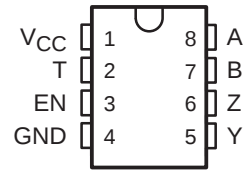


# SN75177B, SN75178B DIFFERENTIAL BUS REPEATERS

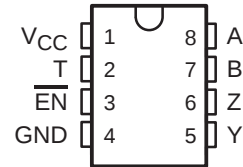
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- Meets EIA Standards RS-422-A and RS-485 and CCITT Recommendations V.11 and X.27
- Designed for Multipoint Transmission on Long Bus Lines in Noisy Environments
- 3-State Outputs
- Bus Voltage Range . . . –7 V to 12 V
- Positive and Negative Current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

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



SN75178B . . . P PACKAGE  
(TOP VIEW)



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 ±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<br>A – B              | ENABLE<br>EN | OUTPUTS |   |   |
|-------------------------------------------|--------------|---------|---|---|
|                                           |              | T       | Y | Z |
| $V_{ID} \geq 0.2 \text{ V}$               | H            | H       | H | L |
| $-0.2 \text{ V} < V_{ID} < 0.2 \text{ V}$ | H            | ?       | ? | ? |
| $V_{ID} \leq 0.2 \text{ V}$               | H            | L       | L | H |
| X                                         | L            | Z       | Z | Z |

SN75178B

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

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

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



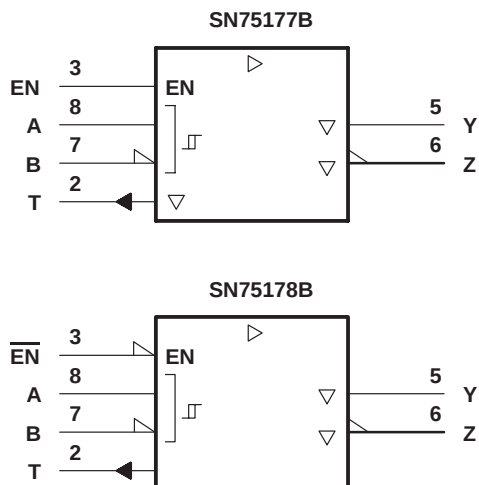
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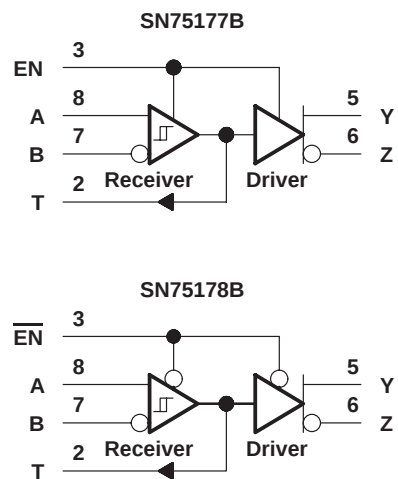
# SN75177B, SN75178B DIFFERENTIAL BUS REPEATERS

