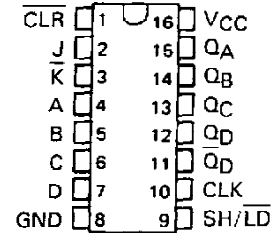


**SN54195, SN54LS195A, SN54S195,
SN74195, SN74LS195A, SN74S195
4-BIT PARALLEL-ACCESS SHIFT REGISTERS**
MARCH 1974—REVISED MARCH 1988

- Synchronous Parallel Load
- Positive-Edge-Triggered Clocking
- Parallel Inputs and Outputs from Each Flip-Flop
- Direct Overriding Clear
- J and $\bar{K}$ Inputs to First Stage
- Complementary Outputs from Last Stage
- For Use in High Performance:
Accumulators/Processors
Serial-to-Parallel, Parallel-to-Serial
Converters

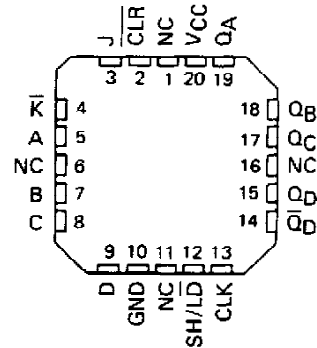
SN54195, SN54LS195A, SN54S195 . . . J OR W PACKAGE
SN74195 . . . N PACKAGE
SN74LS195A, SN74S195 . . . D OR N PACKAGE

(TOP VIEW)



SN54LS195, SN54S195 . . . FK PACKAGE

(TOP VIEW)



NC - No internal connection

description

These 4-bit registers feature parallel inputs, parallel outputs, J- $\bar{K}$ serial inputs, shift/load (SH/LD) control input, and a direct overriding clear. All inputs are buffered to lower the input drive requirements. The register has two modes of operation:

Parallel (broadside) load

Shift (in the direction Q_A toward Q_D)

Parallel loading is accomplished by applying the four bits of data and taking SH/LD low. The data is loaded into the associated flip-flop and appears at the outputs after the positive transition of the clock input. During loading, serial data flow is inhibited.

Shifting is accomplished synchronously when SH/LD is high. Serial data for this mode is entered at the J- $\bar{K}$ inputs. These inputs permit the first stage to perform as a J- $\bar{K}$, D-, or T-type flip-flop as shown in the function table.

The high-performance 'S195, with a 105-megahertz typical maximum shift-frequency, is particularly attractive for very-high-speed data processing systems. In most cases existing systems can be upgraded merely by using this Schottky-clamped shift register.

TYPE	TYPICAL MAXIMUM CLOCK FREQUENCY	TYPICAL POWER DISSIPATION
'195	39 MHz	195 mW
'LS195A	39 MHz	70 mW
'S195	105 MHz	350 mW

FUNCTION TABLE

INPUTS								OUTPUTS					
CLEAR	SHIFT/ LOAD	CLOCK	SERIAL		PARALLEL				Q _A	Q _B	Q _C	Q _D	Q̄ _D
			J	K̄	A	B	C	D					
L	X	X	X	X	X	X	X	X	L	L	L	L	H
H	L	↑	X	X	a	b	c	d	a	b	c	d	d̄
H	H	L	X	X	X	X	X	X	Q _{A0}	Q _{B0}	Q _{C0}	Q _{D0}	Q̄ _{D0}
H	H	↑	L	H	X	X	X	X	Q _{A0}	Q _{A0}	Q _{Bn}	Q _{Cn}	Q̄ _{Cn}
H	H	↑	L	L	X	X	X	X	L	Q _{An}	Q _{Bn}	Q _{Cn}	Q̄ _{Cn}
H	H	↑	H	H	X	X	X	X	H	Q _{An}	Q _{Bn}	Q _{Cn}	Q̄ _{Cn}
H	H	↑	H	L	X	X	X	X	Q̄ _{An}	Q _{An}	Q _{Bn}	Q _{Cn}	Q̄ _{Cn}

