

# SN75LBC179, SN65LBC179, SN65LBC179Q LOW-POWER DIFFERENTIAL LINE DRIVER AND RECEIVER PAIRS

SLLS173B – JANUARY 1994 – REVISED FEBRUARY 1998

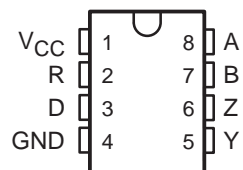
- Designed for High-Speed Multipoint Data Transmission Over Long Cables
- Operate With Pulse Widths as Low as 30 ns
- Low Supply Current . . . 5 mA Max
- Meets or Exceeds the Standard Requirements of ANSI RS-485 and ISO 8482:1987(E)
- Common-Mode Voltage Range of  $-7\text{ V}$  to  $12\text{ V}$
- Positive- 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  $172^{\circ}\text{C}$ .

D OR P PACKAGE  
(TOP VIEW)



## Function Tables

### DRIVER

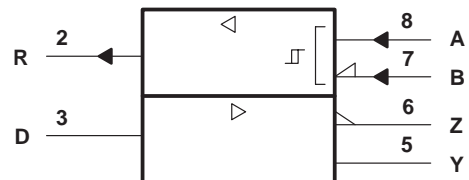
INPUT D	OUTPUTS	
	Y	Z
H	H	L
L	L	H

### 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

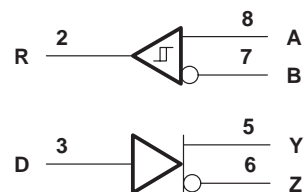
H = high level, L = low level,  
? = indeterminate

## 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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**TEXAS  
INSTRUMENTS**

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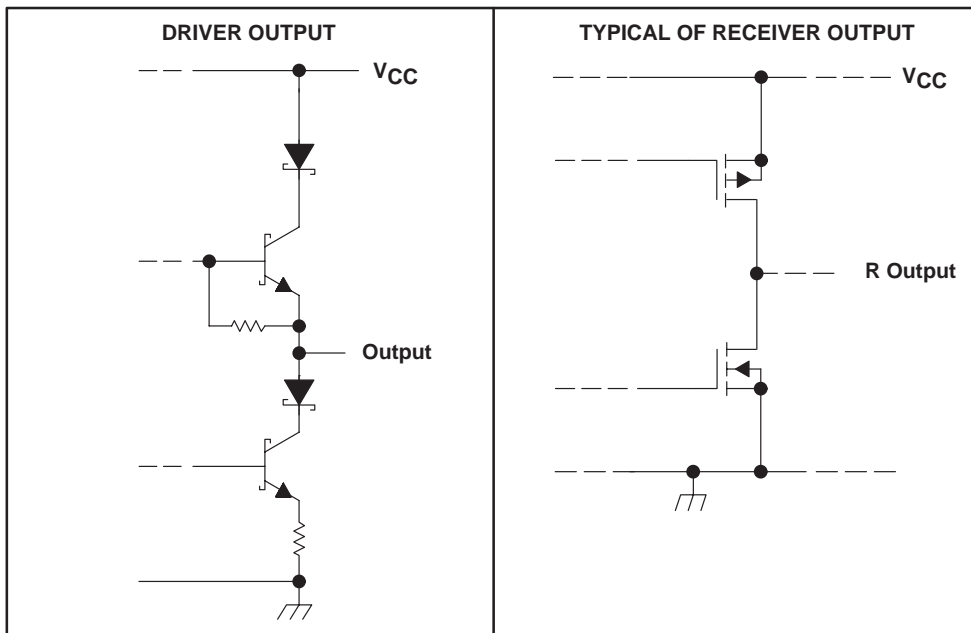
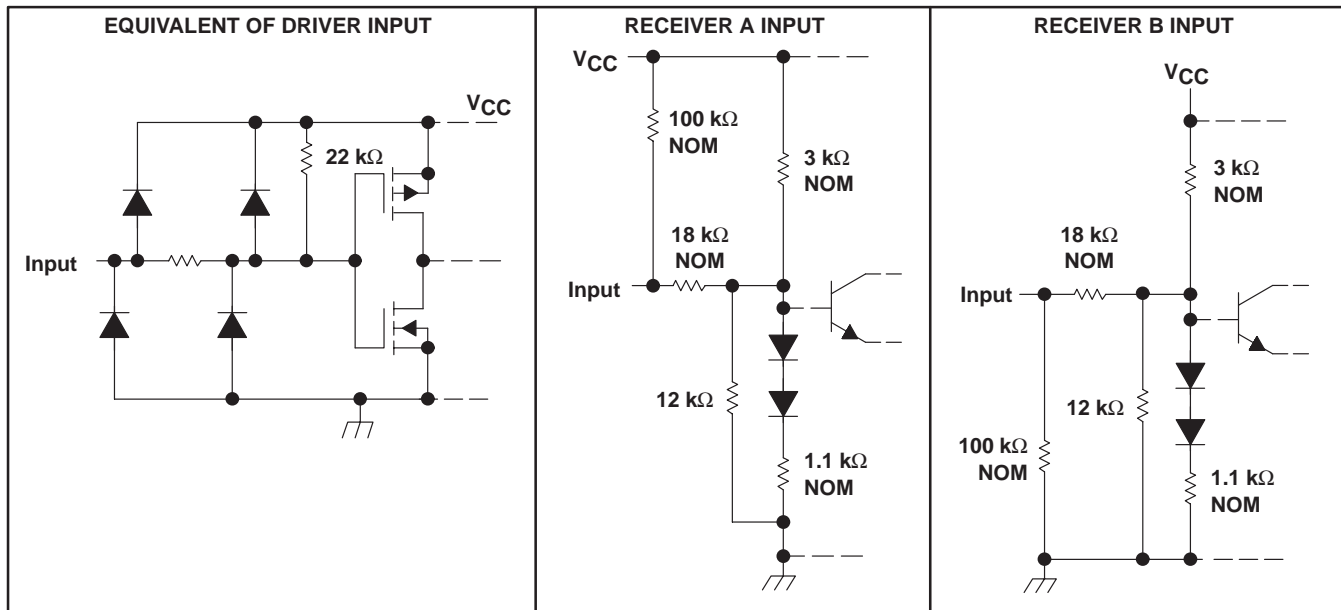
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## description (continued)

