



# SN74AVC4T245 Dual-Bit Bus Transceiver with Configurable Voltage Translation and 3-State Outputs

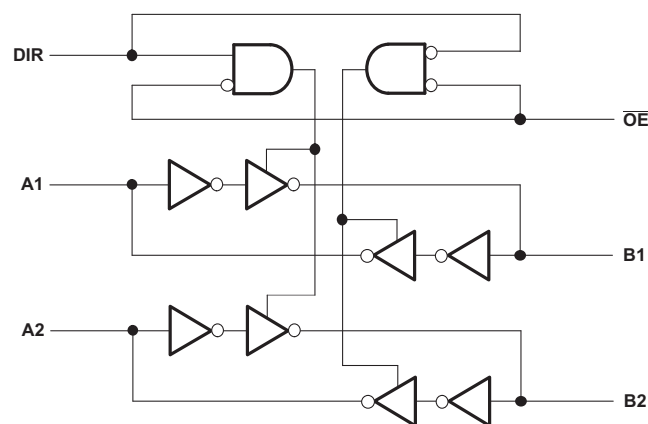
## 1 Features

- Control Inputs  $V_{IH}/V_{IL}$  Levels Are Referenced to  $V_{CCA}$  Voltage
- Fully Configurable Dual-Rail Design Allows Each Port to Operate Over the Full 1.2-V to 3.6-V Power-Supply Range
- I/Os Are 4.6-V Tolerant
- $I_{off}$  Supports Partial Power-Down-Mode Operation
- Maximum Data Rates
  - 380 Mbps (1.8-V to 3.3-V Translation)
  - 200 Mbps (< 1.8-V to 3.3-V Translation)
  - 200 Mbps (Translate to 2.5 V or 1.8 V)
  - 150 Mbps (Translate to 1.5 V)
  - 100 Mbps (Translate to 1.2 V)
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - 8000-V Human-Body Model (A114-A)
  - 150-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

## 2 Applications

- Personal Electronics
- Industrial
- Enterprise
- Telecom

**Logic Diagram (Positive Logic)  
for 1/2 of SN74AVC4T245**



## 3 Description

This 4-bit noninverting bus transceiver 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 1.2 V to 3.6 V. The SN74AVC4T245 is optimized to operate with  $V_{CCA}/V_{CCB}$  set at 1.4 V to 3.6 V. It is operational with  $V_{CCA}/V_{CCB}$  as low as 1.2 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, and 3.3-V voltage nodes.

The SN74AVC4T245 device is designed for asynchronous communication between two data buses. The logic levels of the direction-control (DIR) input and the output-enable ( $\overline{OE}$ ) input activate either the B-port outputs or the A-port outputs or place both output ports into the high-impedance mode. The device transmits data from the A bus to the B bus when the B-port outputs are activated, and from the B bus to the A bus when the A-port outputs are activated. The input circuitry on both A and B ports is always active and must have a logic HIGH or LOW level applied to prevent excess  $I_{CC}$  and  $I_{CCZ}$ .

The SN74AVC4T245 device is designed so that the control pins (1DIR, 2DIR,  $\overline{1OE}$ , and  $\overline{2OE}$ ) are supplied by  $V_{CCA}$ .

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.

The  $V_{CC}$  isolation feature ensures that if either  $V_{CC}$  input is at GND, then both ports are in the high-impedance state.

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.

**Device Information<sup>(1)</sup>**

| PART NUMBER  | PACKAGE    | BODY SIZE (NOM)   |
|--------------|------------|-------------------|
| SN74AVC4T245 | SOIC (16)  | 9.90 mm x 3.91 mm |
|              | TVSOP (16) | 3.60 mm x 4.40 mm |
|              | TSSOP (16) | 5.00 mm x 4.40 mm |
|              | VQFN (16)  | 4.00 mm x 3.50 mm |
|              | UQFN (16)  | 2.60 mm x 1.80 mm |

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



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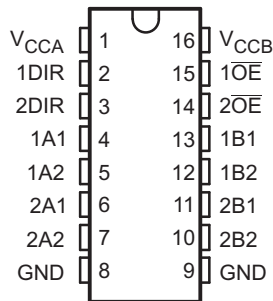
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## 4 Revision History

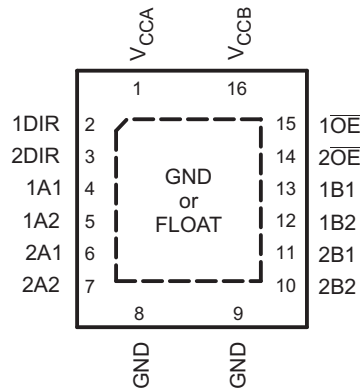
| Changes from Revision F (October 2014) to Revision G                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Page |
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| • Changed <i>Pin Functions</i> table. ....                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 3    |
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| • Fixed $t_{PZL}$ $V_{CCB} = 3.3\text{ V}$ parameter typographical error from 36.6 to 3.6. ....                                                                                                                                                                                                                                                                                                                                                                                                          | 7    |

## 5 Pin Configuration and Functions

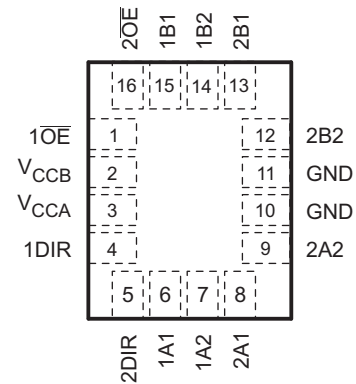
**D, DGV, OR PW PACKAGE  
(TOP VIEW)**



**RGY PACKAGE  
(TOP VIEW)**



**RSV PACKAGE  
(TOP VIEW)**



### Pin Functions

| PIN<br>NAME      | NO.                |        | TYPE | DESCRIPTION                                                                                                            |
|------------------|--------------------|--------|------|------------------------------------------------------------------------------------------------------------------------|
|                  | D, DGV,<br>PW, RGY | RSV    |      |                                                                                                                        |
| 1A1              | 4                  | 6      | I/O  | Input/output 1A1. Referenced to $V_{CCA}$ .                                                                            |
| 1A2              | 5                  | 7      | I/O  | Input/output 1A2. Referenced to $V_{CCA}$ .                                                                            |
| 1B1              | 13                 | 15     | I/O  | Input/output 1B1. Referenced to $V_{CCB}$ .                                                                            |
| 1B2              | 12                 | 14     | I/O  | Input/output 1B2. Referenced to $V_{CCB}$ .                                                                            |
| 1DIR             | 2                  | 4      | I    | Direction-control input for '1' ports                                                                                  |
| $1\overline{OE}$ | 15                 | 1      | I    | 3-state output-mode enables. Pull $\overline{OE}$ high to place '1' outputs in 3-state mode. Referenced to $V_{CCA}$ . |
| 2A1              | 6                  | 8      | I/O  | Input/output 2A1. Referenced to $V_{CCA}$ .                                                                            |
| 2A2              | 7                  | 9      | I/O  | Input/output 2A2. Referenced to $V_{CCA}$ .                                                                            |
| 2B1              | 11                 | 13     | I/O  | Input/output 2B1. Referenced to $V_{CCB}$ .                                                                            |
| 2B2              | 10                 | 12     | I/O  | Input/output 2B2. Referenced to $V_{CCB}$ .                                                                            |
| 2DIR             | 3                  | 5      | I    | Direction-control input for '2' ports                                                                                  |
| $2\overline{OE}$ | 14                 | 16     | I    | 3-state output-mode enables. Pull $\overline{OE}$ high to place '2' outputs in 3-state mode. Referenced to $V_{CCA}$ . |
| GND              | 8, 9               | 10, 11 | —    | Ground                                                                                                                 |
| $V_{CCA}$        | 1                  | 3      | —    | A-port power supply voltage. $1.2\text{ V} \leq V_{CCA} \leq 3.6\text{ V}$                                             |
| $V_{CCB}$        | 16                 | 2      | —    | B-port power supply voltage. $1.2\text{ V} \leq V_{CCB} \leq 3.6\text{ V}$                                             |

## 6 Specifications

### 6.1 Absolute Maximum Ratings<sup>(1)</sup>

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

|                        |                                                                                             |                    | MIN  | MAX             | UNIT |
|------------------------|---------------------------------------------------------------------------------------------|--------------------|------|-----------------|------|
| $V_{CCA}$<br>$V_{CCB}$ | Supply voltage range                                                                        |                    | –0.5 | 4.6             | V    |
| $V_I$                  | Input voltage range <sup>(2)</sup>                                                          | I/O ports (A port) | –0.5 | 4.6             | V    |
|                        |                                                                                             | I/O ports (B port) | –0.5 | 4.6             |      |
|                        |                                                                                             | Control inputs     | –0.5 | 4.6             |      |
| $V_O$                  | Voltage range applied to any output in the high-impedance or power-off state <sup>(2)</sup> | A port             | –0.5 | 4.6             | V    |
|                        |                                                                                             | B port             | –0.5 | 4.6             |      |
| $V_O$                  | Voltage range applied to any output in the high or low state <sup>(2)(3)</sup>              | 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   |

- (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 voltage and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) The output positive-voltage rating may be exceeded up to 4.6 V maximum if the output current rating is observed.

### 6.2 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 <sup>(1)</sup>              |     | 8   | kV   |
|             |                           | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins <sup>(2)</sup> |     | 1   |      |
|             |                           | Machine model (C101)                                                                     |     | 150 | V    |

- (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.

### 6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)<sup>(1)(2)(3)</sup>

|                     |                                    |                                               | $V_{CCI}$       | $V_{CCO}$        | MIN                   | MAX       | UNIT |
|---------------------|------------------------------------|-----------------------------------------------|-----------------|------------------|-----------------------|-----------|------|
| $V_{CCA}$           | Supply voltage                     |                                               |                 |                  | 1.2                   | 3.6       | V    |
| $V_{CCB}$           | Supply voltage                     |                                               |                 |                  | 1.2                   | 3.6       | V    |
| $V_{IH}$            | High-level input voltage           | Data inputs <sup>(4)</sup>                    | 1.2 V to 1.95 V |                  | $V_{CCI} \times 0.65$ |           | V    |
|                     |                                    |                                               | 1.95 V to 2.7 V |                  | 1.6                   |           |      |
|                     |                                    |                                               | 2.7 V to 3.6 V  |                  | 2                     |           |      |
| $V_{IL}$            | Low-level input voltage            | Data inputs <sup>(4)</sup>                    | 1.2 V to 1.95 V |                  | $V_{CCI} \times 0.35$ |           | V    |
|                     |                                    |                                               | 1.95 V to 2.7 V |                  | 0.7                   |           |      |
|                     |                                    |                                               | 2.7 V to 3.6 V  |                  | 0.8                   |           |      |
| $V_{IH}$            | High-level input voltage           | DIR (referenced to $V_{CCA}$ ) <sup>(5)</sup> | 1.2 V to 1.95 V |                  | $V_{CCA} \times 0.65$ |           | V    |
|                     |                                    |                                               | 1.95 V to 2.7 V |                  | 1.6                   |           |      |
|                     |                                    |                                               | 2.7 V to 3.6 V  |                  | 2                     |           |      |
| $V_{IL}$            | Low-level input voltage            | DIR (referenced to $V_{CCA}$ ) <sup>(5)</sup> | 1.2 V to 1.95 V |                  | $V_{CCA} \times 0.35$ |           | V    |
|                     |                                    |                                               | 1.95 V to 2.7 V |                  | 0.7                   |           |      |
|                     |                                    |                                               | 2.7 V to 3.6 V  |                  | 0.8                   |           |      |
| $V_I$               | Input voltage                      |                                               |                 |                  | 0                     | 3.6       | V    |
| $V_O$               | Output voltage                     | Active state                                  |                 |                  | 0                     | $V_{CCO}$ | V    |
|                     |                                    | 3-state                                       |                 |                  | 0                     | 3.6       |      |
| $I_{OH}$            | High-level output current          |                                               |                 | 1.2 V            |                       | –3        | mA   |
|                     |                                    |                                               |                 | 1.4 V to 1.6 V   |                       | –6        |      |
|                     |                                    |                                               |                 | 1.65 V to 1.95 V |                       | –8        |      |
|                     |                                    |                                               |                 | 2.3 V to 2.7 V   |                       | –9        |      |
|                     |                                    |                                               |                 | 3 V to 3.6 V     |                       | –12       |      |
| $I_{OL}$            | Low-level output current           |                                               |                 | 1.1 V to 1.2 V   |                       | 3         | mA   |
|                     |                                    |                                               |                 | 1.4 V to 1.6 V   |                       | 6         |      |
|                     |                                    |                                               |                 | 1.65 V to 1.95 V |                       | 8         |      |
|                     |                                    |                                               |                 | 2.3 V to 2.7 V   |                       | 9         |      |
|                     |                                    |                                               |                 | 3 V to 3.6 V     |                       | 12        |      |
| $\Delta t/\Delta v$ | Input transition rise or fall rate |                                               |                 |                  |                       | 5         | ns/V |
| $T_A$               | Operating free-air temperature     |                                               |                 |                  | –40                   | 85        | °C   |

(1)  $V_{CCI}$  is the  $V_{CC}$  associated with the input port.

(2)  $V_{CCO}$  is the  $V_{CC}$  associated with the output port.

(3) All unused data inputs of the device must be held at  $V_{CCI}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs (SCBA004)*.

