

# SN65LBC174, SN75LBC174 QUADRUPLE LOW-POWER DIFFERENTIAL LINE DRIVERS

SLLS162D – JULY 1993 – REVISED SEPTEMBER 2003

- Meets or Exceeds the Standard EIA-485
- Designed for High-Speed Multipoint Transmission on Long Bus Lines in Noisy Environments
- Supports Data Rates up to and Exceeding Ten Million Transfers Per Second
- Common-Mode Output Voltage Range of  $-7\text{ V}$  to  $12\text{ V}$
- Positive- and Negative-Current Limiting
- Low Power Consumption . . .  $1.5\text{ mA}$  Max (Output Disabled)
- Functionally Interchangeable With SN75174

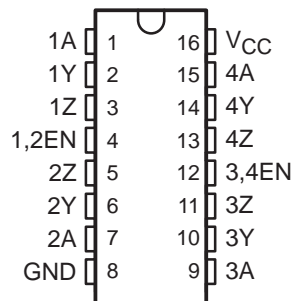
## description

The SN65LBC174 and SN75LBC174 are monolithic, quadruple, differential line drivers with 3-state outputs. Both devices are designed to meet the requirements of the Electronics Industry Association Standard EIA-485. These devices are optimized for balanced multipoint bus transmission at data rates up to and exceeding 10 million bits per second. Each driver features wide positive and negative common-mode output voltage ranges, current limiting, and thermal-shutdown protection, making it suitable for party-line applications in noisy environments. Both devices are designed using LinBiCMOS™, facilitating ultralow power consumption and inherent robustness.

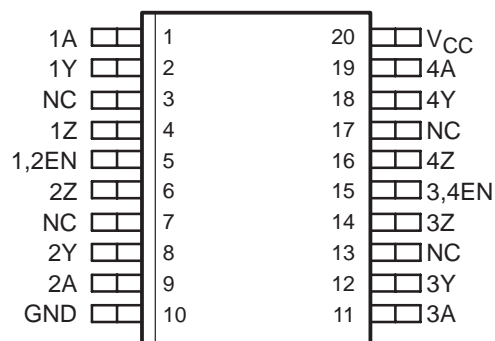
Both the SN65LBC174 and SN75LBC174 provide positive- and negative-current limiting and thermal shutdown for protection from line fault conditions on the transmission bus line. These devices offer optimum performance when used with the SN75LBC173 or SN75LBC175 quadruple line receivers. The SN65LBC174 and SN75LBC174 are available in the 16-terminal DIP package (N) and the 20-terminal wide-body small outline intergrated circuit (SOIC) package (DW).

The SN75LBC174 is characterized for operation over the commercial temperature range of  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ . The SN65LBC174 is characterized over the industrial temperature range of  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

**N PACKAGE  
(TOP VIEW)**



**DW PACKAGE  
(TOP VIEW)**



NC – No internal connection

**FUNCTION TABLE  
(each driver)**

INPUT	ENABLE	OUTPUTS	
		Y	Z
H	H	H	L
L	H	L	H
X	L	Z	Z

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



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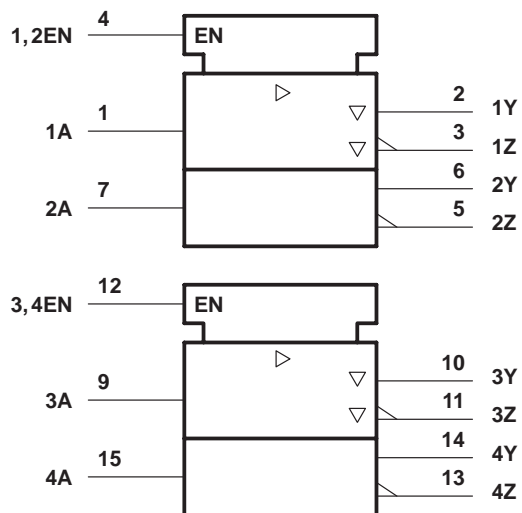
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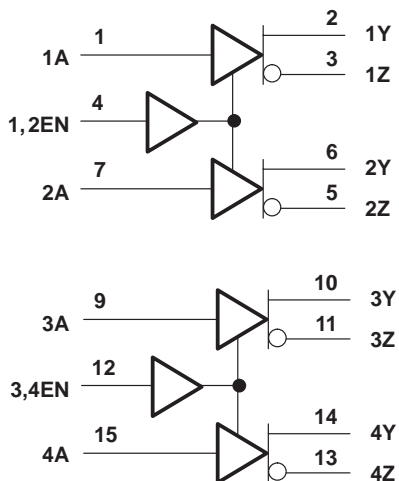
# SN65LBC174, SN75LBC174 QUADRUPLE LOW-POWER DIFFERENTIAL LINE DRIVERS

