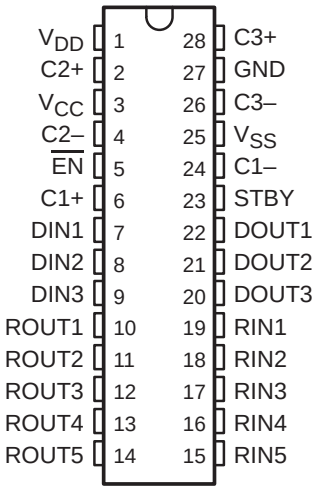
- **Single-Chip and Single-Supply Interface for IBM PC/AT™ Serial Port**
- **Meets or Exceeds the Requirements of TIA/EIA-232-F and ITU v.11 Standards**
- **Operates With 3.3-V or 5-V Supplies**
- **One Receiver Remains Active During Standby (Wake-up Mode)**
- **Designed to Operate at 128 kbit/s Over a 3-m Cable**
- **Low Standby Current . . . 5 μA 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 μF**
  **($V_{CC}$ = 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.



‡ Patent-pending design

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## Function Tables

**EACH DRIVER**

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

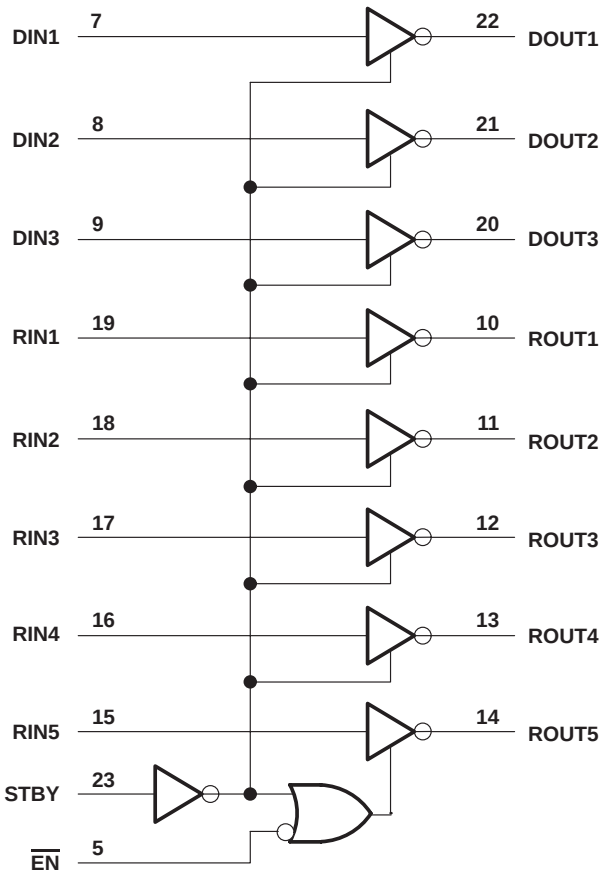
H = high level, L = low level, X = irrelevant, Z = high impedance

