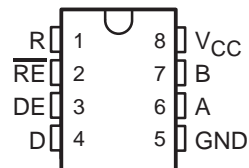


- **Meets or Exceeds the Requirements of TIA/EIA-422-B, TIA/EIA-485-A, and ITU Recommendations V.11 and X.27**
- **Recommended for PROFIBUS Applications**
- **Operates at Data Rates up to 35 MBaud**
- **Operating Temperature Range . . . -25°C to 85°C**
- **Designed for Multipoint Transmission on Long Bus Lines in Noisy Environments**
- **Low Supply-Current Requirement . . . 30 mA Max**
- **Wide Positive and Negative Input/Output Bus-Voltage Ranges**
- **Thermal-Shutdown Protection**
- **Driver Positive- and Negative-Current Limiting**
- **Receiver Input Hysteresis**
- **Glitch-Free Power-Up and Power-Down Protection**
- **Receiver Open-Circuit Fail-Safe Design**
- **Package Options Include Plastic Small-Outline (D) Package and (P) DIPs**

**D† OR P PACKAGE
(TOP VIEW)**



† The D package is available taped and reeled. Add the suffix R to the device type (e.g., SN65ALS1176DR).

description

The SN65ALS1176 differential bus transceiver is designed for bidirectional data communication on multipoint bus transmission lines. It is designed for balanced transmission lines and meets TIA/EIA-422-B, TIA/EIA-485-A, and ITU Recommendations V.11 and X.27.

The SN65ALS1176 combines a 3-state differential line driver and a differential input line receiver, both of which 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 internally to form a differential input/output (I/O) bus port that is designed to offer minimum loading to the bus when the driver is disabled or $V_{CC} = 0$. This port features wide positive and negative common-mode voltage ranges, making the device suitable for party-line applications.

The SN65ALS1176 is characterized for operation from -25°C to 85°C .



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.

SN65ALS1176 DIFFERENTIAL BUS TRANSCEIVER

SLLS295A – APRIL 1998 – REVISED DECEMBER 1999

Function Tables

DRIVERS

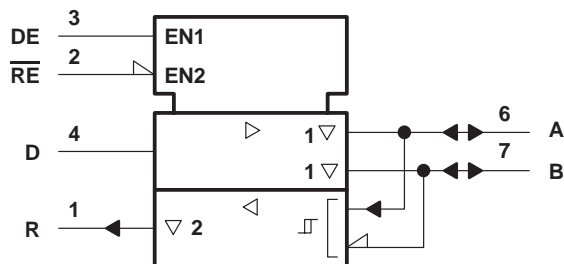
INPUT D	ENABLE DE	OUTPUTS	
		A	B
H	H	H	L
L	H	L	H
X	L	Z	Z

RECEIVER

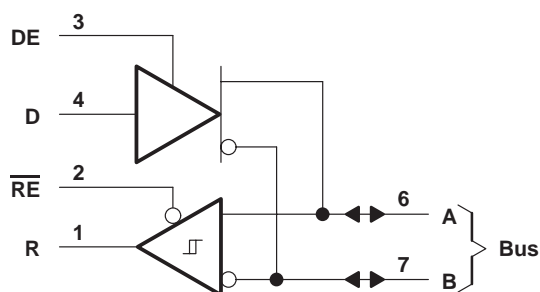
DIFFERENTIAL INPUTS A-B	ENABLE \overline{RE}	OUTPUT R
$V_{ID} \geq 0.2 V$	L	H
$-0.2 V < V_{ID} < 0.2 V$	L	?
$V_{ID} \leq -0.2 V$	L	L
X	H	Z
Inputs open	L	H

