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

- Operates With 3-V to 5.5-V V_{CC} Supply
- Operates 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)
- Applications
  – Battery-Powered Systems, PDAs, Notebooks, Laptops, Palmtop PCs, and Hand-Held Equipment

DB, DW, OR PW PACKAGE
(TOP VIEW)

$\overline{EN}$	1	20 $\overline{PWRDOWN}$
C1+	2	19 V_{CC}
V+	3	18 GND
C1–	4	17 DOUT1
C2+	5	16 RIN1
C2–	6	15 ROUT1
V–	7	14 NC
DOUT2	8	13 DIN1
RIN2	9	12 DIN2
ROUT2	10	11 NC

NC – No internal connection

description/ordering information

The SN65C3222 and SN75C3222 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/μs to 150 V/μs.

The SN65C3222 and SN75C3222 can be placed in the power-down mode by setting $\overline{PWRDOWN}$ low, which draws only 1 μA 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 $\overline{EN}$ high.

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
−0°C to 70°C	SOIC (DW)	Tube of 25	SN75C3222DW	75C3222
		Reel of 2000	SN75C3222DWR	
	SSOP (DB)	Reel of 2000	SN75C3222DBR	CA3222
	TSSOP (PW)	Tube of 70	SN75C3222PW	CA3222
		Reel of 2000	SN75C3222PWR	
−40°C to 85°C	SOIC (DW)	Tube of 25	SN65C3222DW	65C3222
		Reel of 2000	SN65C3222DWR	
	SSOP (DB)	Reel of 2000	SN65C3222DBR	CB3222
	TSSOP (PW)	Tube of 70	SN65C3222PW	CB3222
		Reel of 2000	SN65C3222PWR	

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

Copyright © 2004, Texas Instruments Incorporated

TEXAS INSTRUMENTS

Function Tables

EACH DRIVER

INPUTS		OUTPUT
DIN	$\overline{\text{PWRDOWN}}$	DOUT
X	L	Z
L	H	H
H	H	L

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

EACH RECEIVER

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

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

logic diagram (positive logic)

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: Drivers, $\overline{EN}$, $\overline{PWRDOWN}$ .... –0.3 V to 6 V
                Receivers .... –25 V to 25 V
Output voltage range, V_O: Drivers .... –13.2 V to 13.2 V
                Receivers .... –0.3 V to V_{CC} + 0.3 V
Package thermal impedance, θ_{JA} (see Notes 2 and 3): DB package .... 70°C/W
                                                DW package .... 58°C/W
                                                PW package .... 83°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: 1. All voltages are with respect to network GND.
          2. 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.
          3. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 4 and Figure 5)

				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, $\overline{EN}$, $\overline{PWRDOWN}$	V_{CC} = 3.3 V	2			V
			V_{CC} = 5 V	2.4			
V_{IL}	Driver and control low-level input voltage	DIN, $\overline{EN}$, $\overline{PWRDOWN}$				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	SN65C3222		–40		85	°C
		SN75C3222		0		70	

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.

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 5)

PARAMETER		TEST CONDITIONS	MIN	TYP[‡]	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

[‡] 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.

SN65C3222, SN75C3222
3-V TO 5.5-V MULTICHANNEL RS-232 COMPATIBLE LINE DRIVER/RECEIVER

DRIVER SECTION

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 5)

	PARAMETER	TEST CONDITIONS		MIN	TYP[†]	MAX	UNIT
V_{OH}	High-level output voltage	DOUT at R_L = 3 kΩ to GND,	DIN = GND	5	5.4		V
V_{OL}	Low-level output voltage	DOUT at R_L = 3 kΩ to GND,	DIN = V_{CC}	−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	$\overline{\text{PWRDOWN}}$ = GND	$V_O = ±12$ V, V_{CC} = 3 V to 3.6 V			±25	µA
			$V_O = ±10$ V, V_{CC} = 4.5 V to 5.5 V			±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 4)

	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)	R_L = 3 kΩ to 7 kΩ, V_{CC} = 3.3 V	C_L = 150 pF to 1000 pF	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.

