

# 8-BIT BIDIRECTIONAL VOLTAGE-LEVEL TRANSLATOR WITH AUTO-DIRECTION SENSING AND $\pm 15$ -kV ESD PROTECTION

Check for Samples: [TXB0108](#)

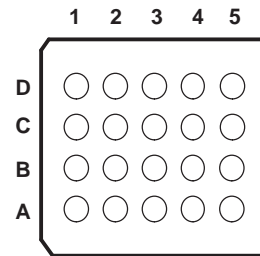
## FEATURES

- 1.2 V to 3.6 V on A Port and 1.65 to 5.5 V on B Port ( $V_{CCA} \leq V_{CCB}$ )
- $V_{CC}$  Isolation Feature – If Either  $V_{CC}$  Input Is at GND, All Outputs Are in the High-Impedance State
- OE Input Circuit Referenced to  $V_{CCA}$
- Low Power Consumption, 4- $\mu$ A Max  $I_{CC}$
- $I_{off}$  Supports Partial-Power-Down Mode Operation
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - A Port
    - 2000-V Human-Body Model (A114-B)
    - 1000-V Charged-Device Model (C101)
  - B Port
    - $\pm 15$ -kV Human-Body Model (A114-B)
    - $\pm 8$ -kV Human-Body Model (A114-B) (YZP Package Only)
    - 1000-V Charged-Device Model (C101)

## APPLICATIONS

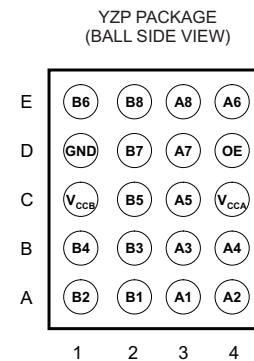
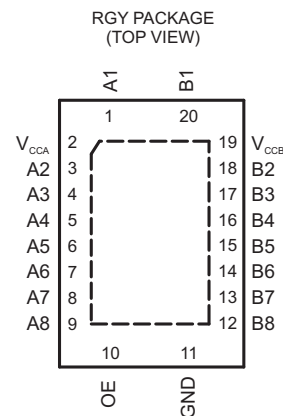
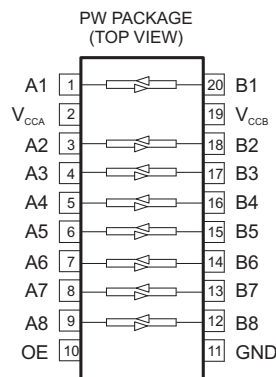
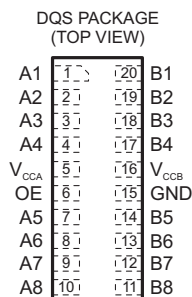
- Handset, Smartphone, Tablet, Desktop PC

GXY OR ZXY PACKAGE  
(BOTTOM VIEW)



**TERMINAL ASSIGNMENTS**  
(20-Ball GXY/ZXY Package)

	1	2	3	4	5
D	$V_{CCB}$	B2	B4	B6	B8
C	B1	B3	B5	B7	GND
B	A1	A3	A5	A7	OE
A	$V_{CCA}$	A2	A4	A6	A8



Note: For the RGY package, the exposed center thermal pad must be connected to ground.

- A. Pull up resistors are not required on both sides for Logic I/O.
- B. If pull up or pull down resistors are needed, the resistor value must be over 50 k $\Omega$ .
- C. 50 k $\Omega$  is a safe recommended value, if the customer can accept higher  $V_{ol}$  or lower  $V_{oh}$ , smaller pull up or pull down resistor is allowed, the draft estimation is  $V_{ol} = V_{ccout} \times 4.5k / (4.5k + R_{pu})$  and  $V_{oh} = V_{ccout} \times R_{dw} / (4.5k + R_{dw})$ .
- D. If pull up resistors are needed, please refer to the TXS0108 or contact TI.
- E. For detailed information, please refer to application note [SCEA043](#).



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.



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

## DESCRIPTION/ORDERING INFORMATION

This 8-bit noninverting translator uses two separate configurable power-supply rails. The A port is designed to track  $V_{CCA}$ .  $V_{CCA}$  accepts any supply voltage from 1.2 V to 3.6 V. The B port is designed to track  $V_{CCB}$ .  $V_{CCB}$  accepts any supply voltage from 1.65 V to 5.5 V. This allows for universal low-voltage bidirectional translation between any of the 1.2-V, 1.5-V, 1.8-V, 2.5-V, 3.3-V, and 5-V voltage nodes.  $V_{CCA}$  should not exceed  $V_{CCB}$ .

When the output-enable (OE) input is low, all outputs are placed in the high-impedance state.

The TXB0101 is designed so that the OE input circuit is supplied by  $V_{CCA}$ .

This device is fully specified for partial-power-down applications using  $I_{off}$ . The  $I_{off}$  circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

To ensure the high-impedance state during power up or power down, OE should be tied to GND through a pulldown resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

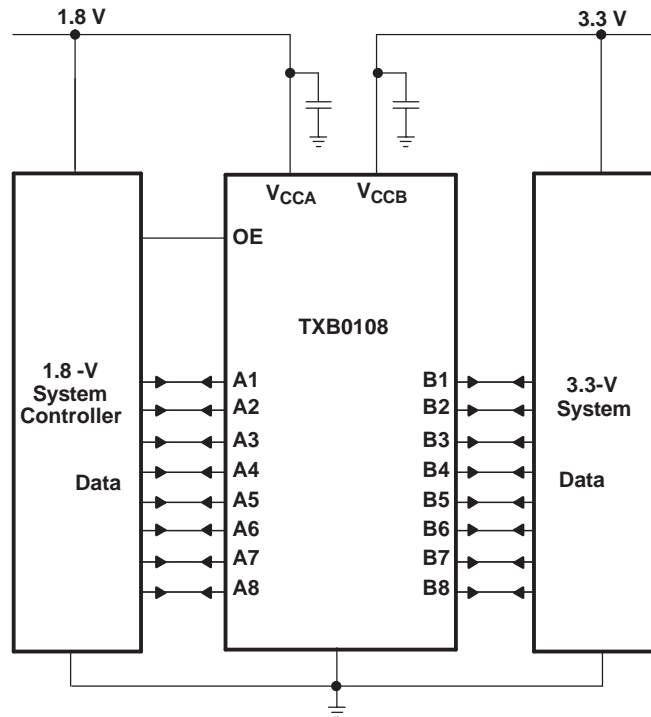
**Table 1. ORDERING INFORMATION<sup>(1)</sup>**

$T_A$	PACKAGE <sup>(2)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	QFN – RGY	Reel of 1000	TXB0108RGYR	YE08
	SON – DQS	Reel of 2000	TXB0108DQSR	5MR
	TSSOP – PW	Reel of 2000	TXB0108PWR	YE08
	VFBGA – GXY	Reel of 2500	TXB0108GXYR	YE08
	VFBGA – ZXY (Pb-free)	Reel of 2500	TXB0108ZXYR	YE08
	DSBGA - YZP	Reel of 2500	TXB0108YZPR	5M

- (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at [www.ti.com](http://www.ti.com).  
 (2) Package drawings, thermal data, and symbolization are available at [www.ti.com/packaging](http://www.ti.com/packaging).

