

SNx4LV245A Octal Bus Transceivers With 3-State Outputs

1 Features

- 2-V to 5.5-V V_{CC} Operation
- Max t_{pd} of 6.5 ns at 5 V
- Typical V_{OLP} (Output Ground Bounce) <0.8 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$
- Typical V_{OHV} (Output V_{OH} Undershoot) >2.3 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$
- Support Mixed-Mode Voltage Operation on All Ports
- I_{off} Supports Partial-Power-Down Mode Operation
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)

2 Applications

- Servers
- LED Displays
- Network Switches
- Telecom Infrastructure
- Motor Drivers
- I/O Expanders

3 Description

These octal bus transceivers are designed for 2-V to 5.5-V V_{CC} operation.

Device Information

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|-------------|------------|--------------------|
| SNx4LV245A | SSOP (20) | 7.20 mm x 5.30 mm |
| | TVSOP (20) | 5.00 mm x 4.40 mm |
| | TSSOP (20) | 6.50 mm x 4.40 mm |
| | VQFN (20) | 4.50 mm x 3.50 mm |
| | SOIC (20) | 12.80 mm x 7.50 mm |

4 Simplified Schematic

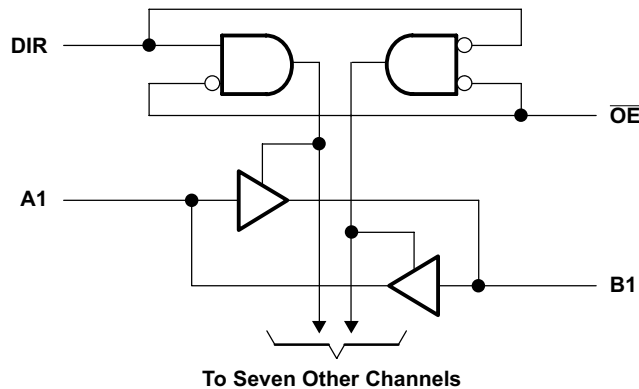


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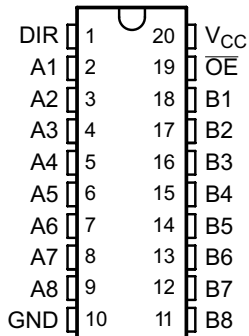
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5 Revision History

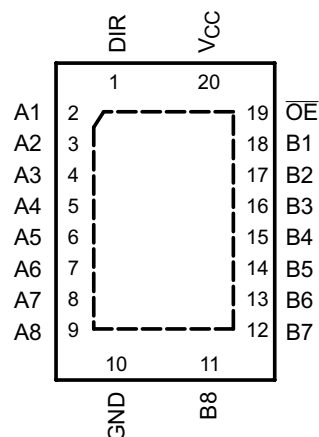
| Changes from Revision N (August 2012) to Revision O | Page |
|--|------|
| • Updated document to new TI data sheet format | 1 |
| • Deleted Ordering Information table. | 1 |
| • Added Applications | 1 |
| • Added Device Information table. | 1 |
| • Added Pin Functions table | 3 |
| • Added Handling Ratings table | 5 |
| • Changed MAX operating temperature to 125°C in Recommended Operating Conditions table. | 6 |
| • Added –40°C to 125°C for SN74LV245A in Electrical Characteristics table | 7 |
| • Added –40°C to 125°C for SN74LV245A in all three Switching Characteristics tables. | 7 |
| • Added Typical Characteristics | 9 |
| • Added Detailed Description section | 11 |
| • Added Application and Implementation section | 12 |
| • Added Power Supply Recommendations and Layout sections | 13 |

6 Pin Configuration and Functions

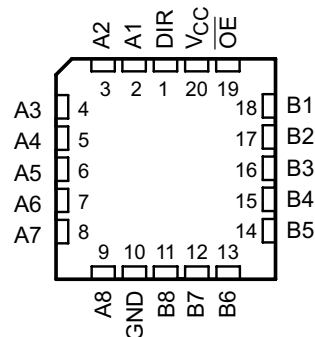
SN54LV245A . . . J OR W PACKAGE
SN74LV245A . . . DB, DGV, DW, NS,
OR PW PACKAGE
(TOP VIEW)



SN74LV245A . . . RGY PACKAGE
(TOP VIEW)

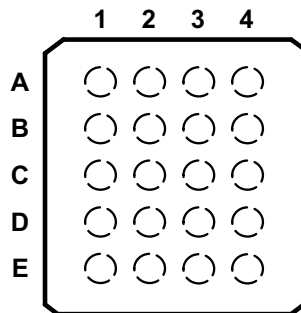


SN54LV245A . . . FK PACKAGE
(TOP VIEW)



Pin Functions

| PIN | | I/O | DESCRIPTION |
|-----|-----------------|-----|---------------|
| NO. | NAME | | |
| 1 | DIR | I | Direction Pin |
| 2 | A1 | I/O | A1 I/O |
| 3 | A2 | I/O | A2 I/O |
| 4 | A3 | I/O | A3 I/O |
| 5 | A4 | I/O | A4 I/O |
| 6 | A5 | I/O | A5 I/O |
| 7 | A6 | I/O | A6 I/O |
| 8 | A7 | I/O | A7 I/O |
| 9 | A8 | I/O | A8 I/O |
| 10 | GND | — | Ground Pin |
| 11 | B8 | I/O | B8 I/O |
| 12 | B7 | I/O | B7 I/O |
| 13 | B6 | I/O | B6 I/O |
| 14 | B5 | I/O | B5 I/O |
| 15 | B4 | I/O | B4 I/O |
| 16 | B3 | I/O | B3 I/O |
| 17 | B2 | I/O | B2 I/O |
| 18 | B1 | I/O | B1 I/O |
| 19 | \overline{OE} | I | Output Enable |
| 20 | V _{CC} | — | Power Pin |

**GQN PACKAGE
(TOP VIEW)**

Pin Assignments

| | 1 | 2 | 3 | 4 |
|---|-----|-----|-----------------|-----------------|
| A | A1 | DIR | V _{CC} | \overline{OE} |
| B | A3 | B2 | A2 | B1 |
| C | A5 | A4 | B4 | B3 |
| D | A7 | B6 | A6 | B5 |
| E | GND | A8 | B8 | B7 |

7 Specifications

7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)⁽¹⁾

| | | MIN | MAX | UNIT | |
|----------|---|---------------------------------|----------------|------|---|
| V_{CC} | Supply voltage range | -0.5 | 7 | V | |
| V_I | Input voltage range | Except I/O ports ⁽²⁾ | -0.5 | 7 | V |
| | | I/O ports ⁽²⁾⁽³⁾ | -0.5 | 7 | |
| V_O | Voltage range applied to any output in the high-impedance or power-off state ⁽²⁾ | -0.5 | 7 | V | |
| V_O | Output voltage range applied in the high or low state ⁽²⁾⁽³⁾ | -0.5 | $V_{CC} + 0.5$ | V | |
| I_{IK} | Input clamp current | $V_I < 0$ | -20 | mA | |
| I_{OK} | Output clamp current | $V_O < 0$ | -50 | mA | |
| I_O | Continuous output current | $V_O = 0$ to V_{CC} | ±35 | mA | |
| | Continuous current through V_{CC} or GND | | ±70 | 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.
- (3) This value is limited to 5.5-V maximum.

