

SN74AUP1G32 Low-Power Single 2-Input Positive-OR Gate

1 Features

- Available in the Ultra Small 0.64 mm² Package (DPW) with 0.5-mm Pitch
- Low Static-Power Consumption ($I_{CC} = 0.9 \mu\text{A Max}$)
- Low Dynamic-Power Consumption ($C_{pd} = 4.3 \text{ pF Typ at } 3.3 \text{ V}$)
- Low Input Capacitance ($C_I = 1.5 \text{ pF Typ}$)
- Low Noise – Overshoot and Undershoot $<10\%$ of V_{CC}
- I_{off} Supports Live Insertion, Partial-Power-Down Mode, and Back Drive Protection
- Input Hysteresis Allows Slow Input Transition and Better Switching Noise Immunity at the Input ($V_{hys} = 250 \text{ mV Typ at } 3.3 \text{ V}$)
- Wide Operating V_{CC} Range of 0.8 V to 3.6 V
- Optimized for 3.3-V Operation
- 3.6-V I/O Tolerant to Support Mixed-Mode Signal Operation
- $t_{pd} = 4.6 \text{ ns Max at } 3.3 \text{ V}$
- Suitable for Point-to-Point Applications
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Performance Tested Per JESD 22
 - 2000-V Human-Body Model (A114-B, Class II)
 - 1000-V Charged-Device Model (C101)

2 Applications

- ATCA Solutions
- Active Noise Cancellation (ANC)
- Barcode Scanner the end of the datasheet.
- Blood Pressure Monitor
- CPAP Machine
- Cable Solutions
- DLP 3D Machine Vision, Hyperspectral Imaging, Optical Networking, and Spectroscopy
- E-Book
- Embedded PC
- Field Transmitter: Temperature or Pressure Sensor
- Fingerprint Biometrics
- HVAC: Heating, Ventilating, and Air Conditioning
- Network-Attached Storage (NAS)
- Server Motherboard and PSU
- Software Defined Radio (SDR)
- TV: High-Definition (HDTV), LCD, and Digital
- Video Communications System
- Wireless Data Access Card, Headset, Keyboard, Mouse, and LAN Card
- X-ray: Baggage Scanner, Medical, and Dental

3 Description

This single 2-input positive-OR gate performs the Boolean function $Y = A \bullet B$ or $Y = A + B$ in positive logic.

Device Information⁽¹⁾

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|-------------|-----------|-------------------|
| SN74AUP1G32 | SOT (5) | 1.60 mm × 1.20 mm |
| | USON (6) | 1.45 mm × 1.00 mm |
| | X2SON (4) | 0.80 mm × 0.80 mm |
| | DSBGA (6) | 1.19 mm × 0.79 mm |
| | DSBGA (5) | 1.41 mm × 0.91 mm |

(1) For all available packages, see the orderable addendum at the end of the data sheet.

4 Simplified Schematic



Table of Contents

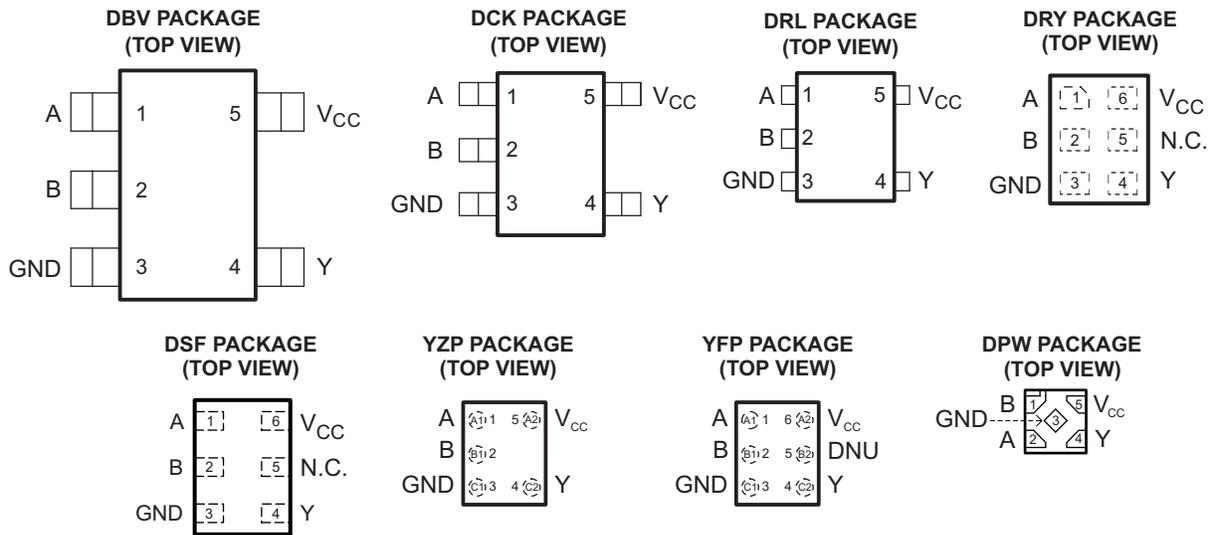
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5 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| Changes from Revision H (August 2012) to Revision I | Page |
|--|-------------|
| • Updated document to new TI data sheet format | 1 |
| • Removed Ordering Information table | 1 |
| • Added Applications | 1 |
| • Added Handling Ratings table | 4 |
| • Added Thermal Information table | 4 |
| • Added Typical Characteristics | 7 |

6 Pin Configuration and Functions



DNU – Do not use
NC – No internal connection
See mechanical drawings for dimensions.

Pin Functions

| NAME | PIN | | | | | I/O | DESCRIPTION |
|-----------------|---------------|-----|----------|-----|-----|-----|-------------|
| | DRL, DCK, DBV | DPW | DRY, DSF | YZP | YFP | | |
| A | 1 | 2 | 1 | A1 | A1 | I | Input A |
| B | 2 | 1 | 2 | B1 | B2 | I | Input B |
| GND | 3 | 3 | 3 | C1 | B3 | – | Ground |
| Y | 4 | 4 | 4 | C2 | C4 | O | Output Y |
| V _{CC} | 5 | 5 | 6 | A2 | A6 | – | Power Pin |

7 Specifications

7.1 Absolute Maximum Ratings⁽¹⁾

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

| | | MIN | MAX | UNIT |
|-----------------|---|--------------------|-----------------------|--------|
| V _{CC} | Supply voltage range | –0.5 | 4.6 | V |
| V _I | Input voltage range ⁽²⁾ | –0.5 | 4.6 | V |
| V _O | Voltage range applied to any output in the high-impedance or power-off state ⁽²⁾ | –0.5 | 4.6 | V |
| V _O | Voltage range applied to any output in the high or low state ⁽²⁾ | –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 | | | ±50 mA |

(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 and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.

7.2 Handling Ratings

| | | MIN | MAX | UNIT |
|-------------|---------------------------|--|------|------|
| T_{stg} | Storage temperature range | -65 | 125 | °C |
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins ⁽¹⁾ | | V |
| | | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins ⁽²⁾ | | |
| | | 0 | 2000 | |
| | | 0 | 1000 | |

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

7.3 Recommended Operating Conditions⁽¹⁾

| | | MIN | MAX | UNIT | |
|---------------------|-------------------------------------|--|----------------------|------|------|
| V_{CC} | Supply voltage | 0.8 | 3.6 | V | |
| V_{IH} | High-level input voltage | $V_{CC} = 0.8\text{ V}$ | V_{CC} | V | |
| | | $V_{CC} = 1.1\text{ V to }1.95\text{ V}$ | $0.65 \times V_{CC}$ | | |
| | | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | 1.6 | | |
| | | $V_{CC} = 3\text{ V to }3.6\text{ V}$ | 2 | | |
| V_{IL} | Low-level input voltage | $V_{CC} = 0.8\text{ V}$ | 0 | V | |
| | | $V_{CC} = 1.1\text{ V to }1.95\text{ V}$ | $0.35 \times V_{CC}$ | | |
| | | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | 0.7 | | |
| | | $V_{CC} = 3\text{ V to }3.6\text{ V}$ | 0.9 | | |
| V_I | Input voltage | 0 | 3.6 | V | |
| V_O | Output voltage | 0 | V_{CC} | V | |
| I_{OH} | High-level output current | $V_{CC} = 0.8\text{ V}$ | -20 | μA | |
| | | $V_{CC} = 1.1\text{ V}$ | -1.1 | | |
| | | $V_{CC} = 1.4\text{ V}$ | -1.7 | | |
| | | $V_{CC} = 1.65\text{ V}$ | -1.9 | | |
| | | $V_{CC} = 2.3\text{ V}$ | -3.1 | | |
| | | $V_{CC} = 3\text{ V}$ | -4 | | |
| I_{OL} | Low-level output current | $V_{CC} = 0.8\text{ V}$ | 20 | μA | |
| | | $V_{CC} = 1.1\text{ V}$ | 1.1 | | |
| | | $V_{CC} = 1.4\text{ V}$ | 1.7 | | |
| | | $V_{CC} = 1.65\text{ V}$ | 1.9 | | |
| | | $V_{CC} = 2.3\text{ V}$ | 3.1 | | |
| | | $V_{CC} = 3\text{ V}$ | 4 | | |
| $\Delta t/\Delta v$ | Input transition rise and fall rate | $V_{CC} = 0.8\text{ V to }1.95\text{ V}$ | | 200 | ns/V |
| T_A | Operating free-air temperature | -40 | 85 | °C | |

(1) All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number [SCBA004](#).

7.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | | DBV | DCK | DRL | DSF | DRY | UNIT |
|-------------------------------|--|--------|--------|--------|--------|--------|------|
| | | 5 PINS | 5 PINS | 5 PINS | 6 PINS | 6 PINS | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 271.4 | 338.4 | 349.7 | 407.1 | 554.9 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 213.5 | 110.6 | 120.5 | 232.0 | 385.4 | |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 108.2 | 118.8 | 171.4 | 306.9 | 388.2 | |
| ψ_{JT} | Junction-to-top characterization parameter | 89.3 | 3.0 | 10.8 | 40.3 | 159.0 | |
| ψ_{JB} | Junction-to-board characterization parameter | 107.6 | 117.8 | 169.4 | 306.0 | 384.1 | |

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, [SPRA953](#).

7.5 Electrical Characteristics

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

| PARAMETER | TEST CONDITIONS | V _{CC} | T _A = 25°C | | | T _A = –40°C to 85°C | | UNIT |
|-------------------|---|---|------------------------|-----|-----|--------------------------------|-----|------|
| | | | MIN | TYP | MAX | MIN | MAX | |
| V _{OH} | I _{OH} = –20 μA | 0.8 V to 3.6 V | V _{CC} – 0.1 | | | V _{CC} – 0.1 | | V |
| | I _{OH} = –1.1 mA | 1.1 V | 0.75 × V _{CC} | | | 0.7 × V _{CC} | | |
| | I _{OH} = –1.7 mA | 1.4 V | 1.11 | | | 1.03 | | |
| | I _{OH} = –1.9 mA | 1.65 V | 1.32 | | | 1.3 | | |
| | I _{OH} = –2.3 mA | 2.3 V | 2.05 | | | 1.97 | | |
| | I _{OH} = –3.1 mA | | 1.9 | | | 1.85 | | |
| | I _{OH} = –2.7 mA | 3 V | 2.72 | | | 2.67 | | |
| | I _{OH} = –4 mA | | 2.6 | | | 2.55 | | |
| V _{OL} | I _{OL} = 20 μA | 0.8 V to 3.6 V | 0.1 | | | 0.1 | | V |
| | I _{OL} = 1.1 mA | 1.1 V | 0.3 × V _{CC} | | | 0.3 × V _{CC} | | |
| | I _{OL} = 1.7 mA | 1.4 V | 0.31 | | | 0.37 | | |
| | I _{OL} = 1.9 mA | 1.65 V | 0.31 | | | 0.35 | | |
| | I _{OL} = 2.3 mA | 2.3 V | 0.31 | | | 0.33 | | |
| | I _{OL} = 3.1 mA | | 0.44 | | | 0.45 | | |
| | I _{OL} = 2.7 mA | 3 V | 0.31 | | | 0.33 | | |
| | I _{OL} = 4 mA | | 0.44 | | | 0.45 | | |
| I _I | A or B input | V _I = GND to 3.6 V | 0 V to 3.6 V | | | 0.1 | 0.5 | μA |
| I _{off} | | V _I or V _O = 0 V to 3.6 V | 0 V | | | 0.2 | 0.6 | μA |
| ΔI _{off} | | V _I or V _O = 0 V to 3.6 V | 0 V to 0.2 V | | | 0.2 | 0.6 | μA |
| I _{CC} | | V _I = GND or (V _{CC} to 3.6 V), I _O = 0 | 0.8 V to 3.6 V | | | 0.5 | 0.9 | μA |
| ΔI _{CC} | | V _I = V _{CC} – 0.6 V ⁽¹⁾ , I _O = 0 | 3.3 V | | | 40 | 50 | μA |
| C _i | V _I = V _{CC} or GND | 0 V | 1.5 | | | | | pF |
| | | 3.6 V | 1.5 | | | | | |
| C _o | V _O = GND | 0 V | 3 | | | | | pF |

(1) One input at V_{CC} – 0.6 V, other input at V_{CC} or GND.

