

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

FEATURES

- Operates With 3-V to 5.5-V V_{CC} Supply
- Always-Active Noninverting Receiver Output (ROUT2B)
- Low Standby Current . . . 1 μ A Typ
- External Capacitors . . . $4 \times 0.1 \mu$ F
- Accepts 5-V Logic Input With 3.3-V Supply
- Inter-Operable With SN65C3238, SN75C3238
- Supports Operation From 250 kbit/s to 1 Mbit/s
- RS-232 Bus-Pin ESD Protection Exceeds ± 15 kV Using Human-Body Model (HBM)
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II

APPLICATIONS

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

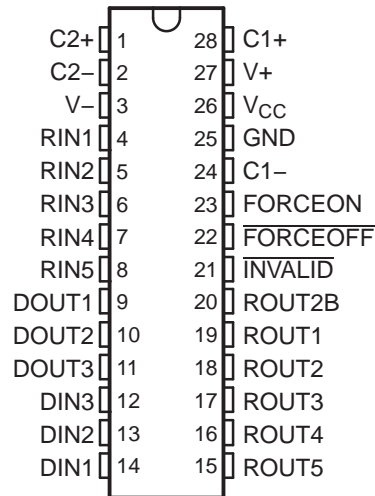
DESCRIPTION/ORDERING INFORMATION

The TRSF3243 consists of three line drivers, five line receivers, and a dual charge-pump circuit with ± 15 -kV ESD protection pin to pin (serial-port connection pins, including GND). This device 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. In addition, this 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 1 Mbit/s and an increased slew-rate range of 24 V/ μ s to 150 V/ μ s.

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 μ A. 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 $\overline{\text{INVALID}}$ 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 μ s. $\overline{\text{INVALID}}$ is low (invalid data) if all receiver input voltages are between -0.3 V and 0.3 V for more than 30 μ s. Refer to Figure 5 for receiver input levels.

DB, DW, OR PW PACKAGE
(TOP VIEW)



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.

ORDERING INFORMATION

T _A	PACKAGE ⁽¹⁾⁽²⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	SOIC – DW	Tube of 20	TRSF3243CDW	TRSF3243C
		Reel of 1000	TRSF3243CDWR	
	SSOP – DB	Reel of 2000	TRSF3243CDBR	TRSF3243C
	TSSOP – PW	Tube of 50	TRSF3243CPW	RT43C
		Reel of 2000	TRSF3243CPWR	
–40°C to 85°C	SOIC – DW	Tube of 20	TRSF3243IDW	TRSF3243I
		Reel of 1000	TRSF3243IDWR	
	SSOP – DB	Reel of 2000	TRSF3243IDBR	TRSF3243I
	TSSOP – PW	Tube of 50	TRSF3243IPW	RT43I
		Reel of 2000	TRSF3243IPWR	

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

FUNCTION TABLES

EACH DRIVER⁽¹⁾

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

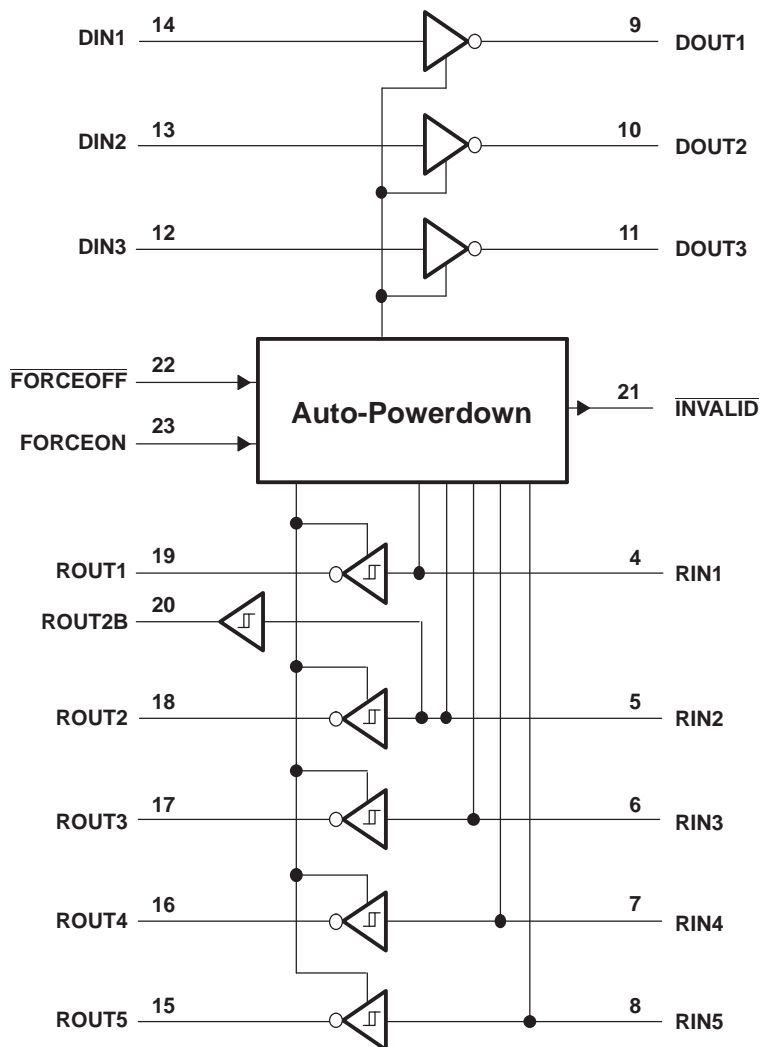
(1) H = high level, L = low level, X = irrelevant, Z = high impedance

EACH RECEIVER⁽¹⁾

INPUTS				OUTPUTS		ROUT1, ROUT3–5	RECEIVER STATUS
RIN2	RIN1, RIN3–RIN5	$\overline{\text{FORCEOFF}}$	VALID RIN RS-232 LEVEL	ROUT2B	ROUT2		
L	X	L	X	L	Z	Z	Powered off while ROUT2B is active
H	X	L	X	H	Z	Z	
L	L	H	YES	L	H	H	Normal operation with auto-powerdown disabled/enabled
L	H	H	YES	L	L	L	
H	L	H	YES	H	H	H	
H	H	H	YES	H	L	L	
Open	Open	H	YES	L	H	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)



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)	−0.3	6	V	
		Receiver	−25	25		
V _O	Output voltage range		Driver	−13.2	13.2	V
θ_{JA}	Package thermal impedance ^{(3) (4)}	DB package		62	°C/W	
		DW package		46		
		PW package		62		
T _J	Operating virtual junction temperature			150	°C	
T _{stg}	Storage temperature range		−65	150	°C	

- (1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltages are with respect to network GND.
- (3) Maximum power dissipation is a function of T_J(max), θ_{JA} , and T_A. The maximum allowable power dissipation at any allowable ambient temperature is P_D = (T_J(max) − T_A)/ θ_{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	TRSF3243I	−40		85	°C
		TRSF3243C	0		70	

- (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.

