

# SN5438, SN54LS38, SN54S38 SN7438, SN74LS38, SN74S38 QUADRUPLE 2-INPUT POSITIVE-NAND BUFFERS WITH OPEN-COLLECTOR OUTPUTS

SDLS105 – 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

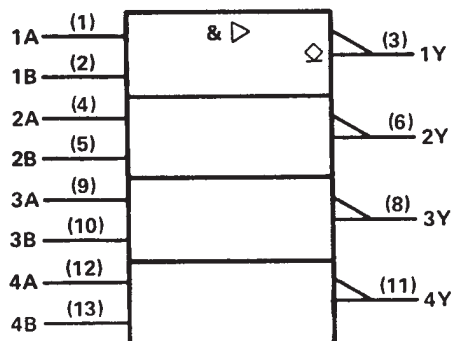
These devices contain four independent 2-input NAND buffer gates with open-collector outputs. The open-collector outputs require pull-up resistors to perform correctly. They may be connected to other open-collector outputs to implement active-low wired-OR or active-high wired-AND functions. Open-collector devices are often used to generate high  $V_{OH}$  levels.

The SN5438, SN54LS38, and SN54S38 are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN7438, SN74LS38, and SN74S38 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

FUNCTION TABLE (each gate)

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

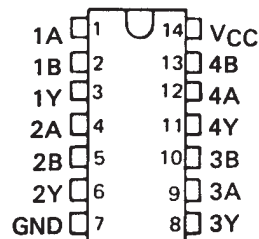
## logic symbol†



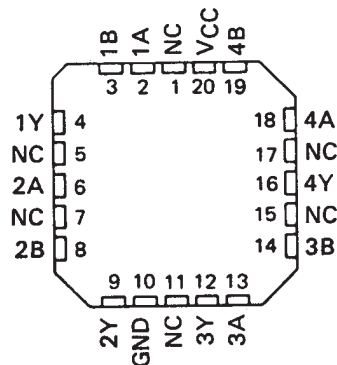
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

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

SN5438, SN54LS38, SN54S38 . . . J OR W PACKAGE  
SN7438 . . . N PACKAGE  
SN74LS38, SN74S38 . . . D OR N PACKAGE  
(TOP VIEW)

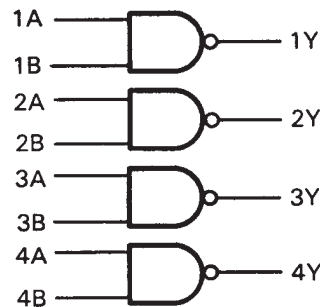


SN54LS38, SN54S38 . . . FK PACKAGE  
(TOP VIEW)



