

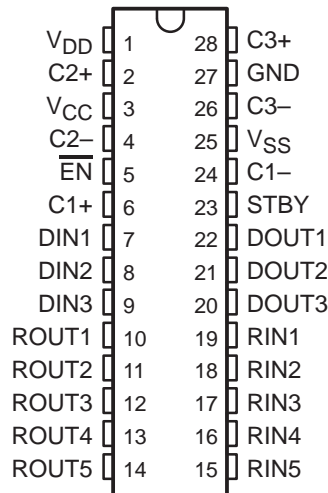
# SN75LV4737A

## 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  $\mu$ 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  $\mu$ 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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### 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

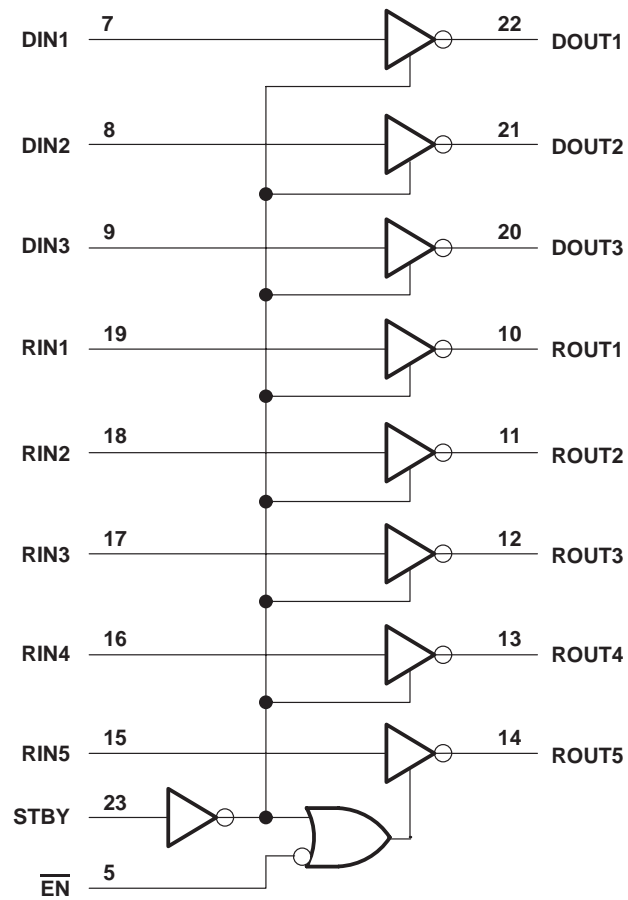
INPUTS				OUTPUTS	
STBY	$\overline{\text{EN}}$	RIN5	RIN1–RIN4	ROUT5	ROUT1–ROUT4
H	H	X	X	Z	Z
H	L	H	X	L	Z
H	L	L	X	H	Z
L	X	L	L	H	H
L	X	H	H	L	L

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

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

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logic diagram (positive logic)

