

SN75LBC179, SN65LBC179, SN65LBC179Q

LOW-POWER DIFFERENTIAL LINE DRIVER AND RECEIVER PAIRS

SLLS173F – JANUARY 1994 – REVISED APRIL 2006

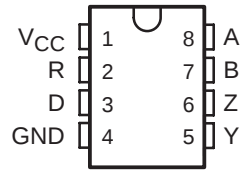
- Designed for High-Speed Multipoint Data Transmission Over Long Cables
- Operates With Pulse Widths as Low as 30 ns
- Low Supply Current . . . 5 mA Max
- Meets or Exceeds the Standard Requirements of ANSI RS-485 and ISO 8482:1987(E)
- Common-Mode Voltage Range of –7 V to 12 V
- Positive- and Negative-Output Current Limiting
- Driver Thermal Shutdown Protection
- Pin Compatible With the SN75179B

description

The SN65LBC179, SN65LBC179Q, and SN75LBC179 differential driver and receiver pairs are monolithic integrated circuits designed for bidirectional data communication over long cables that take on the characteristics of transmission lines. They are balanced, or differential, voltage mode devices that meet or exceed the requirements of industry standards ANSI RS-485 and ISO 8482:1987(E). Both devices are designed using TI's proprietary LinBiCMOS™ with the low power consumption of CMOS and the precision and robustness of bipolar transistors in the same circuit.

The SN65LBC179, SN65LBC179Q, and SN75LBC179 combine a differential line driver and differential line receiver and operate from a single 5-V supply. The driver differential outputs and the receiver differential inputs are connected to separate terminals for full-duplex operation and are designed to present minimum loading to the bus when powered off ($V_{CC} = 0$). These parts feature a wide common-mode voltage range making them suitable for point-to-point or multipoint data bus applications. The devices also provide positive- and negative-current limiting and thermal shutdown for protection from line fault conditions. The line driver shuts down at a junction temperature of approximately 172°C.

D OR P PACKAGE
(TOP VIEW)



Function Tables

DRIVER

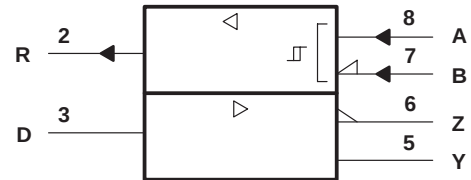
INPUT D	OUTPUTS	
	Y	Z
H	H	L
L	L	H

RECEIVER

DIFFERENTIAL INPUTS A–B	OUTPUT R
$V_{ID} \geq 0.2 \text{ V}$	H
$-0.2 \text{ V} < V_{ID} < 0.2 \text{ V}$	?
$V_{ID} \leq -0.2 \text{ V}$	L
Open circuit	H

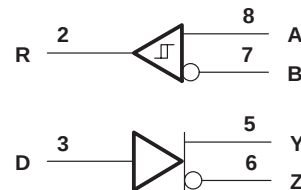
H = high level, L = low level,
? = indeterminate

logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)



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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.



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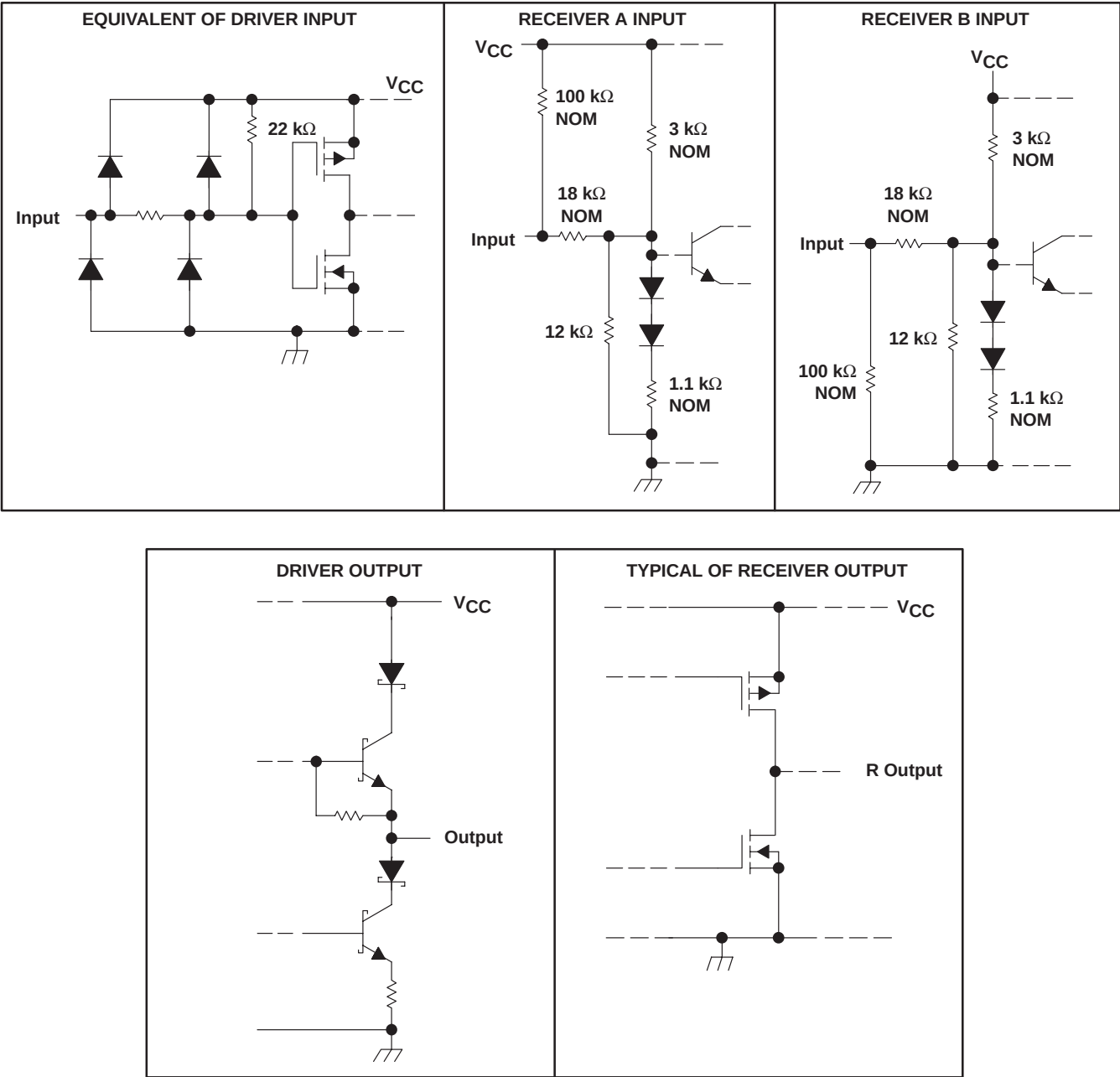
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description (continued)

