

SDIO PORT EXPANDER WITH VOLTAGE-LEVEL TRANSLATION

FEATURES

- 6-to-12 Demultiplexer/Multiplexer Allows SDIO Port Expansion
- Built-in Level Translator Eliminates Voltage Mismatch Between Baseband and SD Card or SDIO Peripheral
- V_{CCA} , V_{CCB0} , and V_{CCB1} Each Operate Over Full 1.1-V to 3.6-V Range
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Performance A Port
 - 2000-V Human-Body Model (A114-B)
 - 100-V Machine Model (A115-A)
 - 1500-V Charged-Device Model (C101)
- ± 8 -kV Contact Discharge IEC 61000-4-2 ESD Performance (B Port)

DESCRIPTION/ORDERING INFORMATION

The TXS02612 is designed to interface the cell phone baseband with external SDIO peripherals. The device includes a 6-channel SPDT switch with voltage-level translation capability. This allows a single SDIO port to be interfaced with two SDIO peripherals. The TXS02612 has three separate supply rails that operate over the full range of 1.1 V to 3.6 V. This allows the baseband and SDIO peripherals to operate at different supply voltages if required.

The select (SEL) input is used to choose between the B0 port and B1 port. When SEL = Low, B0 port is selected; when SEL = High, B1 port is selected. SEL is referenced to V_{CCA} . For the unselected B port, the clock output is held low, whereas the data and command I/Os are pulled high to their respective V_{CCB} through a 70-k Ω resistor ($\pm 30\%$ tolerance).

ORDERING INFORMATION⁽¹⁾

T_A	PACKAGE ⁽²⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	MicroStar Junior™ BGA (VFBGA) – ZQS	Reel of 3000	TXS02612ZQSR	YJ612
	QFN – RTW	Reel of 3000	TXS02612RTWR	YJ612

(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.

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

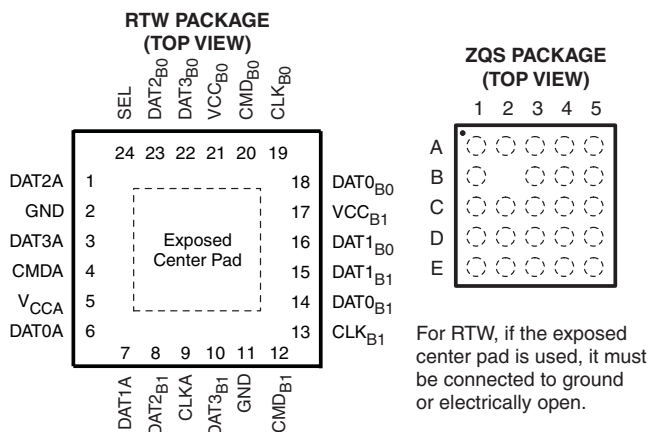


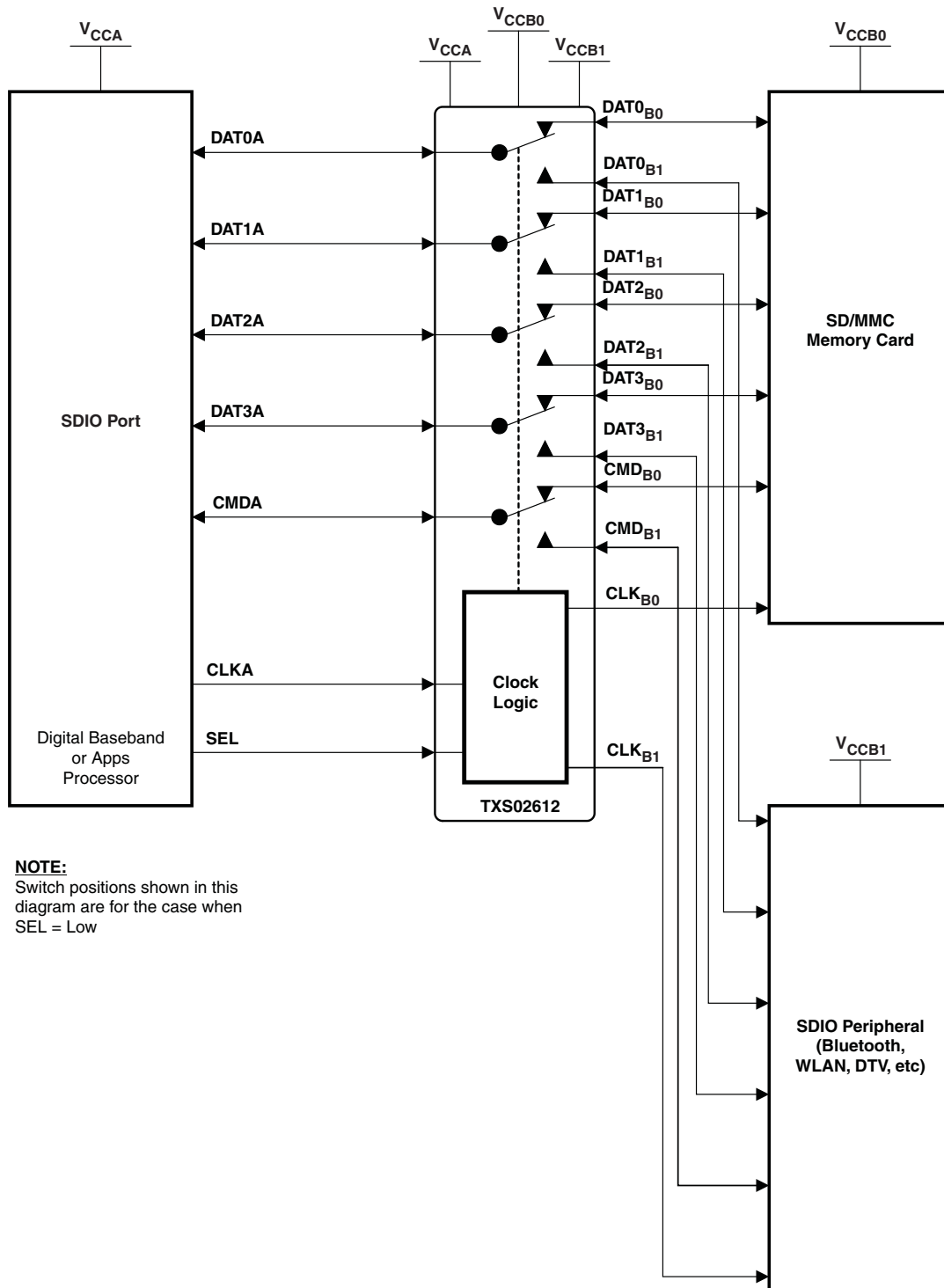
Table 1. ZQS PACKAGE TERMINAL ASSIGNMENTS

	1	2	3	4	5
A	DAT2A	SEL	DAT3 _{B0}	CMD _{B0}	CLK _{B0}
B	DAT3A		DAT2 _{B0}	V_{CCB0}	DAT0 _{B0}
C	CMDA	V_{CCA}	GND	V_{CCB1}	DAT1 _{B0}
D	DAT0A	CLKA	GND	DAT1 _{B1}	DAT0 _{B1}
E	DAT1A	DAT2 _{B1}	DAT3 _{B1}	CMD _{B1}	CLK _{B1}



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.

