

钍地半导体
Tudi Semiconductor

# Product Specification

## TUDI- SN65HVD1781-Q1

RS-485 transceiver with fail-safe function and 3.3V to 5V operating voltage

网址 www.sztdbdt.com

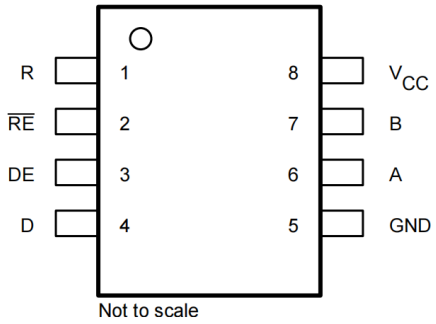
**用芯智造·卓越品质**

**semiconductor device manufacturer**

- Design
- research and development
- production
- and sales

## Features

●Complies with automotive application requirements
●Features the following AEC-Q100 compliant characteristics
– Device temperature grade 1: – 40°C to 125°C ambient operating temperature range – Device HBM ESD classification grade H2
– Device CDM ESG classification grade C3B? Bus pin fault protection:
– > ±70V ('HVD1780-Q1, 'HVD1781-Q1)
- > ±30V ('HVD1782-Q1)
● Operating supply voltage range is 3.3V to 5V
● ±16 HBM protection provided on bus pins
● Reduces unit load by up to 320 nodes
●Fail-safe receiver for open, short, and idle bus conditions
● Low power consumption
– Low standby supply current (maximum 1μA)
– $I_{CC}$ static current during operation is 4mA
●Pin compatible with industry-standard SN5176
●Signal transmission rates of 115kbps, 1Mbps, and up to 10Mbps




D Package, 8-Pin SOIC
(Top View)

## Application

● Automotive data link

## Description

These devices are protected from damage when encountering overvoltage faults (such as power supply direct short, miswiring faults, connector faults cable crushing, and tool misuse) . They also feature advanced human body model protection specifications, remaining stable during electrostatic discharge (ESD) events.
These devices combine a differential driver and a receiver, both powered by a single supply. In the HVD1782, the driver differential output and receiver differential input are internally connected to form a bus port suitable for-duplex (two-wire bus) communication.

This port has a wide common-mode voltage range, making these devices suitable for multi-point applications on long cables. devices have a rated operating temperature range of -40°C to 125°C. These devices are pin-compatible with the industry-standard SN7516 transceiver, making them suitable for use as drop-in upgrade replacements in most systems.

These devices use a 5V supply, are fully compliant with the ANSI TIAEIA 485A standard, and can operate with a 3.3V supply while reducing the driver output voltage to suit low-power applications. For applications requiring over an extended common-mode voltage range, please refer to the SN65HVD1785 (SLLS872) datasheet.

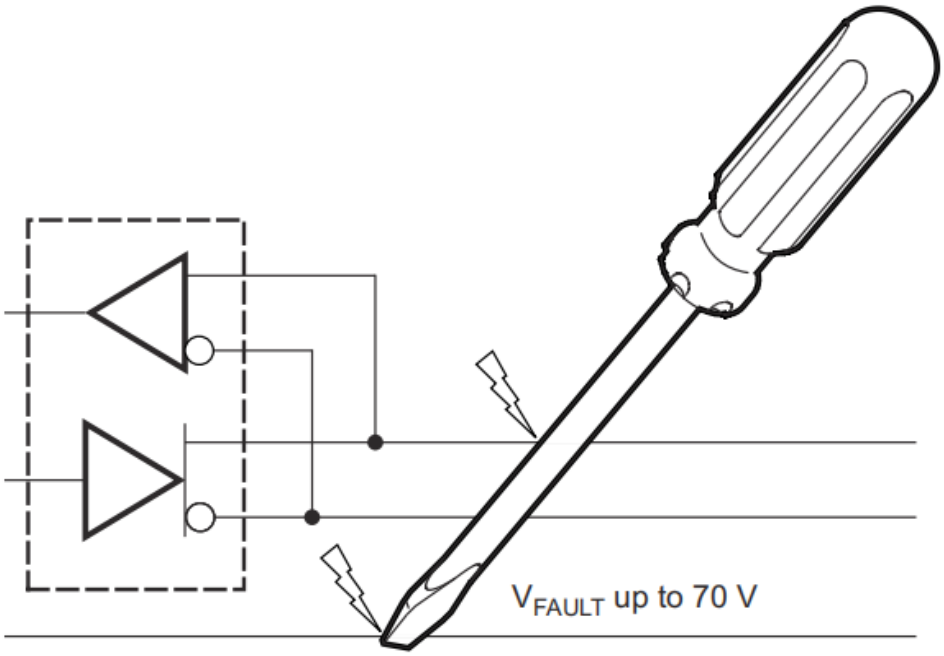


表 **4-1. Pin Functions**

| PIN | | TYPE | DESCRIPTION |
|---|---|---|---|
| NAME | NO | | |
| 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 | Driver enable, active high |
| GND | 5 | Reference potential | Local device ground |
| R | 1 | Digital output | Receive data output |
| $\overline{RE}$ | 2 | Digital input | Receiver enable, active low |
| $V_{CC}$ | 8 | Supply | 3.15V to 5.5V supply |

# 5 Specifications

## 5.1 Absolute Maximum Ratings

See Note (1).

| | | | | MIN | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{CC}$ | Supply voltage | | | - 0.5 | 7 | V |
| | Voltage range at bus pins | 'HVD1780-Q1, 'HVD1781-Q1 | A, B pins | - 70 | 70 | V |
| | | 'HVD1782-Q1 | A, B pins | - 70 | 30 | |
| | Input voltage range at any logic pin | | | - 0.3 | $V_{CC}$ + 0.3 | V |
| | Transient overvoltage pulse through 100 Ω per TIA-485 | | | - 70 | 70 | V |
| | Receiver output current | | | - 24 | 24 | mA |
| | Continuous total power dissipation | | | See *Power Dissipation Ratings* | | |
| $T_J$ | Junction temperature | | | | 170 | °C |
| $T_{stg}$ | Storage temperature | | | - 55 | 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.

