

# SN5402, SN54LS02, SN54S02, SN7402, SN74LS02, SN74S02 QUADRUPLE 2-INPUT POSITIVE-NOR GATES

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

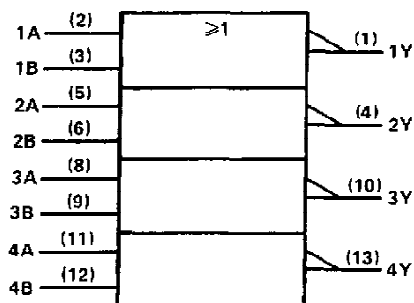
These devices contain four independent 2-input-NOR gates.

The SN5402, SN54LS02, and SN54S02 are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN7402, SN74LS02, and SN74S02 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

FUNCTION TABLE (each gate)

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

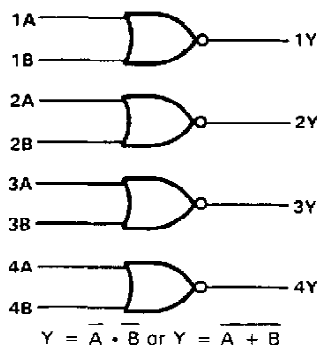
## logic symbol†



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

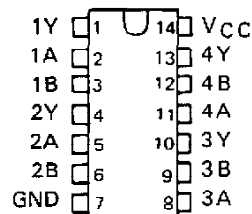
Pin numbers shown are for D, J, and N packages.

## logic diagram (positive logic)

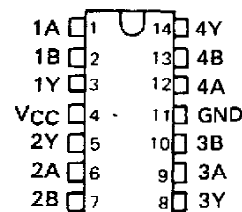


SN5402 ... J PACKAGE  
SN54LS02, SN54S02 ... J OR W PACKAGE  
SN7402 ... N PACKAGE  
SN74LS02, SN74S02 ... D OR N PACKAGE

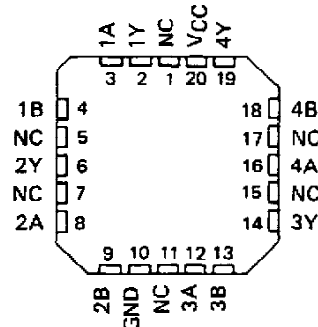
(TOP VIEW)



SN5402 ... W PACKAGE  
(TOP VIEW)



SN54LS02, SN54S02 ... FK PACKAGE  
(TOP VIEW)



NC - No internal connection

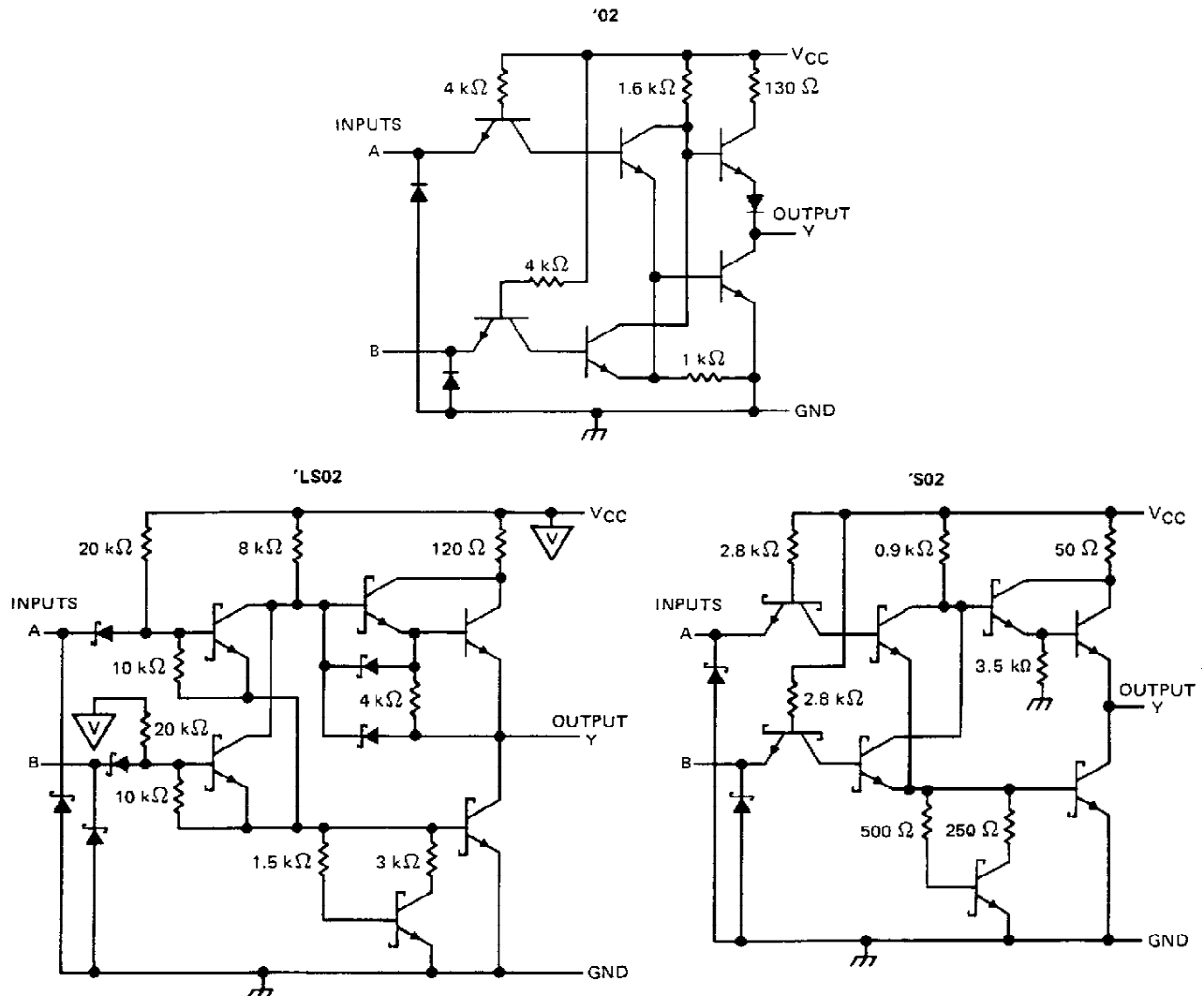
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**SN5402, SN54LS02, SN54S02,  
SN7402, SN74LS02, SN74S02  
QUADRUPLE 2-INPUT POSITIVE-NOR GATES**

