

FEATURES

- ESD Protection for RS-232 Bus Pins
 - ± 15 -kV Human-Body Model (HBM)
 - ± 8 -kV IEC 61000-4-2, Contact Discharge
 - ± 15 -kV IEC 61000-4-2, Air-Gap Discharge
- Meet or Exceed the Requirements of TIA/EIA-232-F and ITU v.28 Standards
- Operate With 3-V to 5.5-V V_{CC} Supply
- Operate up to 1000 kbit/s
- Two Drivers and Two Receivers
- Low Standby Current . . . 1 μ A Typ
- External Capacitors . . . $4 \times 0.1 \mu$ F
- Accepts 5-V Logic Input With 3.3-V Supply

APPLICATIONS

- Battery-Powered Systems
- PDAs
- Notebooks
- Laptops
- Palmtop PCs
- Hand-Held Equipment

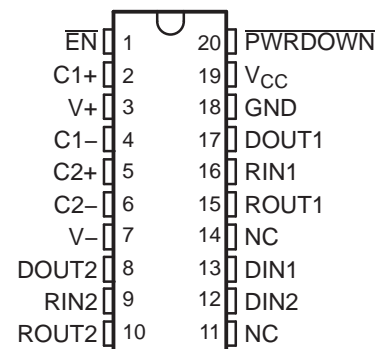
DESCRIPTION/ ORDERING INFORMATION

The SN65C3222E and SN75C3222E 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 meet the requirements of TIA/EIA-232-F and 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 typical data signaling rates up to 1000 kbit/s and are improved drop-in replacements for industry-popular '3222 two-driver, two-receiver functions.

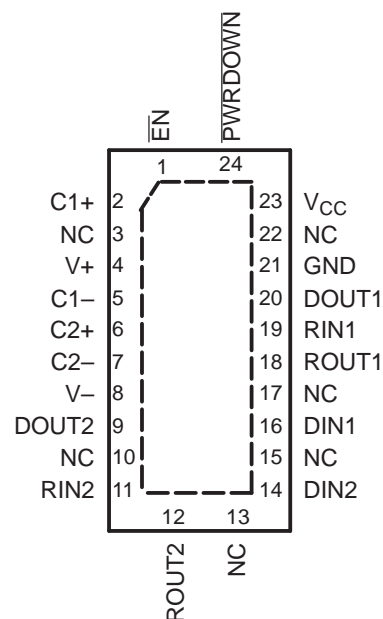
The SN65C3222E and SN75C3222E can be placed in the power-down mode by setting the power-down (PWRDOWN) input low, which draws only 1 μ A from the power supply. When the devices are powered down, the receivers remain active while the drivers are placed in the high-impedance state. Also, during power down, the onboard charge pump is disabled; $V+$ is lowered to V_{CC} , and $V-$ is raised toward GND. Receiver outputs also can be placed in the high-impedance state by setting enable (\overline{EN}) high.

DB, DW, OR PW PACKAGE
(TOP VIEW)



NC – No internal connection

RHL PACKAGE
(TOP VIEW)



NC – No internal connection



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.

SN65C3222E, SN75C3222E
3-V TO 5.5-V MULTICHANNEL RS-232 LINE DRIVERS/RECEIVERS
WITH ±15-kV ESD PROTECTION

SLLS725A–JUNE 2006–REVISED JULY 2006

ORDERING INFORMATION

T _A	PACKAGE ⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	SOIC – DW	Tube of 25	SN75C3222EDW	75C3222E
		Reel of 2000	SN75C3222EDWR	
	SSOP – DB	Tube of 70	SN75C3222EDB	MY222E
		Reel of 2000	SN75C3222EDBR	
	TSSOP – PW	Tube of 70	SN75C3222EPW	MY222E
		Reel of 2000	SN75C3222EPWR	
–40°C to 85°C	SOIC – DW	Tube of 25	SN65C3222EDW	65C3222E
		Reel of 2000	SN65C3222EDWR	
	SSOP – DB	Tube of 70	SN65C3222EDB	MU222E
		Reel of 2000	SN65C3222EDBR	
	TSSOP – PW	Tube of 70	SN65C3222EPW	MU222E
		Reel of 2000	SN65C3222EPWR	

