

## SN75ALS181 Differential Driver and Receiver Pair

### 1 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... $\pm 60$  mA
- Thermal shutdown protection
- Driver common-mode output voltage range of  $-7$  V to 12 V
- Receiver input impedance: 12 k $\Omega$  min
- Receiver input sensitivity:  $\pm 200$  mV
- Receiver input hysteresis: 60 mV typ
- Receiver common-mode input voltage range of  $\pm 12$  V
- Operates from single 5-V supply
- Glitch-free power-up and power-down protection

### 2 Description

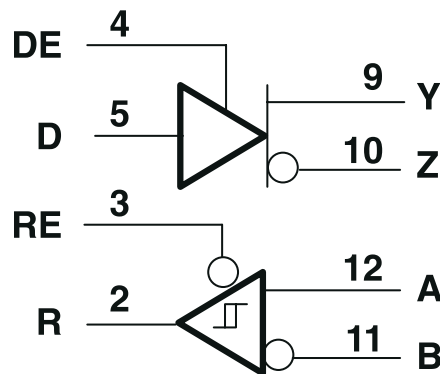
The SN75ALS181 is a differential driver and receiver pair designed for bidirectional data communication on multipoint bus transmission lines. The design provides for balanced transmission lines and meets TIA/EIA-422-B and TIA/EIA-485-A, and CCITT recommendations V.10, V.11, X.26, and X.27.

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.

#### Device Information

PART NUMBER	PACKAGE <sup>(1)</sup>	BODY SIZE (NOM)
SN75ALS181	N (PDIP) 14-pins	19.3 mm x 6.35 mm
	NS (SO) 14-pins	10.3 mm x 5.3 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.



Logic Diagram (Positive Logic)



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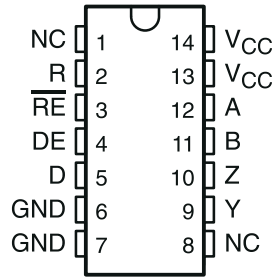
## 3 Revision History

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

<b>Changes from Revision D (August 2013) to Revision E (October 2022)</b>	<b>Page</b>
• Added the <i>Pin Configuration and Functions</i> .....	3
• Deleted the Package thermal impedance from the <i>Absolute Maximum Ratings</i> .....	4
• Added the <i>Thermal Information</i> table.....	4
• Added the <i>Detailed Description</i> section.....	10

<b>Changes from Revision C (May 2010) to Revision D (August 2013)</b>	<b>Page</b>
• Fixed typographical error in MAX value for $\Delta V_{OD} $ . .....	5
• Fixed typographical error in UNITS for $\Delta V_{OC} $ .....	5
• Removed Ordering Information table.....	10
• Fixed graphical error in schematic.....	10

## 4 Pin Configuration and Functions



N.C. – No internal connection

**Figure 4-1. N OR NS Package (Top View)**

**Table 4-1. Pin Functions**

PIN		TYPE	DESCRIPTION
NAME	NO.		
NC	1, 8	No Connect	Not electrically connected
R	2	Digital Output	Logic output RS485 data
$\overline{RE}$	3	Digital Input	Receiver enable, active low
DE	4	Digital Input	Driver enable, active high
D	5	Digital Input	Driver data input
GND	6, 7	Ground	Device ground
Y	9	Bus Output	Bus Output Y (Complementary to Z)
Z	10	Bus Output	Bus Output Z (Complementary to Y)
B	11	Bus Input	Bus Input B (Complementary to A)
A	12	Bus Input	Bus Input A (Complementary to B)
V <sub>CC</sub>	13, 14	Power	5 V Supply

## 5 Specifications

### 5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) see <sup>(1)</sup>

		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		
	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 non-inverting terminal with respect to the inverting terminal.

