

SN74AVC8T245 8-Bit Dual-Supply Bus Transceiver With Configurable Voltage Translation and 3-State Outputs

1 Features

- 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)
- Control inputs V_{IH}/V_{IL} levels are referenced to V_{CCA} voltage
- V_{CC} isolation feature – if either V_{CC} input is at GND, all I/O ports are in the high-impedance state
- I_{off} supports partial power-down mode operation
- Fully configurable dual-rail design allows each port to operate over the full 1.4-V to 3.6-V power-supply range
- I/Os are 4.6-V tolerant
- Maximum data rates:
 - 170Mbps ($V_{CCA} < 1.8\text{ V}$ or $V_{CCB} < 1.8\text{ V}$)
 - 320Mbps ($V_{CCA} \geq 1.8\text{ V}$ and $V_{CCB} \geq 1.8\text{ V}$)

2 Applications

- [Personal electronic](#)
- [Industrial](#)
- [Enterprise](#)
- [Telecom](#)

3 Description

This 8-bit noninverting bus transceiver uses two separate configurable power-supply rails. The SN74AVC8T245 is optimized to operate with V_{CCA}/V_{CCB} set at 1.4 V to 3.6 V. The device is operational with V_{CCA} and V_{CCB} as low as 1.2 V. The A port is designed to track V_{CCA} . V_{CCA} accepts any supply voltage from 1.2 V to 3.6 V. The B port is designed to track V_{CCB} . V_{CCB} accepts any supply voltage from 1.2 V to 3.6 V. 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 SN74AVC8T245 is designed for asynchronous communication between data buses. The device transmits data from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable (\overline{OE}) input can be used to disable the outputs so the buses are effectively isolated.

The SN74AVC8T245 is designed so that the control pins (DIR and \overline{OE}) are supplied by V_{CCA} .

The SN74AVC8T245 is compatible with a single-supply system and can be replaced later with a '245 function, with minimal printed circuit board redesign.

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

The V_{CC} isolation feature allows both ports to be in the high-impedance state when either V_{CC} input is at GND.

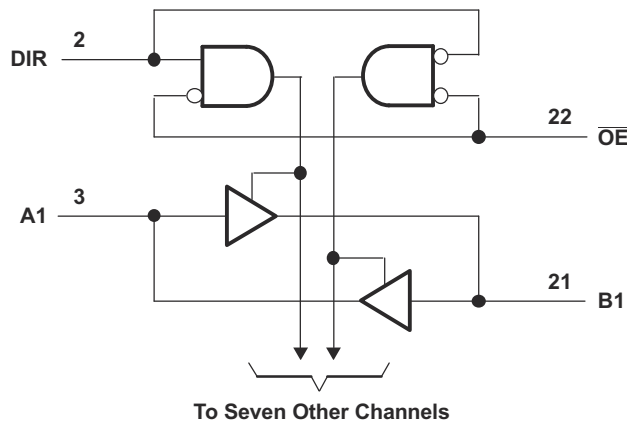
To put the device into the high-impedance state during power up or power down, tie \overline{OE} to V_{CC} through a pullup resistor; the current-sinking capability of the driver determines the minimum value of the resistor.

Package Information

| PART NUMBER | PACKAGE ⁽¹⁾ | PACKAGE SIZE ⁽²⁾ |
|--------------|------------------------|-----------------------------|
| SN74AVC8T245 | RHL (VQFN, 24) | 5.5 mm × 3.5 mm |
| | PW (TSSOP, 24) | 7.8 mm × 6.4 mm |
| | DGV (TVSOP, 24) | 5 mm × 6.4 mm |

(1) For more information, see [Section 10](#).

(2) The package size (length × width) is a nominal value and includes pins, where applicable.



Logic Diagram (Positive Logic)



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4 Pin Configuration and Functions

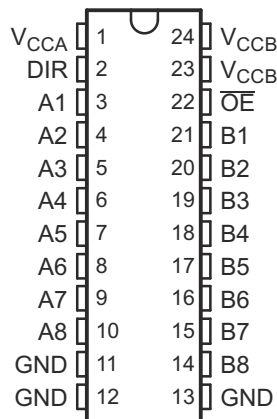


Figure 4-1. DGV or PW Package, 24-Pin TVSOP or TSSOP (Top View)

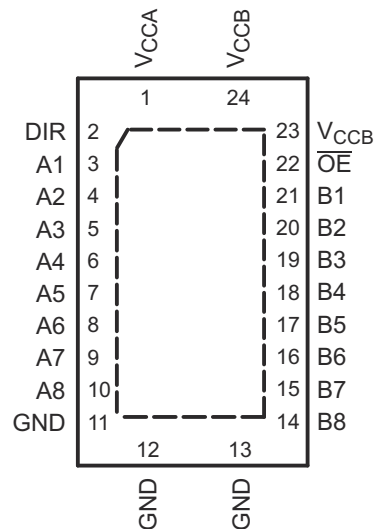


Figure 4-2. RHL Package, 24-Pin VQFN (Top View)

Table 4-1. 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 |
| 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. $1.2\text{ V} \leq V_{CCB} \leq 3.6\text{ V}$ |

5 Specifications

5.1 Absolute Maximum Ratings

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

| | | MIN | MAX | UNIT | |
|--------------------------|---|--------------------|------|-----------------|---|
| V_{CCA} , V_{CCB} | Supply voltage | -0.5 | 4.6 | V | |
| V_I | Input voltage ⁽²⁾ | I/O ports (A port) | -0.5 | 4.6 | V |
| | | I/O ports (B port) | -0.5 | 4.6 | |
| | | Control inputs | -0.5 | 4.6 | |
| V_O | Voltage range applied to any output in the high-impedance or power-off state ⁽²⁾ | A port | -0.5 | 4.6 | V |
| | | B port | -0.5 | 4.6 | |
| V_O | Voltage range applied to any output in the high or low state ⁽²⁾ ⁽³⁾ | A port | -0.5 | $V_{CCA} + 0.5$ | V |
| | | B port | -0.5 | $V_{CCB} + 0.5$ | |
| I_{IK} | Input clamp current | $V_I < 0$ | -50 | mA | |
| I_{OK} | Output clamp current | $V_O < 0$ | -50 | mA | |
| I_O | Continuous output current | -50 | 50 | mA | |
| | Continuous current through V_{CCA} , V_{CCB} , or GND | -100 | 100 | mA | |
| T_{stg} | 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, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) The input voltage and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) The output positive-voltage rating may be exceeded up to 4.6 V maximum if the output current rating is observed.

5.2 ESD Ratings

| | | VALUE | UNIT |
|-------------|-------------------------|--|-------|
| $V_{(ESD)}$ | Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾ | ±8000 |
| | | Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾ | ±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.

5.3 Recommended Operating Conditions

See (1) (2) (3)

| | | V_{CCI} | V_{CCO} | MIN | MAX | UNIT |
|---------------------|------------------------------------|--------------------------------|------------------|-----------------------|-----------|------|
| V_{CCA} | Supply voltage | | | 1.2 | 3.6 | V |
| V_{CCB} | Supply voltage | | | 1.2 | 3.6 | V |
| V_{IH} | High-level input voltage | Data inputs | 1.2 V to 1.95 V | $V_{CCI} \times 0.65$ | | V |
| | | | 1.95 V to 2.7 V | 1.6 | | |
| | | | 2.7 V to 3.6 V | 2 | | |
| V_{IL} | Low-level input voltage | Data inputs | 1.2 V to 1.95 V | $V_{CCI} \times 0.35$ | | V |
| | | | 1.95 V to 2.7 V | 0.7 | | |
| | | | 2.7 V to 3.6 V | 0.8 | | |
| V_{IH} | High-level input voltage | DIR (referenced to V_{CCA}) | 1.2 V to 1.95 V | $V_{CCA} \times 0.65$ | | V |
| | | | 1.95 V to 2.7 V | 1.6 | | |
| | | | 2.7 V to 3.6 V | 2 | | |
| V_{IL} | Low-level input voltage | DIR (referenced to V_{CCA}) | 1.2 V to 1.95 V | $V_{CCA} \times 0.35$ | | V |
| | | | 1.95 V to 2.7 V | 0.7 | | |
| | | | 2.7 V to 3.6 V | 0.8 | | |
| V_I | Input voltage | | | 0 | 3.6 | V |
| V_O | Output voltage | Active state | | 0 | V_{CCO} | V |
| | | 3-state | | 0 | 3.6 | |
| I_{OH} | High-level output current | | 1.2 V | -3 | | mA |
| | | | 1.4 V to 1.6 V | -6 | | |
| | | | 1.65 V to 1.95 V | -8 | | |
| | | | 2.3 V to 2.7 V | -9 | | |
| | | | 3 V to 3.6 V | -12 | | |
| I_{OL} | Low-level output current | | 1.2 V | 3 | | mA |
| | | | 1.4 V to 1.6 V | 6 | | |
| | | | 1.65 V to 1.95 V | 8 | | |
| | | | 2.3 V to 2.7 V | 9 | | |
| | | | 3 V to 3.6 V | 12 | | |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | | | | 5 | ns/V |
| T_A | Operating free-air temperature | | | -40 | 125 | °C |

- (1) V_{CCI} is the V_{CC} associated with the input port.
- (2) V_{CCO} is the V_{CC} associated with the output port.
- (3) All unused data inputs of the device must be held at V_{CCI} or GND to ensure proper device operation. See [Implications of Slow or Floating CMOS Inputs](#), SCBA004.

