

## **Triple Schmitt-Trigger Inverter**

Check for Samples: SN74LVC3G14

### **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 5.4 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  $V_{CC} = 3.3 \text{ V}, T_A = 25^{\circ}\text{C}$
- I<sub>off</sub> Feature Supports Live Insertion, Partial-**Power-Down Mode and Back Drive Protection**
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- **ESD Protection Exceeds JESD 22** 
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

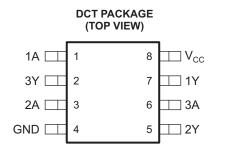
### **DESCRIPTION**

This triple Schmitt-trigger inverter is designed for 1.65-V to 5.5-V  $V_{CC}$  operation.

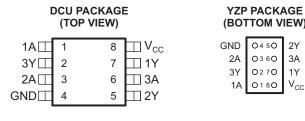
The SN74LVC3G14 contains three inverters and performs the Boolean function  $Y = \overline{A}$ . The device functions as three independent inverters but, because of Schmitt action, it may have different input threshold levels for positive-going (V<sub>T+</sub>) and negative-going  $(V_{T_{-}})$  signals.

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  $I_{\text{off}}$  . The  $I_{\text{off}}$  circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.







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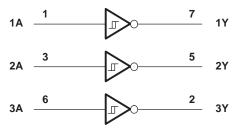


These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

# Function Table (Each Inverter)

INPUT A	OUTPUT Y
Н	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 (2)	Input voltage range (2)					
Vo	Voltage range applied to any output in the high	-0.5	6.5	V			
V <sub>O</sub>	Voltage range applied to any output in the high	gh or low state (2) (3)	-0.5	V <sub>CC</sub> + 0.5	V		
$I_{IK}$	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	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 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	
.,	Consello contra se	Operating	1.65	5.5		
$V_{CC}$	Supply voltage	Data retention only	1.5		V	
VI	Input voltage		0	5.5	V	
Vo	Output voltage		0	$V_{CC}$	V	
		V <sub>CC</sub> = 1.65 V		-4		
		V <sub>CC</sub> = 2.3 V		-8		
$I_{OH}$	High-level output current	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 2V		16	16 mA	
		V <sub>CC</sub> = 3 V		24		
		V <sub>CC</sub> = 4.5 V		32		
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: SN74LVC3G14



### **Electrical Characteristics**

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

		3- (		°C to 85°C	-40°	C to 125°C	
PARAMETER	TEST CONDITIONS	$v_{cc}$	MIN	TYP <sup>(1)</sup> MAX	MIN	TYP <sup>(1)</sup> MAX	UNIT
		1.65 V	0.7	1.4	0.7	1.4	
$V_{T+}$		2.3 V	1	1.7	1	1.7	
Positive-going input		3 V	1.3	2.2	1.3	2.2	٧
threshold voltage		4.5 V	1.9	3.1	1.9	3.1	
		5.5 V	2.2	3.7	2.2	3.7	
		1.65 V	0.3	0.7	0.3	0.7	
$V_{T-}$		2.3 V	0.4	1	0.4	1	
Negative-going input		3 V	0.6	1.3	0.6	1.3	V
threshold voltage		4.5 V	1.1	2	1.1	2	
		5.5 V	1.4	2.5	1.4	2.5	
		1.65 V	0.3	0.8	0.3	0.8	
$\Delta V_{T}$		2.3 V	0.4	0.9	0.4	0.9	
Hysteresis (V <sub>T+</sub> - V <sub>T-</sub> )		3 V	0.4	1.1	0.4	1.1	V
		4.5 V	0.6	1.3	0.6	1.3	
		5.5 V	0.7	1.4	0.7	1.4	
	I <sub>OH</sub> = -100 μA	1.65 V to 4.5 V	V <sub>CC</sub> - 0.1		V <sub>CC</sub> - 0.1		
	$I_{OH} = -4 \text{ mA}$	1.65 V	1.2		1.2		
V <sub>OH</sub>	$I_{OH} = -8 \text{ mA}$	2.3 V	1.9		1.9		V
· · ·	$I_{OH} = -16 \text{ mA}$	3 V	2.4		2.4		
	$I_{OH} = -24 \text{ mA}$	3 V	2.3		2.3		
	$I_{OH} = -32 \text{ mA}$	4.5 V	3.8		3.8		
	Ι <sub>ΟL</sub> = 100 μΑ	1.65 V to 4.5 V		0.1		0.1	
	I <sub>OL</sub> = 4 mA	1.65 V		0.45		0.45	
V <sub>OL</sub>	I <sub>OL</sub> = 8 mA	2.3 V		0.3		0.3	V
-	I <sub>OL</sub> = 16 mA	3 V		0.4		0.4	
	I <sub>OL</sub> = 24 mA	3 V		0.55		0.75	
	I <sub>OL</sub> = 32 mA	4.5 V		0.55		0.75	
A inputs	V <sub>I</sub> = 5.5 V or GND	0 to 5.5 V		±5		±5	μA
off	$V_I$ or $V_O = 5.5 \text{ V}$	0		±10		±10	μA
cc	$V_1 = 5.5 \text{ V or } I_0 = 0$	1.65 V to 5.5 V		10		10	μA
71 <sup>CC</sup>	One input at $V_{CC} - 0.6$ Other inputs at $V_{CC}$ or GND $V$ ,	3 V to 5.5 V		500		500	μA
C <sub>i</sub>	$V_I = V_{CC}$ or GND	3.3 V		4.5			pF