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	Auto-powerdown disabled	No load, $\overline{\text{FORCEOFF}}$ and FORCEON = V _{CC}	0.3	1	μ A
		Powered off	No load, $\overline{\text{FORCEOFF}}$ = GND	1	10	
		Auto-powerdown enabled	No load, $\overline{\text{FORCEOFF}}$ = V _{CC} , FORCEON = GND, All RIN are open or grounded, All DIN are grounded	1	10	

- (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.

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 = GND		±0.01	±1	μA
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		±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 FORCEOFF = 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	

(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⁾

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 (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 ⁽³⁾ C _L = 150 pF to 2500 pF, R _L = 3 kΩ to 7 kΩ, See Figure 2		25		ns
SR(tr)	Slew rate, transition region (see Figure 1) C _L = 150 pF to 1000 pF, R _L = 3 kΩ to 7 kΩ, V _{CC} = 3.3 V	18		150	V/μs

(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.

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 _{OL} = 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)	FORCEOFF = 0 V		±0.05	±10	μA
r _i Input resistance	V _I = ±3 V to ±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	C _L = 150 pF, See Figure 3	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	C _L = 150 pF, R _L = 3 kΩ, See Figure 4	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°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
$V_{T+(valid)}$	Receiver input threshold for $\overline{INVALID}$ high-level output voltage	FORCEON = GND, $\overline{FORCEOFF} = V_{CC}$		2.7	V
$V_{T-(valid)}$	Receiver input threshold for $\overline{INVALID}$ high-level output voltage	FORCEON = GND, $\overline{FORCEOFF} = V_{CC}$	–2.7		V
$V_{T(invalid)}$	Receiver input threshold for $\overline{INVALID}$ low-level output voltage	FORCEON = GND, $\overline{FORCEOFF} = V_{CC}$	–0.3	0.3	V
V_{OH}	$\overline{INVALID}$ high-level output voltage	$I_{OH} = -1\text{ mA}$, FORCEON = GND, $\overline{FORCEOFF} = V_{CC}$	$V_{CC} - 0.6$		V
V_{OL}	$\overline{INVALID}$ low-level output voltage	$I_{OL} = 1.6\text{ mA}$, FORCEON = GND, $\overline{FORCEOFF} = V_{CC}$		0.4	V

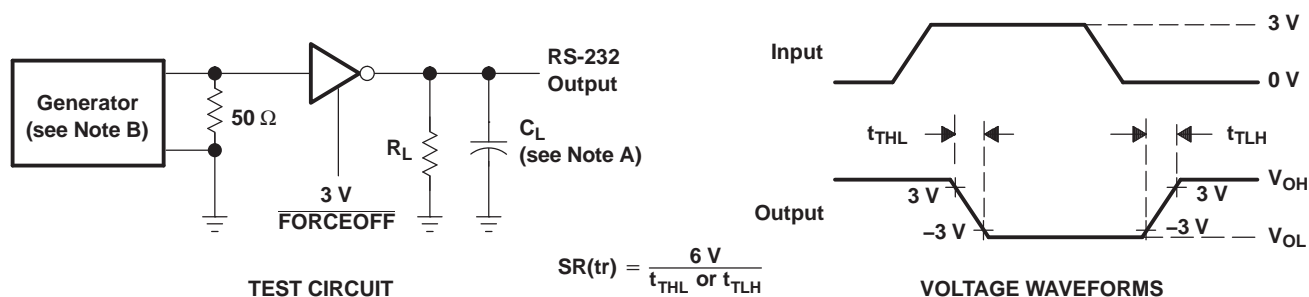
Switching Characteristics

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

PARAMETER		TYP ⁽¹⁾	UNIT
t_{valid}	Propagation delay time, low- to high-level output	1	μs
$t_{invalid}$	Propagation delay time, high- to low-level output	30	μs
t_{en}	Supply enable time	100	μs

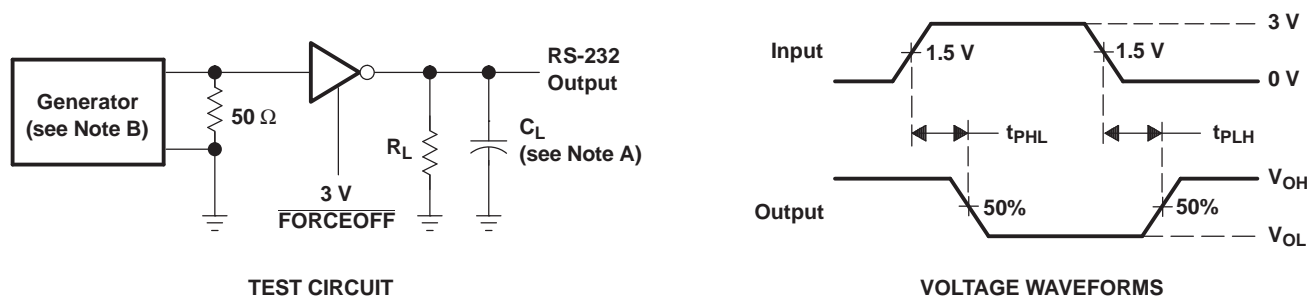
(1) All typical values are at $V_{CC} = 3.3\text{ V}$ or $V_{CC} = 5\text{ V}$, and $T_A = 25^\circ\text{C}$.

