FEATURES

- Available in the Texas Instruments NanoFree™ Package
- **Fully Configurable Dual-Rail Design Allows** Each Port to Operate Over the Full 1.65-V to 5.5-V Power-Supply Range
- V_{CC} Isolation Feature If Either V_{CC} Input Is at GND, Both Ports Are in the High-Impedance
- DIR Input Circuit Referenced to V_{CCA}
- Low Power Consumption, 10-μA Max I_{CC}
- ±24-mA Output Drive at 3.3 V
- I_{off} Supports Partial-Power-Down Mode Operation
- Max Data Rates
 - 420 Mbps (3.3-V to 5-V Translation)
 - 210 Mbps (Translate to 3.3 V)
 - 140 Mbps (Translate to 2.5 V)
 - 75 Mbps (Translate to 1.8 V)
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- **ESD Protection Exceeds JESD 22**
 - 4000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)

DCT OR DCU PACKAGE (TOP VIEW) V_{CCB} $V_{CCA}L$ A1 **∏** 2 7 ∏ B1 A2 **∏** 3 6 **1** B2 GND [5 DIR



YZP PACKAGE



DESCRIPTION/ORDERING INFORMATION

This dual-bit noninverting bus transceiver 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 5.5 V. The B port is designed to track V_{CCB}. V_{CCB} accepts any supply voltage from 1.65 V to 5.5 V. This allows for universal low-voltage bidirectional translation between any of the 1.8-V, 2.5-V, 3.3-V, and 5-V voltage nodes.

ORDERING INFORMATION

T _A	PACKAGE ⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING(2)
	NanoFree – WCSP (DSBGA) 0.23-mm Large Bump – YZP (Pb-free)	Reel of 3000	SN74LVC2T45YZPR	TB_
	SSOP – DCT	Reel of 3000	SN74LVC2T45DCTR	CT2
-40°C to 85°C	330F - DC1	Reel of 250	SN74LVC2T45DCTT	012
	VSSOP – DCU	Reel of 3000	SN74LVC2T45DCUR	CT2
	V550P - DC0	Reel of 250	SN74LVC2T45DCUT	CT2_

- (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.
- DCT: The actual top-side marking has three additional characters that designate the year, month, and assembly/test site. DCU: The actual top-side marking has one additional character that designates the assembly/test site. YZP: The actual top-side marking has three preceding characters to denote year, month, and sequence code, and one following character to designate the assembly/test site. Pin 1 identifier indicates solder-bump composition (1 = SnPb, • = Pb-free).



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. NanoFree is a trademark of Texas Instruments.

DUAL-BIT DUAL-SUPPLY BUS TRANSCEIVER WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS

SCES516I-DECEMBER 2003-REVISED MARCH 2007



DESCRIPTION/ORDERING INFORMATION (CONTINUED)

The SN74LVC2T45 is designed for asynchronous communication between two data buses. The logic levels of the direction-control (DIR) input activate either the B-port outputs or the A-port outputs. The device transmits data from the A bus to the B bus when the B-port outputs are activated, and from the B bus to the A bus when the A-port outputs are activated. The input circuitry on both A and B ports always is active and must have a logic HIGH or LOW level applied to prevent excess I_{CC} and I_{CCZ} .

The SN74LVC2T45 is designed so that the DIR input circuit is supplied by V_{CCA}.

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

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

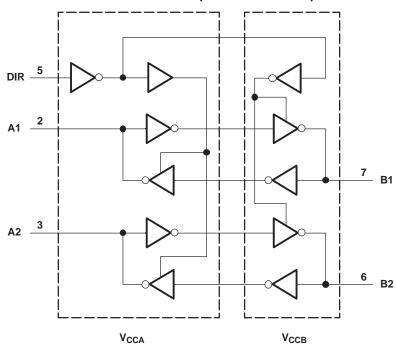
NanoFree™ package technology is a major breakthrough in IC packaging concepts, using the die as the package.

FUNCTION TABLE⁽¹⁾ (EACH TRANSCEIVER)

INPUT DIR	OPERATION
L	B data to A bus
Н	A data to B bus

 Input circuits of the data I/Os always are active.

LOGIC DIAGRAM (POSITIVE LOGIC)



SN74LVC2T45 DUAL-BIT DUAL-SUPPLY BUS TRANSCEIVER WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS

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Absolute Maximum Ratings⁽¹⁾

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

			MIN	MAX	UNIT
V _{CCA}	Supply voltage range	-0.5	6.5	V	
V_{I}	Input voltage range (2)		-0.5	6.5	V
Vo	Voltage range applied to any output in the high-impedance or power-or	off state ⁽²⁾	-0.5	6.5	V
\/	Voltage range applied to any output in the high or law state (2)(3)	A port	-0.5	V _{CCA} + 0.5	V
Vo	Voltage range applied to any output in the high or low state (2)(3)	B port	-0.5	V _{CCB} + 0.5	V
I _{IK}	Input clamp current	V _I < 0		- 50	mA
I _{OK}	Output clamp current	V _O < 0		-50	mA
Io	Continuous output current			±50	mA
	Continuous current through V _{CC} or GND			±100	mA
		DCT package		220	
θ_{JA}	Package thermal impedance ⁽⁴⁾	DCU package		227	°C/W
		YZP package		102	
T _{stg}	Storage temperature range	·	-65	150	°C

⁽¹⁾ Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

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

³⁾ The value of V_{CC} is provided in the recommended operating conditions table.