(4) For  $V_{CCI}$  values not specified in the data sheet,  $V_{IH}$  min =  $V_{CCI} \times 0.7$  V,  $V_{IL}$  max =  $V_{CCI} \times 0.3$  V

(5) For  $V_{CCI}$  values not specified in the data sheet,  $V_{IH}$  min =  $V_{CCA} \times 0.7$  V,  $V_{IL}$  max =  $V_{CCA} \times 0.3$  V

### 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                              | SN74AVC4T245 |       |       |      |       | UNIT |
|-------------------------------|----------------------------------------------|--------------|-------|-------|------|-------|------|
|                               |                                              | D            | DGV   | PW    | RGY  | RSV   |      |
|                               |                                              | 16 PINS      |       |       |      |       |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance       | 85.5         | 126.0 | 112.0 | 37.5 | 146.9 | °C/W |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance    | 46.9         | 50.8  | 46.8  | 54.5 | 53.6  |      |
| R <sub>θJB</sub>              | Junction-to-board thermal resistance         | 43.0         | 57.7  | 57.1  | 15.6 | 75.6  |      |
| ψ <sub>JT</sub>               | Junction-to-top characterization parameter   | 13.4         | 5.7   | 5.7   | 0.5  | 13.5  |      |
| ψ <sub>JB</sub>               | Junction-to-board characterization parameter | 42.7         | 57.2  | 56.5  | 15.8 | 75.6  |      |
| R <sub>θJC(bot)</sub>         | Junction-to-case (bottom) thermal resistance | —            | —     | —     | 3.5  | —     |      |

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

**SN74AVC4T245**

SCES576G – JUNE 2004 – REVISED NOVEMBER 2014

[www.ti.com](http://www.ti.com)
**6.5 Electrical Characteristics<sup>(1)(2)</sup>**

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

| PARAMETER                           |                | TEST CONDITIONS                                                                                                                                                          |                                  | V <sub>CCA</sub> | V <sub>CCB</sub> | T <sub>A</sub> = 25°C |       |     | −40°C to 85°C          |     | UNIT |
|-------------------------------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------------------|------------------|-----------------------|-------|-----|------------------------|-----|------|
|                                     |                |                                                                                                                                                                          |                                  |                  |                  | MIN                   | TYP   | MAX | MIN                    | MAX |      |
| V <sub>OH</sub>                     |                | I <sub>OH</sub> = −100 μA                                                                                                                                                | V <sub>I</sub> = V <sub>IH</sub> | 1.2 V to 3.6 V   | 1.2 V to 3.6 V   |                       |       |     | V <sub>CCO</sub> − 0.2 | V   |      |
|                                     |                | I <sub>OH</sub> = −3 mA                                                                                                                                                  |                                  | 1.2 V            | 1.2 V            | 0.95                  |       |     |                        |     |      |
|                                     |                | I <sub>OH</sub> = −6 mA                                                                                                                                                  |                                  | 1.4 V            | 1.4 V            |                       |       |     | 1.05                   |     |      |
|                                     |                | I <sub>OH</sub> = −8 mA                                                                                                                                                  |                                  | 1.65 V           | 1.65 V           |                       |       |     | 1.2                    |     |      |
|                                     |                | I <sub>OH</sub> = −9 mA                                                                                                                                                  |                                  | 2.3 V            | 2.3 V            |                       |       |     | 1.75                   |     |      |
|                                     |                | I <sub>OH</sub> = −12 mA                                                                                                                                                 |                                  | 3 V              | 3 V              |                       |       |     | 2.3                    |     |      |
| V <sub>OL</sub>                     |                | I <sub>OL</sub> = 100 μA                                                                                                                                                 | V <sub>I</sub> = V <sub>IL</sub> | 1.2 V to 3.6 V   | 1.2 V to 3.6 V   |                       |       |     | 0.2                    | V   |      |
|                                     |                | I <sub>OL</sub> = 3 mA                                                                                                                                                   |                                  | 1.2 V            | 1.2 V            | 0.25                  |       |     |                        |     |      |
|                                     |                | I <sub>OL</sub> = 6 mA                                                                                                                                                   |                                  | 1.4 V            | 1.4 V            |                       |       |     | 0.35                   |     |      |
|                                     |                | I <sub>OL</sub> = 8 mA                                                                                                                                                   |                                  | 1.65 V           | 1.65 V           |                       |       |     | 0.45                   |     |      |
|                                     |                | I <sub>OL</sub> = 9 mA                                                                                                                                                   |                                  | 2.3 V            | 2.3 V            |                       |       |     | 0.55                   |     |      |
|                                     |                | I <sub>OL</sub> = 12 mA                                                                                                                                                  |                                  | 3 V              | 3 V              |                       |       |     | 0.7                    |     |      |
| I <sub>I</sub>                      | Control inputs | V <sub>I</sub> = V <sub>CCA</sub> or GND                                                                                                                                 |                                  | 1.2 V to 3.6 V   | 1.2 V to 3.6 V   | ±0.025                | ±0.25 |     |                        | ±1  | μA   |
| I <sub>off</sub>                    | A or B port    | V <sub>I</sub> or V <sub>O</sub> = 0 to 3.6 V                                                                                                                            |                                  | 0 V              | 0 V to 3.6 V     | ±0.1                  | ±1    |     |                        | ±5  | μA   |
|                                     |                |                                                                                                                                                                          |                                  | 0 V to 3.6 V     | 0 V              | ±0.1                  | ±1    |     |                        | ±5  |      |
| I <sub>OZ</sub>                     | A or B port    | V <sub>O</sub> = V <sub>CCO</sub> or GND, $\overline{\text{OE}}$ = V <sub>IH</sub><br>V <sub>I</sub> = V <sub>CCI</sub> or GND, $\overline{\text{OE}}$ = V <sub>IH</sub> |                                  | 3.6 V            | 3.6 V            | ±0.5                  | ±2.5  |     |                        | ±5  | μA   |
| I <sub>CCA</sub>                    |                | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0                                                                                                             |                                  | 1.2 V to 3.6 V   | 1.2 V to 3.6 V   |                       |       |     | 8                      | μA  |      |
|                                     |                |                                                                                                                                                                          |                                  | 0 V              | 0 V to 3.6 V     |                       |       |     | −2                     |     |      |
|                                     |                |                                                                                                                                                                          |                                  | 0 V to 3.6 V     | 0 V              |                       |       |     | 8                      |     |      |
| I <sub>CCB</sub>                    |                | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0                                                                                                             |                                  | 1.2 V to 3.6 V   | 1.2 V to 3.6 V   |                       |       |     | 8                      | μA  |      |
|                                     |                |                                                                                                                                                                          |                                  | 0 V              | 0 V to 3.6 V     |                       |       |     | 8                      |     |      |
|                                     |                |                                                                                                                                                                          |                                  | 0 V to 3.6 V     | 0 V              |                       |       |     | −2                     |     |      |
| I <sub>CCA</sub> + I <sub>CCB</sub> |                | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0                                                                                                             |                                  | 1.2 V to 3.6 V   | 1.2 V to 3.6 V   |                       |       |     | 16                     | μA  |      |
| C <sub>i</sub>                      | Control inputs | V <sub>I</sub> = 3.3 V or GND                                                                                                                                            |                                  | 3.3 V            | 3.3 V            | 3.5                   |       |     | 4.5                    | pF  |      |
| C <sub>io</sub>                     | A or B port    | V <sub>O</sub> = 3.3 V or GND                                                                                                                                            |                                  | 3.3 V            | 3.3 V            | 6                     |       |     | 7                      | pF  |      |

 (1)  $V_{CCO}$  is the  $V_{CC}$  associated with the output port.

 (2)  $V_{CCI}$  is the  $V_{CC}$  associated with the input port.

## 6.6 Operating Characteristics

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

| PARAMETER       |        |                  | TEST CONDITIONS                                                   | $V_{CCA} = V_{CCB} = 1.2\text{ V}$ | $V_{CCA} = V_{CCB} = 1.5\text{ V}$ | $V_{CCA} = V_{CCB} = 1.8\text{ V}$ | $V_{CCA} = V_{CCB} = 2.5\text{ V}$ | $V_{CCA} = V_{CCB} = 3.3\text{ V}$ | UNIT |
|-----------------|--------|------------------|-------------------------------------------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|------|
|                 |        |                  |                                                                   | TYP                                | TYP                                | TYP                                | TYP                                | TYP                                |      |
| $C_{pdA}^{(1)}$ | A to B | Outputs enabled  | $C_L = 0$ ,<br>$f = 10\text{ MHz}$ ,<br>$t_r = t_f = 1\text{ ns}$ | 1                                  | 1                                  | 1                                  | 1.5                                | 2                                  | pF   |
|                 |        | Outputs disabled |                                                                   | 1                                  | 1                                  | 1                                  | 1                                  | 1                                  |      |
|                 | B to A | Outputs enabled  |                                                                   | 12                                 | 12.5                               | 13                                 | 14                                 | 15                                 |      |
|                 |        | Outputs disabled |                                                                   | 1                                  | 1                                  | 1                                  | 1                                  | 1                                  |      |
| $C_{pdB}^{(1)}$ | A to B | Outputs enabled  | $C_L = 0$ ,<br>$f = 10\text{ MHz}$ ,<br>$t_r = t_f = 1\text{ ns}$ | 12                                 | 12.5                               | 13                                 | 14                                 | 15                                 | pF   |
|                 |        | Outputs disabled |                                                                   | 1                                  | 1                                  | 1                                  | 1                                  | 1                                  |      |
|                 | B to A | Outputs enabled  |                                                                   | 1                                  | 1                                  | 1                                  | 1                                  | 2                                  |      |
|                 |        | Outputs disabled |                                                                   | 1                                  | 1                                  | 1                                  | 1                                  | 1                                  |      |

(1) Power dissipation capacitance per transceiver

## 6.7 Switching Characteristics: $V_{CCA} = 1.2\text{ V}$

over recommended operating free-air temperature range,  $V_{CCA} = 1.2\text{ V}$  (unless otherwise noted) (see [Figure 3](#))

| PARAMETER | FROM (INPUT)    | TO (OUTPUT) | $V_{CCB} = 1.2\text{ V}$ | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | UNIT |
|-----------|-----------------|-------------|--------------------------|-------------------------------------------|--------------------------------------------|-------------------------------------------|-------------------------------------------|------|
|           |                 |             | TYP                      | TYP                                       | TYP                                        | TYP                                       | TYP                                       |      |
| $t_{PLH}$ | A               | B           | 3.4                      | 2.9                                       | 2.7                                        | 2.6                                       | 2.8                                       | ns   |
| $t_{PHL}$ |                 |             | 3.4                      | 2.9                                       | 2.7                                        | 2.6                                       | 2.8                                       |      |
| $t_{PLH}$ | B               | A           | 3.6                      | 3.1                                       | 2.8                                        | 2.6                                       | 2.6                                       | ns   |
| $t_{PHL}$ |                 |             | 3.6                      | 3.1                                       | 2.8                                        | 2.6                                       | 2.6                                       |      |
| $t_{PZH}$ | $\overline{OE}$ | A           | 5.6                      | 4.7                                       | 4.3                                        | 3.9                                       | 3.7                                       | ns   |
| $t_{PZL}$ |                 |             | 5.6                      | 4.7                                       | 4.3                                        | 3.9                                       | 3.7                                       |      |
| $t_{PZH}$ | $\overline{OE}$ | B           | 5                        | 4.3                                       | 3.9                                        | 3.6                                       | 3.6                                       | ns   |
| $t_{PZL}$ |                 |             | 5                        | 4.3                                       | 3.9                                        | 3.6                                       | 3.6                                       |      |
| $t_{PHZ}$ | $\overline{OE}$ | A           | 6.2                      | 5.2                                       | 5.2                                        | 4.3                                       | 4.8                                       | ns   |
| $t_{PLZ}$ |                 |             | 6.2                      | 5.2                                       | 5.2                                        | 4.3                                       | 4.8                                       |      |
| $t_{PHZ}$ | $\overline{OE}$ | B           | 5.9                      | 5.1                                       | 5                                          | 4.7                                       | 5.5                                       | ns   |
| $t_{PLZ}$ |                 |             | 5.9                      | 5.1                                       | 5                                          | 4.7                                       | 5.5                                       |      |

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## 6.8 Switching Characteristics: $V_{CCA} = 1.5 \text{ V} \pm 0.1 \text{ V}$

over recommended operating free-air temperature range,  $V_{CCA} = 1.5 \text{ V} \pm 0.1 \text{ V}$  (see [Figure 3](#))

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | $V_{CCB} = 1.2 \text{ V}$ | $V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$ |      | $V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$ |      | $V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$ |      | $V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$ |      | UNIT |
|-----------|-----------------|----------------|---------------------------|---------------------------------------------|------|----------------------------------------------|------|---------------------------------------------|------|---------------------------------------------|------|------|
|           |                 |                | TYP                       | MIN                                         | MAX  | MIN                                          | MAX  | MIN                                         | MAX  | MIN                                         | MAX  |      |
| $t_{PLH}$ | A               | B              | 3.2                       | 0.3                                         | 6.3  | 0.3                                          | 5.2  | 0.4                                         | 4.2  | 0.4                                         | 4.2  | ns   |
| $t_{PHL}$ |                 |                | 3.2                       | 0.3                                         | 6.3  | 0.3                                          | 5.2  | 0.4                                         | 4.2  | 0.4                                         | 4.2  |      |
| $t_{PLH}$ | B               | A              | 3.3                       | 0.7                                         | 6.3  | 0.5                                          | 6    | 0.4                                         | 5.7  | 0.3                                         | 5.6  | ns   |
| $t_{PHL}$ |                 |                | 3.3                       | 0.7                                         | 6.3  | 0.5                                          | 6    | 0.4                                         | 5.7  | 0.3                                         | 5.6  |      |
| $t_{PZH}$ | $\overline{OE}$ | A              | 4.9                       | 1.4                                         | 9.6  | 1.1                                          | 9.5  | 0.7                                         | 9.4  | 0.4                                         | 9.4  | ns   |
| $t_{PZL}$ |                 |                | 4.9                       | 1.4                                         | 9.6  | 1.1                                          | 9.5  | 0.7                                         | 9.4  | 0.4                                         | 9.4  |      |
| $t_{PZH}$ | $\overline{OE}$ | B              | 4.5                       | 1.4                                         | 9.6  | 1.1                                          | 7.7  | 0.9                                         | 5.8  | 0.9                                         | 5.6  | ns   |
| $t_{PZL}$ |                 |                | 4.5                       | 1.4                                         | 9.6  | 1.1                                          | 7.7  | 0.9                                         | 5.8  | 0.9                                         | 5.6  |      |
| $t_{PHZ}$ | $\overline{OE}$ | A              | 5.6                       | 1.8                                         | 10.2 | 1.5                                          | 10.2 | 1.3                                         | 10.2 | 1.6                                         | 10.2 | ns   |
| $t_{PLZ}$ |                 |                | 5.6                       | 1.8                                         | 10.2 | 1.5                                          | 10.2 | 1.3                                         | 10.2 | 1.6                                         | 10.2 |      |
| $t_{PHZ}$ | $\overline{OE}$ | B              | 5.2                       | 1.9                                         | 10.3 | 1.9                                          | 9.1  | 1.4                                         | 7.4  | 1.2                                         | 7.6  | ns   |
| $t_{PLZ}$ |                 |                | 5.2                       | 1.9                                         | 10.3 | 1.9                                          | 9.1  | 1.4                                         | 7.4  | 1.2                                         | 7.6  |      |

## 6.9 Switching Characteristics: $V_{CCA} = 1.8 \text{ V} \pm 0.15 \text{ V}$

over recommended operating free-air temperature range,  $V_{CCA} = 1.8 \text{ V} \pm 0.15 \text{ V}$  (see [Figure 3](#))

