

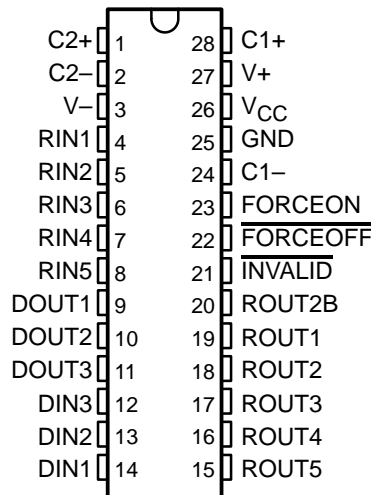
# 3-V TO 5.5-V MULTICHANNEL COMPATIBLE RS-232 LINE DRIVERS/RECEIVERS

SN65C3243, SN75C3243

SLLS353C – JUNE 1999 – REVISED MARCH 2002

- Operate With 3-V to 5.5-V  $V_{CC}$  Supply
- Always-Active Noninverting Receiver Output (ROUT2B)
- Low Standby Current . . . 1  $\mu$ A Typical
- External Capacitors . . .  $4 \times 0.1 \mu$ F
- Accept 5-V Logic Input With 3.3-V Supply
- Inter-Operable With SN65C3238, SN75C3238
- Support Operation From 250 kbit/s to 1 Mbit/s
- RS-232 Bus-Pin ESD Protection Exceeds  $\pm 15$ -kV Using Human-Body Model (HBM)
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- Applications
  - Battery-Powered Systems, PDAs, Notebooks, Laptops, Palmtop PCs, and Hand-Held Equipment
- Package Options Include Plastic Small-Outline (DW), Shrink Small-Outline (DB), and Thin Shrink Small-Outline (PW) Packages

DB, DW, OR PW PACKAGE  
(TOP VIEW)



## description

The SN65C3243 and SN75C3243 consist of three line drivers, five line receivers, and a dual charge-pump circuit with  $\pm 15$ -kV ESD protection pin-to-pin (serial-port connection pins, including GND). These devices provide the electrical interface between an asynchronous communication controller and the serial-port connector. The charge pump and four small external capacitors allow operation from a single 3-V to 5.5-V supply. In addition, these devices include an always-active noninverting output (ROUT2B), which allows applications using the ring indicator to transmit data while the devices are powered down. The devices operate at data signaling rates up to 1 Mbit/s, and an increased slew-rate range of 24 V/ $\mu$ s to 150 V/ $\mu$ s.

Flexible control options for power management are available when the serial port is inactive. The auto-powerdown feature functions when FORCEON is low and FORCEOFF is high. During this mode of operation, if the devices do not sense a valid RS-232 signal, the driver outputs are disabled. If FORCEOFF is set low, both drivers and receivers (except ROUT2B) are shut off, and the supply current is reduced to 1  $\mu$ A. Disconnecting the serial port or turning off the peripheral drivers causes the auto-powerdown condition to occur.

Auto-powerdown can be disabled when FORCEON and FORCEOFF are high, and should be done when driving a serial mouse. With auto-powerdown enabled, the device is activated automatically when a valid signal is applied to any receiver input. The INVALID output is used to notify the user if an RS-232 signal is present at any receiver input. INVALID is high (valid data) if any receiver input voltage is greater than 2.7 V or less than -2.7 V or has been between -0.3 V and 0.3 V for less than 30  $\mu$ s. INVALID is low (invalid data) if all receiver input voltages are between -0.3 V and 0.3 V for more than 30  $\mu$ s. Refer to Figure 5 for receiver input levels.

The SN65C3243 is characterized for operation from -40°C to 85°C. The SN75C3243 is characterized for operation from 0°C to 70°C.



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# SN65C3243, SN75C3243

## 3-V TO 5.5-V MULTICHANNEL COMPATIBLE RS-232 LINE DRIVERS/RECEIVERS

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### AVAILABLE OPTIONS

T <sub>A</sub>	PACKAGED DEVICES		
	SHRINK SMALL OUTLINE (DB)	SMALL OUTLINE (DW)	THIN SHRINK SMALL OUTLINE (PW)
-40°C to 85°C	SN65C3243DB	SN65C3243DW	SN65C3243PW
0°C to 70°C	SN75C3243DB	SN75C3243DW	SN75C3243PW

The DB, DW, and PW packages are available taped and reeled. Add the suffix R to device type (e.g., SN75C3243DBR).

