

## 3.3-V RS-485 TRANSCEIVERS

Check for Samples: [SN65HVD10](#), [SN65HVD10Q](#), [SN75HVD10](#), [SN65HVD11](#), [SN65HVD11Q](#), [SN75HVD11](#), [SN65HVD12](#), [SN75HVD12](#)

### FEATURES

- Operates With a 3.3-V Supply
- Bus-Pin ESD Protection Exceeds 16 kV HBM
- 1/8 Unit-Load Option Available (Up to 256 Nodes on the Bus)
- Optional Driver Output Transition Times for Signaling Rates <sup>(1)</sup> of 1 Mbps, 10 Mbps, and 32 Mbps
- Meets or Exceeds the Requirements of ANSI TIA/EIA-485-A
- Bus-Pin Short Circuit Protection From –7 V to 12 V
- Low-Current Standby Mode . . . 1  $\mu$ A Typical
- Open-Circuit, Idle-Bus, and Shorted-Bus Failsafe Receiver
- Thermal Shutdown Protection
- Glitch-Free Power-Up and Power-Down Protection for Hot-Plugging Applications
- SN75176 Footprint

### APPLICATIONS

- Digital Motor Control
- Utility Meters
- Chassis-to-Chassis Interconnects
- Electronic Security Stations
- Industrial Process Control
- Building Automation
- Point-of-Sale (POS) Terminals and Networks

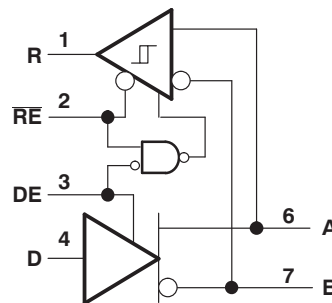
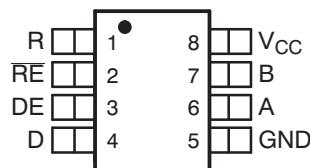
(1) The signaling rate of a line is the number of voltage transitions that are made per second expressed in the units bps (bits per second).

### DESCRIPTION

The SN65HVD10, SN75HVD10, SN65HVD11, SN75HVD11, SN65HVD12, and SN75HVD12 combine a 3-state differential line driver and differential input line receiver that operate with a single 3.3-V power supply. They are designed for balanced transmission lines and meet or exceed ANSI standard TIA/EIA-485-A and ISO 8482:1993. These differential bus transceivers are monolithic integrated circuits designed for bidirectional data communication on multipoint bus-transmission lines. The drivers and receivers have active-high and active-low enables respectively, that can be externally connected together to function as direction control. Very low device standby supply current can be achieved by disabling the driver and the receiver.

The driver differential outputs and receiver differential inputs connect internally to form a differential input/output (I/O) bus port that is designed to offer minimum loading to the bus whenever the driver is disabled or  $V_{CC} = 0$ . These parts feature wide positive and negative common-mode voltage ranges, making them suitable for party-line applications.

**D OR P 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 | T <sub>A</sub> | PACKAGE             |             | SOIC MARKING |
|----------------|------------|----------------|---------------------|-------------|--------------|
|                |            |                | SOIC <sup>(1)</sup> | PDIP        |              |
| 32 Mbps        | 1/2        | –40°C to 85°C  | SN65HVD10D          | SN65HVD10P  | VP10         |
| 10 Mbps        | 1/8        |                | SN65HVD11D          | SN65HVD11P  | VP11         |
| 1 Mbps         | 1/8        |                | SN65HVD12D          | SN65HVD12P  | VP12         |
| 32 Mbps        | 1/2        | –0°C to 70°C   | SN75HVD10D          | SN75HVD10P  | VN10         |
| 10 Mbps        | 1/8        |                | SN75HVD11D          | SN75HVD11P  | VN11         |
| 1 Mbps         | 1/8        |                | SN75HVD12D          | SN75HVD12P  | VN12         |
| 32 Mbps        | 1/2        | –40°C to 125°C | SN65HVD10QD         | SN65HVD10QP | VP10Q        |
| 10 Mbps        | 1/8        |                | SN65HVD11QD         | SN65HVD11QP | VP11Q        |

(1) The D package is available taped and reeled. Add an R suffix to the part number (i.e., SN75HVD11DR).

## ABSOLUTE MAXIMUM RATINGS

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

|                                                |                                                                                             |                 | UNIT                              |
|------------------------------------------------|---------------------------------------------------------------------------------------------|-----------------|-----------------------------------|
| V <sub>CC</sub>                                | Supply voltage range                                                                        |                 | –0.3 V to 6 V                     |
|                                                | Voltage range at A or B                                                                     |                 | –9 V to 14 V                      |
|                                                | Input voltage range at D, DE, R or $\overline{RE}$                                          |                 | –0.5 V to V <sub>CC</sub> + 0.5 V |
|                                                | Voltage input range, transient pulse, A and B, through 100 Ω, see <a href="#">Figure 11</a> |                 | –50 V to 50 V                     |
| I <sub>O</sub>                                 | Receiver output current                                                                     |                 | –11 mA to 11 mA                   |
| Electrostatic discharge                        | Human body model <sup>(3)</sup>                                                             | A, B, and GND   | ±16 kV                            |
|                                                |                                                                                             | All pins        | ±4 kV                             |
|                                                | Charged-device model <sup>(4)</sup>                                                         | All pins charge | ±1 kV                             |
| Continuous total power dissipation             |                                                                                             |                 | See Dissipation Rating Table      |
| Electrical Fast Transient/Burst <sup>(5)</sup> |                                                                                             | A, B, and GND   | ±4 kV                             |
| T <sub>J</sub>                                 | Junction temperature                                                                        |                 | 170°C                             |

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

(2) All voltage values, except differential I/O bus voltages, are with respect to network ground terminal.

(3) Tested in accordance with JEDEC Standard 22, Test Method A114-A and IEC 60749-26.

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

(5) Tested in accordance with IEC 61000-4-4.

## PACKAGE DISSIPATION RATINGS

| PACKAGE          | T <sub>A</sub> ≤ 25°C<br>POWER RATING | DERATING FACTOR <sup>(1)</sup><br>ABOVE T <sub>A</sub> = 25°C | T <sub>A</sub> = 70°C<br>POWER RATING | T <sub>A</sub> = 85°C<br>POWER RATING | T <sub>A</sub> = 125°C<br>POWER RATING |
|------------------|---------------------------------------|---------------------------------------------------------------|---------------------------------------|---------------------------------------|----------------------------------------|
| D <sup>(2)</sup> | 597 mW                                | 4.97 mW/°C                                                    | 373 mW                                | 298 mW                                | 100 mW                                 |
| D <sup>(3)</sup> | 990 mW                                | 8.26 mW/°C                                                    | 620 mW                                | 496 mW                                | 165 mW                                 |
| P                | 1290 mW                               | 10.75 mW/°C                                                   | 806 mW                                | 645 mW                                | 215 mW                                 |

(1) This is the inverse of the junction-to-ambient thermal resistance when board-mounted and with no air flow.

(2) Tested in accordance with the Low-K thermal metric definitions of EIA/JESD51-3.

(3) Tested in accordance with the High-K thermal metric definitions of EIA/JESD51-7.

## RECOMMENDED OPERATING CONDITIONS

over operating free-air temperature range unless otherwise noted

|                                   |                                                         |                        | MIN               | NOM | MAX             | UNIT |
|-----------------------------------|---------------------------------------------------------|------------------------|-------------------|-----|-----------------|------|
| V <sub>CC</sub>                   | Supply voltage                                          |                        | 3                 |     | 3.6             | V    |
| V <sub>I</sub> or V <sub>IC</sub> | Voltage at any bus terminal (separately or common mode) |                        | –7 <sup>(1)</sup> |     | 12              |      |
| V <sub>IH</sub>                   | High-level input voltage                                | D, DE, $\overline{RE}$ | 2                 |     | V <sub>CC</sub> |      |
| V <sub>IL</sub>                   | Low-level input voltage                                 | D, DE, $\overline{RE}$ | 0                 |     | 0.8             |      |
| V <sub>ID</sub>                   | Differential input voltage                              | Figure 7               | –12               |     | 12              |      |
| I <sub>OH</sub>                   | High-level output current                               | Driver                 | –60               |     |                 | mA   |
|                                   |                                                         | Receiver               | –8                |     |                 |      |
| I <sub>OL</sub>                   | Low-level output current                                | Driver                 |                   |     | 60              | mA   |
|                                   |                                                         | Receiver               |                   |     | 8               |      |
| R <sub>L</sub>                    | Differential load resistance                            |                        | 54                | 60  |                 | Ω    |
| C <sub>L</sub>                    | Differential load capacitance                           |                        |                   | 50  |                 | pF   |
| Signaling rate                    |                                                         | HVD10                  |                   |     | 32              | Mbps |
|                                   |                                                         | HVD11                  |                   |     | 10              |      |
|                                   |                                                         | HVD12                  |                   |     | 1               |      |
| T <sub>J</sub> <sup>(2)</sup>     | Junction temperature                                    |                        |                   |     | 145             | °C   |

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

(2) See thermal characteristics table for information regarding this specification.

## DRIVER ELECTRICAL CHARACTERISTICS

over recommended operating conditions unless otherwise noted

| PARAMETER            |                                                    | TEST CONDITIONS                                                                         | MIN   | TYP <sup>(1)</sup> | MAX             | UNIT |
|----------------------|----------------------------------------------------|-----------------------------------------------------------------------------------------|-------|--------------------|-----------------|------|
| V <sub>IK</sub>      | Input clamp voltage                                | I <sub>I</sub> = –18 mA                                                                 | –1.5  |                    |                 | V    |
| V <sub>OD</sub>      | Differential output voltage <sup>(2)</sup>         | I <sub>O</sub> = 0                                                                      | 2     |                    | V <sub>CC</sub> | V    |
|                      |                                                    | R <sub>L</sub> = 54 Ω, See Figure 1                                                     | 1.5   |                    |                 |      |
|                      |                                                    | V <sub>test</sub> = –7 V to 12 V, See Figure 2                                          | 1.5   |                    |                 |      |
| Δ V <sub>OD</sub>    | Change in magnitude of differential output voltage | See Figure 1 and Figure 2                                                               | –0.2  |                    | 0.2             | V    |
| V <sub>OC(PP)</sub>  | Peak-to-peak common-mode output voltage            | See Figure 3                                                                            |       | 400                |                 | mV   |
| V <sub>OC(SS)</sub>  | Steady-state common-mode output voltage            |                                                                                         | 1.4   |                    | 2.5             | V    |
| ΔV <sub>OC(SS)</sub> | Change in steady-state common-mode output voltage  |                                                                                         | –0.05 |                    | 0.05            | V    |
| I <sub>OZ</sub>      | High-impedance output current                      | See receiver input currents                                                             |       |                    |                 |      |
| I <sub>I</sub>       | Input current                                      | D                                                                                       | –100  |                    | 0               | μA   |
|                      |                                                    | DE                                                                                      | 0     |                    | 100             |      |
| I <sub>OS</sub>      | Short-circuit output current                       | –7 V ≤ V <sub>O</sub> ≤ 12 V                                                            | –250  |                    | 250             | mA   |
| C <sub>(OD)</sub>    | Differential output capacitance                    | V <sub>OD</sub> = 0.4 sin (4E6πt) + 0.5 V, DE at 0 V                                    |       | 16                 |                 | pF   |
| I <sub>CC</sub>      | Supply current                                     | $\overline{RE}$ at V <sub>CC</sub> ,<br>D & DE at V <sub>CC</sub> ,<br>No load          |       | 9                  | 15.5            | mA   |
|                      |                                                    | $\overline{RE}$ at V <sub>CC</sub> ,<br>D at V <sub>CC</sub> ,<br>DE at 0 V,<br>No load |       | 1                  | 5               | μA   |
|                      |                                                    | $\overline{RE}$ at 0 V,<br>D & DE at V <sub>CC</sub> ,<br>No load                       |       | 9                  | 15.5            | mA   |

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

(2) For T<sub>A</sub> > 85°C, V<sub>CC</sub> is ±5%.