PARAMETER MEASUREMENT INFORMATION



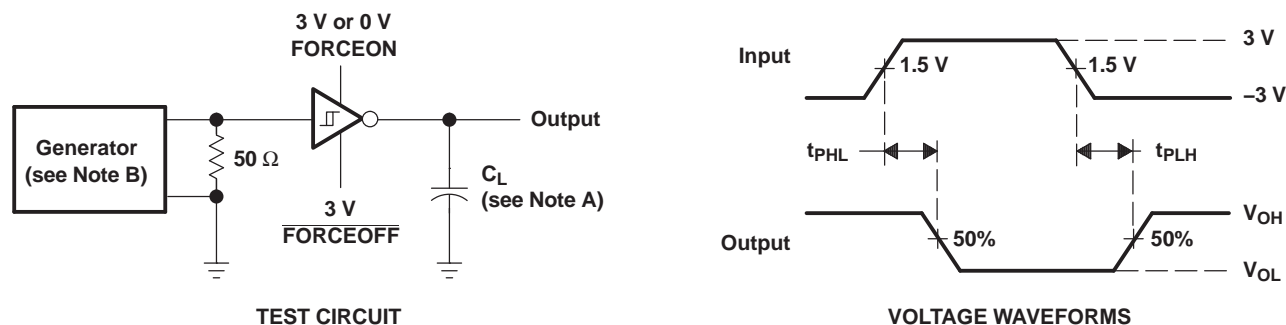
NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: PRR = 1 Mbit/s, $Z_O = 50\ \Omega$, 50% duty cycle, $t_r \leq 10\text{ ns}$, $t_f \leq 10\text{ ns}$.

Figure 1. Driver Slew Rate



NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: PRR = 1 Mbit/s, $Z_O = 50\ \Omega$, 50% duty cycle, $t_r \leq 10\text{ ns}$, $t_f \leq 10\text{ ns}$.

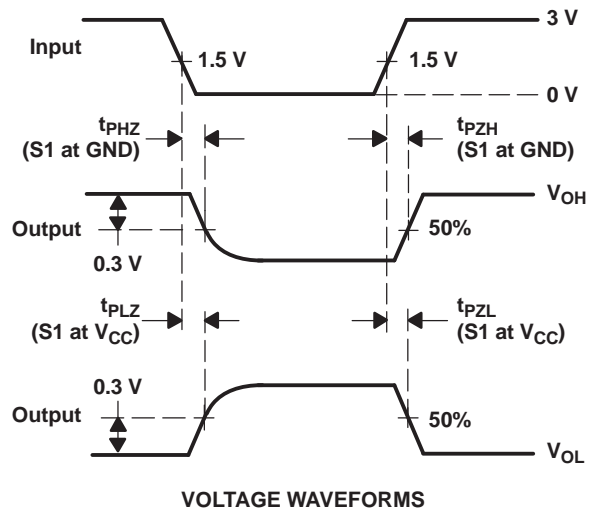
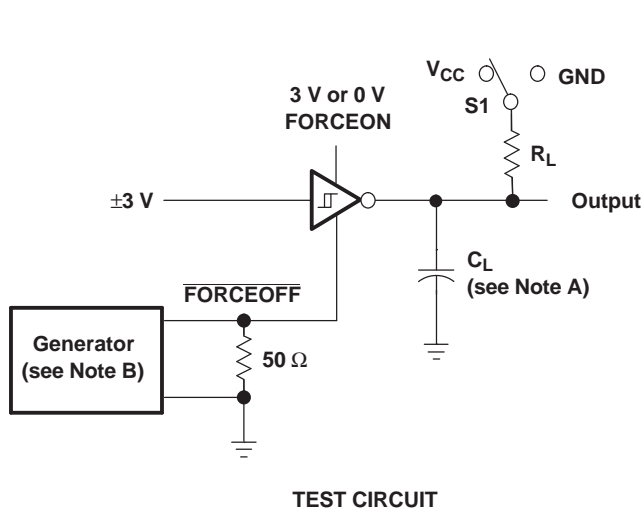
Figure 2. Driver Pulse Skew



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

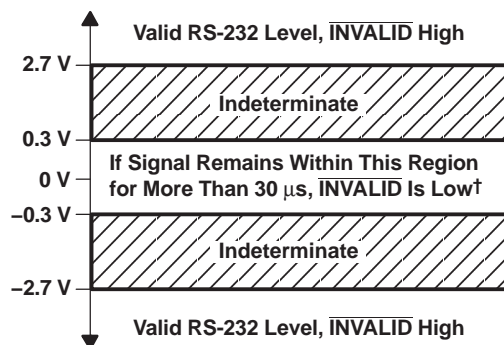
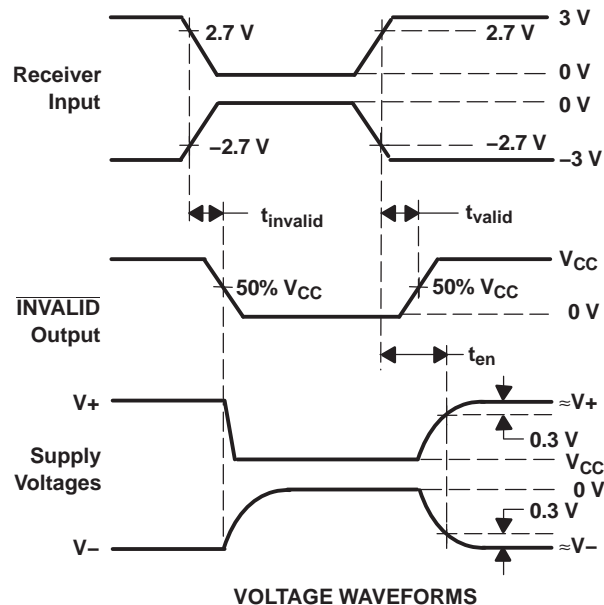
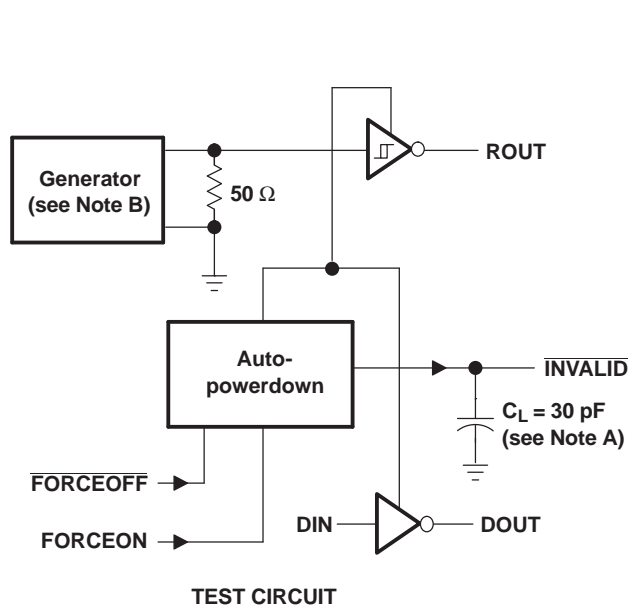
PARAMETER MEASUREMENT INFORMATION (continued)



