

# SN5433, SN54LS33, SN7433, SN74LS33 QUADRUPLE 2-INPUT POSITIVE-NOR BUFFERS WITH OPEN-COLLECTOR OUTPUTS

SDLS101

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

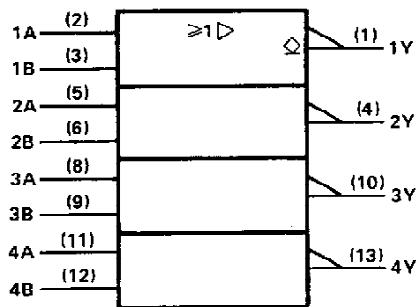
These devices contain four independent 2-input NOR buffer gates with open-collector outputs. Open-collector outputs require resistive pull-up to perform logically but can deliver higher  $V_{OH}$  levels and are commonly used in wired-AND applications.

The SN5433 and SN54LS33 are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN7433, and SN74LS33 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

FUNCTION TABLE (each gate)

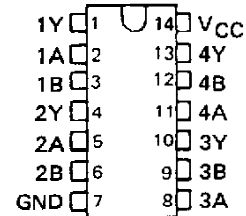
| INPUTS |   | OUTPUT |
|--------|---|--------|
| A      | B | Y      |
| H      | X | L      |
| X      | H | L      |
| L      | L | H      |

### logic symbol†

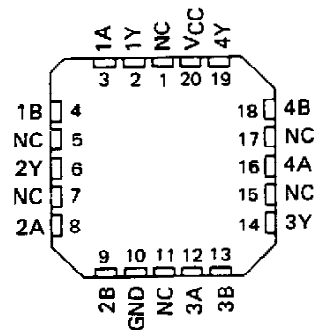


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers shown are for D, J, N, and W packages.

SN5433, SN54LS33 . . . J OR W PACKAGE  
SN7433 . . . N PACKAGE  
SN74LS33 . . . D OR N PACKAGE  
(TOP VIEW)

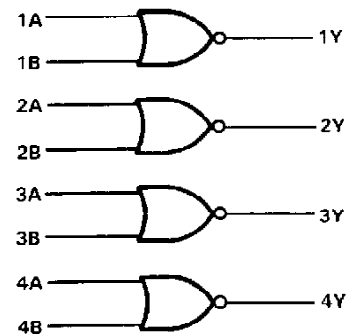


SN54LS33 . . . FK PACKAGE  
(TOP VIEW)



NC - No internal connection

### logic diagram



### positive logic

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

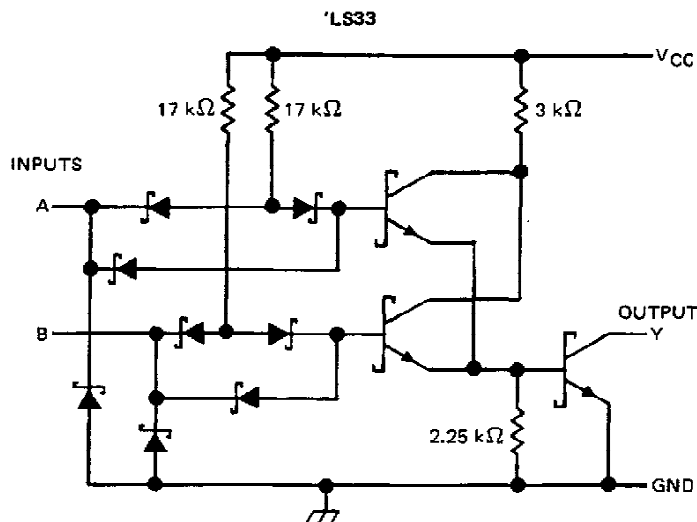
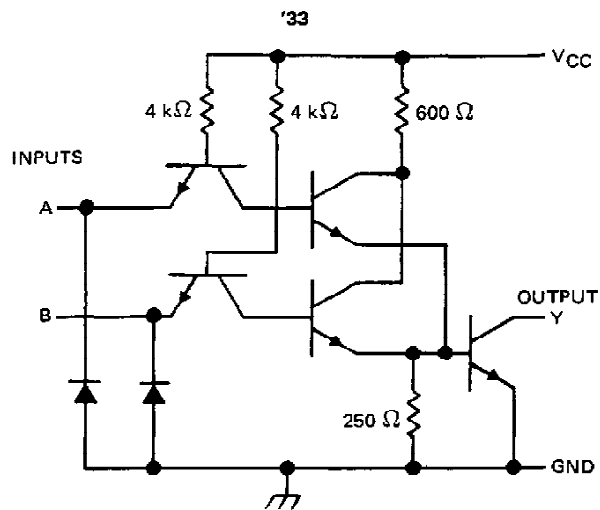
PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

  
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# SN5433, SN54LS33, SN7433, SN74LS33 QUADRUPLE 2-INPUT POSITIVE-NOR BUFFERS WITH OPEN-COLLECTOR OUTPUTS

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: '33 .....                    | 5.5 V          |
| 'LS33 .....                                 | 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.