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

logic symbol†

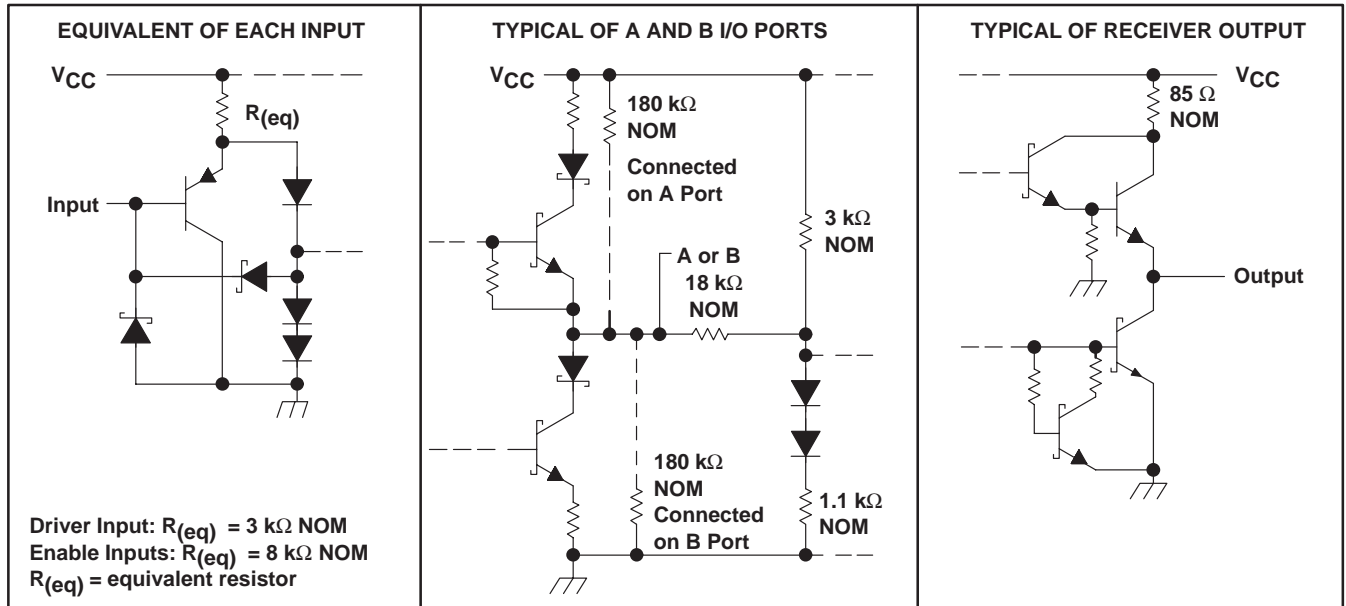


logic diagram (positive logic)



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

schematics of inputs and outputs



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage, V_{CC} (see Note 1)	7 V
Voltage range at any bus terminal	-7 V to 12 V
Enable input voltage, V_I	5.5 V
Package thermal impedance, θ_{JA} (see Note 2): D package	97°C/W
P package	85°C/W
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C
Storage temperature range, T_{stg}	-65°C to 150°C

† 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 I/O bus voltage, are with respect to network ground terminal.
 2. The package thermal impedance is calculated in accordance with JESD 51.

recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}		4.75	5	5.25	V
Input voltage at any bus terminal (separately or common mode), V_I or V_{IC}				12	V
				-7	
High-level input voltage, V_{IH}	D, DE, and \overline{RE}	2			V
Low-level input voltage, V_{IL}	D, DE, and \overline{RE}			0.8	V
Differential input voltage, V_{ID} (see Note 3)				±12	V
High-level output current, I_{OH}	Driver			-60	mA
	Receiver			-400	μA
Low-level output current, I_{OL}	Driver			60	mA
	Receiver			8	
Operating free-air temperature, T_A		-25		85	°C

NOTE 3: Differential input/output bus voltage is measured at the noninverting terminal A with respect to the inverting terminal B.

SN65ALS1176 DIFFERENTIAL BUS TRANSCEIVER

SLLS295A – APRIL 1998 – REVISED DECEMBER 1999

DRIVER SECTION

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

PARAMETER	TEST CONDITION†	MIN	TYP‡	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	R _L = 100 Ω, See Figure 1	1/2 V _{OD1} or 2§			V
	R _L = 54 Ω, See Figure 1	2.1	2.5	5	V
V _{OD3} Differential output voltage	V _{test} = -7 V to 12 V, See Figure 2	1.5		5	V
Δ V _{OD} Change in magnitude of differential output voltage¶				±0.2	V
V _{OC} Common-mode output voltage	R _L = 54 Ω or 100 Ω, See Figure 1			3 -1	V
Δ V _{OC} Change in magnitude of common-mode output voltage¶				±0.2	V
I _O Output current	Outputs disabled, See Note 4	V _O = 12 V		1	mA
		V _O = -7 V		-0.8	
I _{IH} High-level input current	V _I = 2.4 V			20	μA
I _{IL} Low-level input current	V _I = 0.4 V			-400	μA
I _{OS} Short-circuit output current#	V _O = -4 V			-250	mA
	V _O = 0			-150	
	V _O = V _{CC}			250	
	V _O = 8 V			250	
I _{CC} Supply current	No load	Outputs enabled	23	30	mA
		Outputs disabled	19	26	

