SN65HVD72, SN65HVD75, SN65HVD78
JAJSGU3H – MARCH 2012 – REVISED MARCH 2019

# SN65HVD7x IEC ESD 保護機能を持つ 3.3V 電源 RS-485

## 1 特長

- 基板面積を削減できる小型 VSSOP パッケージ、またはドロップイン互換性を備えた SOIC パッケージ
- バス I/O 保護
  - >±15kV HBM 保護
  - >±12kV IEC61000-4-2 接触放電
  - >±4kV IEC 61000-4-4 高速過渡バースト
- 拡張産業用温度範囲：
  -40°C～+125°C
- レシーバの大きなヒステリシス (80mV) によるノイズ除去
- 単位負荷が小さいため、200 を超えるノードを接続可能
- 低消費電力
  - 低いスタンバイ時消費電流: 2µA未満
  - 動作時静止電流 $I_{CC}$ < 1mA
- 5V 許容のロジック入力、
  3.3V または 5V のコントローラと互換
- 信号速度オプション、
  250kbps、20Mbps、50Mbps に最適化
- 電源オンおよび電源オフ時にバスの入力および出力がグリッチ・フリー

## 2 アプリケーション

- ファクトリ・オートメーション
- 通信インフラストラクチャ
- 動作制御

## 3 概要

これらのデバイスは、小さなパッケージに堅牢な 3.3V ドライバおよびレシーバを搭載しており、要求の厳しい産業用アプリケーション向けです。バスのピンは ESD イベントに対して強化されており、人体モデルおよび IEC 接触放電仕様について高いレベルの保護を実現しています。

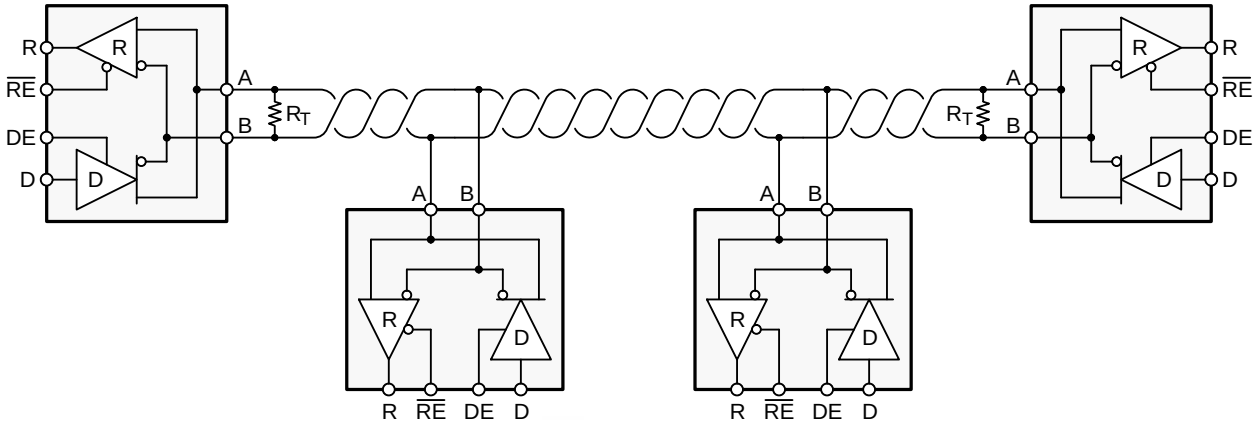
各デバイスは差動ドライバと差動レシーバを組み合わせたもので、3.3V 単一電源で動作します。ドライバの差動出力とレシーバの差動入力は内部的に接続され、半二重 (2 線式バス) 通信に適したバス・ポートを形成しています。これらのデバイスは同相電圧範囲が広いため、長いケーブルを使用するマルチポイント・アプリケーションに適しています。これらのデバイスは、–40°C～125°Cで動作が規定されています。

**製品情報(1)**

| 型番 | パッケージ | 本体サイズ(公称) |
|---|---|---|
| SN65HVD72、SN65HVD75、SN65HVD78 | SOIC (8) | 4.91mm × 3.90mm |
| | VSSOP (8) | 3.00mm×3.00mm |
| | VSON (8) | |

(1) 提供されているすべてのパッケージについては、巻末の注文情報を参照してください。

**代表的なアプリケーションの図**



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## 4 改訂履歴

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

**Revision G (Januarly 2019) から Revision H に変更** **Page**

- Changed the Pin Configuration images ... 5
- Changed Supply voltage, $V_{CC}$ MAX value From = 3.6 V To: 5 V in the *Absolute Maximum Ratings* table ... 6
- Deleted "or R pin" for $V_{CC}$ in the *Absolute Maximum Ratings* ... 6
- Added reliability note to $V_{CC}$ in the *Recommended Operating Conditions* table ... 6

**Revision F (December 2016) から Revision G に変更** **Page**

- Changed From: Supply voltage, $V_{CC}$ MAX value = 5.5 V To: Supply voltage, $V_{CC}$ or R pin MAX value = 3.6 V in the *Absolute Maximum Ratings* table ... 6
- Changed From: Input voltage at any logic pin To: Voltage at D, DE, or $\overline{RE}$ in the *Absolute Maximum Ratings* table ... 6

**Revision E (September 2016) から Revision F に変更** **Page**

- Changed pin A From: 7 To: 6, and pin B From: 6 To: 7 in Figure 26 ... 23

**Revision D (July 2015) から Revision E に変更** **Page**

- 新しい特長を追加:「電源オンおよび電源オフ時にバスの入力および出力がグリッチ・フリー」 ... 1

**Revision C (September 2013)** から **Revision D** に変更 **Page**

- *「ピン構成および機能」セクション、「ESD定格」表、「機能説明」セクション、「デバイスの機能モード」セクション、「アプリケーションと実装」セクション、「電源に関する推奨事項」セクション、「レイアウト」セクション、「デバイスおよびドキュメントのサポート」セクション、「メカニカル、パッケージ、および注文情報」セクション* 追加 ..... 1

**Revision B (June 2012)** から **Revision C** に変更 **Page**

- 「特長」の「±12kV を超える IEC61000-4-2 エアギャップ放電」を削除 ..... 1
- Added Footnote 2 to the *Absolute Maximum Ratings* table ..... 6
- Changed the Switching Characteristics conditions statement From: 250 kbps devices (SN65HVD70, 71, 72) bit time > 4 µs To: 250 kbps device (SN65HVD72) bit time ≥ 4 µs ..... 8
- Changed the Switching Characteristics conditions statement From: 250 kbps devices (SN65HVD73, 74, 75) bit time > 50 ns To: 250 kbps device (SN65HVD75) bit time ≥ 50 ns ..... 9
- Changed the Switching Characteristics conditions statement From: 250 kbps devices (SN65HVD76, 77, 78)bit time > 20 ns To: 250 kbps device (SN65HVD78) bit time ≥ 20 ns ..... 9
- Added note : $R_L$ = 54 Ω to Figure 6, Figure 7, and Figure 8 ..... 10
- Added the DGK package to the SN65HVD72, 75, 78 Logic Diagram ..... 16
- Replaced the LOW-POWER STANDBY MODE section ..... 20
- Added text to the Transient Protection section ..... 21

**Revision A (May 2012)** から **Revision B** に変更 **Page**

- Added the SON-8 package and Nodes column to *Device Comparison Table*, ..... 5
- Changed the Voltage range at A or B Inputs MIN value From: –8 V To: –13 V in the *Absolute Maximum Ratings* table ..... 6
- Added footnote for free-air temperature to the Recommended Operating Conditions table ..... 6
- Changed the Bus input current (disabled driver) TYP values for HVD78 $V_I$ = 12 V From: 150 To: 240 and $V_I$ = –7 V From: –120 To: –180 ..... 8
- Changed, Thermal Information ..... 8
- Changed, Thermal Characteristics ..... 8
- Added TYP values to the Switching Characteristics table ..... 9
- Added TYP values to the Switching Characteristics table ..... 9
- Changed the SN65HVD72, 75, 78 Logic Diagram ..... 16
- Added section: LOW-POWER STANDBY MODE ..... 20

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- Added VALUEs to the Thermal Characteristics table in the DEVICE INFORMATION section. ..... 8
- Changed the Switching Characteristics condition statement From: 15 kbps devices (SN65HVD73, 74, 75) bit time > 65 ns To: 20 Mbps devices (SN65HVD73, 74, 75) bit time > 50 ns ..... 9
- Changed the Switching Characteristics condition statement From: 50 kbps devices (SN65HVD76, 77, 78) bit time > 20 ns To: 50 Mbps devices (SN65HVD76, 77, 78) bit time > 20 ns ..... 9
- Added Figure 4 to *Typical Characteristics*. ..... 10
- Added Figure 5 to *Typical Characteristics*. ..... 10
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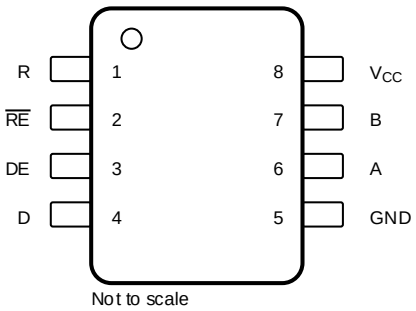
- Added Figure 8 to *Typical Characteristics*. ..... 10
- Added Figure 9 to *Typical Characteristics*. ..... 10
- Added *Application Information* section to data sheet. ..... 18

# 5 Device Comparison Table

| PART NUMBER | SIGNALING RATE | NODES | DUPLEX | ENABLES |
|---|---|---|---|---|
| SN65HVD72 | Up to 250 kbps | 213 | Half | DE, $\overline{RE}$ |
| SN65HVD75 | Up to 20 Mbps | | | |
| SN65HVD78 | Up to 50 Mbps | 96 | | |

# 6 Pin Configuration and Functions

**D Package**
**8-Pin SOIC**
**Top View**

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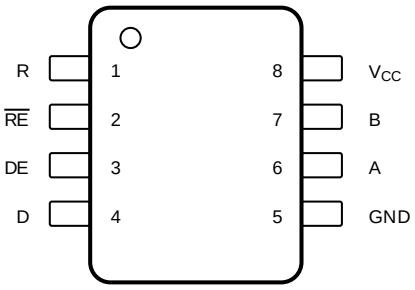
**DGK Package**
**8-Pin VSSOP**
**Top View**

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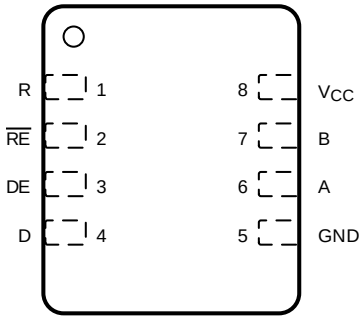
**DRB Package**
**8-Pin VSON**
**Top View**

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**Pin Functions**

| PIN | | TYPE | DESCRIPTION |
|---|---|---|---|
| NAME | NUMBER | | |
| A | 6 | Bus I/O | Driver output or receiver input (complementary to B) |
| B | 7 | Bus I/O | Driver output or receiver input (complementary to A) |
| D | 4 | Digital input | Driver data input |
| DE | 3 | Digital input | Active-high driver enable |
| GND | 5 | Reference potential | Local device ground |
| R | 1 | Digital output | Receive data output |
| $\overline{RE}$ | 2 | Digital input | Active-low receiver enable |
| $V_{CC}$ | 8 | Supply | 3-V to 3.6-V supply |

# 7 Specifications

## 7.1 Absolute Maximum Ratings

over recommended operating range (unless otherwise specified) (1)

| | MIN | MAX | UNIT |
|---|---|---|---|
| Supply voltage, $V_{CC}$ | –0.5 | 5 | V |
| Voltage at A or B inputs | –13 | 16.5 | |
| Voltage at D, DE, or $\overline{RE}$ | –0.3 | 5.7 | |
| Voltage input, transient pulse, A and B, through 100 Ω | –100 | 100 | |
| Receiver output current | –24 | 24 | mA |
| Junction temperature, $T_J$ | | 170 | °C |
| Continuous total power dissipation | See *Power Dissipation* | | |
| Storage temperature, $T_{stg}$ | –65 | 150 | °C |

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

## 7.2 ESD Ratings

| | | | VALUE | UNIT |
|---|---|---|---|---|
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins (1) | ±8000 | V |
| | | Charged device model (CDM), per JEDEC specification JESD22-C101 or ANSI/ESDA/JEDEC JS-002, all pins (2) | ±1500 | |
| | | JEDEC Standard 22, Test Method A115 (Machine Model), all pins | ±300 | |
| | | IEC 61000-4-2 ESD (Air-Gap Discharge), bus pins and GND (3) | ±12000 | |
| | | IEC 61000-4-2 ESD (Contact Discharge), bus pins and GND | ±12000 | |
| | | IEC 61000-4-4 EFT (Fast transient or burst) bus pins and GND | ±4000 | |
| | | IEC 60749-26 ESD (Human Body Model), bus pins and GND | ±15000 | |

(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) By inference from contact discharge results, see *Application and Implementation*.

## 7.3 Recommended Operating Conditions

| | | | MIN | NOM | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{CC}$ (1) | Supply voltage | | 3 | 3.3 | 3.6 | V |
| $V_I$ | Input voltage at any bus terminal (separately or common mode) (2) | | –7 | | 12 | V |
| $V_{IH}$ | High-level input voltage (driver, driver enable, and receiver enable inputs) | | 2 | | $V_{CC}$ | V |
| $V_{IL}$ | Low-level input voltage (driver, driver enable, and receiver enable inputs) | | 0 | | 0.8 | V |
| $V_{ID}$ | Differential input voltage | | –12 | | 12 | V |
| $I_O$ | Output current, driver | | –60 | | 60 | mA |
| $I_O$ | Output current, receiver | | –8 | | 8 | mA |
| $R_L$ | Differential load resistance | | 54 | 60 | | Ω |
| $C_L$ | Differential load capacitance | | | 50 | | pF |
| $1/t_{UI}$ | Signaling rate | SN65HVD72 | | | 250 | kbps |
| | | SN65HVD75 | | | 20 | Mbps |
| | | SN65HVD78 | | | 50 | Mbps |
| $T_A$ (3) | Operating free-air temperature (See *Thermal Information*) | | –40 | | 125 | °C |
| $T_J$ | Junction temperature | | –40 | | 150 | °C |

(1) Exposure to conditions beyond the recommended operation maximum for extended periods may affect device reliability.
(2) The algebraic convention, in which the least positive (most negative) limit is designated as minimum, is used in this data sheet.
(3) Operation is specified for internal (junction) temperatures up to 150°C. Self-heating due to internal power dissipation should be considered for each application. Maximum junction temperature is internally limited by the thermal shutdown (TSD) circuit which disables the driver outputs when the junction temperature reaches 170°C.

## 7.4 Thermal Information

| THERMAL METRIC[1] | | SN65HVD72, SN65HVD75, SN65HVD78 | | | UNIT |
|---|---|---|---|---|---|
| | | D (SOIC) | DGK (VSSOP) | DRB (VSON) | |
| | | 8 PINS | | | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 110.7 | 168.7 | 40 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 54.7 | 62.2 | 49.6 | °C/W |
| $R_{\theta JC(bot)}$ | Junction-to-case (bottom) thermal resistance | — | — | 3.9 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 51.3 | 89.5 | 15.5 | °C/W |
| $\psi_{JT}$ | Junction-to-top characterization parameter | 9.2 | 7.4 | 0.6 | °C/W |
| $\psi_{JB}$ | Junction-to-board characterization parameter | 50.7 | 87.9 | 15.7 | °C/W |

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

## 7.5 Electrical Characteristics

over recommended operating range (unless otherwise specified)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $\lvert V_{OD}\rvert$ | Driver differential output voltage magnitude | $R_L$ = 60 Ω, 375 Ω on each output to –7 V to 12 V | See Figure 10 | 1.5 | 2 | | V |
| | | $R_L$ = 54 Ω (RS-485) | See Figure 11 | 1.5 | 2 | | |
| | | $R_L$ = 100 Ω (RS-422), $T_J \geq 0°C$ $V_{CC} \geq 3.2$ V | | 2 | 2.5 | | |
| $\Delta\lvert V_{OD}\rvert$ | Change in magnitude of driver differential output voltage | $R_L$ = 54 Ω, $C_L$ = 50 pF | | –50 | 0 | 50 | mV |
| $V_{OC(SS)}$ | Steady-state common-mode output voltage | Center of two 27-Ω load resistors | | 1 | $V_{CC}/2$ | 3 | V |
| $\Delta V_{OC}$ | Change in differential driver output common-mode voltage | Center of two 27-Ω load resistors | | –50 | 0 | 50 | mV |
| $V_{OC(PP)}$ | Peak-to-peak driver common-mode output voltage | Center of two 27-Ω load resistors | | | 200 | | mV |
| $C_{OD}$ | Differential output capacitance | | | | 15 | | pF |
| $V_{IT+}$ | Positive-going receiver differential input voltage threshold | | | See (1) | –70 | –20 | mV |
| $V_{IT–}$ | Negative-going receiver differential input voltage threshold | | | –200 | –150 | See (1) | mV |
| $V_{HYS}$ | Receiver differential input voltage threshold hysteresis ($V_{IT+} – V_{IT–}$) | | | 50 | 80 | | mV |
| $V_{OH}$ | Receiver high-level output voltage | $I_{OH}$ = –8 mA | | 2.4 | $V_{CC}$ – 0.3 | | V |
| $V_{OL}$ | Receiver low-level output voltage | $I_{OL}$ = 8 mA | | | 0.2 | 0.4 | V |
| $I_I$ | Driver input, driver enable, and receiver enable input current | | | –2 | | 2 | µA |
| $I_{OZ}$ | Receiver output high-impedance current | $V_O$ = 0 V or $V_{CC}$, $\overline{RE}$ at $V_{CC}$ | | –1 | | 1 | µA |
| $I_{OS}$ | Driver short-circuit output current | | | –160 | | 160 | mA |

(1) Under any specific conditions, $V_{IT+}$ is assured to be at least $V_{HYS}$ higher than $V_{IT–}$.

