

# 16-BIT DUAL-SUPPLY BUS TRANSCEIVER WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS

Check for Samples: [SN74LVCH16T245-EP](#)

## FEATURES

- 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 Outputs Are in the High-Impedance State
- Overvoltage-Tolerant Inputs/Outputs Allow Mixed-Voltage-Mode Data Communications
- Fully Configurable Dual-Rail Design Allows Each Port to Operate Over the Full 1.65-V to 5.5-V Power-Supply Range
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- $I_{off}$  Supports Partial-Power-Down Mode Operation
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

## SUPPORTS DEFENSE, AEROSPACE, AND MEDICAL APPLICATIONS

- Controlled Baseline
- One Assembly/Test Site
- One Fabrication Site
- Available in Military ( $-55^{\circ}\text{C}/125^{\circ}\text{C}$ ) Temperature Range <sup>(1)</sup>
- Extended Product Life Cycle
- Extended Product-Change Notification
- Product Traceability

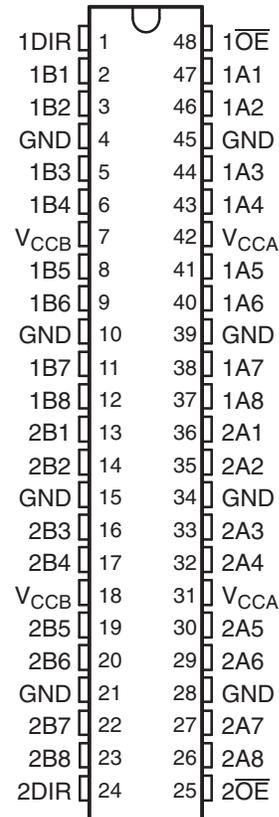
(1) Custom temperature ranges available

## DESCRIPTION

This 16-bit noninverting bus transceiver uses two separate configurable power-supply rails. The A port is designed to track  $V_{CCA}$ .  $V_{CCA}$  accepts any supply voltage from 1.65 V to 5.5 V. The B port is designed to track  $V_{CCB}$ .  $V_{CCB}$  accepts any supply voltage from 1.65 V to 5.5 V. This allows for universal low-voltage bidirectional translation between any of the 1.8-V, 2.5-V, 3.3-V, and 5-V voltage nodes.

The SN74LVCH16T245 is designed so that the control pins (1DIR, 2DIR,  $1\overline{\text{OE}}$ , and  $2\overline{\text{OE}}$ ) are supplied by  $V_{CCA}$ .

DGV PACKAGE  
(TOP VIEW)



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

**DESCRIPTION (CONTINUED)**

The SN74LVCH16T245 is designed for asynchronous communication between two data buses. The logic levels of the direction-control (DIR) input and the output-enable ( $\overline{OE}$ ) input activate either the B-port outputs or the A-port outputs or place both output ports into the high-impedance mode. The device transmits data from the A bus to the B bus when the B-port outputs are activated, and from the B bus to the A bus when the A-port outputs are activated. The input circuitry on both A and B ports is always active and must have a logic HIGH or LOW level applied to prevent excess  $I_{CC}$  and  $I_{CCZ}$ .

Active bus-hold circuitry holds unused or undriven data 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  $I_{off}$ . The  $I_{off}$  circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

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

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

**Table 1. ORDERING INFORMATION<sup>(1)</sup>**

| $T_A$          | PACKAGE <sup>(2)</sup> |               | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|------------------------|---------------|-----------------------|------------------|
| -50°C to 125°C | TVSOP – DGV            | Tape and reel | CLVCH16T245MDGVREP    | LDHT245MEP       |
|                | TSSOP - DGG            | Tape and reel | CLVCH16T245MDGGREP    | 8UT245MEP        |

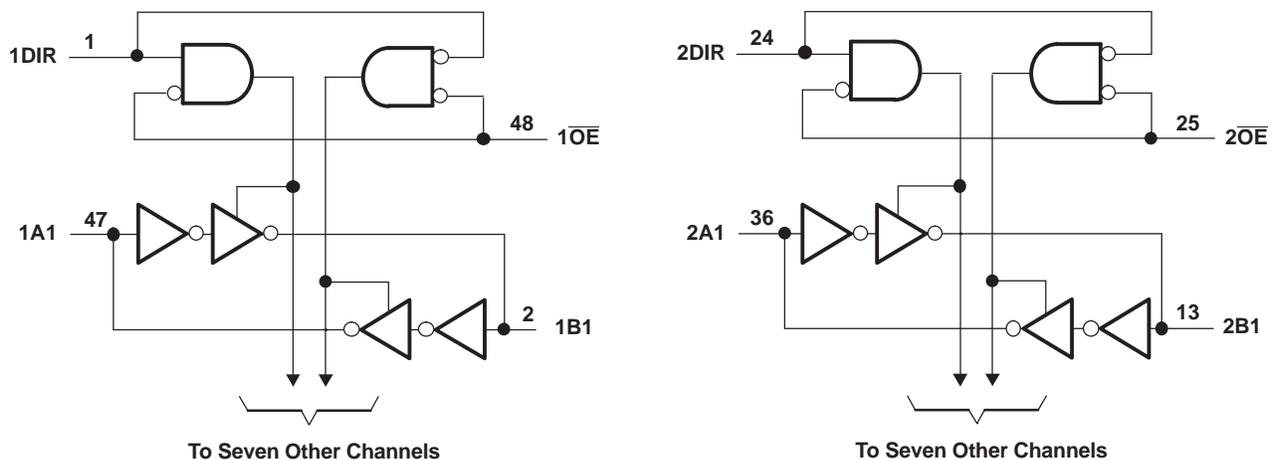
- (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI Web site at [www.ti.com](http://www.ti.com).
- (2) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