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | $V_{CCB} = 1.2 \text{ V}$ | $V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$ |     | $V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$ |     | $V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$ |     | $V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$ |     | UNIT |
|-----------|-----------------|----------------|---------------------------|---------------------------------------------|-----|----------------------------------------------|-----|---------------------------------------------|-----|---------------------------------------------|-----|------|
|           |                 |                | TYP                       | MIN                                         | MAX | MIN                                          | MAX | MIN                                         | MAX | MIN                                         | MAX |      |
| $t_{PLH}$ | A               | B              | 2.9                       | 0.1                                         | 6   | 0.1                                          | 4.9 | 0.1                                         | 3.9 | 0.3                                         | 3.9 | ns   |
| $t_{PHL}$ |                 |                | 2.9                       | 0.1                                         | 6   | 0.1                                          | 4.9 | 0.1                                         | 3.9 | 0.3                                         | 3.9 |      |
| $t_{PLH}$ | B               | A              | 3                         | 0.6                                         | 5.3 | 0.5                                          | 4.9 | 0.3                                         | 4.6 | 0.3                                         | 4.5 | ns   |
| $t_{PHL}$ |                 |                | 3                         | 0.6                                         | 5.3 | 0.5                                          | 4.9 | 0.3                                         | 4.6 | 0.3                                         | 4.5 |      |
| $t_{PZH}$ | $\overline{OE}$ | A              | 4.4                       | 1                                           | 7.4 | 1                                            | 7.3 | 0.6                                         | 7.3 | 0.4                                         | 7.2 | ns   |
| $t_{PZL}$ |                 |                | 4.4                       | 1                                           | 7.4 | 1                                            | 7.3 | 0.6                                         | 7.3 | 0.4                                         | 7.2 |      |
| $t_{PZH}$ | $\overline{OE}$ | B              | 4.1                       | 1.2                                         | 9.2 | 1                                            | 7.4 | 0.8                                         | 5.3 | 0.8                                         | 4.6 | ns   |
| $t_{PZL}$ |                 |                | 4.1                       | 1.2                                         | 9.2 | 1                                            | 7.4 | 0.8                                         | 5.3 | 0.8                                         | 4.6 |      |
| $t_{PHZ}$ | $\overline{OE}$ | A              | 5.4                       | 1.6                                         | 8.6 | 1.8                                          | 8.7 | 1.3                                         | 8.7 | 1.6                                         | 8.7 | ns   |
| $t_{PLZ}$ |                 |                | 5.4                       | 1.6                                         | 8.6 | 1.8                                          | 8.7 | 1.3                                         | 8.7 | 1.6                                         | 8.7 |      |
| $t_{PHZ}$ | $\overline{OE}$ | B              | 5                         | 1.7                                         | 9.9 | 1.6                                          | 8.7 | 1.2                                         | 6.9 | 1                                           | 6.9 | ns   |
| $t_{PLZ}$ |                 |                | 5                         | 1.7                                         | 9.9 | 1.6                                          | 8.7 | 1.2                                         | 6.9 | 1                                           | 6.9 |      |



## 6.10 Switching Characteristics: $V_{CCA} = 2.5 \text{ V} \pm 0.2 \text{ V}$

over recommended operating free-air temperature range,  $V_{CCA} = 2.5 \text{ V} \pm 0.2 \text{ V}$  (see [Figure 3](#))

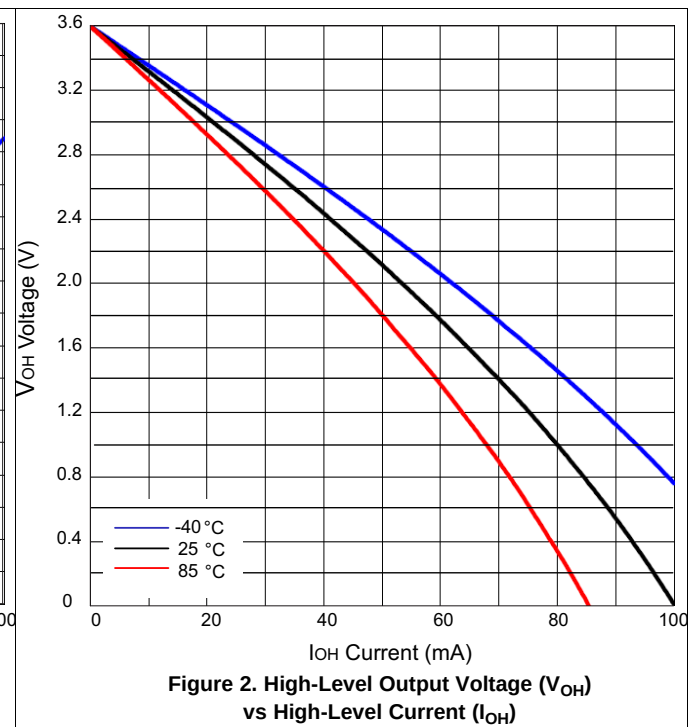
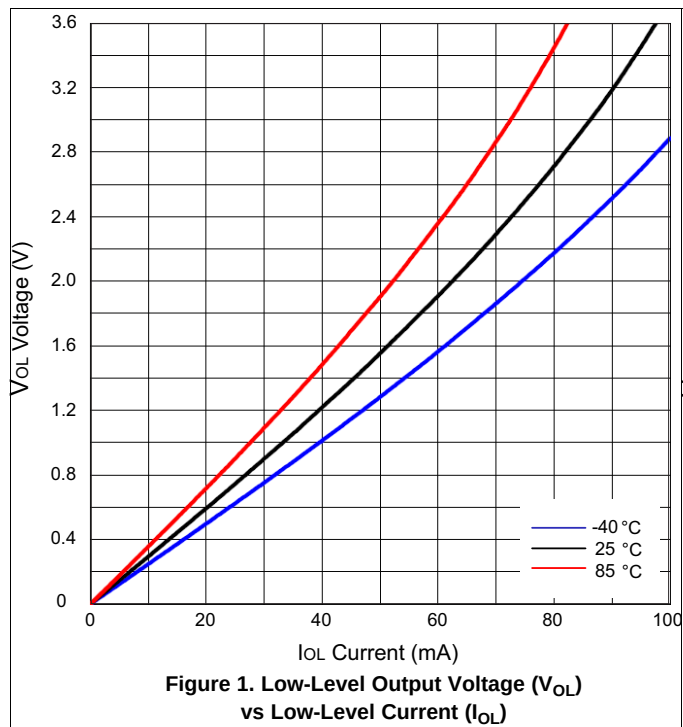
| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | $V_{CCB} = 1.2 \text{ V}$ | $V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$ |     | $V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$ |     | $V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$ |     | $V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$ |     | UNIT |
|-----------|-----------------|----------------|---------------------------|---------------------------------------------|-----|----------------------------------------------|-----|---------------------------------------------|-----|---------------------------------------------|-----|------|
|           |                 |                | TYP                       | MIN                                         | MAX | MIN                                          | MAX | MIN                                         | MAX | MIN                                         | MAX |      |
| $t_{PLH}$ | A               | B              | 2.8                       | 0.1                                         | 5.7 | 0.1                                          | 4.6 | 0.2                                         | 3.5 | 0.1                                         | 3.6 | ns   |
| $t_{PHL}$ |                 |                | 2.8                       | 0.1                                         | 5.7 | 0.1                                          | 4.6 | 0.2                                         | 3.5 | 0.1                                         | 3.6 |      |
| $t_{PLH}$ | B               | A              | 2.7                       | 0.6                                         | 4.2 | 0.4                                          | 3.9 | 0.2                                         | 3.4 | 0.2                                         | 3.3 | ns   |
| $t_{PHL}$ |                 |                | 2.7                       | 0.6                                         | 4.2 | 0.4                                          | 3.9 | 0.2                                         | 3.4 | 0.2                                         | 3.3 |      |
| $t_{PZH}$ | $\overline{OE}$ | A              | 4                         | 0.7                                         | 6.5 | 0.7                                          | 5.2 | 0.6                                         | 4.8 | 0.4                                         | 4.8 | ns   |
| $t_{PZL}$ |                 |                | 4                         | 0.7                                         | 6.5 | 0.7                                          | 5.2 | 0.6                                         | 4.8 | 0.4                                         | 4.8 |      |
| $t_{PZH}$ | $\overline{OE}$ | B              | 3.8                       | 0.9                                         | 8.8 | 0.8                                          | 7   | 0.6                                         | 4.8 | 0.6                                         | 4   | ns   |
| $t_{PZL}$ |                 |                | 3.8                       | 0.9                                         | 8.8 | 0.8                                          | 7   | 0.6                                         | 4.8 | 0.6                                         | 4   |      |
| $t_{PHZ}$ | $\overline{OE}$ | A              | 4.7                       | 1                                           | 8.4 | 1                                            | 8.4 | 1                                           | 6.2 | 1                                           | 6.6 | ns   |
| $t_{PLZ}$ |                 |                | 4.7                       | 1                                           | 8.4 | 1                                            | 8.4 | 1                                           | 6.2 | 1                                           | 6.6 |      |
| $t_{PHZ}$ | $\overline{OE}$ | B              | 4.5                       | 1.5                                         | 9.4 | 1.3                                          | 8.2 | 1.1                                         | 6.2 | 0.9                                         | 5.2 | ns   |
| $t_{PLZ}$ |                 |                | 4.5                       | 1.5                                         | 9.4 | 1.3                                          | 8.2 | 1.1                                         | 6.2 | 0.9                                         | 5.2 |      |

## 6.11 Switching Characteristics: $V_{CCA} = 3.3 \text{ V} \pm 0.3 \text{ V}$

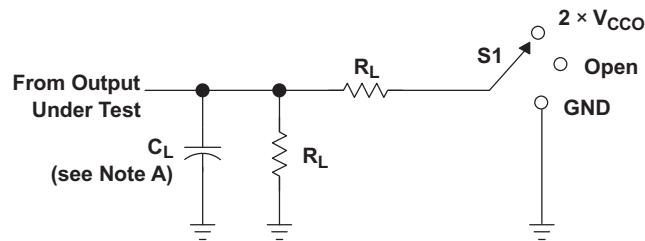
over recommended operating free-air temperature range,  $V_{CCA} = 3.3 \text{ V} \pm 0.3 \text{ V}$  (see [Figure 3](#))

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | $V_{CCB} = 1.2 \text{ V}$ | $V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$ |     | $V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$ |     | $V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$ |     | $V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$ |     | UNIT |
|-----------|-----------------|----------------|---------------------------|---------------------------------------------|-----|----------------------------------------------|-----|---------------------------------------------|-----|---------------------------------------------|-----|------|
|           |                 |                | TYP                       | MIN                                         | MAX | MIN                                          | MAX | MIN                                         | MAX | MIN                                         | MAX |      |
| $t_{PLH}$ | A               | B              | 2.9                       | 0.1                                         | 5.6 | 0.1                                          | 4.5 | 0.1                                         | 3.3 | 0.1                                         | 2.9 | ns   |
| $t_{PHL}$ |                 |                | 2.9                       | 0.1                                         | 5.6 | 0.1                                          | 4.5 | 0.1                                         | 3.3 | 0.1                                         | 2.9 |      |
| $t_{PLH}$ | B               | A              | 2.6                       | 0.6                                         | 4.2 | 0.4                                          | 3.4 | 0.2                                         | 3   | 0.1                                         | 2.8 | ns   |
| $t_{PHL}$ |                 |                | 2.6                       | 0.6                                         | 4.2 | 0.4                                          | 3.4 | 0.2                                         | 3   | 0.1                                         | 2.8 |      |
| $t_{PZH}$ | $\overline{OE}$ | A              | 3.8                       | 0.6                                         | 8.7 | 0.6                                          | 5.2 | 0.6                                         | 3.8 | 0.4                                         | 3.8 | ns   |
| $t_{PZL}$ |                 |                | 3.8                       | 0.6                                         | 8.7 | 0.6                                          | 5.2 | 0.6                                         | 3.8 | 0.4                                         | 3.8 |      |
| $t_{PZH}$ | $\overline{OE}$ | B              | 3.7                       | 0.8                                         | 8.7 | 0.6                                          | 6.8 | 0.5                                         | 4.7 | 0.5                                         | 3.8 | ns   |
| $t_{PZL}$ |                 |                | 3.7                       | 0.8                                         | 8.7 | 0.6                                          | 6.8 | 0.5                                         | 4.7 | 0.5                                         | 3.8 |      |
| $t_{PHZ}$ | $\overline{OE}$ | A              | 4.8                       | 0.7                                         | 9.3 | 0.7                                          | 8.3 | 0.7                                         | 5.6 | 0.7                                         | 6.6 | ns   |
| $t_{PLZ}$ |                 |                | 4.8                       | 0.7                                         | 9.3 | 0.7                                          | 8.3 | 0.7                                         | 5.6 | 0.7                                         | 6.6 |      |
| $t_{PHZ}$ | $\overline{OE}$ | B              | 5.3                       | 1.4                                         | 9.3 | 1.2                                          | 8.1 | 1                                           | 6.4 | 0.8                                         | 6.2 | ns   |
| $t_{PLZ}$ |                 |                | 5.3                       | 1.4                                         | 9.3 | 1.2                                          | 8.1 | 1                                           | 6.4 | 0.8                                         | 6.2 |      |

## 6.12 Typical Characteristics

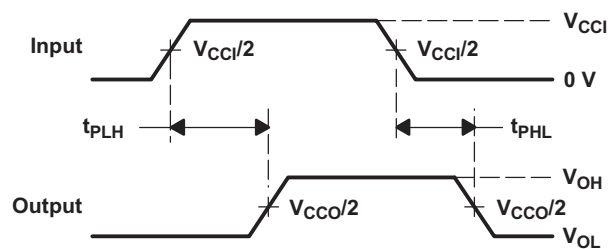


## 7 Parameter Measurement Information



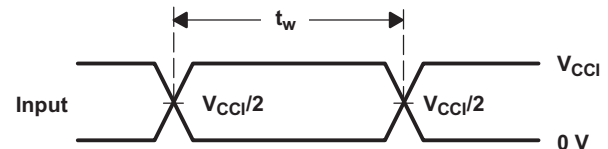
LOAD CIRCUIT

| $V_{CCO}$          | $C_L$ | $R_L$        | $V_{TP}$ |
|--------------------|-------|--------------|----------|
| 1.2 V              | 15 pF | 2 k $\Omega$ | 0.1 V    |
| 1.5 V $\pm$ 0.1 V  | 15 pF | 2 k $\Omega$ | 0.1 V    |
| 1.8 V $\pm$ 0.15 V | 15 pF | 2 k $\Omega$ | 0.15 V   |
| 2.5 V $\pm$ 0.2 V  | 15 pF | 2 k $\Omega$ | 0.15 V   |
| 3.3 V $\pm$ 0.3 V  | 15 pF | 2 k $\Omega$ | 0.3 V    |

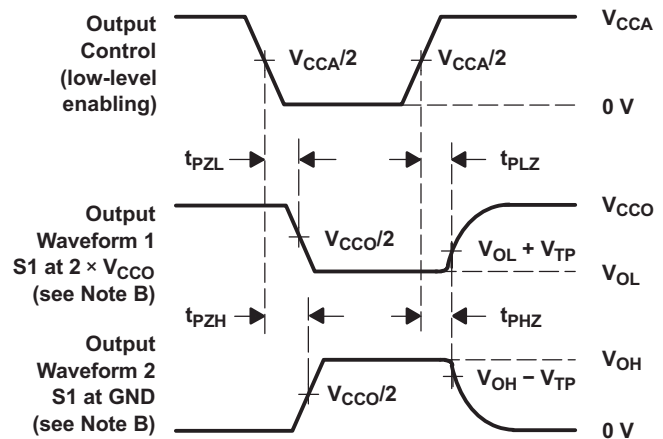


VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES

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



VOLTAGE WAVEFORMS  
PULSE DURATION



VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES

- NOTES:
- $C_L$  includes probe and jig capacitance.
  - Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
  - All input pulses are supplied by generators having the following characteristics: PRR = 10 MHz,  $Z_O = 50 \Omega$ ,  $dv/dt \geq 1$  V/ns.
  - The outputs are measured one at a time, with one transition per measurement.
  - $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
  - $V_{CCI}$  is the  $V_{CC}$  associated with the input port.
  - $V_{CCO}$  is the  $V_{CC}$  associated with the output port.

