# HEX INVERTERS WITH OPEN DRAIN OUTPUTS

## Description

The 74HCT05 provides provides six independent inverters with open drain outputs. The device is designed for operation with a power supply range of 4.5V to 5.5V.

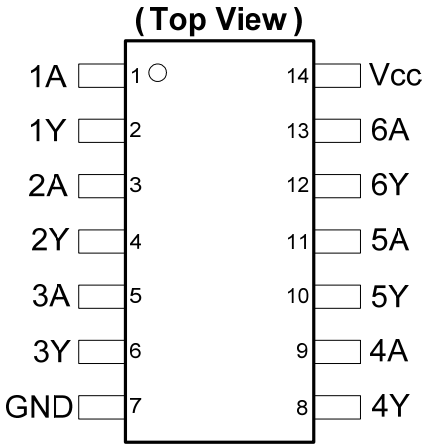
The gates perform the Boolean function:

$$Y = \overline{A}$$

## Features

- Wide Supply Voltage Range from 4.5V to 5.5V
- Pin Compatible with Low Power Schottky (LSTTL)
- Inputs Are TTL Voltage Level Compatible
- Sinks 4mA at $V_{CC}$ = 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




**SO-14 / TSSOP-14**

## Applications

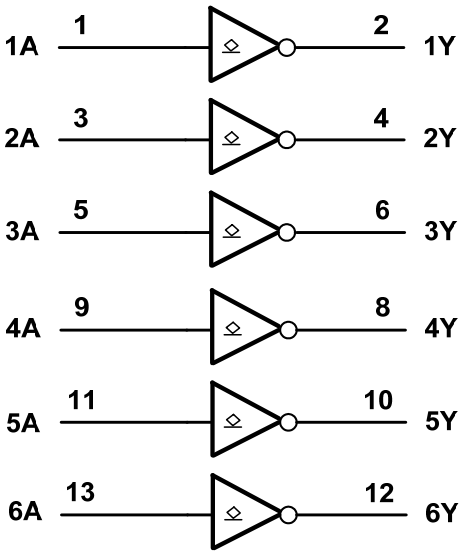
- General Purpose Logic
- Wide array of products such as:
  - PCs, networking, notebooks, netbooks
  - Computer peripherals, hard drives, CD/DVD ROM
  - TV, DVD, DVR, set top box

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 | Z |

## Absolute Maximum Ratings (Note 4) (@$T_A$ = +25°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 $V_I$ < -0.5V or Vi > $V_{CC}$ +0.5V | ±20 | mA |
| $I_{OK}$ | Output Clamp Current $V_O$ < -0.5V or $V_O$ > $V_{CC}$ +0.5V | ±20 | mA |
| $I_O$ | Continuous Output Current -0.5V < $V_O$ $V_{CC}$ +0.5V | +/- 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 | °C |
| $T_{STG}$ | Storage Temperature | -65 to +150 | °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 Vcc to the extent the Maximum clamp current is exceeded.

## Recommended Operating Conditions (Note 6) (@$T_A$ = +25°C, unless otherwise specified.)

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | | 4.5 | 5.5 | V |
| $V_I$ | Input Voltage | | 0 | $V_{CC}$ | V |
| $V_O$ | Output Voltage | | 0 | $V_{CC}$ | V |
| Δt/ΔV | Input Transition Rise or Fall Rate | $V_{CC}$ = 4.5V to 5.5V | | 500 | ns/V |
| $T_A$ | Operating Free-Air Temperature | | -40 | +125 | °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 | | 4.5V to 5.5V | 2.0 | | 2.0 | | V |
| $V_{IL}$ | Low-level Input Voltage | | 4.5V to 5.5V | | 0.8 | | 0.8 | V |
| $V_{OL}$ | Low-level Output Voltage | $I_{OL}$ = 20μA | 4.5V | | 0.1 | | 0.1 | V |
| | | $I_{OL}$ = 4.0 mA | 4.5V | | 0.33 | | 0.4 | |
| $I_{OZ}$ | Z State Leakage Current | $V_O$ = 0 to 5.5V<br>$V_I$ = $V_{IL}$ | 5.5V | | ± 5.0 | | ± 10 | μA |
| $I_I$ | Input Current | $V_I$ = GND to 6.0V | 6.0V | | ± 1 | | ± 1 | μA |
| $I_{CC}$ | Supply Current | $V_I$ = GND or $V_{CC}$, $I_O$ = 0 | 6.0V | | 20 | | 40 | μA |
| $\Delta I_{CC}$ | Additional Supply Current | One Input at $V_{CC}$ -2.1V<br>Other Pins at $V_{CC}$ or GND | 4.5V to 5.5V | | 540 | | 590 | μA |