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: '02, 'S02 .....                    | 5.5 V            |
| 'LS02 .....                                       | 7 V              |
| Off-state output voltage .....                    | 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.

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# SN5402, SN7402

## QUADRUPLE 2-INPUT POSITIVE-NOR GATES

### recommended operating conditions

|                                               | SN5402 |     |       | SN7402 |     |       | 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    |
| I <sub>OH</sub> High-level output current     |        |     | − 0.4 |        |     | − 0.4 | mA   |
| 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 †                                                          | SN5402 |       |       | SN7402 |       |       | 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    |
| V <sub>OH</sub>   | V <sub>CC</sub> = MIN, V <sub>IL</sub> = 0.8 V, I <sub>OH</sub> = − 0.4 mA | 2.4    | 3.4   |       | 2.4    | 3.4   |       | V    |
| 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>OS</sub> § | V <sub>CC</sub> = MAX                                                      | − 20   |       | − 55  | − 18   |       | − 55  | mA   |
| I <sub>CCH</sub>  | V <sub>CC</sub> = MAX, V <sub>I</sub> = 0 V                                |        | 8     | 16    |        | 8     | 16    | mA   |
| I <sub>CCL</sub>  | V <sub>CC</sub> = MAX, See Note 2                                          |        | 14    | 27    |        | 14    | 27    | 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.

§ Not more than one output should be shorted at a time.

NOTE 2: One input at 4.5 V, all others at GND.

### switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C (see note 3)

| PARAMETER        | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEST CONDITIONS         |                        | MIN | TYP | MAX | UNIT |
|------------------|-----------------|----------------|-------------------------|------------------------|-----|-----|-----|------|
| t <sub>PLH</sub> | A or B          | Y              | R <sub>L</sub> = 400 Ω, | C <sub>L</sub> = 15 pF |     | 12  | 22  | ns   |
| t <sub>PHL</sub> |                 |                |                         |                        |     | 8   | 15  | ns   |