## Electrical Characteristics (continued)

over recommended operating range (unless otherwise specified)

| PARAMETER | | TEST CONDITIONS | | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $I_I$ | Bus input current (disabled driver) | $V_{CC}$ = 3 to 3.6 V or $V_{CC}$ = 0 V DE at 0 V | SN65HVD72 SN65HVD75 | $V_I$ = 12 V | | 75 | 150 | µA |
| | | | | $V_I$ = –7 V | –100 | –40 | | |
| | | | SN65HVD78 | $V_I$ = 12 V | | 240 | 333 | |
| | | | | $V_I$ = –7 V | –267 | –180 | | |
| $I_{CC}$ | Supply current (quiescent) | Driver and receiver enabled | DE = $V_{CC}$, $\overline{RE}$ = GND No load | | | 750 | 950 | µA |
| | | Driver enabled, receiver disabled | DE = $V_{CC}$, $\overline{RE}$ = $V_{CC}$ No load | | | 300 | 500 | |
| | | Driver disabled, receiver enabled | DE = GND, $\overline{RE}$ = GND No load | | | 600 | 800 | |
| | | Driver and receiver disabled | $\overline{DE}$ = GND, D = open $\overline{RE}$ = $V_{CC}$, No load | | | 0.1 | 2 | |
| | Supply current (dynamic) | See *Typical Characteristics* | | | | | | |
| $T_{TSD}$ | Thermal shutdown junction temperature | | | | | 170 | | °C |

## 7.6 Power Dissipation

| PARAMETER | | | TEST CONDITIONS | | VALUE | UNIT |
|---|---|---|---|---|---|---|
| PD | Power Dissipation driver and receiver enabled, $V_{CC}$ = 3.6 V, $T_J$ = 150°C 50% duty cycle square-wave signal at signaling rate: • SN65HVD72 at 250 kbps • SN65HVD75 at 20 Mbps • SN65HVD78 at 50 Mbps | Unterminated | $R_L$ = 300 Ω $C_L$ = 50 pF (driver) | SN65HVD72 | 120 | mW |
| | | | | SN65HVD75 | 160 | |
| | | | | SN65HVD78 | 200 | |
| | | RS-422 load | $R_L$ = 100 Ω $C_L$ = 50 pF (driver) | SN65HVD72 | 155 | mW |
| | | | | SN65HVD75 | 195 | |
| | | | | SN65HVD78 | 230 | |
| | | RS-485 load | $R_L$ = 54 Ω $C_L$ = 50 pF (driver) | SN65HVD72 | 190 | mW |
| | | | | SN65HVD75 | 230 | |
| | | | | SN65HVD78 | 260 | |

## 7.7 Switching Characteristics: 250 kbps Device (SN65HVD72) Bit Time ≥ 4 µs

over recommended operating conditions

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| **DRIVER** | | | | | | | |
| $t_r$, $t_f$ | Driver differential output rise or fall time | $R_L$ = 54 Ω $C_L$ = 50 pF | See Figure 12 | 0.3 | 0.7 | 1.2 | µs |
| $t_{PHL}$, $t_{PLH}$ | Driver propagation delay | | | | 0.7 | 1 | µs |
| $t_{SK(P)}$ | Driver pulse skew, $\lvert t_{PHL} - t_{PLH} \rvert$ | | | | | 0.2 | µs |
| $t_{PHZ}$, $t_{PLZ}$ | Driver disable time | | See Figure 13 and Figure 14 | | 0.1 | 0.4 | µs |
| $t_{PZH}$, $t_{PZL}$ | Driver enable time | Receiver enabled | | | 0.5 | 1 | µs |
| | | Receiver disabled | | | 3 | 9 | |
| **RECEIVER** | | | | | | | |
| $t_r$, $t_f$ | Receiver output rise or fall time | $C_L$ = 15 pF | See Figure 15 | | 12 | 30 | ns |
| $t_{PHL}$, $t_{PLH}$ | Receiver propagation delay time | | | | 75 | 100 | ns |
| $t_{SK(P)}$ | Receiver pulse skew, $\lvert t_{PHL} - t_{PLH} \rvert$ | | | | 3 | 15 | ns |
| $t_{PLZ}$, $t_{PHZ}$ | Receiver disable time | | | | 40 | 100 | ns |
| $t_{PZL(1)}$, $t_{PZH(1)}$, $t_{PZL(2)}$, $t_{PZH(2)}$ | Receiver enable time | Driver enabled | See Figure 16 | | 20 | 50 | ns |
| | | Driver disabled | See Figure 17 | | 3 | 8 | µs |

## 7.8 Switching Characteristics: 20 Mbps Device (SN65HVD75) Bit Time ≥50 ns

over recommended operating conditions

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| **DRIVER** | | | | | | | |
| $t_r$, $t_f$ | Driver differential output rise or fall time | $R_L$ = 54 Ω, $C_L$ = 50 pF | See Figure 12 | 2 | 7 | 14 | ns |
| $t_{PHL}$, $t_{PLH}$ | Driver propagation delay | | | 7 | 11 | 17 | ns |
| $t_{SK(P)}$ | Driver pulse skew, $\|t_{PHL} - t_{PLH}\|$ | | | | 0 | 2 | ns |
| $t_{PHZ}$, $t_{PLZ}$ | Driver disable time | | See Figure 13 and Figure 14 | | 12 | 50 | ns |
| $t_{PZH}$, $t_{PZL}$ | Driver enable time | Receiver enabled | | | 10 | 20 | ns |
| | | Receiver disabled | | | 3 | 7 | µs |
| **RECEIVER** | | | | | | | |
| $t_r$, $t_f$ | Receiver output rise or fall time | $C_L$ = 15 pF | See Figure 15 | | 5 | 10 | ns |
| $t_{PHL}$, $t_{PLH}$ | Receiver propagation delay time | | | | 60 | 70 | ns |
| $t_{SK(P)}$ | Receiver pulse skew, $\|t_{PHL} - t_{PLH}\|$ | | | | 0 | 6 | ns |
| $t_{PLZ}$, $t_{PHZ}$ | Receiver disable time | | | | 15 | 30 | ns |
| $t_{pZL(1)}$, $t_{PZH(1)}$, $t_{PZL(2)}$, $t_{PZH(2)}$ | Receiver enable time | Driver enabled | See Figure 16 | | 10 | 50 | ns |
| | | Driver disabled | See Figure 17 | | 3 | 8 | µs |

## 7.9 Switching Characteristics: 50 Mbps Device (SN65HVD78) Bit Time ≥20 ns

over recommended operating conditions

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| **DRIVER** | | | | | | | |
| $t_r$, $t_f$ | Driver differential output rise or fall time | $R_L$ = 54 Ω, $C_L$ = 50 pF | See Figure 12 | 1 | 3 | 6 | ns |
| $t_{PHL}$, $t_{PLH}$ | Driver propagation delay | | | | 9 | 15 | ns |
| $t_{SK(P)}$ | Driver pulse skew, $\|t_{PHL} - t_{PLH}\|$ | | | | 0 | 1 | ns |
| $t_{PHZ}$, $t_{PLZ}$ | Driver disable time | | See Figure 13 and Figure 14 | | 10 | 30 | ns |
| $t_{PZH}$, $t_{PZL}$ | Driver enable time | Receiver enabled | | | 10 | 30 | ns |
| | | Receiver disabled | | | | 8 | µs |
| **RECEIVER** | | | | | | | |
| $t_r$, $t_f$ | Receiver output rise or fall time | $C_L$ = 15 pF | See Figure 15 | 1 | 3 | 6 | ns |
| $t_{PHL}$, $t_{PLH}$ | Receiver propagation delay time | | | | | 35 | ns |
| $t_{SK(P)}$ | Receiver pulse skew, $\|t_{PHL} - t_{PLH}\|$ | | | | | 2.5 | ns |
| $t_{PLZ}$, $t_{PHZ}$ | Receiver disable time | | | | 8 | 30 | ns |
| $t_{pZL(1)}$, $t_{PZH(1)}$, $t_{PZL(2)}$, $t_{PZH(2)}$ | Receiver enable time | Driver enabled | See Figure 16 | | 10 | 30 | ns |
| | | Driver disabled | See Figure 17 | | 3 | 8 | µs |

## 7.10 Typical Characteristics

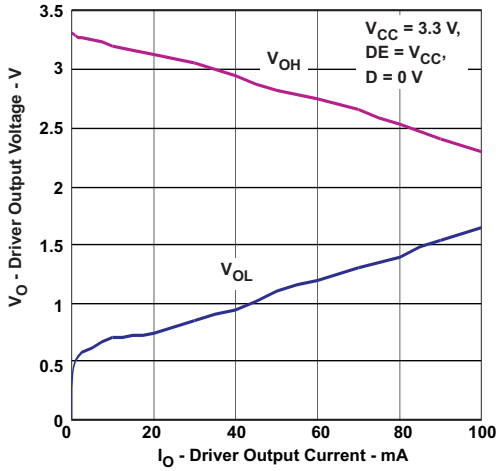



**Figure 1. Driver Output Voltage vs Driver Output Current**

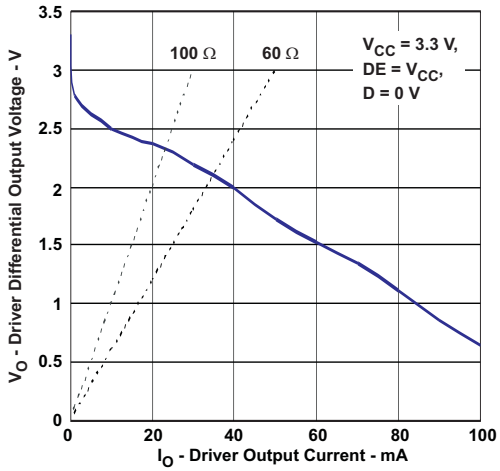



**Figure 2. Driver Differential Output Voltage vs Driver Output Current**

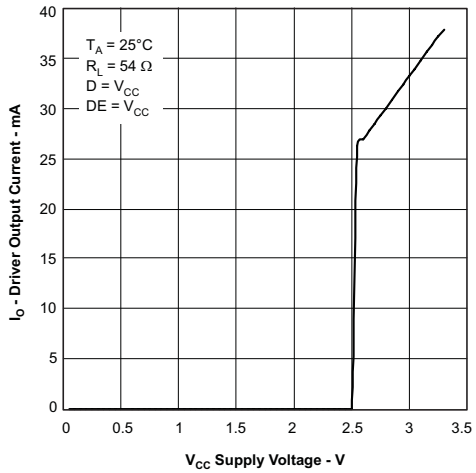



**Figure 3. Driver Output Current vs Supply Voltage**

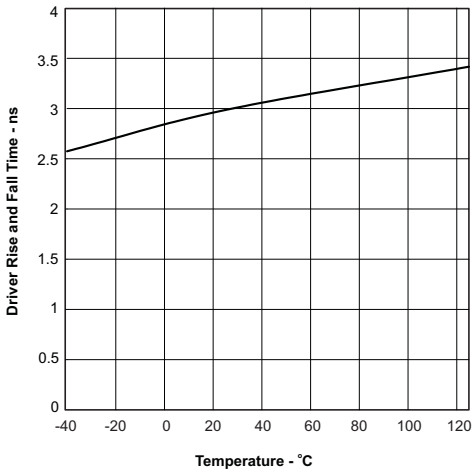



**Figure 4. SN65HVD78 Driver Rise or Fall Time vs Temperature**

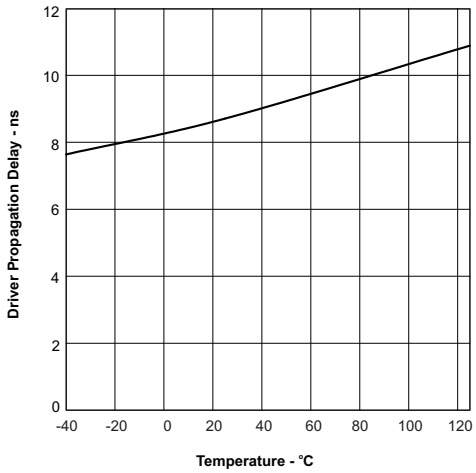



**Figure 5. SN65HVD78 Driver Propagation Delay vs Temperature**

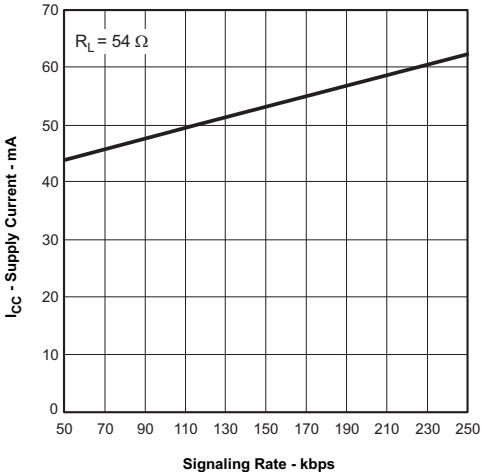



**Figure 6. SN65HVD72 Supply Current vs Signal Rate**

## Typical Characteristics (continued)

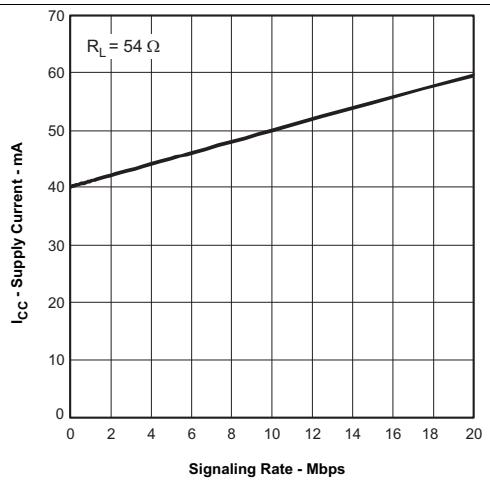



**Figure 7. SN65HVD75 Supply Current vs Signal Rate**

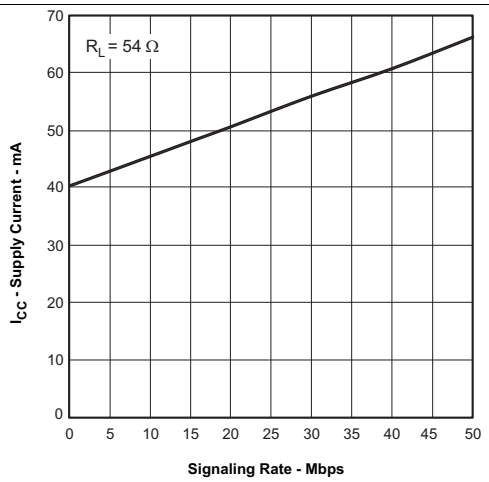



**Figure 8. SN65HVD78 Supply Current vs Signal Rate**

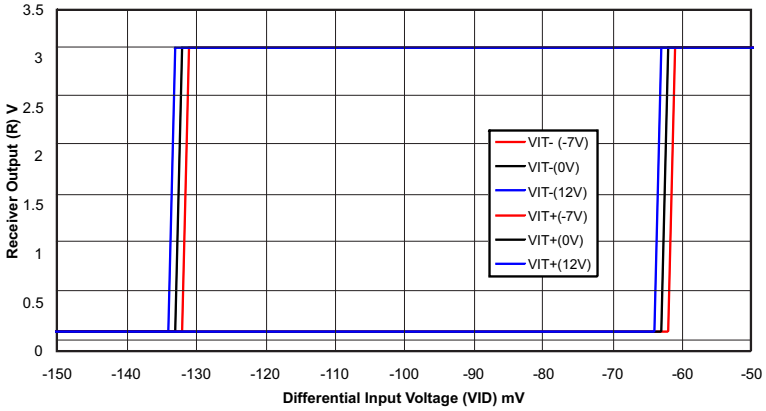



**Figure 9. Receiver Output vs Input**

## 8 Parameter Measurement Information

Input generator rate is 100 kbps, 50% duty cycle, rise or fall time is less than 6 ns, output impedance is 50 Ω.

