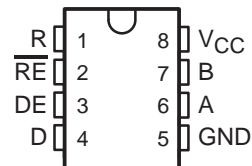


# SN75176A DIFFERENTIAL BUS TRANSCEIVER

SLLS100A – JUNE 1984 – REVISED MAY 1995

- Bidirectional Transceiver
- Meets or Exceeds the Requirements of ANSI Standards EIA/TIA-422-B and ITU Recommendation V.11
- Designed for Multipoint Transmission on Long Bus Lines in Noisy Environments
- 3-State Driver and Receiver Outputs
- Individual Driver and Receiver Enables
- Wide Positive and Negative Input/Output Bus Voltage Ranges
- Driver Output Capability . . .  $\pm 60$  mA Max
- Thermal-Shutdown Protection
- Driver Positive- and Negative-Current Limiting
- 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

D OR P PACKAGE  
(TOP VIEW)



## description

The SN75176A differential bus transceiver is a monolithic integrated circuit designed for bidirectional data communication on multipoint bus-transmission lines. It is designed for balanced transmission lines and meets ANSI Standard EIA/TIA-422-B and ITU Recommendation V.11.

The SN75176A 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 externally connected together to function as a direction control. The driver differential outputs and the receiver differential inputs are connected internally to form differential input/output (I/O) bus ports that are designed to offer minimum loading to the bus whenever the driver is disabled or  $V_{CC} = 0$ . These ports feature wide positive and negative common-mode voltage ranges making the device suitable for party-line applications.

The driver is designed to handle loads up to 60 mA of sink or source current. The driver features positive- and negative-current limiting and thermal shutdown for protection from line fault conditions. Thermal shutdown is designed to occur at a junction temperature of approximately 150°C. The receiver features a minimum input impedance of 12 k $\Omega$ , an input sensitivity of  $\pm 200$  mV, and a typical input hysteresis of 50 mV.

The SN75176A can be used in transmission-line applications employing the SN75172 and SN75174 quadruple differential line drivers and SN75173 and SN75175 quadruple differential line receivers.

The SN75176A is characterized for operation from 0°C to 70°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.

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.

 **TEXAS  
INSTRUMENTS**

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# SN75176A DIFFERENTIAL BUS TRANSCEIVER

SLLS100A – JUNE 1984 – REVISED MAY 1995

## Function Tables

### DRIVER

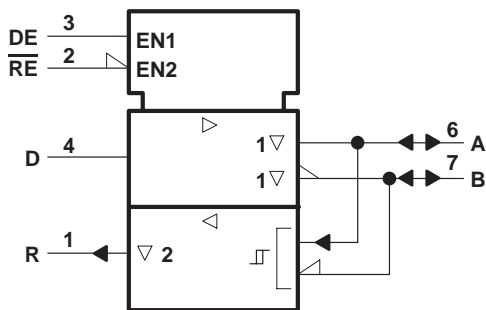
| INPUT<br>D | ENABLE<br>DE | OUTPUTS |   |
|------------|--------------|---------|---|
|            |              | A       | B |
| H          | H            | H       | L |
| L          | H            | L       | H |
| X          | L            | Z       | Z |

### RECEIVER

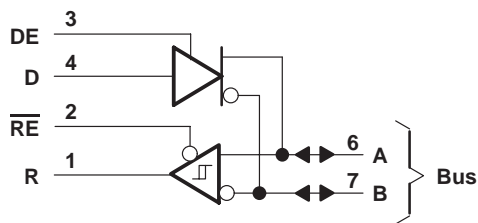
| DIFFERENTIAL INPUTS<br>A – B | ENABLE<br>$\overline{RE}$ | OUTPUT<br>R |
|------------------------------|---------------------------|-------------|
| $V_{ID} \geq 0.2 V$          | L                         | H           |
| $-0.2 V < V_{ID} < 0.2 V$    | L                         | ?           |
| $V_{ID} \leq -0.2 V$         | L                         | L           |
| X                            | H                         | Z           |
| Open                         | L                         | ?           |

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

### logic symbol†

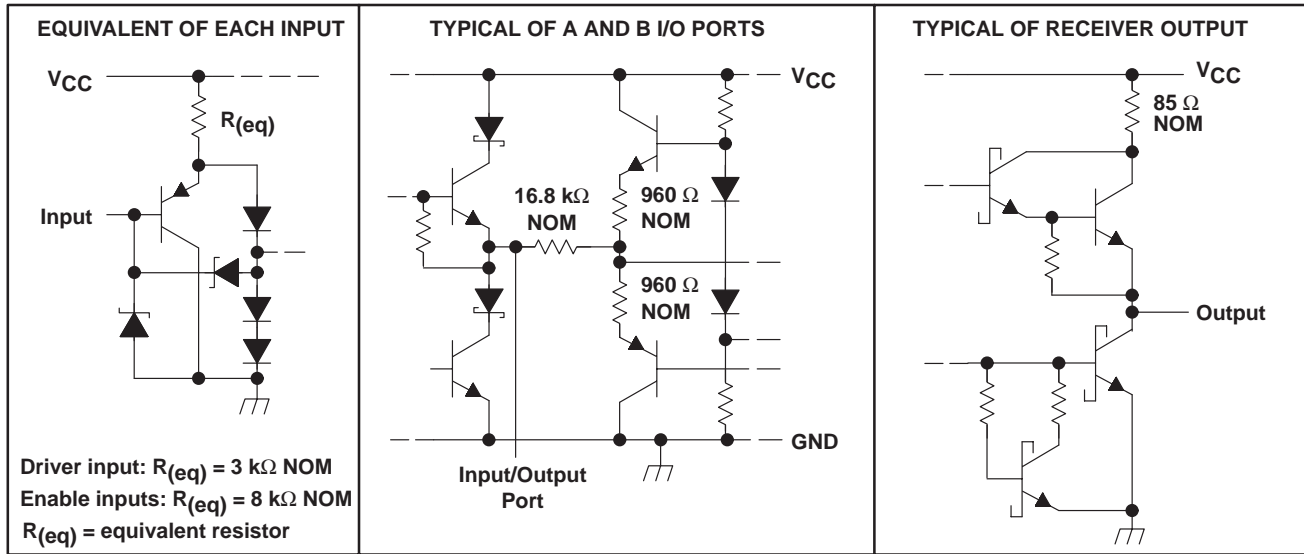


### logic diagram (positive logic)



† 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                            | -10 V to 15 V                |
| Enable input voltage, $V_I$                                  | 5.5 V                        |
| Continuous total power dissipation                           | See Dissipation Rating Table |
| Operating free-air temperature range, $T_A$                  | 0°C to 70°C                  |
| Storage temperature range, $T_{stg}$                         | -65°C to 150°C               |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds | 260°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.

