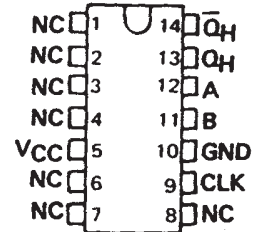


# SN5491A, SN54LS91, SN7491A, SN74LS91 8-BIT SHIFT REGISTERS

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- For applications in:  
Digital Computer Systems  
Data-Handling Systems  
Control Systems

SN5491A, SN54LS91 . . . J PACKAGE  
SN7491A . . . N PACKAGE  
SN74LS91 . . . D OR N PACKAGE  
(TOP VIEW)

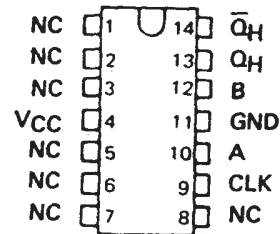


| TYPE  | TYPICAL<br>MAXIMUM<br>CLOCK<br>FREQUENCY | TYPICAL<br>POWER<br>DISSIPATION |
|-------|------------------------------------------|---------------------------------|
| '91A  | 18 MHz                                   | 175 mW                          |
| 'LS91 | 18 MHz                                   | 60 mW                           |

## description

These monolithic serial-in, serial-out, 8-bit shift registers utilize transistor-transistor logic (TTL) circuits and are composed of eight R-S master-slave flip-flops, input gating, and a clock driver. Single-rail data and input control are gated through inputs A and B and an internal inverter to form the complementary inputs to the first bit of the shift register. Drive for the internal common clock line is provided by an inverting clock driver. This clock pulse inverter/driver causes these circuits to shift information one bit on the positive edge of an input clock pulse.

SN5491A, SN54LS91 . . . W PACKAGE  
(TOP VIEW)



NC – No internal connection

## schematics of inputs and outputs

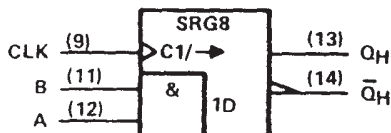
FUNCTION TABLE

| INPUTS<br>AT $t_n$ |   | OUTPUTS<br>AT $t_n + 8$ |             |
|--------------------|---|-------------------------|-------------|
| A                  | B | $Q_H$                   | $\bar{Q}_H$ |
| H                  | H | H                       | L           |
| L                  | X | L                       | H           |
| X                  | L | L                       | H           |

$t_n$  = Reference bit time,  
clock low

$t_n + 8$  = Bit time after 8  
low-to-high  
clock transitions.

## logic symbol†



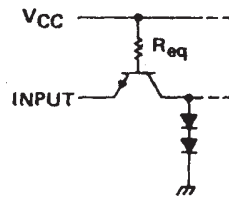
†This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