7.2 Handling Ratings

| | | MIN | MAX | UNIT | |
|-------------|---------------------------|--|-----|------|---|
| T_{stg} | Storage temperature range | -65 | 150 | °C | |
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins ⁽¹⁾ | 0 | 2000 | V |
| | | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins ⁽²⁾ | 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

 over operating free-air temperature range (unless otherwise noted)⁽¹⁾

| | | SN54LV245A ⁽²⁾ | | SN74LV245A | | UNIT | |
|-----------------|------------------------------------|----------------------------------|-----------------------|-----------------------|-----------------------|-----------------|---|
| | | MIN | MAX | MIN | MAX | | |
| V _{CC} | Supply voltage | 2 | 5.5 | 2 | 5.5 | V | |
| V _{IH} | High-level input voltage | V _{CC} = 2 V | 1.5 | 1.5 | | V | |
| | | V _{CC} = 2.3 V to 2.7 V | V _{CC} × 0.7 | V _{CC} × 0.7 | | | |
| | | V _{CC} = 3 V to 3.6 V | V _{CC} × 0.7 | V _{CC} × 0.7 | | | |
| | | V _{CC} = 4.5 V to 5.5 V | V _{CC} × 0.7 | V _{CC} × 0.7 | | | |
| V _{IL} | Low-level input voltage | V _{CC} = 2 V | | 0.5 | 0.5 | V | |
| | | V _{CC} = 2.3 V to 2.7 V | | V _{CC} × 0.3 | V _{CC} × 0.3 | | |
| | | V _{CC} = 3 V to 3.6 V | | V _{CC} × 0.3 | V _{CC} × 0.3 | | |
| | | V _{CC} = 4.5 V to 5.5 V | | V _{CC} × 0.3 | V _{CC} × 0.3 | | |
| V _I | Input voltage | 0 | 5.5 | 0 | 5.5 | V | |
| V _O | Output voltage | High or low state | 0 | V _{CC} | 0 | V _{CC} | V |
| | | 3-state | 0 | 5.5 | 0 | 5.5 | |
| I _{OH} | High-level output current | V _{CC} = 2 V | | –50 | –50 | μA | |
| | | V _{CC} = 2.3 V to 2.7 V | | –2 | –2 | | |
| | | V _{CC} = 3 V to 3.6 V | | –8 | –8 | mA | |
| | | V _{CC} = 4.5 V to 5.5 V | | –16 | –16 | | |
| I _{OL} | Low-level output current | V _{CC} = 2 V | | 50 | 50 | μA | |
| | | V _{CC} = 2.3 V to 2.7 V | | 2 | 2 | | |
| | | V _{CC} = 3 V to 3.6 V | | 8 | 8 | mA | |
| | | V _{CC} = 4.5 V to 5.5 V | | 16 | 16 | | |
| Δt/Δv | Input transition rise or fall rate | V _{CC} = 2.3 V to 2.7 V | | 200 | 200 | ns/V | |
| | | V _{CC} = 3 V to 3.6 V | | 100 | 100 | | |
| | | V _{CC} = 4.5 V to 5.5 V | | 20 | 20 | | |
| T _A | Operating free-air temperature | –55 | 125 | –40 | 125 | °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 (SCBA004)*.

(2) Product Preview

7.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | | SN74LV245A | | | | | | UNIT |
|-------------------------------|--|------------|-------|------|------|-------|------|------|
| | | DB | DGV | DW | NS | PW | RGY | |
| | | 20 PINS | | | | | | |
| R _{θJA} | Junction-to-ambient thermal resistance | 94.6 | 114.8 | 77.5 | 76.6 | 101.5 | 34.1 | °C/W |
| R _{θJC(top)} | Junction-to-case (top) thermal resistance | 56.3 | 30.1 | 43.7 | 43.0 | 35.6 | 38.4 | |
| R _{θJB} | Junction-to-board thermal resistance | 49.8 | 56.3 | 45.1 | 44.1 | 52.5 | 12.0 | |
| ψ _{JT} | Junction-to-top characterization parameter | 18.3 | 0.9 | 16.9 | 16.7 | 2.2 | 0.8 | |
| ψ _{JB} | Junction-to-board characterization parameter | 49.4 | 55.6 | 44.7 | 43.7 | 52.0 | 12.0 | |
| R _{θJC(bot)} | Junction-to-case (bottom) thermal resistance | — | — | — | — | — | 7.1 | |

(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} | SN54LV245A ⁽¹⁾ | | | –40°C to 85°C SN74LV245A | | | –40°C to 125°C SN74LV245A | | | UNIT | |
|------------------|--------------------------|---|---------------------------|-----|-----|-----------------------------|-----|-----|------------------------------|-----|-----|------|----|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | | |
| V _{OH} | I _{OH} = –50 μA | 2 V to 5.5 V | V _{CC} – 0.1 | | | V _{CC} – 0.1 | | | V _{CC} – 0.1 | | | V | |
| | I _{OH} = –2 mA | 2.3 V | 2 | | | 2 | | | 2 | | | | |
| | I _{OH} = –8 mA | 3 V | 2.48 | | | 2.48 | | | 2.48 | | | | |
| | I _{OH} = –16 mA | 4.5 V | 3.8 | | | 3.8 | | | 3.8 | | | | |
| V _{OL} | I _{OL} = 50 μA | 2 V to 5.5 V | 0.1 | | | 0.1 | | | 0.1 | | | V | |
| | I _{OL} = 2 mA | 2.3 V | 0.4 | | | 0.4 | | | 0.4 | | | | |
| | I _{OL} = 8 mA | 3 V | 0.44 | | | 0.44 | | | 0.44 | | | | |
| | I _{OL} = 16 mA | 4.5 V | 0.55 | | | 0.55 | | | 0.55 | | | | |
| I _I | Control inputs | V _I = 5.5 V or GND | 0 to 5.5 V | | | ±1 | | | ±1 | | | μA | |
| I _{OZ} | A or B port | V _O = V _{CC} or GND | 5.5 V | | | ±5 | | | ±5 | | | μA | |
| I _{CC} | | V _I = V _{CC} or GND, I _O = 0 | 5.5 V | | | 20 | | | 20 | | | μA | |
| I _{off} | | V _I or V _O = 0 to 5.5 V | 0 | | | 5 | | | 5 | | | μA | |
| C _i | Control inputs | V _I = V _{CC} or GND | 3.3 V | 3 | | | 3 | | | | | | pF |
| | | | 5 V | 3 | | | 3 | | | | | | |
| C _{io} | A or B port | V _O = V _{CC} or GND | 3.3 V | 5.5 | | | 5.5 | | | | | | pF |
| | | | 5 V | 5.5 | | | 5.5 | | | | | | |

