

SN65LBC170, SN75LBC170 TRIPLE DIFFERENTIAL TRANSCEIVERS

SLLS459B – NOVEMBER 2000 – REVISED FEBRUARY 2002

- Three Differential Transceivers in One Package
- Signaling Rates† Up to 30 Mbps
- Low Power and High Speed
- Designed for TIA/EIA-485, TIA/EIA-422, ISO 8482, and ANSI X3.277 (HVD SCSI Fast-20) Applications
- Common-Mode Bus Voltage Range –7 V to 12 V
- ESD Protection on Bus Terminals Exceeds 12 kV
- Driver Output Current up to ± 60 mA
- Thermal Shutdown Protection
- Driver Positive and Negative Current Limiting
- Power-Up, Power-Down Glitch-Free Operation
- Pin-Compatible With the SN75ALS170
- Available in Shrink Small-Outline Package

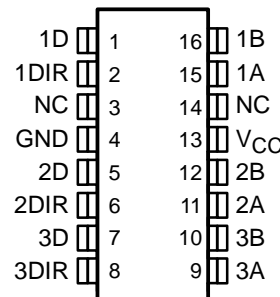
description

The SN65LBC170 and SN75LBC170 are monolithic integrated circuits designed for bidirectional data communication on multipoint bus-transmission lines. Potential applications include serial or parallel data transmission, cabled peripheral buses with twin axial, ribbon, or twisted-pair cabling. These devices are suitable for FAST-20 SCSI and can transmit or receive data pulses as short as 25 ns, with skew less than 3 ns.

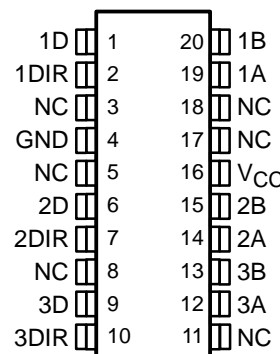
These devices combine three 3-state differential line drivers and three differential input line receivers, all of which operate from a single 5-V power supply.

The driver differential outputs and the receiver differential inputs are connected internally to form three differential input/output (I/O) bus ports that are designed to offer minimum loading to the bus whenever the driver is disabled or $V_{CC} = 0$. These ports feature a wide common-mode voltage range making the device suitable for party-line applications over long cable runs.

SN65LBC170DB (marked as BL170)
SN75LBC170DB (marked as BL170)
(TOP VIEW)

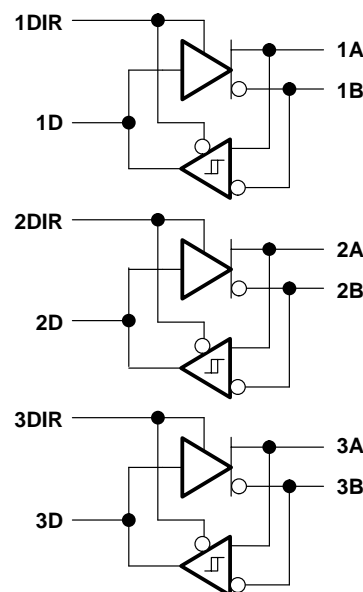


SN65LBC170DW (marked as 65LBC170)
SN75LBC170DW (marked as 75LBC170)
(TOP VIEW)



NC – No internal connection

logic diagram



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.

†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).

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 © 2002, Texas Instruments Incorporated

SN65LBC170, SN75LBC170

TRIPLE DIFFERENTIAL TRANSCEIVERS

SLLS459B – NOVEMBER 2000 – REVISED FEBRUARY 2002

description (continued)

The driver's active-high enable and the receiver's active-low enable are tied together internally and provide a direction input for each driver/receiver pair.

The SN75LBC170 is characterized for operation over the temperature range of 0°C to 70°C. The SN65LBC170 is characterized for operation over the temperature range of –40°C to 85°C.

AVAILABLE OPTIONS†

T _A	PACKAGE	
	PLASTIC SHRINK SMALL-OUTLINE (JEDEC MO-150)	PLASTIC SMALL-OUTLINE (JEDEC MS-013)
0°C to 70°C	SN75LBC170DB	SN75LBC170DW
–40°C to 85°C	SN65LBC170DB	SN65LBC170DW