APPLICATION BLOCK DIAGRAM

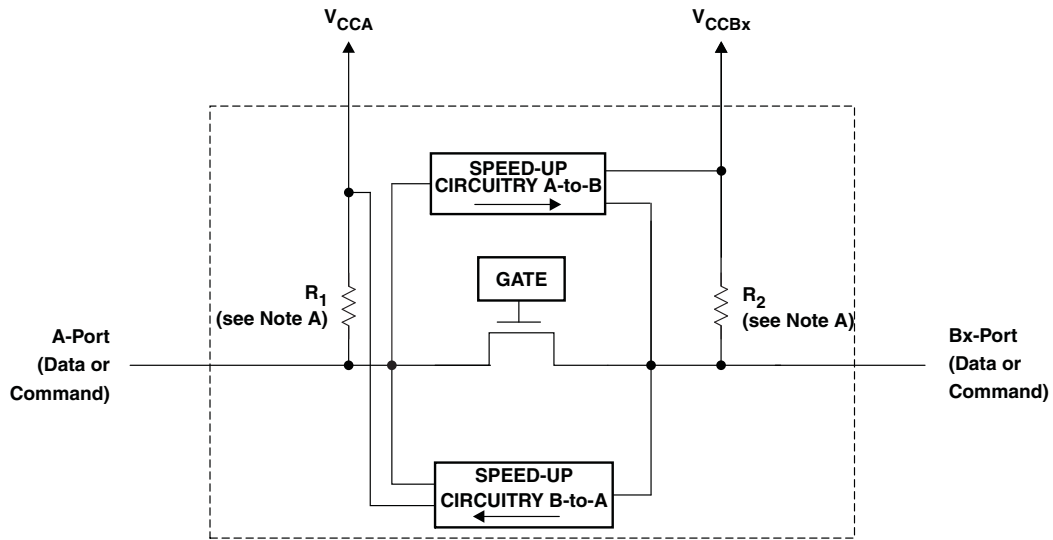


NOTE:
Switch positions shown in this diagram are for the case when $SEL = Low$

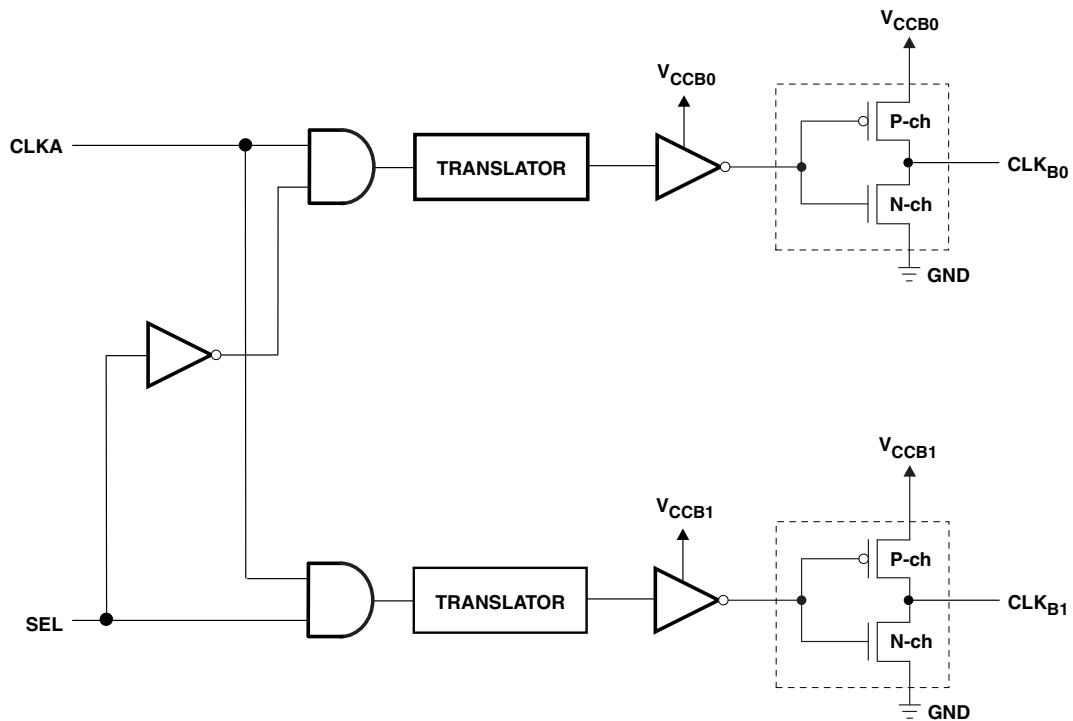
PIN ASSIGNMENTS

RTW PACKAGE PIN NO.	ZQS PACKAGE BALL NO.	NAME	FUNCTION	TYPE
1	A1	DAT2A	Data bit 2. Referenced to V_{CCA} .	I/O
3	B1	DAT3A	Data bit 3. Referenced to V_{CCA} .	I/O
4	C1	CMDA	Command bit. Referenced to V_{CCA} .	I/O
6	D1	DAT0A	Data bit 0. Referenced to V_{CCA} .	I/O
7	E1	DAT1A	Data bit 1. Referenced to V_{CCA} .	I/O
24	A2	SEL	Select pin to choose between B0 and B1. Referenced to V_{CCA} .	Input
	B2		Depopulated	
5	C2	V_{CCA}	A-port supply voltage. $1.1\text{ V} \leq V_{CCA} \leq 3.6\text{ V}$.	Power
9	D2	CLKA	Clock input A. Referenced to V_{CCA} .	Input
8	E2	DAT2 _{B1}	Data bit 2. Referenced to V_{CCB1} .	I/O
22	A3	DAT3 _{B0}	Data bit 3. Referenced to V_{CCB0} .	I/O
23	B3	DAT2 _{B0}	Data bit 2. Referenced to V_{CCB0} .	I/O
2	C3	GND	Ground	
11	D3	GND	Ground	
10	E3	DAT3 _{B1}	Data bit 3. Referenced to V_{CCB1} .	I/O
20	A4	CMD _{B0}	Command bit. Referenced to V_{CCB0} .	I/O
21	B4	V_{CCB0}	B0-port supply voltage. $1.1\text{ V} \leq V_{CCB0} \leq 3.6\text{ V}$.	Power
17	C4	V_{CCB1}	B1-port supply voltage. $1.1\text{ V} \leq V_{CCB1} \leq 3.6\text{ V}$.	Power
15	D4	DAT1 _{B1}	Data bit 1. Referenced to V_{CCB1} .	I/O
12	E4	CMD _{B1}	Command bit. Referenced to V_{CCB1} .	I/O
19	A5	CLK _{B0}	Clock output. Referenced to V_{CCB0} .	Output
18	B5	DAT0 _{B0}	Data bit 0. Referenced to V_{CCB0} .	I/O
16	C5	DAT1 _{B0}	Data bit 1. Referenced to V_{CCB0} .	I/O
14	D5	DAT0 _{B1}	Data bit 0. Referenced to V_{CCB1} .	I/O
13	E5	CLK _{B1}	Clock output. Referenced to V_{CCB1} .	Output

SIMPLIFIED INTERNAL STRUCTURE



Simplified Architecture of Command and Each Data Path



Simplified Architecture of the Clock Path

- A. R_1 and R_2 resistor values are determined based upon the logic level applied to the A port or B port, as follows:
 R_1 and $R_2 = 40\text{ k}\Omega$ when a logic level low is applied to the A port or B port.
 R_1 and $R_2 = 4\text{ k}\Omega$ when a logic level high is applied to the A port or B port.
 R_1 and $R_2 = 70\text{ k}\Omega$ when the port is deselected.

