

CD4002M/CD4002C Dual 4-Input NOR Gate CD4012M/CD4012C Dual 4-Input NAND Gate

General Description

These NOR and NAND gates are monolithic complementary MOS (CMOS) integrated circuits. The N- and P-channel enhancement mode transistors provide a symmetrical circuit with output swings essentially equal to the supply voltage. This results in high noise immunity over a wide supply voltage range. No DC power other than that caused by leakage current is consumed during static conditions. All inputs are protected against static discharge and latching conditions.

Features

- Wide supply voltage range
- Low power
- High noise immunity

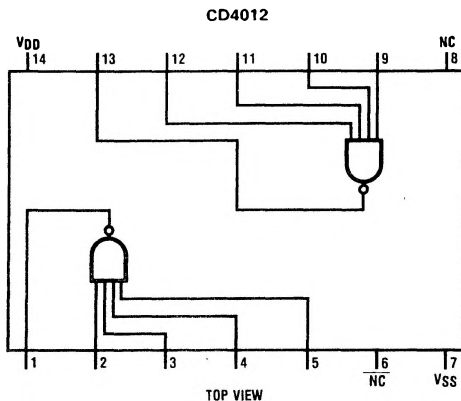
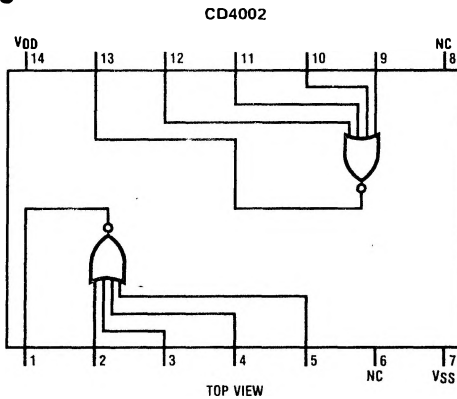
3.0V to 15V
10nW (typ.)
0.45V_{DD} (typ.)

Applications

- Automotive
- Data terminals
- Instrumentation
- Medical Electronics

- Alarm system
- Industrial controls
- Remote metering
- Computers

Connection Diagrams



Absolute Maximum Ratings (Note 1)

Voltage an Any Pin $V_{SS} - 0.3V$ to $V_{DD} + 0.3V$
 Operating Temperature Range
 CD4002M, CD4012M $-55^{\circ}C$ to $+125^{\circ}C$
 CD4002C, CD4012C $-40^{\circ}C$ to $+85^{\circ}C$

Storage Temperature Range $-65^{\circ}C$ to $+150^{\circ}C$
 Package Dissipation 500 mW
 Operating V_{DD} Range $V_{SS} + 3.0V$ to $V_{SS} + 15V$
 Lead Temperature (Soldering, 10 seconds) $300^{\circ}C$