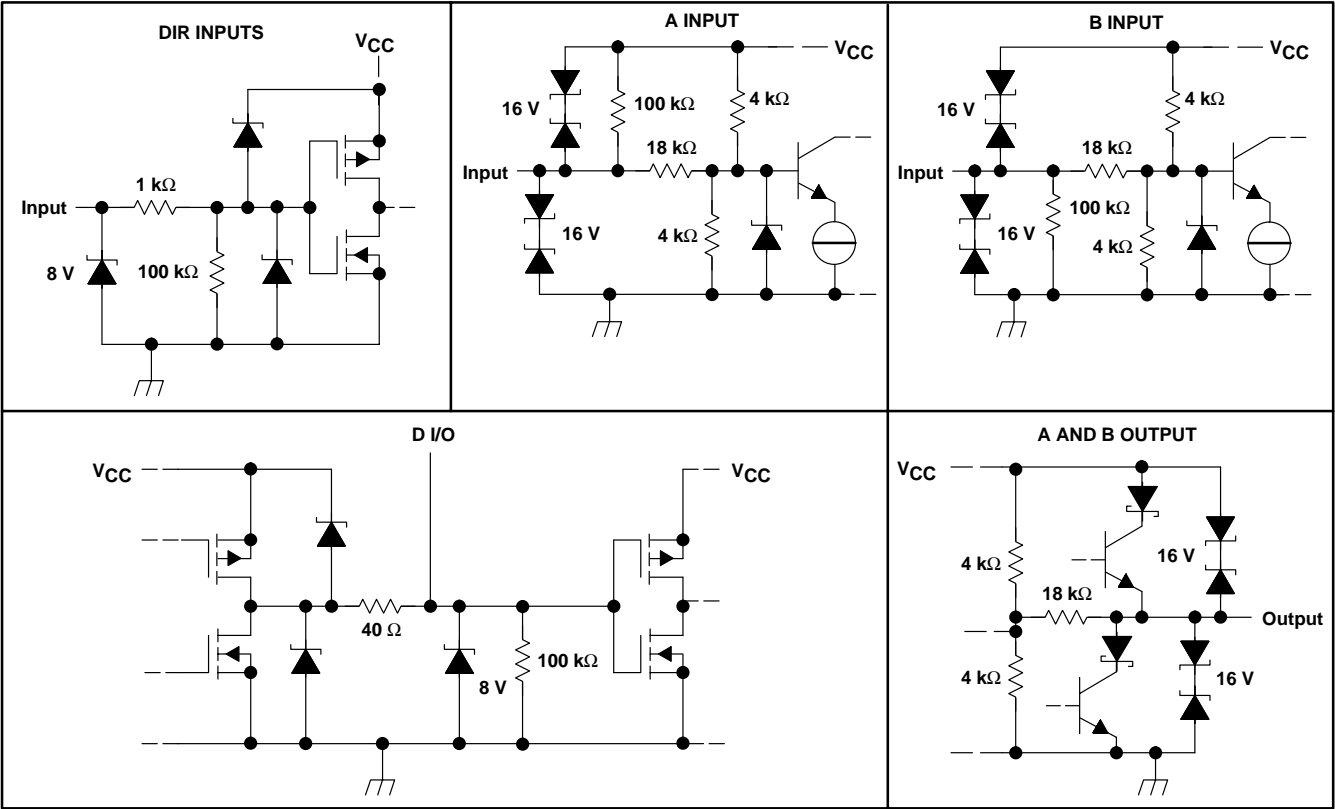
† Add R suffix for taped and reel

Function Tables

EACH DRIVER				EACH RECEIVER		
INPUT D	ENABLE DIR	OUTPUTS		DIFFERENTIAL INPUT (V _A –V _B)	ENABLE DIR	OUTPUT D
		A	B			
H	H	H	L	V _{ID} ≥ 0.2 V	L	H
L	H	L	H	–0.2 V < V _{ID} < 0.2 V	L	?
OPEN	H	L	H	V _{ID} ≤ –0.2 V	L	L
X	L	Z	Z	X	H	Z
X	OPEN	X	X	OPEN	L	H

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

equivalent input and output schematic diagrams



SN65LBC170, SN75LBC170 TRIPLE DIFFERENTIAL TRANSCEIVERS

SLLS459B – NOVEMBER 2000 – REVISED FEBRUARY 2002

absolute maximum ratings†

Supply voltage, V_{CC} (see Note 1)	–0.3 V to 6 V
Voltage range at any bus I/O terminal (steady state)	–10 V to 15 V
Voltage input range, A and B, (transient pulse through 100 Ω , see Figure 12)	–30 V to 30 V
Voltage range at any D or DIR terminal	–0.5 V to $V_{CC} + 0.5$ V
Electrostatic discharge: Human body model (A, B, GND) (see Note 2)	12 kV
All pins	5 kV
Charged-device model (all pins) (see Note 3)	1 kV
Continuous total power dissipation	See Power Dissipation Rating Table
Storage temperature range, T_{stg}	–65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°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 JEDEC Standard 22, Test Method A114–A.
3. Tested in accordance with JEDEC Standard 22, Test Method C101.

POWER DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR‡ ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ POWER RATING
DB	995 mW	8.0 mW/°C	635 mW	515 mW
DW	1480 mW	11.8 mW/°C	950 mW	770 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}		4.75	5	5.25	V
Voltage at any bus I/O terminal	A, B	–7		12	V
High-level input voltage, V_{IH}	D, DIR	2	V_{CC}		V
Low-level input voltage, V_{IL}		0	0.8		
Differential input voltage, V_{ID}	A with respect to B	–12		12	V
Output current	Driver	–60		60	mA
	Receiver	–8		8	
Operating free-air temperature, T_A	SN75LBC170	0		70	°C
	SN65LBC170	–40		85	



SN65LBC170, SN75LBC170

TRIPLE DIFFERENTIAL TRANSCEIVERS

SLLS459B – NOVEMBER 2000 – REVISED FEBRUARY 2002

DRIVER SECTION

electrical characteristics over recommended operating conditions

PARAMETER			TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V _{IK}	Input clamp voltage	D and DIR	I _I = 18 mA		−1.5	−0.7		V
V _O	Open-circuit output voltage (single-ended)		A or B, No load		0		V _{CC}	V
V _{OD(SS)}	Steady-state differential output voltage magnitude‡		No load		3.8	4.3	V _{CC}	V
			R _L = 54 Ω, See Figure 1	1	1.6	2.4		
			With common-mode loading, See Figure 2		1	1.6	2.4	
ΔV _{OD}	Change in differential output voltage magnitude, V _{OD(H)} − V _{OD(L)}		R _L = 54 Ω, C _L = 50 pF	See Figure 1	−0.2		0.2	V
V _{OC(SS)}	Steady-state common-mode output voltage				2	2.4	2.8	
ΔV _{OC(SS)}	Change in steady-state common-mode output voltage (V _{OC(H)} − V _{OC(L)})						−0.2	
I _I	Input current		D, DIR		−100		100	μA
I _O	Output current with power off		V _{CC} = 0 V, V _O = −7 V to 12 V		−700		900	μA
I _{OS}	Short-circuit output current		V _O = −7 V to 12 V, See Figure 7		−250		250	mA
I _{CC}	Supply current (driver enabled)		D at 0 V or V _{CC} , DIR at V _{CC} , No load			14	20	mA

† All typical values are at $V_{CC} = 5 \text{ V}$ and $T_A = 25^\circ\text{C}$.

‡ The minimum V_{OD} may not fully comply with TIA/EIA-485-A at operating temperatures below 0°C . System designers should take the possibly lower output signal into account in determining the maximum signal-transmission distance.

switching characteristics over recommended operating conditions

PARAMETER			TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{PLH}	Differential output propagation delay, low-to-high		$R_L = 54 \Omega$, $C_L = 50 \text{ pF}$, See Figure 3		4	8.5	12	ns
t_{PHL}	Differential output propagation delay, high-to-low				4	8.5	11	
t_r	Differential output rise time				3	7.5	11	
t_f	Differential output fall time				3	7.5	11	
$t_{sk(p)}$	Pulse skew $ (t_{PLH} - t_{PHL}) $						2	
$t_{sk(o)}$	Output skew§						1.5	
$t_{sk(pp)}$	Part-to-part skew¶						2	
t_{PLH}	Differential output propagation delay, low-to-high		See Figure 4, (HVD SCSI double-terminated load)		3	7	10	ns
t_{PHL}	Differential output propagation delay, high-to-low				3	7.5	10	
t_r	Differential output rise time				3	7.5	12	
t_f	Differential output fall time				3	7.5	12	
$t_{sk(p)}$	Pulse skew $ (t_{PLH} - t_{PHL}) $						3	
$t_{sk(o)}$	Output skew§						1.5	
$t_{sk(pp)}$	Part-to-part skew¶						2.5	
t_{pZH}	Output enable time to high level		See Figure 5			15	25	ns
t_{pHZ}	Output disable time from high level					18	25	
t_{pZL}	Output enable time to low level		See Figure 6			10	25	ns
t_{pLZ}	Output disable time from low level					17	25	

§ Output skew ($t_{sk(o)}$) is the magnitude of the time delay difference between the outputs of a single device with all of the inputs connected together.

