

## DIFFERENTIAL DRIVER AND RECEIVER PAIR

Check for Samples: [SN75ALS181](#)

### FEATURES

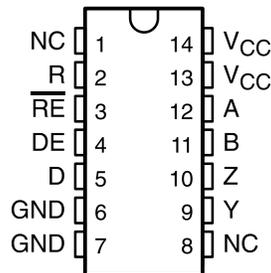
- Meets TIA/EIA-422-B, TIA/EIA-485-A, and CCITT Recommendations V.11 and X.27
- Low Supply-Current Requirements... 30 mA Max
- Driver Output Capacity...±60 mA
- Thermal Shutdown Protection
- Driver Common-Mode Output Voltage Range of -7 V to 12 V
- Receiver Input Impedance...12 kΩ Min
- Receiver Input Sensitivity...±200 mV
- Receiver Input Hysteresis...60 mV Typ
- Receiver Common-Mode Input Voltage Range of ±12 V
- Operates From Single 5-V Supply
- Glitch-Free Power-Up and Power-Down Protection

### DESCRIPTION

The SN75ALS181 is a differential driver and receiver pair designed for bidirectional data communication on multipoint bus transmission lines. The design provides for balanced transmission lines and meets TIA/EIA-422-B and TIA/EIA-485-A, and CCITT recommendations V.10, V.11, X.26, and X.27.

The SN75ALS181 combines a 3-state differential line driver and a differential-input line receiver that operate from a single 5-V power supply. The driver and receiver have active-high and active-low enables, respectively, that can be connected together externally to function as a direction control. The driver differential outputs and the receiver differential inputs are connected to separate pins for greater flexibility and are designed to offer minimum loading to the bus when the driver is disabled or  $V_{CC} = 0$ . These ports feature wide positive and negative common-mode voltage changes, making the device suitable for party-line applications.

**N OR NS PACKAGE  
(TOP VIEW)**



N.C. – No internal connection



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.

## FUNCTION TABLES

### Each Driver

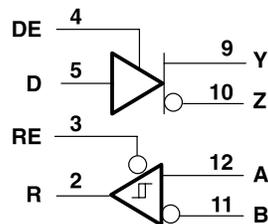
INPUTS D	ENABLE DE	OUTPUTS	
		Y	Z
H	H	H	L
L	H	L	H
X	L	Z	Z

### Each Receiver<sup>(1)</sup>

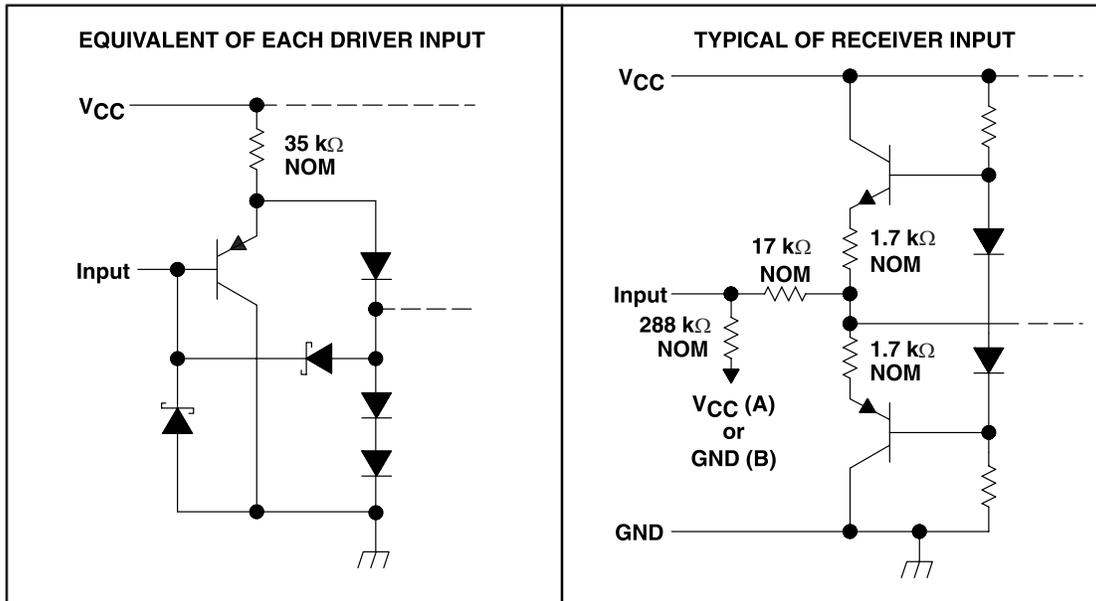
DIFFERENTIAL A-B	ENABLE $\overline{RE}$	OUTPUT R
$V_{ID} \geq 0.2 \text{ V}$	L	H
$-0.2 \text{ V} < V_{ID} < 0.2 \text{ V}$	L	?
$V_{ID} \leq -0.2 \text{ V}$	L	L
X	H	Z

