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...±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

2 Description

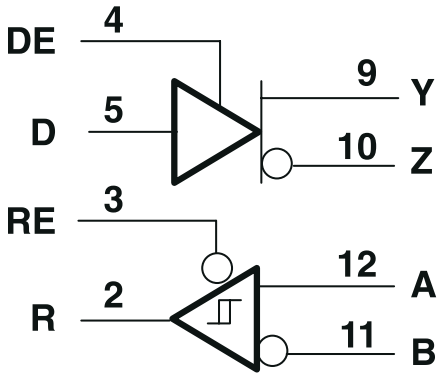
The SN75ALS181 is a differential driver and receiver pair designed for bidirectional data communication on multipoint bus transmission lines. The design provides for balanced transmission lines and meets TIA/EIA-422-B and TIA/EIA-485-A, and CCITT recommendations V.10, V.11, X.26, and X.27.

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(1)	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)

Table of Contents

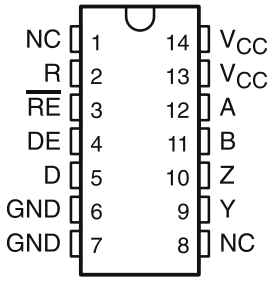
3 Revision History

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

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

Changes from Revision C (May 2010) to Revision D (August 2013)	Page
• 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_{CC}	13, 14	Power	5 V Supply

5 Specifications

5.1 Absolute Maximum Ratings

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

			MIN	MAX	UNIT
V_{CC}	Supply voltage range(2)			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(3)		–14	14	V
	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, 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(1)		N (PDIP)	NS (SO)	UNIT
		14-Pins	14-Pins	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	54.2	88.6	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	41.6	49.12	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	34.0	14.17	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	21.1	48.6	°C/W
$R_{\theta JC(bot)}$	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.

5.3 Recommended Operating Conditions

			MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage		4.75	5	5.25	V
V_{OC}	Common-mode output voltage(1)	Driver	–7		12	V
V_{IC}	Common-mode input voltage(1)	Receiver	–12		12	V
V_{IH}	High-level input voltage	D, DE, and $\overline{RE}$	2			V
V_{IL}	Low-level input voltage	D, DE, and $\overline{RE}$			0.8	V
V_{ID}	Differential input voltage				±12	V
I_{OH}	High-level output current	Driver			–60	mA
		Receiver			–400	µA
I_{OL}	Low-level output current	Driver			60	mA
		Receiver			8	
T_A	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(1)	MAX	UNIT
V_{IK}	Input clamp voltage	I_I = –18 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 V , R_L = 100 Ω	See Figure 6-1	1/2 V_{OD1}			V
				2			
		R_L = 54 Ω		1.5	2.3	5	
$\|V_{OD3}\|$	Differential output voltage	V_{test} = –7 V to 12 V,	See Figure 6-2	1.5		5	V
$\Delta\|V_{OD}\|$	Change in magnitude of differential output voltage	R_L = 54 Ω or 100 Ω,	See Figure 6-1			±0.2	V
V_{OC}	Common mode output voltage	R_L = 54 Ω or 100 Ω,	See Figure 6-1			3	V
						–1	
$\Delta\|V_{OC}\|$	Change in magnitude of common-mode output voltage(2)	R_L = 54 Ω or 100 Ω,	See Figure 6-1			±0.2	V
I_{OZ}	High-impedance-state output current	V_O = –7 V to 12 V(3)				±100	µA
I_{IH}	High-level input current	V_{IH} = 2.4 V				20	µA
I_{IL}	Low-level input current	V_{IL} = 0.4 V				–100	µA
I_{OS}	Short circuit output current	V_O = –7 V				–250	mA
		V_O = V_{CC}				250	
		V_O = 12 V				250	
		V_O = 0 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 V and TA = 25°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

