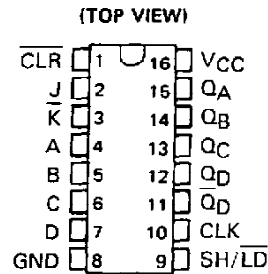


**SN54195, SN54LS195A, SN54S195,
SN74195, SN74LS195A, SN74S195**
4-BIT PARALLEL-ACCESS SHIFT REGISTERS
MARCH 1974—REVISED MARCH 1988

- 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



description

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

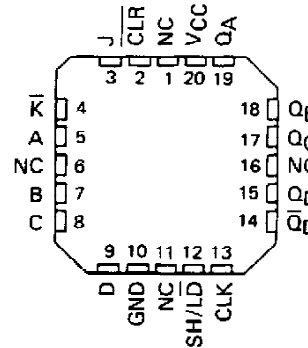
- Parallel (broadside) load
- Shift (in the direction QA toward QD)

Parallel loading is accomplished by applying the four bits of data and taking SH/ \bar{L}_D 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/ \bar{L}_D 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 J | SERIAL \bar{K} | PARALLEL A | PARALLEL B | PARALLEL C | PARALLEL D | QA | QB | QC | QD | \bar{Q}_D |
| L | X | X | X | X | X | X | X | L | L | L | L | H | |
| H | L | ↑ | X | X | a | b | c | d | a | b | c | d | \bar{d} |
| H | H | L | X | X | X | X | X | X | QA0 | QB0 | QC0 | QD0 | \bar{Q}_D0 |
| H | H | ↑ | L | H | X | X | X | X | QA0 | QA0 | QBn | QCn | \bar{Q}_Cn |
| H | H | ↑ | L | L | X | X | X | X | L | QA0 | QBn | QCn | \bar{Q}_Cn |
| H | H | ↑ | H | H | X | X | X | X | H | QA0 | QBn | QCn | \bar{Q}_Cn |
| H | H | ↑ | H | L | X | X | X | X | \bar{Q}_An | QA0 | QBn | QCn | \bar{Q}_Cn |

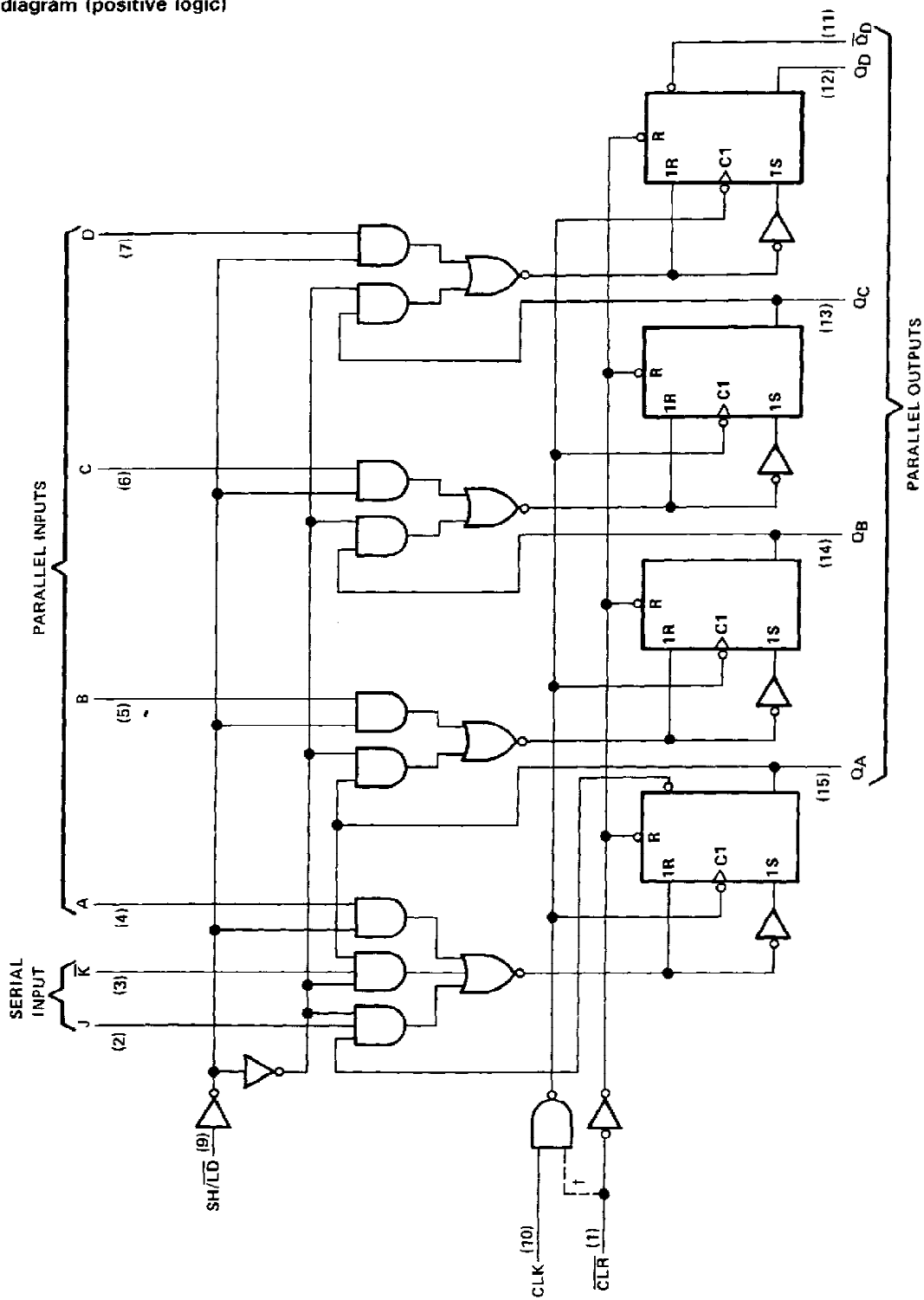
H = high level (steady state)
L = low level (steady state)
X = irrelevant (any input, including transitions)
↑ = transition from low to high level
a, b, c, d = the level of steady-state input at A, B, C, or D, respectively
QA0, QB0, QC0, QD0 = the level of QA, QB, QC, or QD, respectively, before the indicated steady-state input conditions were established
QA0, QB0, QC0 = the level of QA, QB, or QC, respectively, before the most-recent transition of the clock

