

# SN751177, SN751178 DUAL DIFFERENTIAL DRIVERS AND RECEIVERS

SLLS059D – FEBRUARY 1990 – REVISED MAY 1999

- Meet or Exceed the Requirements of ANSI Standards TIA/EIA-422-B and TIA/EIA-485-A and ITU Recommendations V.10 and V.11
- Designed for Multipoint Bus Transmission on Long Bus Lines in Noise Environments
- Driver Positive- and Negative-Current Limiting
- Thermal Shutdown Protection
- Driver 3-State Outputs
- Receiver Common-Mode Input Voltage Range of  $-12\text{ V}$  to  $12\text{ V}$
- Receiver Input Sensitivity . . .  $\pm 200\text{ mV}$
- Receiver Hysteresis . . .  $50\text{ mV Typ}$
- Receiver Input Impedance . . .  $12\text{ k}\Omega\text{ Min}$
- Receiver 3-State Outputs (SN751177 Only)
- Operate From Single 5-V Supply

## description

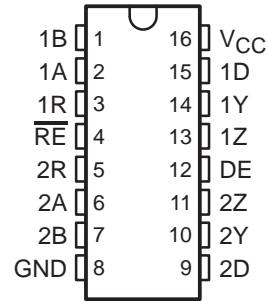
The SN751177 and SN751178 dual differential drivers and receivers are monolithic integrated circuits that are designed for balanced multipoint bus transmission at rates up to 10 Mbit/s. They are designed to improve the performance of full-duplex data communications over long bus lines and meet ANSI Standards TIA/EIA-422-B and TIA/EIA-485-A and ITU Recommendations V.10 and V.11.

The SN751177 and SN751178 driver outputs provide limiting for both positive and negative currents and thermal-shutdown protection from line-fault conditions on the transmission bus line.

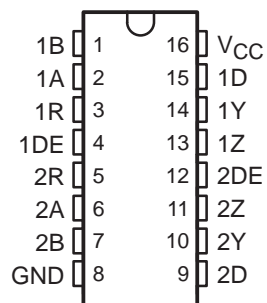
The receiver features high input impedance of at least  $12\text{ k}\Omega$ , an input sensitivity of  $\pm 200\text{ mV}$  over a common-mode input voltage range of  $-12\text{ V}$  to  $12\text{ V}$ , and typical input hysteresis of  $50\text{ mV}$ . Fail-safe design ensures that if the receiver inputs are open, the receiver outputs always will be high.

The SN751177 and SN751178 are characterized for operation from  $-20^\circ\text{C}$  to  $85^\circ\text{C}$ .

SN751177 . . . N OR NS† PACKAGE  
(TOP VIEW)



SN751178 . . . N OR NS† PACKAGE  
(TOP VIEW)



† The NS package is only available taped and reeled.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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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# SN751177, SN751178 DUAL DIFFERENTIAL DRIVERS AND RECEIVERS

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## Function Tables

**SN751177, SN751178**  
(each driver)

INPUT D	ENABLE DE	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)

**SN751177**  
(each receiver)

DIFFERENTIAL INPUTS A – B	ENABLE RE	OUTPUT R
$V_{ID} \geq 0.2 V$	L	H
$-0.2 V < V_{ID} < 0.2 V$	L	?
$V_{ID} \leq -0.2 V$	L	L
X	H	Z
Open	L	H

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

**SN751178**  
(each receiver)

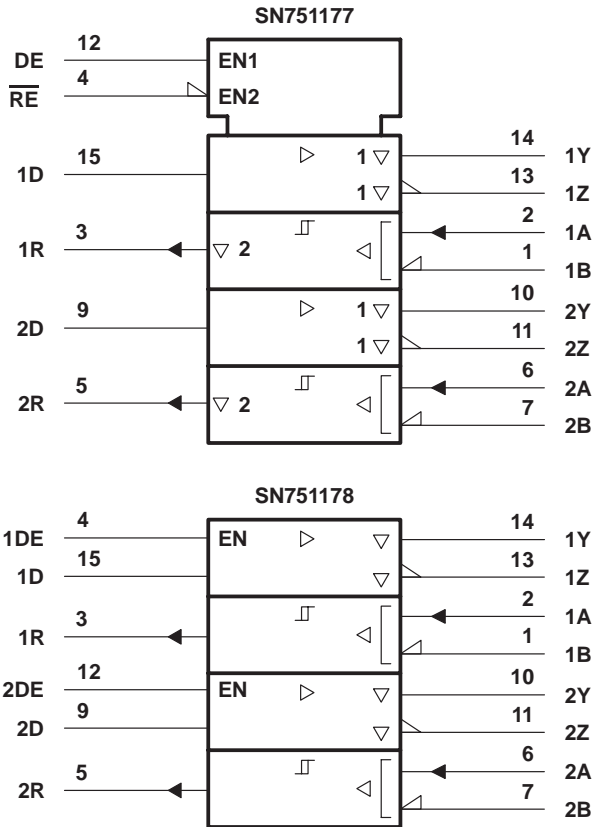
DIFFERENTIAL INPUTS A – B	OUTPUT R
$V_{ID} \geq 0.2 V$	H
$-0.2 V < V_{ID} < 0.2 V$	?
$V_{ID} \leq -0.2 V$	L