FUNCTION TABLE

Clock Channel			
SEL	CLKB0	CLKB1	OPERATION
L	Active	Low	CLKA to CLKB0
H	Low	Active	CLKA to CLKB1
Data and Command Channel			
SEL	DATxB0 or CMDxB0	DATxB1 or CMDxB1	OPERATION
L	Active	Disabled, pulled to V_{CCB1} through 70 k Ω	DATxA to DATxB0, CMDA to CMDB0
H	Disabled, pulled to V_{CCB0} through 70 k Ω	Active	DATxA to DATxB1, CMDA to CMDB1

ABSOLUTE MAXIMUM RATINGS^{(1) (2)}

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

		MIN	MAX	UNIT
V_{CCA} V_{CCB0} V_{CCB1}	Supply voltage range ⁽²⁾	-0.5	4.6	V
V_I	Input voltage range	-0.5	$V_{CCx} + 0.5$	V
V_O	Voltage range applied to any output in the high-impedance or power-off state	-0.5	$V_{CCx} + 0.5$	V
I_{IK}	Input clamp current	$V_I < 0$	-50	mA
I_{OK}	Output clamp current	$V_O < 0$	-50	mA
$I_{CC}/$ I_{GND}	Continuous current through V_{CCA} , V_{CCB0} , V_{CCB1} , or GND		± 100	mA
T_{stg}	Storage temperature range	-65	150	$^{\circ}\text{C}$

- (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 voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

PACKAGE THERMAL IMPEDANCE

PARAMETER			UNIT
θ_{JA}	Package thermal impedance	RTW package	66
		ZQS package	171.6

RECOMMENDED OPERATING CONDITIONS

		V_{CCA}	$V_{CCBx}^{(1)}$	MIN	MAX	UNIT	
V_{CCA} V_{CCB0} V_{CCB1}	Supply voltage			1.1	3.6	V	
V_{IH}	High-level input voltage	A-port I/Os	1.1 V to 3.6 V	1.1 V to 3.6 V	$V_{CCI} - 0.2$	V_{CCI}	V
		B-port I/Os			$V_{CCI} - 0.2$	V_{CCI}	
		SEL, CLKA			$V_{CCA} \times 0.65$ V	3.6	
V_{IL}	Low-level input voltage	A-port I/Os	1.1 V to 3.6 V	1.1 V to 3.6 V	0	0.15	V
		B-port I/Os			0	0.15	
		SEL, CLKA			0	$V_{CCA} \times 0.35$	
$\Delta t/\Delta v$	Input transition rise or fall rate	CLK, SEL			10	ns/V	
T_A	Operating free-air temperature			-40	85	°C	

(1) V_{CCBx} refers to V_{CCB0} and V_{CCB1} .

ELECTRICAL CHARACTERISTICS

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

PARAMETER	TEST CONDITIONS	V_{CCA}	V_{CCBx}	$T_A = 25^\circ\text{C}$	$T_A = -40^\circ\text{C to } 85^\circ\text{C}$		UNIT
				TYP	MIN	MAX	
V_{OHA} (DATA & CMD)	$I_{OH} = -20 \mu\text{A}$, $V_{IBx} \geq V_{CCBx} - 0.2$ V	1.1 V	1.1 V		0.74		V
		1.4 V	1.4 V		$V_{CCA} \times 0.67$		
		1.65 V	1.65 V		$V_{CCA} \times 0.67$		
		2.3 V	2.3 V		$V_{CCA} \times 0.67$		
		3 V	3 V		$V_{CCA} \times 0.67$		
V_{OLA} (DATA & CMD)	$I_{OL} = 135 \mu\text{A}$, $V_{IBx} \leq 0.15$ V	1.1 V	1.1 V		0.35		V
		1.4 V	1.4 V		0.35		
		1.65 V	1.65 V		0.45		
		2.3 V	2.3 V		0.55		
		3 V	3 V		0.70		
V_{OHB} (DATA & CMD)	$I_{OH} = -20 \mu\text{A}$, $V_{IAX} \geq V_{CCAx} - 0.2$ V	1.1 V	1.1 V		0.74		V
		1.4 V	1.4 V		$V_{CCBx} \times 0.67$		
		1.65 V	1.65 V		$V_{CCBx} \times 0.67$		
		2.3 V	2.3 V		$V_{CCBx} \times 0.67$		
		3 V	3 V		$V_{CCBx} \times 0.67$		
V_{OHCLKB}	$I_{OH} = -0.5$ mA	1.1 V	1.1 V		0.74		V
		1.4 V	1.4 V		1.05		
		1.65 V	1.65 V		1.2		
		2.3 V	2.3 V		1.75		
		3 V	3 V		2.3		
V_{OLB} (DATA & CMD)	$I_{OL} = 135 \mu\text{A}$, $V_{IAX} \leq 0.15$ V	1.1 V	1.1 V		0.35		V
		1.4 V	1.4 V		0.35		
		1.65 V	1.65 V		0.45		
		2.3 V	2.3 V		0.55		
		3 V	3 V		0.70		
V_{OLCLKB}	$I_{OL} = 0.5$ mA	1.1 V	1.1 V		0.35		V
		1.4 V	1.4 V		0.35		
		1.65 V	1.65 V		0.45		
		2.3 V	2.3 V		0.55		
		3 V	3 V		0.7		

ELECTRICAL CHARACTERISTICS (continued)

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

PARAMETER	TEST CONDITIONS	V _{CCA}	V _{CCBx}	T _A = 25°C		T _A = -40°C to 85°C		UNIT
				TYP	MIN	MAX		
I _I	SEL, CLKA	1.1 V to 3.6 V	1.1 V to 3.6 V	±1	±2		μA	
	DAT, CMD			±1	±2			
I _{CCA}	V _I = V _O = Open, I _O = 0, SEL, CLK = High or Low	1.1 V to 3.6 V	1.1 V to 3.6 V		12		μA	
		3.6 V	0 V		12			
		0 V	3.6 V		-1			
I _{CCB0} or I _{CCB1}	V _I = V _O = Open, I _O = 0, SEL, CLK = High or Low	1.1 V to 3.6 V	1.1 V to 3.6 V		24		μA	
		3.6 V	0 V		-12			
		0 V	3.6 V		24			
C _i	SEL, CLKA	3.3 V	3.3 V	2.5	3.5		pF	
C _{io}	A port	3.3 V	3.3 V	7	7.5		pF	
	B port			9.5	10			

TIMING REQUIREMENTS

 T_A = 25°C, V_{CCA} = 1.2 V

			V _{CCB} = 1.2 V	V _{CCB} = 1.5 V	V _{CCB} = 1.8 V	V _{CCB} = 2.5 V	V _{CCB} = 3.3 V	UNIT	
			TYP	TYP	TYP	TYP	TYP		
Data rate	Command	Push-pull driving	60	80	120	120	120	Mbps	
		Open-drain driving	2	2	2	2	2		
	Clock	Push-pull driving	30	40	60	60	60	MHz	
	Data	Push-pull driving	60	80	120	120	120	Mbps	
t _w	Pulse duration	Push-pull driving	CLK	17	13	8	8	8	ns
		Open-drain driving	CMD	500	500	500	500	500	
		Push-pull driving	Data	17	13	8	8	8	
			CMD	17	13	8	8	8	

TIMING REQUIREMENTS

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

			$V_{CCB} = 1.2 \text{ V}$	$V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$		$V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Data rate	Command	Push-pull driving	60	80		120		120		120		Mbps
		Open-drain driving	2	2		2		2		2		
	Data	Push-pull driving	30	40		60		60		60		MHz
		Push-pull driving	60	80		120		120		120		
t_w	Pulse duration	Push-pull driving	17	13	8		8		8		ns	
		Open-drain driving	500	500	500		500		500			
		Push-pull driving	Data	17	13	8		8		8		
			CMD	17	13	8		8		8		

TIMING REQUIREMENTS

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

			$V_{CCB} = 1.2 \text{ V}$	$V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$		$V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Data rate	Command	Push-pull driving	60	80		120		120		120		Mbps
		Open-drain driving	2	2		2		2		2		
	Data	Push-pull driving	30	40		60		60		60		MHz
		Push-pull driving	60	80		120		120		120		
t_w	Pulse duration	Push-pull driving	17	13	8		8		8		ns	
		Open-drain driving	500	500	500		500		500			
		Push-pull driving	Data	17	13	8		8		8		
			CMD	17	13	8		8		8		

