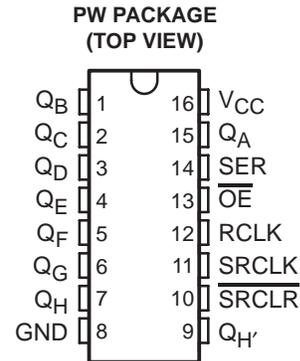


# SN74LV595A-EP 8-BIT SHIFT REGISTER WITH 3-STATE OUTPUT REGISTERS

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- **Controlled Baseline**
  - One Assembly/Test Site, One Fabrication Site
- **Enhanced Diminishing Manufacturing Sources (DMS) Support**
- **Enhanced Product-Change Notification**
- **Qualification Pedigree†**
- **2-V to 5.5-V  $V_{CC}$  Operation**
- **Max  $t_{pd}$  of 7.4 ns at 5 V**
- **Typical  $V_{OLP}$  (Output Ground Bounce) <0.8 V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$**
- **Typical  $V_{OHV}$  (Output  $V_{OH}$  Undershoot) >2.3 V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$**
- **Supports Mixed-Mode Voltage Operation on All Ports**
- **8-Bit Serial-In, Parallel-Out Shift**
- **$I_{off}$  Supports Partial-Power-Down Mode Operation**
- **Shift Register Has Direct Clear**

† Component qualification in accordance with JEDEC and industry standards to ensure reliable operation over an extended temperature range. This includes, but is not limited to, Highly Accelerated Stress Test (HAST) or biased 85/85, temperature cycle, autoclave or unbiased HAST, electromigration, bond intermetallic life, and mold compound life. Such qualification testing should not be viewed as justifying use of this component beyond specified performance and environmental limits.



## description/ordering information

The SN74LV595A is an 8-bit shift register designed for 2-V to 5.5-V  $V_{CC}$  operation.

This device contains an 8-bit serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. The storage register has parallel 3-state outputs. Separate clocks are provided for both the shift and storage register. The shift register has a direct overriding clear ( $\overline{SRCLR}$ ) input, serial (SER) input, and a serial output for cascading. When the output-enable ( $\overline{OE}$ ) input is high, all outputs except  $Q_{H'}$  are in the high-impedance state.

Both the shift register clock (SRCLK) and storage register clock (RCLK) are positive-edge triggered. If both clocks are connected together, the shift register always is one clock pulse ahead of the storage register.

To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The 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.

## ORDERING INFORMATION

$T_A$	PACKAGE‡		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	TSSOP – PW	Reel of 2000	SN74LV595AIPWREP	LV595EP

‡ Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).



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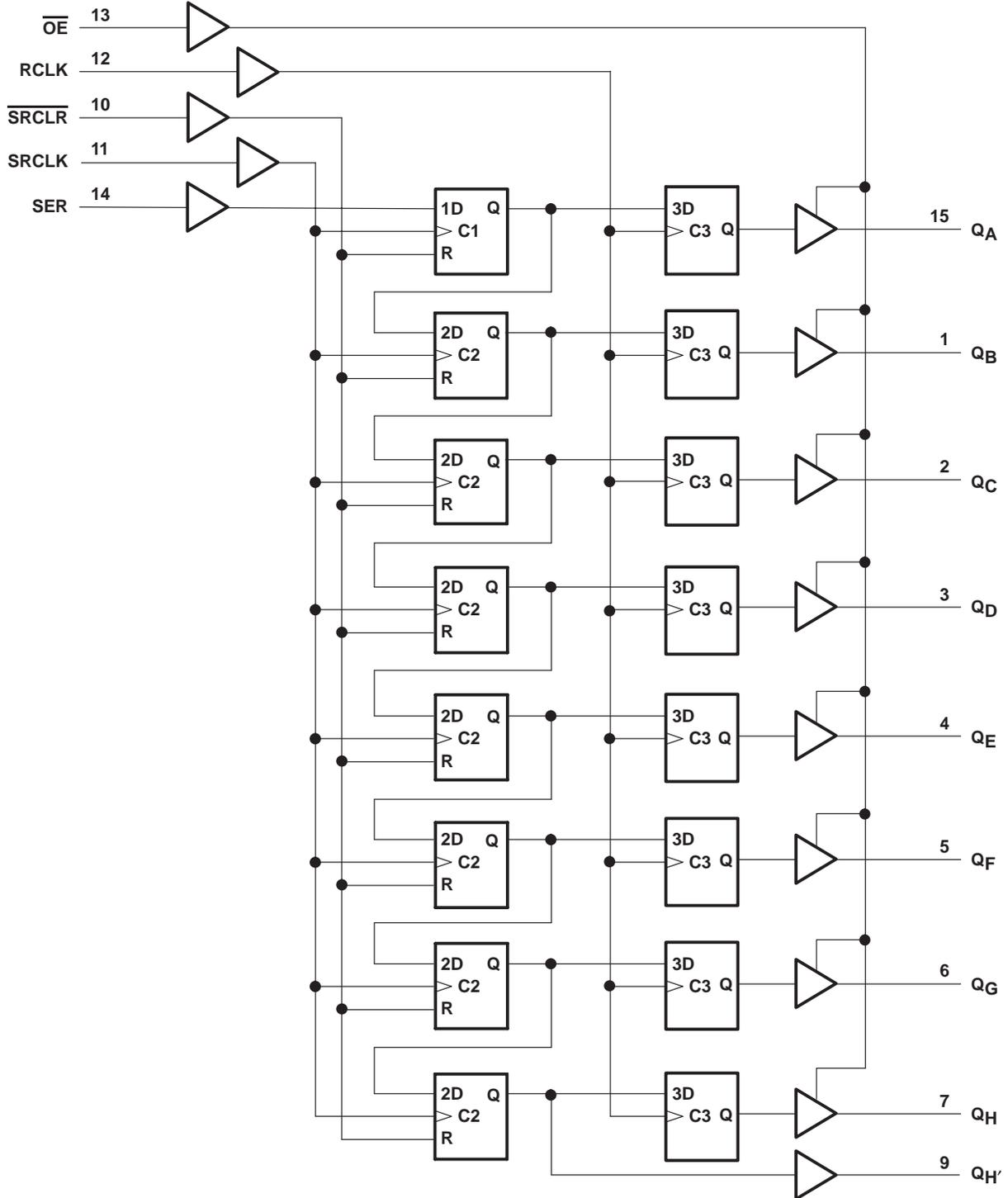
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**FUNCTION TABLE**