### 5.2 Thermal Information

THERMAL METRIC <sup>(1)</sup>		N (PDIP)	NS (SO)	UNIT
		14-Pins	14-Pins	
R <sub>θJA</sub>	Junction-to-ambient thermal resistance	54.2	88.6	°C/W
R <sub>θJB</sub>	Junction-to-board thermal resistance	41.6	49.12	°C/W
ψ <sub>JT</sub>	Junction-to-top characterization parameter	34.0	14.17	°C/W
ψ <sub>JB</sub>	Junction-to-board characterization parameter	21.1	48.6	°C/W
R <sub>θJC(bot)</sub>	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.

### 5.3 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	mA
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.

## 5.4 Electrical Characteristics: Driver

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 <sub>IK</sub>	Input clamp voltage	I <sub>I</sub> = -18 mA				-1.5	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	V
V <sub>OD2</sub>	Differential output voltage	V <sub>CC</sub> = 5 V, R <sub>L</sub> = 100 Ω	See Figure 6-1	1/2 V <sub>OD1</sub>		5	V
				2			
		R <sub>L</sub> = 54 Ω		1.5	2.3		
V <sub>OD3</sub>	Differential output voltage	V <sub>test</sub> = -7 V to 12 V,	See Figure 6-2	1.5		5	V
Δ V <sub>OD</sub>	Change in magnitude of differential output voltage	R <sub>L</sub> = 54 Ω or 100 Ω,	See Figure 6-1			±0.2	V
V <sub>OCC</sub>	Common mode output voltage	R <sub>L</sub> = 54 Ω or 100 Ω,	See Figure 6-1			3	V
						-1	
Δ V <sub>OCC</sub>	Change in magnitude of common-mode output voltage <sup>(2)</sup>	R <sub>L</sub> = 54 Ω or 100 Ω,	See Figure 6-1			±0.2	V
I <sub>OZ</sub>	High-impedance-state output current	V <sub>O</sub> = -7 V to 12 V <sup>(3)</sup>				±100	μA
I <sub>IH</sub>	High-level input current	V <sub>IH</sub> = 2.4 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	V <sub>O</sub> = -7 V				-250	mA
		V <sub>O</sub> = V <sub>CC</sub>				250	
		V <sub>O</sub> = 12 V				250	
		V <sub>O</sub> = 0 V				-150	
I <sub>CC</sub>	Supply current (total package)	No load	Outputs enabled		21	30	mA
			Outputs disabled		14	21	

(1) All typical values are at V<sub>CC</sub> = 5 V and TA = 25°C.

(2) Δ|V<sub>OD</sub>| and Δ|V<sub>OCC</sub>| are the changes in magnitude of V<sub>OD</sub> and V<sub>OCC</sub>, 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

## 5.5 Switching Characteristics: Driver

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 <sub>dD</sub>	Differential output delay time, tdDH or tdDL	R <sub>L</sub> = 54 Ω,	C <sub>L</sub> = 50 pF,	9	13	20	ns
t <sub>sk(p)</sub>	Pulse skew ( tdDH - tdDL )	R <sub>L</sub> = 54 Ω,	C <sub>L</sub> = 50 pF,		1	8	ns
t <sub>t</sub>	Differential output transition time	R <sub>L</sub> = 54 Ω,	C <sub>L</sub> = 50 pF,	3	10	16	ns
t <sub>PZH</sub>	Output enable time to high level	R <sub>L</sub> = 110 Ω,	See Figure 6-4		36	53	ns
t <sub>PZL</sub>	Output enable time to low level	R <sub>L</sub> = 110 Ω,	See Figure 6-5		39	56	ns
t <sub>PHZ</sub>	Output disable time from high level	R <sub>L</sub> = 110 Ω,	See Figure 6-4		20	31	ns
t <sub>PLZ</sub>	Output disable time from low level	R <sub>L</sub> = 110 Ω,	See Figure 6-5		9	20	ns

(1) All typical values are at V<sub>CC</sub> = 5 V and TA = 25°C.

