

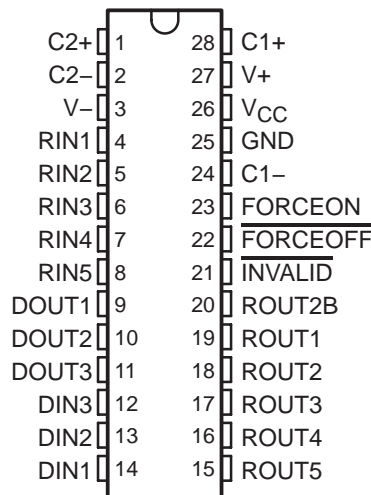
SN65C3243, SN75C3243

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

SLLS353G – JUNE 1999 – REVISED NOVEMBER 2004

- Operate With 3-V to 5.5-V V_{CC} Supply
- Always-Active Noninverting Receiver Output (ROUT2B)
- Low Standby Current . . . 1 μ A Typ
- 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 ± 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

DB, DW, OR PW PACKAGE
(TOP VIEW)



description/ordering information

The SN65C3243 and SN75C3243 consist of three line drivers, five line receivers, and a dual charge-pump circuit with ± 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/ μ s to 150 V/ μ s.

ORDERING INFORMATION

T_A	PACKAGE†	ORDERABLE PART NUMBER	TOP-SIDE MARKING	
–0°C to 70°C	SOIC (DW)	Tube of 20	SN75C3243DW	
		Reel of 1000	SN75C3243DWR	
	SSOP (DB)	Reel of 2000	SN75C3243DBR	75C3243
	TSSOP (PW)	Tube of 50	SN75C3243PW	CA3243
Reel of 2000		SN75C3243PWR		
–40°C to 85°C	SOIC (DW)	Tube of 20	SN65C3243DW	
		Reel of 1000	SN65C3243DWR	
	SSOP (DB)	Reel of 2000	SN65C3243DBR	65C3243
	TSSOP (PW)	Tube of 50	SN65C3243PW	CB3243
		Reel of 2000	SN65C3243PWR	

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



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SN65C3243, SN75C3243

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description/ordering information (continued)

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 devices do not sense a valid RS-232 signal, the driver outputs are disabled. If $\overline{\text{FORCEOFF}}$ is set low, both drivers and receivers (except ROUT2B) are shut off, and the supply current is reduced to 1 μA . 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 $\overline{\text{FORCEOFF}}$ 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 $\overline{\text{INVALID}}$ 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 μs . $\overline{\text{INVALID}}$ is low (invalid data) if all receiver input voltages are between -0.3 V and 0.3 V for more than 30 μs . Refer to Figure 5 for receiver input levels.

