# SN5422, SN54LS22, SN54S22, SN7422, SN74LS22, SN74S22
# DUAL 4-INPUT POSITIVE-NAND GATES WITH OPEN-COLLECTOR OUTPUTS

DECEMBER 1983 – REVISED MARCH 1988

- **Package Options Include Plastic "Small Outline" Packages, Ceramic Chip Carriers and Flat Packages, and Plastic and Ceramic DIPs**
- **Dependable Texas Instruments Quality and Reliability**

## description

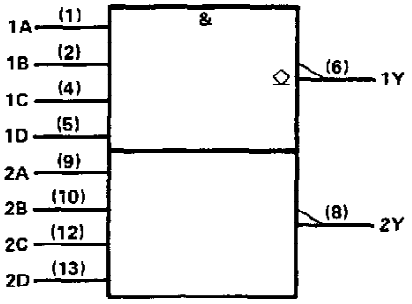
These devices contain two independent 4-input NAND gates. The open-collector outputs require pull-up resistors to perform correctly. They may be connected to other open-collector outputs to implement active-low wired-OR or active-high wired-AND functions. Open-collector devices are often used to generate higher $V_{OH}$ levels.

The SN5422, SN54LS22 and SN54S22 are characterized for operation over the full military temperature range of −55°C to 125°C. The SN7422, SN74LS22, and SN74S22 are characterized for operation from 0°C to 70°C.

**FUNCTION TABLE (each gate)**

| INPUTS | | | | OUTPUT |
|---|---|---|---|---|
| A | B | C | D | Y |
| H | H | H | H | L |
| L | X | X | X | H |
| X | L | X | X | H |
| X | X | L | X | H |
| X | X | X | L | H |

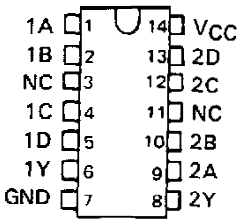
## logic symbol†



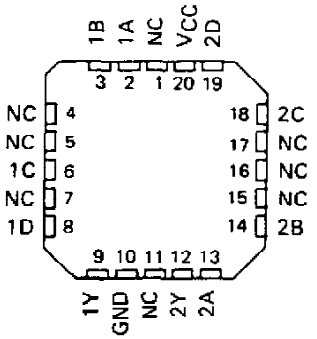

† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

Pin numbers shown are for D, J, N, and W packages.

**SN5422, SN54LS22, SN54S22 . . . J OR W PACKAGE**
**SN7422 . . . N PACKAGE**
**SN74LS22, SN74S22 . . . D OR N PACKAGE**
**(TOP VIEW)**

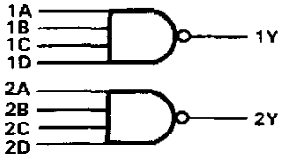



**SN54LS22, SN54S22 . . . FK PACKAGE**
**(TOP VIEW)**




NC—No internal connection

## logic diagram

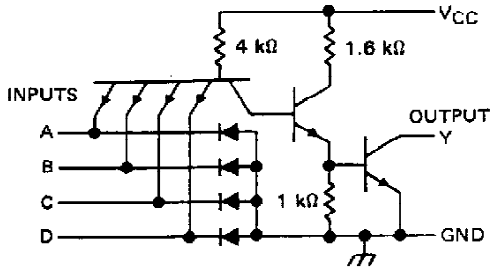



## positive logic

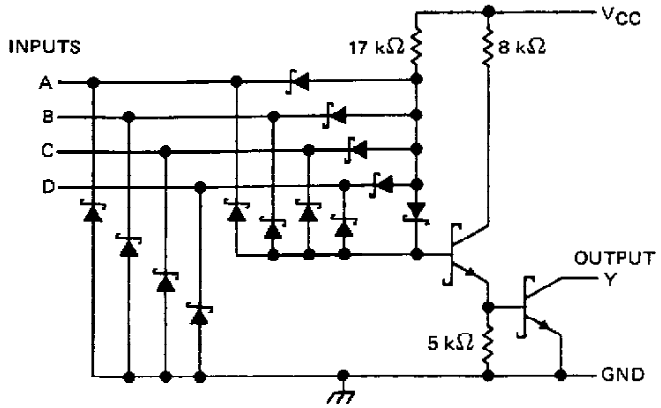
$$Y = \overline{A \cdot B \cdot C \cdot D} \text{ or } Y = \overline{A} + \overline{B} + \overline{C} + \overline{D}$$

schematics (each gate)