## 5.2 ESD Ratings—AEC

| | | | | VALUE | UNIT |
|---|---|---|---|---|---|
| $V_{(ESD)}$ | Electrostatic discharge | Human-body model (HBM), per AEC Q100-002(1) | Bus terminals and GND | ±16000 | V |
| | | | All pins | ±4000 | |
| | | Charged-device model (CDM), per AEC Q100-011 | | ±2000 | |
| | | Machine Model (MM), AEC-Q100-003 | | ±400 | |

(1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

## 5.3 ESD Ratings—IEC

| | | | | VALUE | UNIT |
|---|---|---|---|---|---|
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per IEC 60749-26 | Bus terminals and GND | ±16000 | V |

## 5.4 Recommended Operating Conditions

| | | | MIN | NOM | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{CC}$ | Supply voltage | | 3.15 | 5 | 5.5 | V |
| $V_I$ | Input voltage at any bus terminal (separately or common mode)(1) | | −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 |
| | 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 | SN65HVD1780-Q1 | | | 0.115 | Mbps |
| | | SN65HVD1781-Q1 | | | 1 | |
| | | SN65HVD1782-Q1 | | | 10 | |
| $T_A$ | Operating free-air temperature (See the *Thermal Information* table) | 5V supply | −40 | | 105 | °C |
| | | 3.3V supply | −40 | | 125 | |

## 5.4 Recommended Operating Conditions（续）

| | | MIN | NOM | MAX | UNIT |
|---|---|---|---|---|---|
| $T_J$ | Junction Temperature | －40 | | 150 | °C |

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

## 5.5 Thermal Information

| THERMAL METRIC(1) | | SN65HVD1780-Q1 SN65HVD1781-Q1 SN65HVD1782-Q1 D (SOIC) 8 PINS | UNIT |
|---|---|---|---|
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance (JEDEC high-K model) | 138 | °C/W |
| | Junction-to-ambient thermal resistance (JEDIC low-K model) | 242 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 61 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 62 | °C/W |
| $\psi_{JT}$ | Junction-to-top characterization parameter | 3.8 | °C/W |
| $\psi_{JB}$ | Junction-to-board characterization parameter | 38.6 | °C/W |
| $R_{\theta JC(bot)}$ | Junction-to-case (bottom) thermal resistance | N/A | °C/W |

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, SPRA953.

## 5.6 Electrical Characteristics

over recommended operating conditions (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $\|V_{OD}\|$ | Driver differential output voltage magnitude | $R_L$ = 60 Ω, 4.75 V ≤ $V_{CC}$ 375 Ω on each output to －7 V to 12 V, See 图 6-1 | $T_A$ < 85°C | 1.5 | | | V |
| | | | $T_A$ < 125°C | 1.4 | | | |
| | | $R_L$ = 54 Ω, 4.75 V ≤ $V_{CC}$ ≤ 5.25 V | $T_A$ < 85°C | 1.7 | 2 | | |
| | | | $T_A$ < 125°C | 1.5 | | | |
| | | $R_L$ = 54 Ω, 3.15 V ≤ $V_{CC}$ ≤ 3.45 V | | 0.8 | 1 | | |
| | | $R_L$ = 100 Ω, 4.75 V ≤ $V_{CC}$ ≤ 5.25 V | $T_A$ < 85°C | 2.2 | 2.5 | | |
| | | | $T_A$ < 125°C | 2 | | | |
| $\Delta\|V_{OD}\|$ | Change in magnitude of driver differential output voltage | $R_L$ = 54 Ω | | －50 | 0 | 50 | mV |
| $V_{OC(SS)}$ | Steady-state common-mode output voltage | | | 1 | $V_{CC}$/2 | 3 | V |
| $\Delta V_{OC}$ | Change in differential driver output common-mode voltage | | | －50 | 0 | 50 | mV |
| $V_{OC(PP)}$ | Peak-to-peak driver common-mode output voltage | Center of two 27-Ω load resistors, See 图 6-2 | | | 500 | | mV |
| $C_{OD}$ | Differential output capacitance | | | | 23 | | pF |
| $V_{IT+}$ | Positive-going receiver differential input voltage threshold | | | | －100 | －35 | mV |
| $V_{IT-}$ | Negative-going receiver differential input voltage threshold | | | －180 | －150 | | mV |
| $V_{HYS}$ | Receiver differential input voltage threshold hysteresis ($V_{IT+}$ － $V_{IT-}$)(1) | | | 30 | 50 | | 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 | $T_A$ < 85°C | | 0.2 | 0.4 | V |
| | | | $T_A$ < 125°C | | | 0.5 | |
| $I_{I(LOGIC)}$ | Driver input, driver enable, and receiver enable input current | | | －50 | | 50 | μA |

