CDCV304 200-MHz General-Purpose Clock Buffer, PCI-X Compliant

1 Features

- General-Purpose and PCI-X 1:4 Clock Buffer
- Operating Frequency
  - 0 MHz to 200 MHz General-Purpose
- Low Output Skew: <100 ps
- Distributes One Clock Input to One Bank of Four Outputs
- Output Enable Control that Drives Outputs Low when OE is Low
- Operates from Single 3.3-V Supply or 2.5-V Supply
- PCI-X Compliant
- 8-Pin TSSOP Package

2 Description

The CDCV304 is a high-performance, low-skew, general-purpose PCI-X compliant clock buffer. It distributes one input clock signal (CLKIN) to the output clocks (1Y[0:3]). It is specifically designed for use with PCI-X applications. The CDCV304 operates at 3.3 V and 2.5 V and is therefore compliant to the 3.3-V PCI-X specifications.

The CDCV304 is characterized for operation from –40°C to 85°C for automotive and industrial applications.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
CDCV304	TSSOP (8)	3.00 mm × 4.40 mm

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

Functional Block Diagram

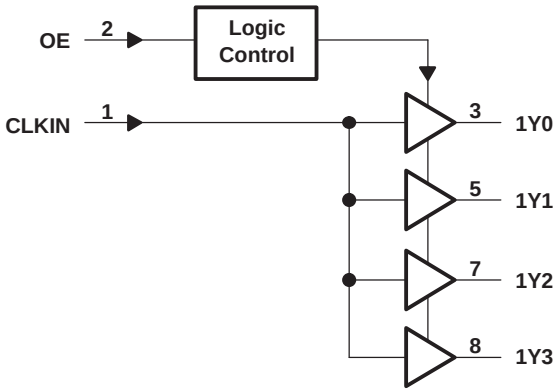


Table of Contents

3 Revision History

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

Changes from Revision H (February 2011) to Revision I — **Page**

- Changed datasheet layout ... 1
- Added Junction temperature, $T_{j,\ max}$125 °C ... 3

Changes from Revision G (January 2011) to Revision H — **Page**

- Added missing characteristics graphs. ... 6

Changes from Revision F (April 2009) to Revision G — **Page**

- Added ψ_{JT} and ψ_{JB} specs to the Thermal Information Table and changed $R_{\theta JB}$ and $R_{\theta JC}$ specs from 65 and 69 °C/W respectively. ... 4

4 Pin Configuration and Functions

PW Package
8-Pin TSSOP
Top View

Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
1Y[0:3]	3, 5, 7, 8	O	Buffered output clocks
CLKIN	1	I	Input reference frequency
GND	4	Power	Ground
OE	2	I	Output enable control
V_{DD}	6	Power	Supply

5 Specifications

5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) (1)

	MIN	MAX	UNIT
Supply voltage range, V_{DD}	–0.5	4.3	V
Input voltage range, V_I (2) (3)	–0.5	V_{DD} + 0.5	V
Output voltage range, V_O (2) (3)	–0.5	V_{DD} + 0.5	V
Input clamp current, I_{IK} (V_I < 0 or V_I> V_{DD})	–50	50	mA
Output clamp current, I_{OK} (V_O < 0 or V_O > V_{DD})	–50	50	mA
Continuous total output current, I_O (V_O = 0 to V_{DD})	–50	50	mA
Package thermal impedance, θ_{JA}: PW package		230.5	°C/W
Junction temperature, $T_{j, max}$		125	°C
Storage temperature range T_{stg}	–65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) The input and output negative voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
(3) This value is limited to 4.6 V maximum.