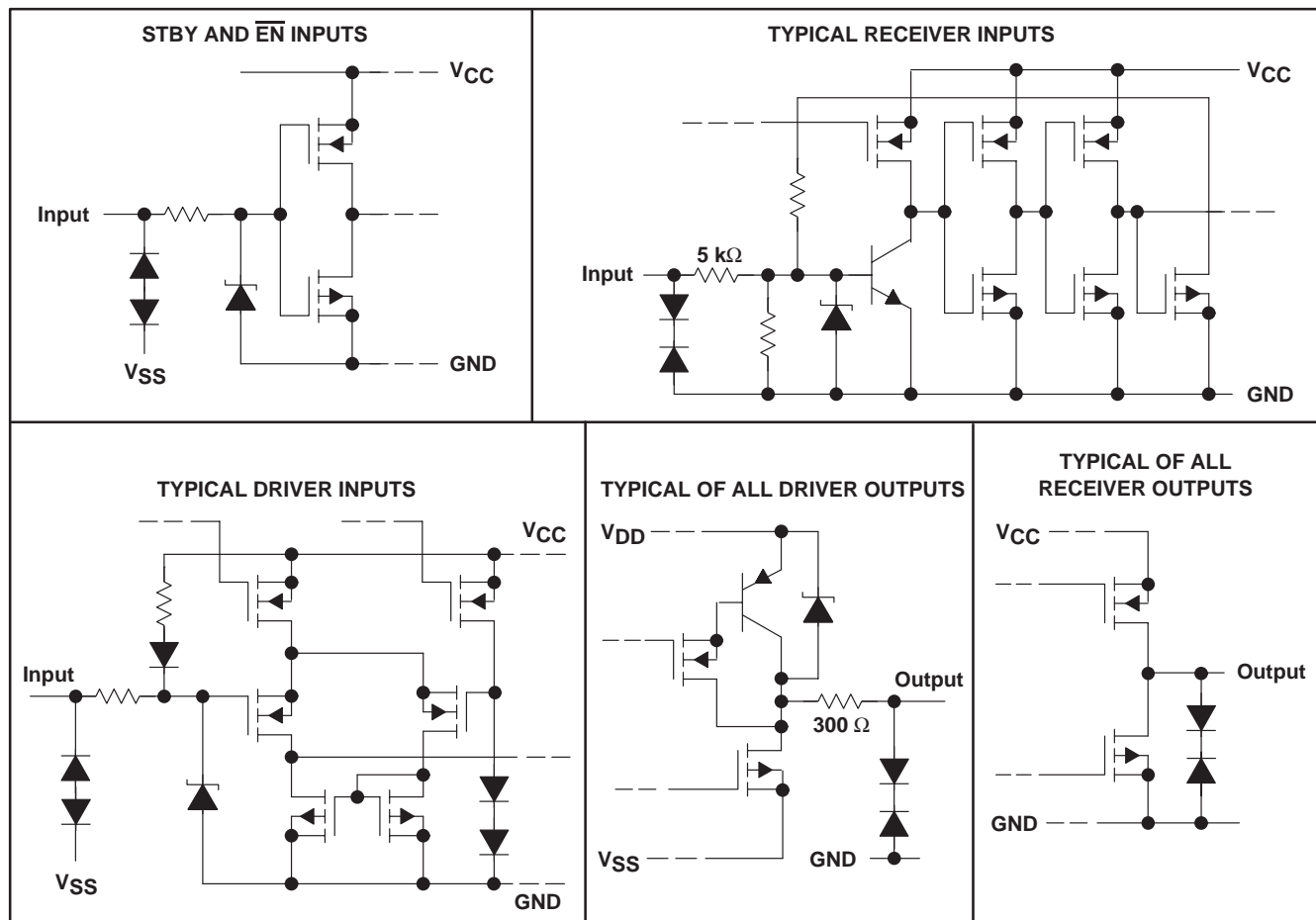


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### schematics of inputs and outputs



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

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

<sup>†</sup> 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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## 3.3-V/5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER

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### recommended operating conditions

			MIN	NOM	MAX	UNIT
V <sub>CC</sub>	Supply voltage	V <sub>CC</sub> = 3.3 V	3	3.3	3.6	V
		V <sub>CC</sub> = 5 V	4.5	5	5.5	V
V <sub>IH</sub>	Driver high-level input voltage	DIN, $\overline{\text{EN}}$ , STBY	V <sub>CC</sub> = 3.3 V			V
		DIN	2			
		$\overline{\text{EN}}$ , STBY	V <sub>CC</sub> = 5 V			
V <sub>IL</sub>	Driver low-level input voltage	DIN, $\overline{\text{EN}}$ , STBY			0.8	V
V <sub>I</sub>	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 <sub>A</sub>	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 <sub>CC</sub> = 3.3 V			V <sub>CC</sub> = 5 V			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
V <sub>DD</sub>	Positive supply voltage	No load	8	10		7	8.7		V
V <sub>SS</sub>	Negative supply voltage	No load		–9.5	–7		–8	–6	V
I <sub>I</sub>	Input current ( $\overline{\text{EN}}$ , STBY)	See Notes 4 and 5			±2			±2	μA
I <sub>CC</sub>	Supply current	No load, Inputs open	STBY at GND, $\overline{\text{EN}}$ at V <sub>CC</sub> or GND			8.4	10	18	mA
	Supply current (standby mode) (see Note 4)		$\overline{\text{EN}}$ , STBY at V <sub>CC</sub>					5	
	Supply current (wake-up mode) (see Note 5)		$\overline{\text{EN}}$ at GND, STBY at V <sub>CC</sub>					10	

