

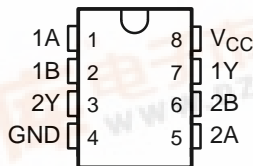
## SN74LVC2G00 DUAL 2-INPUT POSITIVE-NAND GATE

SCES193J–APRIL 1999–REVISED JULY 2005

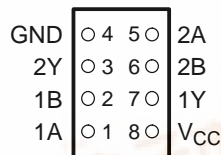
### FEATURES

- Available in the Texas Instruments NanoStar™ and NanoFree™ Packages
- Supports 5-V  $V_{CC}$  Operation
- Inputs Accept Voltages to 5.5 V
- Max  $t_{pd}$  of 4.3 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,  $T_A = 25^\circ\text{C}$
- $I_{off}$  Supports Partial-Power-Down Mode Operation
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 1000-V Charged-Device Model (C101)

DCT OR DCU PACKAGE  
(TOP VIEW)



YEA, YEP, YZA OR YZP PACKAGE  
(BOTTOM VIEW)



### DESCRIPTION/ORDERING INFORMATION

This dual 2-input positive-NAND gate is designed for 1.65-V to 5.5-V  $V_{CC}$  operation.

The SN74LVC2G00 performs the Boolean function  $Y = \overline{A} \cdot \overline{B}$  or  $Y = \overline{A + B}$  in positive logic.

NanoStar™ and 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

| $T_A$         | PACKAGE <sup>(1)</sup>   |              | ORDERABLE PART NUMBER | TOP-SIDE MARKING <sup>(2)</sup> |
|---------------|--|--------------|-----------------------|---------------------------------|
| –40°C to 85°C | NanoStar™ – WCSP (DSBGA)<br>0.17-mm Small Bump – YEA           | Reel of 3000 | SN74LVC2G00YEAR       | _ _ _ CA _                      |
|               | NanoFree™ – WCSP (DSBGA)<br>0.17-mm Small Bump – YZA (Pb-free) |              | SN74LVC2G00YZAR       |                                 |
|               | NanoStar™ – WCSP (DSBGA)<br>0.23-mm Large Bump – YEP           |              | SN74LVC2G00YEPR       |                                 |
|               | NanoFree™ – WCSP (DSBGA)<br>0.23-mm Large Bump – YZP (Pb-free) |              | SN74LVC2G00YZPR       |                                 |
|               | SSOP – DCT   | Reel of 3000 | SN74LVC2G00DCTR       | C00_ _ _                        |
|               | VSSOP – DCU  | Reel of 3000 | SN74LVC2G00DCUR       | C00_                            |
|               |  | Reel of 250  | SN74LVC2G00DCUT       |                                 |

(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.

YEA/YZA, YEP/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. Pin 1 identifier indicates solder-bump composition (1 = SnPb, • = Pb-free).

# SN74LVC2G00

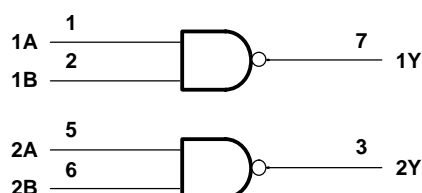
## DUAL 2-INPUT POSITIVE-NAND GATE

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**FUNCTION TABLE  
(EACH GATE)**

| INPUTS |   | OUTPUT<br>Y |
|--------|---|-------------|
| A      | B |             |
| H      | H | L           |
| L      | X | H           |
| X      | 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    |
| $V_O$         | Voltage range applied to any output in the high-impedance or power-off state <sup>(2)</sup> | –0.5            | 6.5            | V    |
| $V_O$         | Voltage range applied to any output in the high or low state <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            |      |
|               |   | YEA/YZA package | 140            |      |
|               |   | YEP/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 clamp-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                     | Operating                                       | 1.65                   | 5.5                    | V    |
|                 |                                    | Data retention only                             | 1.5                    |                        |      |
| V <sub>IH</sub> | High-level input voltage           | V <sub>CC</sub> = 1.65 V to 1.95 V              | 0.65 × V <sub>CC</sub> |                        | V    |
|                 |                                    | V <sub>CC</sub> = 2.3 V to 2.7 V                | 1.7                    |                        |      |
|                 |                                    | V <sub>CC</sub> = 3 V to 3.6 V                  | 2                      |                        |      |
|                 |                                    | V <sub>CC</sub> = 4.5 V to 5.5 V                | 0.7 × V <sub>CC</sub>  |                        |      |
| V <sub>IL</sub> | Low-level input voltage            | V <sub>CC</sub> = 1.65 V to 1.95 V              |                        | 0.35 × V <sub>CC</sub> | V    |
|                 |                                    | V <sub>CC</sub> = 2.3 V to 2.7 V                |                        | 0.7                    |      |
|                 |                                    | V <sub>CC</sub> = 3 V to 3.6 V                  |                        | 0.8                    |      |
|                 |                                    | V <sub>CC</sub> = 4.5 V to 5.5 V                |                        | 0.3 × V <sub>CC</sub>  |      |
| 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                    |      |
|                 |                                    | V <sub>CC</sub> = 4.5 V                         |                        | –24                    |      |
| 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                     |      |
|                 |                                    | V <sub>CC</sub> = 4.5 V                         |                        | 24                     |      |
| Δt/Δv           | Input transition rise or fall rate | V <sub>CC</sub> = 1.8 V ± 0.15 V, 2.5 V ± 0.2 V |                        | 20                     | ns/V |
|                 |                                    | V <sub>CC</sub> = 3.3 V ± 0.3 V                 |                        | 10                     |      |
|                 |                                    | V <sub>CC</sub> = 5 V ± 0.5 V                   |                        | 5                      |      |
| 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.

