



## U74HC04

CMOS IC

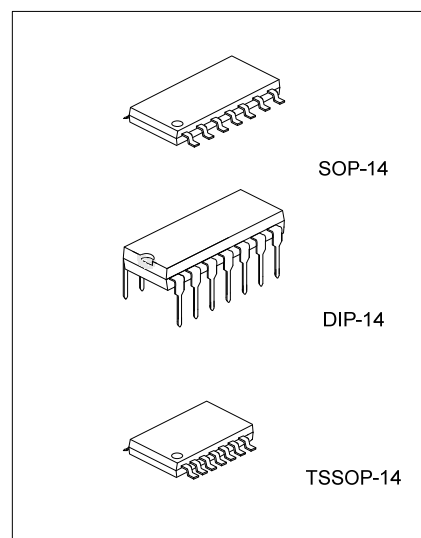
### HEX INVERTERS

#### DESCRIPTION

The U74HC04 devices contain six independent inverters.  
They perform the Boolean function  $Y = \overline{A}$  in positive logic.

#### FEATURES

- \* Wide Operating Voltage Range of 2V to 6V
- \* Outputs Can Drive Up To 10 LSTTL Loads
- \* Low Power Consumption, 2μA Max I<sub>CC</sub>
- \* Typical t<sub>pd</sub>=8ns
- \* ±4mA Output Drive at 5V
- \* Low Input Current of 1uA Max



#### ORDERING INFORMATION

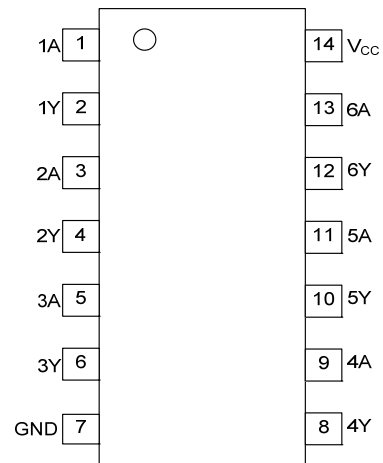
| Ordering Number |                | Package  | Packing   |
|-----------------|----------------|----------|-----------|
| Lead Free       | Halogen Free   |          |           |
| U74HC04L-D14-T  | U74HC04G-D14-T | DIP-14   | Tube      |
| -               | U74HC04G-S14-R | SOP-14   | Tape Reel |
| -               | U74HC04G-P14-R | TSSOP-14 | Tape Reel |

|  |  |
|--|--|
| <p>U74HC04L-D14-T</p> <p>(1) Packing Type<br/>(2) Package Type<br/>(3) Green Package</p> | <p>(1) R: Tape Reel, T: Tube<br/>(2) D14: DIP-14, P14: TSSOP-14, S14: SOP-14<br/>(3) L: Lead Free, G: Halogen Free and Lead Free</p> |
|--|--|

#### MARKING

| DIP-14   | SOP-14 / TSSOP-14  |
|--|--|
| <p>UTC □□□□ → Date Code<br/>L: Lead Free<br/>G: Halogen Free<br/>□□ → Lot Code</p> | <p>UTC □□□□ → Date Code<br/>U74HC04G<br/>□□ → Lot Code</p> |

## ■ PIN CONFIGURATION



## ■ FUNCTION TABLE (each gate)

| INPUT(A) | OUTPUT(Y) |
|----------|-----------|
| L        | H         |
| H        | L         |

## ■ LOGIC DIAGRAM (positive logic)

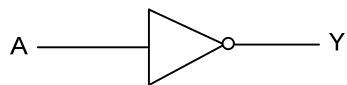


Fig.1 logic diagram for U74HC04

■ ABSOLUTE MAXIMUM RATING ( $T_A = 25^\circ\text{C}$ , unless otherwise specified) (Note 2)

| PARAMETER                         | SYMBOL    | RATINGS    | UNIT             |
|-----------------------------------|-----------|------------|------------------|
| Supply Voltage                    | $V_{CC}$  | -0.5~7     | V                |
| Input Clamp Current( $V_I < 0$ )  | $I_{IK}$  | $\pm 20$   | mA               |
| Output Clamp Current( $V_O < 0$ ) | $I_{OK}$  | $\pm 20$   | mA               |
| Output Current                    | $I_{OUT}$ | $\pm 25$   | mA               |
| $V_{CC}$ or GND Current           | $I_{CC}$  | $\pm 50$   | mA               |
| Storage Temperature               | $T_{STG}$ | -65 ~ +150 | $^\circ\text{C}$ |

Note: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

■ THERMAL DATA

| PARAMETER           | SYMBOL   | RATINGS | UNIT               |
|---------------------|----------|---------|--------------------|
| Junction to Ambient | DIP-14   | 80      | $^\circ\text{C/W}$ |
|                     | SOP-14   | 86      |                    |
|                     | TSSOP-14 | 113     |                    |

