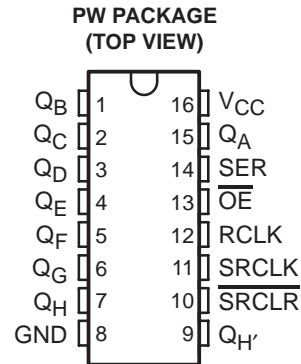


SN74LV595A-EP
8-BIT SHIFT REGISTER
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- **Controlled Baseline**
 - One Assembly/Test Site, One Fabrication Site
- **Enhanced Diminishing Manufacturing Sources (DMS) Support**
- **Enhanced Product-Change Notification**
- **Qualification Pedigree†**
- **2-V 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 $V_{CC} = 3.3 V, T_A = 25^\circ C$**
- **Typical V_{OHV} (Output V_{OH} Undershoot) >2.3 V at $V_{CC} = 3.3 V, T_A = 25^\circ C$**
- **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.



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.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



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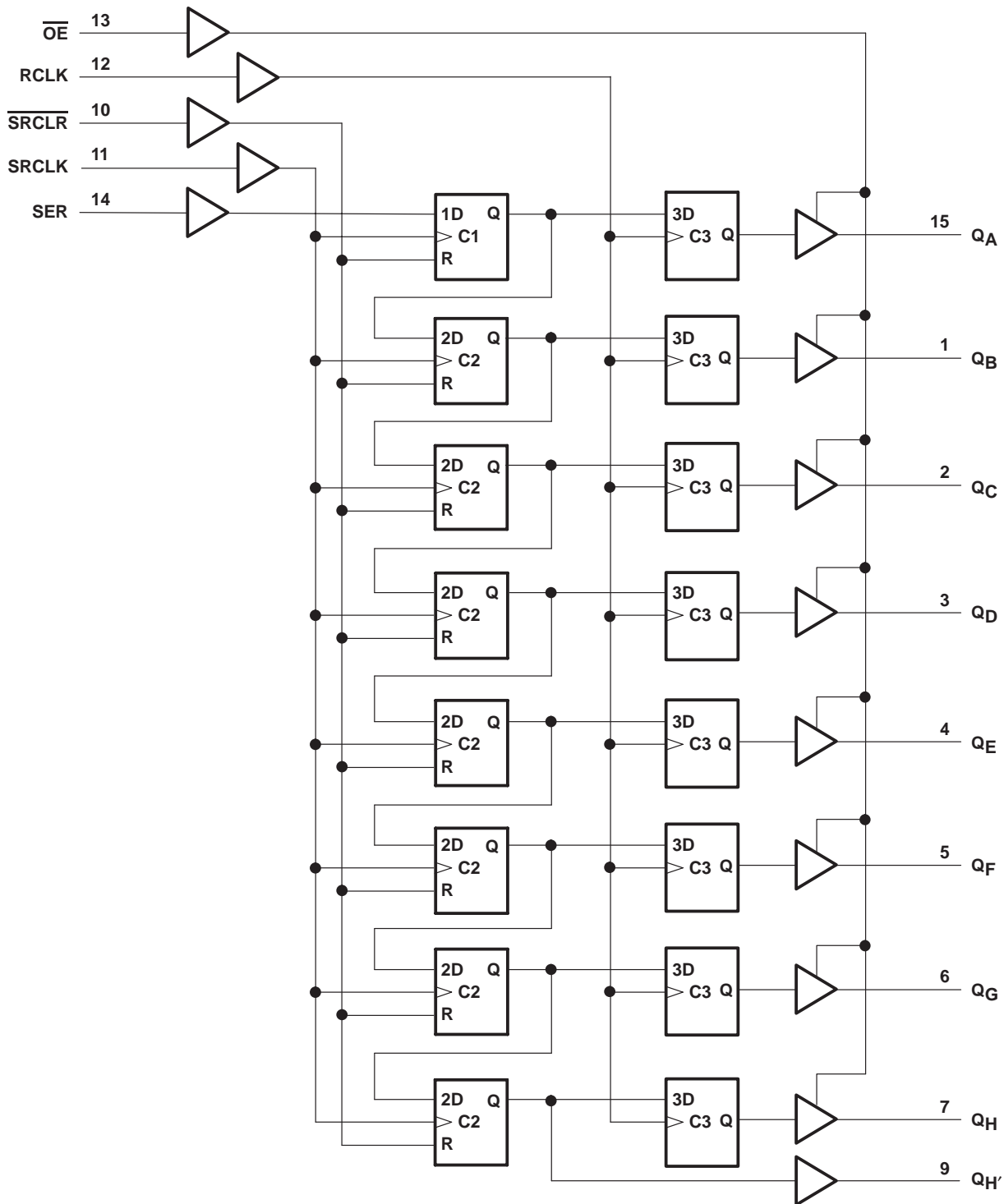
FUNCTION TABLE