† The power-off measurement in TIA/EIA-422-B applies to disabled outputs only and is not applied to combined inputs and outputs.

‡ All typical values are at V_{CC} = 5 V and T_A = 25°C.

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

¶ Δ|V_{OD}| and Δ|V_{OC}| are the changes in magnitude of V_{OD} and V_{OC}, respectively, that occur when the input is changed from one logic state to the other.

Duration of the short circuit should not exceed one second for this test.

NOTE 4: This applies for both power on and power off; refer to TIA/EIA-485-A for exact conditions. The TIA/EIA-422-B limit does not apply for a combined driver and receiver terminal.



switching characteristics over recommended ranges of supply voltage and operating free-air temperature range

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
t _d (OD)	Differential output delay time	R _L = 54 Ω, See Figure 3	C _L = 50 pF,			15	ns
t _{sk} (p)	Pulse skew‡			0	2	ns	
t _t (OD)	Differential output transition time			8	ns		
t _{PZH}	Output enable time to high level	R _L = 110 Ω, See Figure 4	C _L = 50 pF,			80	ns
t _{PZL}	Output enable time to low level	R _L = 110 Ω, See Figure 5	C _L = 50 pF,			30	ns
t _{PHZ}	Output disable time from high level	R _L = 110 Ω, See Figure 4	C _L = 50 pF,			50	ns
t _{PLZ}	Output disable time from low level	R _L = 110 Ω, See Figure 5	C _L = 50 pF,			30	ns

† All typical values are at V_{CC} = 5 V, T_A = 25°C.

‡ Pulse skew is defined as the |t_{PLH} – t_{PHL}| of each channel of the same device.

SYMBOL EQUIVALENTS

DATA-SHEET PARAMETER	TIA/EIA-422-B	TIA/EIA-485-A
V _O	V _{Oa} , V _{Ob}	V _{Oa} , V _{Ob}
V _{OD1}	V _O	V _O
V _{OD2}	V _t (R _L = 100 Ω)	V _t (R _L = 54 Ω)
V _{OD3}	None	V _t (test termination measurement 2)
Δ V _{OD}	V _t – V̄ _t	V _t – V̄ _t
V _{OC}	V _{os}	V _{os}
Δ V _{OC}	V _{os} – V̄ _{os}	V _{os} – V̄ _{os}
I _{OS}	I _{sa} , I _{sb}	None
I _O	I _{xa} , I _{xb}	I _{ia} , I _{ib}

SN65ALS1176

DIFFERENTIAL BUS TRANSCEIVER

SLLS295A – APRIL 1998 – REVISED DECEMBER 1999

RECEIVER SECTION

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

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V _{IT+}	Positive-going input threshold voltage	V _O = 2.7 V,	I _O = -0.4 mA			0.2	V
V _{IT-}	Negative-going input threshold voltage	V _O = 0.5 V,	I _O = 8 mA	-0.2‡			V
V _{hys}	Hysteresis voltage (V _{IT+} - V _{IT-})				60		mV
V _{IK}	Enable-input clamp voltage	I _I = -18 mA				-1.5	V
V _{OH}	High-level output voltage	V _{ID} = 200 mV, See Figure 6	I _{OH} = -400 μA,		2.7		V
V _{OL}	Low-level output voltage	V _{ID} = -200 mV, See Figure 6	I _{OL} = 8 mA,			0.45	V
I _{OZ}	High-impedance-state output current	V _O = 0.4 V to 2.4 V				±20	μA
V _I	Line input current	Other input = 0 V, See Note 5	V _I = 12 V			1	mA
			V _I = -7 V			-0.8	
I _{IH}	High-level-enable input current	V _{IH} = 2.7 V				20	μA
I _{IL}	Low-level-enable input current	V _{IL} = 0.4 V				-100	μA
r _I	Input resistance			12	20		kΩ
I _{OS}	Short-circuit output current	V _{ID} = 200 mV,	V _O = 0	-15		-85	mA
I _{CC}	Supply current	No load	Outputs enabled		23	30	mA
			Outputs disabled		19	26	

† All typical values are at V_{CC} = 5 V, T_A = 25°C.

