

SN65LBC171, SN75LBC171 TRIPLE DIFFERENTIAL TRANSCIEVERS

SLLS460A – NOVEMBER 2000 – REVISED FEBRUARY 2001

AVAILABLE OPTIONS†

T _A	PACKAGE	
	PLASTIC SMALL-OUTLINE (JEDEC MS-013)	PLASTIC SHRINK SMALL-OUTLINE (JEDEC MO-150)
0°C to 70°C	SN75LBC171DW	SN75LBC171DB
-40°C to 85°C	SN65LBC171DW	SN65LBC171DB

† Add R suffix for taped and reel

Function Tables

EACH DRIVER

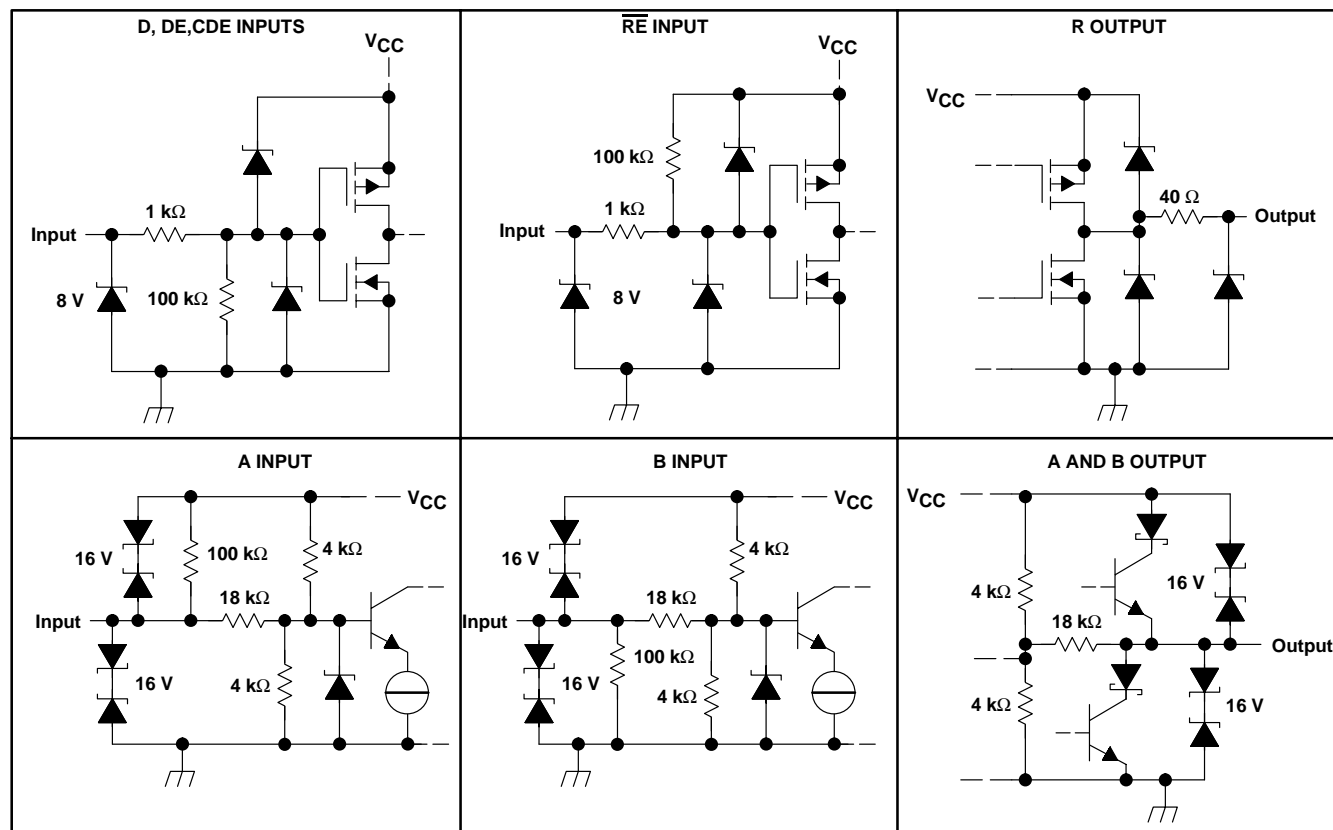
INPUT D	ENABLE		OUTPUTS	
	DE	CDE	A	B
H	H	H	H	L
L	H	H	L	H
OPEN	H	H	L	H
X	L	X	Z	Z
X	X	L	Z	Z
X	OPEN	X	Z	Z
X	X	OPEN	Z	Z

EACH RECEIVER

DIFFERENTIAL INPUT (V _A -V _B)	ENABLE RE	OUTPUT R
V _{ID} ≥ 0.2 V	L	H
-0.2 V < V _{ID} < 0.2 V	L	?
V _{ID} ≤ -0.2 V	L	L
X	H	Z
OPEN	L	H

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

equivalent input and output schematic diagrams



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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 DE, \overline{RE} , or CDE 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	$T_A \leq 25^\circ\text{C}$	DERATING FACTOR‡	$T_A = 70^\circ\text{C}$	$T_A = 85^\circ\text{C}$
	POWER RATING	ABOVE $T_A = 25^\circ\text{C}$	POWER RATING	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}	DE, CDE, RE	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	SN75LBC171	0		70	°C
	SN65LBC171	–40		85	