TIMING REQUIREMENTS

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

			$V_{CCB} = 1.2 \text{ V}$	$V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$		$V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Data rate	Command	Push-pull driving	60	80		120		120		120		Mbps
		Open-drain driving	2	2		2		2		2		
	Data	Push-pull driving	30	40		60		60		60		MHz
		Push-pull driving	60	80		120		120		120		Mbps
t_w	Pulse duration	Push-pull driving	17	13	8		8		8		ns	
		Open-drain driving	500	500	500		500		500			
		Push-pull driving	Data	17	13	8		8		8		
			CMD	17	13	8		8		8		

TIMING REQUIREMENTS

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

			$V_{CCB} = 1.2 \text{ V}$	$V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$		$V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Data rate	Command	Push-pull driving	60	80		120		120		120		Mbps
		Open-drain driving	2	2		2		2		2		
	Data	Push-pull driving	30	40		60		60		60		MHz
		Push-pull driving	60	80		120		120		120		Mbps
t_w	Pulse duration	Push-pull driving	17	13	8		8		8		ns	
		Open-drain driving	500	500	500		500		500			
		Push-pull driving	Data	17	13	8		8		8		
			CMD	17	13	8		8		8		

SWITCHING CHARACTERISTICS

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	$V_{CCB} = 1.2\text{ V}$	$V_{CCB} = 1.5\text{ V}$	$V_{CCB} = 1.8\text{ V}$	$V_{CCB} = 2.5\text{ V}$	$V_{CCB} = 3.3\text{ V}$	UNIT
				TYP	TYP	TYP	TYP	TYP	
t_{PD}	CMDA	CMDB	Push-pull driving	5.9	4.8	4.4	4	4.46	ns
			Open-drain driving	238	214	192	159	140	
	CMDB	CMDA	Push-pull driving	5.6	4.8	4.4	4.1	4	
			Open-drain driving	227	201	176	137	114	
	CLKA	CLKB	Push-pull driving	5.5	4.1	3.6	3.2	3	
	DATA	DATB	Push-pull driving	5.8	4.8	4.4	4.2	6.8	
	DATB	DATA		5.6	4.8	4.4	4.1	4	
SEL	B-Port	Push-pull driving	13	11	10	9.4	9.1		
t_{rA}	A-port rise time		Push-pull driving	4.8	5.1	5.1	5.3	5.7	ns
t_{rB}	B-port rise time		Push-pull driving	6.1	3.8	2.9	1.9	1.5	
t_{rB}	CLKA	CLKB	Push-pull driving	5.2	3.4	2.6	1.7	1.3	
t_{fA}	A-port fall time		Push-pull driving	3.4	2.8	2.6	2.6	2.6	
t_{fB}	B-port fall time		Push-pull driving	4.2	3	2.3	1.7	1.5	
t_{fB}	CLKA	CLKB	Push-pull driving	3.1	2.1	1.6	1.2	1	
$t_{sk(O)}$	ChA-to-ChB skew		Push-pull driving	0.4	0.4	0.3	0.4	0.4	ns
	ChB-to-ChA skew		Push-pull driving	0.3	0.3	0.3	0.3	0.4	
	Channel-to-Clock skew		Push-pull driving	1.68	1.5	1.5	1.5	1.7	
Max data rate	Command		Push-pull driving	60	80	120	120	120	Mbps
			Open-drain driving	2	2	2	2	2	
	Clock		Push-pull driving	30	40	60	60	60	MHz
	Data		Push-pull driving	60	80	120	120	120	Mbps

SWITCHING CHARACTERISTICS

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	$V_{CCB} = 1.2\text{ V}$		$V_{CCB} = 1.5\text{ V} \pm 0.1\text{ V}$		$V_{CCB} = 1.8\text{ V} \pm 0.15\text{ V}$		$V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$		$V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$		UNIT
				TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
t_{PD}	CMDA	CMDB	Push-pull driving	5.1		13		9		8		7.5	ns	
			Open-drain driving	210		777		756		684		758		
	CMDB	CMDA	Push-pull driving	4.5		10.6		9.2		8.5		8.2		
			Open-drain driving	200		616		560		433		375		
	CLKA	CLKB	Push-pull driving	4.7		13.1		9.8		6		5.2		
	DATA	DATB	Push-pull driving	5.1		13		9		8		7.8		
	DATB	DATA		4.5		11		9.3		8.8		8.4		
SEL	B-Port	Push-pull driving	9.5		26		21		19		18			
t_{rA}	A-port rise time		Push-pull driving	2.7	1.5	5.8	1.7	5.9	1.7	6	1.8	6.1	ns	
t_{rB}	B-port rise time		Push-pull driving	3.3	1.7	8.2	1.3	6.6	1	4.3	0.8	2.9		
t_{rB}	CLKA	CLKB	Push-pull driving	5.2	1.7	6.4	1.3	4.9	0.9	3.2	0.8	2.5	ns	
t_{fA}	A-port fall time		Push-pull driving	2.4	1	3.9	0.9	3.4	0.9	3.2	1.3	3.3		
t_{fB}	B-port fall time		Push-pull driving	3.7	1.1	6.3	0.9	5.2	0.6	3.9	0.6	3.2	ns	
t_{fB}	CLKA	CLKB	Push-pull driving	3.1	0.9	4.1	0.8	3.2	0.5	2.2	0.5	1.9		
$t_{sk(O)}$	ChA-to-ChB skew		Push-pull driving	0.32		0.47		0.58		0.63		0.63	ns	
	ChB-to-ChA skew		Push-pull driving	0.27		0.24		0.23		0.22		0.22		
	Channel-to-Clock skew		Push-pull driving	1.47		1.66		1.68		1.82		1.77		
Max data rate	Command		Push-pull driving	60		80		120		120		120	Mbps	
			Open-drain driving	2		2		2		2		2		
	Clock		Push-pull driving	30		40		60		60		60	MHz	
	Data		Push-pull driving	60		80		120		120		120	Mbps	

SWITCHING CHARACTERISTICS

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	$V_{CCB} = 1.2 \text{ V}$		$V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$		$V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		UNIT
				TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
t_{PD}	CMDA	CMDB	Push-pull driving	4.8		12		8		6		5.7	ns	
			Open-drain driving	183		726		715		686		780		
	CMDB	CMDA	Push-pull driving	4		9		7		6.4		6		
			Open-drain driving	175		565		563		441		392		
	CLKA	CLKB	Push-pull driving	4.5		13		9		5.4		4.5		
	DATA	DATB	Push-pull driving	4.7		12		8.4		6		5.8		
	DATB	DATA		4.1		9		7.5		6.4		6.3		
SEL	B-Port	Push-pull driving	8.2		22		17		14.8		14			
t_{rA}	A-port rise time		Push-pull driving	2	1.1	4	1.1	4.3	1.2	4.5	1.3	4.6	ns	
t_{rB}	B-port rise time		Push-pull driving	6.2	1.7	7.9	1.2	6.2	1	4.3	0.8	3.1		
t_{fB}	CLKA	CLKB	Push-pull driving	5.2	1.7	6.4	1.3	4.9	0.9	3.2	0.8	2.5	ns	
t_{fA}	A-port fall time		Push-pull driving	1.8	0.8	3.2	0.7	2.8	0.7	1.7	0.7	2.6		
t_{fB}	B-port fall time		Push-pull driving	3.5	1	5.6	0.9	3.5	0.6	1.9	0.6	3	ns	
t_{fB}	CLKA	CLKB	Push-pull driving	3.1	0.9	4.1	0.8	3.2	0.5	2.2	0.5	1.9		
$t_{sk(O)}$	ChA-to-ChB skew		Push-pull driving	0.33		0.45		0.48		0.53		0.67	ns	
	ChB-to-ChA skew		Push-pull driving	0.28		0.24		0.23		0.23		0.22		
	Channel-to-Clock skew		Push-pull driving	1.51		1.58		1.46		1.56		1.48		
Max data rate	Command		Push-pull driving	60		80		120		120		120	Mbps	
			Open-drain driving	2		2		2		2		2		
	Clock		Push-pull driving	30		40		60		60		60	MHz	
	Data		Push-pull driving	60		80		120		120		120	Mbps	