RECEIVER SECTION

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 5)

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		1.5	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_{off}	Output leakage current	$\overline{EN} = V_{CC}$		±0.05	±10	µA
r_i	Input resistance	$V_I = \pm 3$ 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	MIN	TYP[†]	MAX	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, $R_L = 3$ 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		300		ns

[†] All typical values are at $V_{CC} = 3.3$ V or $V_{CC} = 5$ V, and $T_A = 25°C$.
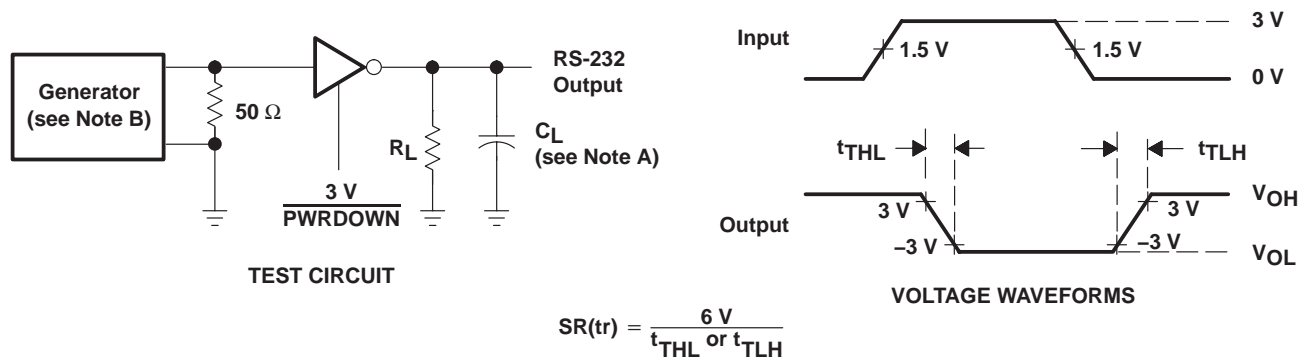[‡] Pulse skew is defined as $|t_{PLH} - t_{PHL}|$ of each channel of the same device.
NOTE 4: Test conditions are C1–C4 = 0.1 µF at $V_{CC} = 3.3$ V ± 0.3 V; C1 = 0.047 µF, C2–C4 = 0.33 µF at $V_{CC} = 5$ V ± 0.5 V.

