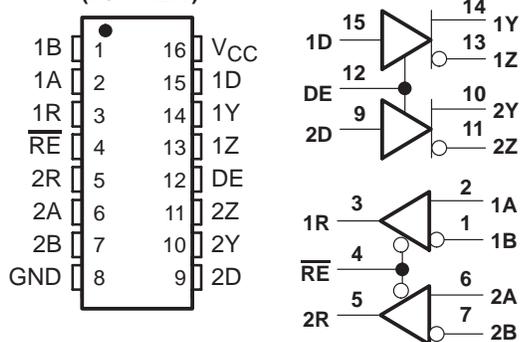


SN65LVDM050-Q1, SN65LVDM051-Q1 HIGH-SPEED DIFFERENTIAL LINE DRIVERS AND RECEIVERS

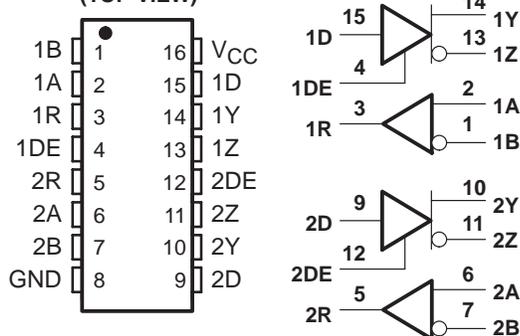
SGLS128A – JULY 2002 – REVISED APRIL 2008

- Qualified for Automotive Applications
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)
- Low-Voltage Differential 50-Ω Line Drivers and Receivers
- Signaling Rates up to 500 Mbps
- Bus-Terminal ESD Exceeds 12 kV
- Operates From a Single 3.3 V Supply
- Low-Voltage Differential Signaling With Typical Output Voltages of 340 mV With a 50-Ω Load
- Valid Output With as Little as 50-mV Input Voltage Difference
- Propagation Delay Times
 - Driver: 1.7 ns Typ
 - Receiver: 3.7 ns Typ
- Power Dissipation at 200 MHz
 - Driver: 50 mW Typical
 - Receiver: 60 mW Typical
- LVTTTL Input Levels Are 5 V Tolerant
- Driver Is High Impedance When Disabled or With $V_{CC} < 1.5$ V
- Receiver Has Open-Circuit Fail Safe

SN65LVDM050QDQ1 (Marked as LVDM050Q)
(TOP VIEW)



SN65LVDM051QDQ1 (Marked as LVDM051Q)
(TOP VIEW)



description

The SN65LVDM050, and SN65LVDM051 are differential line drivers and receivers that use low-voltage differential signaling (LVDS) to achieve signaling rates as high as 500 Mbps (per TIA/EIA-644 definition). These circuits are similar to TIA/EIA-644 standard compliant devices (SN65LVDS) counterparts, except that the output current of the drivers is doubled. This modification provides a minimum differential output voltage magnitude of 247 mV across a 50-Ω load simulating two transmission lines in parallel. This allows having data buses with more than one driver or with two line termination resistors. The receivers detect a voltage difference of 50 mV with up to 1 V of ground potential difference between a transmitter and receiver.

The intended application of these devices and signaling techniques is point-to-point and multipoint, baseband data transmission over a controlled impedance media of approximately 100 Ω of characteristic impedance. The transmission media may be printed-circuit board traces, backplanes, or cables.



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.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2008 Texas Instruments Incorporated

SN65LVDM050-Q1, SN65LVDM051-Q1 HIGH-SPEED DIFFERENTIAL LINE DRIVERS AND RECEIVERS

SGLS128A – JULY 2002 – REVISED APRIL 2008

description (continued)

The SN65LVDM050Q and SN65LVDM051Q are characterized for operation from -40°C to 125°C . Additionally, Q1 suffixed parts are qualified in accordance with AEC-Q100 stress test qualification for integrated circuits.

AVAILABLE OPTIONS†

T _A	PACKAGE‡
	SMALL OUTLINE (D)
-40°C to 125°C	SN65LVDM050QDQ1
	SN65LVDM051QDQ1

† 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 <http://www.ti.com>.

‡ Package drawings, thermal data, and symbolization are available at <http://www.ti.com/packaging>.

NOTE:

The ultimate rate and distance of data transfer is dependent upon the attenuation characteristics of the media, the noise coupling to the environment, and other application-specific characteristics.

Function Tables

SN65LVDM050 and SN65LVDM051 RECEIVER

INPUTS		OUTPUT
$V_{ID} = V_A - V_B$	\overline{RE}	R
$V_{ID} \geq 50\text{ mV}$	L	H
$-50\text{ mV} < V_{ID} < 50\text{ mV}$	L	?
$V_{ID} \leq -50\text{ mV}$	L	L
Open	L	H
X	H	Z

H = high level, L = low level, Z = high impedance, X = don't care

Function Tables (Continued)

SN65LVDM050 and SN65LVDM051 DRIVER

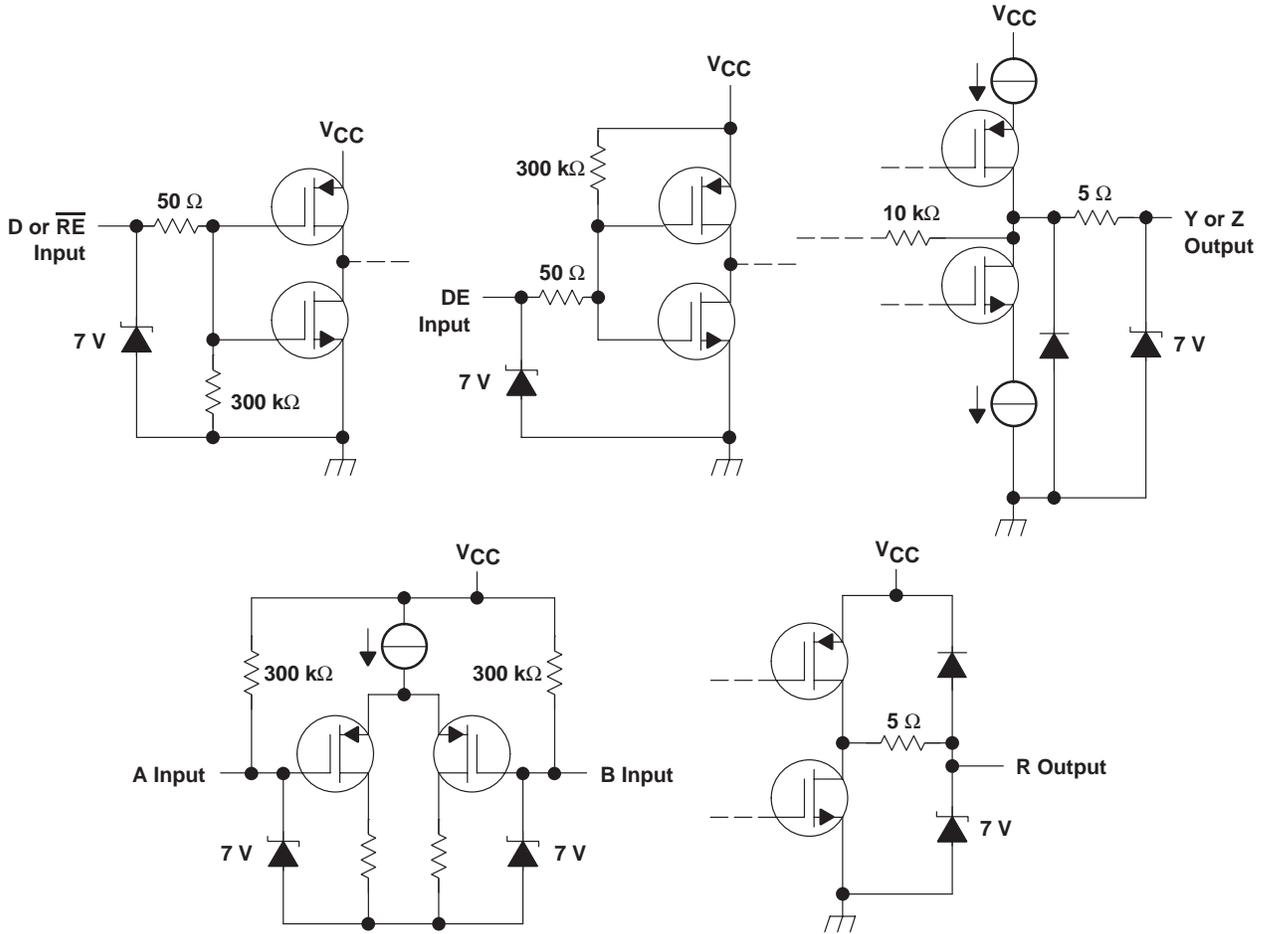
INPUTS		OUTPUTS	
D	DE	Y	Z
L	H	L	H
H	H	H	L
Open	H	L	H
X	L	Z	Z