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



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

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 7 V
Continuous total power dissipation (see Note 2) .....	Internally limited
Total power dissipation .....	See Dissipation Rating Table
Operating free-air temperature range, $T_A$ : SN65LBC179 .....	–40°C to 85°C
SN65LBC179Q .....	–40°C to 125°C
SN75LBC179 .....	0°C to 70°C
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 are with respect to GND.  
 2. The maximum operating junction temperature is internally limited. Uses the dissipation rating table to operate below this temperature.

**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
D	725 mW	5.8 mW/°C	464 mW	377 mW
P	1100 mW	8.8 mW/°C	704 mW	572 mW

## 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	
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.



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## DRIVER SECTION

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

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V <sub>IK</sub>	Input clamp voltage	I <sub>I</sub> = -18 mA				-1.5	V
V <sub>OD</sub>	Differential output voltage (see Note 3)	R <sub>L</sub> = 54 Ω, See Figure 1	SN65LBC179, SN65LBC179Q	1.1	2.2	5	V
			SN75LBC179	1.5	2.2	5	
		R <sub>L</sub> = 60 Ω, See Figure 2	SN65LBC179, SN65LBC179Q	1.1	2.2	5	
			SN75LBC179	1.5	2.2	5	
Δ V <sub>OD</sub>	Change in magnitude of differential output voltage (see Note 4)	See Figures 1 and 2				±0.2	V
V <sub>OC</sub>	Common-mode output voltage	R <sub>L</sub> = 54 Ω, See Figure 1		1	2.5	3	V
Δ V <sub>OC</sub>	Change in magnitude of common-mode output voltage (see Note 4)					±0.2	V
I <sub>O</sub>	Output current with power off	V <sub>CC</sub> = 0,	V <sub>O</sub> = -7 V to 12 V			±100	μA
I <sub>IH</sub>	High-level input current	V <sub>I</sub> = 2.4 V				-100	μA
I <sub>IL</sub>	Low-level input current	V <sub>I</sub> = 0.4 V				-100	μA
I <sub>OS</sub>	Short-circuit output current	-7 V ≤ V <sub>O</sub> ≤ 12 V				±250	mA
I <sub>CC</sub>	Supply current	No load	SN65LBC179, SN75LBC179		4.2	5	mA
			SN65LBC179Q		4.2	7	mA

† All typical values are at V<sub>CC</sub> = 5 V and T<sub>A</sub> = 25°C.

NOTES: 3. The minimum V<sub>OD</sub> 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. Δ|V<sub>OD</sub>| and Δ|V<sub>OC</sub>| are the changes in the steady-state magnitude of V<sub>OD</sub> and V<sub>OC</sub>, respectively, that occur when the input is changed from a high level to a low level.

### switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C

PARAMETER		TEST CONDITIONS		MIN	MAX	UNIT
t <sub>d(OD)</sub>	Differential-output delay time	R <sub>L</sub> = 54 Ω, See Figure 3		7	18	ns
t <sub>t(OD)</sub>	Differential transition time				5	20



# SN75LBC179, SN65LBC179, SN65LBC179Q LOW-POWER DIFFERENTIAL LINE DRIVER AND RECEIVER PAIRS

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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	$I_O = -8 \text{ mA}$			0.2	V
$V_{IT-}$	Negative-going input threshold voltage	$I_O = 8 \text{ mA}$	-0.2			V
$V_{hys}$	Hysteresis voltage ( $V_{IT+} - V_{IT-}$ )			45		mV
$V_{OH}$	High-level output voltage	$V_{ID} = 200 \text{ mV}$ , $I_{OH} = -8 \text{ mA}$	3.5	4.5		V
$V_{OL}$	Low-level output voltage	$V_{ID} = -200 \text{ mV}$ , $I_{OL} = 16 \text{ mA}$		0.3	0.5	V
$I_I$	Bus input current	$V_I = 12 \text{ V}$ , Other inputs at 0 V, $V_{CC} = 5 \text{ V}$	SN65LBC179, SN75LBC179	0.7	1	mA
			SN65LBC179Q	0.7	1.2	mA
		$V_I = 12 \text{ V}$ , Other inputs at 0 V, $V_{CC} = 0 \text{ V}$	SN65LBC179, SN75LBC179	0.8	1	mA
			SN65LBC179Q	0.8	1.2	mA
		$V_I = -7 \text{ V}$ , Other inputs at 0 V, $V_{CC} = 5 \text{ V}$	SN65LBC179, SN75LBC179	-0.5	-0.8	mA
			SN65LBC179Q	-0.5	-1.0	mA
$V_I = -7 \text{ V}$ , Other inputs at 0 V, $V_{CC} = 0 \text{ V}$	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

