



# THE DATASHEET OF SN74AVCH8T245DGVR

## SN74AVCH8T245 8-Bit Dual-Supply Bus Transceiver With Configurable Level-Shifting, Voltage Translation, and 3-State Outputs

### 1 Features

- Control Inputs (DIR and  $\overline{OE}$ )  $V_{IH}$  and  $V_{IL}$  Levels Are Referenced to  $V_{CCA}$  Voltage
- Bus Hold on Data Inputs Eliminates the Need for External Pullup or Pulldown Resistors
- $V_{CC}$  Isolation Feature
- Fully Configurable Dual-Rail Design
- I/Os Are 4.6-V Tolerant
- $I_{off}$  Supports Partial-Power-Down Mode Operation
- Max Data Rates:
  - 320 Mbps ( $V_{CCA} \geq 1.8\text{ V}$  and  $V_{CCB} \geq 1.8\text{ V}$ )
  - 170 Mbps ( $V_{CCA} \leq 1.8\text{ V}$  or  $V_{CCB} \leq 1.8\text{ V}$ )
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - 8000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

### 2 Applications

- Personal Electronics
- Industrial
- Enterprise
- Telecommunications

### 3 Description

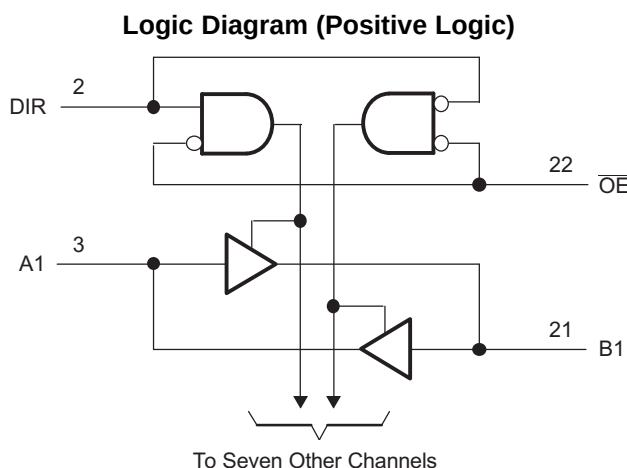
The SN74AVCH8T245 is an 8-bit noninverting bus transceiver that uses two separate configurable power-supply rails. The A port is designed to track  $V_{CCA}$ , which accepts any supply voltage from 1.2 V to 3.6 V. The B port is designed to track  $V_{CCB}$ , which also accepts any supply voltage from 1.2 V to 3.6 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 SN74AVCH8T245 is designed for asynchronous communication between data buses. The device transmits data from either the A bus to the B bus, or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable ( $\overline{OE}$ ) input can be used to disable the outputs so the buses are effectively isolated.

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

| PART NUMBER   | PACKAGE    | BODY SIZE (NOM)   |
|---------------|------------|-------------------|
| SN74AVCH8T245 | TVSOP (24) | 5.00 mm × 4.40 mm |
|               | TSSOP (24) | 7.80 mm × 4.40 mm |
|               | VQFN (24)  | 5.50 mm × 3.50 mm |

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



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## 4 Revision History

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

| Changes from Revision G (March 2007) to Revision H                                                                                                                                                                                                                                                                                          | Page |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <ul style="list-style-type: none"> <li>Added ESD Ratings table, Feature Description section, Device Functional Modes, Application and Implementation section, Power Supply Recommendations section, Layout section, Device and Documentation Support section, and Mechanical, Packaging, and Orderable Information section. ....</li> </ul> | 1    |
| <ul style="list-style-type: none"> <li>Deleted the Ordering Information table. See the POA at the end of the data sheet. ....</li> </ul>                                                                                                                                                                                                    | 1    |

## 5 Description (continued)

The SN74AVCH8T245 is designed so that the control pins (DIR and  $\overline{\text{OE}}$ ) are referenced to  $V_{\text{CCA}}$ .

Active bus-hold circuitry holds unused or undriven inputs at a valid logic state. Use of pullup or pulldown resistors with the bus-hold circuitry is not recommended.

This device is fully specified for partial-power-down applications using  $I_{\text{off}}$ . The  $I_{\text{off}}$  circuitry disables the outputs, preventing damaging current backflow through the device.

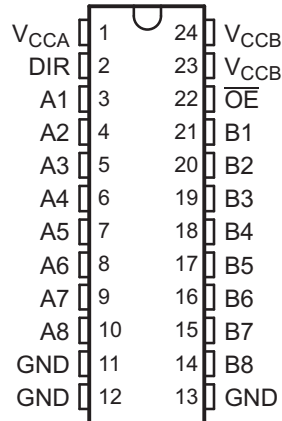
The  $V_{\text{CC}}$  isolation feature ensures that if either  $V_{\text{CCA}}$  or  $V_{\text{CCB}}$  is at GND, then the outputs are in the high-impedance state. The bus-hold circuitry on the powered-up side always stays active.

The SN74AVCH8T245 solution is compatible with a single-supply system and can be replaced later with a '245 function, with minimal printed circuit board redesign.

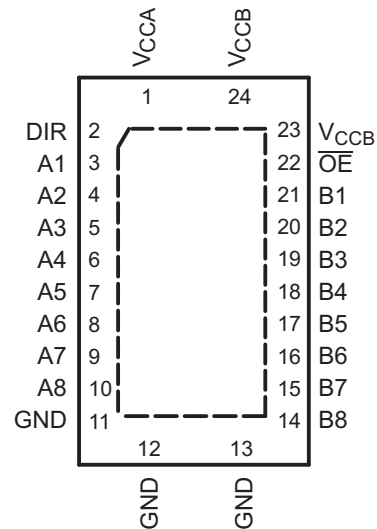
To ensure the high-impedance state during power up or power down,  $\overline{\text{OE}}$  shall be tied to  $V_{\text{CCA}}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

## 6 Pin Configuration and Functions

**DGV or PW Package  
24-Pin TVSOP or TSSOP  
Top View**



**RHL Package  
24-Pin VQFN  
Top View**



### Pin Functions

| PIN             |            | I/O | DESCRIPTION                                                                                                            |
|-----------------|------------|-----|------------------------------------------------------------------------------------------------------------------------|
| NAME            | NO.        |     |                                                                                                                        |
| A1              | 3          | I/O | Input/output A1. Referenced to $V_{CCA}$ .                                                                             |
| A2              | 4          | I/O | Input/output A2. Referenced to $V_{CCA}$ .                                                                             |
| A3              | 5          | I/O | Input/output A3. Referenced to $V_{CCA}$ .                                                                             |
| A4              | 6          | I/O | Input/output A4. Referenced to $V_{CCA}$ .                                                                             |
| A5              | 7          | I/O | Input/output A5. Referenced to $V_{CCA}$ .                                                                             |
| A6              | 8          | I/O | Input/output A6. Referenced to $V_{CCA}$ .                                                                             |
| A7              | 9          | I/O | Input/output A7. Referenced to $V_{CCA}$ .                                                                             |
| A8              | 10         | I/O | Input/output A8. Referenced to $V_{CCA}$ .                                                                             |
| B1              | 21         | I/O | Input/output B1. Referenced to $V_{CCB}$ .                                                                             |
| B2              | 20         | I/O | Input/output B2. Referenced to $V_{CCB}$ .                                                                             |
| B3              | 19         | I/O | Input/output B3. Referenced to $V_{CCB}$ .                                                                             |
| B4              | 18         | I/O | Input/output B4. Referenced to $V_{CCB}$ .                                                                             |
| B5              | 17         | I/O | Input/output B5. Referenced to $V_{CCB}$ .                                                                             |
| B6              | 16         | I/O | Input/output B6. Referenced to $V_{CCB}$ .                                                                             |
| B7              | 15         | I/O | Input/output B7. Referenced to $V_{CCB}$ .                                                                             |
| B8              | 14         | I/O | Input/output B8. Referenced to $V_{CCB}$ .                                                                             |
| DIR             | 2          | I   | Direction-control signal. Referenced to $V_{CCA}$ .                                                                    |
| GND             | 11, 12, 13 | —   | Ground                                                                                                                 |
| $\overline{OE}$ | 22         | I   | 3-state output-mode enables. Pull $\overline{OE}$ high to place all outputs in 3-state mode. Referenced to $V_{CCA}$ . |
| $V_{CCA}$       | 1          | —   | A-port supply voltage. $1.2\text{ V} \leq V_{CCA} \leq 3.6\text{ V}$                                                   |
| $V_{CCB}$       | 23, 24     | —   | B-port supply voltage. $1.2\text{ V} \leq V_{CCB} \leq 3.6\text{ V}$                                                   |

## 7 Specifications

### 7.1 Absolute Maximum Ratings

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

|                  |                                                                                       |                    | MIN  | MAX                    | UNIT |
|------------------|---------------------------------------------------------------------------------------|--------------------|------|------------------------|------|
| V <sub>CCA</sub> | Supply voltage                                                                        |                    | –0.5 | 4.6                    | V    |
| V <sub>CCB</sub> |                                                                                       |                    |      |                        |      |
| V <sub>I</sub>   | Input voltage <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 <sub>O</sub>   | Voltage 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 <sub>O</sub>   | Voltage applied to any output in the high or low state <sup>(2)(3)</sup>              | A port             | –0.5 | V <sub>CCA</sub> + 0.5 | V    |
|                  |                                                                                       | B port             | –0.5 | V <sub>CCB</sub> + 0.5 |      |
| I <sub>IK</sub>  | Input clamp current                                                                   | V <sub>I</sub> < 0 |      | –50                    | mA   |
| I <sub>OK</sub>  | Output clamp current                                                                  | V <sub>O</sub> < 0 |      | –50                    | mA   |
| I <sub>O</sub>   | Continuous output current                                                             |                    |      | ±50                    | mA   |
|                  | Continuous current through V <sub>CCA</sub> , V <sub>CCB</sub> , or GND               |                    |      | ±100                   | mA   |
| T <sub>J</sub>   | Junction temperature                                                                  |                    | –40  | 150                    | °C   |
| T <sub>stg</sub> | Storage temperature                                                                   |                    | –65  | 150                    | °C   |

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. 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.

### 7.2 ESD Ratings

|                    |                         |                                                                                | VALUE | UNIT |
|--------------------|-------------------------|--------------------------------------------------------------------------------|-------|------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>              | ±8000 | V    |
|                    |                         | Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup> | ±1000 |      |
|                    |                         | Machine model (MM)                                                             | ±200  |      |

- (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.