### Function Tables

#### EACH DRIVER

INPUTS				OUTPUT DOUT	DRIVER STATUS
DIN	FORCEON	$\overline{\text{FORCEOFF}}$	VALID RIN RS-232 LEVEL		
X	X	L	X	Z	Powered off
L	H	H	X	H	Normal operation with auto-powerdown disabled
H	H	H	X	L	
L	L	H	Yes	H	Normal operation with auto-powerdown enabled
H	L	H	Yes	L	
L	L	H	No	Z	Powered off by auto-powerdown feature
H	L	H	No	Z	

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

#### EACH RECEIVER

INPUTS				OUTPUTS		RECEIVER STATUS
RIN2	RIN1, RIN3-RIN5	$\overline{\text{FORCEOFF}}$	VALID RIN RS-232 LEVEL	ROUT2B	ROUT	
L	X	L	X	L	Z	Powered off while ROUT2B is active
H	X	L	X	H	Z	
L	L	H	Yes	L	H	Normal operation with auto-powerdown disabled/enabled
L	H	H	Yes	L	L	
H	L	H	Yes	H	H	
H	H	H	Yes	H	L	
Open	Open	H	No	L	H	

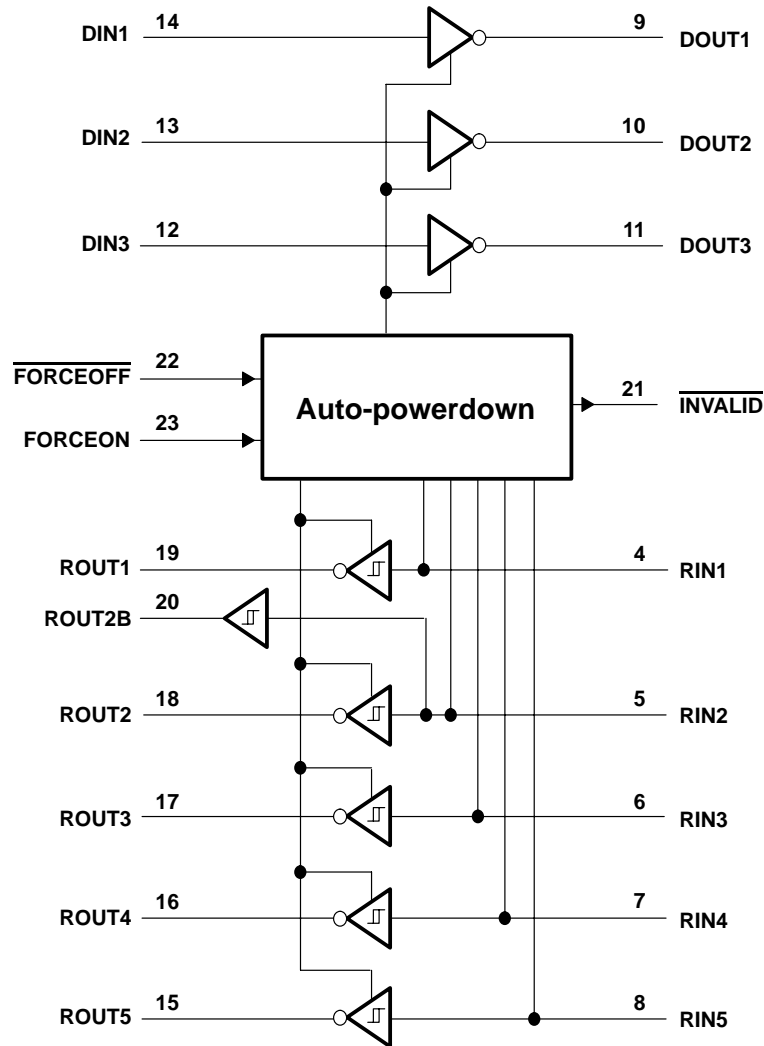
H = high level, L = low level, X = irrelevant, Z = high impedance (off), Open = input disconnected or connected driver off



# SN65C3243, SN75C3243 3-V TO 5.5-V MULTICHANNEL COMPATIBLE RS-232 LINE DRIVERS/RECEIVERS

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logic diagram (positive logic)



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## 3-V TO 5.5-V MULTICHANNEL COMPATIBLE RS-232 LINE DRIVERS/RECEIVERS

