

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.

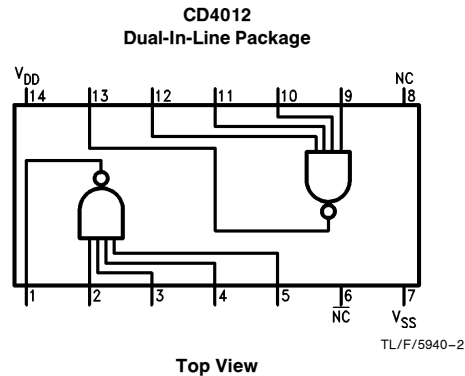
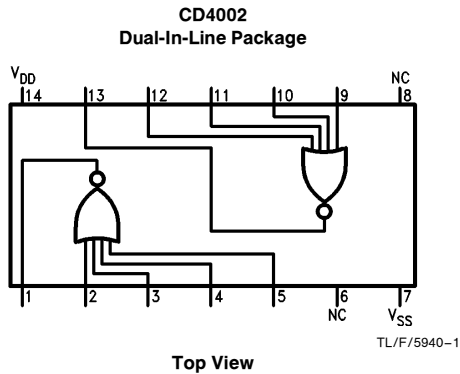
Features

- Wide supply voltage range 3.0V to 15V
- Low power 10 nW (typ.)
- High noise immunity 0.45 V_{DD} (typ.)

Applications

- Automotive
- Data terminals
- Instrumentation
- Medical Electronics
- Alarm system
- Industrial controls
- Remote metering
- Computers

Connection Diagrams



Order Number CD4002 or CD4012

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

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Voltage at 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 (T_S) $-65^{\circ}C$ to $+150^{\circ}C$

Power Dissipation (P_D)
 Dual-In-Line 700 mW
 Small Outline 500 mW

Operating Range (V_{DD}) $V_{SS} + 3.0V$ to $V_{SS} + 15V$

Lead Temperature (T_L)
 (Soldering, 10 seconds) 260°C

DC Electrical Characteristics CD4002M, CD4012M

Symbol	Parameter	Conditions	Limits						Units	
			-55°C		+25°C			+125°C		
			Min	Max	Min	Typ	Max	Min		Max
I_{DD}	Quiescent Device Current	$V_{DD} = 5.0V$ $V_{DD} = 10V$		0.05 0.1		0.001 0.001	0.05 0.1		3.0 6	μA μA
P_D	Quiescent Device Dissipation/Package	$V_{DD} = 5.0V$ $V_{DD} = 10V$		0.25 1.0		0.005 0.01	0.25 1.0		15 60	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)	$V_{DD} = 5.0V, V_O = 3.6V, I_O = 0A$ $V_{DD} = 10V, V_O = 7.2V, I_O = 0A$	1.5 3.0		1.5 3.0	2.25 4.5		1.4 2.9		V V
V_{NH}	Noise Immunity (All Inputs)	$V_{DD} = 5.0V, V_O = 0.95V, I_O = 0A$ $V_{DD} = 10V, V_O = 2.9V, I_O = 0A$	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) (Note 2)	$V_{DD} = 5.0V, V_O = 0.4V, V_I = V_{DD}$ $V_{DD} = 10V, V_O = 0.5V, V_I = V_{DD}$	0.5 1.1		0.40 0.9	1.0 2.5		0.28 0.65		mA mA
I_{DP}	Output Drive Current P-Channel (4002) (Note 2)	$V_{DD} = 5.0V, V_O = 2.5V, V_I = V_{SS}$ $V_{DD} = 10V, V_O = 9.5V, V_I = V_{SS}$	-0.62 -0.62		-0.5 -0.5	-2.0 -1.0		-0.35 -0.35		mA mA
I_{DN}	Output Drive Current N-Channel (4012) (Note 2)	$V_{DD} = 5.0V, V_O = 0.4V, V_I = V_{DD}$ $V_{DD} = 10V, V_O = 0.5V, V_I = V_{DD}$	0.31 0.63		0.25 0.5	0.5 0.6		0.175 0.35		mA mA
I_{DP}	Output Drive Current P-Channel (4012) (Note 2)	$V_{DD} = 5.0V, V_O = 2.5V, V_I = V_{SS}$ $V_{DD} = 10V, V_O = 9.5V, V_I = V_{SS}$	-0.31 -0.75		-0.25 -0.6	-0.5 -1.2		-0.175 -0.4		mA mA
I_I	Input Current					10				pA

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.

Note 2: I_{DN} and I_{DP} are tested one output at a time.