**FUNCTION TABLE<sup>(1)</sup>  
(EACH 16-BIT SECTION)**

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

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

**LOGIC DIAGRAM (POSITIVE LOGIC)**



**Absolute Maximum Ratings<sup>(1)</sup>**

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

|                        |   |                    | <b>MIN</b> | <b>MAX</b>      | <b>UNIT</b> |
|------------------------|---|--------------------|------------|-----------------|-------------|
| $V_{CCA}$<br>$V_{CCB}$ | Supply voltage range  |                    | -0.5       | 6.5             | V           |
| $V_I$                  | Input voltage range <sup>(2)</sup>  | I/O ports (A port) | -0.5       | 6.5             | V           |
|                        |   | I/O ports (B port) | -0.5       | 6.5             |             |
|                        |   | Control inputs     | -0.5       | 6.5             |             |
| $V_O$                  | Voltage range applied to any output in the high-impedance or power-off state <sup>(2)</sup> | A port             | -0.5       | 6.5             | V           |
|                        |   | B port             | -0.5       | 6.5             |             |
| $V_O$                  | Voltage range applied to any output in the high or low state <sup>(2) (3)</sup>             | A port             | -0.5       | $V_{CCA} + 0.5$ | V           |
|                        |   | B port             | -0.5       | $V_{CCB} + 0.5$ |             |
| $I_{IK}$               | Input clamp current   | $V_I < 0$          |            | -50             | mA          |
| $I_{OK}$               | Output clamp current  | $V_O < 0$          |            | -50             | mA          |
| $I_O$                  | Continuous output current   |                    |            | ±50             | mA          |
|                        | Continuous current through each $V_{CCA}$ , $V_{CCB}$ , and GND                             |                    |            | ±100            | mA          |
| $\theta_{JA}$          | Package thermal impedance <sup>(4)</sup>  |                    |            | 58              | °C/W        |
| $T_{stg}$              | Storage temperature range   |                    | -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 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 6.5 V maximum if the output current rating is observed.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.

**Recommended Operating Conditions**<sup>(1) (2) (3)</sup>

|                  |                                    |   | V <sub>CCI</sub> | V <sub>CCO</sub> | MIN                     | MAX              | UNIT |
|------------------|------------------------------------|---|------------------|------------------|-------------------------|------------------|------|
| V <sub>CCA</sub> | Supply voltage                     |   |                  |                  | 1.65                    | 5.5              | V    |
| V <sub>CCB</sub> |                                    |   |                  |                  | 1.65                    | 5.5              |      |
| V <sub>IH</sub>  | High-level input voltage           | Data inputs <sup>(4)</sup>                                      | 1.65 V to 1.95 V |                  | V <sub>CCI</sub> × 0.65 |                  | V    |
|                  |                                    |   | 2.3 V to 2.7 V   |                  | 1.7                     |                  |      |
|                  |                                    |   | 3 V to 3.6 V     |                  | 2                       |                  |      |
|                  |                                    |   | 4.5 V to 5.5 V   |                  | V <sub>CCI</sub> × 0.7  |                  |      |
| V <sub>IL</sub>  | Low-level input voltage            | Data inputs <sup>(4)</sup>                                      | 1.65 V to 1.95 V |                  | V <sub>CCI</sub> × 0.35 |                  | V    |
|                  |                                    |   | 2.3 V to 2.7 V   |                  | 0.7                     |                  |      |
|                  |                                    |   | 3 V to 3.6 V     |                  | 0.8                     |                  |      |
|                  |                                    |   | 4.5 V to 5.5 V   |                  | V <sub>CCI</sub> × 0.3  |                  |      |
| V <sub>IH</sub>  | High-level input voltage           | Control inputs (referenced to V <sub>CCA</sub> ) <sup>(5)</sup> | 1.65 V to 1.95 V |                  | V <sub>CCA</sub> × 0.65 |                  | V    |
|                  |                                    |   | 2.3 V to 2.7 V   |                  | 1.7                     |                  |      |
|                  |                                    |   | 3 V to 3.6 V     |                  | 2                       |                  |      |
|                  |                                    |   | 4.5 V to 5.5 V   |                  | V <sub>CCA</sub> × 0.7  |                  |      |
| V <sub>IL</sub>  | Low-level input voltage            | Control inputs (referenced to V <sub>CCA</sub> ) <sup>(5)</sup> | 1.65 V to 1.95 V |                  | V <sub>CCA</sub> × 0.35 |                  | V    |
|                  |                                    |   | 2.3 V to 2.7 V   |                  | 0.7                     |                  |      |
|                  |                                    |   | 3 V to 3.6 V     |                  | 0.8                     |                  |      |
|                  |                                    |   | 4.5 V to 5.5 V   |                  | V <sub>CCA</sub> × 0.3  |                  |      |
| V <sub>I</sub>   | Input voltage                      | Control inputs  |                  |                  | 0                       | 5.5              | V    |
| V <sub>I/O</sub> | Input/output voltage               | Active state  |                  |                  | 0                       | V <sub>CCO</sub> | V    |
|                  |                                    | 3-State   |                  |                  | 0                       | 5.5              |      |
| I <sub>OH</sub>  | High-level output current          |   | 1.65 V to 1.95 V |                  | -4                      |                  | mA   |
|                  |                                    |   | 2.3 V to 2.7 V   |                  | -8                      |                  |      |
|                  |                                    |   | 3 V to 3.6 V     |                  | -24                     |                  |      |
|                  |                                    |   | 4.5 V to 5.5 V   |                  | -32                     |                  |      |
| I <sub>OL</sub>  | Low-level output current           |   | 1.65 V to 1.95 V |                  | 4                       |                  | mA   |
|                  |                                    |   | 2.3 V to 2.7 V   |                  | 8                       |                  |      |
|                  |                                    |   | 3 V to 3.6 V     |                  | 24                      |                  |      |
|                  |                                    |   | 4.5 V to 5.5 V   |                  | 32                      |                  |      |
| Δt/Δv            | Input transition rise or fall rate | Data inputs   | 1.65 V to 1.95 V |                  | 20                      |                  | ns/V |
|                  |                                    |   | 2.3 V to 2.7 V   |                  | 20                      |                  |      |
|                  |                                    |   | 3 V to 3.6 V     |                  | 10                      |                  |      |
|                  |                                    |   | 4.5 V to 5.5 V   |                  | 5                       |                  |      |
| 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 data input port.

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

(3) All unused control inputs of the device must be held at V<sub>CCA</sub> GND to ensure proper device operation and minimize power consumption. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

(4) For V<sub>CCI</sub> values not specified in the data sheet, V<sub>IH</sub> min = V<sub>CCI</sub> × 0.7 V, V<sub>IL</sub> max = V<sub>CCI</sub> × 0.3 V.

(5) For V<sub>CCA</sub> values not specified in the data sheet, V<sub>IH</sub> min = V<sub>CCA</sub> × 0.7 V, V<sub>IL</sub> max = V<sub>CCA</sub> × 0.3 V.

