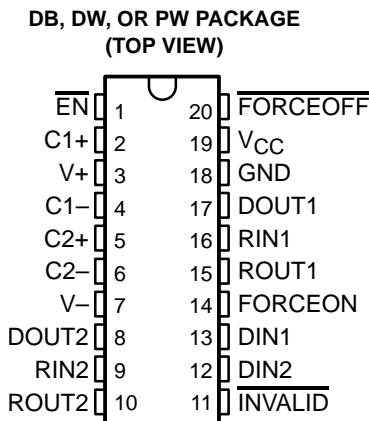


SN65C3223, SN75C3223

3-V TO 5.5-V MULTICHANNEL RS-232 COMPATIBLE LINE DRIVER/RECEIVER

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- Operate With 3-V to 5.5-V V_{CC} Supply
- Operate up to 1 Mbit/s
- Low Standby Current . . . 1 μ A Typical
- External Capacitors . . . $4 \times 0.1 \mu$ F
- Accept 5-V Logic Input With 3.3-V Supply
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- RS-232 Bus-Pin ESD Protection Exceeds ± 15 kV Using Human-Body Model (HBM)
- Applications
 - Battery-Powered Systems, PDAs, Notebooks, Laptops, Palmtop PCs, and Hand-Held Equipment



description/ordering information

The SN65C3223 and SN75C3223 consist of two line drivers, two line receivers, and a dual charge-pump circuit with ± 15 -kV ESD protection pin to pin (serial-port connection pins, including GND). The 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. The devices operate at data signaling rates up to 1 Mbit/s and a driver output slew rate of 24 V/ μ s to 150 V/ μ 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 $\overline{\text{FORCEOFF}}$ is high. During this mode of operation, if the device does not sense a valid RS-232 signal, the driver outputs are disabled. If $\overline{\text{FORCEOFF}}$ is set low and $\overline{\text{EN}}$ is high, both drivers and receivers are shut off, and the supply current is reduced to 1 μ A. Disconnecting the serial port or turning off the peripheral drivers causes auto-powerdown to occur. Auto-powerdown can be disabled when FORCEON and $\overline{\text{FORCEOFF}}$ are high. With auto-powerdown enabled, the device is activated automatically when a valid signal is applied to any receiver input. The $\overline{\text{INVALID}}$ output is used to notify the user if an RS-232 signal is present at any receiver input. $\overline{\text{INVALID}}$ 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 μ s. $\overline{\text{INVALID}}$ is low (invalid data) if the receiver input voltage is between -0.3 V and 0.3 V for more than 30 μ s. Refer to Figure 4 for receiver input levels.

ORDERING INFORMATION

T _A	PACKAGE†	ORDERABLE PART NUMBER	TOP-SIDE MARKING	
–40°C to 85°C	SOIC – DW	Tube	SN65C3223DW	
		Tape and reel	SN65C3223DWR	
	SSOP – DB	Tape and reel	SN65C3223DBR	CB3223
	TSSOP – PW	Tape and reel	SN65C3223PWR	CB3223
0°C to 70°C	SOIC – DW	Tube	SN75C3223DW	
		Tape and reel	SN75C3223DWR	
	SSOP – DB	Tape and reel	SN75C3223DBR	CA3223
	TSSOP – PW	Tape and reel	SN75C3223PWR	CA3223

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



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**TEXAS
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SN65C3223, SN75C3223 3-V TO 5.5-V MULTICHANNEL RS-232 COMPATIBLE LINE DRIVER/RECEIVER