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

## **Switching Characteristics**

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

			SN74LVC3G14 -40°C to 85°C									
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 1 ± 0.15			V <sub>CC</sub> = 2.5 V V <sub>CC</sub> = 3.3 V V <sub>CC</sub> = 5 V ± 0.2 V ± 0.5 V					UNIT	
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	<b>UNIT</b>	
t <sub>pd</sub>	Α	Υ	3.9	9.2	1.9	5.7	2.3	5.4	1.5	4.3	ns	

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## **Switching Characteristics**

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

			SN74LVC3G14 -40°C to 125°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		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t <sub>pd</sub>	Α	Υ	3.9	9.7	1.9	6.2	2.3	5.9	1.5	4.7	ns

## **Operating Characteristics**

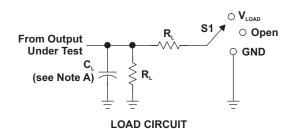
 $T_A = 25^{\circ}C$ 

	PARAMETER	TEST	V <sub>CC</sub> = 1.8 V	$V_{CC} = 2.5 \text{ V}$	$V_{CC} = 3.3 \text{ V}$	$V_{CC} = 5 V$	UNIT
	FANAMEIEN	CONDITIONS	TYP	TYP	TYP TYP		UNIT
$C_{pd}$	Power dissipation capacitance	f = 10 MHz	17	18	19	22	pF