## 5.6 Electrical Characteristics: Receiver

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 <a href="#">Figure 6-6</a>	2.7			V	
$V_{OL}$	Low-level output voltage	$V_{ID} = 200\text{ mV}$ ,	$I_{OL} = 8\text{ mA}$ , See <a href="#">Figure 6-6</a>			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  $T_A = 25^\circ\text{C}$ .

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

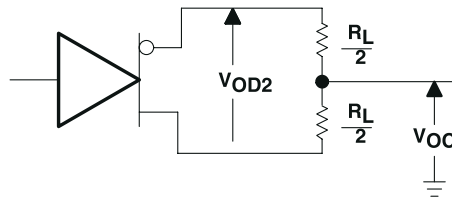
## 5.7 Switching Characteristics: Receiver

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

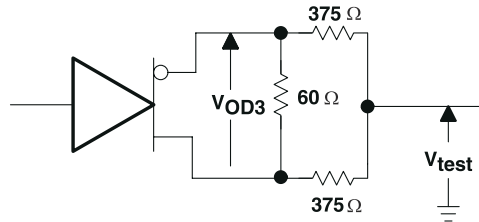
PARAMETER		TEST CONDITIONS		MIN	TYP <sup>(1)</sup>	MAX	UNIT
$t_{PHL}$	Differential output delay time, $td_{DH}$ or $td_{DL}$	$V_{ID} = -1.5\text{ V to } 1.5\text{ V}$		10	16	25	ns
$t_{PLH}$	Propagation delay time, low- to high-level output	$V_{ID} = -1.5\text{ V to } 1.5\text{ V}$		10	16	25	ns
$t_{sk(p)}$	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  $T_A = 25^\circ\text{C}$ .

