



3.3 V FULL-DUPLEX RS-485/RS-422 DRIVERS AND BALANCED RECEIVERS

FEATURES

- Designed for INTERBUS Applications
- Balanced Receiver Thresholds
- 1/2 Unit-Load (up to 64 nodes on the bus)
- Bus-Pin ESD Protection 15 kV HBM
- Bus-Fault Protection of -7V to 12V
- Thermal Shutdown Protection
- Power-Up/Down Glitch-free Bus Inputs and Outputs
- High Input Impedance with Low V_{CC}
- Monotonic Outputs During Power Cycling
- 5V Tolerant Inputs

APPLICATIONS

- Digital Motor Control
- Utility Meters
- Chassis-to-Chassis Interconnections
- Electronic Security Stations
- Industrial, Process, and Building Automation
- Point-of-Sale (POS) Terminals and Networks
- DTE/DCE Interfaces

DESCRIPTION

The SN65HVD379 is a differential line driver and differential-input line receiver that operates with a 3.3-V power supply. Each driver and receiver has separate input and output pins for full-duplex bus communication designs. They are designed for balanced transmission lines and interoperability with ANSI TIA/EIA-485A, TIA/EIA-422-B, ITU-T v.11, and ISO 8482:1993 standard-compliant devices.

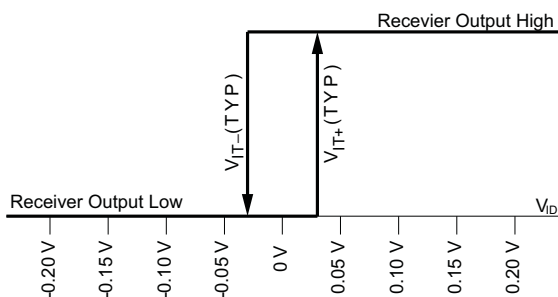
These differential bus drivers and receivers are monolithic, integrated circuits designed for full-duplex bi-directional data communication on multipoint bus-transmission lines at signaling rates⁽¹⁾ up to 25 Mbps. The SN65HVD379 is fully enabled with no external enabling pins.

The 1/2 unit load receiver has a higher receiver input resistance. This results in lower bus leakage currents over the common-mode voltage range, and reduces the total amount of current that an RS-485 driver is forced to source or sink when transmitting.

The balanced differential receiver input threshold makes the SN65HVD379 more compatible with fieldbus requirements that define an external failsafe structure.

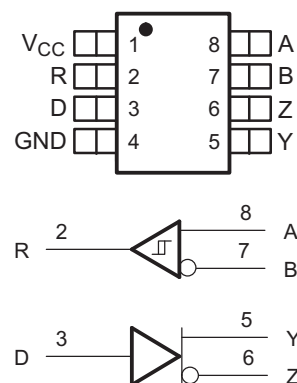
(1) The signaling rate of a line is the number of voltage transitions that are made per second expressed in the units bps (bits per second).

BALANCED RECEIVER INPUT THRESHOLDS



SN65HVD379

D PACKAGE (TOP VIEW)



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



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

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

ORDERING INFORMATION

| SIGNALING RATE | UNIT LOADS | PART NUMBER ⁽¹⁾ | SOIC MARKING |
|----------------|------------|----------------------------|--------------|
| 25 Mbps | 1/2 | SN65HVD379 | |

(1) These are The D package is available taped and reeled. Add an R suffix to the part number (ie. SN65HVD379DR).

ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range unless otherwise noted⁽¹⁾⁽²⁾

| | | UNIT |
|----------------------|--|-----------------------------------|
| V_{CC} | Supply voltage range | -0.3 V to 6 V |
| V_A, V_B, V_Y, V_Z | Voltage range at any bus terminal (A, B, Y, Z) | -9 V to 14 V |
| V_{TRANS} | Voltage input, transient pulse through 100 Ω . See Figure 8 (A, B, Y, Z) ⁽³⁾ | -50 to 50 V |
| V_I | Input voltage range (D, DE, RE) | -0.5 V to 7 V |
| P_{CONT} | Continuous total power dissipation | Internally limited ⁽⁴⁾ |
| I_O | Output current (receiver output only, R) | 11 mA |

- Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- All voltage values, except differential I/O bus voltages, are with respect to network ground terminal.
- This tests survivability only and the output state of the receiver is not specified.
- The Thermal shutdown protection circuit internally limits the continuous total power dissipation. Thermal shutdown typically occurs when the junction temperature reaches 165°C.