SLLS162D – JULY 1993 – REVISED SEPTEMBER 2003

## logic symbol†



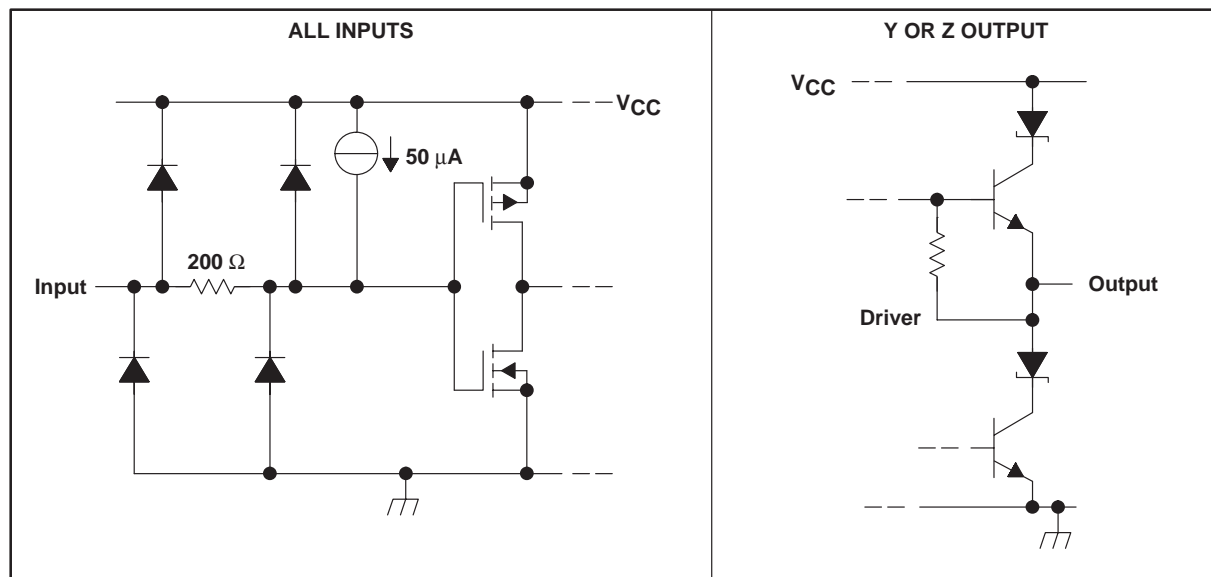
## logic diagram (positive logic)



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

Terminal numbers shown are for the N package.

## schematic of inputs and outputs



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SLLS162D – JULY 1993 – REVISED SEPTEMBER 2003

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

Supply voltage range, $V_{CC}$ (see Note 1)	–0.3 V to 7 V
Output voltage range, $V_O$	–10 V to 15 V
Voltage range at A, 1/2EN, 3/4EN	–0.3 V to $V_{CC} + 0.5$ V
Continuous total power dissipation	Internally limited‡
Operating free-air temperature range, $T_A$ : SN65LBC174	–40°C to 85°C
SN75LBC174	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.

‡ The maximum operating junction temperature is internally limited. Use the Dissipation Rating Table to operate below this temperature.

NOTE 1: All voltage values are with respect to GND.

## recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, $V_{CC}$		4.75	5	5.25	V
High-level input voltage, $V_{IH}$		2			V
Low-level input voltage, $V_{IL}$		0.8			V
Voltage at any bus terminal (separately or common-mode), $V_O$	Y or Z	12			V
		–7			
High-level output current, $I_{OH}$	Y or Z	–60			mA
Low-level output current, $I_{OL}$	Y or Z	60			mA
Continuous total power dissipation		See Dissipation Rating Table			
Operating free-air temperature, $T_A$	SN65LBC174	–40			°C
	SN75LBC174	0	70		

**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
DW	1125 mW	9.0 mW/°C	720 mW	585 mW
N	1150 mW	9.2 mW/°C	736 mW	598 mW

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SLLS162D – JULY 1993 – REVISED SEPTEMBER 2003

**electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (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‡	R <sub>L</sub> = 54 Ω, See Figure 1	SN65LBC174	1.1	1.8	5	V
			SN75LBC174	1.5	1.8	5	
		R <sub>L</sub> = 60 Ω, See Figure 2	SN65LBC174	1.1	1.7	5	
			SN75LBC174	1.5	1.7	5	
Δ V <sub>OD</sub>	Change in magnitude of common-mode output voltage§					±0.2	V
V <sub>OC</sub>	Common-mode output voltage	R <sub>L</sub> = 54 Ω, See Figure 1				3 -1	V
Δ V <sub>OC</sub>	Change in magnitude of common-mode output voltage§					±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>OZ</sub>	High-impedance-state output current	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	V <sub>O</sub> = -7 V to 12 V				±250	mA
I <sub>CC</sub>	Supply current (all drivers)	No load	Outputs enabled			7	mA
			Outputs disabled			1.5	

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

‡ The minimum V<sub>OD</sub> specification does not fully comply with EIA-485 at operating temperatures below 0°C. The lower output signal should be used to determine the maximum signal transmission distance.

§ Δ|V<sub>OD</sub>| and Δ|V<sub>OC</sub>| are the changes in 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	TYP	MAX	UNIT	
t <sub>d(OD)</sub>	Differential output delay time	R <sub>L</sub> = 54 Ω, See Figure 3			2	11	20	ns
t <sub>t(OD)</sub>	Differential output transition time				10	15	25	ns
t <sub>PZH</sub>	Output enable time to high level	R <sub>L</sub> = 110 Ω, See Figure 3				20	30	ns
t <sub>PZL</sub>	Output enable time to low level	R <sub>L</sub> = 110 Ω, See Figure 5				21	30	ns
t <sub>PHZ</sub>	Output disable time from high level	R <sub>L</sub> = 110 Ω, See Figure 4				48	70	ns
t <sub>PLZ</sub>	Output disable time from low level	R <sub>L</sub> = 110 Ω, See Figure 5				21	30	ns



PARAMETER MEASUREMENT INFORMATION

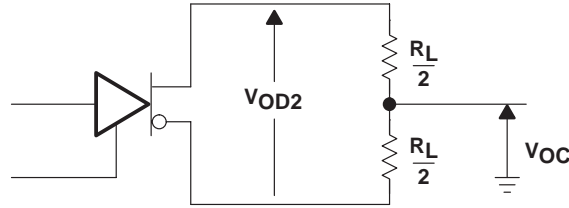


Figure 1. Differential and Common-Mode Output Voltages

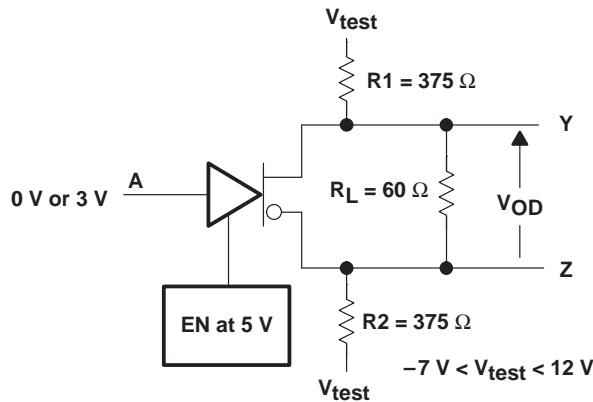
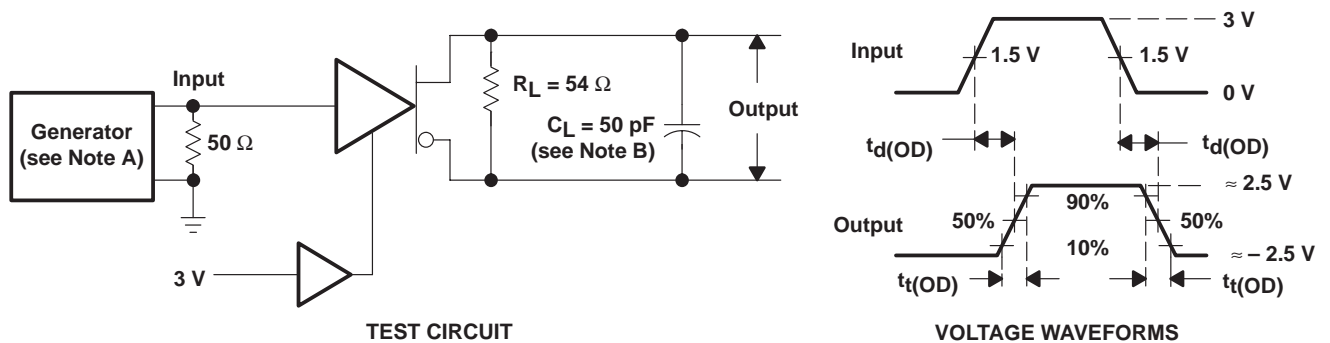


Figure 2. Driver  $V_{OD}$  Test Circuit



- NOTES: A. The input pulse is supplied by a generator having the following characteristics:  $PRR \leq 1$  MHz, duty cycle = 50%,  $t_r \leq 5$  ns,  $t_f \leq 5$  ns,  $Z_O = 50 \Omega$ .  
 B.  $C_L$  includes probe and stray capacitance.

