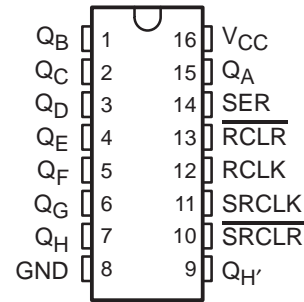


SN54LV594A, SN74LV594A 8-BIT SHIFT REGISTERS WITH OUTPUT REGISTERS

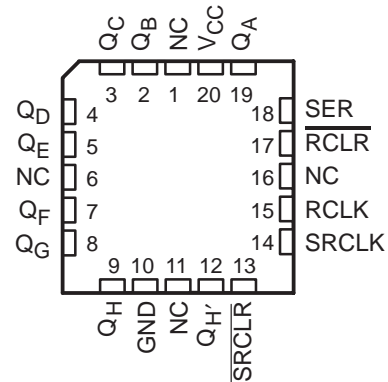
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- **EPIC™ (Enhanced-Performance Implanted CMOS) Process**
- **Typical V_{OLP} (Output Ground Bounce) <0.8 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$**
- **Typical V_{OHV} (Output V_{OH} Undershoot) >2.3 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$**
- **2-V to 5.5-V V_{CC} Operation**
- **Support Mixed-Mode Voltage Operation on All Ports**
- **8-Bit Serial-In, Parallel-Out Shift Registers With Storage**
- **Independent Direct Overriding Clears on Shift and Storage Registers**
- **Independent Clocks for Shift and Storage Registers**
- **Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II**
- **ESD Protection Exceeds JESD 22**
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)
- **Package Options Include Plastic Small-Outline (D, NS), Shrink Small-Outline (DB), and Thin Shrink Small-Outline (PW) Packages, Ceramic Flat (W) Packages, Chip Carriers (FK), and DIPs (J)**

SN54LV594A . . . J OR W PACKAGE
SN74LV594A . . . D, DB, NS, OR PW PACKAGE
(TOP VIEW)



SN54LV594A . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

description

The 'LV594A devices are 8-bit shift registers designed for 2-V to 5.5-V V_{CC} operation.

These devices contain an 8-bit serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. Separate clocks (RCLK, SRCLK) and direct overriding clear ($\overline{\text{RCLR}}$, $\overline{\text{SRCLR}}$) inputs are provided on the shift and storage registers. A serial output ($Q_{H'}$) is provided for cascading purposes.

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

The SN54LV594A is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74LV594A is characterized for operation from -40°C to 85°C .



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**TEXAS
INSTRUMENTS**

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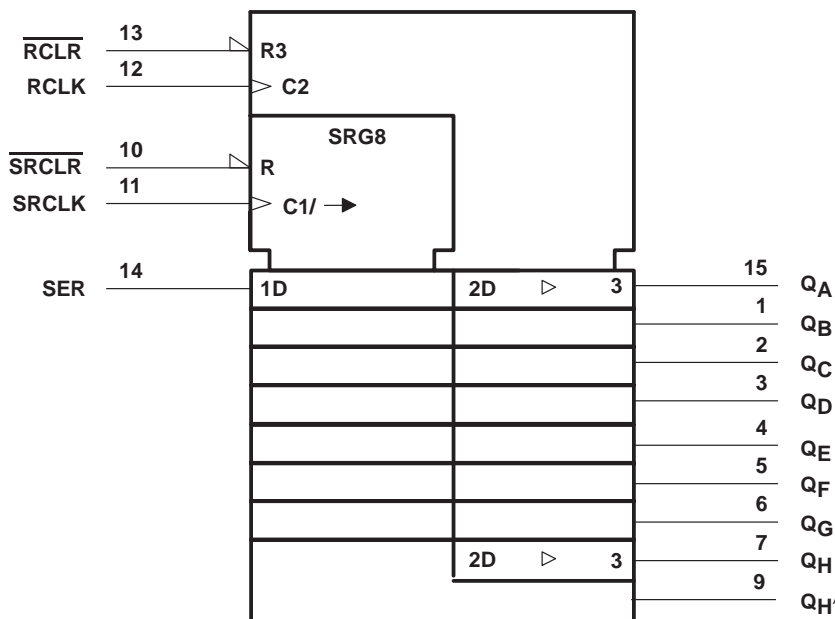
SN54LV594A, SN74LV594A 8-BIT SHIFT REGISTERS WITH OUTPUT REGISTERS

