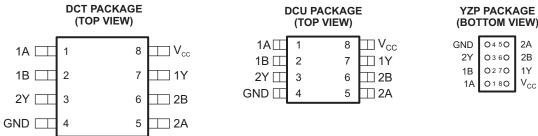


#### **FEATURES**

- Available in the Texas Instruments
   NanoFree<sup>™</sup> Package
- Supports 5-V V<sub>CC</sub> Operation
- Inputs Accept Voltages to 5.5 V
- Max t<sub>nd</sub> of 4.9 ns at 3.3 V
- Low Power Consumption, 10-μA Max I<sub>CC</sub>
- ±24-mA Output Drive at 3.3 V
- 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

- I<sub>off</sub> Supports Partial-Power-Down Mode Operation
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 1000-V Charged-Device Model (C101)



See mechanical drawings for dimensions

### **DESCRIPTION/ORDERING INFORMATION**

This dual 2-input positive-NOR gate is designed for 1.65-V to 5.5-V V<sub>CC</sub> operation.

The SN74LVC2G02 performs the Boolean function  $Y = \overline{A + B}$  or  $Y = \overline{A} \bullet \overline{B}$  in positive logic.

NanoFree<sup>™</sup> package technology is a major breakthrough in IC packaging concepts, using the die as the package.

This device is fully specified for partial-power-down applications using  $I_{off}$ . The  $I_{off}$  circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

#### **ORDERING INFORMATION**

T <sub>A</sub>	PACKAGE <sup>(1)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING(2)
	NanoFree <sup>™</sup> – WCSP (DSBGA) 0.23-mm Large Bump – YZP (Pb-free)	Reel of 3000	SN74LVC2G02YZPR	CB_
-40°C to 85°C	SSOP - DCT	Reel of 3000	SN74LVC2G02DCTR	C02
	VSSOP – DCU	Reel of 3000	SN74LVC2G02DCUR	000
	V330F - DC0	Reel of 250	SN74LVC2G02DCUT	C02_

- Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.
- (2) DCT: The actual top-side marking has three additional characters that designate the year, month, and assembly/test site. DCU: The actual top-side marking has one additional character that designates the assembly/test site. YZP: The actual top-side marking has three preceding characters to denote year, month, and sequence code, and one following character to designate the assembly/test site. Pin 1 identifier indicates solder-bump composition (1 = SnPb, • = Pb-free).



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.

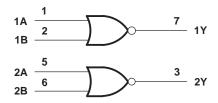
NanoFree is a trademark of Texas Instruments.



### **FUNCTION TABLE** (EACH GATE)

INPL	OUTPUT	
Α	В	Y
Н	Χ	L
X	Н	L
L	L	Н

### **LOGIC DIAGRAM (POSITIVE LOGIC)**



## **Absolute Maximum Ratings**(1)

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

			MIN	MAX.	UNIT
$V_{CC}$	Supply voltage range		-0.5	6.5	V
$V_{I}$	Input voltage range <sup>(2)</sup>		-0.8	6.5	V
Vo	Voltage range applied to any output in the high	n-impedance or power-off state <sup>(2)</sup>	-0.5	6.5	V
Vo	Voltage range applied to any output in the high	or low state (2)(3)	-0.8	$V_{CC} + 0.5$	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 GND			±100	mA
		DCT package		220	
$\theta_{JA}$	Package thermal impedance (4)	DCU package		227	°C/W
		YZP package		102	
T <sub>stg</sub>	Storage temperature range	-65	5 150	°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.

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

 <sup>(3)</sup> The value of V<sub>CC</sub> is provided in the recommended operating conditions table.
 (4) The package thermal impedance is calculated in accordance with JESD 51-7.