¶ Part-to-part skew ($t_{sk(pp)}$) is the magnitude of the difference in propagation delay times between any specified terminals of two devices when both devices operate with the same input signals, the same supply voltages, at the same temperature, and have identical packages and test circuits.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

RECEIVER SECTION

electrical characteristics over recommended operating conditions

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
V_{IT+} Positive-going differential input voltage threshold	See Figure 8			0.2	V
V_{IT-} Negative-going differential input voltage threshold				-0.2	
V_{hys} Hysteresis voltage ($V_{IT+} - V_{IT-}$)			40		mV
V_{OH} High-level output voltage	$V_{ID} = 200$ mV, $I_{OH} = -8$ mA, See Figure 8	4	4.7	V_{CC}	V
V_{OL} Low-level output voltage	$V_{ID} = -200$ mV, $I_{OL} = -8$ mA, See Figure 8	0	0.2	0.4	
I_I Line input current	Other input = 0 V	$V_I = 12$ V		0.9	mA
		$V_I = -7$ V		-0.7	
R_I Input resistance	A, B	12			k Ω
I_{CC} Supply current (receiver enabled)	A, B, D, and DIR open			16	mA

† All typical values are at $V_{CC} = 5$ V and $T_A = 25^\circ\text{C}$.

switching characteristics over recommended operating conditions

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH} Propagation delay time, low-to-high level output	See Figure 9	7		16	ns
t_{PHL} Propagation delay time, high-to-low level output		7		16	ns
t_r Receiver output rise time			1.3	3	ns
t_f Receiver output fall time			1.3	3	ns
t_{PZH} Receiver output enable time to high level	See Figure 10		26	40	ns
t_{PHZ} Receiver output disable time from high level				40	
t_{PZL} Receiver output enable time to low level	See Figure 11		29	40	ns
t_{PLZ} Receiver output enable time to high level				40	
$t_{sk(p)}$ Pulse skew ($ t_{PLH} - t_{PHL} $)				2	ns
$t_{sk(o)}$ Output skew‡				1.5	ns
$t_{sk(pp)}$ Part-to-part skew§				3	ns

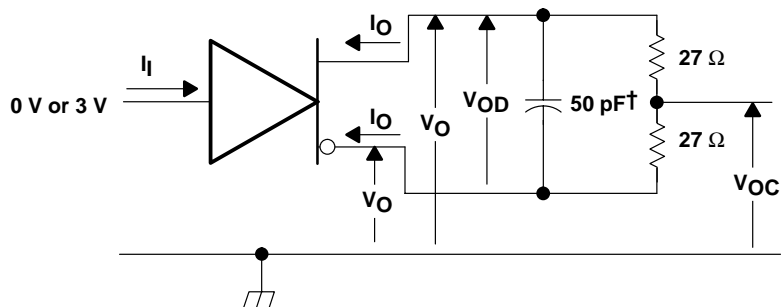
‡ Output skew ($t_{sk(o)}$) is the magnitude of the time delay difference between the outputs of a single device with all of the inputs connected together.

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

SN65LBC170, SN75LBC170 TRIPLE DIFFERENTIAL TRANSCIEVERS

SLLS459B – NOVEMBER 2000 – REVISED FEBRUARY 2002

PARAMETER MEASUREMENT INFORMATION



† Includes probe and jig capacitance

Figure 1. Driver Test Circuit, V_{OD} and V_{OC} Without Common-Mode Loading

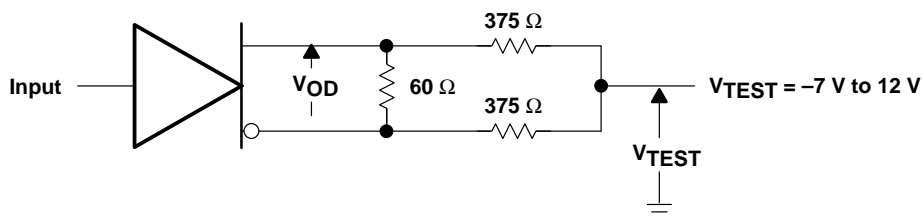


Figure 2. Driver Test Circuit, V_{OD} With Common-Mode Loading

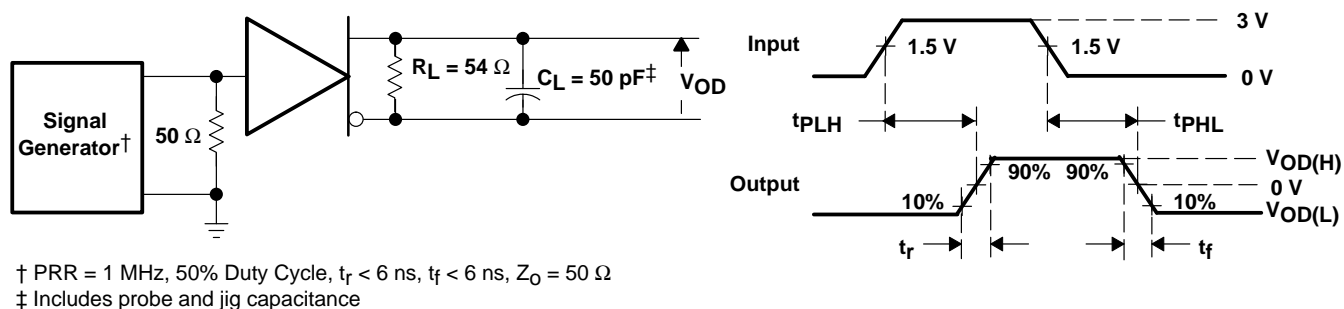
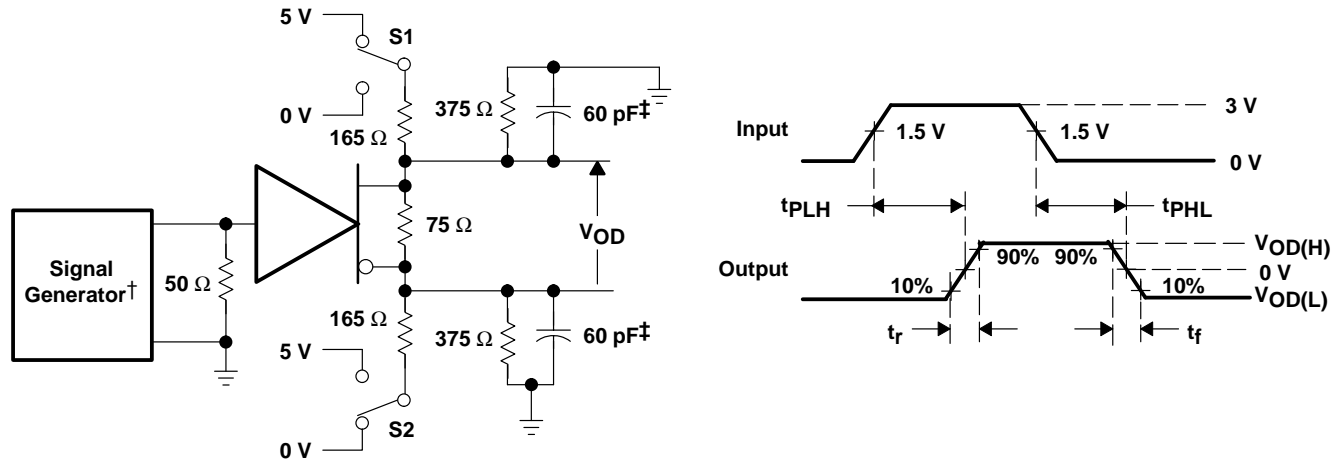


