查询"SN65LVDS33-EP"供应商

HIGH-SPEED DIFFERENTIAL RECEIVER

FEATURES

- **Controlled Baseline – One Assembly/Test Site, One Fabrication Site**
- **Extended Temperature Performance of Up to –55°C to 125°C**
- **Enhanced Diminishing Manufacturing Sources (DMS) Support**
- **Enhanced Product-Change Notification**
- **Qualification Pedigree** (1)
- **400-Mbps Signaling Rate** (2) **and 200-Mxfr/s Data Transfer Rate**
- **Operates With a Single 3.3-V Supply**
- **–4 V to 5 V Common-Mode Input Voltage Range**
- **Differential Input Thresholds < ±50 mV With 50 mV of Hysteresis Over Entire Common-Mode Input Voltage Range**
- **Integrated 110-Ω Line Termination Resistors On LVDT Products**
- **Complies With TIA/EIA-644 (LVDS)**
- **Active Failsafe Assures a High-Level Output With No Input**
- **Bus-Pin ESD Protection Exceeds 15-kV HBM**
- **Input Remains High-Impedance On Power Down**
- **TTL Inputs Are 5-V Tolerant**
- **Pin-Compatible With the AM26LS32, SN65LVDS32B, µA9637, SN65LVDS9637B**

(1) Component qualification in accordance with JEDEC and industry standards to ensure reliable operation over an extended temperature range. This includes, but is not limited to, Highly Accelerated Stress Test (HAST) or biased 85/85, temperature cycle, autoclave or unbiased HAST, electromigration, bond intermetallic life, and mold compound life. Such qualification testing should not be viewed as justifying use of this component beyond specified performance and environmental limits.

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

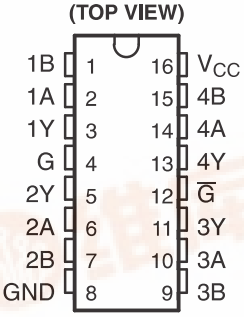
DESCRIPTION

This family of four LVDS data line receivers offers the widest common-mode input voltage range in the industry. These receivers provide an input voltage range specification compatible with a 5-V PECL signal as well as an overall increased ground-noise tolerance. They are in industry standard footprints with integrated termination as an option.

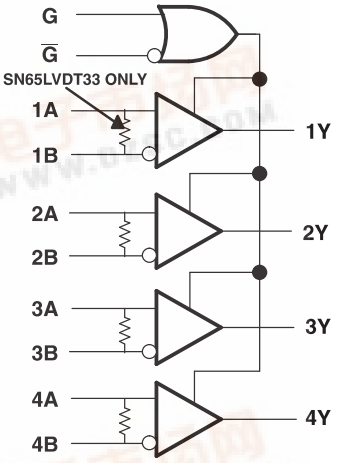
Precise control of the differential input voltage thresholds allows for inclusion of 50 mV of input voltage hysteresis to improve noise rejection on slowly changing input signals. The input thresholds are still no more than +50 mV over the full input common-mode voltage range.

SN65LVDS33D

D PACKAGE
(TOP VIEW)



logic diagram (positive logic)



ORDERING INFORMATION(1)

T_A	PACKAGE(2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–55°C to 125°C	SOIC - D	Reel of 2500	SN65LVDS33MDREP	LVDS33M
	SOIC - D	Reel of 2500	SN65LVDT33MDREP(3)	LVDT33M

(1) 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.

(2) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

(3) Product Preview

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.

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DESCRIPTION (CONTINUED)

The high-speed switching of LVDS signals usually necessitates the use of a line impedance matching resistor at the receiving-end of the cable or transmission media. The SN65LVDT series of receivers eliminates this external resistor by integrating it with the receiver. The nonterminated SN65LVDS series is also available for multidrop or other termination circuits.

The receivers can withstand ±15-kV human-body model (HBM) and ±600-V machine model (MM) electrostatic discharges to the receiver input pins with respect to ground without damage. This provides reliability in cabled and other connections where potentially damaging noise is always a threat.

The receivers also include a (patent pending) failsafe circuit that provides a high-level output within 600 ns after loss of the input signal. The most common causes of signal loss are disconnected cables, shorted lines, or powered-down transmitters. The failsafe circuit prevents noise from being received as valid data under these fault conditions. This feature may also be used for Wired-Or bus signaling. See *The Active Failsafe Feature of the SN65LVDS32B* application note.

The intended application and signaling technique of these devices is point-to-point baseband data transmission over controlled impedance media of approximately 100 Ω. The transmission media may be printed-circuit board traces, backplanes, or cables. The ultimate rate and distance of data transfer is dependent upon the attenuation characteristics of the media and the noise coupling to the environment.

The SN65LVDS33-EP is characterized for operation from –55°C to 125°C.

FUNCTION TABLE(1)

SN65LVDS33 and SN65LVDT33			
DIFFERENTIAL INPUT	**ENABLES**		**OUTPUT**
$V_{ID} = V_A - V_B$	**G**	**$\overline{G}$**	**Y**
$V_{ID} \geq -32$ mV	H	X	H
	X	L	H
-100 mV $< V_{ID} \leq -32$ mV	H	X	?
	X	L	?
$V_{ID} \leq -100$ mV	H	X	L
	X	L	L
X	L	H	Z
Open	H	X	H
	X	L	H