The SN65LBC179, SN65LBC179Q, and SN75LBC179 are available in the 8-pin dual-in-line and small-outline packages. The SN75LBC179 is characterized for operation over the commercial temperature range of 0°C to 70°C. The SN65LBC179 is characterized over the industrial temperature range of -40°C to 85°C. The SN65LBC179Q is characterized over the extended industrial or automotive temperature range of -40°C to 125°C.

schematics of inputs and outputs



SN75LBC179, SN65LBC179, SN65LBC179Q

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absolute maximum ratings[†]

Supply voltage range, V_{CC}	–0.3 V to 7 V
Voltage range at A, B, Y, or Z (see Note 1)	–10 V to 15 V
Voltage range at D or R (see Note 1)	–0.3 V to $V_{CC} + 0.5$ V
Receiver output current, I_O	±10 mA
Continuous total power dissipation (see Note 2)	Internally limited
Total power dissipation	See Dissipation Rating Table

[†] 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 are with respect to GND.

2. The maximum operating junction temperature is internally limited. Uses the dissipation rating table to operate below this temperature.

recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}		4.75	5	5.25	V
High-level input voltage, V_{IH}	D	2			V
Low-level input voltage, V_{IL}	D			0.8	V
Differential input voltage, V_{ID}		–6 [‡]		6	V
Voltage at any bus terminal (separately or common-mode), V_O , V_I , or V_{IC}	A, B, Y, or Z	–7		12	V
High-level output current, I_{OH}	Y or Z			–60	mA
	R			–8	
Low-level output current, I_{OL}	Y or Z			60	mA
	R			8	
Junction temperature, T_J				140	°C
Operating free-air temperature, T_A	SN65LBC179	–40		85	°C
	SN65LBC179Q	–40		125	
	SN75LBC179	0		70	

[‡] The algebraic convention, in which the least positive (most negative) limit is designated as minimum, is used in this data sheet for differential input voltage, voltage at any bus terminal (separately or common mode), operating temperature, input threshold voltage, and common-mode output voltage.

DISSIPATION RATING TABLE

PACKAGE	THERMAL MODEL	$T_A < 25^\circ\text{C}$ 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
D	Low $K^\dagger$	526 mW	5.0 mW/°C	301 mW	226 mW
	High $K^\ddagger$	882 mW	8.4 mW/°C	504 mW	378 mW
P		840 mW	8.0 mW/°C	480 mW	360 mW

[†] In accordance with the low effective thermal conductivity metric definitions of EIA/JESD 51–3.

[‡] In accordance with the high effective thermal conductivity metric definitions of EIA/JESD 51–7.



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DRIVER SECTION

electrical characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP [†]	MAX	UNIT
V_{IK}	Input clamp voltage	$I_I = -18 \text{ mA}$				-1.5	V
$ V_{OD} $	Differential output voltage (see Note 3)	$R_L = 54 \Omega$, See Figure 1	SN65LBC179, SN65LBC179Q	1.1	2.2	5	V
			SN75LBC179	1.5	2.2	5	
		$R_L = 60 \Omega$, See Figure 2	SN65LBC179, SN65LBC179Q	1.1	2.2	5	
			SN75LBC179	1.5	2.2	5	
$\Delta V_{OD} $	Change in magnitude of differential output voltage (see Note 4)	See Figures 1 and 2				± 0.2	V
V_{OC}	Common-mode output voltage	$R_L = 54 \Omega$, See Figure 1		1	2.5	3	V
$\Delta V_{OC} $	Change in magnitude of common-mode output voltage (see Note 4)					± 0.2	V
I_O	Output current with power off	$V_{CC} = 0$, $V_O = -7 \text{ V to } 12 \text{ V}$				± 100	μA
I_{IH}	High-level input current	$V_I = 2.4 \text{ V}$				-100	μA
I_{IL}	Low-level input current	$V_I = 0.4 \text{ V}$				-100	μA
I_{OS}	Short-circuit output current	$-7 \text{ V} \leq V_O \leq 12 \text{ V}$				± 250	mA
I_{CC}	Supply current	No load	SN65LBC179, SN75LBC179		4.2	5	mA
			SN65LBC179Q		4.2	7	mA

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

NOTES: 3. The minimum V_{OD} specification of the SN65179 may not fully comply with ANSI RS-485 at operating temperatures below 0°C . System designers should take the possibly lower output signal into account in determining the maximum signal transmission distance.

4. $\Delta|V_{OD}|$ and $\Delta|V_{OC}|$ are the changes in the steady-state magnitude of V_{OD} and V_{OC} , respectively, that occur when the input is changed from a high level to a low level.

switching characteristics, $V_{CC} = 5 \text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS		MIN	MAX	UNIT
$t_{d(OD)}$	Differential-output delay time	$R_L = 54 \Omega$, See Figure 3		7	18	ns
$t_{t(OD)}$	Differential transition time			5	20	ns



