

## Triple Inverter Gate

Check for Samples: [SN74LVC3GU04](#)

### FEATURES

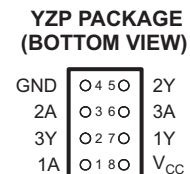
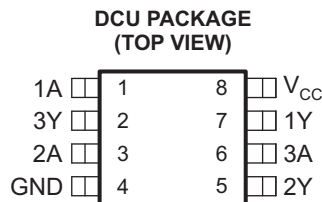
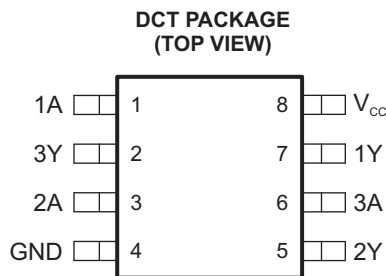
- Available in the Texas Instruments NanoFree™ Package
- Supports 5-V  $V_{CC}$  Operation
- Inputs Accept Voltages to 5.5 V
- Max  $t_{pd}$  of 3.9 ns at 3.3 V
- Low Power Consumption, 10- $\mu$ A Max  $I_{CC}$
- $\pm 24$ -mA Output Drive at 3.3 V
- Typical  $V_{OLP}$  (Output Ground Bounce) < 0.8 V 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  $Y = \overline{A}$ .

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.

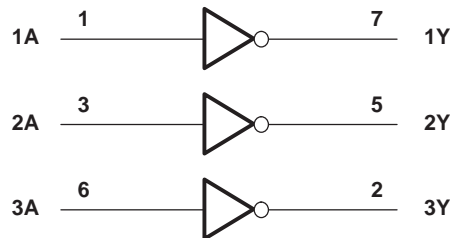


These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

**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)</sup> <sup>(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     |
|  |  | 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 |                        |                 | mA   |
|                 |                                | V <sub>CC</sub> = 2.3 V  |                        |                 |      |
|                 |                                | V <sub>CC</sub> = 3 V    |                        |                 |      |
|                 |                                | V <sub>CC</sub> = 4.5 V  |                        |                 |      |
| I <sub>OL</sub> | Low-level output current       | V <sub>CC</sub> = 1.65 V |                        |                 | mA   |
|                 |                                | V <sub>CC</sub> = 2.3 V  |                        |                 |      |
|                 |                                | V <sub>CC</sub> = 3 V    |                        |                 |      |
|                 |                                | V <sub>CC</sub> = 4.5 V  |                        |                 |      |
| 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](#))

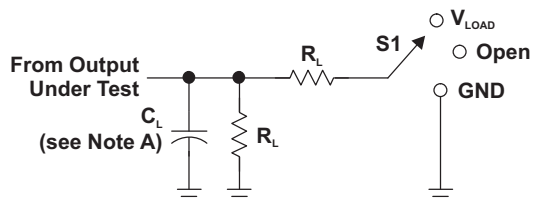
| PARAMETER       | FROM<br>(INPUT) | TO<br>(OUTPUT) | SN74LVC3GU04<br>–40°C to 125°C      |      |                                    |     |                                    |     |                                  |     | UNIT |
|-----------------|-----------------|----------------|-------------------------------------|------|------------------------------------|-----|------------------------------------|-----|----------------------------------|-----|------|
|                 |                 |                | 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<sub>A</sub> = 25°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 |
|---|-----------------|-------------------------|-------------------------|-------------------------|-----------------------|------|
|   |                 | TYP                     | TYP                     | TYP                     | TYP                   |      |
| C <sub>pd</sub> Power dissipation capacitance | f = 10 MHz      | 8                       | 8                       | 11                      | 23                    | pF   |

