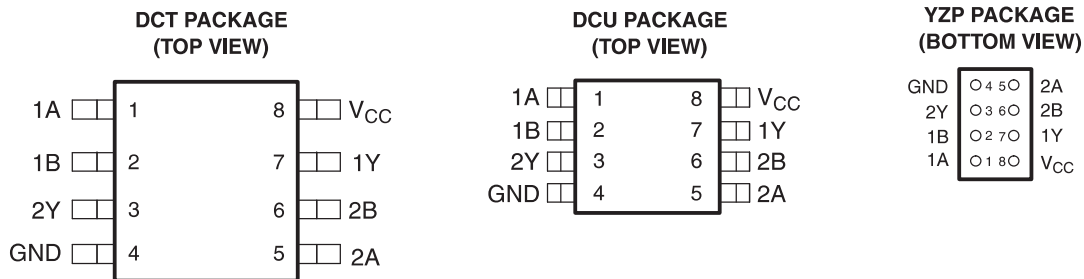


## FEATURES

- Available in the Texas Instruments NanoFree™ Package
- Optimized for 1.8-V Operation and Is 3.6-V I/O Tolerant to Support Mixed-Mode Signal Operation
- $I_{off}$  Supports Partial Power-Down-Mode Operation
- Sub-1-V Operable
- Max  $t_{pd}$  of 1.8 ns at 1.8 V
- Low Power Consumption, 10  $\mu$ A at 1.8 V
- $\pm 8$ -mA Output Drive at 1.8 V
- 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)



See mechanical drawings for dimensions.

## DESCRIPTION/ORDERING INFORMATION

This dual 2-input positive-NOR gate is operational at 0.8-V to 2.7-V  $V_{CC}$ , but is designed specifically for 1.65-V to 1.95-V  $V_{CC}$  operation.

The SN74AUC2G02 performs the Boolean function  $Y = \overline{A + B}$  or  $Y = \overline{A} \cdot \overline{B}$  in positive logic.

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

This device is fully specified for partial-power-down applications using  $I_{off}$ . The  $I_{off}$  circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

## ORDERING INFORMATION

| T <sub>A</sub> | PACKAGE <sup>(1)</sup>   |              | ORDERABLE PART NUMBER | TOP-SIDE MARKING <sup>(2)</sup> |
|----------------|--|--------------|-----------------------|---------------------------------|
| –40°C to 85°C  | NanoFree™ – WCSP (DSBGA)<br>0.23-mm Large Bump – YZP (Pb-free) | Reel of 3000 | SN74AUC2G02YZPR       | __ _UB_                         |
|                | SSOP – DCT   | Reel of 3000 | SN74AUC2G02DCTR       | U02_                            |
|                | VSSOP – DCU  | Reel of 3000 | SN74AUC2G02DCUR       | U02_                            |

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

(2) DCT: The actual top-side marking has three additional characters that designate the year, month, and assembly/test site.

DCU: The actual top-side marking has one additional character that designates the assembly/test site.

YZP: The actual top-side marking has three preceding characters to denote year, month, and sequence code, and one following character to designate the assembly/test site.



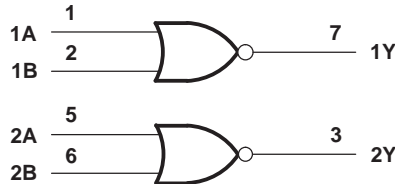
Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

NanoFree is a trademark of Texas Instruments.