INPUTS					FUNCTION
SER	SRCLK	SRCLR	RCLK	OE	
X	X	X	X	H	Outputs Q _A –Q _H are disabled.
X	X	X	X	L	Outputs Q _A –Q _H 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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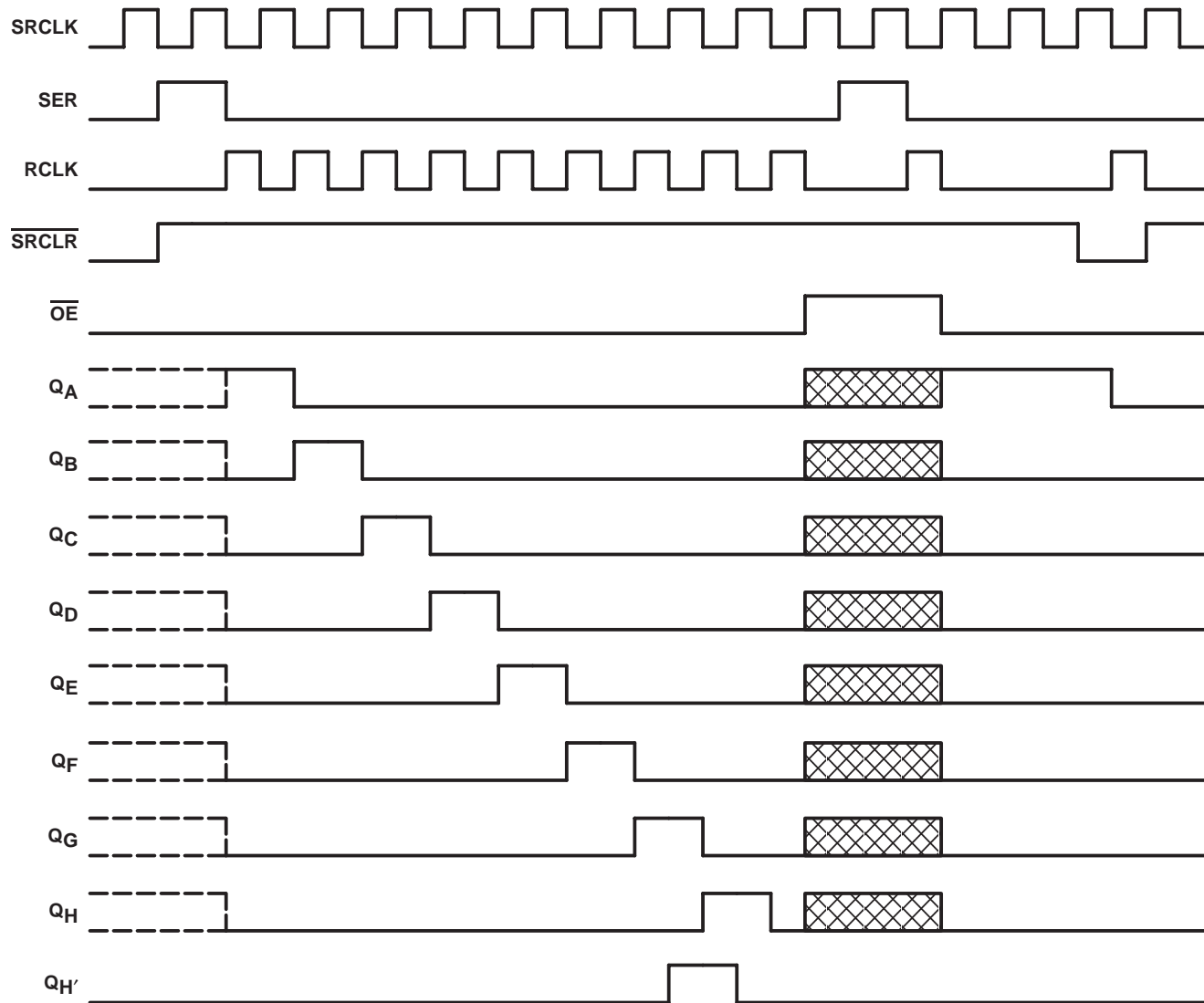
logic diagram (positive logic)



