# SN65HVD1780-Q1, SN65HVD1781-Q1, SN65HVD1782 -Q1

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# Fault-Protected RS-485 Transceivers with 3.3-V to 5-V Operation

Check for Samples: SN65HVD1780-Q1, SN65HVD1781-Q1, SN65HVD1782 -Q1

### **FEATURES**

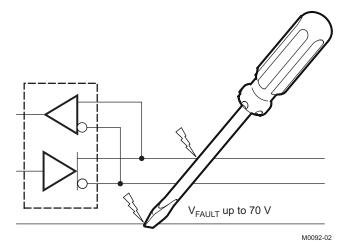
- Qualified for Automotive Applications
- Bus-Pin Fault Protection to:
  - > ±70 V ('HVD1780, 81)
  - > ±30 V ('HVD1782)
- Operation With 3.3-V to 5-V Supply Range
- ±16 kV HBM Protection on Bus Pins
- Reduced Unit Load for up to 320 Nodes
- Failsafe Receiver for Open-Circuit, Short-Circuit and Idle-Bus Conditions
- Low Power Consumption
  - Low Standby Supply Current, 1 μA Max
  - I<sub>CC</sub> 4 mA Quiescent During Operation
- Pin-Compatible With Industry-Standard SN75176
- Signaling Rates of 115 kbps, 1 Mbps, and up to 10 Mbps

## DESCRIPTION

These devices are designed to survive overvoltage faults such as direct shorts to power supplies, mis-wiring faults, connector failures, cable crushes, and tool mis-applications. They are also robust to ESD events, with high levels of protection to the human-body-model specification.

These devices combine a differential driver and a differential receiver, which operate from a single power supply. In the 'HVD1782, the driver differential outputs and the receiver differential inputs are connected internally to form a bus port suitable for half-duplex (two-wire bus) communication. This port features a wide common-mode voltage range, making the devices suitable for multipoint applications over long cable runs. These devices are characterized from -40°C to 125°C. These devices are pin-compatible with the industry-standard SN75176 transceiver, making them drop-in upgrades in most systems.

These devices are fully compliant with ANSI TIA/EIA 485-A with a 5-V supply and can operate with a 3.3-V supply with reduced driver output voltage for low-power applications. For applications where operation is required over an extended common-mode voltage range, see the SN65HVD1785 (SLLS872) data sheet.



Transceiver	Signaling Rate	Number of Nodes
HVD1780	Up to 115 kbps	Up to 320
HVD1781	Up to 1 Mbps	Up to 320
HVD1782	Up to 10 Mbps	Up to 64



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



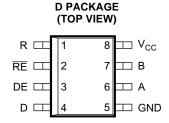


These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

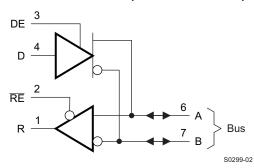
### ORDERING INFORMATION(1)

T <sub>A</sub>	PACK	AGE <sup>(2)</sup>	ORDERABLE PART NUMBER	TOP-SIDE MARKING
			SN65HVD1780QDRQ1 (3)	Product Preview
-40°C to 125°C	SOIC - D	Reel of 2500	SN65HVD1781QDRQ1	1781Q
			SN65HVD1782QDRQ1 (3)	Product Preview

- (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
- 2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.
- (3) Product Preview



# **LOGIC DIAGRAM (POSITIVE LOGIC)**



# **DEVICE INFORMATION**

#### **DRIVER FUNCTION TABLE**

Input	Enable	Outp	uts	Driver State	
D	DE	Α	В		
Н	Н	Н	L	Actively drive bus High	
L	Н	L	Н	Actively drive bus Low	
Х	L	Z	Z	Driver disabled <sup>(1)</sup>	
Х	OPEN	Z	Z	Driver disabled by default (1)	
OPEN	Н	Н	L	Actively drive bus High by default	

(1) When both the driver and receiver are disabled, the device enters a low-power standby mode.