DC Electrical Characteristics CD4002C, CD4012C

Symbol	Parameter	Conditions	Limits						Units	
			- 55°C		+ 25°C			+ 85°C		
			Min	Max	Min	Typ	Max	Min		Max
I_{DD}	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)	$V_{DD} = 5.0V, V_O \geq 3.6V, I_O = 0A$ $V_{DD} = 10V, V_O \geq 7.2V, I_O = 0A$	1.5 3.0		1.5 3.0	2.25 4.5		1.4 2.9		V V
V_{NH}	Noise Immunity (All Inputs)	$V_{DD} = 5.0V, V_O \leq 0.95V, I_O = 0A$ $V_{DD} = 10V, V_O \leq 2.9V, I_O = 0A$	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) (Note 2)	$V_{DD} = 5.0V, V_O = 0.4V, V_I = V_{DD}$ $V_{DD} = 10V, V_O = 0.5V, V_I = V_{DD}$	0.35 0.72		0.3 0.6	1.0 2.5		0.24 0.48		mA mA
I_{DN}	Output Drive Current N-Channel (4012) (Note 2)	$V_{DD} = 5.0V, V_O = 0.4V, V_I = V_{DD}$ $V_{DD} = 10V, V_O = 0.5V, V_I = V_{DD}$	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 (4002) (Note 2)	$V_{DD} = 5.0V, V_O = 2.5V, V_I = V_{SS}$ $V_{DD} = 10V, V_O = 9.5V, V_I = V_{SS}$	-0.35 -0.3		-0.3 -0.25	-2.0 -1.0		-0.24 -0.2		mA mA
I_{DP}	Output Drive Current P-Channel (4012) (Note 2)	$V_{DD} = 5.0V, V_O = 2.5V, V_I = V_{SS}$ $V_{DD} = 10V, V_O = 9.5V, V_I = V_{SS}$	-0.145 -0.35		-0.12 -0.3	-0.5 -1.2		-0.095 -0.24		mA mA
I_I	Input Current					10				pA

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.

Note 2: I_{DN} and I_{DP} are tested one output at a time.

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
CD4002M						
t _{PHL}	Propagation Delay Time High to Low Level	V _{DD} = 5.0V		35	50	ns
		V _{DD} = 10V		25	40	ns
t _{PLH}	Propagation Delay Time Low to High Level	V _{DD} = 5.0V		35	50	ns
		V _{DD} = 10V		25	40	ns
t _{THL}	Transition Time High to Low Level	V _{DD} = 5.0V		65	175	ns
		V _{DD} = 10V		35	75	ns
t _{TLH}	Transition Time Low to High Level	V _{DD} = 5.0V		65	125	ns
		V _{DD} = 10V		35	70	ns
C _{IN}	Input Capacitance	Any Input		5.0		pF
CD4002C						
t _{PHL}	Propagation Delay Time High to Low Level	V _{DD} = 5.0V		35	120	ns
		V _{DD} = 10V		25	65	ns
T _{PLH}	Propagation Delay Time Low to High Level	V _{DD} = 5.0V		35	80	ns
		V _{DD} = 10V		25	55	ns
t _{THL}	Transition Time High to Low Level	V _{DD} = 5.0V		65	300	ns
		V _{DD} = 10V		35	125	ns
t _{TLH}	Transition Time Low to High Level	V _{DD} = 5.0V		65	200	ns
		V _{DD} = 10V		35	115	ns
C _{IN}	Input Capacitance	Any Input		5.0		pF

*AC Parameters are guaranteed by DC correlated testing.