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

SN74LVC2T45

DUAL-BIT DUAL-SUPPLY BUS TRANSCEIVER WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS



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Recommended Operating Conditions (1)(2)(3)

			V _{CCI}	V _{cco}	MIN	MAX	UNIT
V_{CCA}	Cumply voltage				1.65	5.5	V
V _{CCB}	Supply voltage				1.65	5.5	V
			1.65 V to 1.95 V		$V_{CCI} \times 0.65$		
\	High-level	Data inputs ⁽⁴⁾	2.3 V to 2.7 V		1.7		V
V_{IH}	input voltage	Data Inputs(*)	3 V to 3.6 V		2		V
			4.5 V to 5.5 V		$V_{CCI} \times 0.7$		
<u> </u>			1.65 V to 1.95 V			$V_{CCI} \times 0.35$	
\	Low-level	Data in auto (4)	2.3 V to 2.7 V			0.7	V
V_{IL}	input voltage	Data inputs ⁽⁴⁾	3 V to 3.6 V			0.8	V
			4.5 V to 5.5 V			$V_{CCI} \times 0.3$	
			1.65 V to 1.95 V		$V_{CCA} \times 0.65$		
	High-level	DIR	2.3 V to 2.7 V		1.7		.,
V_{IH}	input voltage	(referenced to V _{CCA}) ⁽⁵⁾	3 V to 3.6 V		2		V
			4.5 V to 5.5 V		$V_{CCA} \times 0.7$		
			1.65 V to 1.95 V			$V_{CCA} \times 0.35$	
	Low-level DIR input voltage (referenced to V _{CCA}	DIR	2.3 V to 2.7 V			0.7	.,
V_{IL}		(referenced to V _{CCA}) ⁽⁵⁾	3 V to 3.6 V			0.8	V
			4.5 V to 5.5 V			$V_{CCA} \times 0.3$	
VI	Input voltage	,			0	5.5	V
Vo	Output voltage				0	V_{CCO}	V
				1.65 V to 1.95 V		-4	
	I limb lavel avenue av			2.3 V to 2.7 V		-8	A
I _{OH}	High-level output cu	irrent		3 V to 3.6 V		-24	mA
				4.5 V to 5.5 V		-32	
				1.65 V to 1.95 V		4	
	Lauria al autoritari			2.3 V to 2.7 V		8	A
l _{OL}	Low-level output cui	Low-level output current		3 V to 3.6 V		24	mA
				4.5 V to 5.5 V		32	
			1.65 V to 1.95 V			20	
	Input transition /Δν rise or fall rate	Data lanut	2.3 V to 2.7 V			20	
Δt/Δν		Data inputs	3 V to 3.6 V			10	ns/V
	iise oi iali iale		4.5 V to 5.5 V			5	
	Control input		1.65 V to 5.5 V			5	
T _A	Operating free-air te	emperature			-40	85	°C

V_{CCI} is the V_{CC} associated with the input port.
 V_{CCO} is the V_{CC} associated with the output port.
 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.
 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.
 For V_{CCI} values not specified in the data sheet, V_{IH} min = V_{CCA} × 0.7 V, V_{IL} max = V_{CCA} × 0.3 V.

Electrical Characteristics (1)(2)

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

PARAMETER		TEST CONDITI	ONS	V	V	T _A	= 25°(–40°C to 8	5°C	UNIT	
PARA	AIVIETER	TEST CONDITI	UNS	V _{CCA}	V _{CCB}	MIN 7	ГΥР	MAX	MIN	MAX	UNII	
		$I_{OH} = -100 \mu A$		1.65 V to 4.5 V	1.65 V to 4.5 V				V _{CCO} - 0.1			
		$I_{OH} = -4 \text{ mA}$		1.65 V	1.65 V				1.2			
V_{OH}		$I_{OH} = -8 \text{ mA}$	$V_I = V_{IH}$	2.3 V	2.3 V				1.9		V	
		I _{OH} = -24 mA		3 V	3 V				2.4			
		$I_{OH} = -32 \text{ mA}$		4.5 V	4.5 V				3.8			
		$I_{OL} = 100 \mu A$		1.65 V to 4.5 V	1.65 V to 4.5 V					0.1		
		I _{OL} = 4 mA		1.65 V	1.65 V					0.45		
V_{OL}		I _{OL} = 8 mA	$V_I = V_{IL}$	2.3 V	2.3 V					0.3	V	
		I _{OL} = 24 mA		3 V	3 V					0.55		
		I _{OL} = 32 mA		4.5 V	4.5 V					0.55		
I _L	DIR	$V_I = V_{CCA}$ or GND		1.65 V to 5.5 V	1.65 V to 5.5 V			±1		±2	μΑ	
	A port	\\ or\\ \ O to F.F.\	,	0 V	0 to 5.5 V			±1		±2	^	
l _{off}	B port	V_I or $V_O = 0$ to 5.5 V_I	'	0 to 5.5 V	0 V			±1		±2	μΑ	
l _{OZ}	A or B port	$V_O = V_{CCO}$ or GND		1.65 V to 5.5 V	1.65 V to 5.5 V			±1		±2	μΑ	
					1.65 V to 5.5 V					3		
I_{CCA}		$V_I = V_{CCI}$ or GND,	I _O = 0	5 V	0 V					2	μΑ	
				0 V	5 V					-2		
				1.65 V to 5.5 V	1.65 V to 5.5 V					3		
I_{CCB}		$V_I = V_{CCI}$ or GND,	I _O = 0	5 V	0 V					-2	μΑ	
				0 V	5 V					2		
I _{CCA} + (see Ta	I _{CCB} able 1)	$V_I = V_{CCI}$ or GND,	I _O = 0	1.65 V to 5.5 V	1.65 V to 5.5 V					4	μΑ	
	A port	One A port at V _{CCA} DIR at V _{CCA} , B port = open	– 0.6 V,	3 V to 5.5 V	0.77.5.5.77					50		
Δl _{CCA}	DIR	B port = open,	DIR at V _{CCA} – 0.6 V,		3 V to 5.5 V					50	μА	
ΔI_{CCB}	B port	One B port at V _{CCB} DIR at GND, A port		3 V to 5.5 V	3 V to 5.5 V					50	μΑ	
Cı	DIR	$V_I = V_{CCA}$ or GND		3.3 V	3.3 V		2.5				pF	
C _{io}	A or B port	$V_O = V_{CCA/B}$ or GND)	3.3 V	3.3 V		6				pF	

