

# 4-Bit Dual-Supply Bus Transceiver with Configurable Voltage Translation and 3-State Output

## 1 FEATURES

- Control Inputs  $V_{IH}/V_{IL}$  Levels are Referenced to  $V_{CCA}$  Voltage
- Power-Supply Range:  $V_{CCA}$  and  $V_{CCB}$ : 1.65V to 5.5V
- $V_{CC}$  Isolation: If Either  $V_{CC}$  is at GND, Both Ports are in the High-Impedance State
- $I_{OFF}$ : Supports Partial-Power-Down Mode Operation
- Extended Temperature: -40°C to +125°C

## 2 APPLICATIONS

- Desktop PC
- Personal electronics
- Industrial
- Enterprise

## 3 DESCRIPTIONS

This 4-bit non-inverting bus transceiver is a bidirectional voltage-level translator and can be used to establish digital switching compatibility between mixed-voltage systems. It uses two separate configurable power-supply rails, Both  $V_{CCA}$  and  $V_{CCB}$  supporting operating voltages from 1.65 V to 5.5 V, A ports, DIR and  $\overline{OE}$  tracks the  $V_{CCA}$  supply and B ports tracks the  $V_{CCB}$  supply. This allows the support of both lower and higher logic signal levels while providing bidirectional translation capabilities between any of the 1.8V, 2.5V, 3.3V and 5.5V voltage nodes.

The RS4T245 is designed for asynchronous communication between two data buses. The logic levels of the direction-control (DIR) input and the output-enable ( $\overline{OE}$ ) input activate either the B-port outputs or the A-port outputs or place both output ports into the high-impedance mode. The device transmits data from the A bus to the B bus when the B-port outputs are activated, and from the B bus to the A bus when the A-port outputs are activated. The input circuitry on both A and B ports is always active and must have a logic HIGH or LOW level applied to prevent excess  $I_{CC}$  and  $I_{CCZ}$ .

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

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

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

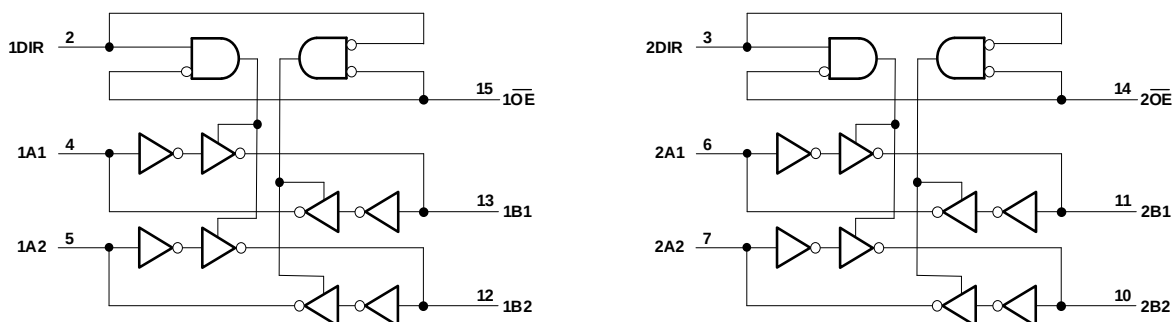
The RS4T245 is designed so that the control pins (DIR and  $\overline{OE}$ ) are supplied by  $V_{CCA}$ . It operates over an ambient temperature range of -40°C to +125°C.

**Device Information (1)**

| PART NUMBER | PACKAGE        | BODY SIZE (NOM) |
|-------------|----------------|-----------------|
| RS4T245     | TSSOP16(16)    | 5.00mm×4.40mm   |
|             | QFN2.5×3.5-16L | 2.50mm×3.50mm   |

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

## 4 Functional Block Diagram



**Function Table**

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

## Table of Contents

|                                                            |    |
|------------------------------------------------------------|----|
| <b>1 FEATURES</b> .....                                    | 1  |
| <b>2 APPLICATIONS</b> .....                                | 1  |
| <b>3 DESCRIPTIONS</b> .....                                | 1  |
| <b>4 Functional Block Diagram</b> .....                    | 2  |
| <b>5 Revision History</b> .....                            | 4  |
| <b>6 PACKAGE/ORDERING INFORMATION <sup>(1)</sup></b> ..... | 5  |
| <b>7 PIN CONFIGURATIONS</b> .....                          | 6  |
| <b>8 SPECIFICATIONS</b> .....                              | 7  |
| 8.1 Absolute Maximum Ratings .....                         | 7  |
| 8.2 ESD Ratings .....                                      | 7  |
| 8.3 Recommended Operating Conditions .....                 | 8  |
| 8.4 Electrical Characteristics .....                       | 9  |
| 8.5 Switching Characteristics .....                        | 10 |
| 8.5.1 $V_{CCA}=1.8V\pm0.15V$ .....                         | 10 |
| 8.5.2 $V_{CCA}=2.5V\pm0.2V$ .....                          | 10 |
| 8.5.3 $V_{CCA}=3.3V\pm0.3V$ .....                          | 11 |
| 8.5.4 $V_{CCA}=5V\pm0.5V$ .....                            | 11 |
| 8.6 Operating Characteristics .....                        | 11 |
| 8.7 Typical Characteristics .....                          | 12 |
| <b>9 Parameter Measurement Information</b> .....           | 13 |
| <b>10 Application Information</b> .....                    | 14 |
| <b>11 PACKAGE OUTLINE DIMENSIONS</b> .....                 | 15 |
| <b>12 TAPE AND REEL INFORMATION</b> .....                  | 17 |

## 5 Revision History

Note: Page numbers for previous revisions may different from page numbers in the current version.

| VERSION | Change Date | Change Item                                                                                                            |
|---------|-------------|------------------------------------------------------------------------------------------------------------------------|
| A.1     | 2022/04/07  | Initial version completed                                                                                              |
| A.2     | 2022/08/31  | 1.Change ESD Ratings<br>2.Delete QFN2.6×1.8-16L PACKAGE<br>3.Update PACKAGE OPTION<br>4.Modify Application Information |
| A.3     | 2022/12/14  | Changed Recommended Operating Conditions and Switching Characteristics and Operating Characteristics                   |