INPUTS					FUNCTION
SER	SRCLK	SRCLR	RCLK	OE	
X	X	X	X	H	Outputs Q <sub>A</sub> –Q <sub>H</sub> are disabled.
X	X	X	X	L	Outputs Q <sub>A</sub> –Q <sub>H</sub> are enabled.
X	X	L	X	X	Shift register is cleared.
L	↑	H	X	X	First stage of the shift register goes low. Other stages store the data of previous stage, respectively.
H	↑	H	X	X	First stage of the shift register goes high. Other stages store the data of previous stage, respectively.
X	↓	H	X	X	Shift-register state is not changed.
X	X	X	↑	X	Shift-register data is stored in the storage register.
X	X	X	↓	X	Storage-register state is not changed.

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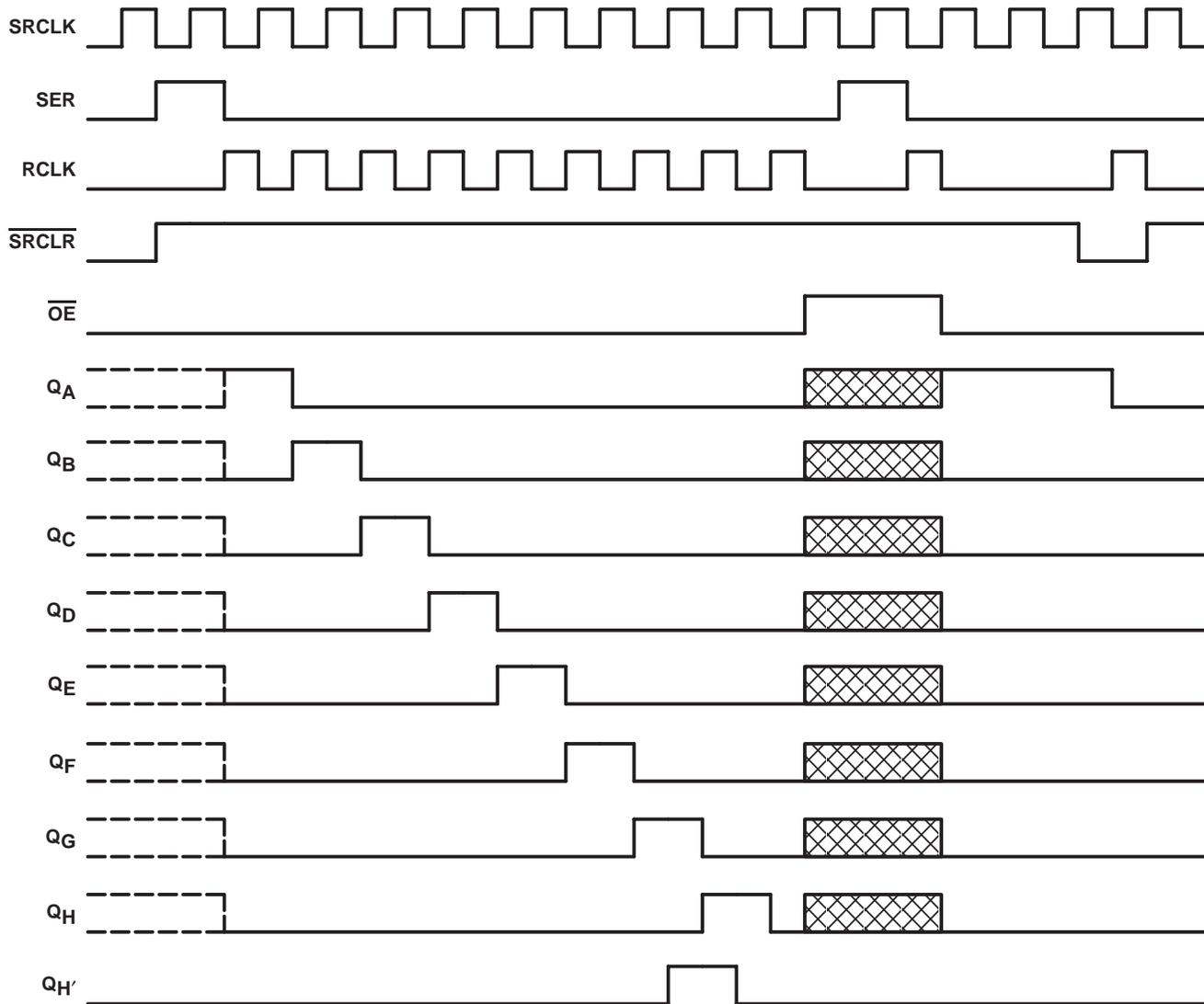
logic diagram (positive logic)



