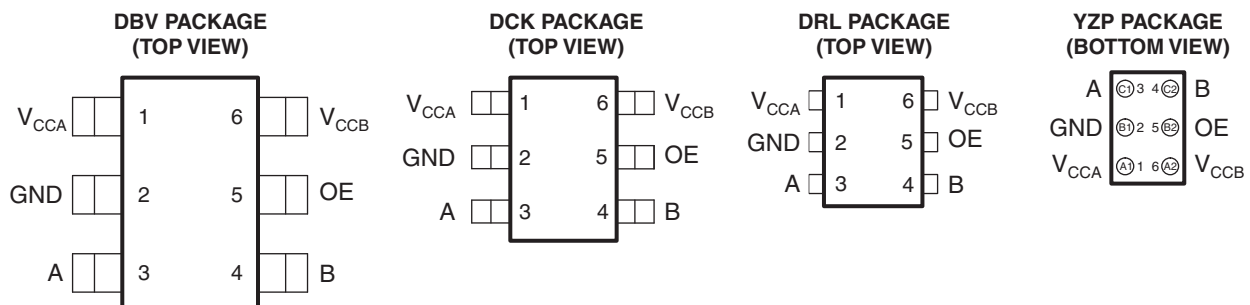


1-BIT BIDIRECTIONAL VOLTAGE-LEVEL TRANSLATOR WITH AUTO DIRECTION SENSING AND ± 15 -kV ESD PROTECTION

FEATURES

- Available in the Texas Instruments NanoFree™ Package
- 1.2 V to 3.6 V on A Port and 1.65 V to 5.5 V on B Port ($V_{CCA} \leq V_{CCB}$)
- V_{CC} Isolation Feature – If Either V_{CC} Input Is at GND, All Outputs Are in the High-Impedance State
- OE Input Circuit Referenced to V_{CCA}
- Low Power Consumption, 5- μ A Max I_{CC}
- I_{off} Supports Partial-Power-Down Mode Operation
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
 - A Port
 - 2000-V Human-Body Model (A114-B)
 - 250-V Machine Model (A115-A)
 - 1500-V Charged-Device Model (C101)
 - B Port
 - 15-kV Human-Body Model (A114-B)
 - 250-V Machine Model (A115-A)
 - 1500-V Charged-Device Model (C101)



See mechanical drawings for dimensions.

DESCRIPTION/ORDERING INFORMATION

This 1-bit noninverting translator uses two separate configurable power-supply rails. The A port is designed to track V_{CCA} . V_{CCA} accepts any supply voltage from 1.2 V to 3.6 V. The B port is designed to track V_{CCB} . V_{CCB} accepts any supply voltage from 1.65 V to 5.5 V. This allows for universal low-voltage bidirectional translation between any of the 1.2-V, 1.5-V, 1.8-V, 2.5-V, 3.3-V, and 5-V voltage nodes. V_{CCA} should not exceed V_{CCB} .

When the output-enable (OE) input is low, all outputs are placed in the high-impedance state.

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.

To ensure the high-impedance state during power up or power down, OE should be tied to GND through a pulldown resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

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



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.

ORDERING INFORMATION⁽¹⁾

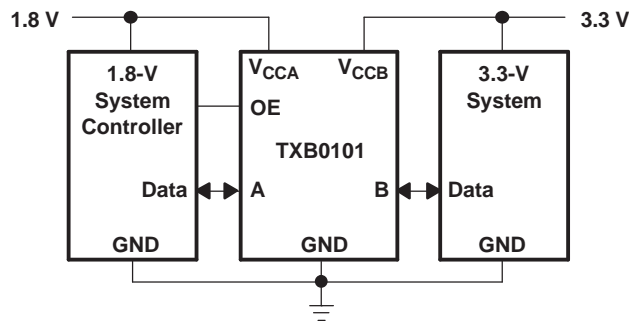
| T _A | PACKAGE ⁽²⁾ | | ORDERABLE PART NUMBER | TOP-SIDE MARKING ⁽³⁾⁽⁴⁾ |
|----------------|--|--------------|----------------------------|------------------------------------|
| –40°C to 85°C | NanoFree™ – WCSP (DSBGA) 0.23-mm Large Bump – YZP (Pb-free) | Reel of 3000 | TXB0101YZPR ⁽⁵⁾ | 27_ |
| | | SOP – DRL | Reel of 4000 | TXB0101DRLR ⁽⁵⁾ |
| | SOT (SOT-23) – DBV | Reel of 3000 | TXB0101DBVR | NFC_ |
| | | Reel of 250 | TXB0101DBVT | NFC_ |
| | SOT (SC-70) – DCK | Reel of 3000 | TXB0101DCKR ⁽⁵⁾ | 27_ |
| | | Reel of 250 | TXB0101DCKT ⁽⁵⁾ | 27_ |

- (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
- (2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.
- (3) YZP: The actual top-side marking has three preceding characters to denote year, month, and sequence code, and one following character to designate the wafer fab/assembly site. Pin 1 identifier indicates solder-bump composition (1 = SnPb, • = Pb-free).
- (4) DBV/DCK: The actual top-side marking has one additional character that designates the wafer fab/assembly site.
- (5) Package preview

PIN DESCRIPTION

| NO. | NAME | FUNCTION |
|-----|------------------|---|
| 1 | V _{CCA} | A-port supply voltage. 1.2 V ≤ V _{CCA} ≤ 3.6 V and V _{CCA} ≤ V _{CCB} |
| 2 | GND | Ground |
| 3 | A | Input/output A. Referenced to V _{CCA} . |
| 4 | B | Input/output B. Referenced to V _{CCB} . |
| 5 | OE | 3-state output enable. Pull OE low to place all outputs in 3-state mode. Referenced to V _{CCA} . |
| 6 | V _{CCB} | B-port supply voltage. 1.65 V ≤ V _{CCB} ≤ 5.5 V |

TYPICAL OPERATING CIRCUIT



Absolute Maximum Ratings⁽¹⁾

over operating free-air temperature range (unless otherwise noted)

| | | MIN | MAX | UNIT |
|---------------|---|-------------|----------------------|------|
| V_{CCA} | Supply voltage range | -0.5 | 4.6 | V |
| V_{CCB} | Supply voltage range | -0.5 | 6.5 | |
| V_I | Input voltage range ⁽²⁾ | -0.5 | 6.5 | V |
| V_O | Voltage range applied to any output in the high-impedance or power-off state ⁽²⁾ | -0.5 | 6.5 | V |
| V_O | Voltage range applied to any output in the high or low state ⁽²⁾⁽³⁾ | A port | -0.5 $V_{CCA} + 0.5$ | V |
| | | B port | -0.5 $V_{CCB} + 0.5$ | |
| 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_{CCA} , V_{CCB} , or GND | | ±100 | mA |
| θ_{JA} | Package thermal impedance ⁽⁴⁾ | DBV package | 165 | °C/W |
| | | DCK package | 259 | |
| | | DRL package | 142 | |
| | | YZP package | 123 | |
| T_{stg} | Storage temperature range | -65 | 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.
- The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
- The value of V_{CCA} and V_{CCB} are provided in the recommended operating conditions table.
- The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions⁽¹⁾⁽²⁾