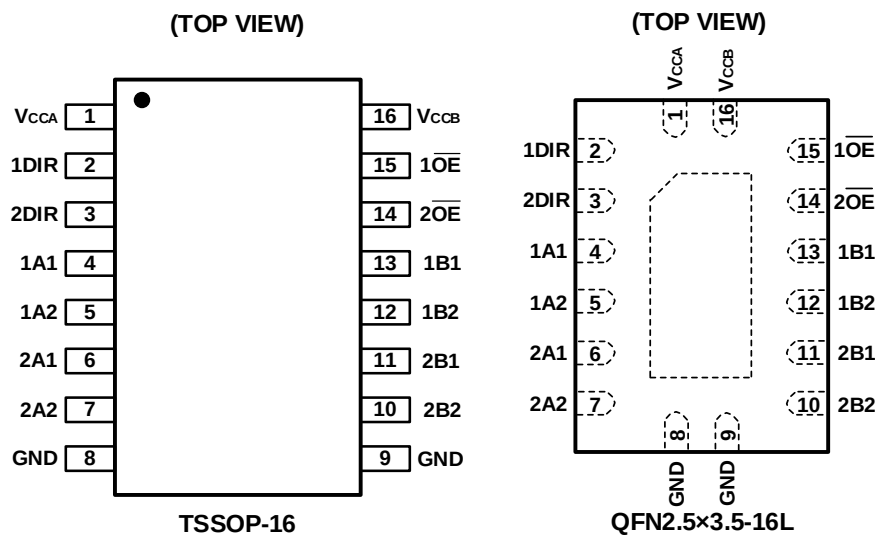
**6 PACKAGE/ORDERING INFORMATION <sup>(1)</sup>**

| PRODUCT | ORDERING NUMBER | TEMPERATURE RANGE | PACKAGE LEAD   | PACKAGE MARKING <sup>(2)</sup> | MSL <sup>(3)</sup> | PACKAGE OPTION     |
|---------|-----------------|-------------------|----------------|--------------------------------|--------------------|--------------------|
| RS4T245 | RS4T245XTSS16   | -40°C ~+125°C     | TSSOP16        | RS4T245                        | MSL3               | Tape and Reel,4000 |
|         | RS4T245XTQW16   | -40°C ~+125°C     | QFN2.5x3.5-16L | RS4T245                        | MSL3               | Tape and Reel,5000 |

## NOTE:

- (1) 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 right-hand navigation.
- (2) There may be additional marking, which relates to the lot trace code information(data code and vendor code), the logo or the environmental category on the device.
- (3) MSL, The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications.

## 7 PIN CONFIGURATIONS



## PIN DESCRIPTION

| PIN                         | NAME             | TYPE <sup>(1)</sup> | FUNCTION                                                                                                             |
|-----------------------------|------------------|---------------------|----------------------------------------------------------------------------------------------------------------------|
| TSSOP-16/<br>QFN2.5x3.5-16L |                  |                     |                                                                                                                      |
| 1                           | V <sub>CCA</sub> | P                   | A-port supply voltage. 1.65V ≤ V <sub>CCA</sub> ≤ 5.5V                                                               |
| 2                           | 1DIR             | I                   | Direction-control input for "1" ports.                                                                               |
| 3                           | 2DIR             | I                   | Direction-control input for "2" ports.                                                                               |
| 4                           | 1A1              | I/O                 | Input/output 1A1. Reference to V <sub>CCA</sub> .                                                                    |
| 5                           | 1A2              | I/O                 | Input/output 1A2. Reference to V <sub>CCA</sub> .                                                                    |
| 6                           | 2A1              | I/O                 | Input/output 2A1. Reference to V <sub>CCA</sub> .                                                                    |
| 7                           | 2A2              | I/O                 | Input/output 2A2. Reference to V <sub>CCA</sub> .                                                                    |
| 8                           | GND              | G                   | Ground.                                                                                                              |
| 9                           | GND              | G                   | Ground.                                                                                                              |
| 10                          | 2B2              | I/O                 | Input/output 2B2. Reference to V <sub>CCB</sub> .                                                                    |
| 11                          | 2B1              | I/O                 | Input/output 2B1. Reference to V <sub>CCB</sub> .                                                                    |
| 12                          | 1B2              | I/O                 | Input/output 1B2. Reference to V <sub>CCB</sub> .                                                                    |
| 13                          | 1B1              | I/O                 | Input/output 1B1. Reference to V <sub>CCB</sub> .                                                                    |
| 14                          | 2OE              | I                   | Output Enable (Active Low). Pull 2OE high to place all "2" outputs in 3-state mode. Referenced to V <sub>CCA</sub> . |
| 15                          | 1OE              | I                   | Output Enable (Active Low). Pull 1OE high to place all "1" outputs in 3-state mode. Referenced to V <sub>CCA</sub> . |
| 16                          | V <sub>CCB</sub> | P                   | B-port supply voltage. 1.65V ≤ V <sub>CCB</sub> ≤ 5.5V                                                               |

(1) I=input, O=output, I/O=input and output, P=power

## 8 SPECIFICATIONS

### 8.1 Absolute Maximum Ratings

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

| SYMBOL                           | PARAMETER                                                                    |                   | MIN  | MAX                   | UNIT |
|----------------------------------|------------------------------------------------------------------------------|-------------------|------|-----------------------|------|
| V <sub>CCA</sub>                 | Supply Voltage Range                                                         |                   | -0.5 | 6.5                   | V    |
| V <sub>CCB</sub>                 | Supply Voltage Range                                                         |                   | -0.5 | 6.5                   | V    |
| V <sub>I</sub> <sup>(2)</sup>    | Input Voltage Range                                                          | A port            | -0.5 | 6.5                   | V    |
|                                  |                                                                              | B port            | -0.5 | 6.5                   | V    |
|                                  |                                                                              | Control inputs    | -0.5 | 6.5                   | V    |
| V <sub>O</sub> <sup>(2)</sup>    | Voltage range applied to any output in the high-impedance or power-off state | A port            | -0.5 | 6.5                   | V    |
|                                  |                                                                              | B port            | -0.5 | 6.5                   | V    |
| V <sub>O</sub> <sup>(2)(3)</sup> | Voltage range applied to any output in the high or low state                 | A port            | -0.5 | V <sub>CCA</sub> +0.5 | V    |
|                                  |                                                                              | B port            | -0.5 | V <sub>CCB</sub> +0.5 | V    |
| I <sub>IK</sub>                  | Input clamp current                                                          | V <sub>I</sub> <0 |      | -50                   | mA   |
| I <sub>OK</sub>                  | Output clamp current                                                         | V <sub>O</sub> <0 |      | -50                   | mA   |
| I <sub>O</sub>                   | Continuous output current                                                    |                   |      | ±50                   | mA   |
|                                  | Continuous current through V <sub>CCA</sub> , V <sub>CCB</sub> or GND        |                   |      | ±100                  | mA   |
| T <sub>J</sub>                   | Junction Temperature <sup>(4)</sup>                                          |                   | -40  | 150                   | °C   |
| T <sub>stg</sub>                 | Storage temperature                                                          |                   | -65  | +150                  | °C   |

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

(2) The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.

(3) The value of V<sub>CCA</sub> and V<sub>CCB</sub> are provided in the recommended operating conditions table.

(4) The maximum power dissipation is a function of T<sub>J(MAX)</sub>, R<sub>θJA</sub>, and T<sub>A</sub>. The maximum allowable power dissipation at any ambient temperature is P<sub>D</sub> = (T<sub>J(MAX)</sub> - T<sub>A</sub>) / R<sub>θJA</sub>. All numbers apply for packages soldered directly onto a PCB.

