

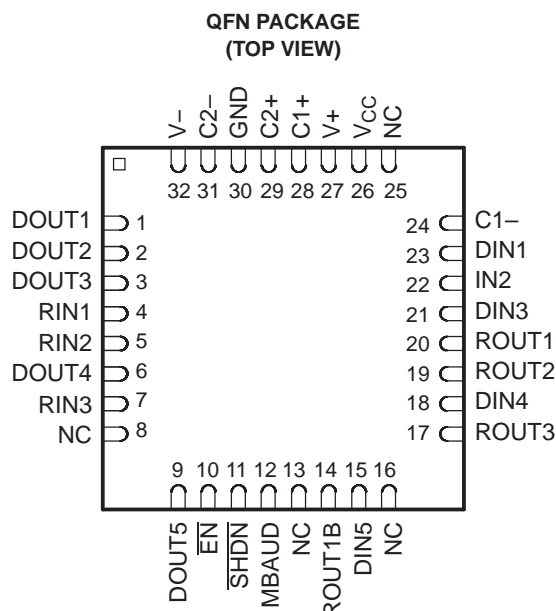
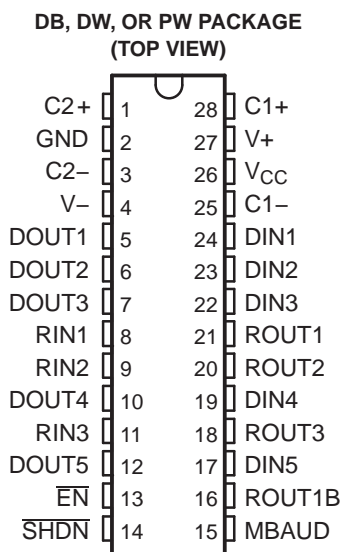
## FEATURES

- Meets or Exceeds the Requirements of TIA/EIA-232-F and ITU v.28 Standards
- Operates With 3-V to 5.5-V  $V_{CC}$  Supply
- Operates From 250 kbits/s to 1 Mbit/s
- Low Standby Current . . . 1  $\mu$ A Typical
- External Capacitors . . .  $4 \times 0.1 \mu$ F
- Accepts 5-V Logic Input With 3.3-V Supply
- Designed to Be Interchangeable With Maxim MAX3237E
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II

- ESD Protection for RS-232 I/O Pins and Logic Input pins
  - $\pm 15$  kV – Human-Body Model (HBM)
  - $\pm 8$  kV – IEC61000-4-2, Contact Discharge
  - $\pm 15$  kV – IEC61000-4-2, Air-Gap Discharge

## 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

The MAX3237E consists of five line drivers, three line receivers, and a dual charge-pump circuit with  $\pm 15$ -kV ESD protection pin to pin (serial-port connection pins, including GND). The device meets the requirements of TIA/EIA-232-F and provides 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. This device operates at data signaling rates of 250 kbit/s in normal operating mode (MBAUD = GND) and 1Mbit/s when MBAUD =  $V_{CC}$ . The driver output slew rate is a maximum of 30 V/ $\mu$ s.

## DESCRIPTION (CONTINUED)

The MAX3237E transmitters are disabled and the outputs are forced into high-impedance state when the device is in shutdown mode ( $\overline{\text{SHDN}}$  = GND) and the supply current falls to less than 1  $\mu$ A. Also, during shutdown, 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 ( $\overline{\text{EN}}$ ) high. ROUT1B remains active all the time, regardless of the  $\overline{\text{EN}}$  and  $\overline{\text{SHDN}}$  condition.



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.

# MAX3237E

## 3-V TO 5.5-V MULTICHANNEL RS-232

### 1-MBit/s LINE DRIVER/RECEIVER

SLLS709A–MAY 2006–REVISED OCTOBER 2006

The MAX3237EC is characterized for operation from 0°C to 70°C. The MAX3237EI is characterized for operation from –40°C to 85°C.