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DRIVER SECTION

electrical characteristics over recommended operating conditions

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT	
V_{IK}	Input clamp voltage	D, DE, CDE $I_I = 18 \text{ mA}$	-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	
		$R_L = 54 \Omega$, See Figure 1	1	1.6	2.4	V	
		With common-mode loading, See Figure 2	1	1.6	2.4	V	
ΔV_{OD}	Change in differential output voltage magnitude, $ V_{OD(H)} - V_{OD(L)} $	$R_L = 54 \Omega$, $C_L = 50 \text{ pF}$	See Figure 1		0.2	V	
$V_{OC(SS)}$	Steady-state common-mode output voltage			2	2.4	2.8	V
$\Delta V_{OC(SS)}$	Change in steady-state common-mode output voltage ($V_{OC(H)} - V_{OC(L)}$)			-0.2		0.2	V
I_I	Input current	D, DE, CDE	-100		100	μA	
I_O	Output current with power off	$V_{CC} = 0 \text{ V}$, $V_O = -7 \text{ V to } 12 \text{ V}$	-700		900	μA	
I_{OS}	Short-circuit output current	$V_O = -7 \text{ V to } 12 \text{ V}$, See Figure 7	-250		250	mA	
I_{CC}	Supply current (driver enabled)	D at 0 V or V_{CC} , CDE, DE, \overline{RE} 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	$R_L = 54 \Omega$, See Figure 3 $C_L = 50 \text{ pF}$,	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.



RECEIVER SECTION

electrical characteristics over recommended operating conditions

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
V_{IT+}	Positive-going differential input voltage threshold				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	$V_{ID} = 200\text{ mV}$, $I_{OH} = -8\text{ mA}$, see Figure 10	4	4.7	V_{CC}	V
V_{OL}	Low-level output voltage	$V_{ID} = -200\text{ mV}$, $I_{OL} = -8\text{ mA}$, see Figure 10	0	0.2	0.4	
I_I	Line input current	Other input = 0 V			0.9	mA
			$V_I = 12\text{ V}$			
					-0.7	
I_I	Input current	\overline{RE}	-100		100	μA
R_I	Input resistance	A, B	12			$\text{k}\Omega$
I_{CC}	Supply current (receiver enabled)	A, B, D open, \overline{RE} , DE, and CDE at 0 V			16	mA

† All typical values are at $V_{CC} = 5\text{ V}$ 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	$V_{ID} = -3\text{ V to } 3\text{ V}$, 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

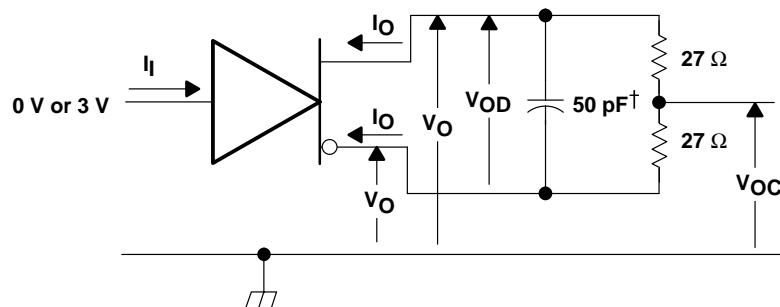
‡ Output skew ($t_{sk(o)}$) is the magnitude of the time delay difference between the outputs of a single device with all of the inputs connected together.

§ 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.

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PARAMETER MEASUREMENT INFORMATION



†Includes probe and jig capacitance

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

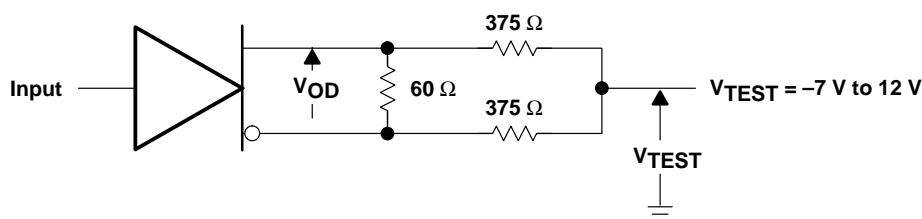
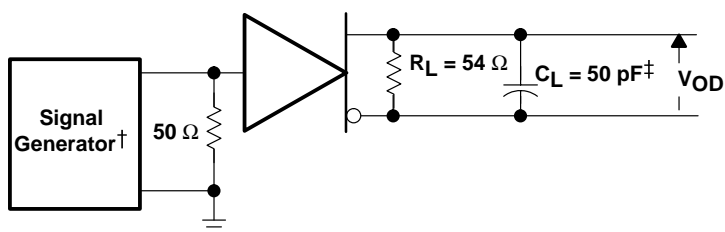