(1) Product Preview

7.6 Switching Characteristics, V_{CC} = 2.5 V ± 0.2 V

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

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE | T _A = 25°C | | | SN54LV245A ⁽¹⁾ | | SN74LV245A | | –40°C to 125°C SN74LV245A | | UNIT |
|--------------------|------------------------|-------------|------------------------|---|-----|-----|---------------------------|-------------------|------------|-----|------------------------------|-----|------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t _{pd} | A or B | B or A | C _L = 15 pF | 8.3 ⁽²⁾ 13 ⁽²⁾ | | | 1 ⁽²⁾ | 15 ⁽²⁾ | 1 | 15 | 1 | 17 | ns |
| t _{en} | $\overline{\text{OE}}$ | A or B | | 11.8 ⁽²⁾ 19.9 ⁽²⁾ | | | 1 ⁽²⁾ | 22 ⁽²⁾ | 1 | 22 | 1 | 24 | |
| t _{dis} | $\overline{\text{OE}}$ | A or B | | 11.8 ⁽²⁾ 18.1 ⁽²⁾ | | | 1 ⁽²⁾ | 20 ⁽²⁾ | 1 | 20 | 1 | 22 | |
| t _{pd} | A or B | B or A | C _L = 50 pF | 11.2 15.9 | | | 1 | 18 | 1 | 18 | 1 | 21 | ns |
| t _{en} | $\overline{\text{OE}}$ | A or B | | 14.1 22.7 | | | 1 | 26 | 1 | 26 | 1 | 28 | |
| t _{dis} | $\overline{\text{OE}}$ | A or B | | 17.6 23.1 | | | 1 | 25 | 1 | 25 | 1 | 27 | |
| t _{sk(o)} | | | | 2 | | | | | 2 | | | | |

(1) Product Preview

(2) On products compliant to MIL-PRF-38535, this parameter is not production tested.

SN54LV245A, SN74LV245A

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7.7 Switching Characteristics, $V_{CC} = 3.3 V \pm 0.3 V$

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 3)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE | $T_A = 25^\circ\text{C}$ | | | SN54LV245A ⁽¹⁾ | | SN74LV245A | | -40°C to 125°C SN74LV245A | | UNIT |
|-------------|-----------------|-------------|-----------------------|--------------------------|--------------------|---------------------|---------------------------|---------------------|------------|------|------------------------------|------|------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_{pd} | A or B | B or A | $C_L = 15 \text{ pF}$ | | 5.9 ⁽²⁾ | 8.4 ⁽²⁾ | 1 ⁽²⁾ | 10 ⁽²⁾ | 1 | 10 | 1 | 11 | ns |
| t_{en} | \overline{OE} | A or B | | | 8.2 ⁽²⁾ | 13.2 ⁽²⁾ | 1 ⁽²⁾ | 15.5 ⁽²⁾ | 1 | 15.5 | 1 | 16.5 | |
| t_{dis} | \overline{OE} | A or B | | | 9.6 ⁽²⁾ | 16.5 ⁽²⁾ | 1 ⁽²⁾ | 19.5 ⁽²⁾ | 1 | 19.5 | 1 | 20.5 | |
| t_{pd} | A or B | B or A | $C_L = 50 \text{ pF}$ | | 7.9 | 11.9 | 1 | 13.5 | 1 | 13.5 | 1 | 14.5 | ns |
| t_{en} | \overline{OE} | A or B | | | 9.9 | 16.7 | 1 | 19 | 1 | 19 | 1 | 20 | |
| t_{dis} | \overline{OE} | A or B | | | 13.9 | 19.8 | 1 | 22 | 1 | 22 | 1 | 23 | |
| $t_{sk(o)}$ | | | | | | 1.5 | | | | 1.5 | | | |

(1) Product Preview

(2) On products compliant to MIL-PRF-38535, this parameter is not production tested.

7.8 Switching Characteristics, $V_{CC} = 5 V \pm 0.5 V$

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 3)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE | $T_A = 25^\circ\text{C}$ | | | SN54LV245A ⁽¹⁾ | | SN74LV245A | | -40°C to 125°C SN74LV245A | | UNIT |
|-------------|-----------------|-------------|-----------------------|--------------------------|--------------------|---------------------|---------------------------|---------------------|------------|------|------------------------------|------|------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_{pd} | A or B | B or A | $C_L = 15 \text{ pF}$ | | 4.3 ⁽²⁾ | 5.5 ⁽²⁾ | 1 ⁽²⁾ | 6.5 ⁽²⁾ | 1 | 6.5 | 1 | 7 | ns |
| t_{en} | \overline{OE} | A or B | | | 5.7 ⁽²⁾ | 8.5 ⁽²⁾ | 1 ⁽²⁾ | 10.6 ⁽²⁾ | 1 | 10 | 1 | 10.5 | |
| t_{dis} | \overline{OE} | A or B | | | 7.8 ⁽²⁾ | 12.8 ⁽²⁾ | 1 ⁽²⁾ | 14.7 ⁽²⁾ | 1 | 14.2 | 1 | 14.7 | |
| t_{pd} | A or B | B or A | $C_L = 50 \text{ pF}$ | | 5.6 | 7.5 | 1 | 8.5 | 1 | 8.5 | 1 | 9 | ns |
| t_{en} | \overline{OE} | A or B | | | 7 | 10.6 | 1 | 12 | 1 | 12 | 1 | 12.5 | |
| t_{dis} | \overline{OE} | A or B | | | 10.9 | 14.7 | 1 | 16 | 1 | 16 | 1 | 16.5 | |
| $t_{sk(o)}$ | | | | | | 1 | | | | 1 | | | |

(1) Product Preview

(2) On products compliant to MIL-PRF-38535, this parameter is not production tested.

7.9 Noise Characteristics⁽¹⁾

$V_{CC} = 3.3 V$, $C_L = 50 \text{ pF}$, $T_A = 25^\circ\text{C}$

| PARAMETER | DESCRIPTION | SN74LV245A | | | UNIT |
|-------------|--|------------|------|------|------|
| | | MIN | TYP | MAX | |
| $V_{OL(P)}$ | Quiet output, maximum dynamic V_{OL} | | 0.5 | 0.8 | V |
| $V_{OL(V)}$ | Quiet output, minimum dynamic V_{OL} | | -0.4 | -0.8 | V |
| $V_{OH(V)}$ | Quiet output, minimum dynamic V_{OH} | | 2.9 | | V |
| $V_{IH(D)}$ | High-level dynamic input voltage | 2.31 | | | V |
| $V_{IL(D)}$ | Low-level dynamic input voltage | 0.99 | | | V |