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

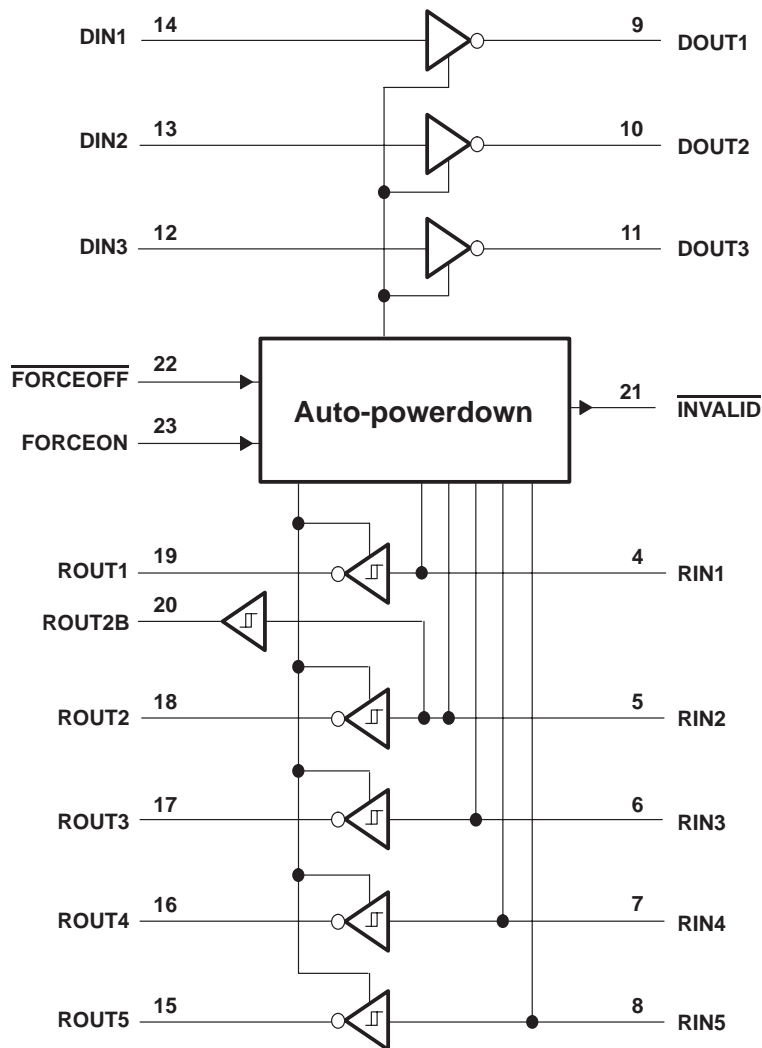


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logic diagram (positive logic)



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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 ($\overline{\text{FORCEOFF}}$, 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
Package thermal impedance, θ_{JA} (see Notes 2 and 3): DB package	62°C/W
DW package	46°C/W
PW package	62°C/W
Operating virtual junction temperature, T_J	150°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:
- All voltages are with respect to network GND.
 - Maximum power dissipation is a function of $T_{J(max)}$, θ_{JA} , and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_{J(max)} - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
 - The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 4 and Figure 6)

			MIN	NOM	MAX	UNIT	
Supply voltage		$V_{CC} = 3.3\text{ V}$	3	3.3	3.6	V	
		$V_{CC} = 5\text{ V}$	4.5	5	5.5		
V_{IH}	Driver and control high-level input voltage	DIN, $\overline{\text{FORCEOFF}}$, FORCEON	$V_{CC} = 3.3\text{ V}$		2	V	
			$V_{CC} = 5\text{ V}$		2.4		
V_{IL}	Driver and control low-level input voltage	DIN, $\overline{\text{FORCEOFF}}$, FORCEON			0.8	V	
V_I	Driver and control input voltage	DIN, $\overline{\text{FORCEOFF}}$, 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 4: Test conditions are C1–C4 = 0.1 μF at $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$; C1 = 0.047 μF , C2–C4 = 0.33 μF at $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$.

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 6)

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

‡ 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 4: Test conditions are C1–C4 = 0.1 μF at $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$; C1 = 0.047 μF , C2–C4 = 0.33 μF at $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$.



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DRIVER SECTION

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 6)

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
V _{OH}	High-level output voltage All DOUT at R _L = 3 kΩ to GND	5	5.4		V
V _{OL}	Low-level output voltage All DOUT at R _L = 3 kΩ to GND	-5	-5.4		V
V _O	Output voltage (mouse driveability) DIN1 = DIN2 = GND, DIN3 = V _{CC} , 3-kΩ to GND at DOUT3, DOUT1 = DOUT2 = 2.5 mA		±5		V
I _{IH}	High-level input current V _I = V _{CC}		±0.01	±1	μA
I _{IL}	Low-level input current V _I = GND		±0.01	±1	μA
I _{OS}	Short-circuit output current‡ V _{CC} = 3.6 V, V _O = 0 V V _{CC} = 5.5 V, V _O = 0 V		±35	±60	mA
			±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			±25	μA
				±25	

† 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 4. 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 4 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		25		ns
SR(tr)	Slew rate, transition region (see Figure 1) C _L = 150 pF to 1000 pF, R _L = 3 kΩ to 7 kΩ, V _{CC} = 3.3 V	18		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 4. 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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RECEIVER SECTION

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 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	V _{CC} - 0.1 V		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 (except ROUT2B)	FORCEOFF = 0 V		±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 4. 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 4)

PARAMETER		TEST CONDITIONS	TYP†	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, R _L = 3 kΩ, See Figure 4	200	ns
t _{dis}	Output disable time	C _L = 150 pF, R _L = 3 kΩ, See Figure 4	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 4. 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.



