

FEATURES

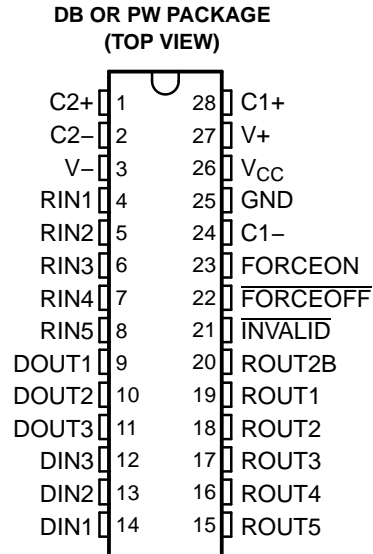
- **Controlled Baseline**
 - One Assembly/Test Site, One Fabrication Site
- **Extended Temperature Performance of -55°C to 125°C**
- **Enhanced Diminishing Manufacturing Sources (DMS) Support**
- **Enhanced Product-Change Notification**
- **Qualification Pedigree ⁽¹⁾**
- **Single-Chip and Single-Supply Interface for IBM™ PC/AT™ Serial Port**
- **RS-232 Bus-Pin ESD Protection Exceeds ± 15 kV Using Human-Body Model (HBM)**
- **D 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**
- **Three Drivers and Five Receivers**
- **Low Standby Current . . . 1 mA Typical**
- **External Capacitors . . . 4×0.1 mF**
- **Accepts 5-V Logic Input With 3.3-V Supply**
- **Always-Active Noninverting Receiver Output (ROUT2B)**
- **Serial-Mouse Driveability**
- **Auto-Powerdown Feature to Disable Driver Outputs When No Valid RS-232 Signal Is Sensed**

(1) Component qualification in accordance with JEDEC and industry standards to ensure reliable operation over an extended temperature range. This includes, but is not limited to, Highly Accelerated Stress Test (HAST) or biased 85/85, temperature cycle, autoclave or unbiased HAST, electromigration, bond intermetallic life, and mold compound life. Such qualification testing should not be viewed as justifying use of this component beyond specified performance and environmental limits.

DESCRIPTION

The MAX3243 consists of three line drivers, five line receivers, and a dual charge-pump circuit with ± 15 -kV ESD (HBM) 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. 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.

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



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MAX3243-EP
3-V TO 5.5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER
WITH ±15-kV ESD (HBM) PROTECTION



SGLS328A—MARCH 2006—REVISED MAY 2006

Flexible control options for power management are available when the serial port is inactive. The auto-powerdown feature functions when FORCEON is low and FORCEOFF is high. During this mode of operation, if the device does not sense a valid RS-232 signal, the driver outputs are disabled. If 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 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. 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. INVALID is low (invalid data) if all receiver input voltages are between -0.3 V and 0.3 V for more than 30 µs. See Figure 5 for receiver input levels.

ORDERING INFORMATION

T _A	PACKAGE ⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-55°C to 125°C	SSOP – DB	Reel of 2000	MAX3243MDBREP	MB3243M
	TSSOP – PW	Reel of 2000	MAX3243MPWREP	MB3243M

(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	DRIVER STATUS
DIN	FORCEON	FORCEOFF	VALID RIN RS-232 LEVEL		
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	
L	L	H	NO	Z	Power off by auto-powerdown feature
H	L	H	NO	Z	

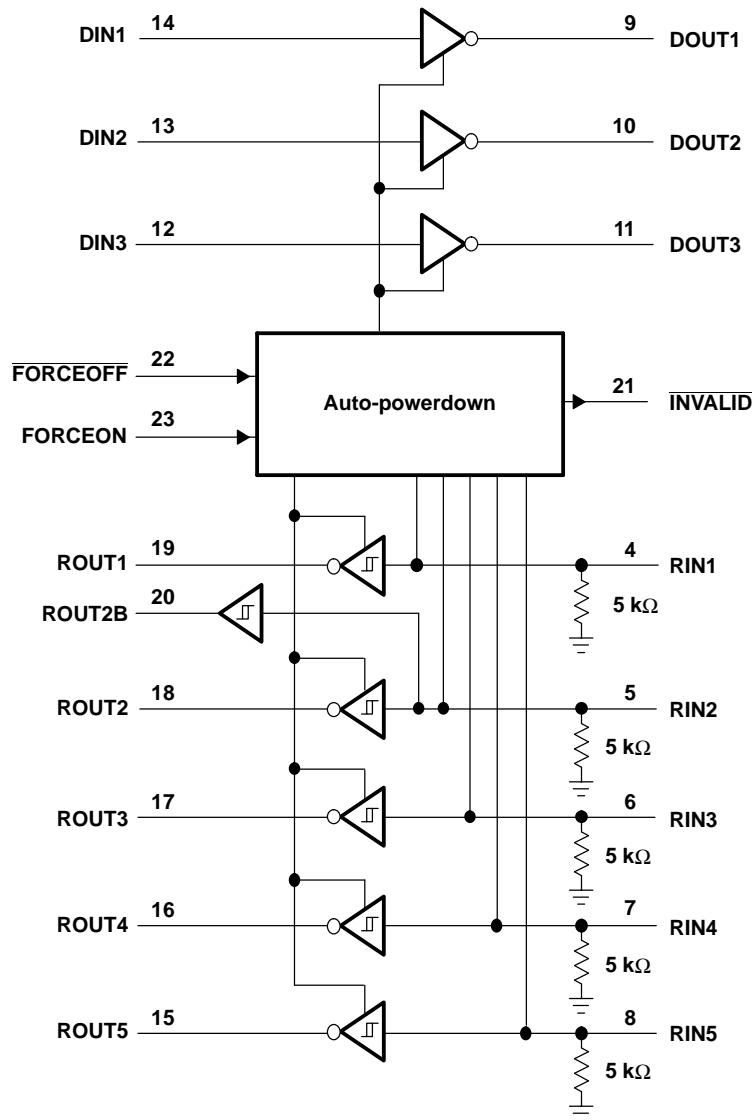
(1) H = high level, L = low level, X = irrelevant, Z = high impedance