SWITCHING CHARACTERISTICS

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	$V_{CCB} = 1.2 \text{ V}$		$V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$		$V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		UNIT
				TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
t_{PD}	CMDA	CMDB	Push-pull driving	4.4		11		7.4		4.4		3.8	ns	
			Open-drain driving	143		544		596		605		669		
	CMDB	CMDA	Push-pull driving	3.8		7.6		5.5		4.2		3.7		
			Open-drain driving	137		434		444		414		372		
	CLKA	CLKB	Push-pull driving	4.1		12		8		4.8		3.8		
	DATA	DATB	Push-pull driving	4.4		11		7		4.5		3.8		
	DATB	DATA		4.4		8		5.5		4.1		3.7		
SEL	B-Port	Push-pull driving	7		18		13		10.5		9			
t_{rA}	A-port rise time		Push-pull driving	1.4	0.75	2.2	0.74	2.2	1.06	2.6	0.7	2.8	ns	
t_{rB}	B-port rise time		Push-pull driving	6.3	1.91	7.7	1.34	6.1	0.95	4.2	0.83	3.2		
t_{rB}	CLKA	CLKB	Push-pull driving	5.2	1.67	6.4	1.27	4.9	0.9	3.2	0.76	2.6	ns	
t_{fA}	A-port fall time		Push-pull driving	1.1	0.58	1.9	0.58	2	0.61	1.9	0.57	1.9		
t_{fB}	B-port fall time		Push-pull driving	3.6	1.04	5.4	0.87	4.3	0.66	3.4	0.57	3	ns	
t_{fB}	CLKA	CLKB	Push-pull driving	3.1	0.92	4.2	0.79	3.2	0.56	2.2	0.49	1.9		
$t_{sk(O)}$	ChA-to-ChB skew		Push-pull driving	0.41		0.43		0.39		0.59		0.68	ns	
	ChB-to-ChA skew		Push-pull driving	0.41		0.24		0.2		0.19		0.18		
	Channel-to-Clock skew		Push-pull driving	2.11		1.47		1.3		1.25		1.21		
Max data rate	Command		Push-pull driving	60		80		120		120		120	Mbps	
			Open-drain driving	2		2		2		2		2		
	Clock		Push-pull driving	30		40		60		60		60	MHz	
	Data		Push-pull driving	60		80		120		120		120	Mbps	

SWITCHING CHARACTERISTICS

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	$V_{CCB} = 1.2 \text{ V}$		$V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$		$V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		UNIT
				TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	
t_{PD}	CMDA	CMDB	Push-pull driving	4.4		11			7		4.1		3.3	ns
			Open-drain driving	116		432			477		506		533	
	CMDB	CMDA	Push-pull driving	4.2		7.5			5.4		3.8		3	
			Open-drain driving	112		349			363		347		324	
	CLKA	CLKB	Push-pull driving	4.1		12			7.8		4.4		3.5	
	DATA	DATB	Push-pull driving	4.3		11			6.8		4		3.8	
	DATB	DATA		7.9		7.8			5.4		3.4		3	
SEL	B-Port	Push-pull driving	6.4		16			11.5		8.8		7.6		
t_{rA}	A-port rise time		Push-pull driving	1.1	0.57	1.7	0.57	1.8	0.56	1.7	0.53	1.8	ns	
t_{rB}	B-port rise time		Push-pull driving	6.2	1.96	7.7	1.43	6.1	0.95	4.2	0.71	3.1		
t_{fB}	CLKA	CLKB	Push-pull driving	5.2	1.67	6.4	1.26	4.9	0.91	3.3	0.76	2.5	ns	
t_{fA}	A-port fall time		Push-pull driving	1	0.53	1.6	0.52	1.6	0.53	1.6	0.56	1.6		
t_{fB}	B-port fall time		Push-pull driving	3.4	0.95	5.2	0.8	4.1	0.63	3.2	0.58	2.9	ns	
t_{fB}	CLKA	CLKB	Push-pull driving	3.1	0.92	4.1	0.79	3.2	0.56	2.2	0.49	1.9		
$t_{sk(O)}$	ChA-to-ChB skew		Push-pull driving	0.39		0.36		0.39		0.57		0.65	ns	
	ChB-to-ChA skew		Push-pull driving	0.45		0.3		0.19		0.19		0.18		
	Channel-to-Clock skew		Push-pull driving	1.7		1.61		1.34		1.22		1.14		
Max data rate	Command		Push-pull driving	60		80		120		120		120	Mbps	
			Open-drain driving	2		2		2		2		2		
	Clock		Push-pull driving	30		40		60		60		60	MHz	
	Data		Push-pull driving	60		80		120		120		120	Mbps	

OPERATING CHARACTERISTICS

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

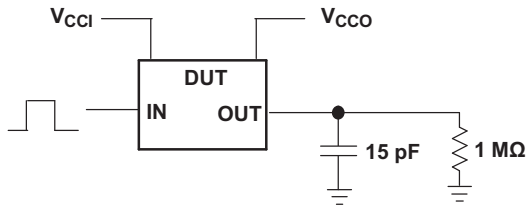
PARAMETER			TEST CONDITIONS	V_{CCA}					UNIT
				1.2 V	1.5 V	1.8 V	2.5 V	3.3 V	
				V_{CCB}					
				1.2 V	1.5 V	1.8 V	2.5 V	3.3 V	
				TYP	TYP	TYP	TYP	TYP	
Data and CMD	C_{pdA}	A-port input, B-port output	$C_L = 0$, $f = 10 \text{ MHz}$, $t_r = t_f = 1 \text{ ns}$, OE = outputs enabled	14.5	12.9	12.1	13.4	15	pF
		B-port input, A-port output		20.7	20.7	21	22	23.2	
	C_{pdB}	A-port input, B-port output		23.2	23.4	23.6	24.5	25.5	
		B-port input, A-port output		14.1	12.2	11.5	12.9	14.4	
		A-port input, B-port output		0.1	0.1	0.1	0.1	0.1	
Clock	C_{pdA}	A-port input, B-port output	$C_L = 0$, $f = 10 \text{ MHz}$, $t_r = t_f = 1 \text{ ns}$, OE = outputs enabled	0.4	0.4	0.4	0.5	0.7	pF
	C_{pdB}	B-port input, A-port output		14	13.9	13.8	13.8	13.7	

POWER-UP CONSIDERATIONS

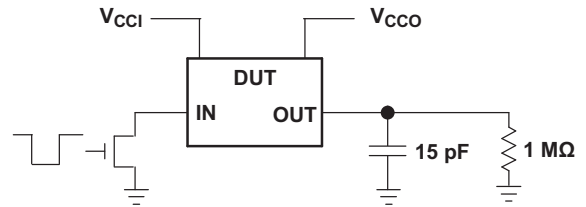
The following power-up sequence for this TXS02612 SDIO port expander with voltage-level translator should be followed to ensure proper operation and to avoid any unnecessary excessive supply current, bus contention, oscillations, or other anomalies caused by improperly biased device pins. The following power-up sequence should be used to safe-guard against these problems:

1. Connect the ground pin of the device first before any power-supply voltage is applied.
2. Connect and power up V_{CCA} , which internally powers up the SEL control logic of the TXS02612.
3. Depending on the port to be chosen, the SEL pin can be high or low. If SEL high is needed (i.e., A port to B₁ port), ramp the SEL pin with the V_{CCA} power supply. Otherwise, keep SEL Low.
4. Apply V_{CCB0} and V_{CCB1} only after the V_{CCA} power supply is applied.

