

SLLS694B-NOVEMBER 2005-REVISED APRIL 2009

3-V TO 5.5-V SINGLE-CHANNEL RS-232 1-Mbit/s LINE DRIVER/RECEIVER WITH ±15-kV IEC ESD PROTECTION

FEATURES

- ESD Protection for RS-232 Pins
 - ±15-kV Human-Body Model (HBM)
 - ±8-kV IEC 61000-4-2 Contact Discharge
 - ±15-kV IEC 61000-4-2 Air-Gap Discharge
- Operate With 3-V to 5.5-V V_{CC} Supply
- Operate up to 1 Mbit/s
- Low Standby Current . . . 1 μA Typ
- External Capacitors . . . 4 × 0.1 μF
- Accepts 5-V Logic Input With 3.3-V Supply
- RS-232 Bus-Pin ESD Protection Exceeds ±15 kV Using Human-Body Model (HBM)
- Auto-Powerdown Feature Automatically Disables Drivers for Power Savings

APPLICATIONS

- Battery-Powered, Hand-Held, and Portable Equipment
- PDAs and Palmtop PCs
- Notebooks, Sub-Notebooks, and Laptops
- Digital Cameras
- Mobile Phones and Wireless Devices

DESCRIPTION/ORDERING INFORMATION

The SN65C3221E and SN75C3221E consist of one line driver, one line receiver, and a dual charge-pump circuit with ± 15 -kV IEC 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. These 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 FORCEOFF is high. During this mode of operation, if the devices do not sense a valid RS-232 signal on the receiver input, the driver output is disabled. If FORCEOFF is set low and EN is high, both the driver and receiver 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 FORCEOFF are high. With auto-powerdown enabled, the device is activated automatically when a valid signal is applied to the receiver input. The INVALID output notifies the user if an RS-232 signal is present at the receiver input. INVALID is high (valid data) if the 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. See Figure 5 for receiver input levels.

(TOP VIEW) 16 FORCEOFF C1+ **∏**2 15 V_{CC} V+ []3 14 GND $C1 - \Pi_4$ 13 DOUT 12 FORCEON C2+ []5 C2-11 ∏ DIN П6 V- **1**7 10 INVALID 9 ROUT RIN ∏8

DB OR PW PACKAGE



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.



ORDERING INFORMATION

T _A	PAC	KAGE ⁽¹⁾⁽²⁾	ORDERABLE PART NUMBER	TOP-SIDE MARKING	
−0°C to 70°C	SSOP - DB	Reel of 2000	SN75C3221EDBR	MY221E	
	TSSOP – PW	Tube of 90	SN75C3221EPW	MY221E	
	1330F – FW	Reel of 2000	SN75C3221EPWR	WITZZIE	
	SSOP – DB	Reel of 2000	SN65C3221EDBR	MU221E	
-40°C to 85°C	T000D DW	Tube of 90	SN65C3221EPW	MU221E	
	TSSOP – PW	Reel of 2000	SN65C3221EPWR	IVIUZZIE	

- (1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.
- (2) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

FUNCTION TABLES

EACH DRIVER(1)

	I	NPUTS		OUTPUT	
DIN	FORCEON	FORCEOFF	VALID RIN RS-232 LEVEL	DOUT	DRIVER STATUS
Х	X	L	Χ	Z	Powered off
L	Н	Н	Χ	Н	Normal operation with
Н	Н	Н	X	L	auto-powerdown disabled
L	L	Н	Yes	Н	Normal operation with
Н	L	Н	Yes	L	auto-powerdown enabled
L	L	Н	No	Z	Powered off by
Н	L	Н	No	Z	auto-powerdown feature

(1) H = high level, L = low level, X = irrelevant, Z = high impedance

EACH RECEIVER⁽¹⁾

	INPU	TS	OUTPUT
RIN	EN	VALID RIN RS-232 LEVEL	ROUT
L	L	Х	Н
Н	L	X	L
X	Н	X	Z
Open	L	No	Н

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

LOGIC DIAGRAM (POSITIVE LOGIC)