5.2 Recommended Operating Conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V_{DD}		2.3		3.6	V
Low-level input voltage, V_{IL}				0.3 x V_{DD}	V
High-level input voltage, V_{IH}		0.7 x V_{DD}			V
Input voltage, V_I		0		V_{DD}	V
High-level output current, I_{OH}	V_{DD} = 2.5 V			–12	mA
	V_{DD} = 3.3 V			–24	
Low-level output current, I_{OL}	V_{DD} = 2.5 V			12	mA
	V_{DD} = 3.3 V			24	
Operating free-air temperature, T_A		–40		85	°C

5.3 Thermal Information

THERMAL METRIC(1)			THERMAL AIR FLOW (CFM)	CDCV304 PW (TSSOP) 8 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	High K	0	149	°C/W
			150	142	
			250	138	
			500	132	
		Low K		230	
				185	
				170	
				150	
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance			43.7	
$R_{\theta JB}$	Junction-to-board thermal resistance			102	
ψ_{JT}	Junction-to-top characterization parameter			1.8	
ψ_{JB}	Junction-to-board characterization parameter			100.2	

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

5.4 Electrical Characteristics

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

PARAMETER		TEST CONDITIONS		MIN	TYP(1)	MAX	UNIT
V_{IK}	Input voltage	V_{DD} = 3 V,	I_I = –18 mA			–1.2	V
V_{OH}	High-level output voltage	V_{DD} = 2.3 V,	I_{OH} = –8 mA	1.8			V
		V_{DD} = 2.3 V,	I_{OH} = –16 mA	1.5			
		V_{DD} = min to max,	I_{OH} = –1 mA	V_{DD} – 0.2			
		V_{DD} = 3 V,	I_{OH} = –24 mA	2			
		V_{DD} = 3 V,	I_{OH} = –12 mA	2.4			
V_{OL}	Low-level output voltage	V_{DD} = 2.3 V,	I_{OL} = 8 mA			0.5	V
		V_{DD} = 2.3 V,	I_{OL} = 16 mA			0.7	
		V_{DD} = min to max,	I_{OL} = 1 mA			0.2	
		V_{DD} = 3 V,	I_{OL} = 24 mA			0.8	
		V_{DD} = 3 V,	I_{OL} = 12 mA			0.55	
I_{OH}	High-level output current	V_{DD} = 3 V,	V_O = 1 V	–50			mA
		V_{DD} = 3.3 V,	V_O = 1.65 V			–55	
I_{OL}	Low-level output current	V_{DD} = 3 V,	V_O = 2 V	60			mA
		V_{DD} = 3.3 V,	V_O = 1.65 V			70	

(1) All typical values are with respect to nominal V_{DD} and T_A = 25°C.

Electrical Characteristics (continued)

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

PARAMETER		TEST CONDITIONS		MIN	TYP(1)	MAX	UNIT
I_I	Input current	$V_I = V_O$ or V_{DD}				±5	µA
I_{DD}	Dynamic current, see Figure 1	f = 67 MHz,	V_{DD} = 2.7 V			28	mA
		f = 67 MHz,	V_{DD} = 3.6 V			37	
C_I	Input capacitance	V_{DD} = 3.3 V,	V_I = 0 V or V_{DD}		3		pF
C_O	Output capacitance	V_{DD} = 3.3 V,	V_I = 0 V or V_{DD}		3.2		pF

5.5 Timing Requirements

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{clk}	Clock frequency		0		200	MHz

5.6 Switching Characteristics: V_{DD} = 2.5 V ± 10%

V_{DD} = 2.5 V ± 10%, C_L= 10 pF (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
t_{PLH}	Low-to-high propagation delay	See Figure 4 and Figure 5	2	2.9	4.5	ns
t_{PHL}	High-to-low propagation delay		2	3	4.5	
$t_{sk(o)}$	Output skew(2)	See Figure 6		50	150	ps
t_r	Output rise slew rate		1.5	2.2	4	V/ns
t_f	Output fall slew rate		1.5	2.2	4	V/ns

(1) All typical values are with respect to nominal V_{DD}.
(2) The $t_{sk(o)}$ specification is only valid for equal loading of all outputs.