NC - No internal connection

## logic diagram



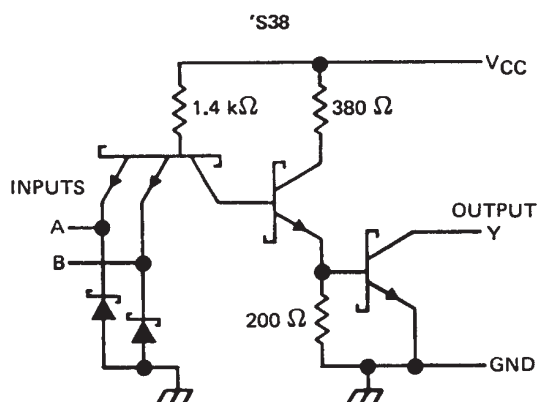
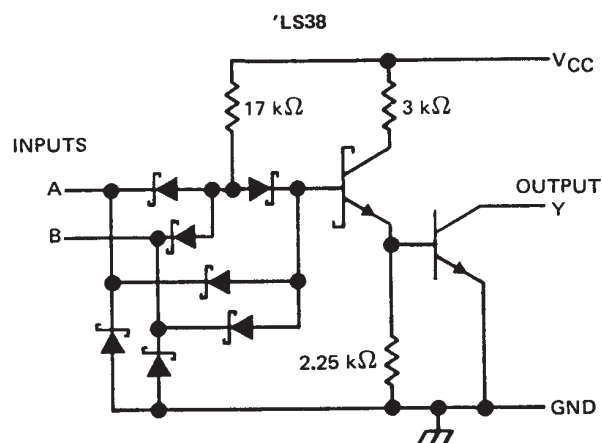
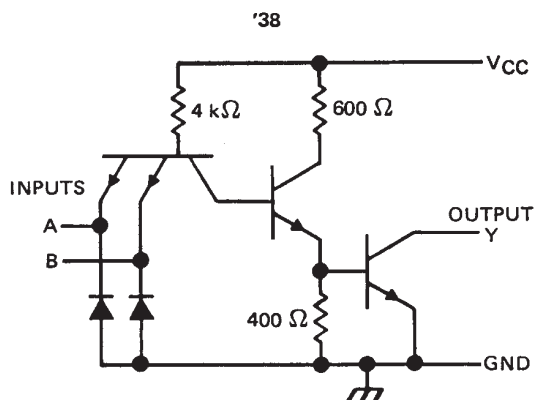
## positive logic

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

## QUADRUPLE 2-INPUT POSITIVE-NAND BUFFERS WITH OPEN-COLLECTOR OUTPUTS

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## schematics (each gate)



Resistor values shown are nominal.

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

|                                             |                                                |
|---------------------------------------------|------------------------------------------------|
| Supply voltage, $V_{CC}$ (see Note 1)       | 7 V                                            |
| Input voltage: '38                          | 5.5 V                                          |
| LS38                                        | 7 V                                            |
| Off-state output voltage                    | 7 V                                            |
| Operating free-air temperature range: SN54' | $-55^{\circ}\text{C}$ to $125^{\circ}\text{C}$ |
| SN74'                                       | $0^{\circ}\text{C}$ to $70^{\circ}\text{C}$    |
| Storage temperature range                   | $-65^{\circ}\text{C}$ to $150^{\circ}\text{C}$ |

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

# QUADRUPLE 2-INPUT POSITIVE-NAND BUFFERS WITH OPEN-COLLECTOR OUTPUTS

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## recommended operating conditions

|                                               | SN5438 |     |     | SN7438 |     |      | UNIT |
|-----------------------------------------------|--------|-----|-----|--------|-----|------|------|
|                                               | MIN    | NOM | MAX | MIN    | NOM | MAX  |      |
| V <sub>CC</sub> Supply voltage                | 4.5    | 5   | 5.5 | 4.75   | 5   | 5.25 | V    |
| V <sub>IH</sub> High-level input voltage      | 2      |     |     | 2      |     |      | V    |
| V <sub>IL</sub> Low-level input voltage       |        |     | 0.8 |        |     | 0.8  | V    |
| V <sub>OH</sub> High-level output voltage     |        |     | 5.5 |        |     | 5.5  | V    |
| I <sub>OL</sub> Low-level output current      |        |     | 48  |        |     | 48   | mA   |
| T <sub>A</sub> Operating free-air temperature | – 55   |     | 125 | 0      |     | 70   | °C   |