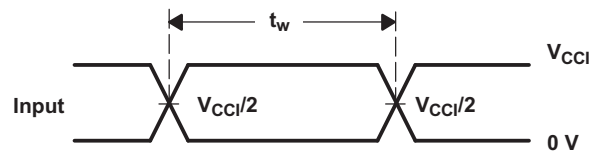
PARAMETER MEASUREMENT INFORMATION



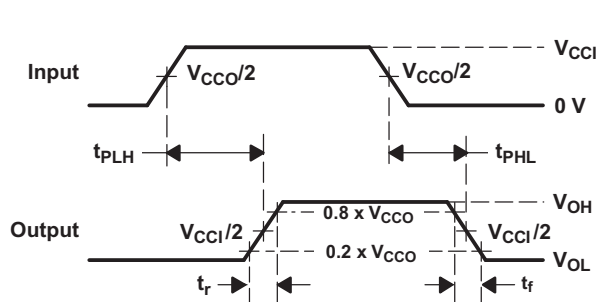
DATA RATE, PULSE DURATION, PROPAGATION DELAY, ENABLE/DISABLE OUTPUT RISE AND FALL TIME MEASUREMENT USING A PUSH-PULL DRIVER



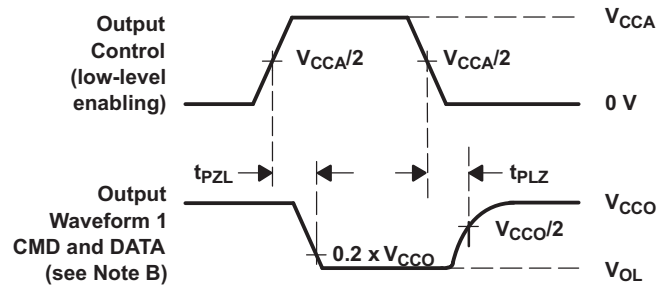
DATA RATE, PULSE DURATION, PROPAGATION DELAY, OUTPUT RISE AND FALL TIME MEASUREMENT USING AN OPEN-DRAIN DRIVER



VOLTAGE WAVEFORMS PULSE DURATION



VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS ENABLE AND DISABLE TIMES

- NOTES:
- A. C_L includes probe and jig capacitance.
 - B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
 - C. All input pulses are supplied by generators having the following characteristics: PRR = 10 MHz, $Z_O = 50\Omega$, $dv/dt \geq 1$ V/ns.
 - D. The outputs are measured one at a time, with one transition per measurement.
 - E. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - F. t_{PZL} and t_{PZH} are the same as t_{en} .
 - G. t_{PLH} and t_{PHL} are the same as t_{cd} .
 - H. V_{CCI} is the V_{CC} associated with the input port.
 - I. V_{CCO} is the V_{CC} associated with the output port.
 - J. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

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)	Device Marking (4/5)	Samples
TXS02612RTWR	ACTIVE	WQFN	RTW	24	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	YJ612	Samples
TXS02612ZQSR	ACTIVE	BGA MICROSTAR JUNIOR	ZQS	24	2500	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	YJ612	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.

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.

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
TXS02612RTWR	WQFN	RTW	24	3000	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
TXS02612ZQSR	BGA MICROSTAR JUNIOR	ZQS	24	2500	330.0	12.4	3.3	3.3	1.6	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS

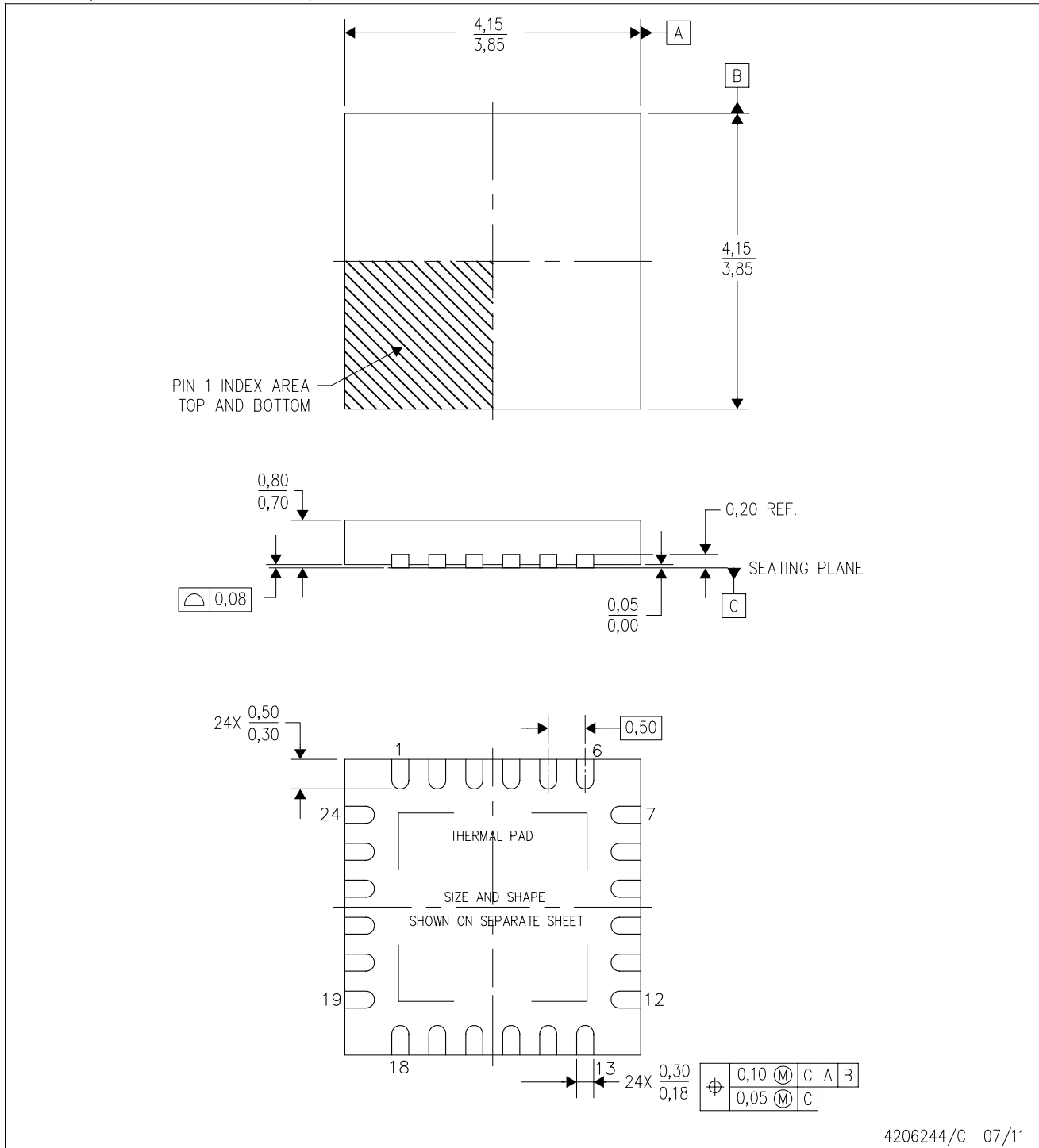


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TXS02612RTWR	WQFN	RTW	24	3000	367.0	367.0	35.0
TXS02612ZQSR	BGA MICROSTAR JUNIOR	ZQS	24	2500	350.0	350.0	43.0

RTW (S-PWQFN-N24)

