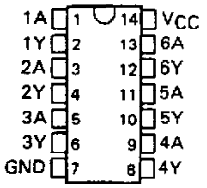
SDLS138

# SN74LS19A, SN74LS24A
# SCHMITT-TRIGGER POSITIVE-NAND GATES AND INVERTERS WITH TOTEM-POLE OUTPUTS

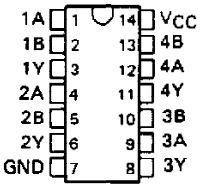
JANUARY 1981 – REVISED MARCH 1988

- Functionally and Mechanically Identical to 'LS13, 'LS14, and 'LS132, Respectively
- Improved Line-Receiving Characteristics
- P-N-P Inputs Reduce System Loading
- Excellent Noise Immunity with Typical Hysteresis of 0.8 V

SN74LS19A . . . D, J, OR N PACKAGE
(TOP VIEW)




SN74LS24A . . . D, J, OR N PACKAGE
(TOP VIEW)



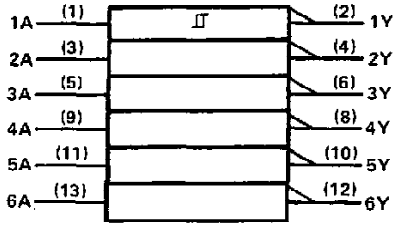

## description

Each circuit functions as a NAND gate or inverter, but because of the Schmitt action, it has different input threshold levels for positive-going ($V_{T+}$) and for negative-going ($V_{T-}$) signals. The hysteresis or backlash, which is the difference between the two threshold levels ($V_{T+} - V_{T-}$), is typically 800 millivolts.

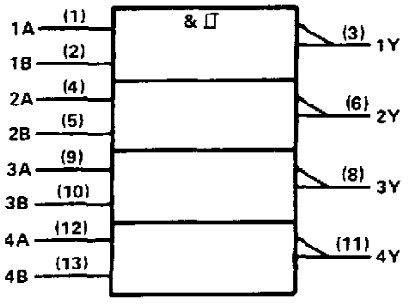
These circuits are temperature-compensated and can be triggered from the slowest of input ramps and still give clean, jitter-free output signals.

## logic symbols†

SN74LS19A



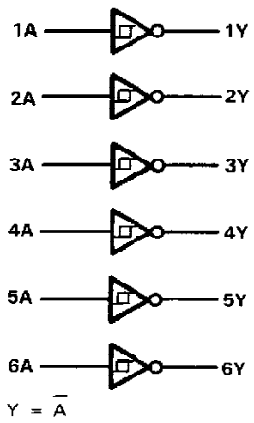

SN74LS24A




† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

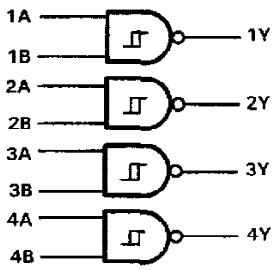
## logic diagrams (positive logic)

SN74LS19A



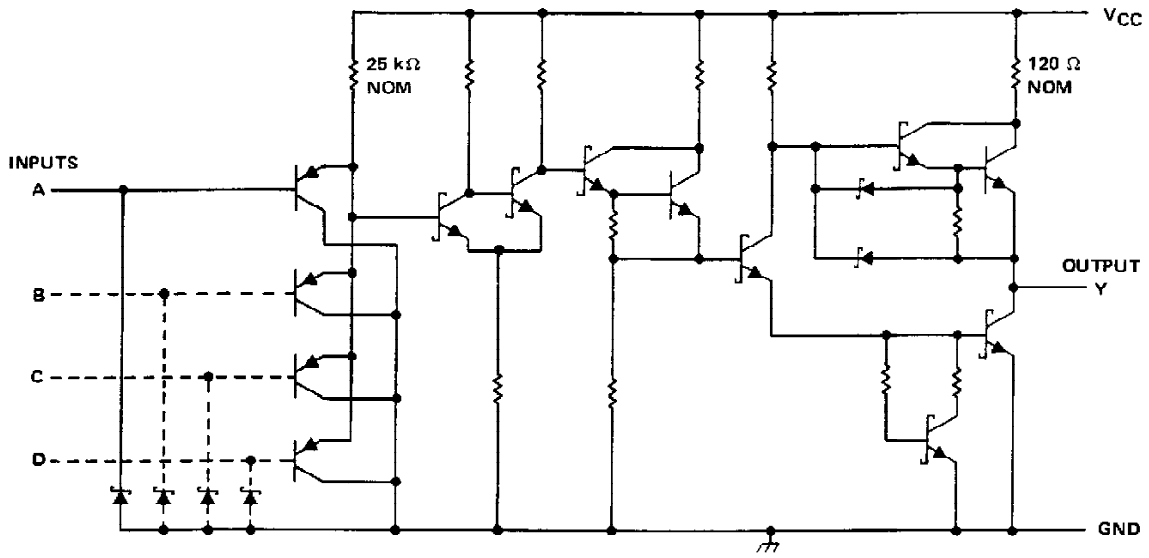

$Y = \overline{A}$

SN74LS24A




$Y = \overline{AB}$

**schematic (each gate)**




**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 . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

**recommended operating conditions**

| | MIN | NOM | MAX | UNIT |
|---|---|---|---|---|
| Supply voltage, $V_{CC}$ | 4.75 | 5 | 5.25 | V |
| High-level output current, $I_{OH}$ | | | −400 | μA |
| Low-level output current, $I_{OL}$ | | | 8 | mA |
| Operating free-air temperature, $T_A$ | 0 | | 70 | °C |