#### AVAILABLE OPTIONS

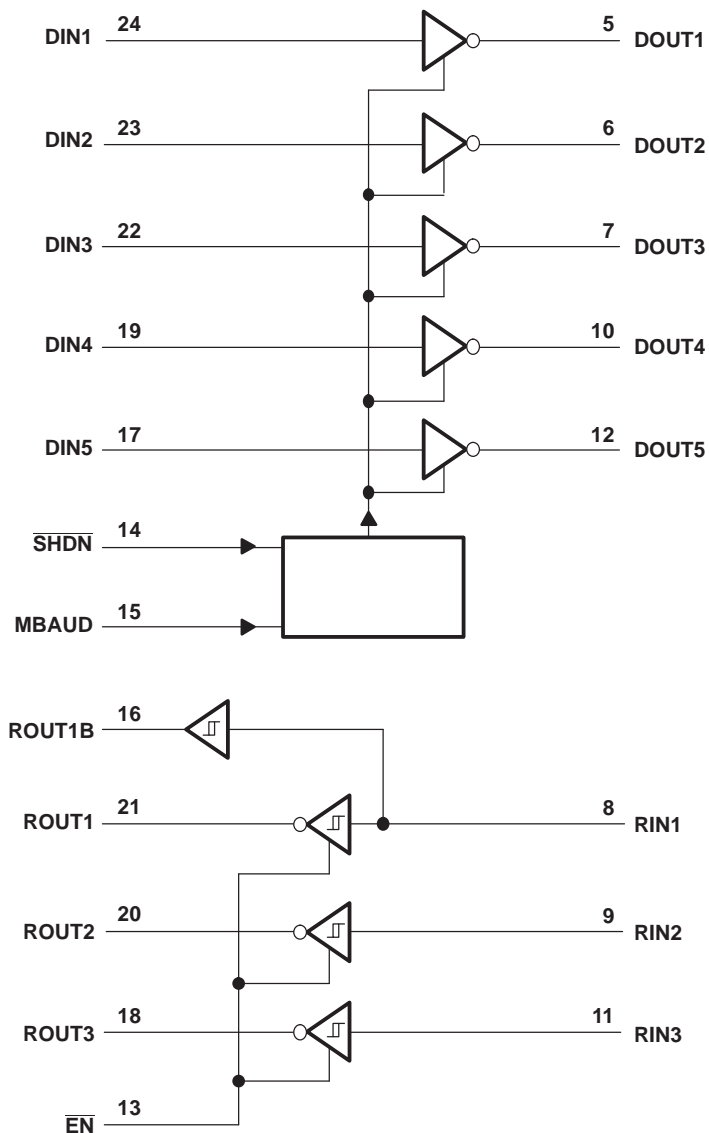
T <sub>A</sub>	PACKAGED DEVICES
0°C to 70°C	MAX3237ECDBR
	MAX3237ECPWR
	MAX3237ECRHBR (QFN package)
	MAX3237ECDWR
–40°C to 85°C	MAX3237EIDBR
	MAX3237EIPWR
	MAX3237EIRHBR (QFN package)
	MAX3237EIDWR

#### FUNCTION TABLE

INPUTS		OUTPUTS		
SHDN	EN	DOUT	ROUT	ROUT1B
0	0	Z <sup>(1)</sup>	Active	Active
0	1	Z <sup>(1)</sup>	Z <sup>(1)</sup>	Active
1	0	Active	Active	Active
1	1	Active	Z <sup>(1)</sup>	Active

(1) Z = high impedance (off)

LOGIC DIAGRAM (POSITIVE LOGIC)



# MAX3237E

## 3-V TO 5.5-V MULTICHANNEL RS-232

### 1-MBit/s LINE DRIVER/RECEIVER

SLLS709A—MAY 2006—REVISED OCTOBER 2006



## Absolute Maximum Ratings<sup>(1)</sup>

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

			MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage range <sup>(2)</sup>		−0.3	6	V
V+	Positive-output supply voltage range <sup>(2)</sup>		−0.3	7	V
V−	Negative-output supply voltage range <sup>(2)</sup>		0.3	−7	V
V+ − V−	Supply voltage difference <sup>(2)</sup>			13	V
V <sub>I</sub>	Input voltage range	Driver ( $\overline{\text{SHDN}}$ , MBAUD, $\overline{\text{EN}}$ )	−0.3	6	V
		Receiver	−25	25	
V <sub>O</sub>	Output voltage range	Driver	−13.2	13.2	V
		Receiver	−0.3	V <sub>CC</sub> + 0.3	
	Short-circuit duration	DOUT to GND	Unlimited		
θ <sub>JA</sub>	Package thermal impedance <sup>(3)</sup>			62	°C/W
	Lead temperature 1,6 mm (1/16 in) from case for 10 s			260	°C
T <sub>std</sub>	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) The package thermal impedance is calculated in accordance with JESD 51-7.

