

Quad 2-input NAND gate

Description

The CD4011 is a quad 2-input NAND gate. The devices also have buffered outputs which improve anti-interference capabilities and reduce the requirements on output impedance.

Features

- All outputs are buffered
- Package: DIP14、SOP14

Diagrams

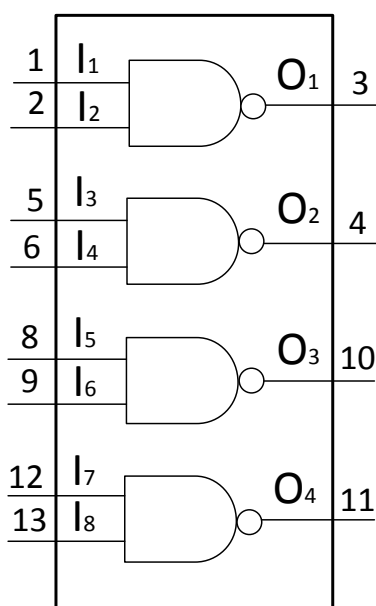


Fig.1 Functional diagram of CD4011

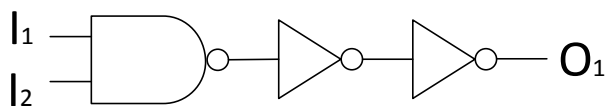
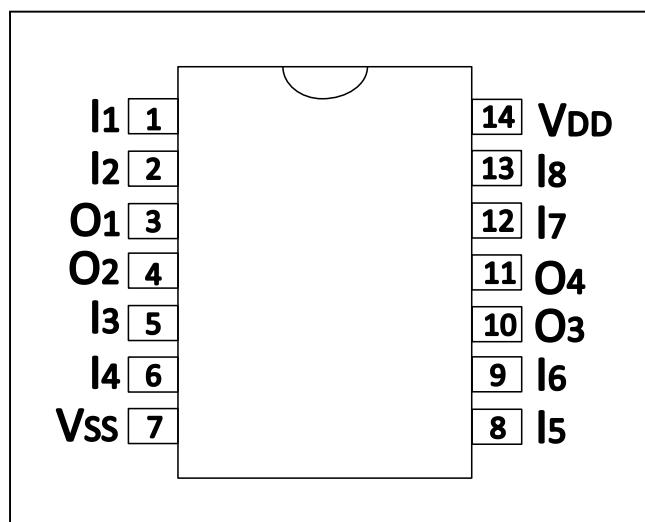


Fig.2 Single-channel schematic diagram of CD4011

Pinning Information



Ordering Information

Chip model	Package
CD4011D	DIP14
CD4011	SOP14

Pin Description

DIP-14	Pin Name	Description
1、2、5、6、8、 9、12、13	I ₁ 、I ₂ 、I ₃ 、I ₄ 、I ₅ 、 I ₆ 、I ₇ 、I ₈	Input
3、4、10、11	O ₁ 、O ₂ 、O ₃ 、O ₄	Output
7	V _{SS}	Ground
14	V _{DD}	Supply voltage

Absolute Maximum Ratings

Unless otherwise specified, $T_A=25^{\circ}\text{C}$.

Parameter		Symbol	Min.	Max.	Unit
Supply voltage		V_{DD}	-0.5	18	V
Input voltage		V_I	-0.5	$V_{DD}+0.5$	V
Input/Output current		$\pm I$	-10	+10	mA
Power dissipation	DIP, $T_A=-40\sim+70^{\circ}\text{C}$	P_D	750		mW
	SOP, $T_A=-40\sim+70^{\circ}\text{C}$		500		mW
Output power dissipation		P	100		mW
Ambient temperature		T_A	-40	+85	$^{\circ}\text{C}$
Storage temperature		T_{stg}	-65	+150	$^{\circ}\text{C}$
Soldering temperature (10 seconds)	DIP	T_L	245		$^{\circ}\text{C}$
	SOP		250		$^{\circ}\text{C}$

Note:

- 1.DIP package: When T_A is greater than 70°C ,the rated power consumption decreases by 12mW for every 1°C increase in temperature.
- 2.SOPpackage: When T_A is greater than 70°C ,the rated power consumption decreases by 8mW for every 1°C increase in temperature.

