



# THE DATASHEET OF TB3R1D





## QUAD DIFFERENTIAL PECL RECEIVERS

 Check for Samples: [TB3R1](#), [TB3R2](#)

### FEATURES

- Low-Voltage Functional Replacements for the Agere BRF1A, BRF2A, BRS2A, and BRS2B
- Pin-Equivalent to General Trade 26LS32 Devices
- High-Input Impedance Approximately 8 kΩ
- 3.5-ns Maximum Propagation Delay
- TB3R1 Provides 50-mV Hysteresis
- TB3R2 With -125-mV Threshold Offset for Preferred State Output
- -0.5-V to 5.2-V Common Mode Range
- Single 3.3 V ±10% Supply
- Slew Rate Limited (0.5 ns min 80% to 20%)
- TB3R2 Output Defaults to Logic 1 When Inputs Left Open or Shorted to V<sub>CC</sub> or GND
- ESD Protection HBM > 3 kV, CDM > 2 kV
- Operating Temperature Range: -40°C to 85°C
- Available SOIC (D) Package

### APPLICATIONS

- Digital Data or Clock Transmission Over Balanced Lines

### DESCRIPTION

These quad differential receivers accept digital data over balanced transmission lines. They translate differential input logic levels to TTL output logic levels.

The TB3R1 is a pin- and function-compatible replacement for the Agere Systems BRF1A and BRF2A; it includes 3-kV HBM and 2-kV CDM ESD protection.

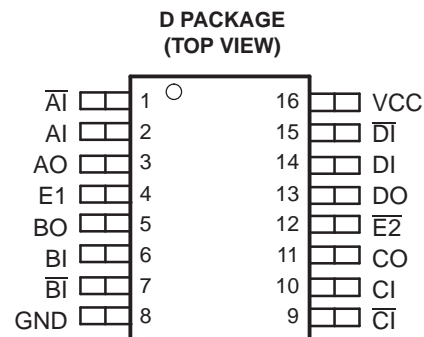
The TB3R2 is a pin- and function-compatible replacement for the Agere Systems BRS2A and BRS2B and incorporates a -125-mV receiver input offset, preferred state output, 3-kV HBM and 2-kV CDM ESD protection. The TB3R2 preferred state feature places the output in the high state when the inputs are open, shorted to ground, or shorted to the power supply.

The power-down loading characteristics of the receiver input circuit are approximately 8 kΩ relative to the power supplies; hence they do not load the transmission line when the circuit is powered down.

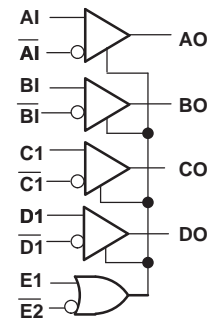
The package for these differential line receivers is the 16-pin SOIC (D) package.

The enable inputs of this device include internal pullup resistors of approximately 40 kΩ that are connected to V<sub>CC</sub> to ensure a logical high level input if the inputs are open circuited.

### PIN ASSIGNMENTS



### FUNCTIONAL BLOCK DIAGRAM



Enable Truth Table

| E1 | E2 | CONDITION |
|----|----|-----------|
| 0  | 0  | Active    |
| 1  | 0  | Active    |
| 0  | 1  | Disabled  |
| 1  | 1  | Active    |



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.

### ORDERING INFORMATION

| PART NUMBER | PART MARKING | Package | LEAD FINISH | STATUS     |
|-------------|--------------|---------|-------------|------------|
| TB3R1D      | TB3R1        | SOIC    | NiPdAu      | Production |
| TB3R2D      | TB3R2        | SOIC    | NiPdAu      | Production |

