

SN75174 Quadruple Differential Line Driver

1 Features

- 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 $-7V$ to $12V$
- Active-high enable
- Thermal shutdown protection
- Positive- and negative-current limiting
- Operates from single $5V$ supply
- Low power requirements
- Functionally interchangeable with MC3487

2 Applications

- Chemical and gas sensors
- **Field transmitters**: temperature sensors and pressure sensors
- **Motor drives**: brushless DC and brushed DC
- **Temperature sensors** and controllers using modbus

3 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 $150^{\circ}C$. This device offers optimum performance when used with the SN75173 or SN75175 quadruple differential line receivers.

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

Package Information

PART NUMBER	PACKAGE ⁽¹⁾	PACKAGE SIZE ⁽²⁾
SN75174	N (PDIP, 16)	19.3mm × 9.4mm
	DW (SOIC, 20)	12.8mm × 10.3mm

(1) For more information, see [Section 11](#).

(2) The package size (length × width) is a nominal value and includes pins, where applicable.

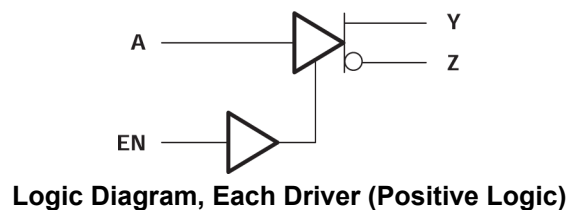
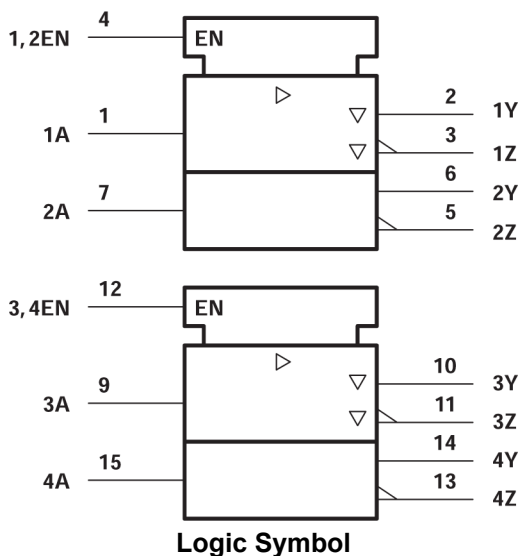


Table of Contents

1 Features	1	7 Detailed Description	11
2 Applications	1	7.1 Device Functional Modes.....	11
3 Description	1	8 Application and Implementation	12
4 Pin Configuration and Functions	3	8.1 Application Information.....	12
5 Specifications	4	9 Device and Documentation Support	13
5.1 Absolute Maximum Ratings.....	4	9.1 Receiving Notification of Documentation Updates....	13
5.2 Dissipation Rating.....	4	9.2 Support Resources.....	13
5.3 Recommended Operating Conditions.....	4	9.3 Trademarks.....	13
5.4 Thermal Information.....	5	9.4 Electrostatic Discharge Caution.....	13
5.5 Electrical Characteristics.....	6	9.5 Glossary.....	13
5.6 Switching Characteristics.....	6	10 Revision History	13
5.7 Symbol Equivalents.....	7	11 Mechanical, Packaging, and Orderable	
5.8 Typical Characteristics.....	8	Information	13
6 Parameter Measurement Information	9		

4 Pin Configuration and Functions

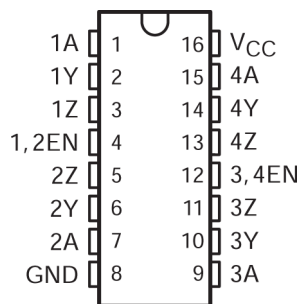


Figure 4-1. N Package (Top View)

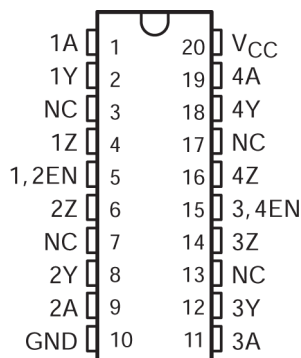


Figure 4-2. DW Package (Top View)