H = high level, L = low level, Z = high impedance, X = don't care

SN65LVDM050-Q1, SN65LVDM051-Q1 HIGH-SPEED DIFFERENTIAL LINE DRIVERS AND RECEIVERS

SGLS128A – JULY 2002 – REVISED APRIL 2008

equivalent input and output schematic diagrams



SN65LVDM050-Q1, SN65LVDM051-Q1 HIGH-SPEED DIFFERENTIAL LINE DRIVERS AND RECEIVERS

SGLS128A – JULY 2002 – REVISED APRIL 2008

absolute maximum ratings over operating free-air temperature (unless otherwise noted)†

Supply voltage range, V_{CC} (see Note 1)	–0.5 V to 4 V
Voltage range (D, R, DE, \overline{RE})	–0.5 V to 6 V
Voltage range (Y, Z, A, and B)	–0.5 V to 4 V
Electrostatic discharge: Y, Z, A, B, and GND (see Note 2)	Class 3, A:12 kV, B:600 V
All	Class 3, A:7 kV, B:500 V
Continuous power dissipation	see dissipation rating table
Storage temperature range	–65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	250°C

† 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.

- NOTES: 1. All voltage values, except differential I/O bus voltages, are with respect to network ground terminal.
2. Tested in accordance with MIL-STD-883C Method 3015.7.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$ ‡	$T_A = 85^\circ\text{C}$ POWER RATING	$T_A = 125^\circ\text{C}$ POWER RATING
D(8)	635 mW	5.1 mW/°C	330 mW	—
D(14)	987 mW	7.9 mW/°C	513 mW	—
D(16)	1110 mW	8.9 mW/°C	577 mW	223 mW
DGK	424 mW	3.4 mW/°C	220 mW	—
PW (14)	736 mW	5.9 mW/°C	383 mW	—
PW (16)	839 mW	6.7 mW/°C	437 mW	—

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

recommended operating conditions

	MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}	3	3.3	3.6	V
High-level input voltage, V_{IH}	2			V
Low-level input voltage, V_{IL}			0.8	V
Magnitude of differential input voltage, $ V_{ID} $	0.1		0.6	V
Common-mode input voltage, V_{IC} (see Figure 6)	$\frac{ V_{ID} }{2}$		$2.4 - \frac{ V_{ID} }{2}$	V
			$V_{CC} - 0.8$	
Operating free-air temperature, T_A	–40		125	°C

device electrical characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
I_{CC} Supply current	SN65LVDM050	Drivers and receivers enabled, no receiver loads, driver $R_L = 50 \Omega$		19	27	mA
		Drivers enabled, receivers disabled, $R_L = 50 \Omega$		16	24	
		Drivers disabled, receivers enabled, no loads		4	6	
		Disabled		0.5	1	
	SN65LVDM051	Drivers enabled, no receiver loads, driver $R_L = 50 \Omega$		19	27	mA
		Drivers disabled, No loads		4	6	

† All typical values are at 25°C and with a 3.3 V supply.



SN65LVDM050-Q1, SN65LVDM051-Q1 HIGH-SPEED DIFFERENTIAL LINE DRIVERS AND RECEIVERS

SGLS128A – JULY 2002 – REVISED APRIL 2008

driver electrical characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$ V_{OD} $	Differential output voltage magnitude	$R_L = 50 \Omega$, See Figure 1 and Figure 2	247	340	454	mV
$\Delta V_{OD} $	Change in differential output voltage magnitude between logic states		-50		50	
$V_{OC(SS)}$	Steady-state common-mode output voltage	See Figure 3	1.125	1.2	1.375	V
$\Delta V_{OC(SS)}$	Change in steady-state common-mode output voltage between logic states		-50		50	mV
$V_{OC(PP)}$	Peak-to-peak common-mode output voltage			50		mV
I_{IH}	High-level input current	$V_{IH} = 5 V$	DE	-0.5	-20	μA
			D		2	
I_{IL}	Low-level input current	$V_{IL} = 0.8 V$	DE	-0.5	-10	μA
			D		2	
I_{OS}	Short-circuit output current	V_{OY} or $V_{OZ} = 0 V$		7	10	mA
		$V_{OD} = 0 V$		7	10	
I_{OZ}	High-impedance output current	$V_{OD} = 600 mV$			± 1	μA
		$V_O = 0 V$ or V_{CC}			± 1	
$I_{O(OFF)}$	Power-off output current	$V_{CC} = 0 V$, $V_O = 3.6 V$			± 1.5	μA
C_{IN}	Input capacitance			3		pF

receiver electrical characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
V_{IT+}	Positive-going differential input voltage threshold	See Figure 4 and Table 1			50	mV
V_{IT-}	Negative-going differential input voltage threshold		-50			
V_{OH}	High-level output voltage	$I_{OH} = -8 mA$	2.4			V
V_{OL}	Low-level output voltage	$I_{OL} = 8 mA$			0.4	V
I_I	Input current (A or B inputs)	$V_I = 0$	-2	-11	-20	μA
		$V_I = 2.4 V$	-1.2	-3		
$I_{I(OFF)}$	Power-off input current (A or B inputs)	$V_{CC} = 0$			± 20	μA
I_{IH}	High-level input current (enables)	$V_{IH} = 5 V$			10	μA
I_{IL}	Low-level input current (enables)	$V_{IL} = 0.8 V$			10	μA
I_{OZ}	High-impedance output current	$V_O = 0$ or $5 V$			± 10	μA
C_I	Input capacitance			5		pF

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

SN65LVDM050-Q1, SN65LVDM051-Q1 HIGH-SPEED DIFFERENTIAL LINE DRIVERS AND RECEIVERS

SGLS128A – JULY 2002 – REVISED APRIL 2008

driver switching characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
t _{PLH}	Propagation delay time, low-to-high-level output	R _L = 50Ω, C _L = 10 pF, See Figure 5		1.7	3	ns
t _{PHL}	Propagation delay time, high-to-low-level output			1.7	3	ns
t _r	Differential output signal rise time			0.6	1.2	ns
t _f	Differential output signal fall time			0.6	1.2	ns
t _{sk(p)}	Pulse skew (t _{pHL} - t _{pLH})				750	ps
t _{sk(o)}	Channel-to-channel output skew‡				100	ps
t _{sk(pp)}	Part-to-part skew§				1	ns
t _{PZH}	Propagation delay time, high-impedance-to-high-level output	See Figure 6		6	10	ns
t _{PZL}	Propagation delay time, high-impedance-to-low-level output			6	10	ns
t _{PHZ}	Propagation delay time, high-level-to-high-impedance output			4	10	ns
t _{PLZ}	Propagation delay time, low-level-to-high-impedance output			5	10	ns

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

‡ t_{sk(o)} is the maximum delay time difference between drivers on the same device.

