



# 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.

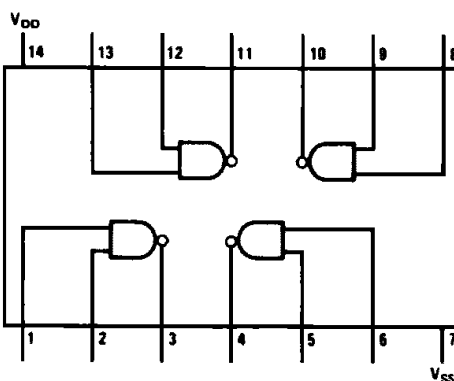
## Features

- Wide supply voltage range
- Low power
- High noise immunity

3.0V to 15V  
10 nW (typ.)  
0.45 V<sub>DD</sub> (typ.)

## Connection Diagrams

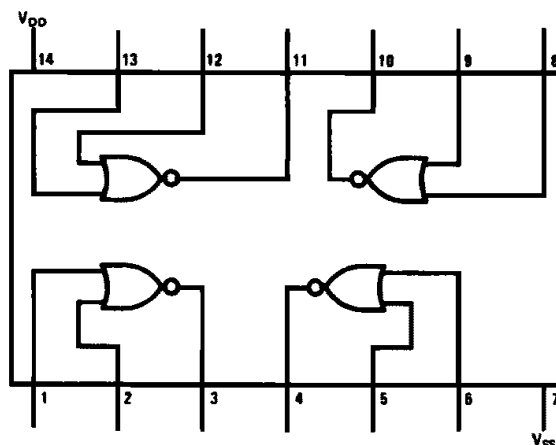
Dual-In-Line Package



TL/F/5938-1

Top View  
CD4011M/CD4011C

Dual-In-Line Package



TL/F/5938-2

Top View  
CD4001M/CD4001C

Order Number CD4001\* or CD4011\*

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

### Absolute Maximum Ratings (Note 1)

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

Voltage on any Pin  $V_{SS} - 0.3V$  to  $V_{DD} + 0.3V$

Operating Temperature Range  
 CD4001M, CD4011M  $-55^{\circ}C$  to  $+125^{\circ}C$   
 CD4001C, CD4011C  $-40^{\circ}C$  to  $+85^{\circ}C$

Storage Temperature Range  $-65^{\circ}C$  to  $+150^{\circ}C$

Power Dissipation ( $P_D$ )  
 Dual-In-Line 700 mW  
 Small Outline 500 mW

Operating  $V_{DD}$  Range  $V_{SS} + 3.0V$  to  $V_{SS} + 15V$   
 Lead Temp. (Soldering, 10 sec.)  $260^{\circ}C$

### DC Electrical Characteristics CD4001M, CD4011M

Symbol	Parameter	Conditions	Limits						Units	
			$-55^{\circ}C$		$+25^{\circ}C$			$+125^{\circ}C$		
			Min	Max	Min	Typ	Max	Min		Max
$I_L$	Quiescent Device Current	$V_{DD} = 5.0V$ $V_{DD} = 10V$		0.05		0.001	0.05		3.0	$\mu A$
				0.1		0.001	0.1		6.0	$\mu A$
$P_D$	Quiescent Device Dissipation/Package	$V_{DD} = 5.0V$ $V_{DD} = 10V$		0.25		0.005	0.25		15	$\mu W$
				1.0		0.01	1.0		60	$\mu W$
$V_{OL}$	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	0.05		0.05	V
				0.05		0	0.05		0.05	V
$V_{OH}$	Output Voltage High Level	$V_{DD} = 5.0V, V_I = V_{SS}, I_O = 0A$ $V_{DD} = 10V, V_I = V_{SS}, I_O = 0A$	4.95		4.95	5.0		4.95		V
			9.95		9.95	10		9.95		V
$V_{NL}$	Noise Immunity (All Inputs)	$V_{DD} = 5.0V, V_O = 3.6V, I_O = 0A$ $V_{DD} = 10V, V_O = 7.2V, I_O = 0A$	1.5		1.5	2.25		1.4		V
			3.0		3.0	4.5		2.9		V
$V_{NH}$	Noise Immunity (All Inputs)	$V_{DD} = 5.0V, V_O = 0.95V, I_O = 0A$ $V_{DD} = 10V, V_O = 2.9V, I_O = 0A$	1.4		1.5	2.25		1.5		V
			2.9		3.0	4.5		3.0		V
$I_{DN}$	Output Drive Current N-Channel (4001) (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		0.40	1.0		0.28		mA
			1.1		0.9	2.5		0.65		mA
$I_{DP}$	Output Drive Current P-Channel (4001) (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		-0.5	-2.0		-0.35		mA
			-0.62		-0.5	-1.0		-0.35		mA
$I_{DN}$	Output Drive Current N-Channel (4011) (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		0.25	0.5		0.175		mA
			0.63		0.5	0.6		0.35		mA
$I_{DP}$	Output Drive Current P-Channel (4011) (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		-0.25	-0.5		-0.175		mA
			-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.