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## logic symbols†

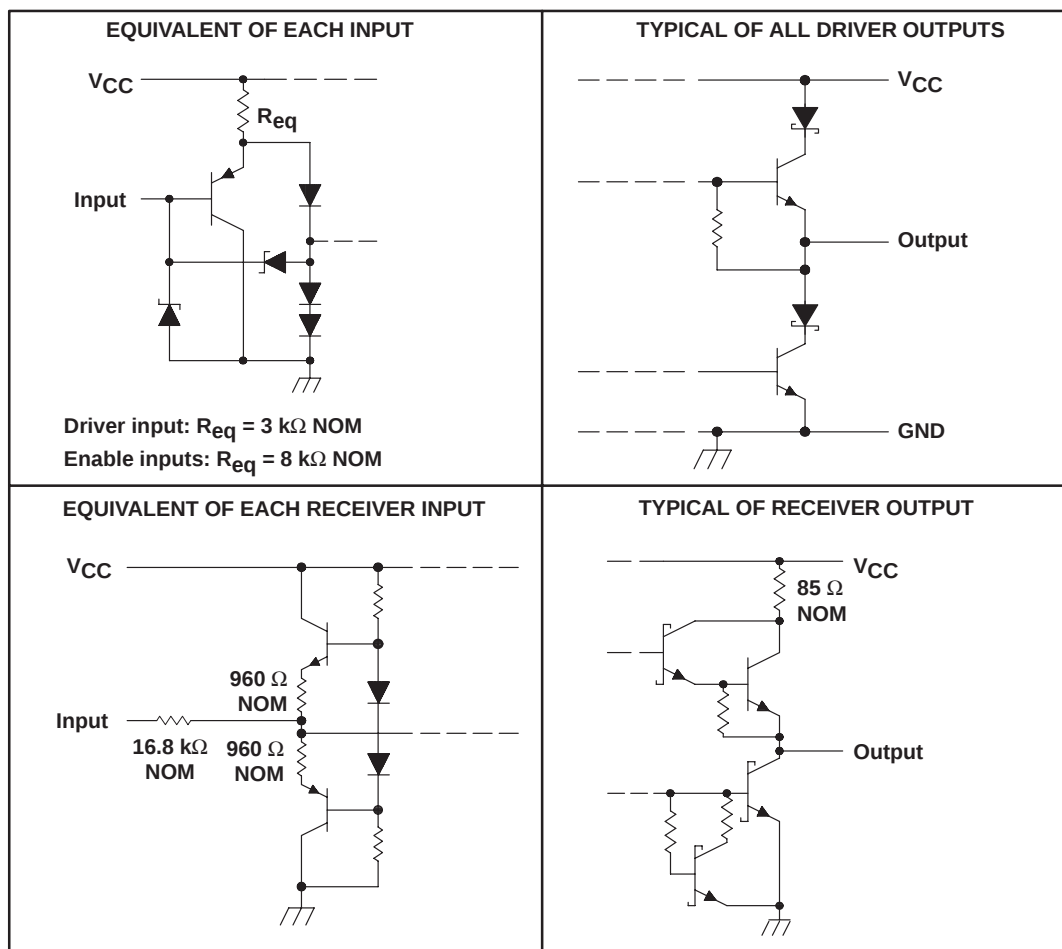


## logic diagrams (positive logic)



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

## schematics of inputs and outputs



# SN75177B, SN75178B DIFFERENTIAL BUS REPEATERS

SLLS002C – D2606, JULY 1985 – REVISED FEBRUARY 1993

## 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)                      | $\pm 25$ 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 | $T_A \leq 25^\circ\text{C}$<br>POWER RATING | DERATING FACTOR<br>ABOVE $T_A = 25^\circ\text{C}$ | $T_A = 70^\circ\text{C}$<br>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 $\overline{\text{EN}}$ | 2               |     |          | V             |
| Low-level input voltage, $V_{IL}$     | EN or $\overline{\text{EN}}$ |                 |     | 0.8      | V             |
| Common-mode input voltage, $V_{IC}$   |                              | –7 <sup>†</sup> |     | 12       | V             |
| Differential input voltage, $V_{ID}$  |                              |                 |     | $\pm 12$ | V             |
| High-level output current, $I_{OH}$   | Driver                       |                 |     | –60      | mA            |
|                                       | Receiver                     |                 |     | –400     | $\mu\text{A}$ |
| Low-level output current, $I_{OL}$    | Driver                       |                 |     | 60       | mA            |
|                                       | Receiver                     |                 |     | 8        | mA            |
| Operating free-air temperature, $T_A$ |                              | 0               |     | 70       | °C            |

<sup>†</sup> 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.

# SN75177B, SN75178B DIFFERENTIAL BUS REPEATERS

SLLS002C – D2606, JULY 1985 – REVISED FEBRUARY 1993

## DRIVER SECTION

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

| PARAMETER                                                                        | TEST CONDITIONS                                    | MIN                       | TYP <sup>†</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                                          | $R_L = 100\ \Omega$ , See Figure 1                 | $1/2 V_{OD1}$ or $2^{\S}$ |                  |           | V             |
|                                                                                  | $R_L = 54\ \Omega$ , 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 differential output voltage <sup>‡</sup> | $R_L = 54\ \Omega$ or $100\ \Omega$ , See Figure 1 |                           |                  | $\pm 0.2$ | V             |
| $V_{OC}$ Common-mode output voltage                                              |                                                    |                           |                  | 3<br>-1   | V             |
| $\Delta V_{OC} $ Change in magnitude of common-mode output voltage <sup>‡</sup>  |                                                    |                           |                  | $\pm 0.2$ | V             |
| $I_O$ Output current                                                             | $V_{CC} = 0$ , $V_O = -7\text{ V to }12\text{ V}$  |                           |                  | $\pm 100$ | $\mu\text{A}$ |
| $I_{OZ}$ High-impedance-state output current                                     | $V_O = -7\text{ V to }12\text{ V}$                 |                           |                  | $\pm 100$ | $\mu\text{A}$ |
| $I_{IH}$ High-level input current                                                | $V_I = 2.4\text{ V}$                               |                           |                  | 20        | $\mu\text{A}$ |
| $I_{IL}$ Low-level input current                                                 | $V_I = 0.4\text{ V}$                               |                           |                  | -400      | $\mu\text{A}$ |
| $I_{OS}$ Short-circuit output current                                            | $V_O = -7\text{ V}$                                |                           |                  | -250      | mA            |
|                                                                                  | $V_O = V_{CC}$                                     |                           |                  | 250       |               |
|                                                                                  | $V_O = 12\text{ V}$                                |                           |                  | 250       |               |
| $I_{CC}$ Supply current (total package)                                          | No load                                            | Outputs enabled           | 57               | 70        | mA            |
|                                                                                  |                                                    | Outputs disabled          | 26               | 35        |               |

<sup>†</sup> All typical values are at  $V_{CC} = 5\text{ V}$  and  $T_A = 25^\circ\text{C}$ .

<sup>‡</sup>  $\Delta|V_{OD}|$  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.

<sup>§</sup> The minimum  $V_{OD2}$  with a  $100\text{-}\Omega$  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, $V_{CC} = 5\text{ V}$ , $T_A = 25^\circ\text{C}$