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

FUNCTION TABLES

Each Driver⁽¹⁾

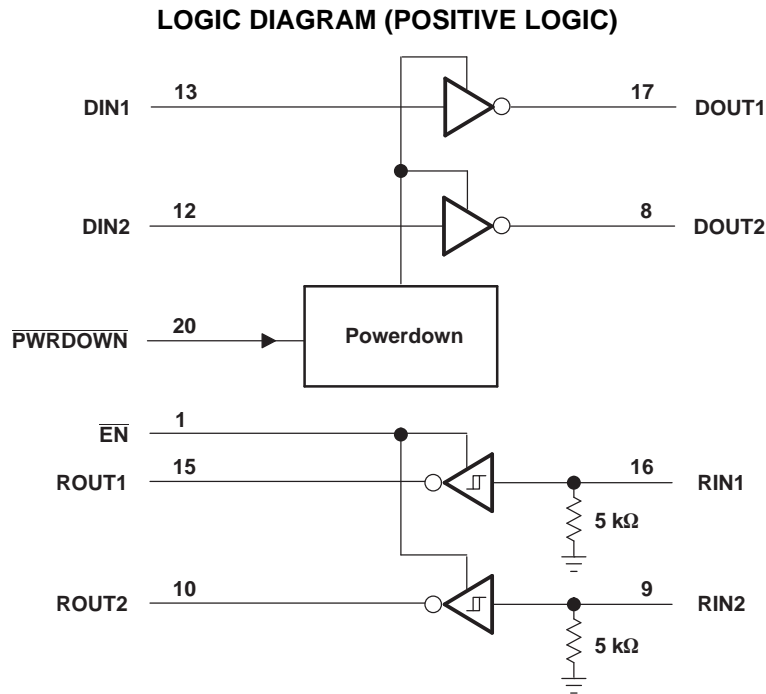
INPUTS		OUTPUT DOUT
DIN	PWRDOWN	
X	L	Z
L	H	H
H	H	L

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

Each Receiver⁽¹⁾

INPUTS		OUTPUT ROUT
RIN	$\overline{\text{EN}}$	
L	L	H
H	L	L
X	H	Z
Open	L	H

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



Pin numbers are for the DB, DW, and PW packages.

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⁾	-0.3	7	V
$V-$	Negative-output supply voltage range ⁽²⁾	0.3	-7	V
$V+ - V-$	Supply voltage difference ⁽²⁾		13	V
V_I	Input voltage range	Driver (EN, PWRDOWN)		V
		Receiver	-25	
V_O	Output voltage range	Driver		V
		Receiver	-0.3	
θ_{JA}	Package thermal impedance ⁽³⁾⁽⁴⁾	DB package		°C/W
		DW package		
		PW package		
		RHL package		
T_J	Operating virtual junction temperature		150	°C
T_{stg}	Storage temperature range	-65	150	°C

- (1) 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.
- (2) All voltages are with respect to network GND.
- (3) 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.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.

SN65C3222E, SN75C3222E
3-V TO 5.5-V MULTICHANNEL RS-232 LINE DRIVERS/RECEIVERS
WITH ± 15 -kV ESD PROTECTION

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Recommended Operating Conditions⁽¹⁾

See [Figure 5](#)

			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{EN} , $\overline{PWRDOWN}$	$V_{CC} = 3.3\text{ V}$	2		V
			$V_{CC} = 5\text{ V}$	2.4		
V_{IL}	Driver and control low-level input voltage	DIN, \overline{EN} , $\overline{PWRDOWN}$			0.8	V
V_I	Driver and control input voltage	DIN, \overline{EN} , $\overline{PWRDOWN}$	0		5.5	V
V_I	Receiver input voltage		–25		25	V
T_A	Operating free-air temperature	SN75C3222E	0		70	°C
		SN65C3222E	–40		85	

(1) 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⁽¹⁾

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

PARAMETER		TEST CONDITIONS	MIN	TYP ⁽²⁾	MAX	UNIT
I_I	Input leakage current (\overline{EN} , $\overline{PWRDOWN}$)			± 0.01	± 1	μA
I_{CC}	Supply current	No load, $\overline{PWRDOWN}$ at V_{CC}		0.3	1	mA
	Supply current (powered off)	No load, $\overline{PWRDOWN}$ at GND		1	10	μA

(1) 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 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$.

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

DRIVER SECTION

Electrical Characteristics⁽¹⁾

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

PARAMETER		TEST CONDITIONS		MIN	TYP ⁽²⁾	MAX	UNIT
V _{OH}	High-level output voltage	DOUT at R _L = 3 k Ω to GND, DIN = GND		5	5.4		V
V _{OL}	Low-level output voltage	DOUT at R _L = 3 k Ω to GND, DIN = V _{CC}		-5	-5.4		V
I _{IH}	High-level input current	V _I = V _{CC}			± 0.01	± 1	μ A
I _{IL}	Low-level input current	V _I at GND			± 0.01	± 1	μ A
I _{OS}	Short-circuit output current ⁽³⁾	V _{CC} = 3.6 V	V _O = 0 V		± 35	± 60	mA
		V _{CC} = 5.5 V					
r _o	Output resistance	V _{CC} , V+, and V- = 0 V, V _O = ± 2 V		300	10M		Ω
I _{OZ}	Output leakage current	$\overline{\text{PWRDOWN}}$ = GND	V _{CC} = 3 V to 3.6 V, V _O = ± 12 V			± 25	μ A
			V _{CC} = 4.5 V to 5.5 V, V _O = ± 10 V			± 25	

(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.