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

NOTE 5: 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 range

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
t _{pd}	Propagation time	V _{ID} = -1.5 V to 1.5 V, See Figure 7	C _L = 15 pF,			25	ns
t _{sk(p)}	Pulse skew§					0	2
t _{pZH}	Output enable time to high level	C _L = 15 pF,	See Figure 8		11	18	ns
t _{pZL}	Output enable time to low level				11	18	ns
t _{PHZ}	Output disable time from high level					50	ns
t _{PLZ}	Output disable time from low level					30	ns

† All typical values are at V_{CC} = 5 V, T_A = 25°C.

§ Pulse skew is defined as the |t_{PLH} - t_{PHL}| of each channel of the same device.



PARAMETER MEASUREMENT INFORMATION

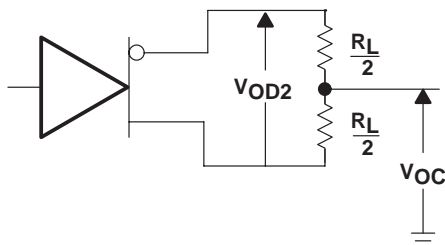


Figure 1. Driver V_{OD2} and V_{OC} Test Circuit

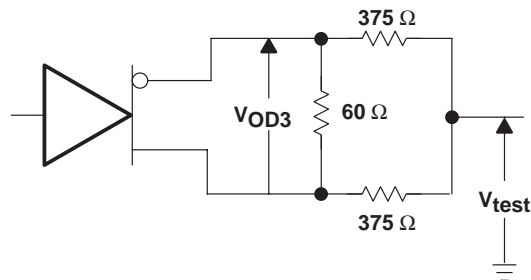
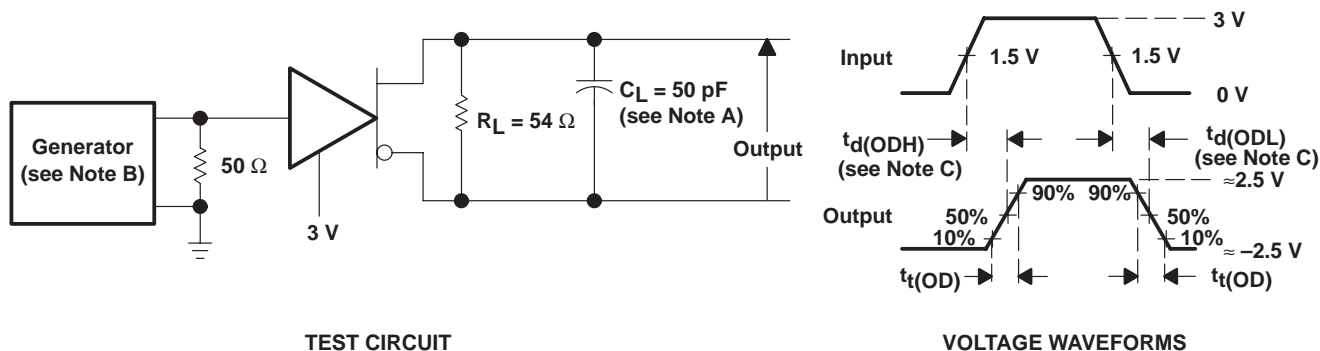


