

# SN75174 QUADRUPLE DIFFERENTIAL LINE DRIVER

SLLS039B – OCTOBER 1980 – REVISED MAY 1995

- Meets or Exceeds the Requirements of ANSI Standards EIA/TIA-422-B and RS-485 and ITU Recommendation V.11.
- Designed for Multipoint Transmission on Long Bus Lines in Noisy Environments
- 3-State Outputs
- Common-Mode Output Voltage Range of  $-7\text{ V}$  to  $12\text{ V}$
- Active-High Enable
- Thermal Shutdown Protection
- Positive- and Negative-Current Limiting
- Operates From Single 5-V Supply
- Low Power Requirements
- Functionally Interchangeable With MC3487

## description

The SN75174 is a monolithic quadruple differential line driver with 3-state outputs. It is designed to meet the requirements of ANSI Standards EIA/TIA-422-B and RS-485 and ITU Recommendation V.11. The device is optimized for balanced multipoint bus transmission at rates up to 4 megabaud. Each driver features wide positive and negative common-mode output voltage ranges making it suitable for party-line applications in noisy environments.

The SN75174 provides positive- and negative-current limiting and thermal shutdown for protection from line fault conditions on the transmission bus line. Shutdown occurs at a junction temperature of approximately  $150^{\circ}\text{C}$ . This device offers optimum performance when used with the SN75173 or SN75175 quadruple differential line receivers.

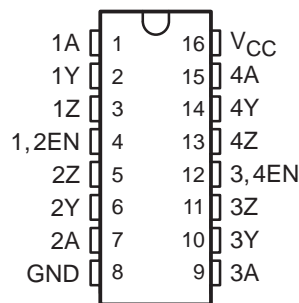
The SN75174 is characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

**FUNCTION TABLE**  
(each driver)

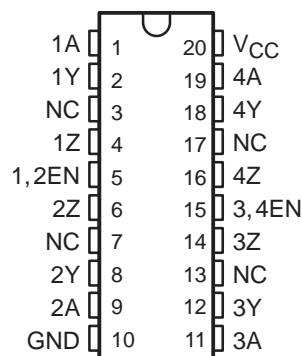
INPUT	ENABLE	OUTPUTS	
		Y	Z
H	H	H	L
L	H	L	H
X	L	Z	Z

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

**N PACKAGE**  
(TOP VIEW)



**DW PACKAGE**  
(TOP VIEW)



NC – No internal connection



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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.

 **TEXAS  
INSTRUMENTS**

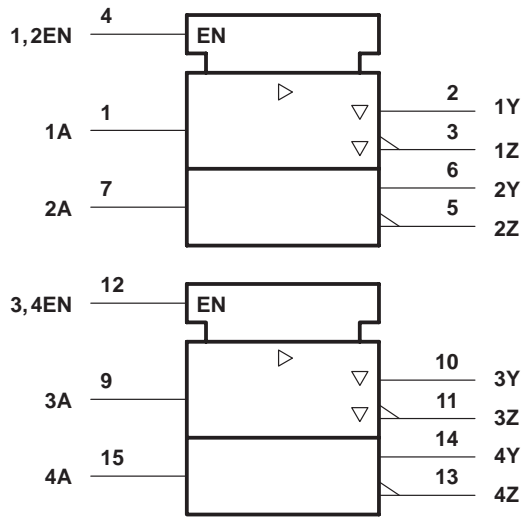
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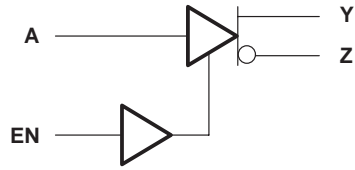
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## logic symbol†

