3-V TO 5.5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER WITH ±15-kV IEC ESD PROTECTION

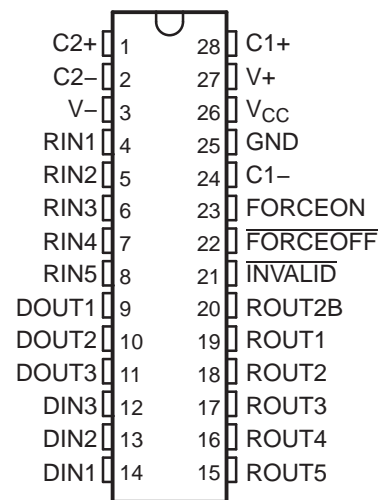Check for Samples: **MAX3243E**

FEATURES

- **Single-Chip and Single-Supply Interface for IBM™ PC/AT™ Serial Port**
- **ESD Protection for RS-232 Bus Pins**
  - **±15-kV Human-Body Model (HBM)**
  - **±8-kV IEC61000-4-2, Contact Discharge**
  - **±15-kV IEC61000-4-2, Air-Gap Discharge**
- **Meets or Exceeds Requirements of TIA/EIA-232-F and ITU v.28 Standards**
- **Operates With 3-V to 5.5-V V_{CC} Supply**
- **Always-Active Noninverting Receiver Output (ROUT2B)**
- **Designed to Transmit at a Data Rate up to 500 kbit/s**
- **Low Standby Current . . . 1 µA Typ**
- **External Capacitors . . . 4 × 0.1 µF**
- **Accepts 5-V Logic Input With 3.3-V Supply**
- **Designed to Be Interchangeable With Maxim MAX3243E**
- **Serial-Mouse Driveability**
- **Auto-Powerdown Feature to Disable Driver Outputs When No Valid RS-232 Signal Is Sensed**
- **Package Options Include Plastic Small-Outline (DW), Shrink Small-Outline (DB), and Thin Shrink Small-Outline (PW) Packages**
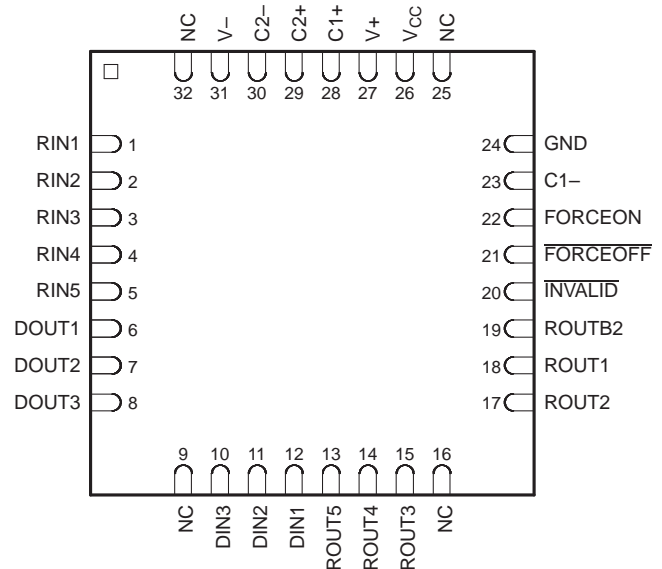
APPLICATIONS

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

DB, DW, OR PW PACKAGE
(TOP VIEW)

C2+	1	28	C1+
C2−	2	27	V+
V−	3	26	V_{CC}
RIN1	4	25	GND
RIN2	5	24	C1−
RIN3	6	23	FORCEON
RIN4	7	22	$\overline{FORCEOFF}$
RIN5	8	21	$\overline{INVALID}$
DOUT1	9	20	ROUT2B
DOUT2	10	19	ROUT1
DOUT3	11	18	ROUT2
DIN3	12	17	ROUT3
DIN2	13	16	ROUT4
DIN1	14	15	ROUT5

QFN PACKAGE
(TOP VIEW)

Top pins (32–25): NC, V−, C2−, C2+, C1+, V+, V_{CC}, NC

Left pins:
- RIN1 — 1
- RIN2 — 2
- RIN3 — 3
- RIN4 — 4
- RIN5 — 5
- DOUT1 — 6
- DOUT2 — 7
- DOUT3 — 8

Right pins:
- 24 — GND
- 23 — C1−
- 22 — FORCEON
- 21 — $\overline{FORCEOFF}$
- 20 — $\overline{INVALID}$
- 19 — ROUTB2
- 18 — ROUT1
- 17 — ROUT2

Bottom pins (9–16): NC, DIN3, DIN2, DIN1, ROUT5, ROUT4, ROUT3, NC

⚠ 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.

IBM, PC/AT are trademarks of International Business Machines Corporation.

DESCRIPTION

The MAX3243E device consists of three line drivers, five line receivers, and a dual charge-pump circuit with ±15-kV ESD (HBM and IEC61000-4-2, Air-Gap Discharge) and ±8-kV ESD (IEC61000-4-2, Contact Discharge) protection on serial-port connection pins. 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. This combination of drivers and receivers matches that needed for the typical serial port used in an IBM PC/AT, or compatible. The charge pump and four small external capacitors allow operation from a single 3-V to 5.5-V supply. In addition, the device includes an always-active noninverting output (ROUT2B), which allows applications using the ring indicator to transmit data while the device is powered down. The device operates at data signaling rates up to 250 kbit/s and a maximum of 30-V/µs driver output slew rate.

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 device does 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 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.

The MAX3243EC is characterized for operation from 0°C to 70°C. The MAX3243EI is characterized for operation from –40°C to 85°C.

ORDERING INFORMATION

T_A	PACKAGE[1] [2]		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	SOIC – DW	Tape and reel	MAX3243ECDW	MAX3243EC
			MAX3243ECDWR	
	SSOP – DB	Tape and reel	MAX3243ECDB	MAX3243EC
			MAX3243ECDBR	
	TSSOP – PW	Tape and reel	MAX3243ECPW	MP243EC
			MAX3243ECPWR	
	QFN – RHB	Tape and reel	MAX3243ECRHBR	MP243E
–40°C to 85°C	SSOP – DB	Tape and reel	MAX3243EIDB	MAX3243EI
			MAX3243EIDBR	
	SOIC – DW	Tape and reel	MAX3243EIDW	MAX3243EI
			MAX3243EIDWR	
	TSSOP – PW	Tape and reel	MAX3243EIPW	MP243EI
			MAX3243EIPWR	
	QFN – RHB	Tape and reel	MAX3243EIRHBR	MR243E

(1) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.
(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.

2   *Submit Documentation Feedback*

Product Folder Link(s): *MAX3243E*

FUNCTION TABLES

Each Driver[1]

INPUTS				OUTPUT	DRIVER STATUS
DIN	FORCEON	$\overline{\text{FORCEOFF}}$	VALID RIN RS-232 LEVEL	DOUT	
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	
X	L	H	No	Z	Powered off by auto-powerdown feature

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

Each Receiver[1]

INPUTS			OUTPUT	RECEIVER STATUS
RIN	FORCEON	$\overline{\text{FORCEOFF}}$	ROUT	
X	X	L	Z	Powered off
L	X	H	H	Normal operation with auto-powerdown disabled/enabled
H	X	H	L	
Open	X	H	H	

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

ROUT2B and Outputs $\overline{\text{INVALID}}$ [1]

INPUTS				OUTPUTS		OUTPUT STATUS
VALID RIN RS-232 LEVEL	RIN2	FORCEON	$\overline{\text{FORCEOFF}}$	$\overline{\text{INVALID}}$	ROUT2B	
Yes	L	X	X	H	L	Always active
Yes	H	X	X	H	H	
Yes	Open	X	X	H	L	
No	Open	X	X	L	L	

