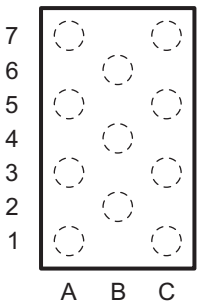
4-BIT DUAL-SUPPLY NON-INVERTING BUS TRANSLATOR

Check for Samples: SN74AVC4T234

FEATURES

- **Wide Operating V_{CC} Range of 0.9 V to 3.6 V**
- **3.6-V I/O Tolerant to Support Mixed-Mode Signal Operation**
- **Max t_{pd} of 3.7 ns at 3.3 V**
- **Balanced propagation delays: $t_{PLH} = t_{PHL}$**
- **Low Static-Power Consumption, 5-µA Max I_{CC}**
- **Input-Disable Feature Allows Floating Input Conditions**
- **±3-mA Output Drive at 1.8 V**
- **26Ω series resistor on A-side outputs**
- **I_{off} Supports Partial Power-Down-Mode Operation**
- **Input Hysteresis Allows Slow Input Transition and Better Switching Noise Immunity at Input**
- **Maximum Data Rates**
  - **380 Mbps (1.8-V to 3.3-V Translation)**
  - **200 Mbps (<1.8-V to 3.3-V Translation)**
  - **200 Mbps (Translate to 2.5 V or 1.8 V)**
  - **150 Mbps (Translate to 1.5 V)**
  - **100 Mbps (Translate to 1.2 V)**
- **Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II**
- **ESD Protection Exceeds JESD 22**
  - **2000-V Human-Body Model (A114-A)**
  - **500-V Charged-Device Model (C101)**

ZSU PACKAGE
(TOP VIEW)



DESCRIPTION

This 4-bit noninverting bus transceiver uses two separate configurable power-supply rails to enable asynchronous communication between B-port inputs and A-port outputs. The A port is designed to track V_{CCA} while the B port is designed to track V_{CCB}. Both V_{CCA} and V_{CCB} are configurable from 0.9 V to 3.6 V.

The SN74AVC4T234 solution offers the industry's low-power needs in battery-powered portable applications by ensuring both a very low static and dynamic power consumption across the entire V_{CC} range of 0.9 V to 3.6 V, resulting in an increased battery life. This product also maintains excellent signal integrity.

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.

The V_{CC} isolation feature ensures that if either V_{CC} input is at GND, then A-side ports are in the high-impedance state.

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.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

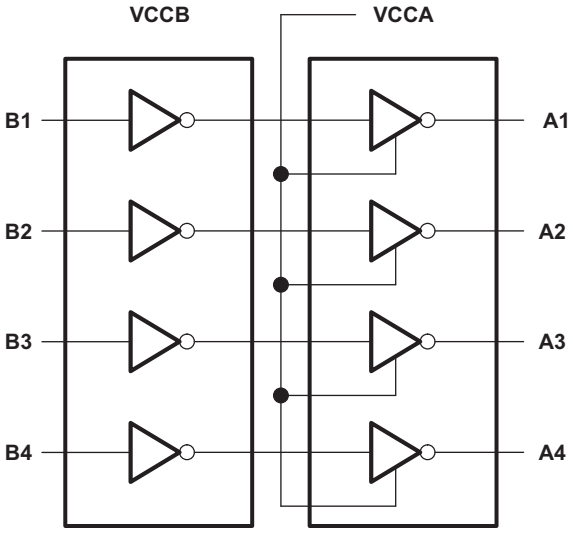
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ORDERING INFORMATION(1)

T_A	PACKAGE(2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	MicroStarCSP -- ZSU	Tape and reel	SN74AVC4T234ZSUR	ZTD _ _(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 web site at www.ti.com.
(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.
(3) ZSU: The actual top-side marking has two additional characters that designate the year and month date code.