5.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | | SN74AVC8T245 | | | UNIT |
|-------------------------------|--|--------------|---------|---------|------|
| | | DGV | PW | RHL | |
| | | 24 PINS | 24 PINS | 24 PINS | |
| R _{θJA} | Junction-to-ambient thermal resistance | 116.7 | 93.1 | 36.8 | °C/W |
| R _{θJC(top)} | Junction-to-case (top) thermal resistance | 48.5 | 36.7 | 32.5 | °C/W |
| R _{θJB} | Junction-to-board thermal resistance | 62.1 | 48.4 | 15.7 | °C/W |
| Ψ _{JT} | Junction-to-top characterization parameter | 7.0 | 93.1 | 0.7 | °C/W |
| Ψ _{JB} | Junction-to-board characterization parameter | 61.6 | 48.0 | 15.6 | °C/W |
| R _{θJC(bot)} | Junction-to-case (bottom) thermal resistance | N/A | N/A | 5.6 | °C/W |

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

5.5 Electrical Characteristics

over recommended operating free-air temperature range (unless otherwise noted)^{(2) (1)}

| PARAMETER | TEST CONDITIONS | V _{CCA} | V _{CCB} | T _A = 25°C | | | -40°C to +85°C | | -40°C to +125°C | | UNIT |
|--|--|------------------|------------------|-----------------------|------------------------|------------------------|----------------|-----|-----------------|-----|------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| V _{OH} | I _{OH} = -100 μA | 1.2 V to 3.6 V | 1.2 V to 3.6 V | 0.95 | V _{CCO} - 0.2 | V _{CCO} - 0.2 | | | | | V |
| | I _{OH} = -3 mA | | | | | | | | | | |
| | I _{OH} = -6 mA | | | | | | | | | | |
| | I _{OH} = -8 mA | | | | | | | | | | |
| | I _{OH} = -9 mA | | | | | | | | | | |
| | I _{OH} = -12 mA | | | | | | | | | | |
| V _{OL} | I _{OL} = 100 μA | 1.2 V to 3.6 V | 1.2 V to 3.6 V | 0.15 | 0.2 | 0.2 | | | | | V |
| | I _{OL} = 3 mA | | | | | | | | | | |
| | I _{OL} = 6 mA | | | | | | | | | | |
| | I _{OL} = 8 mA | | | | | | | | | | |
| | I _{OL} = 9 mA | | | | | | | | | | |
| | I _{OL} = 12 mA | | | | | | | | | | |
| I _I Control inputs | V _I = V _{CCA} or GND | 1.2 V to 3.6 V | 1.2 V to 3.6 V | -0.25 | ±0.025 | 0.25 | -1 | 1 | ±1 | μA | |
| I _{off} A or B port | V _I or V _O = 0 to 3.6 V | 0 V | 0 V to 3.6 V | -1 | ±0.1 | 1 | -5 | 5 | ±5 | μA | |
| | | 0 V to 3.6 V | 0 V | -1 | ±0.1 | 1 | -5 | 5 | ±5 | | |
| I _{OZ} ⁽³⁾ A or B port | V _O = V _{CCO} or GND, V _I = V _{CCI} or GND, OE = V _{IH} | 3.6 V | 3.6 V | ±0.5 | ±2.5 | | ±5 | | ±5 | μA | |
| I _{CCA} | V _I = V _{CCI} or GND, I _O = 0 | 1.2 V to 3.6 V | 1.2 V to 3.6 V | | | | 15 | | 15 | μA | |
| | | 0 V | 3.6 V | | | | -2 | | -2 | | |
| | | 3.6 V | 0 V | | | | 15 | | 15 | | |
| I _{CCB} | V _I = V _{CCI} or GND, I _O = 0 | 1.2 V to 3.6 V | 1.2 V to 3.6 V | | | | 15 | | 15 | μA | |
| | | 0 V | 3.6 V | | | | 15 | | 15 | | |
| | | 3.6 V | 0 V | | | | -2 | | -2 | | |
| I _{CCA} + I _{CCB} | V _I = V _{CCI} or GND, I _O = 0 | 1.2 V to 3.6 V | 1.2 V to 3.6 V | | | | 25 | | 25 | μA | |
| C _i Control inputs | V _I = 3.3 V or GND | 3.3 V | 3.3 V | | 3.5 | | 4.5 | | | pF | |
| C _{io} A or B port | V _O = 3.3 V or GND | 3.3 V | 3.3 V | | 6 | | 7 | | | pF | |

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

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

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

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

over recommended operating free-air temperature range, $V_{CCA} = 1.2\text{ V}$ (see [Figure 6-1](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V_{CCB} | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | | UNIT |
|--------------------|-----------------|-------------|--------------------------|---|--|--|--|------|
| | | | | TYP | | TYP | | |
| t_{PLH}, t_{PHL} | A | B | $V_{CCB} = 1.2\text{ V}$ | 3.1 | | 3.1 | | ns |
| | | | $V_{CCB} = 1.5\text{ V}$ | 2.6 | | 2.6 | | |
| | | | $V_{CCB} = 1.8\text{ V}$ | 2.5 | | 2.5 | | |
| | | | $V_{CCB} = 2.5\text{ V}$ | 3 | | 3 | | |
| | | | $V_{CCB} = 3.3\text{ V}$ | 3.5 | | 3.5 | | |
| t_{PLH}, t_{PHL} | B | A | $V_{CCB} = 1.2\text{ V}$ | 3.1 | | 3.1 | | ns |
| | | | $V_{CCB} = 1.5\text{ V}$ | 2.7 | | 2.7 | | |
| | | | $V_{CCB} = 1.8\text{ V}$ | 2.5 | | 2.5 | | |
| | | | $V_{CCB} = 2.5\text{ V}$ | 2.4 | | 2.4 | | |
| | | | $V_{CCB} = 3.3\text{ V}$ | 2.3 | | 2.3 | | |
| t_{PZH}, t_{PZL} | \overline{OE} | A | $V_{CCB} = 1.2\text{ V}$ | 5.3 | | 5.3 | | ns |
| | | | $V_{CCB} = 1.5\text{ V}$ | | | | | |
| | | | $V_{CCB} = 1.8\text{ V}$ | | | | | |
| | | | $V_{CCB} = 2.5\text{ V}$ | | | | | |
| | | | $V_{CCB} = 3.3\text{ V}$ | | | | | |
| t_{PZH}, t_{PZL} | \overline{OE} | B | $V_{CCB} = 1.2\text{ V}$ | 5.1 | | 5.1 | | ns |
| | | | $V_{CCB} = 1.5\text{ V}$ | 4 | | 4 | | |
| | | | $V_{CCB} = 1.8\text{ V}$ | 3.5 | | 3.5 | | |
| | | | $V_{CCB} = 2.5\text{ V}$ | 3.2 | | 3.2 | | |
| | | | $V_{CCB} = 3.3\text{ V}$ | 3.1 | | 3.1 | | |
| t_{PHZ}, t_{PLZ} | \overline{OE} | A | $V_{CCB} = 1.2\text{ V}$ | 4.8 | | 4.8 | | ns |
| | | | $V_{CCB} = 1.5\text{ V}$ | | | | | |
| | | | $V_{CCB} = 1.8\text{ V}$ | | | | | |
| | | | $V_{CCB} = 2.5\text{ V}$ | | | | | |
| | | | $V_{CCB} = 3.3\text{ V}$ | | | | | |
| t_{PHZ}, t_{PLZ} | \overline{OE} | B | $V_{CCB} = 1.2\text{ V}$ | 4.7 | | 4.7 | | ns |
| | | | $V_{CCB} = 1.5\text{ V}$ | 4 | | 4 | | |
| | | | $V_{CCB} = 1.8\text{ V}$ | 4.1 | | 4.1 | | |
| | | | $V_{CCB} = 2.5\text{ V}$ | 4.3 | | 4.3 | | |
| | | | $V_{CCB} = 3.3\text{ V}$ | 5.1 | | 5.1 | | |