5.7 Switching Characteristics: V_{DD} = 3.3 V ± 10%

V_{DD} = 3.3 V ± 10%, C_L= 10 pF (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
t_{PLH}	Low-to-high propagation delay	See Figure 4 and Figure 5	1.8	2.4	3	ns
t_{PHL}	High-to-low propagation delay		1.8	2.5	3	
$t_{sk(o)}$	Output skew(2)			50	100	ps
t_{jitter}	Additive phase jitter from input to output 1Y0	12 kHz to 5 MHz, f_{out} = 30.72 MHz		63		fs rms
		12 kHz to 20 MHz, f_{out} = 125 MHz		56		
$t_{sk(p)}$	Pulse skew	$V_{IH} = V_{DD}$, V_{IL} = 0 V			150	ps
$t_{sk(pr)}$	Process skew			0.2	0.3	ns
$t_{sk(pp)}$	Part-to-part skew			0.25	0.4	ns
t_{high}	Clock high time, see Figure 7	66 MHz	6			ns
		140 MHz	3			
t_{low}	Clock low time, see Figure 7	66 MHz	6			ns
		140 MHz	3			
t_r	Output rise slew rate(3)	V_O = 0.4 V to 2 V	1.5	2.7	4	V/ns
t_f	Output fall slew rate(3)	V_O = 2 V to 0.4 V	1.5	2.7	4	V/ns

(1) All typical values are with respect to nominal V_{DD}.
(2) The $t_{sk(o)}$ specification is only valid for equal loading of all outputs.
(3) This symbol is according to PCI-X terminology.