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

| PARAMETER        | TEST CONDITIONS†                                                        | SN5438 |      |       | SN7438 |      |       | UNIT |
|------------------|-------------------------------------------------------------------------|--------|------|-------|--------|------|-------|------|
|                  |                                                                         | MIN    | TYP‡ | MAX   | MIN    | TYP‡ | MAX   |      |
| V <sub>IK</sub>  | V <sub>CC</sub> = MIN, I <sub>I</sub> = – 12 mA                         |        |      | – 1.5 |        |      | – 1.5 | V    |
| I <sub>OH</sub>  | V <sub>CC</sub> = MIN, V <sub>IL</sub> = 0.8 V, V <sub>OH</sub> = 5.5 V |        |      |       |        |      | 0.25  | mA   |
|                  | V <sub>CC</sub> = MIN, V <sub>IL</sub> = 0.7 V, V <sub>OH</sub> = 5.5 V |        |      | 0.25  |        |      |       |      |
| V <sub>OL</sub>  | V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, I <sub>OL</sub> = 16 mA   |        |      | 0.4   |        |      | 0.4   | V    |
| I <sub>I</sub>   | V <sub>CC</sub> = MAX, V <sub>I</sub> = 5.5 V                           |        |      | 1     |        |      | 1     | mA   |
| I <sub>IH</sub>  | V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.4 V                           |        |      | 40    |        |      | 40    | μA   |
| I <sub>IL</sub>  | V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V                           |        |      | – 1.6 |        |      | – 1.6 | mA   |
| I <sub>CCH</sub> | V <sub>CC</sub> = MAX, V <sub>I</sub> = 0                               |        |      | 5     |        |      | 5     | 8.5  |
| I <sub>CCL</sub> | V <sub>CC</sub> = MAX, V <sub>I</sub> = 4.5 V                           |        |      | 34    |        |      | 34    | 54   |

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

‡All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

## switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C (see note 2)

| PARAMETER        | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS                                | MIN | TYP | MAX | UNIT |
|------------------|--------------|-------------|------------------------------------------------|-----|-----|-----|------|
| t <sub>PLH</sub> | A or B       | Y           | R <sub>L</sub> = 133 Ω, C <sub>L</sub> = 45 pF |     | 14  | 22  | ns   |
| t <sub>PHL</sub> |              |             |                                                |     | 11  | 18  | ns   |

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

SN5438, SN54LS38, SN54S38

SN7438, SN74LS38, SN74S38

# QUADRUPLE 2-INPUT POSITIVE-NAND BUFFERS WITH OPEN-COLLECTOR OUTPUTS

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## recommended operating conditions

|                                      | SN54LS38 |     |     | SN74LS38 |     |      | 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    |          |     | 12  |          |     | 24   | 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 †                                                   | SN54LS38 |       |       | SN74LS38 |       |       | UNIT |
|-----------|---------------------------------------------------------------------|----------|-------|-------|----------|-------|-------|------|
|           |                                                                     | MIN      | TYP ‡ | MAX   | MIN      | TYP ‡ | MAX   |      |
| $V_{IK}$  | $V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$                         |          |       | – 1.5 |          |       | – 1.5 | V    |
| $I_{OH}$  | $V_{CC} = \text{MIN}, V_{IL} = \text{MAX}, V_{OH} = 5.5 \text{ V}$  |          |       | 0.25  |          |       | 0.25  | mA   |
| $V_{OL}$  | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, I_{OL} = 12 \text{ mA}$ |          | 0.25  | 0.4   |          | 0.25  | 0.4   | V    |
|           | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, I_{OL} = 24 \text{ mA}$ |          |       |       |          | 0.35  | 0.5   |      |
| $I_I$     | $V_{CC} = \text{MAX}, V_I = 7 \text{ V}$                            |          |       | 0.1   |          |       | 0.1   | mA   |
| $I_{IH}$  | $V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$                          |          |       | 20    |          |       | 20    | μA   |
| $I_{IL}$  | $V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$                          |          |       | – 0.4 |          |       | – 0.4 | mA   |
| $I_{CCH}$ | $V_{CC} = \text{MAX}, V_I = 0$                                      |          | 0.9   | 2     |          | 0.9   | 2     | mA   |
| $I_{CCL}$ | $V_{CC} = \text{MAX}, V_I = 4.5 \text{ V}$                          |          | 6     | 12    |          | 6     | 12    | mA   |

† For conditons shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at  $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$ .