5.5 Switching Characteristics: Driver

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

PARAMETER		TEST CONDITIONS			MIN	TYP(1)	MAX	UNIT
t_{dD}	Differential output delay time, tdDH or tdDL	R_L = 54 Ω ,	C_L = 50 pF,	See Figure 6-3	9	13	20	ns
$t_{sk(p)}$	Pulse skew (|tdDH – tdDL|)	R_L = 54 Ω ,	C_L = 50 pF,	See Figure 6-3		1	8	ns
t_t	Differential output transition time	R_L = 54 Ω ,	C_L = 50 pF,	See Figure 6-3	3	10	16	ns
t_{PZH}	Output enable time to high level	R_L = 110 Ω ,	See Figure 6-4			36	53	ns
t_{PZL}	Output enable time to low level	R_L = 110 Ω ,	See Figure 6-5			39	56	ns
t_{PHZ}	Output disable time from high level	R_L = 110 Ω ,	See Figure 6-4			20	31	ns
t_{PLZ}	Output disable time from low level	R_L = 110 Ω ,	See Figure 6-5			9	20	ns

(1) All typical values are at V_{CC} = 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(1)	MAX	UNIT
V_{T+}	Positive-going threshold voltage, differential input	V_O = 2.7 V,	I_O = –0.4 mA				0.2	V
$V_{T–}$	Negative-going threshold voltage, differential input	V_O = 0.5 V,	I_O = 8 mA		–0.2			V
V_{hys}	Input hysteresis (V_{T+} – $V_{T–}$)					60		mV
V_{IK}	Input clamp voltage, $\overline{RE}$	I_I = –18 mA					–1.5	V
V_{OH}	High-level output voltage	V_{ID} = 200 mV,	I_{OH} = –400 µA,	See Figure 6-6	2.7			V
V_{OL}	Low-level output voltage	V_{ID} = 200 mV,	I_{OL} = 8 mA,	See Figure 6-6			0.45	V
I_{OZ}	High-impedance-state output current	V_O = 0.4 V to 2.4 V					±20	µA
I_I	Line input current	Other input at 0 V(2),	V_I = 12 V				1	mA
			V_I = –7 V				–0.8	
I_{IH}	High-level input current, $\overline{RE}$	V_{IH} = 2.7 V					20	µA
I_{IL}	Low-level input current, $\overline{RE}$	V_{IL} = –7 V					–100	µA
R_I	Input resistance				12			kΩ
I_{OS}	Short circuit output current	V_{ID} = 200 mV,	V_O = 0 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 V and TA = 25°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(1)	MAX	UNIT
t_{PHL}	Differential output delay time, tdDH or tdDL	V_{ID} = –1.5 V to 1.5 V	10	16	25	ns
t_{PLH}	Propagation delay time, low- to high-level output	V_{ID} = –1.5 V to 1.5 V	10	16	25	ns
$t_{sk(p)}$	Pulse skew (|tdDH – tdDL|)	V_{ID} = –1.5 V to 1.5 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 V and TA = 25°C.