# SN74LV595A-EP 8-BIT SHIFT REGISTER WITH 3-STATE OUTPUT REGISTERS

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## timing diagram



**SN74LV595A-EP**  
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**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†**

Supply voltage range, $V_{CC}$ .....	–0.5 V to 7 V
Input voltage range, $V_I$ (see Note 1) .....	–0.5 V to 7 V
Voltage range applied to any output in the high-impedance or power-off state, $V_O$ (see Note 1) .....	–0.5 V to 7 V
Output voltage range applied in the high or low state, $V_O$ (see Notes 1 and 2) .....	–0.5 V to $V_{CC} + 0.5$ V
Input clamp current, $I_{IK}$ ( $V_I < 0$ ) .....	–20 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ ) .....	–50 mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) .....	±35 mA
Continuous current through $V_{CC}$ or GND .....	±70 mA
Package thermal impedance, $\theta_{JA}$ (see Note 3) .....	108°C/W
Storage temperature range, $T_{stg}$ .....	–65°C to 150°C

† 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.

- NOTES: 1. The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.  
2. This value is limited to 5.5 V maximum.  
3. The package thermal impedance is calculated in accordance with JESD 51-7.

**recommended operating conditions (see Note 4)**

		MIN	MAX	UNIT	
$V_{CC}$	Supply voltage	2	5.5	V	
$V_{IH}$	High-level input voltage	$V_{CC} = 2$ V	1.5	V	
		$V_{CC} = 2.3$ V to 2.7 V	$V_{CC} \times 0.7$		
		$V_{CC} = 3$ V to 3.6 V	$V_{CC} \times 0.7$		
		$V_{CC} = 4.5$ V to 5.5 V	$V_{CC} \times 0.7$		
$V_{IL}$	Low-level input voltage	$V_{CC} = 2$ V	0.5	V	
		$V_{CC} = 2.3$ V to 2.7 V	$V_{CC} \times 0.3$		
		$V_{CC} = 3$ V to 3.6 V	$V_{CC} \times 0.3$		
		$V_{CC} = 4.5$ V to 5.5 V	$V_{CC} \times 0.3$		
$V_I$	Input voltage	0	5.5	V	
$V_O$	Output voltage	High or low state	0	$V_{CC}$	V
		3-state	0	5.5	
$I_{OH}$	High-level output current	$V_{CC} = 2$ V	–50	μA	
		$V_{CC} = 2.3$ V to 2.7 V	–2	mA	
		$V_{CC} = 3$ V to 3.6 V	–8		
		$V_{CC} = 4.5$ V to 5.5 V	–16		
$I_{OL}$	Low-level output current	$V_{CC} = 2$ V	50	μA	
		$V_{CC} = 2.3$ V to 2.7 V	2	mA	
		$V_{CC} = 3$ V to 3.6 V	8		
		$V_{CC} = 4.5$ V to 5.5 V	16		
$\Delta t/\Delta v$	Input transition rise or fall rate	$V_{CC} = 2.3$ V to 2.7 V	200	ns/V	
		$V_{CC} = 3$ V to 3.6 V	100		
		$V_{CC} = 4.5$ V to 5.5 V	20		
$T_A$	Operating free-air temperature	–40	85	°C	

NOTE 4: All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.