# SN74LVC2G00

## DUAL 2-INPUT POSITIVE-NAND GATE

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### 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  | 1.65 V to 5.5 V | V <sub>CC</sub> − 0.1 |                    |      | V    |
|                  |               | I <sub>OH</sub> = −4 mA  | 1.65 V          | 1.2                   |                    |      |      |
|                  |               | I <sub>OH</sub> = −8 mA  | 2.3 V           | 1.9                   |                    |      |      |
|                  |               | I <sub>OH</sub> = −16 mA   | 3 V             | 2.4                   |                    |      |      |
|                  |               | I <sub>OH</sub> = −24 mA   |                 | 2.3                   |                    |      |      |
|                  |               | I <sub>OH</sub> = −32 mA   | 4.5 V           | 3.8                   |                    |      |      |
| V <sub>OL</sub>  |               | I <sub>OL</sub> = 100 μA   | 1.65 V to 5.5 V |                       |                    | 0.1  | V    |
|                  |               | I <sub>OL</sub> = 4 mA   | 1.65 V          |                       |                    | 0.45 |      |
|                  |               | I <sub>OL</sub> = 8 mA   | 2.3 V           |                       |                    | 0.3  |      |
|                  |               | I <sub>OL</sub> = 16 mA  | 3 V             |                       |                    | 0.4  |      |
|                  |               | I <sub>OL</sub> = 24 mA  |                 |                       |                    | 0.55 |      |
|                  |               | I <sub>OL</sub> = 32 mA  | 4.5 V           |                       |                    | 0.55 |      |
| I <sub>I</sub>   | A or B inputs | V <sub>I</sub> = 5.5 V or GND  | 0 to 5.5 V      |                       |                    | ±5   | μA   |
| I <sub>off</sub> |               | V <sub>I</sub> or V <sub>O</sub> = 5.5 V                                     | 0               |                       |                    | ±10  | 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   | μA   |
| ΔI <sub>CC</sub> |               | One input at V <sub>CC</sub> − 0.6 V, Other inputs at V <sub>CC</sub> or GND | 3 V to 5.5 V    |                       |                    | 500  | μA   |
| C <sub>i</sub>   |               | V <sub>I</sub> = V <sub>CC</sub> or GND                                      | 3.3 V           | 5                     |                    |      | 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](#))

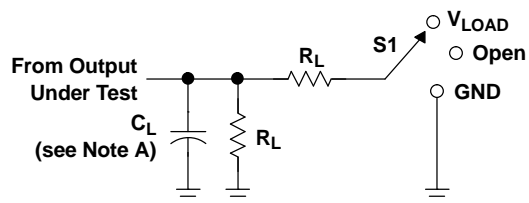
| PARAMETER       | FROM (INPUT) | TO (OUTPUT) | V <sub>CC</sub> = 1.8 V ± 0.15 V |     | V <sub>CC</sub> = 2.5 V ± 0.2 V |     | V <sub>CC</sub> = 3.3 V ± 0.3 V |     | V <sub>CC</sub> = 5 V ± 0.5 V |     | UNIT |
|-----------------|--------------|-------------|----------------------------------|-----|---------------------------------|-----|---------------------------------|-----|-------------------------------|-----|------|
|                 |              |             | MIN                              | MAX | MIN                             | MAX | MIN                             | MAX | MIN                           | MAX |      |
| t <sub>pd</sub> | A or B       | Y           | 3.7                              | 8.6 | 1.6                             | 4.8 | 1.1                             | 4.3 | 1                             | 3.3 | 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      | 19                      | 19                      | 20                      | 22                    | pF   |

