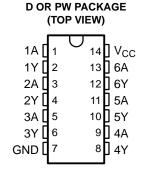


#### **FEATURES**

- Controlled Baseline
  - One Assembly/Test Site, One Fabrication Site
- Extended Temperature Performance of -40°C to 125°C
- Enhanced Diminishing Manufacturing Sources (DMS) Support
- Enhanced Product-Change Notification
- Qualification Pedigree (1)
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)
- Operates From 2 V to 3.6 V
- Inputs Accept Voltages to 5.5 V
- Max t<sub>nd</sub> of 4.5 ns at 3.3 V
- (1) Component qualification in accordance with JEDEC and industry standards to ensure reliable operation over an extended temperature range. This includes, but is not limited to, Highly Accelerated Stress Test (HAST) or biased 85/85, temperature cycle, autoclave or unbiased HAST, electromigration, bond intermetallic life, and mold compound life. Such qualification testing should not be viewed as justifying use of this component beyond specified performance and environmental limits.

- Typical V<sub>OLP</sub> (Output Ground Bounce)
  <0.8 V at V<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 25°C
- Typical V<sub>OHV</sub> (Output V<sub>OH</sub> Undershoot)
  2 V at V<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 25°C



### **DESCRIPTION/ORDERING INFORMATION**

The SN74LVC04A-EP hex inverter contains six independent inverters designed for 2.7-V to 3.6-V V<sub>CC</sub> operation.

The device performs the Boolean function  $Y = \overline{A}$ .

Inputs can be driven from either 3.3-V or 5-V devices. This feature allows the use of this device as a translator in a mixed 3.3-V/5-V system environment.

### **ORDERING INFORMATION**

T <sub>A</sub>	PACK	AGE <sup>(1)</sup>	ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 125°C	SOIC - D	Reel of 2500	SN74LVC04AQDREP	LVC04AE
-40 C to 125 C	TSSOP - PW	Reel of 2000	SN74LVC04AQPWREP	LVC04AE

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

# FUNCTION TABLE (EACH INVERTER)

INPUT A	OUTPUT Y
Н	L
L	Н



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



### LOGIC DIAGRAM, EACH INVERTER (POSITIVE LOGIC)



# Absolute Maximum Ratings<sup>(1)</sup>

over operating free-air temperature range (unless otherwise noted)

			MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage range		-0.5	6.5	V
VI	Input voltage range <sup>(2)</sup>		-0.5	6.5	V
Vo	Output voltage range (2)(3)		-0.5	$V_{CC} + 0.5$	V
I <sub>IK</sub>	Input clamp current	V <sub>1</sub> < 0		-50	mA
I <sub>OK</sub>	Output clamp current	V <sub>O</sub> < 0		-50	mA
Io	Continuous output current			±50	mA
	Continuous current through V <sub>CC</sub> or GNI	)		±100	mΑ
0	Package thermal impedance (4)	D package		86	°C/W
$\theta_{JA}$	Package thermal impedance ***	PW package		113	C/VV
T <sub>stg</sub>	Storage temperature range <sup>(5)</sup>		-65	150	°C

<sup>(1)</sup> Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

# Recommended Operating Conditions<sup>(1)</sup>

			MIN	MAX	UNIT
V	Supply voltage		2	3.6	V
V <sub>CC</sub>	Supply voltage	Data retention only	1.5		V
$V_{IH}$	High-level input voltage	V <sub>CC</sub> = 2.7 V to 3.6 V	2		V
$V_{IL}$	Low-level input voltage	V <sub>CC</sub> = 2.7 V to 3.6 V		0.8	V
VI	Input voltage		0	5.5	V
$V_{O}$	Output voltage		0	$V_{CC}$	V
	High level output ourrent	$V_{CC} = 2.7 \text{ V}$		-12	mA
Іон	High-level output current	$V_{CC} = 3 V$		-24	ША
	Low-level output current	V <sub>CC</sub> = 2.7 V		12	mA
l <sub>OL</sub>	Low-level output current	$V_{CC} = 3 V$		24	ША
$T_A$	Operating free-air temperature		-40	125	°C

All unused inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation. Refer to the TI application report, Implications of Slow or Floating CMOS Inputs, literature number SCBA004.