## Recommended Operating Conditions<sup>(1)</sup>

See [Figure 5](#)

			MIN	NOM	MAX	UNIT
Supply voltage		V <sub>CC</sub> = 3.3 V	3	3.3	3.6	V
		V <sub>CC</sub> = 5 V	4.5	5	5.5	
V <sub>IH</sub>	Driver and control high-level input voltage	DIN, $\overline{\text{SHDN}}$ , MBAUD, $\overline{\text{EN}}$	V <sub>CC</sub> = 3.3 V	2	5.5	V
			V <sub>CC</sub> = 5 V	2.4	5.5	
V <sub>IL</sub>	Driver and control low-level input voltage	DIN, $\overline{\text{SHDN}}$ , MBAUD, $\overline{\text{EN}}$	0		0.8	V
V <sub>I</sub>	Receiver input voltage		−25		25	V
T <sub>A</sub>	Operating free-air temperature	MAX3237EC	0		70	°C
		MAX3237EI	−40		85	

(1) Test conditions are C1–C4 = 0.1 μF at V<sub>CC</sub> = 3 V to 5 V.

## Electrical Characteristics<sup>(1)</sup>

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

PARAMETER		TEST CONDITIONS	MIN	TYP <sup>(2)</sup>	MAX	UNIT
I <sub>I</sub>	Input leakage current	DIN, $\overline{\text{SHDN}}$ , MBAUD, $\overline{\text{EN}}$		9	18	μA
I <sub>CC</sub>	Supply current (T <sub>A</sub> = 25°C)	No load, $\overline{\text{SHDN}} = V_{CC}$		0.5	2	mA
		$\overline{\text{SHDN}} = \text{GND}$		1	10	μA
		$\overline{\text{SHDN}} = \text{RIN} = \text{GND}$ , DIN = GND or V <sub>CC</sub>		10	300	nA

(1) Test conditions are C1–C4 = 0.1 μF at V<sub>CC</sub> = 3 V to 5 V.

(2) All typical values are at V<sub>CC</sub> = 3.3 V or V<sub>CC</sub> = 5 V, and T<sub>A</sub> = 25°C.

## DRIVER SECTION

### Electrical Characteristics<sup>(1)</sup>

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

PARAMETER	TEST CONDITIONS	MIN	TYP <sup>(2)</sup>	MAX	UNIT
V <sub>OH</sub> High-level output voltage	DOUT at R <sub>L</sub> = 3 kΩ to GND, DIN = GND	5	5.4		V
V <sub>OL</sub> Low-level output voltage	DOUT at R <sub>L</sub> = 3 kΩ to GND, DIN = V <sub>CC</sub>	–5	–5.4		V
I <sub>IH</sub> High-level input current	V <sub>I</sub> = V <sub>CC</sub>		±0.01	±1	μA
I <sub>IL</sub> Low-level input current	V <sub>I</sub> at GND		±0.01	±1	μA
I <sub>OS</sub> Short-circuit output current <sup>(3)</sup>	V <sub>CC</sub> = 3.6 V or 3.3 V, V <sub>O</sub> = 0 V			±60	mA
r <sub>O</sub> Output resistance	V <sub>CC</sub> , V <sub>I</sub> , and V <sub>–</sub> = 0 V, V <sub>O</sub> = ±2 V	300	50k		Ω

(1) Test conditions are C1–C4 = 0.1 μF at V<sub>CC</sub> = 3 V to 5 V.

