











SCES638C - OCTOBER 2007 - REVISED DECEMBER 2015

TXS0101

# TXS0101 1-Bit Bidirectional Level-Shifting, Voltage-Level Translator With Auto-Direction-Sensing for Open-Drain and Push-Pull Applications

#### **Features**

- No Direction-Control Signal Needed
- Maximum Data Rates
  - 24 Mbps (Push Pull)
  - 2 Mbps (Open Drain)
- Available in the Texas Instruments NanoFree™ Package
- 1.65 V to 3.6 V on A port and 2.3 V to 5.5 V on B port  $(V_{CCA} \le V_{CCB})$
- $V_{\text{CC}}$  Isolation Feature If Either  $V_{\text{CC}}$  Input Is at GND, Both Ports Are in the High-Impedance State
- No Power-Supply Sequencing Required Either V<sub>CCA</sub> or V<sub>CCB</sub> Can be Ramped First
- I<sub>off</sub> Supports Partial-Power-Down Mode Operation
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - A Port
    - 2500 V Human-Body Model (A114-B)
    - 200 V Machine Model (A115-A)
    - 1500 V Charged-Device Model (C101)
  - B Port
    - 8 kV Human-Body Model (A114-B)
    - 200 V Machine Model (A115-A)
    - 1500 V Charged-Device Model (C101)

## 2 Applications

- Handsets
- **Smartphones**
- **Tablets**
- Desktop PCs

## 3 Description

This one-bit non-inverting translator uses two separate configurable power-supply rails. The A port is designed to track  $V_{CCA}.\ V_{CCA}$  accepts any supply voltage from 1.65 V to 3.6 V. The B port is designed to track V<sub>CCB</sub>. V<sub>CCA</sub> must be less than or equal to V<sub>CCB</sub>. V<sub>CCB</sub> accepts any supply voltage from 2.3 V to 5.5 V. This allows for low voltage bidirectional translation between any of the 1.8 V, 2.5 V, 3.3 V, and 5 V voltage nodes.

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

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

## Device Information<sup>(1)</sup>

PART NUMBER	PACKAGE	BODY SIZE (NOM)		
	SOT-23 (6)	2.90 mm × 1.60 mm		
TXS0101	SC70 (6)	2.00 mm × 1.25 mm		
1720101	SOT (6)	1.90 mm × 1.60 mm		
	DSBGA (6)	0.89 mm × 1.39 mm		

(1) For all available packages, see the orderable addendum at the end of the data sheet.

### **Typical Operating Circuit** 1.8V 3.3V V<sub>CCA</sub> **VCCB** 1.8V 3.3V System System **OE** Controller TXS0101 **Data** Data В **GND GND GND**



## **Table of Contents**

2 Applications 1 8 Detailed Description	
3 Description 1 8.1 Overview	
+ 110 113 1011 1 113 101 y	ram 16
	17
6 Specifications	des 17
6.1 Absolute Maximum Ratings	nentation 18
6.2 ESD Ratings	n 18
9.2 Typical Application	18
10. Power Supply Poses	nendations 20
44 1	20
o.o Timing Requirements: V CCA = 1.0 V 2 0.10 V	20
6.7 Timing Requirements V <sub>CCA</sub> = 2.5 V ± 0.2 V	20
6.8 Timing Requirements: 3.3 V ± 0.3 V	ntion Support2
6.9 Switching Characteristics: V <sub>CCA</sub> = 1.8 V ± 0.15 V 8 12.1 Device Support	2 <sup>2</sup>
0 00/1	es2
	2 <sup>,</sup>
<del> </del>	ge Caution2
	2 <sup>2</sup>
7.1 Load Ollodito	i, and Orderable

## 4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

## Changes from Revision B (January 2009) to Revision C

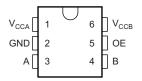
Page

 Added ESD Ratings table, Feature Description section, Device Functional Modes, Application and Implementation section, Power Supply Recommendations section, Layout section, Device and Documentation Support section, and Mechanical, Packaging, and Orderable Information section

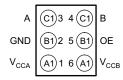


# 5 Pin Configuration and Functions

DBV, DCK, and DRL Package 6-Pin SOT-23, SC70, and SOT Top View



YZP Package 6-Pin DSBGA Bottom View



#### **Pin Functions**

PIN	PIN		DESCRIPTION
NAME	NO.	ITPE	DESCRIPTION
Α	3	I/O	Input/output A. Referenced to V <sub>CCA</sub>
В	4	I/O	Input/output B. Referenced to V <sub>CCB</sub>
GND	2	G	Ground
OE	5	I	Output enable. Pull OE low to place all outputs in 3-state mode. Referenced to V <sub>CCA</sub> .
$V_{CCA}$	1	I	A-port supply voltage. 1.65 V ≤ V <sub>CCA</sub> ≤ 3.6 V and V <sub>CCA</sub> ≤ V <sub>CCB</sub>
$V_{CCB}$	6	I	B-port supply voltage. 2.3 V ≤ V <sub>CCB</sub> ≤ 5.5 V



## 6 Specifications

## 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

			MIN	MAX	UNIT
$V_{CCA}$	Supply voltage		-0.5	4.6	V
V <sub>CCB</sub>	Supply voltage			6.5	V
\/	Input voltage (2)	A port	-0.5	4.6	V
VI	input voitage (=/	B port, OE	-0.5	6.5	V
.,	Voltage range applied to any output	A port	-0.5	4.6	\ /
Vo	in the high-impedance or power-off state <sup>(2)</sup>	B port	-0.5	6.5	V
\/	(0.49)	A port	-0.5	V <sub>CCA</sub> + 0.5	V
Vo	voltage range applied to any output in the high of low state 47 (47	B port	-0.5	$V_{CCB} + 0.5$	V
I <sub>IK</sub>	Input clamp current	V <sub>I</sub> < 0		-50	mA
I <sub>OK</sub>	Output clamp current	V <sub>O</sub> < 0		-50	mA
Io	Continuous output current			±50	mA
	Continuous current through V <sub>CCA</sub> , V <sub>CCB</sub> , or GND			±100	mA
T <sub>stg</sub>	Storage temperature			150	°C

<sup>(1)</sup> Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

## 6.2 ESD Ratings

			VALUE	UNIT
		Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, A Port (1)	±2500	
	<b>-</b> 1	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, B Port (1)	±8000	V
V <sub>(ESD)</sub>	Electrostatic discharge	Charged device model (CDM), per JEDEC specification JESD22-C101, B Port <sup>(2)</sup>	±1500	
		Machine model (MM, A115-A), A Port	±200	

<sup>(1)</sup> JEDEC document JEP155 states that 500 V HBM allows safe manufacturing with a standard ESD control process.