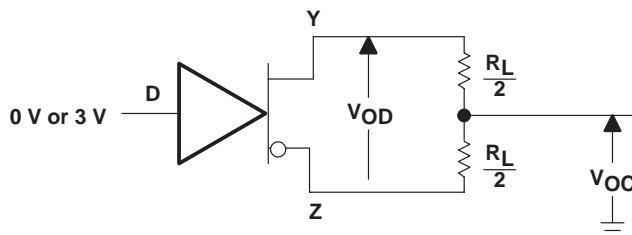


Figure 1. Differential and Common-Mode Output Voltage Test Circuit

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## PARAMETER MEASUREMENT INFORMATION

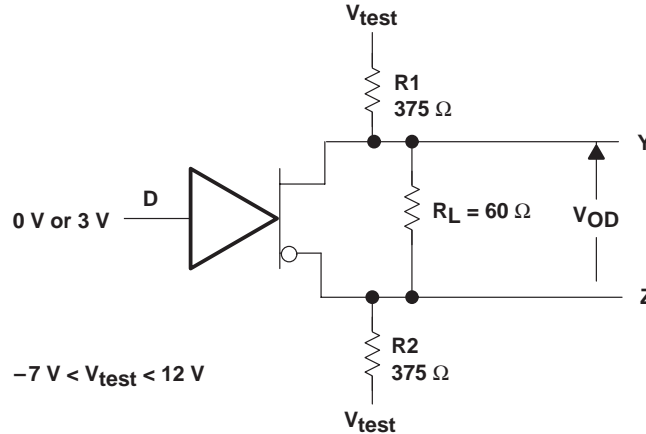


Figure 2. Differential Output Voltage Test Circuit

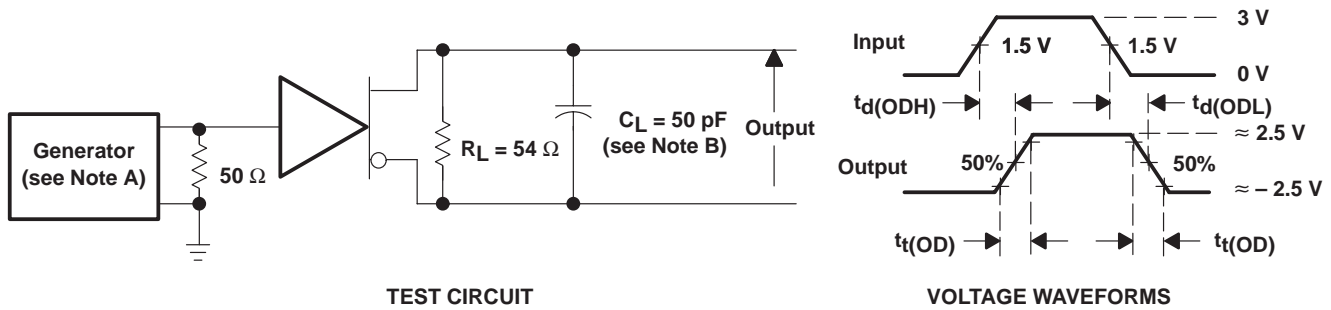


Figure 3. Driver Test Circuits and Differential Output Delay and Transition Time Voltage Waveforms

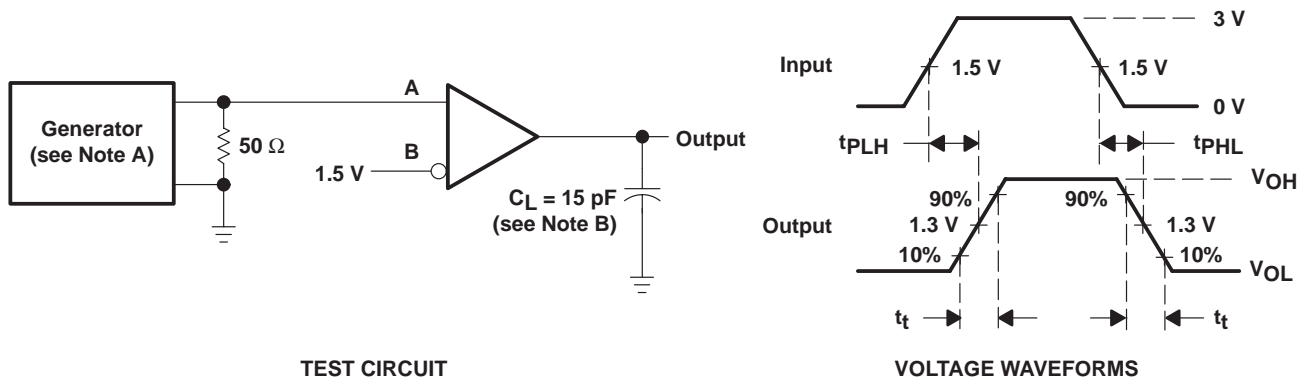


Figure 4. Receiver Test Circuit and Propagation Delay and Transition Time Voltage Waveforms

- 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.

