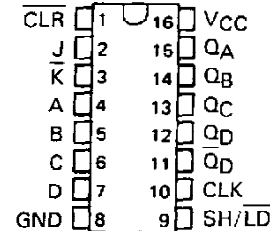


**SN54195, SN54LS195A, SN54S195,
SN74195, SN74LS195A, SN74S195
4-BIT PARALLEL-ACCESS SHIFT REGISTERS**
MARCH 1974—REVISED MARCH 1988

- 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)



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)

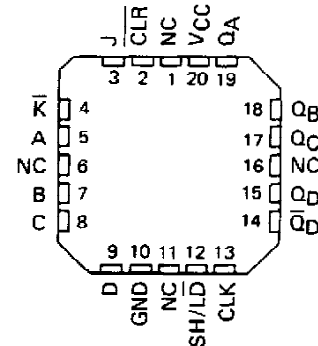
Parallel loading is accomplished by applying the four bits of data and taking SH/LD low. The data is loaded into the associated flip-flop and appears at the outputs after the positive transition of the clock input. During loading, serial data flow is inhibited.

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.

SN54LS195, SN54S195 . . . FK PACKAGE

(TOP VIEW)



NC - No internal connection

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

CLEAR		SHIFT/ LOAD		CLOCK		INPUTS				OUTPUTS				
						SERIAL	PARALLEL			Q_A	Q_B	Q_C	Q_D	$\bar{Q}_D$
						J	$\bar{K}$	A	B	C	D			
L	X	X	X	X	X	X	X	X	X	X	X	L	L	L
H	L	L	L	L	L	X	X	a	b	c	d	a	b	c
H	H	L	L	L	L	X	X	X	X	X	X	Q_{A0}	Q_{B0}	Q_{C0}
H	H	L	L	L	L	X	X	X	X	X	X	Q_{A0}	Q_{A0}	Q_{Bn}
H	H	L	L	L	L	X	X	X	X	X	X	L	Q_{An}	Q_{Bn}
H	H	L	L	L	L	X	X	X	X	X	X	H	Q_{An}	Q_{Bn}
H	H	L	L	L	L	X	X	X	X	X	X	$\bar{Q}_{An}$	Q_{An}	Q_{Bn}

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

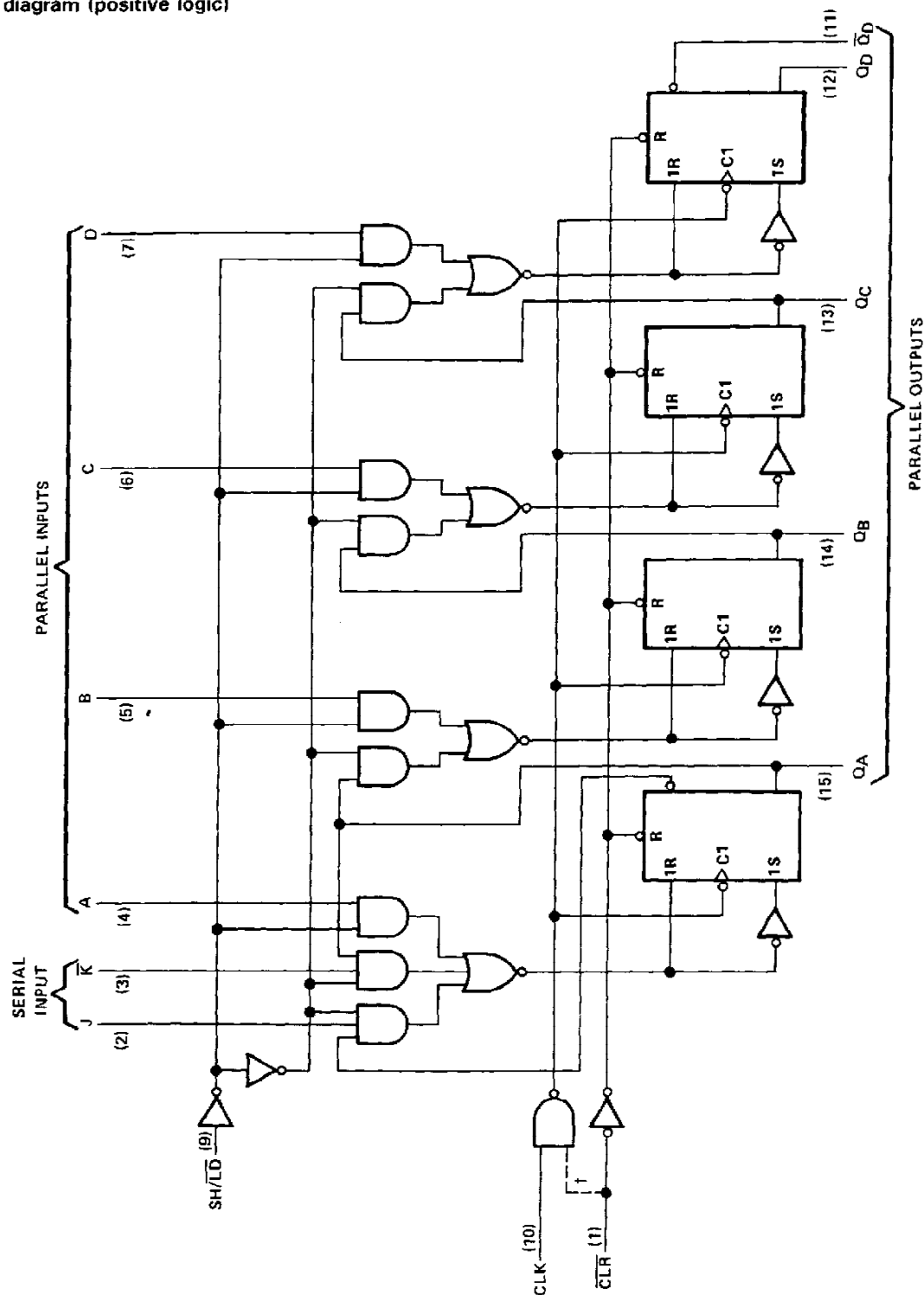
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**SN54195, SN54LS195A, SN54S195,
SN74195, SN74LS195A, SN74S195
4-BIT PARALLEL-ACCESS SHIFT REGISTERS**