NOTE 1: All voltage values, except differential input/output bus voltage, are with respect to network ground terminal.

**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 | $T_A = 105^\circ\text{C}$<br>POWER RATING |
|---------|---|---|--|---|
| D       | 725 mW                                      | 5.8 mW/°C   | 464 mW                                   | 261 mW                                    |
| P       | 1100 mW                                     | 8.8 mW/°C   | 704 mW                                   | 396 mW                                    |

# SN75176A

## DIFFERENTIAL BUS TRANSCEIVER

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### recommended operating conditions

|  |                            | MIN  | TYP | MAX      | UNIT         |
|--|----------------------------|------|-----|----------|--------------|
| Supply voltage, $V_{CC}$   |                            | 4.75 | 5   | 5.25     | V            |
| Voltage at any bus terminal (separately or common mode), $V_I$ or $V_{IC}$ |                            | -7   |     | 12       | V            |
| 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 2)                          |                            |      |     | $\pm 12$ | V            |
| High-level output current, $I_{OH}$  | Driver                     |      |     | -60      | mA           |
|  | Receiver                   |      |     | -400     | $\mu$ A      |
| Low-level output current, $I_{OL}$   | Driver                     |      |     | 60       | mA           |
|  | Receiver                   |      |     | 8        |              |
| Operating free-air temperature, $T_A$                                      |                            | 0    |     | 70       | $^{\circ}$ C |

NOTE 2: Differential-input/output bus voltage is measured at the noninverting terminal A with respect to the inverting terminal B.



### 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       |
| $V_{OH}$         | High-level output voltage                           | $V_{IH} = 2$ V, $I_{OH} = -33$ mA<br>$V_{IL} = 0.8$ V,  |                  | 3.7  |            | V       |
| $V_{OL}$         | Low-level output voltage                            | $V_{IH} = 2$ V, $I_{OH} = 33$ mA<br>$V_{IL} = 0.8$ V,   |                  | 1.1  |            | V       |
| $ V_{OD1} $      | Differential output voltage                         | $I_O = 0$   |                  |      | $2V_{OD2}$ | V       |
| $ V_{OD2} $      | Differential output voltage                         | $R_L = 100$ $\Omega$ , See Figure 1                     | 2                | 2.7  |            | V       |
|                  |   | $R_L = 54$ $\Omega$ , See Figure 1                      | 1.5              | 2.4  |            |         |
| $\Delta V_{OD} $ | Change in magnitude of differential output voltage‡ |   |                  |      | $\pm 0.2$  | V       |
| $V_{OC}$         | Common-mode output voltage§                         | $R_L = 54$ $\Omega$ or $100$ $\Omega$ ,<br>See Figure 1 |                  |      | 3          | V       |
| $\Delta V_{OC} $ | Change in magnitude of common-mode output voltage‡  |   |                  |      | $\pm 0.2$  | V       |
| $I_O$            | Output current                                      | Output disabled,<br>See Note 3                          | $V_O = 12$ V     |      | 1          | mA      |
|                  |   |   | $V_O = -7$ V     |      | -0.8       |         |
| $I_{IH}$         | High-level input current                            | $V_I = 2.4$ V   |                  |      | 20         | $\mu$ A |
| $I_{IL}$         | Low-level input current                             | $V_I = 0.4$ V   |                  |      | -400       | $\mu$ A |
| $I_{OS}$         | Short-circuit output current                        | $V_O = -7$ V  |                  |      | -250       | mA      |
|                  |   | $V_O = V_{CC}$  |                  |      | 250        |         |
|                  |   | $V_O = 12$ V  |                  |      | 500        |         |
| $I_{CC}$         | Supply current (total package)                      | No load   | Outputs enabled  | 35   | 50         | mA      |
|                  |   |   | Outputs disabled | 26   | 40         |         |

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

‡  $\Delta|V_{OD}|$  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.

§ In ANSI Standard EIA/TIA-422-B,  $V_{OC}$ , which is the average of the two output voltages with respect to GND, is called output offset voltage,  $V_{OS}$ .

NOTE 3: This applies for both power on and off; refer to ANSI Standard EIA/TIA-422-B for exact conditions.

### switching characteristics, $V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$

| PARAMETER   |                                     | TEST CONDITIONS                     | MIN | TYP | MAX | UNIT |
|-------------|-------------------------------------|-------------------------------------|-----|-----|-----|------|
| $t_{d(OD)}$ | Differential-output delay time      | $R_L = 60$ $\Omega$ , See Figure 3  |     | 40  | 60  | ns   |
| $t_{t(OD)}$ | Differential-output transition time |                                     |     | 65  | 95  |      |
| $t_{PZH}$   | Output enable time to high level    | $R_L = 110$ $\Omega$ , See Figure 4 |     | 55  | 90  | ns   |
| $t_{PZL}$   | Output enable time to low level     | $R_L = 110$ $\Omega$ , See Figure 5 |     | 30  | 50  | ns   |
| $t_{PHZ}$   | Output disable time from high level | $R_L = 110$ $\Omega$ , See Figure 4 |     | 85  | 130 | ns   |
| $t_{PLZ}$   | Output disable time from low level  | $R_L = 110$ $\Omega$ , See Figure 5 |     | 20  | 40  | ns   |

