

## Triple Inverter Gate

Check for Samples: [SN74LVC3GU04](#)

### FEATURES

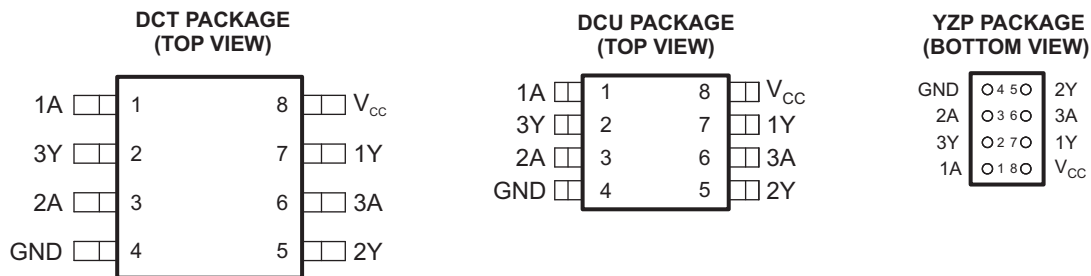
- Available in the Texas Instruments NanoFree™ Package
- Supports 5-V  $V_{CC}$  Operation
- Inputs Accept Voltages to 5.5 V
- Max  $t_{pd}$  of 3.9 ns at 3.3 V
- Low Power Consumption, 10- $\mu$ A Max  $I_{CC}$
- $\pm 24$ -mA Output Drive at 3.3 V
- Typical  $V_{OLP}$  (Output Ground Bounce)  $< 0.8$  V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- Typical  $V_{OHV}$  (Output  $V_{OH}$  Undershoot)  $> 2$  V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- Ioff Support Live Insertion, Partial Power Down Mode and Back Drive Protection
- Unbuffered Outputs
- 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 inverter is designed for 1.65-V to 5.5-V  $V_{CC}$  operation.

The SN74LVC3GU04 contains three inverters with unbuffered outputs and performs the Boolean function  $Y = \bar{A}$ .

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



See mechanical drawings for dimensions.



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.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

Copyright © 2004–2013, Texas Instruments Incorporated

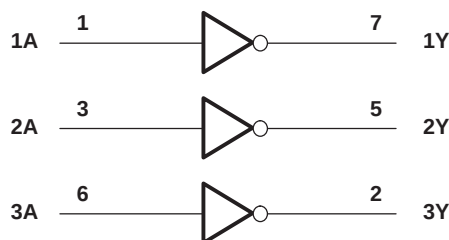


These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

**Function Table  
(Each Inverter)**

| INPUT<br>A | OUTPUT<br>Y |
|------------|-------------|
| H          | L           |
| L          | H           |

**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    |
| $V_I$         | Input voltage range <sup>(2)</sup>         |             | –0.5 | 6.5            | V    |
| $V_O$         | Output voltage range <sup>(2) (3)</sup>    |             | –0.5 | $V_{CC} + 0.5$ | V    |
| $I_{IK}$      | Input clamp current                        | $V_I < 0$   |      | –50            | mA   |
| $I_{OK}$      | Output clamp current                       | $V_O < 0$   |      | –50            | mA   |
| $I_O$         | Continuous output current                  |             |      | ±50            | mA   |
|               | Continuous current through $V_{CC}$ or GND |             |      | ±100           | mA   |
| $\theta_{JA}$ | Package thermal impedance <sup>(4)</sup>   | DCT package |      | 220            | °C/W |
|               |                                            | DCU package |      | 227            |      |
|               |                                            | YZP package |      | 102            |      |
| $T_{stg}$     | 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.