Figure 3. Driver Switching Test Circuit and Waveforms, 485-Loading

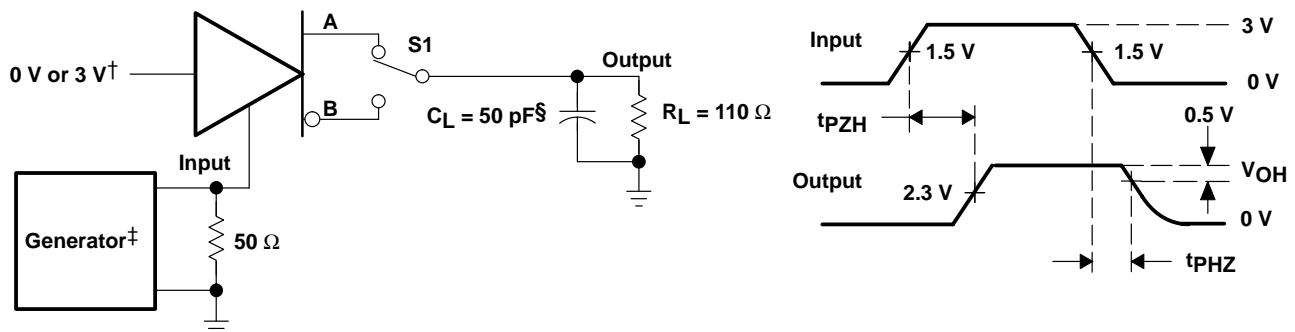
PARAMETER MEASUREMENT INFORMATION



† PRR = 1 MHz, 50% Duty Cycle, t_r < 6 ns, t_f < 6 ns, Z_O = 50 Ω

‡ Includes probe and jig capacitance

Figure 4. Driver Switching Test Circuit and Waveforms, HVD SCSI-Loading (double terminated)

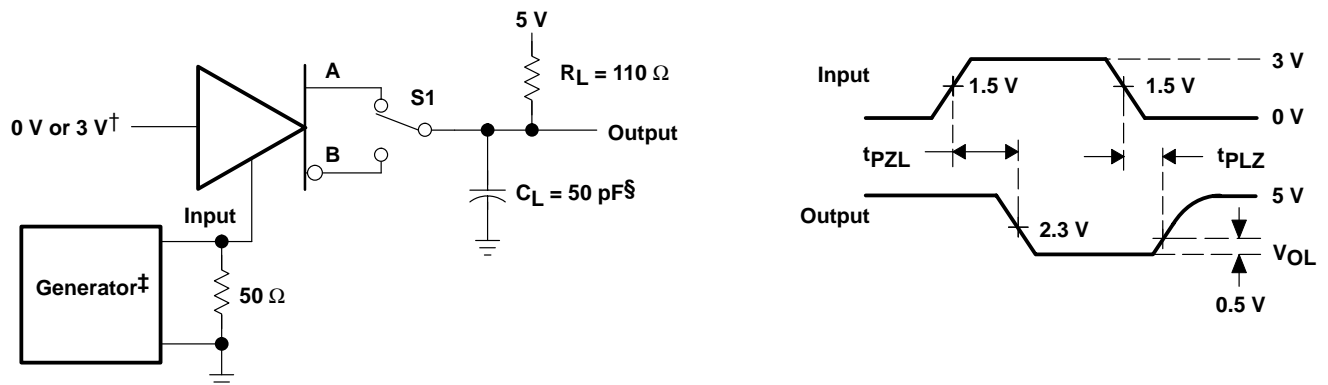


† 3 V if testing A output, 0 V if testing B output

‡ PRR = 1 MHz, 50% Duty Cycle, t_r < 6 ns, t_f < 6 ns, Z_O = 50 Ω

§ Includes probe and jig capacitance

Figure 5. Driver Enable/Disable Test, High Output



† 0 V if testing A output, 3 V if testing B output

‡ PRR = 1 MHz, 50% Duty Cycle, t_r < 6 ns, t_f < 6 ns, Z_O = 50 Ω

§ Includes probe and jig capacitance

Figure 6. Driver Enable/Disable Test, Low Output

SN65LBC170, SN75LBC170 TRIPLE DIFFERENTIAL TRANSCIEVERS

SLLS459B – NOVEMBER 2000 – REVISED FEBRUARY 2002

PARAMETER MEASUREMENT INFORMATION

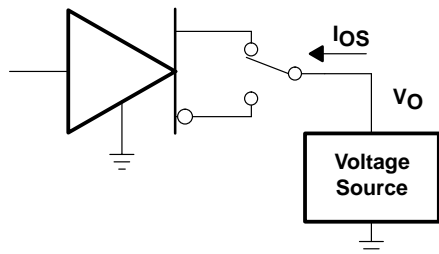


Figure 7. Driver Short-Circuit Test

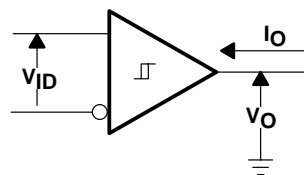
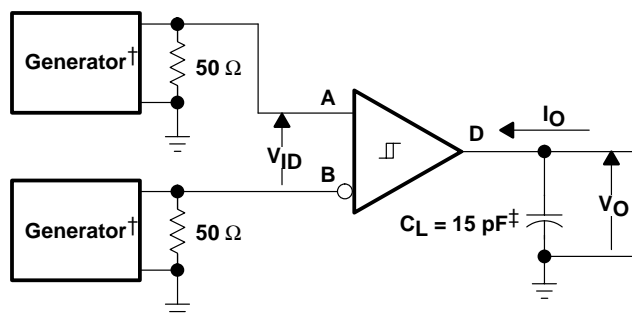
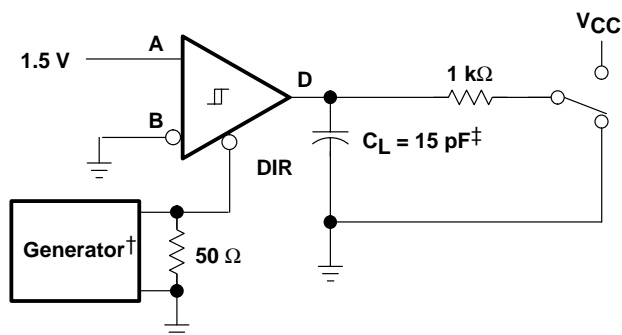