<sup>(2)</sup> The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.

<sup>3)</sup> The value of V<sub>CC</sub> is provided in the recommended operating conditions table.

<sup>(4)</sup> The package thermal impedance is calculated in accordance with JESD 51-7.

<sup>(5)</sup> Long-term high-temperature storage and/or extended use at maximum recommended operating conditions may result in reduction of overall device life. See http://www.ti.com/ep\_quality for additional information on enhanced plastic packaging.



### **Electrical Characteristics**

over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	V <sub>cc</sub>	MIN	TYP <sup>(1)</sup>	MAX	UNIT
	$I_{OH} = -100 \mu A$	2.7 V to 3.6 V	V <sub>CC</sub> - 0.2			
V	I - 12 mA	2.7 V	2.2			V
V <sub>OH</sub>	$I_{OH} = -12 \text{ mA}$	3 V	2.4			V
	$I_{OH} = -24 \text{ mA}$	3 V	2.2			
	$I_{OL} = 100 \mu A$	2.7 V to 3.6 V			0.2	
V <sub>OL</sub>	I <sub>OL</sub> = 12 mA	2.7 V			0.4	V
	I <sub>OL</sub> = 24 mA	3 V			0.55	
I <sub>I</sub>	V <sub>I</sub> = 5.5 V or GND	3.6 V			±5	μΑ
I <sub>CC</sub>	$V_I = V_{CC}$ or GND, $I_O = 0$	3.6 V			10	μΑ
$\Delta I_{CC}$	One input at $V_{CC}$ – 0.6 V, Other inputs at $V_{CC}$ or GND	2.7 V to 3.6 V			500	μΑ
C <sub>i</sub>	$V_I = V_{CC}$ or GND	3.3 V		5		pF

<sup>(1)</sup> All typical values are at  $V_{CC}$  = 3.3 V,  $T_A$  = 25°C.

## **Switching Characteristics**

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

PARAMETER	PARAMETER FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> =	2.7 V	V <sub>CC</sub> = 3 ± 0.3	UNIT	
	(INPOT)	(OUTPOT)	MIN	MAX	MIN	MAX	
t <sub>pd</sub>	A	Y		5.5	0.5	4.5	ns

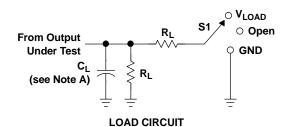
# **Operating Characteristics**

 $T_A = 25^{\circ}C$ 

	PARAMETER	TEST	$V_{CC} = 2.5 V$	$V_{CC} = 3.3 \text{ V}$	UNIT	
	IANAMETEN	CONDITIONS	TYP	TYP	ONI	
$C_{pd}$	Power dissipation capacitance per inverter	f = 10 MHz	7	8	pF	

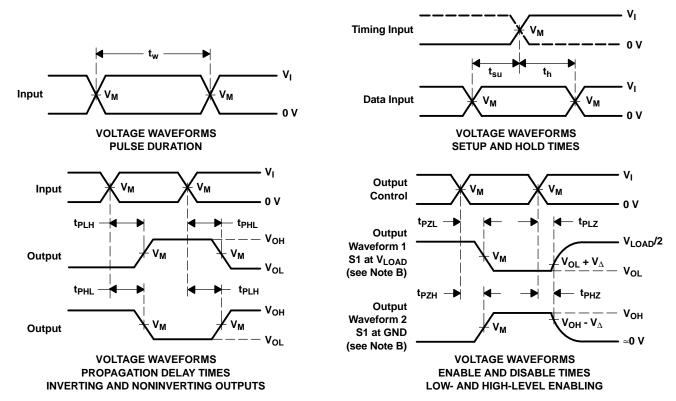


### PARAMETER MEASUREMENT INFORMATION



TEST	S1
t <sub>PLH</sub> /t <sub>PHL</sub>	Open
t <sub>PLZ</sub> /t <sub>PZL</sub>	V <sub>LOAD</sub>
t <sub>PHZ</sub> /t <sub>PZH</sub>	GND

Vac		PUTS	.,	.,		_	.,
V <sub>CC</sub>	VI	t <sub>r</sub> /t <sub>f</sub>	V <sub>M</sub>	V <sub>LOAD</sub>	CL	R <sub>L</sub>	$V_{\Delta}$
2.7 V	2.7 V	≤2.5 ns	1.5 V	6 V	50 pF	500 Ω	0.3 V
3.3 V $\pm$ 0.3 V	2.7 V	≤2.5 ns	1.5 V	6 V	50 pF	500 Ω	0.3 V



NOTES: A. C<sub>L</sub> includes probe and jig capacitance.