## DRIVER SWITCHING CHARACTERISTICS

over recommended operating conditions unless otherwise noted

| PARAMETER          |                                                             | TEST CONDITIONS                                            | MIN | TYP <sup>(1)</sup> | MAX | UNIT    |
|--------------------|-------------------------------------------------------------|------------------------------------------------------------|-----|--------------------|-----|---------|
| $t_{PLH}$          | Propagation delay time, low-to-high-level output            | HVD10                                                      | 5   | 8.5                | 16  | ns      |
|                    |                                                             | HVD11                                                      | 18  | 25                 | 40  |         |
|                    |                                                             | HVD12                                                      | 135 | 200                | 300 |         |
| $t_{PHL}$          | Propagation delay time, high-to-low-level output            | HVD10                                                      | 5   | 8.5                | 16  | ns      |
|                    |                                                             | HVD11                                                      | 18  | 25                 | 40  |         |
|                    |                                                             | HVD12                                                      | 135 | 200                | 300 |         |
| $t_r$              | Differential output signal rise time                        | HVD10                                                      | 3   | 4.5                | 10  | ns      |
|                    |                                                             | HVD11                                                      | 10  | 20                 | 30  |         |
|                    |                                                             | HVD12                                                      | 100 | 170                | 300 |         |
| $t_f$              | Differential output signal fall time                        | HVD10                                                      | 3   | 4.5                | 10  | ns      |
|                    |                                                             | HVD11                                                      | 10  | 20                 | 30  |         |
|                    |                                                             | HVD12                                                      | 100 | 170                | 300 |         |
| $t_{sk(p)}$        | Pulse skew ( $ t_{PHL} - t_{PLH} $ )                        | HVD10                                                      |     |                    | 1.5 | ns      |
|                    |                                                             | HVD11                                                      |     |                    | 2.5 |         |
|                    |                                                             | HVD12                                                      |     |                    | 7   |         |
| $t_{sk(pp)}^{(2)}$ | Part-to-part skew                                           | HVD10                                                      |     |                    | 6   | ns      |
|                    |                                                             | HVD11                                                      |     |                    | 11  |         |
|                    |                                                             | HVD12                                                      |     |                    | 100 |         |
| $t_{PZH}$          | Propagation delay time, high-impedance-to-high-level output | HVD10                                                      |     |                    | 31  | ns      |
|                    |                                                             | HVD11                                                      |     |                    | 55  |         |
|                    |                                                             | HVD12                                                      |     |                    | 300 |         |
| $t_{PHZ}$          | Propagation delay time, high-level-to-high-impedance output | HVD10                                                      |     |                    | 25  | ns      |
|                    |                                                             | HVD11                                                      |     |                    | 55  |         |
|                    |                                                             | HVD12                                                      |     |                    | 300 |         |
| $t_{PZL}$          | Propagation delay time, high-impedance-to-low-level output  | HVD10                                                      |     |                    | 26  | ns      |
|                    |                                                             | HVD11                                                      |     |                    | 55  |         |
|                    |                                                             | HVD12                                                      |     |                    | 300 |         |
| $t_{PLZ}$          | Propagation delay time, low-level-to-high-impedance output  | HVD10                                                      |     |                    | 26  | ns      |
|                    |                                                             | HVD11                                                      |     |                    | 75  |         |
|                    |                                                             | HVD12                                                      |     |                    | 400 |         |
| $t_{PZH}$          | Propagation delay time, standby-to-high-level output        | $R_L = 110\ \Omega$ , $\overline{RE}$ at 3 V, See Figure 5 |     |                    | 6   | $\mu s$ |
| $t_{PZL}$          | Propagation delay time, standby-to-low-level output         | $R_L = 110\ \Omega$ , $\overline{RE}$ at 3 V, See Figure 6 |     |                    | 6   | $\mu s$ |

(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 <sup>(1)</sup> | MAX   | UNIT |
|------------------|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-------|--------------------|-------|------|
| V <sub>IT+</sub> | Positive-going input threshold voltage                    | I <sub>O</sub> = –8 mA                                                                                                            |       |                    | –0.01 | V    |
| V <sub>IT–</sub> | Negative-going input threshold voltage                    | I <sub>O</sub> = 8 mA                                                                                                             | –0.2  |                    |       |      |
| V <sub>hys</sub> | Hysteresis voltage (V <sub>IT+</sub> – V <sub>IT–</sub> ) |                                                                                                                                   |       | 35                 |       | mV   |
| V <sub>IK</sub>  | Enable-input clamp voltage                                | I <sub>I</sub> = –18 mA                                                                                                           | –1.5  |                    |       | V    |
| V <sub>OH</sub>  | High-level output voltage                                 | V <sub>ID</sub> = 200 mV, I <sub>OH</sub> = –8 mA, See Figure 7                                                                   | 2.4   |                    |       | V    |
| V <sub>OL</sub>  | Low-level output voltage                                  | V <sub>ID</sub> = –200 mV, I <sub>OL</sub> = 8 mA, See Figure 7                                                                   |       |                    | 0.4   | V    |
| I <sub>OZ</sub>  | High-impedance-state output current                       | V <sub>O</sub> = 0 or V <sub>CC</sub> $\overline{RE}$ at V <sub>CC</sub>                                                          | –1    |                    | 1     | μA   |
| I <sub>I</sub>   | Bus input current                                         | V <sub>A</sub> or V <sub>B</sub> = 12 V                                                                                           |       | 0.05               | 0.11  | mA   |
|                  |                                                           | V <sub>A</sub> or V <sub>B</sub> = 12 V, V <sub>CC</sub> = 0 V                                                                    |       | 0.06               | 0.13  |      |
|                  |                                                           | V <sub>A</sub> or V <sub>B</sub> = –7 V                                                                                           | –0.1  | –0.05              |       |      |
|                  |                                                           | V <sub>A</sub> or V <sub>B</sub> = –7 V, V <sub>CC</sub> = 0 V                                                                    | –0.05 | –0.04              |       |      |
|                  |                                                           | V <sub>A</sub> or V <sub>B</sub> = 12 V                                                                                           |       | 0.2                | 0.5   | mA   |
|                  |                                                           | V <sub>A</sub> or V <sub>B</sub> = 12 V, V <sub>CC</sub> = 0 V                                                                    |       | 0.25               | 0.5   |      |
|                  |                                                           | V <sub>A</sub> or V <sub>B</sub> = –7 V                                                                                           | –0.4  | –0.2               |       |      |
|                  |                                                           | V <sub>A</sub> or V <sub>B</sub> = –7 V, V <sub>CC</sub> = 0 V                                                                    | –0.4  | –0.15              |       |      |
| I <sub>IH</sub>  | High-level input current, $\overline{RE}$                 | V <sub>IH</sub> = 2 V                                                                                                             | –30   |                    | 0     | μA   |
| I <sub>IL</sub>  | Low-level input current, $\overline{RE}$                  | V <sub>IL</sub> = 0.8 V                                                                                                           | –30   |                    | 0     | μA   |
| C <sub>ID</sub>  | Differential input capacitance                            | V <sub>ID</sub> = 0.4 sin (4E6πt) + 0.5 V, DE at 0 V                                                                              |       | 15                 |       | pF   |
| I <sub>CC</sub>  | Supply current                                            | $\overline{RE}$ at 0 V, D & DE at 0 V, No load<br>Receiver enabled and driver disabled                                            |       | 4                  | 8     | mA   |
|                  |                                                           | $\overline{RE}$ at V <sub>CC</sub> , D at V <sub>CC</sub> , DE at 0 V, No load<br>Receiver disabled and driver disabled (standby) |       | 1                  | 5     |      |
|                  |                                                           | $\overline{RE}$ at 0 V, D & DE at V <sub>CC</sub> , No load<br>Receiver enabled and driver enabled                                |       | 9                  | 15.5  | 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 <sup>(1)</sup> | MAX | UNIT          |
|--------------------|------------------------------------------------------|----------------|----------------------------------------------------------------------------------------------------|--|------|--------------------|-----|---------------|
| $t_{PLH}$          | Propagation delay time, low-to-high-level output     | HVD10          | $V_{ID} = -1.5\text{ V to }1.5\text{ V},$<br>$C_L = 15\text{ pF},$<br>See <a href="#">Figure 8</a> |  | 12.5 | 20                 | 25  | ns            |
| $t_{PHL}$          | Propagation delay time, high-to-low-level output     | HVD10          |                                                                                                    |  | 12.5 | 20                 | 25  |               |
| $t_{PLH}$          | Propagation delay time, low-to-high-level output     | HVD11<br>HVD12 |                                                                                                    |  | 30   | 55                 | 70  | ns            |
| $t_{PHL}$          | Propagation delay time, high-to-low-level output     | HVD11<br>HVD12 |                                                                                                    |  | 30   | 55                 | 70  |               |
| $t_{sk(p)}$        | Pulse skew ( $ t_{PHL} - t_{PLH} $ )                 | HVD10          |                                                                                                    |  |      |                    | 1.5 | ns            |
|                    |                                                      | HVD11          |                                                                                                    |  |      |                    | 4   |               |
|                    |                                                      | HVD12          |                                                                                                    |  |      |                    | 4   |               |
| $t_{sk(pp)}^{(2)}$ | Part-to-part skew                                    | HVD10          |                                                                                                    |  |      |                    | 8   | ns            |
|                    |                                                      | HVD11          |                                                                                                    |  |      |                    | 15  |               |
|                    |                                                      | HVD12          |                                                                                                    |  |      |                    | 15  |               |
| $t_r$              | Output signal rise time                              |                | $C_L = 15\text{ pF},$<br>See <a href="#">Figure 8</a>                                              |  | 1    | 2                  | 5   | ns            |
| $t_f$              | Output signal fall time                              |                |                                                                                                    |  | 1    | 2                  | 5   |               |
| $t_{PZH}^{(1)}$    | Output enable time to high level                     |                | $C_L = 15\text{ pF},$ DE at 3 V,<br>See <a href="#">Figure 9</a>                                   |  |      |                    | 15  | ns            |
| $t_{PZL}^{(1)}$    | Output enable time to low level                      |                |                                                                                                    |  |      |                    | 15  |               |
| $t_{PHZ}$          | Output disable time from high level                  |                |                                                                                                    |  |      |                    | 20  |               |
| $t_{PLZ}$          | Output disable time from low level                   |                |                                                                                                    |  |      |                    | 15  |               |
| $t_{PZH}^{(2)}$    | Propagation delay time, standby-to-high-level output |                | $C_L = 15\text{ pF},$ DE at 0,<br>See <a href="#">Figure 10</a>                                    |  |      |                    | 6   | $\mu\text{s}$ |
| $t_{PZL}^{(2)}$    | Propagation delay time, standby-to-low-level output  |                |                                                                                                    |  |      |                    | 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.

