National Semiconductor

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CD4070BM/CD4070BC Quad 2-Input EXCLUSIVE-OR Gate CD4077BM/CD4077BC Quad 2-Input EXCLUSIVE-NOR Gate

General Description

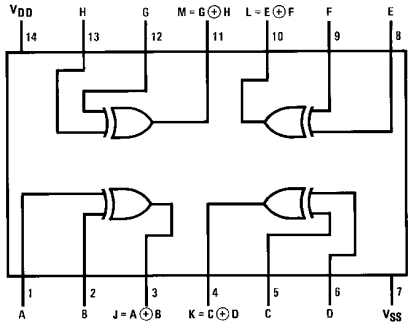
Employing complementary MOS (CMOS) transistors to achieve wide power supply operating range, low power consumption, and high noise margin, the CD4070BM/BC and CD4077BM/BC provide basic functions used in the implementation of digital integrated circuit systems. The N- and P-channel enhancement mode transistors provide a symmetrical circuit with output swing essentially equal to the supply voltage. No DC power other than that caused by leakage current is consumed during static condition. All inputs are protected from damage due to static discharge by diode clamps 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 compatibility Fan out of 2 driving 74L or 1 driving 74LS
- CD4070B—Pin compatible to CD4030A
  —Equivalent to MM54C86/MM74C86 and MC14070B
- CD4077B—Equivalent to MC14077B

Connection Diagram

CD4070BM/CD4070BC
Dual-In-Line Package



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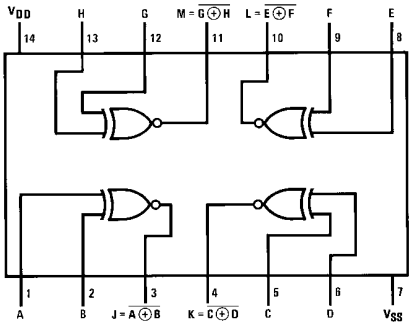
Top View

CD4077BM/CD4077BC
Dual-In-Line Package



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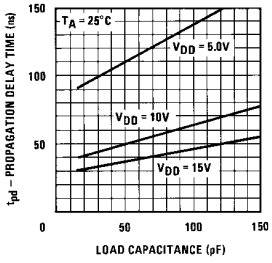
Top View

Typical Performance Characteristics

Propagation Delay Time vs Load Capacitance



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Truth Tables

CD4070BM/CD4070BC

Inputs		Outputs
A	B	Y
L	L	L
L	H	H
H	L	H
H	H	L

CD4077BM/CD4077BC

Inputs		Outputs
A	B	Y
L	L	H
L	H	L
H	L	L
H	H	H

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

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.

DC Supply Voltage (V_{DD})	-0.5 to $+18$ V_{DC}
Input Voltage (V_{IN})	-0.5 to V_{DD} $+0.5$ V_{DC}
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)

DC Supply Voltage (V_{DD})	3V to 15 V_{DC}
Input Voltage (V_{IN})	0 to V_{DD} V_{DC}
Operating Temperature Range (T_A)	
CD4070BC/CD4077BC	$-40°C$ to $+85°C$
CD4070BM/CD4077BM	$-55°C$ to $+125°C$

DC Electrical Characteristics CD4070BM/CD4077BM (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			0.25		7.5	μA
		$V_{DD} = 10V$, $V_{IN} = V_{DD}$ or V_{SS}		0.5			0.5		15	μA
		$V_{DD} = 15V$, $V_{IN} = V_{DD}$ or V_{SS}		1.0			1.0		30	μA
V_{OL}	Low Level Output Voltage	$\|I_O\| < 1\ \mu A$								
		$V_{DD} = 5V$		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	$\|I_O\| < 1\ \mu A$								
		$V_{DD} = 5V$	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	$\|I_O\| < 1\ \mu A$								
		$V_{DD} = 5V$, $V_O = 4.5V$ or $0.5V$		1.5			1.5		1.5	V
		$V_{DD} = 10V$, $V_O = 9V$ or $1.0V$		3.0			3.0		3.0	V
		$V_{DD} = 15V$, $V_O = 13.5V$ or $1.5V$		4.0			4.0		4.0	V
V_{IH}	High Level Input Voltage	$\|I_O\| < 1\ \mu A$								
		$V_{DD} = 5V$, $V_O = 0.5V$ or $4.5V$	3.5		3.5			3.5		V
		$V_{DD} = 10V$, $V_O = 1.0V$ or $9.0V$	7.0		7.0			7.0		V
		$V_{DD} = 15V$, $V_O = 1.5V$ or $13.5V$	11.0		11.0			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	$V_{DD} = 15V$, $V_{IN} = 0V$		-0.1		-10^{-5}	-0.1		-1.0	μA
		$V_{DD} = 15V$, $V_{IN} = 15V$		0.1		10^{-5}	0.1		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 table of "Recommended Operating Conditions" and "Electrical Characteristics" provides 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.

