

## 1. DESCRIPTION

These bidirectional shift registers are designed to incorporate virtually all of the features a system designer may want in a shift register. The circuit contains 46 equivalent gates and features parallel inputs, parallel outputs, right-shift and left-shift serial inputs, operating-mode-control inputs, and a direct overriding clear line. The register has four distinct modes of operation, namely:

- Inhibit clock (do nothing)
- Shift right (in the direction QA toward QD)
- Shift left (in the direction QD toward QA)
- Parallel (broadside) load

Synchronous parallel loading is accomplished by applying the four bits of data and taking both mode control inputs, S0 and S1, high. The data are loaded into the associated flip-flops and appear at the outputs after the positive transition of the clock input. During loading, serial data flow is inhibited.

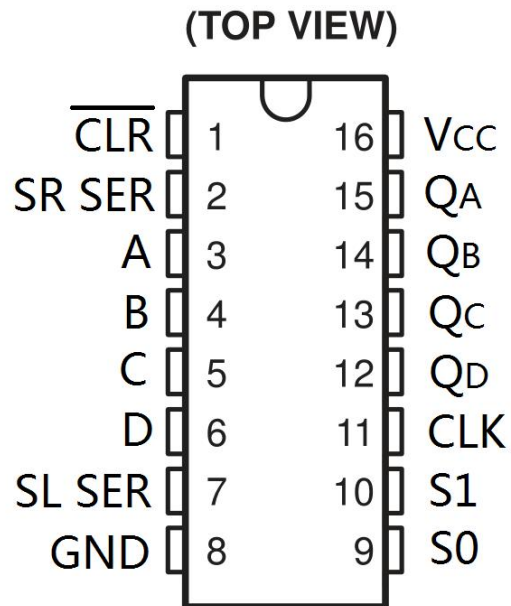
Shift right is accomplished synchronously with the rising edge of the clock pulse when S0 is high and S1 is low. Serial data for this mode is entered at the shift-right data input. When S0 is low and S1 is high, data shifts left synchronously and new data is entered at the shift-left serial input.

Clocking of the shift register is inhibited when both mode control inputs are low.

## 2. FEATURES

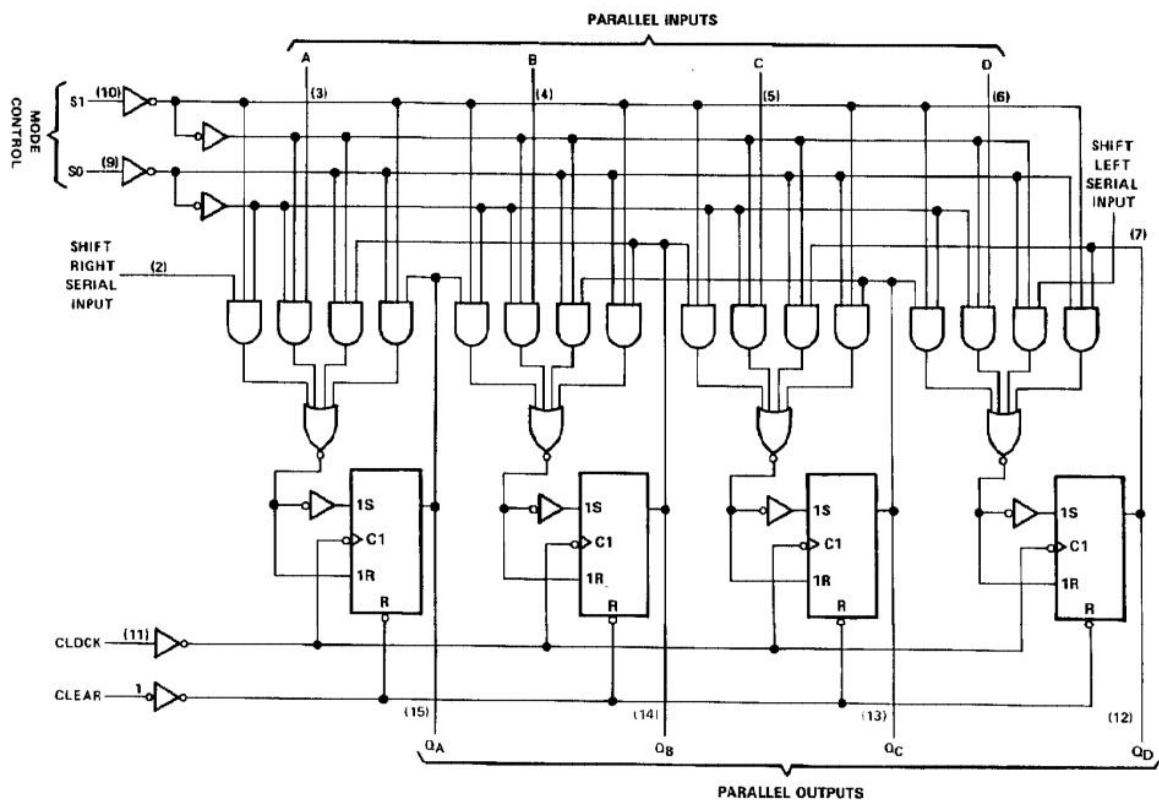
- Parallel Inputs and Outputs
- Four Operating Modes:
  - Synchronous Parallel Load
  - Right Shift
  - Left Shift
  - Do Nothing
- Positive Edge-Triggered Clocking
- Direct Overriding Clear

