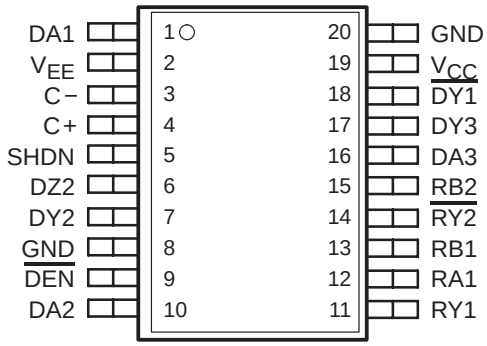
# SN75LBC777
# SINGLE CHIP GEOPORT™/AppleTalk™ TRANSCEIVER

SLLS227 – SEPTEMBER 1996

- **Single-Chip Interface Solution for the 9-Pin GeoPort™ Peripheral Data Circuit-Terminating Equipment (DCE) for the Intelligent Network Port**
- **Designed to Operate up to 4-Mbits/s Full Duplex**
- **Single 5-V Supply Operation**
- **10-kV ESD Protection on Bus Terminals**
- **Backward Compatible with AppleTalk™ and LocalTalk™ LANs**
- **Combines Multiple Components into a Single Chip Solution**
- **Complements the SN75LBC776 9-Terminal GeoPort Host Data Terminal Equipment (DTE) Interface Device**
- **LinBiCMOS™ Process Technology**

**DW PACKAGE**
**(TOP VIEW)**

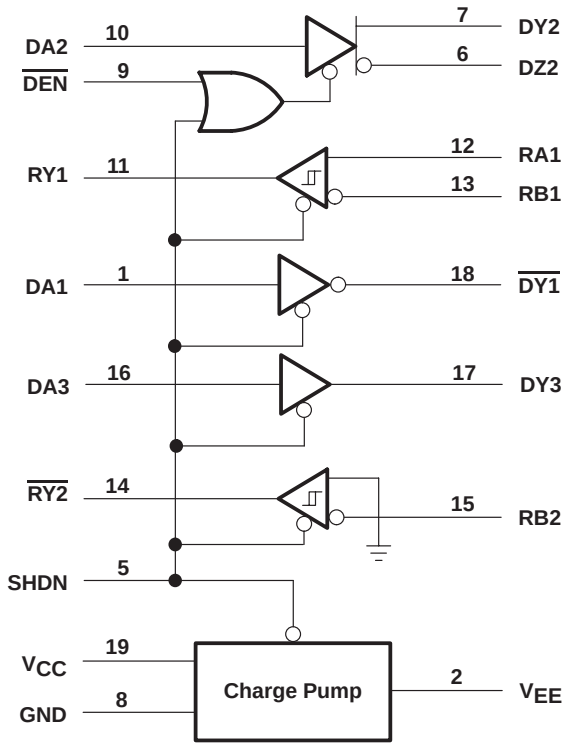



## description

The SN75LBC777 is a low-power LinBiCMOS device that incorporate the drivers and receivers for a 9-pin GeoPort peripheral interface. GeoPort combines hybrid EIA/TIA-422-B and EIA/TIA-423-B drivers and receivers to transmit data up to four-Mbit/s full duplex. GeoPort is a serial communications standard that is intended to replace the RS-232, AppleTalk, and printer ports all in one connector in addition to providing real-time data transfer capability. The SN75LBC777 provides point-to-point connections between GeoPort-compatible devices with data transmission rates up to 4-Mbit/s full duplex over a 4-foot cable. Applications include connection to telephone, integrated services digital network (ISDN), digital sound and imaging, fax-data modems, and other traditional serial and parallel connections. The GeoPort is backwardly compatible to both LocalTalk and AppleTalk LANs.

While the SN75LBC777 is powered off ($V_{CC}$ = 0) the outputs are in a high-impedance state. When the shutdown (SHDN) terminal is high, the charge pump is powered down and the outputs are in a high-impedance state. When high, the driver enable ($\overline{DEN}$) terminal puts the outputs of the differential driver into a high-impedance state.

## logic diagram (positive logic)






TEXAS INSTRUMENTS
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265
POST OFFICE BOX 1443 • HOUSTON, TEXAS 77251–1443

## description (continued)

A switched-capacitor voltage converter generates the negative voltage required from a single 5-V supply using two 0.33-µF capacitors. One capacitor is between the C+ and C− terminals and the other is between $V_{EE}$ and ground.

The SN75LBC777 is characterized for operation over the 0°C to 70°C temperature range.