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

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

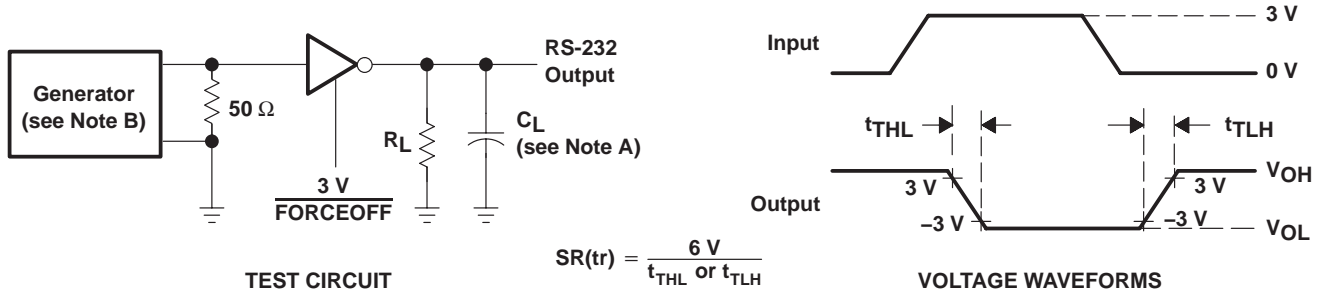
PARAMETER		TYP†	UNIT
t_{valid}	Propagation delay time, low- to high-level output	1	μs
t_{invalid}	Propagation delay time, high- to low-level output	30	μs
t_{en}	Supply enable time	100	μs

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

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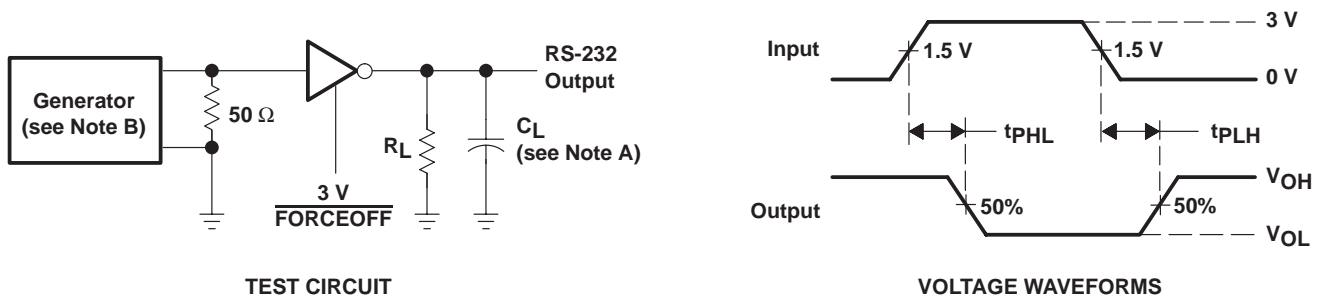
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PARAMETER MEASUREMENT INFORMATION



