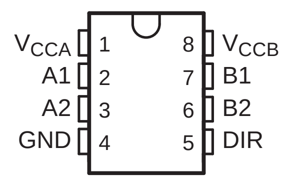
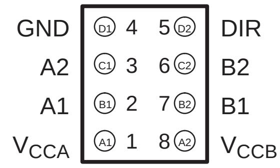
FEATURES

- **Available in the Texas Instruments NanoFree™ Package**
- **Control Inputs V_{IH}/V_{IL} Levels Are Referenced to V_{CCA} Voltage**
- **Fully Configurable Dual-Rail Design Allows Each Port to Operate Over the Full 1.2-V to 3.6-V Power-Supply Range**
- **I/Os Are 4.6-V Tolerant**
- **I_{off} Supports Partial Power-Down-Mode Operation**
- **Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors**
- **Max Data Rates**
  - **500 Mbps (1.8-V to 3.3-V Translation)**
  - **320 Mbps (<1.8-V to 3.3-V Translation)**
  - **320 Mbps (Translate to 2.5 V or 1.8 V)**
  - **280 Mbps (Translate to 1.5 V)**
  - **240 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)**
  - **200-V Machine Model (A115-A)**
  - **1000-V Charged-Device Model (C101)**

DCT OR DCU PACKAGE (TOP VIEW)



YZP PACKAGE (BOTTOM VIEW)



DESCRIPTION/ORDERING INFORMATION

This dual-bit noninverting bus transceiver uses two separate configurable power-supply rails. The SN74AVCH2T45 is optimized to operate with V_{CCA}/V_{CCB} set at 1.4 V to 3.6 V. It is operational with V_{CCA}/V_{CCB} as low as 1.2 V. The A port is designed to track V_{CCA}. V_{CCA} accepts any supply voltage from 1.2 V to 3.6 V. The B port is designed to track V_{CCB}. V_{CCB} accepts any supply voltage from 1.2 V to 3.6 V. This allows for universal low-voltage bidirectional translation between any of the 1.2-V, 1.5-V, 1.8-V, 2.5-V, and 3.3-V voltage nodes.

ORDERING INFORMATION

T_A	PACKAGE (1)(2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING (3)
–40°C to 85°C	NanoFree™ – WCSP (DSBGA) 0.23-mm Large Bump – YZP (Pb-free)	Reel of 3000	SN74AVCH2T45YZPR	_ _ _TF_
	SSOP – DCT	Reel of 3000	SN74AVCH2T45DCTR	ET2_ _ _
	VSSOP – DCU	Reel of 3000	SN74AVCH2T45DCUR	ET2_

(1) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.
(2) 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.
(3) 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).

DESCRIPTION/ORDERING INFORMATION (CONTINUED)

The SN74AVCH2T45 is designed for asynchronous communication between data buses. The device transmits data from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input.

The SN74AVCH2T45 is designed so that the DIR input is powered 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, then both outputs are in the high-impedance state. The bus-hold circuitry on the powered-up side always stays active.

Active bus-hold circuitry holds unused or undriven inputs at a valid logic state. Use of pullup or pulldown resistors with the bus-hold circuitry is not recommended.

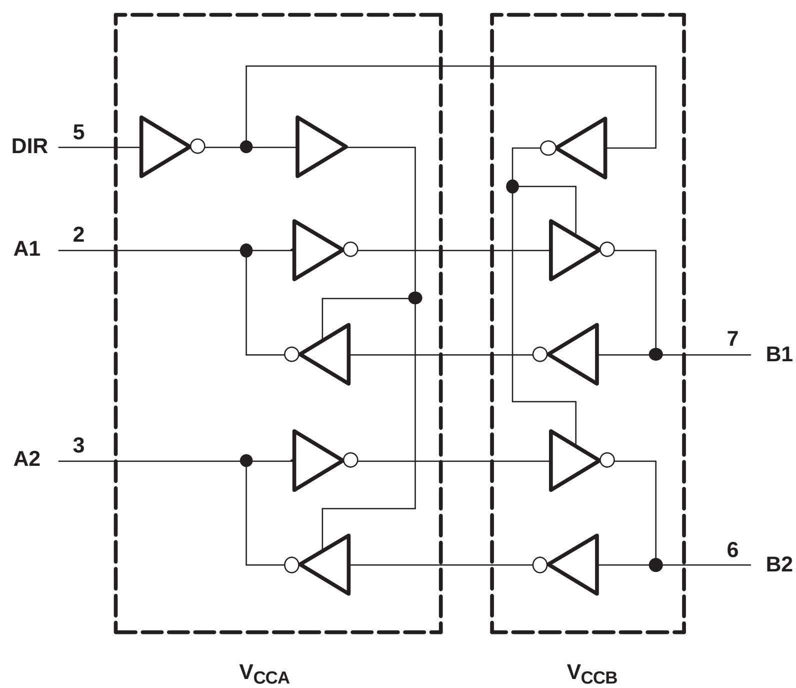
NanoFree™ package technology is a major breakthrough in IC packaging concepts, using the die as the package.

FUNCTION TABLE(1)
(each transceiver)

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

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

LOGIC DIAGRAM (POSITIVE LOGIC)(1)



(1) Pin numbers shown are for the DCT and DCU packages.

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]	I/O ports (A port)	–0.5	4.6	V
		I/O ports (B port)	–0.5	4.6	
		Control inputs	–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
		B port	–0.5	4.6	
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
		B port	–0.5	V_{CCB} + 0.5	
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			±50	mA
	Continuous current through V_{CCA}, V_{CCB}, or GND			±100	mA
θ_{JA}	Package thermal impedance[4]	DCT package		220	°C/W
		DCU package		227	
		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 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.

Recommended Operating Conditions[1][2][3]

			V_{CCI}	V_{CCO}	MIN	MAX	UNIT
V_{CCA}	Supply voltage				1.2	3.6	V
V_{CCB}	Supply voltage				1.2	3.6	V
V_{IH}	High-level input voltage	Data inputs[4]	1.2 V to 1.95 V		$V_{CC} \times 0.65$		V
			1.95 V to 2.7 V		1.6		
			2.7 V to 3.6 V		2		
V_{IL}	Low-level input voltage	Data inputs[4]	1.2 V to 1.95 V			$V_{CCI} \times 0.35$	V
			1.95 V to 2.7 V			0.7	
			2.7 V to 3.6 V			0.8	
V_{IH}	High-level input voltage	DIR (referenced to V_{CCA})[5]	1.2 V to 1.95 V		$V_{CCA} \times 0.65$		V
			1.95 V to 2.7 V		1.6		
			2.7 V to 3.6 V		2		
V_{IL}	Low-level input voltage	DIR (referenced to V_{CCA})[5]	1.2 V to 1.95 V			$V_{CCA} \times 0.35$	V
			1.95 V to 2.7 V			0.7	
			2.7 V to 3.6 V			0.8	
V_I	Input voltage				0	3.6	V
V_O	Output voltage	Active state			0	V_{CCO}	V
		3-state			0	3.6	
I_{OH}	High-level output current			1.2 V		–3	mA
				1.4 V to 1.6 V		–6	
				1.65 V to 1.95 V		–8	
				2.3 V to 2.7 V		–9	
				3 V to 3.6 V		–12	
I_{OL}	Low-level output current			1.2 V		3	mA
				1.4 V to 1.6 V		6	
				1.65 V to 1.95 V		8	
				2.3 V to 2.7 V		9	
				3 V to 3.6 V		12	
$\Delta t/\Delta v$	Input transition rise or fall rate					5	ns/V
T_A	Operating free-air temperature				–40	85	°C

(1) V_{CCI} is the V_{CC} associated with the input port.
(2) V_{CCO} is the V_{CC} associated with the 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 = $V_{CCI} \times 0.7$ V, V_{IL} max = $V_{CCI} \times 0.3$ V.
(5) For V_{CCA} values not specified in the data sheet, V_{IH} min = $V_{CCA} \times 0.7$ V, V_{IL} max = $V_{CCA} \times 0.3$ V.