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

Supply voltage range, $V_{CC}$ (see Note 1)	.....	-0.3 V to 6 V
Positive output supply voltage range, $V_+$ (see Note 1)	.....	-0.3 V to 7 V
Negative output supply voltage range, $V_-$ (see Note 1)	.....	0.3 V to -7 V
Supply voltage difference, $V_+ - V_-$ (see Note 1)	.....	13 V
Input voltage range, $V_I$ : Driver ( $\overline{\text{FORCEOFF}}$ , $\text{FORCEON}$ )	.....	-0.3 V to 6 V
Receiver	.....	-25 V to 25 V
Output voltage range, $V_O$ : Driver	.....	-13.2 V to 13.2 V
Receiver ( $\text{INVALID}$ )	.....	-0.3 V to $V_{CC} + 0.3$ V
Package thermal impedance, $\theta_{JA}$ (see Note 2): DB package	.....	62°C/W
DW package	.....	46°C/W
PW package	.....	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 (see Note 3 and Figure 6)

			MIN	NOM	MAX	UNIT
Supply voltage		$V_{CC} = 3.3$ V	3	3.3	3.6	V
		$V_{CC} = 5$ V	4.5	5	5.5	
$V_{IH}$	Driver and control high-level input voltage	DIN, $\overline{\text{FORCEOFF}}$ , $\text{FORCEON}$	$V_{CC} = 3.3$ V	2		V
			$V_{CC} = 5$ V	2.4		
$V_{IL}$	Driver and control low-level input voltage	DIN, $\overline{\text{FORCEOFF}}$ , $\text{FORCEON}$			0.8	V
$V_I$	Driver and control input voltage	DIN, $\overline{\text{FORCEOFF}}$ , $\text{FORCEON}$	0	5.5		V
$V_I$	Receiver input voltage		-25	25		V
$T_A$	Operating free-air temperature	SN65C3243	-40	85		°C
		SN75C3243	0	70		

NOTE 3: Test conditions are C1–C4 = 0.1  $\mu$ F at  $V_{CC} = 3.3$  V  $\pm$  0.3 V; C1 = 0.047  $\mu$ F, C2–C4 = 0.33  $\mu$ F at  $V_{CC} = 5$  V  $\pm$  0.5 V.

### electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 3 and Figure 6)

PARAMETER		TEST CONDITIONS	MIN	TYP‡	MAX	UNIT
$I_I$	Input leakage current	$\overline{\text{FORCEOFF}}$ , $\text{FORCEON}$		$\pm 0.01$	$\pm 1$	$\mu$ A
$I_{CC}$	Supply current	Auto-powerdown disabled	No load, $\overline{\text{FORCEOFF}}$ and $\text{FORCEON} = V_{CC}$	0.3	1	mA
		Powered off	No load, $\overline{\text{FORCEOFF}} = \text{GND}$	1	10	
		Auto-powerdown enabled	No load, $\overline{\text{FORCEOFF}} = V_{CC}$ , $\text{FORCEON} = \text{GND}$ , All RIN are open or grounded, All DIN are grounded	1	10	$\mu$ A

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

NOTE 3: Test conditions are C1–C4 = 0.1  $\mu$ F at  $V_{CC} = 3.3$  V  $\pm$  0.3 V; C1 = 0.047  $\mu$ F, C2–C4 = 0.33  $\mu$ F at  $V_{CC} = 5$  V  $\pm$  0.5 V.



# SN65C3243, SN75C3243

## 3-V TO 5.5-V MULTICHANNEL COMPATIBLE RS-232 LINE DRIVERS/RECEIVERS

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### DRIVER SECTION

**electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 3 and Figure 6)**

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
V <sub>OH</sub> High-level output voltage	All DOUT at R <sub>L</sub> = 3 kΩ to GND	5	5.4		V
V <sub>OL</sub> Low-level output voltage	All DOUT at R <sub>L</sub> = 3 kΩ to GND	-5	-5.4		V
V <sub>O</sub> Output voltage (mouse driveability)	DIN1 = DIN2 = GND, DIN3 = V <sub>CC</sub> , 3-kΩ to GND at DOUT3, DOUT1 = DOUT2 = 2.5 mA		±5		V
I <sub>IH</sub> High-level input current	V <sub>I</sub> = V <sub>CC</sub>		±0.01	±1	μA
I <sub>IL</sub> Low-level input current	V <sub>I</sub> = GND		±0.01	±1	μA
I <sub>OS</sub> Short-circuit output current‡	V <sub>CC</sub> = 3.6 V, V <sub>O</sub> = 0 V		±35	±60	mA
	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 0 V		±35	±75	
r <sub>o</sub> Output resistance	V <sub>CC</sub> , V+, and V- = 0 V, V <sub>O</sub> = ±2 V	300	10M		Ω
I <sub>off</sub> Output leakage current	FORCEOFF = GND, V <sub>O</sub> = ±12 V, V <sub>CC</sub> = 0 to 5.5 V			±25	μA

† 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.