H = high level (steady state)

L = low level (steady state)

X = irrelevant (any input, including transitions)

↑ = transition from low to high level

a, b, c, d = the level of steady-state input at A, B, C, or D, respectively

Q_{A0} , Q_{B0} , Q_{C0} , Q_{D0} = the level of Q_A , Q_B , Q_C , or Q_D , respectively, before the indicated steady-state input conditions were established

Q_{An} , Q_{Bn} , Q_{Cn} = the level of Q_A , Q_B , or Q_C , respectively, before the most-recent transition of the clock

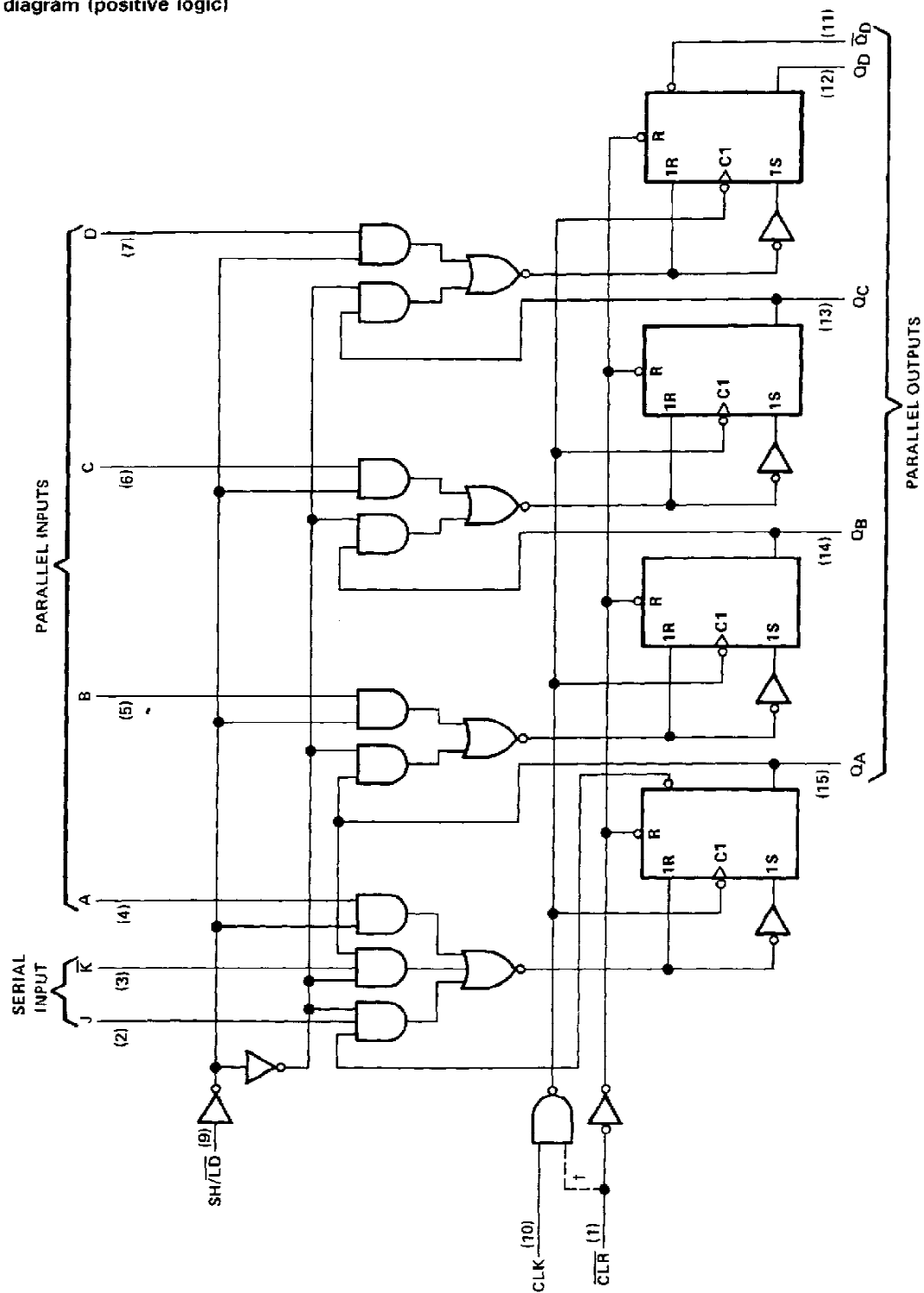
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**SN54195, SN54LS195A, SN54S195,
SN74195, SN74LS195A, SN74S195
4-BIT PARALLEL-ACCESS SHIFT REGISTERS**