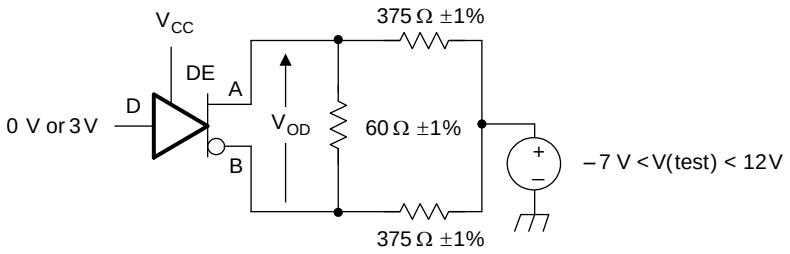





**Figure 10. Measurement of Driver Differential Output Voltage With Common-Mode Load**

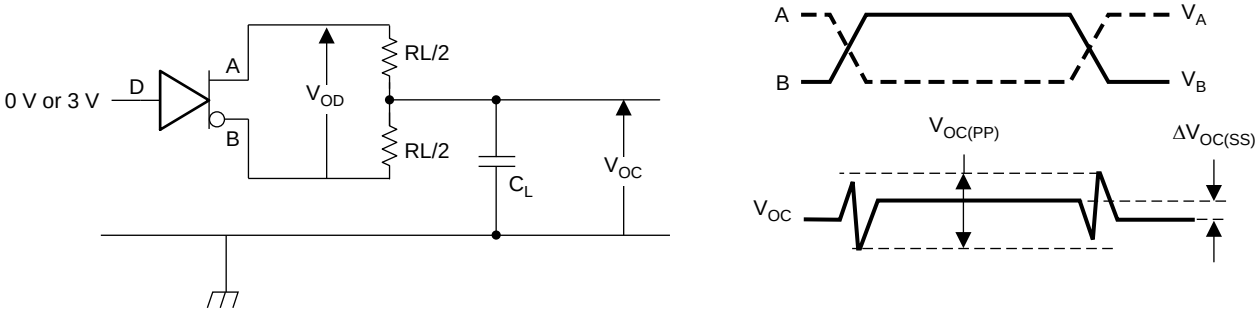





**Figure 11. Measurement of Driver Differential and Common-Mode Output With RS-485 Load**

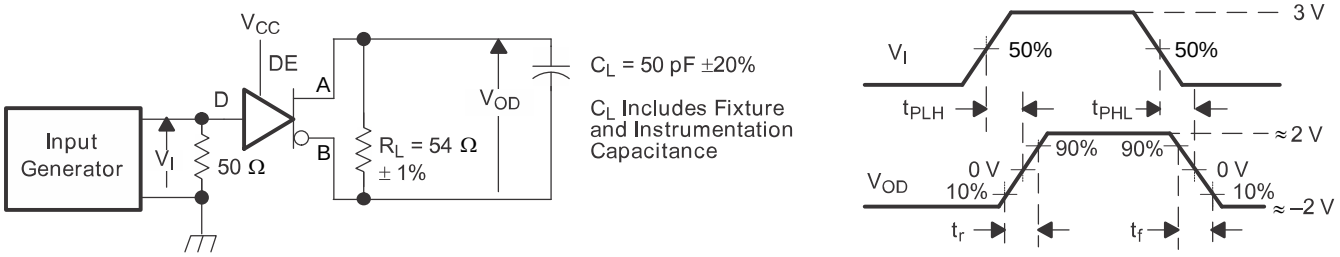
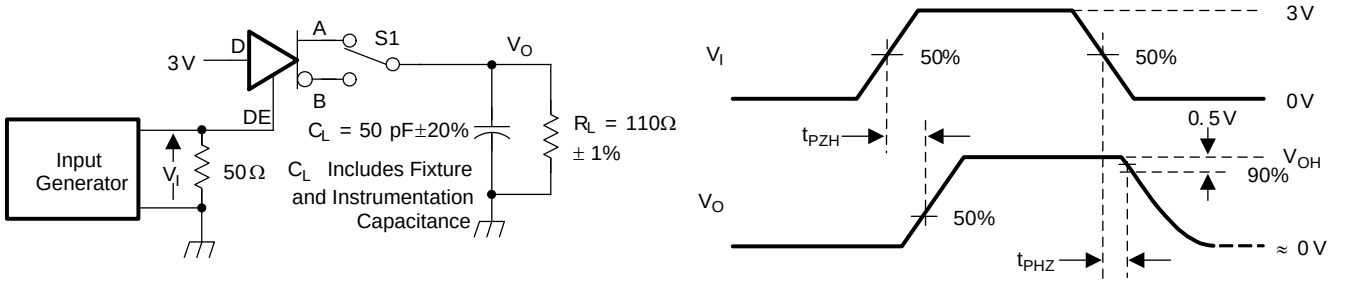





**Figure 12. Measurement of Driver Differential Output Rise and Fall Times and Propagation Delays**

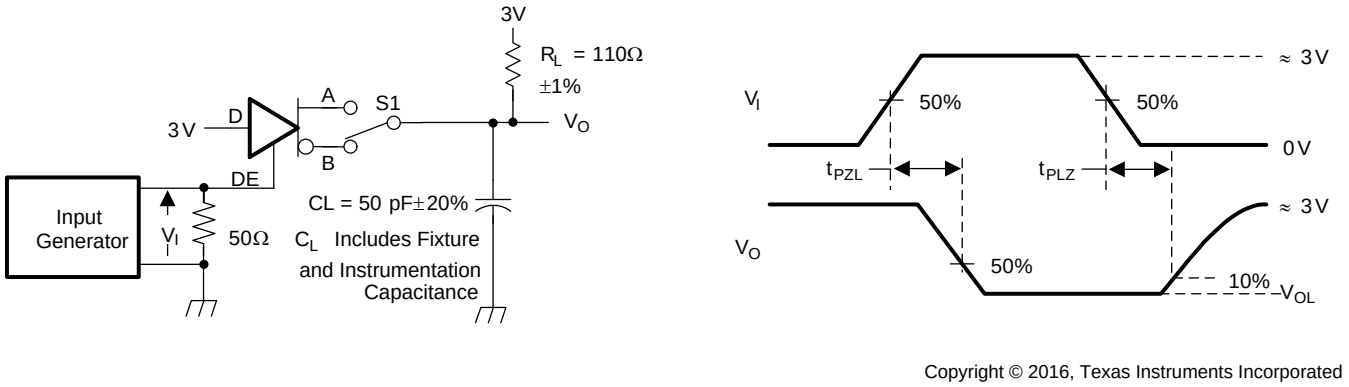





D at 3 V to test non-inverting output, D at 0 V to test inverting output.

**Figure 13. Measurement of Driver Enable and Disable Times With Active High Output and Pulldown Load**

## Parameter Measurement Information (continued)






D at 0 V to test non-inverting output, D at 3 V to test inverting output.

**Figure 14. Measurement of Driver Enable and Disable Times With Active Low Output and Pullup Load**

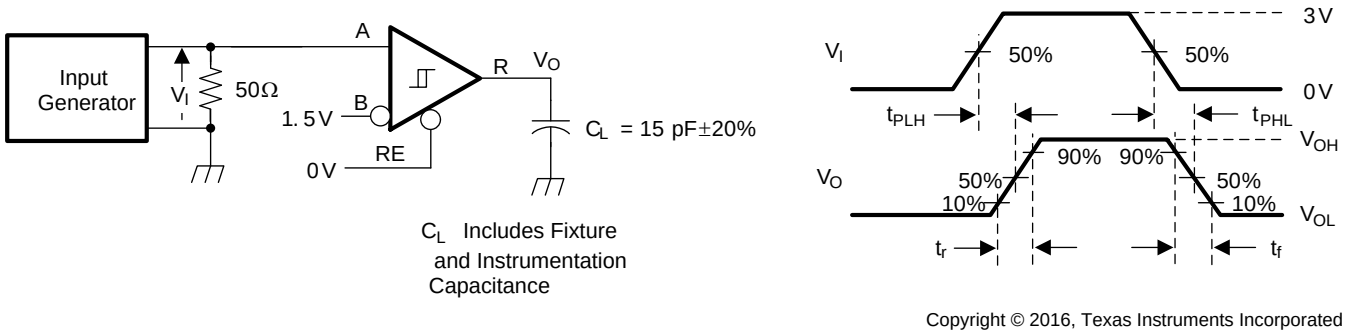





**Figure 15. Measurement of Receiver Output Rise and Fall Times and Propagation Delays**

## Parameter Measurement Information (continued)

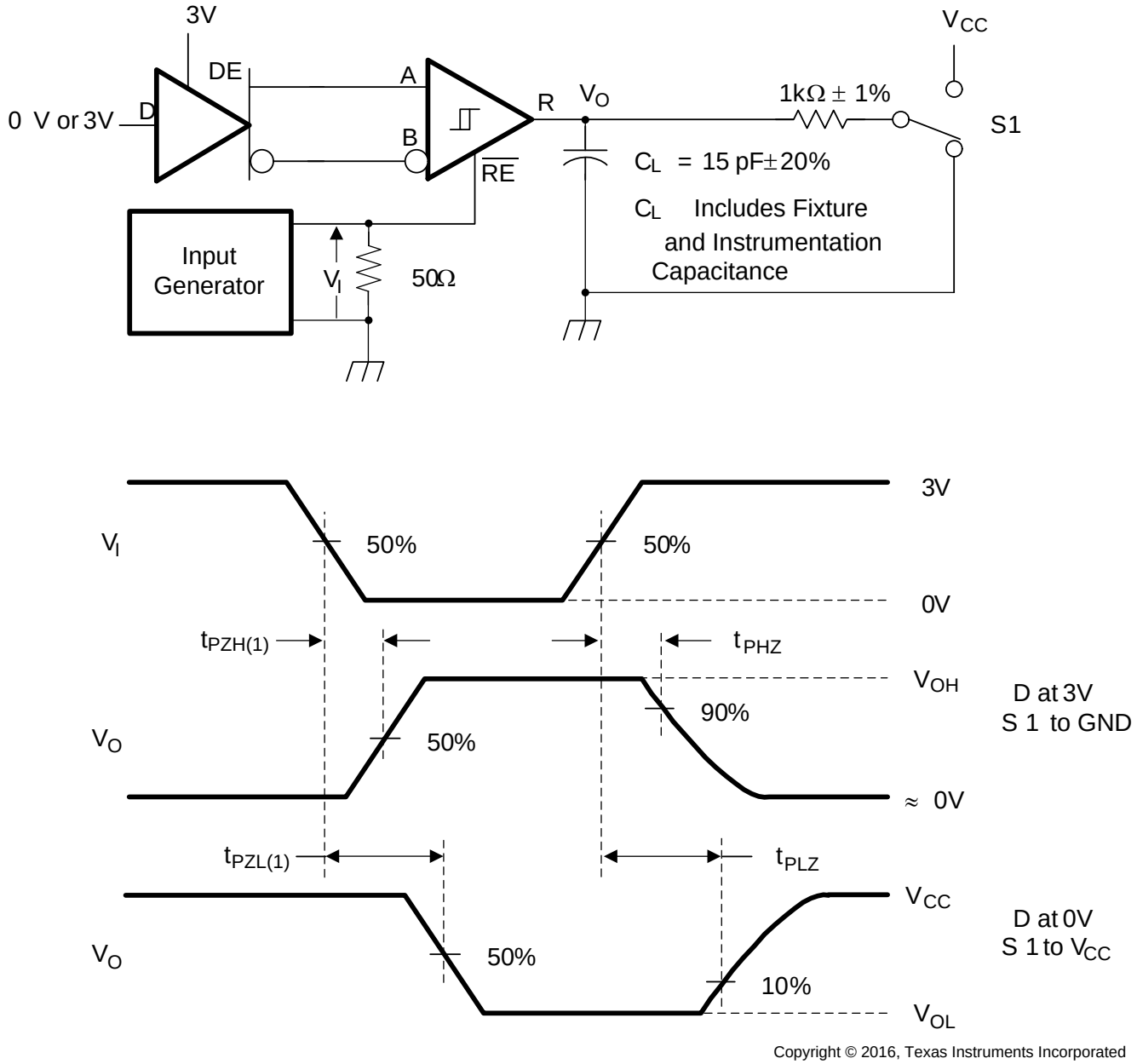





**Figure 16. Measurement of Receiver Enable and Disable Times With Driver Enabled**

## Parameter Measurement Information (continued)

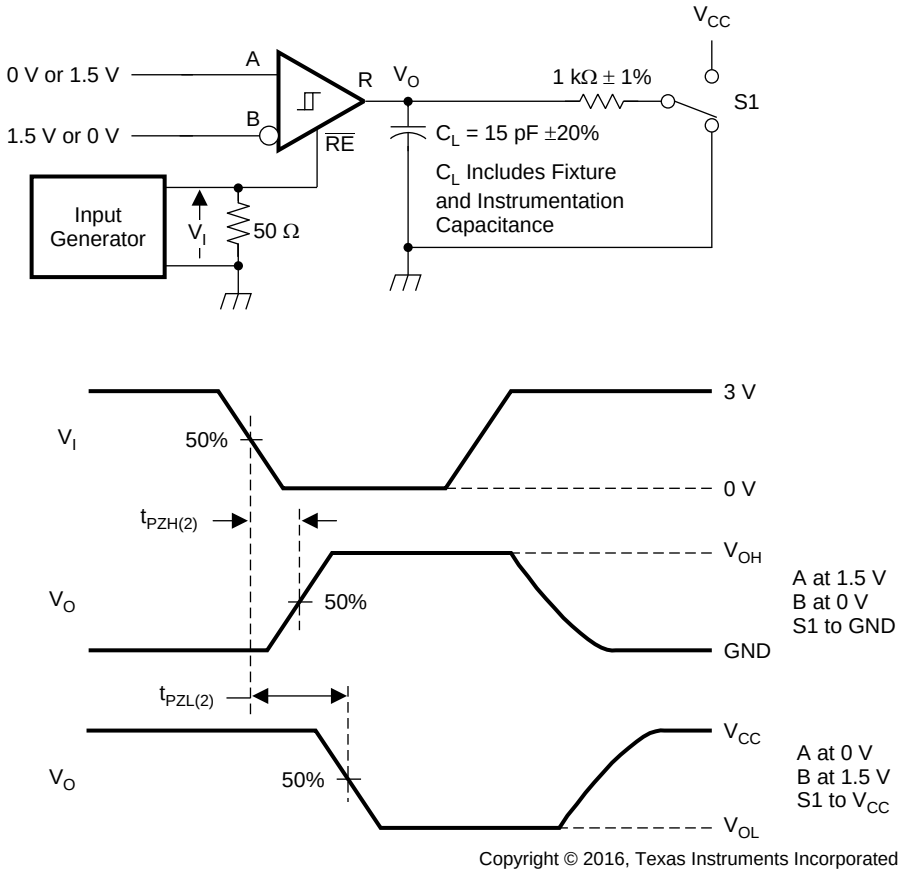





**Figure 17. Measurement of Receiver Enable Times With Driver Disabled**

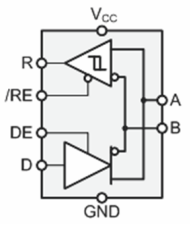
# 9 Detailed Description

## 9.1 Overview

The SN65HVD72, SN65HVD75, and SN65HVD78 are low-power, half-duplex RS-485 transceivers available in 3 speed grades suitable for data transmission up to 250 kbps, 20 Mbps, and 50 Mbps.

These devices have active-high driver enables and active-low receiver enables. A standby current of less than 2 µA can be achieved by disabling both driver and receiver.

## 9.2 Functional Block Diagram






## 9.3 Feature Description

Internal ESD protection circuits protect the transceiver against electrostatic discharges (ESD) according to IEC 61000-4-2 of up to ±12 kV, and against electrical fast transients (EFT) according to IEC 61000-4-4 of up to ±4 kV.

The SN65HVD7x half-duplex family provides internal biasing of the receiver input thresholds in combination with large input threshold hysteresis. At a positive input threshold of $V_{IT+}$ = –20 mV and an input hysteresis of $V_{HYS}$ = 50 mV, the receiver output remains logic high under a bus-idle or bus-short condition even in the presence of 140-$mV_{PP}$ differential noise without the need for external failsafe biasing resistors.

Device operation is specified over a wide ambient temperature range from –40°C to 125°C.

## 9.4 Device Functional Modes

When the driver enable pin, DE, is logic high, the differential outputs A and B follow the logic states at data input D. A logic high at D causes A to turn high and B to turn low. In this case the differential output voltage defined as $V_{OD} = V_A – V_B$ is positive. When D is low, the output states reverse, B turns high, A becomes low, and $V_{OD}$ is negative.