Figure 3. Time Waveforms for Driver Differential Output Test Circuit Delay and Transition

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SLLS162D – JULY 1993 – REVISED SEPTEMBER 2003

## PARAMETER MEASUREMENT INFORMATION

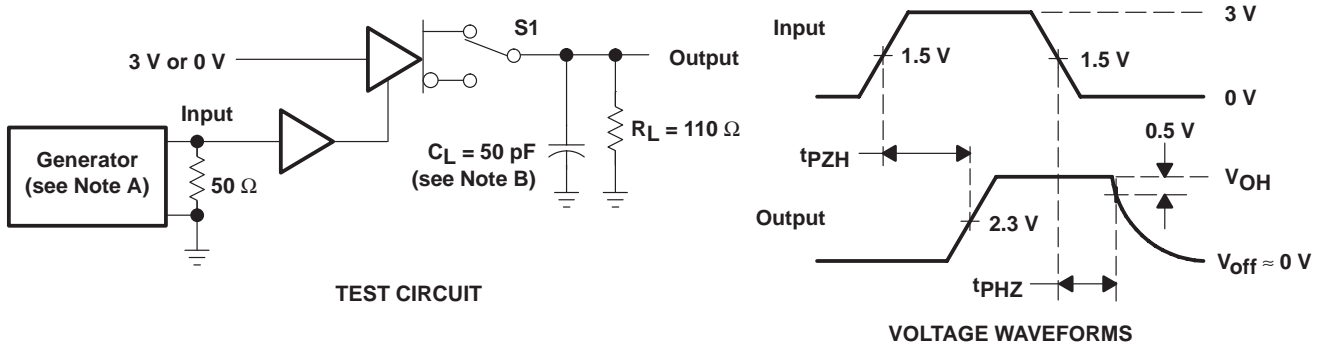
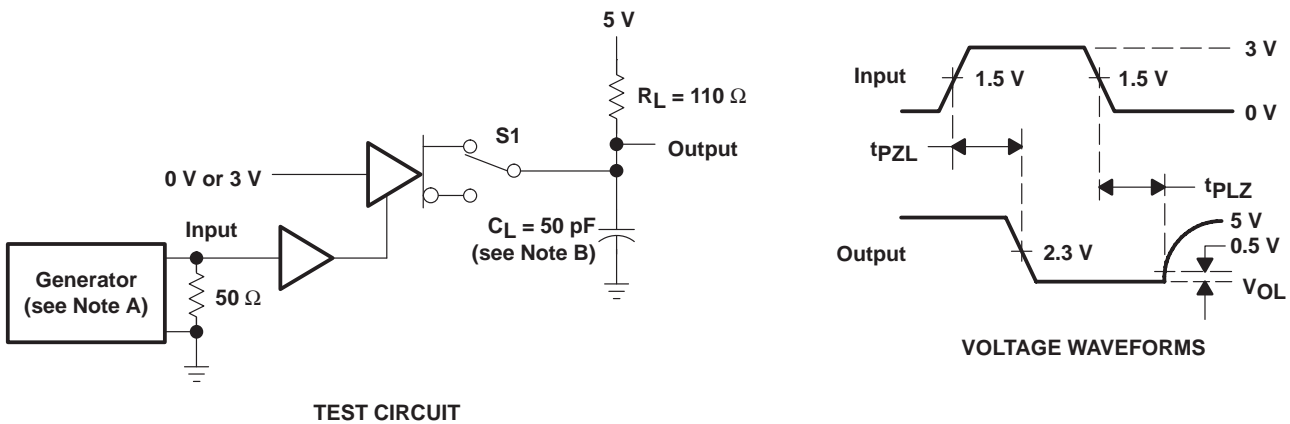


Figure 4.  $t_{pZH}$  and  $t_{pHZ}$  Test Circuit and Waveforms



- NOTES: A. The input pulse is supplied by a generator having the following characteristics:  $PRR \leq 1 \text{ MHz}$ , duty cycle = 50%,  $t_r \leq 5 \text{ ns}$ ,  $t_f \leq 5 \text{ ns}$ ,  $Z_O = 50 \Omega$ .  
 B.  $C_L$  includes probe and stray capacitance.

