

## HEX BUFFERS WITH OPEN DRAIN OUTPUTS

## Description

The 74LVC04A provides six independent inverter buffers. The device is designed for operation with a power supply range of 1.65V to 5.5V. The inputs are tolerant to 5.5V allowing this device to be used in a mixed voltage environment. The device is fully specified for partial power down applications using IOFF. The IOFF circuitry disables the output preventing damaging current backflow when the device is powered down.

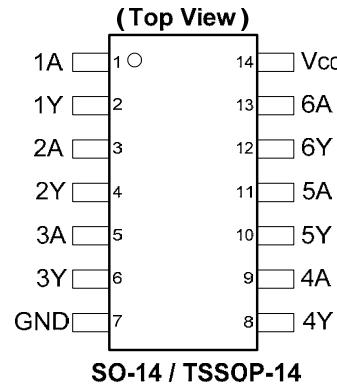
The gates perform the positive Boolean function:

$$Y = \overline{A}$$

## Features

- Wide Supply Voltage Range from 1.65V to 5.5V
- Sinks or sources 24mA at  $V_{CC} = 3.3V$
- CMOS low power consumption
- IOFF Supports Partial-Power-Down Mode Operation
- Inputs or outputs accept up to 5.5V
- Inputs can be driven by 3.3 V or 5.5V allowing for voltage translation applications.
- 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)
- Latch-Up Exceeds 250mA per JESD 78, Class II
- 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

- Voltage Level Shifting
- General Purpose Logic
- Power Down Signal Isolation
- Wide array of products such as:
  - PCs, networking, notebooks, ultrabooks, netbooks
  - Computer peripherals, hard drives, CD/DVD ROM
  - TV, DVD, DVR, set top box

Notes:

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

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## Pin Descriptions

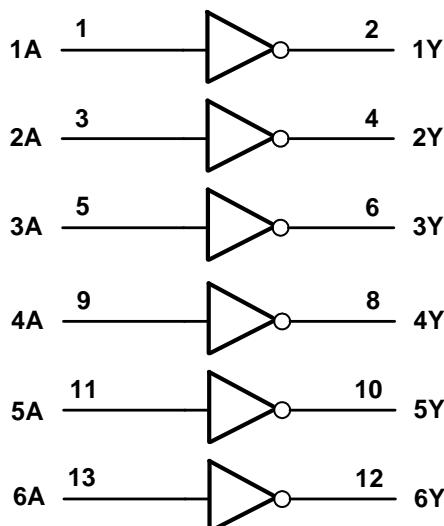
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Pin Number	Pin Name	Description
1	1A	Data Input
2	1Y	Data Output
3	2A	Data Input
4	2Y	Data Output
5	3A	Data Input
6	3Y	Data Output
7	GND	Ground
8	4Y	Data Output
9	4A	Data Input
10	5Y	Data Output
11	5A	Data Input
12	6Y	Data Output
13	6A	Data Input
14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

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## Logic Diagram

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## Function Table

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Inputs	Outputs
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 6.5	V
$V_I$	Input Voltage Range	-0.5 to 6.5	V
$V_O$	Voltage applied to output in high impedance or $I_{OFF}$ state	-0.5 to 6.5	V
$V_O$	Voltage applied to output in high or low state	-0.3 to $V_{CC} + 0.5$	V
$I_{IK}$	Input Clamp Current $V_I < 0$	-50	mA
$I_{OK}$	Output Clamp Current $V_O < 0$	-50	mA
$I_O$	Continuous output current	50	mA
	Continuous current through $V_{DD}$ or GND	$\pm 100$	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

Note: 4. Stresses beyond the absolute maximum may result in immediate failure or reduced reliability. These are stress values and device operation should be within recommended values.

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**Recommended Operating Conditions** (Note 5) (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

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Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	Supply Voltage		1.65	5.5	V
$V_I$	Input Voltage		0	5.5	V
$V_O$	Output Voltage	Active Mode	0	$V_{CC}$	V
		$V_{CC} = 0\text{V}$ ; Power Down Mode	0	5.5	V
$\Delta t/\Delta V$	Input transition rise or fall rate	$V_{CC} = 1.65\text{V}$ to $2.7\text{V}$		20	ns/V
		$V_{CC} = 2.7\text{V}$ to $5.5\text{V}$		10	
$T_A$	Operating free-air temperature		-40	+125	$^\circ\text{C}$

Notes: 5. Unused inputs should be held at  $V_{CC}$  or Ground.