Figure 3. Load and Circuit and Voltage Waveforms

## 8 Detailed Description

### 8.1 Overview

The SN74AVC4T245 is a 4-bit, dual-supply noninverting bidirectional voltage level translation device. Ax pins and control pins (1DIR, 2DIR, 1OE, and 2OE) are supported by  $V_{CCA}$ , and Bx pins are supported by  $V_{CCB}$ . The A port is able to accept I/O voltages ranging from 1.2 V to 3.6 V, while the B port can accept I/O voltages from 1.2 V to 3.6 V. A high on DIR allows data transmission from Ax to Bx and a low on DIR allows data transmission from Bx to Ax when OE is set to low. When OE is set to high, both Ax and Bx pins are in the high-impedance state.

### 8.2 Functional Block Diagram

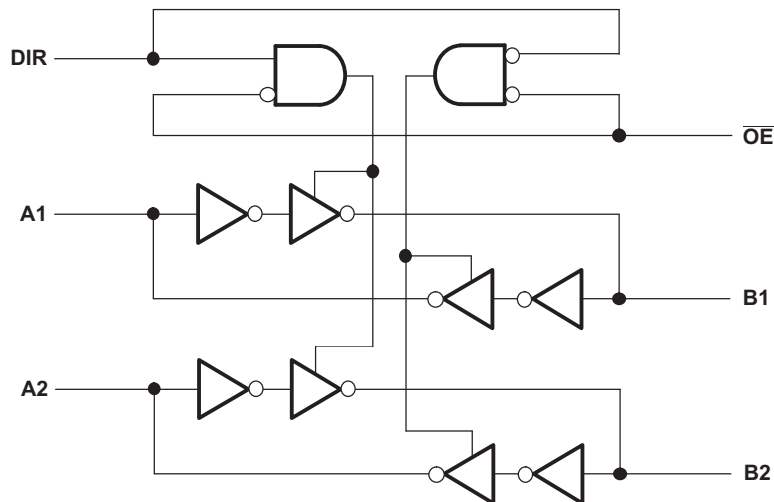


Figure 4. Logic Diagram (Positive Logic) for 1/2 of SN74AVC4T245

## 8.3 Feature Description

### 8.3.1 Fully Configurable Dual-Rail Design Allows Each Port to Operate Over the Full 1.2-V to 3.6-V Power-Supply Range

Both  $V_{CCA}$  and  $V_{CCB}$  can be supplied at any voltage between 1.2 V and 3.6 V; thus, making the device suitable for translating between any of the low voltage nodes (1.2 V, 1.8 V, 2.5 V, and 3.3 V).

### 8.3.2 Supports High Speed Translation

The SN74AVC4T245 device can support high data rate applications. The translated signal data rate can be up to 380 Mbps when the signal is translated from 1.8 V to 3.3 V.

### 8.3.3 $I_{off}$ Supports Partial-Power-Down Mode Operation

$I_{off}$  will prevent backflow current by disabling I/O output circuits when device is in partial-power-down mode.

## 8.4 Device Functional Modes

**Table 1. Function Table  
(Each 2-Bit Section)<sup>(1)</sup>**

| CONTROL INPUTS  |     | OUTPUT CIRCUITS |         | OPERATION       |
|-----------------|-----|-----------------|---------|-----------------|
| $\overline{OE}$ | DIR | A PORT          | B PORT  |                 |
| L               | L   | Enabled         | Hi-Z    | B data to A bus |
| L               | H   | Hi-Z            | Enabled | A data to B bus |
| H               | X   | Hi-Z            | Hi-Z    | Isolation       |

(1) Input circuits of the data I/Os are always active.

## 9 Application and Implementation

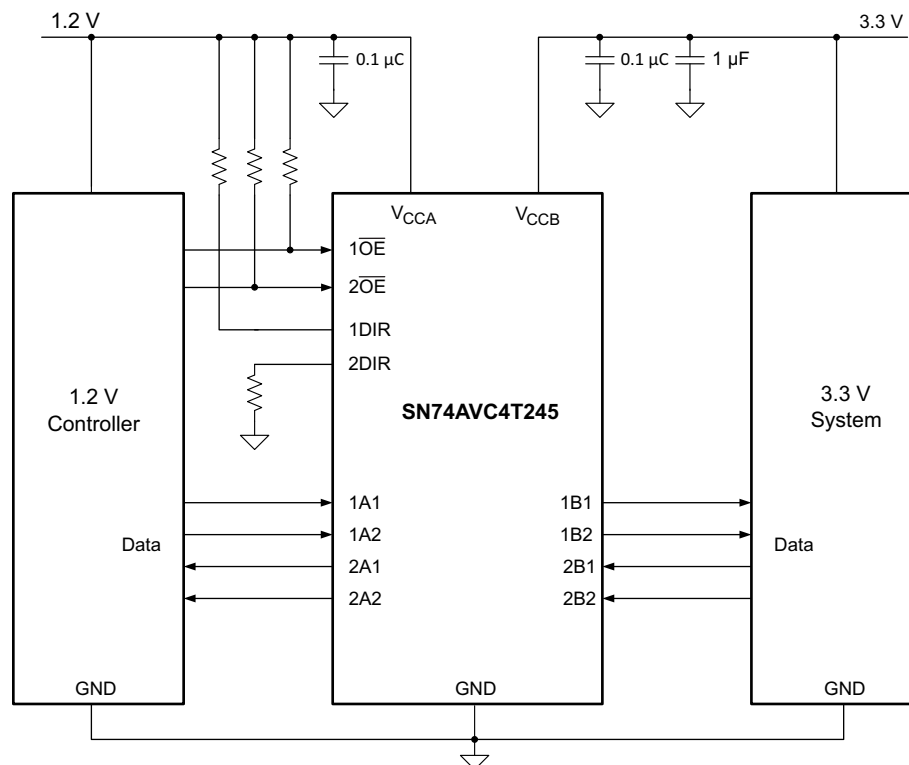
### NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 9.1 Application Information

The SN74AVC4T245 device can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. The SN74AVC4T245 device is ideal for use in applications where a push-pull driver is connected to the data I/Os. The max data rate can be up to 380 Mbps when device translates a signal from 1.8 V to 3.3 V.

### 9.2 Typical Application



**Figure 5. Typical Application Diagram**

## Typical Application (continued)

### 9.2.1 Design Requirements

For the design example shown in [Typical Application](#), use the parameters listed in [Table 2](#).

**Table 2. Design Parameters**

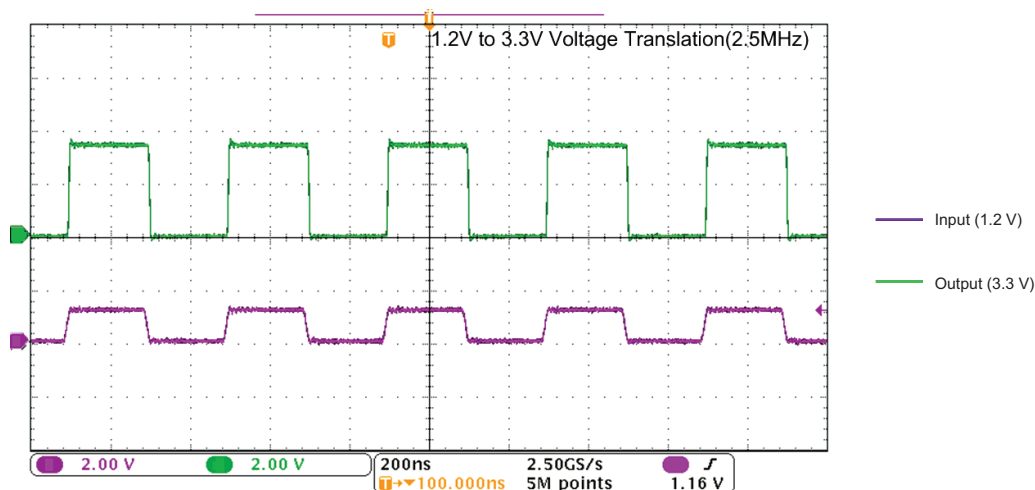
| DESIGN PARAMETER     | EXAMPLE VALUE  |
|----------------------|----------------|
| Input voltage range  | 1.2 V to 3.6 V |
| Output voltage range | 1.2 V to 3.6 V |

### 9.2.2 Detailed Design Procedure

To begin the design process, determine the following:

- Input voltage range
  - Use the supply voltage of the device that is driving the SN74AVC4T245 device to determine the input voltage range. For a valid logic high, the value must exceed the  $V_{IH}$  of the input port. For a valid logic low, the value must be less than the  $V_{IL}$  of the input port.
- Output voltage range
  - Use the supply voltage of the device that the SN74AVC4T245 device is driving to determine the output voltage range.

### 9.2.3 Application Curves



**Figure 6. Translation Up (1.2 V to 3.3 V) at 2.5 MHz**

## 10 Power Supply Recommendations

The SN74AVC4T245 device uses two separate configurable power-supply rails,  $V_{CCA}$  and  $V_{CCB}$ .  $V_{CCA}$  accepts any supply voltage from 1.2 V to 3.6 V and  $V_{CCB}$  accepts any supply voltage from 1.2 V to 3.6 V. The A port and B port are designed to track  $V_{CCA}$  and  $V_{CCB}$  respectively allowing for low-voltage bidirectional translation between any of the 1.2-V, 1.5-V, 1.8-V, 2.5-V and 3.3-V voltage nodes.

The output-enable ( $\overline{OE}$ ) input circuit is designed so that it is supplied by  $V_{CCA}$  and when the  $\overline{OE}$  input is high, all outputs are placed in the high-impedance state. To ensure the high-impedance state of the outputs during power up or power down, the  $\overline{OE}$  input pin must be tied to  $V_{CCA}$  through a pullup resistor and must not be enabled until  $V_{CCA}$  and  $V_{CCB}$  are fully ramped and stable. The minimum value of the pullup resistor to  $V_{CCA}$  is determined by the current-sinking capability of the driver.

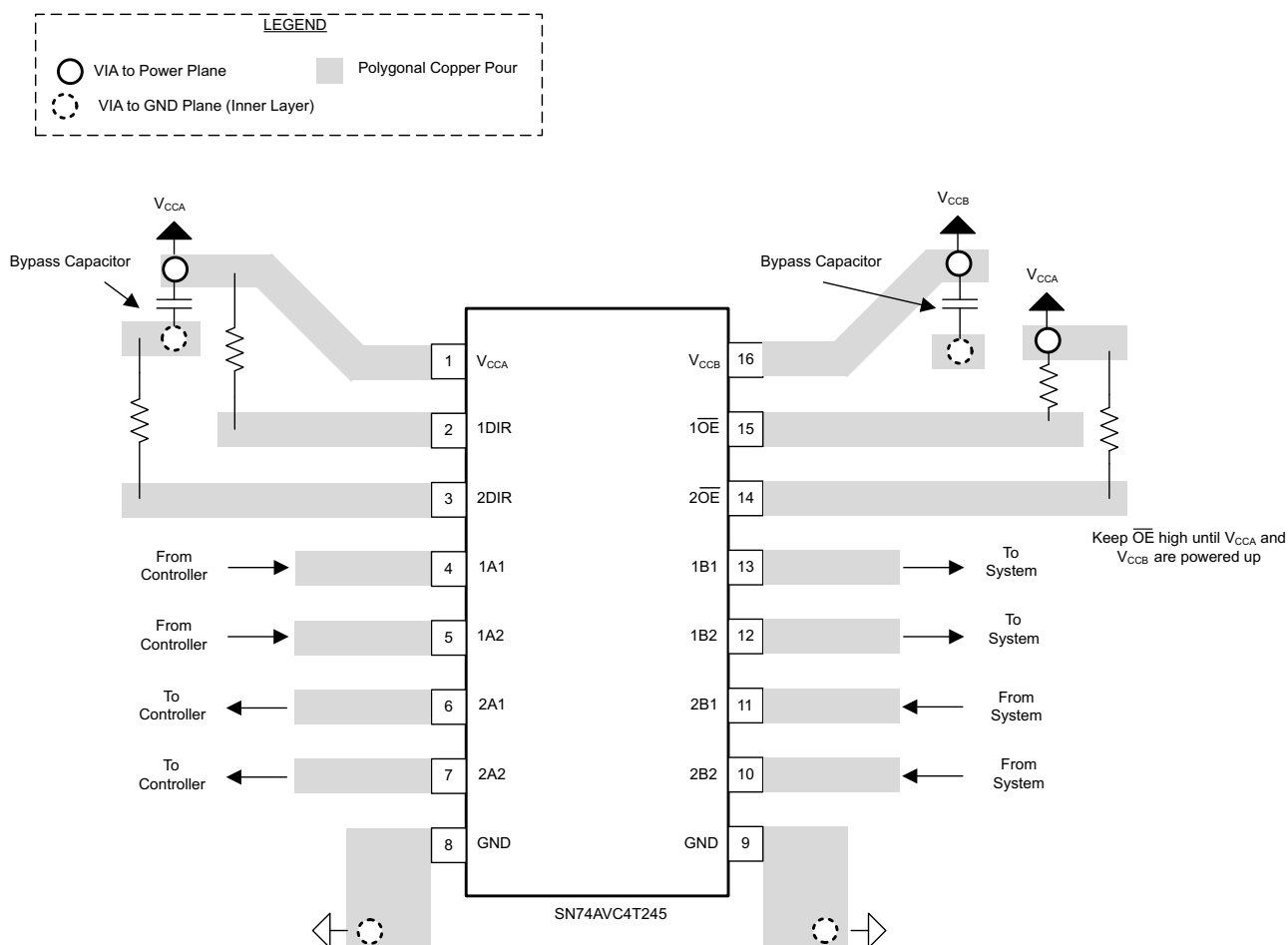
## 11 Layout

### 11.1 Layout Guidelines

To ensure reliability of the device, following common printed-circuit board layout guidelines is recommended.

- Bypass capacitors should be used on power supplies.
- Short trace lengths should be used to avoid excessive loading.
- Place pads on the signal paths for loading capacitors or pullup resistors to help adjust rise and fall times of signals, depending on the system requirements.