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## 7.3 Recommended Operating Conditions

See <sup>(1)(2)</sup>

|                  |                                         |                                                                     | MIN                                | MAX                     | UNIT |
|------------------|-----------------------------------------|---------------------------------------------------------------------|------------------------------------|-------------------------|------|
| V <sub>CCA</sub> | Supply voltage                          |                                                                     | 1.2                                | 3.6                     | V    |
| V <sub>CCB</sub> | Supply voltage                          |                                                                     | 1.2                                | 3.6                     | V    |
| V <sub>IH</sub>  | High-level input voltage <sup>(1)</sup> | Data inputs                                                         | V <sub>CCI</sub> = 1.2 V to 1.95 V | V <sub>CCI</sub> × 0.65 | V    |
|                  |                                         |                                                                     | V <sub>CCI</sub> = 1.95 V to 2.7 V | 1.6                     |      |
|                  |                                         |                                                                     | V <sub>CCI</sub> = 2.7 V to 3.6 V  | 2                       |      |
| V <sub>IL</sub>  | Low-level input voltage <sup>(1)</sup>  | Data inputs                                                         | V <sub>CCI</sub> = 1.2 V to 1.95 V | V <sub>CCI</sub> × 0.35 | V    |
|                  |                                         |                                                                     | V <sub>CCI</sub> = 1.95 V to 2.7 V | 0.7                     |      |
|                  |                                         |                                                                     | V <sub>CCI</sub> = 2.7 V to 3.6 V  | 0.8                     |      |
| V <sub>IH</sub>  | High-level input voltage                | DIR and $\overline{\text{OE}}$<br>(referenced to V <sub>CCA</sub> ) | V <sub>CCI</sub> = 1.2 V to 1.95 V | V <sub>CCA</sub> × 0.65 | V    |
|                  |                                         |                                                                     | V <sub>CCI</sub> = 1.95 V to 2.7 V | 1.6                     |      |
|                  |                                         |                                                                     | V <sub>CCI</sub> = 2.7 V to 3.6 V  | 2                       |      |
| V <sub>IL</sub>  | Low-level input voltage                 | DIR and $\overline{\text{OE}}$<br>(referenced to V <sub>CCA</sub> ) | V <sub>CCI</sub> = 1.2 V to 1.95 V | V <sub>CCA</sub> × 0.35 | V    |
|                  |                                         |                                                                     | V <sub>CCI</sub> = 1.95 V to 2.7 V | 0.7                     |      |
|                  |                                         |                                                                     | V <sub>CCI</sub> = 2.7 V to 3.6 V  | 0.8                     |      |
| V <sub>I</sub>   | Input voltage                           | Control Inputs                                                      | 0                                  | 3.6                     | V    |
| V <sub>O</sub>   | Output voltage <sup>(2)</sup>           | Active state                                                        | 0                                  | V <sub>CCO</sub>        | V    |
|                  |                                         | 3-state                                                             | 0                                  | 3.6                     |      |
| I <sub>OH</sub>  | High-level output current               | V <sub>CCO</sub> = 1.2 V                                            |                                    | –3                      | mA   |
|                  |                                         | V <sub>CCO</sub> = 1.4 V to 1.6 V                                   |                                    | –6                      |      |
|                  |                                         | V <sub>CCO</sub> = 1.65 V to 1.95 V                                 |                                    | –8                      |      |
|                  |                                         | V <sub>CCO</sub> = 2.3 V to 2.7 V                                   |                                    | –9                      |      |
|                  |                                         | V <sub>CCO</sub> = 3 V to 3.6 V                                     |                                    | –12                     |      |
| I <sub>OL</sub>  | Low-level output current                | V <sub>CCO</sub> = 1.2 V                                            |                                    | 3                       | mA   |
|                  |                                         | V <sub>CCO</sub> = 1.4 V to 1.6 V                                   |                                    | 6                       |      |
|                  |                                         | V <sub>CCO</sub> = 1.65 V to 1.95 V                                 |                                    | 8                       |      |
|                  |                                         | V <sub>CCO</sub> = 2.3 V to 2.7 V                                   |                                    | 9                       |      |
|                  |                                         | V <sub>CCO</sub> = 3 V to 3.6 V                                     |                                    | 12                      |      |
| Δt/Δv            | Input transition rise or fall rate      |                                                                     |                                    | 5                       | ns/V |
| T <sub>A</sub>   | Operating free-air temperature          |                                                                     | –40                                | 85                      | °C   |

(1) V<sub>CCI</sub> is the V<sub>CC</sub> associated with the input port.

(2) V<sub>CCO</sub> is the V<sub>CC</sub> associated with the output port.

## 7.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                                       | SN74AVCH8T245 |            |            | UNIT |
|-------------------------------|-------------------------------------------------------|---------------|------------|------------|------|
|                               |                                                       | DGV (TVSOP)   | PW (TSSOP) | RHL (VQFN) |      |
|                               |                                                       | 24 PINS       | 24 PINS    | 24 PINS    |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance <sup>(2)</sup> | 95.5          | 92         | 35         | °C/W |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance             | 27            | 29.3       | 39.9       | °C/W |
| R <sub>θJB</sub>              | Junction-to-board thermal resistance                  | 48.9          | 46.7       | 13.8       | °C/W |
| Ψ <sub>JT</sub>               | Junction-to-top characterization parameter            | 0.7           | 1.5        | 0.3        | °C/W |
| Ψ <sub>JB</sub>               | Junction-to-board characterization parameter          | 48.5          | 46.2       | 13.8       | °C/W |
| R <sub>θJC(bot)</sub>         | Junction-to-case (bottom) thermal resistance          | —             | —          | 1.4        | °C/W |

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

(2) The package thermal impedance is calculated in accordance with JESD 51-7.

## 7.5 Electrical Characteristics

All typical limits apply over  $T_A = 25^\circ\text{C}$ , and all maximum and minimum limits apply over  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                                                 | TEST CONDITIONS                                                                  |                                                                        | MIN             | TYP         | MAX     | UNIT          |
|-----------------------------------------------------------|----------------------------------------------------------------------------------|------------------------------------------------------------------------|-----------------|-------------|---------|---------------|
| $V_{OH}$ High-level output voltage <sup>(1)</sup>         | $I_{OH} = -100\ \mu\text{A}$ , $V_I = V_{IH}$                                    | $V_{CCA} = V_{CCB} = 1.2\ \text{V to } 3.6\ \text{V}$                  | $V_{CCO} - 0.2$ |             |         | V             |
|                                                           | $I_{OH} = -3\ \text{mA}$ , $V_I = V_{IH}$                                        | $V_{CCA} = V_{CCB} = 1.2\ \text{V}$                                    |                 | 0.95        |         |               |
|                                                           | $I_{OH} = -6\ \text{mA}$ , $V_I = V_{IH}$                                        | $V_{CCA} = V_{CCB} = 1.4\ \text{V}$                                    |                 | 1.05        |         |               |
|                                                           | $I_{OH} = -8\ \text{mA}$ , $V_I = V_{IH}$                                        | $V_{CCA} = V_{CCB} = 1.65\ \text{V}$                                   |                 | 1.2         |         |               |
|                                                           | $I_{OH} = -9\ \text{mA}$ , $V_I = V_{IH}$                                        | $V_{CCA} = V_{CCB} = 2.3\ \text{V}$                                    |                 | 1.75        |         |               |
|                                                           | $I_{OH} = -12\ \text{mA}$ , $V_I = V_{IH}$                                       | $V_{CCA} = V_{CCB} = 3\ \text{V}$                                      |                 | 2.3         |         |               |
| $V_{OL}$ Low-level output voltage                         | $I_{OL} = 100\ \mu\text{A}$ , $V_I = V_{IL}$                                     | $V_{CCA} = V_{CCB} = 1.2\ \text{V to } 3.6\ \text{V}$                  |                 |             | 0.2     | V             |
|                                                           | $I_{OL} = 3\ \text{mA}$ , $V_I = V_{IL}$                                         | $V_{CCA} = V_{CCB} = 1.2\ \text{V}$                                    |                 | 0.15        |         |               |
|                                                           | $I_{OL} = 6\ \text{mA}$ , $V_I = V_{IL}$                                         | $V_{CCA} = V_{CCB} = 1.4\ \text{V}$                                    |                 |             | 0.35    |               |
|                                                           | $I_{OL} = 8\ \text{mA}$ , $V_I = V_{IL}$                                         | $V_{CCA} = V_{CCB} = 1.65\ \text{V}$                                   |                 |             | 0.45    |               |
|                                                           | $I_{OL} = 9\ \text{mA}$ , $V_I = V_{IL}$                                         | $V_{CCA} = V_{CCB} = 2.3\ \text{V}$                                    |                 |             | 0.55    |               |
|                                                           | $I_{OL} = 12\ \text{mA}$ , $V_I = V_{IL}$                                        | $V_{CCA} = V_{CCB} = 3\ \text{V}$                                      |                 |             | 0.7     |               |
| $I_I$ Control inputs                                      | $V_I = V_{CCA}$ or GND                                                           | $V_{CCA} = V_{CCB} = 1.2\ \text{V to } 3.6\ \text{V}$                  |                 | $\pm 0.025$ | $\pm 1$ | $\mu\text{A}$ |
| $I_{BHL}$ Bus-hold low sustaining current <sup>(2)</sup>  | $V_I = 0.42\ \text{V}$                                                           | $V_{CCA} = V_{CCB} = 1.2\ \text{V}$                                    |                 | 25          |         | $\mu\text{A}$ |
|                                                           | $V_I = 0.49\ \text{V}$                                                           | $V_{CCA} = V_{CCB} = 1.4\ \text{V}$                                    |                 | 15          |         |               |
|                                                           | $V_I = 0.58\ \text{V}$                                                           | $V_{CCA} = V_{CCB} = 1.65\ \text{V}$                                   |                 | 25          |         |               |
|                                                           | $V_I = 0.7\ \text{V}$                                                            | $V_{CCA} = V_{CCB} = 2.3\ \text{V}$                                    |                 | 45          |         |               |
|                                                           | $V_I = 0.8\ \text{V}$                                                            | $V_{CCA} = V_{CCB} = 3.3\ \text{V}$                                    |                 | 100         |         |               |
| $I_{BHH}$ Bus-hold high sustaining current <sup>(3)</sup> | $V_I = 0.78\ \text{V}$                                                           | $V_{CCA} = V_{CCB} = 1.2\ \text{V}$                                    |                 | -25         |         | $\mu\text{A}$ |
|                                                           | $V_I = 0.91\ \text{V}$                                                           | $V_{CCA} = V_{CCB} = 1.4\ \text{V}$                                    |                 | -15         |         |               |
|                                                           | $V_I = 1.07\ \text{V}$                                                           | $V_{CCA} = V_{CCB} = 1.65\ \text{V}$                                   |                 | -25         |         |               |
|                                                           | $V_I = 1.6\ \text{V}$                                                            | $V_{CCA} = V_{CCB} = 2.3\ \text{V}$                                    |                 | -45         |         |               |
|                                                           | $V_I = 2\ \text{V}$                                                              | $V_{CCA} = V_{CCB} = 3.3\ \text{V}$                                    |                 | -100        |         |               |
| $I_{BHLO}$ Bus-hold low overdrive current <sup>(4)</sup>  | $V_I = 0\ \text{to } V_{CC}$                                                     | $V_{CCA} = V_{CCB} = 1.2\ \text{V}$                                    |                 | 50          |         | $\mu\text{A}$ |
|                                                           |                                                                                  | $V_{CCA} = V_{CCB} = 1.6\ \text{V}$                                    |                 | 125         |         |               |
|                                                           |                                                                                  | $V_{CCA} = V_{CCB} = 1.95\ \text{V}$                                   |                 | 200         |         |               |
|                                                           |                                                                                  | $V_{CCA} = V_{CCB} = 2.7\ \text{V}$                                    |                 | 300         |         |               |
|                                                           |                                                                                  | $V_{CCA} = V_{CCB} = 3.6\ \text{V}$                                    |                 | 500         |         |               |
| $I_{BHHO}$ Bus-hold high overdrive current <sup>(5)</sup> | $V_I = 0\ \text{to } V_{CC}$                                                     | $V_{CCA} = V_{CCB} = 1.2\ \text{V}$                                    |                 | -50         |         | $\mu\text{A}$ |
|                                                           |                                                                                  | $V_{CCA} = V_{CCB} = 1.6\ \text{V}$                                    |                 | -125        |         |               |
|                                                           |                                                                                  | $V_{CCA} = V_{CCB} = 1.95\ \text{V}$                                   |                 | -200        |         |               |
|                                                           |                                                                                  | $V_{CCA} = V_{CCB} = 2.7\ \text{V}$                                    |                 | -300        |         |               |
|                                                           |                                                                                  | $V_{CCA} = V_{CCB} = 3.6\ \text{V}$                                    |                 | -500        |         |               |
| $I_{off}$ Input/output power-off leakage current          | $V_I = 0\ \text{V to } 3.6\ \text{V}$ ,<br>$V_O = 0\ \text{V to } 3.6\ \text{V}$ | $V_{CCA} = 0\ \text{V}$ ,<br>$V_{CCB} = 0\ \text{V to } 3.6\ \text{V}$ | A Port          | $\pm 0.1$   | $\pm 5$ | $\mu\text{A}$ |
|                                                           |                                                                                  | $V_{CCA} = 0\ \text{V to } 3.6\ \text{V}$ ,<br>$V_{CCB} = 0\ \text{V}$ | B Port          | $\pm 0.1$   | $\pm 5$ |               |

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

(2) The bus-hold circuit can sink at least the minimum low sustaining current at  $V_{IL}$  max.  $I_{BHL}$  should be measured after lowering  $V_{IN}$  to GND and then raising it to  $V_{IL}$  max.

