DUAL 4-INPUT POSITIVE-NAND GATES WITH OPEN-COLLECTOR OUTPUTS

DECEMBER 1983 – REVISED MARCH 1986

- 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 VOH 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)

<table>
<thead>
<tr>
<th>INPUTS</th>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>A B C D</td>
<td>Y</td>
</tr>
<tr>
<td>H H H H</td>
<td>L</td>
</tr>
<tr>
<td>L X X X</td>
<td>H</td>
</tr>
<tr>
<td>X L X X</td>
<td>H</td>
</tr>
<tr>
<td>X X L X</td>
<td>H</td>
</tr>
<tr>
<td>X X X L</td>
<td>H</td>
</tr>
</tbody>
</table>

logic symbol†

logic diagram

positive logic

Y = A + B + C + D or Y = A + B + C + D

† 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,
SN7422, SN74LS22, SN74S22
DUAL 4-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, VCC (See Note 1) ................................................................. 7 V
Input voltage: '22, 'S22 ................................................................. 5.5 V
'LS22 ................................................................. 7 V
Operating free-air temperature range: SN54* ........................................... -65°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.
**SN5422, SN7422**

**DUAL 4-INPUT POSITIVE-NAND GATES WITH OPEN-COLLECTOR OUTPUTS**

### Recommended Operating Conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>SN5422</th>
<th>SN7422</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCC</td>
<td>MIN</td>
<td>NOM</td>
<td>MAX</td>
</tr>
<tr>
<td>VIL</td>
<td>4.5</td>
<td>5.5</td>
<td>5.25</td>
</tr>
<tr>
<td>VIL</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VIL</td>
<td>0.8</td>
<td></td>
<td>0.8</td>
</tr>
<tr>
<td>VOH</td>
<td>5.5</td>
<td>5.5</td>
<td></td>
</tr>
<tr>
<td>IOL</td>
<td>16</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>TA</td>
<td>-55</td>
<td>125</td>
<td>0</td>
</tr>
</tbody>
</table>

### Electrical Characteristics Over Recommended Operating Free-Air Temperature Range (Unless Otherwise Noted)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>TEST CONDITIONS†</th>
<th>SN5422</th>
<th>SN7422</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIL</td>
<td>VCC = MIN, VIL = 0.8 V, VOH = 5.5 V</td>
<td>0.2</td>
<td>0.2</td>
<td>V</td>
</tr>
<tr>
<td>IOL</td>
<td>VCC = MAX, VIH = 2 V, IOH = 16 mA</td>
<td>0.2</td>
<td>0.2</td>
<td>V</td>
</tr>
<tr>
<td>IIL</td>
<td>VCC = MIN, VIH = 2.4 V</td>
<td>4.0</td>
<td>4.0</td>
<td>mA</td>
</tr>
<tr>
<td>IIL</td>
<td>VCC = MAX, VI = 0.4 V</td>
<td>-1.6</td>
<td>-1.6</td>
<td>mA</td>
</tr>
<tr>
<td>IOL</td>
<td>VCC = MAX, VI = 4.5 V</td>
<td>6.1</td>
<td>6.1</td>
<td>mA</td>
</tr>
</tbody>
</table>

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

‡All typical values are at VCC = 5 V, TA = 25°C.

### Switching Characteristics, VCC = 5 V, TA = 25°C (see note 2)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>FROM (INPUT)</th>
<th>TO (OUTPUT)</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TVP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>tPLH</td>
<td>V</td>
<td>VIL</td>
<td>RL = 4 kΩ, CL = 16 pF</td>
<td>35</td>
<td>45</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>tPHL</td>
<td>Any</td>
<td>V</td>
<td>RL = 400 Ω, CL = 16 pF</td>
<td>8</td>
<td>16</td>
<td></td>
<td>ns</td>
</tr>
</tbody>
</table>

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.
SN54LS22, SN74LS22
DUAL 4-INPUT POSITIVE-NAND GATES WITH OPEN-COLLECTOR OUTPUTS