# SN75176A

## DIFFERENTIAL BUS TRANSCEIVER

SLLS100A – JUNE 1984 – REVISED MAY 1995

### 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 <sub>IT+</sub> | Positive-going input threshold voltage                          | V <sub>O</sub> = 2.7 V,                    | I <sub>O</sub> = -0.4 mA   |       |      | 0.2  | V    |    |
| V <sub>IT-</sub> | Negative-going input threshold voltage                          | V <sub>O</sub> = 0.5 V,                    | I <sub>O</sub> = 8 mA      | -0.2‡ |      |      | V    |    |
| V <sub>hys</sub> | Input hysteresis voltage (V <sub>IT+</sub> - V <sub>IT-</sub> ) |  |                            |       | 50   |      | mV   |    |
| V <sub>IK</sub>  | Enable clamp voltage  | I <sub>I</sub> = -18 mA                    |                            |       |      | -1.5 | V    |    |
| V <sub>OH</sub>  | High-level output voltage                                       | V <sub>ID</sub> = 200 mV,<br>See Figure 2  | I <sub>OH</sub> = -400 μA, |       | 2.7  |      | V    |    |
| V <sub>OL</sub>  | Low-level output voltage  | V <sub>ID</sub> = -200 mV,<br>See Figure 2 | I <sub>OL</sub> = 8 mA,    |       |      | 0.45 | V    |    |
| I <sub>OZ</sub>  | High-impedance-state output current                             | V <sub>O</sub> = 0.4 V to 2.4 V            |                            |       |      | ±20  | μA   |    |
| I <sub>I</sub>   | Line input current  | Other input = 0 V,<br>See Note 3           | V <sub>I</sub> = 12 V      |       |      | 1    | mA   |    |
|                  |   |  | V <sub>I</sub> = -7 V      |       |      | -0.8 |      |    |
| I <sub>IH</sub>  | High-level enable input current                                 | V <sub>IH</sub> = 2.7 V                    |                            |       |      | 20   | μA   |    |
| I <sub>IL</sub>  | Low-level enable input current                                  | V <sub>IL</sub> = 0.4 V                    |                            |       |      | -100 | μA   |    |
| r <sub>i</sub>   | Input resistance  |  |                            |       | 12   |      | kΩ   |    |
| I <sub>OS</sub>  | Short-circuit output current                                    |  |                            |       |      | -15  | -85  | mA |
| I <sub>CC</sub>  | Supply current (total package)                                  | No load                                    | Outputs enabled            |       |      | 35   | 50   | mA |
|                  |   |  | Outputs disabled           |       |      | 26   | 40   |    |

† All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 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 3: This applies for both power on and power off. Refer to ANSI Standard EIA/TIA-422-B for exact conditions.

### switching characteristics, V<sub>CC</sub> = 5 V, C<sub>L</sub> = 15 pF, T<sub>A</sub> = 25°C

| PARAMETER        |  | TEST CONDITIONS                    |              | MIN | TYP | MAX | UNIT |
|------------------|--|------------------------------------|--------------|-----|-----|-----|------|
| t <sub>PLH</sub> | Propagation delay time, low-to-high-level output | V <sub>ID</sub> = -1.5 V to 1.5 V, | See Figure 6 |     | 21  | 35  | ns   |
| t <sub>PHL</sub> | Propagation delay time, high-to-low-level output |                                    |              |     | 23  | 35  | ns   |
| t <sub>PZH</sub> | Output enable time to high level                 | See Figure 7                       |              |     | 10  | 30  | ns   |
| t <sub>PZL</sub> | Output enable time to low level                  |                                    |              |     | 12  | 30  | ns   |
| t <sub>PHZ</sub> | Output disable time from high level              | See Figure 7                       |              |     | 20  | 35  | ns   |
| t <sub>PLZ</sub> | Output disable time from low level               |                                    |              |     | 17  | 25  | ns   |



PARAMETER MEASUREMENT INFORMATION

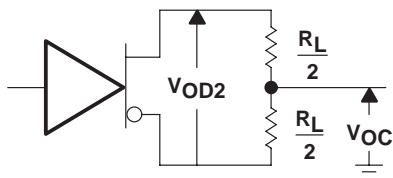


Figure 1. Driver  $V_{OD}$  and  $V_{OC}$

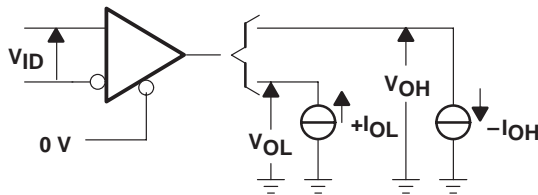
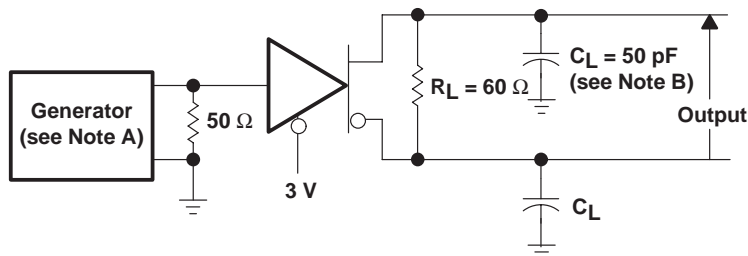
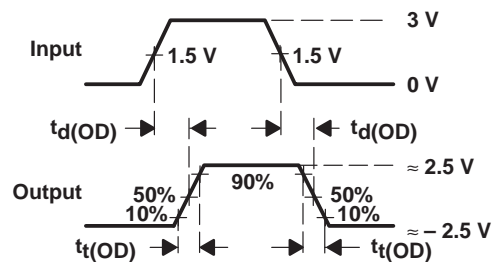