### 8.2 ESD Ratings

The following ESD information is provided for handling of ESD-sensitive devices in an ESD protected area only.

|                    |                         |                                                                       | VALUE | UNIT |
|--------------------|-------------------------|-----------------------------------------------------------------------|-------|------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>     | ±2000 | V    |
|                    |                         | Charged-device model (CDM), per ANSI/ESDA/JEDEC JS-002 <sup>(2)</sup> | ±1500 | V    |
|                    |                         | Machine Model (MM)                                                    | ±200  | V    |

(1) JEDEC document JEP155 states that 500 V HBM allows safe manufacturing with a standard ESD control process.

(2) JEDEC document JEP157 states that 250 V CDM allows safe manufacturing with a standard ESD control process.



#### ESD SENSITIVITY CAUTION

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

### 8.3 Recommended Operating Conditions

$V_{CCI}$  is the supply voltage associated with the input port.  $V_{CCO}$  is the supply voltage associated with the output port.

| PARAMETER                                     |                                                                 | V <sub>CCI</sub> <sup>(1)</sup> | V <sub>CCO</sub> <sup>(2)</sup> | MIN                    | TYP | MAX                    | UNIT |
|-----------------------------------------------|-----------------------------------------------------------------|---------------------------------|---------------------------------|------------------------|-----|------------------------|------|
| Supply voltage <sup>(1)</sup>                 | V <sub>CCA</sub>                                                |                                 |                                 | 1.65                   |     | 5.5                    | V    |
|                                               | V <sub>CCB</sub>                                                |                                 |                                 | 1.65                   |     | 5.5                    |      |
| High-level input Voltage (V <sub>IH</sub> )   | Data inputs <sup>(5)</sup>                                      | 1.65V to 1.95V                  |                                 | V <sub>CCI</sub> x0.75 |     |                        | V    |
|                                               |                                                                 | 2.3V to 2.7V                    |                                 | V <sub>CCI</sub> x0.7  |     |                        |      |
|                                               |                                                                 | 3V to 3.6V                      |                                 | V <sub>CCI</sub> x0.7  |     |                        |      |
|                                               |                                                                 | 4.5V to 5.5V                    |                                 | V <sub>CCI</sub> x0.7  |     |                        |      |
| Low-level input Voltage (V <sub>IL</sub> )    | Data inputs <sup>(5)</sup>                                      | 1.65V to 1.95V                  |                                 |                        |     | V <sub>CCI</sub> x0.35 | V    |
|                                               |                                                                 | 2.3V to 2.7V                    |                                 |                        |     | V <sub>CCI</sub> x0.3  |      |
|                                               |                                                                 | 3V to 3.6V                      |                                 |                        |     | V <sub>CCI</sub> x0.3  |      |
|                                               |                                                                 | 4.5V to 5.5V                    |                                 |                        |     | V <sub>CCI</sub> x0.3  |      |
| High-level input Voltage (V <sub>IH</sub> )   | Control inputs (referenced to V <sub>CCA</sub> ) <sup>(6)</sup> | 1.65V to 1.95V                  |                                 | V <sub>CCA</sub> x0.75 |     |                        | V    |
|                                               |                                                                 | 2.3V to 2.7V                    |                                 | V <sub>CCA</sub> x0.7  |     |                        |      |
|                                               |                                                                 | 3V to 3.6V                      |                                 | V <sub>CCA</sub> x0.7  |     |                        |      |
|                                               |                                                                 | 4.5V to 5.5V                    |                                 | V <sub>CCA</sub> x0.7  |     |                        |      |
| Low-level input Voltage (V <sub>IL</sub> )    | Control inputs (referenced to V <sub>CCA</sub> ) <sup>(6)</sup> | 1.65V to 1.95V                  |                                 |                        |     | V <sub>CCA</sub> x0.35 | V    |
|                                               |                                                                 | 2.3V to 2.7V                    |                                 |                        |     | V <sub>CCA</sub> x0.3  |      |
|                                               |                                                                 | 3V to 3.6V                      |                                 |                        |     | V <sub>CCA</sub> x0.3  |      |
|                                               |                                                                 | 4.5V to 5.5V                    |                                 |                        |     | V <sub>CCA</sub> x0.3  |      |
| Input voltage (V <sub>I</sub> )               | Control inputs <sup>(4)</sup>                                   |                                 |                                 | 0                      |     | 5.5                    | V    |
| Input/output voltage (V <sub>I/O</sub> )      | Active state                                                    |                                 |                                 | 0                      |     | V <sub>CCO</sub>       | V    |
|                                               | 3-state                                                         |                                 |                                 | 0                      |     | 5.5                    | V    |
| High-level output current (I <sub>OH</sub> )  |                                                                 |                                 | 1.65V to 1.95V                  |                        |     | -4                     | mA   |
|                                               |                                                                 |                                 | 2.3V to 2.7V                    |                        |     | -8                     |      |
|                                               |                                                                 |                                 | 3V to 3.6V                      |                        |     | -24                    |      |
|                                               |                                                                 |                                 | 4.5V to 5.5V                    |                        |     | -32                    |      |
| Low-level output current (I <sub>OL</sub> )   |                                                                 |                                 | 1.65V to 1.95V                  |                        |     | 4                      | mA   |
|                                               |                                                                 |                                 | 2.3V to 2.7V                    |                        |     | 8                      |      |
|                                               |                                                                 |                                 | 3V to 3.6V                      |                        |     | 24                     |      |
|                                               |                                                                 |                                 | 4.5V to 5.5V                    |                        |     | 32                     |      |
| Input transition rise or fall rate(Δt/Δv)     | Data inputs <sup>(3)</sup>                                      | 1.65V to 1.95V                  |                                 |                        |     | 20                     | ns/V |
|                                               |                                                                 | 2.3V to 2.7V                    |                                 |                        |     | 20                     |      |
|                                               |                                                                 | 3V to 3.6V                      |                                 |                        |     | 10                     |      |
|                                               |                                                                 | 4.5V to 5.5V                    |                                 |                        |     | 5                      |      |
| T <sub>A</sub> Operating free-air temperature |                                                                 |                                 |                                 | -40                    |     | 125                    | °C   |

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

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

(3) All unused or driven (floating) data inputs (I/Os) of the device must be held at logic HIGH or LOW (preferably  $V_{CCI}$  or GND) to ensure proper device operation and minimize power.

(4) All unused control inputs must be held at  $V_{CCA}$  or GND to ensure proper device operation and minimize power consumption.

