

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.

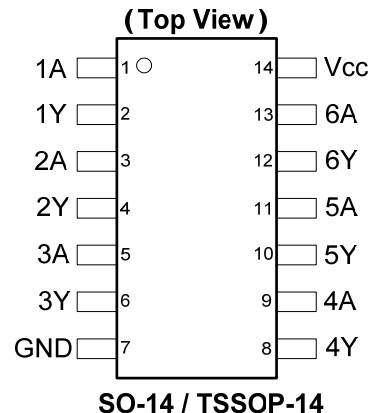
The gates perform the Boolean function:

$$Y = \bar{A}$$

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

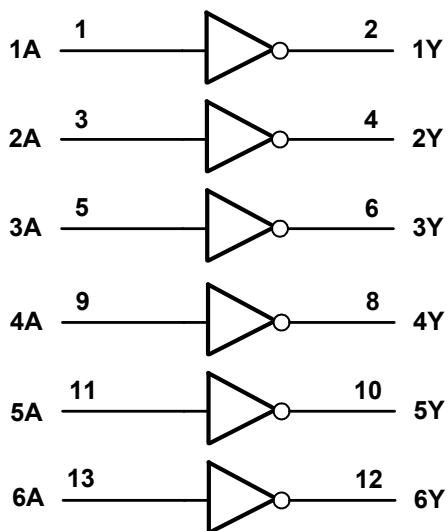
Notes:

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 _{CC} | Supply Voltage |

Logic Diagram



Function Table

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

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

| 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 $V_I > V_{CC} + 0.5\text{V}$ | ± 20 | mA |
| I_{OK} | Output Clamp Current $V_O < -0.5\text{V}$ or $V_O > V_{CC} + 0.5\text{V}$ | ± 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.

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

| 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_A = +25°C, unless otherwise specified.)

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

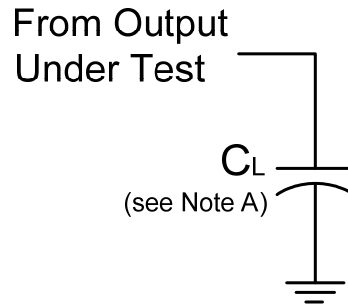
Switching Characteristics

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

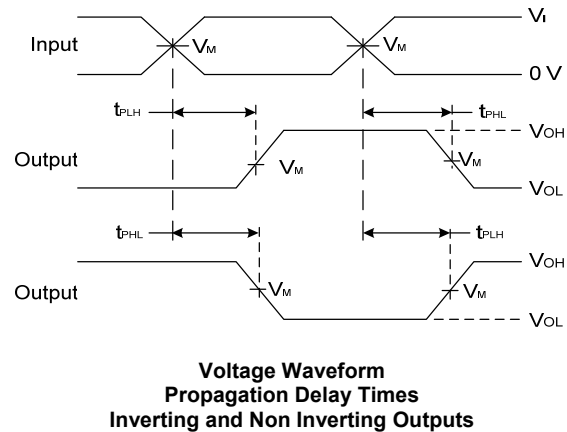
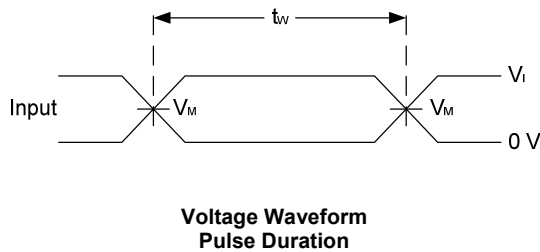
Operating Characteristics (@T_A = +25°C, unless otherwise specified.)

| Parameter | | Test Conditions | V _{CC} = 6V | Unit |
|-----------------|--|---|----------------------|------|
| | | | Typ | |
| C _{pd} | Power Dissipation Capacitance per Gate | f = 1 MHz | 22 | pF |
| C _I | Input Capacitance | V _I = V _{CC} – or GND | 4 | pF |

Parameter Measurement Information



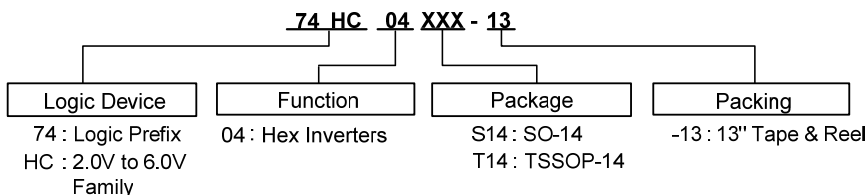
| V_{CC} | Inputs | | V_M | C_L |
|--------------|----------|-----------|------------|------------|
| | V_I | t_r/t_f | | |
| 2.0V to 6.0V | V_{CC} | 6ns | $V_{CC}/2$ | 15pF, 50pF |



