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

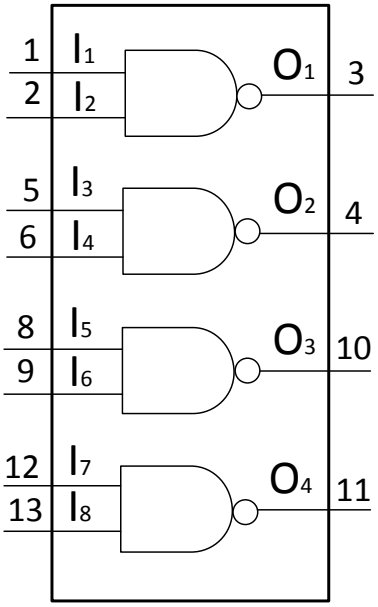


Fig.1 Functional diagram of CD4011

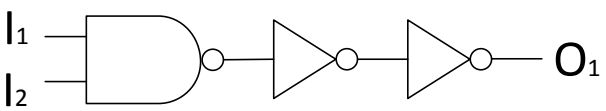
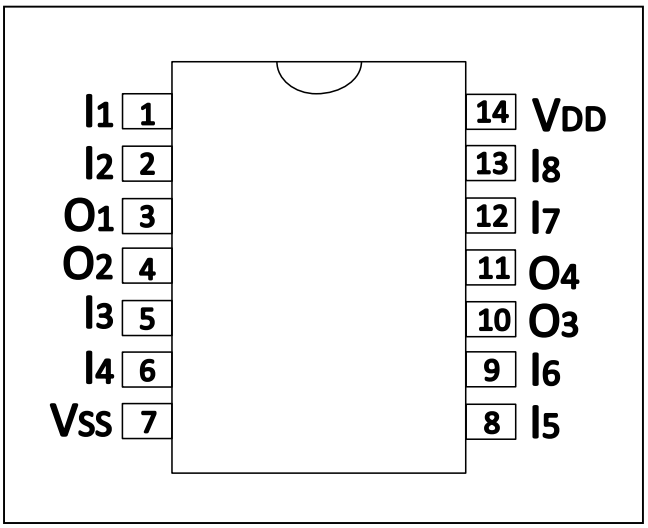


Fig.2 Single-channel schematic diagram of CD4011

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°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		±I	-10	+10	mA
Power dissipation	DIP，T_A=−40~+70° C	P_D	750		mW
	SOP，T_A=−40~+70° C		500		mW
Output power dissipation		P	100		mW
Ambient temperature		T_A	-40	+85	°C
Storage temperature		Tstg	-65	+150	°C
Soldering temperature （10 seconds）	DIP	T_L	245		°C
	SOP		250		°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°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			1.0	uA
			V_{DD}=10V			2.0	uA
			V_{DD}=15V			4.0	uA
LOW-level output voltage	V_{OL}	V_I=V_{SS} or V_{DD}, | I_O | ＜1uA	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 | ＜1uA	V_{DD}=5V	4.95	-		V
			V_{DD}=10V	9.95			V
			V_{DD}=15V	14.95			V
LOW-level intput voltage	V_{IL}	V_O=0.5V or 4.5V, | I_O | ＜1uA	V_{DD}=5V	-	-	1.5	V
		V_O=1.0V or 9.0V, | I_O | ＜1uA	V_{DD}=10V			3.0	V
		V_O=1.5V or 13.5V, | I_O | ＜1uA	V_{DD}=15V			4.0	V
HIGH-level intput voltage	V_{IH}	V_O=0.5V or 4.5V, | I_O | ＜1uA	V_{DD}=5V	3.5			V
		V_O=1.0V or 9.0V, | I_O | ＜1uA	V_{DD}=10V	7.0			V
		V_O=1.5V or 13.5V, | I_O | ＜1uA	V_{DD}=15V	11.0			V

Electrical characteristics(Continued)

1、Unless otherwise specified,T_A=25°C,V_{SS}=0V.

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

2、Unless otherwise specified,T_A=40°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			1.0	uA
			V_{DD}=10V			2.0	uA
			V_{DD}=15V			4.0	uA
LOW-level output voltage	V_{OL}	V_I=V_{SS} or V_{DD}， $\lvert I_O \rvert$＜1uA	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}， $\lvert I_O \rvert$＜1uA	V_{DD}=5V	4.95	-		V
			V_{DD}=10V	9.95			V
			V_{DD}=15V	14.95			V
LOW-level intput voltage	V_{IL}	V_O=0.5V or 4.5V， $\lvert I_O \rvert$＜1uA	V_{DD}=5V	-	-	1.5	V
		V_O=1.0V or 9.0V， $\lvert I_O \rvert$＜1uA	V_{DD}=10V			3.0	V
		V_O=1.5V or 13.5V， $\lvert I_O \rvert$＜1uA	V_{DD}=15V			4.0	V
HIGH-level intput voltage	V_{IH}	V_O=0.5V or 4.5V， $\lvert I_O \rvert$＜1uA	V_{DD}=5V	3.5			V
		V_O=1.0V or 9.0V， $\lvert I_O \rvert$＜1uA	V_{DD}=10V	7.0			V
		V_O=1.5V or 13.5V， $\lvert I_O \rvert$＜1uA	V_{DD}=15V	11.0			V
LOW-level output current	I_{OL}	V_O=0.4V， V_I=0 or 5V	V_{DD}=5V	0.52			mA
		V_O=0.5V， V_I=0 or 10V	V_{DD}=10V	1.3			mA
		V_O=1.5V， V_I=0 or 15V	V_{DD}=15V	3.6			mA

