- **Meets EIA Standards RS-422-A and RS-485 and CCITT Recommendations V.11 and X.27**
- **Designed for Multipoint Transmission on Long Bus Lines in Noisy Environments**
- **3-State Outputs**
- **Bus Voltage Range . . . – 7 V to 12 V**
- **Positive and Negative Current Limiting**
- **Driver Output Capability . . . 60 mA Max**
- **Driver Thermal Shutdown Protection**
- **Receiver Input Impedance . . . 12 kΩ Min**
- **Receiver Input Sensitivity . . . $\pm$200 mV**
- **Receiver Input Hysteresis . . . 50 mV Typ**
- **Operates From Single 5-V Supply**
- **Low Power Requirements**

SN75177B . . . D OR P PACKAGE
(TOP VIEW)

V_{CC}	1	8	A
T	2	7	B
EN	3	6	Z
GND	4	5	Y
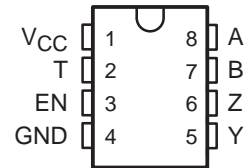
SN75178B . . . P PACKAGE
(TOP VIEW)

V_{CC}	1	8	A
T	2	7	B
$\overline{EN}$	3	6	Z
GND	4	5	Y
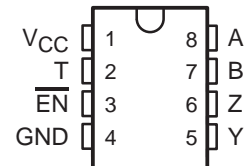
THE SN75177B IS NOT RECOMMENDED FOR NEW DESIGN

description

The SN75177B and SN75178B differential bus repeaters are monolithic integrated devices each designed for one-way data communication on multipoint bus transmission lines. These devices are designed for balanced transmission bus line applications and meet EIA Standard RS-422-A and RS-485 and CCITT Recommendations V.11 and X.27. Each device is designed to improve the performance of the data communication over long bus lines. The SN75177B and SN75178B are identical except for the complementary enable inputs, which allow the devices to be used in pairs for bidirectional communication.

The SN75177B and SN75178B feature positive- and negative-current limiting 3-state outputs for the receiver and driver. The receiver features high input impedance, input hysteresis for increased noise immunity, and input sensitivity of $\pm$200 mV over a common-mode input voltage range of – 7 V to 12 V. The driver features thermal shutdown for protection from line fault conditions. Thermal shutdown is designed to occur at a junction temperature of approximately 150°C. The driver is designed to drive current loads up to 60 mA maximum.

The SN75177B and SN75178B are designed for optimum performance when used on transmission buses employing the SN75172 and SN75174 differential line drivers, SN75173 and SN75175 differential line receivers, or SN75176B bus transceiver.

Function Tables

SN75177B

DIFFERENTIAL INPUTS	ENABLE	OUTPUTS		
A – B	EN	T	Y	Z
$V_{ID} \geq 0.2$ V	H	H	H	L
-0.2 V $< V_{ID} < 0.2$ V	H	?	?	?
$V_{ID} \leq 0.2$ V	H	L	L	H
X	L	Z	Z	Z

SN75178B

DIFFERENTIAL INPUTS	ENABLE	OUTPUTS		
A – B	$\overline{EN}$	T	Y	Z
$V_{ID} \geq 0.2$ V	L	H	H	L
-0.2 V $< V_{ID} < 0.2$ V	L	?	?	?
$V_{ID} \leq 0.2$ V	L	L	L	H
X	H	Z	Z	Z

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

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SN75177B, SN75178B
DIFFERENTIAL BUS REPEATERS

logic symbols†

SN75177B

SN75178B

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

logic diagrams (positive logic)

SN75177B

SN75178B

schematics of inputs and outputs

| EQUIVALENT OF EACH INPUT | TYPICAL OF ALL DRIVER OUTPUTS |

Driver input: R_{eq} = 3 kΩ NOM
Enable inputs: R_{eq} = 8 kΩ NOM

| EQUIVALENT OF EACH RECEIVER INPUT | TYPICAL OF RECEIVER OUTPUT |

TEXAS
INSTRUMENTS

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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 . . . . −10 V to 15 V
Differential input voltage (see Note 2) . . . . ±25 V
Enable input voltage . . . . 5.5 V
Continuous total dissipation . . . . See Dissipation Rating Table
Operating free-air temperature range . . . . 0°C to 70°C
Storage temperature range . . . . −65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . 260°C

NOTES: 1. All voltage values, except differential input voltage, are with respect to network ground terminal.
2. Differential input voltage is measured at the noninverting input with respect to the corresponding inverting input.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING
D	725 mW	5.8 mW/°C	464 mW
P	1000 mW	8.0 mW/°C	640 mW

recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}		4.75	5	5.25	V
High-level input voltage, V_{IH}	EN or $\overline{EN}$	2			V
low-level input voltage, V_{IL}	EN or $\overline{EN}$			0.8	V
Common-mode input voltage, V_{IC}		−7[†]		12	V
Differential input voltage, V_{ID}				±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		0		70	°C

[†] The algebraic convention, where the less-positive (more-negative) limit is designated minimum, is used in this data sheet for common-mode input voltage and threshold voltage.