## THERMAL CHARACTERISTICS

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

| PARAMETER     |                                                       | TEST CONDITIONS                                                                                                                              |                  | MIN | TYP | MAX | UNIT |
|---------------|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----|-----|-----|------|
| $\theta_{JA}$ | Junction-to-ambient thermal resistance <sup>(2)</sup> | High-K board <sup>(3)</sup> , No airflow                                                                                                     | D pkg            |     | 121 |     | °C/W |
|               |                                                       | No airflow <sup>(4)</sup>                                                                                                                    | P pkg            |     | 93  |     |      |
| $\theta_{JB}$ | Junction-to-board thermal resistance                  | High-K board                                                                                                                                 | D pkg            |     | 67  |     |      |
|               |                                                       | See <sup>(4)</sup>                                                                                                                           | P pkg            |     | 57  |     |      |
| $\theta_{JC}$ | Junction-to-case thermal resistance                   |                                                                                                                                              | D pkg            |     | 41  |     |      |
|               |                                                       |                                                                                                                                              | P pkg            |     | 55  |     |      |
| $P_D$         | Device power dissipation                              | $R_L = 60\ \Omega, C_L = 50\text{ pF},$<br>DE at $V_{CC}, RE$ at 0 V,<br>Input to D a 50% duty cycle square wave at indicated signaling rate | HVD10 (32 Mbps)  |     | 198 | 250 | mW   |
|               |                                                       |                                                                                                                                              | HVD11 (10 Mbps)  |     | 141 | 176 |      |
|               |                                                       |                                                                                                                                              | HVD12 (500 kbps) |     | 133 | 161 |      |
| $T_A$         | Ambient air temperature                               | High-K board, No airflow                                                                                                                     | D pkg            | -40 |     | 116 | °C   |
|               |                                                       | No airflow <sup>(4)</sup>                                                                                                                    | P pkg            | -40 |     | 123 |      |
| $T_{JSD}$     | Thermal shutdown junction temperature                 |                                                                                                                                              |                  |     | 165 |     |      |

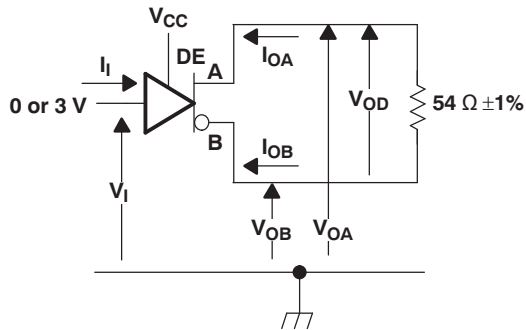
(1) See *Application Information* section for an explanation of these parameters.

(2) The intent of  $\theta_{JA}$  specification is solely for a thermal performance comparison of one package to another in a standardized environment. This methodology is not meant to and will not predict the performance of a package in an application-specific environment.

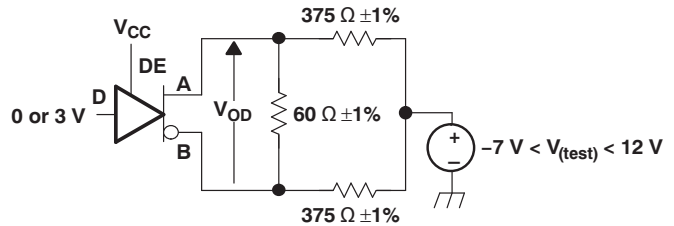
(3) JSD51-7, High Effective Thermal Conductivity Test Board for Leadless Surface Mount Packages.

(4) JESD51-10, Test Boards for Through-Hole Perimeter Leadless Package Thermal Measurements.

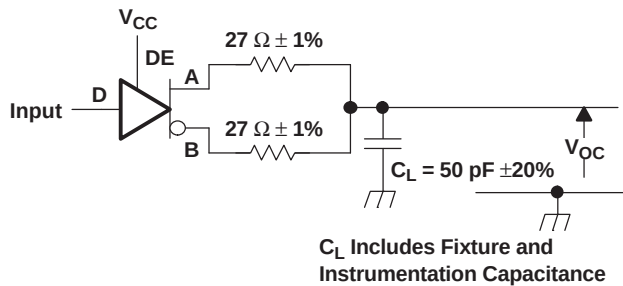
## PARAMETER MEASUREMENT INFORMATION



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

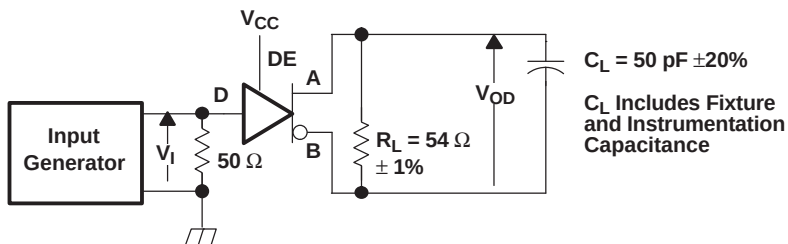
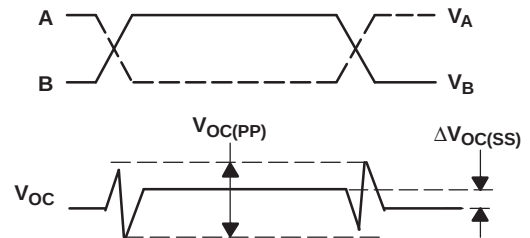


**Figure 2. Driver  $V_{OD}$  With Common-Mode Loading Test Circuit**



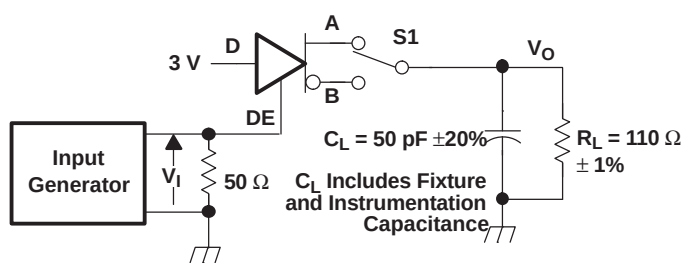
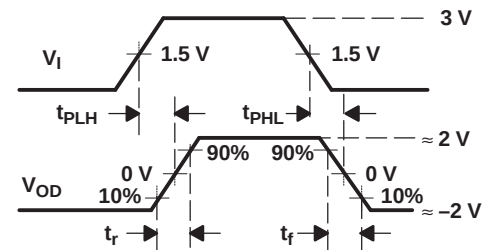
Input: PRR = 500 kHz, 50% Duty Cycle,  $t_r < 6$  ns,  $t_f < 6$  ns,  $Z_O = 50 \Omega$

**Figure 3. Test Circuit and Definitions for the Driver Common-Mode Output Voltage**



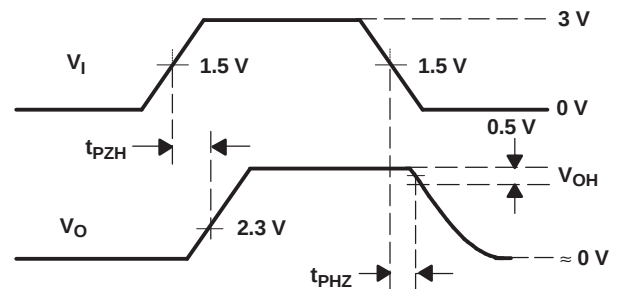
Generator: PRR = 500 kHz, 50% Duty Cycle,  $t_r < 6$  ns,  $t_f < 6$  ns,  $Z_O = 50 \Omega$

**Figure 4. Driver Switching Test Circuit and Voltage Waveforms**



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

**Figure 5. Driver High-Level Enable and Disable Time Test Circuit and Voltage Waveforms**



## PARAMETER MEASUREMENT INFORMATION (continued)

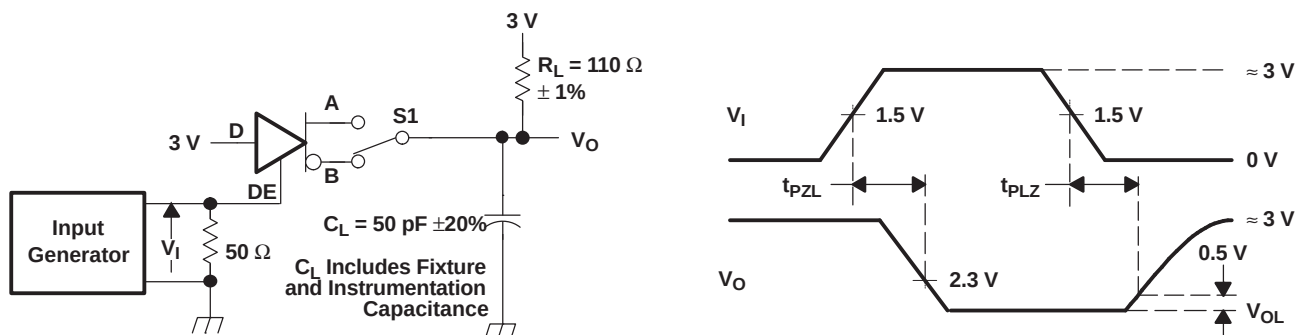


Figure 6. Driver Low-Level Output Enable and Disable Time Test Circuit and Voltage Waveforms