Figure 8. Receiver DC Parameters



† PRR = 1 MHz, 50% Duty Cycle, $t_r < 6$ ns, $t_f < 6$ ns, $Z_0 = 50 \Omega$
‡ Includes probe and jig capacitance

Figure 9. Receiver Switching Test Circuit and Waveforms



† PRR = 1 MHz, 50% Duty Cycle, $t_r < 6$ ns, $t_f < 6$ ns, $Z_0 = 50 \Omega$
‡ Includes probe and jig capacitance

Figure 10. Receiver Enable/Disable Test, High Output

PARAMETER MEASUREMENT INFORMATION

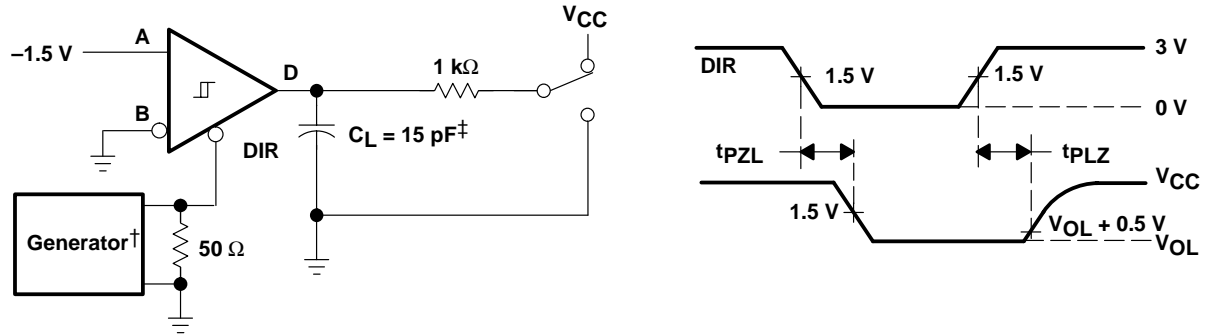


Figure 11. Receiver Enable/Disable Test, Low Output

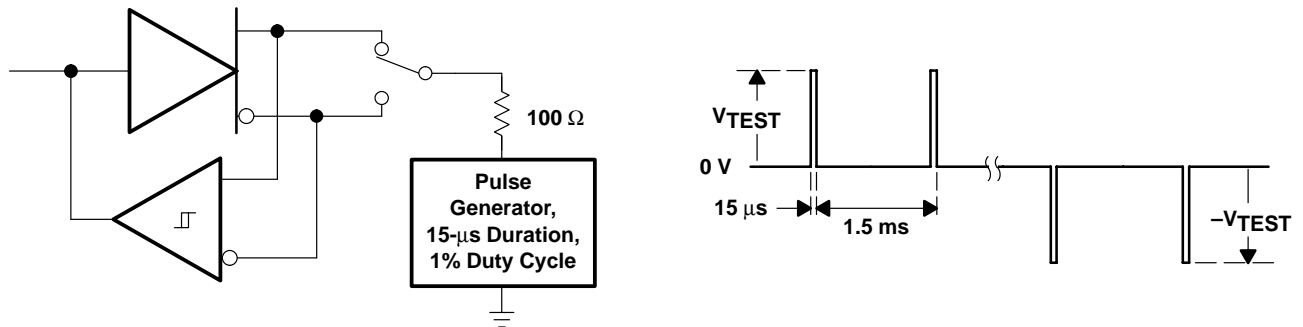


Figure 12. Test Circuit and Waveform, Transient Over Voltage Test

SN65LBC170, SN75LBC170 TRIPLE DIFFERENTIAL TRANSCEIVERS

