

# SN74AXC1T45-Q1 Automotive Qualified Single-Bit Dual-Supply Bus Transceiver with Configurable Voltage Translation, Tri-State Outputs

## 1 Features

- AEC-Q100 Qualified for automotive applications
- Fully configurable dual-rail design allows each port to operate with a power supply range from 0.65 V to 3.6 V
- Operating temperature:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- Glitch-free power supply sequencing
- Maximum quiescent current ( $I_{\text{CCA}} + I_{\text{CCB}}$ ) of 10  $\mu\text{A}$  ( $85^{\circ}\text{C}$  maximum) and 16  $\mu\text{A}$  ( $125^{\circ}\text{C}$  maximum)
- Up to 500-Mbps support when translating from 1.8 to 3.3 V
- $V_{\text{CC}}$  isolation feature
  - If Either  $V_{\text{CC}}$  input is below 100 mV, all I/O outputs are disabled and become high-impedance
- $I_{\text{off}}$  supports partial-power-down mode operation
- Latch-up performance exceeds 100 mA per JESD 78, Class II
- ESD protection exceeds JESD 22
  - 8000-V Human body model
  - 1000-V Charged-device model

## 2 Applications

- ADAS fusion
- ADAS front camera
- HEV battery management system
- Infotainment head unit

## 3 Description

The SN74AXC1T45-Q1 is AEC-Q100 qualified single-bit non-inverting bus transceiver that uses two individually configurable power-supply rails. The device is operational with both  $V_{\text{CCA}}$  and  $V_{\text{CCB}}$  supplies as low as 0.65 V. The A port is designed to track  $V_{\text{CCA}}$ , which accepts any supply voltage from 0.65 V to 3.6 V. The B port is designed to track  $V_{\text{CCB}}$ , which also accepts any supply voltage from 0.65 V to 3.6 V. Additionally, the SN74AXC1T45-Q1 is compatible with a single-supply system.

The DIR pin determines the direction of signal propagation. With the DIR pin configured HIGH, translation is from Port A to Port B. With DIR configured LOW, translation is from Port B to Port A. The DIR pin is referenced to  $V_{\text{CCA}}$ , meaning that its logic-high and logic-low thresholds track with  $V_{\text{CCA}}$ .

This device is fully specified for partial-power-down applications using the  $I_{\text{off}}$  current. The  $I_{\text{off}}$  protection circuitry ensures that no excessive current is drawn from or to an input, output, or combined I/O that is biased to a specific voltage while the device is powered down.

The  $V_{\text{CC}}$  isolation feature ensures that if either  $V_{\text{CCA}}$  or  $V_{\text{CCB}}$  is less than 100 mV, both I/O ports enter a high-impedance state by disabling their outputs.

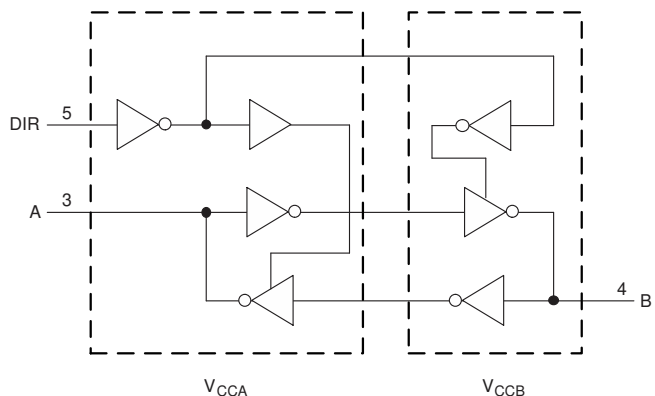
Glitch-free power supply sequencing allows either supply rail to be powered on or off in any order while providing robust power sequencing performance.

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

| PART NUMBER        | PACKAGE  | BODY SIZE (NOM)   |
|--------------------|----------|-------------------|
| SN74AXC1T45QDCKRQ1 | SC70 (6) | 2.00 mm × 1.25 mm |
| SN74AXC1T45QDRYRQ1 | SON (6)  | 1.40 mm × 1.00 mm |

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

### Functional Block Diagram



## Table of Contents

|                                                                 |           |                                                                  |           |
|-----------------------------------------------------------------|-----------|------------------------------------------------------------------|-----------|
| <b>1 Features</b> .....                                         | <b>1</b>  | 8.3 Feature Description .....                                    | 20        |
| <b>2 Applications</b> .....                                     | <b>1</b>  | 8.4 Device Functional Modes .....                                | 21        |
| <b>3 Description</b> .....                                      | <b>1</b>  | <b>9 Application and Implementation</b> .....                    | <b>22</b> |
| <b>4 Revision History</b> .....                                 | <b>2</b>  | 9.1 Application Information .....                                | 22        |
| <b>5 Pin Configuration and Functions</b> .....                  | <b>3</b>  | 9.2 Typical Applications .....                                   | 22        |
| <b>6 Specifications</b> .....                                   | <b>4</b>  | <b>10 Power Supply Recommendations</b> .....                     | <b>25</b> |
| 6.1 Absolute Maximum Ratings .....                              | 4         | <b>11 Layout</b> .....                                           | <b>25</b> |
| 6.2 ESD Ratings .....                                           | 4         | 11.1 Layout Guidelines .....                                     | 25        |
| 6.3 Recommended Operating Conditions .....                      | 5         | 11.2 Layout Example .....                                        | 25        |
| 6.4 Thermal Information .....                                   | 5         | <b>12 Device and Documentation Support</b> .....                 | <b>26</b> |
| 6.5 Electrical Characteristics .....                            | 6         | 12.1 Documentation Support .....                                 | 26        |
| 6.6 Operating Characteristics: $T_A = 25^{\circ}\text{C}$ ..... | 15        | 12.2 Receiving Notification of Documentation Updates .....       | 26        |
| 6.7 Typical Characteristics .....                               | 16        | 12.3 Support Resources .....                                     | 26        |
| <b>7 Parameter Measurement Information</b> .....                | <b>18</b> | 12.4 Trademarks .....                                            | 26        |
| 7.1 Load Circuit and Voltage Waveforms .....                    | 18        | 12.5 Electrostatic Discharge Caution .....                       | 26        |
| <b>8 Detailed Description</b> .....                             | <b>20</b> | 12.6 Glossary .....                                              | 26        |
| 8.1 Overview .....                                              | 20        | <b>13 Mechanical, Packaging, and Orderable Information</b> ..... | <b>26</b> |
| 8.2 Functional Block Diagram .....                              | 20        |                                                                  |           |

## 4 Revision History

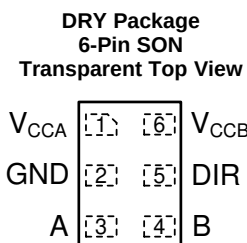
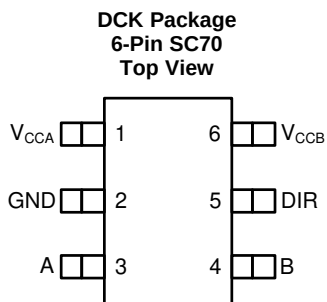
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| Changes from Revision B (September 2019) to Revision C                                                   | Page |
|----------------------------------------------------------------------------------------------------------|------|
| • Device with DRY package is now Active status .....                                                     | 3    |
| • Updated $I_{CCA}$ , $I_{CCB}$ , and $I_{CCA} + I_{CCB}$ to reflect updated performance of device ..... | 6    |

| Changes from Revision A (July 2019) to Revision B    | Page |
|------------------------------------------------------|------|
| • Device with DCK package is now Active status ..... | 3    |

| Changes from Original (February 2019) to Revision A                    | Page |
|------------------------------------------------------------------------|------|
| • Added DRY package to Device Information table .....                  | 1    |
| • Added DRY package to Pin Configurations .....                        | 3    |
| • Added DRY package to <a href="#">Thermal Information</a> table ..... | 5    |

## 5 Pin Configuration and Functions



### Pin Functions

| PIN |                  | TYPE | DESCRIPTION                                                                             |
|-----|------------------|------|-----------------------------------------------------------------------------------------|
| NO. | NAME             |      |                                                                                         |
| 1   | V <sub>CCA</sub> | —    | A-port supply voltage. 0.65V ≤ V <sub>CCA</sub> ≤ 3.6 V                                 |
| 2   | GND              | —    | Ground                                                                                  |
| 3   | A                | I/O  | Input/output A. This pin is referenced to V <sub>CCA</sub> .                            |
| 4   | B                | I/O  | Input/output B. This pin is referenced to V <sub>CCB</sub> .                            |
| 5   | DIR              | I    | Direction control signal. See <a href="#">Device Functional Modes</a> for functionality |
| 6   | V <sub>CCB</sub> | —    | B-port supply voltage. 0.65V ≤ V <sub>CCB</sub> ≤ 3.6 V.                                |

## 6 Specifications

### 6.1 Absolute Maximum Ratings

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

|                  |                                                                                       |                    | MIN  | MAX                    | UNIT |
|------------------|---------------------------------------------------------------------------------------|--------------------|------|------------------------|------|
| V <sub>CCA</sub> | Supply voltage A                                                                      |                    | –0.5 | 4.2                    | V    |
| V <sub>CCB</sub> | Supply voltage B                                                                      |                    | –0.5 | 4.2                    | V    |
| V <sub>I</sub>   | Input Voltage <sup>(2)</sup>                                                          | I/O Ports (A Port) | –0.5 | 4.2                    | V    |
|                  |                                                                                       | I/O Ports (B Port) | –0.5 | 4.2                    |      |
|                  |                                                                                       | Control Inputs     | –0.5 | 4.2                    |      |
| V <sub>O</sub>   | Voltage applied to any output in the high-impedance or power-off state <sup>(2)</sup> | A Port             | –0.5 | 4.2                    | V    |
|                  |                                                                                       | B Port             | –0.5 | 4.2                    |      |
| V <sub>O</sub>   | Voltage applied to any output in the high or low state <sup>(2) (3)</sup>             | A Port             | –0.5 | V <sub>CCA</sub> + 0.2 | V    |
|                  |                                                                                       | B Port             | –0.5 | V <sub>CCB</sub> + 0.2 |      |
| I <sub>IK</sub>  | Input clamp current                                                                   | V <sub>I</sub> < 0 | –50  |                        | mA   |
| I <sub>OK</sub>  | Output clamp current                                                                  | V <sub>O</sub> < 0 | –50  |                        | mA   |
| I <sub>O</sub>   | Continuous output current                                                             |                    | –50  | 50                     | mA   |
|                  | Continuous current through V <sub>CC</sub> or GND                                     |                    | –100 | 100                    | mA   |
| T <sub>J</sub>   | Junction Temperature                                                                  |                    |      | 150                    | °C   |
| T <sub>STG</sub> | Storage temperature                                                                   |                    | –65  | 150                    | °C   |

- (1) Stresses beyond those listed under [Absolute Maximum Ratings](#) may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under [Recommended Operating Conditions](#). Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) The input voltage and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) The output positive-voltage rating may be exceeded up to 4.2 V maximum if the output current rating is observed.

### 6.2 ESD Ratings

|                    |                         |                                                         | VALUE | UNIT |
|--------------------|-------------------------|---------------------------------------------------------|-------|------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human body model (HBM), per AEC Q100-002 <sup>(1)</sup> | ±8000 | V    |
|                    |                         | Charged device model (CDM), per AEC Q100-011            | ±1000 |      |

- (1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

### 6.3 Recommended Operating Conditions

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

|                  |                                |                                                       |                                    | MIN                     | MAX | UNIT |
|------------------|--------------------------------|-------------------------------------------------------|------------------------------------|-------------------------|-----|------|
| V <sub>CCA</sub> | Supply voltage A               |                                                       |                                    | 0.65                    | 3.6 | V    |
| V <sub>CCB</sub> | Supply voltage B               |                                                       |                                    | 0.65                    | 3.6 | V    |
| V <sub>IH</sub>  | High-level input voltage       | Data Inputs                                           | V <sub>CCI</sub> = 0.65 V - 0.75 V | V <sub>CCI</sub> × 0.70 | V   |      |
|                  |                                |                                                       | V <sub>CCI</sub> = 0.76 V - 1 V    | V <sub>CCI</sub> × 0.70 |     |      |
|                  |                                |                                                       | V <sub>CCI</sub> = 1.1 V - 1.95 V  | V <sub>CCI</sub> × 0.65 |     |      |
|                  |                                |                                                       | V <sub>CCI</sub> = 2.3 V - 2.7 V   | 1.6                     |     |      |
|                  |                                |                                                       | V <sub>CCI</sub> = 3 V - 3.6 V     | 2                       |     |      |
|                  |                                | Control Input (DIR)<br>Referenced to V <sub>CCA</sub> | V <sub>CCA</sub> = 0.65 V - 0.75 V | V <sub>CCA</sub> × 0.70 |     |      |
|                  |                                |                                                       | V <sub>CCA</sub> = 0.76 V - 1 V    | V <sub>CCA</sub> × 0.70 |     |      |
|                  |                                |                                                       | V <sub>CCA</sub> = 1.1 V - 1.95 V  | V <sub>CCA</sub> × 0.65 |     |      |
|                  |                                |                                                       | V <sub>CCA</sub> = 2.3 V - 2.7 V   | 1.6                     |     |      |
|                  |                                |                                                       | V <sub>CCA</sub> = 3 V - 3.6 V     | 2                       |     |      |
| V <sub>IL</sub>  | Low-level input voltage        | Data Inputs                                           | V <sub>CCI</sub> = 0.65 V - 0.75 V | V <sub>CCI</sub> × 0.30 | V   |      |
|                  |                                |                                                       | V <sub>CCI</sub> = 0.76 V - 1 V    | V <sub>CCI</sub> × 0.30 |     |      |
|                  |                                |                                                       | V <sub>CCI</sub> = 1.1 V - 1.95 V  | V <sub>CCI</sub> × 0.35 |     |      |
|                  |                                |                                                       | V <sub>CCI</sub> = 2.3 V - 2.7 V   | 0.7                     |     |      |
|                  |                                |                                                       | V <sub>CCI</sub> = 3 V - 3.6 V     | 0.8                     |     |      |
|                  |                                | Control Input (DIR)<br>Referenced to V <sub>CCA</sub> | V <sub>CCA</sub> = 0.65 V - 0.75 V | V <sub>CCA</sub> × 0.30 |     |      |
|                  |                                |                                                       | V <sub>CCA</sub> = 0.76 V - 1 V    | V <sub>CCA</sub> × 0.30 |     |      |
|                  |                                |                                                       | V <sub>CCA</sub> = 1.1 V - 1.95 V  | V <sub>CCA</sub> × 0.35 |     |      |
|                  |                                |                                                       | V <sub>CCA</sub> = 2.3 V - 2.7 V   | 0.7                     |     |      |
|                  |                                |                                                       | V <sub>CCA</sub> = 3 V - 3.6 V     | 0.8                     |     |      |
| V <sub>I</sub>   | Input voltage <sup>(3)</sup>   |                                                       |                                    | 0                       | 3.6 | V    |
| V <sub>O</sub>   | Output voltage                 | Active State                                          | 0                                  | V <sub>CCO</sub>        | V   |      |
|                  |                                | Tri-State                                             | 0                                  | 3.6                     |     |      |
| Δt/Δv            | Input transition rate          |                                                       |                                    |                         | 100 | ns/V |
| T <sub>A</sub>   | Operating free-air temperature |                                                       |                                    | −40                     | 125 | °C   |

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

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

(3) All unused inputs of the device must be held at VCC or GND to ensure proper device operation. Refer to the TI application report, [Implications of Slow or Floating CMOS Inputs](#).