(3) The bus-hold circuit can source at least the minimum high sustaining current at  $V_{IH}$  min.  $I_{BHH}$  should be measured after raising  $V_{IN}$  to  $V_{CC}$  and then lowering it to  $V_{IH}$  min.

(4) An external driver must source at least  $I_{BHLO}$  to switch this node from low to high.

(5) An external driver must sink at least  $I_{BHHO}$  to switch this node from high to low.



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**Electrical Characteristics (continued)**

All typical limits apply over  $T_A = 25^\circ\text{C}$ , and all maximum and minimum limits apply over  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$  (unless otherwise noted)

| PARAMETER                                                  | TEST CONDITIONS                                                                           |                                                     |                   | MIN | TYP       | MAX     | UNIT          |
|------------------------------------------------------------|-------------------------------------------------------------------------------------------|-----------------------------------------------------|-------------------|-----|-----------|---------|---------------|
| $I_{OZ}$ Off-state output current <sup>(1)(6)(7)</sup>     | $V_O = V_{CCO}$ or GND,<br>$V_I = V_{CCI}$ or GND, $\overline{OE} = V_{IH}$               | $V_{CCA} = V_{CCB} = 3.6\text{ V}$                  | A Port,<br>B Port |     | $\pm 0.5$ | $\pm 5$ | $\mu\text{A}$ |
|                                                            | $V_O = V_{CCO}$ or GND,<br>$V_I = V_{CCI}$ or GND,<br>$\overline{OE} = \text{Don't Care}$ | $V_{CCA} = 0\text{ V},$<br>$V_{CCB} = 3.6\text{ V}$ | B Port            |     |           | $\pm 5$ |               |
|                                                            |                                                                                           | $V_{CCA} = 3.6\text{ V},$<br>$V_{CCB} = 0\text{ V}$ | A Port            |     |           | $\pm 5$ |               |
| $I_{CCA}$ Supply current A port <sup>(6)</sup>             | $V_I = V_{CCI}$ or GND, $I_O = 0$                                                         | $V_{CCA} = V_{CCB} = 1.2\text{ V to } 3.6\text{ V}$ |                   |     |           | 8       | $\mu\text{A}$ |
|                                                            |                                                                                           | $V_{CCA} = 0\text{ V}, V_{CCB} = 3.6\text{ V}$      |                   |     |           | -2      |               |
|                                                            |                                                                                           | $V_{CCA} = 3.6\text{ V}, V_{CCB} = 0\text{ V}$      |                   |     |           | 8       |               |
| $I_{CCB}$ Supply current B port <sup>(6)</sup>             | $V_I = V_{CCI}$ or GND, $I_O = 0$                                                         | $V_{CCA} = V_{CCB} = 1.2\text{ V to } 3.6\text{ V}$ |                   |     |           | 8       | $\mu\text{A}$ |
|                                                            |                                                                                           | $V_{CCA} = 0\text{ V}, V_{CCB} = 3.6\text{ V}$      |                   |     |           | 8       |               |
|                                                            |                                                                                           | $V_{CCA} = 3.6\text{ V}, V_{CCB} = 0\text{ V}$      |                   |     |           | -2      |               |
| $I_{CCA} + I_{CCB}$ Combined supply current <sup>(6)</sup> | $V_I = V_{CCI}$ or GND, $I_O = 0$                                                         | $V_{CCA} = V_{CCB} = 1.2\text{ V to } 3.6\text{ V}$ |                   |     |           | 16      | $\mu\text{A}$ |
| $C_i$ Input capacitance control pins                       | $V_I = 3.3\text{ V}$ or GND                                                               | $V_{CCA} = V_{CCB} = 3.3\text{ V}$                  |                   |     | 3.5       | 4.5     | pF            |
| $C_{io}$ Input/output capacitance a or b port              | $V_O = 3.3\text{ V}$ or GND                                                               | $V_{CCA} = V_{CCB} = 3.3\text{ V}$                  |                   |     | 6         | 7       | pF            |

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

(7) For I/O ports, the parameter  $I_{OZ}$  includes the input leakage current.

## 7.6 Switching Characteristics, $V_{CCA} = 1.2\text{ V}$

 $T_A = 25^\circ\text{C}$  (see Figure 10)

| PARAMETER                                                                                                           | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEST CONDITIONS          | MIN | TYP | MAX | UNIT |
|---------------------------------------------------------------------------------------------------------------------|-----------------|----------------|--------------------------|-----|-----|-----|------|
| $t_{PLH}$ ,<br>$t_{PHL}$<br><br>Propagation delay time:<br>low-to-high-level output and<br>high-to-low level output | A               | B              | $V_{CCB} = 1.2\text{ V}$ |     | 3.1 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ |     | 2.6 |     |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ |     | 2.5 |     |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ |     | 3   |     |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ |     | 3.5 |     |      |
| $t_{PLH}$ ,<br>$t_{PHL}$<br><br>Propagation delay time:<br>low-to-high-level output and<br>high-to-low level output | B               | A              | $V_{CCB} = 1.2\text{ V}$ |     | 3.1 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ |     | 2.7 |     |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ |     | 2.5 |     |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ |     | 2.4 |     |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ |     | 2.3 |     |      |
| $t_{PZH}$ ,<br>$t_{PZL}$<br><br>Enable time:<br>to high level and<br>to low level                                   | $\overline{OE}$ | A              | $V_{CCB} = 1.2\text{ V}$ |     | 5.3 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ |     | 5.3 |     |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ |     | 5.3 |     |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ |     | 5.3 |     |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ |     | 5.3 |     |      |
| $t_{PZH}$ ,<br>$t_{PZL}$<br><br>Enable time:<br>to high level and<br>to low level                                   | $\overline{OE}$ | B              | $V_{CCB} = 1.2\text{ V}$ |     | 5.1 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ |     | 4   |     |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ |     | 3.5 |     |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ |     | 3.2 |     |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ |     | 3.1 |     |      |
| $t_{PHZ}$ ,<br>$t_{PLZ}$<br><br>Disable time:<br>from high level and<br>from low level                              | $\overline{OE}$ | A              | $V_{CCB} = 1.2\text{ V}$ |     | 4.8 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ |     | 4.8 |     |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ |     | 4.8 |     |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ |     | 4.8 |     |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ |     | 4.8 |     |      |
| $t_{PHZ}$ ,<br>$t_{PLZ}$<br><br>Disable time:<br>from high level and<br>from low level                              | $\overline{OE}$ | B              | $V_{CCB} = 1.2\text{ V}$ |     | 4.7 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ |     | 4   |     |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ |     | 4.1 |     |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ |     | 4.3 |     |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ |     | 5.1 |     |      |

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**7.7 Switching Characteristics,  $V_{CCA} = 1.5\text{ V} \pm 0.1\text{ V}$** 

All typical limits apply over  $T_A = 25^\circ\text{C}$ , and all maximum and minimum limits apply over  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$  (unless otherwise noted) (see [Figure 10](#))

| PARAMETER                                                                                                           | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEST CONDITIONS          | MIN | TYP | MAX | UNIT |
|---------------------------------------------------------------------------------------------------------------------|-----------------|----------------|--------------------------|-----|-----|-----|------|
| $t_{PLH}$ ,<br>$t_{PHL}$<br><br>Propagation delay time:<br>low-to-high-level output and<br>high-to-low level output | A               | B              | $V_{CCB} = 1.2\text{ V}$ |     | 2.7 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ | 0.5 |     | 5.4 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ | 0.5 |     | 4.6 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ | 0.5 |     | 4.9 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ | 0.5 |     | 6.8 |      |
| $t_{PLH}$ ,<br>$t_{PHL}$<br><br>Propagation delay time:<br>low-to-high-level output and<br>high-to-low level output | B               | A              | $V_{CCB} = 1.2\text{ V}$ |     | 2.6 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ | 0.5 |     | 5.4 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ | 0.5 |     | 5.1 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ | 0.5 |     | 4.7 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ | 0.5 |     | 4.5 |      |
| $t_{PZH}$ ,<br>$t_{PZL}$<br><br>Enable time:<br>to high level and<br>to low level                                   | $\overline{OE}$ | A              | $V_{CCB} = 1.2\text{ V}$ |     | 3.7 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ | 1.1 |     | 8.7 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ | 1.1 |     | 8.7 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ | 1.1 |     | 8.7 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ | 1.1 |     | 8.7 |      |
| $t_{PZH}$ ,<br>$t_{PZL}$<br><br>Enable time:<br>to high level and<br>to low level                                   | $\overline{OE}$ | B              | $V_{CCB} = 1.2\text{ V}$ |     | 4.8 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ | 1.1 |     | 7.6 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ | 1.1 |     | 7.1 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ | 1.1 |     | 5.6 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ | 1.1 |     | 5.2 |      |
| $t_{PHZ}$ ,<br>$t_{PLZ}$<br><br>Disable time:<br>from high level and<br>from low level                              | $\overline{OE}$ | A              | $V_{CCB} = 1.2\text{ V}$ |     | 3.1 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ | 0.5 |     | 8.6 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ | 0.5 |     | 8.6 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ | 0.5 |     | 8.6 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ | 0.5 |     | 8.6 |      |
| $t_{PHZ}$ ,<br>$t_{PLZ}$<br><br>Disable time:<br>from high level and<br>from low level                              | $\overline{OE}$ | B              | $V_{CCB} = 1.2\text{ V}$ |     | 4.1 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ | 0.5 |     | 8.4 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ | 0.5 |     | 7.6 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ | 0.5 |     | 7.2 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ | 0.5 |     | 7.8 |      |

## 7.8 Switching Characteristics, $V_{CCA} = 1.8\text{ V} \pm 0.15\text{ V}$

All typical limits apply over  $T_A = 25^\circ\text{C}$ , and all maximum and minimum limits apply over  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$  (unless otherwise noted) (see [Figure 10](#))

| PARAMETER                                                                                                           | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEST CONDITIONS          | MIN | TYP | MAX | UNIT |
|---------------------------------------------------------------------------------------------------------------------|-----------------|----------------|--------------------------|-----|-----|-----|------|
| $t_{PLH}$ ,<br>$t_{PHL}$<br><br>Propagation delay time:<br>low-to-high-level output and<br>high-to-low level output | A               | B              | $V_{CCB} = 1.2\text{ V}$ |     | 2.5 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ | 0.5 |     | 5.1 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ | 0.5 |     | 4.4 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ | 0.5 |     | 4   |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ | 0.5 |     | 3.9 |      |
| $t_{PLH}$ ,<br>$t_{PHL}$<br><br>Propagation delay time:<br>low-to-high-level output and<br>high-to-low level output | B               | A              | $V_{CCB} = 1.2\text{ V}$ |     | 2.5 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ | 0.5 |     | 4.6 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ | 0.5 |     | 4.4 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ | 0.5 |     | 3.9 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ | 0.5 |     | 3.7 |      |
| $t_{PZH}$ ,<br>$t_{PZL}$<br><br>Enable time:<br>to high level and<br>to low level                                   | $\overline{OE}$ | A              | $V_{CCB} = 1.2\text{ V}$ |     | 3   |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ | 1   |     | 6.8 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ | 1   |     | 6.8 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ | 1   |     | 6.8 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ | 1   |     | 6.8 |      |
| $t_{PZH}$ ,<br>$t_{PZL}$<br><br>Enable time:<br>to high level and<br>to low level                                   | $\overline{OE}$ | B              | $V_{CCB} = 1.2\text{ V}$ |     | 4.6 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ | 1.1 |     | 8.2 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ | 1   |     | 6.7 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ | 0.5 |     | 5.1 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ | 0.5 |     | 4.5 |      |
| $t_{PHZ}$ ,<br>$t_{PLZ}$<br><br>Disable time:<br>from high level and<br>from low level                              | $\overline{OE}$ | A              | $V_{CCB} = 1.2\text{ V}$ |     | 2.8 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ | 0.5 |     | 7.1 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ | 0.5 |     | 7.1 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ | 0.5 |     | 7.1 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ | 0.5 |     | 7.1 |      |
| $t_{PHZ}$ ,<br>$t_{PLZ}$<br><br>Disable time:<br>from high level and<br>from low level                              | $\overline{OE}$ | B              | $V_{CCB} = 1.2\text{ V}$ |     | 3.9 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ | 0.5 |     | 7.8 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ | 0.5 |     | 6.9 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ | 0.5 |     | 6   |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ | 0.5 |     | 5.8 |      |