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

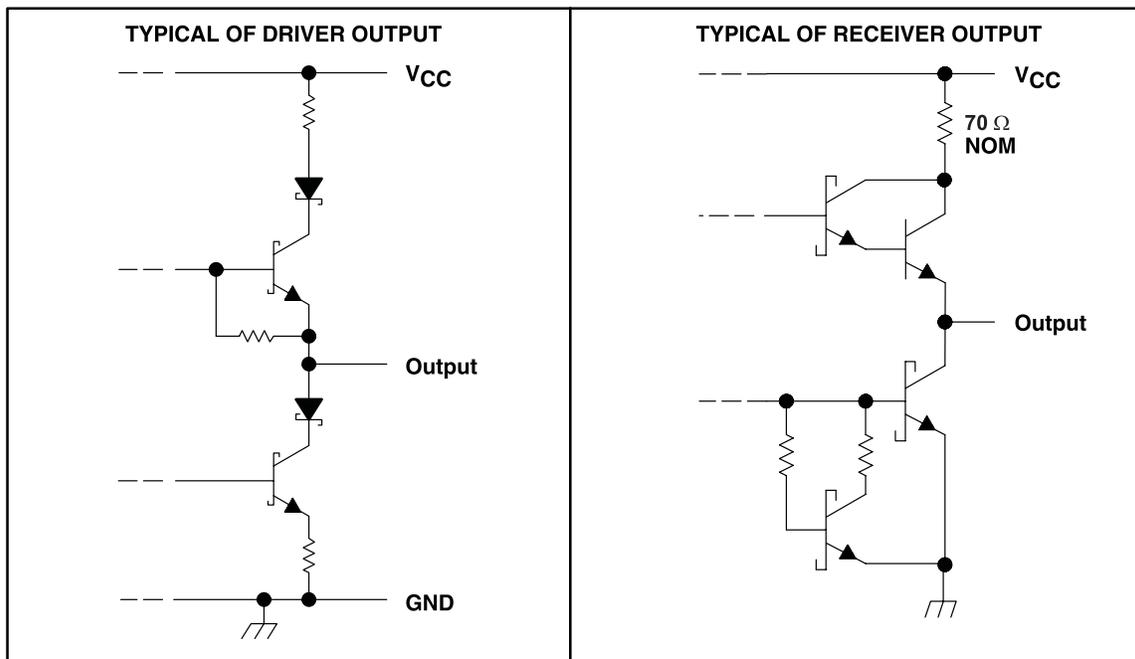
### LOGIC DIAGRAM (POSITIVE LOGIC)



**SCHEMATICS OF INPUTS**



**SCHEMATICS OF OUTPUTS**



**ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>**

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

		MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage range <sup>(2)</sup>		7	V
	Input voltage range	D, DE, and $\overline{RE}$ inputs		7 V
	Output voltage range	Driver		-9 14 V
	Input voltage range	Receiver		-14 14 V
	Receiver differential input voltage range <sup>(3)</sup>	-14	14	V
$\theta_{JA}$	Package thermal impedance <sup>(4)(5)</sup>	N package		80 °C/W
		NS package		76
	Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds		260	°C
T <sub>stg</sub>	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, except differential input voltage, are with respect to network ground terminal.
- (3) Differential input voltage is measured at the noninverting terminal with respect to the inverting terminal.
- (4) Maximum power dissipation is a function of T<sub>J(max)</sub>,  $\theta_{JA}$ , and T<sub>A</sub>. The maximum allowable power dissipation at any allowable ambient temperature is  $PD = (T_{J(max)} - T_A) / \theta_{JA}$ . Operating at the absolute maximum T<sub>J</sub> of 150°C can affect reliability.
- (5) The package thermal impedance is calculated in accordance with JESD 51-7.