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

PARAMETER		TEST CONDITIONS	V <sub>CC</sub>	MIN	TYP	MAX	UNIT
V <sub>OH</sub>		I <sub>OH</sub> = -50 μA	2 V to 5.5 V	V <sub>CC</sub> -0.1			V
		I <sub>OH</sub> = -2 mA	2.3 V	2			
	Q <sub>H</sub> '	I <sub>OH</sub> = -6 mA	3 V	2.48			
	Q <sub>A</sub> -Q <sub>H</sub>	I <sub>OH</sub> = -8 mA		2.48			
	Q <sub>H</sub> '	I <sub>OH</sub> = -12 mA	4.5 V	3.8			
	Q <sub>A</sub> -Q <sub>H</sub>	I <sub>OH</sub> = -16 mA		3.8			
V <sub>OL</sub>		I <sub>OL</sub> = 50 μA	2 V to 5.5 V	0.1			V
		I <sub>OL</sub> = 2 mA	2.3 V	0.4			
	Q <sub>H</sub> '	I <sub>OL</sub> = 6 mA	3 V	0.44			
	Q <sub>A</sub> -Q <sub>H</sub>	I <sub>OL</sub> = 8 mA		0.44			
	Q <sub>H</sub> '	I <sub>OL</sub> = 12 mA	4.5 V	0.55			
	Q <sub>A</sub> -Q <sub>H</sub>	I <sub>OL</sub> = 16 mA		0.55			
I <sub>I</sub>		V <sub>I</sub> = 5.5 V or GND	0 to 5.5 V	±1			μA
I <sub>OZ</sub>		V <sub>O</sub> = V <sub>CC</sub> or GND	5.5 V	±5			μA
I <sub>CC</sub>		V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0	5.5 V	20			μA
I <sub>off</sub>		V <sub>I</sub> or V <sub>O</sub> = 0 to 5.5 V	0	5			μA
C <sub>i</sub>		V <sub>I</sub> = V <sub>CC</sub> or GND	3.3 V	3.5			pF

timing requirements over recommended operating free-air temperature range, V<sub>CC</sub> = 2.5 V ± 0.2 V (unless otherwise noted) (see Figure 1)

		T <sub>A</sub> = 25°C		MIN	MAX	UNIT
		MIN	MAX			
t <sub>w</sub>	Pulse duration	SRCLK high or low	7	7.5		ns
		RCLK high or low	7	7.5		
		SRCLR low	6	6.5		
t <sub>su</sub>	Setup time	SER before SRCLK↑	5.5	5.5		ns
		SRCLK↑ before RCLK↑†	8	9		
		SRCLR low before RCLK↑	8.5	9.5		
		SRCLR high (inactive) before SRCLK↑	4	4		
t <sub>h</sub>	Hold time	SER after SRCLK↑	1.5	1.5		ns

† This setup time allows the storage register to receive stable data from the shift register. The clocks can be tied together, in which case the shift register is one clock pulse ahead of the storage register.



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

		$T_A = 25^\circ\text{C}$		MIN	MAX	UNIT
		MIN	MAX			
$t_w$	Pulse duration	SRCLK high or low	5.5	5.5	ns	
		RCLK high or low	5.5	5.5		
		$\overline{\text{SRCLR}}$ low	5	5		
$t_{su}$	Setup time	SER before SRCLK $\uparrow$	3.5	3.5	ns	
		SRCLK $\uparrow$ before RCLK $\uparrow$ $\dagger$	8	8.5		
		$\overline{\text{SRCLR}}$ low before RCLK $\uparrow$	8	9		
		$\overline{\text{SRCLR}}$ high (inactive) before SRCLK $\uparrow$	3	3		
$t_h$	Hold time	SER after SRCLK $\uparrow$	1.5	1.5	ns	

$\dagger$  This setup time allows the storage register to receive stable data from the shift register. The clocks can be tied together, in which case the shift register is one clock pulse ahead of the storage register.

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

		$T_A = 25^\circ\text{C}$		MIN	MAX	UNIT
		MIN	MAX			
$t_w$	Pulse duration	SRCLK high or low	5	5	ns	
		RCLK high or low	5	5		
		$\overline{\text{SRCLR}}$ low	5.2	5.2		
$t_{su}$	Setup time	SER before SRCLK $\uparrow$	3	3	ns	
		SRCLK $\uparrow$ before RCLK $\uparrow$ $\dagger$	5	5		
		$\overline{\text{SRCLR}}$ low before RCLK $\uparrow$	5	5		
		$\overline{\text{SRCLR}}$ high (inactive) before SRCLK $\uparrow$	2.5	2.5		
$t_h$	Hold time	SER after SRCLK $\uparrow$	2	2	ns	

$\dagger$  This setup time allows the storage register to receive stable data from the shift register. The clocks can be tied together, in which case the shift register is one clock pulse ahead of the storage register.

