A Inter Chip-USB Voltage Level Translator

Check for Samples: TXS0202

FEATURES

- **No Direction Control Signal Required**
- **V_{CCA}, V_{CCB} Supply Voltage: 1.65 V to 3.6 V**
- **Meets All Requirements of the IC-USB Standard**
- **Small Packages: WCSP**
- **Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II**
- **I_{off} Supports Partial-Power-Down Mode Operation**
- **ESD Performance**
  - **A port (Host-Side)**
    - **2000-V Human-Body Model**
    - **100-V Machine Model**
    - **500-V Charged-Device Model**
  - **B port (Peripheral-Side)**
    - **>4kV HBM**

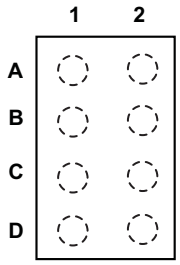


Table 1. YZP TERMINAL ASSIGNMENTS (Top Through View)

	1	2
A	D+(B)	D–(B)
B	GND	V_{CCB}
C	V_{CCA}	OE
D	D+(A)	D–(A)

DESCRIPTION

The TXS0202 is a 2-bit voltage level translator optimized for use in Interchip USB (IC-USB) applications. V_{CCA} and V_{CCB} can each operate over the full range of 1.65 V to 3.6 V. The device has been designed to maintain cross-over skew to be less than 1 ns. The device has integrated pull-ups and pull-down resistors to aid in the protocol communication between a host and a peripheral. The translator is a buffered auto-direction sensing type translator. When the output-enable (OE) input is low, all outputs are placed in the high-impedance state.

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 pull-down resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

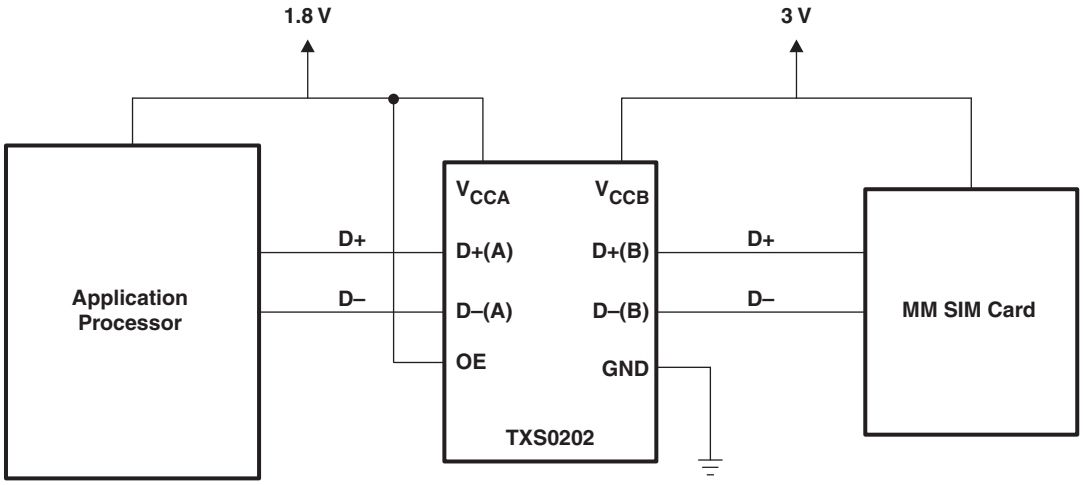
ORDERING INFORMATION(1)

T_A	PACKAGE(2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	WSCP – YZP	Tape and reel	TXS0202YZPR	_ _ _ 7PS _(3)

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.
(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.
(3) YZP: The actual top-side marking has three preceding characters to denote year, month, and sequence code, and one following character to designate the wafer fab/assembly site.

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.

