

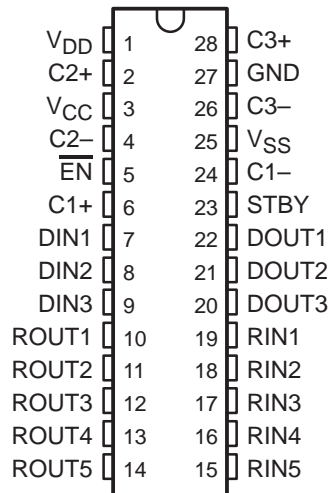
SN75LV4737A

3.3-V/5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER

SLLS178D – APRIL 1994 – REVISED FEBRUARY 2000

- **Single-Chip and Single-Supply Interface for IBM PC/AT™ Serial Port**
- **Meets or Exceeds the Requirements of TIA/EIA-232-F and ITU v.11 Standards**
- **Operates With 3.3-V or 5-V Supplies**
- **One Receiver Remains Active During Standby (Wake-up Mode)**
- **Designed to Operate at 128 kbit/s Over a 3-m Cable**
- **Low Standby Current . . . 5 μ A Max**
- **ESD Protection on RS-232 Pins Meets or Exceeds 4 kV (HBM) and 1.5 kV (HBM) on All Pins Per MIL-STD-883, Method 3015**
- **External Capacitors . . . 0.1 μ F ($V_{CC} = 3.3$ V . . . Five External Capacitors) ($V_{CC} = 5$ V . . . Four External Capacitors)**
- **Accepts 5-V Logic Input With 3.3-V Supply**
- **Applications**
 - RS-232 Interface
 - Battery-Powered Systems, PDAs
 - Notebook, Laptop, and Palmtop PCs
 - External Modems and Hand-Held Terminals
- **Packaged in Shrink Small-Outline Package**

**DB PACKAGE†
(TOP VIEW)**



† The DB package is only available in left-ended tape and reel (order part number SN75LV4737ADBR).

description

The SN75LV4737A† consists of three line drivers, five line receivers, and a charge-pump circuit. It provides the electrical interface between an asynchronous communication controller and the serial-port connector, and meets the requirements of TIA/EIA-232-F. This combination of drivers and receivers matches those needed for the typical serial port used in an IBM PC/AT or compatibles. The charge pump and five small external capacitors allow operation from a single 3.3-V supply, and four capacitors allow operation from a 5-V supply.

The device has flexible control options for power management when the serial port is inactive. A common disable for all of the drivers and receivers is provided with the active-high STBY input. The active-low \overline{EN} input is an enable for one receiver to implement a wake-up feature for the serial port. All the logic inputs can accept signals from controllers operating from a 5-V supply, even though the SN75LV4737A is operating from 3.3 V.

The SN75LV4737A is characterized for operation over the temperature range of 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.

† Patent-pending design

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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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SN75LV4737A

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Function Tables

EACH DRIVER

| INPUTS | | OUTPUT |
|--------|------|--------|
| DIN | STBY | DOUT |
| X | H | Z |
| L | L | H |
| H | L | L |
| Open | L | L |

H = high level, L = low level,
 X = irrelevant, Z = high impedance

EACH RECEIVER

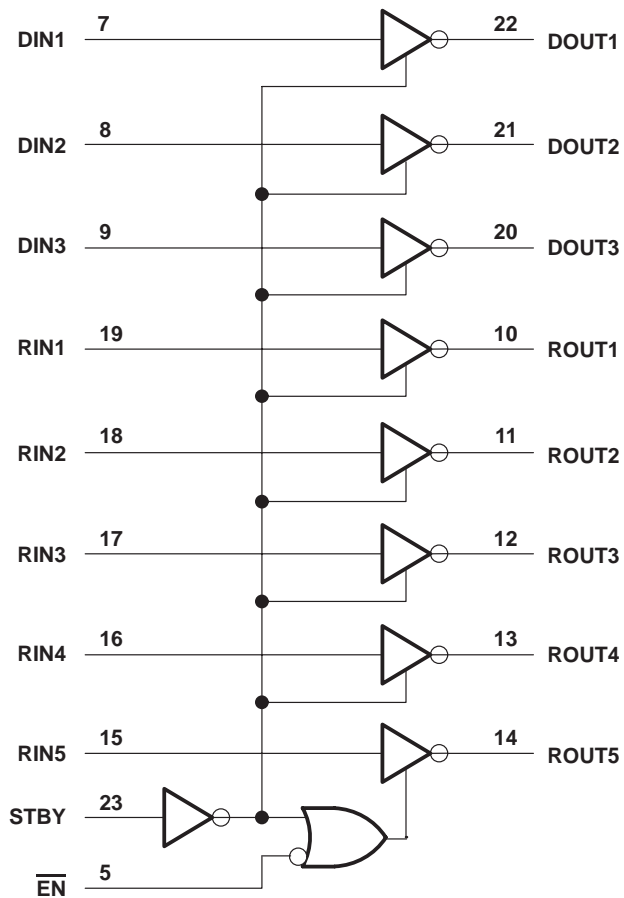
| INPUTS | | | | OUTPUTS | |
|--------|------------------------|------|-----------|---------|-------------|
| STBY | $\overline{\text{EN}}$ | RIN5 | RIN1–RIN4 | ROUT5 | ROUT1–ROUT4 |
| H | H | X | X | Z | Z |
| H | L | H | X | L | Z |
| H | L | L | X | H | Z |
| L | X | L | L | H | H |
| L | X | H | H | L | L |