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

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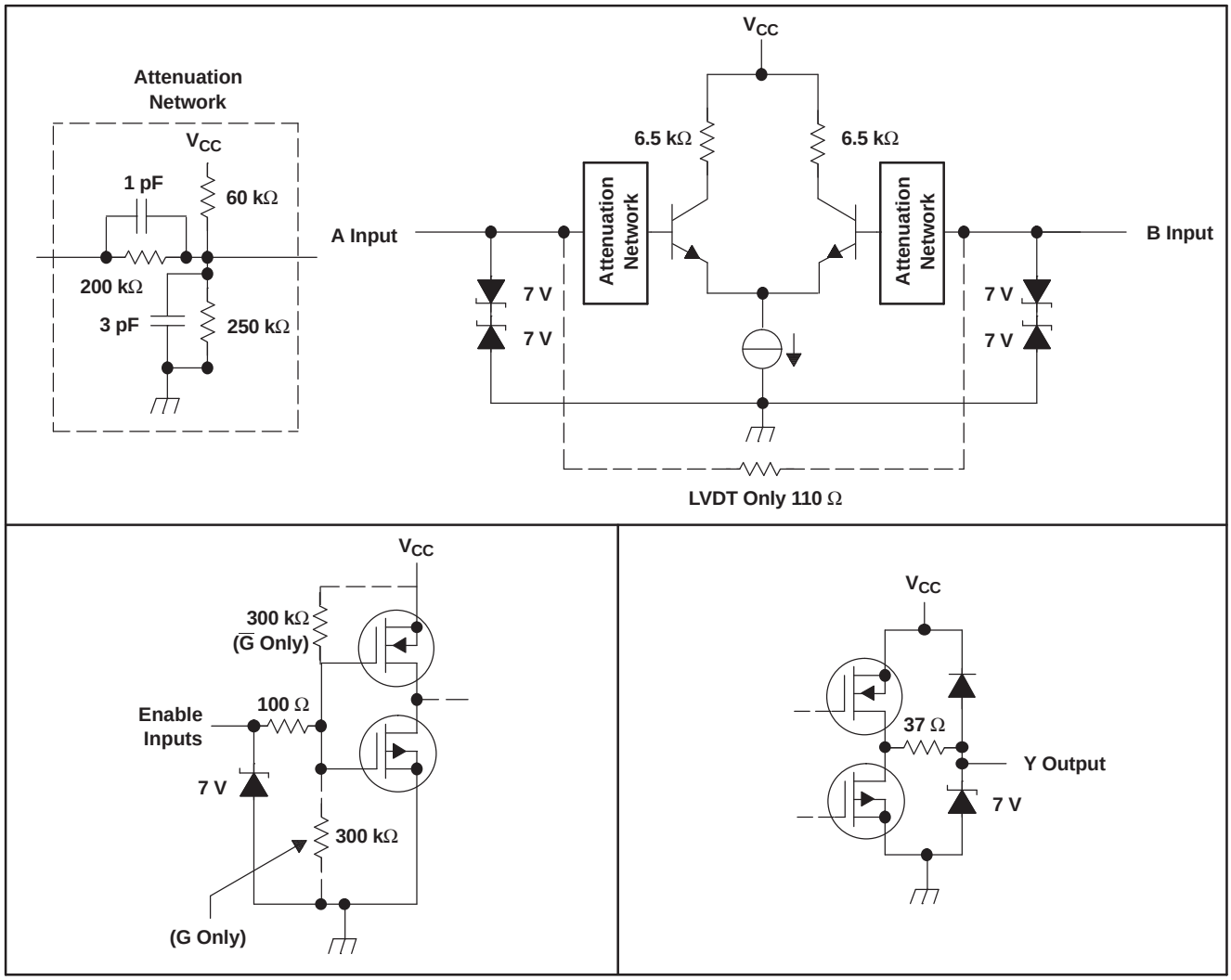
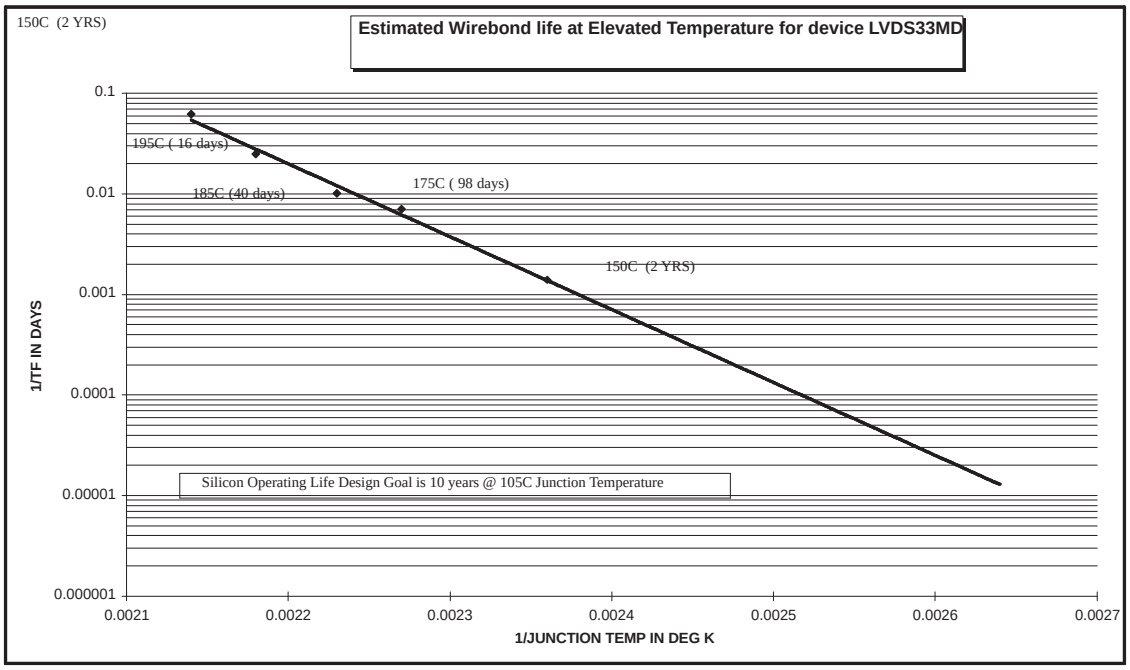
EQUIVALENT INPUT AND OUTPUT SCHEMATIC DIAGRAMS





ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range (unless otherwise noted)(1)

		VALUE/UNIT
Supply voltage range, V_{CC} (2)		–0.5 V to 4 V
Voltage range	Enables or Y	–1 V to 6 V
	A or B	–5 V to 6 V
	|VA – VB| (LVDT)	1 V
Electrostatic discharge	A, B, and GND(3)	Class 3, A: 15 kV, B: 500 V
Charged-device mode	All pins(4)	±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		260°C

(1) Stresses beyond those listed under *absolute maximum ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltage values, except differential I/O bus voltages, are with respect to network ground terminal.
(3) Tested in accordance with JEDEC Standard 22, Test Method A114-A.
(4) Tested in accordance with JEDEC Standard 22, Test Method C101.

DISSIPATION RATINGS

PACKAGE	$T_A \leq 25°C$ POWER RATING	OPERATING FACTOR(1) ABOVE $T_A = 25°C$	$T_A = 85°C$ POWER RATING	$T_A = 125°C$ POWER RATING
D16	950 mW	7.6 mW/°C	494 mW	189 mW

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

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RECOMMENDED OPERATING CONDITIONS

			MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage		3	3.3	3.6	V
V_{IH}	High-level input voltage	Enables	2		5	V
V_{IL}	Low-level input voltage	Enables	0		0.8	V
$\|V_{ID}\|$	Magnitude of differential input voltage	LVDS	0.1		3	V
		LVDT			0.8	
V_I or V_{IC}	Voltage at any bus terminal (separately or common-mode)		–4		5	°C
T_A	Operating free-air temperature		–55		125	

ELECTRICAL CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER			TEST CONDITIONS		MIN	TYP(1)	MAX	UNIT
V_{IT1}	Positive-going differential input voltage threshold		V_{IB} = –4 V or 5 V, See Figure 2				50	mV
V_{IT2}	Negative-going differential input voltage threshold				–50			
V_{IT3}	Differential input failsafe voltage threshold		See Table 1 and Figure 5		–32		–100	mV
$V_{ID(HYS)}$	Differential input voltage hysteresis, $V_{IT1} – V_{IT2}$					50		V
V_{OH}	High-level output voltage		I_{OH} = –4 mA		2.4			V
V_{OL}	Low-level output voltage		I_{OL} = 4 mA				0.4	V
I_{CC}	Supply current	SN65LVDx33	G at V_{CC}, No load,	Steady state		16	25	mA
			G at GND			1.1	6	
I_I	Input current (A or B inputs)	SN65LVDS	V_I = 0 V,	Other input open			±25	µA
			V_I = 2.4 V,	Other input open			±25	
			V_I = –4 V,	Other input open			±80	
			V_I = 5 V,	Other input open			±45	
		SN65LVDT	V_I = 0 V,	Other input open			±50	µA
			V_I = 2.4 V,	Other input open			±50	
			V_I = –4 V,	Other input open			±180	
			V_I = 5 V,	Other input open			±95	
I_{IO}	Differential input current ($I_{IA} – I_{IB}$)	SN65LVDS	V_{ID} = 100 mV,	V_{IC}= –4 V or 5 V			±5	µA
		SN65LVDT	V_{ID} = 200 mV,	V_{IC}= –4 V or 5 V	1.55		2.4	mA
$I_{I(OFF)}$	Power-off input current (A or B inputs)	SN65LVDS	V_A or V_B = 0 V or 2.4 V, V_{CC} = 0 V				±25	µA
			V_A or V_B = –4 or 5 V, V_{CC} = 0 V				±60	
		SN65LVDT	V_A or V_B = 0 V or 2.4 V, V_{CC} = 0 V				±35	
			V_A or V_B = –4 V or 5 V, V_{CC} = 0 V				±120	
I_{IH}	High-level input current (enables)		V_{IH} = 2 V				12	µA
I_{IL}	Low-level input current (enables)		V_{IL} = 0.8 V				12	µA
I_{OZ}	High-impedance output current				–10		12	µA
C_I	Input capacitance, A or B input to GND		V_I = 0.4 sin (4E6πt) + 0.5 V			5		pF