DRIVER SECTION

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

	PARAMETER	TEST CONDITIONS		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		1.5	2.5	5	
$|V_{OD3}|$	Differential output voltage	See Note 3		1.5		5	V
$\Delta|V_{OD}|$	Change in magnitude of diferential output voltage‡	$R_L = 54$ Ω or 100 Ω, See Figure 1				±0.2	V
V_{OC}	Common-mode output voltage					3 −1	V
$\Delta|V_{OC}|$	Change in magnitude of common-mode output voltage‡					±0.2	V
I_O	Output current	$V_{CC} = 0$, $V_O = -7$ V to 12 V				±100	μA
I_{OZ}	High-impedance-state output current	$V_O = -7$ V to 12 V				±100	μA
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	$V_O = -7$ V				−250	mA
		$V_O = V_{CC}$				250	
		$V_O = 12$ V				250	
I_{CC}	Supply current (total package)	No load	Outputs enabled		57	70	mA
			Outputs disabled		26	35	

† All typical values are at $V_{CC} = 5$ V and $T_A = 25°$C.
‡ $\Delta|V_{OD}|$ 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.
§ The minimum V_{OD2} with a 100-Ω load is either 1/2 V_{OD1} or 2, whichever is greater.
NOTE 3: See Figure 3.5 of EIA Standard RS-485.

switching characteristics, $V_{CC} = 5$ V, $T_A = 25°$C

	PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{dD}	Differential-output delay time	$R_L = 54$ Ω, See Figure 3			15	20	ns
t_{tD}	Differential-output transition time				20	30	ns
t_{PZH}	Output enable time to high level	$R_L = 110$ Ω, See Figure 4			85	120	ns
t_{PZL}	Output enable time to low level	$R_L = 110$ Ω, See Figure 5			40	60	ns
t_{PHZ}	Output disable time from high level	$R_L = 110$ Ω, See Figure 4			150	250	ns
t_{PLZ}	Output disable time from low level	$R_L = 110$ Ω, See Figure 5			20	30	ns

SYMBOL EQUIVALENTS

DATA SHEET PARAMETER	RS-422-A	RS-485
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)
$|V_{OD3}|$		V_t (Test Termination) Measurement 2)
$\Delta|V_{OD}|$	$\mid |V_t| - |\overline{V}_t| \mid$	$\mid |V_t| - |\overline{V}_t| \mid$
V_{OC}	$|V_{OS}|$	$|V_{OS}|$
$\Delta|V_{OC}|$	$|V_{OS} - \overline{V}_{OS}|$	$|V_{OS} - \overline{V}_{OS}|$
I_{OS}	$|I_{sa}|,|I_{sb}|$	
I_O	$|I_{xa}|,|I_{xb}|$	I_{ia},I_{ib}

RECEIVER SECTION

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_{T+}	Positive-going input threshold voltage	V_O = 2.7 V,	I_O = − 0.4 mA			0.2	V
V_{T-}	Negative-going input threshold voltage	V_O = 0.5 V,	I_O = 8 mA	− 0.2‡			V
V_{hys}	Input hysteresis ($V_{T+} - V_{T-}$)				50		mV
V_{IK}	Input clamp voltage at EN	I_I = − 18 mA				− 1.5	V
V_{OH}	High-level output voltage	V_{ID} = 200 mV, See Figure 2	I_{OH} = − 400 μA,	2.7			V
V_{OL}	Low-level output voltage	V_{ID} = − 200 mV, See Figure 2	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
						− 400	
I_I	Line input current	Other input at 0 V, See Note 4	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				− 200	μA
r_i	Input resistance				12		kΩ
I_{OS}	Short-circuit output current			− 15		− 85	mA
I_{CC}	Supply current (total package)	No load	Outputs enabled		57	70	mA
			Outputs disabled		26	35	