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

LOGIC DIAGRAM (POSITIVE LOGIC)
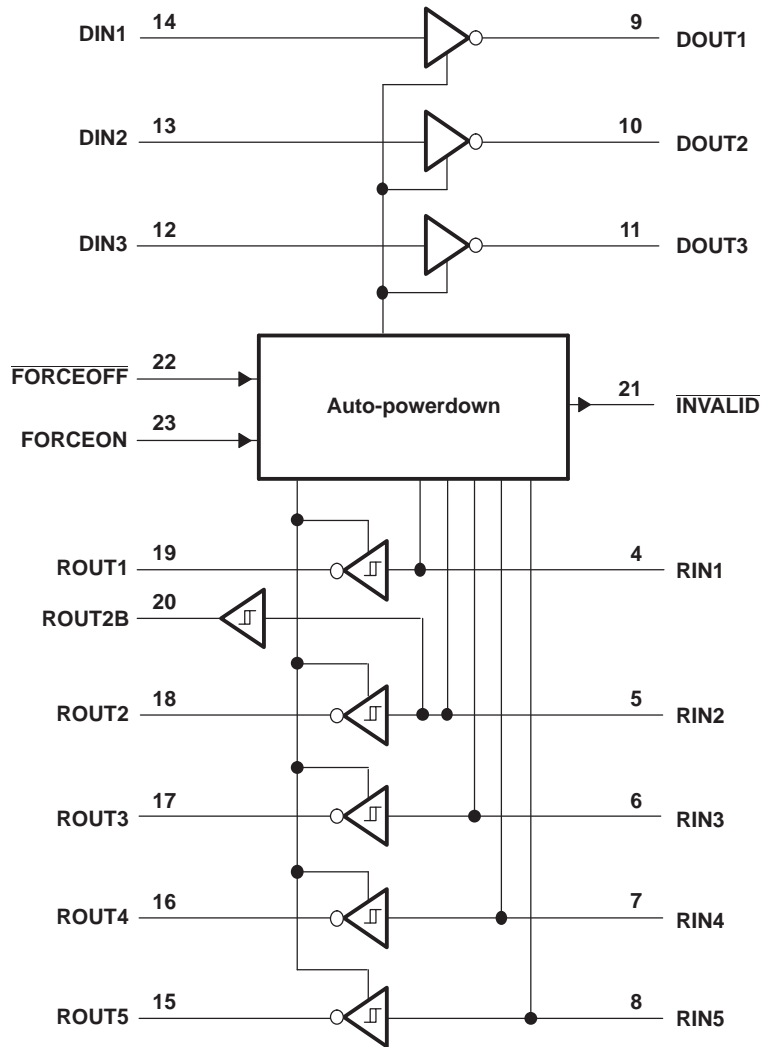
ABSOLUTE MAXIMUM RATINGS[1]

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−	Output supply voltage difference[2]			13	V
V_I	Input voltage range	Driver ($\overline{\text{FORCEOFF}}$, FORCEON)	−0.3	6	V
		Receiver	−25	25	
V_O	Output voltage range	Driver	−13.2	13.2	V
		Receiver ($\overline{\text{INVALID}}$)	−0.3	V_{CC} + 0.3	
θ_{JA}	Package thermal impedance[3] [4]	DB package		62	°C/W
		DW package		46	
		PW package		62	
	Lead temperature 1,6 mm (1/16 in) from case for 10 s			260	°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.

RECOMMENDED OPERATING CONDITIONS[1]

See Figure 6

				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, $\overline{\text{FORCEOFF}}$, FORCEON	V_{CC} = 3.3 V	2			V
			V_{CC} = 5 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		MAX3243EC	0		70	°C
			MAX3243EI	−40		85	

(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.

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
I_I Input leakage current	$\overline{\text{FORCEOFF}}$, FORCEON			±0.01	±1	μA
I_{CC} Supply current (T_A = 25°C)	Auto-powerdown disabled	No load, $\overline{\text{FORCEOFF}}$ and FORCEON at V_{CC}		0.3	1	mA
	Powered off	No load, $\overline{\text{FORCEOFF}}$ at GND		1	10	μA
	Auto-powerdown enabled	No load, $\overline{\text{FORCEOFF}}$ at V_{CC}, FORCEON at GND, All RIN are open or grounded, All DIN are grounded		1	10	

(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.

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	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 at GND		±0.01	±1	µA
V_{hys}	Input hysteresis				±1	V
I_{OS}	Short-circuit output current[3]	V_{CC} = 3.6 V, V_O = 0 V			±60	mA
		V_{CC} = 5.5 V, V_O = 0 V				
r_o	Output resistance	V_{CC}, V+, and V– = 0 V, V_O = ±2 V	300	10M		Ω
I_{off}	Output leakage current	$\overline{FORCEOFF}$ = GND, V_O = ±12 V, V_{CC} = 0 to 5.5 V			±25	µA

(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.

Switching Characteristics[1]

switching characteristics 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	C_L = 1000 pF, One DOUT switching,	R_L = 3 kΩ See Figure 1	250	500		kbit/s
$t_{sk(p)}$	Pulse skew[3]	C_L = 150 pF to 2500 pF,	R_L = 3 kΩ to 7 kΩ, See Figure 2		100		ns
SR(tr)	Slew rate, transition region (see Figure 1)	V_{CC} = 3.3 V, R_L = 3 kΩ to 7 kΩ, PRR = 250 kbit/s	C_L = 150 pF to 1000 pF	6		30	V/µs
			C_L = 150 pF to 2500 pF	4		30	

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

ESD Protection

PARAMETER	TEST CONDITIONS	TYP	UNIT
Driver outputs (pins 9–11)	HBM	±15	kV
	IEC61000-4-2, Air-Gap Discharge	±15	kV
	IEC61000-4-2, Contact Discharge	±8	kV

Product Folder Link(s): MAX3243E

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	$I_{OH} = -1$ mA	$V_{CC} - 0.6$	$V_{CC} - 0.1$		V
V_{OL}	Low-level output voltage	$I_{OH} = 1.6$ 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)	$\overline{FORCEOFF} = 0$ V		±0.05	±10	µA
r_i	Input resistance	$V_I = \pm3$ V or ±25 V	3	5	7	kΩ

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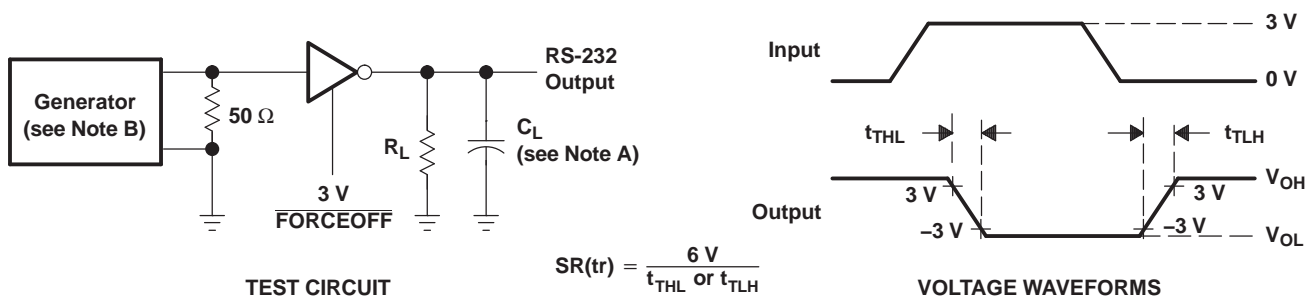(2) All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.

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	150	ns
t_{PHL}	Propagation delay time, high- to low-level output		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		200	ns
$t_{sk(p)}$	Puse skew[3]	See Figure 3	50	ns

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

ESD Protection

PARAMETER	TEST CONDITIONS	TYP	UNIT
Driver outputs (pins 4–8)	HBM	±15	kV
	IEC61000-4-2, Air-Gap discharge	±15	kV
	IEC61000-4-2, Contact Discharge	±8	kV