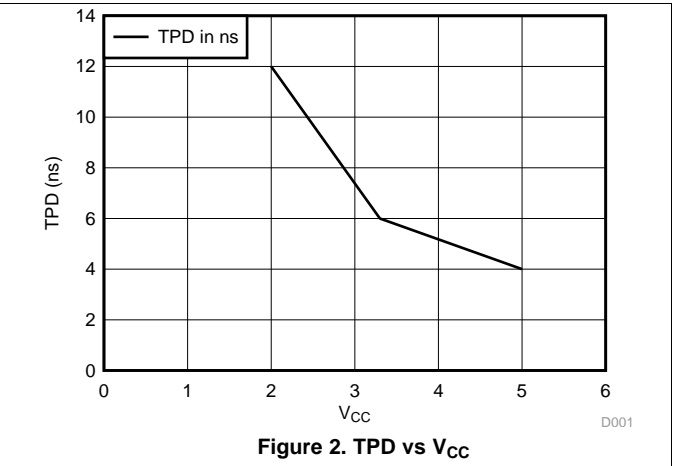
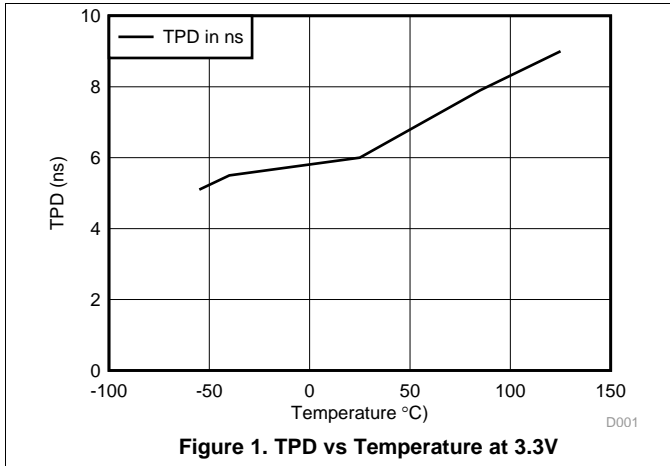
(1) Characteristics are for surface-mount packages only.

7.10 Operating Characteristics

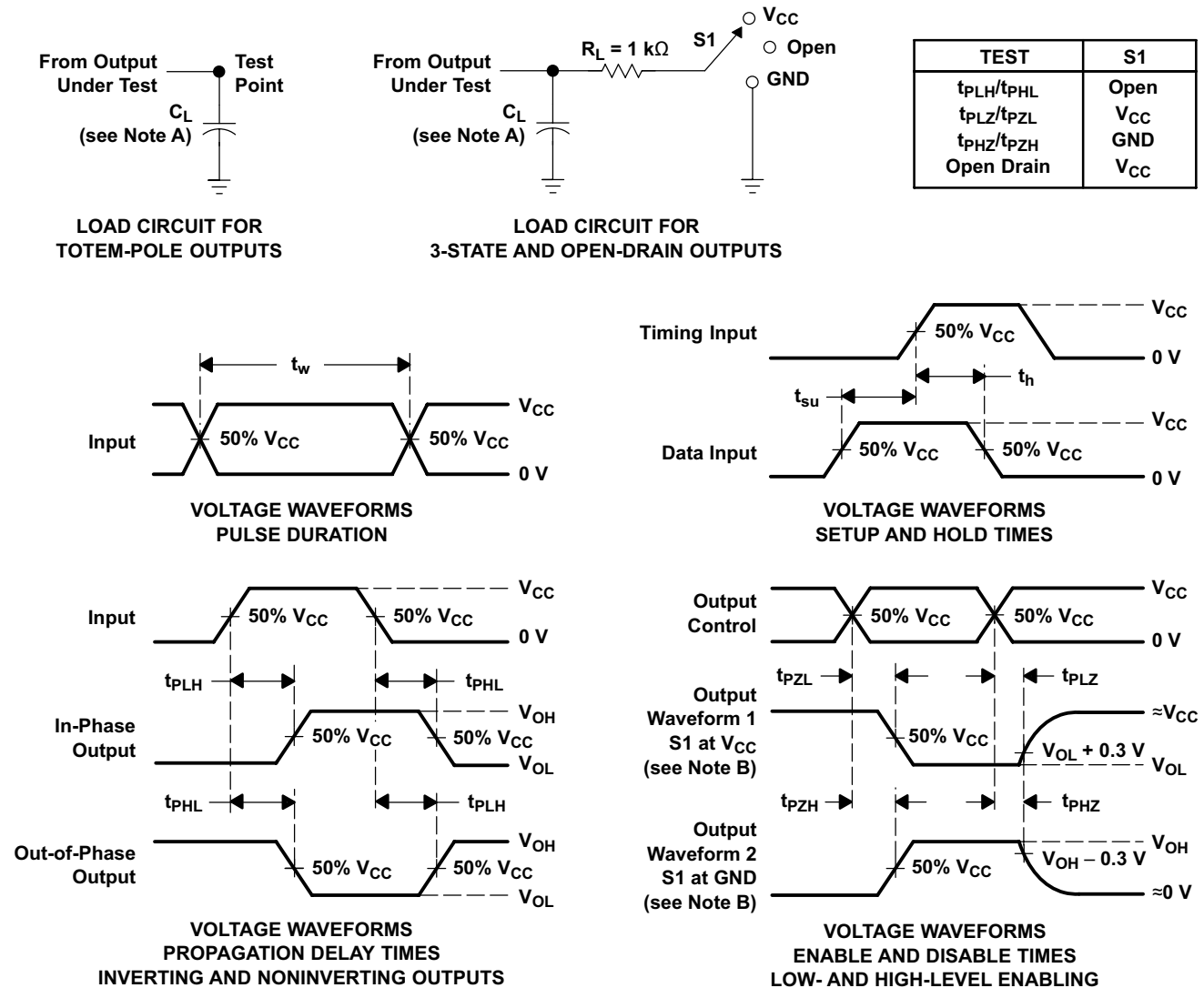
$T_A = 25^\circ\text{C}$

| PARAMETER | | TEST CONDITIONS | V_{CC} | TYP | UNIT | |
|-----------|-------------------------------|-----------------|--|-------|------|----|
| C_{pd} | Power dissipation capacitance | Outputs enabled | $C_L = 50 \text{ pF}$, $f = 10 \text{ MHz}$ | 3.3 V | 20 | pF |
| | | | | 5 V | 25 | |

7.11 Typical Characteristics



8 Parameter Measurement Information



- 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: $PRR \leq 1\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 3\text{ ns}$, $t_f \leq 3\text{ ns}$.
 - D. The outputs are measured one at a time, with one input 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_{PHL} and t_{PLH} are the same as t_{pd} .
 - H. All parameters and waveforms are not applicable to all devices.

Figure 3. Load Circuit and Voltage Waveforms

9 Detailed Description

9.1 Overview

The SNx4LV245A devices are designed for asynchronous communication between data buses. The device transmits data from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable (\overline{OE}) input can be used to disable the device so the buses are effectively isolated.

