

## Description

The 74HC04 provides six independent inverters with standard push-pull outputs. The device is designed for operation with a power supply range of 2.0V to 6.0V.

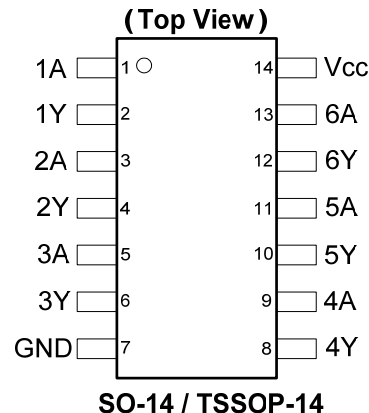
The gates perform the Boolean function:

$$Y = \bar{A}$$

## Features

- Wide Supply Voltage Range from 2.0V to 6.0V
- Sinks or sources 4mA at Vcc = 4.5V
- CMOS low power consumption
- Schmitt Trigger Action at All Inputs
- ESD Protection Exceeds JESD 22
  - 200-V Machine Model (A115-A)
  - 2000-V Human Body Model (A114-A)
  - Exceeds 1000-V Charged Device Model (C101C)
- Range of Package Options SO-14 and TSSOP-14
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

## Pin Assignments



## Applications

- General Purpose Logic
- Wide array of products such as:
  - PCs, networking, notebooks, netbooks
  - Computer peripherals, hard drives, CD/DVD ROM
  - TV, DVD, DVR, set top box

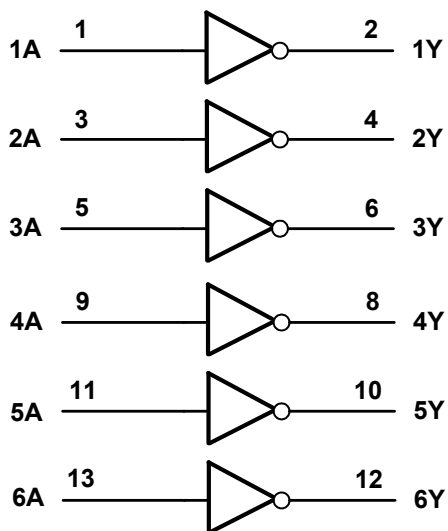
Notes:

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See <http://www.diodes.com> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

## Pin Descriptions

| Pin Number | Pin Name        | Function       |
|------------|-----------------|----------------|
| 1          | 1A              | Data Input     |
| 2          | 1Y              | Data Output    |
| 3          | 2A              | Data Input     |
| 4          | 2Y              | Data Output    |
| 5          | 3A              | Data Input     |
| 6          | 3Y              | Data Output    |
| 7          | GND             | Ground         |
| 8          | 4Y              | Data Output    |
| 9          | 4A              | Data Input     |
| 10         | 5Y              | Data Output    |
| 11         | 5A              | Data Input     |
| 12         | 6Y              | Data Output    |
| 13         | 6A              | Data Input     |
| 14         | V <sub>CC</sub> | Supply Voltage |

## Logic Diagram



## Function Table

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

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**Absolute Maximum Ratings** (Note 4) (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)
 

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| Symbol    | Description                                                               | Rating       | Unit             |
|-----------|---------------------------------------------------------------------------|--------------|------------------|
| ESD HBM   | Human Body Model ESD Protection                                           | 2            | KV               |
| ESD CDM   | Charged Device Model ESD Protection                                       | 1            | KV               |
| ESD MM    | Machine Model ESD Protection                                              | 200          | V                |
| $V_{CC}$  | Supply Voltage Range                                                      | -0.5 to +7.0 | V                |
| $V_I$     | Input Voltage Range (Note 5)                                              | -0.5 to +7.0 | V                |
| $I_{IK}$  | Input Clamp Current $V_I < -0.5\text{V}$ or $V_I > V_{CC} + 0.5\text{V}$  | $\pm 20$     | mA               |
| $I_{OK}$  | Output Clamp Current $V_O < -0.5\text{V}$ or $V_O > V_{CC} + 0.5\text{V}$ | $\pm 20$     | mA               |
| $I_O$     | Continuous output current $-0.5\text{V} < V_O < V_{CC} + 0.5\text{V}$     | +/- 25       | mA               |
| $I_{CC}$  | Continuous current through $V_{CC}$                                       | 50           | mA               |
| $I_{GND}$ | Continuous current through GND                                            | -50          | mA               |
| $T_J$     | Operating Junction Temperature                                            | -40 to +150  | $^\circ\text{C}$ |
| $T_{STG}$ | Storage Temperature                                                       | -65 to +150  | $^\circ\text{C}$ |
| $P_{TOT}$ | Total Power Dissipation                                                   | 500          | mW               |