Each Receiver⁽¹⁾

INPUTS				OUTPUTS		RECEIVER STATUS
RIN2	RIN1, RIN3–RIN5	FORCEOFF	VALID RIN RS-232 LEVEL	ROUT2B	ROUT	
L	X	L	X	L	Z	Powered off while ROUT2B is active
H	X	L	X	H	Z	
L	L	H	YES	L	H	Normal operation with auto-powerdown disabled/enabled
L	H	H	YES	L	L	
H	L	H	YES	H	H	
H	H	H	YES	H	L	
Open	Open	H	YES	L	H	

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

LOGIC DIAGRAM (POSITIVE LOGIC)



MAX3243-EP

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

WITH ± 15 -kV ESD (HBM) PROTECTION

SGLS328A—MARCH 2006—REVISED MAY 2006

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 ($\overline{\text{FORCEOFF}}$, FORCEON)		V
		Receiver		
V _O	Output voltage range	Driver		V
		Receiver (INVALID)		
θ_{JA}	Package thermal impedance ⁽³⁾⁽⁴⁾	DB package		°C/W
		DW package		
		PW package		
T _J	Operating virtual junction temperature		150	°C
T _{stg}	Storage temperature range	-65	150	°C

- Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- All voltages are with respect to network GND.
- 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)/ θ_{JA} . Operating at the absolute maximum T_J of 150°C can affect reliability.
- The package thermal impedance is calculated in accordance with JESD 51-7.

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		-55	125		°C

- 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.

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	μ A
I _{CC}	Supply current (T _A = 25°C)	Auto-powerdown disabled	No load, $\overline{\text{FORCEOFF}}$ and FORCEON at V _{CC}	0.3	2	mA
		Powered off	No load, $\overline{\text{FORCEOFF}}$ at GND	1	10	
		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	20

- 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.
- 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.

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 k Ω to GND	5	5.4		V
V _{OL}	Low-level output voltage All DOUT at R _L = 3 k Ω to GND	-5	-5.4		V
V _O	Output voltage (mouse driveability) DIN1 = DIN2 = GND, DIN3 = V _{CC} , 3-k Ω to GND at DOUT3, DOUT1 = DOUT2 = 2.5 mA	± 5			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
V _{hys}	Input hysteresis			± 1	V
I _{OS}	Short-circuit output current ⁽³⁾ V _{CC} = 3.6 V, V _O = 0 V		± 35	± 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 FORCEOFF = GND,	V _O = ± 12 V, V _{CC} = 3 to 3.6 V		± 25	μ A
		V _O = ± 10 V, V _{CC} = 4.5 to 5.5 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 6)

PARAMETER	TEST CONDITIONS	MIN	TYP ⁽²⁾	MAX	UNIT
Maximum data rate	C _L = 1000 pF, One DOUT switching, R _L = 3 k Ω , See Figure 1	150	250		kbit/s
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		100		ns
SR _(tr)	Slew rate, transition region (see Figure 1) V _{CC} = 3.3 V, R _L = 3 k Ω to 7 k Ω	C _L = 150 pF to 1000 pF	6	30	V/ μ s
		C _L = 150 pF to 2500 pF	4	30	

(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.

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

(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.

MAX3243-EP

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

WITH ± 15 -kV ESD (HBM) PROTECTION

SGLS328A—MARCH 2006—REVISED MAY 2006

Electrical Characteristics (continued)

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_{off} Output leakage current (except ROUT2B)	FORCEOFF = 0 V		± 0.05	± 10	μA
r_i Input resistance	$V_i = \pm 3$ V or ± 25 V	3	5	8	$\text{k}\Omega$

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, $R_L = 3$ k Ω , See Figure 4	200	ns
t_{dis} Output disable time		200	ns
$t_{sk(p)}$ Pulse 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 $T_A = 25^\circ\text{C}$.