'91A

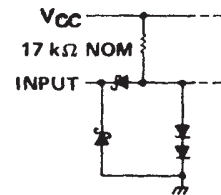
'LS91

EQUIVALENT OF EACH INPUT

EQUIVALENT OF EACH INPUT



'91A:  $R_{eq} = 4 \text{ k}\Omega \text{ NOM}$

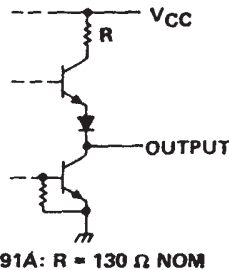


'91A

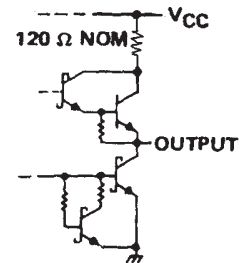
'LS91

TYPICAL OF BOTH OUTPUTS

TYPICAL OF BOTH OUTPUTS



'91A:  $R = 130 \Omega \text{ NOM}$

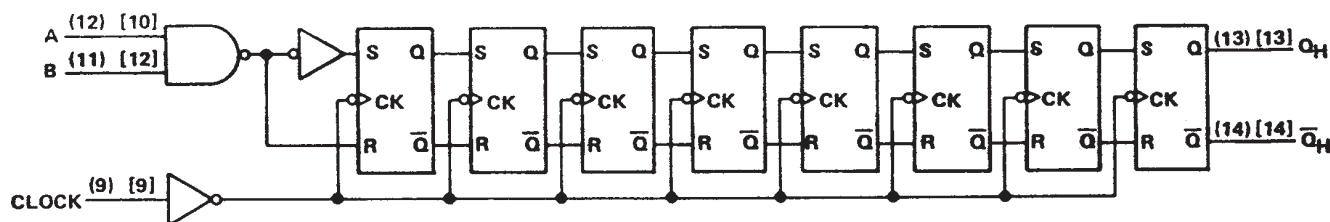


# SN5491A, SN54LS91, SN7491A, SN74LS91

## 8-BIT SHIFT REGISTERS

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### logic diagram (positive logic)



Pin numbers shown in ( ) are for the D, J or N packages and pin numbers shown in [ ] are for the W package.

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

|                                               |                                                |
|-----------------------------------------------|------------------------------------------------|
| Supply voltage, $V_{CC}$ (see Note 1)         | 7 V                                            |
| Input voltage (see Note 2)                    | 5.5 V                                          |
| Operating free-air temperature range: SN5491A | $-55^{\circ}\text{C}$ to $125^{\circ}\text{C}$ |
| SN7491A                                       | $0^{\circ}\text{C}$ to $70^{\circ}\text{C}$    |
| Storage temperature range                     | $-65^{\circ}\text{C}$ to $150^{\circ}\text{C}$ |

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

2. Input signals must be zero or positive with respect to network ground terminal.

### recommended operating conditions

|                                       | SN5491A |     |      | SN7491A |     |      | 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 | $\mu\text{A}$      |
| Low-level output current, $I_{OL}$    |         |     | 16   |         |     | 16   | mA                 |
| Width of clock input pulse, $t_w$     | 25      |     |      | 25      |     |      | ns                 |
| Setup time, $t_{su}$ (see Figure 1)   | 25      |     |      | 25      |     |      | ns                 |
| Hold time, $t_h$ (see Figure 1)       | 0       |     |      | 0       |     |      | ns                 |
| Operating free-air temperature, $T_A$ | -55     |     | 125  | 0       |     | 70   | $^{\circ}\text{C}$ |

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

| PARAMETER                                    | TEST CONDITIONS†                                                                                                | SN5491A |     |      | SN7491A |     |      | UNIT          |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------|---------|-----|------|---------|-----|------|---------------|
|                                              |                                                                                                                 | MIN     | NOM | MAX  | MIN     | NOM | MAX  |               |
| $V_{IH}$ High-level input voltage            |                                                                                                                 | 2       |     |      | 2       |     |      | V             |
| $V_{IL}$ Low-level input voltage             |                                                                                                                 |         |     | 0.8  |         |     | 0.8  | V             |
| $V_{OH}$ High-level output voltage           | $V_{CC} = \text{MIN}$ , $V_{IH} = 2\text{ V}$ ,<br>$V_{IL} = 0.8\text{ V}$ , $I_{OH} = -400\text{ }\mu\text{A}$ | 2.4     | 3.5 |      | 2.4     | 3.5 |      | V             |
| $V_{OL}$ Low-level output voltage            | $V_{CC} = \text{MIN}$ , $V_{IH} = 2\text{ V}$ ,<br>$V_{IL} = 0.8\text{ V}$ , $I_{OL} = 16\text{ mA}$            |         | 0.2 | 0.4  |         | 0.2 | 0.4  | V             |
| $I_I$ Input current at maximum input voltage | $V_{CC} = \text{MAX}$ , $V_I = 5.5\text{ V}$                                                                    |         |     | 1    |         |     | 1    | mA            |
| $I_{IH}$ High-level input current            | $V_{CC} = \text{MAX}$ , $V_I = 2.4\text{ V}$                                                                    |         |     | 40   |         |     | 40   | $\mu\text{A}$ |
| $I_{IL}$ Low-level input current             | $V_{CC} = \text{MAX}$ , $V_I = 0.4\text{ V}$                                                                    |         |     | -1.6 |         |     | -1.6 | mA            |
| $I_{OS}$ Short-circuit output current‡       | $V_{CC} = \text{MAX}$                                                                                           | -20     |     | -57  | -18     |     | -57  | mA            |
| $I_{CC}$ Supply current                      | $V_{CC} = \text{MAX}$ , See Note 3                                                                              |         | 35  | 50   |         | 35  | 58   | 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 3:  $I_{CC}$  is measured after the eighth clock pulse with the output open and A and B inputs grounded.