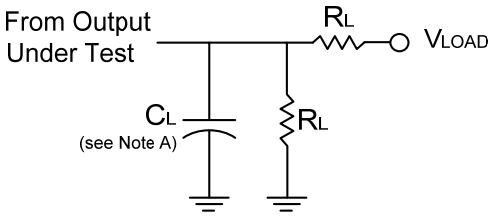
## Switching Characteristics

| 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 $C_L$ = 50pF | 4.5V | — | 12 | 20 | 24 | 27 | ns |
| $t_t$ | Transition time | Figure 1 $C_L$ = 50pF | 4.5V | — | 7 | 14 | 19 | 22 | ns |

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

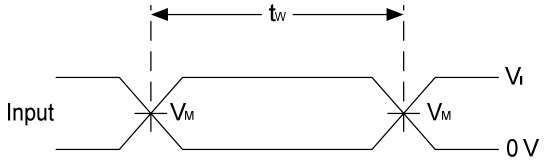
| Parameter | | Test Conditions | $V_{CC}$ = 5.5V | Unit |
|---|---|---|---|---|
| | | | Typ | |
| $C_{pd}$ | Power Dissipation Capacitance per Gate | f = 1MHz | 17 | pF |
| $C_I$ | Input Capacitance | $V_I$ = $V_{CC}$ – or GND | 4 | pF |

## Parameter Measurement Information

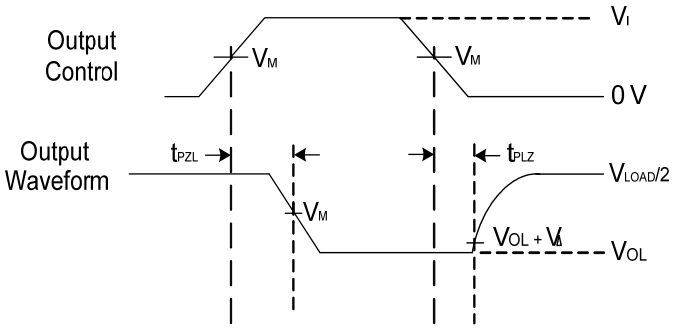



| TEST | Condition |
|---|---|
| $t_{PLZ}$ (see Notes D and E) | Vload |
| $t_{PZL}$(see Notes D and F) | Vload |

| $V_{CC}$ | Inputs | | $V_M$ | $V_{LOAD}$ | $C_L$ | $R_L$ | $V_\Delta$ |
|---|---|---|---|---|---|---|---|
| | $V_I$ | $t_r/t_f$ | | | | | |
| 4.5V | 1.5V | ≤6ns | 3.0V | 2 X $V_{CC}$ | 50pF | 2KΩ | 10% of $V_{CC}$ |




**Voltage Waveform**
**Pulse Duration**

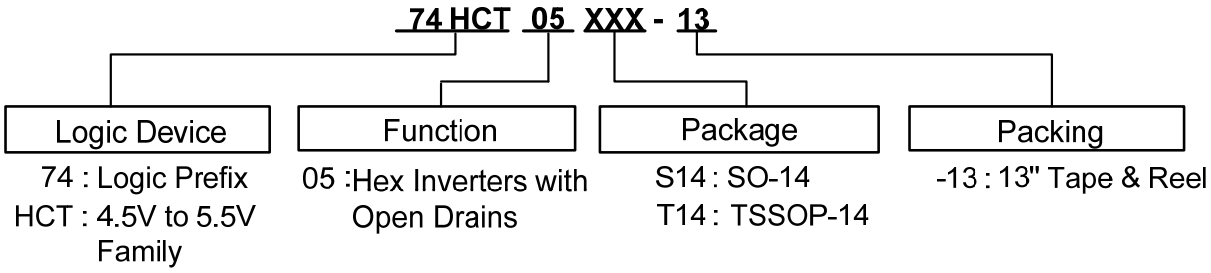



**Voltage Waveform**
**Propagation Delay Times**

Notes:
A. Includes test lead and test apparatus capacitance.
B. All pulses are supplied at pulse repetition rate ≤ 1 MHz
C. The inputs are measured one at a time with one transition per measurement.
D. For the open drain device $t_{PLZ}$ and $t_{PZL}$ are the same as $t_{PD}$
E. $t_{PZL}$ is measured at $V_M$.
D. $t_{PLZ}$ is measured at $V_{OL}$ +$V_\Delta$
F. A Thevenin equivalent load may be used in place of $V_{CC}$ X 2 and resistor divider