TYPICAL APPLICATION BLOCK DIAGRAM



PIN FUNCTIONS

PIN		DESCRIPTION
WSCP (YFP) BALL NO.	NAME	
A1	D+(B)	USB data signal connected to peripheral
A2	D–(B)	USB data signal connected to peripheral
B1	GND	Ground
B2	V_{CCB}	B-side supply voltage (1.65 V to 3.6 V)
C1	V_{CCA}	A-side supply voltage (1.65 V to 3.6 V)
C2	OE	Output enable input control
D1	D+(A)	USB data signal connected to host
D2	D–(A)	USB data signal connected to host

FUNCTIONAL TABLE

CONTROL INPUT	OUTPUT CIRCUIT	OPERATION
OE	B PORT	
L	Hi-Z	Isolation
H	Enabled	Bi-directional communications between host and peripheral

ABSOLUTE MAXIMUM RATINGS(1)

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

			MIN	MAX	UNIT
V_{CCA} V_{CCB}	Supply voltage rang		–0.5	4.6	V
V_I	Input voltage range	A port, B port, control inputs	–0.5	V_{CCx} + 0.5	V
V_O	Voltage range applied to any output in the high-impedance or power-off state	A port, B port	–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_{CCB}, or GND			±100	mA
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.

THERMAL INFORMATION

THERMAL METRIC(1)		TXS0202 YZP 8 PINS	UNITS
θ_{JA}	Junction-to-ambient thermal resistance	102	°C/W

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

RECOMMENDED OPERATING CONDITIONS

			MIN	MAX	UNIT
V_{CCA}, V_{CCB}	Supply voltage		1.65	3.6	V
V_{IH}	High-level input voltage	A port I/Os	V_{CCA} – 0.2	V_{CCA}	V
		B port I/Os	V_{CCB} – 0.2	V_{CCB}	
		OE	V_{CCA} × 0.65	3.6	
V_{IL}	Low-level input voltage	A port I/Os	0	0.15	V
		B port I/Os	0	0.15	
		OE	0	V_{CCA} × 0.35	
Δt/Δv	Input transition rise or fall rate			10	ns/V
T_A	Operating free-air temperature		–40	85	°C