Electrical characteristics

● DC Electrical Characteristics

1、 Unless otherwise specified, $T_A=25^{\circ}\text{C}$, $V_{SS}=0\text{V}$.

Parameter	Sym.	Conditions	Min.	Typ.	Max.	Unit
Static Current	I_{DD}	$V_I=V_{SS}$ or V_{DD} ; $I_O=0$	$V_{DD}=5\text{V}$		1.0	μA
			$V_{DD}=10\text{V}$		2.0	μA
			$V_{DD}=15\text{V}$		4.0	μA
LOW-level output voltage	V_{OL}	$V_I=V_{SS}$ or V_{DD} , $ I_O < 1\mu\text{A}$	$V_{DD}=5\text{V}$		0.05	V
			$V_{DD}=10\text{V}$		0.05	V
			$V_{DD}=15\text{V}$		0.05	V
HIGH-level output voltage	V_{OH}	$V_I=V_{SS}$ or V_{DD} , $ I_O < 1\mu\text{A}$	$V_{DD}=5\text{V}$	4.95	-	V
			$V_{DD}=10\text{V}$	9.95		V
			$V_{DD}=15\text{V}$	14.95		V
LOW-level input voltage	V_{IL}	$V_O=0.5\text{V}$ or 4.5V , $ I_O < 1\mu\text{A}$	$V_{DD}=5\text{V}$	-	1.5	V
		$V_O=1.0\text{V}$ or 9.0V , $ I_O < 1\mu\text{A}$	$V_{DD}=10\text{V}$		3.0	V
		$V_O=1.5\text{V}$ or 13.5V , $ I_O < 1\mu\text{A}$	$V_{DD}=15\text{V}$		4.0	V
HIGH-level input voltage	V_{IH}	$V_O=0.5\text{V}$ or 4.5V , $ I_O < 1\mu\text{A}$	$V_{DD}=5\text{V}$	3.5		V
		$V_O=1.0\text{V}$ or 9.0V , $ I_O < 1\mu\text{A}$	$V_{DD}=10\text{V}$	7.0		V
		$V_O=1.5\text{V}$ or 13.5V , $ I_O < 1\mu\text{A}$	$V_{DD}=15\text{V}$	11.0		V

Electrical characteristics(Continued)

1、Unless otherwise specified, $T_A=25^{\circ}\text{C}$, $V_{SS}=0\text{V}$.

Parameter	Sym.	Conditions		Min.	Typ.	Max.	Unit
LOW-level output current	I_{OL}	$V_O=0.4\text{V}$, $V_I=0$ or 5V	$V_{DD}=5\text{V}$	0.44			mA
		$V_O=0.5\text{V}$, $V_I=0$ or 10V	$V_{DD}=10\text{V}$	1.1			mA
		$V_O=1.5\text{V}$, $V_I=0$ or 15V	$V_{DD}=15\text{V}$	3.0			mA
HIGH-level output current	$-I_{OH}$	$V_O=4.6\text{V}$, $V_I=0$ or 5V	$V_{DD}=5\text{V}$	0.44			mA
		$V_O=9.5\text{V}$, $V_I=0$ or 10V	$V_{DD}=10\text{V}$	1.1			mA
		$V_O=13.5\text{V}$, $V_I=0$ or 15V	$V_{DD}=15\text{V}$	3.0			mA
HIGH-level output current	$-I_{OH}$	$V_O=2.5\text{V}$, $V_I=0$ or 5V	$V_{DD}=5\text{V}$	1.4			mA
Input current	$\pm I_{IN}$	$V_{IN}=0$ or 15V	$V_{DD}=15\text{V}$			0.3	μA

2、Unless otherwise specified, $T_A=40^{\circ}\text{C}$, $V_{SS}=0\text{V}$.