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

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 $\overline{\text{INVALID}}$ high-level output voltage	FORCEON = GND, FORCEOFF = V_{CC}		2.7	V
$V_{IT-(valid)}$ Receiver input threshold for $\overline{\text{INVALID}}$ high-level output voltage	FORCEON = GND, FORCEOFF = V_{CC}	-2.7		V
$V_{T(invalid)}$ Receiver input threshold for $\overline{\text{INVALID}}$ low-level output voltage	FORCEON = GND, FORCEOFF = V_{CC}	-0.3	0.3	V
V_{OH} $\overline{\text{INVALID}}$ high-level output voltage	$I_{OH} = -1$ mA, FORCEON = GND, FORCEOFF = V_{CC}	$V_{CC} - 0.6$		V
V_{OL} $\overline{\text{INVALID}}$ low-level output voltage	$I_{OL} = 1.6$ mA, FORCEON = GND, FORCEOFF = V_{CC}		0.4	V

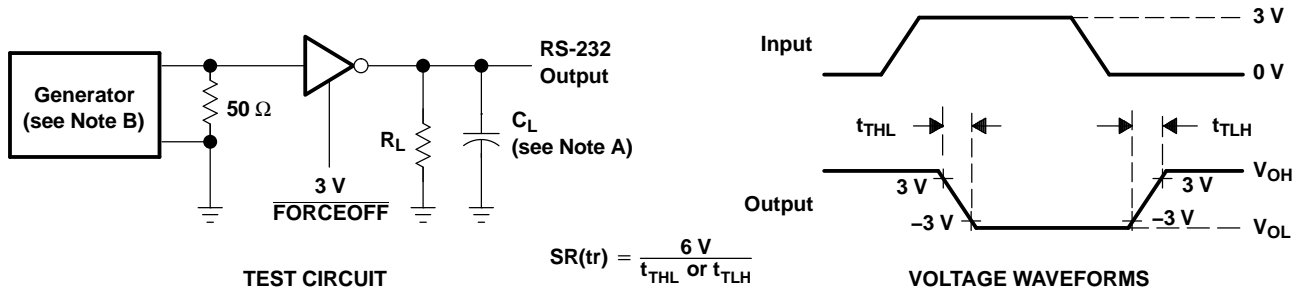
Switching Characteristics

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

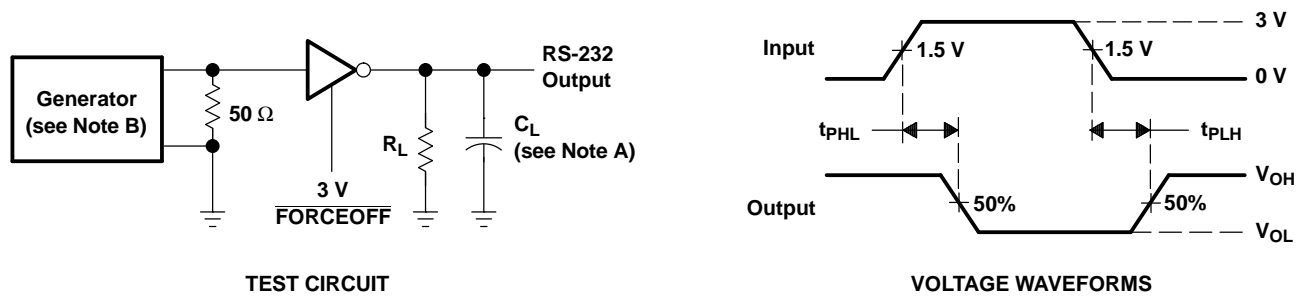
(1) All typical values are at $V_{CC} = 3.3$ V or $V_{CC} = 5$ V and $T_A = 25^\circ\text{C}$.

PARAMETER MEASUREMENT INFORMATION



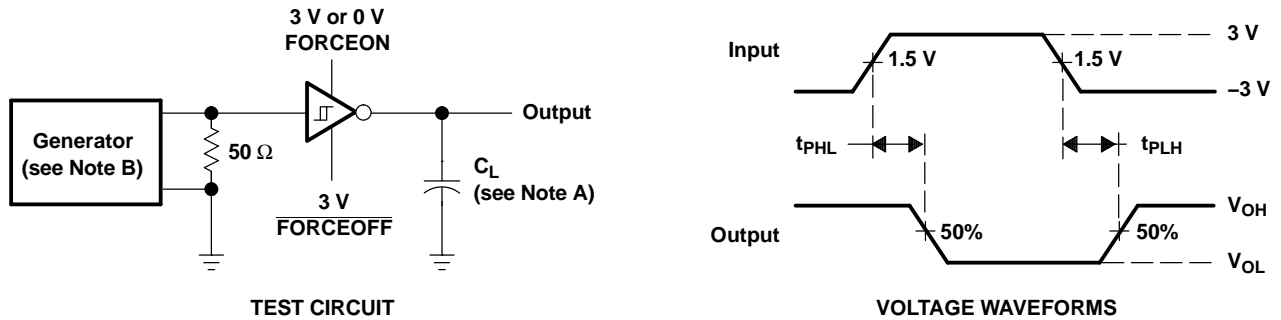
NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: PRR = 250 kbit/s