RECOMMENDED OPERATING CONDITIONS

over operating free-air temperature range unless otherwise noted

| PARAMETER | | MIN | NOM | MAX | UNIT |
|-------------------|---|-------------------|-----|----------|----------|
| V_{CC} | Supply voltage | 3.0 | | 3.6 | V |
| V_I or V_{IC} | Voltage at any bus terminal (separately or common mode) | -7 ⁽¹⁾ | | 12 | |
| $1/t_{UI}$ | Signaling rate | | | 25 | Mbps |
| R_L | Differential load resistance | 54 | 60 | | Ω |
| V_{IH} | High-level input voltage | D | | V_{CC} | |
| V_{IL} | Low-level input voltage | D | | 0.8 | V |
| V_{ID} | Differential input voltage | -12 | | 12 | |
| I_{OH} | High-level output current | Driver | | -60 | mA |
| | | Receiver | | -8 | |
| I_{OL} | Low-level output current | Driver | | 60 | mA |
| | | Receiver | | 8 | |
| T_A | Ambient still-air temperature | -40 | | 85 | °C |

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

ELECTROSTATIC DISCHARGE PROTECTION

| PARAMETER | TEST CONDITIONS | MIN | TYP ⁽¹⁾ | MAX | UNIT |
|-------------------------------------|-----------------------|-----|--------------------|-----|------|
| Human body model | Bus terminals and GND | ±16 | | | kV |
| Human body model ⁽²⁾ | All pins | ±4 | | | |
| Charged-device-model ⁽³⁾ | All pins | ±1 | | | |

- (1) All typical values at 25°C with 3.3-V supply.
 (2) Tested in accordance with JEDEC Standard 22, Test Method A114-A.
 (3) Tested in accordance with JEDEC Standard 22, Test Method C101.

DRIVER ELECTRICAL CHARACTERISTICS

over recommended operating conditions unless otherwise noted

| PARAMETER | TEST CONDITIONS | MIN | TYP ⁽¹⁾ | MAX | UNIT |
|---|---|---|--------------------|--------------------|---------|
| $V_{I(K)}$ Input clamp voltage | $I_I = -18$ mA | -1.5 | | | V |
| $ V_{OD(SS)} $ Steady-state differential output voltage | $I_O = 0$ | 2.0 | | V_{CC} | |
| | $R_L = 54$ Ω , See Figure 1 ⁽²⁾ (RS-485) | 1.5 | 2.0 | | |
| | $R_L = 100$ Ω , See Figure 1 (RS-422) | 2.0 | 2.3 | | |
| | $V_{test} = -7$ V to 12 V, See Figure 2 | 1.5 | | | |
| $\Delta V_{OD(SS)} $ Change in magnitude of steady-state differential output voltage between states | $R_L = 54$ Ω , See Figure 1 and Figure 2 | -0.2 | | 0.2 | V |
| $V_{OD(RING)}$ Differential Output Voltage overshoot and undershoot | $R_L = 54$ Ω , $C_L = 50$ pF, See Figure 5 (Figure 3 for definitions) | | | 10% ⁽³⁾ | |
| $V_{OC(PP)}$ Peak-to-peak common-mode output voltage | See Figure 3 | | 0.5 | | |
| $V_{OC(SS)}$ Steady-state common-mode output voltage | | 1.6 | 2.3 | | |
| $\Delta V_{OC(SS)}$ Change in steady-state common-mode output voltage | | -0.05 | 0.05 | | |
| $I_{Z(Z)}$ or $I_{Y(Z)}$ High-impedance state output current | | $V_{CC} = 0$ V, V_Z or $V_Y = 12$ V, Other input at 0 V | | | 90 |
| | $V_{CC} = 0$ V, V_Z or $V_Y = -7$ V, Other input at 0 V | -10 | | | |
| $I_{Z(S)}$ or $I_{Y(S)}$ Short Circuit output Current | V_Z or $V_Y = -7$ V | Other input at 0 V | -250 | 250 | mA |
| | V_Z or $V_Y = 12$ V | | -250 | 250 | |
| I_I Input current | D | $V_I = 0$ or $V_I = 2.0$ | 0 | 100 | μ A |
| $C_{(OD)}$ Differential output capacitance | | $V_{OD} = 0.4 \sin(4E6\pi t) + 0.5$ V, V_{CC} at 0 V | | 16 | pF |

- (1) All typical values are at 25°C and with a 3.3-V supply.
 (2) V_{CC} is 3.3 Vdc \pm 5%
 (3) 10% of the peak-to-peak Differential Output voltage swing, per TIA/EIA-485.

DRIVER SWITCHING CHARACTERISTICS

over recommended operating conditions unless otherwise noted

| PARAMETER | TEST CONDITIONS | MIN | TYP ⁽¹⁾ | MAX | UNIT |
|--|---|-----|--------------------|-----|------|
| t_{PLH} Propagation delay time, low-to-high-level output | $R_L = 54$ Ω , $C_L = 50$ pF, See Figure 5 | 4 | 10 | 18 | ns |
| t_{PHL} Propagation delay time, high-to-low-level output | | | | | |
| t_r Differential output signal rise time | | 2.5 | 5 | 12 | ns |
| t_f Differential output signal fall time | | | | | |
| $t_{sk(p)}$ Pulse skew ($ t_{PHL} - t_{PLH} $) | | | | 0.6 | ns |
| $t_{sk(pp)}$ ⁽²⁾ Part-to-part skew | | | | 1 | ns |

- (1) All typical values are at 25°C and with a 3.3-V supply.
 (2) $t_{sk(pp)}$ is the magnitude of the difference in propagation delay times between any specified terminals of two devices when both devices operate with the same supply voltages, at the same temperature, and have identical packages and test circuits.