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

over recommended operating free-air temperature range, $V_{CCA} = 1.5\text{ V} \pm 0.1\text{ V}$ (see [Figure 6-1](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V_{CCB} | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | | | UNIT |
|--------------------|--------------|-------------|--|---|-----|-----|--|------|-----|------|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| t_{PLH}, t_{PHL} | A | B | $V_{CCB} = 1.2\text{ V}$ | 2.7 | | | 3.1 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 0.5 | 5.4 | | 0.5 | 14.7 | | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | 4.6 | | 0.5 | 13.3 | | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | 4.9 | | 0.5 | 13.9 | | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | 6.8 | | 0.5 | 17.2 | | |

5.7 Switching Characteristics, $V_{CCA} = 1.5\text{ V} \pm 0.1\text{ V}$ (continued)

 over recommended operating free-air temperature range, $V_{CCA} = 1.5\text{ V} \pm 0.1\text{ V}$ (see [Figure 6-1](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V_{CCB} | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | | | UNIT |
|--------------------|-----------------|-------------|--|---|-----|-----|--|-----|------|------|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| t_{PLH}, t_{PHL} | B | A | $V_{CCB} = 1.2\text{ V}$ | 2.6 | | | 3.1 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 0.5 | | 5.4 | 0.5 | | 14.7 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | | 5.1 | 0.5 | | 14.2 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 4.7 | 0.5 | | 13.5 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 4.5 | 0.5 | | 13.2 | |
| t_{PZH}, t_{PZL} | \overline{OE} | A | $V_{CCB} = 1.2\text{ V}$ | 3.7 | | | 5.3 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 1.1 | | 8.7 | 0.5 | | 20.5 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 1.1 | | 8.7 | 0.5 | | 20.5 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 1.1 | | 8.7 | 0.5 | | 20.5 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 1.1 | | 8.7 | 0.5 | | 20.5 | |
| t_{PZH}, t_{PZL} | \overline{OE} | B | $V_{CCB} = 1.2\text{ V}$ | 4.8 | | | 5.1 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 1.1 | | 7.6 | 0.5 | | 18.6 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 1.1 | | 7.1 | 0.5 | | 17.7 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 1 | | 5.6 | 0.5 | | 15.1 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 1 | | 5.2 | 0.5 | | 14.4 | |
| t_{PHZ}, t_{PLZ} | \overline{OE} | A | $V_{CCB} = 1.2\text{ V}$ | 3.1 | | | 4.8 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 0.5 | | 8.6 | 0.5 | | 20.3 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | | 8.6 | 0.5 | | 20.3 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 8.6 | 0.5 | | 20.3 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 8.6 | 0.5 | | 20.3 | |
| t_{PHZ}, t_{PLZ} | \overline{OE} | B | $V_{CCB} = 1.2\text{ V}$ | 4.1 | | | 4.7 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 0.5 | | 8.4 | 0.5 | | 20 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | | 7.6 | 0.5 | | 18.6 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 7.2 | 0.5 | | 17.9 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 7.8 | 0.5 | | 18.9 | |

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

 over recommended operating free-air temperature range, $V_{CCA} = 1.8\text{ V} \pm 0.15\text{ V}$ (see [Figure 6-1](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V_{CCB} | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | | | UNIT |
|--------------------|--------------|-------------|--|---|-----|-----|--|-----|------|------|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| t_{PLH}, t_{PHL} | A | B | $V_{CCB} = 1.2\text{ V}$ | 2.5 | | | 2.5 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 0.5 | | 5.1 | 0.5 | | 14.2 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | | 4.4 | 0.5 | | 13 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 4 | 0.5 | | 12.3 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 3.9 | 0.5 | | 12.1 | |
| t_{PLH}, t_{PHL} | B | A | $V_{CCB} = 1.2\text{ V}$ | 2.5 | | | 2.5 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 0.5 | | 4.6 | 0.5 | | 13.3 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | | 4.4 | 0.5 | | 13 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 3.9 | 0.5 | | 12.1 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 3.7 | 0.5 | | 11.8 | |

5.8 Switching Characteristics, $V_{CCA} = 1.8\text{ V} \pm 0.15\text{ V}$ (continued)

over recommended operating free-air temperature range, $V_{CCA} = 1.8\text{ V} \pm 0.15\text{ V}$ (see [Figure 6-1](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V_{CCB} | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | | | UNIT |
|--------------------|-----------------|----------------|--|---|-----|-----|--|-----|------|------|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| t_{PZH}, t_{PZL} | \overline{OE} | A | $V_{CCB} = 1.2\text{ V}$ | 3 | | | 3 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 1 | | 6.8 | 0.5 | | 17.2 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 1 | | 6.8 | 0.5 | | 17.2 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 1 | | 6.8 | 0.5 | | 17.2 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 1 | | 6.8 | 0.5 | | 17.2 | |
| t_{PZH}, t_{PZL} | \overline{OE} | B | $V_{CCB} = 1.2\text{ V}$ | 4.6 | | | 4.6 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 1.1 | | 8.2 | 0.5 | | 19.6 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 1 | | 6.7 | 0.5 | | 17 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 5.1 | 0.5 | | 14.2 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 4.5 | 0.5 | | 13.2 | |
| t_{PHZ}, t_{PLZ} | \overline{OE} | A | $V_{CCB} = 1.2\text{ V}$ | 2.8 | | | 2.8 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 0.5 | | 7.1 | 0.5 | | 17.7 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | | 7.1 | 0.5 | | 17.7 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 7.1 | 0.5 | | 17.7 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 7.1 | 0.5 | | 17.7 | |
| t_{PHZ}, t_{PLZ} | \overline{OE} | B | $V_{CCB} = 1.2\text{ V}$ | 3.9 | | | 3.9 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 0.5 | | 7.8 | 0.5 | | 18.9 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | | 6.9 | 0.5 | | 17.3 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 6 | 0.5 | | 15.8 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 5.8 | 0.5 | | 15.4 | |

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

over recommended operating free-air temperature range, $V_{CCA} = 2.5\text{ V} \pm 0.2\text{ V}$ (see [Figure 6-1](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V_{CCB} | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | | | UNIT |
|--------------------|-----------------|----------------|--|---|-----|-----|--|-----|------|------|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| t_{PLH}, t_{PHL} | A | B | $V_{CCB} = 1.2\text{ V}$ | 2.4 | | | 2.4 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 0.5 | | 4.7 | 0.5 | | 13.5 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | | 3.9 | 0.5 | | 12.1 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 3.1 | 0.5 | | 10.7 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 2.8 | 0.5 | | 10.2 | |
| t_{PLH}, t_{PHL} | B | A | $V_{CCB} = 1.2\text{ V}$ | 3 | | | 3 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 0.5 | | 4.9 | 0.5 | | 13.9 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | | 4 | 0.5 | | 12.3 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 3.1 | 0.5 | | 10.7 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 2.9 | 0.5 | | 10.4 | |
| t_{PZH}, t_{PZL} | \overline{OE} | A | $V_{CCB} = 1.2\text{ V}$ | 2.2 | | | 2.2 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 0.5 | | 4.8 | 0.5 | | 13.7 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | | 4.8 | 0.5 | | 13.7 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 4.8 | 0.5 | | 13.7 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 4.8 | 0.5 | | 13.7 | |

5.9 Switching Characteristics, $V_{CCA} = 2.5\text{ V} \pm 0.2\text{ V}$ (continued)

over recommended operating free-air temperature range, $V_{CCA} = 2.5\text{ V} \pm 0.2\text{ V}$ (see Figure 6-1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V_{CCB} | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | | | UNIT |
|--------------------|-----------------|-------------|--|---|-----|-----|--|-----|------|------|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| t_{PZH}, t_{PZL} | \overline{OE} | B | $V_{CCB} = 1.2\text{ V}$ | 4.5 | | | 4.5 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 1.1 | | 7.9 | 0.5 | | 19.1 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | | 6.4 | 0.5 | | 16.5 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 4.6 | 0.5 | | 13.3 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 4 | 0.5 | | 12.3 | |
| t_{PHZ}, t_{PLZ} | \overline{OE} | A | $V_{CCB} = 1.2\text{ V}$ | 1.8 | | | 1.8 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 0.5 | | 5.1 | 0.5 | | 14.2 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | | 5.1 | 0.5 | | 14.2 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 5.1 | 0.5 | | 14.2 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 5.1 | 0.5 | | 14.2 | |
| t_{PHZ}, t_{PLZ} | \overline{OE} | B | $V_{CCB} = 1.2\text{ V}$ | 3.6 | | | 3.6 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 0.5 | | 7.1 | 0.5 | | 17.7 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | | 6.3 | 0.5 | | 16.3 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 5.1 | 0.5 | | 14.2 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 3.9 | 0.5 | | 12.1 | |