PRODUCTION DATA documents contain information 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.



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

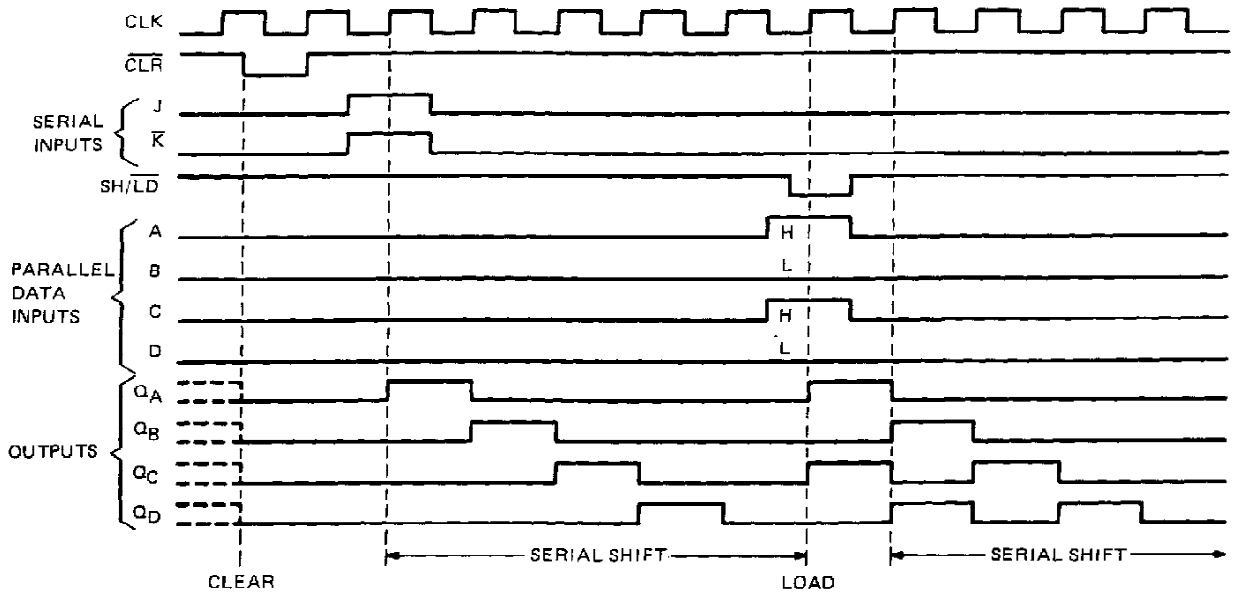
logic diagram (positive logic)



