

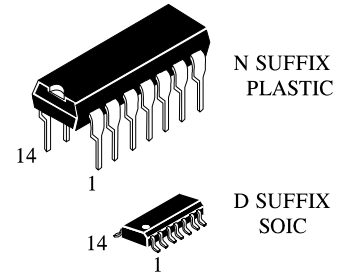
# IN74LV04

## Hex Inverter

The IN74LV04 is a low-voltage Si-gate CMOS device that is pin and function compatible with 74HC/HCT04A.

The IN74LV04 provides six inverting buffers.

- Wide Operating Voltage: 1.0÷5.5 V
- Optimized for Low Voltage applications: 1.0÷3.6 V
- Accepts TTL input levels between  $V_{CC}=2.7$  V and  $V_{CC}=3.6$  V
- Low Input Current

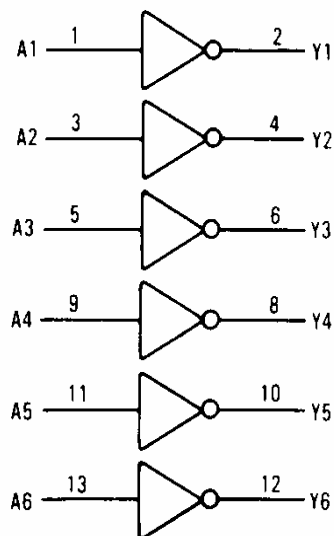


### ORDERING INFORMATION

IN74LV04N Plastic  
IN74LV04D SOIC

$T_A = -40^\circ$  to  $125^\circ$  C for all packages

## LOGIC DIAGRAM



$$Y = \bar{A}$$

PIN 14 =  $V_{CC}$   
PIN 7 = GND

## PIN ASSIGNMENT

|     |   |    |          |
|-----|---|----|----------|
| A1  | 1 | 14 | $V_{CC}$ |
| Y1  | 2 | 13 | A6       |
| A2  | 3 | 12 | Y6       |
| Y2  | 4 | 11 | A5       |
| A3  | 5 | 10 | Y5       |
| Y3  | 6 | 9  | A4       |
| GND | 7 | 8  | Y4       |

## FUNCTION TABLE

| Input | Output |
|-------|--------|
| A     | Y      |
| L     | H      |
| H     | L      |

**MAXIMUM RATINGS\***

| Symbol        | Parameter                                                                                  | Value       | Unit |
|---------------|--------------------------------------------------------------------------------------------|-------------|------|
| $V_{CC}$      | DC supply voltage (Referenced to GND)                                                      | -0.5 ÷ +7.0 | V    |
| $I_{IK}^{*1}$ | DC input diode current                                                                     | ±20         | mA   |
| $I_{OK}^{*2}$ | DC output diode current                                                                    | ±50         | mA   |
| $I_O^{*3}$    | DC output source or sink current<br>-bus driver outputs                                    | ±25         | mA   |
| $I_{GND}$     | DC GND current for types with<br>- bus driver outputs                                      | ±50         | mA   |
| $I_{CC}$      | DC $V_{CC}$ current for types with<br>- bus driver outputs                                 | ±50         | mA   |
| $P_D$         | Power dissipation per package, plastic DIP+<br>SOIC package+                               | 750<br>500  | mW   |
| $T_{stg}$     | Storage temperature                                                                        | -65 ÷ +150  | °C   |
| $T_L$         | Lead temperature, 1.5 mm from Case for 10 seconds<br>(Plastic DIP ), 0.3 mm (SOIC Package) | 260         | °C   |

\*Maximum Ratings are those values beyond which damage to the device may occur.  
Functional operation should be restricted to the Recommended Operating Conditions.

+Derating - Plastic DIP: - 12 mW/°C from 70° to 125°C

SOIC Package: - 8 mW/°C from 70° to 125°C

\*<sup>1</sup>:  $V_I < -0.5V$  or  $V_I > V_{CC}+0.5V$

\*<sup>2</sup>:  $V_O < -0.5V$  or  $V_O > V_{CC}+0.5V$

\*<sup>3</sup>:  $-0.5V < V_O < V_{CC}+0.5V$

**RECOMMENDED OPERATING CONDITIONS**

| Symbol            | Parameter                                            | Min | Max      | Unit |
|-------------------|------------------------------------------------------|-----|----------|------|
| $V_{CC}$          | DC Supply Voltage (Referenced to GND)                | 1.0 | 5.5      | V    |
| $V_{IN}, V_{OUT}$ | DC Input Voltage, Output Voltage (Referenced to GND) | 0   | $V_{CC}$ | V    |
| $T_A$             | Operating Temperature, All Package Types             | -40 | +125     | °C   |
| $t_r, t_f$        | Input Rise and Fall Time                             |     |          |      |
|                   | $V_{CC}=1.2V$                                        | 0   | 1000     | ns   |
|                   | $V_{CC}=2.0V$                                        | 0   | 700      |      |
|                   | $V_{CC}=3.0V$                                        | 0   | 500      |      |
|                   | $V_{CC}=3.6V$                                        | 0   | 400      |      |