#### **RECEIVER FUNCTION TABLE**

Differential Input	Enable	Output	Receiver State
$V_{ID} = V_A - V_B$	RE	R	
$V_{IT+} < V_{ID}$	L	Н	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	Н	Z	Receiver disabled <sup>(1)</sup>
Х	OPEN	Z	Receiver disabled by default (1)
Open-circuit bus	L	Н	Fail-safe high output
Short-circuit bus	L	Н	Fail-safe high output
Idle (terminated) bus	L	Н	Fail-safe high output

(1) When both the driver and receiver are disabled, the device enters a low-power standby mode.



# **ABSOLUTE MAXIMUM RATINGS**(1)

					VALUE	UNIT
$V_{CC}$	Supply voltage			-0.5 to 7	V	
	\/alta a a man a a at la a sin a		'HVD1780, 81	A, B pins	-70 to 70	V
	Voltage range at bus pins		'HVD1782	A, B pins	-70 to 30	V
	Input voltage range at any	/ logic pin			$-0.3$ to $V_{CC} + 0.3$	V
	Transient overvoltage pul	se through 100 Ω per TIA	N-485		-70 to 70	V
	Receiver output current				-24 to 24	mA
TJ	Junction temperature		170		170	°C
	Continuous total power di	ssipation			See Dissipation Rating Table	
		Human-Body Model (H	HBM), IEC 60749-26.	Bus terminals and GND	±16	kV
ESD	Electrostatic discharge	Human-Body Model (Hupon AEC-Q100-002	Human-Body Model (HBM). Test method based Bus terminals and GND		±16	kV
LOD	Licetrostatic discriarge	Human-Body Model (H	HBM), AEC-Q100-002	All Pins	±4	kV
		Charged-Device Mode	el (CDM), AEC-Q100-011	All Pins	±2	kV
		Machine Model (MM)	, AEC-Q100-003	All Pins	±400	V

<sup>(1)</sup> 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.

### PACKAGE DISSIPATION RATINGS

PACKAGE <sup>(1)</sup>	JEDEC THERMAL MODEL	T <sub>A</sub> < 25°C RATING			T <sub>A</sub> = 105°C RATING	T <sub>A</sub> = 125°C RATING (3.3 V ONLY)
COIC (D) 0 nin	High-K	905 mW	7.25 mW/°C	470 mW	325 mW	180 mW
SOIC (D) 8-pin	Low-K	516 mW	4.1 mW/°C	268 mW	186 mW	103 mW

<sup>(1)</sup> For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

# RECOMMENDED OPERATING CONDITIONS

			MIN	NOM	MAX	UNIT
V <sub>CC</sub>	Supply voltage	voltage				V
VI	Input voltage at any bus terminal (separately	y or common mode) <sup>(1)</sup>	-7		12	V
$V_{IH}$	High-level input voltage (driver, driver enable	e, and receiver enable inputs)	2		$V_{CC}$	V
$V_{IL}$	Low-level input voltage (driver, driver enable	e, and receiver enable inputs)	0		0.8	V
$V_{ID}$	Differential input voltage		-12		12	V
	Output current, driver		-60		60	mA
IO	Output current, receiver	-8		8	mA	
$R_L$	Differential load resistance		54	60		Ω
$C_L$	Differential load capacitance			50		pF
		HVD1780			115	
1/t <sub>UI</sub>	Signaling rate	HVD1781			1	Mbps
		HVD1782			10	
_	Operating free-air temperature (See	5-V supply	-40		105	
T <sub>A</sub>	application section for thermal information)	3.3-V supply	-40		125	°C
TJ	Junction Temperature		-40		150	

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

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# **ELECTRICAL CHARACTERISTICS**

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over recommended operating conditions (unless otherwise noted)