**Note 2:**  $I_{DN}$  and  $I_{DP}$  are tested one output at a time.

## DC Electrical Characteristics

CD4001C, CD4011C

Symbol	Parameter	Conditions	Limits						Units	
			- 40°C		+ 25°C			+ 85°C		
			Min	Max	Min	Typ	Max	Min		Max
$I_L$	Quiescent Device Current	$V_{DD} = 5.0V$		0.5		0.005	0.5		15	$\mu A$
		$V_{DD} = 10V$		5.0		0.005	5.0		30	$\mu A$
$P_D$	Quiescent Device Dissipation/Package	$V_{DD} = 5.0V$		2.5		0.025	2.5		75	$\mu W$
		$V_{DD} = 10V$		50		0.05	50		300	$\mu W$
$V_{OL}$	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) (Note 2)	$V_{DD} = 5.0V, V_O = 0.4V, V_I = V_{DD}$	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) (Note 2)	$V_{DD} = 5.0V, V_O = 2.5V, V_I = V_{SS}$	-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) (Note 2)	$V_{DD} = 5.0V, V_O = 0.4V, V_I = V_{DD}$	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) (Note 2)	$V_{DD} = 5.0V, V_O = 2.5V, V_I = V_{SS}$	-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	

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>CD4001M</b>						
$t_{PHL}$	Propagation Delay Time High to Low Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		35 25	50 40	ns ns
$t_{PLH}$	Propagation Delay Time Low to High Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		35 25	65 40	ns ns
$t_{THL}$	Transition Time High to Low Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		65 35	125 70	ns ns
$t_{TLH}$	Transition Time Low to High Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		65 35	175 75	ns ns
$C_{IN}$	Input Capacitance	Any Input		5.0		pF
<b>CD4001C</b>						
$t_{PHL}$	Propagation Delay Time High to Low Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		35 25	80 55	ns ns
$t_{PLH}$	Propagation Delay Time Low to High Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		35 25	120 65	ns ns
$t_{THL}$	Transition Time High to Low Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		65 35	200 115	ns ns
$t_{TLH}$	Transition Time Low to High Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		65 35	300 125	ns ns
$C_{IN}$	Input Capacitance	Any Input		5.0		pF
<b>CD4011M</b>						
$t_{PHL}$	Propagation Delay Time High to Low Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		50 25	75 40	ns ns
$t_{PLH}$	Propagation Delay Time Low to High Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		50 25	75 40	ns ns
$t_{THL}$	Transition Time High to Low Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		75 50	125 75	ns ns
$t_{TLH}$	Transition Time Low to High Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		75 40	100 60	ns ns
$C_{IN}$	Input Capacitance	Any Input		5.0		pF
<b>CD4011C</b>						
$t_{PHL}$	Propagation Delay Time High to Low Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		50 25	100 50	ns ns
$t_{PLH}$	Propagation Delay Time Low to High Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		50 25	100 50	ns ns
$t_{THL}$	Transition Time High to Low Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		75 50	150 100	ns ns
$t_{TLH}$	Transition Time Low to High Level	$V_{DD} = 5.0\text{V}$ $V_{DD} = 10\text{V}$		75 40	125 75	ns ns
$C_{IN}$	Input Capacitance	Any Input		5.0		pF

\*AC Parameters are guaranteed by DC correlated testing.