Figure 2. Driver Test Circuit, V_{OD} With Common-Mode Loading



† PRR = 1 MHz, 50% Duty Cycle, $t_r < 6$ ns, $t_f < 6$ ns, $Z_0 = 50 \Omega$

‡ Includes Probe and Jig Capacitance

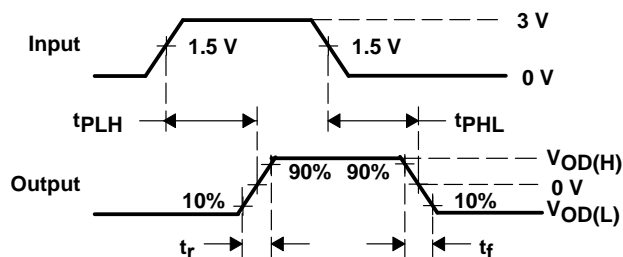
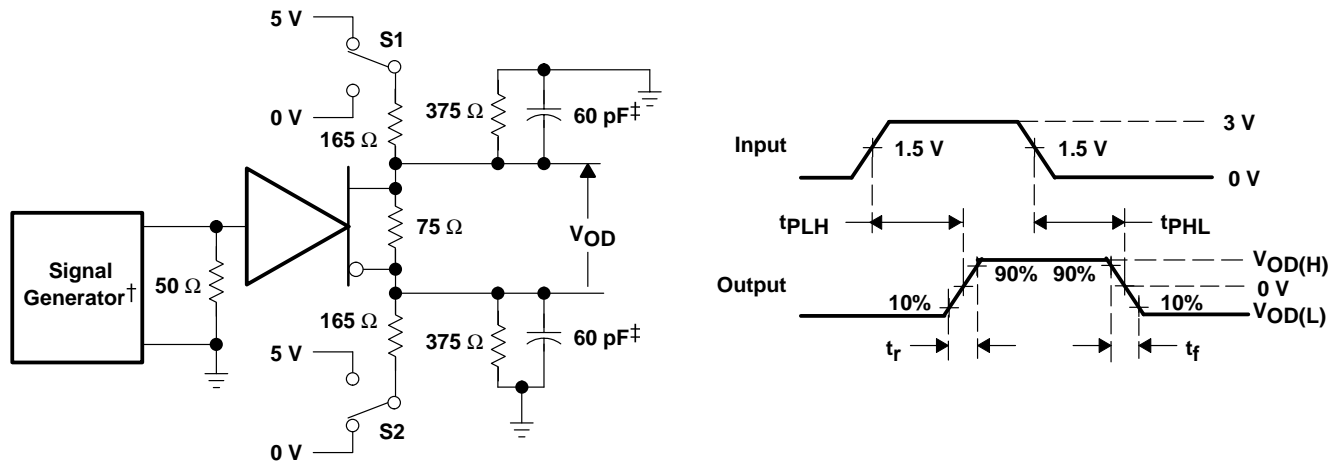


Figure 3. Driver Switching Test Circuit and Waveforms, 485-Loading

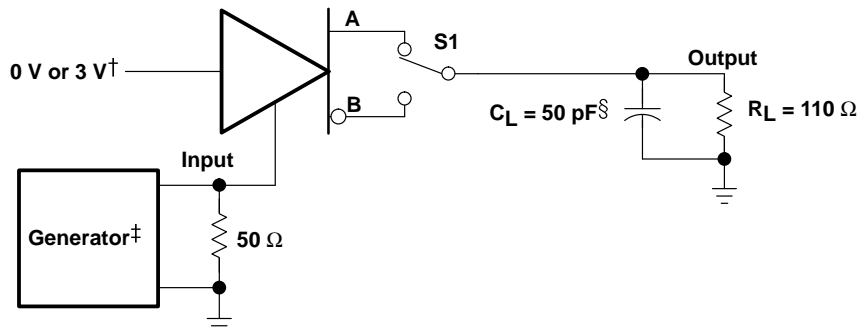
PARAMETER MEASUREMENT INFORMATION



† PRR = 1 MHz, 50% Duty Cycle, $t_r < 6$ ns, $t_f < 6$ ns, $Z_0 = 50 \Omega$

‡ 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, $Z_0 = 50 \Omega$

§ Includes Probe and Jig Capacitance

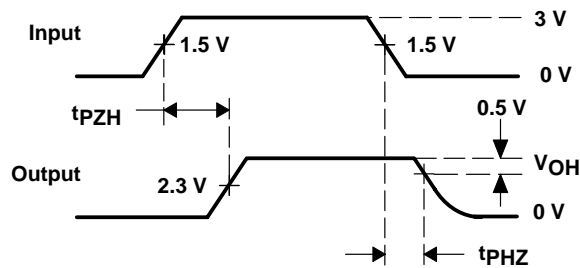
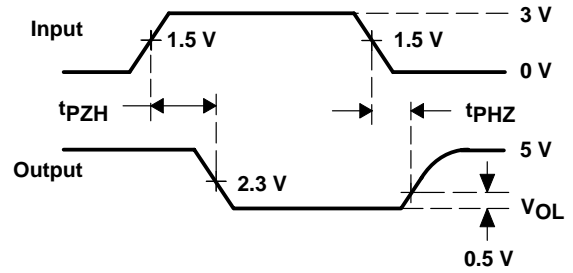
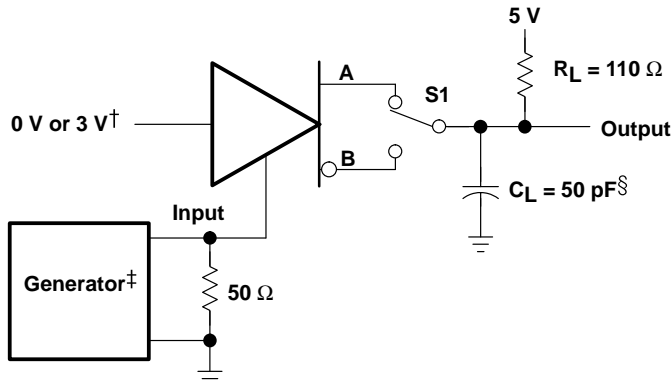


Figure 5. Driver Enable/Disable Test, High Output

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PARAMETER MEASUREMENT INFORMATION



† 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, $Z_0 = 50 \Omega$
§ Includes Probe and Jig Capacitance