**FUNCTION TABLE**  
(each gate)

| INPUTS |   | OUTPUT<br>Y |
|--------|---|-------------|
| A      | B |             |
| H      | X | L           |
| X      | H | L           |
| 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        | 3.6            | V       |
| $V_I$         | Input voltage range <sup>(2)</sup>  | -0.5        | 3.6            | V       |
| $V_O$         | Voltage range applied to any output in the high-impedance or power-off state <sup>(2)</sup> | -0.5        | 3.6            | V       |
| $V_O$         | Output voltage range <sup>(2)</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   |             |                | ±20 mA  |
|               | Continuous current through $V_{CC}$ or GND  |             |                | ±100 mA |
| $\theta_{JA}$ | Package thermal impedance <sup>(3)</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 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                     | 0.8                               | 2.7                    | V    |
| V <sub>IH</sub> | High-level input voltage           | V <sub>CC</sub> = 0.8 V           | V <sub>CC</sub>        | V    |
|                 |                                    | V <sub>CC</sub> = 1.1 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 <sub>IL</sub> | Low-level input voltage            | V <sub>CC</sub> = 0.8 V           | 0                      | V    |
|                 |                                    | V <sub>CC</sub> = 1.1 V to 1.95 V | 0.35 × V <sub>CC</sub> |      |
|                 |                                    | V <sub>CC</sub> = 2.3 V to 2.7 V  | 0.7                    |      |
| V <sub>I</sub>  | Input voltage                      | 0                                 | 3.6                    | 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> = 0.8 V           | –0.7                   | mA   |
|                 |                                    | V <sub>CC</sub> = 1.1 V           | –3                     |      |
|                 |                                    | V <sub>CC</sub> = 1.4 V           | –5                     |      |
|                 |                                    | V <sub>CC</sub> = 1.65 V          | –8                     |      |
|                 |                                    | V <sub>CC</sub> = 2.3 V           | –9                     |      |
| I <sub>OL</sub> | Low-level output current           | V <sub>CC</sub> = 0.8 V           | 0.7                    | mA   |
|                 |                                    | V <sub>CC</sub> = 1.1 V           | 3                      |      |
|                 |                                    | V <sub>CC</sub> = 1.4 V           | 5                      |      |
|                 |                                    | V <sub>CC</sub> = 1.65 V          | 8                      |      |
|                 |                                    | V <sub>CC</sub> = 2.3 V           | 9                      |      |
| Δt/Δv           | Input transition rise or fall rate |                                   | 20                     | ns/V |
| T <sub>A</sub>  | Operating free-air temperature     | –40                               | 85                     | °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>   | MIN                   | TYP <sup>(1)</sup> | MAX  | UNIT |
|------------------|---------------------------|---|-----------------------|--------------------|------|------|
| V <sub>OH</sub>  | I <sub>OH</sub> = –100 μA | 0.8 V to 2.7 V  | V <sub>CC</sub> – 0.1 |                    |      | V    |
|                  | I <sub>OH</sub> = –0.7 mA | 0.8 V   |                       | 0.55               |      |      |
|                  | I <sub>OH</sub> = –3 mA   | 1.1 V   |                       | 0.8                |      |      |
|                  | I <sub>OH</sub> = –5 mA   | 1.4 V   |                       | 1                  |      |      |
|                  | I <sub>OH</sub> = –8 mA   | 1.65 V  |                       | 1.2                |      |      |
|                  | I <sub>OH</sub> = –9 mA   | 2.3 V   |                       | 1.8                |      |      |
| V <sub>OL</sub>  | I <sub>OL</sub> = 100 μA  | 0.8 V to 2.7 V  |                       |                    | 0.2  | V    |
|                  | I <sub>OL</sub> = 0.7 mA  | 0.8 V   |                       | 0.25               |      |      |
|                  | I <sub>OL</sub> = 3 mA    | 1.1 V   |                       |                    | 0.3  |      |
|                  | I <sub>OL</sub> = 5 mA    | 1.4 V   |                       |                    | 0.4  |      |
|                  | I <sub>OL</sub> = 8 mA    | 1.65 V  |                       |                    | 0.45 |      |
|                  | I <sub>OL</sub> = 9 mA    | 2.3 V   |                       |                    | 0.6  |      |
| I <sub>I</sub>   | A or B inputs             | V <sub>I</sub> = V <sub>CC</sub> or GND                     | 0 to 2.7 V            |                    | ±5   | μA   |
| I <sub>off</sub> |                           | V <sub>I</sub> or V <sub>O</sub> = 2.7 V                    | 0                     |                    | ±10  | μA   |
| I <sub>CC</sub>  |                           | V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0 | 0.8 V to 2.7 V        |                    | 10   | μA   |
| C <sub>i</sub>   |                           | V <sub>I</sub> = V <sub>CC</sub> or GND                     | 2.5 V                 |                    | 2.5  | pF   |