7.6 Switching Characteristics, C_L = 5 pF

over recommended operating free-air temperature range (unless otherwise noted) (see [Figure 3](#) and [Figure 4](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V _{CC} | T _A = 25°C | | | T _A = –40°C to 85°C | | UNIT |
|-----------------|--------------|-------------|-----------------|-----------------------|-----|------|--------------------------------|------|------|
| | | | | MIN | TYP | MAX | MIN | MAX | |
| t _{pd} | A or B | Y | 0.8 V | 18 | | | | | ns |
| | | | 1.2 V ± 0.1 V | 2.6 | 7.3 | 13.5 | 2.1 | 16.8 | |
| | | | 1.5 V ± 0.1 V | 1.4 | 5.2 | 9.1 | 0.9 | 11 | |
| | | | 1.8 V ± 0.15 V | 1 | 4.2 | 7 | 0.5 | 8.8 | |
| | | | 2.5 V ± 0.2 V | 1 | 3 | 4.7 | 0.5 | 6 | |
| | | | 3.3 V ± 0.3 V | 1 | 2.4 | 3.7 | 0.5 | 4.6 | |

7.7 Switching Characteristics, $C_L = 10$ pF

 over recommended operating free-air temperature range (unless otherwise noted) (see [Figure 3](#) and [Figure 4](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V_{CC} | $T_A = 25^\circ\text{C}$ | | | $T_A = -40^\circ\text{C}$ to 85°C | | UNIT |
|-----------|--------------|-------------|----------------------------------|--------------------------|-----|------|---|------|------|
| | | | | MIN | TYP | MAX | MIN | MAX | |
| t_{pd} | A or B | Y | 0.8 V | 21 | | | | | ns |
| | | | $1.2\text{ V} \pm 0.1\text{ V}$ | 1.5 | 8.5 | 15.4 | 1 | 18.4 | |
| | | | $1.5\text{ V} \pm 0.1\text{ V}$ | 1 | 6.2 | 10.4 | 0.5 | 12 | |
| | | | $1.8\text{ V} \pm 0.15\text{ V}$ | 1 | 5 | 8.1 | 0.5 | 9.6 | |
| | | | $2.5\text{ V} \pm 0.2\text{ V}$ | 1 | 3.6 | 5.5 | 0.5 | 6.6 | |
| | | | $3.3\text{ V} \pm 0.3\text{ V}$ | 1 | 2.9 | 4.4 | 0.5 | 5 | |

7.8 Switching Characteristics, $C_L = 15$ pF

 over recommended operating free-air temperature range (unless otherwise noted) (see [Figure 3](#) and [Figure 4](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V_{CC} | $T_A = 25^\circ\text{C}$ | | | $T_A = -40^\circ\text{C}$ to 85°C | | UNIT |
|-----------|--------------|-------------|----------------------------------|--------------------------|-----|------|---|------|------|
| | | | | MIN | TYP | MAX | MIN | MAX | |
| t_{pd} | A or B | Y | 0.8 V | 24 | | | | | ns |
| | | | $1.2\text{ V} \pm 0.1\text{ V}$ | 3.6 | 9.9 | 17 | 3.1 | 21.1 | |
| | | | $1.5\text{ V} \pm 0.1\text{ V}$ | 2.3 | 7.2 | 11.5 | 1.8 | 13.9 | |
| | | | $1.8\text{ V} \pm 0.15\text{ V}$ | 1.6 | 5.8 | 9.1 | 1.1 | 11.2 | |
| | | | $2.5\text{ V} \pm 0.2\text{ V}$ | 1 | 4.3 | 6.2 | 0.5 | 7.8 | |
| | | | $3.3\text{ V} \pm 0.3\text{ V}$ | 1 | 3.4 | 5 | 0.5 | 6.2 | |

7.9 Switching Characteristics, $C_L = 30$ pF

 over recommended operating free-air temperature range (unless otherwise noted) (see [Figure 3](#) and [Figure 4](#))

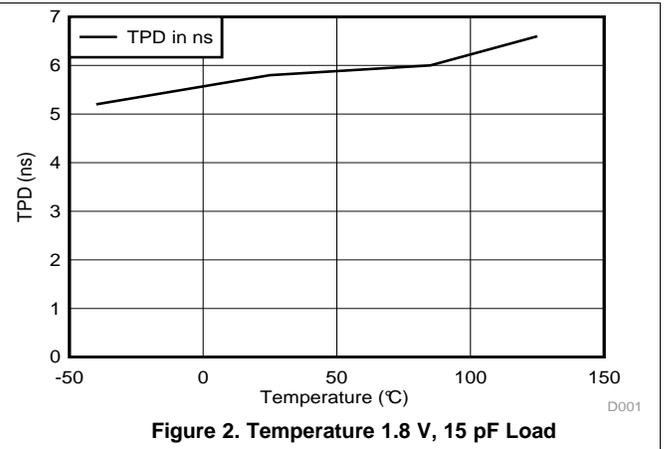
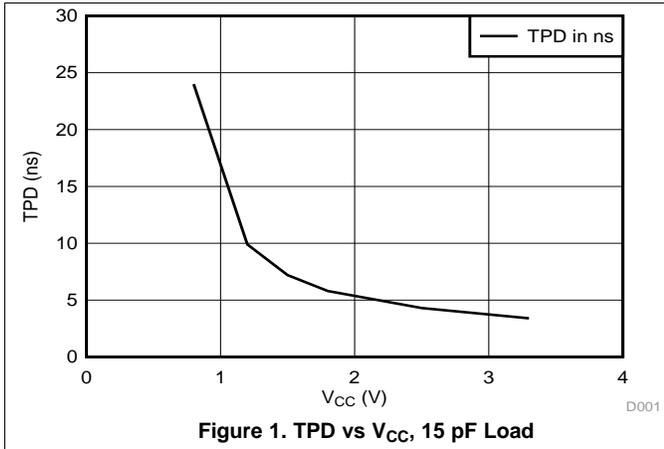
| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V_{CC} | $T_A = 25^\circ\text{C}$ | | | $T_A = -40^\circ\text{C}$ to 85°C | | UNIT |
|-----------|--------------|-------------|----------------------------------|--------------------------|------|------|---|------|------|
| | | | | MIN | TYP | MAX | MIN | MAX | |
| t_{pd} | A or B | Y | 0.8 V | 32.8 | | | | | ns |
| | | | $1.2\text{ V} \pm 0.1\text{ V}$ | 4.9 | 13.1 | 21.6 | 4.4 | 26.7 | |
| | | | $1.5\text{ V} \pm 0.1\text{ V}$ | 3.4 | 9.5 | 14.6 | 2.9 | 17.6 | |
| | | | $1.8\text{ V} \pm 0.15\text{ V}$ | 2.5 | 7.7 | 11.4 | 2 | 14.1 | |
| | | | $2.5\text{ V} \pm 0.2\text{ V}$ | 1.8 | 5.7 | 7.9 | 1.3 | 9.9 | |
| | | | $3.3\text{ V} \pm 0.3\text{ V}$ | 1.5 | 4.7 | 6.4 | 1 | 7.8 | |

7.10 Operating Characteristics

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

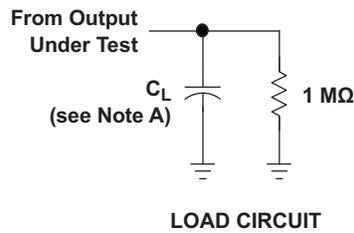
| PARAMETER | TEST CONDITIONS | V_{CC} | TYP | UNIT |
|--|---------------------|----------------------------------|-----|------|
| C_{pd} Power dissipation capacitance | $f = 10\text{ MHz}$ | 0.8 V | 4.1 | pF |
| | | $1.2\text{ V} \pm 0.1\text{ V}$ | 4.1 | |
| | | $1.5\text{ V} \pm 0.1\text{ V}$ | 4.1 | |
| | | $1.8\text{ V} \pm 0.15\text{ V}$ | 4.1 | |
| | | $2.5\text{ V} \pm 0.2\text{ V}$ | 4.2 | |
| | | $3.3\text{ V} \pm 0.3\text{ V}$ | 4.3 | |

7.11 Typical Characteristics

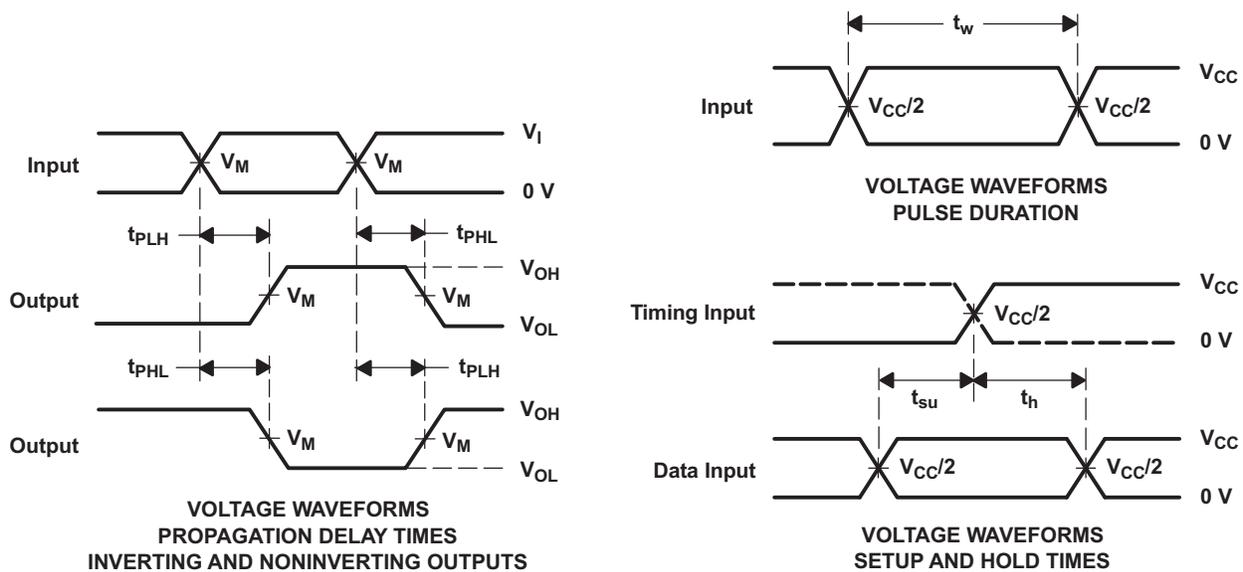


8 Parameter Measurement Information

8.1 Propagation Delays, Setup and Hold Times, and Pulse Width



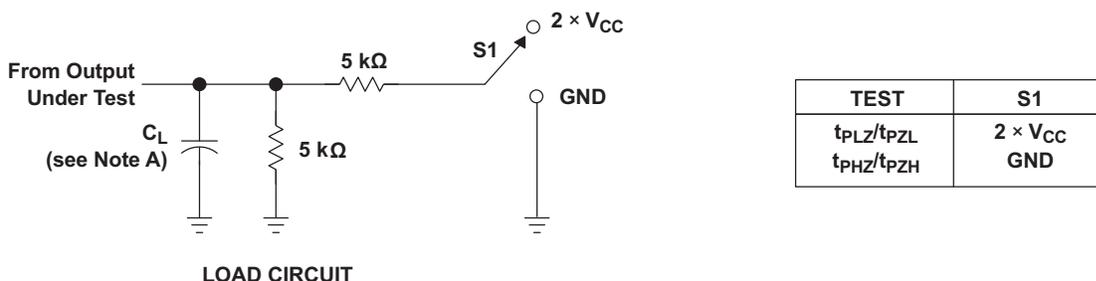
| | $V_{CC} = 0.8 \text{ V}$ | $V_{CC} = 1.2 \text{ V} \pm 0.1 \text{ V}$ | $V_{CC} = 1.5 \text{ V} \pm 0.1 \text{ V}$ | $V_{CC} = 1.8 \text{ V} \pm 0.15 \text{ V}$ | $V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$ | $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$ |
|-------|--------------------------|--|--|---|--|--|
| C_L | 5, 10, 15, 30 pF | 5, 10, 15, 30 pF | 5, 10, 15, 30 pF | 5, 10, 15, 30 pF | 5, 10, 15, 30 pF | 5, 10, 15, 30 pF |
| V_M | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ |
| V_I | V_{CC} | V_{CC} | V_{CC} | V_{CC} | V_{CC} | V_{CC} |