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Function Tables

EACH DRIVER

INPUTS				OUTPUT DOUT	DRIVER STATUS
DIN	FORCEON	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	

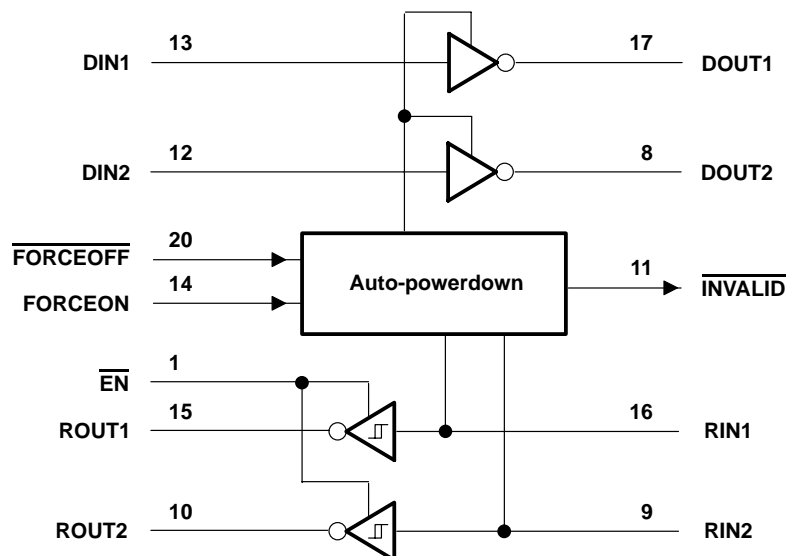
H = high level, L = low level, X = irrelevant, Z = high impedance

EACH RECEIVER

INPUTS			OUTPUT ROUT
RIN	EN	VALID RIN RS-232 LEVEL	
L	L	X	H
H	L	X	L
X	H	X	Z
Open	L	No	H

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

logic diagram (positive logic)



SN65C3223, SN75C3223

3-V TO 5.5-V MULTICHANNEL RS-232 COMPATIBLE LINE DRIVER/RECEIVER

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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, $\overline{FORCEOFF}$, $FORCEON$, \overline{EN}	–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, $\overline{INVALID}$	–0.3 V to $V_{CC} + 0.3$ V
Package thermal impedance, θ_{JA} (see Note 2): DB package	70°C/W
DW package	58°C/W
PW package	83°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 51-7.

recommended operating conditions (see Note 3 and Figure 6)

			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_{IH}	Driver and control high-level input voltage	DIN, \overline{EN} , $\overline{FORCEOFF}$, $FORCEON$	$V_{CC} = 3.3$ V	2		V
			$V_{CC} = 5$ V	2.4		
V_{IL}	Driver and control low-level input voltage	DIN, \overline{EN} , $\overline{FORCEOFF}$, $FORCEON$			0.8	V
V_I	Driver and control input voltage	DIN, \overline{EN} , $\overline{FORCEOFF}$, $FORCEON$	0		5.5	V
	Receiver input voltage		–25		25	
T_A	Operating free-air temperature	SN65C3223	–40		85	°C
		SN65C3223	0		70	

NOTE 3: Test conditions are C1–C4 = 0.1 μ F at $V_{CC} = 3.3$ V \pm 0.3 V; C1 = 0.047 μ F, C2–C4 = 0.33 μ 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{EN} , $\overline{FORCEOFF}$, $FORCEON$		± 0.01	± 1	μ A
I_{CC}	Supply current	Auto-powerdown disabled	No load, $\overline{FORCEOFF}$, $FORCEON$ at V_{CC}	0.3	1	mA
		Powered off	No load, $\overline{FORCEOFF}$ at GND	1	10	
		Auto-powerdown enabled	No load, $\overline{FORCEOFF}$ at V_{CC} , $FORCEON$ at GND, All RIN are open or grounded	1	10	μ A

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

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



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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 _{OH} High-level output voltage	DOUT at R _L = 3 kΩ to GND	5	5.4		V
V _{OL} Low-level output voltage	DOUT at R _L = 3 kΩ to GND	-5	-5.4		V
I _{IH} High-level input current	V _I = V _{CC}		±0.01	±1	μA
I _{IL} Low-level input current	V _I at GND		±0.01	±1	μA
I _{OS} Short-circuit output current‡	V _{CC} = 3.6 V, V _O = 0 V		±35	±60	mA
	V _{CC} = 5.5 V, V _O = 0 V		±35	±90	
r _o Output resistance	V _{CC} , V+, and V- = 0 V, V _O = ±2 V	300	10M		Ω
I _{off} Output leakage current	FORCEOFF = GND, V _O = ±12 V, V _{CC} = 0 to 5.5 V			±25	μA

† All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 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_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 μF, C2–C4 = 0.33 μF at V_{CC} = 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 _L = 3 kΩ, One DOUT switching	C _L = 1000 pF	250		kbit/s
		C _L = 250 pF, V _{CC} = 3 V to 4.5 V	1000		
		C _L = 1000 pF, V _{CC} = 4.5 V to 5.5 V	1000		
t _{sk(p)} Pulse skew§	C _L = 150 pF to 2500 pF, R _L = 3 kΩ to 7 kΩ, See Figure 2		300		ns
SR(tr) Slew rate, transition region (see Figure 1)	V _{CC} = 3.3 V, R _L = 3 kΩ to 7 kΩ		24	150	V/μs

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

§ Pulse skew is defined as |t_{PLH} - t_{PHL}| of each channel of the same device.

