National Semiconductor

CD4001M/CD4001C Quadruple 2-Input NOR Gate
CD4011M/CD4011C Quadruple 2-Input NAND Gate

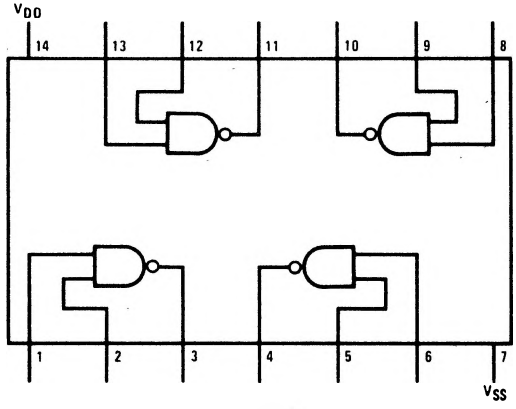
General Description

The CD4001M/CD4001C, CD4011M/CD4011C are monolithic complementary MOS (CMOS) quadruple two-input NOR and NAND gate integrated circuits. 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.

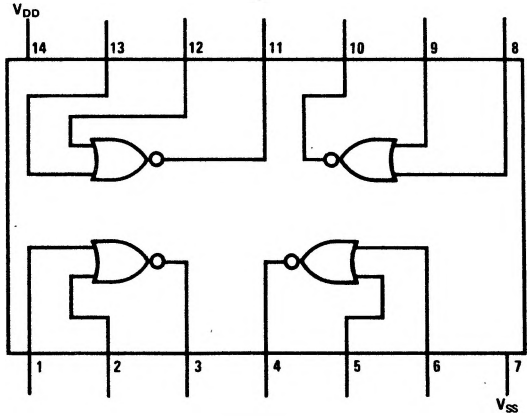
Features

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

Connection Diagrams



TOP VIEW



TOP VIEW

Absolute Maximum Ratings (Note 1)

Voltage an Any Pin	V_{SS} − 0.3 V to V_{DD} + 0.3 V	Storage Temperature Range	−65°C to +150°C
Operating Temperature Range		Package Dissipation	500 mW
CD4001M, CD4011M	−55°C to +125°C	Operating V_{DD} Range	V_{SS} + 3.0 V to V_{SS} + 15 V
CD4001C, CD4011C	−40°C to +85°C	Lead Temperature (Soldering, 10 seconds)	300°C

DC Electrical Characteristics — CD4001M, CD4011M

Parameter		Conditions	Limits						Units
			−55°C		25°C		125°C		
			Min.	Max.	Min.	Typ.	Max.	Min.	Max.	
I_L	Quiescent Device Current	V_{DD} = 5.0V		0.05		0.001	0.05		3.0	μA
		V_{DD} = 10V		0.1		0.001	0.1		6.0	μA
P_D	Quiescent Device Dissipation/Package	V_{DD} = 5.0V		0.25		0.005	0.25		15	μW
		V_{DD} = 10V		1.0		0.01	1.0		60	μW
V_{OL}	Output Voltage Low Level	V_{DD} = 5.0V, V_I = V_{DD}, I_O = 0A		0.05		0	0.05		0.05	V
		V_{DD} = 10V, V_I = V_{DD}, I_O = 0A		0.05		0	0.05		0.05	V
V_{OH}	Output Voltage High Level	V_{DD} = 5.0V, V_I = V_{SS}, I_O = 0A	4.95		4.95	5.0		4.95		V
		V_{DD} = 10V, V_I = V_{SS}, I_O = 0A	9.95		9.95	10		9.95		V
V_{NL}	Noise Immunity (All Inputs)	V_{DD} = 5.0V, V_O = 3.6V, I_O = 0A	1.5		1.5	2.25		1.4		V
		V_{DD} = 10V, V_O = 7.2V, I_O = 0A	3.0		3.0	4.5		2.9		V
V_{NH}	Noise Immunity (All Inputs)	V_{DD} = 5.0V, V_O = 0.95V, I_O = 0A	1.4		1.5	2.25		1.5		V
		V_{DD} = 10V, V_O = 2.9V, I_O = 0A	2.9		3.0	4.5		3.0		V
I_DN	Output Drive Current N-Channel (4001)	V_{DD} = 5.0V, V_O = 0.4V, V_I = V_{DD}	0.5		0.40	1.0		0.28		mA
		V_{DD} = 10V, V_O = 0.5V, V_I = V_{DD}	1.1		0.9	2.5		0.65		mA
I_DP	Output Drive Current P-Channel (4001)	V_{DD} = 5.0V, V_O = 2.5V, V_I = V_{SS}	−0.62		−0.5	−2.0		−0.35		mA
		V_{DD} = 10V, V_O = 9.5V, V_I = V_{SS}	−0.62		−0.5	−1.0		−0.35		mA
I_DN	Output Drive Current N-Channel (4011)	V_{DD} = 5.0V, V_O = 0.4V, V_I = V_{DD}	0.31		0.25	0.5		0.175		mA
		V_{DD} = 10V, V_O = 0.5V, V_I = V_{DD}	0.63		0.5	0.6		0.35		mA
I_DP	Output Drive Current P-Channel (4011)	V_{DD} = 5.0V, V_O = 2.5V, V_I = V_{SS}	−0.31		−0.25	−0.5		−0.175		mA
		V_{DD} = 10V, V_O = 9.5V, V_I = V_{SS}	−0.75		−0.6	−1.2		−0.4		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.