**Electrical Characteristics<sup>(1) (2)</sup>**

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

| PARAMETER                           |  | TEST CONDITIONS   | V <sub>CCA</sub>         | V <sub>CCB</sub> | MIN             | TYP | MAX | MIN                    | MAX  | UNIT |                                     |       |       |  |    |    |
|-------------------------------------|--|---|--------------------------|------------------|-----------------|-----|-----|------------------------|------|------|-------------------------------------|-------|-------|--|----|----|
| V <sub>OH</sub>                     | I <sub>OH</sub> = -100 μA, V <sub>I</sub> = V <sub>IH</sub>  |   | 1.65 V to 4.5 V          | 1.65 V to 4.5 V  |                 |     |     | V <sub>CCO</sub> - 0.1 |      | V    |                                     |       |       |  |    |    |
|                                     | I <sub>OH</sub> = -4 mA, V <sub>I</sub> = V <sub>IH</sub>    |   | 1.65 V                   | 1.65 V           |                 |     |     | 1.2                    |      |      |                                     |       |       |  |    |    |
|                                     | I <sub>OH</sub> = -8 mA, V <sub>I</sub> = V <sub>IH</sub>    |   | 2.3 V                    | 2.3 V            |                 |     |     | 1.9                    |      |      |                                     |       |       |  |    |    |
|                                     | I <sub>OH</sub> = -24 mA, V <sub>I</sub> = V <sub>IH</sub>   |   | 3 V                      | 3 V              |                 |     |     | 2.4                    |      |      |                                     |       |       |  |    |    |
|                                     | I <sub>OH</sub> = -32 mA, V <sub>I</sub> = V <sub>IH</sub>   |   | 4.5 V                    | 4.5 V            |                 |     |     | 3.8                    |      |      |                                     |       |       |  |    |    |
| V <sub>OL</sub>                     | I <sub>OL</sub> = 100 μA, V <sub>I</sub> = V <sub>IL</sub>   |   | 1.65 V to 4.5 V          | 1.65 V to 4.5 V  |                 |     |     |                        | 0.1  | V    |                                     |       |       |  |    |    |
|                                     | I <sub>OL</sub> = 4 mA, V <sub>I</sub> = V <sub>IL</sub>     |   | 1.65 V                   | 1.65 V           |                 |     |     |                        | 0.45 |      |                                     |       |       |  |    |    |
|                                     | I <sub>OL</sub> = 8 mA, V <sub>I</sub> = V <sub>IL</sub>     |   | 2.3 V                    | 2.3 V            |                 |     |     |                        | 0.3  |      |                                     |       |       |  |    |    |
|                                     | I <sub>OL</sub> = 24 mA, V <sub>I</sub> = V <sub>IL</sub>    |   | 3 V                      | 3 V              |                 |     |     |                        | 0.55 |      |                                     |       |       |  |    |    |
|                                     | I <sub>OL</sub> = 32 mA, V <sub>I</sub> = V <sub>IL</sub>    |   | 4.5 V                    | 4.5 V            |                 |     |     |                        | 0.55 |      |                                     |       |       |  |    |    |
| I <sub>I</sub>                      | Control inputs   | V <sub>I</sub> = V <sub>CCA</sub> or GND  | 1.65 V to 5.5 V          | 1.65 V to 5.5 V  | ±0.5            |     | ±1  |                        | ±2   | μA   |                                     |       |       |  |    |    |
| I <sub>BHL</sub> <sup>(3)</sup>     | V <sub>I</sub> = 0.58 V                                      |   | 1.65 V                   | 1.65 V           |                 |     |     |                        | 15   | μA   |                                     |       |       |  |    |    |
|                                     | V <sub>I</sub> = 0.7 V                                       |   | 2.3 V                    | 2.3 V            |                 |     |     |                        | 45   |      |                                     |       |       |  |    |    |
|                                     | V <sub>I</sub> = 0.8 V                                       |   | 3 V                      | 3 V              |                 |     |     |                        | 75   |      |                                     |       |       |  |    |    |
|                                     | V <sub>I</sub> = 0.1.35 V                                    |   | 4.5 V                    | 4.5 V            |                 |     |     |                        | 100  |      |                                     |       |       |  |    |    |
| I <sub>BHH</sub> <sup>(4)</sup>     | V <sub>I</sub> = 1.07 V                                      |   | 1.65 V                   | 1.65 V           |                 |     |     |                        | -15  | μA   |                                     |       |       |  |    |    |
|                                     | V <sub>I</sub> = 1.7 V                                       |   | 2.3 V                    | 2.3 V            |                 |     |     |                        | -45  |      |                                     |       |       |  |    |    |
|                                     | V <sub>I</sub> = 2 V   |   | 3 V                      | 3 V              |                 |     |     |                        | -75  |      |                                     |       |       |  |    |    |
|                                     | V <sub>I</sub> = 3.15 V                                      |   | 4.5 V                    | 4.5 V            |                 |     |     |                        | -100 |      |                                     |       |       |  |    |    |
| I <sub>BHLO</sub> <sup>(5)</sup>    | V <sub>I</sub> = 0 to V <sub>CC</sub>                        |   | 1.95 V                   | 1.95 V           |                 |     |     |                        | 200  | μA   |                                     |       |       |  |    |    |
|                                     |  |   | 2.7 V                    | 2.7 V            |                 |     |     |                        | 300  |      |                                     |       |       |  |    |    |
|                                     |  |   | 3.6 V                    | 3.6 V            |                 |     |     |                        | 500  |      |                                     |       |       |  |    |    |
|                                     |  |   | 5.5 V                    | 5.5 V            |                 |     |     |                        | 900  |      |                                     |       |       |  |    |    |
| I <sub>BHHO</sub> <sup>(6)</sup>    | V <sub>I</sub> = 0 to V <sub>CC</sub>                        |   | 1.95 V                   | 1.95 V           |                 |     |     |                        | -200 | μA   |                                     |       |       |  |    |    |
|                                     |  |   | 2.7 V                    | 2.7 V            |                 |     |     |                        | -300 |      |                                     |       |       |  |    |    |
|                                     |  |   | 3.6 V                    | 3.6 V            |                 |     |     |                        | -500 |      |                                     |       |       |  |    |    |
|                                     |  |   | 5.5 V                    | 5.5 V            |                 |     |     |                        | -900 |      |                                     |       |       |  |    |    |
| I <sub>off</sub>                    | A port   | V <sub>I</sub> or V <sub>O</sub> = 0 to 5.5 V   | 0 V                      | 0 to 5.5 V       | ±0.5            |     | ±1  |                        | ±2   | μA   |                                     |       |       |  |    |    |
|                                     | B port   |   | 0 to 5.5 V               | 0 V              | ±0.5            |     | ±1  |                        | ±2   |      |                                     |       |       |  |    |    |
| I <sub>OZ</sub>                     | A or B port  | V <sub>O</sub> = V <sub>CCO</sub> or GND,<br>V <sub>I</sub> = V <sub>CCI</sub> or GND | $\overline{OE} = V_{IH}$ | 1.65 V to 5.5 V  | 1.65 V to 5.5 V |     | ±1  |                        | ±2   | μA   |                                     |       |       |  |    |    |
|                                     | B port   |   |                          |                  |                 |     |     |                        |      |      | $\overline{OE} = \text{don't care}$ | 0 V   | 5.5 V |  | ±1 | ±2 |
|                                     | A port   |   |                          |                  |                 |     |     |                        |      |      |                                     | 5.5 V | 0 V   |  | ±1 | ±2 |
| I <sub>CCA</sub>                    | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0 |   | 1.65 V to 5.5 V          | 1.65 V to 5.5 V  |                 |     |     |                        | 20   | μA   |                                     |       |       |  |    |    |
|                                     |  |   | 5 V                      | 0 V              |                 |     |     |                        | 20   |      |                                     |       |       |  |    |    |
|                                     |  |   | 0 V                      | 5 V              |                 |     |     |                        | -2   |      |                                     |       |       |  |    |    |
| I <sub>CCB</sub>                    | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0 |   | 1.65 V to 5.5 V          | 1.65 V to 5.5 V  |                 |     |     |                        | 20   | μA   |                                     |       |       |  |    |    |
|                                     |  |   | 5 V                      | 0 V              |                 |     |     |                        | -2   |      |                                     |       |       |  |    |    |
|                                     |  |   | 0 V                      | 5 V              |                 |     |     |                        | 20   |      |                                     |       |       |  |    |    |
| I <sub>CCA</sub> + I <sub>CCB</sub> | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0 |   | 1.65 V to 5.5 V          | 1.65 V to 5.5 V  |                 |     |     |                        | 30   | μA   |                                     |       |       |  |    |    |