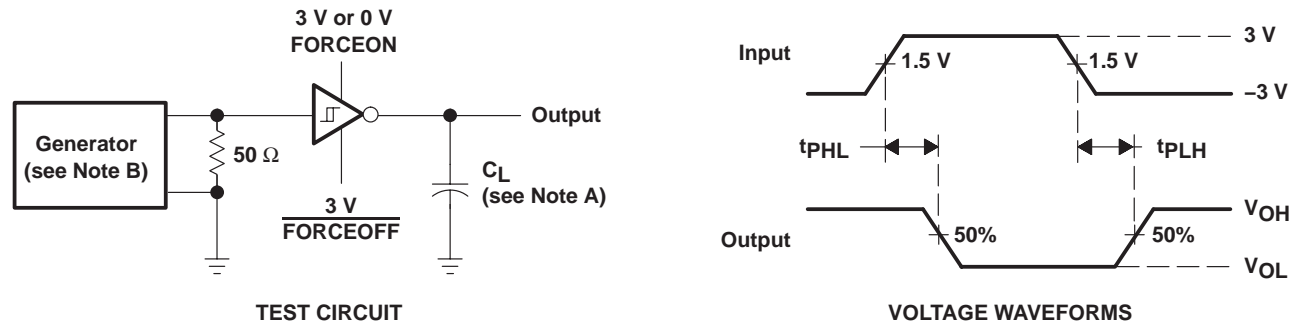
NOTES: A. CL includes probe and jig capacitance.
B. The pulse generator has the following characteristics: PRR = 1 Mbit/s, ZO = 50 Ω, 50% duty cycle, tr ≤ 10 ns, tf ≤ 10 ns.

Figure 1. Driver Slew Rate



NOTES: A. CL includes probe and jig capacitance.
B. The pulse generator has the following characteristics: PRR = 1 Mbit/s, ZO = 50 Ω, 50% duty cycle, tr ≤ 10 ns, tf ≤ 10 ns.

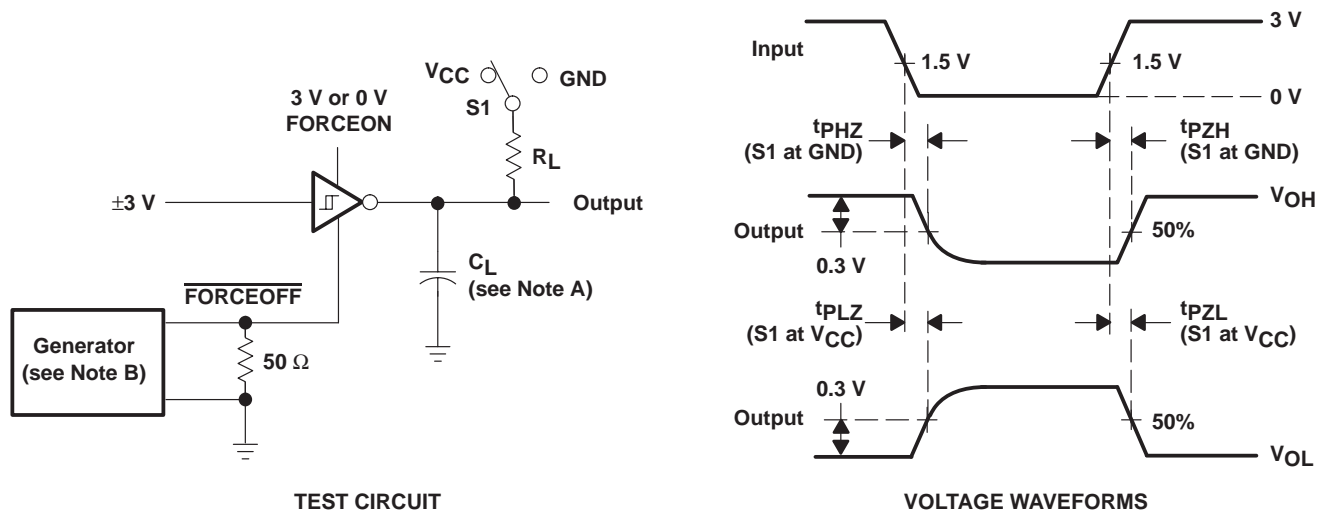
Figure 2. Driver Pulse Skew



NOTES: A. CL includes probe and jig capacitance.
B. The pulse generator has the following characteristics: ZO = 50 Ω, 50% duty cycle, tr ≤ 10 ns, tf ≤ 10 ns.