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

SWITCHING CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
$t_{PLH(1)}$	Propagation delay time, low-to-high level output	See Figure 3	1.8	4	8	ns
$t_{PHL(1)}$	Propagation delay time, high-to-low level output		1.8	4	8	ns
t_{d1}	Delay time, failsafe deactivate time	C_L = 10 pF, See Figure 3 and Figure 6			11	ns
t_{d2}	Delay time, failsafe activate time		0.2		2	µs
$t_{sk(p)}$	Pulse skew ($\lvert t_{PHL(1)} - t_{PLH(1)} \rvert$)	See Figure 3		200		ps
$t_{sk(o)}$	Output skew(2)			150		ps
$t_{sk(pp)}$	Part-to-part skew(3)				1.2	ns
t_r	Output signal rise time			0.8		ns
t_f	Output signal fall time			0.8		ns
t_{PHZ}	Propagation delay time, high level-to-high impedance output	See Figure 4		5.5	12	ns
t_{PLZ}	Propagation delay time, low level-to-high impedance output			4.4	12	ns
t_{PZH}	Propagation delay time, high impedance-to-high level output			3.8	12	ns
t_{PZL}	Propagation delay time, high impedance-to-low level output			7	12	ns

(1) All typical values are at 25°C and with a 3.3-V supply.
(2) $t_{sk(o)}$ is the magnitude of the time difference between the t_{PLH} or t_{PHL} of all receivers of a single device with all of their inputs driven together.
(3) $t_{sk(pp)}$ is the magnitude of the time 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.

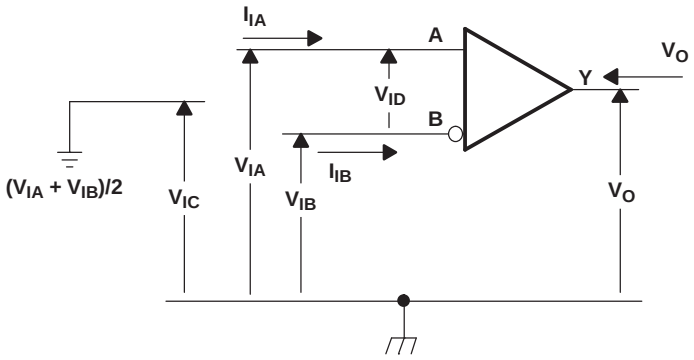
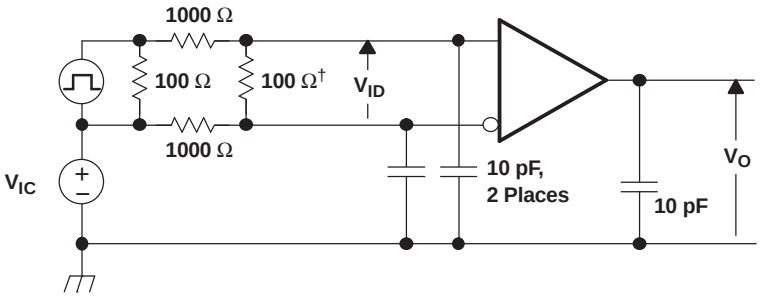
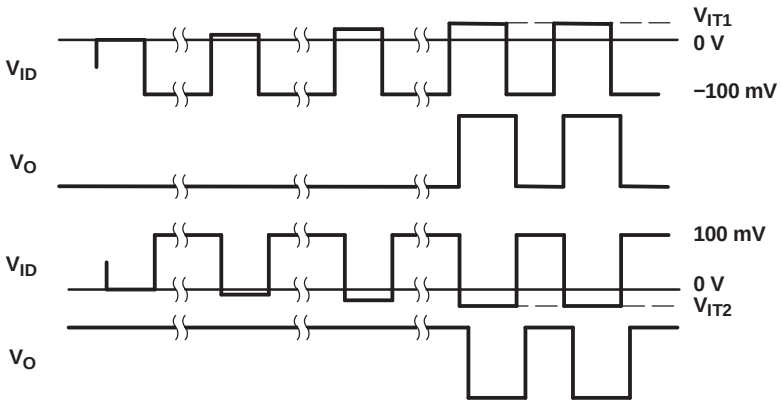


Figure 1. Voltage and Current Definitions

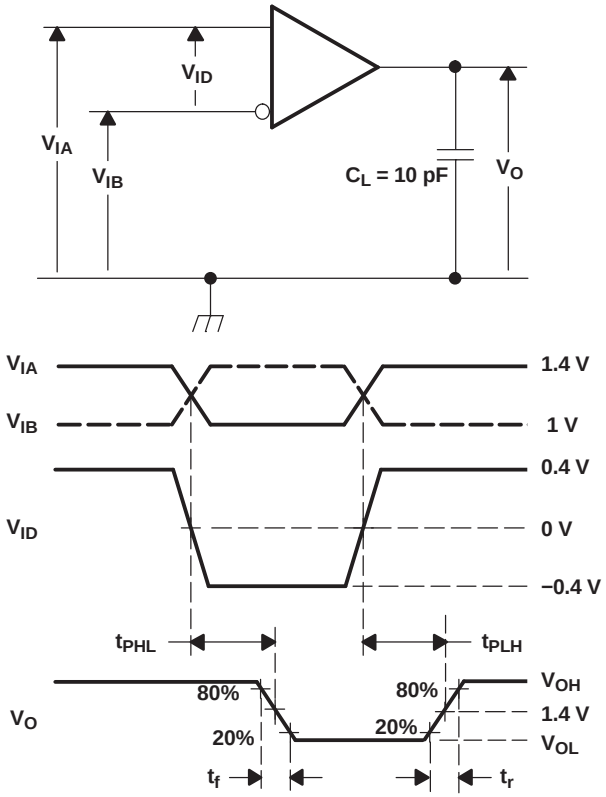


† Remove for testing LVDT device.



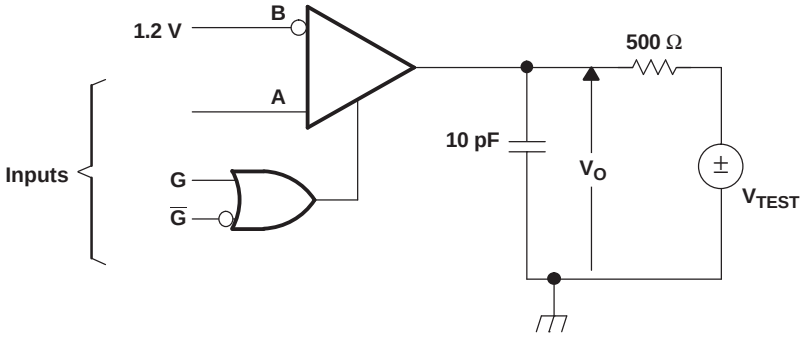
NOTE: Input signal of 3 Mpps, duration of 167 ns, and transition time of <1 ns.

Figure 2. V_{IT1} and V_{IT2} Input Voltage Threshold Test Circuit and Definitions



NOTE: 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, pulsewidth = 10 ±0.2 ns . C_L includes instrumentation and fixture capacitance within 0,06 mm of the D.U.T.