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

# SN74AUC2G02

## DUAL 2-INPUT POSITIVE-NOR GATE

SCES441C–MAY 2003–REVISED JANUARY 2007

### Switching Characteristics

over recommended operating free-air temperature range,  $C_L = 15$  pF (unless otherwise noted) (see [Figure 1](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CC} = 0.8$ V | $V_{CC} = 1.2$ V<br>$\pm 0.1$ V |     | $V_{CC} = 1.5$ V<br>$\pm 0.1$ V |     | $V_{CC} = 1.8$ V<br>$\pm 0.15$ V |     |     | $V_{CC} = 2.5$ V<br>$\pm 0.2$ V |     | UNIT |
|-----------|--------------|-------------|------------------|---------------------------------|-----|---------------------------------|-----|----------------------------------|-----|-----|---------------------------------|-----|------|
|           |              |             | TYP              | MIN                             | MAX | MIN                             | MAX | MIN                              | TYP | MAX | MIN                             | MAX |      |
| $t_{pd}$  | A or B       | Y           | 8                | 0.8                             | 3.5 | 0.6                             | 2.2 | 0.5                              | 1   | 1.8 | 0.5                             | 1.3 | ns   |

### Switching Characteristics

over recommended operating free-air temperature range,  $C_L = 30$  pF (unless otherwise noted) (see [Figure 1](#))

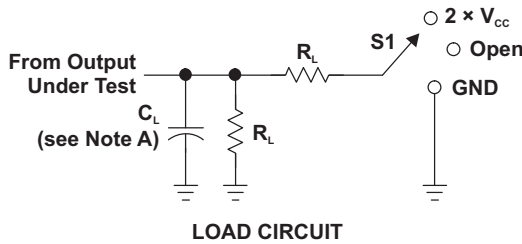
| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CC} = 1.8$ V<br>$\pm 0.15$ V |     |     | $V_{CC} = 2.5$ V<br>$\pm 0.2$ V |     | UNIT |
|-----------|--------------|-------------|----------------------------------|-----|-----|---------------------------------|-----|------|
|           |              |             | MIN                              | TYP | MAX | MIN                             | MAX |      |
| $t_{pd}$  | A or B       | Y           | 1                                | 1.6 | 2.4 | 0.8                             | 1.9 | ns   |

### Operating Characteristics

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

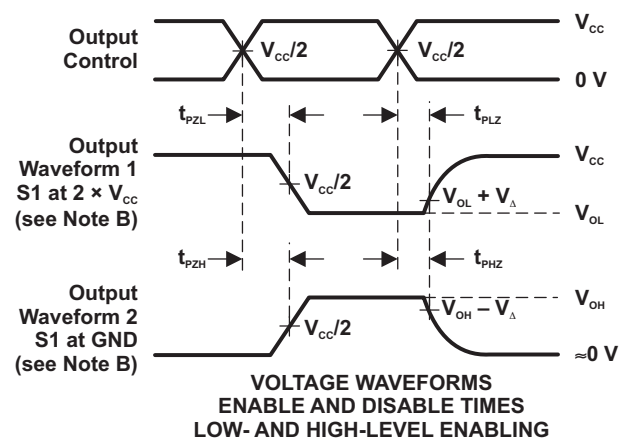
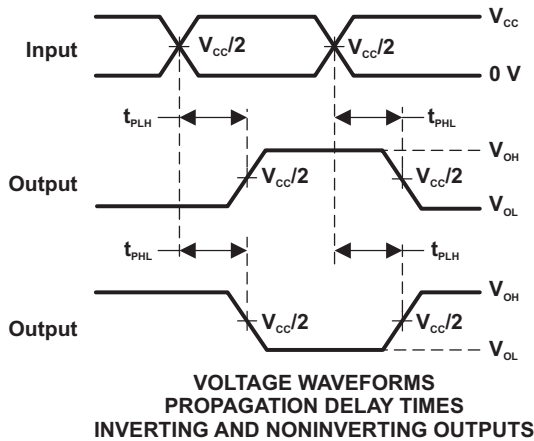
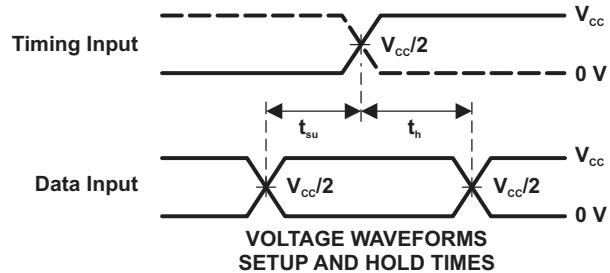
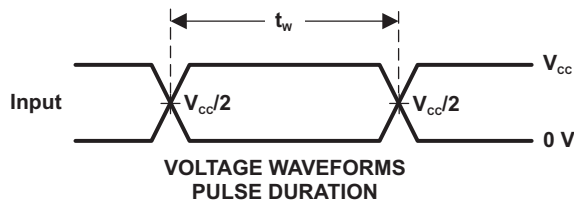
| PARAMETER | TEST CONDITIONS                             | $V_{CC} = 0.8$ V | $V_{CC} = 1.2$ V | $V_{CC} = 1.5$ V | $V_{CC} = 1.8$ V | $V_{CC} = 2.5$ V | UNIT |
|-----------|---|------------------|------------------|------------------|------------------|------------------|------|
|           |   | TYP              | TYP              | TYP              | TYP              | TYP              |      |
| $C_{pd}$  | Power dissipation capacitance<br>f = 10 MHz | 13               | 13               | 14               | 14               | 14               | pF   |