| | | V_{CCA} | V_{CCB} | MIN | MAX | UNIT | |
|---------------------|------------------------------------|---------------|----------------|-----------------|-----------------------------|-----------------------------|------|
| V_{CCA} | Supply voltage | | | 1.2 | 3.6 | V | |
| V_{CCB} | | | | 1.65 | 5.5 | | |
| V_{IH} | High-level input voltage | Data inputs | 1.2 V to 3.6 V | 1.65 V to 5.5 V | $V_{CCI} \times 0.65^{(3)}$ | V_{CCI} | V |
| | | OE | 1.2 V to 3.6 V | 1.65 V to 5.5 V | $V_{CCA} \times 0.65$ | 5.5 | |
| V_{IL} | Low-level input voltage | Data inputs | 1.2 V to 5.5 V | 1.65 V to 5.5 V | 0 | $V_{CCI} \times 0.35^{(3)}$ | V |
| | | OE | 1.2 V to 3.6 V | 1.65 V to 5.5 V | 0 | $V_{CCA} \times 0.35$ | |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | A-port inputs | 1.2 V to 3.6 V | 1.65 V to 5.5 V | | 40 | ns/V |
| | | B-port inputs | 1.2 V to 3.6 V | 1.65 V to 3.6 V | | 40 | |
| | | | | 4.5 V to 5.5 V | | 30 | |
| T_A | Operating free-air temperature | | | -40 | 85 | °C | |

- The A and B sides of an unused data I/O pair must be held in the same state, i.e., both at V_{CCI} or both at GND.
- V_{CCA} must be less than or equal to V_{CCB} and must not exceed 3.6 V.
- V_{CCI} is the supply voltage associated with the input port.

Electrical Characteristics⁽¹⁾⁽²⁾

over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | V _{CCA} | V _{CCB} | T _A = 25°C | | | –40°C to 85°C | | UNIT |
|-------------------------------------|-------------|--|------------------|------------------|-----------------------|-----|-----|------------------------|-----|------|
| | | | | | MIN | TYP | MAX | MIN | MAX | |
| V _{OHA} | | I _{OH} = –20 μA | 1.2 V | | 1.1 | | | V _{CCA} – 0.4 | V | |
| | | | 1.4 V to 3.6 V | | | | | | | |
| V _{OLA} | | I _{OL} = 20 μA | 1.2 V | | 0.9 | | | 0.4 | V | |
| | | | 1.4 V to 3.6 V | | | | | | | |
| V _{OHB} | | I _{OH} = –20 μA | | 1.65 V to 5.5 V | | | | V _{CCB} – 0.4 | V | |
| V _{OLB} | | I _{OL} = 20 μA | | 1.65 V to 5.5 V | | | | 0.4 | V | |
| I _I | OE | | 1.2 V to 3.6 V | 1.65 V to 5.5 V | ±1 | | | ±2 | μA | |
| I _{off} | A port | | 0 V | 0 V to 5.5 V | ±1 | | | ±2 | μA | |
| | B port | | 0 V to 3.6 V | 0 V | ±1 | | | ±2 | | |
| I _{OZ} | A or B port | OE = GND | 1.2 V to 3.6 V | 1.65 V to 5.5 V | ±1 | | | ±2 | μA | |
| I _{CCA} | | V _I = V _{CC1} or GND, I _O = 0 | 1.2 V | 1.65 V to 5.5 V | 0.06 | | | 3 | μA | |
| | | | 1.4 V to 3.6 V | 1.65 V to 5.5 V | | | | | | |
| | | | 3.6 V | 0 V | | | | | | |
| | | | 0 V | 5.5 V | | | | | | |
| I _{CCB} | | V _I = V _{CC1} or GND, I _O = 0 | 1.2 V | 1.65 V to 5.5 V | 3.4 | | | 5 | μA | |
| | | | 1.4 V to 3.6 V | 1.65 V to 5.5 V | | | | | | |
| | | | 3.6 V | 0 V | | | | | | |
| | | | 0 V | 5.5 V | | | | | | |
| I _{CCA} + I _{CCB} | | V _I = V _{CC1} or GND, I _O = 0 | 1.2 V | 1.65 V to 5.5 V | 3.5 | | | 8 | μA | |
| | | | 1.4 V to 3.6 V | 1.65 V to 5.5 V | | | | | | |
| I _{CCZA} | | V _I = V _{CC1} or GND, I _O = 0, OE = GND | 1.2 V | 1.65 V to 5.5 V | 0.05 | | | 3 | μA | |
| | | | 1.4 V to 3.6 V | 1.65 V to 5.5 V | | | | | | |
| I _{CCZB} | | V _I = V _{CC1} or GND, I _O = 0, OE = GND | 1.2 V | 1.65 V to 5.5 V | 3.3 | | | 5 | μA | |
| | | | 1.4 V to 3.6 V | 1.65 V to 5.5 V | | | | | | |
| C _i | OE | | 1.2 V to 3.6 V | 1.65 V to 5.5 V | 2.5 | | | 3 | pF | |
| C _{io} | A port | | 1.2 V to 3.6 V | 1.65 V to 5.5 V | 5 | | | 6 | pF | |
| | B port | | | | 11 | | | 13 | | |

(1) V_{CC1} is the supply voltage associated with the input port.(2) V_{CC0} is the supply voltage associated with the output port.**Timing Requirements**T_A = 25°C, V_{CCA} = 1.2 V

| | | | V _{CCB} = 1.8 V | V _{CCB} = 2.5 V | V _{CCB} = 3.3 V | V _{CCB} = 5 V | UNIT |
|----------------|----------------|-------------|--------------------------|--------------------------|--------------------------|------------------------|------|
| | | | TYP | TYP | TYP | TYP | |
| Data rate | | | 20 | 20 | 20 | 20 | Mbps |
| t _w | Pulse duration | Data inputs | 50 | 50 | 50 | 50 | ns |

Timing Requirementsover recommended operating free-air temperature range, V_{CCA} = 1.5 V ± 0.1 V (unless otherwise noted)

| | | | V _{CCB} = 1.8 V ± 0.15 V | | V _{CCB} = 2.5 V ± 0.2 V | | V _{CCB} = 3.3 V ± 0.3 V | | V _{CCB} = 5 V ± 0.5 V | | UNIT |
|----------------|----------------|-------------|--------------------------------------|-----|-------------------------------------|-----|-------------------------------------|-----|-----------------------------------|-----|------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| Data rate | | | 40 | | 40 | | 40 | | 40 | | Mbps |
| t _w | Pulse duration | Data inputs | 25 | | 25 | | 25 | | 25 | | ns |

Timing Requirements

 over recommended operating free-air temperature range, $V_{CCA} = 1.8\text{ V} \pm 0.15\text{ V}$ (unless otherwise noted)

| | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | | $V_{CCB} = 5\text{ V} \pm 0.5\text{ V}$ | | UNIT |
|-------|----------------|--|-----|---|-----|---|-----|---|-----|------|
| | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| | Data rate | 60 | | 60 | | 60 | | 60 | | Mbps |
| t_w | Pulse duration | 17 | | 17 | | 17 | | 17 | | ns |