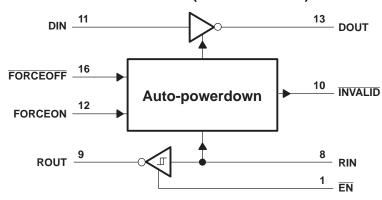




Table 1. 1-Mbit/s RS-232 Parts

PART NO.	TEMPERATURE RANGE	DRIVER NO.	RECEIVER NO.	ESD	SUPPLY V _{CC} (V)	FEATURE	PIN/PACKAGE
SN65C3221E		1	1	±15-kV Air-Gap, ±8-kV Contact, ±15-kV HBM	3.3 or 5	Auto powerdown	16-pin SOIC, SSOP, TSSOP
SN65C3232E		2	2	±15-kV Air-Gap, ±8-kV Contact, ±15-kV HBM	3.3 or 5	Low pin count	16-pin SOIC, SSOP, TSSOP
MAX3227I		1	1	±8-kV Air-Gap, ±8-k V Contact, ±15-kV HBM	3.3 or 5	Auto powerdown plus, ready signal	16-pin SSOP
SN65C3221	-40°C to 85°C	1	1	±15-kV HBM	3.3 or 5	Auto powerdown	16-pin SOIC, SSOP, TSSOP
SN65C3223		2	2	±15-kV HBM	3.3 or 5	Auto powerdown, enable signal	20-pin SOIC, SSOP, TSSOP
SN65C3222		2	2	±15-kV HBM	3.3 or 5	Enable, powerdown signal	20-pin SOIC, SSOP, TSSOP
SN65C3232		2	2	±15-kV HBM	3.3 or 5	Low pin count	16-pin SOIC, SSOP, TSSOP
SN65C3238		5	3	±15-kV HBM	3.3 or 5	Auto powerdown plus	28-pin SOIC, SSOP, TSSOP
SN65C3243		3	5	±15-kV HBM	3.3 or 5	Auto powerdown	28-pin SOIC, SSOP, TSSOP
SN75C3221E		1	1	±15-kV Air-Gap, ±8-kV Contact, ±15-kV HBM	3.3 or 5	Auto powerdown	16-pin SOIC, SSOP, TSSOP
SN75C3232E		2	2	±15-kV Air-Gap, ±8-kV Contact, ±15-kV HBM	3.3 or 5	Low pin count	16-pin SOIC, SSOP, TSSOP
MAX3227C		1	1	±8-kV Air-Gap, ±8-kV Contact, ±15-kV HBM	3.3 or 5	Auto powerdown plus, ready signal	16-pin SSOP
SN75C3221	0°C to 70°C	1	1	±15-kV HBM	3.3 or 5	Auto powerdown	16-pin SOIC, SSOP, TSSOP
SN75C3223		2	2	±15-kV HBM	3.5 or 5	Auto powerdown, enable signal	20-pin SOIC, SSOP, TSSOP
SN75C3222		2	2	±15-kV HBM	3.3 or 5	Enable, powerdown signal	20-pin SOIC, SSOP, TSSOP
SN75C3232		2	2	±15-kV HBM	3.3 or 5	Low pin count	16-pin SOIC, SSOP, TSSOP
SN75C3238		5	3	±15-kV HBM	3.3 or 5	Auto powerdown plus	28-pin SOIC, SSOP, TSSOP
SN75C3243		3	5	±15-kV HBM	3.3 or 5	Auto powerdown	28-pin SOIC, SSOP, TSSOP

Absolute Maximum Ratings(1)

over operating free-air temperature range (unless otherwise noted)

			MIN	MAX	UNIT	
V _{CC}	Supply voltage range ⁽²⁾		-0.3	6	V	
V+	Positive output supply voltage range (2)			7	V	
V-	Negative output supply voltage range ⁽²⁾		0.3	-7	V	
V+ - V-	Supply voltage difference ⁽²⁾			13	V	
V	Input voltage range	Driver (FORCEOFF, FORCEON, EN)	-0.3	6	V	
V _I		Receiver	-25	25		
V	Q	Driver	-13.2	13.2	V	
Vo	Output voltage range	Receiver (INVALID)	-0.3	V _{CC} + 0.3		
0	Dockers thermal impedance (3)(4)	DB package		82	0000	
θ_{JA}	Package thermal impedance (3)(4) PW package			108	°C/W	
TJ	Operating virtual junction temperature			150	°C	
T _{stg}	Storage temperature range		-65	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.

All voltages are with respect to network GND.