- 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

PARAMETER MEASUREMENT INFORMATION (continued)



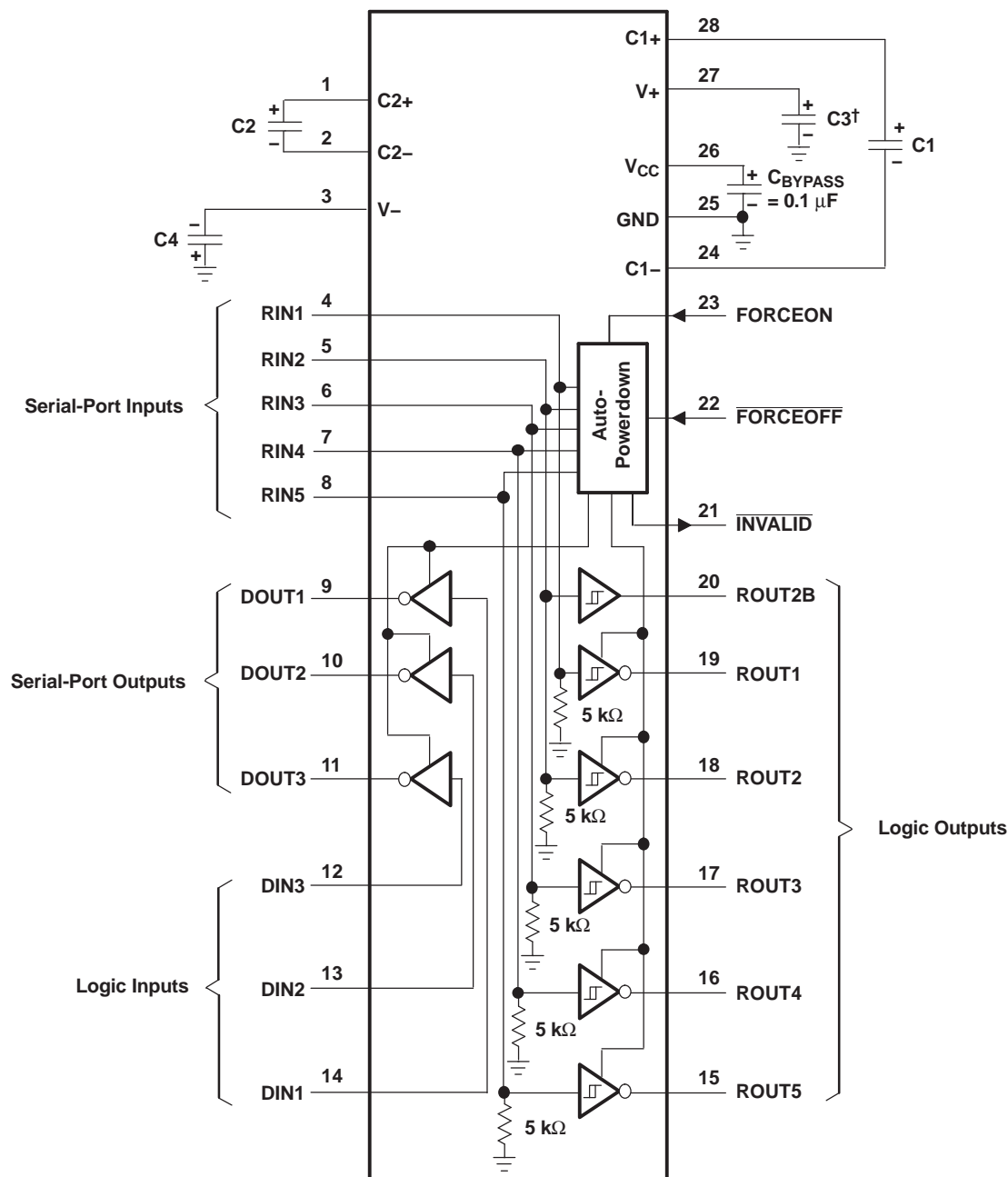
† Auto-powerdown disables drivers and reduces supply current to 1 μA .

NOTES: A. C_L includes probe and jig capacitance.

B. The pulse generator has the following characteristics: PRR = 5 kbit/s, $Z_O = 50 \Omega$, 50% duty cycle, $t_r \leq 10 \text{ ns}$, $t_f \leq 10 \text{ ns}$.

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

PARAMETER MEASUREMENT INFORMATION (continued)



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

NOTE A: Resistor values shown are nominal.

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

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TRSF3243CPWR	ACTIVE	TSSOP	PW	28	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM		RT43C	Samples
TRSF3243IDB	ACTIVE	SSOP	DB	28	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM		TRSF3243I	Samples
TRSF3243IPWR	ACTIVE	TSSOP	PW	28	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	RT43I	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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(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.