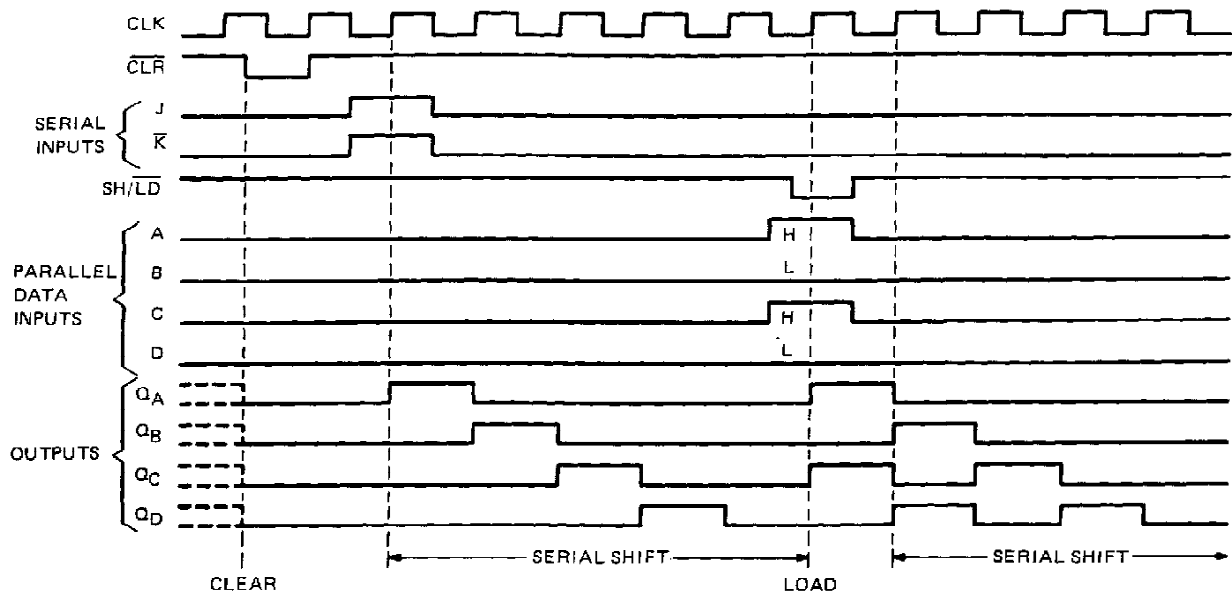
logic diagram (positive logic)