| PARAMETER                                     | TEST CONDITIONS                    | MIN | TYP | MAX | UNIT |
|-----------------------------------------------|------------------------------------|-----|-----|-----|------|
| $t_{dD}$ Differential-output delay time       | $R_L = 54\ \Omega$ , See Figure 3  |     | 15  | 20  | ns   |
| $t_{tD}$ Differential-output transition time  |                                    |     | 20  | 30  | ns   |
| $t_{PZH}$ Output enable time to high level    | $R_L = 110\ \Omega$ , See Figure 4 |     | 85  | 120 | ns   |
| $t_{PZL}$ Output enable time to low level     | $R_L = 110\ \Omega$ , See Figure 5 |     | 40  | 60  | ns   |
| $t_{PHZ}$ Output disable time from high level | $R_L = 110\ \Omega$ , See Figure 4 |     | 150 | 250 | ns   |
| $t_{PLZ}$ Output disable time from low level  | $R_L = 110\ \Omega$ , 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} $          | $V_t (R_L = 100 \Omega)$  | $V_t (R_L = 54 \Omega)$                |
| $ V_{OD3} $          |                           | $V_t$ (Test Termination Measurement 2) |
| $\Delta V_{OD} $     | $   V_t  -  \bar{V}_t   $ | $   V_t  -  \bar{V}_t   $              |
| $V_{OC}$             | $ V_{OS} $                | $ V_{OS} $                             |
| $\Delta V_{OC} $     | $ V_{OS} - \bar{V}_{OS} $ | $ V_{OS} - \bar{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 <sup>†</sup> | MAX        | UNIT          |
|--------------------------------------------------|--------------------------------------------------------------------------------|-------------------|------------------|------------|---------------|
| $V_{T+}$ Positive-going input threshold voltage  | $V_O = 2.7 \text{ V}$ , $I_O = -0.4 \text{ mA}$                                |                   |                  | 0.2        | V             |
| $V_{T-}$ Negative-going input threshold voltage  | $V_O = 0.5 \text{ V}$ , $I_O = 8 \text{ mA}$                                   | -0.2 <sup>‡</sup> |                  |            | V             |
| $V_{hys}$ Input hysteresis ( $V_{T+} - V_{T-}$ ) |                                                                                |                   | 50               |            | mV            |
| $V_{IK}$ Input clamp voltage at EN               | $I_I = -18 \text{ mA}$                                                         |                   |                  | -1.5       | V             |
| $V_{OH}$ High-level output voltage               | $V_{ID} = 200 \text{ mV}$ ,<br>See Figure 2 $I_{OH} = -400 \mu\text{A}$ ,      | 2.7               |                  |            | V             |
| $V_{OL}$ Low-level output voltage                | $V_{ID} = -200 \text{ mV}$ ,<br>See Figure 2 $I_{OL} = 8 \text{ mA}$ ,         |                   |                  | 0.45       | V             |
| $I_{OZ}$ High-impedance-state output current     | $V_O = 0.4 \text{ V to } 2.4 \text{ V}$                                        |                   |                  | 20<br>-400 | $\mu\text{A}$ |
| $I_I$ Line input current                         | Other input at 0 V,<br>See Note 4 $V_I = 12 \text{ V}$<br>$V_I = -7 \text{ V}$ |                   |                  | 1<br>-0.8  | mA            |
| $I_{IH}$ High-level enable-input current         | $V_{IH} = 2.7 \text{ V}$                                                       |                   |                  | 20         | $\mu\text{A}$ |
| $I_{IL}$ Low-level enable-input current          | $V_{IL} = 0.4 \text{ V}$                                                       |                   |                  | -200       | $\mu\text{A}$ |
| $r_i$ Input resistance                           |                                                                                | 12                |                  |            | k $\Omega$    |
| $I_{OS}$ Short-circuit output current            |                                                                                | -15               |                  | -85        | mA            |
| $I_{CC}$ Supply current (total package)          | No load                                                                        |                   |                  |            |               |
|                                                  | Outputs enabled                                                                |                   | 57               | 70         | mA            |
|                                                  | Outputs disabled                                                               |                   | 26               | 35         |               |

<sup>†</sup> All typical values are at  $V_{CC} = 5 \text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

<sup>‡</sup> 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,  $V_{CC} = 5 \text{ V}$ ,  $T_A = 25^\circ\text{C}$

| PARAMETER                                                  | TEST CONDITIONS                                                                       | MIN | TYP | MAX | UNIT |
|------------------------------------------------------------|---------------------------------------------------------------------------------------|-----|-----|-----|------|
| $t_{PLH}$ Propagation delay time, low-to-high level output | $V_{ID} = -1.5 \text{ V to } 1.5 \text{ V}$ ,<br>$C_L = 15 \text{ pF}$ , 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                 | $C_L = 15 \text{ pF}$ , See Figure 7                                                  |     | 10  | 20  | ns   |
| $t_{PZL}$ Output enable time to high level                 |                                                                                       |     | 12  | 20  |      |
| $t_{PHZ}$ Output disable time from high level              | $C_L = 15 \text{ pF}$ , See Figure 8                                                  |     | 25  | 35  | ns   |
| $t_{PLZ}$ Output disable time from low level               |                                                                                       |     | 17  | 25  |      |

# SN75177B, SN75178B DIFFERENTIAL BUS REPEATERS

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## PARAMETER MEASUREMENT INFORMATION