PLASTIC QUAD FLATPACK NO-LEAD



4206244/C 07/11

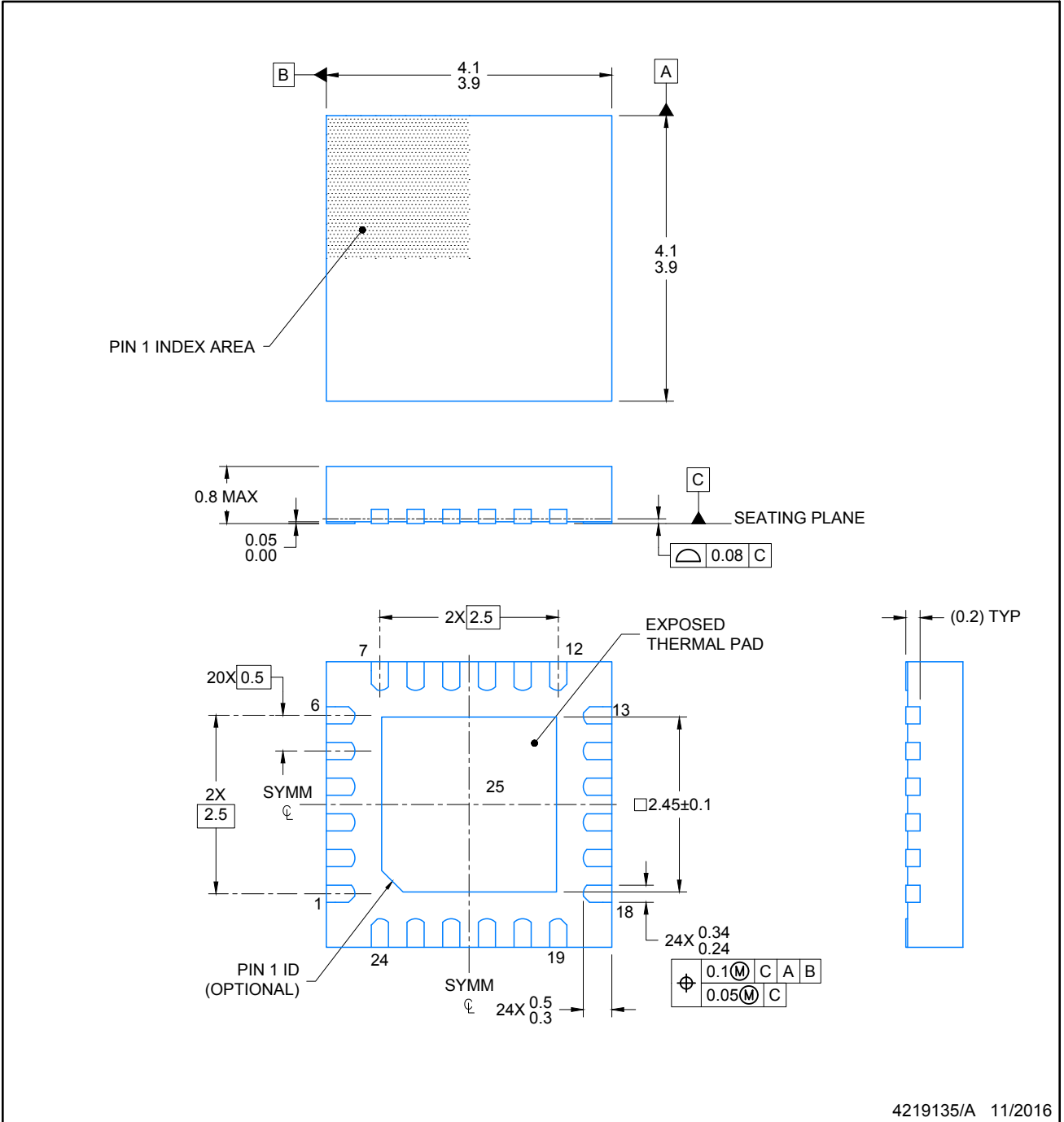
- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Quad Flatpack, No-Leads (QFN) package configuration.
 - D. The package thermal pad must be soldered to the board for thermal and mechanical 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.

PACKAGE OUTLINE

RTW0024B

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK-NO LEAD



4219135/A 11/2016

NOTES:

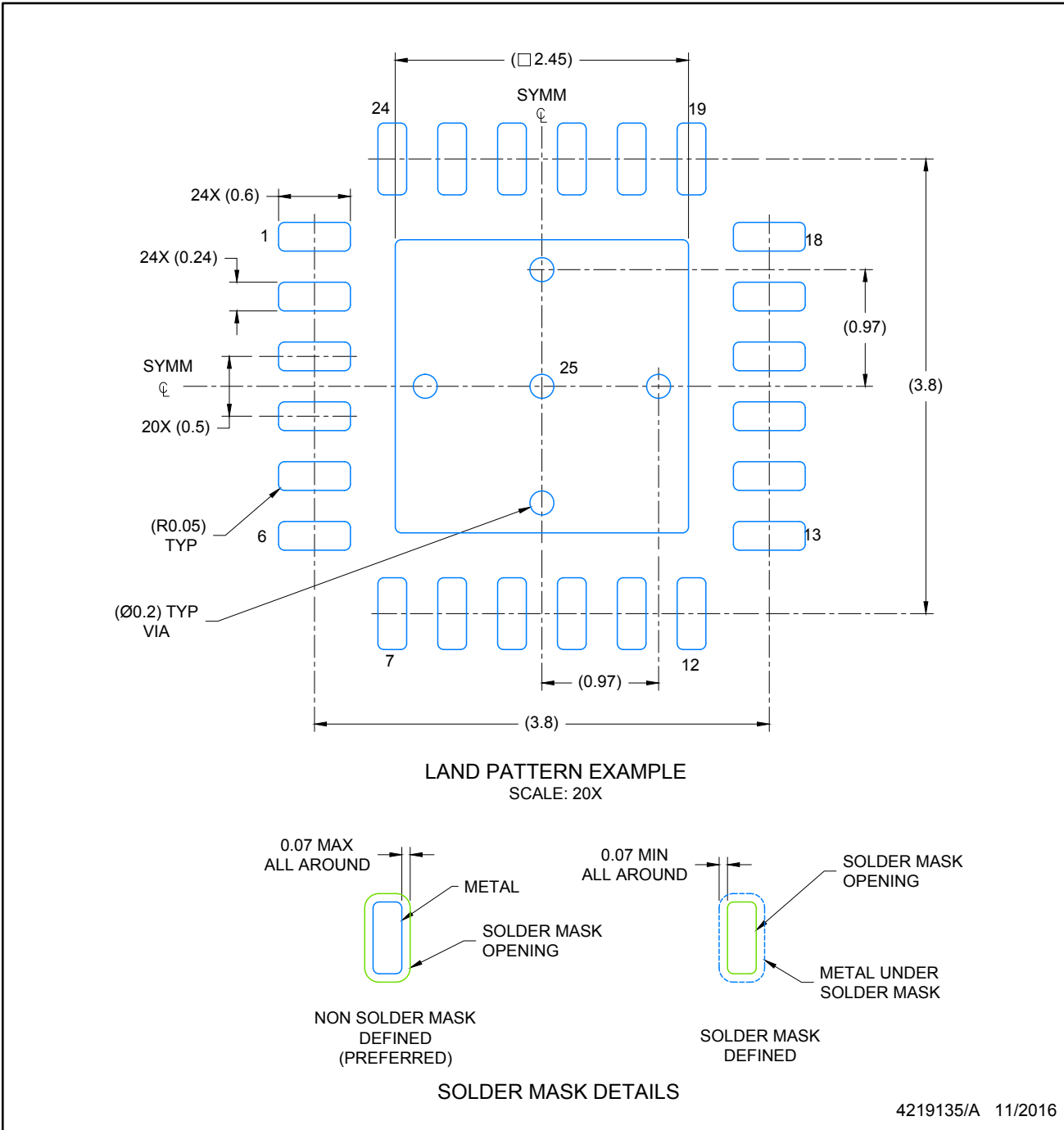
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

EXAMPLE BOARD LAYOUT

WQFN - 0.8 mm max height

RTW0024B

PLASTIC QUAD FLATPACK-NO LEAD



NOTES: (continued)