Figure 5.  $t_{pZL}$  and  $t_{pLZ}$  Test Circuit and Waveforms

TYPICAL CHARACTERISTICS

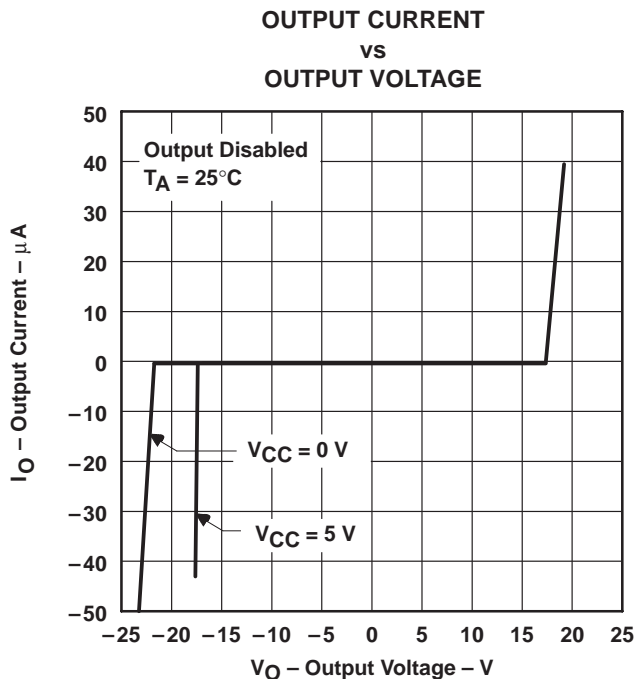


Figure 6

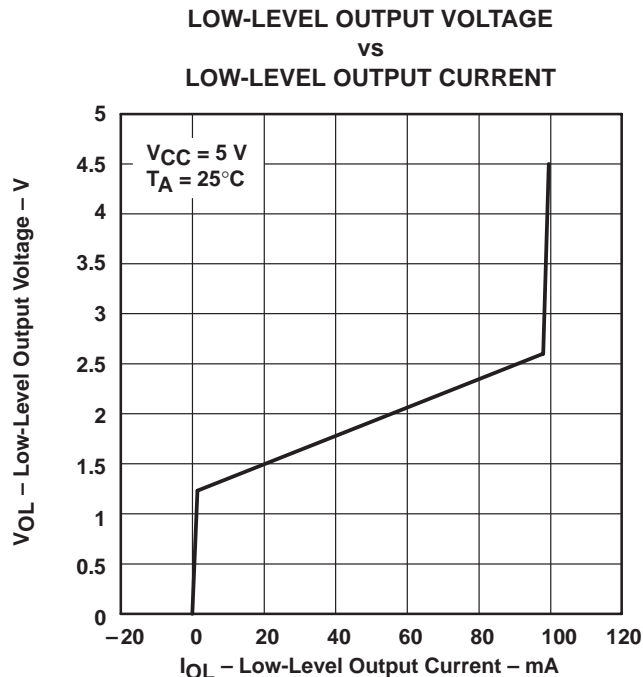