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

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



## 8.4 Electrical Characteristics

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

| PARAMETER                                                   | CONDITIONS                                                                    | V <sub>CCA</sub> | V <sub>CCB</sub> | TEMP  | MIN <sup>(3)</sup>     | TYP <sup>(4)</sup> | MAX <sup>(3)</sup> | UNIT    |
|-------------------------------------------------------------|-------------------------------------------------------------------------------|------------------|------------------|-------|------------------------|--------------------|--------------------|---------|
| V <sub>OH</sub>                                             | I <sub>OH</sub> = -100 $\mu$ A V <sub>I</sub> =V <sub>IH</sub>                | 1.65V to 4.5V    | 1.65V to 4.5V    | Full  | V <sub>CCO</sub> - 0.1 |                    |                    | V       |
|                                                             | I <sub>OH</sub> = -4mA V <sub>I</sub> =V <sub>IH</sub>                        | 1.65V            | 1.65V            |       | 1.2                    |                    |                    |         |
|                                                             | I <sub>OH</sub> = -8mA V <sub>I</sub> =V <sub>IH</sub>                        | 2.3V             | 2.3V             |       | 1.9                    |                    |                    |         |
|                                                             | I <sub>OH</sub> = -24mA V <sub>I</sub> =V <sub>IH</sub>                       | 3V               | 3V               |       | 2.4                    |                    |                    |         |
|                                                             | I <sub>OH</sub> = -32mA V <sub>I</sub> =V <sub>IH</sub>                       | 4.5V             | 4.5V             |       | 3.8                    |                    |                    |         |
| V <sub>OL</sub>                                             | I <sub>OL</sub> = 100 $\mu$ A V <sub>I</sub> =V <sub>IL</sub>                 | 1.65V to 4.5V    | 1.65V to 4.5V    |       |                        |                    | 0.1                | V       |
|                                                             | I <sub>OL</sub> = 4mA V <sub>I</sub> =V <sub>IL</sub>                         | 1.65V            | 1.65V            |       |                        |                    | 0.45               |         |
|                                                             | I <sub>OL</sub> = 8mA V <sub>I</sub> =V <sub>IL</sub>                         | 2.3V             | 2.3V             |       |                        |                    | 0.3                |         |
|                                                             | I <sub>OL</sub> = 24mA V <sub>I</sub> =V <sub>IL</sub>                        | 3V               | 3V               |       |                        |                    | 0.55               |         |
|                                                             | I <sub>OL</sub> = 32mA V <sub>I</sub> =V <sub>IL</sub>                        | 4.5V             | 4.5V             |       |                        |                    | 0.55               |         |
| I <sub>I</sub> DIR                                          | V <sub>I</sub> = V <sub>CCA</sub> or GND                                      | 1.65V to 5.5V    | 1.65V to 5.5V    | +25°C |                        |                    | $\pm 1$            | $\mu$ A |
|                                                             |                                                                               |                  |                  | Full  |                        |                    | $\pm 2$            |         |
| I <sub>off</sub> A or B Port                                | V <sub>I</sub> or V <sub>O</sub> = 0 to 5.5V                                  | 0V               | 0V to 5.5V       | +25°C |                        |                    | $\pm 1$            | $\mu$ A |
|                                                             |                                                                               | 0V to 5.5V       | 0V               | Full  |                        |                    | $\pm 2$            |         |
| I <sub>OZ</sub> <sup>(5)</sup> A or B Port                  | V <sub>O</sub> =V <sub>CCO</sub> or GND<br>$\overline{OE}$ =V <sub>IH</sub>   | 1.65V to 5.5V    | 1.65V to 5.5V    | +25°C |                        |                    | $\pm 1$            | $\mu$ A |
|                                                             |                                                                               |                  |                  | Full  |                        |                    | $\pm 2$            |         |
| I <sub>CCA</sub> V <sub>CCA</sub> supply current            | V <sub>I</sub> = V <sub>CCI</sub> or GND <sup>(6)</sup><br>I <sub>O</sub> = 0 | 1.65V to 5.5V    | 1.65V to 5.5V    | Full  |                        |                    | 8                  | $\mu$ A |
|                                                             |                                                                               | 5V               | 0V               | Full  |                        |                    | 8                  |         |
|                                                             |                                                                               | 0V               | 5V               | Full  |                        |                    | -2                 |         |
| I <sub>CCB</sub> V <sub>CCB</sub> supply current            | V <sub>I</sub> = V <sub>CCI</sub> or GND <sup>(6)</sup><br>I <sub>O</sub> = 0 | 1.65V to 5.5V    | 1.65V to 5.5V    | Full  |                        |                    | 8                  | $\mu$ A |
|                                                             |                                                                               | 5V               | 0V               | Full  |                        |                    | -2                 |         |
|                                                             |                                                                               | 0V               | 5V               | Full  |                        |                    | 8                  |         |
| I <sub>CCA</sub> + I <sub>CCB</sub> Combined supply current | V <sub>I</sub> = V <sub>CCI</sub> or GND<br>I <sub>O</sub> = 0                | 1.65V to 5.5V    | 1.65V to 5.5V    | Full  |                        |                    | 20                 | $\mu$ A |
| $\Delta$ I <sub>CCA</sub>                                   | A port                                                                        | 3V to 5.5V       | 3V to 5.5V       | Full  |                        |                    | 50                 | $\mu$ A |
|                                                             | DIR                                                                           |                  |                  | Full  |                        |                    | 50                 | $\mu$ A |
| $\Delta$ I <sub>CCB</sub>                                   | B port                                                                        | 3V to 5.5V       | 3V to 5.5V       | Full  |                        |                    | 50                 | $\mu$ A |
| C <sub>i</sub> Control inputs                               | V <sub>I</sub> = V <sub>CCA</sub> or GND                                      | 3.3V             | 3.3V             | +25°C |                        | 4                  |                    | pF      |
| C <sub>IO</sub>                                             | A port                                                                        | 3.3V             | 3.3V             | +25°C |                        | 8.5                |                    | pF      |
|                                                             | B port                                                                        | 3.3V             | 3.3V             | +25°C |                        | 8.5                |                    |         |

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

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

(3) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.

(4) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration.

(5) For I/O ports, the parameter I<sub>OZ</sub> includes the input leakage current.

(6) Hold all unused data inputs of the device at V<sub>CCI</sub> or GND to assure proper device operation.

## 8.5 Switching Characteristics

### 8.5.1 $V_{CCA}=1.8V\pm0.15V$

over recommended operating free-air temperature range, Full=-40°C to 125°C.

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEMP | $V_{CCB}=1.8V$<br>$\pm0.15V^{(1)}$ |      | $V_{CCB}=2.5V$<br>$\pm0.2V^{(1)}$ |      | $V_{CCB}=3.3V$<br>$\pm0.3V^{(1)}$ |      | $V_{CCB}=5V$<br>$\pm0.5V^{(1)}$ |      | UNIT |
|-----------|-----------------|----------------|------|------------------------------------|------|-----------------------------------|------|-----------------------------------|------|---------------------------------|------|------|
|           |                 |                |      | MIN                                | MAX  | MIN                               | MAX  | MIN                               | MAX  | MIN                             | MAX  |      |
| $t_{PLH}$ | An              | Bn             | Full | 2.0                                | 24.5 | 1.5                               | 17.3 | 1.1                               | 18.8 | 0.8                             | 18.5 | ns   |
| $t_{PHL}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PLH}$ | Bn              | An             | Full | 1.0                                | 24.5 | 0.8                               | 24.4 | 0.8                               | 23.3 | 0.7                             | 23.4 | ns   |
| $t_{PHL}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PHZ}$ | $\overline{OE}$ | An             | Full | 1.8                                | 31.0 | 1.7                               | 21.8 | 1.7                               | 25.2 | 1.5                             | 20.8 | ns   |
| $t_{PLZ}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PHZ}$ | $\overline{OE}$ | Bn             | Full | 2.6                                | 28.0 | 2.1                               | 29.0 | 2.0                               | 30.4 | 1.5                             | 28.5 | ns   |
| $t_{PLZ}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PZH}$ | $\overline{OE}$ | An             | Full | 0.6                                | 29.5 | 0.5                               | 21.3 | 0.5                               | 23.3 | 0.5                             | 18.6 | ns   |
| $t_{PZL}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PZH}$ | $\overline{OE}$ | Bn             | Full | 2.0                                | 24.0 | 1.8                               | 24.0 | 1.3                               | 38.9 | 1.0                             | 41.8 | ns   |
| $t_{PZL}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |

(1) This parameter is ensured by design and/or characterization and is not tested in production.