**Electrical Characteristics** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

Symbol	Parameter	Test Conditions	$V_{CC}$	$T_A = -40^\circ\text{C} \text{ to } +85^\circ\text{C}$		$T_A = -40^\circ\text{C} \text{ to } +125^\circ\text{C}$		Unit
				Min	Max	Min	Max	
$V_{IH}$	High-level Input Voltage		1.65V to 1.95V	0.65 X $V_{CC}$		0.65 X $V_{CC}$		V
			2.3V to 2.7V	1.7		1.6		
			2.7V to 3.6V	2.0		2.0		
			4.5V to 5.5V	0.7 X $V_{CC}$		2.0		
$V_{IL}$	Low-level input voltage		1.65V to 1.95V		0.35 X $V_{CC}$		0.35 X $V_{CC}$	V
			2.3V to 2.7V		0.7		0.7	
			2.7V to 3.6V		0.8		0.8	
			4.5V to 5.5V		0.3 X $V_{CC}$		0.3 X $V_{CC}$	
$V_{OH}$	High Level Output Voltage	$I_{OH} = -100\mu\text{A}$	1.65V to 3.6V	$V_{CC} - 0.2$		$V_{CC} - 0.3$		V
		$I_{OH} = -4\text{mA}$	1.65V	1.2				
		$I_{OH} = -8\text{mA}$	2.3V	1.9				
		$I_{OH} = -12\text{mA}$	2.7V	2.2		2.05		
			3.0V	2.3		2.1		
$V_{OL}$	High-level Output Voltage	$I_{OH} = -24\text{mA}$	3.0V	2.2		2.0		V
		$I_{OH} = 100\mu\text{A}$	1.65V to 5.5V		0.2		0.3	
		$I_{OH} = 4\text{mA}$	1.65V		0.45		0.6	
		$I_{OH} = 8\text{mA}$	2.3V		0.70		0.85	
		$I_{OH} = 12\text{mA}$	2.7V		0.40		0.6	
			3.0V		0.55		0.6	
$I_I$	Input Current	$V_I = \text{GND to } 5.5\text{V}$	3.6V		$\pm 5$		$\pm 20$	$\mu\text{A}$
$I_{OFF}$	Power Down Leakage Current	$V_I \text{ or } V_O = 0\text{V to } 3.6\text{V}$	0		10		20	$\mu\text{A}$
$I_{CC}$	Supply Current	$V_I = \text{GND or } V_{CC}$ $I_O = 0$	3.6V		10		40	$\mu\text{A}$
$\Delta I_{CC}$	Additional Supply Current	One input at $V_{CC} - 0.6\text{V}$ Other	2.7V to 3.6V		500		5000	$\mu\text{A}$

## 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	Min	Max	Min	Max		
t <sub>PD</sub>	Propagation Delay A <sub>N</sub> to Y <sub>N</sub>	Figure 1	1.65V to 1.95V	0.5	4.1	7.5	0.5	8.0	0.5	9.5	ns	
			2.3V to 2.7V	0.5	3.6	7.0	0.5	7.5	0.5	9.0		
			2.7V	0.5	3.0	5.3	0.5	5.5	0.5	7.0		
			3V to 3.6V	0.5	2.5	4.3	0.5	4.5	0.5	6.0		
t <sub>sk(0)</sub>	Output Skew Time		3V to 3.6V						1.0		1.5	ns

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

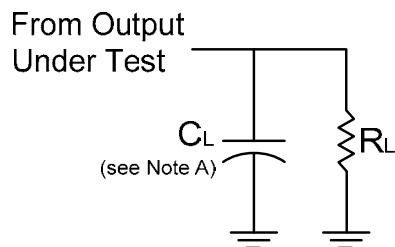
Parameter		Test Conditions	V <sub>cc</sub> = 1.8V	V <sub>cc</sub> = 2.5V	V <sub>cc</sub> = 3.3V	V <sub>cc</sub> = 5V	Unit
			Typ	Typ	Typ	Typ	
C <sub>pd</sub>	Power dissipation capacitance per gate	f = 10 MHz	7.0	7.5	8.0	8.6	pF
C <sub>I</sub>	Input Capacitance	V <sub>i</sub> = V <sub>cc</sub> – or GND	4	4	4	4	pF