When DE is low, both outputs turn high-impedance. In this condition the logic state at D is irrelevant. The DE pin has an internal pulldown resistor to ground; thus, when left open, the driver is disabled (high-impedance) by default. The D pin has an internal pullup resistor to $V_{CC}$; thus, when left open while the driver is enabled, output A turns high and B turns low.

**Table 1. Driver Function Table**

| INPUT | ENABLE | OUTPUTS | | DESCRIPTION |
|---|---|---|---|---|
| D | DE | A | B | |
| H | H | H | L | Actively drive bus high |
| L | H | L | H | Actively drive bus low |
| X | L | Z | Z | Driver disabled |
| X | OPEN | Z | Z | Driver disabled by default |
| OPEN | H | H | L | Actively drive bus high by default |

When the receiver enable pin, $\overline{RE}$, is logic low, the receiver is enabled. When the differential input voltage defined as $V_{ID} = V_A - V_B$ is positive and higher than the positive input threshold, $V_{IT+}$, the receiver output, R, turns high. When $V_{ID}$ is negative and lower than the negative input threshold, $V_{IT-}$, the receiver output turns low. If $V_{ID}$ is between $V_{IT+}$ and $V_{IT-}$, the output is indeterminate.

When $\overline{RE}$ is logic high or left open, the receiver output is high-impedance and the magnitude and polarity of $V_{ID}$ are irrelevant. Internal biasing of the receiver inputs causes the output to go failsafe-high when the transceiver is disconnected from the bus (open-circuit), the bus lines are shorted (short-circuit), or the bus is not actively driven (idle bus).

**Table 2. Receiver Function Table**

| DIFFERENTIAL INPUT | ENABLE | OUTPUT | DESCRIPTION |
|---|---|---|---|
| $V_{ID} = V_A - V_B$ | $\overline{RE}$ | R | |
| $V_{IT+} < V_{ID}$ | L | H | Receive valid bus high |
| $V_{IT-} < V_{ID} < V_{IT+}$ | L | ? | Indeterminate bus state |
| $V_{ID} < V_{IT-}$ | L | L | Receive valid bus low |
| X | H | Z | Receiver disabled |
| X | OPEN | Z | Receiver disabled by default |
| Open-circuit bus | L | H | Failsafe high output |
| Short-circuit bus | L | H | Failsafe high output |
| Idle (terminated) bus | L | H | Failsafe high output |

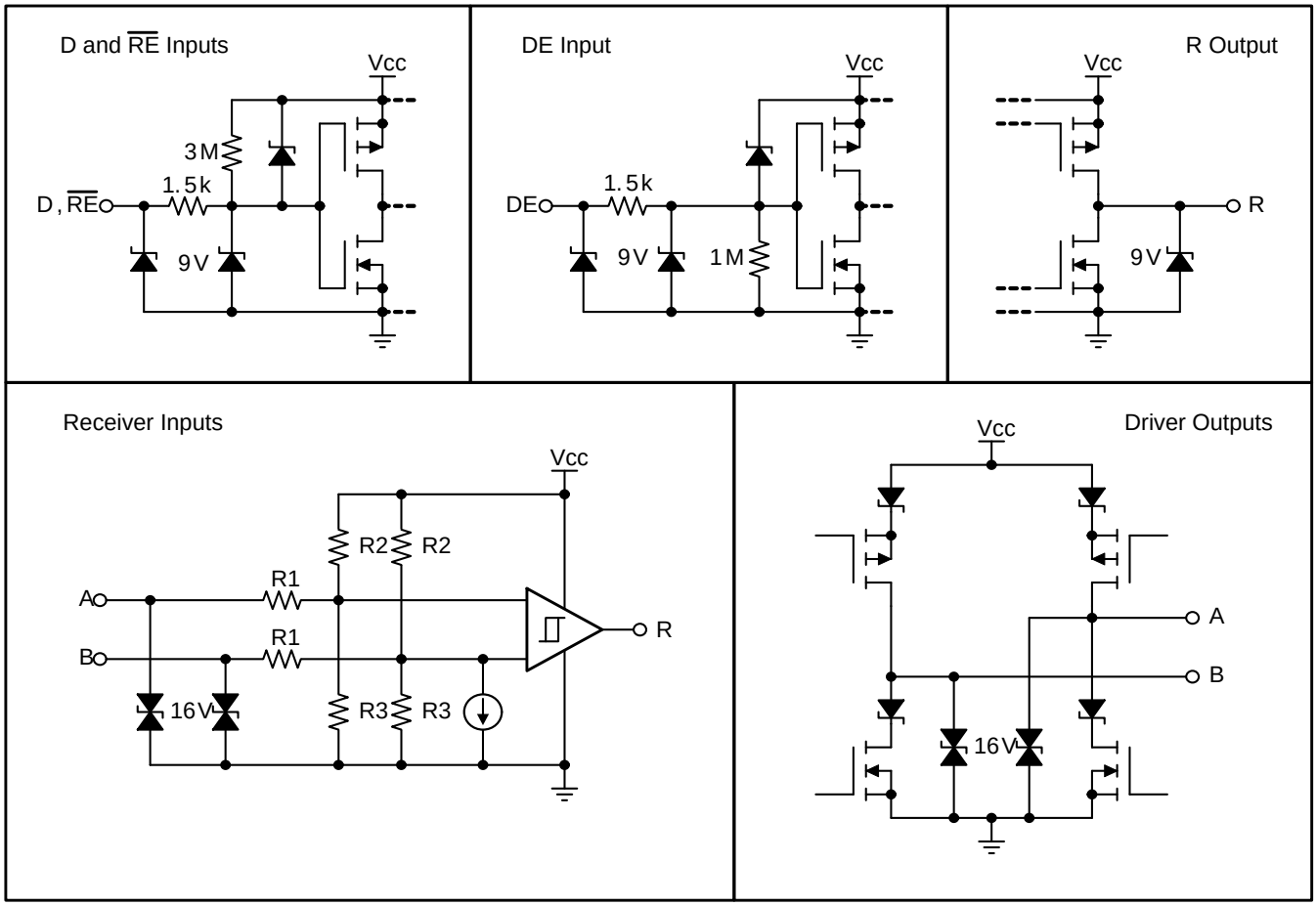





**Figure 18. Equivalent Input and Output Circuit Diagrams**

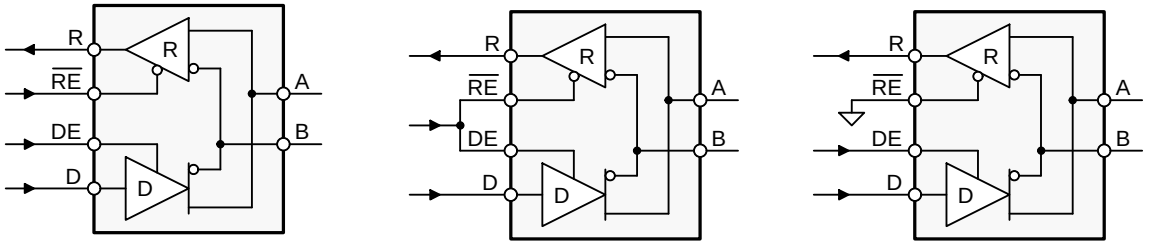
# 10 Application and Implementation

**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.

## 10.1 Application Information

The SN65HVD72, SN65HVD75, and SN65HVD78 are half-duplex RS-485 transceivers commonly used for asynchronous data transmission. The driver and receiver enable pins allow for the configuration of different operating modes.




a) Independent driver and receiver enable signals

b) Combined enable signals for use as directional control pin

c) Receiver always on



**Figure 19. Transceiver Configurations**

Using independent enable lines provides the most flexible control as it allows for the driver and the receiver to be turned on and off individually. While this configuration requires two control lines, it allows for selective listening into the bus traffic, whether the driver is transmitting data or not.

Combining the enable signals simplifies the interface to the controller by forming a single direction-control signal. In this configuration, the transceiver operates as a driver when the direction-control line is high, and as a receiver when the direction-control line is low.

Additionally, only one line is required when connecting the receiver-enable input to ground and controlling only the driver-enable input. In this configuration, a node not only receives the data from the bus, but also the data it sends and can verify that the correct data have been transmitted.

## 10.2 Typical Application

An RS-485 bus consists of multiple transceivers connected in parallel to a bus cable. To eliminate line reflections, each cable end is terminated with a termination resistor, $R_T$, whose value matches the characteristic impedance, $Z_0$, of the cable. This method, known as parallel termination, allows for relatively high data rates over long cable lengths.

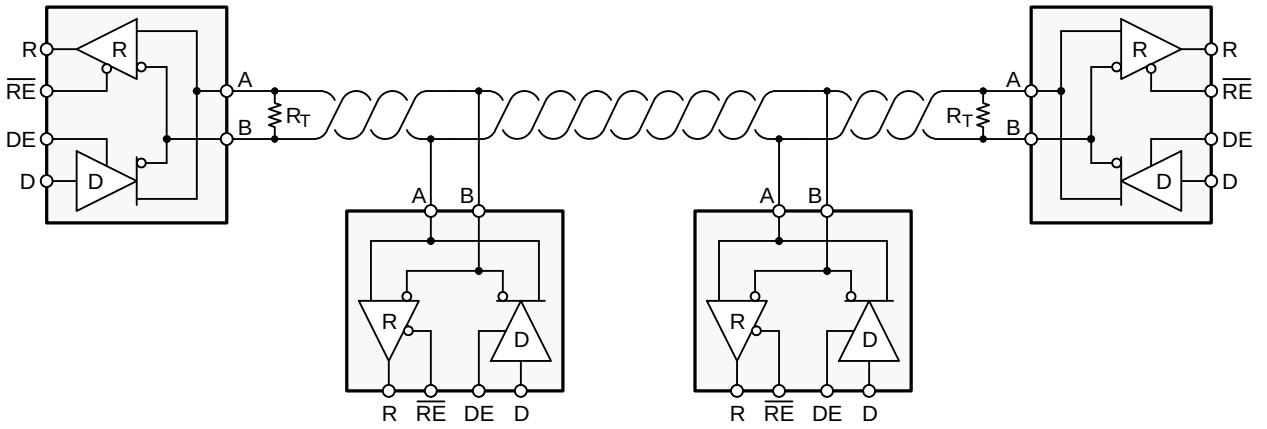





**Figure 20. Typical RS-485 Network With SN65HVD7x Transceivers**

Common cables used are unshielded twisted pair (UTP), such as low-cost CAT-5 cable with $Z_0$ = 100 Ω, and RS-485 cable with $Z_0$ = 120 Ω. Typical cable sizes are AWG 22 and AWG 24.

The maximum bus length is typically given as 4000 ft or 1200 m, and represents the length of an AWG 24 cable whose cable resistance approaches the value of the termination resistance, thus reducing the bus signal by half or 6 dB. Actual maximum usable cable length depends on the signaling rate, cable characteristics, and environmental conditions.

### 10.2.1 Design Requirements

RS-485 is a robust electrical standard suitable for long-distance networking that may be used in a wide range of applications with varying requirements, such as distance, data rate, and number of nodes.

#### *10.2.1.1 Data Rate and Bus Length*

There is an inverse relationship between data rate and bus length, meaning the higher the data rate, the shorter the cable length; and conversely, the lower the data rate, the longer the cable may be without introducing data errors. While most RS-485 systems use data rates between 10 kbps and 100 kbps, some applications require data rates up to 250 kbps at distances of 4000 feet and longer. Longer distances are possible by allowing for small signal jitter of up to 5 or 10%.

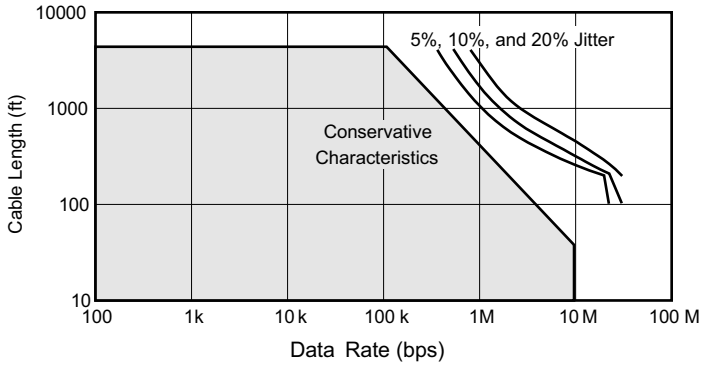



**Figure 21. Cable Length vs Data Rate Characteristic**

## Typical Application (continued)

### 10.2.1.2 Stub Length

When connecting a node to the bus, the distance between the transceiver inputs and the cable trunk, known as the stub, should be as short as possible. Stubs present a non-terminated piece of bus line which can introduce reflections as the length of the stub increases. As a general guideline, the electrical length, or round-trip delay, of a stub should be less than one-tenth of the rise time of the driver, thus giving a maximum physical stub length as shown in Equation 1.

$$L_{stub} \leq 0.1 \times t_r \times v \times c \quad (1)$$

where:

- $t_r$ is the 10/90 rise time of the driver
- c is the speed of light ($3 \times 10^8$ m/s)
- v is the signal velocity of the cable or trace as a factor of c

Per Equation 1, Table 3 shows the maximum cable-stub lengths for the minimum driver output rise times of the SN65HVD7x half-duplex family of transceivers for a signal velocity of 78%.

**Table 3. Maximum Stub Length**

| DEVICE | MINIMUM DRIVER OUTPUT RISE TIME (ns) | MAXIMUM STUB LENGTH | |
|---|---|---|---|
| | | (m) | (ft) |
| SN65HVD72 | 300 | 7 | 23 |
| SN65HVD75 | 2 | 0.05 | 0.16 |
| SN65HVD78 | 1 | 0.025 | 0.08 |

### 10.2.1.3 Bus Loading

The RS-485 standard specifies that a compliant driver must be able to drive 32 unit loads (UL), where 1 unit load represents a receiver input current of 1 mA at 12 V, or a load impedance of approximately 12 kΩ. Because the SN65HVD72 and SN65HVD75 have a receiver input current of 150 µA at 12 V, they are 3/20 UL transceivers, and no more than 213 transceivers should be connected to the bus. Similarly, the SN65HVD78 has a receiver input current of 333 µA at 12 V and is a 1/3 UL transceiver, meaning no more than 96 transceivers should be connected to the bus.

### 10.2.1.4 Receiver Failsafe

The differential receiver is failsafe to invalid bus states caused by:

- Open bus conditions such as a disconnected connector
- Shorted bus conditions such as cable damage shorting the twisted-pair together, or
- Idle bus conditions that occur when no driver on the bus is actively driving

In any of these cases, the differential receiver will output a failsafe logic high so that the output of the receiver is not indeterminate.

Receiver failsafe is accomplished by offsetting the receiver thresholds such that the input-indeterminate range does not include zero volts differential. To comply with the RS-422 and RS-485 standards, the receiver output must output a high when the differential input $V_{ID}$ is more positive than 200 mV, and must output a low when $V_{ID}$ is more negative than –200 mV. The receiver parameters which determine the failsafe performance are $V_{IT+}$, $V_{IT-}$, and $V_{HYS}$ (the separation between $V_{IT+}$ and $V_{IT-}$). As shown in *Electrical Characteristics*, differential signals more negative than –200 mV will always cause a low receiver output, and differential signals more positive than 200 mV will always cause a high receiver output.

When the differential input signal is close to zero, it is still above the maximum $V_{IT+}$ threshold of –20 mV, and the receiver output will be high. Only when the differential input is more than $V_{HYS}$ below $V_{IT+}$ will the receiver output transition to a low state. Therefore, the noise immunity of the receiver inputs during a bus fault condition includes the receiver hysteresis value, $V_{HYS}$, as well as the value of $V_{IT+}$.

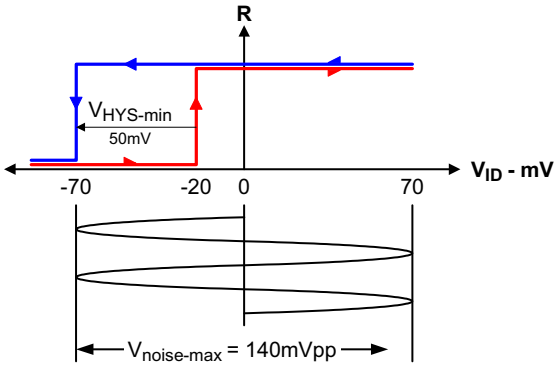



**Figure 22. SN65HVD7x Noise Immunity**

### *10.2.1.5 Transient Protection*

The bus pins of the SN65HVD7x transceiver family possess on-chip ESD protection against ±15-kV human body model (HBM) and ±12-kV IEC 61000-4-2 contact discharge. The IEC-ESD test is far more severe than the HBM-ESD test. The 50% higher charge capacitance, $C_S$, and 78% lower discharge resistance, $R_D$, of the IEC-model produce significantly higher discharge currents than the HBM-model.

As stated in the IEC 61000-4-2 standard, contact discharge is the preferred test method; although IEC air-gap testing is less repeatable than contact testing, air discharge protection levels are inferred from the contact discharge test results.