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	$V_I = V_{IH}$	1.2 V to 3.6 V	1.2 V to 3.6 V				V_{CCO} – 0.2		V
	I_{OH} = –3 mA		1.2 V	1.2 V		0.95				
	I_{OH} = –6 mA		1.4 V	1.4 V				1.05		
	I_{OH} = –8 mA		1.65 V	1.65 V				1.2		
	I_{OH} = –9 mA		2.3 V	2.3 V				1.75		
	I_{OH} = –12 mA		3 V	3 V				2.3		
V_{OL}	I_{OL} = 100 µA	$V_I = V_{IL}$	1.2 V to 3.6 V	1.2 V to 3.6 V					0.2	V
	I_{OL} = 3 mA		1.2 V	1.2 V		0.15				
	I_{OL} = 6 mA		1.4 V	1.4 V					0.35	
	I_{OL} = 8 mA		1.65 V	1.65 V					0.45	
	I_{OL} = 9 mA		2.3 V	2.3 V					0.55	
	I_{OL} = 12 mA		3 V	3 V					0.7	
I_I DIR input	$V_I = V_{CCA}$ or GND		1.2 V to 3.6 V	1.2 V to 3.6 V		±0.025	±0.25		±1	µA
I_{BHL}[3]	V_I = 0.42 V		1.2 V	1.2 V		25				µA
	V_I = 0.49 V		1.4 V	1.4 V				15		
	V_I = 0.58 V		1.65 V	1.65 V				25		
	V_I = 0.7 V		2.3 V	2.3 V				45		
	V_I = 0.8 V		3.3 V	3.3 V				100		
I_{BHH}[4]	V_I = 0.78 V		1.2 V	1.2 V		–25				µA
	V_I = 0.91 V		1.4 V	1.4 V				–15		
	V_I = 1.07 V		1.65 V	1.65 V				–25		
	V_I = 1.6 V		2.3 V	2.3 V				–45		
	V_I = 2 V		3.3 V	3.3 V				–100		
I_{BHLO}[5]	V_I = 0 to V_{CC}		1.2 V	1.2 V		50				µA
			1.6 V	1.6 V				125		
			1.95 V	1.95 V				200		
			2.7 V	2.7 V				300		
			3.6 V	3.6 V				500		
I_{BHHO}[6]	V_I = 0 to V_{CC}		1.2 V	1.2 V		–50				µA
			1.6 V	1.6 V				–125		
			1.95 V	1.95 V				–200		
			2.7 V	2.7 V				–300		
			3.6 V	3.6 V				–500		

(1) V_{CCI} is the V_{CC} associated with the input port.
(2) V_{CCO} is the V_{CC} associated with the output port.
(3) The bus-hold circuit can sink at least the minimum low sustaining current at V_{IL} max. I_{BHL} should be measured after lowering V_{IN} to GND and then raising it to V_{IL} max.
(4) The bus-hold circuit can source at least the minimum high sustaining current at V_{IH} min. I_{BHH} should be measured after raising V_{IN} to V_{CC} and then lowering it to V_{IH} min.
(5) An external driver must source at least I_{BHLO} to switch this node from low to high.
(6) An external driver must sink at least I_{BHHO} to switch this node from high to low.

Electrical Characteristics (continued)[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	
I_{off}	A port	V_I or V_O = 0 to 3.6 V	0 V	0 V to 3.6 V		±0.1	±1		±5	µA
	B port		0 V to 3.6 V	0 V		±0.1	±1		±5	
I_{OZ}	B port	$V_O = V_{CCO}$ or GND, $V_I = V_{CCI}$ or GND	0 V	3.6 V		±0.5	±2.5		±5	µA
	A port		3.6 V	0 V		±0.5	±2.5		±5	
I_{CCA}		$V_I = V_{CCI}$ or GND, I_O = 0	1.2 V to 3.6 V	1.2 V to 3.6 V					10	µA
			0 V	3.6 V					–2	
			3.6 V	0 V					10	
I_{CCB}		$V_I = V_{CCI}$ or GND, I_O = 0	1.2 V to 3.6 V	1.2 V to 3.6 V					10	µA
			0 V	3.6 V					10	
			3.6 V	0 V					–2	
$I_{CCA} + I_{CCB}$		$V_I = V_{CCI}$ or GND, I_O = 0	1.2 V to 3.6 V	1.2 V to 3.6 V					20	µA
C_i	Control inputs	V_I = 3.3 V or GND	3.3 V	3.3 V		2.5				pF
C_{io}	A or B port	V_O = 3.3 V or GND	3.3 V	3.3 V		6				pF

(1) V_{CCO} is the V_{CC} associated with the output port.
(2) V_{CCI} is the V_{CC} associated with the input port.

Switching Characteristics

over recommended operating free-air temperature range, V_{CCA} = 1.2 V (see Figure 11)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.2 V	V_{CCB} = 1.5 V	V_{CCB} = 1.8 V	V_{CCB} = 2.5 V	V_{CCB} = 3.3 V	UNIT
			TYP	TYP	TYP	TYP	TYP	
t_{PLH}	A	B	3.1	2.6	2.4	2.2	2.2	ns
t_{PHL}			3.1	2.6	2.4	2.2	2.2	
t_{PLH}	B	A	3.4	3.1	3	2.9	2.9	ns
t_{PHL}			3.4	3.1	3	2.9	2.9	
t_{PHZ}	DIR	A	5.2	5.2	5.1	5	4.8	ns
t_{PLZ}			5.2	5.2	5.1	5	4.8	
t_{PHZ}	DIR	B	5	4	3.8	2.8	3.2	ns
t_{PLZ}			5	4	3.8	2.8	3.2	
t_{PZH} [1]	DIR	A	8.4	7.1	6.8	5.7	6.1	ns
t_{PZL} [1]			8.4	7.1	6.8	5.7	6.1	
t_{PZH} [1]	DIR	B	8.3	7.8	7.5	7.2	7	ns
t_{PZL} [1]			8.3	7.8	7.5	7.2	7	

(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} = 1.5 V ± 0.1 V (see Figure 11)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.2 V	V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	A	B	2.8	0.7	5.4	0.5	4.6	0.4	3.7	0.3	3.5	ns
t_{PHL}			2.8	0.7	5.4	0.5	4.6	0.4	3.7	0.3	3.5	
t_{PLH}	B	A	2.7	0.8	5.4	0.7	5.2	0.6	4.9	0.5	4.7	ns
t_{PHL}			2.7	0.8	5.4	0.7	5.2	0.6	4.9	0.5	4.7	
t_{PHZ}	DIR	A	3.9	1.3	8.5	1.3	7.8	1.1	7.7	1.4	7.6	ns
t_{PLZ}			3.9	1.3	8.5	1.3	7.8	1.1	7.7	1.4	7.6	
t_{PHZ}	DIR	B	4.7	1.1	7	1.4	6.9	1.2	6.9	1.7	7.1	ns
t_{PLZ}			4.7	1.1	7	1.4	6.9	1.2	6.9	1.7	7.1	
t_{PZH} (1)	DIR	A	7.4		12.4		12.1		11.8		11.8	ns
t_{PZL} (1)			7.4		12.4		12.1		11.8		11.8	
t_{PZH} (1)	DIR	B	6.7		13.9		12.4		11.4		11.1	ns
t_{PZL} (1)			6.7		13.9		12.4		11.4		11.1	

(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} = 1.8 V ± 0.15 V (see Figure 11)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.2 V	V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	A	B	2.7	0.5	5.2	0.4	4.3	0.2	3.4	0.2	3.1	ns
t_{PHL}			2.7	0.5	5.2	0.4	4.3	0.2	3.4	0.2	3.1	
t_{PLH}	B	A	2.4	0.7	4.7	0.5	4.4	0.5	4	0.4	3.8	ns
t_{PHL}			2.4	0.7	4.7	0.5	4.4	0.5	4	0.4	3.8	
t_{PHZ}	DIR	A	3.7	1.3	8.1	0.7	6.9	1.4	5.3	1.1	5.2	ns
t_{PLZ}			3.7	1.3	8.1	0.7	6.9	1.4	5.3	1.1	5.2	
t_{PHZ}	DIR	B	4.4	1.3	5.8	1.3	5.9	0.8	5.7	1.5	5.9	ns
t_{PLZ}			4.4	1.3	5.8	1.3	5.9	0.8	5.7	1.5	5.9	
t_{PZH} (1)	DIR	A	6.8		10.5		10.3		9.7		9.7	ns
t_{PZL} (1)			6.8		10.5		10.3		9.7		9.7	
t_{PZH} (1)	DIR	B	6.4		13.3		11.2		8.7		8.3	ns
t_{PZL} (1)			6.4		13.3		11.2		8.7		8.3	