**RECOMMENDED OPERATING CONDITIONS**

		MIN	NOM	MAX	UNIT
V <sub>CC</sub>	Supply voltage	4.75	5	5.25	V
V <sub>OC</sub>	Common-mode output voltage <sup>(1)</sup>	Driver		12	V
V <sub>IC</sub>	Common-mode input voltage <sup>(1)</sup>	Receiver		12	V
V <sub>IH</sub>	High-level input voltage	D, DE, and $\overline{RE}$		2	V
V <sub>IL</sub>	Low-level input voltage	D, DE, and $\overline{RE}$		0.8	V
V <sub>ID</sub>	Differential input voltage			±12	V
I <sub>OH</sub>	High-level output current	Driver		-60	mA
		Receiver		-400	µA
I <sub>OL</sub>	Low-level output current	Driver		60	mA
		Receiver		8	
T <sub>A</sub>	Operating free-air temperature	0		70	°C

- (1) The algebraic convention, where the less positive (more negative) limit is designated as minimum, is used in this table for common-mode output voltage level only.

## Driver Section

### ELECTRICAL CHARACTERISTICS

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

PARAMETER		TEST CONDITIONS		MIN	TYP <sup>(1)</sup>	MAX	UNIT
$V_{IK}$	Input clamp voltage	$I_I = -18 \text{ mA}$				-1.5	V
$V_O$	Output voltage	$I_O = 0$		0		6	V
$ V_{OD1} $	Differential output voltage	$I_O = 0$		1.5		6	V
$ V_{OD2} $	Differential output voltage	$V_{CC} = 5 \text{ V}$ , $R_L = 100 \Omega$	See <a href="#">Figure 1</a>	1/2 $V_{OD1}$			V
				2			
		$R_L = 54 \Omega$		1.5	2.3	5	
$ V_{OD3} $	Differential output voltage	$V_{test} = -7 \text{ V to } 12 \text{ V}$ ,	See <a href="#">Figure 2</a>	1.5		5	V
$\Delta V_{OD} $	Change in magnitude of differential output voltage	$R_L = 54 \Omega$ or $100 \Omega$ ,	See <a href="#">Figure 1</a>			$\pm 0.2$	V
$V_{OC}$	Common mode output voltage	$R_L = 54 \Omega$ or $100 \Omega$ ,	See <a href="#">Figure 1</a>			3	V
						-1	
$\Delta V_{OC} $	Change in magnitude of common-mode output voltage <sup>(2)</sup>	$R_L = 54 \Omega$ or $100 \Omega$ ,	See <a href="#">Figure 1</a>			$\pm 0.2$	V
$I_{OZ}$	High-impedance-state output current	$V_O = -7 \text{ V to } 12 \text{ V}^{(3)}$				$\pm 100$	$\mu\text{A}$
$I_{IH}$	High-level input current	$V_{IH} = 2.4 \text{ V}$				20	$\mu\text{A}$
$I_{IL}$	Low-level input current	$V_{IL} = 0.4 \text{ V}$				-100	$\mu\text{A}$
$I_{OS}$	Short circuit output current	$V_O = -7 \text{ V}$				-250	mA
		$V_O = V_{CC}$				250	
		$V_O = 12 \text{ V}$				250	
		$V_O = 0 \text{ V}$				-150	
$I_{CC}$	Supply current (total package)	No load	Outputs enabled		21	30	mA
			Outputs disabled		14	21	

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

(2)  $\Delta|V_{OD}|$  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.

(3) This applies for both power on and power off. Refer to TIA/EIA-485-A for exact conditions

### SWITCHING CHARACTERISTICS

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

PARAMETER		TEST CONDITIONS		MIN	TYP <sup>(1)</sup>	MAX	UNIT
$t_{dD}$	Differential output delay time, $t_{dDH}$ or $t_{dDL}$	$R_L = 54 \Omega$ ,	$C_L = 50 \text{ pF}$ , See <a href="#">Figure 3</a>	9	13	20	ns
$t_{sk(p)}$	Pulse skew ( $ t_{dDH} - t_{dDL} $ )	$R_L = 54 \Omega$ ,	$C_L = 50 \text{ pF}$ , See <a href="#">Figure 3</a>		1	8	ns
$t_t$	Differential output transition time	$R_L = 54 \Omega$ ,	$C_L = 50 \text{ pF}$ , See <a href="#">Figure 3</a>	3	10	16	ns
$t_{PZH}$	Output enable time to high level	$R_L = 110 \Omega$ ,	See <a href="#">Figure 4</a>		36	53	ns
$t_{PZL}$	Output enable time to low level	$R_L = 110 \Omega$ ,	See <a href="#">Figure 5</a>		39	56	ns
$t_{PHZ}$	Output disable time from high level	$R_L = 110 \Omega$ ,	See <a href="#">Figure 4</a>		20	31	ns
$t_{PLZ}$	Output disable time from low level	$R_L = 110 \Omega$ ,	See <a href="#">Figure 5</a>		9	20	ns