(2) All typical values are at V<sub>CC</sub> = 3.3 V or V<sub>CC</sub> = 5 V, and T<sub>A</sub> = 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<sup>(1)</sup>

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

PARAMETER		TEST CONDITIONS			MIN	TYP <sup>(2)</sup>	MAX	UNIT
Maximum data rate	C <sub>L</sub> = 1000 pF, MBAUD = GND	R <sub>L</sub> = 3 kΩ, 1 DIN switching, See <a href="#">Figure 1</a>			250		kbit/s	
	1000							
	1000							
t <sub>sk(p)</sub> Pulse skew <sup>(3)</sup>	C <sub>L</sub> = 150 pF to 2500 pF, R <sub>L</sub> = 3 kΩ to 7 kΩ, MBAUD = V <sub>CC</sub> or GND, See <a href="#">Figure 2</a>				100		ns	
SR(tr) Slew rate, transition region (see <a href="#">Figure 1</a> )	V <sub>CC</sub> = 3.3 V, R <sub>L</sub> = 3 kΩ to 7 kΩ, T <sub>A</sub> = 25°C	C <sub>L</sub> = 150 pF to 1000 pF	MBAUD = GND	6	30	V/μs		
			MBAUD = V <sub>CC</sub>	24	150			
		C <sub>1</sub> = 150 pF to 2500 pF,	MBAUD = GND	4	30			

(1) Test conditions are C1–C4 = 0.1 μF at V<sub>CC</sub> = 3 V to 5 V.

(2) All typical values are at V<sub>CC</sub> = 3.3 V or V<sub>CC</sub> = 5 V, and T<sub>A</sub> = 25°C.

(3) Pulse skew is defined as |t<sub>PLH</sub> – t<sub>PHL</sub>| of each channel of the same device.

## RECEIVER SECTION

### Electrical Characteristics<sup>(1)</sup>

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

PARAMETER		TEST CONDITIONS	MIN	TYP <sup>(2)</sup>	MAX	UNIT
V <sub>OH</sub>	High-level output voltage	I <sub>OH</sub> = –1 mA	V <sub>CC</sub> – 0.6	V <sub>CC</sub> – 0.1		V
V <sub>OL</sub>	Low-level output voltage	I <sub>OL</sub> = 1 mA			0.4	V
V <sub>IT+</sub>	Positive-going input threshold voltage	V <sub>CC</sub> = 3.3 V		1.5	2.4	V
		V <sub>CC</sub> = 5 V		2	2.4	
V <sub>IT–</sub>	Negative-going input threshold voltage	V <sub>CC</sub> = 3.3 V	0.6	1.1		V
		V <sub>CC</sub> = 5 V	0.8	1.5		
V <sub>hys</sub>	Input hysteresis (V <sub>IT+</sub> – V <sub>IT–</sub> )			0.5		V
I <sub>oz</sub>	Output leakage current	$\overline{\text{EN}} = V_{\text{CC}}$		±0.05	±10	μA
r <sub>i</sub>	Input resistance	V <sub>I</sub> = ±3 V to ±25 V	3	5	7	kΩ

(1) Test conditions are C1–C4 = 0.1 mF at V<sub>CC</sub> = 3 V to 5 V.

(2) All typical values are at V<sub>CC</sub> = 3.3 V or V<sub>CC</sub> = 5 V, and T<sub>A</sub> = 25°C.

### Switching Characteristics<sup>(1)</sup>

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

PARAMETER		TEST CONDITIONS	TYP <sup>(2)</sup>	UNIT
t <sub>PLH</sub>	Propagation delay time, low- to high-level output	C <sub>L</sub> = 150 pF, See <a href="#">Figure 3</a>	150	ns
t <sub>PHL</sub>	Propagation delay time, high- to low-level output	C <sub>L</sub> = 150 pF, See <a href="#">Figure 3</a>	150	ns
t <sub>en</sub>	Output enable time	C <sub>L</sub> = 150 pF, R <sub>L</sub> = 3 kΩ, See <a href="#">Figure 4</a>	2.6	μs
t <sub>dis</sub>	Output disable time	C <sub>L</sub> = 150 pF, R <sub>L</sub> = 3 kΩ, See <a href="#">Figure 4</a>	2.4	μs
t <sub>sk(p)</sub>	Pulse skew <sup>(3)</sup>	See <a href="#">Figure 3</a>	50	ns

(1) Test conditions are C1–C4 = 0.1 μF at V<sub>CC</sub> = 3 V to 5 V.