**DRIVER FUNCTION TABLE**

| INPUTS | | | ENABLE | | OUTPUTS | | | |
|---|---|---|---|---|---|---|---|---|
| DA1 | DA2 | DA3 | SHDN | $\overline{DEN}$ | $\overline{DY1}$ | DY2 | DZ2 | DY3 |
| H | X | H | L | X | L | X | X | H |
| L | X | L | L | X | H | X | X | L |
| X | H | X | L | L | X | H | L | X |
| X | L | X | L | L | X | L | H | X |
| OPEN | OPEN | OPEN | L | L | L | H | L | H |
| X | X | X | H | X | Z | Z | Z | Z |
| X | X | X | X | H | X | Z | Z | X |
| X | X | X | OPEN | OPEN | Z | Z | Z | Z |

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

**RECEIVER FUNCTION TABLE**

| INPUTS | | | ENABLE | OUTPUTS | |
|---|---|---|---|---|---|
| RA1 | RB1 | RB2 | SHDN | RY1 | $\overline{RY2}$ |
| H | L | H | L | H | L |
| L | H | L | L | L | H |
| OPEN | | OPEN | L | H | H |
| SHORT† | | SHORT† | L | ? | ? |
| X | X | X | H | Z | Z |
| X | X | X | OPEN | Z | Z |

† $-0.2\ V < V_{ID} < 0.2\ V$

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

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

Positive supply voltage range, $V_{CC,}$ (see Note 1) . . . . . −0.5 to 7 V
Negative supply voltage range, $V_{EE,}$ (see Note 1) . . . . . −7 to 0.5 V
Receiver input voltage range (RA1, RB1, RB2) . . . . . −15 V to 15 V
Receiver differential input voltage range, $V_{ID}$ . . . . . −12 V to 12 V
Receiver output voltage range (RY1, $\overline{RY2}$) . . . . . −0.5 V to 5.5 V
Driver output voltage range (Power Off)($\overline{DY1}$, DY2, DZ2, DY3) . . . . . −15 V to 15 V
Driver output voltage range (Power On)($\overline{DY1}$, DY2, DZ2, DY3) . . . . . −11 V to 11 V
Driver input voltage range (DA, SHDN, $\overline{DEN}$) . . . . . −0.5 V to $V_{CC}$ +0.4 V
Electrostatic discharge (see Note 2)
  Bus Pins (Class 3 A) . . . . . 10 kV
  Bus Pins (Class 3 B) . . . . . 600 V
  All Pins (Class 3, A) . . . . . 2 kV
  All Pins (Class 3 B) . . . . . 200 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.

NOTES: 1. All voltages values are with respect to the network ground terminal unless otherwise noted.
2. This rating is measured using MIL-STD-883C Method, 3015.7.

**DISSIPATION RATING TABLE**

| PACKAGE | $T_A \le 25°C$ POWER RATING | DERATE FACTOR ABOVE $T_A = 25°C$ | $T_A = 70°C$ POWER RATING |
|---|---|---|---|
| DW | 1125 mW | 9.0°C | 720 mW |

## recommended operating conditions

| | MIN | NOM | MAX | UNIT |
|---|---|---|---|---|
| Supply voltage, $V_{CC}$ | 4.75 | 5 | 5.25 | V |
| High-level input voltage, $V_{IH}$ (DA, SHDN, $\overline{DEN}$) | 2 | | 5.25 | V |
| Low-level input voltage, $V_{IL}$ (DA, SHDN, $\overline{DEN}$) | | | 0.8 | V |
| Receiver common-mode input voltage, $V_{IC}$ | −7 | | 7 | V |
| Receiver differential input voltage, $V_{ID}$ | −12 | | 12 | V |
| Voltage converter filter capacitance | 0.33 | | | µF |
| Voltage converter filter capacitor equivalent series resistance (ESR) | 0 | | 0.2 | Ω |
| Operating free-air temperature, $T_A$ | | | 70 | °C |

## driver electrical characteristics over operating free-air temperature range (unless otherwise noted)

| PARAMETER | | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{OH}$ | High-level output voltage | Single ended, See Figure 1 | $R_L$= 12 kΩ | | 3.6 | 4.5 | | V |
| | | | $R_L$= 120 Ω | | 2 | 3.6 | | V |
| $V_{OL}$ | Low-level output voltage | | $R_L$= 12 kΩ | | | −4.5 | −3.6 | V |
| | | | $R_L$ = 120 Ω | | | −2.7 | −1.8 | V |
| $\lvert V_{OD}\rvert$ | Magnitude of differential output voltage $\lvert V_{DY} - V_{DZ}\rvert$ | | $R_L$ = 120 Ω, | See Figure 2 | 4 | | | V |
| $\Delta\lvert V_{OD}\rvert$ | Change in differential voltage magnitude | | | | | | 250 | mV |
| $V_{OC}$ | Common-mode output voltage | | See Figure 3 | | −1 | | 3 | V |
| $\lvert\Delta V_{OC(SS)}\rvert$ | Magnitude of change, common-mode steady-state output voltage | | | | | | 200 | mV |
| $\lvert\Delta V_{OC(PP)}\rvert$ | Magnitude of change, common-mode peak-to-peak output voltage | | | | | 700 | | mV |
| $I_{CC}$ | Supply current | | SHDN = $\overline{DEN}$ = 0 V, | No Load | | 7 | 15 | mA |
| | | | SHDN = $\overline{DEN}$ = 5 V, | No Load | | | 100 | µA |
| $I_{OZ}$ | High-impedance output current | | $V_{CC}$ = 0 or 5 V, | $-10 \le V_O \le 10$ V | | | ±100 | µA |
| $I_{OS}$ | Short-circuit output current | | $V_{CC}$ = 5.25 V, See Note 3 | $-5$ V $\le V_O \le 5$ V, | | ±170 | ±450 | mA |

NOTE 3: Not more than one output should be shorted at one time.