Parameter	Sym.	Conditions		Min.	Typ.	Max.	Unit
Static Current	I_{DD}	$V_I=V_{SS}$ or V_{DD} ; $I_O=0$	$V_{DD}=5\text{V}$			1.0	μA
			$V_{DD}=10\text{V}$			2.0	μA
			$V_{DD}=15\text{V}$			4.0	μA
LOW-level output voltage	V_{OL}	$V_I=V_{SS}$ or V_{DD} , $ I_O < 1\mu\text{A}$	$V_{DD}=5\text{V}$			0.05	V
			$V_{DD}=10\text{V}$			0.05	V
			$V_{DD}=15\text{V}$			0.05	V
HIGH-level output voltage	V_{OH}	$V_I=V_{SS}$ or V_{DD} , $ I_O < 1\mu\text{A}$	$V_{DD}=5\text{V}$	4.95	-		V
			$V_{DD}=10\text{V}$	9.95			V
			$V_{DD}=15\text{V}$	14.95			V
LOW-level input voltage	V_{IL}	$V_O=0.5\text{V}$ or 4.5V , $ I_O < 1\mu\text{A}$	$V_{DD}=5\text{V}$	-	-	1.5	V
		$V_O=1.0\text{V}$ or 9.0V , $ I_O < 1\mu\text{A}$	$V_{DD}=10\text{V}$			3.0	V
		$V_O=1.5\text{V}$ or 13.5V , $ I_O < 1\mu\text{A}$	$V_{DD}=15\text{V}$			4.0	V
HIGH-level input voltage	V_{IH}	$V_O=0.5\text{V}$ or 4.5V , $ I_O < 1\mu\text{A}$	$V_{DD}=5\text{V}$	3.5			V
		$V_O=1.0\text{V}$ or 9.0V , $ I_O < 1\mu\text{A}$	$V_{DD}=10\text{V}$	7.0			V
		$V_O=1.5\text{V}$ or 13.5V , $ I_O < 1\mu\text{A}$	$V_{DD}=15\text{V}$	11.0			V
LOW-level output current	I_{OL}	$V_O=0.4\text{V}$, $V_I=0$ or 5V	$V_{DD}=5\text{V}$	0.52			mA
		$V_O=0.5\text{V}$, $V_I=0$ or 10V	$V_{DD}=10\text{V}$	1.3			mA
		$V_O=1.5\text{V}$, $V_I=0$ or 15V	$V_{DD}=15\text{V}$	3.6			mA

Electrical characteristics(Continued)

2、Unless otherwise specified, $T_A=40^{\circ}$, $V_{SS}=0$.

Parameter	Sym.	Conditions		Min.	Typ.	Max.	Unit
HIGH-level output current	$-I_{OH}$	$V_O=4.6V, V_I=0$ or $5V$	$V_{DD}=5V$	0.52			mA
		$V_O=9.5V, V_I=0$ or $10V$	$V_{DD}=10V$	1.3			mA
		$V_O=13.5V, V_I=0$ or $15V$	$V_{DD}=15V$	3.6			mA
HIGH-level output current	$-I_{OH}$	$V_O=2.5V, V_I=0$ or $5V$	$V_{DD}=5V$	1.7			mA
Input current	$\pm I_{IN}$	$V_{IN}=0$ or $15V$	$V_{DD}=15V$			0.3	uA

3、Unless otherwise specified, $T_A=85^{\circ}C$, $V_{SS}=0V$.