SLLS459B – NOVEMBER 2000 – REVISED FEBRUARY 2002

TYPICAL CHARACTERISTICS

DIFFERENTIAL OUTPUT VOLTAGE
vs
OUTPUT CURRENT

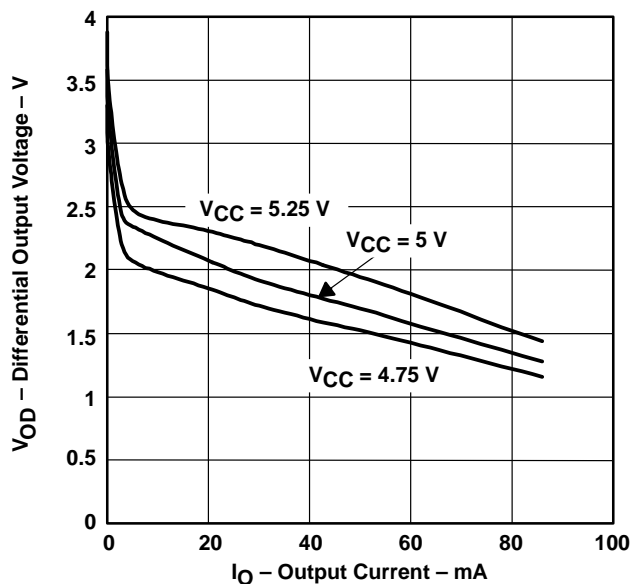


Figure 13

DIFFERENTIAL OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE

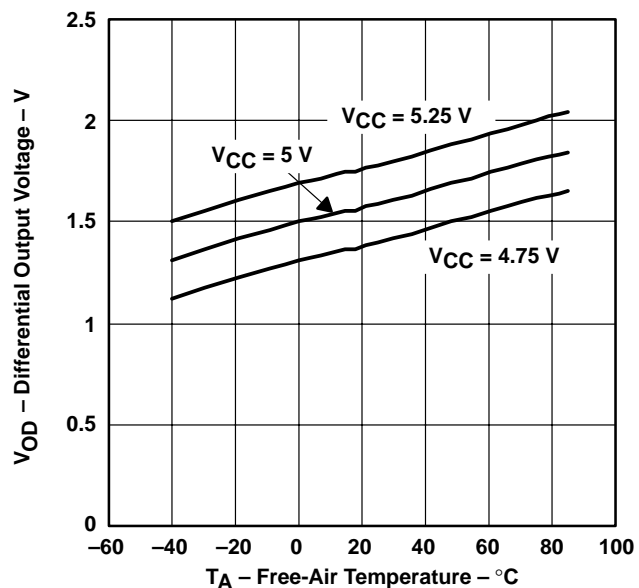


Figure 14

DRIVER PROPAGATION DELAY
vs
FREE-AIR TEMPERATURE

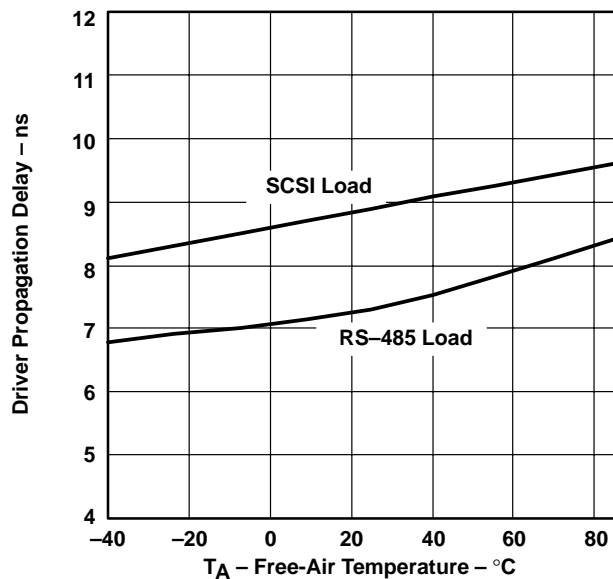


Figure 15

SUPPLY CURRENT
vs
SIGNALING RATE

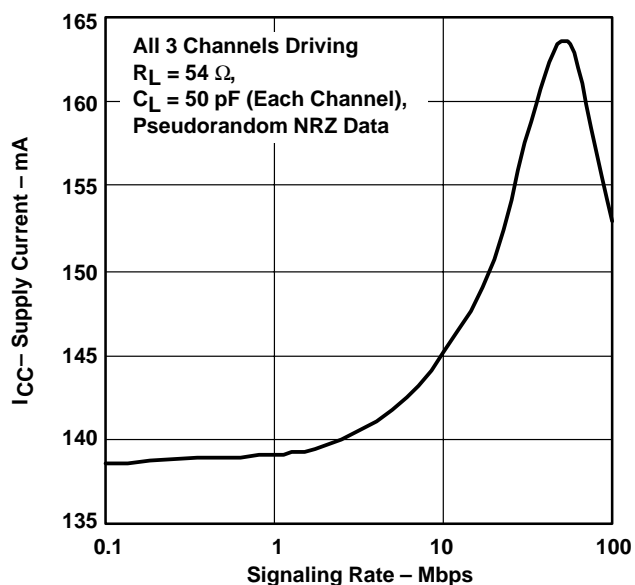


Figure 16

TYPICAL CHARACTERISTICS

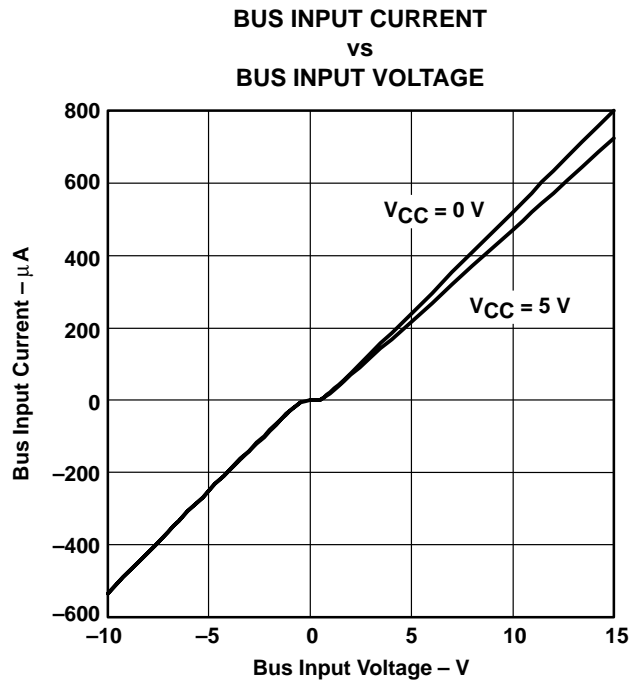


Figure 17

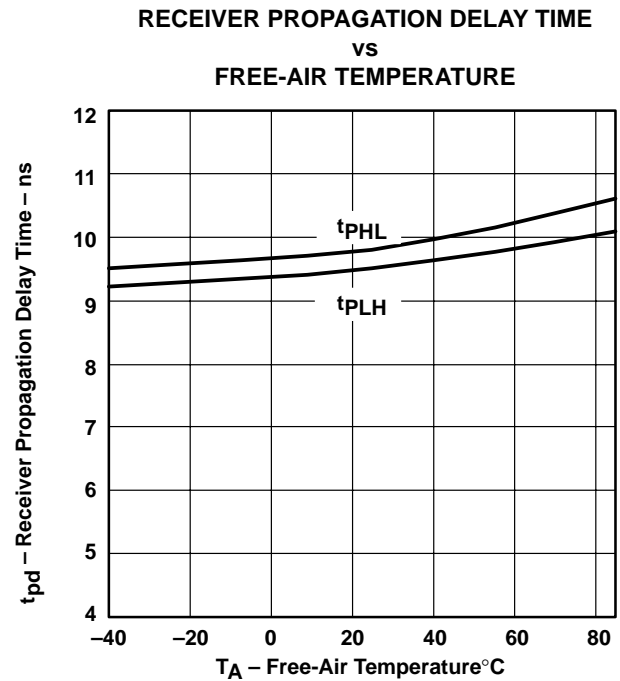


Figure 18

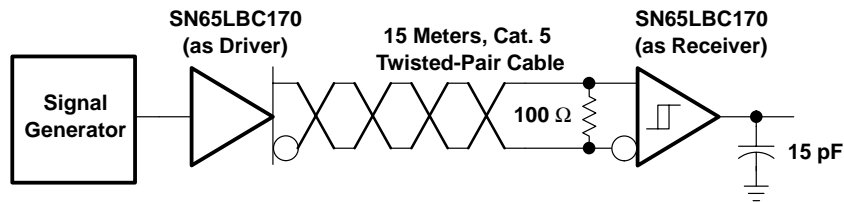