### POWER DISSIPATION RATINGS

| PACKAGE | CIRCUIT BOARD MODEL   | POWER RATING<br>$T_A \leq 25^\circ\text{C}$ | THERMAL RESISTANCE,<br>JUNCTION-TO-AMBIENT<br>WITH NO AIR FLOW | DERATING FACTOR <sup>(1)</sup><br>$T_A \geq 25^\circ\text{C}$ | POWER RATING<br>$T_A = 85^\circ\text{C}$ |
|---------|-----------------------|---|--|---|--|
| D       | Low-K <sup>(1)</sup>  | 763 mW                                      | 131.1°C/W  | 7.6 mW/°C   | 305 mW                                   |
|         | High-K <sup>(2)</sup> | 1190 mW                                     | 84.1°C/W   | 11.9 mW/°C  | 475 mW                                   |
| DW      | Low-K <sup>(1)</sup>  | 831 mW                                      | 120.3°C/W  | 8.3 mW/°C   | 332 mW                                   |
|         | High-K <sup>(2)</sup> | 1240 mW                                     | 80.8°C/W   | 12.4 mW/°C  | 494 mW                                   |

(1) In accordance with the low-K thermal metric definitions of EIA/JESD51-3.

(2) In accordance with the high-K thermal metric definitions of EIA/JESD51-7.

### THERMAL CHARACTERISTICS

| PARAMETER     |                                      | PACKAGE | VALUE | UNIT |
|---------------|--------------------------------------|---------|-------|------|
| $\theta_{JB}$ | Junction-to-Board Thermal Resistance | D       | 47.5  | °C/W |
|               |                                      | DW      | 53.7  | °C/W |
| $\theta_{JC}$ | Junction-to-Case Thermal Resistance  | D       | 44.2  | °C/W |
|               |                                      | DW      | 47.1  | °C/W |

### ABSOLUTE MAXIMUM RATINGS

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

|  |                                     |          | UNIT                         |
|--|-------------------------------------|----------|------------------------------|
| Supply voltage, $V_{CC}$   |                                     |          | 0 V to 6 V                   |
| Magnitude of differential bus (input) voltage, $ V_{AI} - V $ , $ V_{BI} - V $ , $ V_{CI} - V $ , $ V_{DI} - V $ |                                     |          | 6.5 V                        |
| ESD  | Human Body Model <sup>(2)</sup>     | All pins | ±3 kV                        |
|  | Charged-Device Model <sup>(3)</sup> | All pins | ±2 kV                        |
| Continuous power dissipation   |                                     |          | See Dissipation Rating Table |
| Storage temperature, $T_{stg}$   |                                     |          | -65°C to 150°C               |

(1) Stresses beyond those listed under, "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under, "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) Tested in accordance with JEDEC Standard 22, Test Method A114-A.

(3) Tested in accordance with JEDEC Standard 22, Test Method C101.

## RECOMMENDED OPERATING CONDITIONS

|  | MIN                 | Nom | MAX | UNIT |
|--|---------------------|-----|-----|------|
| Supply voltage, $V_{CC}$   | 3                   | 3.3 | 3.6 | V    |
| Bus pin input voltage, $V_{AI}$ , V, $V_{BI}$ , V, $V_{CI}$ , V, $V_{DI}$ , V                              | -0.6 <sup>(1)</sup> |     | 5.3 | V    |
| Magnitude of differential input voltage, $ V_{AI} - V $ , $ V_{BI} - V $ , $ V_{CI} - V $ , $ V_{DI} - V $ | 0.1                 |     | 5   | V    |
| Operating free-air temperature, $T_A$  | -40                 |     | 85  | °C   |

(1) The algebraic convention, in which the least positive (most negative) limit is designated as minimum is used in this data sheet, unless otherwise noted.

## DEVICE ELECTRICAL CHARACTERISTICS

over operating free-air temperature range unless otherwise noted

| PARAMETER |                               | TEST CONDITIONS  | MIN | TYP | MAX | UNIT |
|-----------|-------------------------------|------------------|-----|-----|-----|------|
| $I_{CC}$  | Supply current <sup>(1)</sup> | Outputs disabled |     |     | 34  | mA   |
|           |                               | Outputs enabled  |     |     | 32  | mA   |

(1) Current is dc power draw as measured through GND pin and does not include power delivered to load.