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

receiver switching characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
t _{PLH}	Propagation delay time, low-to-high-level output	C _L = 10 pF, See Figure 7		3.7	4.5	ns
t _{PHL}	Propagation delay time, high-to-low-level output			3.7	4.5	ns
t _{sk(p)}	Pulse skew (t _{pHL} - t _{pLH})			0.1		ns
t _{sk(o)}	Channel-to-channel output skew			0.2		ns
t _{sk(pp)}	Part-to-part skew‡				1	ns
t _r	Output signal rise time	C _L = 10 pF, See Figure 7		0.7	1.5	ns
t _f	Output signal fall time			0.9	1.5	ns
t _{PZH}	Propagation delay time, high-level-to-high-impedance output	See Figure 8		2.5		ns
t _{PZL}	Propagation delay time, low-level-to-low-impedance output			2.5		ns
t _{PHZ}	Propagation delay time, high-impedance-to-high-level output			7		ns
t _{PLZ}	Propagation delay time, low-impedance-to-high-level output			4		ns

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

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



PARAMETER MEASUREMENT INFORMATION

driver

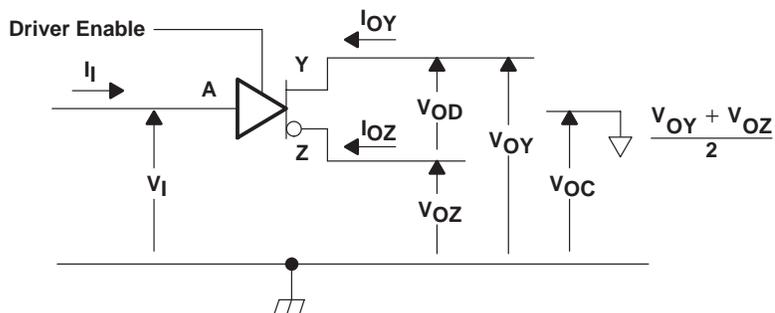
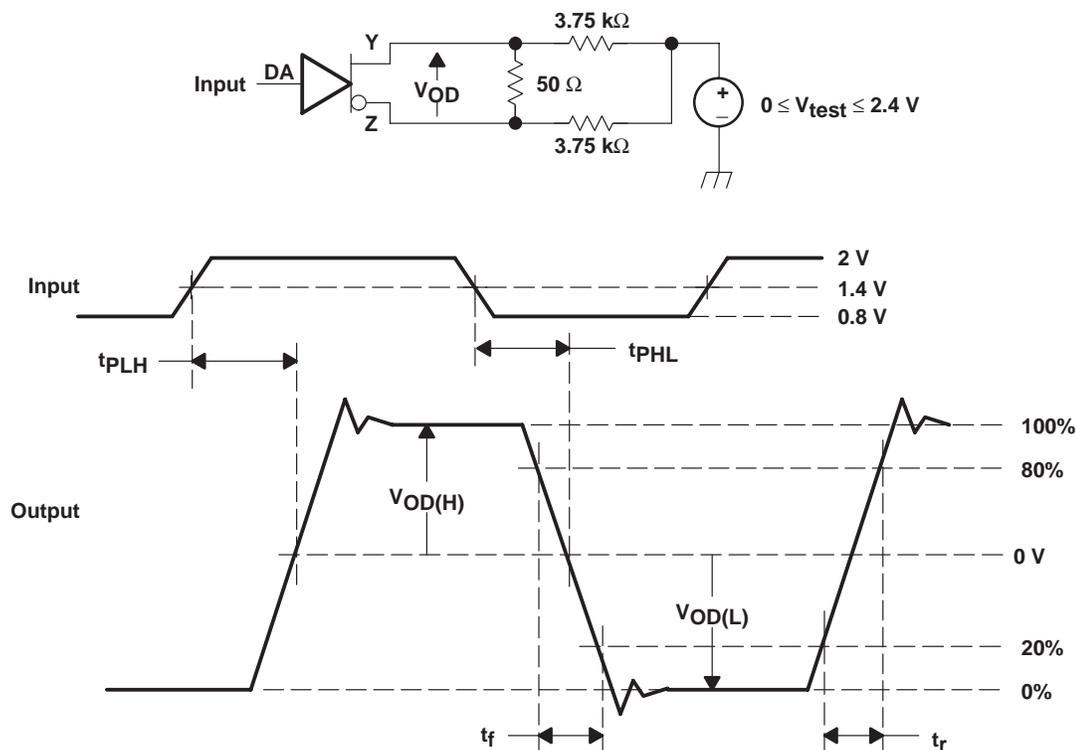


Figure 1. Driver Voltage and Current Definitions



NOTE A: All input pulses are supplied by a generator having the following characteristics: t_r or $t_f \leq 1$ ns, pulse repetition rate (PRR) = 50 Mpps, pulse width = 10 ± 0.2 ns. C_L includes instrumentation and fixture capacitance within 0,06 mm of the D.U.T.

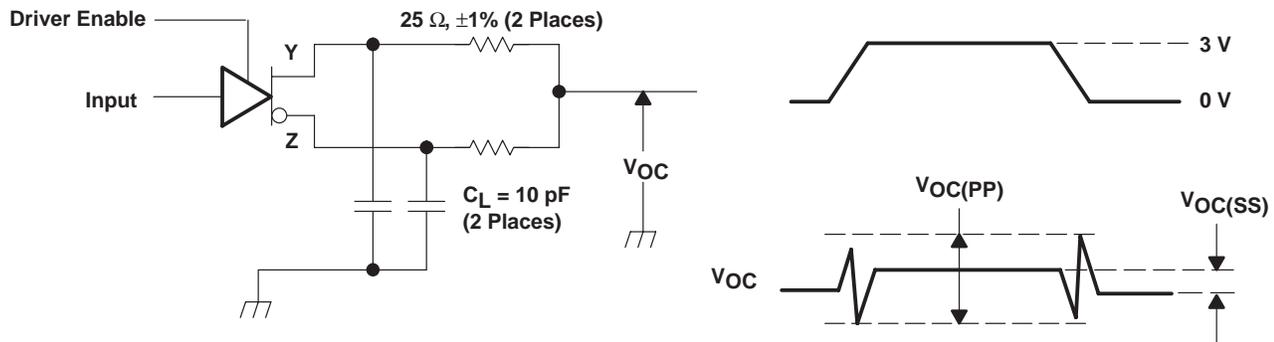
Figure 2. Test Circuit, Timing, and Voltage Definitions for the Differential Output Signal

SN65LVDM050-Q1, SN65LVDM051-Q1 HIGH-SPEED DIFFERENTIAL LINE DRIVERS AND RECEIVERS

SGLS128A – JULY 2002 – REVISED APRIL 2008

PARAMETER MEASUREMENT INFORMATION

driver (continued)



NOTE A: All input pulses are supplied by a generator having the following characteristics: t_r or $t_f \leq 1\ \text{ns}$, pulse repetition rate (PRR) = 50 Mpps, pulse width = $10 \pm 0.2\ \text{ns}$. C_L includes instrumentation and fixture capacitance within 0,06 mm of the D.U.T. The measurement of $V_{OC(PP)}$ is made on test equipment with a $-3\ \text{dB}$ bandwidth of at least 300 MHz.

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

PARAMETER MEASUREMENT INFORMATION

receiver

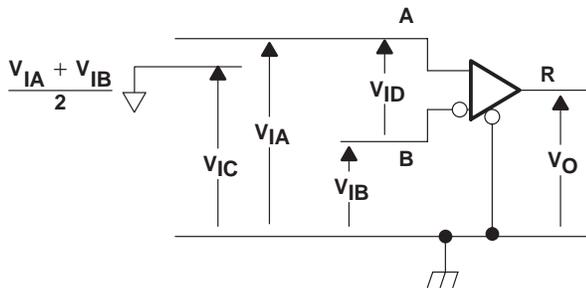


Figure 4. Receiver Voltage Definitions

Table 1. Receiver Minimum and Maximum Input Threshold Test Voltages

APPLIED VOLTAGES (V)		RESULTING DIFFERENTIAL INPUT VOLTAGE (mV)	RESULTING COMMON-MODE INPUT VOLTAGE (V)
V_{IA}	V_{IB}	V_{ID}	V_{IC}
1.225	1.175	50	1.2
1.175	1.225	-50	1.2
2.375	2.325	50	2.35
2.325	2.375	-50	2.35
0.05	0	50	0.05
0	0.05	-50	0.05
1.5	0.9	600	1.2
0.9	1.5	-600	1.2
2.4	1.8	600	2.1
1.8	2.4	-600	2.1
0.6	0	600	0.3
0	0.6	-600	0.3