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

over recommended operating free-air temperature range, $V_{CCA} = 3.3\text{ V} \pm 0.3\text{ V}$ (see Figure 6-1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V_{CCB} | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | | | UNIT | |
|--------------------|-----------------|-------------|--|---|-----|-----|--|-----|------|------|------|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | | |
| t_{PLH}, t_{PHL} | A | B | $V_{CCB} = 1.2\text{ V}$ | 2.3 | | | 2.3 | | | ns | |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 0.5 | | 4.5 | 0.5 | | 13.2 | | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | t_{PLH} | 0.5 | | 3.7 | 0.5 | | | 11.1 |
| | | | | t_{PHL} | 0.5 | | 3.3 | 0.5 | | | 11.1 |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 2.9 | 0.5 | | 10.4 | | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 2.5 | 0.5 | | 9.7 | | |
| t_{PLH}, t_{PHL} | B | A | $V_{CCB} = 1.2\text{ V}$ | 3.5 | | | 3.5 | | | ns | |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 0.5 | | 6.8 | 0.5 | | 17.2 | | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | | 3.9 | 0.5 | | 12.1 | | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 2.8 | 0.5 | | 10.2 | | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 2.5 | 0.5 | | 9.7 | | |
| t_{PZH}, t_{PZL} | \overline{OE} | A | $V_{CCB} = 1.2\text{ V}$ | 2 | | | 2 | | | ns | |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 0.5 | | 4 | 0.5 | | 12.3 | | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | | 4 | 0.5 | | 12.3 | | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 4 | 0.5 | | 12.3 | | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 4 | 0.5 | | 12.3 | | |
| t_{PZH}, t_{PZL} | \overline{OE} | B | $V_{CCB} = 1.2\text{ V}$ | 4.5 | | | 4.5 | | | ns | |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 1.1 | | 7.8 | 0.5 | | 18.9 | | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | | 6.2 | 0.5 | | 16.1 | | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 4.5 | 0.5 | | 13.2 | | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 3.9 | 0.5 | | 12.3 | | |

5.10 Switching Characteristics, $V_{CCA} = 3.3\text{ V} \pm 0.3\text{ V}$ (continued)

over recommended operating free-air temperature range, $V_{CCA} = 3.3\text{ V} \pm 0.3\text{ V}$ (see Figure 6-1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V_{CCB} | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | | | UNIT |
|--------------------|-----------------|-------------|--|---|-----|-----|--|-----|------|------|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| t_{PHZ}, t_{PLZ} | \overline{OE} | A | $V_{CCB} = 1.2\text{ V}$ | 1.7 | | | 1.7 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 0.5 | | 4 | 0.5 | | 12.3 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | | 4 | 0.5 | | 12.3 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 4 | 0.5 | | 12.3 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 4 | 0.5 | | 12.3 | |
| t_{PHZ}, t_{PLZ} | \overline{OE} | B | $V_{CCB} = 1.2\text{ V}$ | 3.4 | | | 3.4 | | | ns |
| | | | $V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$ | 0.5 | | 6.9 | 0.5 | | 17.4 | |
| | | | $V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$ | 0.5 | | 6 | 0.5 | | 15.8 | |
| | | | $V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$ | 0.5 | | 4.8 | 0.5 | | 13.7 | |
| | | | $V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$ | 0.5 | | 4.2 | 0.5 | | 12.6 | |

5.11 Operating Characteristics

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

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

(1) Power dissipation capacitance per transceiver

5.12 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 | μA |
| 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 | |