PARAMETER MEASUREMENT INFORMATION



| TEST              | S1                |
|-------------------|-------------------|
| $t_{PLH}/t_{PHL}$ | Open              |
| $t_{PZL}/t_{PZH}$ | $2 \times V_{CC}$ |
| $t_{PHZ}/t_{PZH}$ | GND               |

| $V_{CC}$       | $C_L$ | $R_L$ | $V_A$  |
|----------------|-------|-------|--------|
| 0.8 V          | 15 pF | 2 kΩ  | 0.1 V  |
| 1.2 V ± 0.1 V  | 15 pF | 2 kΩ  | 0.1 V  |
| 1.5 V ± 0.1 V  | 15 pF | 2 kΩ  | 0.1 V  |
| 1.8 V ± 0.15 V | 15 pF | 2 kΩ  | 0.15 V |
| 2.5 V ± 0.2 V  | 15 pF | 2 kΩ  | 0.15 V |
| 1.8 V ± 0.15 V | 30 pF | 1 kΩ  | 0.15 V |
| 2.5 V ± 0.2 V  | 30 pF | 500 Ω | 0.15 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 ≤ 10 MHz,  $Z_o = 50 \Omega$ , slew rate ≥ 1 V/ns.  
 D. The outputs are measured one at a time, with one transition per measurement.  
 E.  $t_{PZL}$  and  $t_{PZH}$  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  $t_{pd}$ .

Figure 1. Load Circuit and Voltage Waveforms

**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                 |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| SN74AUC2G02DCTR  | ACTIVE        | SM8          | DCT             | 8    | 3000        | Green (RoHS & no Sb/Br) | NIPDAU                  | Level-1-260C-UNLIM   | -40 to 85    | U02<br>(R, Z)           | <a href="#">Samples</a> |
| SN74AUC2G02DCUR  | ACTIVE        | VSSOP        | DCU             | 8    | 3000        | Green (RoHS & no Sb/Br) | NIPDAU   SN             | Level-1-260C-UNLIM   | -40 to 85    | (U02Q, U02R)<br>UR      | <a href="#">Samples</a> |
| SN74AUC2G02YZPR  | ACTIVE        | DSBGA        | YZP             | 8    | 3000        | Green (RoHS & no Sb/Br) | SNAGCU                  | Level-1-260C-UNLIM   | -40 to 85    | UBN                     | <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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74AUC2G02DCTR | SM8          | DCT             | 8    | 3000 | 180.0              | 13.0               | 3.35    | 4.5     | 1.55    | 4.0     | 12.0   | Q3            |
| SN74AUC2G02DCUR | VSSOP        | DCU             | 8    | 3000 | 178.0              | 9.5                | 2.25    | 3.35    | 1.05    | 4.0     | 8.0    | Q3            |
| SN74AUC2G02DCUR | VSSOP        | DCU             | 8    | 3000 | 180.0              | 8.4                | 2.25    | 3.35    | 1.05    | 4.0     | 8.0    | Q3            |
| SN74AUC2G02YZPR | DSBGA        | YZP             | 8    | 3000 | 178.0              | 9.2                | 1.02    | 2.02    | 0.63    | 4.0     | 8.0    | Q1            |