NOTE 3: Test conditions are C1–C4 = 0.1 μF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 μF, C2–C4 = 0.33 μF at V_{CC} = 5 V ± 0.5 V.



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 _{OH}	High-level output voltage	I _{OH} = -1 mA	V _{CC} -0.6	V _{CC} -0.1		V
V _{OL}	Low-level output voltage	I _{OL} = 1.6 mA			0.4	V
V _{IT+}	Positive-going input threshold voltage	V _{CC} = 3.3 V		1.6	2.4	V
		V _{CC} = 5 V		1.9	2.4	
V _{IT-}	Negative-going input threshold voltage	V _{CC} = 3.3 V	0.6	1.1		V
		V _{CC} = 5 V	0.8	1.4		
V _{hys}	Input hysteresis (V _{IT+} - V _{IT-})			0.5		V
I _{off}	Output leakage current	$\overline{\text{EN}} = V_{\text{CC}}$		±0.05	±10	µA
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.

NOTE 3: Test conditions are C1-C4 = 0.1 µF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 µF, C2-C4 = 0.33 µF at V_{CC} = 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		MIN	TYP†	MAX	UNIT
t _{PLH}	Propagation delay time, low- to high-level output	C _L = 150 pF,	See Figure 3		150		ns
t _{PHL}	Propagation delay time, high- to low-level output	C _L = 150 pF,	See Figure 3		150		ns
t _{en}	Output enable time	C _L = 150 pF, See Figure 4	R _L = 3 kΩ,		200		ns
t _{dis}	Output disable time	C _L = 150 pF, See Figure 4	R _L = 3 kΩ,		200		ns
t _{sk(p)}	Pulse skew‡	See Figure 3			50		ns

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

‡ Pulse skew is defined as |t_{PLH} - t_{PHL}| of each channel of the same device.

NOTE 3: Test conditions are C1-C4 = 0.1 µF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 µF, C2-C4 = 0.33 µF at V_{CC} = 5 V ± 0.5 V.

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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)

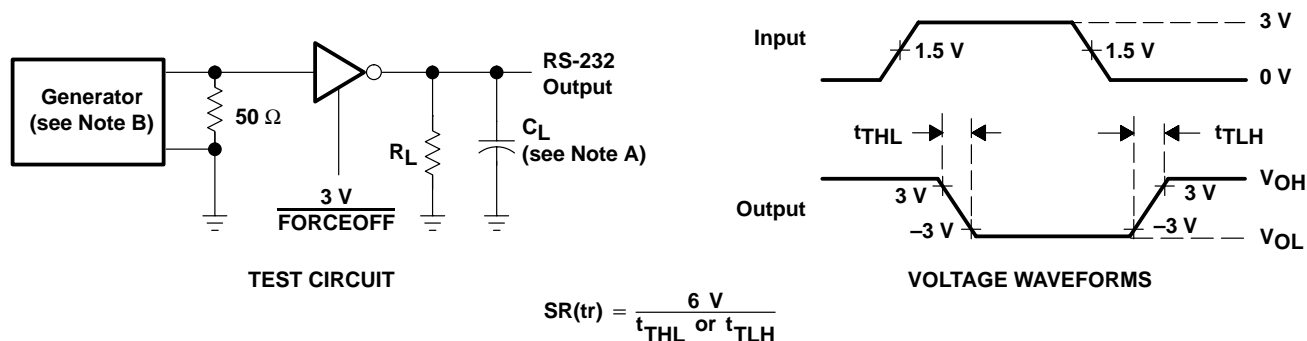
PARAMETER		TEST CONDITIONS	MIN	MAX	UNIT
V _{T+(valid)}	Receiver input threshold for INVALID high-level output voltage	FORCEON = GND, $\overline{\text{FORCEOFF}} = V_{CC}$		2.7	V
V _{T-(valid)}	Receiver input threshold for INVALID high-level output voltage	FORCEON = GND, $\overline{\text{FORCEOFF}} = V_{CC}$	-2.7		V
V _{T(invalid)}	Receiver input threshold for INVALID low-level output voltage	FORCEON = GND, $\overline{\text{FORCEOFF}} = V_{CC}$	-0.3	0.3	V
V _{OH}	$\overline{\text{INVALID}}$ high-level output voltage	I _{OH} = -1 mA, $\overline{\text{FORCEOFF}} = V_{CC}$ FORCEON = GND,	V _{CC} -0.6		V
V _{OL}	$\overline{\text{INVALID}}$ low-level output voltage	I _{OL} = 1.6 mA, $\overline{\text{FORCEOFF}} = V_{CC}$ FORCEON = GND,		0.4	V