## ELECTRICAL CHARACTERISTICS

over operating free-air temperature range unless otherwise noted

| parameter  |   | test conditions  | min                     | typ | max                 | unit          |
|------------|---|--|-------------------------|-----|---------------------|---------------|
| $V_{OL}$   | Output low voltage  | $V_{CC} = 3\text{ V}$ , $I_{OL} = 8\text{ mA}$             |                         |     | 0.4                 | V             |
| $V_{OH}$   | Output high voltage   | $V_{CC} = 3\text{ V}$ , $I_{OH} = -400\text{ }\mu\text{A}$ | 2.4                     |     |                     | V             |
| $V_{IL}$   | Low level enable input voltage <sup>(1)</sup>   | $V_{CC} = 3.6\text{ V}$                                    |                         |     | 0.8                 | V             |
| $V_{IH}$   | High level enable input voltage <sup>(1)</sup>  | $V_{CC} = 3.6\text{ V}$                                    | 2                       |     |                     | V             |
| $V_{IK}$   | Enable input clamp voltage  | $V_{CC} = 3\text{ V}$ , $I_I = -5\text{ mA}$               |                         |     | -1 <sup>(2)</sup>   | V             |
| $V_{TH+}$  | Positive-going differential input threshold voltage <sup>(1)</sup> , ( $V_{xI} - V$ ) | x = A, B, C, or D  | TB3R1                   |     | 100                 | mV            |
|            |   |  | TB3R2 <sup>(3)</sup>    |     | -50                 | mV            |
| $V_{TH-}$  | Negative-going differential input threshold voltage <sup>(1)</sup> , ( $V_{xI} - V$ ) | x = A, B, C, or D  | TB3R1                   |     | -100 <sup>(2)</sup> | mV            |
|            |   |  | TB3R2 <sup>(3)</sup>    |     | -200 <sup>(2)</sup> | mV            |
| $V_{HYST}$ | Differential input threshold voltage hysteresis, ( $V_{TH+} - V_{TH-}$ )              | TB3R1  |                         | 50  |                     | mV            |
| $I_{OZL}$  | Output off-state current, (High-Z)  | $V_{CC} = 3.6\text{ V}$                                    | $V_O = 0.4\text{ V}$    |     | -20 <sup>(2)</sup>  | $\mu\text{A}$ |
| $I_{OZH}$  |   |  | $V_O = 2.4\text{ V}$    |     | 20                  | $\mu\text{A}$ |
| $I_{OS}$   | Output short circuit current <sup>(4)</sup>   | $V_{CC} = 3.6\text{ V}$                                    |                         |     | -100 <sup>(2)</sup> | mA            |
| $I_{IL}$   | Enable input low current  | $V_{CC} = 3.6\text{ V}$ , $V_{IN} = 0.4\text{ V}$          |                         |     | -400 <sup>(2)</sup> | $\mu\text{A}$ |
| $I_{IH}$   | Enable input high current   | $V_{CC} = 3.6\text{ V}$                                    | $V_{IN} = 2.7\text{ V}$ |     | 20                  | $\mu\text{A}$ |
|            | Enable input reverse current  |  | $V_{IN} = 3.6\text{ V}$ |     | 100                 | $\mu\text{A}$ |
| $I_{IL}$   | Differential input low current  | $V_{CC} = 3.6\text{ V}$ , $V_{IN} = -1.2\text{ V}$         |                         |     | -2 <sup>(2)</sup>   | mA            |
| $I_{IH}$   | Differential input high current   | $V_{CC} = 3.6\text{ V}$ , $V_{IN} = 5.3\text{ V}$          |                         |     | 1                   | mA            |
| $R_O$      | Output resistance   |  |                         | 20  |                     | $\Omega$      |

- (1) The input levels and difference voltage provide no noise immunity and should be tested only in a static, noise-free environment.
- (2) This parameter is listed using a magnitude and polarity/direction convention, rather than an algebraic convention, to match the original Agere data sheet.
- (3) Outputs of unused receivers assume a logic 1 level when the inputs are left open. (It is recommended that all unused positive inputs be tied to the positive power supply. No external series resistor is required.)
- (4) Test must be performed one lead at a time to prevent damage to the device.