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
$V_{IT+(valid)}$	Receiver input threshold for INVALID high-level output voltage	FORCEON = GND, FORCEOFF = V_{CC}		2.7	V
$V_{IT-(valid)}$	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 = GND, FORCEOFF = V_{CC}	V_{CC} − 0.6		V
V_{OL}	INVALID low-level output voltage	I_{OL} = 1.6 mA, FORCEON = GND, 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		TEST CONDITIONS	TYP[1]	UNIT
t_{valid}	Propagation delay time, low- to high-level output	V_{CC} = 5 V	1	µs
$t_{invalid}$	Propagation delay time, high- to low-level output	V_{CC} = 5 V	30	µs
t_{en}	Supply enable time	V_{CC} = 5 V	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

$$SR(tr) = \frac{6\ V}{t_{THL}\ or\ t_{TLH}}$$

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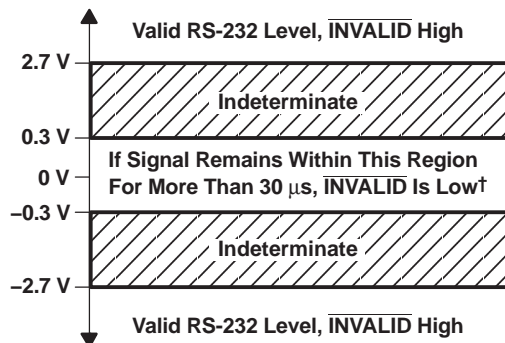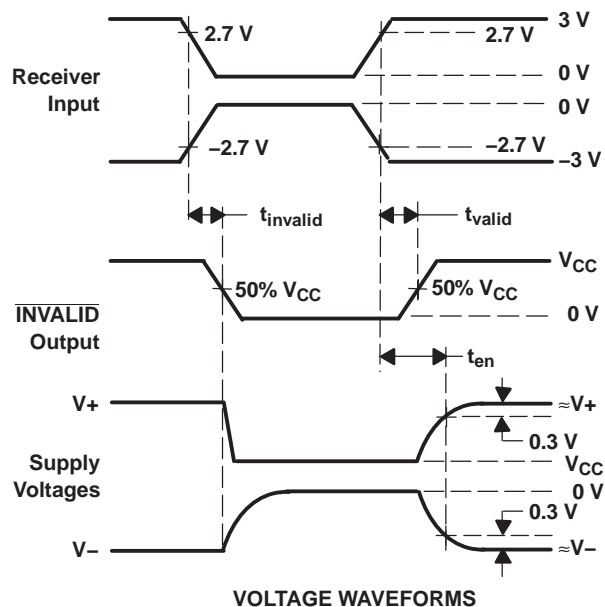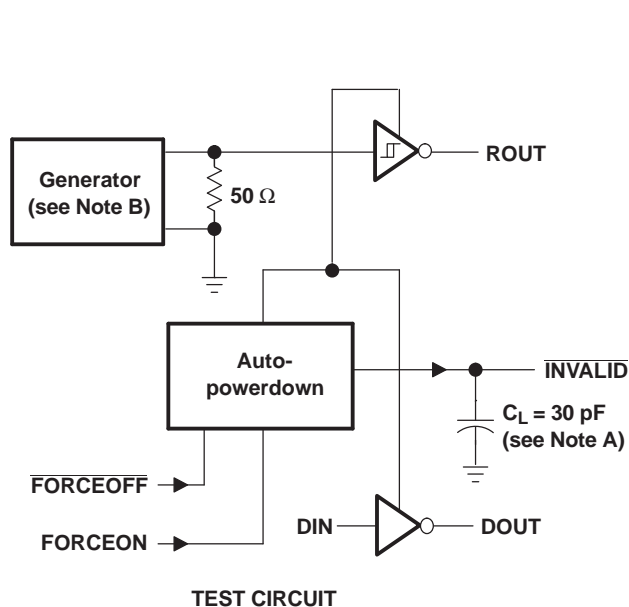
NOTES: A. C_L includes probe and jig capacitance.
        B. The pulse generator has the following characteristics: Z_O = 50 Ω, 50% duty cycle, t_r ≤ 10 ns, t_f ≤ 10 ns.

Figure 1. Driver Slew Rate
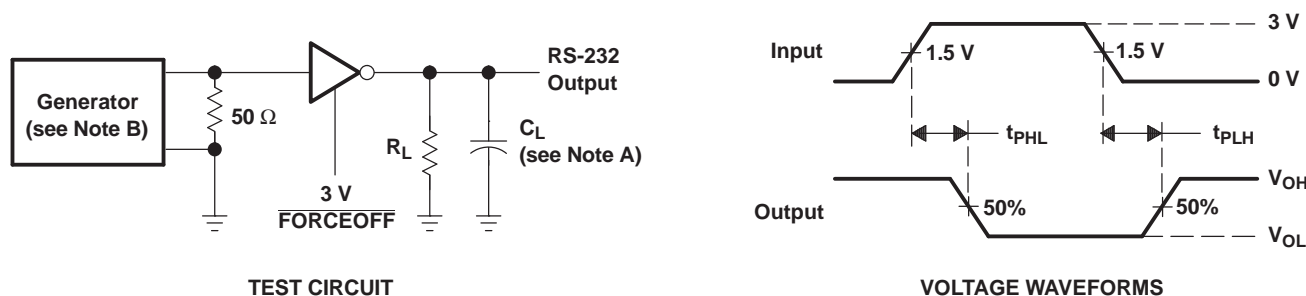
TEST CIRCUIT   **VOLTAGE WAVEFORMS**

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 ≤ 10 ns, t_f ≤ 10 ns.

Figure 2. Driver Pulse Skew
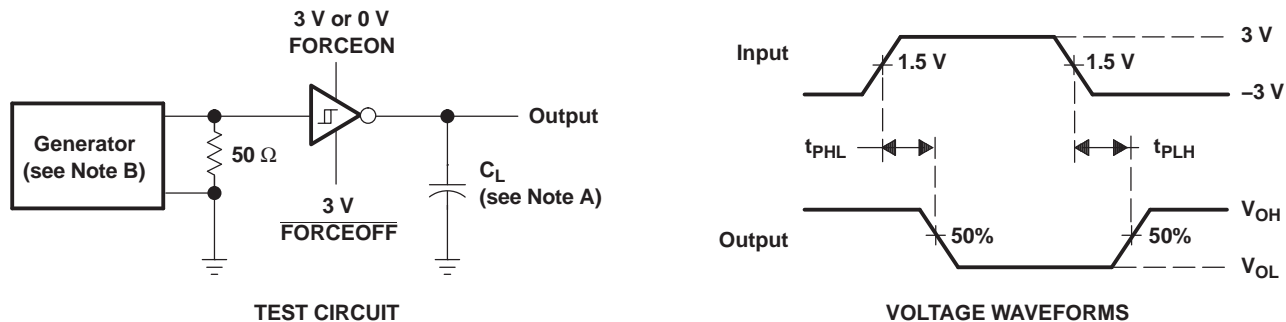
TEST CIRCUIT   **VOLTAGE WAVEFORMS**

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 ≤ 10 ns, t_f ≤ 10 ns.

Figure 3. Receiver Propagation Delay Times

PARAMETER MEASUREMENT INFORMATION
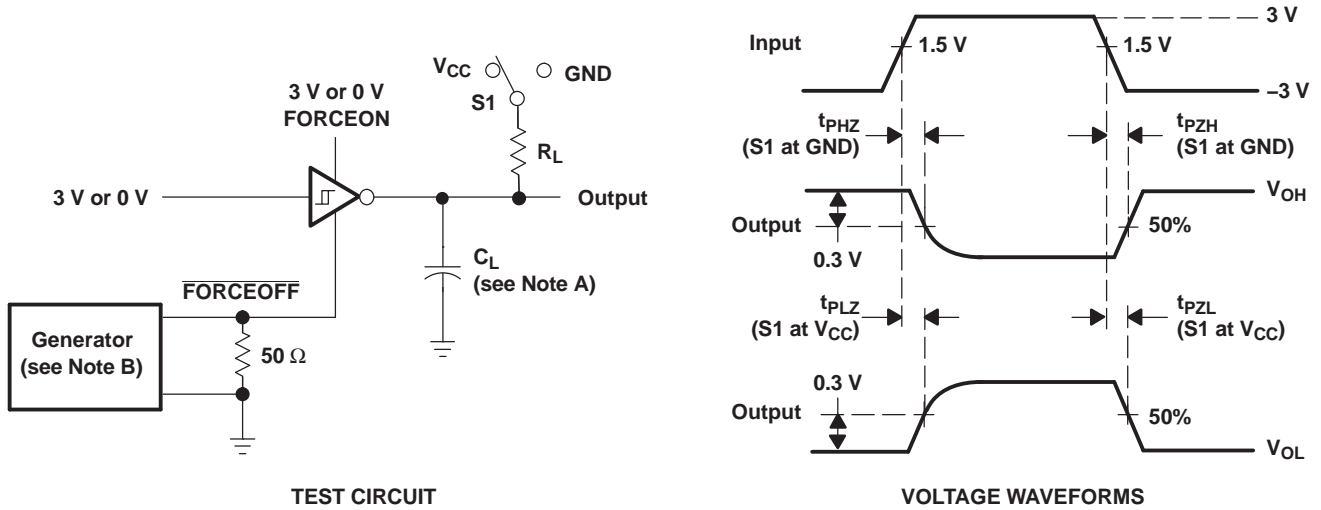
TEST CIRCUIT

VOLTAGE WAVEFORMS

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

Product Folder Link(s): *MAX3243E*

PARAMETER MEASUREMENT INFORMATION

TEST CIRCUIT

VOLTAGE WAVEFORMS

† 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_O = 50 Ω, 50% duty cycle, t_r ≤ 10 ns, t_f ≤ 10 ns.