Figure 7

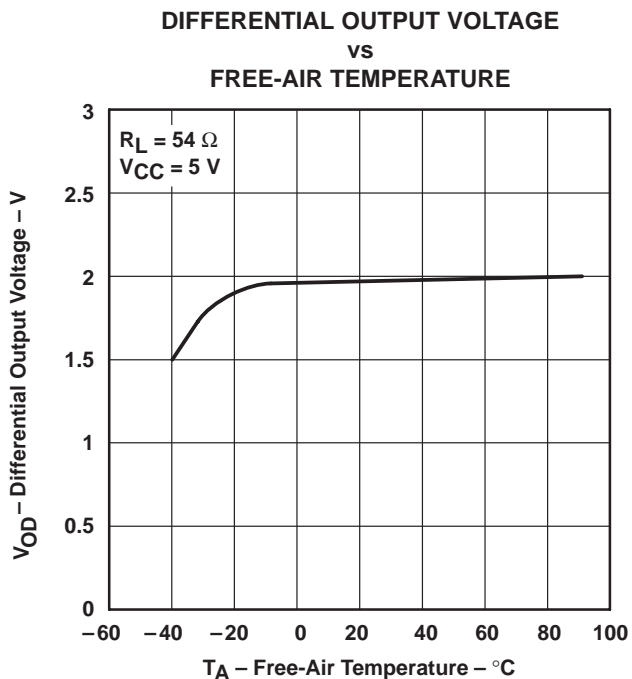


Figure 8

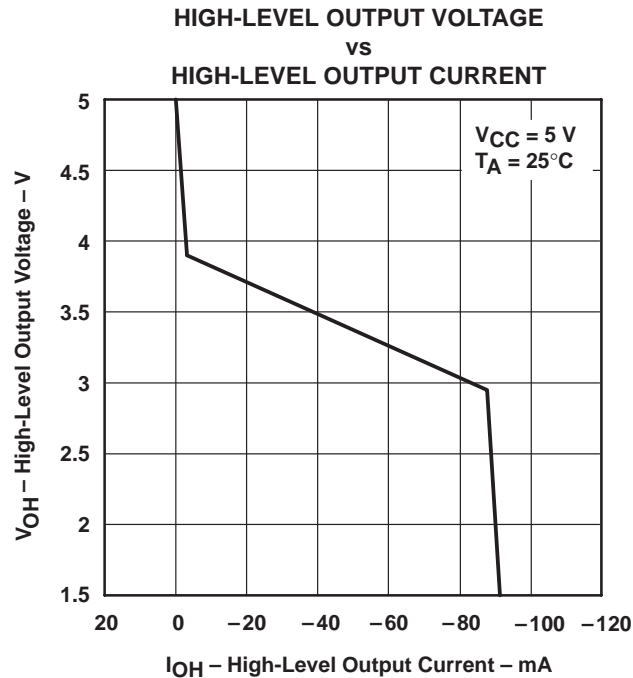
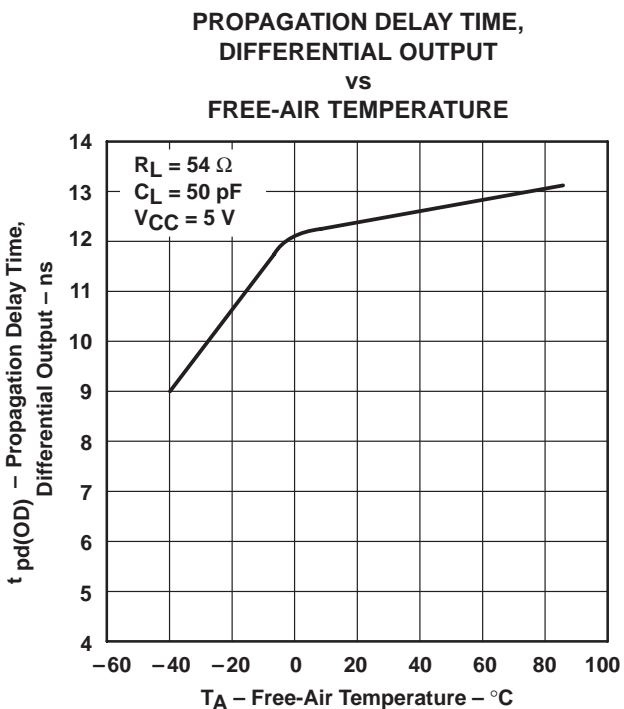
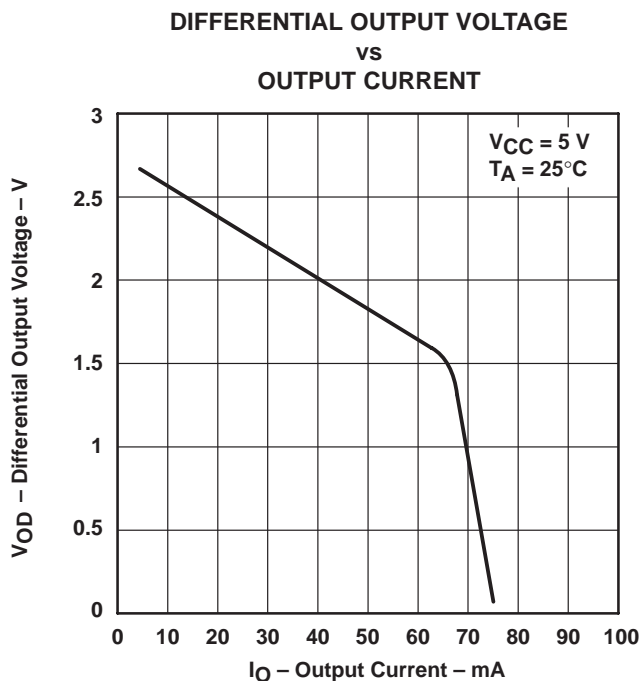