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

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# SN54LS02, SN74LS02

## QUADRUPLE 2-INPUT POSITIVE-NOR GATES

### recommended operating conditions

|                                      | SN54LS02 |     |      | SN74LS02 |     |      | 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    |
| $I_{OH}$ High-level output current   |          |     | -0.4 |          |     | -0.4 | mA   |
| $I_{OL}$ 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 †                                                    | SN54LS02 |       |      | SN74LS02 |       |      | UNIT |
|------------|----------------------------------------------------------------------|----------|-------|------|----------|-------|------|------|
|            |                                                                      | MIN      | TYP ‡ | MAX  | MIN      | TYP ‡ | MAX  |      |
| $V_{IK}$   | $V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$                          |          |       | -1.5 |          |       | -1.5 | V    |
| $V_{OH}$   | $V_{CC} = \text{MIN}, V_{IL} = \text{MAX}, I_{OH} = -0.4 \text{ mA}$ | 2.5      | 3.4   |      | 2.7      | 3.4   |      | V    |
| $V_{OL}$   | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, I_{OL} = 4 \text{ mA}$   | 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   |
| $I_{OS} §$ | $V_{CC} = \text{MAX}$                                                | -20      |       | -100 | -20      |       | -100 | mA   |
| $I_{CCH}$  | $V_{CC} = \text{MAX}, V_I = 0 \text{ V}$                             |          | 1.6   | 3.2  |          | 1.6   | 3.2  | mA   |
| $I_{CCL}$  | $V_{CC} = \text{MAX}, \text{ See Note 2}$                            |          | 2.8   | 5.4  |          | 2.8   | 5.4  | mA   |

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

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

§ Not more than one output should be shorted at a time, and the duration of the short-circuit should not exceed one second.

NOTE 2: One input at 4.5 V, all others at GND.

### switching characteristics, $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$ (see note 3)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS                                | MIN | TYP | MAX | UNIT |
|-----------|--------------|-------------|------------------------------------------------|-----|-----|-----|------|
| $t_{PLH}$ | A or B       | Y           | $R_L = 2 \text{ k}\Omega, C_L = 15 \text{ pF}$ | 10  | 15  |     | ns   |
| $t_{PHL}$ |              |             |                                                | 10  | 15  |     | ns   |

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.



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# **SN54S02, SN74S02** **QUADRUPL 2-INPUT POSITIVE-NOR GATES**

## **recommended operating conditions**

|                                      | SN54S02 |     |     | SN74S02 |     |      | 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    |
| $I_{OH}$ High-level output current   |         |     | -1  |         |     | -1   | mA   |
| $I_{OL}$ 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 †                                                     | SN54S02 |      |      | SN74S02 |      |      | UNIT |
|-----------|-----------------------------------------------------------------------|---------|------|------|---------|------|------|------|
|           |                                                                       | MIN     | TYP‡ | MAX  | MIN     | TYP‡ | MAX  |      |
| $V_{IK}$  | $V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$                           |         |      | -1.2 |         |      | -1.2 | V    |
| $V_{OH}$  | $V_{CC} = \text{MIN}, V_{IL} = 0.8 \text{ V}, I_{OH} = -1 \text{ mA}$ | 2.5     | 3.4  |      | 2.7     | 3.4  |      | V    |
| $V_{OL}$  | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, I_{OL} = 20 \text{ mA}$   |         |      | 0.5  |         |      | 0.5  | V    |
| $I_I$     | $V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$                            |         |      | 1    |         |      | 1    | mA   |
| $I_{IH}$  | $V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$                            |         |      | 50   |         |      | 50   | µA   |
| $I_{IL}$  | $V_{CC} = \text{MAX}, V_I = 0.5 \text{ V}$                            |         |      | -2   |         |      | -2   | mA   |
| $I_{OS}§$ | $V_{CC} = \text{MAX}$                                                 | -40     |      | -100 | -40     |      | -100 | mA   |
| $I_{CCH}$ | $V_{CC} = \text{MAX}, V_I = 0 \text{ V}$                              |         | 17   | 29   |         | 17   | 29   | mA   |
| $I_{CCL}$ | $V_{CC} = \text{MAX}, \text{ See Note 2}$                             |         | 26   | 45   |         | 26   | 45   | mA   |

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

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

§ Not more than one output should be shorted at a time, and the duration of the short-circuit should not exceed one second.

NOTE 2: One input at 4.5 V, all others at GND.

## **switching characteristics, $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$ (see note 3)**

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEST CONDITIONS                         | MIN | TYP | MAX | UNIT |
|-----------|-----------------|----------------|-----------------------------------------|-----|-----|-----|------|
| $t_{PLH}$ | A or B          | Y              | $R_L = 280 \Omega, C_L = 15 \text{ pF}$ | 3.5 | 5.5 |     | ns   |
| $t_{PHL}$ |                 |                |                                         | 3.5 | 5.5 |     | ns   |
| $t_{PLH}$ |                 |                | $R_L = 280 \Omega, C_L = 50 \text{ pF}$ | 5   |     |     | ns   |
| $t_{PHL}$ |                 |                |                                         | 5   |     |     | ns   |

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

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