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

NOTE 3. Test conditions are C1–C4 = 0.1 μF at V<sub>CC</sub> = 3.3 V ± 0.3 V; C1 = 0.047 μF, C2–C4 = 0.33 μF at V<sub>CC</sub> = 5 V ± 0.5 V.

**switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 3 and Figure 6)**

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
Maximum data rate (see Figure 1)	R <sub>L</sub> = 3 kΩ, One DOUT switching	C <sub>L</sub> = 1000 pF	250		kbit/s
		C <sub>L</sub> = 250 pF, V <sub>CC</sub> = 3 V to 4.5 V	1000		
		C <sub>L</sub> = 1000 pF, V <sub>CC</sub> = 4.5 V to 5.5 V	1000		
t <sub>sk(p)</sub> Pulse skew§	C <sub>L</sub> = 150 pF to 2500 pF, R <sub>L</sub> = 3 kΩ to 7 kΩ, See Figure 2		25		ns
SR(tr) Slew rate, transition region (see Figure 1)	C <sub>L</sub> = 150 pF to 1000 pF, R <sub>L</sub> = 3 kΩ to 7 kΩ, V <sub>CC</sub> = 3.3 V		24	150	V/μs

† 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.

§ Pulse skew is defined as |t<sub>PLH</sub> - t<sub>PHL</sub>| of each channel of the same device.

NOTE 3. Test conditions are C1–C4 = 0.1 μF at V<sub>CC</sub> = 3.3 V ± 0.3 V; C1 = 0.047 μF, C2–C4 = 0.33 μF at V<sub>CC</sub> = 5 V ± 0.5 V.



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**RECEIVER SECTION**

**electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 3 and Figure 6)**

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
V <sub>OH</sub> High-level output voltage	I <sub>OH</sub> = -1 mA	V <sub>CC</sub> - 0.6 V	V <sub>CC</sub> - 0.1 V		V
V <sub>OL</sub> Low-level output voltage	I <sub>OL</sub> = 1.6 mA			0.4	V
V <sub>IT+</sub> Positive-going input threshold voltage	V <sub>CC</sub> = 3.3 V		1.6	2.4	V
	V <sub>CC</sub> = 5 V		1.9	2.4	
V <sub>IT-</sub> Negative-going input threshold voltage	V <sub>CC</sub> = 3.3 V	0.6	1.1		V
	V <sub>CC</sub> = 5 V	0.8	1.4		
V <sub>hys</sub> Input hysteresis (V <sub>IT+</sub> - V <sub>IT-</sub> )			0.5		V
I <sub>off</sub> Output leakage current (except ROUT2B)	FORCEOFF = 0 V		±0.05	±10	µA
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.

NOTE 3. Test conditions are C1-C4 = 0.1 µF at V<sub>CC</sub> = 3.3 V ± 0.3 V; C1 = 0.047 µF, C2-C4 = 0.33 µF at V<sub>CC</sub> = 5 V ± 0.5 V.

**switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 3)**

PARAMETER	TEST CONDITIONS	TYP†	UNIT
t <sub>PLH</sub> Propagation delay time, low- to high-level output	C <sub>L</sub> = 150 pF, See Figure 3	150	ns
t <sub>PHL</sub> Propagation delay time, high- to low-level output	C <sub>L</sub> = 150 pF, See Figure 3	150	ns
t <sub>en</sub> Output enable time	C <sub>L</sub> = 150 pF, R <sub>L</sub> = 3 kΩ, See Figure 4	200	ns
t <sub>dis</sub> Output disable time	C <sub>L</sub> = 150 pF, R <sub>L</sub> = 3 kΩ, See Figure 4	200	ns
t <sub>sk(p)</sub> Pulse skew‡	See Figure 3	50	ns

† 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.

