

SN54AHC595, SN74AHC595 8-BIT SHIFT REGISTERS WITH 3-STATE OUTPUT REGISTERS

SCLS373E – MAY 1997 – REVISED JANUARY 2000

- **EPIC™** (Enhanced-Performance Implanted CMOS) Process
- Operating Range 2-V to 5.5-V V_{CC}
- 8-Bit Serial-In, Parallel-Out Shift
- Shift Register Has Direct Clear
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model ($C = 200$ pF, $R = 0$)
- Package Options Include Plastic Small-Outline (D), Shrink Small-Outline (DB), Thin Shrink Small-Outline (PW), and Ceramic Flat (W) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) DIPs

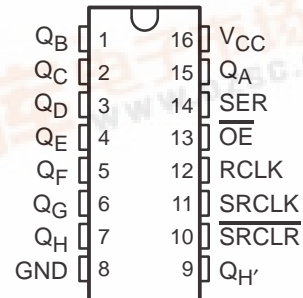
description

The 'AHC595 devices contain 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 registers. 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.

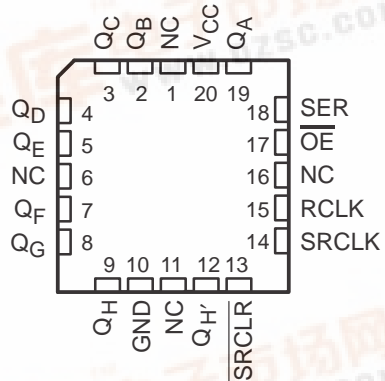
Both the shift-register clock (SRCLK) and storage-register clock (RCLK) are positive-edge triggered. If both clocks are connected together, the shift register always is one clock pulse ahead of the storage register.

The SN54AHC595 is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74AHC595 is characterized for operation from -40°C to 85°C .

SN54AHC595 ... J OR W PACKAGE
SN74AHC595 ... D, DB, N, OR PW PACKAGE
(TOP VIEW)



SN54AHC595 ... FK PACKAGE
(TOP VIEW)



NC – No internal connection

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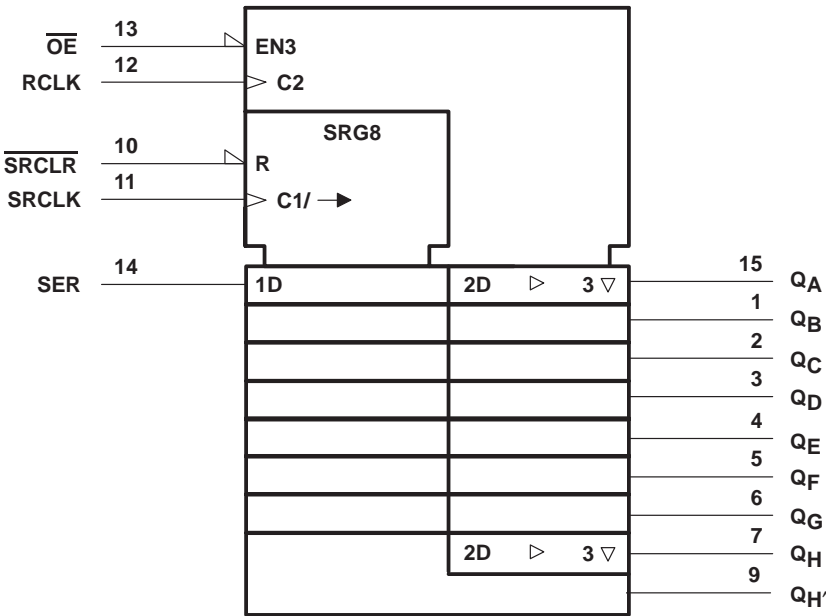
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FUNCTION TABLE					
INPUTS					FUNCTION
SER	SRCLK	SRCLR	RCLK	OE	
X	X	X	X	H	Outputs Q _A –Q _H are disabled.
X	X	X	X	L	Outputs Q _A –Q _H are enabled.
X	X	L	X	X	Shift register is cleared.
L	↑	H	X	X	First stage of the shift register goes low. Other stages 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 into the storage register.
X	X	X	↓	X	Storage-register state is not changed.