## driver switching characteristics over recommended operating conditions (unless otherwise noted)

| PARAMETER | | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $t_{PHL}$ | Propagation delay time, high-to-low level output | | Single-ended, $R_L$ = 120 Ω, See Figure 4 | | 40 | 75 | ns |
| $t_{PLH}$ | Propagation delay time, low-to-high level output | | | | 40 | 75 | ns |
| $t_{PZL}$ | Driver output enable time to low-level output | SHDN | | | 25 | 100 | µs |
| $t_{PZH}$ | Driver output enable time to high-level output | SHDN | | | 25 | 100 | µs |
| $t_{PLZ}$ | Driver output disable time from low-level output | SHDN | | | 30 | 100 | ns |
| $t_{PHZ}$ | Driver output disable time from high-level output | SHDN | | | 30 | 100 | ns |
| $t_r$ | Rise time | | | 10 | 25 | 75 | ns |
| $t_f$ | Fall time | | | 10 | 25 | 75 | ns |
| $t_{PHL}$ | Propagation delay time, high-to-low level output | | Differential, $R_L$ = 120 Ω, See Figure 5 | | 40 | 75 | ns |
| $t_{PLH}$ | Propagation delay time, low-to-high level output | | | | 40 | 75 | ns |
| $t_{PZL}$ | Driver output enable time to low-level output | SHDN | | | 25 | 100 | µs |
| | | $\overline{DEN}$ | | | 35 | 100 | ns |
| $t_{PZH}$ | Driver output enable time to high-level output | SHDN | | | 25 | 100 | µs |
| | | $\overline{DEN}$ | | | 35 | 150 | ns |
| $t_{PLZ}$ | Driver output disable time from low-level output | SHDN | | | 30 | 100 | ns |
| | | $\overline{DEN}$ | | | 30 | 100 | ns |
| $t_{PHZ}$ | Driver output disable time from high-level output | SHDN | | | 35 | 100 | ns |
| | | $\overline{DEN}$ | | | 35 | 100 | ns |
| $t_r$ | Rise time | | | 10 | 25 | 75 | ns |
| $t_f$ | Fall time | | | 10 | 25 | 75 | ns |
| $t_{SK(P)}$ | Pulse skew, $\lvert t_{PLH} - t_{PHL} \rvert$ | | | | | 22 | ns |

## receiver electrical characteristics over free-air temperature range (unless otherwise noted)

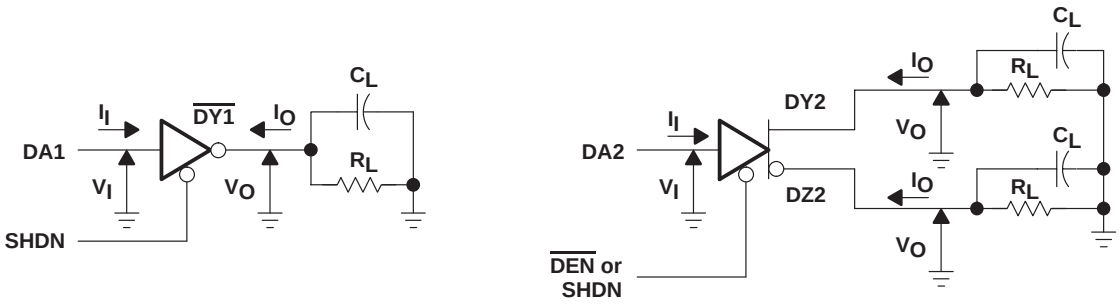
| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $V_{IT+}$ | Positive-going input threshold voltage | | | | | 200 | mV |
| $V_{IT-}$ | Negative-going input threshold voltage | | | −200 | | | mV |
| $V_{hys}$ | Differential input voltage hysteresis ($V_{IT+} - V_{IT-}$) | | | | 50 | | mV |
| $V_{OH}$ | High-level output voltage (see Note 4) | $I_{OH}$ = 2 mA, | $V_{IC}$ = 0 | 2 | 4.9 | | V |
| $V_{OL}$ | Low-level output voltage | $I_{OL}$ = −2 mA, | $V_{IC}$ = 0 | | 0.2 | 0.8 | V |
| $I_{OS}$ | Short-circuit output current | $V_O$ = 0 | | −85 | −45 | | mA |
| | | $V_O$ = 5.25 V | | | 45 | 85 | mA |
| $R_I$ | Input resistance | $V_{CC}$ = 0 or 5.25 V, | −12 V ≤ $V_I$ ≤ 12 V | 6 | 30 | | kΩ |

NOTE 4: If the inputs are left unconnected, RA1 interprets this as a high-level input and RB1 and RB2 interpret this as a low-level input so that all outputs are at the high level.