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

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timing diagram



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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, θ_{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 _{CC}	MIN	TYP	MAX	UNIT
V _{OH}		I _{OH} = -50 μA	2 V to 5.5 V	V _{CC} -0.1			V
		I _{OH} = -2 mA	2.3 V	2			
	Q _H '	I _{OH} = -6 mA	3 V	2.48			
	Q _A -Q _H	I _{OH} = -8 mA		2.48			
	Q _H '	I _{OH} = -12 mA	4.5 V	3.8			
	Q _A -Q _H	I _{OH} = -16 mA		3.8			
V _{OL}		I _{OL} = 50 μA	2 V to 5.5 V	0.1			V
		I _{OL} = 2 mA	2.3 V	0.4			
	Q _H '	I _{OL} = 6 mA	3 V	0.44			
	Q _A -Q _H	I _{OL} = 8 mA		0.44			
	Q _H '	I _{OL} = 12 mA	4.5 V	0.55			
	Q _A -Q _H	I _{OL} = 16 mA		0.55			
I _I		V _I = 5.5 V or GND	0 to 5.5 V	±1			μA
I _{OZ}		V _O = V _{CC} or GND	5.5 V	±5			μA
I _{CC}		V _I = V _{CC} or GND, I _O = 0	5.5 V	20			μA
I _{off}		V _I or V _O = 0 to 5.5 V	0	5			μA
C _i		V _I = V _{CC} or GND	3.3 V	3.5			pF

timing requirements over recommended operating free-air temperature range, V_{CC} = 2.5 V ± 0.2 V (unless otherwise noted) (see Figure 1)