5 Specifications

5.1 Absolute Maximum Ratings

over operating free-air temperature (unless otherwise noted)⁽¹⁾

		MIN	MAX	UNIT
V_{CC} (see (2))	Supply voltage	-0.3	7	V
V_O	Output voltage range	-10	15	V
V_I	Input voltage	-0.3	5.5	V
P_D	Continuous total dissipation	See <i>Dissipation Rating</i> table		
T_A	Operating free-air temperature range	0	70	°C
T_{Lead}	Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds		260	°C
T_{stg}	Storage temperature range	-65	150	°C

(1) 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.

(2) All voltage values are with respect to the network ground terminal.

5.2 Dissipation Rating

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

5.3 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		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

5.4 Thermal Information

THERMAL METRIC ⁽¹⁾		N (PDIP)	DW	UNIT
		16 PINS	20 PINS	
R _{θJA}	Junction-to-ambient thermal resistance	60.6	66.8	°C/W
R _{θJC(top)}	Junction-to-case (top) thermal resistance	48.1	34.4	°C/W
R _{θJB}	Junction-to-board thermal resistance	40.6	39.7	°C/W
Ψ _{JT}	Junction-to-top characterization parameter	27.5	8.9	°C/W
Ψ _{JB}	Junction-to-board characterization parameter	40.3	39	°C/W
R _{θJC(bot)}	Junction-to-case (bottom) thermal resistance	n/a	n/a	°C/W

- (1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

5.5 Electrical Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP ⁽¹⁾	MAX	UNIT
V_{IK} Input clamp voltage	$I_I = -18\text{ mA}$			-1.5	V
V_{OH} High-level output voltage	$V_{IH} = 2\text{V}$, $I_{OH} = -33\text{mA}$ $V_{IL} = 0.8\text{V}$,		3.7		V
V_{OL} Low-level output voltage	$V_{IH} = 2\text{V}$, $I_{OL} = 33\text{mA}$ $V_{IL} = 0.8\text{V}$,		1.1		V
V_O Output voltage	$I_O = 0$	0		6	V
$ V_{OD1} $ Differential output voltage	$I_O = 0$	1.5	6	6	V
$ V_{OD2} $ Differential output voltage	$R_L = 100\Omega$, See Figure 6-1	$1/2 V_{OD1}$ or 2 ⁽²⁾			V
	$R_L = 54\Omega$, See Figure 6-1	1.5	2.5	5	V
V_{OD3} Differential output voltage	See ⁽⁵⁾	1.5		5	V
$\Delta V_{OD} $ Change in magnitude of differential output voltage ⁽³⁾				± 0.2	V
V_{OC} Common-mode output voltage ⁽⁴⁾	$R_L = 54\Omega$ or 100Ω , See Figure 6-1	-1		3	V
$\Delta V_{OC} $ Change in magnitude of common-mode output voltage ⁽³⁾				± 0.2	V
I_O Output current with power off	$V_{CC} = 0$, $V_O = -7\text{V}$ to 12V			± 100	μA
I_{OZ} High-impedance-state output current	$V_O = -7\text{V}$ to 12V			± 100	μA
I_{IH} High-level input current	$V_I = 2.7\text{V}$			20	μA
I_{IL} Low-level input current	$V_I = 0.5\text{V}$			± 360	μA
I_{OS} Short-circuit output current	$V_O = \pm 7\text{V}$			± 180	
	$V_O = V_{CC}$			180	mA
	$V_O = 12\text{V}$			500	
I_{CC} Supply current (all drivers)	No load	Outputs enabled	38	60	mA
		Outputs disabled	18	40	

(1) All typical values are at $V_{CC} = 5\text{V}$ and $T_A = 25^\circ\text{C}$.

(2) The minimum V_{OD2} with a 100Ω load is either $1/2 V_{OD1}$ or 2V , whichever is greater.

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

(4) In ANSI Standard EIA/TIA-422-B, V_{OC} , which is the average of the two output voltages with respect to ground, is called output offset voltage, V_{OS} .

