

## SSC Clock Generator/Buffer

### FEATURES

- Part of a Family of Easy to use Clock Generator Devices With Optional SSC
- SSC Capable Clock Generator / Buffer
- SSC Controllable via 3 External Pins
  - $\pm 0\%$  to  $\pm 1.5\%$  Center Spread
- 1 External Control Pin for SSC ON / OFF Selection
- 40 MHz to 108 MHz Single-Ended LVCMOS Input
- Single 3.3V Device Power Supply
- Wide Temperature Range – 40°C to 85°C
- Low Space Consumption by 8 Pin TSSOP Package

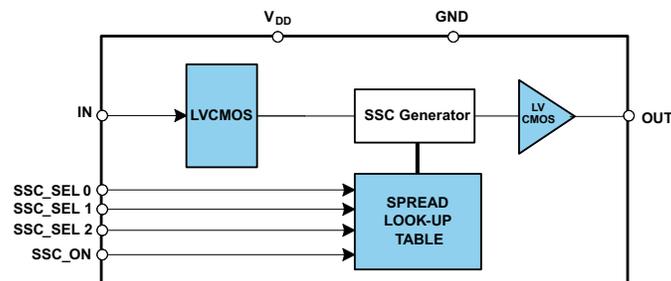
### APPLICATIONS

- Consumer and Industrial Applications Requiring EMI Reduction through Spread Spectrum Clocking

### PACKAGE

IN	1	8	VDD
SSC_SEL 0	2	7	SSC_SEL 2
SSC_SEL 1	3	6	OUT
GND	4	5	SSC_ON

### BLOCK DIAGRAM



### DESCRIPTION

The CDCS501 is a spread spectrum capable, LVCMOS Input Clock Buffer for EMI reduction.

The device is designed to counter common EMI problems in modern electronic designs.

It accepts a 3.3V LVCMOS signal at the input and spread this signal by a small amount, centered around the input frequency. The amount of spread can be selected via 3 control pins. The Functional Table contains detailed information on the amount of spread. A 4th control pin can be used to activate or deactivate the Spread Spectrum Clock Generator.

Selecting SSC\_ON = off will turn the Spread Spectrum Clock Generator off only. The device will still pass the LVCMOS signal that's presented at its input through to its output. This pin is low active.

The wide operating frequency range covers most commonly used midrange Audio and Video frequencies. The CDCS501 operates in 3.3V environment.

It is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ , and available in an 8-pin TSSOP package.



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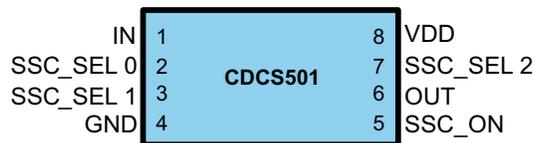
These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

**FUNCTION TABLE**

SSC_ON	SSC_SEL 0	SSC_SEL 1	SSC_SEL 2	SPREAD AMOUNT
1	x	x	X	0.00%
0	0	0	0	1.00%
0	0	0	1	1.50%
0	0	1	0	1.00%
0	0	1	1	1.50%
0	1	0	0	0.50%
0	1	0	1	0.75%
0	1	1	0	0.00%
0	1	1	1	0.50%

**DEVICE INFORMATION**

**PACKAGE**



**PIN FUNCTIONS**

PIN			
NAME	NO.	Type	Description
IN	1	I	LVC MOS Clock Input
OUT	6	O	LVC MOS Clock Output
SSC_SEL 0, 1, 2	2, 3, 7	I	Spread Selection Pins, internal Pull-up
SSC_ON	5	I	SSC on/off Pin, active low; internal Pull-down
VDD	8	Power	3.3V Power Supply
GND	4	Ground	Ground

**PACKAGE THERMAL RESISTANCE FOR TSSOP (PW) PACKAGE<sup>(1)</sup>**

CDCS501PW 8-PIN TSSOP			THERMAL AIRFLOW (CFM)				UNIT
			0	150	250	500	
R <sub>θJA</sub>	High K		149	142	138	132	°C / W
	Low K		230	185	170	150	
R <sub>θJc</sub>	High K	65					°C / W
	Low K	69					

(1) The package thermal impedance is calculated in accordance with JESD 51 and JEDEC2S2P (high-k board).

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

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

		VALUE	UNIT
$V_{DD}$	Supply voltage range	–0.5 to 4.6	V
$V_{IN}$	Input voltage range	–0.5 to 4.6	V
$V_{out}$	Output voltage range	–0.5 to 4.6	V
$I_{IN}$	Input current ( $V_I < 0$ , $V_I > V_{DD}$ )	20	mA
$I_{out}$	Continuous output current	50	mA
$T_{ST}$	Storage temperature range	–65 to 150	°C
$T_J$	Maximum junction temperature	125	°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.

