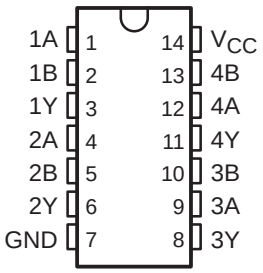
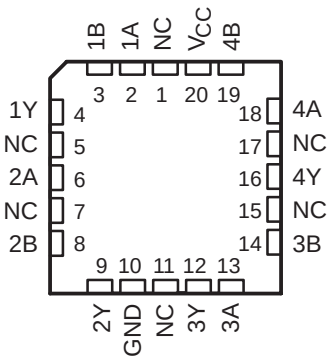
- **Operation From Very Slow Input Transitions**
- **Temperature-Compensated Threshold Levels**
- **High Noise Immunity**
- **Package Options Include Plastic Small-Outline (D) and Ceramic Flat (W) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs**

**SN54HC7002 . . . J OR W PACKAGE**
**SN74HC7002 . . . D OR N PACKAGE**
**(TOP VIEW)**




**SN54HC7002 . . . FK PACKAGE**
**(TOP VIEW)**




NC – No internal connection

## description

In these devices, each circuit functions as a quadruple NOR gate. They perform the Boolean function $Y = \overline{A} \bullet \overline{B}$ or $Y = \overline{A + B}$ in positive logic. However, because of the Schmitt action, the inputs have different input threshold levels for positive- and negative-going signals.

These circuits are temperature compensated and can be triggered from the slowest of input ramps and still give clean jitter-free output signals.

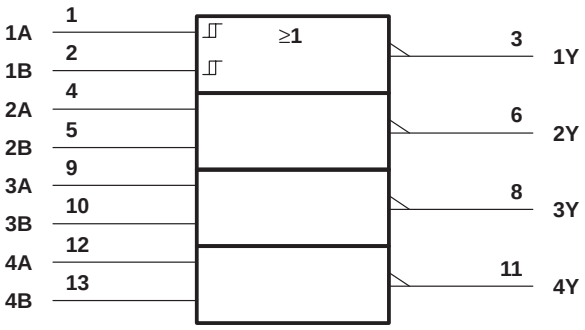
The SN54HC7002 is characterized for operation over the full military temperature range of –55°C to 125°C. The SN74HC7002 is characterized for operation from –40°C to 85°C.

**FUNCTION TABLE**
**(each gate)**

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

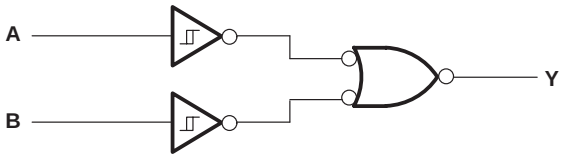
Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

## logic symbol†




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

## logic diagram (positive logic)




## absolute maximum ratings over operating free-air temperature range‡

Supply voltage range, $V_{CC}$ . . . . . –0.5 V to 7 V
Input clamp current, $I_{IK}$ ($V_I < 0$ or $V_I > V_{CC}$) (see Note 1) . . . . . ±20 mA
Output clamp current, $I_{OK}$ ($V_O < 0$ or $V_O > V_{CC}$) (see Note 1) . . . . . ±20 mA
Continuous output current, $I_O$ ($V_O = 0$ to $V_{CC}$) . . . . . ±25 mA
Continuous current through $V_{CC}$ or GND . . . . . ±50 mA
Package thermal impedance, $\theta_{JA}$ (see Note 2): D package . . . . . 127°C/W
N package . . . . . 78°C/W
Storage temperature range, $T_{stg}$ . . . . . –65°C to 150°C

‡ Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. The package thermal impedance is calculated in accordance with JESD 51, except for through-hole packages, which use a trace length of zero.