DC Electrical Characteristics — CD4001C, CD4011C

Parameter		Conditions	Limits						Units
			−40°C		25°C			80°C	
			Min.	Max.	Min.	Typ.	Max.	Min.	Max.	
I_L	Quiescent Device Current	$V_{DD} = 5.0V$		0.5		0.005	0.5		15	μA
		$V_{DD} = 10V$		5.0		0.005	5.0		30	μA
P_D	Quiescent Device Dissipation/Package	$V_{DD} = 5.0V$		2.5		0.025	2.5		75	μW
		$V_{DD} = 10V$		50		0.05	50		300	μW
V_{OL}	Output Voltage Low Level	$V_{DD} = 5.0V$, $V_I = V_{DD}$, $I_O = 0A$		0.05		0	0.05		0.05	V
		$V_{DD} = 10V$, $V_I = V_{DD}$, $I_O = 0A$		0.05		0	0.05		0.05	V
V_{OH}	Output Voltage High Level	$V_{DD} = 5.0V$, $V_I = V_{SS}$, $I_O = 0A$	4.95		4.95	5.0		4.95		V
		$V_{DD} = 10V$, $V_I = V_{SS}$, $I_O = 0A$	9.95		9.95	10		9.95		V
V_{NL}	Noise Immunity (All Inputs)	$V_{DD} = 5.0V$, $V_O = 3.6V$, $I_O = 0A$	1.5		1.5	2.25		1.4		V
		$V_{DD} = 10V$, $V_O = 7.2V$, $I_O = 0A$	3.0		3.0	4.5		2.9		V
V_{NH}	Noise Immunity (All Inputs)	$V_{DD} = 5.0V$, $V_O = 0.95V$, $I_O = 0A$	1.4		1.5	2.25		1.5		V
		$V_{DD} = 10V$, $V_O = 2.9V$, $I_O = 0A$	2.9		3.0	4.5		3.0		V
I_DN	Output Drive Current N-Channel (4001)	$V_{DD} = 5.0V$, $V_O = 0.4V$, $V_I = V_{DD}$	0.35		0.3	1.0		0.24		mA
		$V_{DD} = 10V$, $V_O = 0.5V$, $V_I = V_{DD}$	0.72		0.6	2.5		0.48		mA
I_DP	Output Drive Current P-Channel (4001)	$V_{DD} = 5.0V$, $V_O = 2.5V$, $V_I = V_{SS}$	−0.35		−0.3	−2.0		−0.24		mA
		$V_{DD} = 10V$, $V_O = 9.5V$, $V_I = V_{SS}$	−0.3		−0.25	−1.0		−0.2		mA
I_DN	Output Drive Current N-Channel (4011)	$V_{DD} = 5.0V$, $V_O = 0.4V$, $V_I = V_{DD}$	0.145		0.12	0.5		0.095		mA
		$V_{DD} = 10V$, $V_O = 0.5V$, $V_I = V_{DD}$	0.3		0.25	0.6		0.2		mA
I_DP	Output Drive Current P-Channel (4011)	$V_{DD} = 5.0V$, $V_O = 2.5V$, $V_I = V_{SS}$	−0.145		−0.12	−0.5		−0.095		mA
		$V_{DD} = 10V$, $V_O = 9.5V$, $V_I = V_{SS}$	−0.35		−0.3	−1.2		−0.24		mA
I_I	Input Current					10				pA

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 $V_{DD} = 0.3\%/°C$

	Parameter	Conditions	Min.	Typ.	Max.	Units
	CD4001M					
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	65 40	ns ns
t_{THL}	Transition Time High to Low Level	$V_{DD} = 5.0V$ $V_{DD} = 10V$		65 35	125 70	ns ns
t_{TLH}	Transition Time Low to High Level	$V_{DD} = 5.0V$ $V_{DD} = 10V$		65 35	175 75	ns ns
C_{IN}	Input Capacitance	Any Input		5.0		pF
	CD4001C					
t_{PHL}	Propagation Delay Time High to Low Level	$V_{DD} = 5.0V$ $V_{DD} = 10V$		35 25	80 55	ns ns
t_{PLH}	Propagation Delay Time Low to High Level	$V_{DD} = 5.0V$ $V_{DD} = 10V$		35 25	120 65	ns ns
t_{THL}	Transition Time High to Low Level	$V_{DD} = 5.0V$ $V_{DD} = 10V$		65 35	200 115	ns ns
t_{TLH}	Transition Time Low to High Level	$V_{DD} = 5.0V$ $V_{DD} = 10V$		65 35	300 125	ns ns
C_{IN}	Input Capacitance	Any Input		5.0		pF

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 $V_{DD} = 0.3\%/°C$

	Parameter	Conditions	Min.	Typ.	Max.	Units
	CD4011M					
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
	CD4011C					
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