SN65LVDM050-Q1, SN65LVDM051-Q1 HIGH-SPEED DIFFERENTIAL LINE DRIVERS AND RECEIVERS

SGLS128A – JULY 2002 – REVISED APRIL 2008

PARAMETER MEASUREMENT INFORMATION

driver

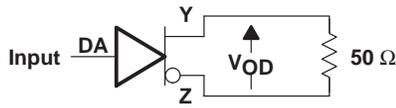
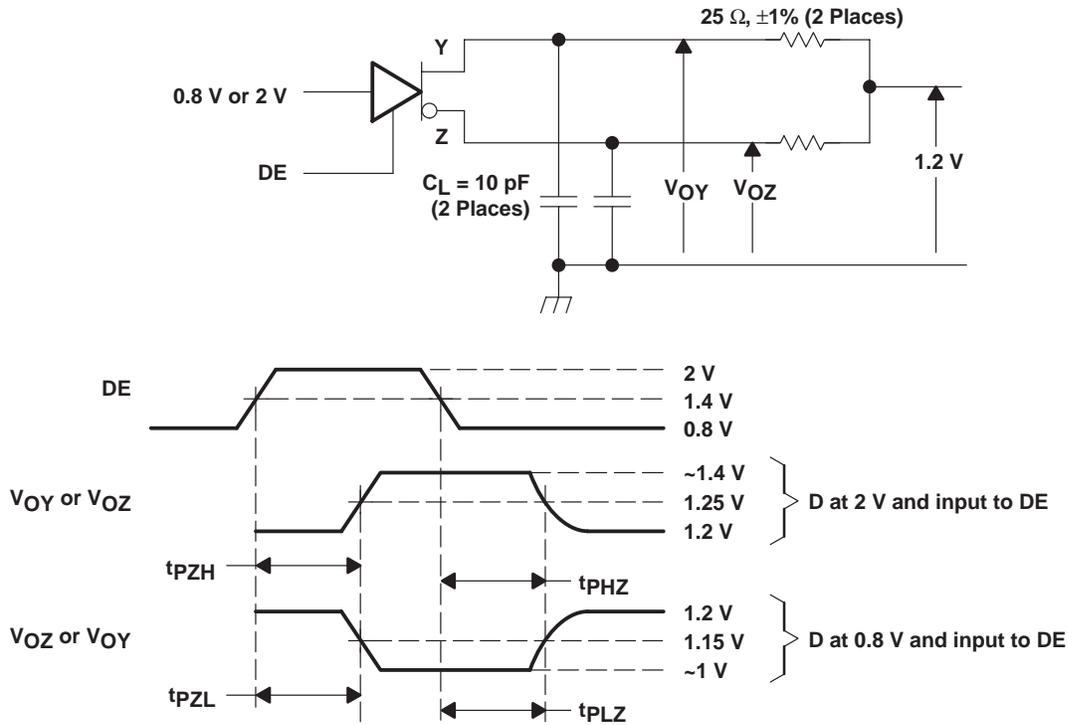


Figure 5. Timing Test Circuit

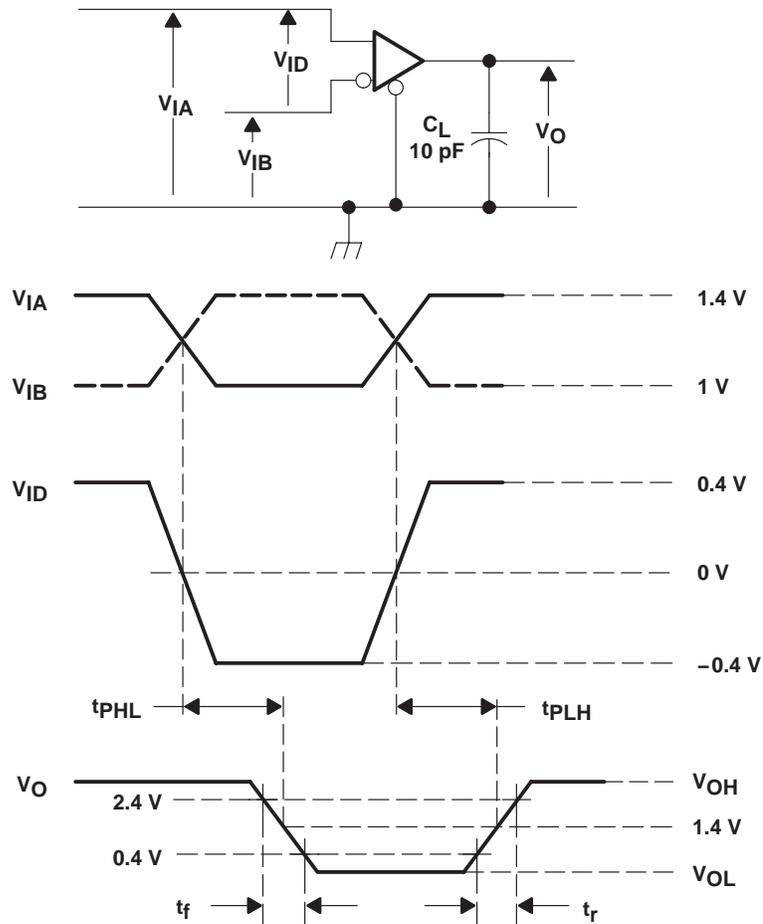


NOTE A: All input pulses are supplied by a generator having the following characteristics: t_r or $t_f \leq 1$ ns, pulse repetition rate (PRR) = 0.5 Mpps, pulse width = 500 ± 10 ns. C_L includes instrumentation and fixture capacitance within 0,06 mm of the D.U.T.

Figure 6. Enable and Disable Time Circuit and Definitions

PARAMETER MEASUREMENT INFORMATION

receiver



NOTE A: All input pulses are supplied by a generator having the following characteristics: t_r or $t_f \leq 1$ ns, pulse repetition rate (PRR) = 50 Mpps, pulse width = 10 ± 0.2 ns. C_L includes instrumentation and fixture capacitance within 0,06 mm of the D.U.T.

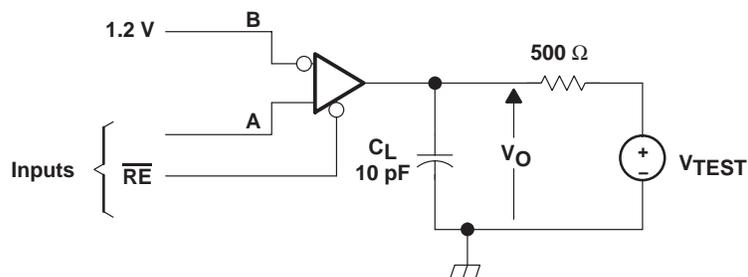
Figure 7. Timing Test Circuit and Waveforms

SN65LVDM050-Q1, SN65LVDM051-Q1 HIGH-SPEED DIFFERENTIAL LINE DRIVERS AND RECEIVERS

SGLS128A – JULY 2002 – REVISED APRIL 2008

PARAMETER MEASUREMENT INFORMATION

receiver (continued)



NOTE A: All input pulses are supplied by a generator having the following characteristics: t_r or $t_f \leq 1$ ns, pulse repetition rate (PRR) = 0.5 Mpps, pulse width = 500 ± 10 ns. C_L includes instrumentation and fixture capacitance within 0,06 mm of the D.U.T.