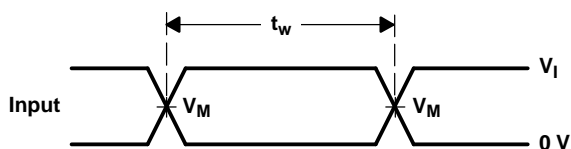
## PARAMETER MEASUREMENT INFORMATION



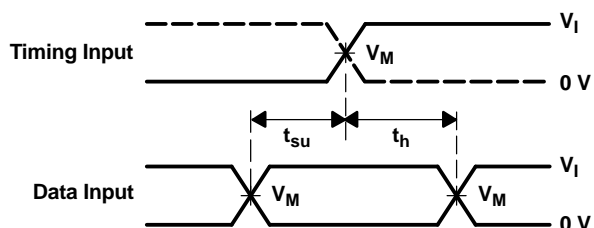
LOAD CIRCUIT

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

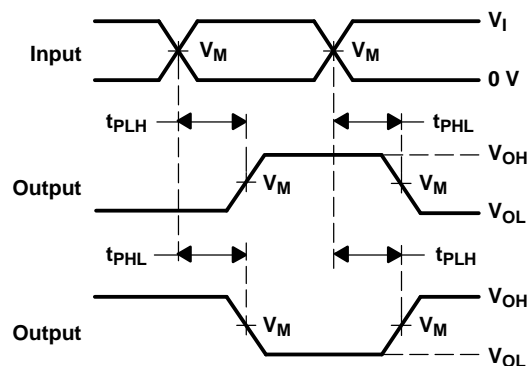
| $V_{CC}$                         | INPUTS   |                      | $V_M$      | $V_{LOAD}$        | $C_L$ | $R_L$        | $V_{\Delta}$ |
|----------------------------------|----------|----------------------|------------|-------------------|-------|--------------|--------------|
|                                  | $V_I$    | $t_r/t_f$            |            |                   |       |              |              |
| $1.8\text{ V} \pm 0.15\text{ V}$ | $V_{CC}$ | $\leq 2\text{ ns}$   | $V_{CC}/2$ | $2 \times V_{CC}$ | 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        |



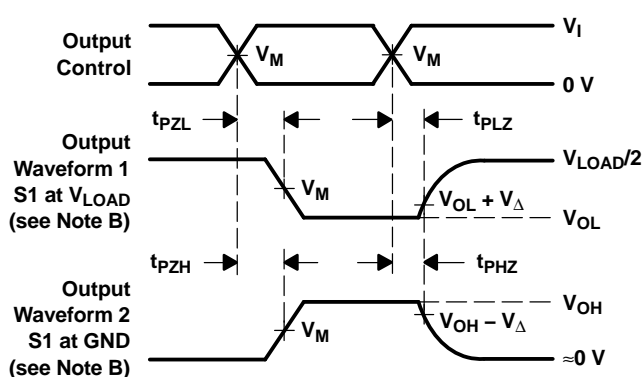
VOLTAGE WAVEFORMS  
PULSE DURATION



VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES  
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES  
LOW- AND HIGH-LEVEL ENABLING

- NOTES:
- $C_L$  includes probe and jig capacitance.
  - 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.
  - All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10\text{ MHz}$ ,  $Z_O = 50\ \Omega$ .
  - The outputs are measured one at a time, with one transition per measurement.
  - $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
  - All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

## PACKAGING INFORMATION

| Orderable Device  | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|-------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN74LVC2G00DCTR   | ACTIVE                | SM8          | DCT             | 8    | 3000        | Pb-Free (RoHS)          | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74LVC2G00DCTRE4 | ACTIVE                | SM8          | DCT             | 8    | 3000        | Pb-Free (RoHS)          | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74LVC2G00DCUR   | ACTIVE                | US8          | DCU             | 8    | 3000        | Pb-Free (RoHS)          | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74LVC2G00DCURE4 | ACTIVE                | US8          | DCU             | 8    | 3000        | Pb-Free (RoHS)          | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74LVC2G00DCUT   | ACTIVE                | US8          | DCU             | 8    | 250         | Pb-Free (RoHS)          | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74LVC2G00DCUTE4 | ACTIVE                | US8          | DCU             | 8    | 250         | Pb-Free (RoHS)          | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74LVC2G00YEAR   | ACTIVE                | WCSP         | YEA             | 8    | 3000        | TBD                     | SNPB             | Level-1-260C-UNLIM           |
| SN74LVC2G00YEPR   | ACTIVE                | WCSP         | YEP             | 8    | 3000        | TBD                     | SNPB             | Level-1-260C-UNLIM           |
| SN74LVC2G00YZAR   | ACTIVE                | WCSP         | YZA             | 8    | 3000        | Pb-Free (RoHS)          | SNAGCU           | Level-1-260C-UNLIM           |
| SN74LVC2G00YZPR   | ACTIVE                | WCSP         | YZP             | 8    | 3000        | Pb-Free (RoHS)          | SNAGCU           | Level-1-260C-UNLIM           |

<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.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

