

## **Dual 2-Input Positive-NAND Gate**

Check for Samples: SN74LVC2G00

#### **FEATURES**

- Available in the Texas Instruments NanoFree™ **Package**
- Supports 5-V V<sub>CC</sub> Operation
- Inputs Accept Voltages to 5.5 V
- Max t<sub>pd</sub> of 4.3 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)**  $< 0.8 \text{ V at V}_{CC} = 3.3 \text{ V}, T_A = 25^{\circ}\text{C}$
- Typical V<sub>OHV</sub> (Output V<sub>OH</sub> Undershoot) >2 V at  $V_{CC} = 3.3$  V,  $T_A = 25$ °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)

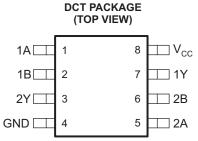
#### **DESCRIPTION**

This dual 2-input positive-NAND gate is designed for 1.65-V to 5.5-V  $V_{CC}$  operation.

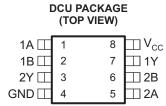
The SN74LVC2G00 performs the Boolean function Y  $= \overline{A \cdot B}$  or  $Y = \overline{A} + \overline{B}$  in positive logic.

NanoFree™ 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 Ioff. The Ioff circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.









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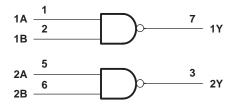


These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

# Function Table (Each Gate)

INPL	ОИТРИТ	
Α	В	Υ
Н	Н	L
L	Χ	Н
Х	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	٧			
VI	Input voltage range <sup>(2)</sup>	nput voltage range <sup>(2)</sup>						
Vo	Voltage range applied to any output in the	-0.5	6.5	V				
Vo	Voltage range applied to any output in the	-0.5	V <sub>CC</sub> + 0.5	V				
I <sub>IK</sub>	Input clamp current	V <sub>I</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 GNE	)		±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	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.

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<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.

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



## **Recommended Operating Conditions**(1)

			MIN	MAX	UNIT	
V	Complexed to me	Operating	1.65	5.5	V	
$V_{CC}$	Supply voltage	Data retention only	1.5		V	
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.65 × V <sub>CC</sub>			
\ /	High lavel input valtage	V <sub>CC</sub> = 2.3 V to 2.7 V	1.7		V	
$V_{IH}$	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 × V <sub>CC</sub>			
		V <sub>CC</sub> = 1.65 V to 1.95 V		0.35 × V <sub>CC</sub>		
.,	Lava lava Paradoraka	V <sub>CC</sub> = 2.3 V to 2.7 V		0.7		
$V_{IL}$	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 × V <sub>CC</sub>		
VI	Input voltage	·	0	5.5	٧	
Vo	Output voltage		0	V <sub>CC</sub>	٧	
		V <sub>CC</sub> = 1.65 V		-4		
		V <sub>CC</sub> = 2.3 V		-8		
I <sub>OH</sub>	High-level output current	v		-16	mA	
		$V_{CC} = 3 V$		-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		
l <sub>OL</sub>	Low-level output current	у оу		16	mA	
		$V_{CC} = 3 V$		24		
		V <sub>CC</sub> = 4.5 V		32	1	
		$V_{CC} = 1.8 \text{ V} \pm 0.15 \text{ V}, 2.5 \text{ V} \pm 0.2 \text{ V}$		20		
Δt/Δν	Input transition rise or fall rate	$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$		10	+	
		$V_{CC} = 5 \text{ V} \pm 0.5 \text{ V}$		5		
T <sub>A</sub>	Operating free-air temperature	,	-40	125	°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.