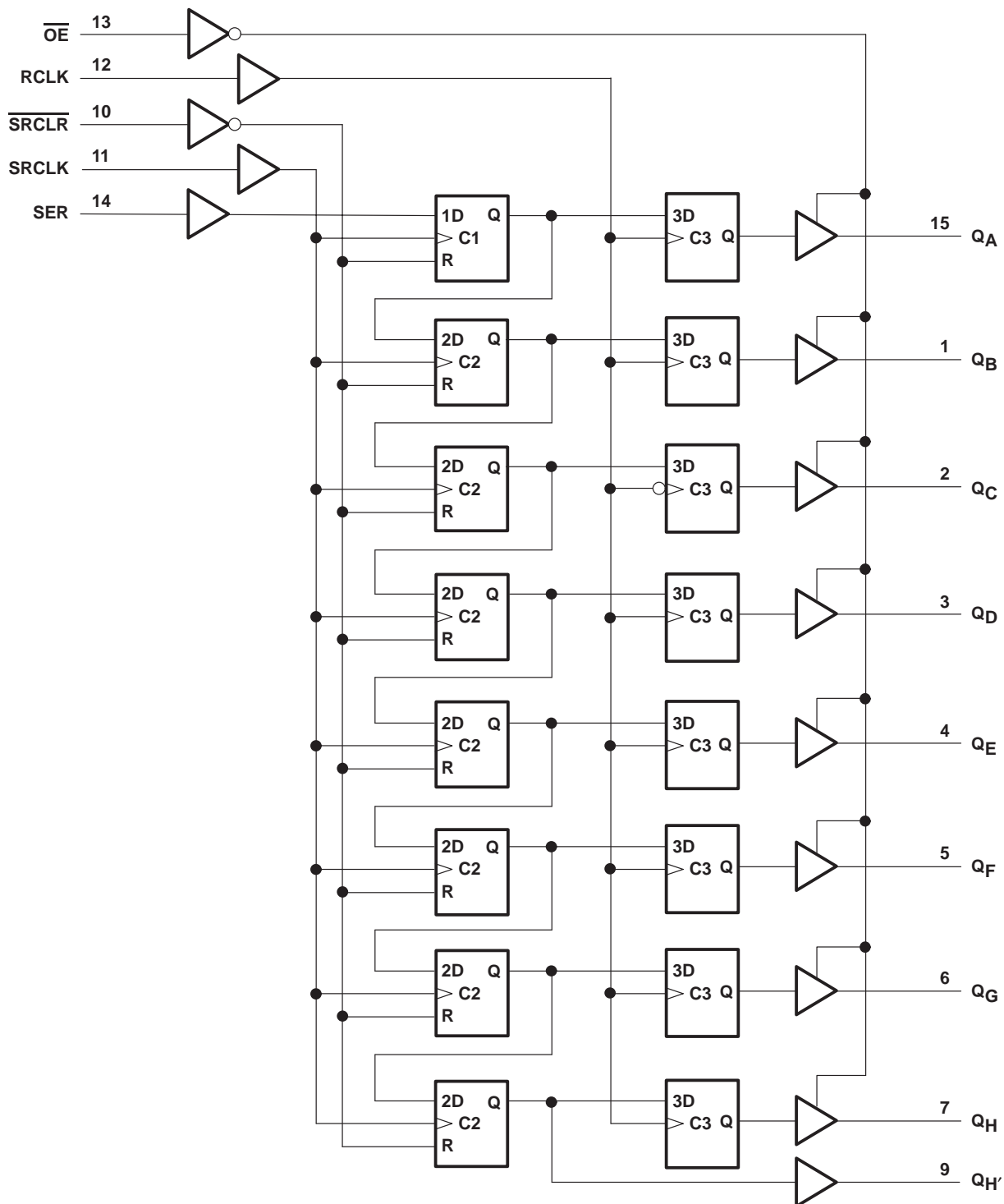
logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
 Pin numbers shown are for the D, DB, J, N, PW, and W packages.