Timing Requirements

 over recommended operating free-air temperature range, $V_{CCA} = 2.5\text{ V} \pm 0.2\text{ V}$ (unless otherwise noted)

| | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | | $V_{CCB} = 5\text{ V} \pm 0.5\text{ V}$ | | UNIT |
|-------|----------------|---|-----|---|-----|---|-----|------|
| | | MIN | MAX | MIN | MAX | MIN | MAX | |
| | Data rate | 100 | | 100 | | 100 | | Mbps |
| t_w | Pulse duration | 10 | | 10 | | 10 | | ns |

Timing Requirements

 over recommended operating free-air temperature range, $V_{CCA} = 3.3\text{ V} \pm 0.3\text{ V}$ (unless otherwise noted)

| | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | | $V_{CCB} = 5\text{ V} \pm 0.5\text{ V}$ | | UNIT |
|-------|----------------|---|-----|---|-----|------|
| | | MIN | MAX | MIN | MAX | |
| | Data rate | 100 | | 100 | | Mbps |
| t_w | Pulse duration | 10 | | 10 | | ns |

Switching Characteristics

 $T_A = 25^\circ\text{C}$, $V_{CCA} = 1.2\text{ V}$

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.8\text{ V}$ | $V_{CCB} = 2.5\text{ V}$ | $V_{CCB} = 3.3\text{ V}$ | $V_{CCB} = 5\text{ V}$ | UNIT |
|---------------------|----------------------------|-------------|--------------------------|--------------------------|--------------------------|------------------------|---------------|
| | | | TYP | TYP | TYP | TYP | |
| t_{pd} | A | B | 6.9 | 5.7 | 5.3 | 5.5 | ns |
| | B | A | 7.4 | 6.4 | 6 | 5.8 | |
| t_{en} | OE | A | 1 | 1 | 1 | 1 | μs |
| | | B | 1 | 1 | 1 | 1 | |
| t_{dis} | OE | A | 18 | 15 | 14 | 14 | ns |
| | | B | 20 | 17 | 16 | 16 | |
| t_{rA} , t_{fA} | A-port rise and fall times | | 4.2 | 4.2 | 4.2 | 4.2 | ns |
| t_{rB} , t_{fB} | B-port rise and fall times | | 2.1 | 1.5 | 1.2 | 1.1 | ns |
| Max data rate | | | 20 | 20 | 20 | 20 | Mbps |

Switching Characteristics

over recommended operating free-air temperature range, $V_{CCA} = 1.5 \text{ V} \pm 0.1 \text{ V}$ (unless otherwise noted)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$ | | $V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$ | | $V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$ | | $V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$ | | UNIT |
|------------------|----------------------------|----------------|--|------|---|------|---|------|---|------|---------------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_{pd} | A | B | 1.4 | 12.9 | 1.2 | 10.1 | 1.1 | 10 | 0.8 | 9.9 | ns |
| | B | A | 0.9 | 14.2 | 0.7 | 12 | 0.4 | 11.7 | 0.3 | 13.7 | |
| t_{en} | OE | A | | 1 | | 1 | | 1 | | 1 | μs |
| | | B | | 1 | | 1 | | 1 | | 1 | |
| t_{dis} | OE | A | 5.9 | 31 | 5.7 | 25.9 | 5.6 | 23 | 5.7 | 22.4 | ns |
| | | B | 5.4 | 30.3 | 4.9 | 22.8 | 4.8 | 20 | 4.9 | 19.5 | |
| t_{rA}, t_{fA} | A-port rise and fall times | | 1.4 | 5.1 | 1.4 | 5.1 | 1.4 | 5.1 | 1.4 | 5.1 | ns |
| t_{rB}, t_{fB} | B-port rise and fall times | | 0.9 | 4.5 | 0.6 | 3.2 | 0.5 | 2.8 | 0.4 | 2.7 | ns |
| Max data rate | | | 40 | | 40 | | 40 | | 40 | | Mbps |

Switching Characteristics

over recommended operating free-air temperature range, $V_{CCA} = 1.8 \text{ V} \pm 0.15 \text{ V}$ (unless otherwise noted)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$ | | $V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$ | | $V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$ | | $V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$ | | UNIT |
|------------------|----------------------------|----------------|--|------|---|------|---|------|---|------|---------------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_{pd} | A | B | 1.6 | 11 | 1.4 | 7.7 | 1.3 | 6.8 | 1.2 | 6.5 | ns |
| | B | A | 1.5 | 12 | 1.3 | 8.4 | 1 | 7.6 | 0.9 | 7.1 | |
| t_{en} | OE | A | | 1 | | 1 | | 1 | | 1 | μs |
| | | B | | 1 | | 1 | | 1 | | 1 | |
| t_{dis} | OE | A | 5.9 | 31 | 5.1 | 21.3 | 5 | 19.3 | 5 | 17.4 | ns |
| | | B | 5.4 | 30.3 | 4.4 | 20.8 | 4.2 | 17.9 | 4.3 | 16.3 | |
| t_{rA}, t_{fA} | A-port rise and fall times | | 1 | 4.2 | 1.1 | 4.1 | 1.1 | 4.1 | 1.1 | 4.1 | ns |
| t_{rB}, t_{fB} | B-port rise and fall times | | 0.9 | 4.5 | 0.6 | 3.2 | 0.5 | 2.8 | 0.4 | 2.7 | ns |
| Max data rate | | | 60 | | 60 | | 60 | | 60 | | Mbps |

Switching Characteristics

 over recommended operating free-air temperature range, $V_{CCA} = 2.5 \text{ V} \pm 0.2 \text{ V}$ (unless otherwise noted)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$ | | $V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$ | | $V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$ | | UNIT |
|------------------|----------------------------|-------------|---|------|---|------|---|------|---------------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_{pd} | A | B | 1.1 | 6.3 | 1 | 5.2 | 0.9 | 4.7 | ns |
| | B | A | 1.2 | 6.6 | 1.1 | 5.1 | 0.9 | 4.4 | |
| t_{en} | OE | A | | 1 | | 1 | | 1 | μs |
| | | B | | 1 | | 1 | | 1 | |
| t_{dis} | OE | A | 5.1 | 21.3 | 4.6 | 15.2 | 4.6 | 13.2 | ns |
| | | B | 4.4 | 20.8 | 3.8 | 16 | 3.9 | 13.9 | |
| t_{rA}, t_{fA} | A-port rise and fall times | | 0.8 | 3 | 0.8 | 3 | 0.8 | 3 | ns |
| t_{rB}, t_{fB} | B-port rise and fall times | | 0.7 | 3 | 0.5 | 2.8 | 0.4 | 2.7 | ns |
| Max data rate | | | 100 | | 100 | | 100 | | Mbps |