Parameter Measurement Information

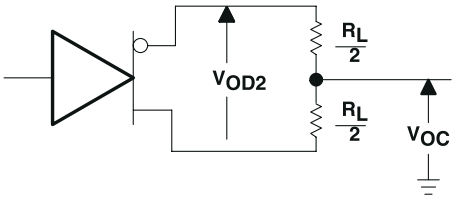


Figure 6-1. Driver Test Circuit, V_{OD} and V_{OC}

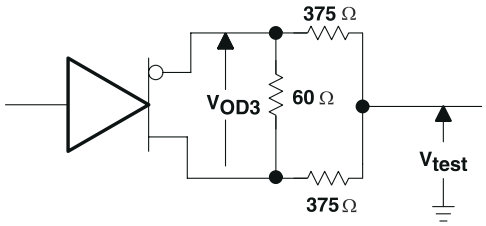
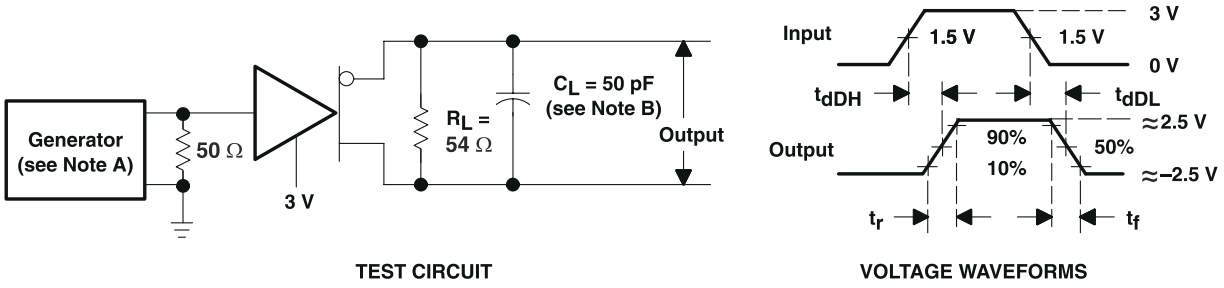


Figure 6-2. Driver Circuit, V_{OD3}

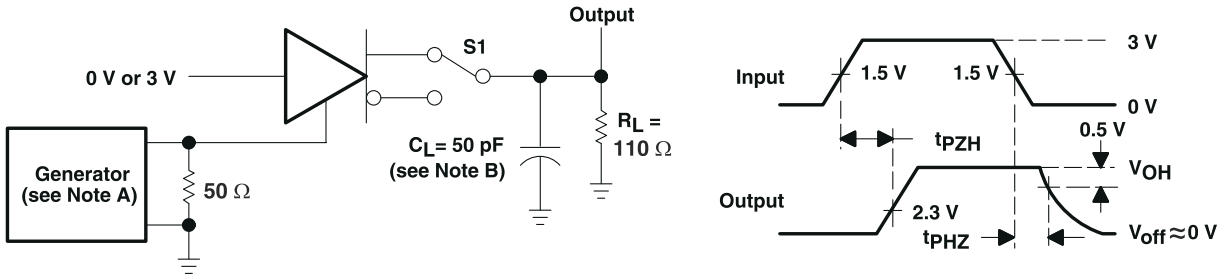


TEST CIRCUIT VOLTAGE WAVEFORMS

A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 1 MHz, 50% duty cycle, t_r ≤ 6 ns, t_f ≤ 6 ns, Z_O = 50 Ω

B. C_L includes probe and jig capacitance.

Figure 6-3. Driver Differential-Output Delay and Transition Times

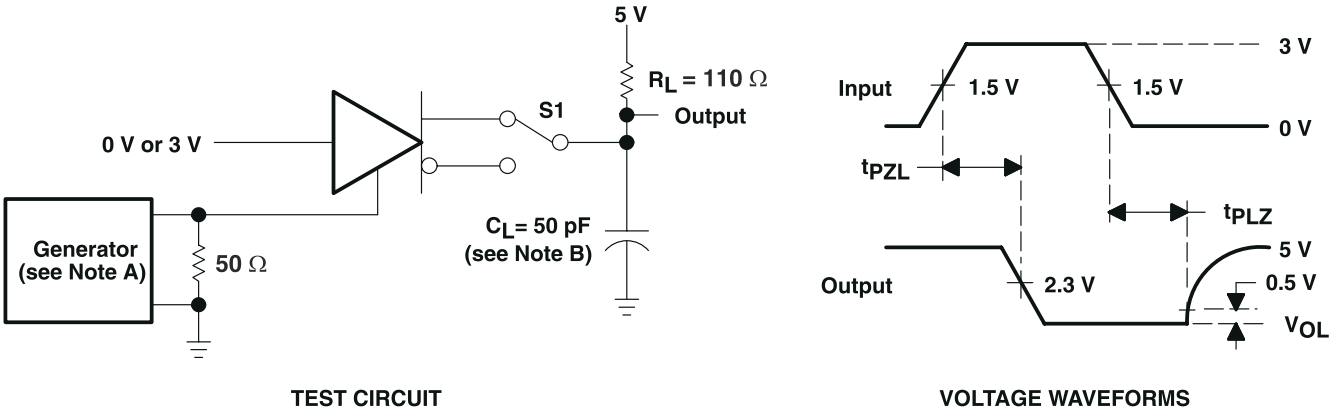


TEST CIRCUIT VOLTAGE WAVEFORMS

A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 1 MHz, 50% duty cycle, t_r ≤ 6 ns, t_f ≤ 6 ns, Z_O = 50 Ω

