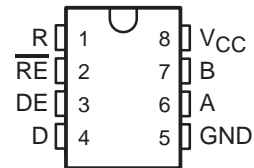


SN75276 FAIL-SAFE DIFFERENTIAL BUS TRANSCEIVER

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- **Bidirectional Transceiver With Fail-Safe Receiver**
- **Meets or Exceeds the Requirements of ITU Recommendation V.11**
- **Electrically Compatible With ANSI Standards TIA/EIA-422-B and TIA/EIA-485-A**
- **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 . . . ± 60 mA Max**
- **Thermal Shutdown Protection**
- **Driver Positive and Negative Current Limiting**
- **Receiver Input Impedance . . . 12 k Ω Min**
- **Receiver Input Sensitivity . . . -300 mV/0 mV**
- **Operates From Single 5-V Supply**
- **Pin-to-Pin Compatible With SN75176A**

**D OR P PACKAGE
(TOP VIEW)**



description

The SN75276 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 is electrically compatible with ANSI Standards TIA/EIA-422-B and TIA/EIA-485-A, and meets ITU Recommendation V.11.

The fail-safe operation ensures a known level on the circuit output under bus fault conditions. The circuit provides a high-level output under floating-line, idle-line, open-circuit, and short-circuit bus conditions (see Function Tables).

The SN75276 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 for 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 Ω .

The SN75276 can be used in transmission line applications employing the SN75172 and SN75174 quadruple differential line drivers and SN75173 and SN75175 quadruple differential line receivers.

SN75276 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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Function Tables

EACH DRIVER

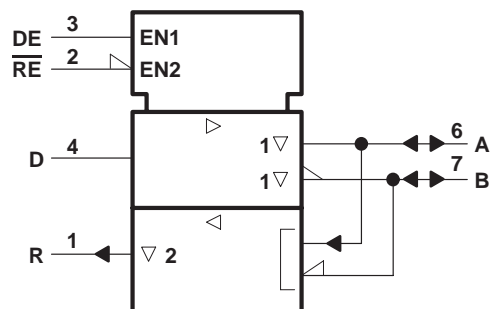
| INPUT D | ENABLE DE | OUTPUTS | |
|------------|--------------|---------|---|
| | | A | B |
| H | H | H | L |
| L | H | L | H |
| X | L | Z | Z |

EACH RECEIVER

| DIFFERENTIAL A – B | ENABLE \overline{RE} | OUTPUT R |
|-------------------------|---------------------------|-------------|
| $V_{ID} \geq 0 V$ | L | H |
| $-0.3 V < V_{ID} < 0 V$ | L | ? |
| $V_{ID} \leq -0.3$ | L | L |
| X | H | Z |
| Open | L | H |

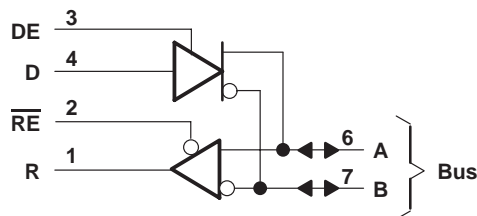
H = high level, L = low level, ? = indeterminate,
X = irrelevant, Z = high impedance (off)