RECEIVER ELECTRICAL CHARACTERISTICS

over recommended operating conditions unless otherwise noted

| PARAMETER | | TEST CONDITIONS | MIN | TYP ⁽¹⁾ | MAX | UNIT |
|----------------|---|--|--------------------|--------------------|-------|------|
| V_{IT+} | Positive-going differential input threshold voltage | $I_O = -8$ mA | | | 0.2 | V |
| V_{IT-} | Negative-going differential input threshold voltage | $I_O = 8$ mA | -0.2 | | | |
| V_{hys} | Hysteresis voltage ($V_{IT+} - V_{IT-}$) | | | 50 | | mV |
| V_O | Output voltage | $V_{ID} = 200$ mV, $I_O = -8$ mA, See Figure 7 | 2.4 | | | V |
| | | $V_{ID} = -200$ mV, $I_O = 8$ mA, See Figure 7 | | | 0.4 | |
| I_A or I_B | Bus input current | V_A or $V_B = 12$ V | Other input at 0 V | 0.20 | 0.35 | mA |
| | | V_A or $V_B = 12$ V, $V_{CC} = 0$ V | | 0.24 | 0.40 | |
| | | V_A or $V_B = -7$ V | | -0.35 | -0.18 | |
| | | V_A or $V_B = -7$ V, $V_{CC} = 0$ V | | -0.25 | -0.13 | |
| C_{ID} | Differential input capacitance | $V_{ID} = 0.4 \sin(4E6\pi t) + 0.5$ V, DE at 0 V | | 15 | | pF |
| I_{CC} | Supply current | D at 0 V or V_{CC} and No Load | | | 2.1 | mA |

(1) All typical values are at 25°C and with a 3.3-V supply.

RECEIVER SWITCHING CHARACTERISTICS

over recommended operating conditions unless otherwise noted

| PARAMETER | | TEST CONDITIONS | MIN | TYP ⁽¹⁾ | MAX | UNIT |
|--------------|--|---|-----|--------------------|-----|------|
| t_{PLH} | Propagation delay time, low-to-high-level output | $V_{ID} = -1.5$ V to 1.5 V, $C_L = 15$ pF, See Figure 7 | | 26 | 45 | ns |
| t_{PHL} | Propagation delay time, high-to-low-level output | | | | | |
| $t_{sk(p)}$ | Pulse skew ($ t_{PHL} - t_{PLH} $) | | | | 7 | |
| $t_{sk(pp)}$ | Part-to-part skew ⁽²⁾ | | | 5 | | |
| t_r | Output signal rise time | | | | 5 | |
| t_f | Output signal fall time | | | | 6 | |

(1) All typical values are at 25°C and with a 3.3-V supply

(2) $t_{sk(pp)}$ is the magnitude of the difference in propagation delay times between any specified terminals of two devices when both devices operate with the same supply voltages, at the same temperature, and have identical packages and test circuits.

DEVICE POWER DISSIPATION – P_D

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------|--|-----|-----|-----|------|
| P_D | $R_L = 60$, $C_L = 50$ pF, Input to D a 50% duty cycle square wave at indicated signaling rate $T_A = 85^\circ\text{C}$ | | | 197 | mW |

FUNCTION TABLES

| DRIVER | | | RECEIVER | |
|--------|---------|---|-----------------------------|---------|
| INPUT | OUTPUTS | | DIFFERENTIAL INPUTS | OUTPUTS |
| D | Y | Z | $V_{ID} = V_A - V_B$ | R |
| H | H | L | $V_{ID} \leq -0.2$ V | L |
| L | L | H | -0.2 V $< V_{ID} < 0.2$ V | ? |
| Open | L | H | 0.2 V $\leq V_{ID}$ | H |