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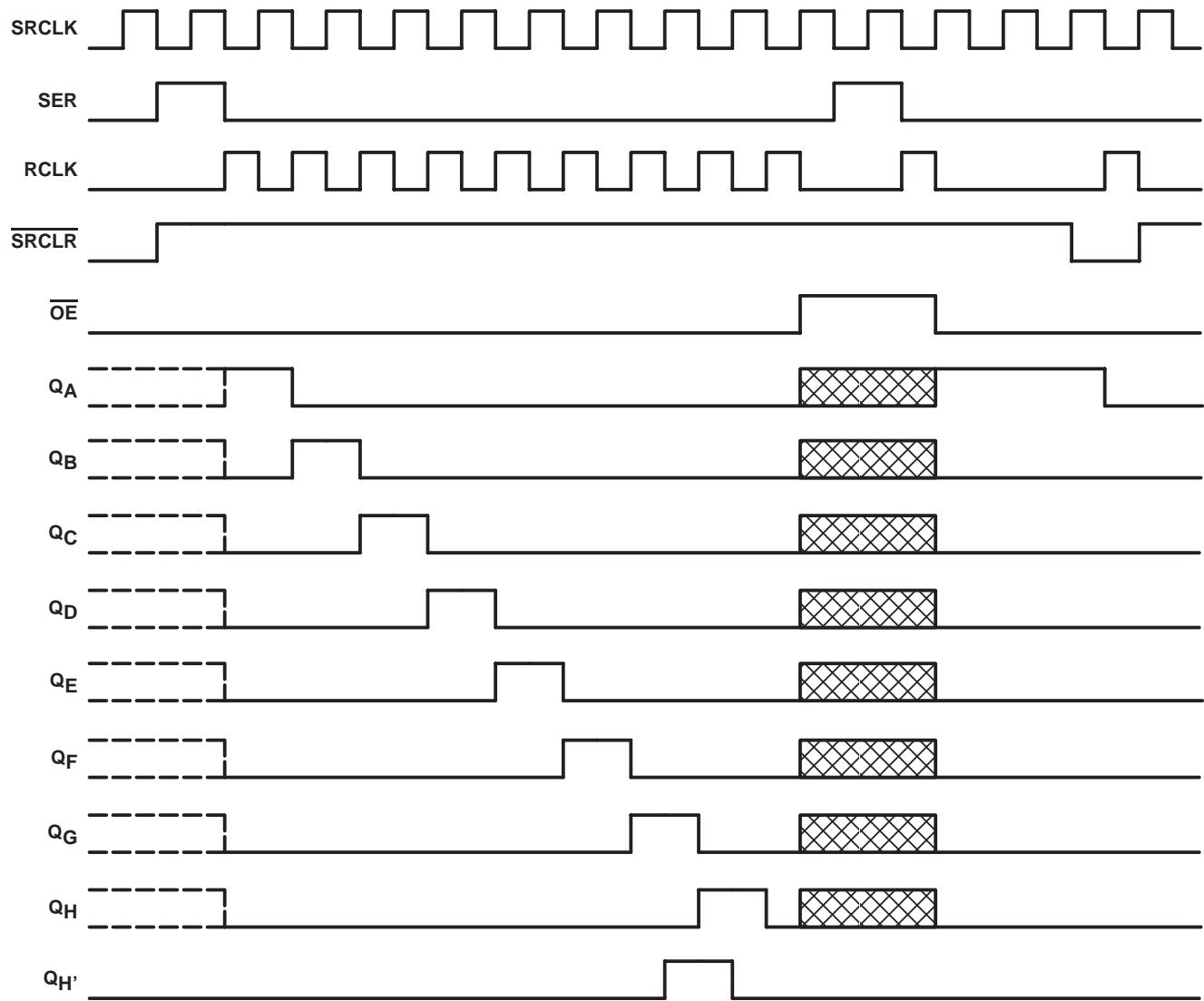
logic diagram (positive logic)



Pin numbers shown are for the D, DB, J, N, PW, and W packages.