Product Folder Links: SN74LVC2G00



#### **Electrical Characteristics**

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

DADAMETED	TEST CONDITIONS		-40°C	C to 85°C		–40°C	to 125°C			
PARAMETER	TEST CONDITIONS	V <sub>cc</sub>	MIN	TYP <sup>(1)</sup>	MAX	MIN	TYP <sup>(1)</sup>	MAX	UNIT	
	I <sub>OH</sub> = -100 μA	1.65 V to 5.5 V	V <sub>CC</sub> - 0.1			V <sub>CC</sub> - 0.1				
V <sub>OH</sub>	I <sub>OH</sub> = -4 mA	1.65 V	1.2			1.2				
	$I_{OH} = -8 \text{ mA}$	2.3 V	1.9			1.9			٧	
<b></b>	$I_{OH} = -16 \text{ mA}$	3 V	2.4			2.4				
	$I_{OH} = -24 \text{ mA}$	3 V	2.3			2.3				
	I <sub>OH</sub> = -32 mA	4.5 V	3.8			3.8				
	I <sub>OL</sub> = 100 μA	1.65 V to 5.5 V			0.1			0.1		
	I <sub>OL</sub> = 4 mA	1.65 V			0.45			0.45		
$V_{OL}$	I <sub>OL</sub> = 8 mA	2.3 V			0.3			0.3	٧	
-	$I_{OL} = 16 \text{ mA}$	3 V			0.4			0.4		
	I <sub>OL</sub> = 24 mA	3 V			0.55			0.55		
	I <sub>OL</sub> = 32 mA	4.5 V			0.55			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			±5	μΑ	
I <sub>off</sub>	$V_I$ or $V_O = 5.5 \text{ V}$	0			±10			±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			10	μΑ	
ΔI <sub>CC</sub>	$ \begin{array}{cccc} \text{One input at} & \text{Other inputs at V}_{\text{CC}} \text{ or} \\ \text{V}_{\text{CC}} - 0.6 \text{ V}, & \text{GND} \\ \end{array} $	3 V to 5.5 V			500			500	μΑ	
Cı	V <sub>I</sub> = V <sub>CC</sub> 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)

	, ,	1 0	`			, ,	•	,			
							/C2G00 to 85°C				
PARAMETER	FROM (INPUT)	TO (OUTPUT)		V <sub>CC</sub> = 1.8 V ± 0.15 V		V <sub>CC</sub> = 2.5 V ± 0.2 V		V <sub>CC</sub> = 3.3 V ± 0.3 V		V <sub>CC</sub> = 5 V ± 0.5 V	
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t <sub>pd</sub>	A or B	Υ	3.7	8.6	1.6	4.8	1.1	4.3	1	3.3	ns

## **Switching Characteristics**

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

						SN74LV -40°C to					
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 1 ± 0.15		V <sub>CC</sub> = 2.5 V ± 0.2 V		V <sub>CC</sub> = 3.3 V ± 0.3 V		V <sub>CC</sub> = 5 V ± 0.5 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t <sub>pd</sub>	A or B	Υ	3.7	9.4	1.6	5.5	1.1	4.9	1	3.8	ns

## **Operating Characteristics**

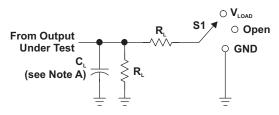
 $T_A = 25^{\circ}C$ 

	PARAMETER	TEST CONDITIONS	V <sub>CC</sub> = 1.8 V	V <sub>CC</sub> = 2.5 V	V <sub>CC</sub> = 3.3 V	V <sub>CC</sub> = 5 V	UNIT	
	FANAMETER	1231 CONDITIONS	TYP	TYP	TYP	TYP	ONIT	
C <sub>pd</sub>	Power dissipation capacitance	f = 10 MHz	19	19	20	22	pF	