PARAMETER MEASUREMENT INFORMATION

$$SR(tr) = \frac{6 \text{ V}}{t_{THL} \text{ or } t_{TLH}}$$
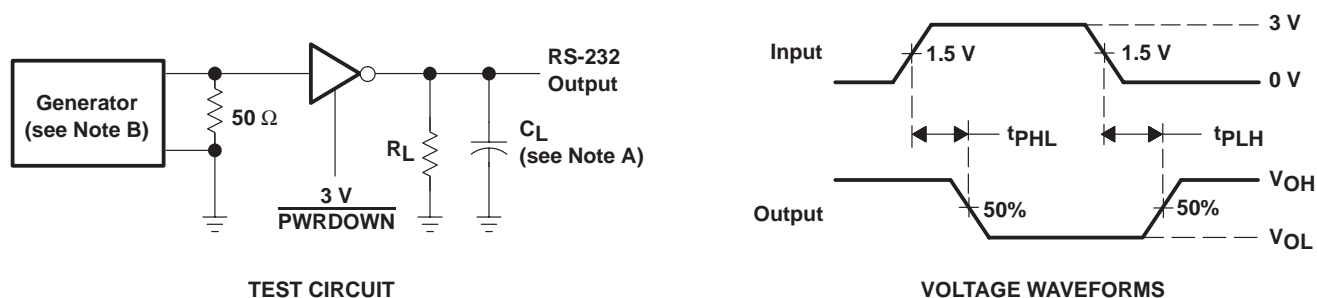
NOTES: A. C_L includes probe and jig capacitance.
      B. The pulse generator has the following characteristics: PRR = 250 kbit/s, Z_O = 50 Ω, 50% duty cycle, $t_r \leq$ 10 ns, $t_f \leq$ 10 ns.
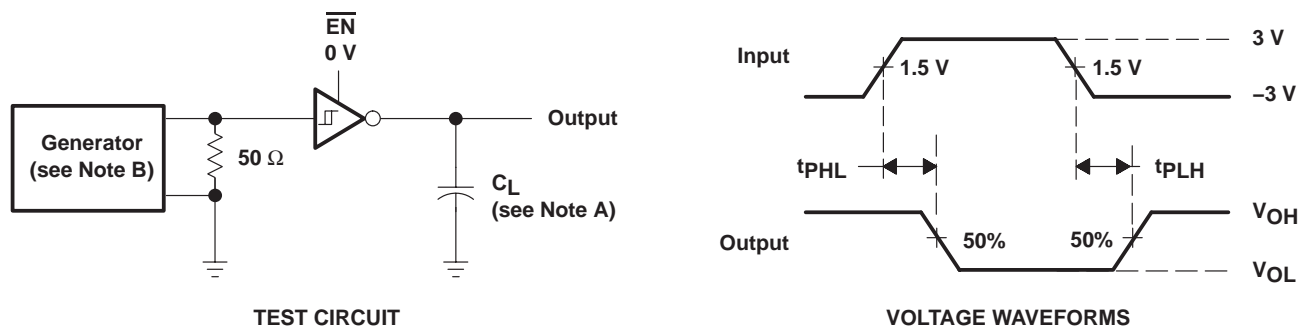
Figure 1. Driver Slew Rate

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

Figure 2. Driver Pulse Skew
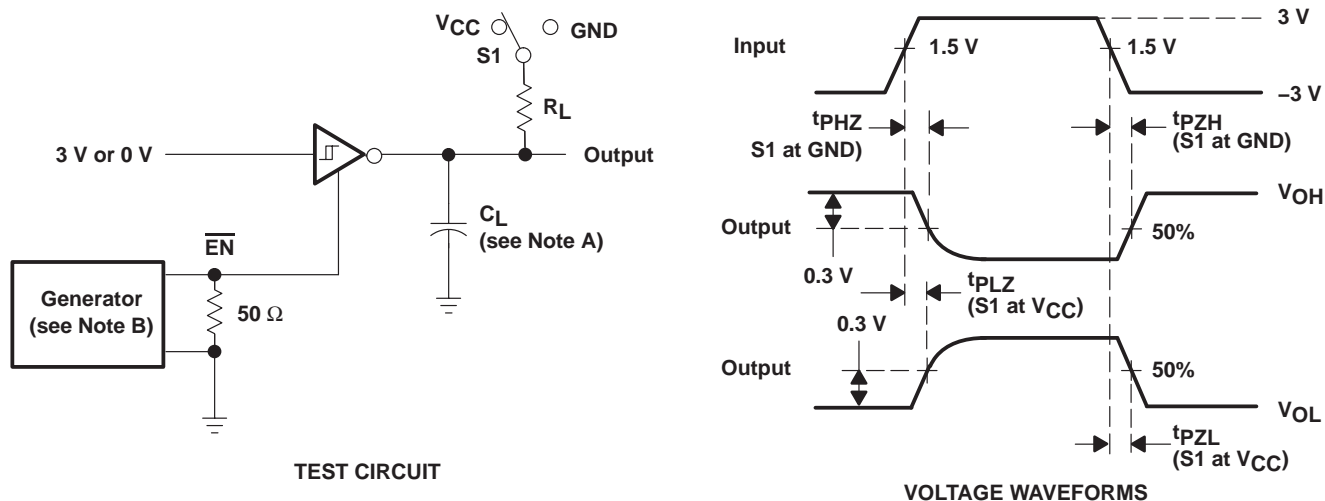

NOTES: A. C_L includes probe and jig capacitance.
      B. The pulse generator has the following characteristics: Z_O = 50 Ω, 50% duty cycle, $t_r \leq$ 10 ns, $t_f \leq$ 10 ns.