(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 ± 0.2 V (see Figure 11)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.2 V	V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	A	B	2.6	0.4	4.9	0.2	4	0.2	3	0.2	2.6	ns
t_{PHL}			2.6	0.4	4.9	0.2	4	0.2	3	0.2	2.6	
t_{PLH}	B	A	2.1	0.6	3.8	0.5	3.4	0.4	3	0.3	2.8	ns
t_{PHL}			2.1	0.6	3.8	0.5	3.4	0.4	3	0.3	2.8	
t_{PHZ}	DIR	A	2.4	0.7	7.9	0.8	6.4	0.8	5	0.5	4.3	ns
t_{PLZ}			2.4	0.7	7.9	0.8	6.4	0.8	5	0.5	4.3	
t_{PHZ}	DIR	B	3.8	1	4.3	0.6	4.3	0.5	4.2	1.1	4.1	ns
t_{PLZ}			3.8	1	4.3	0.6	4.3	0.5	4.2	1.1	4.1	
t_{PZH} (1)	DIR	A	5.9		8.5		7.7		7.2		6.9	ns
t_{PZL} (1)			5.9		8.5		7.7		7.2		6.9	
t_{PZH} (1)	DIR	B	5		12.8		10.4		8		6.9	ns
t_{PZL} (1)			5		12.8		10.4		8		6.9	

(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 ± 0.3 V (see Figure 11)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.2 V	V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			TYP	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	A	B	2.5	0.3	4.7	0.2	3.8	0.2	2.8	0.2	2.4	ns
t_{PHL}			2.5	0.3	4.7	0.2	3.8	0.2	2.8	0.2	2.4	
t_{PLH}	B	A	2.1	0.6	3.6	0.4	3.1	0.3	2.6	0.3	2.4	ns
t_{PHL}			2.1	0.6	3.6	0.4	3.1	0.3	2.6	0.3	2.4	
t_{PHZ}	DIR	A	2.9	1.1	8	1	6.5	1.3	4.7	1.2	4	ns
t_{PLZ}			2.9	1.1	8	1	6.5	1.3	4.7	1.2	4	
t_{PHZ}	DIR	B	3.4	0.5	6.6	0.3	5.6	0.3	4.6	1.1	4.2	ns
t_{PLZ}			3.4	0.5	6.6	0.3	5.6	0.3	4.6	1.1	4.2	
t_{PZH} (1)	DIR	A	5.5		10.2		8.7		7.2		6.6	ns
t_{PZL} (1)			5.5		10.2		8.7		7.2		6.6	
t_{PZH} (1)	DIR	B	5.4		12.7		10.3		7.5		6.4	ns
t_{PZL} (1)			5.4		12.7		10.3		7.5		6.4	

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

Operating Characteristics

T_A = 25°C

PARAMETER		TEST CONDITIONS	V_{CCA} = V_{CCB} = 1.2 V	V_{CCA} = V_{CCB} = 1.5 V	V_{CCA} = V_{CCB} = 1.8 V	V_{CCA} = V_{CCB} = 2.5 V	V_{CCA} = V_{CCB} = 3.3 V	UNIT
			TYP	TYP	TYP	TYP	TYP	
C_{pdA} (1)	A-port input, B-port output	C_L = 0, f = 10 MHz, t_r = t_f = 1 ns	3	3	3	3	4	pF
	B-port input, A-port output		13	13	14	15	15	
C_{pdB} (1)	A-port input, B-port output	C_L = 0, f = 10 MHz, t_r = t_f = 1 ns	13	13	14	15	15	pF
	B-port input, A-port output		3	3	3	3	4	

(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_{CCB}	V_{CCA}						UNIT
	0 V	1.2 V	1.5 V	1.8 V	2.5 V	3.3 V	
0 V	0	<0.5	<0.5	<0.5	<0.5	<0.5	µA
1.2 V	<0.5	<1	<1	<1	<1	1	
1.5 V	<0.5	<1	<1	<1	<1	1	
1.8 V	<0.5	<1	<1	<1	<1	<1	
2.5 V	<0.5	1	<1	<1	<1	<1	
3.3 V	<0.5	1	<1	<1	<1	<1	

TYPICAL CHARACTERISTICS

Typical Propagation Delay (A to B) vs Load Capacitance
T_A = 25°C, V_{CCA} = 1.2 V

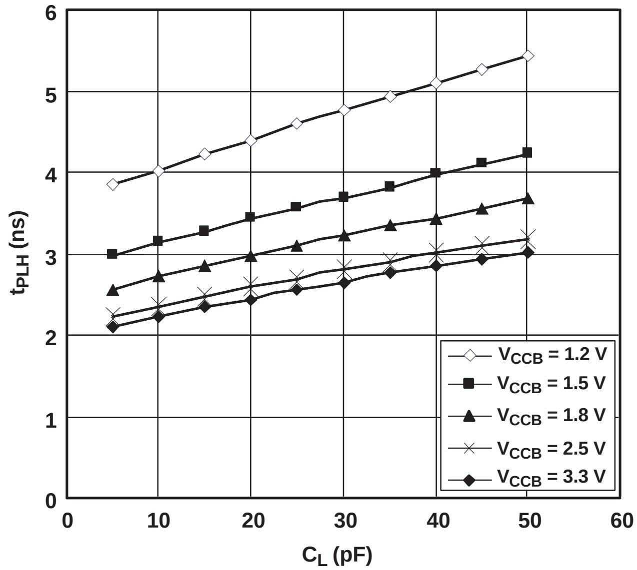


Figure 1.

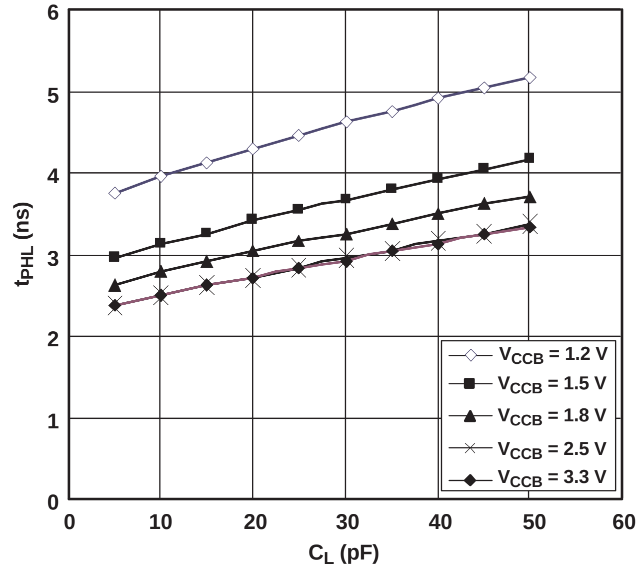


Figure 2.

Typical Propagation Delay (A to B) vs Load Capacitance
T_A = 25°C, V_{CCA} = 1.5 V

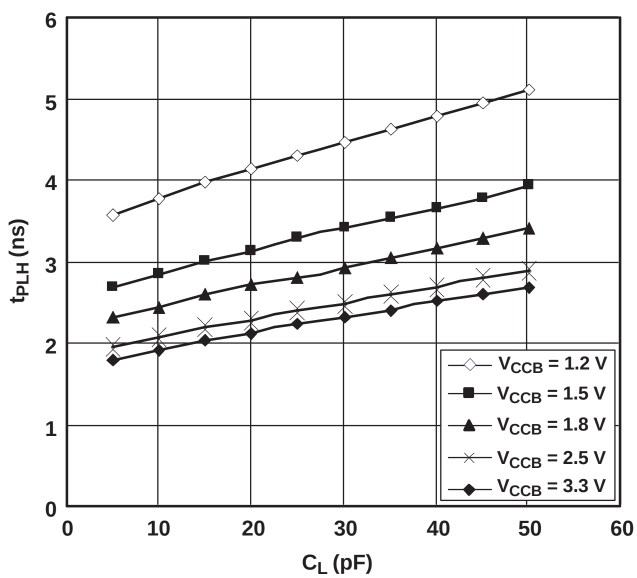


Figure 3.