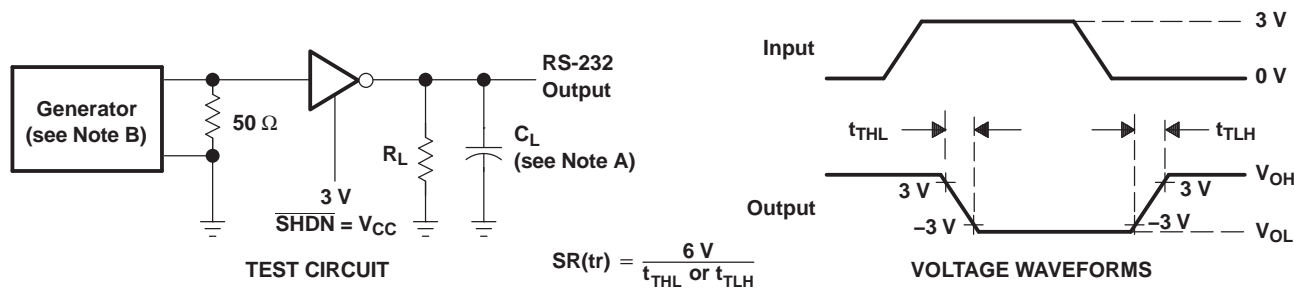
(2) All typical values are at V<sub>CC</sub> = 3.3 V or V<sub>CC</sub> = 5 V, and T<sub>A</sub> = 25°C.

(3) Pulse skew is defined as |t<sub>PLH</sub> – t<sub>PHL</sub>| of each channel of the same device.

## ESD Protection

PIN	TEST CONDITIONS	TYP	UNIT
DIN, RIN, ROUT	HBM	±15	kV
	IEC61000-4-2, Contact Discharge	±8	
	IEC61000-4-2, Air-Gap Discharge	±15	