		T _A = 25°C		MIN	MAX	UNIT
		MIN	MAX			
t _w	Pulse duration	SRCLK high or low	7	7.5		ns
		RCLK high or low	7	7.5		
		SRCLR low	6	6.5		
t _{su}	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 _h	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_{max}			$C_L = 15\text{ pF}$	65	80		45		MHz
			$C_L = 50\text{ pF}$	60	70		40		
t_{PLH}	RCLK	Q_A-Q_H	$C_L = 15\text{ pF}$		8.4	14.2	1	15.8	ns
t_{PHL}					8.4	14.2	1	15.8	
t_{PLH}	SRCLK	Q_H'			9.4	19.6	1	22.2	
t_{PHL}					9.4	19.6	1	22.2	
t_{PHL}	$\overline{\text{SRCLR}}$	Q_H'			8.7	14.6	1	16.3	
t_{PZH}	$\overline{\text{OE}}$	Q_A-Q_H			8.2	13.9	1	15	
t_{PZL}					10.9	18.1	1	20.3	
t_{PHZ}	$\overline{\text{OE}}$	Q_A-Q_H			8.3	13.7	1	15.6	
t_{PLZ}					9.2	15.2	1	16.7	
t_{PLH}	RCLK	Q_A-Q_H		$C_L = 50\text{ pF}$		11.2	17.2	1	
t_{PHL}					11.2	17.2	1	19.3	
t_{PLH}	SRCLK	Q_H'			13.1	22.5	1	25.5	
t_{PHL}					13.1	22.5	1	25.5	
t_{PHL}	$\overline{\text{SRCLR}}$	Q_H'			12.4	18.8	1	21.1	
t_{PZH}	$\overline{\text{OE}}$	Q_A-Q_H			10.8	17	1	18.3	
t_{PZL}					13.4	21	1	23	
t_{PHZ}	$\overline{\text{OE}}$	Q_A-Q_H			12.2	18.3	1	19.5	
t_{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_{max}			$C_L = 15\text{ pF}$	80	120		70		MHz
			$C_L = 50\text{ pF}$	55	105		50		
t_{PLH}	RCLK	Q_A-Q_H	$C_L = 15\text{ pF}$		6	11.9	1	13.5	ns
t_{PHL}					6	11.9	1	13.5	
t_{PLH}	SRCLK	Q_H'			6.6	13	1	15	
t_{PHL}					6.6	13	1	15	
t_{PHL}	$\overline{\text{SRCLR}}$	Q_H'			6.2	12.8	1	13.7	
t_{PZH}	$\overline{\text{OE}}$	Q_A-Q_H			6	11.5	1	13.5	
t_{PZL}					7.8	11.5	1	13.5	
t_{PHZ}	$\overline{\text{OE}}$	Q_A-Q_H			6.1	14.7	1	15.2	
t_{PLZ}					6.3	14.7	1	15.2	
t_{PLH}	RCLK	Q_A-Q_H		$C_L = 50\text{ pF}$		7.9	15.4	1	
t_{PHL}					7.9	15.4	1	17	
t_{PLH}	SRCLK	Q_H'			9.2	16.5	1	18.5	
t_{PHL}					9.2	16.5	1	18.5	
t_{PHL}	$\overline{\text{SRCLR}}$	Q_H'			9	16.3	1	17.2	
t_{PZH}	$\overline{\text{OE}}$	Q_A-Q_H			7.8	15	1	17	
t_{PZL}					9.6	15	1	17	
t_{PHZ}	$\overline{\text{OE}}$	Q_A-Q_H			8.1	15.7	1	16.2	
t_{PLZ}					9.3	15.7	1	16.2	

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8-BIT SHIFT REGISTER

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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_{max}			$C_L = 15\text{ pF}$	135	170		115		MHz
			$C_L = 50\text{ pF}$	120	140		95		
t_{PLH}	RCLK	Q_A-Q_H	$C_L = 15\text{ pF}$		4.3	7.4	1	8.5	ns
t_{PHL}					4.3	7.4	1	8.5	
t_{PLH}	SRCLK	$Q_{H'}$			4.5	8.2	1	9.4	
t_{PHL}					4.5	8.2	1	9.4	
t_{PHL}	$\overline{\text{SRCLR}}$	$Q_{H'}$			4.5	8	1	9.1	
t_{PZH}	$\overline{\text{OE}}$	Q_A-Q_H			4.3	8.6	1	10	
t_{PZL}					5.4	8.6	1	10	
t_{PHZ}	$\overline{\text{OE}}$	Q_A-Q_H			2.4	6	1	7.1	
t_{PLZ}					2.7	5.1	1	7.2	
t_{PLH}	RCLK	Q_A-Q_H		$C_L = 50\text{ pF}$		5.6	9.4	1	
t_{PHL}					5.6	9.4	1	10.5	
t_{PLH}	SRCLK	$Q_{H'}$			6.4	10.2	1	11.4	
t_{PHL}					6.4	10.2	1	11.4	
t_{PHL}	$\overline{\text{SRCLR}}$	$Q_{H'}$			6.4	10	1	11.1	
t_{PZH}	$\overline{\text{OE}}$	Q_A-Q_H			5.7	10.6	1	12	
t_{PZL}					6.8	10.6	1	12	
t_{PHZ}	$\overline{\text{OE}}$	Q_A-Q_H			3.5	10.3	1	11	
t_{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