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**SN5433, SN7433**  
**QUADRUPLE 2-INPUT POSITIVE-NOR BUFFERS WITH OPEN-COLLECTOR OUTPUTS**

**recommended operating conditions**

|                 |                                | SN5433 |     |     | SN7433 |     |      | 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    |     |      | V    |
| V <sub>OH</sub> | High-level output voltage      |        |     |     | 5.5    |     |      | V    |
| I <sub>OL</sub> | Low-level output current       |        |     |     | 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†  | SN5433 |      |     | SN7433 |      |     | 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, See Note 2                                       | 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.

NOTE 2: One input at 4.5 V, all others at 0 V.

**switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C (see Figure 1)**

| PARAMETER        | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS                                  | MIN | TYP | MAX | UNIT |
|------------------|--------------|-------------|--|-----|-----|-----|------|
| t <sub>PLH</sub> | A or B       | Y           | R <sub>L</sub> = 133 kΩ, C <sub>L</sub> = 50 pF  | 10  | 15  |     | ns   |
| t <sub>PHL</sub> |              |             |  | 12  | 18  |     | ns   |
| t <sub>PLH</sub> |              |             | R <sub>L</sub> = 133 kΩ, C <sub>L</sub> = 150 pF | 15  | 22  |     | ns   |
| t <sub>PHL</sub> |              |             |  | 16  | 24  |     | ns   |

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

# SN54LS33, SN74LS33

## QUADRUPLE 2-INPUT POSITIVE-NOR BUFFERS WITH OPEN-COLLECTOR OUTPUTS

### recommended operating conditions

|                                      | SN54LS33 |     |     | SN74LS33 |     |      | 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 †   | SN54LS33 |       |      | SN74LS33 |       |      | UNIT |
|-----------|---|----------|-------|------|----------|-------|------|------|
|           |   | MIN      | TYP ‡ | MAX  | MIN      | TYP ‡ | MAX  |      |
| $V_{IK}$  | $V_{CC} = \text{MIN}$ , $I_I = -18 \text{ mA}$  |          | -1.5  |      |          | -1.5  |      | V    |
| $I_{OH}$  | $V_{CC} = \text{MIN}$ , $V_{IH} = 2 \text{ V}$ , $V_{IL} = \text{MAX}$ , $V_{OH} = 5.5 \text{ V}$ |          |       | 0.25 |          |       | 0.25 | mA   |
| $V_{OL}$  | $V_{CC} = \text{MIN}$ , $V_{IH} = 2 \text{ V}$ , $V_{IL} = \text{MAX}$ , $I_{OL} = 12 \text{ mA}$ |          | 0.25  | 0.4  |          | 0.25  | 0.4  | V    |
|           | $V_{CC} = \text{MIN}$ , $V_{IL} = \text{MAX}$ , $I_{OL} = 24 \text{ mA}$                          |          |       |      |          | 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   |
| $I_{CCH}$ | $V_{CC} = \text{MAX}$ , $V_I = 0$   |          | 1.8   | 3.6  |          | 1.8   | 3.6  | mA   |
| $I_{CCL}$ | $V_{CC} = \text{MAX}$ , See Note 2  |          | 6.9   | 13.8 |          | 6.9   | 13.8 | mA   |

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

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

NOTE 2: One input at 4.5 V, all others at 0 V.

### 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           | $R_L = 667 \Omega$ , $C_L = 45 \text{ pF}$ |     | 20  | 32  | ns   |
| $t_{PHL}$ |              |             |  |     | 18  | 28  |      |

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

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**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

| Device      | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74LS33DR  | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| SN74LS33NSR | SO           | NS              | 14   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

| Device      | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74LS33DR  | SOIC         | D               | 14   | 2500 | 356.0       | 356.0      | 35.0        |
| SN74LS33NSR | SO           | NS              | 14   | 2000 | 356.0       | 356.0      | 35.0        |

**TUBE**


\*All dimensions are nominal

| Device     | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| 8512601DA  | W            | CFP          | 14   | 1   | 506.98 | 26.16  | 6220   | NA     |
| SN74LS33D  | D            | SOIC         | 14   | 50  | 506.6  | 8      | 3940   | 4.32   |
| SN74LS33N  | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SN74LS33N  | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SNJ54LS33W | W            | CFP          | 14   | 1   | 506.98 | 26.16  | 6220   | NA     |

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