Product Folder Links: SN74LVC3G14

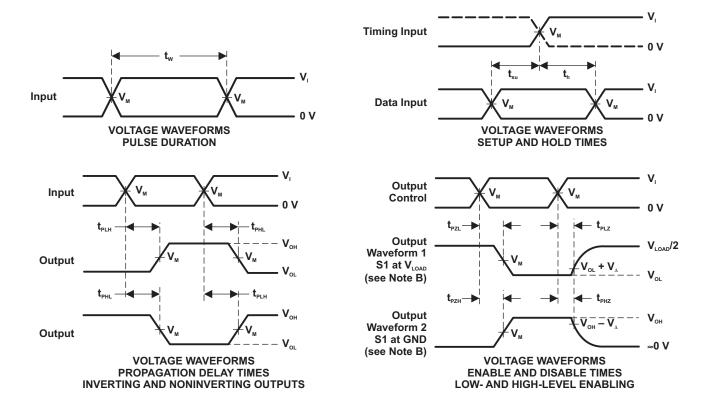


## **Parameter Measurement Information**



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

.,	INPUTS		.,	.,		_	.,
V <sub>cc</sub>	V,	t,/t,	V <sub>M</sub>	<b>V</b> <sub>LOAD</sub>	C <sub>L</sub>	R <sub>⊾</sub>	V <sub>A</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
$2.5~V~\pm~0.2~V$	V <sub>cc</sub>	≤2 ns	V <sub>cc</sub> /2	2 × V <sub>cc</sub>	30 pF	500 Ω	0.15 V
$3.3~V\pm0.3~V$	3 V	≤2.5 ns	1.5 V	6 V	50 pF	500 Ω	0.3 V
5 V ± 0.5 V	V <sub>cc</sub>	≤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,  $Z_o$  = 50  $\Omega$ .
- D. The outputs are measured one at a time, with one transition per measurement.
- E.  $t_{\mbox{\tiny PLZ}}$  and  $\dot{t}_{\mbox{\tiny PHZ}}$  are the same as  $t_{\mbox{\tiny dis}}.$
- F.  $t_{\mbox{\tiny PZL}}$  and  $t_{\mbox{\tiny PZH}}$  are the same as  $t_{\mbox{\tiny en}}.$
- G.  $t_{\mbox{\tiny PLH}}$  and  $t_{\mbox{\tiny PHL}}$  are the same as  $t_{\mbox{\tiny pd}}.$
- H. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

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## **REVISION HISTORY**

CI	hanges from Revision I (Feburary 2007) to Revision J	Page
•	Updated document to new TI data sheet format.	1
•	Added ESD warning.	2
•	Updated operating temperature range.	3

Product Folder Links: SN74LVC3G14

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#### PACKAGING INFORMATION

Orderable Device	Status	Package Type	Package Drawing	Pins	Package Qty	Eco Plan	Lead finish/ Ball material	MSL Peak Temp	Op Temp (°C)	Device Marking (4/5)	Samples
SN74LVC3G14DCTR	ACTIVE	SM8	DCT	8	3000	RoHS & Green	NIPDAU   SN	Level-1-260C-UNLIM	-40 to 125	(2X15, C14) (R, Z)	Samples
SN74LVC3G14DCTRE4	ACTIVE	SM8	DCT	8	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(2X15, C14) (R, Z)	Samples
SN74LVC3G14DCUR	ACTIVE	VSSOP	DCU	8	3000	RoHS & Green	NIPDAU   SN	Level-1-260C-UNLIM	-40 to 125	(14, C14J, C14Q, C 14R) (CR, CZ)	Samples
SN74LVC3G14DCURG4	ACTIVE	VSSOP	DCU	8	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	C14R	Samples
SN74LVC3G14DCUT	ACTIVE	VSSOP	DCU	8	250	RoHS & Green	NIPDAU   SN	Level-1-260C-UNLIM	-40 to 125	(C14J, C14Q, C14R) CR	Samples
SN74LVC3G14DCUTG4	ACTIVE	VSSOP	DCU	8	250	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	C14R	Samples
SN74LVC3G14YZPR	ACTIVE	DSBGA	YZP	8	3000	RoHS & Green	SNAGCU	Level-1-260C-UNLIM	-40 to 125	CFN	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) RoHS: TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (CI) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

<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.



## **PACKAGE OPTION ADDENDUM**

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(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 finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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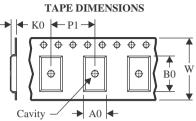
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## **PACKAGE MATERIALS INFORMATION**

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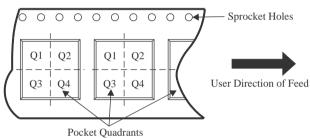
## TAPE AND REEL INFORMATION





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

### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

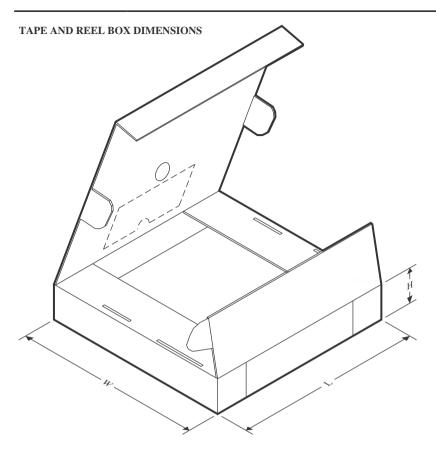


#### \*All dimensions are nominal

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
SN74LVC3G14DCTR	SM8	DCT	8	3000	180.0	13.0	3.35	4.5	1.55	4.0	12.0	Q3
SN74LVC3G14DCUR	VSSOP	DCU	8	3000	178.0	9.0	2.25	3.35	1.05	4.0	8.0	Q3
SN74LVC3G14DCURG4	VSSOP	DCU	8	3000	180.0	8.4	2.25	3.35	1.05	4.0	8.0	Q3
SN74LVC3G14DCUT	VSSOP	DCU	8	250	178.0	9.0	2.25	3.35	1.05	4.0	8.0	Q3
SN74LVC3G14DCUT	VSSOP	DCU	8	250	178.0	9.5	2.25	3.35	1.05	4.0	8.0	Q3
SN74LVC3G14DCUTG4	VSSOP	DCU	8	250	180.0	8.4	2.25	3.35	1.05	4.0	8.0	Q3
SN74LVC3G14YZPR	DSBGA	YZP	8	3000	178.0	9.2	1.02	2.02	0.63	4.0	8.0	Q1