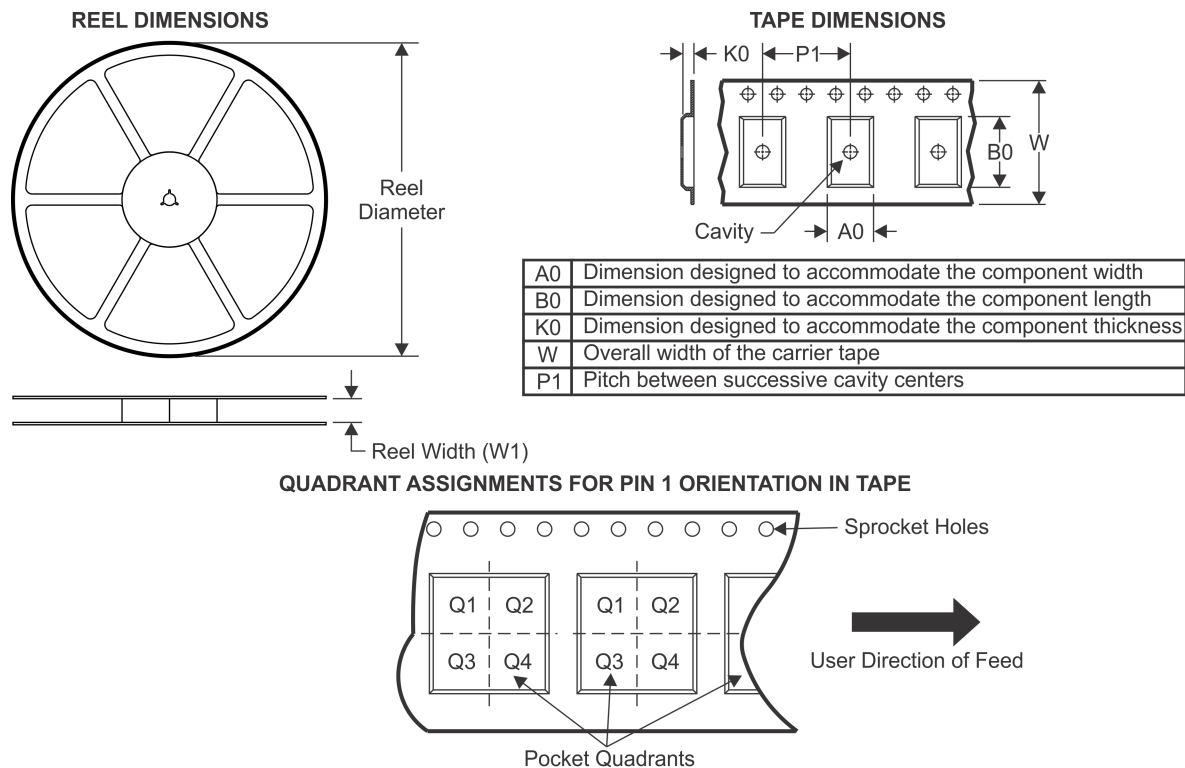
(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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

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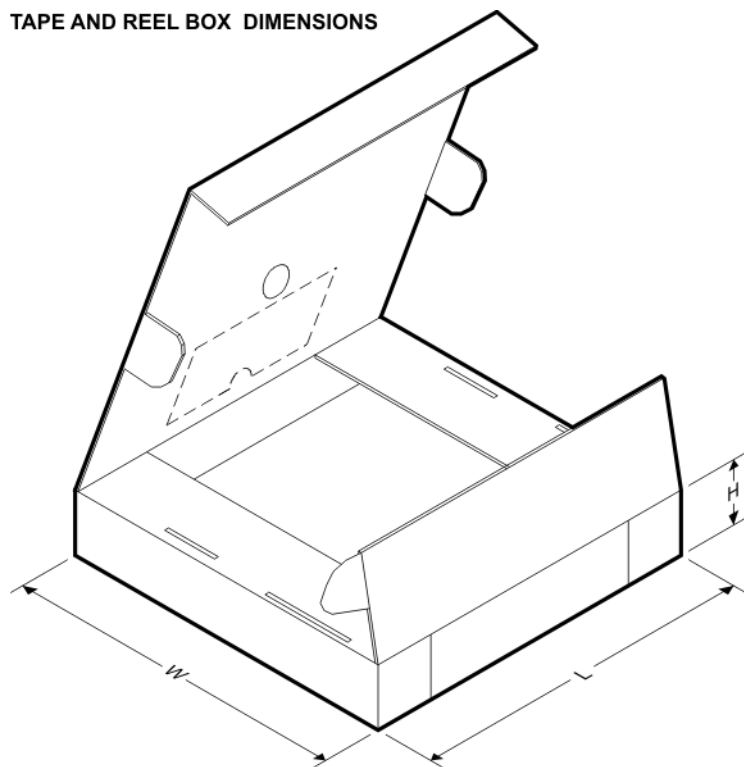
TAPE AND REEL INFORMATION



*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
TRSF3243CPWR	TSSOP	PW	28	2000	330.0	16.4	6.9	10.2	1.8	12.0	16.0	Q1
TRSF3243IPWR	TSSOP	PW	28	2000	330.0	16.4	6.9	10.2	1.8	12.0	16.0	Q1

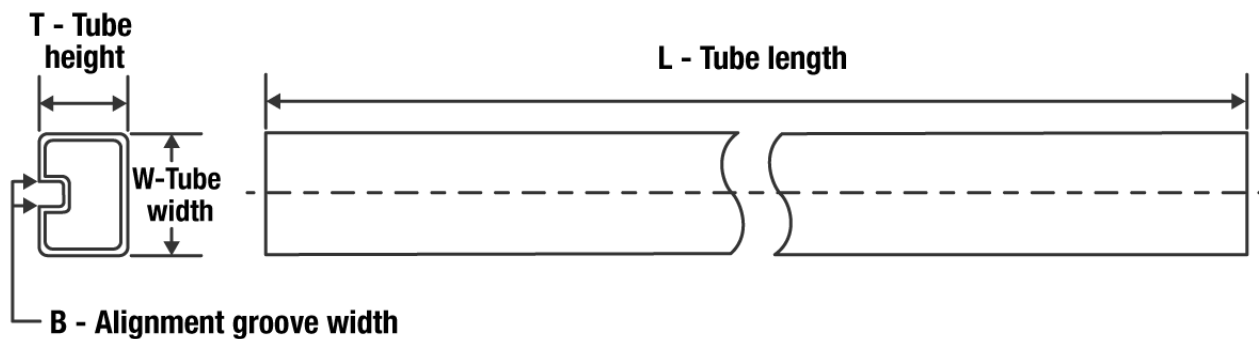
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TRSF3243CPWR	TSSOP	PW	28	2000	853.0	449.0	35.0
TRSF3243IPWR	TSSOP	PW	28	2000	853.0	449.0	35.0