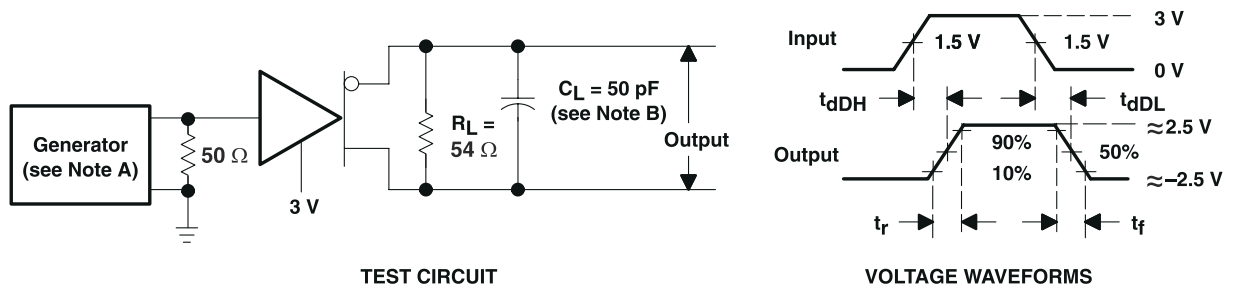
### Parameter Measurement Information



**Figure 6-1. Driver Test Circuit,  $V_{OD}$  and  $V_{OC}$**

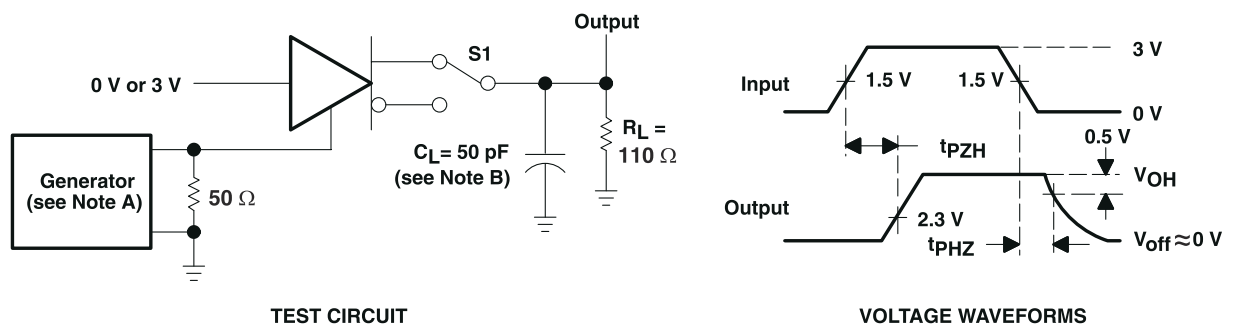


**Figure 6-2. Driver Circuit,  $V_{OD3}$**



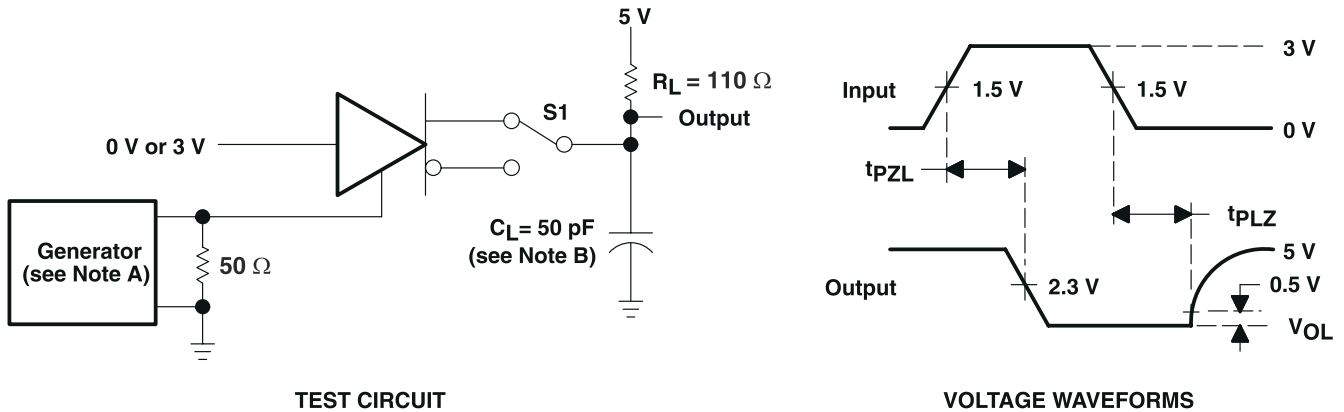
- A. The input pulse is supplied by a generator having the following characteristics: PRR  $\leq$  1 MHz, 50% duty cycle,  $t_r \leq$  6 ns,  $t_f \leq$  6 ns,  $Z_O = 50 \Omega$
- B.  $C_L$  includes probe and jig capacitance.

**Figure 6-3. 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 6-4. Driver Enable and Disable 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.

Figure 6-5. Driver Enable and Disable Times

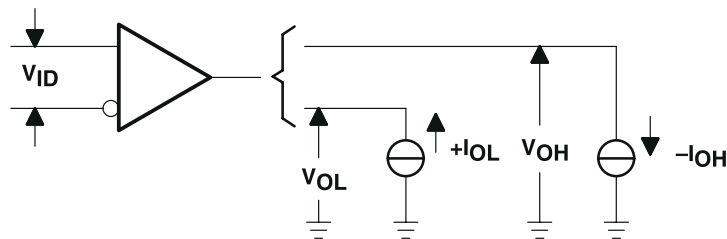
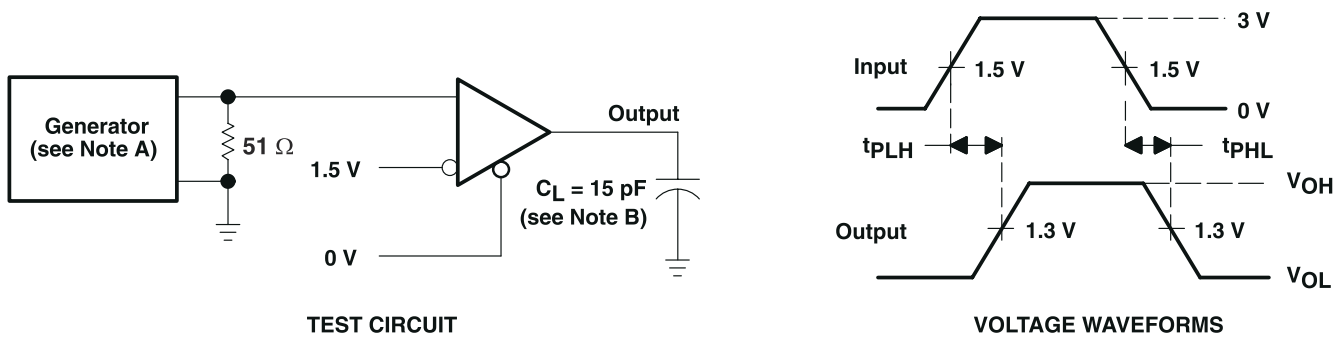