Parameter	Sym.	Conditions		Min.	Typ.	Max.	Unit
Static Current	I_{DD}	$V_I=V_{SS}$ or V_{DD} ; $I_O=0$	$V_{DD}=5V$	-		7.5	uA
			$V_{DD}=10V$	-		15.0	uA
			$V_{DD}=15V$	-		30.0	uA
LOW-level output voltage	V_{OL}	$V_I=V_{SS}$ or V_{DD} , $ I_O < 1\mu A$	$V_{DD}=5V$			0.05	V
			$V_{DD}=10V$			0.05	V
			$V_{DD}=15V$			0.05	V
HIGH-level output voltage	V_{OH}	$V_I=V_{SS}$ or V_{DD} , $ I_O < 1\mu A$	$V_{DD}=5V$	4.95	-		V
			$V_{DD}=10V$	9.95			V
			$V_{DD}=15V$	14.95			V
LOW-level input voltage	V_{IL}	$V_O=0.5V$ or $4.5V$, $ I_O < 1\mu A$	$V_{DD}=5V$	-	-	1.5	V
		$V_O=1.0V$ or $9.0V$, $ I_O < 1\mu A$	$V_{DD}=10V$			3.0	V
		$V_O=1.5V$ or $13.5V$, $ I_O < 1\mu A$	$V_{DD}=15V$			4.0	V
HIGH-level input voltage	V_{IH}	$V_O=0.5V$ or $4.5V$, $ I_O < 1\mu A$	$V_{DD}=5V$	3.5			V
		$V_O=1.0V$ or $9.0V$, $ I_O < 1\mu A$	$V_{DD}=10V$	7.0			V
		$V_O=1.5V$ or $13.5V$, $ I_O < 1\mu A$	$V_{DD}=15V$	11.0			V
LOW-level output current	I_{OL}	$V_O=0.4V$, $V_I=0$ or $5V$	$V_{DD}=5V$	0.36			mA
		$V_O=0.5V$, $V_I=0$ or $10V$	$V_{DD}=10V$	0.9			mA
		$V_O=1.5V$, $V_I=0$ or $15V$	$V_{DD}=15V$	2.4			mA
HIGH-level output current	$-I_{OH}$	$V_O=4.6V$, $V_I=0$ or $5V$	$V_{DD}=5V$	0.36			mA
		$V_O=9.5V$, $V_I=0$ or $10V$	$V_{DD}=10V$	0.9			mA
		$V_O=13.5V$, $V_I=0$ or $15V$	$V_{DD}=15V$	2.4			mA

Electrical characteristics(Continued)

3、 Unless otherwise specified, $T_A=85^{\circ}\text{C}$, $V_{SS}=0\text{V}$.

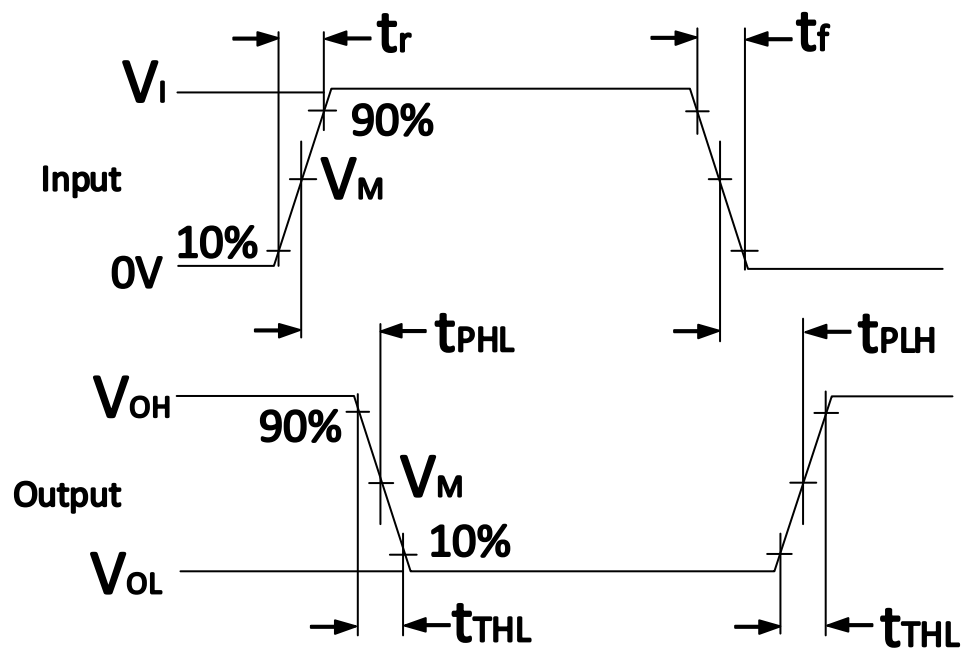
Parameter	Sym.	Conditions		Min.	Typ.	Max.	Unit
HIGH-level output current	$-I_{OH}$	$V_O=2.5\text{V}$, $V_I=0$ or 5V	$V_{DD}=5\text{V}$	1.1			mA
Input current	$\pm I_{IN}$	$V_{IN}=0$ or 15V	$V_{DD}=15\text{V}$			1.0	μA

● AC electrical characteristics

Unless otherwise specified, $T_A=25^{\circ}\text{C}$, $V_{SS}=0\text{V}$. $CL=50\text{pF}$. Input $t_r=t_f \leq 20\text{ns}$.