LOGIC DIAGRAM (POSITIVE LOGIC)



TERMINAL FUNCTIONS

TERMINAL		TYPE	DESCRIPTION
NAME	ZSU Package		
B1	C7	I	Data input port
B2	C5	I	Data input port
B3	C3	I	Data input port
B4	C1	I	Data input port
A1	A7	O	Data output port
A2	A5	O	Data output port
A3	A3	O	Data output port
A4	A1	O	Data output port
V_{CCA}	B6	PWR	A-side output port power supply voltage (0.9 V to 3.6 V)
V_{CCB}	B4	PWR	B-side input port power supply voltage (0.9 V to 3.6 V)
GND	B2	PWR	Ground

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ABSOLUTE MAXIMUM RATINGS(1)

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

			MIN	MAX	UNIT
V_{CCA} V_{CCB}	Supply voltage range		–0.5	4.6	V
V_I	Input voltage range(2)	Output ports (A port)	–0.5	4.6	V
		Input ports (B port)	–0.5	4.6	
V_O	Voltage range applied to any output in the high-impedance or power-off state(2)	A port	–0.5	4.6	V
V_O	Voltage range applied to any output in the high or low state(2) (3)	A port	–0.5	V_{CCA} + 0.5	V
I_{IK}	Input clamp current	V_I < 0		–50	mA
I_{OK}	Output clamp current	V_O < 0		–50	mA
I_O	Continuous output current			±20	mA
	Continuous current through V_{CCA}, V_{CCB}, or GND			±50	mA
θ_{JA}	Package thermal impedance(4)			180.4	ºC/W
T_{stg}	Storage temperature range		–65	150	˚C

(1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) The input voltage and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
(3) The output positive-voltage rating may be exceeded up to 4.6 V maximum if the output current rating is observed.
(4) The package thermal impedance is calculated in accordance with JESD 51-7.

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RECOMMENDED OPERATING CONDITIONS(1) (2) (3)

			V_{CCI}	V_{CCO}	MIN	MAX	UNIT
V_{CCA}	Supply voltage				0.9	3.6	V
V_{CCB}	Supply voltage				0.9	3.6	V
V_{IH}	High-level input voltage	Data inputs(4)	0.9 V to 1.1 V		V_{CCI} × 0.8	3.6	V
			1.1 V to 1.4 V		V_{CCI} × 0.8	3.6	
			1.4 V to 1.95 V		V_{CCI} × 0.65	3.6	
			2.3 V to 2.7 V		V_{CCI} × 0.65	3.6	
			3 V to 3.6 V		V_{CCI} × 0.65	3.6	
V_{IL}	Low-level input voltage	Data inputs(4)	0.9 V to 1.1 V		0	V_{CCI} × 0.2	V
			1.1 V to 1.4 V		0	V_{CCI} × 0.2	
			1.1 V to 1.95 V		0	V_{CCI} × 0.35	
			2.3 V to 2.7 V		0	V_{CCI} × 0.35	
			3 V to 3.6 V		0	V_{CCI} × 0.35	
V_I	Input voltage				0	3.6	V
V_O	Output voltage	Active state			0	V_{CCO}	V
I_{OH}	High-level output current			0.9 V to 1.1 V		-0.1	mA
				1.1 V to 1.3 V		–1	
				1.4 V to 1.6 V		–2	
				1.65 V to 1.95 V		–3	
				2.3 V to 2.7 V		–6	
				3 V to 3.6 V		–12	
I_{OL}	Low-level output current			0.9 V to 1.1 V		0.1	mA
				1.1 V to 1.3 V		1	
				1.4 V to 1.6 V		2	
				1.65 V to 1.95 V		3	
				2.3 V to 2.7 V		6	
				3 V to 3.6 V		12	
Δt/Δv	Input transition rise or fall rate			3 V to 3.6 V		10	ns/V
				2.3 V to 2.7 V		20	
				1.65 V to 1.95 V		50	
				1.4 V to 1.6 V		100	
				1.1 V to 1.3 V		100	
T_A	Operating free-air temperature				–40	85	°C