**TAPE AND REEL BOX DIMENSIONS**

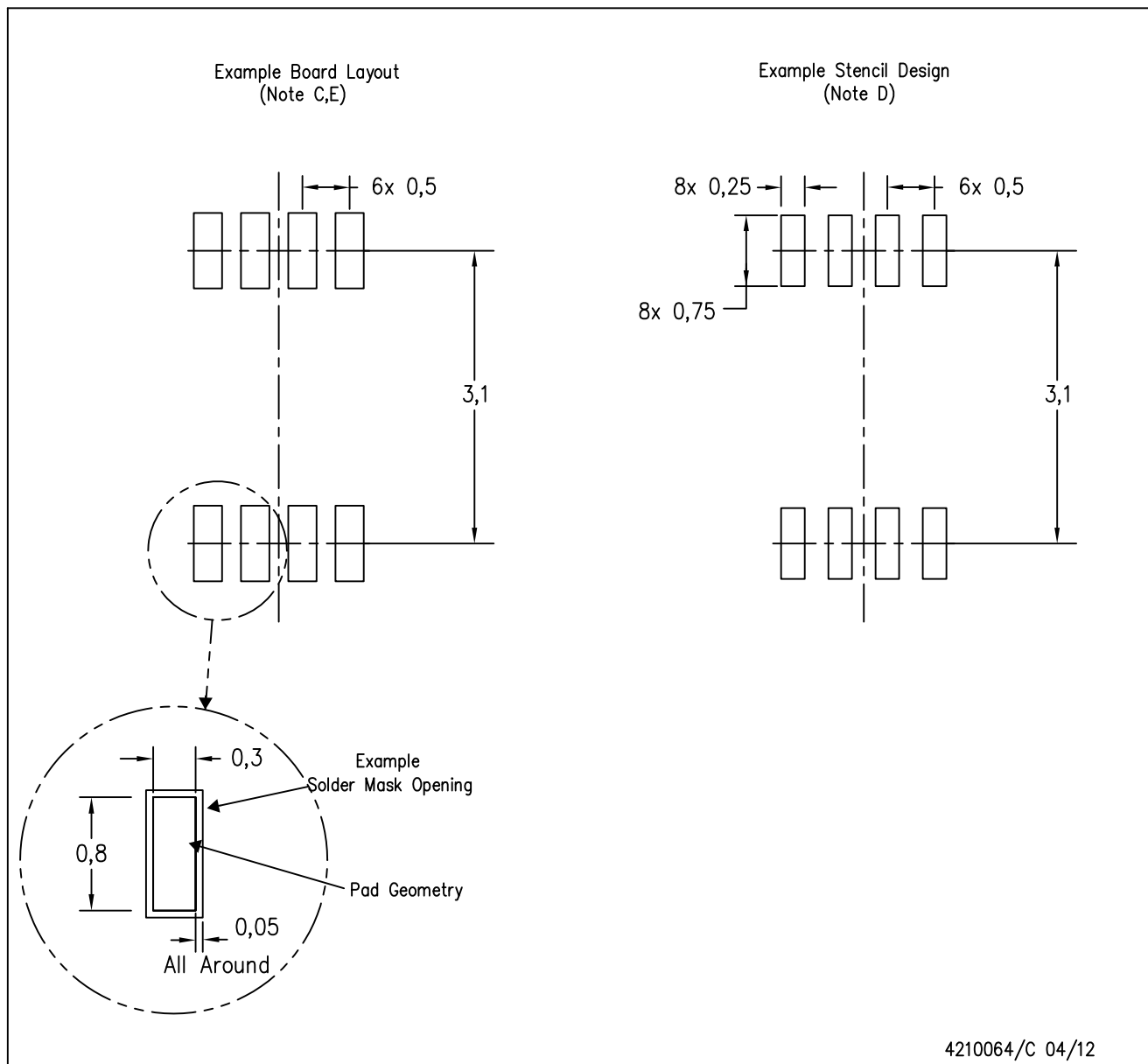

\*All dimensions are nominal

| Device          | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74AUC2G02DCTR | SM8          | DCT             | 8    | 3000 | 182.0       | 182.0      | 20.0        |
| SN74AUC2G02DCUR | VSSOP        | DCU             | 8    | 3000 | 202.0       | 201.0      | 28.0        |
| SN74AUC2G02DCUR | VSSOP        | DCU             | 8    | 3000 | 202.0       | 201.0      | 28.0        |
| SN74AUC2G02YZPR | DSBGA        | YZP             | 8    | 3000 | 220.0       | 220.0      | 35.0        |