SCLS413C – APRIL 1998 – REVISED MAY 2000

FUNCTION TABLE

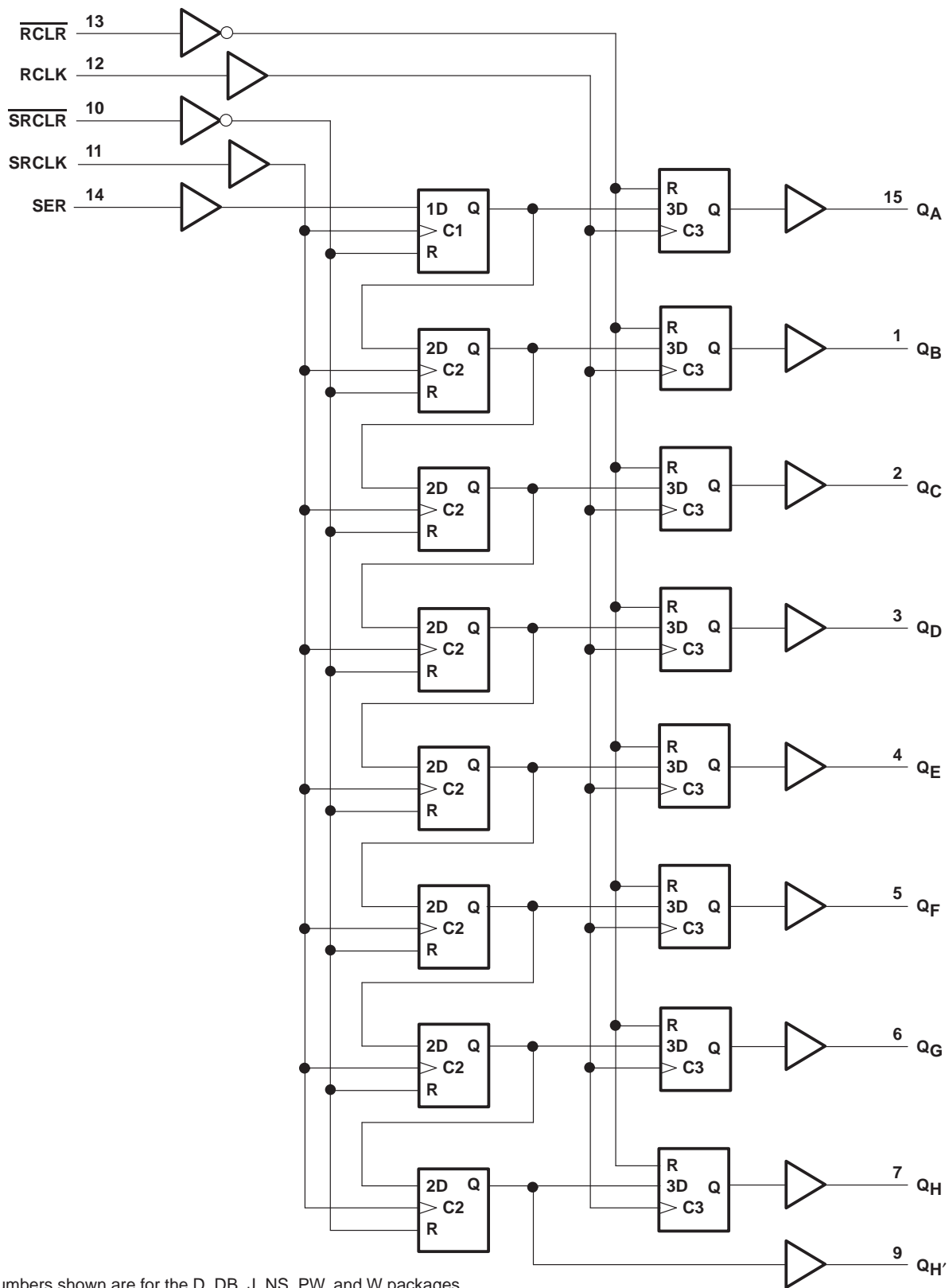
| INPUTS | | | | | FUNCTION |
|--------|-------|-------|------|------|--|
| SER | SRCLK | SRCLR | RCLK | RCLR | |
| X | X | L | X | X | Shift register is cleared. |
| L | ↑ | H | X | X | First stage of shift register goes low. Other stages store the data of previous stage, respectively. |
| H | ↑ | H | X | X | First stage of shift register goes high. Other stages store the data of previous stage, respectively. |
| L | ↓ | H | X | X | Shift register state is not changed. |
| X | X | X | X | L | Storage register is cleared. |
| X | X | X | ↑ | H | Shift register data is stored in the storage register. |
| X | X | X | ↓ | H | 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, NS, PW, and W packages.