## SWITCHING CHARACTERISTICS

over operating free-air temperature range unless otherwise noted

| parameter             |   | test conditions   | min | typ | max | unit |
|-----------------------|---|---|-----|-----|-----|------|
| $t_{PLH}$             | Propagation delay time, low-to-high-level output                        | $C_L = 0 \text{ pF}^{(1)}$ , See Figure 2 and Figure 4  | 1.8 | 3.5 |     | ns   |
| $t_{PHL}$             | Propagation delay time, high-to-low-level output                        |   | 1.8 | 3.5 |     |      |
| $t_{PLH}$             | Propagation delay time, low-to-high-level output                        | $C_L = 15 \text{ pF}$ , See Figure 2 and Figure 4   | 2.3 | 4   |     | ns   |
| $t_{PHL}$             | Propagation delay time, high-to-low-level output                        |   | 2.3 | 4   |     |      |
| $t_{PHZ}$             | Output disable time, high-level-to-high-impedance output <sup>(2)</sup> | $C_L = 5 \text{ pF}$ See Figure 3 and Figure 5  | 4.4 | 12  |     | ns   |
| $t_{PLZ}$             | Output disable time, low-level-to-high-impedance output <sup>(2)</sup>  |   | 3.3 | 12  |     |      |
| $t_{skew1}$           | Pulse width distortion, $ t_{PHL} - t_{PLH} $                           | $C_L = 10 \text{ pF}$ , See Figure 2 and Figure 4   |     | 0.7 |     | ns   |
|                       |   | $C_L = 150 \text{ pF}$ , See Figure 2 and Figure 4  |     |     | 4   | ns   |
| $\Delta t_{skew1p-p}$ | Part-to-part output waveform skew <sup>(3)</sup>                        | $C_L = 10 \text{ pF}$ , $T_A = 75^\circ\text{C}$ , See Figure 2 and Figure 4                        | 0.8 | 1.4 |     | ns   |
|                       |   | $C_L = 10 \text{ pF}$ , $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ , See Figure 2 and Figure 4 |     |     | 1.5 | ns   |
| $\Delta t_{skew}$     | Same part output waveform skew <sup>(3)</sup>                           | $C_L = 10 \text{ pF}$ , See Figure 2 and Figure 4   |     | 0.3 |     | ns   |
| $t_{PZH}$             | Output enable time, high-impedance-to-high-level output <sup>(2)</sup>  | $C_L = 10 \text{ pF}$ , See Figure 3 and Figure 4   |     | 6   | 12  | ns   |
| $t_{PZL}$             | Output enable time, high-impedance-to-low-level output <sup>(2)</sup>   |   |     | 4   | 12  |      |
| $t_{TLH}$             | Rise time (20%-80%)   | $C_L = 10 \text{ pF}$ , See Figure 2 and Figure 4   | 0.5 |     | 2   | ns   |
| $t_{THL}$             | Fall time (80%-20%)   |   | 0.5 |     | 2   |      |

(1) The propagation delay values with a 0 pF load are based on design and simulation.

(2) See Table 1.

(3) Output waveform skews are when devices operate with the same supply voltage, same temperature, have the same packages and the same test circuits.

## TYPICAL CHARACTERISTICS

Parametric values specified under the Electrical Characteristics and Timing Characteristics sections for the data transmission driver devices are measured with the following output load circuits.

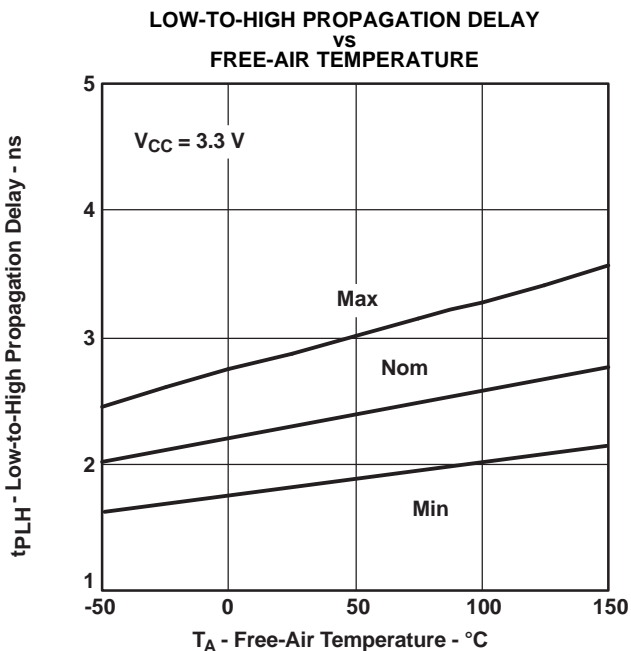


Figure 6.

