

## TC74VHC04F, TC74VHC04FN, TC74VHC04FT

## HEX INVERTER

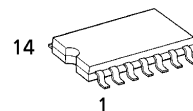
The TC74VHC04 is an advanced high speed CMOS INVERTER fabricated with silicon gate C<sup>2</sup>MOS technology. It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

The internal circuit is composed of 3 stages including buffer output, which provide high noise immunity and stable output. An input protection circuit ensures that 0 to 5.5V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

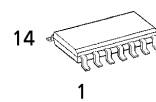
## FEATURES:

- High Speed..... $t_{pd} = 3.8\text{ns}(\text{typ.})$  at  $V_{CC} = 5\text{V}$
- Low Power Dissipation..... $I_{CC} = 2\mu\text{A}(\text{Max.})$  at  $T_a = 25^\circ\text{C}$
- High Noise Immunity..... $V_{NIH} = V_{NIL} = 28\% V_{CC}(\text{Min.})$
- Power Down Protection is provided on all inputs.
- Balanced Propagation Delays..... $t_{pLH} \approx t_{pHL}$
- Wide Operating Voltage Range..... $V_{CC}(\text{opr}) = 2\text{V} \sim 5.5\text{V}$
- Low Noise ..... $V_{OLP} = 0.8\text{V}(\text{Max.})$
- Pin and Function Compatible with 74ALS04

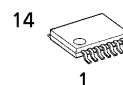
(Note) The JEDEC SOP (FN) is not available in Japan.



F (SOP14-P-300-1.27)  
Weight : 0.18g (Typ.)

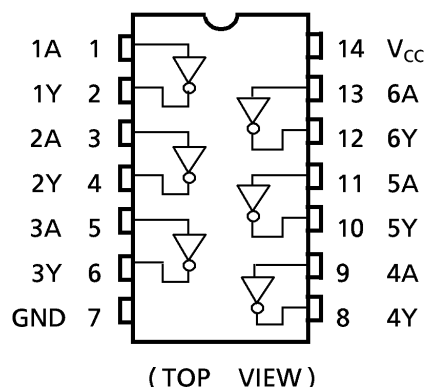


FN (SOL14-P-150-1.27)  
Weight : 0.12g (Typ.)

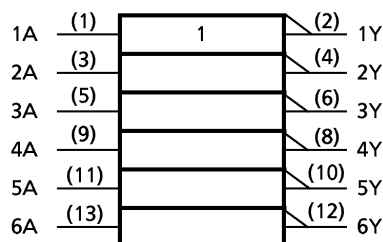


FT (TSSOP14-P-0044-0.65)  
Weight : 0.06g (Typ.)

## PIN ASSIGNMENT



## IEC LOGIC SYMBOL



## TRUTH TABLE

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

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## ABSOLUTE MAXIMUM RATINGS

| PARAMETER                   | SYMBOL    | VALUE                    | UNIT               |
|-----------------------------|-----------|--------------------------|--------------------|
| Supply Voltage Range        | $V_{CC}$  | $-0.5 \sim 7.0$          | V                  |
| DC Input Voltage            | $V_{IN}$  | $-0.5 \sim 7.0$          | V                  |
| DC Output Voltage           | $V_{OUT}$ | $-0.5 \sim V_{CC} + 0.5$ | V                  |
| Input Diode Current         | $I_{IK}$  | $-20$                    | 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           | $P_D$     | 180                      | mW                 |
| Storage Temperature         | $T_{stg}$ | $-65 \sim 150$           | $^{\circ}\text{C}$ |

## RECOMMENDED OPERATING CONDITIONS

| PARAMETER                | SYMBOL    | VALUE                                                                                           | UNIT               |
|--------------------------|-----------|-------------------------------------------------------------------------------------------------|--------------------|
| Supply Voltage           | $V_{CC}$  | $2.0 \sim 5.5$                                                                                  | V                  |
| Input Voltage            | $V_{IN}$  | $0 \sim 5.5$                                                                                    | V                  |
| Output Voltage           | $V_{OUT}$ | $0 \sim V_{CC}$                                                                                 | V                  |
| Operating Temperature    | $T_{opr}$ | $-40 \sim 85$                                                                                   | $^{\circ}\text{C}$ |
| Input Rise and Fall Time | $dt/dv$   | $0 \sim 100$ ( $V_{CC} = 3.3 \pm 0.3\text{V}$ )<br>$0 \sim 20$ ( $V_{CC} = 5 \pm 0.5\text{V}$ ) | ns / V             |