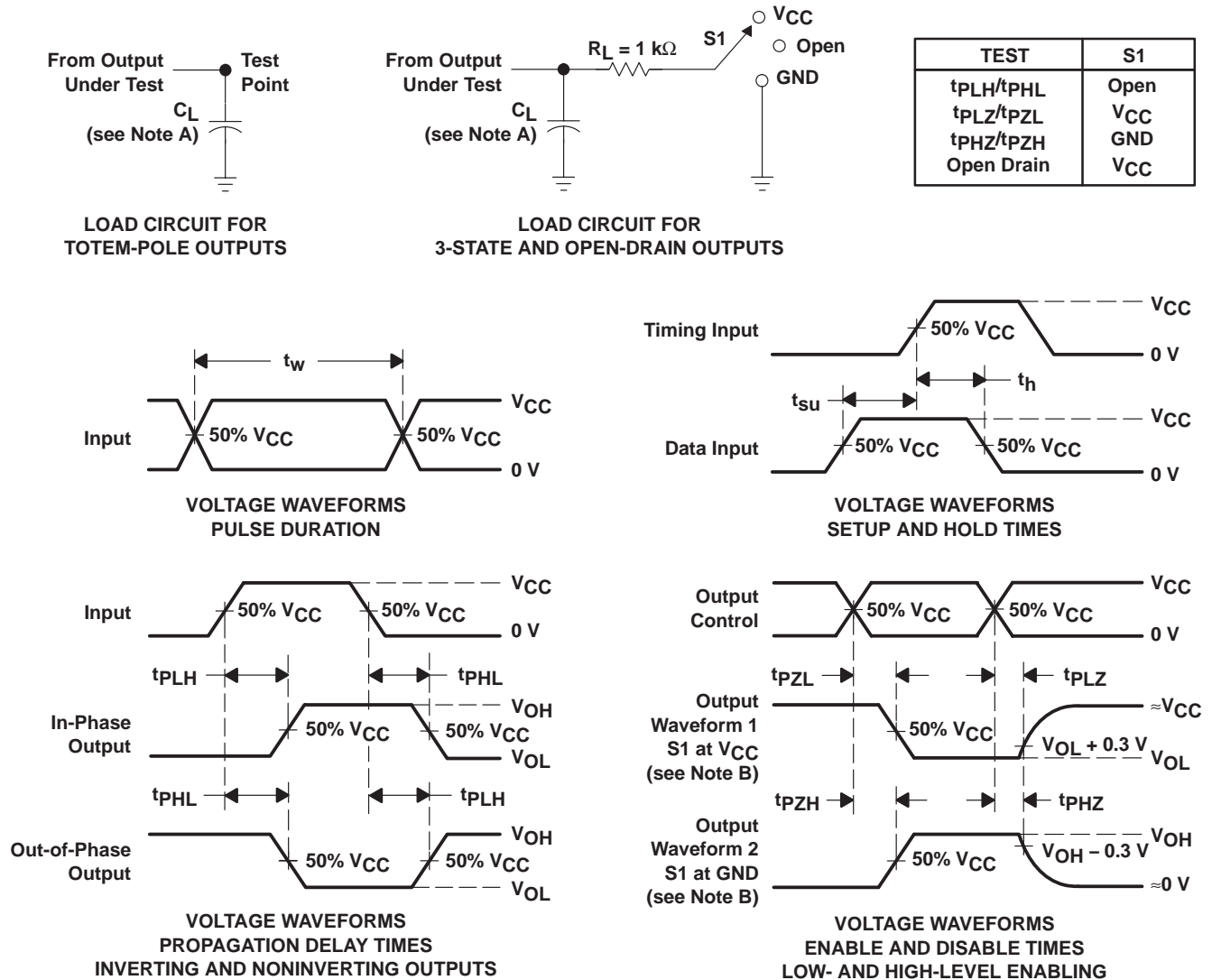
NOTE 5: Characteristics are for surface-mount packages only.

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

PARAMETER		TEST CONDITIONS	V_{CC}	TYP	UNIT
C_{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: $PRR \leq 1\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 3\text{ ns}$, $t_f \leq 3\text{ ns}$.
 - 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 Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN74LV595AIPWREP	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
V62/04696-01XE	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	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.

