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

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

# description

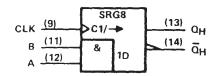
These monolithic serial-in, serial-out, 8-bit shift registers utilize transistor-transistor logic (TTL) circuits and are composed of eight R-S master-slave flip-flops, input gating, and a clock driver. Single-rail data and input control are gated through inputs A and B and an internal inverter to form 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.

#### **FUNCTION TABLE**

| 1 | NPUTS<br>AT t <sub>ri</sub> | 1  | PUTS               |
|---|-----------------------------|----|--------------------|
| A | В                           | QН | $\bar{\alpha}_{H}$ |
| Н | Н                           | Н  | L                  |
| L | X                           | L  | Н                  |
| X | L                           | L  | Н                  |

t<sub>n</sub> = Reference bit time,
clock low
t<sub>n+8</sub> = Bit time after 8
low-to-high
clock transitions.

# logic symbol†

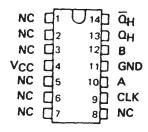


<sup>&</sup>lt;sup>†</sup>This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

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

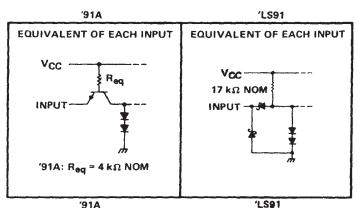
| NC    | 1 | U14 | Þ <u>α</u> μ   |
|-------|---|-----|----------------|
| NC    | 2 | 13  | ПОН            |
| NC    | 3 | 12  | □ <sub>A</sub> |
| NC    | 4 | 11  | В              |
| Vcc □ | 5 | 10  | GND            |
| NC    | 6 | 9   | CLK            |
| NC    | 7 | 8   | JNC            |

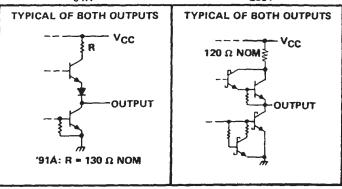
# SN5491A, SN54LS91 ... W PACKAGE (TOP VIEW)



NC - No internal connection

#### schematics of inputs and outputs

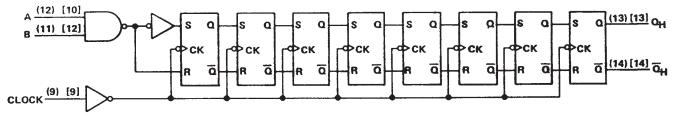






SDLS126 - MARCH 1974 - REVISED MARCH 1988

#### 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, VCC (see Note 1)      |         |  |  |  |  |  |  | • |  | <br>•      |        | •    | 7 V |
|---------------------------------------|---------|--|--|--|--|--|--|---|--|------------|--------|------|-----|
| Input voltage (see Note 2)            |         |  |  |  |  |  |  |   |  |            |        |      |     |
| Operating free-air temperature range: | SN5491A |  |  |  |  |  |  |   |  | _Ę         | 5°C t  | o 12 | 5°C |
|                                       | SN7491A |  |  |  |  |  |  |   |  |            | 0°C    | to 7 | 0°C |
| Storage temperature range             |         |  |  |  |  |  |  |   |  | <b>−</b> € | 55°C t | o 15 | 0°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

|  |     | N5491 | A    | :    | SN7491 | A               | UNIT |
|--|-----|-------|------|------|--------|-----------------|------|
|  | MIN | NOM   | MAX  | MIN  | NOM    | MAX             | UNIT |
| Supply voltage, VCC                        | 4.5 | 5     | 5.5  | 4.75 | 5      | 5.25            | ٧    |
| High-level output current, IOH             |     |       | -400 |      |        | <del>-400</del> | μΑ   |
| Low-level output current, IOL              |     |       | 16   |      |        | 16              | mA   |
| Width of clock input pulse, t <sub>W</sub> | 25  |       |      | 25   |        |                 | ns   |
| Setup time, t <sub>su</sub> (see Figure 1) | 25  |       | _    | 25   |        |                 | ns   |
| Hold time, th (see Figure 1)               | 0   |       |      | 0    |        |                 | าร   |
| Operating free-air temperature, TA         | -55 |       | 125  | 0    |        | 70              | °c   |

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

|                 |  |   |     | SN5491      | A    |     | N7491 | A    | UNIT |
|-----------------|--|---|-----|-------------|------|-----|-------|------|------|
|                 | PARAMETER                              | TEST CONDITIONS <sup>†</sup>  | MIN | MIN NOM MAX |      | MIN | NOM   | MAX  | ONII |
| VIH             | High-level input voltage               |   | 2   |             |      | 2   |       |      | V    |
| VIL             | Low-level input voltage                |   |     |             | 0.8  |     |       | 0.8  | ٧    |
| V <sub>OH</sub> | High-level output voltage              | V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V,<br>V <sub>IL</sub> = 0.8 V, I <sub>OH</sub> = -400 μA | 2.4 | 3.5         |      | 2.4 | 3.5   |      | V    |
| VOL             | Low-level output voltage               | V <sub>CC</sub> = MIN, V <sub>1H</sub> = 2 V,<br>V <sub>1L</sub> = 0.8 V, I <sub>OL</sub> = 16 mA   |     | 0.2         | 0.4  |     | 0.2   | 0.4  | V    |
| l <sub>1</sub>  | Input current at maximum input voltage | V <sub>CC</sub> = MAX, V <sub>I</sub> = 5.5 V   |     |             | 1    |     |       | 1    | mA   |
| Чн              | High-level input current               | V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.4 V   |     |             | 40   |     |       | 40   | μА   |
| fiL             | Low-level input current                | V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V   |     |             | -1.6 |     |       | -1.6 | mA   |
| Tos             | Short-circuit output current §         | V <sub>CC</sub> = MAX   | -20 |             | -57  | -18 |       | -57  | mA   |
| 1cc             | Supply current                         | V <sub>CC</sub> = MAX, See Note 3   |     | 35          | 50   |     | 35    | 58   | mA   |