Figure 2. Driver V_{OD3} Test Circuit



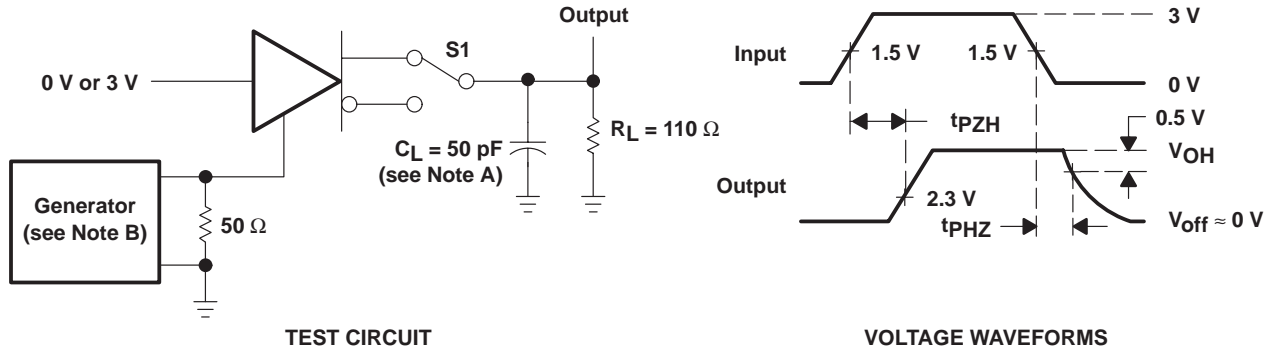
- NOTES: A. C_L includes probe and jig capacitance.
 B. The input pulse is supplied by a generator having the following characteristics: $PRR \leq 1$ MHz, 50% duty cycle, $t_r \leq 6$ ns, $t_f \leq 6$ ns, $Z_O = 50 \Omega$.
 C. $t_d(OD) = t_d(ODH)$ or $t_d(ODL)$

Figure 3. Driver Differential-Output Delay and Transition Times

SN65ALS1176 DIFFERENTIAL BUS TRANSCEIVER

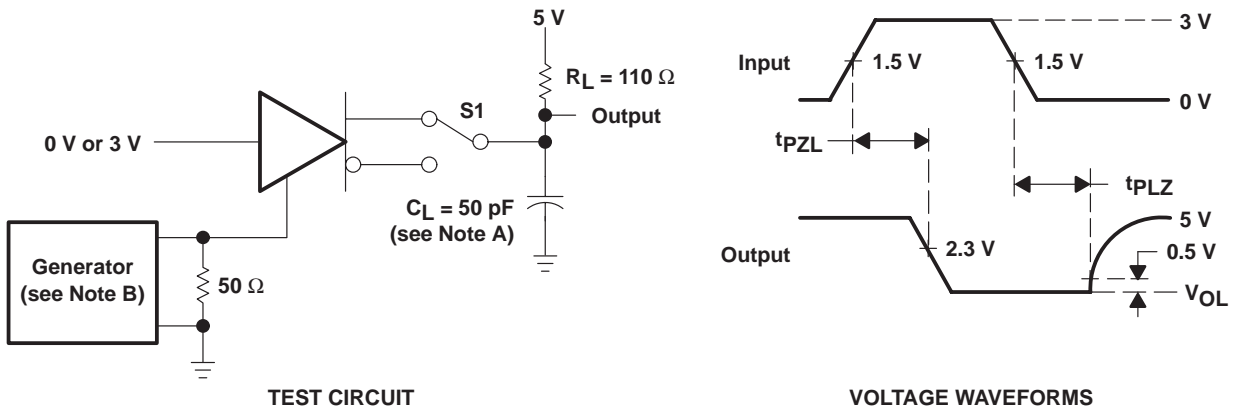
SLLS295A – APRIL 1998 – REVISED DECEMBER 1999

PARAMETER MEASUREMENT INFORMATION



- NOTES: A. C_L includes probe and jig capacitance.
 B. 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, $Z_O = 50 \Omega$.

Figure 4. Driver Enable and Disable Times



- NOTES: A. C_L includes probe and jig capacitance.
 B. 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, $Z_O = 50 \Omega$.