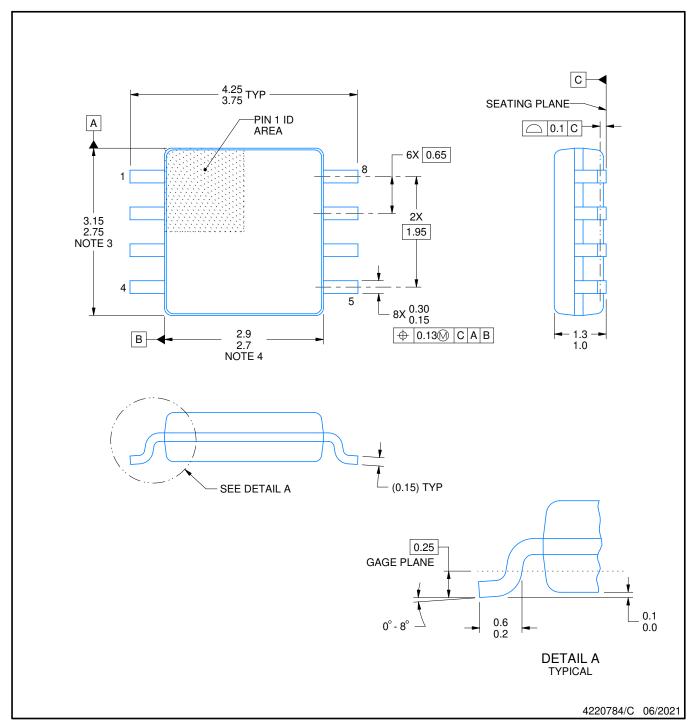
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## \*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LVC3G14DCTR	SM8	DCT	8	3000	182.0	182.0	20.0
SN74LVC3G14DCUR	VSSOP	DCU	8	3000	180.0	180.0	18.0
SN74LVC3G14DCURG4	VSSOP	DCU	8	3000	202.0	201.0	28.0
SN74LVC3G14DCUT	VSSOP	DCU	8	250	180.0	180.0	18.0
SN74LVC3G14DCUT	VSSOP	DCU	8	250	202.0	201.0	28.0
SN74LVC3G14DCUTG4	VSSOP	DCU	8	250	202.0	201.0	28.0
SN74LVC3G14YZPR	DSBGA	YZP	8	3000	220.0	220.0	35.0





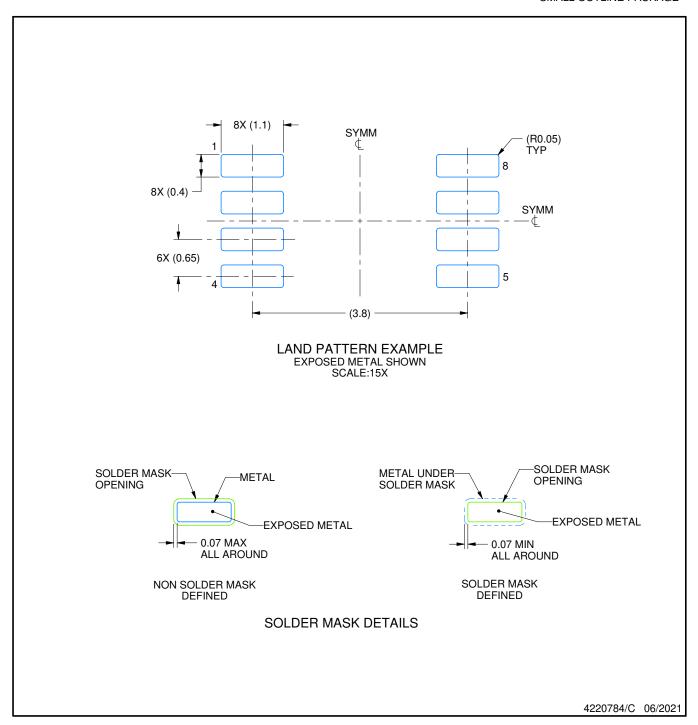
#### NOTES:

- 1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.