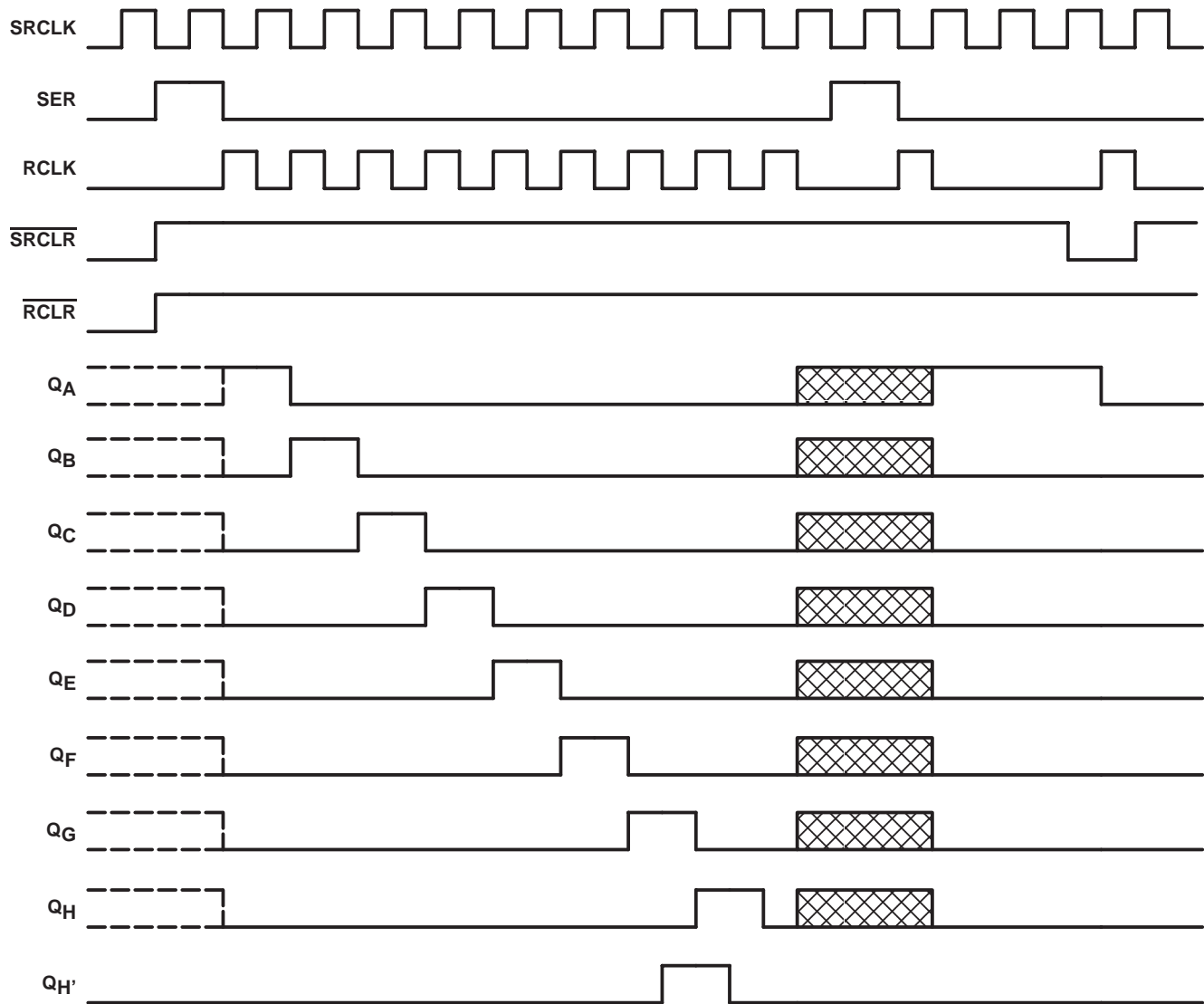
logic diagram (positive logic)