Figure 3. Receiver Propagation Delay Times

PARAMETER MEASUREMENT INFORMATION



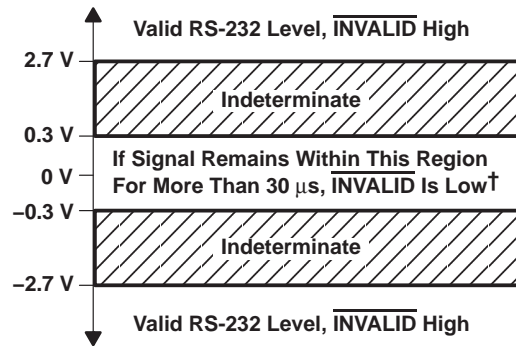
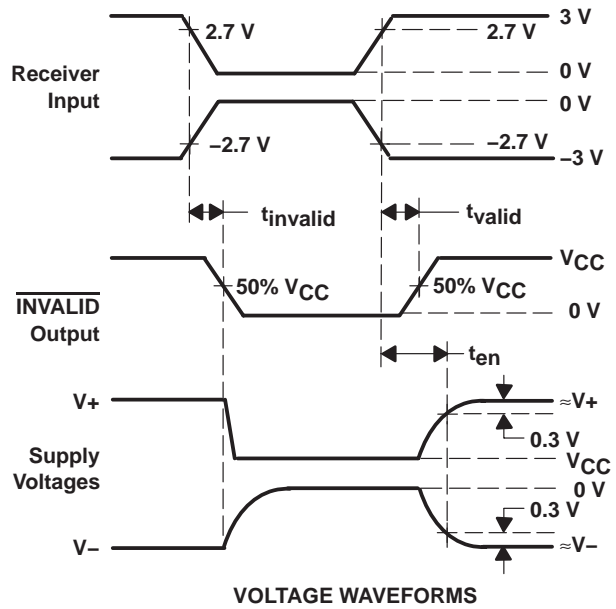
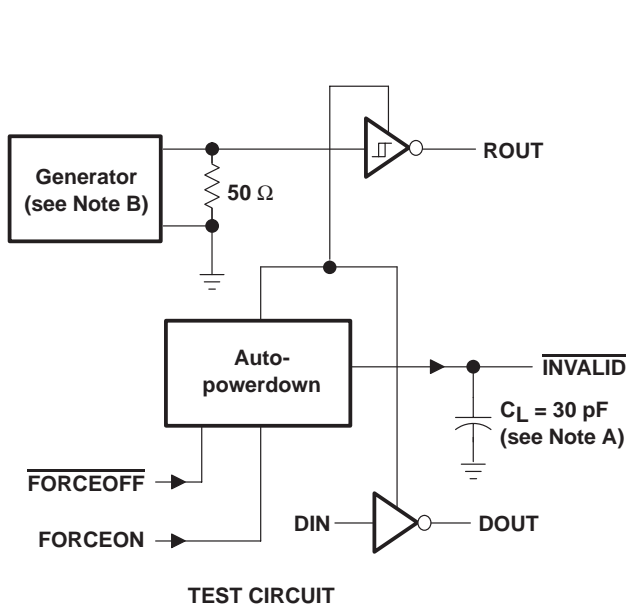
- NOTES: A. C_L includes probe and jig capacitance.
 B. The pulse generator has the following characteristics: $Z_O = 50 \Omega$, 50% duty cycle, $t_r \leq 10 \text{ ns}$, $t_f \leq 10 \text{ ns}$.
 C. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 D. t_{PZL} and t_{PZH} are the same as t_{en} .

Figure 4. Receiver Enable and Disable Times

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PARAMETER MEASUREMENT INFORMATION



[†] 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, $t_r \leq 10 \text{ ns}$, $t_f \leq 10 \text{ ns}$.