# SN75LBC179, SN65LBC179, SN65LBC179Q

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### TYPICAL CHARACTERISTICS

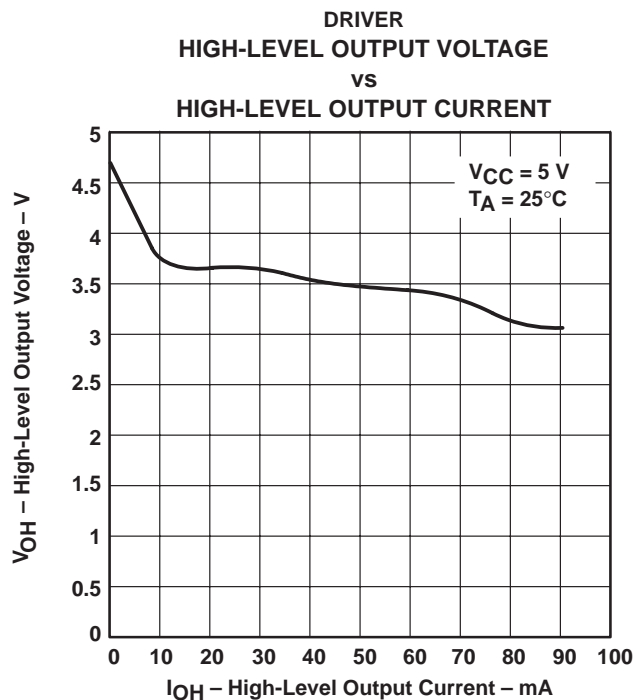


Figure 5

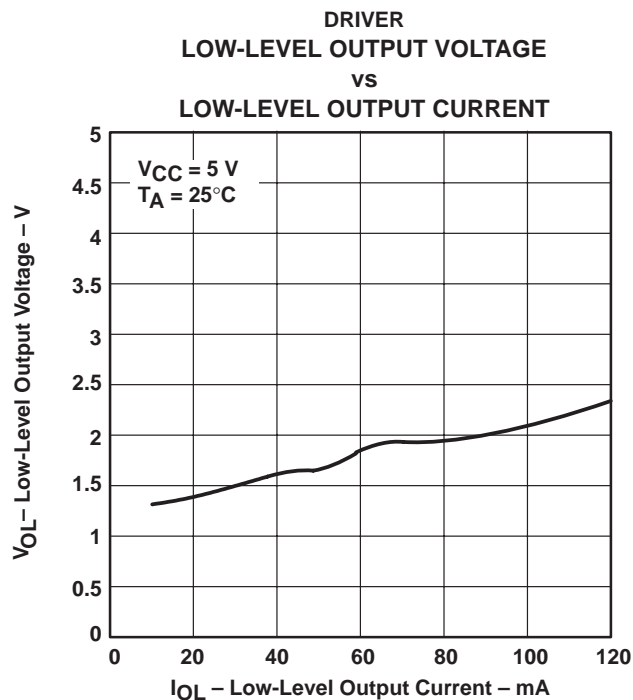


Figure 6

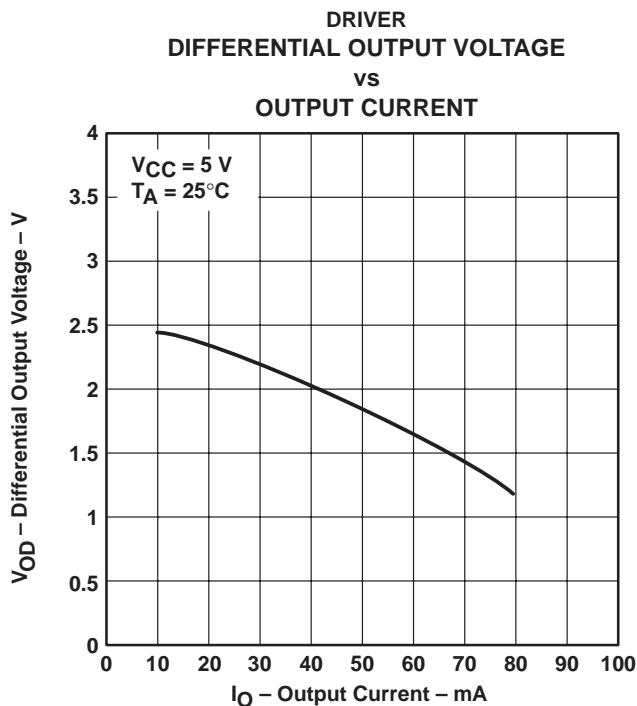


Figure 7