- Notes:
4. Stresses beyond the absolute maximum may result in immediate failure or reduced reliability. These are stress values and device operation should be within recommend values.
  5. Input Voltage cannot exceed  $V_{CC}$  to the extent the Maximum clamp current is exceeded.

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**Recommended Operating Conditions** (Note 6) (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)
 

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| Symbol              | Parameter                          | Conditions             | Min | Max      | Unit             |
|---------------------|------------------------------------|------------------------|-----|----------|------------------|
| $V_{CC}$            | Supply Voltage                     |                        | 2.0 | 6.0      | V                |
| $V_I$               | Input Voltage                      |                        | 0   | $V_{CC}$ | V                |
| $V_O$               | Output Voltage                     |                        | 0   | $V_{CC}$ | V                |
| $\Delta t/\Delta V$ | Input Transition Rise or Fall Rate | $V_{CC} = 2.0\text{V}$ |     | 625      | ns/V             |
|                     |                                    | $V_{CC} = 4.5\text{V}$ |     | 140      |                  |
|                     |                                    | $V_{CC} = 6.0\text{V}$ |     | 85       |                  |
| $T_A$               | Operating free-air temperature     |                        | -40 | +125     | $^\circ\text{C}$ |

- Note: 6. Unused inputs should be held at  $V_{CC}$  or Ground.

**Electrical Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Symbol          | Parameter                 | Test Conditions                                              | V <sub>CC</sub> | T <sub>A</sub> = -40°C to +85°C |      | T <sub>A</sub> = -40°C to +125°C |      | Unit |
|-----------------|---------------------------|--------------------------------------------------------------|-----------------|---------------------------------|------|----------------------------------|------|------|
|                 |                           |                                                              |                 | Min                             | Max  | Min                              | Max  |      |
| V <sub>IH</sub> | High-level Input Voltage  |                                                              | 2.0V            | 1.5                             |      | 1.5                              |      | V    |
|                 |                           |                                                              | 4.5V            | 3.15                            |      | 3.15                             |      |      |
|                 |                           |                                                              | 6.0V            | 4.2                             |      | 4.2                              |      |      |
| V <sub>IL</sub> | Low-level input voltage   |                                                              | 2.0V            |                                 | 0.5  |                                  | 0.5  | V    |
|                 |                           |                                                              | 4.5V            |                                 | 1.35 |                                  | 1.35 |      |
|                 |                           |                                                              | 6.0V            |                                 | 1.8  |                                  | 1.8  |      |
| V <sub>OH</sub> | High-level Output Voltage | I <sub>OH</sub> = -20μA                                      | 2.0V            | 1.9                             |      | 1.9                              |      | V    |
|                 |                           | I <sub>OH</sub> = -20μA                                      | 4.5V            | 4.4                             |      | 4.4                              |      |      |
|                 |                           | I <sub>OH</sub> = -20μA                                      | 6.0V            | 5.9                             |      | 5.9                              |      |      |
|                 |                           | I <sub>OH</sub> = -4.0mA                                     | 4.5V            | 3.84                            |      | 3.7                              |      |      |
|                 |                           | I <sub>OH</sub> = -5.2mA                                     | 6.0V            | 5.34                            |      | 5.2                              |      |      |
| V <sub>OL</sub> | Low level Output Voltage  | I <sub>OL</sub> = 20μA                                       | 2.0V            |                                 | 0.1  |                                  | 0.1  | V    |
|                 |                           | I <sub>OL</sub> = 20μA                                       | 4.5V            |                                 | 0.1  |                                  | 0.1  |      |
|                 |                           | I <sub>OL</sub> = 20μA                                       | 6.0V            |                                 | 0.1  |                                  | 0.1  |      |
|                 |                           | I <sub>OL</sub> = 4mA                                        | 4.5V            |                                 | 0.33 |                                  | 0.44 |      |
|                 |                           | I <sub>OL</sub> = 5.2mA                                      | 6.0V            |                                 | 0.33 |                                  | 0.44 |      |
| I <sub>I</sub>  | Input Current             | V <sub>I</sub> = GND to 5.5V                                 | 6.0V            |                                 | ± 1  |                                  | ± 1  | μA   |
| I <sub>CC</sub> | Supply Current            | V <sub>I</sub> = GND or V <sub>CC</sub> , I <sub>O</sub> = 0 | 6.0V            |                                 | 20   |                                  | 40   | μA   |