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

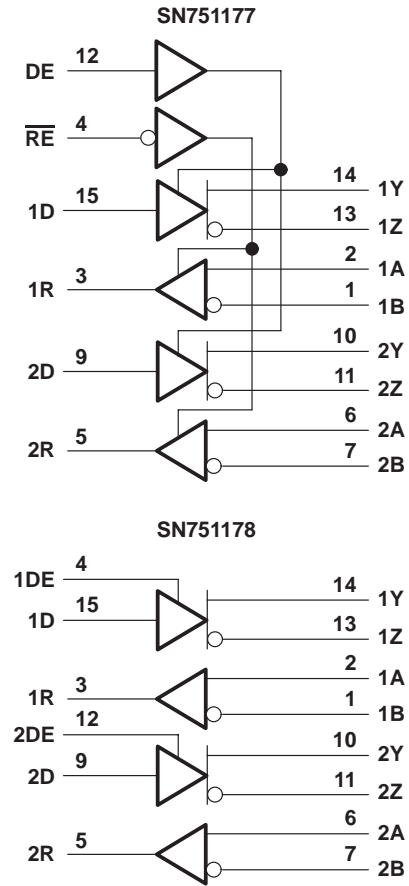
# SN751177, SN751178 DUAL DIFFERENTIAL DRIVERS AND RECEIVERS