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation,  $V_{IN}$  and  $V_{OUT}$  should be constrained to the range  $GND \leq (V_{IN} \text{ or } V_{OUT}) \leq V_{CC}$ .

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or  $V_{CC}$ ). Unused outputs must be left open.

**DC ELECTRICAL CHARACTERISTICS** (Voltages Referenced to GND)

| Symbol          | Parameter                              | Test Conditions                                                                | V <sub>CC</sub> ,<br>V | Guaranteed Limit |      |                 |      |                  |      | Unit |
|-----------------|----------------------------------------|--------------------------------------------------------------------------------|------------------------|------------------|------|-----------------|------|------------------|------|------|
|                 |                                        |                                                                                |                        | 25°C             |      | -40°C ÷<br>85°C |      | -40°C ÷<br>125°C |      |      |
|                 |                                        |                                                                                |                        | min              | max  | min             | max  | min              | max  |      |
| V <sub>IH</sub> | High-Level Input Voltage               |                                                                                | 1.2                    | 0.9              | -    | 0.9             | -    | 0.9              | -    | V    |
|                 |                                        |                                                                                | 2.0                    | 1.4              | -    | 1.4             | -    | 1.4              | -    |      |
|                 |                                        |                                                                                | 3.0                    | 2.1              | -    | 2.1             | -    | 2.1              | -    |      |
|                 |                                        |                                                                                | 3.6                    | 2.5              | -    | 2.5             | -    | 2.5              | -    |      |
| V <sub>IL</sub> | Low-Level Input Voltage                |                                                                                | 1.2                    | -                | 0.3  | -               | 0.3  | -                | 0.3  | V    |
|                 |                                        |                                                                                | 2.0                    | -                | 0.6  | -               | 0.6  | -                | 0.6  |      |
|                 |                                        |                                                                                | 3.0                    | -                | 0.9  | -               | 0.9  | -                | 0.9  |      |
|                 |                                        |                                                                                | 3.6                    | -                | 1.1  | -               | 1.1  | -                | 1.1  |      |
| V <sub>OH</sub> | High-Level Output Voltage              | V <sub>I</sub> = V <sub>IL</sub><br>I <sub>O</sub> = -50 μA                    | 1.2                    | 1.1              | -    | 1.0             | -    | 1.0              | -    | V    |
|                 |                                        |                                                                                | 2.0                    | 1.92             | -    | 1.9             | -    | 1.9              | -    |      |
|                 |                                        | V <sub>I</sub> = V <sub>IL</sub><br>I <sub>O</sub> = -6.0 μA                   | *                      | 2.92             | -    | 2.9             | -    | 2.9              | -    | V    |
|                 |                                        |                                                                                |                        |                  |      |                 |      |                  |      |      |
| V <sub>OL</sub> | Low-Level Output Voltage               | V <sub>I</sub> = V <sub>IH</sub><br>I <sub>O</sub> = 50 μA                     | 1.2                    | -                | 0.09 | -               | 0.1  | -                | 0.1  | V    |
|                 |                                        |                                                                                | 2.0                    | -                | 0.09 | -               | 0.1  | -                | 0.1  |      |
|                 |                                        | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>O</sub> = 6.0 mA | 3.0                    | -                | 0.09 | -               | 0.1  | -                | 0.1  | V    |
|                 |                                        |                                                                                |                        |                  |      |                 |      |                  |      |      |
| I <sub>IL</sub> | Low-Level Input Leakage Current        |                                                                                |                        | -                | -0.1 | -               | -1.0 | -                | -1.0 | μA   |
| I <sub>IH</sub> | High-Level Input Leakage Current       | V <sub>I</sub> = V <sub>CC</sub>                                               | *                      | -                | 0.1  | -               | 1.0  | -                | 1.0  | μA   |
| I <sub>CC</sub> | Quiescent Supply Current (per Package) | V <sub>I</sub> = 0 B or V <sub>CC</sub><br>I <sub>O</sub> = 0 μA               | *                      | -                | 2.0  | -               | 20   | -                | 40   | μA   |