### 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                              | SN74AXC1T45-Q1 |           | UNIT |
|-------------------------------|----------------------------------------------|----------------|-----------|------|
|                               |                                              | DCK (SC70)     | DRY (SON) |      |
|                               |                                              | 6 PINS         | 6 PINS    |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance       | 235.3          | 305.2     | °C/W |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance    | 160.5          | 202.2     | °C/W |
| R <sub>θJB</sub>              | Junction-to-board thermal resistance         | 76.9           | 181.1     | °C/W |
| ψ <sub>JT</sub>               | Junction-to-top characterization parameter   | 59.7           | 41.9      | °C/W |
| ψ <sub>JB</sub>               | Junction-to-board characterization parameter | 77.1           | 180.0     | °C/W |

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

## 6.5 Electrical Characteristics

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

| PARAMETER                           |                                 | TEST CONDITIONS                                               |                           | V <sub>CCA</sub> | V <sub>CCB</sub> | Operating free-air temperature (T <sub>A</sub> ) |                    |     |                        |     |     | UNIT |
|-------------------------------------|---------------------------------|---------------------------------------------------------------|---------------------------|------------------|------------------|--------------------------------------------------|--------------------|-----|------------------------|-----|-----|------|
|                                     |                                 |                                                               |                           |                  |                  | -40°C to 85°C                                    |                    |     | -40°C to 125°C         |     |     |      |
|                                     |                                 |                                                               |                           |                  |                  | MIN                                              | TYP <sup>(3)</sup> | MAX | MIN                    | TYP | MAX |      |
| V <sub>OH</sub>                     | High-level output voltage       | V <sub>I</sub> = V <sub>IH</sub>                              | I <sub>OH</sub> = -100 μA | 0.7 V - 3.6 V    | 0.7 V - 3.6 V    | V <sub>CCO</sub> – 0.1                           |                    |     | V <sub>CCO</sub> – 0.1 |     |     | V    |
|                                     |                                 |                                                               | I <sub>OH</sub> = -50 μA  | 0.65 V           | 0.65 V           | 0.55                                             |                    |     | 0.55                   |     |     |      |
|                                     |                                 |                                                               | I <sub>OH</sub> = -200 μA | 0.76 V           | 0.76 V           | 0.58                                             |                    |     | 0.58                   |     |     |      |
|                                     |                                 |                                                               | I <sub>OH</sub> = -500 μA | 0.85 V           | 0.85 V           | 0.65                                             |                    |     | 0.65                   |     |     |      |
|                                     |                                 |                                                               | I <sub>OH</sub> = -3 mA   | 1.1 V            | 1.1 V            | 0.85                                             |                    |     | 0.85                   |     |     |      |
|                                     |                                 |                                                               | I <sub>OH</sub> = -6 mA   | 1.4 V            | 1.4 V            | 1.05                                             |                    |     | 1.05                   |     |     |      |
|                                     |                                 |                                                               | I <sub>OH</sub> = -8 mA   | 1.65 V           | 1.65 V           | 1.2                                              |                    |     | 1.2                    |     |     |      |
|                                     |                                 |                                                               | I <sub>OH</sub> = -9 mA   | 2.3 V            | 2.3 V            | 1.75                                             |                    |     | 1.75                   |     |     |      |
|                                     |                                 |                                                               | I <sub>OH</sub> = -12 mA  | 3 V              | 3 V              | 2.3                                              |                    |     | 2.3                    |     |     |      |
| V <sub>OL</sub>                     | Low-level output voltage        | V <sub>I</sub> = V <sub>IL</sub>                              | I <sub>OL</sub> = 100 μA  | 0.7 V - 3.6 V    | 0.7 V - 3.6 V    | 0.1                                              |                    |     | 0.1                    |     |     | V    |
|                                     |                                 |                                                               | I <sub>OL</sub> = 50 μA   | 0.65 V           | 0.65 V           | 0.1                                              |                    |     | 0.1                    |     |     |      |
|                                     |                                 |                                                               | I <sub>OL</sub> = 200 μA  | 0.76 V           | 0.76 V           | 0.18                                             |                    |     | 0.18                   |     |     |      |
|                                     |                                 |                                                               | I <sub>OL</sub> = 500 μA  | 0.85 V           | 0.85 V           | 0.2                                              |                    |     | 0.2                    |     |     |      |
|                                     |                                 |                                                               | I <sub>OL</sub> = 3 mA    | 1.1 V            | 1.1 V            | 0.25                                             |                    |     | 0.25                   |     |     |      |
|                                     |                                 |                                                               | I <sub>OL</sub> = 6 mA    | 1.4 V            | 1.4 V            | 0.35                                             |                    |     | 0.35                   |     |     |      |
|                                     |                                 |                                                               | I <sub>OL</sub> = 8 mA    | 1.65 V           | 1.65 V           | 0.45                                             |                    |     | 0.45                   |     |     |      |
|                                     |                                 |                                                               | I <sub>OL</sub> = 9 mA    | 2.3 V            | 2.3 V            | 0.55                                             |                    |     | 0.55                   |     |     |      |
|                                     |                                 |                                                               | I <sub>OL</sub> = 12 mA   | 3 V              | 3 V              | 0.7                                              |                    |     | 0.7                    |     |     |      |
| I <sub>I</sub>                      | Input leakage current           | Control input (DIR): V <sub>I</sub> = V <sub>CCA</sub> or GND |                           | 0.65 V- 3.6 V    | 0.65 V- 3.6 V    | –1                                               |                    | 1   | –1.5                   |     | 1.5 | μA   |
|                                     |                                 | A or B Port: V <sub>i</sub> = V <sub>CCI</sub> or GND         |                           | 0.65 V- 3.6 V    | 0.65 V- 3.6 V    | –4                                               |                    | 4   | –8                     |     | 8   |      |
| I <sub>off</sub>                    | Partial power down current      | A or B Port: V <sub>i</sub> or V <sub>o</sub> = 0 V - 3.6 V   |                           | 0 V              | 0 V - 3.6 V      | –5                                               |                    | 5   | –7.5                   |     | 7.5 | μA   |
|                                     |                                 |                                                               |                           | 0 V - 3.6 V      | 0 V              | –5                                               |                    | 5   | –7.5                   |     | 7.5 |      |
| I <sub>CCA</sub>                    | V <sub>CCA</sub> supply current | V <sub>I</sub> = V <sub>CCI</sub> or GND                      | I <sub>o</sub> = 0        | 0.65 V- 3.6 V    | 0.65 V- 3.6 V    | 8                                                |                    | 12  |                        |     |     | μA   |
|                                     |                                 |                                                               |                           | 0 V              | 3.6 V            | –2                                               |                    | –8  |                        |     |     |      |
|                                     |                                 |                                                               |                           | 3.6 V            | 0 V              | 2                                                |                    | 8   |                        |     |     |      |
| I <sub>CCB</sub>                    | V <sub>CCB</sub> supply current | V <sub>I</sub> = V <sub>CCI</sub> or GND                      | I <sub>o</sub> = 0        | 0.65 V- 3.6 V    | 0.65 V- 3.6 V    | 8                                                |                    | 12  |                        |     |     | μA   |
|                                     |                                 |                                                               |                           | 0 V              | 3.6 V            | 2                                                |                    | 8   |                        |     |     |      |
|                                     |                                 |                                                               |                           | 3.6 V            | 0 V              | –2                                               |                    | –8  |                        |     |     |      |
| I <sub>CCA</sub> + I <sub>CCB</sub> | Combined supply current         | V <sub>I</sub> = V <sub>CCI</sub> or GND                      | I <sub>o</sub> = 0        | 0.65 V- 3.6 V    | 0.65 V- 3.6 V    | 10                                               |                    | 16  |                        |     |     | μA   |
| C <sub>I</sub>                      | Control input capacitance       | V <sub>I</sub> = 3.3 V or GND                                 |                           | 3.3 V            | 3.3 V            | 4.5                                              |                    | 4.5 |                        |     |     | pF   |
| C <sub>IO</sub>                     | Data I/O capacitance, A Port    | V <sub>O</sub> = 1.65V DC +1 MHz -16 dBm sine wave            |                           | 3.3 V            | 0 V              | 5                                                |                    | 5   |                        |     |     | pF   |
| C <sub>IO</sub>                     | Data I/O capacitance, B Port    | V <sub>O</sub> = 1.65V DC +1 MHz -16 dBm sine wave            |                           | 0 V              | 3.3 V            | 5                                                |                    | 5   |                        |     |     | pF   |

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

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

(3) All typical data is taken at 25°C.

**Table 1. Switching Characteristics,  $V_{CCA} = 0.7\text{ V}$** 

| PARAMETER                  | FROM | TO | Test Conditions | B-Port Supply Voltage (V <sub>CCB</sub> ) |     |              |     |               |     |             |     |             |     |              |     |             |     |             |     | UNIT |
|----------------------------|------|----|-----------------|-------------------------------------------|-----|--------------|-----|---------------|-----|-------------|-----|-------------|-----|--------------|-----|-------------|-----|-------------|-----|------|
|                            |      |    |                 | 0.7 ± 0.05 V                              |     | 0.8 ± 0.04 V |     | 0.9 ± 0.045 V |     | 1.2 ± 0.1 V |     | 1.5 ± 0.1 V |     | 1.8 ± 0.15 V |     | 2.5 ± 0.2 V |     | 3.3 ± 0.3 V |     |      |
|                            |      |    |                 | MIN                                       | MAX | MIN          | MAX | MIN           | MAX | MIN         | MAX | MIN         | MAX | MIN          | MAX | MIN         | MAX | MIN         | MAX |      |
| $t_{pd}$ Propagation delay | A    | B  | -40°C to 85°C   | 0.5                                       | 173 | 0.5          | 117 | 0.5           | 85  | 0.5         | 51  | 0.5         | 50  | 0.5          | 53  | 0.5         | 65  | 0.5         | 143 | ns   |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 173 | 0.5          | 117 | 0.5           | 85  | 0.5         | 51  | 0.5         | 50  | 0.5          | 53  | 0.5         | 65  | 0.5         | 143 |      |
|                            | B    | A  | -40°C to 85°C   | 0.5                                       | 173 | 0.5          | 154 | 0.5           | 127 | 0.5         | 88  | 0.5         | 83  | 0.5          | 82  | 0.5         | 80  | 0.5         | 80  |      |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 173 | 0.5          | 154 | 0.5           | 127 | 0.5         | 88  | 0.5         | 83  | 0.5          | 82  | 0.5         | 80  | 0.5         | 80  |      |
| $t_{dis}$ Disable time     | DIR  | A  | -40°C to 85°C   | 0.5                                       | 143 | 0.5          | 143 | 0.5           | 143 | 0.5         | 143 | 0.5         | 143 | 0.5          | 143 | 0.5         | 143 | 0.5         | 143 | ns   |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 143 | 0.5          | 143 | 0.5           | 143 | 0.5         | 143 | 0.5         | 143 | 0.5          | 143 | 0.5         | 143 | 0.5         | 143 |      |
|                            | DIR  | B  | -40°C to 85°C   | 0.5                                       | 163 | 0.5          | 123 | 0.5           | 100 | 0.5         | 50  | 0.5         | 45  | 0.5          | 49  | 0.5         | 61  | 0.5         | 109 |      |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 163 | 0.5          | 123 | 0.5           | 100 | 0.5         | 50  | 0.5         | 45  | 0.5          | 49  | 0.5         | 61  | 0.5         | 109 |      |
| $t_{en}$ Enable time       | DIR  | A  | -40°C to 85°C   | 0.5                                       | 389 | 0.5          | 331 | 0.5           | 287 | 0.5         | 143 | 0.5         | 134 | 0.5          | 137 | 0.5         | 147 | 0.5         | 200 | ns   |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 406 | 0.5          | 333 | 0.5           | 287 | 0.5         | 143 | 0.5         | 134 | 0.5          | 137 | 0.5         | 147 | 0.5         | 200 |      |
|                            | DIR  | B  | -40°C to 85°C   | 0.5                                       | 369 | 0.5          | 313 | 0.5           | 281 | 0.5         | 247 | 0.5         | 246 | 0.5          | 249 | 0.5         | 261 | 0.5         | 339 |      |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 395 | 0.5          | 339 | 0.5           | 307 | 0.5         | 273 | 0.5         | 272 | 0.5          | 275 | 0.5         | 287 | 0.5         | 365 |      |