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

#### switching characteristics, VCC = 5 V, TA = 25°C

| PARAMETER  | TEST CONDITIONS         | MIN | TYP | MAX | UNIT |
|--|-------------------------|-----|-----|-----|------|
| fmax Maximum clock frequency                           | C <sub>L</sub> = 15 pF, | 10  | 18  |     | MHz  |
| tpl H Propagation delay time, low-to-high-level output | R <sub>L</sub> = 400 Ω, |     | 24  | 40  | ns   |
| tpHL Propagation delay time, high-to-low-level output  | See Figure 1            |     | 27  | 40  | ns   |



<sup>‡</sup>All typical values are at  $V_{CC}$  = 5 V,  $T_A$  = 25°C.

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

NOTE 3: ICC is measured after the eighth clock pulse with the output open and A and B inputs grounded.

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

| Supply voltage, V <sub>CC</sub> (see Note 1)  | <br>. 7 V     |
|---|---------------|
|   |               |
| Operating free-air temperature range: SN54LS9 | <br>to 125°C  |
| SN74LS9                                       | <br>C to 70°C |
| Storage temperature range                     | <br>to 150°C  |

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

## recommended operating conditions

|  | S   | N54LS | 91   | S    | N74LS | UNIT |      |
|--|-----|-------|------|------|-------|------|------|
|  | MIN | NOM   | MAX  | MIN  | NOM   | MAX  | UNII |
| Supply voltage, VCC                        | 4.5 | 5     | 5.5  | 4.75 | 5     | 5.25 | V    |
| High-level output current, IOH             |     |       | -400 |      |       | -400 | μА   |
| Low-level output current, IOL              |     |       | 4    |      |       | 8    | mA   |
| Width of clock input pulse, tw             | 25  |       |      | 25   |       |      | ns   |
| Setup time, t <sub>SU</sub> (see Figure 1) | 25  |       |      | 25   |       |      | ns   |
| Hold time, th (see Figure 1)               | 0   |       |      | 0    |       |      | ns   |
| Operating free-air temperature, TA         | -55 |       | 125  | 0    |       | 70   | С    |

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

|                 |  |   | 7  |            | SI  | N54LS9 | 1    | SI  | N74LS9 |      |      |
|-----------------|--|---|--|------------|-----|--------|------|-----|--------|------|------|
|                 | PARAMETER                              | I Es  | ST CONDITIONS  | o'<br>     | MIN | TYP‡   | MAX  | MIN | TYP‡   | MAX  | UNIT |
| VIH             | High-level input voltage               |   |  |            | 2   |        |      | 2   |        |      | V    |
| VIL             | Low-level input voltage                | 1   |  |            |     |        | 0.7  |     |        | 0.8  | ٧    |
| VIK             | Input clamp voltage                    | V <sub>CC</sub> = MIN,  | $I_1 = -18 \text{ mA}$                               |            |     |        | -1.5 |     |        | 1.5  | V    |
| V <sub>OH</sub> | High-level output voltage              | V <sub>CC</sub> = MIN,<br>V <sub>IL</sub> = V <sub>IL</sub> max | V <sub>IH</sub> = 2 V,<br>, I <sub>OH</sub> = -400 μ | A          | 2.5 | 3.5    |      | 2.7 | 3.5    |      | ٧    |
| ,,              | 1 1 1                                  | V <sub>CC</sub> = MIN,  | V <sub>1H</sub> = 2 V,                               | IOL = 4 mA |     | 0.25   | 0.4  |     | 0.25   | 0.4  | V    |
| VOL             | Low-level output voltage               | VIL = VIL max   | t  | IOL = 8 mA |     |        |      |     | 0.35   | 0.5  |      |
| 11              | Input current at maximum input voltage | V <sub>CC</sub> = MAX,  | V <sub>I</sub> = 7 V                                 |            |     |        | 0.1  |     |        | 0.1  | mA   |
| ЧН              | High-level input current               | V <sub>CC</sub> = MAX,  | V <sub>1</sub> = 2.7 V                               |            |     |        | 20   |     |        | 20   | μА   |
| IIL             | Low-level input current                | V <sub>CC</sub> = MAX,  | V <sub>I</sub> = 0.4 V                               |            |     | -      | -0.4 |     |        | -0.4 | mA   |
| los             | Short-circuit output current §         | V <sub>CC</sub> = MAX   |  |            | -20 |        | -100 | -20 |        | -100 | mA   |
| 1cc             | Supply current                         | V <sub>CC</sub> = MAX,  | See Note 3   |            |     | 12     | 20   |     | 12     | 20   | mA   |