DCU (S-PDSO-G8)

PLASTIC SMALL OUTLINE PACKAGE (DIE DOWN)

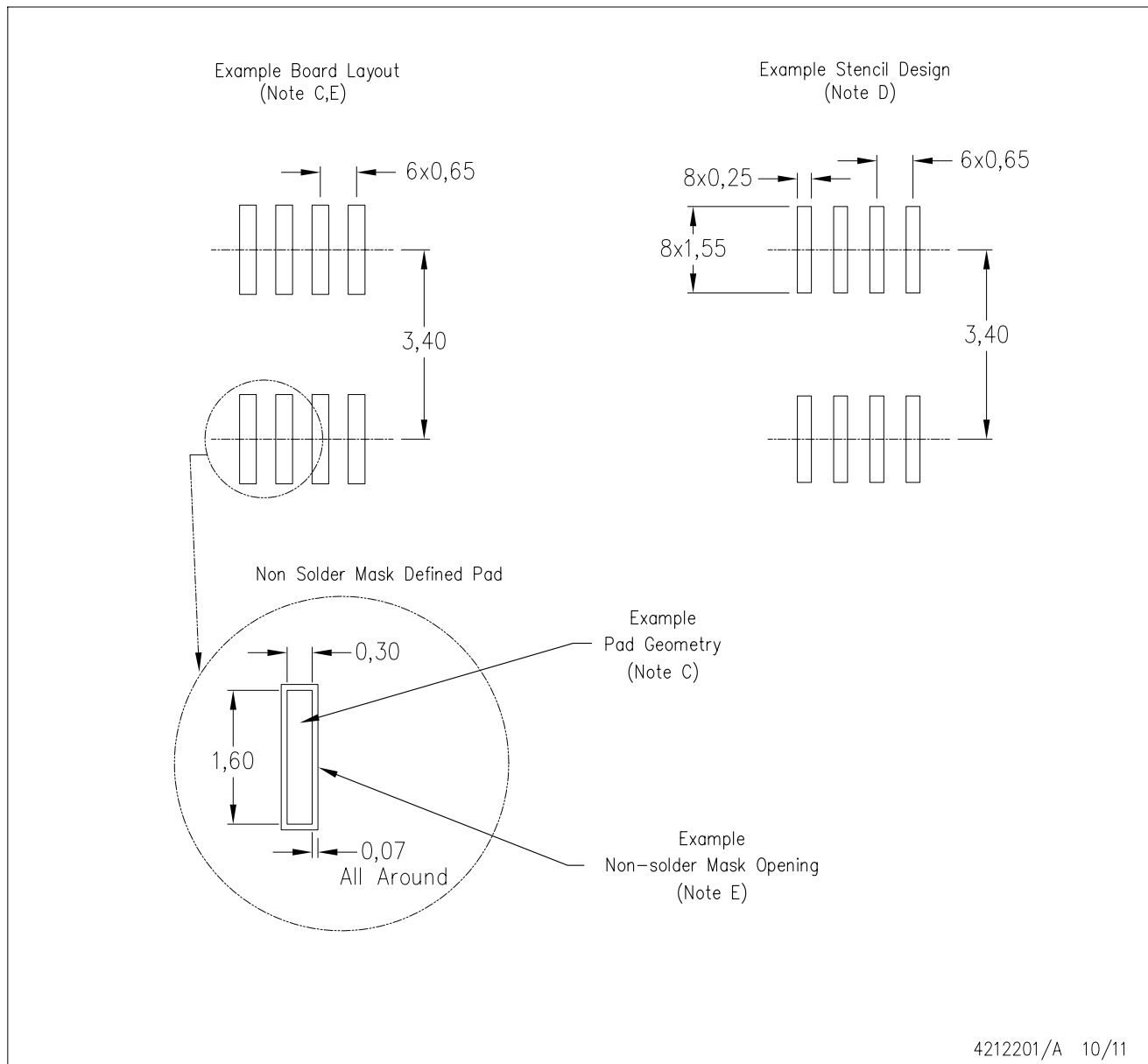


- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers 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.