**Table 2. Switching Characteristics,  $V_{CCA} = 0.8\text{ V}$** 

| PARAMETER                         | FROM | TO | Test Conditions | B-Port Supply Voltage (V <sub>CCB</sub> ) |     |              |     |               |     |             |     |             |     |              |     |             |     |             |     | UNIT |
|-----------------------------------|------|----|-----------------|-------------------------------------------|-----|--------------|-----|---------------|-----|-------------|-----|-------------|-----|--------------|-----|-------------|-----|-------------|-----|------|
|                                   |      |    |                 | 0.7 ± 0.05 V                              |     | 0.8 ± 0.04 V |     | 0.9 ± 0.045 V |     | 1.2 ± 0.1 V |     | 1.5 ± 0.1 V |     | 1.8 ± 0.15 V |     | 2.5 ± 0.2 V |     | 3.3 ± 0.3 V |     |      |
|                                   |      |    |                 | MIN                                       | MAX | MIN          | MAX | MIN           | MAX | MIN         | MAX | MIN         | MAX | MIN          | MAX | MIN         | MAX | MIN         | MAX |      |
| t <sub>pd</sub> Propagation delay | A    | B  | -40°C to 85°C   | 0.5                                       | 153 | 0.5          | 95  | 0.5           | 64  | 0.5         | 33  | 0.5         | 27  | 0.5          | 26  | 0.5         | 27  | 0.5         | 36  | ns   |
|                                   |      |    | -40°C to 125°C  | 0.5                                       | 153 | 0.5          | 95  | 0.5           | 64  | 0.5         | 33  | 0.5         | 27  | 0.5          | 26  | 0.5         | 27  | 0.5         | 36  |      |
|                                   | B    | A  | -40°C to 85°C   | 0.5                                       | 117 | 0.5          | 96  | 0.5           | 78  | 0.5         | 52  | 0.5         | 42  | 0.5          | 41  | 0.5         | 40  | 0.5         | 39  |      |
|                                   |      |    | -40°C to 125°C  | 0.5                                       | 117 | 0.5          | 96  | 0.5           | 78  | 0.5         | 52  | 0.5         | 42  | 0.5          | 41  | 0.5         | 40  | 0.5         | 39  |      |
| t <sub>dis</sub> Disable time     | DIR  | A  | -40°C to 85°C   | 0.5                                       | 100 | 0.5          | 100 | 0.5           | 100 | 0.5         | 100 | 0.5         | 100 | 0.5          | 100 | 0.5         | 100 | 0.5         | 100 | ns   |
|                                   |      |    | -40°C to 125°C  | 0.5                                       | 100 | 0.5          | 100 | 0.5           | 100 | 0.5         | 100 | 0.5         | 100 | 0.5          | 100 | 0.5         | 100 | 0.5         | 100 |      |
|                                   | DIR  | B  | -40°C to 85°C   | 0.5                                       | 151 | 0.5          | 111 | 0.5           | 88  | 0.5         | 38  | 0.5         | 32  | 0.5          | 30  | 0.5         | 30  | 0.5         | 38  |      |
|                                   |      |    | -40°C to 125°C  | 0.5                                       | 151 | 0.5          | 111 | 0.5           | 88  | 0.5         | 38  | 0.5         | 32  | 0.5          | 30  | 0.5         | 30  | 0.5         | 38  |      |
| t <sub>en</sub> Enable time       | DIR  | A  | -40°C to 85°C   | 0.5                                       | 321 | 0.5          | 261 | 0.5           | 226 | 0.5         | 96  | 0.5         | 80  | 0.5          | 78  | 0.5         | 76  | 0.5         | 87  | ns   |
|                                   |      |    | -40°C to 125°C  | 0.5                                       | 341 | 0.5          | 266 | 0.5           | 229 | 0.5         | 97  | 0.5         | 80  | 0.5          | 78  | 0.5         | 76  | 0.5         | 87  |      |
|                                   | DIR  | B  | -40°C to 85°C   | 0.5                                       | 309 | 0.5          | 251 | 0.5           | 220 | 0.5         | 189 | 0.5         | 183 | 0.5          | 182 | 0.5         | 183 | 0.5         | 192 |      |
|                                   |      |    | -40°C to 125°C  | 0.5                                       | 317 | 0.5          | 259 | 0.5           | 228 | 0.5         | 197 | 0.5         | 191 | 0.5          | 190 | 0.5         | 191 | 0.5         | 200 |      |



**Table 3. Switching Characteristics,  $V_{CCA} = 0.9\text{ V}$** 

| PARAMETER                  | FROM | TO | Test Conditions | B-Port Supply Voltage (V <sub>CCB</sub> ) |     |              |     |               |     |             |     |             |     |              |     |             |     |             |     | UNIT |
|----------------------------|------|----|-----------------|-------------------------------------------|-----|--------------|-----|---------------|-----|-------------|-----|-------------|-----|--------------|-----|-------------|-----|-------------|-----|------|
|                            |      |    |                 | 0.7 ± 0.05 V                              |     | 0.8 ± 0.04 V |     | 0.9 ± 0.045 V |     | 1.2 ± 0.1 V |     | 1.5 ± 0.1 V |     | 1.8 ± 0.15 V |     | 2.5 ± 0.2 V |     | 3.3 ± 0.3 V |     |      |
|                            |      |    |                 | MIN                                       | MAX | MIN          | MAX | MIN           | MAX | MIN         | MAX | MIN         | MAX | MIN          | MAX | MIN         | MAX | MIN         | MAX |      |
| $t_{pd}$ Propagation delay | A    | B  | -40°C to 85°C   | 0.5                                       | 126 | 0.5          | 78  | 0.5           | 52  | 0.5         | 23  | 0.5         | 18  | 0.5          | 16  | 0.5         | 15  | 0.5         | 18  | ns   |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 126 | 0.5          | 78  | 0.5           | 52  | 0.5         | 23  | 0.5         | 18  | 0.5          | 16  | 0.5         | 15  | 0.5         | 18  |      |
|                            | B    | A  | -40°C to 85°C   | 0.5                                       | 85  | 0.5          | 64  | 0.5           | 53  | 0.5         | 40  | 0.5         | 28  | 0.5          | 24  | 0.5         | 22  | 0.5         | 21  |      |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 85  | 0.5          | 64  | 0.5           | 53  | 0.5         | 40  | 0.5         | 28  | 0.5          | 24  | 0.5         | 22  | 0.5         | 21  |      |
| $t_{dis}$ Disable time     | DIR  | A  | -40°C to 85°C   | 0.5                                       | 75  | 0.5          | 75  | 0.5           | 75  | 0.5         | 75  | 0.5         | 75  | 0.5          | 75  | 0.5         | 75  | 0.5         | 75  | ns   |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 79  | 0.5          | 79  | 0.5           | 79  | 0.5         | 79  | 0.5         | 79  | 0.5          | 79  | 0.5         | 79  | 0.5         | 79  |      |
|                            | DIR  | B  | -40°C to 85°C   | 0.5                                       | 144 | 0.5          | 105 | 0.5           | 82  | 0.5         | 32  | 0.5         | 25  | 0.5          | 24  | 0.5         | 21  | 0.5         | 23  |      |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 144 | 0.5          | 105 | 0.5           | 83  | 0.5         | 36  | 0.5         | 28  | 0.5          | 26  | 0.5         | 21  | 0.5         | 23  |      |
| $t_{en}$ Enable time       | DIR  | A  | -40°C to 85°C   | 0.5                                       | 282 | 0.5          | 223 | 0.5           | 195 | 0.5         | 77  | 0.5         | 59  | 0.5          | 54  | 0.5         | 48  | 0.5         | 54  | ns   |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 304 | 0.5          | 229 | 0.5           | 199 | 0.5         | 81  | 0.5         | 62  | 0.5          | 56  | 0.5         | 49  | 0.5         | 54  |      |
|                            | DIR  | B  | -40°C to 85°C   | 0.5                                       | 262 | 0.5          | 214 | 0.5           | 188 | 0.5         | 159 | 0.5         | 154 | 0.5          | 152 | 0.5         | 151 | 0.5         | 154 |      |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 269 | 0.5          | 221 | 0.5           | 195 | 0.5         | 166 | 0.5         | 161 | 0.5          | 159 | 0.5         | 158 | 0.5         | 161 |      |

**Table 4. Switching Characteristics,  $V_{CCA} = 1.2\text{ V}$** 

| PARAMETER                         | FROM | TO | Test Conditions | B-Port Supply Voltage (V <sub>CCB</sub> ) |     |              |     |               |     |             |     |             |     |              |     |             |     |             |     | UNIT |
|-----------------------------------|------|----|-----------------|-------------------------------------------|-----|--------------|-----|---------------|-----|-------------|-----|-------------|-----|--------------|-----|-------------|-----|-------------|-----|------|
|                                   |      |    |                 | 0.7 ± 0.05 V                              |     | 0.8 ± 0.04 V |     | 0.9 ± 0.045 V |     | 1.2 ± 0.1 V |     | 1.5 ± 0.1 V |     | 1.8 ± 0.15 V |     | 2.5 ± 0.2 V |     | 3.3 ± 0.3 V |     |      |
|                                   |      |    |                 | MIN                                       | MAX | MIN          | MAX | MIN           | MAX | MIN         | MAX | MIN         | MAX | MIN          | MAX | MIN         | MAX | MIN         | MAX |      |
| t <sub>pd</sub> Propagation delay | A    | B  | -40°C to 85°C   | 0.5                                       | 87  | 0.5          | 52  | 0.5           | 39  | 0.5         | 15  | 0.5         | 9   | 0.5          | 8   | 0.5         | 7   | 0.5         | 7   | ns   |
|                                   |      |    | -40°C to 125°C  | 0.5                                       | 87  | 0.5          | 52  | 0.5           | 39  | 0.5         | 15  | 0.5         | 10  | 0.5          | 9   | 0.5         | 7   | 0.5         | 8   |      |
|                                   | B    | A  | -40°C to 85°C   | 0.5                                       | 51  | 0.5          | 33  | 0.5           | 23  | 0.5         | 15  | 0.5         | 12  | 0.5          | 10  | 0.5         | 7   | 0.5         | 7   |      |
|                                   |      |    | -40°C to 125°C  | 0.5                                       | 51  | 0.5          | 33  | 0.5           | 23  | 0.5         | 15  | 0.5         | 12  | 0.5          | 10  | 0.5         | 8   | 0.5         | 7   |      |
| t <sub>dis</sub> Disable time     | DIR  | A  | -40°C to 85°C   | 0.5                                       | 22  | 0.5          | 22  | 0.5           | 22  | 0.5         | 22  | 0.5         | 22  | 0.5          | 22  | 0.5         | 22  | 0.5         | 22  | ns   |
|                                   |      |    | -40°C to 125°C  | 0.5                                       | 29  | 0.5          | 29  | 0.5           | 29  | 0.5         | 29  | 0.5         | 29  | 0.5          | 29  | 0.5         | 29  | 0.5         | 29  |      |
|                                   | DIR  | B  | -40°C to 85°C   | 0.5                                       | 137 | 0.5          | 98  | 0.5           | 74  | 0.5         | 24  | 0.5         | 18  | 0.5          | 16  | 0.5         | 13  | 0.5         | 13  |      |
|                                   |      |    | -40°C to 125°C  | 0.5                                       | 137 | 0.5          | 98  | 0.5           | 78  | 0.5         | 30  | 0.5         | 23  | 0.5          | 21  | 0.5         | 17  | 0.5         | 16  |      |
| t <sub>en</sub> Enable time       | DIR  | A  | -40°C to 85°C   | 0.5                                       | 240 | 0.5          | 185 | 0.5           | 157 | 0.5         | 45  | 0.5         | 36  | 0.5          | 33  | 0.5         | 26  | 0.5         | 29  | ns   |
|                                   |      |    | -40°C to 125°C  | 0.5                                       | 265 | 0.5          | 193 | 0.5           | 164 | 0.5         | 51  | 0.5         | 41  | 0.5          | 37  | 0.5         | 30  | 0.5         | 32  |      |
|                                   | DIR  | B  | -40°C to 85°C   | 0.5                                       | 115 | 0.5          | 80  | 0.5           | 67  | 0.5         | 43  | 0.5         | 37  | 0.5          | 36  | 0.5         | 35  | 0.5         | 35  |      |
|                                   |      |    | -40°C to 125°C  | 0.5                                       | 121 | 0.5          | 86  | 0.5           | 73  | 0.5         | 49  | 0.5         | 44  | 0.5          | 43  | 0.5         | 41  | 0.5         | 42  |      |