logic diagram (positive logic)



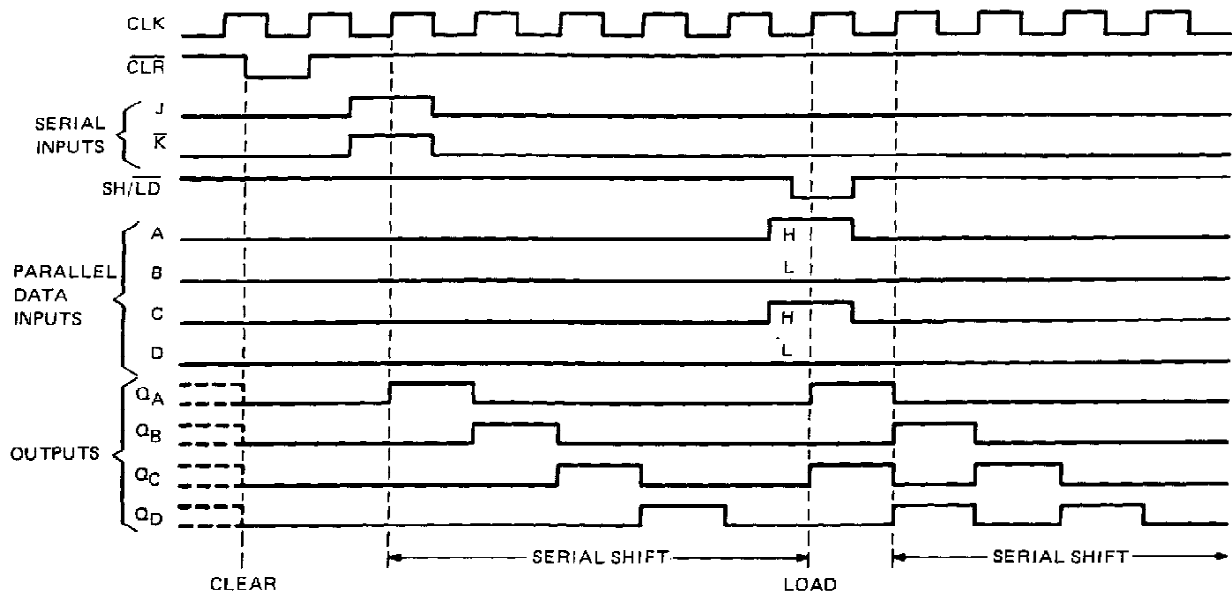
† This connection is made on '195 only.
Pin numbers shown are for D, J, N, and W packages.