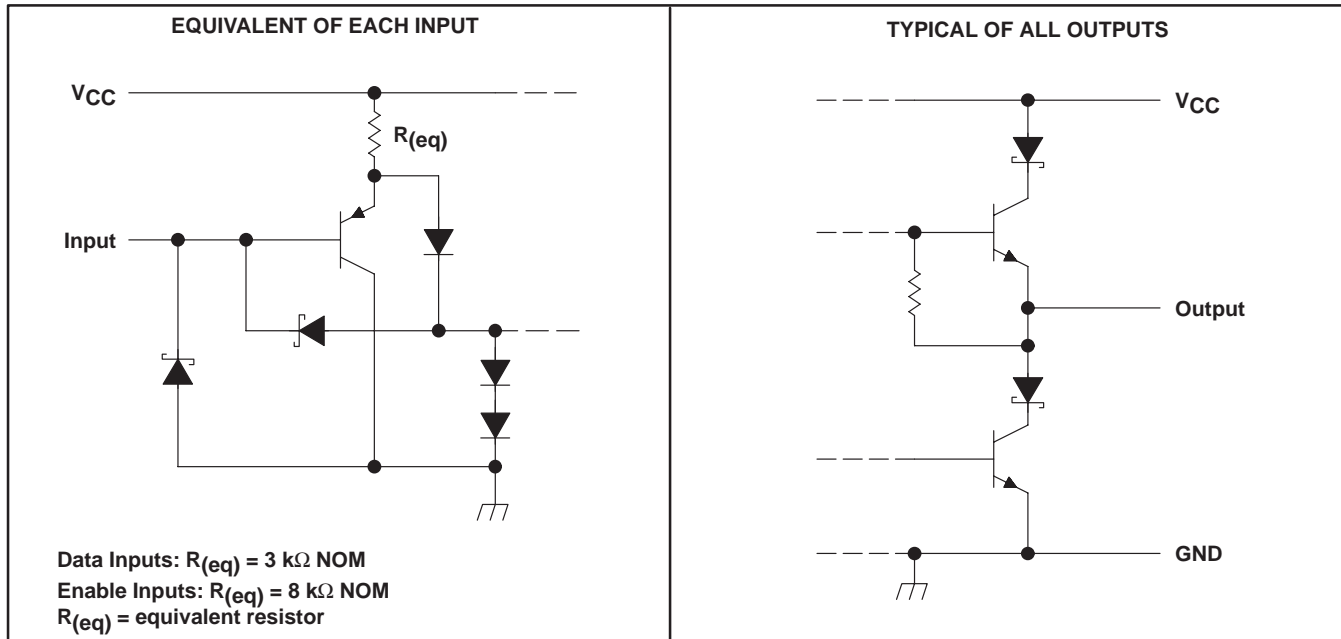


## logic diagram, each driver (positive logic)



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

## schematics of inputs and outputs



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

Supply voltage, $V_{CC}$ (see Note 1)	7 V
Output voltage range, $V_O$	–10 V to 15 V
Input voltage, $V_I$	5.5 V
Continuous total dissipation	See Dissipation Rating Table
Operating free-air temperature range, $T_A$	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.

NOTE 1: All voltage values are with respect to the network ground terminal.

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

## 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
Common-mode output voltage, $V_{OC}$		–7 to 12		V
High-level output current, $I_{OH}$			–60	mA
Low-level output current, $I_{OL}$			60	mA
Operating free-air temperature, $T_A$	0		70	°C



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**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>OH</sub>	High-level output voltage	V <sub>IH</sub> = 2 V, I <sub>OH</sub> = -33 mA	V <sub>IL</sub> = 0.8 V,		3.7		V
V <sub>OL</sub>	Low-level output voltage	V <sub>IH</sub> = 2 V, I <sub>OL</sub> = 33 mA	V <sub>IL</sub> = 0.8 V,		1.1		V
V <sub>O</sub>	Output voltage	I <sub>O</sub> = 0		0		6	V
V <sub>OD1</sub>	Differential output voltage	I <sub>O</sub> = 0		1.5	6	6	V
V <sub>OD2</sub>	Differential output voltage	R <sub>L</sub> = 100 Ω,	See Figure 1	1/2 V <sub>OD1</sub> or 2‡			V
		R <sub>L</sub> = 54 Ω,	See Figure 1	1.5	2.5	5	V
V <sub>OD3</sub>	Differential output voltage	See Note 2		1.5		5	V
Δ V <sub>OD</sub>	Change in magnitude of differential output voltage§					±0.2	V
V <sub>OC</sub>	Common-mode output voltage¶	R <sub>L</sub> = 54 Ω or 100 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> = 2.7 V				20	μA
I <sub>IL</sub>	Low-level input current	V <sub>I</sub> = 0.5 V				-360	μA
I <sub>OS</sub>	Short-circuit output current	V <sub>O</sub> = -7 V				-180	mA
		V <sub>O</sub> = V <sub>CC</sub>				180	
		V <sub>O</sub> = 12 V				500	
I <sub>CC</sub>	Supply current (all drivers)	No load	Outputs enabled		38	60	mA
			Outputs disabled		18	40	

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

‡ The minimum V<sub>OD2</sub> with a 100-Ω load is either 1/2 V<sub>OD1</sub> or 2 V, whichever is greater.