## Package Characteristics

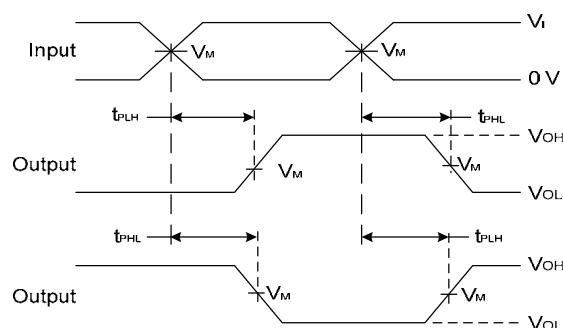
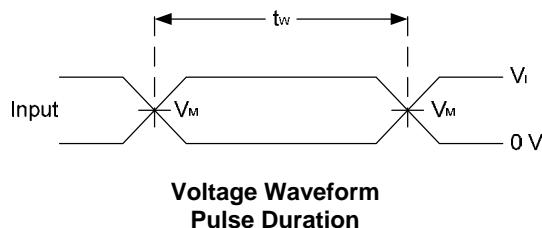
Symbol	Parameter	Test Conditions	V <sub>cc</sub>	Min	Typ	Max	Unit
θ <sub>JA</sub>	Thermal Resistance Junction-to-Ambient	SO-14	(Note 6)		TBD		°C/W
		TSSOP-14			159		
θ <sub>JC</sub>	Thermal Resistance Junction-to-Case	SO-14	(Note 6)		TBD		°C/W
		TSSOP-14			25		

Note: 6. Test condition for SO-14 and TSSOP-14 : Device mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout.

## Parameter Measurement Information



V <sub>cc</sub>	Inputs		V <sub>M</sub>	C <sub>L</sub>	R <sub>L</sub>
	V <sub>I</sub>	t <sub>r</sub> /t <sub>f</sub>			
1.8V $\pm 0.15$ V	V <sub>cc</sub>	$\leq 2$ ns	V <sub>cc</sub> /2	30pF	1K $\Omega$
2.5V $\pm 0.2$ V	V <sub>cc</sub>	$\leq 2$ ns	V <sub>cc</sub> /2	30pF	500 $\Omega$
3.3V $\pm 0.3$ V	3V	$\leq 2.5$ ns	1.5V	50pF	500 $\Omega$
5V $\pm 0.5$ V	V <sub>cc</sub>	$\leq 2.5$ ns	V <sub>cc</sub> /2	50pF	500 $\Omega$

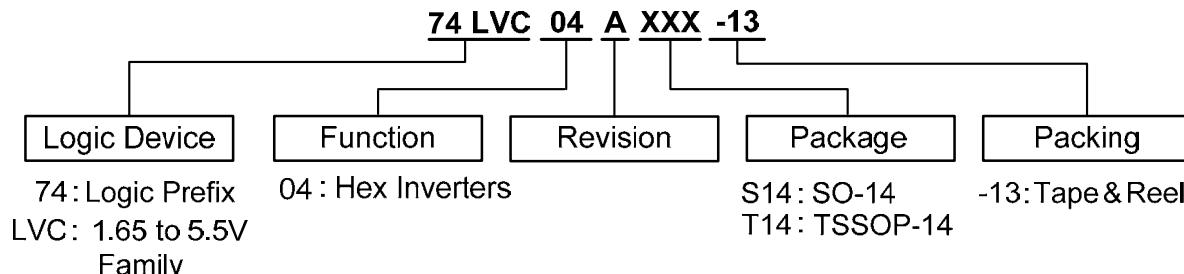


Notes:

- A. Includes test lead and test apparatus capacitance.
- B. All pulses are supplied at pulse repetition rate  $\leq 10$  MHz.
- C. Inputs are measured separately one transition per measurement.
- D. t<sub>PLH</sub> and t<sub>PHL</sub> are the same as t<sub>PD</sub>.