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

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

 (3) The bus-hold circuit can sink at least the minimum low sustaining current at V<sub>IL</sub> max. I<sub>BHL</sub> should be measured after lowering V<sub>IN</sub> to GND and then raising it to V<sub>IL</sub> max.

 (4) The bus-hold circuit can source at least the minimum high sustaining current at V<sub>IH</sub> min. I<sub>BHH</sub> should be measured after raising V<sub>IN</sub> to V<sub>CC</sub> and then lowering it to V<sub>IH</sub> min.

 (5) An external driver must source at least I<sub>BHLO</sub> to switch this node from low to high.

 (6) An external driver must sink at least I<sub>BHHO</sub> to switch this node from high to low.

## Electrical Characteristics<sup>(1) (2)</sup> (continued)

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

| PARAMETER        |                | TEST CONDITIONS   | V <sub>CCA</sub> | V <sub>CCB</sub> | MIN | TYP | MAX | MIN | MAX | UNIT |
|------------------|----------------|---|------------------|------------------|-----|-----|-----|-----|-----|------|
| $\Delta I_{CCA}$ | DIR            | DIR at V <sub>CCA</sub> – 0.6 V,<br>B port = open,<br>A port at V <sub>CCA</sub> or GND | 3 V to 5.5 V     | 3 V to 5.5 V     |     |     |     | 50  |     | μA   |
| C <sub>i</sub>   | Control inputs | V <sub>i</sub> = V <sub>CCA</sub> or GND  | 3.3 V            | 3.3 V            |     | 4   |     | 5   |     | pF   |
| C <sub>io</sub>  | A or B port    | V <sub>O</sub> = V <sub>CCA/B</sub> or GND  | 3.3 V            | 3.3 V            |     | 8.5 |     | 10  |     | pF   |

## Switching Characteristics

over recommended operating free-air temperature range, V<sub>CCA</sub> = 1.8 V ± 0.15 V (unless otherwise noted) (see Figure 1)

| PARAMETER        | FROM (INPUT)    | TO (OUTPUT) | V <sub>CCB</sub> = 1.8 V ± 0.15 V |      | V <sub>CCB</sub> = 2.5 V ± 0.2 V |      | V <sub>CCB</sub> = 3.3 V ± 0.3 V |      | V <sub>CCB</sub> = 5 V ± 0.5 V |      | UNIT |
|------------------|-----------------|-------------|-----------------------------------|------|----------------------------------|------|----------------------------------|------|--------------------------------|------|------|
|                  |                 |             | MIN                               | MAX  | MIN                              | MAX  | MIN                              | MAX  | MIN                            | MAX  |      |
| t <sub>PLH</sub> | A               | B           | 1.7                               | 21.9 | 1.3                              | 9.2  | 1                                | 7.4  | 0.4                            | 7.1  | ns   |
| t <sub>PHL</sub> |                 |             |                                   |      |                                  |      |                                  |      |                                |      |      |
| t <sub>PLH</sub> | B               | A           | 0.9                               | 23.8 | 0.8                              | 23.8 | 0.7                              | 23.4 | 0.7                            | 23.4 | ns   |
| t <sub>PHL</sub> |                 |             |                                   |      |                                  |      |                                  |      |                                |      |      |
| t <sub>PHZ</sub> | $\overline{OE}$ | A           | 1.5                               | 29.6 | 1.5                              | 29.4 | 1.5                              | 29.3 | 1.4                            | 29.2 | ns   |
| t <sub>PLZ</sub> |                 |             |                                   |      |                                  |      |                                  |      |                                |      |      |
| t <sub>PHZ</sub> | $\overline{OE}$ | B           | 2.4                               | 32.2 | 1.9                              | 13.1 | 1.7                              | 12   | 1.3                            | 10.3 | ns   |
| t <sub>PLZ</sub> |                 |             |                                   |      |                                  |      |                                  |      |                                |      |      |
| t <sub>PZH</sub> | $\overline{OE}$ | A           | 0.4                               | 24   | 0.4                              | 23.8 | 0.4                              | 23.7 | 0.4                            | 23.7 | ns   |
| t <sub>PZL</sub> |                 |             |                                   |      |                                  |      |                                  |      |                                |      |      |
| t <sub>PZH</sub> | $\overline{OE}$ | B           | 1.8                               | 32   | 1.5                              | 18   | 1.2                              | 12.6 | 0.9                            | 10.8 | ns   |
| t <sub>PZL</sub> |                 |             |                                   |      |                                  |      |                                  |      |                                |      |      |