H = high level, L = low level, X = irrelevant, Z = high impedance

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logic diagram (positive logic)

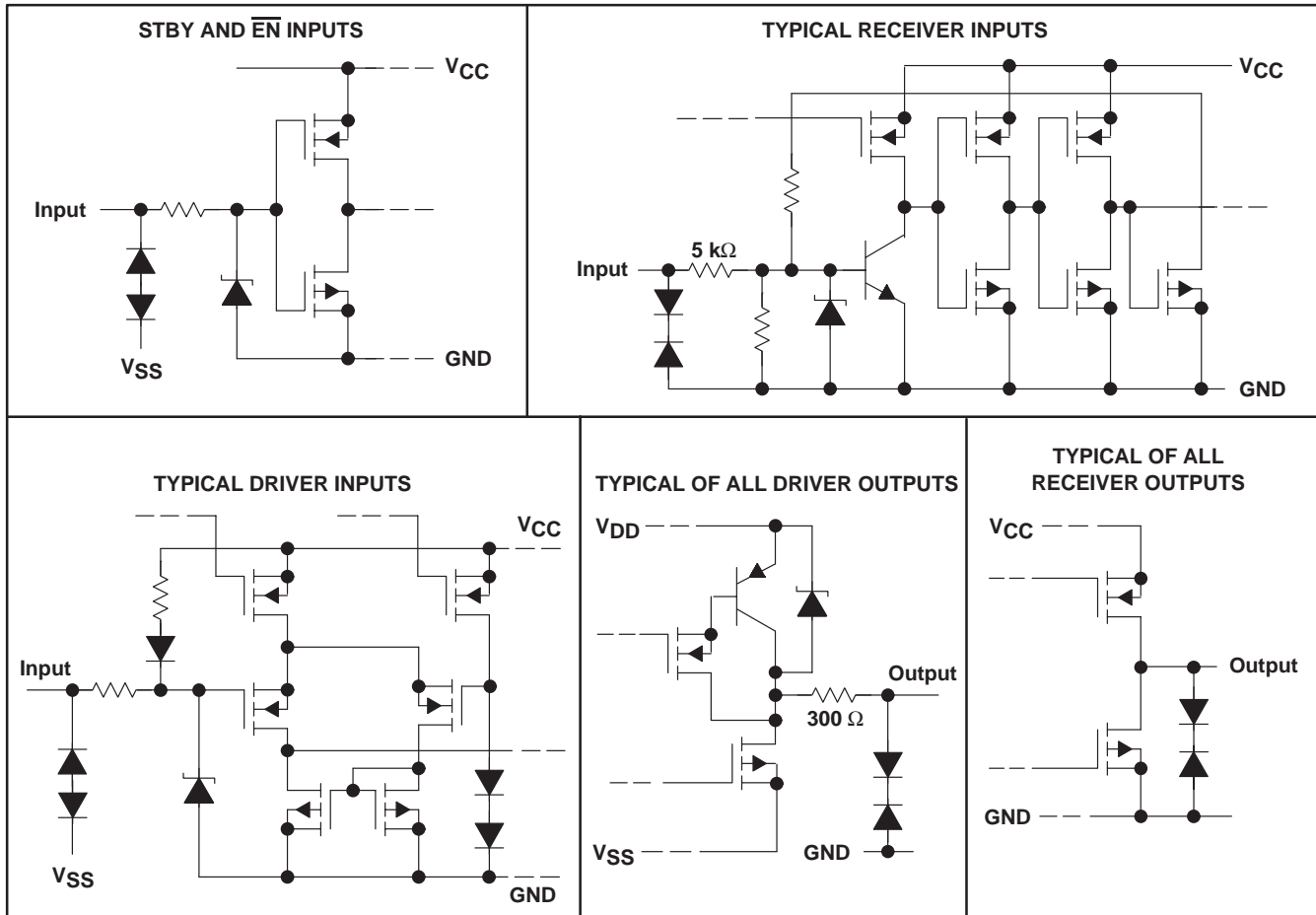


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schematics of inputs and outputs