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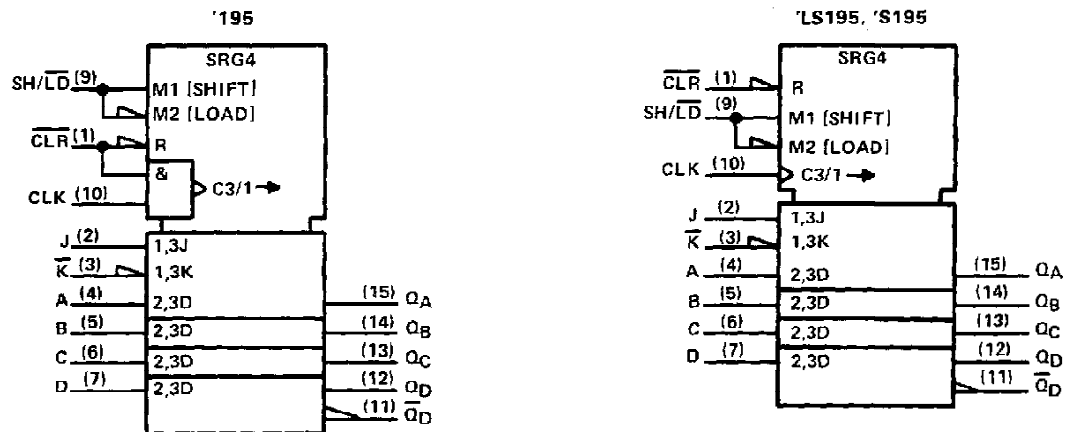
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**SN54195, SN54LS195A, SN54S195,
SN74195, SN74LS195A, SN74S195
4-BIT PARALLEL-ACCESS SHIFT REGISTERS**

typical clear, shift, and load sequences



logic symbols†

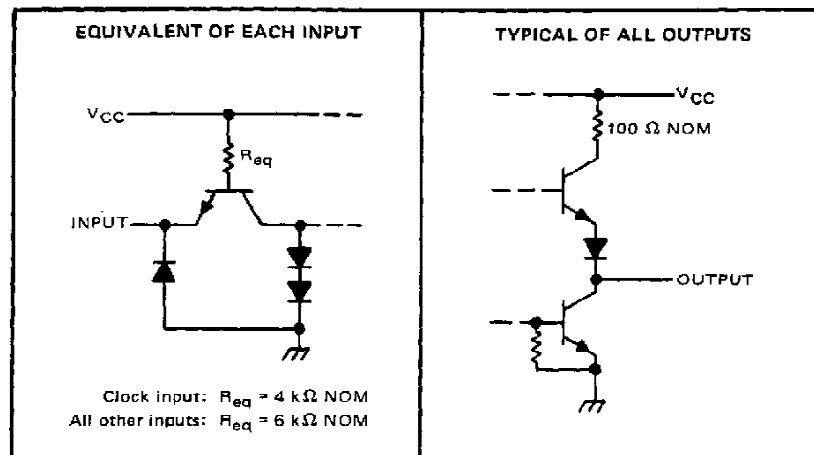


†These symbols are in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.
Pin numbers are for D, J, N, and W packages.

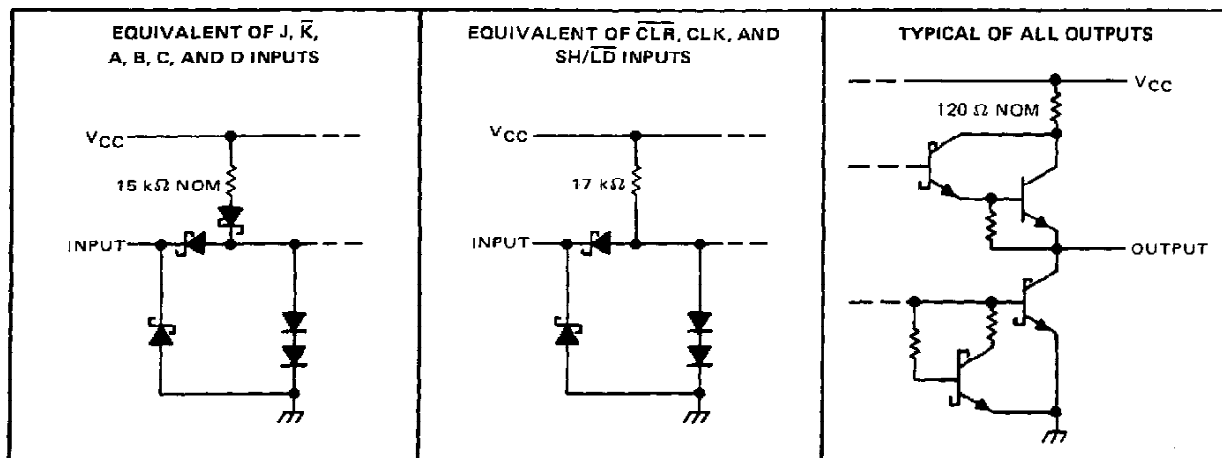
SN54195, SN54LS195A, SN54S195, SN74195, SN74LS195A, SN74S195
4-BIT PARALLEL-ACCESS SHIFT REGISTERS