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

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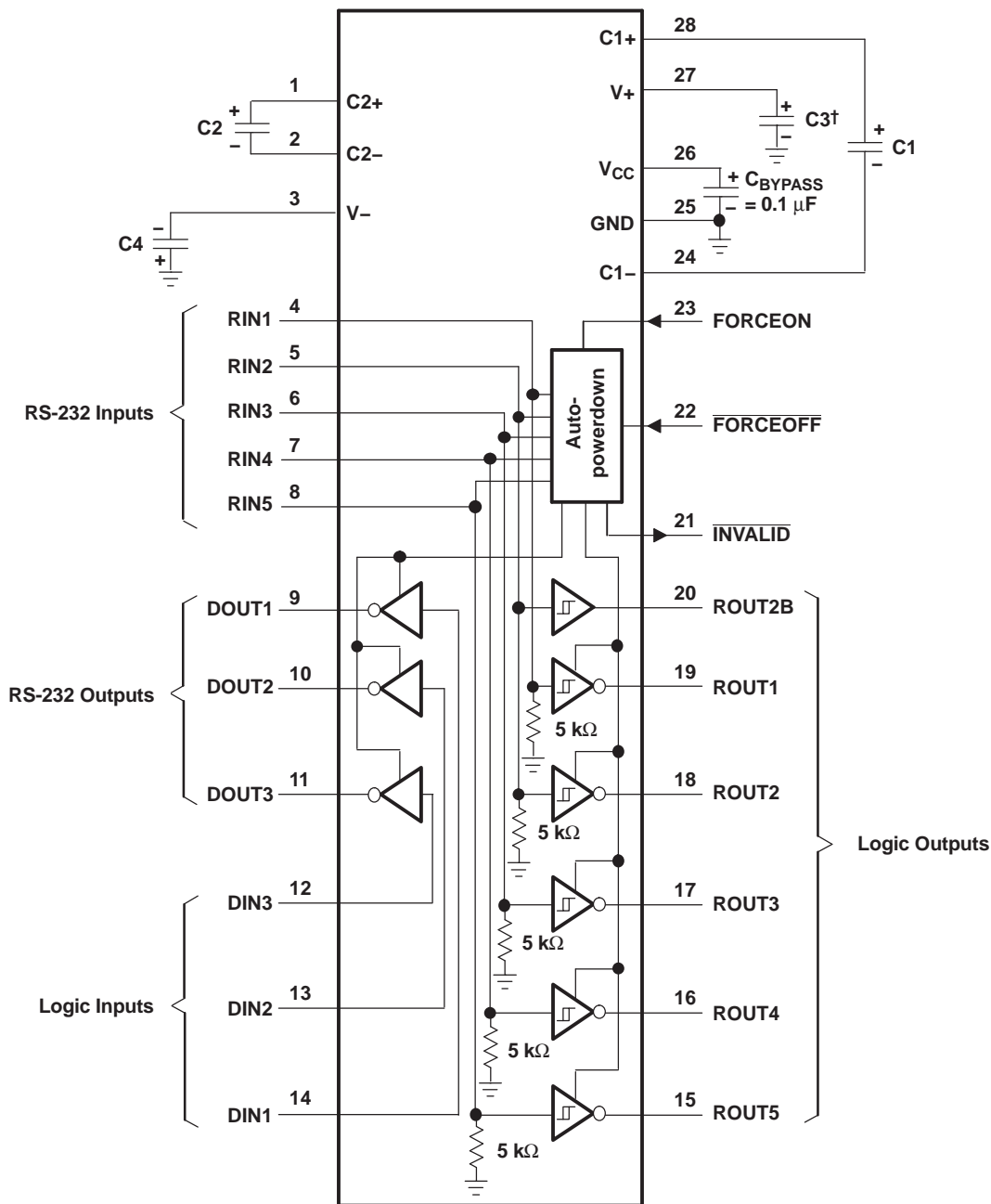
† C3 can be connected to V_{CC} or GND.

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

Product Folder Link(s): *MAX3243E*

APPLICATION INFORMATION

ESD Protection

TI MAX3243E devices have standard ESD protection structures incorporated on the pins to protect against electrostatic discharges encountered during assembly and handling. In addition, the RS232 bus pins (driver outputs and receiver inputs) of these devices have an extra level of ESD protection. Advanced ESD structures were designed to successfully protect these bus pins against ESD discharge of ±15-kV in all states: normal operation, shutdown, and powered down. The MAX3243E devices are designed to continue functioning properly after an ESD occurrence without any latchup.

The MAX3243E devices have three specified ESD limits on the driver outputs and receiver inputs, with respect to GND:

- ±15-kV Human Body Model (HBM)
- ±15-kV IEC61000-4-2, Air-Gap Discharge (formerly IEC1000-4-2)
- ±8-kV IEC61000-4-2, Contact Discharge

ESD Test Conditions

ESD testing is stringently performed by TI, based on various conditions and procedures. Please contact TI for a reliability report that documents test setup, methodology, and results.

Human Body Model (HBM)

The Human Body Model of ESD testing is shown in Figure 7, while Figure 8 shows the current waveform that is generated during a discharge into a low impedance. The model consists of a 100-pF capacitor, charged to the ESD voltage of concern, and subsequently discharged into the DUT through a 1.5k-Ω resistor.
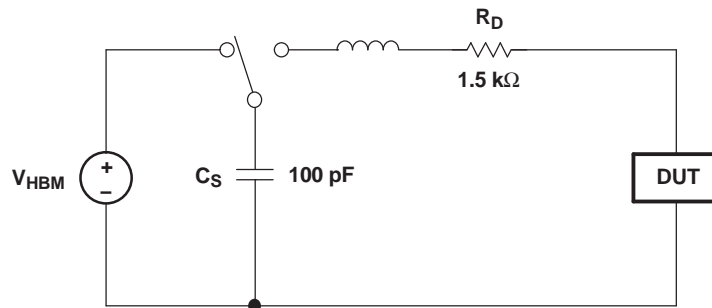
Figure 7. HBM ESD Test Circuit

Submit Documentation Feedback

Product Folder Link(s): *MAX3243E*

APPLICATION INFORMATION
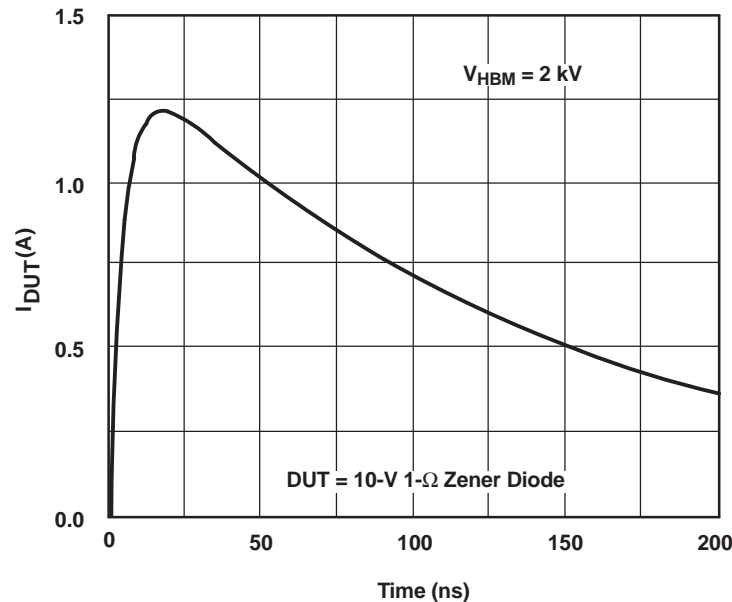
Figure 8. Typical HBM Current Waveform

IEC61000-4-2 (Formerly Known as IEC1000-4-2)

Unlike the HBM, MM, and CDM ESD tests that apply to component level integrated circuits, the IEC61000-4-2 is a system-level ESD testing and performance standard that pertains to the end equipment. The MAX3243E is designed to enable the manufacturer in meeting the highest level (Level 4) of IEC61000-4-2 ESD protection with no further need of external ESD protection circuitry. The more stringent IEC test standard has a higher peak current than the HBM, due to the lower series resistance in the IEC model.