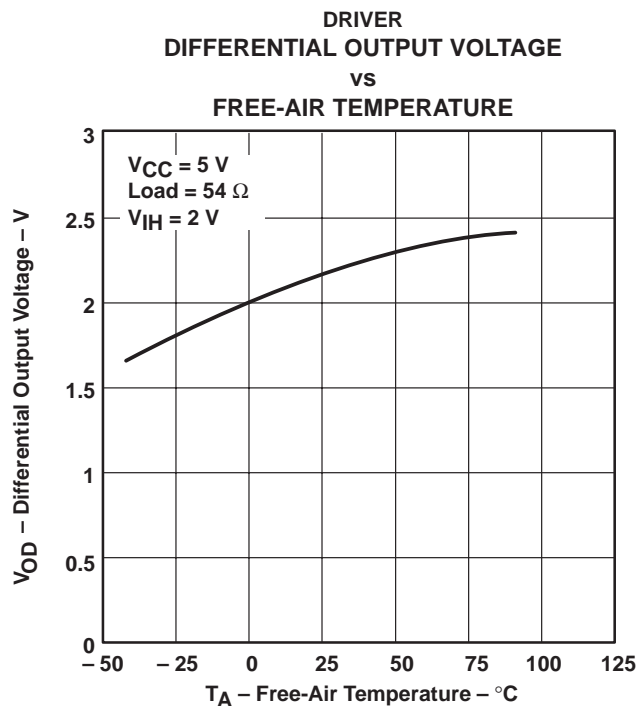


Figure 8



# SN75LBC179, SN65LBC179, SN65LBC179Q LOW-POWER DIFFERENTIAL LINE DRIVER AND RECEIVER PAIRS

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## TYPICAL CHARACTERISTICS

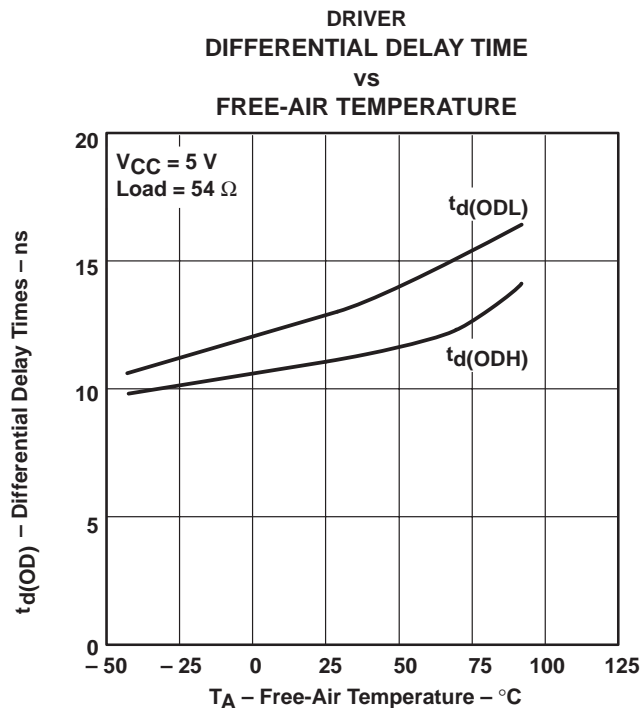


Figure 9