## PIN DESCRIPTION

PIN NUMBER			NAME	FUNCTION
PW, RGY	DQS	YZP		
1	1	A3	A1	Input/output 1. Referenced to $V_{CCA}$ .
2	5	C4	$V_{CCA}$	A-port supply voltage. $1.1\text{ V} \leq V_{CCA} \leq 3.6\text{ V}$ , $V_{CCA} \leq V_{CCB}$ .
3	2	A4	A2	Input/output 2. Referenced to $V_{CCA}$ .
4	3	B3	A3	Input/output 3. Referenced to $V_{CCA}$ .
5	4	B4	A4	Input/output 4. Referenced to $V_{CCA}$ .
6	7	C3	A5	Input/output 5. Referenced to $V_{CCA}$ .
7	8	E4	A6	Input/output 6. Referenced to $V_{CCA}$ .
8	9	D3	A7	Input/output 7. Referenced to $V_{CCA}$ .
9	10	E3	A8	Input/output 8. Referenced to $V_{CCA}$ .
10	6	D4	OE	Output enable. Pull OE low to place all outputs in 3-state mode. Referenced to $V_{CCA}$ .
11	15	D1	GND	Ground
12	11	E2	B8	Input/output 8. Referenced to $V_{CCB}$ .
13	12	D2	B7	Input/output 7. Referenced to $V_{CCB}$ .
14	13	E1	B6	Input/output 6. Referenced to $V_{CCB}$ .
15	14	C2	B5	Input/output 5. Referenced to $V_{CCB}$ .
16	17	B1	B4	Input/output 4. Referenced to $V_{CCB}$ .
17	18	B2	B3	Input/output 3. Referenced to $V_{CCB}$ .
18	19	A1	B2	Input/output 2. Referenced to $V_{CCB}$ .
19	16	C1	$V_{CCB}$	B-port supply voltage. $1.65\text{ V} \leq V_{CCB} \leq 5.5\text{ V}$ .
20	20	A2	B1	Input/output 1. Referenced to $V_{CCB}$ .
—			Thermal Pad	For the RGY package, the exposed center thermal pad must be connected to ground.

**TYPICAL OPERATING CIRCUIT**

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

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

		MIN	MAX	UNIT	
$V_{CCA}$	Supply voltage range	-0.5	4.6	V	
$V_{CCB}$	Supply voltage range	-0.5	6.5	V	
$V_I$	Input voltage range <sup>(2)</sup>	-0.5	6.5	V	
$V_O$	Voltage range applied to any output in the high-impedance or power-off state <sup>(2)</sup>	-0.5	6.5	V	
$V_O$	Voltage range applied to any output in the high or low state <sup>(2) (3)</sup>	A inputs	-0.5	$V_{CCA} + 0.5$	V
		B inputs	-0.5	$V_{CCB} + 0.5$	
$I_{IK}$	Input clamp current		-50	mA	
$I_{OK}$	Output clamp current		-50	mA	
$I_O$	Continuous output current		$\pm 50$	mA	
	Continuous current through $V_{CCA}$ , $V_{CCB}$ , or GND		$\pm 100$	mA	
$\theta_{JA}$	Package thermal impedance	DQS package		TBD	°C/W
		GXY/ZXY package <sup>(4)</sup>		78	
		PW package <sup>(4)</sup>		83	
		RGY package <sup>(5)</sup>		37	
$T_{stg}$	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) The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.

(3) The value of  $V_{CCA}$  and  $V_{CCB}$  are provided in the recommended operating conditions table.

(4) The package thermal impedance is calculated in accordance with JESD 51-7.

(5) The package thermal impedance is calculated in accordance with JESD 51-5.

**Recommended Operating Conditions**<sup>(1) (2)</sup>

		$V_{CCA}$	$V_{CCB}$	MIN	MAX	UNIT	
$V_{CCA}$	Supply voltage			1.2	3.6	V	
$V_{CCB}$				1.65	5.5		
$V_{IH}$	High-level input voltage	Data inputs	1.2 V to 3.6 V	1.65 V to 5.5 V	$V_{CCI} \times 0.65^{(3)}$	$V_{CCI}$	V
		OE			$V_{CCA} \times 0.65$	5.5	
$V_{IL}$	Low-level input voltage	Data inputs	1.2 V to 5.5 V	1.65 V to 5.5 V	0	$V_{CCI} \times 0.35^{(3)}$	V
		OE	1.2 V to 3.6 V		0	$V_{CCA} \times 0.35$	
$\Delta t/\Delta v$	Input transition rise or fall rate	A-port inputs	1.2 V to 3.6 V	1.65 V to 5.5 V		40	ns/V
		B-port inputs		1.65 V to 3.6 V		40	
				1.2 V to 3.6 V	4.5 V to 5.5 V		
$T_A$	Operating free-air temperature				-40	85	°C

(1) The A and B sides of an unused data I/O pair must be held in the same state, i.e., both at  $V_{CCI}$  or both at GND.

(2)  $V_{CCA}$  must be less than or equal to  $V_{CCB}$  and must not exceed 3.6 V.

(3)  $V_{CCI}$  is the supply voltage associated with the input port.

**Electrical Characteristics<sup>(1) (2)</sup>**

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

PARAMETER		TEST CONDITIONS	V <sub>CCA</sub>	V <sub>CCB</sub>	T <sub>A</sub> = 25°C			-40°C to 85°C		UNIT
					MIN	TYP	MAX	MIN	MAX	
V <sub>OHA</sub>		I <sub>OH</sub> = -20 μA	1.2 V		1.1			V <sub>CCA</sub> - 0.4		V
			1.4 V to 3.6 V							
V <sub>OLA</sub>		I <sub>OL</sub> = 20 μA	1.2 V		0.9			0.4		V
			1.4 V to 3.6 V							
V <sub>OHB</sub>		I <sub>OH</sub> = -20 μA		1.65 V to 5.5 V				V <sub>CCB</sub> - 0.4		V
V <sub>OLB</sub>		I <sub>OL</sub> = 20 μA		1.65 V to 5.5 V				0.4		V
I <sub>I</sub>	OE		1.2 V to 3.6 V	1.65 V to 5.5 V	±1			±2		μA
I <sub>off</sub>	A port		0 V	0 V to 5.5 V	±1			±2		μA
	B port		0 V to 3.6 V	0 V	±1			±2		
I <sub>OZ</sub>	A or B port	OE = GND	1.2 V to 3.6 V	1.65 V to 5.5 V	±1			±2		μA
I <sub>CCA</sub>		V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0	1.2 V	1.65 V to 5.5 V	0.06					μA
			1.4 V to 3.6 V							
			3.6 V	0 V				5		
			0 V	5.5 V				-2		
I <sub>CCB</sub>		V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0	1.2 V	1.65 V to 5.5 V	3.4					μA
			1.4 V to 3.6 V							
			3.6 V	0 V				5		
			0 V	5.5 V				-2		
I <sub>CCA</sub> + I <sub>CCB</sub>		V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0	1.2 V	1.65 V to 5.5 V	3.5					μA
			1.4 V to 3.6 V							
I <sub>CCZA</sub>		V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0, OE = GND	1.2 V	1.65 V to 5.5 V	0.05					μA
			1.4 V to 3.6 V							
I <sub>CCZB</sub>		V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0, OE = GND	1.2 V	1.65 V to 5.5 V	3.3					μA
			1.4 V to 3.6 V							
C <sub>I</sub>	OE		1.2 V to 3.6 V	1.65 V to 5.5 V	5			5.5		pF
C <sub>io</sub>	A port		1.2 V to 3.6 V	1.65 V to 5.5 V	5			6.5		pF
	B port									

 (1) V<sub>CCI</sub> is the supply voltage associated with the input port.

 (2) V<sub>CCO</sub> is the supply voltage associated with the output port.