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

## Receiver Section

### ELECTRICAL CHARACTERISTICS

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

PARAMETER		TEST CONDITIONS		MIN	TYP <sup>(1)</sup>	MAX	UNIT	
$V_{T+}$	Positive-going threshold voltage, differential input	$V_O = 2.7\text{ V}$ ,	$I_O = -0.4\text{ mA}$			0.2	V	
$V_{T-}$	Negative-going threshold voltage, differential input	$V_O = 0.5\text{ V}$ ,	$I_O = 8\text{ mA}$	-0.2			V	
$V_{hys}$	Input hysteresis ( $V_{T+} - V_{T-}$ )				60		mV	
$V_{IK}$	Input clamp voltage, $\overline{RE}$	$I_I = -18\text{ mA}$				-1.5	V	
$V_{OH}$	High-level output voltage	$V_{ID} = 200\text{ mV}$ ,	$I_{OH} = -400\text{ }\mu\text{A}$ , See Figure 6	2.7			V	
$V_{OL}$	Low-level output voltage	$V_{ID} = 200\text{ mV}$ ,	$I_{OL} = 8\text{ mA}$ , See Figure 6			0.45	V	
$I_{OZ}$	High-impedance-state output current	$V_O = 0.4\text{ V to } 2.4\text{ V}$				$\pm 20$	$\mu\text{A}$	
$I_I$	Line input current	Other input at 0 V <sup>(2)</sup> ,	$V_I = 12\text{ V}$			1	mA	
			$V_I = -7\text{ V}$			-0.8		
$I_{IH}$	High-level input current, $\overline{RE}$	$V_{IH} = 2.7\text{ V}$				20	$\mu\text{A}$	
$I_{IL}$	Low-level input current, $\overline{RE}$	$V_{IL} = -7\text{ V}$				-100	$\mu\text{A}$	
$R_I$	Input resistance			12			k $\Omega$	
$I_{OS}$	Short circuit output current	$V_{ID} = 200\text{ mV}$ ,	$V_O = 0\text{ V}$	-15		-85	mA	
$I_{CC}$	Supply current (total package)	No load	Outputs enabled			21	30	mA
			Outputs disabled			14	21	

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

(2) This applies for both power on and power off. Refer to TIA/EIA-485-A for exact conditions

### SWITCHING CHARACTERISTICS

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

PARAMETER		TEST CONDITIONS		MIN	TYP <sup>(1)</sup>	MAX	UNIT
$t_{PHL}$	Differential output delay time, $td_{DH}$ or $td_{DL}$	$V_{ID} = -1.5\text{ V to } 1.5\text{ V}$		10	16	25	ns
$t_{PLH}$	Propagation delay time, low- to high-level output	$V_{ID} = -1.5\text{ V to } 1.5\text{ V}$		10	16	25	ns
$t_{sk(p)}$	Pulse skew ( $ td_{DH} - td_{DL} $ )	$V_{ID} = -1.5\text{ V to } 1.5\text{ V}$			1	8	ns
$t_{PZH}$	Output enable time to high level				7	15	ns
$t_{PZL}$	Output enable time to low level				9	19	ns
$t_{PHZ}$	Output disable time from high level				18	27	ns
$t_{PLZ}$	Output disable time from low level				10	15	ns

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

PARAMETER MEASUREMENT INFORMATION

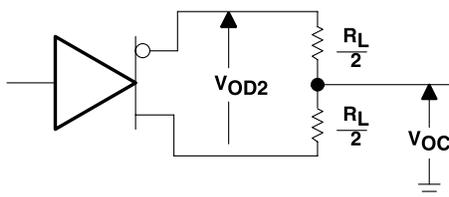


Figure 1. Driver Test Circuit,  $V_{OD}$  and  $V_{OC}$

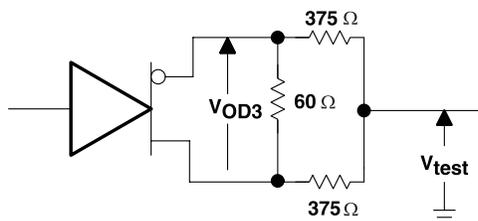


Figure 2. Driver Circuit,  $V_{OD3}$

- A. The input pulse is supplied by a generator having the following characteristics:  $PRR \leq 1$  MHz, 50% duty cycle,  $t_r \leq 6$  ns,  $t_f \leq 6$  ns,  $Z_O = 50 \Omega$
- B.  $C_L$  includes probe and jig capacitance.