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

PARAMETER		TYPT†	UNIT
t _{valid}	Propagation delay time, low- to high-level output	1	μs
t _{invalid}	Propagation delay time, high- to low-level output	30	μs
t _{en}	Supply enable time	100	μs

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

PARAMETER MEASUREMENT INFORMATION

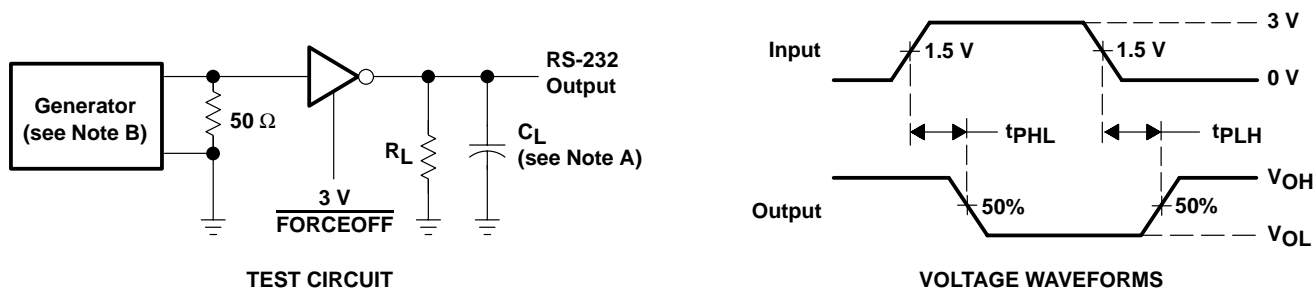


NOTES: A. C_L includes probe and jig capacitance.

B. The pulse generator has the following characteristics: PRR = 250 kbit/s, Z_O = 50 Ω, 50% duty cycle, t_r ≤ 10 ns, t_f ≤ 10 ns.