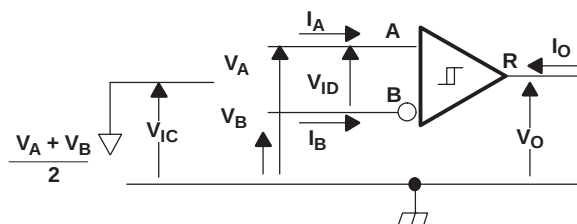


Figure 7. Receiver Voltage and Current Definitions

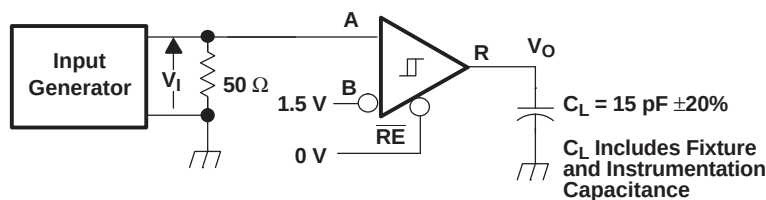
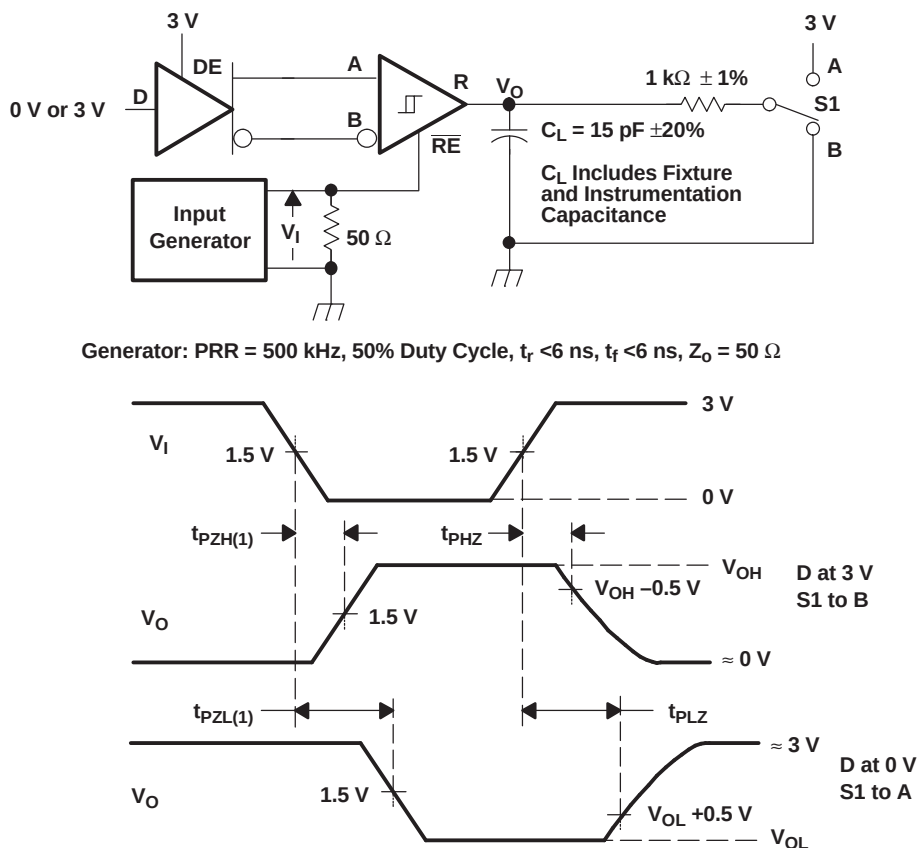


Figure 8. Receiver Switching Test Circuit and Voltage Waveforms



## PARAMETER MEASUREMENT INFORMATION (continued)



**Figure 9. Receiver Enable and Disable Time Test Circuit and Voltage Waveforms With Drivers Enabled**

## PARAMETER MEASUREMENT INFORMATION (continued)

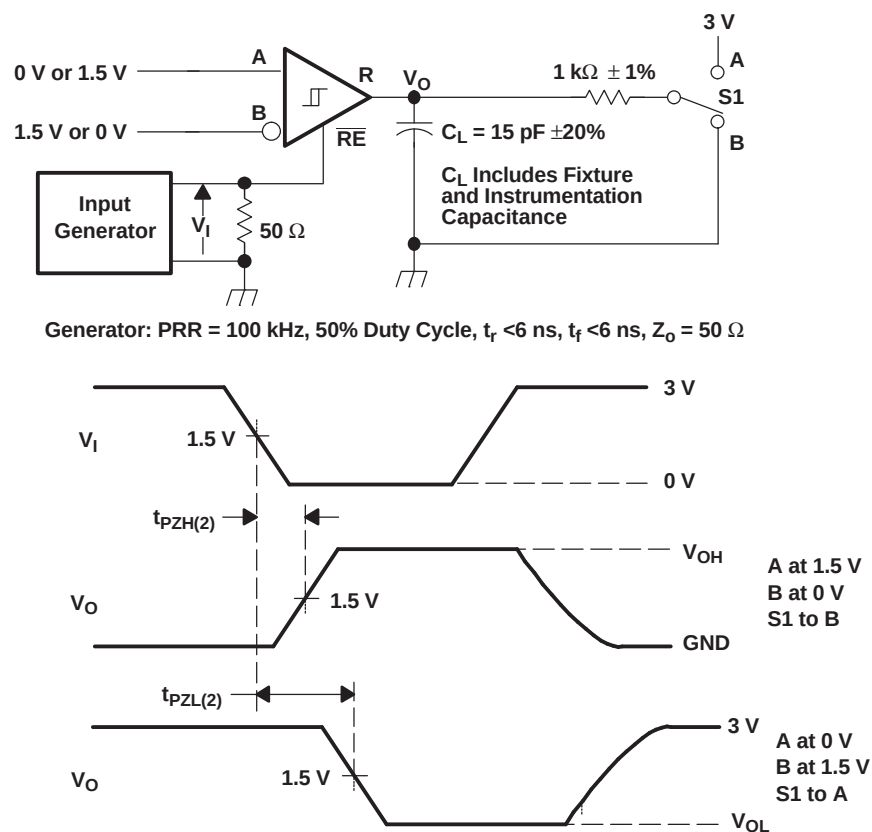
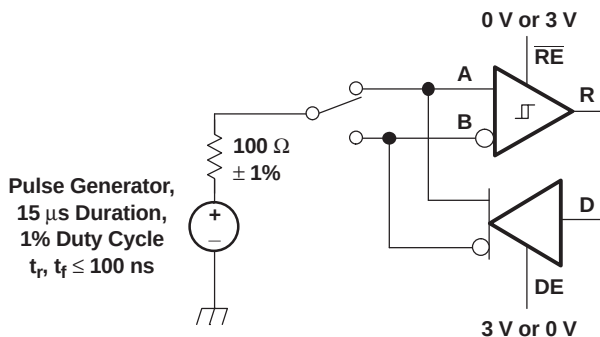


Figure 10. Receiver Enable Time From Standby (Driver Disabled)



NOTE: This test is conducted to test survivability only. Data stability at the R output is not specified.

Figure 11. Test Circuit, Transient Over Voltage Test

## PARAMETER MEASUREMENT INFORMATION (continued)

### FUNCTION TABLES

**Table 1. DRIVER<sup>(1)</sup>**

|            |              | OUTPUTS |   |
|------------|--------------|---------|---|
| INPUT<br>D | ENABLE<br>DE | A       | B |
| H          | H            | H       | L |
| L          | H            | L       | H |
| X          | L            | Z       | Z |
| Open       | H            | H       | L |

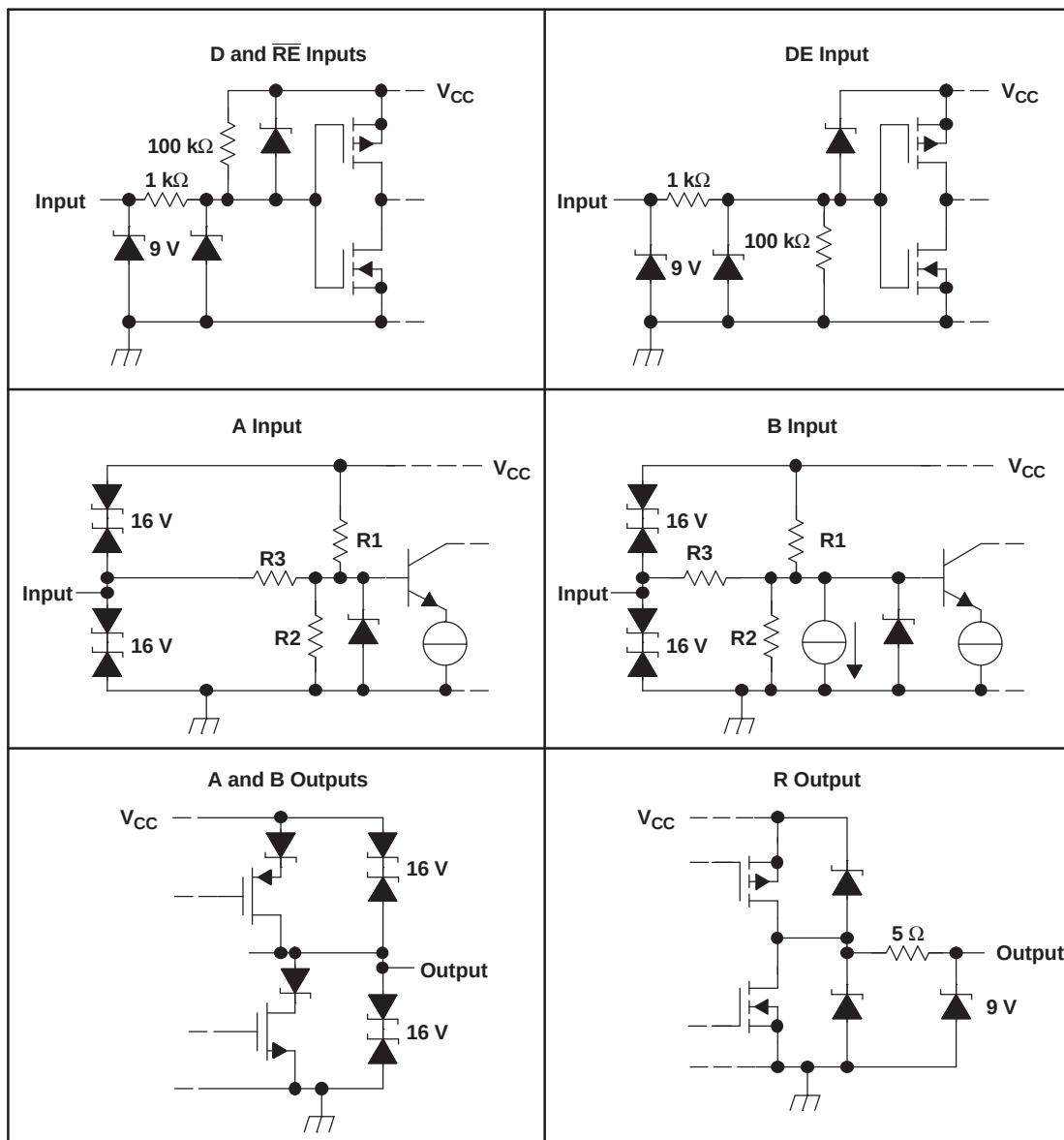
(1) H = high level; L = low level; Z = high impedance; X = irrelevant; ? = indeterminate

**Table 2. RECEIVER<sup>(1)</sup>**

| DIFFERENTIAL INPUTS<br>$V_{ID} = V_A - V_B$ | ENABLE<br>RE | OUTPUT<br>R |
|---------------------------------------------|--------------|-------------|
| $V_{ID} \leq -0.2 \text{ V}$                | L            | L           |
| $-0.2 \text{ V} < V_{ID} < -0.01 \text{ V}$ | L            | ?           |
| $-0.01 \text{ V} \leq V_{ID}$               | L            | H           |
| X                                           | H            | Z           |
| Open Circuit                                | L            | H           |
| Short circuit                               | L            | H           |