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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
Output voltage range, V_O (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Input clamp current, I_{IK} ($V_I < 0$)	–20 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$)	±20 mA
Continuous output current, I_O ($V_O = 0$ to V_{CC})	±25 mA
Continuous current through V_{CC} or GND	±75 mA
Package thermal impedance, θ_{JA} (see Note 2): D package	113°C/W
DB package	131°C/W
N package	78°C/W
PW package	149°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 voltage ratings may be exceeded if the input and output current ratings are observed.
2. The package thermal impedance is calculated in accordance with JESD 51.

recommended operating conditions (see Note 3)

			SN54AHC595		SN74AHC595		UNIT
			MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage		2	5.5	2	5.5	V
V_{IH}	High-level input voltage	$V_{CC} = 2$ V	1.5		1.5		V
		$V_{CC} = 3$ V	2.1		2.1		
		$V_{CC} = 5.5$ V	3.85		3.85		
V_{IL}	Low-level input voltage	$V_{CC} = 2$ V		0.5		0.5	V
		$V_{CC} = 3$ V		0.9		0.9	
		$V_{CC} = 5.5$ V		1.65		1.65	
V_I	Input voltage		0	5.5	0	5.5	V
V_O	Output voltage		0	V_{CC}	0	V_{CC}	V
I_{OH}	High-level output current	$V_{CC} = 2$ V		–50		–50	µA
		$V_{CC} = 3.3$ V ± 0.3 V		–4		–4	mA
		$V_{CC} = 5$ V ± 0.5 V		–8		–8	mA
I_{OL}	Low-level output current	$V_{CC} = 2$ V		50		50	µA
		$V_{CC} = 3.3$ V ± 0.3 V		4		4	mA
		$V_{CC} = 5$ V ± 0.5 V		8		8	mA
$\Delta t/\Delta v$	Input transition rise or fall rate	$V_{CC} = 3.3$ V ± 0.3 V		100		100	ns/V
		$V_{CC} = 5$ V ± 0.5 V		20		20	ns/V
T_A	Operating free-air temperature		–55	125	–40	85	°C

NOTE 3: 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}	T _A = 25°C			SN54AHC595		SN74AHC595		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V _{OH}	I _{OH} = –50 µA	2 V	1.9	2		1.9		1.9		V
		3 V	2.9	3		2.9		2.9		
		4.5 V	4.4	4.5		4.4		4.4		
	I _{OH} = –4 mA	3 V	2.58			2.48		2.48		
	I _{OH} = –8 mA	4.5 V	3.94			3.8		3.8		
V _{OL}	I _{OL} = 50 µA	2 V			0.1		0.1		0.1	V
		3 V			0.1		0.1		0.1	
		4.5 V			0.1		0.1		0.1	
	I _{OL} = 4 mA	3 V			0.36		0.5		0.44	
	I _{OL} = 8 mA	4.5 V			0.36		0.5		0.44	
I _I	V _I = V _{CC} or GND	0 V to 5.5 V			±0.1		±1*		±1	µA
I _{OZ}	V _I = V _{CC} or GND, V _O = V _{CC} or GND, OE = V _{IH} or V _{IL}	5.5 V			±0.25		±2.5		±2.5	µA
I _{CC}	V _I = V _{CC} or GND, I _O = 0	5.5 V			4		40		40	µA
C _i	V _I = V _{CC} or GND	5 V			3 10				10	pF
C _o	V _O = V _{CC} or GND	5 V			5.5					pF

* On products compliant to MIL-PRF-38535, this parameter is not production tested at V_{CC} = 0 V.

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

		T _A = 25°C		SN54AHC595		SN74AHC595		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
t _w Pulse duration	SRCLK high or low	5		5		5		ns
	RCLK high or low	5		5		5		
	SRCLR low	5		5		5		
t _{su} Setup time	SER before SRCLK↑	3.5		3.5		3.5		ns
	SRCLK↑ before RCLK↑†	8		8.5		8.5		
	SRCLR low before RCLK↑	8		9		9		
	SRCLR high (inactive) before SRCLK↑	3		3		3		
t _h Hold time	SER after SRCLK↑	1.5		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,
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ (unless otherwise noted) (see Figure 1)

		T _A = 25°C		SN54AHC595		SN74AHC595		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
t _w	Pulse duration	SRCLK high or low		5		5		ns
		RCLK high or low		5		5		
		SRCLR low		5		5		
t _{su}	Setup time	SER before SRCLK↑		3		3		ns
		SRCLK↑ before RCLK↑†		5		5		
		SRCLR low before RCLK↑		5		5		
		SRCLR high (inactive) before SRCLK↑		2.5		2.5		
t _h	Hold time	SER after SRCLK↑		2		2		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.