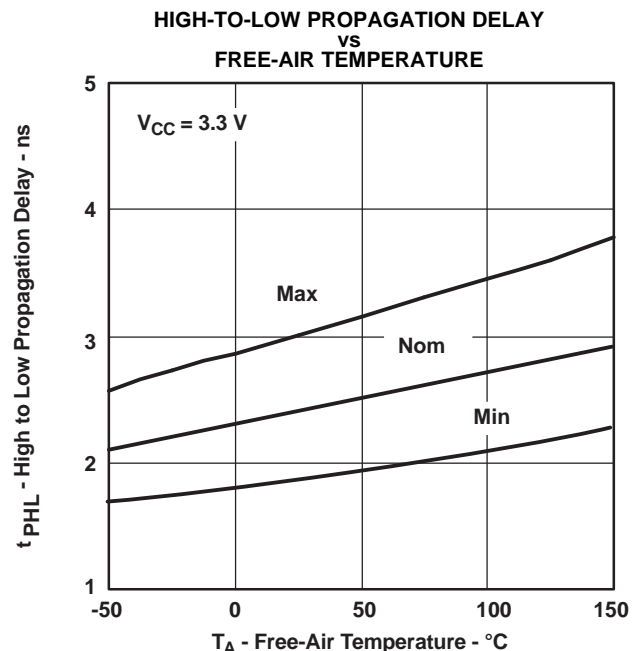
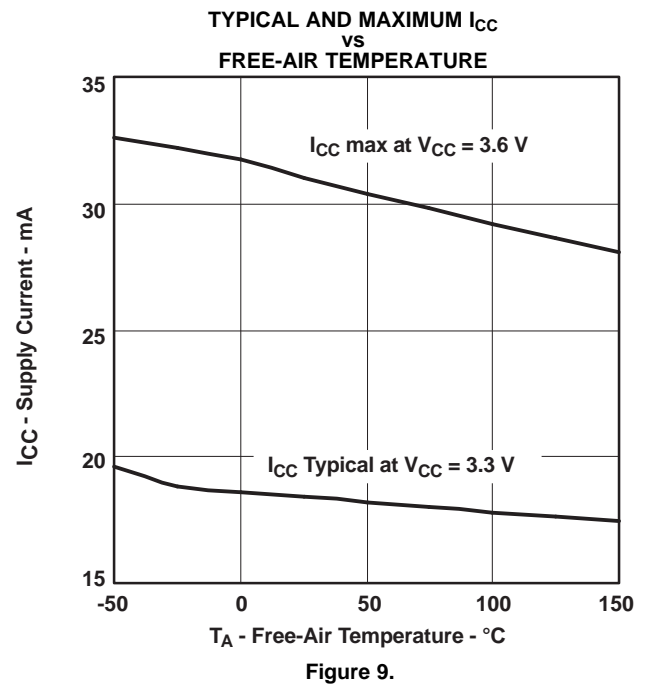
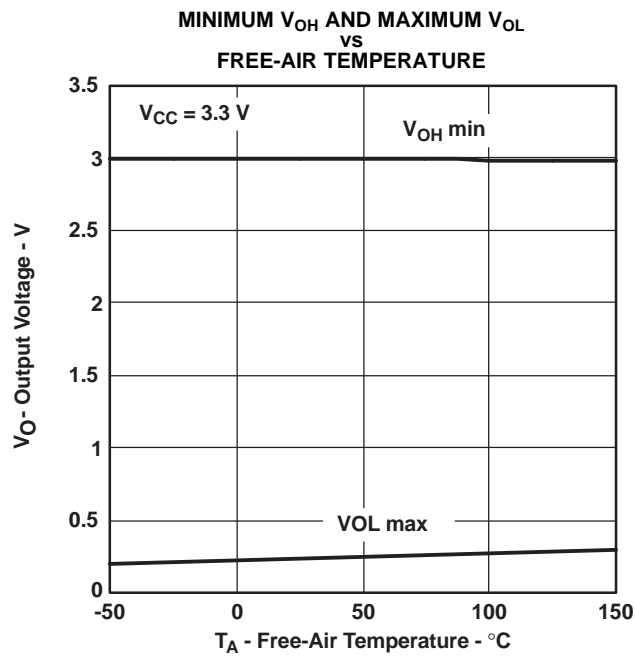