Recommended Operating Conditions⁽¹⁾

See Figure 6

				MIN	NOM	MAX	UNIT
	Supply voltage	Supply voltage				3.6	V
	Supply voltage		$V_{CC} = 5 V$	4.5	5	5.5	V
V	Driver and control	DIN, FORCEOFF, FORCEON, EN	$V_{CC} = 3.3 \text{ V}$	2			V
V _{IH}	high-level input voltage	DIN, FORCEOFF, FORCEON, EN	$V_{CC} = 5 V$	2.4			v
V_{IL}	Driver and control low-level input voltage	DIN, FORCEOFF, FORCEON, EN				0.8	V
VI	Driver and control input voltage	DIN, FORCEOFF, FORCEON		0		5.5	V
V_{I}	Receiver input voltage			-25		25	V
T _A			SN65C3221E	-40		85	°C
	Operating free-air temperature		SN75C3221E	0		70	

⁽¹⁾ Test conditions are C1–C4 = 0.1 μ F at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 μ F, C2–C4 = 0.33 μ F at V_{CC} = 5 V ± 0.5 V.

Electrical Characteristics(1)

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

	PARA	METER	TEST CONDITIONS	MIN	TYP ⁽²⁾	MAX	UNIT	
I _I	Input leakage current	FORCEOFF, FORCEON, EN			±0.01	±1	μΑ	
I _{cc}	Supply current (T _A = 25°C)	Auto-powerdown disabled	No load, FORCEOFF and FORCEON at V _{CC}		0.3	1	mA	
			Powered off	No load, FORCEOFF at GND		1	10	
		Auto-powerdown enabled	No load, FORCEOFF at V _{CC} , FORCEON at GND, All RIN are open or grounded		1	10	μΑ	

Test conditions are C1–C4 = 0.1 μ F at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 μ F, C2–C4 = 0.33 μ F at V_{CC} = 5 V ± 0.5 V. All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.

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.



DRIVER SECTION

Electrical Characteristics(1)

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

	PARAMETER	TEST	CONDITIONS		MIN	TYP ⁽²⁾	MAX	UNIT
V_{OH}	High-level output voltage	DOUT at $R_L = 3 \text{ k}\Omega$ to GND,	DIN = GND		5	5.4		٧
V_{OL}	Low-level output voltage	DOUT at $R_L = 3 \text{ k}\Omega$ to GND,	$DIN = V_{CC}$		- 5	-5.4		٧
I _{IH}	High-level input current	$V_I = V_{CC}$				±0.01	±1	μΑ
I _{IL}	Low-level input current	V _I at GND				±0.01	±1	μΑ
	Short-circuit output current ⁽³⁾	V _{CC} = 3.6 V,	V _O = 0 V			±35	±60	mA
los		$V_{CC} = 5.5 \text{ V},$	$V_O = 0 V$			±35	±90	ША
ro	Output resistance	V_{CC} , V+, and V- = 0 V,	$V_O = \pm 2 V$		300	10M		Ω
	Output lookage ourrent	FORCEOFF = GND	$V_0 = \pm 12 V$,	V_{CC} = 3 V to 3.6 V			±25	^
I _{off}	Output leakage current	reakage current FORCEOFF = GND	$V_{O} = \pm 10 \text{ V},$	$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$			±25	μΑ

Switching Characteristics⁽¹⁾

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

	PARAMETER		TEST CONDITIONS		MIN	TYP ⁽²⁾	MAX	UNIT
Maximum data rate (see Figure 1)			C _L = 1000 pF		250			
		$R_L = 3 k\Omega$	$C_L = 250 \text{ pF},$	$V_{CC} = 3 \text{ V to } 4.5 \text{ V}$	1000			kbit/s
			$C_L = 1000 \text{ pF},$	$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$	1000			
t _{sk(p)}	Pulse skew ⁽³⁾	$C_L = 150 \text{ pF to } 2500 \text{ pF},$	$R_L = 3 \text{ k}\Omega \text{ to } 7 \text{ k}\Omega,$	See Figure 2		100		ns
SR(tr)	Slew rate, transition region (see Figure 1)	V _{CC} = 3.3 V,	$R_L = 3 \text{ k}\Omega \text{ to } 7 \text{ k}\Omega,$	C _L = 150 pF to 1000 pF	18		150	V/μs

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

ESD Protection

TERMINAL		TEST CONDITIONS		UNIT
NAME	NO.	TEST CONDITIONS	TYP	UNII
		НВМ	±15	
DOUT	13	IEC 61000-4-2 Contact Discharge	±8	kV
		IEC 61000-4-2 Air-Gap Discharge	±15	

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 ⁽¹⁾ 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.
 (2) All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.
 (3) 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.