Figure 3. Receiver Propagation-Delay Times

TEXAS
INSTRUMENTS

PARAMETER MEASUREMENT INFORMATION

TEST CIRCUIT

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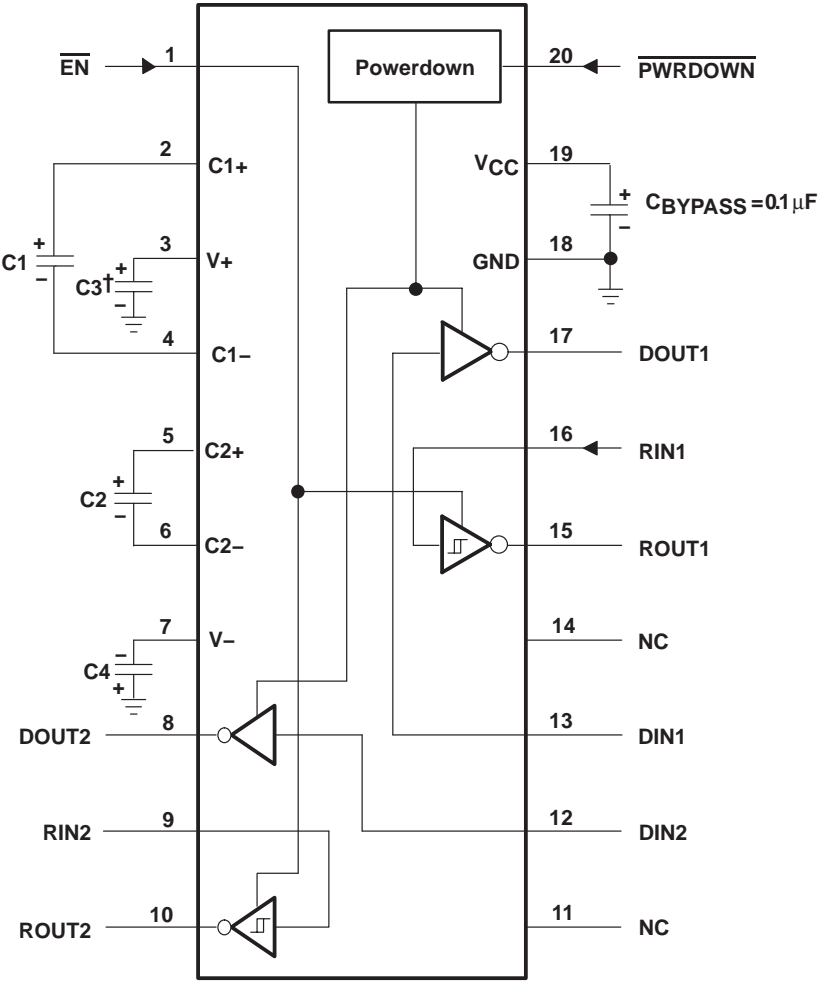
NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: Z_O = 50 Ω, 50% duty cycle, $t_r \leq 10$ ns, $t_f \leq 10$ ns.