Figure 2. Receiver  $V_{OH}$  and  $V_{OL}$



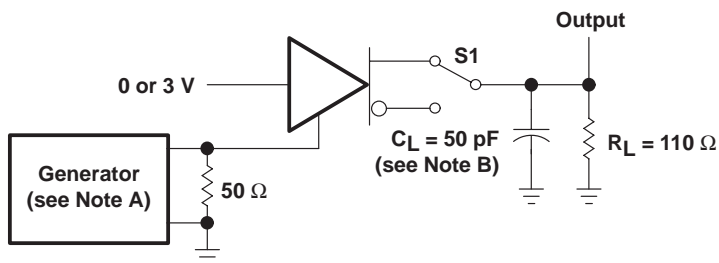
TEST CIRCUIT



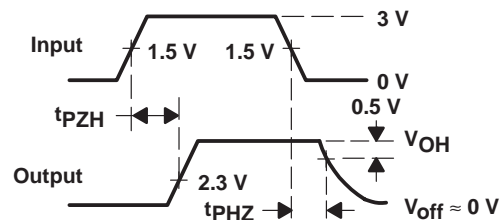
VOLTAGE WAVEFORMS

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

Figure 3. Driver Test Circuit and Voltage Waveforms



TEST CIRCUIT



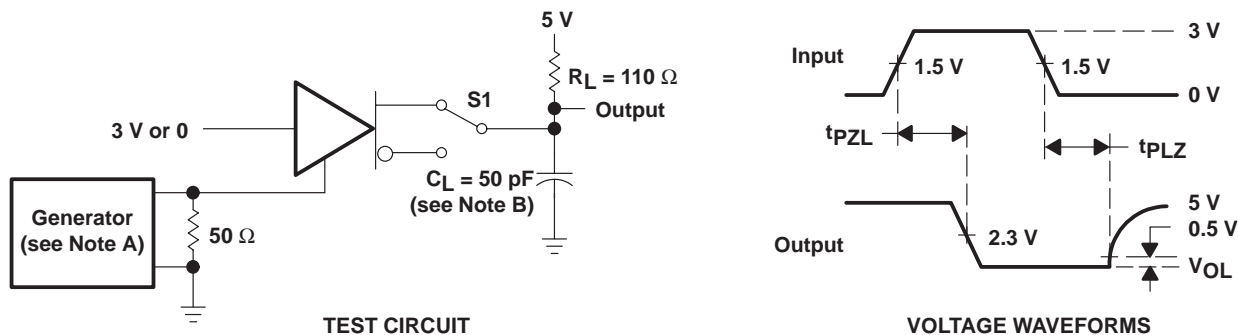
VOLTAGE WAVEFORMS

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

Figure 4. Driver Test Circuit and Voltage Waveforms

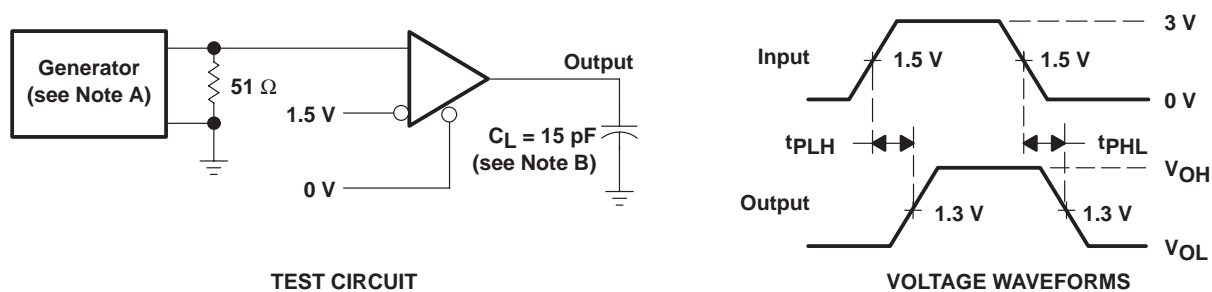
# SN75176A DIFFERENTIAL BUS TRANSCEIVER

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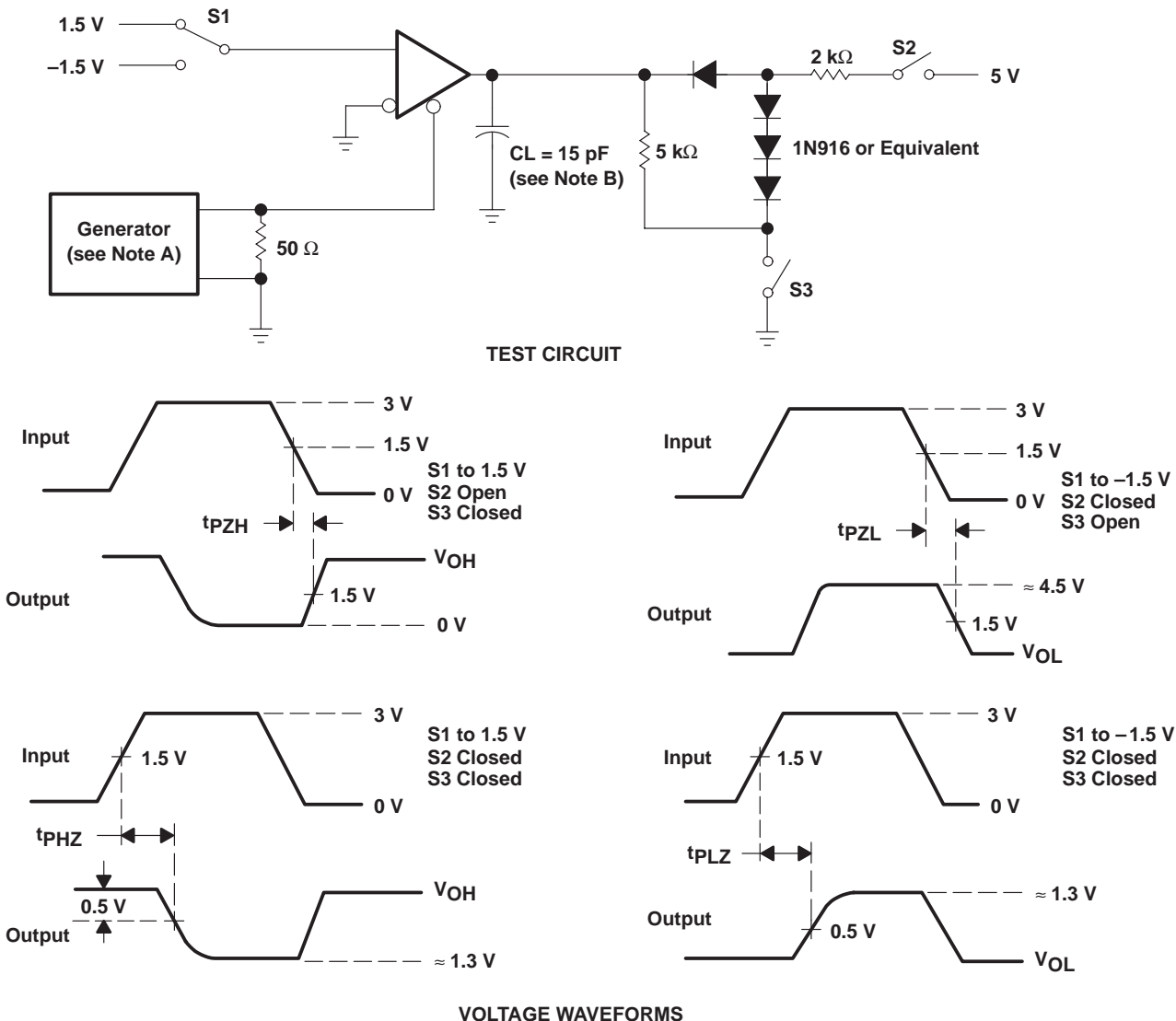
NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR = 1 MHz, 50% duty cycle,  $t_r \leq 6$  ns,  $t_f \leq 6$  ns,  $Z_O = 50 \Omega$ .  
 B.  $C_L$  includes probe and jig capacitance.