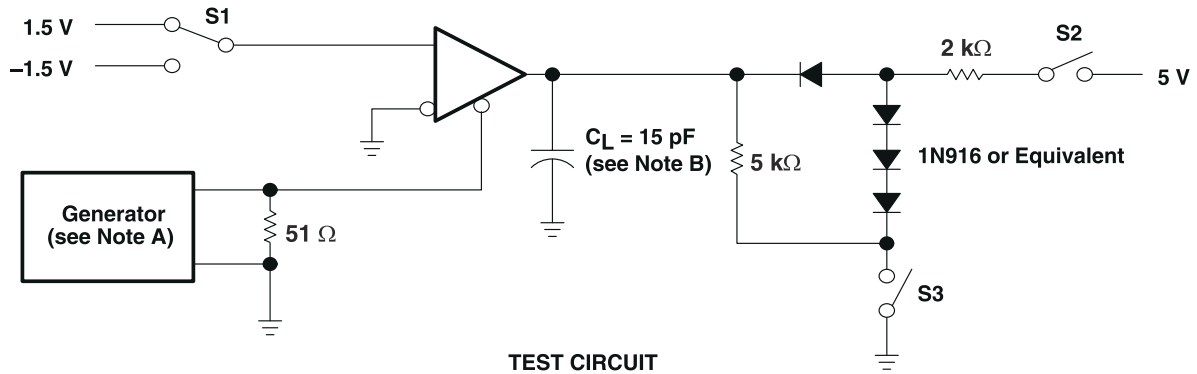
Figure 6-6. Receiver,  $V_{OH}$  and  $V_{OL}$