over rec	ommended operating conditions (unless other		-		MIN			
	PARAMETER	TEST CONDITIONS $R_{L} = 60 \Omega, 4.75 \text{ V} \leq V_{CC} 375 \Omega  T_{A} < 85^{\circ}\text{C}$				TYP	MAX	UNIT
		R <sub>L</sub> = 60 Ω, 4.75 V ≤ N on each output to $-7$ Figure 1	/ <sub>CC</sub> 375 Ω V to 12 V	T <sub>A</sub> < 85°C T <sub>A</sub> < 125°C	1.5 1.4			
		$R_L = 54 \Omega$ , $T_A < 85^{\circ}C$		1.7	2			
$ V_{OD} $	Driver differential output voltage magnitude	$4.75 \text{ V} \le \text{V}_{CC} \le 5.25 \text{ V}$	J	T <sub>A</sub> < 125°C	1.5			V
		$R_L = 54 \Omega,$ 3.15 V $\leq V_{CC} \leq 3.45 V$	/		0.8	1		
		$R_L = 100 \Omega,$ 4.75 V $\leq$ V <sub>CC</sub> $\leq$ 5.25 \	J	T <sub>A</sub> < 85°C T <sub>A</sub> < 125°C	2.2	2.5		
$\Delta  V_{OD} $	Change in magnitude of driver differential output voltage	R <sub>L</sub> = 54 Ω		1	-50	0	50	mV
V <sub>OC(SS)</sub>	Steady-state common-mode output voltage				1	V <sub>CC</sub> /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 lo See Figure 2	ad resistors	5,		500		mV
C <sub>OD</sub>	Differential output capacitance					23		pF
$V_{\text{IT+}}$	Positive-going receiver differential input voltage threshold					-100	-35	
V <sub>IT</sub> -	Negative-going receiver differential input voltage threshold					-150		mV
$V_{HYS}$	Receiver differential input voltage threshold hysteresis $(V_{IT+} - V_{IT-})^{(1)}$					50		
$V_{OH}$	Receiver high-level output voltage	$I_{OH} = -8 \text{ mA}$			2.4	V <sub>CC</sub> - 0.3		V
$V_{OL}$	Receiver low-level output voltage	I <sub>OL</sub> = 8 mA	T <sub>A</sub> < 85°C			0.2	0.4	V
	· · · ·	T <sub>A</sub> < 125°C					0.5	
$I_{I(LOGIC)}$	Driver input, driver enable, and receiver enable input current				-50		50	μΑ
$I_{OZ}$	Receiver output high-impedance current	$V_O = 0 \text{ V or } V_{CC}, \overline{RE}$	at V <sub>CC</sub>		-1		1	μΑ
I <sub>OS</sub>	Driver short-circuit output current			T	-200		200	mA
		$V_{CC} = 3.15 \text{ to } 5.5 \text{ V}$	V <sub>I</sub> = 12 V	1780, 1781		75	100	
I <sub>I(BUS)</sub>	Bus input current (disabled driver)	or		1782		400	500	μΑ
( /		V <sub>CC</sub> = 0 V, DE at 0 V	V <sub>I</sub> = -7 V	1780, 1781 1782	-60 -400	-40 -300		
		Driver and receiver enabled	DE = V <sub>CC</sub> RE = GNI no load	,	-400	4	6	
		Driver enabled, receiver disabled	DE = V <sub>CC</sub> RE = V <sub>CC</sub> no load	,		3	5	mA
I <sub>CC</sub> Supply cur	Supply current (quiescent)	Driver disabled, receiver enabled DE = GND, RE = GND, no load				2	4	
		Driver and receiver disabled, standby	DE = GNI D = open, RE = V <sub>CC</sub> no load, T	A < 85°C		0.15	1	μА
		mode $DE = GNE$ $D = open$ , $RE = V_{CC}$		•			12	L., ,
	Supply current (dynamic)	See the Typical C	Characterist	ics section				

<sup>(1)</sup> Ensured by design. Not production tested.



# **SWITCHING CHARACTERISTICS**

over recommended operating conditions (unless otherwise noted)