## 5.6 Electrical Characteristics（续）

over recommended operating conditions (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $I_{OZ}$ | 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 | | | | -200 | | 200 | mA |
| $I_{I(BUS)}$ | Bus input current (disabled driver) | $V_{CC}$ = 3.15 to 5.5 V or $V_{CC}$ = 0 V, DE at 0 V | $V_I$ = 12 V | HVD1780-Q1, HVD1781-Q1 | | 75 | 100 | μA |
| | | | | HVD1782-Q1 | | 400 | 500 | |
| | | | $V_I$ = -7 V | HVD1780-Q1, HVD1781-Q1 | -60 | -40 | | |
| | | | | HVD1782-Q1 | -400 | -300 | | |
| $I_{CC}$ | Supply current (quiescent) | Driver and receiver enabled | DE = $V_{CC}$, RE = GND, no load | | | 4 | 6 | mA |
| | | Driver enabled, receiver disabled | DE = $V_{CC}$, RE = $V_{CC}$, no load | | | 3 | 5 | |
| | | Driver disabled, receiver enabled | DE = GND, RE = GND, no load | | | 2 | 4 | |
| | | Driver and receiver disabled, standby mode | DE = GND, D = open, RE = $V_{CC}$, no load, $T_A$ < 85°C | | | 0.15 | 1 | μA |
| | | | DE = GND, D = open, RE = $V_{CC}$, no load, $T_A$ < 125°C | | | | 12 | |
| | Supply current (dynamic) | See the *Typical Characteristics* section | | | | | | |

(1) Specified by design. Not production tested.

## 5.7 Power Dissipation Ratings

| PARAMETER | | TEST CONDITIONS | VALUE | UNIT |
|---|---|---|---|---|
| $P_D$ | Power dissipation | $V_{CC}$ = 3.6 V, $T_J$ = 150°C, $R_L$ = 300 Ω, $C_L$ = 50 pF (driver), $C_L$ = 15 pF (receiver) 3.3-V supply, unterminated(1) | 75 | mW |
| | | $V_{CC}$ = 3.6 V, $T_J$ = 150°C, $R_L$ = 100 Ω, $C_L$ = 50 pF (driver), $C_L$ = 15 pF (receiver) 3.3-V supply, RS-422 load(1) | 95 | |
| | | $V_{CC}$ = 3.6 V, $T_J$ = 150°C, $R_L$ = 54 Ω, $C_L$ = 50 pF (driver), $C_L$ = 15 pF (receiver) 3.3-V supply, RS-485 load(1) | 115 | |
| | | $V_{CC}$ = 5.5 V, $T_J$ = 150°C, $R_L$ = 300 Ω, $C_L$ = 50 pF (driver), $C_L$ = 15 pF (receiver) 5-V supply, unterminated(1) | 290 | |
| | | $V_{CC}$ = 5.5 V, $T_J$ = 150°C, $R_L$ = 100 Ω, $C_L$ = 50 pF (driver), $C_L$ = 15 pF (receiver) 5-V supply, RS-422 load(1) | 320 | |
| | | $V_{CC}$ = 5.5 V, $T_J$ = 150°C, $R_L$ = 54 Ω, $C_L$ = 50 pF (driver), $C_L$ = 15 pF (receiver) 5-V supply, RS-485 load(1) | 400 | |
| $T_{SD}$ | Thermal-shutdown junction temperature | | 170 | °C |

(1) Driver and receiver enabled, 50% duty cycle square-wave signal at signaling rate: 1 Mbps.

## 5.8 Switching Characteristics

over recommended operating conditions (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| **DRIVER (SN65HVD1780)** | | | | | | | |
| $t_r$, $t_f$ | Driver differential output rise/fall time | $R_L$ = 54 Ω, $C_L$ = 50 pF, See 图 6-3 | 3.15 V < $V_{CC}$ < 3.45 V | 0.4 | 1.4 | 1.8 | μs |
| | | | 3.15 V < $V_{CC}$ < 5.5 V | 0.4 | 1.7 | 2.6 | μs |
| $t_{PHL}$, $t_{PLH}$ | Driver propagation delay | $R_L$ = 54 Ω, $C_L$ = 50 pF, See 图 6-3 | | | 0.8 | 2 | μs |
| $t_{SK(P)}$ | Driver differential output pulse skew, $\|t_{PHL} - t_{PLH}\|$ | $R_L$ = 54 Ω, $C_L$ = 50 pF, See 图 6-3 | | | 20 | 250 | ns |
| $t_{PHZ}$, $t_{PLZ}$ | Driver disable time | See 图 6-4 and 图 6-5 | | | 0.1 | 5 | μs |
| $t_{PZH}$, $t_{PZL}$ | Driver enable time | Receiver enabled | See 图 6-4 and 图 6-5 | | 0.2 | 3 | μs |
| | | Receiver disabled | | | 3 | 12 | |
| **DRIVER (SN65HVD1781)** | | | | | | | |
| $t_r$, $t_f$ | Driver differential output rise/fall time | $R_L$ = 54 Ω, $C_L$ = 50 pF, See 图 6-3 | | 50 | | 300 | ns |
| $t_{PHL}$, $t_{PLH}$ | Driver propagation delay | $R_L$ = 54 Ω, $C_L$ = 50 pF, See 图 6-3 | | | | 200 | ns |
| $t_{SK(P)}$ | Driver differential output pulse skew, $\|t_{PHL} - t_{PLH}\|$ | $R_L$ = 54 Ω, $C_L$ = 50 pF, See 图 6-3 | | | | 25 | ns |
| $t_{PHZ}$, $t_{PLZ}$ | Driver disable time | See 图 6-4 and 图 6-5 | | | | 3 | μs |
| $t_{PZH}$, $t_{PZL}$ | Driver enable time | Receiver enabled | See 图 6-4 and 图 6-5 | | | 300 | ns |
| | | Receiver disabled | | | | 10 | μs |
| **DRIVER (SN65HVD1782)** | | | | | | | |
| $t_r$, $t_f$ | Driver differential output rise/fall time | $R_L$ = 54 Ω, $C_L$ = 50 pF | All $V_{CC}$ and Temp | | | 50 | ns |
| | | | $V_{CC}$ > 4.5V and T < 105°C | | 16 | | |
| $t_{PHL}$, $t_{PLH}$ | Driver propagation delay | $R_L$ = 54 Ω, $C_L$ = 50 pF, See 图 6-3 | | | | 55 | ns |
| $t_{SK(P)}$ | Driver differential output pulse skew, $\|t_{PHL} - t_{PLH}\|$ | $R_L$ = 54 Ω, $C_L$ = 50 pF, See 图 6-3 | | | | 10 | ns |
| $t_{PHZ}$, $t_{PLZ}$ | Driver disable time | See 图 6-4 and 图 6-5 | | | | 3 | μs |
| $t_{PZH}$, $t_{PZL}$ | Driver enable time | Receiver enabled | See 图 6-4 and 图 6-5 | | | 300 | ns |
| | | Receiver disabled | | | | 9 | μs |
| **RECEIVER (ALL DEVICES UNLESS OTHERWISE NOTED)** | | | | | | | |
| $t_r$, $t_f$ | Receiver output rise/fall time (1) | $C_L$ = 15 pF, See 图 6-6 | All devices | | 4 | 15 | ns |
| $t_{PHL}$, $t_{PLH}$ | Receiver propagation delay time | $C_L$ = 15 pF, See 图 6-6 | HVD1780-Q1, HVD1781-Q1 | | 100 | 200 | ns |
| | | | HVD1782-Q1 | | | 80 | |
| $t_{SK(P)}$ | Receiver output pulse skew, $\|t_{PHL} - t_{PLH}\|$ | $C_L$ = 15 pF, See 图 6-6 | HVD1780-Q1, HVD1781-Q1 | | 6 | 20 | ns |
| | | | HVD1782-Q1 | | | 5 | |
| $t_{PLZ}$, $t_{PHZ}$ | Receiver disable time (1) | Driver enabled, See 图 6-7 | | | 15 | 100 | ns |
| $t_{PZL(1)}$, $t_{PZH(1)}$ $t_{PZL(2)}$, $t_{PZH(2)}$ | Receiver enable time | Driver enabled, See 图 6-7 | | | 80 | 300 | ns |
| | | Driver disabled, See 图 6-8 | | | 3 | 9 | μs |