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

SN54LV594A, SN74LV594A
8-BIT SHIFT REGISTERS
WITH OUTPUT REGISTERS
SCLS413C – APRIL 1998 – REVISED MAY 2000

timing diagram



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, 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} ($V_O < 0$ or $V_O > V_{CC}$) | ±50 mA |
| Continuous output current, I_O ($V_O = 0$ to V_{CC}) | ±25 mA |
| Continuous current through V_{CC} or GND | ±50 mA |
| Package thermal impedance, θ_{JA} (see Note 3): D package | 73°C/W |
| DB package | 82°C/W |
| NS package | 64°C/W |
| PW package | 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 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.

SN54LV594A, SN74LV594A 8-BIT SHIFT REGISTERS WITH OUTPUT REGISTERS

SCLS413C – APRIL 1998 – REVISED MAY 2000

recommended operating conditions (see Note 4)

| | | SN54LV594A | | SN74LV594A | | 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} = 2.3 V to 2.7 V | V _{CC} × 0.7 | V _{CC} × 0.7 | | | |
| | | V _{CC} = 3 V to 3.6 V | V _{CC} × 0.7 | V _{CC} × 0.7 | | | |
| | | V _{CC} = 4.5 V to 5.5 V | V _{CC} × 0.7 | V _{CC} × 0.7 | | | |
| V _{IL} | Low-level input voltage | V _{CC} = 2 V | 0.5 | 0.5 | | V | |
| | | V _{CC} = 2.3 V to 2.7 V | V _{CC} × 0.3 | V _{CC} × 0.3 | | | |
| | | V _{CC} = 3 V to 3.6 V | V _{CC} × 0.3 | V _{CC} × 0.3 | | | |
| | | V _{CC} = 4.5 V to 5.5 V | V _{CC} × 0.3 | V _{CC} × 0.3 | | | |
| 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} = 2.3 V to 2.7 V | | -2 | -2 | mA | |
| | | V _{CC} = 3 V to 3.6 V | | -6 | -6 | | |
| | | V _{CC} = 4.5 V to 5.5 V | | -12 | -12 | | |
| I _{OL} | Low-level output current | V _{CC} = 2 V | | 50 | 50 | μA | |
| | | V _{CC} = 2.3 V to 2.7 V | | 2 | 2 | mA | |
| | | V _{CC} = 3 V to 3.6 V | | 6 | 6 | | |
| | | V _{CC} = 4.5 V to 5.5 V | | 12 | 12 | | |
| Δt/Δv | Input transition rise or fall rate | V _{CC} = 2.3 V to 2.7 V | 0 | 200 | 0 | 200 | ns/V |
| | | V _{CC} = 3 V to 3.6 V | 0 | 100 | 0 | 100 | |
| | | V _{CC} = 4.5 V to 5.5 V | 0 | 20 | 0 | 20 | |
| T _A | Operating free-air temperature | -55 | 125 | -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.