### 8.5.2 $V_{CCA}=2.5V\pm0.2V$

over recommended operating free-air temperature range, Full=-40°C to 125°C.

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEMP | $V_{CCB}=1.8V$<br>$\pm0.15V^{(1)}$ |      | $V_{CCB}=2.5V$<br>$\pm0.2V^{(1)}$ |      | $V_{CCB}=3.3V$<br>$\pm0.3V^{(1)}$ |      | $V_{CCB}=5V$<br>$\pm0.5V^{(1)}$ |      | UNIT |
|-----------|-----------------|----------------|------|------------------------------------|------|-----------------------------------|------|-----------------------------------|------|---------------------------------|------|------|
|           |                 |                |      | MIN                                | MAX  | MIN                               | MAX  | MIN                               | MAX  | MIN                             | MAX  |      |
| $t_{PLH}$ | An              | Bn             | Full | 1.6                                | 24.6 | 1.3                               | 16.5 | 0.9                               | 15.7 | 0.6                             | 16.9 | ns   |
| $t_{PHL}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PLH}$ | Bn              | An             | Full | 1.4                                | 17.4 | 1.2                               | 16.5 | 1.1                               | 16.5 | 1.0                             | 16.6 | ns   |
| $t_{PHL}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PHZ}$ | $\overline{OE}$ | An             | Full | 1.4                                | 29.6 | 1.7                               | 18.0 | 1.4                               | 21.6 | 1.5                             | 15.9 | ns   |
| $t_{PLZ}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PHZ}$ | $\overline{OE}$ | Bn             | Full | 2.3                                | 17.4 | 2.1                               | 16.7 | 2.0                               | 17.5 | 1.0                             | 18.5 | ns   |
| $t_{PLZ}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PZH}$ | $\overline{OE}$ | An             | Full | 1.3                                | 25.3 | 1.1                               | 16.7 | 1.1                               | 18.5 | 1.3                             | 13.5 | ns   |
| $t_{PZL}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PZH}$ | $\overline{OE}$ | Bn             | Full | 2.0                                | 16.7 | 1.5                               | 15.6 | 1.3                               | 24.7 | 1.2                             | 22.3 | ns   |
| $t_{PZL}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |

(1) This parameter is ensured by design and/or characterization and is not tested in production.

### 8.5.3 $V_{CCA}=3.3V\pm0.3V$

over recommended operating free-air temperature range, Full=-40°C to 125°C.

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEMP | $V_{CCB}=1.8V$<br>$\pm0.15V^{(1)}$ |      | $V_{CCB}=2.5V$<br>$\pm0.2V^{(1)}$ |      | $V_{CCB}=3.3V$<br>$\pm0.3V^{(1)}$ |      | $V_{CCB}=5V$<br>$\pm0.5V^{(1)}$ |      | UNIT |
|-----------|-----------------|----------------|------|------------------------------------|------|-----------------------------------|------|-----------------------------------|------|---------------------------------|------|------|
|           |                 |                |      | MIN                                | MAX  | MIN                               | MAX  | MIN                               | MAX  | MIN                             | MAX  |      |
| $t_{PLH}$ | An              | Bn             | Full | 1.6                                | 23.7 | 1.5                               | 16.7 | 0.8                               | 15.6 | 0.6                             | 15.6 | ns   |
| $t_{PHL}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PLH}$ | Bn              | An             | Full | 0.8                                | 18.9 | 0.7                               | 15.7 | 0.7                               | 15.6 | 0.7                             | 15.8 | ns   |
| $t_{PHL}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PHZ}$ | $\overline{OE}$ | An             | Full | 1.7                                | 27.3 | 1.6                               | 17.6 | 1.5                               | 20.5 | 1.5                             | 15.7 | ns   |
| $t_{PLZ}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PHZ}$ | $\overline{OE}$ | Bn             | Full | 2.4                                | 21.9 | 2.0                               | 19.7 | 1.7                               | 20.4 | 0.9                             | 19.7 | ns   |
| $t_{PLZ}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PZH}$ | $\overline{OE}$ | An             | Full | 0.9                                | 23.7 | 0.9                               | 16.5 | 0.7                               | 17.9 | 0.9                             | 13.7 | ns   |
| $t_{PZL}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PZH}$ | $\overline{OE}$ | Bn             | Full | 2.3                                | 13.8 | 1.4                               | 14.4 | 1.6                               | 17.3 | 1.1                             | 17.5 | ns   |
| $t_{PZL}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |

(1) This parameter is ensured by design and/or characterization and is not tested in production.

### 8.5.4 $V_{CCA}=5V\pm0.5V$

over recommended operating free-air temperature range, Full=-40°C to 125°C.

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEMP | $V_{CCB}=1.8V$<br>$\pm0.15V^{(1)}$ |      | $V_{CCB}=2.5V$<br>$\pm0.2V^{(1)}$ |      | $V_{CCB}=3.3V$<br>$\pm0.3V^{(1)}$ |      | $V_{CCB}=5V$<br>$\pm0.5V^{(1)}$ |      | UNIT |
|-----------|-----------------|----------------|------|------------------------------------|------|-----------------------------------|------|-----------------------------------|------|---------------------------------|------|------|
|           |                 |                |      | MIN                                | MAX  | MIN                               | MAX  | MIN                               | MAX  | MIN                             | MAX  |      |
| $t_{PLH}$ | An              | Bn             | Full | 1.6                                | 23.5 | 1.4                               | 16.2 | 0.8                               | 15.8 | 0.5                             | 15.5 | ns   |
| $t_{PHL}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PLH}$ | Bn              | An             | Full | 0.6                                | 18.8 | 0.5                               | 16.9 | 0.5                               | 15.3 | 0.5                             | 15.4 | ns   |
| $t_{PHL}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PHZ}$ | $\overline{OE}$ | An             | Full | 0.4                                | 27.9 | 0.4                               | 17.4 | 0.5                               | 19.7 | 0.5                             | 15.6 | ns   |
| $t_{PLZ}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PHZ}$ | $\overline{OE}$ | Bn             | Full | 2.5                                | 14.9 | 1.9                               | 14.6 | 1.6                               | 14.6 | 0.8                             | 14.8 | ns   |
| $t_{PLZ}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PZH}$ | $\overline{OE}$ | An             | Full | 0.8                                | 24.8 | 0.8                               | 16.6 | 0.7                               | 18.5 | 0.7                             | 13.5 | ns   |
| $t_{PZL}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |
| $t_{PZH}$ | $\overline{OE}$ | Bn             | Full | 1.7                                | 12.8 | 1.4                               | 12.8 | 1.2                               | 12.8 | 1.0                             | 12.8 | ns   |
| $t_{PZL}$ |                 |                |      |                                    |      |                                   |      |                                   |      |                                 |      |      |

(1) This parameter is ensured by design and/or characterization and is not tested in production.