- Notes:
- A. Includes test lead and test apparatus capacitance.
 - B. All pulses are supplied at pulse repetition rate ≤ 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

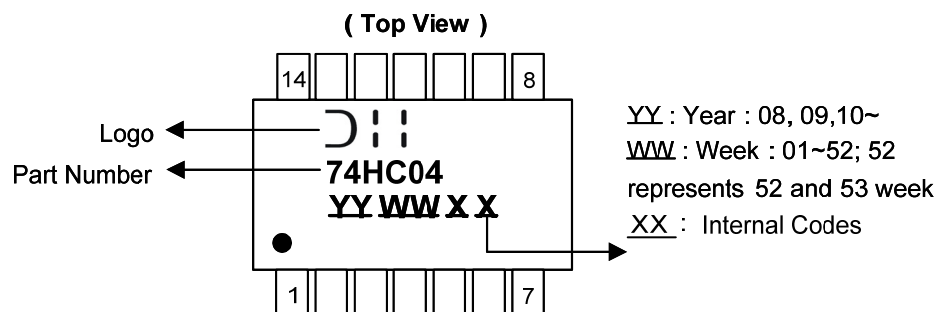
Ordering Information



| 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

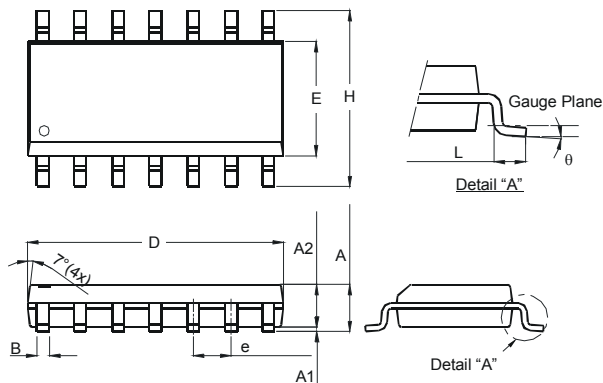


| Part Number | Package |
|-------------|----------|
| 74HC04S14 | SO-14 |
| 74HC04T14 | TSSOP-14 |

Package Outline Dimensions (All dimensions in mm.)

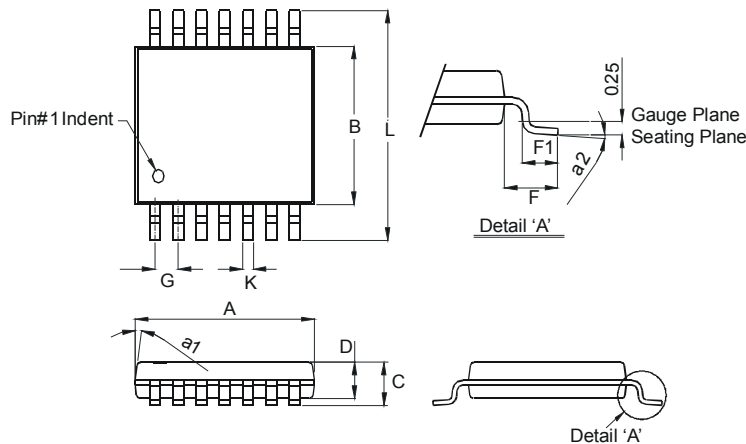
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

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 |
| θ | 0° | 8° |
| All Dimensions in mm | | |

Package Type: TSSOP-14

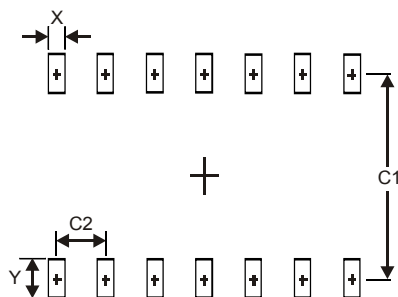


| TSSOP-14 | | |
|-----------------------------|----------|------|
| Dim | Min | Max |
| a1 | 7° (4X) | |
| a2 | 0° | 8° |
| A | 4.9 | 5.10 |
| B | 4.30 | 4.50 |
| C | — 1.2 | |
| D | 0.8 | 1.05 |
| F | 1.00 Typ | |
| F1 | 0.45 | 0.75 |
| G | 0.65 Typ | |
| K | 0.19 | 0.30 |
| L | 6.40 Typ | |
| All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

Suggested Pad Layout

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

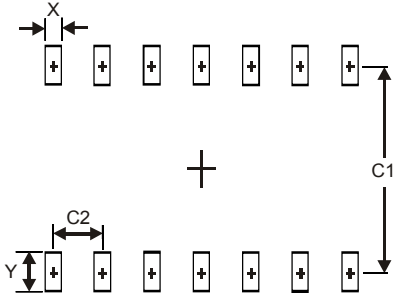
Package Type: SO-14



| 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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