## 3. PIN CONFIGURATIONS

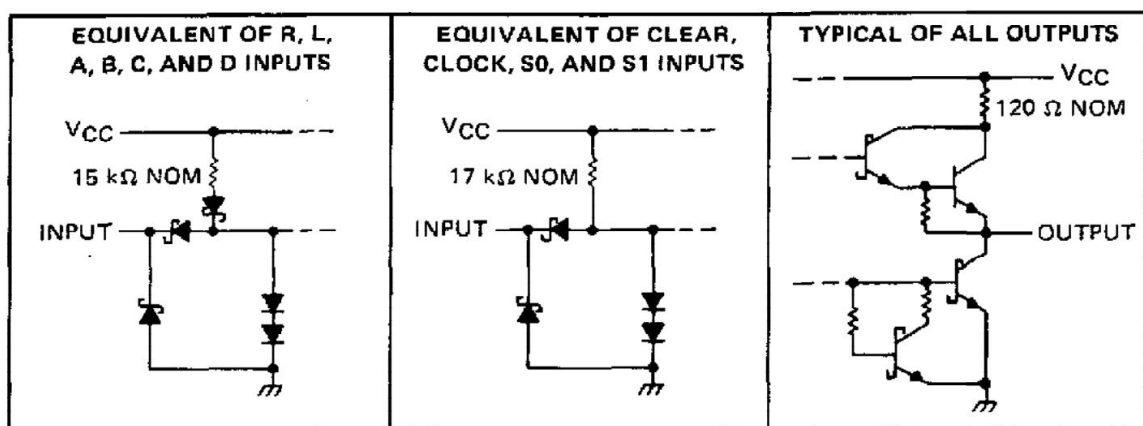


| INPUTS |      |    |       |        |       |          |   |   |   | OUTPUTS |     |     |     |
|--------|------|----|-------|--------|-------|----------|---|---|---|---------|-----|-----|-----|
| CLEAR  | MODE |    | CLOCK | SERIAL |       | PARALLEL |   |   |   | QA      | QB  | QC  | QD  |
|        | S1   | S0 |       | LEFT   | RIGHT | A        | B | C | D |         |     |     |     |
| L      | X    | X  | X     | X      | X     | X        | X | X | X | L       | L   | L   | L   |
| H      | X    | X  | L     | X      | X     | X        | X | X | X | QA0     | QB0 | QC0 | QD0 |
| H      | H    | H  | ↑     | X      | X     | a        | b | c | d | a       | b   | c   | d   |
| H      | L    | H  | ↑     | X      | H     | X        | X | X | X | H       | QAn | QBn | QCn |
| H      | L    | H  | ↑     | X      | L     | X        | X | X | X | L       | QAn | QBn | QCn |
| H      | H    | L  | ↑     | H      | X     | X        | X | X | X | QBn     | QCn | QDn | H   |
| H      | H    | L  | ↑     | L      | X     | X        | X | X | X | QBn     | QCn | QDn | L   |
| H      | L    | L  | X     | X      | X     | X        | X | X | X | QA0     | QB0 | QC0 | QD0 |

#### 4. LOGIC DIAGRAM



#### 5. SCHEMATICS OF INPUTS AND OUTPUTS



**6. ABSOLUTE MAXIMUM RATINGS OVER OPERATING FREE-AIR TEMPERATURE RANGE (UNLESS OTHERWISE NOTES)**

|                                                        |                |
|--------------------------------------------------------|----------------|
| Supply voltage, $V_{CC}$ .....                         | 7V             |
| Input voltage, $V_I$ : 74LS194.....                    | 7V             |
| Operating free-air temperature range: DIP package..... | 0°C to 70°C    |
| Storage temperature range, $T_{stg}$ .....             | -65°C to 150°C |