\* : V<sub>CC</sub> = (3.3±0.3) V

**AC ELECTRICAL CHARACTERISTICS** ( $C_L=50$  pF,  $t_{LH} = t_{HL} = 6.0$  ns,  $V_{IL}=0V$ ,  $V_{IH}=V_{CC}$ ,  $R_L=1$  k $\Omega$ )

| Symbol                                 | Parameter                                         | V <sub>CC</sub><br>V | Guaranteed Limit |     |              |     |               |     | Unit |
|----------------------------------------|---------------------------------------------------|----------------------|------------------|-----|--------------|-----|---------------|-----|------|
|                                        |                                                   |                      | 25°C             |     | -40°C ÷ 85°C |     | -40°C ÷ 125°C |     |      |
|                                        |                                                   |                      | min              | max | min          | max | min           | max |      |
| t <sub>THL</sub> , (t <sub>TLH</sub> ) | Output Transition Time, Any Output (Figure 1)     | 1.2                  | -                | 70  | -            | 85  | -             | 100 | ns   |
|                                        |                                                   | 2.0                  | -                | 16  | -            | 20  | -             | 24  |      |
|                                        |                                                   | *                    | -                | 10  | -            | 13  | -             | 15  |      |
| t <sub>PHL</sub> , (t <sub>PLH</sub> ) | Propagation Delay, Input A to Output Y (Figure 1) | 1.2                  | -                | 90  | -            | 120 | -             | 150 |      |
|                                        |                                                   | 2.0                  | -                | 23  | -            | 28  | -             | 34  |      |
|                                        |                                                   | *                    | -                | 14  | -            | 18  | -             | 21  |      |
| C <sub>I</sub>                         | Input Capacitance                                 | 3.0                  | -                | -   | -            | 3.5 | -             | 3.5 | pF   |

|                 |                                              |                                                          |    |
|-----------------|----------------------------------------------|----------------------------------------------------------|----|
| C <sub>PD</sub> | Power Dissipation Capacitance (Per Inverter) | T <sub>A</sub> =25°C, V <sub>I</sub> =0V÷V <sub>CC</sub> | pF |
|                 |                                              | 42                                                       |    |

Used to determine the no-load dynamic power consumption:

$$P_D = C_{PD}V_{CC}^2f_i + \sum(C_LV_{CC}^2f_o), f_i - \text{input frequency, } f_o - \text{output frequency (MHz)}$$