To ensure the high-impedance state during power up or power down, \overline{OE} should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

These devices are fully specified for partial-power-down applications using I_{off} . The I_{off} circuitry disables the outputs, preventing damaging current backflow through the devices when they are powered down.

9.2 Functional Block Diagram

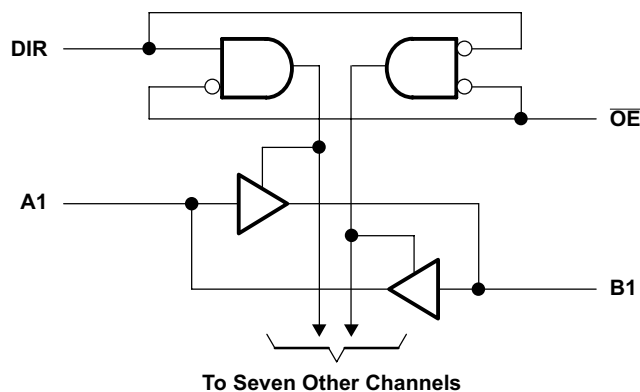


Figure 4. Logic Diagram (Positive Logic)

9.3 Feature Description

- Allows down voltage translation from 5 V to 3.3 V
 - Inputs accept voltage levels up to 5.5 V
- Slow edge rates minimize output ringing

9.4 Device Functional Modes

Table 1. Function Table

| INPUTS | | OPERATION |
|-----------------|-----|-----------------|
| \overline{OE} | DIR | |
| L | L | B data to A bus |
| L | H | A data to B bus |
| H | X | Isolation |

10 Application and Implementation

10.1 Application Information

The SNx4LV245A is a low-drive CMOS device that can be used for a multitude of bus-interface type applications where output ringing is a concern. The low drive and slow edge rates will minimize overshoot and undershoot on the outputs. The inputs can accept voltages to 5.5 V at any valid V_{CC} making the device ideal for down translation.

10.2 Typical Application

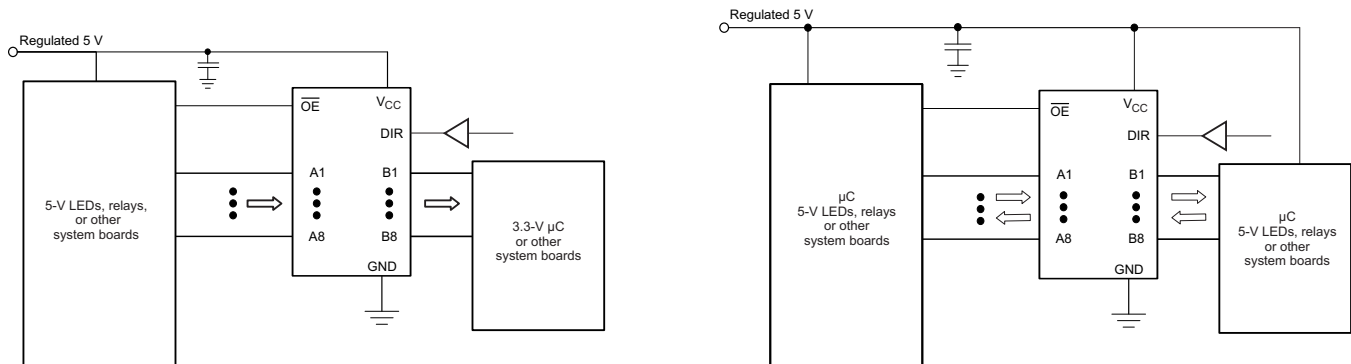


Figure 5. Typical Application Schematic

10.2.1 Design Requirements

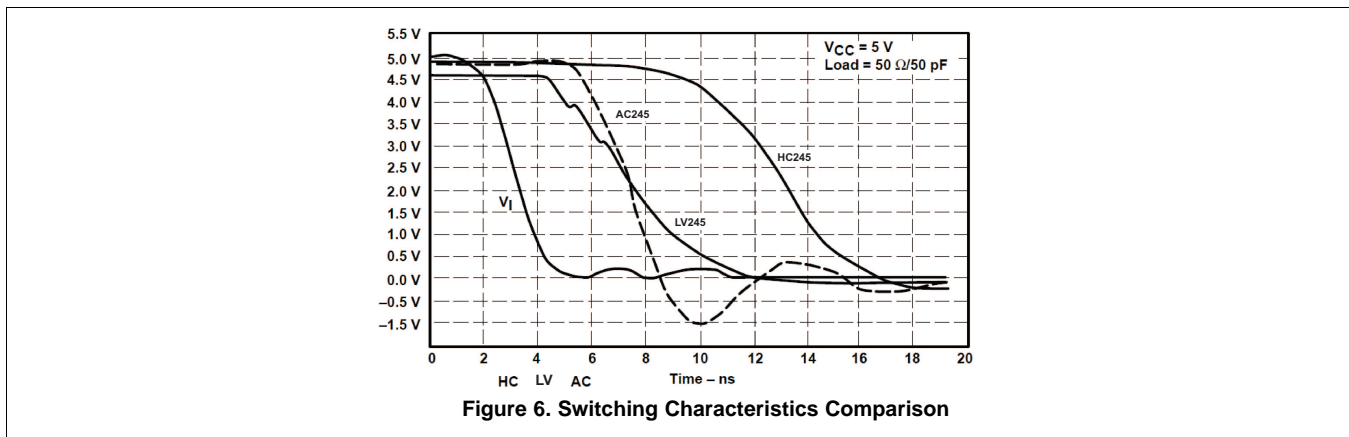
This device uses CMOS technology and has balanced output drive. Care should be taken to avoid bus contention, because it can drive currents that would exceed maximum limits. Outputs can be combined to produce higher drive, but the high drive will also create faster edges into light loads; therefore, routing and load conditions should be considered to prevent ringing.

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 5.5 V at any valid V_{CC} .
2. Recommend Output Conditions:
 - Load currents should not exceed 35 mA per output and 70 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 μF is recommended and if there are multiple V_{CC} terminals then 0.01 μF or 0.022 μF is recommended for each power terminal. It is acceptable to parallel multiple bypass caps to reject different frequencies of noise. A 0.1 μF and 1 μF 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 in [Figure 7](#) 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 makes more sense or is more convenient. It is generally acceptable 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/Os so they cannot float when disabled.