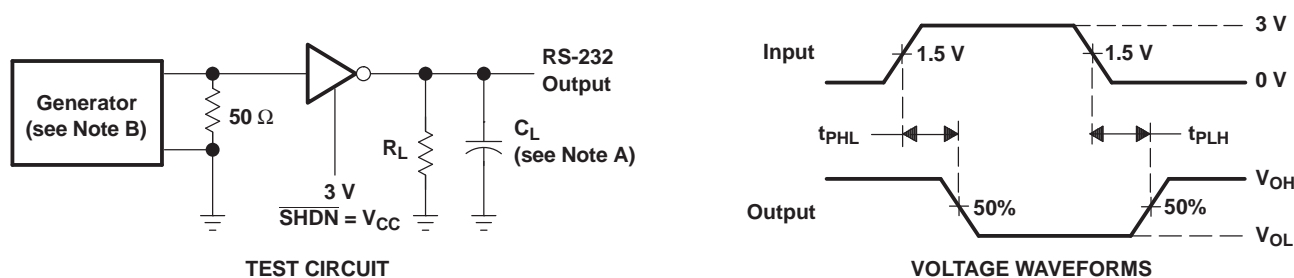
## PARAMETER MEASUREMENT INFORMATION



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

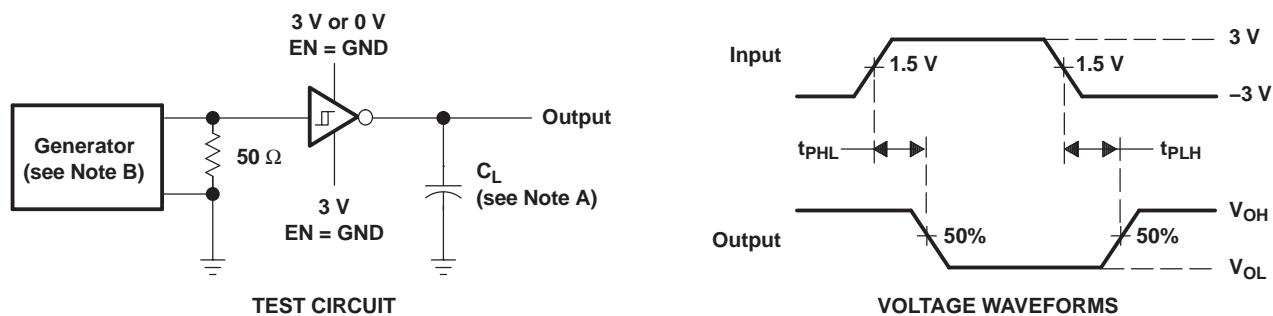
Figure 1. Driver Slew Rate



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

Figure 2. Driver Pulse Skew

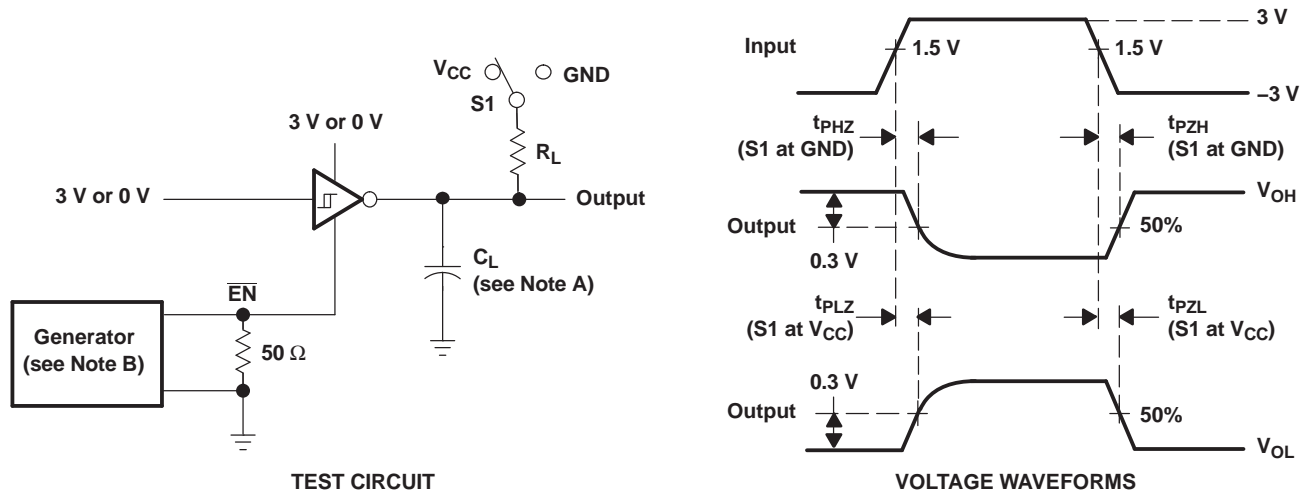


NOTES: A.  $C_L$  includes probe and jig capacitance.

B. The pulse generator has the following characteristics:  $Z_O = 50 \Omega$ , 50% duty cycle,  $t_r \leq 10 \text{ ns}$ ,  $t_f \leq 10 \text{ ns}$ .