† All typical values are at V<sub>CC</sub> = 3.3 V or V<sub>CC</sub> = 5 V, and T<sub>A</sub> = 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	$R_L = 3\text{ k}\Omega$	5.5	7		V
$V_{OL}$ Low-level output voltage	$R_L = 3\text{ k}\Omega$		–6	–5	V
$I_{IH}$ High-level input current	$V_I = V_{CC}$			1	$\mu\text{A}$
$I_{IL}$ Low-level input current	$V_I$ at GND			–10	$\mu\text{A}$
$I_{OS}$ Short-circuit output current (see Note 6)	$V_{CC} = 3.6\text{ V}$ , $V_O = 0\text{ V}$	$\pm 15$	$\pm 40$		mA
	$V_{CC} = 5.5\text{ V}$ , $V_O = 0\text{ V}$				
$r_o$ Output resistance	$V_{CC} = V_{DD} = V_{SS} = 0\text{ V}$ , $V_O = \pm 2\text{ V}$	300	500		$\Omega$

† All typical values are at  $V_{CC} = 3.3\text{ V}$  or  $V_{CC} = 5\text{ V}$ , and  $T_A = 25^\circ\text{C}$ .

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
tPLH	Propagation delay time, low- to high-level output	CL = 50 pF, RL = 3 kΩ to 7 kΩ, See Figure 1	VCC = 3.3 V	100	500	850	ns
	VCC = 5 V		100	500	850		
tPHL	Propagation delay time, high- to low-level output		VCC = 3.3 V	100	500	850	ns
			VCC = 5 V	100	500	850	
tPZH	Output enable time to high level	CL = 50 pF, See Figure 2	RL = 3 kΩ to 7 kΩ,		1	5	ms
tPZL	Output enable time to low level				3	7	ms
tPHZ	Output disable time from high level	CL = 50 pF, RL = 3 kΩ to 7 kΩ, See Figure 2	VCC = 3.3 V		0.9	3	μs
			VCC = 5 V		0.6	3	
tPLZ	Output disable time from low level		VCC = 3.3 V		0.5	3	μs
			VCC = 5 V		0.3	3	
SR	Slew rate	CL = 50 pF, See Figure 1	RL = 3 kΩ to 7 kΩ,	4		30	V/μs
SR(tr)	Slew rate, transition region	CL = 2500 pF, See Figure 3	RL = 3 kΩ to 7 kΩ,	3		30	V/μs

† All typical values are at  $V_{CC} = 3.3\text{ V}$  or  $V_{CC} = 5\text{ V}$ , and  $T_A = 25^\circ\text{C}$ .



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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 <sub>OH</sub> High-level output voltage	I <sub>OH</sub> = –2 mA	V <sub>CC</sub> = 3.3 V	2.4	3	V
		V <sub>CC</sub> = 5 V	3.5	5	
V <sub>OL</sub> Low-level output voltage	I <sub>OL</sub> = 2 mA		0.2	0.4	V
V <sub>IT+</sub> Positive-going input threshold voltage			2.2	2.6	V
V <sub>IT–</sub> Negative-going input threshold voltage			0.6	1	V
V <sub>hys</sub> Input hysteresis (V <sub>IT+</sub> – V <sub>IT–</sub> )			0.5	1.2	1.8
r <sub>i</sub> Input resistance	V <sub>I</sub> = ±3 V to ±25 V		3	5	7
					kΩ

† All typical values are at V<sub>CC</sub> = 3.3 V or V<sub>CC</sub> = 5 V, and T<sub>A</sub> = 25°C.