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RECEIVER SECTION

electrical characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V _{IT+}	Positive-going input threshold voltage	I _O = −8 mA				0.2	V
V _{IT−}	Negative-going input threshold voltage	I _O = 8 mA		−0.2			V
V _{hys}	Hysteresis voltage (V _{IT+} − V _{IT−})				45		mV
V _{OH}	High-level output voltage	V _{ID} = 200 mV,	I _{OH} = −8 mA	3.5	4.5		V
V _{OL}	Low-level output voltage	V _{ID} = −200 mV,	I _{OL} = 8 mA		0.3	0.5	V
I _I	Bus input current	V _I = 12 V, Other inputs at 0 V, V _{CC} = 5 V	SN65LBC179, SN75LBC179		0.7	1	mA
			SN65LBC179Q		0.7	1.2	mA
		V _I = 12 V, Other inputs at 0 V, V _{CC} = 0 V	SN65LBC179, SN75LBC179		0.8	1	mA
			SN65LBC179Q		0.8	1.2	mA
		V _I = −7 V, Other inputs at 0 V, V _{CC} = 5 V	SN65LBC179, SN75LBC179		−0.5	−0.8	mA
			SN65LBC179Q		−0.5	−1.0	mA
		V _I = −7 V, Other inputs at 0 V, V _{CC} = 0 V	SN65LBC179, SN75LBC179		−0.5	−0.8	mA
			SN65LBC179Q		−0.5	−1.0	mA

switching characteristics, $V_{CC} = 5 \text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PHL} Propagation delay time, high- to low-level output	$V_{ID} = -1.5 \text{ V to } 1.5 \text{ V}$, See Figure 4	15		30	ns
t_{PLH} Propagation delay time, low- to high-level output		15		30	ns
$t_{sk(p)}$ Pulse skew ($ t_{PHL} - t_{PLH} $)	See Figure 4		3	6	ns
t_t Transition time			3	5	ns

PARAMETER MEASUREMENT INFORMATION

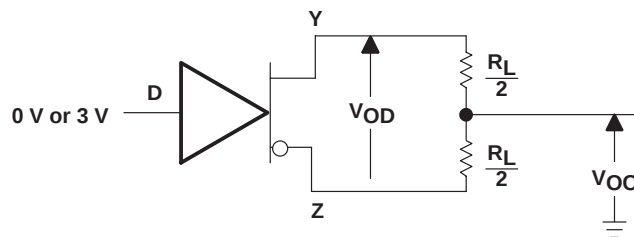


Figure 1. Differential and Common-Mode Output Voltage Test Circuit

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PARAMETER MEASUREMENT INFORMATION

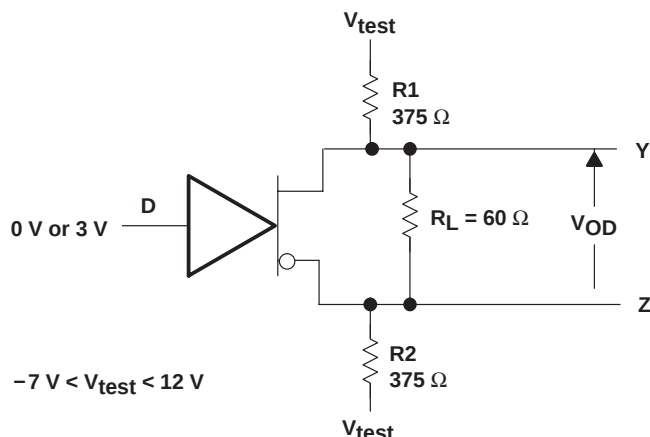
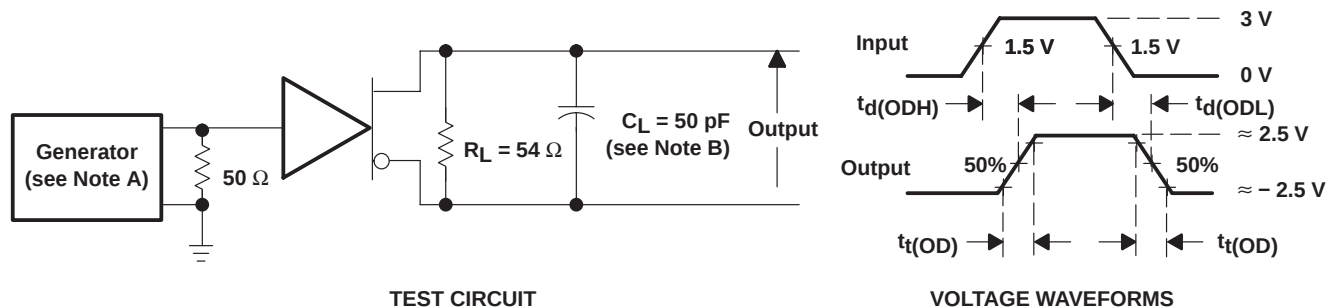
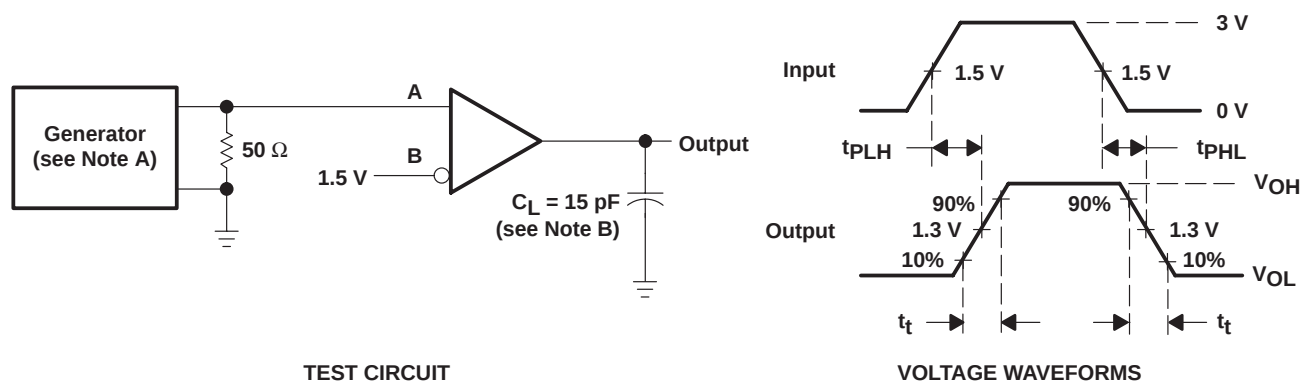


Figure 2. Differential Output Voltage Test Circuit



NOTES: A. The input pulse is supplied by a generator having the following characteristics: $PRR \leq 1 \text{ MHz}$, 50% duty cycle, $t_r \leq 6 \text{ ns}$, $t_f \leq 6 \text{ ns}$, $Z_O = 50 \Omega$.
B. C_L includes probe and jig capacitance.