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

|                 |                                |                          | MIN                    | MAX                    | UNIT |
|-----------------|--------------------------------|--------------------------|------------------------|------------------------|------|
| V <sub>CC</sub> | Supply voltage                 |                          | 1.65                   | 5.5                    | V    |
| V <sub>IH</sub> | High-level input voltage       | I <sub>O</sub> = –100 µA | 0.75 × V <sub>CC</sub> |                        | V    |
| V <sub>IL</sub> | Low-level input voltage        | I <sub>O</sub> = 100 µA  |                        | 0.25 × V <sub>CC</sub> | V    |
| V <sub>I</sub>  | Input voltage                  |                          | 0                      | 5.5                    | V    |
| V <sub>O</sub>  | Output voltage                 |                          | 0                      | V <sub>CC</sub>        | V    |
| I <sub>OH</sub> | High-level output current      | V <sub>CC</sub> = 1.65 V |                        | –4                     | mA   |
|                 |                                | V <sub>CC</sub> = 2.3 V  |                        | –8                     |      |
|                 |                                | V <sub>CC</sub> = 3 V    |                        | –16                    |      |
|                 |                                |                          |                        | –24                    |      |
|                 |                                | V <sub>CC</sub> = 4.5 V  |                        | –32                    |      |
| I <sub>OL</sub> | Low-level output current       | V <sub>CC</sub> = 1.65 V |                        | 4                      | mA   |
|                 |                                | V <sub>CC</sub> = 2.3 V  |                        | 8                      |      |
|                 |                                | V <sub>CC</sub> = 3 V    |                        | 16                     |      |
|                 |                                |                          |                        | 24                     |      |
|                 |                                | V <sub>CC</sub> = 4.5 V  |                        | 32                     |      |
| 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)

| PARAMETER       | TEST CONDITIONS                                   |                           | V <sub>CC</sub> | –40°C to 85°C         |                    |     | –40°C to 125°C        |                    |     | UNIT |
|-----------------|---------------------------------------------------|---------------------------|-----------------|-----------------------|--------------------|-----|-----------------------|--------------------|-----|------|
|                 |                                                   |                           |                 | MIN                   | TYP <sup>(1)</sup> | MAX | MIN                   | TYP <sup>(1)</sup> | MAX |      |
| V <sub>OH</sub> | V <sub>IL</sub> = 0 V                             | I <sub>OH</sub> = –100 mA | 1.65 V to 5.5 V | V <sub>CC</sub> – 0.1 |                    |     | V <sub>CC</sub> – 0.1 |                    |     | V    |
|                 |                                                   | I <sub>OH</sub> = –4 mA   | 1.65 V          | 1.2                   |                    |     | 1.2                   |                    |     |      |
|                 |                                                   | I <sub>OH</sub> = –8 mA   | 2.3 V           | 1.9                   |                    |     | 1.9                   |                    |     |      |
|                 |                                                   | I <sub>OH</sub> = –16 mA  | 3 V             | 2.4                   |                    |     | 2.4                   |                    |     |      |
|                 |                                                   | I <sub>OH</sub> = –24 mA  |                 | 2.3                   |                    |     | 2.3                   |                    |     |      |
|                 |                                                   | I <sub>OH</sub> = –32 mA  | 4.5 V           | 3.8                   |                    |     | 3.8                   |                    |     |      |
| V <sub>OL</sub> | V <sub>IH</sub> = V <sub>CC</sub>                 | I <sub>OL</sub> = 100 mA  | 1.65 V to 5.5 V | 0.1                   |                    |     | 0.1                   |                    |     | V    |
|                 |                                                   | I <sub>OL</sub> = 4 mA    | 1.65 V          | 0.45                  |                    |     | 0.45                  |                    |     |      |
|                 |                                                   | I <sub>OL</sub> = 8 mA    | 2.3 V           | 0.3                   |                    |     | 0.3                   |                    |     |      |
|                 |                                                   | I <sub>OL</sub> = 16 mA   | 3 V             | 0.4                   |                    |     | 0.4                   |                    |     |      |
|                 |                                                   | I <sub>OL</sub> = 24 mA   |                 | 0.55                  |                    |     | 0.75                  |                    |     |      |
|                 |                                                   | I <sub>OL</sub> = 32 mA   | 4.5 V           | 0.55                  |                    |     | 0.75                  |                    |     |      |
| I <sub>I</sub>  | V <sub>I</sub> = 5.5 V or GND                     |                           | 0 to 5.5 V      | ±5                    |                    |     | ±5                    |                    |     | μA   |
| I <sub>CC</sub> | V <sub>I</sub> = 5.5 V or GND, I <sub>O</sub> = 0 |                           | 1.65 V to 5.5 V | 10                    |                    |     | 10                    |                    |     | μA   |
| C <sub>i</sub>  | V <sub>I</sub> = V <sub>CC</sub> or GND           |                           | 3.3 V           | 7                     |                    |     |                       |                    |     | pF   |

(1) All typical values are at V<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 25°C.