 $[\]begin{array}{ll} \hbox{(1)} & V_{CCO} \text{ is the } V_{CC} \text{ associated with the output port.} \\ \hbox{(2)} & V_{CCI} \text{ is the } V_{CC} \text{ associated with the input port.} \\ \end{array}$

SN74LVC2T45

DUAL-BIT DUAL-SUPPLY BUS TRANSCEIVER WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS



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Switching Characteristics

over recommended operating free-air temperature range, V_{CCA} = 1.8 V \pm 0.15 V (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V _{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V \pm 0.2 V		V _{CCB} = ± 0.3		V _{CCB} = ± 0.5		UNIT
	(INPOT)	(001701)	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t _{PLH}	Α	В	3	17.7	2.2	10.3	1.7	8.3	1.4	7.2	20
t _{PHL}	A	ь	2.8	14.3	2.2	8.5	1.8	7.1	1.7	7	ns
t _{PLH}	В	Α	3	17.7	2.3	16	2.1	15.5	1.9	15.1	ns
t _{PHL}	ь	A	2.8	14.3	2.1	12.9	2	12.6	1.8	12.2	115
t _{PHZ}	DIR	Α	10.6	30.9	10.3	30.5	10.5	30.5	10.7	29.3	no
t _{PLZ}	DIK	A	7.3	19.7	7.5	19.6	7.5	19.5	7	19.4	ns
t _{PHZ}	DIR	В	10	27.9	8.4	14.9	6.5	11.3	4.1	8.6	20
t _{PLZ}	DIK	ь	6.5	19.5	7.2	12.6	4.3	9.7	2.1	7.1	ns
t _{PZH} ⁽¹⁾	DIR	۸		37.2		28.6		25.2		22.2	20
t _{PZL} ⁽¹⁾	אוט	DIR A		42.2		27.8		23.9		20.8	ns
t _{PZH} ⁽¹⁾	DID	В		37.4		29.9		27.8		26.6	
t _{PZL} ⁽¹⁾	DIR	D D		45.2		39		37.6		36.3	ns

⁽¹⁾ The enable time is a calculated value, derived using the formula shown in the *enable times* section.

Switching Characteristics

over recommended operating free-air temperature range, V_{CCA} = 2.5 V \pm 0.2 V (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V _{CCB} = ± 0.15	V _{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V \pm 0.2 V		3.3 V V	V _{CCB} = 5 V ± 0.5 V		UNIT
	(INPOT)	(001701)	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t _{PLH}	А	В	2.3	16	1.5	8.5	1.3	6.4	1.1	5.1	no
t _{PHL}	A	ь	2.1	12.9	1.4	7.5	1.3	5.4	0.9	4.6	ns
t _{PLH}	В	А	2.2	10.3	1.5	8.5	1.4	8	1	7.5	no
t _{PHL}	ь	A	2.2	8.5	1.4	7.5	1.3	7	0.9	6.2	ns
t _{PHZ}	DIR	А	6.6	17.1	7.1	16.8	6.8	16.8	5.2	16.5	ns
t_{PLZ}	DIK	A	5.3	12.6	5.2	12.5	4.9	12.3	4.8	12.3	115
t _{PHZ}	DIR	В	10.7	27.9	8.1	13.9	5.8	10.5	3.5	7.6	no
t _{PLZ}	DIK	ь	7.8	18.9	6.2	11.2	3.6	8.9	1.4	6.2	ns
t _{PZH} ⁽¹⁾	DIR	۸		29.2		19.7		16.9		13.7	no
t _{PZL} ⁽¹⁾	DIK	Α		36.4		21.4		17.5		13.8	ns
t _{PZH} ⁽¹⁾	DIR	В		28.6		21		18.7		17.4	nc
t _{PZL} ⁽¹⁾		В		30	·	24.3		22.2		21.1	ns

⁽¹⁾ The enable time is a calculated value, derived using the formula shown in the enable times section.