(1) V_{CCI} is the V_{CCB} input port.
(2) V_{CCO} is the V_{CCA} output port.
(3) All unused data inputs of the device must be held at V_{CCI} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.
(4) For V_{CCI} values not specified in the data sheet, V_{IH} min = V_{CCI} × 0.7 V, V_{IL} max = V_{CCI} × 0.3 V

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ELECTRICAL CHARACTERISTICS(1) (2)

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

PARAMETER		TEST CONDITIONS		V_{CCA}	V_{CCB}	T_A = 25°C			–40°C to 85°C		UNIT
						MIN	TYP	MAX	MIN	MAX	
V_{OH}		I_{OH} = –100 µA	$V_I = V_{IH}$	0.9 V	0.9 V to 3.6 V				V_{CCA} – 0.1		V
		I_{OH} = –1 mA		1.1 V					0.88		
		I_{OH} = –2 mA		1.4 V					1.05		
		I_{OH} = –3 mA		1.65 V					1.2		
		I_{OH} = –6 mA		2.3V					1.75		
		I_{OH} = –12 mA		3 V					2.3		
V_{OL}		I_{OL} = 100 µA	$V_I = V_{IL}$	0.9 V	0.9 V to 3.6 V					0.1	V
		I_{OL} = 1 mA		1.1 V						0.2	
		I_{OL} = 2 mA		1.4 V						0.2	
		I_{OL} = 3 mA		1.65 V						0.25	
		I_{OL} = 6 mA		2.3V						0.3	
		I_{OL} = 12 mA		3 V						0.55	
I_{off}	A or B port	V_I or V_O = 0 to 3.6 V		0 V	0 V to 3.6 V		±0.1	±1		±5	µA
				0 V to 3.6 V	0 V		±0.1	±1		±5	
I_{CCA}		V_{CCB} or GND, I_O = 0		0.8 V to 3.6 V	0.8 V to 3.6 V					8	µA
				0 V	0 V to 3.6 V					8	
				0 V to 3.6 V	0 V					8	
I_{CCB}		V_{CCB} or GND, I_O = 0		0.8 V to 3.6 V	0.8 V to 3.6 V					8	µA
				0 V	0 V to 3.6 V					8	
				0 V to 3.6 V	0 V					8	
$I_{CCA} + I_{CCB}$		V_{CCB} or GND, I_O = 0		0.8 V to 3.6 V	0.8 V to 3.6 V					16	µA
C_i	V_{CCB}	V_{CCB} = 3.3 V or GND		3.3 V	3.3 V		22				pF
C_{io}	A or B port	V_{CCA} = 3.3 V or GND		3.3 V	3.3 V		5			7	pF

(1) V_{CCO} is the V_{CCA} output port.
(2) V_{CCI} is the V_{CCB} input port.

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SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, V_{CCB} = 1.1 V (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCA} = 1.1 V	V_{CCA} = 1.4 V	V_{CCA} = 1.65 V	V_{CCA} = 2.3 V	V_{CCA} = 3 V	UNIT
			TYP	TYP	TYP	TYP	TYP	
t_{PLH}	B	A	5.5	4.6	4.2	3.7	3.9	ns
t_{PHL}			4.7	3.9	3.4	3	3.1	

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, V_{CCB} = 1.4 V (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCA} = 1.1 V	V_{CCA} = 1.4 V		V_{CCA} = 1.65 V		V_{CCA} = 2.3 V		V_{CCA} = 3 V		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	B	A	4.7	2.0	5	1.5	3.8	1.2	3.8	1.0	3.8	ns
t_{PHL}			4.2	2.0	5	1.5	3.9	1.2	3	1.0	3.0	

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SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, V_{CCB} = 1.65 V (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCA} = 1.1 V	V_{CCA} = 1.4 V		V_{CCA} = 1.65 V		V_{CCA} = 2.3 V		V_{CCA} = 3 V		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	B	A	4.3	2.0	4.2	1.5	4.1	1.2	3.8	1.0	3.7	ns
t_{PHL}			2.6	2.0	4.2	1.5	4.1	1.2	3.8	1.0	3.7	