## Switching Characteristics

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

| PARAMETER       | FROM<br>(INPUT) | TO<br>(OUTPUT) | SN74LVC3GU04<br>–40°C to 85°C       |     |                                    |     |                                    |     |                                  |     | UNIT |
|-----------------|-----------------|----------------|-------------------------------------|-----|------------------------------------|-----|------------------------------------|-----|----------------------------------|-----|------|
|                 |                 |                | V <sub>CC</sub> = 1.8 V<br>± 0.15 V |     | V <sub>CC</sub> = 2.5 V<br>± 0.2 V |     | V <sub>CC</sub> = 3.3 V<br>± 0.3 V |     | V <sub>CC</sub> = 5 V<br>± 0.5 V |     |      |
|                 |                 |                | MIN                                 | MAX | MIN                                | MAX | MIN                                | MAX | MIN                              | MAX |      |
| t <sub>pd</sub> | A               | Y              | 0.2                                 | 9.2 | 0.2                                | 4   | 0.6                                | 3.9 | 0.5                              | 3.2 | ns   |

## Switching Characteristics

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

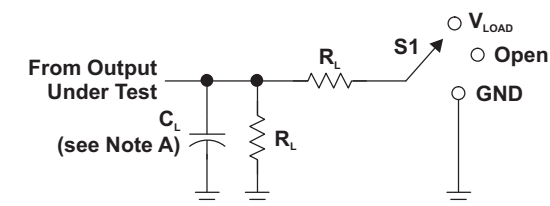
| PARAMETER       | FROM<br>(INPUT) | TO<br>(OUTPUT) | SN74LVC3GU04<br>–40°C to 125°C      |      |                                    |     |                                    |     |                                  |     | UNIT |
|-----------------|-----------------|----------------|-------------------------------------|------|------------------------------------|-----|------------------------------------|-----|----------------------------------|-----|------|
|                 |                 |                | V <sub>CC</sub> = 1.8 V<br>± 0.15 V |      | V <sub>CC</sub> = 2.5 V<br>± 0.2 V |     | V <sub>CC</sub> = 3.3 V<br>± 0.3 V |     | V <sub>CC</sub> = 5 V<br>± 0.5 V |     |      |
|                 |                 |                | MIN                                 | MAX  | MIN                                | MAX | MIN                                | MAX | MIN                              | MAX |      |
| t <sub>pd</sub> | A               | Y              | 0.2                                 | 10.5 | 0.2                                | 4.5 | 0.6                                | 4.7 | 1.1                              | 4   | ns   |

## Operating Characteristics

$T_A = 25^\circ\text{C}$

| PARAMETER |                               | TEST CONDITIONS     | $V_{CC} = 1.8\text{ V}$ | $V_{CC} = 2.5\text{ V}$ | $V_{CC} = 3.3\text{ V}$ | $V_{CC} = 5\text{ V}$ | UNIT |
|-----------|-------------------------------|---------------------|-------------------------|-------------------------|-------------------------|-----------------------|------|
|           |                               |                     | TYP                     | TYP                     | TYP                     | TYP                   |      |
| $C_{pd}$  | Power dissipation capacitance | $f = 10\text{ MHz}$ | 8                       | 8                       | 11                      | 23                    | pF   |