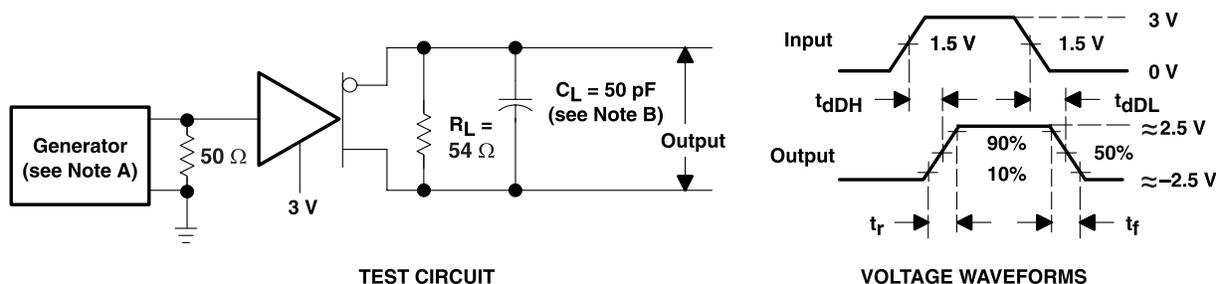


Figure 3. Driver Differential-Output Delay and Transition Times

- A. The input pulse is supplied by a generator having the following characteristics:  $PRR \leq 1$  MHz, 50% duty cycle,  $t_r \leq 6$  ns,  $t_f \leq 6$  ns,  $Z_O = 50 \Omega$
- B.  $C_L$  includes probe and jig capacitance.

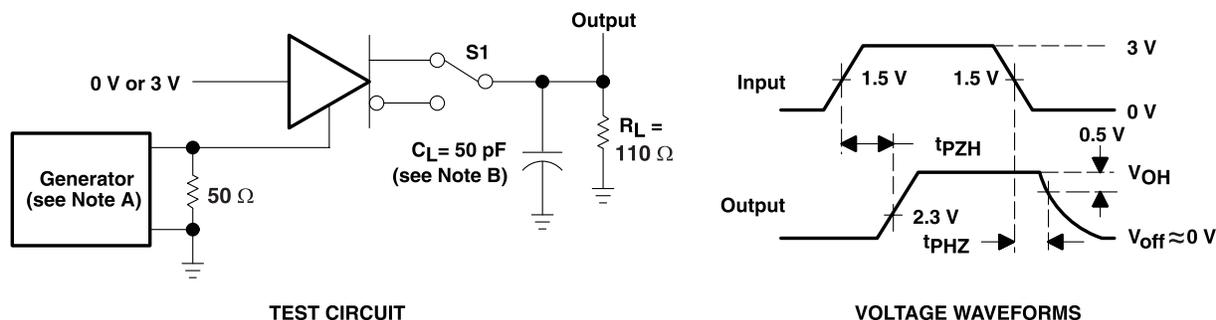
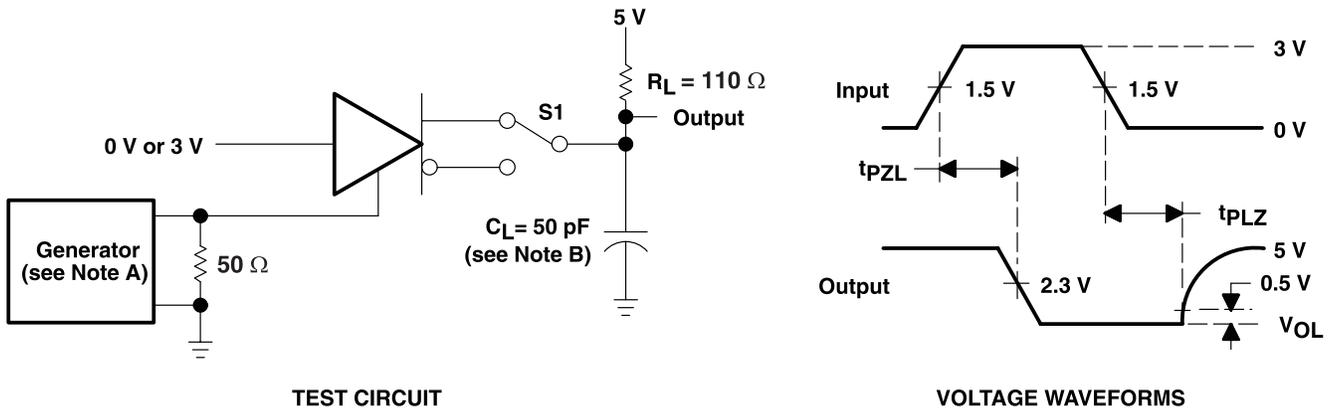