	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT	
DRIVER (HVD	1780)	<u> </u>					
	D: ""		3.15 V < V <sub>CC</sub> < 3.45 V	0.4	1.4	1.8	μS
t <sub>r</sub> , t <sub>f</sub>	Driver differential output rise/fall time	D 5400 50	3.15 V < V <sub>CC</sub> < 5.5 V	0.4	1.7	2.6	μs
t <sub>PHL</sub> , t <sub>PLH</sub>	Driver propagation delay	$R_L = 54 \Omega, C_L = 50$ pF, See Figure 3			0.8	2	μS
t <sub>SK(P)</sub>	Driver differential output pulse skew,  t <sub>PHL</sub> - t <sub>PLH</sub>	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			20	250	ns
t <sub>PHZ</sub> , t <sub>PLZ</sub>	Driver disable time				0.1	5	μS
t <sub>PZH</sub> , t <sub>PZL</sub>	Driver enable time	Receiver enabled Receiver disabled	See Figure 4 and Figure 5		0.2	3 12	μS
DRIVER (HVD	1781)	receiver disabled			-	12	
t <sub>r</sub> , t <sub>f</sub>	Driver differential output rise/fall time			50		300	ns
t <sub>PHL</sub> , t <sub>PLH</sub>	Driver propagation delay		5 0 <b>5</b> 0			200	ns
t <sub>SK(P)</sub>	Driver differential output pulse skew,  tpHL - tpLH	$R_L = 54 \Omega, C_L = 50$	pr, See Figure 3			25	ns
t <sub>PHZ</sub> , t <sub>PLZ</sub>	Driver disable time					3	μS
	Driver enable time	Receiver enabled	See Figure 4 and Figure 5			300	ns
t <sub>PZH</sub> , t <sub>PZL</sub>	Driver enable time	Receiver disabled	1 iguio o			10	μS
DRIVER (HVD	1782)						
			All V <sub>CC</sub> and Temp			50	
$t_r$ , $t_f$	Driver differential output rise/fall time	$R_L = 54 \Omega$ ,	V <sub>CC</sub> > 4.5V and T < 105°C		16		ns
t <sub>PHL</sub> , t <sub>PLH</sub>	Driver propagation delay	$C_{L} = 50 \text{ pF}$				55	ns
t <sub>SK(P)</sub>	Driver differential output pulse skew, $ t_{PHL} - t_{PLH} $		See Figure 3			10	ns
t <sub>PHZ</sub> , t <sub>PLZ</sub>	Driver disable time					3	μS
t t	Driver enable time	Receiver enabled	See Figure 4 and Figure 5			300	ns
t <sub>PZH</sub> , t <sub>PZL</sub>	Driver enable time	Receiver disabled	- iguiro c			9	μS
RECEIVER (A	LL DEVICES UNLESS OTHERWISE NOT	ED)					
$t_r$ , $t_f$	Receiver output rise/fall time (1)		All devices		4	15	ns
t <sub>PHL</sub> , t <sub>PLH</sub>	Receiver propagation delay time	C 45 - 5	HVD1780, HVD1781		100	200	ns
YAL! YLH	. 10001701 propagation dolay time	C <sub>L</sub> = 15 pF, See Figure 6	HVD1782			80	110
t <sub>SK(P)</sub>	Receiver output pulse skew,  tphl - tplh		HVD1780, HVD1781 HVD1782	6		20 5	ns
t t	Receiver disable time (1)	Driver enabled, See	_		15	100	nc
t <sub>PLZ</sub> , t <sub>PHZ</sub>	receiver disable time V	Driver enabled, See			80	300	ns ns
$t_{PZL(1)}, t_{PZH(1)}$ $t_{PZL(2)}, t_{PZH(2)}$	Receiver enable time	Driver disabled, See	•		3	9	
(		Driver disabled, See		J	9	μS	

<sup>(1)</sup> Ensured by design. Not production tested.