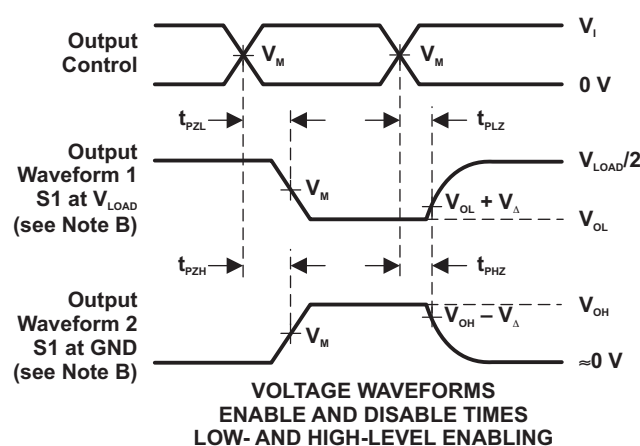
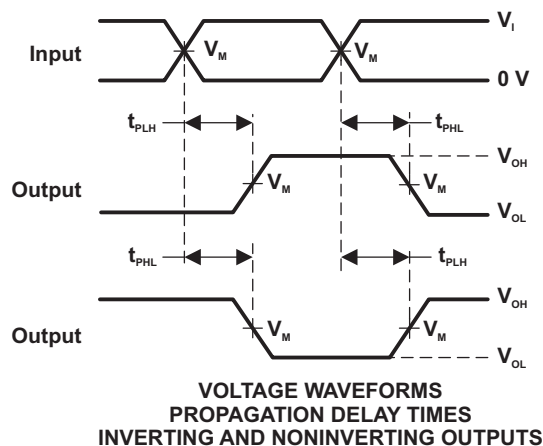
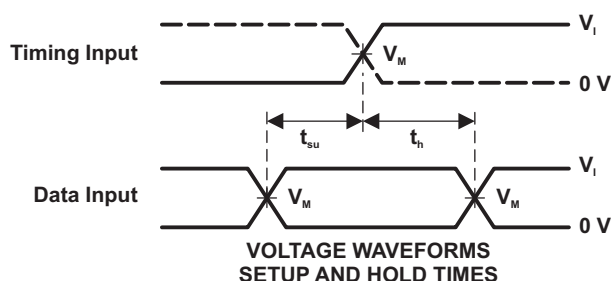
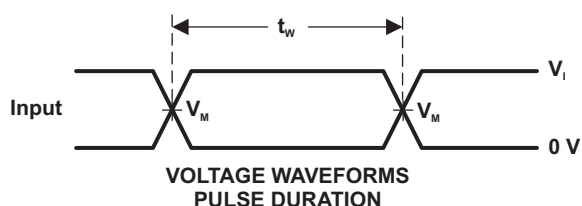
## Parameter Measurement Information



LOAD CIRCUIT

| TEST              | S1         |
|-------------------|------------|
| $t_{PLH}/t_{PHL}$ | Open       |
| $t_{PLZ}/t_{PZL}$ | $V_{LOAD}$ |
| $t_{PHZ}/t_{PZH}$ | GND        |

| $V_{CC}$                         | INPUTS   |                      | $V_M$      | $V_{LOAD}$        | $C_L$ | $R_L$        | $V_{\Delta}$ |
|----------------------------------|----------|----------------------|------------|-------------------|-------|--------------|--------------|
|                                  | $V_I$    | $t_i/t_f$            |            |                   |       |              |              |
| $1.8\text{ V} \pm 0.15\text{ V}$ | $V_{CC}$ | $\leq 2\text{ ns}$   | $V_{CC}/2$ | $2 \times V_{CC}$ | 30 pF | 1 k $\Omega$ | 0.15 V       |
| $2.5\text{ V} \pm 0.2\text{ V}$  | $V_{CC}$ | $\leq 2\text{ ns}$   | $V_{CC}/2$ | $2 \times V_{CC}$ | 30 pF | 500 $\Omega$ | 0.15 V       |
| $3.3\text{ V} \pm 0.3\text{ V}$  | 3 V      | $\leq 2.5\text{ ns}$ | 1.5 V      | 6 V               | 50 pF | 500 $\Omega$ | 0.3 V        |
| $5\text{ V} \pm 0.5\text{ V}$    | $V_{CC}$ | $\leq 2.5\text{ ns}$ | $V_{CC}/2$ | $2 \times V_{CC}$ | 50 pF | 500 $\Omega$ | 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  $\leq 10\text{ MHz}$ ,  $Z_o = 50\ \Omega$ .
  - 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.  $t_{PZL}$  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