Figure 3. Timing Test Circuit and Waveforms



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

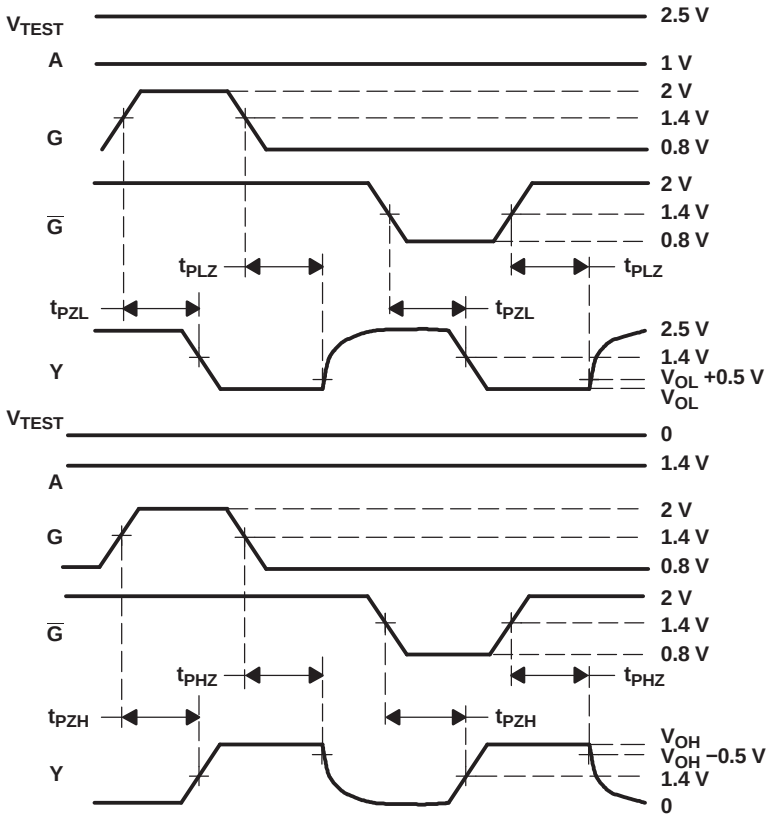


Figure 4. Enable/Disable Time Test Circuit and Waveforms

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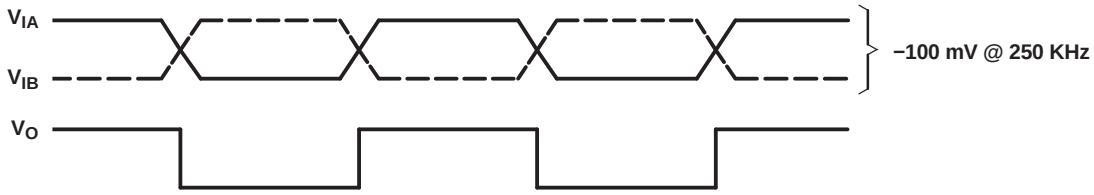
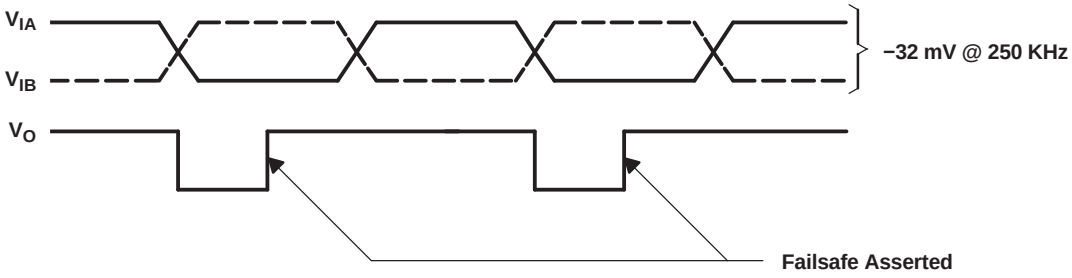
Table 1. Receiver Minimum and Maximum V_{IT3} Input Threshold Test Voltages

APPLIED VOLTAGES(1)		RESULTANT INPUTS		
V_{IA} (mV)	V_{IB} (mV)	V_{ID} (mV)	V_{IC} (mV)	Output
–4000	–3900	–100	–3950	L
–4000	–3968	–32	–3984	H
4900	5000	–100	4950	L
4968	5000	–32	4984	H

(1) These voltages are applied for a minimum of 1.5 µs.



a) No Failsafe



b) Failsafe Asserted

Figure 5. V_{IT3} Failsafe Threshold Test

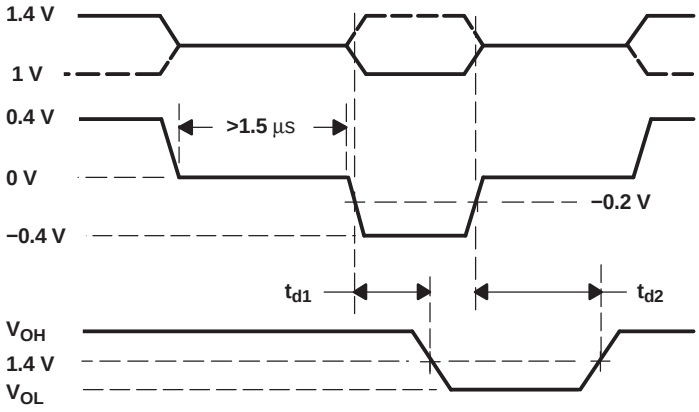


Figure 6. Waveforms for Failsafe Activate and Deactivate

TYPICAL CHARACTERISTICS

LOW-LEVEL OUTPUT VOLTAGE
vs
LOW-LEVEL OUTPUT CURRENT

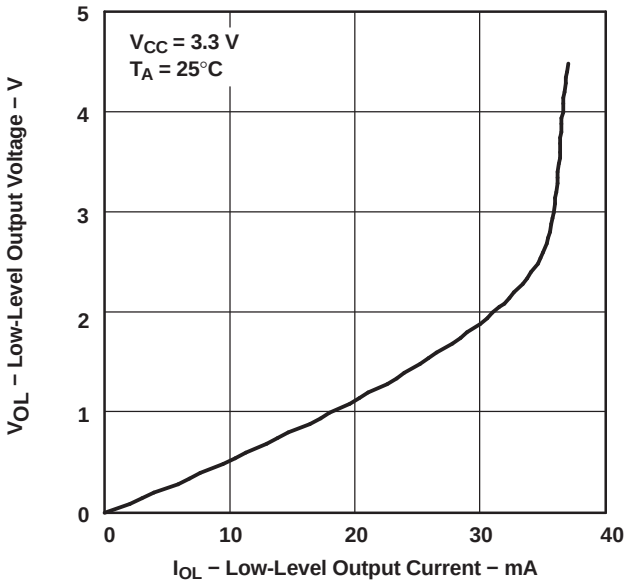


Figure 7.

HIGH-LEVEL OUTPUT VOLTAGE
vs
HIGH-LEVEL OUTPUT CURRENT

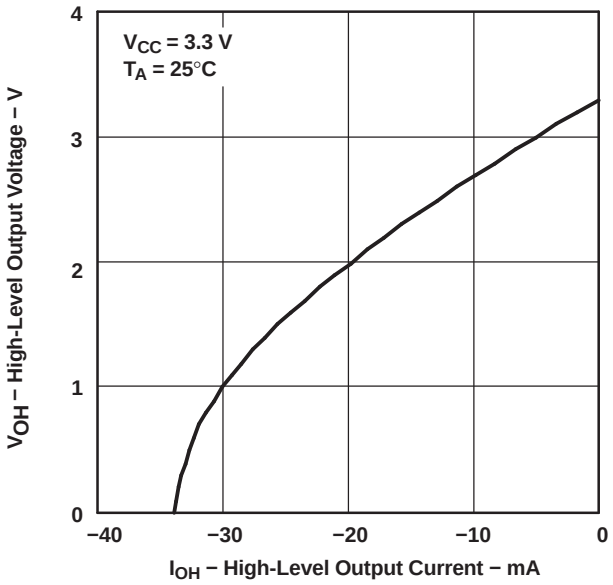


Figure 8.