### 11.2 Layout Example





## 12 Device and Documentation Support

### 12.1 Trademarks

All trademarks are the property of their respective owners.

### 12.2 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.

### 12.3 Glossary

[SLYZ022](#) — *TI Glossary*.

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

## 13 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.

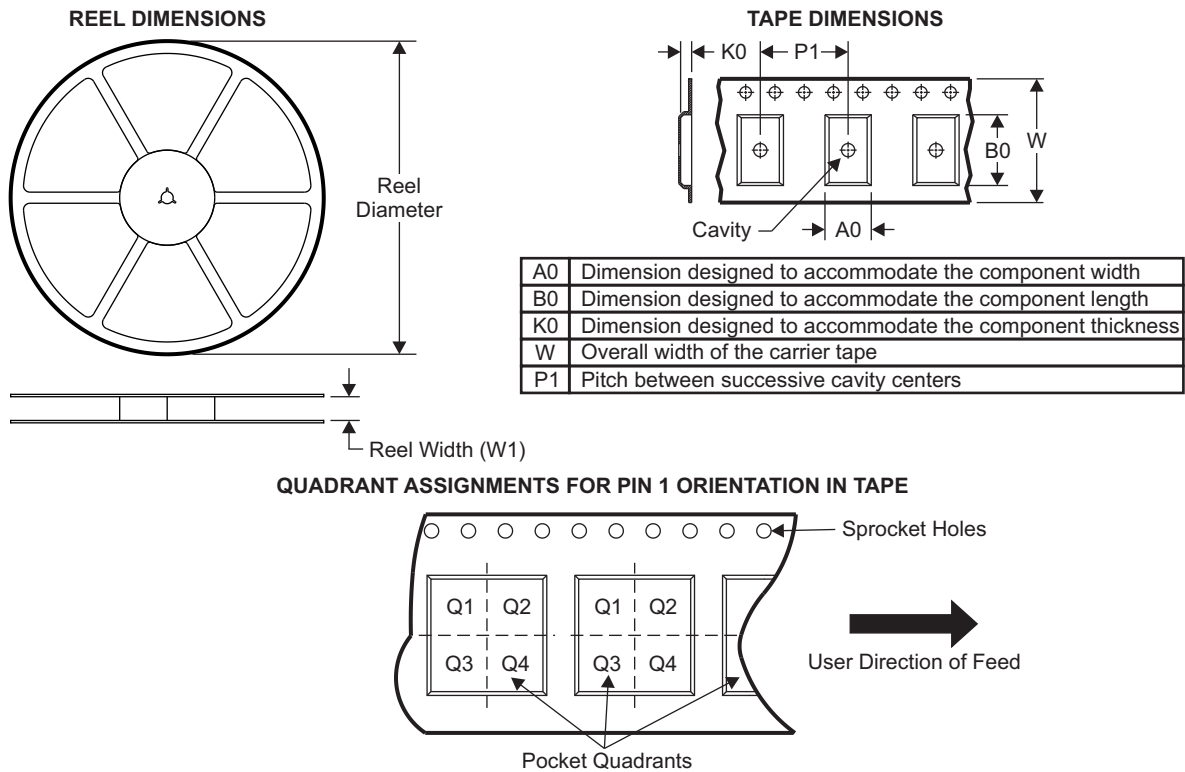
## SN74AVC4T245

SCES576G – JUNE 2004 – REVISED NOVEMBER 2014

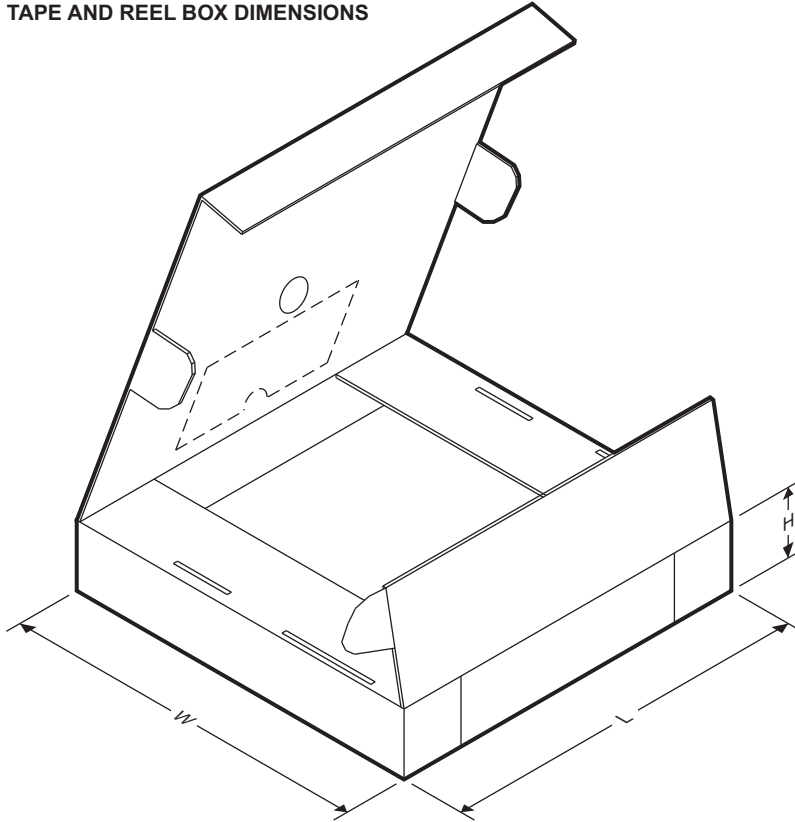
www.ti.com

### 13.1 Package Materials Information

#### 13.1.1 Tape and Reel Information



| 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 |
|------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74AVC4T245DGVR | TVSOP        | DGV             | 16   | 2000 | 330.0              | 12.4               | 6.8     | 4.0     | 1.6     | 8.0     | 12.0   | Q1            |
| SN74AVC4T245DR   | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| SN74AVC4T245PWR  | TSSOP        | PW              | 16   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| SN74AVC4T245RGYR | VQFN         | RGY             | 16   | 3000 | 330.0              | 12.4               | 3.8     | 4.3     | 1.5     | 8.0     | 12.0   | Q1            |
| SN74AVC4T245RGYR | VQFN         | RGY             | 16   | 3000 | 330.0              | 12.4               | 3.8     | 4.3     | 1.5     | 8.0     | 12.0   | Q1            |
| SN74AVC4T245RSVR | UQFN         | RSV             | 16   | 3000 | 180.0              | 12.4               | 2.1     | 2.9     | 0.75    | 4.0     | 12.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**


| Device           | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74AVC4T245DGVR | TVSOP        | DGV             | 16   | 2000 | 367.0       | 367.0      | 35.0        |
| SN74AVC4T245DR   | SOIC         | D               | 16   | 2500 | 333.2       | 345.9      | 28.6        |
| SN74AVC4T245PWR  | TSSOP        | PW              | 16   | 2000 | 367.0       | 367.0      | 35.0        |
| SN74AVC4T245RGYR | VQFN         | RGY             | 16   | 3000 | 367.0       | 367.0      | 35.0        |
| SN74AVC4T245RGYR | VQFN         | RGY             | 16   | 3000 | 355.0       | 350.0      | 50.0        |
| SN74AVC4T245RSVR | UQFN         | RSV             | 16   | 3000 | 203.0       | 203.0      | 35.0        |

**PACKAGING INFORMATION**

| Orderable Device  | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|-------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| 74AVC4T245DGVRE4  | ACTIVE        | TVSOP        | DGV                | 16   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | WT245                   | <a href="#">Samples</a> |
| 74AVC4T245RGYRG4  | ACTIVE        | VQFN         | RGY                | 16   | 3000           | RoHS & Green    | NIPDAU                               | Level-2-260C-1 YEAR  | -40 to 85    | WT245                   | <a href="#">Samples</a> |
| 74AVC4T245RSVR-NT | ACTIVE        | UQFN         | RSV                | 16   | 3000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | ZWU                     | <a href="#">Samples</a> |
| 74AVC4T245RSVRG4  | ACTIVE        | UQFN         | RSV                | 16   | 3000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | ZWU                     | <a href="#">Samples</a> |
| HPA00719RSVR      | ACTIVE        | UQFN         | RSV                | 16   | 3000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | ZWU                     | <a href="#">Samples</a> |
| SN74AVC4T245D     | ACTIVE        | SOIC         | D                  | 16   | 40             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | AVC4T245                | <a href="#">Samples</a> |
| SN74AVC4T245DGV   | ACTIVE        | TVSOP        | DGV                | 16   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | WT245                   | <a href="#">Samples</a> |
| SN74AVC4T245DR    | ACTIVE        | SOIC         | D                  | 16   | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | AVC4T245                | <a href="#">Samples</a> |
| SN74AVC4T245DRE4  | ACTIVE        | SOIC         | D                  | 16   | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | AVC4T245                | <a href="#">Samples</a> |
| SN74AVC4T245DT    | ACTIVE        | SOIC         | D                  | 16   | 250            | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | AVC4T245                | <a href="#">Samples</a> |
| SN74AVC4T245PW    | ACTIVE        | TSSOP        | PW                 | 16   | 90             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | WT245                   | <a href="#">Samples</a> |
| SN74AVC4T245PWE4  | ACTIVE        | TSSOP        | PW                 | 16   | 90             | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | WT245                   | <a href="#">Samples</a> |
| SN74AVC4T245PWR   | ACTIVE        | TSSOP        | PW                 | 16   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | WT245                   | <a href="#">Samples</a> |
| SN74AVC4T245PWRE4 | ACTIVE        | TSSOP        | PW                 | 16   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | WT245                   | <a href="#">Samples</a> |
| SN74AVC4T245PWRG4 | ACTIVE        | TSSOP        | PW                 | 16   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | WT245                   | <a href="#">Samples</a> |
| SN74AVC4T245PWT   | ACTIVE        | TSSOP        | PW                 | 16   | 250            | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | WT245                   | <a href="#">Samples</a> |
| SN74AVC4T245PWTE4 | ACTIVE        | TSSOP        | PW                 | 16   | 250            | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | WT245                   | <a href="#">Samples</a> |
| SN74AVC4T245PWTG4 | ACTIVE        | TSSOP        | PW                 | 16   | 250            | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | WT245                   | <a href="#">Samples</a> |
| SN74AVC4T245RGYR  | ACTIVE        | VQFN         | RGY                | 16   | 3000           | RoHS & Green    | NIPDAU                               | Level-2-260C-1 YEAR  | -40 to 85    | WT245                   | <a href="#">Samples</a> |
| SN74AVC4T245RSVR  | ACTIVE        | UQFN         | RSV                | 16   | 3000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | ZWU                     | <a href="#">Samples</a> |

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of  $\leq 1000$ ppm threshold. Antimony trioxide based flame retardants must also meet the  $\leq 1000$ ppm threshold requirement.

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

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

<sup>(5)</sup> 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.

<sup>(6)</sup> Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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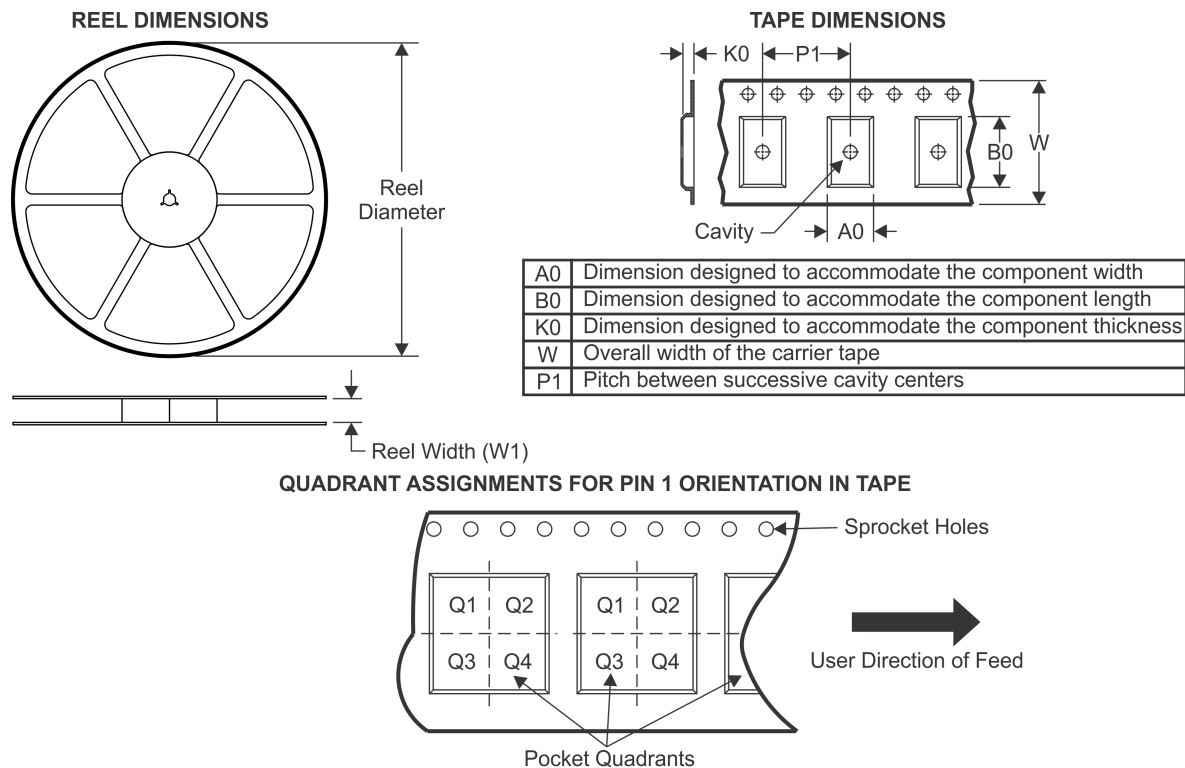
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

#### **OTHER QUALIFIED VERSIONS OF SN74AVC4T245 :**

- Automotive: [SN74AVC4T245-Q1](#)

NOTE: Qualified Version Definitions:

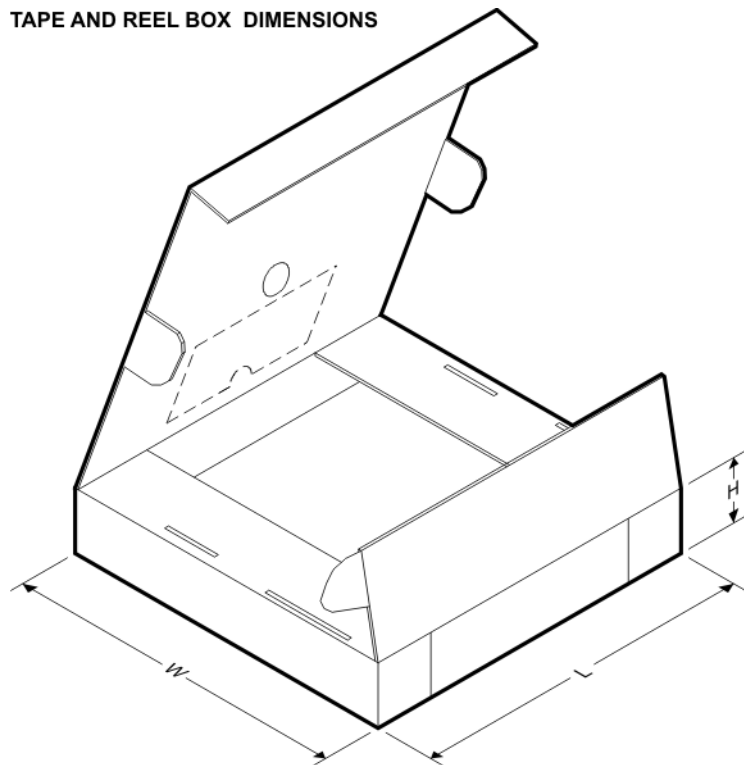
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

**TAPE AND REEL INFORMATION**


\*All dimensions are nominal

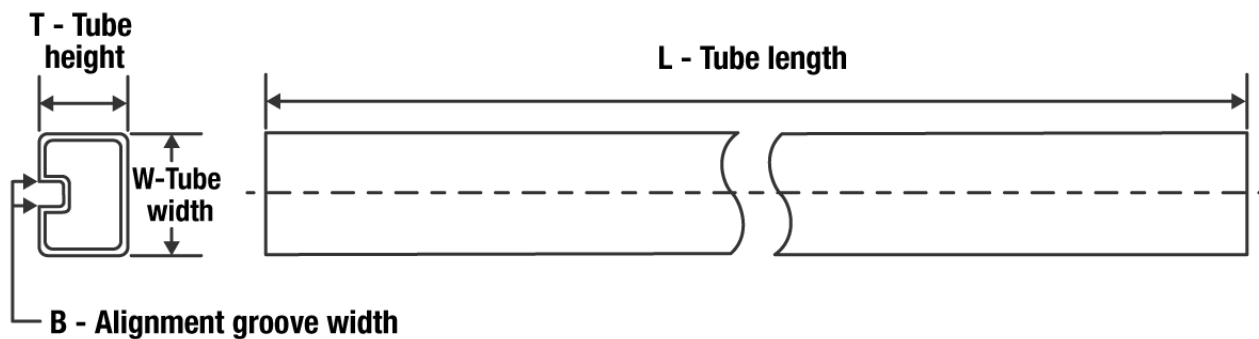
| Device            | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| 74AVC4T245RSVR-NT | UQFN         | RSV             | 16   | 3000 | 180.0              | 8.4                | 2.0     | 2.8     | 0.7     | 4.0     | 8.0    | Q1            |
| 74AVC4T245RSVR-NT | UQFN         | RSV             | 16   | 3000 | 180.0              | 9.5                | 2.1     | 2.9     | 0.75    | 4.0     | 8.0    | Q1            |
| SN74AVC4T245DGVR  | TVSOP        | DGV             | 16   | 2000 | 330.0              | 12.4               | 6.8     | 4.0     | 1.6     | 8.0     | 12.0   | Q1            |
| SN74AVC4T245DR    | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| SN74AVC4T245PWR   | TSSOP        | PW              | 16   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| SN74AVC4T245PWT   | TSSOP        | PW              | 16   | 250  | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| SN74AVC4T245RGYR  | VQFN         | RGY             | 16   | 3000 | 330.0              | 12.4               | 3.8     | 4.3     | 1.5     | 8.0     | 12.0   | Q1            |
| SN74AVC4T245RSVR  | UQFN         | RSV             | 16   | 3000 | 178.0              | 13.5               | 2.1     | 2.9     | 0.75    | 4.0     | 12.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

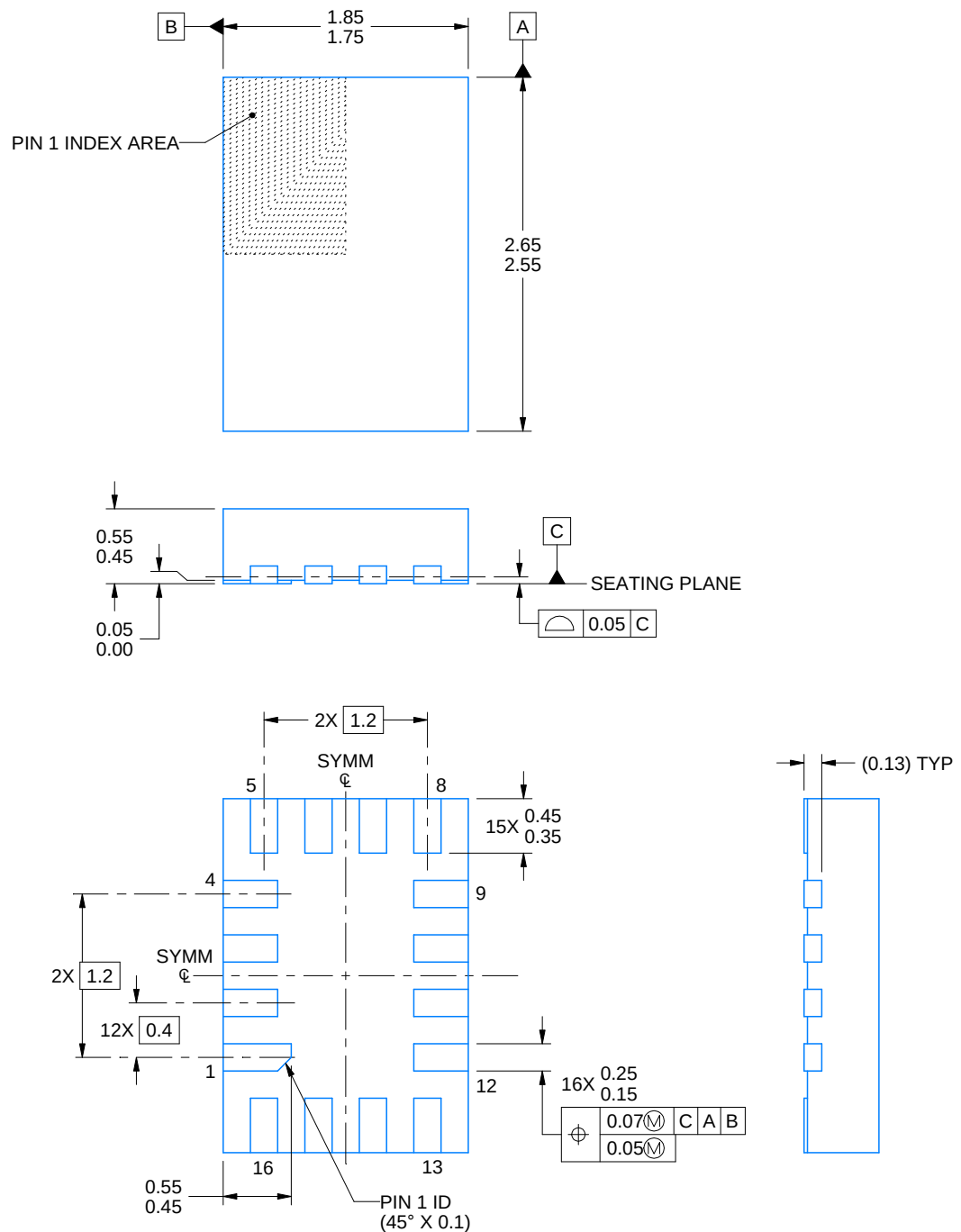
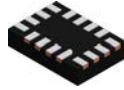
| Device            | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| 74AVC4T245RSVR-NT | UQFN         | RSV             | 16   | 3000 | 200.0       | 183.0      | 25.0        |
| 74AVC4T245RSVR-NT | UQFN         | RSV             | 16   | 3000 | 189.0       | 185.0      | 36.0        |
| SN74AVC4T245DGVR  | TVSOP        | DGV             | 16   | 2000 | 853.0       | 449.0      | 35.0        |
| SN74AVC4T245DR    | SOIC         | D               | 16   | 2500 | 340.5       | 336.1      | 32.0        |
| SN74AVC4T245PWR   | TSSOP        | PW              | 16   | 2000 | 853.0       | 449.0      | 35.0        |
| SN74AVC4T245PWT   | TSSOP        | PW              | 16   | 250  | 853.0       | 449.0      | 35.0        |
| SN74AVC4T245RGYR  | VQFN         | RGY             | 16   | 3000 | 853.0       | 449.0      | 35.0        |
| SN74AVC4T245RSVR  | UQFN         | RSV             | 16   | 3000 | 189.0       | 185.0      | 36.0        |

**TUBE**


\*All dimensions are nominal

| Device           | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|------------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| SN74AVC4T245D    | D            | SOIC         | 16   | 40  | 507    | 8      | 3940   | 4.32   |
| SN74AVC4T245PW   | PW           | TSSOP        | 16   | 90  | 530    | 10.2   | 3600   | 3.5    |
| SN74AVC4T245PWE4 | PW           | TSSOP        | 16   | 90  | 530    | 10.2   | 3600   | 3.5    |





4220314/C 02/2020

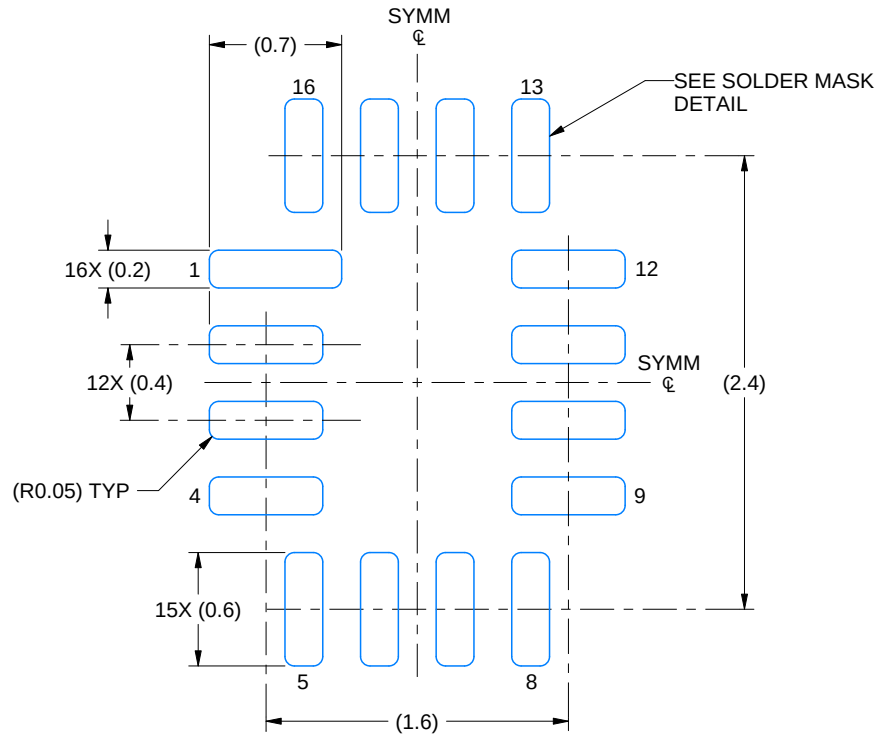
## NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

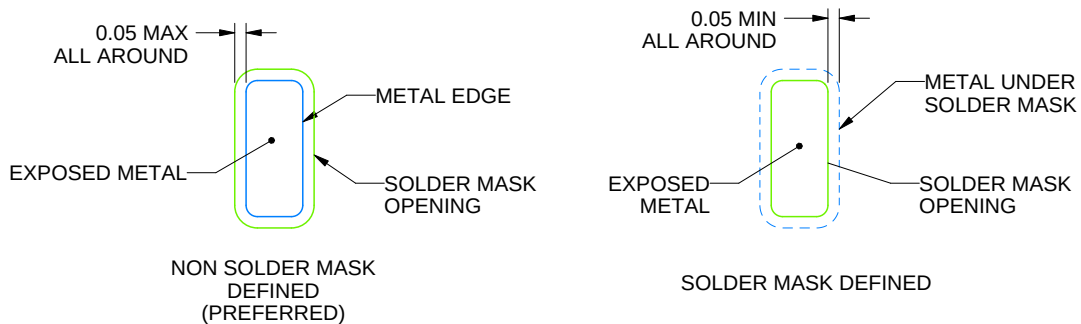
**RSV0016A**

**UQFN - 0.55 mm max height**

ULTRA THIN QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 25X



## SOLDER MASK DETAILS

4220314/C 02/2020

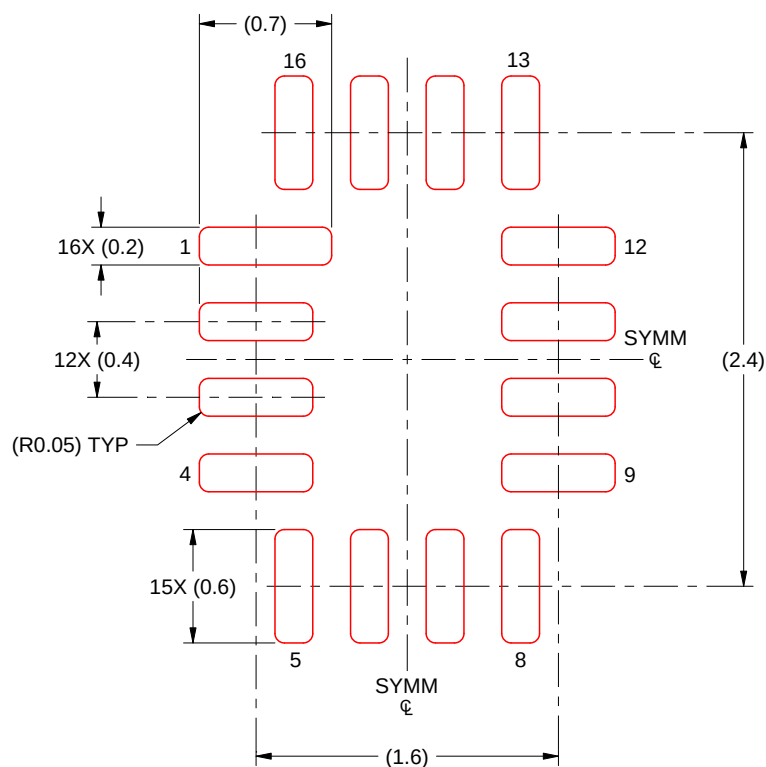
NOTES: (continued)