## receiver switching characteristics over free-air temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $t_{PHL}$ | Propagation delay time, high-to-low level output | $R_L$ = 2 kΩ, See Figure 6 | $C_L$ = 15 pF, | | 30 | 75 | ns |
| $t_{PLH}$ | Propagation delay time, low-to-high level output | | | | 30 | 75 | ns |
| $t_r$ | Rise time | | | | 15 | 30 | ns |
| $t_f$ | Fall time | | | | 15 | 30 | ns |
| $t_{sk(p)}$ | Pulse skew $\lvert t_{PLH}-t_{PHL}\rvert$ | | | | | 20 | ns |
| $t_{PZL}$ | Receiver output enable time to low-level output | Differential, See Figure 7 | $C_L$ = 50 pF, | | 35 | 100 | ns |
| $t_{PZH}$ | Receiver output enable time to high-level output | | | | 35 | 100 | ns |
| $t_{PLZ}$ | Receiver output disable time from low-level output | | | | 21 | 100 | ns |
| $t_{PHZ}$ | Receiver output disable time from high-level output | | | | 21 | 100 | ns |
| $t_{PZL}$ | Receiver output enable time to low-level output | Single-ended, See Figure 7 | $C_L$ = 50 pF, | | 12 | 25 | µs |
| $t_{PZH}$ | Receiver output enable time to high-level output | | | | 12 | 25 | µs |
| $t_{PLZ}$ | Receiver output disable time from low-level output | | | | 25 | 100 | ns |
| $t_{PHZ}$ | Receiver output disable time from high-level output | | | | 125 | 400 | ns |

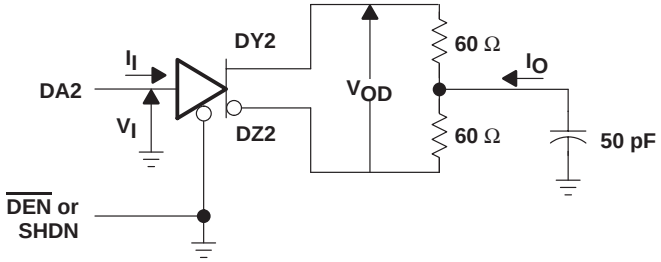
## PARAMETER MEASUREMENT INFORMATION




TEST CIRCUIT

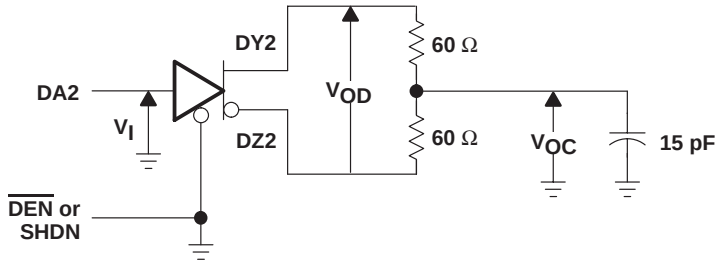
NOTES: A. $C_L$ = 50 pF
B. Driver 3 is a noninverting version of driver 1.

**Figure 1. Single-Ended Driver DC Parameter Test Circuits**

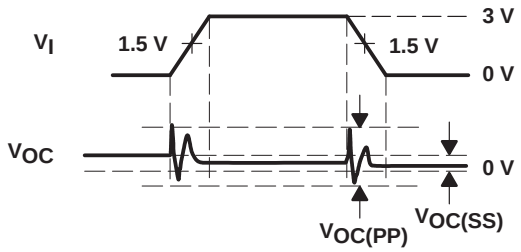



TEST CIRCUIT

**Figure 2. Differential Driver DC Parameter Test Circuit**




TEST CIRCUIT (see Note A)