logic symbol†

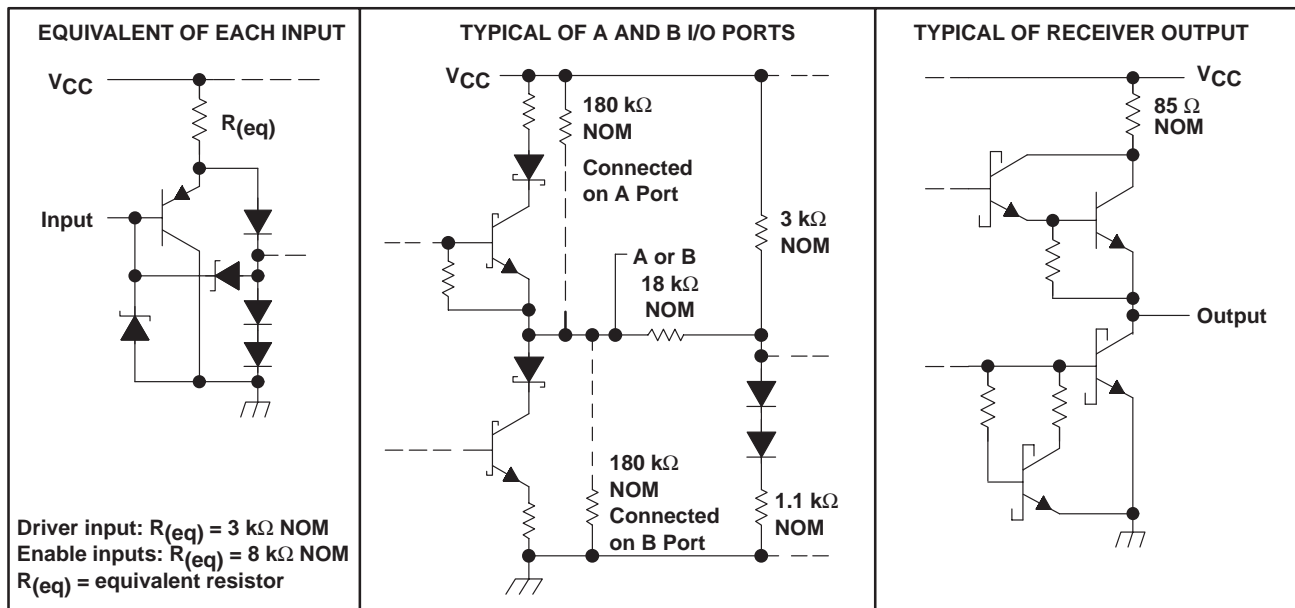


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)



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 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 |
| 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 | $T_A \leq 25^\circ\text{C}$ POWER RATING | DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$ | $T_A = 70^\circ\text{C}$ POWER RATING | $T_A = 105^\circ\text{C}$ POWER RATING |
|---------|---|---|--|---|
| D | 725 mW | 5.8 mW/°C | 464 mW | 261 mW |
| P | 1100 mW | 8.8 mW/°C | 704 mW | 396 mW |

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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} | | 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 2) | | ± 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 | | $^{\circ}C$ |

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 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 | 3.6 | 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 |
| V _{OD3} | Differential output voltage | See Note 3 | | 1.5 | | 5 | V |
| Δ V _{OD} | Change in magnitude of differential output voltage [¶] | R _L = 54 Ω or 100 Ω, See Figure 1 | | | | ±0.2 | V |
| V _{OC} | Common-mode output voltage | | | | | +3 -1 | V |
| Δ V _{OC} | Change in magnitude of common-mode output voltage [¶] | | | | | ±0.2 | V |
| I _O | Output current | Output 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 = -7 V | | | | -250 | mA |
| | | V _O = 0 | | | | 150 | |
| | | V _O = V _{CC} | | | | 250 | |
| | | V _O = 12 V | | | | 250 | |
| I _{CC} | Supply current (total package) | No load | Outputs enabled | | 42 | 70 | mA |
| | | | Outputs disabled | | 26 | 35 | |

[†] The power-off measurement in ANSI Standard 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 a high level to a low level.

NOTES: 3. This applies for both power on and 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.

4. See TIA/EIA-485-A Figure 3.5, Test Termination Measurement 2.

switching characteristics, V_{CC} = 5 V, R_L = 110 kΩ, T_A = 25°C (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|--------------------|-------------------------------------|------------------------|--------------|-----|-----|-----|------|
| t _{d(OD)} | Differential-output delay time | R _L = 54 Ω, | See Figure 3 | | 15 | 22 | ns |
| t _{t(OD)} | Differential-output transition time | | | | 20 | 30 | ns |
| t _{PZH} | Output enable time to high level | See Figure 4 | | | 85 | 120 | ns |
| t _{PZL} | Output enable time to low level | See Figure 5 | | | 40 | 60 | ns |
| t _{PHZ} | Output disable time from high level | See Figure 4 | | | 150 | 250 | ns |
| t _{PLZ} | Output disable time from low level | See Figure 5 | | | 20 | 30 | ns |