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	$T_A = 25^\circ\text{C}$			SN54AHC595		SN74AHC595		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			$C_L = 15\text{ pF}$	80*	120*		70*		70		MHz
			$C_L = 50\text{ pF}$	55	105		50		50		
t_{PLH}	RCLK	Q_A-Q_H	$C_L = 15\text{ pF}$	6*	11.9*		1*	13.5*	1	13.5	ns
t_{PHL}				6*	11.9*		1*	13.5*	1	13.5	
t_{PLH}	SRCLK	$Q_{H'}$	$C_L = 15\text{ pF}$	6.6*	13*		1*	15*	1	15	ns
t_{PHL}				6.6*	13*		1*	15*	1	15	
t_{PHL}	SRCLR	$Q_{H'}$	$C_L = 15\text{ pF}$	6.2*	12.8*		1*	13.7*	1	13.7	ns
t_{PZH}	\overline{OE}	Q_A-Q_H	$C_L = 15\text{ pF}$	6*	11.5*		1*	13.5*	1	13.5	ns
t_{PZL}				7.8*	11.5*		1*	13.5*	1	13.5	
t_{PLH}	RCLK	Q_A-Q_H	$C_L = 50\text{ pF}$	7.9	15.4		1	17	1	17	ns
t_{PHL}				7.9	15.4		1	17	1	17	
t_{PLH}	SRCLK	$Q_{H'}$	$C_L = 50\text{ pF}$	9.2	16.5		1	18.5	1	18.5	ns
t_{PHL}				9.2	16.5		1	18.5	1	18.5	
t_{PHL}	SRCLR	$Q_{H'}$	$C_L = 50\text{ pF}$	9	16.3		1	17.2	1	17.2	ns
t_{PZH}	\overline{OE}	Q_A-Q_H	$C_L = 50\text{ pF}$	7.8	15		1	17	1	17	ns
t_{PZL}				9.6	15		1	17	1	17	
t_{PHZ}	\overline{OE}	Q_A-Q_H	$C_L = 50\text{ pF}$	8.1	15.7		1	16.2	1	16.2	ns
t_{PLZ}				9.3	15.7		1	16.2	1	16.2	

* On products compliant to MIL-PRF-38535, this parameter is not production tested.

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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	$T_A = 25^\circ\text{C}$			SN54AHC595		SN74AHC595		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			$C_L = 15\text{ pF}$	135*	170*		115*		115		MHz
			$C_L = 50\text{ pF}$	95	140		85		85		
t_{PLH}	RCLK	Q_A-Q_H	$C_L = 15\text{ pF}$		4.3*	7.4*	1*	8.5*	1	8.5	ns
t_{PHL}					4.3*	7.4*	1*	8.5*	1	8.5	
t_{PLH}	SRCLK	Q_H'	$C_L = 15\text{ pF}$		4.5*	8.2*	1*	9.4*	1	9.4	ns
t_{PHL}					4.5*	8.2*	1*	9.4*	1	9.4	
t_{PHL}	$\overline{\text{SRCLR}}$	Q_H'	$C_L = 15\text{ pF}$		4.5*	8*	1*	9.1*	1	9.1	ns
t_{PZH}	$\overline{\text{OE}}$	Q_A-Q_H	$C_L = 15\text{ pF}$		4.3*	8.6*	1*	10*	1	10	ns
t_{PZL}					5.4*	8.6*	1*	10*	1	10	
t_{PLH}	RCLK	Q_A-Q_H	$C_L = 50\text{ pF}$		5.6	9.4	1	10.5	1	10.5	ns
t_{PHL}					5.6	9.4	1	10.5	1	10.5	
t_{PLH}	SRCLK	Q_H'	$C_L = 50\text{ pF}$		6.4	10.2	1	11.4	1	11.4	ns
t_{PHL}					6.4	10.2	1	11.4	1	11.4	
t_{PHL}	$\overline{\text{SRCLR}}$	Q_H'	$C_L = 50\text{ pF}$		6.4	10	1	11.1	1	11.1	ns
t_{PZH}	$\overline{\text{OE}}$	Q_A-Q_H	$C_L = 50\text{ pF}$		5.7	10.6	1	12	1	12	ns
t_{PZL}					6.8	10.6	1	12	1	12	
t_{PHZ}	$\overline{\text{OE}}$	Q_A-Q_H	$C_L = 50\text{ pF}$		3.5	10.3	1	11	1	11	ns
t_{PLZ}					3.4	10.3	1	11	1	11	