#### 6.3 Recommended Operating Conditions

See(1) (2)

			V <sub>CCA</sub>	V <sub>CCB</sub>	MIN	MAX	UNIT
$V_{CCA}$	Cumply yellogo (3)			1.65	3.6	V	
$V_{CCB}$	Supply voltage (*)	Supply voltage <sup>(3)</sup>			2.3	5.5	V
V High lavel in actual to a	A-port I/Os	1.65 V to 1.95 V	2.3 V to 5.5 V	V <sub>CCI</sub> - 0.2	V <sub>CCI</sub>		
	High lovel input voltage	2.3 V to 3.6 V	2.3 V to 3.6 V	2.5 V to 5.5 V	$V_{CCI} - 0.4$	V <sub>CCI</sub>	V
VIH	V <sub>IH</sub> High-level input voltage	B-port I/Os	1.65 V to 3.6 V	2.3 V to 5.5 V	$V_{CCI} - 0.4$	V <sub>CCI</sub>	V
		OE input	1.05 V to 3.6 V	2.5 V to 5.5 V	$V_{CCA} \times 0.65$	5.5	
		A-port I/Os			0	0.15	
V <sub>IL</sub> Lov	Low-level input voltage	B-port I/Os	1.65 V to 3.6 V	2.3 V to 5.5 V	0	0.15	V
		OE input			0	$V_{CCA} \times 0.35$	

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

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

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

<sup>(2)</sup> The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.

<sup>(3)</sup> The value of V<sub>CCA</sub> and V<sub>CCB</sub> are provided in the recommended operating conditions table.

<sup>(2)</sup> JEDEC document JEP157 states that 250 V CDM allows safe manufacturing with a standard ESD control process.



# **Recommended Operating Conditions (continued)**

See(1) (2)

			V <sub>CCA</sub>	V <sub>CCB</sub>	MIN MAX	UNIT
		A-port I/Os, push- pull driving			10	
Δt/Δν	$\Delta t/\Delta v$ Input transition rise or fall rate	B-port I/Os, push- pull driving	1.65 V to 3.6 V	2.3 V to 5.5 V	10	ns/V
	Control Input			10		
T <sub>A</sub>	T <sub>A</sub> Operating free-air temperature				-40 85	°C

#### 6.4 Thermal Information

		TXS0101					
THERMAL METRIC <sup>(1)</sup>		DBV (SOT-23)	DCK (SC70)	DRL (SOT)	DSBGA (YZP)	UNIT	
		6 PINS	6 PINS	6 PINS	6 PINS		
$R_{\theta JA}$	Junction-to-ambient thermal resistance	223.9	266.9	204.2	107.8	°C/W	
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	185.6	80.4	76.4	1.6	°C/W	
$R_{\theta JB}$	Junction-to-board thermal resistance	63.5	99.1	38.7	10.8	°C/W	
ΨЈТ	Junction-to-top characterization parameter	63.5	1.5	3.4	3.1	°C/W	
$\psi_{JB}$	Junction-to-board characterization parameter	71.8	98.3	38.5	10.8	°C/W	

For more information about traditional and new thermal metrics, see the Semiconductor and IC Package Thermal Metrics application report, SPRA953.



#### 6.5 Electrical Characteristics

over recommended operating free-air temperature range of -40°C to 85°C (unless otherwise noted) See<sup>(1)</sup> (2) (3)

P	ARAMETER	TEST CONDITIONS	V <sub>CCA</sub>	V <sub>CCB</sub>	MIN TYP	MAX	UNIT	
$V_{OHA}$		$\begin{split} I_{OH} &= -20 \ \mu\text{A}, \\ V_{IB} &\geq V_{CCB} \ -0.4 \ \text{V} \end{split}$	1.65 V to 3.6 V	2.3 V to 5.5 V	V <sub>CCA</sub> × 0.67		V	
$V_{OLA}$		$I_{OL} = 1 \text{ mA},$ $V_{IB} \le 0.15 \text{ V}$	1.65 V to 3.6 V	2.3 V to 5.5 V		0.4	V	
V <sub>OHB</sub>		$\begin{split} I_{OH} &= -20 \ \mu\text{A}, \\ V_{IA} &\geq V_{CCA} \ -0.2 \ V \end{split}$	1.65 V to 3.6 V	2.3 V to 5.5 V	V <sub>CCB</sub> × 0.67		V	
V <sub>OLB</sub>		$I_{OL} = 1 \text{ mA},$ $V_{IA} \le 0.15 \text{ V}$	1.65 V to 3.6 V	2.3 V to 5.5 V		0.4	V	
l <sub>l</sub>	OE	T <sub>A</sub> = 25°C -40°C to 85°C	1.65 V to 3.6 V	1.65 V to 5.5 V		±1	μΑ	
	A port	T <sub>A</sub> = 25°C -40°C to 85°C	0 V	0 to 5.5 V		±1	μΑ	
l <sub>off</sub>	B port	T <sub>A</sub> = 25°C -40°C to 85°C	0 to 3.6 V	0 V		±1	μΑ	
l <sub>OZ</sub>	A or B port	T <sub>A</sub> = 25°C -40°C to 85°C	1.65 V to 3.6 V	2.3 V to 5.5 V		±1	μΑ	
			1.65 V to V <sub>CCB</sub>	2.3 V to 5.5 V		2.4		
I <sub>CCA</sub>		$V_I = V_O = open,$ $I_O = 0$	3.6 V 0 V	0 V 5.5 V		2.2 -1	μΑ	
			1.65 V to V <sub>CCB</sub>	2.3 V to 5.5 V		12		
I <sub>CCB</sub>		$V_I = V_O = open,$ $I_O = 0$	3.6 V 0 V	0 V 5.5 V		-1 1	μΑ	
I <sub>CCA</sub> +	- I <sub>CCB</sub>	$V_I = V_{CCI},$ $I_O = 0$	1.65 V to V <sub>CCB</sub>	2.3 V to 5.5 V		14.4	μΑ	
Cı	OE	T <sub>A</sub> = 25°C -40°C to 85°C	3.3 V	3.3 V	2.5	3.5	pF	
0	A port	T <sub>A</sub> = 25°C -40°C to 85°C	0.07	0.0.1/	6			
C <sub>io</sub>	B port	T <sub>A</sub> = 25°C -40°C to 85°C	3.3 V	3.3 V	7.5		pF	

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 $<sup>\</sup>begin{array}{ll} \hbox{(1)} & V_{CCI} \text{ is the $V_{CC}$ associated with the input port.} \\ \hbox{(2)} & V_{CCO} \text{ is the $V_{CC}$ associated with the output port.} \\ \hbox{(3)} & V_{CCA} \text{ must be less than or equal to $V_{CCB}$, and $V_{CCA}$ must not exceed 3.6 V.} \\ \end{array}$ 



## 6.6 Timing Requirements: $V_{CCA} = 1.8 V \pm 0.15 V$

				MIN	NOM	MAX	UNIT
						21	
	Push-pull driving, Figure 4		$V_{CCB} = 3.3 \text{ V}, \pm 0.3 \text{ V}$			22	
Data rata			$V_{CCB} = 5 \text{ V}, \pm 0.5 \text{ V}$			24	Mbps
Data rate			$V_{CCB} = 2.5 \text{ V}, \pm 0.2 \text{ V}$			2	ivibps
	Open-drain driving, Figure 5		$V_{CCB} = 3.3 \text{ V}, \pm 0.3 \text{ V}$			2	
			$V_{CCB} = 5 \text{ V}, \pm 0.5 \text{ V}$			2	
t <sub>w</sub>			$V_{CCB} = 2.5 \text{ V}, \pm 0.2 \text{ V}$	47			
	Push-pull driving, Figure 4		$V_{CCB} = 3.3 \text{ V}, \pm 0.3 \text{ V}$	45			
Pulse duration Figure 7		Data inputs	$V_{CCB} = 5 \text{ V}, \pm 0.5 \text{ V}$	41			ns
ruise duraiion rigure /		Data inputs	$V_{CCB} = 2.5 \text{ V}, \pm 0.2 \text{ V}$	500			115
	Open-drain driving, Figure 5		$V_{CCB} = 3.3 \text{ V}, \pm 0.3 \text{ V}$	500			
			$V_{CCB} = 5 \text{ V}, \pm 0.5 \text{ V}$	500			

