

# ISO1044 Isolated CAN FD Transceiver in Small Package

## 1 Features

- Meets the ISO 11898-2:2016 physical layer standard
- Supports classic CAN up to 1 Mbps and FD (flexible data rate) up to 5 Mbps
- Protection features
  - DC Bus Fault Protection Voltage:  $\pm 58$  V
  - IEC ESD tolerance on bus pins:  $\pm 8$  kV
  - HBM ESD tolerance on bus pins:  $\pm 10$  kV
  - Driver dominant time out (TXD DTO)
  - Undervoltage protection on  $V_{CC1}$  and  $V_{CC2}$
- Common-mode voltage range:  $\pm 12$  V
- Ideal passive, high impedance bus terminals when unpowered
- High CMTI: 85 kV/ $\mu$ s minimum
- $V_{CC1}$  voltage range: 1.71 V to 5.5 V
  - Supports 1.8-V, 2.5-V, 3.3-V and 5.0-V logic interface to the CAN controller
- $V_{CC2}$  voltage range: 4.5 V to 5.5 V
- Robust electromagnetic compatibility (EMC)
  - System-Level ESD, EFT, and surge Immunity
  - Low Emissions
- Ambient temperature range:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- 8-SOIC package
- **Safety-related certifications:**
  - All certifications planned
  - VDE reinforced insulation per DIN VDE V 0884-11:2017-01
  - UL 1577 component recognition program
  - IEC 60950-1, IEC 62368-1, IEC 61010-1 and GB 4943.1-2011 certifications

## 2 Applications

- **AC and servo drives**
- **Solar inverters**
- **PLC and DCS communication modules**
- **Elevators and escalators**
- **Industrial power supplies**
- **Battery charging and management**

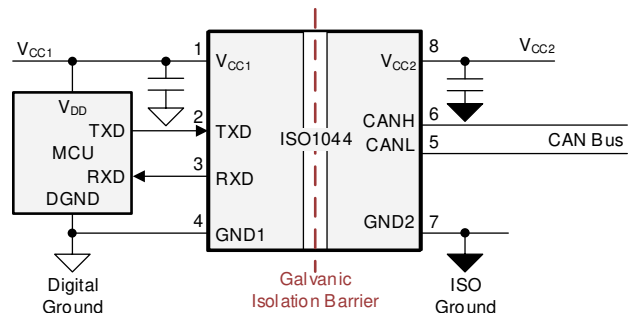
## 3 Description

The ISO1044B device is a galvanically-isolated controller area network (CAN) transceiver that meets the specifications of the ISO11898-2 (2016) standard. The ISO1044B device offers  $\pm 58$ -V DC bus fault protection and  $\pm 12$ -V common-mode voltage range. The device supports up to 5-Mbps data rate in CAN FD mode allowing much faster transfer of payload compared to classic CAN. This device uses a silicon dioxide ( $\text{SiO}_2$ ) insulation barrier with a withstand voltage of  $3000 V_{\text{RMS}}$  and a working voltage of  $450 V_{\text{RMS}}$ . Electromagnetic compatibility has been significantly enhanced to enable system-level ESD, EFT, surge, and emissions compliance. Used in conjunction with isolated power supplies, the device protects against high voltage, and prevents noise currents from the bus from entering the local ground. The ISO1044B device supports a wide ambient temperature range of  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ . The device is available in the small SOIC-8 (D) package which significantly reduces the solution size compared to a traditional approach using optocouplers to isolate the CAN transceiver.

### Device Information

| PART NUMBER <sup>(1)</sup> | PACKAGE  | BODY SIZE (NOM)          |
|----------------------------|----------|--------------------------|
| ISO1044B                   | SOIC (8) | 4.90 mm $\times$ 3.91 mm |

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



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### Application Diagram



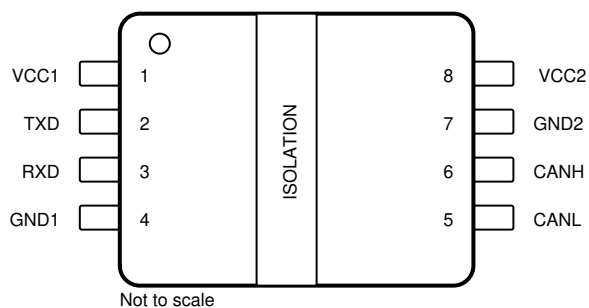
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## 4 Revision History

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

## 5 Pin Configuration and Functions



**Figure 5-1. D Package 8-Pin SOIC Top View**

### Pin Functions—8 Pins

| PIN | NAME             | I/O | DESCRIPTION                                                                  |
|-----|------------------|-----|------------------------------------------------------------------------------|
| 1   | V <sub>CC1</sub> | —   | Digital-side supply voltage, Side 1                                          |
| 2   | TXD              | I   | CAN transmit data input (LOW for dominant and HIGH for recessive bus states) |
| 3   | RXD              | O   | CAN receive data output (LOW for dominant and HIGH for recessive bus states) |
| 4   | GND1             | —   | Digital-side ground connection, Side 1                                       |
| 5   | CANL             | I/O | Low-level CAN bus line                                                       |
| 6   | CANH             | I/O | High-level CAN bus line                                                      |
| 7   | GND2             | —   | Transceiver-side ground connection, Side 2                                   |
| 8   | V <sub>CC2</sub> | —   | Transceiver-side supply voltage, Side 2                                      |

## 6 Specifications

### 6.1 Absolute Maximum Ratings

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

|                       |                                                    | MIN  | MAX                                  | UNIT |
|-----------------------|----------------------------------------------------|------|--------------------------------------|------|
| V <sub>CC1</sub>      | Supply voltage, side 1                             | -0.5 | 6                                    | V    |
| V <sub>CC2</sub>      | Supply voltage, side 2                             | -0.5 | 6                                    | V    |
| V <sub>IO</sub>       | Logic input and output voltage range (TXD and RXD) | -0.5 | V <sub>CC1</sub> +0.5 <sup>(3)</sup> | V    |
| I <sub>O</sub>        | Output current on RXD pin                          | -15  | 15                                   | mA   |
| V <sub>BUS</sub>      | Voltage on bus pins (CANH, CANL)                   | -58  | 58                                   | V    |
| V <sub>BUS_DIFF</sub> | Differential voltage on bus pins (CANH-CANL)       | -45  | 45                                   | V    |
| T <sub>J</sub>        | Junction temperature                               | -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) All voltage values except differential I/O bus voltages are with respect to the local ground terminal (GND1 or GND2) and are peak voltage values.
- (3) Maximum voltage must not exceed 6 V

### 6.2 ESD Ratings

|                        |                                                                                                                                             |                                                    | VALUE  | UNIT |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|--------|------|
| V <sub>(ESD)</sub>     | Electrostatic discharge<br>Human body model (HBM), per ANSI/<br>ESDA/JEDEC JS-001                                                           | All pins <sup>(1)</sup>                            | ±4000  | V    |
|                        |                                                                                                                                             | CANH and CANL to GND2 <sup>(1)</sup>               | ±10000 | V    |
|                        | Electrostatic discharge<br>Charged device model (CDM), per<br>JEDEC specification JESD22-C101                                               | All pins <sup>(2)</sup>                            | ±750   |      |
| V <sub>(IEC_ESD)</sub> | IEC 61000-4-2 System Level Electrostatic<br>discharge (tested directly on device pins<br>with no external components on PCB) <sup>(3)</sup> | Powered, CANH, CANL to bus side<br>ground (GND2)   | ±8000  | V    |
|                        |                                                                                                                                             | Unpowered, CANH, CANL to bus side<br>ground (GND2) | ±12000 | 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.
- (3) External components on bus pins may lead to different results

### 6.3 Recommended Operating Conditions

|                      |                                                            | MIN  | MAX  | UNIT |
|----------------------|------------------------------------------------------------|------|------|------|
| V <sub>CC1</sub>     | Supply Voltage, Side 1, 1.8 V operation                    | 1.71 | 1.89 | V    |
|                      | Supply Voltage, Side 1, 2.5 V, 3.3 V and 5.5 V operation   | 2.25 | 5.5  | V    |
| V <sub>CC2</sub>     | Supply Voltage, Side 2                                     | 4.5  | 5.5  | V    |
| I <sub>OH(RXD)</sub> | High-Level Output current, V <sub>CC1</sub> = 5 V          | -4   |      | mA   |
|                      | High-Level Output current, V <sub>CC1</sub> = 3.3 V        | -2   |      | mA   |
|                      | High-Level Output current, V <sub>CC1</sub> = 2.5 V, 1.8 V | -1   |      | mA   |
| I <sub>OL(RXD)</sub> | Low-level output current, V <sub>CC1</sub> = 5 V           |      | 4    | mA   |
|                      | Low-level output current, V <sub>CC1</sub> = 3.3 V         |      | 2    | mA   |
|                      | Low-level output current, V <sub>CC1</sub> = 2.5 V, 1.8 V  |      | 1    | mA   |
| T <sub>A</sub>       | Operating ambient temperature                              | -40  | 125  | °C   |

## 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                              | ISO1044B | UNIT |
|-------------------------------|----------------------------------------------|----------|------|
|                               |                                              | D (SOIC) |      |
|                               |                                              | 8 PINS   |      |
| R <sub>ΘJA</sub>              | Junction-to-ambient thermal resistance       | 119.5    | °C/W |
| R <sub>ΘJC(top)</sub>         | Junction-to-case (top) thermal resistance    | 44.8     | °C/W |
| R <sub>ΘJB</sub>              | Junction-to-board thermal resistance         | 56.1     | °C/W |
| Ψ <sub>JT</sub>               | Junction-to-top characterization parameter   | 28.7     | °C/W |
| Ψ <sub>JB</sub>               | Junction-to-board characterization parameter | 55.3     | °C/W |
| R <sub>ΘJC(bot)</sub>         | Junction-to-case (bottom) thermal resistance | -        | °C/W |

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

## 6.5 Power Ratings

| PARAMETER       |                                        | TEST CONDITIONS                                                                                                                     | MIN | TYP | MAX | UNIT |
|-----------------|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|------|
| P <sub>D</sub>  | Maximum power dissipation (both sides) | V <sub>CC1</sub> = V <sub>CC2</sub> = 5.5 V, T <sub>J</sub> = 150°C, R <sub>L</sub> = 60 Ω, TXD with 5V, 5Mbps 50% duty square wave |     |     | 146 | mW   |
| P <sub>D1</sub> | Maximum power dissipation (side-1)     | V <sub>CC1</sub> = V <sub>CC2</sub> = 5.5 V, T <sub>J</sub> = 150°C, R <sub>L</sub> = 60 Ω, TXD with 5V, 5Mbps 50% duty square wave |     |     | 15  | mW   |
| P <sub>D2</sub> | Maximum power dissipation (side-2)     | V <sub>CC1</sub> = V <sub>CC2</sub> = 5.5 V, T <sub>J</sub> = 150°C, R <sub>L</sub> = 60 Ω, TXD with 5V, 5Mbps 50% duty square wave |     |     | 131 | mW   |

## 6.6 Insulation Specifications

| PARAMETER                                |                                                       | TEST CONDITIONS                                                                                                                                                                                                    | SPECIFIC ACTIONS   | UNIT             |
|------------------------------------------|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|
|                                          |                                                       |                                                                                                                                                                                                                    | D-8                |                  |
| IEC 60664-1                              |                                                       |                                                                                                                                                                                                                    |                    |                  |
| CLR                                      | External clearance <sup>(1)</sup>                     | Side 1 to side 2 distance through air                                                                                                                                                                              | > 4                | mm               |
| CPG                                      | External Creepage <sup>(1)</sup>                      | Side 1 to side 2 distance across package surface                                                                                                                                                                   | > 4                | mm               |
| DTI                                      | Distance through the insulation                       | Minimum internal gap (internal clearance)                                                                                                                                                                          | >17                | μm               |
| CTI                                      | Comparative tracking index                            | IEC 60112; UL 746A                                                                                                                                                                                                 | >600               | V                |
|                                          | Material Group                                        | According to IEC 60664-1                                                                                                                                                                                           | I                  |                  |
|                                          | Overvoltage category                                  | Rated mains voltage ≤ 150 V <sub>RMS</sub>                                                                                                                                                                         | I-IV               |                  |
|                                          |                                                       | Rated mains voltage ≤ 300 V <sub>RMS</sub>                                                                                                                                                                         | I-III              |                  |
| DIN VDE V 0884-11:2017-01 <sup>(2)</sup> |                                                       |                                                                                                                                                                                                                    |                    |                  |
| V <sub>IORM</sub>                        | Maximum repetitive peak isolation voltage             | AC voltage (bipolar)                                                                                                                                                                                               | 637                | V <sub>PK</sub>  |
| V <sub>IOWM</sub>                        | Maximum isolation working voltage                     | AC voltage (sine wave); time-dependent dielectric breakdown (TDDb) test;                                                                                                                                           | 450                | V <sub>RMS</sub> |
|                                          |                                                       | DC voltage                                                                                                                                                                                                         | 637                | V <sub>DC</sub>  |
| V <sub>IOTM</sub>                        | Maximum transient isolation voltage                   | V <sub>TEST</sub> = V <sub>IOTM</sub> , t = 60 s (qualification); V <sub>TEST</sub> = 1.2 × V <sub>IOTM</sub> , t = 1 s (100% production)                                                                          | 4242               | V <sub>PK</sub>  |
| V <sub>IOSM</sub>                        | Maximum surge isolation voltage <sup>(3)</sup>        | Test method per IEC 62368-1, 1.2/50 μs waveform, V <sub>TEST</sub> = 1.6 × V <sub>IOSM</sub> = 8 kV <sub>PK</sub> (qualification)                                                                                  | 5000               | V <sub>PK</sub>  |
| q <sub>pd</sub>                          | Apparent charge <sup>(4)</sup>                        | Method a: After I/O safety test subgroup 2/3, V <sub>Ini</sub> = V <sub>IOTM</sub> , t <sub>ini</sub> = 60 s; V <sub>pd(m)</sub> = 1.2 × V <sub>IORM</sub> , t <sub>m</sub> = 10 s                                 | ≤ 5                | pC               |
|                                          |                                                       | Method a: After environmental tests subgroup 1, V <sub>ini</sub> = V <sub>IOTM</sub> , t <sub>ini</sub> = 60 s; V <sub>pd(m)</sub> = 1.6 × V <sub>IORM</sub> , t <sub>m</sub> = 10 s                               | ≤ 5                |                  |
|                                          |                                                       | Method b1: At routine test (100% production) and preconditioning (type test), V <sub>ini</sub> = V <sub>IOTM</sub> , t <sub>ini</sub> = 1 s; V <sub>pd(m)</sub> = 1.875 × V <sub>IORM</sub> , t <sub>m</sub> = 1 s | ≤ 5                |                  |
| C <sub>IO</sub>                          | Barrier capacitance, input to output <sup>(5)</sup>   | V <sub>IO</sub> = 0.4 × sin (2 πft), f = 1 MHz                                                                                                                                                                     | ~1                 | pF               |
| R <sub>IO</sub>                          | Insulation resistance, input to output <sup>(5)</sup> | V <sub>IO</sub> = 500 V, T <sub>A</sub> = 25°C                                                                                                                                                                     | > 10 <sup>12</sup> | Ω                |
|                                          |                                                       | V <sub>IO</sub> = 500 V, 100°C ≤ T <sub>A</sub> ≤ 150°C                                                                                                                                                            | > 10 <sup>11</sup> |                  |
|                                          |                                                       | V <sub>IO</sub> = 500 V at T <sub>S</sub> = 150°C                                                                                                                                                                  | > 10 <sup>9</sup>  |                  |
|                                          | Pollution degree                                      |                                                                                                                                                                                                                    | 2                  |                  |
|                                          | Climatic category                                     |                                                                                                                                                                                                                    | 40/125/21          |                  |
| UL 1577                                  |                                                       |                                                                                                                                                                                                                    |                    |                  |
| V <sub>ISO</sub>                         | Withstand isolation voltage                           | V <sub>TEST</sub> = V <sub>ISO</sub> , t = 60 s (qualification); V <sub>TEST</sub> = 1.2 × V <sub>ISO</sub> , t = 1 s (100% production)                                                                            | 3000               | V <sub>RMS</sub> |

- (1) Creepage and clearance requirements should be applied according to the specific equipment isolation standards of an application. Care should be taken to maintain the creepage and clearance distance of a board design to ensure that the mounting pads of the isolator on the printed-circuit board do not reduce this distance. Creepage and clearance on a printed-circuit board become equal in certain cases. Techniques such as inserting grooves, ribs, or both on a printed circuit board are used to help increase these specifications.
- (2) ISO1044B is suitable for *safe electrical insulation* within the safety ratings. Compliance with the safety ratings shall be ensured by means of suitable protective circuits.
- (3) Testing is carried out in air or oil to determine the intrinsic surge immunity of the isolation barrier.
- (4) Apparent charge is electrical discharge caused by a partial discharge (pd).
- (5) All pins on each side of the barrier tied together creating a two-pin device.