12.2 Layout Example

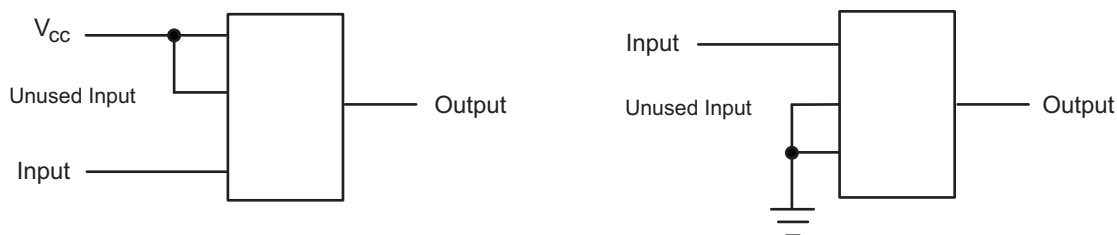


Figure 7. Layout Diagram

13 Device and Documentation Support

13.1 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

Table 2. Related Links

| PARTS | PRODUCT FOLDER | SAMPLE & BUY | TECHNICAL DOCUMENTS | TOOLS & SOFTWARE | SUPPORT & COMMUNITY |
|------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| SN54LV245A | Click here | Click here | Click here | Click here | Click here |
| SN74LV245A | Click here | Click here | Click here | Click here | Click here |

13.2 Trademarks

All trademarks are the property of their respective owners.

13.3 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.

13.4 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 |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| SN74LV245ADBR | ACTIVE | SSOP | DB | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV245A | Samples |
| SN74LV245ADGVR | ACTIVE | TVSOP | DGV | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV245A | Samples |
| SN74LV245ADGVRG4 | ACTIVE | TVSOP | DGV | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV245A | Samples |
| SN74LV245ADW | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV245A | Samples |
| SN74LV245ADWE4 | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV245A | Samples |
| SN74LV245ADWG4 | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV245A | Samples |
| SN74LV245ADWR | ACTIVE | SOIC | DW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV245A | Samples |
| SN74LV245ADWRG4 | ACTIVE | SOIC | DW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV245A | Samples |
| SN74LV245ANSR | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 74LV245A | Samples |
| SN74LV245ANSRG4 | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 74LV245A | Samples |
| SN74LV245APW | ACTIVE | TSSOP | PW | 20 | 70 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV245A | Samples |
| SN74LV245APWG4 | ACTIVE | TSSOP | PW | 20 | 70 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV245A | Samples |
| SN74LV245APWR | ACTIVE | TSSOP | PW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -40 to 125 | LV245A | Samples |
| SN74LV245APWRE4 | ACTIVE | TSSOP | PW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV245A | Samples |
| SN74LV245APWRG3 | ACTIVE | TSSOP | PW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | LV245A | Samples |
| SN74LV245APWRG4 | ACTIVE | TSSOP | PW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | LV245A | Samples |
| SN74LV245ARGYR | ACTIVE | VQFN | RGY | 20 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR | -40 to 125 | LV245A | Samples |

| 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 |
|------------------|---------------|----------------------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|----------------|
| SN74LV245AZQNR | ACTIVE | BGA MICROSTAR JUNIOR | ZQN | 20 | 1000 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM | -40 to 85 | LV245A | 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 |
|-----------------|----------------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74LV245ADBR | SSOP | DB | 20 | 2000 | 330.0 | 16.4 | 8.2 | 7.5 | 2.5 | 12.0 | 16.0 | Q1 |
| SN74LV245ADGVR | TVSOP | DGV | 20 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74LV245ADWR | SOIC | DW | 20 | 2000 | 330.0 | 24.4 | 10.8 | 13.3 | 2.7 | 12.0 | 24.0 | Q1 |
| SN74LV245ANSR | SO | NS | 20 | 2000 | 330.0 | 24.4 | 9.0 | 13.0 | 2.4 | 12.0 | 24.0 | Q1 |
| SN74LV245APWR | TSSOP | PW | 20 | 2000 | 330.0 | 16.4 | 6.95 | 7.1 | 1.6 | 8.0 | 16.0 | Q1 |
| SN74LV245APWR | TSSOP | PW | 20 | 2000 | 330.0 | 16.4 | 6.95 | 7.1 | 1.6 | 8.0 | 16.0 | Q1 |
| SN74LV245APWRG3 | TSSOP | PW | 20 | 2000 | 330.0 | 16.4 | 6.95 | 7.1 | 1.6 | 8.0 | 16.0 | Q1 |
| SN74LV245ARGYR | VQFN | RGY | 20 | 3000 | 330.0 | 12.4 | 3.8 | 4.8 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74LV245AZQNR | BGA MICROSTAR JUNIOR | ZQN | 20 | 1000 | 330.0 | 12.4 | 3.3 | 4.3 | 1.6 | 8.0 | 12.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-----------------|----------------------|-----------------|------|------|-------------|------------|-------------|
| SN74LV245ADBR | SSOP | DB | 20 | 2000 | 367.0 | 367.0 | 38.0 |
| SN74LV245ADGVR | TVSOP | DGV | 20 | 2000 | 367.0 | 367.0 | 35.0 |
| SN74LV245ADWR | SOIC | DW | 20 | 2000 | 367.0 | 367.0 | 45.0 |
| SN74LV245ANSR | SO | NS | 20 | 2000 | 367.0 | 367.0 | 45.0 |
| SN74LV245APWR | TSSOP | PW | 20 | 2000 | 367.0 | 367.0 | 38.0 |
| SN74LV245APWR | TSSOP | PW | 20 | 2000 | 364.0 | 364.0 | 27.0 |
| SN74LV245APWRG3 | TSSOP | PW | 20 | 2000 | 364.0 | 364.0 | 27.0 |
| SN74LV245ARGYR | VQFN | RGY | 20 | 3000 | 367.0 | 367.0 | 35.0 |
| SN74LV245AZQNR | BGA MICROSTAR JUNIOR | ZQN | 20 | 1000 | 336.6 | 336.6 | 28.6 |

RGY (R-PVQFN-N20)

PLASTIC QUAD FLATPACK NO-LEAD



- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - This drawing is subject to change without notice.
 - QFN (Quad Flatpack 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.
 - Pin 1 identifiers are located on both top and bottom of the package and within the zone indicated. The Pin 1 identifiers are either a molded, marked, or metal feature.
 - Package complies to JEDEC MO-241 variation BA.

RGY (R-PVQFN-N20)

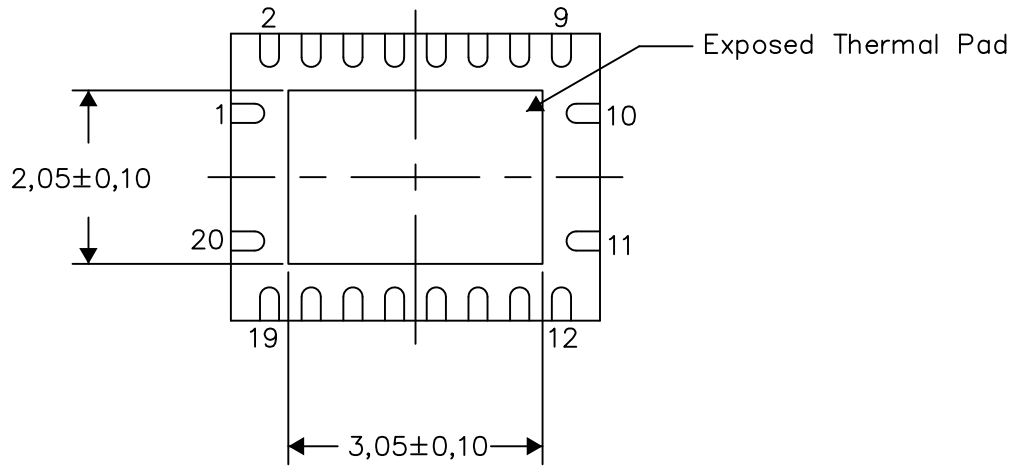
PLASTIC QUAD FLATPACK NO-LEAD

THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at www.ti.com.