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

| PARAMETER | TEST CONDITIONS | V _{CC} | SN54LV594A | | | SN74LV594A | | | UNIT |
|------------------|---|-----------------|----------------------|-----|-----|----------------------|-----|-----|------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| V _{OH} | I _{OH} = -50 μA | 2 V to 5.5 V | V _{CC} -0.1 | | | V _{CC} -0.1 | | | V |
| | I _{OH} = -2 mA | 2.3 V | 2 | | | 2 | | | |
| | I _{OH} = -6 mA | 3 V | 2.48 | | | 2.48 | | | |
| | I _{OH} = -12 mA | 4.5 V | 3.8 | | | 3.8 | | | |
| V _{OL} | I _{OL} = 50 μA | 2 V to 5.5 V | 0.1 | | | 0.1 | | | V |
| | I _{OL} = 2 mA | 2.3 V | 0.4 | | | 0.4 | | | |
| | I _{OL} = 6 mA | 3 V | 0.44 | | | 0.44 | | | |
| | I _{OL} = 12 mA | 4.5 V | 0.55 | | | 0.55 | | | |
| I _I | V _I = V _{CC} or GND | 0 V to 5.5 V | ±1 | | | ±1 | | | μA |
| I _{CC} | V _I = V _{CC} or GND, I _O = 0 | 5.5 V | 20 | | | 20 | | | μA |
| I _{off} | V _I or V _O = 0 to 5.5 V | 0 V | 5 | | | 5 | | | μA |
| C _i | V _I = V _{CC} or GND | 3.3 V | 3.5 | | | 3.5 | | | pF |

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

| | | $T_A = 25^\circ\text{C}$ | | SN54LV594A | | SN74LV594A | | UNIT |
|----------|----------------|---|-----|------------|-----|------------|-----|------|
| | | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_w | Pulse duration | RCLK or SRCLK high or low | | 7 | 7.5 | 7.5 | | ns |
| | | RCLR or SRCLR low | | 6 | 6.5 | 6.5 | | |
| t_{su} | Setup time | SER before SRCLK \uparrow | | 2.5 | 3 | 3 | | ns |
| | | SRCLK \uparrow before RCLK \uparrow \dagger | | 8 | 9 | 9 | | |
| | | SRCLR low before RCLK \uparrow | | 8.5 | 9.5 | 9.5 | | |
| | | SRCLR high (inactive) before SRCLK \uparrow | | 6 | 6.8 | 6.8 | | |
| | | RCLR high (inactive) before RCLK \uparrow | | 6.7 | 7.6 | 7.6 | | |
| t_h | Hold time | SER after SRCLK \uparrow | | 1.5 | 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, $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ (unless otherwise noted) (see Figure 1)

| | | $T_A = 25^\circ\text{C}$ | | SN54LV594A | | SN74LV594A | | UNIT |
|----------|----------------|---|-----|------------|-----|------------|-----|------|
| | | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_w | Pulse duration | RCLK or SRCLK high or low | | 5.5 | 5.5 | 5.5 | | ns |
| | | RCLR or SRCLR low | | 5 | 5 | 5 | | |
| t_{su} | Setup time | SER before SRCLK \uparrow | | 3.5 | 3.5 | 3.5 | | ns |
| | | SRCLK \uparrow before RCLK \uparrow \dagger | | 8 | 8.5 | 8.5 | | |
| | | SRCLR low before RCLK \uparrow | | 8 | 9 | 9 | | |
| | | SRCLR high (inactive) before SRCLK \uparrow | | 4.2 | 4.8 | 4.8 | | |
| | | RCLR high (inactive) before RCLK \uparrow | | 4.6 | 5.3 | 5.3 | | |
| t_h | Hold time | SER after SRCLK \uparrow | | 1.5 | 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)

| | | $T_A = 25^\circ\text{C}$ | | SN54LV594A | | SN74LV594A | | UNIT |
|----------|----------------|---|-----|------------|-----|------------|-----|------|
| | | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_w | Pulse duration | RCLK or SRCLK high or low | | 5 | 5 | 5 | | ns |
| | | RCLR or SRCLR low | | 5.2 | 5.2 | 5.2 | | |
| t_{su} | Setup time | SER before SRCLK \uparrow | | 3 | 3 | 3 | | ns |
| | | SRCLK \uparrow before RCLK \uparrow \dagger | | 5 | 5 | 5 | | |
| | | SRCLR low before RCLK \uparrow | | 5 | 5 | 5 | | |
| | | SRCLR high (inactive) before SRCLK \uparrow | | 2.9 | 3.3 | 3.3 | | |
| | | RCLR high (inactive) before RCLK \uparrow | | 3.2 | 3.7 | 3.7 | | |
| t_h | Hold time | SER after SRCLK \uparrow | | 2 | 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.