Figure 6. Driver Enable/Disable Test, Low Output

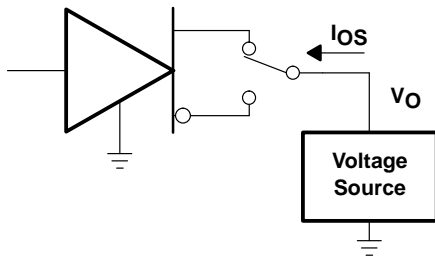


Figure 7. Driver Short-Circuit Test

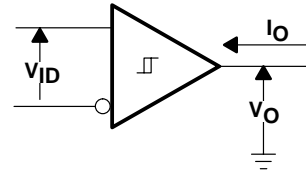
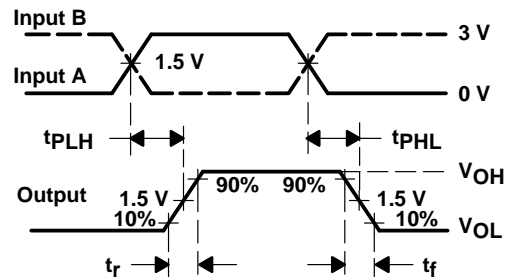
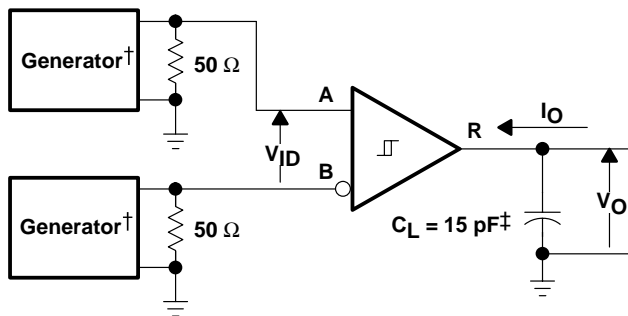


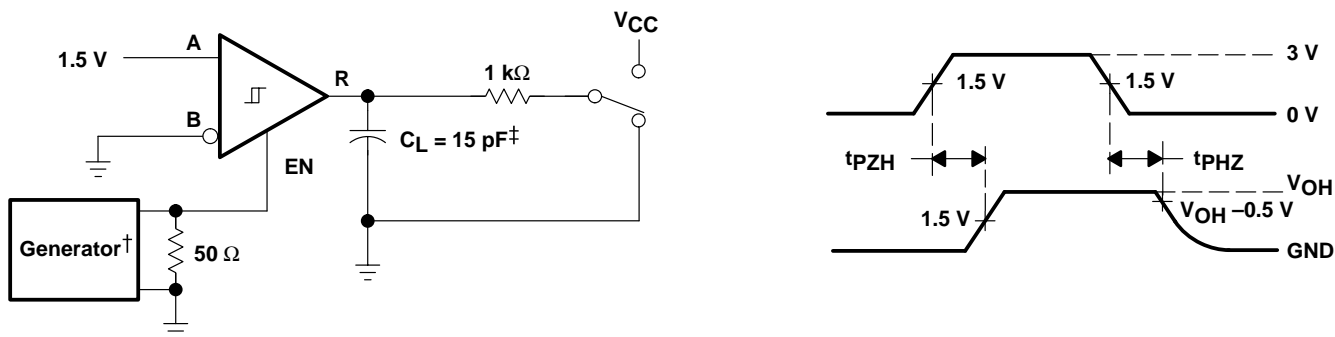
Figure 8. Receiver DC Parameters



† PRR = 1 MHz, 50% Duty Cycle, $t_r < 6$ ns, $t_f < 6$ ns, $Z_0 = 50 \Omega$
‡ Includes Probe and Jig Capacitance

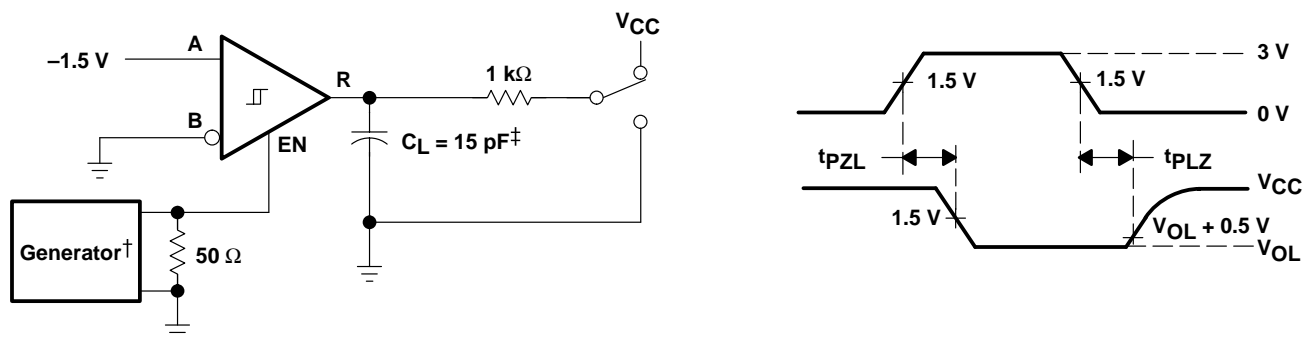
Figure 9. Receiver Switching Test Circuit and Waveforms

PARAMETER MEASUREMENT INFORMATION



† 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



† PRR = 1 MHz, 50% Duty Cycle, $t_r < 6$ ns, $t_f < 6$ ns, $Z_0 = 50 \Omega$
‡ Includes Probe and Jig Capacitance