Figure 3. Driver Test Circuits and Differential Output Delay and Transition Time Voltage Waveforms



NOTES: A. The input pulse is supplied by a generator having the following characteristics: $PRR \leq 1 \text{ MHz}$, 50% duty cycle, $t_r \leq 6 \text{ ns}$, $t_f \leq 6 \text{ ns}$, $Z_O = 50 \Omega$.
B. C_L includes probe and jig capacitance.

Figure 4. Receiver Test Circuit and Propagation Delay and Transition Time Voltage Waveforms

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TYPICAL CHARACTERISTICS

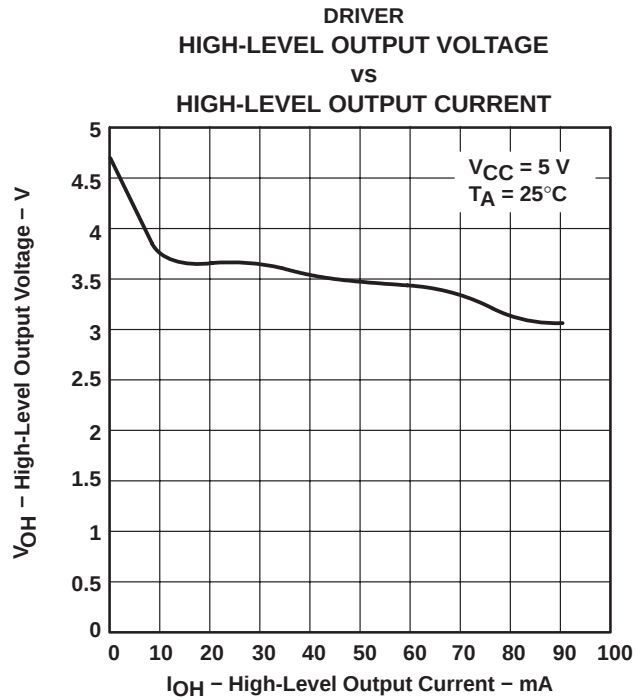


Figure 5

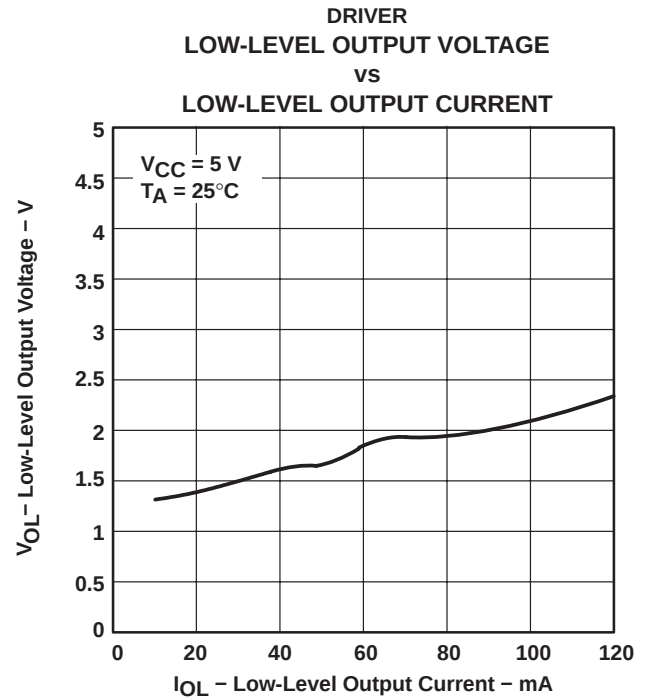


Figure 6

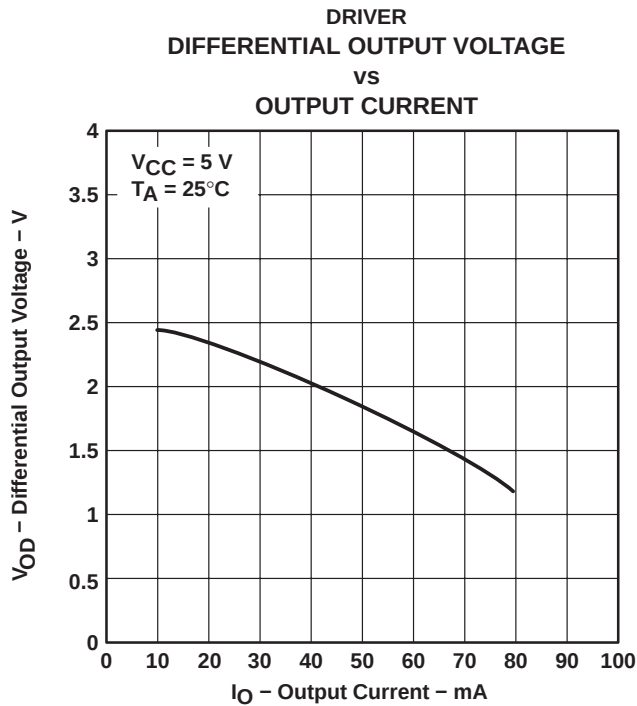


Figure 7

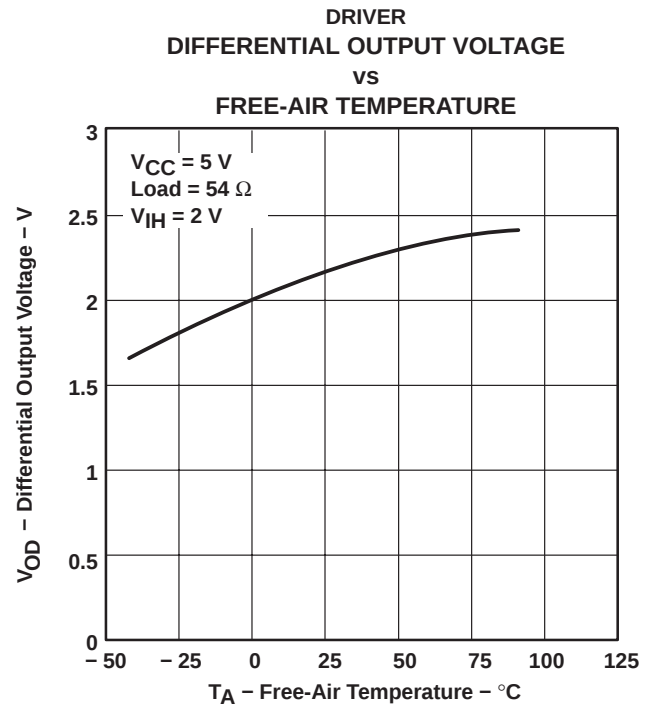