3. For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/sl原因271](http://www.ti.com/lit/sl原因271)).

**RSV0016A**

## UQFN - 0.55 mm max height

ULTRA THIN QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE  
BASED ON 0.125 MM THICK STENCIL  
SCALE: 25X

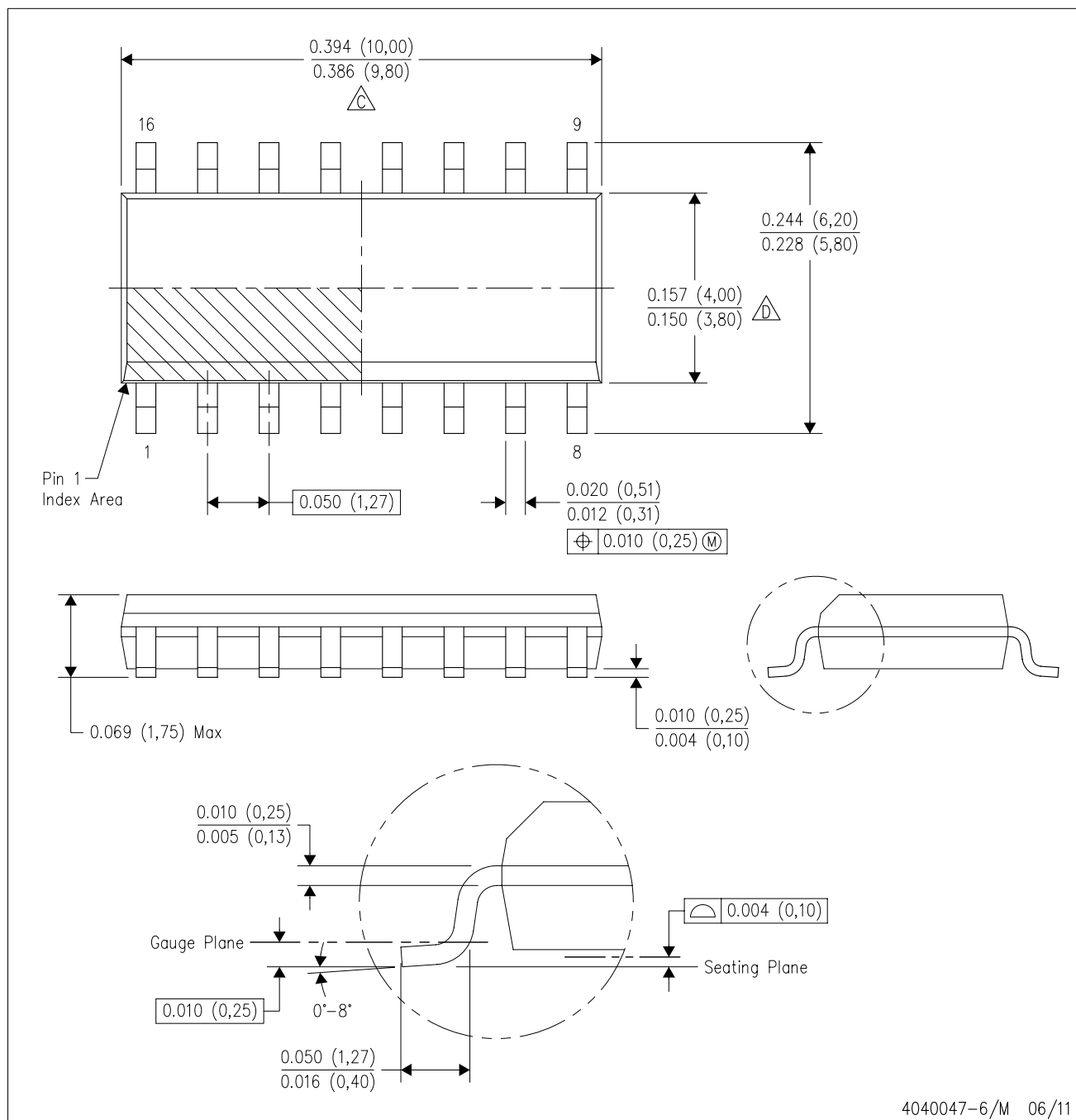
4220314/C 02/2020

NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

D (R-PDSO-G16)

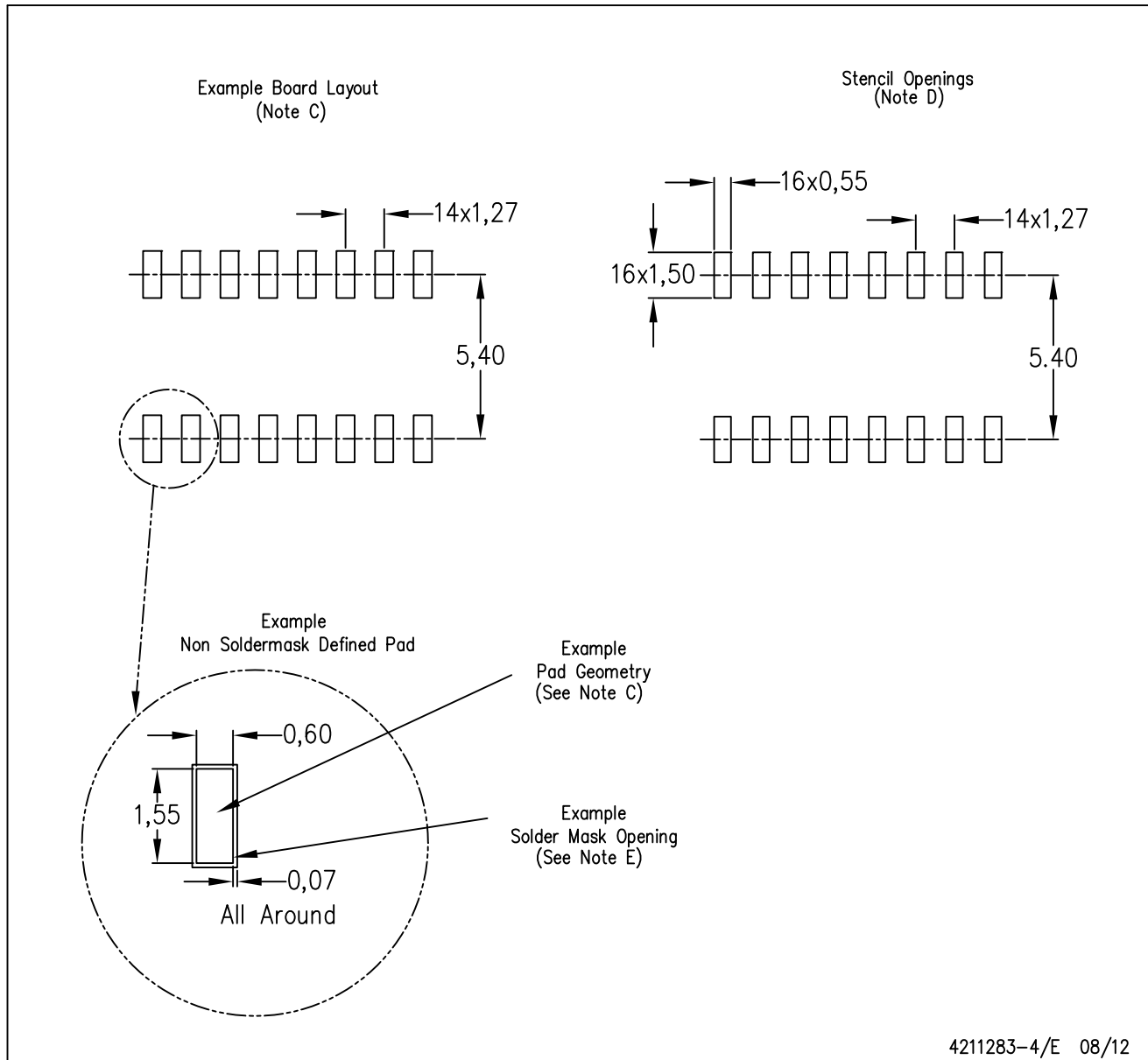
PLASTIC SMALL OUTLINE



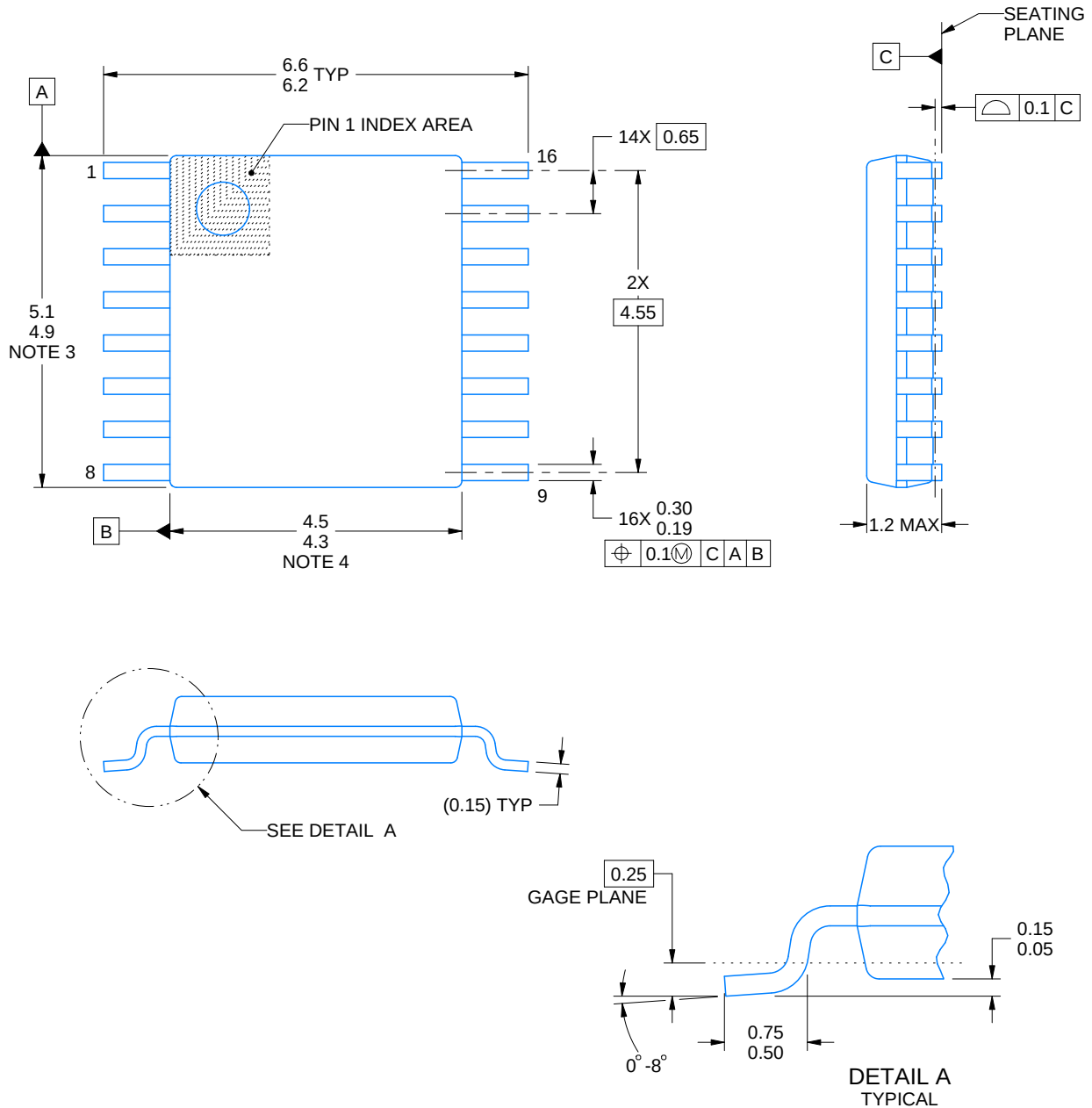
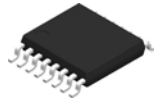
- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - $\triangle C$  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  - $\triangle D$  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AC.

D (R-PDSO-G16)

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 designs.
  - 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.



4220204/A 02/2017

## NOTES:

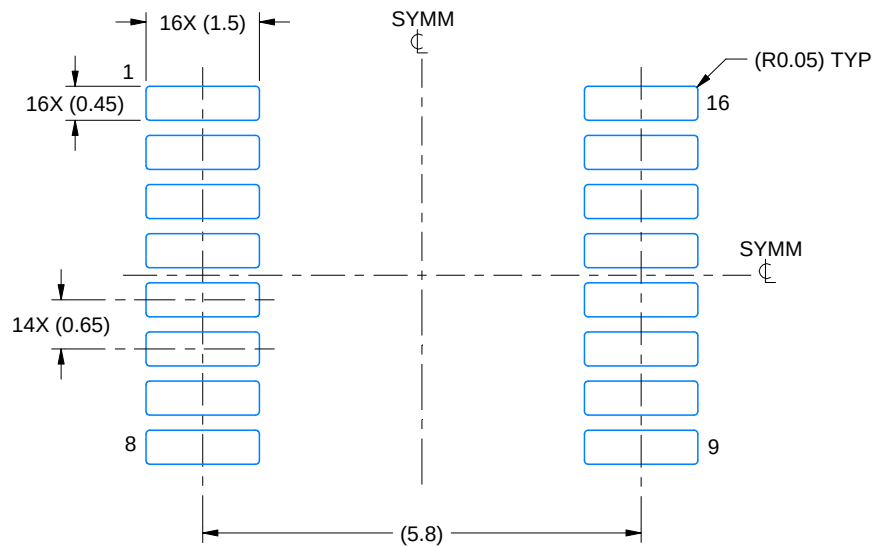
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

# EXAMPLE BOARD LAYOUT

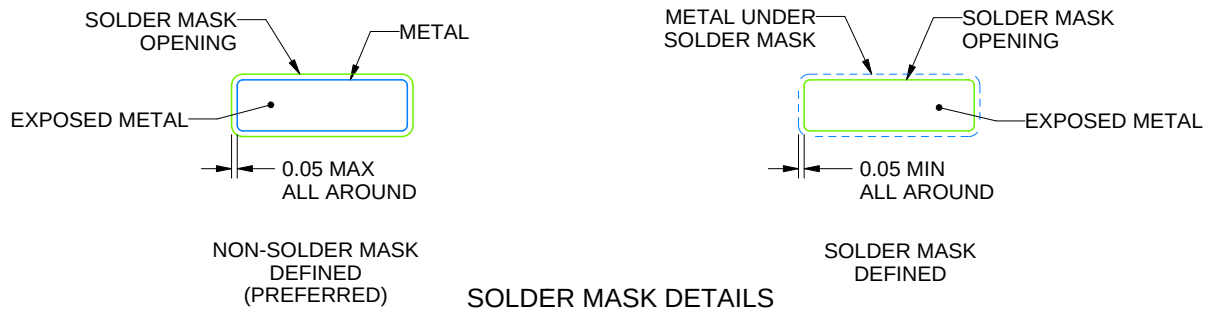
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