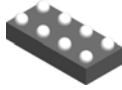
DCT (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- 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.

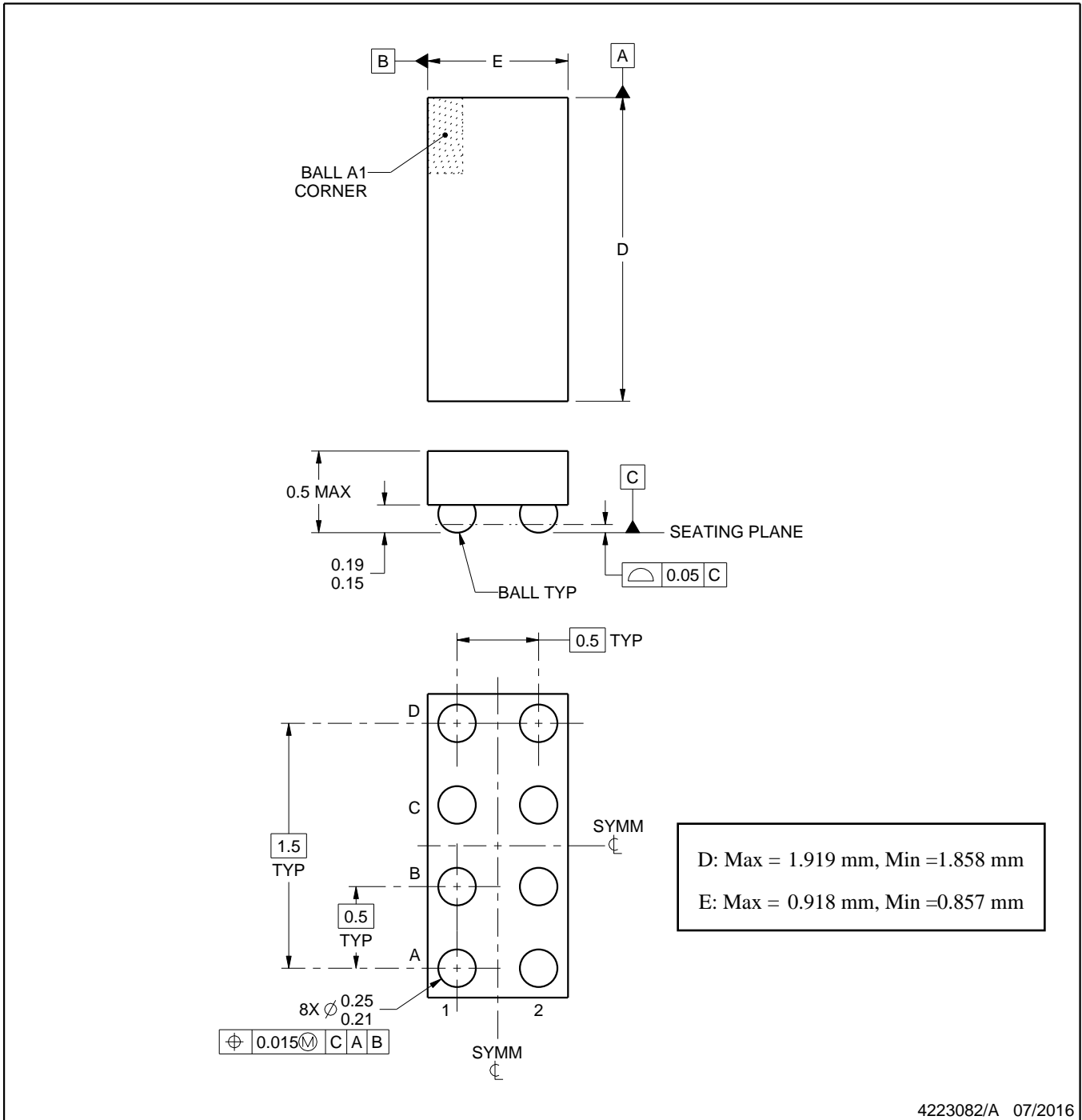
YZP0008



# PACKAGE OUTLINE

DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



NOTES:

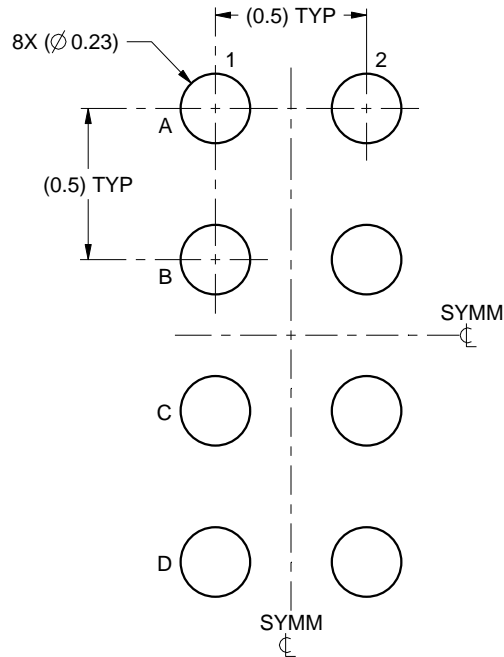
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

# EXAMPLE BOARD LAYOUT

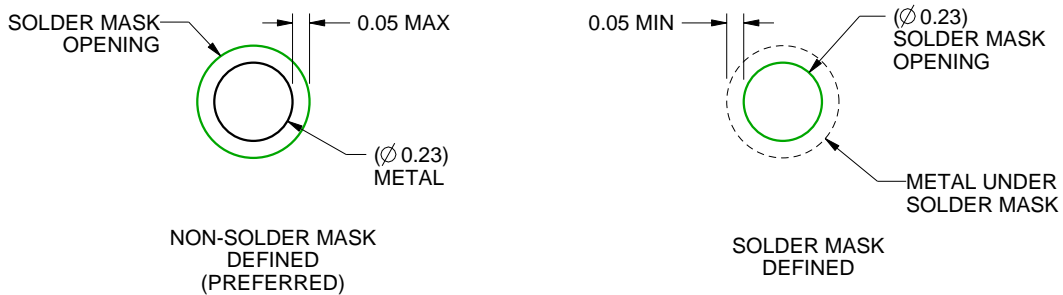
YZP0008

DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



LAND PATTERN EXAMPLE  
SCALE:40X



SOLDER MASK DETAILS  
NOT TO SCALE

4223082/A 07/2016

NOTES: (continued)

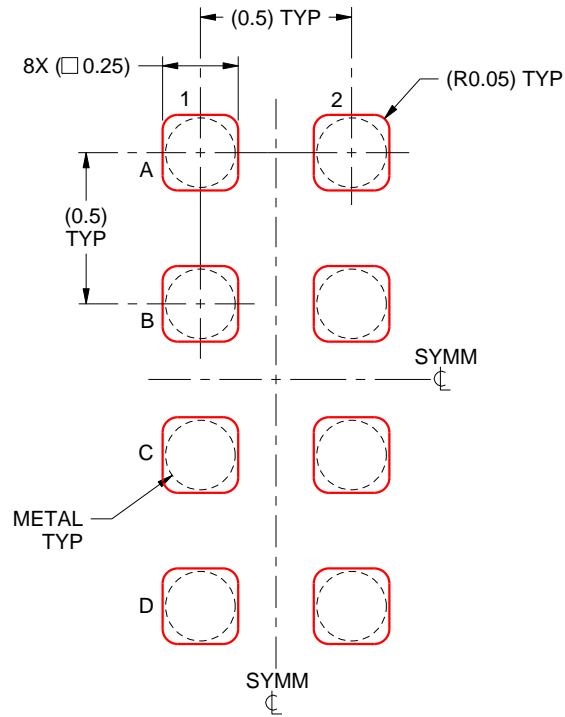
3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SNVA009 ([www.ti.com/lit/snva009](http://www.ti.com/lit/snva009)).

# EXAMPLE STENCIL DESIGN

YZP0008

DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



SOLDER PASTE EXAMPLE  
BASED ON 0.1 mm THICK STENCIL  
SCALE:40X

4223082/A 07/2016

NOTES: (continued)

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

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