**Table 5. Switching Characteristics,  $V_{CCA} = 1.5\text{ V}$** 

| PARAMETER                  | FROM | TO | Test Conditions | B-Port Supply Voltage (V <sub>CCB</sub> ) |     |              |     |               |     |             |     |             |     |              |     |             |     |             |     | UNIT |
|----------------------------|------|----|-----------------|-------------------------------------------|-----|--------------|-----|---------------|-----|-------------|-----|-------------|-----|--------------|-----|-------------|-----|-------------|-----|------|
|                            |      |    |                 | 0.7 ± 0.05 V                              |     | 0.8 ± 0.04 V |     | 0.9 ± 0.045 V |     | 1.2 ± 0.1 V |     | 1.5 ± 0.1 V |     | 1.8 ± 0.15 V |     | 2.5 ± 0.2 V |     | 3.3 ± 0.3 V |     |      |
|                            |      |    |                 | MIN                                       | MAX | MIN          | MAX | MIN           | MAX | MIN         | MAX | MIN         | MAX | MIN          | MAX | MIN         | MAX | MIN         | MAX |      |
| $t_{pd}$ Propagation delay | A    | B  | -40°C to 85°C   | 0.5                                       | 83  | 0.5          | 42  | 0.5           | 28  | 0.5         | 12  | 0.5         | 8   | 0.5          | 7   | 0.5         | 5   | 0.5         | 5   | ns   |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 83  | 0.5          | 42  | 0.5           | 28  | 0.5         | 12  | 0.5         | 9   | 0.5          | 8   | 0.5         | 6   | 0.5         | 6   |      |
|                            | B    | A  | -40°C to 85°C   | 0.5                                       | 50  | 0.5          | 28  | 0.5           | 18  | 0.5         | 10  | 0.5         | 8   | 0.5          | 7   | 0.5         | 5   | 0.5         | 4   |      |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 50  | 0.5          | 28  | 0.5           | 18  | 0.5         | 10  | 0.5         | 9   | 0.5          | 8   | 0.5         | 6   | 0.5         | 5   |      |
| $t_{dis}$ Disable time     | DIR  | A  | -40°C to 85°C   | 0.5                                       | 15  | 0.5          | 15  | 0.5           | 15  | 0.5         | 15  | 0.5         | 15  | 0.5          | 15  | 0.5         | 15  | 0.5         | 15  | ns   |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 20  | 0.5          | 20  | 0.5           | 20  | 0.5         | 20  | 0.5         | 20  | 0.5          | 20  | 0.5         | 20  | 0.5         | 20  |      |
|                            | DIR  | B  | -40°C to 85°C   | 0.5                                       | 136 | 0.5          | 96  | 0.5           | 72  | 0.5         | 22  | 0.5         | 16  | 0.5          | 14  | 0.5         | 11  | 0.5         | 11  |      |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 136 | 0.5          | 96  | 0.5           | 76  | 0.5         | 29  | 0.5         | 21  | 0.5          | 19  | 0.5         | 15  | 0.5         | 14  |      |
| $t_{en}$ Enable time       | DIR  | A  | -40°C to 85°C   | 0.5                                       | 238 | 0.5          | 178 | 0.5           | 151 | 0.5         | 38  | 0.5         | 30  | 0.5          | 28  | 0.5         | 22  | 0.5         | 24  | ns   |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 263 | 0.5          | 186 | 0.5           | 157 | 0.5         | 44  | 0.5         | 36  | 0.5          | 33  | 0.5         | 26  | 0.5         | 27  |      |
|                            | DIR  | B  | -40°C to 85°C   | 0.5                                       | 104 | 0.5          | 63  | 0.5           | 49  | 0.5         | 33  | 0.5         | 29  | 0.5          | 28  | 0.5         | 26  | 0.5         | 26  |      |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 109 | 0.5          | 68  | 0.5           | 54  | 0.5         | 38  | 0.5         | 35  | 0.5          | 34  | 0.5         | 32  | 0.5         | 32  |      |

**Table 6. Switching Characteristics,  $V_{CCA} = 1.8\text{ V}$** 

| PARAMETER                  | FROM | TO | Test Conditions | B-Port Supply Voltage (V <sub>CCB</sub> ) |     |              |     |               |     |             |     |             |     |              |     |             |     |             |     | UNIT |
|----------------------------|------|----|-----------------|-------------------------------------------|-----|--------------|-----|---------------|-----|-------------|-----|-------------|-----|--------------|-----|-------------|-----|-------------|-----|------|
|                            |      |    |                 | 0.7 ± 0.05 V                              |     | 0.8 ± 0.04 V |     | 0.9 ± 0.045 V |     | 1.2 ± 0.1 V |     | 1.5 ± 0.1 V |     | 1.8 ± 0.15 V |     | 2.5 ± 0.2 V |     | 3.3 ± 0.3 V |     |      |
|                            |      |    |                 | MIN                                       | MAX | MIN          | MAX | MIN           | MAX | MIN         | MAX | MIN         | MAX | MIN          | MAX | MIN         | MAX | MIN         | MAX |      |
| $t_{pd}$ Propagation delay | A    | B  | -40°C to 85°C   | 0.5                                       | 81  | 0.5          | 41  | 0.5           | 24  | 0.5         | 10  | 0.5         | 7   | 0.5          | 6   | 0.5         | 5   | 0.5         | 4   | ns   |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 81  | 0.5          | 41  | 0.5           | 24  | 0.5         | 10  | 0.5         | 8   | 0.5          | 7   | 0.5         | 5   | 0.5         | 5   |      |
|                            | B    | A  | -40°C to 85°C   | 0.5                                       | 53  | 0.5          | 26  | 0.5           | 16  | 0.5         | 8   | 0.5         | 7   | 0.5          | 6   | 0.5         | 5   | 0.5         | 4   |      |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 53  | 0.5          | 26  | 0.5           | 16  | 0.5         | 9   | 0.5         | 7   | 0.5          | 7   | 0.5         | 5   | 0.5         | 4   |      |
| $t_{dis}$ Disable time     | DIR  | A  | -40°C to 85°C   | 0.5                                       | 13  | 0.5          | 13  | 0.5           | 13  | 0.5         | 13  | 0.5         | 13  | 0.5          | 13  | 0.5         | 13  | 0.5         | 13  | ns   |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 18  | 0.5          | 18  | 0.5           | 18  | 0.5         | 18  | 0.5         | 18  | 0.5          | 18  | 0.5         | 18  | 0.5         | 18  |      |
|                            | DIR  | B  | -40°C to 85°C   | 0.5                                       | 136 | 0.5          | 96  | 0.5           | 72  | 0.5         | 22  | 0.5         | 15  | 0.5          | 14  | 0.5         | 11  | 0.5         | 11  |      |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 136 | 0.5          | 96  | 0.5           | 75  | 0.5         | 28  | 0.5         | 20  | 0.5          | 18  | 0.5         | 14  | 0.5         | 13  |      |
| $t_{en}$ Enable time       | DIR  | A  | -40°C to 85°C   | 0.5                                       | 241 | 0.5          | 176 | 0.5           | 148 | 0.5         | 35  | 0.5         | 28  | 0.5          | 26  | 0.5         | 21  | 0.5         | 24  | ns   |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 266 | 0.5          | 184 | 0.5           | 155 | 0.5         | 42  | 0.5         | 33  | 0.5          | 32  | 0.5         | 24  | 0.5         | 26  |      |
|                            | DIR  | B  | -40°C to 85°C   | 0.5                                       | 101 | 0.5          | 61  | 0.5           | 44  | 0.5         | 30  | 0.5         | 27  | 0.5          | 26  | 0.5         | 25  | 0.5         | 24  |      |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 105 | 0.5          | 65  | 0.5           | 48  | 0.5         | 34  | 0.5         | 32  | 0.5          | 31  | 0.5         | 29  | 0.5         | 29  |      |

**Table 7. Switching Characteristics,  $V_{CCA} = 2.5\text{ V}$** 

| PARAMETER                  | FROM | TO | Test Conditions | B-Port Supply Voltage (V <sub>CCB</sub> ) |     |              |     |               |     |             |     |             |     |              |     |             |     |             |     | UNIT |
|----------------------------|------|----|-----------------|-------------------------------------------|-----|--------------|-----|---------------|-----|-------------|-----|-------------|-----|--------------|-----|-------------|-----|-------------|-----|------|
|                            |      |    |                 | 0.7 ± 0.05 V                              |     | 0.8 ± 0.04 V |     | 0.9 ± 0.045 V |     | 1.2 ± 0.1 V |     | 1.5 ± 0.1 V |     | 1.8 ± 0.15 V |     | 2.5 ± 0.2 V |     | 3.3 ± 0.3 V |     |      |
|                            |      |    |                 | MIN                                       | MAX | MIN          | MAX | MIN           | MAX | MIN         | MAX | MIN         | MAX | MIN          | MAX | MIN         | MAX | MIN         | MAX |      |
| $t_{pd}$ Propagation delay | A    | B  | -40°C to 85°C   | 0.5                                       | 80  | 0.5          | 40  | 0.5           | 22  | 0.5         | 7   | 0.5         | 5   | 0.5          | 5   | 0.5         | 4   | 0.5         | 4   | ns   |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 80  | 0.5          | 40  | 0.5           | 22  | 0.5         | 8   | 0.5         | 6   | 0.5          | 5   | 0.5         | 5   | 0.5         | 4   |      |
|                            | B    | A  | -40°C to 85°C   | 0.5                                       | 66  | 0.5          | 27  | 0.5           | 15  | 0.5         | 7   | 0.5         | 5   | 0.5          | 5   | 0.5         | 4   | 0.5         | 3   |      |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 66  | 0.5          | 27  | 0.5           | 15  | 0.5         | 7   | 0.5         | 6   | 0.5          | 5   | 0.5         | 5   | 0.5         | 4   |      |
| $t_{dis}$ Disable time     | DIR  | A  | -40°C to 85°C   | 0.5                                       | 10  | 0.5          | 10  | 0.5           | 10  | 0.5         | 10  | 0.5         | 10  | 0.5          | 10  | 0.5         | 10  | 0.5         | 10  | ns   |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 13  | 0.5          | 13  | 0.5           | 13  | 0.5         | 13  | 0.5         | 13  | 0.5          | 13  | 0.5         | 13  | 0.5         | 13  |      |
|                            | DIR  | B  | -40°C to 85°C   | 0.5                                       | 136 | 0.5          | 95  | 0.5           | 71  | 0.5         | 21  | 0.5         | 14  | 0.5          | 13  | 0.5         | 10  | 0.5         | 10  |      |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 136 | 0.5          | 95  | 0.5           | 75  | 0.5         | 27  | 0.5         | 20  | 0.5          | 17  | 0.5         | 13  | 0.5         | 12  |      |
| $t_{en}$ Enable time       | DIR  | A  | -40°C to 85°C   | 0.5                                       | 254 | 0.5          | 176 | 0.5           | 147 | 0.5         | 33  | 0.5         | 25  | 0.5          | 24  | 0.5         | 19  | 0.5         | 22  | ns   |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 278 | 0.5          | 185 | 0.5           | 153 | 0.5         | 39  | 0.5         | 31  | 0.5          | 29  | 0.5         | 23  | 0.5         | 25  |      |
|                            | DIR  | B  | -40°C to 85°C   | 0.5                                       | 99  | 0.5          | 55  | 0.5           | 41  | 0.5         | 22  | 0.5         | 24  | 0.5          | 20  | 0.5         | 23  | 0.5         | 19  |      |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 98  | 0.5          | 58  | 0.5           | 40  | 0.5         | 26  | 0.5         | 24  | 0.5          | 23  | 0.5         | 23  | 0.5         | 22  |      |

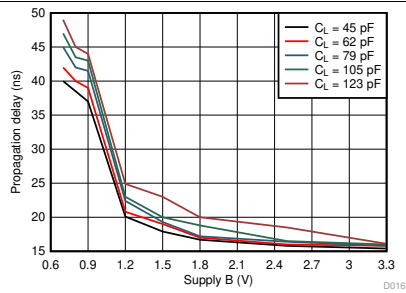
**Table 8. Switching Characteristics,  $V_{CCA} = 3.3\text{ V}$** 

| PARAMETER                  | FROM | TO | Test Conditions | B-Port Supply Voltage (V <sub>CCB</sub> ) |     |              |     |               |     |             |     |             |     |              |     |             |     |             |     | UNIT |
|----------------------------|------|----|-----------------|-------------------------------------------|-----|--------------|-----|---------------|-----|-------------|-----|-------------|-----|--------------|-----|-------------|-----|-------------|-----|------|
|                            |      |    |                 | 0.7 ± 0.05 V                              |     | 0.8 ± 0.04 V |     | 0.9 ± 0.045 V |     | 1.2 ± 0.1 V |     | 1.5 ± 0.1 V |     | 1.8 ± 0.15 V |     | 2.5 ± 0.2 V |     | 3.3 ± 0.3 V |     |      |
|                            |      |    |                 | MIN                                       | MAX | MIN          | MAX | MIN           | MAX | MIN         | MAX | MIN         | MAX | MIN          | MAX | MIN         | MAX | MIN         | MAX |      |
| $t_{pd}$ Propagation delay | A    | B  | -40°C to 85°C   | 0.5                                       | 79  | 0.5          | 39  | 0.5           | 22  | 0.5         | 7   | 0.5         | 4   | 0.5          | 4   | 0.5         | 3   | 0.5         | 3   | ns   |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 79  | 0.5          | 39  | 0.5           | 22  | 0.5         | 7   | 0.5         | 5   | 0.5          | 4   | 0.5         | 4   | 0.5         | 4   |      |
|                            | B    | A  | -40°C to 85°C   | 0.5                                       | 144 | 0.5          | 36  | 0.5           | 18  | 0.5         | 7   | 0.5         | 5   | 0.5          | 4   | 0.5         | 4   | 0.5         | 3   |      |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 144 | 0.5          | 36  | 0.5           | 18  | 0.5         | 8   | 0.5         | 6   | 0.5          | 5   | 0.5         | 4   | 0.5         | 4   |      |
| $t_{dis}$ Disable time     | DIR  | A  | -40°C to 85°C   | 0.5                                       | 9   | 0.5          | 9   | 0.5           | 9   | 0.5         | 9   | 0.5         | 9   | 0.5          | 9   | 0.5         | 9   | 0.5         | 9   | ns   |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 12  | 0.5          | 12  | 0.5           | 12  | 0.5         | 12  | 0.5         | 12  | 0.5          | 12  | 0.5         | 12  | 0.5         | 12  |      |
|                            | DIR  | B  | -40°C to 85°C   | 0.5                                       | 136 | 0.5          | 95  | 0.5           | 71  | 0.5         | 21  | 0.5         | 14  | 0.5          | 12  | 0.5         | 10  | 0.5         | 10  |      |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 136 | 0.5          | 95  | 0.5           | 75  | 0.5         | 27  | 0.5         | 19  | 0.5          | 17  | 0.5         | 13  | 0.5         | 12  |      |
| $t_{en}$ Enable time       | DIR  | A  | -40°C to 85°C   | 0.5                                       | 331 | 0.5          | 185 | 0.5           | 149 | 0.5         | 33  | 0.5         | 25  | 0.5          | 23  | 0.5         | 19  | 0.5         | 22  | ns   |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 356 | 0.5          | 93  | 0.5           | 156 | 0.5         | 40  | 0.5         | 31  | 0.5          | 29  | 0.5         | 22  | 0.5         | 24  |      |
|                            | DIR  | B  | -40°C to 85°C   | 0.5                                       | 98  | 0.5          | 58  | 0.5           | 41  | 0.5         | 26  | 0.5         | 23  | 0.5          | 23  | 0.5         | 22  | 0.5         | 22  |      |
|                            |      |    | -40°C to 125°C  | 0.5                                       | 99  | 0.5          | 59  | 0.5           | 42  | 0.5         | 27  | 0.5         | 25  | 0.5          | 24  | 0.5         | 24  | 0.5         | 24  |      |