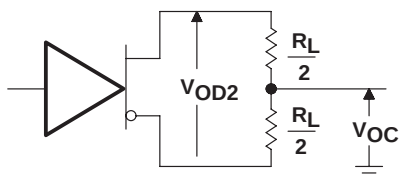


Figure 1. Driver  $V_{OD}$  and  $V_{OC}$

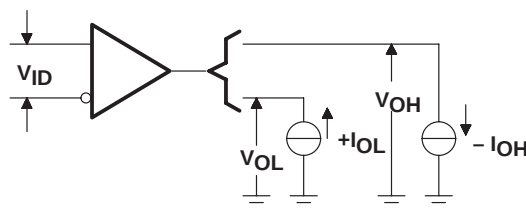
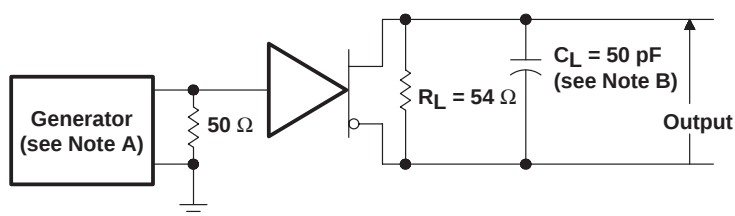
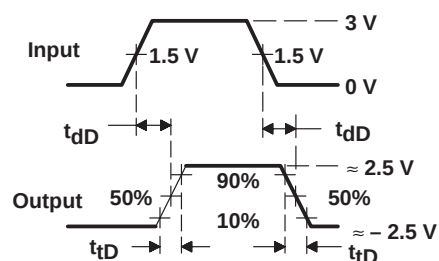


Figure 2. Receiver  $V_{OH}$  and  $V_{OL}$

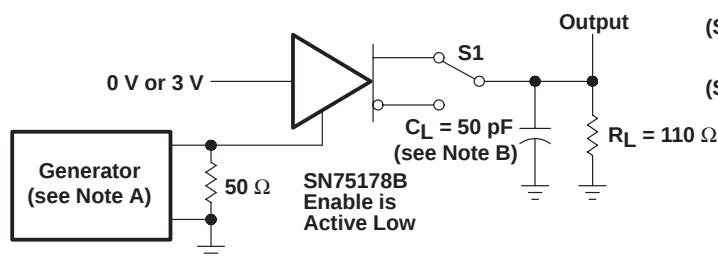


TEST CIRCUIT

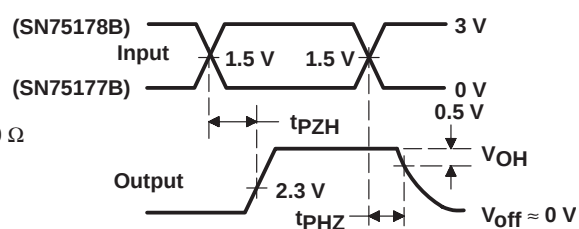


VOLTAGE WAVEFORMS

Figure 3. Driver Differential-Output Test Circuit and Voltage Waveforms

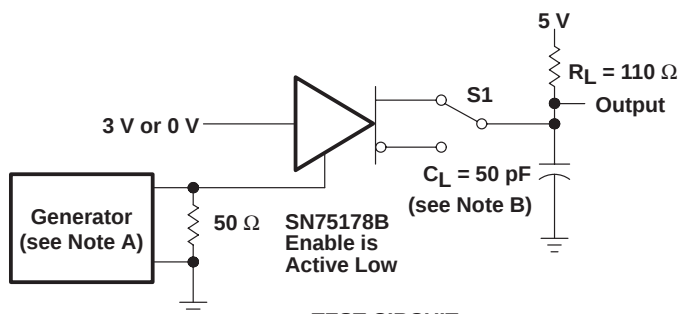


TEST CIRCUIT

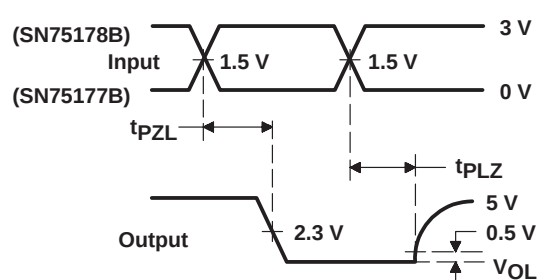


VOLTAGE WAVEFORMS

Figure 4. Driver Enable and Disable Times



TEST CIRCUIT



VOLTAGE WAVEFORMS

Figure 5. Driver Enable and Disable Times

NOTES: 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.

