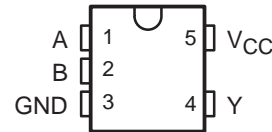


# SN74LVC1G02 SINGLE 2-INPUT POSITIVE-NOR GATE

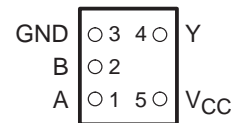
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- Available in the Texas Instruments NanoStar™ and NanoFree™ Packages
- Supports 5-V V<sub>CC</sub> Operation
- Inputs Accept Voltages to 5.5 V
- Max t<sub>pd</sub> of 3.6 ns at 3.3 V
- Low Power Consumption, 10-μA Max I<sub>CC</sub>
- ±24-mA Output Drive at 3.3 V
- I<sub>off</sub> 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)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

DBV OR DCK PACKAGE  
(TOP VIEW)



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



## description/ordering information

This single 2-input positive-NOR gate is designed for 1.65-V to 5.5-V V<sub>CC</sub> operation.

The SN74LVC1G02 performs the Boolean function  $Y = \overline{A + B}$  or  $Y = \overline{A} \cdot \overline{B}$  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<sub>off</sub>. The I<sub>off</sub> circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

## ORDERING INFORMATION

| T <sub>A</sub> | PACKAGE†   |              | ORDERABLE PART NUMBER | TOP-SIDE MARKING‡ |
|----------------|--|--------------|-----------------------|-------------------|
| -40°C to 85°C  | NanoStar™ – WCSP (DSBGA)<br>0.17-mm Small Bump – YEA           | Reel of 3000 | SN74LVC1G02YEAR       | ---CB_            |
|                | NanoFree™ – WCSP (DSBGA)<br>0.17-mm Small Bump – YZA (Pb-free) |              | SN74LVC1G02YZAR       |                   |
|                | NanoStar™ – WCSP (DSBGA)<br>0.23-mm Large Bump – YEP           |              | SN74LVC1G02YEPR       |                   |
|                | NanoFree™ – WCSP (DSBGA)<br>0.23-mm Large Bump – YZP (Pb-free) |              | SN74LVC1G02YZPR       |                   |
|                | SOT (SOT-23) – DBV   | Reel of 3000 | SN74LVC1G02DBVR       | C02_              |
|                |  | Reel of 250  | SN74LVC1G02DBVT       |                   |
|                | SOT (SC-70) – DCK  | Reel of 3000 | SN74LVC1G02DCKR       | CB_               |
|                |  | Reel of 250  | SN74LVC1G02DCKT       |                   |

† 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).

‡ DBV/DCK: 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).



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.

NanoStar and NanoFree are trademarks of Texas Instruments.

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

 **TEXAS  
INSTRUMENTS**

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# SN74LVC1G02

## SINGLE 2-INPUT POSITIVE-NOR GATE

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FUNCTION TABLE

| INPUTS |   | OUTPUT |
|--------|---|--------|
| A      | B | Y      |
| H      | X | L      |
| X      | H | L      |
| L      | L | H      |

### logic diagram (positive logic)



### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

|   |                            |
|---|----------------------------|
| Supply voltage range, $V_{CC}$ .....  | -0.5 V to 6.5 V            |
| Input voltage range, $V_I$ (see Note 1) .....   | -0.5 V to 6.5 V            |
| Voltage range applied to any output in the high-impedance or power-off state, $V_O$<br>(see Note 1) ..... | -0.5 V to 6.5 V            |
| Voltage range applied to any output in the high or low state, $V_O$<br>(see Notes 1 and 2) .....          | -0.5 V to $V_{CC} + 0.5$ V |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ ) .....   | -50 mA                     |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ ) .....  | -50 mA                     |
| Continuous output current, $I_O$ .....  | $\pm 50$ mA                |
| Continuous current through $V_{CC}$ or GND .....  | $\pm 100$ mA               |
| Package thermal impedance, $\theta_{JA}$ (see Note 3): DBV package .....                                  | 206°C/W                    |
| DCK package .....   | 252°C/W                    |
| YEA/YZA package .....   | 154°C/W                    |
| YEP/YZP package .....   | 132°C/W                    |
| Storage temperature range, $T_{stg}$ .....  | -65°C to 150°C             |

† 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.

- NOTES: 1. The input negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.  
 2. The value of  $V_{CC}$  is provided in the recommended operating conditions table.  
 3. The package thermal impedance is calculated in accordance with JESD 51-7.

# SN74LVC1G02 SINGLE 2-INPUT POSITIVE-NOR GATE

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## recommended operating conditions (see Note 4)

|                 |                                    | 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                    |      |      |
|                 |                                    |   | –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                     |      |      |
| 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   |      |

NOTE 4: 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.