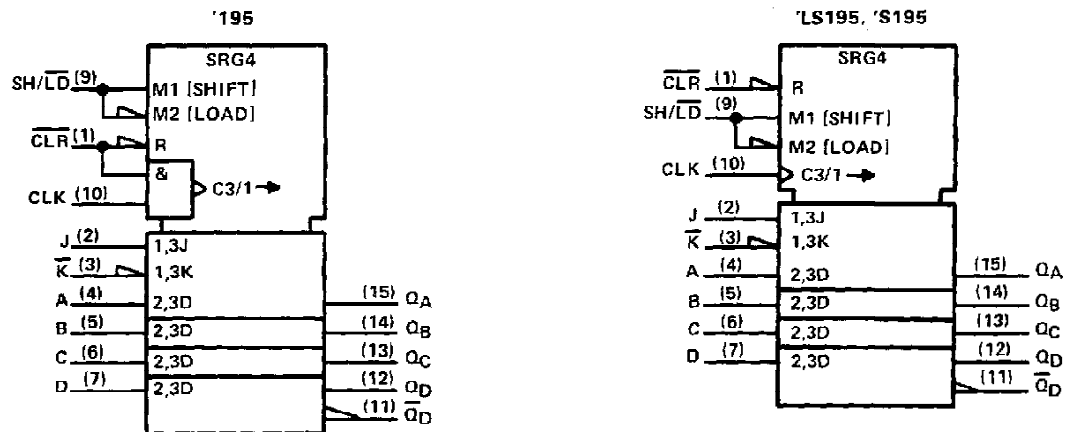
† This connection is made on '195 only.
Pin numbers shown are for D, J, N, and W packages.

**SN54195, SN54LS195A, SN54S195,
SN74195, SN74LS195A, SN74S195
4-BIT PARALLEL-ACCESS SHIFT REGISTERS**

typical clear, shift, and load sequences



logic symbols†

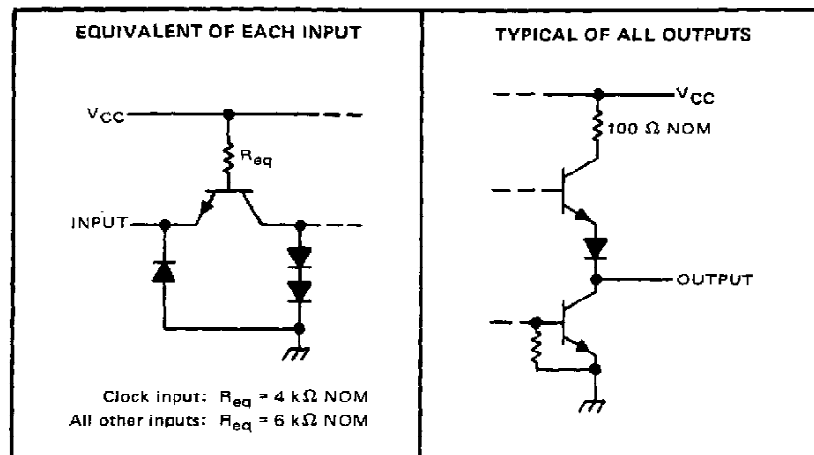


†These symbols are in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12. Pin numbers are for D, J, N, and W packages.

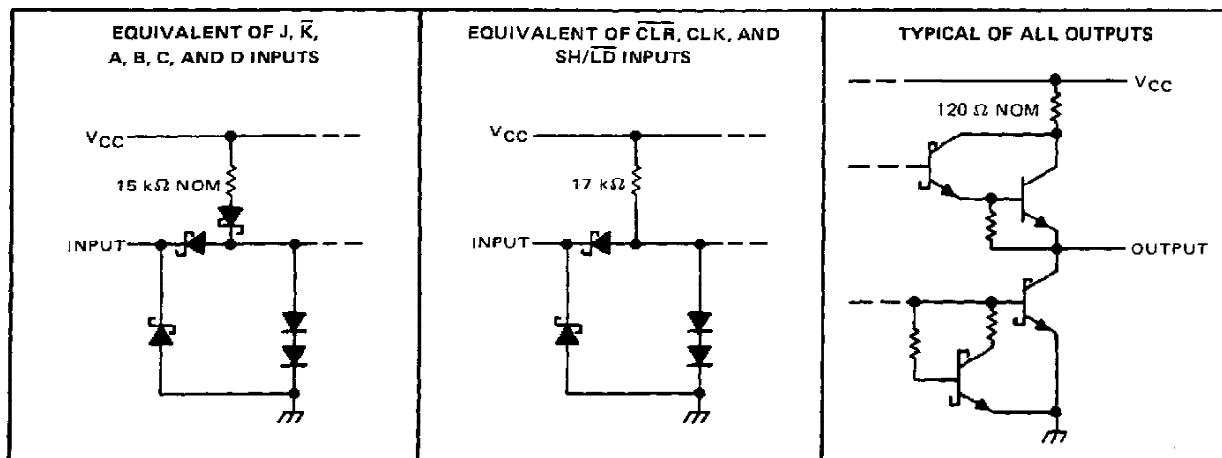
SN54195, SN54LS195A, SN54S195, SN74195, SN74LS195A, SN74S195
4-BIT PARALLEL-ACCESS SHIFT REGISTERS