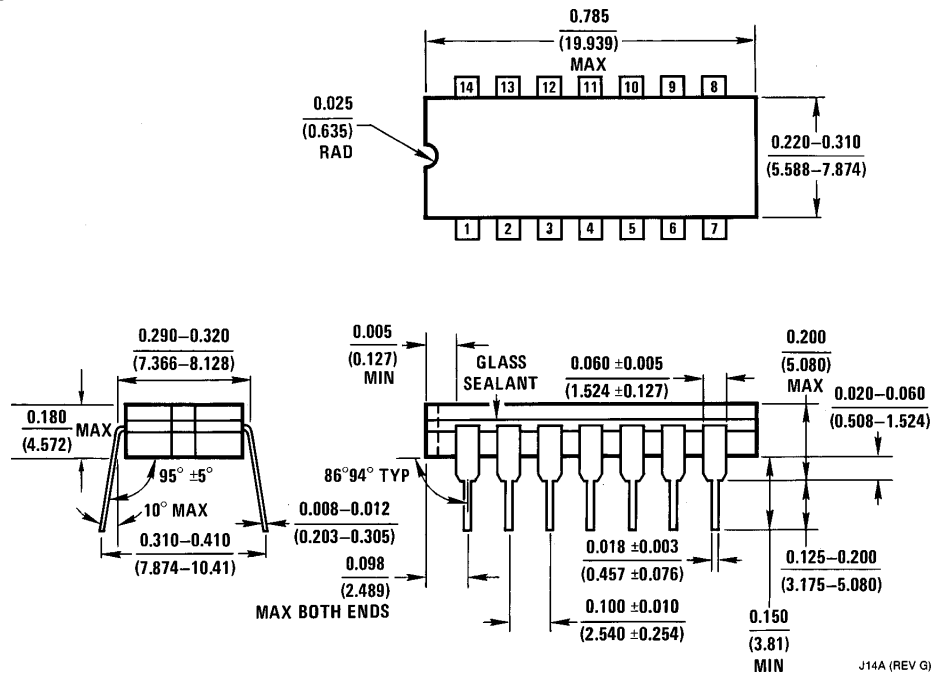
AC Electrical Characteristics* $T_A = 25^\circ\text{C}$, $C_L = 15\text{ pF}$, and input rise and fall times = 20 ns. Typical temperature coefficient for all values of $V_{DD} = 0.3\%/^\circ\text{C}$.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
CD4012M						
t _{PHL}	Propagation Delay Time High to Low Level	V _{DD} = 5.0V		50	75	ns
		V _{DD} = 10V		25	40	ns
t _{PLH}	Propagation Delay Time Low to High Level	V _{DD} = 5.0V		50	75	ns
		V _{DD} = 10V		25	40	ns
t _{THL}	Transition Time High to Low Level	V _{DD} = 5.0V		75	125	ns
		V _{DD} = 10V		50	75	ns
t _{TLH}	Transition Time Low to High Level	V _{DD} = 5.0V		75	100	ns
		V _{DD} = 10V		40	60	ns
C _{IN}	Input Capacitance	Any Input		5.0		pF
CD4012C						
t _{PHL}	Propagation Delay Time High to Low Level	V _{DD} = 5.0V		50	100	ns
		V _{DD} = 10V		25	50	ns
T _{PLH}	Propagation Delay Time Low to High Level	V _{DD} = 5.0V		50	100	ns
		V _{DD} = 10V		25	50	ns
t _{THL}	Transition Time High to Low Level	V _{DD} = 5.0V		75	150	ns
		V _{DD} = 10V		50	100	ns
t _{TLH}	Transition Time Low to High Level	V _{DD} = 5.0V		75	125	ns
		V _{DD} = 10V		40	75	ns
C _{IN}	Input Capacitance	Any Input		5.0		pF

*AC Parameters are guaranteed by DC correlated testing.

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.

Physical Dimensions inches (millimeters)

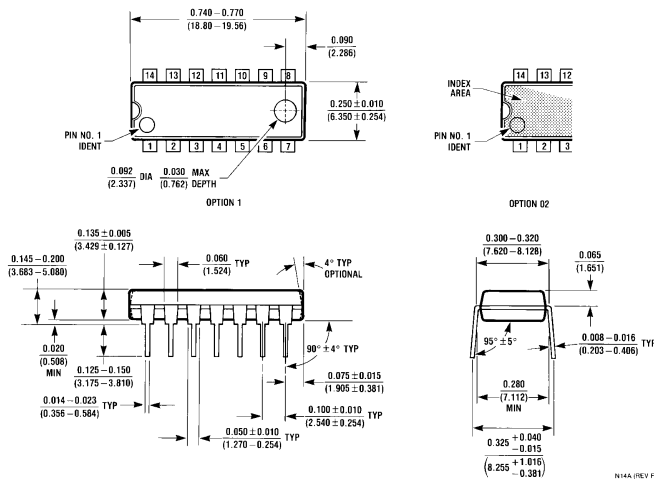


Ceramic Dual-In-Line Package (J)
 Order Number CD4002MJ, CD4002CJ, CD4012MJ or CD4012CJ
 NS Package Number J14A

J14A (REV G)

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

Physical Dimensions inches (millimeters) (Continued)



Molded Dual-In-Line Package (N)
Order Number CD4002MN, CD4002CN, CD4012MN or CD4012CN
NS Package Number N14A

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National Semiconductor Corporation
 1111 West Bardin Road
 Arlington, TX 76017
 Tel: 1(800) 272-9959
 Fax: 1(800) 737-7018

National Semiconductor Europe
 Fax: (+49) 0-180-530 85 86
 Email: onjwge@tevm2.nsc.com
 Deutsch Tel: (+49) 0-180-530 85 85
 English Tel: (+49) 0-180-532 78 32
 Français Tel: (+49) 0-180-532 93 58
 Italiano Tel: (+49) 0-180-534 16 80

National Semiconductor Hong Kong Ltd.
 19th Floor, Straight Block,
 Ocean Centre, 5 Canton Rd.
 Tsimshatsui, Kowloon
 Hong Kong
 Tel: (852) 2737-1600
 Fax: (852) 2736-9960

National Semiconductor Japan Ltd.
 Tel: 81-043-299-2309
 Fax: 81-043-299-2408

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