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

| PARAMETER                                                  | TEST CONDITIONS                                                       | MIN | TYP | MAX | UNIT |
|------------------------------------------------------------|-----------------------------------------------------------------------|-----|-----|-----|------|
| $f_{\text{max}}$ Maximum clock frequency                   | $C_L = 15\text{ pF}$ ,<br>$R_L = 400\text{ }\Omega$ ,<br>See Figure 1 | 10  | 18  |     | MHz  |
| $t_{PLH}$ Propagation delay time, low-to-high-level output |                                                                       |     | 24  | 40  | ns   |
| $t_{PHL}$ Propagation delay time, high-to-low-level output |                                                                       |     | 27  | 40  | ns   |



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# SN5491A, SN54LS91, SN7491A, SN74LS91 8-BIT SHIFT REGISTERS

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## 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: SN54LS91 | –55°C to 125°C |
| SN74LS91                                       | 0°C to 70°C    |
| Storage temperature range                      | –65°C to 150°C |

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

## recommended operating conditions

|                                       | SN54LS91 |     |      | SN74LS91 |     |      | 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 | $\mu$ A |
| Low-level output current, $I_{OL}$    |          |     | 4    |          |     | 8    | mA      |
| Width of clock input pulse, $t_W$     | 25       |     |      | 25       |     |      | ns      |
| Setup time, $t_{SU}$ (see Figure 1)   | 25       |     |      | 25       |     |      | ns      |
| 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†                                                                                                  | SN54LS91               |      |      | SN74LS91 |          |      | UNIT |
|-------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|------------------------|------|------|----------|----------|------|------|
|                                                       |                                                                                                                   | MIN                    | TYP‡ | MAX  | MIN      | TYP‡     | MAX  |      |
| V <sub>IH</sub> High-level input voltage              |                                                                                                                   | 2                      |      |      | 2        |          |      | V    |
| V <sub>IL</sub> Low-level input voltage               |                                                                                                                   |                        |      | 0.7  |          |          | 0.8  | V    |
| V <sub>IK</sub> Input clamp voltage                   | V <sub>CC</sub> = MIN, I <sub>I</sub> = −18 mA                                                                    |                        |      | −1.5 |          |          | −1.5 | V    |
| V <sub>OH</sub> High-level output voltage             | V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V,<br>V <sub>IL</sub> = V <sub>IL</sub> max, I <sub>OH</sub> = −400 μA | 2.5                    | 3.5  |      | 2.7      | 3.5      |      | V    |
| V <sub>OL</sub> Low-level output voltage              | V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V,<br>V <sub>IL</sub> = V <sub>IL</sub> max                            | I <sub>OL</sub> = 4 mA |      | 0.25 | 0.4      | 0.25 0.4 |      | V    |
|                                                       |                                                                                                                   | I <sub>OL</sub> = 8 mA |      |      |          | 0.35 0.5 |      |      |
| I <sub>I</sub> Input current at maximum input voltage | V <sub>CC</sub> = MAX, V <sub>I</sub> = 7 V                                                                       |                        |      | 0.1  |          |          | 0.1  | mA   |
| I <sub>IH</sub> High-level input current              | V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V                                                                     |                        |      | 20   |          |          | 20   | μA   |
| I <sub>IL</sub> Low-level input current               | V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V                                                                     |                        |      | −0.4 |          |          | −0.4 | mA   |
| I <sub>OS</sub> Short-circuit output current‡         | V <sub>CC</sub> = MAX                                                                                             | −20                    |      | −100 | −20      |          | −100 | mA   |
| I <sub>CC</sub> Supply current                        | V <sub>CC</sub> = MAX, See Note 3                                                                                 |                        | 12   | 20   |          | 12       | 20   | 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 3:  $I_{CC}$  is measured after the eighth clock pulse with the output open and A and B inputs grounded.