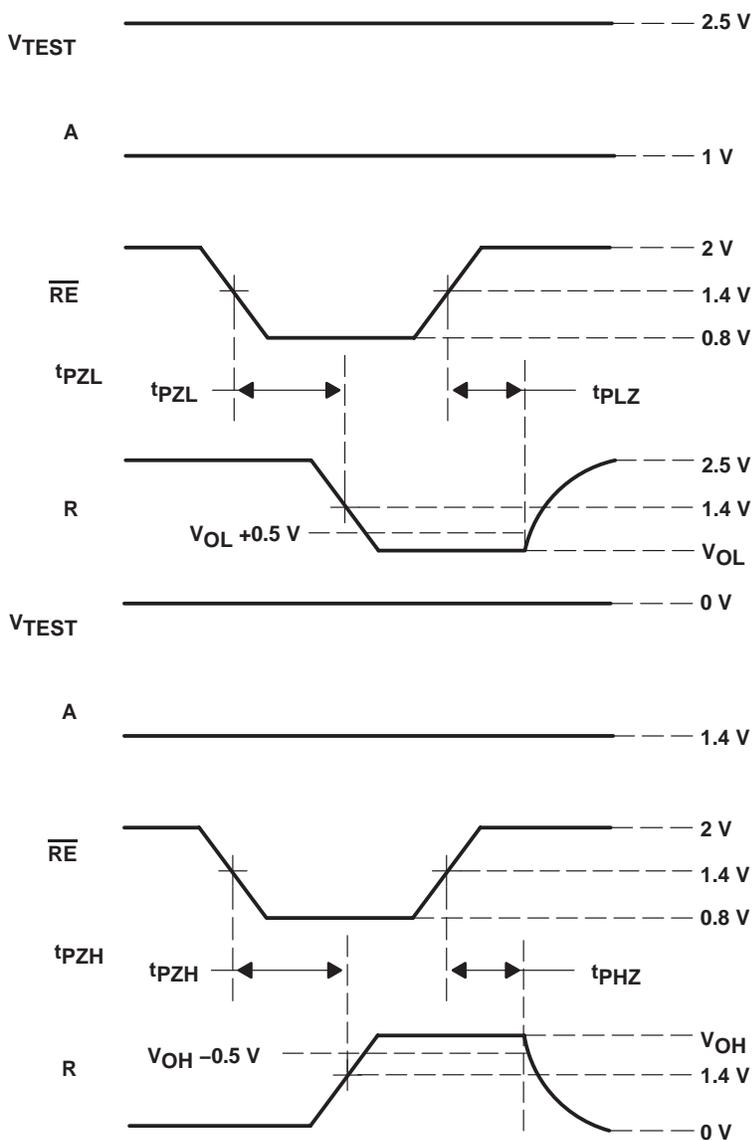


Figure 8. Enable/Disable Time Test Circuit and Waveforms

TYPICAL CHARACTERISTICS

COMMON-MODE INPUT VOLTAGE
vs
SUPPLY VOLTAGE

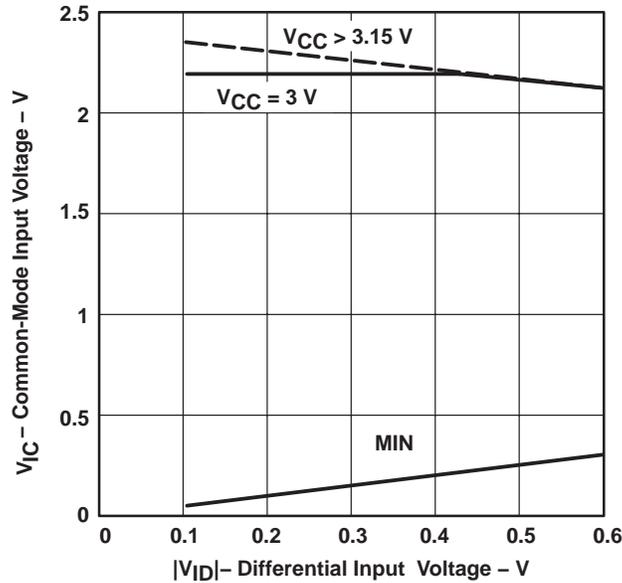


Figure 9

DRIVER
LOW-LEVEL OUTPUT VOLTAGE
vs
LOW-LEVEL OUTPUT CURRENT

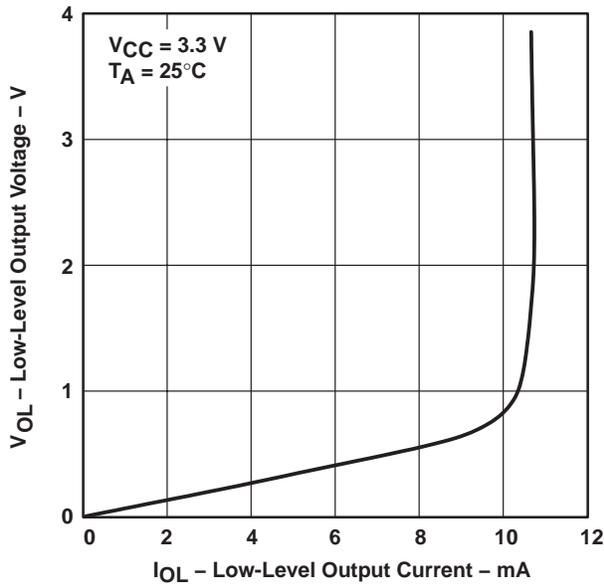


Figure 10

DRIVER
HIGH-LEVEL OUTPUT VOLTAGE
vs
HIGH-LEVEL OUTPUT CURRENT

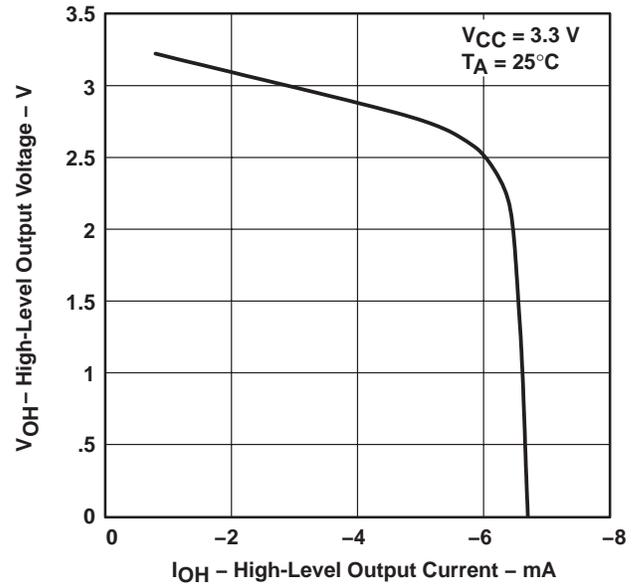
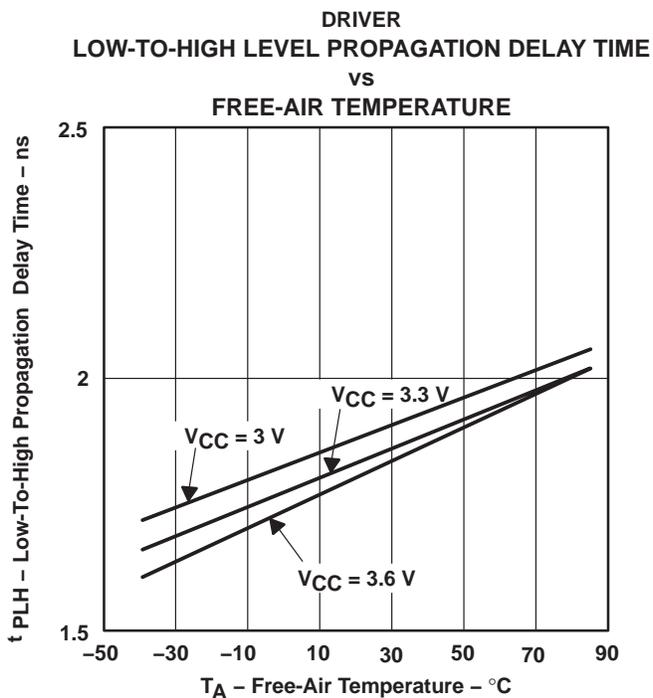
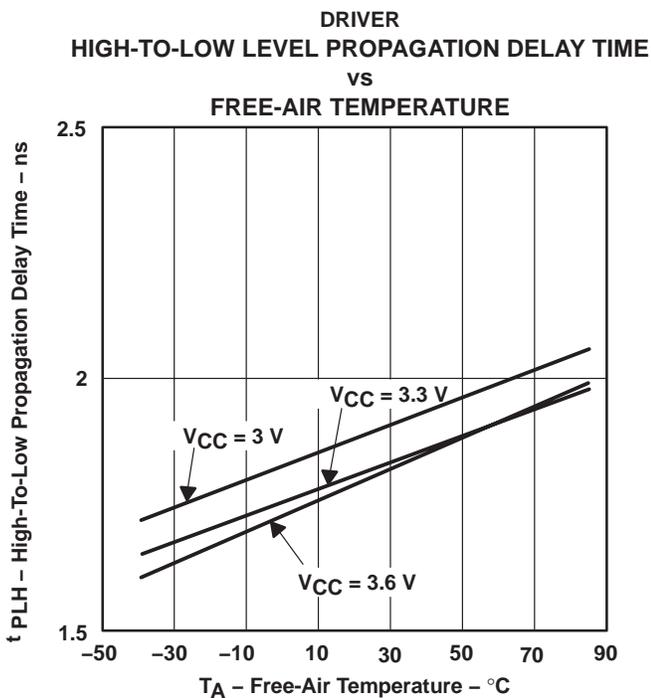
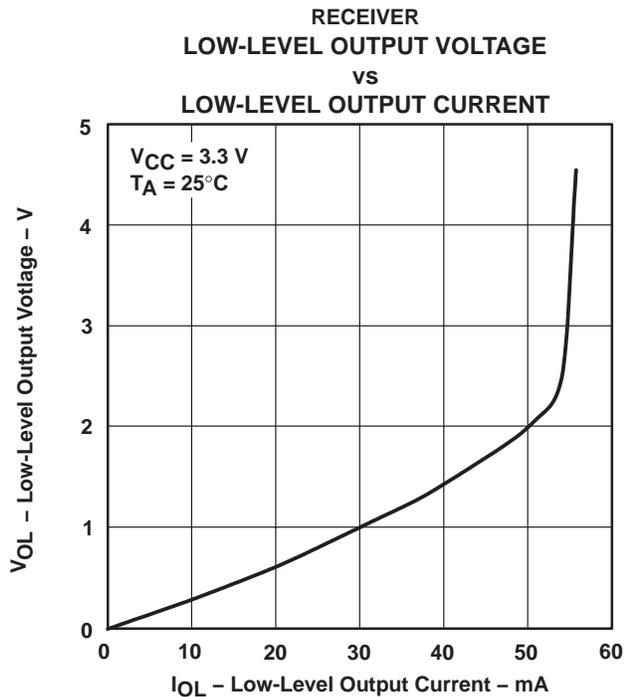
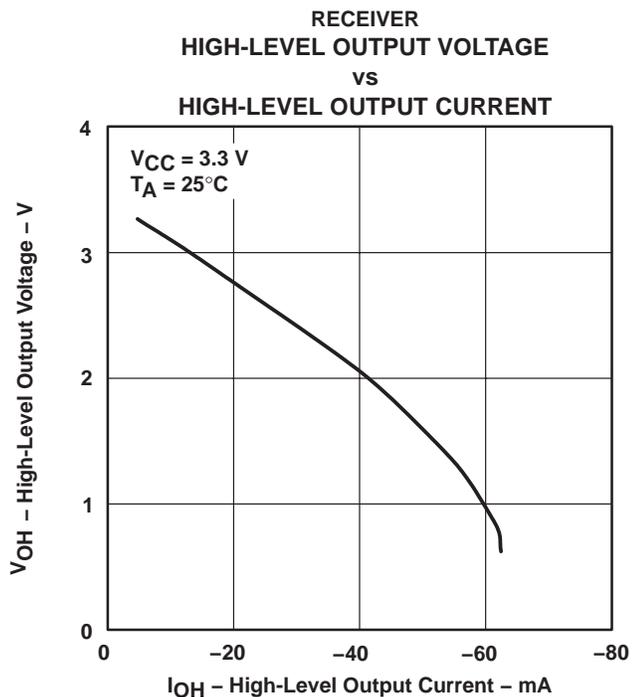


Figure 11

SN65LVDM050-Q1, SN65LVDM051-Q1 HIGH-SPEED DIFFERENTIAL LINE DRIVERS AND RECEIVERS