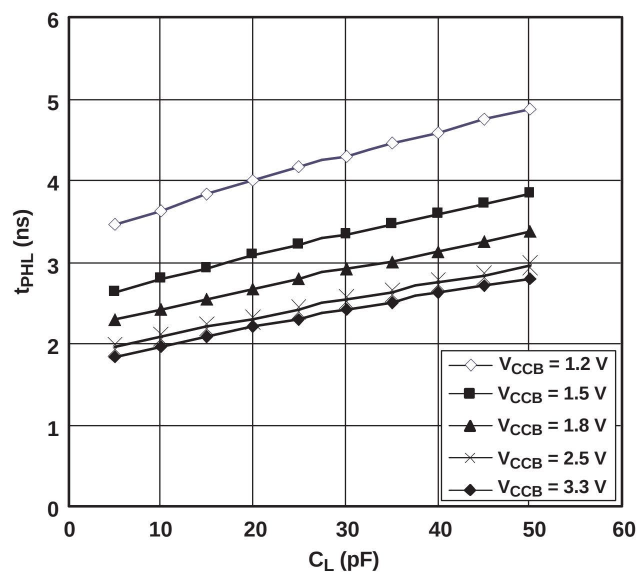


Figure 4.

TYPICAL CHARACTERISTICS (continued)

Typical Propagation Delay (A to B) vs Load Capacitance
T_A = 25°C, V_{CCA} = 1.8 V

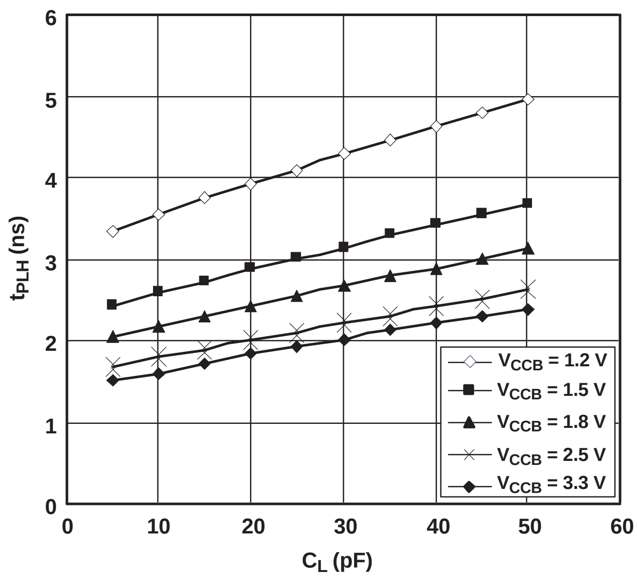


Figure 5.

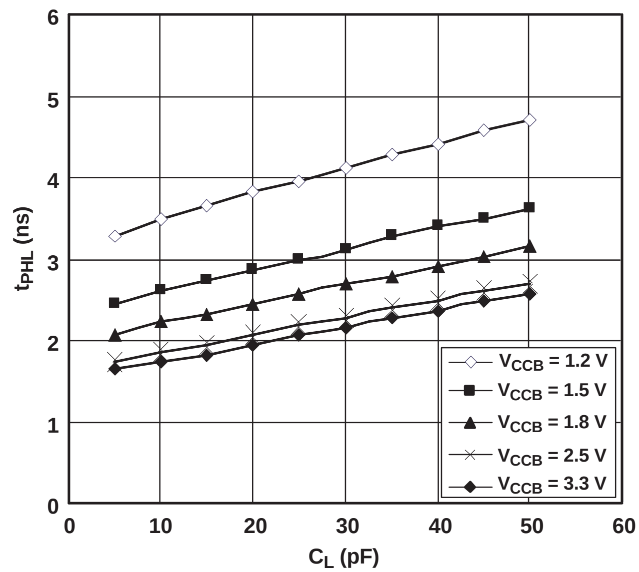


Figure 6.

Typical Propagation Delay (A to B) vs Load Capacitance
T_A = 25°C, V_{CCA} = 2.5 V

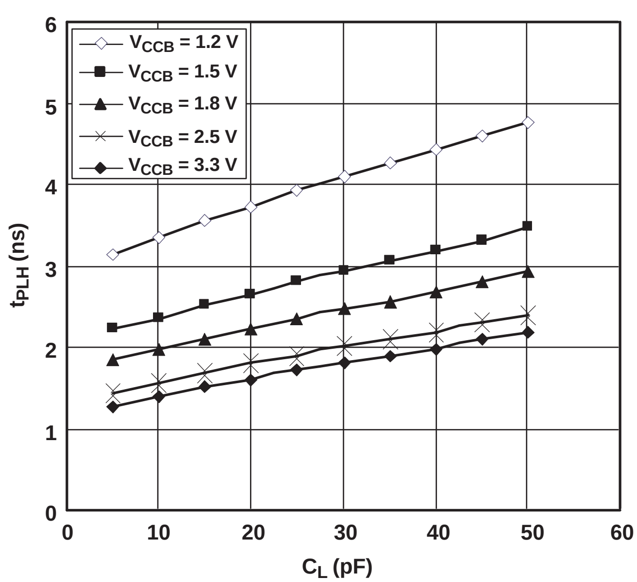


Figure 7.

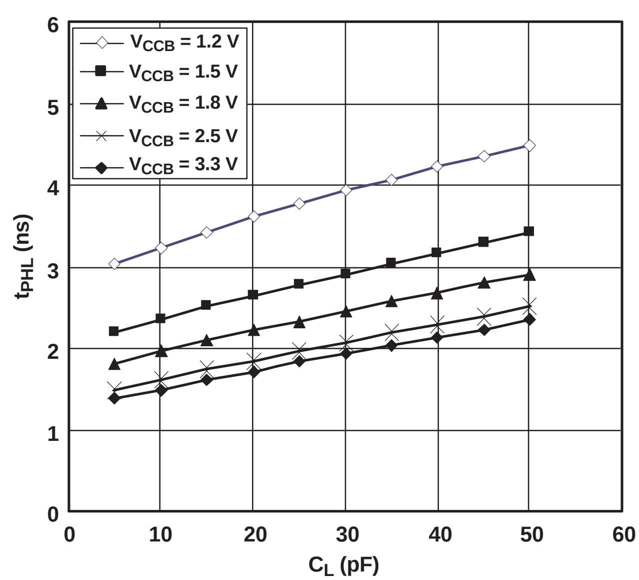


Figure 8.

TYPICAL CHARACTERISTICS (continued)

Typical Propagation Delay (A to B) vs Load Capacitance
$T_A = 25°C$, $V_{CCA} = 3.3$ V

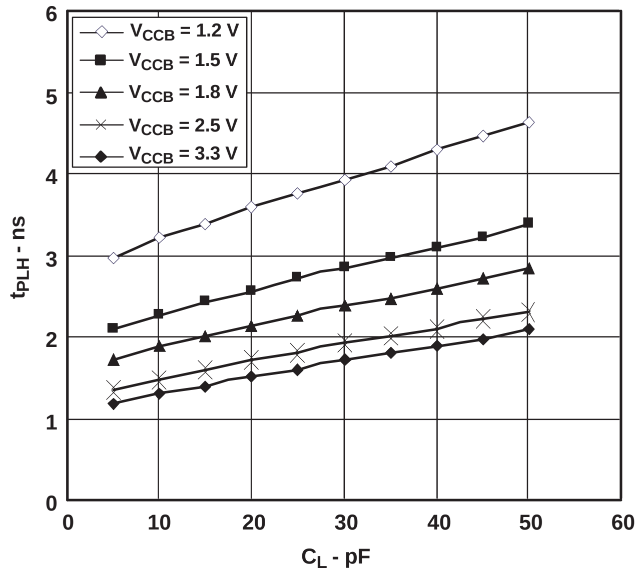


Figure 9.