# SN74LVC1G02

## SINGLE 2-INPUT POSITIVE-NOR 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† | 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           |                      |      | 4    | pF   |

† 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, C<sub>L</sub> = 15 pF (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           | 1.9                              | 7.2 | 0.8                             | 4.4 | 0.8                             | 3.6 | 0.8                           | 3.4 | ns   |

switching characteristics over recommended operating free-air temperature range, C<sub>L</sub> = 30 pF or 50 pF (unless otherwise noted) (see Figure 2)

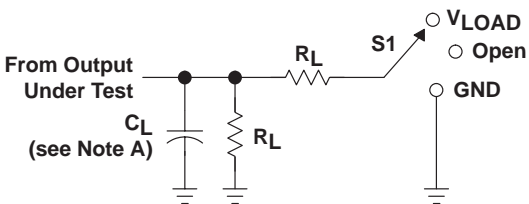
| PARAMETER       | FROM (INPUT) | TO (OUTPUT) | V <sub>CC</sub> = 1.8 V ± 0.15 V |     | V <sub>CC</sub> = 2.5 V ± 0.2 V |     | V <sub>CC</sub> = 3.3 V ± 0.3 V |     | V <sub>CC</sub> = 5 V ± 0.5 V |     | UNIT |
|-----------------|--------------|-------------|----------------------------------|-----|---------------------------------|-----|---------------------------------|-----|-------------------------------|-----|------|
|                 |              |             | MIN                              | MAX | MIN                             | MAX | MIN                             | MAX | MIN                           | MAX |      |
| t <sub>pd</sub> | A or B       | Y           | 2.8                              | 8   | 1.2                             | 5.5 | 1                               | 4.5 | 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      | 23                      | 23                      | 23                      | 25                    | pF   |



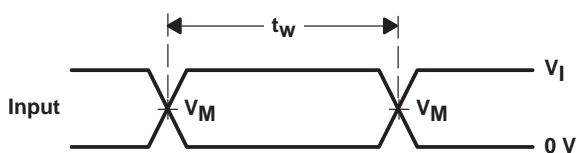
PARAMETER MEASUREMENT INFORMATION



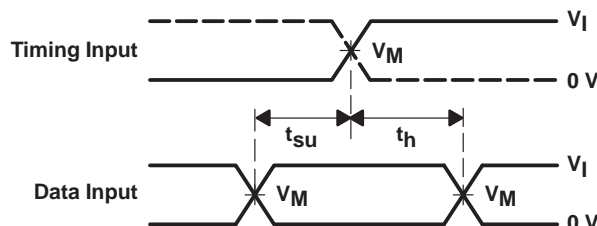
LOAD CIRCUIT

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

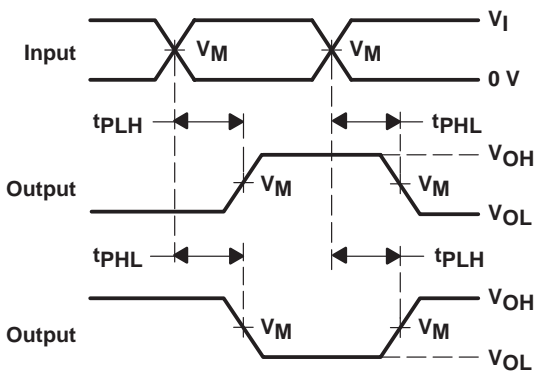
| $V_{CC}$           | INPUTS   |                       | $V_M$      | $V_{LOAD}$        | $C_L$ | $R_L$        | $V_{\Delta}$ |
|--------------------|----------|-----------------------|------------|-------------------|-------|--------------|--------------|
|                    | $V_I$    | $t_r/t_f$             |            |                   |       |              |              |
| $1.8 V \pm 0.15 V$ | $V_{CC}$ | $\leq 2 \text{ ns}$   | $V_{CC}/2$ | $2 \times V_{CC}$ | 15 pF | 1 M $\Omega$ | 0.15 V       |
| $2.5 V \pm 0.2 V$  | $V_{CC}$ | $\leq 2 \text{ ns}$   | $V_{CC}/2$ | $2 \times V_{CC}$ | 15 pF | 1 M $\Omega$ | 0.15 V       |
| $3.3 V \pm 0.3 V$  | 3 V      | $\leq 2.5 \text{ ns}$ | 1.5 V      | 6 V               | 15 pF | 1 M $\Omega$ | 0.3 V        |
| $5 V \pm 0.5 V$    | $V_{CC}$ | $\leq 2.5 \text{ ns}$ | $V_{CC}/2$ | $2 \times V_{CC}$ | 15 pF | 1 M $\Omega$ | 0.3 V        |