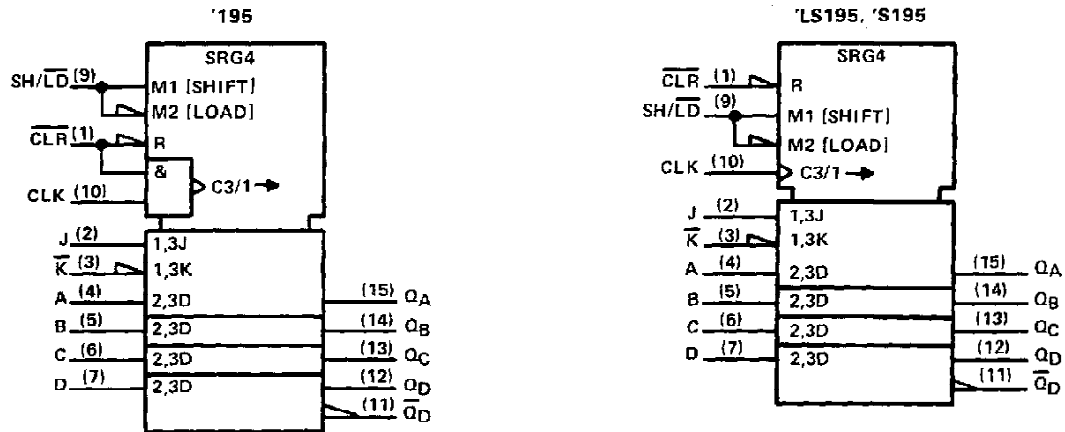
† This connection is made on '195 only.
Pin numbers shown are for D, J, N, and W packages.

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

typical clear, shift, and load sequences



logic symbols†

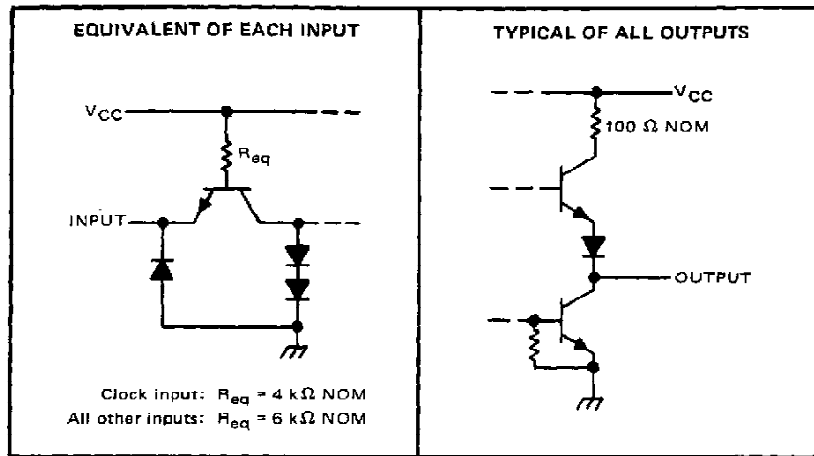


†These symbols are in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12. Pin numbers are for D, J, N, and W packages.