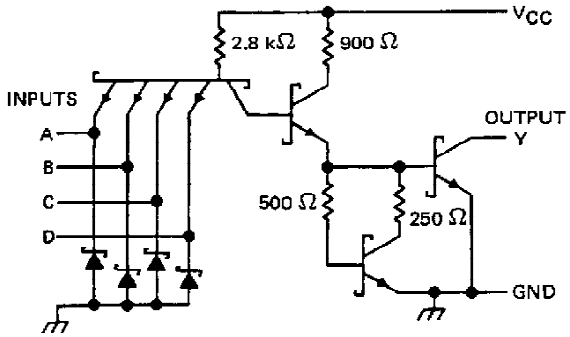
'22




'LS22




'S22




Resistor values shown are nominal.

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

Supply voltage, $V_{CC}$ (See Note 1) . . . . . 7 V
Input voltage: '22, 'S22 . . . . . 5.5 V
'LS22 . . . . . 7 V
Operating free-air temperature range: SN54' . . . . . −55°C to 125°C
SN74' . . . . . 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

| | | SN5422 | | | SN7422 | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN | NOM | MAX | MIN | NOM | MAX | |
| $V_{CC}$ | Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| $V_{IH}$ | High-level input voltage | 2 | | | 2 | | | V |
| $V_{IL}$ | Low-level input voltage | | | 0.8 | | | 0.8 | V |
| $V_{OH}$ | High-level output voltage | | | 5.5 | | | 5.5 | V |
| $I_{OL}$ | Low-level output current | | | 16 | | | 16 | mA |
| $T_A$ | Operating free-air temperature | −55 | | 125 | 0 | | 70 | °C |

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

| PARAMETER | TEST CONDITIONS† | SN5422 | | | SN7422 | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| $V_{IK}$ | $V_{CC}$ = MIN, $I_I$ = −12 mA | | | −1.5 | | | −1.5 | V |
| $I_{OH}$ | $V_{CC}$ = MIN, $V_{IL}$ = 0.8 V, $V_{OH}$ = 5.5 V | | | | | | 0.25 | mA |
| | $V_{CC}$ = MIN, $V_{IL}$ = 0.7 V, $V_{OH}$ = 5.5 V | | | 0.25 | | | | |
| $V_{OL}$ | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $I_{OL}$ = 16 mA | | 0.2 | 0.4 | | 0.2 | 0.4 | V |
| $I_I$ | $V_{CC}$ = MAX, $V_I$ = 5.5 V | | | 1 | | | 1 | mA |
| $I_{IH}$ | $V_{CC}$ = MAX, $V_I$ = 2.4 V | | | 40 | | | 40 | μA |
| $I_{IL}$ | $V_{CC}$ = MAX, $V_I$ = 0.4 V | | | −1.6 | | | −1.6 | mA |
| $I_{CCH}$ | $V_{CC}$ = MAX, $V_I$ = 0 | | 2 | 4 | | 2 | 4 | mA |
| $I_{CCL}$ | $V_{CC}$ = MAX, $V_I$ = 4.5 V | | 6 | 11 | | 6 | 11 | 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 V, $T_A$ = 25°C.

## switching characteristics, $V_{CC}$ = 5 V, $T_A$ = 25°C (see note 2)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $t_{PLH}$ | Any | Y | $R_L$ = 4 kΩ, | $C_L$ = 15 pF | | 35 | 45 | ns |
| $t_{PHL}$ | | | $R_L$ = 400 Ω, | $C_L$ = 15 pF | | 8 | 15 | ns |

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

## recommended operating conditions

| | SN54LS22 | | | SN74LS22 | | | UNIT |
|---|---|---|---|---|---|---|---|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| $V_{CC}$ Supply voltage | 4.5 | 5 | 5.5 | 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 |
| $V_{OH}$ High-level output voltage | | | 5.5 | | | 5.5 | V |
| $I_{OL}$ Low-level output current | | | 4 | | | 8 | mA |
| $T_A$ Operating free-air temperature | −55 | | 125 | 0 | | 70 | °C |