## 6.7 Timing Requirements $V_{CCA} = 2.5 \text{ V} \pm 0.2 \text{ V}$

3 14	COA			MIN	NOM	MAX	UNIT
			$V_{CCB} = 2.5 \text{ V}, \pm 0.2 \text{ V}$			20	
	Push-pull driving, Figure 4		$V_{CCB} = 3.3 \text{ V}, \pm 0.3 \text{ V}$			22	
Data rate			$V_{CCB} = 5 \text{ V}, \pm 0.5 \text{ V}$			24	Mbps
Data fate			$V_{CCB} = 2.5 \text{ V}, \pm 0.2 \text{ V}$			2	Minha
	Open-drain driving, Figure 5		$V_{CCB} = 3.3 \text{ V}, \pm 0.3 \text{ V}$			2	
			$V_{CCB} = 5 \text{ V}, \pm 0.5 \text{ V}$			1	
t <sub>w</sub>			$V_{CCB} = 2.5 \text{ V}, \pm 0.2 \text{ V}$	50			
	Push-pull driving, Figure 4		$V_{CCB} = 3.3 \text{ V}, \pm 0.3 \text{ V}$	45			
Dulgo duration Figure 7		Doto inputo	$V_{CCB} = 5 \text{ V}, \pm 0.5 \text{ V}$	41			ns
Pulse duration Figure 7		Data inputs	$V_{CCB} = 2.5 \text{ V}, \pm 0.2 \text{ V}$	500			115
	Open-drain driving, Figure 5		$V_{CCB} = 3.3 \text{ V}, \pm 0.3 \text{ V}$	500			
			$V_{CCB} = 5 \text{ V}, \pm 0.5 \text{ V}$	500			

## 6.8 Timing Requirements: 3.3 V ± 0.3 V

				MIN	NOM	MAX	UNIT
	Push-pull driving, Figure 4  V <sub>CCB</sub> V <sub>CCB</sub> V <sub>CCB</sub>		$V_{CCB} = 3.3 \text{ V}, \pm 0.3 \text{ V}$			23	
Data rate			$V_{CCB} = 5 \text{ V}, \pm 0.5 \text{ V}$			24	Mbps
			$V_{CCB} = 3.3 \text{ V}, \pm 0.3 \text{ V}$			2	MDPS
			$V_{CCB} = 5 \text{ V}, \pm 0.5 \text{ V}$			2	
	Duch pull driving Figure 4		$V_{CCB} = 3.3 \text{ V}, \pm 0.3 \text{ V}$	43			
Dulas duration Figure 7	Push-pull driving, Figure 4	5	$V_{CCB} = 5 \text{ V}, \pm 0.5 \text{ V}$	41			
Pulse duration Figure 7	Open-drain driving, Figure 5	Data inputs	$V_{CCB} = 3.3 \text{ V}, \pm 0.3 \text{ V}$	500			ns
	Open-drain driving, Figure 5		$V_{CCB} = 5 \text{ V}, \pm 0.5 \text{ V}$	500			



# 6.9 Switching Characteristics: $V_{CCA} = 1.8 \text{ V} \pm 0.15 \text{ V}$

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)	TEST CONDIT	TIONS (DRIVING)	MIN	MAX	UNIT	
				V <sub>CCB</sub> = 2.5 V ± 0.2 V		5.3		
			Push-pull, Figure 4	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		5.4		
				$V_{CCB} = 5 V \pm 0.5 V$		6.8		
t <sub>PHL</sub> Figure 8				$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	2.3	8.8		
			Open-drain, Figure 5	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	2.4	9.6		
		_		$V_{CCB} = 5 V \pm 0.5 V$	2.6	10		
	Α	В		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		6.8	ns	
			Push-pull, Figure 4	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		7.1		
				$V_{CCB} = 5 V \pm 0.5 V$		7.5		
t <sub>PLH</sub> Figure 8				$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	45	260		
			Open-drain, Figure 5	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	36	208		
				$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	27	198		
				$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		4.4		
			Push-pull, Figure 4	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		4.5		
				$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$		4.7		
t <sub>PHL</sub> Figure 8				V <sub>CCB</sub> = 2.5 V ± 0.2 V	1.9	5.3	ns	
			Open-drain, Figure 5	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	1.1	4.4		
				$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	1.2	4		
	В	Α		V <sub>CCB</sub> = 2.5 V ± 0.2 V		5.3		
			Push-pull, Figure 4	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		4.5		
				$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$		0.5		
t <sub>PLH</sub> Figure 8				V <sub>CCB</sub> = 2.5 V ± 0.2 V	45	175		
			Open-drain, Figure 5	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	36	140		
			, 5	$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	27	102		
				$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		200		
t <sub>en</sub> Figure 9	OE	A or B	Push-pull, Figure 6	V <sub>CCB</sub> = 3.3 V ± 0.3 V		200	ns	
GII 3				$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$		200		
				V <sub>CCB</sub> = 2.5 V ± 0.2 V		50		
t <sub>dis</sub> Figure 9	OE	A or B		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		40	ns	
uis o				$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$		35	113	
		I.		V <sub>CCB</sub> = 2.5 V ± 0.2 V	3.2	9.5		
			Push-pull	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	2.3	9.3		
				$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	2	7.6		
$t_{rA}$	A-port	rise time		V <sub>CCB</sub> = 2.5 V ± 0.2 V	38	165	ns	
			Open-drain	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	30	132		
			'	$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	22	95		
				$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	1.1	10.8		
			Push-pull	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	1	9.1		
				$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	 1	7.6	ns	
t <sub>rB</sub>	B-port	rise time		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	34	145		
			Open-drain	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	23	106		
			Sport didni	$V_{CCB} = 5.5 \text{ V} \pm 0.5 \text{ V}$	10	76		



# Switching Characteristics: V<sub>CCA</sub> = 1.8 V ± 0.15 V (continued)

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)	TEST CONDITIO	ONS (DRIVING)	MIN	MAX	UNIT	
				$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	1.9	5.9		
			Push-pull	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	1.9	6		
4	A nor	t fall time		$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	1.4	13.3		
t <sub>fA</sub>	A-por	i iaii iime		V <sub>CCB</sub> = 2.5 V ± 0.2 V	4.4	6.9		
			Open-drain	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	4.3	6.4		
				$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	4.2	6.1		
				V <sub>CCB</sub> = 2.5 V ± 0.2 V	2.2	13.8	ns	
	B-port fall time		Push-pull	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	2.2	16.2		
				$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	2.6	16.2		
t <sub>fB</sub>				$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	6.9	13.8		
			Open-drain	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	7.5	16.2		
				$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	7	16.2		
				$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	21			
			Push-pull	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	22		ı	
Mass data nata		- D		$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	24		Mhma	
Max data rate	A	or B		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	2		Mbps	
			Open-drain	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	2			
				$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	2			