5.13 Typical Characteristics

T_A = 25°C

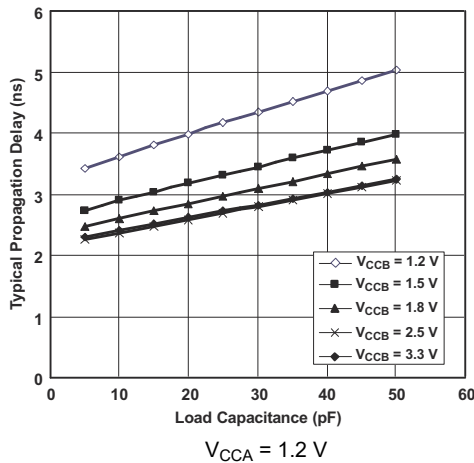


Figure 5-1. Typical Propagation Delay (A to B) vs Load Capacitance

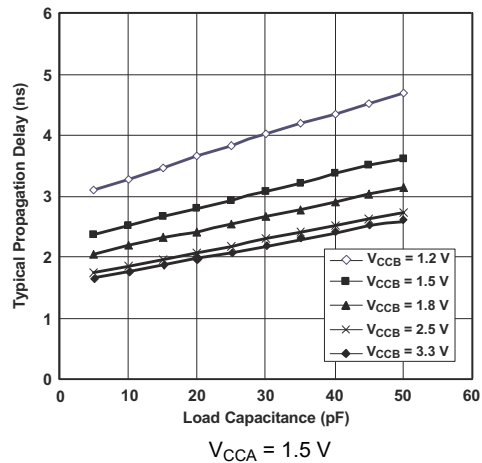


Figure 5-2. Typical Propagation Delay (A to B) vs Load Capacitance

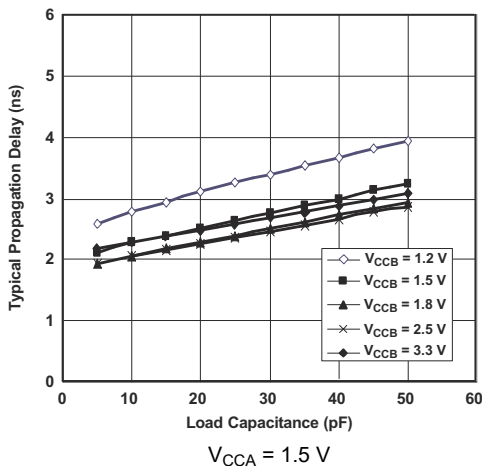


Figure 5-3. Typical Propagation Delay (A to B) vs Load Capacitance

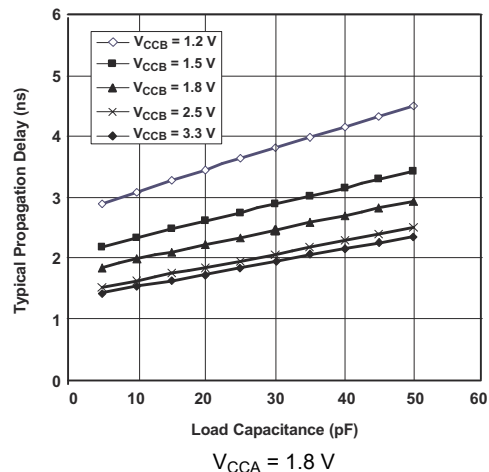


Figure 5-4. Typical Propagation Delay (A to B) vs Load Capacitance

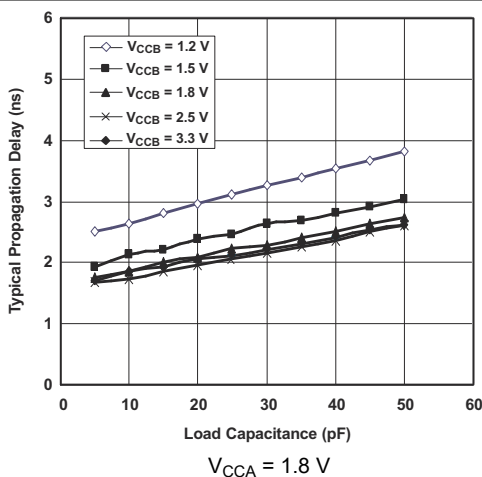


Figure 5-5. Typical Propagation Delay (A to B) vs Load Capacitance

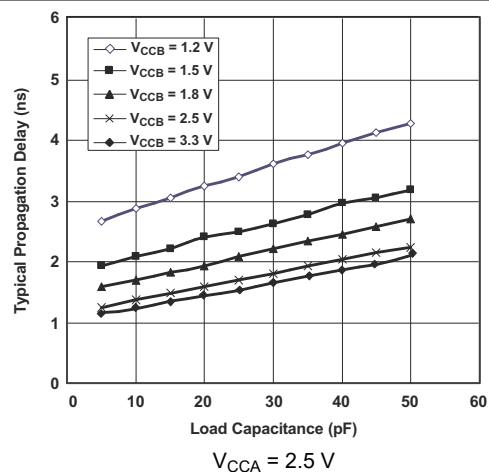


Figure 5-6. Typical Propagation Delay (A to B) vs Load Capacitance

5.13 Typical Characteristics (continued)

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

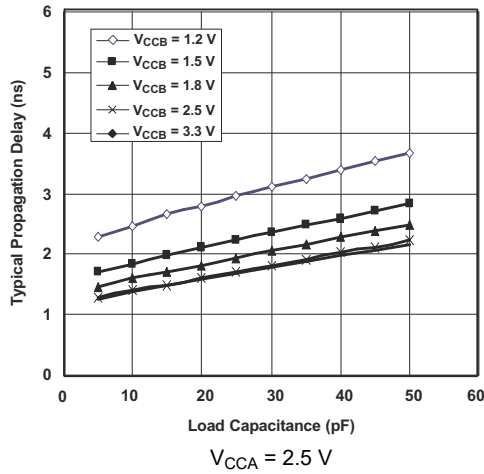


Figure 5-7. Typical Propagation Delay (A to B) vs Load Capacitance

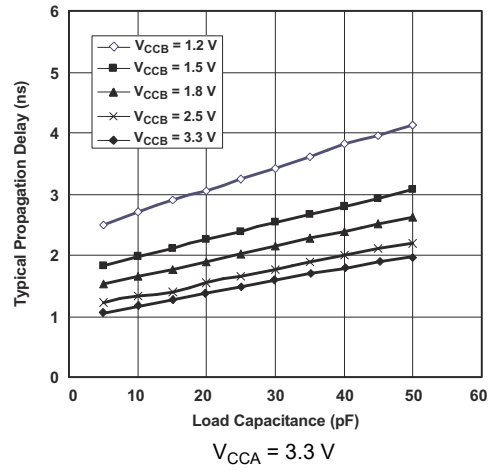


Figure 5-8. Typical Propagation Delay (A to B) vs Load Capacitance

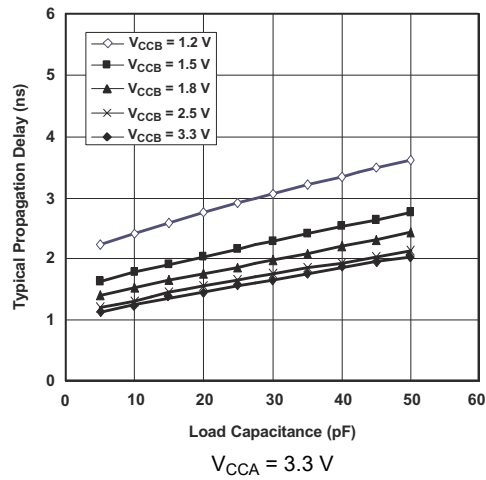
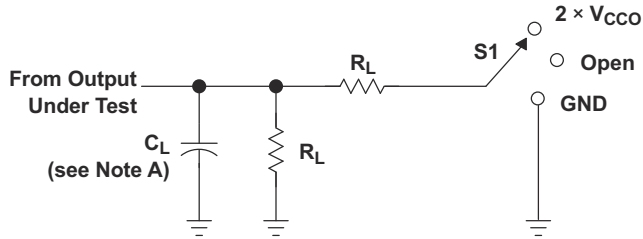


Figure 5-9. Typical Propagation Delay (A to B) vs Load Capacitance

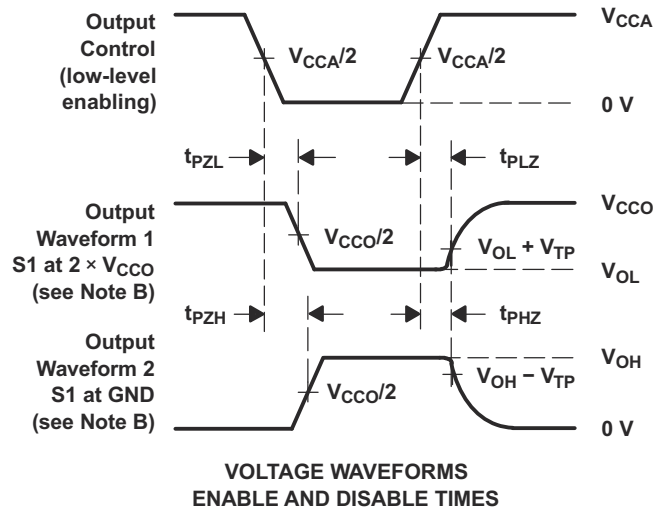
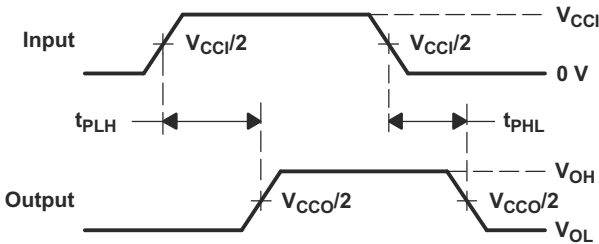
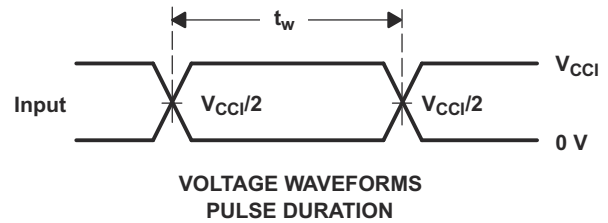
Parameter Measurement Information



LOAD CIRCUIT

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

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



- 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_{CC1} is the V_{CC} associated with the input port.
 - I. V_{CCO} is the V_{CC} associated with the output port.

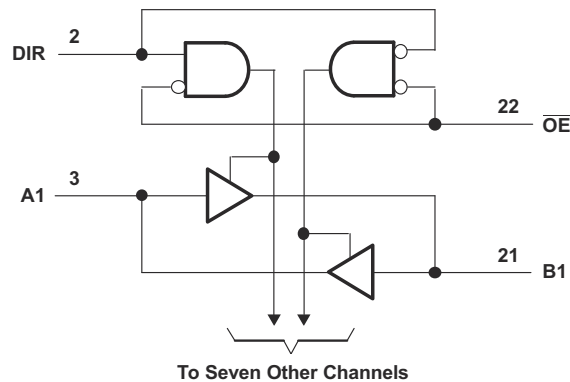
Figure 6-1. Load Circuit and Voltage Waveforms

6 Detailed Description

6.1 Overview

The SN74AVC8T245 is an 8-bit, dual-supply noninverting transceiver with bidirectional voltage level translation. V_{CCA} supports pins A and the control pins (DIR and \overline{OE}), and V_{CCB} supports pins B. The A port is able to accept I/O voltages ranging from 1.2 V to 3.6 V, while the B port can accept I/O voltages from 1.2 V to 3.6 V. A high on DIR allows data transmission from A to B and a low on DIR allows data transmission from B to A when \overline{OE} is set to low. When \overline{OE} is set to high, both A and B are in the high-impedance state.

6.2 Functional Block Diagram



6.3 Feature Description

6.3.1 Fully Configurable Dual-Rail Design

The fully configurable dual-rail design allows each port to operate over the full 1.2-V to 3.6-V power-supply range. Both V_{CCA} and V_{CCB} can be supplied at any voltage between 1.2 V and 3.6 V making the device an excellent choice for translating between any of the low voltage nodes (1.2 V, 1.8 V, 2.5 V, and 3.3 V).

6.3.2 Support High-Speed Translation

SN74AVC8T245 can support high data rate application. The translated signal data rate can be up to 320Mbps when the device power supply is more than 1.8 V.

6.3.3 I_{off} Supports Partial-Power-Down Mode Operation

I_{off} prevents backflow current by disabling I/O output circuits when device is in partial power-down mode. The inputs and outputs for this device enter a high-impedance state when the device is powered down, inhibiting current backflow into the device. The maximum leakage into or out of any input or output pin on the device is specified by I_{off} in the *Electrical Characteristics*.