(1) Specified by design. Not production tested.

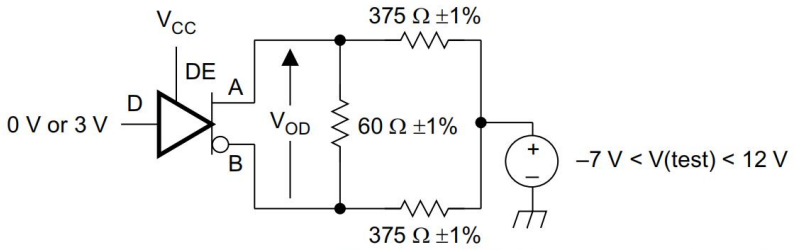
## 5.9 Package Dissipation Ratings

| PACKAGE(1) | JEDEC THERMAL MODEL | $T_A$ < 25°C RATING | DERATING FACTOR ABOVE $T_A$ = 25°C | $T_A$ = 85°C RATING | $T_A$ = 105°C RATING | $T_A$ = 125°C RATING (3.3 V ONLY) |
|---|---|---|---|---|---|---|
| SOIC (D) 8-pin | High-K | 905 mW | 7.25 mW/°C | 470 mW | 325 mW | 180 mW |
| | Low-K | 516 mW | 4.1 mW/°C | 268 mW | 186 mW | 103 mW |

(1) For the most current package and ordering information, see the *Mechanical, Packaging, and Orderable Information* section, or see the TI website at www.ti.com.

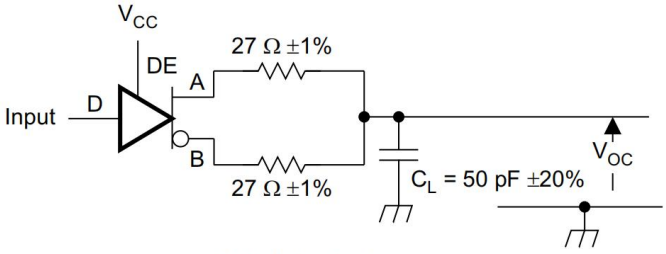
## 6 Parameter Measurement Information

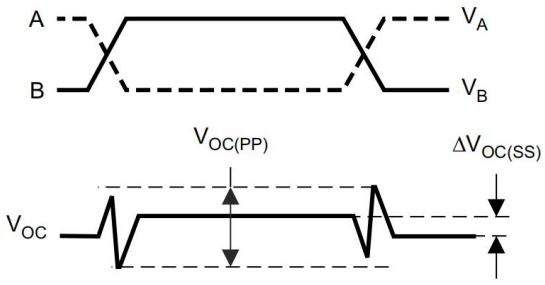
Input generator rate is 100 kbps, 50% duty cycle, rise and fall times less than 6 ns, output impedance 50 Ω.