DC Electrical Characteristics – CD4002M, CD4012M

| Parameter | Conditions | Limits | | | | | | Units | |
|--|---|----------------|------|---------------|-------|----------------|--------|-------|---------|
| | | $-55^{\circ}C$ | | $25^{\circ}C$ | | $125^{\circ}C$ | | | |
| | | Min. | Max. | Min. | Typ. | Max. | Min. | | Max. |
| I_L Quiescent Device Current | $V_{DD} = 5.0V$ | | 0.05 | | 0.001 | 0.05 | | 3.0 | μA |
| | $V_{DD} = 10V$ | | 0.1 | | 0.001 | 0.1 | | 6.0 | μA |
| P_D Quiescent Device Dissipation/Package | $V_{DD} = 5.0V$ | | 0.25 | | 0.005 | 0.25 | | 15 | μW |
| | $V_{DD} = 10V$ | | 1.0 | | 0.01 | 1.0 | | 60 | μW |
| V_{OL} Output Voltage Low Level | $V_{DD} = 5.0V, V_I = V_{DD}, I_O = 0A$ | | 0.05 | | 0 | 0.05 | | 0.05 | V |
| | $V_{DD} = 10V, V_I = V_{DD}, I_O = 0A$ | | 0.05 | | 0 | 0.05 | | 0.05 | V |
| V_{OH} Output Voltage High Level | $V_{DD} = 5.0V, V_I = V_{SS}, I_O = 0A$ | 4.95 | | 4.95 | 5.0 | | 4.95 | | V |
| | $V_{DD} = 10V, V_I = V_{SS}, I_O = 0A$ | 9.95 | | 9.95 | 10 | | 9.95 | | V |
| V_{NL} Noise Immunity (All Inputs) | $V_{DD} = 5.0V, V_O = 3.6V, I_O = 0A$ | 1.5 | | 1.5 | 2.25 | | 1.4 | | V |
| | $V_{DD} = 10V, V_O = 7.2V, I_O = 0A$ | 3.0 | | 3.0 | 4.5 | | 2.9 | | V |
| V_{NH} Noise Immunity (All Inputs) | $V_{DD} = 5.0V, V_O = 0.95V, I_O = 0A$ | 1.4 | | 1.5 | 2.25 | | 1.5 | | V |
| | $V_{DD} = 10V, V_O = 2.9V, I_O = 0A$ | 2.9 | | 3.0 | 4.5 | | 3.0 | | V |
| I_{DN} Output Drive Current N-Channel (4002) | $V_{DD} = 5.0V, V_O = 0.4V, V_I = V_{DD}$ | 0.5 | | 0.40 | 1.0 | | 0.28 | | mA |
| | $V_{DD} = 10V, V_O = 0.5V, V_I = V_{DD}$ | 1.1 | | 0.9 | 2.5 | | 0.65 | | mA |
| I_{DP} Output Drive Current P-Channel (4002) | $V_{DD} = 5.0V, V_O = 2.5V, V_I = V_{SS}$ | -0.62 | | -0.5 | -2.0 | | -0.35 | | mA |
| | $V_{DD} = 10V, V_O = 9.5V, V_I = V_{SS}$ | -0.62 | | -0.5 | -1.0 | | -0.35 | | mA |
| I_{DN} Output Drive Current N-Channel (4012) | $V_{DD} = 5.0V, V_O = 0.4V, V_I = V_{DD}$ | 0.31 | | 0.25 | 0.5 | | 0.175 | | mA |
| | $V_{DD} = 10V, V_O = 0.5V, V_I = V_{DD}$ | 0.63 | | 0.5 | 0.6 | | 0.35 | | mA |
| I_{DP} Output Drive Current P-Channel (4012) | $V_{DD} = 5.0V, V_O = 2.5V, V_I = V_{SS}$ | -0.31 | | -0.25 | -0.5 | | -0.175 | | mA |
| | $V_{DD} = 10V, V_O = 9.5V, V_I = V_{SS}$ | -0.75 | | -0.6 | -1.2 | | -0.4 | | mA |
| I_I Input Current | | | | | 10 | | | | pA |

DC Electrical Characteristics — CD4002C, CD4012C

CD4002M/CD4002C, CD4011M/CD4012C

| Parameter | Conditions | Limits | | | | | | Units | |
|--|---|-----------------|--------------|---------------|----------------|--------------|-----------------|--------------|--------------------|
| | | -40°C | | 25°C | | | 85°C | | |
| | | Min. | Max. | Min. | Typ. | Max. | Min. | | Max. |
| I_L Quiescent Device Current | $V_{DD} = 5.0V$ $V_{DD} = 10V$ | | 0.5 5.0 | | 0.005 0.005 | 0.5 5.0 | | 15 30 | μA μA |
| P_D Quiescent Device Dissipation/Package | $V_{DD} = 5.0V$ $V_{DD} = 10V$ | | 2.5 50 | | 0.025 0.05 | 2.5 50 | | 75 300 | μW μW |
| V_{OL} Output Voltage Low Level | $V_{DD} = 5.0V, V_I = V_{DD}, I_O = 0A$ $V_{DD} = 10V, V_I = V_{DD}, I_O = 0A$ | | 0.05 0.05 | | 0 0 | 0.05 0.05 | | 0.05 0.05 | V V |
| V_{OH} Output Voltage High Level | $V_{DD} = 5.0V, V_I = V_{SS}, I_O = 0A$ $V_{DD} = 10V, V_I = V_{SS}, I_O = 0A$ | 4.95 9.95 | | 4.95 9.95 | 5.0 10 | | 4.95 9.95 | | V V |
| V_{NL} Noise Immunity (All Inputs) | $V_{DD} = 5.0V, V_O \geq 3.5V, I_O = 0A$ $V_{DD} = 10V, V_O \geq 7.2V, I_O = 0A$ | 1.5 3.0 | | 1.5 3.0 | 2.25 4.5 | | 1.4 2.9 | | V V |
| V_{NH} Noise Immunity (All Inputs) | $V_{DD} = 5.0V, V_O \leq 1.5V, I_O = 0A$ $V_{DD} = 10V, V_O \leq 3.5V, I_O = 0A$ | 1.4 2.9 | | 1.5 3.0 | 2.25 4.5 | | 1.5 3.0 | | V V |
| I_{DN} Output Drive Current N-Channel (4002) | $V_{DD} = 5.0V, V_O = 0.4V, V_I = V_{DD}$ $V_{DD} = 10V, V_O = 0.5V, V_I = V_{DD}$ | 0.35 0.72 | | 0.3 0.6 | 1.0 2.5 | | 0.24 0.48 | | mA mA |
| i_{DP} Output Drive Current P-Channel (4002) | $V_{DD} = 5.0V, V_O = 2.5V, V_I = V_{SS}$ $V_{DD} = 10V, V_O = 9.5V, V_I = V_{SS}$ | -0.35 -0.3 | | -0.3 -0.25 | -2.0 -1.0 | | -0.24 -0.2 | | mA mA |
| I_{DN} Output Drive Current N-Channel (4012) | $V_{DD} = 5.0V, V_O = 0.4V, V_I = V_{DD}$ $V_{DD} = 10V, V_O = 0.5V, V_I = V_{DD}$ | 0.145 0.3 | | 0.12 0.25 | 0.5 0.6 | | 0.095 0.2 | | mA mA |
| I_{DP} Output Drive Current P-Channel (4012) | $V_{DD} = 5.0V, V_O = 2.5V, V_I = V_{SS}$ $V_{DD} = 10V, V_O = 9.5V, V_I = V_{SS}$ | -0.145 -0.35 | | -0.12 -0.3 | -0.5 -1.2 | | -0.095 -0.24 | | mA mA |
| I_I Input Current | | | | | 10 | | | | μA |