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

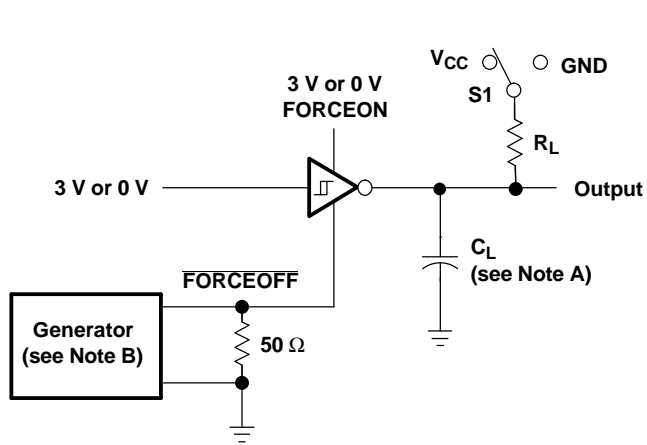
Figure 2. Driver Pulse Skew



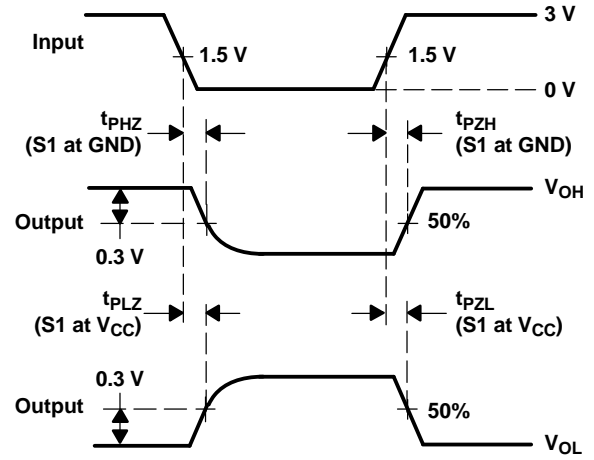
NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: $Z_O = 50\ \Omega$, 50% duty cycle, $t_r \leq 10\text{ ns}$, $t_f \leq 10\text{ ns}$.

Figure 3. Receiver Propagation Delay Times

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT

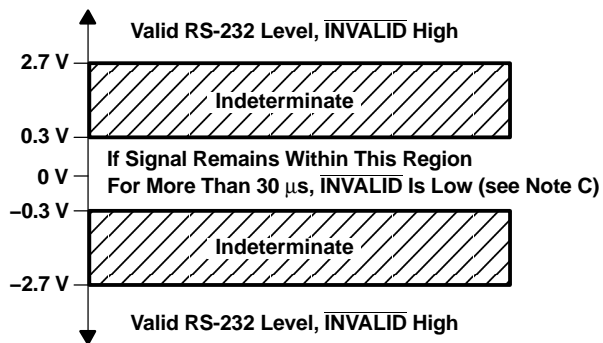
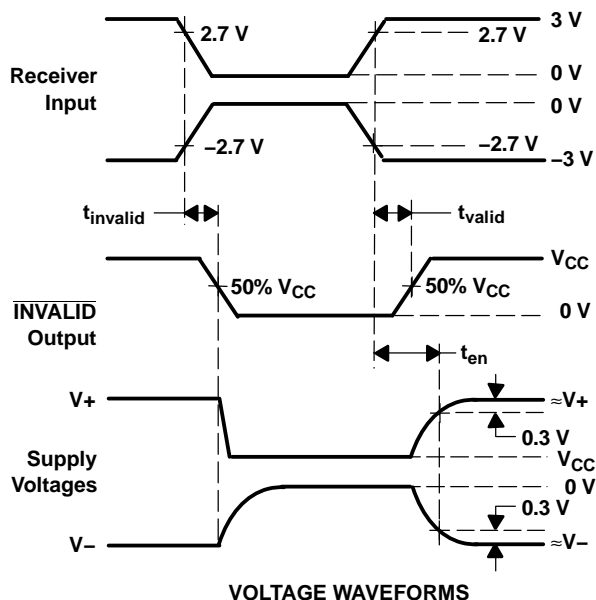
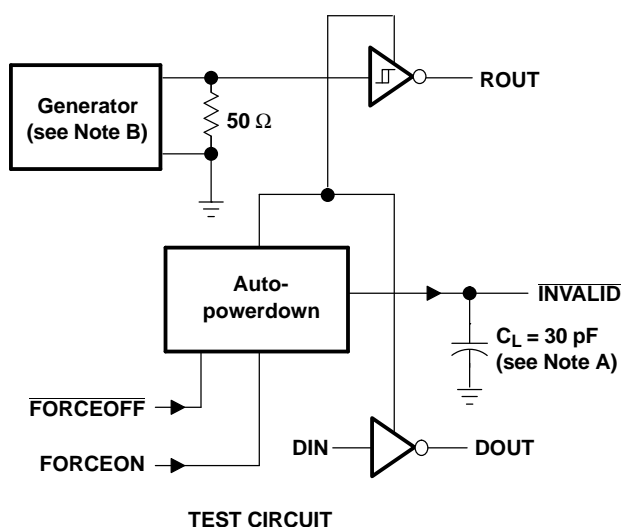


VOLTAGE WAVEFORMS

- 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.
C. t_{PLZ} and t_{PHZ} are the same as t_{dis}.
D. t_{PZL} and t_{PZH} are the same as t_{en}.