RECEIVER SECTION

Electrical Characteristics(1)

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

	PARAMETER	TEST CONDITIONS	MIN	TYP ⁽²⁾	MAX	UNIT	
V_{OH}	High-level output voltage	$I_{OH} = -1 \text{ mA}$	$V_{CC} - 0.6 V$	V_{CC} – 0.1 V		V	
V_{OL}	Low-level output voltage	I _{OL} = 1.6 mA			0.4	V	
V	Positive-going input threshold voltage	V _{CC} = 3.3 V		1.6	2.4	V	
V _{IT+}		V _{CC} = 5 V		1.9	2.4		
V	No see Conservation Conservation and a lade and to see	V _{CC} = 3.3 V	0.6	1.1		V	
V _{IT}	Negative-going input threshold voltage	V _{CC} = 5 V	0.8	1.4		V	
V_{hys}	Input hysteresis (V _{IT+} - V _{IT-})			0.5		٧	
I _{off}	Output leakage current	FORCEOFF = 0 V		±0.05	±10	μΑ	
r _i	Input resistance	V _I = ±3 V to ±25 V	3	5	7	kΩ	

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

Switching Characteristics⁽¹⁾

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

	PARAMETER	TEST CONDITIONS	TYP ⁽²⁾	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	$C_L = 150 \text{ pF}, R_L = 3 \text{ k}\Omega, \text{ See Figure 4}$	200	ns
t _{dis}	Output disable time	$C_L = 150 \text{ pF}, R_L = 3 \text{ k}\Omega, \text{ See Figure 4}$	200	ns
t _{sk(p)}	Pulse skew ⁽³⁾	See Figure 3	50	ns

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. 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.

ESD Protection

TERMI	NAL	TEST CONDITIONS				
NAME	NO.	TEST CONDITIONS	TYP	UNIT		
		НВМ	±15			
RIN	8	IEC 61000-4-2 Contact Discharge				
		IEC 61000-4-2 Air-Gap Discharge	±15			



AUTO-POWERDOWN SECTION

Electrical Characteristics

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

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

Switching Characteristics

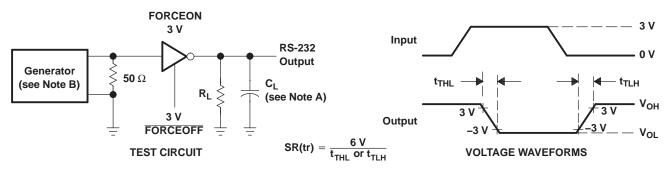
over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 5)

	PARAMETER	TYP ⁽¹⁾	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

⁽¹⁾ All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.



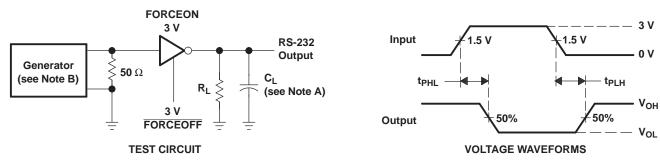
PARAMETER MEASUREMENT INFORMATION



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, $t_f \le 10$ ns.

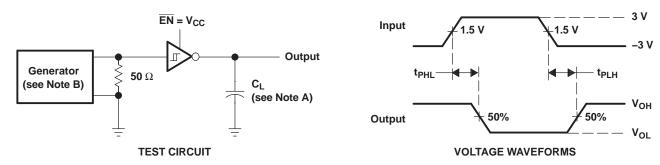
Figure 1. Driver Slew Rate



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, $t_r \le 10$ ns. $t_f \le 10$ ns.

Figure 2. Driver Pulse Skew



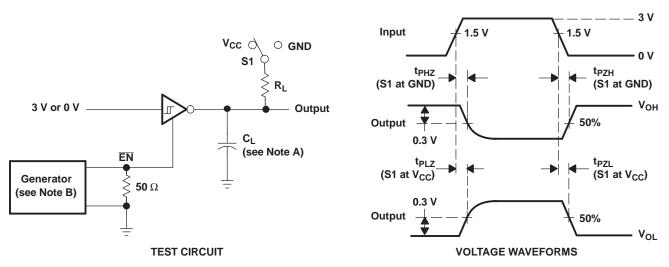
NOTES: A. C_L includes probe and jig capacitance.

B. The pulse generator has the following characteristics: Z_O = 50 Ω , 50% duty cycle, $t_f \le 10$ ns, $t_f \le 10$ ns.

Figure 3. Receiver Propagation Delay Times



PARAMETER MEASUREMENT INFORMATION



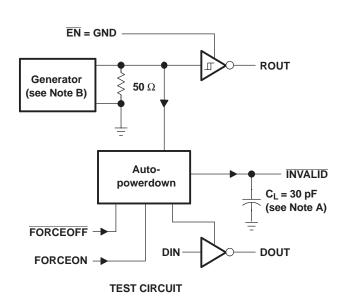
NOTES: A. C_L includes probe and jig capacitance.