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 SN74LV595A-EP :

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

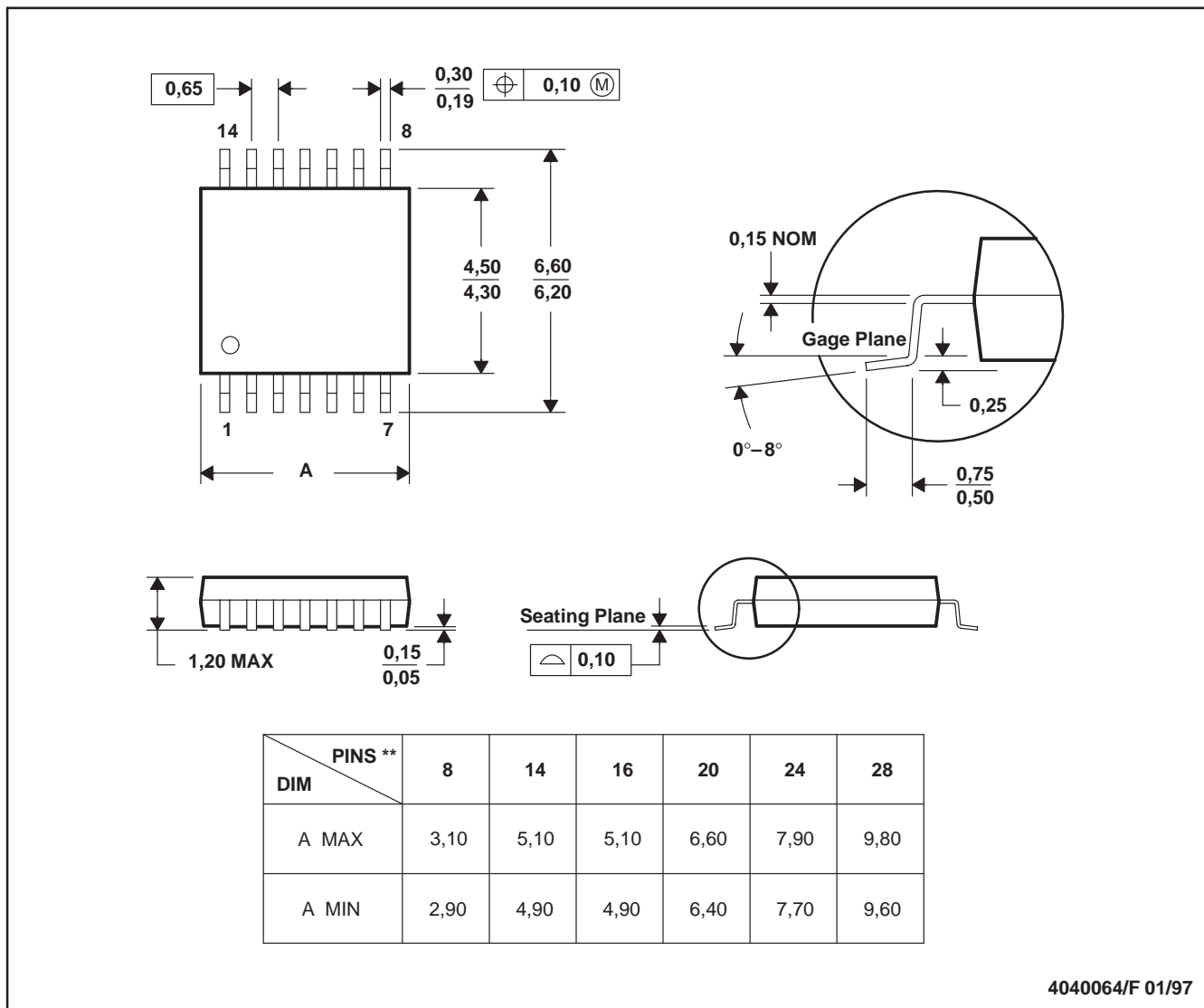
NOTE: Qualified Version Definitions:

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

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- 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 not to exceed 0,15.
 D. Falls within JEDEC MO-153

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