Parameter	Sym.	Cond.	Min.	Typ.	Max.	Unit	Typical formula
Propagation delay	t _{PHL}	V _{DD} =5V		55	110	ns	28ns+(0.55ns/pF)CL
		V _{DD} =10V		25	45	ns	14ns+(0.23ns/pF)CL
		V _{DD} =15V		20	35	ns	12ns+(0.16ns/pF)CL
	t _{PLH}	V _{DD} =5V		55	110	ns	28ns+(0.55ns/pF)CL
		V _{DD} =10V		25	45	ns	14ns+(0.23ns/pF)CL
		V _{DD} =15V		20	35	ns	12ns+(0.16ns/pF)CL
Output ramp delay	t _{THL}	V _{DD} =5V		60	120	ns	10ns+(1.0ns/pF)CL
		V _{DD} =10V		30	60	ns	9ns+(0.2ns/pF)CL
		V _{DD} =15V		20	40	ns	6ns+(0.28ns/pF)CL
	t _{TLH}	V _{DD} =5V		60	120	ns	10ns+(1.0ns/pF)CL
		V _{DD} =10V		30	60	ns	9ns+(0.42ns/pF)CL
		V _{DD} =15V		20	40	ns	6ns+(0.28ns/pF)CL
Dynamic power dissipation	p	V _{DD} =5V	1300 fi+ ∑ (foCL)xV _{DD} ²			uW	fi:Input frequency,fo:Output frequency,CL:Load Capacitance, ∑ (foCL):Output sum,V _{DD} :Supply Voltage
		V _{DD} =10V	6000 fi+ ∑ (foCL)xV _{DD} ²				
		V _{DD} =15V	20100 fi+ ∑ (foCL)xV _{DD} ²				