## 6.7 Safety-Related Certifications

| VDE                                                                                                                                                                                               | CSA                                                                                                                                              | UL                                                                 | CQC                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| Plan to certify according to DIN V VDE V 0884-11:2017- 01                                                                                                                                         | Plan to certify according to IEC 60950-1, IEC 62368-1                                                                                            | Plan to certify according to UL 1577 Component Recognition Program | Plan to certify according to GB4943.1-2011                                                          |
| Maximum transient isolation voltage,<br>4242 V <sub>PK</sub> ;<br>Maximum repetitive peak isolation voltage,<br>637 V <sub>PK</sub> ;<br>Maximum surge isolation voltage,<br>5000 V <sub>PK</sub> | 400 V <sub>RMS</sub> basic insulation working voltage per CSA 60950-1-07+A1+A2 and IEC 60950-1 2nd Ed., for pollution degree 2, material group I | Single protection,<br>3000 V <sub>RMS</sub>                        | Basic Insulation, Altitude ≤ 5000 m, Tropical Climate, 400 V <sub>RMS</sub> maximum working voltage |
| Certificate planned                                                                                                                                                                               | Certificate planned                                                                                                                              | Certificate planned                                                | Certificate planned                                                                                 |

## 6.8 Safety Limiting Values

Safety limiting<sup>(1)</sup> intends to minimize potential damage to the isolation barrier upon failure of input or output circuitry.

| PARAMETER             |                                         | TEST CONDITIONS                                                                                                                       | MIN | TYP | MAX  | UNIT |
|-----------------------|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-----|-----|------|------|
| <b>SOIC-8 PACKAGE</b> |                                         |                                                                                                                                       |     |     |      |      |
| I <sub>S</sub>        | Safety input, output, or supply current | R <sub>θJA</sub> = 119.5 °C/W, V <sub>I</sub> = 5.5 V, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C, see <a href="#">Figure 6-1</a>  |     |     | 190  | mA   |
|                       |                                         | R <sub>θJA</sub> = 119.5 °C/W, V <sub>I</sub> = 3.6 V, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C, see <a href="#">Figure 6-1</a>  |     |     | 290  | mA   |
|                       |                                         | R <sub>θJA</sub> = 119.5 °C/W, V <sub>I</sub> = 2.75 V, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C, see <a href="#">Figure 6-1</a> |     |     | 380  | mA   |
|                       |                                         | R <sub>θJA</sub> = 119.5 °C/W, V <sub>I</sub> = 1.89 V, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C, see <a href="#">Figure 6-1</a> |     |     | 553  | mA   |
| P <sub>S</sub>        | Safety input, output, or total power    | R <sub>θJA</sub> = 119.5 °C/W, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C, see <a href="#">Figure 6-2</a>                          |     |     | 1044 | mW   |
| T <sub>S</sub>        | Maximum safety temperature              |                                                                                                                                       |     |     | 150  | °C   |

- (1) The maximum safety temperature, T<sub>S</sub>, has the same value as the maximum junction temperature, T<sub>J</sub>, specified for the device. The I<sub>S</sub> and P<sub>S</sub> parameters represent the safety current and safety power respectively. The maximum limits of I<sub>S</sub> and P<sub>S</sub> should not be exceeded. These limits vary with the ambient temperature, T<sub>A</sub>.  
The junction-to-air thermal resistance, R<sub>θJA</sub>, in the table is that of a device installed on a high-K test board for leaded surface-mount packages. Use these equations to calculate the value for each parameter:  
T<sub>J</sub> = T<sub>A</sub> + R<sub>θJA</sub> × P, where P is the power dissipated in the device.  
T<sub>J(max)</sub> = T<sub>S</sub> = T<sub>A</sub> + R<sub>θJA</sub> × P<sub>S</sub>, where T<sub>J(max)</sub> is the maximum allowed junction temperature.  
P<sub>S</sub> = I<sub>S</sub> × V<sub>I</sub>, where V<sub>I</sub> is the maximum input voltage.

## 6.9 Electrical Characteristics - DC Specification

Typical specifications are at  $V_{CC1} = 3.3\text{ V}$ ,  $V_{CC2} = 5\text{ V}$ , Min/Max are over recommended operating conditions (unless otherwise noted)

| PARAMETER                     |                                                       | TEST CONDITIONS                                                                                                 | MIN                  | TYP   | MAX  | UNIT          |
|-------------------------------|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|----------------------|-------|------|---------------|
| <b>SUPPLY CHARACTERISTICS</b> |                                                       |                                                                                                                 |                      |       |      |               |
| $I_{CC1}$                     | Supply current Side 1                                 | $V_{CC1} = 1.71\text{ V to } 1.89\text{ V}$ , TXD = 0 V, bus dominant                                           |                      | 2.3   | 3.5  | mA            |
|                               |                                                       | $V_{CC1} = 2.25\text{ V to } 5.5\text{ V}$ , TXD = 0 V, bus dominant                                            |                      | 2.4   | 3.5  | mA            |
|                               |                                                       | $V_{CC1} = 1.71\text{ V to } 1.89\text{ V}$ , TXD = $V_{CC1}$ , bus recessive                                   |                      | 1.2   | 2.1  | mA            |
|                               |                                                       | $V_{CC1} = 2.25\text{ V to } 5.5\text{ V}$ , TXD = $V_{CC1}$ , bus recessive                                    |                      | 1.3   | 2.1  | mA            |
|                               |                                                       | $V_{CC1} = 4.5\text{ to } 5.5\text{ V}$ , TXD = 1Mbps 50% duty square wave                                      |                      | 1.8   | 2.7  | mA            |
|                               |                                                       | $V_{CC1} = 4.5\text{ to } 5.5\text{ V}$ , TXD = 5Mbps 50% duty square wave                                      |                      | 1.8   | 2.7  | mA            |
| $I_{CC2}$                     | Supply current Side 2                                 | TXD = 0 V, bus dominant, $R_L = 60\ \Omega$                                                                     |                      | 52    | 70   | mA            |
|                               |                                                       | TXD = $V_{CC1}$ , bus recessive, $R_L = 60\ \Omega$                                                             |                      | 5.9   | 9    | mA            |
|                               |                                                       | $V_{CC2} = 4.5\text{ to } 5.5\text{ V}$ , TXD = 1Mbps 50% duty square wave, $R_L = 60\ \text{ohm}$              |                      | 29.5  | 38   | mA            |
|                               |                                                       | $V_{CC2} = 4.5\text{ to } 5.5\text{ V}$ , TXD = 5Mbps 50% duty square wave, $R_L = 60\ \text{ohm}$              |                      | 29.5  | 39   | mA            |
| $UV_{VCC1+}$                  | Rising under voltage detection, Side 1                |                                                                                                                 |                      |       | 1.7  | V             |
| $UV_{VCC1-}$                  | Falling under voltage detection, Side 1               |                                                                                                                 | 1.0                  |       |      | V             |
| $V_{HYS}(UV_{VCC1})$          | Hysteresis voltage on $V_{CC1}$ undervoltage lock-out |                                                                                                                 | 80.0                 | 125   |      | mV            |
| $UV_{VCC2+}$                  | Rising under voltage detection, side 2                |                                                                                                                 |                      | 4.2   | 4.45 | V             |
| $UV_{VCC2-}$                  | Falling under voltage detection, side 2               |                                                                                                                 | 3.8                  | 4.0   | 4.25 | V             |
| $V_{HYS}(UV_{VCC2})$          | Hysteresis voltage on $V_{CC2}$ undervoltage lock-out |                                                                                                                 |                      | 200   |      | mV            |
| <b>TXD TERMINAL</b>           |                                                       |                                                                                                                 |                      |       |      |               |
| $V_{IH}$                      | High level input voltage                              |                                                                                                                 | $0.7 \times V_{CC1}$ |       |      | V             |
| $V_{IL}$                      | Low level input voltage                               |                                                                                                                 | $0.3 \times V_{CC1}$ |       |      | V             |
| $I_{IH}$                      | High level input leakage current                      | TXD = $V_{CC1}$                                                                                                 |                      |       | 1    | $\mu\text{A}$ |
| $I_{IL}$                      | Low level input leakage current                       | TXD = 0V                                                                                                        | -20                  |       |      | $\mu\text{A}$ |
| $C_I$                         | Input capacitance                                     | $V_{IN} = 0.4 \times \sin(2 \times \pi \times 1\text{E}+6 \times t) + 1.65\text{ V}$ , $V_{CC1} = 3.3\text{ V}$ |                      | 2     |      | pF            |
| <b>RXD TERMINAL</b>           |                                                       |                                                                                                                 |                      |       |      |               |
| $V_{OH} - V_{CC1}$            | High level output voltage                             | See Figure 7-4, $I_O = -4\text{ mA}$ for $4.5\text{ V} \leq V_{CC1} \leq 5.5\text{ V}$                          | -0.4                 | -0.2  |      | V             |
|                               |                                                       | See Figure 7-4, $I_O = -2\text{ mA}$ for $3.0\text{ V} \leq V_{CC1} \leq 3.6\text{ V}$                          | -0.2                 | -0.06 |      | V             |
|                               |                                                       | See Figure 7-4, $I_O = -1\text{ mA}$ for $2.25\text{ V} \leq V_{CC1} \leq 2.75\text{ V}$                        | -0.1                 | -0.04 |      | V             |
|                               |                                                       | See Figure 7-4, $I_O = -1\text{ mA}$ for $1.71\text{ V} \leq V_{CC1} \leq 1.89\text{ V}$                        | -0.1                 | -0.04 |      | V             |

| PARAMETER                           |                                                                                       | TEST CONDITIONS                                                                                                                          | MIN    | TYP                    | MAX   | UNIT |
|-------------------------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------------|-------|------|
| V <sub>OL</sub>                     | Low level output voltage                                                              | See <a href="#">Figure 7-4</a> , I <sub>O</sub> = 4 mA for 4.5 V ≤ V <sub>CC1</sub> ≤ 5.5 V                                              |        | 0.2                    | 0.4   | V    |
|                                     |                                                                                       | See <a href="#">Figure 7-4</a> , I <sub>O</sub> = 2 mA for 3.0 V ≤ V <sub>CC1</sub> ≤ 3.6 V                                              |        | 0.07                   | 0.2   | V    |
|                                     |                                                                                       | See <a href="#">Figure 7-4</a> , I <sub>O</sub> = 1 mA for 2.25 V ≤ V <sub>CC1</sub> ≤ 2.75 V                                            |        | 0.035                  | 0.1   | V    |
|                                     |                                                                                       | See <a href="#">Figure 7-4</a> , I <sub>O</sub> = 1 mA for 1.71 V ≤ V <sub>CC1</sub> ≤ 1.89 V                                            |        | 0.04                   | 0.1   | V    |
| DRIVER ELECTRICAL CHARACTERISTICS   |                                                                                       |                                                                                                                                          |        |                        |       |      |
| V <sub>O(DOM)</sub>                 | Bus output voltage(Dominant), CANH                                                    | See <a href="#">Figure 7-1</a> and <a href="#">Figure 7-2</a> ,TXD = 0 V, 50 Ω ≤ R <sub>L</sub> ≤ 65 Ω, and C <sub>L</sub> = open        | 2.75   |                        | 4.5   | V    |
|                                     | Bus output voltage(Dominant), CANL                                                    | See <a href="#">Figure 7-1</a> and <a href="#">Figure 7-2</a> ,TXD = 0 V, 50 Ω ≤ R <sub>L</sub> ≤ 65 Ω, and C <sub>L</sub> = open        | 0.5    |                        | 2.25  | V    |
| V <sub>O(REC)</sub>                 | Bus output voltage(recessive), CANH and CANL                                          | See <a href="#">Figure 7-1</a> and <a href="#">Figure 7-2</a> ,TXD = V <sub>CC1</sub> and R <sub>L</sub> = open                          | 2.0    | 0.5 x V <sub>CC2</sub> | 3.0   | V    |
| V <sub>OD(DOM)</sub>                | Differential output voltage(dominant)                                                 | See <a href="#">Figure 7-1</a> and <a href="#">Figure 7-2</a> ,TXD = 0 V, 45 Ω ≤ R <sub>L</sub> ≤ 70 Ω, and C <sub>L</sub> = open        | 1.4    |                        | 3.3   | V    |
|                                     | Differential output voltage(dominant)                                                 | See <a href="#">Figure 7-1</a> and <a href="#">Figure 7-2</a> ,TXD = 0 V, 50 Ω ≤ R <sub>L</sub> ≤ 65 Ω, and C <sub>L</sub> = open        | 1.5    |                        | 3.0   | V    |
|                                     | Differential output voltage(dominant)                                                 | See <a href="#">Figure 7-1</a> and <a href="#">Figure 7-2</a> ,TXD = 0 V, R <sub>L</sub> = 2240 Ω, and C <sub>L</sub> = open             | 1.5    |                        | 5.0   | V    |
| V <sub>OD(REC)</sub>                | Differential output voltage(recessive)                                                | See <a href="#">Figure 7-1</a> and <a href="#">Figure 7-2</a> ,TXD = V <sub>CC1</sub> , R <sub>L</sub> = 60 Ω, and C <sub>L</sub> = open | -120.0 |                        | 12.0  | mV   |
|                                     | Differential output voltage(recessive)                                                | See <a href="#">Figure 7-1</a> and <a href="#">Figure 7-2</a> ,TXD = V <sub>CC1</sub> , R <sub>L</sub> = open, and C <sub>L</sub> = open | -50.0  |                        | 50.0  | mV   |
| V <sub>SYM_DC</sub>                 | Output symmetry (V <sub>CC2</sub> - V <sub>O(CANH)</sub> - V <sub>O(CANL)</sub> )     | See <a href="#">Figure 7-1</a> and <a href="#">Figure 7-2</a> ,R <sub>L</sub> = 60 Ω and C <sub>L</sub> = open                           | -400.0 |                        | 400.0 | mV   |
| I <sub>OS(SS_DOM)</sub>             | Short circuit current steady state output current, dominant                           | See <a href="#">Figure 7-8</a> , -15 V < CANH < 40 V, CANL = open, and TXD = 0V                                                          | -115.0 |                        |       | mA   |
|                                     |                                                                                       | See <a href="#">Figure 7-8</a> , -15 V < CANL < 40 V, CANH = open, and TXD = 0V                                                          |        |                        | 115.0 | mA   |
| I <sub>OS(SS_REC)</sub>             | Short circuit current steady state output current, recessive                          | See <a href="#">Figure 7-8</a> , -27 V < VBUS < 32 V, VBUS = CANH = CANL, and TXD = V <sub>CC1</sub>                                     | -5.0   |                        | 5.0   | mA   |
| RECEIVER ELECTRICAL CHARACTERISTICS |                                                                                       |                                                                                                                                          |        |                        |       |      |
| V <sub>IT</sub>                     | Differential input threshold voltage                                                  | See <a href="#">Figure 7-4</a> and <a href="#">Table 7-1</a> , -12 V ≤ V <sub>CM</sub> ≤ 12 V                                            | 500.0  |                        | 900.0 | mV   |
| V <sub>HYS</sub>                    | Hysteresis voltage for differential input threshold                                   | See <a href="#">Figure 7-4</a> and <a href="#">Table 7-1</a> , -12 V ≤ V <sub>CM</sub> ≤ 12 V                                            |        | 100                    |       | mV   |
| V <sub>DIFF(DOM)</sub>              | Dominant state differential input voltage range                                       | See <a href="#">Figure 7-4</a> and <a href="#">Table 7-1</a> , -12 V ≤ V <sub>CM</sub> ≤ 12 V                                            | 0.9    |                        | 9     | V    |
| V <sub>DIFF(REC)</sub>              | Recessive state differential input voltage range                                      | See <a href="#">Figure 7-4</a> and <a href="#">Table 7-1</a> , -12 V ≤ V <sub>CM</sub> ≤ 12 V                                            | -4     |                        | 0.5   | V    |
| V <sub>CM</sub>                     | Input common mode range                                                               | See <a href="#">Figure 7-4</a> and <a href="#">Table 7-1</a>                                                                             | -12    |                        | 12    | V    |
| I <sub>OFF(LKG)</sub>               | power-off bus input leakage current                                                   | CANH = CANL = 5V, VCC to GND via 0Ω and 47kΩ resistor                                                                                    |        |                        | 5     | μA   |
| C <sub>I</sub>                      | Input capacitance to ground (CANH or CANL)                                            | TXD = V <sub>CC1</sub>                                                                                                                   |        |                        | 20    | pF   |
| C <sub>ID</sub>                     | Differential input capacitance                                                        | TXD = V <sub>CC1</sub>                                                                                                                   |        |                        | 10    | pF   |
| R <sub>ID</sub>                     | Differential input resistance                                                         | TXD = V <sub>CC1</sub> ; -12 V ≤ VCM ≤ +12 V ; R <sub>ID</sub> = R <sub>CAN_H</sub> + R <sub>CAN_L</sub>                                 | 40     |                        | 90    | kΩ   |
| R <sub>IN</sub>                     | Input resistance (CANH or CANL)                                                       | TXD = V <sub>CC1</sub> ; -12 V ≤ VCM ≤ +12 V ; R <sub>CAN_H</sub> or R <sub>CAN_L</sub> = Δ V / Δ I                                      | 20     |                        | 45    | kΩ   |
| R <sub>IN(M)</sub>                  | Input resistance matching: (1 - R <sub>IN(CANH)</sub> /R <sub>IN(CANL)</sub> ) x 100% | V <sub>CANH</sub> = V <sub>CANL</sub> = 5 V                                                                                              | -1     |                        | 1     | %    |