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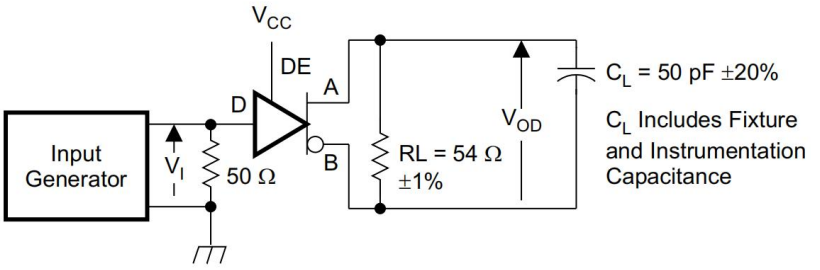
**图 6-1. Measurement of Driver Differential Output Voltage With Common-Mode Load**

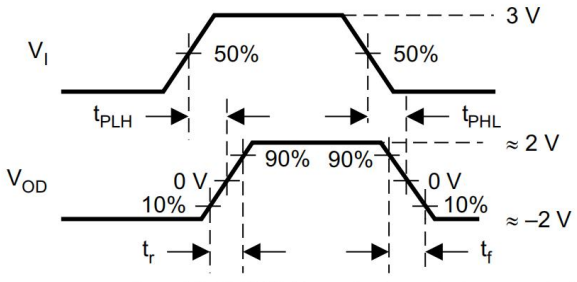



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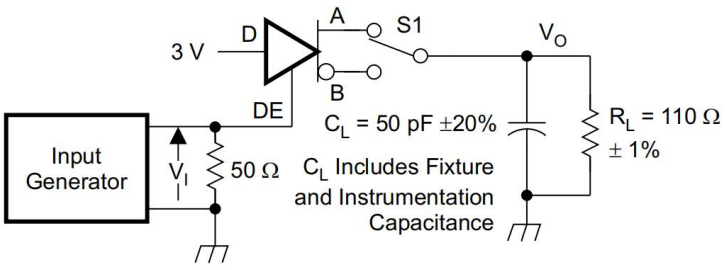
**图 6-2. Measurement of Driver Differential and Common-Mode Output With RS-485 Load**

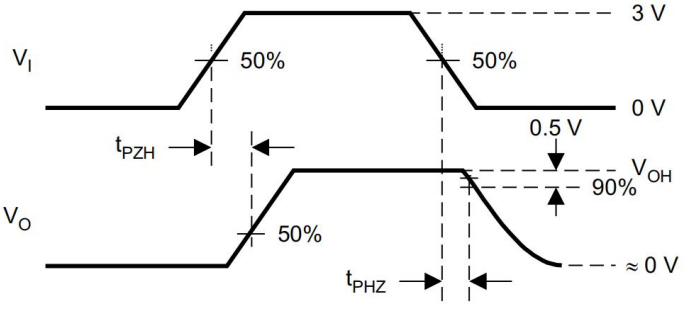



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**图 6-3. Measurement of Driver Differential Output Rise and Fall Times and Propagation Delays**

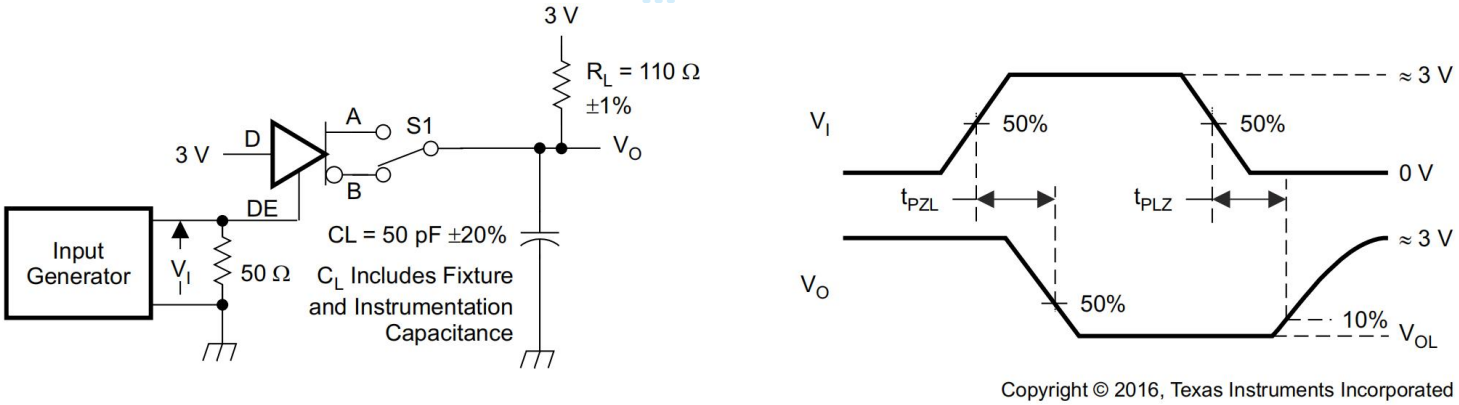



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D at 3 V to test non-inverting output, D at 0 V to test inverting output.

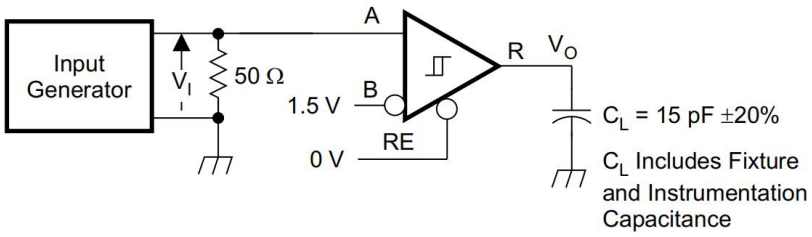
**图 6-4. Measurement of Driver Enable and Disable Times With Active High Output and Pulldown Load**

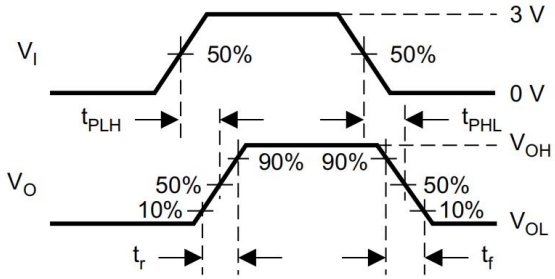



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D at 0 V to test non-inverting output, D at 3 V to test inverting output.