**switching characteristics over recommended ranges of supply voltage and operating free-air temperature, C<sub>L</sub> = 50 pF, R<sub>L</sub> = 3 kΩ to GND**

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

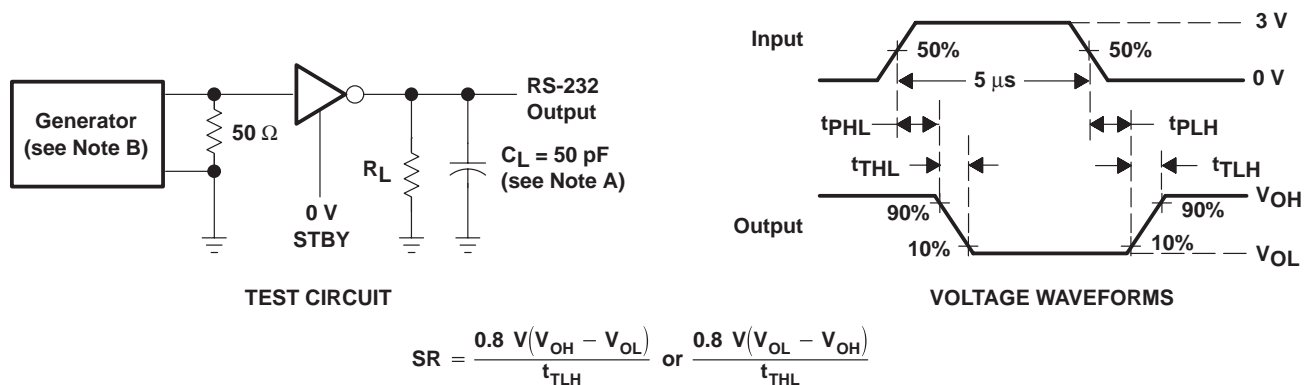


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## 3.3-V/5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER

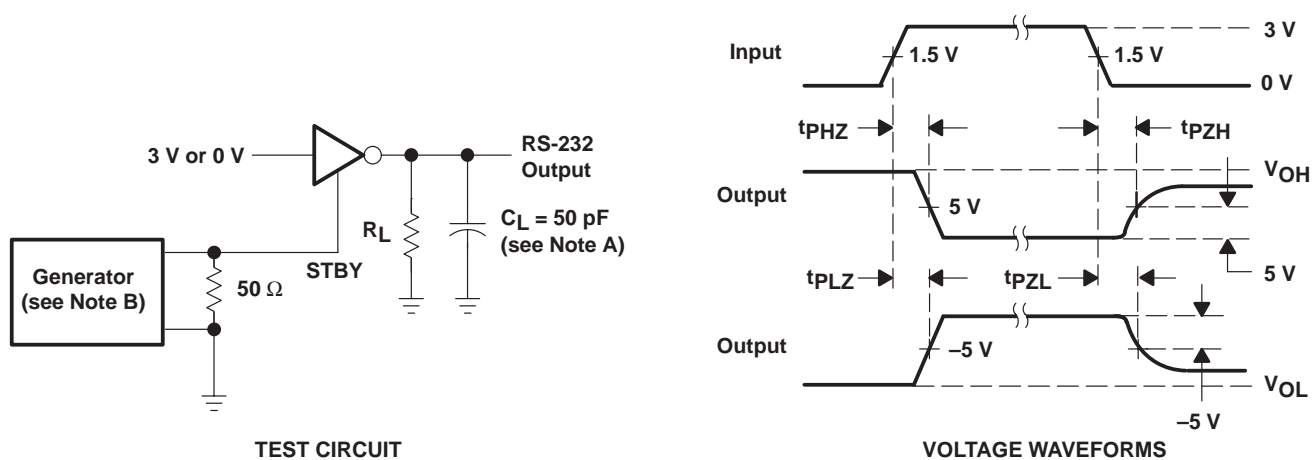
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### PARAMETER MEASUREMENT INFORMATION



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)