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

			MIN	MAX	UNIT	
W	Committee	Operating	1.65	5.5	V	
$V_{CC}$	Supply voltage Dat	Data retention only	1.5		V	
		V <sub>CC</sub> = 1.65 V to 1.95 V	$0.65 \times V_{CC}$			
V	High lavel inner value	V <sub>CC</sub> = 2.3 V to 2.7 V	1.7			
$V_{IH}$	High-level input voltage	V <sub>CC</sub> = 3 V to 3.6 V	2		V	
		V <sub>CC</sub> = 4.5 V to 5.5 V	$0.7 \times V_{CC}$			
		V <sub>CC</sub> = 1.65 V to 1.95 V		$0.35 \times V_{CC}$		
V	Low level input voltage	V <sub>CC</sub> = 2.3 V to 2.7 V		0.7	V	
V <sub>IL</sub> Low-level input voltage	Low-level input voltage	V <sub>CC</sub> = 3 V to 3.6 V		0.8	V	
		V <sub>CC</sub> = 4.5 V to 5.5 V		$0.3 \times V_{CC}$		
$V_{I}$	Input voltage		0	5.5	V	
Vo	Output voltage		0	V <sub>CC</sub>	V	
		V <sub>CC</sub> = 1.65 V		-4		
	High-level output current	V <sub>CC</sub> = 2.3 V		-8		
$I_{OH}$		V 2V		-16	mA	
		V <sub>CC</sub> = 3 V		-24		
		V <sub>CC</sub> = 4.5 V		-32		
		V <sub>CC</sub> = 1.65 V		4		
		V <sub>CC</sub> = 2.3 V		8		
$I_{OL}$	Low-level output current	V 0V		16	mA	
		V <sub>CC</sub> = 3 V		24		
		V <sub>CC</sub> = 4.5 V		32		
		$V_{CC}$ = 1.8 V ± 0.15 V, 2.5 V ± 0.2 V		20		
Δt/Δν	Input transition rise or fall rate	$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$		10	ns/V	
		$V_{CC} = 5 \text{ V} \pm 0.5 \text{ V}$		5		
T <sub>A</sub>	Operating free-air temperature		-40	85	°C	

<sup>(1)</sup> All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, Implications of Slow or Floating CMOS Inputs, literature number SCBA004.

# SN74LVC2G02 DUAL 2-INPUT POSITIVE-NOR GATE

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### **Electrical Characteristics**

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

PARAMETER	TEST CONDITIONS	V <sub>cc</sub>	MIN TYP(1) MAX	UNIT
	$I_{OH} = -100 \mu A$	1.65 V to 5.5 V	V <sub>CC</sub> – 0.1	
	$I_{OH} = -4 \text{ mA}$	1.65 V	1.2	
V	$I_{OH} = -8 \text{ mA}$	2.3 V	1.9	V
V <sub>OH</sub>	$I_{OH} = -16 \text{ mA}$	3 V	2.4	v
	$I_{OH} = -24 \text{ mA}$	3 V	2.3	
	$I_{OH} = -32 \text{ mA}$	4.5 V	3.8	
	$I_{OL} = 100 \mu A$	1.65 V to 5.5 V	0.1	
	I <sub>OL</sub> = 4 mA	1.65 V	0.45	
V	I <sub>OL</sub> = 8 mA	2.3 V	0.3	V
V <sub>OL</sub>	I <sub>OL</sub> = 16 mA	3 V	0.4	v
	I <sub>OL</sub> = 24 mA	3 V	0.55	
	I <sub>OL</sub> = 32 mA	4.5 V	0.55	
I <sub>I</sub> A or B inputs	V <sub>I</sub> = 5.5 V or GND	0 to 5.5 V	±5	μΑ
l <sub>off</sub>	$V_I$ or $V_O = 5.5 \text{ V}$	0	±10	μΑ
I <sub>CC</sub>	$V_I = 5.5 \text{ V or GND}, \qquad I_O = 0$	1.65 V to 5.5 V	10	μΑ
$\Delta I_{CC}$	One input at $V_{CC}$ – 0.6 V, Other inputs at $V_{CC}$ or GND	3 V to 5.5 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	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = ± 0.1		V <sub>CC</sub> = ± 0.2		V <sub>CC</sub> = ± 0.3		V <sub>CC</sub> = ± 0.5		UNIT
	(INFOT)	(001701)	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t <sub>pd</sub>	A or B	Y	3.2	8.9	1	5.4	1	4.9	1	4.4	ns