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

| | |
|--|--|
| Supply voltage, V_{CC} | 7 V |
| Positive output supply voltage, V_{DD} (see Note 1) | 15 V |
| Negative output supply voltage, V_{SS} | -15 V |
| Input voltage range, V_I : Driver | -3 V to 7 V |
| Receiver | -30 V to 30 V |
| Output voltage range, V_O : Driver | $V_{SS} - 0.3\text{ V}$ to $V_{DD} + 0.3\text{ V}$ |
| Receiver | -0.3 V to 7 V |
| Package thermal impedance, θ_{JA} (see Note 2) | 62°C/W |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds | 260°C |
| Storage temperature range, T_{stg} | -65°C to 150°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 are with respect to network GND.
2. The package thermal impedance is calculated in accordance with JESD 51.

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recommended operating conditions

| | | | MIN | NOM | MAX | UNIT | |
|-----------------|---------------------------------|--|-------------------------|-----|-----|------|----|
| V _{CC} | Supply voltage | V _{CC} = 3.3 V | 3 | 3.3 | 3.6 | V | |
| | | V _{CC} = 5 V | 4.5 | 5 | 5.5 | V | |
| V _{IH} | Driver high-level input voltage | DIN, $\overline{\text{EN}}$, STBY | V _{CC} = 3.3 V | | | V | |
| | | DIN | 2 | | | | |
| | | $\overline{\text{EN}}$, STBY | V _{CC} = 5 V | | | | |
| V _{IL} | Driver low-level input voltage | DIN, $\overline{\text{EN}}$, STBY | | | 0.8 | V | |
| V _I | Receiver input voltage | | | | ±30 | V | |
| | External capacitor | 3.3-V operation (C1, C2, C3, C4, C5), 5-V operation (C1, C3, C4, C5), See Note 3 and Figures 6 and 7 | | | 0.1 | μF | |
| T _A | Operating free-air temperature | | | | 0 | 70 | °C |

NOTE 3: C2 is needed only for 3.3-V operation.

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (see Figures 6 and 7) (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | V _{CC} = 3.3 V | | | V _{CC} = 5 V | | | UNIT | | |
|-----------------|--|-------------------------|--|------|------|-----------------------|------|-----|------|------|----|
| | | | MIN | TYP† | MAX | MIN | TYP† | MAX | | | |
| V _{DD} | Positive supply voltage | No load | 8 | 10 | | 7 | 8.7 | | V | | |
| V _{SS} | Negative supply voltage | No load | | | -9.5 | -7 | | -8 | -6 | V | |
| I _I | Input current ($\overline{\text{EN}}$, STBY) | See Notes 4 and 5 | | | | | | ±2 | ±2 | μA | |
| I _{CC} | Supply current | No load, Inputs open | STBY at GND, $\overline{\text{EN}}$ at V _{CC} or GND | | 8.4 | 10 | 18 | 10 | 12 | 20.7 | mA |
| | Supply current (standby mode) (see Note 4) | | $\overline{\text{EN}}$, STBY at V _{CC} | | | | 5 | | | 5 | μA |
| | Supply current (wake-up mode) (see Note 5) | | $\overline{\text{EN}}$ at GND, STBY at V _{CC} | | | | 10 | | | 10 | |

† All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.

- NOTES: 4. When standby mode is not used, STBY input must be taken low.
5. When wake-up mode is not used, $\overline{\text{EN}}$ input must be taken high.



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3.3-V/5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER

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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 _{OH} | High-level output voltage | R _L = 3 kΩ | 5.5 | 7 | | V |
| V _{OL} | Low-level output voltage | R _L = 3 kΩ | | -6 | -5 | V |
| I _{IH} | High-level input current | V _I = V _{CC} | | | 1 | μA |
| I _{IL} | Low-level input current | V _I at GND | | | -10 | μA |
| I _{OS} | Short-circuit output current (see Note 6) | V _{CC} = 3.6 V, V _O = 0 V | | ±15 | ±40 | mA |
| | | V _{CC} = 5.5 V, V _O = 0 V | | | | |
| r _o | Output resistance | V _{CC} = V _{DD} = V _{SS} = 0 V, V _O = ±2 V | 300 | 500 | | Ω |

† All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.

NOTE 6: Short-circuit durations should be controlled to prevent exceeding the device absolute maximum power dissipation ratings, and not more than one output should be shorted at a time.