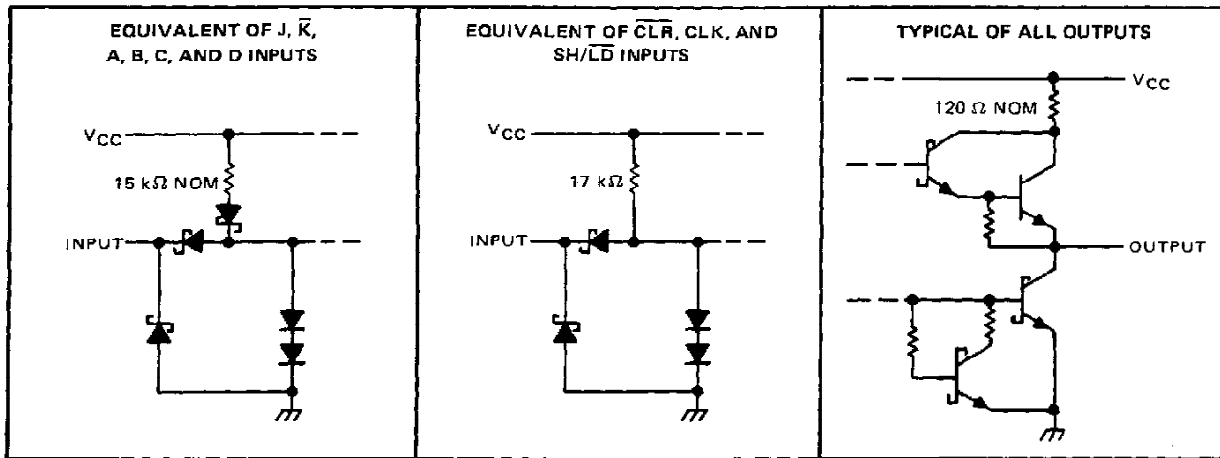
SN54195, SN54LS195A, SN54S195, SN74195, SN74LS195A, SN74S195
4-BIT PARALLEL-ACCESS SHIFT REGISTERS

schematics of inputs and outputs

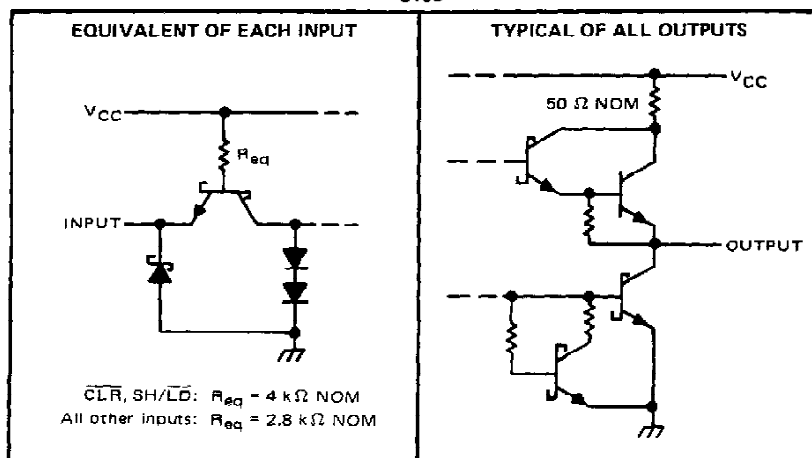
'195



'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 | μ A |
| Low-level output current, I_{OL} | | | 16 | | | 16 | mA |
| Clock frequency, f_{clock} | 0 | | 30 | 0 | | 30 | MHz |
| Width of clock input pulse, $t_w(\text{clock})$ | 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 | | 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 | | | ns |
| | Serial and parallel data | | | 15 | | | |
| | Clear inactive-state | | | 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 | °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 | $V_{CC} = \text{MIN}$, $I_I = -18 \text{ mA}$ | | | -1.5 | | -1.5 | V | |
| V_{OH} High-level output voltage | $V_{CC} = \text{MIN}$, $V_{IH} = 2 \text{ V}$, $V_{IL} = V_{IL \text{ max}}$, $I_{OH} = -400 \mu\text{A}$ | 2.5 | 3.4 | | 2.7 | 3.4 | V | |
| V_{OL} Low-level output voltage | $V_{CC} = \text{MIN}$, $V_{IH} = 2 \text{ V}$, $V_{IL} = V_{IL \text{ max}}$ | | 0.25 | 0.4 | | 0.25 | 0.4 | V |
| | | | | | | 0.35 | 0.5 | V |
| I_I Input current at maximum input voltage | $V_{CC} = \text{MAX}$, $V_I = 7 \text{ V}$ | | | 0.1 | | | 0.1 | mA |
| I_{IH} High-level input current | $V_{CC} = \text{MAX}$, $V_I = 2.7 \text{ V}$ | | | 20 | | | 20 | μ A |
| I_{IL} Low-level input current | $V_{CC} = \text{MAX}$, $V_I = 0.4 \text{ V}$ | | | -0.4 | | | -0.4 | mA |
| I_{OS} Short-circuit output current‡ | $V_{CC} = \text{MAX}$ | -20 | | -100 | -20 | | -100 | mA |
| I_{CC} Supply current | $V_{CC} = \text{MAX}$, 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, $t_w(\text{clock})$ | 7 | | | 7 | | | ns |
| Width of clear input pulse, $t_w(\text{clear})$ | 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 | $V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$ | | | | -1.2 | V |
| V_{OH} High-level output voltage | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OH} = -1 \text{ mA}$ | SN54S195 | 2.5 | 3.4 | | V |
| | | SN74S195 | 2.7 | 3.4 | | |
| V_{OL} Low-level output voltage | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OL} = 20 \text{ mA}$ | | | | 0.5 | 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 | $V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$ | | | | 50 | µA |
| I_{IL} Low-level input current | $V_{CC} = \text{MAX}, V_I = 0.5 \text{ V}$ | | | | -2 | mA |
| I_{OS} Short-circuit output current§ | $V_{CC} = \text{MAX}$ | | -40 | | -100 | mA |
| I_{CC} Supply current | $V_{CC} = \text{MAX},$ 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, $V_{CC} = 5 \text{ V}, T_A = 25^\circ \text{C}$