REVISION HISTORY

| Changes from Revision C (Feburary 2007) to Revision D | Page              |
|-------------------------------------------------------|-------------------|
| • Updated document to new TI data sheet format. ....  | <a href="#">1</a> |
| • Removed Ordering Information table. ....            | <a href="#">2</a> |
| • Added ESD warning. ....                             | <a href="#">2</a> |
| • Updated operating temperature range. ....           | <a href="#">3</a> |

## PACKAGING INFORMATION

| Orderable part number            | Status<br>(1) | Material type<br>(2) | Package   Pins  | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6)   |
|----------------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|-----------------------|
| <a href="#">SN74LVC3GU04DCTR</a> | Active        | Production           | SSOP (DCT)   8  | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | (2X45, CU4)<br>(R, Z) |
| SN74LVC3GU04DCTR.B               | Active        | Production           | SSOP (DCT)   8  | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 125   | (2X45, CU4)<br>(R, Z) |
| <a href="#">SN74LVC3GU04DCUR</a> | Active        | Production           | VSSOP (DCU)   8 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 125   | (CU4J, CU4Q, CU4R)    |
| SN74LVC3GU04DCUR.B               | Active        | Production           | VSSOP (DCU)   8 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | (CU4J, CU4Q, CU4R)    |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts 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.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.



## TAPE AND REEL INFORMATION



\*All dimensions are nominal

| Device           | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74LVC3GU04DCTR | SSOP         | DCT             | 8    | 3000 | 180.0              | 13.0               | 3.35    | 4.5     | 1.55    | 4.0     | 12.0   | Q3            |
| SN74LVC3GU04DCTR | SSOP         | DCT             | 8    | 3000 | 180.0              | 12.4               | 3.15    | 4.35    | 1.55    | 4.0     | 12.0   | Q3            |
| SN74LVC3GU04DCUR | VSSOP        | DCU             | 8    | 3000 | 178.0              | 9.5                | 2.25    | 3.35    | 1.05    | 4.0     | 8.0    | Q3            |
| SN74LVC3GU04DCUR | VSSOP        | DCU             | 8    | 3000 | 178.0              | 9.0                | 2.25    | 3.35    | 1.05    | 4.0     | 8.0    | Q3            |

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

| Device           | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74LVC3GU04DCTR | SSOP         | DCT             | 8    | 3000 | 182.0       | 182.0      | 20.0        |
| SN74LVC3GU04DCTR | SSOP         | DCT             | 8    | 3000 | 190.0       | 190.0      | 30.0        |
| SN74LVC3GU04DCUR | VSSOP        | DCU             | 8    | 3000 | 202.0       | 201.0      | 28.0        |
| SN74LVC3GU04DCUR | VSSOP        | DCU             | 8    | 3000 | 180.0       | 180.0      | 18.0        |



