National Semiconductor

March 1988

CD4001BM/CD4001BC Quad 2-Input NOR Buffered B Series Gate
CD4011BM/CD4011BC Quad 2-Input NAND Buffered B Series Gate

General Description

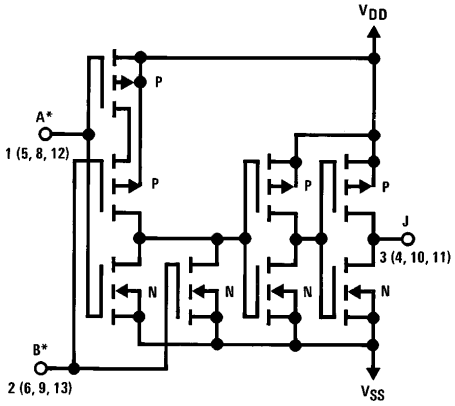
These quad gates are monolithic complementary MOS (CMOS) integrated circuits constructed with N- and P-channel enhancement mode transistors. They have equal source and sink current capabilities and conform to standard B series output drive. The devices also have buffered outputs which improve transfer characteristics by providing very high gain.

All inputs are protected against static discharge with diodes to V_{DD} and V_{SS}.

Features

- Low power TTL compatibility — Fan out of 2 driving 74L or 1 driving 74LS
- 5V–10V–15V parametric ratings
- Symmetrical output characteristics
- Maximum input leakage 1 μA at 15V over full temperature range

Schematic Diagrams



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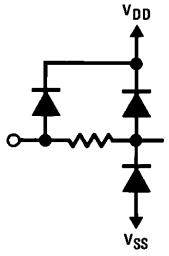
CD4001BC/BM



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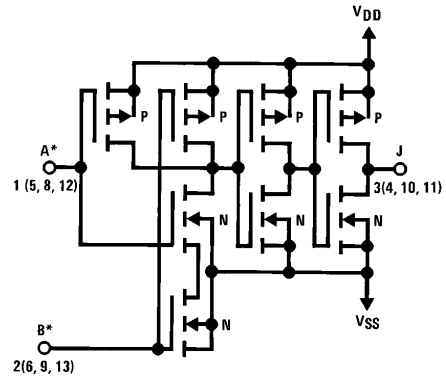
¼ of device shown

$J = \overline{A + B}$

Logical "1" = High

Logical "0" = Low

*All inputs protected by standard CMOS protection circuit.



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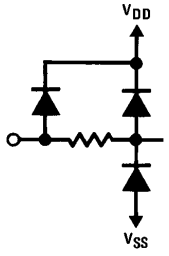
CD4011BC/BM



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¼ of device shown

$J = \overline{A \bullet B}$

Logical "1" = High

Logical "0" = Low

*All inputs protected by standard CMOS protection circuit.

CD4001BM/CD4001BC Quad 2-Input NOR Buffered B Series Gate
CD4011BM/CD4011BC Quad 2-Input NAND Buffered B Series Gate

Absolute Maximum Ratings (Notes 1 and 2)

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

Voltage at any Pin	$-0.5V$ to $V_{DD} + 0.5V$
Power Dissipation (P_D)	
Dual-In-Line	700 mW
Small Outline	500 mW
V_{DD} Range	$-0.5\ V_{DC}$ to $+18\ V_{DC}$
Storage Temperature (T_S)	$-65°C$ to $+150°C$
Lead Temperature (T_L)	
(Soldering, 10 seconds)	260°C

Operating Conditions

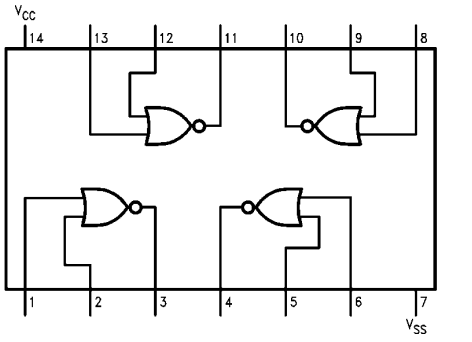
Operating Range (V_{DD})	$3\ V_{DC}$ to $15\ V_{DC}$
Operating Temperature Range	
CD4001BM, CD4011BM	$-55°C$ to $+125°C$
CD4001BC, CD4011BC	$-40°C$ to $+85°C$