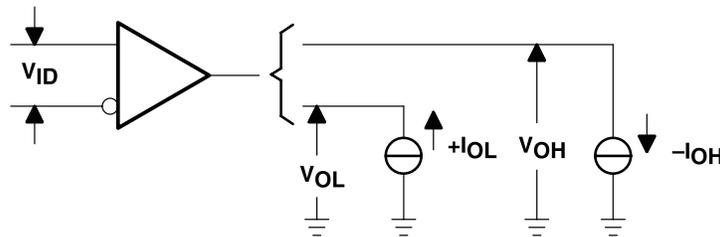
Figure 4. Driver Enable and Disable Times

- A. The input pulse is supplied by a generator having the following characteristics:  $PRR \leq 1$  MHz, 50% duty cycle,  $t_r \leq 6$  ns,  $t_f \leq 6$  ns,  $Z_O = 50 \Omega$
- B.  $C_L$  includes probe and jig capacitance.

**PARAMETER MEASUREMENT INFORMATION (continued)**

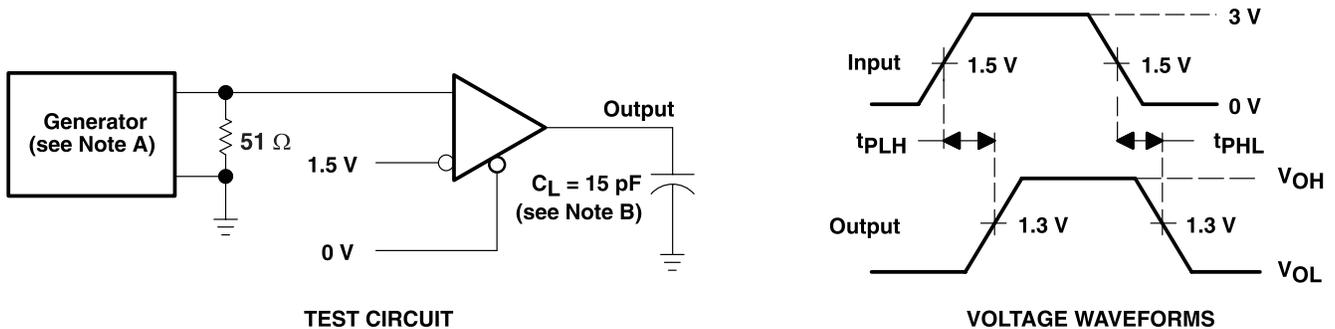


**Figure 5. Driver Enable and Disable Times**



**Figure 6. Receiver, VOH and VOL**

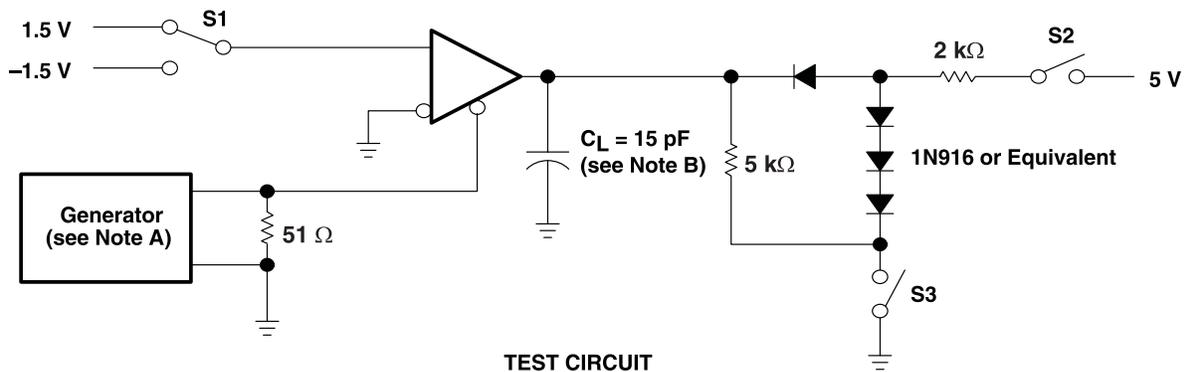
- A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 1 MHz, 50% duty cycle,  $t_r \leq 6$  ns,  $t_f \leq 6$  ns,  $Z_O = 50 \Omega$
- B.  $C_L$  includes probe and jig capacitance.