## DC ELECTRICAL CHARACTERISTICS

| PARAMETER                   | SYMBOL   | TEST CONDITION                   | $V_{CC}$<br>(V)           | $T_a = 25^{\circ}\text{C}$  |                   |                             | $T_a = -40 \sim 85^{\circ}\text{C}$ |                             | UNIT          |
|-----------------------------|----------|----------------------------------|---------------------------|-----------------------------|-------------------|-----------------------------|-------------------------------------|-----------------------------|---------------|
|                             |          |                                  |                           | MIN.                        | TYP.              | MAX.                        | MIN.                                | MAX.                        |               |
| High - Level Input Voltage  | $V_{IH}$ |                                  | 2.0<br>3.0~5.5            | 1.50<br>$V_{CC} \times 0.7$ | —<br>—            | —<br>—                      | 1.50<br>$V_{CC} \times 0.7$         | —<br>—                      | V             |
| Low - Level Input Voltage   | $V_{IL}$ |                                  | 2.0<br>3.0~5.5            | —<br>—                      | —<br>—            | 0.50<br>$V_{CC} \times 0.3$ | —<br>—                              | 0.50<br>$V_{CC} \times 0.3$ | V             |
| High - Level Output Voltage | $V_{OH}$ | $V_{IN} = V_{IL}$                | $I_{OH} = -50\mu\text{A}$ | 2.0<br>3.0<br>4.5           | 1.9<br>2.9<br>4.4 | —<br>—<br>—                 | 1.9<br>2.9<br>4.4                   | —<br>—<br>—                 | V             |
|                             |          |                                  | $I_{OH} = -4\text{mA}$    | 3.0                         | 2.58              | —                           | 2.48                                | —                           |               |
|                             |          |                                  | $I_{OH} = -8\text{mA}$    | 4.5                         | 3.94              | —                           | 3.80                                | —                           |               |
| Low - Level Output Voltage  | $V_{OL}$ | $V_{IN} = V_{IH}$                | $I_{OL} = 50\mu\text{A}$  | 2.0<br>3.0<br>4.5           | —<br>—<br>—       | 0.0<br>0.0<br>0.1           | —<br>—<br>—                         | 0.1<br>0.1<br>0.1           | V             |
|                             |          |                                  | $I_{OL} = 4\text{mA}$     | 3.0                         | —                 | 0.36                        | —                                   | 0.44                        |               |
|                             |          |                                  | $I_{OL} = 8\text{mA}$     | 4.5                         | —                 | 0.36                        | —                                   | 0.44                        |               |
| Input Leakage Current       | $I_{IN}$ | $V_{IN} = 5.5\text{V or GND}$    | 0~5.5                     | —                           | —                 | $\pm 0.1$                   | —                                   | $\pm 1.0$                   | $\mu\text{A}$ |
| Quiescent Supply Current    | $I_{CC}$ | $V_{IN} = V_{CC} \text{ or GND}$ | 5.5                       | —                           | —                 | 2.0                         | —                                   | 20.0                        |               |

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### AC ELECTRICAL CHARACTERISTICS ( Input $t_r = t_f = 3\text{ns}$ )

| PARAMETER                     | SYMBOL                               | TEST CONDITION      |           | Ta = 25°C |      |      | Ta = − 40~85°C |      | UNIT |    |
|-------------------------------|--------------------------------------|---------------------|-----------|-----------|------|------|----------------|------|------|----|
|                               |                                      | V <sub>CC</sub> (V) | CL (pF)   | MIN.      | TYP. | MAX. | MIN.           | MAX. |      |    |
| Propagation Delay Time        | t <sub>pLH</sub><br>t <sub>pHL</sub> |                     | 3.3 ± 0.3 | 15        | —    | 5.0  | 7.1            | 1.0  | 8.5  | ns |
|                               |                                      |                     |           | 50        | —    | 7.5  | 10.6           | 1.0  | 12.0 |    |
|                               |                                      |                     | 5.0 ± 0.5 | 15        | —    | 3.8  | 5.5            | 1.0  | 6.5  |    |
|                               |                                      |                     |           | 50        | —    | 5.3  | 7.5            | 1.0  | 8.5  |    |
| Input Capacitance             | C <sub>I N</sub>                     |                     |           |           | —    | 4    | 10             | —    | 10   | pF |
| Power Dissipation Capacitance | C <sub>PD</sub>                      | (Note 1)            |           |           | —    | 18   | —              | —    | —    |    |

Note (1)  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

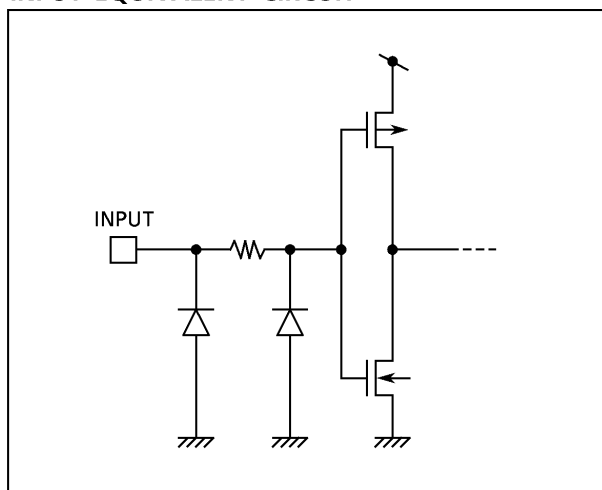
Average operating current can be obtained by the equation:

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

### NOISE CHARACTERISTICS ( Input $t_r = t_f = 3\text{ns}$ )

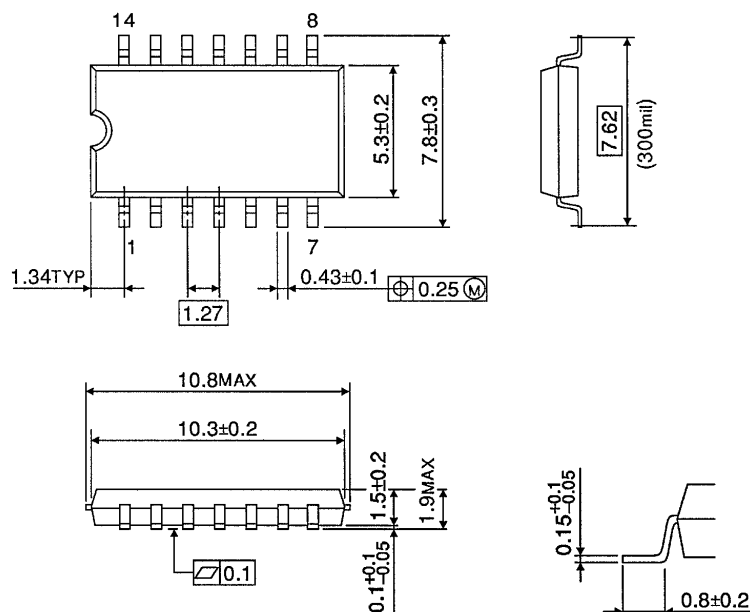
| PARAMETER                                       | SYMBOL           | TEST CONDITION        |                     | Ta = 25°C |       | UNIT |
|-------------------------------------------------|------------------|-----------------------|---------------------|-----------|-------|------|
|                                                 |                  |                       | V <sub>CC</sub> (V) | TYP.      | LIMIT |      |
| Quiet Output<br>Maximum Dynamic V <sub>OL</sub> | V <sub>OLP</sub> | C <sub>L</sub> = 50pF | 5.0                 | 0.4       | 0.8   | V    |
| Quiet Output<br>Minimum Dynamic V <sub>OL</sub> | V <sub>OLV</sub> | C <sub>L</sub> = 50pF | 5.0                 | −0.4      | −0.8  | V    |
| Minimum High Level<br>Dynamic Input Voltage     | V <sub>IHD</sub> | C <sub>L</sub> = 50pF | 5.0                 | —         | 3.5   | V    |
| Maximum Low Level<br>Dynamic Input Voltage      | V <sub>ILD</sub> | C <sub>L</sub> = 50pF | 5.0                 | —         | 1.5   | V    |

### INPUT EQUIVALENT CIRCUIT



**SOP 14PIN (200mil BODY) PACKAGE DIMENSIONS (SOP14-P-300-1.27)**

Unit in mm

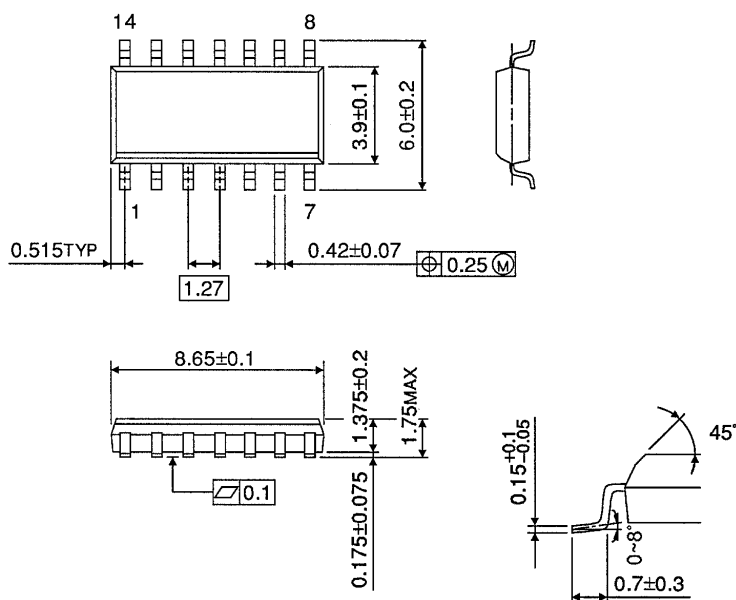


Weight : 0.18g (Typ.)

**SOP 14PIN (150mil BODY) PACKAGE DIMENSIONS (SOP14-P-150-1.27)**

Unit in mm

(Note) This package is not available in Japan.



Weight : 0.12g (Typ.)

TSSOP 14PIN PACKAGE DIMENSIONS (TSSOP14-P-0044-0.65)

Unit in mm