## PARAMETER MEASUREMENT INFORMATION

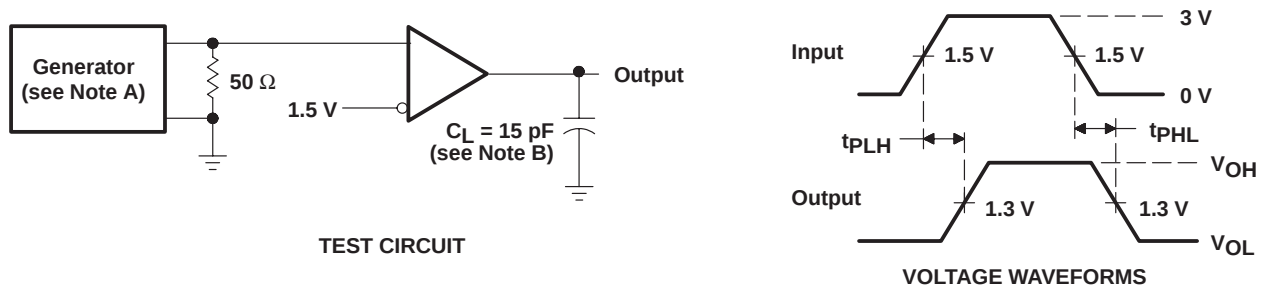


Figure 6. Receiver Propagation Delay Times

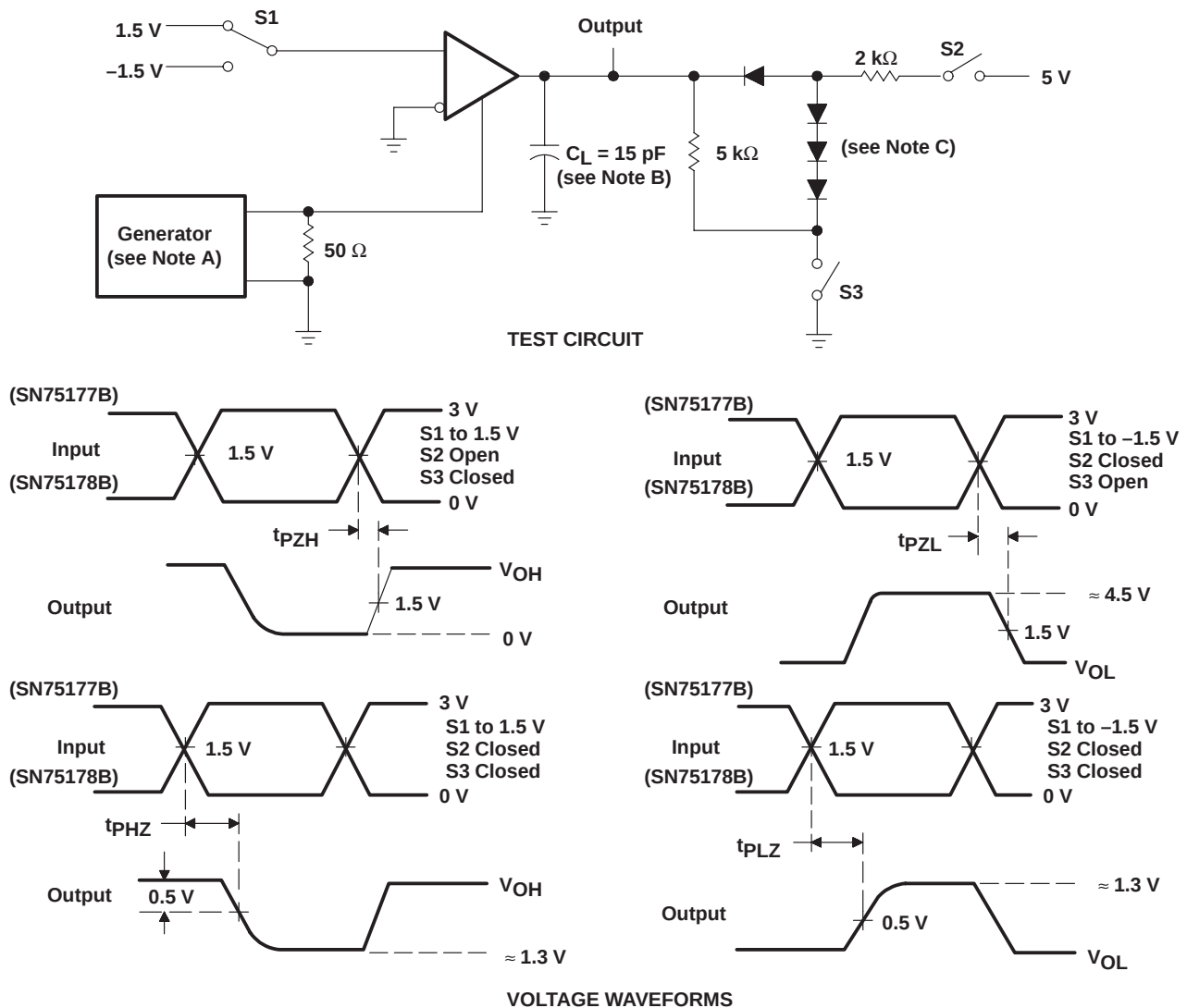


Figure 7. Receiver Output Enable and Disable Times

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

# SN75177B, SN75178B DIFFERENTIAL BUS REPEATERS

SLLS002C – D2606, JULY 1985 – REVISED FEBRUARY 1993

## TYPICAL CHARACTERISTICS

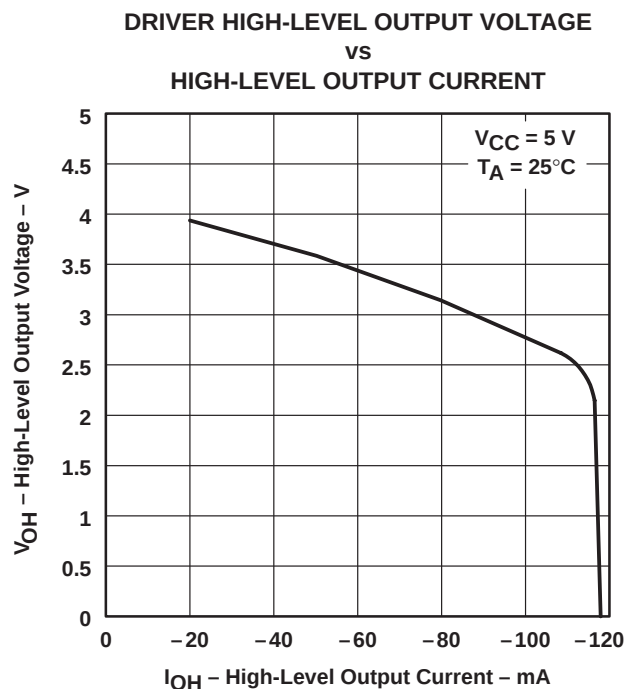


Figure 8

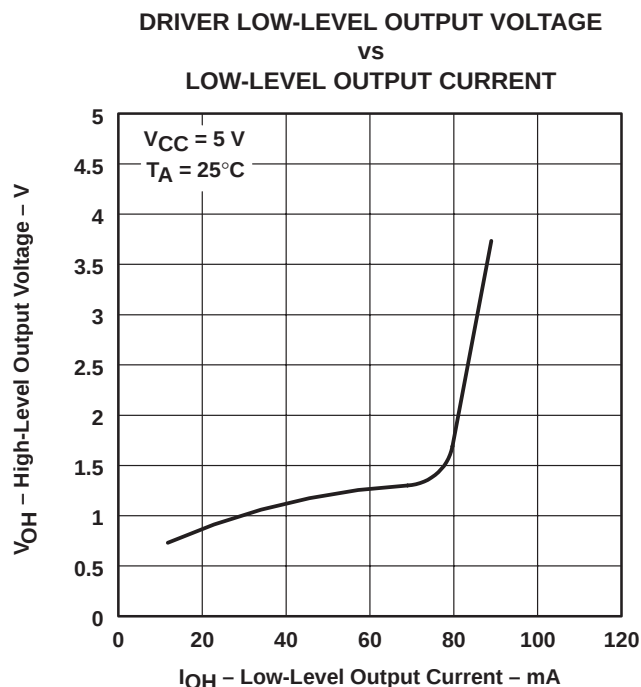


Figure 9

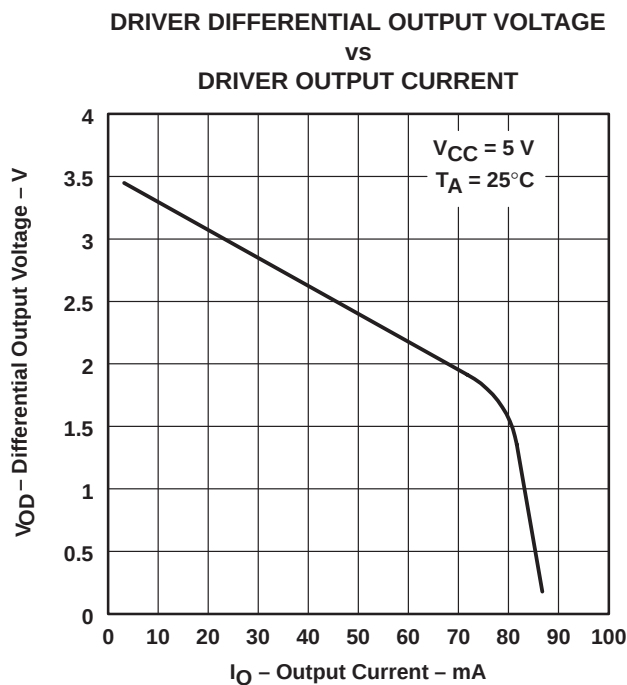


Figure 10

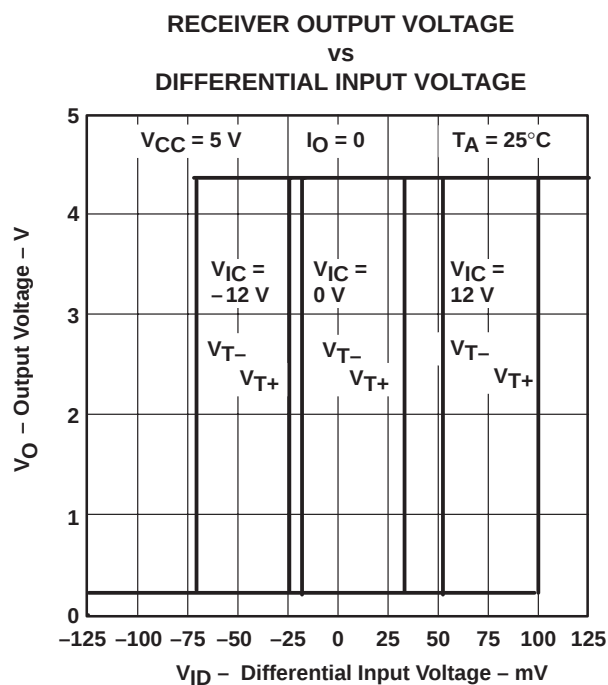


Figure 11

# TYPICAL CHARACTERISTICS

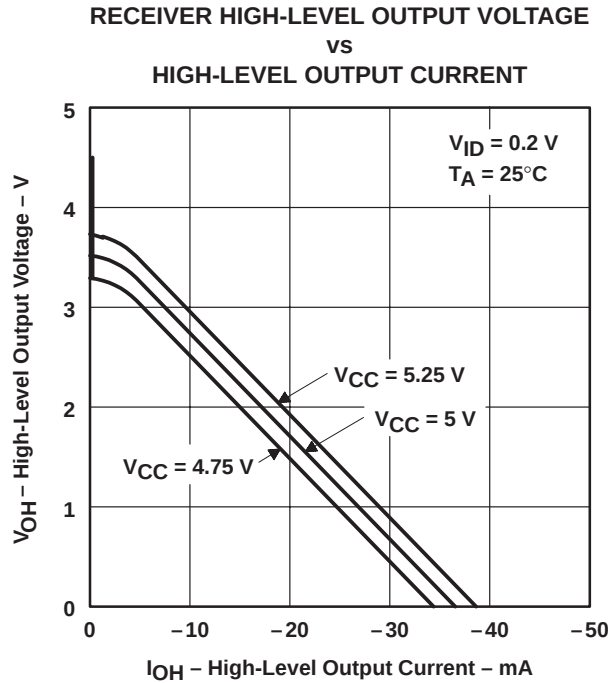


Figure 12

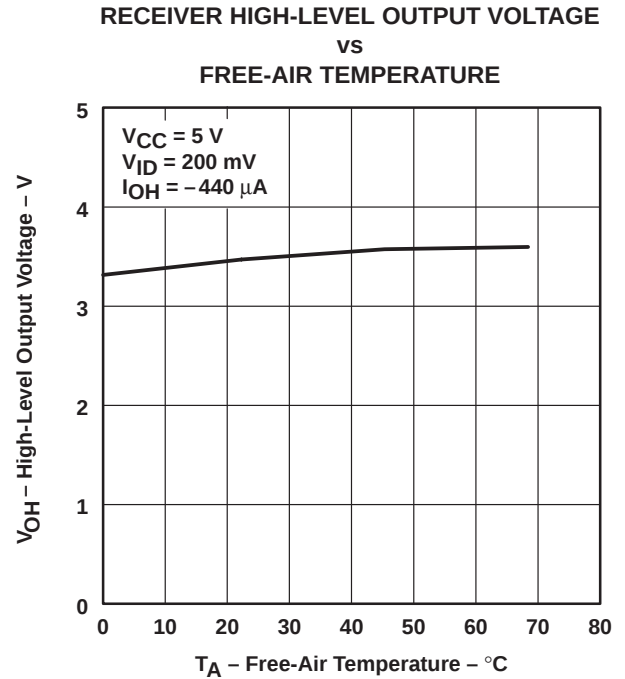


Figure 13

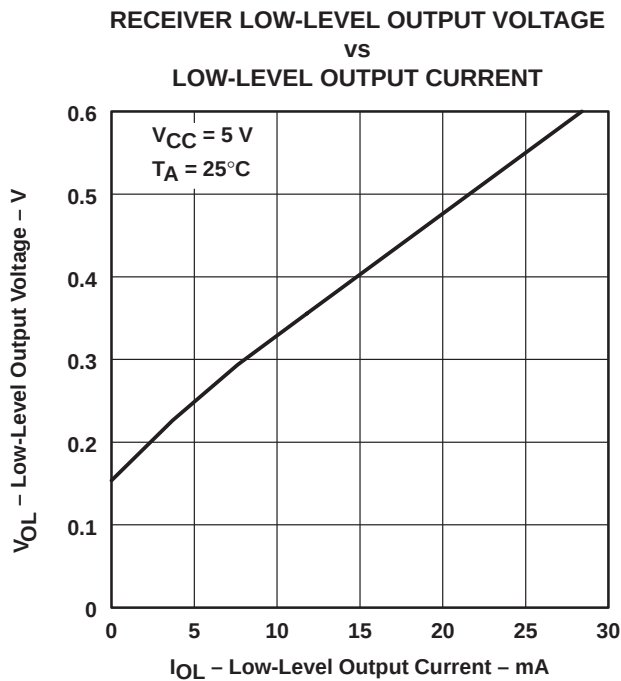


Figure 14

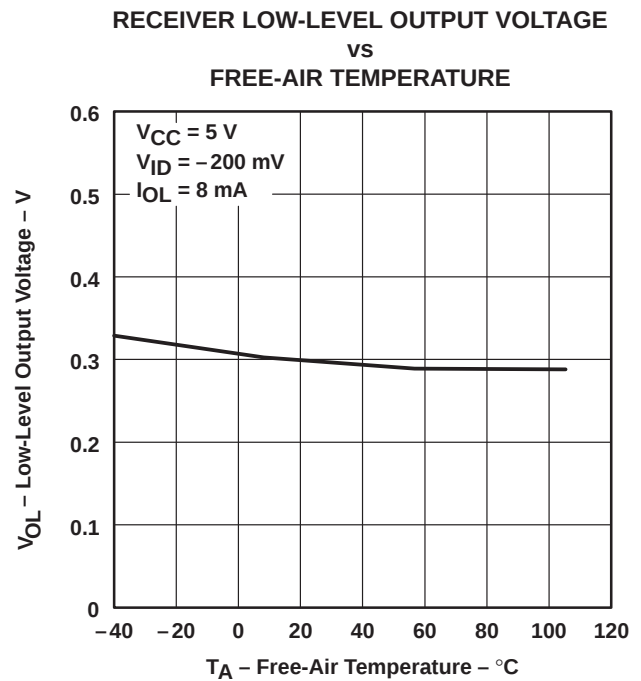
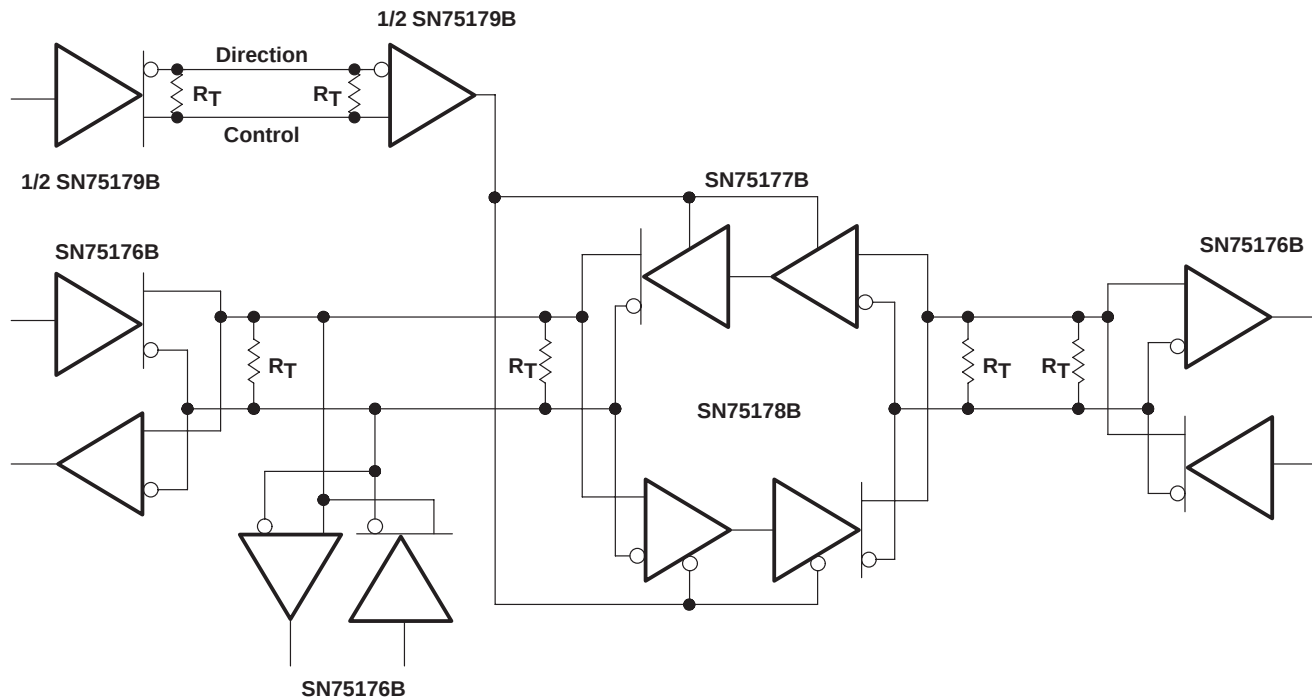


Figure 15

# SN75177B, SN75178B DIFFERENTIAL BUS REPEATERS

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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