**Figure 7. Receiver Propagation-Delay Times**

- A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 1 MHz, 50% duty cycle,  $t_r \leq 6$  ns,  $t_f \leq 6$  ns,  $Z_O = 50 \Omega$
- B.  $C_L$  includes probe and jig capacitance.

PARAMETER MEASUREMENT INFORMATION (continued)



TEST CIRCUIT

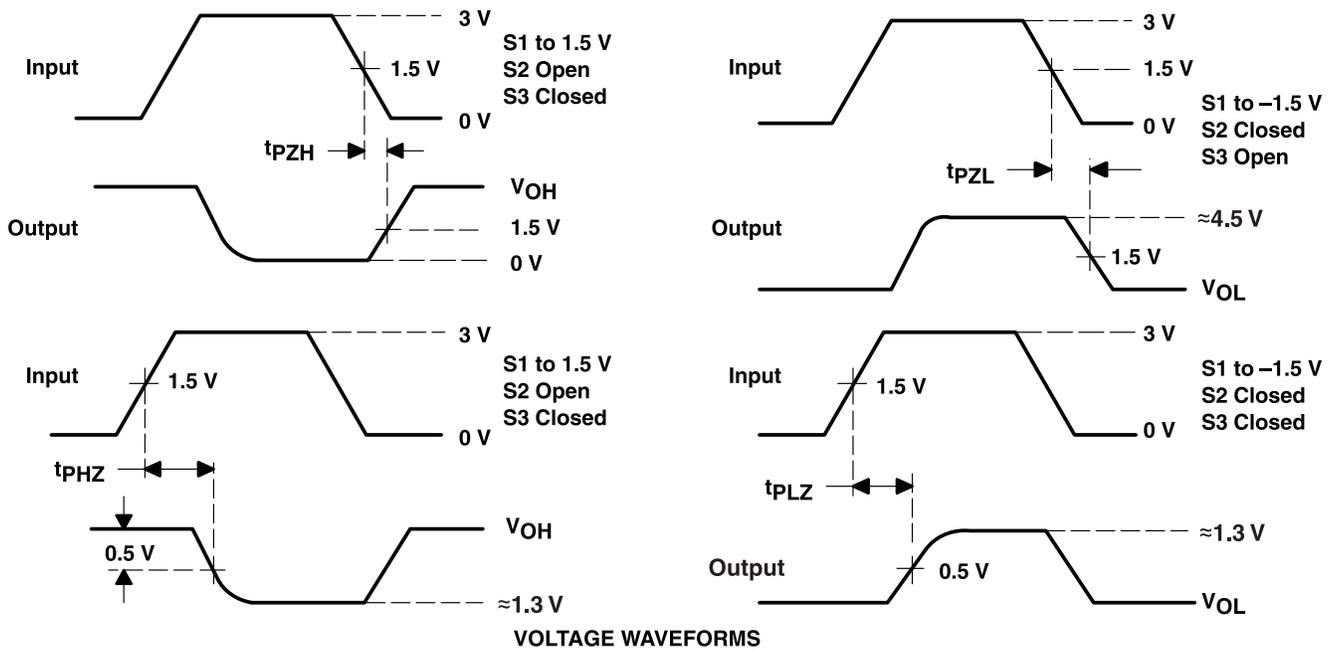


Figure 8. Receiver Output Enable and Disable Times

**REVISION HISTORY**

<b>Changes from Revision C (May 2010) to Revision D</b>	<b>Page</b>
• Removed Ordering Information table. ....	2
• Fixed graphical error in schematic. ....	3
• Fixed typographical error in MAX value for $\Delta V_{OD} $ . ....	5
• Fixed typographical error in UNITS for $\Delta V_{OC} $ . ....	5

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN75ALS181N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	SN75ALS181N	<a href="#">Samples</a>
SN75ALS181NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	SN75ALS181N	<a href="#">Samples</a>
SN75ALS181NSLE	OBSOLETE	SO	NS	14		TBD	Call TI	Call TI	0 to 70		
SN75ALS181NSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	75ALS181	<a href="#">Samples</a>
SN75ALS181NSRG4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	75ALS181	<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.