Figure 4. Receiver Enable and Disable Times

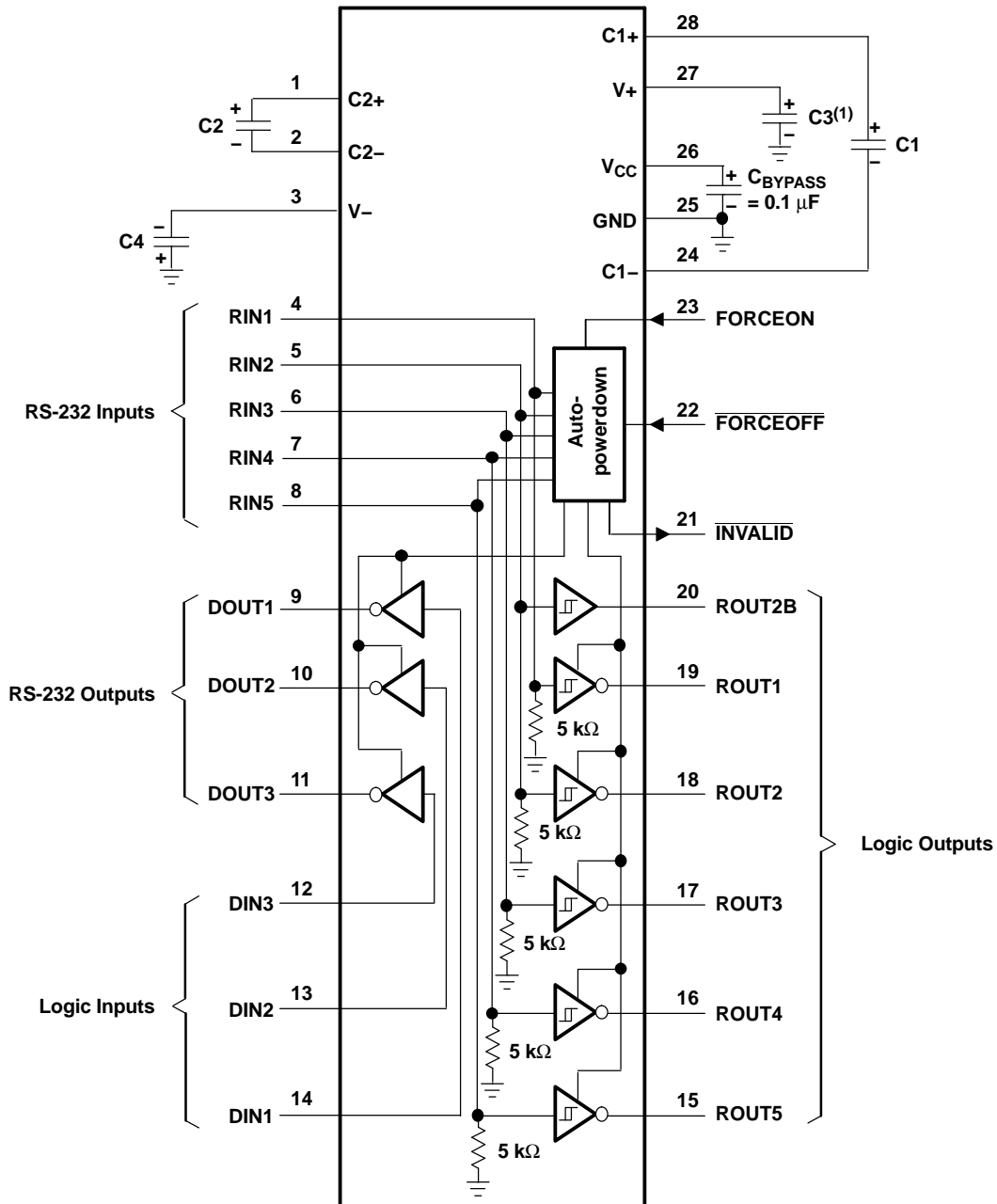
PARAMETER MEASUREMENT INFORMATION



- NOTES: A. C_L includes probe and jig capacitance.
 B. The pulse generator has the following characteristics: PRR = 5 kbit/s, $Z_O = 50 \Omega$, 50% duty cycle, $t_r \leq 10$ ns, $t_f \leq 10$ ns.
 C. Auto-powerdown disables drivers and reduces supply current to 1 μA .

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

APPLICATION INFORMATION



(1) 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 \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 6. Typical Operating Circuit and Capacitor Values

TAPE AND REEL INFORMATION

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
MAX3243MDBREP	SSOP	DB	28	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
MAX3243MPWREP	TSSOP	PW	28	2000	330.0	16.4	6.9	10.2	1.8	12.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