† All typical values are at V_{CC} = 5 V, T_A = 25°C.
‡ The algebraic convention, where 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 4: Refer to EIA Standard RS-422 for exact conditions.

switching characteristics, V_{CC} = 5 V, T_A = 25°C

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	Propagation delay time, low-to-high level output	V_{ID} = − 1.5 V to 1.5 V, C_L = 15 pF, See Figure 6		19	35	ns
t_{PHL}	Propagation delay time, high-to-low level output			30	40	
t_{PZH}	Output enable time to high level	C_L = 15 pF, See Figure 7		10	20	ns
t_{PZL}	Output enable time to high level			12	20	
t_{PHZ}	Output disable time from high level	C_L = 15 pF, See Figure 8		25	35	ns
t_{PLZ}	Output disable time from low level			17	25	

![Texas Instruments logo]

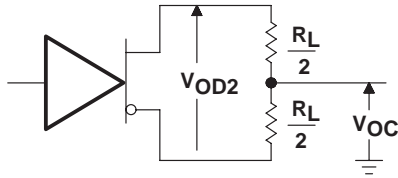POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

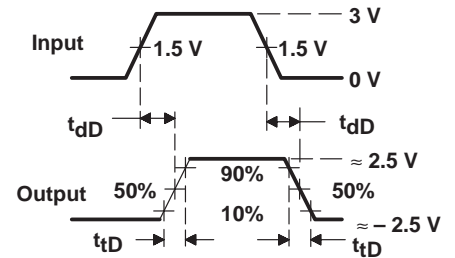## PARAMETER MEASUREMENT INFORMATION

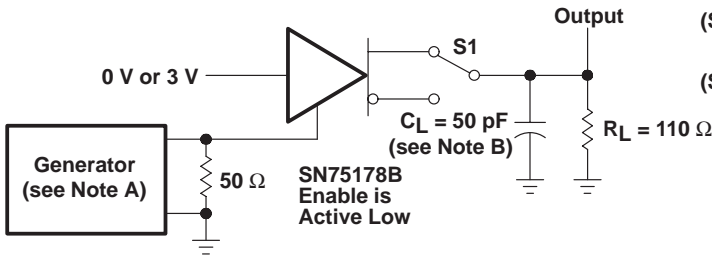**Figure 1. Driver V_{OD} and V_{OC}**
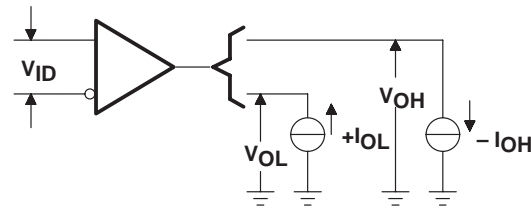
Figure 2. Receiver V_{OH} and V_{OL}
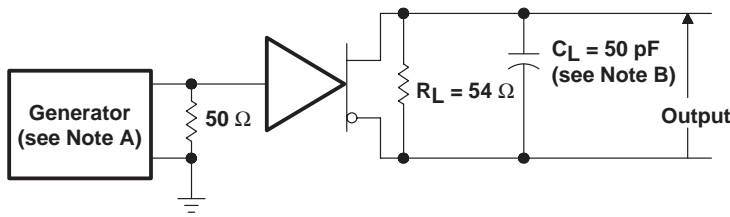
Figure 3. Driver Differential-Output Test Circuit and Voltage Waveforms
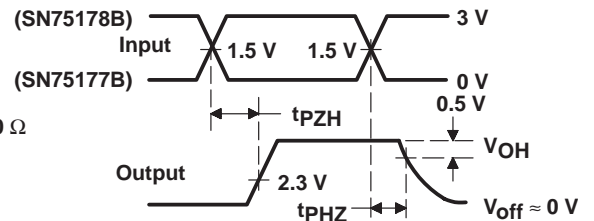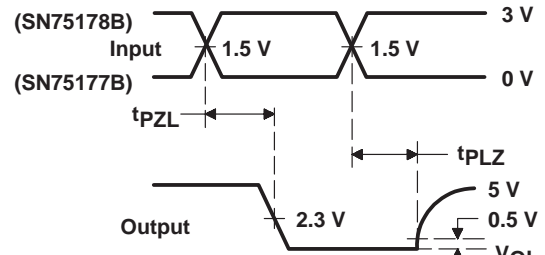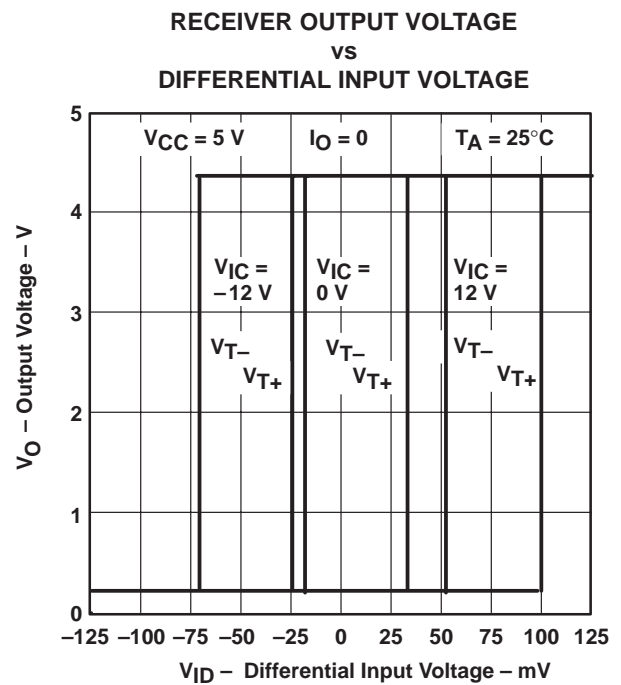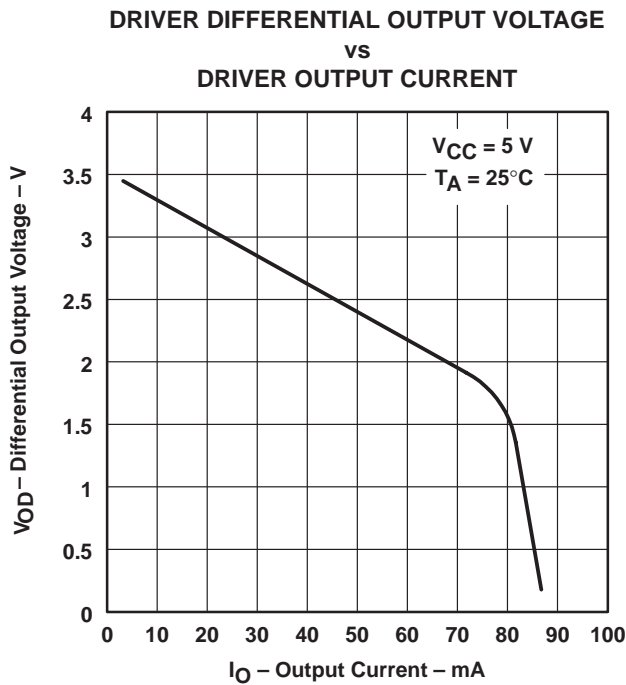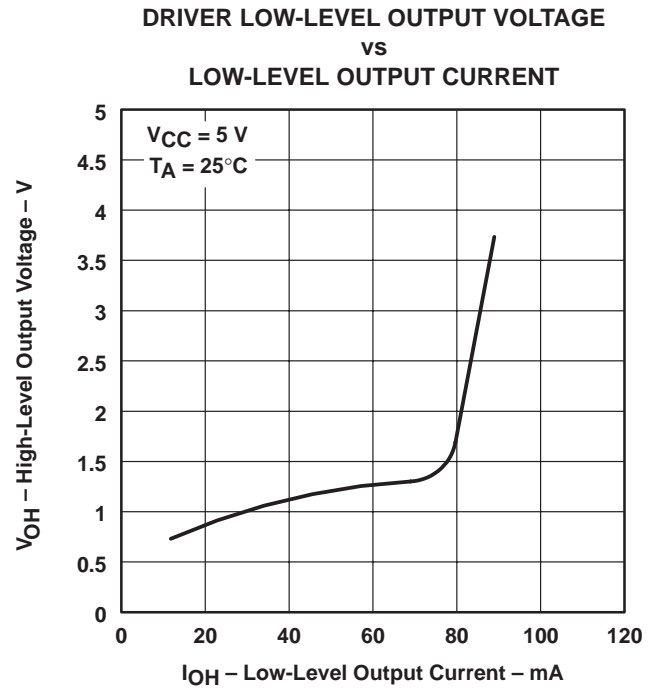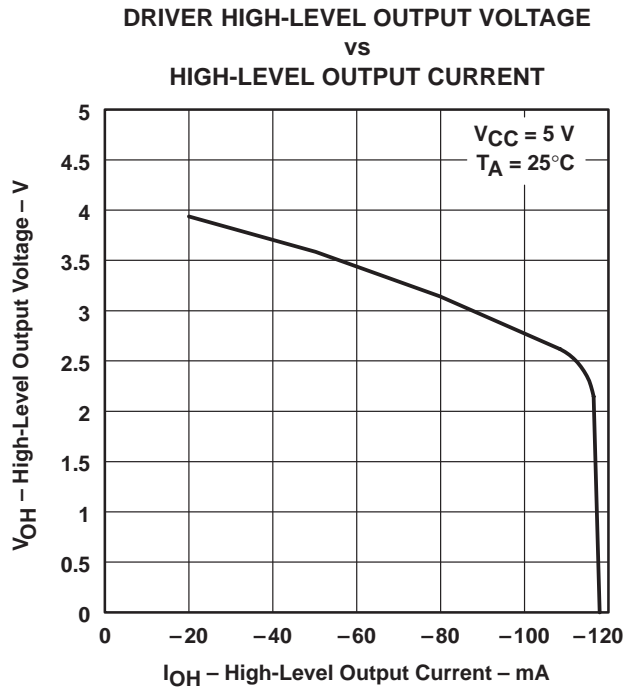
Figure 4. Driver Enable and Disable Times
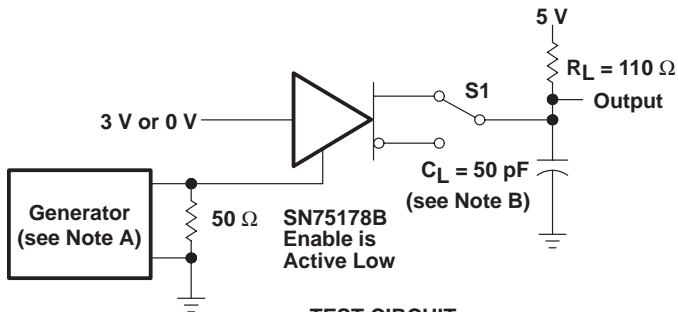
Figure 5. Driver Enable and Disable Times