## 6.10 Switching Characteristics: $V_{CCA} = 2.5 \text{ V} \pm 0.2 \text{ V}$

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)	TEST CONDITIO	ONS (DRIVING)	MIN	MAX	UNIT
				$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		3.2	
			Push-pull, Figure 4	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		3.7	
t <sub>PHL</sub> Figure 8				$V_{CCB} = 5 V \pm 0.5 V$		3.8	
			Open-drain, Figure 5	$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	1.7	6.3	
		В		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	2	6	
	Α			$V_{CCB} = 5 V \pm 0.5 V$	2.1	5.8	
				$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		3.5	ns
			Push-pull, Figure 4	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		4.1	-
t Figure 0				$V_{CCB} = 5 V \pm 0.5 V$		4.4	
t <sub>PLH</sub> Figure 8				$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	43	250	
			Open-drain, Figure 5	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	36	206	
				$V_{CCB} = 5 V \pm 0.5 V$	27	190	



# Switching Characteristics: $V_{CCA} = 2.5 \text{ V} \pm 0.2 \text{ V}$ (continued)

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)	TEST CONDITI	ONS (DRIVING)	MIN	MAX	UNIT	
				$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		3		
			Push-pull, Figure 4	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		3.6		
. Figure 0				$V_{CCB} = 5 V \pm 0.5 V$		4.3		
t <sub>PHL</sub> Figure 8				$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	1.8	4.7		
			Open-drain, Figure 5	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	1.6	4.2		
				$V_{CCB} = 5 V \pm 0.5 V$	1.2	4	20	
	В	Α		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		2.5	ns	
			Push-pull, Figure 4	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		1.6		
				$V_{CCB} = 5 V \pm 0.5 V$		1		
t <sub>PLH</sub> Figure 8				$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	44	170		
			Open-drain, Figure 5	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	37	140		
				$V_{CCB} = 5 V \pm 0.5 V$	27	103		
				$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		200		
t <sub>en</sub> Figure 9	OE	A or B		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		200	ns	
			Deale and Figure 0	$V_{CCB} = 5 V \pm 0.5 V$		200		
			Push-pull, Figure 6	$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		50		
t <sub>dis</sub> Figure 9	OE	A or B		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		40	ns	
				$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$		35		
		*		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	2.8	7.4		
			Push-pull	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	2.1	6.6		
	A			$V_{CCB} = 5 V \pm 0.5 V$	0.9	5.6	ns	
t <sub>rA</sub>	A-pon	t rise time		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	34	149		
			Open-drain	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	28	121		
				$V_{CCB} = 5 V \pm 0.5 V$	24	89		
				$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	1.3	8.3		
			Push-pull	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	0.9	7.2		
	D			$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	0.4	6.1	ns	
t <sub>rB</sub>	B-pon	t rise time		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	35	151		
			Open-drain	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	24	112		
				$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	12	81		
				$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	1.9	5.7		
			Push-pull	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	1.4	5.5		
	Δ	a Call Cara		$V_{CCB} = 5 V \pm 0.5 V$	0.8	5.3		
t <sub>fA</sub>	A-por	t fall time		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	4.4	6.9		
			Open-drain	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	4.3	6.2		
				$V_{CCB} = 5 V \pm 0.5 V$	4.2	5.8		
				$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	2.2	7.8	ns	
			Push-pull	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	2.4	6.7		
		. 6. 11. 2		$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	2.6	6.6		
t <sub>fB</sub>	B-por	t fall time		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	5.1	8.8		
			Open-drain	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	5.4	9.4		
				$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	5.4	10.4		



# Switching Characteristics: $V_{CCA} = 2.5 \text{ V} \pm 0.2 \text{ V}$ (continued)

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)	TEST CONDITION:	S (DRIVING)	MIN	MAX	UNIT
			$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	20			
	A or B		Push-pull	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	22		Mhna
Max data rate				$V_{CCB} = 5 V \pm 0.5 V$	24		
Max uala rale	A	OI B		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$	2		Mbps
			Open-drain	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	2		
				$V_{CCB} = 5 V \pm 0.5 V$	2		



# 6.11 Switching Characteristics: $V_{CCA} = 3.3 \text{ V} \pm 0.3 \text{ V}$

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)	TEST CONDI	TIONS (DRIVING)	MIN	MAX	UNIT	
			Push-pull, Figure 4	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		2.4		
t <sub>PHL</sub> Figure 8			T don pull, T igulo 4	$V_{CCB} = 5 V \pm 0.5 V$		3.1		
PHL 1 Iguic 0			Open-drain, Figure 5	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	1.3	4.2		
	Α	В	Open-drain, rigure 3	$V_{CCB} = 5 V \pm 0.5 V$	1.4	4.6	ns	
	^	5	Push-pull, Figure 4	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		4.2		
t <sub>PLH</sub> Figure 8			1 dan puli, 1 igulo 4	$V_{CCB} = 5 V \pm 0.5 V$		4.4		
PLH I Iguic o			Open-drain, Figure 5	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	36	204		
			Open-drain, Figure 5	$V_{CCB} = 5 V \pm 0.5 V$	28	165		
			Duch pull Figure 4	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		2.5		
t Figuro 9			Push-pull, Figure 4	$V_{CCB} = 5 V \pm 0.5 V$		3.3		
t <sub>PHL</sub> Figure 8			Open-drain, Figure 5	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	1	124		
	Ь	^		$V_{CCB} = 5 V \pm 0.5 V$	1	97	no	
	В	Α	Duch pull Figure 4	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		2.5	ns	
Figure 0			Push-pull, Figure 4	$V_{CCB} = 5 V \pm 0.5 V$		2.6		
t <sub>PLH</sub> Figure 8			Open drain Figure 5	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	3	139		
			Open-drain, Figure 5	$V_{CCB} = 5 V \pm 0.5 V$	3	105		
Linux 0	05	A D		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		200		
en Figure 9	OE	A or B	D      F	$V_{CCB} = 5 V \pm 0.5 V$		200	ns	
t <sub>dis</sub> Figure 9 OE			Push-pull, Figure 6	$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		40		
	A or B		$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$		9.8	ns		
				$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	2.3	5.6		
	A-port rise time		Push-pull	$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	1.9	4.8	ns	
rA				$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	25	116		
			Open-drain	$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	19	85		
				$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	1.6	6.4		
	_		Push-pull	$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	0.6	7.4		
t <sub>rB</sub>	B-port r	ise time		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	26	116	ns	
			Open-drain	$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	14	72		
				$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	1.4	5.4		
			Push-pull	$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	1	5		
t <sub>fA</sub>	A-port	fall time		V <sub>CCB</sub> = 3.3 V ± 0.3 V	4.3	6.1		
			Open-drain	$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	4.2	5.7		
				$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	2.3	7.4	ns	
			Push-pull	$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	2.4	7.6		
fB	B-port	fall time		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	5	7.6		
			Open-drain	$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	4.8	8.3		
				$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	23			
			Push-pull	$V_{CCB} = 5 \text{ V} \pm 0.5 \text{ V}$	24			
Max data rate	Ac	or B		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$	2		Mbps	
			Open-drain	$V_{CCB} = 5.0 \text{ V} \pm 0.5 \text{ V}$	2			