  2. This drawing is subject to change without notice.

  3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not
- exceed 0.15 mm per side.
- 4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.

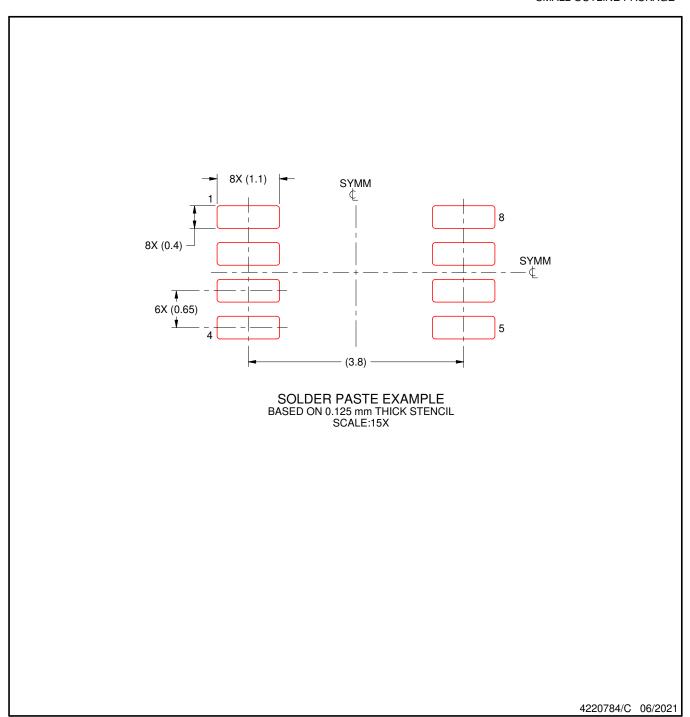




NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.





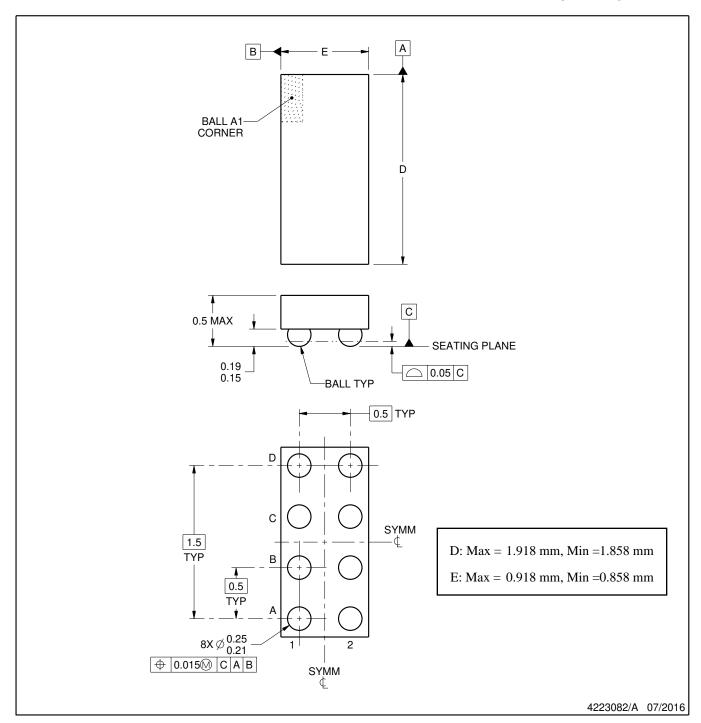
NOTES: (continued)

- 7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
- 8. Board assembly site may have different recommendations for stencil design.