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## logic symbols†

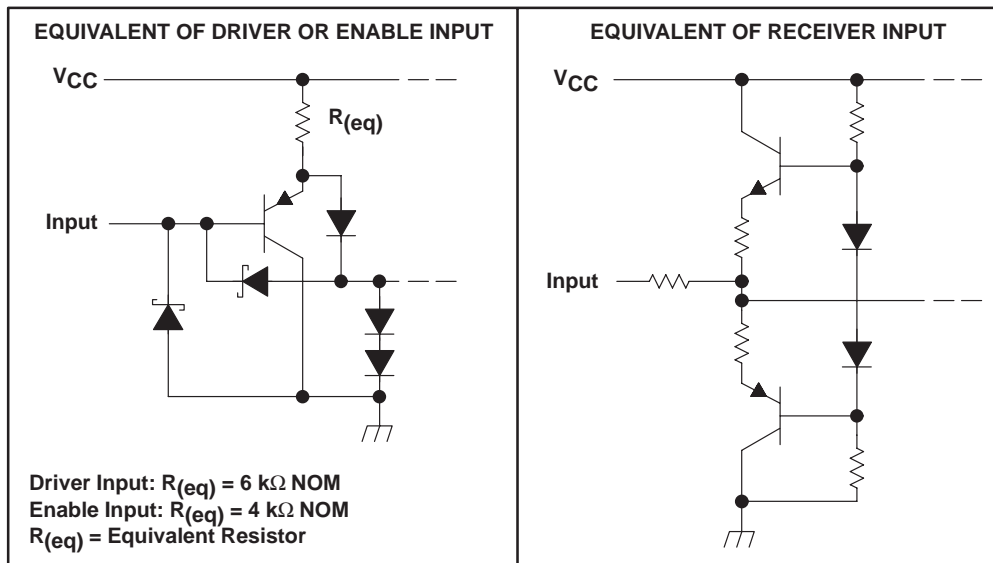


## logic diagrams (positive logic)



† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

## schematics of inputs

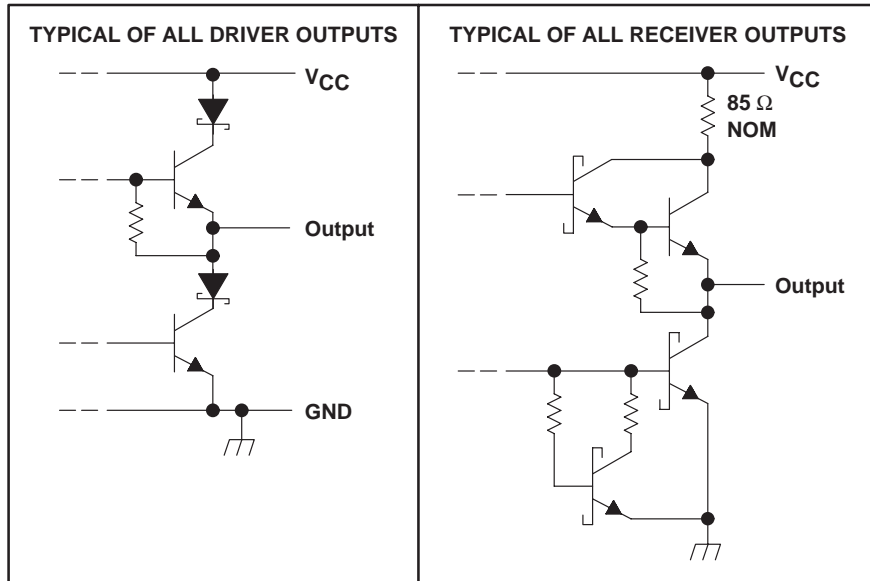


All resistor values are nominal.

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## schematics of outputs



All resistor values are nominal.

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

Supply voltage, $V_{CC}$ (see Note 1)	7 V
Input voltage, $V_I$ (DE, $\overline{RE}$ , and D inputs)	7 V
Receiver input voltage range, $V_I$ (A or B inputs)	-25 V to 25 V
Receiver differential input voltage range, $V_{ID}$ (see Note 2)	-25 V to 25 V
Driver output voltage range, $V_O$	-10 V to 15 V
Receiver low-level output current, $I_{OL}$	50 mA
Package thermal impedance, $\theta_{JA}$ (see Note 3): N package	78°C/W
NS package	111°C/W
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

<sup>†</sup> 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, except differential input voltage, are with respect to the network ground terminal.
  2. Differential input voltage is measured at the noninverting terminal with respect to the inverting terminal.
  3. The package thermal impedance is calculated in accordance with JESD 51, except for through-hole packages, which use a trace length of zero.

# SN751177, SN751178 DUAL DIFFERENTIAL DRIVERS AND RECEIVERS

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## recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, $V_{CC}$		4.75	5	5.25	V
High-level input voltage, $V_{IH}$	DE, $\overline{RE}$ , and D inputs	2			V
Low-level input voltage, $V_{IL}$		0.8			V
Common-mode output voltage, $V_{OC}$	Driver	$-7^\dagger$		12	V
High-level output current, $I_{OH}$				-60	mA
Low-level output current, $I_{OL}$				60	mA
Common-mode input voltage, $V_{IC}$	Receiver			$\pm 12$	V
Differential input voltage, $V_{ID}$				$\pm 12$	V
High-level output current, $I_{OH}$				-400	$\mu A$
Low-level output current, $I_{OL}$				16	mA
Operating free-air temperature, $T_A$		-20		85	$^\circ C$

<sup>†</sup> The algebraic convention, where the less positive (more negative) limit is designated as minimum, is used in this data sheet for common-mode output and threshold voltage levels only.