**Timing Requirements**

 T<sub>A</sub> = 25°C, V<sub>CCA</sub> = 1.2 V

			V <sub>CCB</sub> = 1.8 V	V <sub>CCB</sub> = 2.5 V	V <sub>CCB</sub> = 3.3 V	V <sub>CCB</sub> = 5 V	UNIT
			TYP	TYP	TYP	TYP	
Data rate			20	20	20	20	Mbps
t <sub>w</sub>	Pulse duration	Data inputs	50	50	50	50	ns

**Timing Requirements**

 over recommended operating free-air temperature range, V<sub>CCA</sub> = 1.5 V ± 0.1 V (unless otherwise noted)

			V <sub>CCB</sub> = 1.8 V ± 0.15 V		V <sub>CCB</sub> = 2.5 V ± 0.2 V		V <sub>CCB</sub> = 3.3 V ± 0.3 V		V <sub>CCB</sub> = 5 V ± 0.5 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Data rate			50		50		50		50		Mbps
t <sub>w</sub>	Pulse duration	Data inputs	20		20		20		20		ns

## Timing Requirements

over recommended operating free-air temperature range,  $V_{CCA} = 1.8 \text{ V} \pm 0.15 \text{ V}$  (unless otherwise noted)

		$V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Data rate		52		60		60		60		Mbps
$t_w$	Pulse duration	Data inputs		19	17	17	17	17	17	ns

## Timing Requirements

over recommended operating free-air temperature range,  $V_{CCA} = 2.5 \text{ V} \pm 0.2 \text{ V}$  (unless otherwise noted)

		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
Data rate		70		100		100		Mbps
$t_w$	Pulse duration	Data inputs		14	10	10	10	ns

## Timing Requirements

over recommended operating free-air temperature range,  $V_{CCA} = 3.3 \text{ V} \pm 0.3 \text{ V}$  (unless otherwise noted)

		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$		UNIT
		MIN	MAX	MIN	MAX	
Data rate		100		100		Mbps
$t_w$	Pulse duration	Data inputs		10	10	ns

## Switching Characteristics

$T_A = 25^\circ\text{C}$ ,  $V_{CCA} = 1.2 \text{ V}$

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CCB} = 1.8 \text{ V}$	$V_{CCB} = 2.5 \text{ V}$	$V_{CCB} = 3.3 \text{ V}$	$V_{CCB} = 5 \text{ V}$	UNIT
			TYP	TYP	TYP	TYP	
$t_{pd}$	A	B	9.5	7.9	7.6	8.5	ns
	B	A	9.2	8.8	8.4	8	
$t_{en}$	OE	A	1	1	1	1	$\mu\text{s}$
		B	1	1	1	1	
$t_{dis}$	OE	A	20	17	17	18	ns
		B	20	16	15	15	
$t_{rA}, t_{fA}$	A-port rise and fall times		4.1	4.4	4.1	3.9	ns
$t_{rB}, t_{fB}$	B-port rise and fall times		5	5	5.1	5.1	ns
$t_{SK(O)}$	Channel-to-channel skew		2.4	1.7	1.9	7	ns
Max data rate			20	20	20	20	Mbps

## Switching Characteristics

 over recommended operating free-air temperature range,  $V_{CCA} = 1.5 \text{ V} \pm 0.1 \text{ V}$  (unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	A	B	1.4	12.9	1.2	10.1	1.1	10	0.8	9.9	ns
	B	A	0.9	14.2	0.7	12	0.4	11.7	0.3	13.7	
$t_{en}$	OE	A		1		1		1		1	$\mu\text{s}$
		B		1		1		1		1	
$t_{dis}$	OE	A	6.6	33	6.4	25.3	6.1	23.1	5.9	24.6	ns
		B	6.6	35.6	5.8	25.6	5.5	22.1	5.6	20.6	
$t_{rA}, t_{fA}$	A-port rise and fall times		0.8	6.5	0.8	6.3	0.8	6.3	0.8	6.3	ns
$t_{rB}, t_{fB}$	B-port rise and fall times		1	7.3	0.7	4.9	0.7	4.6	0.6	4.6	ns
$t_{SK(O)}$	Channel-to-channel skew			2.6		1.9		1.6		1.3	ns
Max data rate			50		50		50		50		Mbps

## Switching Characteristics

 over recommended operating free-air temperature range,  $V_{CCA} = 1.8 \text{ V} \pm 0.15 \text{ V}$  (unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	A	B	1.6	11	1.4	7.7	1.3	6.8	1.2	6.5	ns
	B	A	1.5	12	1.2	8.4	0.8	7.6	0.5	7.1	
$t_{en}$	OE	A		1		1		1		1	$\mu\text{s}$
		B		1		1		1		1	
$t_{dis}$	OE	A	5.9	26.7	5.6	21.6	5.4	18.9	4.8	18.7	ns
		B	6.1	33.9	5.2	23.7	5	19.9	5	17.6	
$t_{rA}, t_{fA}$	A-port rise and fall times		0.7	5.1	0.7	5	1	5	0.7	5	ns
$t_{rB}, t_{fB}$	B-port rise and fall times		1	7.3	0.7	5	0.7	3.9	0.6	3.8	ns
$t_{SK(O)}$	Channel-to-channel skew			0.8		0.7		0.6		0.6	ns
Max data rate			52		60		60		60		Mbps

## Switching Characteristics

over recommended operating free-air temperature range,  $V_{CCA} = 2.5 \text{ V} \pm 0.2 \text{ V}$  (unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	A	B	1.1	6.4	1	5.3	0.9	4.7	ns
	B	A	1	7	0.6	5.6	0.3	4.4	
$t_{en}$	OE	A	1		1		1		$\mu\text{s}$
		B	1		1		1		
$t_{dis}$	OE	A	5	16.9	4.9	15	4.5	13.8	ns
		B	4.8	21.8	4.5	17.9	4.4	15.2	
$t_{rA}, t_{fA}$	A-port rise and fall times		0.8	3.6	0.6	3.6	0.5	3.5	ns
$t_{rB}, t_{fB}$	B-port rise and fall times		0.6	4.9	0.7	3.9	0.6	3.2	ns
$t_{SK(O)}$	Channel-to-channel skew		0.4		0.3		0.3		ns
Max data rate			70		100		100		Mbps

## Switching Characteristics

over recommended operating free-air temperature range,  $V_{CCA} = 3.3 \text{ V} \pm 0.3 \text{ V}$  (unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$		UNIT
			MIN	MAX	MIN	MAX	
$t_{pd}$	A	B	0.9	4.9	0.8	4	ns
	B	A	0.5	5.4	0.2	4	
$t_{en}$	OE	A	1		1		$\mu\text{s}$
		B	1		1		
$t_{dis}$	OE	A	4.5	13.9	4.1	12.4	ns
		B	4.1	17.3	4	14.4	
$t_{rA}, t_{fA}$	A-port rise and fall times		0.5	3	0.5	3	ns
$t_{rB}, t_{fB}$	B-port rise and fall times		0.7	3.9	0.6	3.2	ns
$t_{SK(O)}$	Channel-to-channel skew		0.4		0.3		ns
Max data rate			100		100		Mbps



## Operating Characteristics

 $T_A = 25^\circ\text{C}$ 

PARAMETER		TEST CONDITIONS	$V_{CCA}$						UNIT	
			1.2 V	1.2 V	1.5 V	1.8 V	2.5 V	2.5 V		3.3 V
			$V_{CCB}$							3.3 V to 5 V
			5 V	1.8 V	1.8 V	1.8 V	2.5 V	5 V		
				TYP	TYP	TYP	TYP	TYP	TYP	TYP
$C_{pdA}$	A-port input, B-port output	$C_L = 0$ , $f = 10$ MHz, $t_r = t_f = 1$ ns, OE = $V_{CCA}$ (outputs enabled)	9	8	7	7	7	7	8	pF
	B-port input, A-port output		12	11	11	11	11	11	11	
$C_{pdB}$	A-port input, B-port output		35	26	27	27	27	27	28	
	B-port input, A-port output		26	19	18	18	18	20	21	
$C_{pdA}$	A-port input, B-port output	$C_L = 0$ , $f = 10$ MHz, $t_r = t_f = 1$ ns, OE = GND (outputs disabled)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	pF
	B-port input, A-port output		0.01	0.01	0.01	0.01	0.01	0.01	0.01	
$C_{pdB}$	A-port input, B-port output		0.01	0.01	0.01	0.01	0.01	0.01	0.03	
	B-port input, A-port output		0.01	0.01	0.01	0.01	0.01	0.01	0.03	

## PRINCIPLES OF OPERATION

### Applications

The TXB0108 can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another.