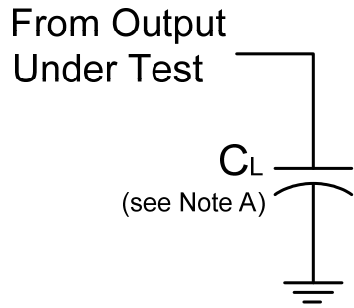
**Switching Characteristics**

| Symbol          | Parameter                                          | Test Conditions                    | V <sub>CC</sub> | T <sub>A</sub> = +25°C |     |     | -40°C to +85°C | -40°C to +125°C | Unit |
|-----------------|----------------------------------------------------|------------------------------------|-----------------|------------------------|-----|-----|----------------|-----------------|------|
|                 |                                                    |                                    |                 | Min                    | Typ | Max | Max            | Max             |      |
| t <sub>PD</sub> | Propagation Delay A <sub>N</sub> to Y <sub>N</sub> | Figure 1<br>C <sub>L</sub> = 50 pF | 2.0V            | —                      | 25  | 90  | 115            | 135             | ns   |
|                 |                                                    |                                    | 4.5V            | —                      | 9   | 18  | 23             | 27              |      |
|                 |                                                    |                                    | 6.0V            | —                      | 7   | 15  | 20             | 23              |      |
| t <sub>t</sub>  | Transition time                                    | Figure 1<br>C <sub>L</sub> = 50 pF | 2.0V            | —                      | 19  | 75  | 95             | 110             | ns   |
|                 |                                                    |                                    | 4.5V            | —                      | 7   | 15  | 19             | 22              |      |
|                 |                                                    |                                    | 6.0V            | —                      | 6   | 13  | 16             | 19              |      |

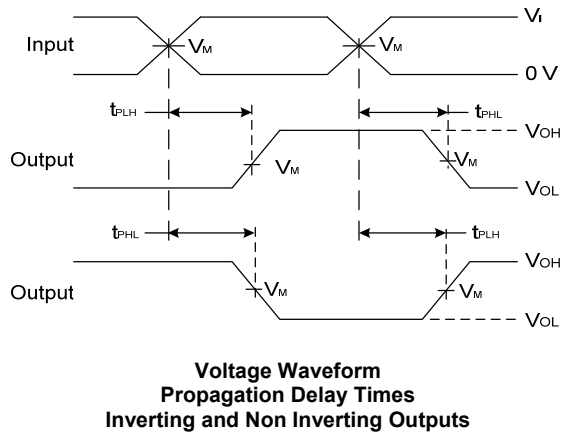
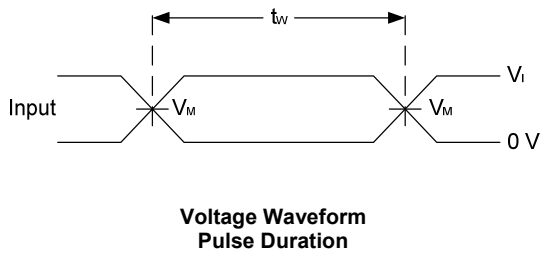
**Operating Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Parameter       |                                        | Test Conditions                           | V <sub>CC</sub> = 6V | Unit |
|-----------------|----------------------------------------|-------------------------------------------|----------------------|------|
|                 |                                        |                                           | Typ                  |      |
| C <sub>pd</sub> | Power Dissipation Capacitance per Gate | f = 1 MHz                                 | 22                   | pF   |
| C <sub>I</sub>  | Input Capacitance                      | V <sub>I</sub> = V <sub>CC</sub> – or GND | 4                    | pF   |