§ 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.

¶ In ANSI Standard EIA/TIA-422-B, V<sub>OC</sub>, which is the average of the two output voltages with respect to ground, is called output offset voltage, V<sub>OS</sub>.

NOTE 2: See EIA Standard RS-485.

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

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
t <sub>d</sub> (OD)	Differential-output delay time	R <sub>L</sub> = 54 Ω,	See Figure 2		45	65	ns
t <sub>t</sub> (OD)	Differential-output transition time				80	120	ns
t <sub>pZH</sub>	Output enable time to high level	R <sub>L</sub> = 110 Ω,	See Figure 3		80	120	ns
t <sub>pZL</sub>	Output enable time to low level	R <sub>L</sub> = 110 Ω,	See Figure 4		55	80	ns
t <sub>pHZ</sub>	Output disable time from high level	R <sub>L</sub> = 110 Ω,	See Figure 3		75	115	ns
t <sub>pLZ</sub>	Output disable time from low level	R <sub>L</sub> = 110 Ω,	See Figure 3		18	30	ns



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### SYMBOL EQUIVALENTS

DATA SHEET PARAMETER	EIA/TIA-422-B	RS-485
$V_O$	$V_{oa}, V_{ob}$	$V_{oa}, V_{ob}$
$ V_{OD1} $	$V_o$	$V_o$
$ V_{OD2} $	$V_t (R_L = 100 \Omega)$	$V_t (R_L = 54 \Omega)$
$ V_{OD3} $		$V_t$ (Test Termination Measurement 2)
$\Delta V_{OD} $	$  V_t  -  \bar{V}_t  $	$  V_t  -  \bar{V}_t  $
$V_{OC}$	$ V_{os} $	$ V_{os} $
$\Delta V_{OC} $	$ V_{os} - \bar{V}_{os} $	$ V_{os} - \bar{V}_{os} $
$I_{OS}$	$ I_{sa} ,  I_{sb} $	
$I_O$	$ I_{xa} ,  I_{xb} $	$I_{ia}, I_{ib}$

### PARAMETER MEASUREMENT INFORMATION

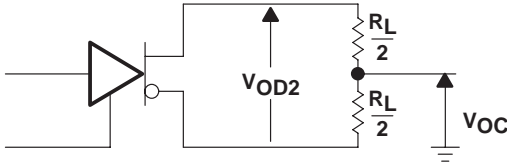
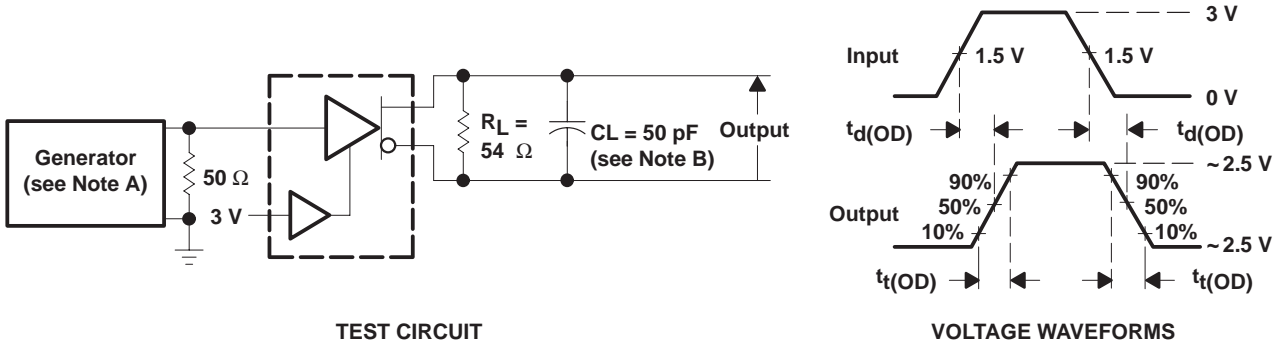