Figure 7.

TYPICAL CHARACTERISTICS (continued)



## APPLICATION INFORMATION

### Power Dissipation

The power dissipation rating, often listed as the package dissipation rating, is a function of the ambient temperature,  $T_A$ , and the airflow around the device. This rating correlates with the device's maximum junction temperature, sometimes listed in the absolute maximum ratings tables. The maximum junction temperature accounts for the processes and materials used to fabricate and package the device, in addition to the desired life expectancy.

There are two common approaches to estimating the internal die junction temperature,  $T_J$ . In both of these methods, the device internal power dissipation  $P_D$  needs to be calculated. This is done by totaling the supply power(s) to arrive at the system power dissipation:

$$\sum (V_{Sn} \times I_{Sn}) \quad (1)$$

and then subtracting the total power dissipation of the external load(s):

$$\sum (V_{Ln} \times I_{Ln}) \quad (2)$$

The first  $T_J$  calculation uses the power dissipation and ambient temperature, along with one parameter:  $\theta_{JA}$ , the junction-to-ambient thermal resistance, in degrees Celsius per watt.

The product of  $P_D$  and  $\theta_{JA}$  is the junction temperature rise above the ambient temperature. Therefore:

$$T_J = T_A + (P_D \times \theta_{JA}) \quad (3)$$

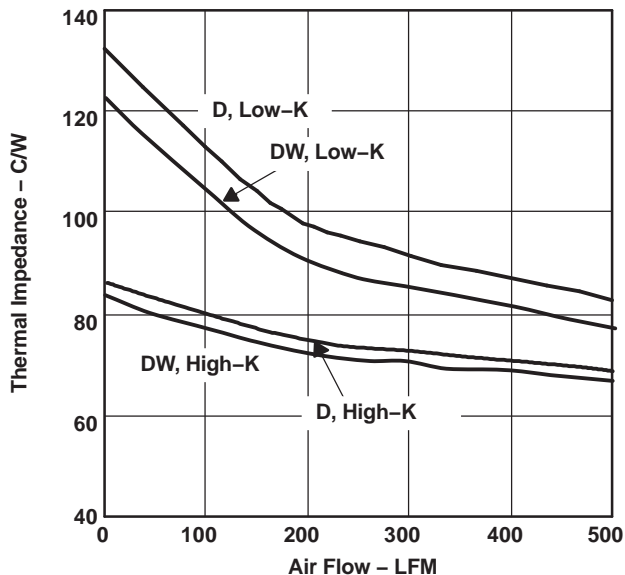


Figure 10. Thermal Impedance vs Air Flow

Note that  $\theta_{JA}$  is highly dependent on the PCB on which the device is mounted, and on the airflow over the device and PCB. JEDEC/EIA has defined standardized test conditions for measuring  $\theta_{JA}$ . Two commonly used conditions are the low-K and the high-K boards, covered by EIA/JESD51-3 and EIA/JESD51-7 respectively. Figure 10 shows the low-K and high-K values of  $\theta_{JA}$  versus air flow for this device and its package options.