5.8 Typical Characteristics

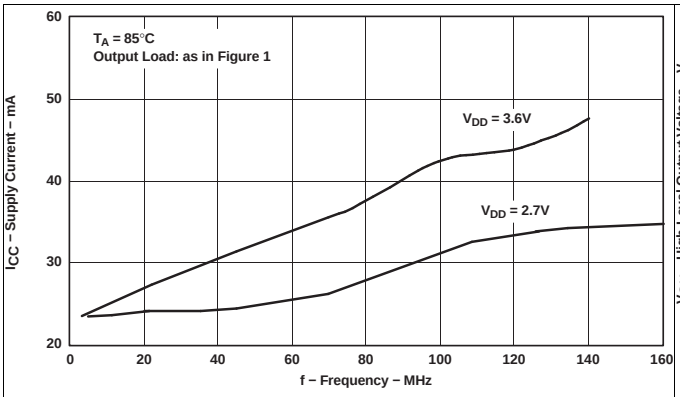


Figure 1. Supply Current vs Frequency

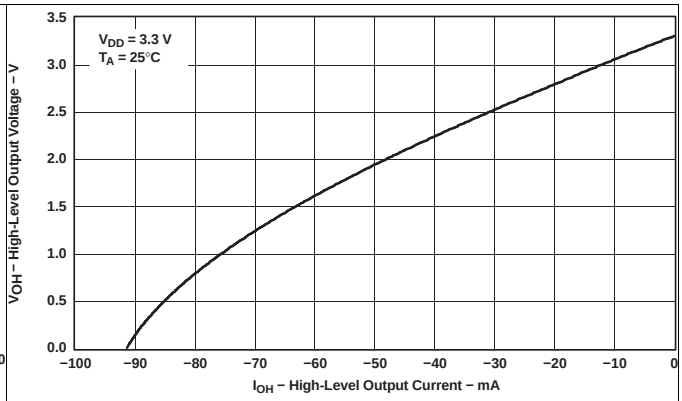


Figure 2. High-Level Output Voltage vs High-Level Output Current

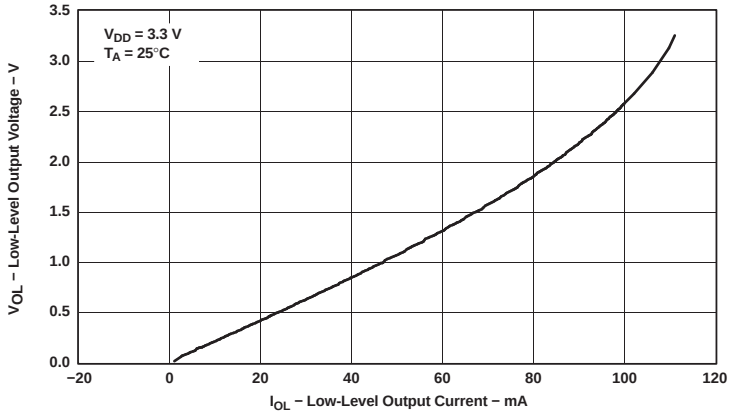


Figure 3. Low-Level Output Voltage vs Low-Level Output Current

6 Parameter Measurement Information

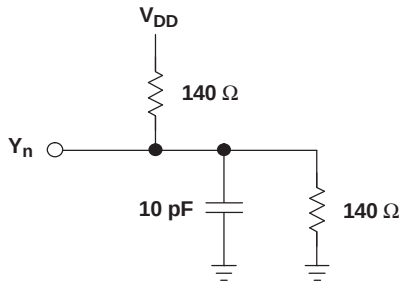


Figure 4. Test Load Circuit

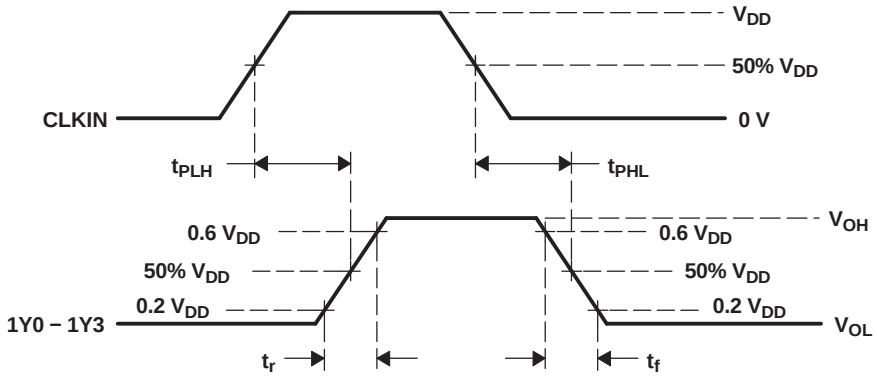


Figure 5. Voltage Waveforms Propagation Delay (t_{pd}) Measurements

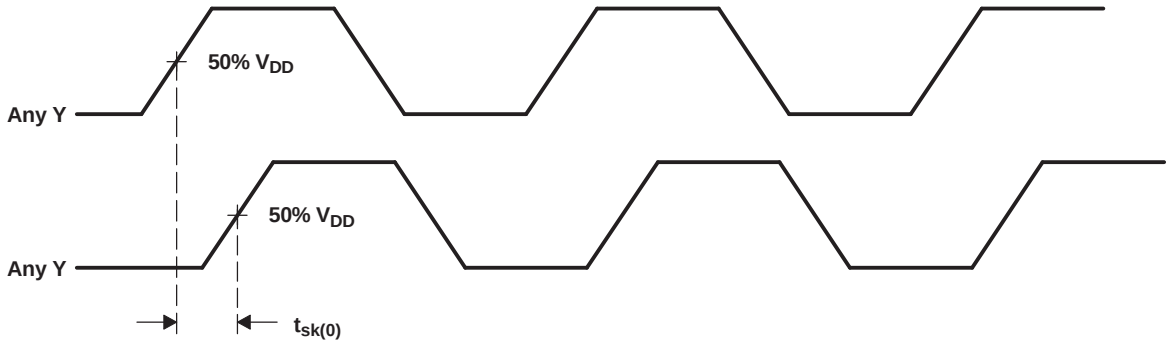
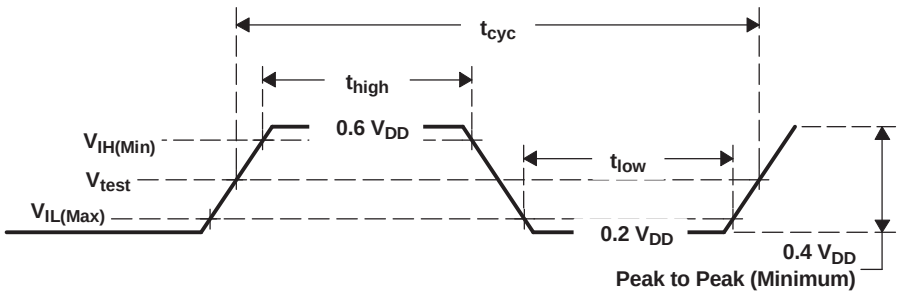