Figure 8

SN75LBC179, SN65LBC179, SN65LBC179Q

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TYPICAL CHARACTERISTICS

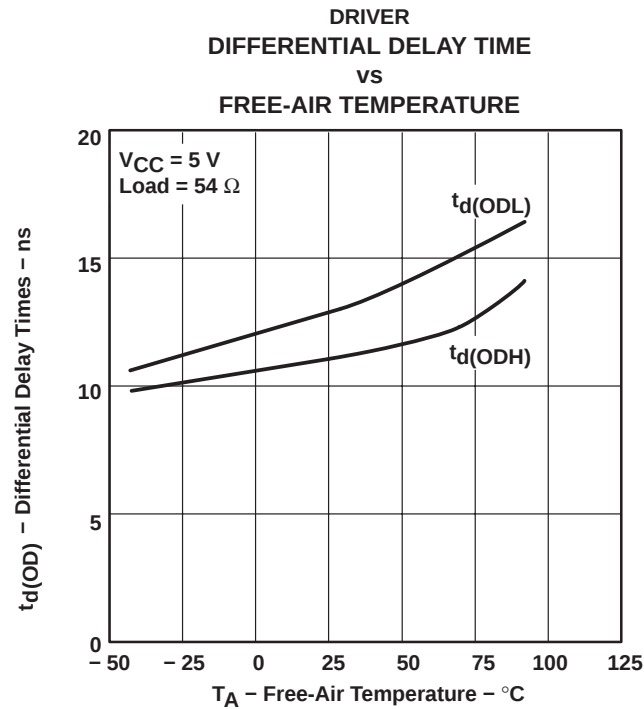


Figure 9

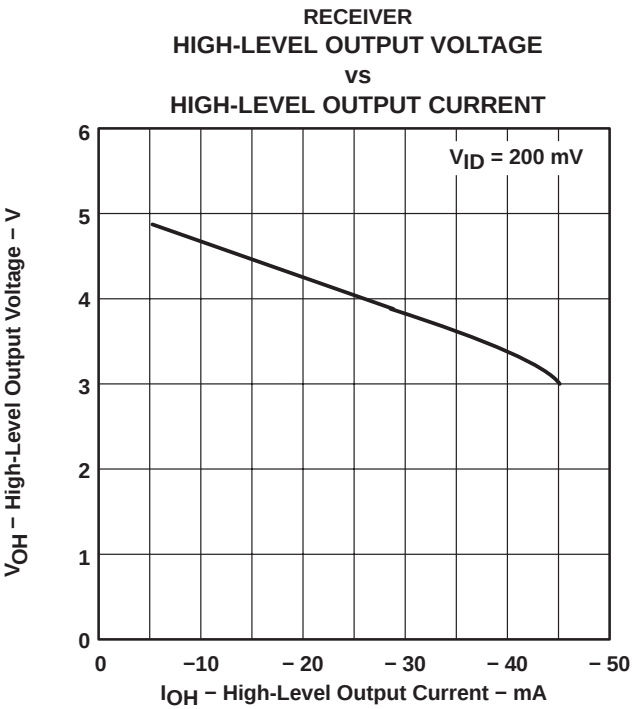


Figure 10

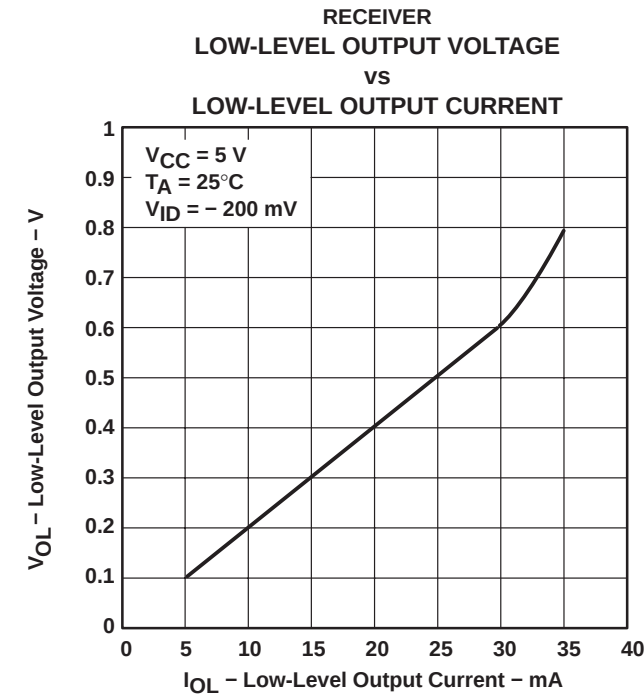


Figure 11

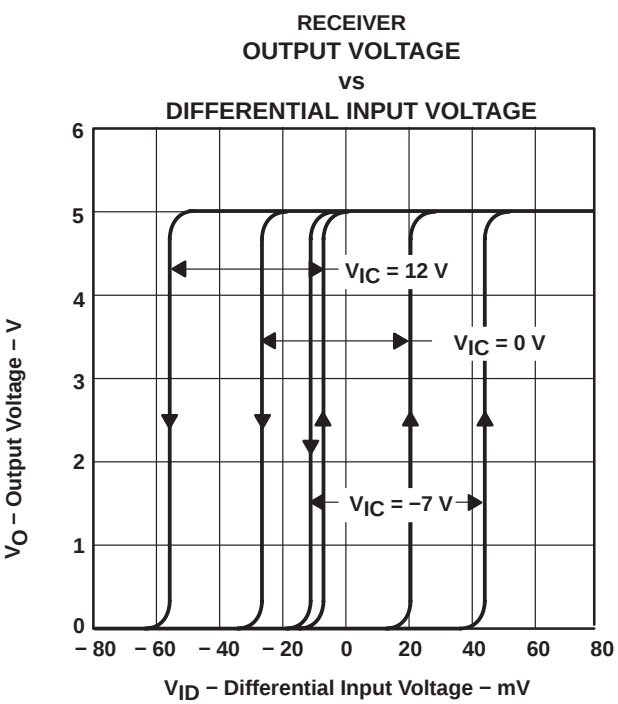


Figure 12

SN75LBC179, SN65LBC179, SN65LBC179Q

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TYPICAL CHARACTERISTICS

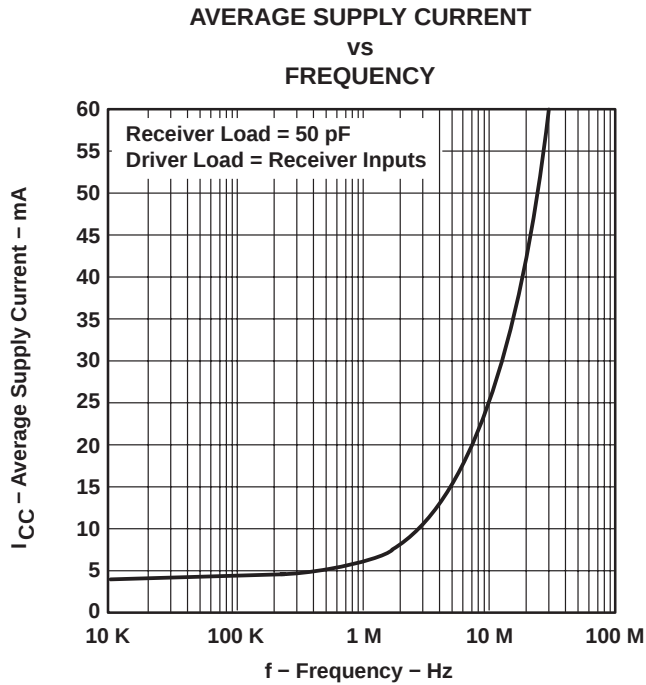


Figure 13

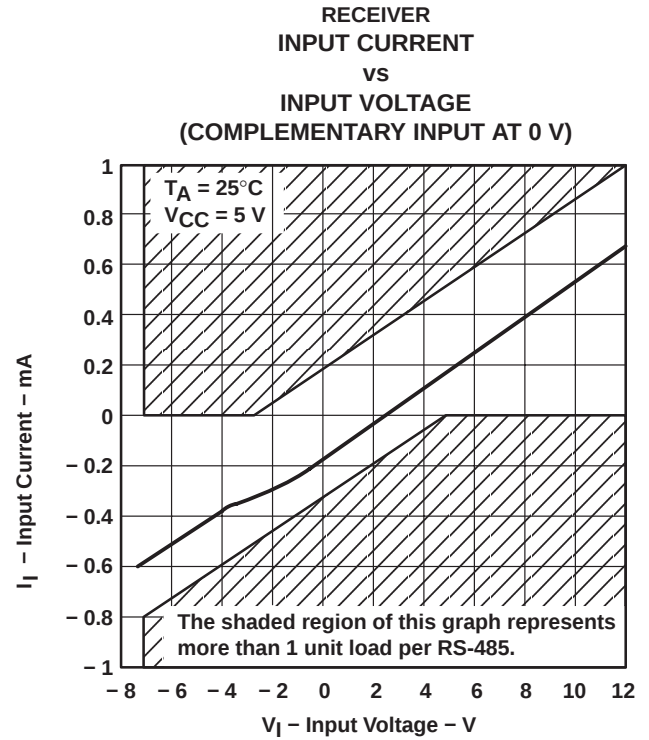


Figure 14

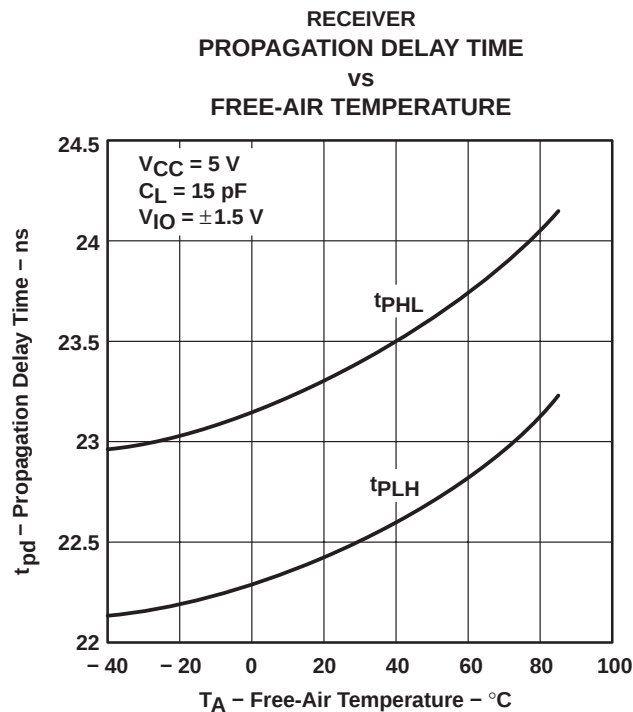


Figure 15

SN75LBC179, SN65LBC179, SN65LBC179Q

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THERMAL CHARACTERISTICS – D PACKAGE

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Junction-to-ambient thermal resistance, θ_{JA} [†]	Low-K board, no air flow		199.4		°C/W
	High-K board, no air flow		119		
Junction-to-board thermal resistance, θ_{JB}	High-K board, no air flow		67		
Junction-to-case thermal resistance, θ_{JC}			46.6		
Average power dissipation, $P_{(AVG)}$	$R_L = 54 \Omega$, input to D is 10 Mbps 50% duty cycle square wave, $V_{CC} = 5.25 \text{ V}$, $T_J = 130^\circ\text{C}$.			330	mW
Thermal shutdown junction temperature, T_{SD}			165		°C

[†] See TI application note literature number SZZA003, Package Thermal Characterization Methodologies, for an explanation of this parameter.