B. C_L includes probe and jig capacitance.

Figure 6-4. Driver Enable and Disable Times



TEST CIRCUIT VOLTAGE WAVEFORMS

A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 1 MHz, 50% duty cycle, t_r ≤ 6 ns, t_f ≤ 6 ns, Z_O = 50 Ω

B. C_L includes probe and jig capacitance.

Figure 6-5. Driver Enable and Disable Times

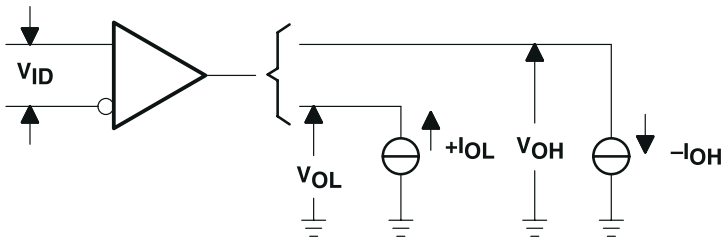
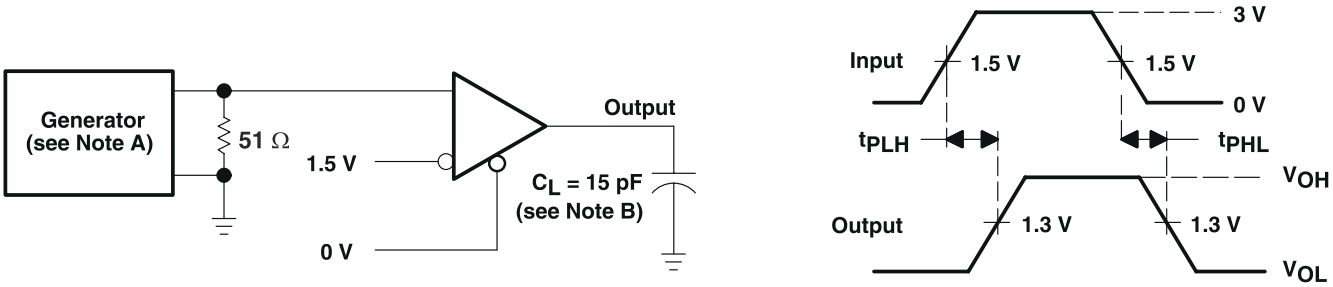