AC Electrical Characteristics $T_A = 25^\circ\text{C}$, $C_L = 15\text{pF}$, and input rise and fall times = 20ns.
 Typical temperature coefficient for all values of $V_{DD} = 0.3\%/^\circ\text{C}$

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|--|---|------|----------|------------|----------|
| CD4002M | | | | | |
| t_{PHL} Propagation Delay Time High to Low Level | $V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$ | | 35 25 | 50 40 | ns ns |
| t_{PLH} Propagation Delay Time Low to High Level | $V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$ | | 35 25 | 50 40 | ns ns |
| t_{THL} Transition Time High to Low Level | $V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$ | | 65 35 | 175 75 | ns ns |
| t_{TLH} Transition Time Low to High Level | $V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$ | | 65 35 | 125 70 | ns ns |
| C_{IN} Input Capacitance | Any Input | | 5.0 | | pF |
| CD4002C | | | | | |
| t_{PHL} Propagation Delay Time High to Low Level | $V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$ | | 35 25 | 120 65 | ns ns |
| t_{PLH} Propagation Delay Time Low to High Level | $V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$ | | 35 25 | 80 55 | ns ns |
| t_{THL} Transition Time High to Low Level | $V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$ | | 65 35 | 300 125 | ns ns |
| t_{TLH} Transition Time Low to High Level | $V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$ | | 65 35 | 200 115 | ns ns |
| C_{IN} Input Capacitance | Any Input | | 5.0 | | pF |

AC Electrical Characteristics $T_A = 25^\circ\text{C}$, $C_L = 15\text{pF}$, and input rise and fall times = 20ns.
 Typical temperature coefficient for all values of $V_{DD} = 0.3\%/^\circ\text{C}$

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|--|---|------|----------|------------|----------|
| CD4012M | | | | | |
| t_{PHL} Propagation Delay Time High to Low Level | $V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$ | | 50 25 | 75 40 | ns ns |
| t_{PLH} Propagation Delay Time Low to High Level | $V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$ | | 50 25 | 75 40 | ns ns |
| t_{THL} Transition Time High to Low Level | $V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$ | | 75 50 | 125 75 | ns ns |
| t_{TLH} Transition Time Low to High Level | $V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$ | | 75 40 | 100 60 | ns ns |
| C_{IN} Input Capacitance | Any Input | | 5.0 | | pF |
| CD4012C | | | | | |
| t_{PHL} Propagation Delay Time High to Low Level | $V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$ | | 50 25 | 100 50 | ns ns |
| t_{PLH} Propagation Delay Time Low to High Level | $V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$ | | 50 25 | 100 50 | ns ns |
| t_{THL} Transition Time High to Low Level | $V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$ | | 75 50 | 150 100 | ns ns |
| t_{TLH} Transition Time Low to High Level | $V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$ | | 75 40 | 125 75 | ns ns |
| C_{IN} Input Capacitance | Any Input | | 5.0 | | pF |

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.