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THERMAL CHARACTERISTICS OF IC PACKAGES

Θ_{JA} (Junction-to-Ambient Thermal Resistance) is defined as the difference in junction temperature to ambient temperature divided by the operating power

Θ_{JA} is NOT a constant and is a strong function of

- the PCB design (50% variation)
- altitude (20% variation)
- device power (5% variation)

Θ_{JA} can be used to compare the thermal performance of packages if the specific test conditions are defined and used. Standardized testing includes specification of PCB construction, test chamber volume, sensor locations, and the thermal characteristics of holding fixtures. Θ_{JA} is often misused when it is used to calculate junction temperatures for other installations.

TI uses two test PCBs as defined by JEDEC specifications. The low-k board gives *average* in-use condition thermal performance and consists of a single trace layer 25 mm long and 2-oz thick copper. The high-k board gives *best case* in-use condition and consists of two 1-oz buried power planes with a single trace layer 25 mm long with 2-oz thick copper. A 4% to 50% difference in Θ_{JA} can be measured between these two test cards

Θ_{JC} (Junction-to-Case Thermal Resistance) is defined as difference in junction temperature to case divided by the operating power. It is measured by putting the mounted package up against a copper block cold plate to force heat to flow from die, through the mold compound into the copper block.

Θ_{JC} is a useful thermal characteristic when a heatsink is applied to package. It is NOT a useful characteristic to predict junction temperature as it provides pessimistic numbers if the case temperature is measured in a non-standard system and junction temperatures are backed out. It can be used with Θ_{JB} in 1-dimensional thermal simulation of a package system.

Θ_{JB} (Junction-to-Board Thermal Resistance) is defined to be the difference in the junction temperature and the PCB temperature at the center of the package (closest to the die) when the PCB is clamped in a cold-plate structure. Θ_{JB} is only defined for the high-k test card.

Θ_{JB} provides an overall thermal resistance between the die and the PCB. It includes a bit of the PCB thermal resistance (especially for BGA's with thermal balls) and can be used for simple 1-dimensional network analysis of package system (see Figure 16).

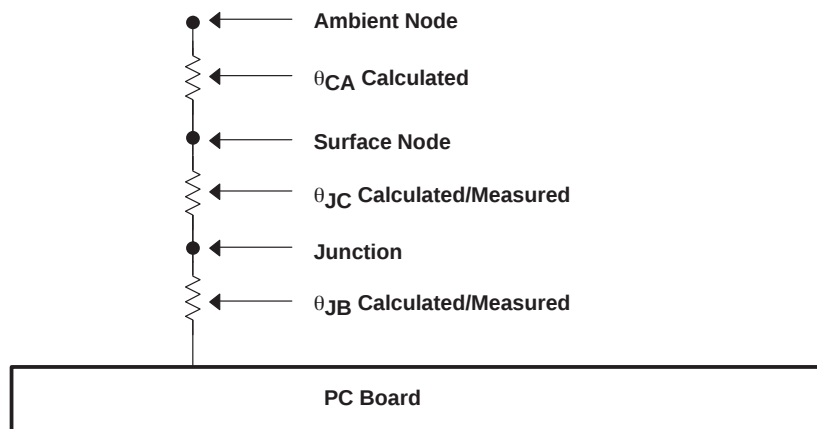


Figure 16. Thermal Resistance

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN65LBC179D	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC179DG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC179DR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC179DRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC179P	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN65LBC179PE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN65LBC179QD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC179QDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC179QDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC179QDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC179D	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC179DG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC179DR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC179DRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC179P	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN75LBC179PE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type

⁽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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TAPE AND REEL INFORMATION


*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
SN65LBC179DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
SN75LBC179DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN65LBC179DR	SOIC	D	8	2500	340.5	338.1	20.6
SN75LBC179DR	SOIC	D	8	2500	340.5	338.1	20.6

P (R-PDIP-T8)