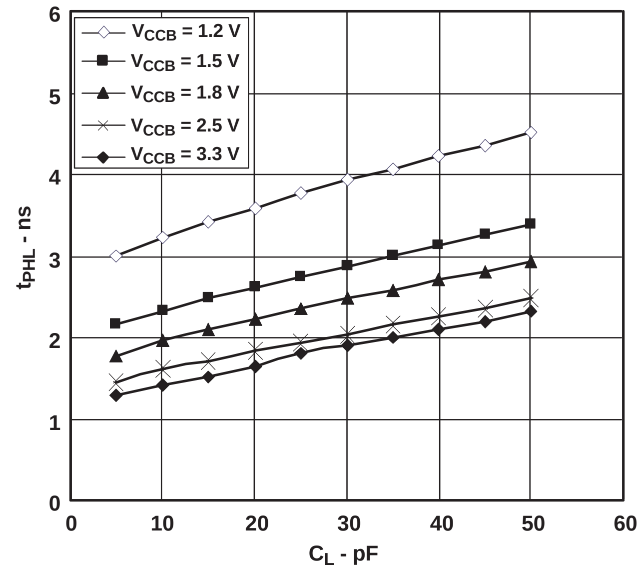
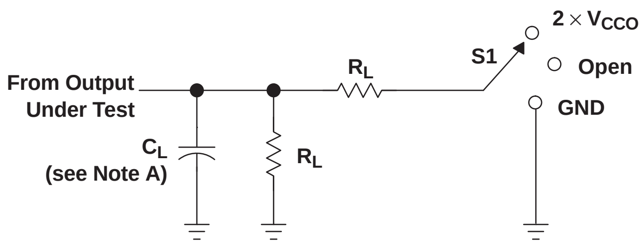


Figure 10.

PARAMETER MEASUREMENT INFORMATION

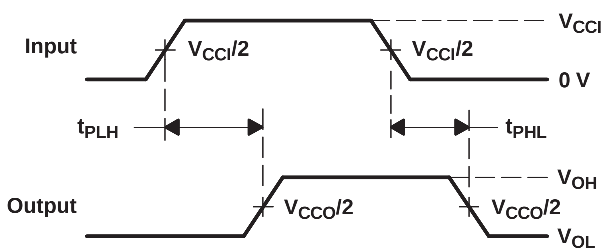


LOAD CIRCUIT

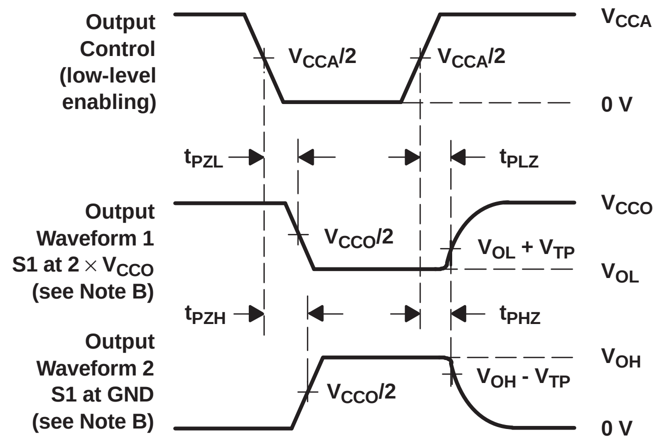
TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	$2 \times V_{CCO}$
t_{PHZ}/t_{PZH}	GND

VOLTAGE WAVEFORMS
PULSE DURATION

V_{CCO}	C_L	R_L	V_{TP}
1.2 V	15 pF	2 kΩ	0.1 V
1.5 V ± 0.1 V	15 pF	2 kΩ	0.1 V
1.8 V ± 0.15 V	15 pF	2 kΩ	0.15 V
2.5 V ± 0.2 V	15 pF	2 kΩ	0.15 V
3.3 V ± 0.3 V	15 pF	2 kΩ	0.3 V



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

NOTES:
- A. C_L includes probe and jig capacitance.
- B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
- C. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50 Ω, dv/dt ≥ 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.

Figure 11. Load Circuit and Voltage Waveforms

APPLICATION INFORMATION

Figure 12 is an example of the SN74AVCH2T45 circuit used in a unidirectional logic level-shifting application.

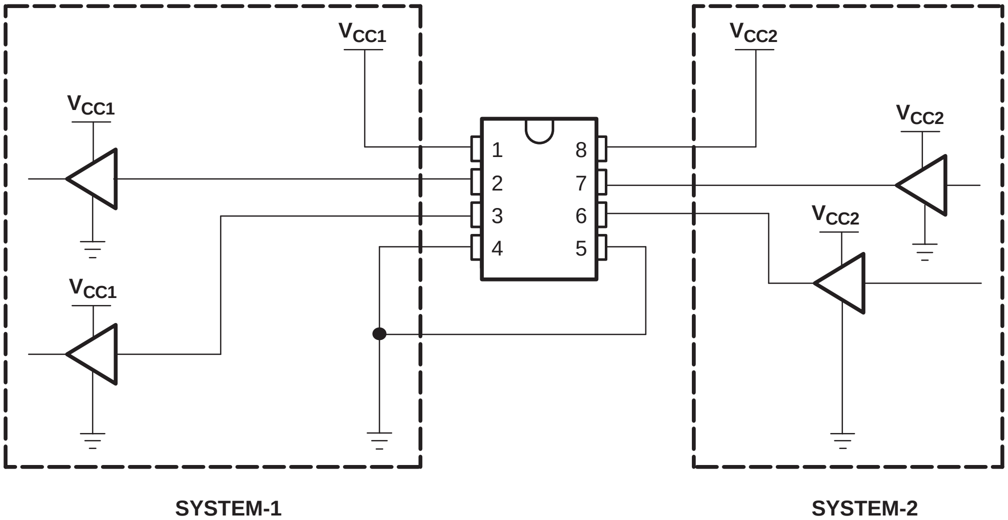


Figure 12. Bidirectional Logic Level-Shifting Application

PIN	NAME	FUNCTION	DESCRIPTION
1	V_{CCA}	V_{CC1}	SYSTEM-1 supply voltage (1.2 V to 3.6 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 (1.2 V to 3.6 V)

Figure 13 shows the SN74AVCH2T45 used in a bidirectional logic level-shifting application. Since the SN74AVCH2T45 does not have an output-enable (OE) pin, system designers should take precautions to avoid bus contention between SYSTEM-1 and SYSTEM-2 when changing directions.

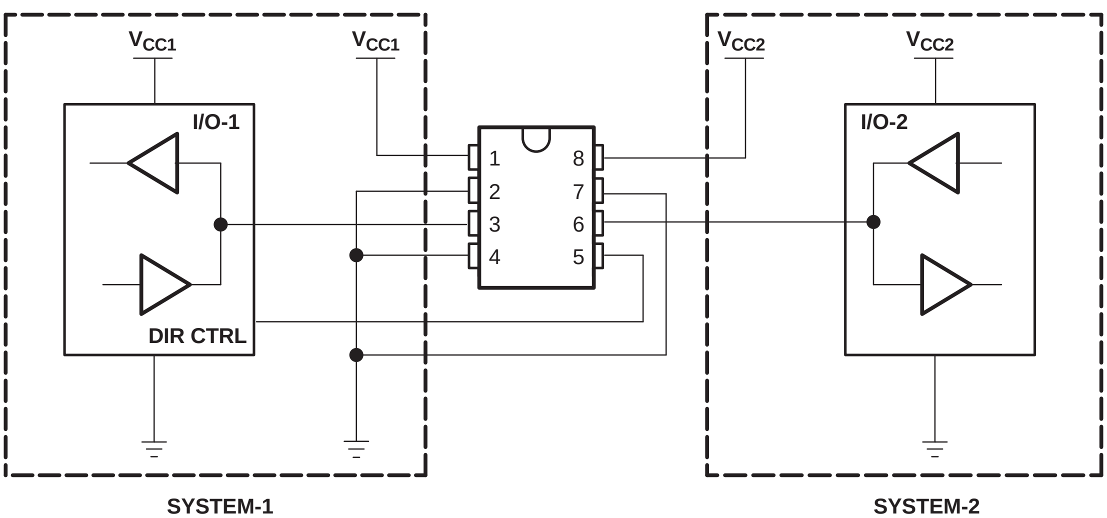


Figure 13. Bidirectional Logic Level-Shifting Application

Following is a sequence that 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	H	Out	In	SYSTEM-1 data to SYSTEM-2
2	H	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 bus hold.
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 bus hold.
4	L	In	Out	SYSTEM-2 data to SYSTEM-1

Enable Times

Calculate the enable times for the SN74AVCH2T45 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 SN74AVCH2T45 initially is transmitting from A to B, 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.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
74AVCH2T45DCTRE4	ACTIVE	SM8	DCT	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ET2 Z	Samples
74AVCH2T45DCTRG4	ACTIVE	SM8	DCT	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ET2 Z	Samples
74AVCH2T45DCTTE4	ACTIVE	SM8	DCT	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ET2 Z	Samples
74AVCH2T45DCURE4	ACTIVE	US8	DCU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ET2R	Samples
74AVCH2T45DCURG4	ACTIVE	US8	DCU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ET2R	Samples
74AVCH2T45DCUTE4	ACTIVE	US8	DCU	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ET2R	Samples
74AVCH2T45DCUTG4	ACTIVE	US8	DCU	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ET2R	Samples
SN74AVCH2T45DCTR	ACTIVE	SM8	DCT	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ET2 Z	Samples
SN74AVCH2T45DCTT	ACTIVE	SM8	DCT	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ET2 Z	Samples
SN74AVCH2T45DCUR	ACTIVE	US8	DCU	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ET2R	Samples
SN74AVCH2T45DCUT	ACTIVE	US8	DCU	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ET2R	Samples
SN74AVCH2T45YZPR	ACTIVE	DSBGA	YZP	8	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	TF7	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) Only one of markings shown within the brackets will appear on the physical device.