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

| PARAMETER                                                  | TEST CONDITIONS            | MIN | TYP | MAX | UNIT |
|------------------------------------------------------------|----------------------------|-----|-----|-----|------|
| $f_{\text{max}}$ Maximum clock frequency                   | $C_L = 15 \text{ pF},$     | 10  | 18  |     | MHz  |
| $t_{PLH}$ Propagation delay time, low-to-high-level output | $R_L = 2 \text{ k}\Omega,$ |     | 24  | 40  | ns   |
| $t_{PHL}$ Propagation delay time, high-to-low-level output | See Figure 1               |     | 27  | 40  | ns   |

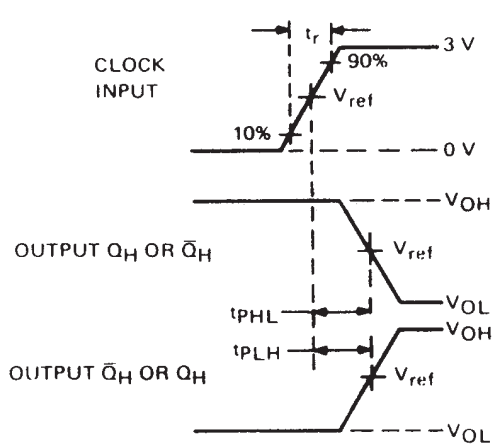
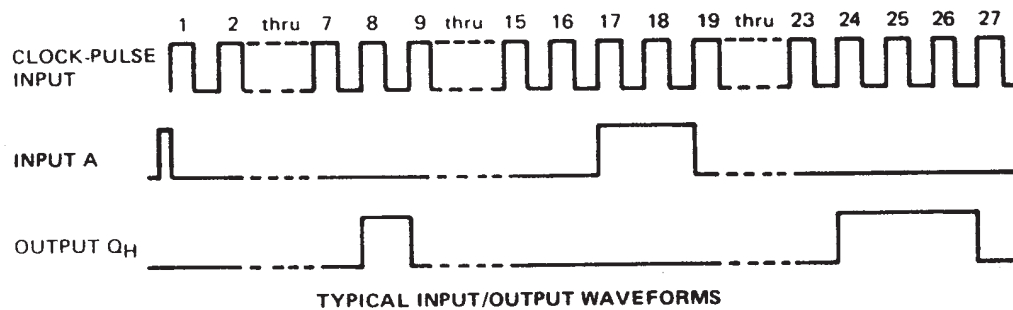
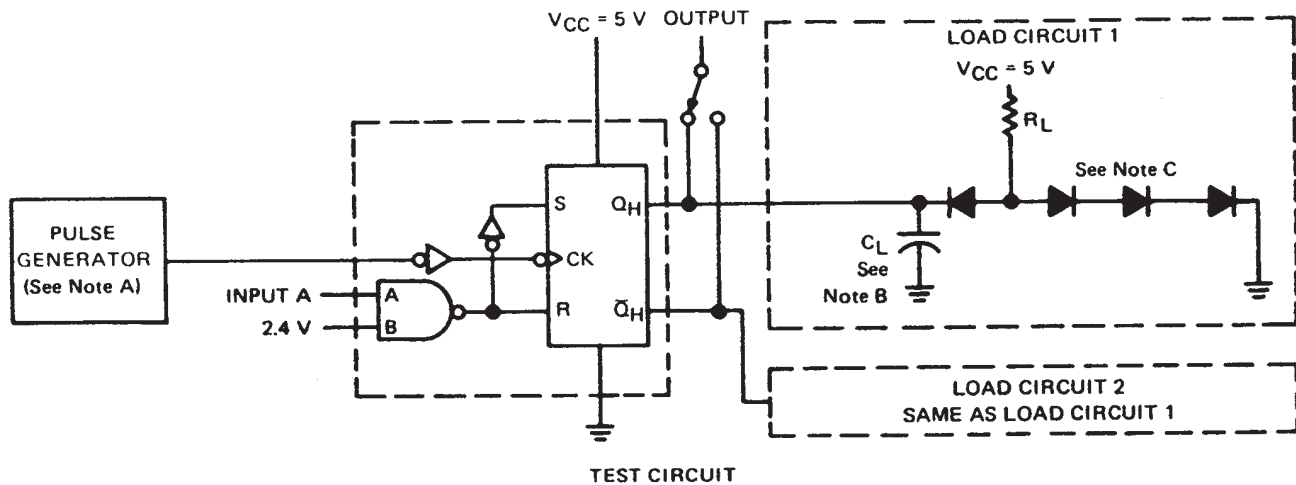