**图 6-5. Measurement of Driver Enable and Disable Times With Active-Low Output and Pullup Load**




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**图 6-6. Measurement of Receiver Output Rise and Fall Times and Propagation Delays**

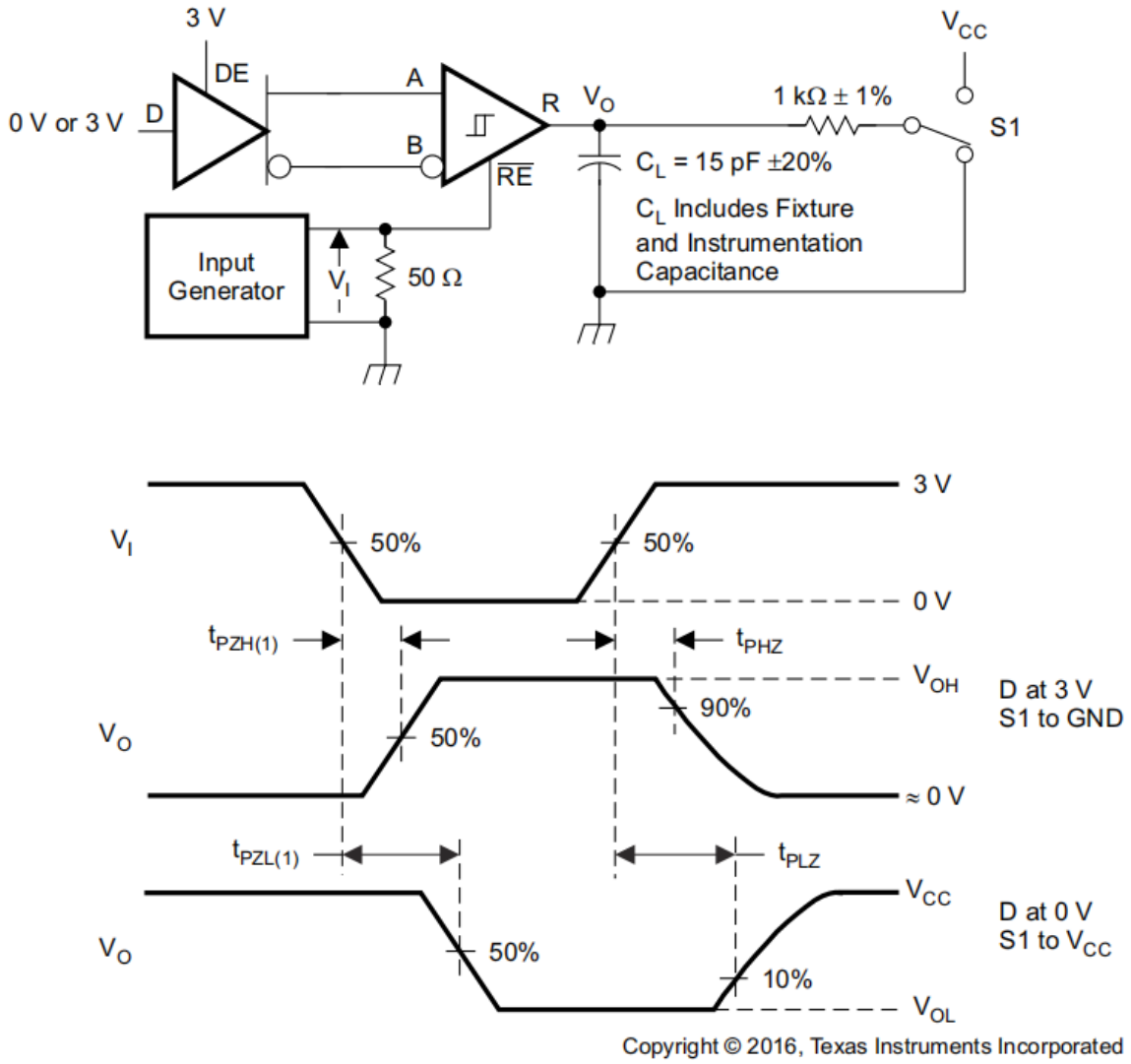
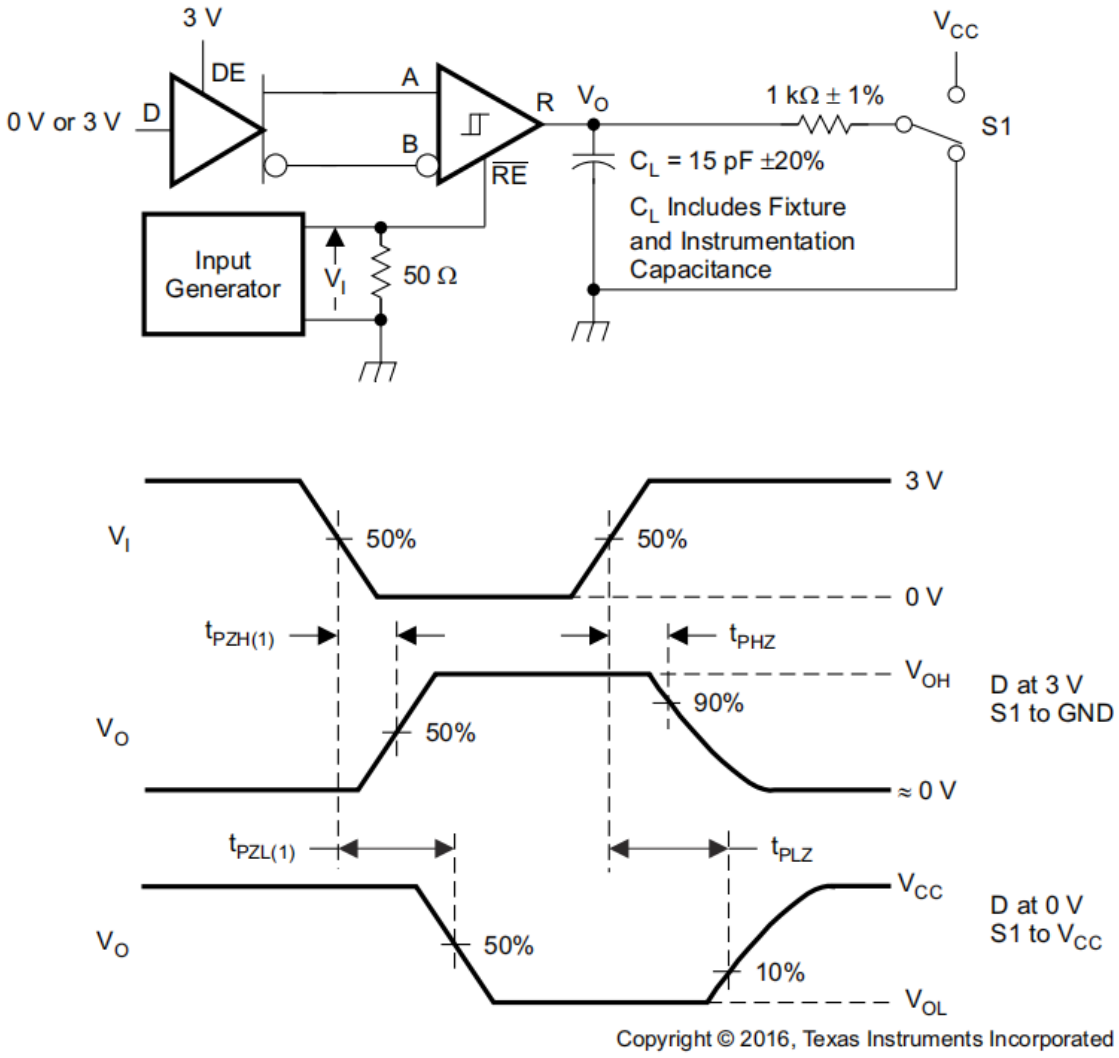