## 7.9 Switching Characteristics, $V_{CCA} = 2.5\text{ V} \pm 0.2\text{ V}$

All typical limits apply over  $T_A = 25^\circ\text{C}$ , and all maximum and minimum limits apply over  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$  (unless otherwise noted) (see [Figure 10](#))

| PARAMETER                                                                                                           | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEST CONDITIONS          | MIN | TYP | MAX | UNIT |
|---------------------------------------------------------------------------------------------------------------------|-----------------|----------------|--------------------------|-----|-----|-----|------|
| $t_{PLH}$ ,<br>$t_{PHL}$<br><br>Propagation delay time:<br>low-to-high-level output and<br>high-to-low level output | A               | B              | $V_{CCB} = 1.2\text{ V}$ |     | 2.4 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ | 0.5 |     | 4.7 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ | 0.5 |     | 3.9 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ | 0.5 |     | 3.1 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ | 0.5 |     | 2.8 |      |
| $t_{PLH}$ ,<br>$t_{PHL}$<br><br>Propagation delay time:<br>low-to-high-level output and<br>high-to-low level output | B               | A              | $V_{CCB} = 1.2\text{ V}$ |     | 3   |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ | 0.5 |     | 4.9 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ | 0.5 |     | 4   |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ | 0.5 |     | 3.1 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ | 0.5 |     | 2.9 |      |
| $t_{PZH}$ ,<br>$t_{PZL}$<br><br>Enable time:<br>to high level and<br>to low level                                   | $\overline{OE}$ | A              | $V_{CCB} = 1.2\text{ V}$ |     | 2.2 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ | 0.5 |     | 4.8 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ | 0.5 |     | 4.8 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ | 0.5 |     | 4.8 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ | 0.5 |     | 4.8 |      |
| $t_{PZH}$ ,<br>$t_{PZL}$<br><br>Enable time:<br>to high level and<br>to low level                                   | $\overline{OE}$ | B              | $V_{CCB} = 1.2\text{ V}$ |     | 4.5 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ | 1.1 |     | 7.9 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ | 0.5 |     | 6.4 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ | 0.5 |     | 4.6 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ | 0.5 |     | 4   |      |
| $t_{PHZ}$ ,<br>$t_{PLZ}$<br><br>Disable time:<br>from high level and<br>from low level                              | $\overline{OE}$ | A              | $V_{CCB} = 1.2\text{ V}$ |     | 1.8 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ | 0.5 |     | 5.1 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ | 0.5 |     | 5.1 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ | 0.5 |     | 5.1 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ | 0.5 |     | 5.1 |      |
| $t_{PHZ}$ ,<br>$t_{PLZ}$<br><br>Disable time:<br>from high level and<br>from low level                              | $\overline{OE}$ | B              | $V_{CCB} = 1.2\text{ V}$ |     | 3.6 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5\text{ V}$ | 0.5 |     | 7.1 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8\text{ V}$ | 0.5 |     | 6.3 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5\text{ V}$ | 0.5 |     | 5.1 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3\text{ V}$ | 0.5 |     | 3.9 |      |

## 7.10 Switching Characteristics, $V_{CCA} = 3.3 \text{ V} \pm 0.3 \text{ V}$

All typical limits apply over  $T_A = 25^\circ\text{C}$ , and all maximum and minimum limits apply over  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$  (unless otherwise noted) (see [Figure 10](#))

| PARAMETER                                                                                                           | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEST CONDITIONS           | MIN | TYP | MAX | UNIT |
|---------------------------------------------------------------------------------------------------------------------|-----------------|----------------|---------------------------|-----|-----|-----|------|
| $t_{PLH}$ ,<br>$t_{PHL}$<br><br>Propagation delay time:<br>low-to-high-level output and<br>high-to-low level output | A               | B              | $V_{CCB} = 1.2 \text{ V}$ |     | 2.3 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5 \text{ V}$ | 0.5 |     | 4.5 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8 \text{ V}$ | 0.5 |     | 3.7 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5 \text{ V}$ | 0.5 |     | 2.9 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3 \text{ V}$ | 0.5 |     | 2.5 |      |
| $t_{PLH}$ ,<br>$t_{PHL}$<br><br>Propagation delay time:<br>low-to-high-level output and<br>high-to-low level output | B               | A              | $V_{CCB} = 1.2 \text{ V}$ |     | 3.5 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5 \text{ V}$ | 0.5 |     | 6.8 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8 \text{ V}$ | 0.5 |     | 3.9 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5 \text{ V}$ | 0.5 |     | 2.8 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3 \text{ V}$ | 0.5 |     | 2.5 |      |
| $t_{PZH}$ ,<br>$t_{PZL}$<br><br>Enable time:<br>to high level and<br>to low level                                   | $\overline{OE}$ | A              | $V_{CCB} = 1.2 \text{ V}$ |     | 2   |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5 \text{ V}$ | 0.5 |     | 4   |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8 \text{ V}$ | 0.5 |     | 4   |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5 \text{ V}$ | 0.5 |     | 4   |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3 \text{ V}$ | 0.5 |     | 4   |      |
| $t_{PZH}$ ,<br>$t_{PZL}$<br><br>Enable time:<br>to high level and<br>to low level                                   | $\overline{OE}$ | B              | $V_{CCB} = 1.2 \text{ V}$ |     | 4.5 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5 \text{ V}$ | 1.1 |     | 7.8 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8 \text{ V}$ | 0.5 |     | 6.2 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5 \text{ V}$ | 0.5 |     | 4.5 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3 \text{ V}$ | 0.5 |     | 3.9 |      |
| $t_{PHZ}$ ,<br>$t_{PLZ}$<br><br>Disable time:<br>from high level and<br>from low level                              | $\overline{OE}$ | A              | $V_{CCB} = 1.2 \text{ V}$ |     | 1.7 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5 \text{ V}$ | 0.5 |     | 4   |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8 \text{ V}$ | 0.5 |     | 4   |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5 \text{ V}$ | 0.5 |     | 4   |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3 \text{ V}$ | 0.5 |     | 4   |      |
| $t_{PHZ}$ ,<br>$t_{PLZ}$<br><br>Disable time:<br>from high level and<br>from low level                              | $\overline{OE}$ | B              | $V_{CCB} = 1.2 \text{ V}$ |     | 3.4 |     | ns   |
|                                                                                                                     |                 |                | $V_{CCB} = 1.5 \text{ V}$ | 0.5 |     | 6.9 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 1.8 \text{ V}$ | 0.5 |     | 6   |      |
|                                                                                                                     |                 |                | $V_{CCB} = 2.5 \text{ V}$ | 0.5 |     | 4.8 |      |
|                                                                                                                     |                 |                | $V_{CCB} = 3.3 \text{ V}$ | 0.5 |     | 4.2 |      |

## 7.11 Operating Characteristics

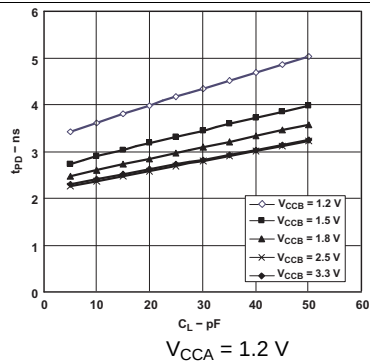
 $T_A = 25^\circ\text{C}$ 

| PARAMETER |                                                                                           | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEST CONDITIONS                                                             |                                    | TYP | UNIT |
|-----------|-------------------------------------------------------------------------------------------|-----------------|----------------|-----------------------------------------------------------------------------|------------------------------------|-----|------|
| $C_{pdA}$ | Power dissipation capacitance per transceiver <sup>(1)</sup><br>port A - outputs enabled  | A               | B              | $C_L = 0\text{ pF}$ ,<br>$f = 10\text{ MHz}$ ,<br>$t_r = t_f = 1\text{ ns}$ | $V_{CCA} = V_{CCB} = 1.2\text{ V}$ | 1   | pF   |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 1.5\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 1.8\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 2.5\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 3.3\text{ V}$ | 1   |      |
|           | Power dissipation capacitance per transceiver <sup>(1)</sup><br>port A - outputs disabled | A               | B              | $C_L = 0\text{ pF}$ ,<br>$f = 10\text{ MHz}$ ,<br>$t_r = t_f = 1\text{ ns}$ | $V_{CCA} = V_{CCB} = 1.2\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 1.5\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 1.8\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 2.5\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 3.3\text{ V}$ | 1   |      |
|           | Power dissipation capacitance per transceiver <sup>(1)</sup><br>port A - outputs enabled  | B               | A              | $C_L = 0\text{ pF}$ ,<br>$f = 10\text{ MHz}$ ,<br>$t_r = t_f = 1\text{ ns}$ | $V_{CCA} = V_{CCB} = 1.2\text{ V}$ | 12  |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 1.5\text{ V}$ | 12  |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 1.8\text{ V}$ | 12  |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 2.5\text{ V}$ | 13  |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 3.3\text{ V}$ | 14  |      |
|           | Power dissipation capacitance per transceiver <sup>(1)</sup><br>port A - outputs disabled | B               | A              | $C_L = 0\text{ pF}$ ,<br>$f = 10\text{ MHz}$ ,<br>$t_r = t_f = 1\text{ ns}$ | $V_{CCA} = V_{CCB} = 1.2\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 1.5\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 1.8\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 2.5\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 3.3\text{ V}$ | 1   |      |
| $C_{pdB}$ | Power dissipation capacitance per transceiver <sup>(1)</sup><br>port B - outputs enabled  | A               | B              | $C_L = 0\text{ pF}$ ,<br>$f = 10\text{ MHz}$ ,<br>$t_r = t_f = 1\text{ ns}$ | $V_{CCA} = V_{CCB} = 1.2\text{ V}$ | 12  | pF   |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 1.5\text{ V}$ | 12  |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 1.8\text{ V}$ | 12  |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 2.5\text{ V}$ | 13  |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 3.3\text{ V}$ | 14  |      |
|           | Power dissipation capacitance per transceiver <sup>(1)</sup><br>port B - outputs disabled | A               | B              | $C_L = 0\text{ pF}$ ,<br>$f = 10\text{ MHz}$ ,<br>$t_r = t_f = 1\text{ ns}$ | $V_{CCA} = V_{CCB} = 1.2\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 1.5\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 1.8\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 2.5\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 3.3\text{ V}$ | 1   |      |
|           | Power dissipation capacitance per transceiver <sup>(1)</sup><br>port B - outputs enabled  | B               | A              | $C_L = 0\text{ pF}$ ,<br>$f = 10\text{ MHz}$ ,<br>$t_r = t_f = 1\text{ ns}$ | $V_{CCA} = V_{CCB} = 1.2\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 1.5\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 1.8\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 2.5\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 3.3\text{ V}$ | 1   |      |
|           | Power dissipation capacitance per transceiver <sup>(1)</sup><br>port B - outputs disabled | B               | A              | $C_L = 0\text{ pF}$ ,<br>$f = 10\text{ MHz}$ ,<br>$t_r = t_f = 1\text{ ns}$ | $V_{CCA} = V_{CCB} = 1.2\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 1.5\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 1.8\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 2.5\text{ V}$ | 1   |      |
|           |                                                                                           |                 |                |                                                                             | $V_{CCA} = V_{CCB} = 3.3\text{ V}$ | 1   |      |

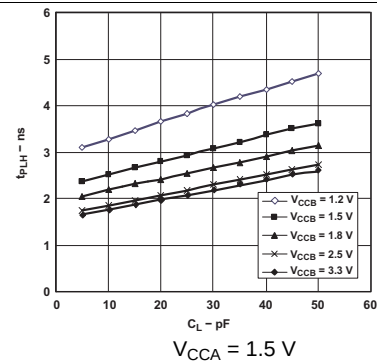
(1) See to TI application report, *CMOS Power Consumption and Cpd Calculation* (SCAA035).