## 6.12 Typical Characteristics

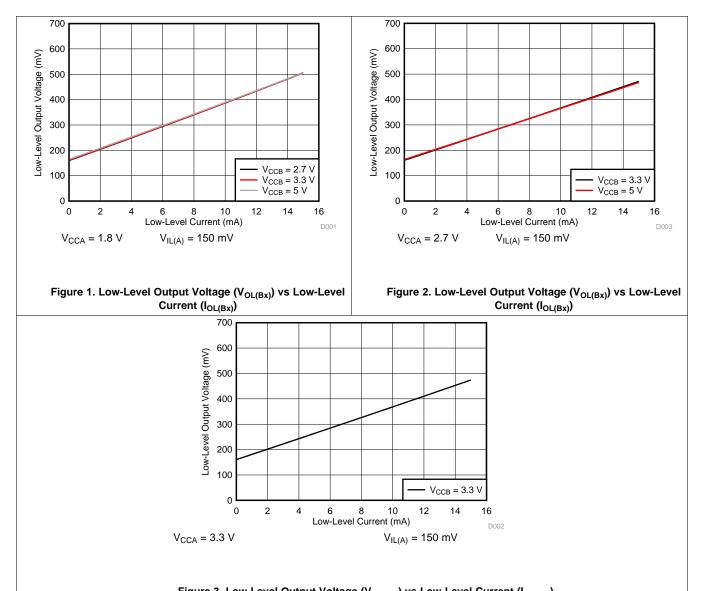


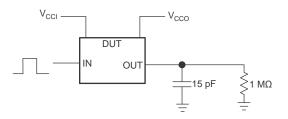
Figure 3. Low-Level Output Voltage ( $V_{OL(Bx)}$ ) vs Low-Level Current ( $I_{OL(Bx)}$ )



#### 7 Parameter Measurement Information

#### 7.1 Load Circuits

Figure 4 shows the push-pull driver circuit used for measuring data rate, pulse duration, propagation delay, output rise-time and fall-time. Figure 5 shows the open-drain driver circuit used for measuring data rate, pulse duration, propagation delay, output rise-time and fall-time.



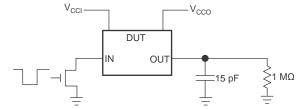


Figure 4. Data Rate, Pulse Duration, Propagation Delay, Output Rise-Time and Fall-Time Measurement Using a Push-Pull Driver

Figure 5. Data Rate, Pulse Duration, Propagation Delay, Output Rise-Time and Fall-Time Measurement Using an Open-Drain Driver

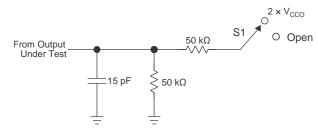


Figure 6. Load Circuit for Enable-Time and Disable-Time Measurement

TEST	S1			
t <sub>PZL</sub> / t <sub>PLZ</sub> (t <sub>dis</sub> )	2 × V <sub>CCO</sub>			
t <sub>PHZ</sub> / t <sub>PZH</sub> (t <sub>en</sub> )	Open			

- 1.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
- 2.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
- 3.  $V_{\text{CCI}}$  is the  $V_{\text{CC}}$  associated with the input port.
- 4.  $V_{CCO}$  is the  $V_{CC}$  associated with the output port.

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## 7.2 Voltage Waveforms

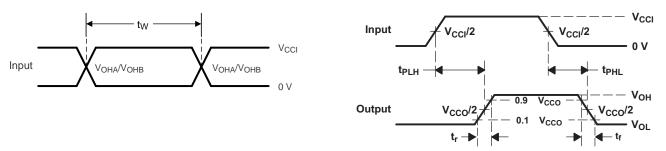
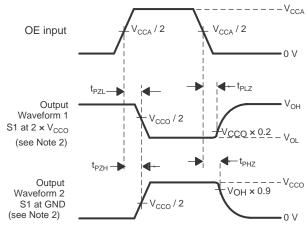


Figure 7. Pulse Duration (Push-Pull)

Figure 8. Propagation Delay Times



- C<sub>L</sub> includes probe and jig capacitance.
- Waveform 1 in Figure 9 is for an output with internal such that the output is high, except when OE is high (see Figure 6). Waveform 2 in Figure 9 is for an output with conditions such that the output is low, except when OE is high.
- All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z<sub>O</sub> = 50 Ω, dv/dt ≥ 1 V/ns.
- The outputs are measured one at a time, with one transition per measurement.
- t<sub>PLZ</sub> and t<sub>PHZ</sub> are the same as t<sub>dis</sub>.
- $\bullet \quad \ \ t_{PZL} \ and \ t_{PZH} \ are \ the \ same \ as \ t_{en}.$
- $\bullet \quad \ \ t_{PLH} \ and \ t_{PHL} \ are \ the \ same \ as \ t_{pd}.$
- V<sub>CCI</sub> is the V<sub>CC</sub> associated with the input port.
- V<sub>CCO</sub> is the V<sub>CC</sub> associated with the output port.

Figure 9. Enable and Disable Times

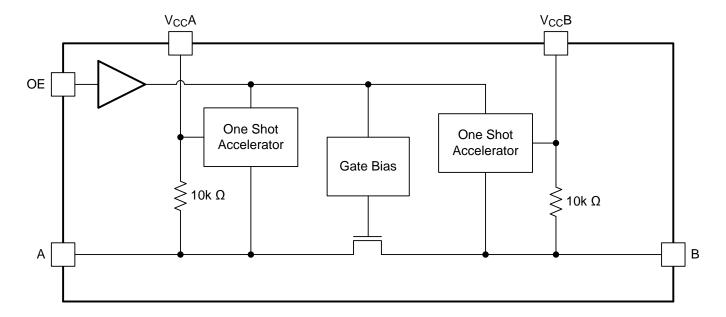


## 8 Detailed Description

## 8.1 Overview

The TXS0101 device is a directionless voltage-level translator specifically designed for translating logic voltage levels. The A port is able to accept I/O voltages ranging from 1.65 V to 3.6 V, while the B port can accept I/O voltages from 2.3 V to 5.5 V. The device is a pass gate architecture with edge rate accelerators (one shots) to improve the overall data rate. 10 k $\Omega$  pullup resistors, commonly used in open drain applications, have been conveniently integrated so that an external resistor is not needed. While this device is designed for open drain applications, the device can also translate push-pull CMOS logic outputs.

## 8.2 Functional Block Diagram



Product Folder Links: TXS0101

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#### 8.3 Feature Description

#### 8.3.1 Architecture

The TXS0101 architecture (see Figure 10) does not require a direction-control signal to control the direction of data flow from A to B or from B to A.

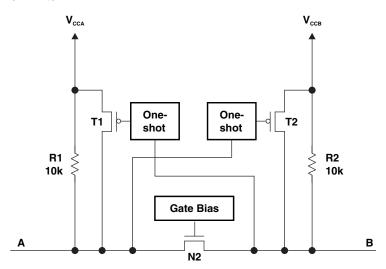


Figure 10. Architecture of a TXS01xx Cell

Each A-port I/O has an internal 10 k $\Omega$  pullup resistor to V<sub>CCA</sub>, and each B-port I/O has an internal 10 k $\Omega$  pullup resistor to V<sub>CCB</sub>. The output one-shots detect rising edges on the A or B ports. During a rising edge, the one-shot turns on the PMOS transistors (T1,T2) for a short duration, which speeds up the low-to-high transition.