PARAMETER MEASUREMENT INFORMATION

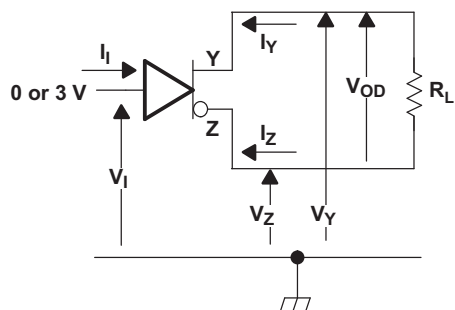


Figure 1. Driver V_{OD} Test Circuit and Voltage and Current Definitions

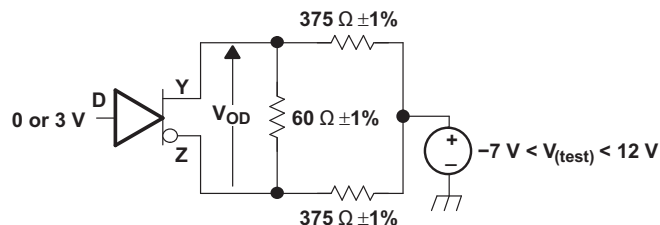


Figure 2. Driver V_{OD} With Common-Mode Loading Test Circuit

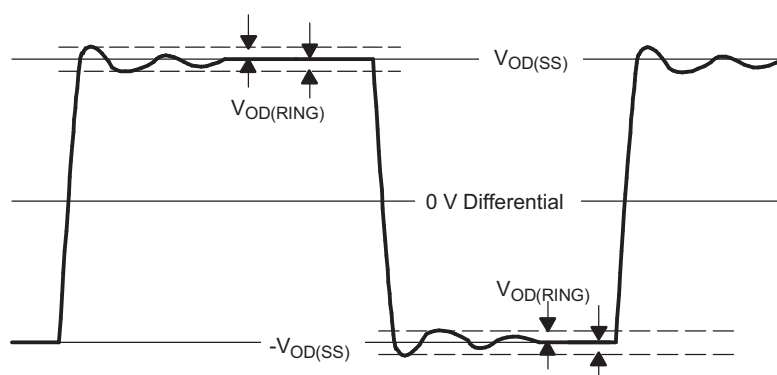
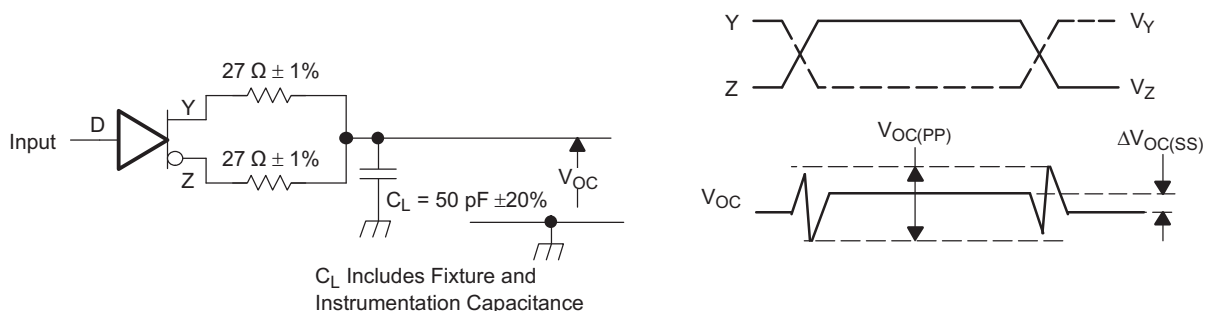


Figure 3. $V_{OD(RING)}$ Waveform and Definitions

$V_{OD(RING)}$ is measured at four points on the output waveform, corresponding to overshoot and undershoot from the $V_{OD(H)}$ and $V_{OD(L)}$ steady state values.



Input: PRR = 500 kHz, 50% Duty Cycle, $t_r < 6ns$, $t_f < 6ns$, $Z_O = 50 \Omega$

Figure 4. Test Circuit and Definitions for the Driver Common-Mode Output Voltage

PARAMETER MEASUREMENT INFORMATION (continued)