SGLS128A – JULY 2002 – REVISED APRIL 2008

TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS

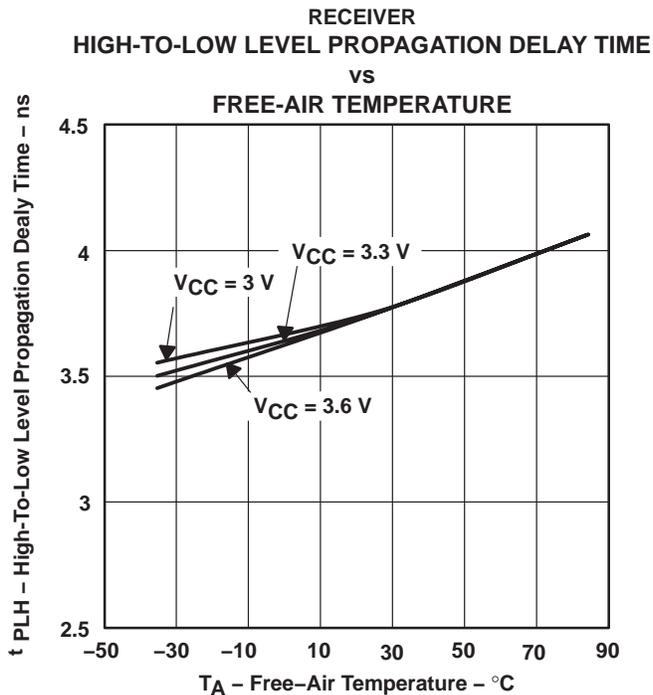


Figure 16

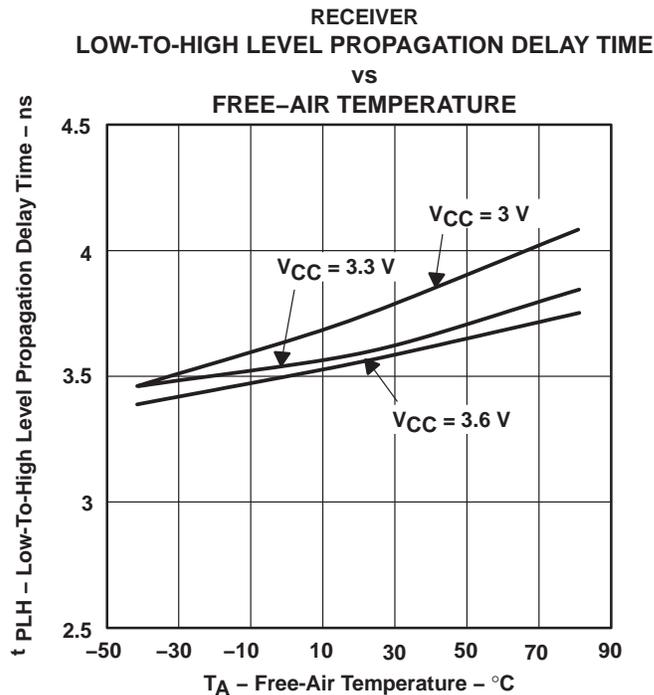


Figure 17

SN65LVDM050-Q1, SN65LVDM051-Q1 HIGH-SPEED DIFFERENTIAL LINE DRIVERS AND RECEIVERS

SGLS128A – JULY 2002 – REVISED APRIL 2008

APPLICATION INFORMATION

The devices are generally used as building blocks for high-speed point-to-point data transmission. Ground differences are less than 1 V with a low common-mode output and balanced interface for very low noise emissions. Devices can interoperate with RS-422, PECL, and IEEE-P1596. Drivers/receivers maintain ECL speeds without the power and dual supply requirements.