**Figure 5. Driver Test Circuit and Voltage Waveforms**



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

**Figure 6. Receiver Test Circuit and Voltage Waveforms**



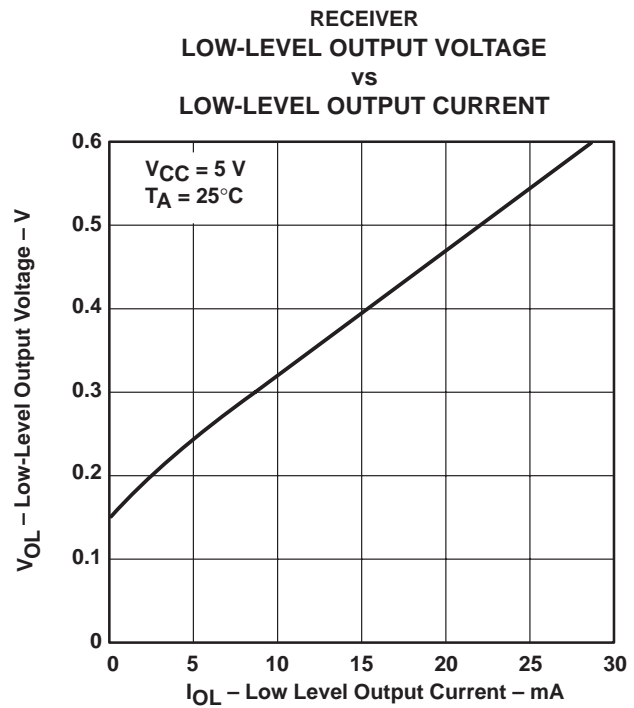
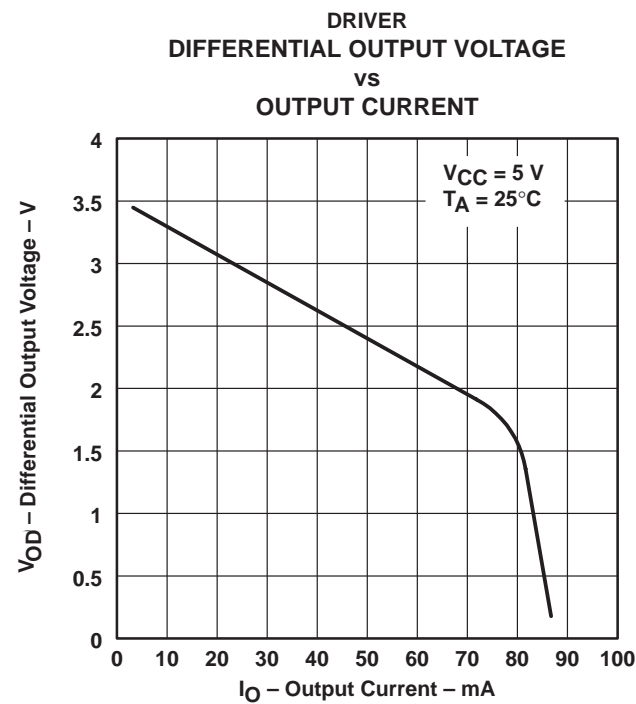
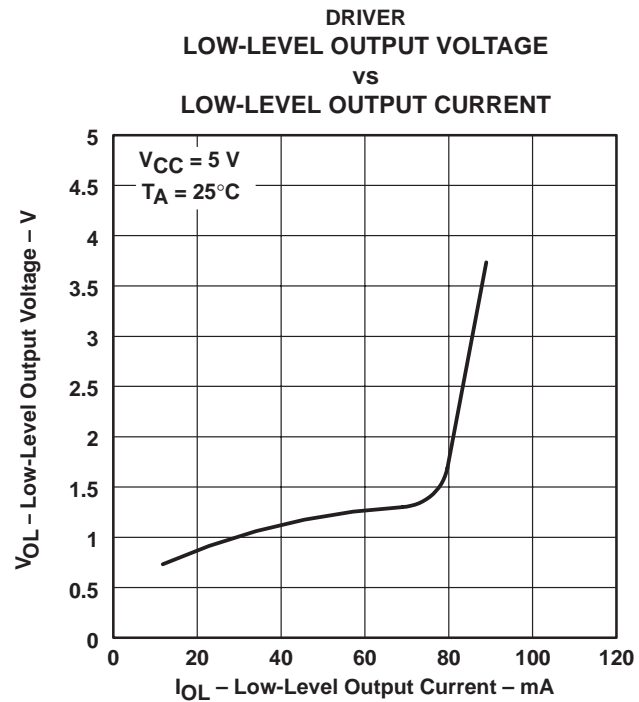
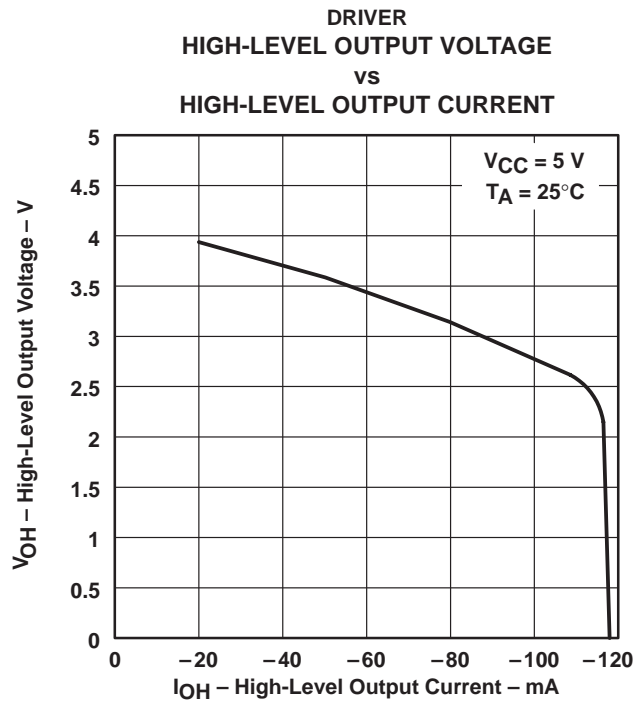
- NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR = 1 MHz, 50% duty cycle,  $t_r \leq 6$  ns,  $t_f \leq 6$  ns,  $Z_O = 50 \Omega$ .  
 B.  $C_L$  includes probe and jig capacitance.