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

(2) 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)

(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.

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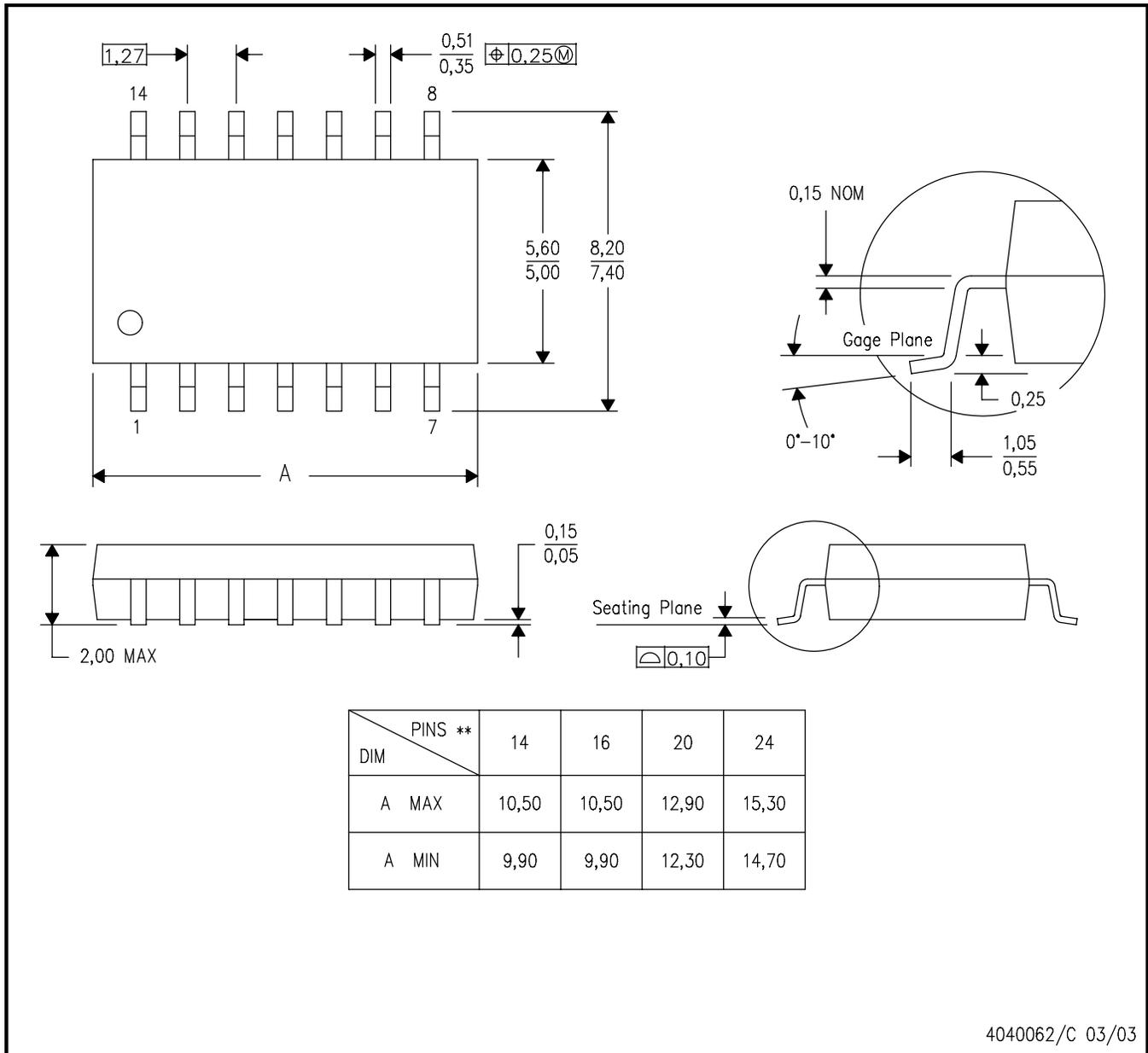


# MECHANICAL DATA

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.

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### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
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>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
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