## RECOMMENDED OPERATING CONDITIONS

		MIN	NOM	MAX	UNIT
$V_{DD}$	Supply voltage	3.0		3.6	V
$f_{IN}$	Input Frequency	40		108	MHz
$V_{IL}$	Low level input voltage LVCMOS			$0.3 V_{DD}$	V
$V_{IH}$	High level input voltage LVCMOS	$0.7 V_{DD}$			V
$V_I$	Input Voltage threshold LVCMOS		$0.5 V_{DD}$		V
$C_L$	Output Load Test LVCMOS			15	pF
$I_{OH}/I_{OL}$	Output Current			12	mA
$T_A$	Operating free-air temperature	–40		85	°C

### DEVICE CHARACTERISTICS

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$I_{DD}$	Device supply current	$f_{IN} = 80 \text{ MHz}$		26		mA
$f_{OUT}$	Output frequency		40		108	MHz
$I_{IH}$	LVC MOS input current	$V_I = V_{DD}; V_{DD} = 3.6V$			10	$\mu A$
$I_{IL}$	LVC MOS input current	$V_I = 0 \text{ V}; V_{DD} = 3.6V$			-10	$\mu A$
$V_{OH}$	LVC MOS high-level output voltage	$I_{OH} = -0.1mA$	2.9			V
		$I_{OH} = -8mA$	2.4			
		$I_{OH} = -12mA$	2.2			
$V_{OL}$	LVC MOS low-level output voltage	$I_{OL} = 0.1mA$			0.1	V
		$I_{OL} = 8mA$			0.5	
		$I_{OL} = 12mA$			0.8	
$t_{JIT(C-C)}$	Cycle to cycle jitter cycles	$f_{out} = 80 \text{ MHz}; SSC = 1\%, 10000 \text{ cycles}$		110		ps
$t_r/t_f$	Rise and fall time	20%–80%		0.75		ns
$O_{dc}$	Output duty cycle		45%		55%	
$f_{MOD}$	Modulation frequency			30		kHz

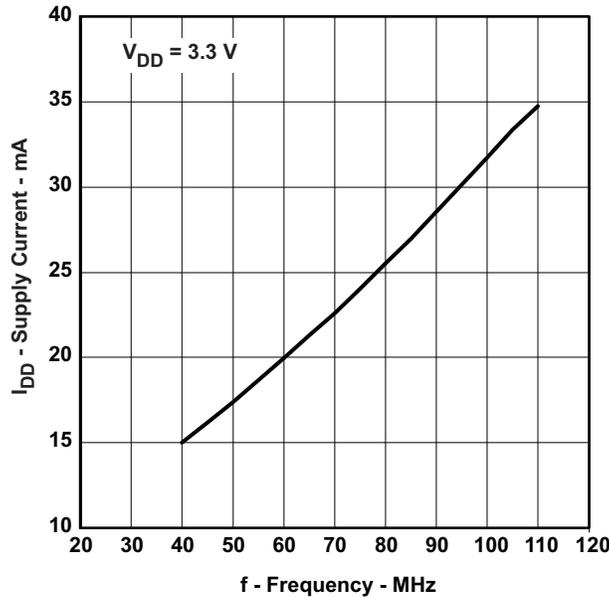


Figure 1.  $I_{DD}$  vs. Input Frequency,  $V_{DD} = 3.3V$

## APPLICATION INFORMATION

### SSC MODULATION

The exact implementation of the SSC modulation plays a vital role for the EMI reduction. The CDCS501 uses a triangular modulation scheme implemented in a way that the modulation frequency depends on the VCO frequency of the internal PLL and the spread amount is independent from the VCO frequency.

The modulation frequency can be calculated by using the below formula.

$$f_{\text{mod}} = f_{\text{IN}} / 2480$$

### PARAMETER MEASUREMENT INFORMATION

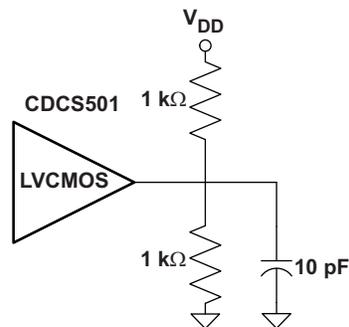


Figure 2. Test Load

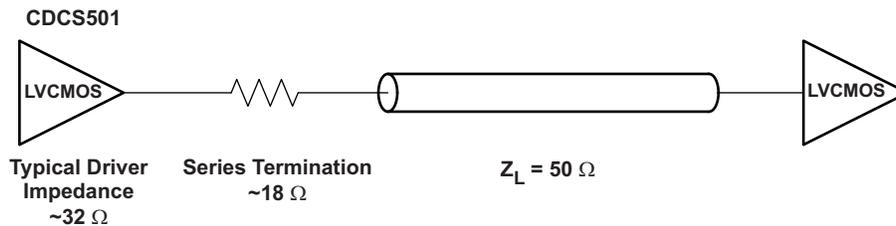


Figure 3. Test Load for 50-Ω Board Environment

**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
CDCS501PW	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	CS501	<a href="#">Samples</a>
CDCS501PWR	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	CS501	<a href="#">Samples</a>