recommended operating conditions

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SN54LS22</th>
<th>SN74LS22</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CC}$</td>
<td>MIN 4.5</td>
<td>5 NOM 5.3</td>
<td>MAX 4.75</td>
</tr>
<tr>
<td>$V_{IH}$</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{IL}$</td>
<td>0.7</td>
<td></td>
<td>0.8</td>
</tr>
<tr>
<td>$I_{OL}$</td>
<td>4</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>$T_A$</td>
<td>-55</td>
<td>126</td>
<td>0</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS†</th>
<th>SN54LS22</th>
<th>SN74LS22</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{IK}$</td>
<td>$V_{CC} = MIN$, $I_I = -16$ mA</td>
<td>-1.5</td>
<td>-1.5</td>
<td>V</td>
</tr>
<tr>
<td>$I_{OH}$</td>
<td>$V_{CC} = MIN$, $V_{IL} = MAX$, $V_{OH} = 5.8$ V</td>
<td>0.1</td>
<td>0.1</td>
<td>mA</td>
</tr>
<tr>
<td>$V_{OL}$</td>
<td>$V_{CC} = MIN$, $V_{IH} = 2$ V, $I_{OL} = 4$ mA</td>
<td>0.25</td>
<td>0.4</td>
<td>V</td>
</tr>
<tr>
<td>$I_I$</td>
<td>$V_{CC} = MAX$, $V_I = 7$ V</td>
<td>0.1</td>
<td>0.1</td>
<td>mA</td>
</tr>
<tr>
<td>$I_{IH}$</td>
<td>$V_{CC} = MAX$, $V_I = 2.7$ V</td>
<td>20</td>
<td>20</td>
<td>μA</td>
</tr>
<tr>
<td>$I_{IL}$</td>
<td>$V_{CC} = MAX$, $V_I = 0$</td>
<td>-0.4</td>
<td>-0.4</td>
<td>mA</td>
</tr>
<tr>
<td>$I_{CCCH}$</td>
<td>$V_{CC} = MAX$, $V_I = 0$</td>
<td>0.4</td>
<td>0.8</td>
<td>mA</td>
</tr>
<tr>
<td>$I_{CCL}$</td>
<td>$V_{CC} = MAX$, $V_I = -4.5$ V</td>
<td>1.2</td>
<td>2.2</td>
<td>mA</td>
</tr>
</tbody>
</table>

† 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; $T_A = 25^\circ$C.

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

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>FROM</th>
<th>TO (OUTPUT)</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t_{PLH}$</td>
<td>Any</td>
<td>Y</td>
<td>$RL = 2$ kΩ, $CL = 15$ μF</td>
<td>17</td>
<td>32</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>$t_{PHL}$</td>
<td>Any</td>
<td>Y</td>
<td>$RL = 2$ kΩ, $CL = 15$ μF</td>
<td>15</td>
<td>20</td>
<td>ns</td>
<td></td>
</tr>
</tbody>
</table>

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.
**SN54S22, SN74S22**

**DUAL 4-INPUT POSITIVE-NAND GATES WITH OPEN-COLLECTOR OUTPUTS**

### Recommended Operating Conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>SN54S22</th>
<th>SN74S22</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCC (Supply voltage)</td>
<td>MIN: 4.5</td>
<td>NOM: 5</td>
<td>MAX: 5.5</td>
</tr>
<tr>
<td>VIL (Low-level input voltage)</td>
<td>0.8</td>
<td>0.8</td>
<td>V</td>
</tr>
<tr>
<td>VOH (High-level output voltage)</td>
<td>5.5</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>IOL (Low-level output current)</td>
<td>20</td>
<td>20</td>
<td>mA</td>
</tr>
<tr>
<td>TA (Operating free-air temperature)</td>
<td>-55</td>
<td>125</td>
<td>°C</td>
</tr>
</tbody>
</table>

### Electrical Characteristics over Recommended Operating Free-Air Temperature Range (unless otherwise noted)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>SN54S22</th>
<th>SN74S22</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIL</td>
<td>VCC = MIN, VIH = 0.8 V, VOH = 5.5 V</td>
<td>0.25 mA</td>
<td>0.25 mA</td>
<td>mA</td>
</tr>
<tr>
<td>IOL</td>
<td>VCC = MIN, VIH = 2 V, IOL = 20 mA</td>
<td>0.5</td>
<td>0.5</td>
<td>V</td>
</tr>
<tr>
<td>HI</td>
<td>VCC = MAX, VIH = 6.6 V</td>
<td>1</td>
<td>1</td>
<td>mA</td>
</tr>
<tr>
<td>IL</td>
<td>VCC = MAX, VIH = 0.5 V</td>
<td>2</td>
<td>2</td>
<td>mA</td>
</tr>
<tr>
<td>ICCH</td>
<td>VCC = MAX, VIH = 0</td>
<td>3</td>
<td>6.6</td>
<td>mA</td>
</tr>
<tr>
<td>ICCL</td>
<td>VCC = MAX, VIH = 4.6 V</td>
<td>10</td>
<td>10</td>
<td>mA</td>
</tr>
</tbody>
</table>

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

\*All typical values are at VCC = 5 V, TA = 25°C.

### Switching Characteristics, VCC = 5 V, TA = 25°C (see note 2)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>From (Input)</th>
<th>To (Output)</th>
<th>Test Conditions</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>tPLH</td>
<td>Any</td>
<td>V</td>
<td>RL = 200 Ω, CL = 15 µF</td>
<td>2</td>
<td>5</td>
<td>7.5</td>
<td>ns</td>
</tr>
<tr>
<td>tPHL</td>
<td></td>
<td></td>
<td>RL = 200 Ω, CL = 50 µF</td>
<td>2</td>
<td>4.5</td>
<td>7</td>
<td>ns</td>
</tr>
<tr>
<td>tPLH</td>
<td></td>
<td></td>
<td>RL = 200 Ω, CL = 15 µF</td>
<td>7</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>tPHL</td>
<td></td>
<td></td>
<td>RL = 200 Ω, CL = 50 µF</td>
<td>7</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
</tbody>
</table>

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