Switching Characteristics

 over recommended operating free-air temperature range, $V_{CCA} = 3.3 \text{ V} \pm 0.3 \text{ V}$ (unless otherwise noted)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$ | | $V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$ | | UNIT |
|------------------|----------------------------|-------------|---|------|---|------|---------------|
| | | | MIN | MAX | MIN | MAX | |
| t_{pd} | A | B | 0.9 | 4.7 | 0.8 | 4 | ns |
| | B | A | 1 | 4.9 | 0.9 | 4.5 | |
| t_{en} | OE | A | | 1 | | 1 | μs |
| | | B | | 1 | | 1 | |
| t_{dis} | OE | A | 4.6 | 15.2 | 4.3 | 12.1 | ns |
| | | B | 3.8 | 16 | 3.4 | 13.2 | |
| t_{rA}, t_{fA} | A-port rise and fall times | | 0.7 | 2.5 | 0.7 | 2.5 | ns |
| t_{rB}, t_{fB} | B-port rise and fall times | | 0.5 | 2.3 | 0.4 | 2.7 | ns |
| Max data rate | | | 100 | | 100 | | Mbps |

Operating Characteristics

T_A = 25°C

| PARAMETER | | TEST CONDITIONS | V _{CCA} | | | | | | UNIT | |
|------------------|-----------------------------|--|------------------|-------|-------|-------|-------|-------|------|--------------|
| | | | 1.2 V | 1.2 V | 1.5 V | 1.8 V | 2.5 V | 2.5 V | | 3.3 V |
| | | | V _{CCB} | | | | | | | 3.3 V to 5 V |
| | | | 5 V | 1.8 V | 1.8 V | 1.8 V | 2.5 V | 5 V | | |
| | | | TYP | TYP | TYP | TYP | TYP | TYP | TYP | |
| C _{pdA} | A-port input, B-port output | C _L = 0, f = 10 MHz, t _r = t _f = 1 ns, OE = V _{CCA} (outputs enabled) | 7.8 | 8 | 8 | 7 | 7 | 8 | 8 | pF |
| | B-port input, A-port output | | 12 | 11 | 11 | 11 | 11 | 11 | 11 | |
| C _{pdB} | A-port input, B-port output | | 38.1 | 28 | 29 | 29 | 29 | 29 | 30 | |
| | B-port input, A-port output | | 25.4 | 18 | 17 | 17 | 18 | 20 | 21 | |
| C _{pdA} | A-port input, B-port output | C _L = 0, f = 10 MHz, t _r = t _f = 1 ns, OE = GND (outputs disabled) | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | pF |
| | B-port input, A-port output | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | |
| C _{pdB} | A-port input, B-port output | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | |
| | B-port input, A-port output | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.03 | |

PRINCIPLES OF OPERATION

Applications

The TXB0101 can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another.

Architecture

The TXB0101 architecture (see Figure 1) does not require a direction-control signal to control the direction of data flow from A to B or from B to A. In a dc state, the output drivers of the TXB0101 can maintain a high or low, but are designed to be weak, so that they can be overdriven by an external driver when data on the bus starts flowing the opposite direction.

The output one shots detect rising or falling edges on the A or B ports. During a rising edge, the one shot turns on the PMOS transistors (T1, T3) for a short duration, which speeds up the low-to-high transition. Similarly, during a falling edge, the one shot turns on the NMOS transistors (T2, T4) for a short duration, which speeds up the high-to-low transition. The typical output impedance during output transition is 70 Ω at $V_{CC0} = 1.2\text{ V}$ to 1.8 V, 50 Ω at $V_{CC0} = 1.8\text{ V}$ to 3.3 V, and 40 Ω at $V_{CC0} = 3.3\text{ V}$ to 5 V.

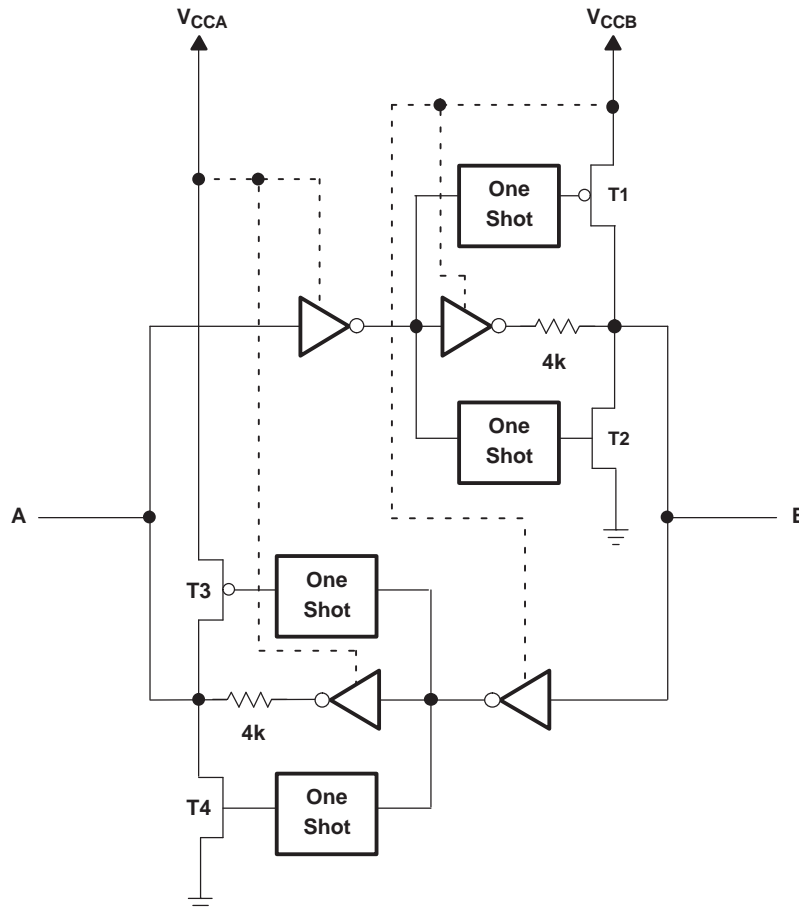
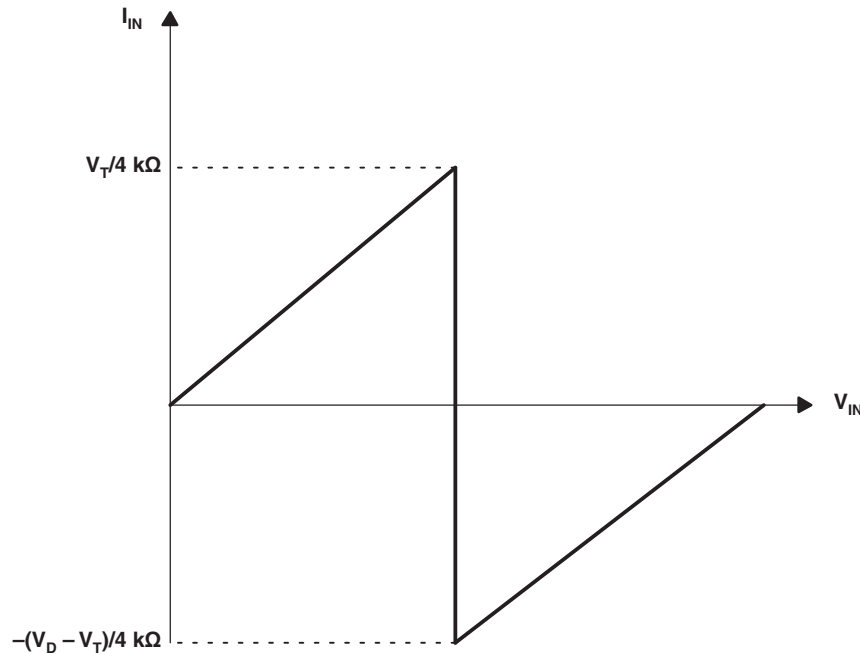


Figure 1. Architecture of TXB0101 I/O Cell

Input Driver Requirements

Typical I_{IN} vs V_{IN} characteristics of the TXB0101 are shown in Figure 2. For proper operation, the device driving the data I/Os of the TXB0101 must have drive strength of at least ± 2 mA.