Figure 5. Driver Enable and Disable Times

PARAMETER MEASUREMENT INFORMATION

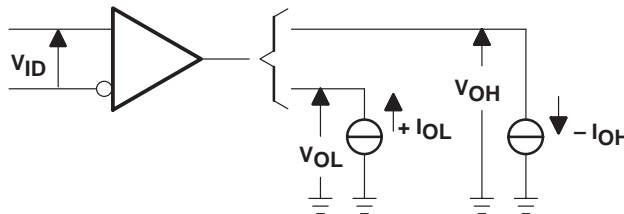
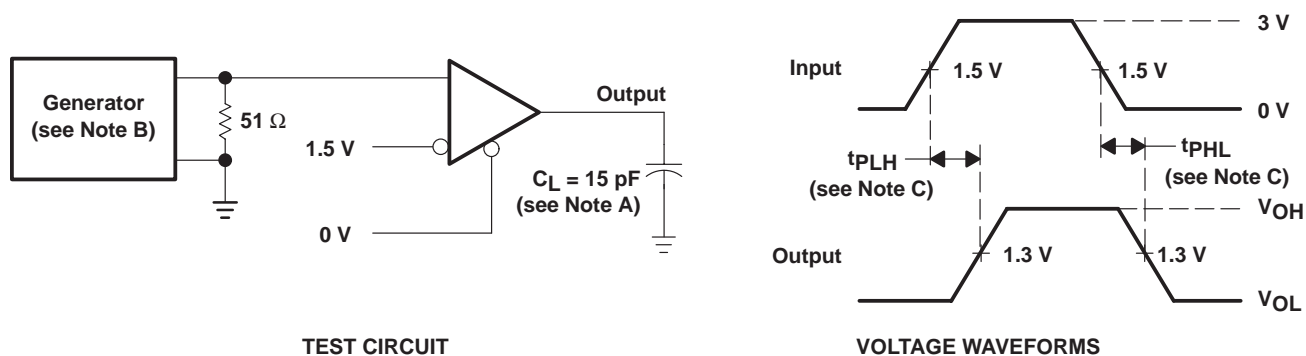


Figure 6. Receiver V_{OH} and V_{OL} Test Circuit



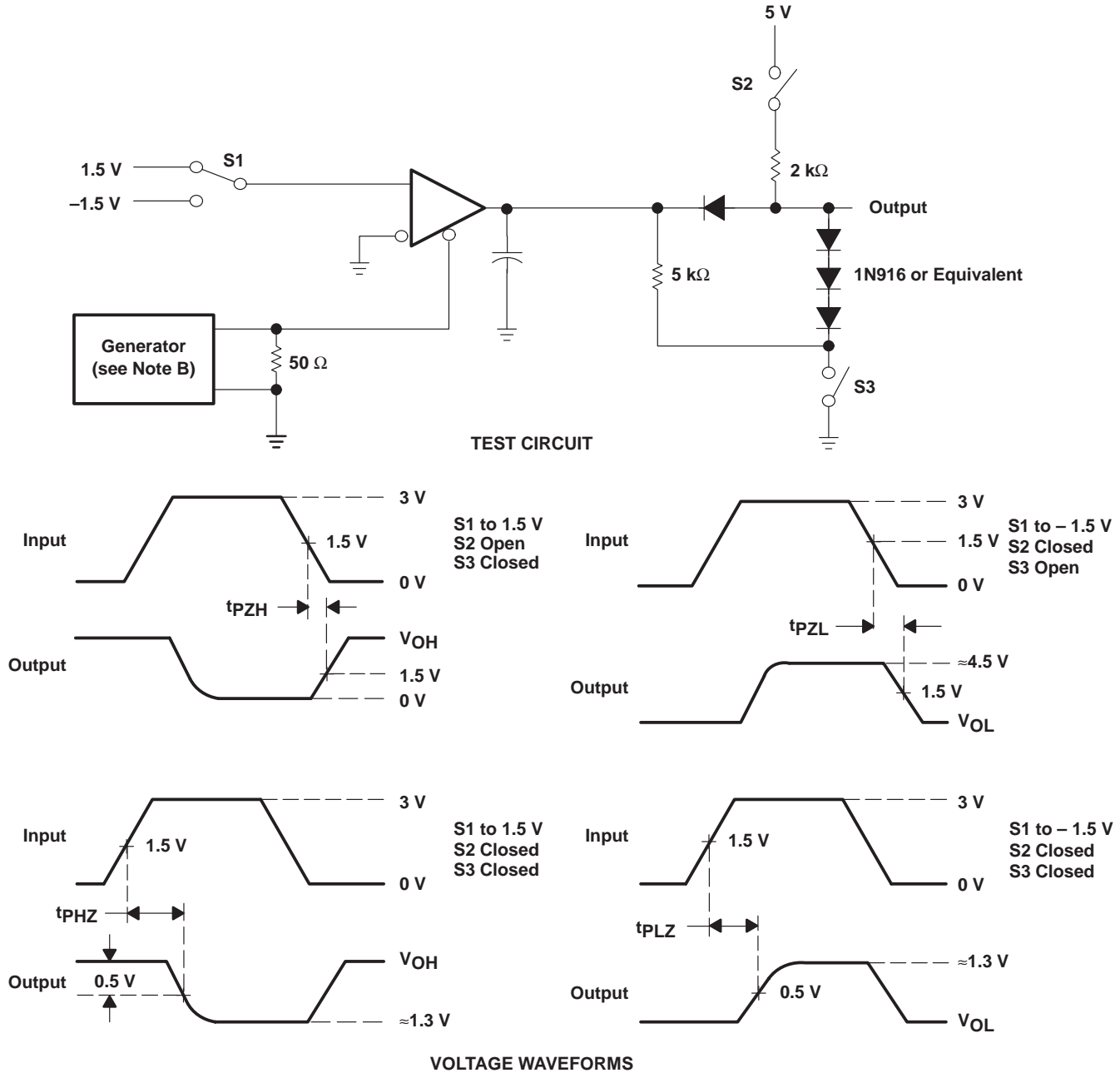
- NOTES: A. C_L includes probe and jig capacitance.
 B. The input pulse is supplied by a generator having the following characteristics: $PRR \leq 1$ MHz, 50% duty cycle, $t_r \leq 6$ ns, $t_f \leq 6$ ns, $Z_O = 50 \Omega$.
 C. $t_{pd} = t_{PLH}$ or t_{PHL}