**Figure 7. Receiver Test Circuit and Voltage Waveforms**

# SN75176A DIFFERENTIAL BUS TRANSCEIVER

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## TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS

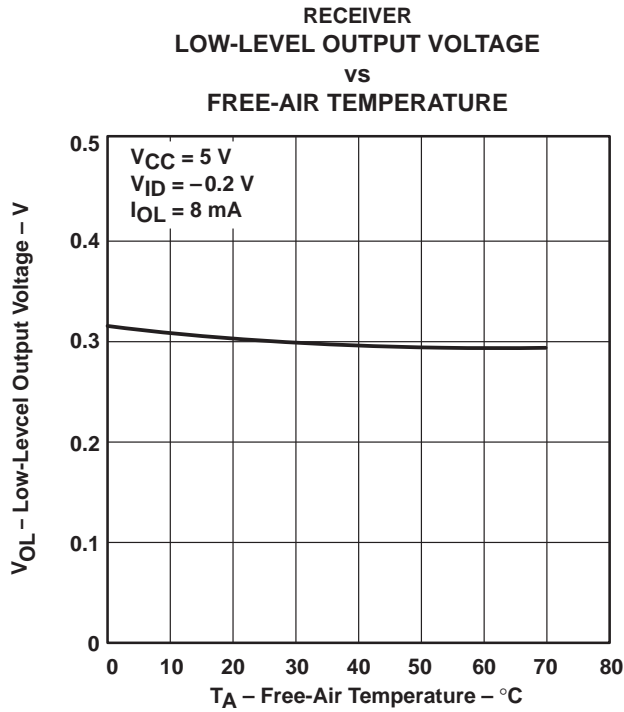


Figure 12

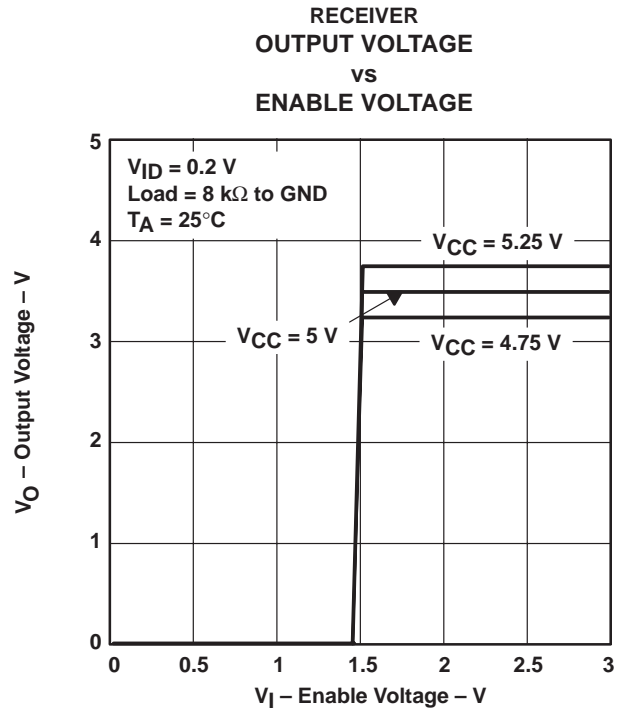


Figure 13

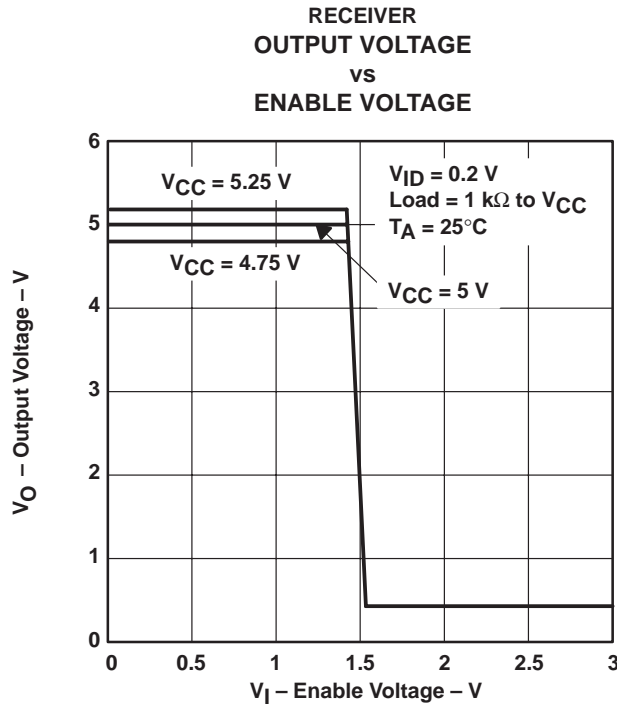
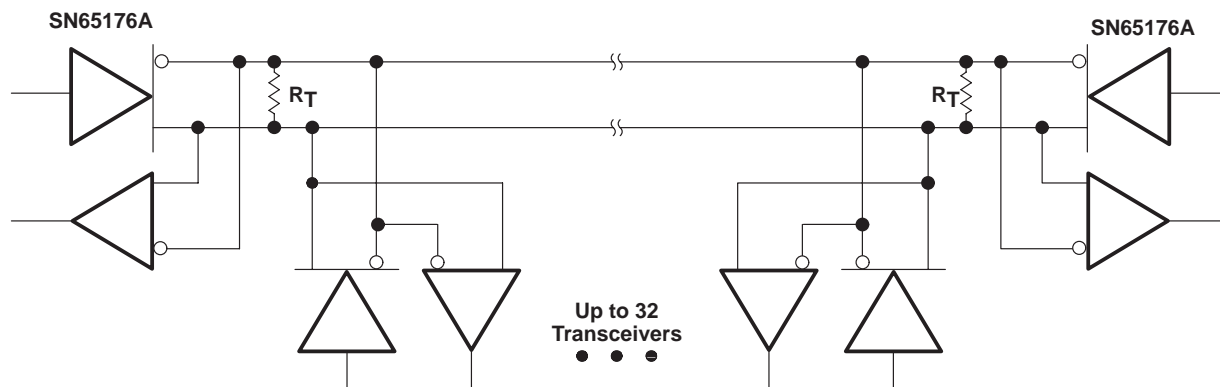


Figure 14

# SN75176A DIFFERENTIAL BUS TRANSCEIVER

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## APPLICATION INFORMATION



NOTE A: The line should be terminated 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 15. Typical Application Circuit

**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN75176AD        | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN75176ADE4      | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN75176ADG4      | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN75176ADR       | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN75176ADRE4     | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN75176ADRG4     | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN75176AP        | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| SN75176APE4      | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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**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 |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN75176ADR | 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) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN75176ADR | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |

P (R-PDIP-T8)

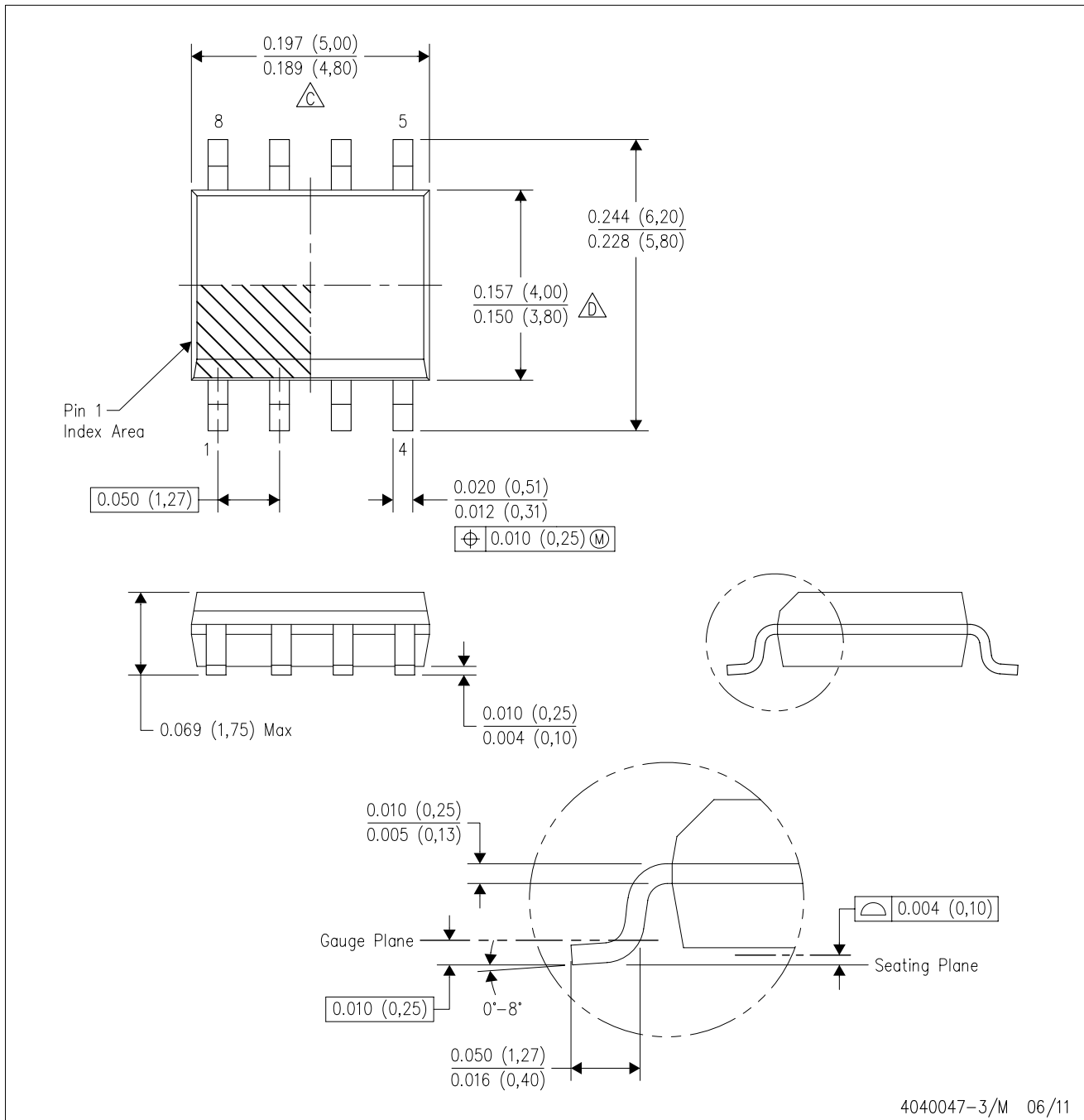
PLASTIC DUAL-IN-LINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Falls within JEDEC MS-001 variation BA.