Figure 6. Output Skew

PARAMETER	VALUE	UNIT
$V_{IH(Min)}$	0.5 V_{DD}	V
$V_{IL(Max)}$	0.35 V_{DD}	V
V_{test}	0.4 V_{DD}	V

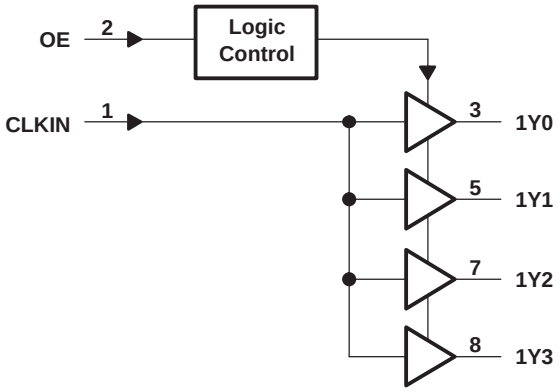


A. All parameters in Figure 7 are according to PCI-X 1.0 specifications.

Figure 7. Clock Waveform

7 Detailed Description

7.1 Functional Block Diagram



7.2 Device Functional Modes

Table 1. Function Table

INPUTS		OUTPUTS
CLKIN	OE	1Y[0:3]
L	L	L
H	L	L
L	H	L
H	H	H

8 Device and Documentation Support

8.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

8.2 Community Resources

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

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

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

8.3 Trademarks

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

8.4 Electrostatic Discharge Caution

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

8.5 Glossary

SLYZ022 — *TI Glossary*.

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

9 Mechanical, Packaging, and Orderable Information

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

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)
CDCV304PW	Active	Production	TSSOP (PW) | 8	150 | TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	CKV304
CDCV304PW.A	Active	Production	TSSOP (PW) | 8	150 | TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	CKV304
CDCV304PWG4	Active	Production	TSSOP (PW) | 8	150 | TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	CKV304
CDCV304PWR	Active	Production	TSSOP (PW) | 8	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	CKV304
CDCV304PWR.A	Active	Production	TSSOP (PW) | 8	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	CKV304
CDCV304PWRG4	Active	Production	TSSOP (PW) | 8	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	CKV304

(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.

OTHER QUALIFIED VERSIONS OF CDCV304 :

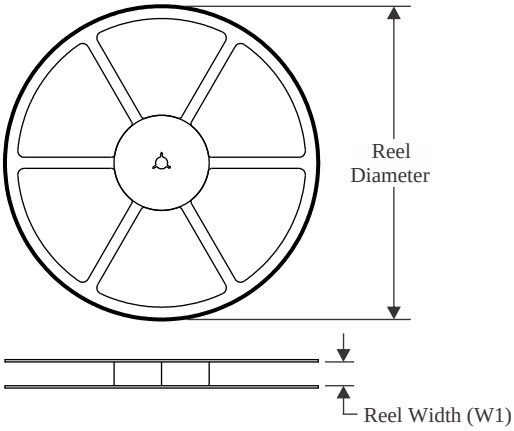
- Enhanced Product : CDCV304-EP

NOTE: Qualified Version Definitions:

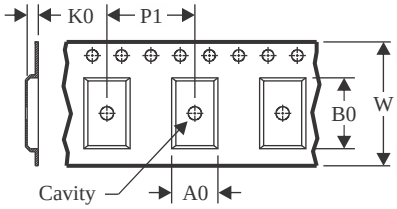
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