$\sum(C_LV_{CC}^2f_o)$  – sum of the outputs

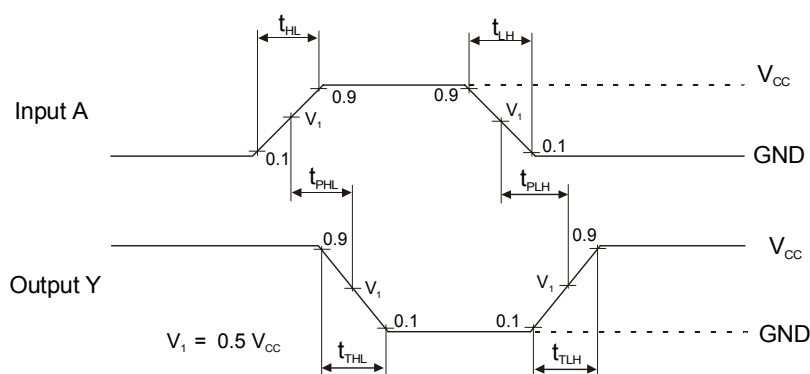


Figure 1. Switching Waveforms

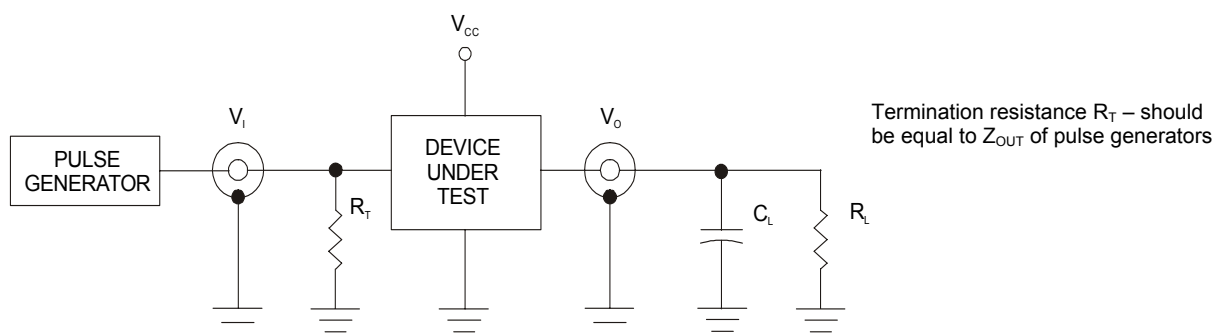
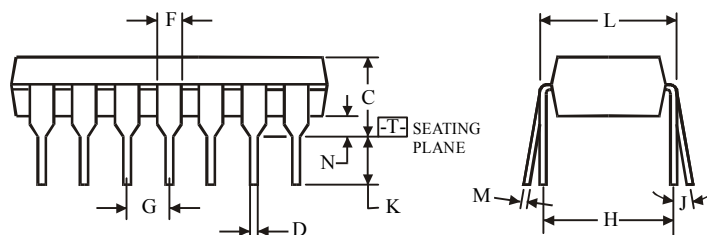
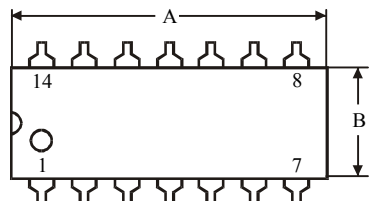
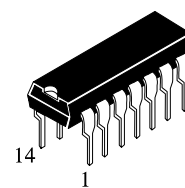


Figure 2. Test Circuit

**N SUFFIX PLASTIC DIP**  
(MS - 001AA)



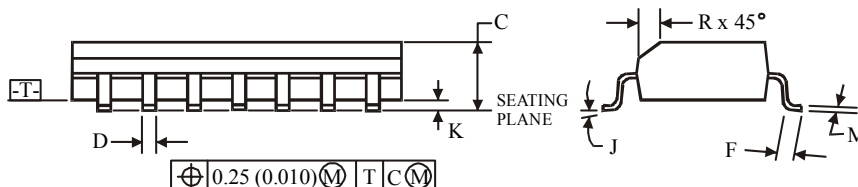
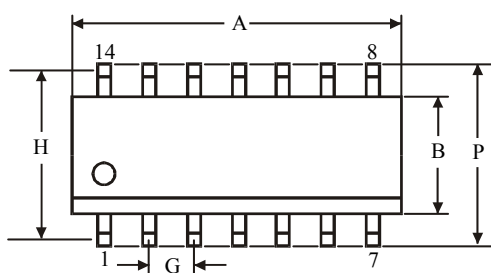
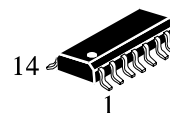
$$\oplus 0.25 (0.010) \text{ (M) } T$$

**NOTES:**

- Dimensions "A", "B" do not include mold flash or protrusions.  
Maximum mold flash or protrusions 0.25 mm (0.010) per side.

|        | Dimension, mm |       |
|--------|---------------|-------|
| Symbol | MIN           | MAX   |
| A      | 18.67         | 19.69 |
| B      | 6.1           | 7.11  |
| C      |               | 5.33  |
| D      | 0.36          | 0.56  |
| F      | 1.14          | 1.78  |
| G      | 2.54          |       |
| H      | 7.62          |       |
| J      | 0°            | 10°   |
| K      | 2.92          | 3.81  |
| L      | 7.62          | 8.26  |
| M      | 0.2           | 0.36  |
| N      | 0.38          |       |

**D SUFFIX SOIC**  
(MS - 012AB)



$$\oplus 0.25 (0.010) \text{ (M) } T \text{ (C) (M)}$$

**NOTES:**

- Dimensions A and B do not include mold flash or protrusion.
- Maximum mold flash or protrusion 0.15 mm (0.006) per side  
for A; for B - 0.25 mm (0.010) per side.

|        | Dimension, mm |      |
|--------|---------------|------|
| Symbol | MIN           | MAX  |
| A      | 8.55          | 8.75 |
| B      | 3.8           | 4    |
| C      | 1.35          | 1.75 |
| D      | 0.33          | 0.51 |
| F      | 0.4           | 1.27 |
| G      | 1.27          |      |
| H      | 5.27          |      |
| J      | 0°            | 8°   |
| K      | 0.1           | 0.25 |
| M      | 0.19          | 0.25 |
| P      | 5.8           | 6.2  |
| R      | 0.25          | 0.5  |