The standardized  $\theta_{JA}$  values may not accurately represent the conditions under which the device is used. This can be due to adjacent devices acting as heat sources or heat sinks, to nonuniform airflow, or to the system PCB having significantly different thermal characteristics than the standardized test PCBs. The second method of system thermal analysis is more accurate. This calculation uses the power dissipation and ambient temperature, along with two device and two system-level parameters:

- $\theta_{JC}$ , the junction-to-case thermal resistance, in degrees Celsius per watt
- $\theta_{JB}$ , the junction-to-board thermal resistance, in degrees Celsius per watt
- $\theta_{CA}$ , the case-to-ambient thermal resistance, in degrees Celsius per watt
- $\theta_{BA}$ , the board-to-ambient thermal resistance, in degrees Celsius per watt.

In this analysis, there are two parallel paths, one through the case (package) to the ambient, and another through the device to the PCB to the ambient. The system-level junction-to-ambient thermal impedance,  $\theta_{JA(S)}$ , is the equivalent parallel impedance of the two parallel paths:

$$T_J = T_A + (P_D \times \theta_{JA(S)}) \quad (4)$$

where

$$\theta_{JA(S)} = \frac{[(\theta_{JC} + \theta_{CA}) \times (\theta_{JB} + \theta_{BA})]}{(\theta_{JC} + \theta_{CA} + \theta_{JB} + \theta_{BA})} \quad (5)$$

The device parameters  $\theta_{JC}$  and  $\theta_{JB}$  account for the internal structure of the device. The system-level parameters  $\theta_{CA}$  and  $\theta_{BA}$  take into account details of the PCB construction, adjacent electrical and mechanical components, and the environmental conditions including airflow. Finite element (FE), finite difference (FD), or computational fluid dynamics (CFD) programs can determine  $\theta_{CA}$  and  $\theta_{BA}$ . Details on using these programs are beyond the scope of this data sheet, but are available from the software manufacturers.

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3)                      | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|-------------------------|---|--------------|-------------------------|-------------------------|
| TB3R1D           | ACTIVE        | SOIC         | D               | 16   | 40          | Pb-Free (RoHS)  | CU NIPDAU               | Level-2-250C-1YEAR/<br>Level-1-220C-UNLIM | -40 to 85    | TB3R1                   | <a href="#">Samples</a> |
| TB3R1DR          | ACTIVE        | SOIC         | D               | 16   | 2500        | Pb-Free (RoHS)  | CU NIPDAU               | Level-2-250C-1YEAR/<br>Level-1-220C-UNLIM | -40 to 85    | TB3R1                   | <a href="#">Samples</a> |
| TB3R1DRE4        | ACTIVE        | SOIC         | D               | 16   | 2500        | Pb-Free (RoHS)  | CU NIPDAU               | Level-2-250C-1YEAR/<br>Level-1-220C-UNLIM | -40 to 85    | TB3R1                   | <a href="#">Samples</a> |
| TB3R2D           | ACTIVE        | SOIC         | D               | 16   | 40          | Pb-Free (RoHS)  | CU NIPDAU               | Level-2-250C-1YEAR/<br>Level-1-220C-UNLIM | -40 to 85    | TB3R2                   | <a href="#">Samples</a> |
| TB3R2DR          | ACTIVE        | SOIC         | D               | 16   | 2500        | Pb-Free (RoHS)  | CU NIPDAU               | Level-2-250C-1YEAR/<br>Level-1-220C-UNLIM | -40 to 85    | TB3R2                   | <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.

**OBSELETE:** 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.

## TAPE AND REEL INFORMATION



### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*All dimensions are nominal

| Device  | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TB3R1DR | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| TB3R2DR | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

| Device  | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------|--------------|-----------------|------|------|-------------|------------|-------------|
| TB3R1DR | SOIC         | D               | 16   | 2500 | 350.0       | 350.0      | 43.0        |
| TB3R2DR | SOIC         | D               | 16   | 2500 | 350.0       | 350.0      | 43.0        |

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AC.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

## 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 © 2019, Texas Instruments Incorporated

## Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

 [View TB3R1D on WIN SOURCE](#)

 [Texas Instruments](#) Information

## Optimize Your Supply Chain with WIN SOURCE Solutions

-  Global Sourcing Solution
-  Obsolete Management
-  Cost Control Management
-  Shortage Management
-  Alternative Solution
-  Excess Inventory Management