TAPE AND REEL INFORMATION

REEL DIMENSIONS

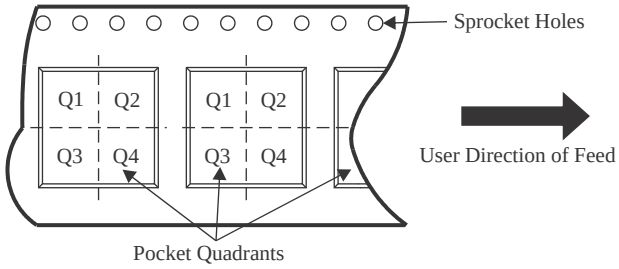


TAPE DIMENSIONS



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

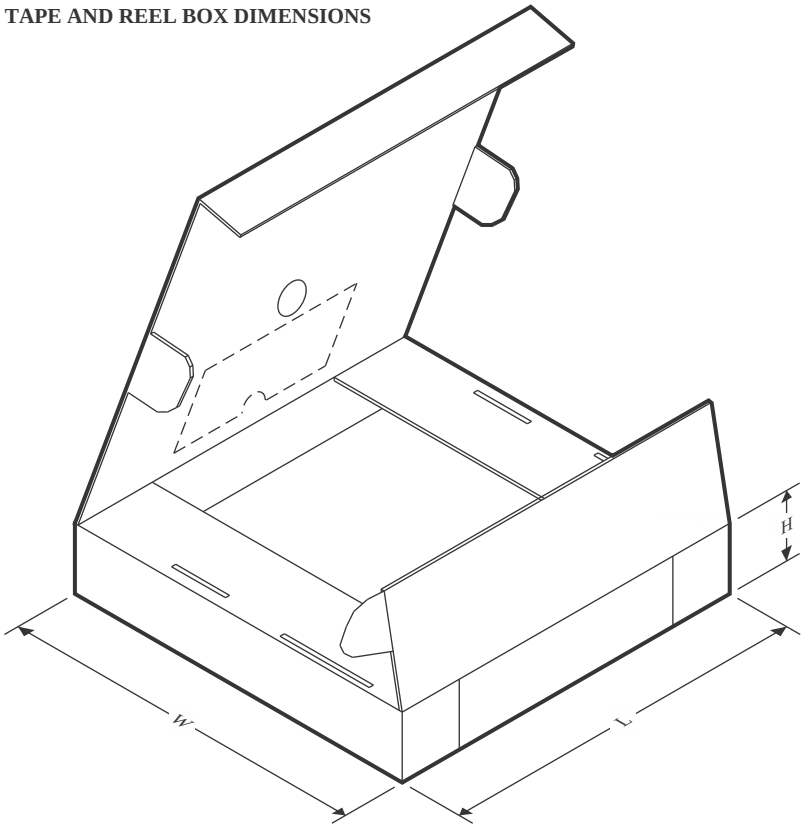
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
CDCV304PWR	TSSOP	PW	8	2000	330.0	12.4	7.0	3.6	1.6	8.0	12.0	Q1

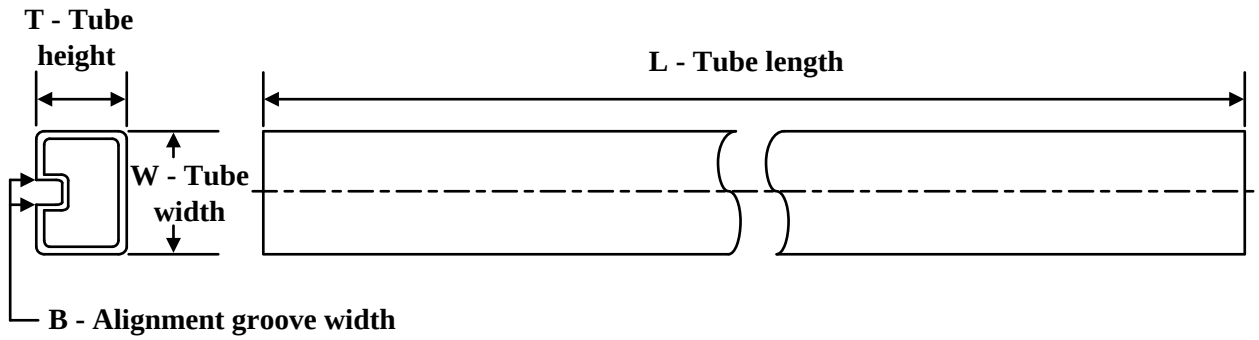
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CDCV304PWR	TSSOP	PW	8	2000	353.0	353.0	32.0