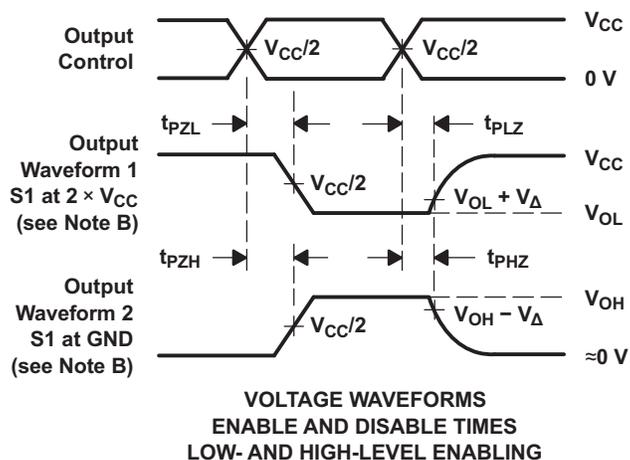
- A. C_L includes probe and jig capacitance.
- B. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, t_r and $t_f = 3 \text{ ns}$.
- C. The outputs are measured one at a time, with one transition per measurement.
- D. t_{PLH} and t_{PHL} are the same as t_{pd} .
- E. All parameters and waveforms are not applicable to all devices.

Figure 3. Load Circuit and Voltage Waveforms

8.2 Enable and Disable Times



| | $V_{CC} = 0.8 \text{ V}$ | $V_{CC} = 1.2 \text{ V} \pm 0.1 \text{ V}$ | $V_{CC} = 1.5 \text{ V} \pm 0.1 \text{ V}$ | $V_{CC} = 1.8 \text{ V} \pm 0.15 \text{ V}$ | $V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$ | $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$ |
|-------|--------------------------|--|--|---|--|--|
| C_L | 5, 10, 15, 30 pF | 5, 10, 15, 30 pF | 5, 10, 15, 30 pF | 5, 10, 15, 30 pF | 5, 10, 15, 30 pF | 5, 10, 15, 30 pF |
| V_M | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ |
| V_I | V_{CC} | V_{CC} | V_{CC} | V_{CC} | V_{CC} | V_{CC} |
| V_D | 0.1 V | 0.1 V | 0.1 V | 0.15 V | 0.15 V | 0.3 V |



- A. C_L includes probe and jig capacitance.
- B.
- C. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, t_r and $t_f = 3 \text{ ns}$.
- 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. All parameters and waveforms are not applicable to all devices.

Figure 4. Load Circuit and Voltage Waveforms

9 Detailed Description

9.1 Overview

This single 2-input positive-OR gate that operates from 0.8 V to 3.6 V and performs the Boolean function $Y = A \bullet B$ or $Y = \overline{A + B}$ in positive logic.

The AUP family of devices has quiescent power consumption less than 1 μA and comes in the ultra small DPW package. The DPW package technology is a major breakthrough in IC packaging. Its tiny 0.64 mm square footprint saves significant board space over other package options while still retaining the traditional manufacturing friendly lead pitch of 0.5 mm.

9.2 Functional Block Diagram



9.3 Feature Description

- Wide operating V_{CC} range of 0.8 V to 3.6 V
- 3.6-V I/O tolerant to support down translation
- Input hysteresis allows slow input transition and better switching noise immunity at the input
- I_{off} feature allows voltages on the inputs and outputs when V_{CC} is 0 V
- Low noise due to slower edge rates

9.4 Device Functional Modes

Table 1. Function Table

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

10 Application and Implementation

10.1 Application Information

The AUP family is TI's premier solution to the industry's low-power needs in battery-powered portable applications. This family ensures a very low static and dynamic power consumption across the entire VCC range of 0.8 V to 3.6 V, resulting in an increased battery life. This product also maintains excellent signal integrity. It has a small amount of hysteresis built in allowing for slower or noisy input signals. The lowered drive produces slower edges and prevents overshoot and undershoot on the outputs.

The AUP family of single gate logic makes excellent translators for the new lower voltage Micro- processors that typically are powered from 0.8 V to 1.2 V. They can drop the voltage of peripheral drivers and accessories that are still powered by 3.3 V to the new uC power levels.

10.2 Typical Application

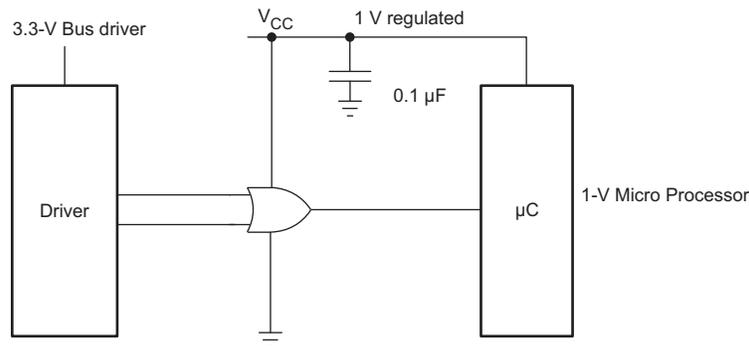


Figure 5. Typical Application Schematic

10.2.1 Design Requirements

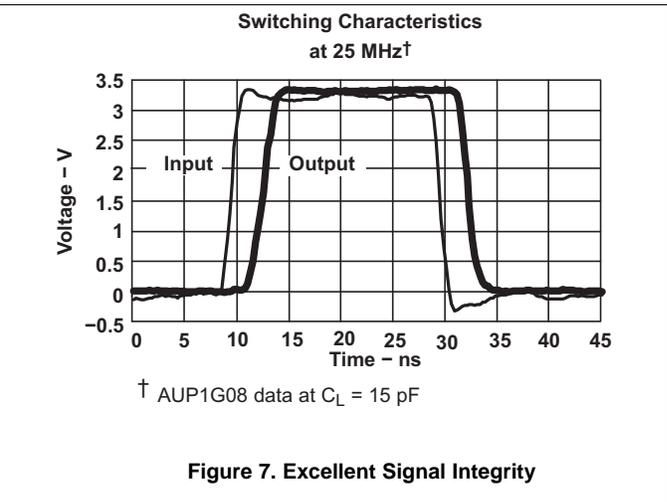
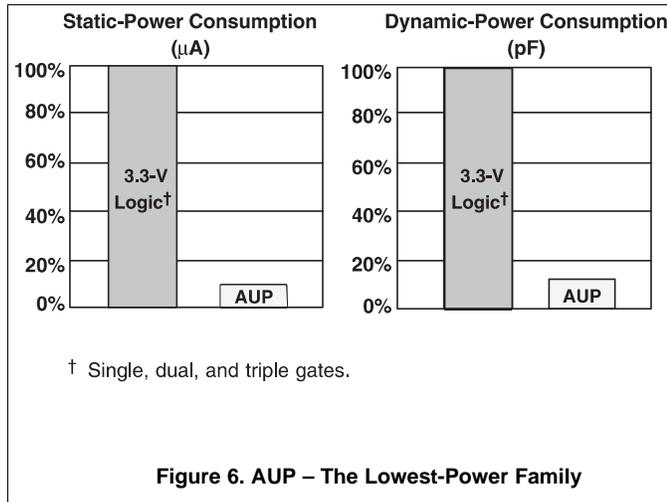
This device uses CMOS technology and has balanced output drive. Care should be taken to avoid bus contention because it can drive currents that would exceed maximum limits.

10.2.2 Detailed Design Procedure

1. Recommended Input conditions
 - Rise time and fall time specifications. See $(\Delta t/\Delta V)$ in [Recommended Operating Conditions](#) table.
 - Specified high and low levels. See $(V_{IH}$ and $V_{IL})$ in [Recommended Operating Conditions](#) table.
 - Inputs are overvoltage tolerant allowing them to go as high as 3.6 V at any valid V_{CC}
2. Recommend output conditions
 - Load currents should not exceed 20 mA on the output and 50 mA total for the part
 - Outputs should not be pulled above V_{CC}

Typical Application (continued)

10.2.3 Application Curves



11 Power Supply Recommendations

The power supply can be any voltage between the Min and Max supply voltage rating located in the [Recommended Operating Conditions](#) table.

Each V_{CC} terminal should have a good bypass capacitor to prevent power disturbance. For devices with a single supply, $0.1 \mu\text{F}$ is recommended and if there are multiple V_{CC} terminals then $.01 \mu\text{F}$ or $.022 \mu\text{F}$ is recommended for each power terminal. It is ok to parallel multiple bypass caps to reject different frequencies of noise. A $0.1 \mu\text{F}$ and $1 \mu\text{F}$ are commonly used in parallel. The bypass capacitor should be installed as close to the power terminal as possible for best results.

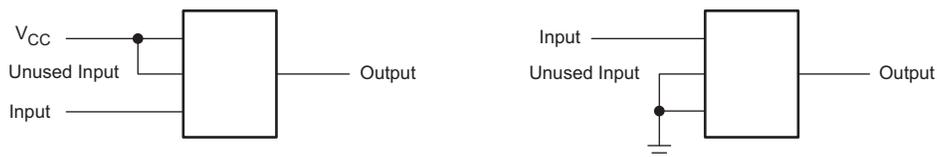
12 Layout

12.1 Layout Guidelines

When using multiple bit logic devices inputs should not ever float.

In many cases, functions or parts of functions of digital logic devices are unused, for example, when only two inputs of a triple-input AND gate are used or only 3 of the 4 buffer gates are used. Such input pins should not be left unconnected because the undefined voltages at the outside connections result in undefined operational states. Specified below are the rules that must be observed under all circumstances. All unused inputs of digital logic devices must be connected to a high or low bias to prevent them from floating. The logic level that should be applied to any particular unused input depends on the function of the device. Generally they will be tied to GND or V_{CC} whichever make more sense or is more convenient. It is generally OK to float outputs unless the part is a transceiver. If the transceiver has an output enable pin it will disable the outputs section of the part when asserted. This will not disable the input section of the I.O's so they also cannot float when disabled.

12.2 Layout Example



13 Device and Documentation Support

13.1 Trademarks

All trademarks are the property of their respective owners.