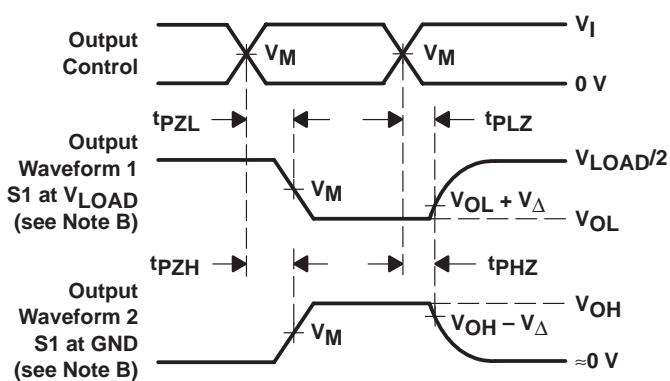
VOLTAGE WAVEFORMS  
PULSE DURATION



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:
- A.  $C_L$  includes probe and jig capacitance.
  - B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
  - C. All input pulses are supplied by generators having the following characteristics: PRR  $\leq 10$  MHz,  $Z_O = 50 \Omega$ .
  - D. The outputs are measured one at a time with one transition per measurement.
  - E.  $t_{PLZ}$  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.

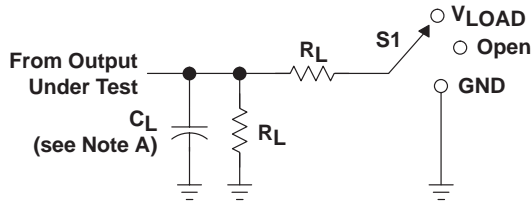
Figure 1. Load Circuit and Voltage Waveforms

# SN74LVC1G02

## SINGLE 2-INPUT POSITIVE-NOR GATE

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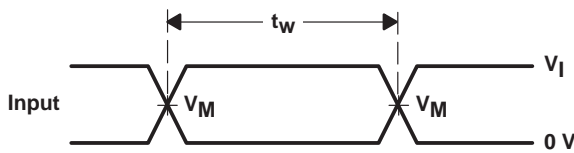
### PARAMETER MEASUREMENT INFORMATION



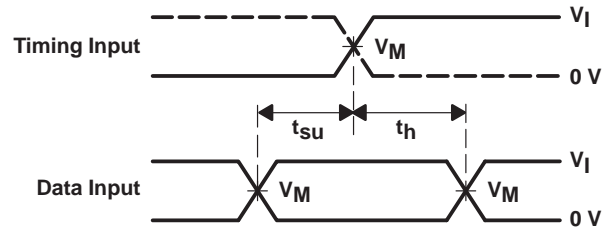
LOAD CIRCUIT

| TEST                               | S1                |
|------------------------------------|-------------------|
| t <sub>PLH</sub> /t <sub>PHL</sub> | Open              |
| t <sub>PLZ</sub> /t <sub>PZL</sub> | V <sub>LOAD</sub> |
| t <sub>PHZ</sub> /t <sub>PZH</sub> | GND               |

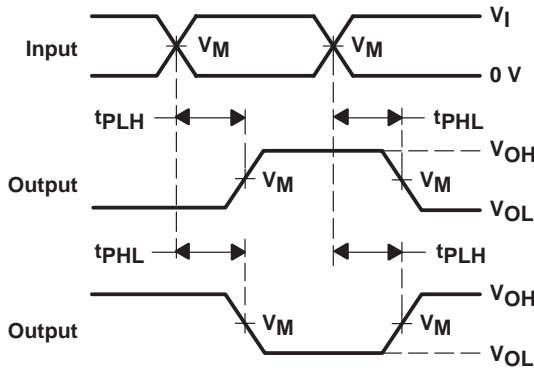
| V <sub>CC</sub> | INPUTS          |                                | V <sub>M</sub>     | V <sub>LOAD</sub>   | C <sub>L</sub> | R <sub>L</sub> | V <sub>Δ</sub> |
|-----------------|-----------------|--------------------------------|--------------------|---------------------|----------------|----------------|----------------|
|                 | V <sub>I</sub>  | t <sub>r</sub> /t <sub>f</sub> |                    |                     |                |                |                |
| 1.8 V ± 0.15 V  | V <sub>CC</sub> | ≤ 2 ns                         | V <sub>CC</sub> /2 | 2 × V <sub>CC</sub> | 30 pF          | 1 kΩ           | 0.15 V         |
| 2.5 V ± 0.2 V   | V <sub>CC</sub> | ≤ 2 ns                         | V <sub>CC</sub> /2 | 2 × V <sub>CC</sub> | 30 pF          | 500 Ω          | 0.15 V         |
| 3.3 V ± 0.3 V   | 3 V             | ≤ 2.5 ns                       | 1.5 V              | 6 V                 | 50 pF          | 500 Ω          | 0.3 V          |
| 5 V ± 0.5 V     | V <sub>CC</sub> | ≤ 2.5 ns                       | V <sub>CC</sub> /2 | 2 × V <sub>CC</sub> | 50 pF          | 500 Ω          | 0.3 V          |