Figure 9 shows the IEC61000-4-2 model, and Figure 10 shows the current waveform for the corresponding ±8-kV Contact-Discharge (Level 4) test. This waveform is applied to a probe that has been connected to the DUT. On the other hand, the corresponding ±15-kV (Level 4) Air-Gap Discharge test involves approaching the DUT with an already energized probe.
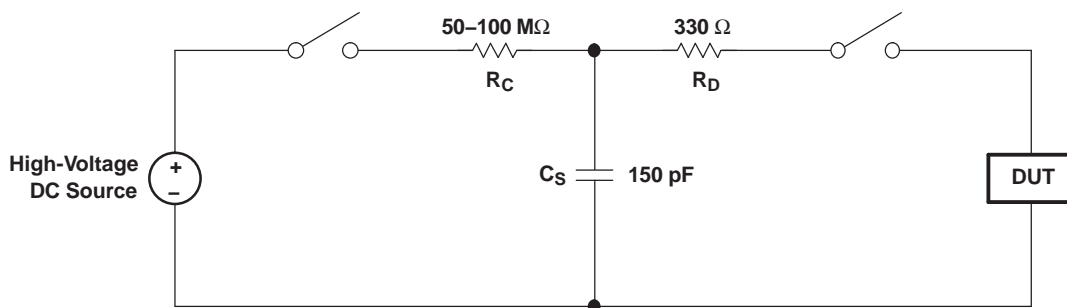
Figure 9. Simplified IEC61000-4-2 ESD Test Circuit

Product Folder Link(s): *MAX3243E*

APPLICATION INFORMATION
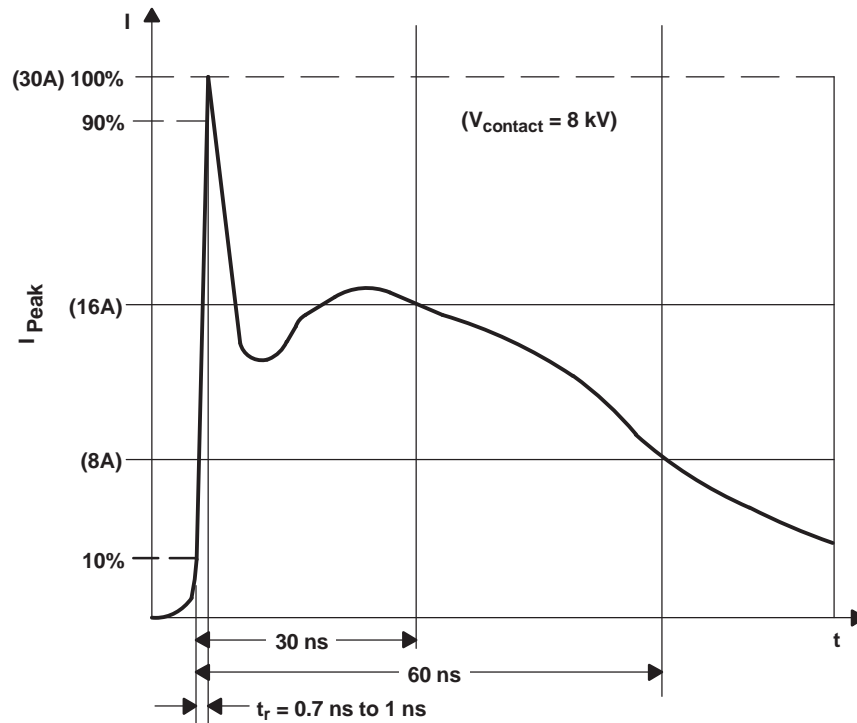
Figure 10. Typical Current Waveform of IEC61000-4-2 ESD Generator

Machine Model

The Machine Model (MM) ESD test applies to all pins using a 200-pF capacitor with no discharge resistance. The purpose of the MM test is to simulate possible ESD conditions that can occur during the handling and assembly processes of manufacturing. In this case, ESD protection is required for all pins, not just RS-232 pins. However, after PC board assembly, the MM test is no longer as pertinent to the RS-232 pins.

REVISION HISTORY

Product Folder Link(s): *MAX3243E*

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
MAX3243ECDB	ACTIVE	SSOP	DB	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3243EC	Samples
MAX3243ECDBE4	ACTIVE	SSOP	DB	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3243EC	Samples
MAX3243ECDBG4	ACTIVE	SSOP	DB	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3243EC	Samples
MAX3243ECDBR	ACTIVE	SSOP	DB	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3243EC	Samples
MAX3243ECDBRE4	ACTIVE	SSOP	DB	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3243EC	Samples
MAX3243ECDW	ACTIVE	SOIC	DW	28	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3243EC	Samples
MAX3243ECDWR	ACTIVE	SOIC	DW	28	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	MAX3243EC	Samples
MAX3243ECPW	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	MP243EC	Samples
MAX3243ECPWE4	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	MP243EC	Samples
MAX3243ECPWG4	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	MP243EC	Samples
MAX3243ECPWR	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	MP243EC	Samples
MAX3243ECPWRE4	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	MP243EC	Samples
MAX3243ECPWRG4	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	MP243EC	Samples
MAX3243ECRHBR	ACTIVE	VQFN	RHB	32	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	0 to 70	MP243E	Samples
MAX3243EIDB	ACTIVE	SSOP	DB	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3243EI	Samples
MAX3243EIDBG4	ACTIVE	SSOP	DB	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3243EI	Samples
MAX3243EIDBR	ACTIVE	SSOP	DB	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3243EI	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
MAX3243EIDW	ACTIVE	SOIC	DW	28	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3243EI	Samples
MAX3243EIDWR	ACTIVE	SOIC	DW	28	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3243EI	Samples
MAX3243EIDWRG4	ACTIVE	SOIC	DW	28	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	MAX3243EI	Samples
MAX3243EIPW	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	MP243EI	Samples
MAX3243EIPWE4	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	MP243EI	Samples
MAX3243EIPWG4	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	MP243EI	Samples
MAX3243EIPWR	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	MP243EI	Samples
MAX3243EIPWRE4	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	MP243EI	Samples
MAX3243EIPWRG4	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	MP243EI	Samples
MAX3243EIRHBR	ACTIVE	VQFN	RHB	32	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	MR243E	Samples
MAX3243EIRHBRG4	ACTIVE	VQFN	RHB	32	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	MR243E	Samples

(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.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

![Texas Instruments logo]

PACKAGE MATERIALS INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS

TAPE DIMENSIONS

A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
MAX3243ECDWR	SOIC	DW	28	1000	330.0	32.4	11.35	18.67	3.1	16.0	32.0	Q1
MAX3243ECPWR	TSSOP	PW	28	2000	330.0	16.4	6.9	10.2	1.8	12.0	16.0	Q1
MAX3243ECRHBR	VQFN	RHB	32	3000	330.0	12.4	5.3	5.3	1.5	8.0	12.0	Q2
MAX3243EIDWR	SOIC	DW	28	1000	330.0	32.4	11.35	18.67	3.1	16.0	32.0	Q1
MAX3243EIPWR	TSSOP	PW	28	2000	330.0	16.4	6.9	10.2	1.8	12.0	16.0	Q1
MAX3243EIPWR	TSSOP	PW	28	2000	330.0	16.4	6.9	10.2	1.8	12.0	16.0	Q1
MAX3243EIRHBR	VQFN	RHB	32	3000	330.0	12.4	5.3	5.3	1.5	8.0	12.0	Q2

TAPE AND REEL BOX DIMENSIONS

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
MAX3243ECDWR	SOIC	DW	28	1000	367.0	367.0	55.0
MAX3243ECPWR	TSSOP	PW	28	2000	367.0	367.0	38.0
MAX3243ECRHBR	VQFN	RHB	32	3000	367.0	367.0	35.0
MAX3243EIDWR	SOIC	DW	28	1000	367.0	367.0	55.0
MAX3243EIPWR	TSSOP	PW	28	2000	367.0	367.0	38.0
MAX3243EIPWR	TSSOP	PW	28	2000	367.0	367.0	38.0
MAX3243EIRHBR	VQFN	RHB	32	3000	367.0	367.0	35.0

