

# **Dual Inverter Buffer/Driver With Open-Drain Outputs**

Check for Samples: SN74LVC2G06

### **FEATURES**

- Available in the Texas Instruments NanoFree<sup>™</sup> Package
- Supports 5-V V<sub>CC</sub> Operation
- Max t<sub>pd</sub> of 3.4 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  $V_{CC} = 3.3 \text{ V}, T_A = 25^{\circ}\text{C}$
- Typical V<sub>OHV</sub> (Output V<sub>OH</sub> Undershoot) >2 V at  $V_{CC} = 3.3 \text{ V}, T_A = 25^{\circ}\text{C}$
- Inputs and Open-Drain Outputs Accept • Voltages up to 5.5 V
- Ioff Supports Live Insertion, Partial Power • Down Mode, and Back Drive Protection
- Latch-Up Performance Exceeds 100 mA Per . JESD 78, Class II
- support Down-Translation (5V to 3.3V and 3.3V to 1.8V)
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

#### **DBV PACKAGE** DCK PACKAGE (TOP VIEW) (TOP VIEW) 1Y 1A [ 6 6 1Y GND 2 5 Vcc 2 5 Vcc 2Y 2A 🗌 3 2Y 4

### DESCRIPTION

This dual inverter buffer/driver is designed for 1.65-V to 5.5-V V<sub>CC</sub> operation.

The output of the SN74LVC2G06 device is open drain and can be connected to other open-drain outputs to implement active-low wired-OR or activehigh wired-AND functions. The maximum sink current is 32 mA.

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.

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

DRY PACKAGI	Ξ
(TOP VIEW)	

**YZP PACKAGE** 

(BOTTOM VIEW)

O3 4O

O 2 5 O

O1 6O

2Y

Vcc

1Y

2A

GND

1A

1A	Ξł	[ <u>6</u> ]	1Y
GND	<u>12</u>	<u>[5]</u>	Vcc
2A	<u>13</u>	<u>[4]</u>	2Y
2A	<u>[3</u> ]	4	2Y

DSF PACKAGE
(TOP VIEW)

1A	70	6	1Y
GND	_2_1	<b>[</b> 5]	Vcc
2A	 3_I	<u>[</u> 4_	2Y



1A

2A

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.

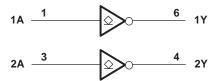
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These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

	n Table nverter)
INPUT A	OUTPUT Y
Н	L
L	Н

#### Logic Diagram (Positive Logic)



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

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

			MIN	MAX	UNIT
$V_{CC}$	Supply voltage range		-0.5	6.5	V
VI	Input voltage range <sup>(2)</sup>		-0.5	6.5	V
Vo	Voltage range applied to any output in the hi	gh-impedance or power-off state <sup>(2)</sup>	-0.5	6.5	V
Vo	Voltage range applied to any output in the hi	gh or low state <sup>(2) (3)</sup>	-0.5	6.5	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
I <sub>O</sub>	Continuous output current			±50	mA
	Continuous current through $V_{CC}$ or GND			±100	mA
		DBV package		165	
$\theta_{JA}$	Package thermal impedance <sup>(4)</sup>	DCK package		259	°C/W
		YZP package		123	
T <sub>stg</sub>	Storage temperature range		-65	150	°C

(1) 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.

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

(3) The value of  $V_{CC}$  is provided in the recommended operating conditions table.

