National Semiconductor

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

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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

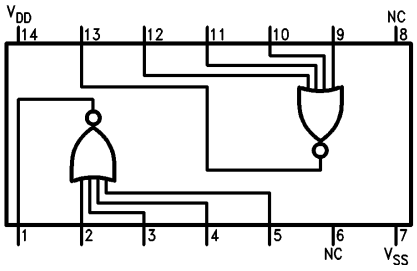
■ Wide supply voltage range	3.0V to 15V
■ Low power	10 nW (typ.)
■ High noise immunity	0.45 V_{DD} (typ.)

Applications

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

Connection Diagrams

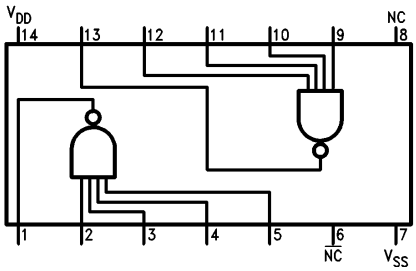
CD4002
Dual-In-Line Package



TL/F/5940–1

Top View

CD4012
Dual-In-Line Package



TL/F/5940–2

Top View

Order Number CD4002 or CD4012

RRD-B30M105/Printed in U. S. A.

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°C to +125°C
- CD4002C, CD4012C −40°C to +85°C

Storage Temperature Range (T_S) −65°C to +150°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*

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

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

*AC Parameters are guaranteed by DC correlated testing.

AC Electrical Characteristics*

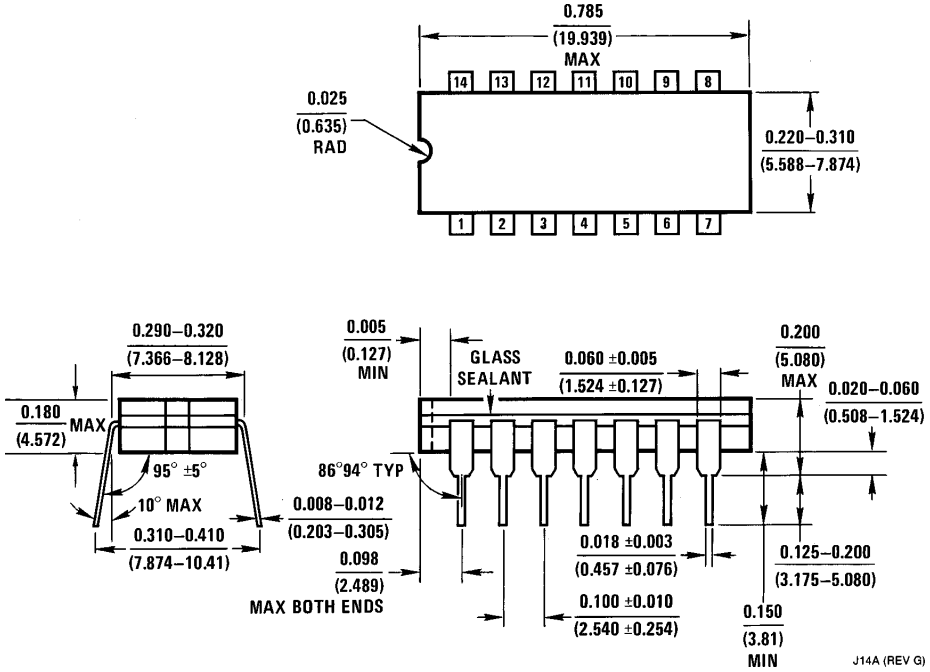
$T_A = 25°C$, $C_L = 15$ pF, and input rise and fall times = 20 ns. Typical temperature coefficient for all values of $V_{DD} = 0.3\%/°C$.

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

*AC Parameters are guaranteed by DC correlated testing.

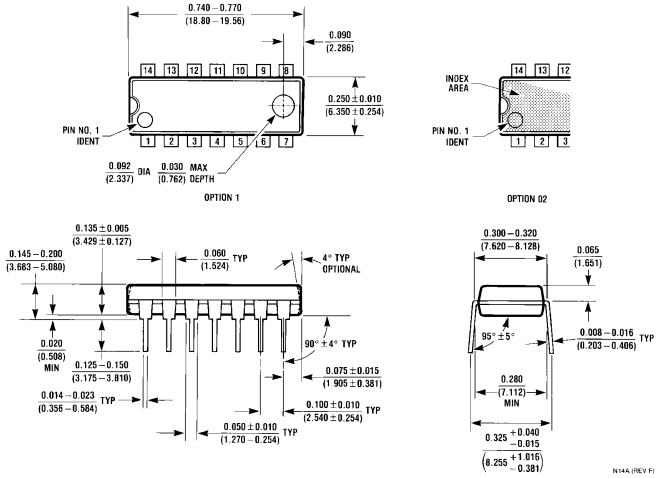
Note 1: ''Absolute Maximum Ratings'' are those values beyond which the safety of the device cannot be guaranteed. Except for ''Operating Temperature Range'' they are not meant to imply that the devices should be operated at these limits. The table of ''Electrical Characteristics'' provides conditions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

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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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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