schematics of inputs and outputs

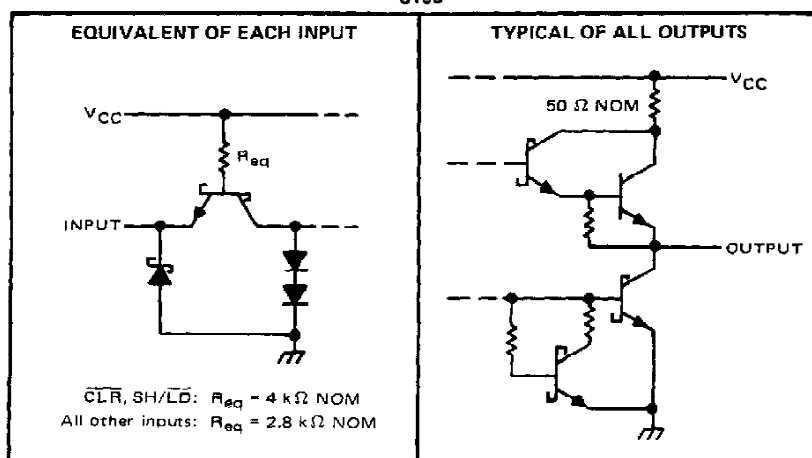
'195



'LS195A



'S195



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SN54195, SN74195 4-BIT PARALLEL-ACCESS SHIFT REGISTERS

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

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage	5.5 V
Operating free-air temperature range: SN54195	-55°C to 125°C
SN74195	0°C to 70°C
Storage temperature range	-65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

			SN54195			SN74195			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V _{CC}			4.5	5	5.5	4.75	5	5.25	V
High-level output current, I _{OH}			-800			-800			μA
Low-level output current, I _{OL}			16			16			mA
Clock frequency, f _{clock}			0		30	0		30	MHz
Width of clock input pulse, t _{w(clock)}			16			16			ns
Width of clear input pulse, t _{w(clear)}			12			12			ns
Setup time, t _{su} (see Figure 1)	Shift/load		25			25			ns
	Serial and parallel data		20			20			
	Clear inactive-state		25			25			
Shift/load release time, t _{release} (see Figure 1)			10			10			ns
Serial and parallel data hold time, t _h (see Figure 1)			0			0			ns
Operating free-air temperature, T _A			-55		125	0		70	°C

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

PARAMETER	TEST CONDITIONS†	MIN	TYP‡	MAX	UNIT
V_{IH} High-level input voltage		2			V
V_{IL} Low-level input voltage				0.8	V
V_{IK} Input clamp voltage	$V_{CC} = \text{MIN}$, $I_I = -12 \text{ mA}$			-1.5	V
V_{OH} High-level output voltage	$V_{CC} = \text{MIN}$, $V_{IH} = 2 \text{ V}$, $V_{IL} = 0.8 \text{ V}$, $I_{OH} = -800 \mu\text{A}$	2.4	3.4		V
V_{OL} Low-level output voltage	$V_{CC} = \text{MIN}$, $V_{IH} = 2 \text{ V}$, $V_{IL} = 0.8 \text{ V}$, $I_{OL} = 16 \text{ mA}$		0.2	0.4	V
I_I Input current at maximum input voltage	$V_{CC} = \text{MAX}$, $V_I = 5.5 \text{ V}$			1	mA
I_{IH} High-level input current	$V_{CC} = \text{MAX}$, $V_I = 2.4 \text{ V}$			40	μ A
I_{IL} Low-level input current	$V_{CC} = \text{MAX}$, $V_I = 0.4 \text{ V}$			-1.6	mA
I_{OS} Short-circuit output current§	$V_{CC} = \text{MAX}$	SN54195	-20	-57	mA
		SN74195	-18	-57	
I_{CC} Supply current	$V_{CC} = \text{MAX}$, See Note 2		39	63	mA