LOW-TO-HIGH PROPAGATION DELAY TIME
vs
FREE-AIR TEMPERATURE

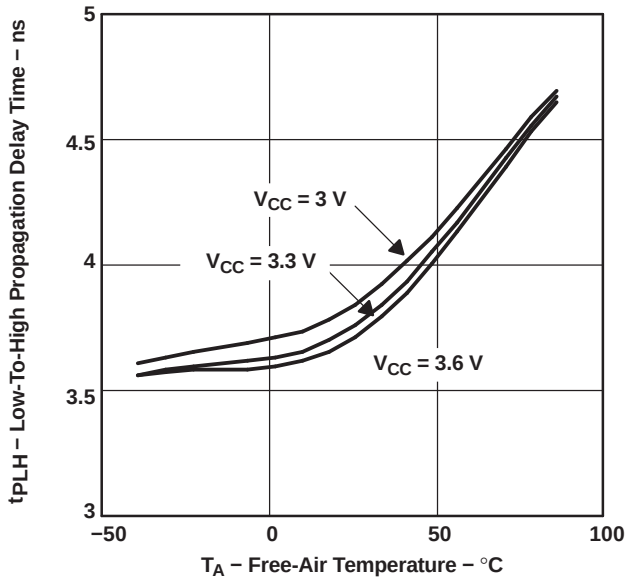


Figure 9.

HIGH-TO-LOW PROPAGATION DELAY TIME
vs
FREE-AIR TEMPERATURE

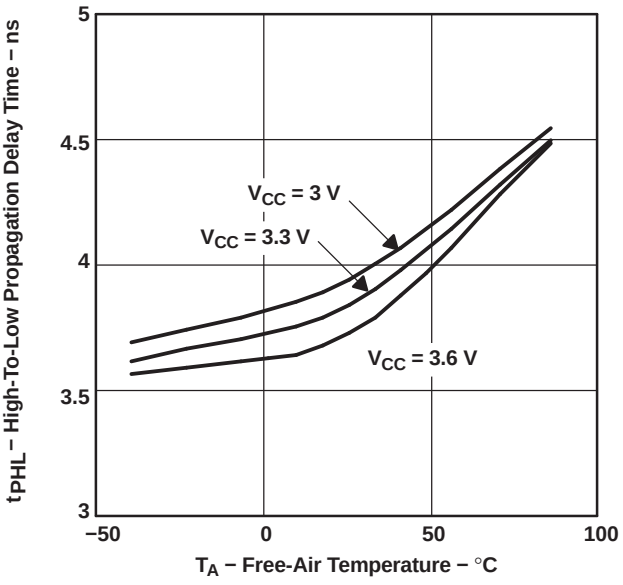


Figure 10.

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TYPICAL CHARACTERISTICS (continued)

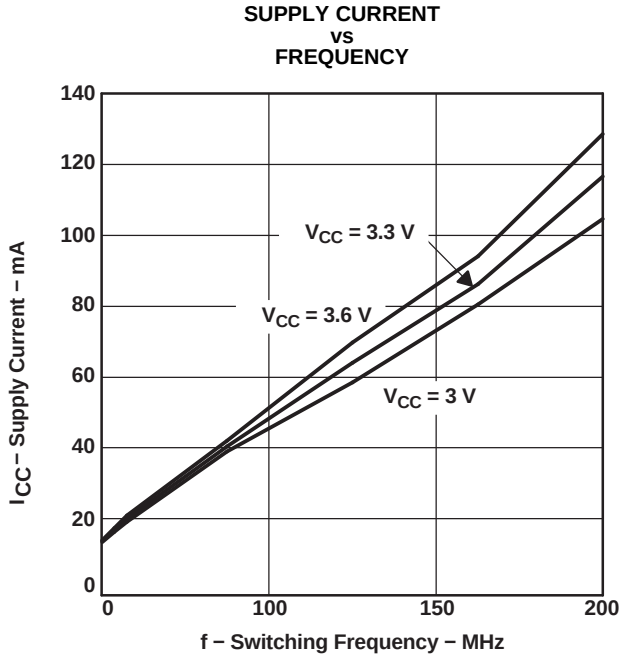
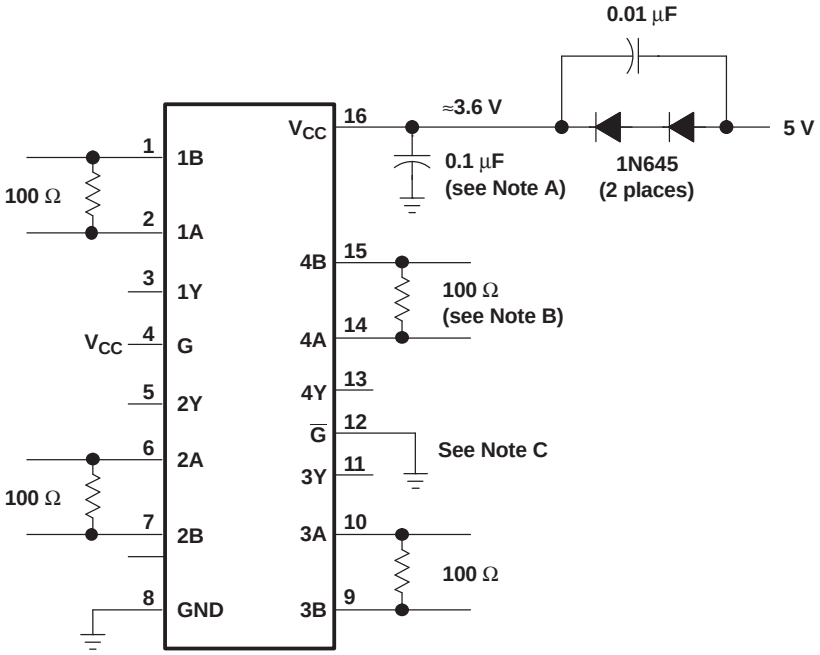


Figure 11.

APPLICATION INFORMATION



A. Place a 0.1-µF Z5U ceramic, mica or polystyrene dielectric, 0805 size, chip capacitor between V_{CC} and the ground plane. The capacitor should be located as close as possible to the device terminals.

B. The termination resistance value should match the nominal characteristic impedance of the transmission media with ±10%.

C. Unused enable inputs should be tied to V_{CC} or GND as appropriate.

Figure 12. Operation With 5-V Supply

RELATED INFORMATION

IBIS modeling is available for this device. Contact the local Texas Instruments sales office or the Texas Instruments Web site at www.ti.com for more information.

For more application guidelines, see the following documents:

- *Low-Voltage Differential Signalling Design Notes* (SLLA014)
- *Interface Circuits for TIA/EIA-644* (LVDS) (SLLA038)
- *Reducing EMI With LVDS* (SLLA030)
- *Slew Rate Control of LVDS Circuits* (SLLA034)
- *Using an LVDS Receiver With RS-422 Data* (SLLA031)
- *Evaluating the LVDS EVM* (SLLA033)

APPLICATION INFORMATION (continued)

ACTIVE FAILSAFE FEATURE

A differential line receiver commonly has a failsafe circuit to prevent it from switching on input noise. Current LVDS failsafe solutions require either external components with subsequent reductions in signal quality or integrated solutions with limited application. This family of receivers has a new integrated failsafe that solves the limitations seen in present solutions. A detailed theory of operation is presented in application note, *The Active Failsafe Feature of the SN65LVDS32B* (SLLA082A).