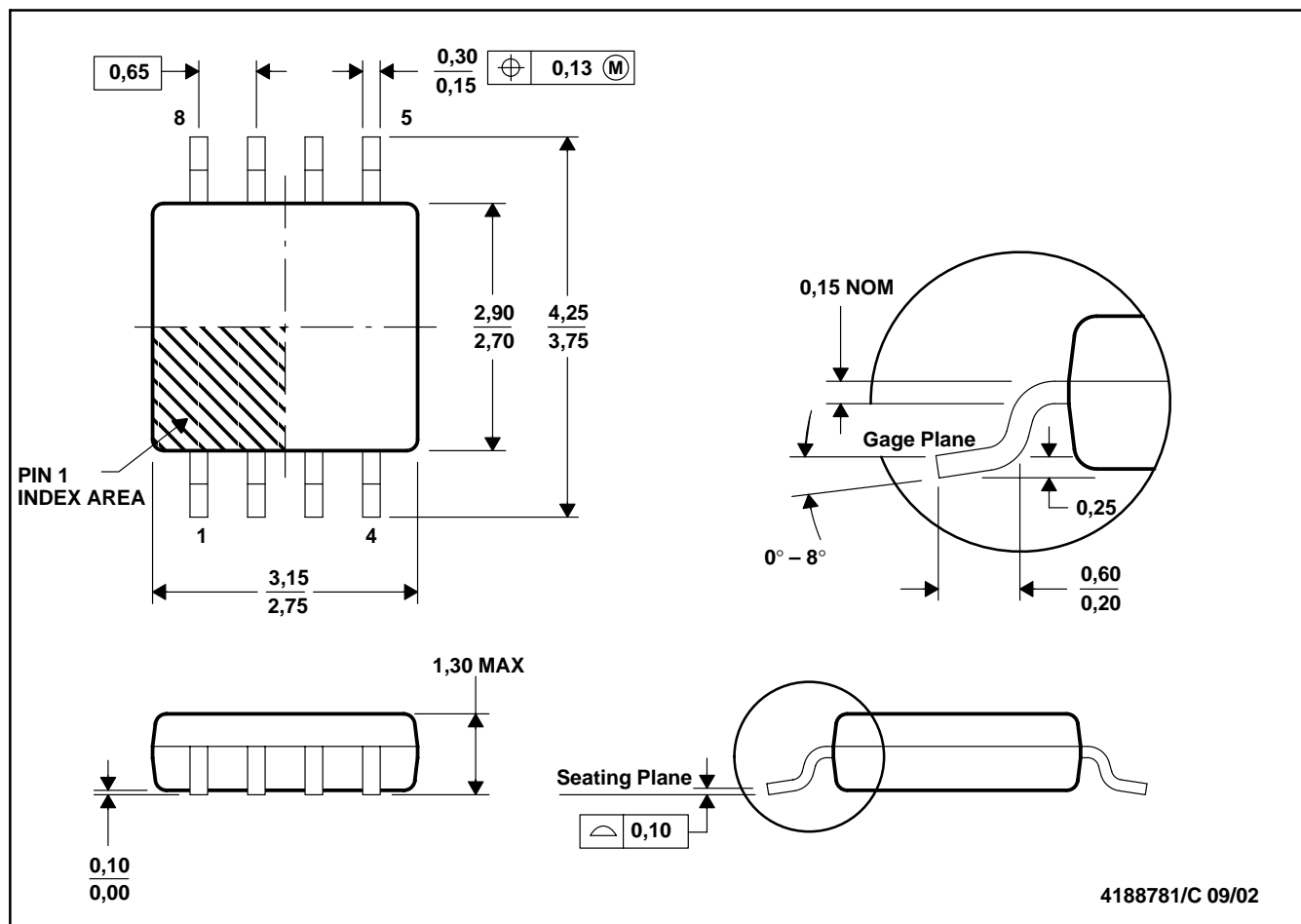
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## MECHANICAL DATA