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

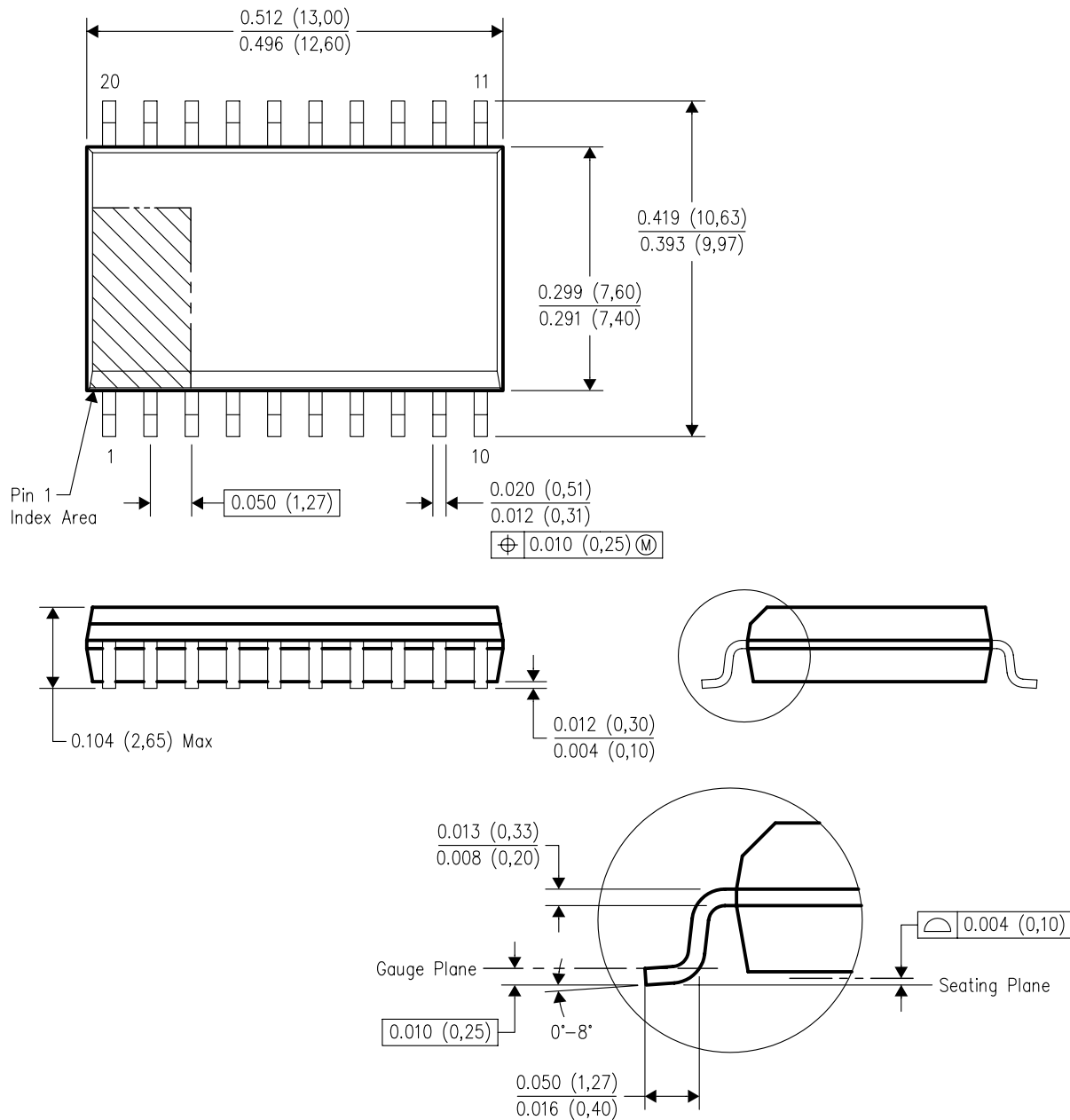### V_{CC} vs CAPACITOR VALUES

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 5. Typical Operating Circuit and Capacitor Values

DW (R−PDSO−G20)   PLASTIC SMALL−OUTLINE PACKAGE

0.512 (13,00)
0.496 (12,60)

20   11

0.419 (10,63)
0.393 (9,97)