Figure 11. Receiver Enable/Disable Test, Low Output

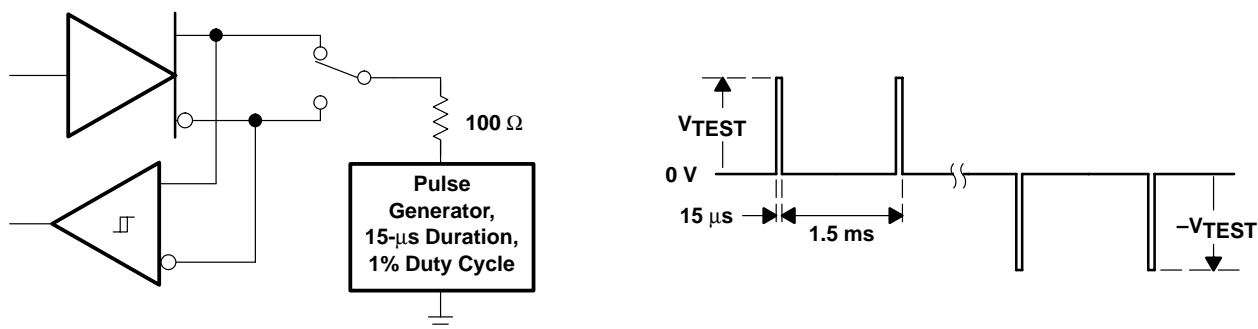


Figure 12. Test Circuit and Waveform, Transient Over Voltage Test

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TYPICAL CHARACTERISTICS

DIFFERENTIAL OUTPUT VOLTAGE
vs
OUTPUT CURRENT

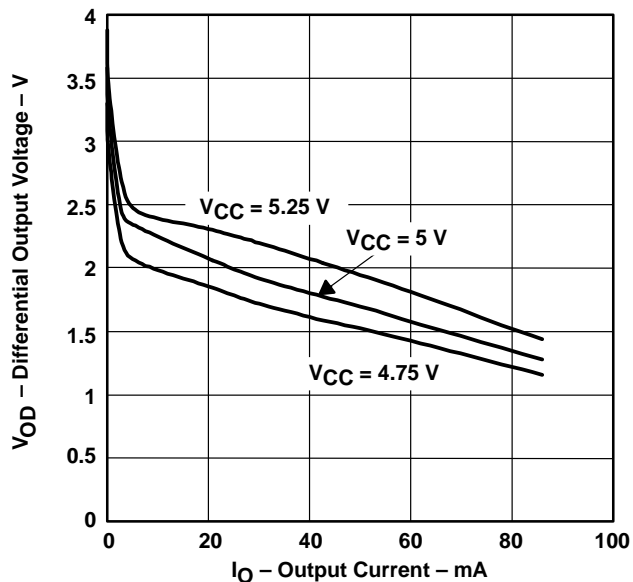


Figure 13

DIFFERENTIAL OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE

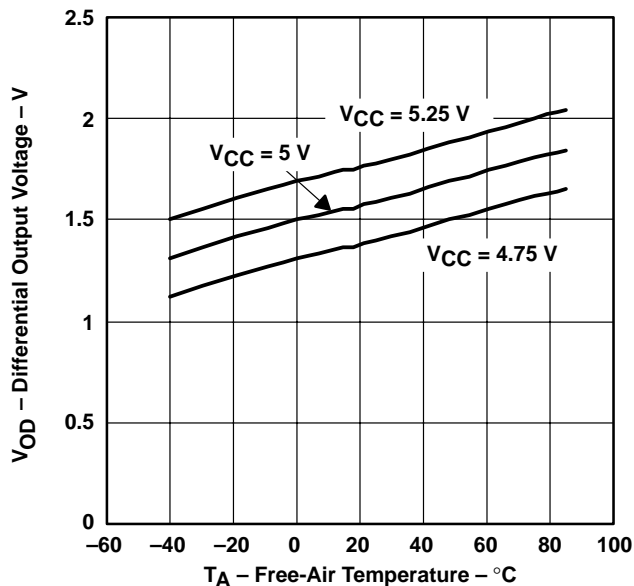


Figure 14

DRIVER PROPAGATION DELAY
vs
FREE-AIR TEMPERATURE