DC Electrical Characteristics CD4070BC/CD4077BC (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			1.0		7.5	μA
		V_{DD} = 10V, V_{IN} = V_{DD} or V_{SS}		2.0			2.0		15	μA
		V_{DD} = 15V, V_{IN} = V_{DD} or V_{SS}		4.0			4.0		30	μA
V_{OL}	Low Level Output Voltage	$\|I_O\| < 1$ μA								
		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	$\|I_O\| < 1$ μA								
		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	$\|I_O\| < 1$ μA								
		V_{DD} = 5V, V_O = 4.5V or 0.5V		1.5			1.5		1.5	V
		V_{DD} = 10V, V_O = 9V or 1.0V		3.0			3.0		3.0	V
		V_{DD} = 15V, V_O = 13.5V or 1.5V		4.0			4.0		4.0	V
V_{IH}	High Level Input Voltage	$\|I_O\| < 1$ μA								
		V_{DD} = 5V, V_O = 0.5V or 4.5V	3.5		3.5			3.5		V
		V_{DD} = 10V, V_O = 1V or 9.0V	7.0		7.0			7.0		V
		V_{DD} = 15V, V_O = 1.5V or 13.5V	11.0		11.0			11.0		V
I_{OL}	Low Level Output Current	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	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		−0.3		-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, R_L = 200k, t_r and $t_f \leq$ 20 ns, unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{PHL} or t_{PLH}	Propagation Delay Time from Input to Output	V_{DD} = 5V		110	185	ns
		V_{DD} = 10V		50	90	ns
		V_{DD} = 15V		40	75	ns
t_{THL} or 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	7.5	pF
C_{PD}	Power Dissipation Capacitance	Any Input (Note 4)		20		pF

*AC Parameters are guaranteed by DC correlated testing.

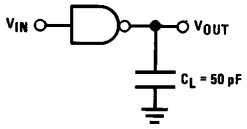
Note 1: ''Absolute Maximum Ratings'' are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The table of ''Recommended Operating Conditions'' and ''Electrical Characteristics'' provides conditions for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

AC Test Circuit and Switching Time Waveforms



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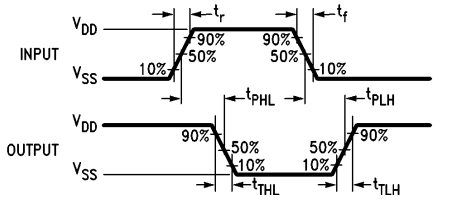
Note: Delays measured with input t_r, t_f = 20 ns.



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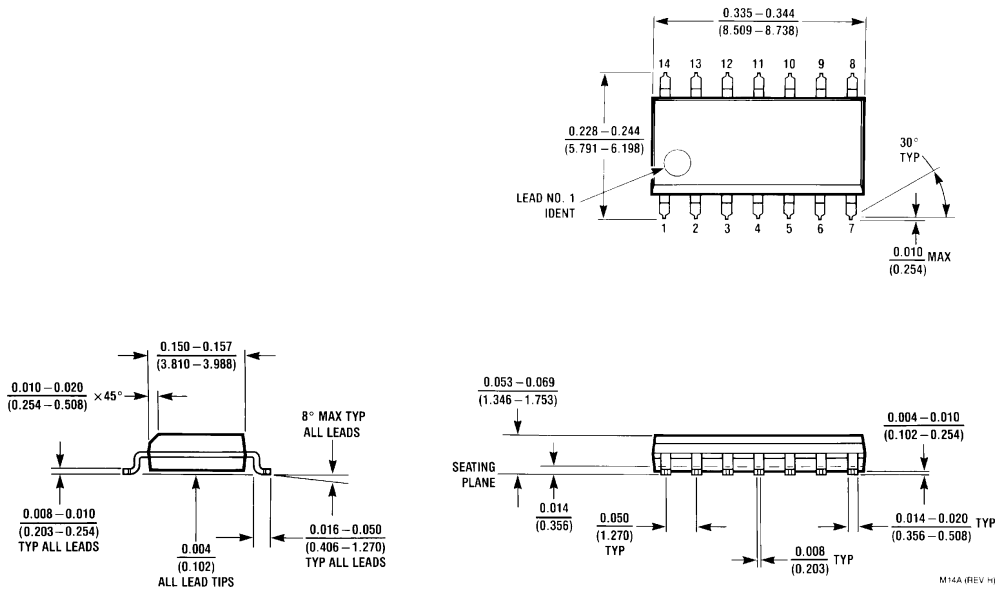
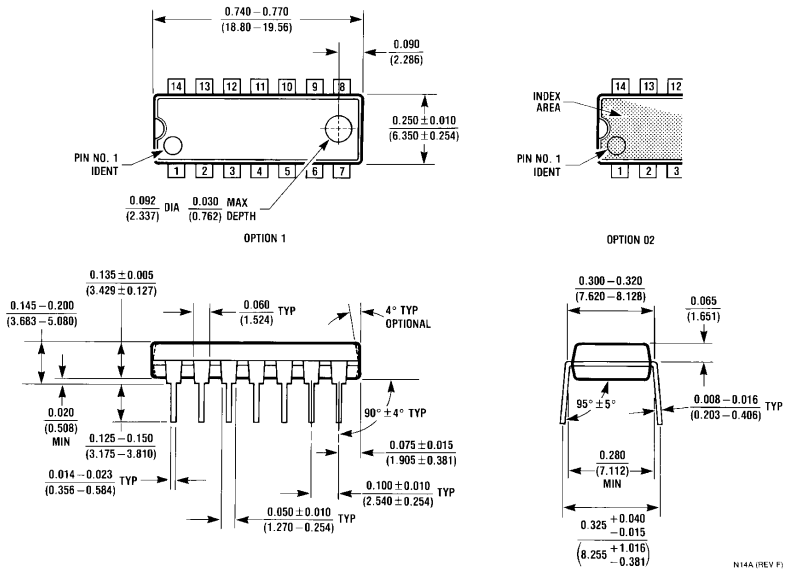
$t_r = t_f = 20$ ns

Physical Dimensions inches (millimeters)



Molded Small Outline Package (M)
Order Number CD4070BCM or CD4077BCM
NS Package Number M14A

Physical Dimensions inches (millimeters) (Continued)



Molded Dual-In-Line Package (N)
Order Number CD4070BCN or CD4077BCN
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.

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