DW (R−PDSO−G28)   PLASTIC SMALL OUTLINE

0.713 (18,10)
0.697 (17,70)

28   15

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

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

1   14

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)
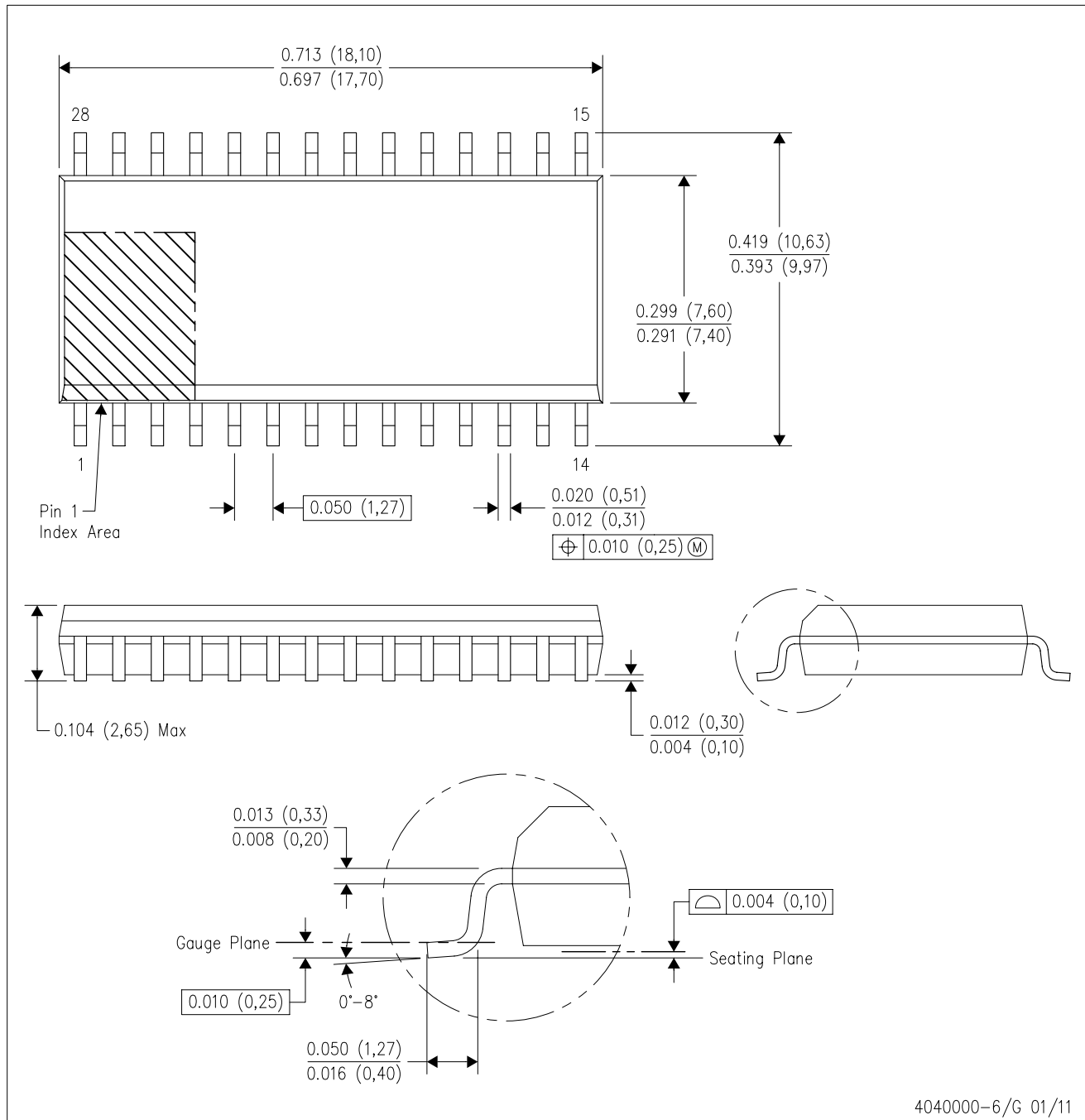
4040000−6/G 01/11

NOTES: A.   All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M−1994.
         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 AE.