(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.

Switching Characteristics⁽¹⁾

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

PARAMETER		TEST CONDITIONS		MIN	TYP ⁽²⁾	MAX	UNIT
Maximum data rate (See Figure 1)	R _L = 3 k Ω , 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 ⁽³⁾	C _L = 150 pF to 2500 pF,	R _L = 3 k Ω to 7 k Ω , See Figure 2		300		ns
SR(tr)	Slew rate, transition region (see Figure 1)	R _L = 7 k Ω ,	C _L = 150 pF to 1000 pF		8	90	V/ μ s
			C _L = 1000 pF		12	60	
		R _L = 3 k Ω	C _L = 150 pF to 250 pF		24	150	

(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.

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

SN65C3222E, SN75C3222E
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WITH ± 15 -kV ESD PROTECTION

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RECEIVER SECTION

Electrical Characteristics⁽¹⁾

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

PARAMETER		TEST CONDITIONS	MIN	TYP ⁽²⁾	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		1.5	2.4	V
		V _{CC} = 5 V		1.8	2.4	
V _{IT-}	Negative-going input threshold voltage	V _{CC} = 3.3 V	0.6	1.2		V
		V _{CC} = 5 V	0.8	1.5		
V _{hys}	Input hysteresis (V _{IT+} - V _{IT-})			0.3		V
I _{OZ}	Output leakage current	$\overline{EN} = 1$		± 0.05	± 10	μ A
r _i	Input resistance	V _I = ± 3 V to ± 25 V	3	5	7	k Ω

(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)

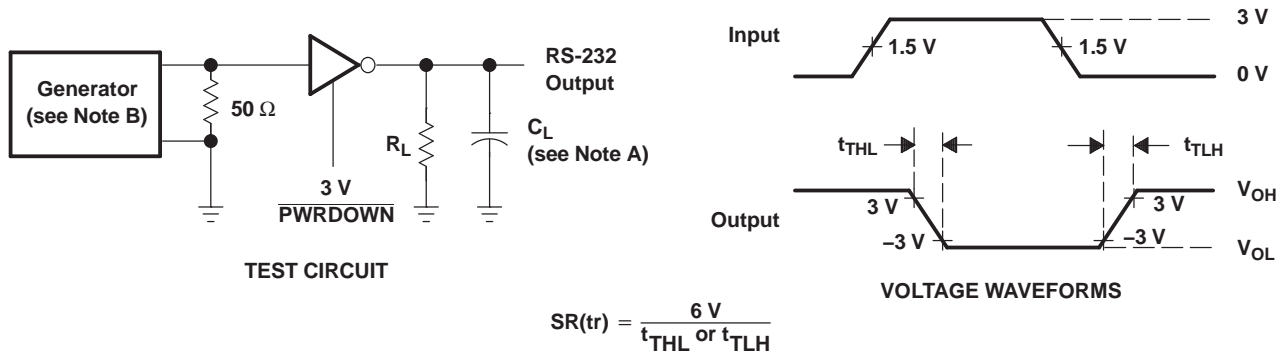
PARAMETER		TEST CONDITIONS	TYP ⁽²⁾	UNIT
t _{PLH}	Propagation delay time, low- to high-level output	C _L = 150 pF, See Figure 3	300	ns
t _{PHL}	Propagation delay time, high- to low-level output	C _L = 150 pF, See Figure 3	300	ns
t _{en}	Output enable time	C _L = 150 pF, R _L = 3 k Ω , See Figure 4	200	ns
t _{dis}	Output disable time	C _L = 150 pF, R _L = 3 k Ω , See Figure 4	200	ns
t _{sk(p)}	Pulse skew ⁽³⁾	See Figure 3	300	ns

(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.