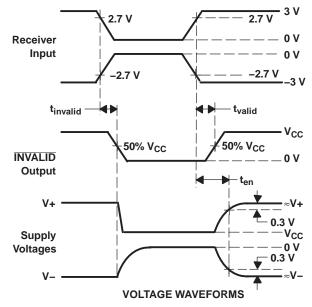
- B. The pulse generator has the following characteristics: $Z_0 = 50 \Omega$, 50% duty cycle, $t_r \le 10$ ns. $t_f \le 10$ ns.
- C. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
- D. t_{PZL} and t_{PZH} are the same as t_{en}.

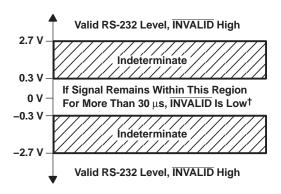
Figure 4. Receiver Enable and Disable Times



PARAMETER MEASUREMENT INFORMATION







 $^{^{\}dagger}$ Auto-powerdown disables drivers and reduces supply current to 1 $\mu A.$

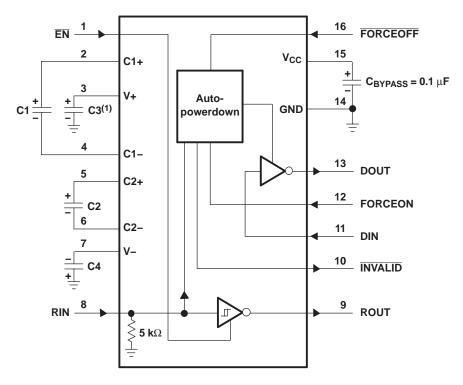
NOTES: A. C_L includes probe and jig capacitance.

B. The pulse generator has the following characteristics: PRR = 5 kbit/s, Z_O = 50 Ω , 50% duty cycle, $t_f \le$ 10 ns, $t_f \le$ 10 ns.

Figure 5. INVALID Propagation Delay Times and Driver Enabling Time



APPLICATION INFORMATION



(1) C3 can be connected to $V_{\mbox{\footnotesize CC}}$ or GND.

NOTES: A. Resistor values shown are nominal.

B. Nonpolarized ceramic capacitors are acceptable. If polarized tantalum or electrolytic capacitors are used, they should be connected as shown

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

PACKAGE OPTION ADDENDUM

14-Apr-2009 www.ti.com

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	e Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN65C3221EDB	ACTIVE	SSOP	DB	16	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3221EDBG4	ACTIVE	SSOP	DB	16	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3221EDBR	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3221EDBRG4	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3221EPW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3221EPWE4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3221EPWG4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3221EPWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3221EPWRE4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3221EPWRG4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3221EDB	ACTIVE	SSOP	DB	16	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3221EDBG4	ACTIVE	SSOP	DB	16	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3221EDBR	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3221EDBRG4	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3221EPW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3221EPWE4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3221EPWG4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3221EPWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3221EPWRE4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3221EPWRG4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-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 - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.



PACKAGE OPTION ADDENDUM

www.ti.com 14-Apr-2009

TBD: The Pb-Free/Green conversion plan has not been defined.

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.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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PACKAGE MATERIALS INFORMATION

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TAPE AND REEL INFORMATION





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	A0	Dimension designed to accommodate the component width
Γ	B0	Dimension designed to accommodate the component length
		Dimension designed to accommodate the component thickness
	W	Overall width of the carrier tape
Γ	P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

All dimensions are nominal												
Device		Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN65C3221EDBR	SSOP	DB	16	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
SN65C3221EPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN75C3221EDBR	SSOP	DB	16	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
SN75C3221EPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

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*All dimensions are nominal

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Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN65C3221EDBR	SSOP	DB	16	2000	346.0	346.0	33.0
SN65C3221EPWR	TSSOP	PW	16	2000	346.0	346.0	29.0
SN75C3221EDBR	SSOP	DB	16	2000	346.0	346.0	33.0
SN75C3221EPWR	TSSOP	PW	16	2000	346.0	346.0	29.0

PW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



NOTES:

- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M—1994.
- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
- Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
- E. Falls within JEDEC MO-153



PW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



NOTES:

- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



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

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