6.3.4 Balanced High-Drive CMOS Push-Pull Outputs

A balanced output allows the device to sink and source similar currents. The high drive capability of this device creates fast edges into light loads, so routing and load conditions should be considered to prevent ringing. Additionally, the outputs of this device are capable of driving larger currents than the device can sustain without being damaged. Two outputs can be connected together for 2X stronger output drive strength. The electrical and thermal limits defined in the *Absolute Maximum Ratings* must be followed at all times.

6.3.5 Vcc Isolation

The I/Os of both ports will enter a high-impedance state when one of the supplies are at GND, while the other supply is still connected to the device (IOZ shown in *Electrical Characteristics*).

6.4 Device Functional Modes

The SN74AVC8T245 is a voltage level transceiver that can operate from 1.2 V to 3.6 V (V_{CCA}) and 1.2 V to 3.6 V (V_{CCB}). The signal translation between 1.2 V and 3.6 V requires direction control and output enable control. When \overline{OE} is low and DIR is high, data transmission is from A to B. When \overline{OE} is low and DIR is low, data transmission is from B to A. When \overline{OE} is high, both output ports will be high-impedance.

**Table 6-1. Function Table
(Each 8-Bit Section)**

| INPUTS | | OPERATION |
|-----------------|-----|------------------|
| \overline{OE} | DIR | |
| L | L | B data to A bus |
| L | H | A data to B bus |
| H | X | All outputs Hi-Z |

7 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, as well as validating and testing their design implementation to confirm system functionality.

7.1 Application Information

The SN74AVC8T245 device can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. The SN74AVC8T245 device is an excellent choice for data transmission when direction is different. It is recommended to tie all unused I/Os to GND. The device should not have any floating I/Os when changing translation direction. The maximum data rate can be up to 320Mbps when device voltage power supply is more than 1.8 V.

7.2 Typical Application

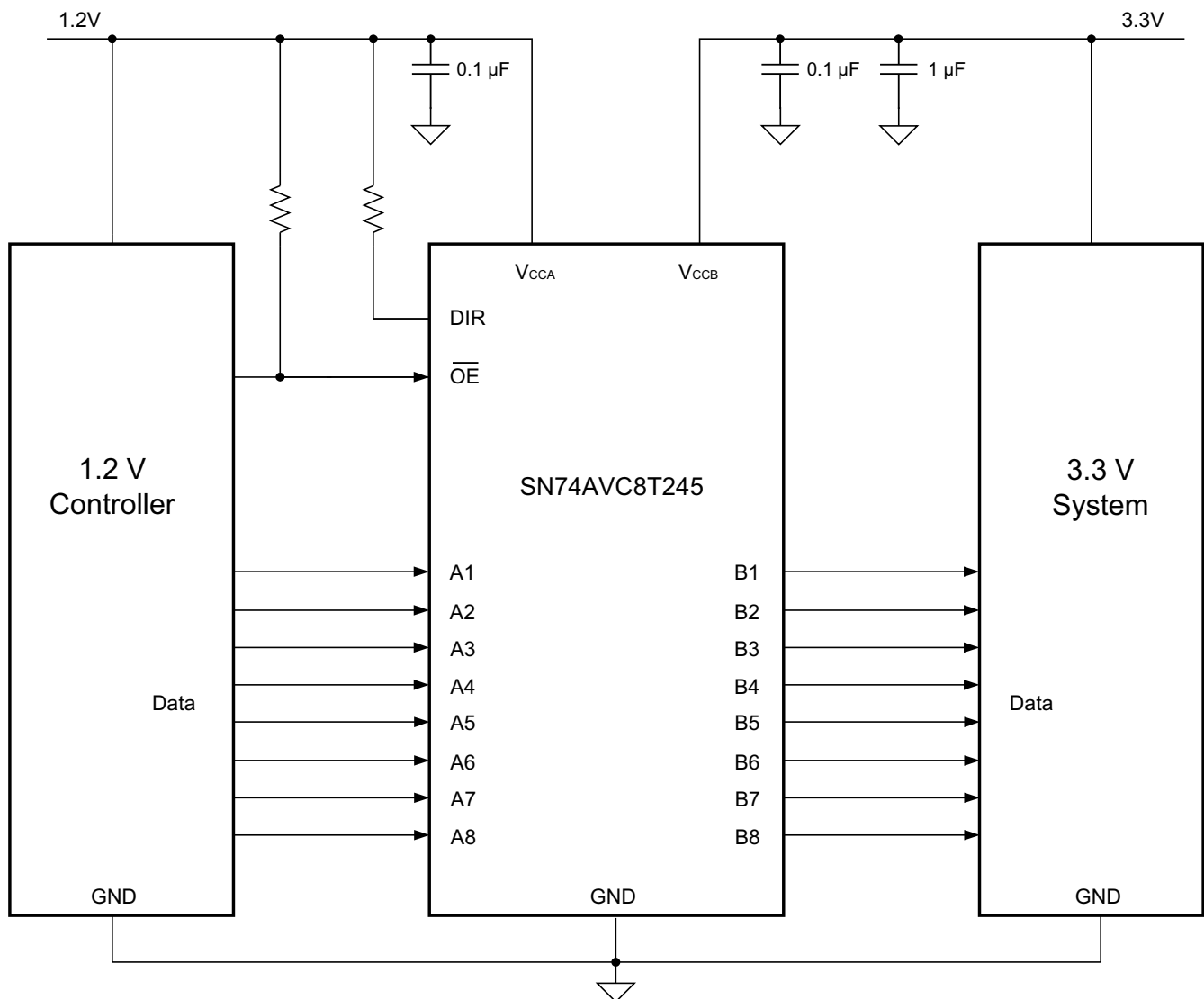


Figure 7-1. Typical Application Schematic

7.2.1 Design Requirements

For this design example, use the parameters listed in [Table 7-1](#).

Table 7-1. Design Parameters

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

7.2.2 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 SN74AVC8T245 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 SN74AVC8T245 device is driving to determine the output voltage range.

7.2.3 Application Curve

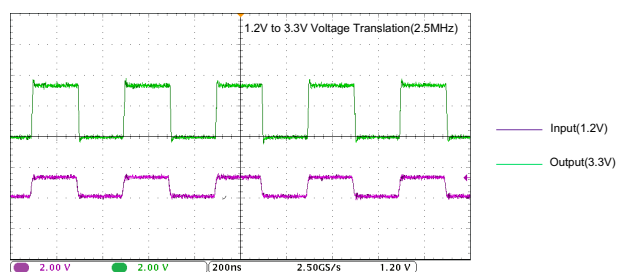


Figure 7-2. Translation Up (1.2 V to 3.3 V) at 2.5 MHz

7.3 Power Supply Recommendations

The SN74AVC8T245 device uses two separate configurable power-supply rails, V_{CCA} and V_{CCB} . V_{CCA} accepts any supply voltage from 1.2 V to 3.6 V and V_{CCB} accepts any supply voltage from 1.2 V to 3.6 V. The A port and B port are designed to track V_{CCA} and V_{CCB} , respectively, allowing for low-voltage bidirectional translation between any of the 1.2-V, 1.5-V, 1.8-V, 2.5-V and 3.3-V voltage nodes. The recommendation is to first power-up the input supply rail to help avoid internal floating while the output supply rail ramps up. However, both power-supply rails can be ramped up simultaneously.

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

7.4 Layout

7.4.1 Layout Guidelines

For device reliability, follow common printed-circuit board layout guidelines such as:

- Use bypass capacitors on power supplies.
- Use short trace lengths to avoid excessive loading.
- Place pads on the signal paths for loading capacitors or pullup resistors to adjust the signals rise and fall times, depending on the system requirements.