## 7.12 Typical Characteristics

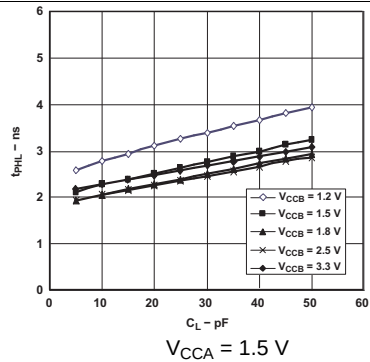
$T_A = 25^\circ\text{C}$



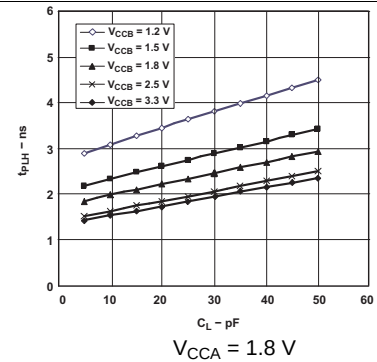
**Figure 1. Typical Propagation Delay (A to B) vs Load Capacitance**



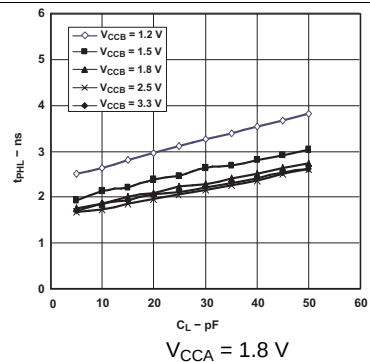
**Figure 2. Typical Propagation Delay (A to B) vs Load Capacitance**



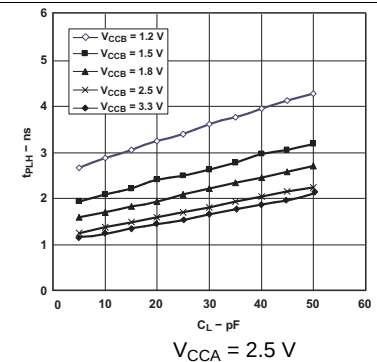
**Figure 3. Typical Propagation Delay (A to B) vs Load Capacitance**



**Figure 4. Typical Propagation Delay (A to B) vs Load Capacitance**



**Figure 5. Typical Propagation Delay (A to B) vs Load Capacitance**



**Figure 6. Typical Propagation Delay (A to B) vs Load Capacitance**



## Typical Characteristics (continued)

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

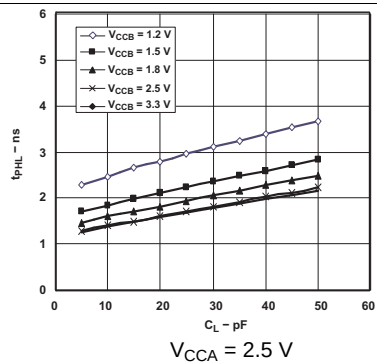


Figure 7. Typical Propagation Delay (A to B) vs Load Capacitance

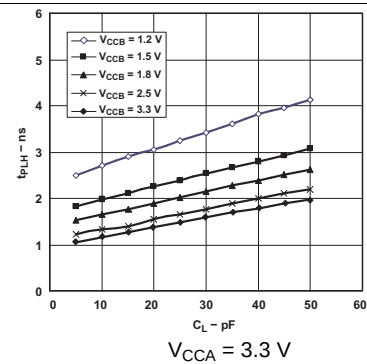


Figure 8. Typical Propagation Delay (A to B) vs Load Capacitance

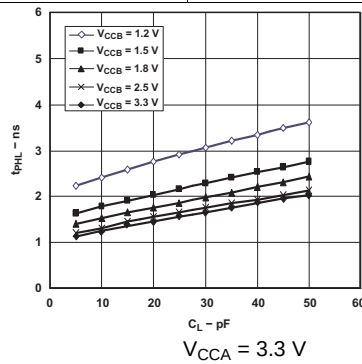
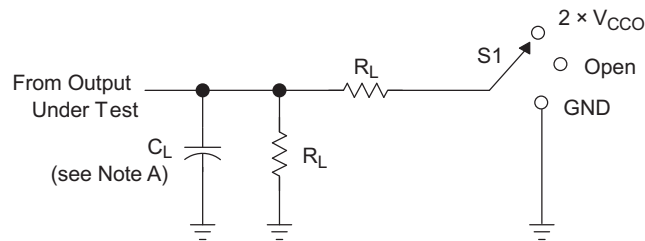


Figure 9. Typical Propagation Delay (A to B) vs Load Capacitance

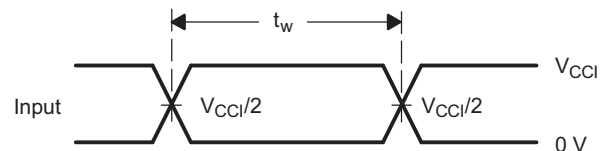
## 8 Parameter Measurement Information



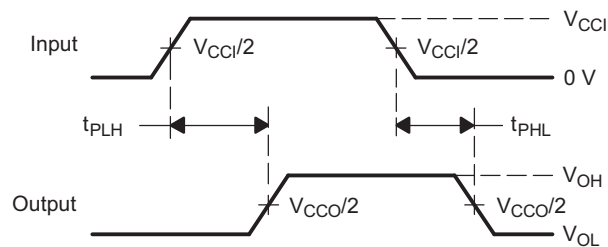
LOAD CIRCUIT

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

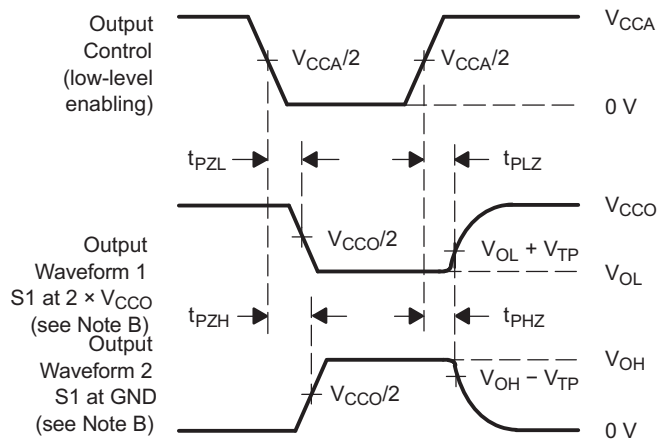
| TEST              | S1                 |
|-------------------|--------------------|
| $t_{pd}$          | Open               |
| $t_{PLZ}/t_{PZL}$ | $2 \times V_{CCO}$ |
| $t_{PHZ}/t_{PZH}$ | GND                |



VOLTAGE WAVEFORMS  
PULSE DURATION



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES

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

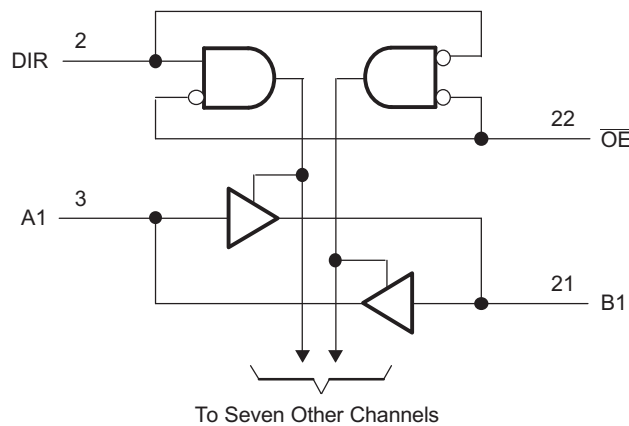
Figure 10. Load Circuit and Voltage Waveforms

## 9 Detailed Description

### 9.1 Overview

The SN74AVCH8T245 is an 8-bit, dual supply noninverting bidirectional voltage level translator. Pins A1 through A4, and the control pins (DIR and  $\overline{OE}$ ) are referenced to  $V_{CCA}$ , while pins B1 through B4 are referenced to  $V_{CCB}$ . Both the A port and B port can accept I/O voltages ranging from 1.2 V to 3.6 V. With  $\overline{OE}$  set to low, a high on DIR allows data transmission from Port A to Port B, and a low on DIR allows data transmission from Port B to Port A. When  $\overline{OE}$  is set to high, both Port A and Port B outputs are in the high-impedance state. See *AVC Logic Family Technology and Application* (SCEA006).

### 9.2 Functional Block Diagram



**Figure 11. Logic Diagram (Positive Logic)**

### 9.3 Feature Description

#### 9.3.1 Fully Configurable Dual-Rail Design

Both  $V_{CCA}$  and  $V_{CCB}$  can be supplied at any voltage from 1.2 V to 3.6 V, 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.

**Table 1. Typical Total Static Power Consumption ( $I_{CCA} + I_{CCB}$ )**

| $V_{CCB}$ | $V_{CCA}$ |       |       |       |       |       | UNIT    |
|-----------|-----------|-------|-------|-------|-------|-------|---------|
|           | 0 V       | 1.2 V | 1.5 V | 1.8 V | 2.5 V | 3.3 V |         |
| 0 V       | 0         | <0.5  | <0.5  | <0.5  | <0.5  | <0.5  | $\mu A$ |
| 1.2 V     | <0.5      | <1    | <1    | <1    | <1    | 1     |         |
| 1.5 V     | <0.5      | <1    | <1    | <1    | <1    | 1     |         |
| 1.8 V     | <0.5      | <1    | <1    | <1    | <1    | <1    |         |
| 2.5 V     | <0.5      | 1     | <1    | <1    | <1    | <1    |         |
| 3.3 V     | <0.5      | 1     | <1    | <1    | <1    | <1    |         |

#### 9.3.2 Supports High-Speed Translation

SN74AVCH8T245 can support high data rate applications, which can be calculated from the maximum propagation delay. This is also dependent on output load. The translated signal data rate can be up to 320 Mbps when both  $V_{CCA}$  and  $V_{CCB}$  are at least 1.8 V.

#### 9.3.3 Partial-Power-Down Mode Operation

$I_{off}$  circuitry disables the outputs, preventing damaging current backflow through the SN74AVCH8T245 when it is powered down. This can occur in applications where subsections of a system are powered down (partial-power-down) to reduce power consumption.

### 9.3.4 Bus-Hold Circuitry

Active bus-hold circuitry holds unused or undriven data inputs at a valid logic state, which helps with board space savings and reduced component costs. Use of pull-up or pull-down resistors with the bus-hold circuitry is not recommended. See *Bus-Hold Circuit* ([SCLA015](#)).