Product Folder Links: SN74LVC2G00



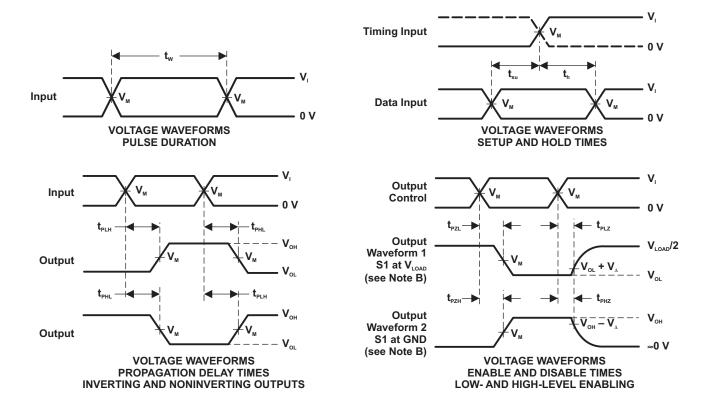
#### **Parameter Measurement Information**



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

LOAD CIRCUIT

.,	INI	PUTS	.,	v		-	.,
V <sub>cc</sub>	V,	t,/t,	V <sub>M</sub>	V <sub>LOAD</sub>	C <sub>L</sub>	$R_{\scriptscriptstyle L}$	V <sub>Δ</sub>
1.8 V ± 0.15 V	V <sub>cc</sub>	≤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 <sub>cc</sub>	≤2 ns	V <sub>cc</sub> /2	2 × V <sub>cc</sub>	30 pF	<b>500</b> Ω	0.15 V
$3.3~V\pm0.3~V$	3 V	≤2.5 ns	1.5 V	6 V	50 pF	500 $\Omega$	0.3 V
5 V ± 0.5 V	V <sub>cc</sub>	≤2.5 ns	V <sub>cc</sub> /2	2 × V <sub>cc</sub>	50 pF	500 $\Omega$	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 ≤ 10 MHz, Z₀ = 50 Ω.
- 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.  $t_{\mbox{\tiny PZL}}$  and  $t_{\mbox{\tiny PZH}}$  are the same as  $t_{\mbox{\tiny en}}.$
- G.  $t_{\text{PLH}}$  and  $t_{\text{PHL}}$  are the same as  $t_{\text{pd}}$ .
- H. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

Product Folder Links: SN74LVC2G00

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#### SCES193M - APRIL 1999 - REVISED NOVEMBER 2013



## **REVISION HISTORY**

CI	Changes from Revision L (January 2007) to Revision M							
•	Updated document to new TI data sheet format	1						
•	Added ESD warning	2						
•	Updated operating temperature range.	3						





17-May-2014

#### **PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan	Lead/Ball Finish	MSL Peak Temp	Op Temp (°C)	Device Marking (4/5)	Samples
SN74LVC2G00DCTR	ACTIVE	SM8	DCT	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	C00 Z	Samples
SN74LVC2G00DCTRE4	ACTIVE	SM8	DCT	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	C00 Z	Samples
SN74LVC2G00DCTRG4	ACTIVE	SM8	DCT	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	C00 Z	Samples
SN74LVC2G00DCUR	ACTIVE	US8	DCU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU   CU SN	Level-1-260C-UNLIM	-40 to 125	(C00Q ~ C00R)	Samples
SN74LVC2G00DCURE4	ACTIVE	US8	DCU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	(C00Q ~ C00R)	Samples
SN74LVC2G00DCURG4	ACTIVE	US8	DCU	8		Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	C00R	Samples
SN74LVC2G00DCUT	ACTIVE	US8	DCU	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU   CU SN	Level-1-260C-UNLIM	-40 to 125	(C00Q ~ C00R)	Samples
SN74LVC2G00DCUTE4	ACTIVE	US8	DCU	8		TBD	Call TI	Call TI	-40 to 125		Samples
SN74LVC2G00DCUTG4	ACTIVE	US8	DCU	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	(C00Q ~ C00R)	Samples
SN74LVC2G00YZPR	ACTIVE	DSBGA	YZP	8	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 125	(CA7 ~ CAN)	Samples

<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.

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

Pb-Free (RoHS): Tl'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, Tl 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)

<sup>(2)</sup> 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.