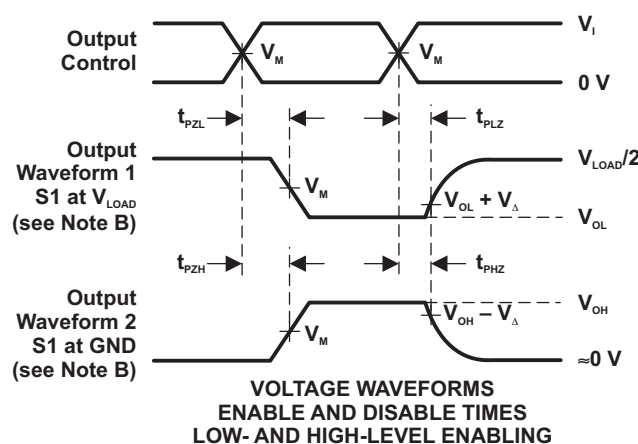
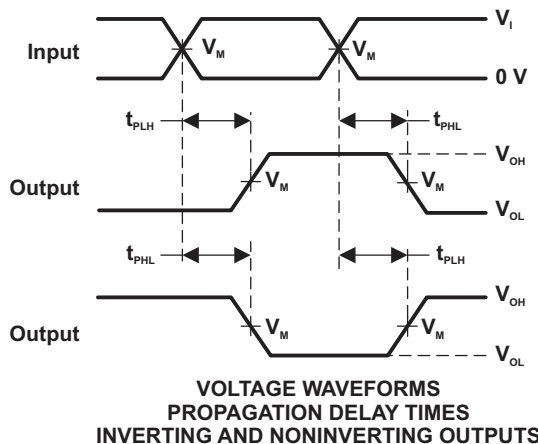
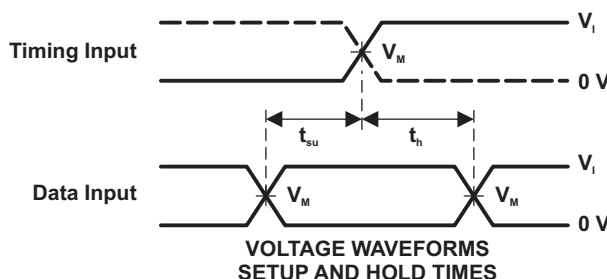
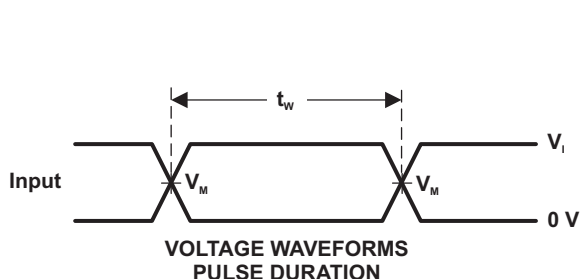
Parameter Measurement Information



LOAD CIRCUIT

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

| $V_{CC}$                         | INPUTS   |                      | $V_M$      | $V_{LOAD}$        | $C_L$ | $R_L$        | $V_{\Delta}$ |
|----------------------------------|----------|----------------------|------------|-------------------|-------|--------------|--------------|
|                                  | $V_I$    | $t_r/t_f$            |            |                   |       |              |              |
| $1.8\text{ V} \pm 0.15\text{ V}$ | $V_{CC}$ | $\leq 2\text{ ns}$   | $V_{CC}/2$ | $2 \times V_{CC}$ | 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 (February 2007) to Revision D | Page |
|---|------|
| • Updated document to new TI data sheet format. ....  | 1    |
| • Removed Ordering Information table. ....            | 2    |
| • Added ESD warning. ....                             | 2    |
| • Updated operating temperature range. ....           | 3    |

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)         | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| SN74LVC3GU04DCTR | ACTIVE        | SM8          | DCT             | 8    | 3000        | Green (RoHS & no Sb/Br) | NIPDAU                  | Level-1-260C-UNLIM   | -40 to 125   | CU4<br>(R, Z)           | <a href="#">Samples</a> |
| SN74LVC3GU04DCUR | ACTIVE        | VSSOP        | DCU             | 8    | 3000        | Green (RoHS & no Sb/Br) | NIPDAU   SN             | Level-1-260C-UNLIM   | -40 to 125   | (CU4Q, CU4R)            | <a href="#">Samples</a> |

(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) **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 (Cl) 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.