DC Electrical Characteristics CD4001BM, CD4011BM (Note 2)

Symbol	Parameter	Conditions	−55°C		+25°C			+125°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
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}		0.50		0.005	0.50		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	$V_{DD} = 5V$ | $\lvert I_O \rvert < 1\ \mu A$		0.05		0	0.05		0.05	V
		$V_{DD} = 10V$ | $\lvert I_O \rvert < 1\ \mu A$		0.05		0	0.05		0.05	V
		$V_{DD} = 15V$ | $\lvert I_O \rvert < 1\ \mu A$		0.05		0	0.05		0.05	V
V_{OH}	High Level Output Voltage	$V_{DD} = 5V$ | $\lvert I_O \rvert < 1\ \mu A$	4.95		4.95	5		4.95		V
		$V_{DD} = 10V$ | $\lvert I_O \rvert < 1\ \mu A$	9.95		9.95	10		9.95		V
		$V_{DD} = 15V$ | $\lvert I_O \rvert < 1\ \mu A$	14.95		14.95	15		14.95		V
V_{IL}	Low Level Input Voltage	$V_{DD} = 5V$, $V_O = 4.5V$		1.5		2	1.5		1.5	V
		$V_{DD} = 10V$, $V_O = 9.0V$		3.0		4	3.0		3.0	V
		$V_{DD} = 15V$, $V_O = 13.5V$		4.0		6	4.0		4.0	V
V_{IH}	High Level Input Voltage	$V_{DD} = 5V$, $V_O = 0.5V$	3.5		3.5	3		3.5		V
		$V_{DD} = 10V$, $V_O = 1.0V$	7.0		7.0	6		7.0		V
		$V_{DD} = 15V$, $V_O = 1.5V$	11.0		11.0	9		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	2.25		0.9		mA
		$V_{DD} = 15V$, $V_O = 1.5V$	4.2		3.4	8.8		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	−2.25		−0.9		mA
		$V_{DD} = 15V$, $V_O = 13.5V$	−4.2		−3.4	−8.8		−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

Connection Diagrams

CD4001BC/CD4001BM
Dual-In-Line Package



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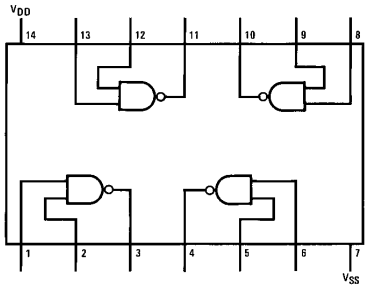
Top View

CD4011BC/CD4011BM
Dual-In-Line Package



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Top View

Order Number CD4001B or CD4011B

DC Electrical Characteristics CD4001BC, CD4011BC (Note 2)

