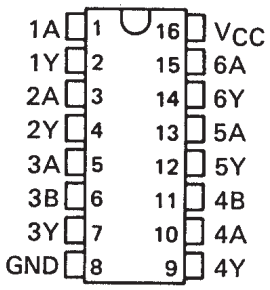
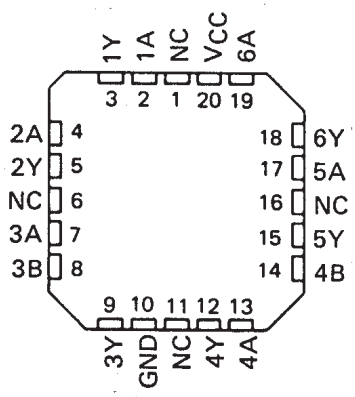
SDLS157 – DECEMBER 1983 – REVISED MARCH 1988

- **Delay Elements for Generating Delay Lines**
- **Inverting and Non-inverting Elements**
- **Buffer NAND Elements Rated at $I_{OL}$ of 12/24 mA**
- **PNP Inputs Reduce Fan-In ($I_{IL}$ = −0.2 mA MAX)**
- **Worst Case MIN/MAX Delays Guaranteed Across Temperature and $V_{CC}$ Ranges**

**SN54LS31 . . . J OR W PACKAGE**
**SN74LS31 . . . D OR N PACKAGE**
**(TOP VIEW)**




**SN54LS31 . . . FK PACKAGE**
**(TOP VIEW)**




NC - No internal connection

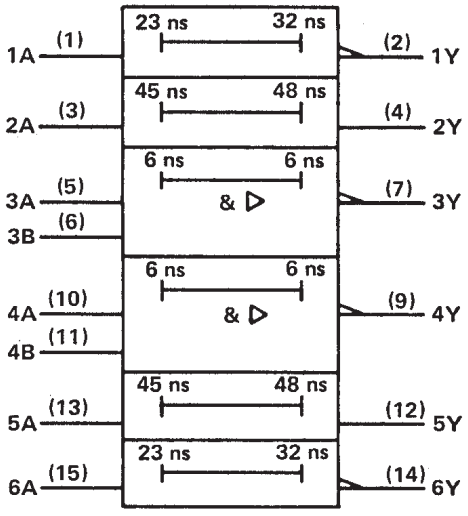
## description

These 'LS31 delay elements are intended to provide well-defined delays across both temperature and $V_{CC}$ ranges. Used in cascade, a limitless range of delay gating is possible.

All inputs are PNP with $I_{IL}$ MAX of −0.2 mA. Gates 1, 2, 5, and 6 have standard Low-Power Schottky output sink current capability of 4 and 8 mA $I_{OL}$. Buffers 3 and 4 are rated at 12 and 24 mA.

The SN54LS31 is characterized for operation over the full military temperature range of −55°C to 125°C. The SN74LS31 is characterized for operation from 0°C to 70°C.

## logic symbol†




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

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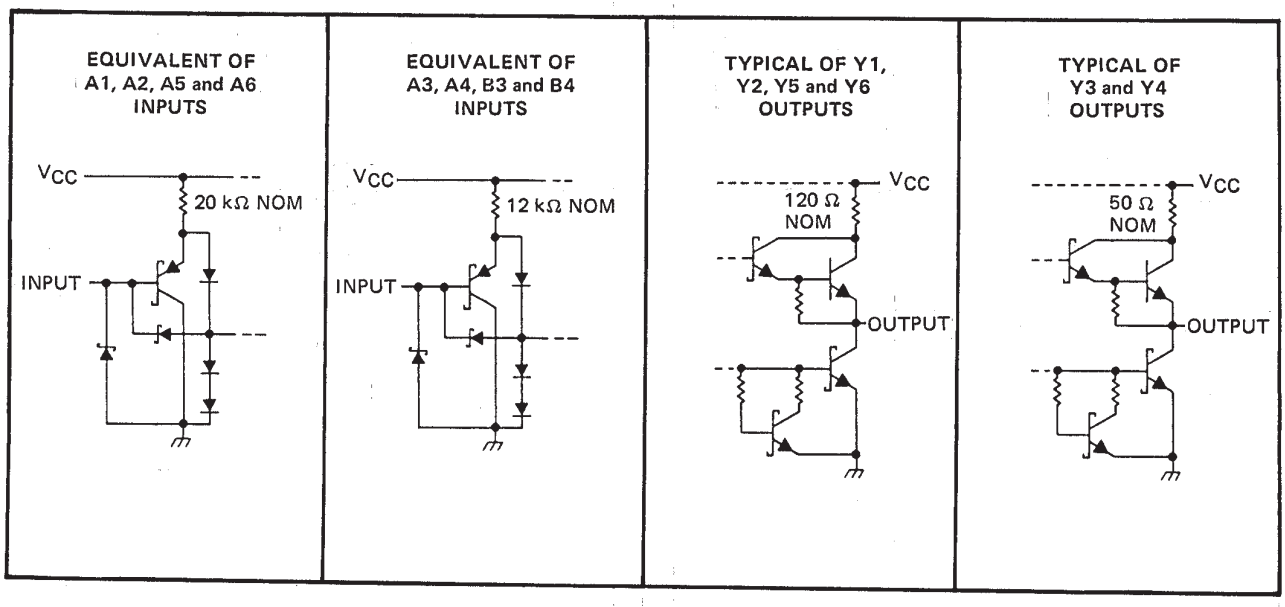
| Delay Element | Logic | Typical Delays | | | Rated $I_{OL}$ |
|---|---|---|---|---|---|
| | | $t_{PLH}$ | $t_{PHL}$ | AVG. | |
| Gates 1 and 6 | Inverting | 32 ns | 23 ns | 27.5 ns | 4 and 8 mA |
| Gates 2 and 5 | Non-Inverting | 45 ns | 48 ns | 46.5 ns | 4 and 8 mA |
| Buffers 3 and 4 | 2-Input NAND | 6 ns | 6 ns | 6 ns | 12 and 24 mA |