### Architecture

The TXB0108 architecture (see [Figure 1](#)) does not require a direction-control signal to control the direction of data flow from A to B or from B to A. In a dc state, the output drivers of the TXB0108 can maintain a high or low, but are designed to be weak, so that they can be overdriven by an external driver when data on the bus starts flowing the opposite direction.

The output one shots detect rising or falling edges on the A or B ports. During a rising edge, the one shot turns on the PMOS transistors (T1, T3) for a short duration, which speeds up the low-to-high transition. Similarly, during a falling edge, the one shot turns on the NMOS transistors (T2, T4) for a short duration, which speeds up the high-to-low transition. The typical output impedance during output transition is 70Ω at  $V_{CCO} = 1.2\text{ V to }1.8\text{ V}$ , 50Ω at  $V_{CCO} = 1.8\text{ V to }3.3\text{ V}$  and 40Ω at  $V_{CCO} = 3.3\text{ V to }5\text{ V}$ .

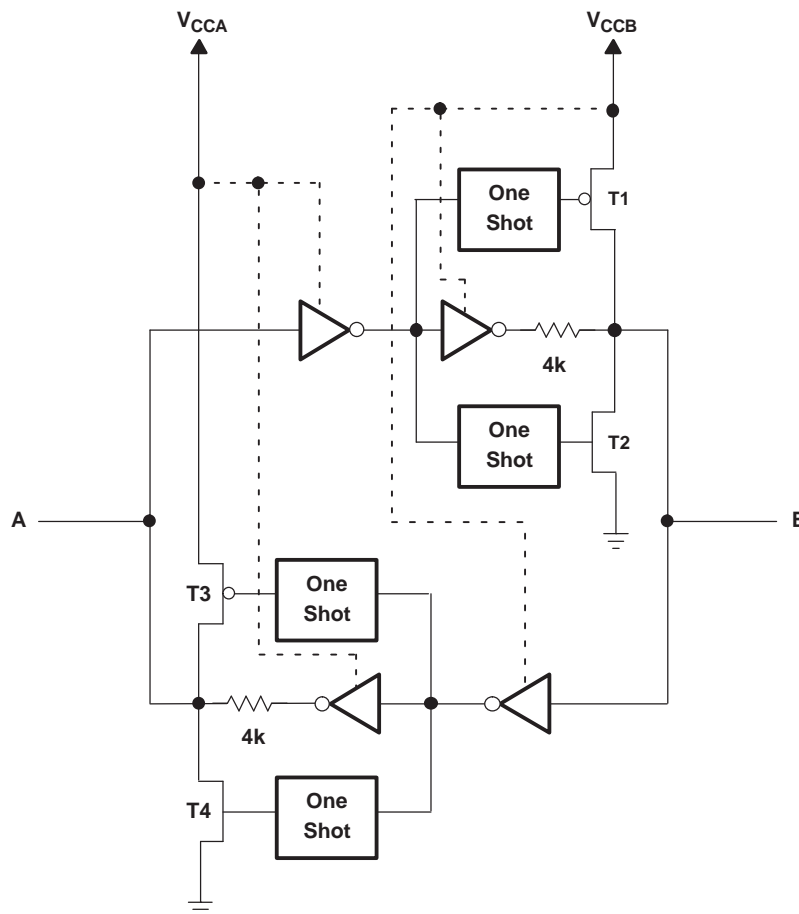
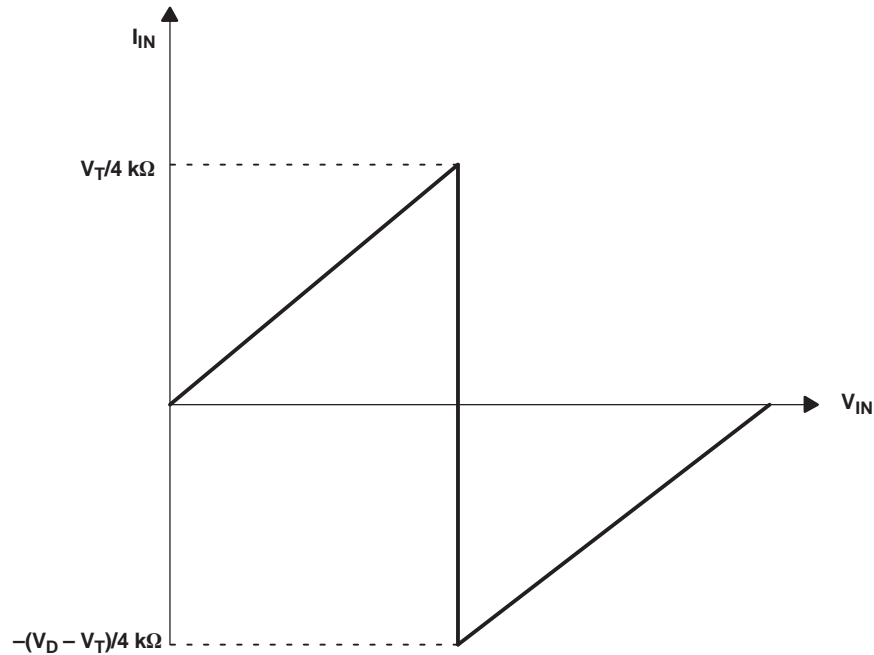


Figure 1. Architecture of TXB0108 I/O Cell

### Input Driver Requirements

Typical  $I_{IN}$  vs  $V_{IN}$  characteristics of the TXB0108 are shown in [Figure 2](#). For proper operation, the device driving the data I/Os of the TXB0108 must have drive strength of at least  $\pm 2\text{ mA}$ .



- A.  $V_T$  is the input threshold voltage of the TXB0108 (typically  $V_{CC}/2$ ).
- B.  $V_D$  is the supply voltage of the external driver.

**Figure 2. Typical  $I_{IN}$  vs  $V_{IN}$  Curve**

### Power Up

During operation, ensure that  $V_{CCA} \leq V_{CCB}$  at all times. During power-up sequencing,  $V_{CCA} \geq V_{CCB}$  does not damage the device, so any power supply can be ramped up first. The TXB0108 has circuitry that disables all output ports when either  $V_{CC}$  is switched off ( $V_{CCA/B} = 0 \text{ V}$ ).

### Enable and Disable

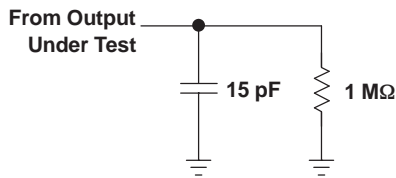
The TXB0108 has an OE input that is used to disable the device by setting OE = low, which places all I/Os in the high-impedance (Hi-Z) state. The disable time ( $t_{dis}$ ) indicates the delay between when OE goes low and when the outputs actually get disabled (Hi-Z). The enable time ( $t_{en}$ ) indicates the amount of time the user must allow for the one-shot circuitry to become operational after OE is taken high.

### Pullup or Pulldown Resistors on I/O Lines

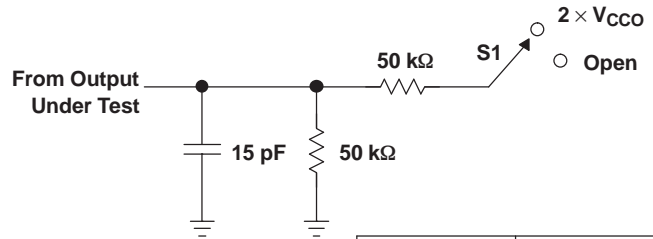
The TXB0108 is designed to drive capacitive loads of up to 70 pF. The output drivers of the TXB0108 have low dc drive strength. If pullup or pulldown resistors are connected externally to the data I/Os, their values must be kept higher than 50 k $\Omega$  to ensure that they do not contend with the output drivers of the TXB0108.

For the same reason, the TXB0108 should not be used in applications such as I<sup>2</sup>C or 1-Wire where an open-drain driver is connected on the bidirectional data I/O. For these applications, use a device from the TI TXS01xx series of level translators.