Switching Characteristics

over recommended operating free-air temperature range, V_{CCA} = 3.3 V \pm 0.3 V (unless otherwise noted) (see Figure 1)

PARAMETER	FROM TO (OUTPUT)		V _{CCB} = ± 0.15	1.8 V 5 V	V _{CCB} = ± 0.2		V _{CCB} = 3.3 V ± 0.3 V		V _{CCB} = 5 V ± 0.5 V		UNIT		
	(INPOT)	(001701)	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX			
t _{PLH}	А	В	2.1	15.5	1.4	8	0.7	5.6	0.7	4.4	no		
t _{PHL}	A	ь	2	12.6	1.3	7	0.8	5	0.7	4	ns		
t _{PLH}	В	А	1.7	8.3	1.3	6.4	0.7	5.8	0.6	5.4	ns		
t _{PHL}	Ь	A	1.8	7.1	1.3	5.4	0.8	5	0.7	4.5	115		
t _{PHZ}	DIR	А	5	10.9	5.1	10.8	5	10.8	5	10.4	no		
t _{PLZ}	DIK	A	3.4	8.4	3.7	8.4	3.9	8.1	3.3	7.8	ns		
t _{PHZ}	DIR	В	11.2	27.3	8	13.7	5.8	10.4	2.9	7.4	ns		
t _{PLZ}	DIK	ь	9.4	17.7	5.6	11.3	4.3	8.3	1	5.6	115		
t _{PZH} ⁽¹⁾	DIR	۸		26		17.7		14.1		11	ns		
t _{PZL} ⁽¹⁾	DIK	DIR A		34.4	·	19.1		15.4		11.9	115		
t _{PZH} ⁽¹⁾	DID	DIR	DID	В		23.9		16.4		13.9		12.2	no
t _{PZL} ⁽¹⁾	אוט	В		23.5		17.8		15.8		14.4	ns		

⁽¹⁾ The enable time is a calculated value, derived using the formula shown in the *enable times* section.

Switching Characteristics

over recommended operating free-air temperature range, V_{CCA} = 5 V \pm 0.5 V (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V _{CCB} = ± 0.15	1.8 V 5 V	V _{CCB} = ± 0.2		V _{CCB} = 3 ± 0.3		V _{CCB} = ± 0.5	5 V V	UNIT	
	(INPOT)	(001F01)	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
t _{PLH}	А	В	1.9	15.1	1	7.5	0.6	5.4	0.5	3.9	ns	
t _{PHL}	A	Б	1.8	12.2	0.9	6.2	0.7	4.5	0.5	3.5	115	
t _{PLH}	В	А	1.4	7.2	1	5.1	0.7	4.4	0.5	3.9	no	
t _{PHL}	ь	A	1.7	7	0.9	4.6	0.7	4	0.5	3.5	ns	
t _{PHZ}	DIR	Α	2.9	8.2	2.9	7.9	2.8	7.9	2.2	7.8	ns	
t _{PLZ}	DIK	A	1.4	6.9	1.3	6.7	0.7	6.7	0.7	6.6	115	
t _{PHZ}	DIR	В	11.2	26.1	7.2	13.9	5.8	10.1	1.3	7.3	no	
t_{PLZ}	DIK	ь	8.4	16.9	5	11	4	7.7	1	5.6	ns	
t _{PZH} ⁽¹⁾	DIR	۸		24.1		16.1		12.1		9.5	no	
t _{PZL} ⁽¹⁾	אוט	A		33.1		18.5		14.1		10.8	ns	
t _{PZH} ⁽¹⁾	DID		В		22		14.2		12.1		10.5	no
t _{PZL} ⁽¹⁾	DIK	В		20.4		14.1		12.4		11.3	ns	

⁽¹⁾ The enable time is a calculated value, derived using the formula shown in the enable times section.

SN74LVC2T45 DUAL-BIT DUAL-SUPPLY BUS TRANSCEIVER

DUAL-BIT DUAL-SUPPLY BUS TRANSCEIVER WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS



Operating Characteristics

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 $T_A = 25^{\circ}C$

ı	PARAMETER	TEST CONDITIONS	$V_{CCA} = V_{CCB} = 1.8 V$	V _{CCA} = V _{CCB} = 2.5 V	$V_{CCA} = V_{CCB} = 3.3 \text{ V}$ TYP	V _{CCA} = V _{CCB} = 5 V	UNIT
C (1)	A-port input, B-port output	$C_L = 0 \text{ pF},$	3	4	4	4	~F
C _{pdA} ⁽¹⁾	B-port input, A-port output	f = 10 MHz, $t_r = t_f = 1 \text{ ns}$	18	19	20	21	pF
C (1)	A-port input, B-port output	$C_L = 0 \text{ pF},$	18	19	20	21	~F
C _{pdB} ⁽¹⁾	B-port input, A-port output	f = 10 MHz, $t_r = t_f = 1 \text{ ns}$	3	4	4	4	pF

⁽¹⁾ Power dissipation capacitance per transceiver

Power-Up Considerations

A proper power-up sequence always should be followed to avoid excessive supply current, bus contention, oscillations, or other anomalies. To guard against such power-up problems, take the following precautions:

- 1. Connect ground before any supply voltage is applied.
- 2. Power up V_{CCA}.
- 3. V_{CCB} can be ramped up along with or after V_{CCA} .