**Parameter Measurement Information**



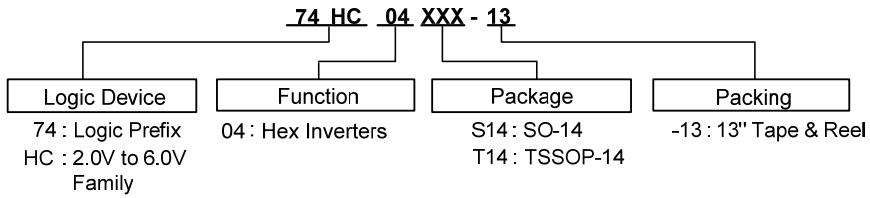
| $V_{CC}$     | Inputs   |           | $V_M$      | $C_L$      |
|--------------|----------|-----------|------------|------------|
|              | $V_I$    | $t_r/t_f$ |            |            |
| 2.0V to 6.0V | $V_{CC}$ | 6ns       | $V_{CC}/2$ | 15pF, 50pF |



- Notes:
- A. Includes test lead and test apparatus capacitance.
  - B. All pulses are supplied at pulse repetition rate  $\leq 1$  MHz.
  - C. Inputs are measured separately one transition per measurement.
  - D.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{PD}$ .

**Figure 1 Load Circuit and Voltage Waveforms**

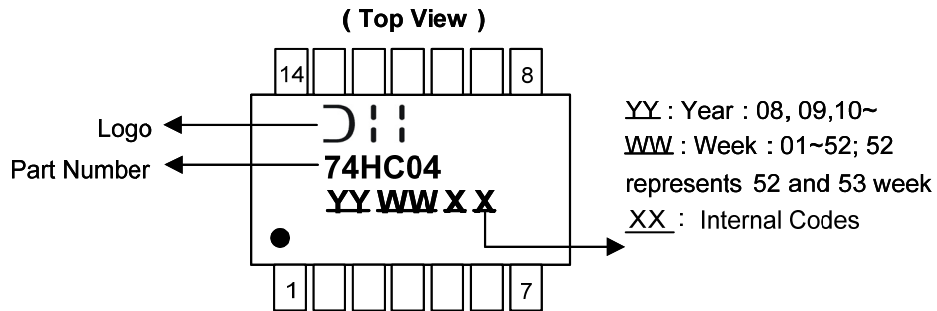
**Ordering Information**



| Device       | Package Code | Packaging | 7" Tape and Reel |                    |
|--------------|--------------|-----------|------------------|--------------------|
|              |              |           | Quantity         | Part Number Suffix |
| 74HC04S14-13 | S14          | SO-14     | 2500/Tape & Reel | -13                |
| 74HC04T14-13 | T14          | TSSOP-14  | 2500/Tape & Reel | -13                |

**Marking Information**

(1) SO-14, TSSOP-14

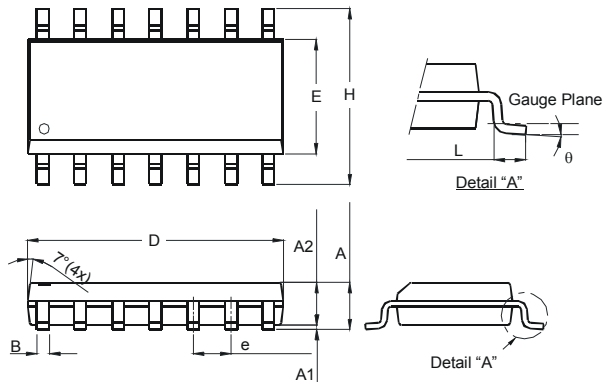


| Part Number | Package  |
|-------------|----------|
| 74HC04S14   | SO-14    |
| 74HC04T14   | TSSOP-14 |