**EACH RECEIVER**

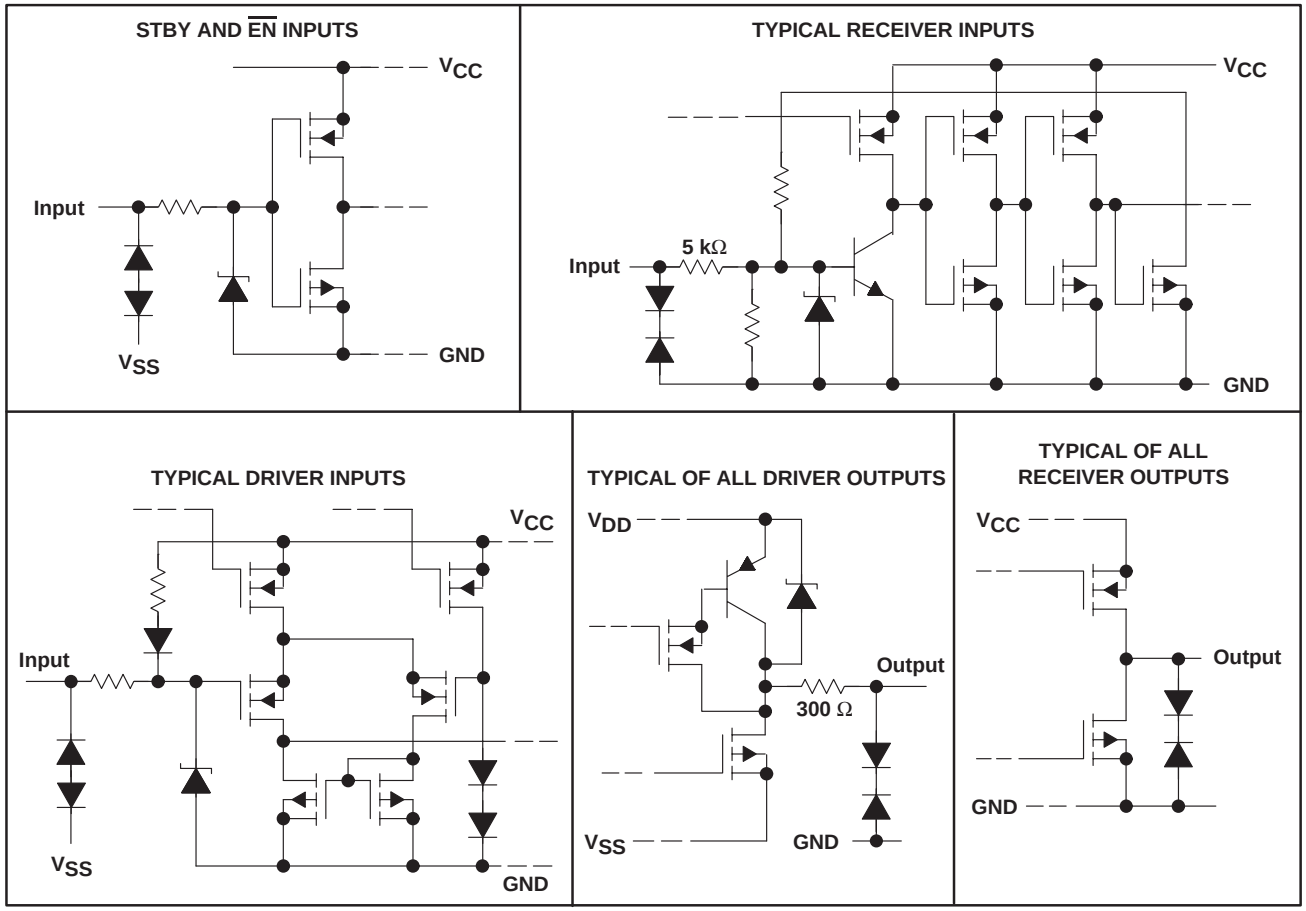
| INPUTS | | | | OUTPUTS | |
|---|---|---|---|---|---|
| STBY | $\overline{EN}$ | RIN5 | RIN1–RIN4 | ROUT5 | ROUT1–ROUT4 |
| H | H | X | X | Z | Z |
| H | L | H | X | L | Z |
| H | L | L | X | H | Z |
| L | X | L | L | H | H |
| L | X | H | H | L | L |

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

## logic diagram (positive logic)



## schematics of inputs and outputs




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

Supply voltage, $V_{CC}$ . . . . . 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 V to $V_{DD}$ + 0.3 V
Receiver . . . . . –0.3 V to 7 V
Package thermal impedance, $\theta_{JA}$ (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.

## 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, $\overline{EN}$, STBY | $V_{CC}$ = 3.3 V | 2 | | | V |
| | | DIN | $V_{CC}$ = 5 V | 2 | | | |
| | | $\overline{EN}$, STBY | | 2.5 | | | |
| $V_{IL}$ | Driver low-level input voltage | DIN, $\overline{EN}$, 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 ($\overline{EN}$, STBY) | See Notes 4 and 5 | | | | ±2 | | | ±2 | µA |
| $I_{CC}$ | Supply current | No load, Inputs open | STBY at GND, $\overline{EN}$ at $V_{CC}$ or GND | 8.4 | 10 | 18 | 10 | 12 | 20.7 | mA |
| | Supply current (standby mode) (see Note 4) | | $\overline{EN}$, STBY at $V_{CC}$ | | | 5 | | | 5 | µA |
| | Supply current (wake-up mode) (see Note 5) | | $\overline{EN}$ 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, $\overline{EN}$ input must be taken high.