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



# SN74LVC2G06

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

			MIN	MAX	UNIT
V	Supply voltage	Operating	1.65	5.5	V
V <sub>CC</sub>	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>		
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.7		V
VIH	High-level input voltage	$V_{CC} = 3 V \text{ to } 3.6 V$	2		v
		$V_{CC} = 4.5 \text{ V} \text{ to } 5.5 \text{ V}$	$0.7 \times V_{CC}$		
		$V_{CC} = 1.65 \text{ V} \text{ to } 1.95 \text{ V}$		$0.35 \times V_{CC}$	
V		V <sub>CC</sub> = 2.3 V to 2.7 V		0.7	V
V <sub>IL</sub>	Low-level input voltage	$V_{CC} = 3 V \text{ to } 3.6 V$		0.8	V
		$V_{CC} = 4.5 V \text{ to } 5.5 V$		$0.3 \times V_{CC}$	
VI	Input voltage		0	5.5	V
Vo	Output voltage		0	5.5	V
		V <sub>CC</sub> = 1.65 V		4	
		V <sub>CC</sub> = 2.3 V		8	
I <sub>OL</sub>	Low-level output current	N 2 N		16	mA
		$V_{CC} = 3 V$		24	
		$V_{CC} = 4.5 V$		32	
		$V_{CC}$ = 1.8 V ± 0.15 V, 2.5 V ± 0.2 V		20	
Δt/Δv	Input transition rise or fall rate	$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$		10	ns/V
		$V_{CC} = 5 V \pm 0.5 V$		5	
T <sub>A</sub>	Operating free-air temperature		-40	125	°C

(1) 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.

### **Electrical Characteristics**

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

		TEAT CONDITIONS		–40°C to 85°C	-40°C to 125°C	
PAR	AMETER	TEST CONDITIONS	V <sub>cc</sub>	MIN TYP <sup>(1)</sup> MAX	MIN TYP <sup>(1)</sup> MAX	UNIT
		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		I <sub>OL</sub> = 8 mA	2.3 V	0.3	0.3	V
V <sub>OL</sub>		I <sub>OL</sub> = 16 mA	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 inputs	$V_1 = 5.5 V \text{ or GND}$	0 to 5.5 V	±5	±5	μA
I <sub>off</sub>		$V_{I} \text{ or } V_{O} = 5.5 \text{ V}$	0	±10	±10	μA
I <sub>CC</sub>		$V_1 = 5.5 \text{ V or}$ GND, $I_0 = 0$	1.65 V to 5.5 V	10	10	μA
ΔI <sub>CC</sub>		One input at $V_{CC}$ – 0.6 V, Other inputs at $V_{CC}$ or GND	3 V to 5.5 V	500	500	μA
Ci		V <sub>I</sub> = V <sub>CC</sub> or GND	3.3 V	3.5	3.5	pF

(1) All typical values are at  $V_{CC} = 3.3 \text{ V}$ ,  $T_A = 25^{\circ}C$ .

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#### **Switching Characteristics**

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

			SN74LVC2G34 -40°C to 85°C								
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 1 ± 0.1		V <sub>CC</sub> = 2 ± 0.2		V <sub>CC</sub> = 3 ± 0.3		V <sub>CC</sub> = ± 0.5		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t <sub>pd</sub>	А	Y	1.8	7.2	1	3.9	1	3.4	1	2.9	ns

### **Switching Characteristics**

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

	FROM TO					SN74LV -40°C to					
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>cc</sub> = ^ ± 0.1		V <sub>CC</sub> = 2 ± 0.2		V <sub>CC</sub> = 3 ± 0.3		V <sub>CC</sub> = ± 0.5		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t <sub>pd</sub>	А	Y	1.8	8.2	1	4.4	1	3.9	1	3.4	ns

### **Operating Characteristics**

 $T_A = 25^{\circ}C$ 

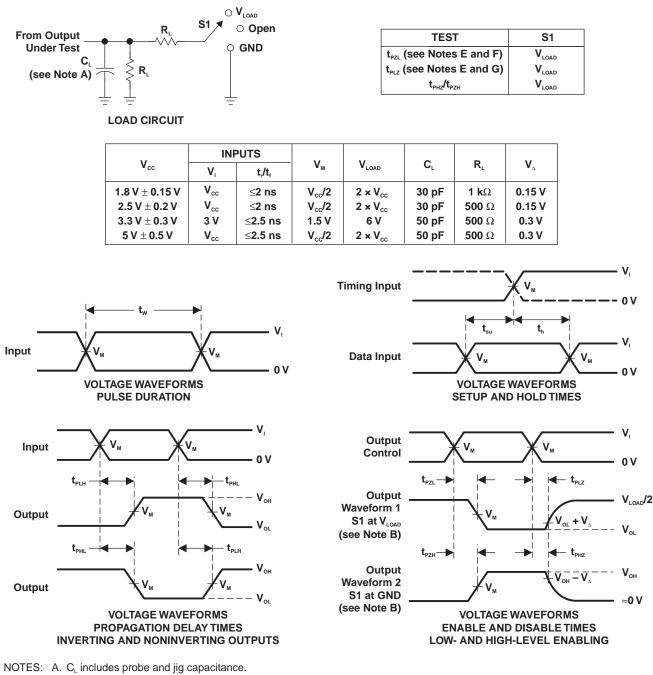
	PARAMETER	TEST CONDITIONS	V <sub>CC</sub> = 1.8 V	V <sub>CC</sub> = 2.5 V	$V_{CC}$ = 3.3 V	$V_{CC} = 5 V$	UNIT
	PARAMETER	TEST CONDITIONS	ТҮР	TYP	ТҮР	TYP	UNIT
$C_{pd}$	Power dissipation capacitance	f = 10 MHz	2	2	3	4	pF