## VSSOP - 0.9 mm max height

## SMALL OUTLINE PACKAGE



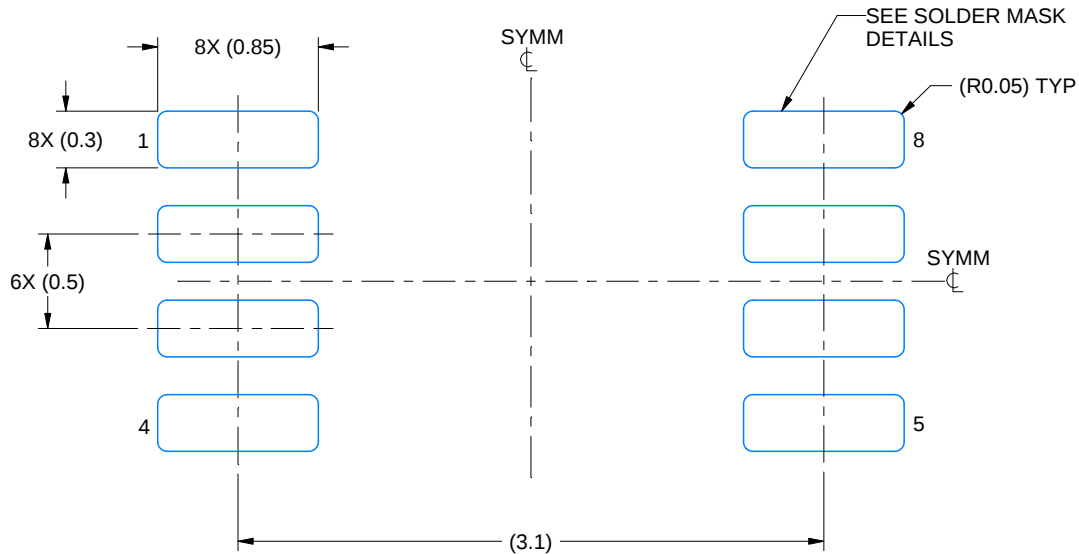
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MO-187 variation CA.

# EXAMPLE BOARD LAYOUT

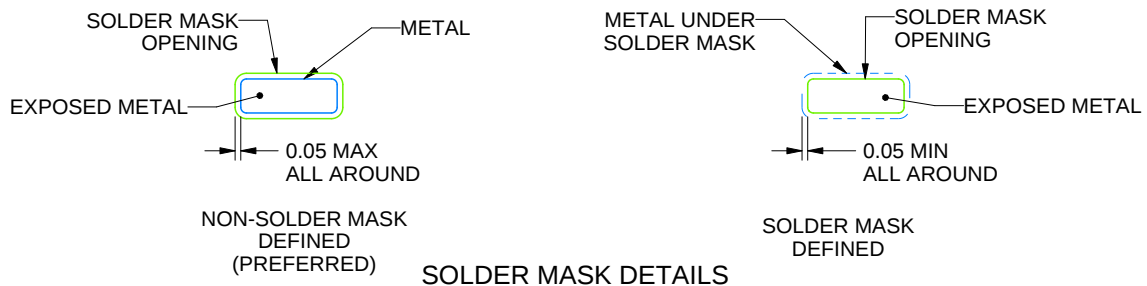
DCU0008A

VSSOP - 0.9 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 25X



4225266/A 09/2014

NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.

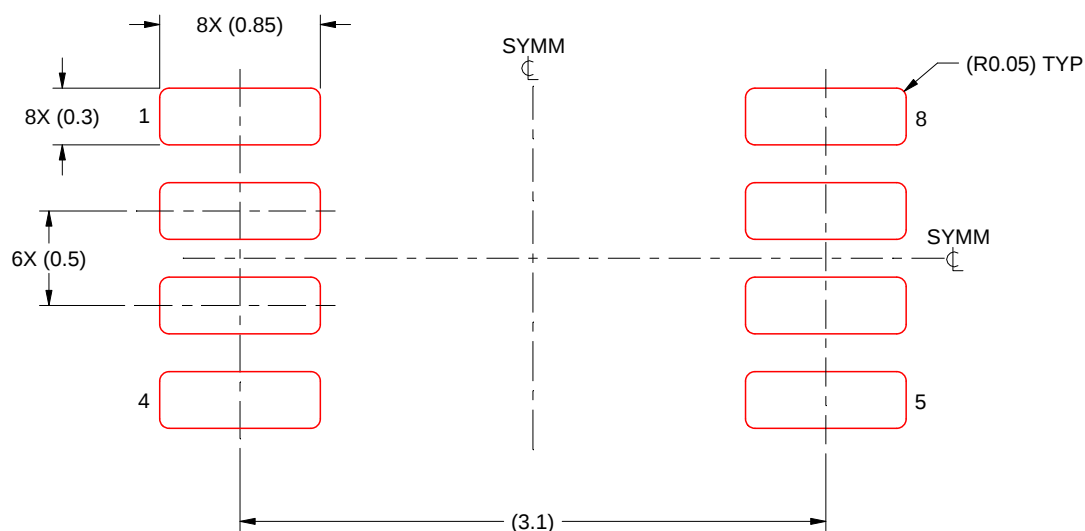
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

DCU0008A

VSSOP - 0.9 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 25X

4225266/A 09/2014

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.