- B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
- C. All input pulses are supplied by generators having the following characteristics: PRR  $\leq$  10 MHz,  $Z_0 = 50~\Omega$ .
- D. The outputs are measured one at a time, with one transition per measurement.
- E.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
- F. t<sub>PZL</sub> and t<sub>PZH</sub> are the same as t<sub>en</sub>.
- G.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
- H. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms





i.com 18-Sep-2008

#### PACKAGING INFORMATION

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	e Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
SN74LVC04AQDREP	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC04AQPWREP	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
V62/04653-01XE	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
V62/04653-01YE	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

<sup>(1)</sup> The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

**Pb-Free** (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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#### OTHER QUALIFIED VERSIONS OF SN74LVC04A-EP:

Catalog: SN74LVC04A
 Automotive: SN74LVC04

Automotive: SN74LVC04A-Q1Military: SN54LVC04A

NOTE: Qualified Version Definitions:

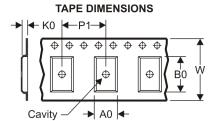
- Catalog TI's standard catalog product
- Automotive Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Military QML certified for Military and Defense Applications

# PACKAGE MATERIALS INFORMATION

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# TAPE AND REEL INFORMATION





_		
	A0	Dimension designed to accommodate the component width
Γ	B0	Dimension designed to accommodate the component length
		Dimension designed to accommodate the component thickness
	W	Overall width of the carrier tape
Γ	P1	Pitch between successive cavity centers

## QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



#### \*All dimensions are nominal

Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74LVC04AQDREP	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN74LVC04AQPWREP	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

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### \*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LVC04AQDREP	SOIC	D	14	2500	333.2	345.9	28.6
SN74LVC04AQPWREP	TSSOP	PW	14	2000	346.0	346.0	29.0

# D (R-PDSO-G14)

## PLASTIC SMALL OUTLINE



NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
- Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
- E. Reference JEDEC MS-012 variation AB.



PW (R-PDSO-G14)

# PLASTIC SMALL OUTLINE



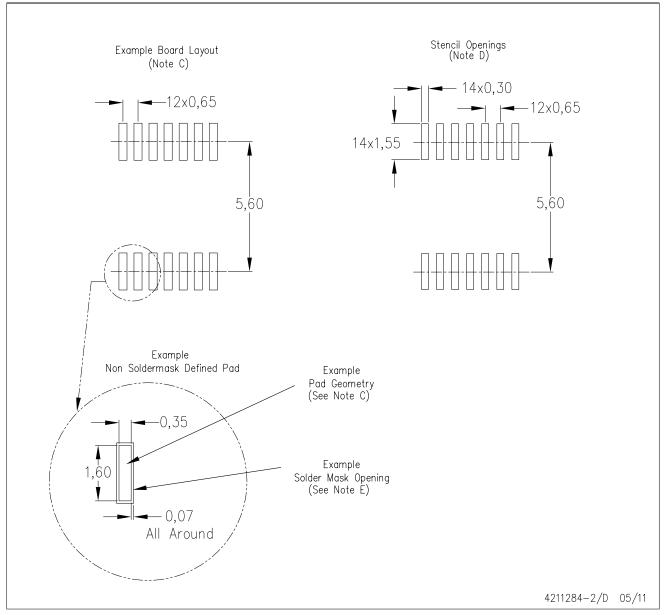
NOTES:

- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M—1994.
- B. This drawing is subject to change without notice.
  - Sody length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
- Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
- E. Falls within JEDEC MO-153



# PW (R-PDSO-G14)

# PLASTIC SMALL OUTLINE



NOTES:

- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



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