MPDS049B – MAY 1999 – REVISED OCTOBER 2002

### DCT (R-PDSO-G8)

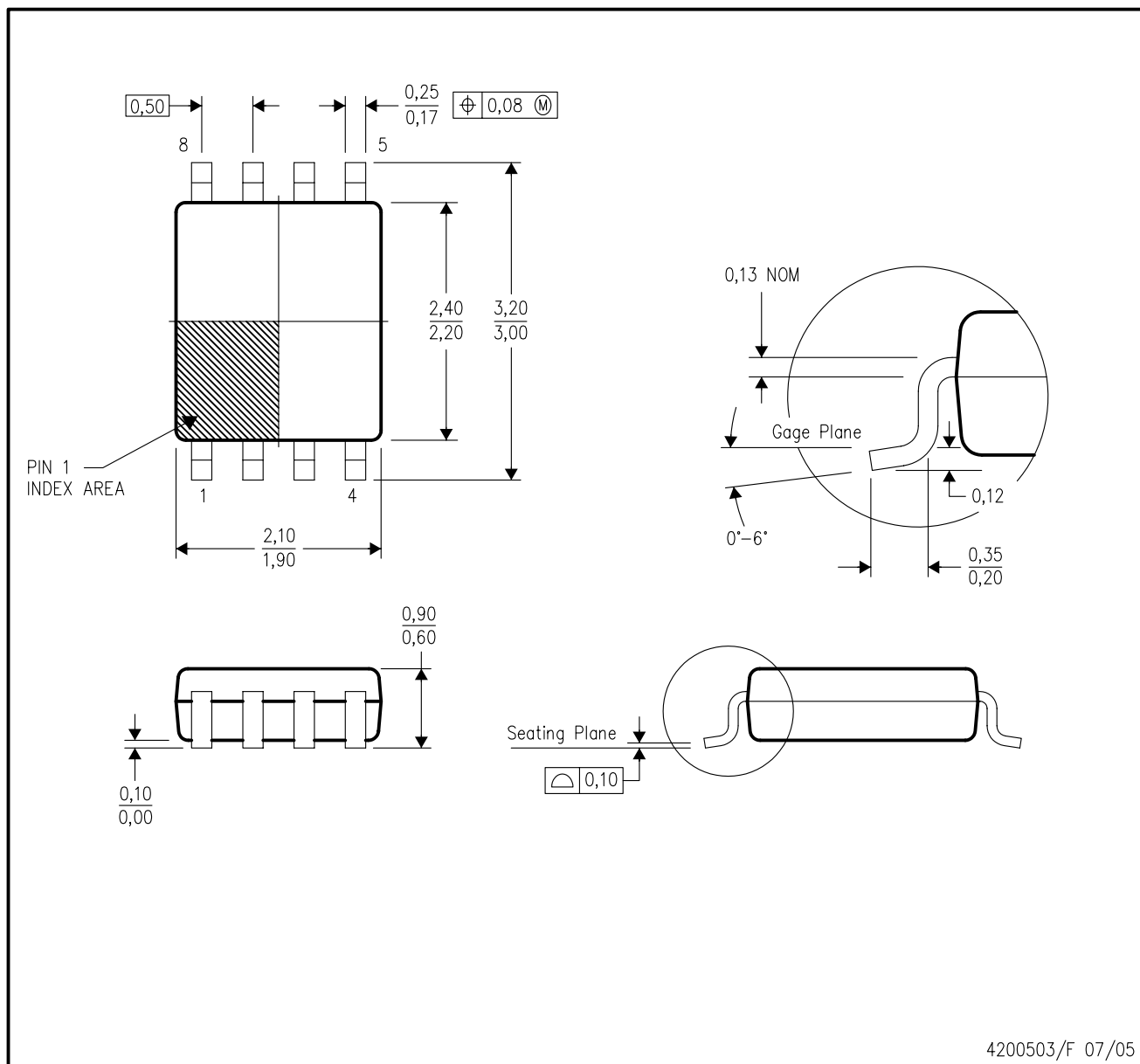
**PLASTIC SMALL-OUTLINE PACKAGE**

- 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.

## MECHANICAL DATA

DCU (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE (DIE DOWN)



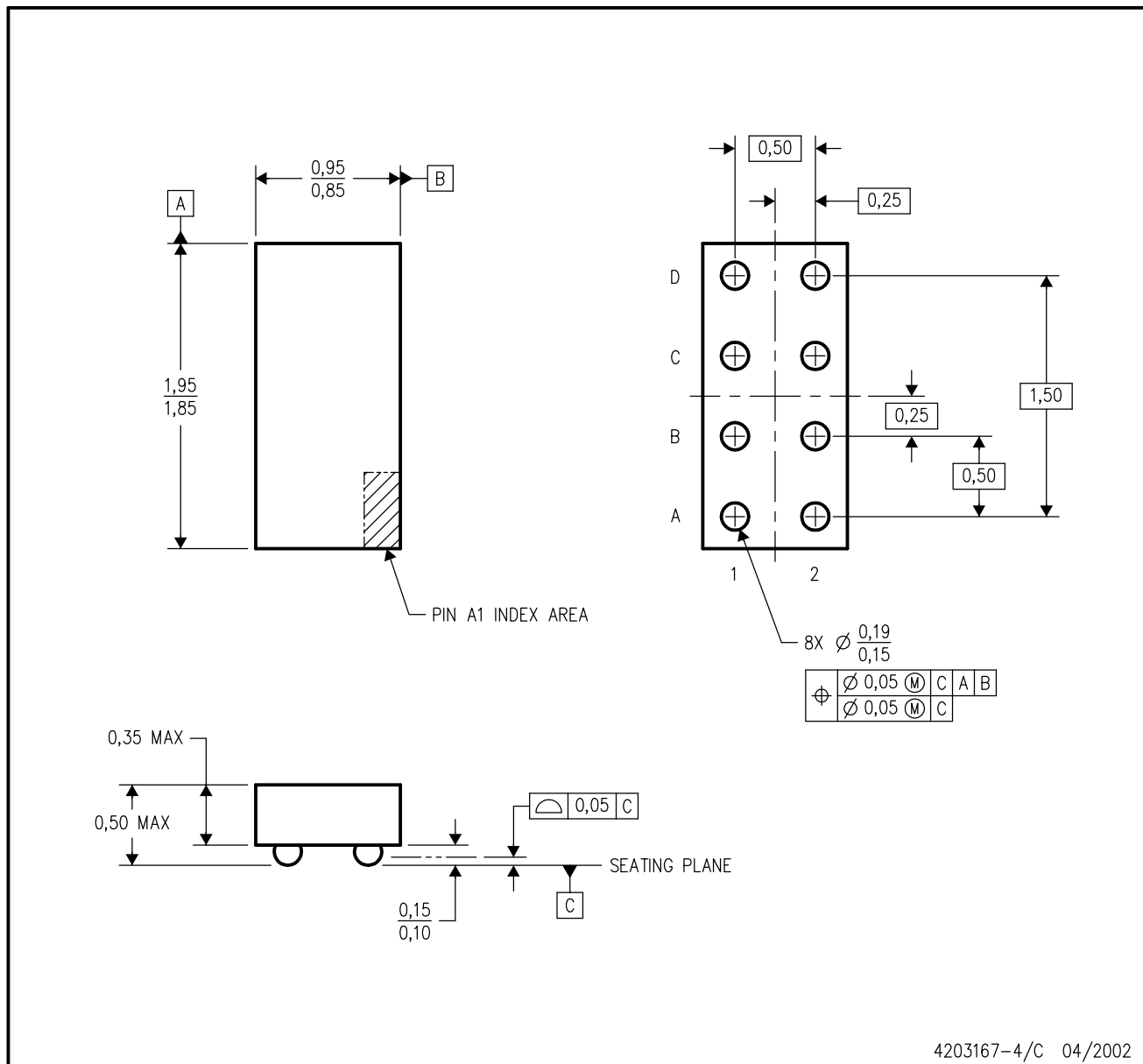
- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
  - D. Falls within JEDEC MO-187 variation CA.