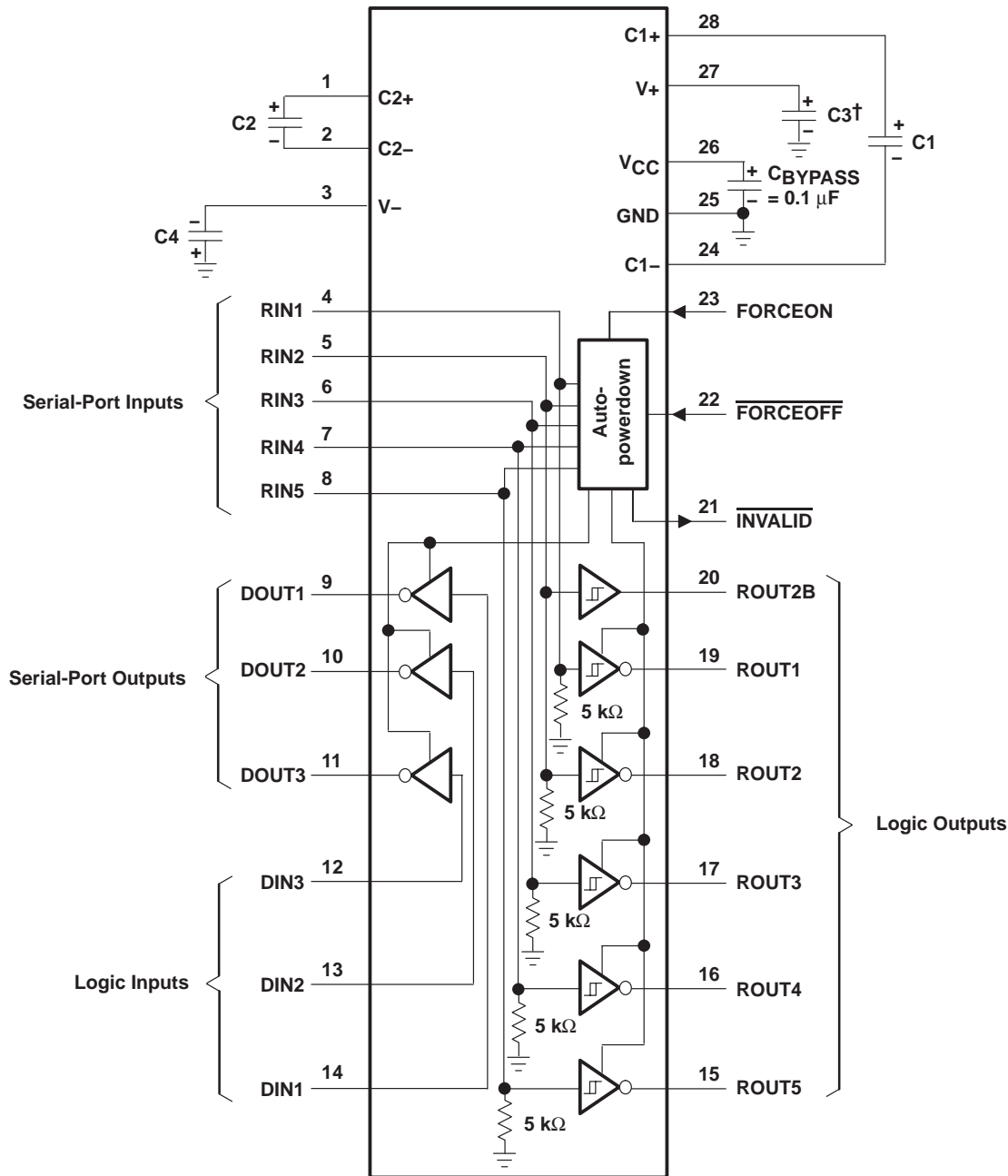
Figure 5. $\overline{\text{INVALID}}$ Propagation Delay Times and Supply Enabling Time

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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, 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



PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN65C3243DBR	ACTIVE	SSOP	DB	28	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN65C3243DW	ACTIVE	SOIC	DW	28	20	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
SN65C3243DWR	ACTIVE	SOIC	DW	28	1000	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
SN65C3243PW	ACTIVE	TSSOP	PW	28	50	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN65C3243PWR	ACTIVE	TSSOP	PW	28	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN75C3243DBR	ACTIVE	SSOP	DB	28	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN75C3243DW	ACTIVE	SOIC	DW	28	20	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
SN75C3243DWR	ACTIVE	SOIC	DW	28	1000	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
SN75C3243PW	ACTIVE	TSSOP	PW	28	50	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN75C3243PWR	ACTIVE	TSSOP	PW	28	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-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 - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

None: Not yet available Lead (Pb-Free).