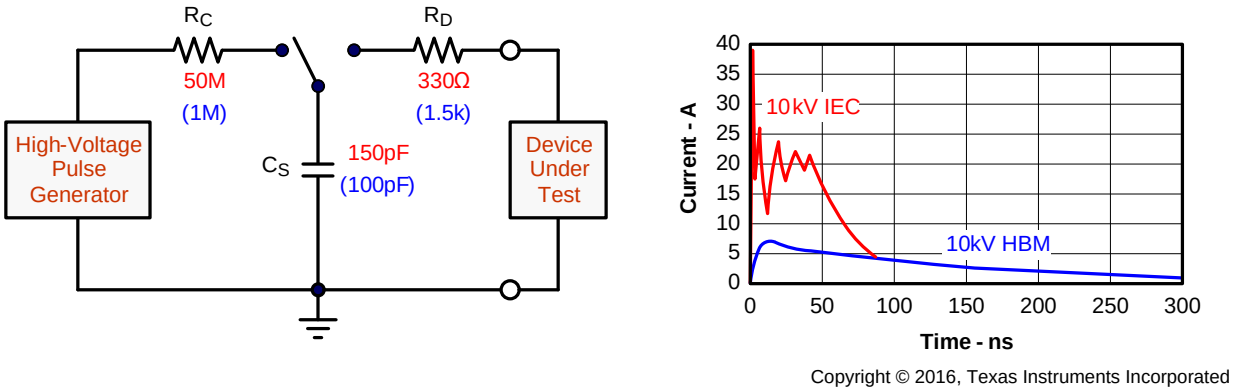





**Figure 23. HBM and IEC-ESD Models and Currents in Comparison (HBM Values in Parenthesis)**

The on-chip implementation of IEC ESD protection significantly increases the robustness of equipment. Common discharge events occur due to human contact with connectors and cables. Designers may choose to implement protection against longer duration transients, typically referred to as surge transients.

EFTs are generally caused by relay-contact bounce or the interruption of inductive loads. Surge transients often result from lightning strikes (direct strike or an indirect strike which induce voltages and currents), or the switching of power systems, including load changes and short circuit switching. These transients are often encountered in industrial environments, such as factory automation and power-grid systems.

Figure 24 compares the pulse-power of the EFT and surge transients with the power caused by an IEC ESD transient. The left-hand diagram shows the relative pulse-power for a 0.5-kV surge transient and 4-kV EFT transient, both of which dwarf the 10-kV ESD transient visible in the lower-left corner. 500-V surge transients are representative of events that may occur in factory environments in industrial and process automation.

The right-hand diagram shows the pulse-power of a 6-kV surge transient, relative to the same 0.5-kV surge transient. 6-kV surge transients are most likely to occur in power generation and power-grid systems.

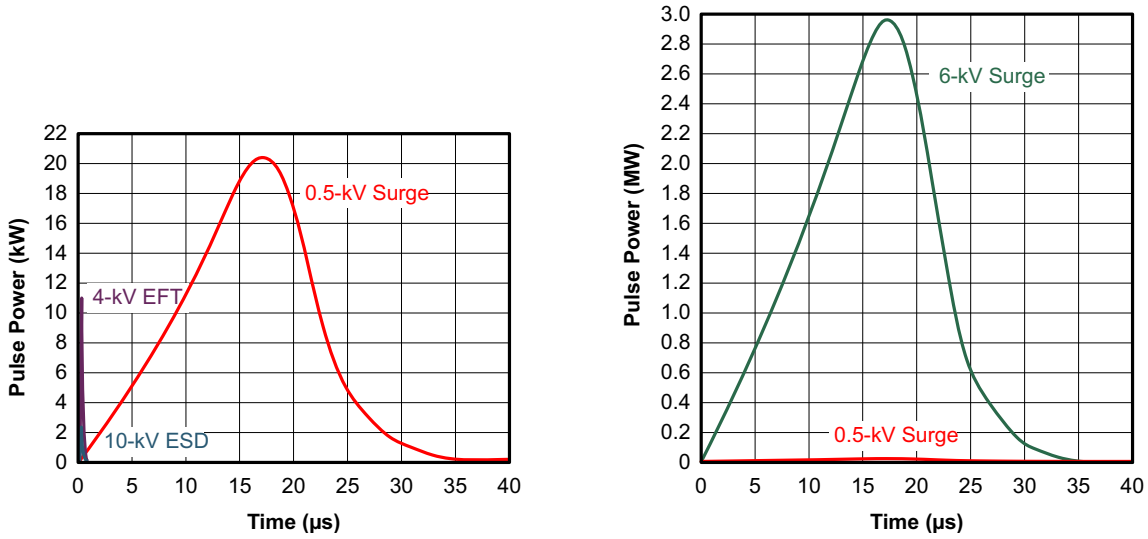



**Figure 24. Power Comparison of ESD, EFT, and Surge Transients**

In the case of surge transients, high-energy content is characterized by long pulse duration and slow decaying pulse power. The electrical energy of a transient that is dumped into the internal protection cells of a transceiver is converted into thermal energy which heats and destroys the protection cells, thus destroying the transceiver. Figure 25 shows the large differences in transient energies for single ESD, EFT, and surge transients, as well as for an EFT pulse train, commonly applied during compliance testing.

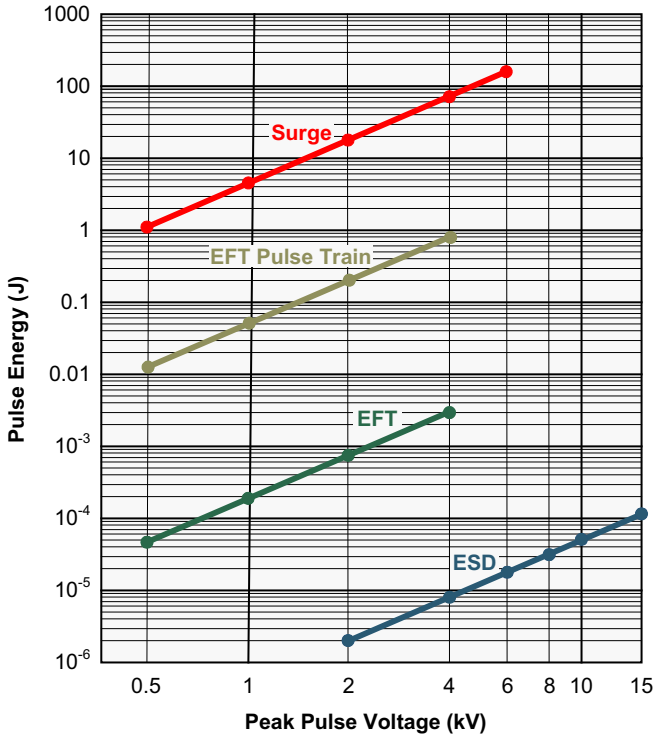



**Figure 25. Comparison of Transient Energies**

### 10.2.2 Detailed Design Procedure

#### *10.2.2.1 External Transient Protection*

To protect bus nodes against high-energy transients, the implementation of external transient protection devices is necessary. Figure 26 suggests two circuits that provide protection against light and heavy surge transients, in addition to ESD and EFT transients. Table 4 presents the associated bill of materials.

**Table 4. Bill of Materials**

| DEVICE | FUNCTION | ORDER NUMBER | MANUFACTURER |
|---|---|---|---|
| XCVR | 3.3-V, 250-kbps RS-485 Transceiver | SN65HVD72D | TI |
| R1, R2 | 10-Ω, Pulse-Proof Thick-Film Resistor | CRCW060310RJNEAHP | Vishay |
| TVS | Bidirectional 400-W Transient Suppressor | CDSOT23-SM712 | Bourns |
| TBU1, TBU2 | Bidirectional Surge Suppressor | TBU-CA-065-200-WH | Bourns |
| MOV1, MOV2 | 200-mA Transient Blocking Unit, 200-V, Metal-Oxide Varistor | MOV-10D201K | Bourns |

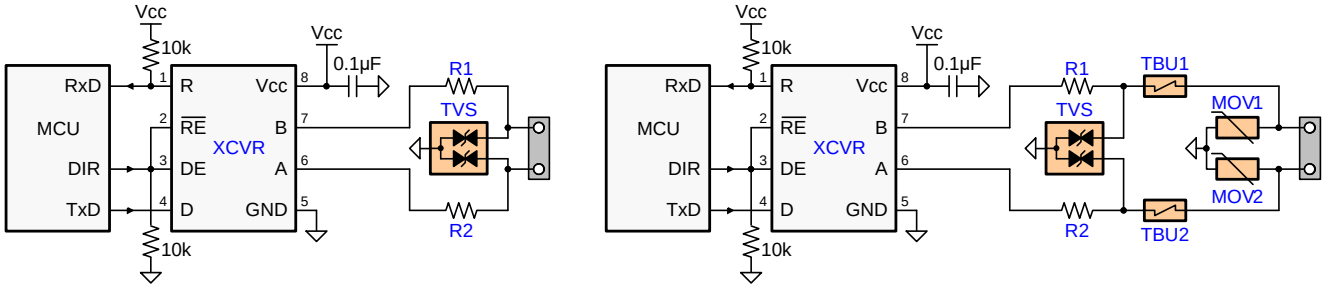





**Figure 26. Transient Protections Against ESD, EFT, and Surge Transients**

The left-hand circuit provides surge protection of ≥500-V surge transients, while the right-hand circuit can withstand surge transients of up to 5 kV.

### 10.2.2.2 Isolated Bus Node Design

Many RS-485 networks use isolated bus nodes to prevent the creation of unintended ground loops and their disruptive impact on signal integrity. An isolated bus node typically includes a microcontroller that connects to the bus transceiver via a multi-channel, digital isolator (Figure 27).

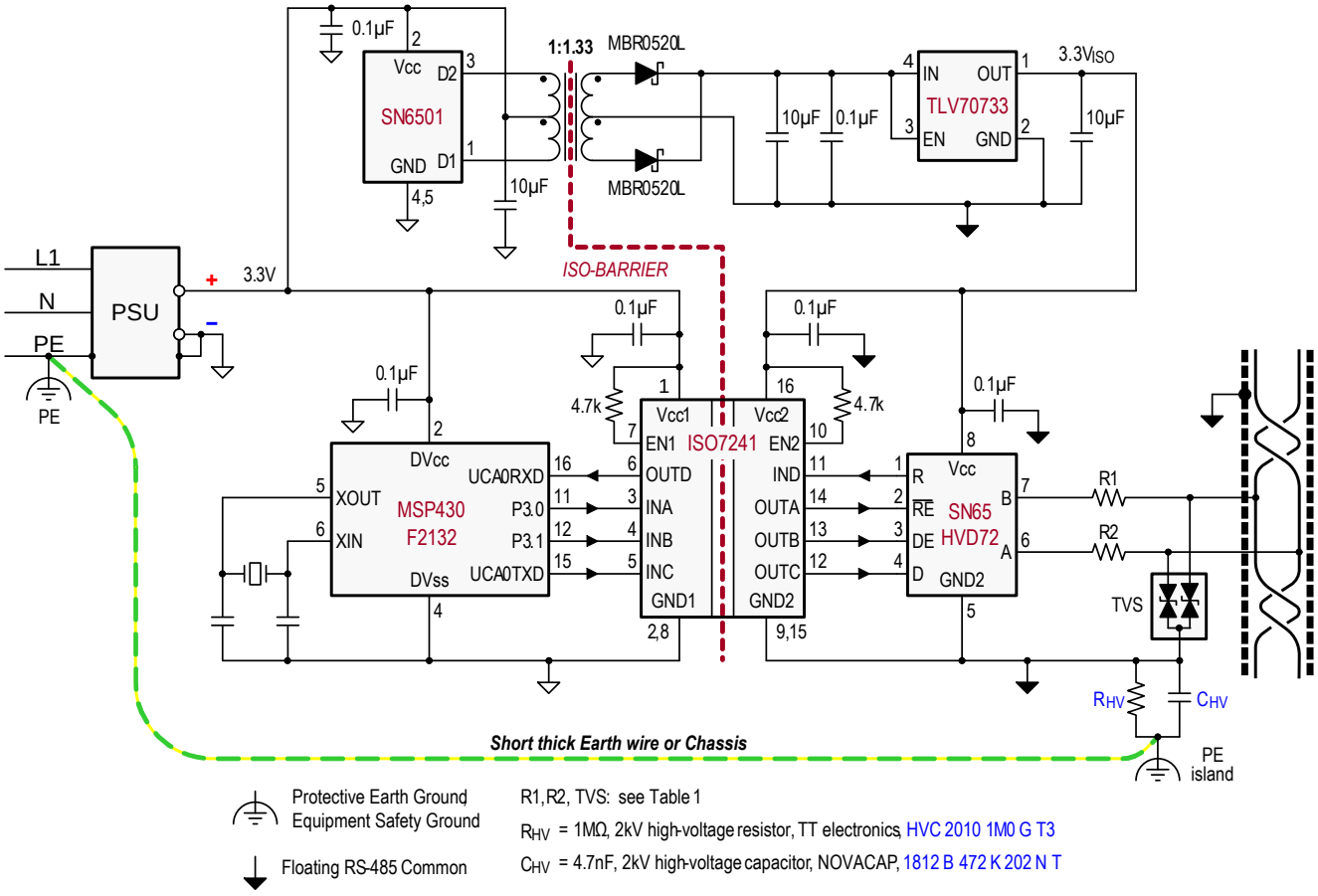





**Figure 27. Isolated Bus Node with Transient Protection**

Power isolation is accomplished using the push-pull transformer driver SN6501 and a low-cost LDO, TLV70733.

Signal isolation uses the quadruple digital isolator ISO7241. Notice that both enable inputs, $EN_1$ and $EN_2$, are pulled up via 4.7 kΩ resistors to limit their input currents during transient events.

While the transient protection is similar to the one in Figure 26 (left circuit), an additional high-voltage capacitor is used to divert transient energy from the floating RS-485 common further towards Protective Earth (PE) ground. This is necessary as noise transients on the bus are usually referred to Earth potential.

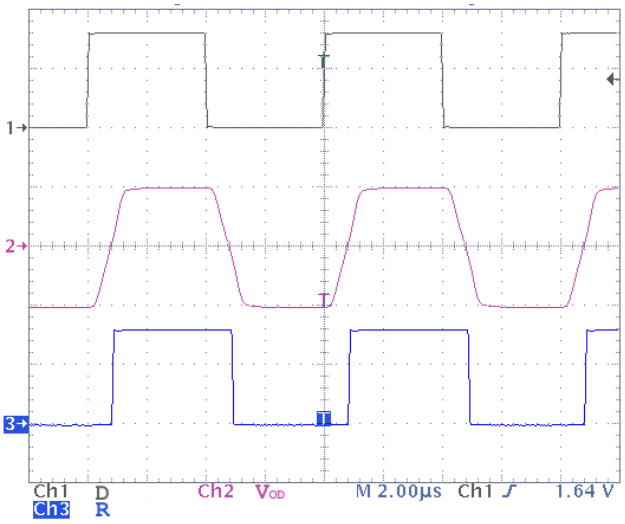
$R_{HV}$ refers to a high voltage resistor, and in some applications even a varistor. This resistance is applied to prevent charging of the floating ground to dangerous potentials during normal operation.

Occasionally varistors are used instead of resistors to rapidly discharge $C_{HV}$, if it is expected that fast transients might charge $C_{HV}$ to high-potentials.

Note that the PE island represents a copper island on the PCB for the provision of a short, thick Earth wire connecting this island to PE ground at the entrance of the power supply unit (PSU).

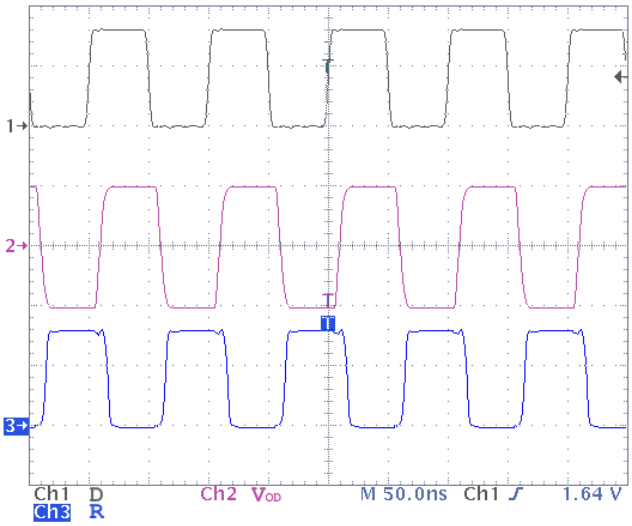
In equipment designs using a chassis, the PE connection is usually provided through the chassis itself. Typically the PE conductor is tied to the chassis at one end while the high-voltage components, $C_{HV}$ and $R_{HV}$, are connecting to the chassis at the other end.