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

Supply voltage, $V_{CC}$ (See Note 1) . . . . . 7 V
Input voltage, $V_I$: All inputs . . . . . 7 V
Operating free-air temperature range: SN54LS31 . . . . . – 55°C to 125°C
SN74LS31 . . . . . 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

| | | | SN54LS31 | | | SN74LS31 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | NOM | MAX | MIN | NOM | MAX | |
| $V_{CC}$ | Supply voltage | | 4.5 | 5 | 55 | 4.75 | 5 | 5.25 | V |
| $V_{IH}$ | High-level input voltage | | 2 | | | 2 | | | V |
| $V_{IL}$ | Low-level input voltage | | | | 0.7 | | | 0.8 | V |
| $I_{OH}$ | High-level output current | Y3, Y4 outputs | | | – 1.2 | | | – 1.2 | mA |
| | | All other outpus | | | – 0.4 | | | – 0.4 | |
| $I_{OL}$ | Low-level output current | Y3, Y4 outputs | | | 12 | | | 24 | mA |
| | | All other outputs | | | 4 | | | 8 | |
| $T_A$ | Operating free-air temperature | | – 55 | | 125 | 0 | | 70 | °C |

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

| PARAMETER | | TEST CONDITIONS† | | | SN54LS31 | | | SN74LS31 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| $V_{IK}$ | | $V_{CC}$ = MIN, $I_I$ = – 18 mA | | | | | – 1.5 | | | – 1.5 | V |
| $V_{OH}$ | | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $V_{IL}$ = MAX | Y3, Y4 | $I_{OH}$ = – 1.2 mA | 2.4 | 3.1 | | 2.4 | 3.1 | | V |
| | | | Others | $I_{OH}$ = – 0.4 mA | 2.5 | 3.1 | | 2.7 | 3.1 | | |
| $V_{OL}$ | | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $V_{IL}$ = MAX | Y3, Y4 | $I_{OL}$ = 12 mA | | 0.25 | 0.4 | | 0.25 | 0.4 | V |
| | | | | $I_{OL}$ = 24 mA | | | | | 0.35 | 0.5 | |
| | | | Others | $I_{OL}$ = 4 mA | | 0.25 | 0.4 | | 0.25 | 0.4 | |
| | | | | $I_{OL}$ = 8 mA | | | | | 0.35 | 0.5 | |
| $I_I$ | | $V_{CC}$ = MAX, $V_I$ = 7 V | | | | | 0.1 | | | 0.1 | mA |
| $I_{IH}$ | | $V_{CC}$ = MAX, $V_I$ = 2.7 V | | | | | 20 | | | 20 | μA |
| $I_{IL}$ | | $V_{CC}$ = MAX, $V_I$ = 0.4 V | | | | | – 0.2 | | | – 0.2 | mA |
| $I_{OS}$§ | | $V_{CC}$ = MAX, A3, A4, B3, B4 = 0 V | | Y3, Y4 | – 30 | | – 130 | – 30 | | – 130 | mA |
| | | $V_{CC}$ = MAX, A1, A6 = 0 V, A2, A5 = 4.5 V | | Y1, Y2, Y5, Y6 | – 20 | | – 100 | – 20 | | – 100 | |
| $I_{CC}$ | $I_{CCH}$ | $V_{CC}$ = MAX, A2, A5 = 4.5 V, all other inputs 0 V | | | | 2.3 | 4 | | 2.3 | 4 | mA |
| | $I_{CCL}$ | $V_{CC}$ = MAX, A2, A5 = 0 V, all other inputs 4.5 V | | | | 13 | 20 | | 13 | 20 | |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values are at $V_{CC}$ = 5 V, $T_A$ = 25°C.
§ Not more than one output should be shorted at a time, and the duration of the short-circuit should not exceed one second.