Electrical characteristics(Continued)

2、Unless otherwise specified,T_A=40°,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°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}, $\lvert I_O \rvert$<1uA	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}, $\lvert I_O \rvert$< 1uA	V_{DD}=5V	4.95	-		V
			V_{DD}=10V	9.95			V
			V_{DD}=15V	14.95			V
LOW-level intput voltage	V_{IL}	V_O=0.5V or 4.5V, $\lvert I_O \rvert$<1uA	V_{DD}=5V	-	-	1.5	V
		V_O=1.0V or 9.0V, $\lvert I_O \rvert$<1uA	V_{DD}=10V			3.0	V
		V_O=1.5V or 13.5V, $\lvert I_O \rvert$<1uA	V_{DD}=15V			4.0	V
HIGH-level intput voltage	V_{IH}	V_O=0.5V or 4.5V, $\lvert I_O \rvert$<1uA	V_{DD}=5V	3.5			V
		V_O=1.0V or 9.0V, $\lvert I_O \rvert$<1uA	V_{DD}=10V	7.0			V
		V_O=1.5V or 13.5V, $\lvert I_O \rvert$<1uA	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° C,V_{SS}=0V.

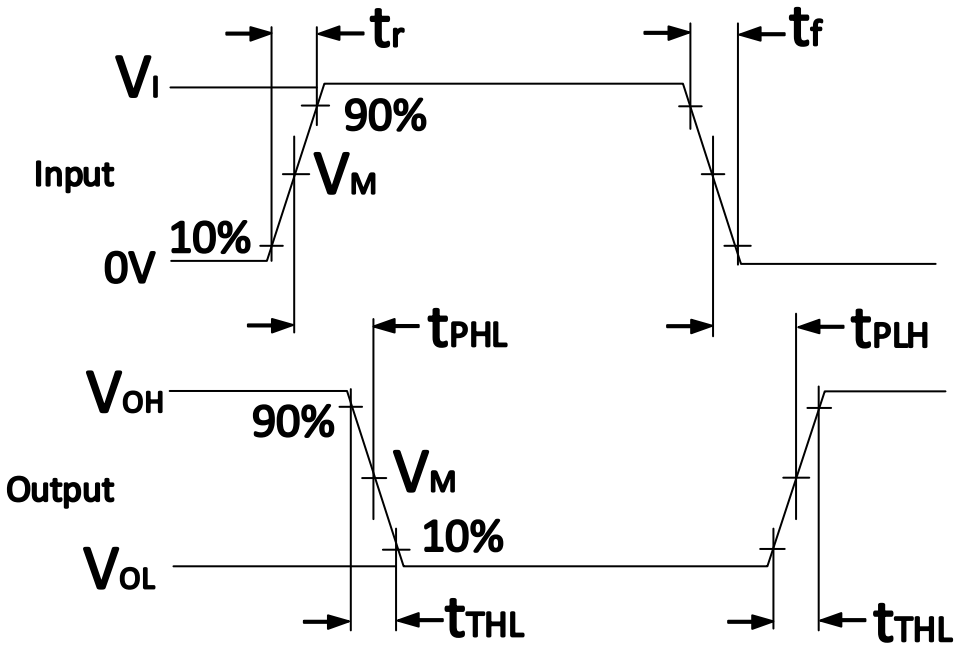
Parameter	Sym.	Conditions		Min.	Typ.	Max.	Unit
HIGH-level output current	$-I_{OH}$	V_O=2.5V， V_I=0 or 5V	V_{DD}=5V	1.1			mA
Input current	$\pm I_{IN}$	V_{IN}=0 or 15V	V_{DD}=15V			1.0	uA

- **AC electrical characteristics**

Unless otherwise specified,T_A=25°C,V_{SS}=0V. CL=50pF.Input tr=tf≤20ns.