 $<sup>\</sup>frac{1}{2}$  For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

# switching characteristics, VCC = 5 V, TA = 25°C

| PARAMETER   | TEST CONDITIONS         | MIN | TYP | MAX | UNIT |
|---|-------------------------|-----|-----|-----|------|
| f <sub>max</sub> Maximum clock frequency              | C <sub>L</sub> = 15 pF, | 10  | 18  |     | MHz  |
| tpLH Propagation delay time, low-to-high-level output | Rլ≈2kΩ,                 |     | 24  | 40  | ns   |
| tpHL Propagation delay time, high-to-low-level output | See Figure 1            |     | 27  | 40  | ns   |

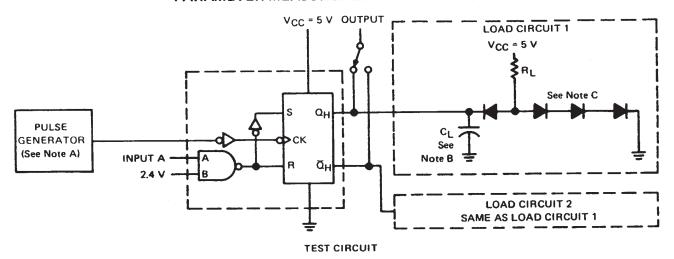


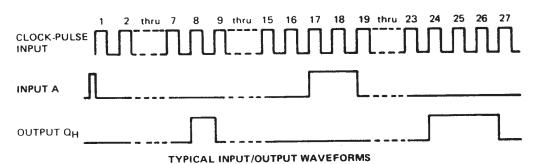
 $<sup>^{\</sup>ddagger}$ All typical values are at V<sub>CC</sub> 5 V, T<sub>A</sub> 25 C.

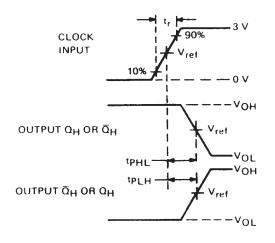
Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

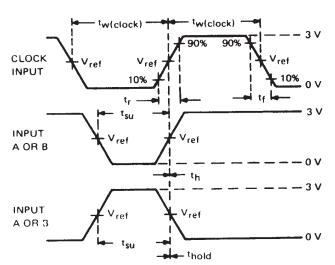
NOTE 3: 1 CC is measured after the eighth clock pulse with the output open and A and B inputs grounded.

#### PARAMETER MEASUREMENT INFORMATION









## PROPAGATION DELAY TIMES VOLTAGE WAVEFORMS

# SWITCHING TIMES VOLTAGE WAVEFORMS

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

FIGURE 1-SWITCHING TIMES



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#### PACKAGING INFORMATION

| Orderable part number | Status<br>(1) | Material type | Package   Pins | Package qty   Carrier | <b>RoHS</b> (3) | Lead finish/<br>Ball material | MSL rating/<br>Peak reflow | Op temp (°C) | Part marking (6) |
|-----------------------|---------------|---------------|----------------|-----------------------|-----------------|-------------------------------|----------------------------|--------------|------------------|
| SN54LS91J             | Active        | Production    | CDIP (J)   14  | 25   TUBE             | No              | SNPB                          | N/A for Pkg Type           | -55 to 125   | SN54LS91J        |
| SN54LS91J.A           | Active        | Production    | CDIP (J)   14  | 25   TUBE             | No              | SNPB                          | N/A for Pkg Type           | -55 to 125   | SN54LS91J        |

<sup>(1)</sup> Status: For more details on status, see our product life cycle.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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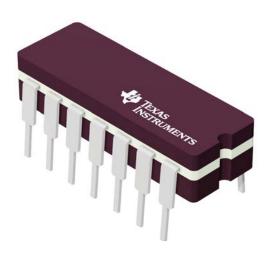
<sup>(3)</sup> RoHS values: Yes, No. RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

<sup>(4)</sup> Lead finish/Ball material: Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

<sup>(5)</sup> MSL rating/Peak reflow: The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> Part marking: There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

CERAMIC DUAL IN LINE PACKAGE



Images above are just a representation of the package family, actual package may vary. Refer to the product data sheet for package details.

4040083-5/G





CERAMIC DUAL IN LINE PACKAGE



#### NOTES:

- 1. All controlling linear dimensions are in inches. Dimensions in brackets are in millimeters. Any dimension in brackets or parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- 2. This drawing is subject to change without notice.
- 3. This package is hermitically sealed with a ceramic lid using glass frit.
- His package is remitted by sealed with a ceramic its using glass mit.
   Index point is provided on cap for terminal identification only and on press ceramic glass frit seal only.
   Falls within MIL-STD-1835 and GDIP1-T14.



CERAMIC DUAL IN LINE PACKAGE



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