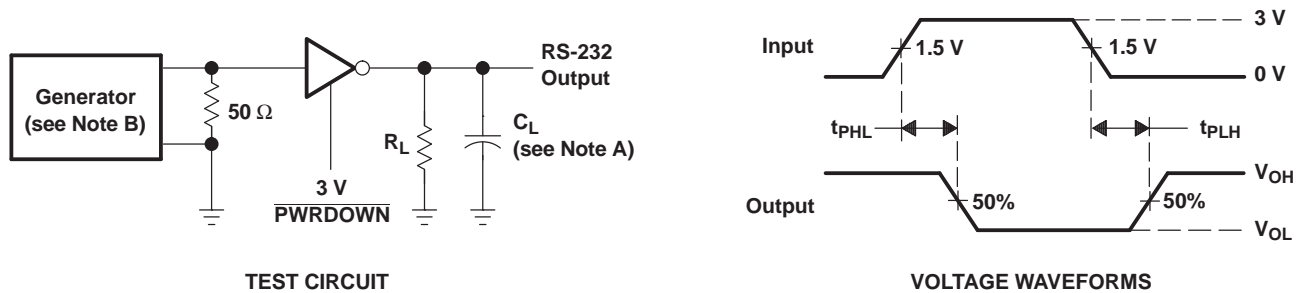
(3) Pulse skew is defined as |t_{PLH} - t_{PHL}| of each channel of the same device.

PARAMETER MEASUREMENT INFORMATION



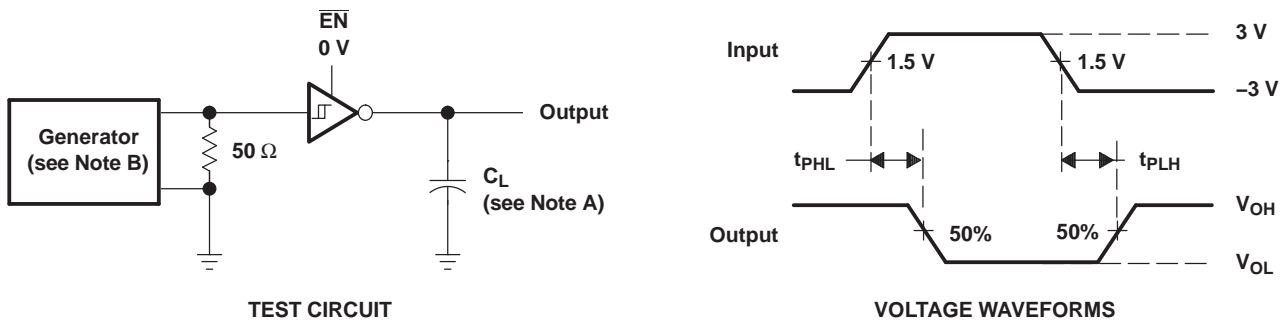
- A. C_L includes probe and jig capacitance.
- B. The pulse generator has the following characteristics: PRR = 250 kbit/s, $Z_O = 50\ \Omega$, 50% duty cycle, $t_r \leq 10\text{ ns}$, $t_f \leq 10\text{ ns}$.

Figure 1. Driver Slew Rate



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

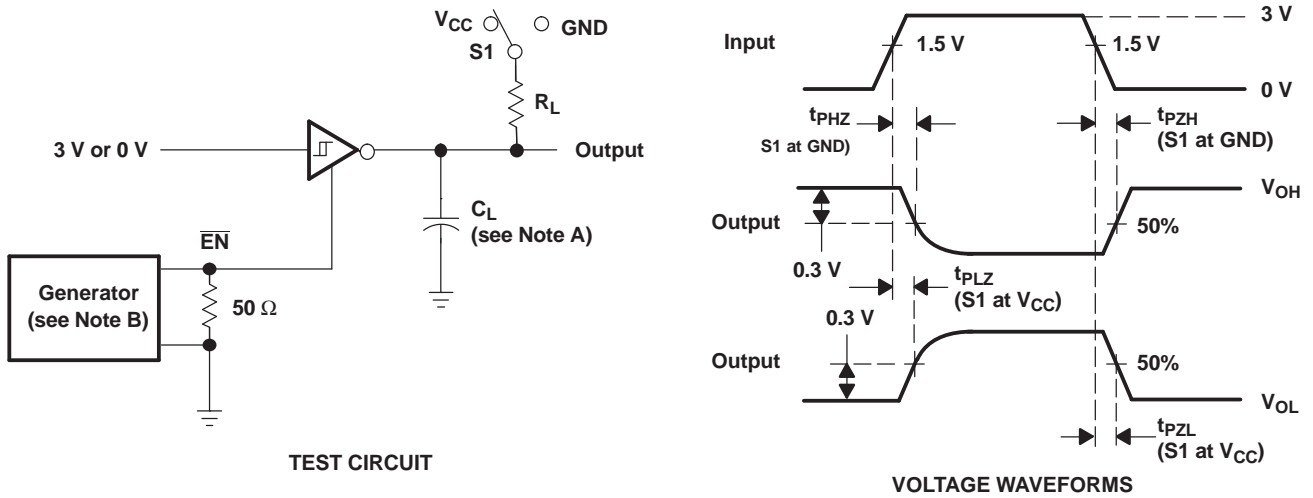
Figure 2. Driver Pulse Skew



- 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. Receiver Propagation Delay Times