7.4.2 Layout Example

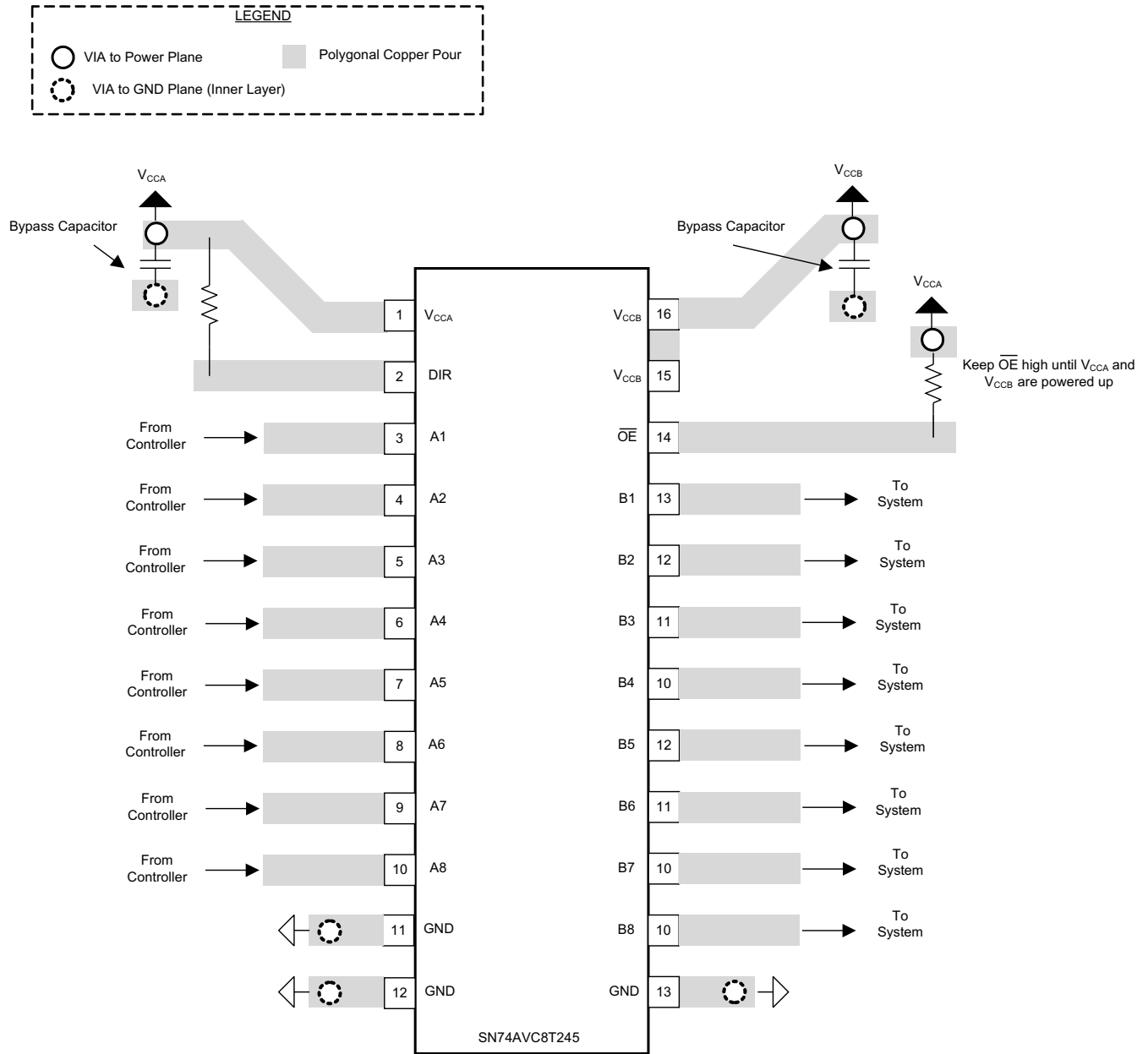


Figure 7-3. SN74AVC8T245 Layout Example

8 Device and Documentation Support

8.1 Documentation Support

8.1.1 Related Documentation

For related documentation, see the following:

- Texas Instruments, [Implications of Slow or Floating CMOS Inputs application note](#)

8.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](#). Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

8.3 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is 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](#).

8.4 Trademarks

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8.5 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

8.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

9 Revision History

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

| Changes from Revision J (March 2017) to Revision K (November 2023) | Page |
|---|-------------|
| • Updated the numbering format for tables, figures, and cross-references throughout the document..... | 1 |
| • Updated the <i>Package Information</i> table to include package lead size..... | 1 |
| • Updated the <i>Thermal Information</i> table for all packages..... | 6 |
| Changes from Revision I (December 2014) to Revision J (March 2017) | Page |
| • Changed MAX value for Operating free-air temperature, T_A from: 85°C to: 125°C..... | 5 |
| • Added values for $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ in <i>Electrical Characteristics</i> and all <i>Switching Characteristics</i> tables. | 6 |
| • Added <i>Documentation Support</i> section, <i>Receiving Notification of Documentation Updates</i> , and <i>Community Resources</i> section..... | 20 |
| Changes from Revision H (February 2007) to Revision I (December 2014) | Page |
| • Added <i>Pin Configuration and Functions</i> section, <i>ESD Rating</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section | 1 |

10 Mechanical, Packaging, and Orderable Information

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

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|-------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| 74AVC8T245RHLRG4 | ACTIVE | VQFN | RHL | 24 | 1000 | RoHS & Green | NIPDAU | Level-2-260C-1 YEAR | -40 to 125 | WE245 | Samples |
| SN74AVC8T245DGVR | ACTIVE | TVSOP | DGV | 24 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | WE245 | Samples |
| SN74AVC8T245PW | ACTIVE | TSSOP | PW | 24 | 60 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | WE245 | Samples |
| SN74AVC8T245PWE4 | ACTIVE | TSSOP | PW | 24 | 60 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | WE245 | Samples |
| SN74AVC8T245PWG4 | ACTIVE | TSSOP | PW | 24 | 60 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | WE245 | Samples |
| SN74AVC8T245PWR | ACTIVE | TSSOP | PW | 24 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | WE245 | Samples |
| SN74AVC8T245PWRE4 | ACTIVE | TSSOP | PW | 24 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | WE245 | Samples |
| SN74AVC8T245PWRG4 | ACTIVE | TSSOP | PW | 24 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | WE245 | Samples |
| SN74AVC8T245RHLR | ACTIVE | VQFN | RHL | 24 | 1000 | RoHS & Green | NIPDAU | Level-2-260C-1 YEAR | -40 to 125 | WE245 | Samples |

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

ACTIVE: Product device recommended for new designs.

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

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

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

OBSOLETE: TI has discontinued the production of the device.

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

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

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

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

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

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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

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OTHER QUALIFIED VERSIONS OF SN74AVC8T245 :

- Automotive : [SN74AVC8T245-Q1](#)

NOTE: Qualified Version Definitions:

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

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74AVC8T245DGVR | TVSOP | DGV | 24 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74AVC8T245PWR | TSSOP | PW | 24 | 2000 | 330.0 | 16.4 | 6.95 | 8.3 | 1.6 | 8.0 | 16.0 | Q1 |
| SN74AVC8T245RHLR | 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) |
|------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74AVC8T245DGVR | TVSOP | DGV | 24 | 2000 | 356.0 | 356.0 | 35.0 |
| SN74AVC8T245PWR | TSSOP | PW | 24 | 2000 | 356.0 | 356.0 | 35.0 |
| SN74AVC8T245RHLR | VQFN | RHL | 24 | 1000 | 210.0 | 185.0 | 35.0 |

TUBE


*All dimensions are nominal

| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|------------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| SN74AVC8T245PW | PW | TSSOP | 24 | 60 | 530 | 10.2 | 3600 | 3.5 |
| SN74AVC8T245PWE4 | PW | TSSOP | 24 | 60 | 530 | 10.2 | 3600 | 3.5 |
| SN74AVC8T245PWG4 | PW | TSSOP | 24 | 60 | 530 | 10.2 | 3600 | 3.5 |

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



NOTES: (continued)

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

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

24 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.
 D. Falls within JEDEC: 24/48 Pins – MO-153
 14/16/20/56 Pins – MO-194