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			MIN	MAX	UNIT
				MIN	TYP	MAX			
$f_{\text{max}}$			$C_L = 15\text{ pF}$	65	80		45		MHz
			$C_L = 50\text{ pF}$	60	70		40		
$t_{\text{PLH}}$	RCLK	$Q_A-Q_H$	$C_L = 15\text{ pF}$		8.4	14.2	1	15.8	ns
$t_{\text{PHL}}$					8.4	14.2	1	15.8	
$t_{\text{PLH}}$	SRCLK	$Q_H'$			9.4	19.6	1	22.2	
$t_{\text{PHL}}$					9.4	19.6	1	22.2	
$t_{\text{PHL}}$	$\overline{\text{SRCLR}}$	$Q_H'$			8.7	14.6	1	16.3	
$t_{\text{PZH}}$	$\overline{\text{OE}}$	$Q_A-Q_H$			8.2	13.9	1	15	
$t_{\text{PZL}}$					10.9	18.1	1	20.3	
$t_{\text{PHZ}}$	$\overline{\text{OE}}$	$Q_A-Q_H$			8.3	13.7	1	15.6	
$t_{\text{PLZ}}$					9.2	15.2	1	16.7	
$t_{\text{PLH}}$	RCLK	$Q_A-Q_H$		$C_L = 50\text{ pF}$		11.2	17.2	1	
$t_{\text{PHL}}$					11.2	17.2	1	19.3	
$t_{\text{PLH}}$	SRCLK	$Q_H'$			13.1	22.5	1	25.5	
$t_{\text{PHL}}$					13.1	22.5	1	25.5	
$t_{\text{PHL}}$	$\overline{\text{SRCLR}}$	$Q_H'$			12.4	18.8	1	21.1	
$t_{\text{PZH}}$	$\overline{\text{OE}}$	$Q_A-Q_H$			10.8	17	1	18.3	
$t_{\text{PZL}}$					13.4	21	1	23	
$t_{\text{PHZ}}$	$\overline{\text{OE}}$	$Q_A-Q_H$			12.2	18.3	1	19.5	
$t_{\text{PLZ}}$					14	20.9	1	22.6	

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			MIN	MAX	UNIT
				MIN	TYP	MAX			
$f_{\text{max}}$			$C_L = 15\text{ pF}$	80	120		70		MHz
			$C_L = 50\text{ pF}$	55	105		50		
$t_{\text{PLH}}$	RCLK	$Q_A-Q_H$	$C_L = 15\text{ pF}$		6	11.9	1	13.5	ns
$t_{\text{PHL}}$					6	11.9	1	13.5	
$t_{\text{PLH}}$	SRCLK	$Q_H'$			6.6	13	1	15	
$t_{\text{PHL}}$					6.6	13	1	15	
$t_{\text{PHL}}$	$\overline{\text{SRCLR}}$	$Q_H'$			6.2	12.8	1	13.7	
$t_{\text{PZH}}$	$\overline{\text{OE}}$	$Q_A-Q_H$			6	11.5	1	13.5	
$t_{\text{PZL}}$					7.8	11.5	1	13.5	
$t_{\text{PHZ}}$	$\overline{\text{OE}}$	$Q_A-Q_H$			6.1	14.7	1	15.2	
$t_{\text{PLZ}}$					6.3	14.7	1	15.2	
$t_{\text{PLH}}$	RCLK	$Q_A-Q_H$		$C_L = 50\text{ pF}$		7.9	15.4	1	
$t_{\text{PHL}}$					7.9	15.4	1	17	
$t_{\text{PLH}}$	SRCLK	$Q_H'$			9.2	16.5	1	18.5	
$t_{\text{PHL}}$					9.2	16.5	1	18.5	
$t_{\text{PHL}}$	$\overline{\text{SRCLR}}$	$Q_H'$			9	16.3	1	17.2	
$t_{\text{PZH}}$	$\overline{\text{OE}}$	$Q_A-Q_H$			7.8	15	1	17	
$t_{\text{PZL}}$					9.6	15	1	17	
$t_{\text{PHZ}}$	$\overline{\text{OE}}$	$Q_A-Q_H$			8.1	15.7	1	16.2	
$t_{\text{PLZ}}$					9.3	15.7	1	16.2	

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			MIN	MAX	UNIT
				MIN	TYP	MAX			
$f_{\text{max}}$			$C_L = 15\text{ pF}$	135	170		115		MHz
			$C_L = 50\text{ pF}$	120	140		95		
$t_{\text{PLH}}$	RCLK	$Q_A-Q_H$	$C_L = 15\text{ pF}$		4.3	7.4	1	8.5	ns
$t_{\text{PHL}}$					4.3	7.4	1	8.5	
$t_{\text{PLH}}$	SRCLK	$Q_{H'}$			4.5	8.2	1	9.4	
$t_{\text{PHL}}$					4.5	8.2	1	9.4	
$t_{\text{PHL}}$	$\overline{\text{SRCLR}}$	$Q_{H'}$			4.5	8	1	9.1	
$t_{\text{PZH}}$	$\overline{\text{OE}}$	$Q_A-Q_H$			4.3	8.6	1	10	
$t_{\text{PZL}}$					5.4	8.6	1	10	
$t_{\text{PHZ}}$	$\overline{\text{OE}}$	$Q_A-Q_H$			2.4	6	1	7.1	
$t_{\text{PLZ}}$					2.7	5.1	1	7.2	
$t_{\text{PLH}}$	RCLK	$Q_A-Q_H$		$C_L = 50\text{ pF}$		5.6	9.4	1	
$t_{\text{PHL}}$					5.6	9.4	1	10.5	
$t_{\text{PLH}}$	SRCLK	$Q_{H'}$			6.4	10.2	1	11.4	
$t_{\text{PHL}}$					6.4	10.2	1	11.4	
$t_{\text{PHL}}$	$\overline{\text{SRCLR}}$	$Q_{H'}$			6.4	10	1	11.1	
$t_{\text{PZH}}$	$\overline{\text{OE}}$	$Q_A-Q_H$			5.7	10.6	1	12	
$t_{\text{PZL}}$					6.8	10.6	1	12	
$t_{\text{PHZ}}$	$\overline{\text{OE}}$	$Q_A-Q_H$			3.5	10.3	1	11	
$t_{\text{PLZ}}$					3.4	10.3	1	11	