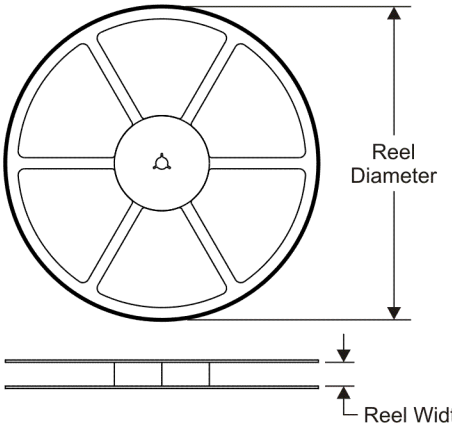
## switching characteristics, (see note 2)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | SN54LS31 | | | SN74LS31 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| $t_{PLH}$ | A1, A6 | Y1, Y6 | 15 | | 70 | 22 | | 65 | ns |
| $t_{PHL}$ | | | 9 | | 50 | 13 | | 45 | ns |
| $t_{PLH}$ | A2, A5 | Y2, Y5 | 22 | | 90 | 31 | | 80 | ns |
| $t_{PHL}$ | | | 20 | | 105 | 30 | | 95 | ns |
| $t_{PLH}$ | A3, B3, A4, Y4 | Y3, Y4 | 2 | | 20 | 2 | | 15 | ns |
| $t_{PHL}$ | | | 2 | | 20 | 2 | | 15 | ns |

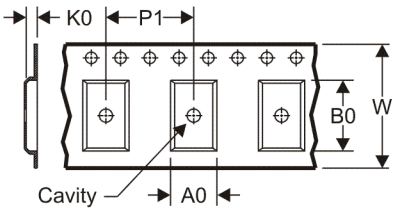
NOTE 2: $V_{CC}$ = MIN to MAX
$R_L$ = 667 Ω, $C_L$ = 45 pF for Y3 and Y4.
$R_L$ = 2 kΩ, $C_L$ = 15 pF for Y1, Y2, Y5 and Y6.
$T_A$ = MIN to MAX
Load circuits and voltage waveforms are shown in Section 1.

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

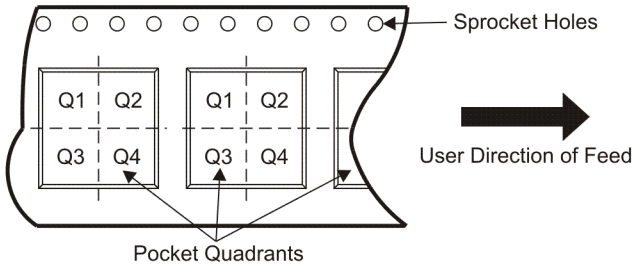



**TAPE DIMENSIONS**




| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

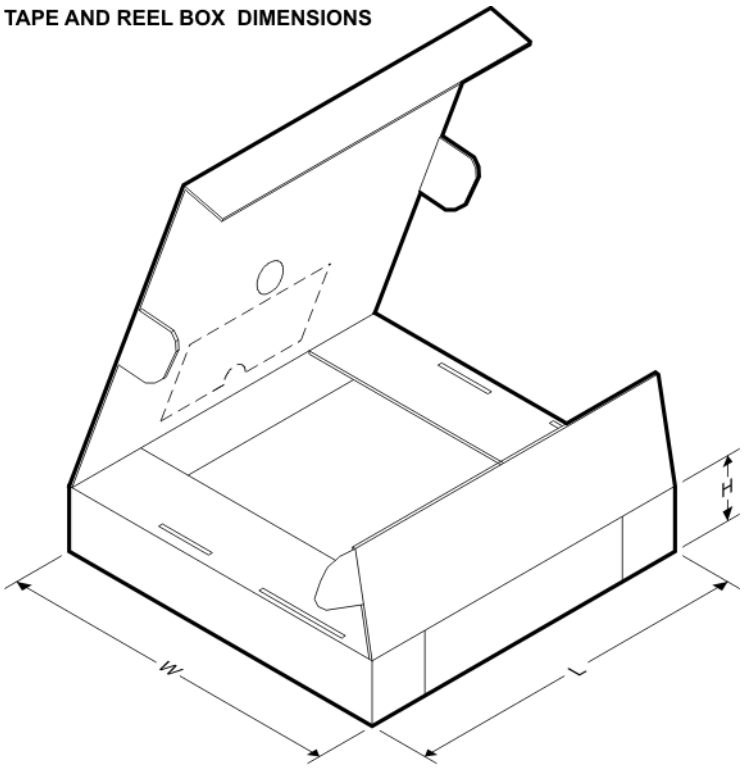
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**




*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SN74LS31DR | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74LS31NSR | SO | NS | 16 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |

**TAPE AND REEL BOX DIMENSIONS**




*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| SN74LS31DR | SOIC | D | 16 | 2500 | 333.2 | 345.9 | 28.6 |
| SN74LS31NSR | SO | NS | 16 | 2000 | 346.0 | 346.0 | 33.0 |

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