(5) See EIA Standard RS-485.

5.6 Switching Characteristics

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

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{d(OD)}$ Differential-output delay time	$R_L = 54\Omega$, See Figure 6-2		45	65	ns
$t_{t(OD)}$ Differential-output transition time			80	120	ns
t_{PZH} Output enable time to high level	$R_L = 110\Omega$, See Figure 6-3		80	120	ns
t_{PZL} Output enable time to low level	$R_L = 110\Omega$, See Figure 6-4		55	80	ns
t_{PHZ} Output disable time from high level	$R_L = 110\Omega$, See Figure 6-3		75	115	ns
t_{PLZ} Output disable time from low level	$R_L = 110\Omega$, See Figure 6-3		18	30	ns

5.7 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}

5.8 Typical Characteristics

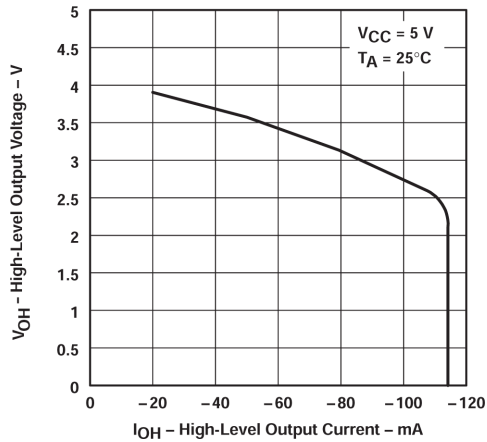


Figure 5-1. High-level Output Voltage vs High-level Output Current

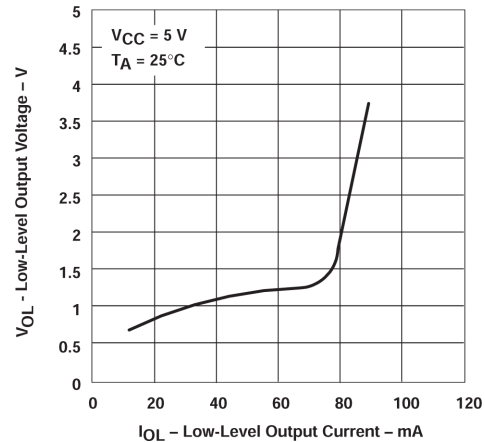


Figure 5-2. Low-level Output Voltage vs Low-level Output Current

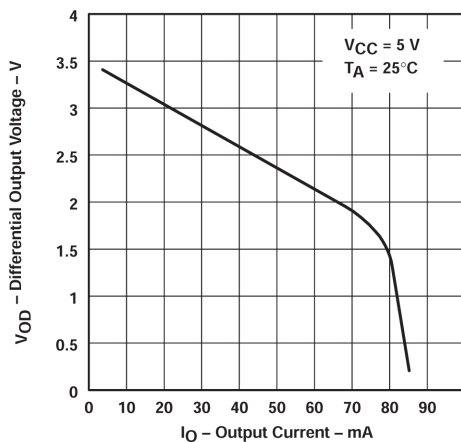


Figure 5-3. Differential Output Voltage vs Output Current

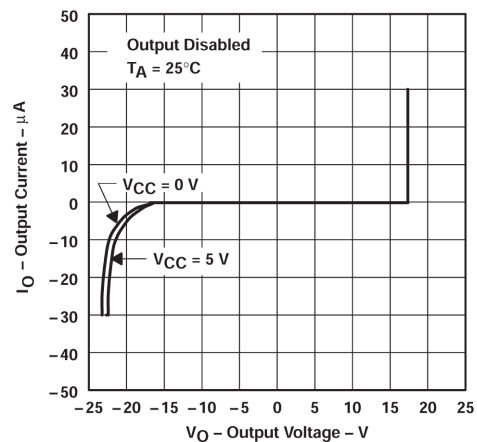


Figure 5-4. Output Current vs Output Voltage

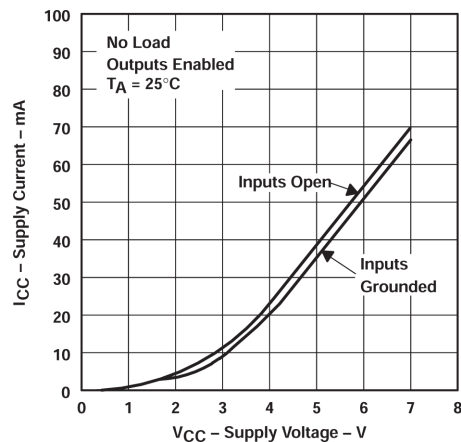


Figure 5-5. Supply Current vs Supply Voltage

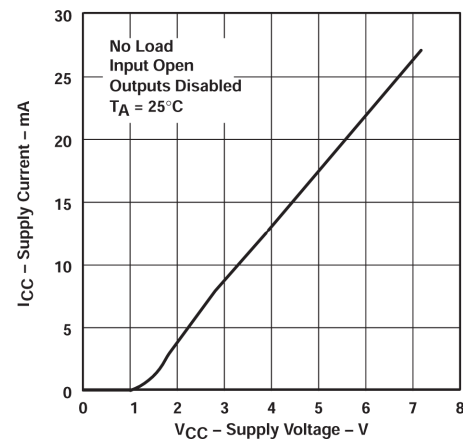


Figure 5-6. Supply Current vs Supply Voltage

6 Parameter Measurement Information

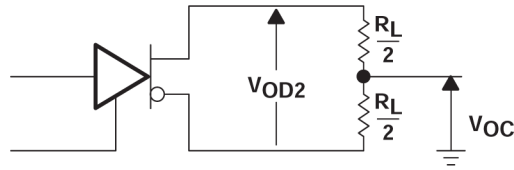
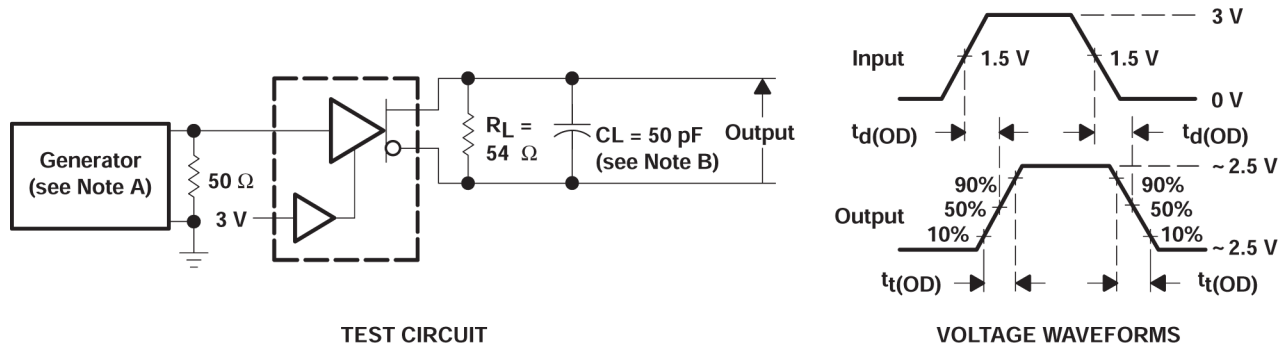
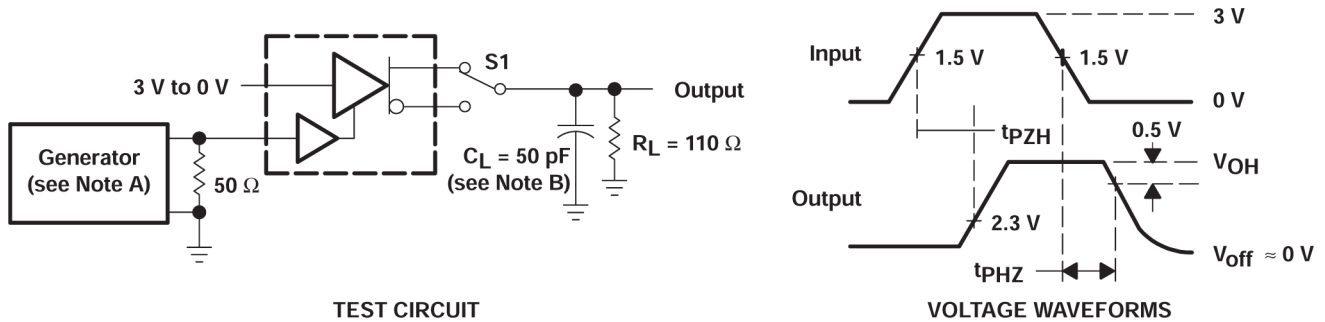