TUBE

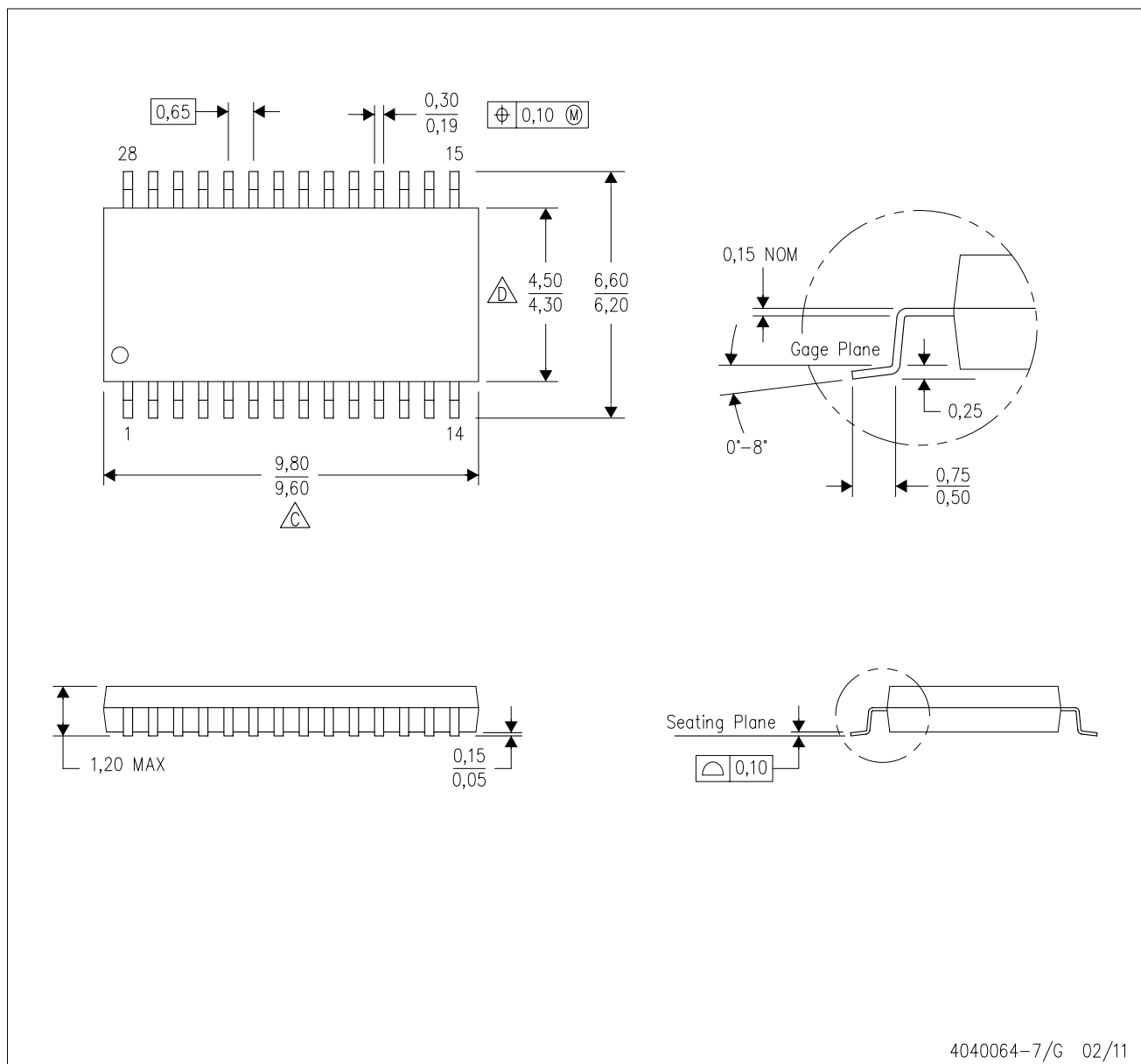


*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
TRSF3243IDB	DB	SSOP	28	50	530	10.5	4000	4.1

PW (R-PDSO-G28)