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DRIVER SECTION

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} $ | $V_t (R_L = 100 \Omega)$ | $V_t (R_L = 54 \Omega)$ |
| V_{OD3} | None | 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† | MAX | UNIT |
|--|--|----------------------|-------|----------|---------------|
| V_{IT+} Positive-going input threshold voltage | $V_O = 2.7 \text{ V}$, $I_O = -0.4 \text{ mA}$ | | | 0 | V |
| V_{IT-} Negative-going input threshold voltage | $V_O = 0.5 \text{ V}$, $I_O = 8 \text{ mA}$ | $-0.3\ddagger$ | | | V |
| V_{IK} Enable clamp voltage | $I_I = -18 \text{ mA}$ | | | -1.5 | V |
| V_{OH} High-level output voltage | $V_{ID} = 0$, See Figure 2 | | 2.7 | | V |
| V_{OL} Low-level output voltage | $V_{ID} = -300 \text{ mV}$, See Figure 2 | | | 0.45 | V |
| I_{OZ} High-impedance-state output current | $V_O = 0.4 \text{ V to } 2.4 \text{ V}$ | | | ± 20 | μA |
| I_I Line input current | Other input = 0 V, See Note 5 | $V_I = 12 \text{ V}$ | | 1 | mA |
| | | $V_I = -7 \text{ V}$ | | -0.8 | |
| I_{IH} High-level enable input current | $V_{IH} = 2.7 \text{ V}$ | | | 20 | μA |
| I_{IL} Low-level enable input current | $V_{IL} = 0.4 \text{ V}$ | | | -100 | μA |
| r_i Input resistance | $V_I = 12 \text{ V}$ | | 12 | | k Ω |
| I_{OS} Short-circuit output current | | | -15 | -85 | mA |
| I_{CC} Supply current (total package) | No load | Outputs enabled | 42 | 55 | mA |
| | | Outputs disabled | 26 | 35 | |

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

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

NOTE 5: This applies for both power on and power off. Refer to TIA/EIA-485-A for exact conditions.



RECEIVER SECTION

switching characteristics, $V_{CC} = 5\text{ V}$, $C_L = 15\text{ pF}$, $T_A = 25^\circ\text{C}$

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|--|-----|-----|-----|------|
| t_{PLH} Propagation delay time, low- to high-level output | $V_{ID} = 0\text{ to }3\text{ V}$, See Figure 6 | | 21 | 35 | ns |
| t_{PHL} Propagation delay time, high- to low-level output | | | 23 | 35 | ns |
| t_{PZH} Output enable time to high level | See Figure 7 | | 10 | 20 | ns |
| t_{PZL} Output enable time to low level | | | 12 | 20 | ns |
| t_{PHZ} Output disable time from high level | See Figure 7 | | 20 | 35 | ns |
| t_{PLZ} Output disable time from low level | | | 17 | 25 | ns |

PARAMETER MEASUREMENT INFORMATION

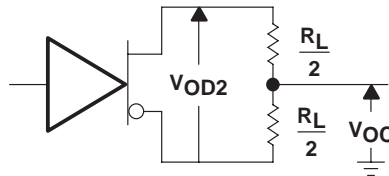


Figure 1. Driver V_{OD} and V_{OC}

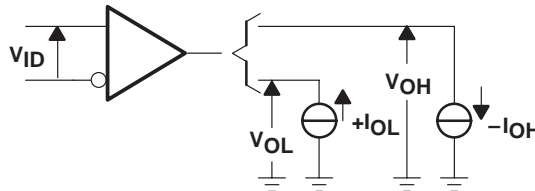
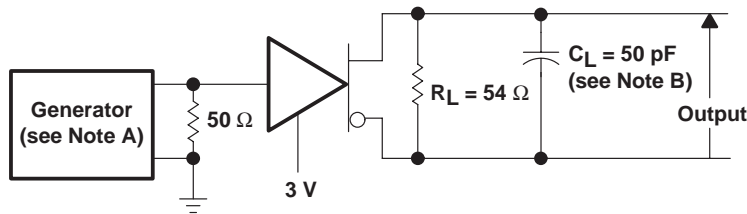
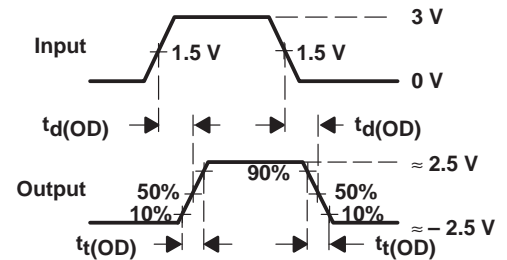


Figure 2. Receiver V_{OH} and V_{OL}



TEST CIRCUIT



VOLTAGE WAVEFORMS

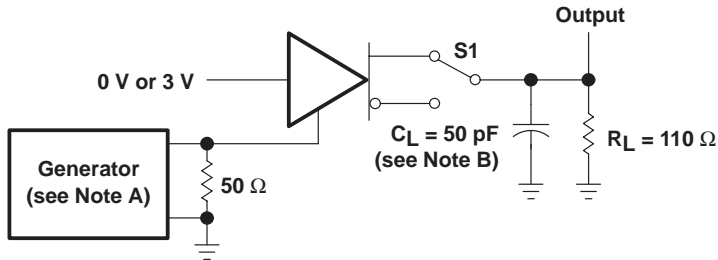
- NOTES: A. The input pulse is supplied by a generator having the following characteristics: $PRR \leq 1\text{ MHz}$, 50% duty cycle, $t_r \leq 6\text{ ns}$, $t_f \leq 6\text{ ns}$, $Z_O = 50\ \Omega$.
 B. C_L includes probe and jig capacitance.