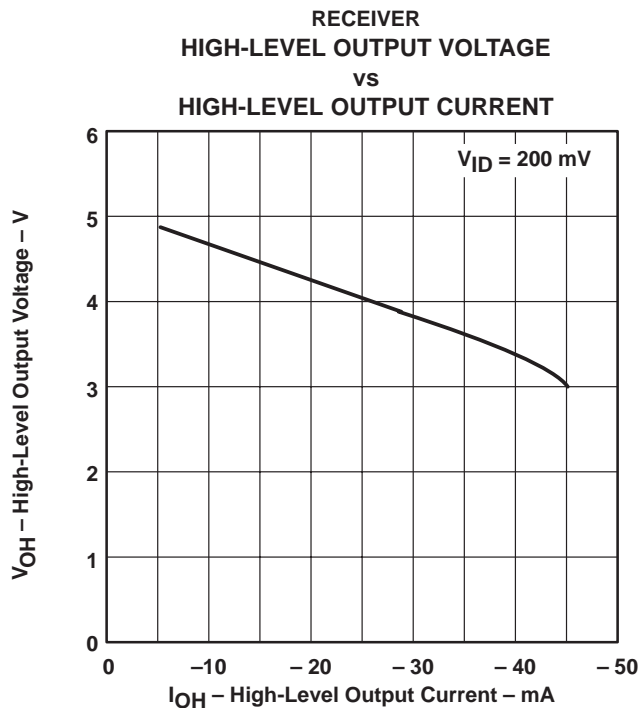


Figure 10

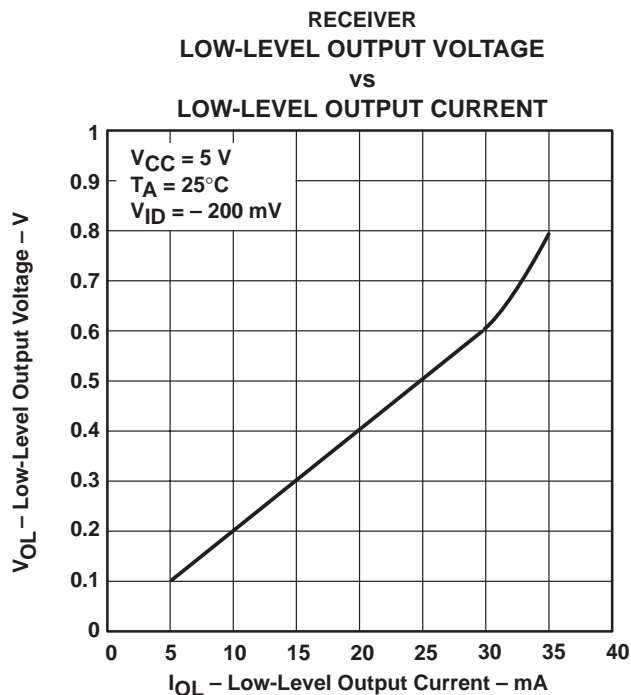


Figure 11

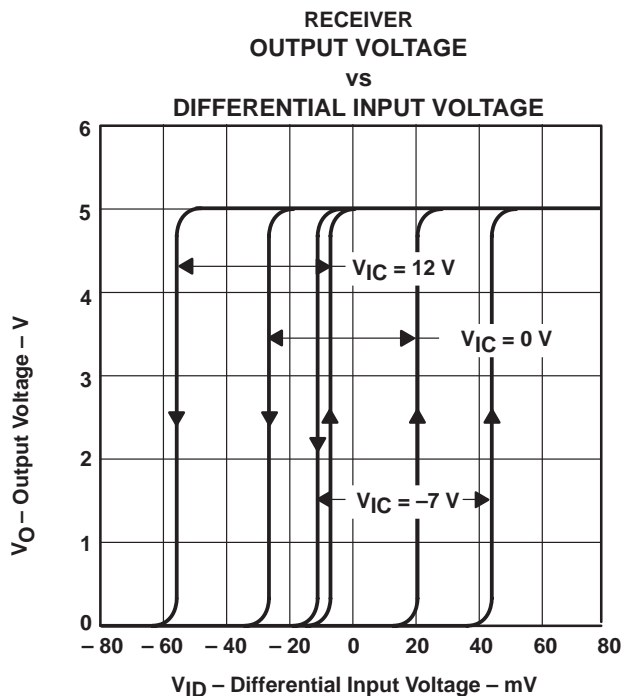


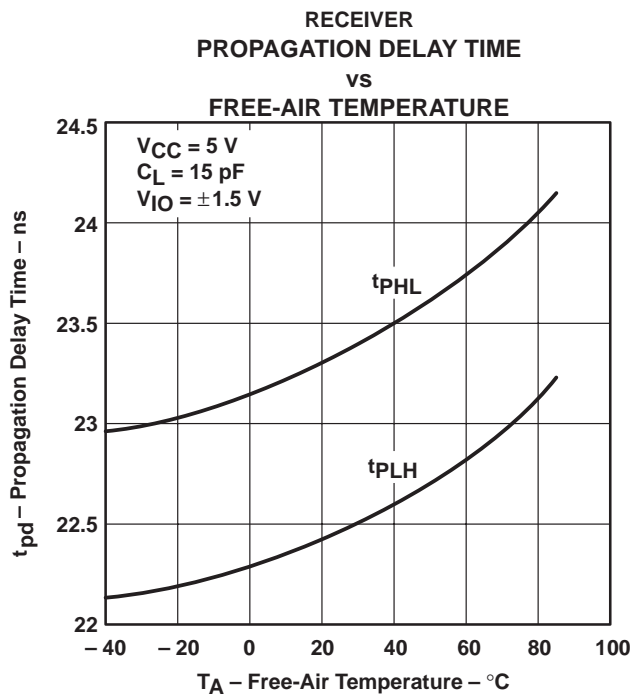
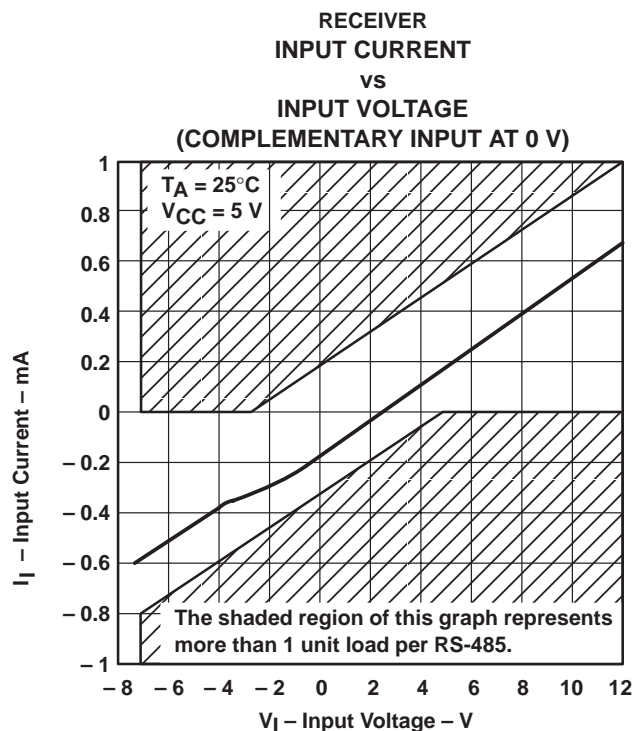
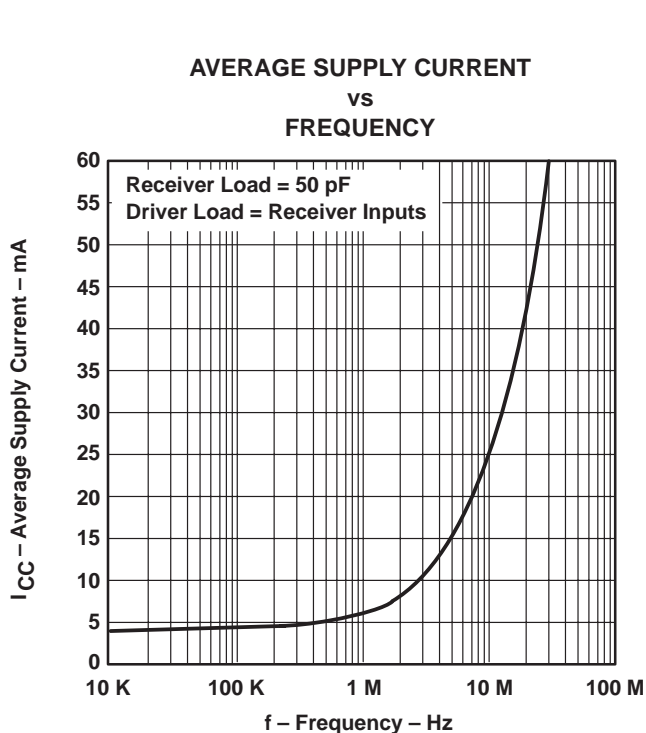
Figure 12



