National Semiconductor

CD4002BM/CD4002BC Dual 4-Input NOR Gate
CD4012BM/CD4012BC Dual 4-Input NAND Gate
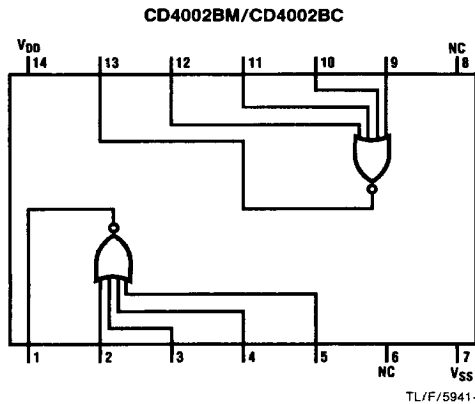
General Description

These dual gates are monolithic complementary MOS (CMOS) integrated circuits constructed with N- and P-channel enhancement mode transistors. They have equal source and sink current capabilities and conform to standard B series output drive. The devices also have buffered outputs which improve transfer characteristics by providing very high gain. All inputs are protected against static discharge with doides to V_{DD} and V_{SS}.
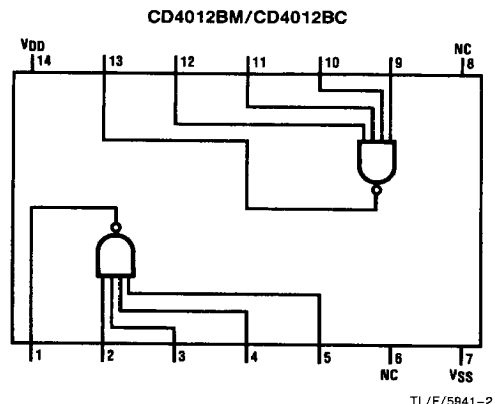
Features

■ Wide supply voltage range   3.0V to 15V
■ High noise immunity   0.45 V_{DD} (typ.)
■ Low power TTL   fanout of 2 driving 74L
   compatibility   or 1 driving 74LS
■ 5V–10V–15V parametric ratings
■ Symmetrical output characteristics
■ Maximum input leakage:
       μA at 15V over full temperature range

Connection Diagrams

Dual-In-Line Packages

CD4002BM/CD4002BC

TL/F/5941–1

Top View

CD4012BM/CD4012BC

TL/F/5941–2

Top View

Order Number CD4002B* or CD4012B*

*Please look into Section 8, Appendix D for availability of package types.

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Absolute Maximum Ratings (Notes 1 & 2)

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

Supply Voltage (V_{DD})	$-0.5V$ to $+18V$
Input Voltage (V_{IN})	$-0.5V$ to $V_{DD} + 0.5V$
Storage Temperature Range (T_S)	$-65°C$ to $+150°C$
Power Dissipation (P_D)	
Dual-In-Line	700 mW
Small Outline	500 mW
Lead Temperature (T_L)	
(soldering, 10 seconds)	260°C

Recommended Operating Conditions (Note 2)

Supply Voltage (V_{DD})	3.0V to 15V
Input Voltage (V_{IN})	0V to V_{DD} V
Operating Temperature Range (T_A)	
CD4002BM, CD4012BM	$-55°C$ to $+125°C$
CD4002BC, CD4012BC	$-40°C$ to $+85°C$

DC Electrical Characteristics CD4002BM, CD4012BM (Note 2)

Symbol	Parameter	Conditions	$-55°C$ Min	$-55°C$ Max	$+25°C$ Min	$+25°C$ Typ	$+25°C$ Max	$+125°C$ Min	$+125°C$ Max	Units
I_{DD}	Quiescent Device Current	$V_{DD}=5V, V_{IN}=V_{DD}$ or V_{SS}		0.25		0.004	0.25		7.5	μA
		$V_{DD}=10V, V_{IN}=V_{DD}$ or V_{SS}		0.5		0.005	0.5		15	μA
		$V_{DD}=15V, V_{IN}=V_{DD}$ or V_{SS}		1.0		0.006	1.0		30	μA
V_{OL}	Low Level Output Voltage	$V_{DD}=5V$		0.05		0	0.05		0.05	V
		$V_{DD}=10V$		0.05		0	0.05		0.05	V
		$V_{DD}=15V$		0.05		0	0.05		0.05	V
V_{OH}	High Level Output Voltage	$V_{DD}=5V$	4.95		4.95	5		4.95		V
		$V_{DD}=10V$	9.95		9.95	10		9.95		V
		$V_{DD}=15V$	14.95		14.95	15		14.95		V
V_{IL}	Low Level Input Voltage	$V_{DD}=5V, V_O=0.5V$ or $4.5V$		1.5		2.25	1.5		1.5	V
		$V_{DD}=10V, V_O=1.0V$ or $9.0V$		3.0		4.50	3.0		3.0	V
		$V_{DD}=15V, V_O=1.5V$ or $13.5V$		4.0		6.75	4.0		4.0	V
V_{IH}	High Level Input Voltage	$V_{DD}=5V, V_O=0.5V$ or $4.5V$	3.5		3.5	2.75		3.5		V
		$V_{DD}=10V, V_O=1.0V$ or $9.0V$	7.0		7.0	5.50		7.0		V
		$V_{DD}=15V, V_O=1.5V$ or $13.5V$	11.0		11.0	8.25		11.0		V
I_{OL}	Low Level Output Current (Note 3)	$V_{DD}=5V, V_O=0.4V$	0.64		0.51	0.88		0.36		mA
		$V_{DD}=10V, V_O=0.5V$	1.6		1.3	2.20		0.90		mA
		$V_{DD}=15V, V_O=1.5V$	4.2		3.4	8.0		2.4		mA
I_{OH}	High Level Output Current (Note 3)	$V_{DD}=5V, V_O=4.6V$	-0.64		-0.51	-0.88		-0.36		mA
		$V_{DD}=10V, V_O=9.5V$	-1.6		-1.3	-2.20		-0.90		mA
		$V_{DD}=15V, V_O=13.5V$	-4.2		-3.4	-8.0		-2.4		mA
I_{IN}	Input Current	$V_{DD}=15V, V_{IN}=0V$		-0.10		-10^{-5}	-0.10		-1.0	μA
		$V_{DD}=15V, V_{IN}=15V$		0.10		10^{-5}	0.10		1.0	μA