Figure 3. Driver Test Circuit and Voltage Waveforms

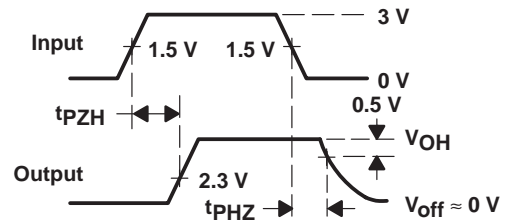
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PARAMETER MEASUREMENT INFORMATION



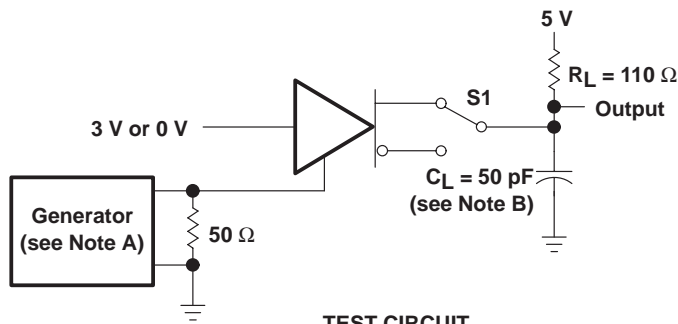
TEST CIRCUIT



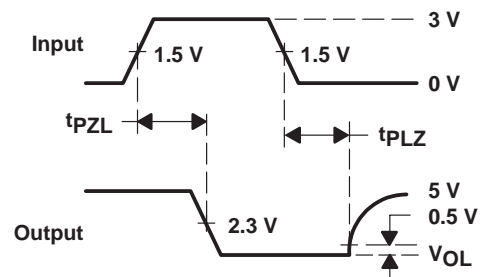
VOLTAGE WAVEFORMS

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

Figure 4. Driver Test Circuit and Voltage Waveforms



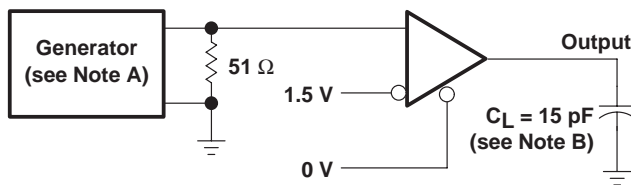
TEST CIRCUIT



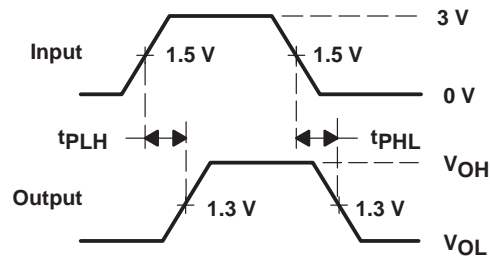
VOLTAGE WAVEFORMS

- NOTES: A. The input pulse is supplied by a generator having the following characteristics: $PRR \leq 1$ 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