## SN74LVC2G06

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#### **Parameter Measurement Information** (Open Drain)



- 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 have 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. Because this device has open-drain outputs,  $t_{\mbox{\tiny PLZ}}$  and  $t_{\mbox{\tiny PZL}}$  are the same as  $t_{\mbox{\tiny PD}}$
- F.  $t_{_{PZL}}$  is measured at V\_M. G.  $t_{PLZ}$  is measured at  $V_{OL} + V_{\Delta}$ .
- H. All parameters and waveforms are not applicable to all devices.

## Figure 1. Load Circuit and Voltage Waveforms

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### **REVISION HISTORY**

Change	ges from Revision G (January 2007) to Revision H	Page
• Upo	odated package views and ordering information. Added DRY & DSF packages	1
Change	ges from Revision H (August 2012) to Revision I	Page
• Upc	dated document to new TI data sheet format.	1
•	odated document to new TI data sheet format	
• Rer		1



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10-Dec-2013

## PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp	Op Temp (°C)	Device Marking (4/5)	Samples
SN74LVC2G06DBVR	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	(C062 ~ C065 ~ C06R)	Samples
SN74LVC2G06DBVRE4	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	(C062 ~ C065 ~ C06R)	Samples
SN74LVC2G06DBVRG4	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	(C062 ~ C065 ~ C06R)	Samples
SN74LVC2G06DCKR	ACTIVE	SC70	DCK	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	(CT5 ~ CTR)	Samples
SN74LVC2G06DCKRE4	ACTIVE	SC70	DCK	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	(CT5 ~ CTR)	Samples
SN74LVC2G06DCKRG4	ACTIVE	SC70	DCK	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	(CT5 ~ CTR)	Samples
SN74LVC2G06DRYR	ACTIVE	SON	DRY	6	5000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	СТ	Samples
SN74LVC2G06DSFR	ACTIVE	SON	DSF	6	5000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	СТ	Samples
SN74LVC2G06YZPR	ACTIVE	DSBGA	YZP	6	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	(CT7 ~ CTN)	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.

(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)



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

<sup>(4)</sup> 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.

<sup>(6)</sup> 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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#### OTHER QUALIFIED VERSIONS OF SN74LVC2G06 :

- Automotive: SN74LVC2G06-Q1
- Enhanced Product: SN74LVC2G06-EP

NOTE: Qualified Version Definitions:

- Automotive Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Enhanced Product Supports Defense, Aerospace and Medical Applications

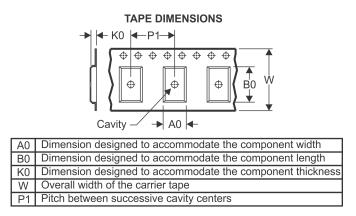
# PACKAGE MATERIALS INFORMATION

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### TAPE AND REEL INFORMATION





## QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



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
SN74LVC2G06DBVR	SOT-23	DBV	6	3000	178.0	9.2	3.3	3.2	1.55	4.0	8.0	Q3
SN74LVC2G06DCKR	SC70	DCK	6	3000	178.0	9.2	2.4	2.4	1.22	4.0	8.0	Q3
SN74LVC2G06DRYR	SON	DRY	6	5000	180.0	9.5	1.15	1.6	0.75	4.0	8.0	Q1
SN74LVC2G06DSFR	SON	DSF	6	5000	180.0	9.5	1.16	1.16	0.5	4.0	8.0	Q2
SN74LVC2G06YZPR	DSBGA	YZP	6	3000	178.0	9.2	1.02	1.52	0.63	4.0	8.0	Q1