# SN751177, SN751178 DUAL DIFFERENTIAL DRIVERS AND RECEIVERS

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## DRIVER SECTIONS

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, V <sub>IL</sub> = 0.8 V, I <sub>OH</sub> = -33 mA		3.7		V
V <sub>OL</sub>	Low-level output voltage	V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.8 V, I <sub>OH</sub> = 33 mA		1.1		V
V <sub>OD1</sub>	Differential output voltage	I <sub>O</sub> = 0	1.5		6	V
V <sub>OD2</sub>	Differential output voltage	R <sub>L</sub> = 100 Ω, See Figure 1	2 or 1/2 V <sub>OD1</sub> ‡			V
		R <sub>L</sub> = 54 Ω, See Figure 1	1.5		5	
V <sub>OD3</sub>	Differential output voltage	See Note 4	1.5		5	V
Δ V <sub>OD</sub>	Change in magnitude of differential output voltage (see Note 5)	R <sub>L</sub> = 54 Ω or 100 Ω, See Figure 1			±0.2	V
V <sub>OC</sub>	Common-mode output voltage		-1§		3	V
Δ V <sub>OC</sub>	Change in magnitude of common-mode output voltage (see Note 5)				±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>IH</sub> = 2.7 V			20	μA
I <sub>IL</sub>	Low-level input current	V <sub>IL</sub> = 0.4 V			-100	μA
I <sub>OS</sub>	Short-circuit output current (see Note 6)	V <sub>O</sub> = -7 V			-250	mA
		V <sub>O</sub> = V <sub>CC</sub>			250	
		V <sub>O</sub> = 12 V			250	
I <sub>CC</sub>	Supply current	No load	Outputs enabled	80	110	mA
			Outputs disabled	50	80	

† 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.

§ The algebraic convention, where the less positive (more negative) limit is designated as minimum, is used in this data sheet for common-mode output and threshold voltage levels only.

NOTES: 4. See TIA/EIA-485-A Figure 3.5, Test Termination Measurement 2

5. 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.

6. Not more than one output should be shorted at a time, and the duration of the short circuit should not exceed one second.

## switching characteristics at V<sub>CC</sub> = 5 V, C<sub>L</sub> = 50 pF, 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 3		20	25	ns
t <sub>t</sub> (OD)	Differential output transition time			27	35	
t <sub>PLH</sub>	Propagation delay time, low- to high-level output	R <sub>L</sub> = 27 Ω, See Figure 4		20	25	ns
t <sub>PHL</sub>	Propagation delay time, high- to low-level output			20	25	
t <sub>PZH</sub>	Output enable time to high level	R <sub>L</sub> = 110 Ω, See Figure 5		80	120	ns
t <sub>PZL</sub>	Output enable time to low level	R <sub>L</sub> = 110 Ω, See Figure 6		40	60	ns
t <sub>PHZ</sub>	Output disable time from high level	R <sub>L</sub> = 110 Ω, See Figure 5		90	120	ns
t <sub>PLZ</sub>	Output disable time from low level	R <sub>L</sub> = 110 Ω, See Figure 6		30	45	ns



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## SYMBOL EQUIVALENTS

DATA-SHEET PARAMETER	TIA/EIA-422-B	TIA/EIA-485-A
$ 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} $	$I_{ia}, I_{ib}$

## RECEIVER SECTIONS

electrical characteristics over recommended ranges of common-mode input voltage, supply voltage, and operating free-air temperature (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
$V_{IT+}$	Positive-going input threshold voltage	$V_O = 2.7 \text{ V}$ , $I_O = -0.4 \text{ mA}$			0.2	V
$V_{IT-}$	Negative-going input threshold voltage	$V_O = 0.5 \text{ V}$ , $I_O = 16 \text{ mA}$	-0.2‡			V
$V_{hys}$	Input hysteresis voltage ( $V_{IT+} - V_{IT-}$ )			50		mV
$V_{IK}$	Enable clamp voltage	SN751177 $I_I = -18 \text{ mA}$			-1.5	V
$V_{OH}$	High-level output voltage	$V_{ID} = 200 \text{ mV}$ , $I_{OH} = -400 \mu\text{A}$		2.7		V
$V_{OL}$	Low-level output voltage	$V_{ID} = -200 \text{ mV}$			0.45	V
					0.5	
$I_{OZ}$	High-impedance-state output current	SN751177 $V_O = 0.4 \text{ V to } 2.4 \text{ V}$			$\pm 20$	$\mu\text{A}$
$I_I$	Line input current (see Note 7)	Other input at 0 V			1	mA
					-0.8	
$I_{IH}$	High-level enable input current	SN751177 $V_{IH} = 2.7 \text{ V}$			20	$\mu\text{A}$
$I_{IL}$	Low-level enable input current	SN751177 $V_{IL} = 0.4 \text{ V}$			-100	$\mu\text{A}$
$I_{OS}$	Short-circuit output current (see Note 6)		-15		-85	$\mu\text{A}$
$I_{CC}$	Supply current	No load, Outputs enabled		80	110	mA
$r_i$	Input resistance			12		k $\Omega$

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

‡ The algebraic convention, where the less positive (more negative) limit is designated as minimum, is used in this data sheet for common-mode output and threshold voltage levels only.