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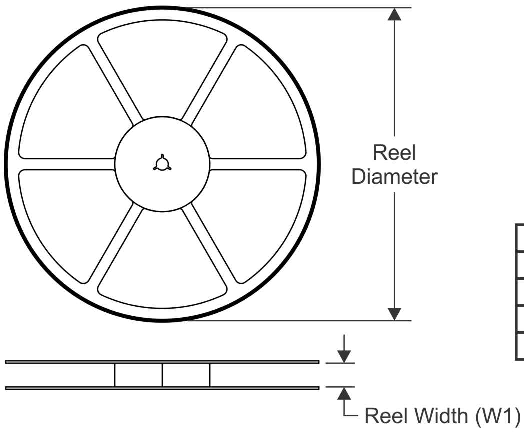
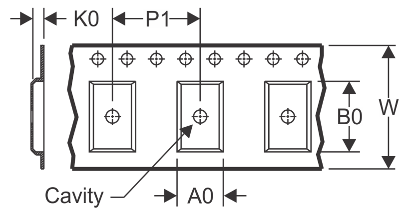
TAPE AND REEL INFORMATION

REEL DIMENSIONS

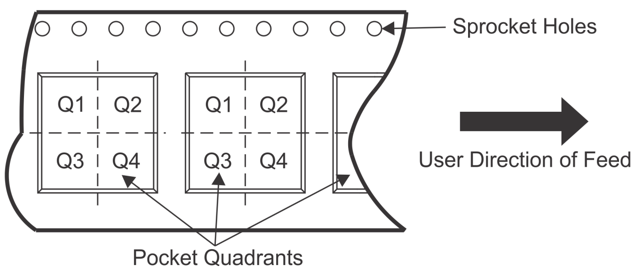


TAPE DIMENSIONS



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

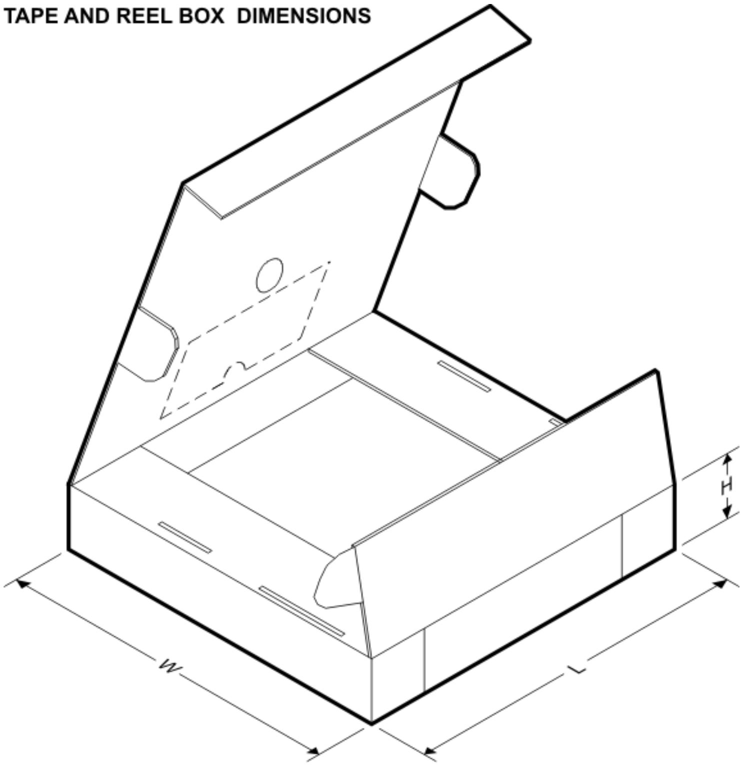
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
SN74AVCH2T45DCUR	US8	DCU	8	3000	180.0	8.4	2.25	3.35	1.05	4.0	8.0	Q3
SN74AVCH2T45YZPR	DSBGA	YZP	8	3000	180.0	8.4	1.02	2.02	0.63	4.0	8.0	Q1

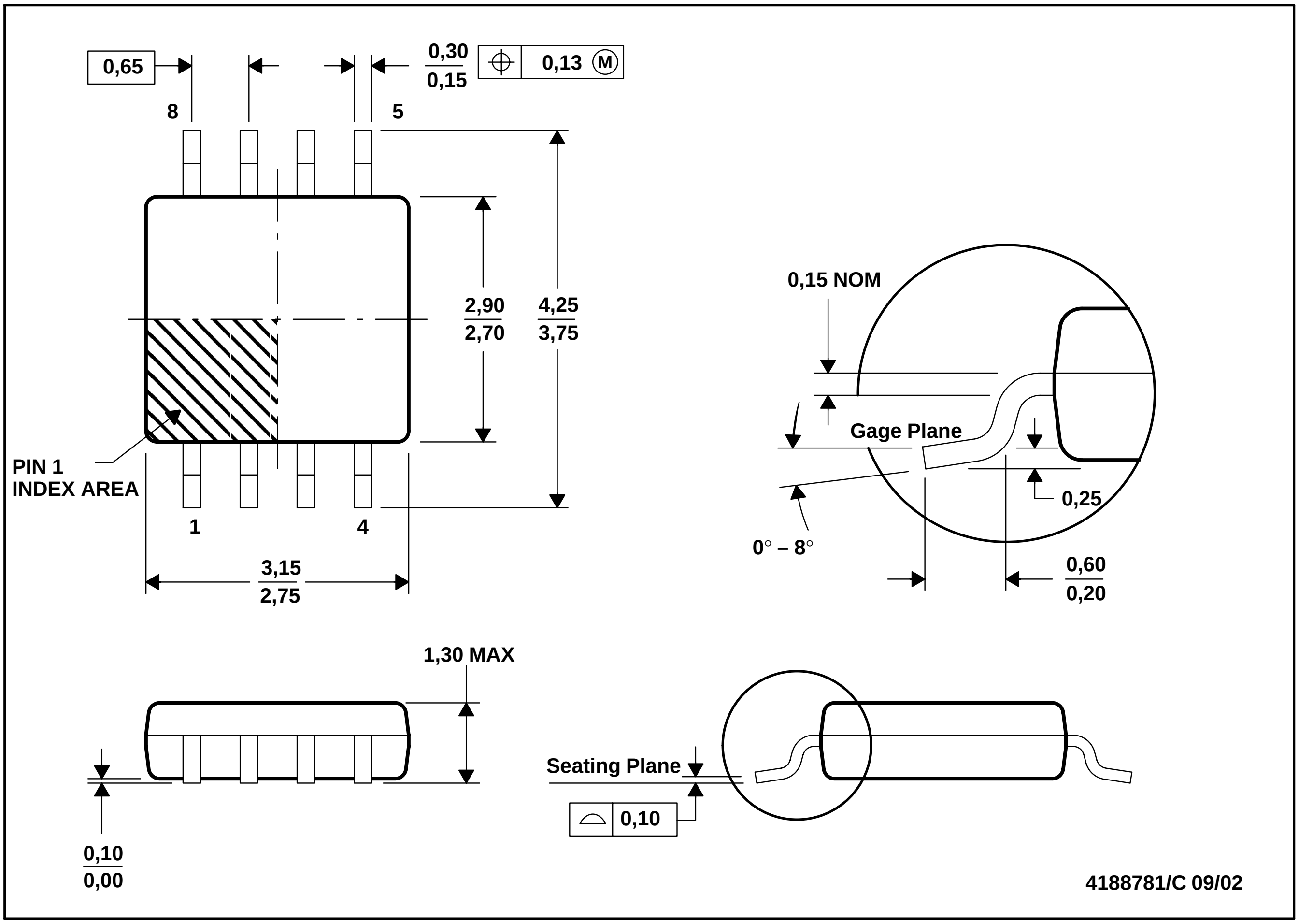
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