## 8.6 Operating Characteristics

$T_A=25^\circ C$

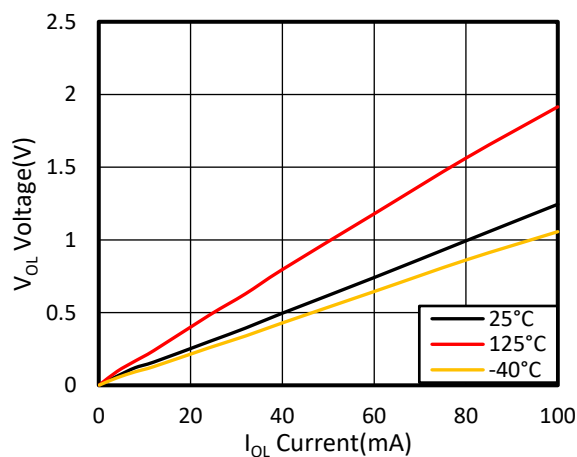
| PARAMETER       |                             | TEST<br>CONDITIONS                      | $V_{CCA}=$<br>$V_{CCB}=1.8V$ | $V_{CCA}=$<br>$V_{CCB}=2.5V$ | $V_{CCA}=$<br>$V_{CCB}=3.3V$ | $V_{CCA}=$<br>$V_{CCB}=5V$ | UNIT |
|-----------------|-----------------------------|-----------------------------------------|------------------------------|------------------------------|------------------------------|----------------------------|------|
|                 |                             |                                         | TYP                          | TYP                          | TYP                          | TYP                        |      |
| $C_{pdA}^{(1)}$ | A-port input, B-port output | $C_L=0,$<br>$f=10MHz,$<br>$t_r=t_f=5ns$ | 3                            | 4                            | 6                            | 9                          | pF   |
|                 | B-port input, A-port output |                                         | 14                           | 17                           | 22                           | 32                         |      |
| $C_{pdB}^{(1)}$ | A-port input, B-port output |                                         | 14                           | 16                           | 21                           | 32                         |      |
|                 | B-port input, A-port output |                                         | 3                            | 4                            | 6                            | 9                          |      |

(1) Power dissipation capacitance per transceiver.

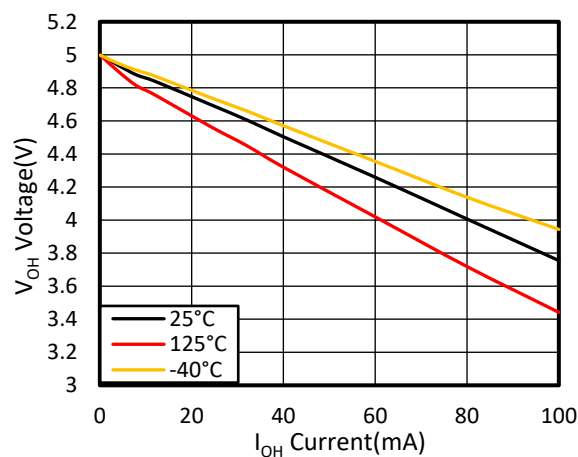
## 8.7 Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

At  $T_A = +25^{\circ}\text{C}$ ,  $V_{CCA}=5\text{V}$ ,  $V_{CCB}=5\text{V}$ , unless otherwise noted.

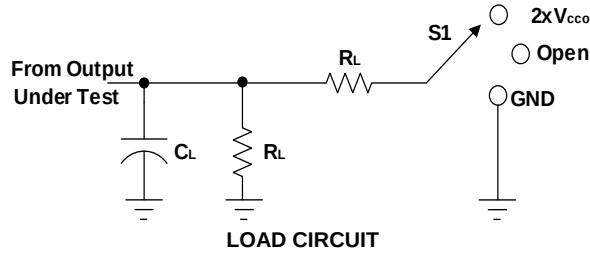


**Figure 1. Voltage vs Current**



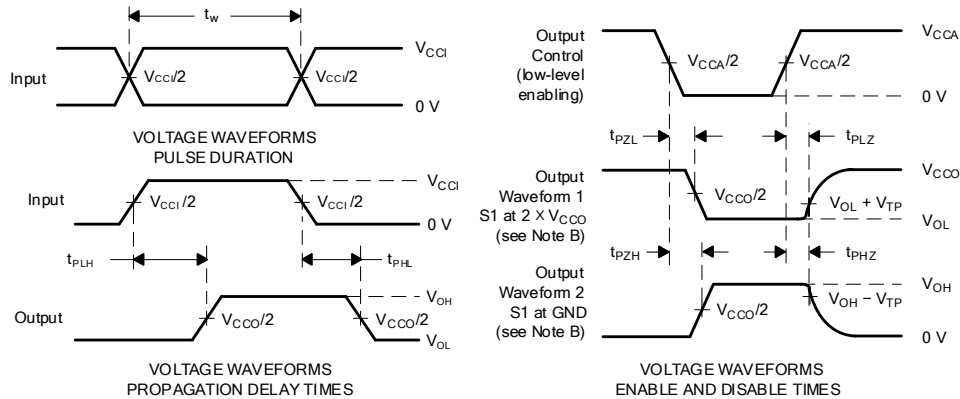
**Figure 2. Voltage vs Current**

## 9 Parameter Measurement Information



| TEST                               | S1                   |
|------------------------------------|----------------------|
| t <sub>pd</sub>                    | Open                 |
| t <sub>PLZ</sub> /t <sub>PZL</sub> | 2 x V <sub>CCO</sub> |
| t <sub>PHZ</sub> /t <sub>PZH</sub> | GND                  |

| V <sub>CC</sub> | C <sub>L</sub> | R <sub>L</sub> | V <sub>TP</sub> |
|-----------------|----------------|----------------|-----------------|
| 1.8V±0.15V      | 15pF           | 2kΩ            | 0.15V           |
| 2.5V±0.2V       | 15pF           | 2kΩ            | 0.15V           |
| 3.3V±0.3V       | 15pF           | 2kΩ            | 0.3V            |
| 5V±0.5V         | 15pF           | 2kΩ            | 0.3V            |



NOTES: A. C<sub>L</sub> includes probe and jig capacitance.

B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control.

Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.