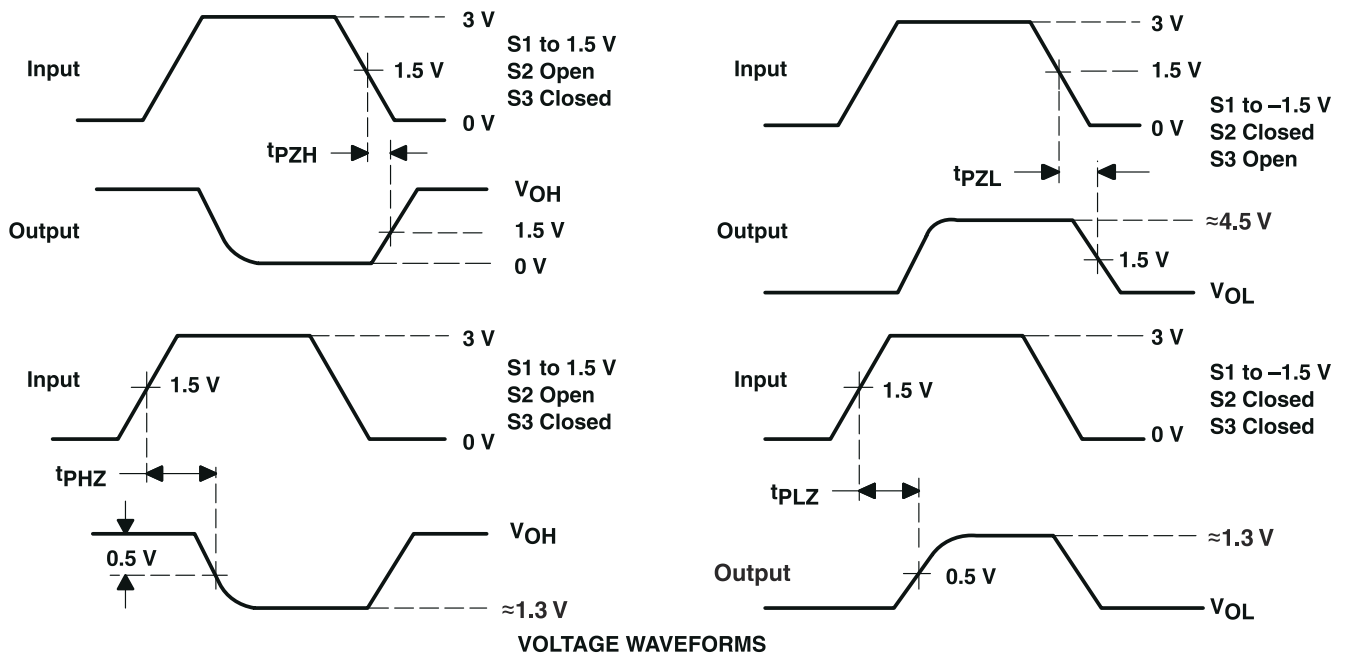
- A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 1 MHz, 50% duty cycle,  $t_r \leq 6$  ns,  $t_f \leq 6$  ns,  $Z_O = 50 \Omega$
- B.  $C_L$  includes probe and jig capacitance.

Figure 6-7. Receiver Propagation-Delay Times





TEST CIRCUIT



VOLTAGE WAVEFORMS

- 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,  $Z_0 =$  50  $\Omega$
- B.  $C_L$  includes probe and jig capacitance.