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

| PARAMETER | | TEST CONDITIONS | | MIN | TYP† | MAX | UNIT |
|------------------|---|---|--------------------------------|-----|------|-----|------|
| t _{PLH} | Propagation delay time, low- to high-level output | C _L = 50 pF, R _L = 3 kΩ to 7 kΩ, See Figure 1 | V _{CC} = 3.3 V | 100 | 500 | 850 | ns |
| | | | V _{CC} = 5 V | 100 | 500 | 850 | |
| t _{PHL} | Propagation delay time, high- to low-level output | | V _{CC} = 3.3 V | 100 | 500 | 850 | ns |
| | | | V _{CC} = 5 V | 100 | 500 | 850 | |
| t _{PZH} | Output enable time to high level | C _L = 50 pF, See Figure 2 | R _L = 3 kΩ to 7 kΩ, | | 1 | 5 | ms |
| t _{PZL} | Output enable time to low level | | | | 3 | 7 | ms |
| t _{PHZ} | Output disable time from high level | C _L = 50 pF, R _L = 3 kΩ to 7 kΩ, See Figure 2 | V _{CC} = 3.3 V | | 0.9 | 3 | μs |
| | | | V _{CC} = 5 V | | 0.6 | 3 | |
| t _{PLZ} | Output disable time from low level | | V _{CC} = 3.3 V | | 0.5 | 3 | μs |
| | | | V _{CC} = 5 V | | 0.3 | 3 | |
| SR | Slew rate | C _L = 50 pF, See Figure 1 | R _L = 3 kΩ to 7 kΩ, | 4 | | 30 | V/μs |
| SR(tr) | Slew rate, transition region | C _L = 2500 pF, See Figure 3 | R _L = 3 kΩ to 7 kΩ, | 3 | | 30 | V/μs |

† All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.



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RECEIVER 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 _{OH} | High-level output voltage | I _{OH} = -2 mA | V _{CC} = 3.3 V | 2.4 | 3 | V |
| | | | V _{CC} = 5 V | 3.5 | 5 | |
| V _{OL} | Low-level output voltage | I _{OL} = 2 mA | | 0.2 | 0.4 | V |
| V _{IT+} | Positive-going input threshold voltage | | | 2.2 | 2.6 | V |
| V _{IT-} | Negative-going input threshold voltage | | 0.6 | 1 | | V |
| V _{hys} | Input hysteresis (V _{IT+} - V _{IT-}) | | 0.5 | 1.2 | 1.8 | V |
| r _i | Input resistance | V _I = ±3 V to ±25 V | 3 | 5 | 7 | kΩ |

† All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.

switching characteristics over recommended ranges of supply voltage and operating free-air temperature, C_L = 50 pF, R_L = 3 kΩ to GND

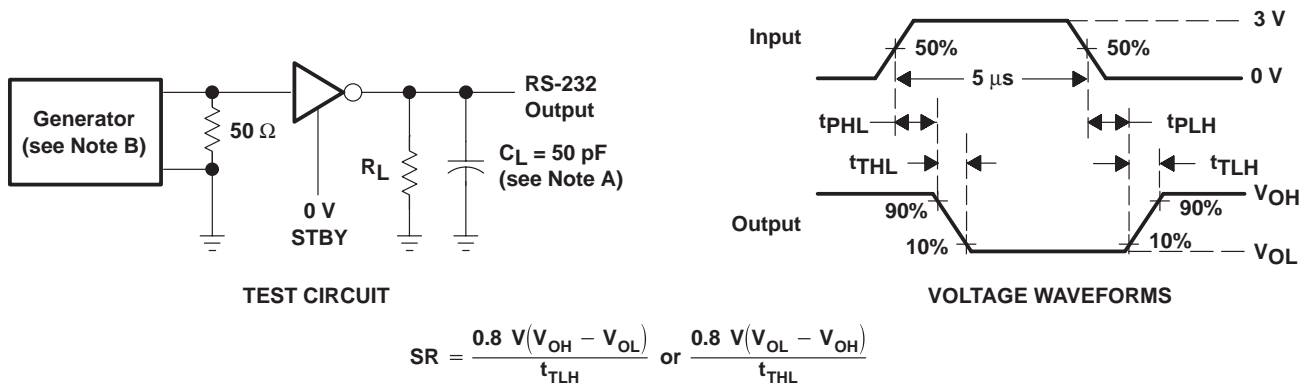
| PARAMETER | TEST CONDITIONS | V _{CC} = 3.3 V | | | V _{CC} = 5 V | | | UNIT | |
|------------------|--|-------------------------|-----|-----|-----------------------|-----|-----|------|----|
| | | MIN | TYP | MAX | MIN | TYP | MAX | | |
| t _{PLH} | Propagation delay time, low- to high-level output | See Figure 4 | 10 | 70 | 200 | 10 | 70 | 200 | ns |
| t _{PHL} | Propagation delay time, high- to low-level output | | 10 | 60 | 200 | 10 | 55 | 200 | ns |
| t _{PLH} | Propagation delay time, low- to high-level output (wake-up mode) | | 40 | 200 | | 40 | 200 | | μs |
| t _{PHL} | Propagation delay time, high- to low-level output (wake-up mode) | | 90 | 500 | | 70 | 500 | | ns |
| t _{pZH} | Output enable time to high level | See Figure 5 | 3 | 10 | | 1.2 | 10 | | μs |
| t _{pZL} | Output enable time to low level | | 100 | 250 | | 60 | 250 | | ns |
| t _{PHZ} | Output disable time from high level | | 100 | 200 | 600 | 100 | 150 | 600 | ns |
| t _{PLZ} | Output disable time from low level | | 130 | 250 | | 60 | 250 | | ns |