‡ Pulse skew is defined as |t<sub>PLH</sub> - t<sub>PHL</sub>| of each channel of the same device.

NOTE 3. Test conditions are C1-C4 = 0.1 µF at V<sub>CC</sub> = 3.3 V ± 0.3 V; C1 = 0.047 µF, C2-C4 = 0.33 µF at V<sub>CC</sub> = 5 V ± 0.5 V.



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## 3-V TO 5.5-V MULTICHANNEL COMPATIBLE RS-232 LINE DRIVERS/RECEIVERS

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### AUTO-POWERDOWN SECTION

**electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 5)**

PARAMETER		TEST CONDITIONS	MIN	MAX	UNIT
V <sub>T+(valid)</sub>	Receiver input threshold for <u>INVALID</u> high-level output voltage	FORCEON = GND, FORCEOFF = V <sub>CC</sub>		2.7	V
V <sub>T-(valid)</sub>	Receiver input threshold for <u>INVALID</u> high-level output voltage	FORCEON = GND, FORCEOFF = V <sub>CC</sub>	-2.7		V
V <sub>T(invalid)</sub>	Receiver input threshold for <u>INVALID</u> low-level output voltage	FORCEON = GND, FORCEOFF = V <sub>CC</sub>	-0.3	0.3	V
V <sub>OH</sub>	<u>INVALID</u> high-level output voltage	I <sub>QH</sub> = -1 mA, FORCEON = GND, FORCEOFF = V <sub>CC</sub>	V <sub>CC</sub> - 0.6		V
V <sub>OL</sub>	<u>INVALID</u> low-level output voltage	I <sub>QL</sub> = 1.6 mA, FORCEON = GND, FORCEOFF = V <sub>CC</sub>		0.4	V

**switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 5)**

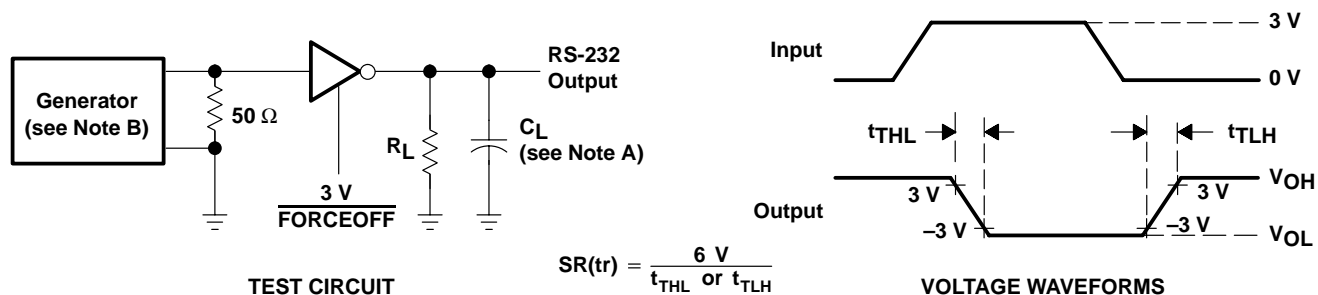
PARAMETER		TYP†	UNIT
t <sub>valid</sub>	Propagation delay time, low- to high-level output	1	μs
t <sub>invalid</sub>	Propagation delay time, high- to low-level output	30	μs
t <sub>en</sub>	Supply enable time	100	μs

† 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.

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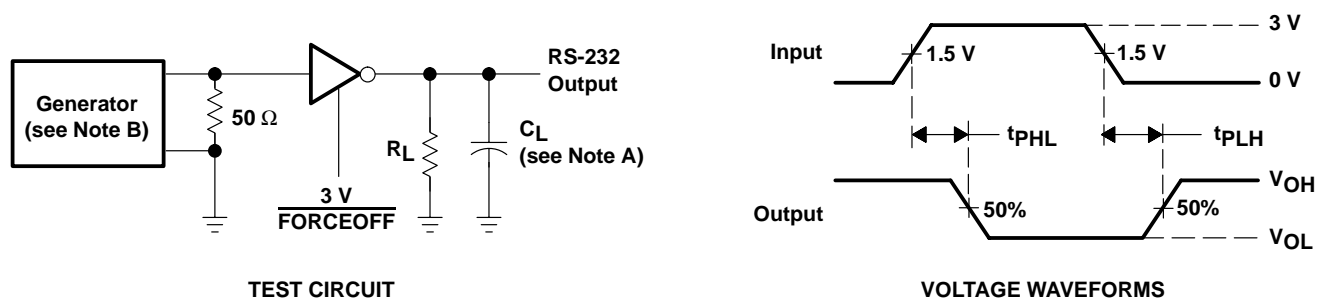
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## PARAMETER MEASUREMENT INFORMATION