NOTES: 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.

PARAMETER MEASUREMENT INFORMATION

TEST CIRCUIT

VOLTAGE WAVEFORMS
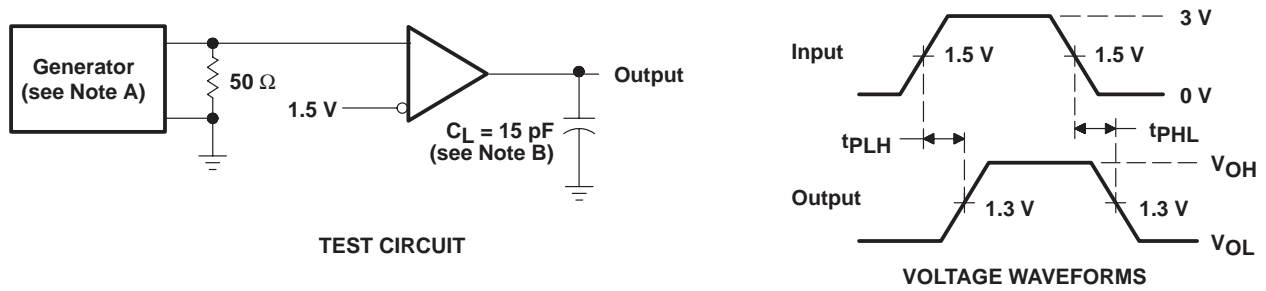
Figure 6. Receiver Propagation Delay Times