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## SN75178B, DIFFERENTIAL BUS REPEATERS

Device Status: Active

- > [Description](#)
- > [Features](#)
- > [Datasheets](#)
- > [Pricing/Samples/Availability](#)
- > [Application Notes](#)
- > [Related Documents](#)
- > [Applications](#)

### 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.

## Features

- 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 k $\Omega$  Min
- Receiver Input Sensitivity . . .  $\pm 200$  mV
- Receiver Input Hysteresis . . . 50 mV Typ
- Operates From Single 5-V Supply
- Low Power Requirements

To view the following documents, [Acrobat Reader 3.x](#) is required.

To download a document to your hard drive, right-click on the link and choose 'Save'.

## Datasheets

Full datasheet in Acrobat PDF: [slls002c.pdf](#) (165 KB)

Full datasheet in Zipped PostScript: [slls002c.psz](#) (151 KB)

## Pricing/Samples/Availability

| <a href="#">Orderable Device</a> | <a href="#">Package</a> | <a href="#">Pins</a> | <a href="#">Temp (°C)</a> | <a href="#">Status</a> | <a href="#">Price/unit USD (100-999)</a> | <a href="#">Pack Qty</a> | <a href="#">Availability / Samples</a> |
|----------------------------------|-------------------------|----------------------|---------------------------|------------------------|------------------------------------------|--------------------------|----------------------------------------|
| SN75178BD                        | <a href="#">D</a>       | 8                    | 0 TO 70                   | NRND                   | 1.80                                     | 75                       | <a href="#">Check stock or order</a>   |
| SN75178BDR                       | <a href="#">D</a>       | 8                    |                           | ACTIVE                 | 1.54                                     | 2500                     | <a href="#">Check stock or order</a>   |
| SN75178BP                        | <a href="#">P</a>       | 8                    | 0 TO 70                   | ACTIVE                 | 1.80                                     | 50                       | <a href="#">Check stock or order</a>   |
| SN75178BPS                       | <a href="#">PS</a>      | 8                    |                           | OBSOLETE               |                                          |                          |                                        |

## Application Reports

- [422 AND 485 STANDARDS OVERVIEW AND SYSTEM CONFIGURATIONS](#) (SLLA070A - Updated: 05/25/2000)
- [COMPARING BUS SOLUTIONS](#) (SLLA067 - Updated: 03/06/2000)
- [ELECTROSTATIC DISCHARGE APPLICATION NOTE](#) (SSYA008 - Updated: 05/05/1999)
- [JITTER ANALYSIS](#) (SLLA075 - Updated: 03/31/2000)

- [SKEW DEFINITIONS](#) (SLLA060 - Updated: 08/13/1999)
- [THERMAL CHARACTERISTICS OF LINEAR AND LOGIC PACKAGES USING JEDEC PCB DESIGNS](#) (SZZA017A - Updated: 09/10/1999)

## Related Documents

- [A STATISTICAL SURVEY OF COMMON-MODE NOISE](#) (SLLA057, 131 KB - Updated: 12/23/1999)

## Table Data Updated on: 8/3/2000

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