## 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.

## RECEIVER SECTION

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

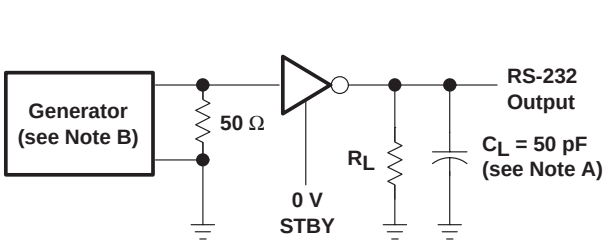
| PARAMETER | | TEST CONDITIONS | | MIN | TYP† | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $V_{OH}$ | High-level output voltage | $I_{OH}$ = –2 mA | $V_{CC}$ = 3.3 V | 2.4 | 3 | | V |
| | | | $V_{CC}$ = 5 V | 3.5 | 5 | | |
| $V_{OL}$ | Low-level output voltage | $I_{OL}$ = 2 mA | | | 0.2 | 0.4 | 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.

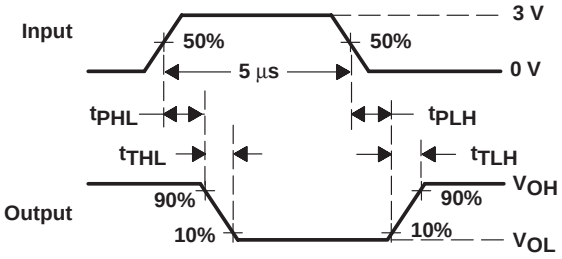
### switching characteristics over recommended ranges of supply voltage and operating free-air temperature, $C_L$ = 50 pF, $R_L$ = 3 kΩ to GND

| 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 |

## PARAMETER MEASUREMENT INFORMATION




TEST CIRCUIT

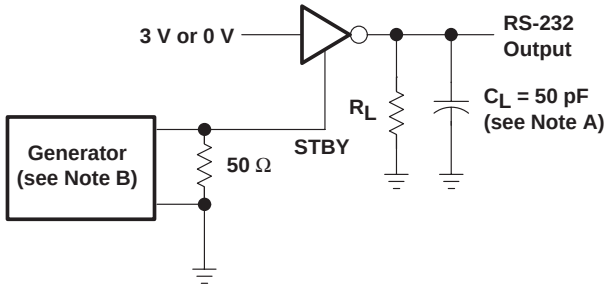



VOLTAGE WAVEFORMS

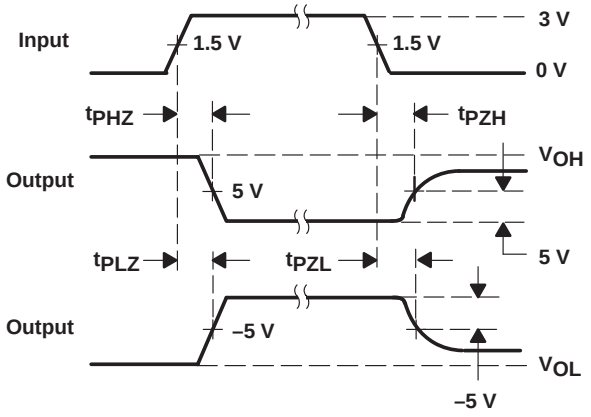
$$SR = \frac{0.8\ V(V_{OH} - V_{OL})}{t_{TLH}} \text{ or } \frac{0.8\ V(V_{OL} - V_{OH})}{t_{THL}}$$