Figure 1. Differential and Common-Mode Output Voltages



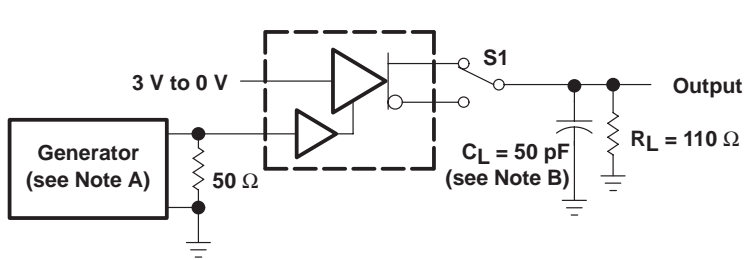
- NOTES: A. The input pulse is supplied by a generator having the following characteristics:  $t_r \leq 5 \text{ ns}$ ,  $t_f \leq 5 \text{ ns}$ ,  $\text{PRR} \leq 1 \text{ MHz}$ , duty cycle = 50%,  $Z_O = 50 \Omega$ .  
 B.  $C_L$  includes probe and stray capacitance.

Figure 2. Differential-Output Test Circuit and Voltage Waveforms

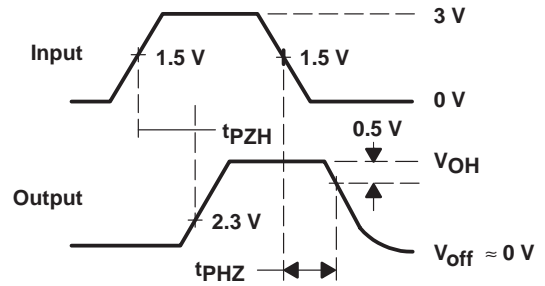
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## PARAMETER MEASUREMENT INFORMATION



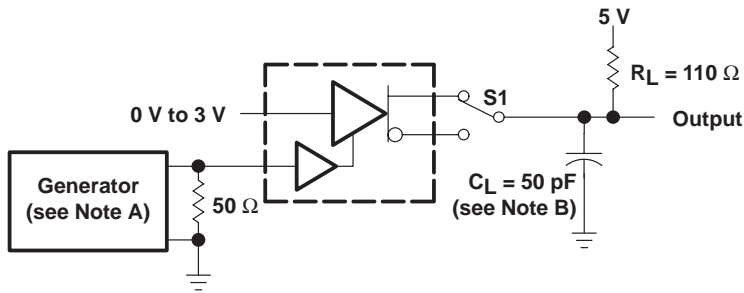
TEST CIRCUIT



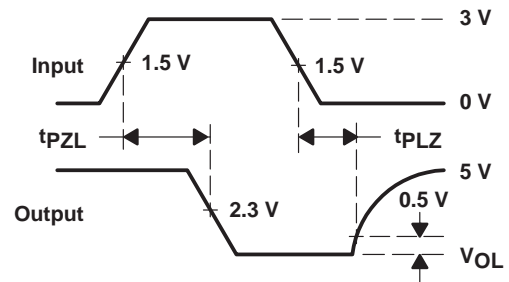
VOLTAGE WAVEFORMS

- 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. Test Circuit and Voltage Waveforms



TEST CIRCUIT



VOLTAGE WAVEFORMS

- 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 4. Test Circuit and Voltage Waveforms