- A. V_T is the input threshold voltage of the TXB0101 (typically $V_{CC1}/2$).
- B. V_D is the supply voltage of the external driver.

Figure 2. Typical I_{IN} vs V_{IN} Curve

Power Up

During operation, ensure that $V_{CCA} \leq V_{CCB}$ at all times. During power-up sequencing, $V_{CCA} \geq V_{CCB}$ does not damage the device, so any power supply can be ramped up first. The TXB0101 has circuitry that disables all output ports when either V_{CC} is switched off ($V_{CCA/B} = 0 \text{ V}$).

Enable and Disable

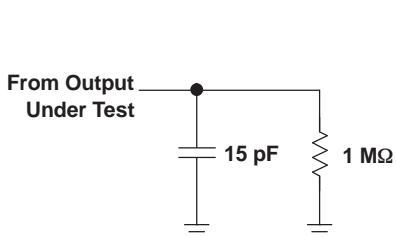
The TXB0101 has an OE input that is used to disable the device by setting OE = low, which places all I/Os in the high-impedance (Hi-Z) state. The disable time (t_{dis}) indicates the delay between when OE goes low and when the outputs are actually disabled (Hi-Z). The enable time (t_{en}) indicates the amount of time the user must allow for the one-shot circuitry to become operational after OE is taken high.

Pullup or Pulldown Resistors on I/O Lines

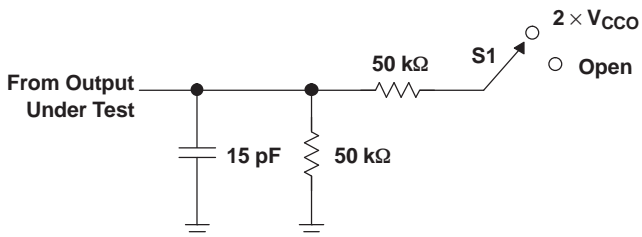
The TXB0101 is designed to drive capacitive loads of up to 70 pF. The output drivers of the TXB0101 have low dc drive strength. If pullup or pulldown resistors are connected externally to the data I/Os, their values must be kept higher than 50 k Ω to ensure that they do not contend with the output drivers of the TXB0101.

For the same reason, the TXB0101 should not be used in applications such as I²C or 1-Wire where an open-drain driver is connected on the bidirectional data I/O. For these applications, use a device from the TI TXS01xx series of level translators.

PARAMETER MEASUREMENT INFORMATION

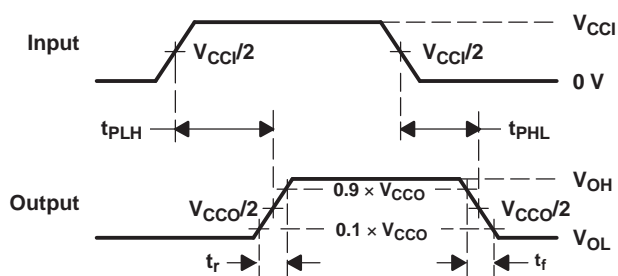


LOAD CIRCUIT FOR MAX DATA RATE, PULSE DURATION PROPAGATION DELAY OUTPUT RISE AND FALL TIME MEASUREMENT

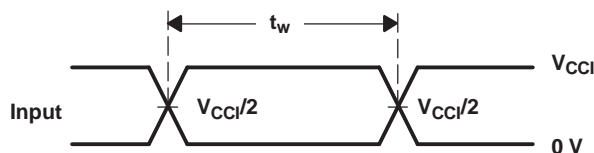


LOAD CIRCUIT FOR ENABLE/DISABLE TIME MEASUREMENT

| TEST | S1 |
|-------------------|--------------------|
| t_{PZL}/t_{PLZ} | $2 \times V_{CCO}$ |
| t_{PHZ}/t_{PZH} | Open |



VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS PULSE DURATION

- A. C_L includes probe and jig capacitance.
- B. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10$ MHz, $Z_O = 50 \Omega$, $dv/dt \geq 1$ V/ns.
- C. The outputs are measured one at a time, with one transition per measurement.
- D. t_{PLH} and t_{PHL} are the same as t_{pd} .
- E. V_{CCI} is the V_{CC} associated with the input port.
- F. V_{CCO} is the V_{CC} associated with the output port.
- G. All parameters and waveforms are not applicable to all devices.

Figure 3. Load Circuits and Voltage Waveforms

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| TXB0101DBVR | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TXB0101DBVRG4 | ACTIVE | SOT-23 | DBV | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TXB0101DBVT | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TXB0101DBVTG4 | ACTIVE | SOT-23 | DBV | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TXB0101DCKR | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TXB0101DCKRG4 | ACTIVE | SC70 | DCK | 6 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TXB0101DCKT | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TXB0101DCKTG4 | ACTIVE | SC70 | DCK | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TXB0101DRLR | ACTIVE | SOT | DRL | 6 | 4000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TXB0101DRLRG4 | ACTIVE | SOT | DRL | 6 | 4000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TXB0101DRLT | ACTIVE | SOT | DRL | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TXB0101DRLTG4 | ACTIVE | SOT | DRL | 6 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TXB0101YZPR | ACTIVE | DSBGA | YZP | 6 | 3000 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM |

⁽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⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), 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.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

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)

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

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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 |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TXB0101DBVR | SOT-23 | DBV | 6 | 3000 | 180.0 | 9.2 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TXB0101DBVT | SOT-23 | DBV | 6 | 250 | 180.0 | 9.2 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TXB0101DCKR | SC70 | DCK | 6 | 3000 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TXB0101DCKT | SC70 | DCK | 6 | 250 | 179.0 | 8.4 | 2.2 | 2.5 | 1.2 | 4.0 | 8.0 | Q3 |
| TXB0101DRLR | SOT | DRL | 6 | 4000 | 180.0 | 9.2 | 1.98 | 1.78 | 0.69 | 4.0 | 8.0 | Q3 |
| TXB0101DRLT | SOT | DRL | 6 | 250 | 180.0 | 9.2 | 1.98 | 1.78 | 0.69 | 4.0 | 8.0 | Q3 |
| TXB0101YZPR | DSBGA | YZP | 6 | 3000 | 180.0 | 8.4 | 1.02 | 1.52 | 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) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TXB0101DBVR | SOT-23 | DBV | 6 | 3000 | 202.0 | 201.0 | 28.0 |
| TXB0101DBVT | SOT-23 | DBV | 6 | 250 | 202.0 | 201.0 | 28.0 |
| TXB0101DCKR | SC70 | DCK | 6 | 3000 | 203.0 | 203.0 | 35.0 |
| TXB0101DCKT | SC70 | DCK | 6 | 250 | 203.0 | 203.0 | 35.0 |
| TXB0101DRLR | SOT | DRL | 6 | 4000 | 202.0 | 201.0 | 28.0 |
| TXB0101DRLT | SOT | DRL | 6 | 250 | 202.0 | 201.0 | 28.0 |
| TXB0101YZPR | DSBGA | YZP | 6 | 3000 | 220.0 | 220.0 | 34.0 |