TUBE



*All dimensions are nominal

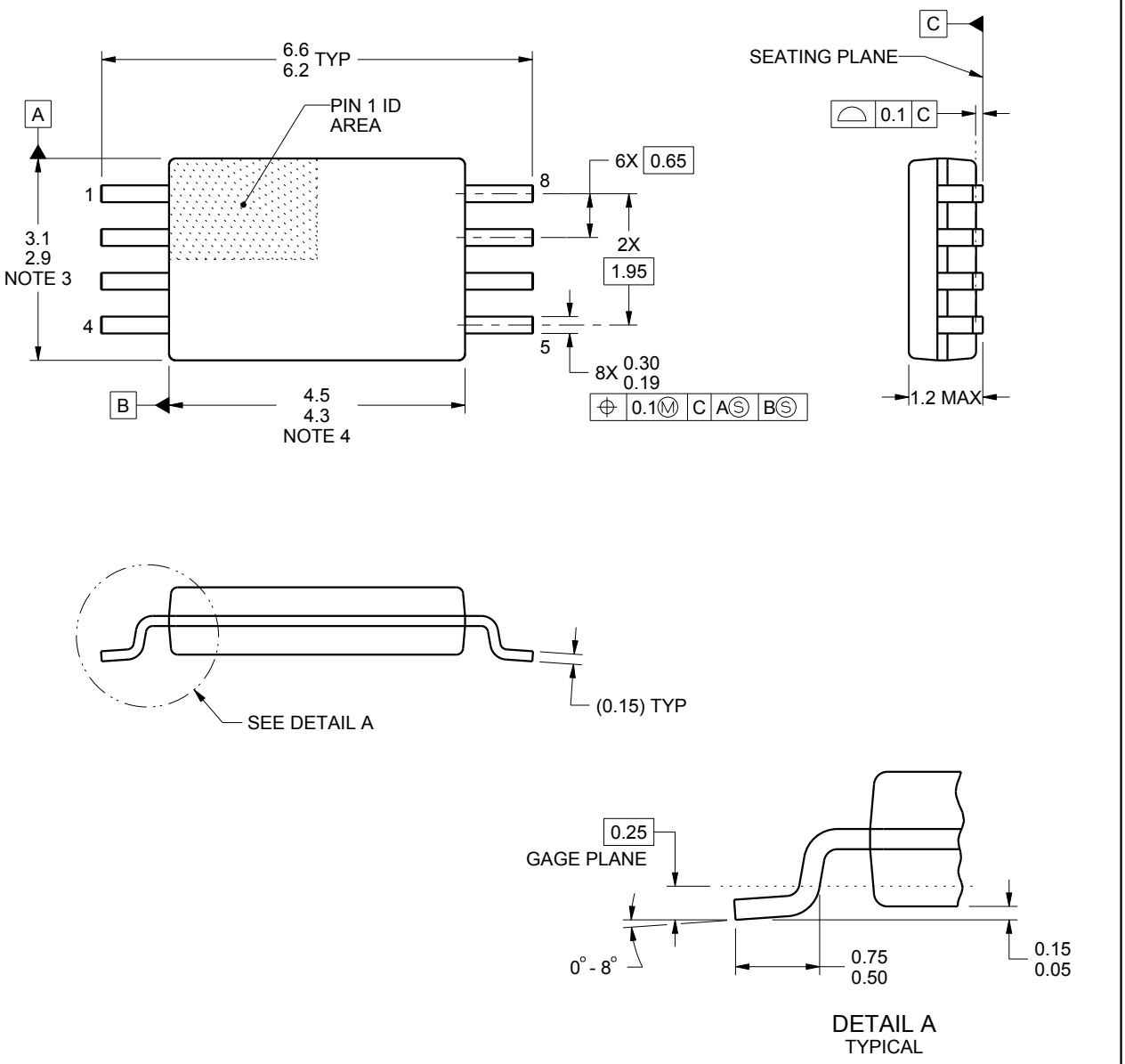
Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
CDCV304PW	PW	TSSOP	8	150	530	10.2	3600	3.5
CDCV304PW.A	PW	TSSOP	8	150	530	10.2	3600	3.5
CDCV304PWG4	PW	TSSOP	8	150	530	10.2	3600	3.5