| PARAMETER               |                              | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-------------------------|------------------------------|-----------------|-----|-----|-----|------|
| <b>THERMAL SHUTDOWN</b> |                              |                 |     |     |     |      |
| T <sub>TSD</sub>        | Thermal shutdown temperature |                 |     | 190 |     | °C   |
| T <sub>TSD_HYST</sub>   | Thermal shutdown hysteresis  |                 |     | 8   |     | °C   |

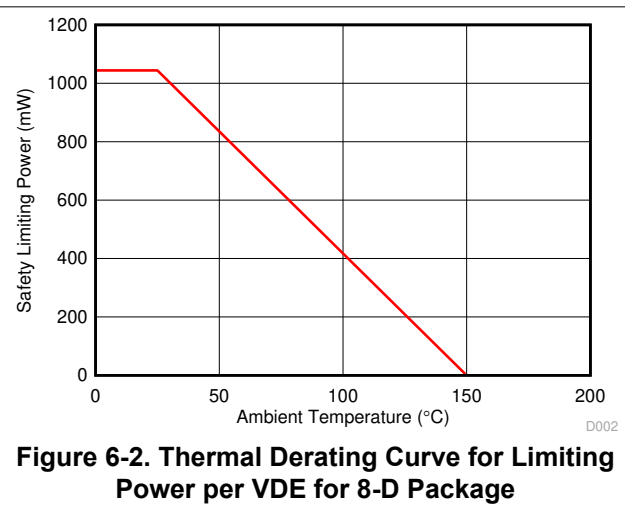
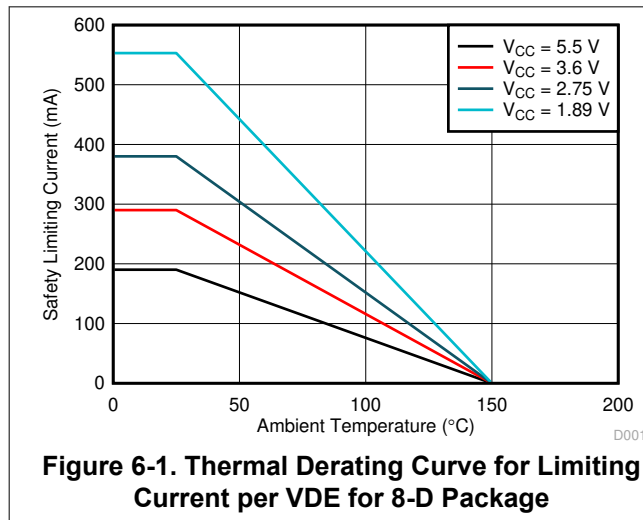
## 6.10 Switching Characteristics

Typical specifications are at  $V_{CC1} = 3.3\text{ V}$ ,  $V_{CC2} = 5\text{ V}$ , Min/Max are over recommended operating conditions (unless otherwise noted)

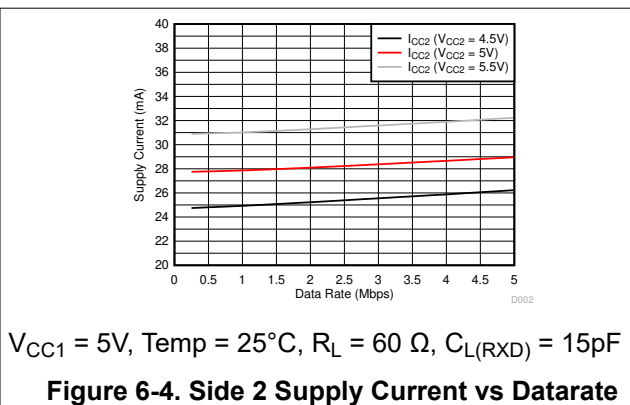
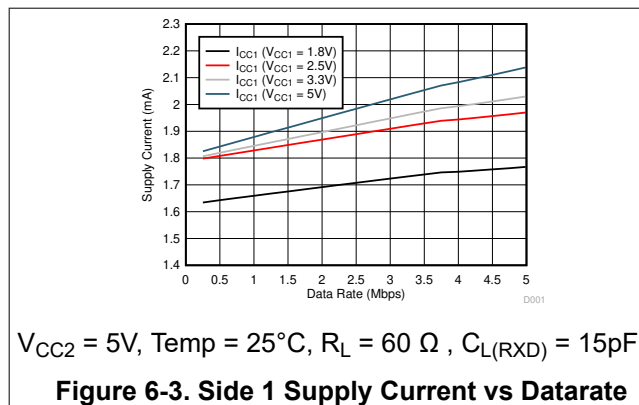
| PARAMETER                          |                                                                                 | TEST CONDITIONS                                                                                                                                                                                     | MIN   | TYP  | MAX   | UNIT  |
|------------------------------------|---------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|-------|-------|
| DEVICE SWITCHING CHARACTERISTICS   |                                                                                 |                                                                                                                                                                                                     |       |      |       |       |
| t <sub>PROP(LOOP1)</sub>           | Total loop delay, driver input TXD to receiver RXD, recessive to dominant       | See <a href="#">Figure 7-6</a> , R <sub>L</sub> = 60 Ω, C <sub>L</sub> = 100 pF, C <sub>L(RXD)</sub> = 15 pF; input rise/fall time (10% to 90%) on TXD =1 ns; 1.71 V ≤ V <sub>CC1</sub> ≤ 1.89 V    |       | 150  | 203   | ns    |
|                                    |                                                                                 | See <a href="#">Figure 7-6</a> , R <sub>L</sub> = 60 Ω, C <sub>L</sub> = 100 pF, C <sub>L(RXD)</sub> = 15 pF; input rise/fall time (10% to 90%) on TXD =1 ns; 2.25 V ≤ V <sub>CC1</sub> ≤ 5.5 V     |       | 150  | 199   | ns    |
| t <sub>PROP(LOOP2)</sub>           | Total loop delay, driver input TXD to receiver RXD, dominant to recessive       | See <a href="#">Figure 7-6</a> , R <sub>L</sub> = 60 Ω, C <sub>L</sub> = 100 pF, C <sub>L(RXD)</sub> = 15 pF; input rise/fall time (10% to 90%) on TXD =1 ns; 1.71 V ≤ V <sub>CC1</sub> ≤ 1.89 V    |       | 175  | 219   | ns    |
|                                    |                                                                                 | See <a href="#">Figure 7-6</a> , R <sub>L</sub> = 60 Ω, C <sub>L</sub> = 100 pF, C <sub>L(RXD)</sub> = 15 pF; input rise/fall time (10% to 90%) on TXD =1 ns; 2.25 V ≤ V <sub>CC1</sub> ≤ 5.5 V     |       | 175  | 212   | ns    |
| t <sub>UV_RE_ENABLE</sub>          | Re-enable time after Undervoltage event                                         | Time for device to return to normal operation from V <sub>CC1</sub> or V <sub>CC2</sub> under voltage event                                                                                         |       |      | 300.0 | μs    |
| CMTI                               | Common mode transient immunity                                                  | TXD=V <sub>CC1</sub> or GND1, V <sub>CM</sub> = 1200V <sub>PK</sub> , See <a href="#">Figure 7-9</a>                                                                                                | 85    |      |       | kV/μs |
| DRIVER SWITCHING CHARACTERISTICS   |                                                                                 |                                                                                                                                                                                                     |       |      |       |       |
| t <sub>pHR</sub>                   | Propagation delay time, Low-to-High TXD edge to driver recessive                | See <a href="#">Figure 7-3</a> , R <sub>L</sub> = 60 Ω and C <sub>L</sub> = 100 pF; input rise/fall time (10% to 90%) on TXD =1 ns                                                                  |       | 85   | 105   | ns    |
| t <sub>pLD</sub>                   | Propagation delay time, High-to-Low TXD edge to driver dominant                 |                                                                                                                                                                                                     |       | 70   | 105   |       |
| t <sub>sk(p)</sub>                 | pulse skew ( t <sub>pHR</sub> - t <sub>pLD</sub>  )                             |                                                                                                                                                                                                     |       | 12.5 |       |       |
| t <sub>R</sub>                     | Differential output signal rise time                                            |                                                                                                                                                                                                     |       | 27   |       |       |
| t <sub>F</sub>                     | Differential output signal fall time                                            |                                                                                                                                                                                                     |       | 42   |       |       |
| V <sub>SYM</sub>                   | Driver symmetry (V <sub>O(CANH)</sub> + V <sub>O(CANL)</sub> )/V <sub>CC</sub>  | See <a href="#">Figure 7-3</a> and <a href="#">Figure 9-3</a> , R <sub>TERM</sub> =60 Ω, C <sub>L</sub> =open, C <sub>SPLIT</sub> = 4.7nF, TXD= Dominant or recessive or toggling at 250 kHz, 1 MHz | 0.9   |      | 1.1   | V/V   |
| t <sub>TXD_DTO</sub>               | Dominant time out                                                               | See <a href="#">Figure 7-7</a> , R <sub>L</sub> = 60 Ω and C <sub>L</sub> = open                                                                                                                    | 1.2   |      | 3.8   | ms    |
| RECEIVER SWITCHING CHARACTERISTICS |                                                                                 |                                                                                                                                                                                                     |       |      |       |       |
| t <sub>pRH</sub>                   | Propagation delay time, bus dominant-to-recessive input edge to RXD high output | See <a href="#">Figure 7-5</a> , C <sub>L(RXD)</sub> = 15 pF,                                                                                                                                       |       | 90   | 130   | ns    |
| t <sub>pDL</sub>                   | Propogation delay time, bus recessive-to-dominant input edge to RXD low output  |                                                                                                                                                                                                     |       | 71   | 110   | ns    |
| t <sub>R</sub>                     | Output signal rise time(RXD)                                                    |                                                                                                                                                                                                     |       | 1    |       | ns    |
| t <sub>F</sub>                     | Output signal fall time(RXD)                                                    |                                                                                                                                                                                                     |       | 1    |       | ns    |
| FD TIMING PARAMETERS               |                                                                                 |                                                                                                                                                                                                     |       |      |       |       |
| t <sub>BIT(BUS)</sub>              | Bit time on CAN bus output pins with t <sub>BIT(TXD)</sub> = 500 ns             | See <a href="#">Figure 7-6</a> , R <sub>L</sub> = 60 Ω, C <sub>L</sub> = 100 pF, C <sub>L(RXD)</sub> = 15 pF; input rise/fall time (10% to 90%) on TXD =1 ns                                        | 435.0 |      | 530.0 | ns    |
|                                    | Bit time on CAN bus output pins with t <sub>BIT(TXD)</sub> = 200 ns             | See <a href="#">Figure 7-6</a> , R <sub>L</sub> = 60 Ω, C <sub>L</sub> = 100 pF, C <sub>L(RXD)</sub> = 15 pF; input rise/fall time (10% to 90%) on TXD =1 ns                                        | 155.0 |      | 210.0 | ns    |