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

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS                         | MIN | TYP | MAX | UNIT |
|-----------|--------------|-------------|-----------------------------------------|-----|-----|-----|------|
| $t_{PLH}$ | A or B       | Y           | $R_L = 667 \Omega, C_L = 45 \text{ pF}$ |     | 20  | 32  | ns   |
| $t_{PHL}$ |              |             |                                         |     | 18  | 28  | ns   |

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



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# QUADRUPLE 2-INPUT POSITIVE-NAND BUFFERS WITH OPEN-COLLECTOR OUTPUTS

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## recommended operating conditions

|                                               | SN54S38 |     |     | SN74S38 |     |      | UNIT |
|-----------------------------------------------|---------|-----|-----|---------|-----|------|------|
|                                               | MIN     | NOM | MAX | MIN     | NOM | MAX  |      |
| V <sub>CC</sub> Supply voltage                | 4.5     | 5   | 5.5 | 4.75    | 5   | 5.25 | V    |
| V <sub>IH</sub> High-level input voltage      | 2       |     |     | 2       |     |      | V    |
| V <sub>IL</sub> Low-level input voltage       |         |     | 0.8 |         |     | 0.8  | V    |
| V <sub>OH</sub> High-level output voltage     |         |     | 5.5 |         |     | 5.5  | V    |
| I <sub>OL</sub> Low-level output current      |         |     | 60  |         |     | 60   | mA   |
| T <sub>A</sub> Operating free-air temperature | – 55    |     | 125 | 0       |     | 70   | °C   |

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

| PARAMETER        | TEST CONDITIONS†                                                        | SN54S38 |       | SN74S38 |       | UNIT |
|------------------|-------------------------------------------------------------------------|---------|-------|---------|-------|------|
|                  |                                                                         | MIN     | TYP‡  | MIN     | TYP‡  |      |
| V <sub>IK</sub>  | V <sub>CC</sub> = MIN, I <sub>I</sub> = – 18 mA                         |         | – 1.2 |         | – 1.2 | V    |
| I <sub>OH</sub>  | V <sub>CC</sub> = MIN, V <sub>IL</sub> = 0.8 V, V <sub>OH</sub> = 5.5 V |         |       |         | 0.25  | mA   |
|                  | V <sub>CC</sub> = MIN, V <sub>IL</sub> = 0.7 V, V <sub>OH</sub> = 5.5 V |         | 0.25  |         |       |      |
| V <sub>OL</sub>  | V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, I <sub>OL</sub> = 60 mA   |         | 0.5   |         | 0.5   | V    |
| I <sub>I</sub>   | V <sub>CC</sub> = MAX, V <sub>I</sub> = 5.5 V                           |         | 1     |         | 1     | mA   |
| I <sub>IH</sub>  | V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.4 V                           |         | 0.1   |         | 0.1   | mA   |
| I <sub>IL</sub>  | V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.5 V                           |         | – 4   |         | – 4   | mA   |
| I <sub>CCH</sub> | V <sub>CC</sub> = MAX, V <sub>I</sub> = 0                               | 20      | 36    | 20      | 36    | mA   |
| I <sub>CCL</sub> | V <sub>CC</sub> = MAX, V <sub>I</sub> = 4.5 V                           | 46      | 80    | 46      | 80    | mA   |

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

‡All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

## switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C (see note 2)

| PARAMETER        | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS                                | MIN | TYP | MAX | UNIT |
|------------------|--------------|-------------|------------------------------------------------|-----|-----|-----|------|
| t <sub>PLH</sub> | A or B       | Y           | R <sub>L</sub> = 93 Ω, C <sub>L</sub> = 50 pF  | 6.5 | 10  |     | ns   |
| t <sub>PHL</sub> |              |             |                                                | 6.5 | 10  |     | ns   |
| t <sub>PLH</sub> |              |             | R <sub>L</sub> = 93 Ω, C <sub>L</sub> = 150 pF | 9   |     |     | ns   |
| t <sub>PHL</sub> |              |             |                                                | 8.5 |     |     | ns   |

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

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