Figure 6-6. Receiver, V_{OH} and V_{OL}

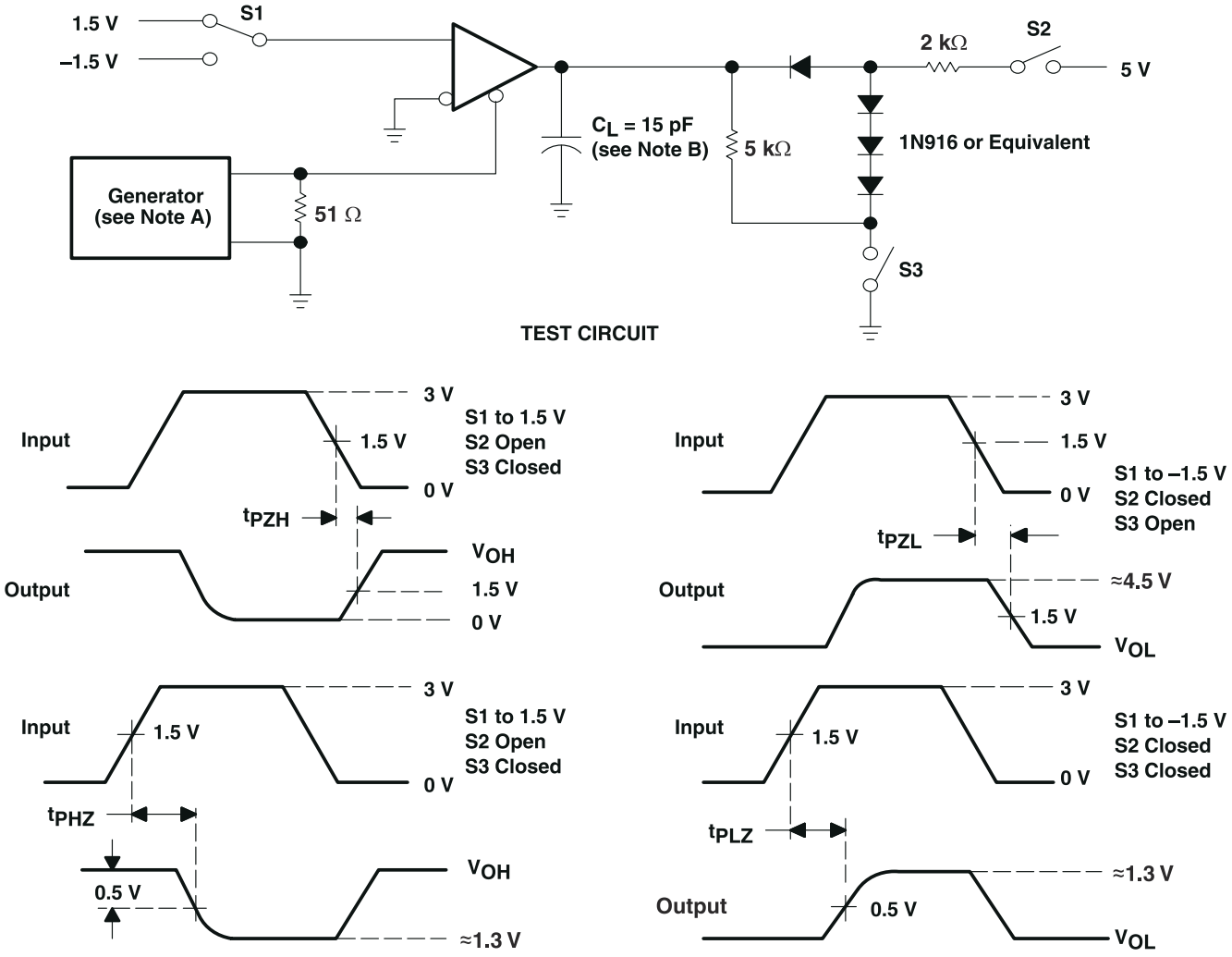


TEST CIRCUIT VOLTAGE WAVEFORMS

A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 1 MHz, 50% duty cycle, t_r ≤ 6 ns, t_f ≤ 6 ns, Z_O = 50 Ω

B. C_L includes probe and jig capacitance.

Figure 6-7. 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 ≤ 6 ns, t_f ≤ 6 ns, Z_O = 50 Ω

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	OUTPUTS Z
H	H	H	L
L	H	L	H
X	L	Z	Z

Each Receiver(1)

DIFFERENTIAL A–B	ENABLE $\overline{RE}$	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