DIE SIZE BALL GRID ARRAY



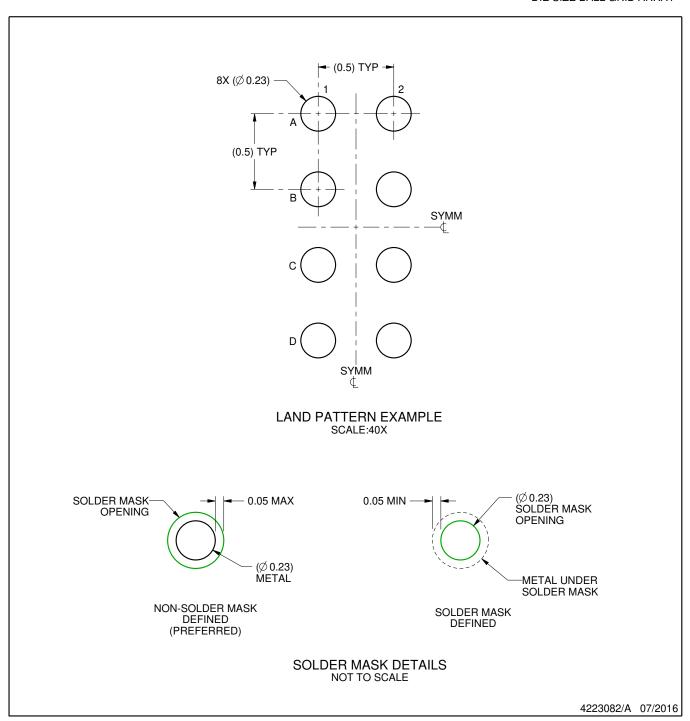
### NOTES:

- 1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.

  2. This drawing is subject to change without notice.



DIE SIZE BALL GRID ARRAY

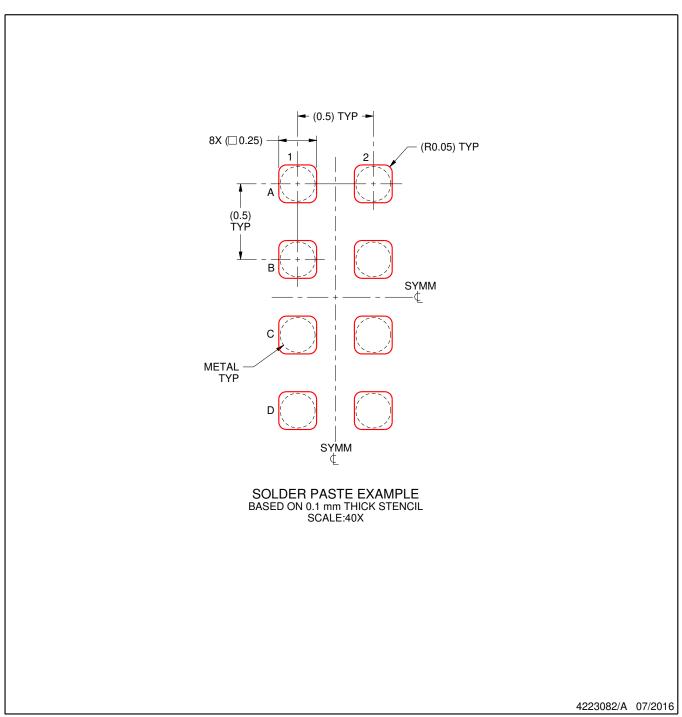


NOTES: (continued)

3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SNVA009 (www.ti.com/lit/snva009).