**Package Outline Dimensions** (All dimensions in mm.)

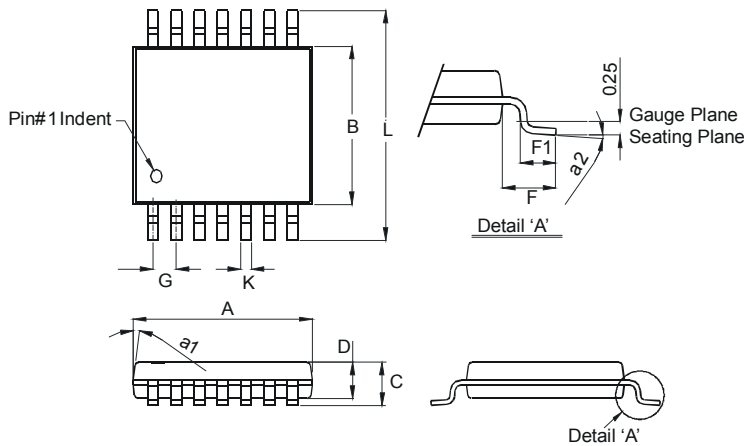
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

**Package Type: SO-14**



| SO-14                       |          |      |
|-----------------------------|----------|------|
| Dim                         | Min      | Max  |
| A                           | 1.47     | 1.73 |
| A1                          | 0.10     | 0.25 |
| A2                          | 1.45 Typ |      |
| B                           | 0.33     | 0.51 |
| D                           | 8.53     | 8.74 |
| E                           | 3.80     | 3.99 |
| e                           | 1.27 Typ |      |
| H                           | 5.80     | 6.20 |
| L                           | 0.38     | 1.27 |
| $\theta$                    | 0°       | 8°   |
| <b>All Dimensions in mm</b> |          |      |

**Package Type: TSSOP-14**

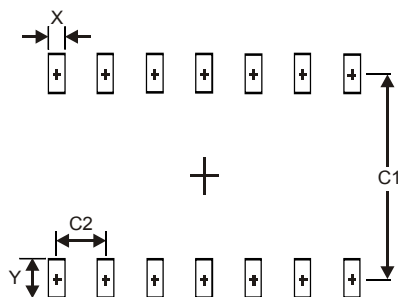


| TSSOP-14                    |          |      |
|-----------------------------|----------|------|
| Dim                         | Min      | Max  |
| a1                          | 7° (4X)  |      |
| a2                          | 0°       | 8°   |
| A                           | 4.9      | 5.10 |
| B                           | 4.30     | 4.50 |
| C                           | — 1.2    |      |
| D                           | 0.8      | 1.05 |
| F                           | 1.00 Typ |      |
| F1                          | 0.45     | 0.75 |
| G                           | 0.65 Typ |      |
| K                           | 0.19     | 0.30 |
| L                           | 6.40 Typ |      |
| <b>All Dimensions in mm</b> |          |      |

**Suggested Pad Layout**

Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for latest version.

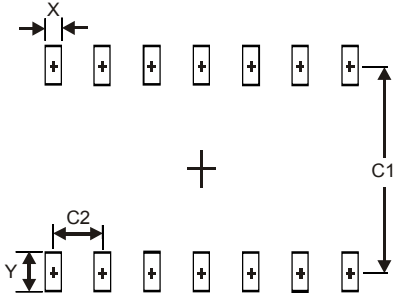
**Package Type: SO-14**



| Dimensions | Value (in mm) |
|------------|---------------|
| X          | 0.60          |
| Y          | 1.50          |
| C1         | 5.4           |
| C2         | 1.27          |

**Suggested Pad Layout (cont.)**

Package Type: TSSOP-14



| Dimensions | Value (in mm) |
|------------|---------------|
| X          | 0.45          |
| Y          | 1.45          |
| C1         | 5.9           |
| C2         | 0.65          |

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