The exposed thermal pad dimensions for this package are shown in the following illustration.



Bottom View

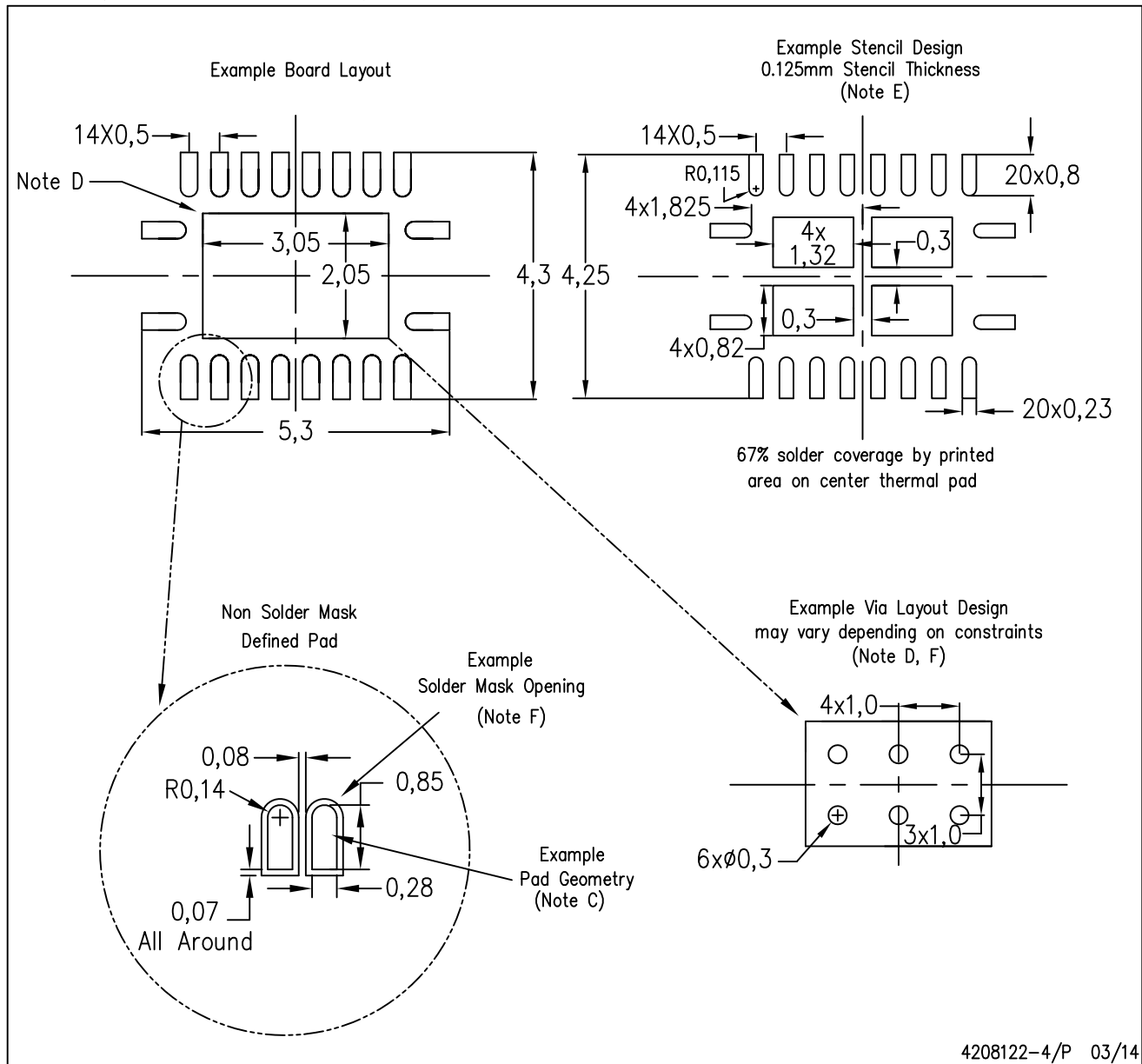
Exposed Thermal Pad Dimensions

4206353-4/P 03/14

NOTE: All linear dimensions are in millimeters

RGY (R-PVQFN-N20)

PLASTIC QUAD FLATPACK NO-LEAD



4208122-4/P 03/14

- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, Quad Flat-Pack QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at www.ti.com <<http://www.ti.com>>.
 - 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.
 - Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads.

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- 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, not to exceed 0,15.