Figure 19. Circuit Diagram for Signaling Characteristics

SN65LBC170, SN75LBC170 TRIPLE DIFFERENTIAL TRANSCEIVERS

SLLS459B – NOVEMBER 2000 – REVISED FEBRUARY 2002

TYPICAL CHARACTERISTICS

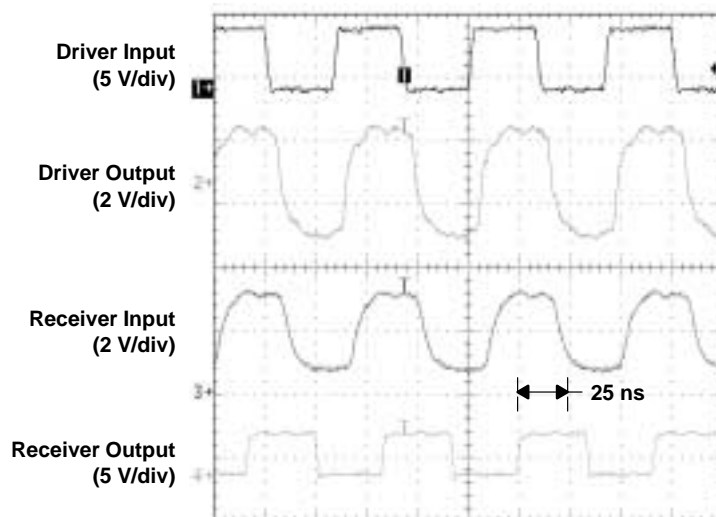


Figure 20. Signal Waveforms at 30 Mbps

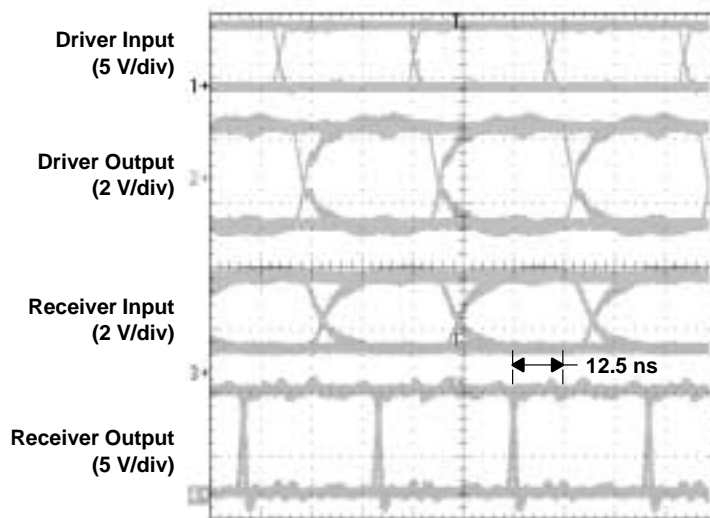


Figure 21. Eye Patterns, Pseudorandom Data at 30 Mbps

TYPICAL CHARACTERISTICS

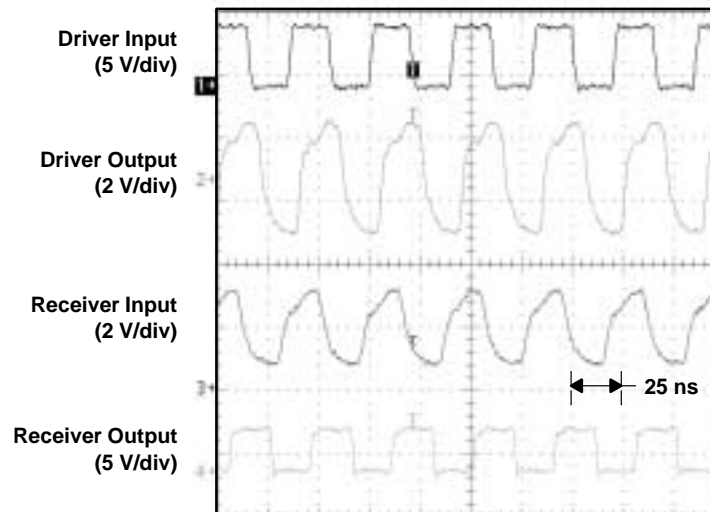


Figure 22. Signal Waveforms at 50 Mbps

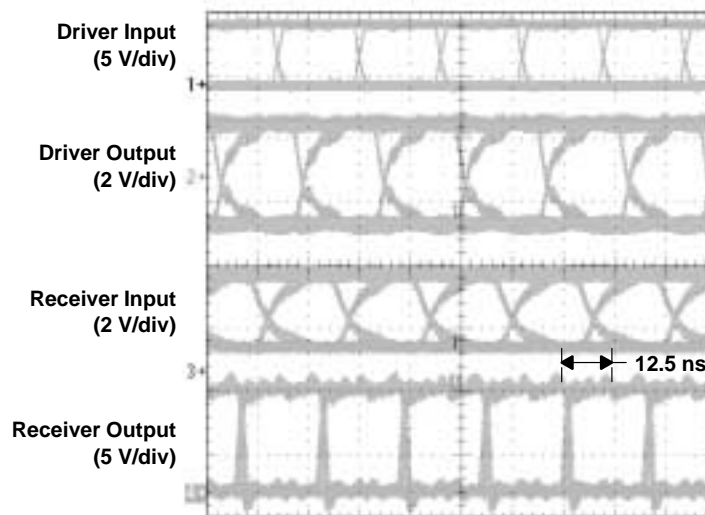


Figure 23. Eye Patterns, Pseudorandom Data at 50 Mbps

SN65LBC170, SN75LBC170 TRIPLE DIFFERENTIAL TRANSCEIVERS

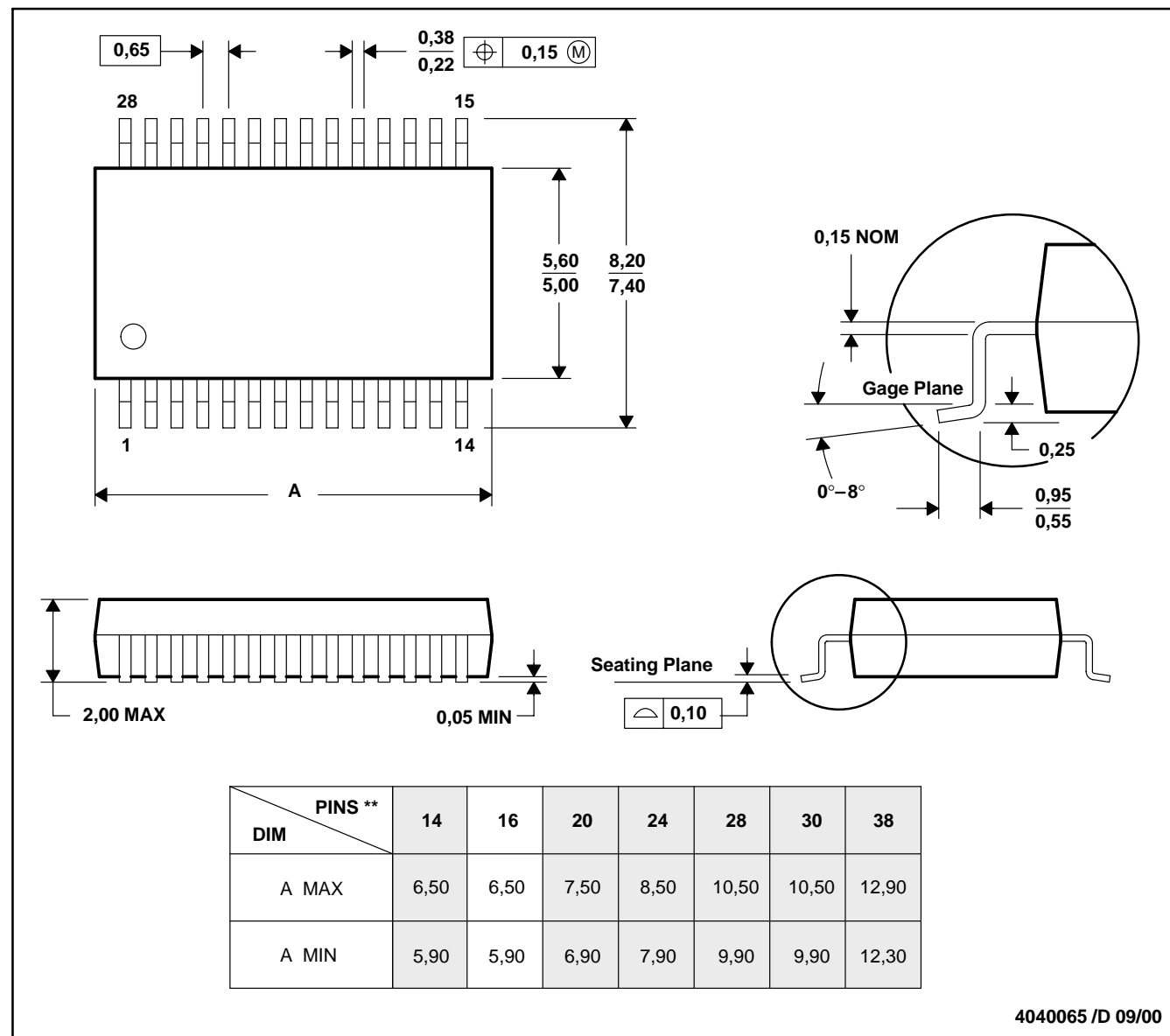
SLLS459B – NOVEMBER 2000 – REVISED FEBRUARY 2002