Figure 6-1. Differential and Common-Mode Output Voltages



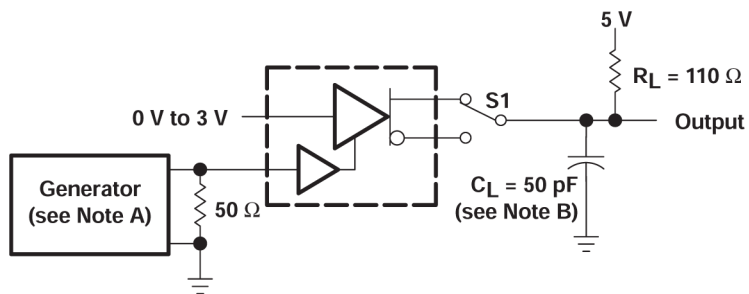
- A. The input pulse is supplied by a generator having the following characteristics: $t_r \leq 5\text{ ns}$, $t_f \leq 5\text{ ns}$, $\text{PRR} \leq 1\text{ MHz}$, duty cycle = 50%, $Z_O = 50\Omega$.
- B. C_L includes probe and stray capacitance.

Figure 6-2. Differential-Output Test Circuit and Voltage Waveforms

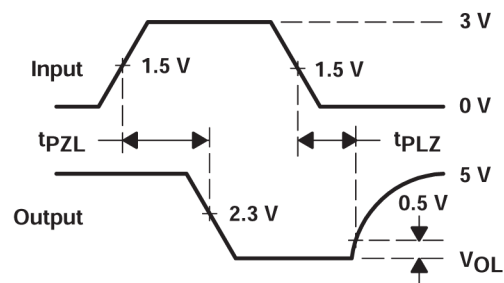


- A. The input pulse is supplied by a generator having the following characteristics: $\text{PRR} \leq 1\text{ MHz}$, duty cycle = 50%, $t_r \leq 10\text{ ns}$, $t_f \leq 10\text{ ns}$, $Z_O = 50\Omega$.
- B. C_L includes probe and stray capacitance.

Figure 6-3. Test Circuit and Voltage Waveforms



TEST CIRCUIT



VOLTAGE WAVEFORMS

- A. The input pulse is supplied by a generator having the following characteristics: $\text{PRR} \leq 1\text{MHz}$, 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 6-4. Test Circuit and Voltage Waveforms

7 Detailed Description

7.1 Device Functional Modes

Table 7-1. Function Table (Each Driver)