noise characteristics,  $V_{CC} = 3.3\text{ V}$ ,  $C_L = 50\text{ pF}$ ,  $T_A = 25^\circ\text{C}$  (see Note 5)

PARAMETER		MIN	TYP	MAX	UNIT
$V_{OL(P)}$	Quiet output, maximum dynamic $V_{OL}$		0.3		V
$V_{OL(V)}$	Quiet output, minimum dynamic $V_{OL}$		-0.2		V
$V_{OH(V)}$	Quiet output, minimum dynamic $V_{OH}$		2.8		V
$V_{IH(D)}$	High-level dynamic input voltage	2.31			V
$V_{IL(D)}$	Low-level dynamic input voltage			0.99	V

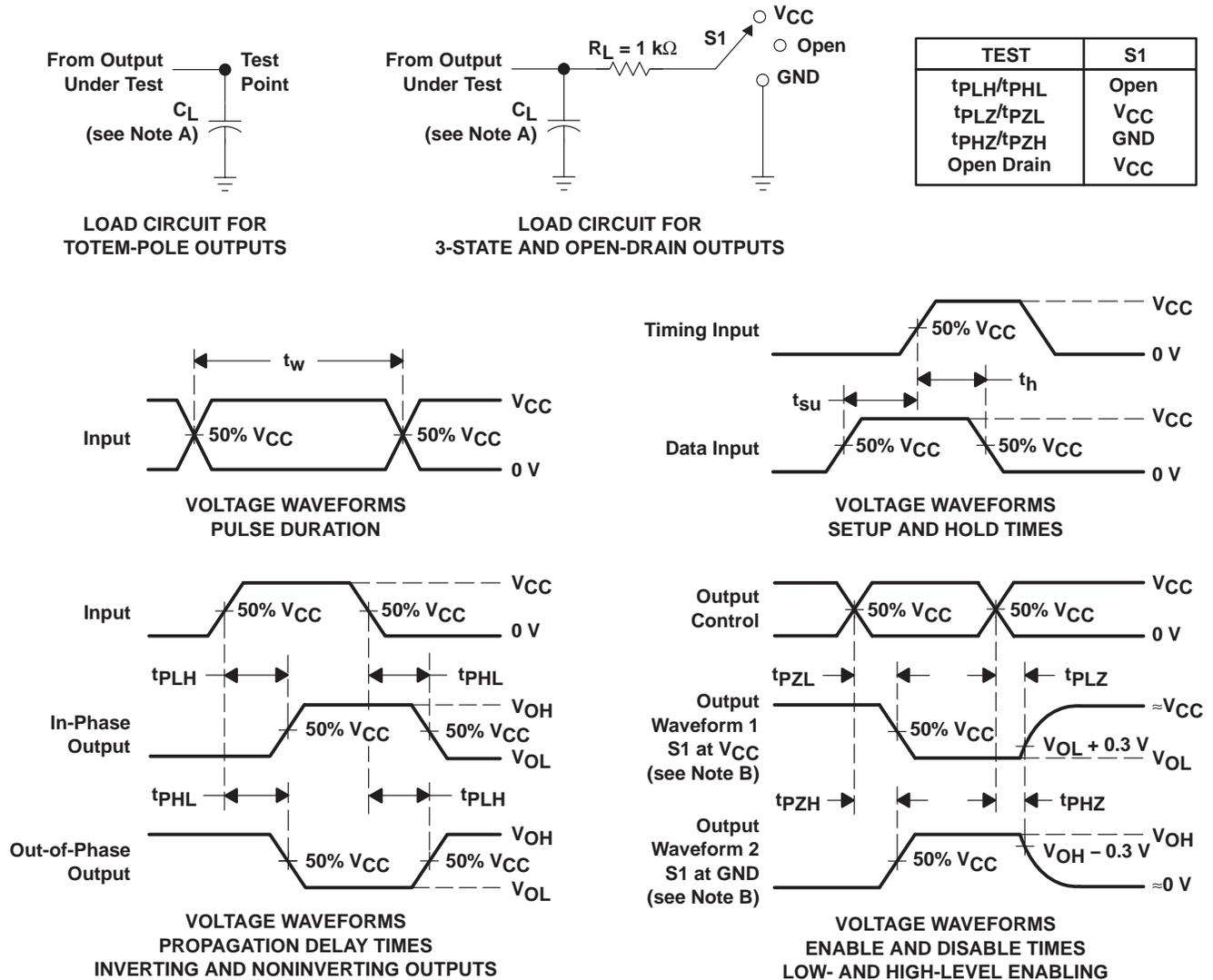
NOTE 5: Characteristics are for surface-mount packages only.