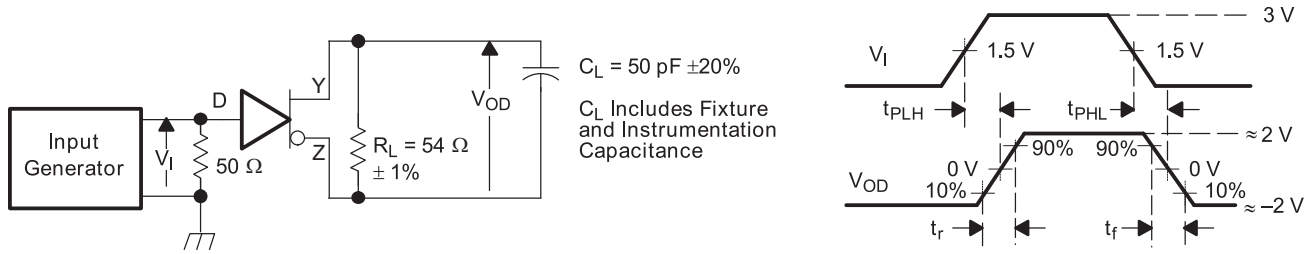


Figure 5. Driver Switching Test Circuit and Voltage Waveforms

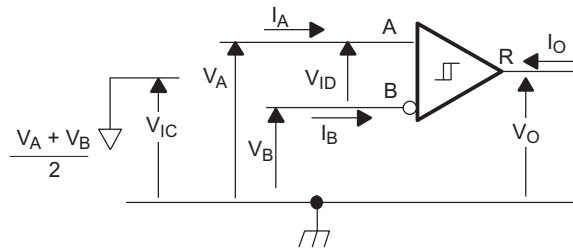


Figure 6. Receiver Voltage and Current Definitions

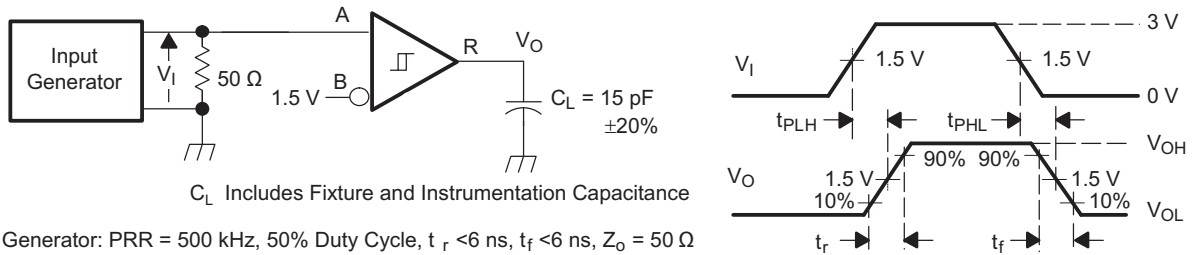


Figure 7. Receiver Switching Test Circuit and Voltage Waveforms

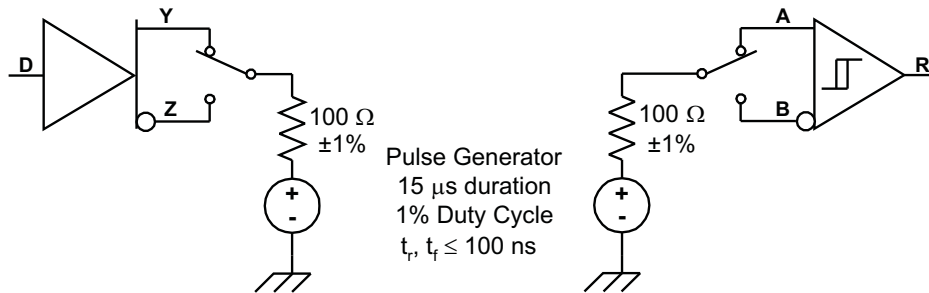
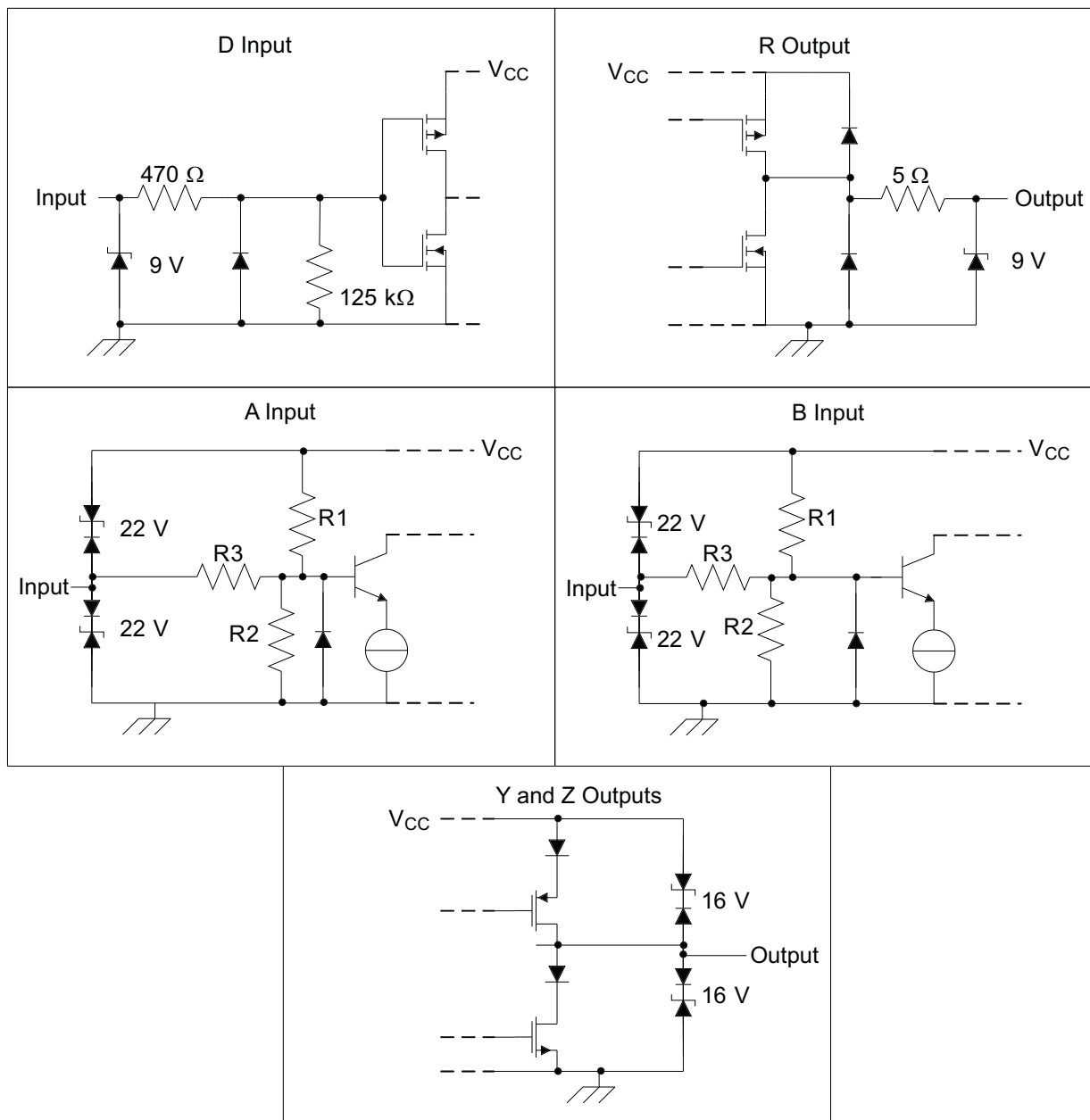