## Switching Characteristics

over recommended operating free-air temperature range, V<sub>CCA</sub> = 2.5 V ± 0.2 V (unless otherwise noted) (see Figure 1)

| PARAMETER        | FROM (INPUT)    | TO (OUTPUT) | V <sub>CCB</sub> = 1.8 V ± 0.15 V |      | V <sub>CCB</sub> = 2.5 V ± 0.2 V |      | V <sub>CCB</sub> = 3.3 V ± 0.3 V |      | V <sub>CCB</sub> = 5 V ± 0.5 V |      | UNIT |
|------------------|-----------------|-------------|-----------------------------------|------|----------------------------------|------|----------------------------------|------|--------------------------------|------|------|
|                  |                 |             | MIN                               | MAX  | MIN                              | MAX  | MIN                              | MAX  | MIN                            | MAX  |      |
| t <sub>PLH</sub> | A               | B           | 1.5                               | 21.4 | 1.2                              | 9    | 0.8                              | 6.2  | 0.6                            | 4.8  | ns   |
| t <sub>PHL</sub> |                 |             |                                   |      |                                  |      |                                  |      |                                |      |      |
| t <sub>PLH</sub> | B               | A           | 1.2                               | 9.3  | 1                                | 9.1  | 1                                | 8.9  | 0.9                            | 8.8  | ns   |
| t <sub>PHL</sub> |                 |             |                                   |      |                                  |      |                                  |      |                                |      |      |
| t <sub>PHZ</sub> | $\overline{OE}$ | A           | 1.4                               | 9    | 1.4                              | 9    | 1.4                              | 9    | 1.4                            | 9    | ns   |
| t <sub>PLZ</sub> |                 |             |                                   |      |                                  |      |                                  |      |                                |      |      |
| t <sub>PHZ</sub> | $\overline{OE}$ | B           | 2.3                               | 29.6 | 1.8                              | 11   | 1.7                              | 9.3  | 0.9                            | 6.9  | ns   |
| t <sub>PLZ</sub> |                 |             |                                   |      |                                  |      |                                  |      |                                |      |      |
| t <sub>PZH</sub> | $\overline{OE}$ | A           | 1                                 | 10.9 | 1                                | 10.9 | 1                                | 10.9 | 1                              | 10.9 | ns   |
| t <sub>PZL</sub> |                 |             |                                   |      |                                  |      |                                  |      |                                |      |      |
| t <sub>PZH</sub> | $\overline{OE}$ | B           | 1.7                               | 28.2 | 1.5                              | 12.9 | 1.2                              | 9.4  | 1                              | 6.9  | ns   |
| t <sub>PZL</sub> |                 |             |                                   |      |                                  |      |                                  |      |                                |      |      |

## Switching Characteristics

over recommended operating free-air temperature range,  $V_{CCA} = 3.3 \text{ V} \pm 0.3 \text{ V}$  (unless otherwise noted) (see [Figure 1](#))

| PARAMETER | FROM (INPUT)    | TO (OUTPUT) | $V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$ |      | $V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$ |      | $V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$ |     | $V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$ |     | UNIT |
|-----------|-----------------|-------------|--|------|---|------|---|-----|---|-----|------|
|           |                 |             | MIN  | MAX  | MIN   | MAX  | MIN   | MAX | MIN                                       | MAX |      |
| $t_{PLH}$ | A               | B           | 1.6  | 21.2 | 1.1   | 8.8  | 0.8   | 6.2 | 0.6                                       | 4.4 | ns   |
| $t_{PHL}$ |                 |             |  |      |   |      |   |     |   |     |      |
| $t_{PLH}$ | B               | A           | 0.8  | 7.2  | 0.8   | 6.2  | 0.7   | 6.1 | 0.6                                       | 6   | ns   |
| $t_{PHL}$ |                 |             |  |      |   |      |   |     |   |     |      |
| $t_{PHZ}$ | $\overline{OE}$ | A           | 1.6  | 8.2  | 1.6   | 8.2  | 1.6   | 8.2 | 1.6                                       | 8.2 | ns   |
| $t_{PLZ}$ |                 |             |  |      |   |      |   |     |   |     |      |
| $t_{PHZ}$ | $\overline{OE}$ | B           | 2.1  | 29   | 1.7   | 10.3 | 1.5   | 8.8 | 0.8                                       | 6.3 | ns   |
| $t_{PLZ}$ |                 |             |  |      |   |      |   |     |   |     |      |
| $t_{PZH}$ | $\overline{OE}$ | A           | 0.8  | 7.8  | 0.8   | 8.1  | 0.8   | 8.1 | 0.8                                       | 8.1 | ns   |
| $t_{PZL}$ |                 |             |  |      |   |      |   |     |   |     |      |
| $t_{PZH}$ | $\overline{OE}$ | B           | 1.8  | 27.7 | 1.4   | 12.4 | 1.1   | 8.5 | 0.8                                       | 6.4 | ns   |
| $t_{PZL}$ |                 |             |  |      |   |      |   |     |   |     |      |

## Switching Characteristics

over recommended operating free-air temperature range,  $V_{CCA} = 5 \text{ V} \pm 0.5 \text{ V}$  (unless otherwise noted) (see [Figure 1](#))

| PARAMETER | FROM (INPUT)    | TO (OUTPUT) | $V_{CC} = 1.8 \text{ V} \pm 0.15 \text{ V}$ |      | $V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$ |      | $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$ |     | $V_{CC} = 5 \text{ V} \pm 0.5 \text{ V}$ |     | UNIT |
|-----------|-----------------|-------------|---|------|--|------|--|-----|--|-----|------|
|           |                 |             | MIN   | MAX  | MIN  | MAX  | MIN  | MAX | MIN                                      | MAX |      |
| $t_{PLH}$ | A               | B           | 1.5   | 21.4 | 1  | 8.8  | 0.7  | 6   | 0.4                                      | 4.2 | ns   |
| $t_{PHL}$ |                 |             |   |      |  |      |  |     |  |     |      |
| $t_{PLH}$ | B               | A           | 0.7   | 7    | 0.4  | 4.8  | 0.3  | 4.5 | 0.3                                      | 4.3 | ns   |
| $t_{PHL}$ |                 |             |   |      |  |      |  |     |  |     |      |
| $t_{PHZ}$ | $\overline{OE}$ | A           | 0.3   | 5.4  | 0.3  | 5.4  | 0.3  | 5.4 | 0.3                                      | 5.4 | ns   |
| $t_{PLZ}$ |                 |             |   |      |  |      |  |     |  |     |      |
| $t_{PHZ}$ | $\overline{OE}$ | B           | 2   | 28.7 | 1.8  | 9.7  | 1.4  | 8   | 0.7                                      | 5.7 | ns   |
| $t_{PLZ}$ |                 |             |   |      |  |      |  |     |  |     |      |
| $t_{PZH}$ | $\overline{OE}$ | A           | 0.7   | 6.4  | 0.7  | 6.4  | 0.7  | 6.4 | 0.7                                      | 6.4 | ns   |
| $t_{PZL}$ |                 |             |   |      |  |      |  |     |  |     |      |
| $t_{PZH}$ | $\overline{OE}$ | B           | 1.5   | 27.6 | 1.3  | 11.4 | 1  | 8.1 | 0.9                                      | 6   | ns   |
| $t_{PZL}$ |                 |             |   |      |  |      |  |     |  |     |      |