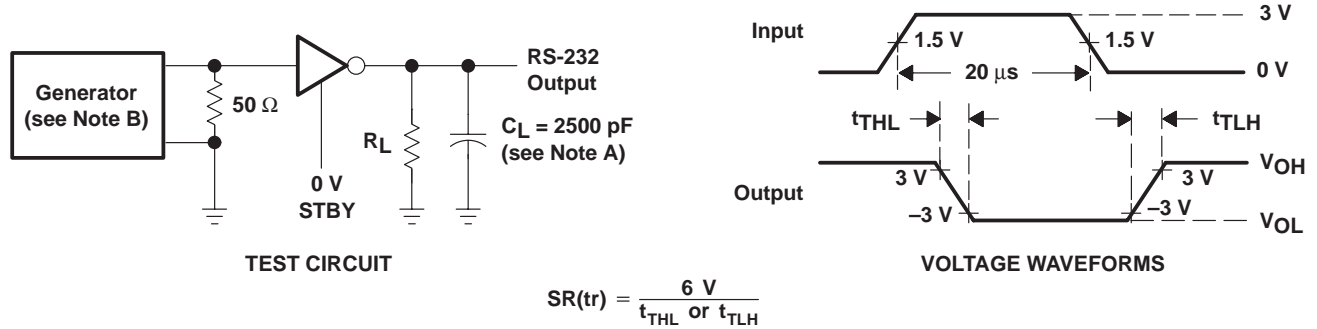


NOTES: A.  $C_L$  includes probe and jig capacitance.  
B. The pulse generator has the following characteristics:  $Z_O = 50 \Omega$ , 50% duty cycle,  $t_r \leq 10$  ns,  $t_f \leq 10$  ns.

Figure 2. Driver Enable and Disable Test Times



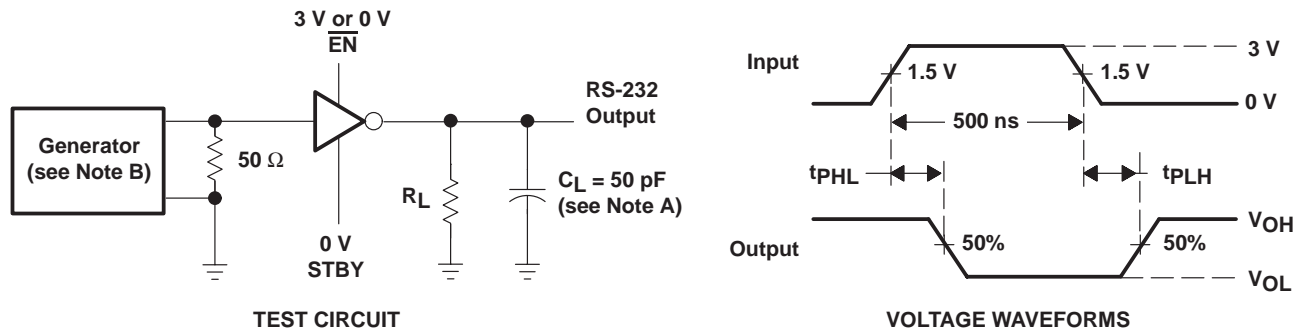
### PARAMETER MEASUREMENT INFORMATION



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- $\mu$ s 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,  $t_r \leq 10\text{ ns}$ ,  $t_f \leq 10\text{ ns}$ .

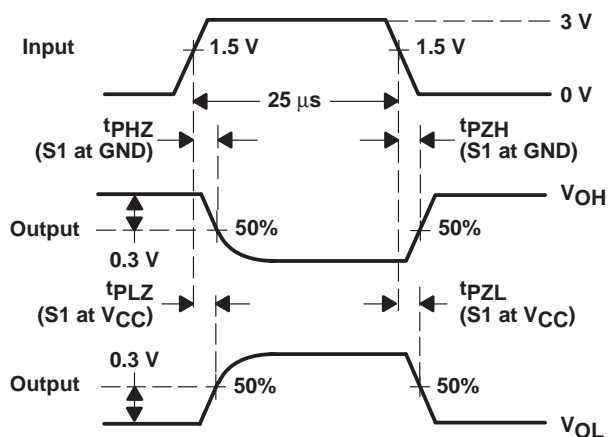
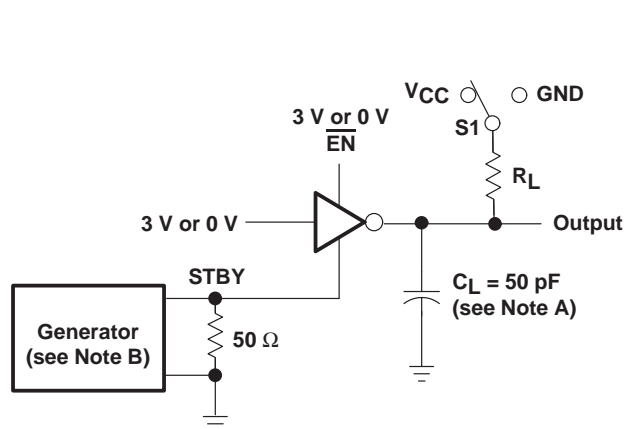
**Figure 4. Receiver Propagation Delay Times**