NOTES: 6. Not more than one output should be shorted at a time, and the duration of the short circuit should not exceed one second.

7. Refer to ANSI Standards TIA/EIA-422-B, TIA/EIA-423-A, and TIA/EIA-485-A for exact conditions.



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switching characteristics at  $V_{CC} = 5\text{ V}$ ,  $C_L = 15\text{ pF}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{PLH}$ Propagation delay time, low- to high-level output	$V_{ID} = -1.5\text{ V to } 1.5\text{ V}$ , See Figure 7		20	35	ns
$t_{PHL}$ Propagation delay time, high- to low-level output			22	35	ns
$t_{PZH}$ Output enable time to high level	SN751177 See Figure 8		17	25	ns
$t_{PZL}$ Output enable time to low level			20	27	ns
$t_{PHZ}$ Output disable time from high level			25	40	ns
$t_{PLZ}$ Output disable time from low level			30	40	ns

## PARAMETER MEASUREMENT INFORMATION

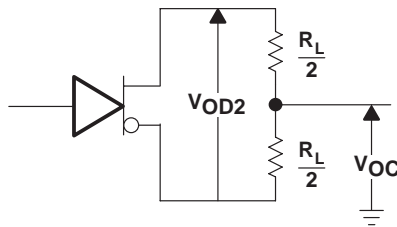


Figure 1. Driver Test Circuit,  $V_{OD}$  and  $V_{OC}$

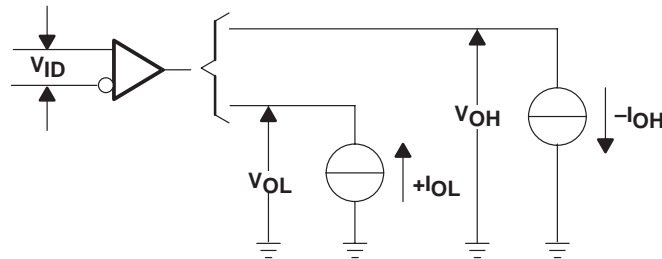
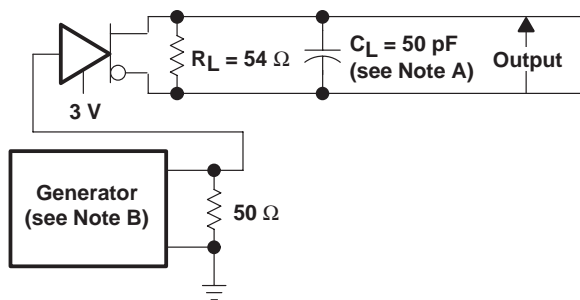
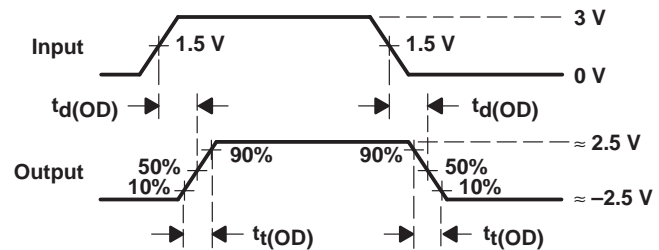


Figure 2. Receiver Test Circuit,  $V_{OH}$  and  $V_{OL}$



TEST CIRCUIT



VOLTAGE WAVEFORMS

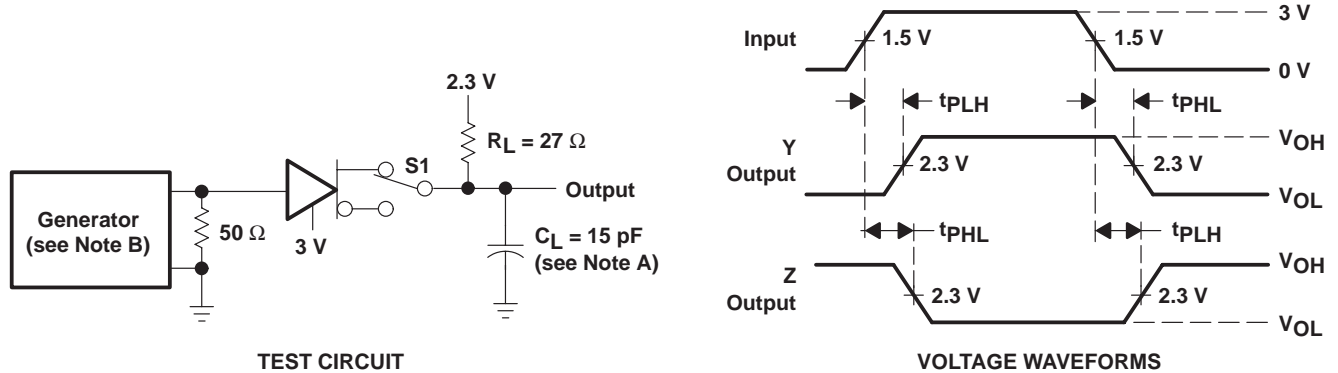
NOTES: A.  $C_L$  includes probe and jig capacitance.