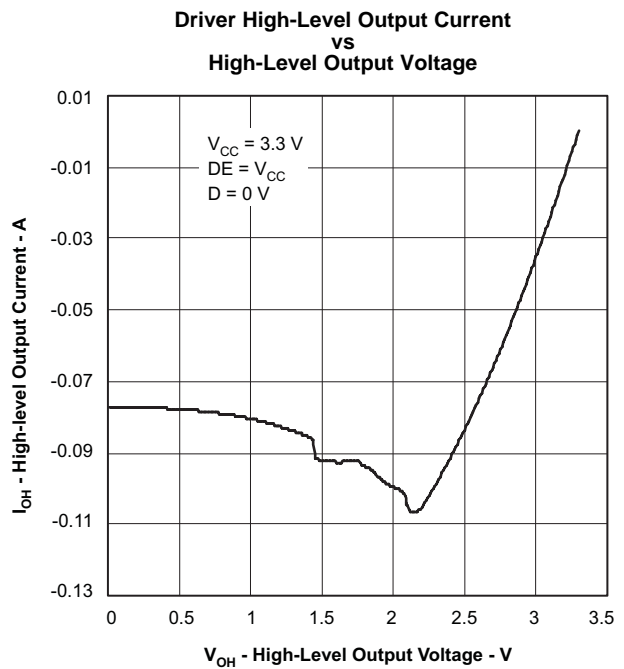
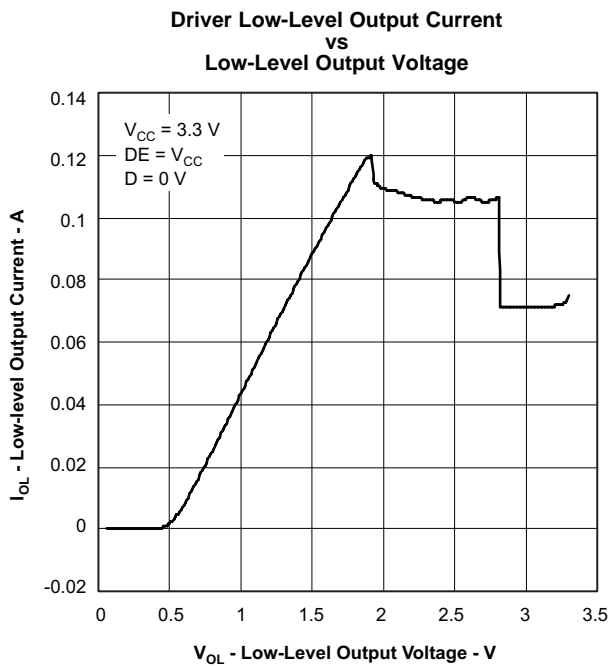
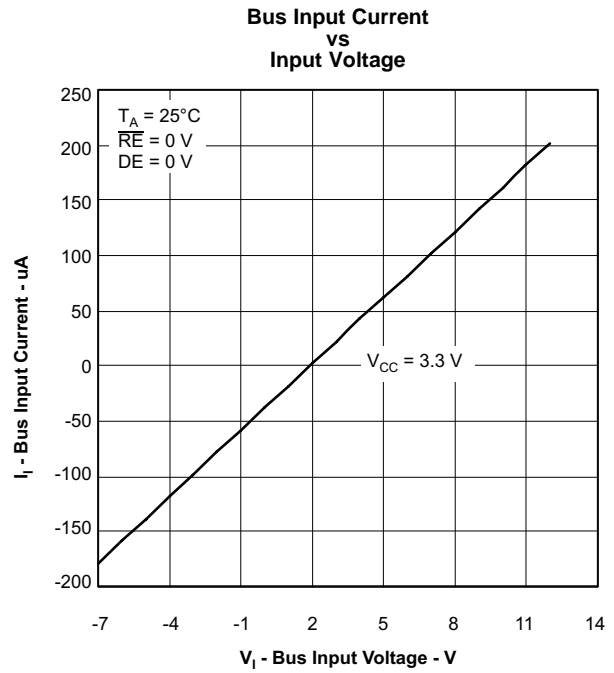
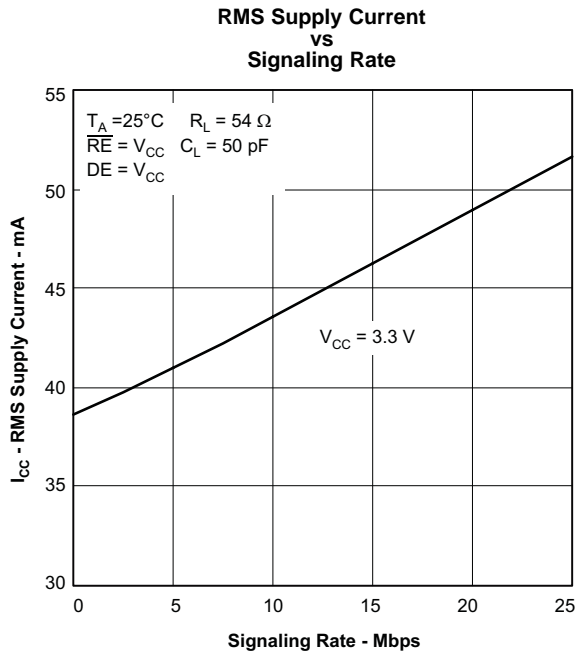
Figure 8. Test Circuit, Transient Over Voltage Test