# SN75LBC179, SN65LBC179, SN65LBC179Q LOW-POWER DIFFERENTIAL LINE DRIVER AND RECEIVER PAIRS

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## TYPICAL CHARACTERISTICS



# SN75LBC179, SN65LBC179, SN65LBC179Q LOW-POWER DIFFERENTIAL LINE DRIVER AND RECEIVER PAIRS

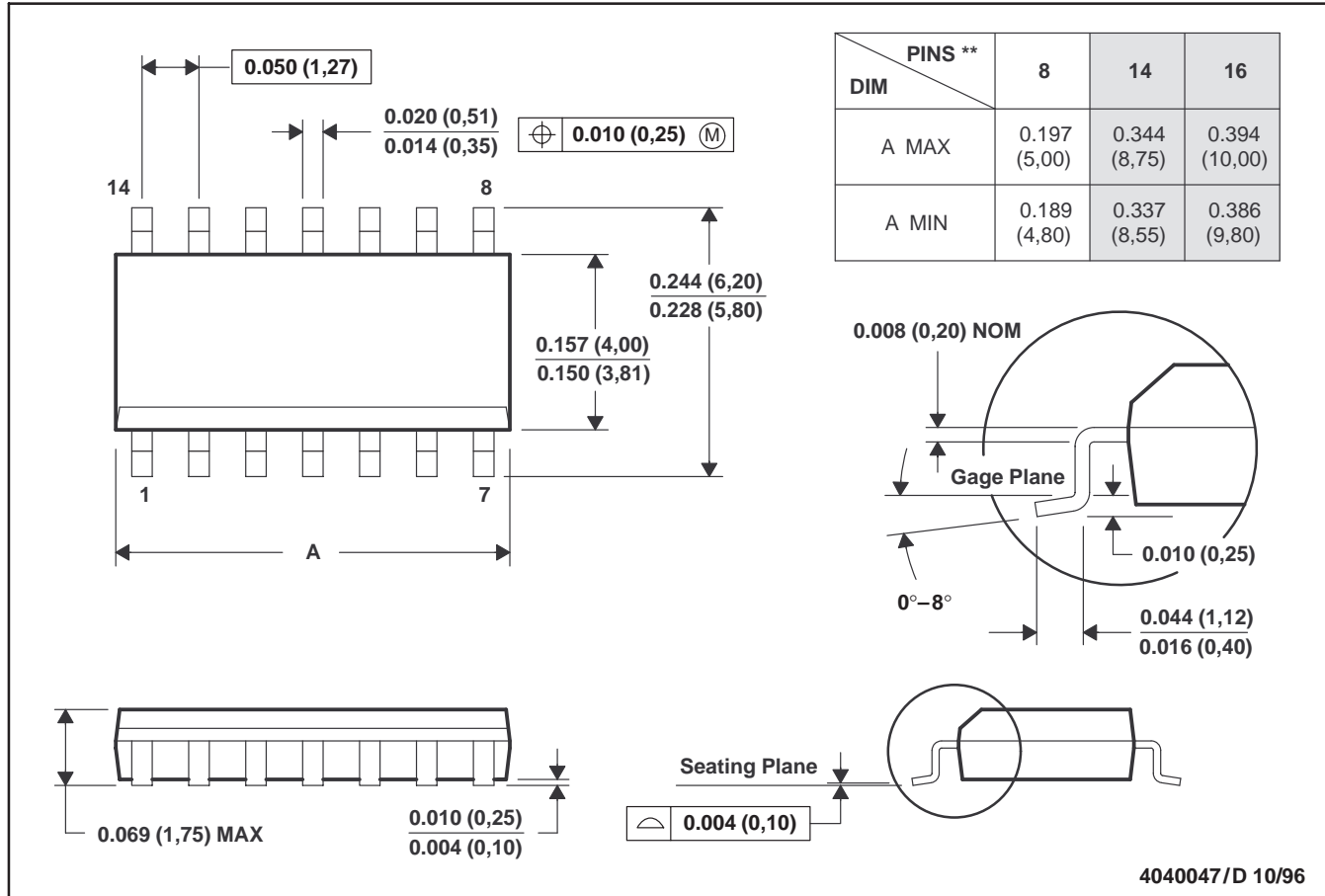
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## MECHANICAL INFORMATION