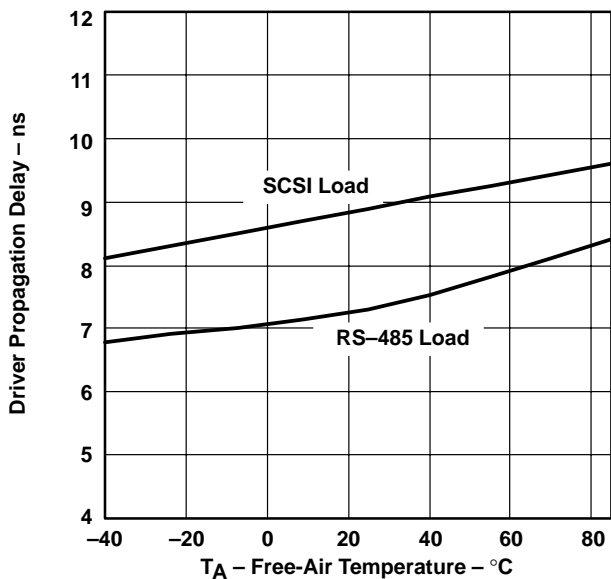


Figure 15

SUPPLY CURRENT
vs
SIGNALLING RATE

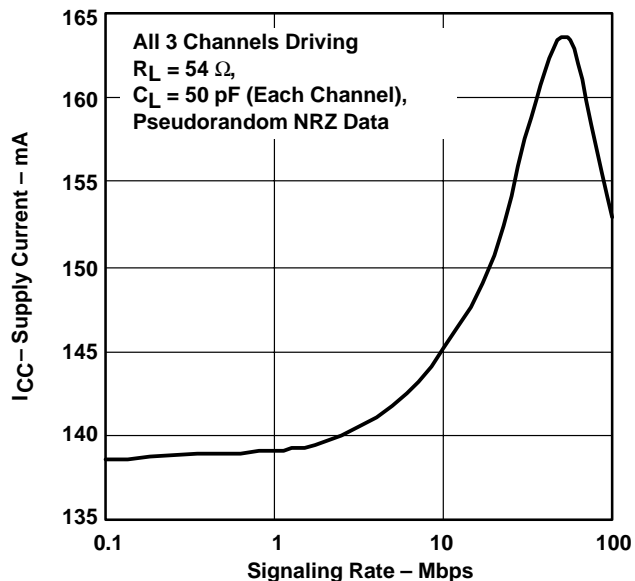


Figure 16



TYPICAL CHARACTERISTICS

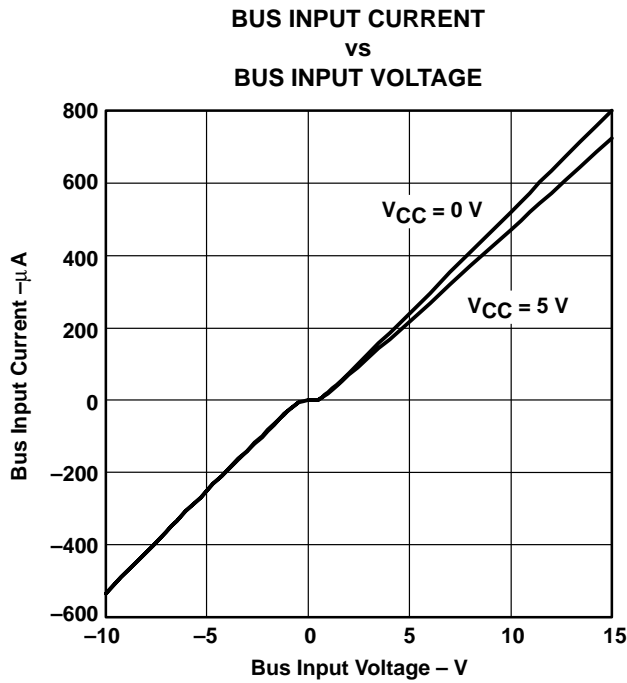


Figure 17

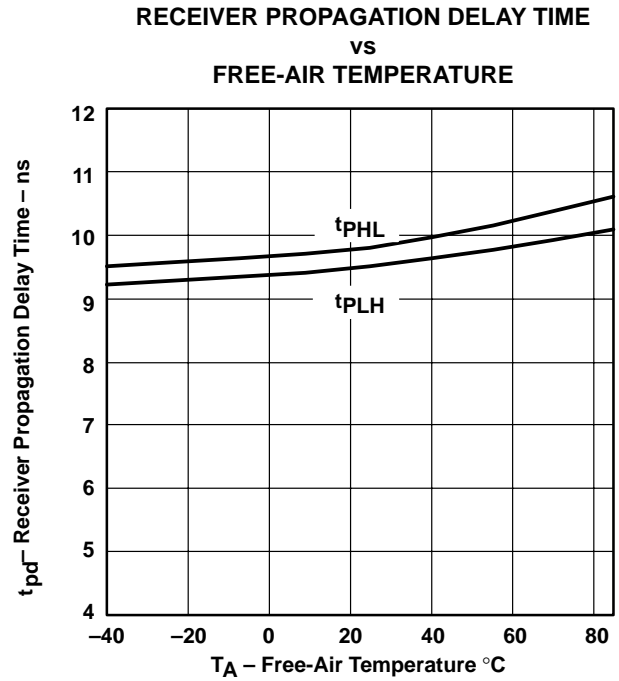


Figure 18

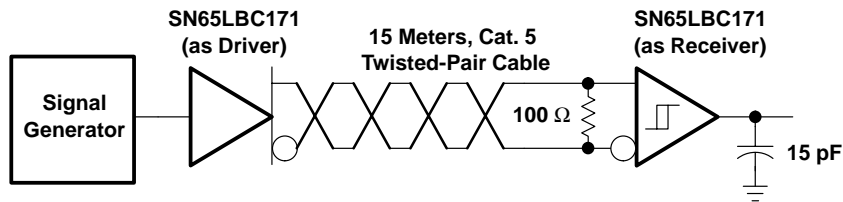


Figure 19. Circuit Diagram for Signaling Characteristics

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TYPICAL CHARACTERISTICS

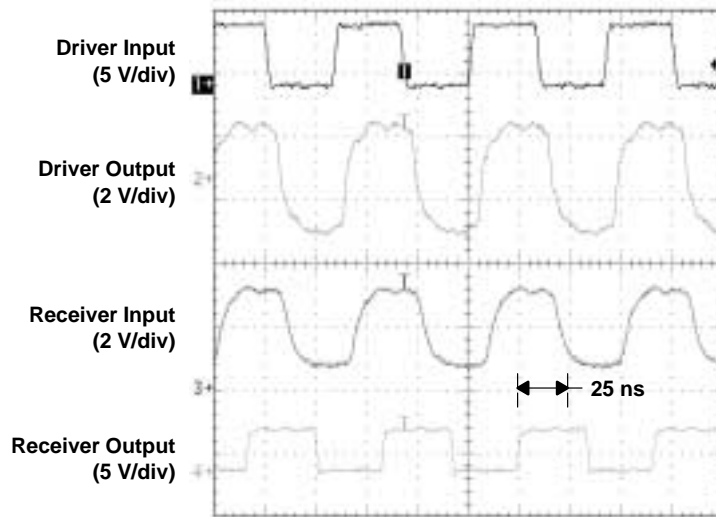