### 9.3.5 V<sub>CC</sub> Isolation Feature

The V<sub>CC</sub> isolation feature ensures that if either V<sub>CCA</sub> or V<sub>CCB</sub> are at GND (or < 0.4 V), both ports will be in a high-impedance state (I<sub>OZ</sub> shown in [Electrical Characteristics](#)). This prevents false logic levels from being presented to either bus.

## 9.4 Device Functional Modes

[Table 2](#) lists the functional modes of the SN74AVCH8T245.

**Table 2. Function Table (Each 8-Bit Section)**

| CONTROL INPUTS <sup>(1)</sup> |     | 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.

## 10 Application and Implementation

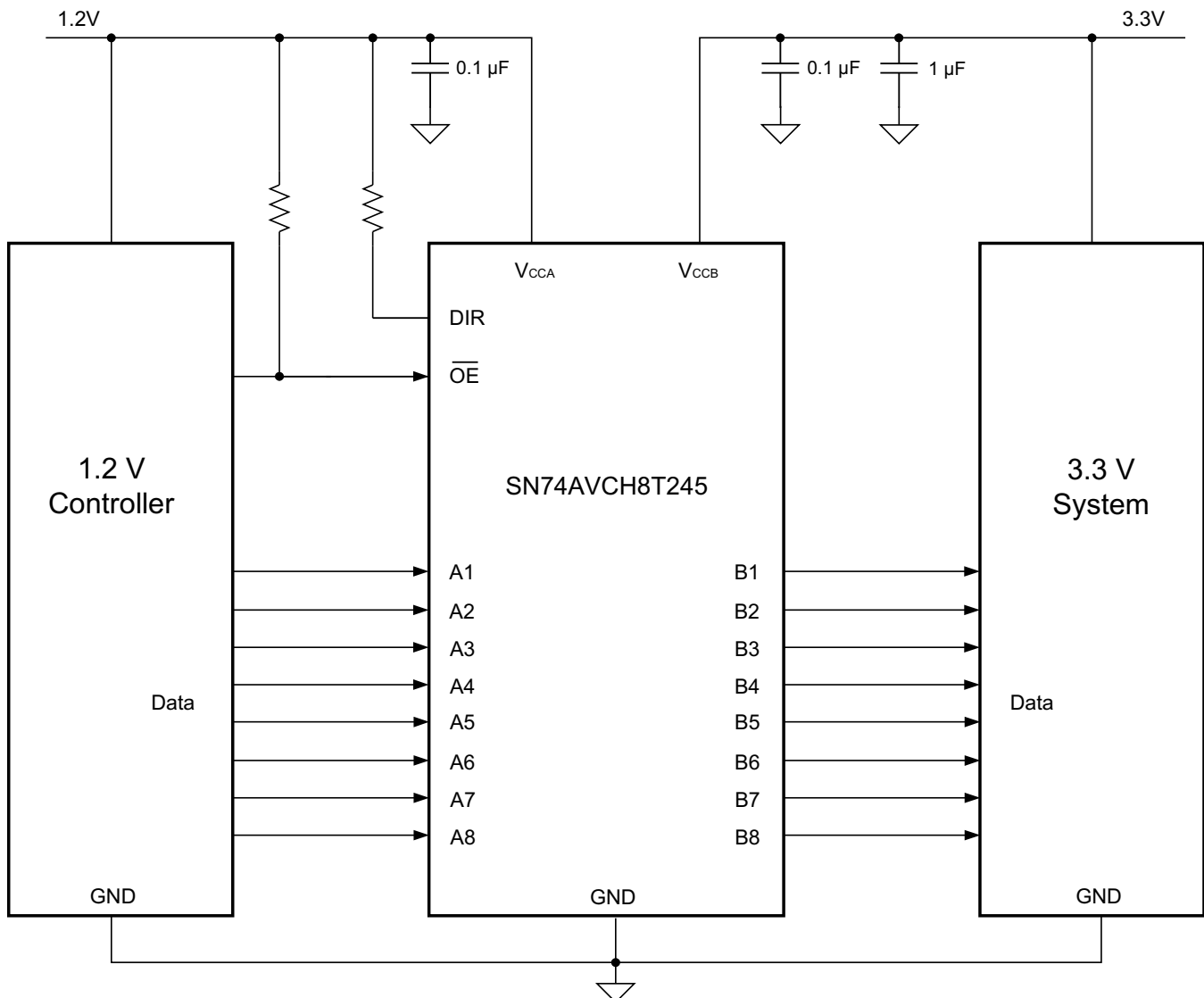
### NOTE

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.

### 10.1 Application Information

The SN74AVCH8T245 device can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. The SN74AVCH8T245 device is ideal for data transmission which direction is different with each channel. The maximum data rate can be up to 320 Mbps when device voltage power supply is more than 1.8 V.

### 10.2 Typical Application



**Figure 12. Typical Application Schematic**

## Typical Application (continued)

### 10.2.1 Design Requirements

For this design example, use the parameters listed in [Table 3](#).

**Table 3. Design Parameters**

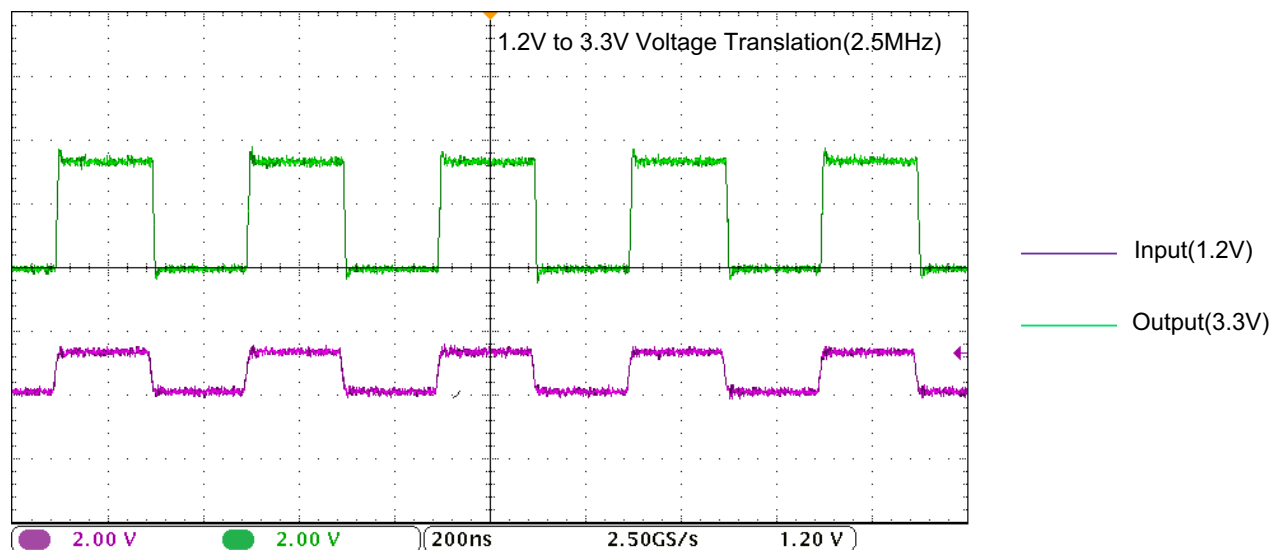
| DESIGN PARAMETERS | EXAMPLE VALUE  |
|-------------------|----------------|
| Input voltage     | 1.2 V to 3.6 V |
| Output voltage    | 1.2 V to 3.6 V |

### 10.2.2 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 SN74AVCH8T245 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 SN74AVCH8T245 device is driving to determine the output voltage range.

### 10.2.3 Application Curves



**Figure 13. Translation Up (1.2 V to 3.3 V) at 2.5 MHz**

## 11 Power Supply Recommendations

The output-enable ( $\overline{OE}$ ) input circuit is designed so that it is referenced to  $V_{CCA}$  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.

$V_{CCA}$  or  $V_{CCB}$  can be powered up first. If the SN74LVCH8T245 is powered up in a permanently enabled state (for example  $\overline{OE}$  is always kept low), pullup resistors are recommended at the input. This ensures proper, glitch-free, power-up. See *Designing with SN4LVCXT245 and SN74LVCHXT245 Family of Direction Controlled Voltage Translators/Level-Shifters* (SLVA746). In addition, the  $\overline{OE}$  pin may be shorted to GND if the application does not require use of the high-impedance state at any time.

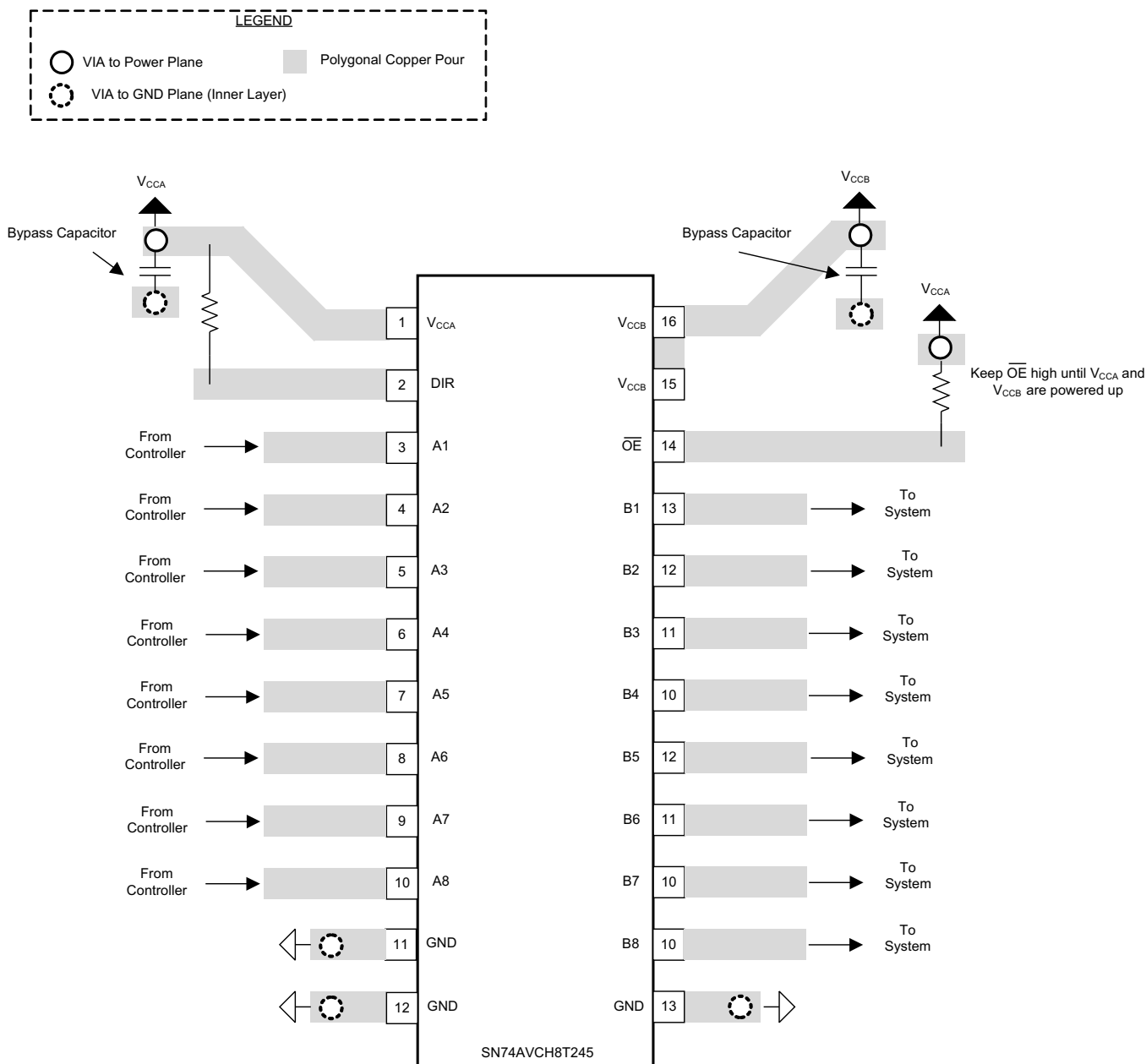
## 12 Layout

### 12.1 Layout Guidelines

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

- Bypass capacitors should be used on power supplies.
- Short trace lengths should be used to avoid excessive loading.
- Placing 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.