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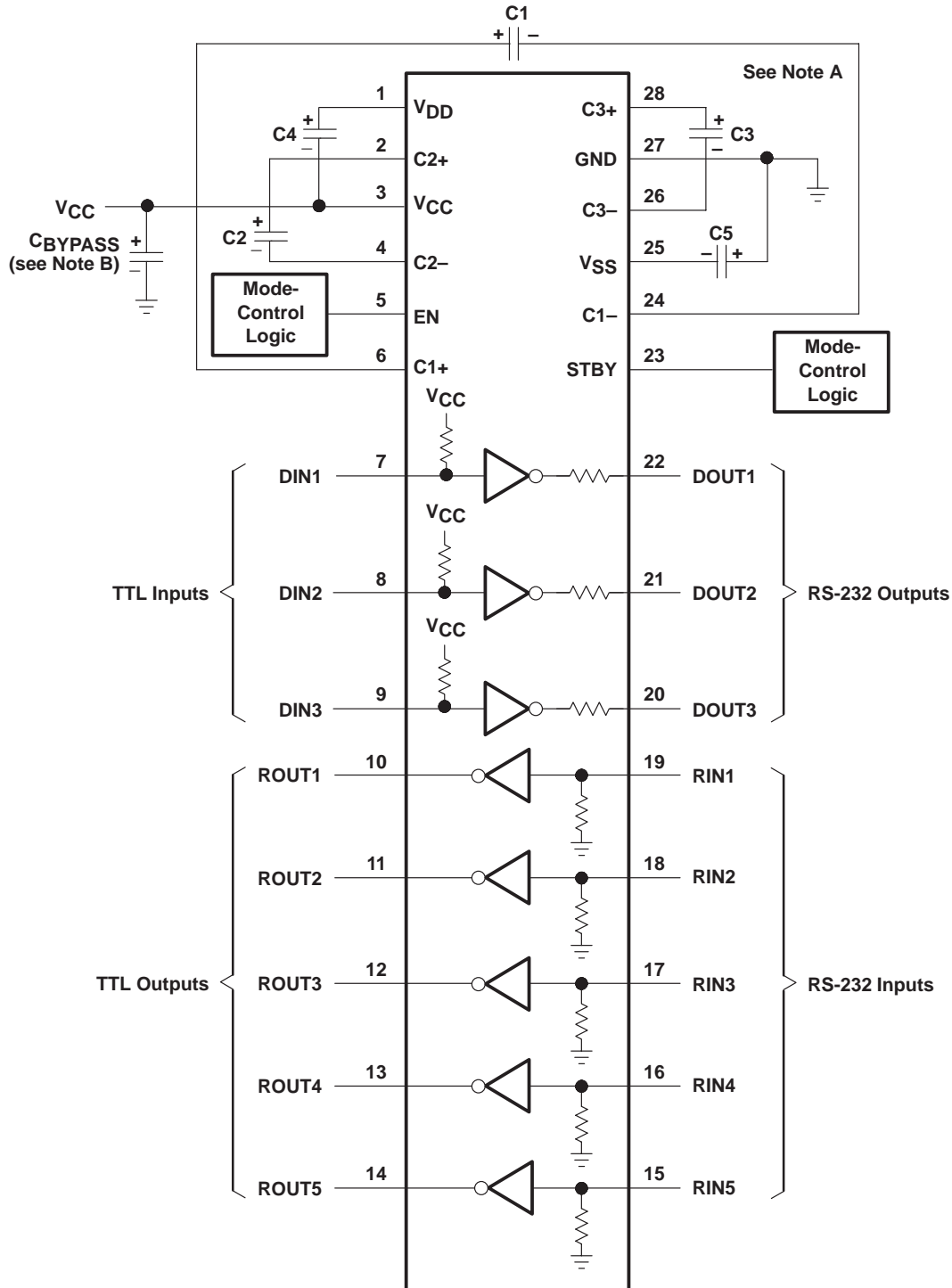
### PARAMETER MEASUREMENT INFORMATION



- 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  $\mu$ F  
 B. CBYPASS is used as a decoupling capacitor.