Figure 13 shows one receiver channel with active failsafe. It consists of a main receiver that can respond to a high-speed input differential signal. Also connected to the input pair are two failsafe receivers that form a window comparator. The window comparator has a much slower response than the main receiver and it detects when the input differential falls below 80 mV. A 600-ns failsafe timer filters the window comparator outputs. When failsafe is asserted, the failsafe logic drives the main receiver output to logic high.

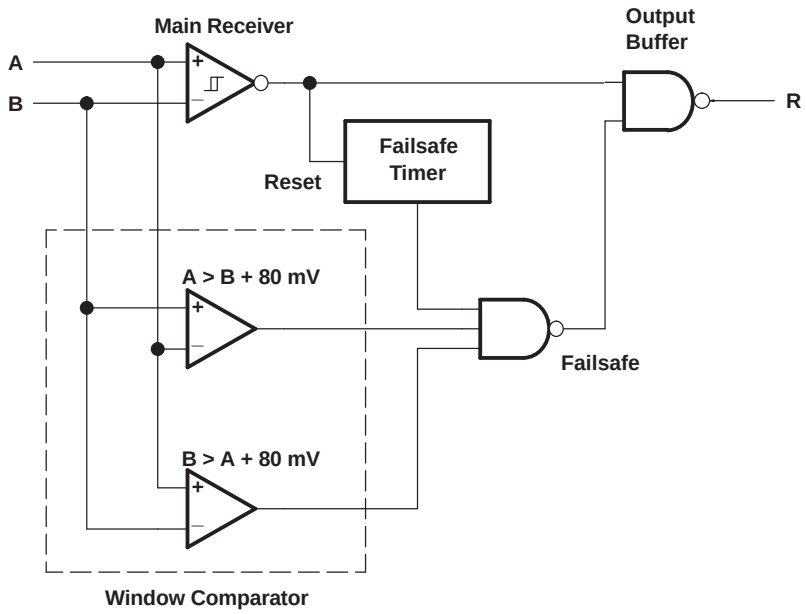


Figure 13. Receiver With Active Failsafe

APPLICATION INFORMATION (continued)

ECL/PECL-to-LVTTL CONVERSION WITH TI's LVDS RECEIVER

The various versions of emitter-coupled logic (i.e., ECL, PECL and LVPECL) are often the physical layer of choice for system designers. Designers know of the established technology and that it is capable of high-speed data transmission. In the past, system requirements often forced the selection of ECL. Now technologies like LVDS provide designers with another alternative. While the total exchange of ECL for LVDS may not be a design option, designers have been able to take advantage of LVDS by implementing a small resistor divider network at the input of the LVDS receiver. Texas Instruments has taken the next step by introducing a wide common-mode LVDS receiver (no divider network required) which can be connected directly to an ECL driver with only the termination bias voltage required for ECL termination (V_{CC} – 2 V).

Figure 14 and Figure 15 show the use of an LV/PECL driver driving five meters of CAT-5 cable and being received by Texas Instruments wide common-mode receiver and the resulting eye-pattern. The values for R3 are required in order to provide a resistor path to ground for the LV/PECL driver. With no resistor divider, R1 simply needs to match the characteristic load impedance of 50 Ω. The R2 resistor is a small value and is intended to minimize any possible common-mode current reflections.

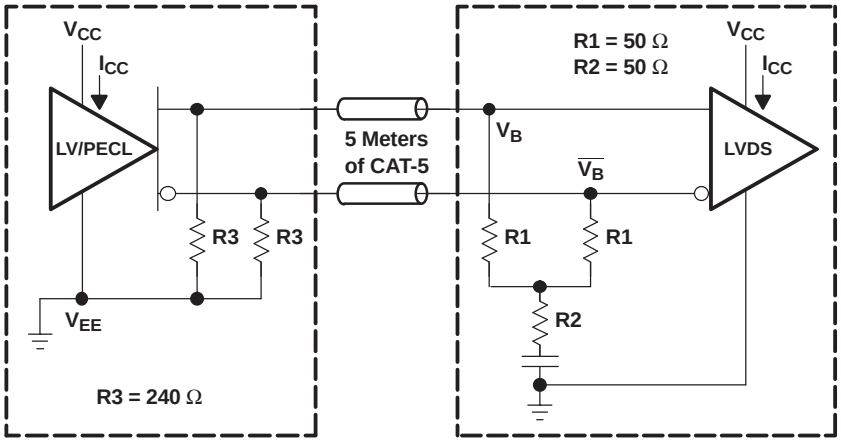


Figure 14. LVPECL or PECL to Remote Wide Common-Mode LVDS Receiver

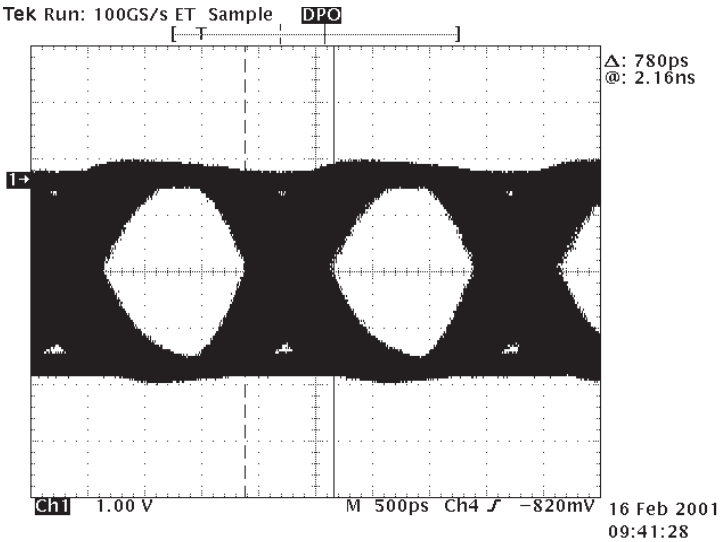


Figure 15. LV/PECL to Remote SN65LVDS33 at 500 Mbps Receiver Output (CH1)

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APPLICATION INFORMATION (continued)

TEST CONDITIONS

- V_{CC} = 3.3 V
- T_A = 25°C (ambient temperature)
- All four channels switching simultaneously with NRZ data. The scope is pulse-triggered simultaneously with NRZ data.