13.2 Electrostatic Discharge Caution



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

13.3 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

14 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|-------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| SN74AUP1G32DBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | H32R | Samples |
| SN74AUP1G32DBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | H32R | Samples |
| SN74AUP1G32DBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | H32R | Samples |
| SN74AUP1G32DCKR | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (HG5 ~ HGF ~ HGK ~ HGR) | Samples |
| SN74AUP1G32DCKRE4 | ACTIVE | SC70 | DCK | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (HG5 ~ HGF ~ HGK ~ HGR) | Samples |
| SN74AUP1G32DCKT | ACTIVE | SC70 | DCK | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (HG5 ~ HGR) | Samples |
| SN74AUP1G32DCKTE4 | ACTIVE | SC70 | DCK | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (HG5 ~ HGR) | Samples |
| SN74AUP1G32DPWR | ACTIVE | X2SON | DPW | 4 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | F4 | Samples |
| SN74AUP1G32DRLR | ACTIVE | SOT | DRL | 5 | 4000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (HG7 ~ HGR) | Samples |
| SN74AUP1G32DRY2 | ACTIVE | SON | DRY | 6 | 5000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HG | Samples |
| SN74AUP1G32DRYR | ACTIVE | SON | DRY | 6 | 5000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HG | Samples |
| SN74AUP1G32DSF2 | ACTIVE | SON | DSF | 6 | 5000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HG | Samples |
| SN74AUP1G32DSFR | ACTIVE | SON | DSF | 6 | 5000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HG | Samples |
| SN74AUP1G32YFPR | ACTIVE | DSBGA | YFP | 6 | 3000 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM | | (HG2 ~ HG7 ~ HGN) | Samples |
| SN74AUP1G32YZPR | ACTIVE | DSBGA | YZP | 5 | 3000 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM | -40 to 85 | (HG2 ~ HG7 ~ HGN) | Samples |

(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.

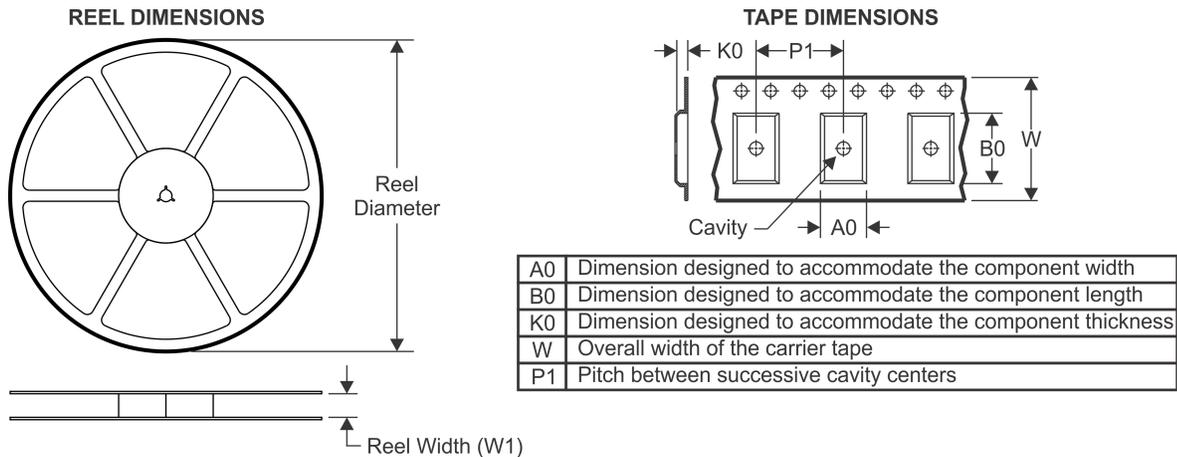
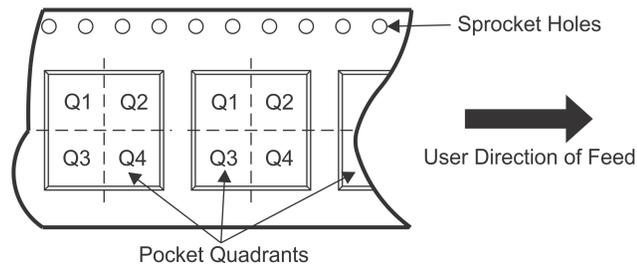
⁽⁴⁾ There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

⁽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.

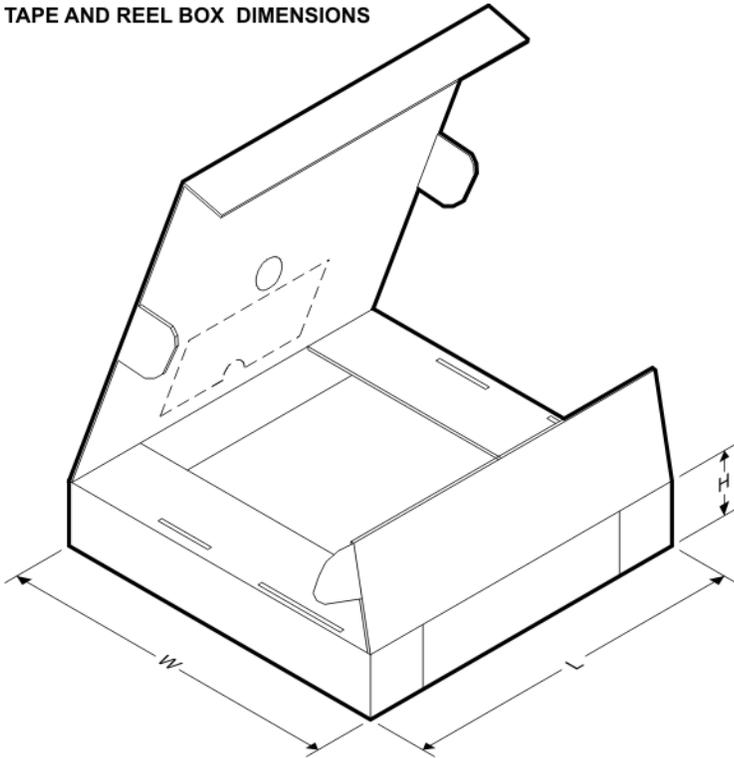
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TAPE AND REEL INFORMATION

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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74AUP1G32DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 8.4 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| SN74AUP1G32DBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 8.4 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| SN74AUP1G32DCKR | SC70 | DCK | 5 | 3000 | 178.0 | 9.2 | 2.4 | 2.4 | 1.22 | 4.0 | 8.0 | Q3 |
| SN74AUP1G32DCKR | SC70 | DCK | 5 | 3000 | 180.0 | 9.2 | 2.3 | 2.55 | 1.2 | 4.0 | 8.0 | Q3 |
| SN74AUP1G32DCKT | SC70 | DCK | 5 | 250 | 178.0 | 9.2 | 2.4 | 2.4 | 1.22 | 4.0 | 8.0 | Q3 |
| SN74AUP1G32DRLR | SOT | DRL | 5 | 4000 | 180.0 | 9.5 | 1.78 | 1.78 | 0.69 | 4.0 | 8.0 | Q3 |
| SN74AUP1G32DRLR | SOT | DRL | 5 | 4000 | 180.0 | 8.4 | 1.98 | 1.78 | 0.69 | 4.0 | 8.0 | Q3 |
| SN74AUP1G32DRY2 | SON | DRY | 6 | 5000 | 180.0 | 9.5 | 1.6 | 1.15 | 0.75 | 4.0 | 8.0 | Q3 |
| SN74AUP1G32DRYR | SON | DRY | 6 | 5000 | 180.0 | 9.5 | 1.15 | 1.6 | 0.75 | 4.0 | 8.0 | Q1 |
| SN74AUP1G32DSF2 | SON | DSF | 6 | 5000 | 180.0 | 9.5 | 1.16 | 1.16 | 0.5 | 4.0 | 8.0 | Q3 |
| SN74AUP1G32DSFR | SON | DSF | 6 | 5000 | 180.0 | 9.5 | 1.16 | 1.16 | 0.5 | 4.0 | 8.0 | Q2 |
| SN74AUP1G32YFPR | DSBGA | YFP | 6 | 3000 | 178.0 | 9.2 | 0.89 | 1.29 | 0.62 | 4.0 | 8.0 | Q1 |
| SN74AUP1G32YZPR | DSBGA | YZP | 5 | 3000 | 178.0 | 9.2 | 1.02 | 1.52 | 0.63 | 4.0 | 8.0 | Q1 |

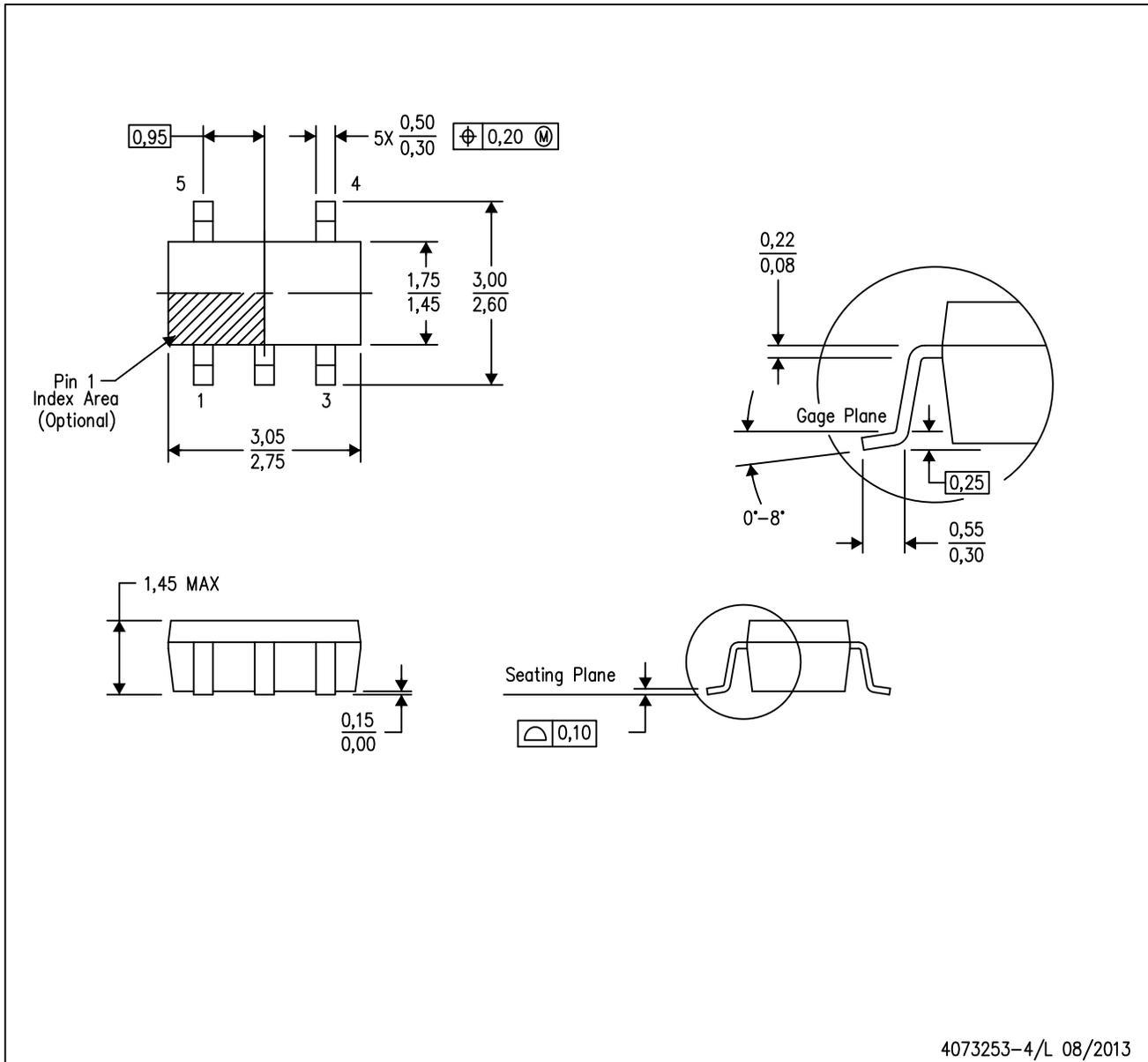
TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74AUP1G32DBVR | SOT-23 | DBV | 5 | 3000 | 202.0 | 201.0 | 28.0 |
| SN74AUP1G32DBVT | SOT-23 | DBV | 5 | 250 | 202.0 | 201.0 | 28.0 |
| SN74AUP1G32DCKR | SC70 | DCK | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| SN74AUP1G32DCKR | SC70 | DCK | 5 | 3000 | 205.0 | 200.0 | 33.0 |
| SN74AUP1G32DCKT | SC70 | DCK | 5 | 250 | 180.0 | 180.0 | 18.0 |
| SN74AUP1G32DRLR | SOT | DRL | 5 | 4000 | 184.0 | 184.0 | 19.0 |
| SN74AUP1G32DRLR | SOT | DRL | 5 | 4000 | 202.0 | 201.0 | 28.0 |
| SN74AUP1G32DRY2 | SON | DRY | 6 | 5000 | 184.0 | 184.0 | 19.0 |
| SN74AUP1G32DRYR | SON | DRY | 6 | 5000 | 184.0 | 184.0 | 19.0 |
| SN74AUP1G32DSF2 | SON | DSF | 6 | 5000 | 184.0 | 184.0 | 19.0 |
| SN74AUP1G32DSFR | SON | DSF | 6 | 5000 | 184.0 | 184.0 | 19.0 |
| SN74AUP1G32YFPR | DSBGA | YFP | 6 | 3000 | 220.0 | 220.0 | 35.0 |
| SN74AUP1G32YZPR | DSBGA | YZP | 5 | 3000 | 220.0 | 220.0 | 35.0 |