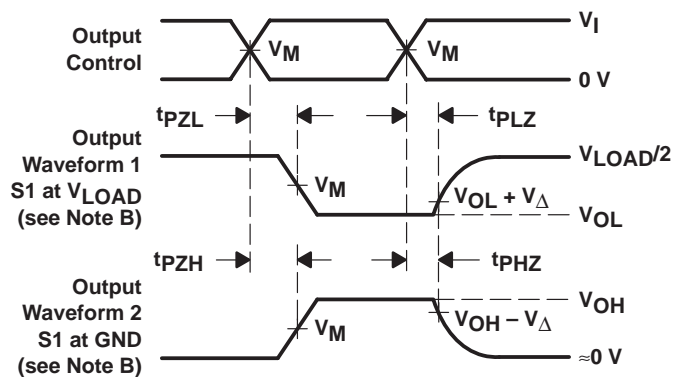
VOLTAGE WAVEFORMS  
PULSE DURATION



VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES  
INVERTING AND NONINVERTING OUTPUTS



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- NOTES:
- C<sub>L</sub> includes probe and jig capacitance.
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  - All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z<sub>O</sub> = 50 Ω.
  - The outputs are measured one at a time with one transition per measurement.
  - t<sub>PLZ</sub> and t<sub>PHZ</sub> are the same as t<sub>dis</sub>.
  - t<sub>PZL</sub> and t<sub>PZH</sub> are the same as t<sub>en</sub>.
  - t<sub>PLH</sub> and t<sub>PHL</sub> are the same as t<sub>pd</sub>.
  - All parameters and waveforms are not applicable to all devices.

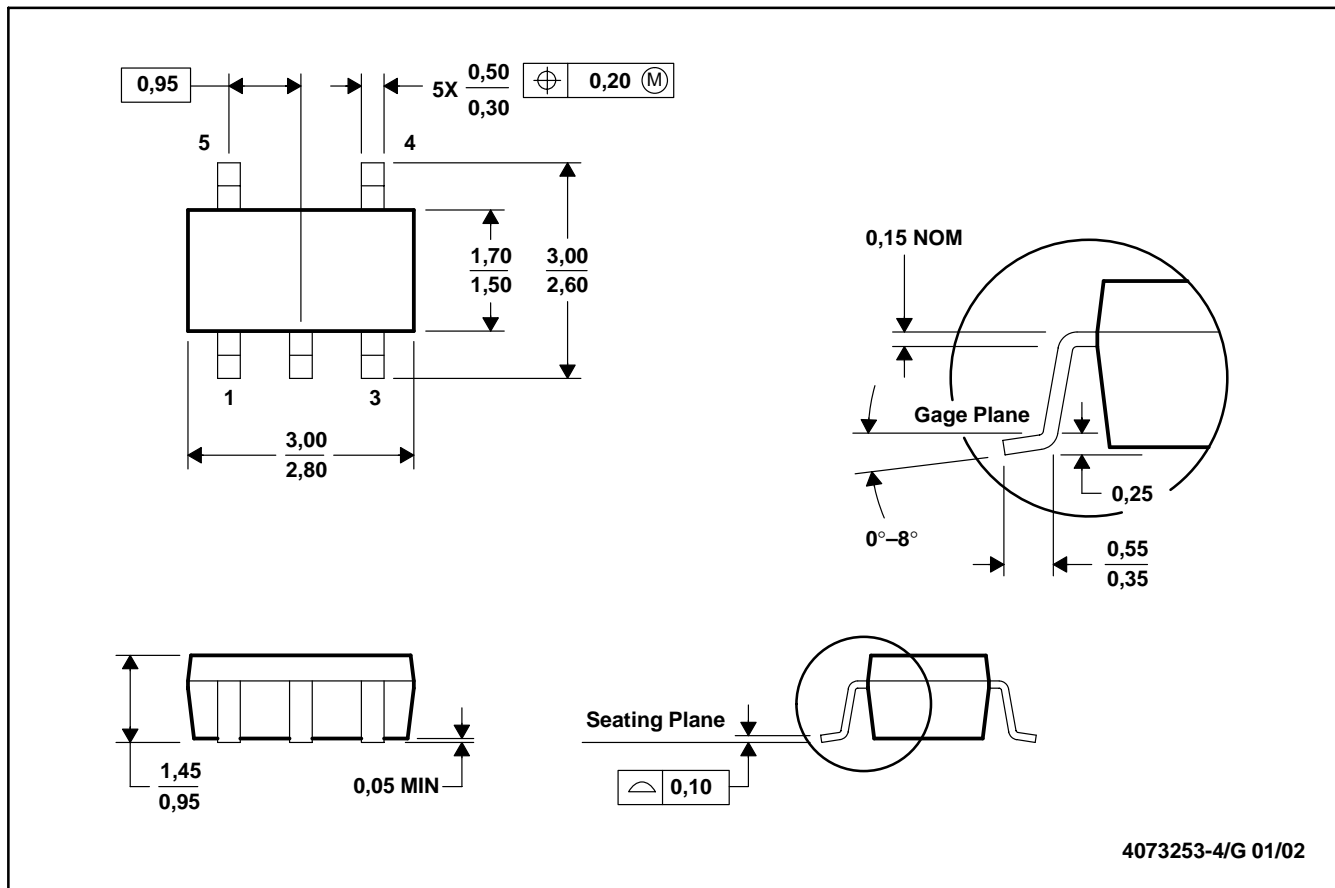
Figure 2. Load Circuit and Voltage Waveforms