(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



### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*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 | SM8          | DCT             | 8    | 3000 | 180.0              | 13.0               | 3.35    | 4.5     | 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 | 180.0              | 8.4                | 2.25    | 3.35    | 1.05    | 4.0     | 8.0    | Q3            |

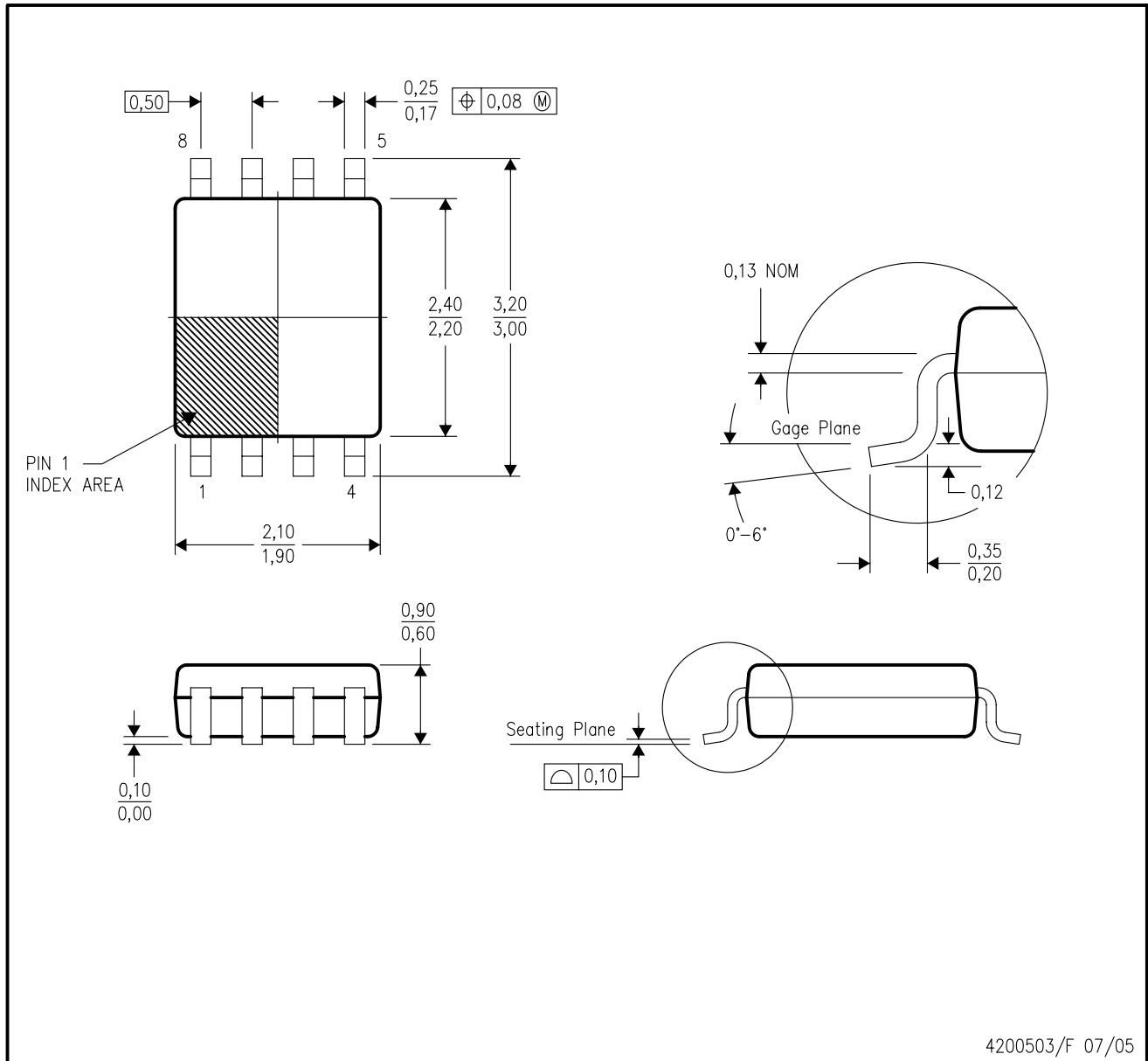
**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

| Device           | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74LVC3GU04DCTR | SM8          | DCT             | 8    | 3000 | 182.0       | 182.0      | 20.0        |
| SN74LVC3GU04DCUR | VSSOP        | DCU             | 8    | 3000 | 202.0       | 201.0      | 28.0        |
| SN74LVC3GU04DCUR | VSSOP        | DCU             | 8    | 3000 | 202.0       | 201.0      | 28.0        |