†For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡All typical values are at $V_{CC} = 5 \text{ V}$, $T_A = 25^\circ\text{C}$.

§Not more than one output should be shorted at a time.

NOTE 2: With all outputs open, shift/load grounded, and 4.5 V applied to the J, K, and data inputs, I_{CC} is measured by applying a momentary ground, followed by 4.5 V, to clear and then applying a momentary ground, followed by 4.5 V, to clock.

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

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max} Maximum clock frequency	$C_L = 15 \text{ pF}$, $R_L = 400 \Omega$, See Figure 1	30	39		MHz
t_{PHL} Propagation delay time, high-to-low-level output from clear			19	30	ns
t_{PLH} Propagation delay time, low-to-high-level output from clock			14	22	ns
t_{PHL} Propagation delay time, high-to-low-level output from clock			17	26	ns

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SN54LS195A, SN74LS195A

4-BIT PARALLEL-ACCESS SHIFT REGISTERS

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

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage	7 V
Operating free-air temperature range: SN54LS195A	-55°C to 125°C
SN74LS195A	0°C to 70°C
Storage temperature range	-65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

		SN54LS195A			SN74LS195A			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}		4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}				-400			-400	μ A
Low-level output current, I_{OL}				4			8	mA
Clock frequency, f_{clock}		0		30	0		30	MHz
Width of clock or clear pulse, $t_w(\text{clock})$		16			16			ns
Width of clear input pulse, $t_w(\text{clear})$		12			12			ns
Setup time, t_{su} (see Figure 1)	Shift/load	25			25			ns
	Serial and parallel data	15			15			
	Clear inactive-state	25			25			
Shift/load release time, $t_{release}$ (see Figure 1)				10			20	ns
Serial and parallel data hold time, t_h (see Figure 1)		0			0			ns
Operating free-air temperature, T_A		-55		125	0		70	$^{\circ}$ C

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

PARAMETER	TEST CONDITIONS†	SN54LS195A			SN74LS195A			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V _{IH} High-level input voltage		2			2			V
V _{IL} Low-level input voltage				0.7			0.8	V
V _{IK} Input clamp voltage	V _{CC} = MIN, I _I = -18 mA			-1.5			-1.5	V
V _{OH} High-level output voltage	V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = V _{IL} max, I _{OH} = -400 μA	2.5	3.4		2.7	3.4		V
V _{OL} Low-level output voltage	V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = V _{IL} max	I _{OL} = 4 mA		0.25	0.4	0.25 0.4		V
		I _{OL} = 8 mA				0.35 0.5		
I _I Input current at maximum input voltage	V _{CC} = MAX, V _I = 7 V			0.1			0.1	mA
I _{IH} High-level input current	V _{CC} = MAX, V _I = 2.7 V			20			20	μA
I _{IL} Low-level input current	V _{CC} = MAX, V _I = 0.4 V			-0.4			-0.4	mA
I _{OS} Short-circuit output current §	V _{CC} = MAX	-20		-100	-20		-100	mA
I _{CC} Supply current	V _{CC} = MAX, See Note 2		14	21		14	21	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at $V_{CC} = 5 \text{ V}$, $T_A = 25^\circ\text{C}$.

§ Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

NOTE 2: With all outputs open, shift/load grounded, and 4.5 V applied to the J, K, and data inputs, I_{CC} is measured by applying a momentary ground, followed by 4.5 V, to clear and then applying a momentary ground, followed by 4.5 V, to clock.

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

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max} Maximum clock frequency	$C_L = 15 \text{ pF}$, $R_L = 2 \text{ k}\Omega$, See Figure 1	30	39		MHz
t_{PHL} Propagation delay time, high-to-low-level output from clear			19	30	ns
t_{PLH} Propagation delay time, low-to-high-level output from clock			14	22	ns
t_{PHL} Propagation delay time, high-to-low-level output from clock			17	26	ns

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SN54S195, SN74S195

4-BIT PARALLEL-ACCESS SHIFT REGISTERS

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

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage	5.5 V
Operating free-air temperature range: SN54S195	-55°C to 125°C
SN74S195	0°C to 70°C
Storage temperature range	-65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

		SN54S195			SN74S195			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}		4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}		-1			-1			mA
Low-level output current, I_{OL}		20			20			mA
Clock frequency, f_{clock}		0		70	0		70	MHz
Width of clock input pulse, $t_w(clock)$		7			7			ns
Width of clear input pulse, $t_w(clear)$		12			12			ns
Setup time, t_{su} (see Figure 1)	Shift/load	11			11			ns
	Serial and parallel data	5			5			
	Clear inactive-state	9			9			
Shift/load release time, $t_{release}$ (see Figure 1)		2			6			ns
Serial and parallel data hold time, t_h (see Figure 1)		3			3			ns
Operating free-air temperature, T_A		-55		125	0		70	°C

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

PARAMETER		TEST CONDITIONS†			MIN	TYP‡	MAX	UNIT
V _{IH}	High-level input voltage				2			V
V _{IL}	Low-level input voltage						0.8	V
V _{IK}	Input clamp voltage	V _{CC} = MIN,	I _I = -18 mA				-1.2	V
V _{OH}	High-level output voltage	V _{CC} = MIN, V _{IL} = 0.8 V,	V _{IH} = 2 V,	SN54S195	2.5	3.4		V
			I _{OH} = -1 mA	SN74S195	2.7	3.4		
V _{OL}	Low-level output voltage	V _{CC} = MIN, V _{IL} = 0.8 V,	V _{IH} = 2 V, I _{OL} = 20 mA				0.5	V
I _I	Input current at maximum input voltage	V _{CC} = MAX,	V _I = 5.5 V				1	mA
I _{IH}	High-level input current	V _{CC} = MAX,	V _I = 2.7 V				50	µA
I _{IL}	Low-level input current	V _{CC} = MAX,	V _I = 0.5 V				-2	mA
I _{OS}	Short-circuit output current §	V _{CC} = MAX			-40		-100	mA
I _{CC}	Supply current	V _{CC} = MAX,	See Note 2	SN54S195	70	99		mA
				SN74S195	70	109		

†For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡All typical values are at $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}.$

§Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

NOTE 2: With all outputs open, shift/load grounded, and 4.5 V applied to the J, K, and data inputs, I_{CC} is measured by applying a momentary ground, followed by 4.5 V, to clear, and then applying a momentary ground, followed by 4.5 V, to clock.

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

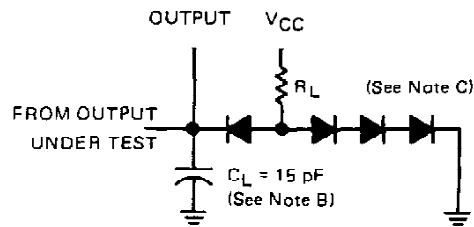
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max} Maximum clock frequency	$C_L = 15 \text{ pF},$ $R_L = 280 \Omega,$ See Figure 1	70	105		MHz
t_{PHL} Propagation delay time, high-to-low-level output from clear			12.5	18.5	ns
t_{PLH} Propagation delay time, low-to-high-level output from clock			8	12	ns
t_{PHL} Propagation delay time, high-to-low-level output from clock			11	16.5	ns