Figure 20. Signal Waveforms at 30 Mbps

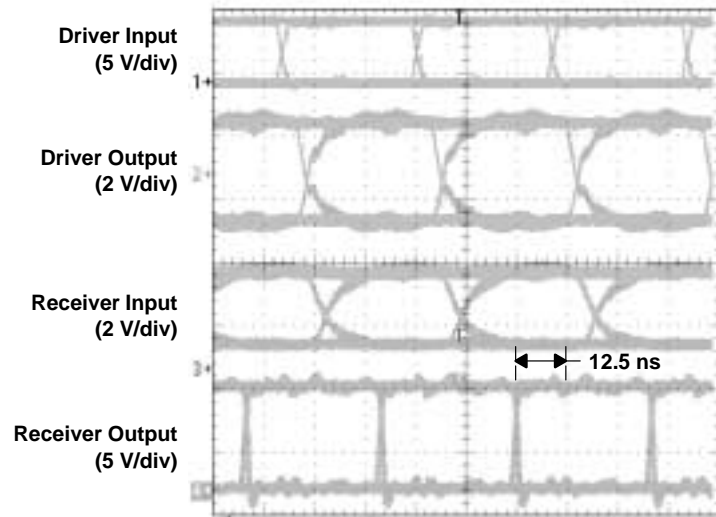


Figure 21. Eye Patterns, Pseudorandom Data at 30 Mbps

TYPICAL CHARACTERISTICS

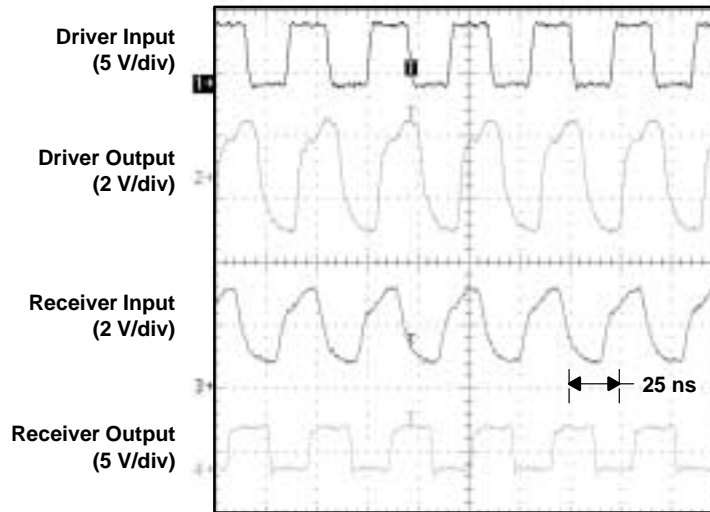


Figure 22. Signal Waveforms at 50 Mbps

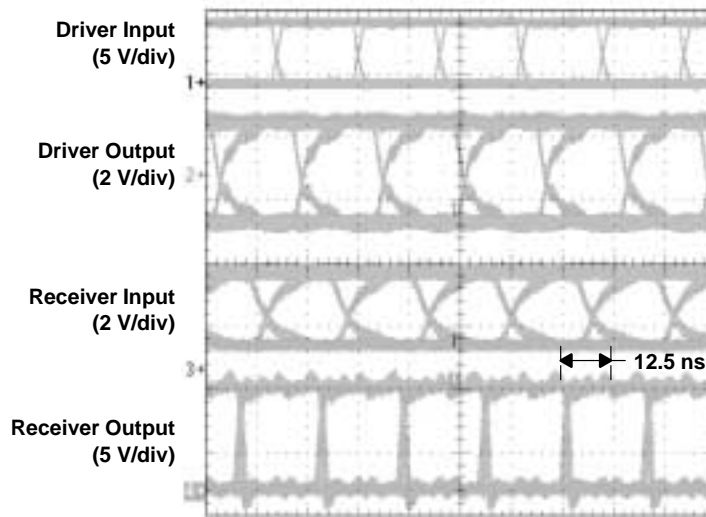


Figure 23. Eye Patterns, Pseudorandom Data at 50 Mbps

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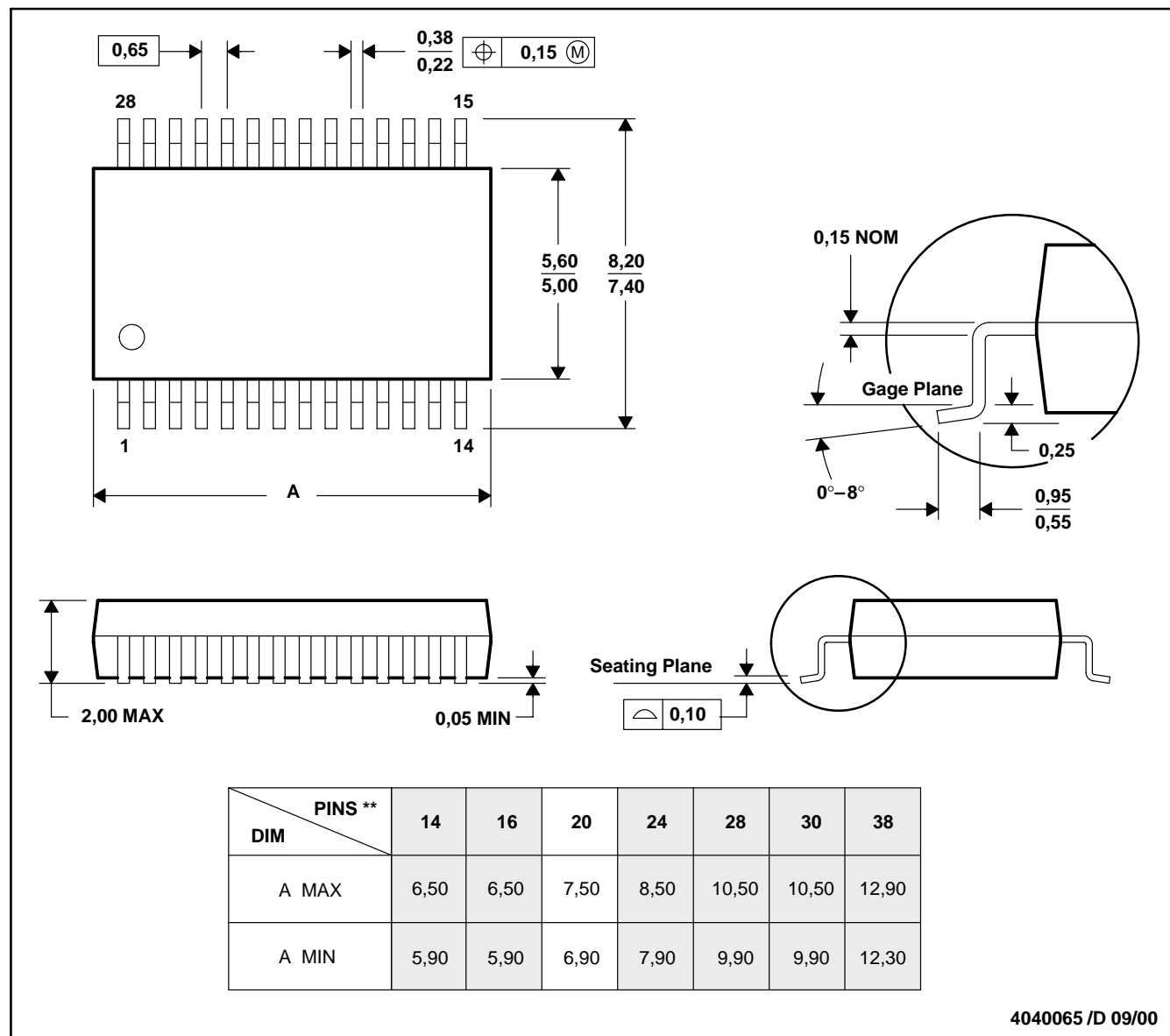
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MECHANICAL DATA