#### THERMAL INFORMATION

PARAMETER		TEST CONDITIONS	VALUE	UNIT
D lunction to embient thermal registeres (no cirtleux)	SOIC-8	JEDEC high-K model	138	°C/W
R <sub>θJA</sub> Junction-to-ambient thermal resistance (no airflow)	SOIC-8	JEDIC low-K model	242	*C/VV
R <sub>0JB</sub> Junction-to-board thermal resistance	SOIC-8		62	°C/W
R <sub>eJC</sub> Junction-to-case thermal resistance	SOIC-8		61	°C/W
		$V_{CC} = 3.6V$ , $T_J = 150^{\circ}C$ , $R_L = 300 \Omega$ , $C_L = 50$ pF (driver), $C_L = 15$ pF (receiver) 3.3-V supply, unterminated <sup>(1)</sup>	75	
		$V_{CC}$ = 3.6V, $T_J$ = 150°C, $R_L$ = 100 Ω, $C_L$ = 50 pF (driver), $C_L$ = 15 pF (receiver) 3.3-V supply, RS-422 load <sup>(1)</sup>	95	
D. Devus discipation		$V_{CC} = 3.6V, T_J = 150^{\circ}C, R_L = 54 \Omega,$ $C_L = 50 \text{ pF (driver)}, C_L = 15 \text{ pF (receiver)}$ 3.3-V supply, RS-485 load <sup>(1)</sup>	115	
P <sub>D</sub> Power dissipation		$V_{CC}$ = 5.5V, $T_J$ = 150°C, $R_L$ = 300 $\Omega$ , $C_L$ = 50 pF (driver), $C_L$ = 15 pF (receiver) 5-V supply, unterminated <sup>(1)</sup>	290	mW
		$V_{CC} = 5.5V$ , $T_J = 150^{\circ}C$ , $R_L = 100 \Omega$ , $C_L = 50 pF$ (driver), $C_L = 15 pF$ (receiver) 5-V supply, RS-422 load <sup>(1)</sup>	320	
		$V_{CC} = 5.5V$ , $T_J = 150^{\circ}C$ , $R_L = 54 \Omega$ , $C_L = 50 pF$ (driver), $C_L = 15 pF$ (receiver) 5-V supply, RS-485 load <sup>(1)</sup>	400	
T <sub>SD</sub> Thermal-shutdown junction temperature			170	°C

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

# **APPLICATION INFORMATION**

# **Hot-Plugging**

These devices are designed to operate in "hot swap" or "hot pluggable" applications. Key features for hot-pluggable applications are power-up, power-down glitch free operation, default disabled input/output pins, and receiver failsafe. As shown in Figure 9, 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 ensures that no problems will occur on the bus pin outputs as the power supply turns on or turns off.

As shown in the device FUNCTION TABLE, the enable inputs have the feature of default disable on both the driver enable and receiver enable. This ensures that the device will neither drive the bus nor report data on the R pin until the associated controller actively drives the enable pins.

#### Receiver Failsafe

The differential receiver is "failsafe" to invalid bus states caused by open bus conditions such as, a disconnected connector, shorted bus conditions caused by damaged cabling, or idle bus conditions that occur when no driver is actively driving a valid RD-485 bus state on the network. In any of these cases, the differential receiver will output a failsafe HIGH state, so that small noise signals do not cause problems at the receiver output.



### PARAMETER MEASUREMENT INFORMATION

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

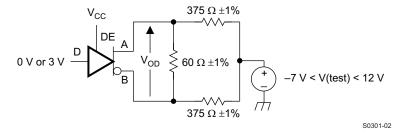


Figure 1. Measurement of Driver Differential Output Voltage With Common-Mode Load

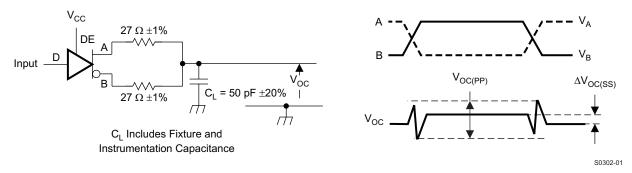


Figure 2. Measurement of Driver Differential and Common-Mode Output With RS-485 Load

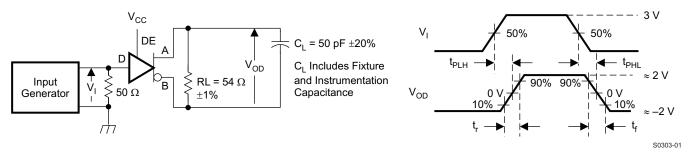
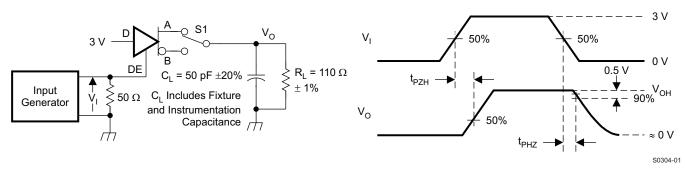