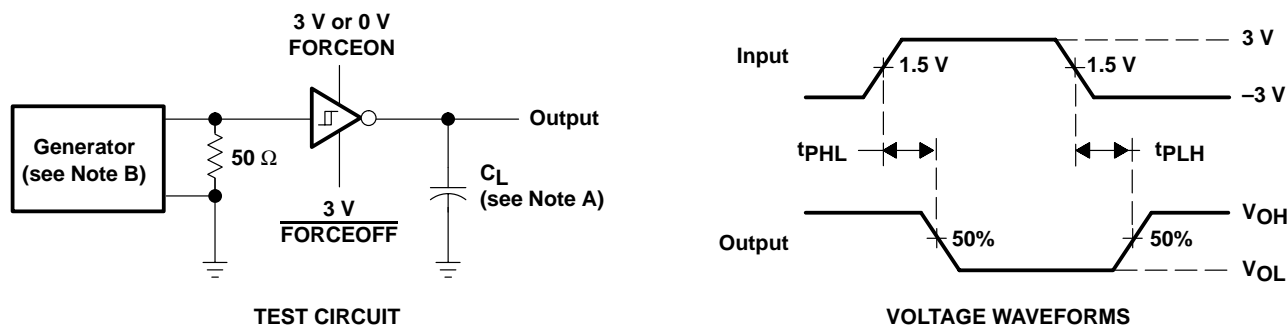
NOTES: A.  $C_L$  includes probe and jig capacitance.  
B. The pulse generator has the following characteristics: PRR = 1 Mbit/s,  $Z_O = 50 \Omega$ , 50% duty cycle,  $t_r \leq 10 \text{ ns}$ ,  $t_f \leq 10 \text{ ns}$ .

Figure 1. Driver Slew Rate



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

Figure 2. Driver Pulse Skew

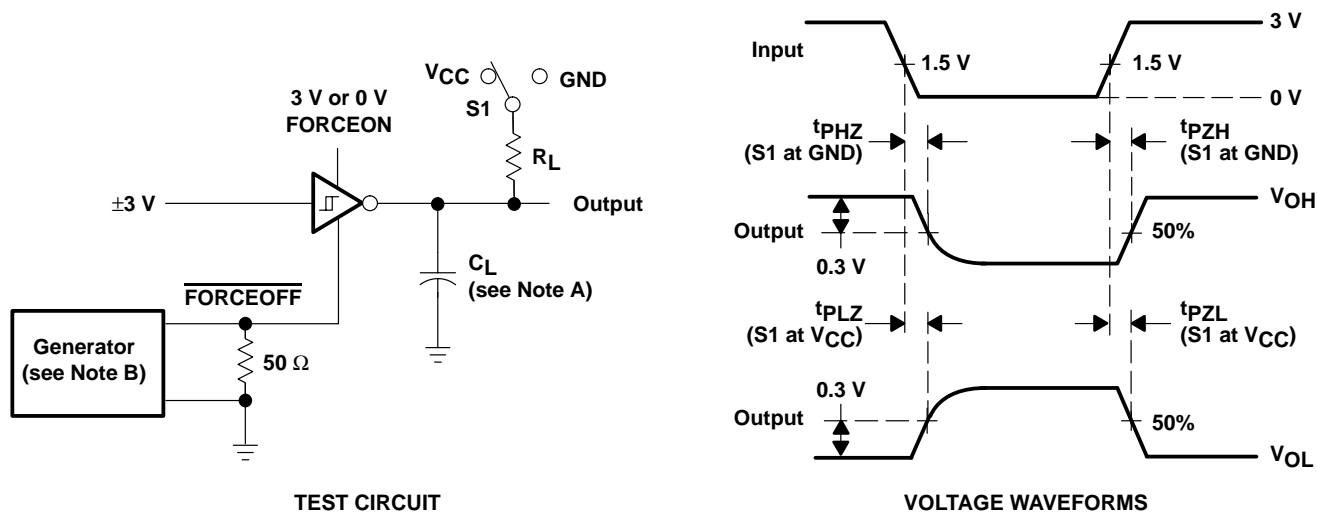


NOTES: C.  $C_L$  includes probe and jig capacitance.  
D. The pulse generator has the following characteristics:  $Z_O = 50 \Omega$ , 50% duty cycle,  $t_r \leq 10 \text{ ns}$ ,  $t_f \leq 10 \text{ ns}$ .