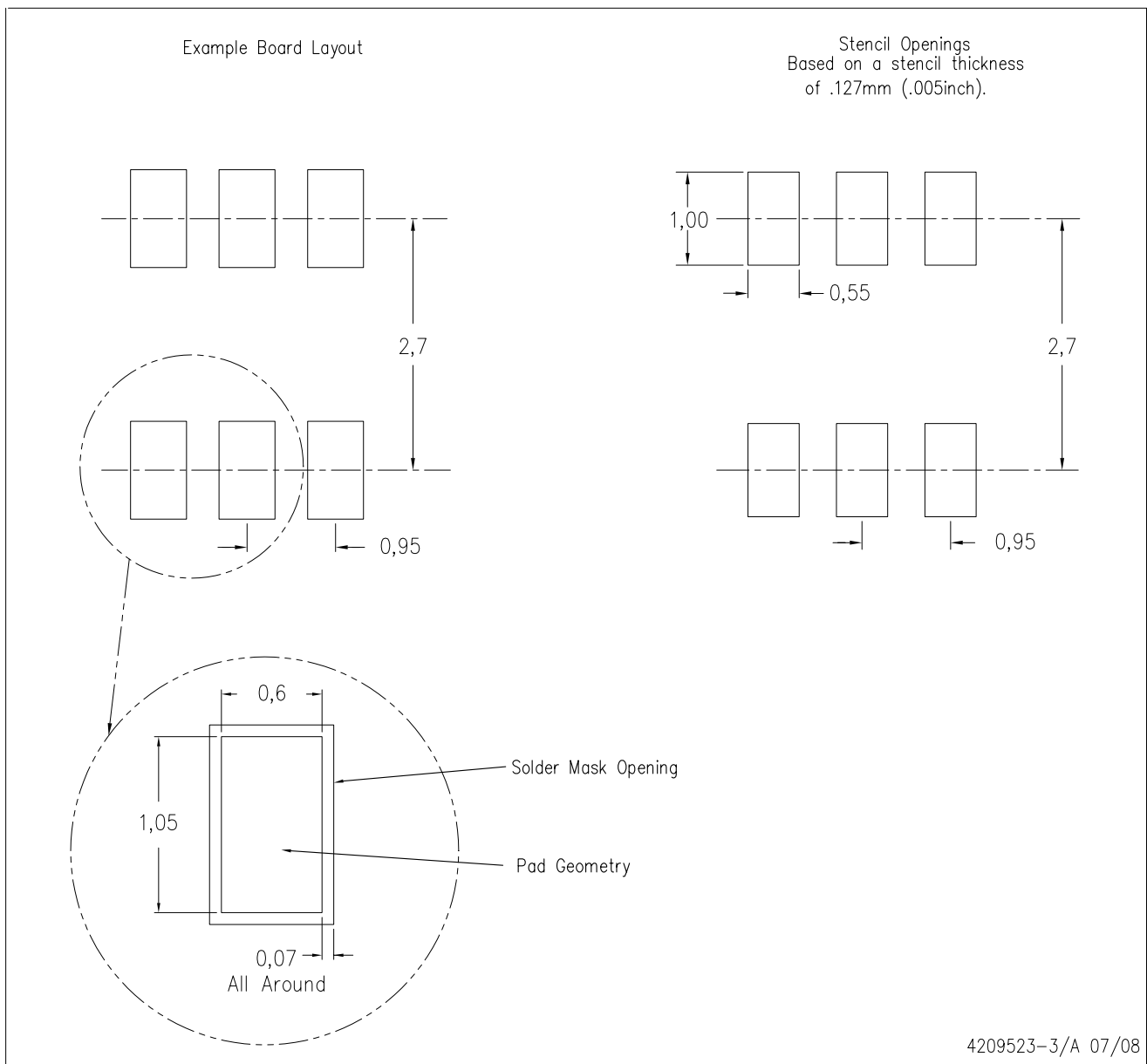
DBV (R-PDSO-G6)

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. Mold flash and protrusion shall not exceed 0.15 per side.
 - D. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
- Δ Falls within JEDEC MO-178 Variation AB, except minimum lead width.

DBV (R-PDSO-G6)



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
 - D. Publication IPC-7351 is recommended for alternate designs.
 - E. 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. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

DCK (R-PDSO-G6)