DIE SIZE BALL GRID ARRAY

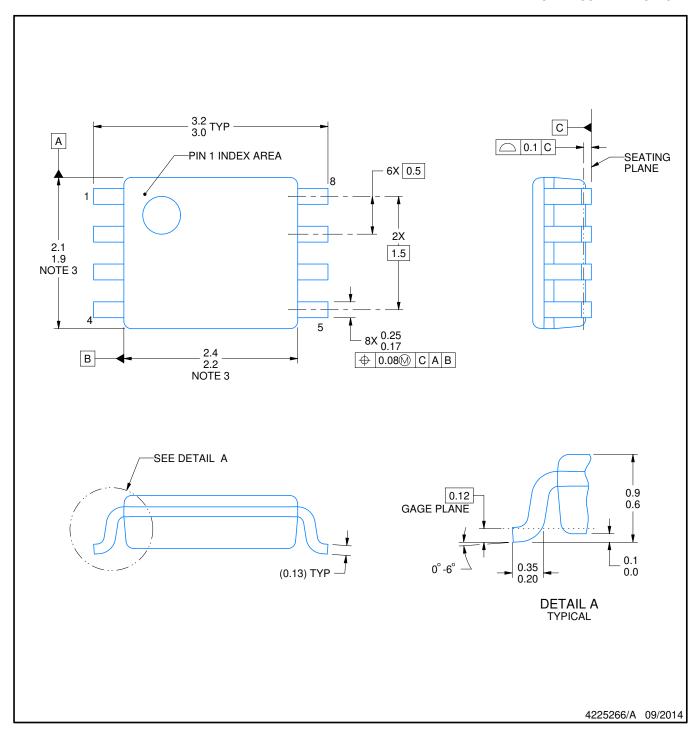


NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.







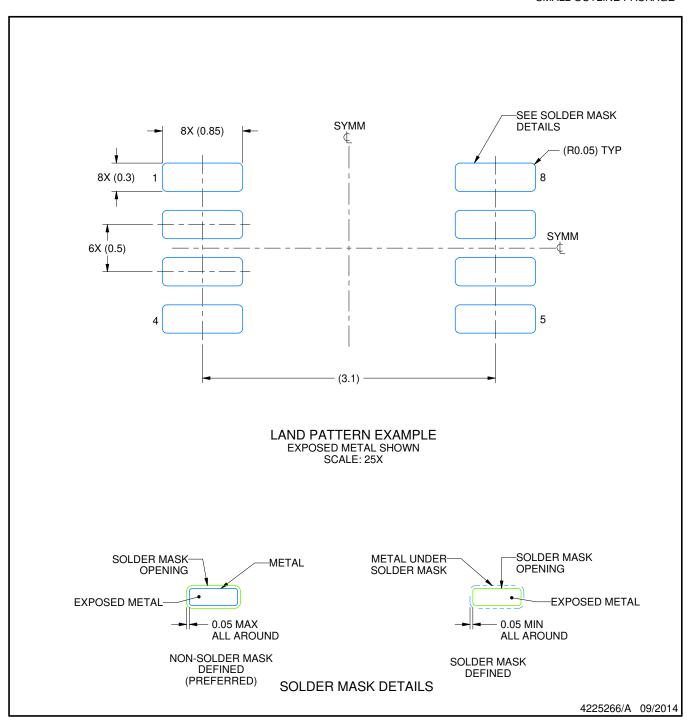
#### NOTES:

- 1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.

  2. This drawing is subject to change without notice.

  3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not
- exceed 0.15 mm per side.
  4. Reference JEDEC registration MO-187 variation CA.



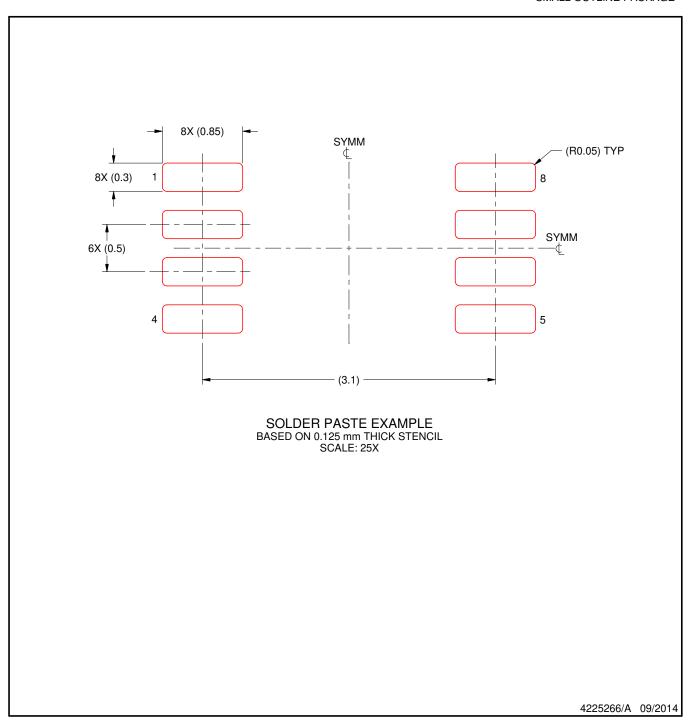


NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.

6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.





NOTES: (continued)

- 7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
- 8. Board assembly site may have different recommendations for stencil design.



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