#### 8.3.2 Input Driver Requirements

The fall time ( $t_{fA}$ ,  $t_{fB}$ ) of a signal depends on the output impedance of the external device driving the data I/Os of the TXS0101. Similarly, the  $t_{PHL}$  and max data rates also depend on the output impedance of the external driver. The values for  $t_{fA}$ ,  $t_{fB}$ ,  $t_{PHL}$ , and maximum data rates in the data sheet assume that the output impedance of the external driver is less than 50  $\Omega$ .

#### 8.3.3 Power Up

During operation, ensure that  $V_{CCA} \le V_{CCB}$  at all times. During power-up sequencing,  $V_{CCA} \ge V_{CCB}$  does not damage the device, so any power supply can be ramped up first.

#### 8.3.4 Enable and Disable

The TXS0101 has an OE input that is used to disable the device by setting OE low, which places all I/Os in the Hi-Z state. The disable time  $(t_{dis})$  indicates the delay between the time 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.

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

Each A-port I/O has an internal 10 k $\Omega$  pullup resistor to V<sub>CCA</sub>, and each B-port I/O has an internal 10 k $\Omega$  pullup resistor to V<sub>CCB</sub>. If a smaller value of pullup resistor is required, an external resistor must be added from the I/O to V<sub>CCA</sub> or V<sub>CCB</sub> (in parallel with the internal 10 k $\Omega$  resistors).

#### 8.4 Device Functional Modes

The TXS0101 device has two functional modes, enabled and disabled. To disable the device set the OE input low, which places all I/Os in a high impedance state. Setting the OE input high will enable the device.



## 9 Application and Implementation

#### NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

#### 9.1 Application Information

The TXS0101 can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. The TXS0101 is ideal for use in applications where an open-drain driver is connected to the data I/Os. The TXB0101 can also be used in applications where a push-pull driver is connected to the data I/Os, but the TXB0102 might be a better option for such push-pull applications.

## 9.2 Typical Application

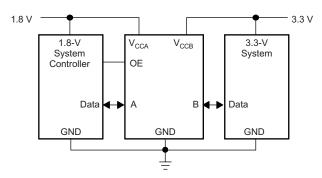


Figure 11. Typical Application Schematic

#### 9.2.1 Design Requirements

For this design example, use the parameters listed in Table 1.

**Table 1. Design Parameters** 

DESIGN PARAMETER	EXAMPLE VALUE				
Input voltage range	1.65 to 3.6 V				
Output voltage range	2.3 to 5.5 V				

### 9.2.2 Detailed Design Procedure

To begin the design process, determine the following:

- Input voltage range
  - Use the supply voltage of the device that is driving the TXS0101 device to determine the input voltage range. For a valid logic high the value must exceed the V<sub>IH</sub> of the input port. For a valid logic low the value must be less than the V<sub>IL</sub> of the input port.
- Output voltage range
  - Use the supply voltage of the device that the TXS0101 device is driving to determine the output voltage range.
  - The TXS0101 device has 10 kΩ internal pullup resistors. External pullup resistors can be added to reduce the total RC of a signal trace if necessary.

(1)



An external pull down resistor decreases the output V<sub>OH</sub> and V<sub>OL</sub>. Use Equation 1 to calculate the V<sub>OH</sub> as a
result of an external pull down resistor.

$$V_{OH} = V_{CCx} \times R_{PD} / (R_{PD} + 10 \text{ k}\Omega)$$

#### where

- $V_{CCx}$  is the supply voltage on either  $V_{CCA}$  or  $V_{CCB}$
- $\bullet \quad R_{PD}$  is the value of the external pull down resistor

## 9.2.3 Application Curve

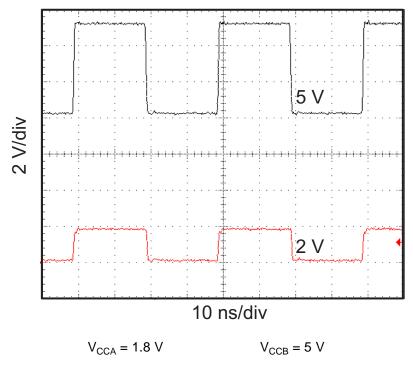


Figure 12. Level-Translation of a 2.5-MHz Signal



## 10 Power Supply Recommendations

The TXS0101 device uses two separate configurable power-supply rails,  $V_{CCA}$  and  $V_{CCB}$ .  $V_{CCB}$  accepts any supply voltage from 2.3 V to 5.5 V and  $V_{CCA}$  accepts any supply voltage from 1.65 V to 3.6 V as long as Vs is less than or equal to  $V_{CCB}$ . The A port and B port are designed to track  $V_{CCA}$  and  $V_{CCB}$  respectively allowing for low voltage bidirectional translation between any of the 1.8 V, 2.5 V, 3.3 V, and 5 V voltage nodes.

The TXS0101 device does not require power sequencing between  $V_{CCA}$  and  $V_{CCB}$  during power-up so the power-supply rails can be ramped in any order. A  $V_{CCA}$  value greater than or equal to  $V_{CCB}$  ( $V_{CCA} \ge V_{CCB}$ ) does not damage the device, but during operation,  $V_{CCA}$  must be less than or equal to  $V_{CCB}$  ( $V_{CCA} \le V_{CCB}$ ) at all times.

The output-enable (OE) input circuit is designed so that it is supplied by  $V_{CCA}$  and when the (OE) input is low, all outputs are placed in the high-impedance state. To ensure the high-impedance state of the outputs during power up or power down, the OE input pin must be tied to GND through a pulldown resistor and must not be enabled until  $V_{CCA}$  and  $V_{CCB}$  are fully ramped and stable. The minimum value of the pulldown resistor to ground is determined by the current-sourcing capability of the driver.

## 11 Layout

## 11.1 Layout Guidelines

To ensure reliability of the device, following common printed-circuit board layout guidelines is recommended.

- · Bypass capacitors should be used on power supplies.
- Short trace lengths should be used to avoid excessive loading.
- PCB signal trace-lengths must be kept short enough so that the round-trip delay of any reflection is less than
  the one shot duration, approximately 30 ns, ensuring that any reflection encounters low impedance at the
  source driver.
- Placing pads on the signal paths for loading capacitors or pullup resistors to help adjust rise and fall times of signals depending on the system requirements

#### 11.2 Layout Example



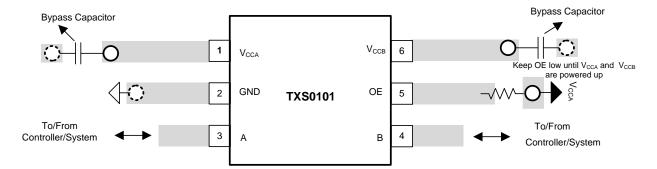


Figure 13. Typical Layout of TXS0101



## 12 Device and Documentation Support

## 12.1 Device Support

#### 12.1.1 Related Documentation

For related documentation, see the following:

- A Guide to Voltage Translation With TXS-Type Translators, SCEA044
- Introduction to Logic, SLVA700

## 12.2 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

TI E2E™ Online Community TI's Engineer-to-Engineer (E2E) Community. Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

#### 12.3 Trademarks

NanoFree, E2E are trademarks of Texas Instruments. All other trademarks are the property of their respective owners.