Figure 1. Load Circuit and Voltage Waveforms

## Ordering Information

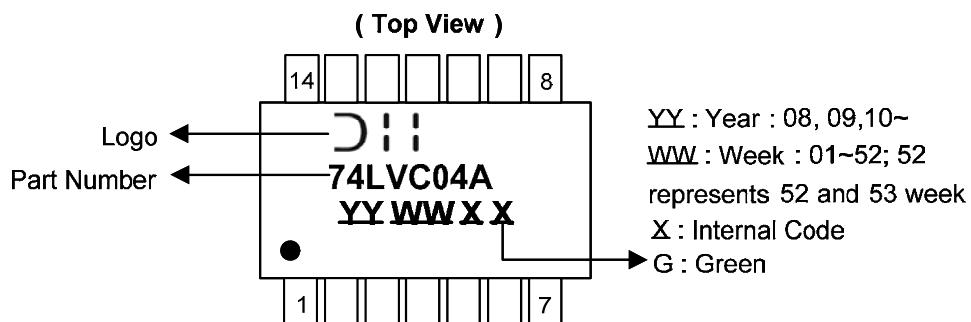


Device	Package Code	Packaging (Note 7)	13" Tape and Reel	
			Quantity	Part Number Suffix
74LVC04AS14-13	S14	SO-14	2500/Tape & Reel	-13
74LVC04AT14-13	T14	TSSOP-14	2500/Tape & Reel	-13

Notes: 7. The taping orientation and tape details can be found at <http://www.diodes.com/datasheets/ap02007.pdf>

## Marking Information

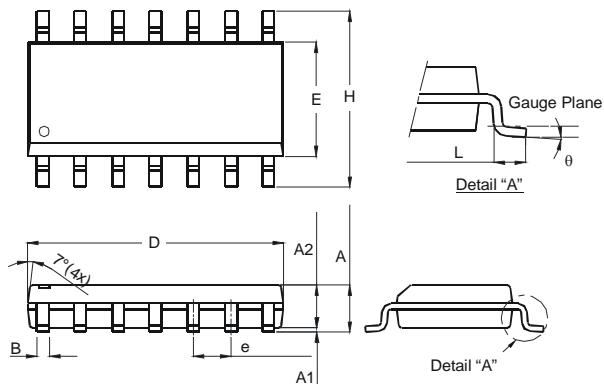
### (1) SO-14, TSSOP-14



Part Number	Package
74LVC04AS14	SO-14
74LVC04AT14	TSSOP-14

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

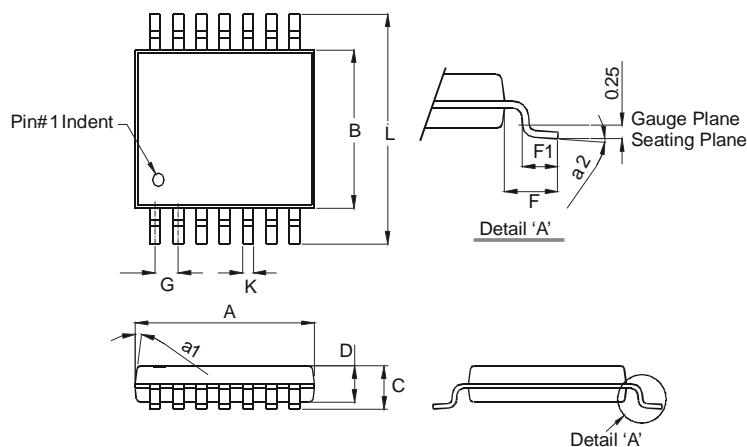
**Package Type: SO-14**



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°

All Dimensions in mm

**Package Type: TSSOP-14**

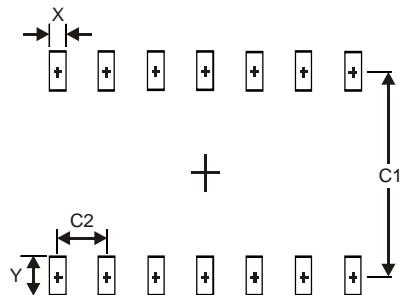


TSSOP-14		
Dim	Min	Max
a1	7° (4X)	
a2	0°	8°
A	4.9	5.10
B	4.30	4.50
C	—	1.2
D	0.8	1.05
F	1.00	Typ
F1	0.45	0.75
G	0.65	Typ
K	0.19	0.30
L	6.40	Typ

All Dimensions in mm

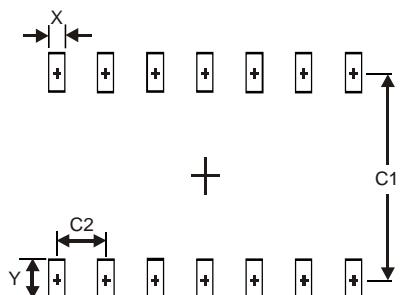
## Suggested Pad Layout

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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