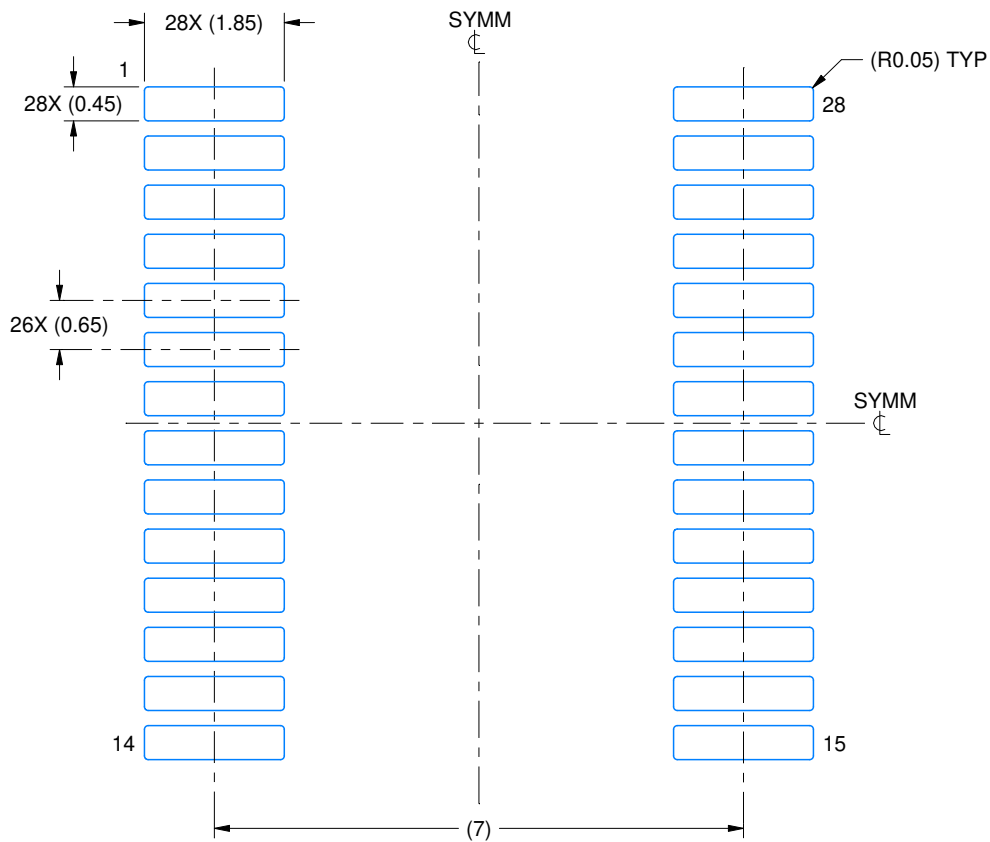
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
MAX3243MDBREP	SSOP	DB	28	2000	356.0	356.0	35.0
MAX3243MPWREP	TSSOP	PW	28	2000	356.0	356.0	35.0

EXAMPLE BOARD LAYOUT

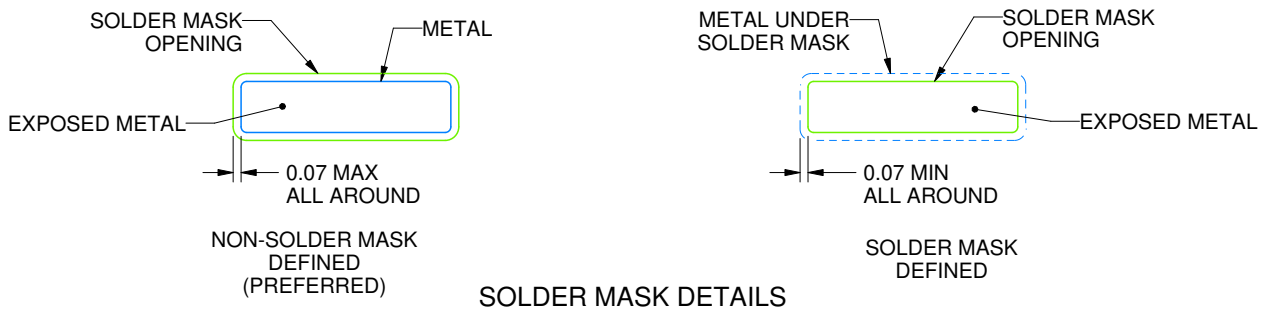
DB0028A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



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NOTES: (continued)