DBV (R-PDSO-G5)

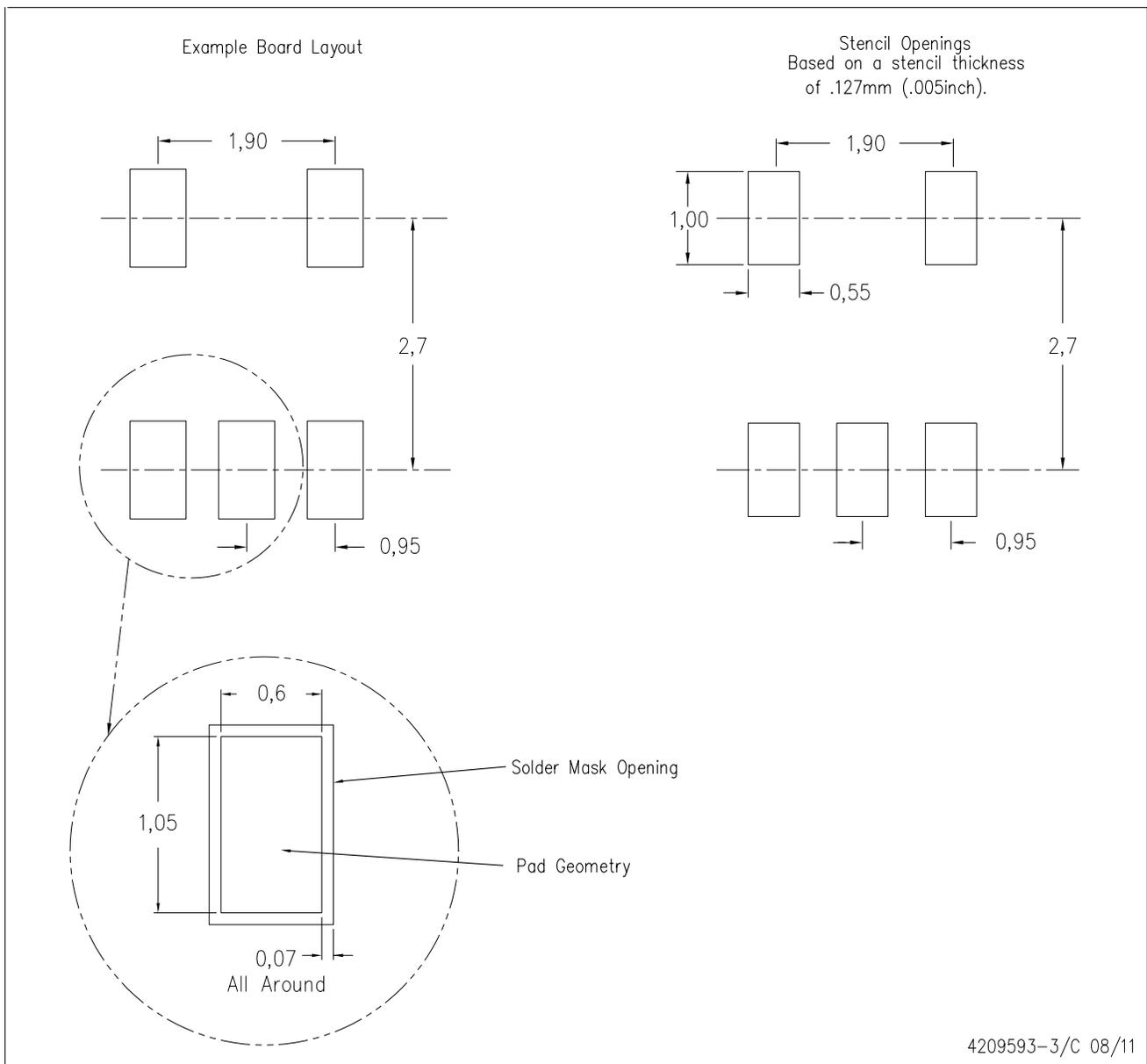
PLASTIC SMALL-OUTLINE PACKAGE



- 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-178 Variation AA.

DBV (R-PDSO-G5)

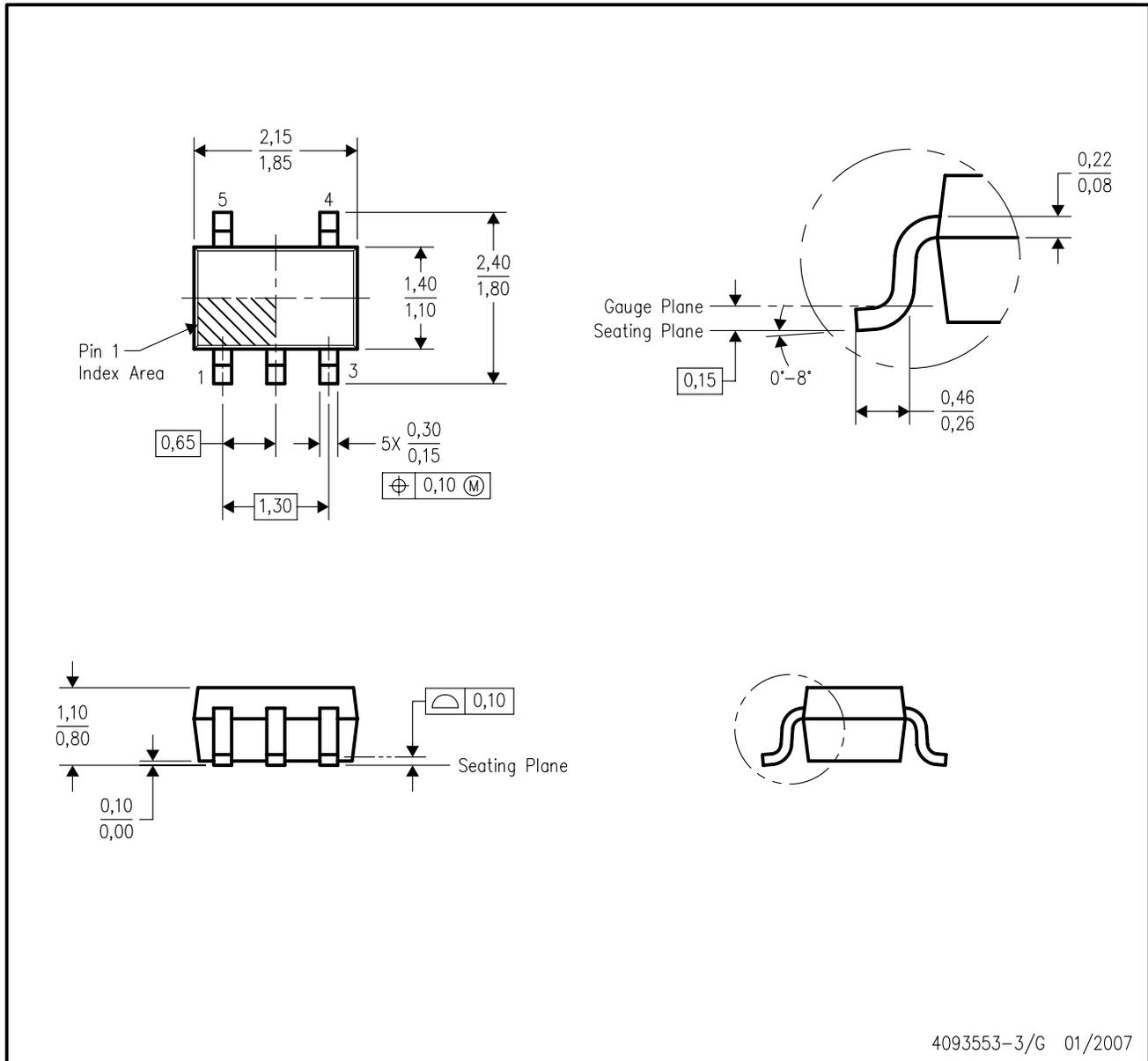
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. 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-G5)