TEST CIRCUIT

VOLTAGE WAVEFORMS
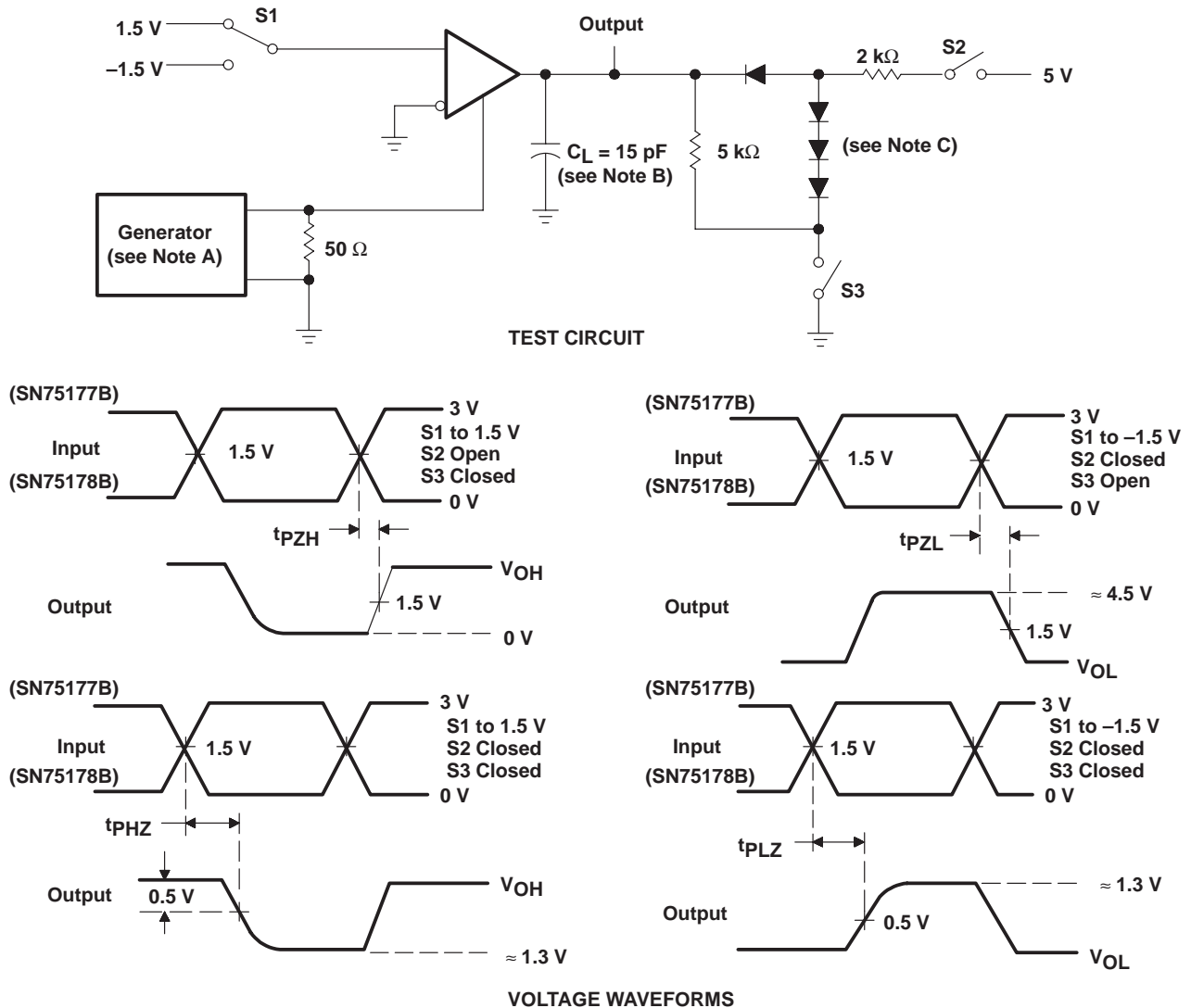
Figure 7. Receiver Output Enable and Disable Times

NOTES: 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.
      C. All diodes are 1N916 or equivalent.