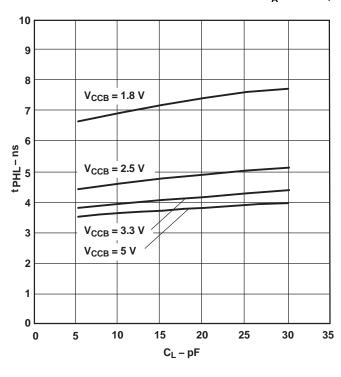
Table 1. Typical Total Static Power Consumption (I_{CCA} + I_{CCB})

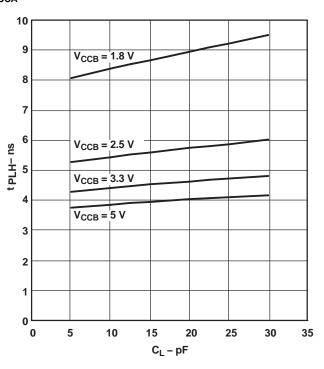
V			V _{CCA}			UNIT
V _{CCB}	0 V	1.8 V	2.5 V	3.3 V	5 V	UNIT
0 V	0	<1	<1	<1	<1	
1.8 V	<1	<2	<2	<2	2	
2.5 V	<1	<2	<2	<2	<2	μΑ
3.3 V	<1	<2	<2	<2	<2	
5 V	<1	2	<2	<2	<2	



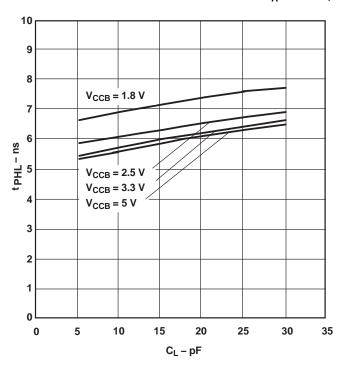
TYPICAL CHARACTERISTICS

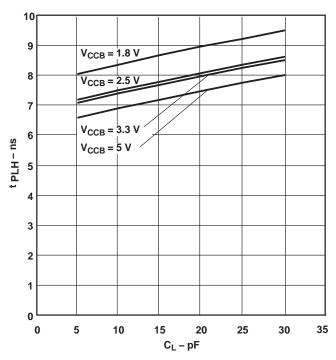
TYPICAL PROPAGATION DELAY (A to B) vs LOAD CAPACITANCE $\rm T_A = 25^{\circ}C, \, V_{CCA} = 1.8 \; V$





TYPICAL PROPAGATION DELAY (B to A) vs LOAD CAPACITANCE $T_{\rm A}$ = 25°C, $V_{\rm CCA}$ = 1.8 V

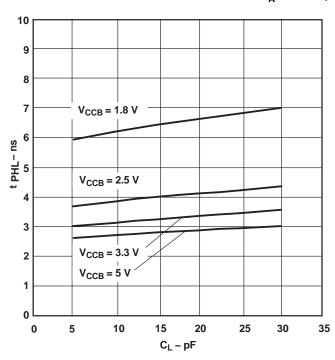


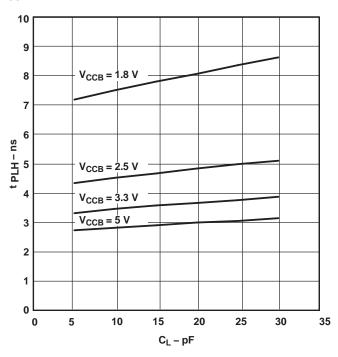




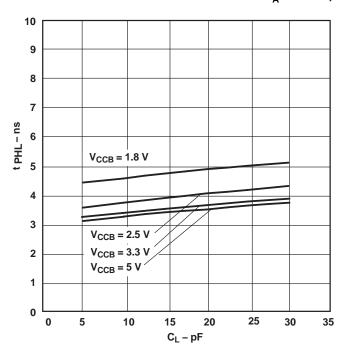
TYPICAL CHARACTERISTICS

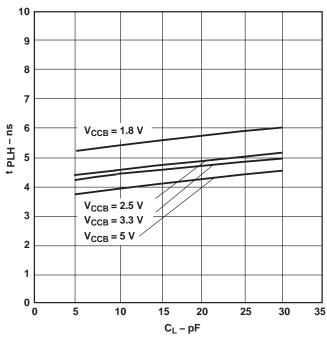
TYPICAL PROPAGATION DELAY (A to B) vs LOAD CAPACITANCE $T_{\rm A}$ = 25°C, $V_{\rm CCA}$ = 2.5 V