### 12.2 Layout Example



## 13 Device and Documentation Support

### 13.1 Documentation Support

#### 13.1.1 Related Documentation

For related documentation, see the following:

- *Designing with SN74LVCXT245 and SN74LVCHXT245 Family of Direction Controlled Voltage Translators/Level-Shifters*, [SLVA746](#)
- *Bus-Hold Circuit*, [SCLA015](#)
- *AVC Logic Family Technology and Applications*, [SCEA006](#)
- *CMOS Power Consumption and Cpd Calculation*, [SCAA035](#)

### 13.2 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

**TI E2E™ Online Community** *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At [e2e.ti.com](#), you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

### 13.3 Trademarks

E2E is a trademark of Texas Instruments.

All other trademarks are the property of their respective owners.

### 13.4 Electrostatic Discharge Caution



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

### 13.5 Glossary

[SLYZ022](#) — *TI Glossary*.

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

## 14 Mechanical, Packaging, and Orderable Information

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



## PACKAGING INFORMATION

| Orderable Device  | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|-------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| 74AVCH8T245PWRG4  | ACTIVE        | TSSOP        | PW                 | 24   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | WP245                   | <a href="#">Samples</a> |
| 74AVCH8T245RHLRG4 | ACTIVE        | VQFN         | RHL                | 24   | 1000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-2-260C-1 YEAR  | -40 to 85    | WP245                   | <a href="#">Samples</a> |
| SN74AVCH8T245DGVR | ACTIVE        | TVSOP        | DGV                | 24   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | WP245                   | <a href="#">Samples</a> |
| SN74AVCH8T245PW   | ACTIVE        | TSSOP        | PW                 | 24   | 60             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | WP245                   | <a href="#">Samples</a> |
| SN74AVCH8T245PWG4 | ACTIVE        | TSSOP        | PW                 | 24   | 60             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | WP245                   | <a href="#">Samples</a> |
| SN74AVCH8T245PWR  | ACTIVE        | TSSOP        | PW                 | 24   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | WP245                   | <a href="#">Samples</a> |
| SN74AVCH8T245RHLR | ACTIVE        | VQFN         | RHL                | 24   | 1000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-2-260C-1 YEAR  | -40 to 85    | WP245                   | <a href="#">Samples</a> |

(1) The marketing status values are defined as follows:

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

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

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

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

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

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

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

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

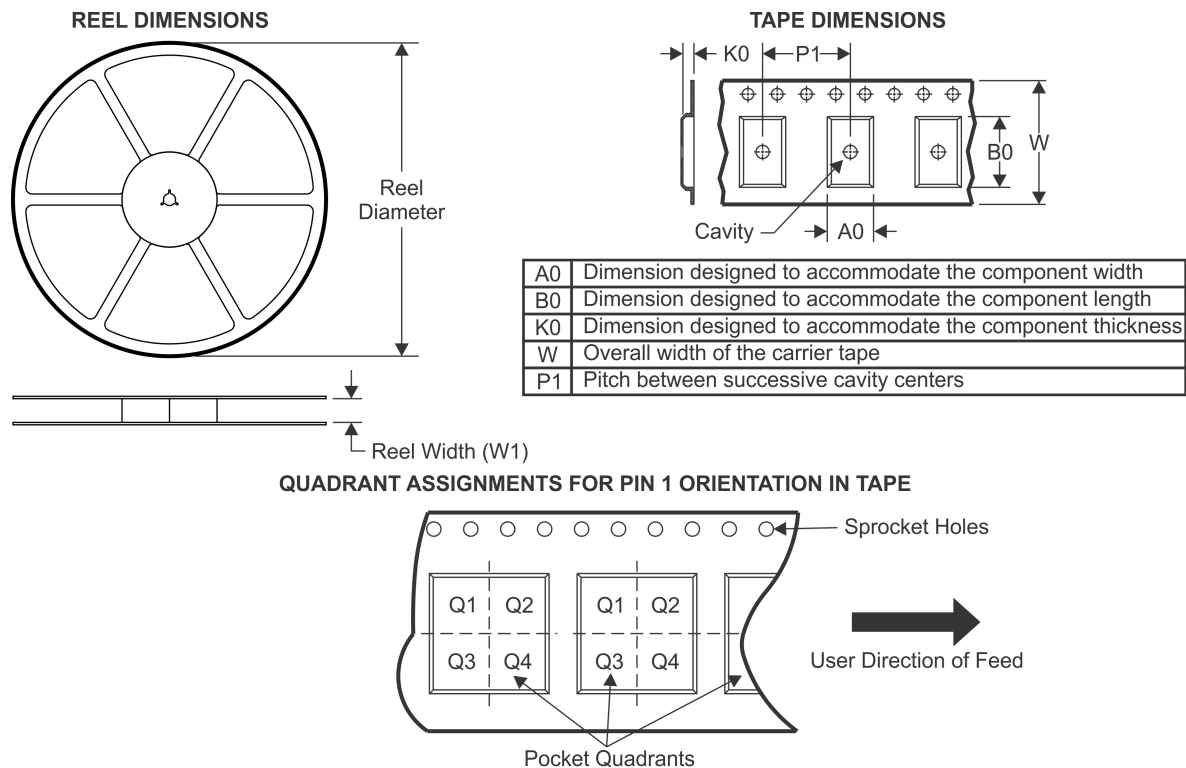
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

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

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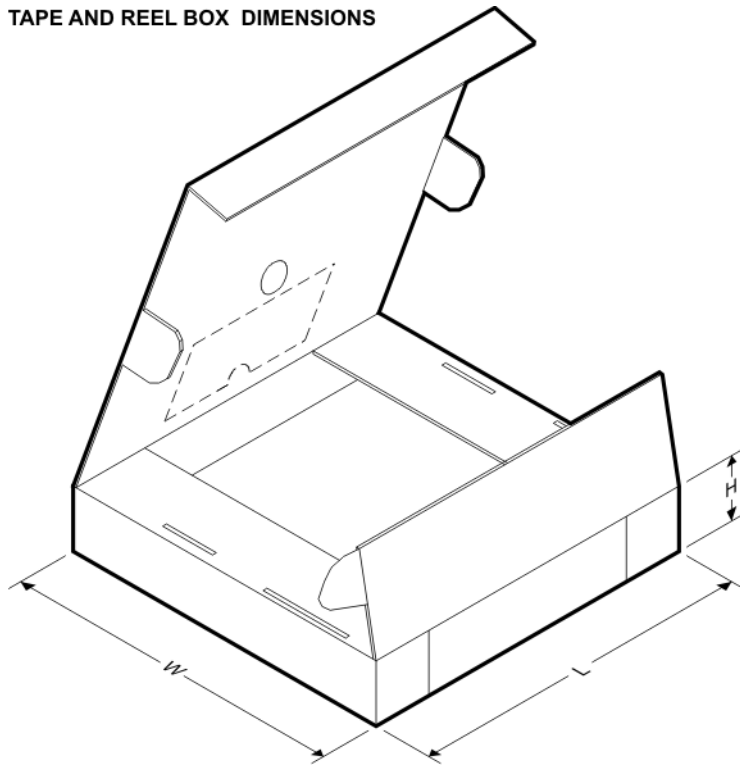
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**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 |
|--------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74AVCH8T245DGVR  | TVSOP        | DGV             | 24   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| SN74AVCH8T245PWR   | TSSOP        | PW              | 24   | 2000 | 330.0              | 16.4               | 6.95    | 8.3     | 1.6     | 8.0     | 16.0   | Q1            |
| SN74AVCH8T245RHRLR | VQFN         | RHL             | 24   | 1000 | 180.0              | 12.4               | 3.8     | 5.8     | 1.2     | 8.0     | 12.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

| Device            | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74AVCH8T245DGVR | TVSOP        | DGV             | 24   | 2000 | 367.0       | 367.0      | 35.0        |
| SN74AVCH8T245PWR  | TSSOP        | PW              | 24   | 2000 | 367.0       | 367.0      | 38.0        |
| SN74AVCH8T245RHLR | VQFN         | RHL             | 24   | 1000 | 210.0       | 185.0      | 35.0        |



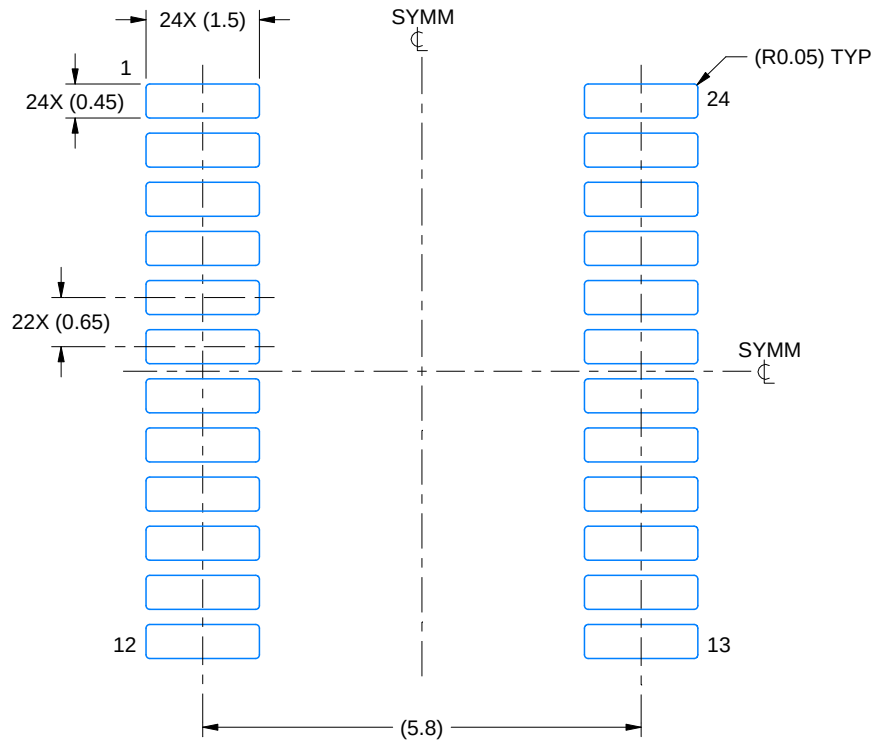
## TSSOP - 1.2 mm max height

# EXAMPLE BOARD LAYOUT

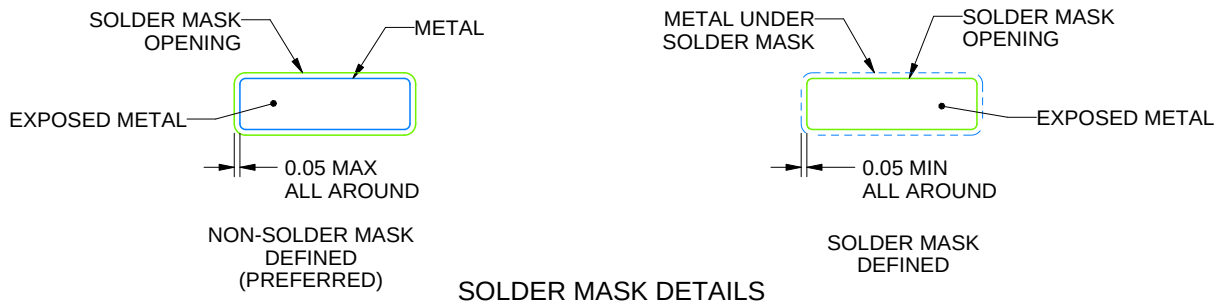
PW0024A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220208/A 02/2017