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

| PARAMETER | TEST CONDITIONS† | SN54LS22 | | | SN74LS22 | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| $V_{IK}$ | $V_{CC}$ = MIN, $I_I$ = −18 mA | | | −1.5 | | | −1.5 | V |
| $I_{OH}$ | $V_{CC}$ = MIN, $V_{IL}$ = MAX, $V_{OH}$ = 5.5 V | | | 0.1 | | | 0.1 | mA |
| $V_{OL}$ | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $I_{OL}$ = 4 mA | | 0.25 | 0.4 | | 0.25 | 0.4 | V |
| | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $I_{OL}$ = 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 | | | −0.4 | | | −0.4 | mA |
| $I_{CCH}$ | $V_{CC}$ = MAX, $V_I$ = 0 | | 0.4 | 0.8 | | 0.4 | 0.8 | mA |
| $I_{CCL}$ | $V_{CC}$ = MAX, $V_I$ = 4.5 V | | 1.2 | 2.2 | | 1.2 | 2.2 | 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 V, $T_A$ = 25°C.

## switching characteristics, $V_{CC}$ = 5 V, $T_A$ = 25°C (see note 2)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $t_{PLH}$ | Any | Y | $R_L$ = 2 kΩ, $C_L$ = 15 pF | | 17 | 32 | ns |
| $t_{PHL}$ | | | | | 15 | 28 | ns |

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

## recommended operating conditions

| | | SN54S22 | | | SN74S22 | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN | NOM | MAX | MIN | NOM | MAX | |
| $V_{CC}$ | Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| $V_{IH}$ | High-level input voltage | 2 | | | 2 | | | V |
| $V_{IL}$ | Low-level input voltage | | | 0.8 | | | 0.8 | V |
| $V_{OH}$ | High-level output voltage | | | 5.5 | | | 5.5 | V |
| $I_{OL}$ | Low-level output current | | | 20 | | | 20 | mA |
| $T_A$ | Operating free-air temperature | −55 | | 125 | 0 | | 70 | °C |

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

| PARAMETER | TEST CONDITIONS† | SN54S22 | | | SN74S22 | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| $V_{IK}$ | $V_{CC}$ = MIN, $I_I$ = −18 mA | | | −1.2 | | | −1.2 | V |
| $I_{OH}$ | $V_{CC}$ = MIN, $V_{IL}$ = 0.8 V, $V_{OH}$ = 5.5 V | | | | | | 0.25 | mA |
| | $V_{CC}$ = MIN, $V_{IL}$ = 0.7 V, $V_{OH}$ = 5.5 V | | | 0.25 | | | | |
| $V_{OL}$ | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $I_{OL}$ = 20 mA | | | 0.5 | | | 0.5 | V |
| $I_I$ | $V_{CC}$ = MAX, $V_I$ = 5.5 V | | | 1 | | | 1 | mA |
| $I_{IH}$ | $V_{CC}$ = MAX, $V_I$ = 2.7 V | | | 50 | | | 50 | μA |
| $I_{IL}$ | $V_{CC}$ = MAX, $V_I$ = 0.5 V | | | −2 | | | −2 | mA |
| $I_{CCH}$ | $V_{CC}$ = MAX, $V_I$ = 0 | | 3 | 6.6 | | 3 | 6.6 | mA |
| $I_{CCL}$ | $V_{CC}$ = MAX, $V_I$ = 4.5 V | | 10 | 18 | | 10 | 18 | 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 V, $T_A$ = 25°C.

## switching characteristics, $V_{CC}$ = 5 V, $T_A$ = 25°C (see note 2)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $t_{PLH}$ | Any | Y | $R_L$ = 280 Ω, $C_L$ = 15 pF | 2 | 5 | 7.5 | ns |
| $t_{PHL}$ | | | | 2 | 4.5 | 7 | ns |
| $t_{PLH}$ | | | $R_L$ = 280 Ω, $C_L$ = 50 pF | | 7.5 | | ns |
| $t_{PHL}$ | | | | | 7 | | ns |

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

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