Figure 9

# SN65LBC174, SN75LBC174 QUADRUPLE LOW-POWER DIFFERENTIAL LINE DRIVERS

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## TYPICAL CHARACTERISTICS



# SN65LBC174, SN75LBC174 QUADRUPLE LOW-POWER DIFFERENTIAL LINE DRIVERS

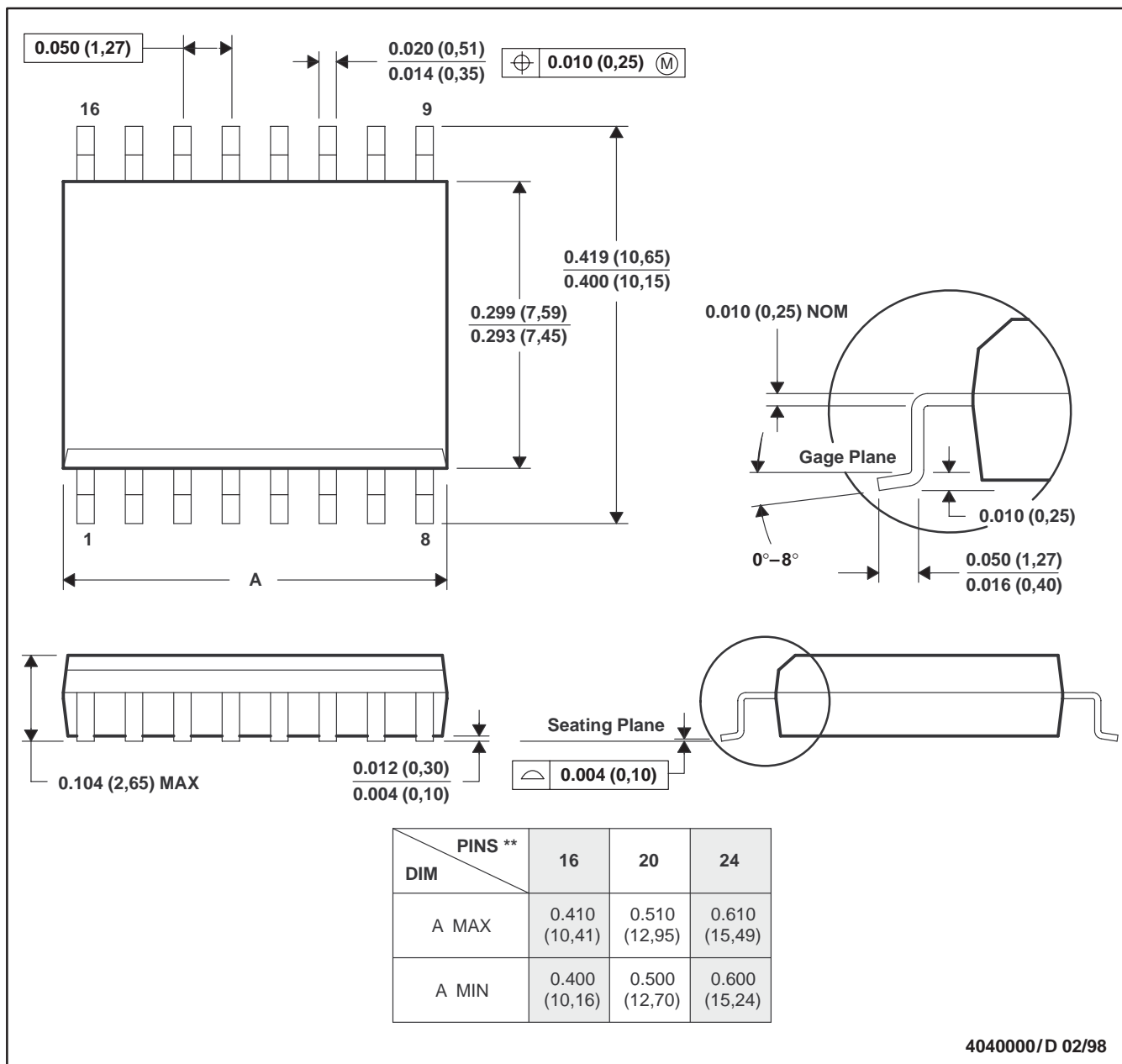
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## MECHANICAL DATA