C. All input pulses are supplied by generators having the following characteristics: PRR≤10 MHz, Z<sub>o</sub> = 50 Ω, dv/dt≥1V/ns.

D. The outputs are measured one at a time, with one transition per measurement.

E. t<sub>PLZ</sub> and t<sub>PHZ</sub> are the same as t<sub>dis</sub>.

F. t<sub>PZL</sub> and t<sub>PZH</sub> are the same as t<sub>en</sub>.

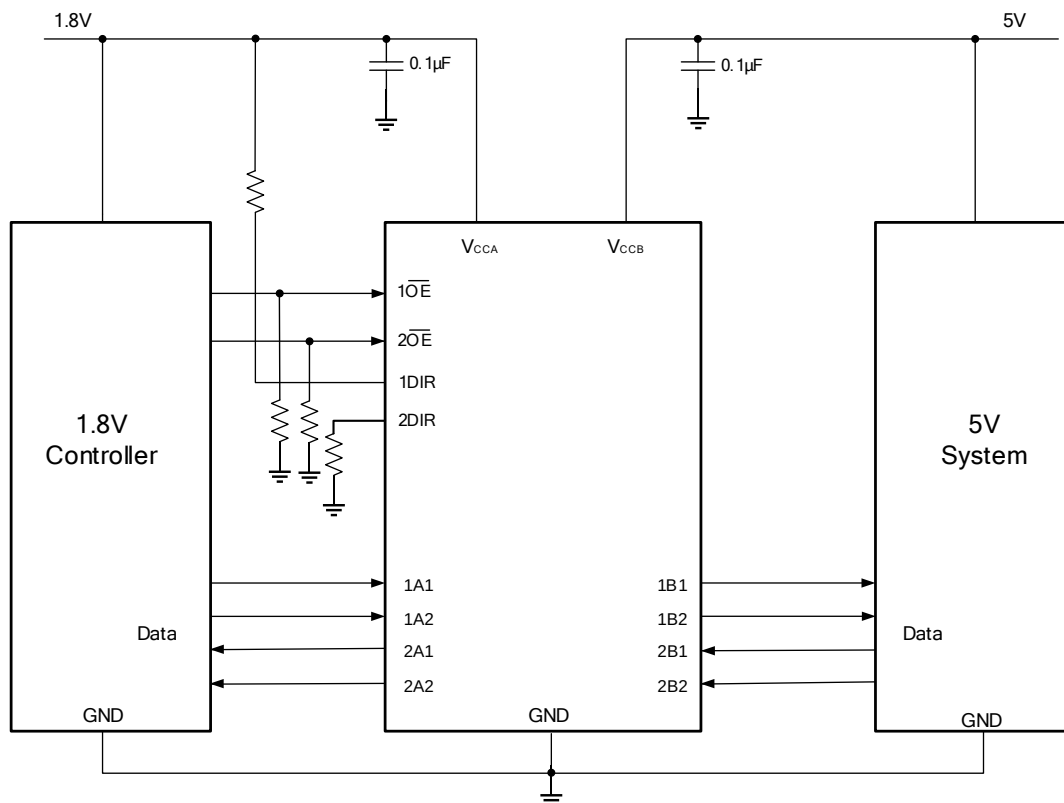
G. t<sub>PLH</sub> and t<sub>PHL</sub> are the same as t<sub>pd</sub>.

H. All parameters and waveforms are not applicable to all devices.

Figure 3. Load Circuit and Voltage Waveforms

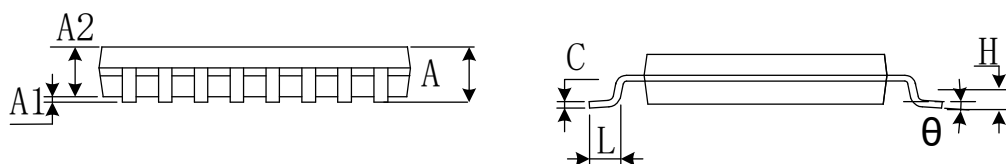
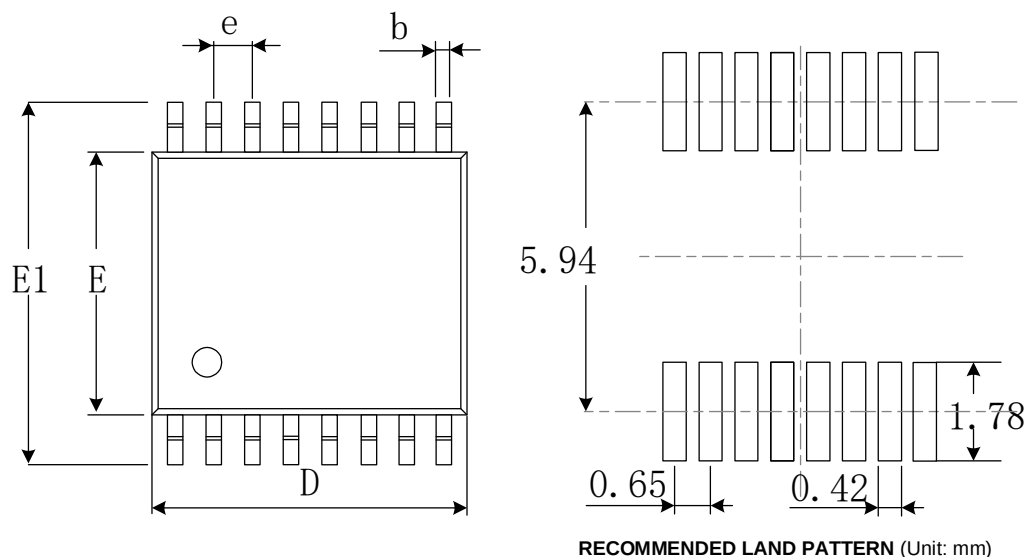
## 10 Application Information

The RS4T245 device can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. The maximum output current can be up to 32 mA when device is powered by 5 V.



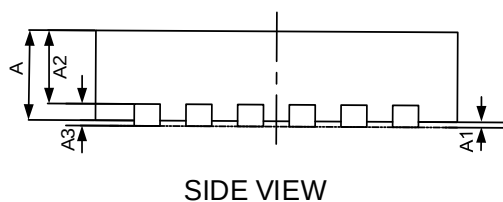
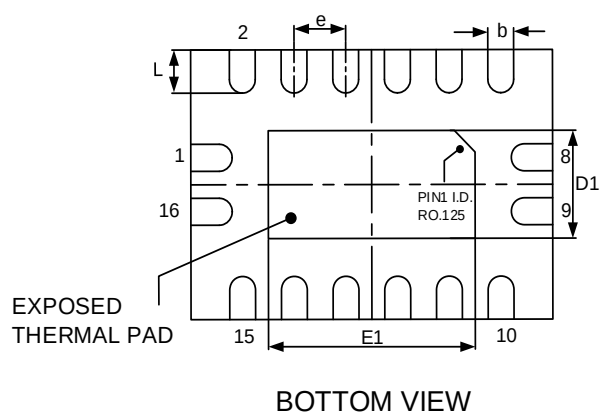
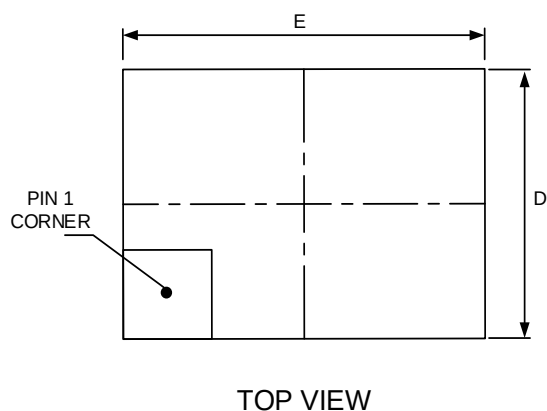
**Figure 4. Typical Application Circuit**