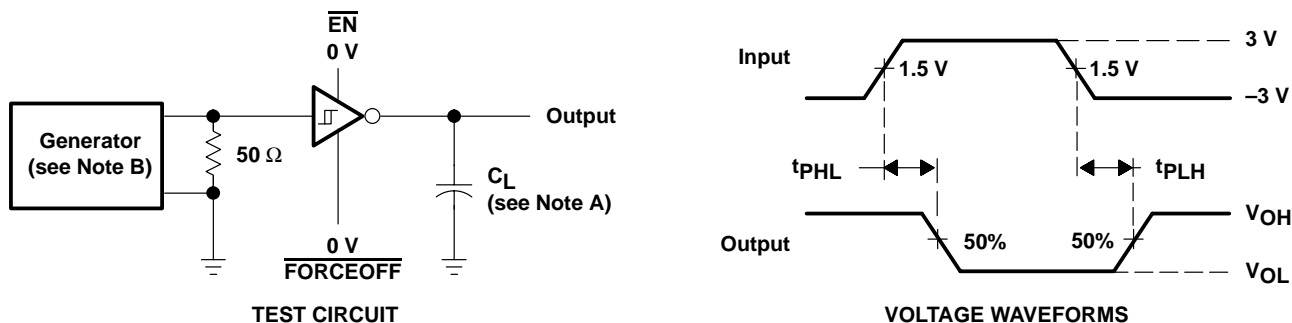
Figure 1. Driver Slew Rate

PARAMETER MEASUREMENT INFORMATION



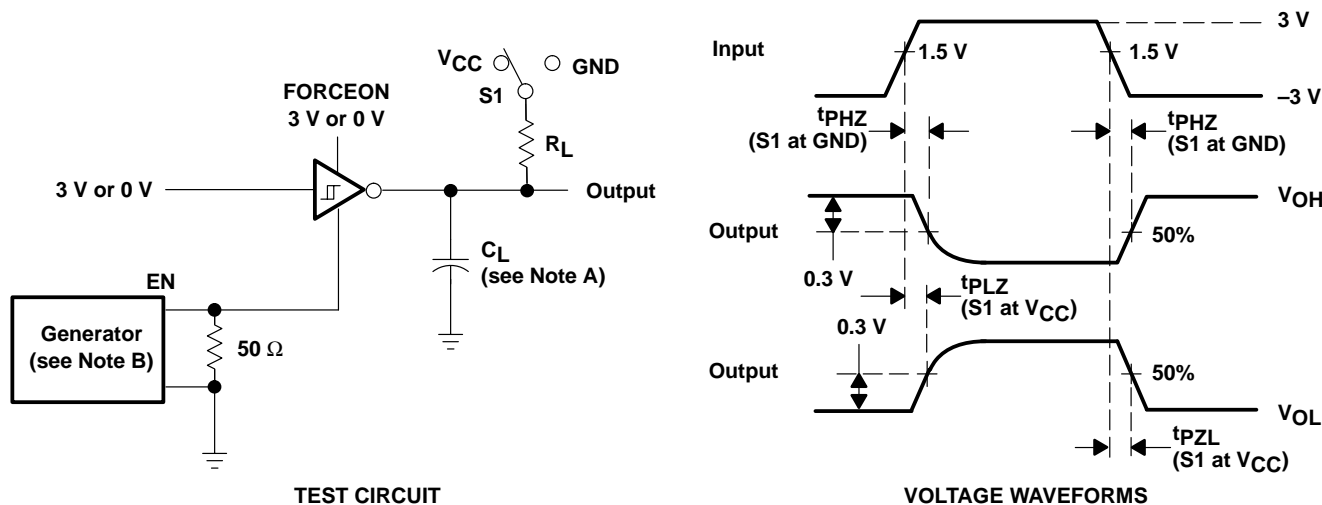
NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: PRR = 250 kbit/s, $Z_O = 50 \Omega$, 50% duty cycle, $t_r \leq 10$ ns, $t_f \leq 10$ ns.

Figure 2. Driver Pulse Skew



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 3. Receiver Propagation Delay Times



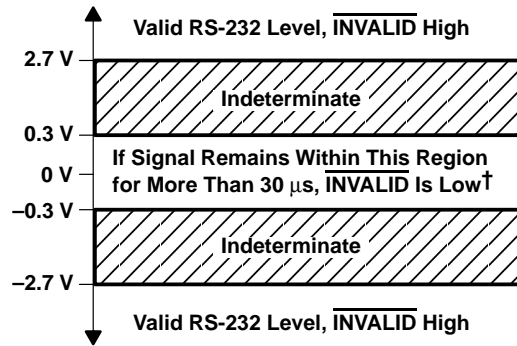
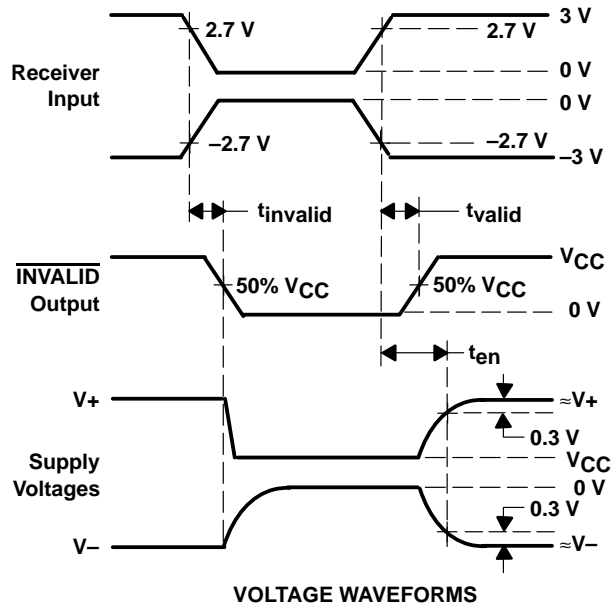
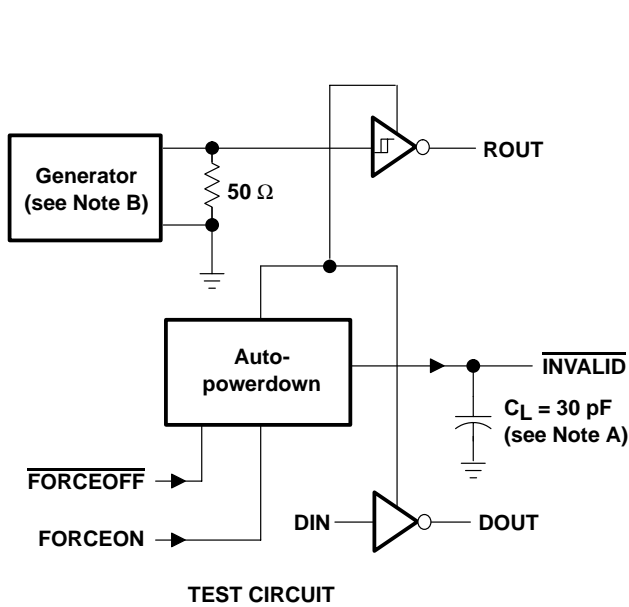
NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: $Z_O = 50 \Omega$, 50% duty cycle, $t_r \leq 10$ ns, $t_f \leq 10$ ns.