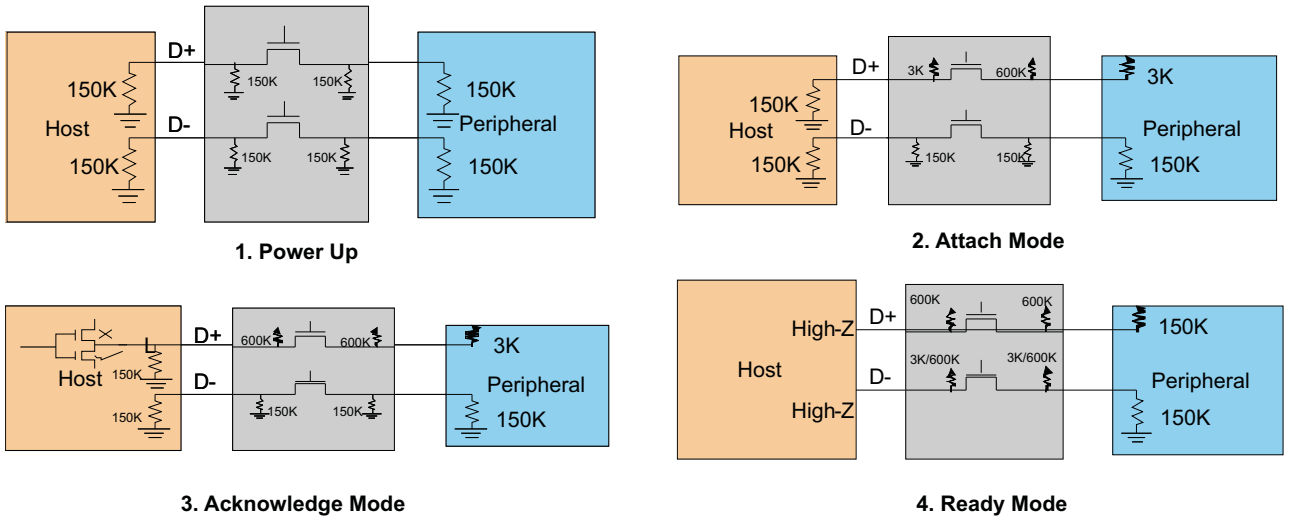


Figure 1. Block Diagram Showing Different Modes in the TXS0202

ELECTRICAL CHARACTERISTICS

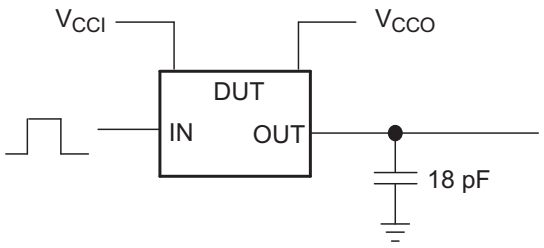
PARAMETER	TEST CONDITIONS	V_{CCA}	V_{CCBx}	T_A = 25°C	T_A = –40°C to 85°C		UNIT
				TYP	MIN	MAX	
$V_{OH(D–)}$ (D– A or B port)	I_{OH} = –20 µA, V_{Ix} ≥ V_{CCx} – 0.2 V	1.65 V	1.65 V		V_{CCO} × 0.67		V
		2.3 V	2.3 V		V_{CCO} × 0.67		
		3.3 V	3.3 V		V_{CCO} × 0.67		
$V_{OL(D–)}$ (D– A or B port)	I_{OL} = 220 µA, V_{Ix} ≤ 0.15 V	1.65 V	1.65 V			0.45	V
	I_{OL} = 180 µA, V_{Ix} ≤ 0.15 V	2.3 V	2.3 V			0.55	
	I_{OL} = 220 µA, V_{Ix} ≤ 0.15 V	3.3 V	3.3 V			0.7	
$V_{OH(D+)}$ (D+ A or B port)	I_{OH} = –20 µA, V_{Ix} ≥ V_{CCx} – 0.2 V	1.65 V	1.65 V		V_{CCO} × 0.67		V
		2.3 V	2.3 V		V_{CCO} × 0.67		
		3.3 V	3.3 V		V_{CCO} × 0.67		
$V_{OL(D+)}$ (D– A or B port)	I_{OL} = 220 µA, V_{Ix} ≤ 0.15 V	1.65 V	1.65 V			0.45	V
	I_{OL} = 300 µA, V_{Ix} ≤ 0.15 V	2.3 V	2.3 V			0.55	
	I_{OL} = 620 µA, V_{Ix} ≤ 0.15 V	3.3 V	3.3 V			0.7	
I_I	OE	1.65 V to 3.6 V	1.65 V to 3.6 V	±2		±2	µA
	D–/D+ A or B port, OE = OPEN			±2		±2	
	I_{BOFF}, D+, D– B port	1.65 V to 3.6 V	0 V			±2	
	I_{AOFF}, D+, D– A port	0 V	1.65 V to 3.6 V			±2	
I_{CCA}	V_I = V_O = Open, OE = High	1.65 V to 3.6 V	1.65 V to 3.6 V	2.2		12	µA
		3.6 V	0 V	2.3		12	
		0 V	3.6 V	0.026		–1	
I_{CCB}	V_I = V_O = Open, OE = High	1.65 V to 3.6 V	1.65 V to 3.6 V	2.7		24	µA
		3.6 V	0 V	0.031		–12	
		0 V	3.6 V	2.7		24	
C_i	OE	3.6 V	3.6 V	2.5		3.5	pF
C_{io}	A port	3.6 V	3.6 V	7		7.5	pF
	B port			9.5		10	

SWITCHING CHARACTERISTICS

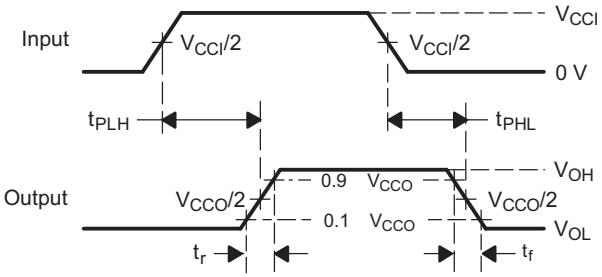
over recommended operating free-air temperature range, V_{CCA} = 1.8 V ± 0.15 V (unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.8 V ± 0.15 V	V_{CCB} = 3.3 V ± 0.3 V	UNIT
			TYP	TYP	
t_{pd}	A	B	5	5	ns
	B	A	5	5	
t_{rA}	A port rise times		2	2	ns
t_{fA}	A port fall times		2	2	ns
t_{rB}	B port rise times		2	2	ns
t_{fB}	B port fall times		2	2	ns
$t_{sk(o)}$	Channel-to-channel		0.5	0.5	ns
Max data rate			15	15	Mbps