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DBV (R-PDSO-G5)

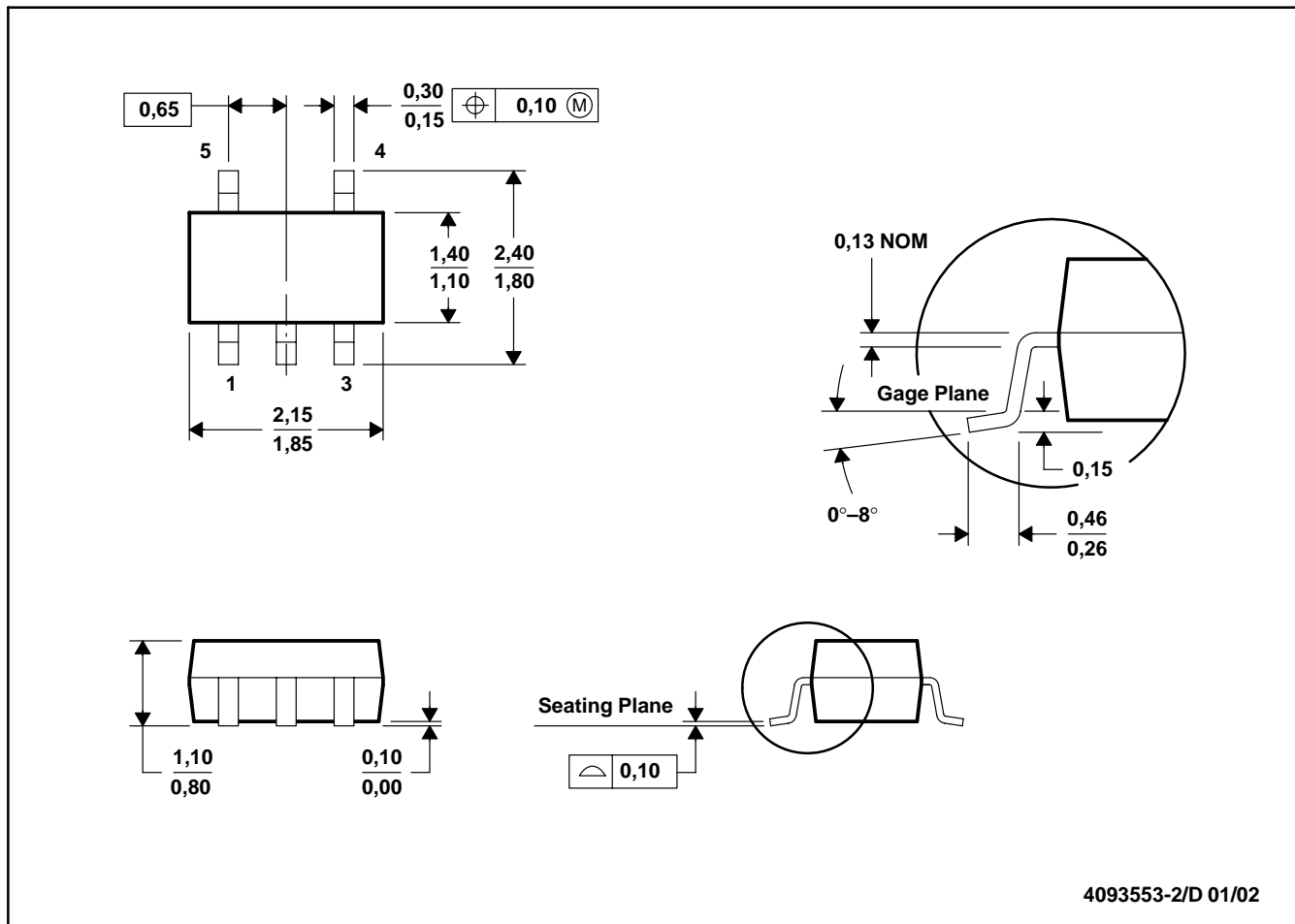
PLASTIC SMALL-OUTLINE



- 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-178

DCK (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE



4093553-2/D 01/02

- 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-203