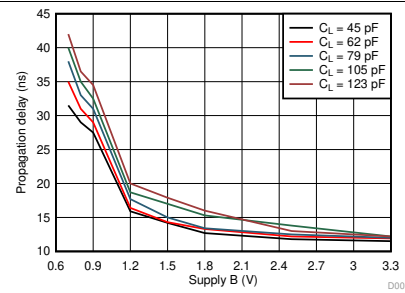
## 6.6 Operating Characteristics: $T_A = 25^\circ\text{C}$

| PARAMETER |                                                        | TEST CONDITIONS                                                 | $V_{CCA}$ | $V_{CCB}$ | MIN | TYP  | MAX | UNIT |
|-----------|--------------------------------------------------------|-----------------------------------------------------------------|-----------|-----------|-----|------|-----|------|
| $C_{pdA}$ | Power Dissipation Capacitance per transceiver (A to B) | $C_L = 0$ , $R_L = \text{Open}$ $f = 1$ MHz, $t_r = t_f = 1$ ns | 0.7 V     | 0.7 V     |     | 1.3  |     | pF   |
|           |                                                        |                                                                 | 0.8 V     | 0.8 V     |     | 1.3  |     |      |
|           |                                                        |                                                                 | 0.9 V     | 0.9 V     |     | 1.3  |     |      |
|           |                                                        |                                                                 | 1.2 V     | 1.2 V     |     | 1.3  |     |      |
|           |                                                        |                                                                 | 1.5 V     | 1.5 V     |     | 1.3  |     |      |
|           |                                                        |                                                                 | 1.8 V     | 1.8 V     |     | 1.4  |     |      |
|           |                                                        |                                                                 | 2.5 V     | 2.5 V     |     | 1.7  |     |      |
|           |                                                        |                                                                 | 3.3 V     | 3.3 V     |     | 2.1  |     |      |
|           | Power Dissipation Capacitance per transceiver (B to A) | $C_L = 0$ , $R_L = \text{Open}$ $f = 1$ MHz, $t_r = t_f = 1$ ns | 0.7 V     | 0.7 V     |     | 9.2  |     | pF   |
|           |                                                        |                                                                 | 0.8 V     | 0.8 V     |     | 9.4  |     |      |
|           |                                                        |                                                                 | 0.9 V     | 0.9 V     |     | 9.4  |     |      |
|           |                                                        |                                                                 | 1.2 V     | 1.2 V     |     | 9.8  |     |      |
|           |                                                        |                                                                 | 1.5 V     | 1.5 V     |     | 10.1 |     |      |
|           |                                                        |                                                                 | 1.8 V     | 1.8 V     |     | 11.0 |     |      |
|           |                                                        |                                                                 | 2.5 V     | 2.5 V     |     | 14.4 |     |      |
|           |                                                        |                                                                 | 3.3 V     | 3.3 V     |     | 18.6 |     |      |
| $C_{pdB}$ | Power Dissipation Capacitance per transceiver (A to B) | $C_L = 0$ , $R_L = \text{Open}$ $f = 1$ MHz, $t_r = t_f = 1$ ns | 0.7 V     | 0.7 V     |     | 9.2  |     | pF   |
|           |                                                        |                                                                 | 0.8 V     | 0.8 V     |     | 9.3  |     |      |
|           |                                                        |                                                                 | 0.9 V     | 0.9 V     |     | 9.4  |     |      |
|           |                                                        |                                                                 | 1.2 V     | 1.2 V     |     | 9.7  |     |      |
|           |                                                        |                                                                 | 1.5 V     | 1.5 V     |     | 10.1 |     |      |
|           |                                                        |                                                                 | 1.8 V     | 1.8 V     |     | 11.0 |     |      |
|           |                                                        |                                                                 | 2.5 V     | 2.5 V     |     | 14.4 |     |      |
|           |                                                        |                                                                 | 3.3 V     | 3.3 V     |     | 18.3 |     |      |
|           | Power Dissipation Capacitance per transceiver (B to A) | $C_L = 0$ , $R_L = \text{Open}$ $f = 1$ MHz, $t_r = t_f = 1$ ns | 0.7 V     | 0.7 V     |     | 1.3  |     | pF   |
|           |                                                        |                                                                 | 0.8 V     | 0.8 V     |     | 1.3  |     |      |
|           |                                                        |                                                                 | 0.9 V     | 0.9 V     |     | 1.3  |     |      |
|           |                                                        |                                                                 | 1.2 V     | 1.2 V     |     | 1.3  |     |      |
|           |                                                        |                                                                 | 1.5 V     | 1.5 V     |     | 1.3  |     |      |
|           |                                                        |                                                                 | 1.8 V     | 1.8 V     |     | 1.4  |     |      |
|           |                                                        |                                                                 | 2.5 V     | 2.5 V     |     | 1.7  |     |      |
|           |                                                        |                                                                 | 3.3 V     | 3.3 V     |     | 2.1  |     |      |

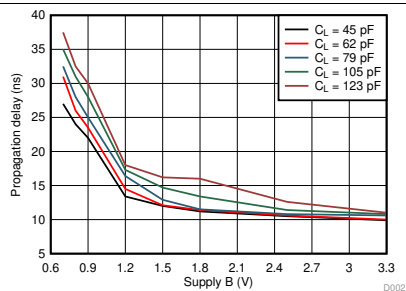
## 6.7 Typical Characteristics


 $T_A = 25^\circ\text{C}$     $V_{CCA} = 0.7\text{ V}$ 

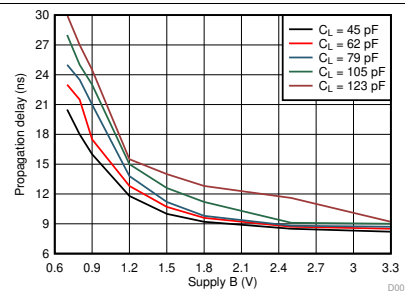
**Figure 1. Typical Propagation Delay of Low-to-High (A to B) vs Load Capacitance**


 $T_A = 25^\circ\text{C}$     $V_{CCA} = 0.8\text{ V}$ 

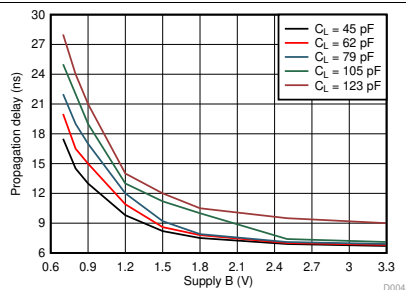
**Figure 2. Typical Propagation Delay of Low-to-High (A to B) vs Load Capacitance**


 $T_A = 25^\circ\text{C}$     $V_{CCA} = 0.9\text{ V}$ 

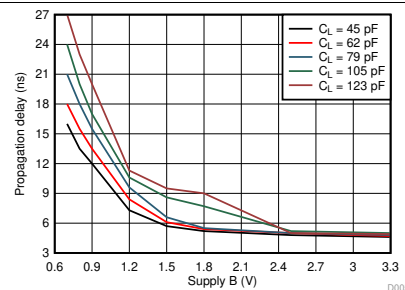
**Figure 3. Typical Propagation Delay of Low-to-High (A to B) vs Load Capacitance**


 $T_A = 25^\circ\text{C}$     $V_{CCA} = 1.2\text{ V}$ 

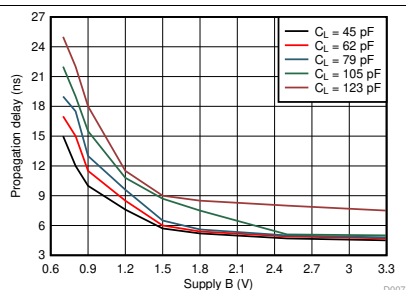
**Figure 4. Typical Propagation Delay of Low-to-High (A to B) vs Load Capacitance**


 $T_A = 25^\circ\text{C}$     $V_{CCA} = 1.5\text{ V}$ 

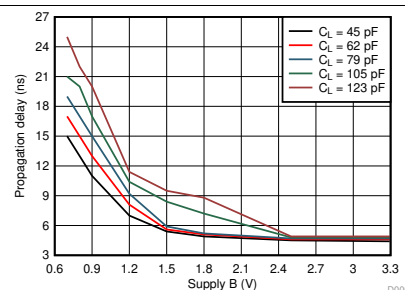
**Figure 5. Typical Propagation Delay of Low-to-High (A to B) vs Load Capacitance**


 $T_A = 25^\circ\text{C}$     $V_{CCA} = 1.8\text{ V}$ 

**Figure 6. Typical Propagation Delay of Low-to-High (A to B) vs Load Capacitance**


 $T_A = 25^\circ\text{C}$     $V_{CCA} = 3.3\text{ V}$ 

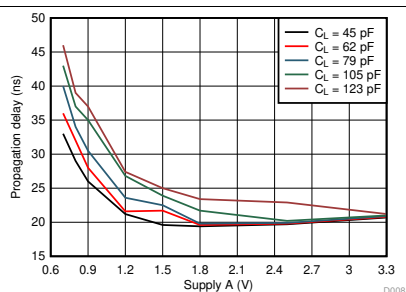
**Figure 7. Typical Propagation Delay of Low-to-High (A to B) vs Load Capacitance**


 $T_A = 25^\circ\text{C}$     $V_{CCA} = 2.5\text{ V}$ 

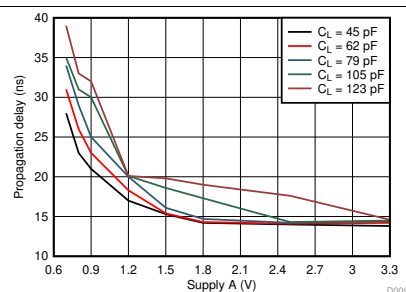
**Figure 8. Typical Propagation Delay of Low-to-High (A to B) vs Load Capacitance**



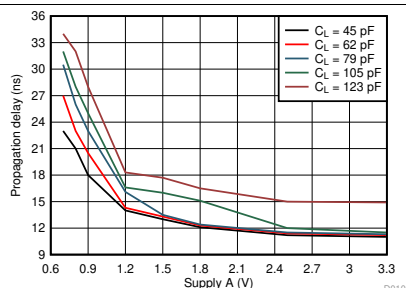
## Typical Characteristics (continued)


 $T_A = 25^\circ\text{C}$      $V_{CCA} = 0.7\text{ V}$ 

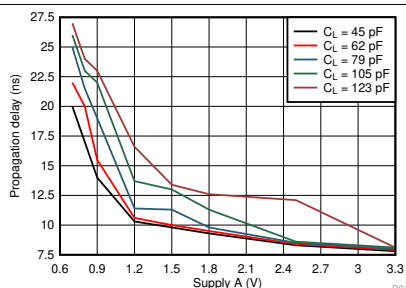
**Figure 9. Typical Propagation Delay of Low-to-High (B to A) vs Load Capacitance**


 $T_A = 25^\circ\text{C}$      $V_{CCA} = 0.8\text{ V}$ 

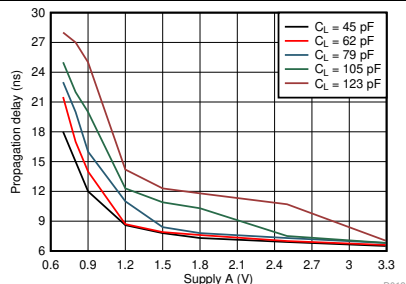
**Figure 10. Typical Propagation Delay of Low-to-High (B to A) vs Load Capacitance**


 $T_A = 25^\circ\text{C}$      $V_{CCA} = 0.9\text{ V}$ 

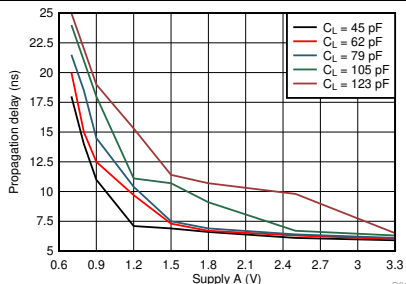
**Figure 11. Typical Propagation Delay of Low-to-High (B to A) vs Load Capacitance**


 $T_A = 25^\circ\text{C}$      $V_{CCA} = 1.2\text{ V}$ 

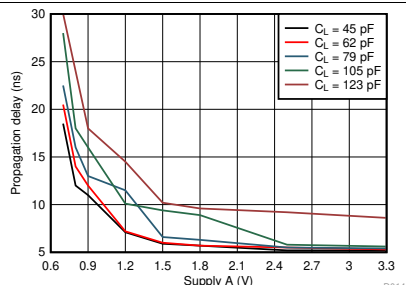
**Figure 12. Typical Propagation Delay of Low-to-High (B to A) vs Load Capacitance**