TYPICAL CHARACTERISTICS

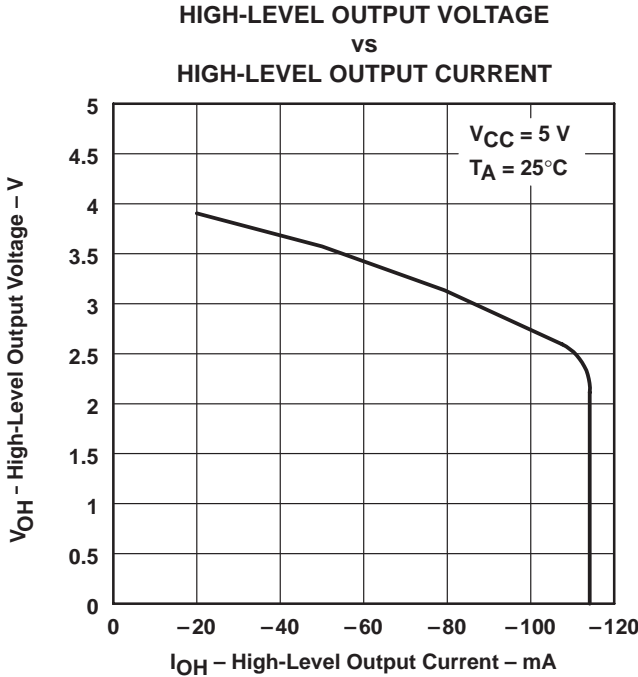


Figure 5

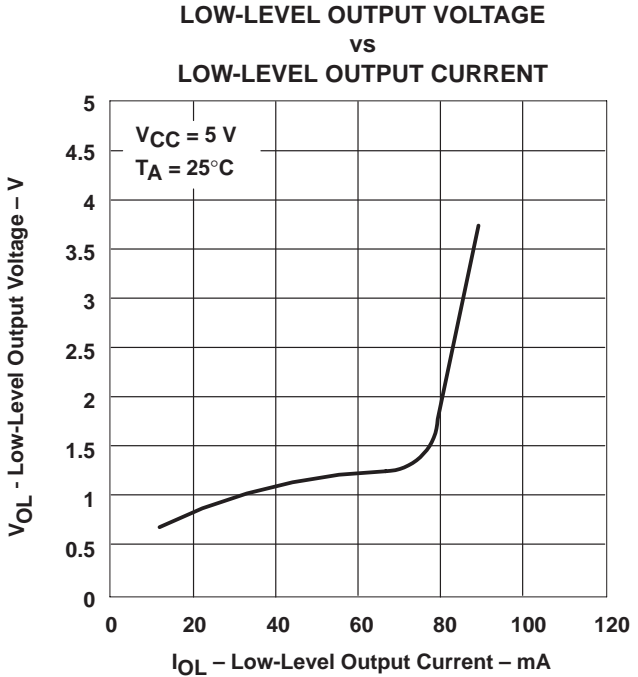


Figure 6

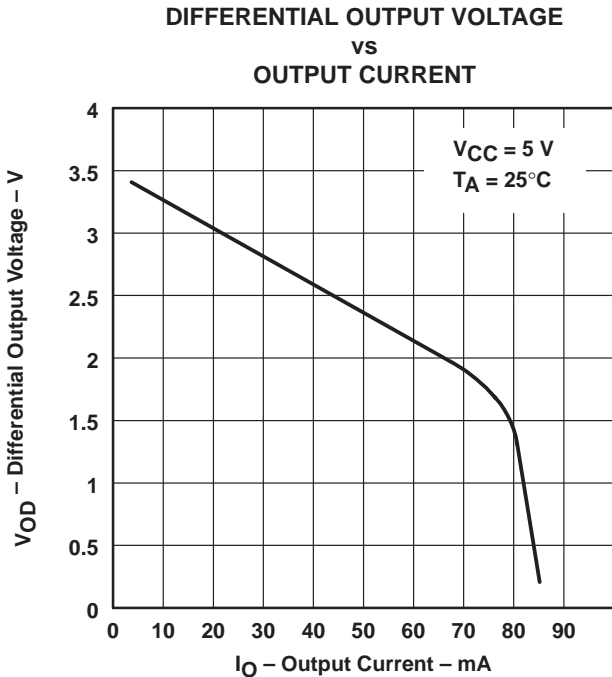


Figure 7

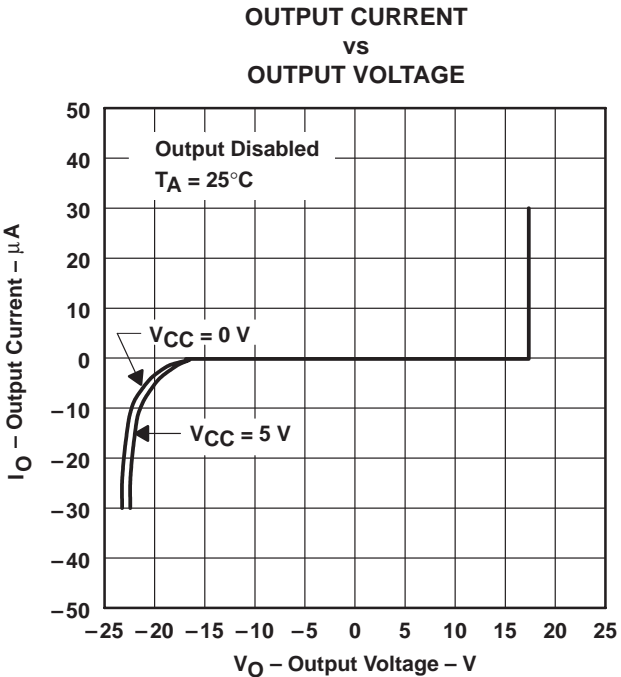


Figure 8

# SN75174 QUADRUPLE DIFFERENTIAL LINE DRIVER