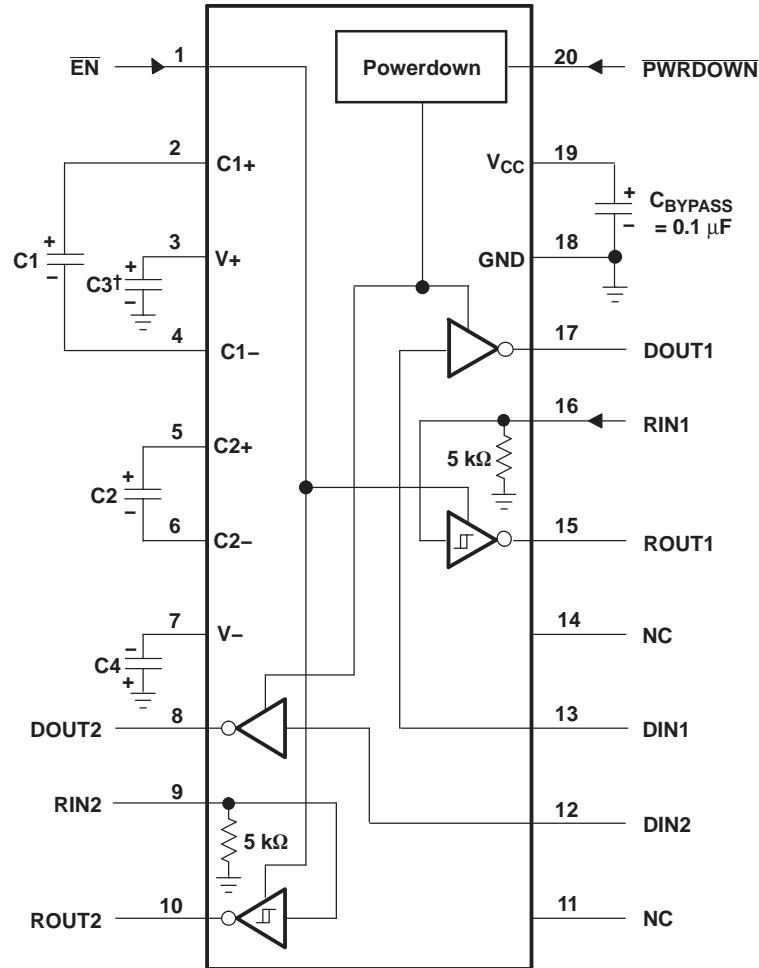
PARAMETER MEASUREMENT INFORMATION (continued)



- 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

APPLICATION INFORMATION



† C3 can be connected to V_{CC} or GND.

NOTES: A. Resistor values shown are nominal.

B. NC – No internal connection

C. 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 \pm 0.3 V	0.1 μ F	0.1 μ F
5 V \pm 0.5 V	0.047 μ F	0.33 μ F
3 V to 5.5 V	0.1 μ F	0.47 μ F

Figure 5. 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⁾
SN65C3222EDB	ACTIVE	SSOP	DB	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3222EDBG4	ACTIVE	SSOP	DB	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3222EDBR	ACTIVE	SSOP	DB	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3222EDBRG4	ACTIVE	SSOP	DB	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3222EDW	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3222EDWG4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3222EDWR	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3222EDWRG4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3222EPW	ACTIVE	TSSOP	PW	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3222EPWG4	ACTIVE	TSSOP	PW	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3222EPWR	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN65C3222EPWRG4	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3222EDB	ACTIVE	SSOP	DB	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3222EDBG4	ACTIVE	SSOP	DB	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3222EDBR	ACTIVE	SSOP	DB	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3222EDBRG4	ACTIVE	SSOP	DB	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3222EDW	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3222EDWG4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3222EDWR	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3222EDWRG4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3222EPW	ACTIVE	TSSOP	PW	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3222EPWG4	ACTIVE	TSSOP	PW	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3222EPWR	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN75C3222EPWRG4	ACTIVE	TSSOP	PW	20	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.

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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DW (R-PDSO-G20)

PLASTIC SMALL-OUTLINE PACKAGE



4040000-4/F 06/2004

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - D. Falls within JEDEC MS-013 variation AC.

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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