#### 12.4 Electrostatic Discharge Caution



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.

### 12.5 Glossary

SLYZ022 — TI Glossary.

This glossary lists and explains terms, acronyms, and definitions.

## 13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.





8-Sep-2015

#### **PACKAGING INFORMATION**

Orderable Device	Status	Package Type	Package Drawing	Pins	Package Qty	Eco Plan	Lead/Ball Finish (6)	MSL Peak Temp	Op Temp (°C)	Device Marking (4/5)	Samples
TXS0101DBVR	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	(NFFF ~ NFFR)	Samples
TXS0101DBVRG4	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	(NFFF ~ NFFR)	Samples
TXS0101DBVT	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	NFFR	Samples
TXS0101DBVTG4	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	NFFR	Samples
TXS0101DCKR	ACTIVE	SC70	DCK	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	2GO	Samples
TXS0101DCKRG4	ACTIVE	SC70	DCK	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	2GO	Samples
TXS0101DCKT	ACTIVE	SC70	DCK	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	2GO	Samples
TXS0101DRLR	ACTIVE	SOT	DRL	6	4000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	2GR	Samples
TXS0101DRLRG4	ACTIVE	SOT	DRL	6	4000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	2GR	Samples
TXS0101YZPR	ACTIVE	DSBGA	YZP	6	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	(2G7 ~ 2GN)	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.

**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)

<sup>(2)</sup> 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.



## PACKAGE OPTION ADDENDUM

8-Sep-2015

- (3) MSL, Peak Temp. The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.
- (4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.
- (5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.
- (6) Lead/Ball Finish Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

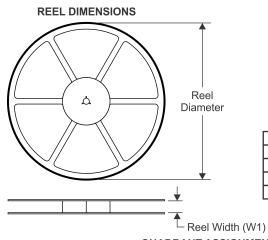
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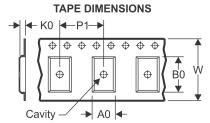
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

PACKAGE MATERIALS INFORMATION

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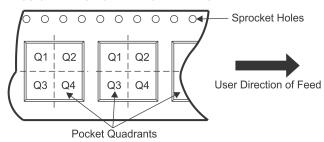
## TAPE AND REEL INFORMATION





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

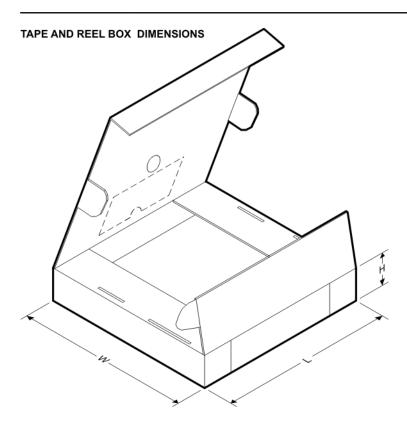
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



#### \*All dimensions are nominal

Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TXS0101DBVR	SOT-23	DBV	6	3000	180.0	8.4	3.23	3.17	1.37	4.0	8.0	Q3
TXS0101DBVT	SOT-23	DBV	6	250	180.0	8.4	3.23	3.17	1.37	4.0	8.0	Q3
TXS0101DCKR	SC70	DCK	6	3000	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TXS0101DCKT	SC70	DCK	6	250	179.0	8.4	2.2	2.5	1.2	4.0	8.0	Q3
TXS0101DRLR	SOT	DRL	6	4000	180.0	8.4	1.98	1.78	0.69	4.0	8.0	Q3
TXS0101YZPR	DSBGA	YZP	6	3000	178.0	9.2	1.02	1.52	0.63	4.0	8.0	Q1

www.ti.com 8-Sep-2015

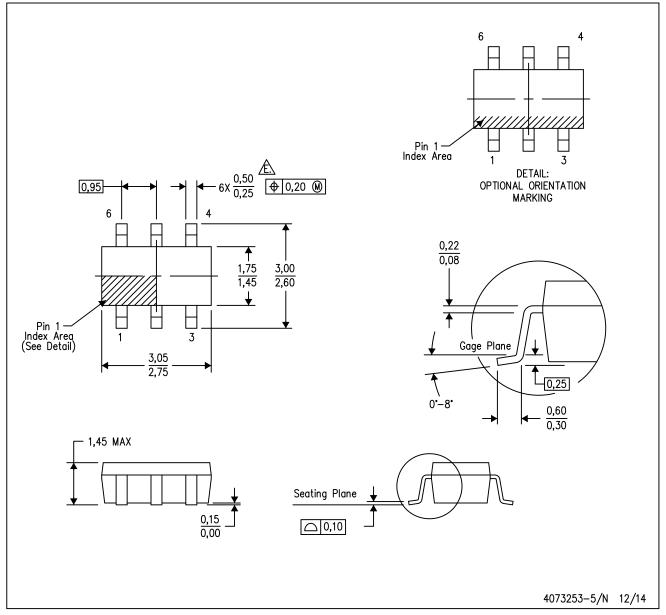


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TXS0101DBVR	SOT-23	DBV	6	3000	202.0	201.0	28.0
TXS0101DBVT	SOT-23	DBV	6	250	202.0	201.0	28.0
TXS0101DCKR	SC70	DCK	6	3000	203.0	203.0	35.0
TXS0101DCKT	SC70	DCK	6	250	203.0	203.0	35.0
TXS0101DRLR	SOT	DRL	6	4000	202.0	201.0	28.0
TXS0101YZPR	DSBGA	YZP	6	3000	220.0	220.0	35.0

# DBV (R-PDSO-G6)

## PLASTIC SMALL-OUTLINE PACKAGE



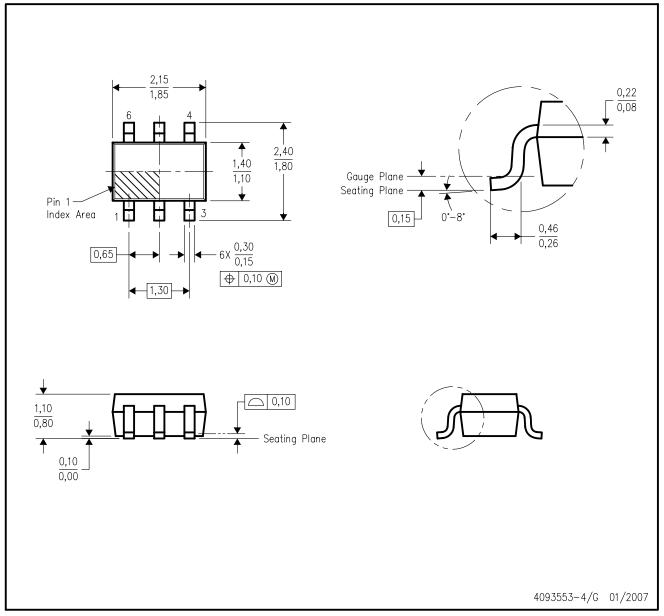
NOTES:

- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
- D. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
- Falls within JEDEC MO-178 Variation AB, except minimum lead width.