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

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




TEST CIRCUIT

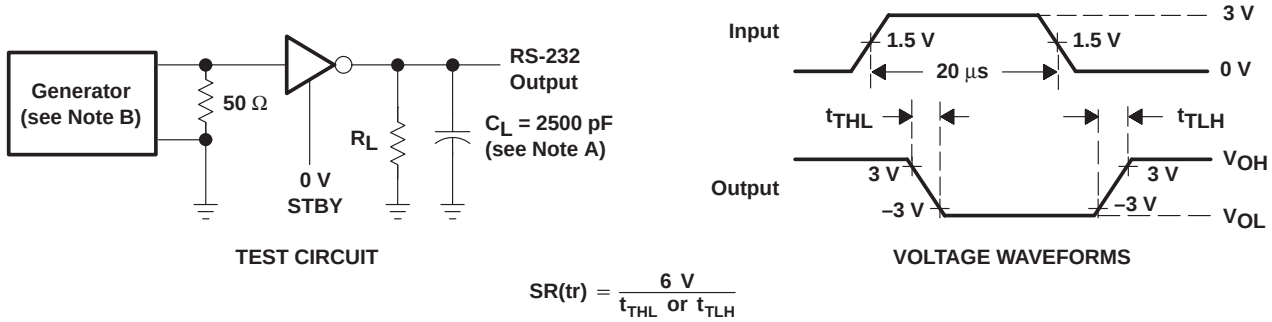



VOLTAGE WAVEFORMS

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

**Figure 2. Driver Enable and Disable Test Times**

## PARAMETER MEASUREMENT INFORMATION



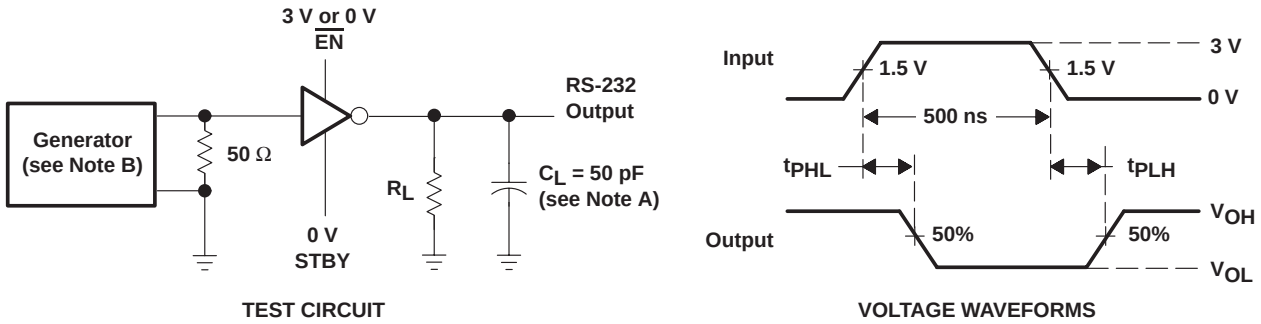

TEST CIRCUIT

VOLTAGE WAVEFORMS

$$SR(tr) = \frac{6\ V}{t_{THL}\ or\ t_{TLH}}$$

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

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



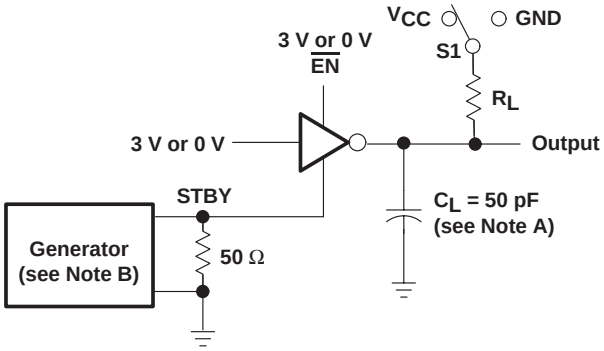

TEST CIRCUIT

VOLTAGE WAVEFORMS

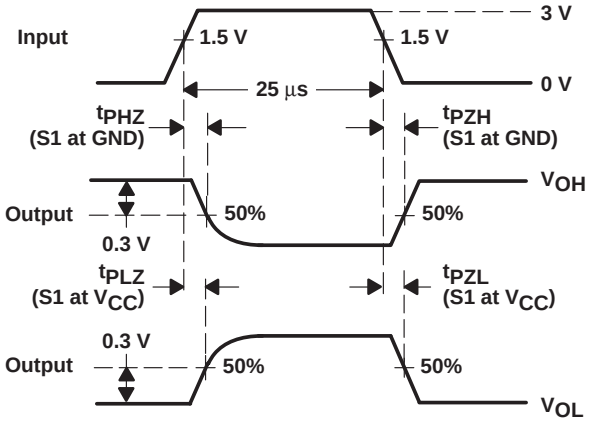
NOTES: A. $C_L$ includes probe and jig capacitance.
B. The pulse generator has the following characteristics: PRR = 1 MHz, $Z_O$ = 50 Ω, 50% duty cycle, $t_r \le 10$ ns, $t_f \le 10$ ns.