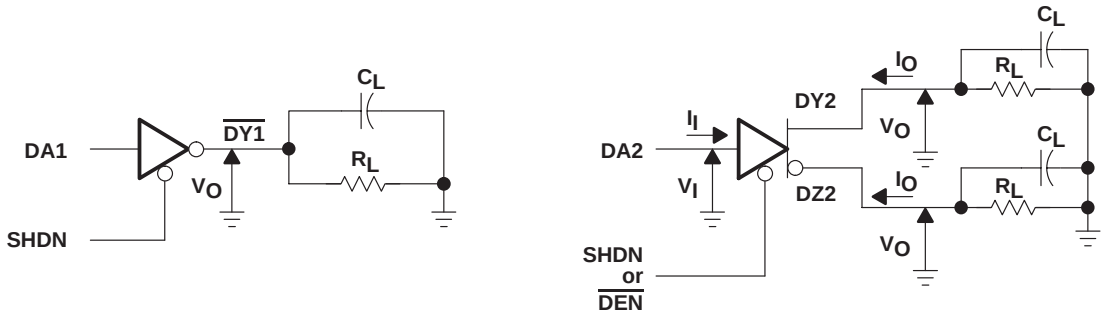



VOLTAGE WAVEFORM

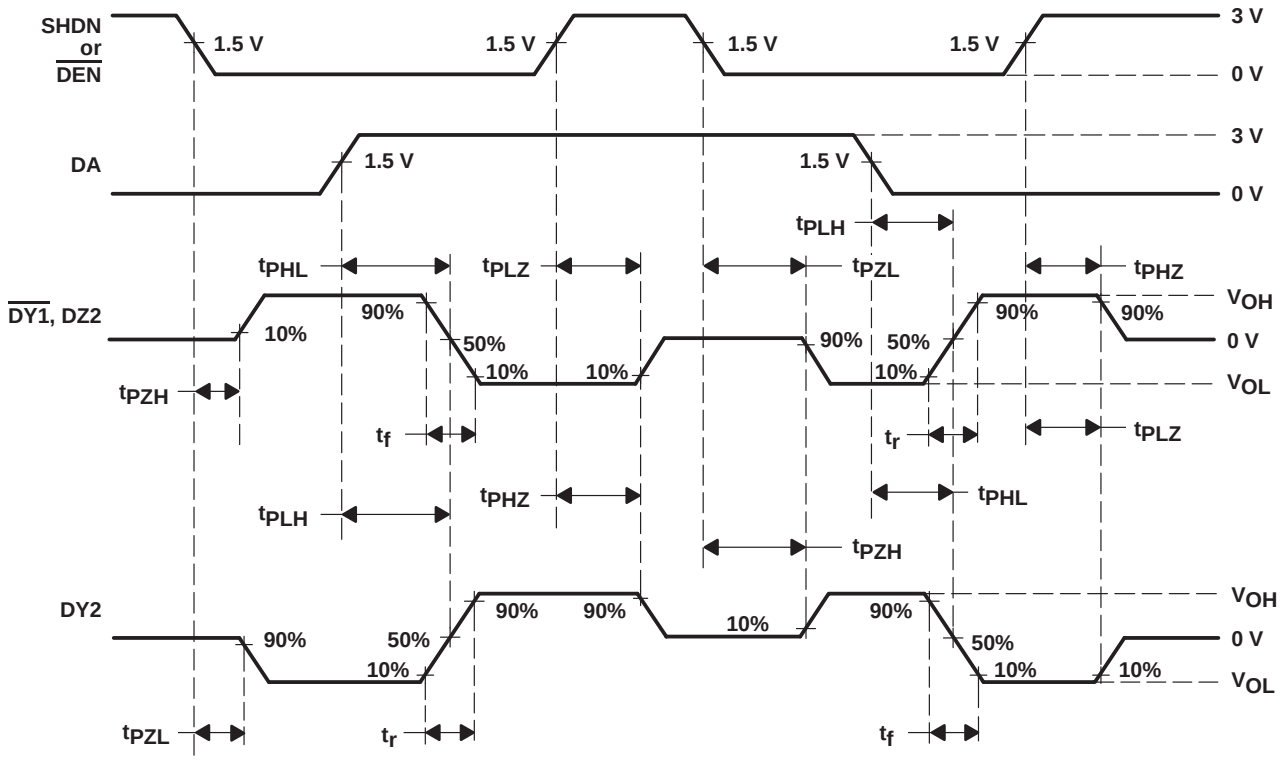
NOTE A. Measured 3dB Bandwidth = 300 MHz

**Figure 3. Differential Driver Common-Mode Output Voltage Test Circuit and Waveform**

## PARAMETER MEASUREMENT INFORMATION




**TEST CIRCUIT**
**(see Note A)**




**VOLTAGE WAVEFORM**
**(see Note B)**

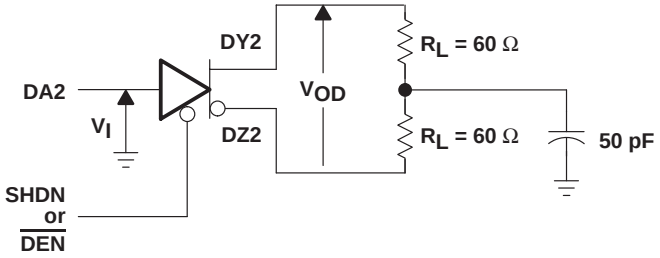
NOTES: A. $C_L$ = 50 pF, $R_L$ = 120 Ω
B. The input waveform $t_r$, $t_f \leq$ 10 ns.
C. Driver 3 is a noninverting version of driver 1.