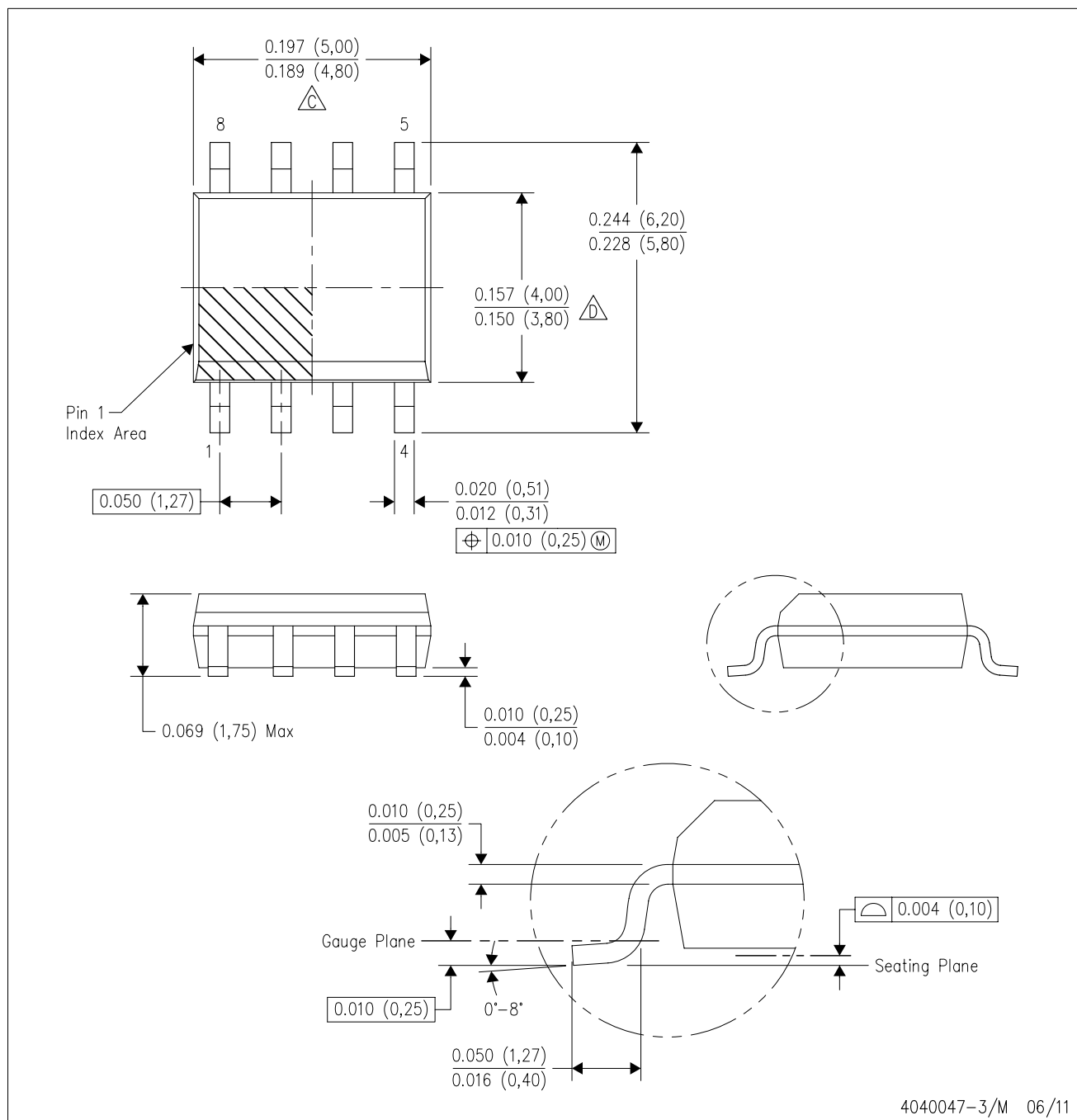
PLASTIC DUAL-IN-LINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MS-001 variation BA.

D (R-PDSO-G8)

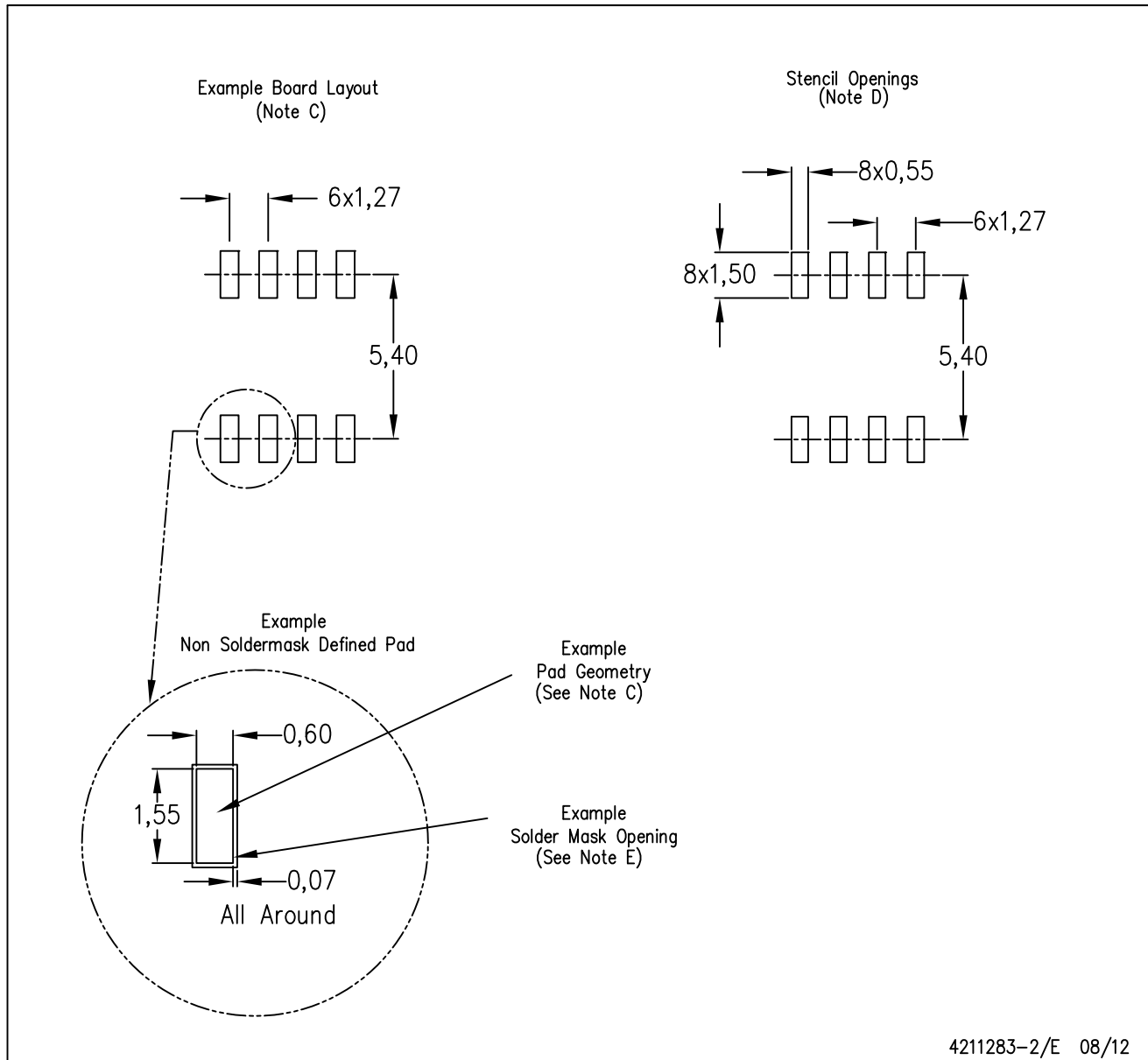
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ 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.
 - $\triangle D$ Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AA.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



4211283-2/E 08/12

- 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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