Figure 3. Receiver Propagation Delay Times



PARAMETER MEASUREMENT INFORMATION



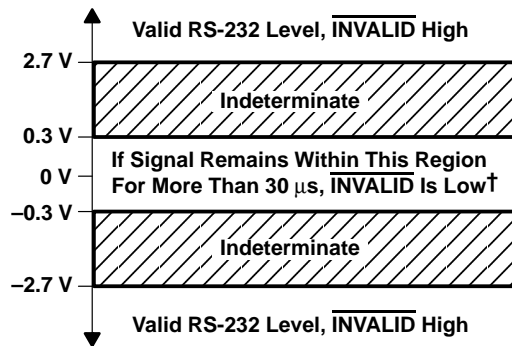
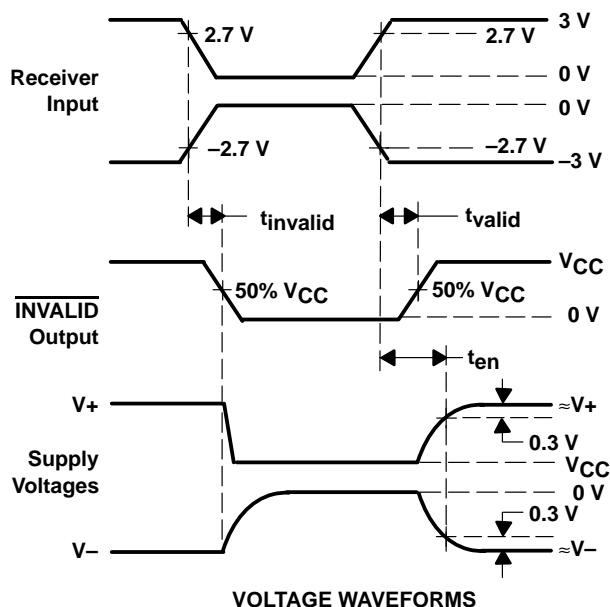
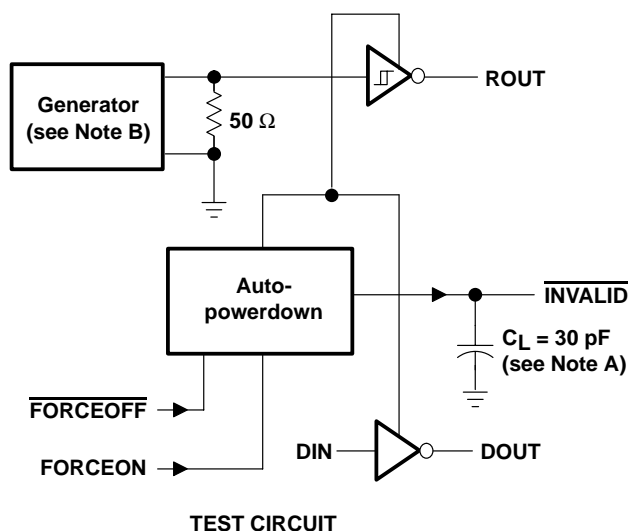
- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. The pulse generator has the following characteristics:  $Z_O = 50 \Omega$ , 50% duty cycle,  $t_r \leq 10$  ns,  $t_f \leq 10$  ns.  
 C.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .  
 D.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .

Figure 4. Receiver Enable and Disable Times

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## PARAMETER MEASUREMENT INFORMATION