(1) H = high level; L = low level; Z = high impedance; X = irrelevant; ? = indeterminate

## EQUIVALENT INPUT AND OUTPUT SCHEMATIC DIAGRAMS



|           | R1/R2 | R3     |
|-----------|-------|--------|
| SN65HVD10 | 9 kΩ  | 45 kΩ  |
| SN65HVD11 | 36 kΩ | 180 kΩ |
| SN65HVD12 | 36 kΩ | 180 kΩ |

## TYPICAL CHARACTERISTICS

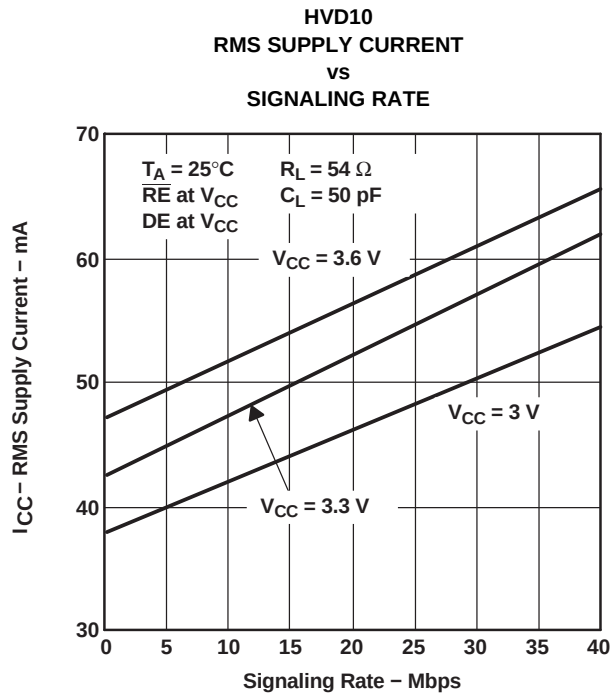


Figure 12.

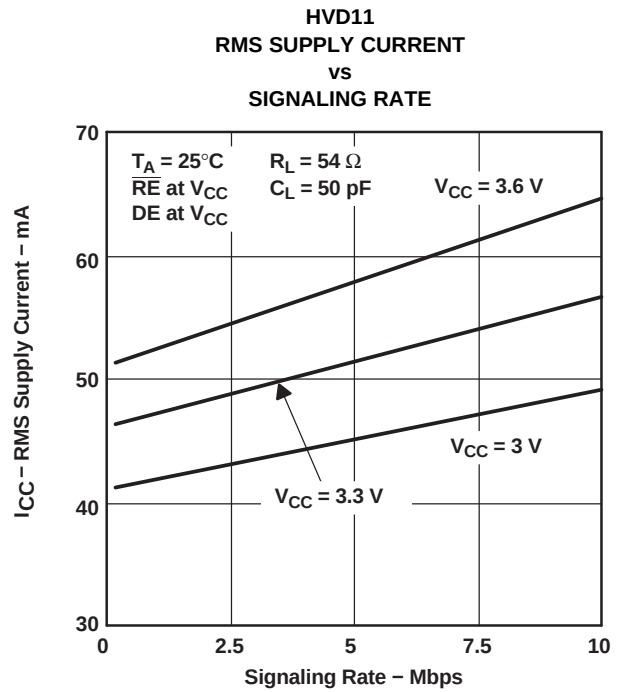


Figure 13.

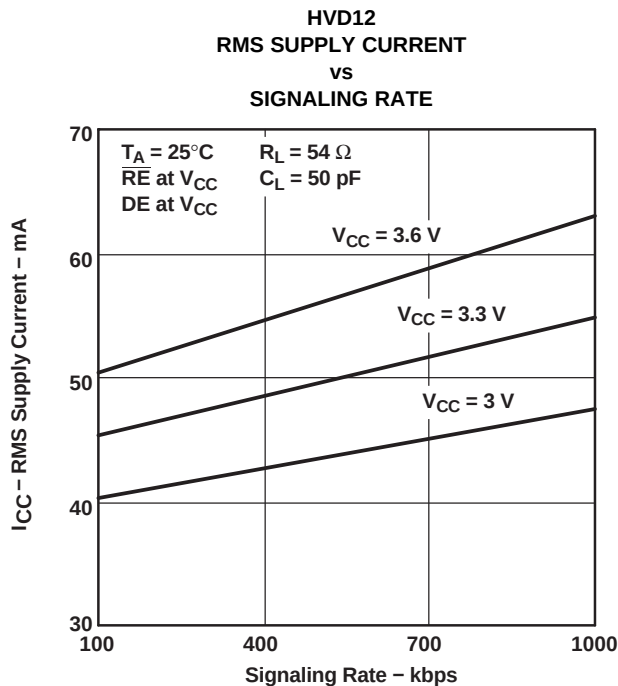


Figure 14.

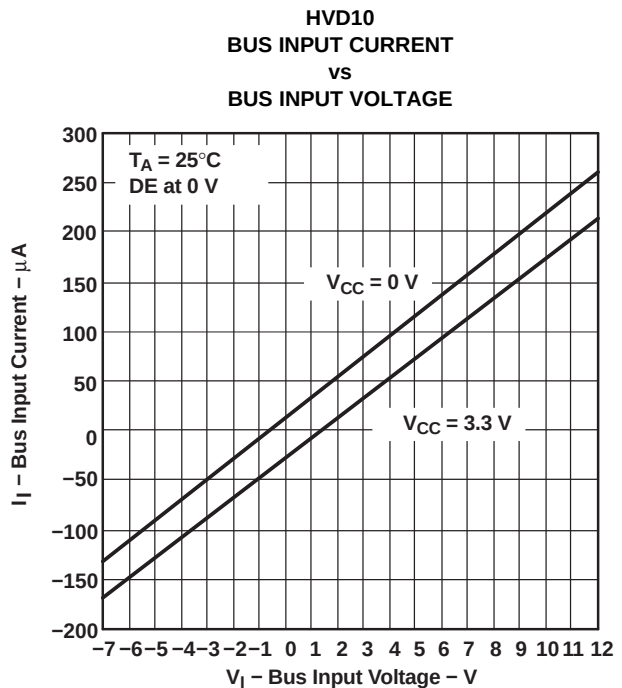


Figure 15.

## TYPICAL CHARACTERISTICS (continued)

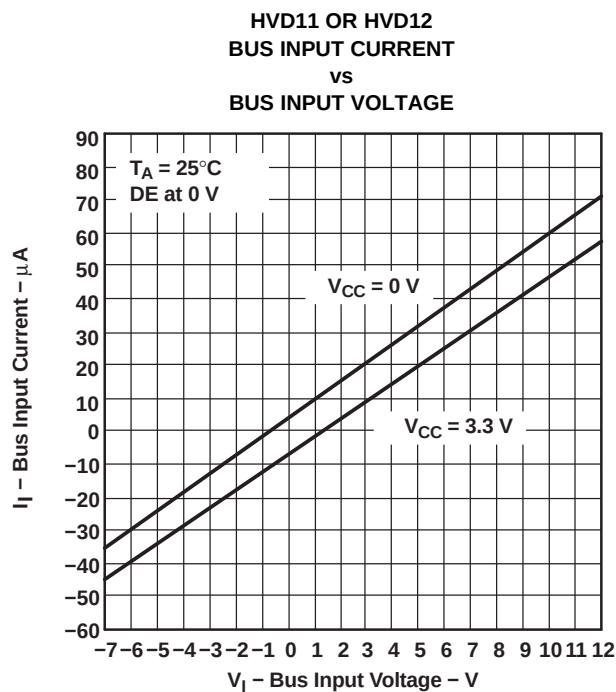


Figure 16.

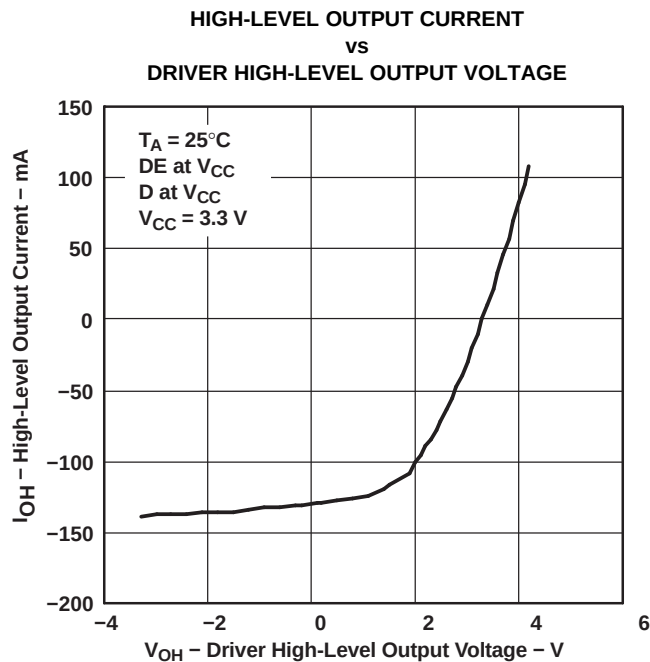


Figure 17.

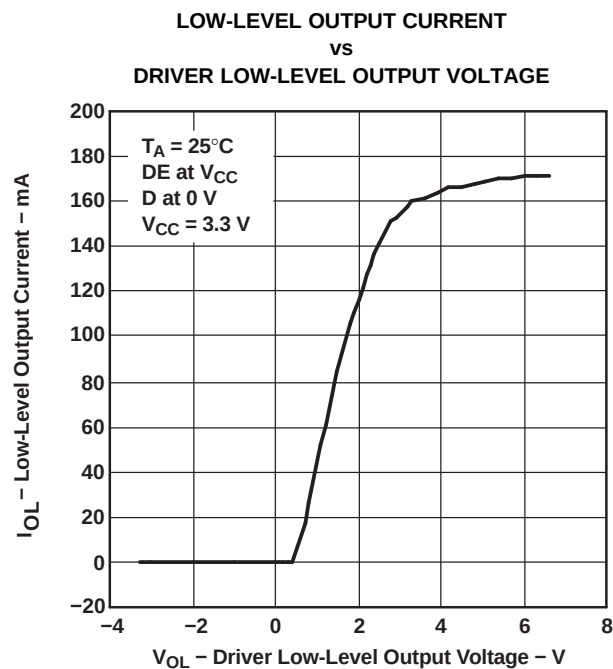


Figure 18.

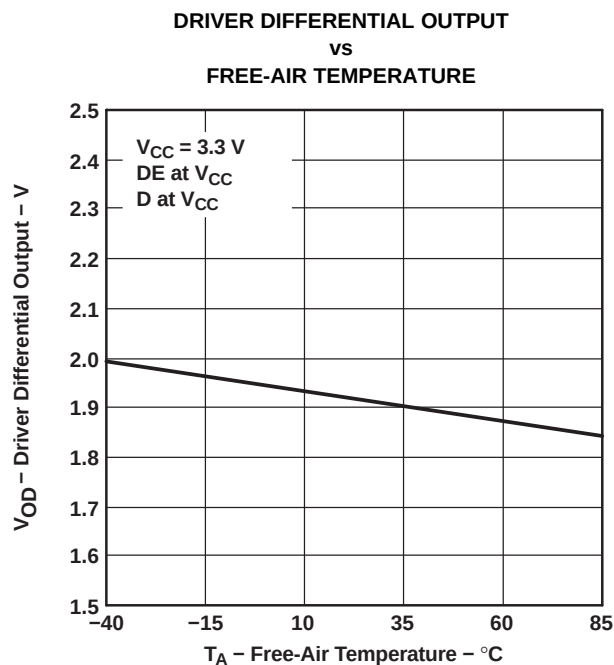


Figure 19.