EQUIVALENT INPUT AND OUTPUT SCHEMATIC DIAGRAMS



| | R1/R2 | R3 |
|------------|--------------|-----------|
| SN65HVD379 | 9 kΩ | 45 kΩ |

TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS (continued)

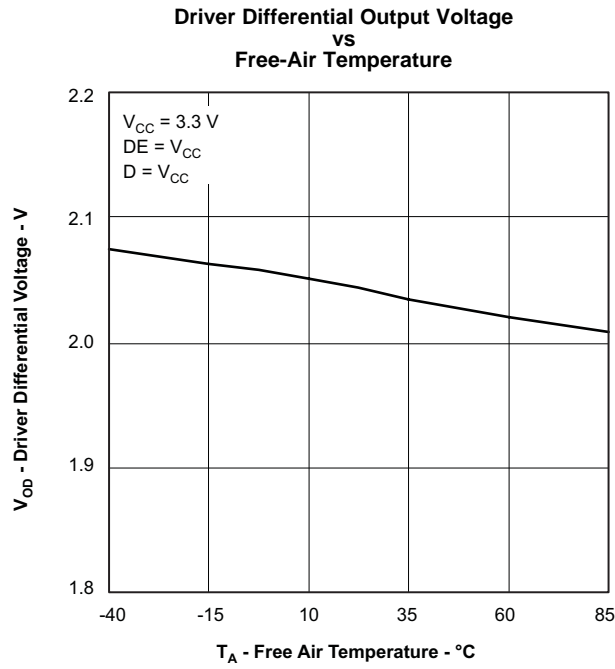


Figure 13.

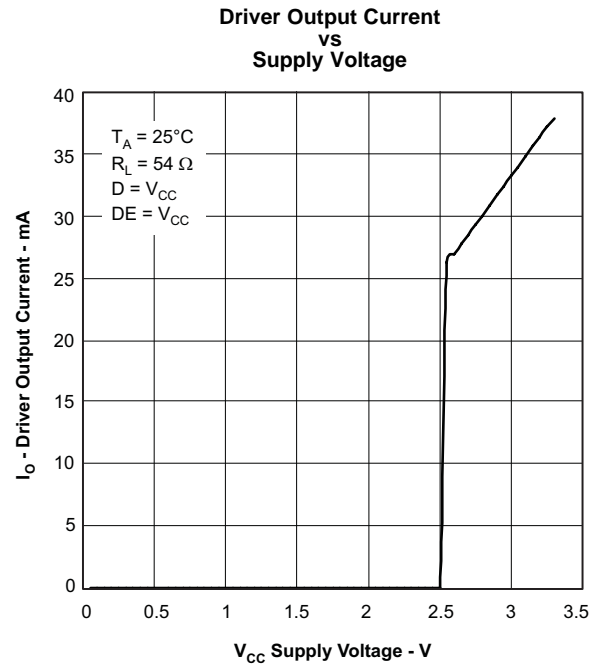


Figure 14.