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The tables of "Recommended Operating Conditions" and "Electrical Characteristics" provide conditions for actual device operation.

Note 2: $V_{SS}=0V$ unless otherwise specified.

Note 3: I_{OL} and I_{OH} are tested one output at a time.

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DC Electrical Characteristics CD4002BC, CD4012BC (Note 2)

Symbol	Parameter	Conditions	$-40°C$ Min	$-40°C$ Max	$+25°C$ Min	$+25°C$ Typ	$+25°C$ Max	$+85°C$ Min	$+85°C$ Max	Units
I_{DD}	Quiescent Device Current	$V_{DD} = 5V$, $V_{IN} = V_{DD}$ or V_{SS}		1.0		0.004	1.0		7.5	µA
		$V_{DD} = 10V$, $V_{IN} = V_{DD}$ or V_{SS}		2.0		0.005	2.0		15	µA
		$V_{DD} = 15V$, $V_{IN} = V_{DD}$ or V_{SS}		4.0		0.006	4.0		30	µA
V_{OL}	Low Level Output Voltage	$V_{DD} = 5V$		0.05		0	0.05		0.05	V
		$V_{DD} = 10V$		0.05		0	0.05		0.05	V
		$V_{DD} = 15V$		0.05		0	0.05		0.05	V
V_{OH}	High Level Output Voltage	$V_{DD} = 5V$	4.95		4.95	5		4.95		V
		$V_{DD} = 10V$	9.95		9.95	10		9.95		V
		$V_{DD} = 15V$	14.95		14.95	15		14.95		V
V_{IL}	Low Level Input Voltage	$V_{DD} = 5V$, $V_O = 0.5V$ or $4.5V$		1.5		2.25	1.5		1.5	V
		$V_{DD} = 10V$, $V_O = 1.0V$ or $9.0V$		3.0		4.50	3.0		3.0	V
		$V_{DD} = 15V$, $V_O = 1.5V$ or $13.5V$		4.0		6.75	4.0		4.0	V
V_{IH}	High Level Input Voltage	$V_{DD} = 5V$, $V_O = 0.5V$ or $4.5V$	3.5		3.5	2.75		3.5		V
		$V_{DD} = 10V$, $V_O = 1.0V$ or $9.0V$	7.0		7.0	5.50		7.0		V
		$V_{DD} = 15V$, $V_O = 1.5V$ or $13.5V$	11.0		11.0	8.25		11.0		V
I_{OL}	Low Level Output Current (Note 3)	$V_{DD} = 5V$, $V_O = 0.4V$	0.52		0.44	0.88		0.36		mA
		$V_{DD} = 10V$, $V_O = 0.5V$	1.3		1.1	2.2		0.90		mA
		$V_{DD} = 15V$, $V_O = 1.5V$	3.6		3.0	8.0		2.4		mA
I_{OH}	High Level Output Current (Note 3)	$V_{DD} = 5V$, $V_O = 4.6V$	-0.52		-0.44	-0.88		-0.36		mA
		$V_{DD} = 10V$, $V_O = 9.5V$	-1.3		-1.1	-2.2		-0.90		mA
		$V_{DD} = 15V$, $V_O = 13.5V$	-3.6		-3.0	-8.0		-2.4		mA
I_{IN}	Input Current	$V_{DD} = 15V$, $V_{IN} = 0V$		-0.3		-10^{-5}	-0.3		-1.0	µA
		$V_{DD} = 15V$, $V_{IN} = 15V$		0.3		10^{-5}	0.3		1.0	µA

AC Electrical Characteristics* $T_A = 25°C$, $C_L = 50$ pF, unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{PHL}	Propagation Delay High to Low Level	$V_{DD} = 5V$		125	250	ns
		$V_{DD} = 10V$		60	100	ns
		$V_{DD} = 15V$		45	70	ns
t_{PLH}	Propagation Delay Low to High Level	$V_{DD} = 5V$		125	250	ns
		$V_{DD} = 10V$		60	100	ns
		$V_{DD} = 15V$		45	70	ns
t_{THL}, t_{TLH}	Transition Time	$V_{DD} = 5V$		100	200	ns
		$V_{DD} = 10V$		50	100	ns
		$V_{DD} = 15V$		40	80	ns
C_{IN}	Average Input Capacitance	Any Input		5.0	7.5	pF
C_{PD}	Power Dissipation Capacitance (Note 4)	Any Gate		20		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. They are not meant to imply that the devices should be operated at these limits. The tables of "Recommended Operating Conditions" and "Electrical Characteristics" provide conditions for actual device operation.

Note 2: $V_{SS} = 0V$ unless otherwise specified.

Note 3: I_{OL} and I_{OH} are tested one output at a time.

Note 4: C_{PD} determines the no load AC power consumption of any CMOS device. For complete explanation see 54C/74C Family Characteristics, Application Note AN-90.

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