YEA (R-XBGA-N5)

DIE-SIZE BALL GRID ARRAY

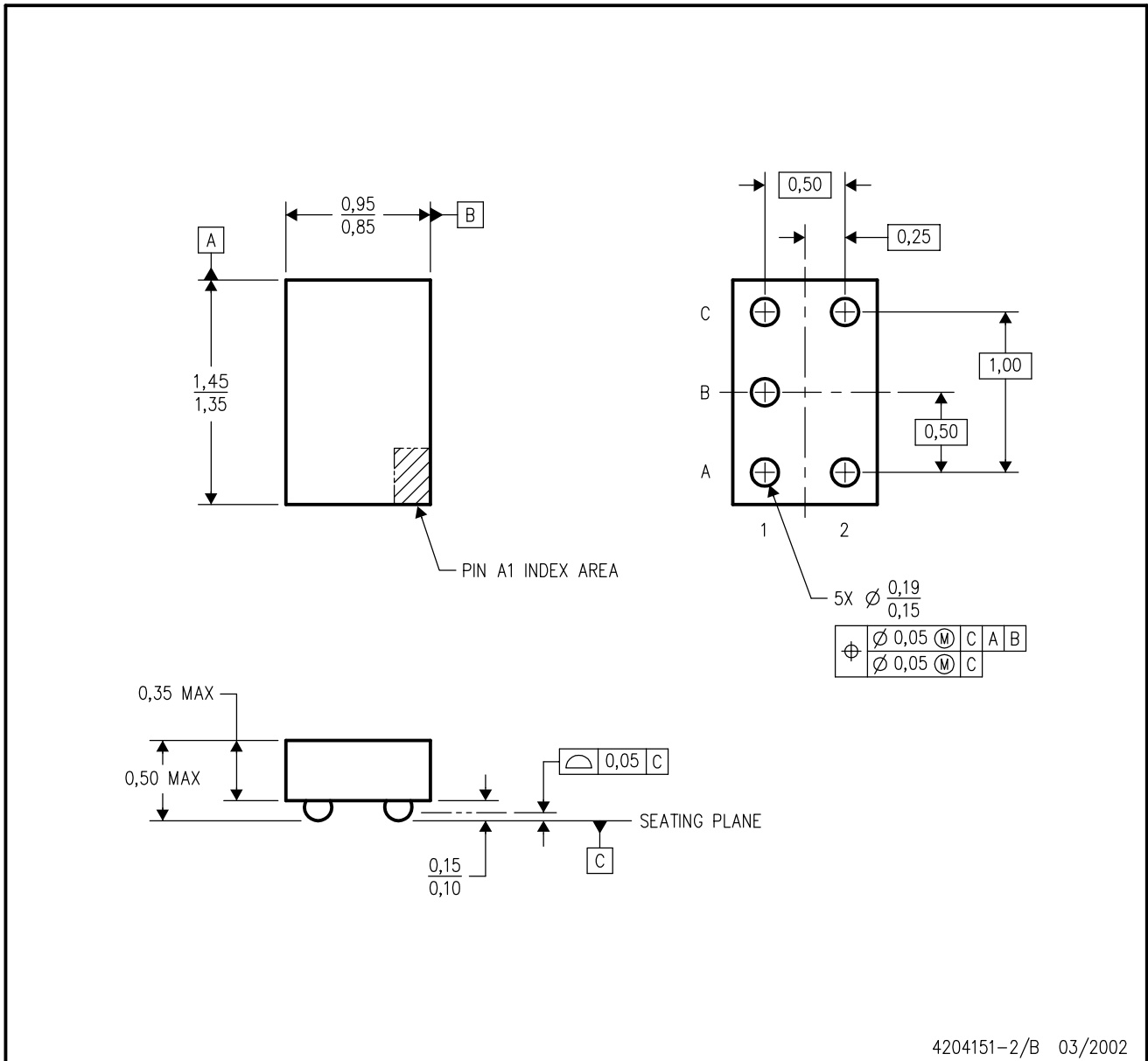


- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. NanoStar™ package configuration.
  - D. Package complies to JEDEC MO-211 variation EA.
  - E. This package is tin-lead (SnPb). Refer to the 5 YZA package (drawing 4204151) for lead-free.

