

## 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.

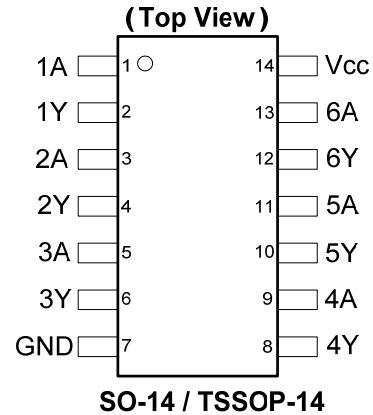
The gates perform the Boolean function:

$$Y = \bar{A}$$

## 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

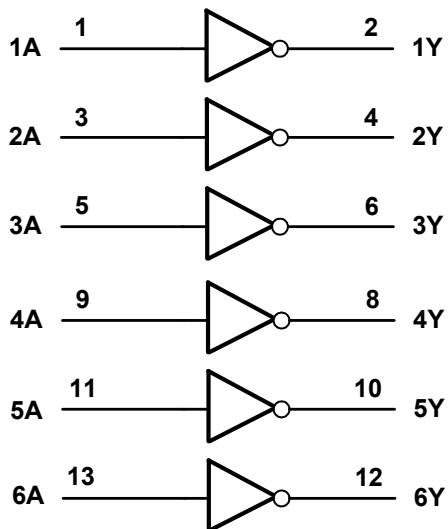
Notes:

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

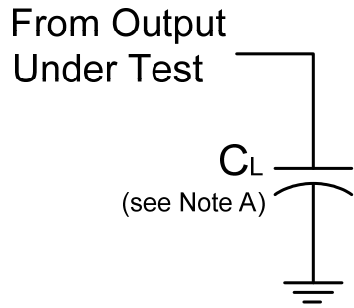
**Switching Characteristics**

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 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 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	

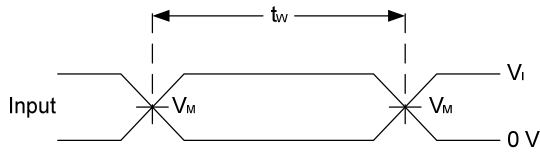
**Operating Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