PARAMETER MEASUREMENT INFORMATION



DATA RATE, SKEW, PROPAGATION DELAY,
OUTPUT RISE AND FALL TIME MEASUREMENT



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES

A. C_L includes probe and jig capacitance.
B. The outputs are measured one at a time, with one transition per measurement.
C. t_{PLH} and t_{PHL} are the same as t_{pd}.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
TXS0202YZPR	Active	Production	DSBGA (YZP) | 8	3000 | LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	7P
TXS0202YZPR.B	Active	Production	DSBGA (YZP) | 8	3000 | LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	7P

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

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

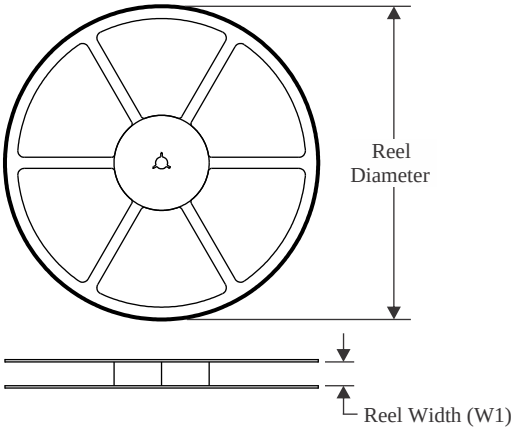
(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

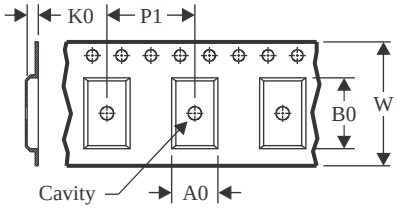
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

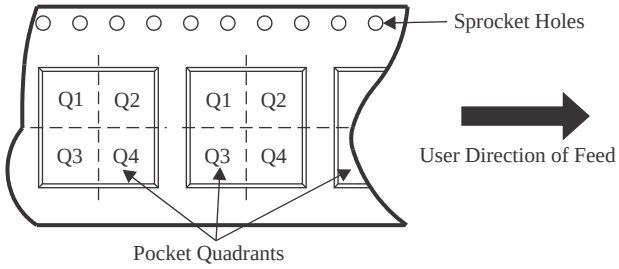


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	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

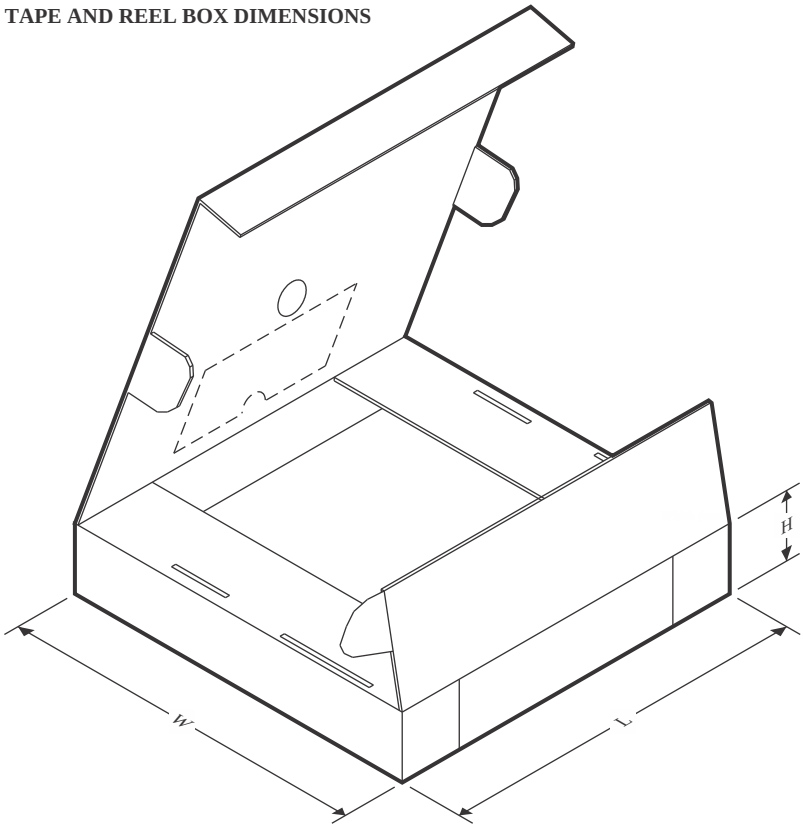
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TXS0202YZPR	DSBGA	YZP	8	3000	180.0	8.4	1.02	2.02	0.63	4.0	8.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