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

6.1.2 Schematics

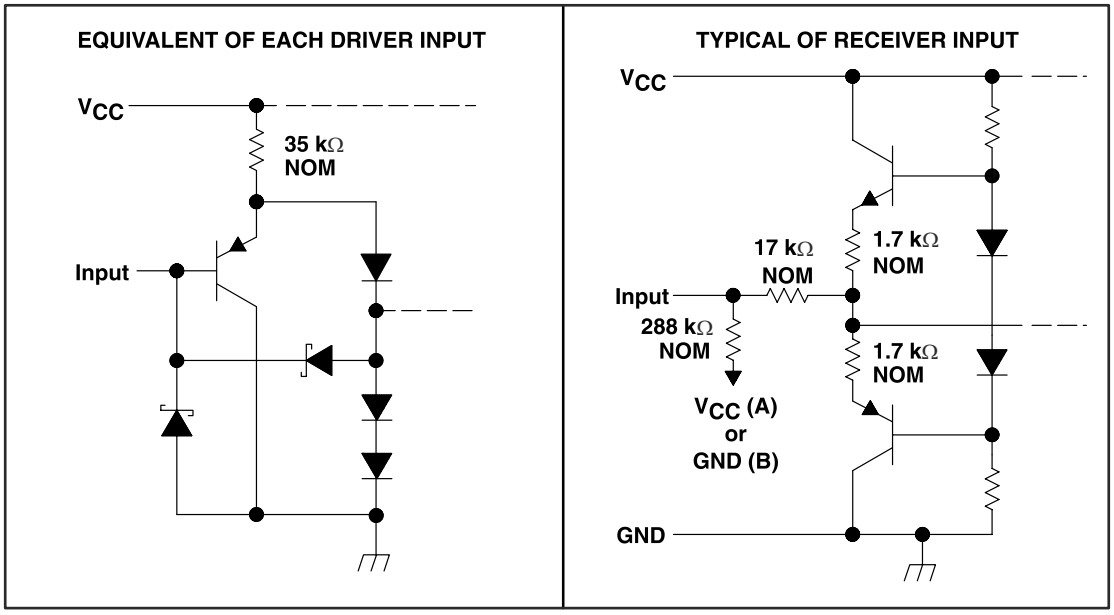


Figure 6-1. SCHEMATICS OF INPUTS

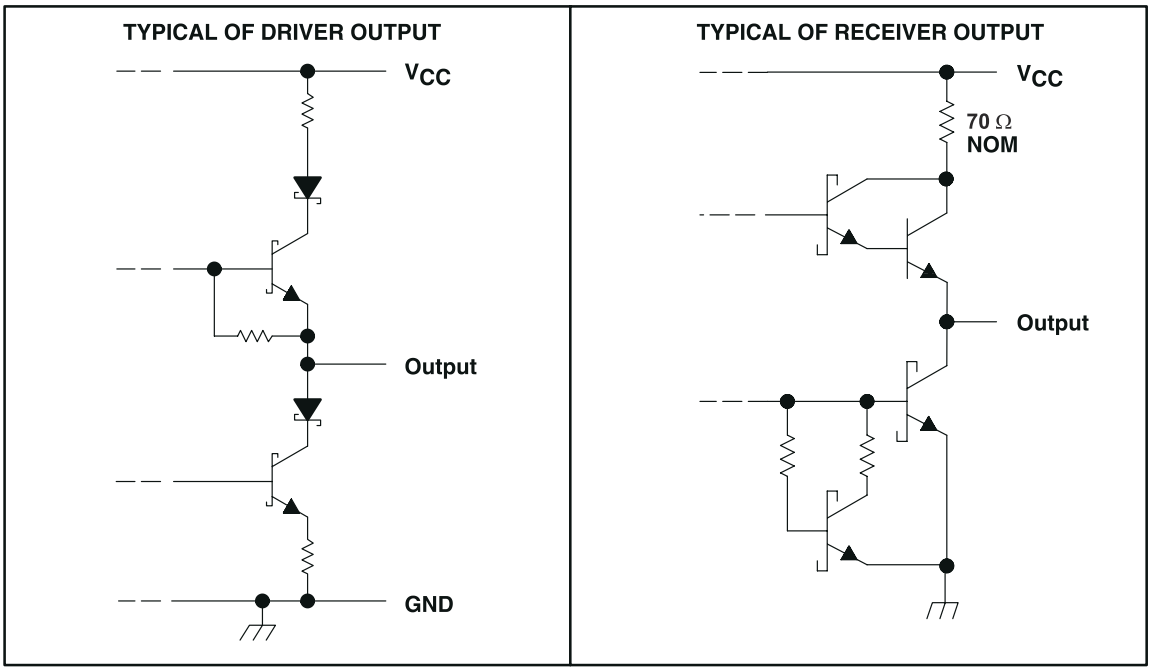


Figure 6-2. SCHEMATICS OF OUTPUTS

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. 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.

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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.

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