# 11 PACKAGE OUTLINE DIMENSIONS TSSOP-16



| Symbol   | Dimensions In Millimeters |       | Dimensions In Inches |       |
|----------|---------------------------|-------|----------------------|-------|
|          | Min                       | Max   | Min                  | Max   |
| A        |                           | 1.200 |                      | 0.047 |
| A1       | 0.050                     | 0.150 | 0.002                | 0.006 |
| A2       | 0.800                     | 1.050 | 0.031                | 0.041 |
| b        | 0.190                     | 0.300 | 0.007                | 0.012 |
| c        | 0.090                     | 0.200 | 0.004                | 0.008 |
| D        | 4.860                     | 5.100 | 0.191                | 0.201 |
| E        | 4.300                     | 4.500 | 0.169                | 0.177 |
| E1       | 6.200                     | 6.600 | 0.244                | 0.260 |
| e        | 0.650(BSC)                |       | 0.026(BSC)           |       |
| L        | 0.500                     | 0.700 | 0.02                 | 0.028 |
| H        | 0.250 TYP                 |       | 0.010 TYP            |       |
| $\theta$ | 1°                        | 7°    | 1°                   | 7°    |

## QFN2.5x3.5-16L



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min                       | Max   | Min                  | Max   |
| A      | 0.800                     | 1.000 | 0.031                | 0.039 |
| A1     | 0.000                     | 0.050 | 0.000                | 0.002 |
| A2     | 0.600                     | 0.700 | 0.024                | 0.028 |
| A3     | 0.203(REF)                |       | 0.008(REF)           |       |
| D      | 2.400                     | 2.600 | 0.094                | 0.102 |
| E      | 3.400                     | 3.600 | 0.134                | 0.142 |
| e      | 0.500(BSC)                |       | 0.020(BSC)           |       |
| b      | 0.180                     | 0.300 | 0.007                | 0.012 |
| L      | 0.300                     | 0.500 | 0.012                | 0.020 |
| D1     | 0.850                     | 1.150 | 0.033                | 0.045 |
| E1     | 1.850                     | 2.150 | 0.073                | 0.085 |

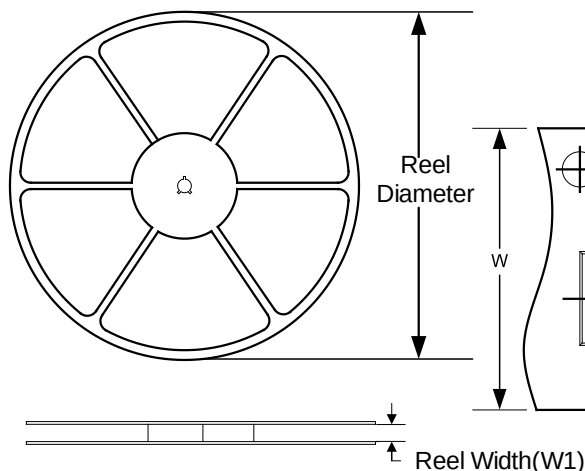
## NOTE:

- A. All linear dimension is in millimeters.
- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
- D. BSC: Basic Dimension. Theoretically exact value shown without tolerances.
- E. REF: Reference Dimension, usually without tolerance, for information purposes only.

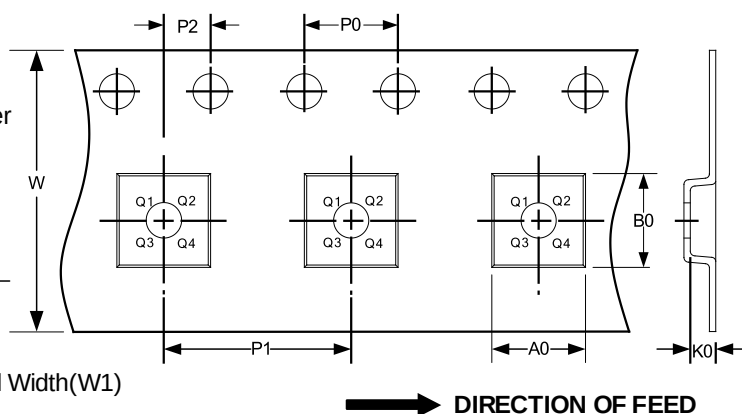


## 12 TAPE AND REEL INFORMATION

### REEL DIMENSIONS



### TAPE DIMENSION



NOTE: The picture is only for reference. Please make the object as the standard.

### KEY PARAMETER LIST OF TAPE AND REEL

| Package Type   | Reel Diameter | Reel Width (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P0 (mm) | P1 (mm) | P2 (mm) | W (mm) | Pin1 Quadrant |
|----------------|---------------|-----------------|---------|---------|---------|---------|---------|---------|--------|---------------|
| TSSOP16        | 13"           | 12.4            | 6.90    | 5.60    | 1.20    | 4.0     | 8.0     | 2.0     | 12.0   | Q1            |
| QFN2.5x3.5-16L | 7"            | 15.0            | 2.80    | 3.80    | 1.20    | 4.0     | 4.0     | 2.0     | 12.0   | Q1            |

NOTE:

1. All dimensions are nominal.
2. Plastic or metal protrusions of 0.15mm maximum per side are not included.

## IMPORTANT NOTICE AND DISCLAIMER

Jiangsu Runic Technology Co., Ltd. will accurately and reliably provide technical and reliability data (including data sheets), design resources (including reference designs), application or other design advice, WEB tools, safety information and other resources, without warranty of any defect, and will not make any express or implied warranty, including but not limited to the warranty of merchantability Implied warranty that it is suitable for a specific purpose or does not infringe the intellectual property rights of any third party.

These resources are intended for skilled developers designing with Runic products You will be solely responsible for: (1) Selecting the appropriate products for your application; (2) Designing, validating and testing your application; (3) Ensuring your application meets applicable standards and any other safety, security or other requirements; (4) Runic and the Runic logo are registered trademarks of Runic Incorporated. All trademarks are the property of their respective owners; (5) For change details, review the revision history included in any revised document. The resources are subject to change without notice. Our company will not be liable for the use of this product and the infringement of patents or third-party intellectual property rights due to its use.