### PACKAGE OPTION ADDENDUM

17-May-2014

- (3) MSL, Peak Temp. The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.
- (4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.
- (5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.
- (6) Lead/Ball Finish Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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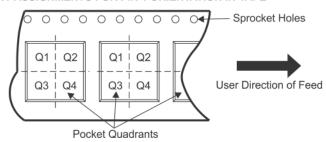
## TAPE AND REEL INFORMATION





		Dimension designed to accommodate the component width
		Dimension designed to accommodate the component length
	K0	Dimension designed to accommodate the component thickness
	W	Overall width of the carrier tape
1	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
SN74LVC2G00DCUR	US8	DCU	8	3000	180.0	8.4	2.25	3.35	1.05	4.0	8.0	Q3
SN74LVC2G00YZPR	DSBGA	YZP	8	3000	178.0	9.2	1.02	2.02	0.63	4.0	8.0	Q1

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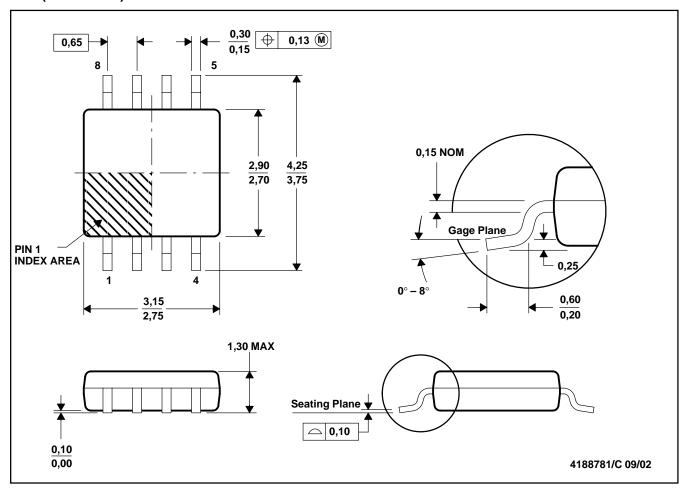


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LVC2G00DCUR	US8	DCU	8	3000	202.0	201.0	28.0
SN74LVC2G00YZPR	DSBGA	YZP	8	3000	220.0	220.0	35.0

## DCT (R-PDSO-G8)

#### PLASTIC SMALL-OUTLINE PACKAGE

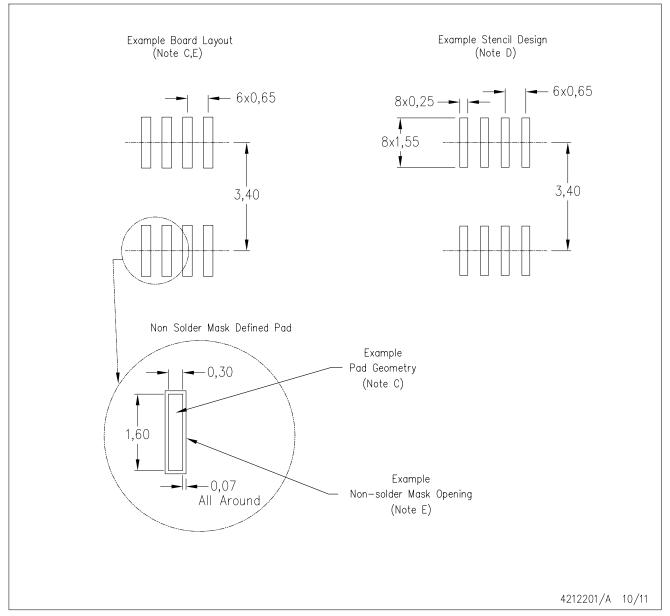


NOTES: A. All linear dimensions are in millimeters.