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

**PLASTIC SMALL-OUTLINE PACKAGE**

16 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-013



# SN65LBC174, SN75LBC174 QUADRUPLE LOW-POWER DIFFERENTIAL LINE DRIVERS

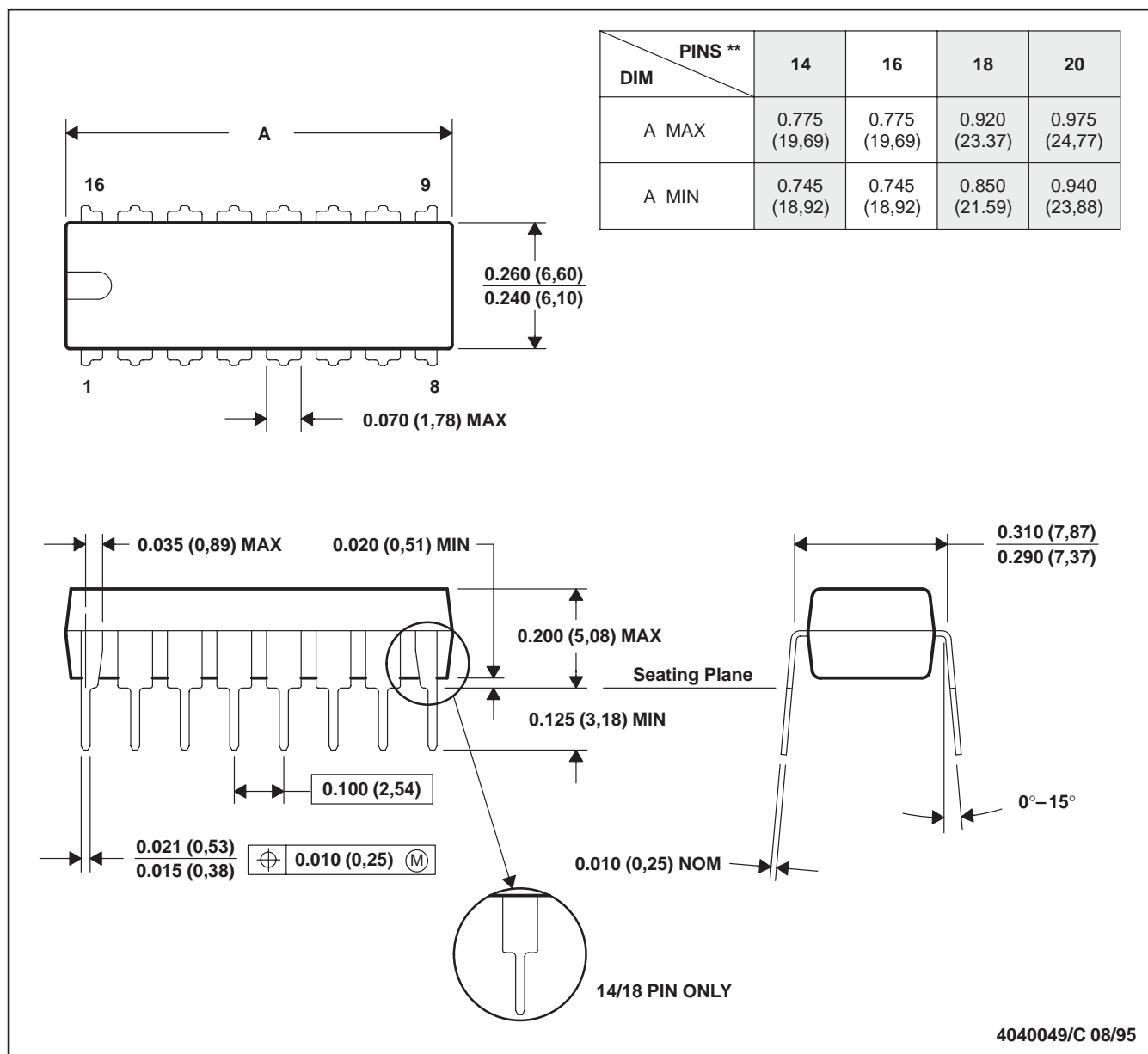
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## MECHANICAL DATA

N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PIN SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Falls within JEDEC MS-001 (20 pin package is shorter than MS-001.)

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
SN65LBC174DW	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC174DWG4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC174DWR	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC174DWRG4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65LBC174N	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPD	N / A for Pkg Type
SN65LBC174NE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPD	N / A for Pkg Type
SN75LBC174DW	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC174DWR	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC174DWRG4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75LBC174N	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPD	N / A for Pkg Type

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



4040049/E 12/2002

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - $\triangle C$  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - $\triangle D$  The 20 pin end lead shoulder width is a vendor option, either half or full width.

DW (R-PDSO-G20)

PLASTIC SMALL-OUTLINE PACKAGE



- 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 variation AC.

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