operating characteristics,  $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	$V_{CC}$	TYP	UNIT
$C_{\text{pd}}$	Power dissipation capacitance	$C_L = 50\text{ pF}$ , $f = 10\text{ MHz}$	3.3 V	111	pF
			5 V	114	



**PARAMETER MEASUREMENT INFORMATION**



- 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:  $PRR \leq 1$  MHz,  $Z_O = 50 \Omega$ ,  $t_r \leq 3$  ns,  $t_f \leq 3$  ns.
  - D. The outputs are measured one at a time, with one input 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.  $t_{PHL}$  and  $t_{PLH}$  are the same as  $t_{pd}$ .
  - H. All parameters and waveforms are not applicable to all devices.

**Figure 1. Load Circuit and Voltage Waveforms**

**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)
<a href="#">SN74LV595AIPWREP</a>	Obsolete	Production	TSSOP (PW)   16	-	-	Call TI	Call TI	-40 to 85	LV595EP

(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.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

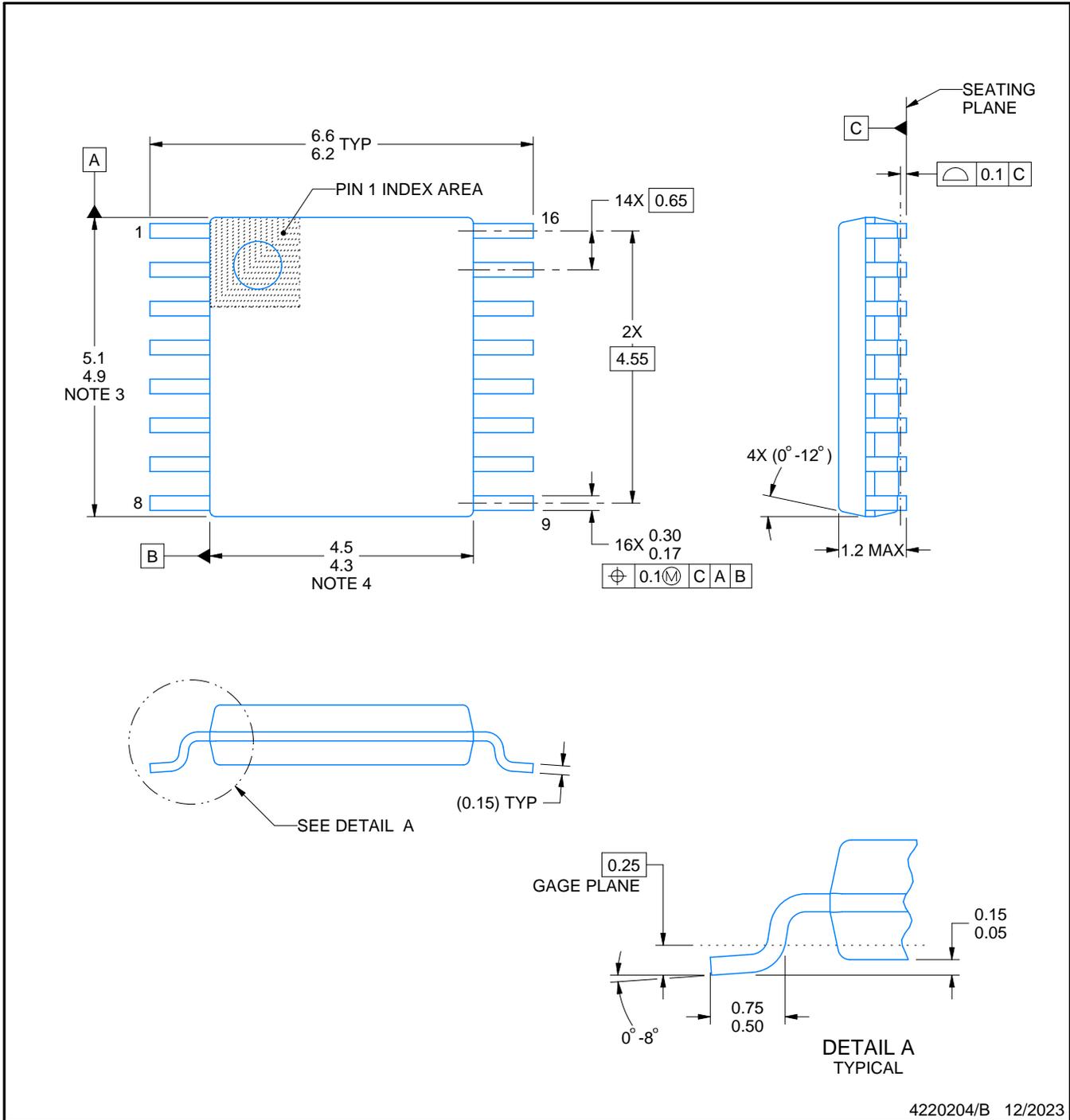
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF SN74LV595A-EP :**