**图 6-7. Measurement of Receiver Enable and Disable Times With Driver Enabled**




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**图 6-7. Measurement of Receiver Enable and Disable Times With Driver Enabled**

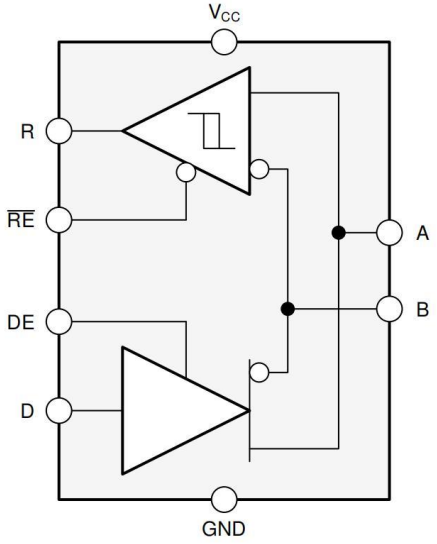
# 7 Detailed Description

## 7.1 Overview

The SN65HVD1780-Q1, SN65HVD1781-Q1, and SN65HVD1782-Q1 devices are half-duplex RS-485 transceivers available in three speed grades suitable for data transmission up to 115kbps, 1Mbps, and 10Mbps.

These devices feature a wide common-mode operating range and bus-pin fault protection up to ±70V. Each device has an active-high driver enable and active-low receiver enable. A standby current of less than 1μA can be achieved by disabling both driver and receiver.

## 7.2 Functional Block Diagram




## 7.3 Feature Description

Internal ESD protection circuits protect the transceiver bus terminals against ±16kV Human Body Model (HBM) electrostatic discharges.

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

### *7.3.1 Bus Fault Conditions*

The SN65HVD178x-Q1 family of RS-485 transceivers is designed to survive bus pin faults up to ±70V. The SN65HVD1782-Q1 device will not survive a bus pin fault with a direct short to voltages above 30V when all of the following occurs:

- The device is powered on
- The driver is enabled (DE = HIGH), and one of the following is true
  - D = HIGH AND the bus fault is applied to the A pin
  - D = LOW AND the bus fault is applied to the B pin

Under other conditions, the device survives shorts to bus pin faults up to ±70V. 表 7-1 summarizes the conditions under which the device may be damaged, and the conditions under which the device will not be damaged.