## TYPICAL CHARACTERISTICS (continued)

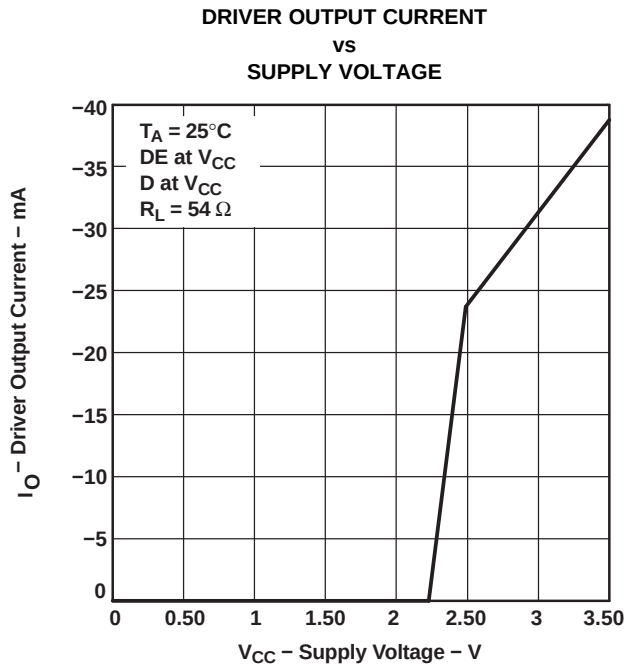


Figure 20.

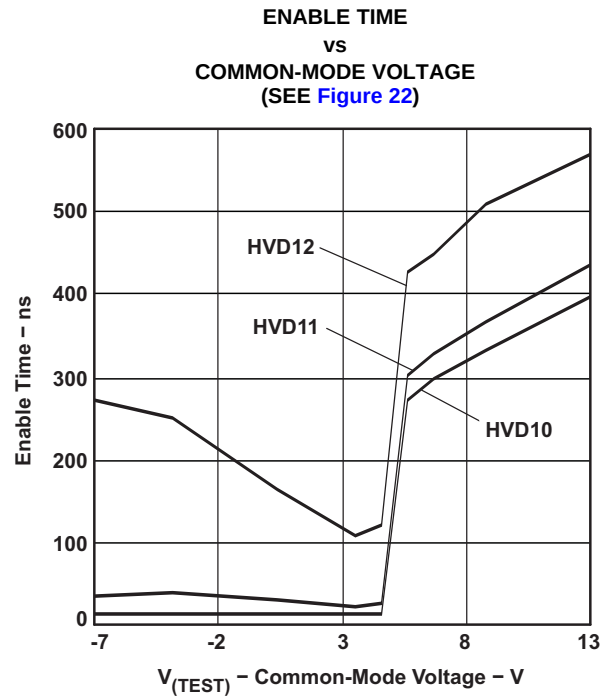


Figure 21.

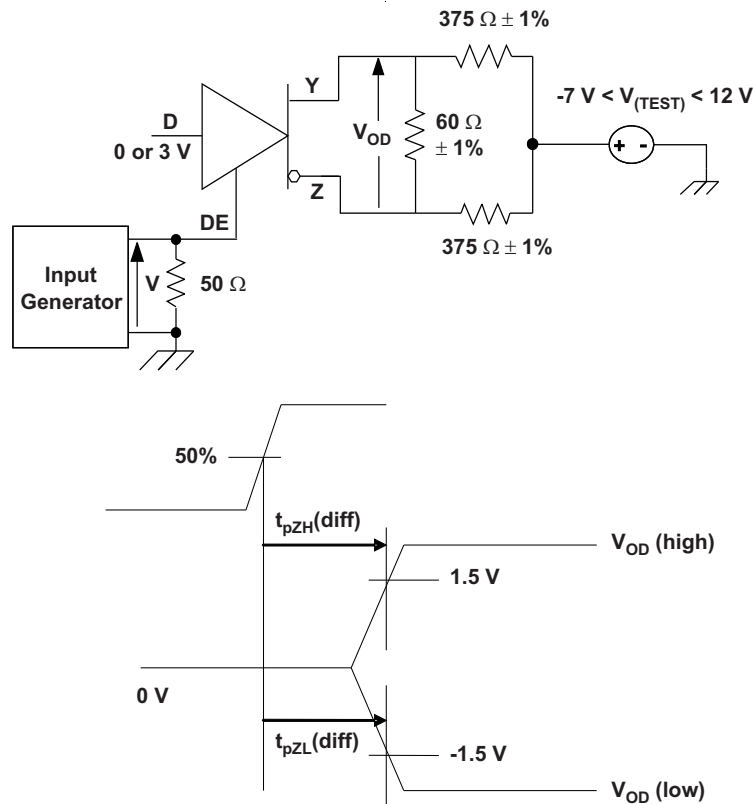
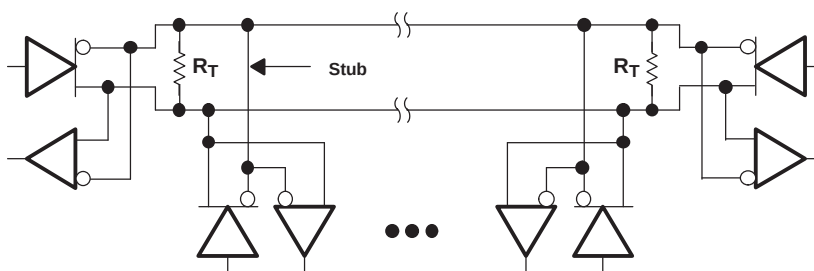


Figure 22. Driver Enable Time From DE to  $V_{OD}$

The time  $t_{pZL}(x)$  is the measure from DE to  $V_{OD}(x)$ .  $V_{OD}$  is valid when it is greater than 1.5 V.

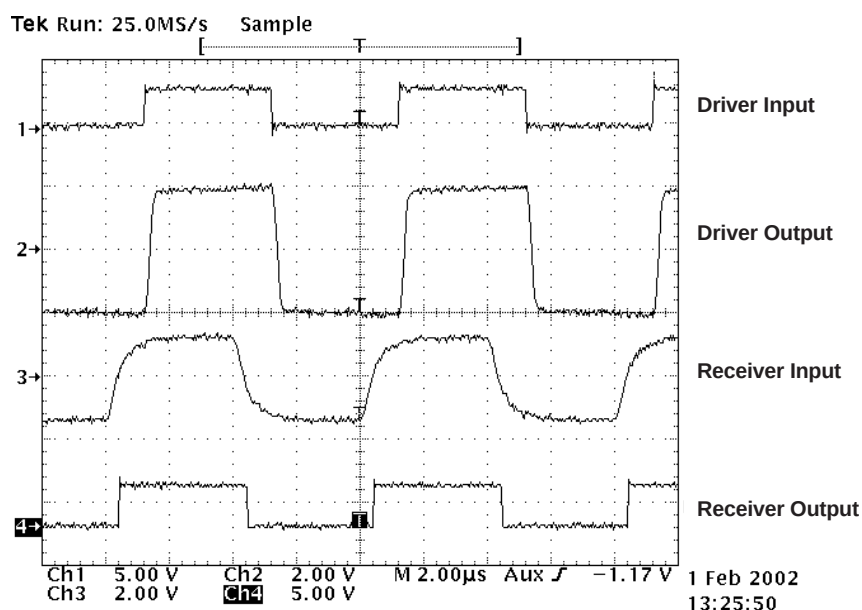
## APPLICATION INFORMATION



| Device | Number of Devices on Bus |
|--------|--------------------------|
| HVD10  | 64                       |
| HVD11  | 256                      |
| HVD12  | 256                      |

NOTE: The line should be terminated at both ends with its characteristic impedance ( $R_T = Z_0$ ). Stub lengths off the main line should be kept as short as possible.

**Figure 23. Typical Application Circuit**



**Figure 24. HVD12 Input and Output Through 2000 Feet of Cable**

An example application for the HVD12 is illustrated in Figure 23. Two HVD12 transceivers are used to communicate data through a 2000 foot (600 m) length of Commscope 5524 category 5e+ twisted pair cable. The bus is terminated at each end by a 100-Ω resistor, matching the cable characteristic impedance. Figure 24 illustrates operation at a signaling rate of 250 kbps.

## LOW-POWER STANDBY MODE

When both the driver and receiver are disabled (DE low and RE high) the device is in standby mode. If the enable inputs are in this state for less than 60 ns, the device does not enter standby mode. This guards against inadvertently entering standby mode during driver/receiver enabling. Only when the enable inputs are held in this state for 300 ns or more, the device is assured to be in standby mode. In this low-power standby mode, most internal circuitry is powered down, and the supply current is typically less than 1 nA. When either the driver or the receiver is re-enabled, the internal circuitry becomes active.



## THERMAL CHARACTERISTICS OF IC PACKAGES

$\theta_{JA}$  (**Junction-to-Ambient Thermal Resistance**) is defined as the difference in junction temperature to ambient temperature divided by the operating power.

$\theta_{JA}$  is *not* a constant and is a strong function of:

- the PCB design (50% variation)
- altitude (20% variation)
- device power (5% variation)

$\theta_{JA}$  can be used to compare the thermal performance of packages if the specific test conditions are defined and used. Standardized testing includes specification of PCB construction, test chamber volume, sensor locations, and the thermal characteristics of holding fixtures.  $\theta_{JA}$  is often misused when it is used to calculate junction temperatures for other installations.

TI uses two test PCBs as defined by JEDEC specifications. The low-k board gives *average* in-use condition thermal performance, and it consists of a single copper trace layer 25 mm long and 2-oz thick. The high-k board gives best case in-use condition, and it consists of two 1-oz buried power planes with a single copper trace layer 25 mm long and 2-oz thick. A 4% to 50% difference in  $\theta_{JA}$  can be measured between these two test cards.

$\theta_{JC}$  (**Junction-to-Case Thermal Resistance**) is defined as difference in junction temperature to case divided by the operating power. It is measured by putting the mounted package up against a copper block cold plate to force heat to flow from die, through the mold compound into the copper block.

$\theta_{JC}$  is a useful thermal characteristic when a heatsink is applied to package. It is *not* a useful characteristic to predict junction temperature because it provides pessimistic numbers if the case temperature is measured in a nonstandard system and junction temperatures are backed out. It can be used with  $\theta_{JB}$  in 1-dimensional thermal simulation of a package system.