SN54LV594A, SN74LV594A 8-BIT SHIFT REGISTERS WITH OUTPUT REGISTERS

SCLS413C – APRIL 1998 – REVISED MAY 2000

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 | $T_A = 25^\circ\text{C}$ | | | SN54LV594A | | SN74LV594A | | UNIT |
|------------|---------------------------|-------------|----------------------|--------------------------|------|-------|------------|-------|------------|------|------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| f_{\max} | | | $C_L = 15\text{ pF}$ | 65* | 80* | | 45* | | 45 | | MHz |
| | | | $C_L = 50\text{ pF}$ | 60 | 70 | | 40 | | 40 | | |
| t_{PLH} | RCLK | Q_A-Q_H | $C_L = 15\text{ pF}$ | | 6.4* | 10.6* | 1* | 11.1* | 1 | 11.1 | ns |
| t_{PHL} | | | | | 6.3* | 10.4* | 1* | 11.1* | 1 | 11.1 | |
| t_{PLH} | SRCLK | Q_H' | | | 7.4* | 12.1* | 1* | 12.8* | 1 | 12.8 | |
| t_{PHL} | | | | | 7.2* | 11.6* | 1* | 12.8* | 1 | 12.8 | |
| t_{PHL} | $\overline{\text{RCLR}}$ | Q_A-Q_H | | | 7.9* | 12.7* | 1* | 13.6* | 1 | 13.6 | |
| t_{PHL} | $\overline{\text{SRCLR}}$ | Q_H' | | | 7.4* | 11.9* | 1* | 13.1* | 1 | 13.1 | |
| t_{PLH} | RCLK | Q_A-Q_H | $C_L = 50\text{ pF}$ | | 9.5 | 14.1 | 1 | 14.6 | 1 | 14.6 | ns |
| t_{PHL} | | | | | 10.8 | 15.5 | 1 | 17.2 | 1 | 17.2 | |
| t_{PLH} | SRCLK | Q_H' | | | 10.6 | 15.7 | 1 | 16.5 | 1 | 16.5 | |
| t_{PHL} | | | | | 11.3 | 16.1 | 1 | 18.6 | 1 | 18.6 | |
| t_{PHL} | $\overline{\text{RCLR}}$ | Q_A-Q_H | | | 12.1 | 17.4 | 1 | 19 | 1 | 19 | |
| t_{PHL} | $\overline{\text{SRCLR}}$ | Q_H' | | | 11.6 | 16.5 | 1 | 18.6 | 1 | 18.6 | |

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

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 | $T_A = 25^\circ\text{C}$ | | | SN54LV594A | | SN74LV594A | | 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 | $C_L = 15\text{ pF}$ | | 4.6* | 8* | 1* | 8.5* | 1 | 8.5 | ns |
| t_{PHL} | | | | | 4.9* | 8.2* | 1* | 8.8* | 1 | 8.8 | |
| t_{PLH} | SRCLK | Q_H' | | | 5.4* | 9.1* | 1* | 9.7* | 1 | 9.7 | |
| t_{PHL} | | | | | 5.5* | 9.2* | 1* | 9.9* | 1 | 9.9 | |
| t_{PHL} | $\overline{\text{RCLR}}$ | Q_A-Q_H | | | 6* | 9.8* | 1* | 10.6* | 1 | 10.6 | |
| t_{PHL} | $\overline{\text{SRCLR}}$ | Q_H' | | | 5.6* | 9.2* | 1* | 10* | 1 | 10 | |
| t_{PLH} | RCLK | Q_A-Q_H | $C_L = 50\text{ pF}$ | | 6.9 | 10.5 | 1 | 11.1 | 1 | 11.1 | ns |
| t_{PHL} | | | | | 8.1 | 11.9 | 1 | 13.1 | 1 | 13.1 | |
| t_{PLH} | SRCLK | Q_H' | | | 7.7 | 11.7 | 1 | 12.4 | 1 | 12.4 | |
| t_{PHL} | | | | | 8.4 | 12.5 | 1 | 13.9 | 1 | 13.9 | |
| t_{PHL} | $\overline{\text{RCLR}}$ | Q_A-Q_H | | | 9.1 | 13.1 | 1 | 14.4 | 1 | 14.4 | |
| t_{PHL} | $\overline{\text{SRCLR}}$ | Q_H' | | | 8.5 | 12.4 | 1 | 14 | 1 | 14 | |