- Catalog : [SN74LV595A](#)
- Automotive : [SN74LV595A-Q1](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects



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NOTES:

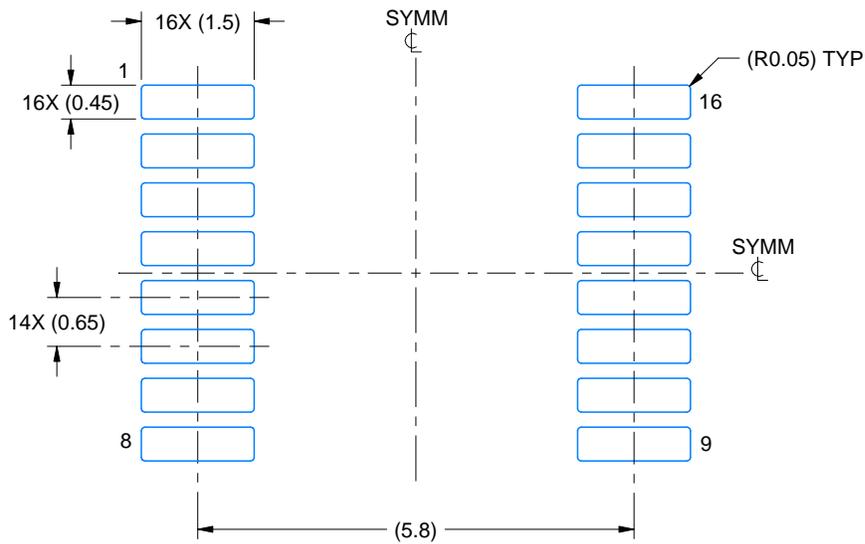
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

# EXAMPLE BOARD LAYOUT

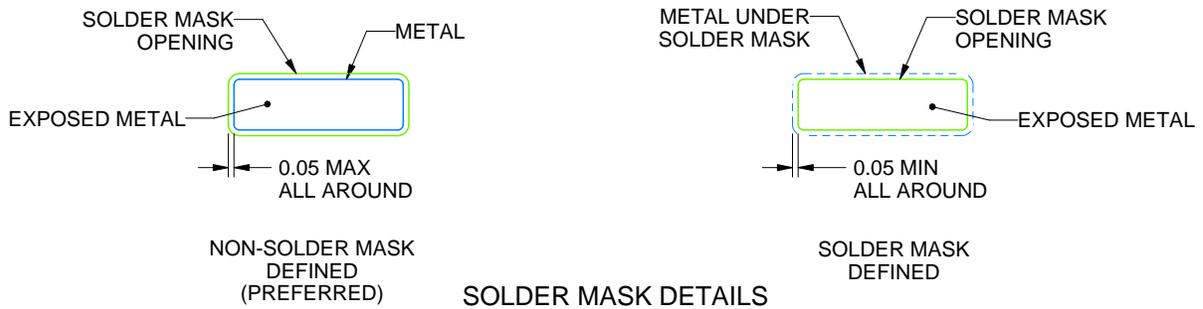
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



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NOTES: (continued)

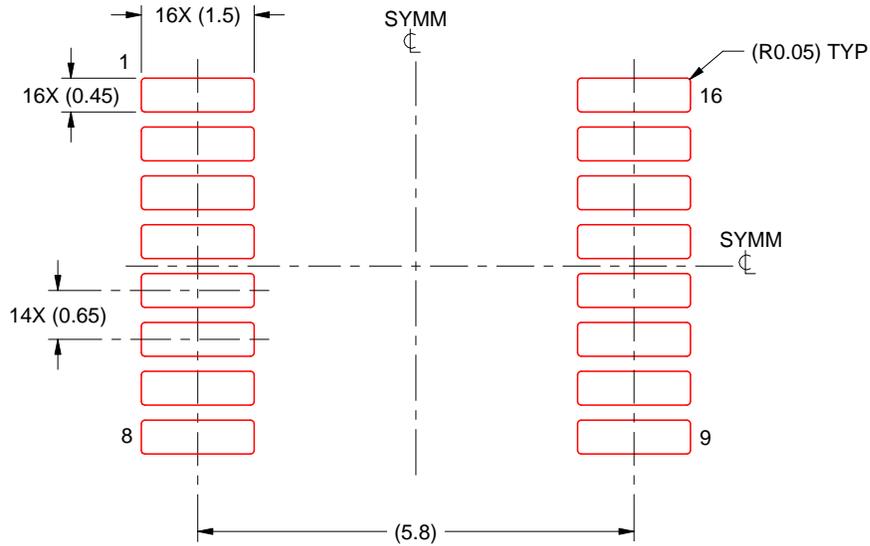
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

PW0016A

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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