EQUIPMENT

- Tektronix PS25216 programmable power supply
- Tektronix HFS 9003 stimulus system
- Tektronix TDS 784D 4-channel digital phosphor oscilloscope – DPO

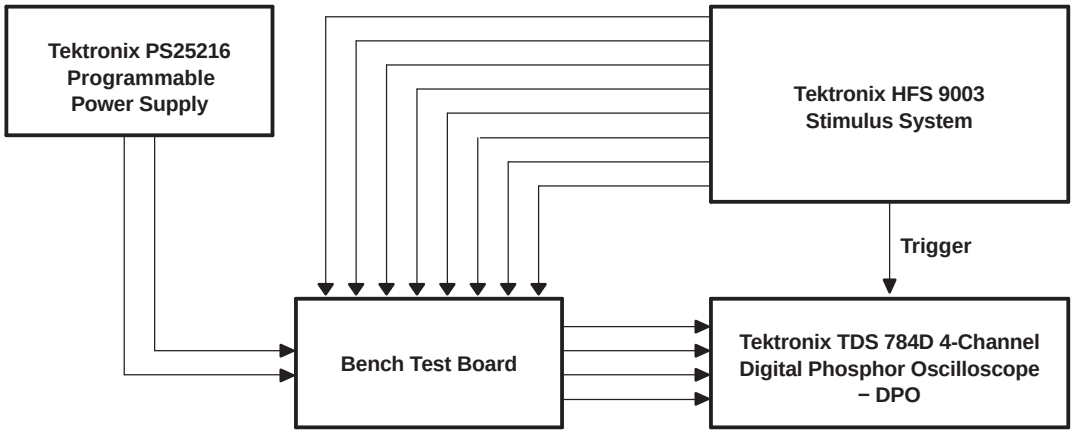
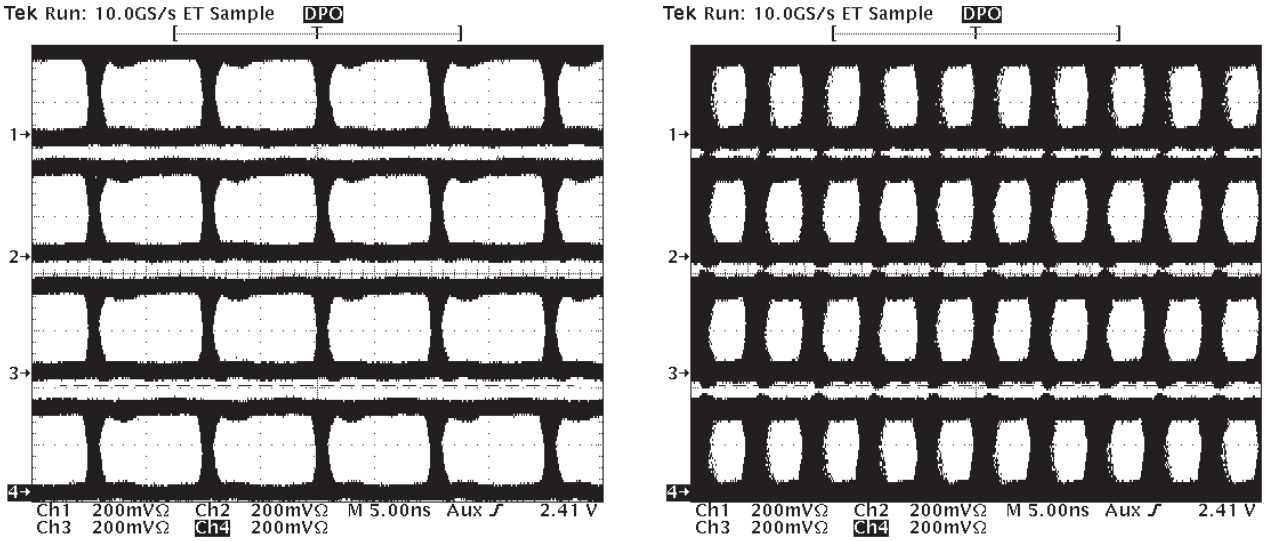


Figure 16. Equipment Setup



100 Mbit/s 200 Mbit/s

Figure 17. Typical Eye Pattern SN65LVDS33

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PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
SN65LVDS33MDREP	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
V62/05614-01XE	ACTIVE	SOIC	D	16	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 SN65LVDS33-EP :
- Catalog: SN65LVDS33

NOTE: Qualified Version Definitions:
- Catalog - TI's standard catalog product

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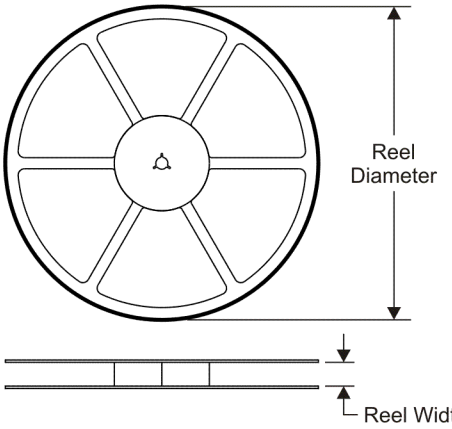
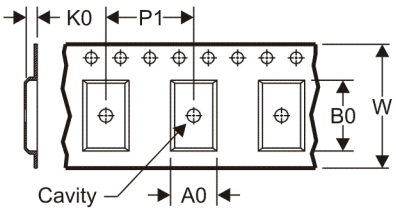
TAPE AND REEL INFORMATION

REEL DIMENSIONS

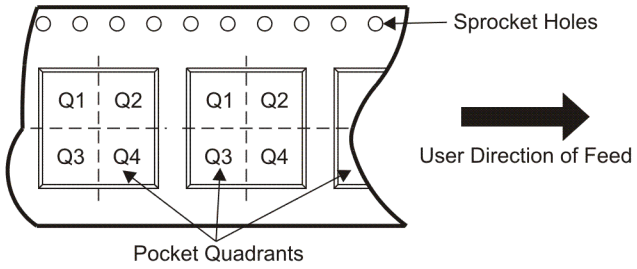


TAPE DIMENSIONS



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

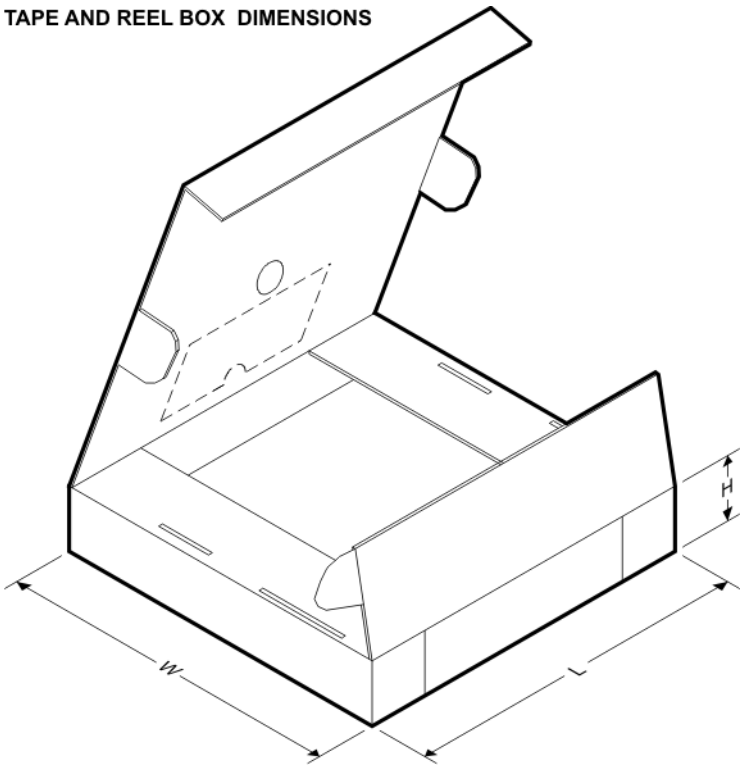
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN65LVDS33MDREP	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)
SN65LVDS33MDREP	SOIC	D	16	2500	346.0	346.0	33.0