(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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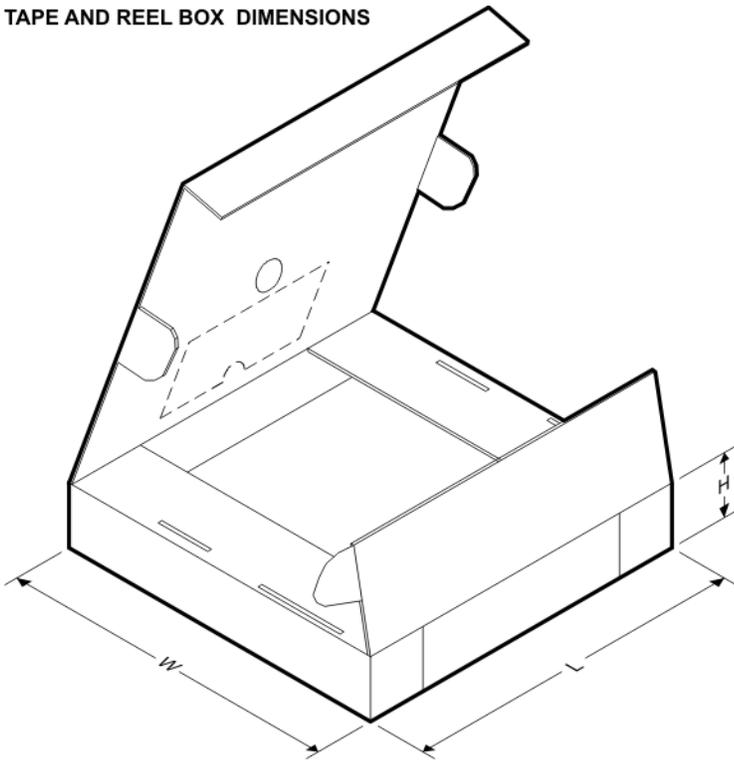
### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*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
CDCS501PWR	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)
CDCS501PWR	TSSOP	PW	8	2000	367.0	367.0	35.0