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3.3-V/5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER

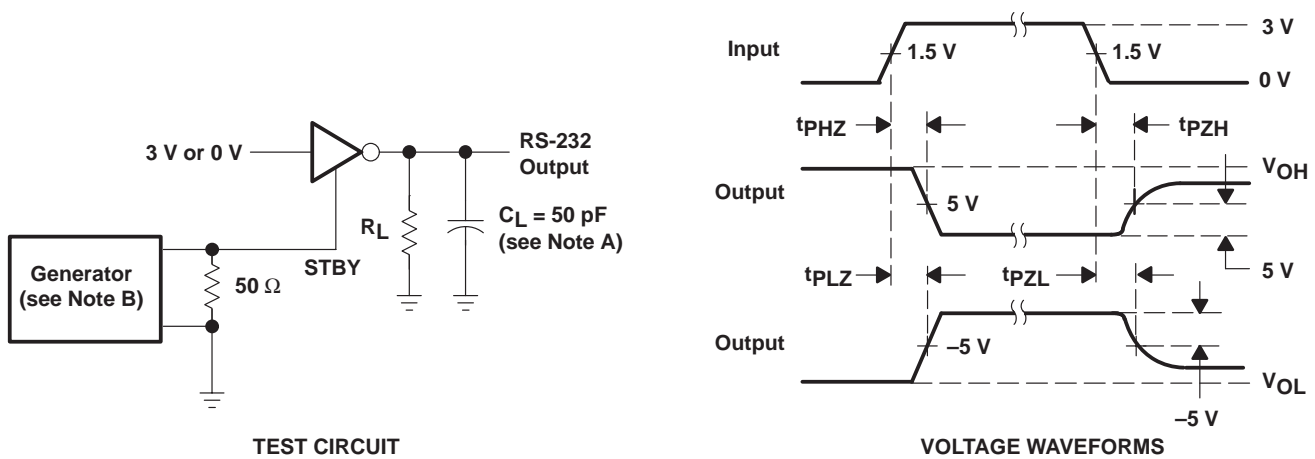
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PARAMETER MEASUREMENT INFORMATION



NOTES: A. C_L includes probe and jig capacitance.
 B. The pulse generator has the following characteristics: $Z_O = 50 \Omega$, 50% duty cycle, $t_r \leq 10$ ns, $t_f \leq 10$ ns.

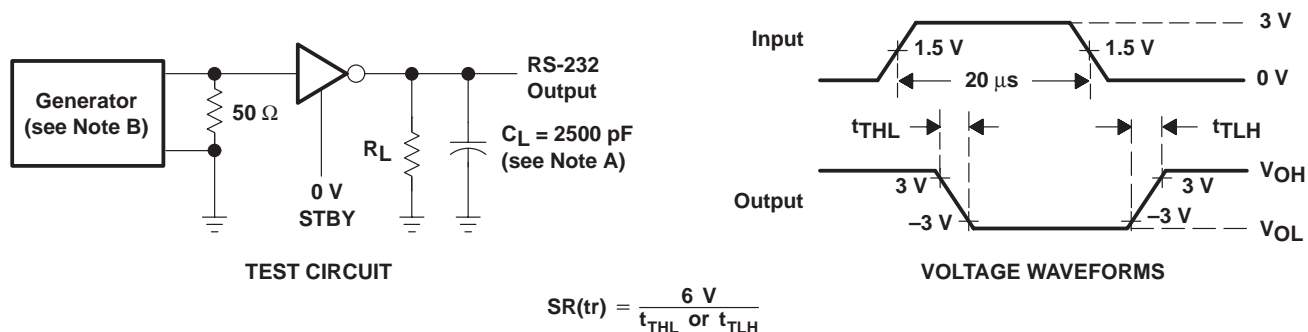
Figure 1. Driver Propagation Delay Times and Slew Rate (5-μs Input)



NOTES: A. C_L includes probe and jig capacitance.
 B. The pulse generator has the following characteristics: $Z_O = 50 \Omega$, 50% duty cycle, $t_r \leq 10$ ns, $t_f \leq 10$ ns.