**Figure 4. Receiver Propagation Delay Times**

## PARAMETER MEASUREMENT INFORMATION




TEST CIRCUIT

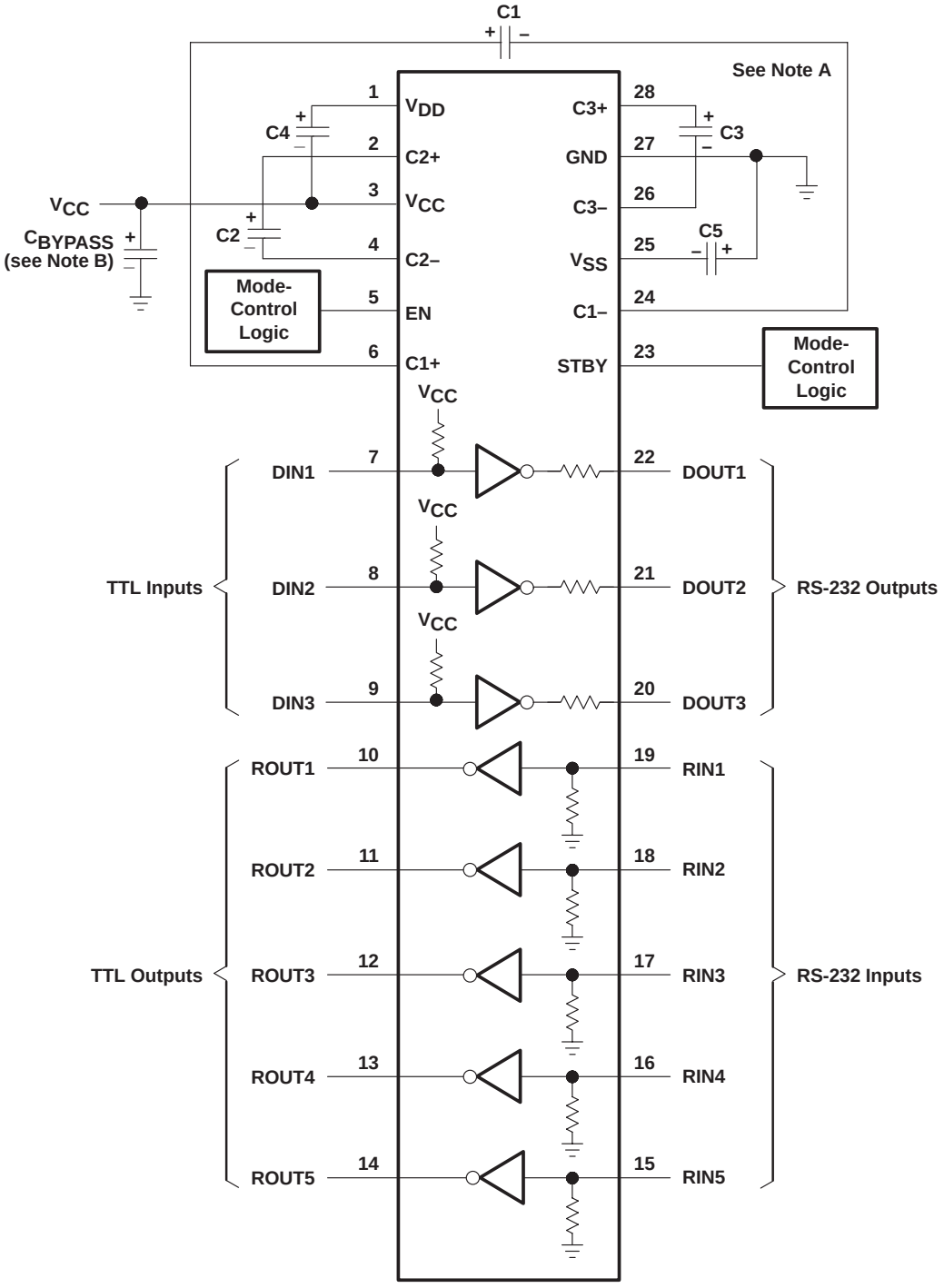



VOLTAGE WAVEFORMS

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

**Figure 5. Receiver Enable and Disable Times**

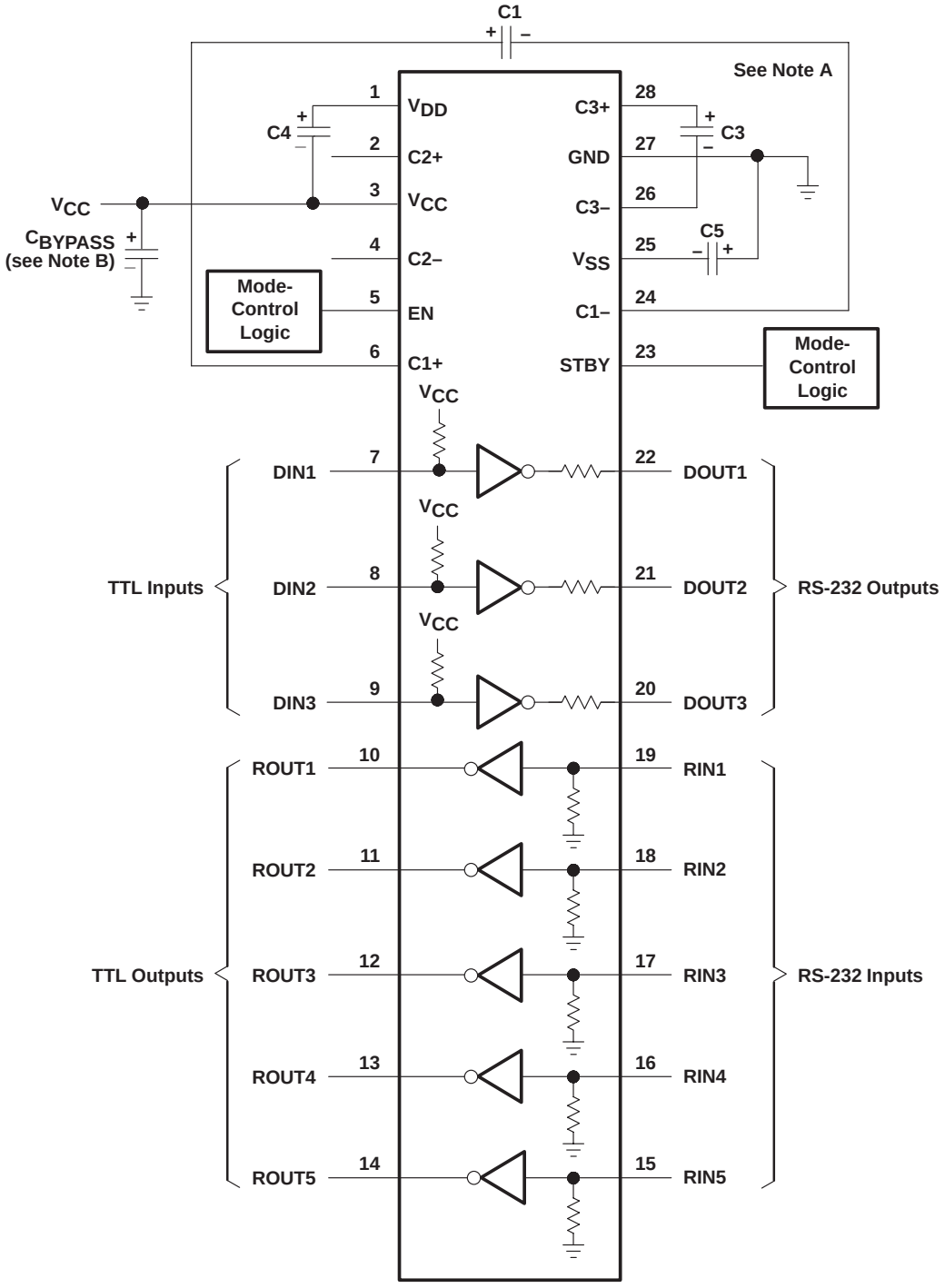
## APPLICATION INFORMATION




NOTES: A. $C1 = C2 = C3 = C4 = C5 = C_{BYPASS} = 0.1\ \mu F$
B. $C_{BYPASS}$ is used as a decoupling capacitor.

**Figure 6. Typical 3.3-V Operating Circuit**

## 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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