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## TYPICAL CHARACTERISTICS

**SUPPLY CURRENT  
vs  
SUPPLY VOLTAGE**

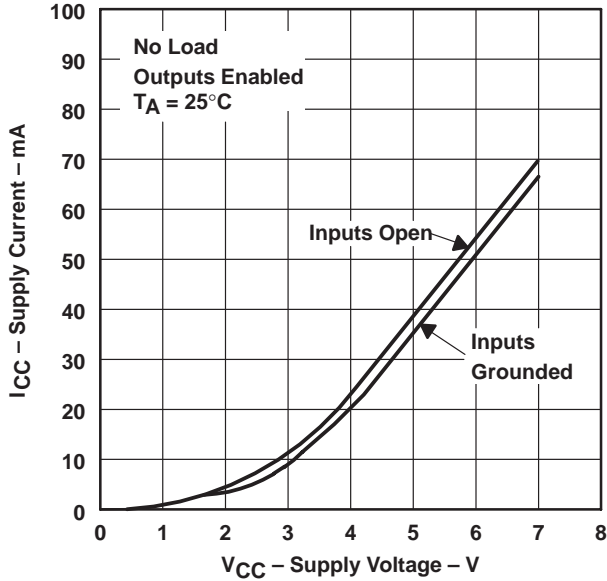


Figure 9

**SUPPLY CURRENT  
vs  
SUPPLY VOLTAGE**

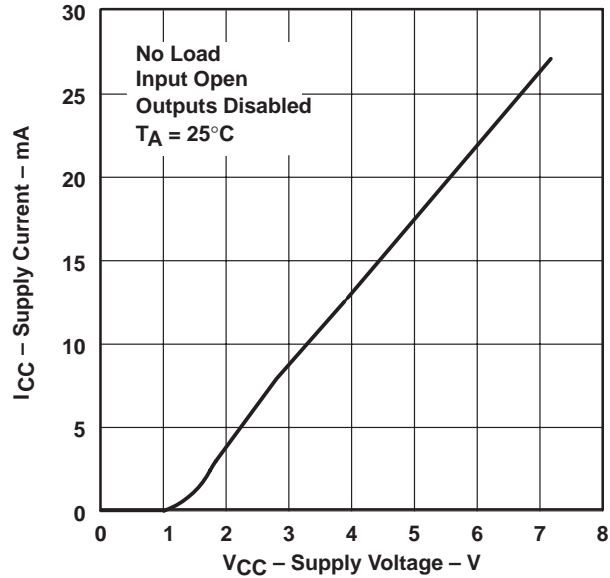
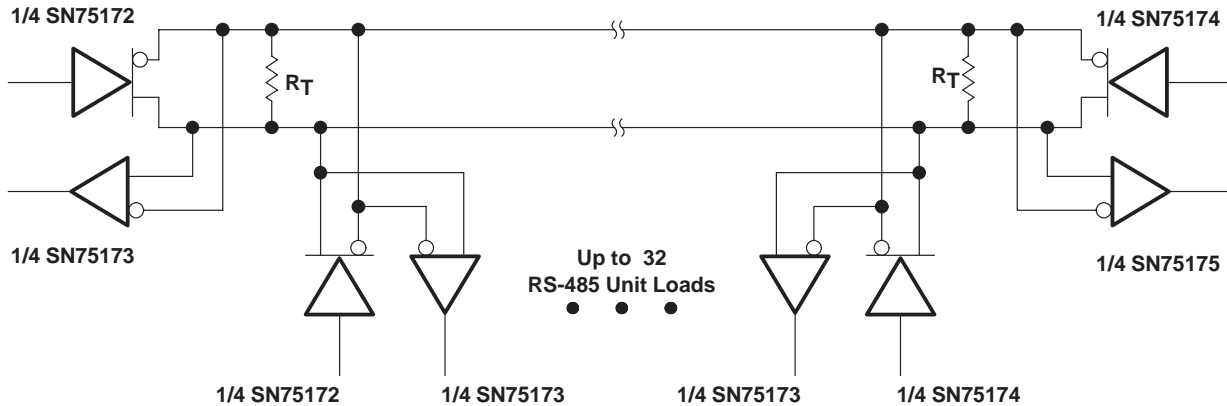