0.299 (7,60)
0.291 (7,40)

1   10

Pin 1
Index Area

0.050 (1,27)

0.020 (0,51)
0.012 (0,31)

⊕ 0.010 (0,25) Ⓜ

0.104 (2,65) Max

0.012 (0,30)
0.004 (0,10)

0.013 (0,33)
0.008 (0,20)

⌂ 0.004 (0,10)

Gauge Plane

Seating Plane

0.010 (0,25)   0°−8°

0.050 (1,27)
0.016 (0,40)

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).
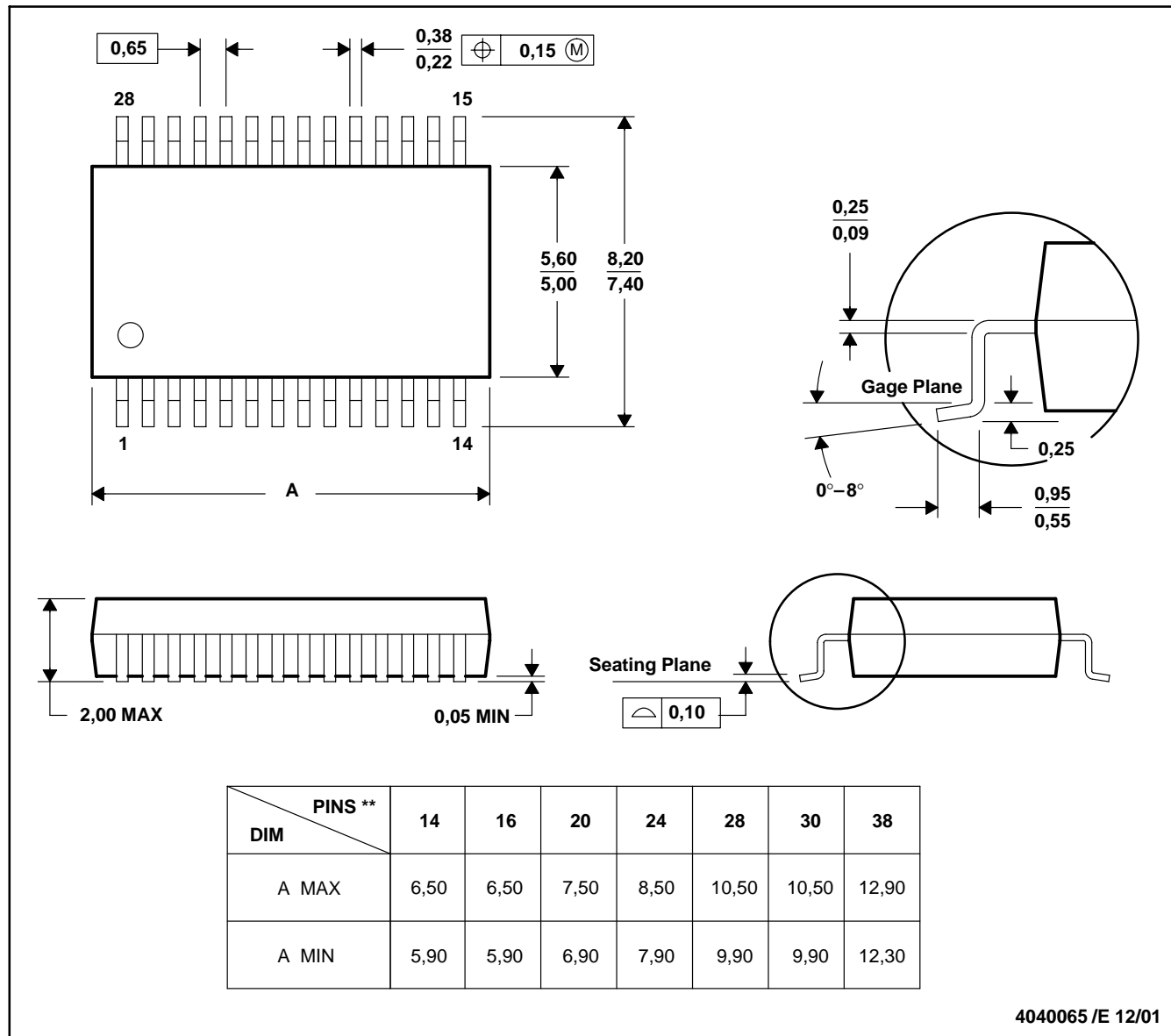   D.   Falls within JEDEC MS−013 variation AC.