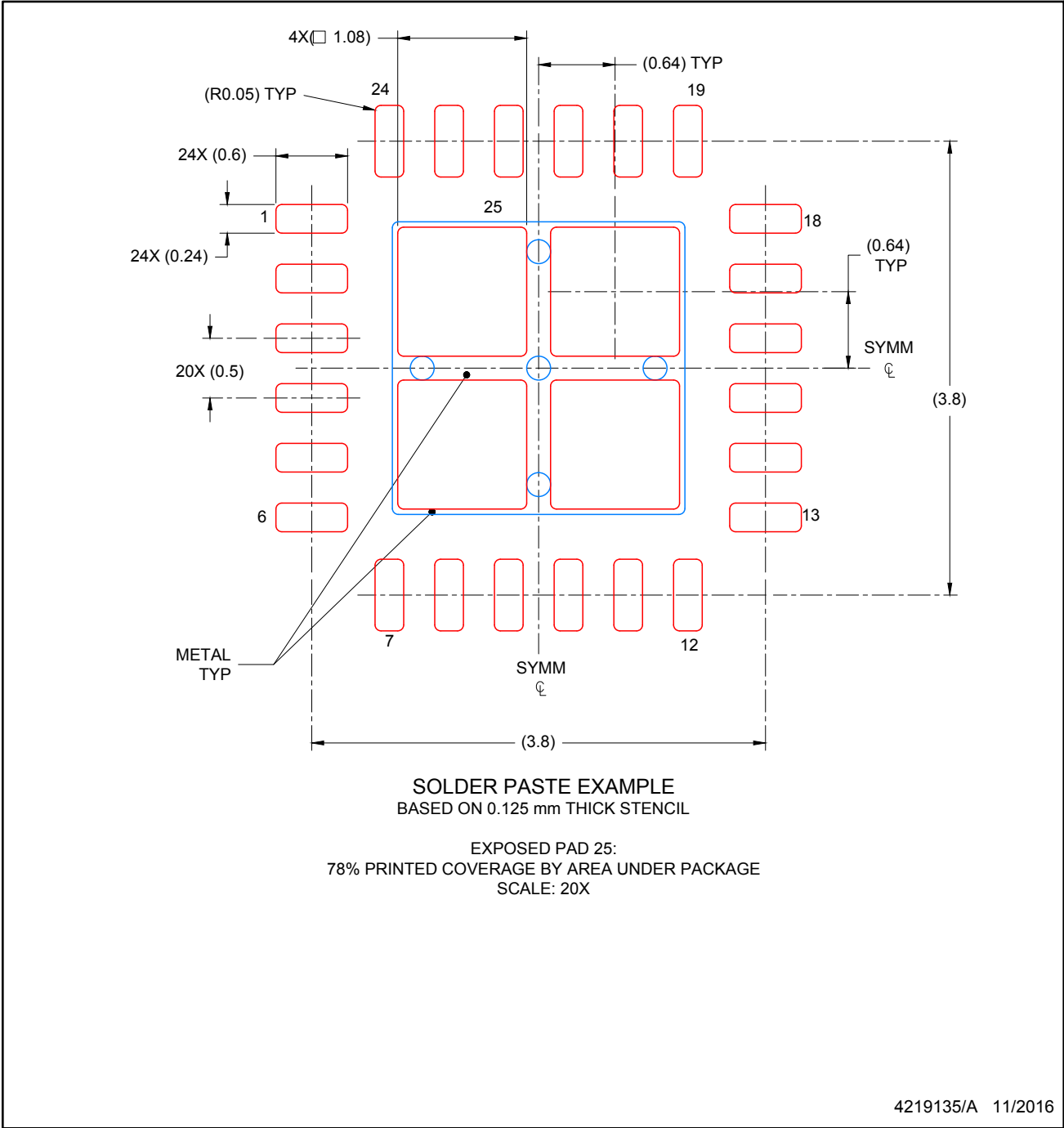
- For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slue271).

EXAMPLE STENCIL DESIGN

WQFN - 0.8 mm max height

RTW0024B

PLASTIC QUAD FLATPACK-NO LEAD

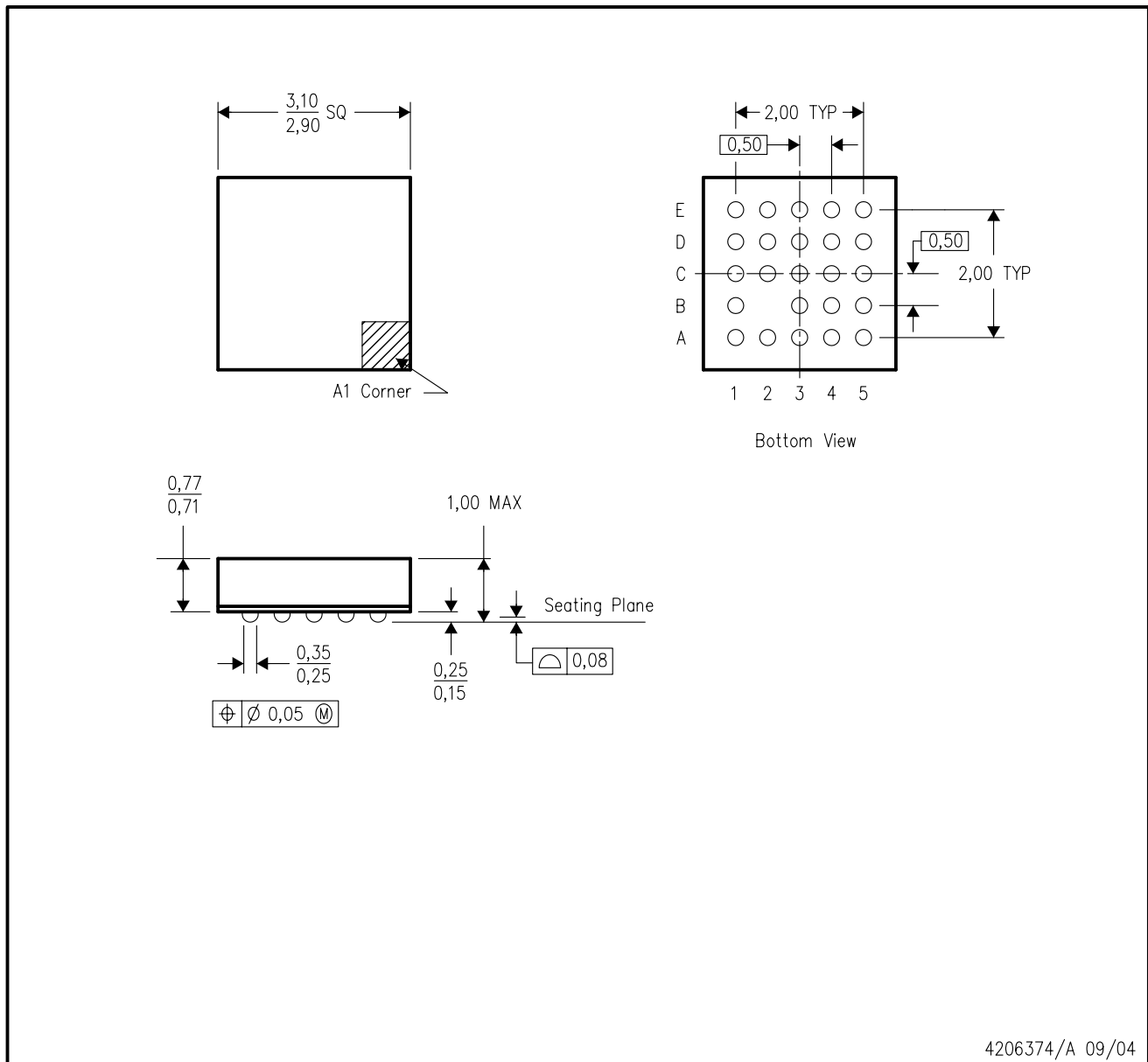


NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

ZQS (S-PBGA-N24)

PLASTIC BALL GRID ARRAY



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MO-225
 - D. This package is lead-free.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale (www.ti.com/legal/termsofsale.html) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2019, Texas Instruments Incorporated