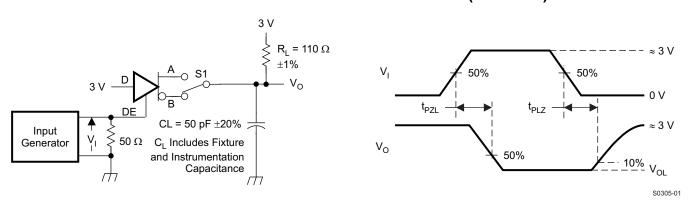
Figure 3. Measurement of Driver Differential Output Rise and Fall Times and Propagation Delays



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

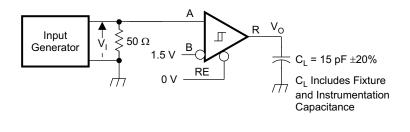
Figure 4. Measurement of Driver Enable and Disable Times With Active High Output and Pulldown Load

# PARAMETER MEASUREMENT INFORMATION (continued)



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

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



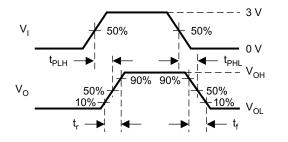


Figure 6. Measurement of Receiver Output Rise and Fall Times and Propagation Delays

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# PARAMETER MEASUREMENT INFORMATION (continued)

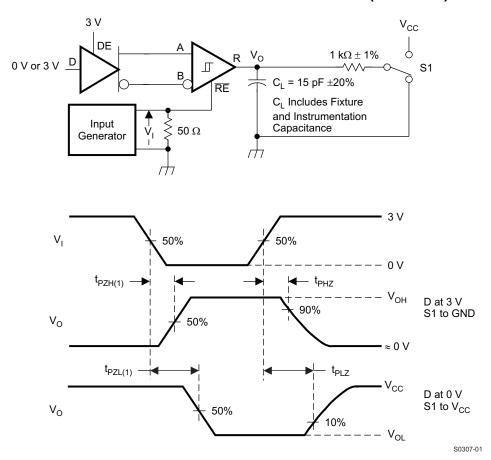


Figure 7. Measurement of Receiver Enable/Disable Times With Driver Enabled

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# PARAMETER MEASUREMENT INFORMATION (continued)

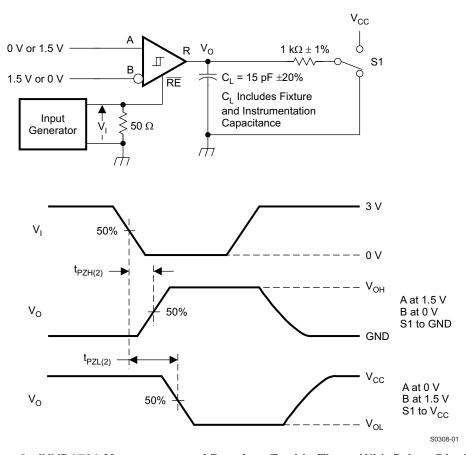
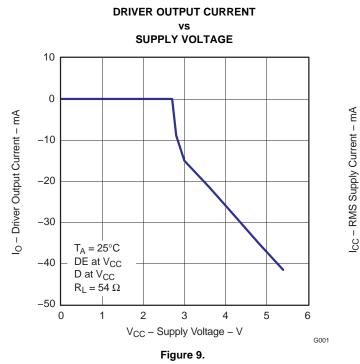


Figure 8. 'HVD1781 Measurement of Receiver Enable Times With Driver Disabled

### TYPICAL CHARACTERISTICS



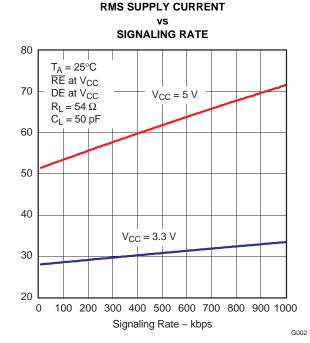


Figure 10.