Figure 4. Receiver Enable and Disable Times

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PARAMETER MEASUREMENT INFORMATION

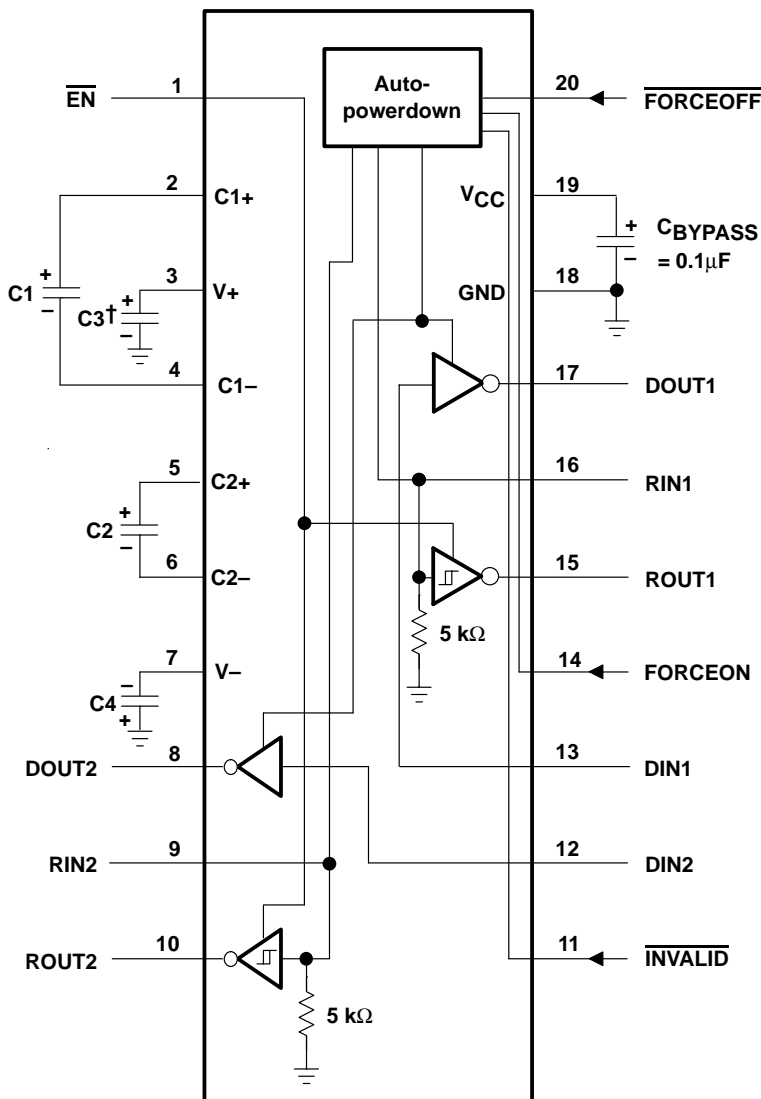


[†] Auto-powerdown disables drivers and reduces supply current to 1 μA .

- NOTES: A. C_L includes probe and jig capacitance.
 B. The pulse generator has the following characteristics: PRR = 5 kbit/s, $Z_0 = 50 \Omega$, 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_{CC} or GND.
NOTE A: Resistor values shown are nominal.

V_{CC} vs CAPACITOR VALUES

V _{CC}	C1	C2, C3, 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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