D (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14 PIN 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-012

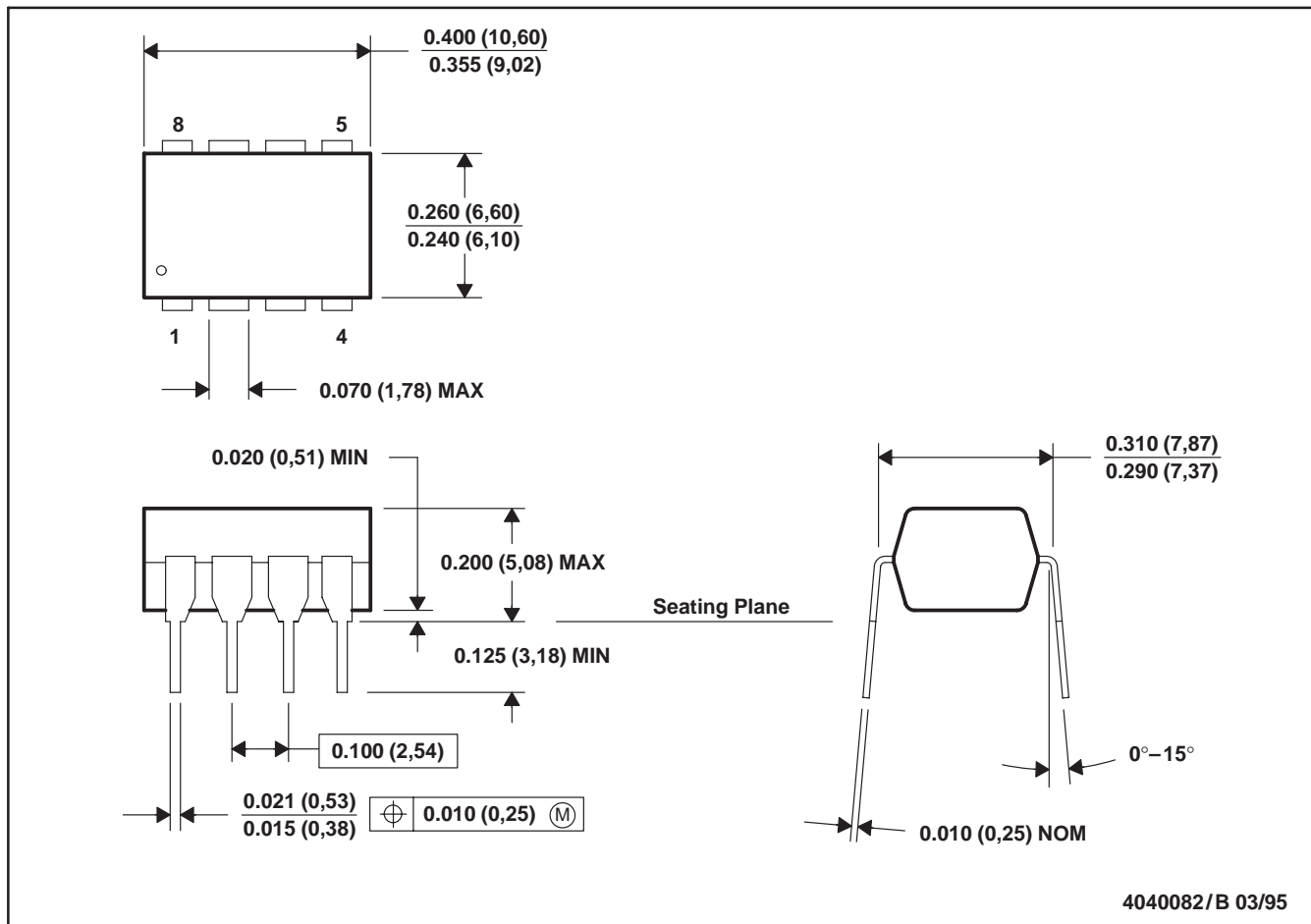
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## MECHANICAL INFORMATION

**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

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