Figure 7. Receiver Propagation-Delay Times

SN65ALS1176 DIFFERENTIAL BUS TRANSCEIVER

SLLS295A – APRIL 1998 – REVISED DECEMBER 1999

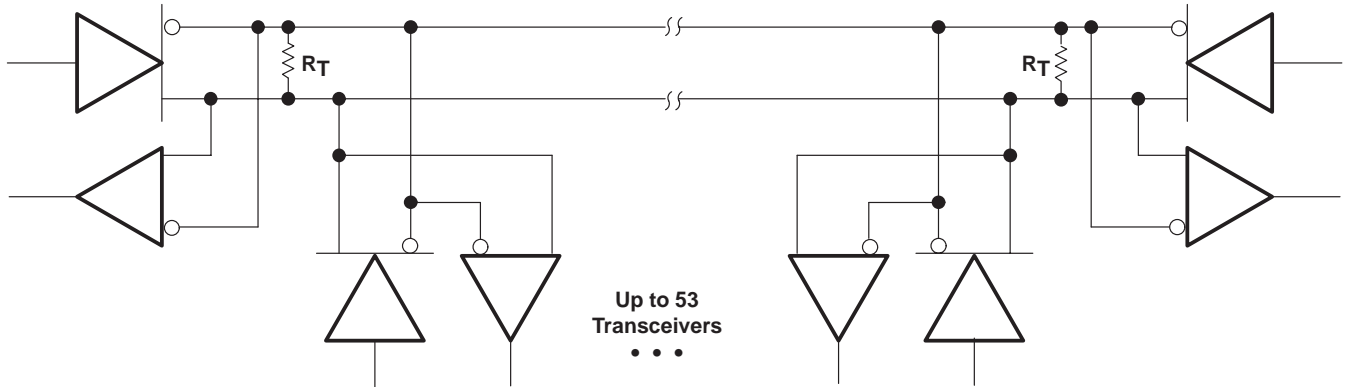
PARAMETER MEASUREMENT INFORMATION



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

Figure 8. Receiver Output Enable and Disable Times

APPLICATION INFORMATION



NOTE A: The line should terminate 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 9. Typical Application Circuit

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN65ALS1176D	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-25 to 85	6A1176	Samples
SN65ALS1176DR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-25 to 85	6A1176	Samples
SN65ALS1176DRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-25 to 85	6A1176	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) 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.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish 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
SN65ALS1176DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN65ALS1176DR	SOIC	D	8	2500	340.5	338.1	20.6

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AA.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com