### 10.2.3 Application Curves



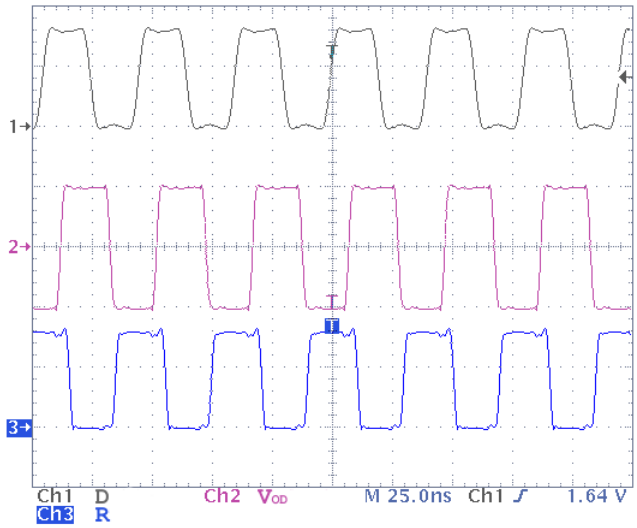

$R_L$ = 60 Ω

**Figure 28. SN65HVD72, 250 kbps**




$R_L$ = 60 Ω

**Figure 29. SN65HVD75, 20 Mbps**




$R_L$ = 60 Ω

**Figure 30. SN65HVD78, 50 Mbps**

## 11 Power Supply Recommendations

To assure reliable operation at all data rates and supply voltages, each supply should be buffered with a 100-nF ceramic capacitor located as close to the supply pins as possible. The TPS76333 is a linear voltage regulator suitable for the 3.3 V supply.

See the SN6501 data sheet for isolated power supply designs.

# 12 Layout

## 12.1 Layout Guidelines

On-chip IEC ESD protection is sufficient for laboratory and portable equipment but often insufficient for EFT and surge transients occurring in industrial environments. Therefore, robust and reliable bus node design requires the use of external transient protection devices.

Because ESD and EFT transients have a wide frequency bandwidth from approximately 3 MHz to 3 GHz, high-frequency layout techniques must be applied during PCB design.

For a successful PCB design, start with the design of the protection circuit in mind.

1. Place the protection circuitry close to the bus connector to prevent noise transients from entering the board.
2. Use $V_{CC}$ and ground planes to provide low-inductance. Note that high-frequency currents follow the path of least inductance and not the path of least impedance.
3. Design the protection components into the direction of the signal path. Do not force the transients currents to divert from the signal path to reach the protection device.
4. Apply 100-nF to 220-nF bypass capacitors as close as possible to the $V_{CC}$ pins of transceiver, UART, and controller ICs on the board.
5. Use at least two vias for $V_{CC}$ and ground connections of bypass capacitors and protection devices to minimize effective via-inductance.
6. Use 1-kΩ to 10-kΩ pullup or pulldown resistors for enable lines to limit noise currents in these lines during transient events.
7. Insert pulse-proof series resistors into the A and B bus lines if the TVS clamping voltage is higher than the specified maximum voltage of the transceiver bus pins. These resistors limit the residual clamping current into the transceiver and prevent it from latching up.
8. While pure TVS protection is sufficient for surge transients up to 1 kV, higher transients require metal-oxide varistors (MOVs) which reduce the transients to a few hundred volts of clamping voltage, and transient blocking units (TBUs) that limit transient current to 200 mA.

## 12.2 Layout Example

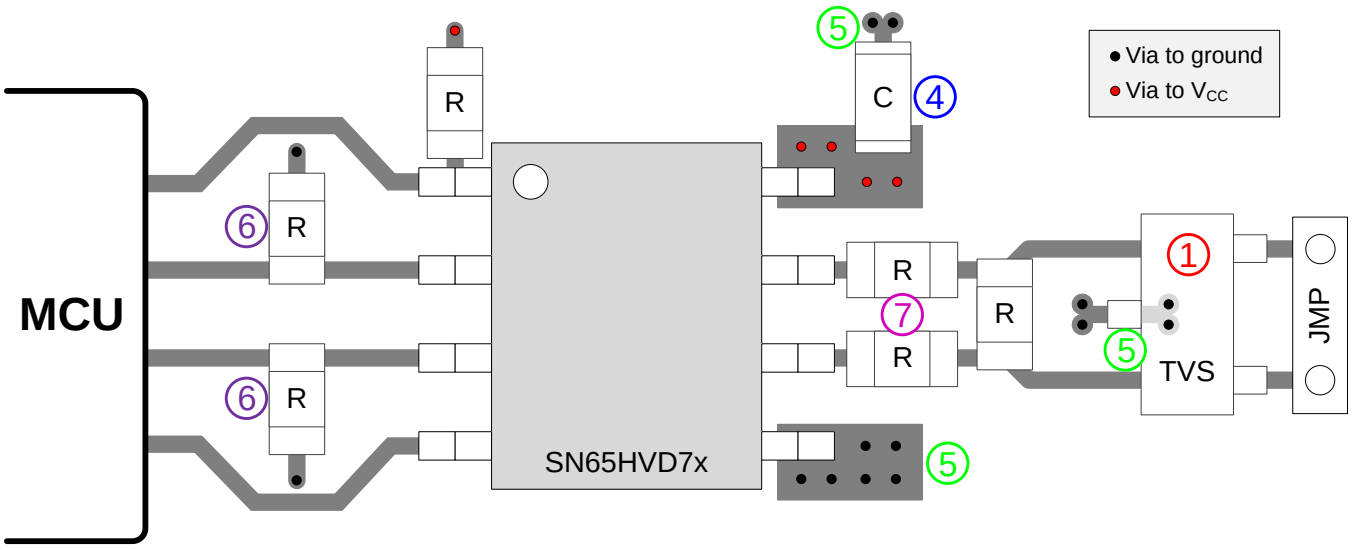



**Figure 31. SN65HVD7x Half-Duplex Layout Example**

# 13 デバイスおよびドキュメントのサポート

## 13.1 デバイス・サポート

### 13.1.1 デベロッパー・ネットワークの製品に関する免責事項

デベロッパー・ネットワークの製品またはサービスに関するTIの出版物は、単独またはTIの製品、サービスと一緒に提供される場合に関係なく、デベロッパー・ネットワークの製品またはサービスの適合性に関する是認、デベロッパー・ネットワークの製品またはサービスの是認の表明を意味するものではありません。

## 13.2 ドキュメントのサポート

### 13.2.1 関連資料

関連資料については、以下を参照してください。

*『SN6501 絶縁電源用の変圧器ドライバ』*、SLLSEA0

## 13.3 関連リンク

次の表に、クイック・アクセス・リンクを示します。カテゴリには、技術資料、サポートおよびコミュニティ・リソース、ツールとソフトウェア、およびサンプル注文またはご購入へのクイック・アクセスが含まれます。

**表 5. 関連リンク**

| 製品 | プロダクト・フォルダ | サンプルとご購入 | 技術資料 | ツールとソフトウェア | サポートとコミュニティ |
|---|---|---|---|---|---|
| SN65HVD72 | ここをクリック | ここをクリック | ここをクリック | ここをクリック | ここをクリック |
| SN65HVD75 | ここをクリック | ここをクリック | ここをクリック | ここをクリック | ここをクリック |
| SN65HVD78 | ここをクリック | ここをクリック | ここをクリック | ここをクリック | ここをクリック |

## 13.4 コミュニティ・リソース

The following links connect to TI community resources. Linked contents are 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.

**TI E2E™ Online Community** ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** ***TI's Design Support*** Quickly find helpful E2E forums along with design support tools and contact information for technical support.

## 13.5 商標

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

## 13.6 静電気放電に関する注意事項

これらのデバイスは、限定的なESD（静電破壊）保護機能を内 蔵しています。保存時または取り扱い時は、MOSゲートに対す る静電破壊を防止するために、リード線同士をショートさせて おくか、デバイスを導電フォームに入れる必要があります。

## 13.7 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

# 14 メカニカル、パッケージ、および注文情報

以降のページには、メカニカル、パッケージ、および注文に関する情報が記載されています。この情報は、そのデバイスについて利用可能な最新のデータです。このデータは予告なく変更されることがあり、ドキュメントが改訂される場合もあります。本データシートのブラウザ版を使用されている場合は、画面左側の説明をご覧ください。

## PACKAGING INFORMATION

| Orderable part number | Status (1) | Material type (2) | Package \| Pins | Package qty \| Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|---|---|---|---|---|---|---|---|---|---|
| SN65HVD72D | Active | Production | SOIC (D) \| 8 | 75 \| TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72D.A | Active | Production | SOIC (D) \| 8 | 75 \| TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72D.B | Active | Production | SOIC (D) \| 8 | 75 \| TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DGK | Active | Production | VSSOP (DGK) \| 8 | 80 \| TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DGK.A | Active | Production | VSSOP (DGK) \| 8 | 80 \| TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DGK.B | Active | Production | VSSOP (DGK) \| 8 | 80 \| TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DGKR | Active | Production | VSSOP (DGK) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU \| NIPDAUAG \| SN | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DGKR.A | Active | Production | VSSOP (DGK) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DGKR.B | Active | Production | VSSOP (DGK) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DR | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DR.A | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DR.B | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DRBR | Active | Production | SON (DRB) \| 8 | 3000 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DRBR.A | Active | Production | SON (DRB) \| 8 | 3000 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DRBR.B | Active | Production | SON (DRB) \| 8 | 3000 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DRBT | Active | Production | SON (DRB) \| 8 | 250 \| SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DRBT.A | Active | Production | SON (DRB) \| 8 | 250 \| SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DRBT.B | Active | Production | SON (DRB) \| 8 | 250 \| SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DRBTG4 | Active | Production | SON (DRB) \| 8 | 250 \| SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DRBTG4.A | Active | Production | SON (DRB) \| 8 | 250 \| SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DRBTG4.B | Active | Production | SON (DRB) \| 8 | 250 \| SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DRG4 | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DRG4.A | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD72DRG4.B | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD72 |
| SN65HVD75D | Active | Production | SOIC (D) \| 8 | 75 \| TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75D.A | Active | Production | SOIC (D) \| 8 | 75 \| TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75D.B | Active | Production | SOIC (D) \| 8 | 75 \| TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DGK | Active | Production | VSSOP (DGK) \| 8 | 80 \| TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HVD75 |

| Orderable part number | Status (1) | Material type (2) | Package \| Pins | Package qty \| Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|---|---|---|---|---|---|---|---|---|---|
| SN65HVD75DGK.A | Active | Production | VSSOP (DGK) \| 8 | 80 \| TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DGK.B | Active | Production | VSSOP (DGK) \| 8 | 80 \| TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DGKR | Active | Production | VSSOP (DGK) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU \| NIPDAUAG \| SN | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DGKR.A | Active | Production | VSSOP (DGK) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DGKR.B | Active | Production | VSSOP (DGK) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DR | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DR.A | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DR.B | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DRBR | Active | Production | SON (DRB) \| 8 | 3000 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DRBR.A | Active | Production | SON (DRB) \| 8 | 3000 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DRBR.B | Active | Production | SON (DRB) \| 8 | 3000 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DRBRG4 | Active | Production | SON (DRB) \| 8 | 3000 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DRBRG4.A | Active | Production | SON (DRB) \| 8 | 3000 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DRBRG4.B | Active | Production | SON (DRB) \| 8 | 3000 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DRBT | Active | Production | SON (DRB) \| 8 | 250 \| SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DRBT.A | Active | Production | SON (DRB) \| 8 | 250 \| SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DRBT.B | Active | Production | SON (DRB) \| 8 | 250 \| SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DRG4 | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DRG4.A | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD75DRG4.B | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD75 |
| SN65HVD78D | Active | Production | SOIC (D) \| 8 | 75 \| TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78D.A | Active | Production | SOIC (D) \| 8 | 75 \| TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78D.B | Active | Production | SOIC (D) \| 8 | 75 \| TUBE | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DGK | Active | Production | VSSOP (DGK) \| 8 | 80 \| TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DGK.A | Active | Production | VSSOP (DGK) \| 8 | 80 \| TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DGK.B | Active | Production | VSSOP (DGK) \| 8 | 80 \| TUBE | Yes | NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DGKR | Active | Production | VSSOP (DGK) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU \| NIPDAUAG | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DGKR.A | Active | Production | VSSOP (DGK) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DGKR.B | Active | Production | VSSOP (DGK) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DR | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |

| Orderable part number | Status (1) | Material type (2) | Package \| Pins | Package qty \| Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|---|---|---|---|---|---|---|---|---|---|
| SN65HVD78DR.A | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DR.B | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DRBR | Active | Production | SON (DRB) \| 8 | 3000 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DRBR.A | Active | Production | SON (DRB) \| 8 | 3000 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DRBR.B | Active | Production | SON (DRB) \| 8 | 3000 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DRBT | Active | Production | SON (DRB) \| 8 | 250 \| SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DRBT.A | Active | Production | SON (DRB) \| 8 | 250 \| SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DRBT.B | Active | Production | SON (DRB) \| 8 | 250 \| SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DRBTG4 | Active | Production | SON (DRB) \| 8 | 250 \| SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DRBTG4.A | Active | Production | SON (DRB) \| 8 | 250 \| SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DRBTG4.B | Active | Production | SON (DRB) \| 8 | 250 \| SMALL T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DRG4 | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DRG4.A | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |
| SN65HVD78DRG4.B | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | HVD78 |

(1) **Status:** For more details on status, see our product life cycle.

(2) **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.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **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.

(5) **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.

(6) **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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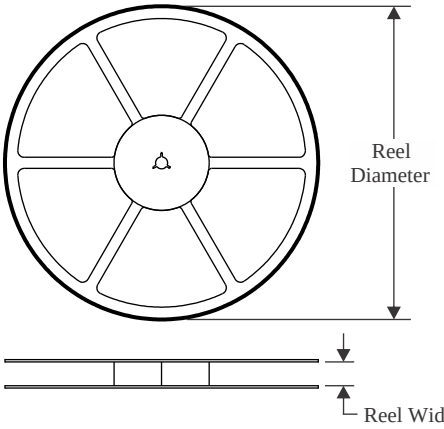
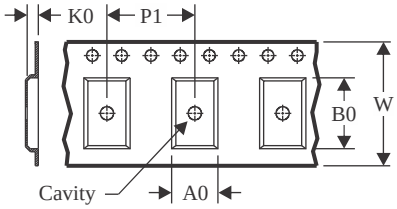
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

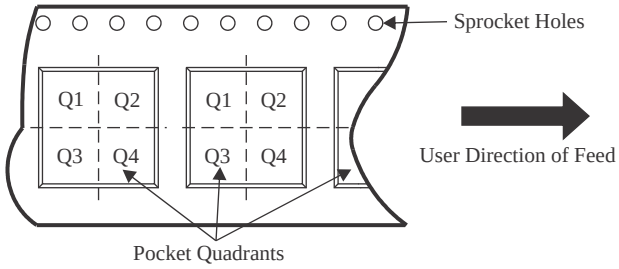



**TAPE DIMENSIONS**




| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**

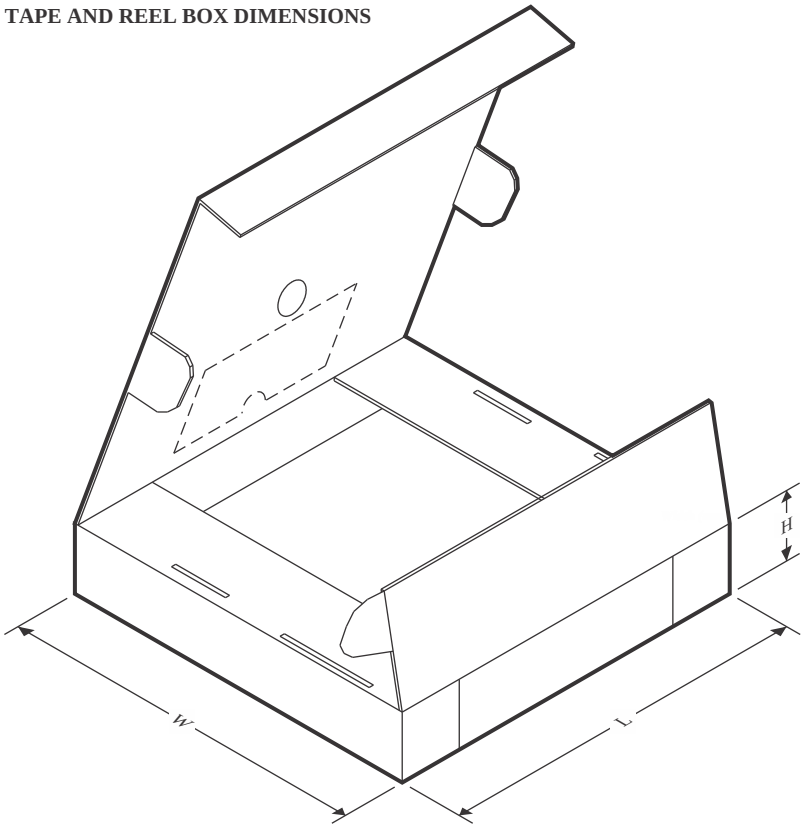



*All dimensions are nominal

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SN65HVD72DGKR | VSSOP | DGK | 8 | 2500 | 330.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| SN65HVD72DR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| SN65HVD72DRBR | SON | DRB | 8 | 3000 | 330.0 | 12.4 | 3.3 | 3.3 | 1.1 | 8.0 | 12.0 | Q2 |
| SN65HVD72DRBT | SON | DRB | 8 | 250 | 180.0 | 12.4 | 3.3 | 3.3 | 1.1 | 8.0 | 12.0 | Q2 |
| SN65HVD72DRBTG4 | SON | DRB | 8 | 250 | 180.0 | 12.4 | 3.3 | 3.3 | 1.1 | 8.0 | 12.0 | Q2 |
| SN65HVD72DRG4 | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| SN65HVD75DGKR | VSSOP | DGK | 8 | 2500 | 330.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| SN65HVD75DR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| SN65HVD75DRBR | SON | DRB | 8 | 3000 | 330.0 | 12.4 | 3.3 | 3.3 | 1.1 | 8.0 | 12.0 | Q2 |
| SN65HVD75DRBRG4 | SON | DRB | 8 | 3000 | 330.0 | 12.4 | 3.3 | 3.3 | 1.1 | 8.0 | 12.0 | Q2 |
| SN65HVD75DRBT | SON | DRB | 8 | 250 | 180.0 | 12.4 | 3.3 | 3.3 | 1.1 | 8.0 | 12.0 | Q2 |
| SN65HVD75DRG4 | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| SN65HVD78DGKR | VSSOP | DGK | 8 | 2500 | 330.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| SN65HVD78DR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| SN65HVD78DRBR | SON | DRB | 8 | 3000 | 330.0 | 12.4 | 3.3 | 3.3 | 1.1 | 8.0 | 12.0 | Q2 |
| SN65HVD78DRBT | SON | DRB | 8 | 250 | 180.0 | 12.4 | 3.3 | 3.3 | 1.1 | 8.0 | 12.0 | Q2 |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SN65HVD78DRBTG4 | SON | DRB | 8 | 250 | 180.0 | 12.4 | 3.3 | 3.3 | 1.1 | 8.0 | 12.0 | Q2 |
| SN65HVD78DRG4 | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |

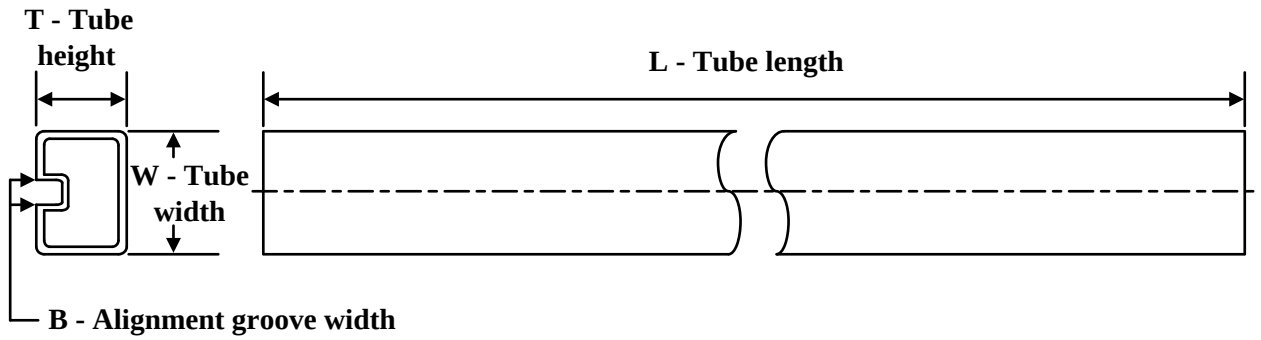
TAPE AND REEL BOX DIMENSIONS




*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| SN65HVD72DGKR | VSSOP | DGK | 8 | 2500 | 353.0 | 353.0 | 32.0 |
| SN65HVD72DR | SOIC | D | 8 | 2500 | 353.0 | 353.0 | 32.0 |
| SN65HVD72DRBR | SON | DRB | 8 | 3000 | 346.0 | 346.0 | 33.0 |
| SN65HVD72DRBT | SON | DRB | 8 | 250 | 210.0 | 185.0 | 35.0 |
| SN65HVD72DRBTG4 | SON | DRB | 8 | 250 | 210.0 | 185.0 | 35.0 |
| SN65HVD72DRG4 | SOIC | D | 8 | 2500 | 353.0 | 353.0 | 32.0 |
| SN65HVD75DGKR | VSSOP | DGK | 8 | 2500 | 353.0 | 353.0 | 32.0 |
| SN65HVD75DR | SOIC | D | 8 | 2500 | 353.0 | 353.0 | 32.0 |
| SN65HVD75DRBR | SON | DRB | 8 | 3000 | 346.0 | 346.0 | 33.0 |
| SN65HVD75DRBRG4 | SON | DRB | 8 | 3000 | 346.0 | 346.0 | 33.0 |
| SN65HVD75DRBT | SON | DRB | 8 | 250 | 182.0 | 182.0 | 20.0 |
| SN65HVD75DRG4 | SOIC | D | 8 | 2500 | 353.0 | 353.0 | 32.0 |
| SN65HVD78DGKR | VSSOP | DGK | 8 | 2500 | 353.0 | 353.0 | 32.0 |
| SN65HVD78DR | SOIC | D | 8 | 2500 | 353.0 | 353.0 | 32.0 |
| SN65HVD78DRBR | SON | DRB | 8 | 3000 | 346.0 | 346.0 | 33.0 |
| SN65HVD78DRBT | SON | DRB | 8 | 250 | 210.0 | 185.0 | 35.0 |
| SN65HVD78DRBTG4 | SON | DRB | 8 | 250 | 210.0 | 185.0 | 35.0 |
| SN65HVD78DRG4 | SOIC | D | 8 | 2500 | 353.0 | 353.0 | 32.0 |

## TUBE




*All dimensions are nominal

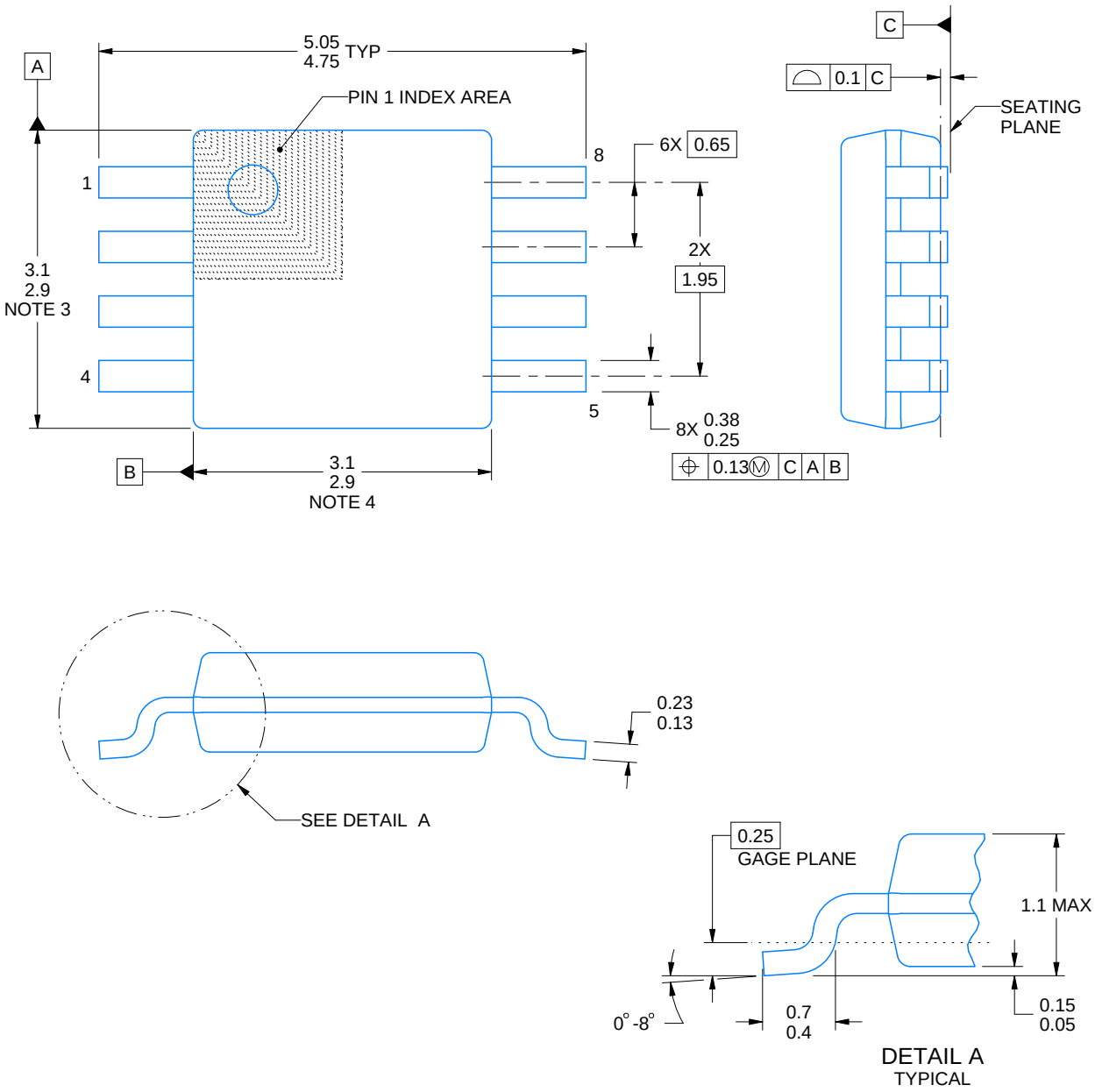
| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (µm) | B (mm) |
|---|---|---|---|---|---|---|---|---|
| SN65HVD72D | D | SOIC | 8 | 75 | 506.6 | 8 | 3940 | 4.32 |
| SN65HVD72D.A | D | SOIC | 8 | 75 | 506.6 | 8 | 3940 | 4.32 |
| SN65HVD72D.B | D | SOIC | 8 | 75 | 506.6 | 8 | 3940 | 4.32 |
| SN65HVD72DGK | DGK | VSSOP | 8 | 80 | 330 | 6.55 | 500 | 2.88 |
| SN65HVD72DGK.A | DGK | VSSOP | 8 | 80 | 330 | 6.55 | 500 | 2.88 |
| SN65HVD72DGK.B | DGK | VSSOP | 8 | 80 | 330 | 6.55 | 500 | 2.88 |
| SN65HVD75D | D | SOIC | 8 | 75 | 506.6 | 8 | 3940 | 4.32 |
| SN65HVD75D.A | D | SOIC | 8 | 75 | 506.6 | 8 | 3940 | 4.32 |
| SN65HVD75D.B | D | SOIC | 8 | 75 | 506.6 | 8 | 3940 | 4.32 |
| SN65HVD75DGK | DGK | VSSOP | 8 | 80 | 330 | 6.55 | 500 | 2.88 |
| SN65HVD75DGK.A | DGK | VSSOP | 8 | 80 | 330 | 6.55 | 500 | 2.88 |
| SN65HVD75DGK.B | DGK | VSSOP | 8 | 80 | 330 | 6.55 | 500 | 2.88 |
| SN65HVD78D | D | SOIC | 8 | 75 | 506.6 | 8 | 3940 | 4.32 |
| SN65HVD78D.A | D | SOIC | 8 | 75 | 506.6 | 8 | 3940 | 4.32 |
| SN65HVD78D.B | D | SOIC | 8 | 75 | 506.6 | 8 | 3940 | 4.32 |
| SN65HVD78DGK | DGK | VSSOP | 8 | 80 | 330 | 6.55 | 500 | 2.88 |
| SN65HVD78DGK.A | DGK | VSSOP | 8 | 80 | 330 | 6.55 | 500 | 2.88 |
| SN65HVD78DGK.B | DGK | VSSOP | 8 | 80 | 330 | 6.55 | 500 | 2.88 |

# PACKAGE OUTLINE

## DGK0008A

## VSSOP - 1.1 mm max height

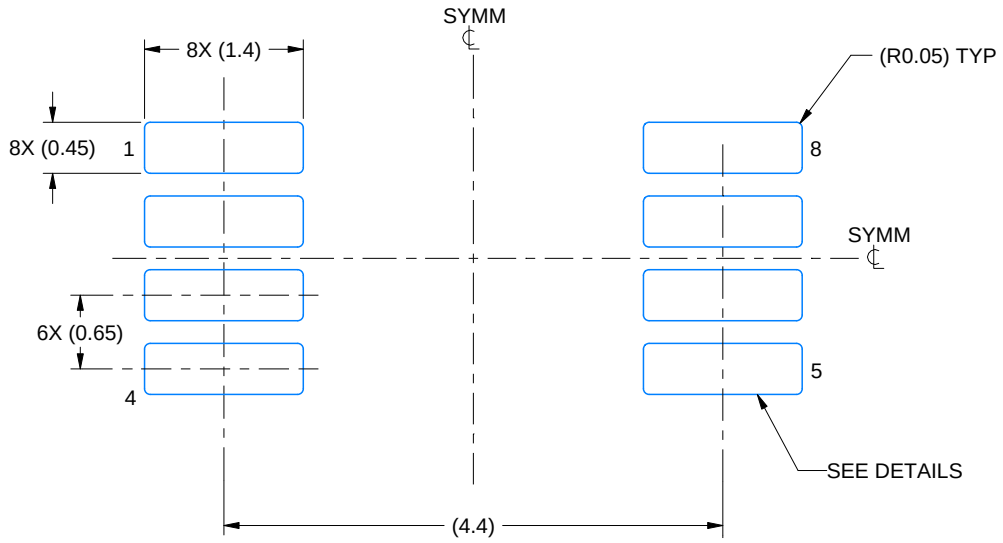
SMALL OUTLINE PACKAGE



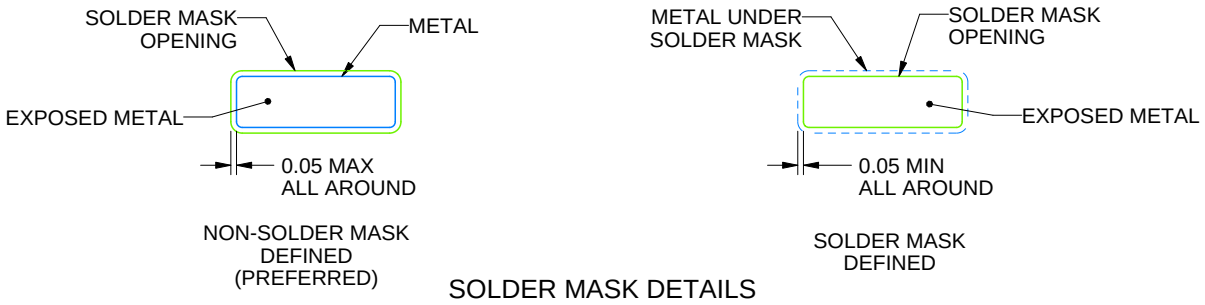

PowerPAD is a trademark of Texas Instruments.

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-187.




LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X

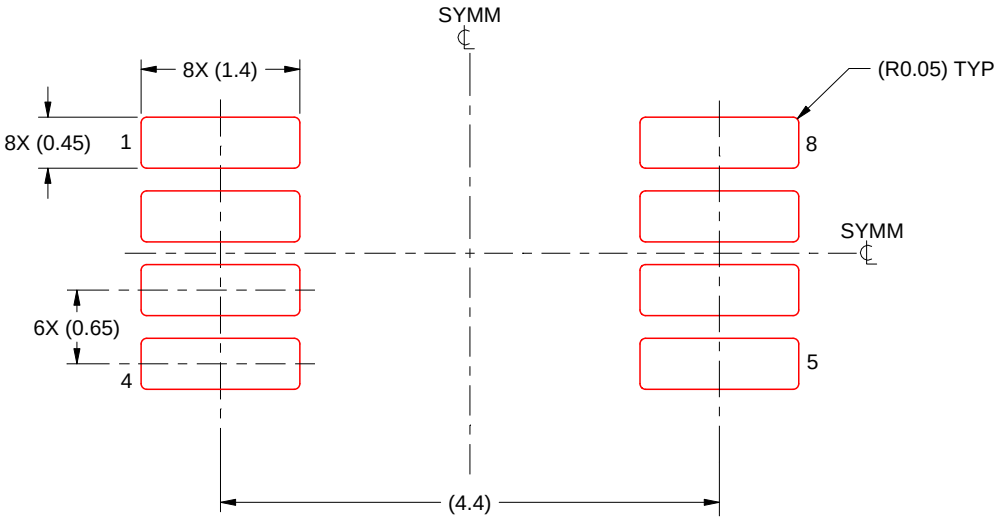



SOLDER MASK DETAILS

4214862/A 04/2023

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.
8. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.
9. Size of metal pad may vary due to creepage requirement.