* 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 | $T_A = 25^\circ\text{C}$ | | | SN54LV594A | | SN74LV594A | | UNIT | | |
|------------------|---------------------------|-------------|----------------------|--------------------------|------|------|------------|------|------------|------|------|------|----|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | | | |
| f_{max} | | | $C_L = 15\text{ pF}$ | 135* | 170* | | 115* | | 115 | | MHz | | |
| | | | $C_L = 50\text{ pF}$ | 120 | 140 | | 95 | | 95 | | | | |
| t_{PLH} | RCLK | Q_A-Q_H | $C_L = 15\text{ pF}$ | | 3.3* | 6.2* | 1* | 6.5* | 1 | 6.5 | ns | | |
| t_{PHL} | | | | | 3.7* | 6.5* | 1* | 6.9* | 1 | 6.9 | | | |
| t_{PLH} | SRCLK | Q_H' | | | 3.7* | 6.8* | 1* | 7.2* | 1 | 7.2 | | | |
| t_{PHL} | | | | | 4.1* | 7.2* | 1* | 7.6* | 1 | 7.6 | | | |
| t_{PHL} | $\overline{\text{RCLR}}$ | Q_A-Q_H | | | 4.5* | 7.6* | 1* | 8.2* | 1 | 8.2 | | | |
| t_{PHL} | $\overline{\text{SRCLR}}$ | Q_H' | | | 4.1* | 7.1* | 1* | 7.6* | 1 | 7.6 | | | |
| t_{PLH} | RCLK | Q_A-Q_H | | $C_L = 50\text{ pF}$ | | 4.9 | 7.8 | 1 | 8.3 | 1 | | 8.3 | ns |
| t_{PHL} | | | | | | 5.8 | 8.9 | 1 | 9.7 | 1 | | 9.7 | |
| t_{PLH} | SRCLK | Q_H' | | | | 5.5 | 8.6 | 1 | 9.1 | 1 | | 9.1 | |
| t_{PHL} | | | | | | 6 | 9.2 | 1 | 10.1 | 1 | | 10.1 | |
| t_{PHL} | $\overline{\text{RCLR}}$ | Q_A-Q_H | | | 6.6 | 10 | 1 | 10.7 | 1 | 10.7 | | | |
| t_{PHL} | $\overline{\text{SRCLR}}$ | Q_H' | | | 6 | 9.2 | 1 | 10.1 | 1 | 10.1 | | | |

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

noise characteristics, $V_{CC} = 3.3\text{ V}$, $C_L = 50\text{ pF}$, $T_A = 25^\circ\text{C}$ (see Note 5)

| PARAMETER | | SN74LV594A | | | UNIT |
|-------------|--|------------|------|------|------|
| | | MIN | TYP | MAX | |
| $V_{OL(P)}$ | Quiet output, maximum dynamic V_{OL} | | 0.5 | 0.8 | V |
| $V_{OL(V)}$ | Quiet output, minimum dynamic V_{OL} | | -0.1 | -0.8 | 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.