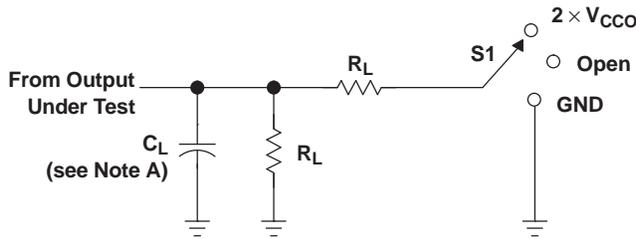
## Operating Characteristics

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

| PARAMETER     | TEST CONDITIONS             | $V_{CCA} = V_{CCB} = 1.8 \text{ V}$ | $V_{CCA} = V_{CCB} = 2.5 \text{ V}$ | $V_{CCA} = V_{CCB} = 3.3 \text{ V}$ | $V_{CCA} = V_{CCB} = 5 \text{ V}$ | UNIT |
|---------------|-----------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-----------------------------------|------|
|               |                             | TYP                                 | TYP                                 | TYP                                 | TYP                               |      |
| $C_{pdA}$ (1) | A-port input, B-port output | 2                                   | 2                                   | 2                                   | 3                                 | pF   |
|               | B-port input, A-port output | 18                                  | 19                                  | 19                                  | 22                                |      |
| $C_{pdB}$ (1) | A-port input, B-port output | 18                                  | 19                                  | 20                                  | 22                                |      |
|               | B-port input, A-port output | 2                                   | 2                                   | 2                                   | 2                                 |      |

(1) Power dissipation capacitance per transceiver

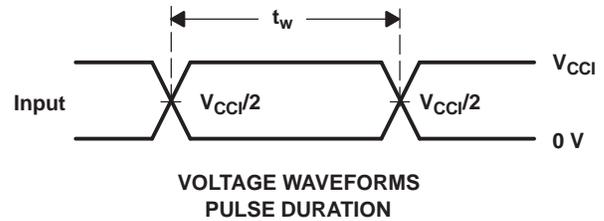
PARAMETER MEASUREMENT INFORMATION



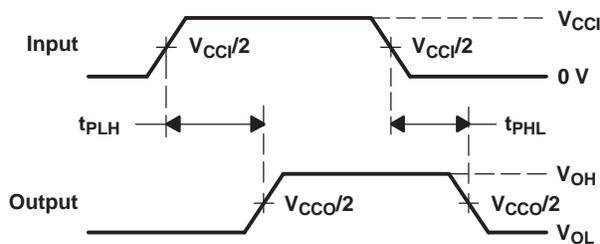
LOAD CIRCUIT

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

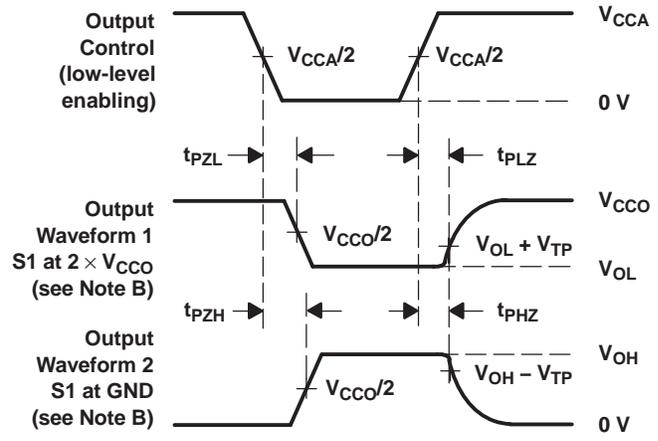
| $V_{CCO}$                        | $C_L$ | $R_L$        | $V_{TP}$ |
|----------------------------------|-------|--------------|----------|
| $1.8\text{ V} \pm 0.15\text{ V}$ | 15 pF | 2 k $\Omega$ | 0.15 V   |
| $2.5\text{ V} \pm 0.2\text{ V}$  | 15 pF | 2 k $\Omega$ | 0.15 V   |
| $3.3\text{ V} \pm 0.3\text{ V}$  | 15 pF | 2 k $\Omega$ | 0.3 V    |
| $5\text{ V} \pm 0.5\text{ V}$    | 15 pF | 2 k $\Omega$ | 0.3 V    |



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:  $PRR \leq 10\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $dv/dt \geq 1\text{ V/ns}$ ,  $dv/dt \geq 1\text{ V/ns}$ .
  - 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.
  - J. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