## MECHANICAL DATA

YEA (R-XBGA-N8)

DIE-SIZE BALL GRID ARRAY

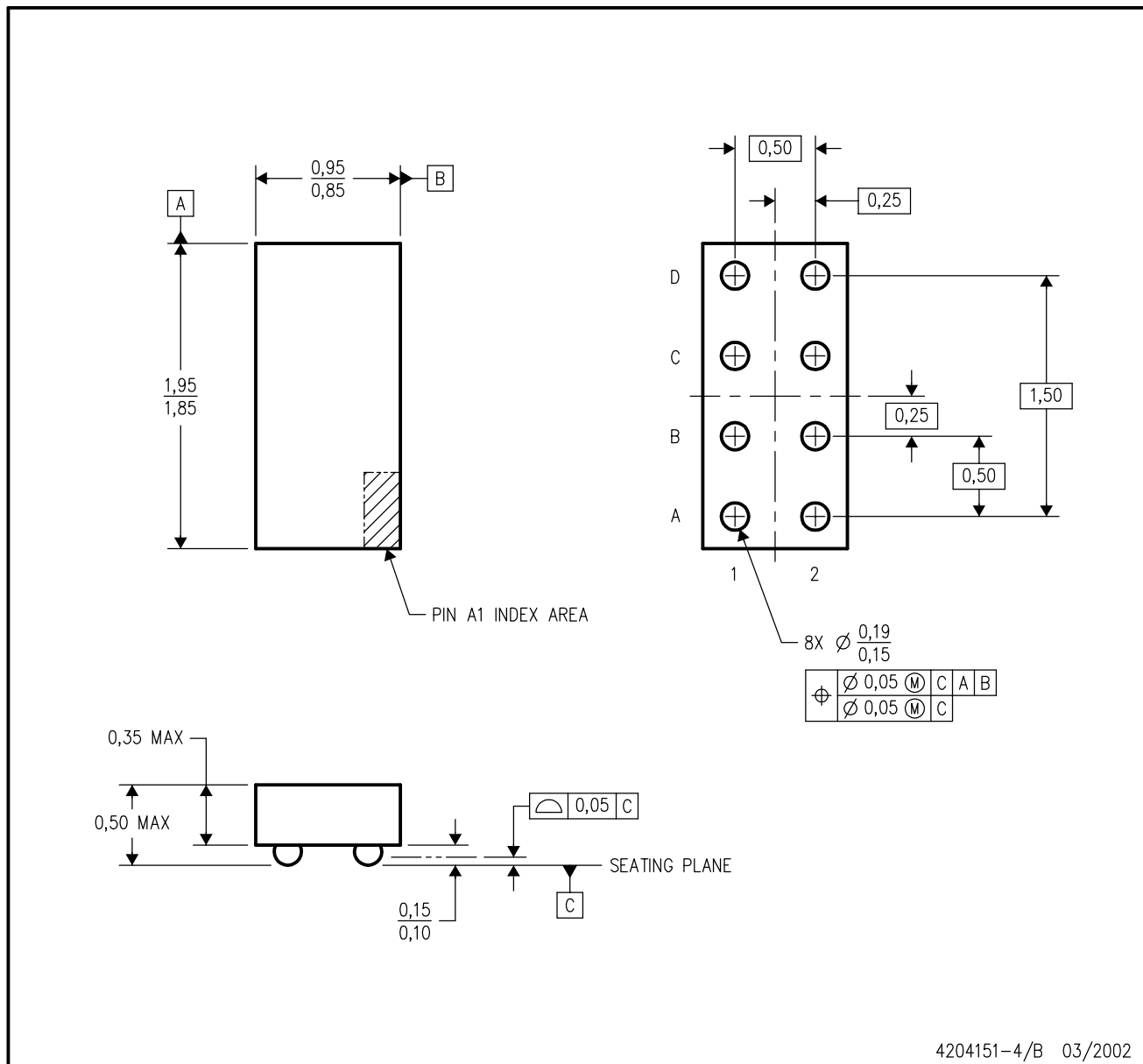


- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - NanoStar™ package configuration.
  - Package complies to JEDEC MO-211 variation EB.
  - This package is tin-lead (SnPb). Refer to the 8 YZA package (drawing 4204151) for lead-free.