Symbol	Parameter	Conditions	−40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I_{DD}	Quiescent Device Current	V_{DD} = 5V, V_{IN} = V_{DD} or V_{SS}		1		0.004	1		7.5	μA
		V_{DD} = 10V, V_{IN} = V_{DD} or V_{SS}		2		0.005	2		15	μA
		V_{DD} = 15V, V_{IN} = V_{DD} or V_{SS}		4		0.006	4		30	μA
V_{OL}	Low Level Output Voltage	V_{DD} = 5V, $\|I_O\| < 1$ μA		0.05		0	0.05		0.05	V
		V_{DD} = 10V, $\|I_O\| < 1$ μA		0.05		0	0.05		0.05	V
		V_{DD} = 15V, $\|I_O\| < 1$ μA		0.05		0	0.05		0.05	V
V_{OH}	High Level Output Voltage	V_{DD} = 5V, $\|I_O\| < 1$ μA	4.95		4.95	5		4.95		V
		V_{DD} = 10V, $\|I_O\| < 1$ μA	9.95		9.95	10		9.95		V
		V_{DD} = 15V, $\|I_O\| < 1$ μA	14.95		14.95	15		14.95		V
V_{IL}	Low Level Input Voltage	V_{DD} = 5V, V_O = 4.5V		1.5		2	1.5		1.5	V
		V_{DD} = 10V, V_O = 9.0V		3.0		4	3.0		3.0	V
		V_{DD} = 15V, V_O = 13.5V		4.0		6	4.0		4.0	V
V_{IH}	High Level Input Voltage	V_{DD} = 5V, V_O = 0.5V	3.5		3.5	3		3.5		V
		V_{DD} = 10V, V_O = 1.0V	7.0		7.0	6		7.0		V
		V_{DD} = 15V, V_O = 1.5V	11.0		11.0	9		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	2.25		0.9		mA
		V_{DD} = 15V, V_O = 1.5V	3.6		3.0	8.8		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	−2.25		−0.9		mA
		V_{DD} = 15V, V_O = 13.5V	−3.6		−3.0	−8.8		−2.4		mA
I_{IN}	Input Current	V_{DD} = 15V, V_{IN} = 0V		−0.30		-10^{-5}	−0.30		−1.0	μA
		V_{DD} = 15V, V_{IN} = 15V		0.30		10^{-5}	0.30		1.0	μA

AC Electrical Characteristics* CD4001BC, CD4001BM

T_A = 25°C, Input t_r; t_f = 20 ns. C_L = 50 pF, R_L = 200k. Typical temperature coefficient is 0.3%/°C.

Symbol	Parameter	Conditions	Typ	Max	Units
t_{PHL}	Propagation Delay Time, High-to-Low Level	V_{DD} = 5V	120	250	ns
		V_{DD} = 10V	50	100	ns
		V_{DD} = 15V	35	70	ns
t_{PLH}	Propagation Delay Time, Low-to-High Level	V_{DD} = 5V	110	250	ns
		V_{DD} = 10V	50	100	ns
		V_{DD} = 15V	35	70	ns
t_{THL}, t_{TLH}	Transition Time	V_{DD} = 5V	90	200	ns
		V_{DD} = 10V	50	100	ns
		V_{DD} = 15V	40	80	ns
C_{IN}	Average Input Capacitance	Any Input	5	7.5	pF
C_{PD}	Power Dissipation Capacity	Any Gate	14		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.

Note 2: All voltages measured with respect to V_{SS} unless otherwise specified.

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

AC Electrical Characteristics* CD4011BC, CD4011BM

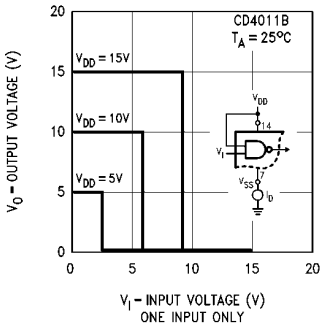
T_A = 25°C, Input t_r; t_f = 20 ns. C_L = 50 pF, R_L = 200k. Typical Temperature Coefficient is 0.3%/°C.

Symbol	Parameter	Conditions	Typ	Max	Units
t_{PHL}	Propagation Delay, High-to-Low Level	V_{DD} = 5V	120	250	ns
		V_{DD} = 10V	50	100	ns
		V_{DD} = 15V	35	70	ns
t_{PLH}	Propagation Delay, Low-to-High Level	V_{DD} = 5V	85	250	ns
		V_{DD} = 10V	40	100	ns
		V_{DD} = 15V	30	70	ns
t_{THL}, t_{TLH}	Transition Time	V_{DD} = 5V	90	200	ns
		V_{DD} = 10V	50	100	ns
		V_{DD} = 15V	40	80	ns
C_{IN}	Average Input Capacitance	Any Input	5	7.5	pF
C_{PD}	Power Dissipation Capacity	Any Gate	14		pF

*AC Parameters are guaranteed by DC correlated testing.