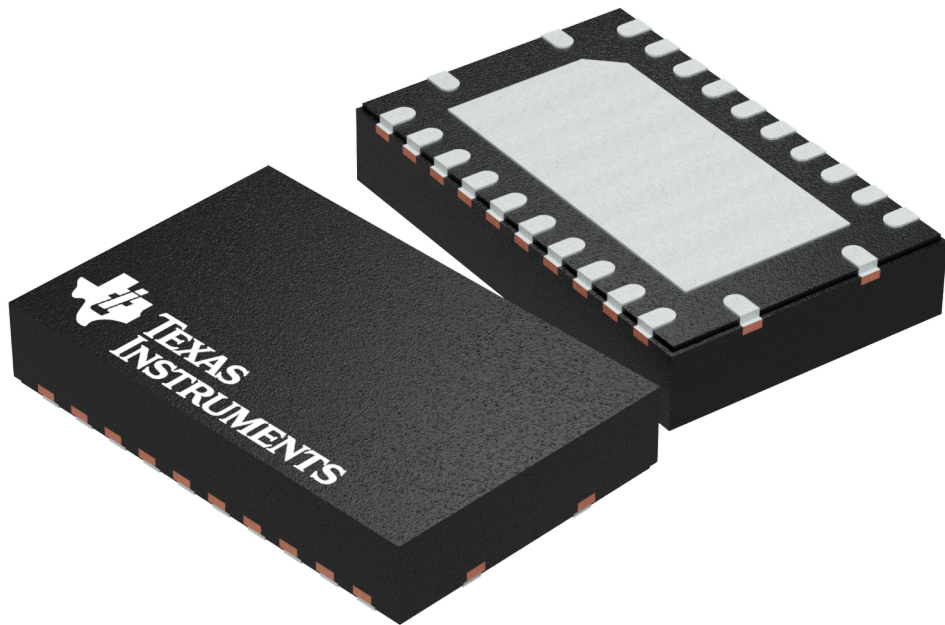
GENERIC PACKAGE VIEW

RGY 24

VQFN - 1 mm max height

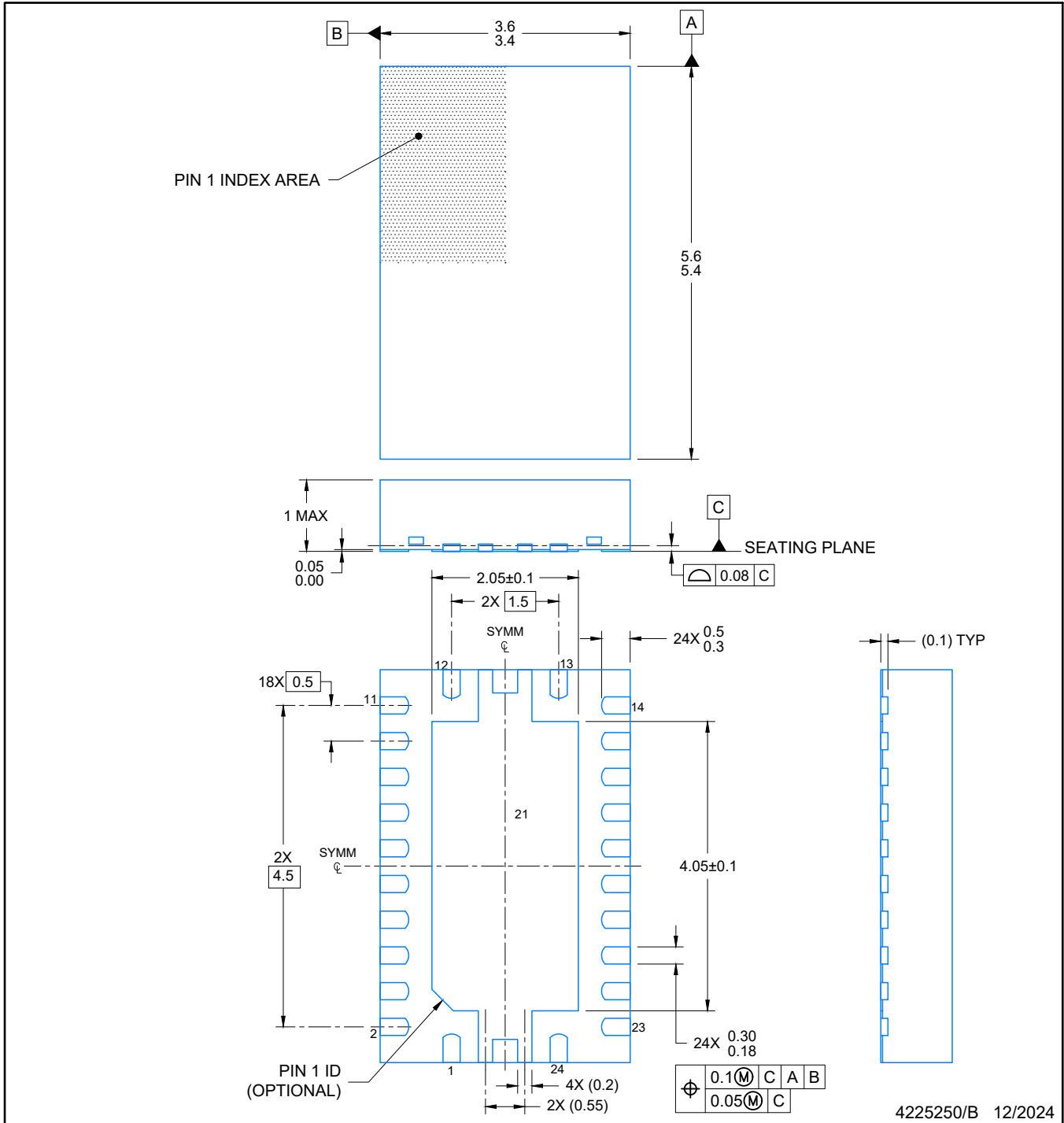
5.5 x 3.5 mm, 0.5 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

4203539-5/J



NOTES:

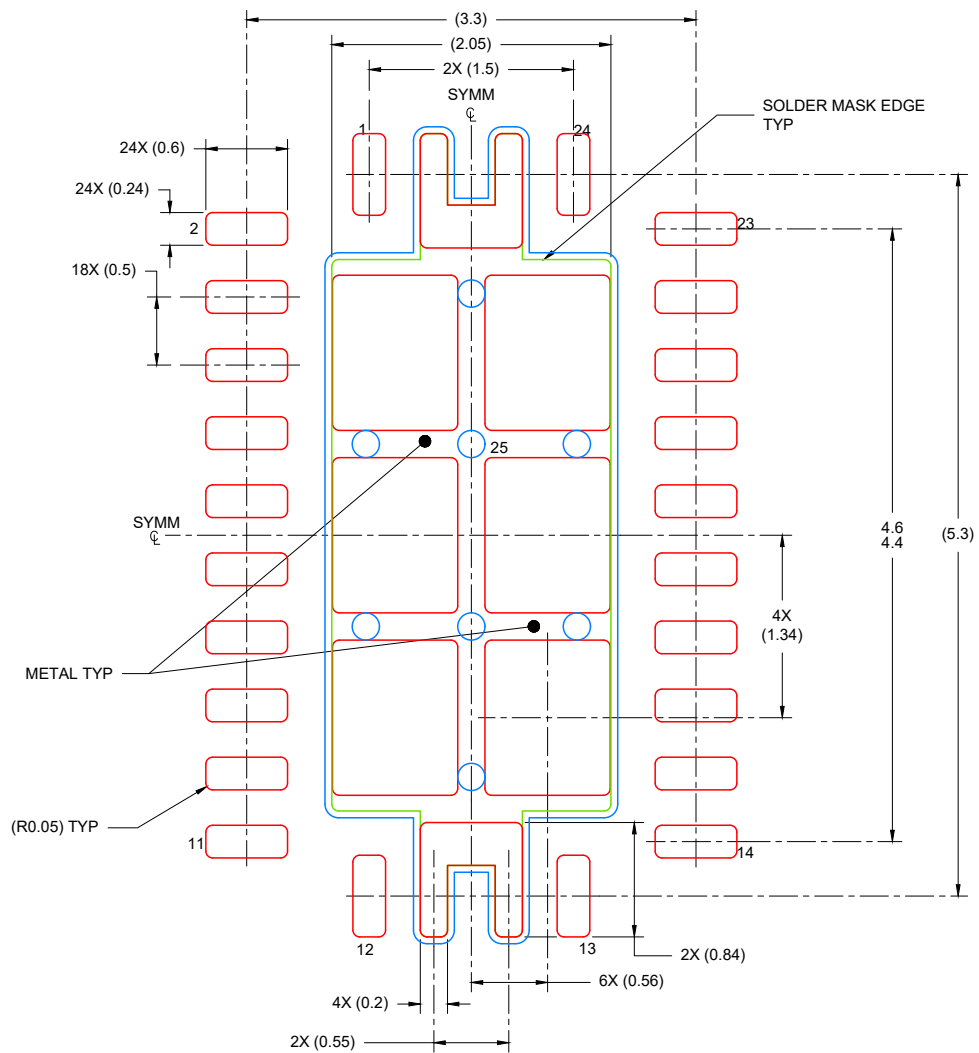
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for optimal thermal and mechanical performance.

EXAMPLE STENCIL DESIGN

VQFN - 1 mm max height

RHL0024A

PLASTIC QUAD FLATPACK- NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD
80% PRINTED COVERAGE BY AREA
SCALE: 18X

4225250/B 12/2024

NOTES: (continued)

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

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