B. The pulse generator has the following characteristics:  $PRR \leq 1\text{ MHz}$ , 50% duty cycle,  $Z_O = 50\ \Omega$ ,  $t_r \leq 6\text{ ns}$ ,  $t_f \leq 6\text{ ns}$ .

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

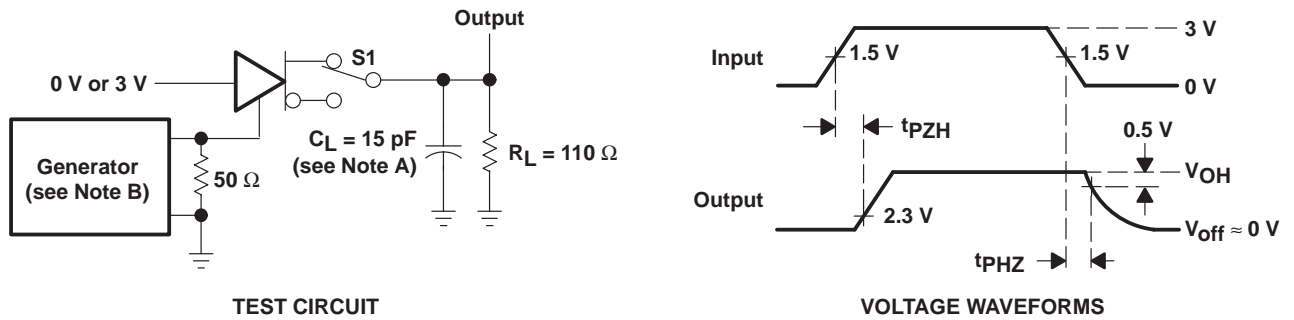


PARAMETER MEASUREMENT INFORMATION



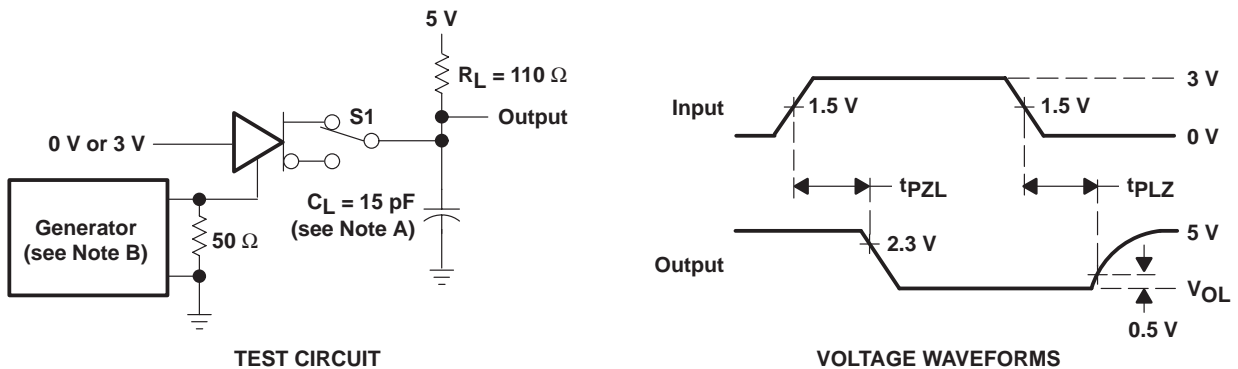
NOTES: A.  $C_L$  includes probe and jig capacitance.  
B. The pulse generator has the following characteristics:  $PRR \leq 1$  MHz, 50% duty cycle,  $Z_O = 50 \Omega$ ,  $t_r \leq 6$  ns,  $t_f \leq 6$  ns.