Typical Performance Characteristics

Typical Transfer Characteristics



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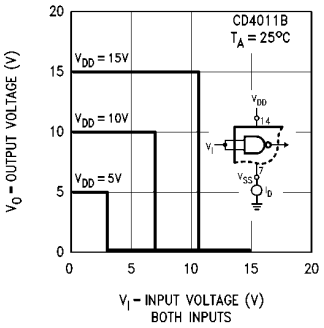
Typical Transfer Characteristics



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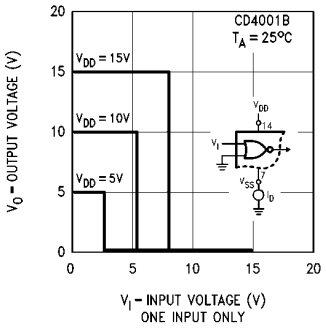
Typical Transfer Characteristics



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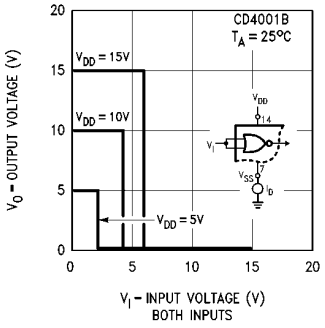
Typical Transfer Characteristics



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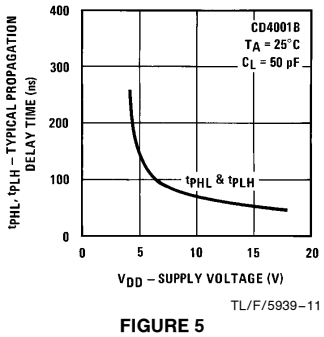

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FIGURE 5

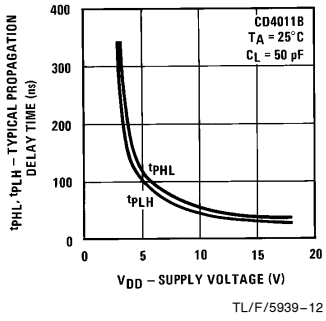

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FIGURE 6

Typical Performance Characteristics (Continued)