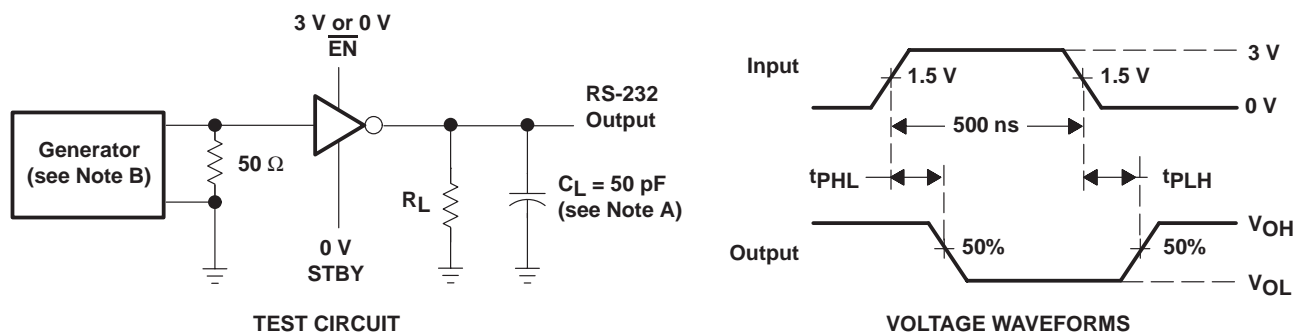
Figure 2. Driver Enable and Disable Test Times

PARAMETER MEASUREMENT INFORMATION



NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: $Z_O = 50\ \Omega$, 50% duty cycle, $t_r \leq 10\text{ ns}$, $t_f \leq 10\text{ ns}$.

Figure 3. Driver Transition Times and Slew Rate (20-µs Input)



NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: PRR = 1 MHz, $Z_O = 50\ \Omega$, 50% duty cycle, $t_r \leq 10\text{ ns}$, $t_f \leq 10\text{ ns}$.

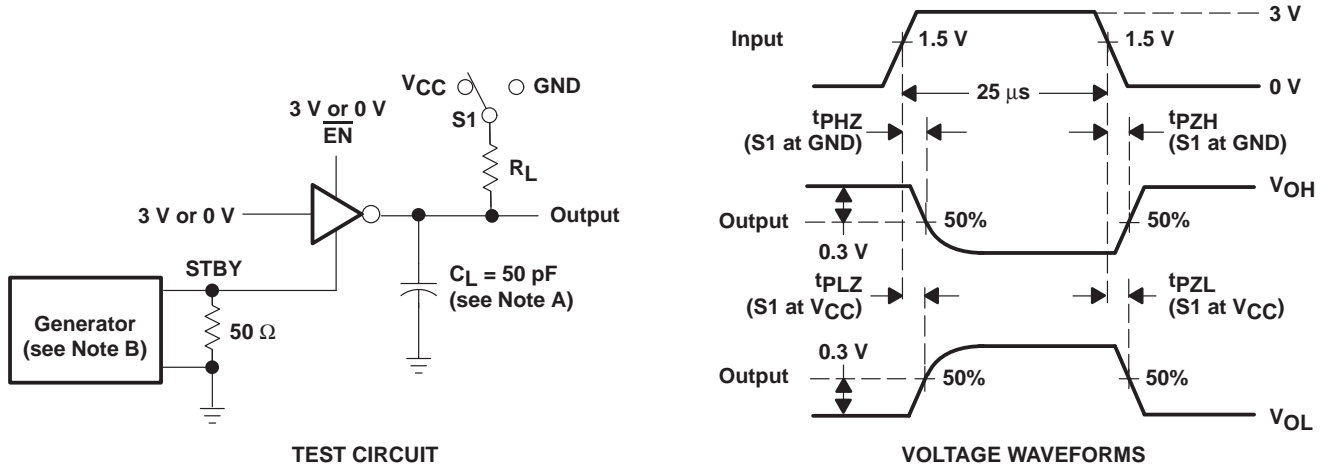
Figure 4. Receiver Propagation Delay Times