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)

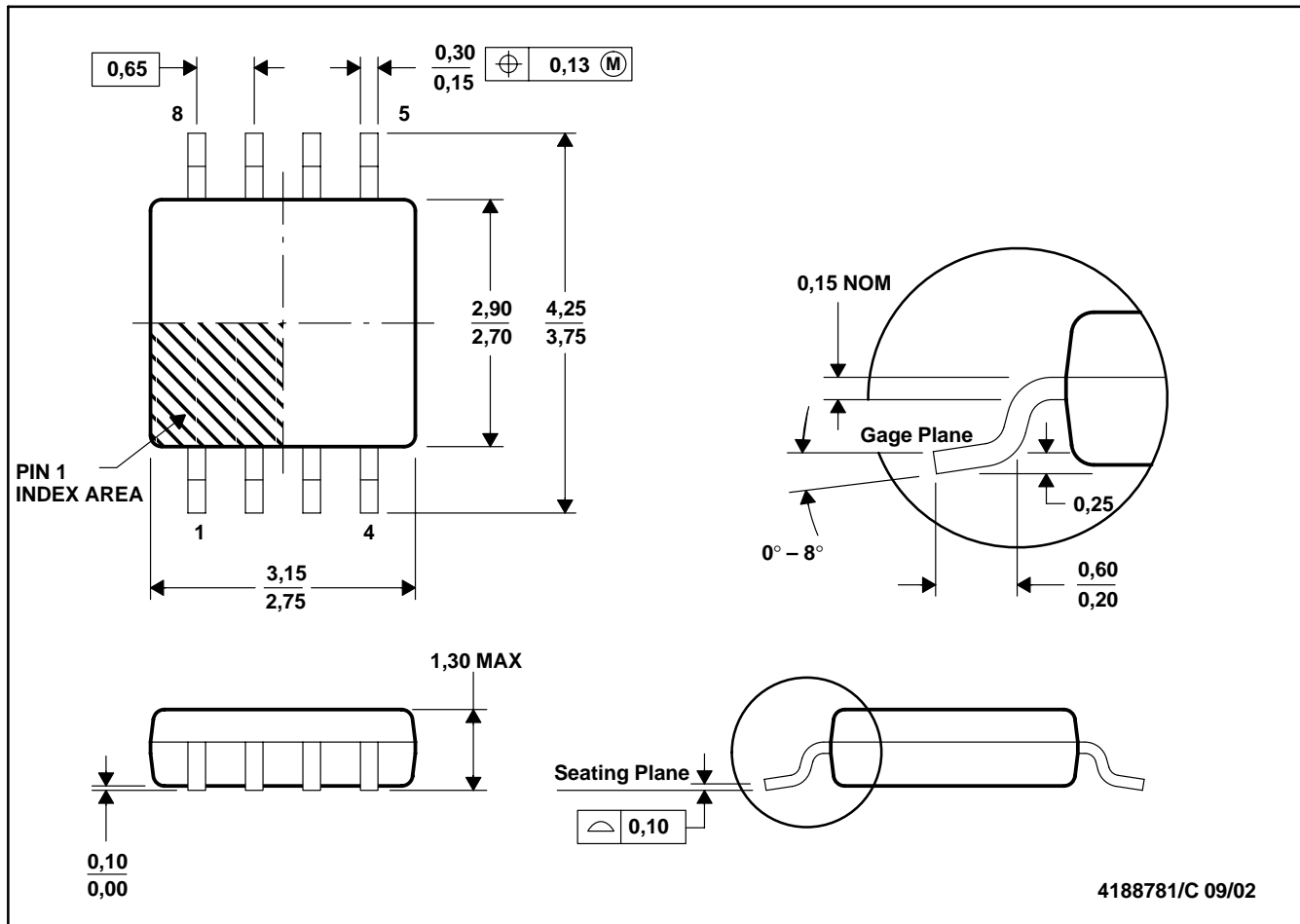
PLASTIC SMALL OUTLINE PACKAGE (DIE DOWN)



- 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.