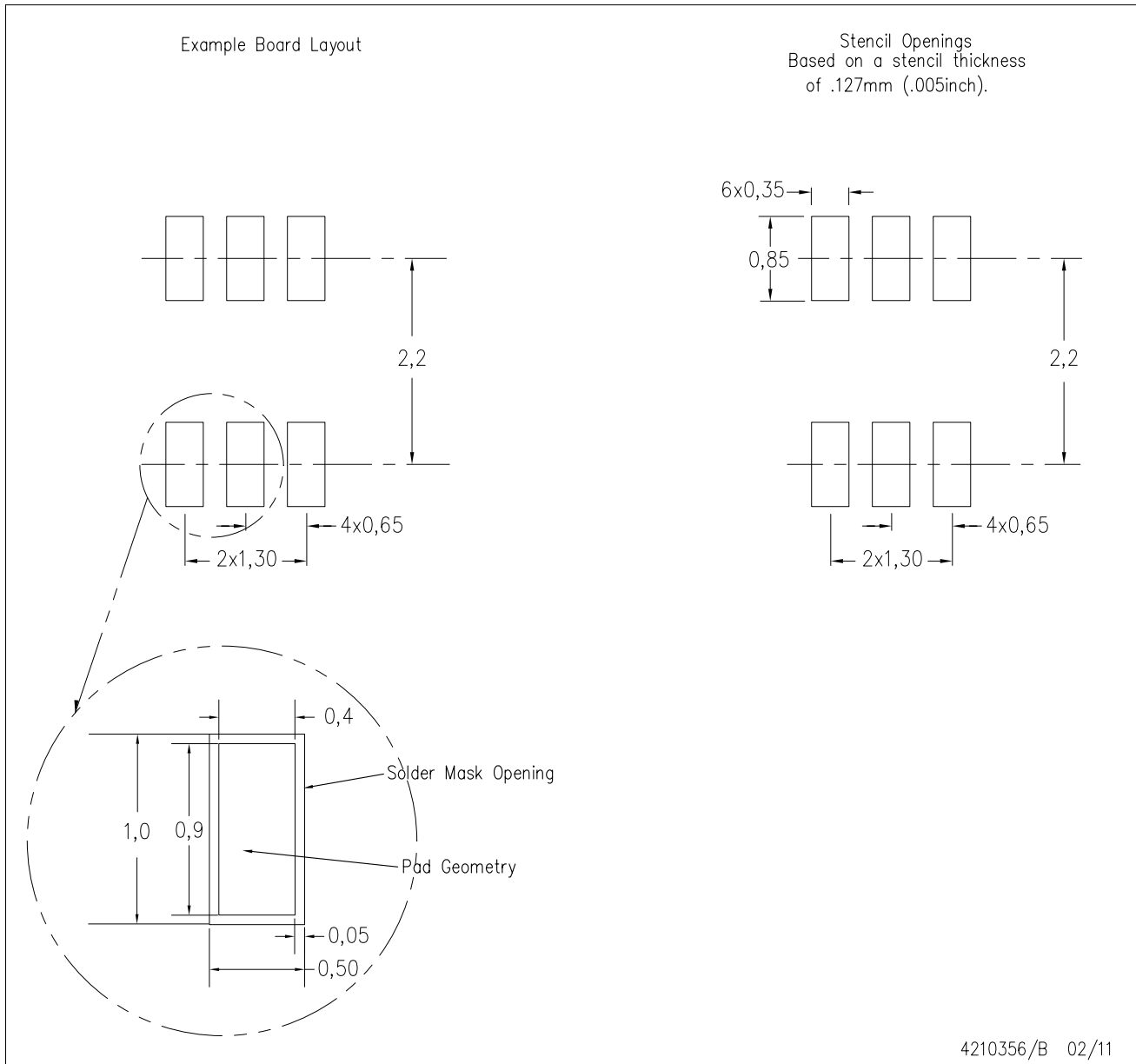
PLASTIC SMALL-OUTLINE PACKAGE



- 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. Mold flash and protrusion shall not exceed 0.15 per side.
 - D. Falls within JEDEC MO-203 variation AB.

DCK (R-PDSO-G6)

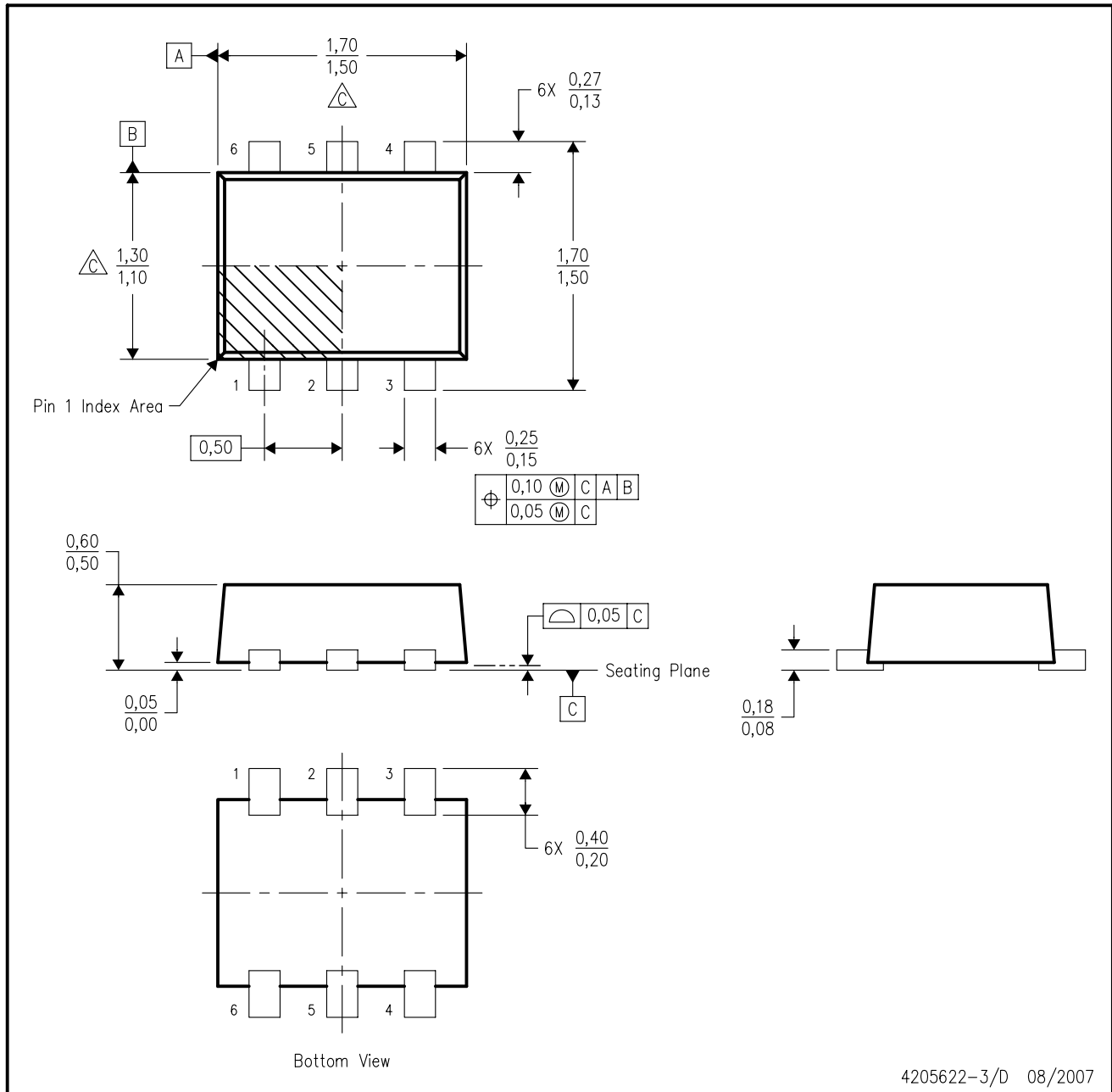
PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
 - Publication IPC-7351 is recommended for alternate designs.
 - 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. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