## recommended operating conditions

| | | | SN54HC7002 | | | SN74HC7002 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | NOM | MAX | MIN | NOM | MAX | |
| $V_{CC}$ | Supply voltage | | 2 | 5 | 6 | 2 | 5 | 6 | V |
| $V_{IH}$ | High-level input voltage | $V_{CC}$ = 2 V | 1.5 | | | 1.5 | | | V |
| | | $V_{CC}$ = 4.5 V | 3.15 | | | 3.15 | | | |
| | | $V_{CC}$ = 6 V | 4.2 | | | 4.2 | | | |
| $V_{IL}$ | Low-level input voltage | $V_{CC}$ = 2 V | 0 | | 0.5 | 0 | | 0.5 | V |
| | | $V_{CC}$ = 4.5 V | 0 | | 1.35 | 0 | | 1.35 | |
| | | $V_{CC}$ = 6 V | 0 | | 1.8 | 0 | | 1.8 | |
| $V_I$ | Input voltage | | 0 | | $V_{CC}$ | 0 | | $V_{CC}$ | V |
| $V_O$ | Output voltage | | 0 | | $V_{CC}$ | 0 | | $V_{CC}$ | V |
| $T_A$ | Operating free-air temperature | | –55 | | 125 | –40 | | 85 | °C |



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

| PARAMETER | TEST CONDITIONS | | $V_{CC}$ | $T_A$ = 25°C | | | SN54HC7002 | | SN74HC7002 | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| $V_{OH}$ | $V_I$ = $V_{IH}$ or $V_{IL}$ | $I_{OH}$ = –20 μA | 2 V | 1.9 | 1.998 | | 1.9 | | 1.9 | | V |
| | | | 4.5 V | 4.4 | 4.499 | | 4.4 | | 4.4 | | |
| | | | 6 V | 5.9 | 5.999 | | 5.9 | | 5.9 | | |
| | | $I_{OH}$ = –4 mA | 4.5 V | 3.98 | 4.3 | | 3.7 | | 3.84 | | |
| | | $I_{OH}$ = –5.2 mA | 6 V | 5.48 | 5.8 | | 5.2 | | 5.34 | | |
| $V_{OL}$ | $V_I$ = $V_{IH}$ or $V_{IL}$ | $I_{OL}$ = 20 μA | 2 V | | 0.002 | 0.1 | | 0.1 | | 0.1 | V |
| | | | 4.5 V | | 0.001 | 0.1 | | 0.1 | | 0.1 | |
| | | | 6 V | | 0.001 | 0.1 | | 0.1 | | 0.1 | |
| | | $I_{OL}$ = 4 mA | 4.5 V | | 0.17 | 0.26 | | 0.4 | | 0.33 | |
| | | $I_{OL}$ = 5.2 mA | 6 V | | 0.15 | 0.26 | | 0.4 | | 0.33 | |
| $V_{T+}$ | | | 2 V | 0.7 | 1.2 | 1.5 | 0.7 | 1.5 | 0.7 | 1.5 | V |
| | | | 4.5 V | 1.55 | 2.5 | 3.15 | 1.55 | 3.15 | 1.55 | 3.15 | |
| | | | 6 V | 2.1 | 3.3 | 4.2 | 2.1 | 4.2 | 2.1 | 4.2 | |
| $V_{T–}$ | | | 2 V | 0.3 | 0.6 | 1 | 0.3 | 1 | 0.3 | 1 | V |
| | | | 4.5 V | 0.9 | 1.6 | 2.45 | 0.9 | 2.45 | 0.9 | 2.45 | |
| | | | 6 V | 1.2 | 2 | 3.2 | 1.2 | 3.2 | 1.2 | 3.2 | |
| $V_{T+} – V_{T–}$ | | | 2 V | 0.2 | 0.6 | 1.2 | 0.2 | 1.2 | 0.2 | 1.2 | V |
| | | | 4.5 V | 0.4 | 0.9 | 2.1 | 0.4 | 2.1 | 0.4 | 2.1 | |
| | | | 6 V | 0.5 | 1.3 | 2.5 | 0.5 | 2.5 | 0.5 | 2.5 | |
| $I_I$ | $V_I$ = $V_{CC}$ or 0 | | 6 V | | ±0.1 | ±100 | | ±1000 | | ±1000 | nA |
| $I_{CC}$ | $V_I$ = $V_{CC}$ or 0, | $I_O$ = 0 | 6 V | | | 2 | | 40 | | 20 | μA |
| $C_i$ | | | 2 V to 6 V | | 3 | 10 | | 10 | | 10 | pF |