TYPICAL PROPAGATION DELAY (B to A) vs LOAD CAPACITANCE $\rm T_A = 25^{\circ}C, \, V_{CCA} = 2.5 \, \, V$

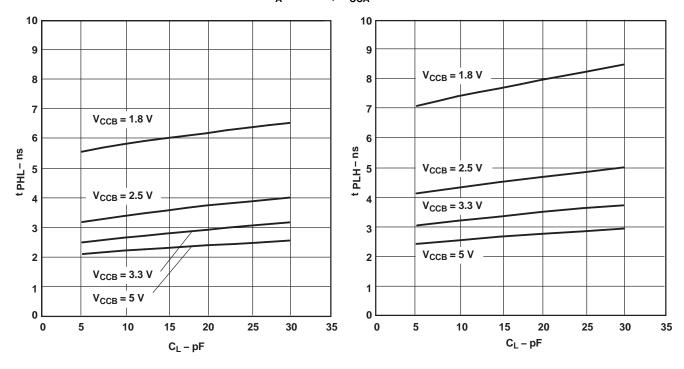




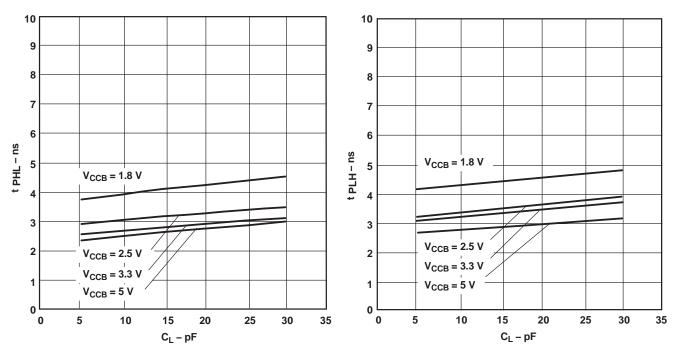


TYPICAL CHARACTERISTICS

TYPICAL PROPAGATION DELAY (A to B) vs LOAD CAPACITANCE $\rm T_A = 25^{\circ}C, \, V_{CCA} = 3.3 \; V$



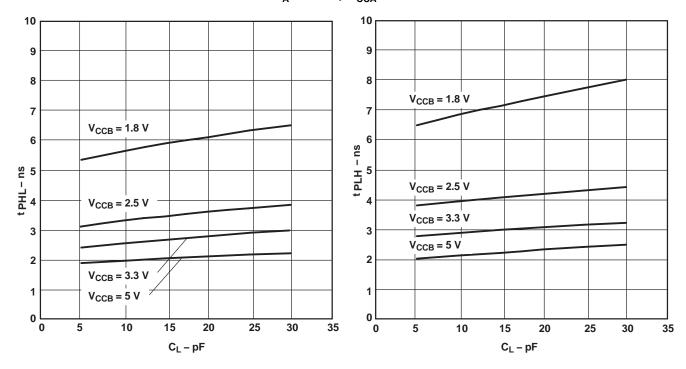
TYPICAL PROPAGATION DELAY (B to A) vs LOAD CAPACITANCE $T_{\rm A}$ = 25°C, $V_{\rm CCA}$ = 3.3 V



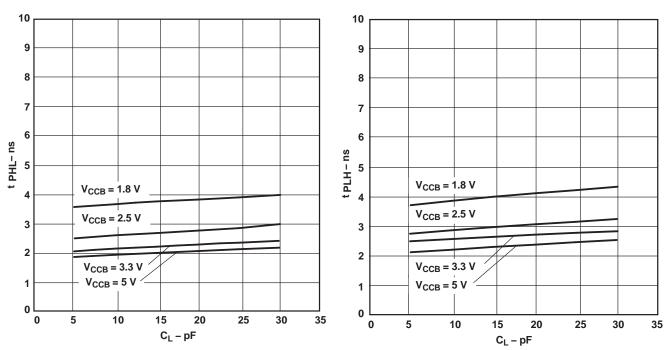


TYPICAL CHARACTERISTICS

TYPICAL PROPAGATION DELAY (A to B) vs LOAD CAPACITANCE T_{A} = 25°C, V_{CCA} = 5 V



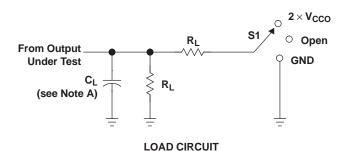
TYPICAL PROPAGATION DELAY (B to A) vs LOAD CAPACITANCE T_{A} = 25°C, V_{CCA} = 5 V



 V_{CCA}

V_{CCA}/2

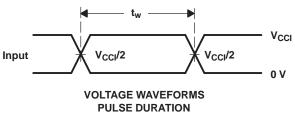
PARAMETER MEASUREMENT INFORMATION



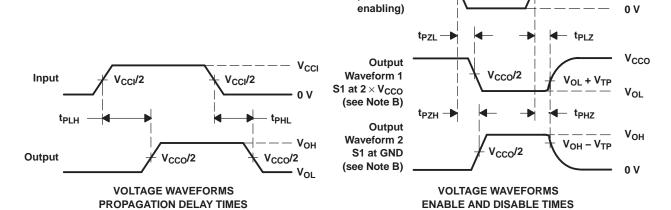
SCES516I-DECEMBER 2003-REVISED MARCH 2007