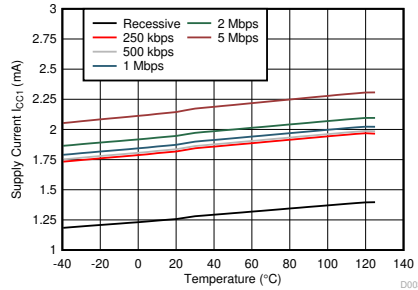
| PARAMETER               |                                                                | TEST CONDITIONS                                                                                                                                                                                       | MIN   | TYP | MAX   | UNIT |
|-------------------------|----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----|-------|------|
| $t_{\text{BIT(RXD)}}$   | Bit time on RXD output pin with $t_{\text{BIT(TXD)}} = 500$ ns | See Figure 7-6, $R_L = 60 \Omega$ , $C_L = 100$ pF, $C_{L(\text{RXD})} = 15$ pF; input rise/fall time (10% to 90%) on TXD = 1 ns                                                                      | 400   |     | 550.0 | ns   |
|                         | Bit time on RXD output pin with $t_{\text{BIT(TXD)}} = 200$ ns | See Figure 7-6, $R_L = 60 \Omega$ , $C_L = 100$ pF, $C_{L(\text{RXD})} = 15$ pF; input rise/fall time (10% to 90%) on TXD = 1 ns                                                                      | 120.0 |     | 220.0 | ns   |
| $\Delta t_{\text{REC}}$ | Receiver timing symmetry with $t_{\text{BIT(TXD)}} = 500$ ns   | See Figure 7-6, $R_L = 60 \Omega$ , $C_L = 100$ pF, $C_{L(\text{RXD})} = 15$ pF; input rise/fall time (10% to 90%) on TXD = 1 ns; $\Delta t_{\text{REC}} = t_{\text{BIT(RXD)}} - t_{\text{BIT(BUS)}}$ | -65.0 |     | 40.0  | ns   |
|                         | Receiver timing symmetry with $t_{\text{BIT(TXD)}} = 200$ ns   | See Figure 7-6, $R_L = 60 \Omega$ , $C_L = 100$ pF, $C_{L(\text{RXD})} = 15$ pF; input rise/fall time (10% to 90%) on TXD = 1 ns; $\Delta t_{\text{REC}} = t_{\text{BIT(RXD)}} - t_{\text{BIT(BUS)}}$ | -45.0 |     | 15.0  | ns   |

## 6.11 Insulation Characteristics Curves



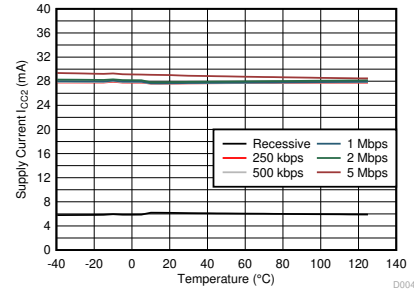
## 6.12 Typical Characteristics





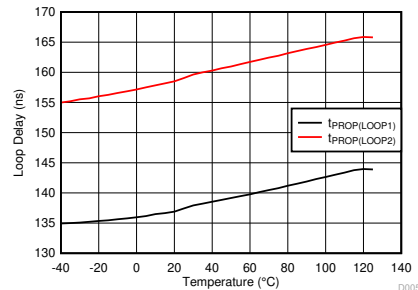
$V_{CC1} = V_{CC2} = 5V$ ,  $R_L = 60 \Omega$ ,  $C_{L(RXD)} = 15pF$

**Figure 6-5. Side 1 Supply Current vs Ambient Temperature**



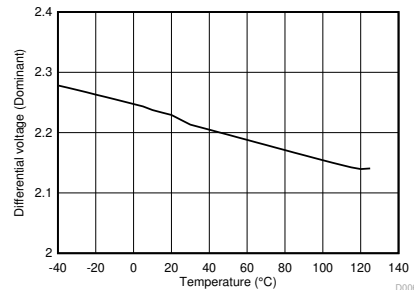
$V_{CC1} = V_{CC2} = 5V$ ,  $R_L = 60 \Omega$ ,  $C_{L(RXD)} = 15pF$

**Figure 6-6. Side 2 Supply Current vs Ambient Temperature**



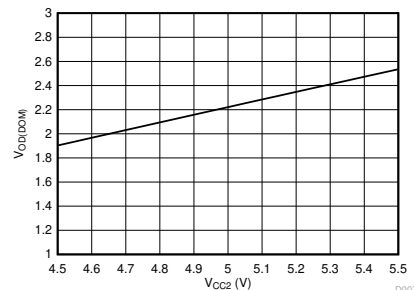
$V_{CC1} = V_{CC2} = 5V$ , Bus Load =  $60 \Omega \parallel 100 pF$ ,  $C_{L(RXD)} = 15pF$

**Figure 6-7. Loop Delay vs Ambient Temperature**



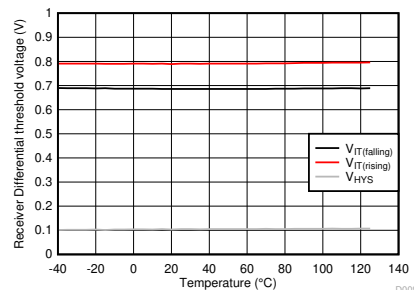
$V_{CC1} = V_{CC2} = 5V$ ,  $R_L = 60 \Omega$

**Figure 6-8. Dominant state differential output voltage vs Ambient Temperature**



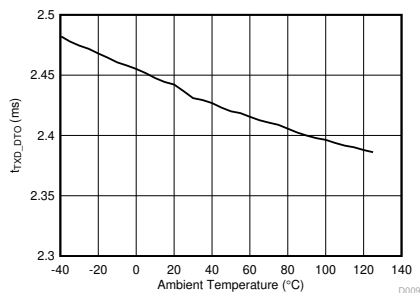
$V_{CC1} = 5V$ , Temp =  $25^{\circ}C$ ,  $R_L = 60 \Omega$

**Figure 6-9. Dominant state differential output voltage vs Side2 supply voltage**



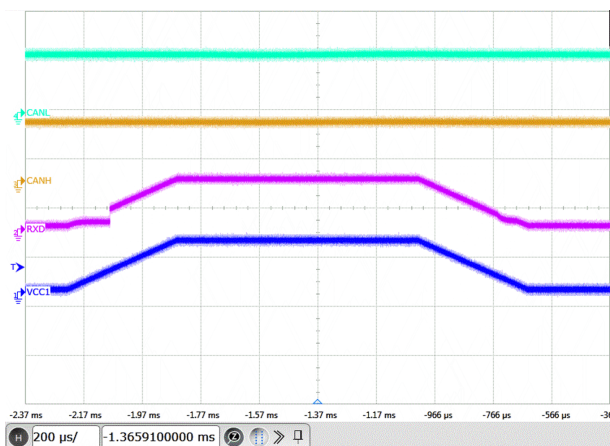
$V_{CC1} = V_{CC2} = 5V$ , TXD = Floating

**Figure 6-10. Receiver differential threshold voltage vs Ambient Temperature**

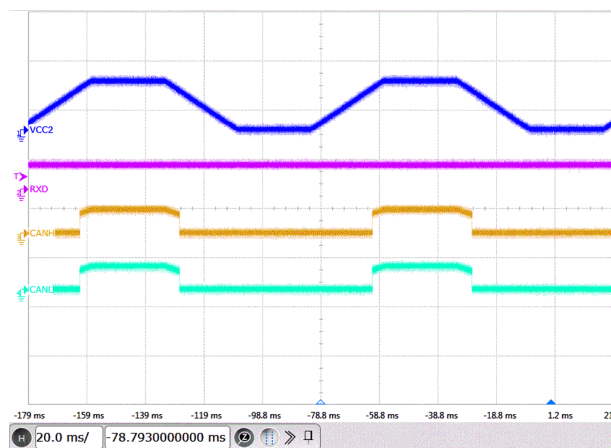


$$V_{CC1} = V_{CC2} = 5V, R_L = 60\Omega$$

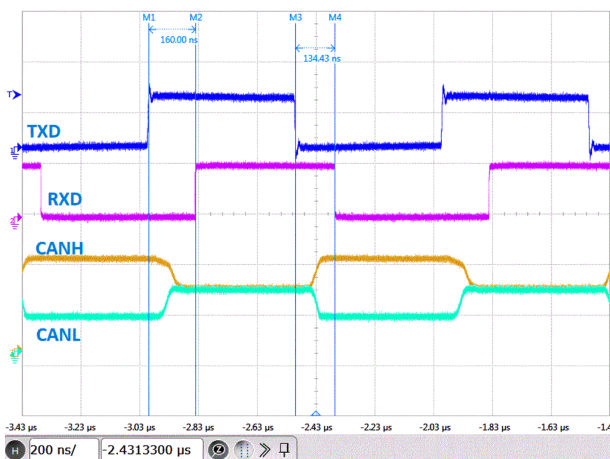
**Figure 6-11. Dominant timeout vs Ambient Temperature**



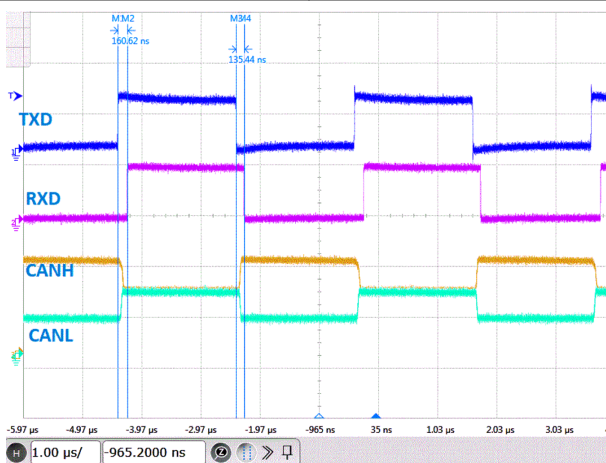
**Figure 6-12. Glitch Free Power Up on  $V_{CC1}$  – CAN Bus Remains Recessive**



**Figure 6-13. Glitch Free Power Up on  $V_{CC2}$  – CAN Bus Remains Recessive**

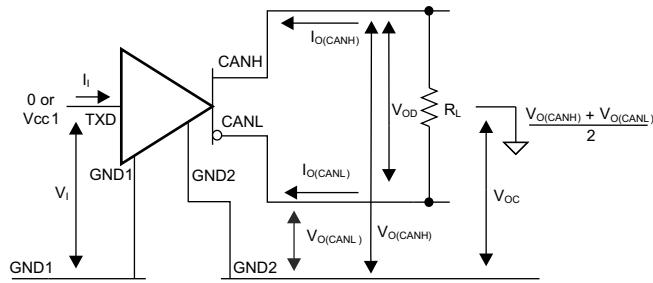


**Figure 6-14. Typical TXD, RXD, CANH and CANL Waveforms at 2 Mbps**

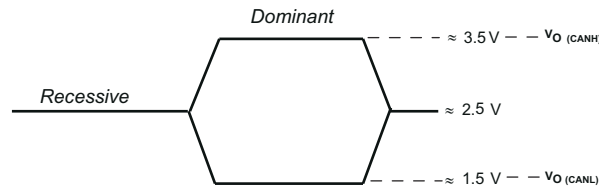


**Figure 6-15. Typical TXD, RXD, CANH and CANL Waveforms at 500 kbps**

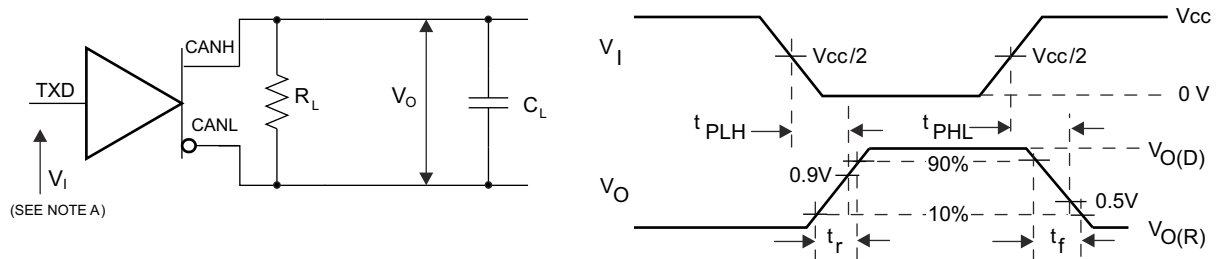
## 7 Parametric Measurement Information



**Figure 7-1. Driver Voltage, Current and Test Definitions**

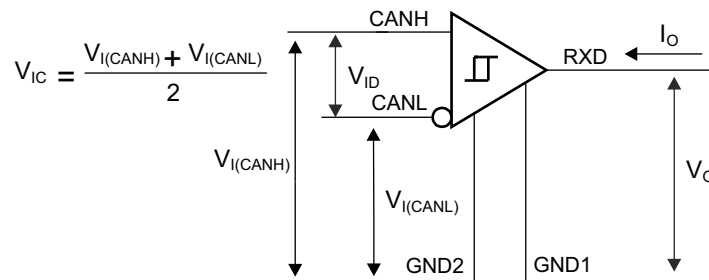


**Figure 7-2. Bus Logic State Voltage Definitions**

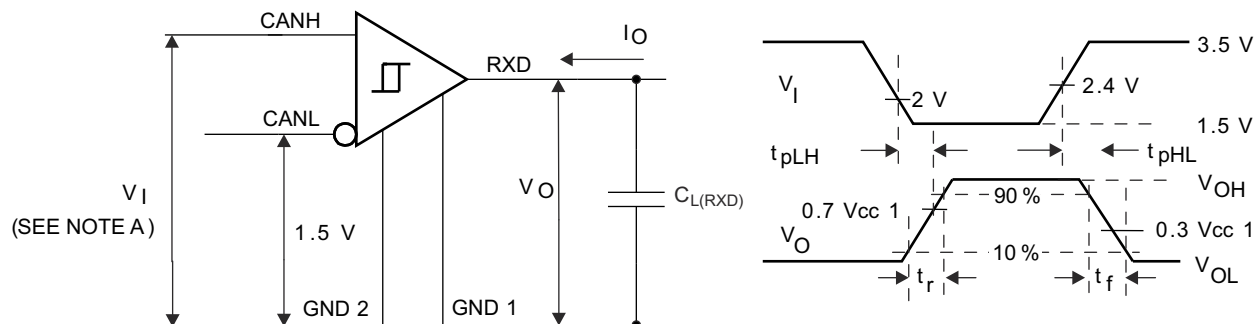


A. The input pulse is supplied by a generator having the following characteristics: PRR  $\leq$  125 kHz, 50% duty cycle,  $t_r \leq 6$  ns,  $t_f \leq 6$  ns,  $Z_O = 50 \Omega$ .