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN65HVD379D | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN65HVD379DG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN65HVD379DR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN65HVD379DRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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TAPE AND REEL INFORMATION



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN65HVD379DR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS

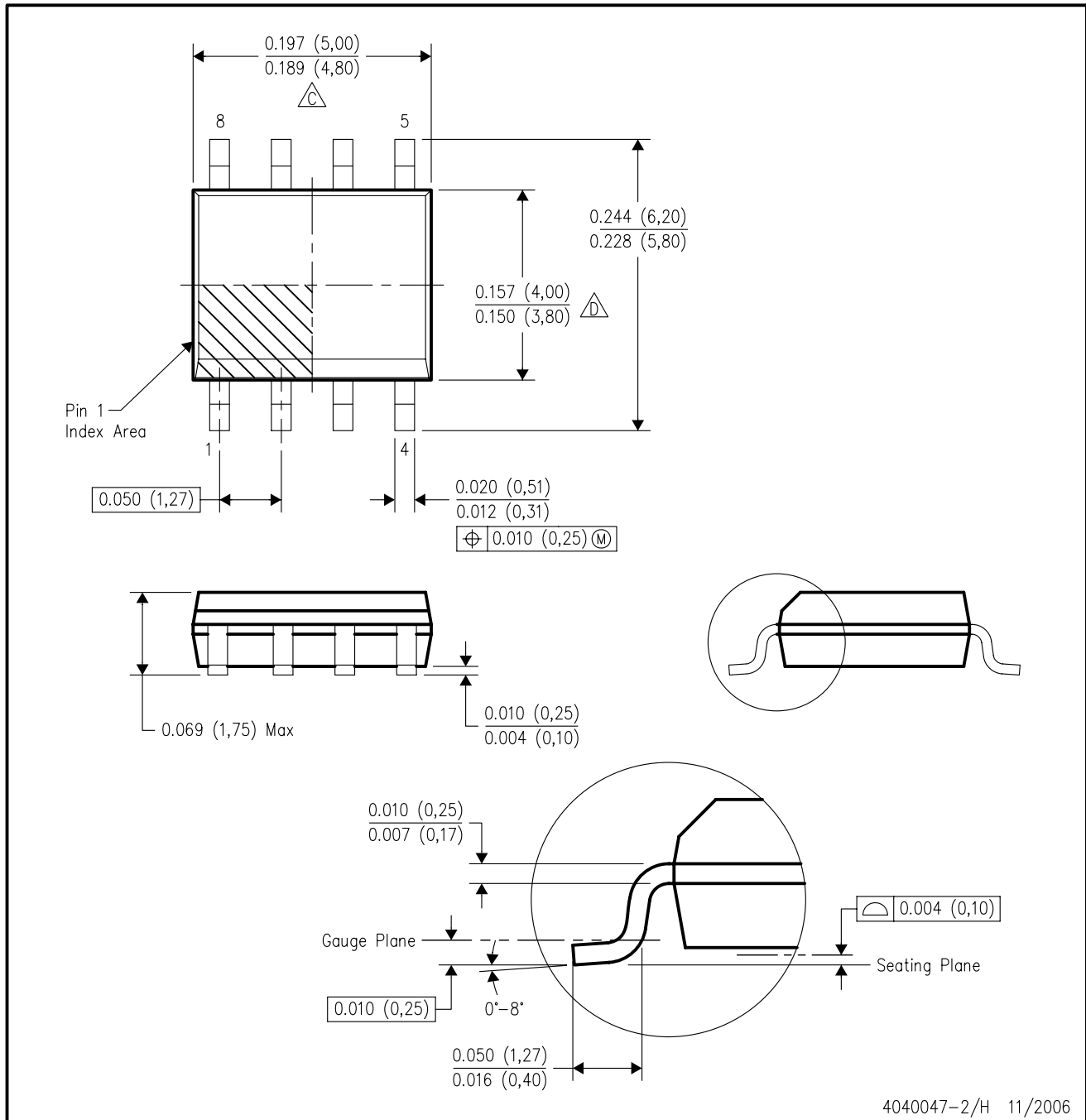


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN65HVD379DR | SOIC | D | 8 | 2500 | 346.0 | 346.0 | 29.0 |

D (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
 - E. Reference JEDEC MS-012 variation AA.

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| Interface | interface.ti.com |
| Logic | logic.ti.com |
| Power Mgmt | power.ti.com |
| Microcontrollers | microcontroller.ti.com |
| RFID | www.ti-rfid.com |
| RF/IF and ZigBee® Solutions | www.ti.com/lprf |

Applications

| | |
|--------------------|--|
| Audio | www.ti.com/audio |
| Automotive | www.ti.com/automotive |
| Broadband | www.ti.com/broadband |
| Digital Control | www.ti.com/digitalcontrol |
| Medical | www.ti.com/medical |
| Military | www.ti.com/military |
| Optical Networking | www.ti.com/opticalnetwork |
| Security | www.ti.com/security |
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