TEST	S 1
t _{pd} t _{PLZ} /t _{PZL} t _{PHZ} /t _{PZH}	Open 2×V _{CCO} GND

V _{CCO}	CL	R_L	V _{TP}
1.8 V \pm 0.15 V	15 pF	2 k Ω	0.15 V
2.5 V \pm 0.2 V	15 pF	2 k Ω	0.15 V
3.3 V \pm 0.3 V	15 pF	2 k Ω	0.3 V
5 V \pm 0.5 V	15 pF	2 k Ω	0.3 V



V_{CCA}/2



Output Control

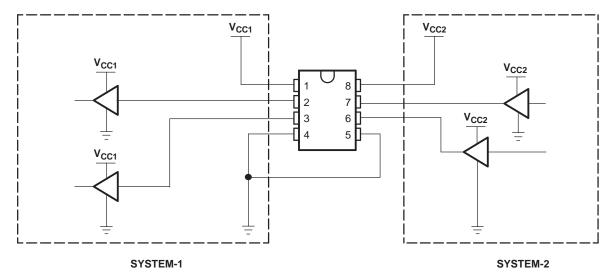
(low-level

- NOTES: A. C₁ 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 \leq 10 MHz, $Z_0 = 50 \Omega$, $dv/dt \geq$ 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_{pd} .
 - 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

APPLICATION INFORMATION

The following shows an example of the SN74LVC2T45 being used in a unidirectional logic level-shifting application.



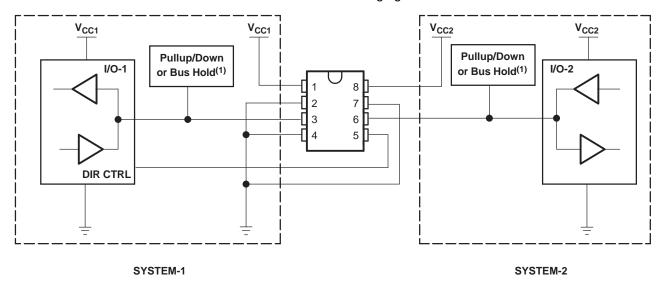
PIN	NAME	FUNCTION	DESCRIPTION
1	V _{CCA}	V _{CC1}	SYSTEM-1 supply voltage (1.65 V to 5.5 V)
2	A1	OUT1	Output level depends on V _{CC1} voltage.
3	A2	OUT2	Output level depends on V _{CC1} voltage.
4	GND	GND	Device GND
5	DIR	DIR	GND (low level) determines B-port to A-port direction.
6	B2	IN2	Input threshold value depends on V _{CC2} voltage.
7	B1	IN1	Input threshold value depends on V _{CC2} voltage.
8	V _{CCB}	V _{CC2}	SYSTEM-2 supply voltage (1.65 V to 5.5 V)

Figure 2. Unidirectional Logic Level-Shifting Application



APPLICATION INFORMATION

Figure 3 shows the SN74LVC2T45 being used in a bidirectional logic level-shifting application. Since the SN74LVC2T45 does not have an output-enable (OE) pin, the system designer should take precautions to avoid bus contention between SYSTEM-1 and SYSTEM-2 when changing directions.



The following table shows data transmission from SYSTEM-1 to SYSTEM-2 and then from SYSTEM-2 to SYSTEM-1.

STATE	DIR CTRL	I/O-1	I/O-2	DESCRIPTION
1	Н	Out	In	SYSTEM-1 data to SYSTEM-2
2	Н	Hi-Z	Hi-Z	SYSTEM-2 is getting ready to send data to SYSTEM-1. I/O-1 and I/O-2 are disabled. The bus-line state depends on pullup or pulldown. ⁽¹⁾
3	L	Hi-Z	Hi-Z	DIR bit is flipped. I/O-1 and I/O-2 still are disabled. The bus-line state depends on pullup or pulldown. (1)
4	L	In	Out	SYSTEM-2 data to SYSTEM-1

(1) SYSTEM-1 and SYSTEM-2 must use the same conditions, i.e., both pullup or both pulldown.

Figure 3. Bidirectional Logic Level-Shifting Application

Enable Times

Calculate the enable times for the SN74LVC2T45 using the following formulas:

- t_{PZH} (DIR to A) = t_{PLZ} (DIR to B) + t_{PLH} (B to A)
- t_{PZL} (DIR to A) = t_{PHZ} (DIR to B) + t_{PHL} (B to A)
- t_{PZH} (DIR to B) = t_{PLZ} (DIR to A) + t_{PLH} (A to B)
- t_{PZL} (DIR to B) = t_{PHZ} (DIR to A) + t_{PHL} (A to B)

In a bidirectional application, these enable times provide the maximum delay from the time the DIR bit is switched until an output is expected. For example, if the SN74LVC2T45 initially is transmitting from A to B, then the DIR bit is switched; the B port of the device must be disabled before presenting it with an input. After the B port has been disabled, an input signal applied to it appears on the corresponding A port after the specified propagation delay.