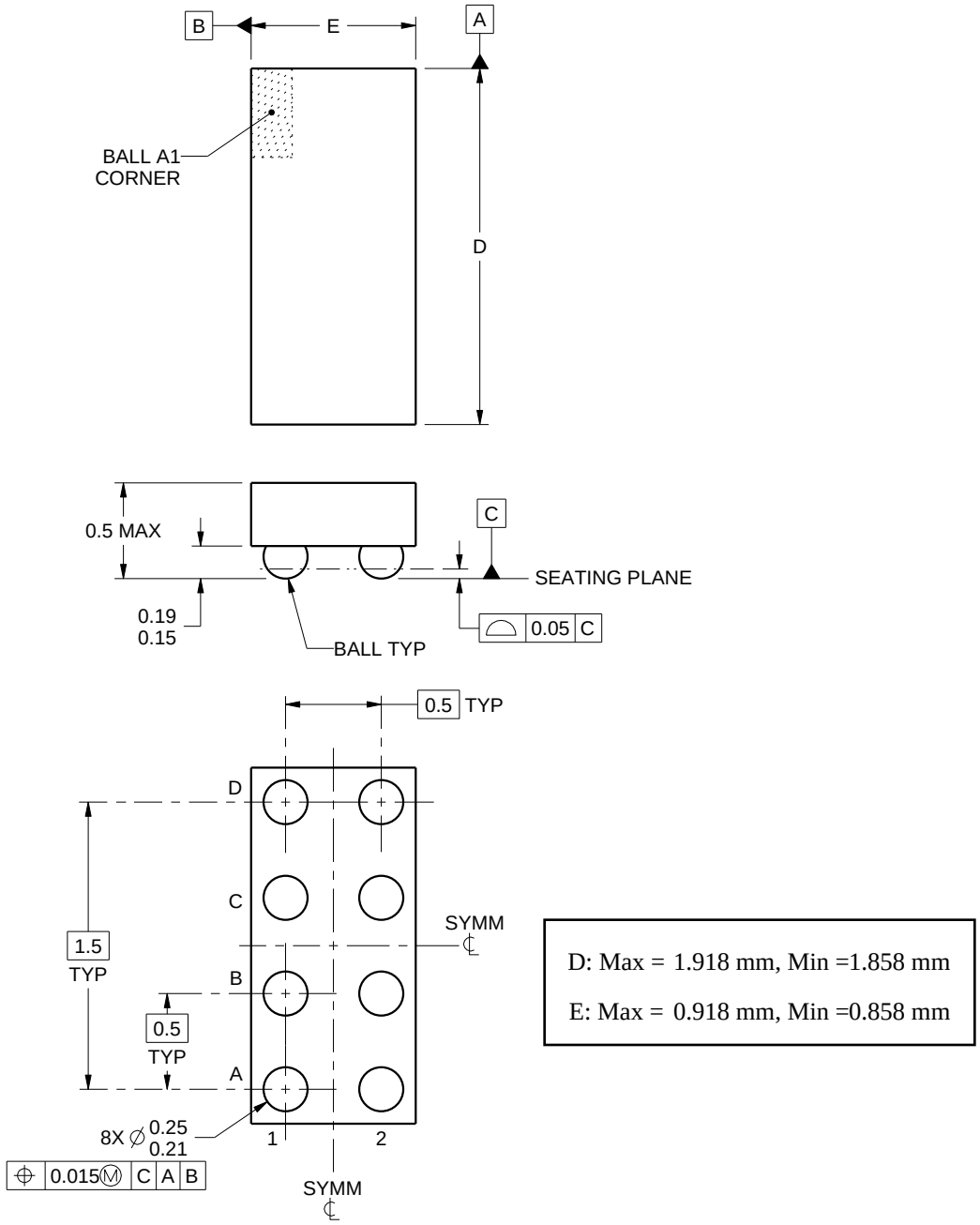
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TXS0202YZPR	DSBGA	YZP	8	3000	182.0	182.0	20.0