$\theta_{JB}$  (**Junction-to-Board Thermal Resistance**) is defined as the difference in the junction temperature and the PCB temperature at the center of the package (closest to the die) when the PCB is clamped in a cold-plate structure.  $\theta_{JB}$  is only defined for the high-k test card.

$\theta_{JB}$  provides an overall thermal resistance between the die and the PCB. It includes a bit of the PCB thermal resistance (especially for BGAs with thermal balls) and can be used for simple 1-dimensional network analysis of package system, see [Figure 25](#).

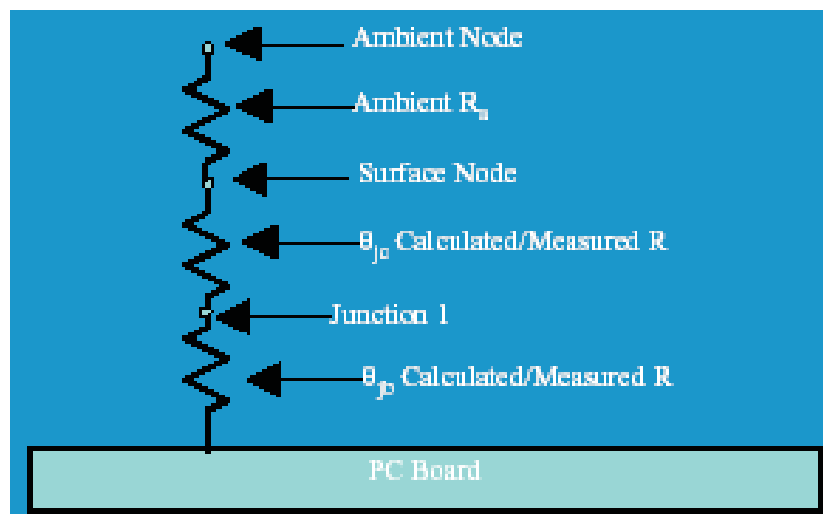


Figure 25. Thermal Resistance

## REVISION HISTORY

| Changes from Revision J (February 2009) to Revision K                                      | Page               |
|--------------------------------------------------------------------------------------------|--------------------|
| • Added new section 'LOW-POWER STANDBY MODE', in the Application Information section ..... | <a href="#">16</a> |

**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup>    | Lead/<br>Ball Finish | MSL Peak Temp <sup>(3)</sup> | Samples<br>(Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|----------------------------|----------------------|------------------------------|-----------------------------|
| SN65HVD10D       | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN65HVD10DG4     | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN65HVD10DR      | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN65HVD10DRG4    | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN65HVD10P       | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)             | CU NIPDAU            | N / A for Pkg Type           |                             |
| SN65HVD10PE4     | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)             | CU NIPDAU            | N / A for Pkg Type           |                             |
| SN65HVD10QD      | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN65HVD10QDG4    | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN65HVD10QDR     | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN65HVD10QDRG4   | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN65HVD11D       | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN65HVD11DG4     | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN65HVD11DR      | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN65HVD11DRG4    | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN65HVD11P       | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)             | CU NIPDAU            | N / A for Pkg Type           |                             |
| SN65HVD11PE4     | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)             | CU NIPDAU            | N / A for Pkg Type           |                             |
| SN65HVD11QD      | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN65HVD11QDG4    | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup>    | Lead/<br>Ball Finish | MSL Peak Temp <sup>(3)</sup> | Samples<br>(Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|----------------------------|----------------------|------------------------------|-----------------------------|
| SN65HVD11QDR     | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN65HVD11QDRG4   | ACTIVE                | SOIC         | D               | 8    |             | TBD                        | Call TI              | Call TI                      |                             |
| SN65HVD12D       | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN65HVD12DG4     | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN65HVD12DR      | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN65HVD12DRG4    | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN65HVD12P       | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)             | CU NIPDAU            | N / A for Pkg Type           |                             |
| SN65HVD12PE4     | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)             | CU NIPDAU            | N / A for Pkg Type           |                             |
| SN75HVD10D       | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN75HVD10DG4     | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN75HVD10DR      | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN75HVD10DRG4    | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN75HVD10P       | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)             | CU NIPDAU            | N / A for Pkg Type           |                             |
| SN75HVD10PE4     | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)             | CU NIPDAU            | N / A for Pkg Type           |                             |
| SN75HVD11D       | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN75HVD11DG4     | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN75HVD11DR      | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN75HVD11DRG4    | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN75HVD12D       | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN75HVD12DG4     | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/<br>Ball Finish | MSL Peak Temp <sup>(3)</sup> | Samples<br>(Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|----------------------|------------------------------|-----------------------------|
| SN75HVD12DR      | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN75HVD12DRG4    | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN75HVD12P       | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU            | N / A for Pkg Type           |                             |
| SN75HVD12PE4     | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU            | N / A for Pkg Type           |                             |

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

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

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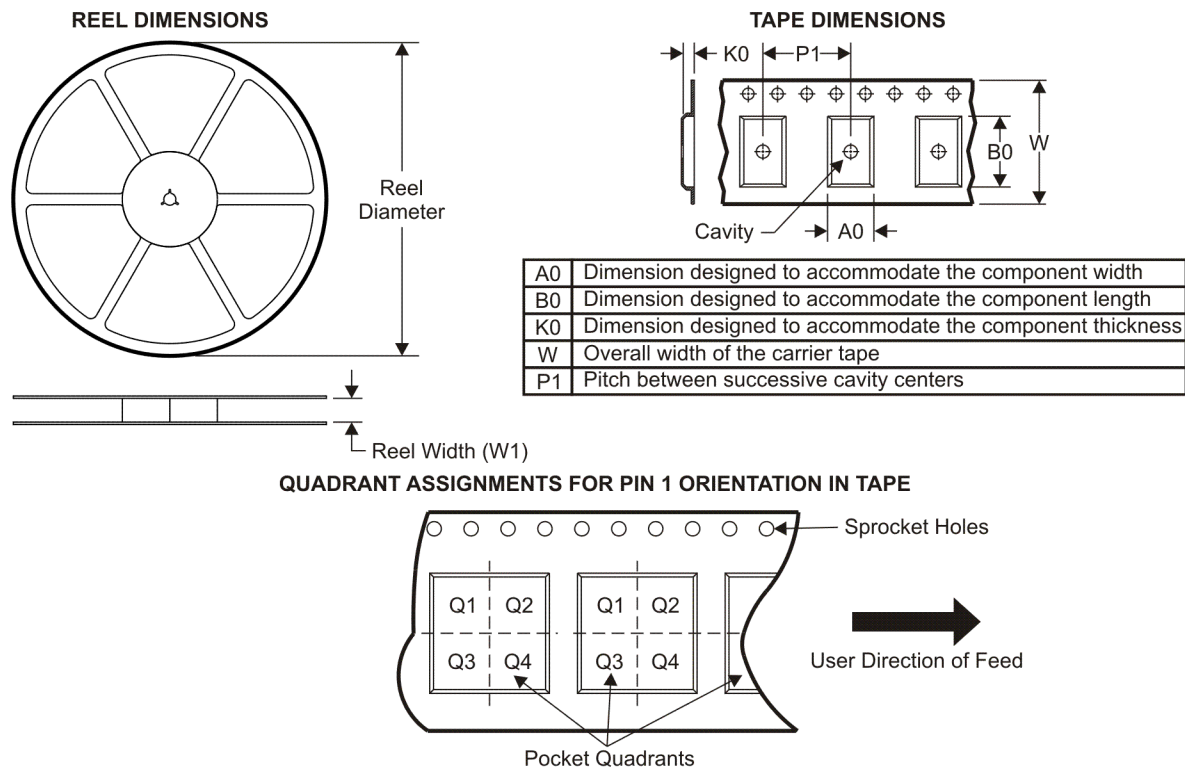
#### OTHER QUALIFIED VERSIONS OF SN65HVD10, SN65HVD11, SN65HVD12 :

- Enhanced Product: [SN65HVD10-EP](#), [SN65HVD12-EP](#)

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NOTE: Qualified Version Definitions:

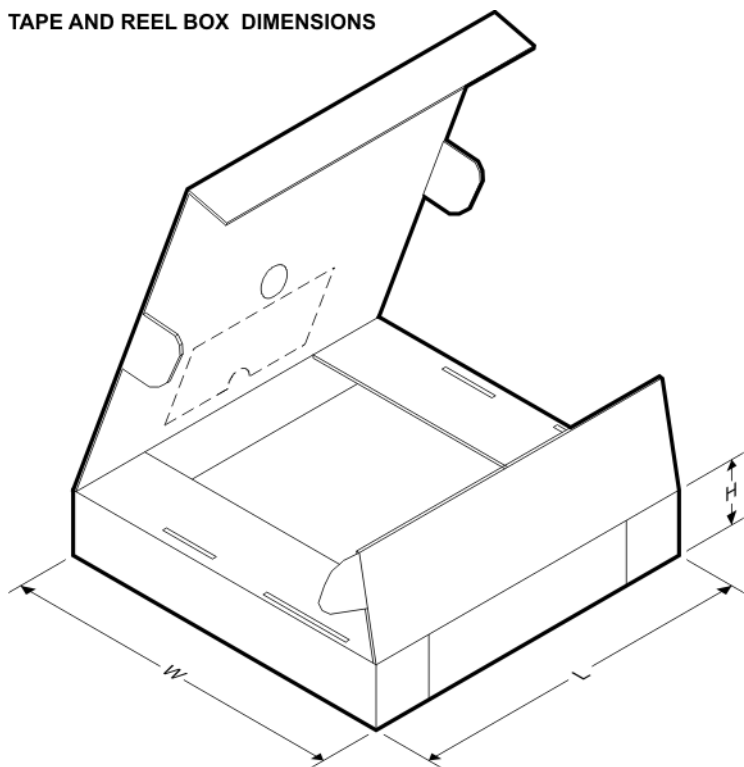
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

**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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN65HVD10DR  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| SN65HVD10QDR | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| SN65HVD11DR  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| SN65HVD11QDR | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| SN65HVD12DR  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| SN75HVD10DR  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| SN75HVD11DR  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| SN75HVD12DR  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS



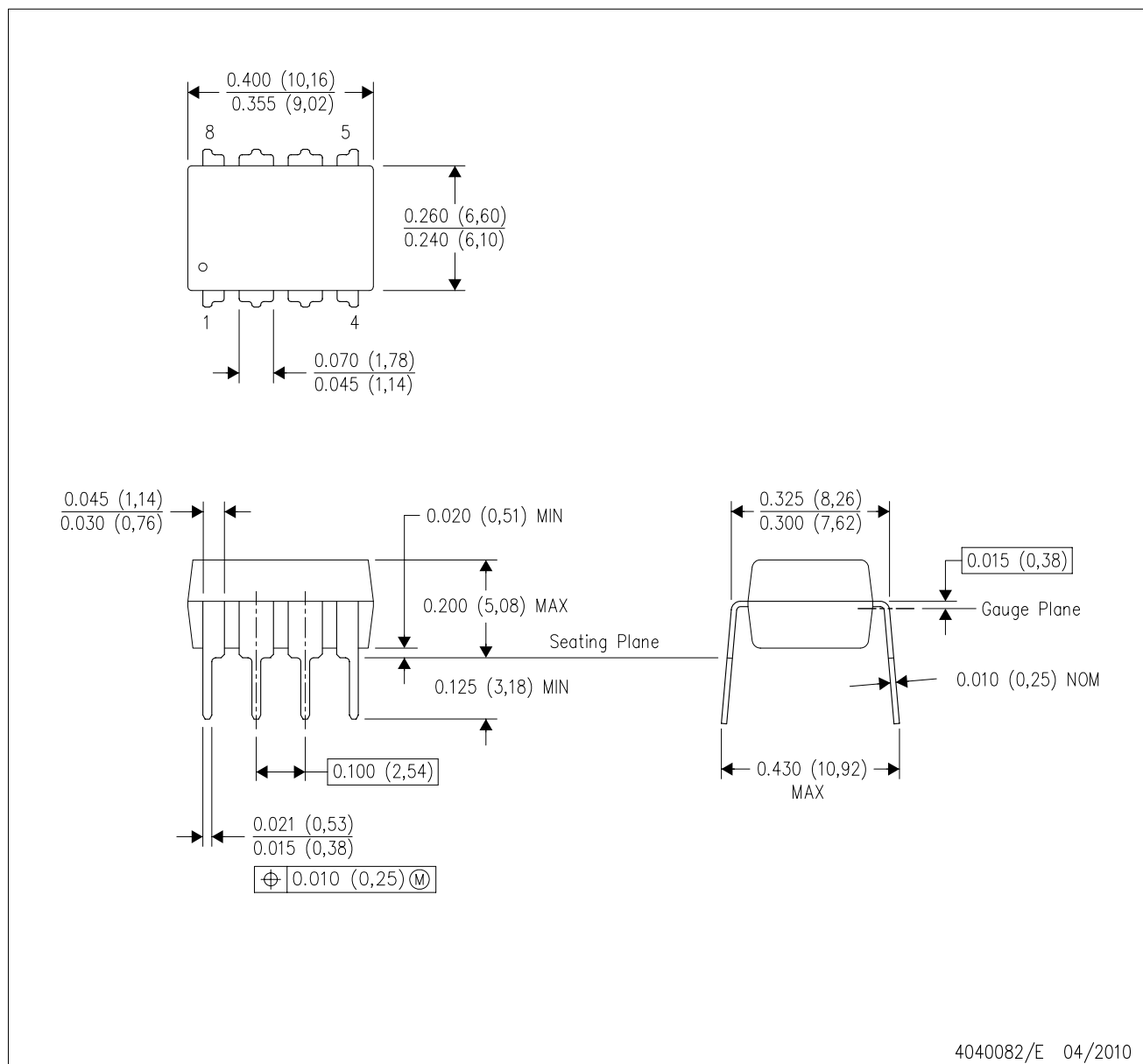
\*All dimensions are nominal

| Device       | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN65HVD10DR  | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| SN65HVD10QDR | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| SN65HVD11DR  | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| SN65HVD11QDR | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| SN65HVD12DR  | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| SN75HVD10DR  | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| SN75HVD11DR  | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| SN75HVD12DR  | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |



P (R-PDIP-T8)

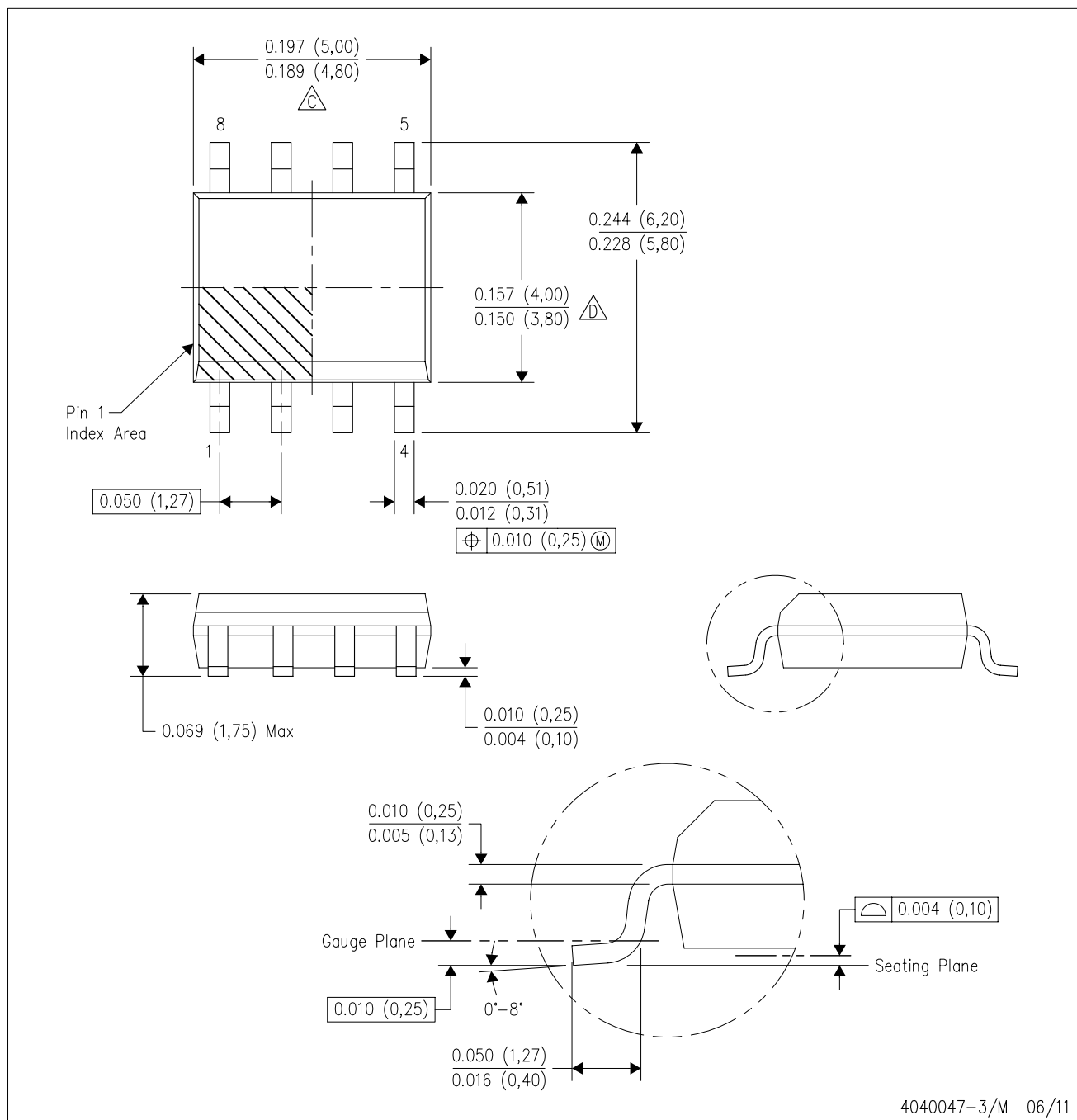
PLASTIC DUAL-IN-LINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Falls within JEDEC MS-001 variation BA.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE

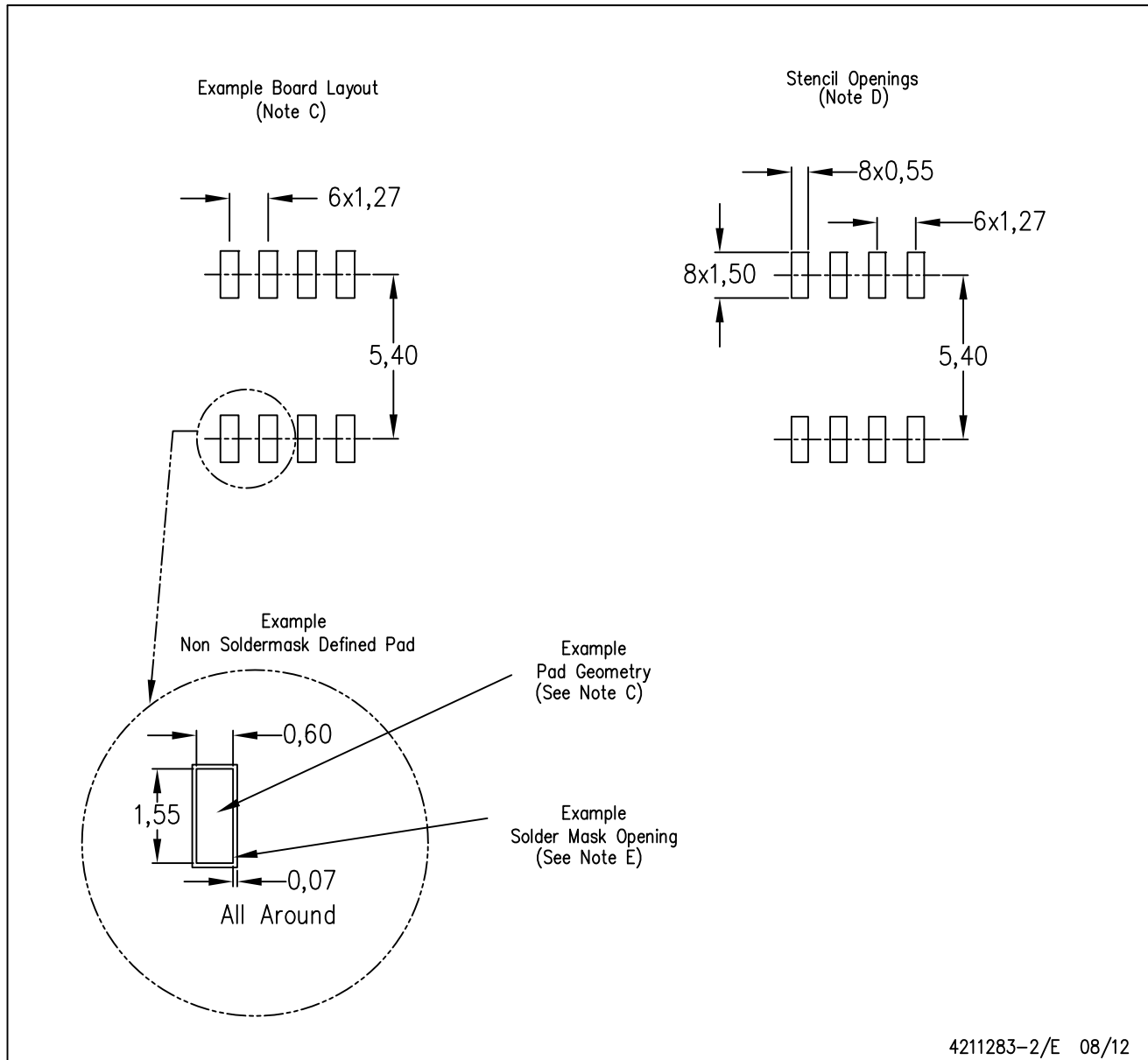


## NOTES:

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

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



4211283-2/E 08/12

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

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### Applications

|                               |                                                                                          |
|-------------------------------|------------------------------------------------------------------------------------------|
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