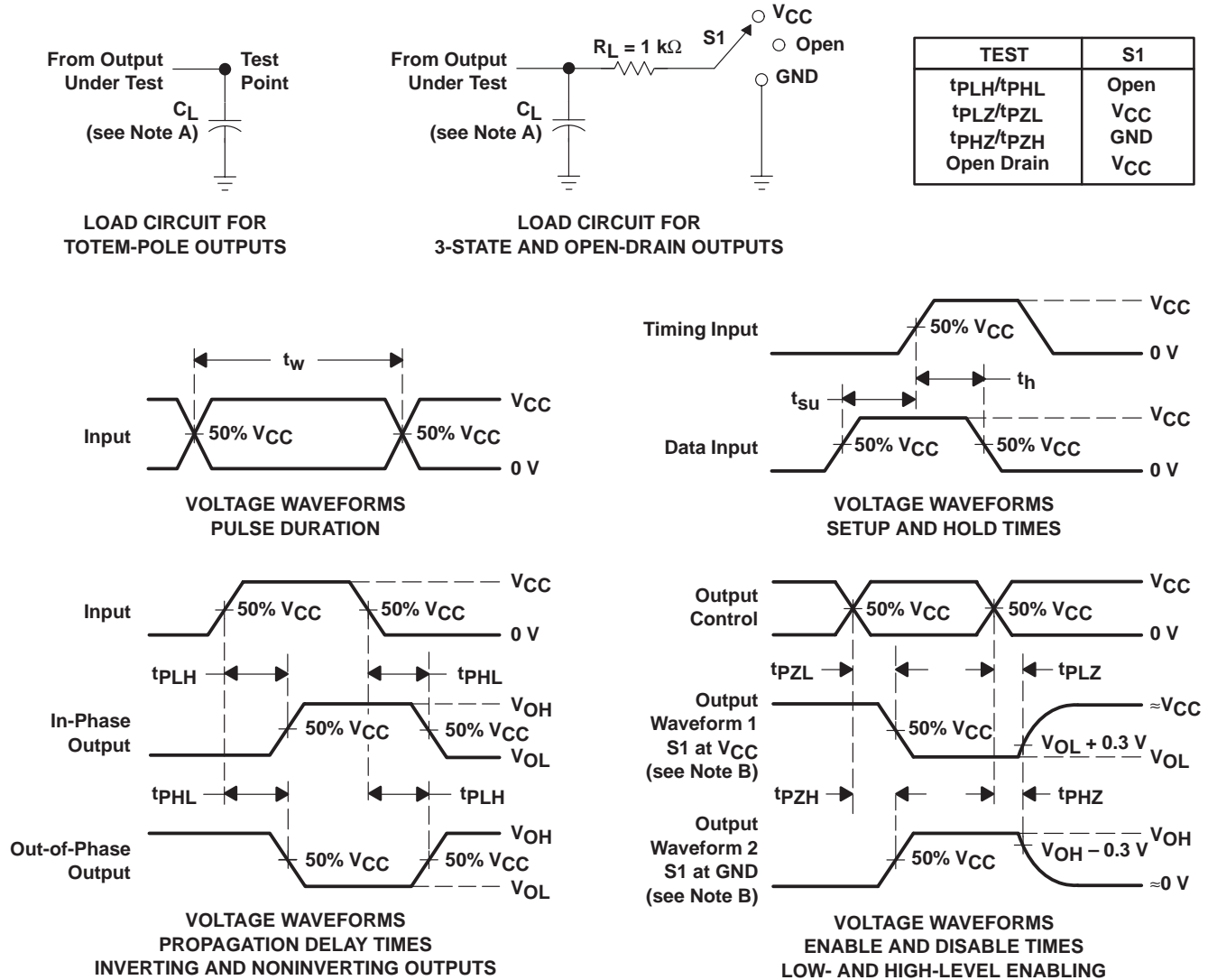
operating characteristics, $T_A = 25^\circ\text{C}$

| PARAMETER | | TEST CONDITIONS | V_{CC} | TYP | UNIT |
|-----------|-----|-----------------|-----------------|-------------------------------|------|
| | | | C_{pd} | Power dissipation capacitance | |
| 5 V | 112 | | | | |

SN54LV594A, SN74LV594A 8-BIT SHIFT REGISTERS WITH OUTPUT REGISTERS

SCLS413C – APRIL 1998 – REVISED MAY 2000

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} .

Figure 1. Load Circuit and Voltage Waveforms

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