Waveforms

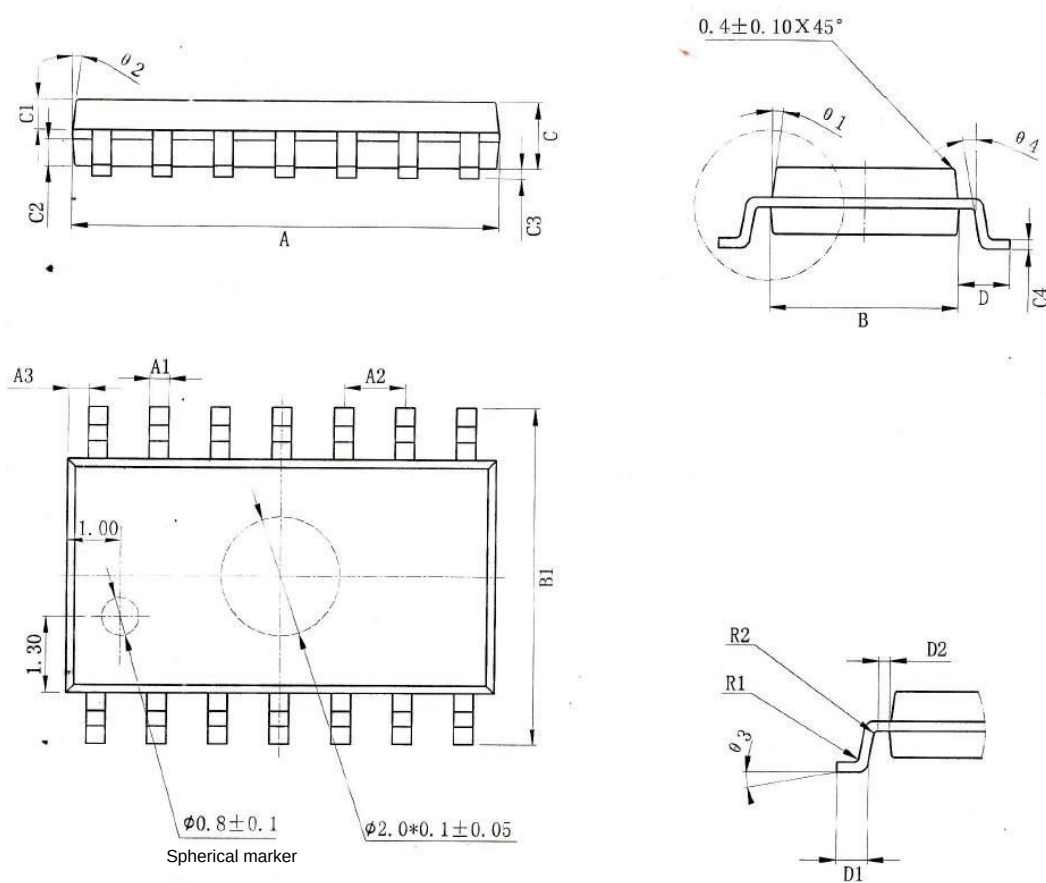


Illustrate:

1. $V_M = 1/2 V_{DD}$
2. V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

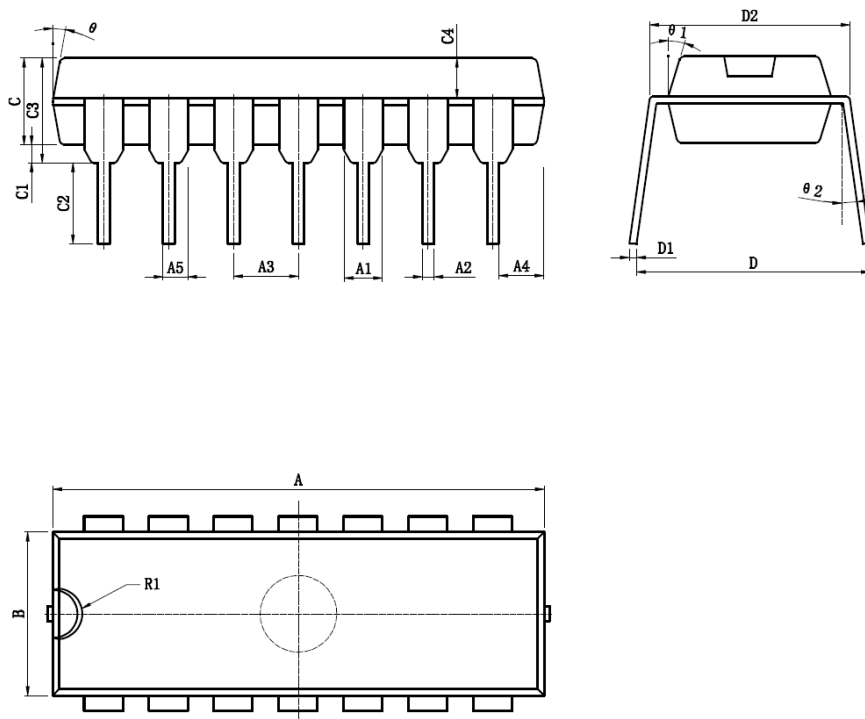
Package outline

1、SOP14



Symbol	Dimensions (mm)		Symbol	Dimensions (mm)	
	Min.	Max.		Min.	Max.
A	8.55	8.75	C4	0.203	0.233
A1	0.356	0.456	D	0.95	1.15
A2	1.27TYP		D1	0.40	0.70
A3	0.302TYP		D2	0.20TYP	
B	3.80	4.00	R1	0.20TYP	
B1	5.80	6.20	R2	0.20TYP	
C	1.40	1.60	θ1	8°~12°TYP	
C1	0.60	0.70	θ2	8°~12°TYP	
C2	0.52	0.62	θ3	0°~8°	
C3	0.05	0.25	θ4	4°~12°	

2、DIP14 Package



Symbol	Dimensions (mm)		Symbol	Dimensions (mm)	
	Min.	Max.		Min.	Max.
A	19.00	19.20	C3	3.85	4.45
A1	1.524TYP		C4	1.40	4.50
A2	0.41	0.51	D	8.20	8.80
A3	2.54TYP		D1	0.20	0.35
A4	1.70TYP		D2	7.74	8.00
A5	0.99TYP		θ	10°TYP	
B	6.30	6.50	θ1	17°TYP	
C	3.00	3.20	θ2	6°TYP	
C1	0.51TYP		R1	1.27TYP	
C2	3.00	3.60			