■ RECOMMENDED OPERATING CONDITIONS ( $T_A = 25^\circ\text{C}$ , unless otherwise specified)

| PARAMETER                       | SYMBOL              | CONDITIONS           | MIN | TYP | MAX      | UNIT             |
|---------------------------------|---------------------|----------------------|-----|-----|----------|------------------|
| Supply Voltage                  | $V_{CC}$            | Operating            | 2   | 5   | 6        | V                |
| Input Voltage                   | $V_I$               |                      | 0   |     | $V_{CC}$ | V                |
| Output Voltage                  | $V_O$               |                      | 0   |     | $V_{CC}$ | V                |
| Operating Temperature           | $T_A$               |                      | -40 |     | +85      | $^\circ\text{C}$ |
| Input transition rise/fall time | $\Delta t/\Delta v$ | $V_{CC}=2\text{V}$   |     |     | 1000     | ns               |
|                                 |                     | $V_{CC}=4.5\text{V}$ |     |     | 500      |                  |
|                                 |                     | $V_{CC}=6\text{V}$   |     |     | 400      |                  |

■ STATIC CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ , unless otherwise specified)

| PARAMETER                              | SYMBOL   | TEST CONDITIONS                                  | MIN  | TYP       | MAX       | UNIT          |
|--|----------|--|------|-----------|-----------|---------------|
| Positive-Going Input Threshold Voltage | $V_{IH}$ | $V_{CC}=2\text{V}$                               | 1.5  |           |           | V             |
|  |          | $V_{CC}=4.5\text{V}$                             | 3.15 |           |           |               |
|  |          | $V_{CC}=6\text{V}$                               | 4.2  |           |           |               |
| Negative-Going Input Threshold Voltage | $V_{IL}$ | $V_{CC}=2\text{V}$                               |      |           | 0.5       | V             |
|  |          | $V_{CC}=4.5\text{V}$                             |      |           | 1.35      |               |
|  |          | $V_{CC}=6\text{V}$                               |      |           | 1.8       |               |
| High-Level Output Voltage              | $V_{OH}$ | $V_{CC}=2\text{V}, I_{OH}=-20\mu\text{A}$        | 1.9  | 1.998     |           | V             |
|  |          | $V_{CC}=4.5\text{V}, I_{OH}=-20\mu\text{A}$      | 4.4  | 4.499     |           | V             |
|  |          | $V_{CC}=6\text{V}, I_{OH}=-20\mu\text{A}$        | 5.9  | 5.999     |           | V             |
|  |          | $V_{CC}=4.5\text{V}, I_{OH}=-4\text{mA}$         | 3.98 | 4.3       |           | V             |
|  |          | $V_{CC}=6\text{V}, I_{OH}=-5.2\text{mA}$         | 5.48 | 5.8       |           | V             |
| Low-Level Output Voltage               | $V_{OL}$ | $V_{CC}=2\text{V}, I_{OH}=20\mu\text{A}$         |      | 0.002     | 0.1       | V             |
|  |          | $V_{CC}=4.5\text{V}, I_{OH}=20\mu\text{A}$       |      | 0.001     | 0.1       | V             |
|  |          | $V_{CC}=6\text{V}, I_{OH}=20\mu\text{A}$         |      | 0.001     | 0.1       | V             |
|  |          | $V_{CC}=4.5\text{V}, I_{OH}=4\text{mA}$          |      | 0.17      | 0.26      | V             |
|  |          | $V_{CC}=6\text{V}, I_{OH}=5.2\text{mA}$          |      | 0.15      | 0.26      | V             |
| Input Leakage Current                  | $I_I$    | $V_{CC}=6\text{V}, V_I=V_{CC}$ or GND            |      | $\pm 0.1$ | $\pm 100$ | nA            |
| Quiescent Supply Current               | $I_{CC}$ | $V_{CC}=6\text{V}, V_I=V_{CC}$ or GND<br>$I_O=0$ |      |           | 2         | $\mu\text{A}$ |
| Input Capacitance                      | $C_I$    | $V_{CC}=2\text{V}$ to $6\text{V}$                |      | 3         | 10        | pF            |

■ DYNAMIC CHARACTERISTICS (Input:  $t_R$ ,  $t_F=6\text{ns}$ ,  $C_L=50\text{pF}$ ;  $\text{PRR}\leq 1\text{MHz}$ )

See Fig. 2 and Fig. 3 for test circuit and waveforms.