# DIFFERENTIAL OUTPUT VOLTAGE

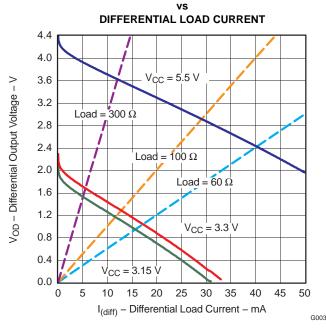


Figure 11.

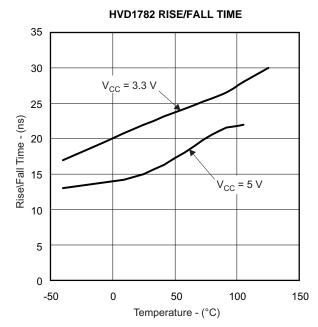
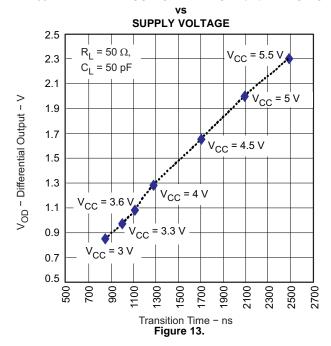


Figure 12.



# TYPICAL CHARACTERISTICS (continued)

**HVD1780 DIFFERENTIAL OUTPUT AMPLITUDE and TRANSITION TIME** 



### 70-V Fault-Protection

The SN65HVD17xx family of RS-485 devices is designed to survive bus pin faults up to  $\pm 70$ V. The devices designed for fast signaling rate (10 Mbps) will not survive a bus pin fault with a direct short to voltages above 30V when:

- 1. the device is powered on AND
- 2a. the driver is enabled (DE=HIGH) AND D=HIGH AND the bus fault is applied to the A pin OR
- 2b. the driver is enabled (DE=HIGH) AND D=LOW AND the bus fault is applied to the B pin

Under other conditions, the device will survive shorts to bus pin faults up to 70V. Table 1 summarizes the conditions under which the device may be damaged, and the conditions under which the device will not be damaged.

**Table 1. Device Conditions** 

POWER	DE	D	Α	В	RESULTS
OFF	Х	X	-70V < V <sub>A</sub> < 70V	-70V < V <sub>B</sub> < 70V	Device survives
ON	LO	Х	-70V < V <sub>A</sub> < 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 <sub>A</sub> < 70V	30V < V <sub>B</sub>	Damage may occur
ON	HI	Н	-70V < V <sub>A</sub> < 30V	$-70V < V_B < 30V$	Device survives
ON	HI	Н	30V < V <sub>A</sub>	-70V < V <sub>B</sub> < 30V	Damage may occur

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12-Oct-2011

#### **PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/ Ball Finish	MSL Peak Temp <sup>(3)</sup>	Samples (Requires Login)
SN65HVD1781QDRQ1	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	

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

ACTIVE: Product device recommended for new designs.

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

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

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

**OBSOLETE:** TI has discontinued the production of the device.

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

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

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

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

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

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

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#### OTHER QUALIFIED VERSIONS OF SN65HVD1781-Q1:

Catalog: SN65HVD1781

NOTE: Qualified Version Definitions:

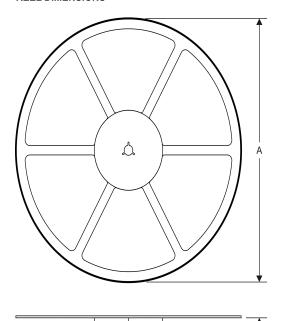
Catalog - TI's standard catalog product

# PACKAGE MATERIALS INFORMATION

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# TAPE AND REEL INFORMATION

# **REEL DIMENSIONS**



# **TAPE DIMENSIONS**



A0	Dimension designed to accommodate the component width
В0	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

# TAPE AND REEL INFORMATION

\*All dimensions are nominal

Device	Package Type	Package Drawing			Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN65HVD1781QDRQ1	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

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#### \*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)	
SN65HVD1781QDRQ1	SOIC	D	8	2500	346.0	346.0	29.0	

# D (R-PDSO-G8)

# PLASTIC SMALL OUTLINE



NOTES:

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



# D (R-PDSO-G8)

# PLASTIC SMALL OUTLINE



NOTES:

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



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