D (R-PDSO-G8)

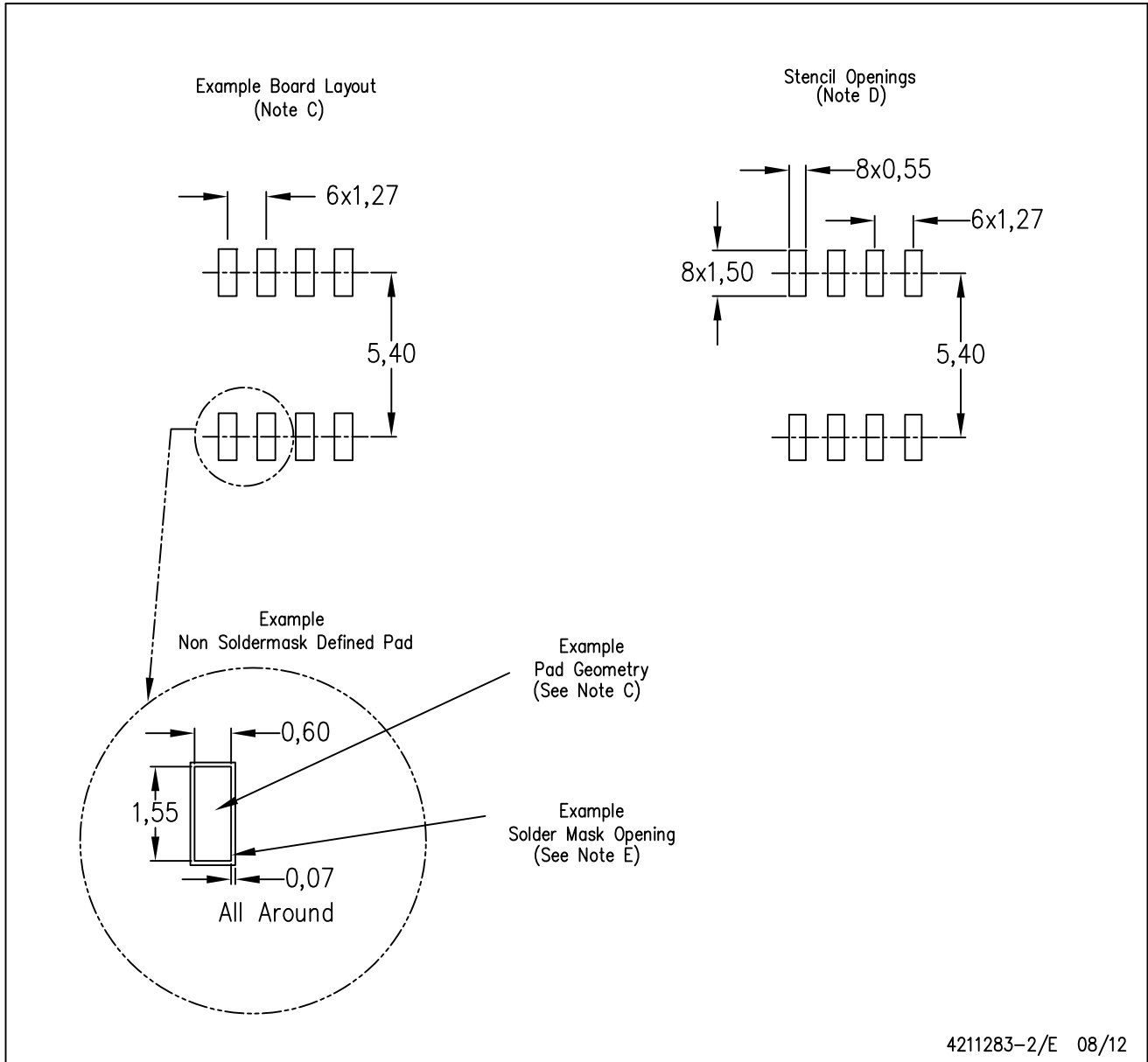
PLASTIC SMALL OUTLINE



NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. 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.  
 D. 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.

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| DSP                    | <a href="http://dsp.ti.com">dsp.ti.com</a>   |
| Clocks and Timers      | <a href="http://www.ti.com/clocks">www.ti.com/clocks</a>                             |
| Interface              | <a href="http://interface.ti.com">interface.ti.com</a>                               |
| Logic                  | <a href="http://logic.ti.com">logic.ti.com</a>                                       |
| Power Mgmt             | <a href="http://power.ti.com">power.ti.com</a>                                       |
| Microcontrollers       | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a>                   |
| RFID                   | <a href="http://www.ti-rfid.com">www.ti-rfid.com</a>                                 |
| OMAP Mobile Processors | <a href="http://www.ti.com/omap">www.ti.com/omap</a>                                 |
| Wireless Connectivity  | <a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a> |

### Applications

|                               |  |
|-------------------------------|--|
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| Consumer Electronics          | <a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>                   |
| Energy and Lighting           | <a href="http://www.ti.com/energy">www.ti.com/energy</a>                                 |
| Industrial                    | <a href="http://www.ti.com/industrial">www.ti.com/industrial</a>                         |
| Medical                       | <a href="http://www.ti.com/medical">www.ti.com/medical</a>                               |
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