**Figure 4. Single-Ended Driver Propagation and Transition Times Test Circuits and Waveform**

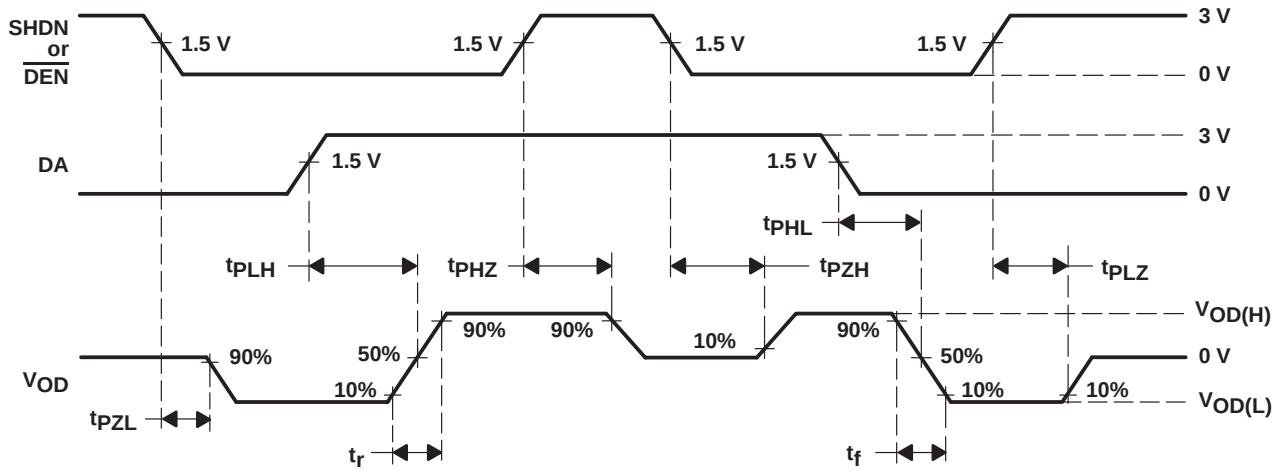


TEXAS INSTRUMENTS
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265
POST OFFICE BOX 1443 • HOUSTON, TEXAS 77251−1443

## PARAMETER MEASUREMENT INFORMATION



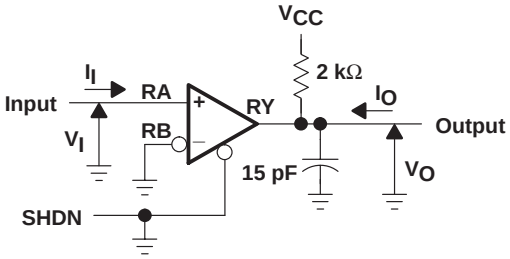

TEST CIRCUIT



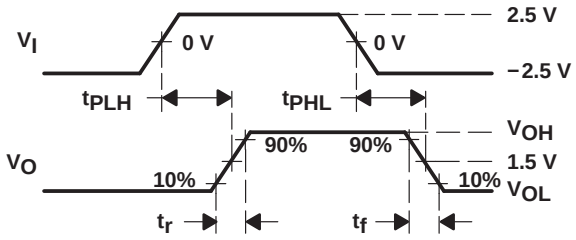

VOLTAGE WAVEFORM

NOTE A: For the input waveform $t_r$, $t_f$ < = 10 ns

**Figure 5. Differential Driver Propagation and Transition Times Test Circuit and Waveforms**




TEST CIRCUIT

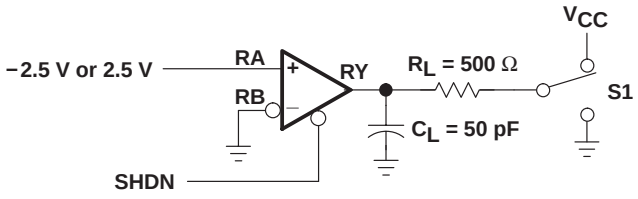



VOLTAGE WAVEFORM

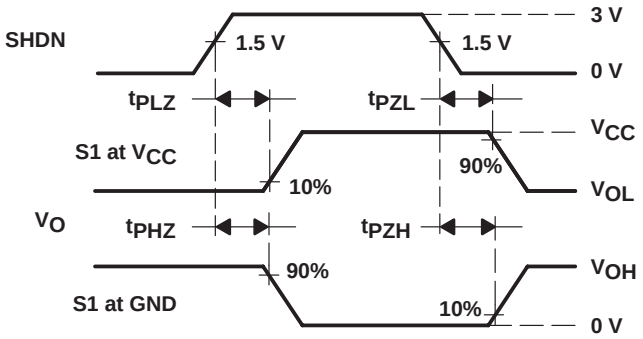
NOTE A: For the input waveform $t_r$, $t_f$ < = 10 ns

**Figure 6. Receiver Propagation and Transition Times Test Circuit and Waveform**

## PARAMETER MEASUREMENT INFORMATION




TEST CIRCUIT




VOLTAGE WAVEFORM

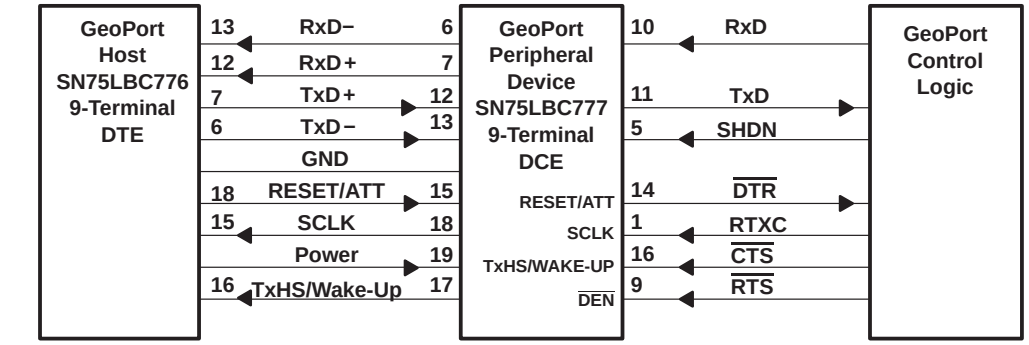
NOTE A: For the input waveform $t_r$, $t_f$ < = 10 ns