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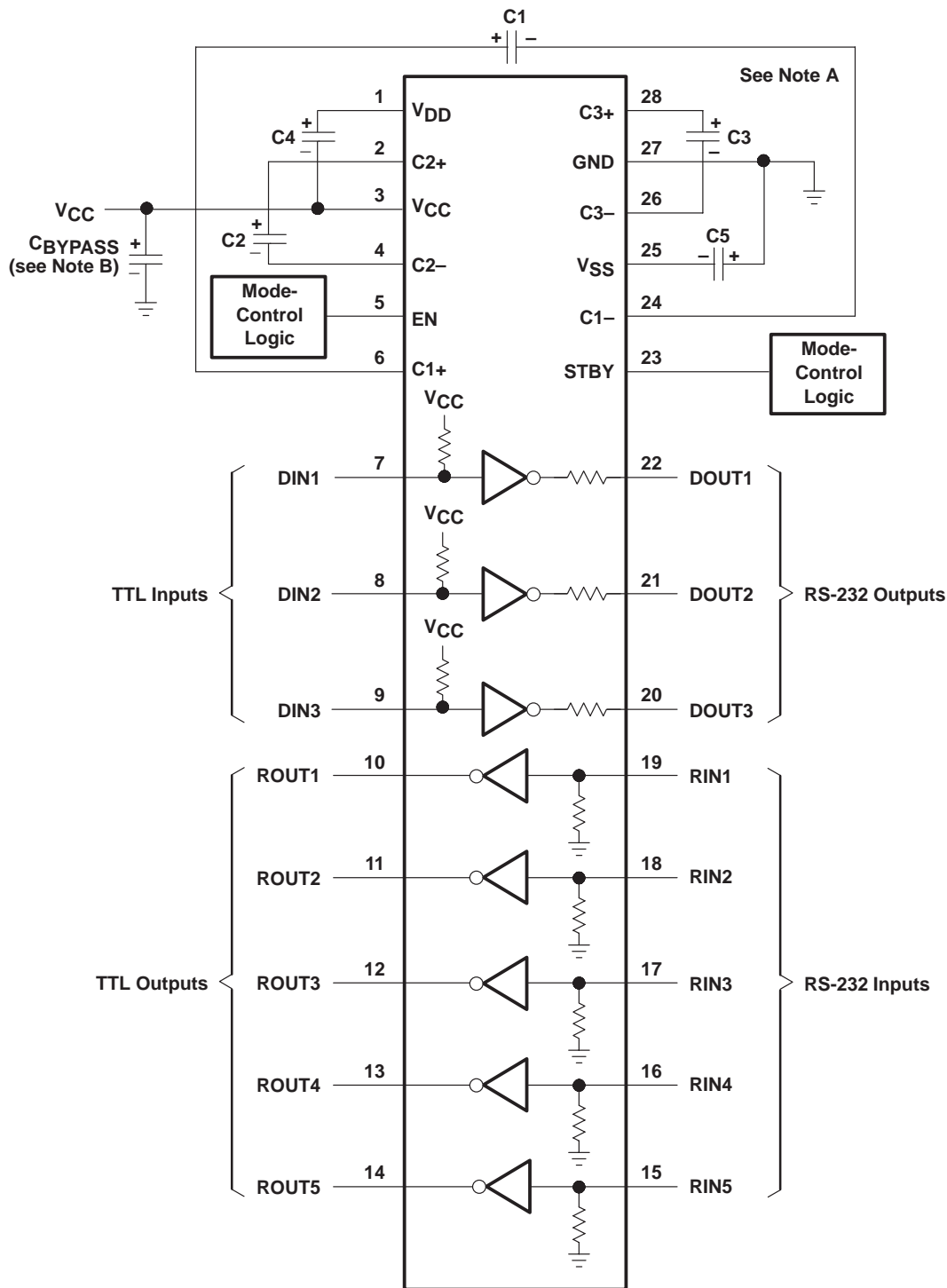
PARAMETER MEASUREMENT INFORMATION



- NOTES: A. C_L includes probe and jig capacitance.
 B. The pulse generator has the following characteristics: PRR = 1 MHz, $Z_O = 50 \Omega$, 50% duty cycle, $t_r \leq 10$ ns, $t_f \leq 10$ ns.

Figure 5. Receiver Enable and Disable Times

APPLICATION INFORMATION



NOTES: A. C1 = C2 = C3 = C4 = C5 = CBYPASS = 0.1 μ F
B. CBYPASS is used as a decoupling capacitor.