**PARAMETER MEASUREMENT INFORMATION**

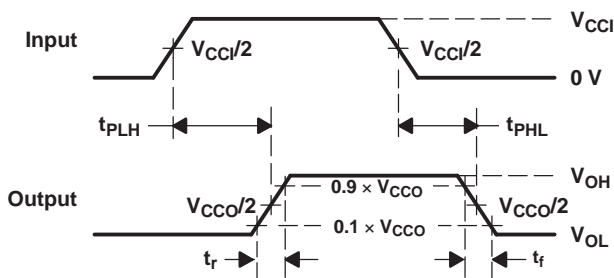


**LOAD CIRCUIT FOR MAX DATA RATE, PULSE DURATION PROPAGATION DELAY OUTPUT RISE AND FALL TIME MEASUREMENT**

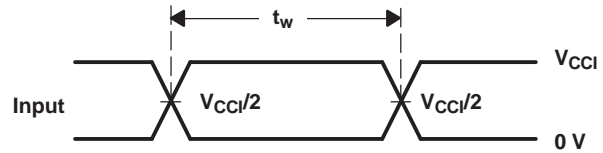


**LOAD CIRCUIT FOR ENABLE/DISABLE TIME MEASUREMENT**

TEST	S1
$t_{pZL}/t_{pLZ}$	$2 \times V_{CCO}$
$t_{pHZ}/t_{pZH}$	Open



**VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES**



**VOLTAGE WAVEFORMS PULSE DURATION**

- A.  $C_L$  includes probe and jig capacitance.
- B. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10$  MHz,  $Z_O = 50 \Omega$ ,  $dv/dt \geq 1$  V/ns.
- C. The outputs are measured one at a time, with one transition per measurement.
- D.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
- E.  $V_{CCI}$  is the  $V_{CC}$  associated with the input port.
- F.  $V_{CCO}$  is the  $V_{CC}$  associated with the output port.
- G. All parameters and waveforms are not applicable to all devices.

**Figure 3. Load Circuits and Voltage Waveforms**

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**REVISION HISTORY**

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**Changes from Revision C (August 2011) to Revision D** **Page**

- Added  $\pm 8$ -kV Human-Body Model (A114-B) (YZP Package Only) to Features ..... [1](#)
  - Added YZP TOP-SIDE MARKING. .... [2](#)
- 

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**Changes from Revision D (September 2011) to Revision E** **Page**

- Added notes to pin out graphics. .... [1](#)
-

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
TXB0108DQSR	ACTIVE	USON	DQS	20	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	5MR	<a href="#">Samples</a>
TXB0108PWR	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	YE08	<a href="#">Samples</a>
TXB0108PWRG4	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	YE08	<a href="#">Samples</a>
TXB0108RGYR	ACTIVE	VQFN	RGY	20	3000	Green (RoHS & no Sb/Br)	Call TI	Level-2-260C-1 YEAR	-40 to 85	YE08	<a href="#">Samples</a>
TXB0108RGYRG4	ACTIVE	VQFN	RGY	20	3000	Green (RoHS & no Sb/Br)	Call TI	Level-2-260C-1 YEAR	-40 to 85	YE08	<a href="#">Samples</a>
TXB0108YZPR	ACTIVE	DSBGA	YZP	20	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	5M	<a href="#">Samples</a>
TXB0108ZXYP	ACTIVE	BGA MICROSTAR JUNIOR	ZXY	20	2500	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	YE08	<a href="#">Samples</a>

(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) Only one of markings shown within the brackets will appear on the physical device.

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## 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
TXB0108DQSR	USON	DQS	20	3000	177.8	12.4	2.21	4.22	0.81	4.0	12.0	Q1
TXB0108PWR	TSSOP	PW	20	2000	330.0	16.4	6.95	7.1	1.6	8.0	16.0	Q1
TXB0108RGYR	VQFN	RGY	20	3000	330.0	12.4	3.8	4.8	1.6	8.0	12.0	Q1
TXB0108RGYR	VQFN	RGY	20	3000	330.0	12.4	3.8	4.8	1.6	8.0	12.0	Q1
TXB0108YZPR	DSBGA	YZP	20	3000	180.0	8.4	1.99	2.49	0.56	4.0	8.0	Q1
TXB0108ZXYR	BGA MICROSTAR JUNIOR	ZXY	20	2500	330.0	12.4	2.8	3.3	1.0	4.0	12.0	Q2



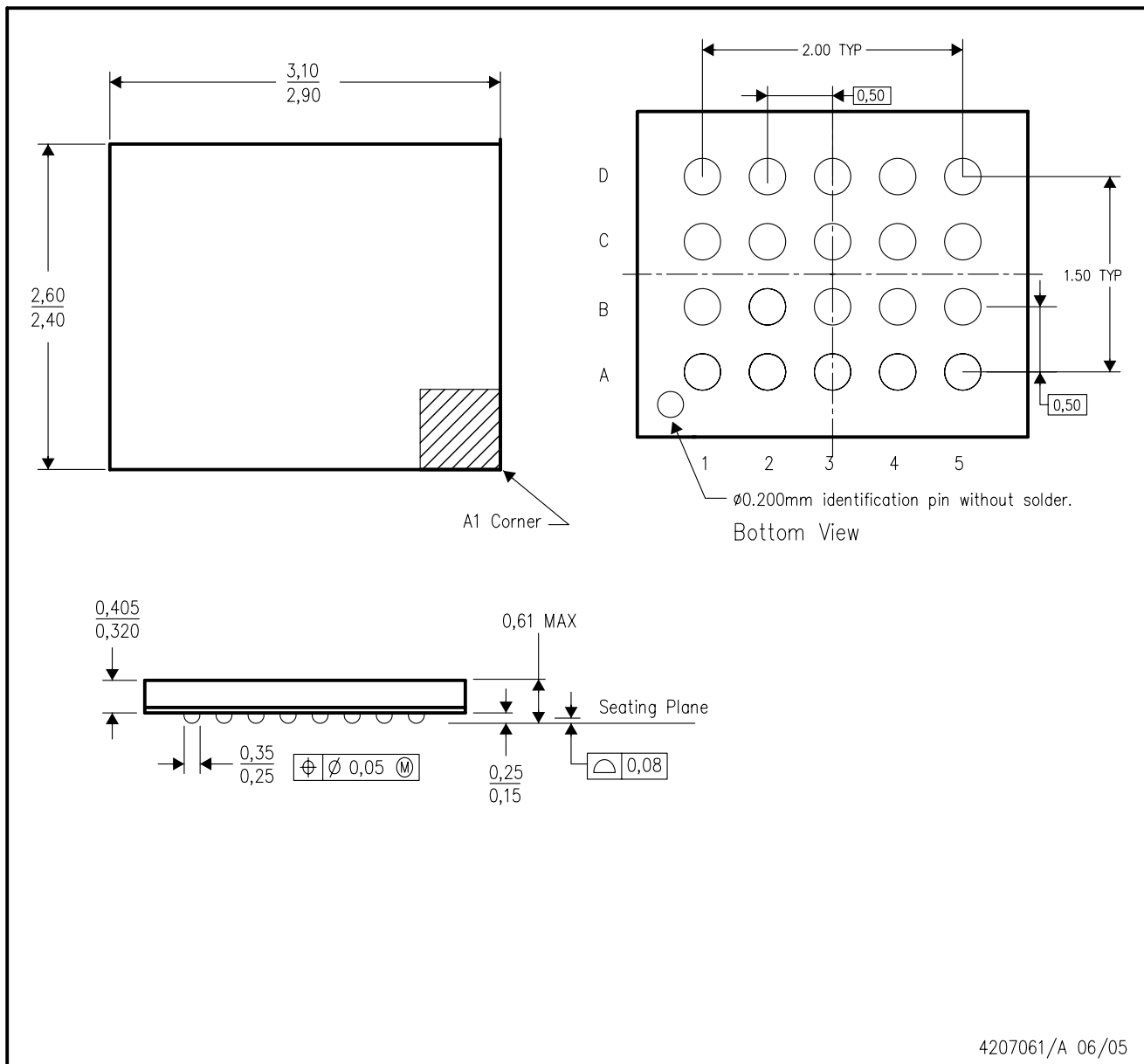
**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TXB0108DQSR	USON	DQS	20	3000	202.0	201.0	28.0
TXB0108PWR	TSSOP	PW	20	2000	367.0	367.0	38.0
TXB0108RGYR	VQFN	RGY	20	3000	367.0	367.0	35.0
TXB0108RGYR	VQFN	RGY	20	3000	355.0	350.0	50.0
TXB0108YZPR	DSBGA	YZP	20	3000	210.0	185.0	35.0
TXB0108ZXZR	BGA MICROSTAR JUNIOR	ZXY	20	2500	338.1	338.1	20.6

ZXY (S-PBGA-N20)

PLASTIC BALL GRID ARRAY



4207061/A 06/05

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. This package is a lead-free solder ball design.