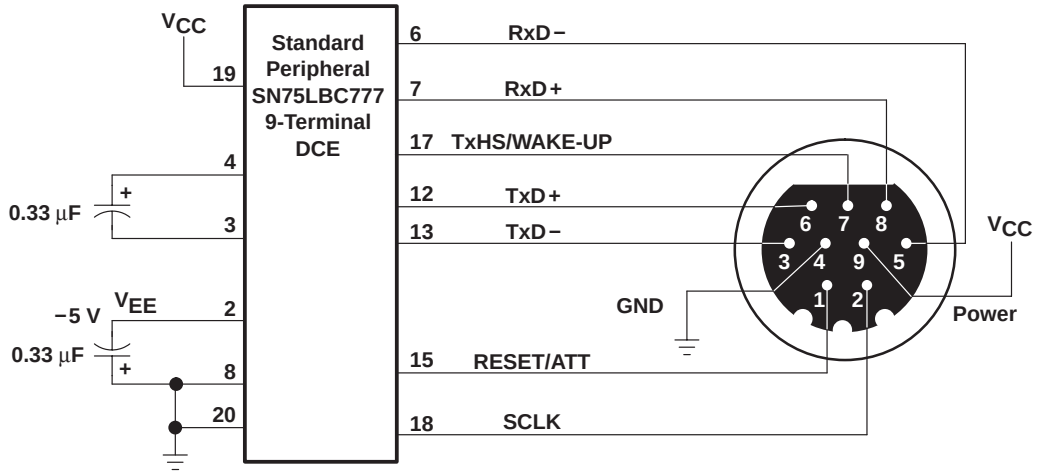
**Figure 7. Receiver Enable and Disable Test Circuit and Waveforms**



TEXAS INSTRUMENTS
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265
POST OFFICE BOX 1443 • HOUSTON, TEXAS 77251−1443

## APPLICATION INFORMATION




NOTE A: A potential charge pump capacitor is the AVX 0805YC334MATXA or an equivalent.

**Figure 8. GeoPort 9-terminal DCE Connection Application**

## generator characteristics

| PARAMETER | | TEST CONDITIONS | 232/V.28 | | 423/V.10 | | 562 | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| $\|V_O\|$ | Output voltage magnitude | Open circuit | | 25 | 4 | 6 | | 13.2 | V |
| | | 3 kΩ ≤ $R_L$ ≤ 7 kΩ | 5 | 15 | NA | | 3.7 | | V |
| | | $R_L$ = 450 Ω | NA | | 3.6 | | NA | | V |
| $I_{OS}$ | Short-circuit output current | $V_O$ = 0 | | 100 | | 150 | | 60 | mA |
| $R_{O(OFF)}$ | Power-off source resistance | $V_{CC}$ = 0, $\|V_O\|$ < 2 V | 300 | | NA | | 300 | | Ω |
| $I_{O(OFF)}$ | Power-off output current | $V_{CC}$ = 0, $\|V_O\|$ < 6 V | NA | | | ±100 | NA | | µA |
| SR | Output voltage slew rate | | | 30 | NA | | 4 | 30 | V/µs |
| $t_t$ | Output transition time | ±3.3 V to ±3.3 V | NA | | NA | | 0.22 | 2.1 | µs |
| | | ±3 V to ±3 V | | 0.04 | NA | | NA | | ui† |
| | | 10% to 90% | NA | | | 0.3 | NA | | ui† |
| $V_{O(RING)}$ | Output voltage ringing | | NA | | | 10% | | 5% | |

† ui is the unit interval and is the inverse of the signaling rate (a.k.a. bit time).

## receiver characteristics

| PARAMETER | | TEST CONDITIONS | 232/V.28 | | 423/V.10 | | 562 | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| $\|V_I\|$ | Input voltage | | | 25 | | 10 | | 25 | V |
| $V_{IT}$ | Input voltage threshold | $\|V_I\|$ < 15 V | −3 | 3 | NA | | −3 | 3 | V |
| | | $\|V_I\|$ < 10 V | NA | | −0.2 | 0.2 | NA | | V |
| $R_I$ | Input resistance | 3 V < $\|V_I\|$ < 15 V | 3 | 7 | NA | | 3 | 7 | kΩ |
| | | $\|V_I\|$ < 10 V | NA | | 4 | | NA | | kΩ |

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SN75LBC777DWG4 | OBSOLETE | SOIC | DW | 20 | | TBD | Call TI | Call TI | | SN75LBC777 | |

(1) The marketing status values are defined as follows:
**ACTIVE:** Product device recommended for new designs.
**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.
**OBSOLETE:** TI has discontinued the production of the device.