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

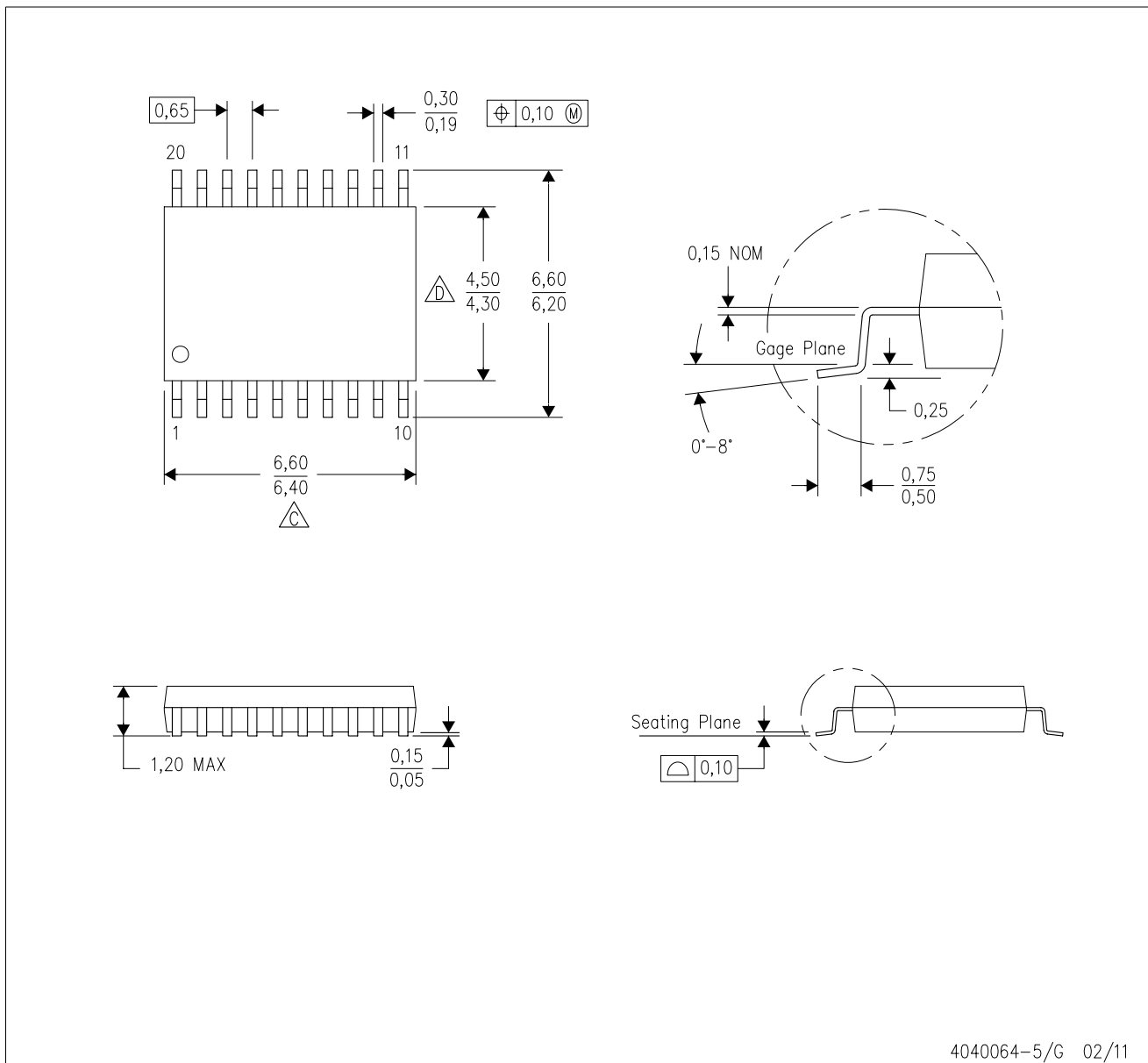
24 PINS SHOWN



- 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, not to exceed 0,15 per side.
 D. Falls within JEDEC: 24/48 Pins – MO-153
 14/16/20/56 Pins – MO-194

PW (R-PDSO-G20)

PLASTIC SMALL OUTLINE



4040064-5/G 02/11

- 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 length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
 - E. Falls within JEDEC MO-153

PW (R-PDSO-G20)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate design.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- 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 not to exceed 0,15.
 D. Falls within JEDEC MO-150

4040065 /E 12/01

DW0020A



PACKAGE OUTLINE

SOIC - 2.65 mm max height

SOIC



4220724/A 05/2016

NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm per side.
5. Reference JEDEC registration MS-013.

EXAMPLE BOARD LAYOUT

DW0020A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE
SCALE:6X



SOLDER MASK DETAILS

4220724/A 05/2016

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DW0020A

SOIC - 2.65 mm max height

SOIC



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:6X

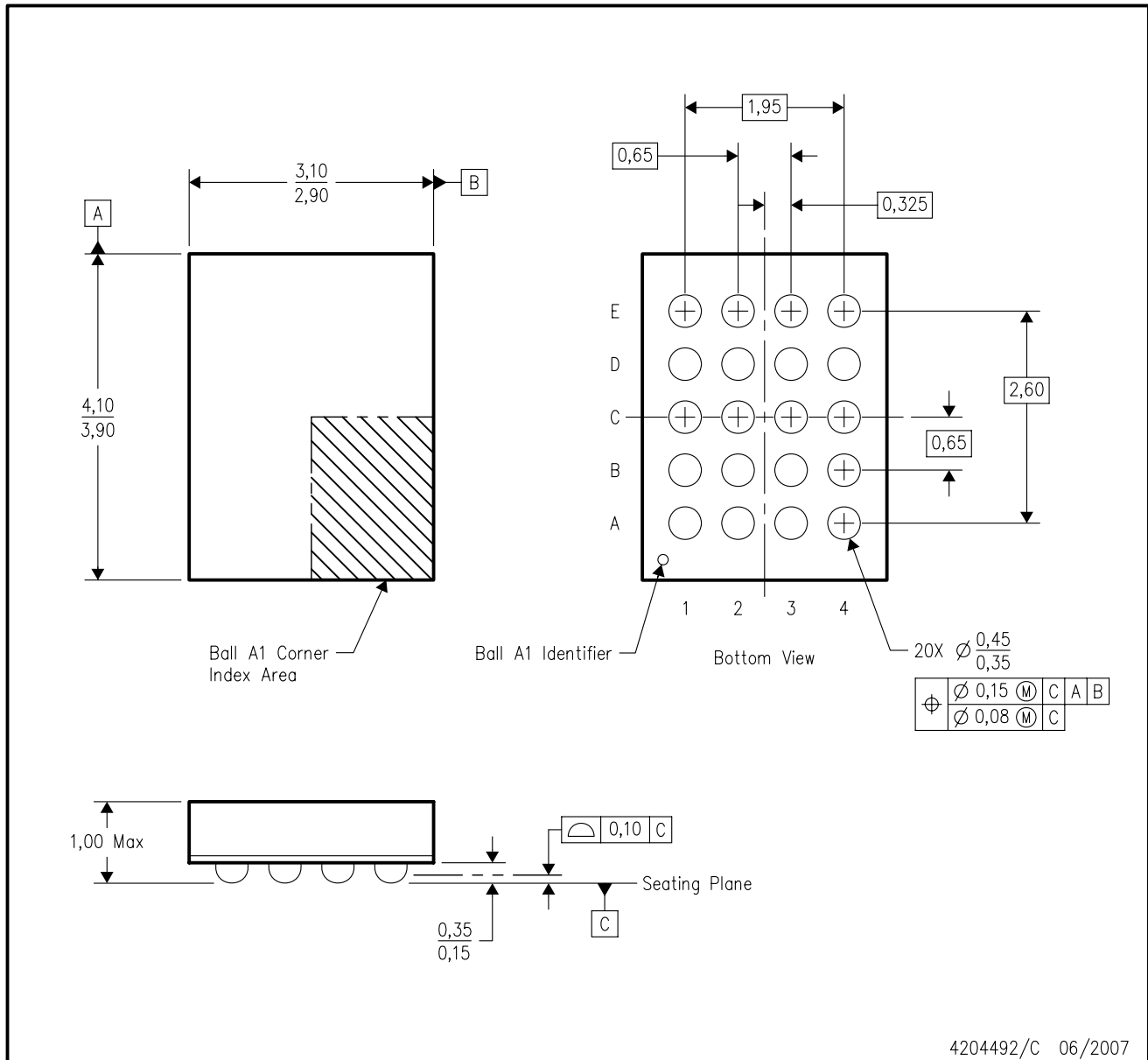
4220724/A 05/2016

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

ZQN (R-PBGA-N20)

PLASTIC 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. Falls within JEDEC MO-285 variation BC-2.
 - D. This package is lead-free. Refer to the 20 GQN package (drawing 4200704) for tin-lead (SnPb).

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