| PARAMETER                                     | SYMBOL            | TEST CONDITIONS      | MIN | TYP | MAX | UNIT |
|---|-------------------|----------------------|-----|-----|-----|------|
| Propagation delay from input (A) to output(Y) | $t_{PLH}/t_{PHL}$ | $V_{CC}=2\text{V}$   |     | 45  | 95  | ns   |
|   |                   | $V_{CC}=4.5\text{V}$ |     | 9   | 19  | ns   |
|   |                   | $V_{CC}=6\text{V}$   |     | 8   | 16  | ns   |
| Rise/fall time for output(Y)                  | $t_t$             | $V_{CC}=2\text{V}$   |     | 38  | 75  | ns   |
|   |                   | $V_{CC}=4.5\text{V}$ |     | 8   | 15  | ns   |
|   |                   | $V_{CC}=6\text{V}$   |     | 6   | 13  | ns   |

■ OPERATING CHARACTERISTICS

| PARAMETER                     | SYMBOL   | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-------------------------------|----------|-----------------|-----|-----|-----|------|
| Power Dissipation Capacitance | $C_{PD}$ | No Load         |     | 20  |     | pF   |

## ■ TEST CIRCUIT AND WAVEFORMS

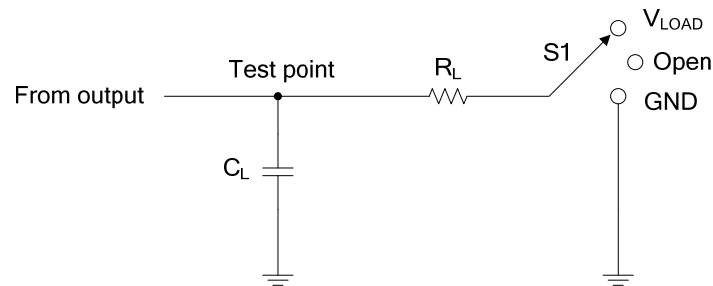
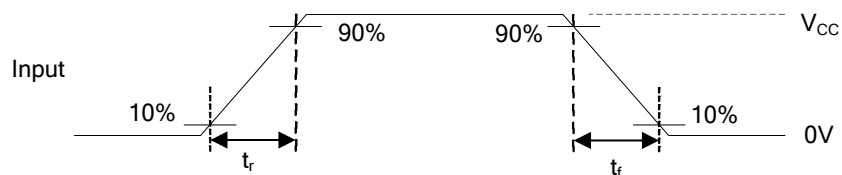


Fig. 2 TEST CIRCUIT

| TEST              | S1   |
|-------------------|------|
| $t_{PLH}/t_{PHL}$ | Open |

| Inputs   |            | $V_M$      | $V_{LOAD}$ | $C_L$ |
|----------|------------|------------|------------|-------|
| $V_{IN}$ | $t_r, t_f$ |            |            |       |
| $V_{CC}$ | 6 ns       | $V_{CC}/2$ | $V_{CC}$   | 50 pF |



VOLTAGE WAVEFORMS  
INPUT RISE AND FALL TIMES

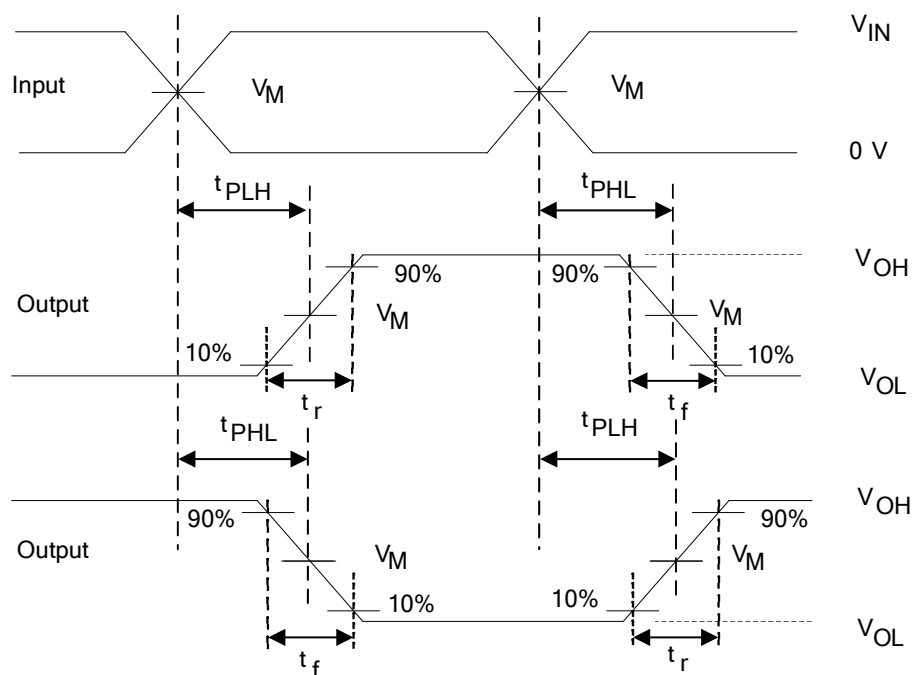


Fig3 VOLTAGE WAVEFORMS  
PROPAGATION DELAY AND OUTPUT TRANSITION TIMES

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