DCT (R-PDSO-G8)

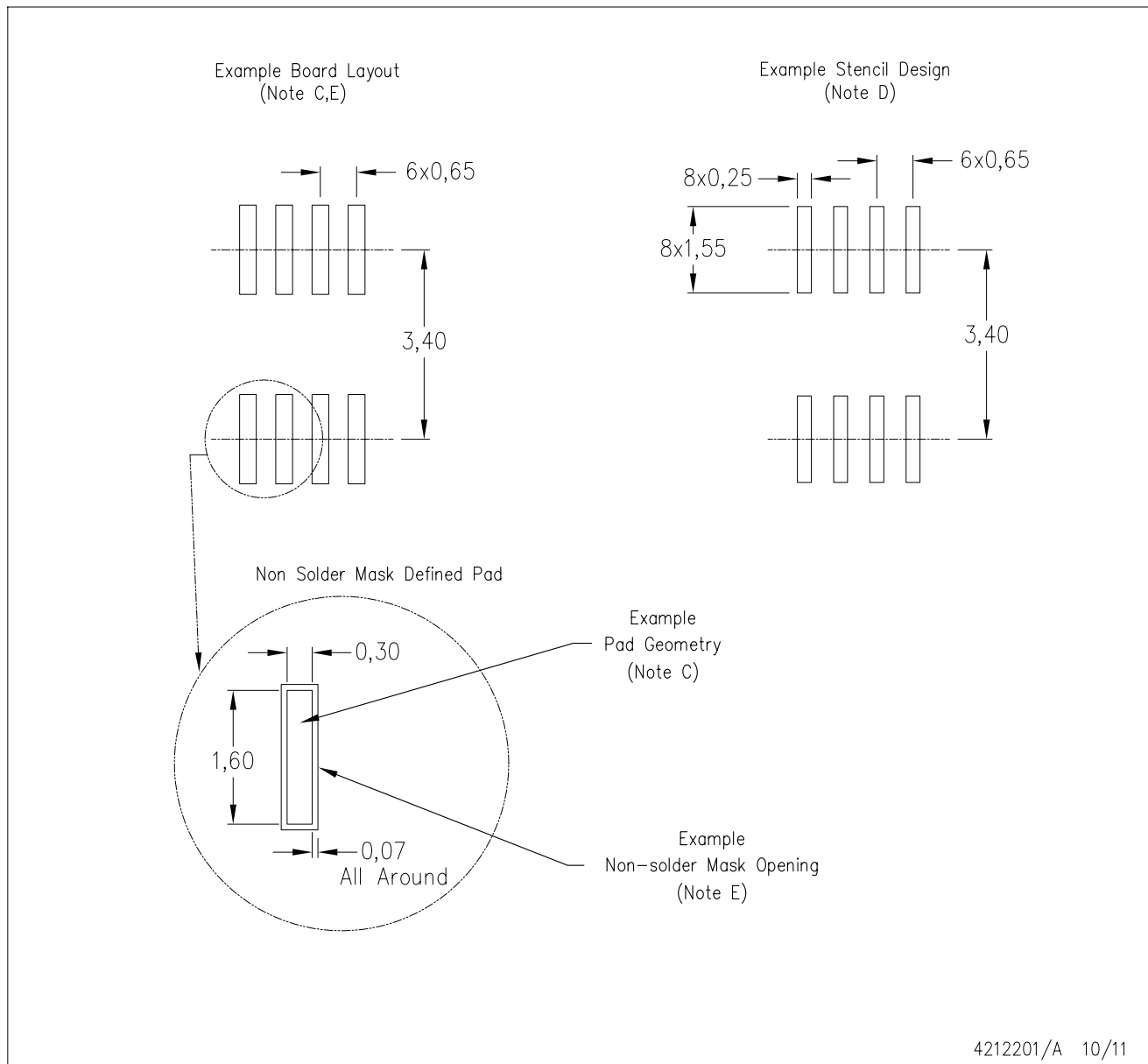
PLASTIC SMALL-OUTLINE PACKAGE



- 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.

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