NanoStar is a trademark of Texas Instruments.

YZA (R-XBGA-N5)

DIE-SIZE BALL GRID ARRAY

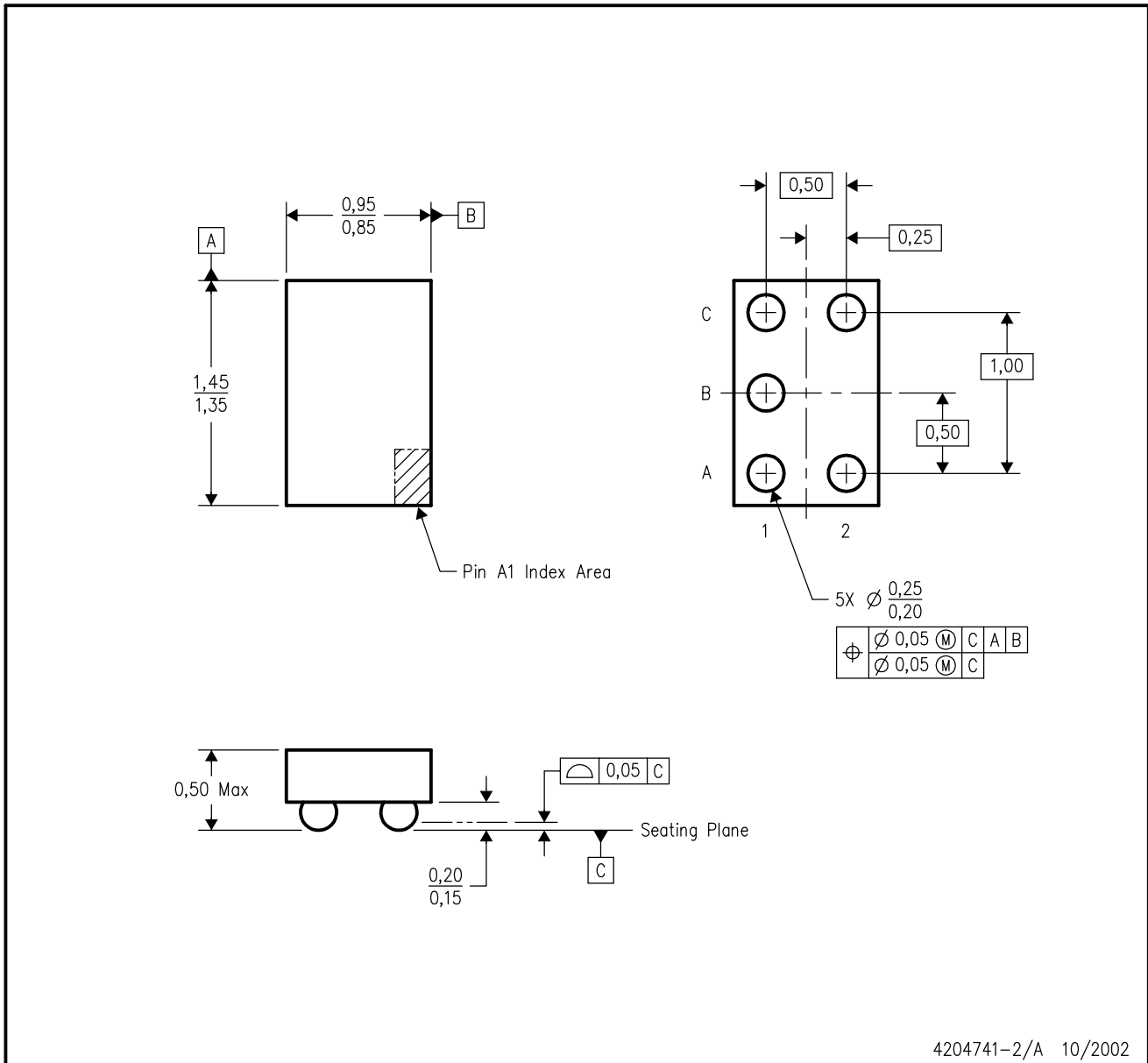


- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. NanoFree™ package configuration.
  - D. Package complies to JEDEC MO-211 variation EA.
  - E. This package is lead-free. Refer to the 5 YEA package (drawing 4203167) for tin-lead (SnPb).