**Figure 7-3. Driver Test Circuit and Voltage Waveforms**



**Figure 7-4. Receiver Voltage and Current Definitions**

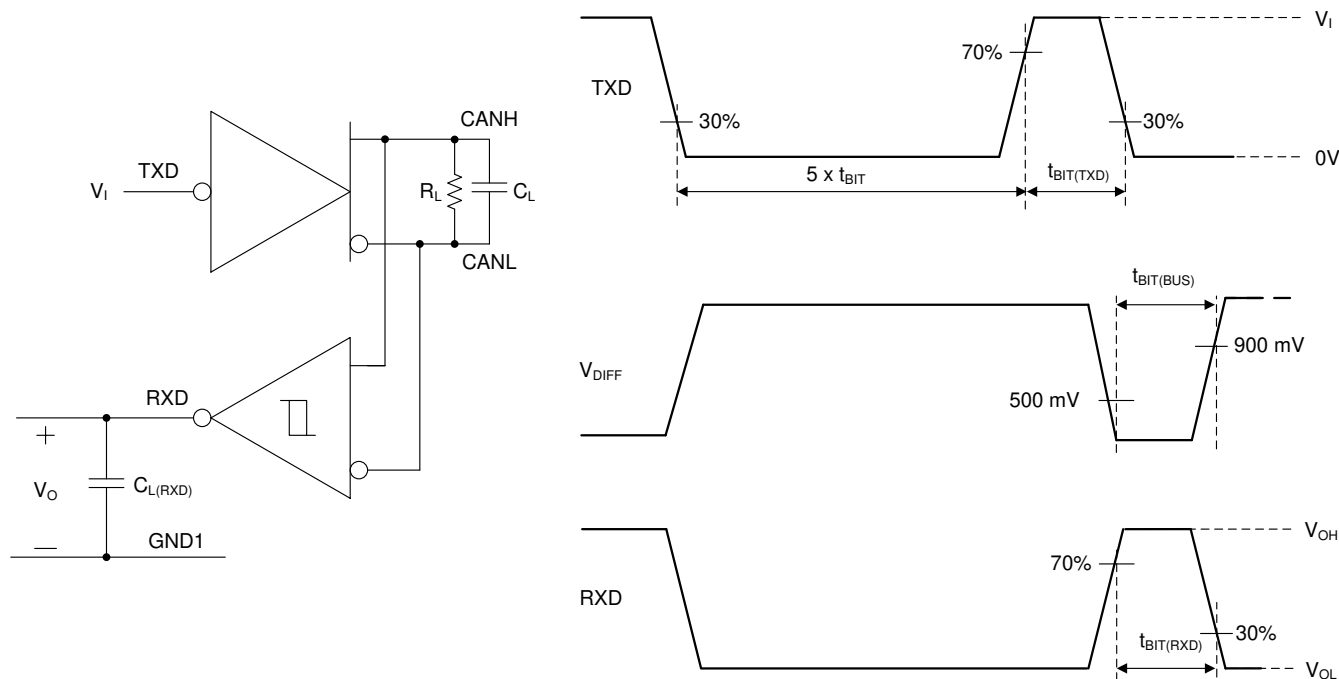


A. The input pulse is supplied by a generator having the following characteristics: PRR  $\leq$  125 kHz, 50% duty cycle,  $t_r \leq 6$  ns,  $t_f \leq 6$  ns,  $Z_O = 50 \Omega$ .

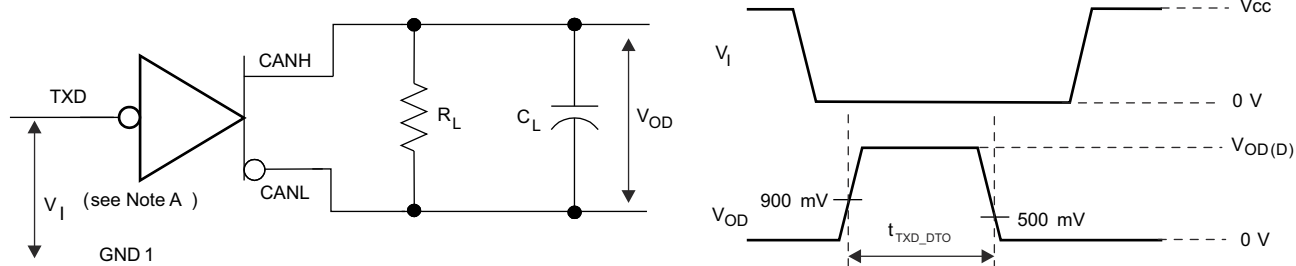
**Figure 7-5. Receiver Test Circuit and Voltage Waveforms**

**Table 7-1. Receiver Differential Input Voltage Threshold Test**

| INPUT      |            |            | OUTPUT |          |
|------------|------------|------------|--------|----------|
| $V_{CANH}$ | $V_{CANL}$ | $ V_{ID} $ | RXD    |          |
| -11.5 V    | -12.5 V    | 1000 mV    | L      | $V_{OL}$ |
| 12.5 V     | 11.5 V     | 1000 mV    | L      |          |
| -8.55 V    | -9.45 V    | 900 mV     | L      |          |
| 9.45 V     | 8.55 V     | 900 mV     | L      |          |
| -8.75 V    | -9.25 V    | 500 mV     | H      | $V_{OH}$ |
| 9.25 V     | 8.75 V     | 500 mV     | H      |          |
| -11.8 V    | -12.2 V    | 400 mV     | H      |          |
| 12.2 V     | 11.8 V     | 400 mV     | H      |          |
| Open       | Open       | X          | H      |          |

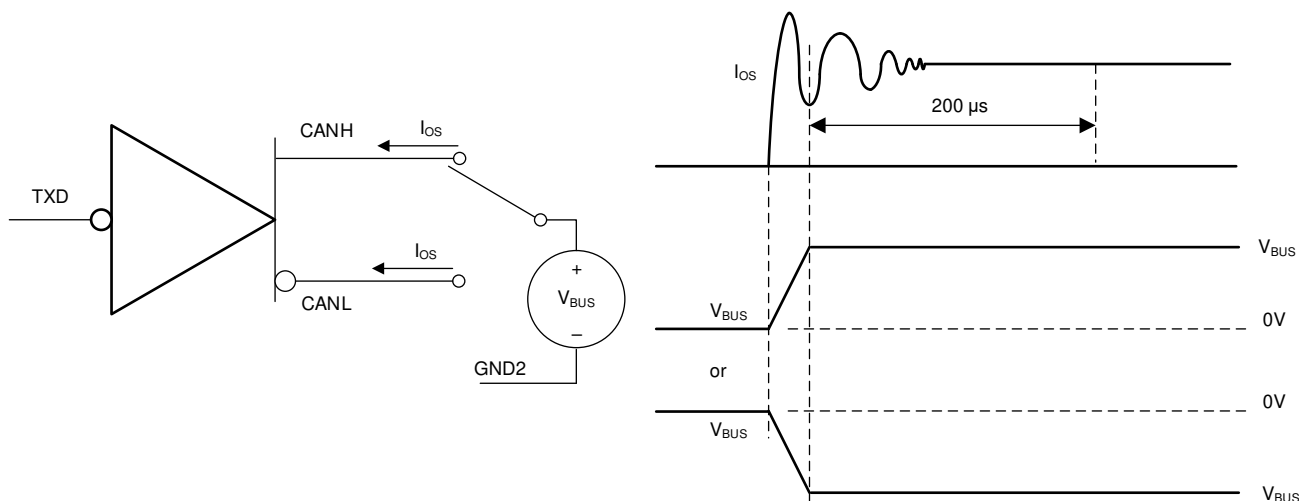


**Figure 7-6.  $t_{LOOP}$  and CAN FD Timing Parameter Measurement**

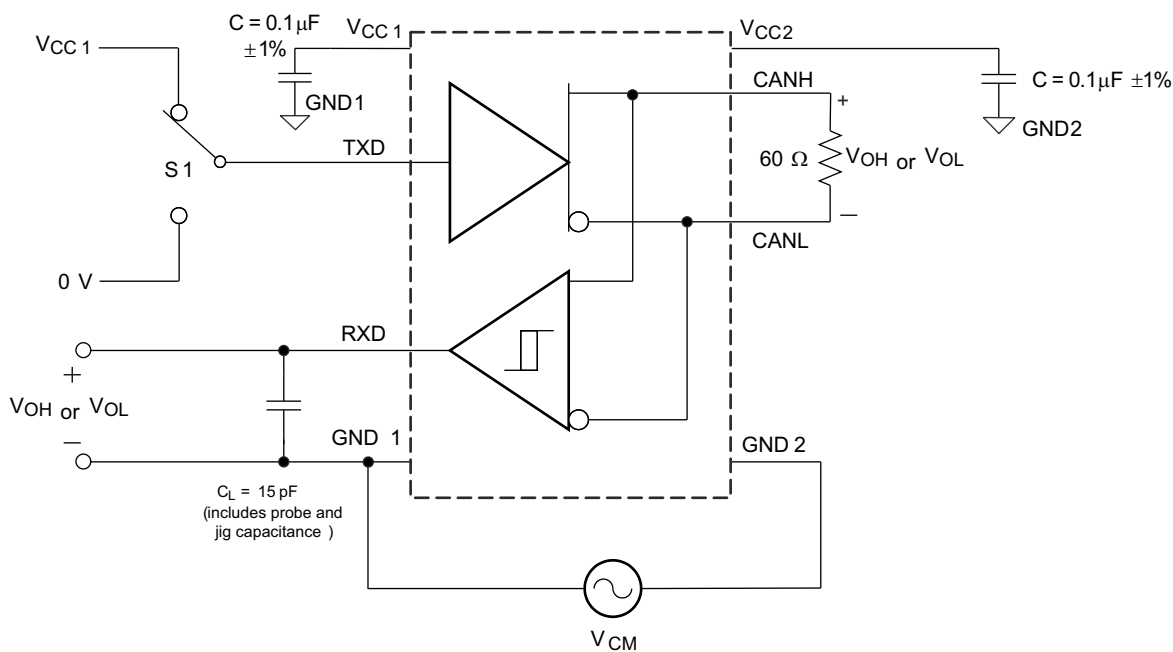


A. The input pulse is supplied by a generator having the following characteristics:  $t_r \leq 6 \text{ ns}$ ,  $t_f \leq 6 \text{ ns}$ ,  $Z_O = 50 \Omega$ .

**Figure 7-7. Dominant Time-out Test Circuit and Voltage Waveforms**



**Figure 7-8. Driver Short-Circuit Current Test Circuit and Waveforms**



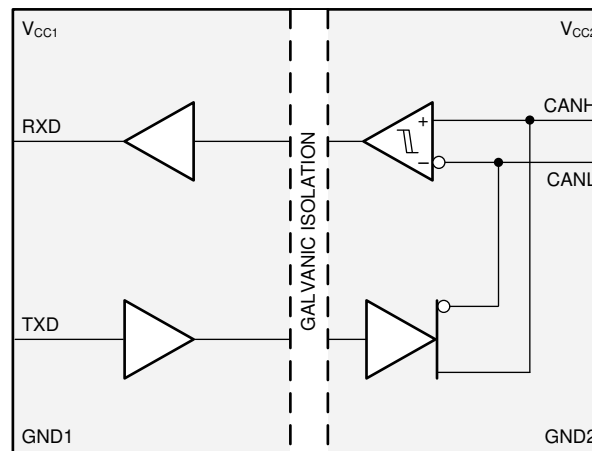
**Figure 7-9. Common-Mode Transient Immunity Test Circuit**

## 8 Detailed Description

### 8.1 Overview

The ISO1044B device is a digitally isolated CAN transceiver that offers  $\pm 58$ -V DC bus fault protection and  $\pm 12$ -V common-mode voltage range. The device supports up to 5-Mbps data rate in CAN FD mode allowing much faster transfer of payload compared to classic CAN. The ISO1044B device has an isolation withstand voltage of 3000 V<sub>RMS</sub> with a surge isolation voltage of 5kV<sub>PK</sub>. The device can operate from 1.8-V, 2.5-V, 3.3-V, and 5-V supplies on side 1 and a 5-V supply on side 2. This supply range is of particular advantage for applications operating in harsh industrial environments because the low voltage on side 1 enables the connection to low-voltage microcontrollers for power conservation, whereas the 5 V on side 2 maintains a high signal-to-noise ratio of the bus signals.

### 8.2 Functional Block Diagram

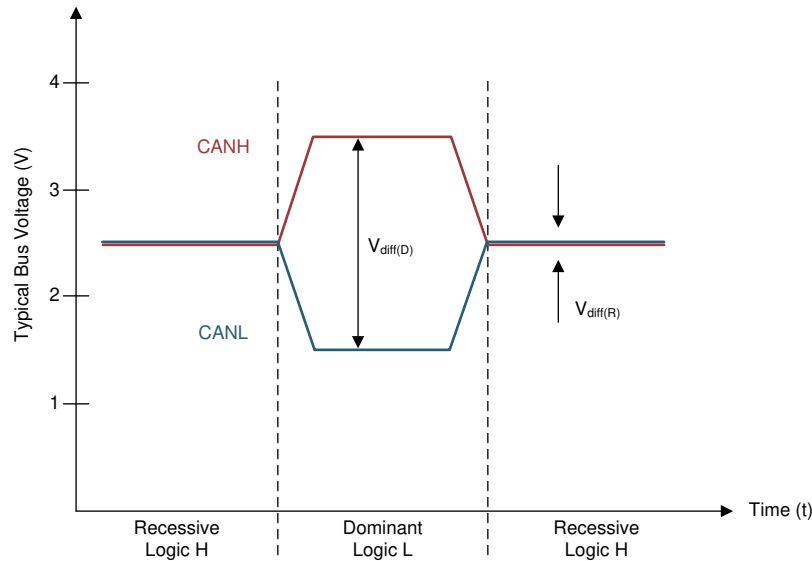


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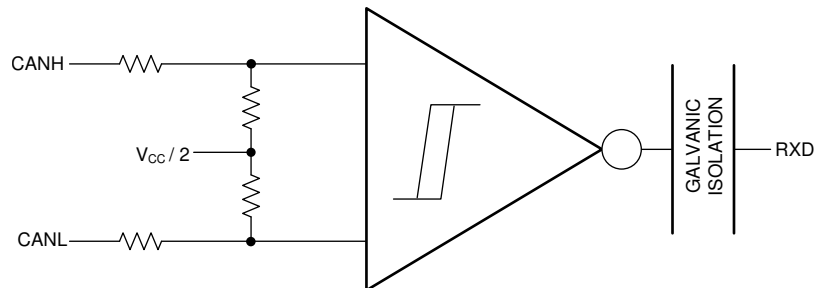
### 8.3 Feature Description

#### 8.3.1 CAN Bus States

The CAN bus has two states during operation: *dominant* and *recessive*. A dominant bus state, equivalent to logic low, is when the bus is driven differentially by a driver. A recessive bus state is when the bus is biased to a common mode of  $V_{CC} / 2$  through the high-resistance internal input resistors of the receiver, equivalent to a logic high. The host microprocessor of the CAN node uses the TXD pin to drive the bus and receives data from the bus on the RXD pin. See [Figure 8-1](#) and [Figure 8-2](#).