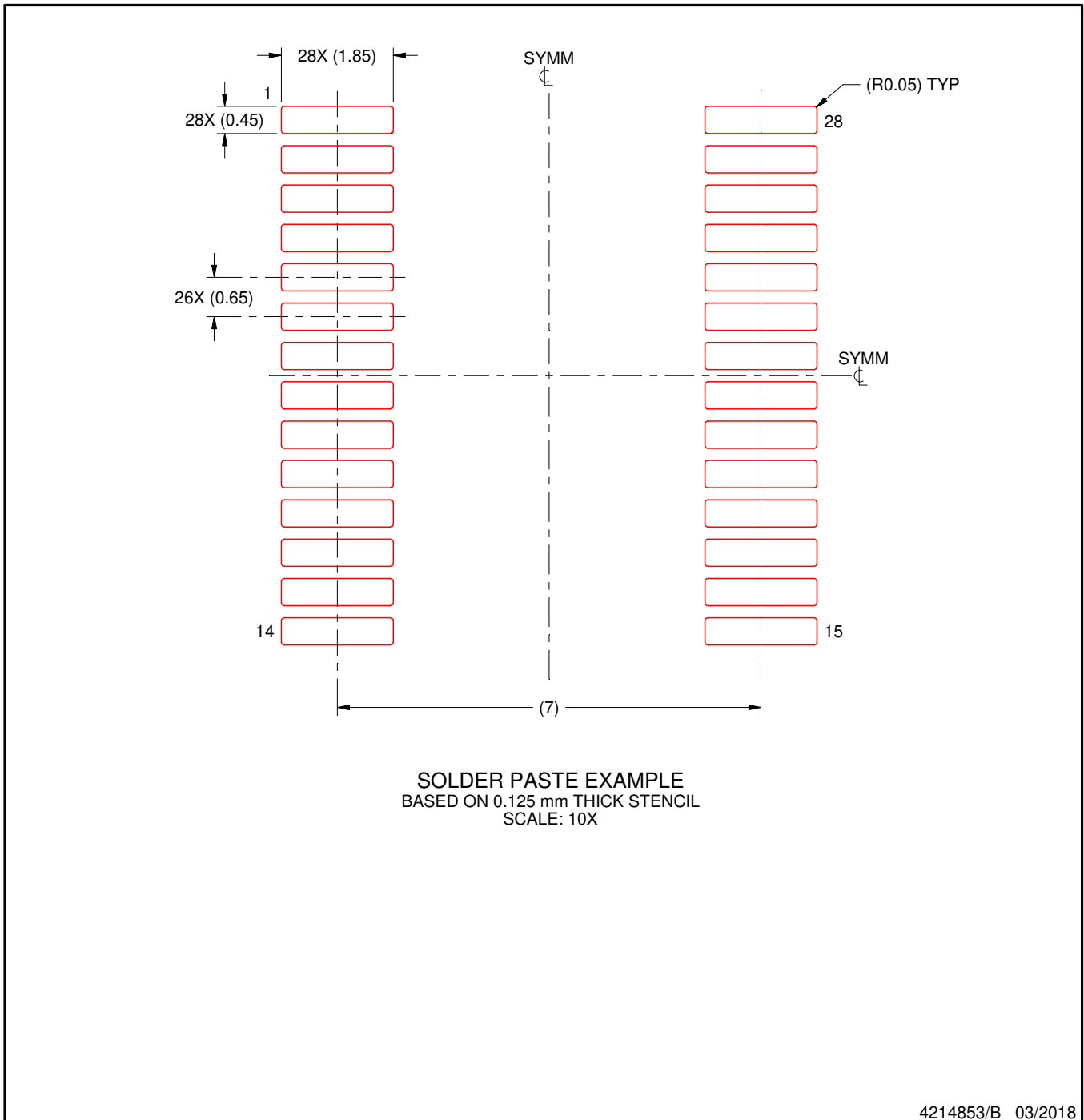
- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DB0028A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE

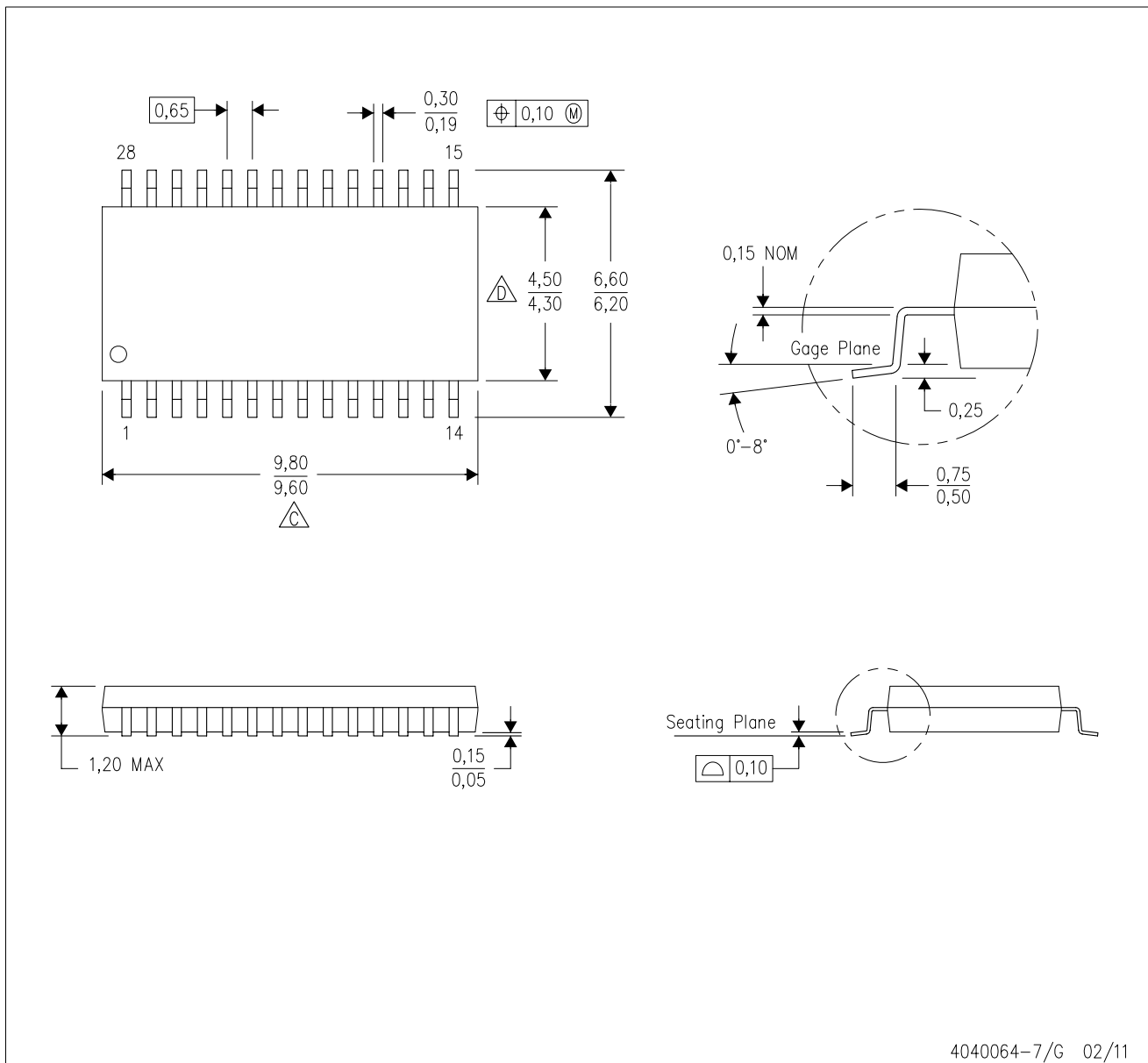


NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

PW (R-PDSO-G28)

PLASTIC SMALL OUTLINE

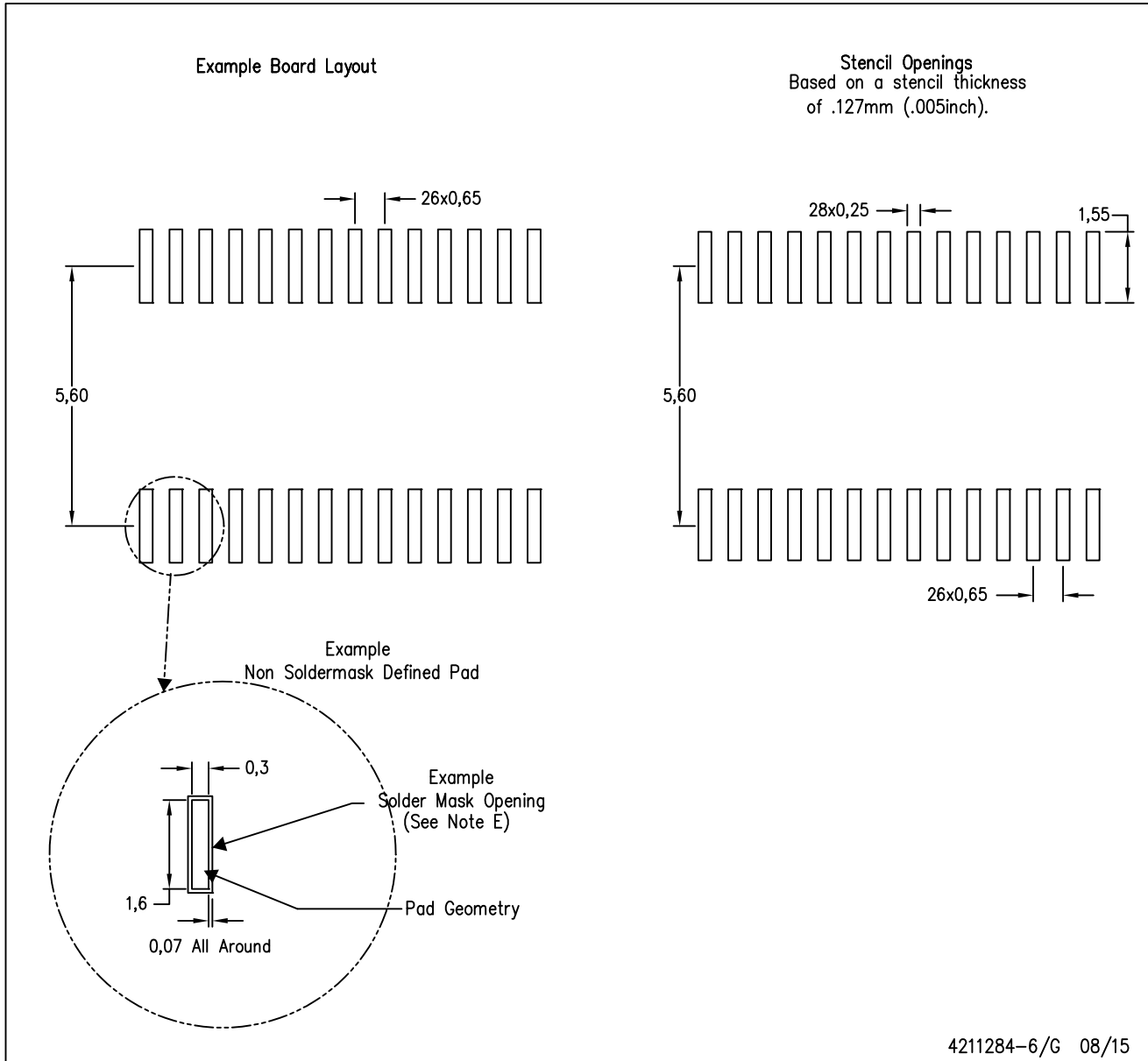


4040064-7/G 02/11

- 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.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
 - D. 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



- 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.

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