TEST CIRCUIT

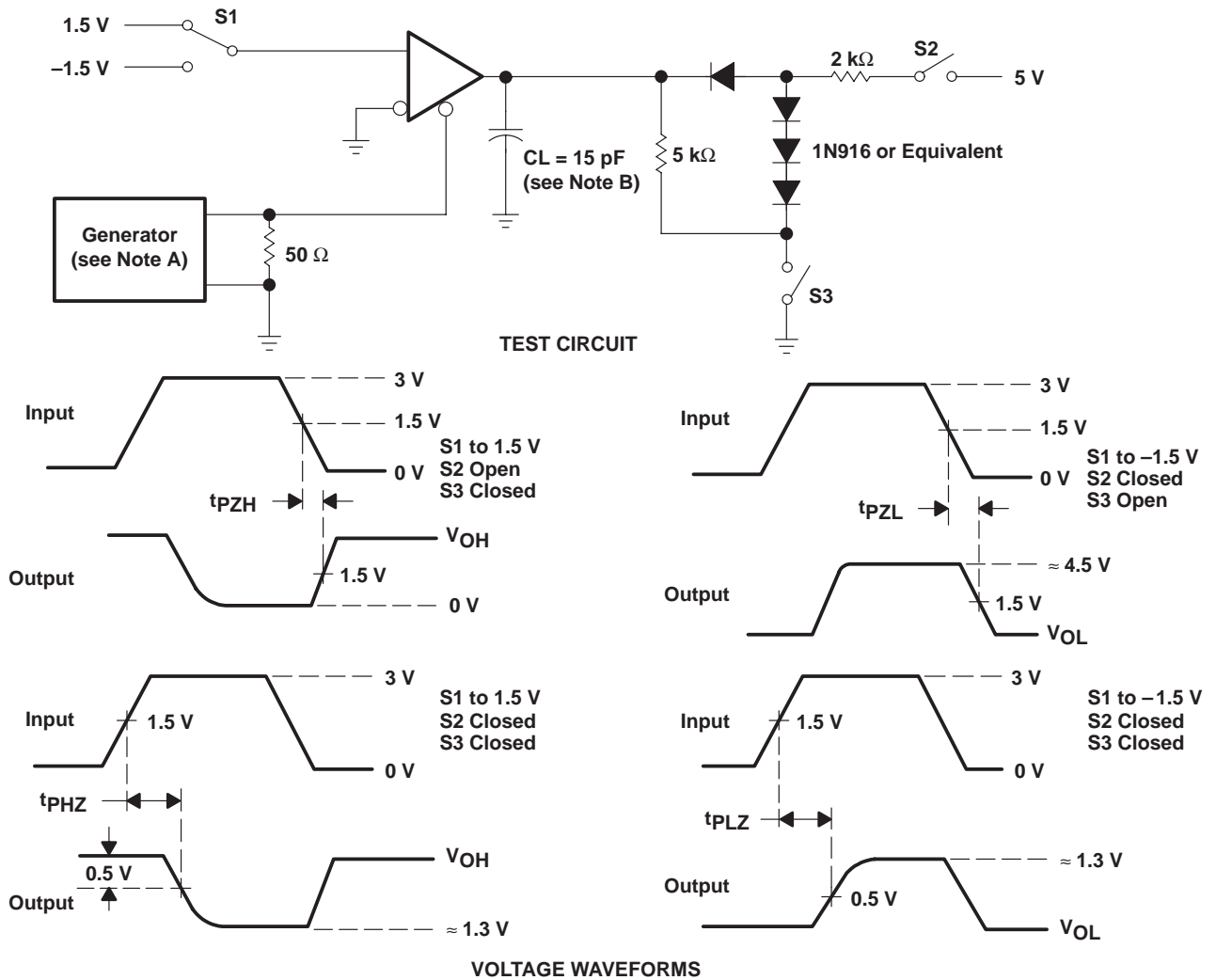


VOLTAGE WAVEFORMS

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

Figure 6. Receiver Test Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION



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

Figure 7. Receiver Test Circuit and Voltage Waveforms

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TYPICAL CHARACTERISTICS

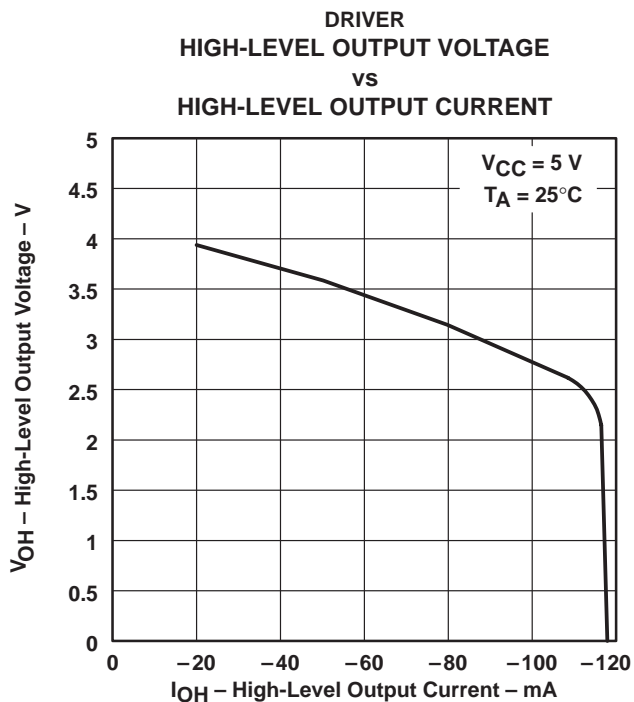


Figure 8

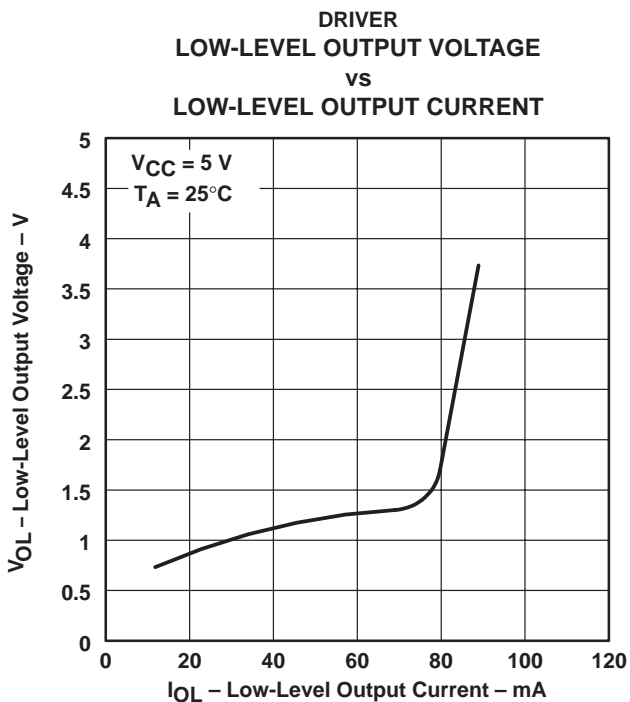