**Figure 1 Load Circuit and Voltage Waveforms**

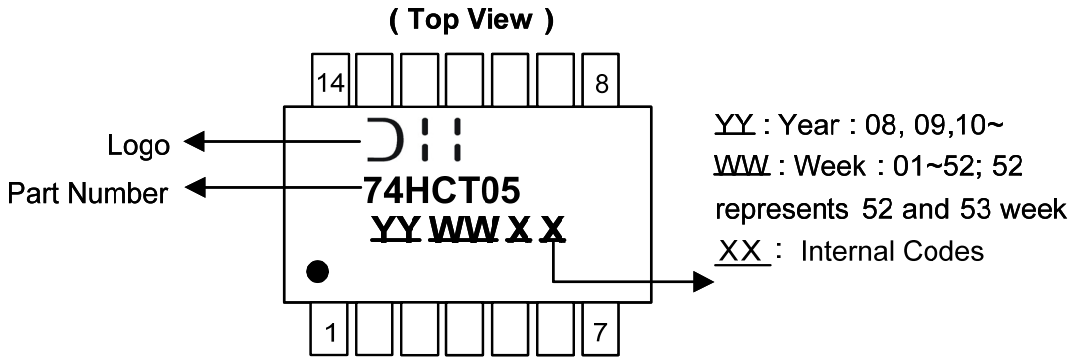
## Ordering Information




| Device | Package Code | Packaging | 7" Tape and Reel | |
|---|---|---|---|---|
| | | | Quantity | Part Number Suffix |
| 74HCT05S14-13 | S14 | SO-14 | 2500/Tape & Reel | -13 |
| 74HCT05T14-13 | T14 | TSSOP-14 | 2500/Tape & Reel | -13 |

## Marking Information

**(1) SO-14, TSSOP-14**

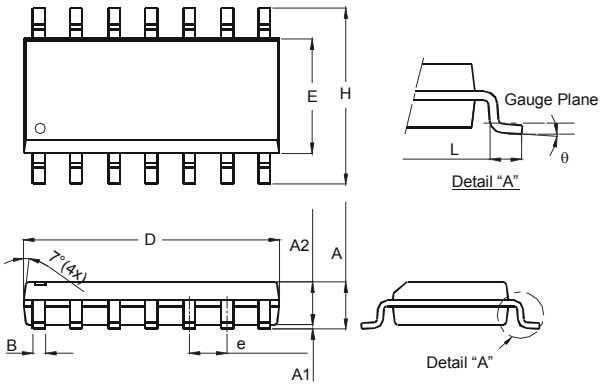



| Part Number | Package |
|---|---|
| 74HCT05S14 | SO-14 |
| 74HCT05T14 | TSSOP-14 |

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

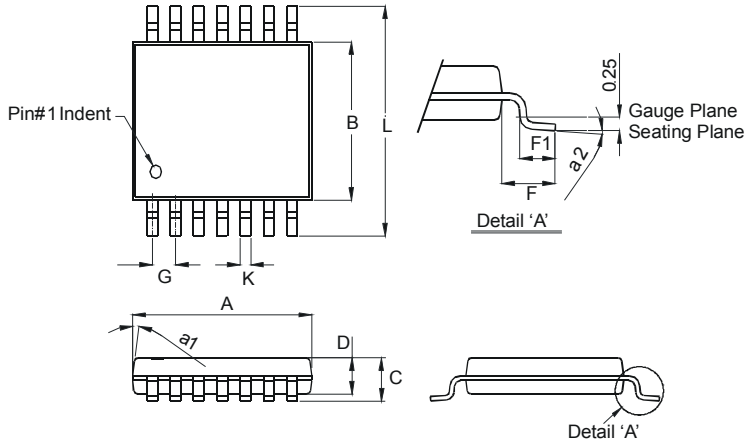
Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for latest version.

### 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

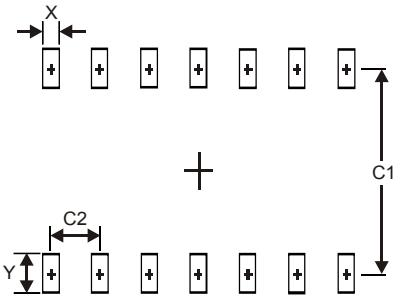



| TSSOP-14 | | |
|---|---|---|
| **Dim** | **Min** | **Max** |
| **a1** | 7° (4X) | |
| **a2** | 0° | 8° |
| **A** | 4.9 | 5.10 |
| **B** | 4.30 | 4.50 |
| **C** | — | 1.2 |
| **D** | 0.8 | 1.05 |
| **F** | 1.00 Typ | |
| **F1** | 0.45 | 0.75 |
| **G** | 0.65 Typ | |
| **K** | 0.19 | 0.30 |
| **L** |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

## Suggested Pad Layout

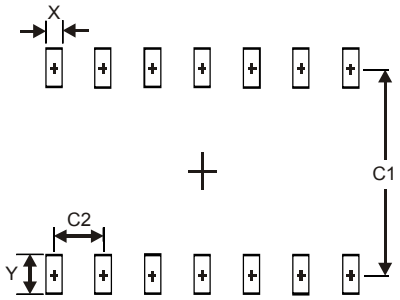
Please see AP02001 at http://www.diodes.com/datasheets/ap02001.pdf for latest version.

**Package Type: SO-14**




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

**Package Type: TSSOP-14**




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

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