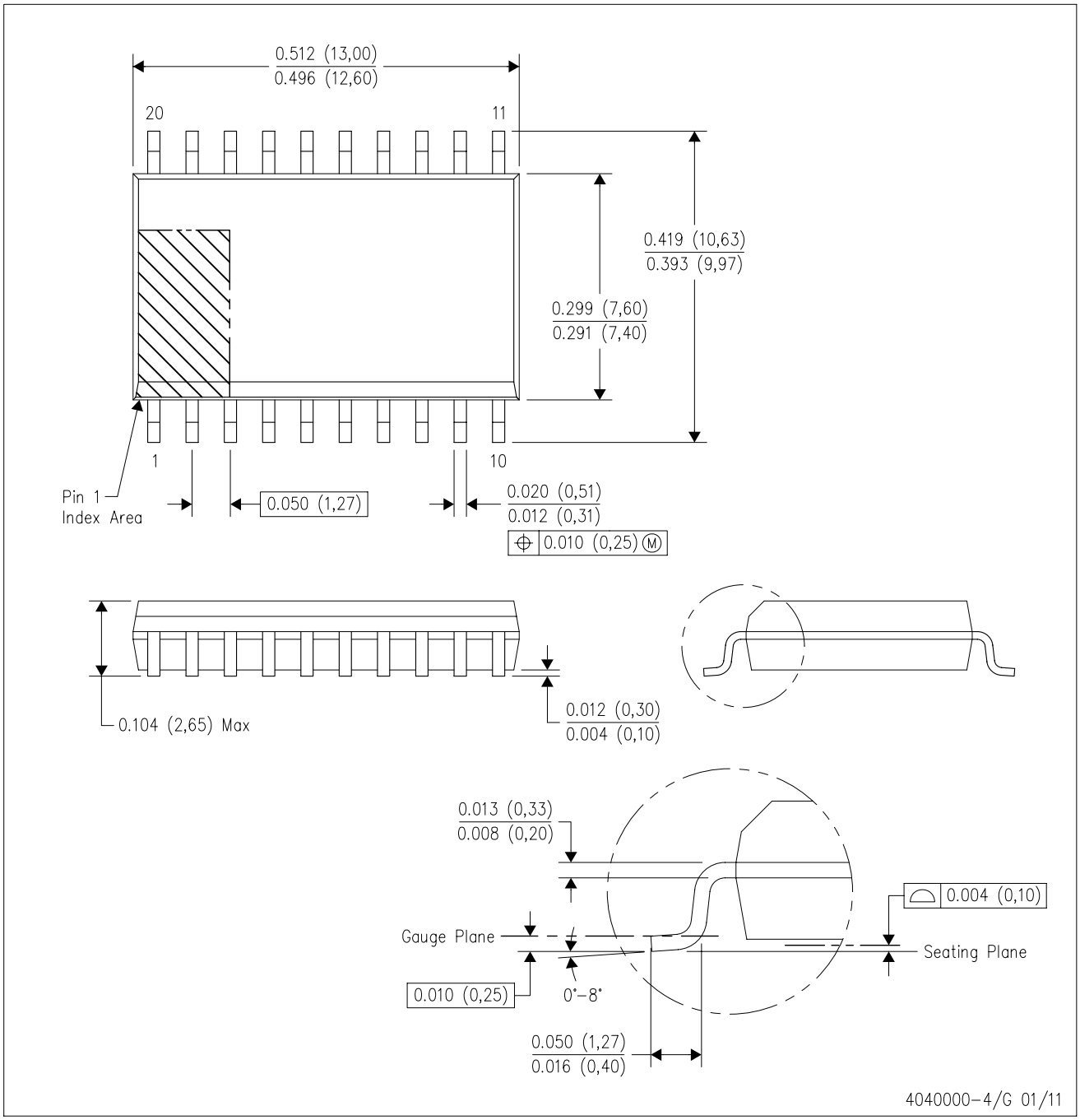
(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
**TBD:** The Pb-Free/Green conversion plan has not been defined.
**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

DW (R–PDSO–G20) PLASTIC SMALL OUTLINE




NOTES:
A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M–1994.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MS–013 variation AC.

## IMPORTANT NOTICE

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

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

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

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

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

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

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

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

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

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

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

| **Products** | | **Applications** | |
|---|---|---|---|
| Audio | www.ti.com/audio | Automotive and Transportation | www.ti.com/automotive |
| Amplifiers | amplifier.ti.com | Communications and Telecom | www.ti.com/communications |
| Data Converters | dataconverter.ti.com | Computers and Peripherals | www.ti.com/computers |
| DLP® Products | www.dlp.com | Consumer Electronics | www.ti.com/consumer-apps |
| DSP | dsp.ti.com | Energy and Lighting | www.ti.com/energy |
| Clocks and Timers | www.ti.com/clocks | Industrial | www.ti.com/industrial |
| Interface | interface.ti.com | Medical | www.ti.com/medical |
| Logic | logic.ti.com | Security | www.ti.com/security |
| Power Mgmt | power.ti.com | Space, Avionics and Defense | www.ti.com/space-avionics-defense |
| Microcontrollers | microcontroller.ti.com | Video and Imaging | www.ti.com/video |
| RFID | www.ti-rfid.com | | |
| OMAP Applications Processors | www.ti.com/omap | **TI E2E Community** | e2e.ti.com |
| Wireless Connectivity | www.ti.com/wirelessconnectivity | | |

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265