- 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



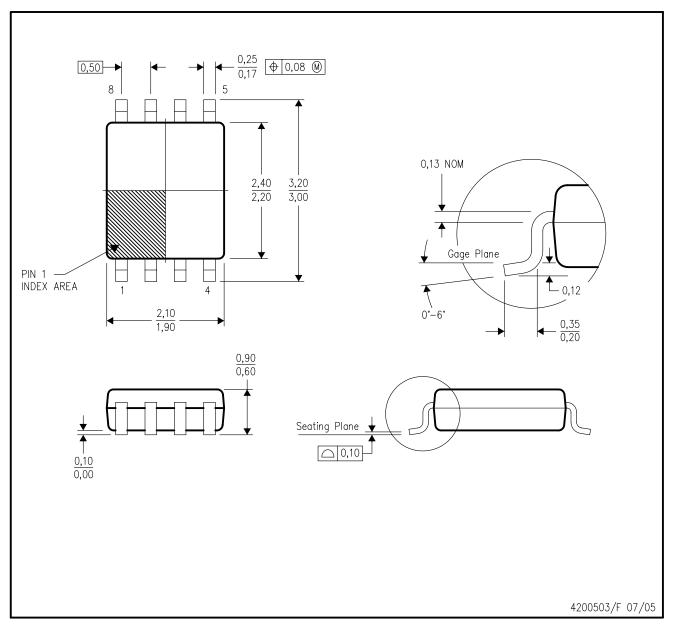
NOTES: A. All linear dimensions are in millimeters.

- 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)



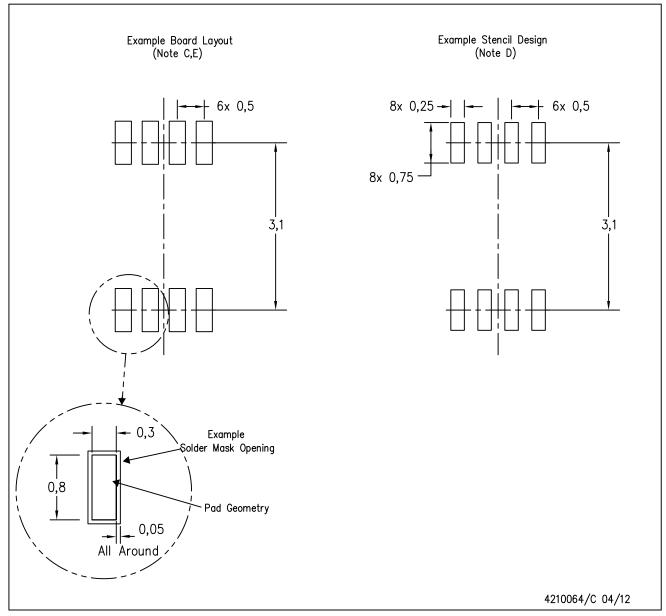
NOTES:

- 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)



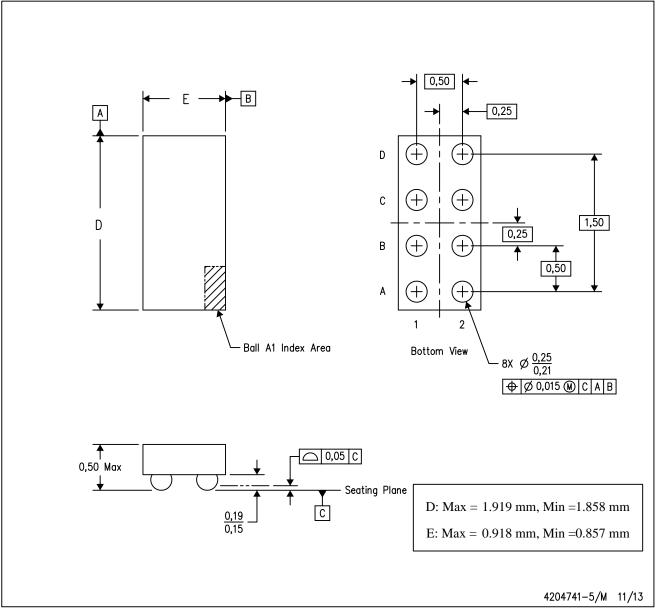
NOTES: A. All linear dimensions are in millimeters.

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

- B. This drawing is subject to change without notice.
- C. NanoFree™ package configuration.

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