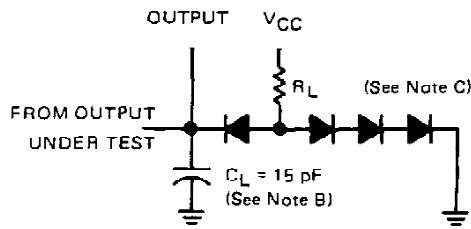
| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|--|-----|------|------|------|
| f_{max} Maximum clock frequency | $C_L = 15 \text{ pF}, R_L = 280 \Omega,$ See Figure 1 | 70 | 105 | | MHz |
| t_{PHL} Propagation delay time, high-to-low-level output from clear | | | 12.5 | 18.5 | ns |
|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


**TEXAS
INSTRUMENTS**

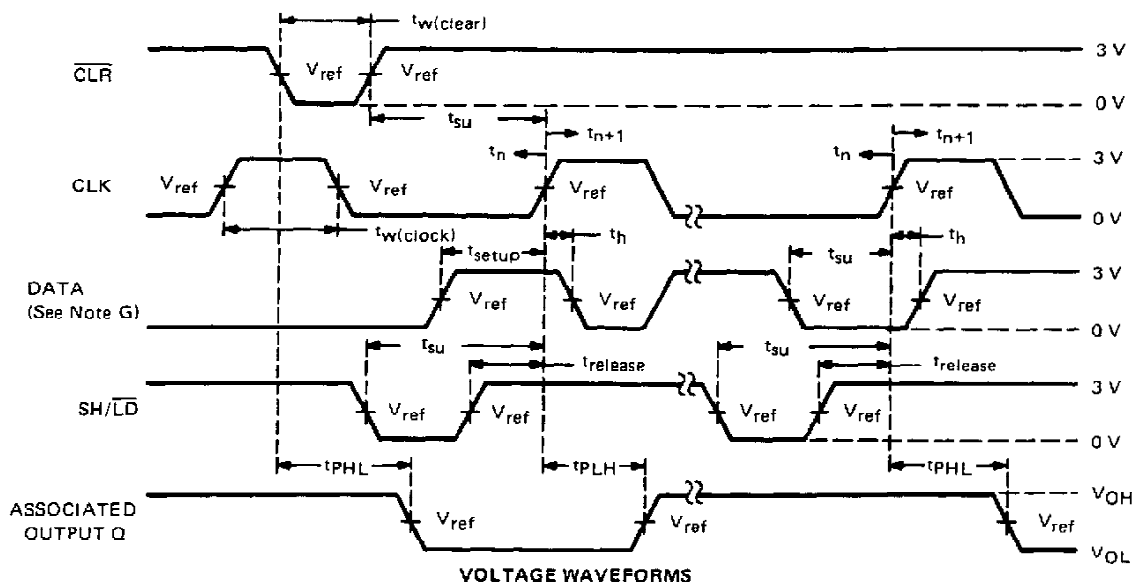
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**SN54195, SN54LS195A, SN54S195,
SN74195, SN74LS195A, SN74S195
4-BIT PARALLEL-ACCESS SHIFT REGISTERS**

PARAMETER MEASUREMENT INFORMATION



LOAD FOR OUTPUT UNDER TEST



- 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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