INPUT ⁽¹⁾	ENABLE	OUTPUTS	
		Y	Z
H	H	H	L
L	H	L	H
X	L	Z	Z

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

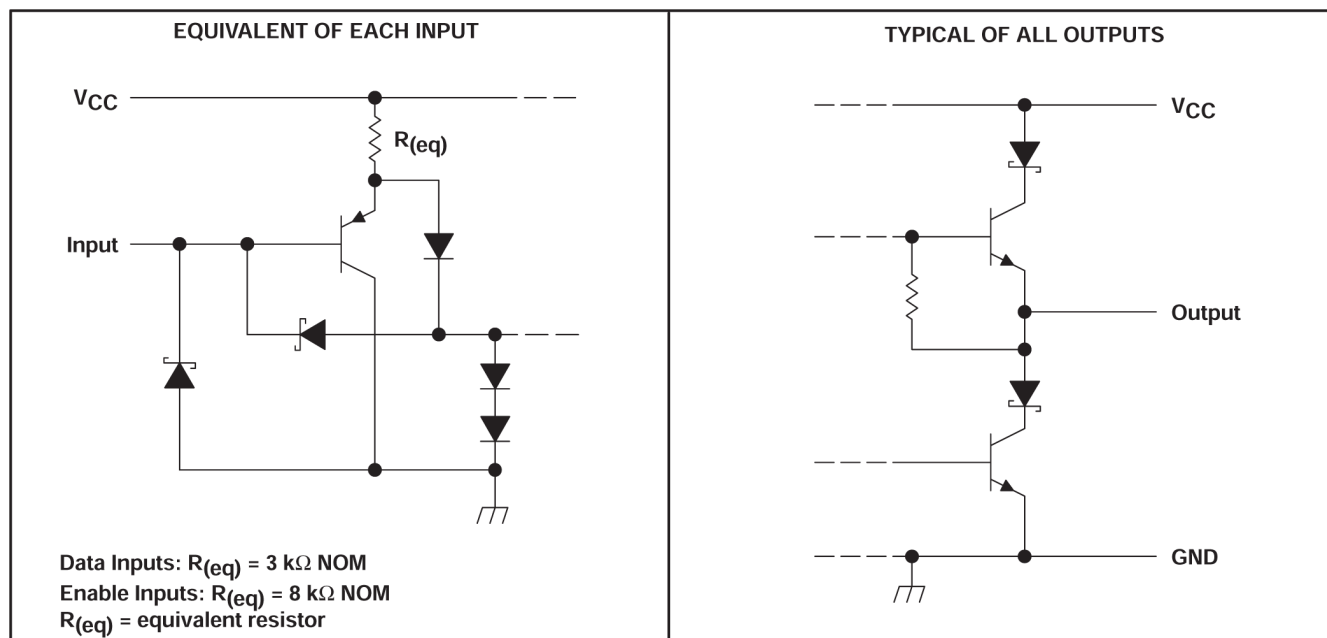


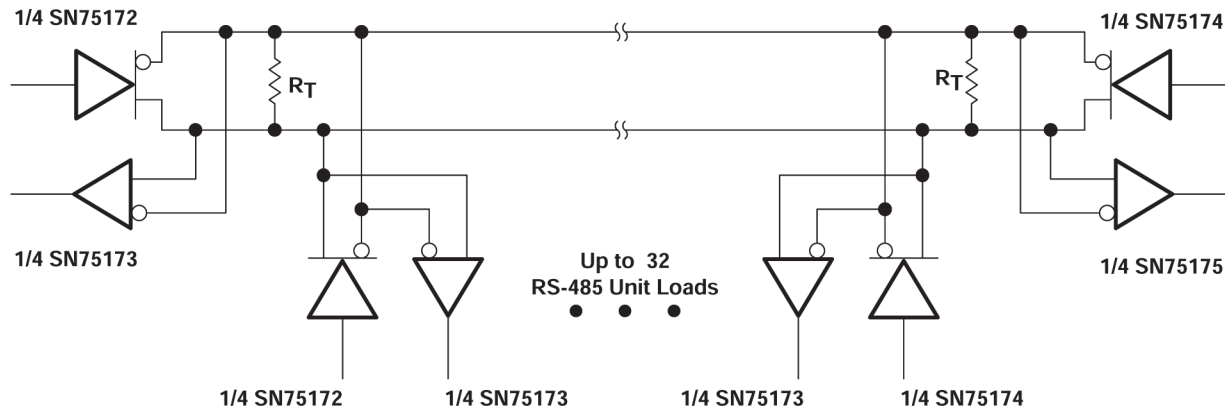
Figure 7-1. Schematics of Inputs and Outputs

8 Application and Implementation

Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

8.1 Application Information



- A. 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 8-1. Typical Application Circuit

9 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

9.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](https://www.ti.com). Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

9.2 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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9.3 Trademarks

TI E2E™ is a trademark of Texas Instruments.
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9.4 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

9.5 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

10 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision B (May 1995) to Revision C (April 2024)	Page
• Changed the numbering format for tables, figures, and cross-references throughout the document.....	1
• Added the <i>Thermal Information</i> table.....	5
• Changed Note A in Figure 6-3	9