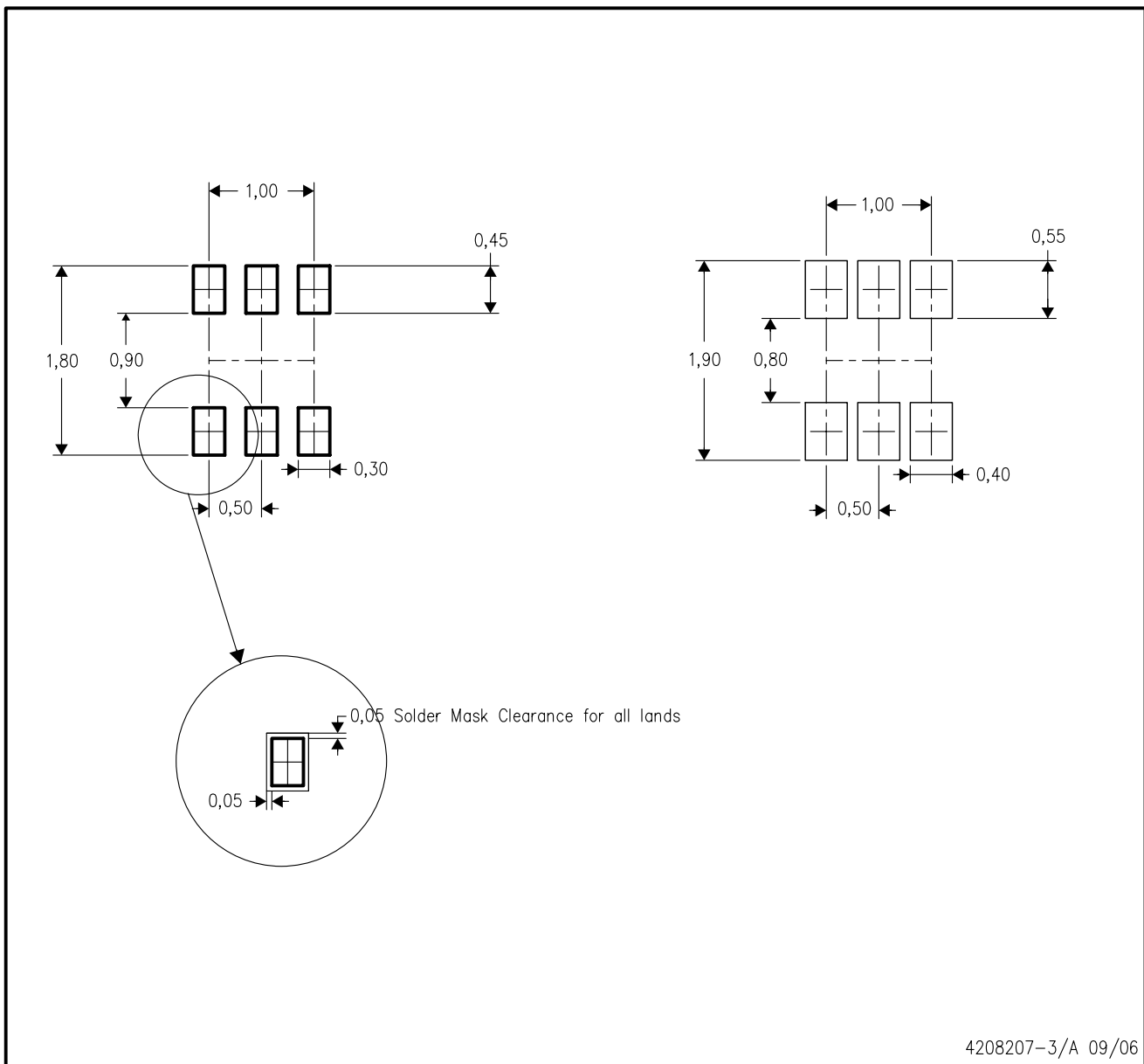
DRL (R-PDSO-N6)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash, interlead flash, protrusions, or gate burrs. Mold flash, interlead flash, protrusions, or gate burrs shall not exceed 0,15 per end or side.
 - D. JEDEC package registration is pending.

DRL (R-PDSO-N6)

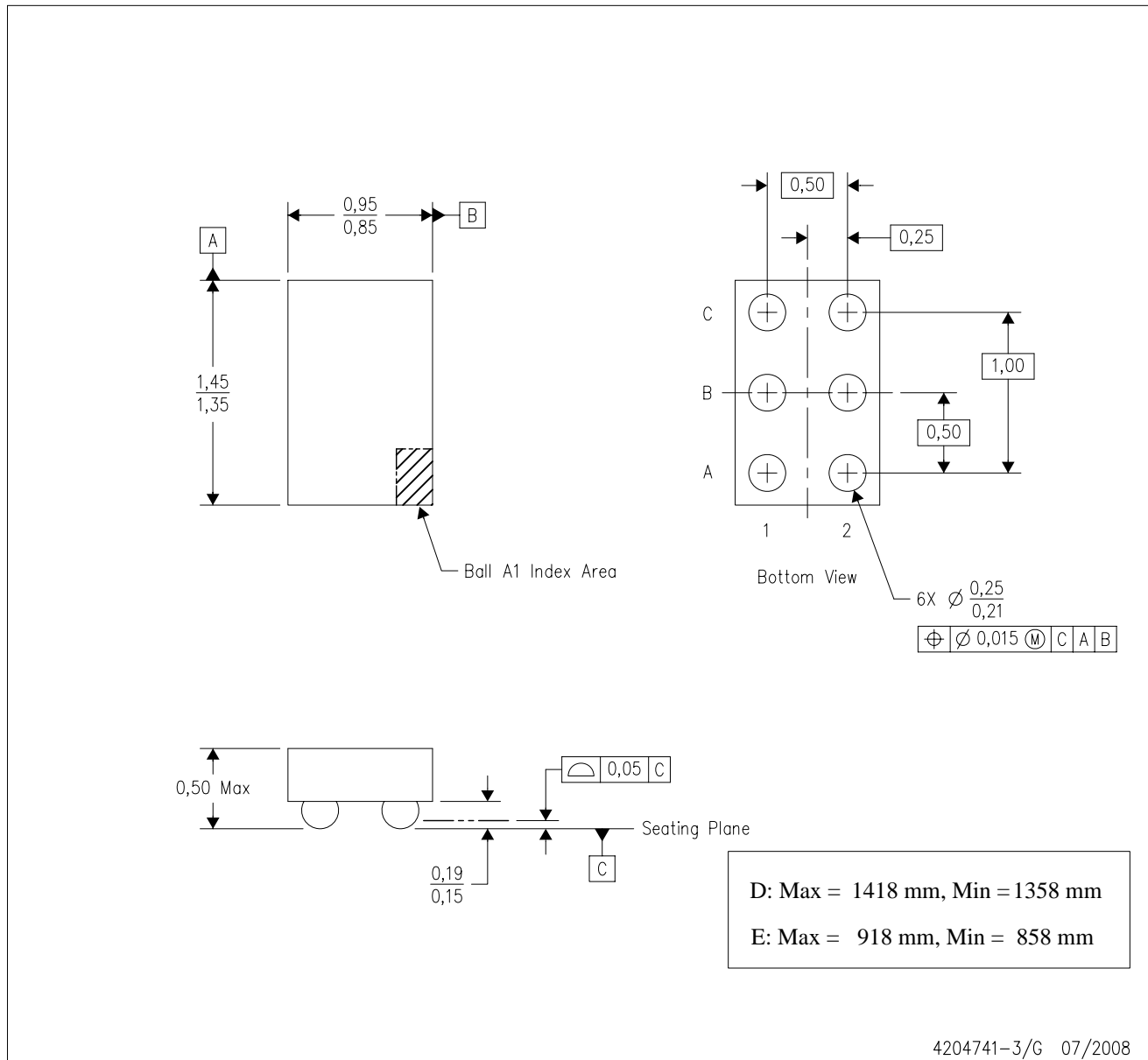


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- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads.
 - E. Maximum stencil thickness 0,127 mm (5 mils). All linear dimensions are in millimeters.
 - F. 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 stencil design considerations.
 - G. Side aperture dimensions over-print land for acceptable area ratio > 0.66. Customer may reduce side aperture dimensions if stencil manufacturing process allows for sufficient release at smaller opening.

YZP (R-XBGA-N6)

DIE-SIZE BALL GRID ARRAY



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. NanoFree™ package configuration.
 - D. This package is lead-free. Refer to the 6 YEP package (drawing 4204725) for tin-lead (SnPb).

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