PW (R-PDSO-G20)

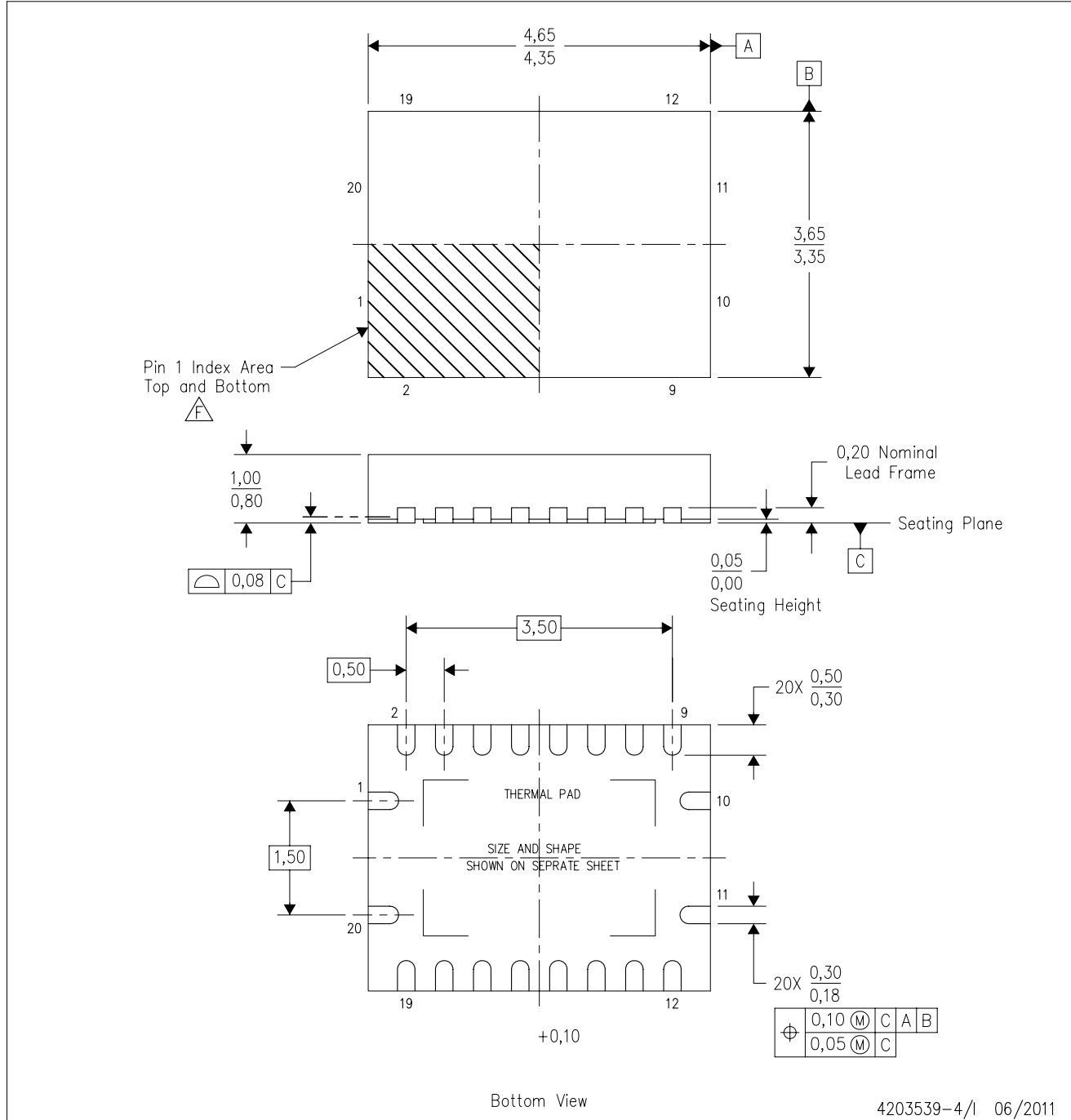
PLASTIC SMALL OUTLINE



- 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.

RGY (R-PVQFN-N20)

PLASTIC QUAD FLATPACK NO-LEAD



- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - This drawing is subject to change without notice.
  - QFN (Quad Flatpack No-Lead) package configuration.
  - The package thermal pad must be soldered to the board for thermal and mechanical performance.
  - See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
  - △ Pin 1 identifiers are located on both top and bottom of the package and within the zone indicated. The Pin 1 identifiers are either a molded, marked, or metal feature.
  - Package complies to JEDEC MO-241 variation BA.

RGY (R-PVQFN-N20)