schematics of inputs and outputs

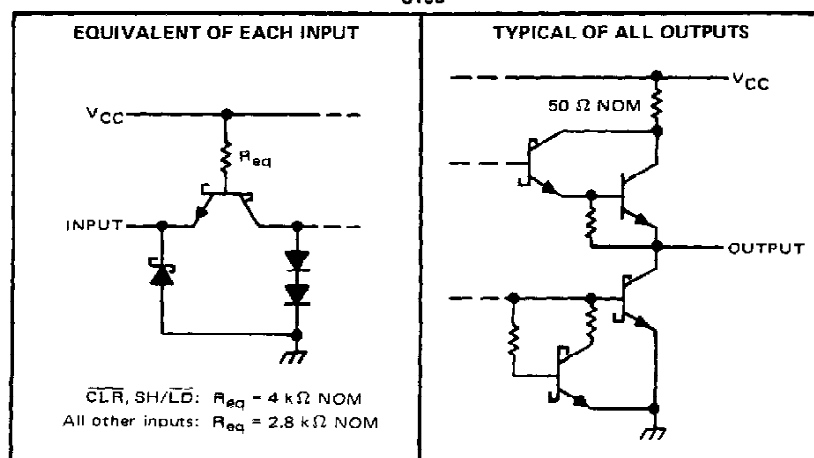
'195



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

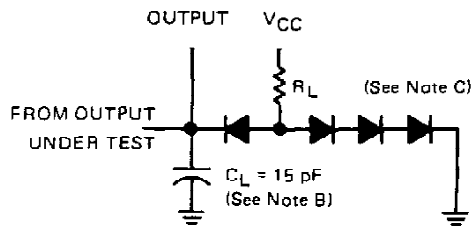
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max} Maximum clock frequency	$C_L = 15 \text{ pF},$ $R_L = 280 \Omega,$ See Figure 1	70	105		MHz
t_{PHL} Propagation delay time, high-to-low-level output from clear			12.5	18.5	ns
t_{PLH} Propagation delay time, low-to-high-level output from clock			8	12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

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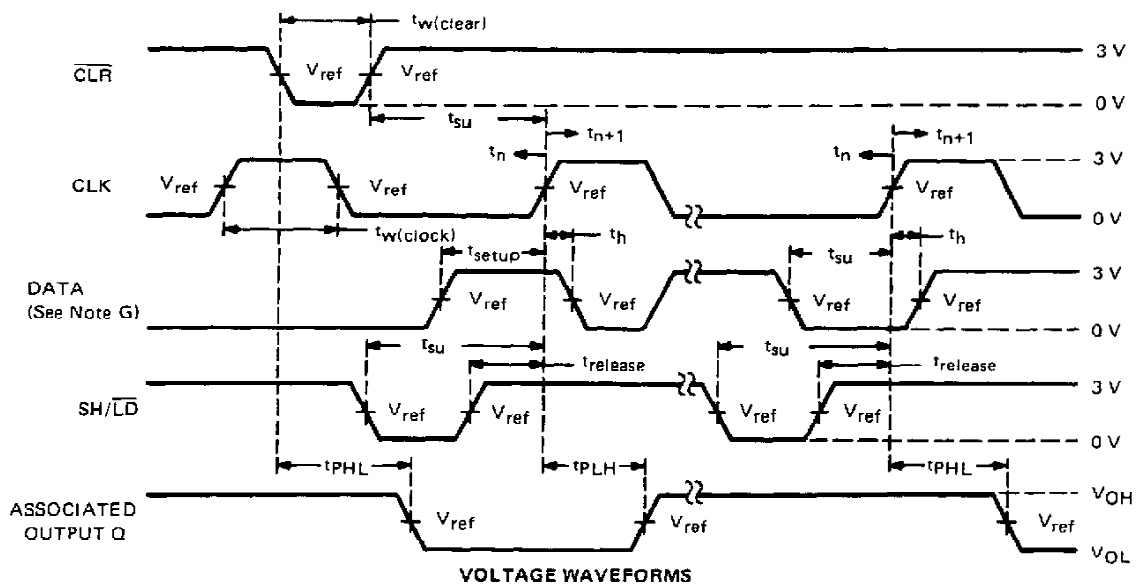
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**SN54195, SN54LS195A, SN54S195,
SN74195, SN74LS195A, SN74S195
4-BIT PARALLEL-ACCESS SHIFT REGISTERS**

PARAMETER MEASUREMENT INFORMATION



LOAD FOR OUTPUT UNDER TEST



VOLTAGE WAVEFORMS

- NOTES: A. The clock pulse generator has the following characteristics: $Z_{out} \approx 50 \Omega$ and $PRR \leq 1 \text{ MHz}$. 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 PRR.
- 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, $V_{ref} = 1.5 \text{ V}$; for 'LS195A, $V_{ref} = 1.3 \text{ V}$.
- 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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