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# PACKAGE MATERIALS INFORMATION

9-Apr-2014



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LVC2G06DBVR	SOT-23	DBV	6	3000	180.0	180.0	18.0
SN74LVC2G06DCKR	SC70	DCK	6	3000	180.0	180.0	18.0
SN74LVC2G06DRYR	SON	DRY	6	5000	184.0	184.0	19.0
SN74LVC2G06DSFR	SON	DSF	6	5000	184.0	184.0	19.0
SN74LVC2G06YZPR	DSBGA	YZP	6	3000	220.0	220.0	35.0

DBV (R-PDSO-G6)

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. Mold flash and protrusion shall not exceed 0.15 per side.
  - D. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
  - E Falls within JEDEC MO-178 Variation AB, except minimum lead width.



## LAND PATTERN DATA



NOTES:

- A. All linear dimensions are in millimeters.B. This drawing is subject to change without notice.
- C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
- D. Publication IPC-7351 is recommended for alternate designs.
- E. 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. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.



DCK (R-PDSO-G6)

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. Mold flash and protrusion shall not exceed 0.15 per side.
  - D. Falls within JEDEC MO-203 variation AB.



# LAND PATTERN DATA

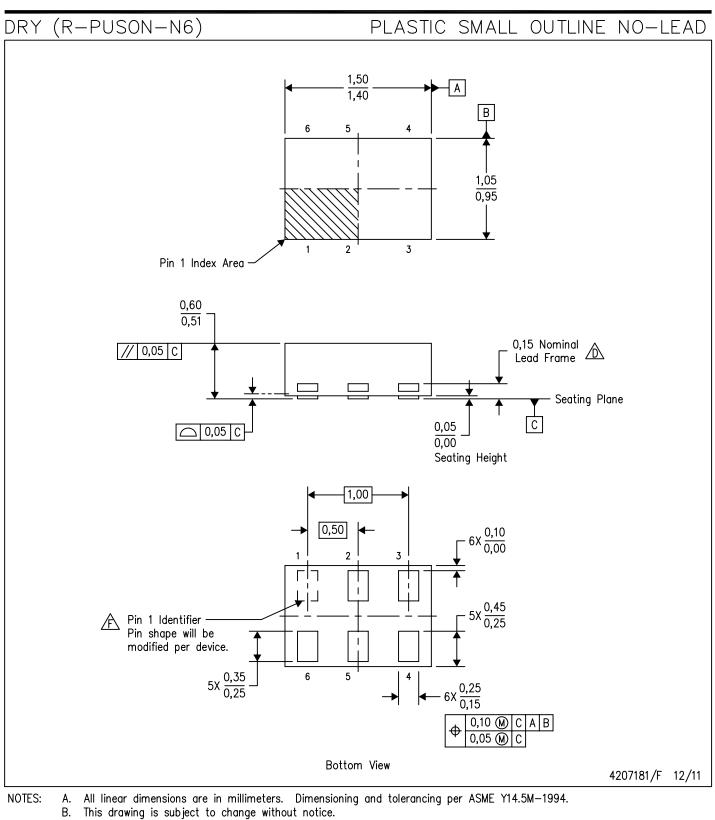


NOTES:

- A. All linear dimensions are in millimeters.B. This drawing is subject to change without notice.
- C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
- D. Publication IPC-7351 is recommended for alternate designs.
- E. 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. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.



## **MECHANICAL DATA**



- C. SON (Small Outline No-Lead) package configuration.
- $\Delta$  The exposed lead frame feature on side of package may or may not be present due to alternative lead frame designs.
- E. This package complies to JEDEC MO-287 variation UFAD.
- 🖄 See the additional figure in the Product Data Sheet for details regarding the pin 1 identifier shape.