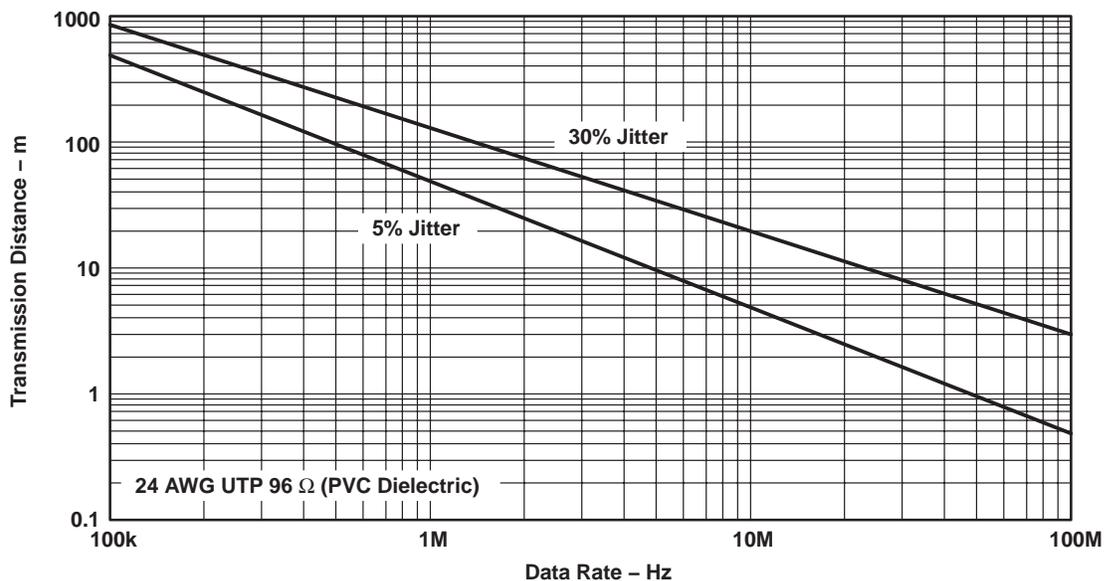


Figure 18. Data Transmission Distance Versus Rate

APPLICATION INFORMATION

fail safe

One of the most common problems with differential signaling applications is how the system responds when no differential voltage is present on the signal pair. The LVDS receiver is like most differential line receivers, in that its output logic state can be indeterminate when the differential input voltage is between -50 mV and 50 mV and within its recommended input common-mode voltage range. TI's LVDS receiver is different, however, in how it handles the open-input circuit situation.

Open-circuit means that there is little or no input current to the receiver from the data line itself. This could be when the driver is in a high-impedance state or the cable is disconnected. When this occurs, the LVDS receiver pulls each line of the signal pair to near V_{CC} through $300\text{-k}\Omega$ resistors as shown in Figure 18. The fail-safe feature uses an AND gate with input voltage thresholds at about 2.3 V to detect this condition and force the output to a high-level, regardless of the differential input voltage.

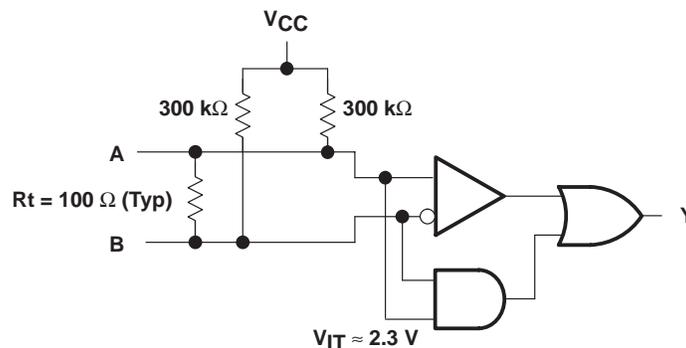


Figure 19. Open-Circuit Fail Safe of the LVDS Receiver

It is only under these conditions that the output of the receiver is valid with less than a 50-mV differential input voltage magnitude. The presence of the termination resistor, R_t , does not affect the fail-safe function as long as it is connected as shown in the figure. Other termination circuits may allow a dc current to ground that could defeat the pullup currents from the receiver and the fail-safe feature.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN65LVDM050QDG4Q1	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	LVDM050Q	Samples
SN65LVDM050QDQ1	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	LVDM050Q	Samples
SN65LVDM050QDRG4Q1	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	LVDM050Q	Samples
SN65LVDM050QDRQ1	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	LVDM050Q	Samples
SN65LVDM051QDG4Q1	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	LVDM051Q	Samples
SN65LVDM051QDQ1	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	LVDM051Q	Samples
SN65LVDM051QDRG4Q1	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	LVDM051Q	Samples
SN65LVDM051QDRQ1	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	LVDM051Q	Samples

(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.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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.

OTHER QUALIFIED VERSIONS OF SN65LVDM050-Q1, SN65LVDM051-Q1 :

- Catalog: [SN65LVDM050](#), [SN65LVDM051](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

TAPE AND REEL INFORMATION



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN65LVDM050QDRQ1	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
SN65LVDM051QDRG4Q1	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
SN65LVDM051QDRQ1	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1

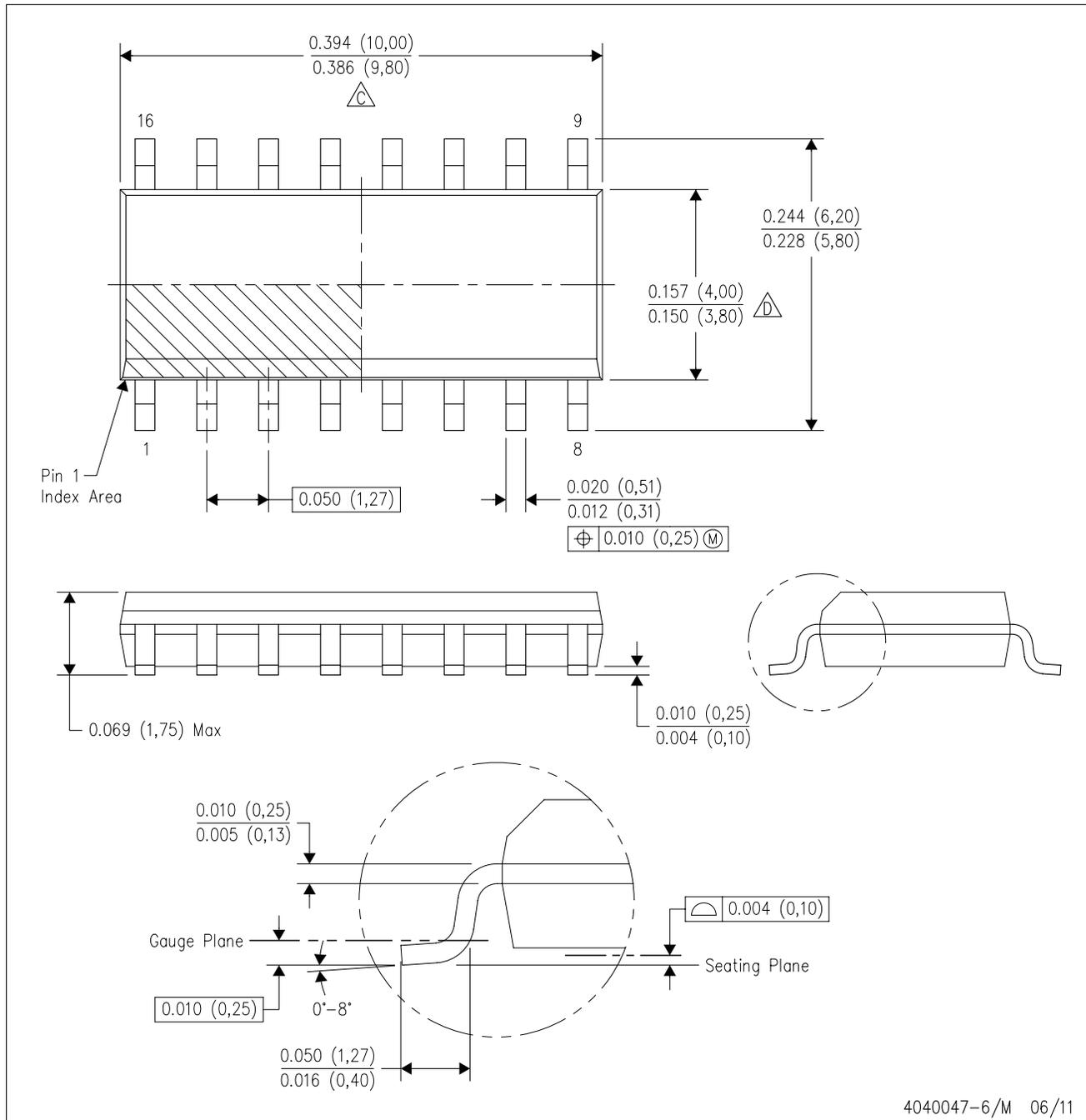
TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN65LVDM050QDRQ1	SOIC	D	16	2500	367.0	367.0	38.0
SN65LVDM051QDRG4Q1	SOIC	D	16	2500	367.0	367.0	38.0
SN65LVDM051QDRQ1	SOIC	D	16	2500	367.0	367.0	38.0