NanoFree is a trademark of Texas Instruments.

YZP (R-XBGA-N5)

DIE-SIZE BALL GRID ARRAY



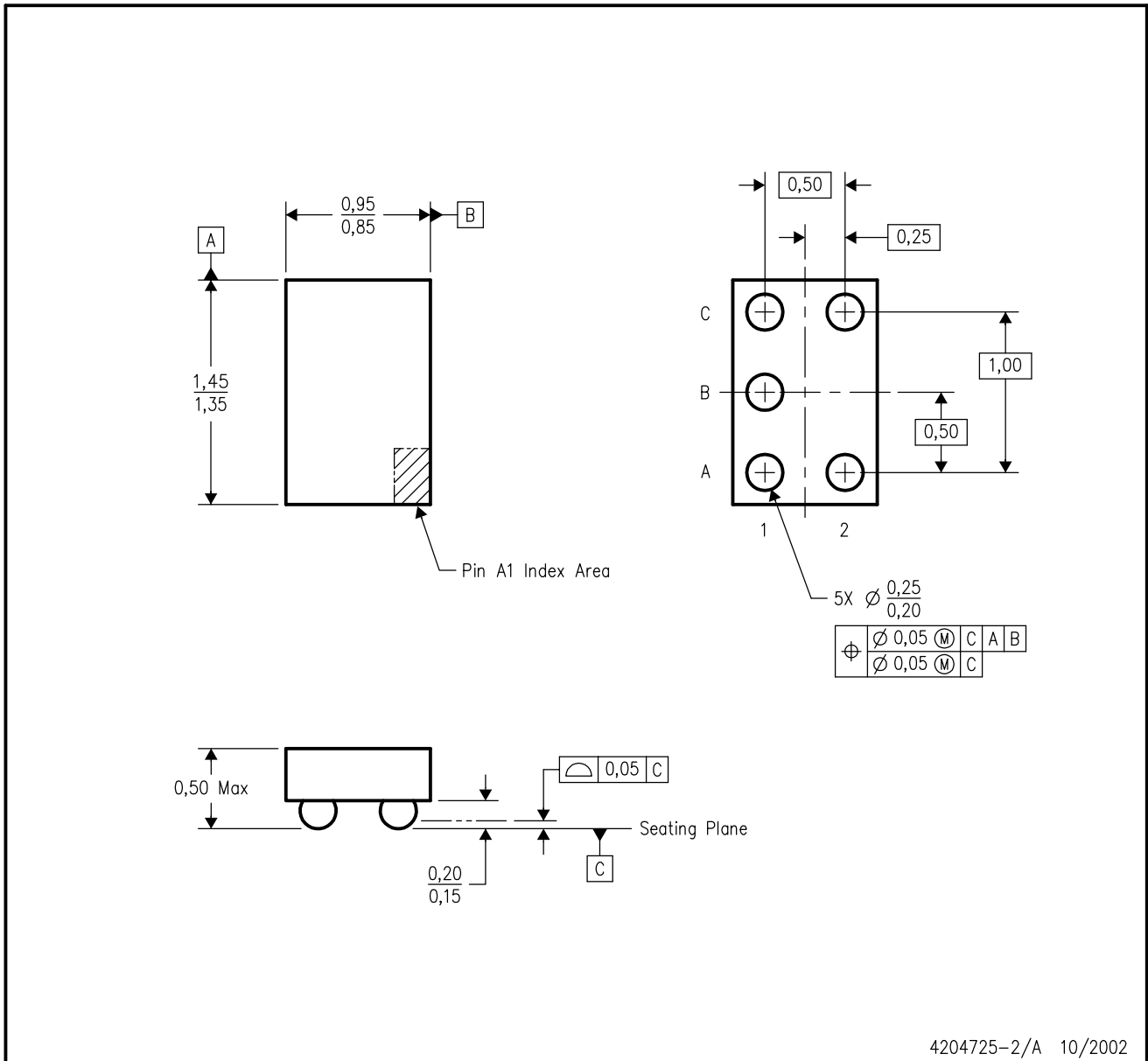
4204741-2/A 10/2002

- 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 5 YEP package (drawing 4204725) for tin-lead (SnPb).

NanoFree is a trademark of Texas Instruments.

YEP (R-XBGA-N5)

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  - C. NanoStar™ package configuration.
  - D. This package is tin-lead (SnPb). Refer to the 5 YZP package (drawing 4204741) for lead-free.

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