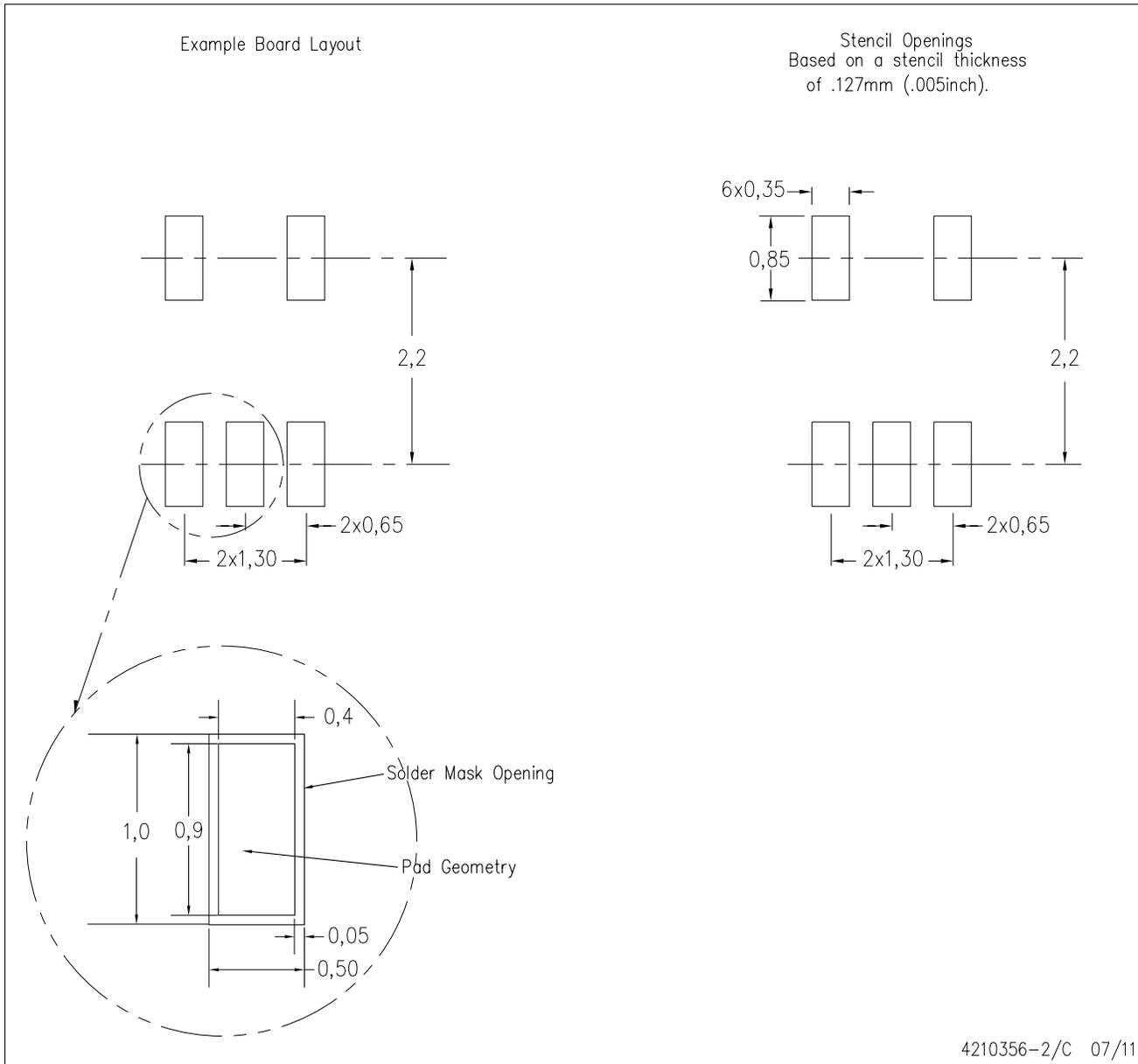
PLASTIC SMALL-OUTLINE PACKAGE



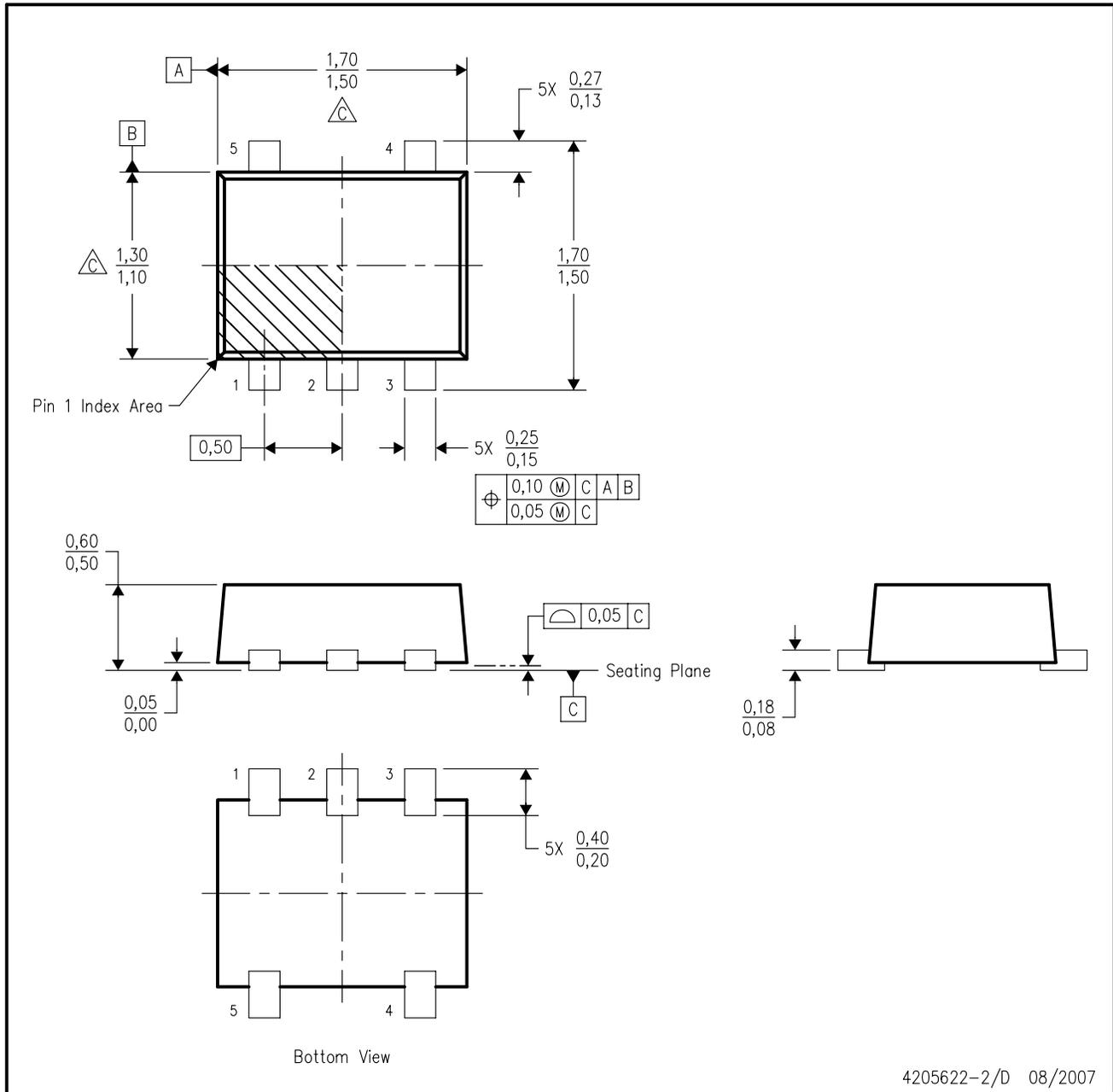
- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
 - D. Falls within JEDEC MO-203 variation AA.

DCK (R-PDSO-G5)

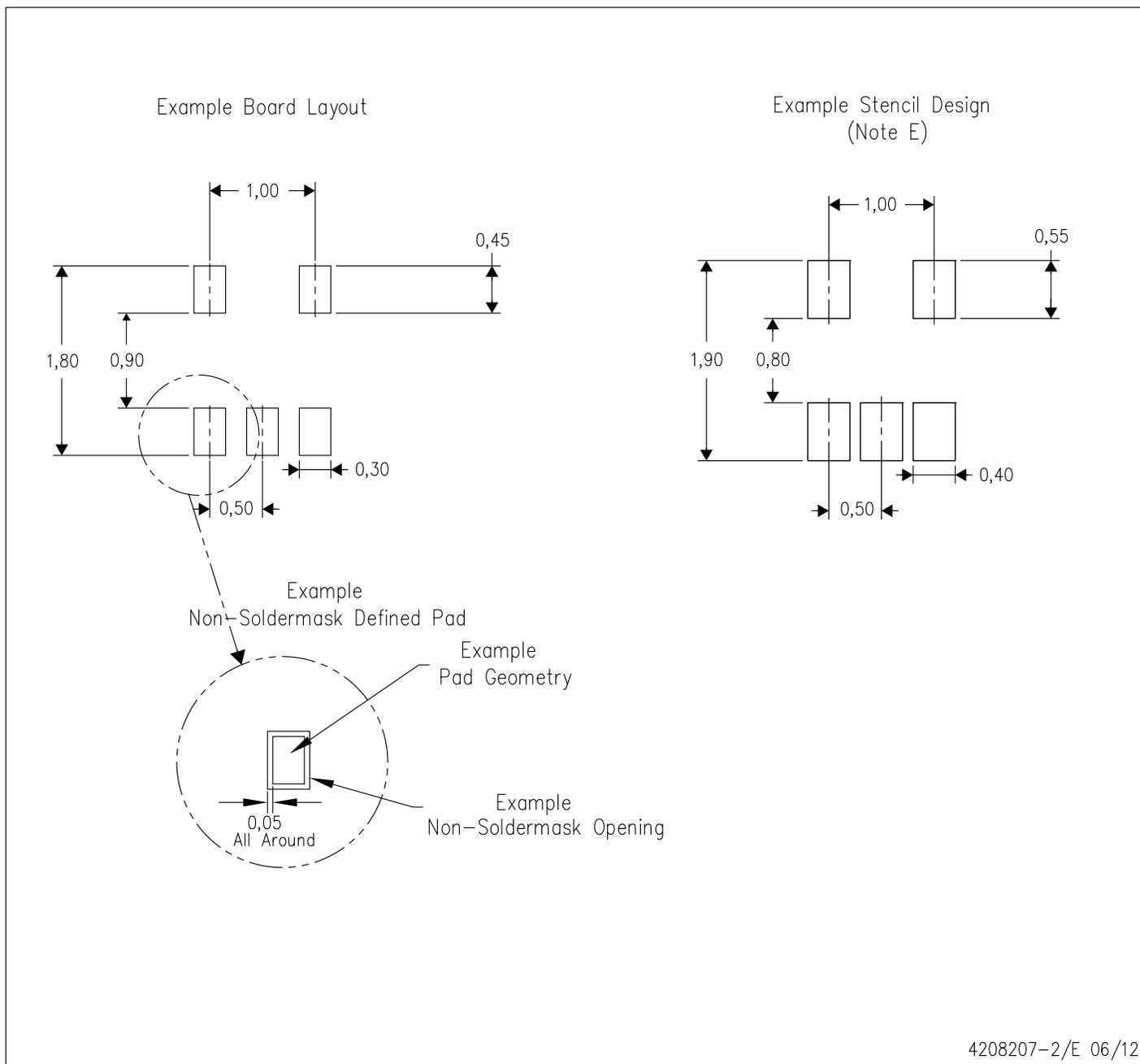
PLASTIC SMALL OUTLINE



- 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.



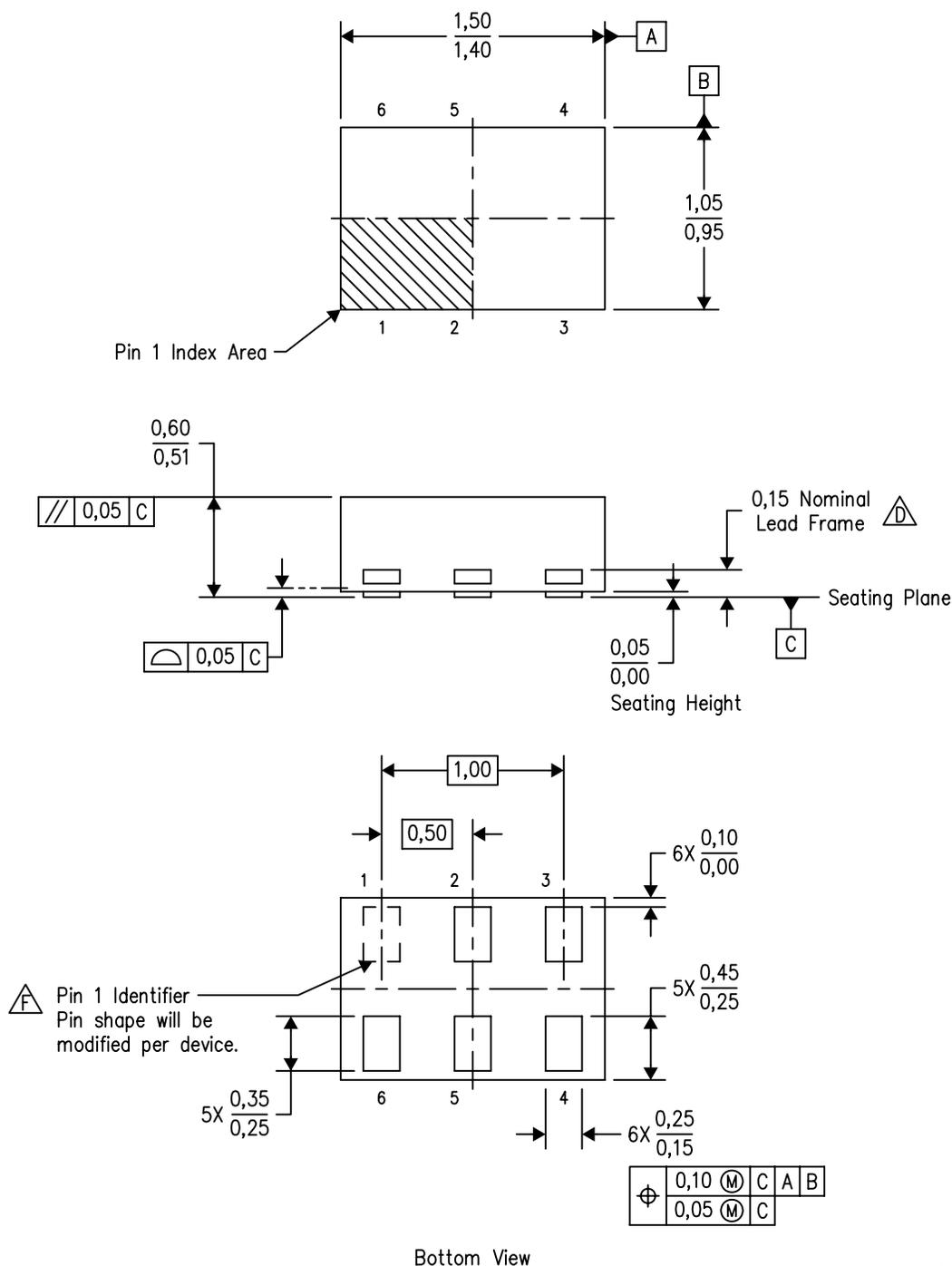
- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash, interlead flash, protrusions, or gate burrs. Mold flash, interlead flash, protrusions, or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



- 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.