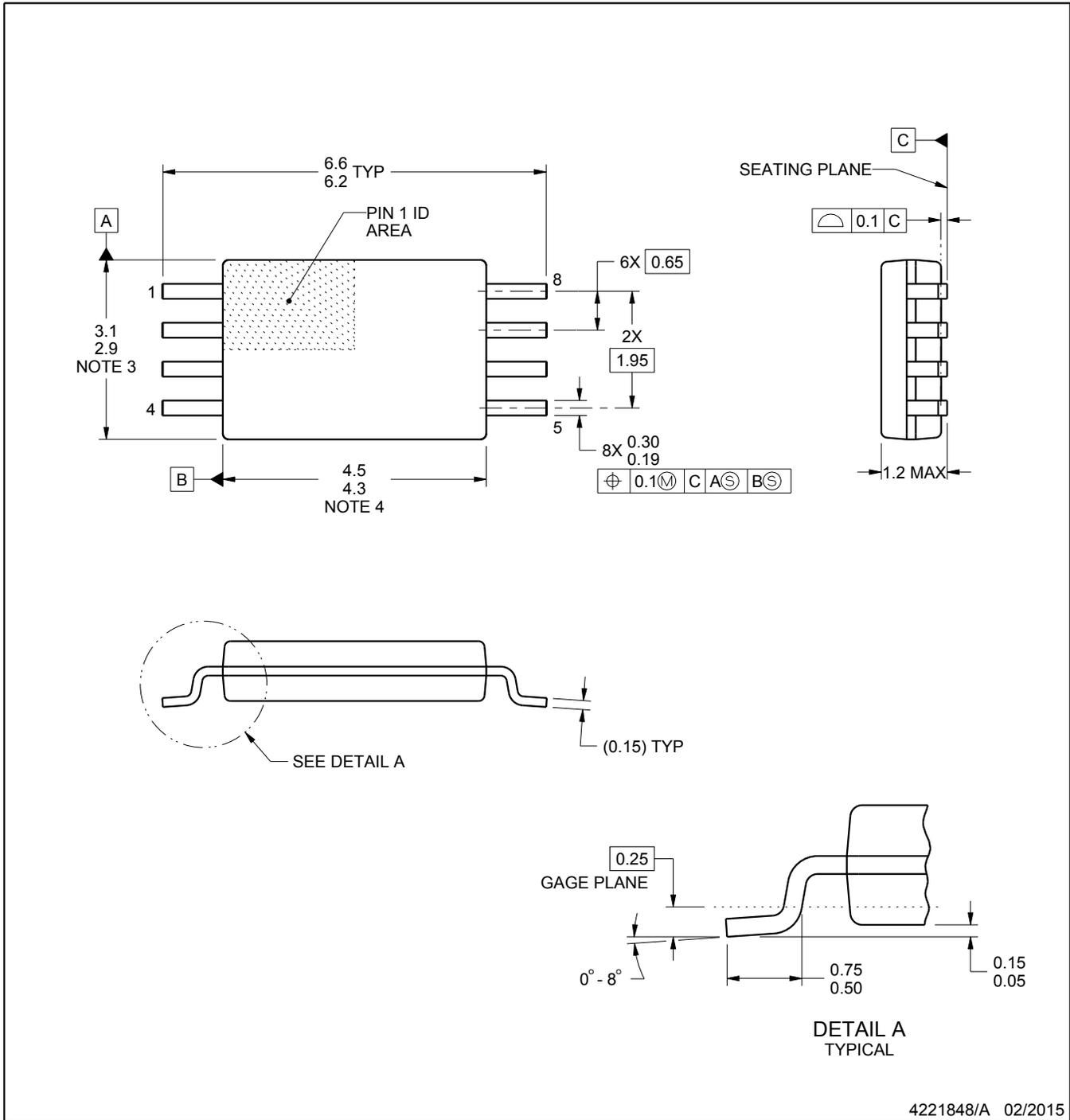
PW0008A



# PACKAGE OUTLINE

## TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



NOTES:

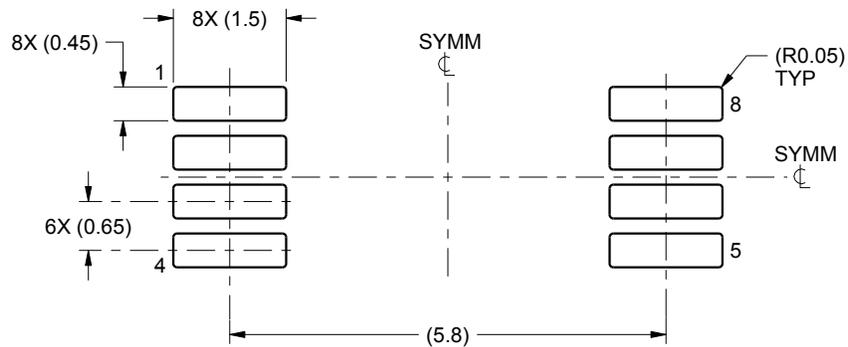
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or 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.

# EXAMPLE BOARD LAYOUT

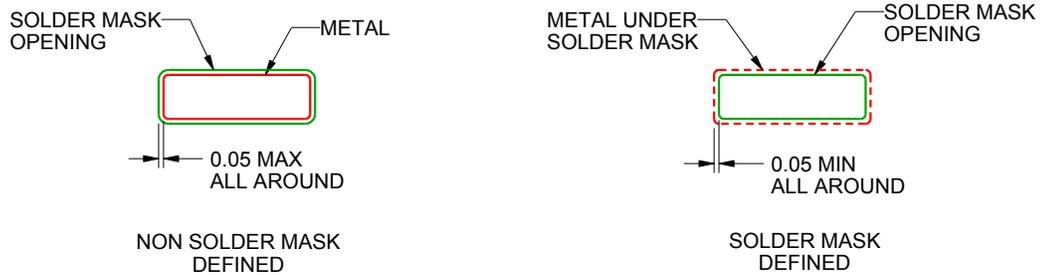
PW0008A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
SCALE:10X



SOLDER MASK DETAILS  
NOT TO SCALE

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NOTES: (continued)

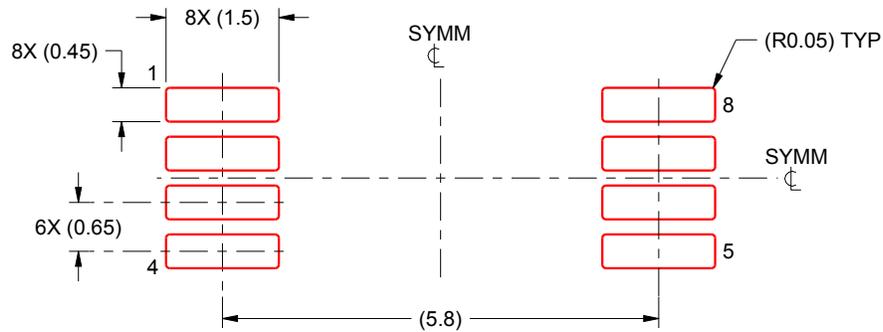
- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

PW0008A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

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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.

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