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

| PARAMETER | TEST CONDITIONS† | | | MIN | TYP‡ | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $V_{T+}$ | $V_{CC}$ = 5 V | | | 1.65 | 1.9 | 2.15 | V |
| $V_{T-}$ | $V_{CC}$ = 5 V | | | 0.75 | 1.0 | 1.25 | V |
| Hysteresis ($V_{T+} - V_{T-}$) | $V_{CC}$ = 5 V | | | 0.4 | 0.9 | | V |
| $V_{IK}$ | $V_{CC}$ = MIN, | $I_I$ = −18 mA | | | −1.5 | | V |
| $V_{OH}$ | $V_{CC}$ = MIN, | $V_I = V_{T-min}$ | $I_{OH}$ = −0.4 mA | 2.7 | 3.4 | | V |
| $V_{OL}$ | $V_{CC}$ = MIN, | $V_I = V_{T+max}$ | $I_{OL}$ = 4 mA | | 0.25 | 0.4 | V |
| | | | $I_{OL}$ = 8 mA | | 0.35 | 0.5 | |
| $I_{T+}$ | $V_{CC}$ = 5 V, | $V_I = V_{T+}$ | | | −2 | −20 | μA |
| $I_{T-}$ | $V_{CC}$ = 5 V, | $V_I = V_{T-}$ | | | −5 | −30 | μA |
| $I_I$ | $V_{CC}$ = MAX, | $V_I$ = 7 V | | | 0.1 | | mA |
| $I_{IH}$ | $V_{CC}$ = MAX, | $V_I$ = 2.7 V | | | | 20 | μA |
| $I_{IL}$ | $V_{CC}$ = MAX, | $V_I$ = 0.4 V | | | | −50 | μA |
| $I_{OS}$§ | $V_{CC}$ = MAX, | $V_I = V_O$ = 0 V | | −20 | | −100 | mA |
| $I_{CCH}$ | $V_{CC}$ = MAX, | $V_I$ = 0 V | 'LS19A | | 9.9 | 18 | mA |
| | | | 'LS24A | | 6.6 | 12 | |
| $I_{CCL}$ | $V_{CC}$ = MAX, | $V_I$ = 4.5 V | 'LS19A | | 17 | 30 | mA |
| | | | 'LS24A | | 11 | 20 | |

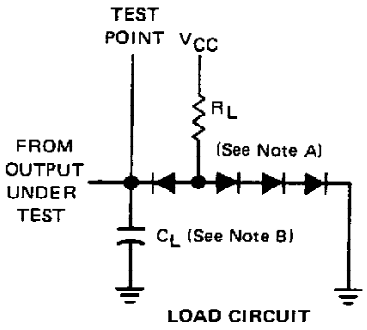
† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values are at $V_{CC}$ = 5 V, $T_A$ = 25°C.
§ Not more than one output should be shorted at a time, and the duration of the short-circuit should not exceed one second.

## switching characteristics, $V_{CC}$ = 5 V, $T_A$ = 25°C (see Figure 1)

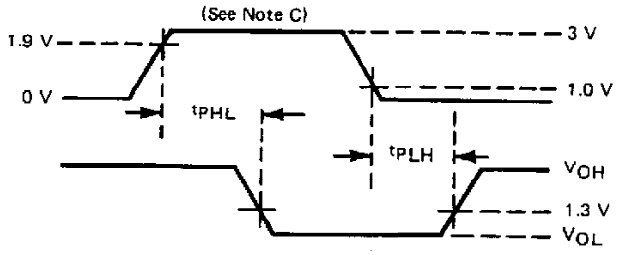
| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | SN74LS19A | | | SN74LS24A | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| $t_{PLH}$ | Any | Y | $R_L$ = 2 kΩ, $C_L$ = 15 pF | | 13 | 20 | | 13 | 20 | ns |
| $t_{PHL}$ | Any | Y | | | 18 | 30 | | 25 | 40 | ns |

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

## PARAMETER MEASUREMENT INFORMATION




LOAD CIRCUIT




VOLTAGE WAVEFORMS

NOTES: A. All diodes are IN3064 or equivalent.
B. $C_L$ includes probe and circuit capacitance.
C. The generator characteristics are: PRR = 1 MHz, $t_r$ = 15 ns, $t_p$ = 6 ns, $Z_o$ = 50 Ω.

**FIGURE 1**

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