DRY (R-PUSON-N6)

PLASTIC SMALL OUTLINE NO-LEAD

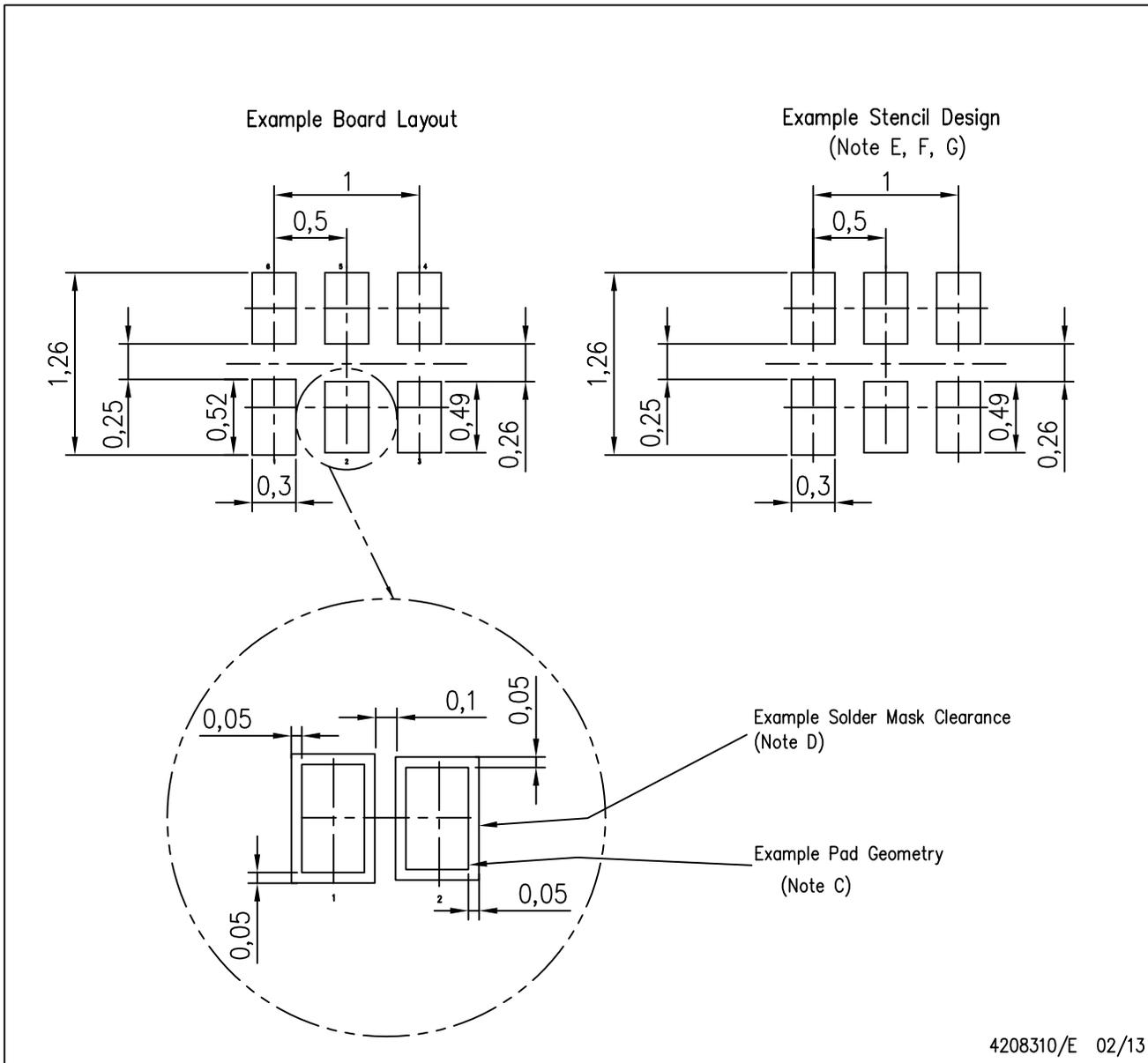


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- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. SON (Small Outline No-Lead) package configuration.
 - $\triangle D$ The exposed lead frame feature on side of package may or may not be present due to alternative lead frame designs.
 - E. This package complies to JEDEC MO-287 variation UFAD.
 - $\triangle F$ See the additional figure in the Product Data Sheet for details regarding the pin 1 identifier shape.

DRY (R-PUSON-N6)

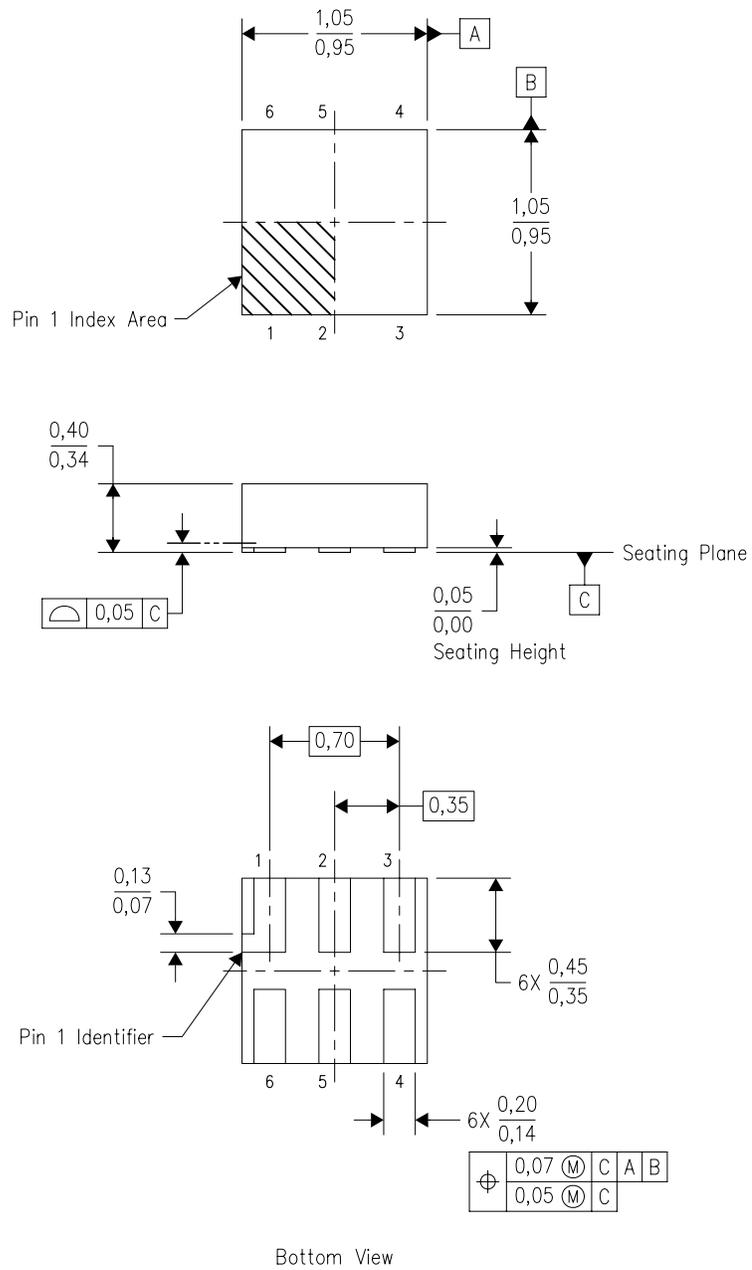
PLASTIC SMALL OUTLINE NO-LEAD



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads.
 - Maximum stencil thickness 0,127 mm (5 mils). All linear dimensions are in millimeters.
 - 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.
 - 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.

DSF (S-PX2SON-N6)

PLASTIC SMALL OUTLINE NO-LEAD

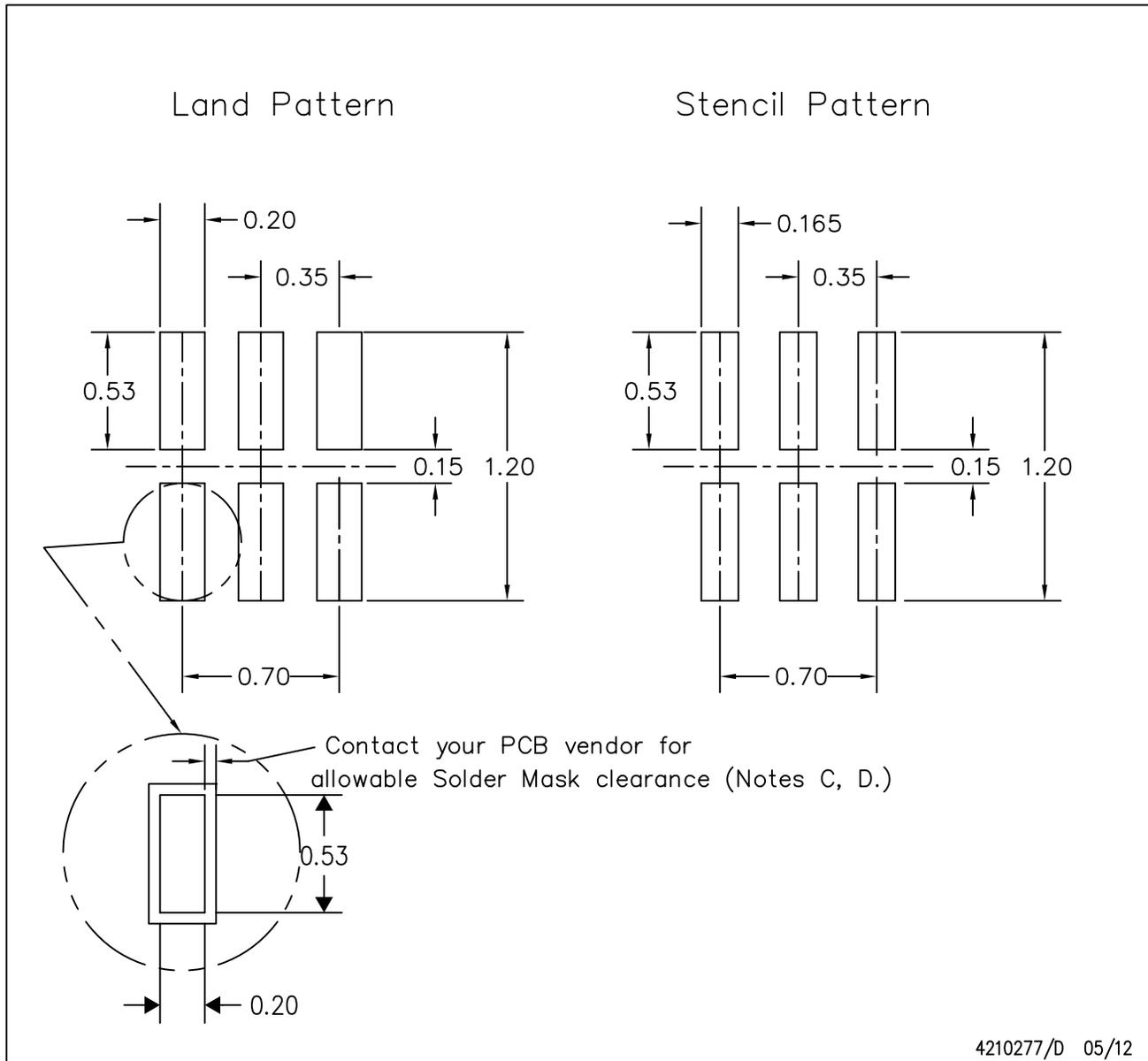


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- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - This drawing is subject to change without notice.
 - SON (Small Outline No-Lead) package configuration.
 - This package complies to JEDEC MO-287 variation X2AAF.