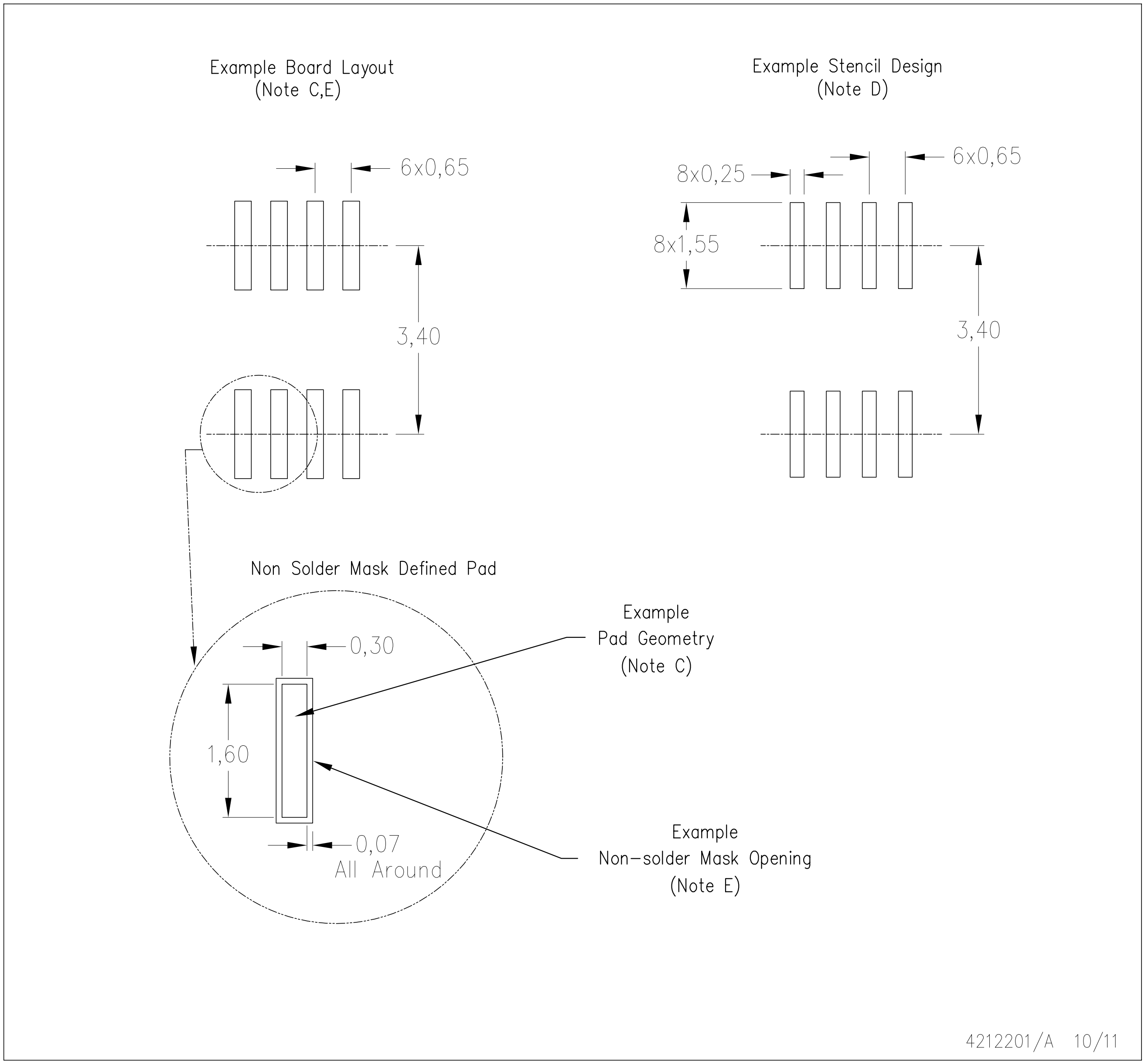
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74AVCH2T45DCUR	US8	DCU	8	3000	202.0	201.0	28.0
SN74AVCH2T45YZPR	DSBGA	YZP	8	3000	220.0	220.0	34.0

DCT (R-PDSO-G8) **PLASTIC SMALL-OUTLINE PACKAGE**



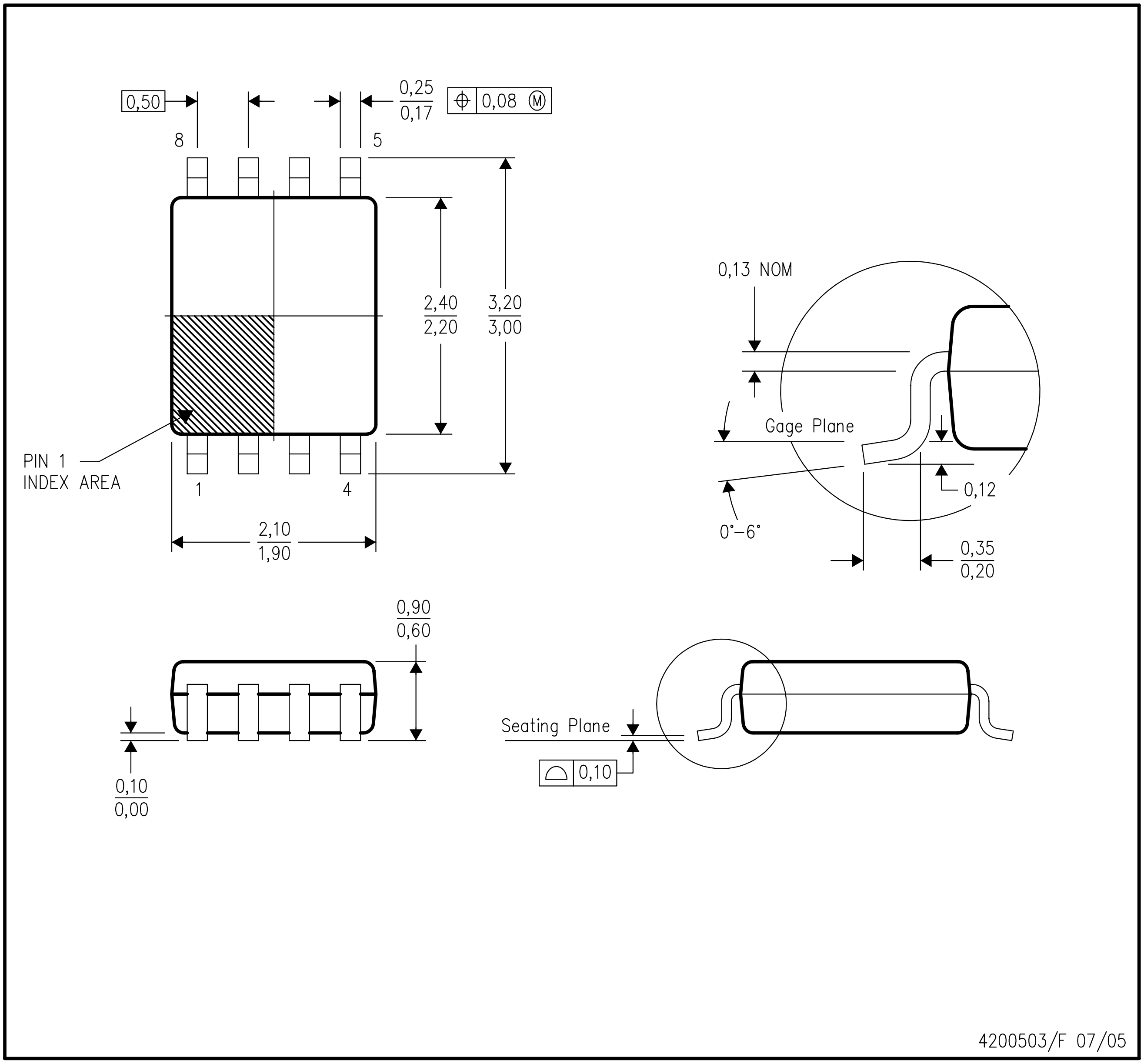
NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion
D. Falls within JEDEC MO-187 variation DA.