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TYPICAL CHARACTERISTICS

DRIVER HIGH-LEVEL OUTPUT VOLTAGE
vs
HIGH-LEVEL OUTPUT CURRENT

Figure 8

DRIVER LOW-LEVEL OUTPUT VOLTAGE
vs
LOW-LEVEL OUTPUT CURRENT

Figure 9

DRIVER DIFFERENTIAL OUTPUT VOLTAGE
vs
DRIVER OUTPUT CURRENT

Figure 10

RECEIVER OUTPUT VOLTAGE
vs
DIFFERENTIAL INPUT VOLTAGE

Figure 11

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TYPICAL CHARACTERISTICS

RECEIVER HIGH-LEVEL OUTPUT VOLTAGE
vs
HIGH-LEVEL OUTPUT CURRENT

Figure 12

RECEIVER HIGH-LEVEL OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE

Figure 13

RECEIVER LOW-LEVEL OUTPUT VOLTAGE
vs
LOW-LEVEL OUTPUT CURRENT

Figure 14

RECEIVER LOW-LEVEL OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE

Figure 15

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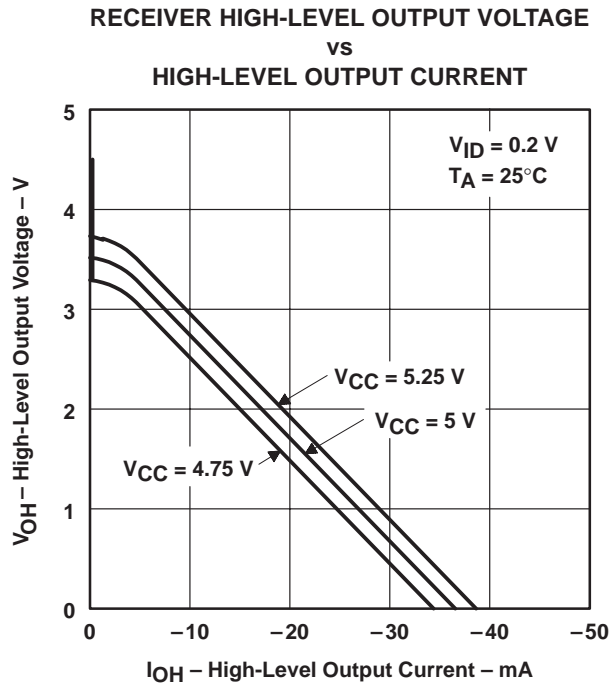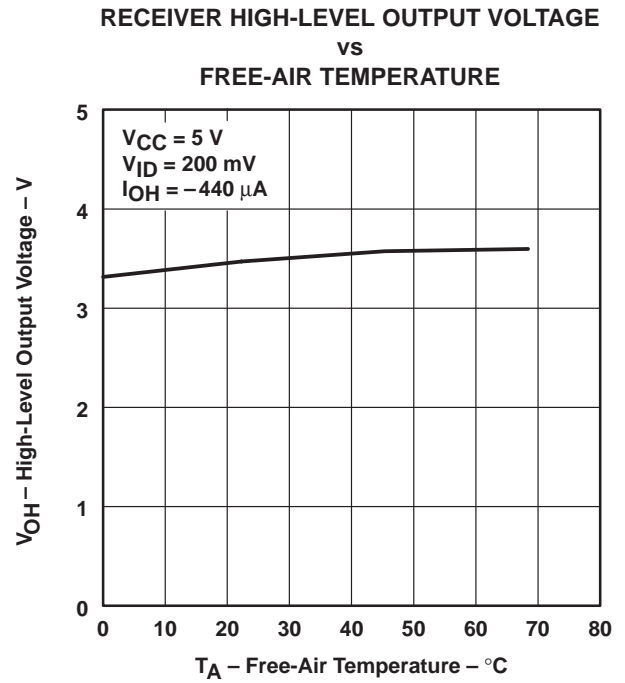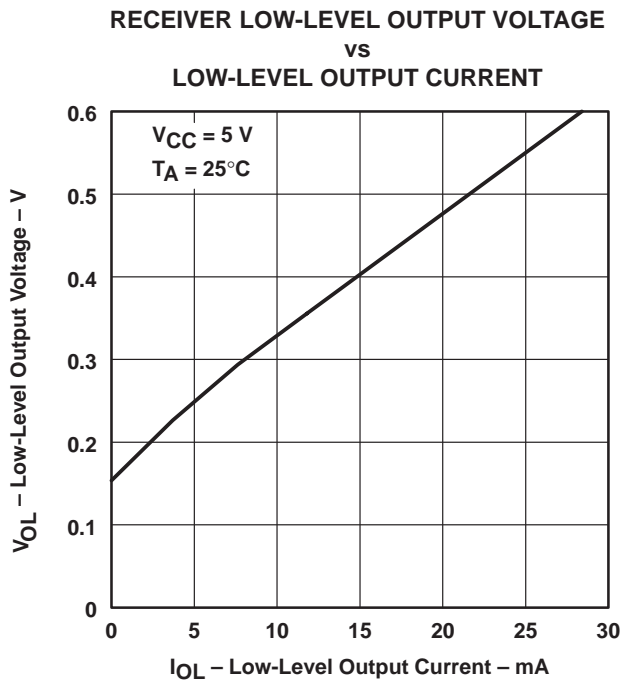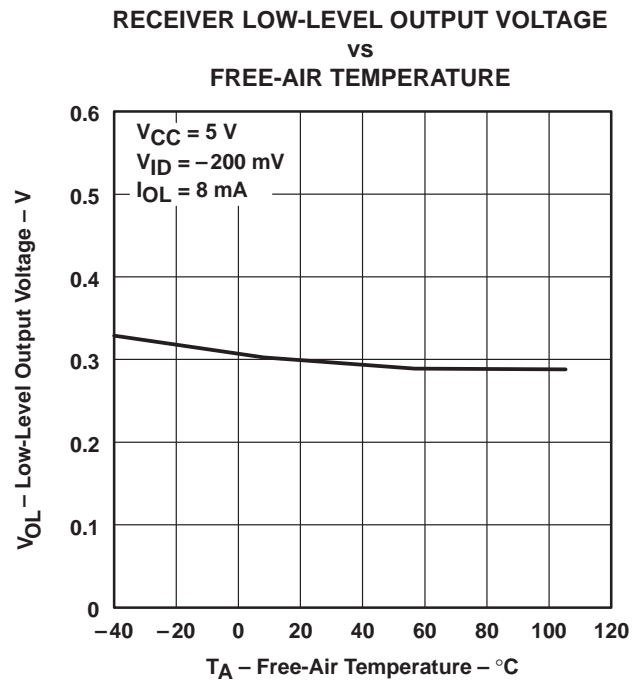
APPLICATION INFORMATION
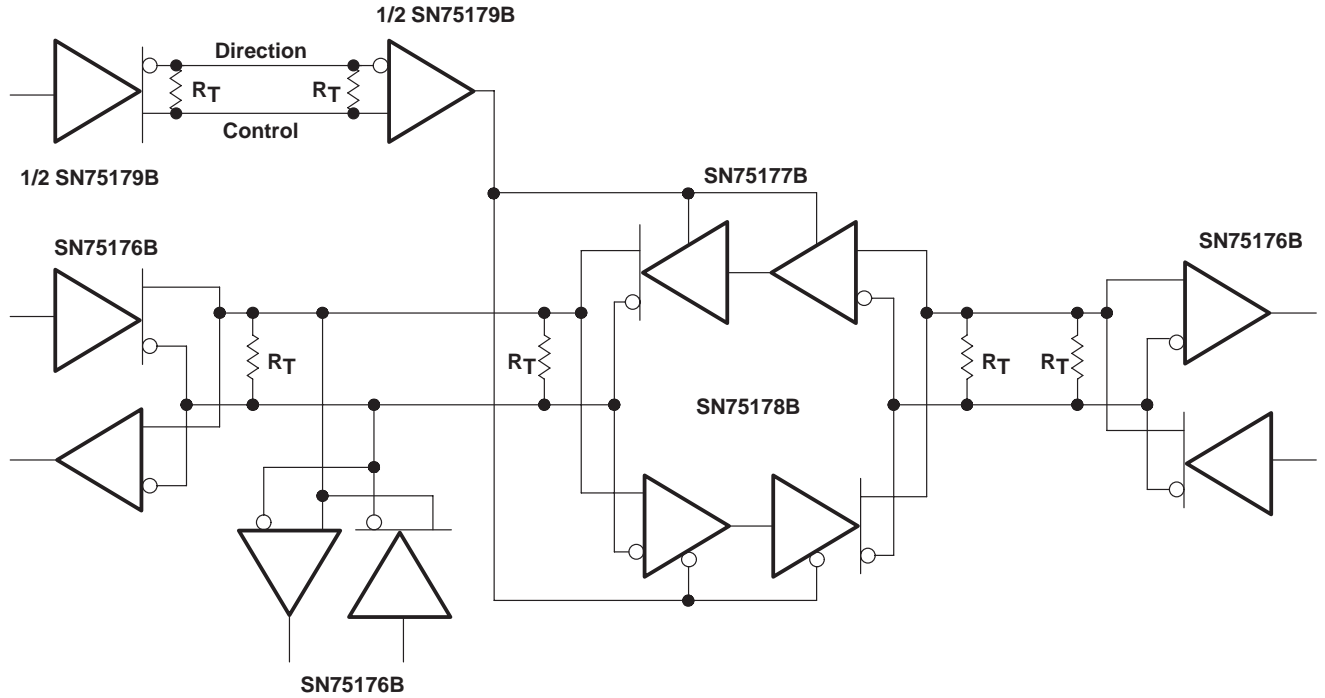
NOTE: The line should be terminated at both ends in its characteristic impedance. Stub lengths off the main line should be kept as short as possible.

Figure 16. Typical Application Circuit

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
SN75178BP	ACTIVE	PDIP	P	8	50	RoHS & Green	NIPDAU	N / A for Pkg Type	0 to 70	SN75178BP	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.

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