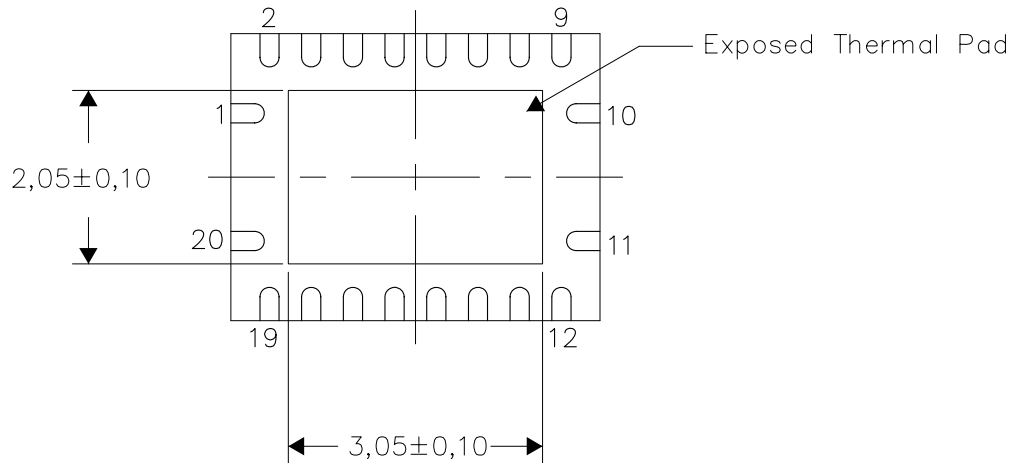
PLASTIC QUAD FLATPACK NO-LEAD

**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](http://www.ti.com).

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



Bottom View

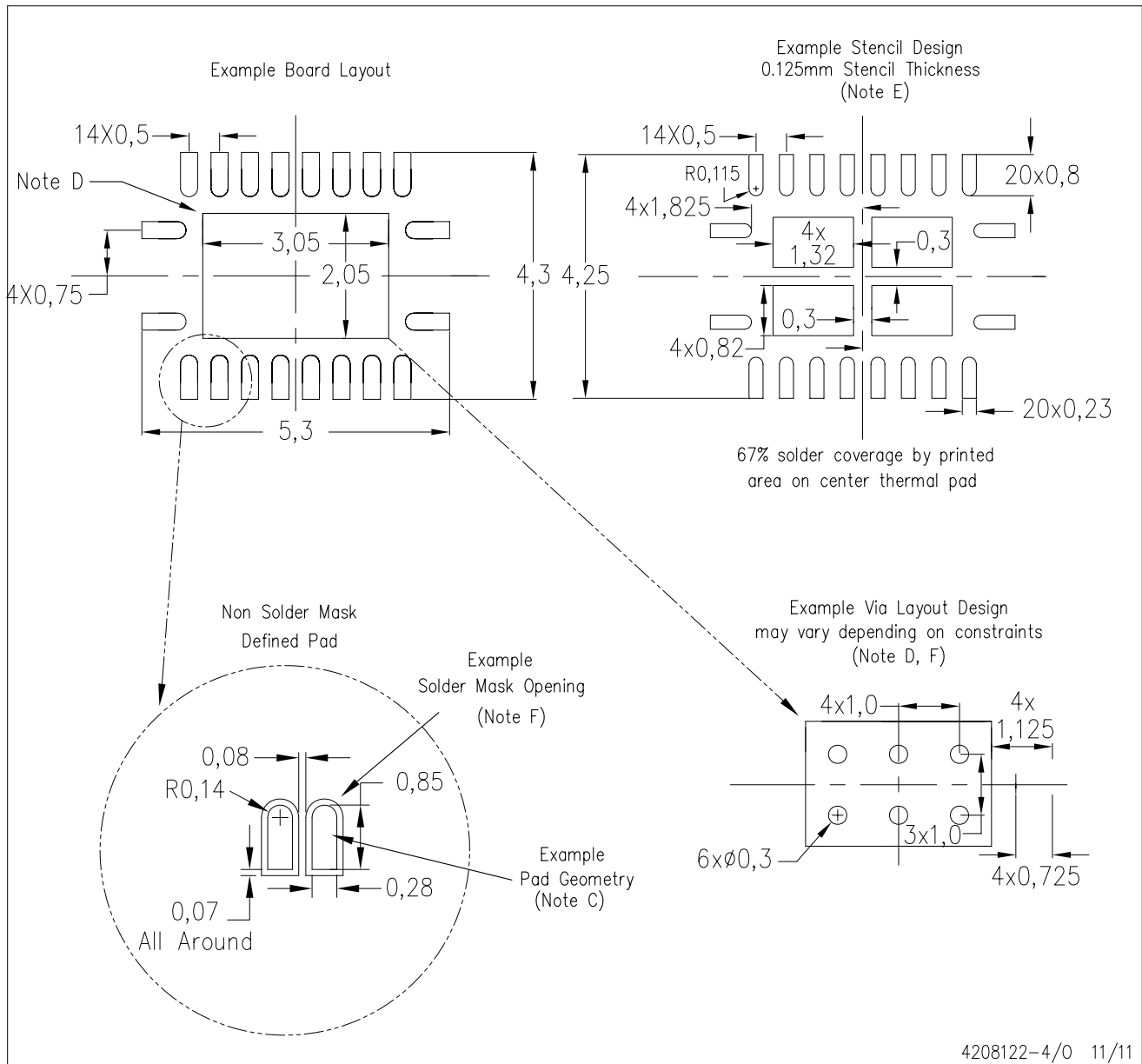
Exposed Thermal Pad Dimensions

4206353-4/0 11/11

NOTE: All linear dimensions are in millimeters

RGY (R-PVQFN-N20)

PLASTIC QUAD FLATPACK NO-LEAD

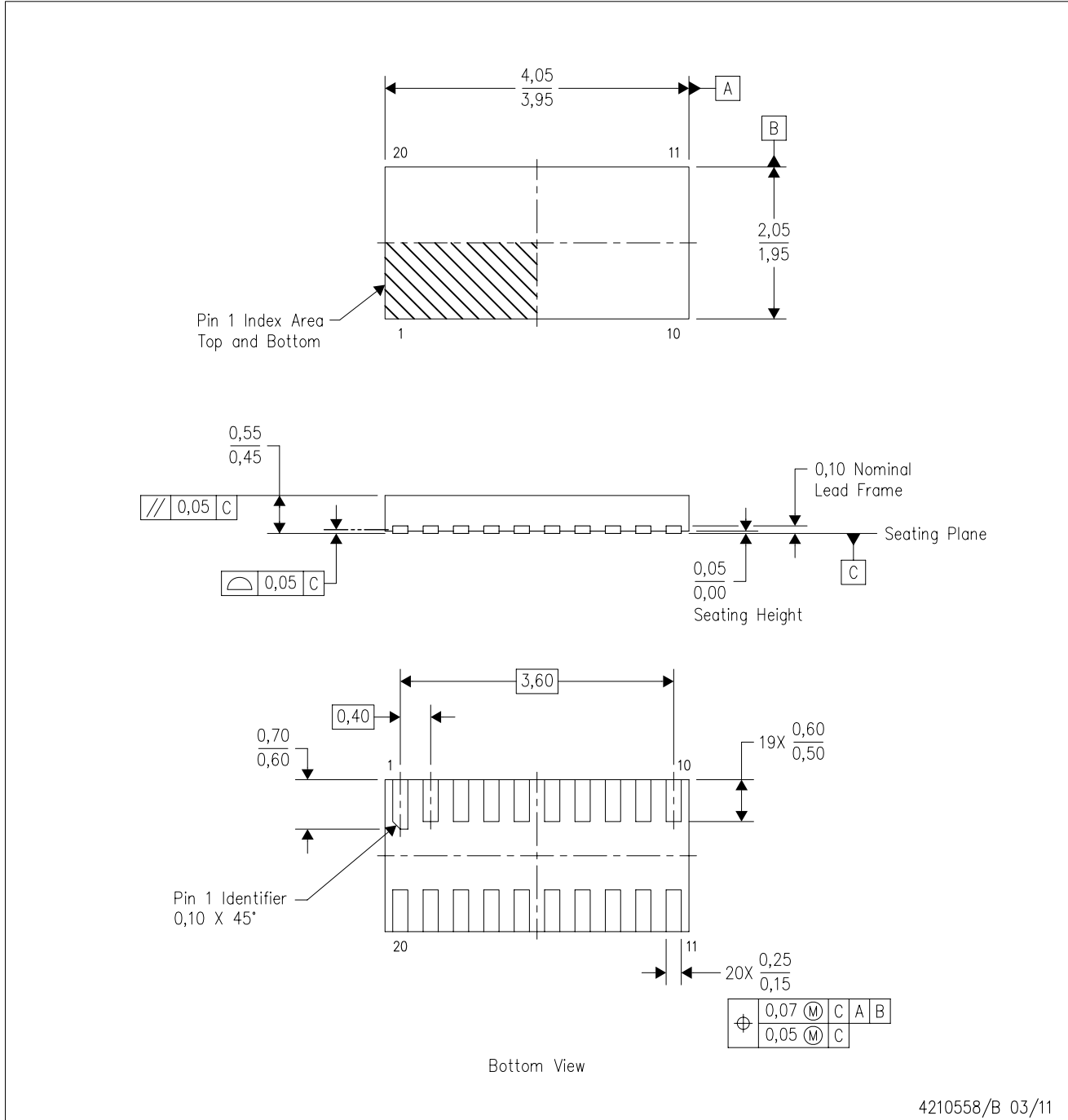


4208122-4/0 11/11

- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, Quad Flat-Pack QFN/SON PCB Attachment, 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) <<http://www.ti.com>>.
  - 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.
  - Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads.