Figure 10

## APPLICATION INFORMATION



NOTE: The line length should be terminated at both ends in its characteristic impedance ( $R_T = Z_0$ ). Stub lengths off the main line should be kept as short as possible.

Figure 11. Typical Application Circuit



**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>
SN75174DW	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75174DWG4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75174DWR	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75174DWRE4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75174DWRG4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75174J	OBSOLETE	CDIP	J	16		TBD	Call TI	Call TI
SN75174N	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN75174NE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	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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**TAPE AND REEL INFORMATION**



**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**



\*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
SN75174DWR	SOIC	DW	20	2000	330.0	24.4	10.8	13.1	2.65	12.0	24.0	Q1

**TAPE AND REEL BOX DIMENSIONS**

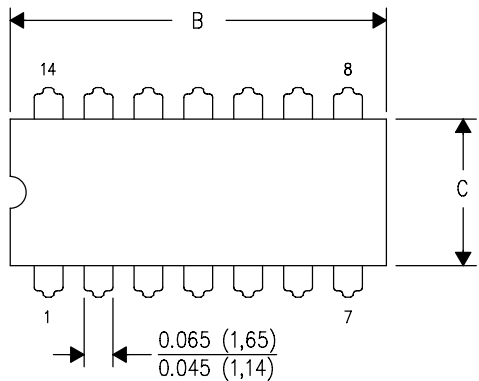


\*All dimensions are nominal

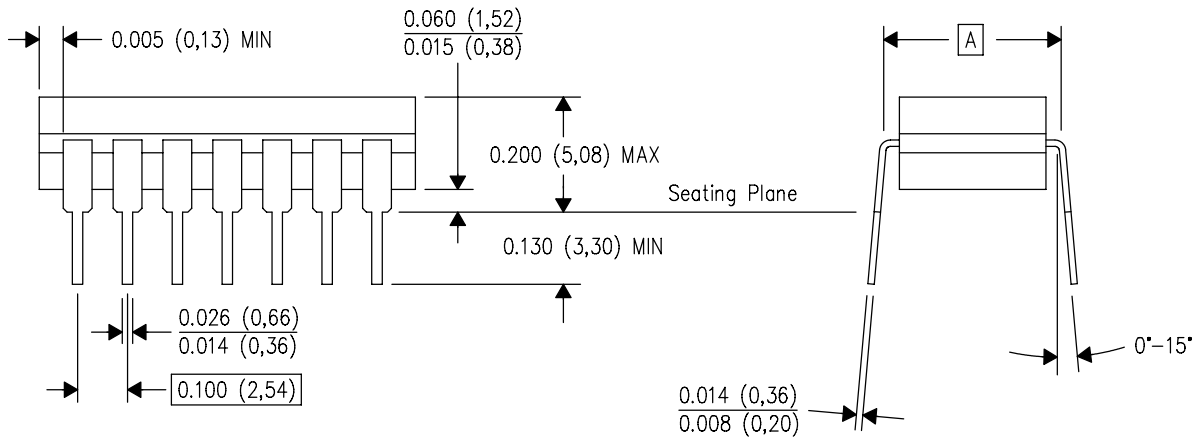
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN75174DWR	SOIC	DW	20	2000	346.0	346.0	41.0

J (R-GDIP-T\*\*) 14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package is hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

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.

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

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- 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.

4040049/E 12/2002

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Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
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