Figure 6-8. Receiver Output Enable and Disable Times

## 6 Detailed Description

### 6.1 Device Functional Modes

#### 6.1.1 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 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)

#### 6.1.2 Schematics

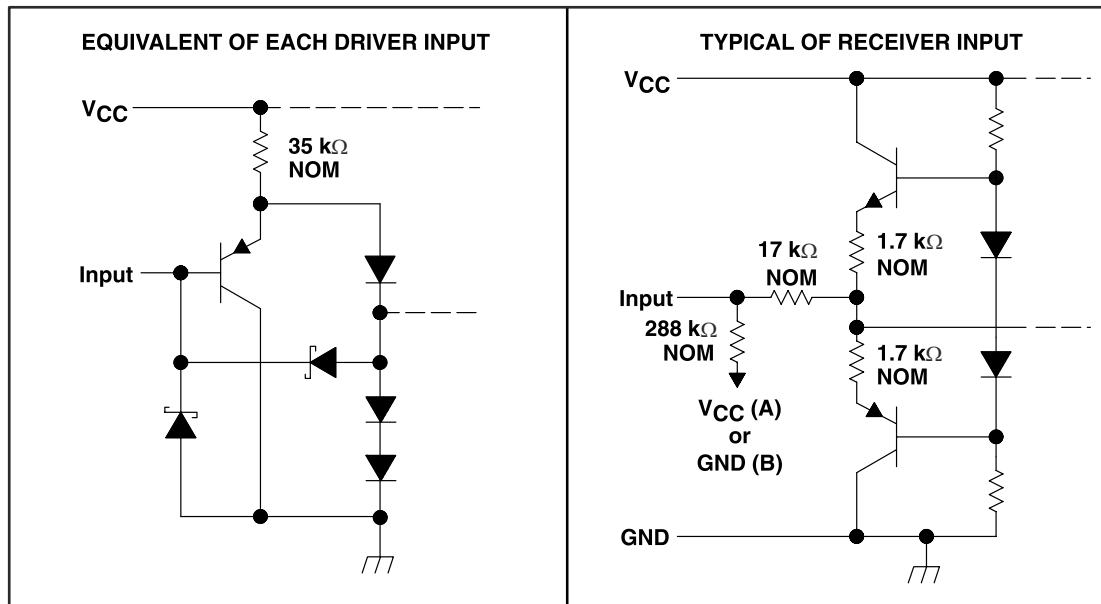
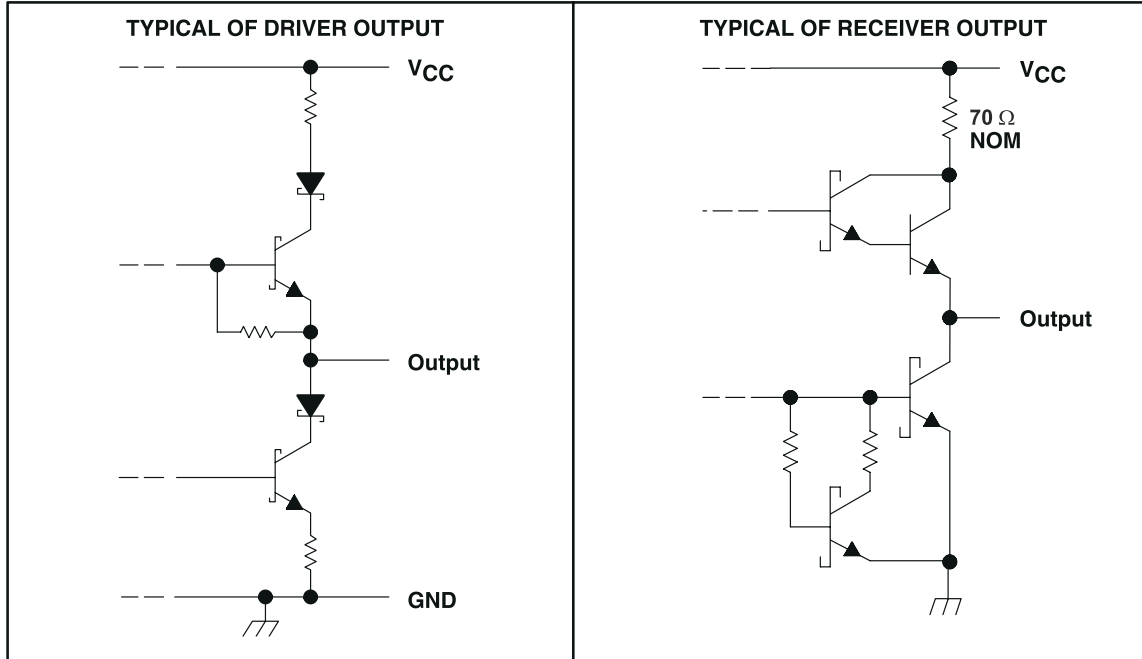


Figure 6-1. SCHEMATICS OF INPUTS



**Figure 6-2. SCHEMATICS OF OUTPUTS**

## 7 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.

### 7.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](http://ti.com). Click on *Subscribe to updates* 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.

### 7.2 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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### 7.3 Trademarks

TI E2E™ is a trademark of Texas Instruments.

All trademarks are the property of their respective owners.

### 7.4 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.

### 7.5 Glossary

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

**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
SN75ALS181N	LIFEBUY	PDIP	N	14	25	RoHS & Green	NIPDAU	N / A for Pkg Type	0 to 70	SN75ALS181N	
SN75ALS181NSR	ACTIVE	SO	NS	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	75ALS181	Samples
SN75ALS181NSRG4	ACTIVE	SO	NS	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	75ALS181	Samples

(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) **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.

**Important Information and Disclaimer:**The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**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
SN75ALS181NSR	SO	NS	14	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN75ALS181NSR	SO	NS	14	2000	367.0	367.0	38.0



**TUBE**



\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
SN75ALS181N	N	PDIP	14	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.

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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