DSF (S-PX2SON-N6)

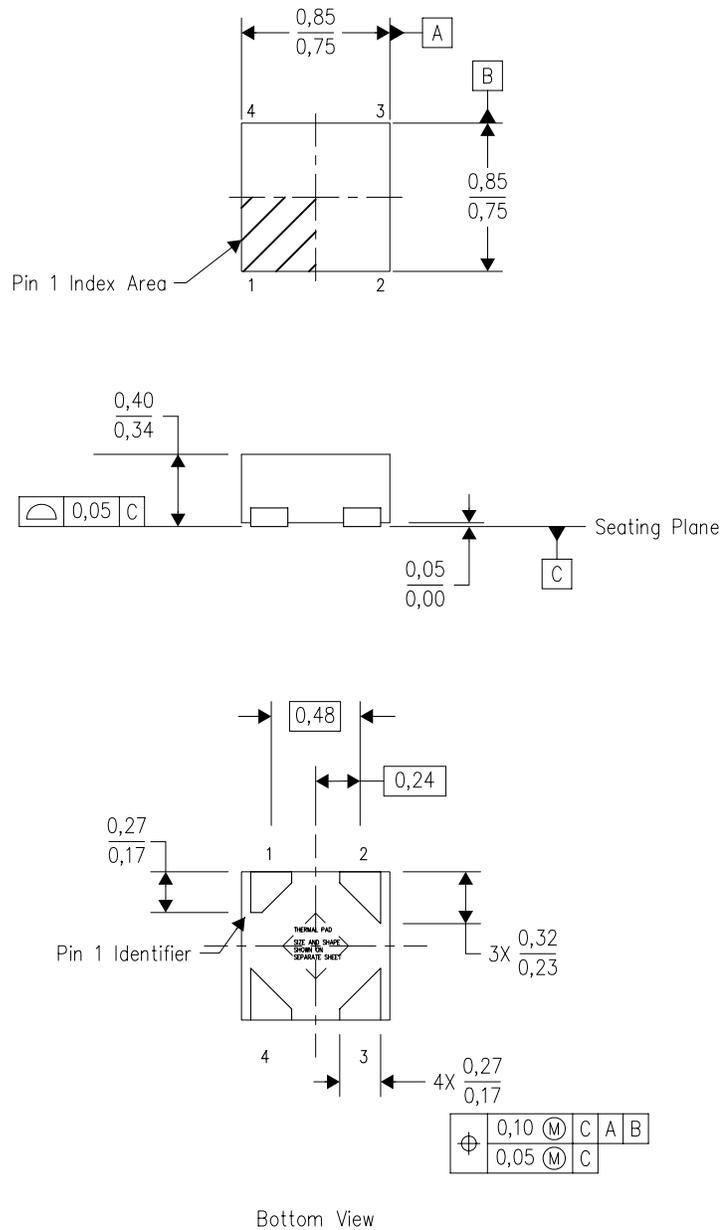
PLASTIC SMALL OUTLINE NO-LEAD



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads. If 2 mil solder mask is outside PCB vendor capability, it is advised to omit solder mask.
 - Maximum stencil thickness 0,1016 mm (4 mils). All linear dimensions are in millimeters.
 - 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.
 - Suggest stencils cut with lasers such as Fiber Laser that produce the greatest positional accuracy.
 - Component placement force should be minimized to prevent excessive paste block deformation.

DPW (S-PX2SON-N4)

PLASTIC SMALL OUTLINE NO-LEAD

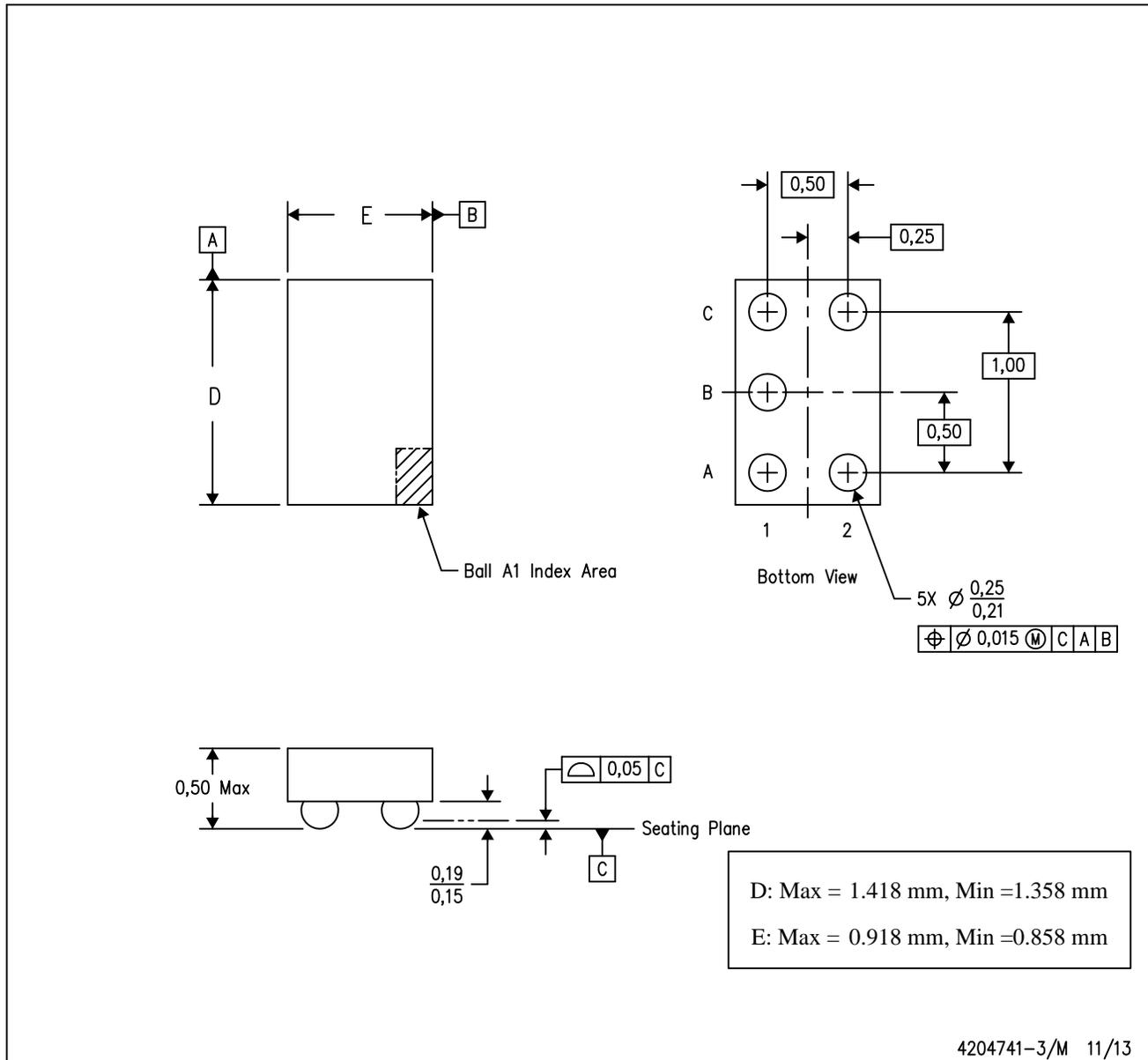


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- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - This drawing is subject to change without notice.
 - SON (Small Outline No-Lead) package configuration.
 - The package thermal pad must be soldered to the board for thermal and mechanical performance.
 - See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.

YZP (R-XBGA-N5)

DIE-SIZE BALL GRID ARRAY

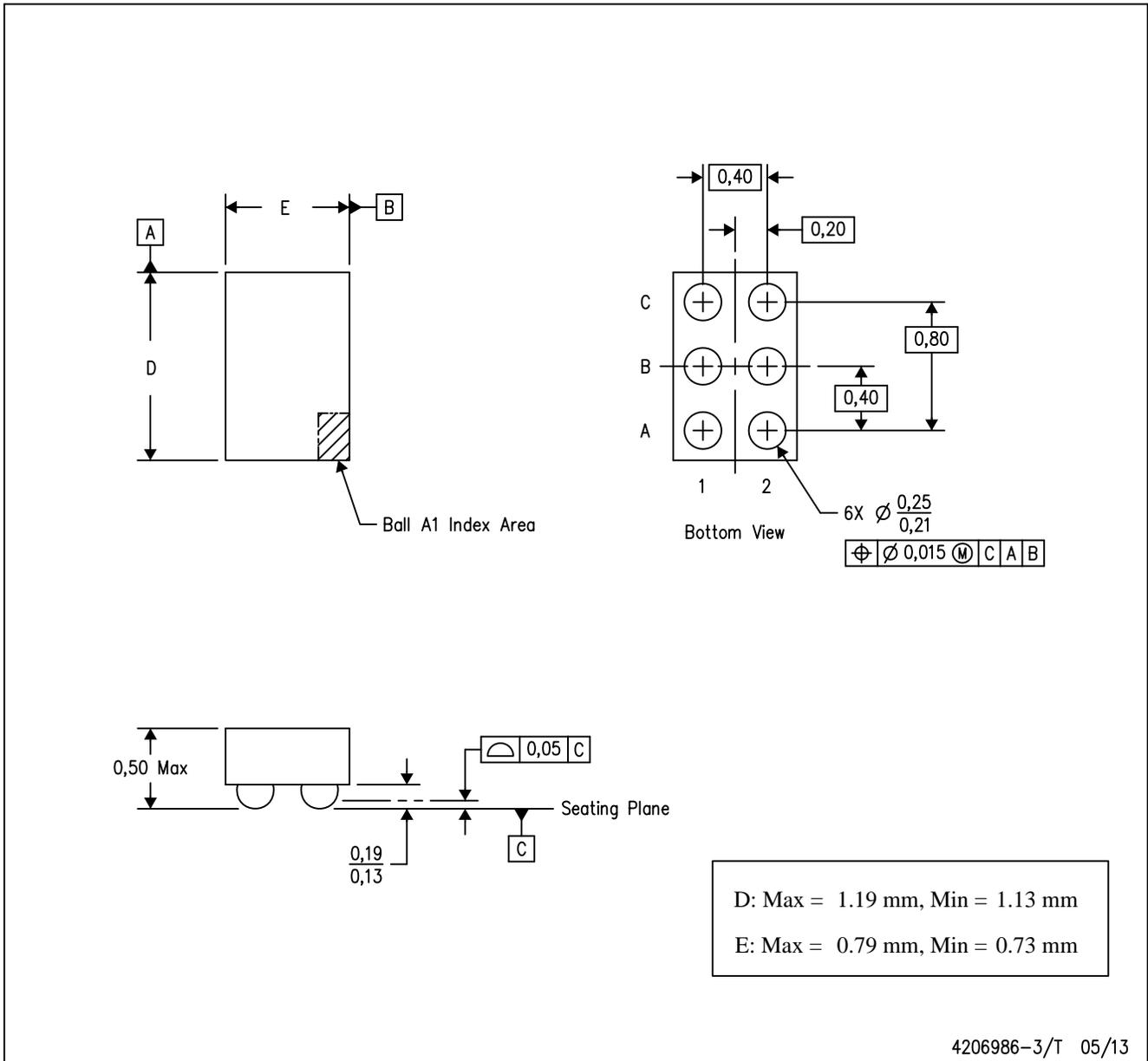


- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. NanoFree™ package configuration.

NanoFree is a trademark of Texas Instruments.

YFP (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.

NanoFree is a trademark of Texas Instruments

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