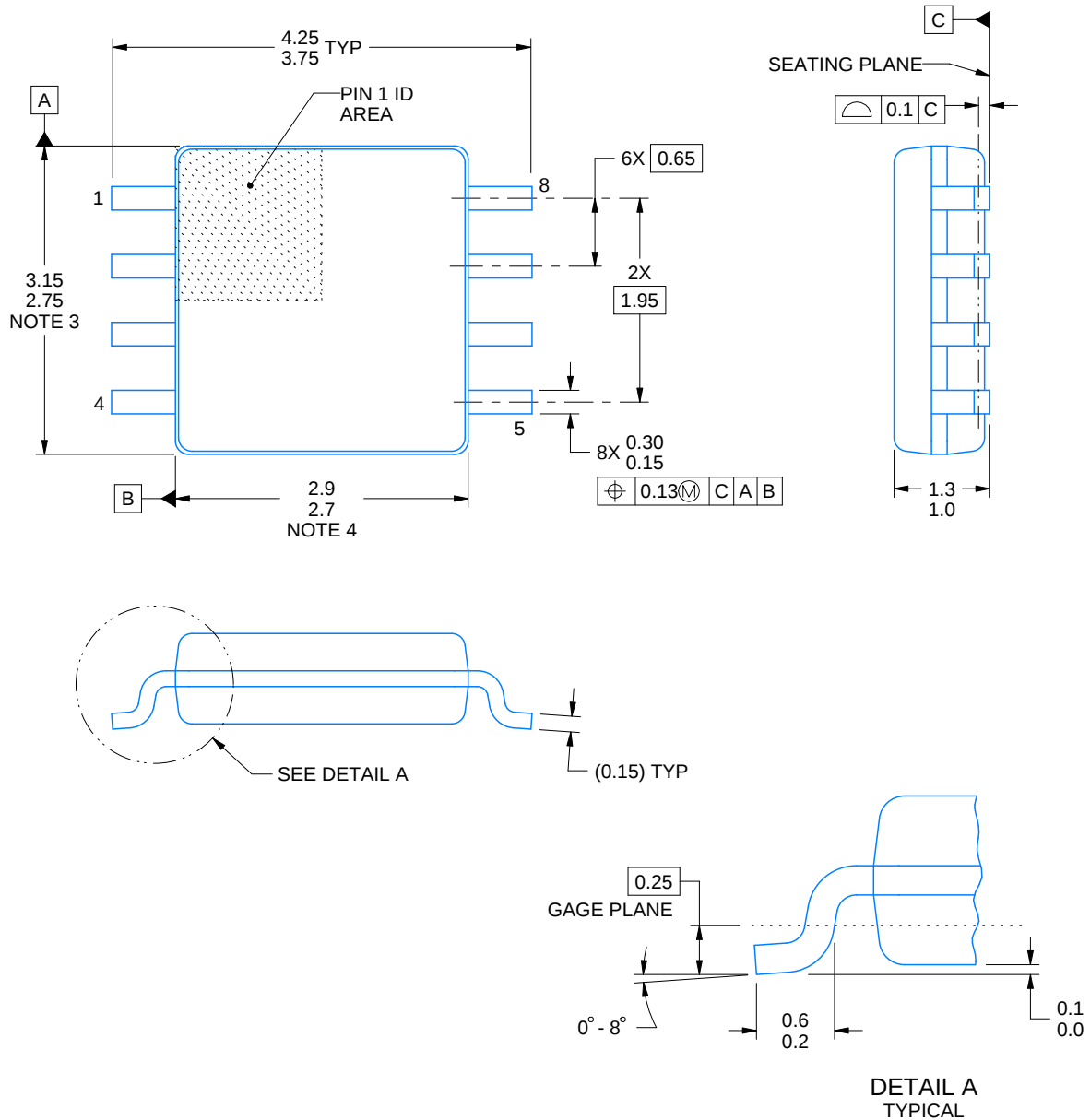


DCT0008A

## PACKAGE OUTLINE

SSOP - 1.3 mm max height

SMALL OUTLINE PACKAGE



4220784/C 06/2021

### NOTES:

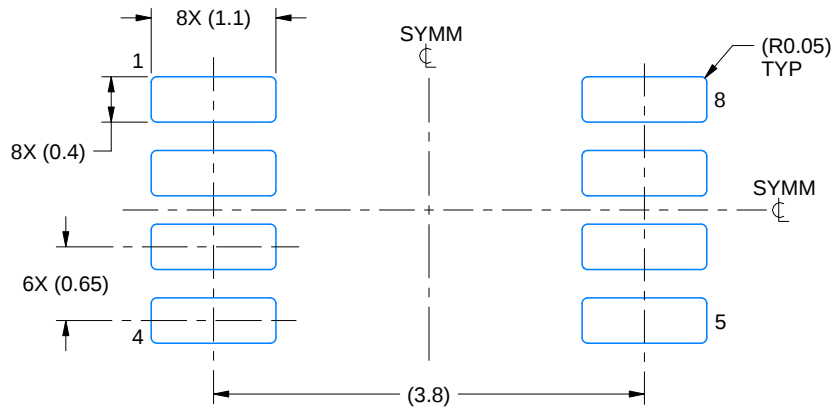
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate 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.

# EXAMPLE BOARD LAYOUT

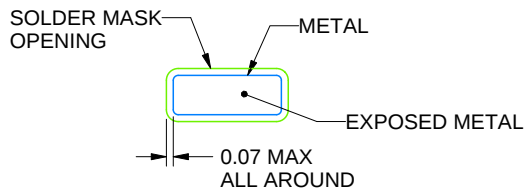
DCT0008A

SSOP - 1.3 mm max height

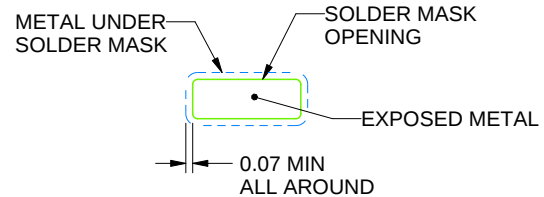
SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:15X



NON SOLDER MASK  
DEFINED



SOLDER MASK  
DEFINED

SOLDER MASK DETAILS

4220784/C 06/2021

NOTES: (continued)

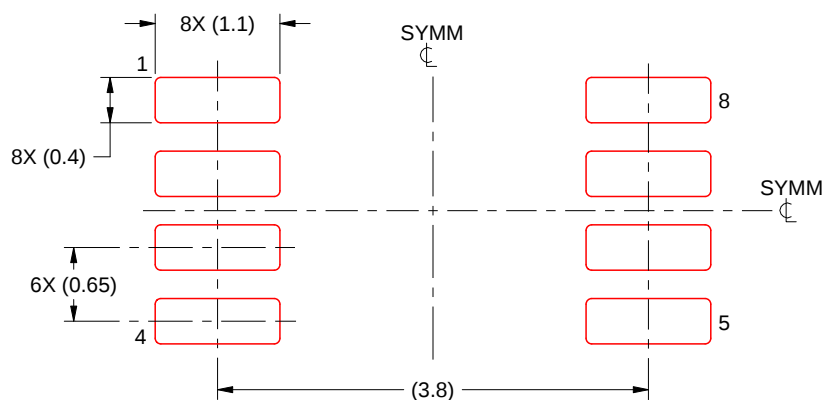
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

DCT0008A

SSOP - 1.3 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:15X

4220784/C 06/2021

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.

## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you fully indemnify TI and its representatives against any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#), [TI's General Quality Guidelines](#), or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products. Unless TI explicitly designates a product as custom or customer-specified, TI products are standard, catalog, general purpose devices.

TI objects to and rejects any additional or different terms you may propose.

Copyright © 2025, Texas Instruments Incorporated

Last updated 10/2025