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.

Green (RoHS & no Sb/Br): TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

28 PINS SHOWN

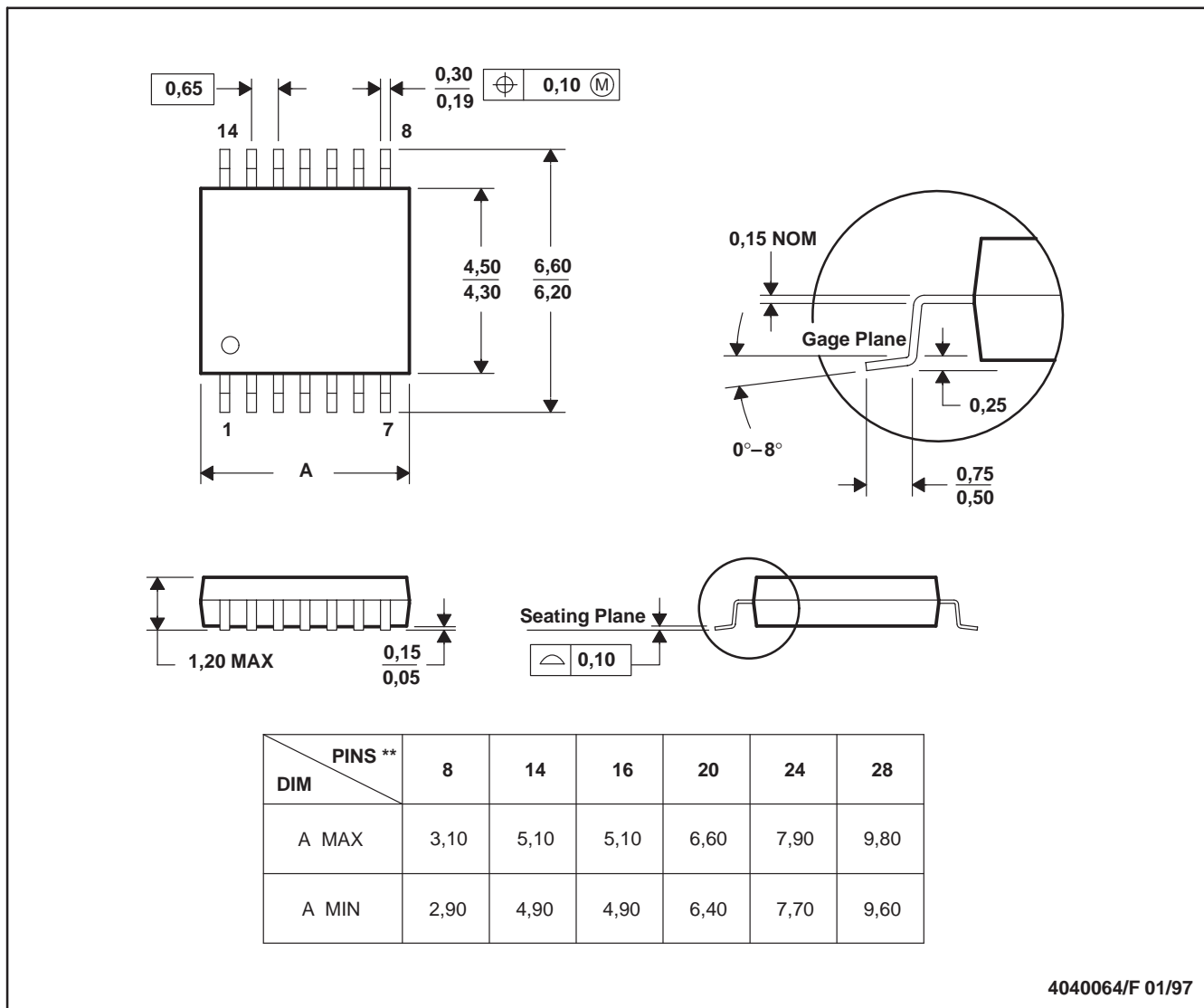


- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-150

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- 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-153

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