SOLDER PASTE EXAMPLE
SCALE: 15X

4214862/A 04/2023

NOTES: (continued)

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

## GENERIC PACKAGE VIEW

# DRB 8

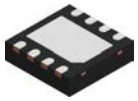
# VSON - 1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD


Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

4203482/L

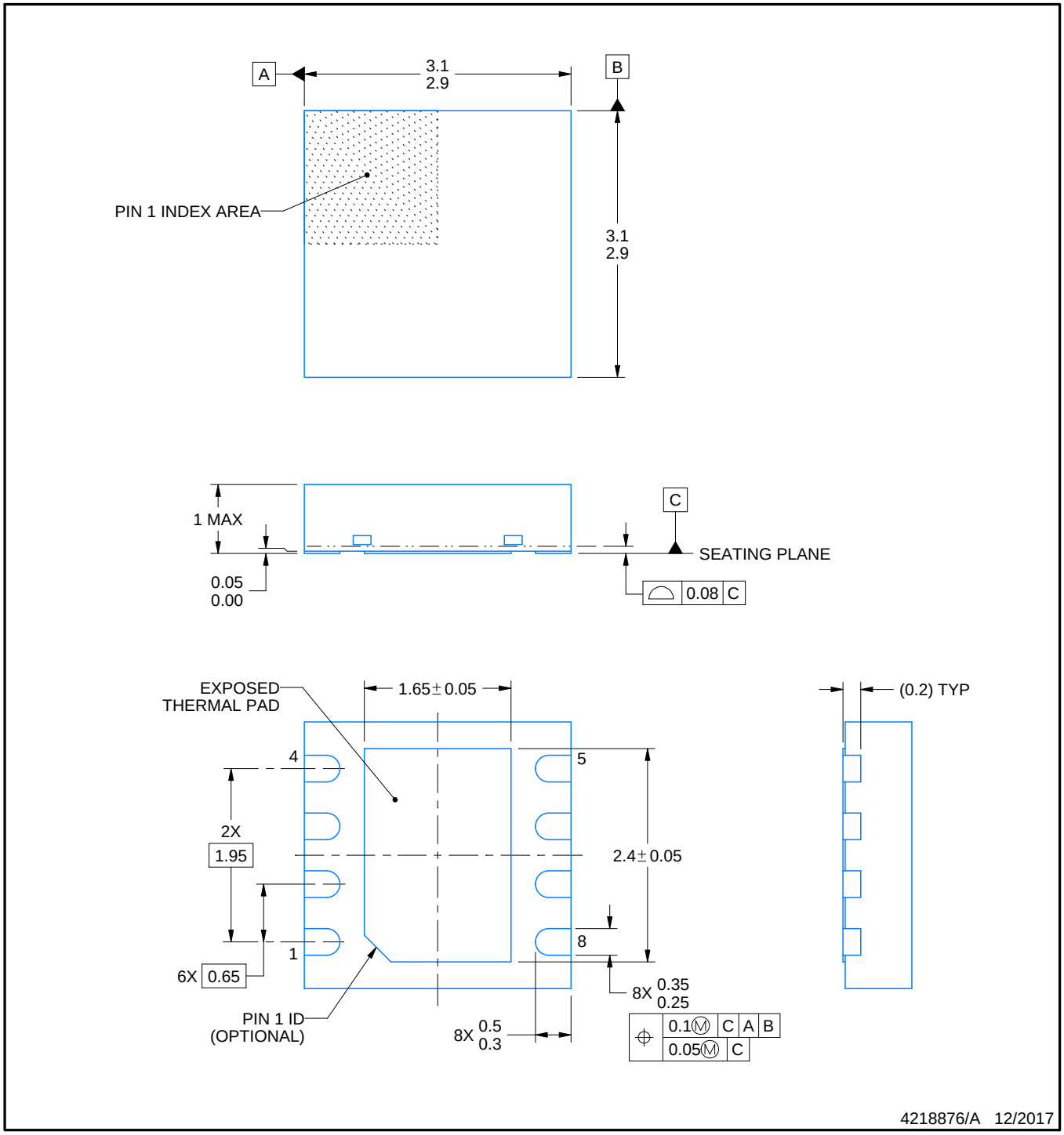
# DRB0008B



# PACKAGE OUTLINE

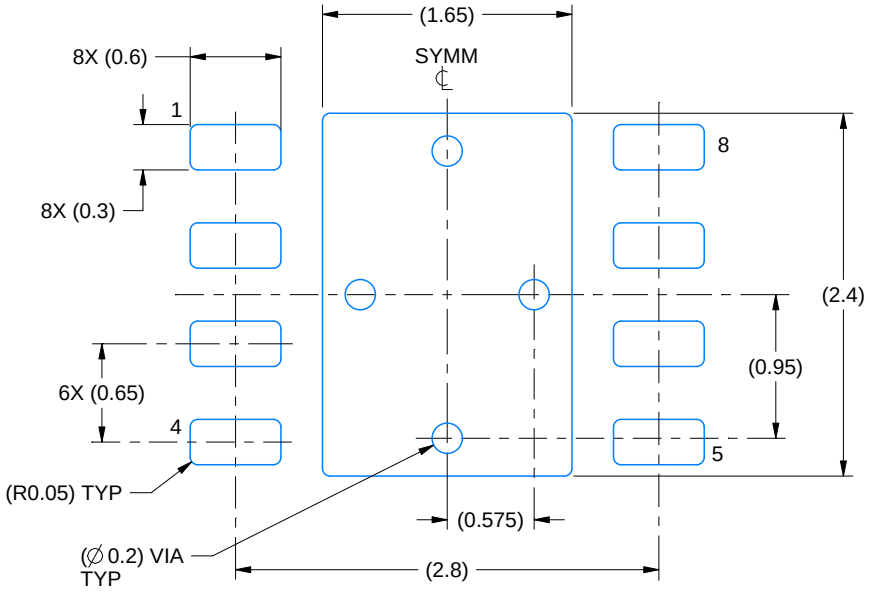
## VSON - 1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD

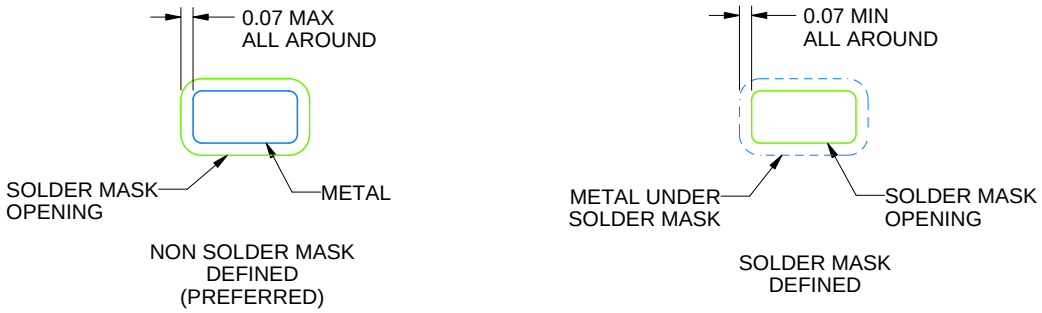



NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.




LAND PATTERN EXAMPLE
SCALE:20X

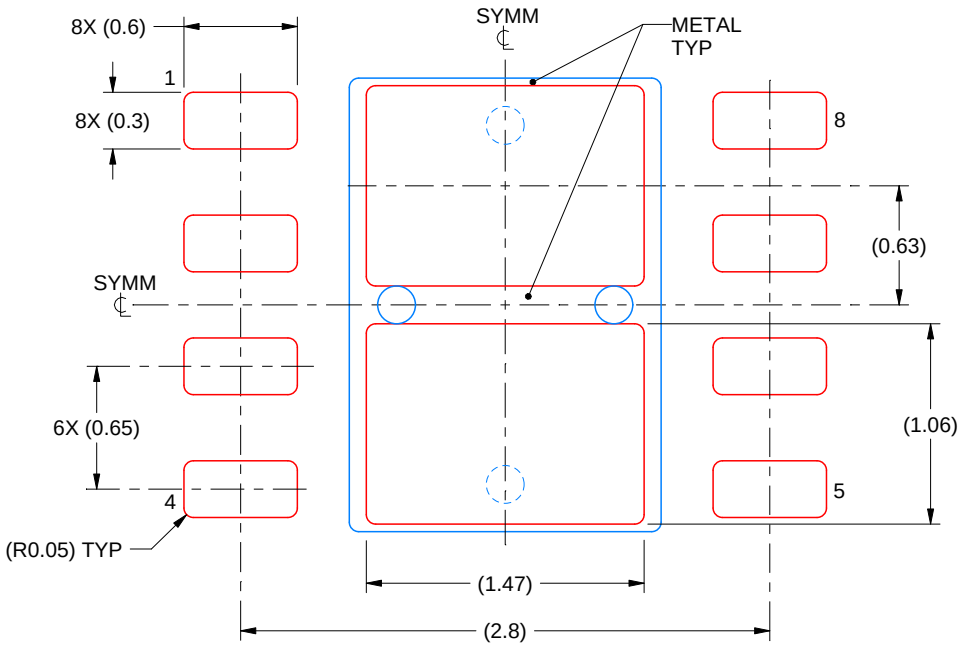



SOLDER MASK DETAILS

4218876/A 12/2017

NOTES: (continued)

4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.



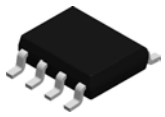

SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD
81% PRINTED SOLDER COVERAGE BY AREA
SCALE:25X

4218876/A 12/2017

NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

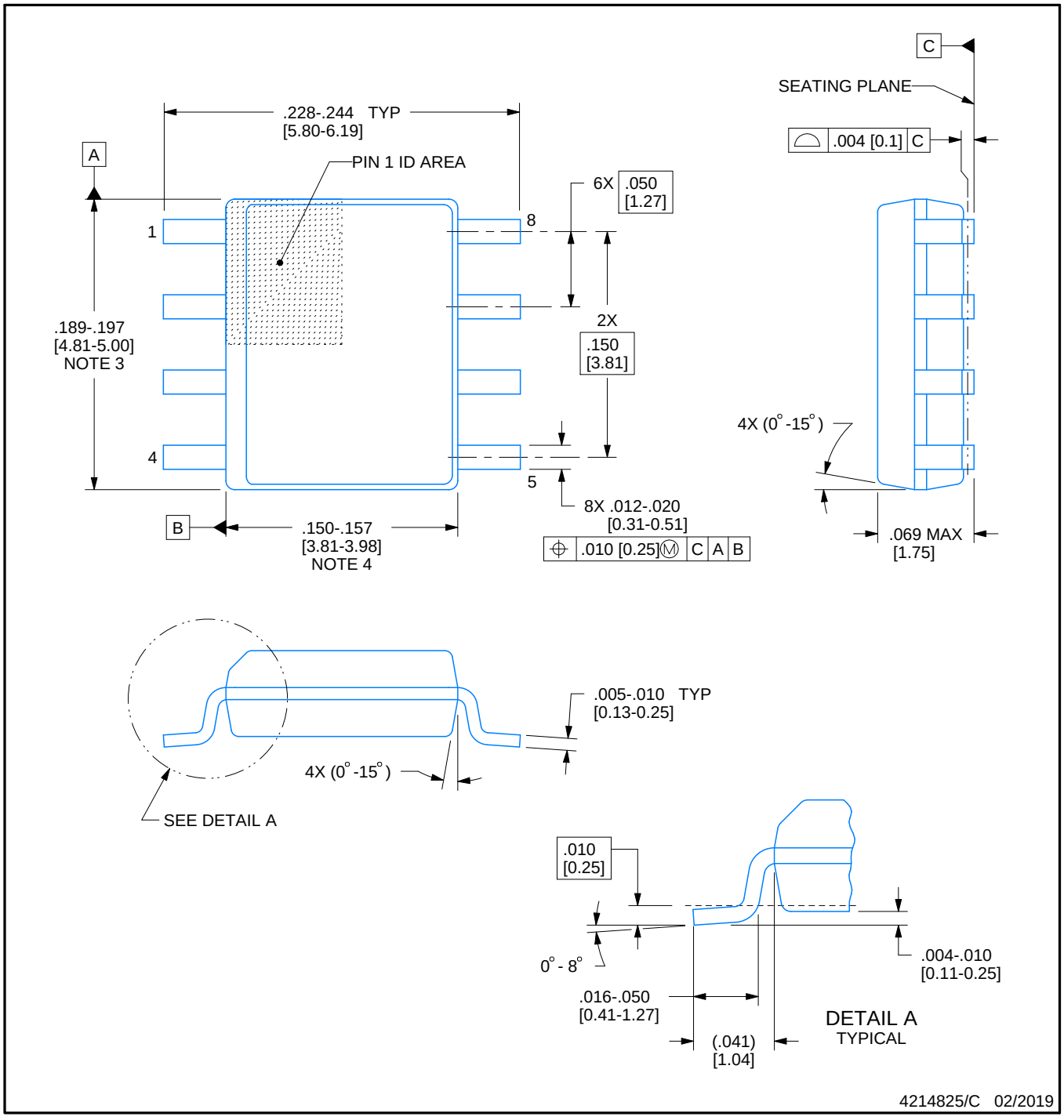


# PACKAGE OUTLINE

## D0008A

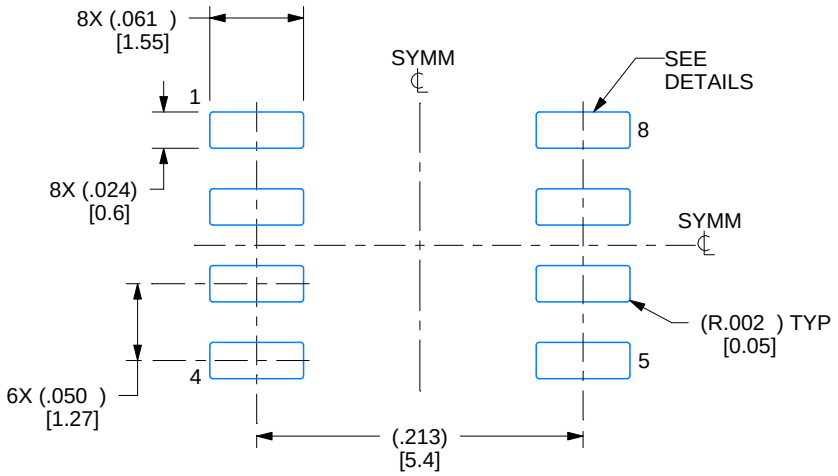
## SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

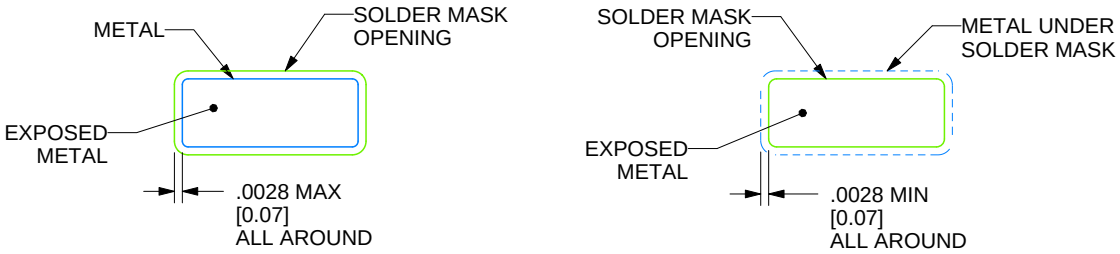



NOTES:

1. 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.
2. This drawing is subject to change without notice.
3. 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.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.




LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X




SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

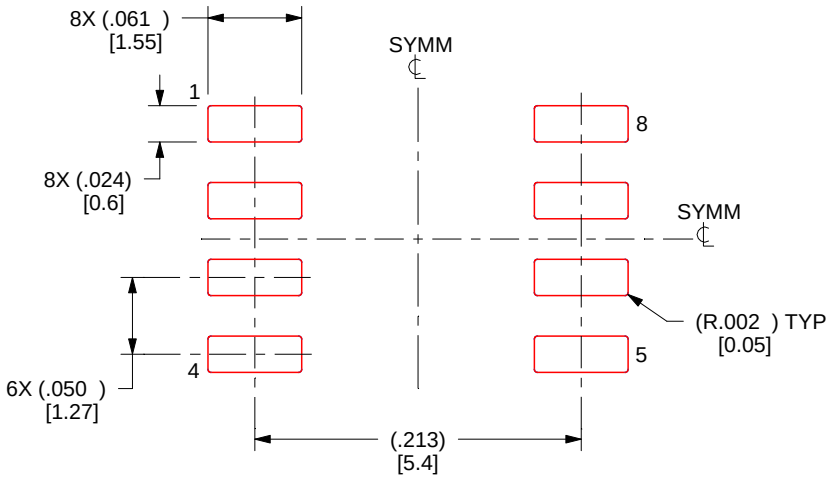
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

## D0008A

## SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT




SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

4214825/C 02/2019

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.

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最終更新日：2025 年 10 月