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, V_{CCB} = 2.3 V (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCA} = 1.1 V	V_{CCA} = 1.4 V		V_{CCA} = 1.65 V		V_{CCA} = 2.3 V		V_{CCA} = 3 V		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	B	A	2.7	2.0	3.5	1.5	3.1	1.2	2.8	0.2	4.1	ns
t_{PHL}			2.4	2.0	3.7	1.5	3.7	1.2	2.8	0.2	3.5	

SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range, V_{CCB} = 3 V (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCA} = 1.1 V	V_{CCA} = 1.4 V		V_{CCA} = 1.65 V		V_{CCA} = 2.3 V		V_{CCA} = 3 V		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	B	A	3.9	2.0	3.8	1.5	3.6	0.5	3.6	0.2	3.6	ns
t_{PHL}			3.9	2.0	3.7	1.5	3.1	0.5	3.5	0.2	3.0	

OPERATING CHARACTERISTICS

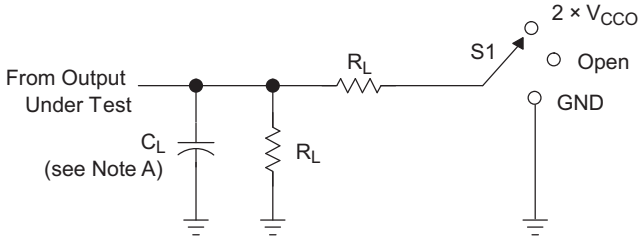
T_A = 25°C

PARAMETER			TEST CONDITIONS	V_{CCA} = V_{CCB} = 1.1 V	V_{CCA} = V_{CCB} = 1.4 V	V_{CCA} = V_{CCB} = 1.65 V	V_{CCA} = V_{CCB} = 2.3 V	V_{CCA} = V_{CCB} = 3 V	UNIT
				TYP	TYP	TYP	TYP	TYP	
C_{pdA} (1)	B to A	Outputs enabled	C_L = 0, f = 10 MHz, t_r = t_f = 1 ns	18.5	18.5	18.5	18.5	18.5	pF

(1) Power dissipation capacitance per transceiver

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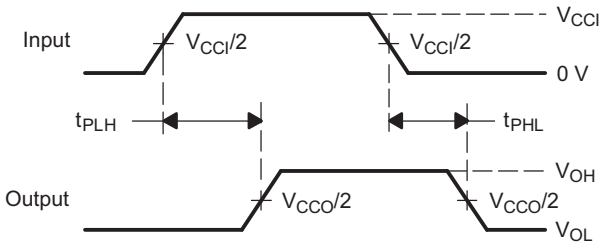
PARAMETER MEASUREMENT INFORMATION



TEST	S1
t_{pd}	Open

LOAD CIRCUIT

V_{CCO}	C_L	R_L	V_{TP}
1.2 V	30 pF	0.5 kΩ	0.1 V
1.5 V ± 0.1 V	30 pF	0.5 kΩ	0.1 V
1.8 V ± 0.15 V	30 pF	0.5 kΩ	0.15 V
2.5 V ± 0.2 V	30 pF	0.5 kΩ	0.15 V
3.3 V ± 0.3 V	30 pF	0.5 kΩ	0.3 V



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES

NOTES: A. C_L includes probe and jig capacitance.
B. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50 Ω, dv/dt ≥ 1 V/ns.
C. The outputs are measured one at a time, with one transition per measurement.
D. t_{PLH} and t_{PHL} are the same as t_{pd}.
E. V_{CCI} is V_{CCB}.
F. V_{CCO} is V_{CCA}.