**PACKAGING INFORMATION**

| Orderable Device   | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|--------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| CLVCH16T245MDGGREP | ACTIVE        | TSSOP        | DGG             | 48   | 2000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | 8UT245MEP               | <a href="#">Samples</a> |
| CLVCH16T245MDGVREP | ACTIVE        | TVSOP        | DGV             | 48   | 2000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | LDHT245MEP              | <a href="#">Samples</a> |
| V62/09605-01XE     | ACTIVE        | TSSOP        | DGG             | 48   | 2000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | 8UT245MEP               | <a href="#">Samples</a> |
| V62/09605-01YE     | ACTIVE        | TVSOP        | DGV             | 48   | 2000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | LDHT245MEP              | <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) **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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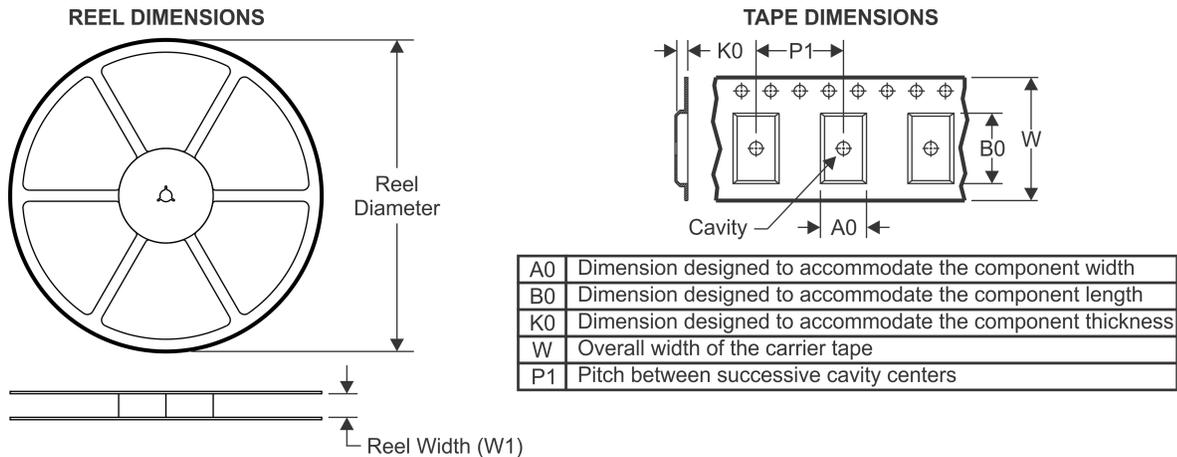
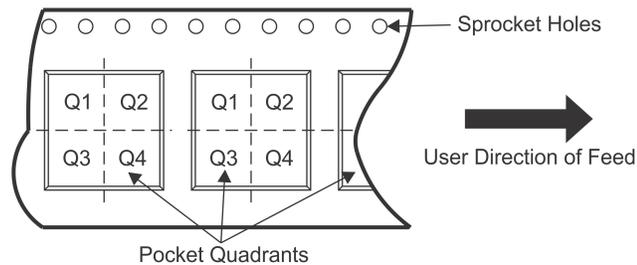
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**OTHER QUALIFIED VERSIONS OF SN74LVCH16T245-EP :**

- Catalog: [SN74LVCH16T245](#)

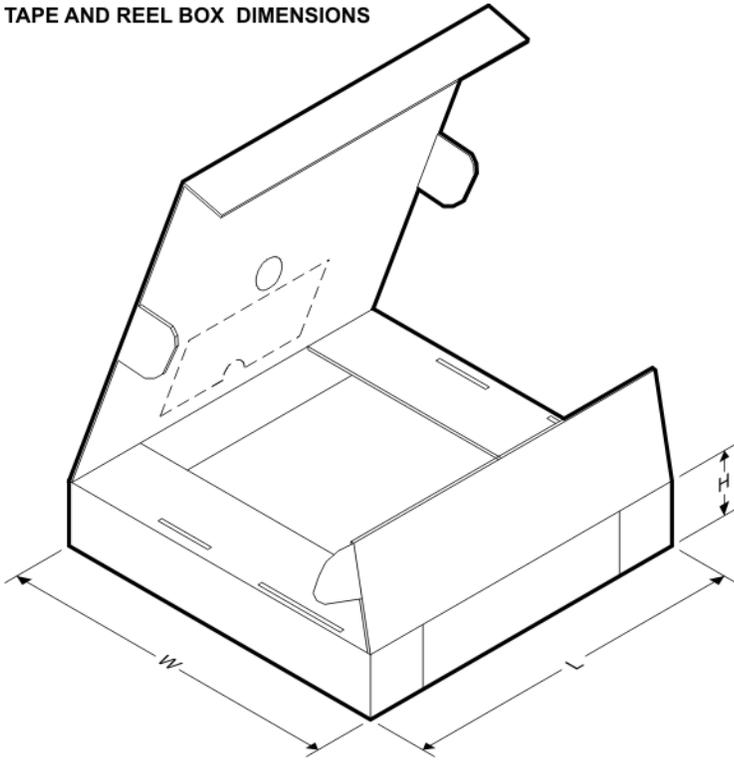
NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

**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 |
|--------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CLVCH16T245MDGGREP | TSSOP        | DGG             | 48   | 2000 | 330.0              | 24.4               | 8.6     | 13.0    | 1.8     | 12.0    | 24.0   | Q1            |
| CLVCH16T245MDGVREP | TVSOP        | DGV             | 48   | 2000 | 330.0              | 16.4               | 7.1     | 10.2    | 1.6     | 12.0    | 16.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

| Device             | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CLVCH16T245MDGGREP | TSSOP        | DGG             | 48   | 2000 | 367.0       | 367.0      | 45.0        |
| CLVCH16T245MDGVREP | TVSOP        | DGV             | 48   | 2000 | 853.0       | 449.0      | 35.0        |

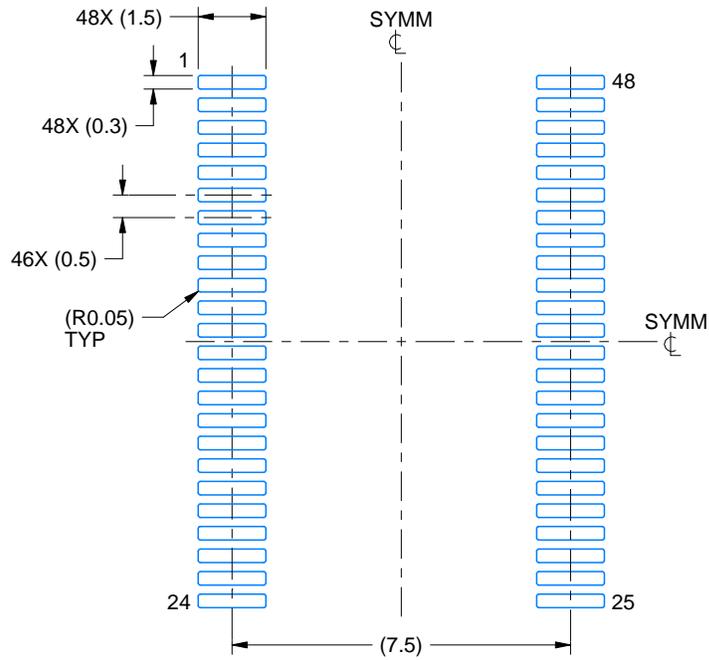


# EXAMPLE BOARD LAYOUT

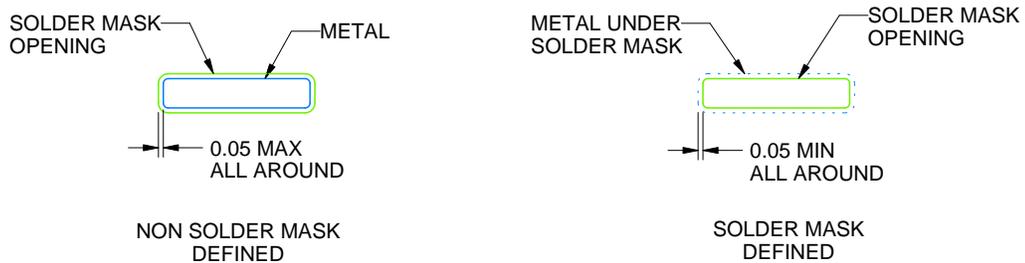
DGG0048A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
SCALE:6X