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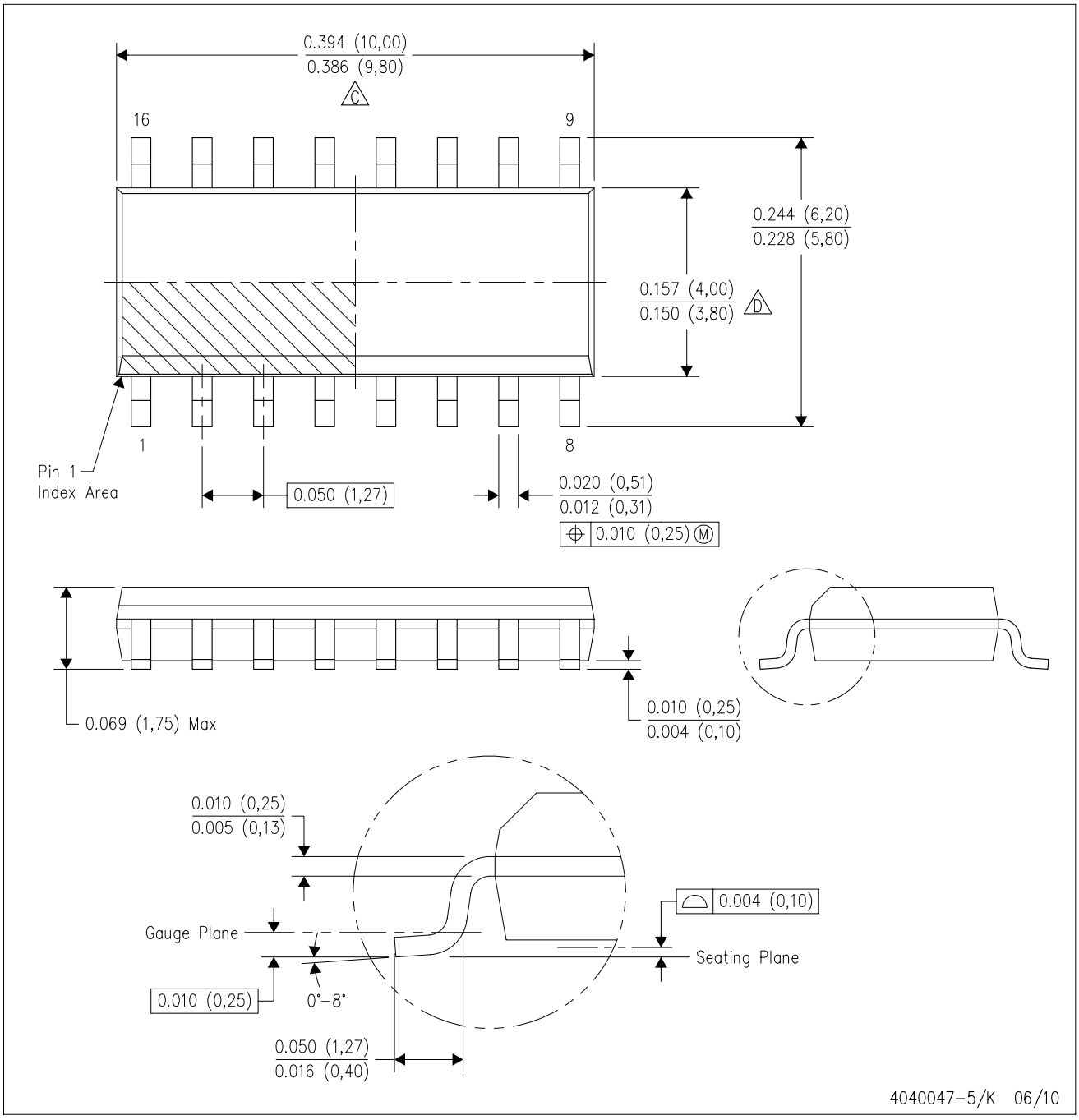
D (R–PDSO–G16) PLASTIC SMALL–OUTLINE PACKAGE



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 .006 (0,15) per end.
D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
E. Reference JEDEC MS–012 variation AC.

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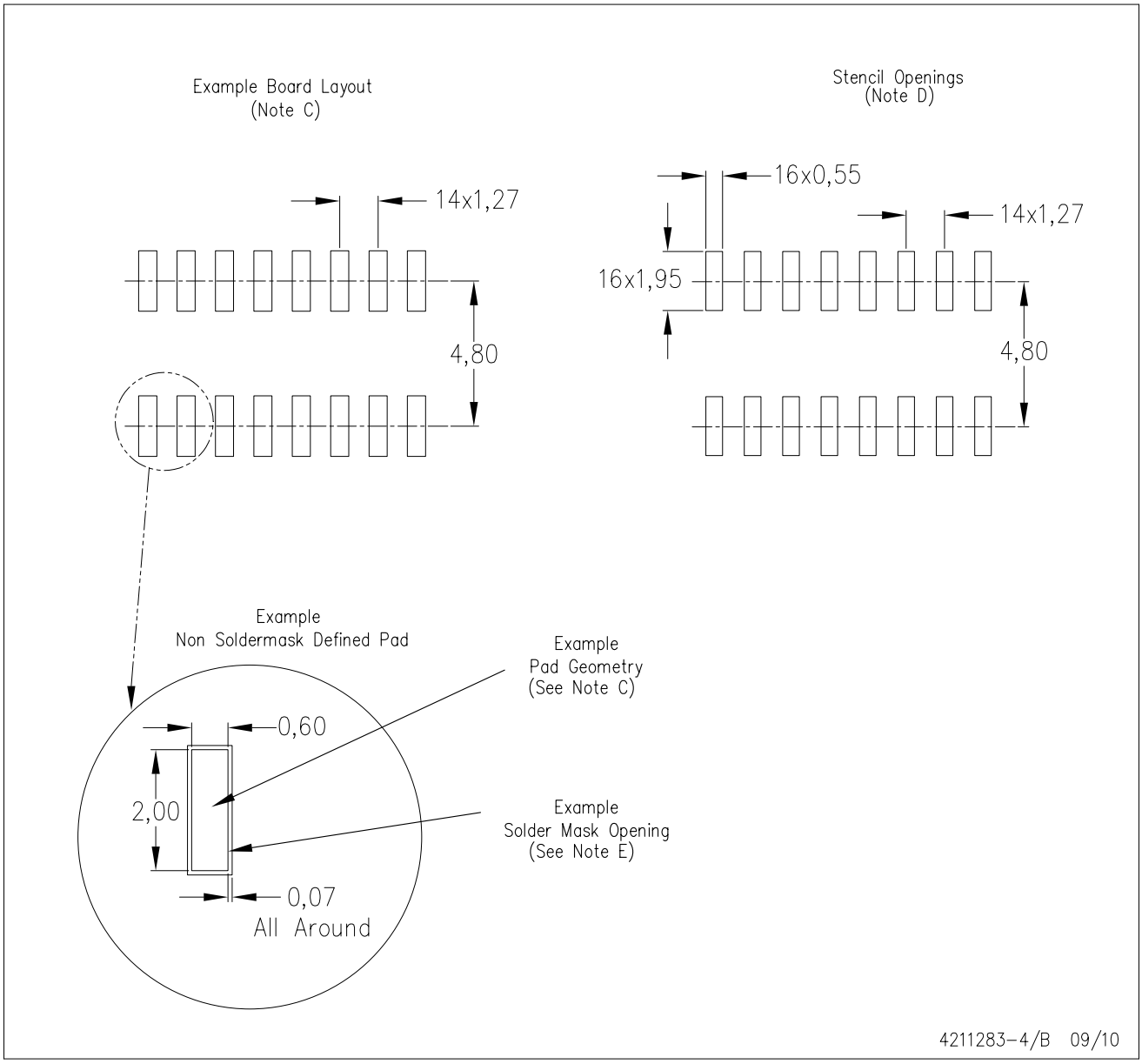
D (R–PDSO–G16) PLASTIC SMALL OUTLINE



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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