DRY (R-PUSON-N6)

PLASTIC SMALL OUTLINE NO-LEAD

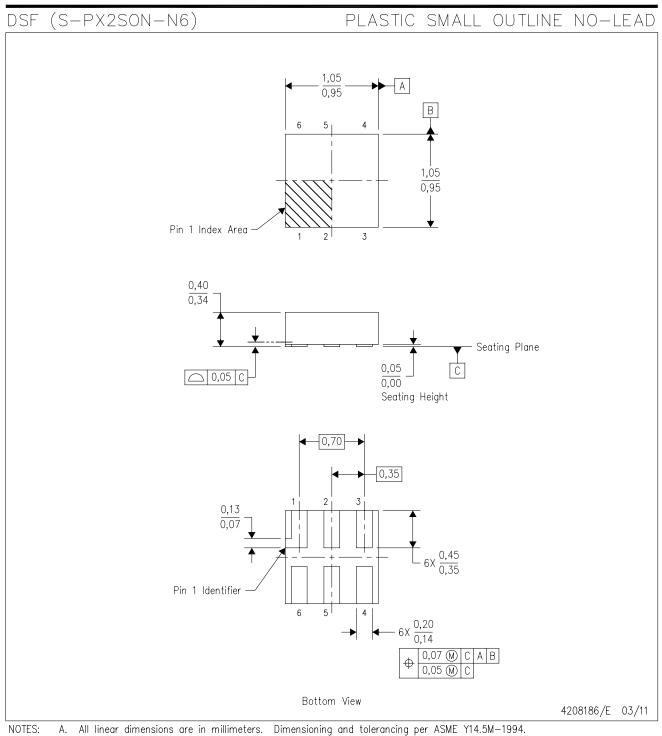


NOTES: A. All linear dimensions are in millimeters.

- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads.
- E. Maximum stencil thickness 0,127 mm (5 mils). All linear dimensions are in millimeters.
- F. 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 stencil design considerations.
- G. Side aperture dimensions over-print land for acceptable area ratio > 0.66. Customer may reduce side aperture dimensions if stencil manufacturing process allows for sufficient release at smaller opening.

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# **MECHANICAL DATA**



- - B. This drawing is subject to change without notice.
    C. SON (Small Outline No-Lead) package configuration.
    D. This package complies to JEDEC M0-287 variation X2AAF.





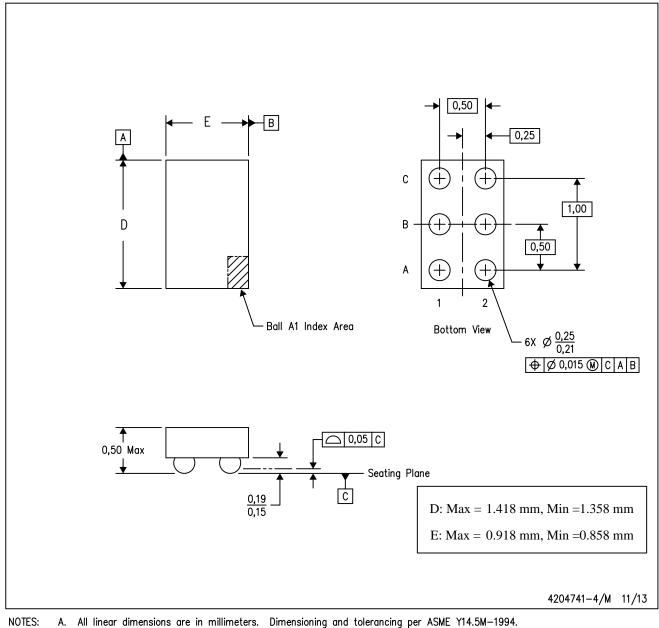
NOTES: A. All linear dimensions are in millimeters.

- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads. If 2 mil solder mask is outside PCB vendor capability, it is advised to omit solder mask.
- E. Maximum stencil thickness 0,1016 mm (4 mils). All linear dimensions are in millimeters.
- F. 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 stencil design considerations.
- G. Suggest stencils cut with lasers such as Fiber Laser that produce the greatest positional accuracy.
- H. Component placement force should be minimized to prevent excessive paste block deformation.



YZP (R-XBGA-N6)

DIE-SIZE BALL GRID ARRAY



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

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