PW (R−PDSO−G28)   PLASTIC SMALL OUTLINE

0,65

0,30
0,19

⊕ 0,10 Ⓜ

28   15

1   14

4,50
4,30

6,60
6,20

9,80
9,60

Ⓒ

Ⓓ

0,15 NOM

Gage Plane

0°−8°

0,25

0,75
0,50

1,20 MAX

0,15
0,05

Seating Plane

⌓ 0,10
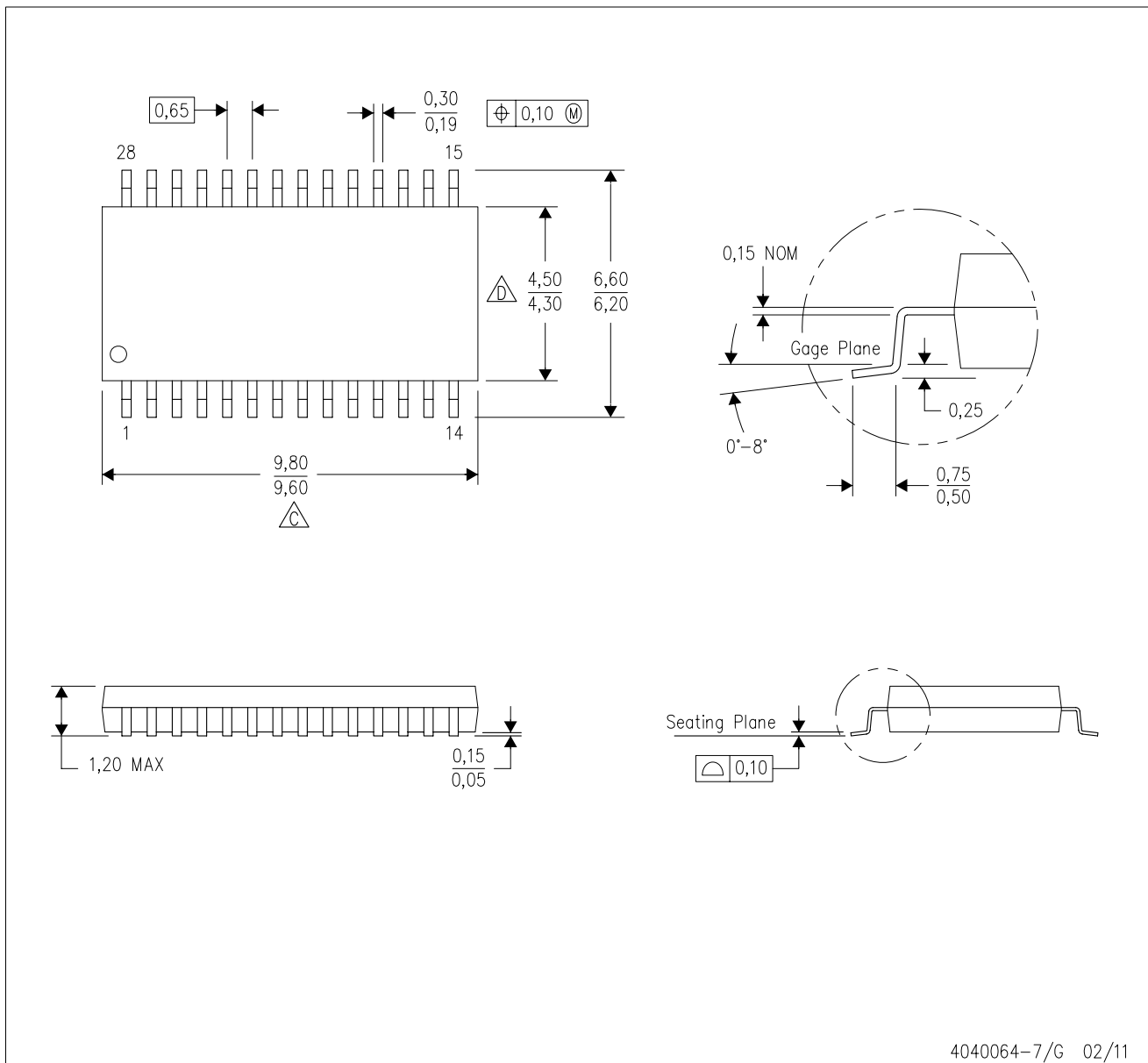
4040064−7/G 02/11

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−G28)   PLASTIC SMALL OUTLINE
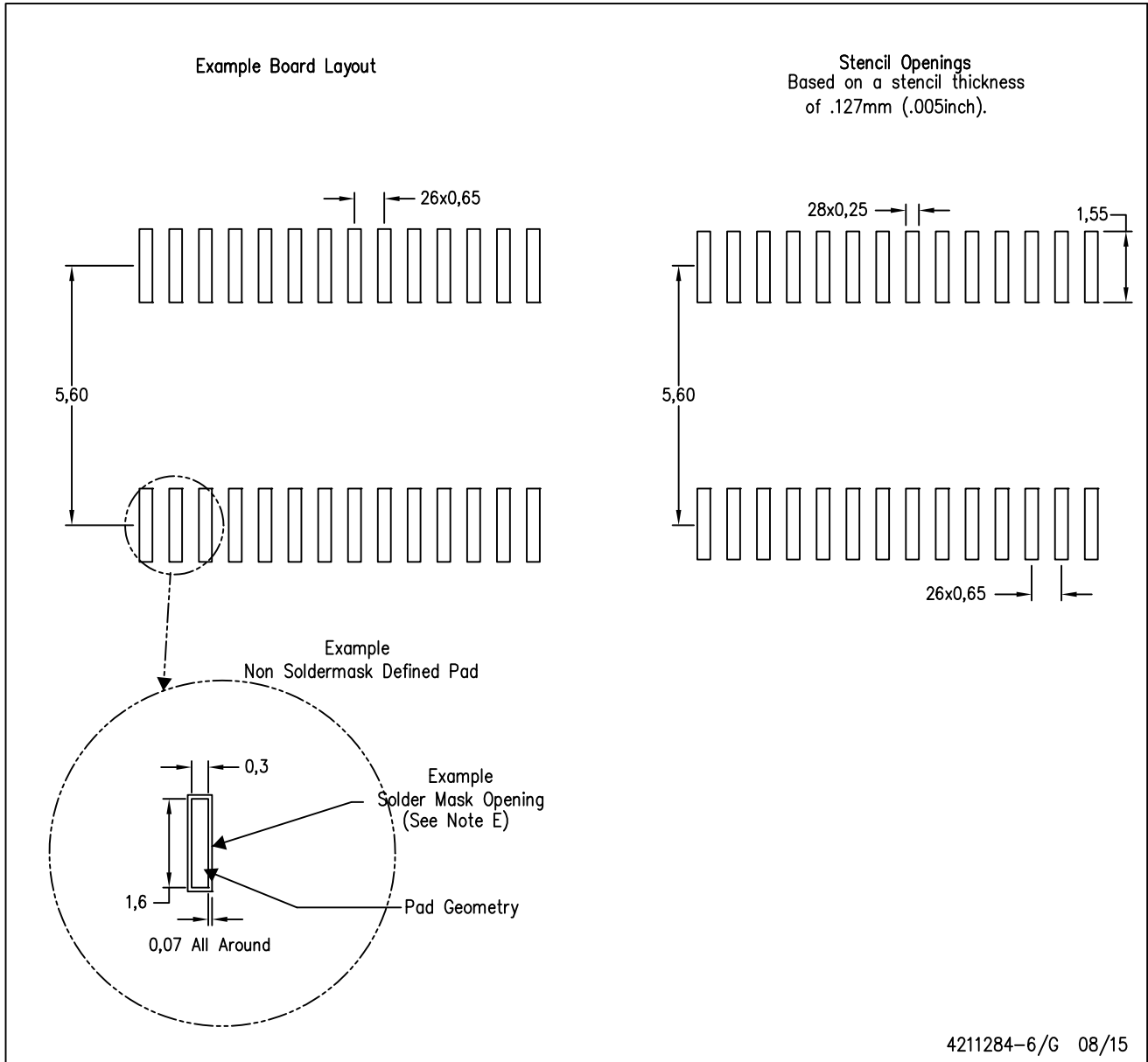
Example Board Layout

Stencil Openings
Based on a stencil thickness
of .127mm (.005inch).

26x0,65

28x0,25   1,55

5,60

5,60

26x0,65

Example
Non Soldermask Defined Pad

0,3

Example
Solder Mask Opening
(See Note E)

1,6

Pad Geometry

0,07 All Around

4211284−6/G   08/15

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 design.
         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

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

RHB (S−PVQFN−N32)   PLASTIC QUAD FLATPACK NO−LEAD

Bottom View
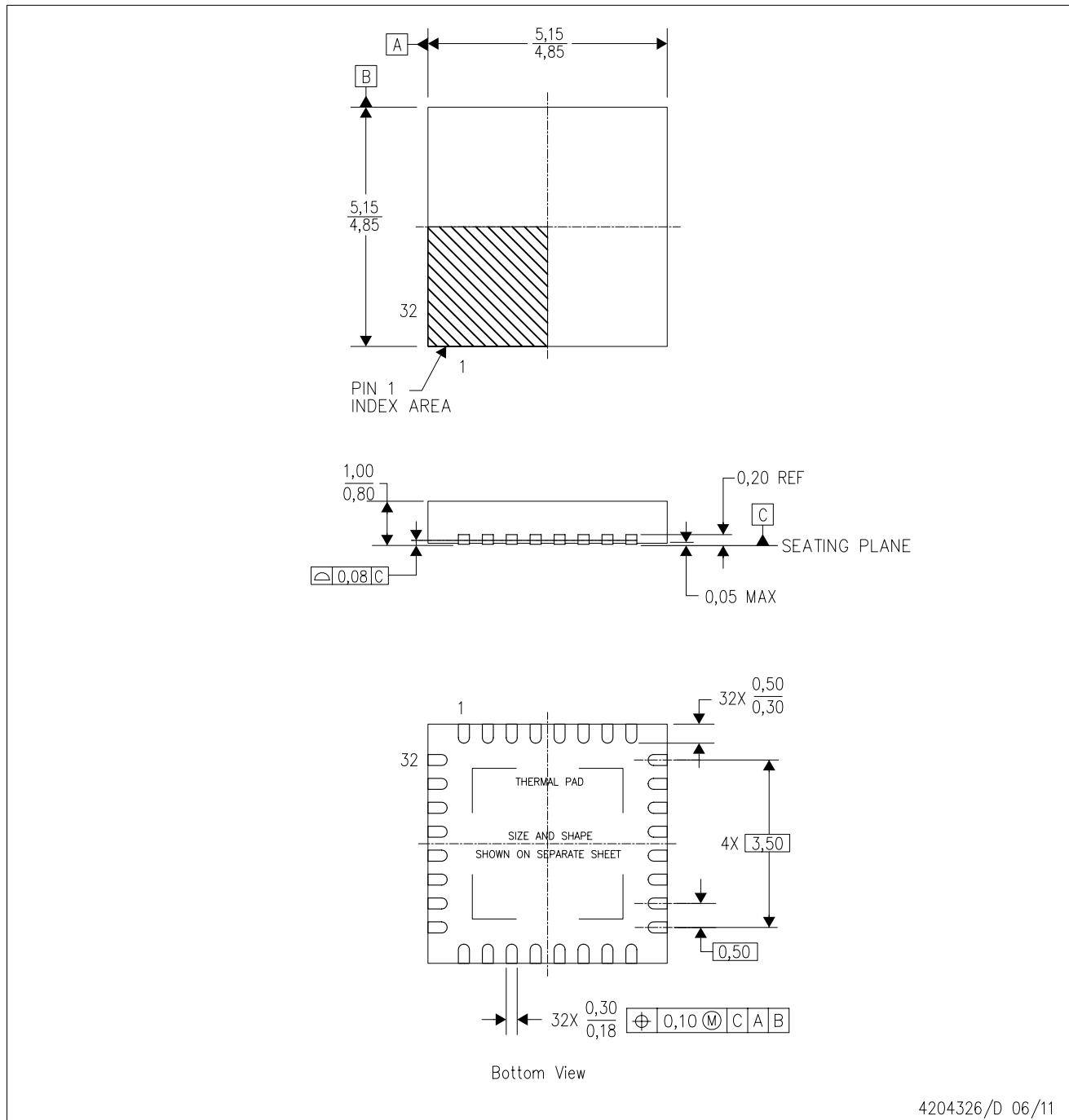
4204326/D 06/11

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.
        C. QFN (Quad Flatpack No−Lead) Package configuration.
        D. The package thermal pad must be soldered to the board for thermal and mechanical performance.
        E. See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
        F. Falls within JEDEC MO−220.