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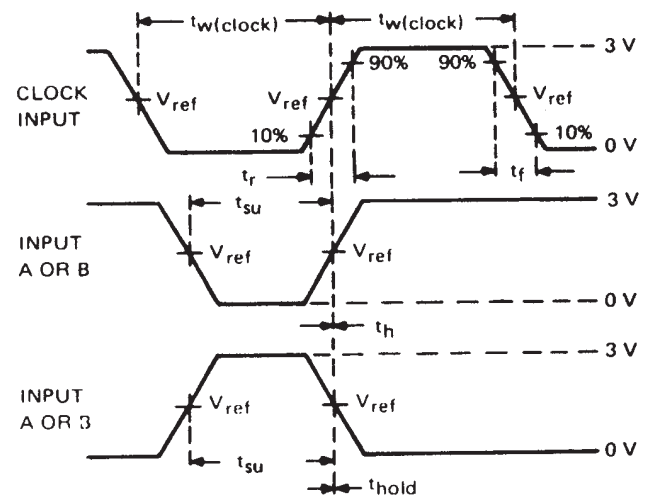
# SN5491A, SN54LS91, SN7491A, SN74LS91 8-BIT SHIFT REGISTERS

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## PARAMETER MEASUREMENT INFORMATION



PROPAGATION DELAY TIMES VOLTAGE WAVEFORMS



SWITCHING TIMES VOLTAGE WAVEFORMS

- NOTES: A. The generator has the following characteristics:  $t_{w(\text{clock})} = 500 \text{ ns}$ ,  $\text{PRR} \leq 1 \text{ MHz}$ ,  $Z_{\text{out}} \approx 50 \Omega$ . For SN5491A/SN7491A,  $t_r \leq 10 \text{ ns}$  and  $t_f \leq 10 \text{ ns}$ ; for SN54LS91,  $t_r = 15 \text{ ns}$ , and  $t_f = 6 \text{ ns}$ .  
B.  $C_L$  includes probe and jig capacitance.  
C. All diodes are 1N3064 or equivalent.  
D. For SN5491A/SN7491A,  $V_{\text{ref}} = 1.5 \text{ V}$ ; for SN54LS91/SN74LS91,  $V_{\text{ref}} = 1.3 \text{ V}$ .

FIGURE 1—SWITCHING TIMES

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