**Figure 8-1. Bus States (Physical Bit Representation)**



**Figure 8-2. Simplified Recessive Common Mode Bias and Receiver**

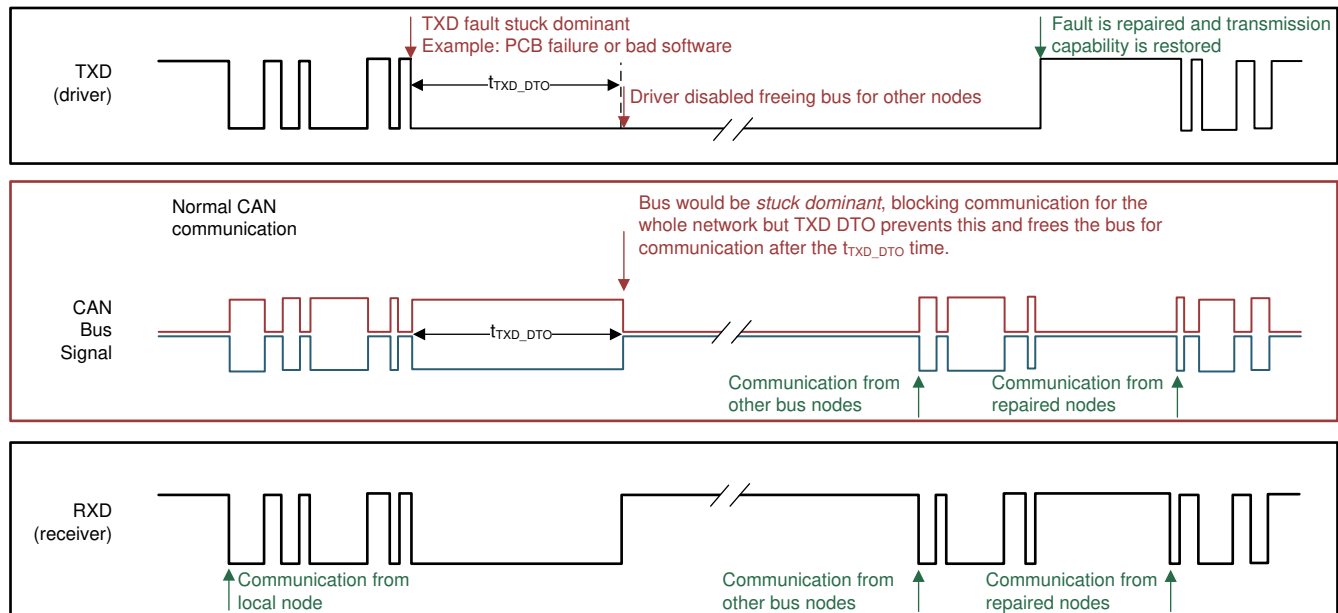
### 8.3.2 Digital Inputs and Outputs: TXD (Input) and RXD (Output)

The  $V_{CC1}$  supply for the isolated digital input and output side of the device can be supplied by 1.8-V, 2.5-V, 3.3-V, and 5-V supplies and therefore the digital inputs and outputs are 1.8-V, 2.5-V, 3.3-V, and 5-V compatible.

### 8.3.3 Protection Features

#### 8.3.3.1 TXD Dominant Timeout (DTO)

The TXD DTO circuit prevents the transceiver from blocking network communication in the event of a hardware or software failure where the TXD pin is held dominant longer than the timeout period,  $t_{TXD\_DTO}$ . The DTO circuit timer starts on a falling edge on the TXD pin. The DTO circuit disables the CAN bus driver if no rising edge occurs before the timeout period expires, which frees the bus for communication between other nodes on the network. The CAN driver is activated again when a recessive signal occurs on the TXD pin, clearing the TXD DTO condition. The receiver and RXD pin still reflect activity on the CAN bus, and the bus terminals are biased to the recessive level during a TXD dominant timeout.



**Figure 8-3. Example Timing Diagram for TXD DTO**

#### Note

The minimum dominant TXD time ( $t_{TXD\_DTO}$ ) allowed by the TXD DTO circuit limits the minimum possible transmitted data rate of the device. The CAN protocol allows a maximum of eleven successive dominant bits (on TXD) for the worst case, where five successive dominant bits are followed immediately by an error frame. This, along with the  $t_{TXD\_DTO}$  minimum, limits the minimum data rate. Calculate the minimum transmitted data rate with [Equation 1](#).

$$\text{Minimum Data Rate} = 11 / t_{TXD\_DTO} \quad (1)$$

#### 8.3.3.2 Thermal Shutdown (TSD)

If the junction temperature of the device exceeds the thermal shutdown threshold ( $T_{TSD}$ ), the device turns off the CAN driver circuits, blocking the TXD-to-bus transmission path. The CAN bus terminals are biased to the recessive level during a thermal shutdown, and the receiver-to-RXD path remains operational. The shutdown condition is cleared when the junction temperature drops at least the thermal shutdown hysteresis temperature ( $T_{TSD\_HYST}$ ) below the thermal shutdown temperature ( $T_{TSD}$ ) of the device.

#### 8.3.3.3 Undervoltage Lockout and Default State

The supply pins have undervoltage detection that places the device in protected or default mode which protects the bus during an undervoltage event on the  $V_{CC1}$  or  $V_{CC2}$  supply pins. If the bus-side power supply,  $V_{CC2}$ , is less than about 4 V, the power shutdown circuits in the ISO1044B device disable the transceiver to prevent false transmissions because of an unstable supply. If the  $V_{CC1}$  supply is still active when this occurs, the receiver output (RXD) goes to a default HIGH (recessive) value. [Table 8-1](#) summarizes the undervoltage lockout and fail-safe behavior.

**Table 8-1. Undervoltage Lockout and Default State**

| $V_{CC1}$     | $V_{CC2}$     | DEVICE STATE | BUS OUTPUT               | RXD                      |
|---------------|---------------|--------------|--------------------------|--------------------------|
| $> UV_{VCC1}$ | $> UV_{VCC2}$ | Functional   | Per Device State and TXD | Mirrors Bus              |
| $< UV_{VCC1}$ | $> UV_{VCC2}$ | Protected    | Recessive                | Undetermined             |
| $> UV_{VCC1}$ | $< UV_{VCC2}$ | Protected    | High Impedance           | Recessive (Default High) |

### Note

After an undervoltage condition is cleared and the supplies have returned to valid levels, the device typically resumes normal operation in 300  $\mu$ s.

#### 8.3.3.4 Floating Pins

The ISO1044B has internal pull-ups on critical pins which places the device into known states if the pin floats. This internal bias should not be relied upon by design though, especially in noisy environments, but instead should be considered a failsafe protection feature.

When a CAN controller supporting open drain outputs is used, an adequate external pull-up resistor must be used to ensure that the TXD output of the CAN controller maintains adequate bit timing to the input of the CAN transceiver.

#### 8.3.3.5 Unpowered Device

The device is designed to be *ideal passive* or *no load* to the CAN bus if it is unpowered. The bus pins (CANH, CANL) have extremely low leakage currents when the device is unpowered to avoid loading down the bus which is critical if some nodes of the network are unpowered while the rest of the of network remains in operation.

#### 8.3.3.6 CAN Bus Short Circuit Current Limiting

The device has two protection features that limit the short circuit current when a CAN bus line has a short-circuit fault condition. The first protection feature is driver current limiting (both dominant and recessive states) and the second feature is TXD dominant state time out to prevent permanent higher short circuit current of the dominant state during a system fault. During CAN communication the bus switches between dominant and recessive states, therefore the short circuit current may be viewed either as the instantaneous current during each bus state or as an average current of the two states. For system current (power supply) and power considerations in the termination resistors and common-mode choke ratings, use the average short circuit current. Determine the ratio of dominant and recessive bits by the data in the CAN frame plus the following factors of the protocol and PHY that force either recessive or dominant at certain times:

- Control fields with set bits
- Bit stuffing
- Interframe space
- TXD dominant time out (fault case limiting)

These factors ensure a minimum recessive amount of time on the bus even if the data field contains a high percentage of dominant bits. The short circuit current of the bus depends on the ratio of recessive to dominant bits and their respective short circuit currents. Use [Equation 2](#) to calculate the average short circuit current.

$$I_{OS(AVG)} = \%Transmit \times [(\%REC\_Bits \times I_{OS(SS)\_REC}) + (\%DOM\_Bits \times I_{OS(SS)\_DOM})] + [\%Receive \times I_{OS(SS)\_REC}] \quad (2)$$

where

- $I_{OS(AVG)}$  is the average short circuit current
- $\%Transmit$  is the percentage the node is transmitting CAN messages
- $\%Receive$  is the percentage the node is receiving CAN messages
- $\%REC\_Bits$  is the percentage of recessive bits in the transmitted CAN messages
- $\%DOM\_Bits$  is the percentage of dominant bits in the transmitted CAN messages
- $I_{OS(SS)\_REC}$  is the recessive steady state short circuit current
- $I_{OS(SS)\_DOM}$  is the dominant steady state short circuit current

### Note

Consider the short circuit current and possible fault cases of the network when sizing the power ratings of the termination resistance and other network components.

## 8.4 Device Functional Modes

Table 8-2 and Table 8-3 list the driver and receiver functions. Table 8-4 lists the functional modes for the ISO1044B device.

**Table 8-2. Driver Function Table**

| INPUT              | OUTPUTS             |                     | DRIVEN BUS STATE |
|--------------------|---------------------|---------------------|------------------|
| TXD <sup>(1)</sup> | CANH <sup>(1)</sup> | CANL <sup>(1)</sup> |                  |
| L                  | H                   | L                   | Dominant         |
| H                  | Z                   | Z                   | Recessive        |

- (1) H = high level, L = low level, Z = common mode (recessive) bias to  $V_{CC} / 2$ . See Figure 8-1 and Figure 8-2 for bus state and common mode bias information.

**Table 8-3. Receiver Function Table**

| DEVICE MODE | CAN DIFFERENTIAL INPUTS<br>$V_{ID} = V_{CANH} - V_{CANL}$ <sup>(3)</sup> | BUS STATE | RXD PIN <sup>(1)</sup> |
|-------------|--------------------------------------------------------------------------|-----------|------------------------|
| Normal      | $V_{ID} \geq V_{IT(MAX)}$                                                | Dominant  | L                      |
|             | $V_{IT(MIN)} < V_{ID} < V_{IT(MAX)}$                                     | Undefined | Undefined              |
|             | $V_{ID} \leq V_{IT(MIN)}$                                                | Recessive | H                      |
|             | Open ( $V_{ID} \approx 0$ V)                                             | Open      | H                      |

- (1) H = high level, L = low level

**Table 8-4. Function Table**

| DRIVER <sup>(1)</sup>                  |         |      |           | RECEIVER                                                     |               |           |
|----------------------------------------|---------|------|-----------|--------------------------------------------------------------|---------------|-----------|
| INPUTS                                 | OUTPUTS |      | BUS STATE | DIFFERENTIAL INPUTS<br>$V_{ID} = CANH - CANL$ <sup>(3)</sup> | OUTPUT<br>RXD | BUS STATE |
| TXD                                    | CANH    | CANL |           |                                                              |               |           |
| L <sup>(2)</sup>                       | H       | L    | DOMINANT  | $V_{ID} \geq V_{IT(MAX)}$                                    | L             | DOMINANT  |
| H                                      | Z       | Z    | RECESSIVE | $V_{IT(MIN)} < V_{ID} < V_{IT(MAX)}$                         | Undefined     | Undefined |
| Open                                   | Z       | Z    | RECESSIVE | $V_{ID} \leq V_{IT(MIN)}$                                    | H             | RECESSIVE |
| X if $V_{CC1}$ supply<br>< $UV_{VCC1}$ | Z       | Z    | RECESSIVE | Open ( $V_{ID} \approx 0$ V)                                 | H             | RECESSIVE |

- (1) H = high level; L = low level; X = irrelevant; Z = high impedance  
 (2) Logic low pulses to prevent dominant time-out.  
 (3) See Receiver Electrical Characteristics section for input thresholds.

## 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 ISO1044B device can be used with other components from Texas Instruments such as a microcontroller, a transformer driver, and a linear voltage regulator to form a fully isolated CAN interface.

### 9.2 Typical Application

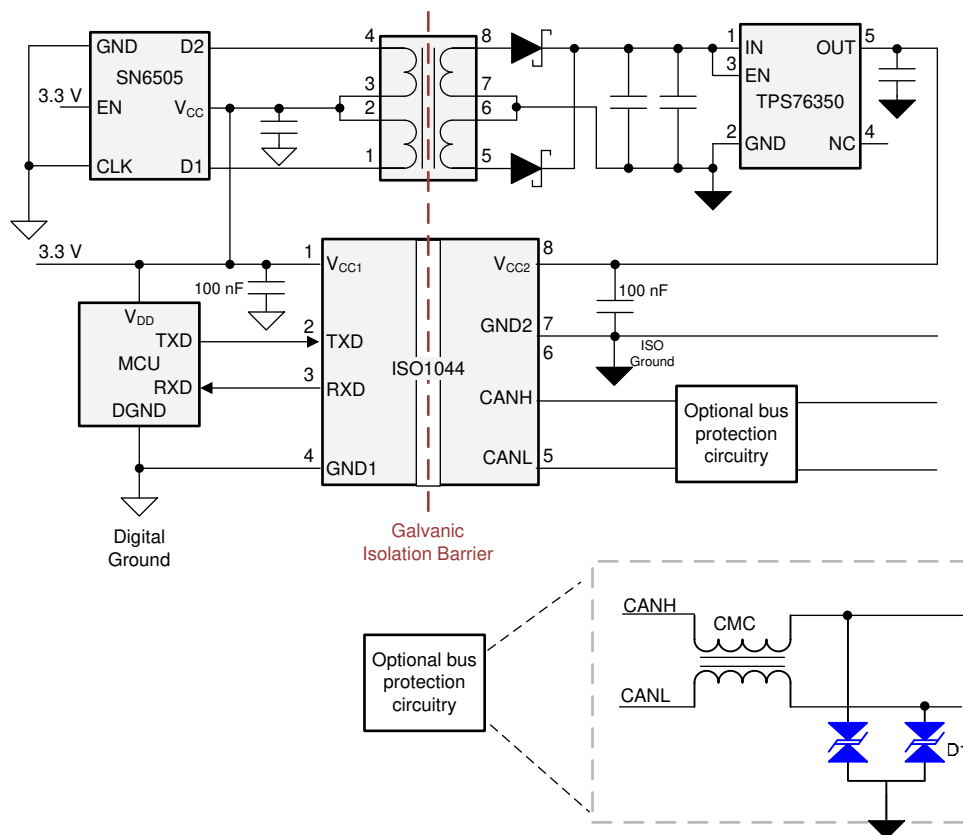


Figure 9-1. Application Circuit With ISO1044 in 8-SOIC Package

ISO1044B is optimized for small solution size and meets 8 kV contact ESD (Electrostatic discharge) per IEC 61000-4-2 standalone with no external components on bus. If the application requires the usage of Common mode choke (CMC) as shown in Figure 9-1, then use of Transient voltage suppressor (TVS) is a must to achieve 8kV IEC ESD. Test results with CMC Part number: ACT45B-101-2P-TL003 and TVS Part number: CPDT-12V show 8 kV IEC ESD (Level 4) pass.

#### 9.2.1 Design Requirements

Unlike an optocoupler-based solution, which requires several external components to improve performance, provide bias, or limit current, the ISO1044B device only requires external bypass capacitors to operate.

## 9.2.2 Detailed Design Procedure

### 9.2.2.1 Bus Loading, Length and Number of Nodes

The ISO 11898-2 Standard specifies a maximum bus length of 40 m and maximum stub length of 0.3 m. However, with careful design, users can have longer cables, longer stub lengths, and many more nodes to a bus. A large number of nodes requires transceivers with high input impedance such as the ISO1044B transceiver.