DCT (R–PDSO–G8) PLASTIC SMALL OUTLINE



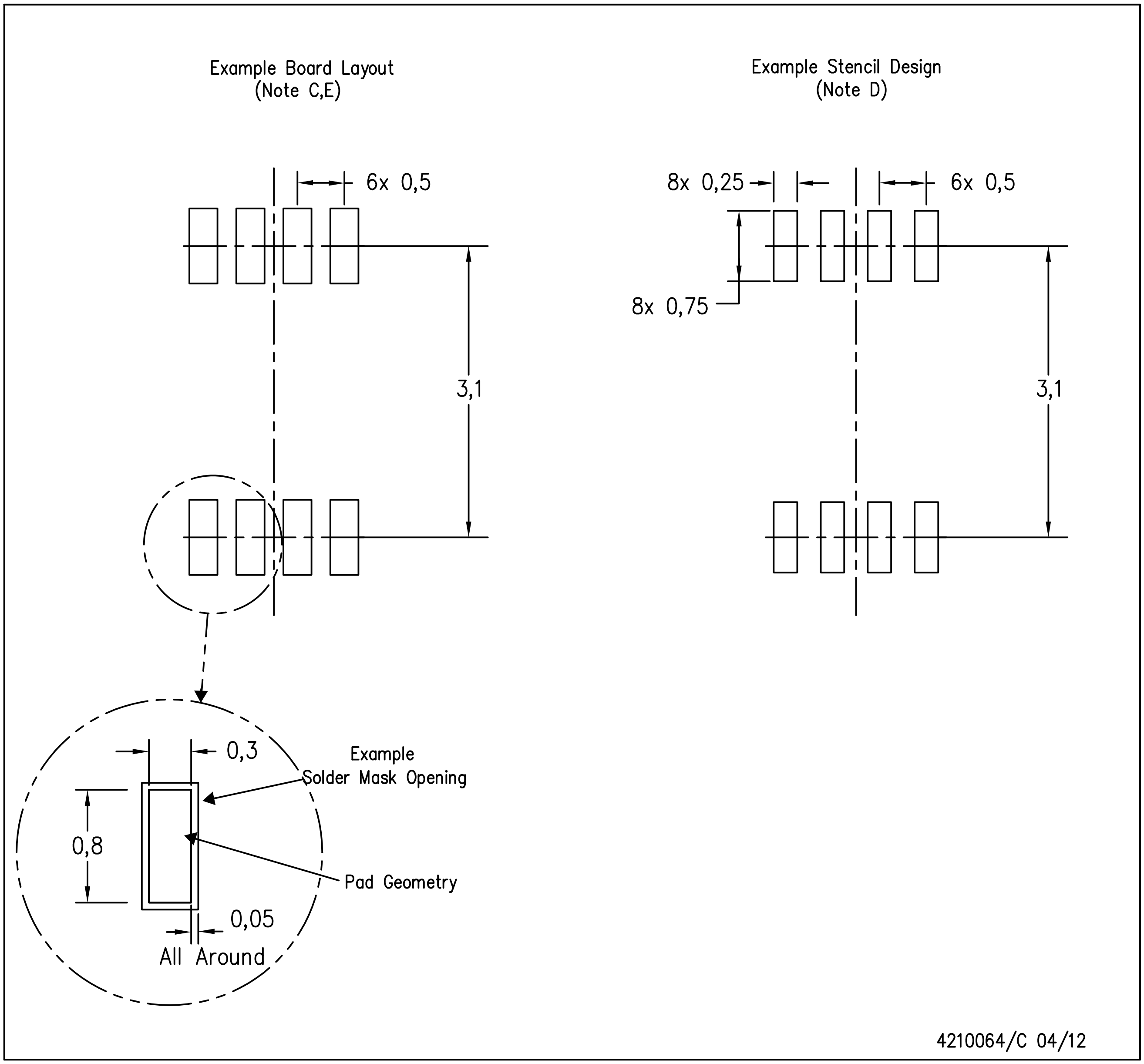
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact 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)



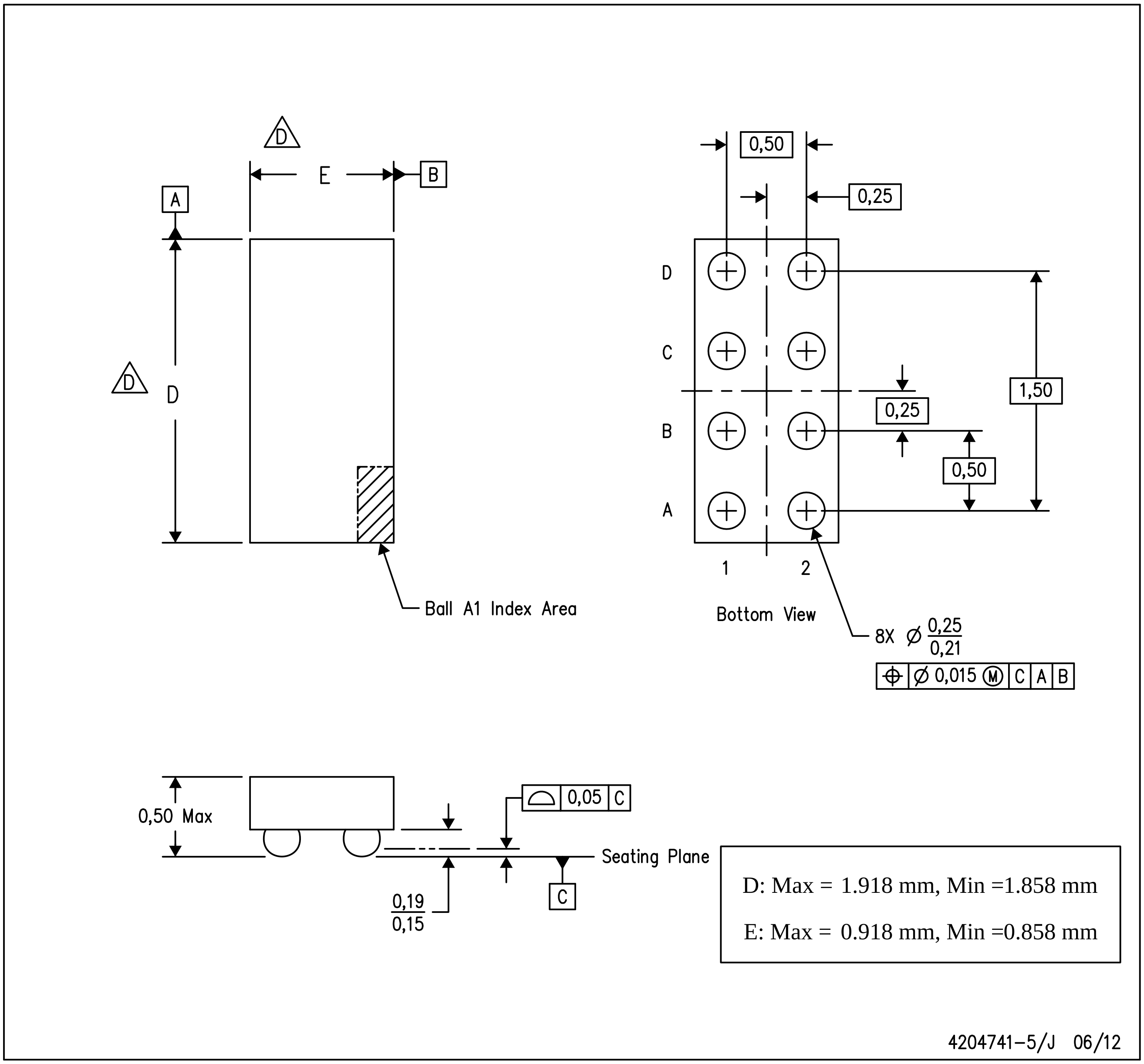
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
D. Falls within JEDEC MO-187 variation CA.

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:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
- B. This drawing is subject to change without notice.
- C. NanoFree™ package configuration.
- D. 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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