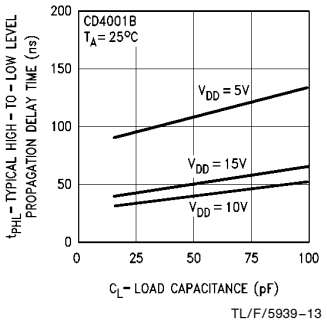


FIGURE 7

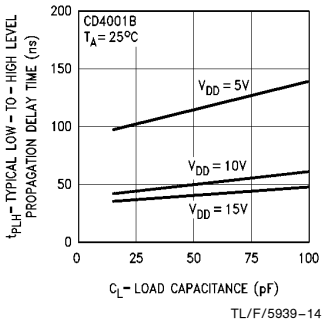


FIGURE 8

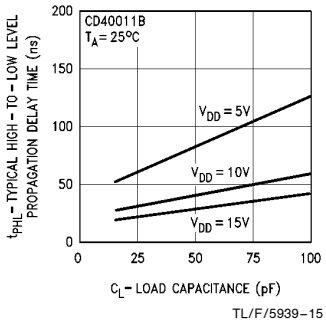


FIGURE 9

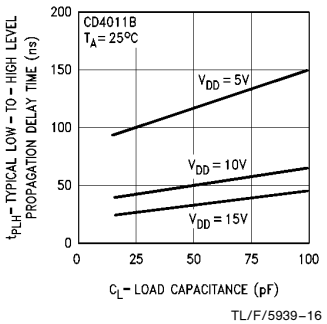


FIGURE 10

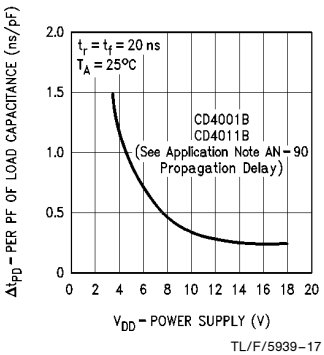


FIGURE 11

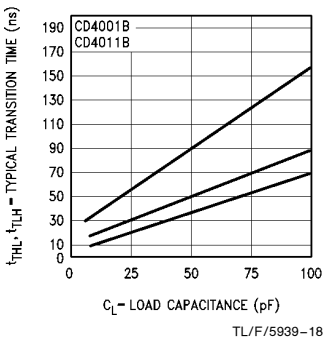


FIGURE 12

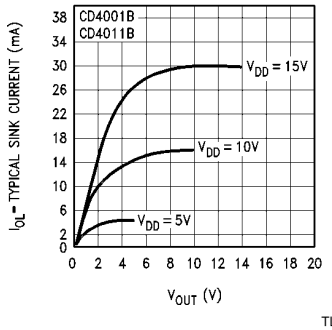


FIGURE 13

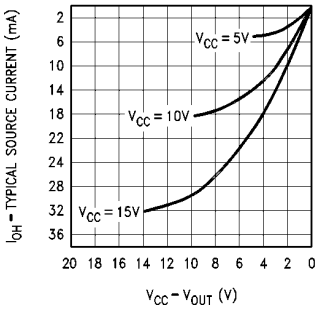
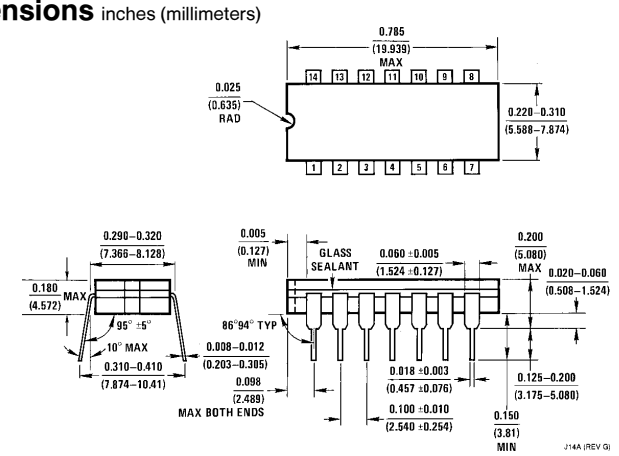
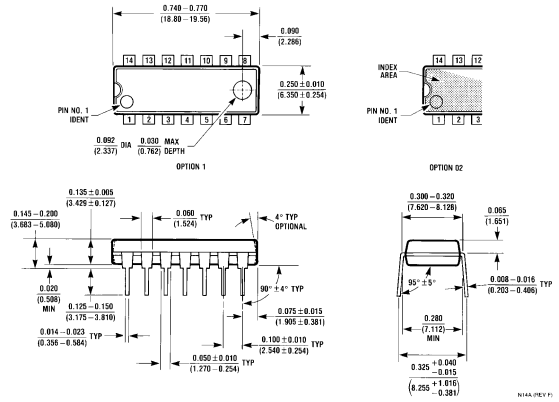


FIGURE 14

Physical Dimensions inches (millimeters)



Ceramic Dual-In-Line Package (J)
Order Number CD4001BMJ, CD4001BCJ, CD40011BMJ or CD4011BCJ
NS Package Number J14A



Molded Dual-In-Line Package (N)
Order Number CD4001BMN, CD4001BCN, CD4011BMN or CD4011BCN
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: cnjwge@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.
13th 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