 $T_A = 25^\circ\text{C}$      $V_{CCA} = 1.5\text{ V}$ 

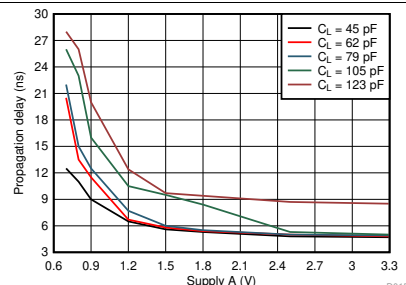
**Figure 13. Typical Propagation Delay of Low-to-High (B to A) vs Load Capacitance**


 $T_A = 25^\circ\text{C}$      $V_{CCA} = 1.8\text{ V}$ 

**Figure 14. Typical Propagation Delay of Low-to-High (B to A) vs Load Capacitance**


 $T_A = 25^\circ\text{C}$      $V_{CCA} = 2.5\text{ V}$ 

**Figure 15. Typical Propagation Delay of Low-to-High (B to A) vs Load Capacitance**


 $T_A = 25^\circ\text{C}$      $V_{CCA} = 3.3\text{ V}$ 

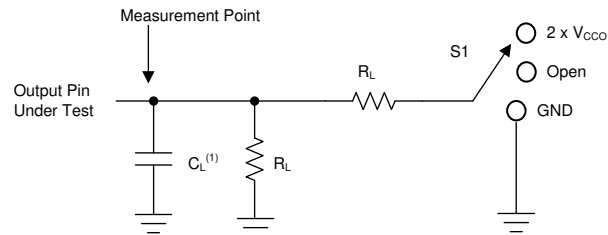
**Figure 16. Typical Propagation Delay of Low-to-High (B to A) vs Load Capacitance**

## 7 Parameter Measurement Information

### 7.1 Load Circuit and Voltage Waveforms

Unless otherwise noted, all input pulses are supplied by generators having the following characteristics:

- $f = 1 \text{ MHz}$
- $Z_O = 50 \Omega$
- $dv/dt \leq 1 \text{ ns/V}$

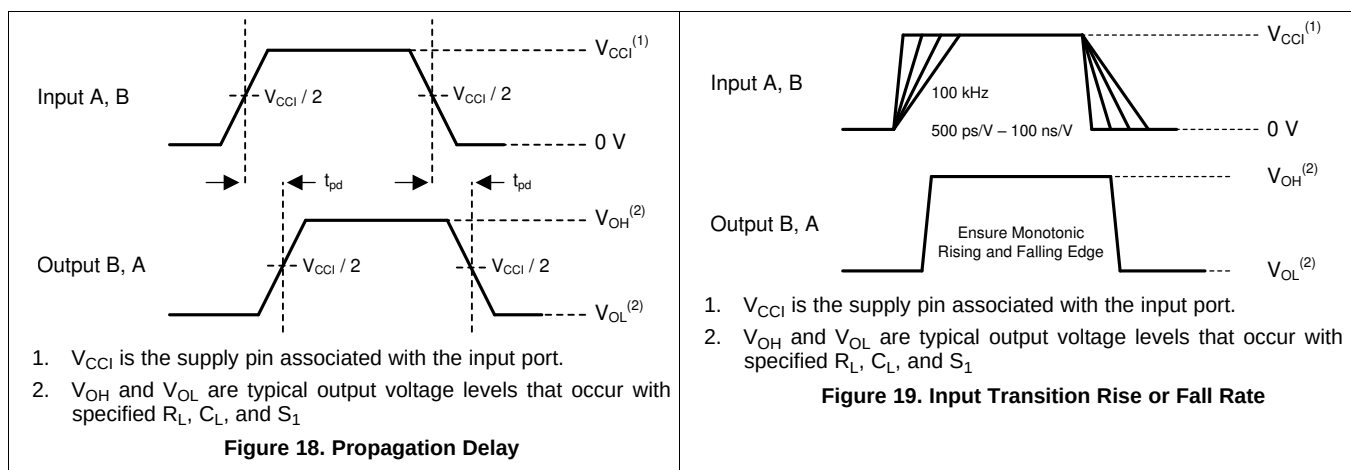


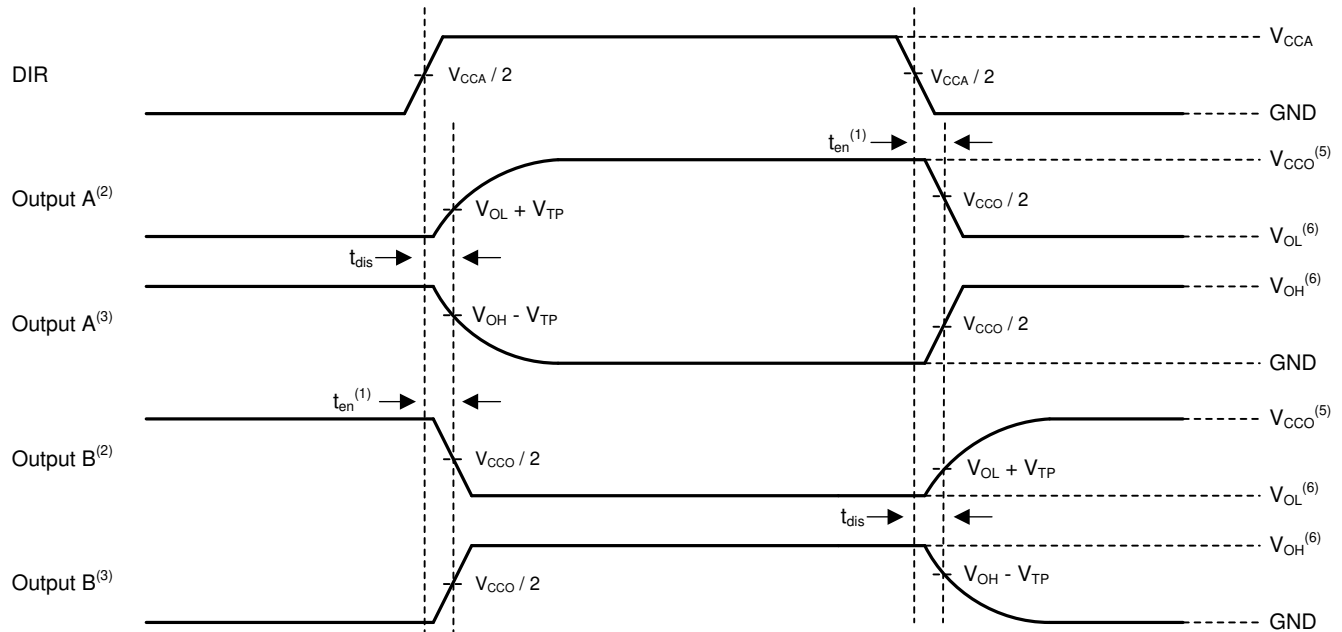
(1)  $C_L$  includes probe and jig capacitance.

**Figure 17. Load Circuit**

**Table 9. Load Circuit Conditions**

| Parameter                                              | $V_{CCO}$       | $R_L$         | $C_L$ | $S_1$              | $V_{TP}$ |
|--------------------------------------------------------|-----------------|---------------|-------|--------------------|----------|
| $\Delta t/\Delta v$ Input transition rise or fall rate | 0.65 V – 3.6 V  | 1 M $\Omega$  | 15 pF | Open               | N/A      |
| $t_{pd}$ Propagation (delay) time                      | 1.1 V – 3.6 V   | 2 k $\Omega$  | 15 pF | Open               | N/A      |
|                                                        | 0.65 V – 0.95 V | 20 k $\Omega$ | 15 pF | Open               | N/A      |
| $t_{en}, t_{dis}$ Enable time, disable time            | 3 V – 3.6 V     | 2 k $\Omega$  | 15 pF | $2 \times V_{CCO}$ | 0.3 V    |
|                                                        | 1.65 V – 2.7 V  | 2 k $\Omega$  | 15 pF | $2 \times V_{CCO}$ | 0.15 V   |
|                                                        | 1.1 V – 1.6 V   | 2 k $\Omega$  | 15 pF | $2 \times V_{CCO}$ | 0.1 V    |
|                                                        | 0.65 V – 0.95 V | 20 k $\Omega$ | 15 pF | $2 \times V_{CCO}$ | 0.1 V    |
| $t_{en}, t_{dis}$ Enable time, disable time            | 3 V – 3.6 V     | 2 k $\Omega$  | 15 pF | GND                | 0.3 V    |
|                                                        | 1.65 V – 2.7 V  | 2 k $\Omega$  | 15 pF | GND                | 0.15 V   |
|                                                        | 1.1 V – 1.6 V   | 2 k $\Omega$  | 15 pF | GND                | 0.1 V    |
|                                                        | 0.65 V – 0.95 V | 20 k $\Omega$ | 15 pF | GND                | 0.1 V    |





1. Illustrative purposes only. Enable Time is a calculation as described in the data sheet.
2. Output waveform on the condition that input is driven to a valid Logic Low.
3. Output waveform on the condition that input is driven to a valid Logic High.
4.  $V_{CCI}$  is the supply pin associated with the input port
5.  $V_{CCO}$  is the supply pin associated with the output port.
6.  $V_{OH}$  and  $V_{OL}$  are typical output voltage levels that occur with specified  $R_L$ ,  $C_L$ , and  $S_1$

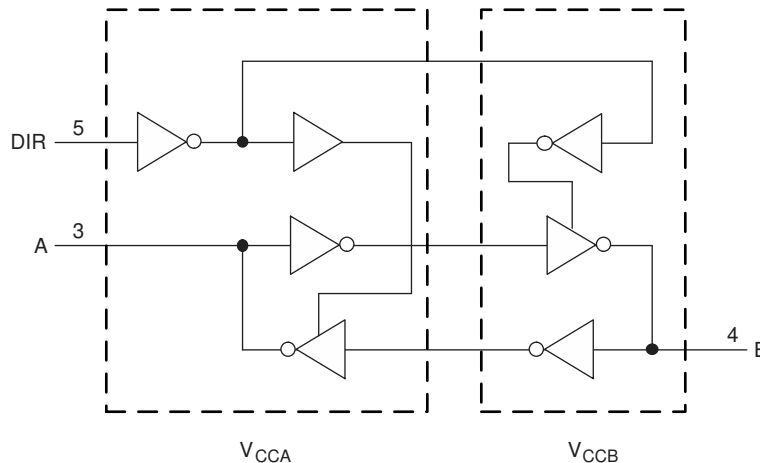
**Figure 20. Disable and Enable Time**

## 8 Detailed Description

### 8.1 Overview

The SN74AXC1T45-Q1 is AEC-Q100 qualified single-bit, dual-supply, non-inverting voltage level translator. Pin A and the direction control pin are referenced to  $V_{CCA}$  logic levels and pin B is referenced to  $V_{CCB}$  logic levels, as depicted in the [Functional Block Diagram](#). The A port can accept I/O voltages ranging from 0.65 V to 3.6 V, and the B port can accept I/O voltages from 0.65 V to 3.6 V. A logic high on the DIR pin enables data transmission from A to B and a logic low on the DIR pin enables data transmission from B to A.

### 8.2 Functional Block Diagram



**Figure 21. Functional Block Diagram**

### 8.3 Feature Description

#### 8.3.1 Standard CMOS Inputs

Standard CMOS inputs are high impedance and are typically modeled as a resistor in parallel with the input capacitance given in the [Electrical Characteristics](#). The worst case resistance is calculated with the maximum input voltage, given in the [Absolute Maximum Ratings](#), and the maximum input leakage current, given in the [Electrical Characteristics](#), using ohm's law ( $R = V \div I$ ).

Signals applied to the inputs need to have fast edge rates, as defined by  $\Delta t/\Delta v$  in [Recommended Operating Conditions](#) to avoid excessive current consumption and oscillations. If a slow or noisy input signal is required, a device with a Schmitt-trigger input should be used to condition the input signal prior to the standard CMOS input.

#### 8.3.2 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. The electrical and thermal limits defined in the [Absolute Maximum Ratings](#) must be followed at all times.

#### 8.3.3 Partial Power Down ( $I_{off}$ )

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](#).

#### 8.3.4 $V_{CC}$ Isolation

The inputs and outputs for this device enter a high-impedance state when either supply is  $<100\text{mV}$ .

## Feature Description (continued)

### 8.3.5 Over-voltage Tolerant Inputs

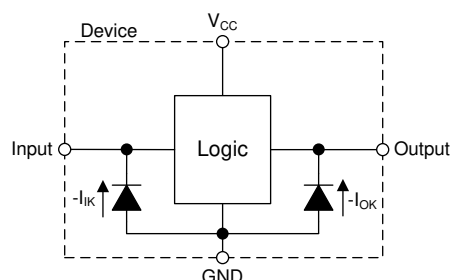
Input signals to this device can be driven above the supply voltage so long as they remain below the maximum input voltage value specified in the [Recommended Operating Conditions](#).

### 8.3.6 Negative Clamping Diodes

The inputs and outputs to this device have negative clamping diodes as depicted in [Figure 22](#).

**CAUTION**

Voltages beyond the values specified in the [Absolute Maximum Ratings](#) table can cause damage to the device. The input negative-voltage and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.



**Figure 22. Electrical Placement of Clamping Diodes for Each Input and Output**

### 8.3.7 Fully Configurable Dual-Rail Design

Both the  $V_{CCA}$  and  $V_{CCB}$  pins can be supplied at any voltage from 0.65 V to 3.6 V, making the device suitable for translating between any of the voltage nodes (0.7 V, 0.8 V, 0.9 V, 1.2 V, 1.8 V, 2.5 V and 3.3 V).

### 8.3.8 Supports High-Speed Translation

The SN74AXC1T45-Q1 device can support high data-rate applications. The translated signal data rate can be up to 500 Mbps when the signal is translated from 1.8 V to 3.3 V.