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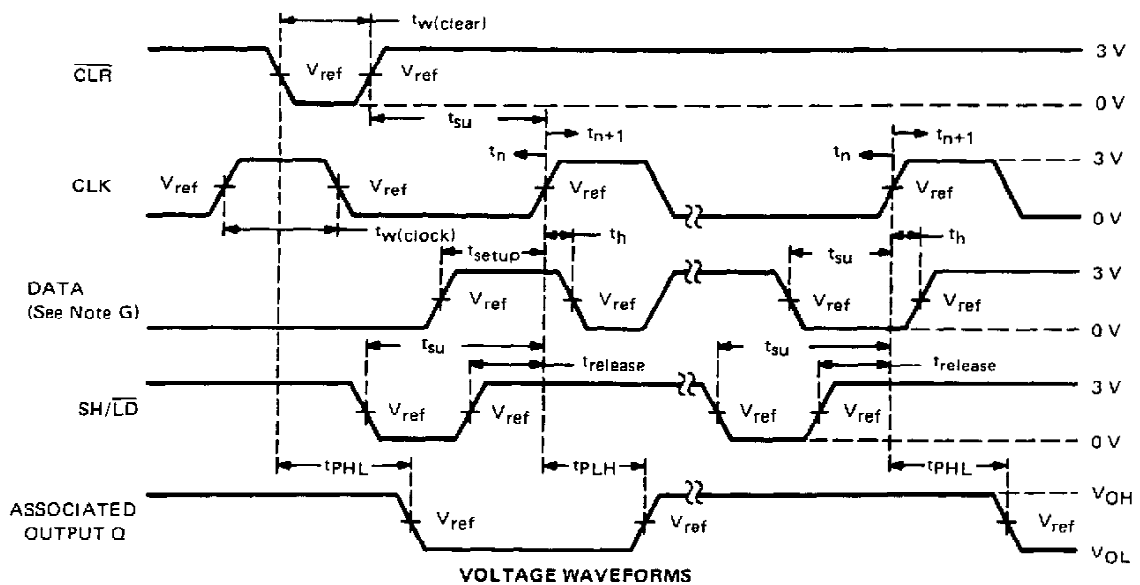
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**SN54195, SN54LS195A, SN54S195,
SN74195, SN74LS195A, SN74S195
4-BIT PARALLEL-ACCESS SHIFT REGISTERS**

PARAMETER MEASUREMENT INFORMATION



LOAD FOR OUTPUT UNDER TEST



VOLTAGE WAVEFORMS

- NOTES: A. The clock pulse generator has the following characteristics: $Z_{\text{out}} \approx 50 \Omega$ and $\text{PPR} \leq 1 \text{ MHz}$. For '195, $t_r \leq 7 \text{ ns}$ and $t_f \leq 7 \text{ ns}$. For 'LS195A, $t_r \leq 15 \text{ ns}$ and $t_f \leq 6 \text{ ns}$. For 'S195, $t_r = 2.5 \text{ ns}$ and $t_f = 2.5 \text{ ns}$. When testing f_{max} , vary the clock PPR.
- B. C_L includes probe and jig capacitance.
- C. All diodes are 1N3064 or equivalent.
- D. A clear pulse is applied prior to each test.
- E. For '195 and 'S195, $V_{\text{ref}} = 1.5 \text{ V}$; for 'LS195A, $V_{\text{ref}} = 1.3 \text{ V}$.
- F. Propagation delay times (t_{PLH} and t_{PHL}) are measured at t_{n+1} . Proper shifting of data is verified at t_{n+4} with a functional test.
- G. J and K inputs are tested the same as data A, B, C, and D inputs except that shift/load input remains high.
- H. t_n = bit time before clocking transition.
 t_{n+1} = bit time after one clocking transition.
 t_{n+4} = bit time after four clocking transitions.

FIGURE 1—SWITCHING TIMES

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