DQS (R-PUSON-N20)

PLASTIC SMALL OUTLINE NO-LEAD

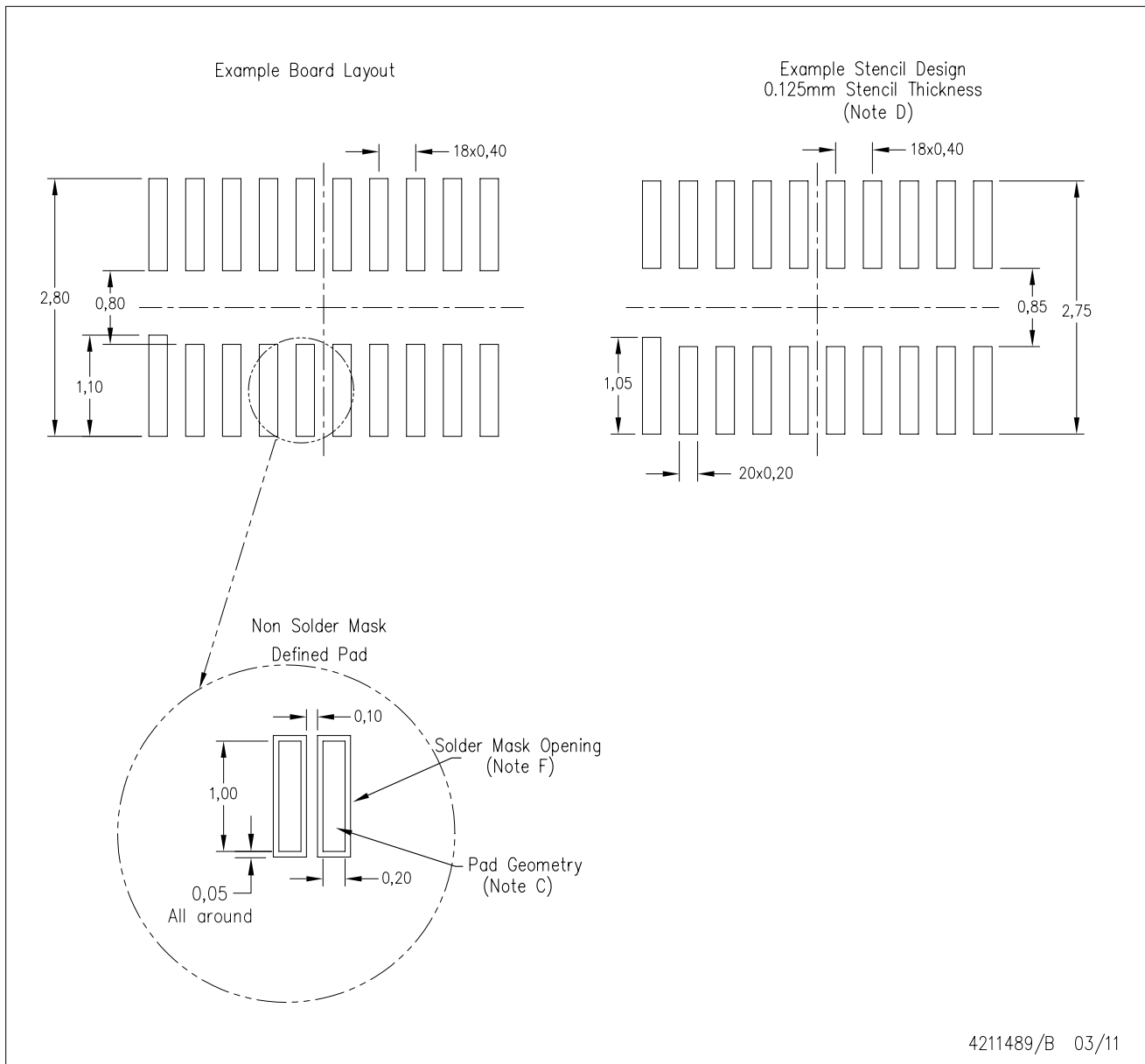


- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. SON (Small Outline No-Lead) package configuration.



DQS (R-PUSON-N20)

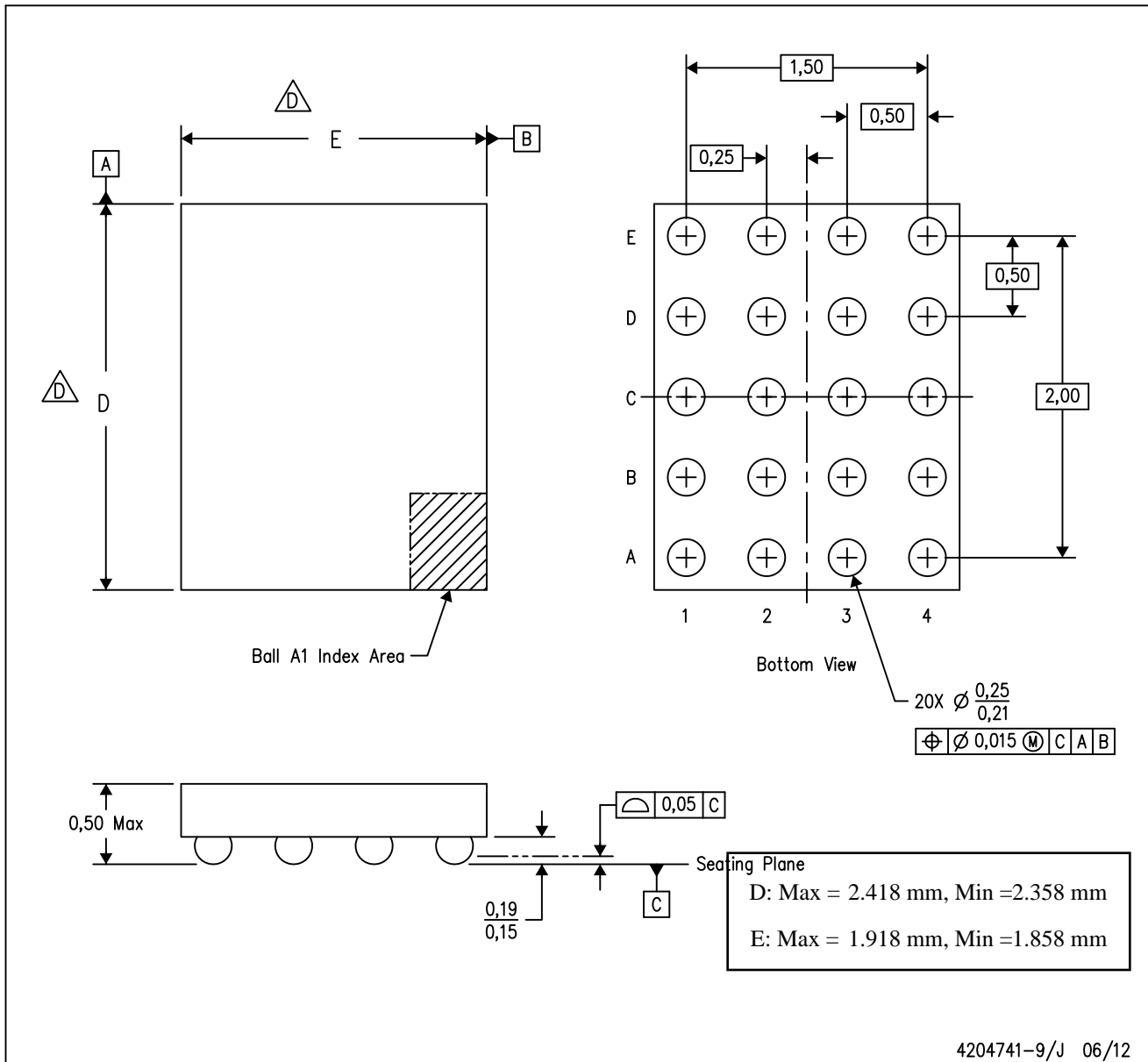
PLASTIC SMALL OUTLINE NO-LEAD



- 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 designs.
  - 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 minimum solder mask web tolerances between signal pads.

YZP (R-XBGA-N20)

DIE-SIZE BALL GRID ARRAY



- 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. NanoFree™ package configuration.
  - $\triangle$  The package size (Dimension D and E) of a particular device is specified in the device Product Data Sheet version of this drawing, in case it cannot be found in the product data sheet please contact a local TI representative.
  - E. This package is a Pb-free solder ball design.

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### Applications

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Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
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