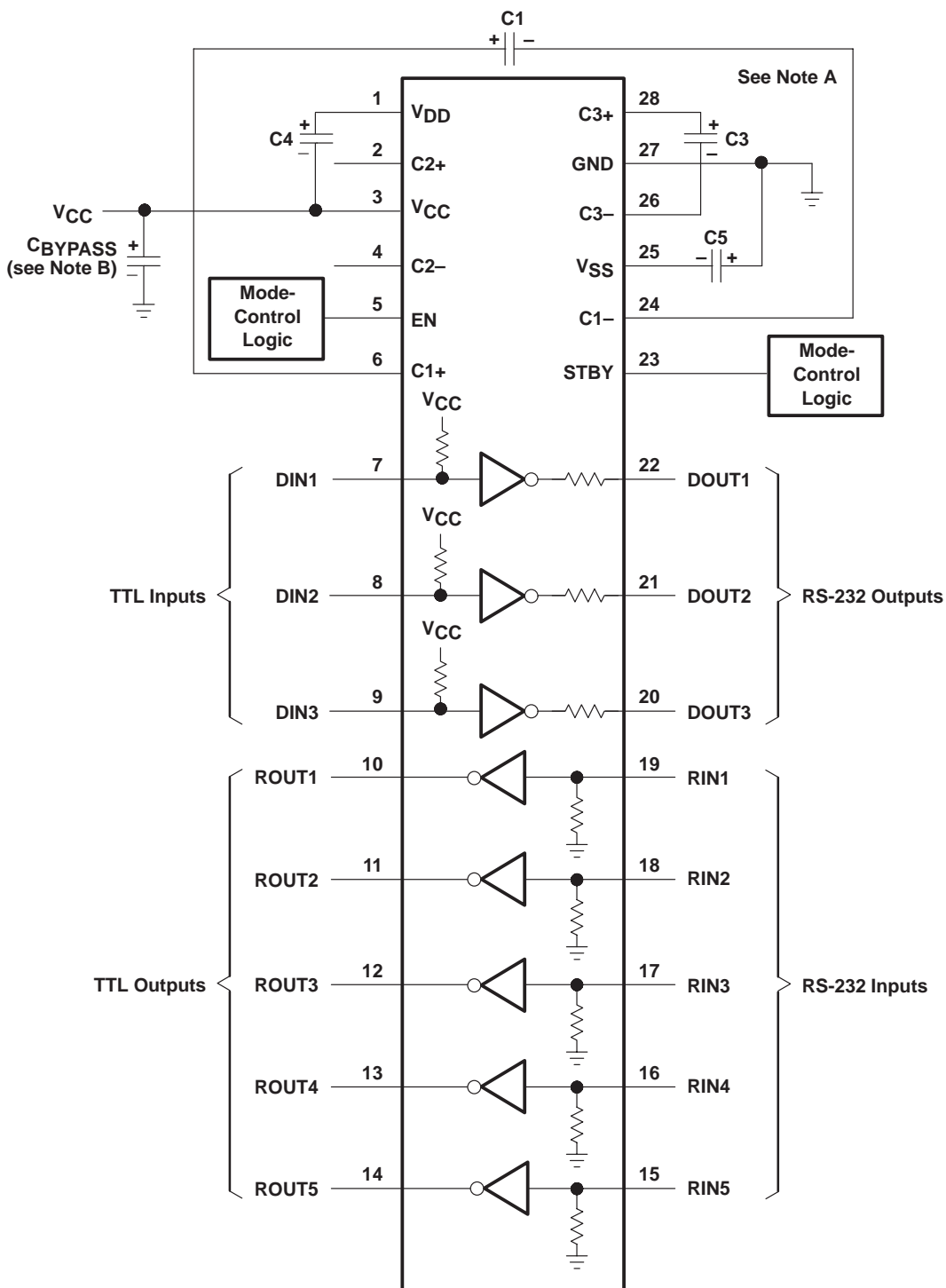
**Figure 6. Typical 3.3-V Operating Circuit**

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

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### APPLICATION INFORMATION



- NOTES: A. C2 is not used. C1 = C3 = C4 = C5 = C<sub>BYPASS</sub> = 0.1  $\mu$ F  
B. C<sub>BYPASS</sub> is used as a decoupling capacitor.

Figure 7. Typical 5-V Operating Circuit

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