Figure 1. Load and Circuit and Voltage Waveforms

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PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN74AVC4T234ZSUR	ACTIVE	uCSP	ZSU	11	2500	Green (RoHS & no Sb/Br)	SN98.5/AG1/CU0.5	Level-2-260C-1 YEAR	-40 to 85	ZTD	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.

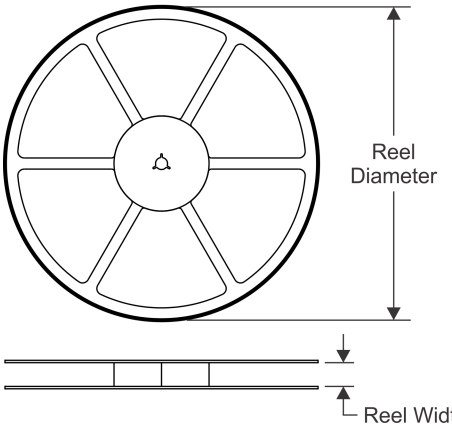
(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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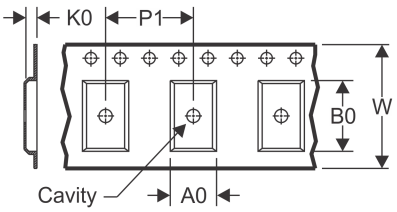
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TAPE AND REEL INFORMATION

REEL DIMENSIONS

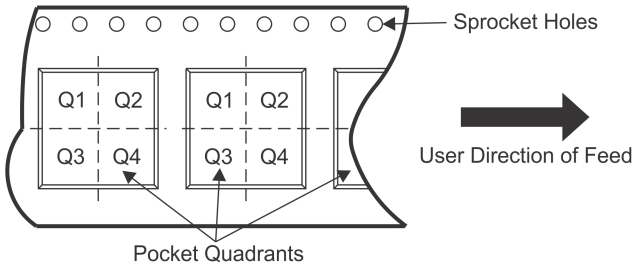


TAPE DIMENSIONS



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

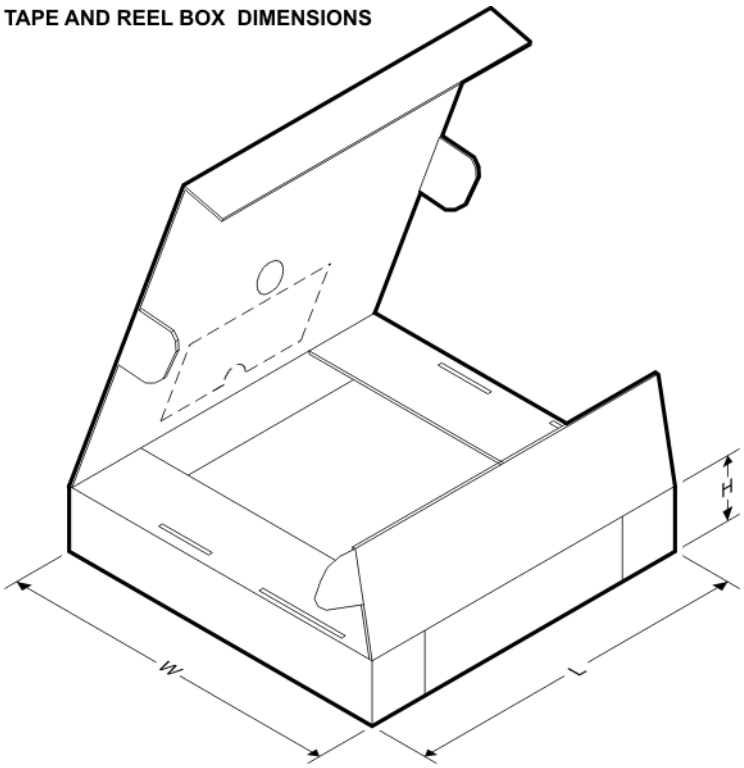
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