RHB (S—PVQFN—N32)   PLASTIC QUAD FLATPACK NO—LEAD

THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No—Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at www.ti.com.

The exposed thermal pad dimensions for this package are shown in the following illustration.

PIN 1 INDICATOR
(OPTIONAL)

Exposed Thermal Pad

3,45±0,10

3,45±0,10
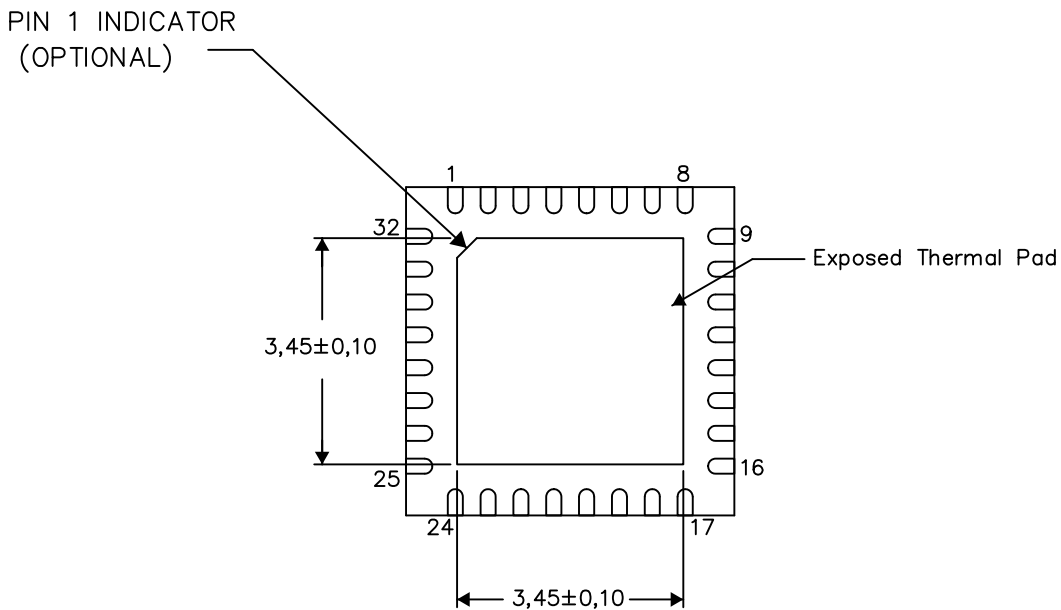
Bottom View

Exposed Thermal Pad Dimensions

4206356—2/AC 05/15

NOTE: A. All linear dimensions are in millimeters

RHB (S–PVQFN–N32)   PLASTIC QUAD FLATPACK NO–LEAD
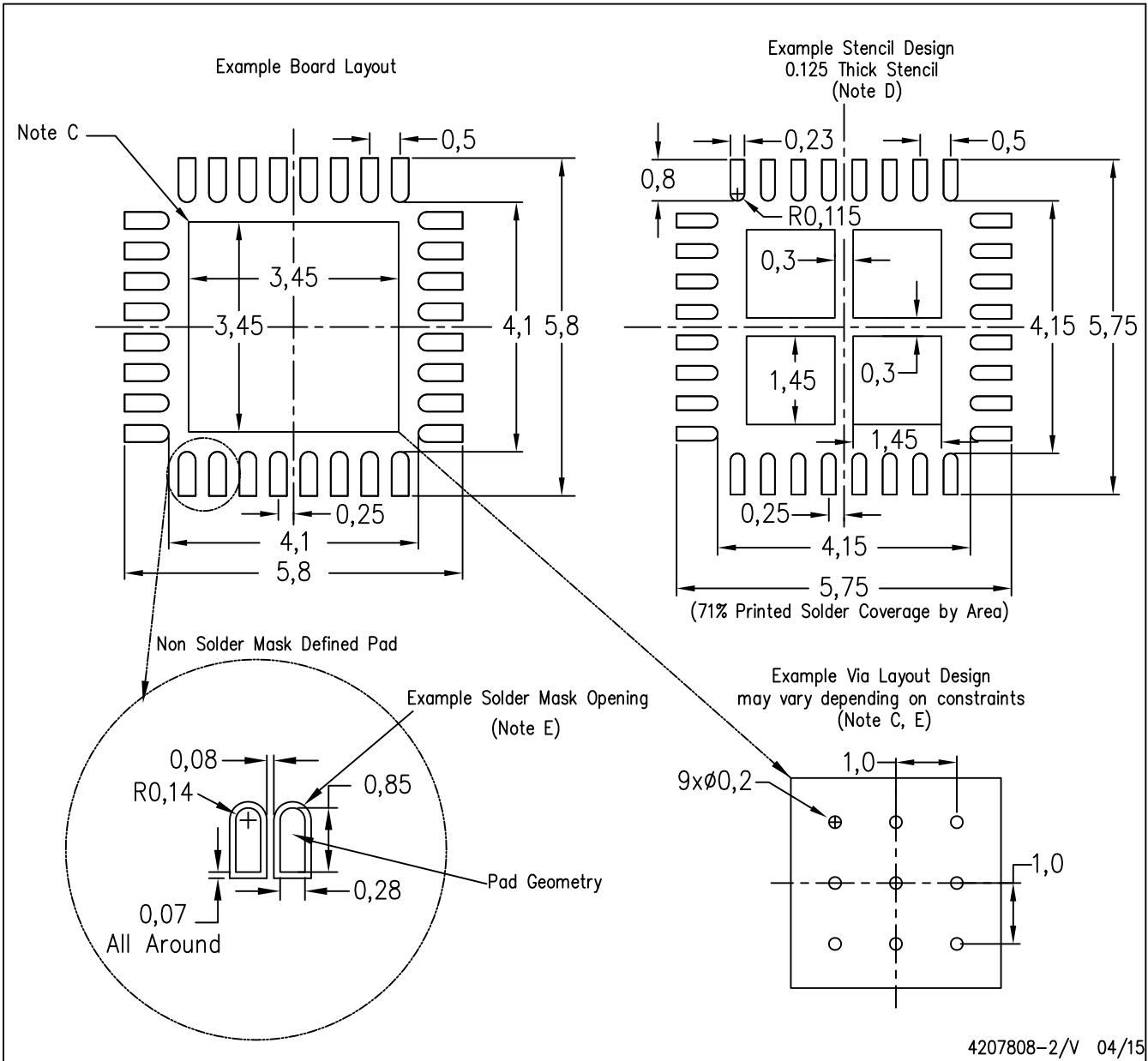
Example Board Layout

Note C

0,5

3,45

3,45

4,1 5,8

0,25

4,1

5,8

Non Solder Mask Defined Pad

Example Solder Mask Opening
(Note E)

0,08

R0,14

0,85

0,07

0,28

All Around

Pad Geometry

Example Stencil Design
0.125 Thick Stencil
(Note D)

0,23

0,5

0,8

R0,115

0,3

1,45

0,3

1,45

4,15 5,75

0,25

4,15

5,75

(71% Printed Solder Coverage by Area)

Example Via Layout Design
may vary depending on constraints
(Note C, E)

1,0

9x∅0,2

1,0

4207808–2/V 04/15

NOTES: A. All linear dimensions are in millimeters.
         B. This drawing is subject to change without notice.
         C. This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, Quad Flat–Pack
             Packages, Texas Instruments Literature No. SLUA271, and also the Product Data Sheets
             for specific thermal information, via requirements, and recommended board layout. These documents are available at
             www.ti.com <http://www.ti.com>.
         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 stencil design considerations.
         E. Customers should contact their board fabrication site for recommended solder mask tolerances and via tenting
             recommendations for any larger diameter vias placed in the thermal pad.

IMPORTANT NOTICE

Products		Applications	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		