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+$\sum$(foCL)xV_{DD}^2			uW	fi:Input frequency,fo:Output frequency,CL:Load Capacitance,$\sum$(foCL):Output sum,V_{DD}:Supply Voltage
		V_{DD}=10V	6000 fi+$\sum$(foCL)xV_{DD}^2				
		V_{DD}=15V	20100 fi+$\sum$(foCL)xV_{DD}^2				

Waveforms



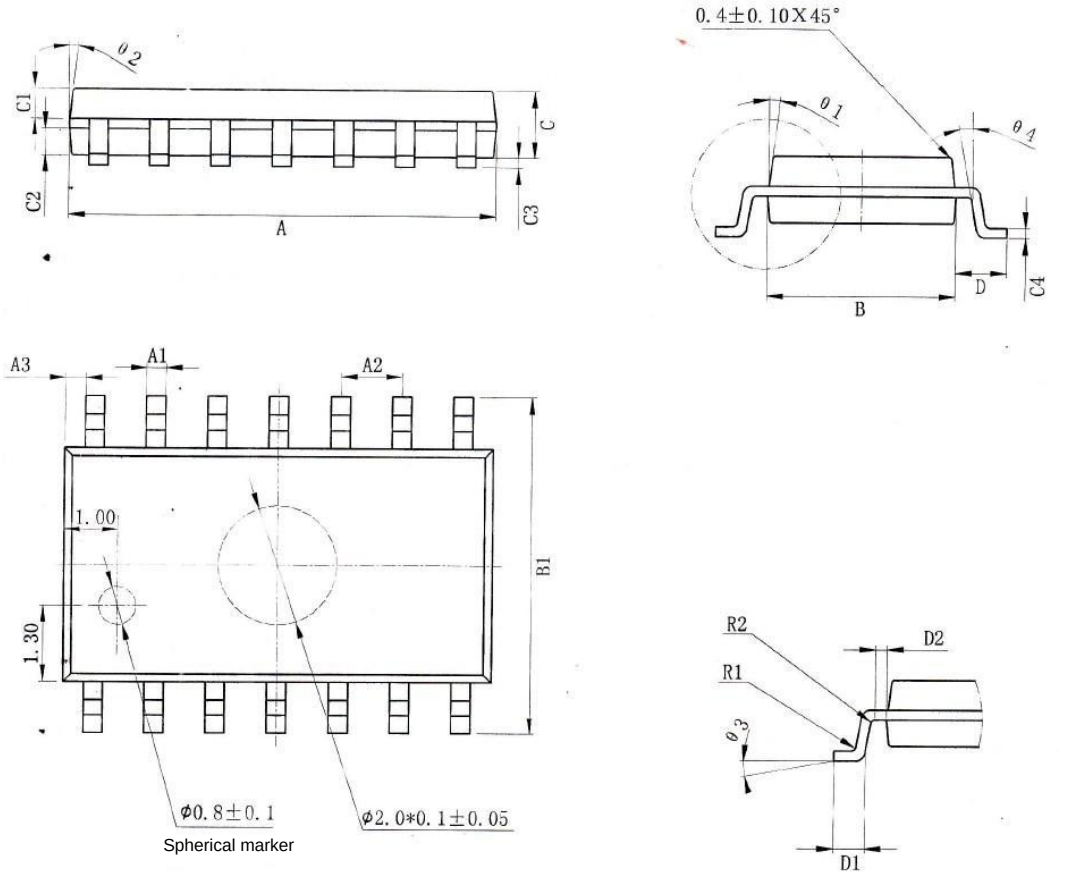
Illustrate：

1.V_M=1/2 V_{DD}

2.V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

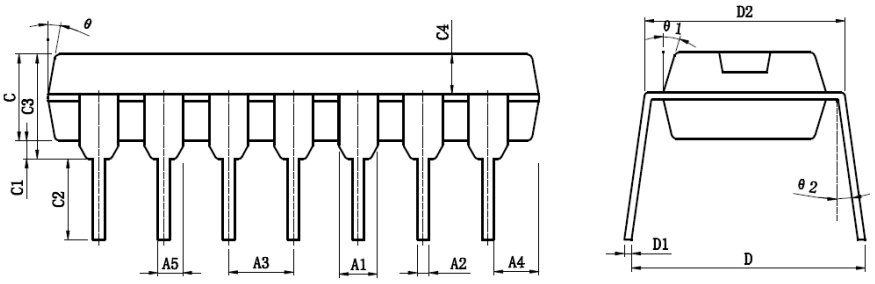
Package outline

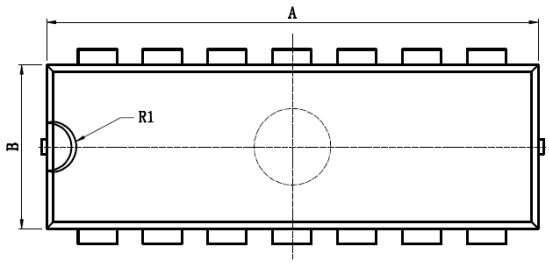
1、SOP14



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			