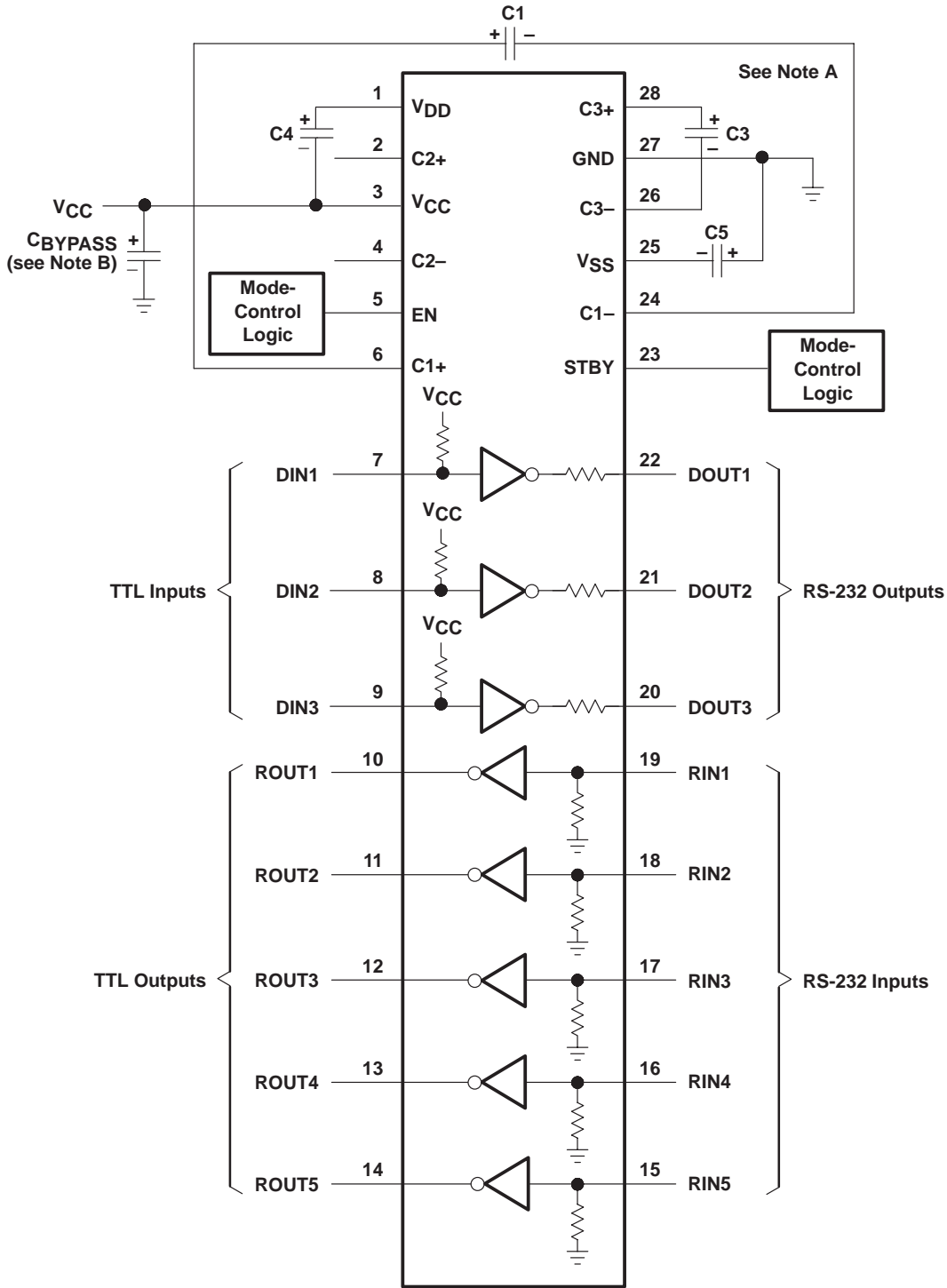
Figure 6. Typical 3.3-V Operating Circuit

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APPLICATION INFORMATION



NOTES: A. C2 is not used. C1 = C3 = C4 = C5 = C_{BYPASS} = 0.1 μF
 B. C_{BYPASS} is used as a decoupling capacitor.

Figure 7. Typical 5-V Operating Circuit



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PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN75LV4737ADB | ACTIVE | SSOP | DB | 28 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75LV4737ADBE4 | ACTIVE | SSOP | DB | 28 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75LV4737ADBG4 | ACTIVE | SSOP | DB | 28 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75LV4737ADBLE | OBSOLETE | SSOP | DB | 28 | | TBD | Call TI | Call TI |
| SN75LV4737ADBR | ACTIVE | SSOP | DB | 28 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75LV4737ADBRE4 | ACTIVE | SSOP | DB | 28 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75LV4737ADBRG4 | ACTIVE | SSOP | DB | 28 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |

⁽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.

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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 |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN75LV4737ADBR | SSOP | DB | 28 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN75LV4737ADBR | SSOP | DB | 28 | 2000 | 346.0 | 346.0 | 33.0 |

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-150

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