Figure 3. Receiver Propagation Delay Times

**PARAMETER MEASUREMENT INFORMATION (continued)**

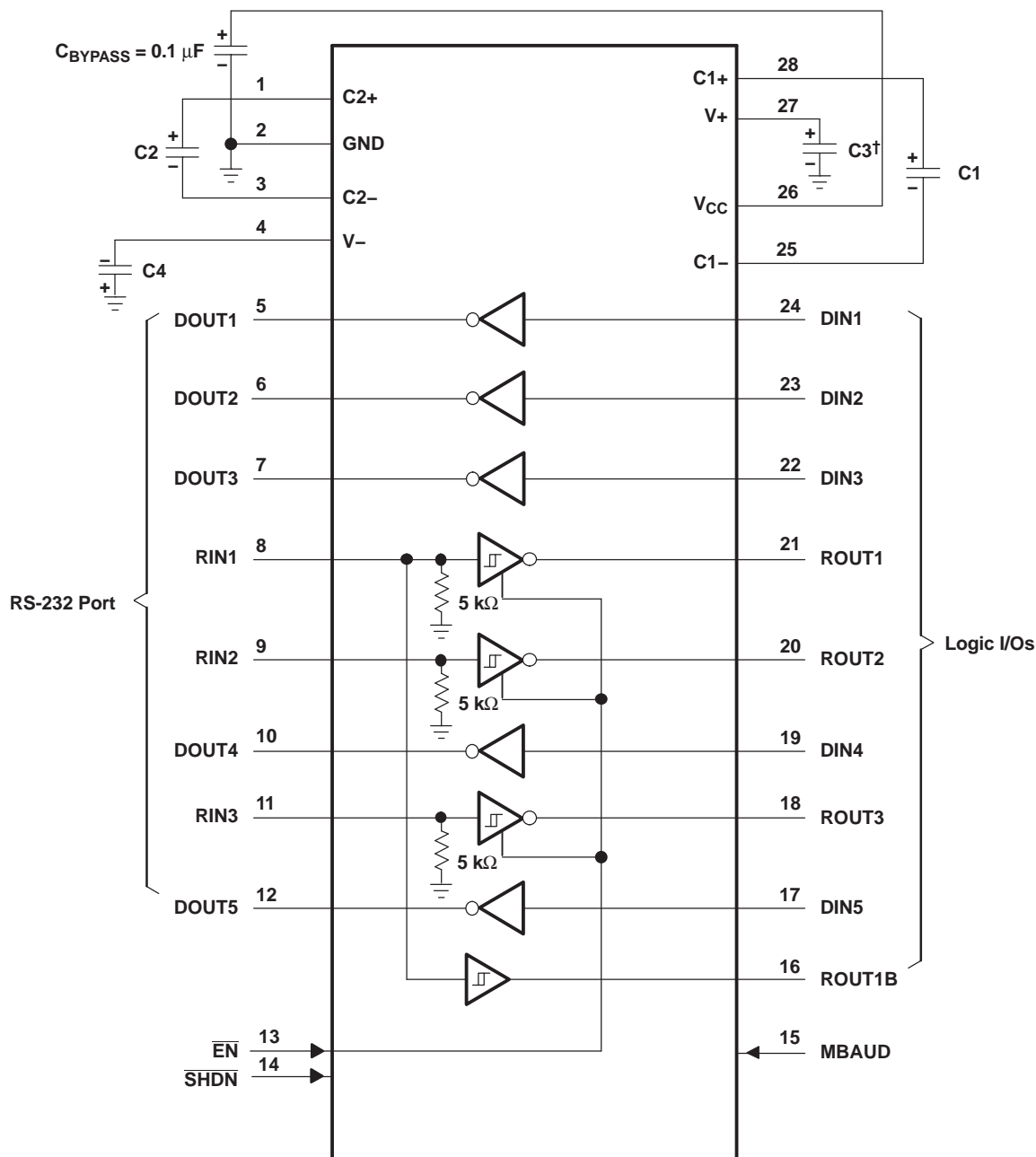


- NOTES: A.  $C_L$  includes probe and jig capacitance.  
B. The pulse generator has the following characteristics:  $Z_O = 50\ \Omega$ , 50% duty cycle,  $t_r \leq 10\text{ ns}$ ,  $t_f \leq 10\text{ ns}$ .  
C.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .  
D.  $t_{PZL}$  and  $t_{PZH}$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

**Figure 4. Receiver Enable and Disable Times**



## APPLICATION INFORMATION



† C3 can be connected to V<sub>CC</sub> 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<sub>CC</sub> vs CAPACITOR VALUES

V <sub>CC</sub>	C1	C2, C3, and C4
3.3 V ± 0.15 V	0.1 μF	0.1 μF
3.3 V ± 0.3 V	0.22 μF	0.22 μF
5 V ± 0.5 V	0.047 μF	0.33 μF
3 V to 5.5 V	0.22 μF	1 μF

Figure 5. Typical Operating Circuit and Capacitor Values

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
MAX3237ECDB	ACTIVE	SSOP	DB	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237ECDBG4	ACTIVE	SSOP	DB	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237ECDBR	ACTIVE	SSOP	DB	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237ECDBRG4	ACTIVE	SSOP	DB	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237ECDW	ACTIVE	SOIC	DW	28	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237ECDWG4	ACTIVE	SOIC	DW	28	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237ECDWR	ACTIVE	SOIC	DW	28	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237ECDWRG4	ACTIVE	SOIC	DW	28	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237ECPW	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237ECPWG4	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237ECPWR	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237ECPWRG4	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237EIDB	ACTIVE	SSOP	DB	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237EIDBG4	ACTIVE	SSOP	DB	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237EIDBR	ACTIVE	SSOP	DB	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237EIDBRG4	ACTIVE	SSOP	DB	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237EIDW	ACTIVE	SOIC	DW	28	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237EIDWG4	ACTIVE	SOIC	DW	28	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237EIDWR	ACTIVE	SOIC	DW	28	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237EIDWRG4	ACTIVE	SOIC	DW	28	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237EIPW	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237EIPWG4	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237EIPWR	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MAX3237EIPWRG4	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

<sup>(1)</sup> The marketing status values are defined as follows:

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**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.