## MECHANICAL DATA

YZA (R-XBGA-N8)

DIE-SIZE BALL GRID ARRAY



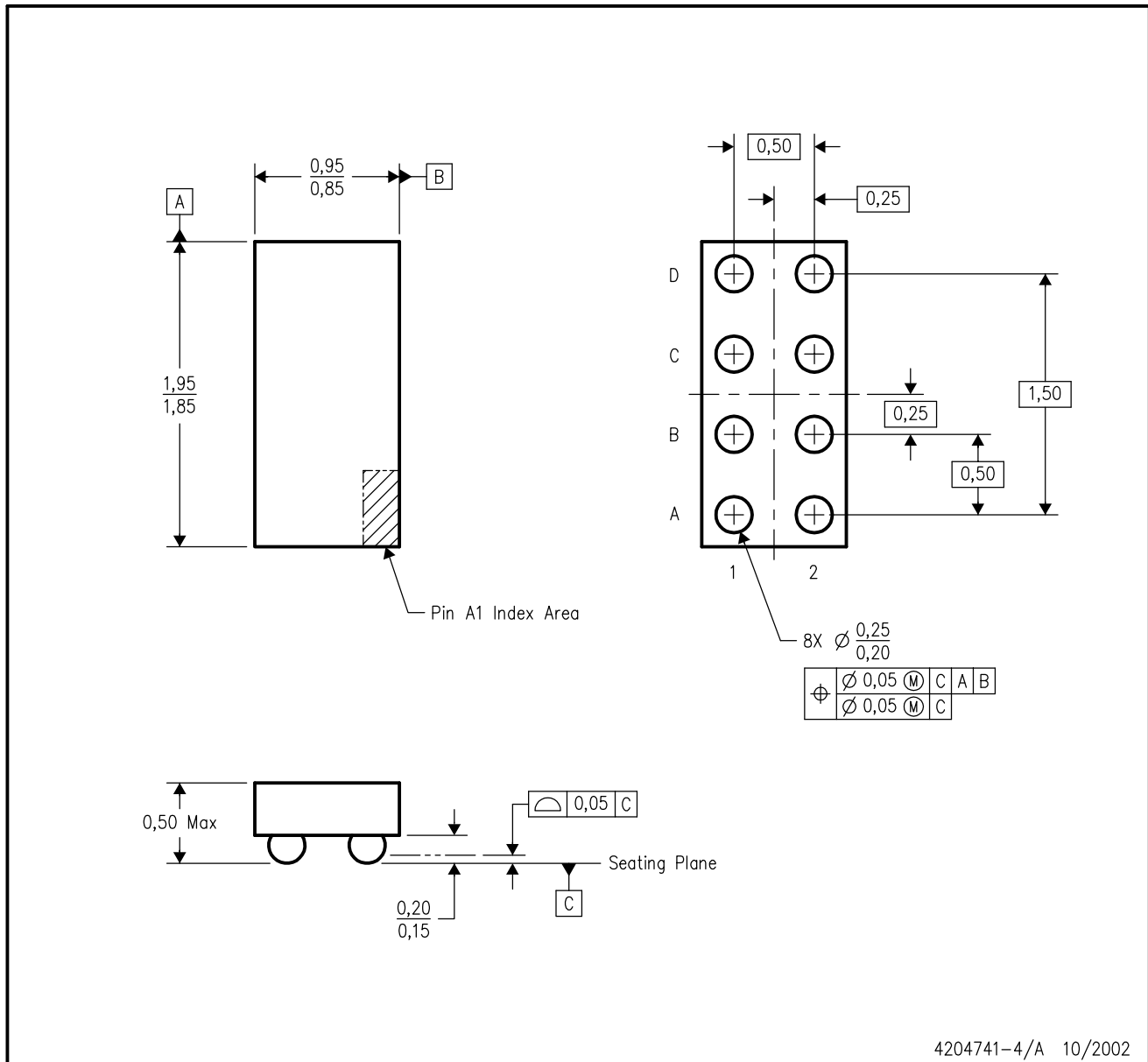
4204151-4/B 03/2002

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. NanoFree™ package configuration.
  - D. Package complies to JEDEC MO-211 variation EB.
  - E. This package is lead-free. Refer to the 8 YEA package (drawing 4203167) for tin-lead (SnPb).