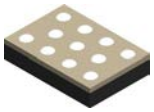
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74AVC4T234ZSUR	uCSP	ZSU	11	2500	330.0	8.4	1.6	2.2	0.55	4.0	8.0	Q2

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74AVC4T234ZSUR	uCSP	ZSU	11	2500	338.1	338.1	20.6

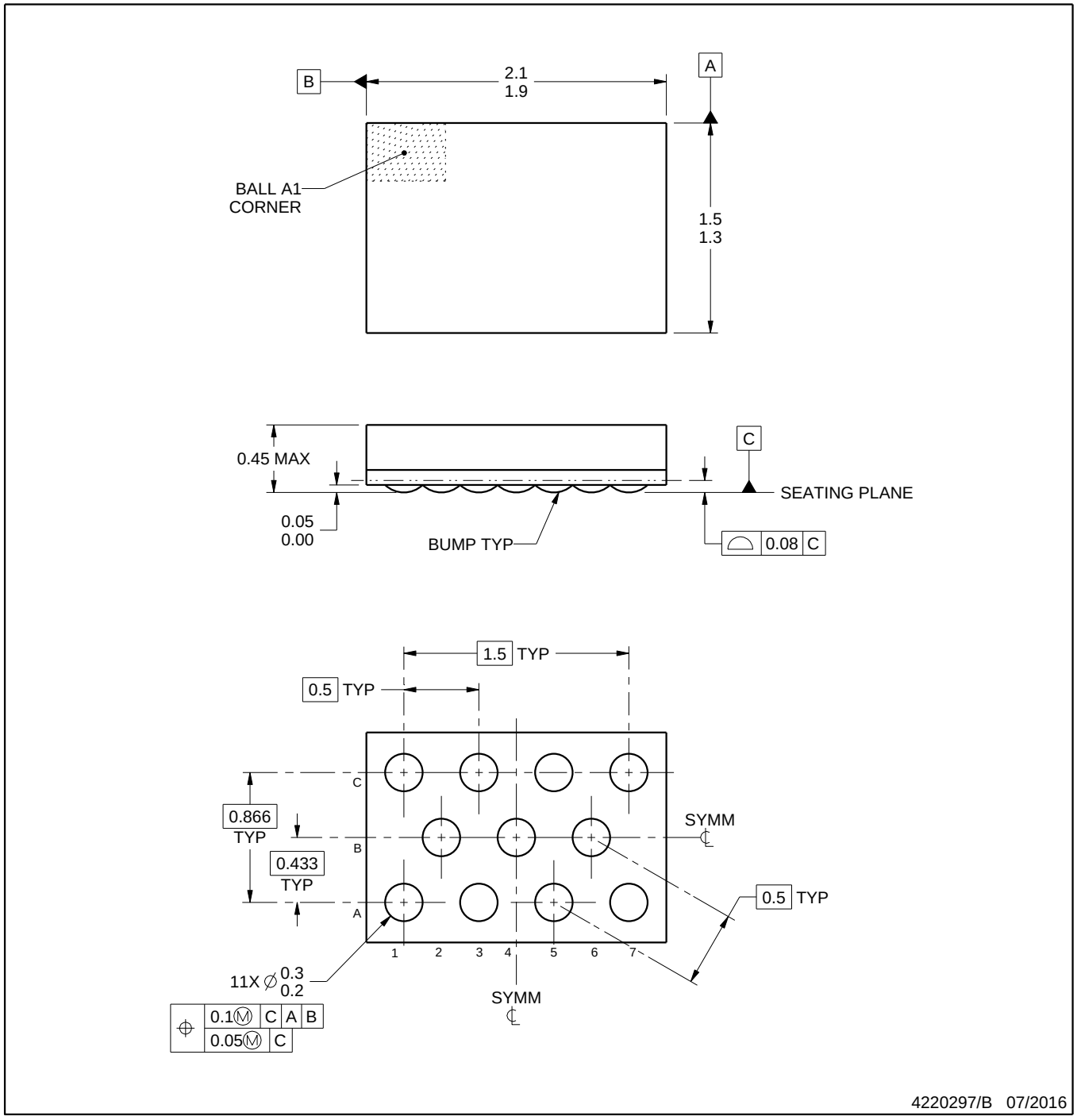


PACKAGE OUTLINE

ZSU0011A

MicroStar CSP™ - 0.45 mm max height

MICRO CHIP SCALE PACKAGE

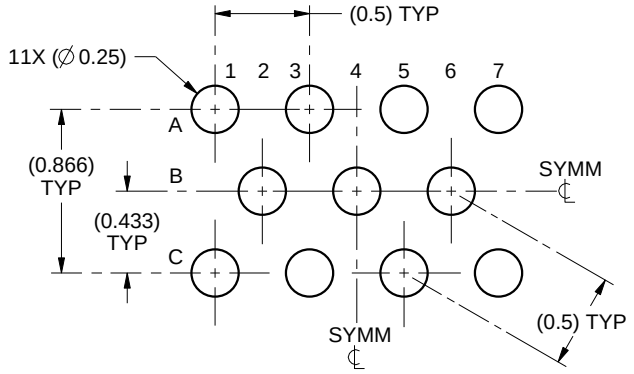


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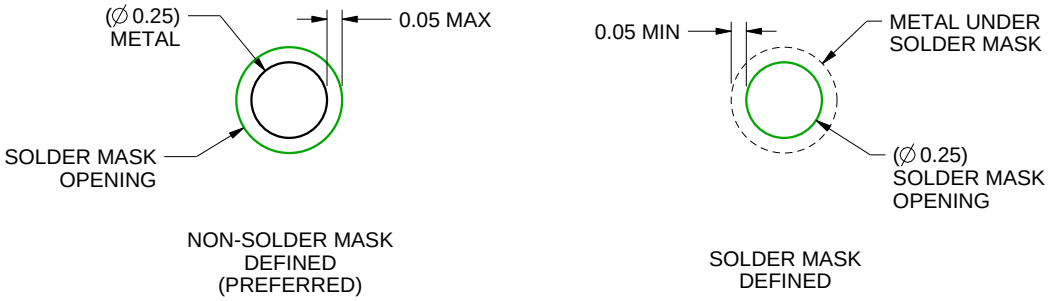
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NOTES:

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



LAND PATTERN EXAMPLE
SCALE:25X

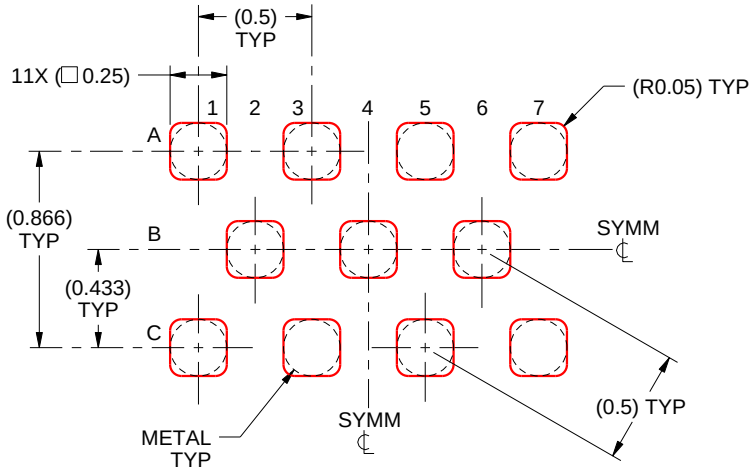


SOLDER MASK DETAILS
NOT TO SCALE

4220297/B 07/2016

NOTES: (continued)

3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints.
   See Texas Instruments Literature No. SLUA271 (www.ti.com/lit/slua271).



SOLDER PASTE EXAMPLE
BASED ON 0.1 mm THICK STENCIL
SCALE:30X

4220297/B 07/2016

NOTES: (continued)

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

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