MECHANICAL DATA

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-150

SN65LBC170, SN75LBC170 TRIPLE DIFFERENTIAL TRANSCEIVERS

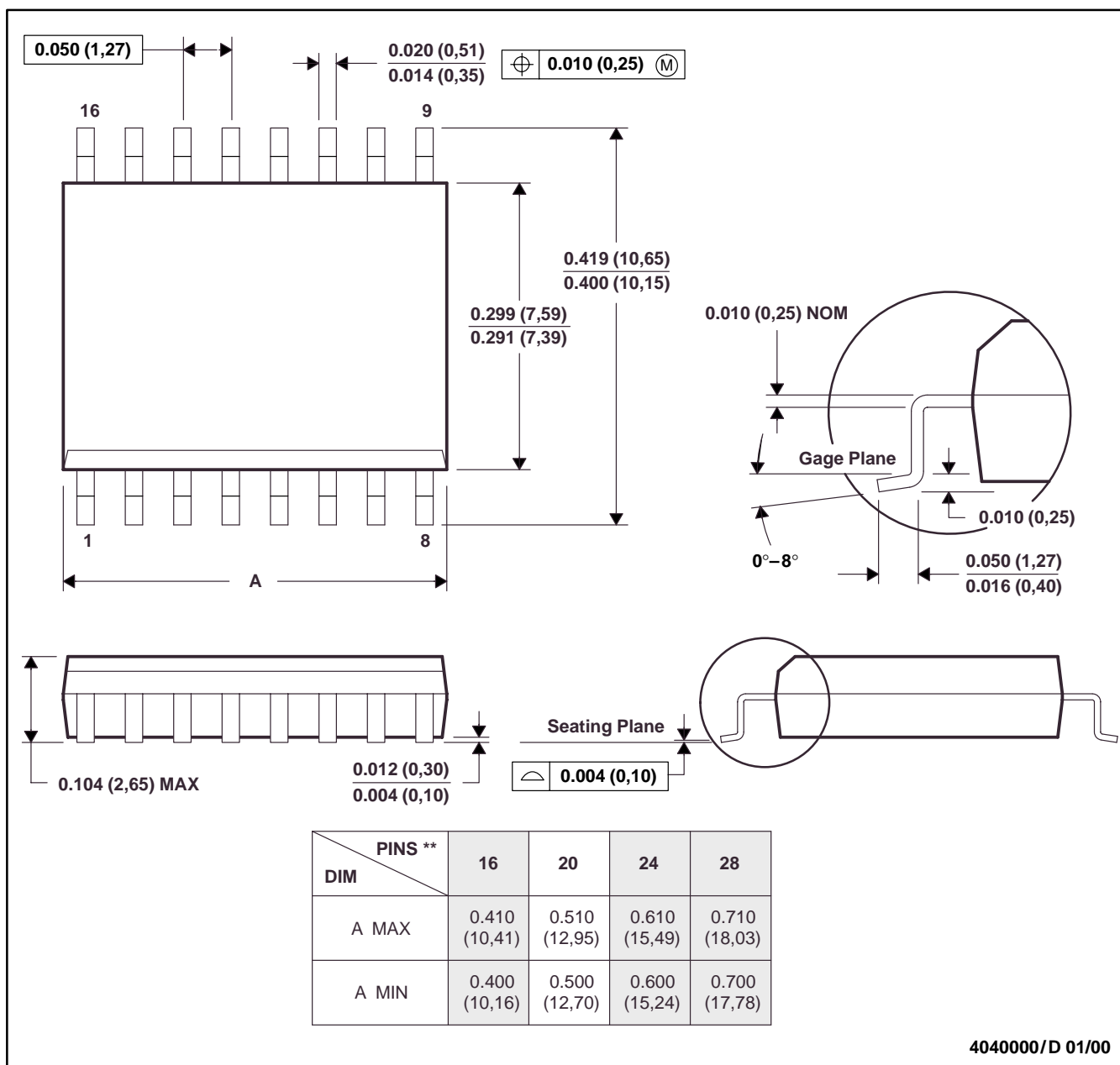
SLLS459B – NOVEMBER 2000 – REVISED FEBRUARY 2002

MECHANICAL DATA

DW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

16 PINS SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 D. Falls within JEDEC MS-013

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information 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.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

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.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265