Figure 4. Driver Propagation-Time Test Circuit and Voltage Waveforms



NOTES: A.  $C_L$  includes probe and jig capacitance.  
B. The pulse generator has the following characteristics:  $PRR \leq 1$  MHz, 50% duty cycle,  $Z_O = 50 \Omega$ ,  $t_r \leq 6$  ns,  $t_f \leq 6$  ns.

Figure 5. Driver Enable- and Disable-Time Test Circuit and Voltage Waveforms



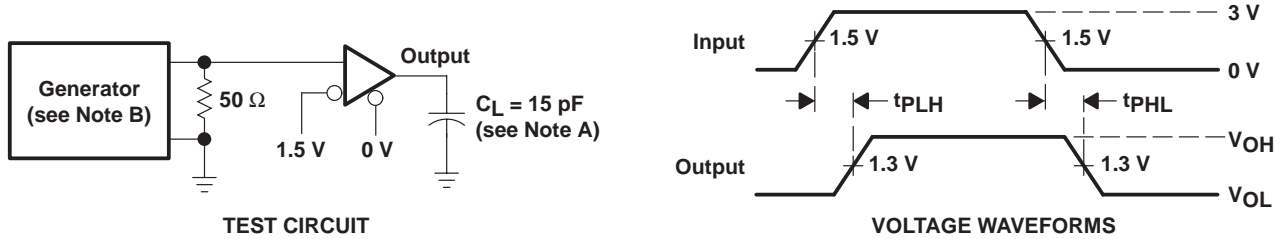
NOTES: A.  $C_L$  includes probe and jig capacitance.  
B. The pulse generator has the following characteristics:  $PRR \leq 1$  MHz, 50% duty cycle,  $Z_O = 50 \Omega$ ,  $t_r \leq 6$  ns,  $t_f \leq 6$  ns.

Figure 6. Driver Enable- and Disable-Time Test Circuit and Voltage Waveforms

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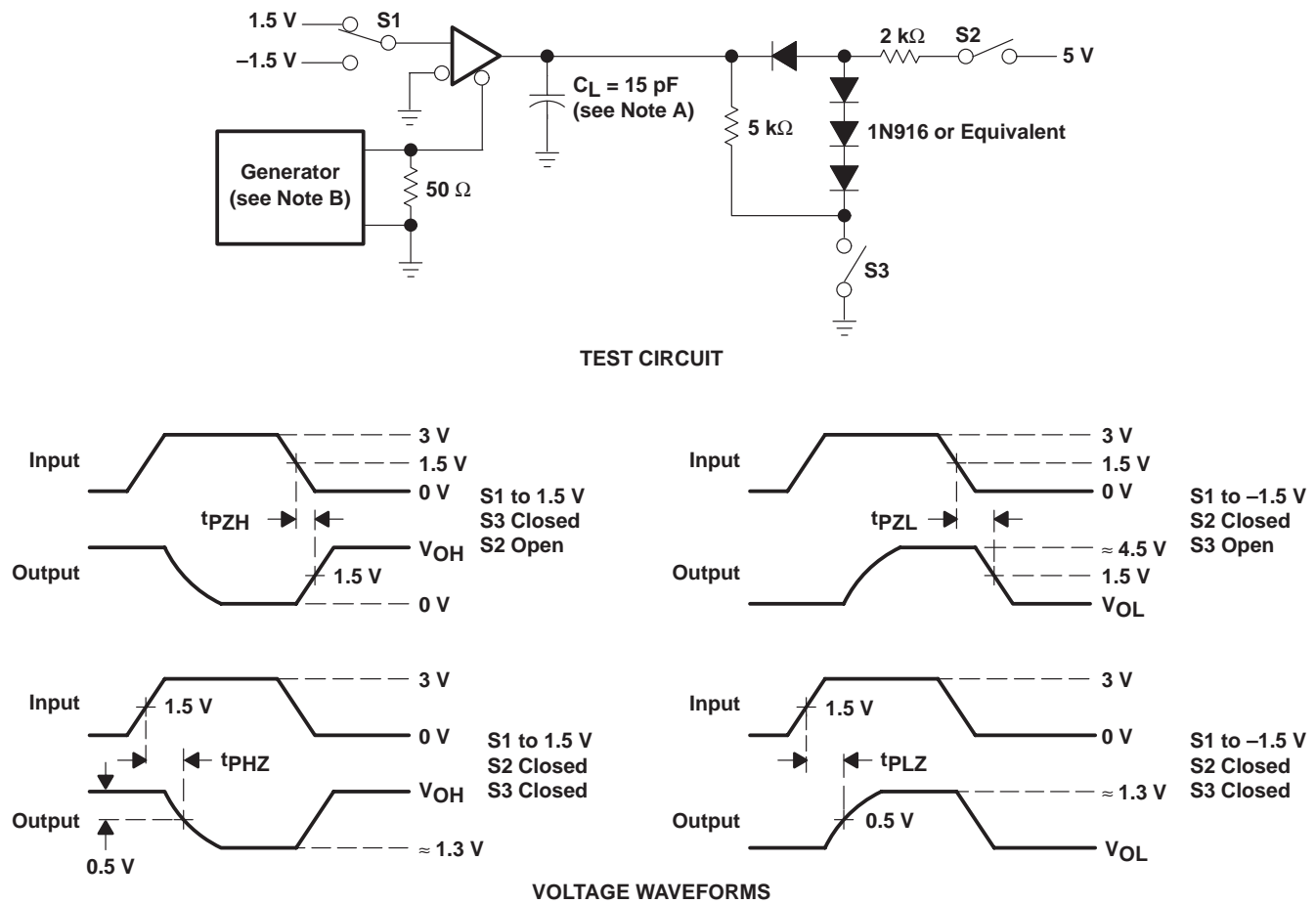
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## PARAMETER MEASUREMENT INFORMATION