9-Mar-2012

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/ Ball Finish	MSL Peak Temp ⁽³⁾	Samples (Requires Login)
SN74LVC2T45DCTR	ACTIVE	SM8	DCT	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LVC2T45DCTRE4	ACTIVE	SM8	DCT	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LVC2T45DCTRG4	ACTIVE	SM8	DCT	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LVC2T45DCTT	ACTIVE	SM8	DCT	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LVC2T45DCTTE4	ACTIVE	SM8	DCT	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LVC2T45DCTTG4	ACTIVE	SM8	DCT	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LVC2T45DCUR	ACTIVE	US8	DCU	8	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
SN74LVC2T45DCURE4	ACTIVE	US8	DCU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LVC2T45DCURG4	ACTIVE	US8	DCU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LVC2T45DCUT	ACTIVE	US8	DCU	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LVC2T45DCUTE4	ACTIVE	US8	DCU	8		TBD	Call TI	Call TI	
SN74LVC2T45DCUTG4	ACTIVE	US8	DCU	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74LVC2T45YZPR	ACTIVE	DSBGA	YZP	8	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	

⁽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.



PACKAGE OPTION ADDENDUM

9-Mar-2012

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.

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OTHER QUALIFIED VERSIONS OF SN74LVC2T45:

Automotive: SN74LVC2T45-Q1

Enhanced Product: SN74LVC2T45-EP

NOTE: Qualified Version Definitions:

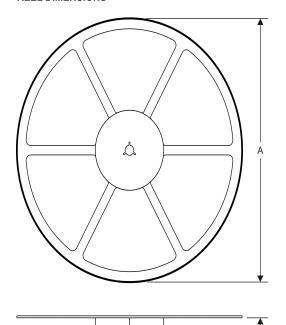
- Automotive Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Enhanced Product Supports Defense, Aerospace and Medical Applications

PACKAGE MATERIALS INFORMATION

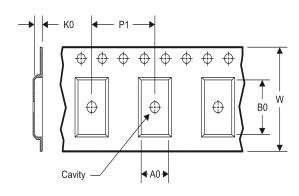
www.ti.com 18-Feb-2012

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
В0	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

TAPE AND REEL INFORMATION

*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
SN74LVC2T45DCUR	US8	DCU	8	3000	180.0	8.4	2.25	3.35	1.05	4.0	8.0	Q3
SN74LVC2T45DCUR	US8	DCU	8	3000	180.0	9.0	2.05	3.3	1.0	4.0	8.0	Q3
SN74LVC2T45YZPR	DSBGA	YZP	8	3000	178.0	9.2	1.02	2.02	0.63	4.0	8.0	Q1
SN74LVC2T45YZPR	DSBGA	YZP	8	3000	180.0	8.4	1.02	2.02	0.63	4.0	8.0	Q1

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*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LVC2T45DCUR	US8	DCU	8	3000	202.0	201.0	28.0
SN74LVC2T45DCUR	US8	DCU	8	3000	182.0	182.0	20.0
SN74LVC2T45YZPR	DSBGA	YZP	8	3000	220.0	220.0	35.0
SN74LVC2T45YZPR	DSBGA	YZP	8	3000	210.0	185.0	35.0

DCT (R-PDSO-G8)

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
- D. Falls within JEDEC MO-187 variation DA.

DCT (R-PDSO-G8)

PLASTIC SMALL OUTLINE



NOTES: A. All linear dimensions are in millimeters.

- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525.
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



DCU (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE (DIE DOWN)



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-187 variation CA.



DCU (S-PDSO-G8)

PLASTIC SMALL OUTLINE PACKAGE (DIE DOWN)



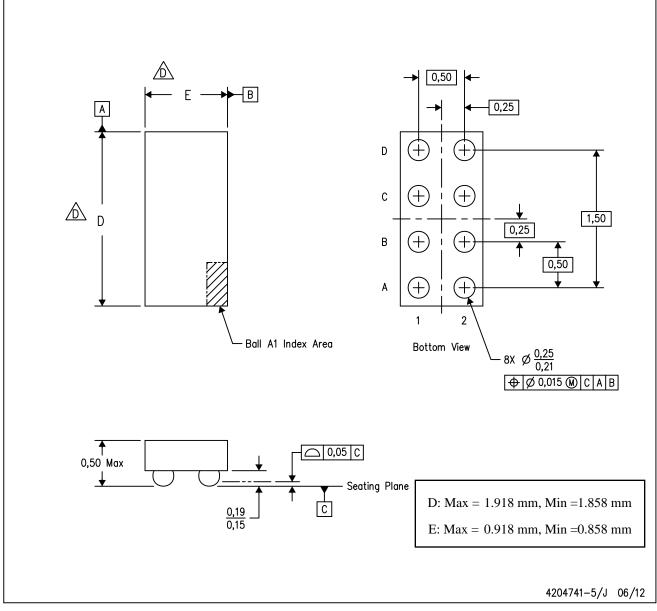
NOTES: A. All linear dimensions are in millimeters.

- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



YZP (R-XBGA-N8)

DIE-SIZE BALL GRID ARRAY



NOTES: All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.

- This drawing is subject to change without notice.
- NanoFree™ package configuration. Ç.
- ⚠ The package size (Dimension D and E) of a particular device is specified in the device Product Data Sheet version of this drawing, in case it cannot be found in the product data sheet please contact a local TI representative. E. This package is a Pb—free solder ball design. Refer to the 8 YEP package (drawing 4204725) for tin—lead (SnPb).

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