

- 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

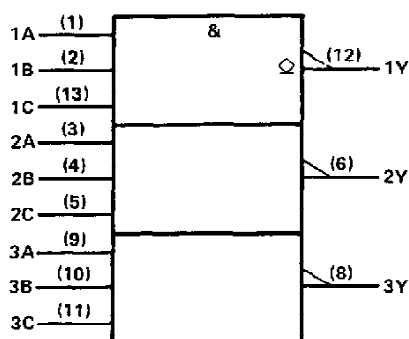
These devices contain three independent 3-input NAND gates with open-collector outputs. The open-collector outputs require pull-up resistors to perform correctly. They may be connected to other open-collector outputs to implement active-low wired-OR or active-high wired-AND functions. Open-collector devices are often used to generate higher  $V_{OH}$  levels.

The SN5412 and SN54LS12 are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN7412 and SN74LS12 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

FUNCTION TABLE (each gate)

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

### logic symbol†



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

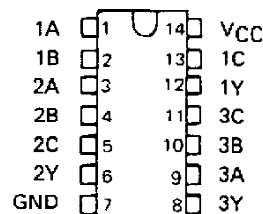
Pin numbers shown are for D, J, N, and W packages.

SN5412, SN54LS12 . . . J OR W PACKAGE

SN7412 . . . N PACKAGE

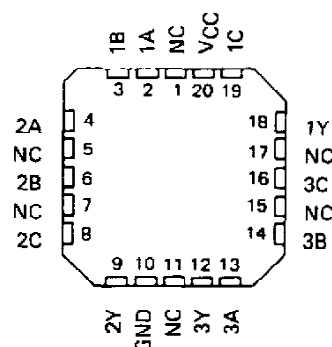
SN74LS12 . . . D OR N PACKAGE

(TOP VIEW)



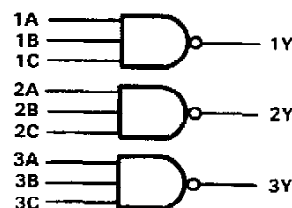
SN54LS12 . . . FK PACKAGE

(TOP VIEW)



NC—No internal connection

### logic diagram (positive logic)

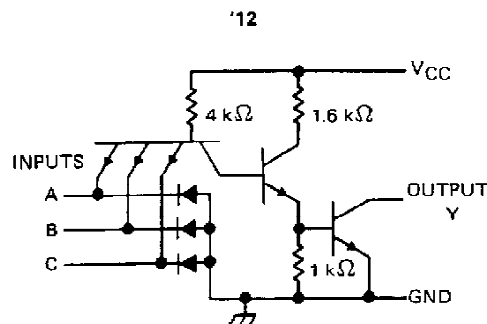


$$Y = \overline{A \cdot B \cdot C} \text{ or}$$

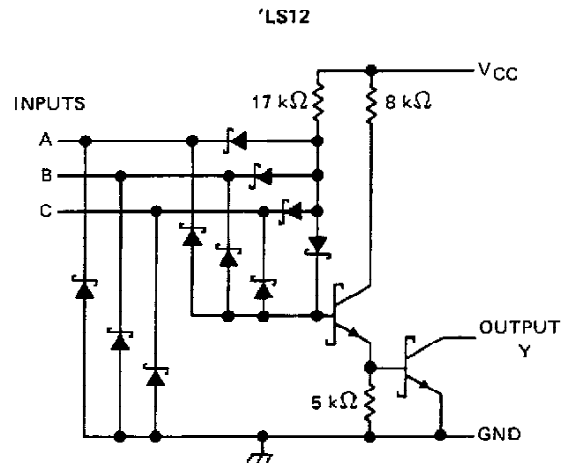
$$Y = \overline{A} + \overline{B} + \overline{C}$$

**SN5412, SN54LS12**  
**SN7412, SN74LS12**  
**TRIPLE 3-INPUT POSITIVE-NAND GATES WITH OPEN-COLLECTOR OUTPUTS**

schematics (each gate)



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: '12                    | 5.5 V          |
| 'LS12                                 | 7 V            |
| Off-state output voltage              | 7 V            |
| Operating free-air temperature: 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.

# SN5412, SN5412

## TRIPLE 3-INPUT POSITIVE-NAND GATES WITH OPEN-COLLECTOR OUTPUTS

### recommended operating conditions

|                                               | SN5412 |     |     | SN7412 |     |      | 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      |        |     | 16  |        |     | 16   | 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†                                                        | SN5412 |      |      | SN7412 |      |      | 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   | 0.2    | 0.4  |      | 0.2    | 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                               | 3      | 6    |      | 3      | 6    |      | mA   |
| I <sub>CCL</sub> | V <sub>CC</sub> = MAX, V <sub>I</sub> = 4.5 V                           | 9      | 16.5 |      | 9      | 16.5 |      | 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<br>(INPUT) | TO<br>(OUTPUT) | TEST CONDITIONS         |                        | MIN | TYP | MAX | UNIT |
|------------------|-----------------|----------------|-------------------------|------------------------|-----|-----|-----|------|
| t <sub>PLH</sub> | A, B or C       | Y              | R <sub>L</sub> = 4 kΩ,  | C <sub>L</sub> = 15 pF | 35  | 45  |     | ns   |
| t <sub>PHL</sub> |                 |                | R <sub>L</sub> = 400 Ω, | C <sub>L</sub> = 15 pF | 8   | 15  |     | ns   |

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



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# SN54LS12, SN74LS12

## TRIPLE 3-INPUT POSITIVE-NAND GATES WITH OPEN-COLLECTOR OUTPUTS

### recommended operating conditions

|                                      | SN54LS12 |     |     | SN74LS12 |     |      | 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†                                                   | SN54LS12 |      |      | SN74LS12 |      |      | UNIT |
|-----------|--------------------------------------------------------------------|----------|------|------|----------|------|------|------|
|           |                                                                    | MIN      | TYP‡ | MAX  | MIN      | TYP‡ | MAX  |      |
| $V_{IK}$  | $V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$                        |          |      | -1.5 |          |      | -1.5 | V    |
| $I_{OH}$  | $V_{CC} = \text{MIN}, V_{IL} = \text{MAX}, V_{OH} = 5.5 \text{ V}$ |          |      | 0.1  |          |      | 0.1  | mA   |
| $V_{OL}$  | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, I_{OL} = 4 \text{ mA}$ | 0.25     |      | 0.4  | 0.25     |      | 0.4  | V    |
|           | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, I_{OL} = 8 \text{ mA}$ |          |      |      | 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   |
| $I_{CCH}$ | $V_{CC} = \text{MAX}, V_I = 0$                                     | 0.7      |      | 1.4  | 0.7      |      | 1.4  | mA   |
| $I_{CCL}$ | $V_{CC} = \text{MAX}, V_I = 4.5 \text{ V}$                         | 1.8      |      | 3.3  | 1.8      |      | 3.3  | mA   |

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

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

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

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEST CONDITIONS            |                       | MIN | TYP | MAX | UNIT |
|-----------|-----------------|----------------|----------------------------|-----------------------|-----|-----|-----|------|
| $t_{PLH}$ | A, B or C       | Y              | $R_L = 2 \text{ k}\Omega,$ | $C_L = 15 \text{ pF}$ | 17  |     | 32  | ns   |
| $t_{PHL}$ |                 |                |                            |                       | 15  |     | 28  | ns   |

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



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