## 8.4 Device Functional Modes

[Table 10](#) lists the device functions for the DIR input.

**Table 10. Function Table**

| INPUT <sup>(1)</sup><br>DIR | OPERATION       |
|-----------------------------|-----------------|
| L                           | B data to A bus |
| H                           | A data to B bus |

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

## 9 Application and Implementation

### NOTE

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

### 9.1 Application Information

The SN74AXC1T45-Q1 device can be used in level-translation applications for interfacing devices or systems with one another when they are operating at different interface voltages. The maximum data rate can be up to 500 Mbps when the device translate signals from 1.8 V to 3.3 V.

#### 9.1.1 Enable Times

Calculate the enable times for the SN74AXC1T45-Q1 using the following formulas:

$$t_{PZH} \text{ (DIR to A)} = t_{PLZ} \text{ (DIR to B)} + t_{PLH} \text{ (B to A)} \quad (1)$$

$$t_{PZL} \text{ (DIR to A)} = t_{PHZ} \text{ (DIR to B)} + t_{PHL} \text{ (B to A)} \quad (2)$$

$$t_{PZH} \text{ (DIR to B)} = t_{PLZ} \text{ (DIR to A)} + t_{PLH} \text{ (A to B)} \quad (3)$$

$$t_{PZL} \text{ (DIR to B)} = t_{PHZ} \text{ (DIR to A)} + t_{PHL} \text{ (A to B)} \quad (4)$$

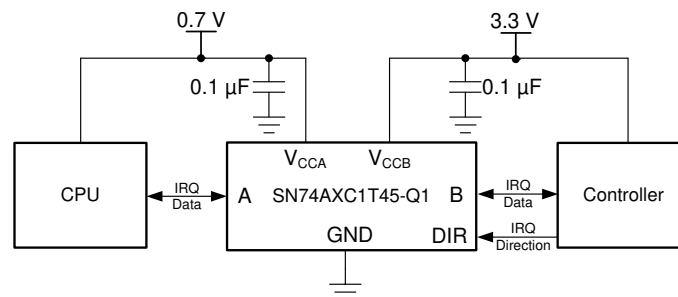
In a bidirectional application, these enable times provide the maximum delay time from the time the DIR bit is switched until an output is expected. For example, if the SN74AXC1T45-Q1 initially is transmitting from A to B, then the DIR bit is switched; the B port of the device must be disabled before presenting it with an input. After the B port has been disabled, an input signal applied to it appears on the corresponding A port after the specified propagation delay.

### 9.2 Typical Applications

#### 9.2.1 Interrupt Request Application

Figure 23 shows an example of the SN74AXC1T45-Q1 being used in an application where a system controller flags an interrupt request (IRQ) to the CPU. The system controller determines the direction of the IRQ line to either flag an interrupt to the CPU or allow the CPU to drive data on the line. In this application the controller is operating at 3.3 V while the CPU can be operating as low as 0.65 V.

The SN74AXC1T45-Q1 device is used to ensure that these devices can communicate at the appropriate voltage levels. Because the SN74AXC1T45-Q1 does not have an output-enable (OE) pin, the system designer should take precautions to avoid bus contention between the CPU and controller when changing directions.



**Figure 23. Interrupt Request Application**

##### 9.2.1.1 Design Requirements

For this design example, use the parameters listed in Table 11.

## Typical Applications (continued)

**Table 11. Design Parameters**

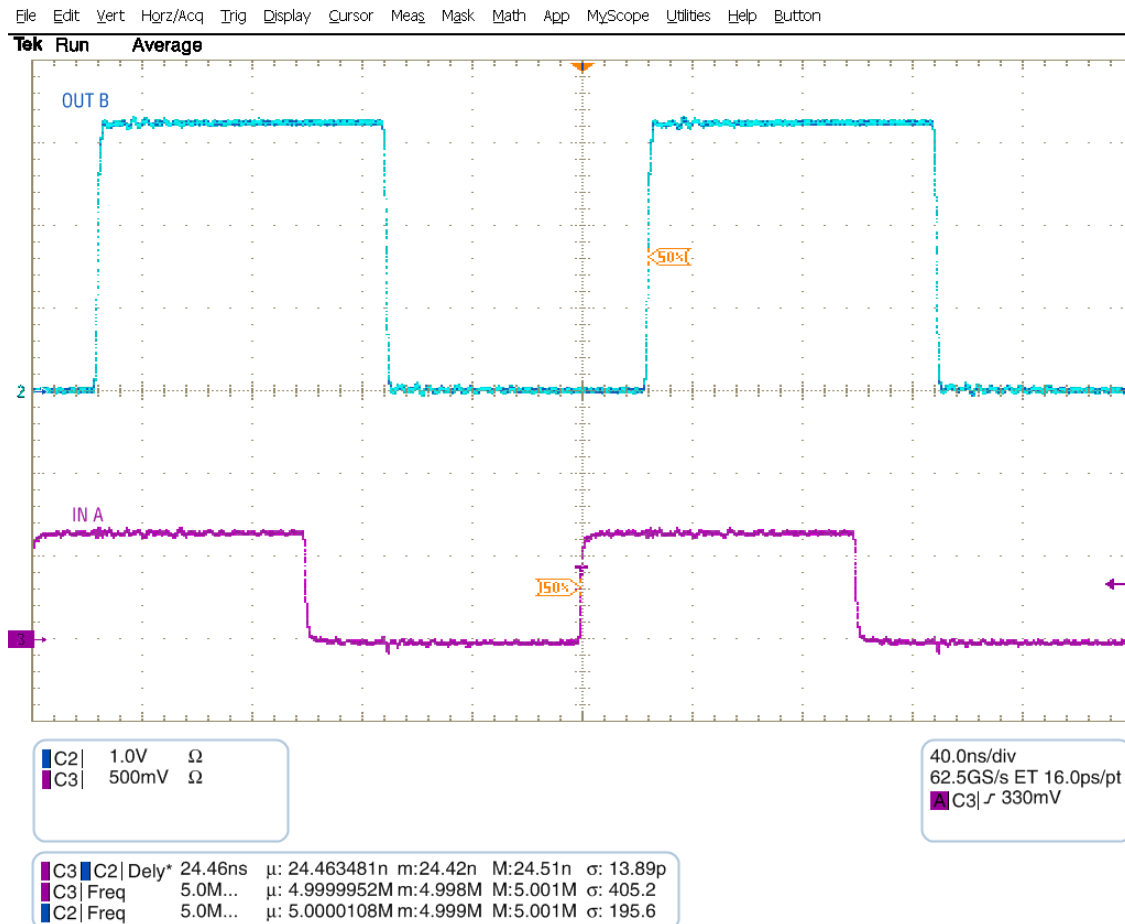
| DESIGN PARAMETERS    | EXAMPLE VALUES  |
|----------------------|-----------------|
| Input voltage range  | 0.65 V to 3.6 V |
| Output voltage range | 0.65 V to 3.6 V |

### 9.2.1.2 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 SN74AXC1T45-Q1 device to determine the input voltage range. For a valid logic-high, the value must exceed the high-level input voltage ( $V_{IH}$ ) of the input port. For a valid logic low the value must be less than the low-level input voltage ( $V_{IL}$ ) of the input port.
- Output voltage range
  - Use the supply voltage of the device that the SN74AXC1T45-Q1 device is driving to determine the output voltage range.

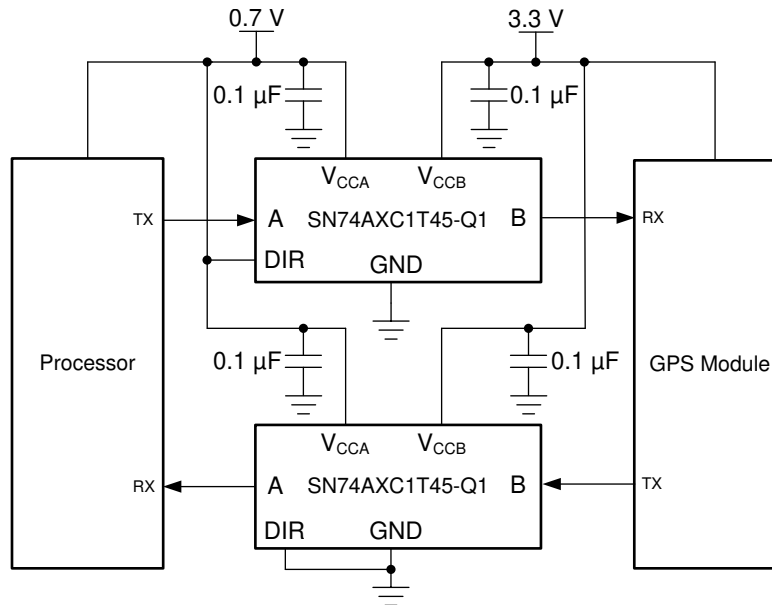
### 9.2.1.3 Application Curve



**Figure 24. Up Translation at 2.5 MHz (0.7 V to 3.3 V)**

## 9.2.2 Universal Asynchronous Receiver-Transmitter (UART) Interface Application

Figure 25 shows the SN74AXC1T45-Q1 being used for the two-bit UART interface application. One SN74AXC1T45-Q1 device is used to level shift the voltage and drive the TX from the processor to the GPS Module while a second SN74AXC1T45-Q1 device is used to drive the TX Data line from the GPS Module to the Processor.



**Figure 25. UART Interface Application**

### 9.2.2.1 Design Requirements

Refer to [Design Requirements](#).

### 9.2.2.2 Detailed Design Procedure

Refer to [Detailed Design Procedure](#).



## 10 Power Supply Recommendations

Always apply a ground reference to the GND pins first. This device is designed for glitch free power sequencing without any supply sequencing requirements such as ramp order or ramp rate.

This device was designed with various power supply sequencing methods in mind to help prevent unintended triggering of downstream devices. For more information regarding the power up glitch performance of the AXC family of level translators, see the [Power Sequencing for AXC Family of Devices](#) application report

## 11 Layout

### 11.1 Layout Guidelines

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

- Use bypass capacitors on the power supply pins and place them as close to the device as possible.
- Use short trace lengths to avoid excessive loading.

### 11.2 Layout Example

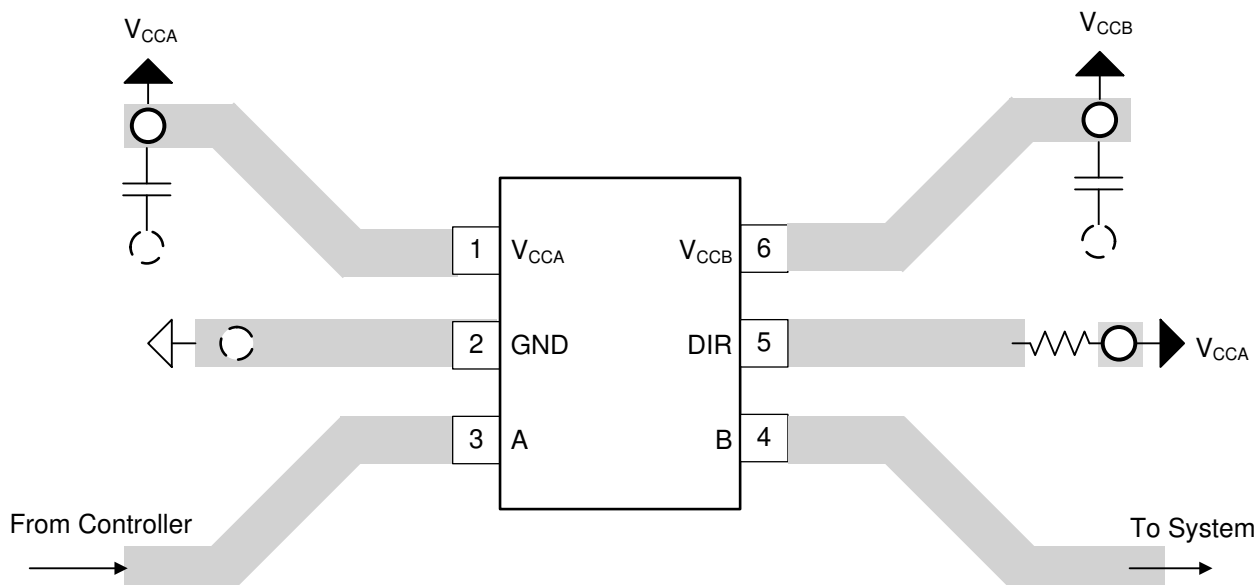
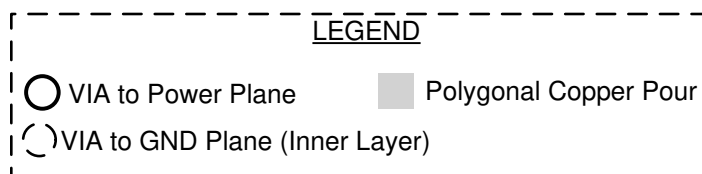


Figure 26. PCB Layout Example

## 12 Device and Documentation Support

### 12.1 Documentation Support

For related documentation see the following:

- Texas Instruments, [Evaluate SN74AXC1T45DRL Using a Generic EVM](#) application report
- Texas Instruments, [Implications of Slow or Floating CMOS Inputs](#) application report
- Texas Instruments, [Power Sequencing for the AXC Family of Devices](#) application report

### 12.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* 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.

### 12.3 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](#).

### 12.4 Trademarks

E2E is a trademark of Texas Instruments.

### 12.5 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.

### 12.6 Glossary

[SLYZ022](#) — *TI Glossary*.