Figure 9

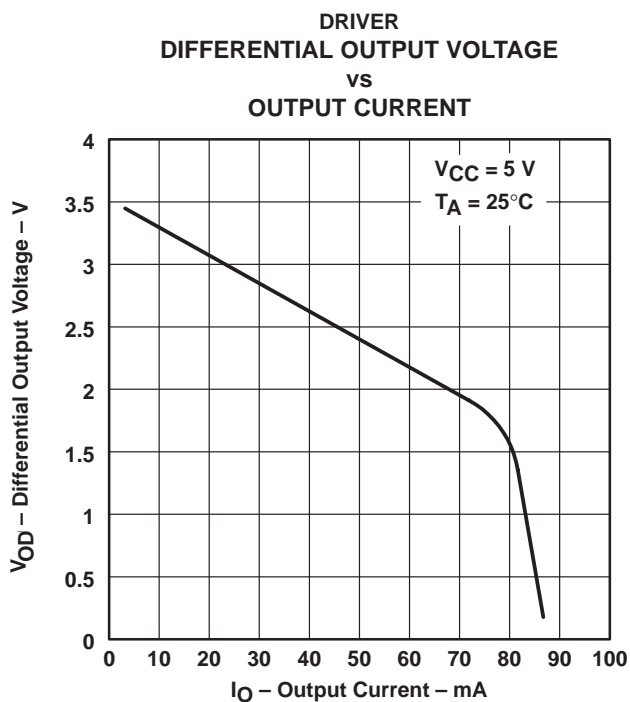
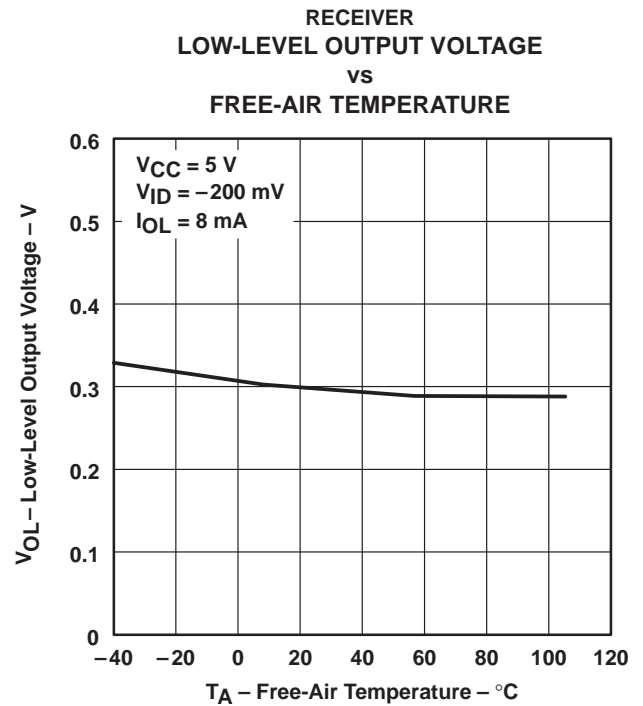
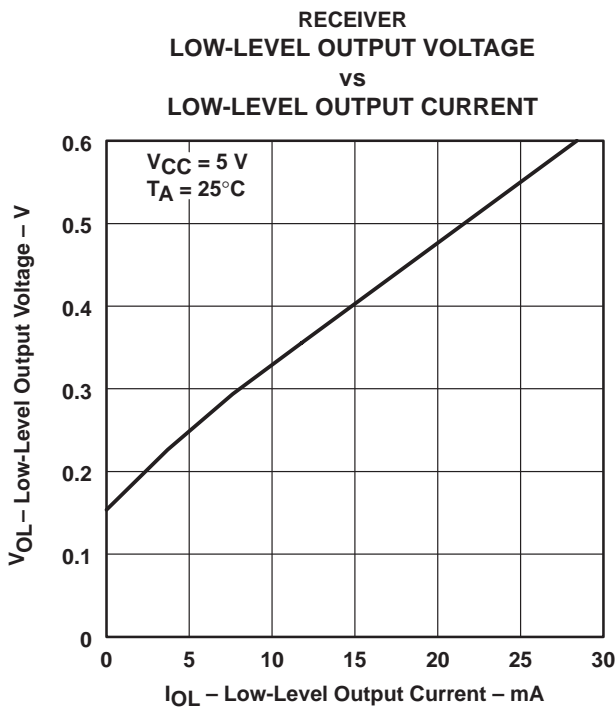
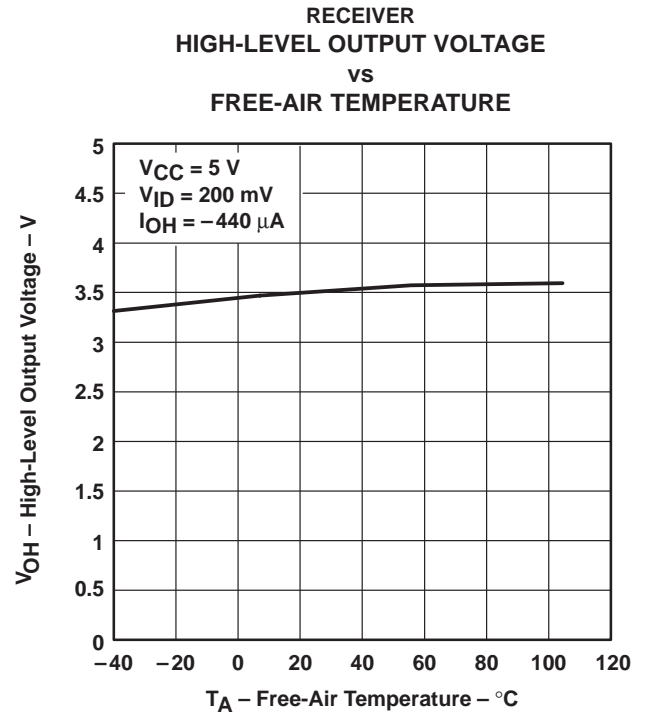
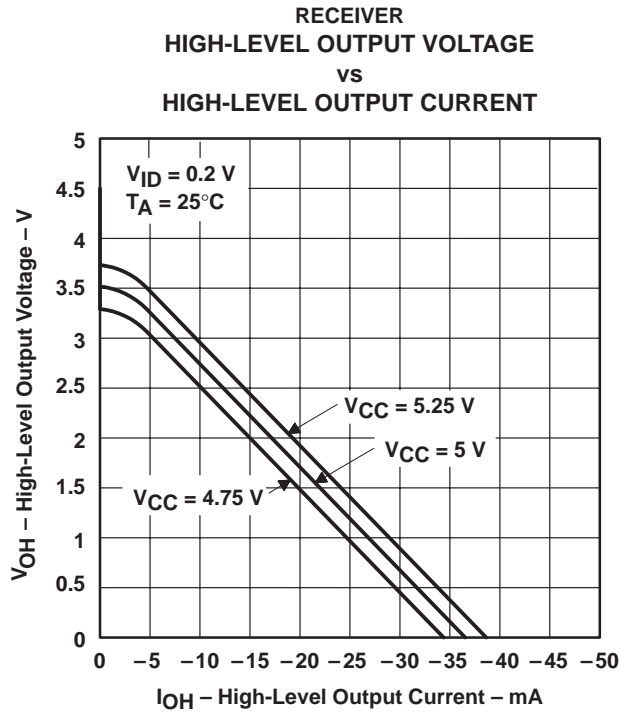