D (R-PDSO-G16)

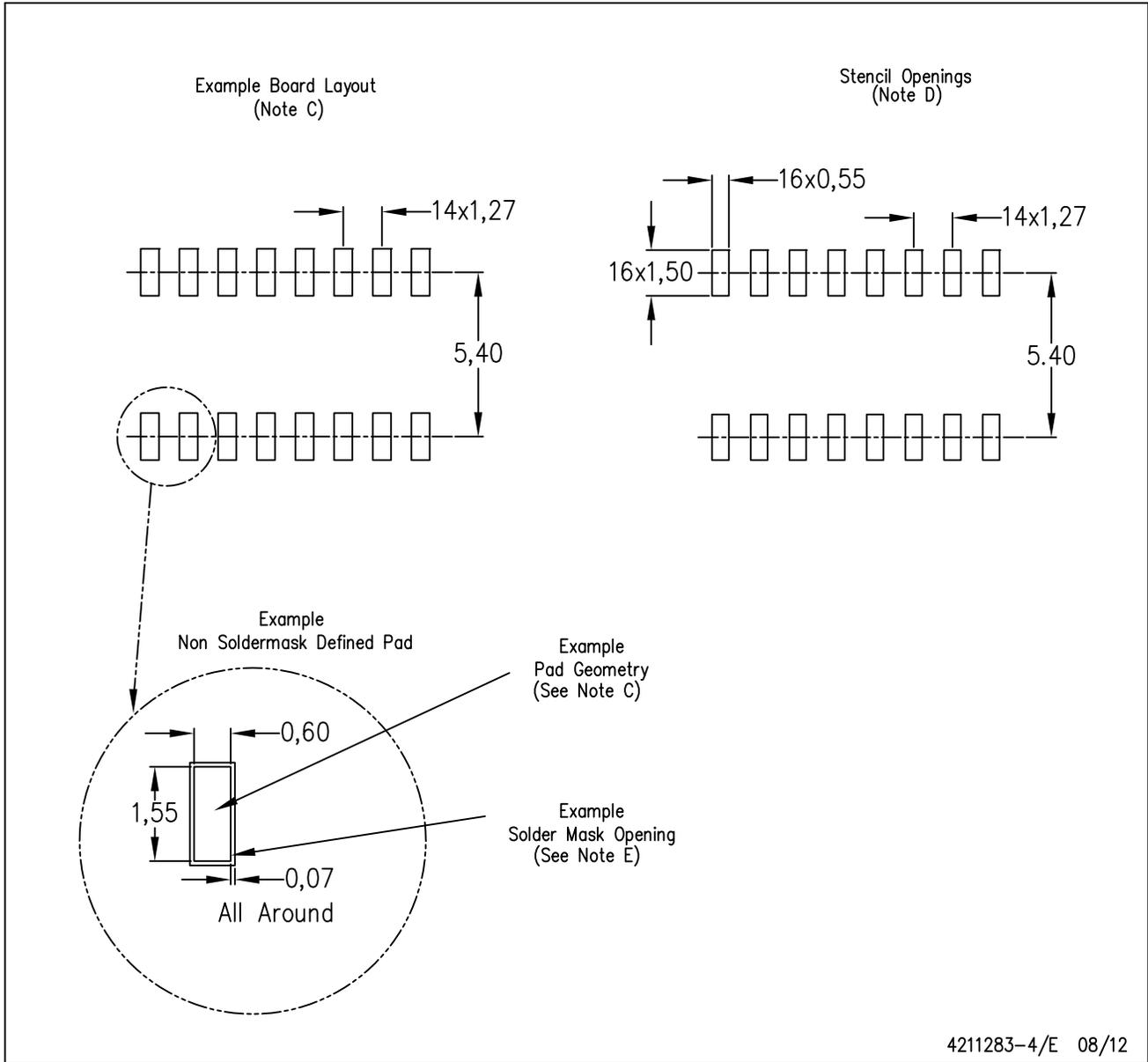
PLASTIC SMALL OUTLINE



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

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - 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.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

IMPORTANT NOTICE

Texas Instruments Incorporated (TI) reserves the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete.

TI's published terms of sale for semiconductor products (<http://www.ti.com/sc/docs/stdterms.htm>) apply to the sale of packaged integrated circuit products that TI has qualified and released to market. Additional terms may apply to the use or sale of other types of TI products and services.

Reproduction of significant portions of TI information in TI data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such reproduced documentation. Information of third parties may be subject to additional restrictions. Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyers and others who are developing systems that incorporate TI products (collectively, "Designers") understand and agree that Designers remain responsible for using their independent analysis, evaluation and judgment in designing their applications and that Designers have full and exclusive responsibility to assure the safety of Designers' applications and compliance of their applications (and of all TI products used in or for Designers' applications) with all applicable regulations, laws and other applicable requirements. Designer represents that, with respect to their applications, Designer has all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. Designer agrees that prior to using or distributing any applications that include TI products, Designer will thoroughly test such applications and the functionality of such TI products as used in such applications.

TI's provision of technical, application or other design advice, quality characterization, reliability data or other services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, "TI Resources") are intended to assist designers who are developing applications that incorporate TI products; by downloading, accessing or using TI Resources in any way, Designer (individually or, if Designer is acting on behalf of a company, Designer's company) agrees to use any particular TI Resource solely for this purpose and subject to the terms of this Notice.

TI's provision of TI Resources does not expand or otherwise alter TI's applicable published warranties or warranty disclaimers for TI products, and no additional obligations or liabilities arise from TI providing such TI Resources. TI reserves the right to make corrections, enhancements, improvements and other changes to its TI Resources. TI has not conducted any testing other than that specifically described in the published documentation for a particular TI Resource.

Designer is authorized to use, copy and modify any individual TI Resource only in connection with the development of applications that include the TI product(s) identified in such TI Resource. NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER TI INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT OF TI OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of TI Resources may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

TI RESOURCES ARE PROVIDED "AS IS" AND WITH ALL FAULTS. TI DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS. TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY DESIGNER AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN TI RESOURCES OR OTHERWISE. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF TI RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Unless TI has explicitly designated an individual product as meeting the requirements of a particular industry standard (e.g., ISO/TS 16949 and ISO 26262), TI is not responsible for any failure to meet such industry standard requirements.

Where TI specifically promotes products as facilitating functional safety or as compliant with industry functional safety standards, such products are intended to help enable customers to design and create their own applications that meet applicable functional safety standards and requirements. Using products in an application does not by itself establish any safety features in the application. Designers must ensure compliance with safety-related requirements and standards applicable to their applications. Designer may not use any TI products in life-critical medical equipment unless authorized officers of the parties have executed a special contract specifically governing such use. Life-critical medical equipment is medical equipment where failure of such equipment would cause serious bodily injury or death (e.g., life support, pacemakers, defibrillators, heart pumps, neurostimulators, and implantables). Such equipment includes, without limitation, all medical devices identified by the U.S. Food and Drug Administration as Class III devices and equivalent classifications outside the U.S.

TI may expressly designate certain products as completing a particular qualification (e.g., Q100, Military Grade, or Enhanced Product). Designers agree that it has the necessary expertise to select the product with the appropriate qualification designation for their applications and that proper product selection is at Designers' own risk. Designers are solely responsible for compliance with all legal and regulatory requirements in connection with such selection.

Designer will fully indemnify TI and its representatives against any damages, costs, losses, and/or liabilities arising out of Designer's non-compliance with the terms and provisions of this Notice.