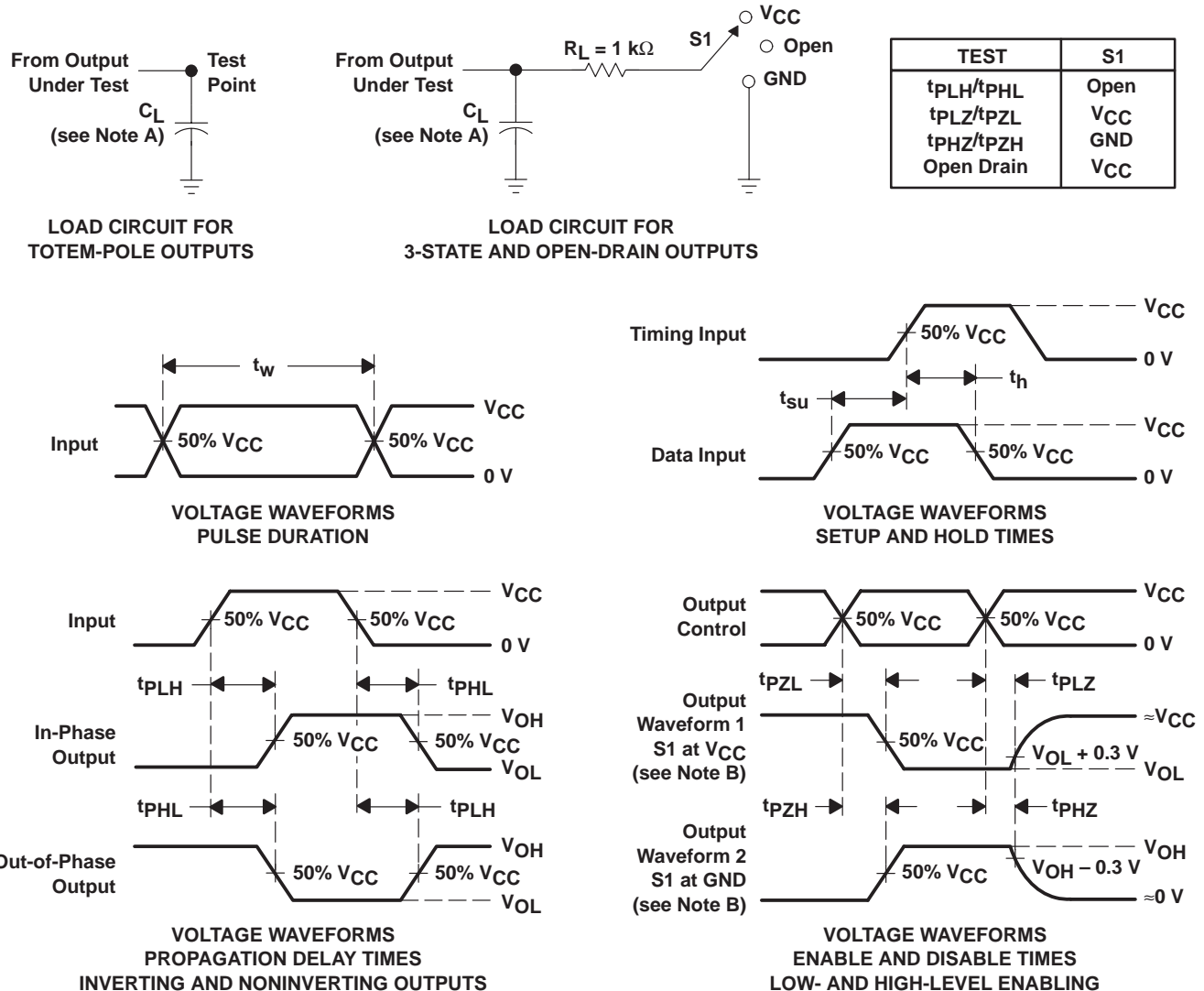
* On products compliant to MIL-PRF-38535, this parameter is not production tested.

operating characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	TYP	UNIT
C_{pd} Power dissipation capacitance	No load, $f = 1\text{ MHz}$	25.2	pF

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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.

Figure 1. Load Circuit and Voltage Waveforms

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