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

## 13 Mechanical, Packaging, and Orderable Information

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

## PACKAGING INFORMATION

| Orderable Device   | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|--------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| SN74AXC1T45QDCKRQ1 | ACTIVE        | SC70         | DCK                | 6    | 3000           | Green (RoHS<br>& no Sb/Br) | NIPDAU                  | Level-1-260C-UNLIM   | -40 to 125   | 1E1                     | <a href="#">Samples</a> |
| SN74AXC1T45QDRYRQ1 | ACTIVE        | SON          | DRY                | 6    | 5000           | Green (RoHS<br>& no Sb/Br) | NIPDAU                  | Level-1-260C-UNLIM   | -40 to 125   | G2                      | <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/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

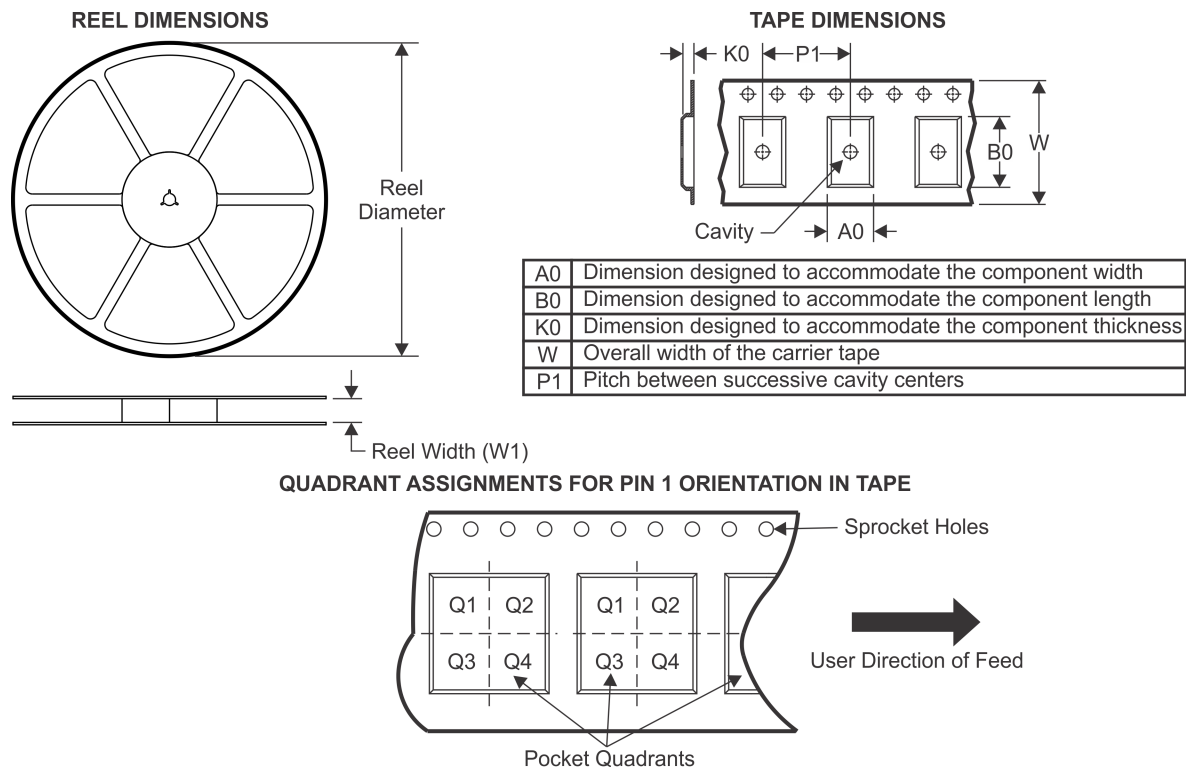
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF SN74AXC1T45-Q1 :**

- Catalog: [SN74AXC1T45](#)

**NOTE:** Qualified Version Definitions:

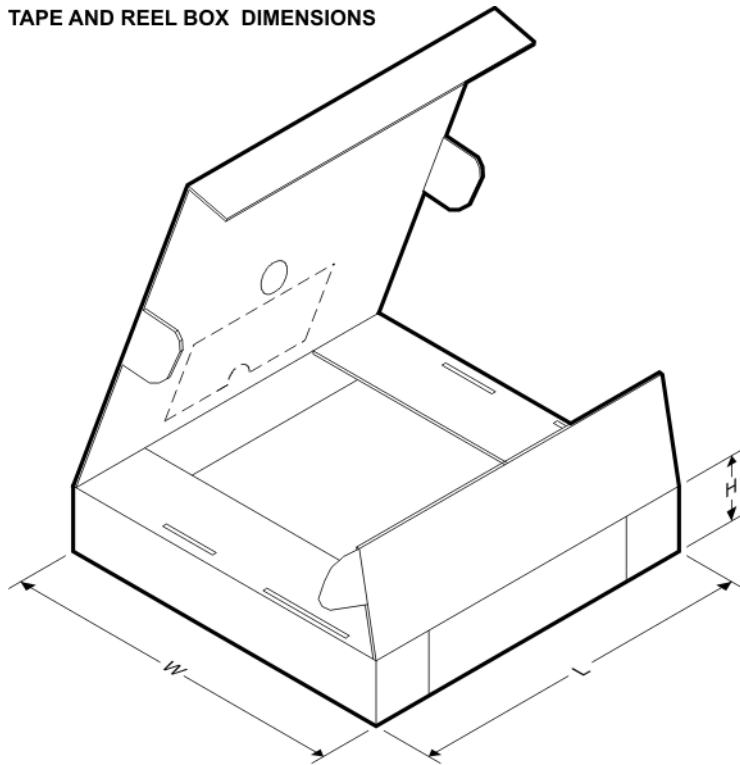
- Catalog - TI's standard catalog product

**TAPE AND REEL INFORMATION**


\*All dimensions are nominal

| Device             | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|--------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74AXC1T45QDCKRQ1 | SC70         | DCK             | 6    | 3000 | 178.0              | 9.0                | 2.4     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| SN74AXC1T45QDRYRQ1 | SON          | DRY             | 6    | 5000 | 180.0              | 9.5                | 1.2     | 1.65    | 0.7     | 4.0     | 8.0    | Q1            |

## TAPE AND REEL BOX DIMENSIONS

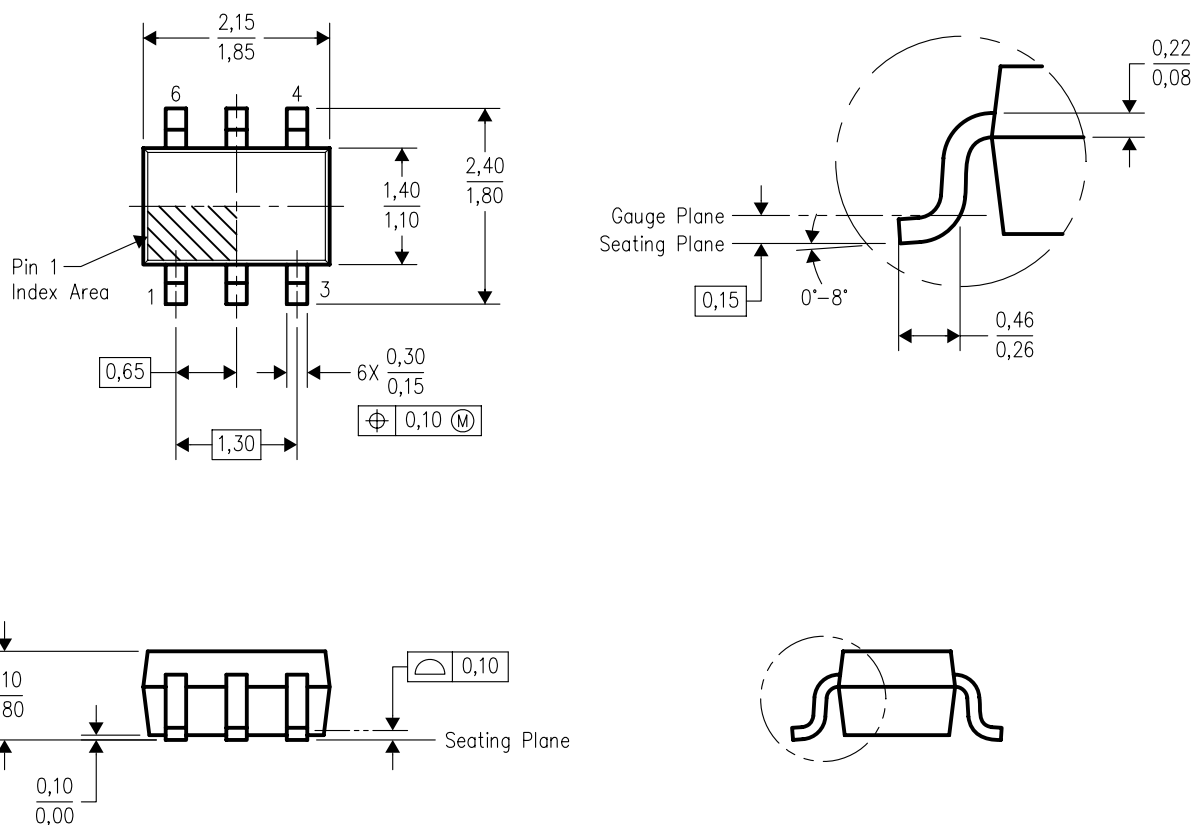


\*All dimensions are nominal

| Device             | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74AXC1T45QDCKRQ1 | SC70         | DCK             | 6    | 3000 | 190.0       | 190.0      | 30.0        |
| SN74AXC1T45QDRYRQ1 | SON          | DRY             | 6    | 5000 | 189.0       | 185.0      | 36.0        |

## DCK (R-PDSO-G6)

## PLASTIC SMALL-OUTLINE PACKAGE

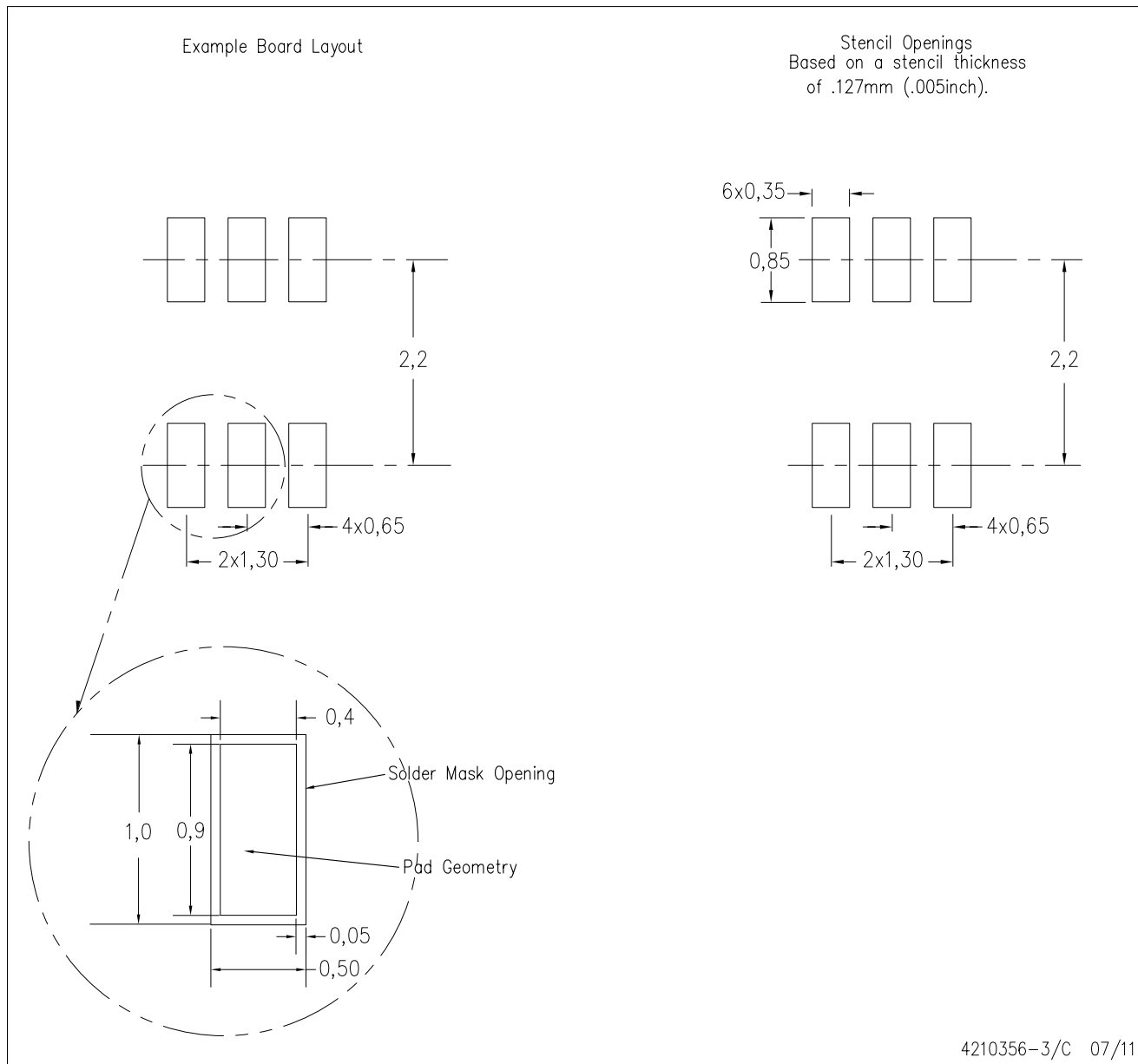


4093553-4/G 01/2007

- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
  - Falls within JEDEC MO-203 variation AB.

DCK (R-PDSO-G6)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
  - D. Publication IPC-7351 is recommended for alternate designs.
  - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.



## GENERIC PACKAGE VIEW

**DRY 6**

**USON - 0.6 mm max height**

PLASTIC SMALL OUTLINE - 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.

4207181/G

## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale ([www.ti.com/legal/termsofsale.html](http://www.ti.com/legal/termsofsale.html)) or other applicable terms available either on [ti.com](http://ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2020, Texas Instruments Incorporated