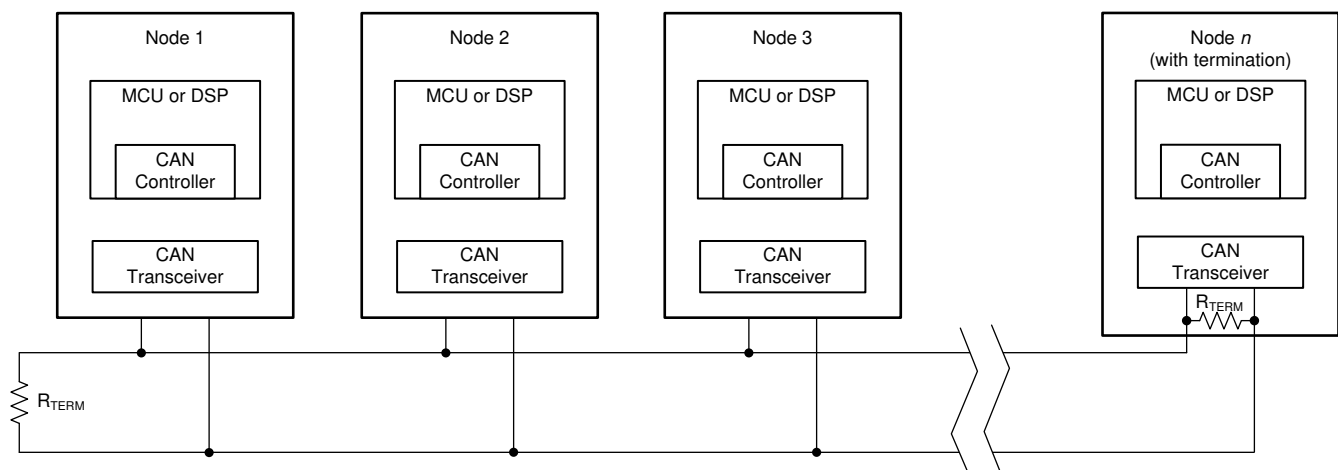
Many CAN organizations and standards have scaled the use of CAN for applications outside the original ISO 11898-2 Standard. These organizations and standards have made system-level trade-offs for data rate, cable length, and parasitic loading of the bus. Examples of some of these specifications are ARINC825, CANopen, DeviceNet, and NMEA2000.

The ISO1044B device is specified to meet the 1.5-V requirement with a 50- $\Omega$  load, incorporating the worst case including parallel transceivers. The differential input resistance of the ISO1044B device is a minimum of 30 k $\Omega$ . If 100 ISO1044B transceivers are in parallel on a bus, this requirement is equivalent to a 300- $\Omega$  differential load worst case. That transceiver load of 300  $\Omega$  in parallel with the 60  $\Omega$  gives an equivalent loading of 50  $\Omega$ . Therefore, the ISO1044B device theoretically supports up to 100 transceivers on a single bus segment. However, for CAN network design margin must be given for signal loss across the system and cabling, parasitic loadings, network imbalances, ground offsets and signal integrity, therefore a practical maximum number of nodes is typically much lower. Bus length may also be extended beyond the original ISO 11898 standard of 40 m by careful system design and data-rate tradeoffs. For example, CANopen network design guidelines allow the network to be up to 1 km with changes in the termination resistance, cabling, less than 64 nodes, and a significantly lowered data rate.

This flexibility in CAN network design is one of the key strengths of the various extensions and additional standards that have been built on the original ISO 11898-2 CAN standard. Using this flexibility requires the responsibility of good network design and balancing these tradeoffs.

#### 9.2.2.2 CAN Termination

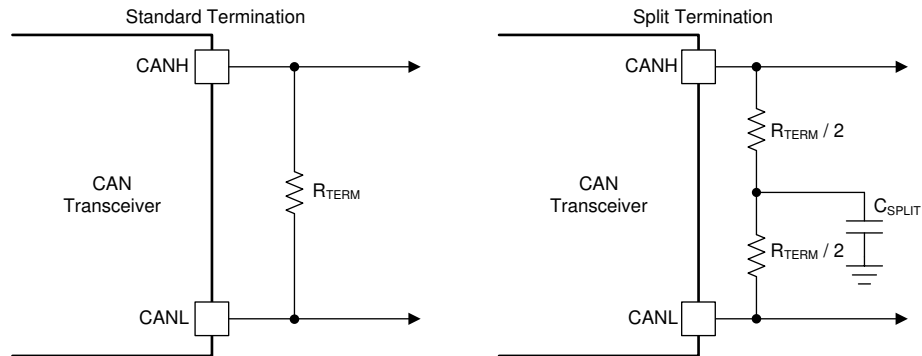
The ISO11898 standard specifies the interconnect to be a single twisted pair cable (shielded or unshielded) with 120- $\Omega$  characteristic impedance ( $Z_0$ ). Resistors equal to the characteristic impedance of the line should be used to terminate both ends of the cable to prevent signal reflections. Unterminated drop-lines (stubs) connecting nodes to the bus should be kept as short as possible to minimize signal reflections. The termination may be in a node, but if nodes are removed from the bus, the termination must be carefully placed so that it is not removed from the bus.



**Figure 9-2. Typical CAN Bus**

Termination may be a single 120- $\Omega$  resistor at the end of the bus, either on the cable or in a terminating node. If filtering and stabilization of the common-mode voltage of the bus is desired, then split termination can be used.

(See [Figure 9-3](#)). Split termination improves the electromagnetic emissions behavior of the network by eliminating fluctuations in the bus common-mode voltages at the start and end of message transmissions.



**Figure 9-3. CAN Bus Termination Concepts**

## 10 Power Supply Recommendations

To make sure operation is reliable at all data rates and supply voltages, a 0.1- $\mu$ F bypass capacitor is recommended at the input and output supply pins ( $V_{CC1}$  and  $V_{CC2}$ ). The capacitors should be placed as close to the supply pins as possible. In addition, a bulk capacitance, typically 4.7  $\mu$ F, can be placed near the  $V_{CC2}$  supply pin. If only a single primary-side power supply is available in an application, isolated power can be generated for the secondary-side with the help of a transformer driver such as TI's [SN6505B](#). For such applications, detailed power supply design, and transformer selection recommendations are available in the [SN6505 Low-Noise 1-A Transformer Drivers for Isolated Power Supplies](#) data sheet.

## 11 Layout

### 11.1 Layout Guidelines

A minimum of four layers is required to accomplish a low EMI PCB design (see [Section 11.2](#) Figure 11-1). Layer stacking should be in the following order (top-to-bottom): high-speed signal layer, ground plane, power plane and low-frequency signal layer.

- Routing the high-speed traces on the top layer avoids the use of vias (and the introduction of their inductances) and allows for clean interconnects between the isolator and the transmitter and receiver circuits of the data link.
- Placing a solid ground plane next to the high-speed signal layer establishes controlled impedance for transmission line interconnects and provides an excellent low-inductance path for the return current flow.
- Placing the power plane next to the ground plane creates additional high-frequency bypass capacitance of approximately 100 pF/in<sup>2</sup>.
- Routing the slower speed control signals on the bottom layer allows for greater flexibility as these signal links usually have margin to tolerate discontinuities such as vias.

Suggested placement and routing of ISO1044B bypass capacitors and optional TVS diodes is shown in [Figure 11-2](#). In particular, place the  $V_{CC2}$  bypass capacitors on the top layer, as close to the device pins as possible, and complete the connection to the  $V_{CC2}$  and  $G_{ND2}$  pins without using vias.

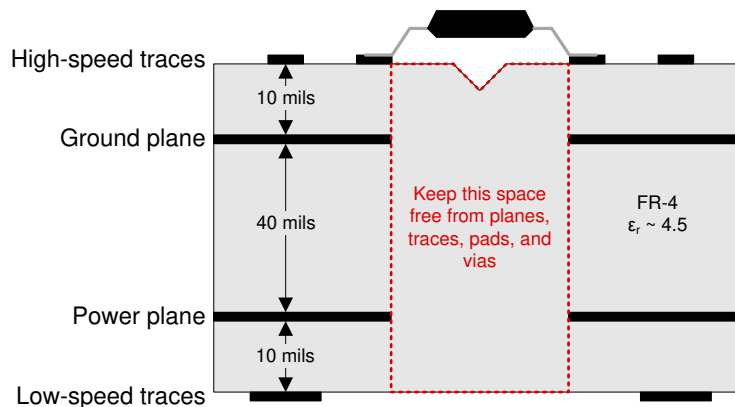
If an additional supply voltage plane or signal layer is needed, add a second power or ground plane system to the stack to keep it symmetrical. This makes the stack mechanically stable and prevents it from warping. Also the power and ground plane of each power system can be placed closer together, thus increasing the high-frequency bypass capacitance significantly.

For detailed layout recommendations, refer to the [Digital Isolator Design Guide](#).

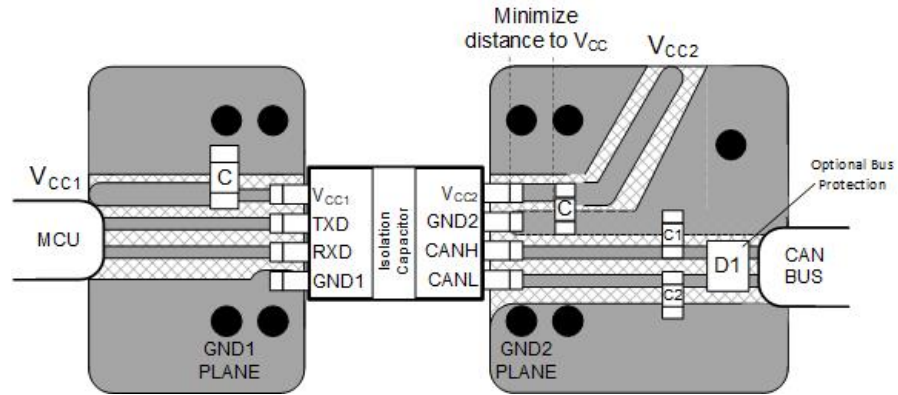
#### 11.1.1 PCB Material

For digital circuit boards operating at less than 150 Mbps, (or rise and fall times greater than 1 ns), and trace lengths of up to 10 inches, use standard FR-4 UL94V-0 printed circuit board. This PCB is preferred over lower-cost alternatives because of lower dielectric losses at high frequencies, less moisture absorption, greater strength and stiffness, and the self-extinguishing flammability-characteristics.

### 11.2 Layout Example



**Figure 11-1. Recommended Layer Stack**



**Figure 11-2. 8-D Layout Example**

## 12 Device and Documentation Support

### 12.1 Documentation Support

#### 12.1.1 Related Documentation

For related documentation see the following:

- Texas Instruments, [Digital Isolator Design Guide](#)
- Texas Instruments, [ISO1044 Isolated CAN Transceiver Evaluation Module User's Guide](#)
- Texas Instruments, [Isolate your CAN systems without compromising on performance or space TI TechNote](#)
- Texas Instruments, [Isolation Glossary](#)
- Texas Instruments, [High-voltage reinforced isolation: Definitions and test methodologies](#)
- Texas Instruments, [How to Isolate Signal and Power in Isolated CAN Systems TI TechNote](#)
- Texas Instruments, [How to Design Isolated CAN Systems With Correct Bus Protection 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

TI E2E™ is a trademark of Texas Instruments.

All other trademarks are the property of their respective owners.

#### 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

[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.