11 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
SN75174DW	Obsolete	Production	SOIC (DW) 20	-	-	Call TI	Call TI	0 to 70	SN75174
SN75174DWR	Active	Production	SOIC (DW) 20	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	SN75174
SN75174DWR.A	Active	Production	SOIC (DW) 20	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	SN75174
SN75174DWRE4	Active	Production	SOIC (DW) 20	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	SN75174
SN75174DWRG4	Active	Production	SOIC (DW) 20	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	SN75174
SN75174N	Active	Production	PDIP (N) 16	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	SN75174N
SN75174N.A	Active	Production	PDIP (N) 16	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	SN75174N
SN75174NE4	Active	Production	PDIP (N) 16	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	SN75174N

(1) **Status:** For more details on status, see our [product life cycle](#).

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

(4) **Lead finish/Ball material:** Parts 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.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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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
SN75174DWR	SOIC	DW	20	2000	330.0	24.4	10.8	13.3	2.7	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	356.0	356.0	45.0

TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
SN75174N	N	PDIP	16	25	506	13.97	11230	4.32
SN75174N.A	N	PDIP	16	25	506	13.97	11230	4.32
SN75174NE4	N	PDIP	16	25	506	13.97	11230	4.32

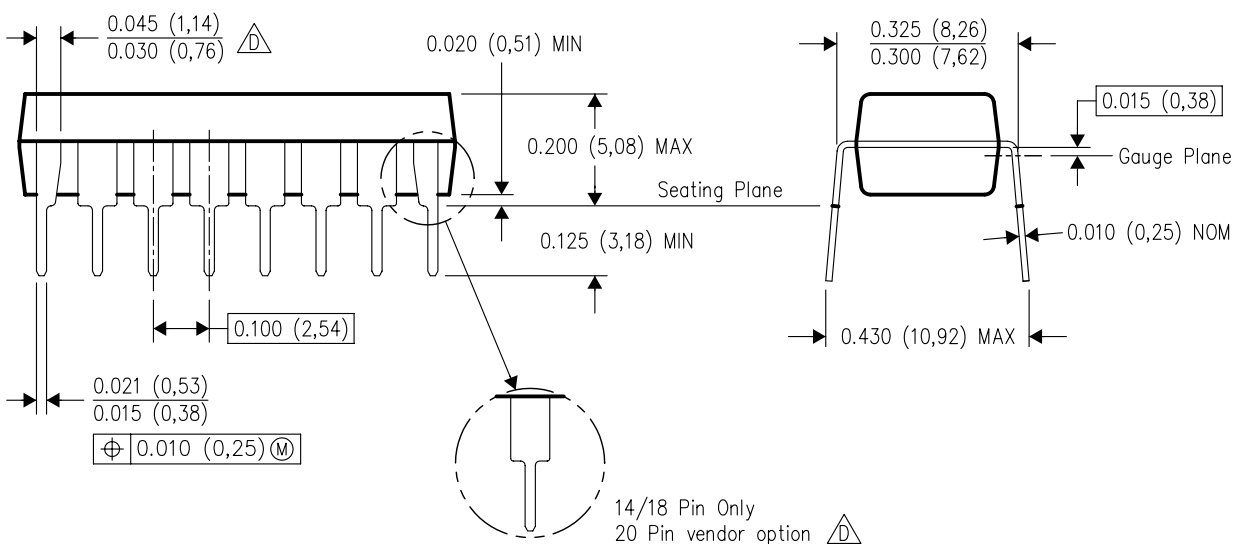
N (R-PDIP-T**)

16 PINS SHOWN



PLASTIC DUAL-IN-LINE PACKAGE



PINS ** DIM	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS-001 VARIATION	AA	BB	AC	AD



4040049/E 12/2002

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

DW0020A**PACKAGE OUTLINE****SOIC - 2.65 mm max height**

SOIC



4220724/A 05/2016

NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm per side.
5. Reference JEDEC registration MS-013.

DW0020A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE
SCALE:6X



SOLDER MASK DETAILS

4220724/A 05/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DW0020A

SOIC - 2.65 mm max height

SOIC



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:6X

4220724/A 05/2016

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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