SOLDER MASK DETAILS

4214859/B 11/2020

NOTES: (continued)

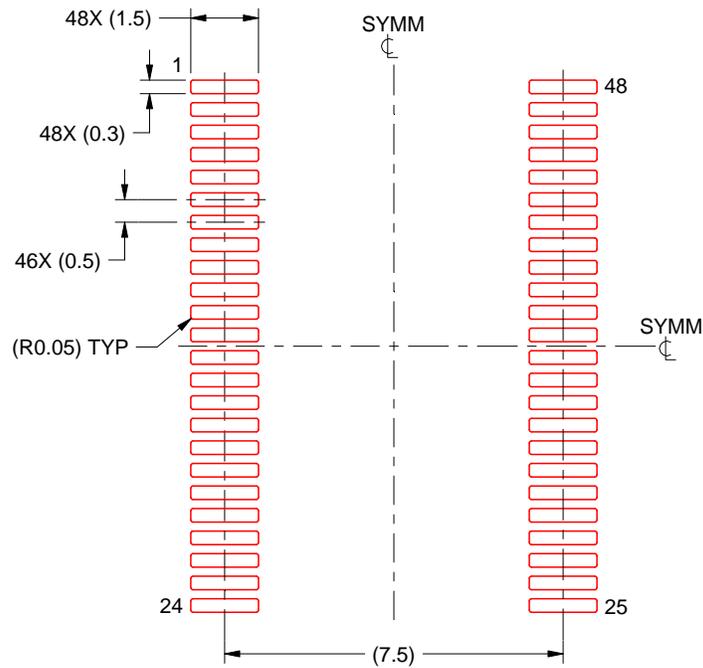
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DGG0048A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

4214859/B 11/2020

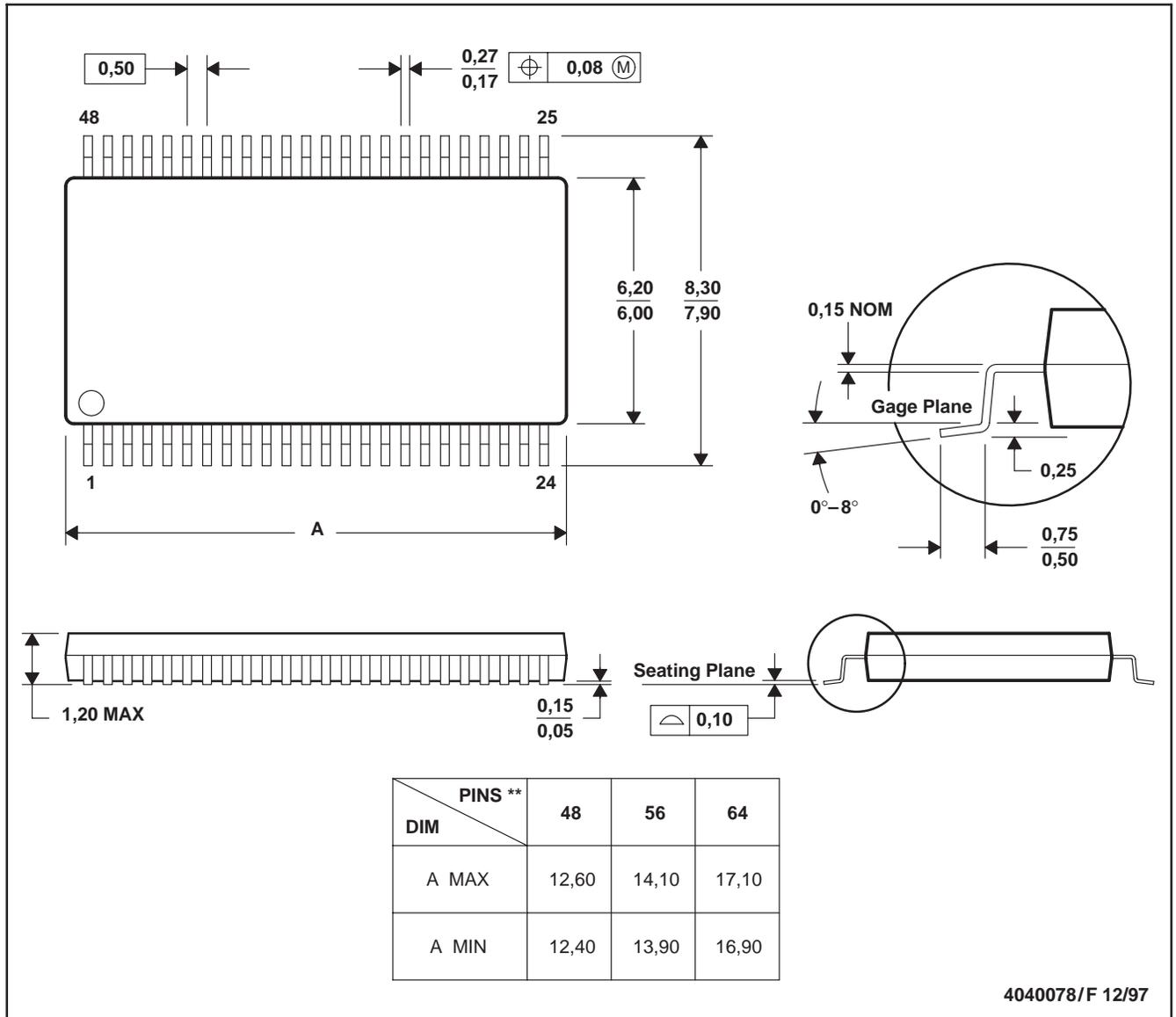
NOTES: (continued)

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

DGG (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

48 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 protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-153

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