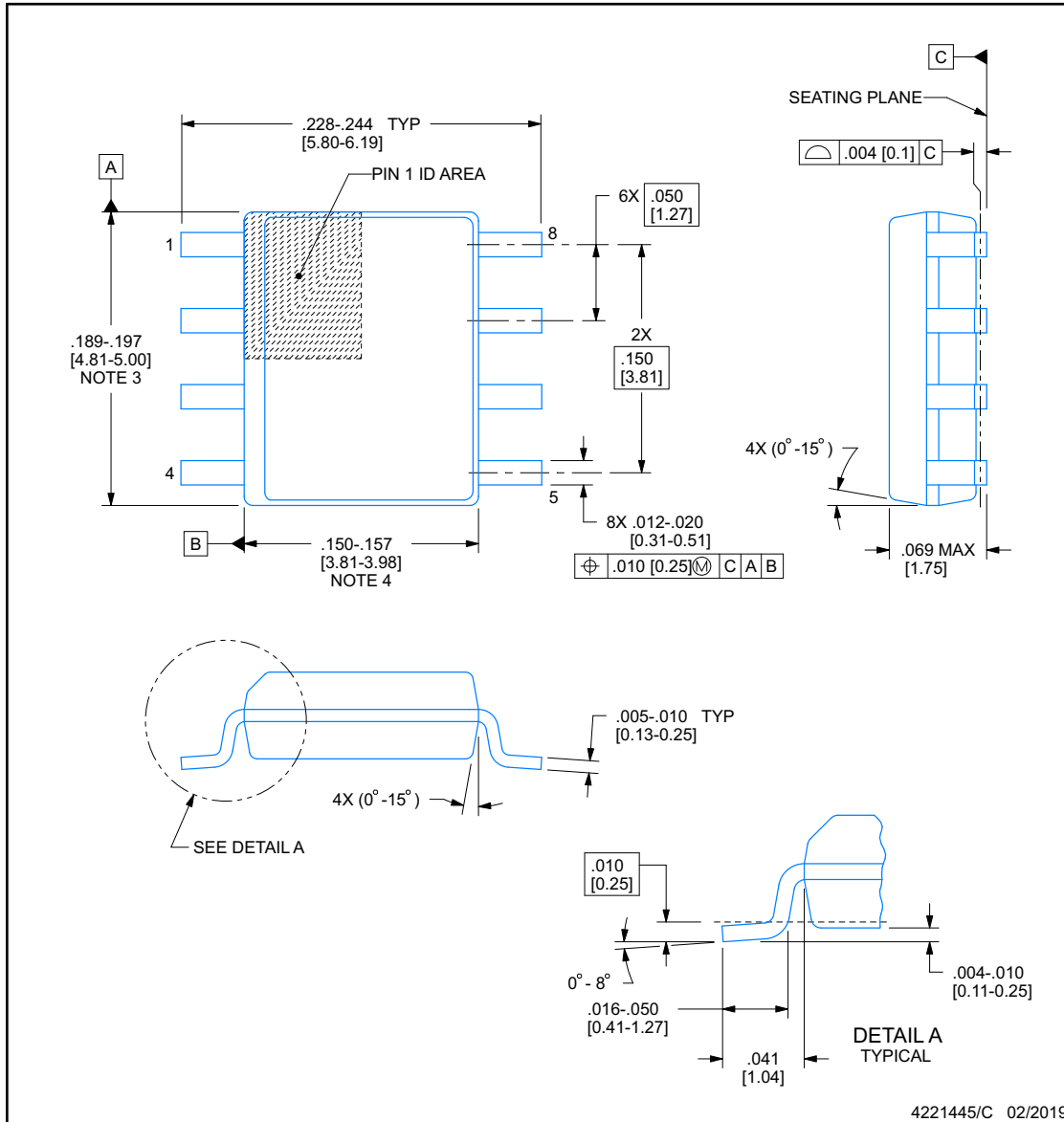


## D0008B

## PACKAGE OUTLINE

### SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

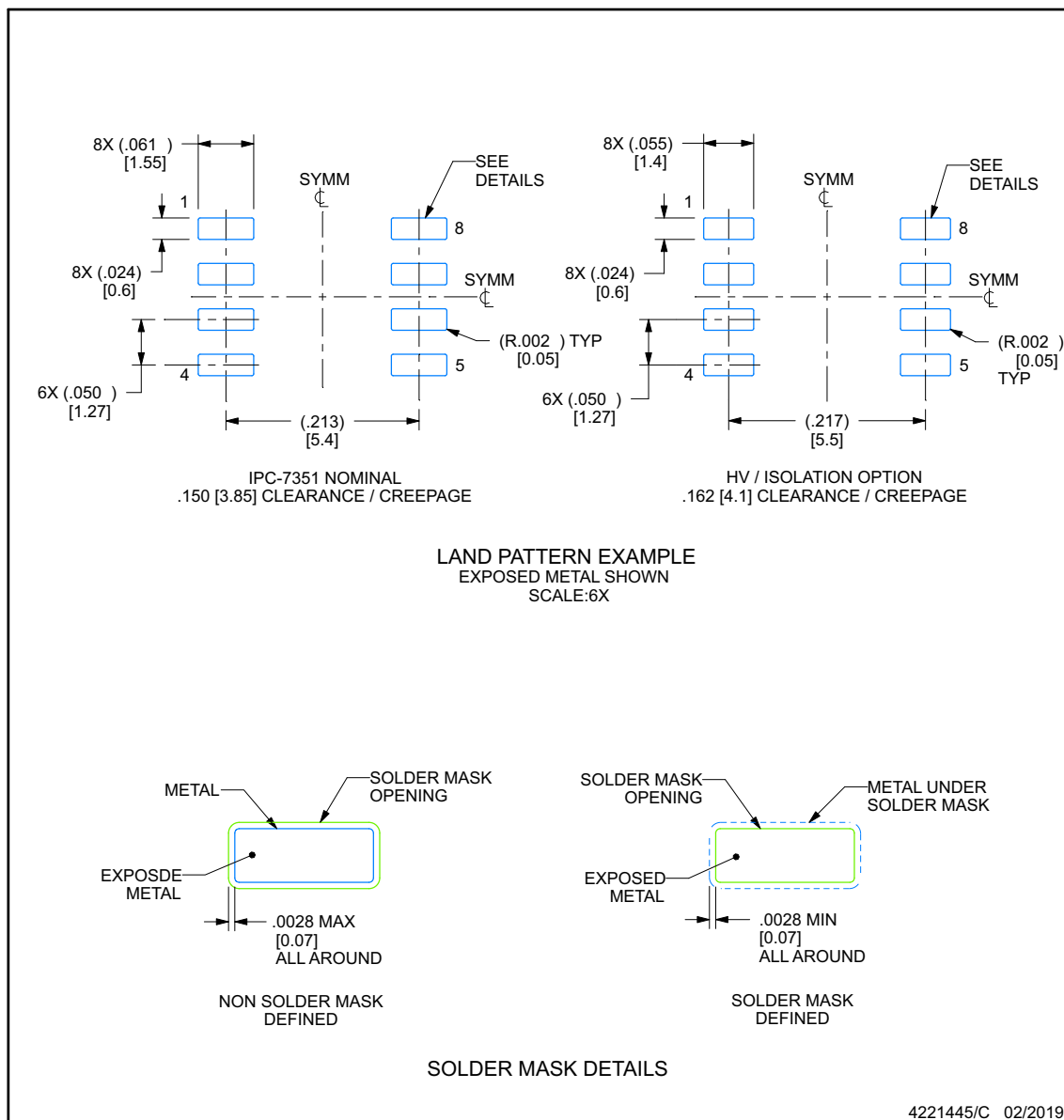


#### NOTES:

- Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15], per side.
- This dimension does not include interlead flash.
- Reference JEDEC registration MS-012, variation AA.

**EXAMPLE BOARD LAYOUT****D0008B****SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



NOTES: (continued)

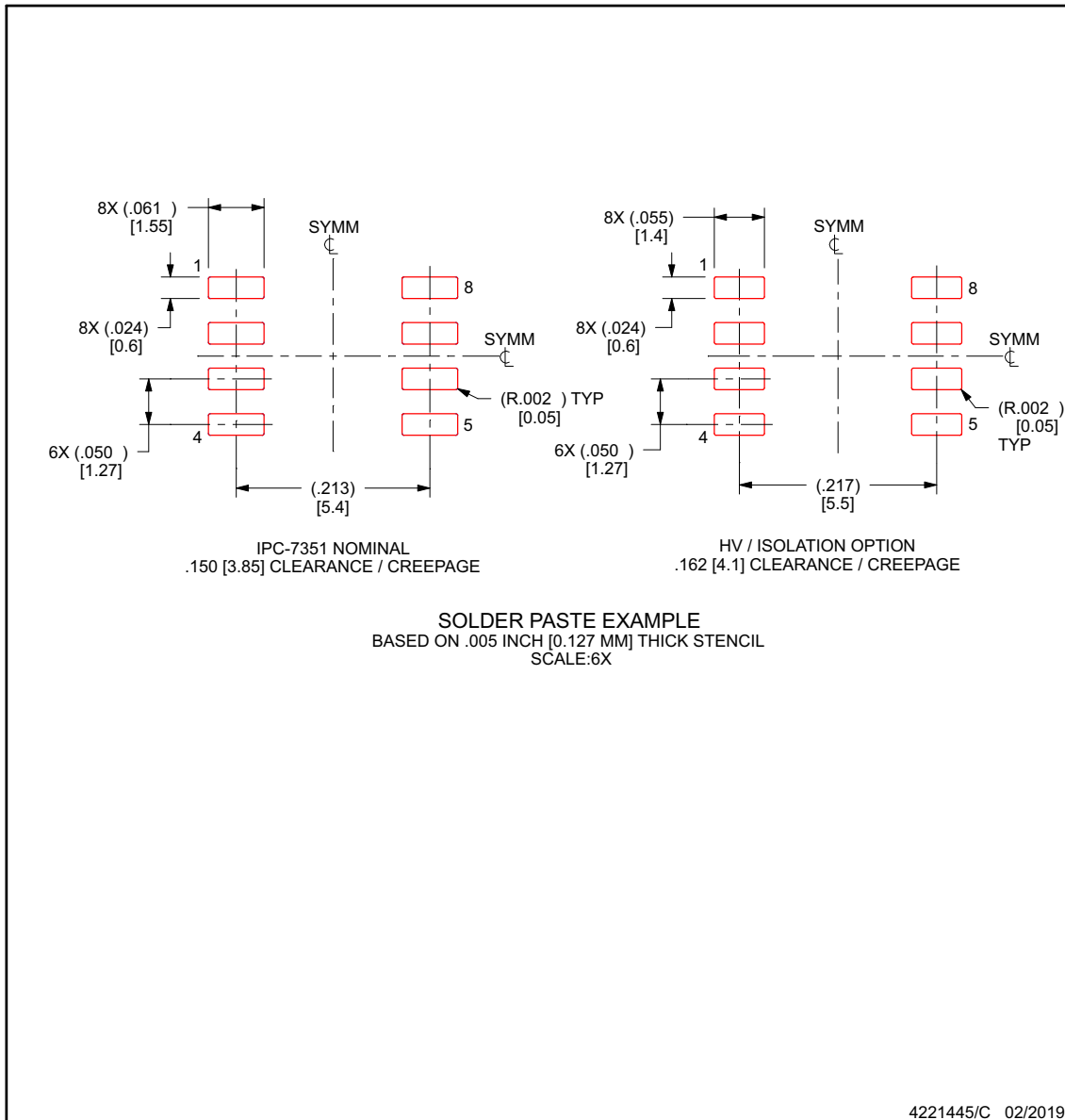
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

**D0008B**

**SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



NOTES: (continued)

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

## PACKAGING INFORMATION

| Orderable part number      | Status<br>(1) | Material type<br>(2) | Package   Pins | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|----------------------------|---------------|----------------------|----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">ISO1044BD</a>  | Active        | Production           | SOIC (D)   8   | 75   TUBE             | Yes         | NIPDAU                               | Level-2-260C-1 YEAR               | -40 to 125   | 1044B               |
| ISO1044BD.A                | Active        | Production           | SOIC (D)   8   | 75   TUBE             | Yes         | NIPDAU                               | Level-2-260C-1 YEAR               | -40 to 125   | 1044B               |
| ISO1044BDG4                | Active        | Production           | SOIC (D)   8   | 75   TUBE             | Yes         | NIPDAU                               | Level-2-260C-1 YEAR               | -40 to 125   | 1044B               |
| ISO1044BDG4.A              | Active        | Production           | SOIC (D)   8   | 75   TUBE             | Yes         | NIPDAU                               | Level-2-260C-1 YEAR               | -40 to 125   | 1044B               |
| <a href="#">ISO1044BDR</a> | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-2-260C-1 YEAR               | -40 to 125   | 1044B               |
| ISO1044BDR.A               | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-2-260C-1 YEAR               | -40 to 125   | 1044B               |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

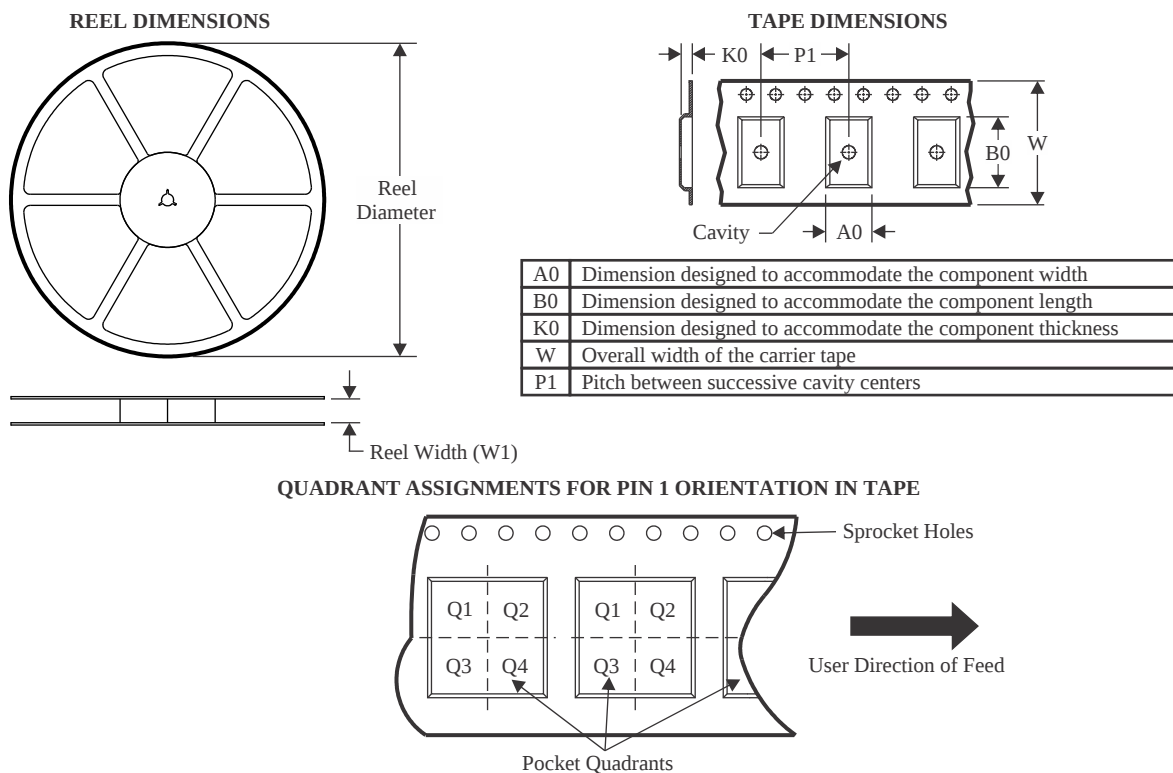
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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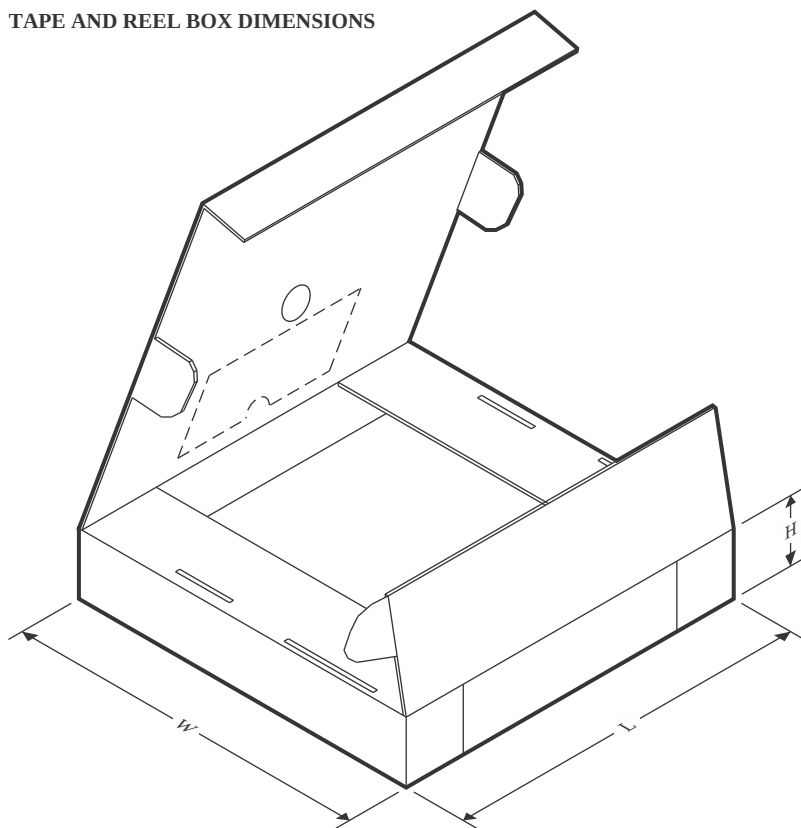
## TAPE AND REEL INFORMATION



\*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 |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| ISO1044BDR | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |

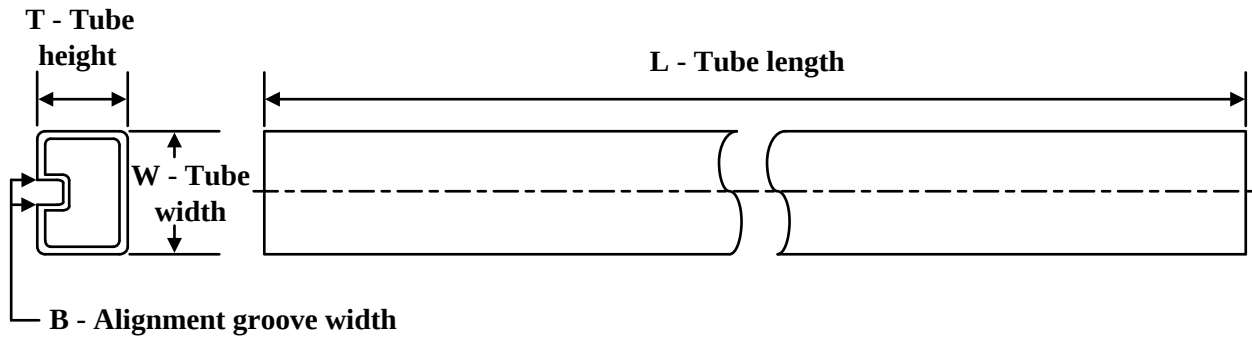
## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

| Device     | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| ISO1044BDR | SOIC         | D               | 8    | 2500 | 350.0       | 350.0      | 43.0        |

## TUBE



\*All dimensions are nominal

| Device        | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|---------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| ISO1044BD     | D            | SOIC         | 8    | 75  | 505.46 | 6.76   | 3810   | 4      |
| ISO1044BD.A   | D            | SOIC         | 8    | 75  | 505.46 | 6.76   | 3810   | 4      |
| ISO1044BDG4   | D            | SOIC         | 8    | 75  | 505.46 | 6.76   | 3810   | 4      |
| ISO1044BDG4.A | D            | SOIC         | 8    | 75  | 505.46 | 6.76   | 3810   | 4      |

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