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

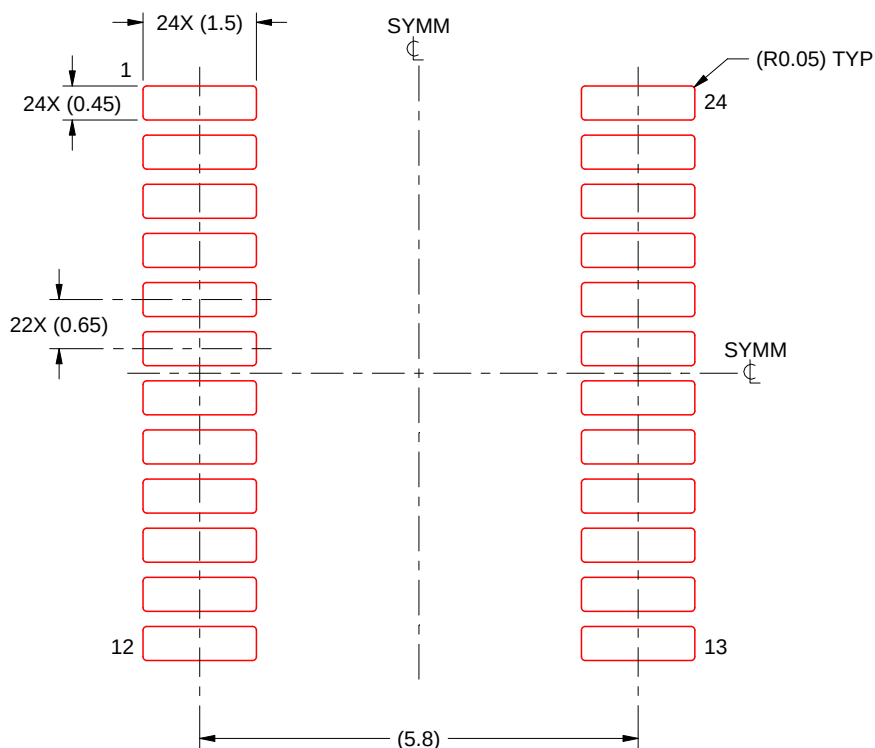
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

PW0024A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

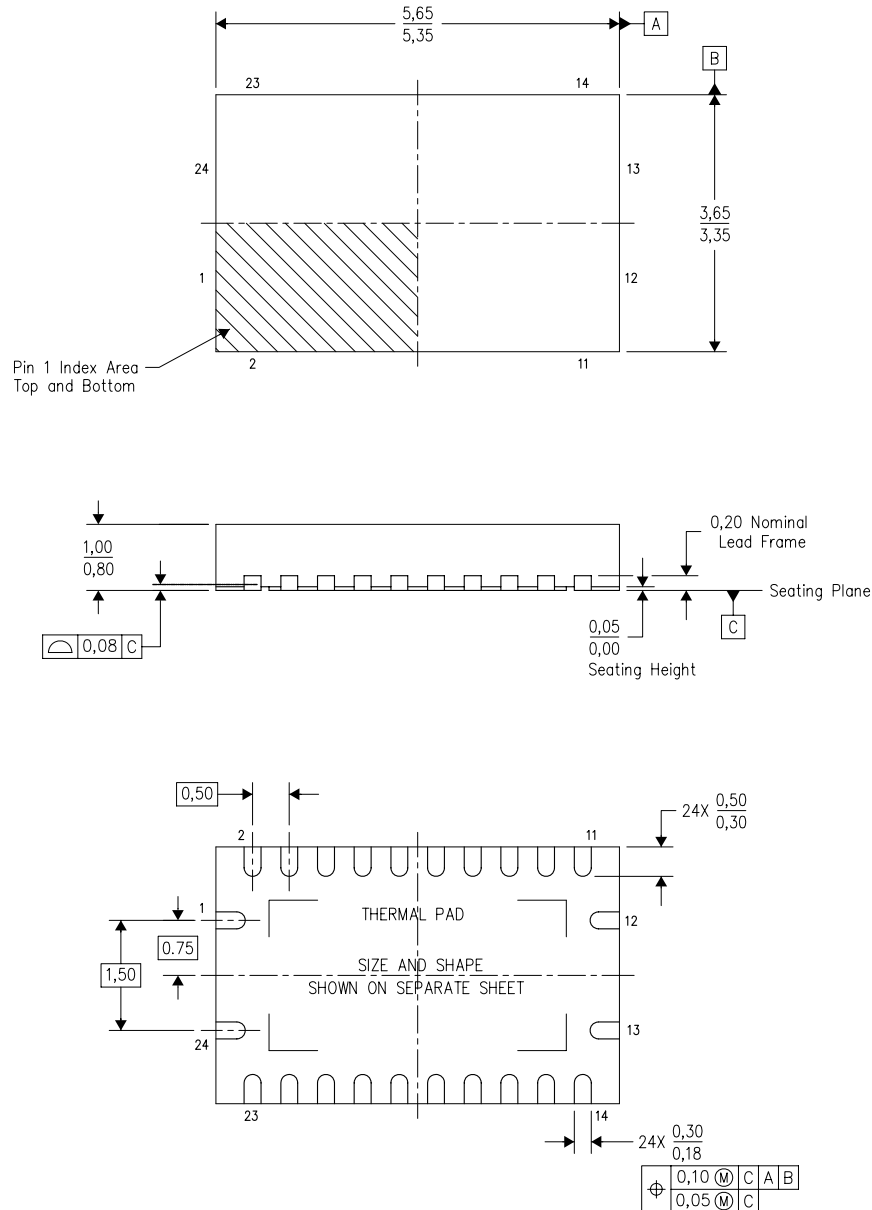
4220208/A 02/2017

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.

RHL (R-PVQFN-N24)

PLASTIC QUAD FLATPACK NO-LEAD



Bottom View

4205346-4/J 12/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. QFN (Quad Flatpack No-Lead) package configuration.
  - D. The package thermal pad must be soldered to the board for thermal and mechanical performance.
  - E. See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
  - F. JEDEC MO-241 package registration pending.



RHL (S-PVQFN-N24)

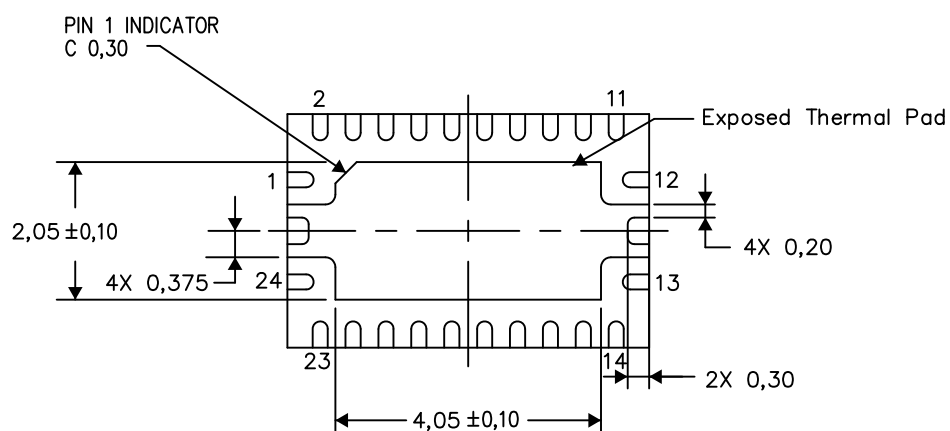
PLASTIC QUAD FLATPACK NO-LEAD

## 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

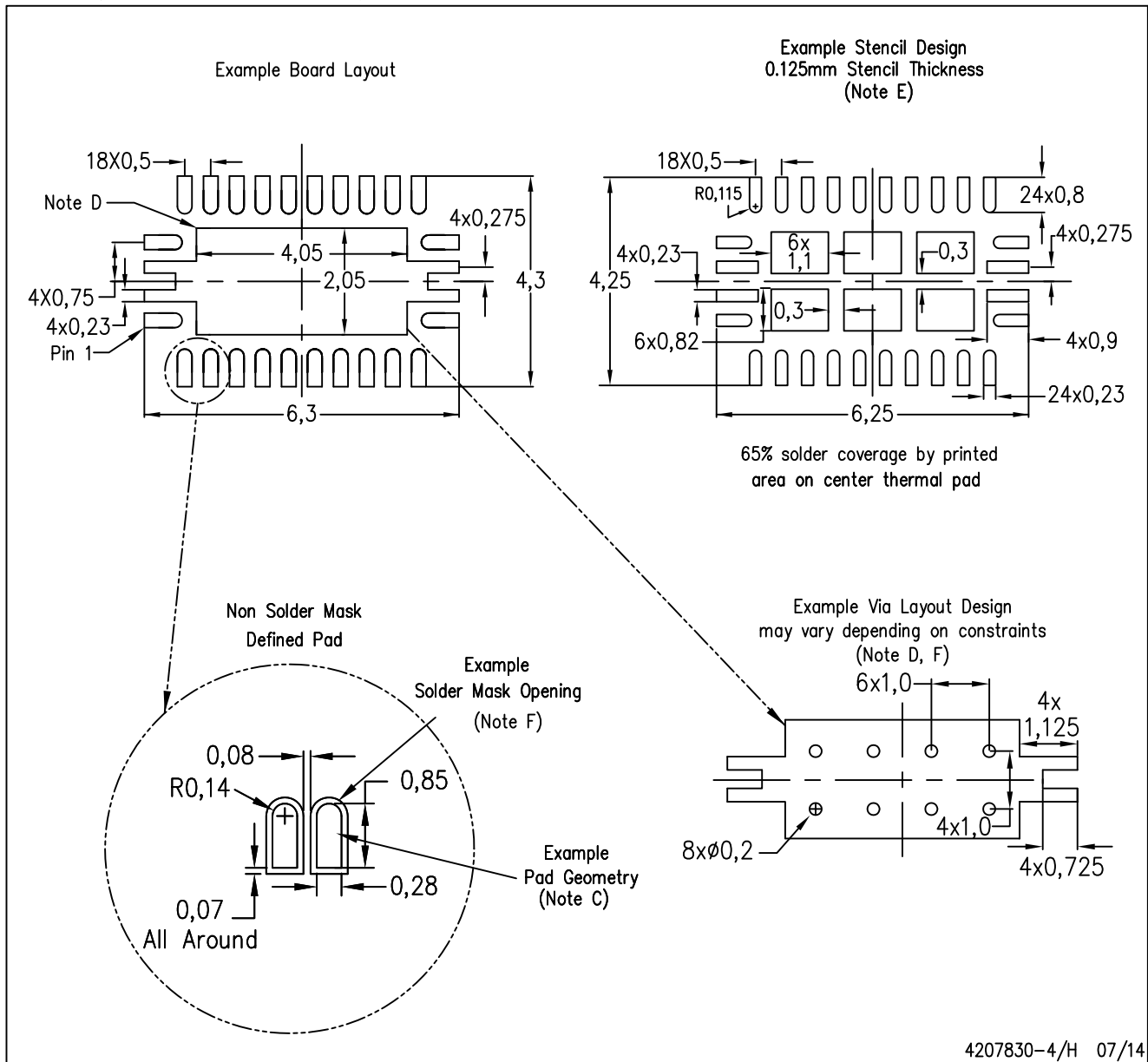
Exposed Thermal Pad Dimensions

4206363-4/N 07/14

NOTE: All linear dimensions are in millimeters

RHL (R-PVQFN-N24)

PLASTIC QUAD FLATPACK NO-LEAD



4207830-4/H 07/14

- 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 Packages, 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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