Figure 10



TYPICAL CHARACTERISTICS†

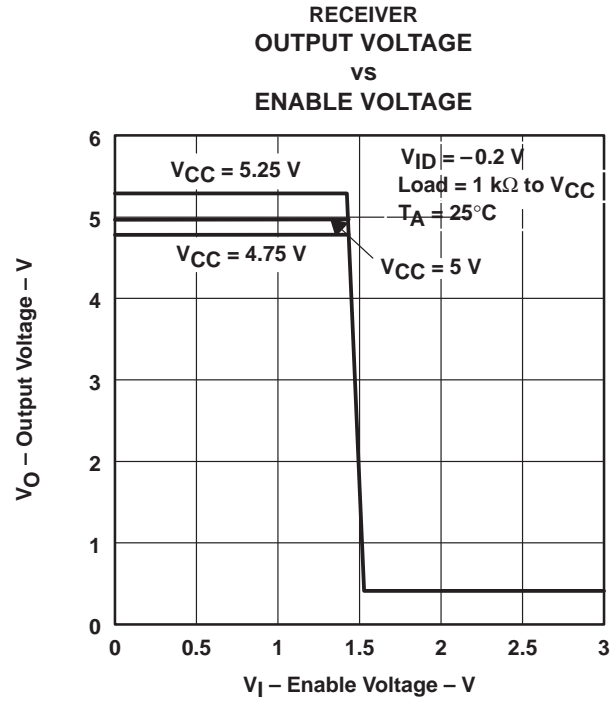
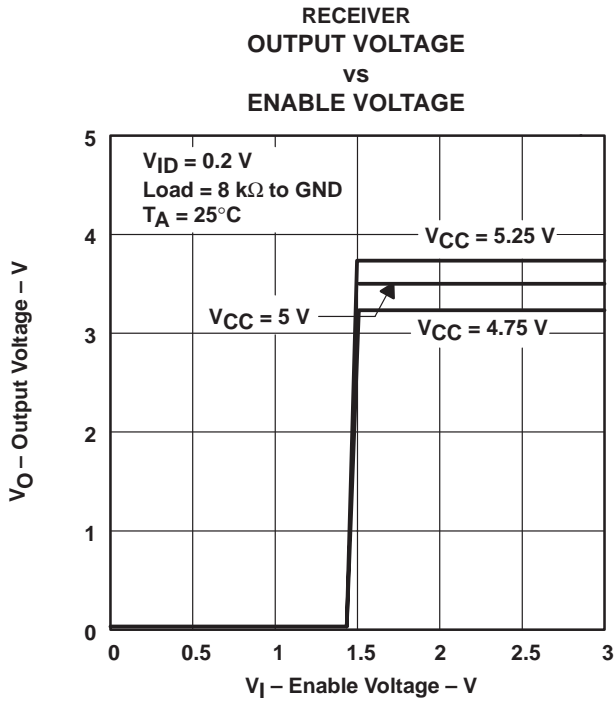


† Operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied.

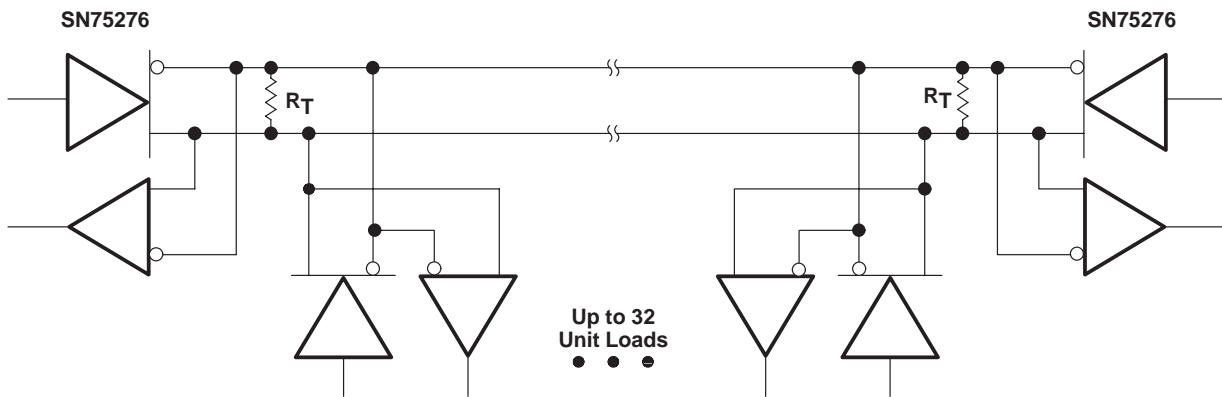
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TYPICAL CHARACTERISTICS



APPLICATION INFORMATION



NOTE A: 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 ($R_T = Z_0$).

Figure 17. Typical Application Circuit

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