PACKAGE OUTLINE

YZP0008

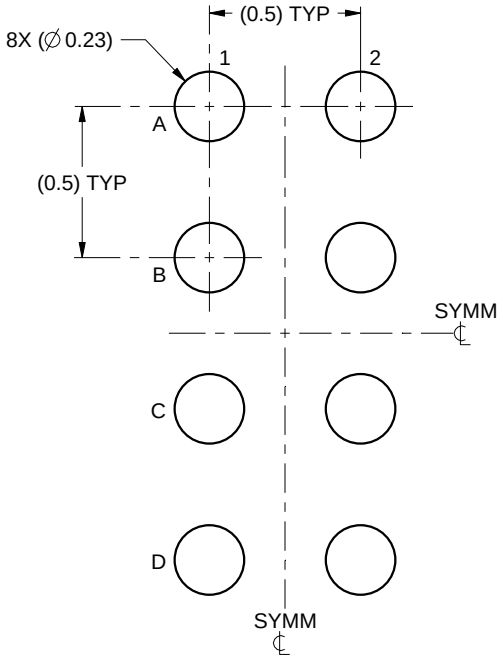
DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY

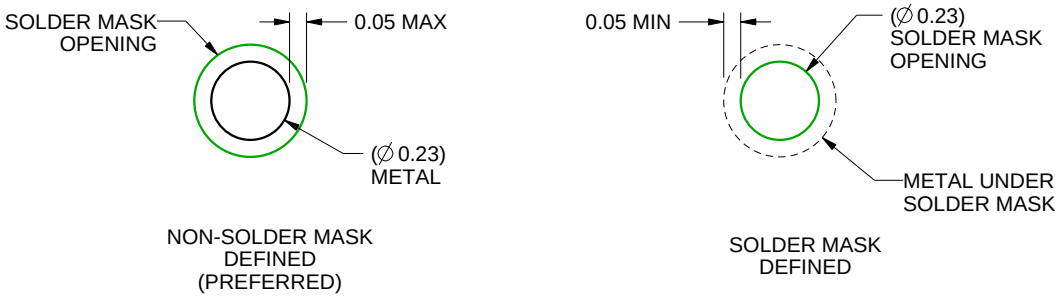


NOTES:

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.



LAND PATTERN EXAMPLE
SCALE:40X



SOLDER MASK DETAILS
NOT TO SCALE

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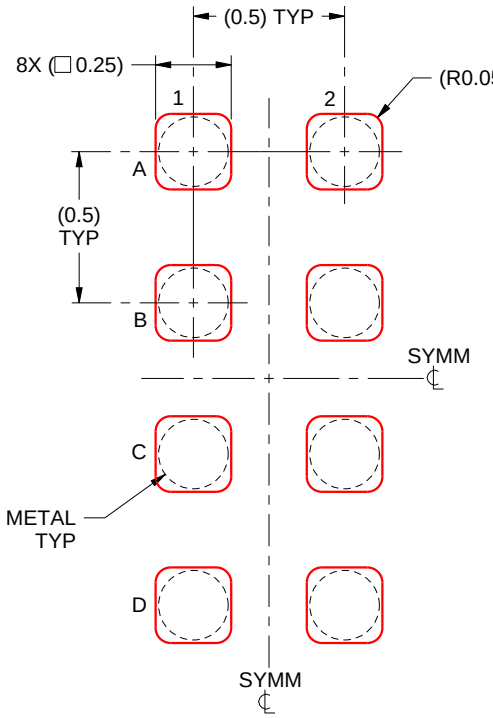
NOTES: (continued)

3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SNVA009 (www.ti.com/lit/snva009).



SOLDER PASTE EXAMPLE
BASED ON 0.1 mm THICK STENCIL
SCALE:40X

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NOTES: (continued)

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

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