### switching characteristics over recommended operating free-air temperature range, $C_L$ = 50 pF (unless otherwise noted) (see Figure 1)

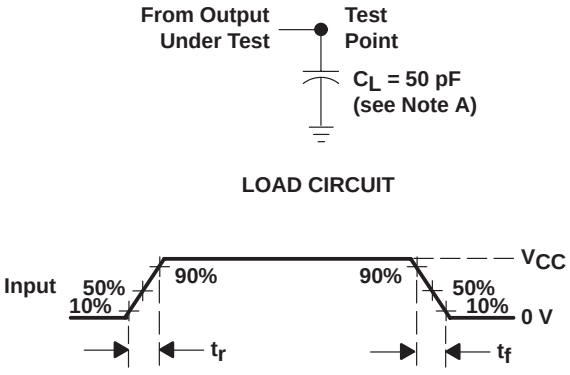
| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CC}$ | $T_A$ = 25°C | | | SN54HC7002 | | SN74HC7002 | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| $t_{pd}$ | A or B | Y | 2 V | | 60 | 130 | | 195 | | 163 | ns |
| | | | 4.5 V | | 18 | 26 | | 39 | | 33 | |
| | | | 6 V | | 14 | 22 | | 33 | | 28 | |
| $t_t$ | | Any | 2 V | | 28 | 75 | | 110 | | 95 | ns |
| | | | 4.5 V | | 8 | 15 | | 22 | | 19 | |
| | | | 6 V | | 6 | 13 | | 19 | | 16 | |



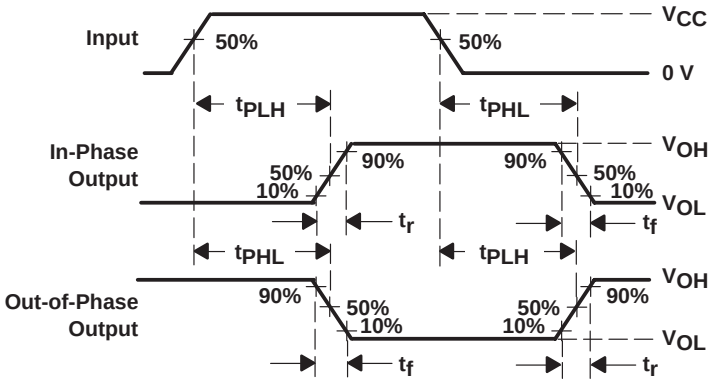
### operating characteristics, $T_A$ = 25°C

| PARAMETER | | TEST CONDITIONS | TYP | UNIT |
|---|---|---|---|---|
| $C_{pd}$ | Power dissipation capacitance per gate | No load | 20 | pF |

## PARAMETER MEASUREMENT INFORMATION




VOLTAGE WAVEFORM
INPUT RISE AND FALL TIMES




VOLTAGE WAVEFORMS
PROPAGATION DELAY AND OUTPUT TRANSITION TIMES

NOTES: A. $C_L$ includes probe and test-fixture capacitance.
B. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, $Z_O$ = 50 Ω, $t_r$ = 6 ns, $t_f$ = 6 ns.
C. The outputs are measured one at a time with one input transition per measurement.
D. $t_{PLH}$ and $t_{PHL}$ are the same as $t_{pd}$.

**Figure 1. Load Circuit and Voltage Waveforms**

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