PLASTIC SMALL OUTLINE

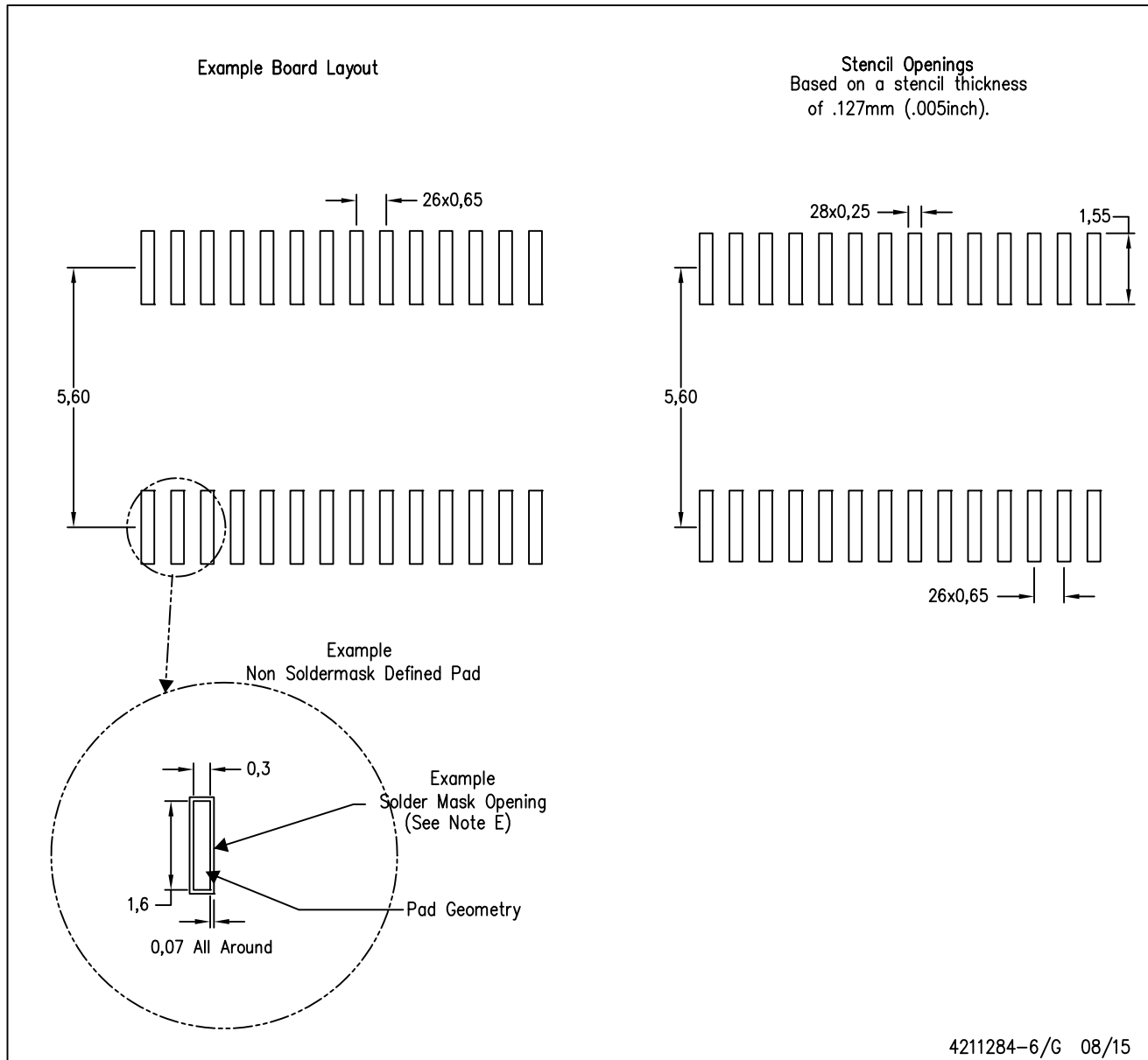


4040064-7/G 02/11

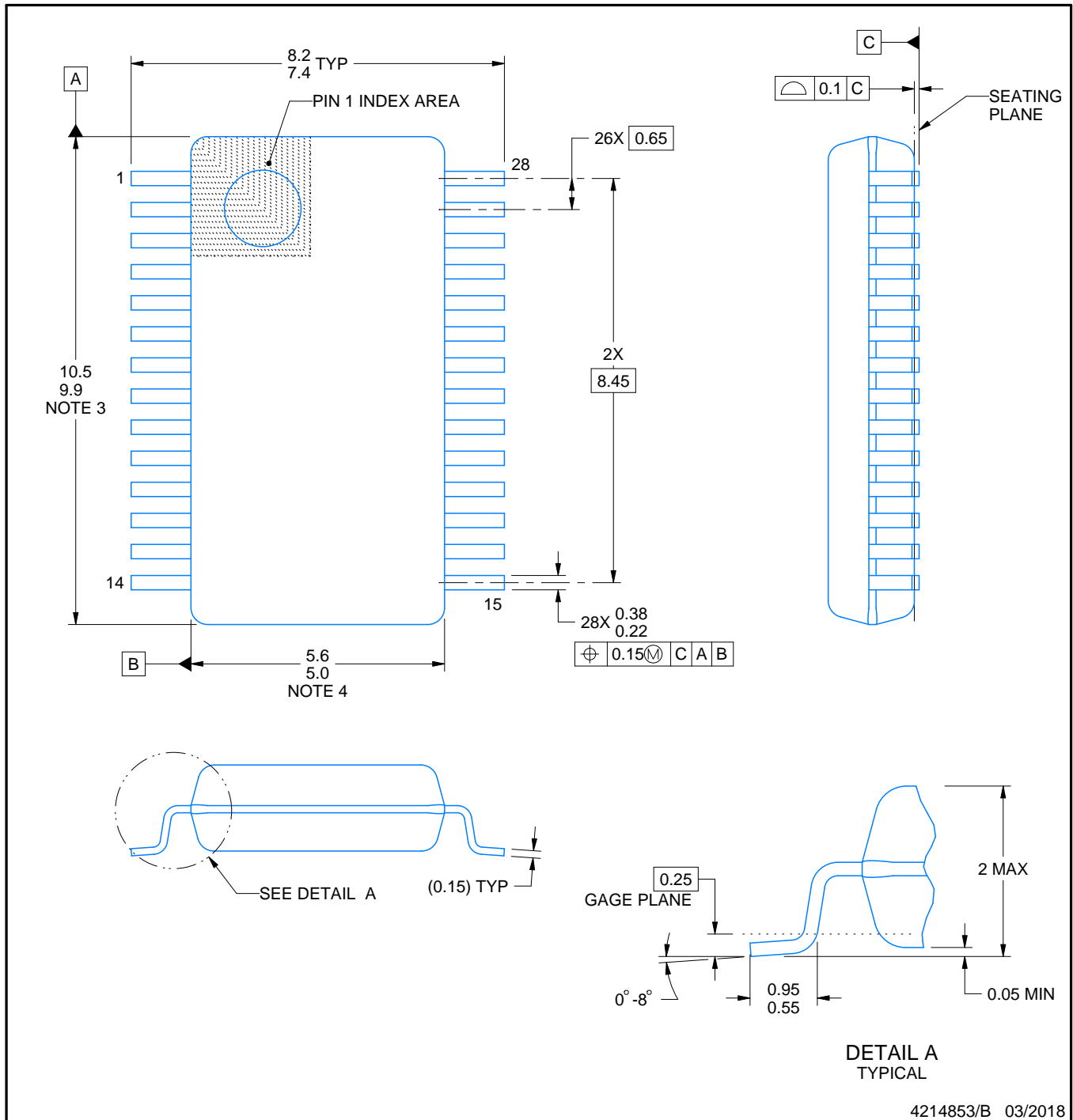
- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each 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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NOTES:

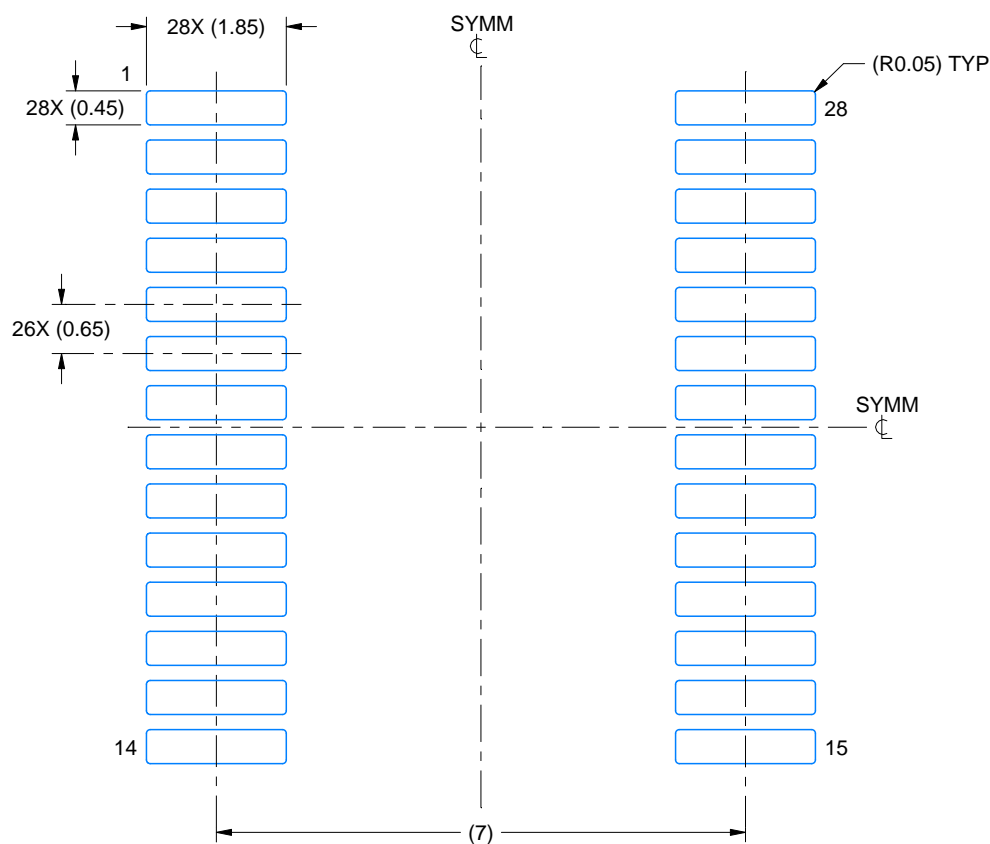
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-150.

EXAMPLE BOARD LAYOUT

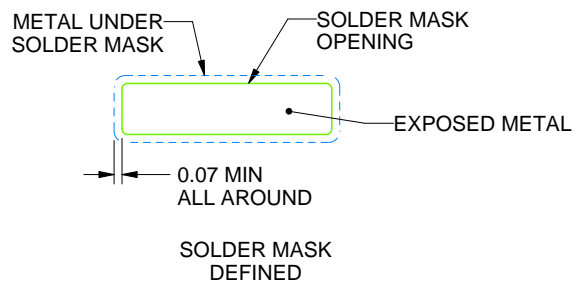
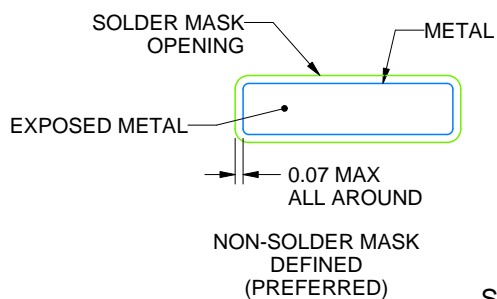
DB0028A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

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NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

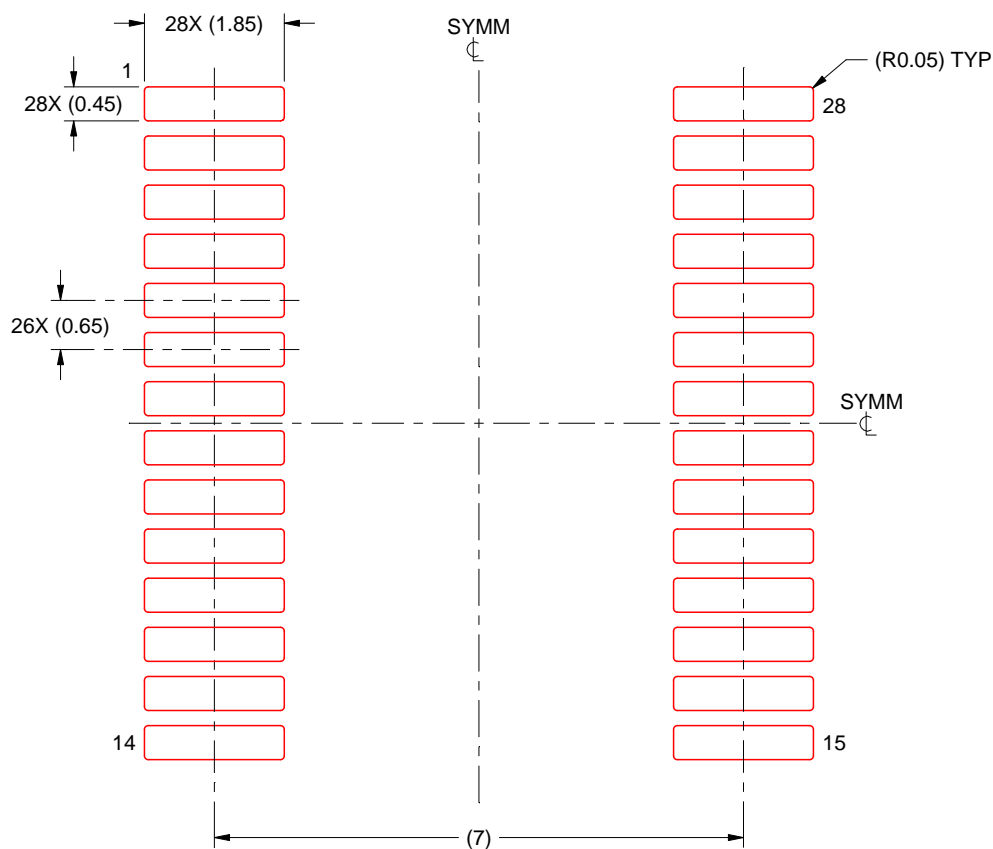
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DB0028A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

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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.

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