PACKAGE OUTLINE

PW0008A

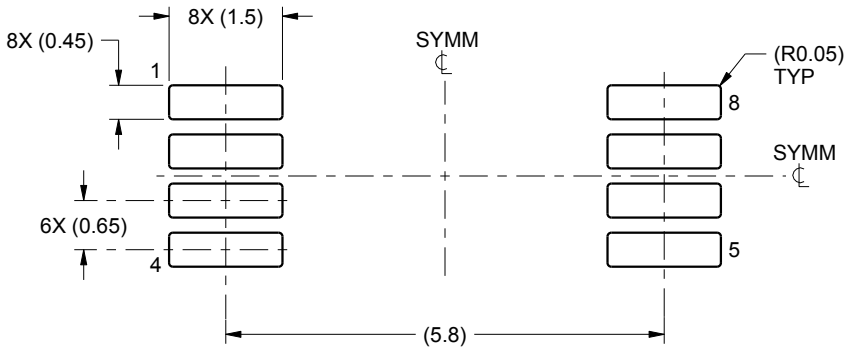
TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE

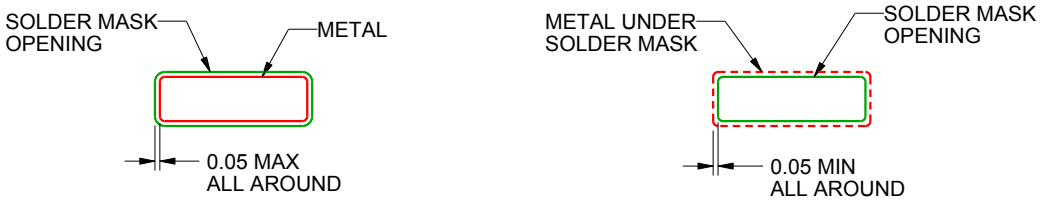


NOTES:

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.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153, variation AA.



LAND PATTERN EXAMPLE
SCALE:10X

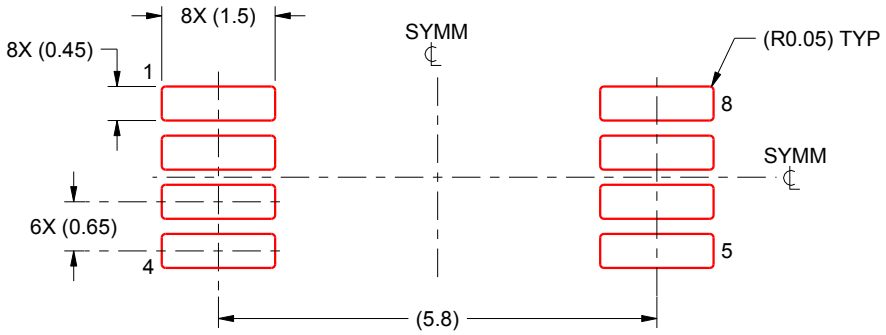


SOLDER MASK DETAILS
NOT TO SCALE

4221848/A 02/2015

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:10X

4221848/A 02/2015

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265