表 7-1. Bus Fault Conditions for the HVD1782

| POWER | DE | D | A | B | RESULTS |
|---|---|---|---|---|---|
| OFF | X | X | $-70V < V_A < 70V$ | $-70V < V_B < 70V$ | Device survives |
| ON | LO | X | $-70V < V_A < 70V$ | $-70V < V_B < 70V$ | Device survives |
| ON | HI | L | $-70V < V_A < 70V$ | $-70V < V_B < 30V$ | Device survives |
| ON | HI | L | $-70V < V_A < 70V$ | $30V < V_B$ | Damage may occur |
| ON | HI | H | $-70V < V_A < 30V$ | $-70 V < V_B < 30V$ | Device survives |
| ON | HI | H | $30V < V_A$ | $-70V < V_B < 30V$ | Damage may occur |

### *7.3.2 Receiver Failsafe*

The SN65HVD178x-Q1 family of half-duplex transceivers provides internal biasing of the receiver input thresholds in combination with large input-threshold hysteresis. At a positive input threshold of $V_{IT+}$ = –35mV and an input hysteresis of $V_{HYS}$ = 30mV, the receiver output remains logic high under bus-idle, bus-short, or open bus conditions in the presence of up to 130$mV_{PP}$ differential noise without the need for external failsafe biasing resistors.

### *7.3.3 Hot-Plugging*

These devices are designed to operate in *hot swap* or *hot-pluggable* applications. Key features for hot-pluggable applications are power-up and power-down glitch free operation, default disabled input and output pins, and receiver failsafe.

As shown in the *Functional Block Diagram*, an internal power-on reset circuit keeps the driver outputs in a high impedance state until the supply voltage has reached a level at which the device will reliably operate. This circuit makes sure no problems occur on the bus pin outputs as the power supply turns on or off.

As shown in *Device Functional Modes*, the driver and receiver enable inputs (DE and $\overline{RE}$) are disabled by default. This default makes sure the device neither drives the bus nor reports data on the R pin until the associated controller actively drivers the enable pins.

## 7.4 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 pull-down resistor to ground, thus when left open the driver is disabled (high-impedance) by default. The D pin has an internal pull-up resistor to $V_{CC}$, thus, when left open while the driver is enabled, output A turns high and B turns low.

表 7-2. Driver Function Table

| INPUT | ENABLE | OUTPUTS | | DRIVER STATE |
|---|---|---|---|---|
| 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, R, 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).

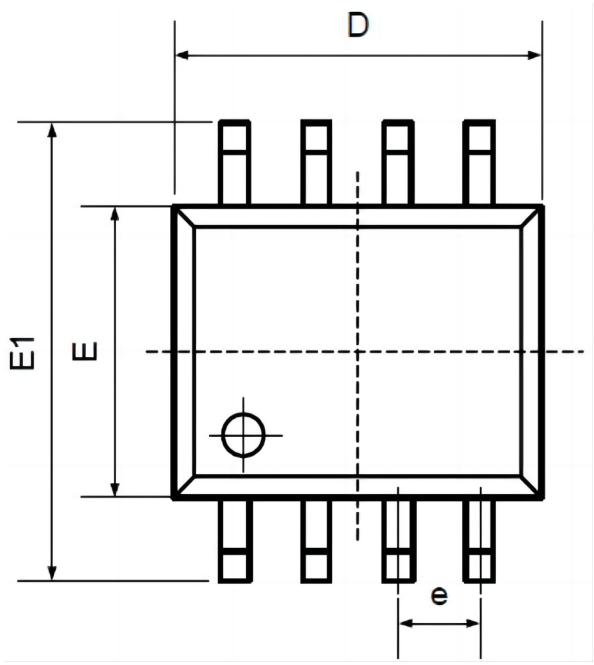
表 **7-3. Receiver Function Table**

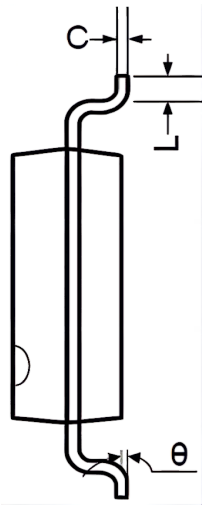
| DIFFERENTIAL INPUT | ENABLE | OUTPUT | RECEIVER STATE |
|---|---|---|---|
| $V_{ID} = V_A - V_B$ | $\overline{RE}$ | R | |
| $V_{ID} > V_{IT+}$ | L | H | Receive valid bus High |
| $V_{IT-} < V_{ID} < V_{IT+}$ | L | ? | Indeterminate bus state |
| $V_{ID} < V_{IT-}$ | L | L | Receive valid bus Low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

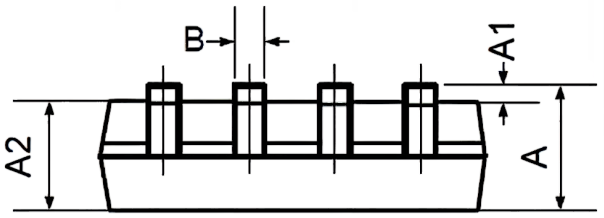
# Order information

| Order Number | Package | Package Quantity | Marking On The park |
|---|---|---|---|
| SN65HVD1781AQDRQ1-TUDI | SOP8 | Tape,Reel,2500 | SN65HVD1781AQDRQ1 |
| SN65HVD1781QDRQ1-TUDI | SOP8 | Tape,Reel,2500 | SN65HVD1781QDRQ1 |

# Package SOP8




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.350 | 1.750 | 0.053 | 0.069 |
| A1 | 0.100 | 0.250 | 0.004 | 0.010 |
| A2 | 1.350 | 1.550 | 0.053 | 0.061 |
| B | 0.330 | 0.510 | 0.013 | 0.020 |
| C | 0.190 | 0.250 | 0.007 | 0.010 |
| D | 4.780 | 5.000 | 0.188 | 0.197 |
| E | 3.800 | 4.000 | 0.150 | 0.157 |
| E1 | 5.800 | 6.300 | 0.228 | 0.248 |
| e | 1.270TYP | | 0.050TYP | |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |

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