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

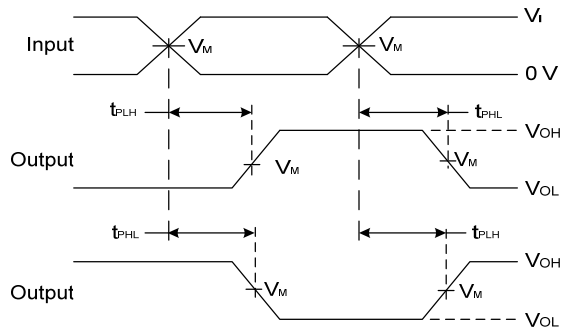
**Parameter Measurement Information**



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



**Voltage Waveform  
Pulse Duration**

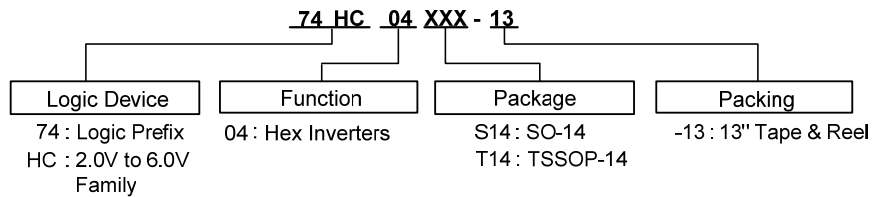


**Voltage Waveform  
Propagation Delay Times  
Inverting and Non Inverting Outputs**

- 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**

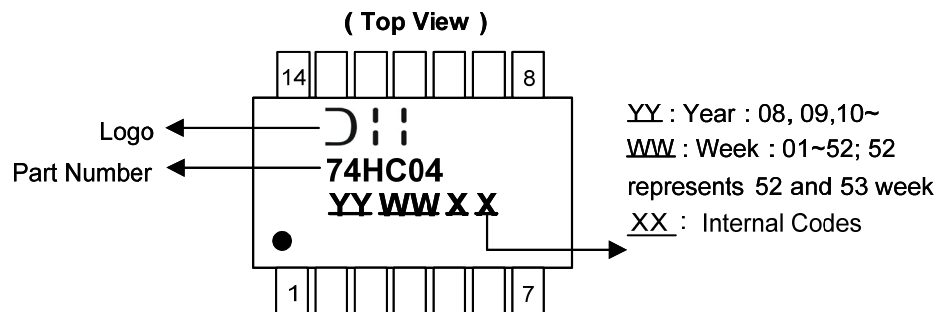
**Ordering Information**



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

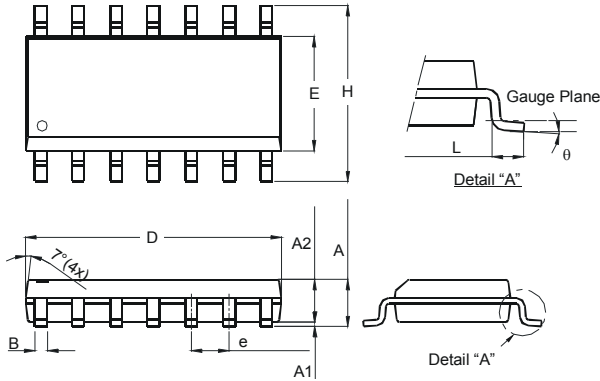


Part Number	Package
74HC04S14	SO-14
74HC04T14	TSSOP-14

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

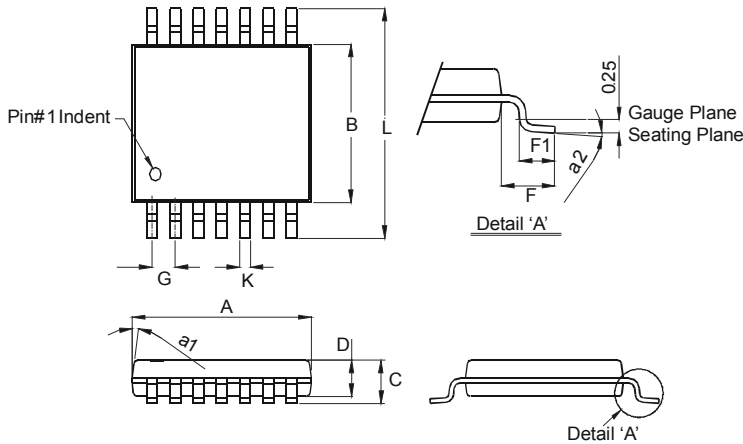
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

**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**

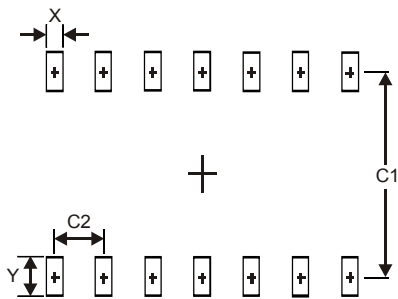


TSSOP-14		
Dim	Min	Max
a1	7° (4X)	
a2	0°	8°
A	4.9	5.10
B	4.30	4.50
C	— 1.2	
D	0.8	1.05
F	1.00 Typ	
F1	0.45	0.75
G	0.65 Typ	
K	0.19	0.30
L	6.40 Typ	
<b>All Dimensions in mm</b>		

**Suggested Pad Layout**

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

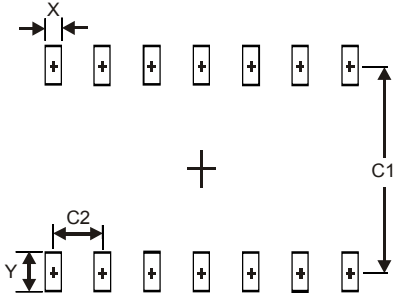
**Package Type: SO-14**



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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