NOTES: A.  $C_L$  includes probe and jig capacitance.  
B. The pulse generator has the following characteristics:  $PRR \leq 1$  MHz, 50% duty cycle,  $Z_O = 50 \Omega$ ,  $t_r \leq 6$  ns,  $t_f \leq 6$  ns.

Figure 7. Receiver Propagation-Time Test Circuit and Voltage Waveforms



NOTES: A.  $C_L$  includes probe and jig capacitance.  
B. The pulse generator has the following characteristics:  $PRR \leq 1$  MHz, 50% duty cycle,  $Z_O = 50 \Omega$ ,  $t_r \leq 6$  ns,  $t_f \leq 6$  ns.

Figure 8. Receiver Output Enable- and Disable-Time Test Circuit and Voltage Waveforms

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN751177N	ACTIVE	PDIP	N	16	25	RoHS & Green	NIPDAU	N / A for Pkg Type	-20 to 85	SN751177N	<a href="#">Samples</a>
SN751177NSR	ACTIVE	SO	NS	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-20 to 85	SN751177	<a href="#">Samples</a>
SN751177NSRE4	ACTIVE	SO	NS	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-20 to 85	SN751177	<a href="#">Samples</a>
SN751178N	ACTIVE	PDIP	N	16	25	RoHS & Green	NIPDAU	N / A for Pkg Type	-20 to 85	SN751178N	<a href="#">Samples</a>
SN751178NSR	ACTIVE	SO	NS	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-20 to 85	SN751178	<a href="#">Samples</a>

(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.

**OBSELETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices 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.

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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
SN751177NSR	SO	NS	16	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
SN751178NSR	SO	NS	16	2000	330.0	16.4	8.45	10.55	2.5	12.0	16.2	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN751177NSR	SO	NS	16	2000	356.0	356.0	35.0
SN751178NSR	SO	NS	16	2000	356.0	356.0	35.0

**TUBE**


\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
SN751177N	N	PDIP	16	25	506	13.97	11230	4.32
SN751177N	N	PDIP	16	25	506	13.97	11230	4.32
SN751178N	N	PDIP	16	25	506	13.97	11230	4.32
SN751178N	N	PDIP	16	25	506	13.97	11230	4.32

# MECHANICAL DATA

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

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.





# PACKAGE OUTLINE

## NS0016A

### SOP - 2.00 mm max height

SOP



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#### 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 0.25 mm, per side.

# EXAMPLE BOARD LAYOUT

NS0016A

SOP - 2.00 mm max height

SOP



SOLDER MASK DETAILS

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NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.

6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

NS0016A

SOP - 2.00 mm max height

SOP



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:7X

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NOTES: (continued)

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

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.
  - 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.

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