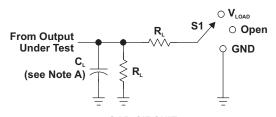
## **Operating Characteristics**

 $T_A = 25^{\circ}C$ 

	PARAMETER	TEST CONDITIONS	V <sub>CC</sub> = 1.8 V	V <sub>CC</sub> = 2.5 V	V <sub>CC</sub> = 3.3 V	$C_{CC} = 3.3 \text{ V}$ $V_{CC} = 5 \text{ V}$		
	FARAMETER	TEST CONDITIONS	TYP	TYP	TYP	TYP	UNIT	
$C_{pd}$	Power dissipation capacitance	f = 10 MHz	18	18	19	22	pF	



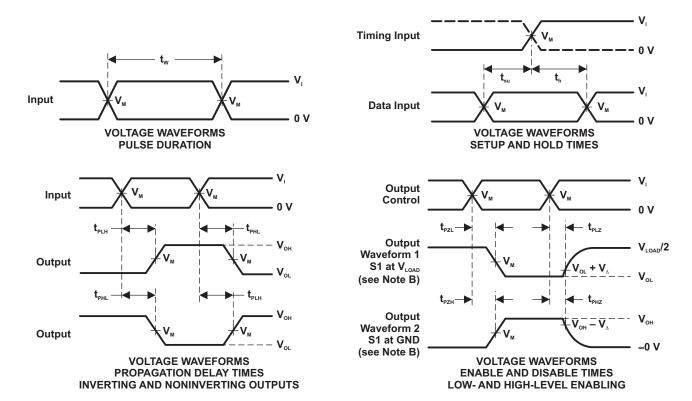
### PARAMETER MEASUREMENT INFORMATION



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

LOAD CIRCUIT

INPUTS		V	V		<b>D</b>	.,		
V <sub>cc</sub>	V,	t,/t,	V <sub>M</sub>	V <sub>LOAD</sub>	C <sub>L</sub>	R <sub>L</sub>	$\mathbf{V}_{\scriptscriptstyle{\Delta}}$	
1.8 V ± 0.15 V	$V_{cc}$	≤2 ns	V <sub>cc</sub> /2	2 × V <sub>cc</sub>	30 pF	<b>1 k</b> Ω	0.15 V	
2.5 V ± 0.2 V	$V_{cc}$	≤2 ns	V <sub>cc</sub> /2	2 × V <sub>cc</sub>	30 pF	500 Ω	0.15 V	
$3.3~V~\pm~0.3~V$	3 V	≤2.5 ns	1.5 V	6 V	50 pF	500 Ω	0.3 V	
5 V ± 0.5 V	$V_{cc}$	≤2.5 ns	V <sub>cc</sub> /2	2 × V <sub>cc</sub>	50 pF	500 Ω	0.3 V	



NOTES: A.  $C_L$  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<sub>o</sub> = 50  $\Omega$ .
- D. The outputs are measured one at a time, with one transition per measurement.
- E.  $t_{PLZ}$  and  $\dot{t}_{PHZ}$  are the same as  $t_{dis}$ .
- F.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
- 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

### PACKAGE OPTION ADDENDUM



com 5-Dec-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>
SN74LVC2G02DCTR	ACTIVE	SM8	DCT	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G02DCTRE4	ACTIVE	SM8	DCT	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G02DCTRG4	ACTIVE	SM8	DCT	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G02DCUR	ACTIVE	US8	DCU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G02DCURE4	ACTIVE	US8	DCU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G02DCUT	ACTIVE	US8	DCU	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G02DCUTE4	ACTIVE	US8	DCU	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G02DCUTG4	ACTIVE	US8	DCU	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LVC2G02YZPR	ACTIVE	DSBGA	YZP	8	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM

(1) 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 SN74LVC2G02:

Enhanced Product: SN74LVC2G02-EP



# **PACKAGE OPTION ADDENDUM**

5-Dec-2008

NOT	E · O · · ·	alifiad \	/arcian	Definitions:

• Enhanced Product - Supports Defense, Aerospace and Medical Applications

# PACKAGE MATERIALS INFORMATION

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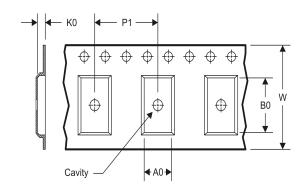
## TAPE AND REEL INFORMATION

### **REEL DIMENSIONS**





### **TAPE DIMENSIONS**



A0	Dimension designed to accommodate the component width
В0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

### TAPE AND REEL INFORMATION

### \*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
SN74LVC2G02DCUR	US8	DCU	8	3000	180.0	8.4	2.25	3.35	1.05	4.0	8.0	Q3
SN74LVC2G02YZPR	DSBGA	YZP	8	3000	180.0	8.4	1.02	2.02	0.63	4.0	8.0	Q1

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#### \*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LVC2G02DCUR	US8	DCU	8	3000	202.0	201.0	28.0
SN74LVC2G02YZPR	DSBGA	YZP	8	3000	220.0	220.0	34.0

### DCT (R-PDSO-G8)

### PLASTIC SMALL-OUTLINE PACKAGE



NOTES: A. All linear dimensions are in millimeters.

- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold flash or protrusion
- D. Falls within JEDEC MO-187 variation DA.

# DCT (R-PDSO-G8)

### 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.
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



# DCU (R-PDSO-G8)

# PLASTIC SMALL-OUTLINE PACKAGE (DIE DOWN)



NOTES:

- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
  - D. Falls within JEDEC MO-187 variation CA.



DCU (S-PDSO-G8)

PLASTIC SMALL OUTLINE PACKAGE (DIE DOWN)



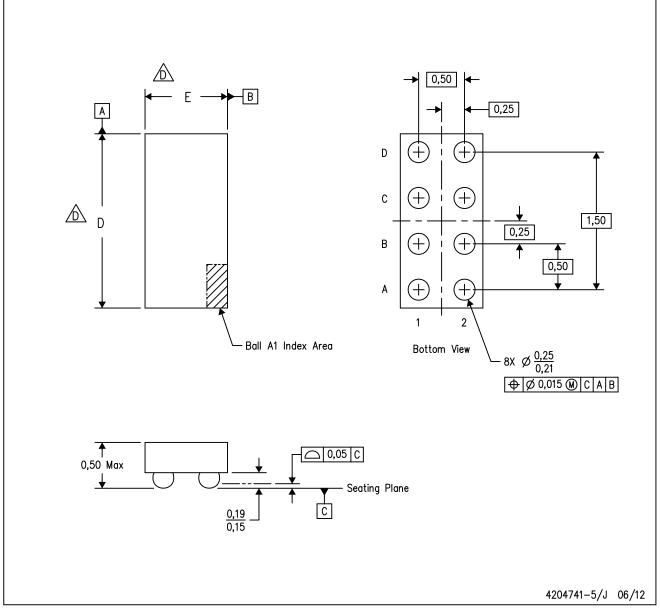
NOTES: A. All linear dimensions are in millimeters.

- 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.



YZP (R-XBGA-N8)

DIE-SIZE BALL GRID ARRAY



NOTES: All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.

- This drawing is subject to change without notice.
- Ç. NanoFree™ package configuration.
- ⚠ The package size (Dimension D and E) of a particular device is specified in the device Product Data Sheet version of this drawing, in case it cannot be found in the product data sheet please contact a local TI representative. E. This package is a Pb-free solder ball design. Refer to the 8 YEP package (drawing 4204725) for tin-lead (SnPb).

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