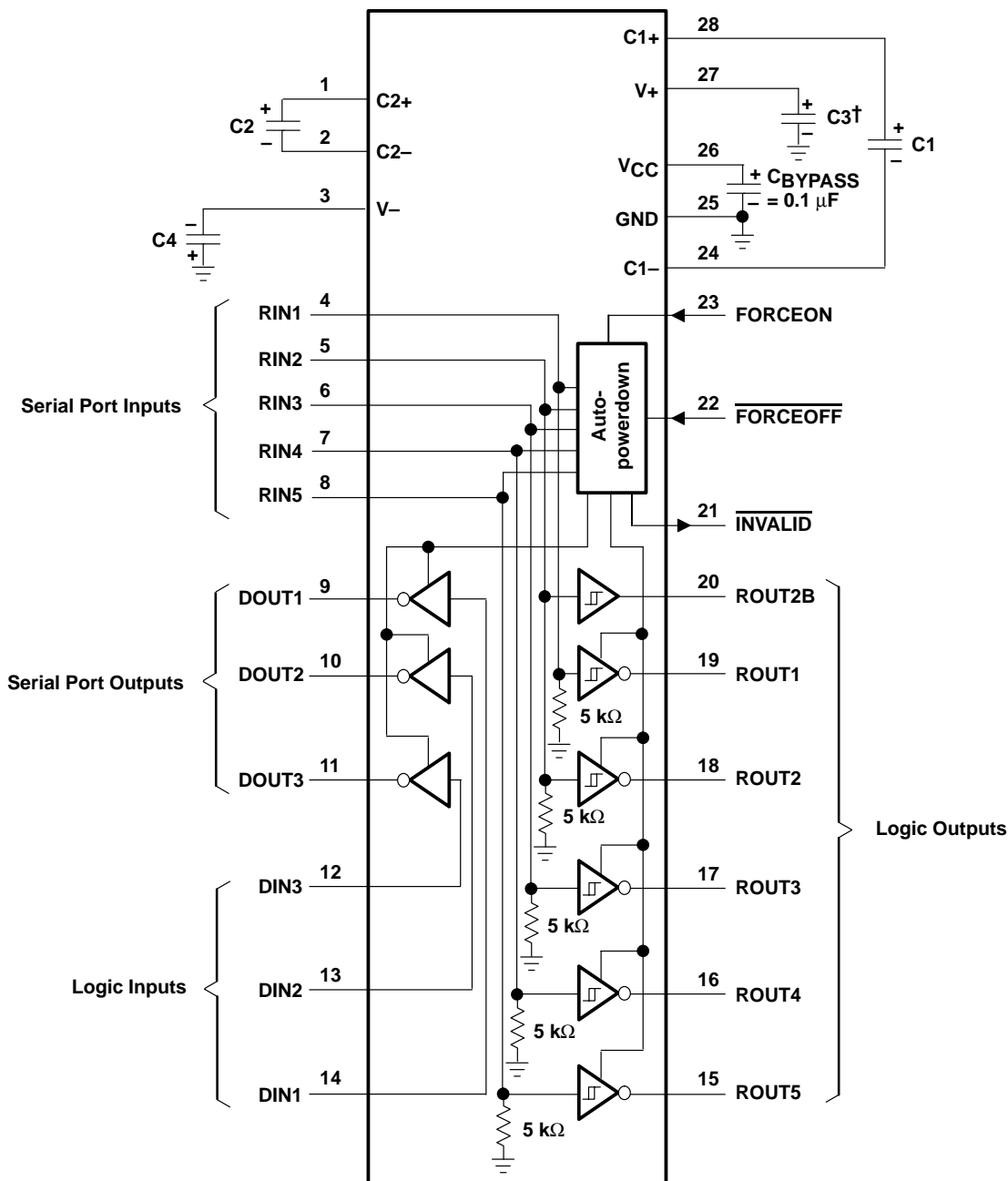


<sup>†</sup> Auto-powerdown disables drivers and reduces supply current to 1  $\mu\text{A}$ .

- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. The pulse generator has the following characteristics: PRR = 5 kbit/s,  $Z_O = 50 \Omega$ , 50% duty cycle,  $t_r \leq 10 \text{ ns}$ ,  $t_f \leq 10 \text{ ns}$ .

**Figure 5.  $\overline{\text{INVALID}}$  Propagation Delay Times and Supply Enabling Time**

**APPLICATION INFORMATION**



† C3 can be connected to V<sub>CC</sub> or GND.  
 NOTE A: Resistor values shown are nominal.

**V<sub>CC</sub> vs CAPACITOR VALUES**

V <sub>CC</sub>	C1	C2, C3, and C4
3.3 V ± 0.3 V	0.1 μF	0.1 μF
5 V ± 0.5 V	0.047 μF	0.33 μF
3 V to 5.5 V	0.1 μF	0.47 μF

**Figure 6. Typical Operating Circuit and Capacitor Values**

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