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



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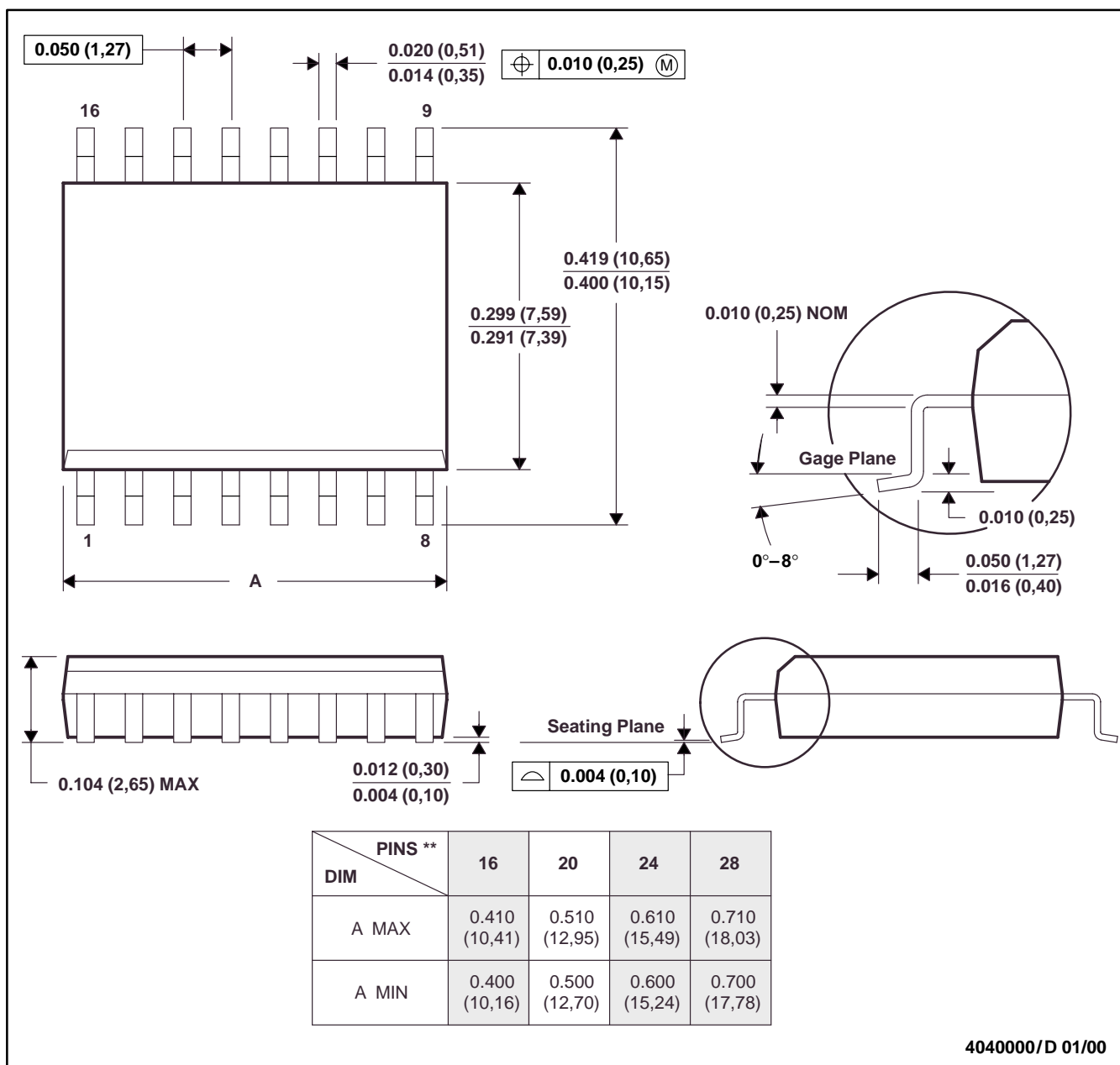
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MECHANICAL DATA

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



PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN65LBC171DB	ACTIVE	SSOP	DB	20	70	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	BL171	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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

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TUBE


*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
SN65LBC171DB	DB	SSOP	20	70	530	10.5	4000	4.1

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