<sup>(2)</sup> 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)

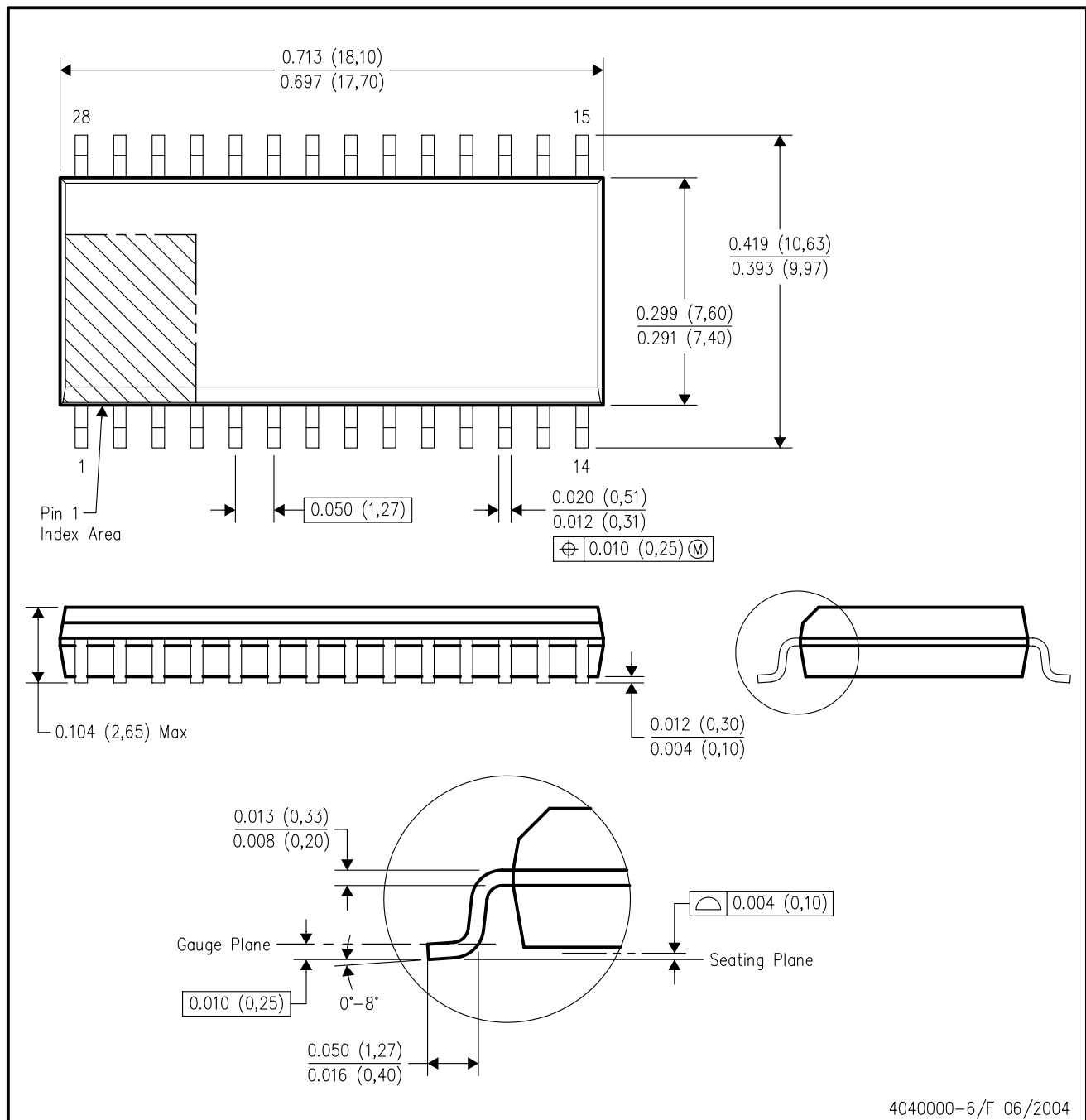
<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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## DW (R-PDSO-G28)

## PLASTIC SMALL-OUTLINE PACKAGE



4040000-6/F 06/2004

## 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



- 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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