## 7. RECOMMENDED OPERATING CONDITIONS

|                    |                                      | 74LS194 |     |      | UNIT |
|--------------------|--------------------------------------|---------|-----|------|------|
|                    |                                      | MIN     | NOM | MAX  |      |
| V <sub>CC</sub>    | Supply voltage                       | 4.75    | 5   | 5.25 | V    |
| I <sub>OH</sub>    | High-level output current            |         |     | -400 | μA   |
| I <sub>OL</sub>    | Low-level output current             |         |     | 8    | mA   |
| f <sub>clock</sub> | Clock frequency                      | 0       |     | 25   | MHz  |
| t <sub>w</sub>     | Width of any input pulse             | 20      |     |      | ns   |
| t <sub>su</sub>    | Clear inactive-state setup time      | 30      |     |      | ns   |
|                    | Load inactive-state setup time       | 20      |     |      | ns   |
|                    | Data setup time                      | 25      |     |      | ns   |
| t <sub>h</sub>     | Data hold time                       | 0       |     |      | ns   |
| T <sub>A</sub>     | Operating free-air temperature range | 0       |     | 70   | °C   |

## 8. ELECTRICAL CHARACTERISTICS OVER RECOMMENDED OPERATING FREE-AIR RANGE (UNLESS OTHERWISE NOTED)

| PARAMETER       |                                           | TEST CONDITIONS <sup>†</sup>                                                                                   | 74LS194                |                  |      | UNIT |
|-----------------|-------------------------------------------|----------------------------------------------------------------------------------------------------------------|------------------------|------------------|------|------|
|                 |                                           |                                                                                                                | MIN                    | TYP <sup>‡</sup> | MAX  |      |
| V <sub>IH</sub> | High-level input voltage                  |                                                                                                                | 2                      |                  |      | V    |
| V <sub>IL</sub> | Low-level input voltage                   |                                                                                                                |                        |                  | 0.8  | V    |
| V <sub>IK</sub> | Input clamp voltage                       | V <sub>CC</sub> = MIN, I <sub>I</sub> = -18 mA                                                                 |                        |                  | -1.5 | V    |
| V <sub>OH</sub> | High-level output voltage                 | V <sub>CC</sub> = MIN, V <sub>IL</sub> = V <sub>IL</sub> MAX, V <sub>IH</sub> = 2 V, I <sub>OH</sub> = -400 μA | 2.7                    | 3.5              |      | V    |
| V <sub>OL</sub> | Low-level output voltage                  | V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = V <sub>IL</sub> MAX                            | I <sub>OL</sub> = 4 mA |                  | 0.25 | V    |
|                 |                                           |                                                                                                                | I <sub>OL</sub> = 8 mA |                  | 0.35 |      |
| I <sub>I</sub>  | Input current at maximum input voltage    | V <sub>CC</sub> = MAX, V <sub>I</sub> = 7 V                                                                    |                        |                  | 0.1  | mA   |
| I <sub>IH</sub> | High-level input current                  | V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V                                                                  |                        |                  | 20   | μA   |
| I <sub>IL</sub> | Low-level input current                   | V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V                                                                  |                        |                  | -0.4 | mA   |
| I <sub>OS</sub> | Short-circuit output current <sup>§</sup> | V <sub>CC</sub> = MAX                                                                                          | -20                    |                  | -100 | mA   |
| I <sub>CC</sub> | Supply current                            | V <sub>CC</sub> = MAX                                                                                          |                        | 15               | 23   | mA   |

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

<sup>‡</sup> All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

<sup>§</sup> Not more than one output should be shorted at a time.

## 9. SWITCHING CHARACTERISTICS, $V_{CC} = 5\text{ V}$ , $T_A = 25^\circ\text{C}$

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

| PARAMETER <sup>†</sup> |                                                             | TEST CONDITIONS                                    | MIN | TYP | MAX | UNIT |
|------------------------|-------------------------------------------------------------|----------------------------------------------------|-----|-----|-----|------|
| $f_{MAX}$              | Maximum clock frequency                                     | $C_L = 15\text{ pF}$ ,<br>$R_L = 2\text{ k}\Omega$ | 25  | 36  |     | 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 clear |                                                    |     | 14  | 22  | ns   |
| $t_{PHL}$              | Propagation delay time, high-to-low-level output from clear |                                                    |     | 17  | 26  | ns   |

<sup>†</sup>  $t_{PLH}$  = propagation delay time, low-to-high-level output

$t_{PHL}$  = propagation delay time, high-to-low-level output

## 10. ORDERING INFORMATION

Ordering Information

| Part Number | Device Marking | Package Type | Body size (mm) | Temperature (°C) | MSL  | Transport Media | Package Quantity |
|-------------|----------------|--------------|----------------|------------------|------|-----------------|------------------|
| XD74LS194   | XD74LS194      | DIP16        | 19.05 * 6.35   | -0 to 70         | MSL3 | Tube 25         | 1000             |

## 11. DIMENSIONAL DRAWINGS