## MECHANICAL DATA

YZP (R-XBGA-N8)

DIE-SIZE BALL GRID ARRAY



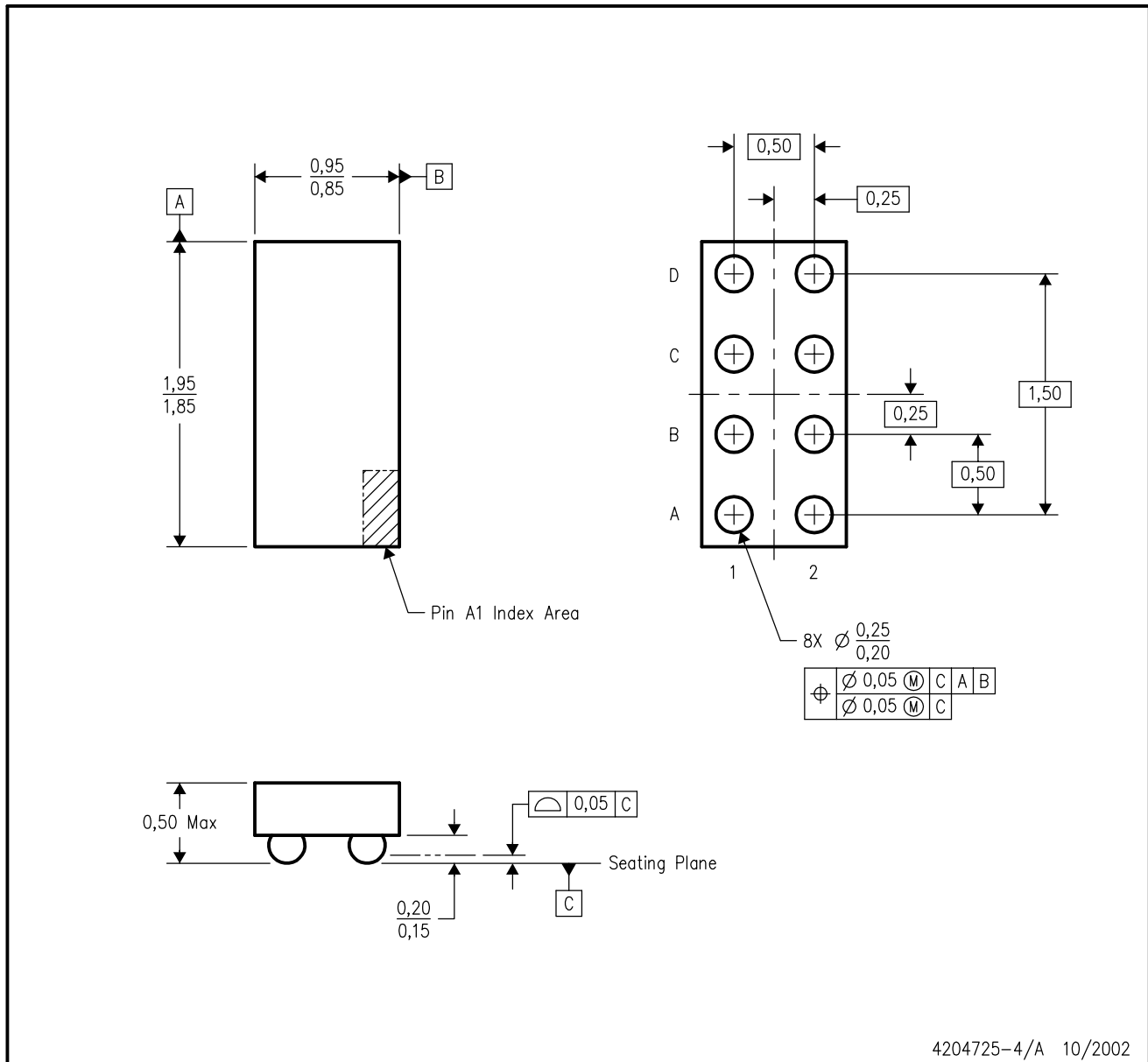
4204741-4/A 10/2002

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. NanoFree™ package configuration.
  - D. This package is lead-free. Refer to the 8 YEP package (drawing 4204725) for tin-lead (SnPb).

## MECHANICAL DATA

YEP (R-XBGA-N8)

DIE-SIZE BALL GRID ARRAY



4204725-4/A 10/2002

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. NanoStar™ package configuration.
  - D. This package is tin-lead (SnPb). Refer to the 8 YZP package (drawing 4204741) for lead-free.

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