# DCK (R-PDSO-G6)

# PLASTIC SMALL-OUTLINE PACKAGE



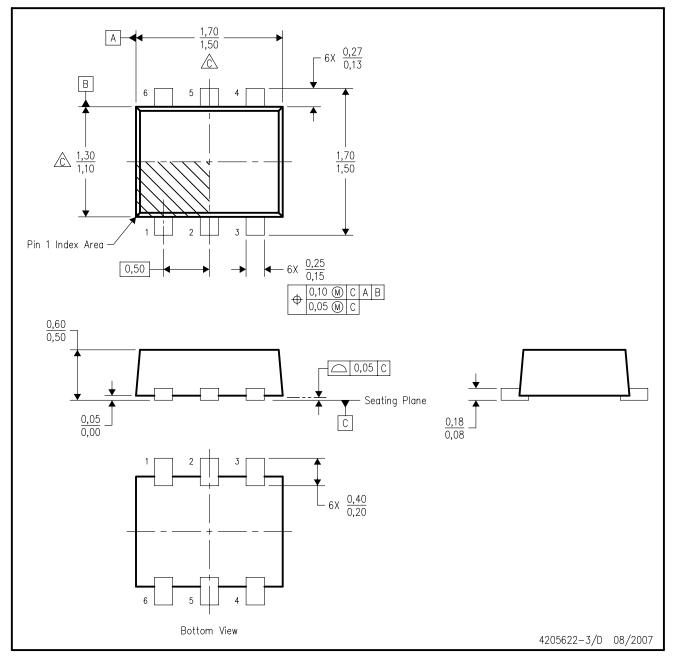
NOTES: A. All linear dimensions are in millimeters.

- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
- D. Falls within JEDEC MO-203 variation AB.



# DRL (R-PDSO-N6)

# PLASTIC SMALL OUTLINE



NOTES:

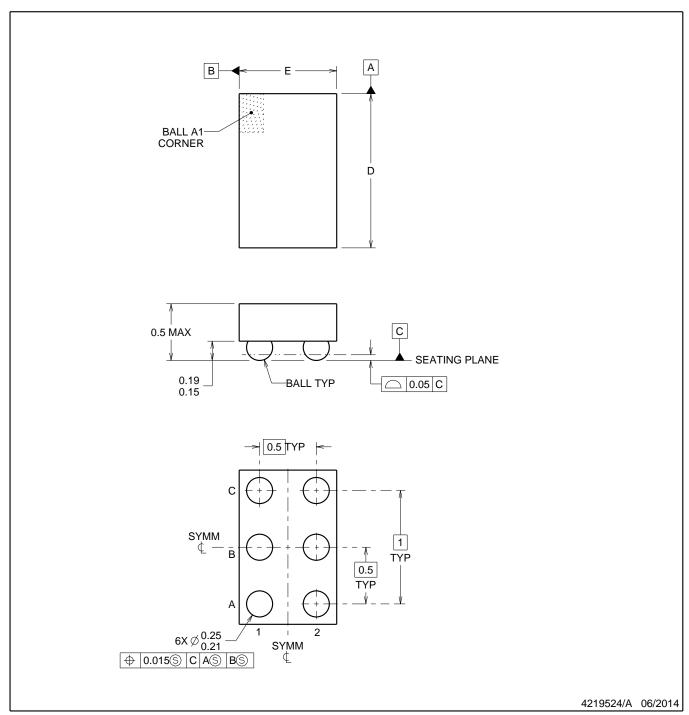
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M—1994.
- B. This drawing is subject to change without notice.
- Body dimensions do not include mold flash, interlead flash, protrusions, or gate burrs.

  Mold flash, interlead flash, protrusions, or gate burrs shall not exceed 0,15 per end or side.
- D. JEDEC package registration is pending.





DIE SIZE BALL GRID ARRAY



#### NOTES:

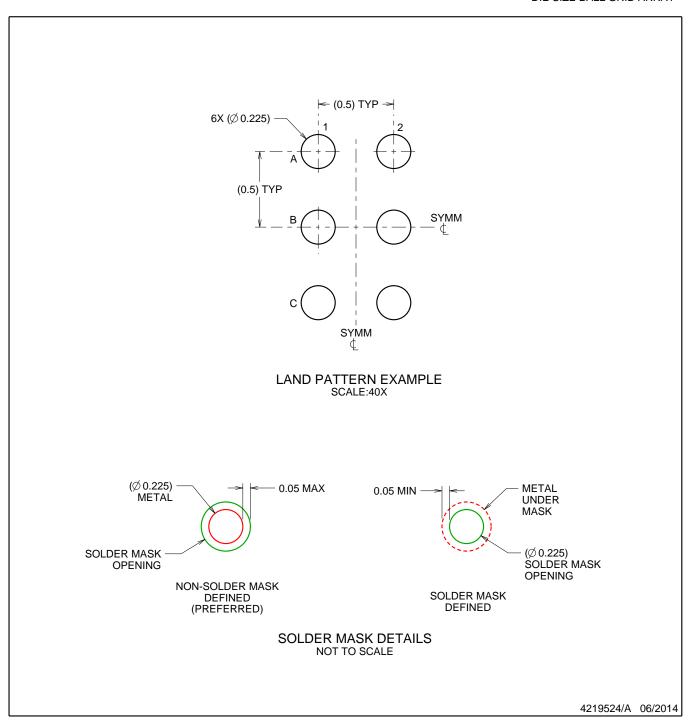
NanoFree Is a trademark of Texas Instruments.

- 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. NanoFree<sup>™</sup> package configuration.



DIE SIZE BALL GRID ARRAY

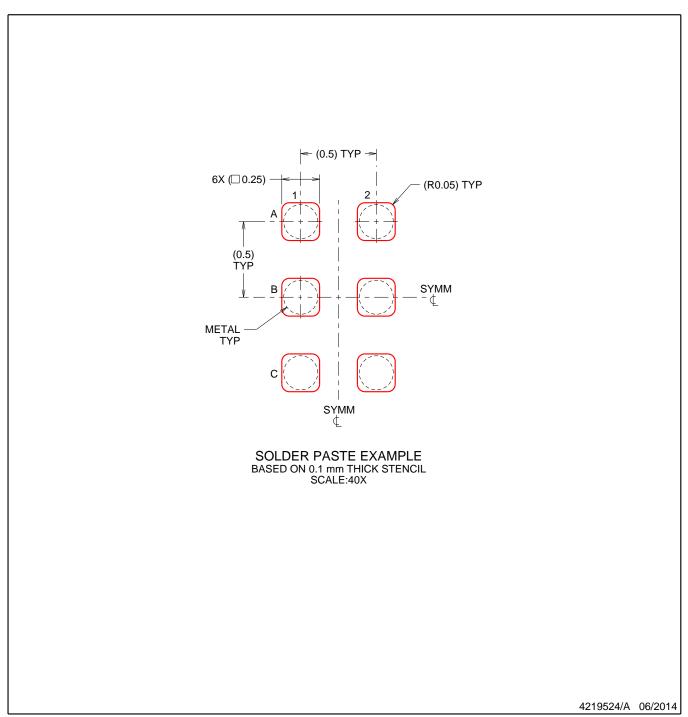


NOTES: (continued)

4. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SBVA017 (www.ti.com/lit/sbva017).



DIE SIZE BALL GRID ARRAY



NOTES: (continued)

5. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.



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