4220204/A 02/2017

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

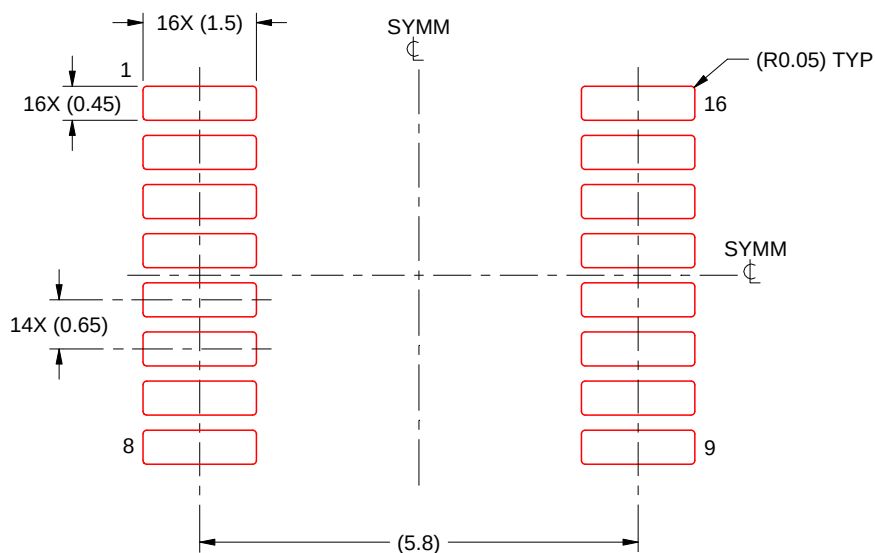
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

4220204/A 02/2017

NOTES: (continued)

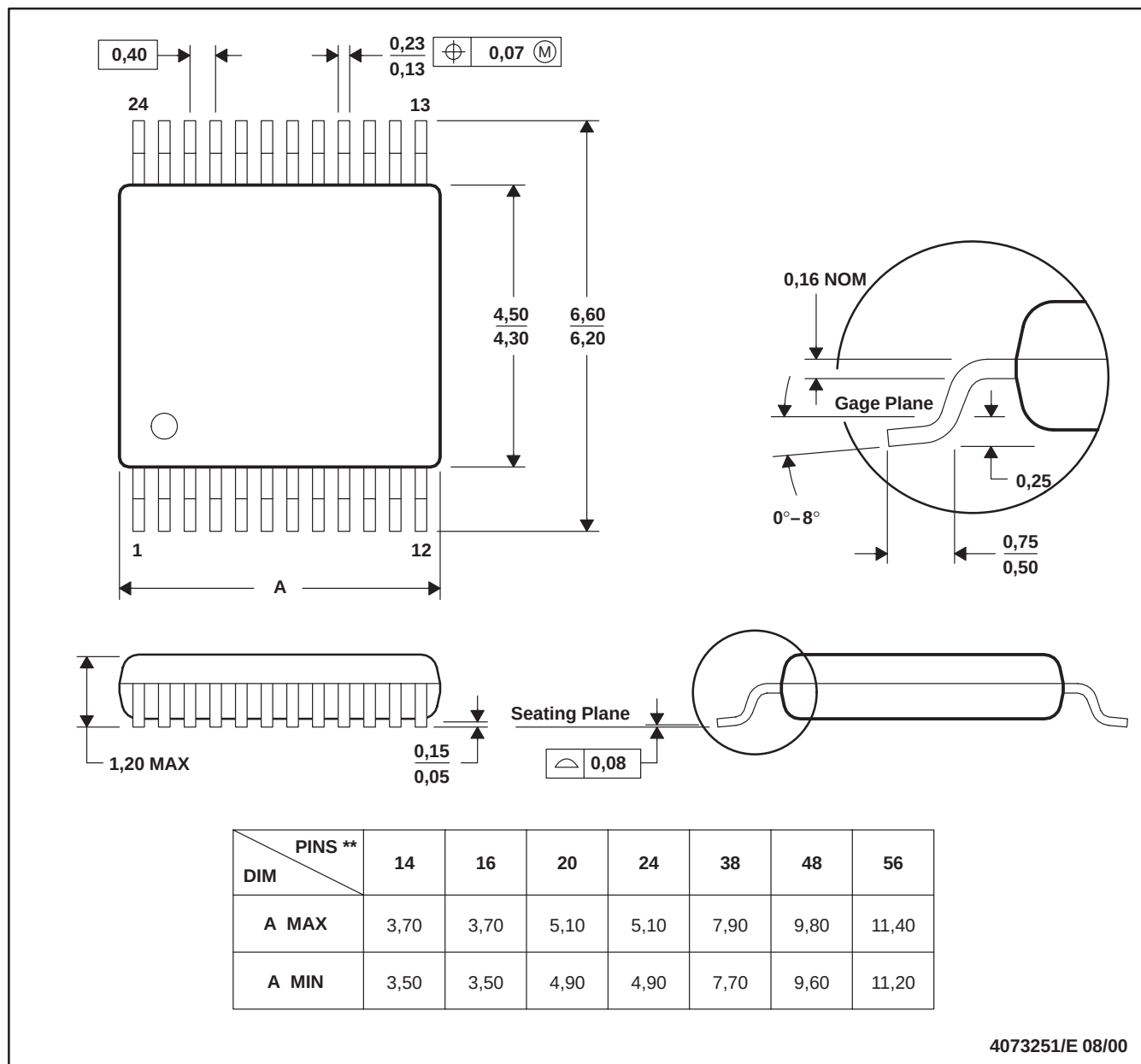
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.



## DGV (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE

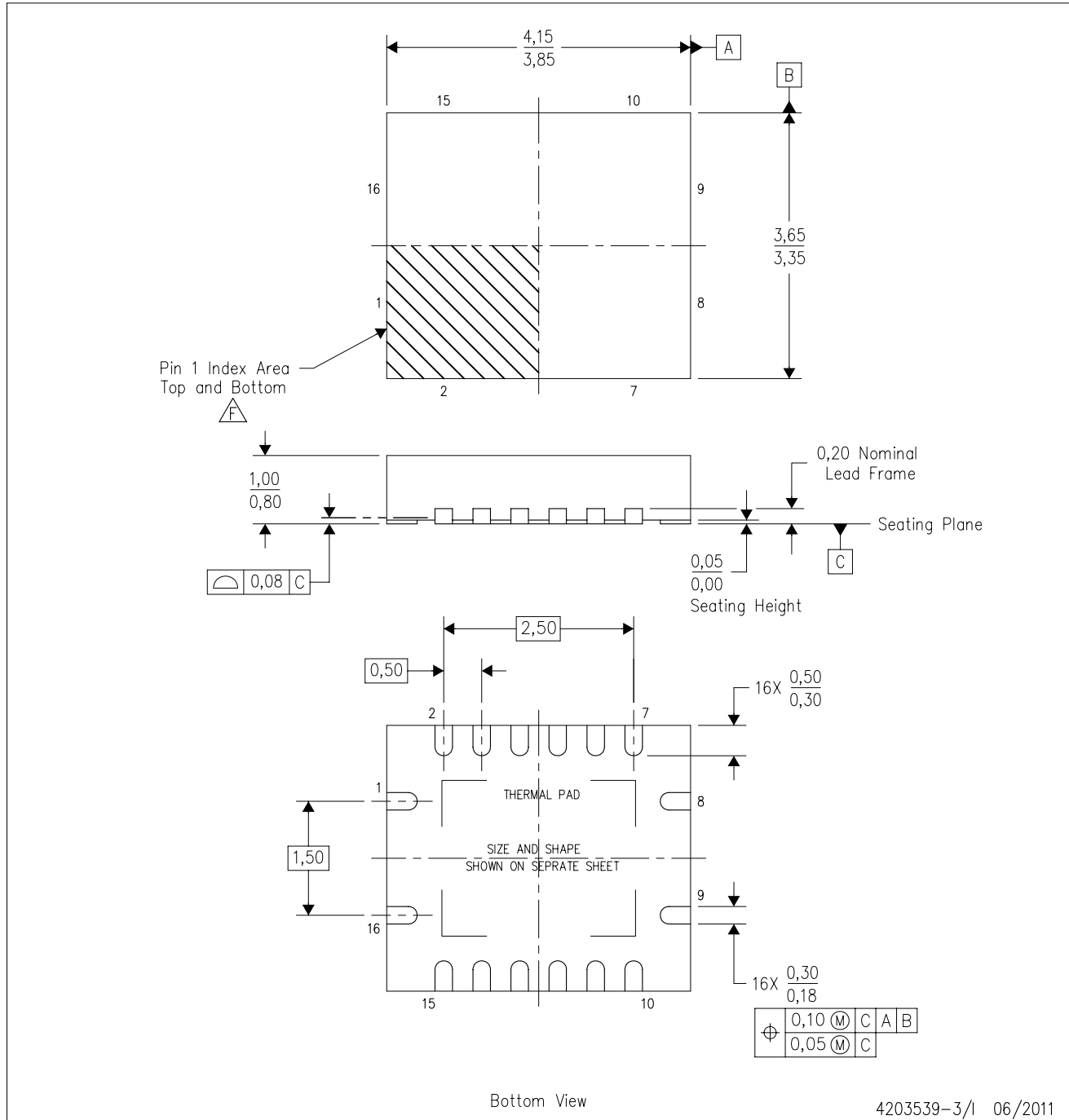
24 PINS SHOWN



- 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

RGY (R-PVQFN-N16)

PLASTIC QUAD FLATPACK NO-LEAD



4203539-3/I 06/2011

- 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.
- F** 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-N16)

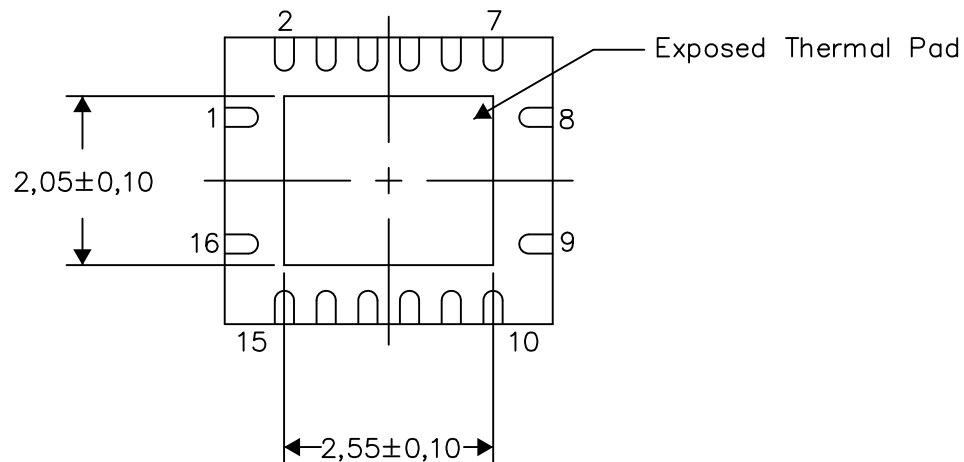
PLASTIC QUAD FLATPACK NO-LEAD

## 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](http://www.ti.com).

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



Bottom View

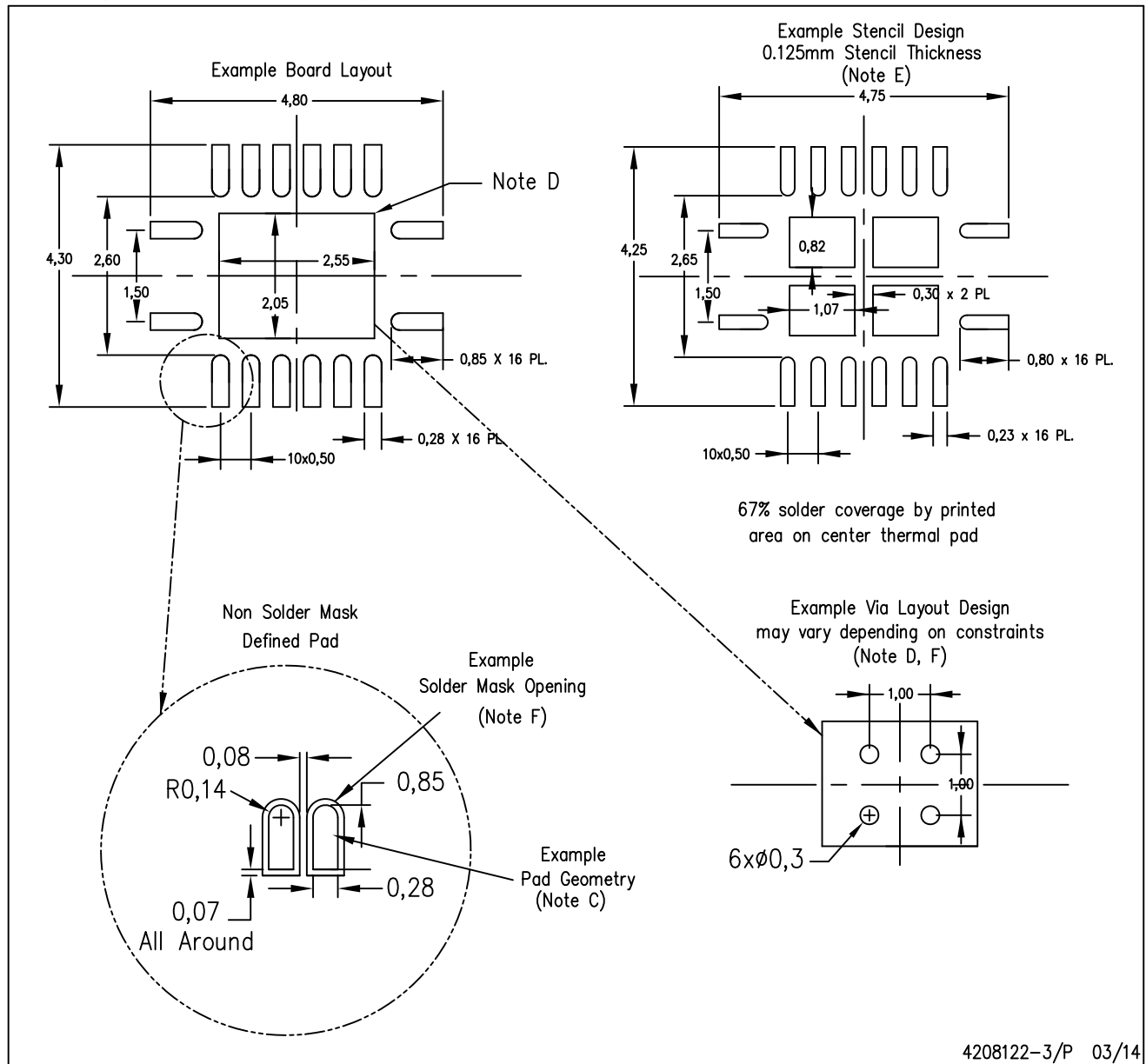
Exposed Thermal Pad Dimensions

4206353-3/P 03/14

NOTE: All linear dimensions are in millimeters

RGY (R-PVQFN-N16)

PLASTIC QUAD FLATPACK NO-LEAD



4208122-3/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) <<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.

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