MECHANICAL DATA

DB (R-PDSO-G**)   **PLASTIC SMALL-OUTLINE**

28 PINS SHOWN

PINS ** DIM	14	16	20	24	28	30	38
A MAX	6,50	6,50	7,50	8,50	10,50	10,50	12,90
A MIN	5,90	5,90	6,90	7,90	9,90	9,90	12,30

4040065 /E 12/01

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.
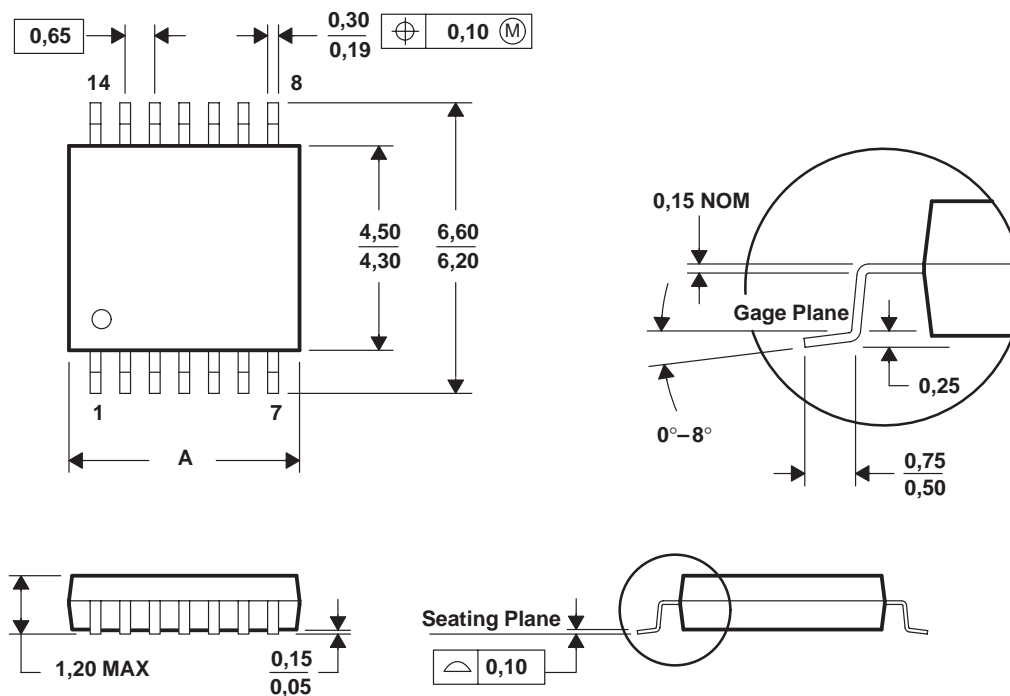D. Falls within JEDEC MO-150

TEXAS INSTRUMENTS

MECHANICAL DATA

PW (R-PDSO-G**) PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN

DIM \ PINS **	8	14	16	20	24	28
A MAX	3,10	5,10	5,10	6,60	7,90	9,80
A MIN	2,90	4,90	4,90	6,40	7,70	9,60

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

TEXAS
INSTRUMENTS

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
                             Post Office Box 655303 Dallas, Texas 75265

Copyright © 2004, Texas Instruments Incorporated