

CD4011A, CD4012A, CD4023A Types

CMOS NAND Gates

Quad 2 Input – CD4011A
Dual 4 Input – CD4012A
Triple 3 Input – CD4023A

The RCA-CD4011A, CD4012A, and CD4023A NAND gates provide the system designer with direct implementation of the NAND function and supplement the existing family of CMOS gates.

These types are supplied in 14-lead hermetic dual-in-line ceramic packages (D and F suffixes), 14-lead dual-in-line plastic packages (E suffix), 14-lead ceramic flat packages (K suffix), and in chip form (H suffix).

Features:

- Quiescent current specified to 15 V
- Maximum input leakage of 1 μ A at 15 V (full package-temperature range)
- 1-V noise margin (full package-temperature range)

RECOMMENDED OPERATING CONDITIONS

For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

Characteristic	Min.	Max.	Units
Supply Voltage Range (over full package temperature range)	3	12	V

MAXIMUM RATINGS, Absolute-Maximum Values:

- STORAGE-TEMPERATURE RANGE (T_{stg}) -65 to +150°C
- OPERATING-TEMPERATURE RANGE (T_A):
- PACKAGE TYPES D, F, K, H -55 to +125°C
- PACKAGE TYPE E -40 to +85°C
- DC SUPPLY-VOLTAGE RANGE, (V_{DD})
- (Voltages referenced to V_{SS} Terminal): -0.5 to +15 V
- POWER DISSIPATION PER PACKAGE (P_D):
- FOR $T_A = -40$ to +60°C (PACKAGE TYPE E) 500 mW
- FOR $T_A = +60$ to +85°C (PACKAGE TYPE E) Derate Linearly at 12 mW/°C to 200 mW
- FOR $T_A = -55$ to +100°C (PACKAGE TYPES D, F, K) 500 mW
- FOR $T_A = +100$ to +125°C (PACKAGE TYPES D, F, K) Derate Linearly at 12 mW/°C to 200 mW
- DEVICE DISSIPATION PER OUTPUT TRANSISTOR
- FOR $T_A =$ FULL PACKAGE-TEMPERATURE RANGE (ALL PACKAGE TYPES) 100 mW
- INPUT VOLTAGE RANGE, ALL INPUTS -0.5 to $V_{DD} + 0.5$ V
- LEAD TEMPERATURE (DURING SOLDERING):
- At distance 1/16 \pm 1/32 inch (1.59 \pm 0.79 mm) from case for 10 s max +265°C

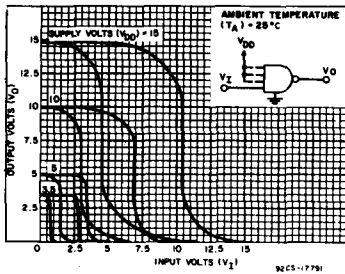


Fig. 2 - Minimum & maximum voltage transfer characteristics.

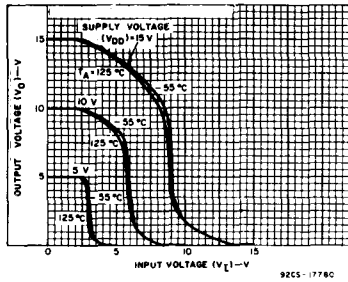


Fig. 3 - Typical voltage transfer characteristics as a function of temperature.

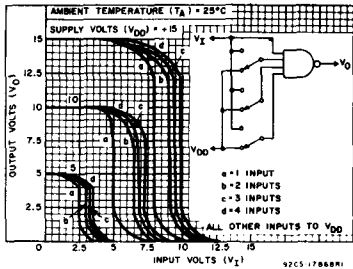


Fig. 4 - Typical multiple input switching transfer characteristics for CD4012A.

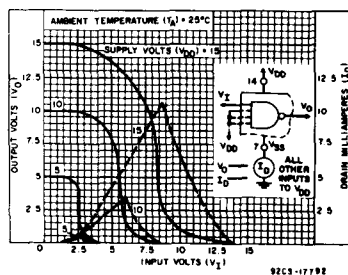
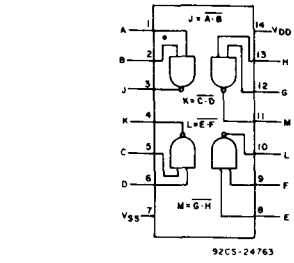
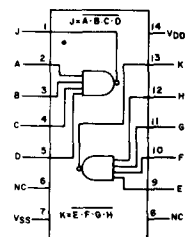


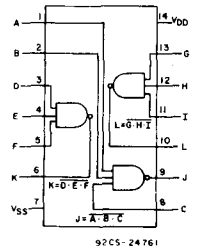
Fig. 5 - Typical current & voltage transfer characteristics.



CD4011A

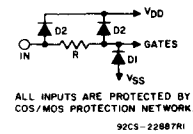


CD4012A



CD4023AH

Fig. 1 - Functional diagrams.



ALL INPUTS ARE PROTECTED BY COS/MOS PROTECTION NETWORK

CD4011A, CD4012A, CD4023A Types

STATIC ELECTRICAL CHARACTERISTICS

Characteristic	Conditions			Limits at Indicated Temperatures (°C)									Units
				D, F, K, H Packages						E Package			
				-55	+25		+125	-40	+25		+85		
V _O (V)	V _{IN} (V)	V _{DD} (V)	Typ.	Limit	Typ.	Limit	Typ.	Limit	Typ.	Limit			
Quiescent Device Current, I _Q Max.	-	-	5	0.05	0.001	0.05	3	0.5	0.005	0.5	15	μA	
	-	-	10	0.1	0.001	0.1	6	5	0.005	5	30		
	-	-	15	2	0.02	2	40	50	0.5	50	500		
Output Voltage: Low-Level V _{OL}	-	0.5	5	0 Typ.; 0.05 Max.									V
High Level, V _{OH}	-	0.10	10	0 Typ.; 0.05 Max.									
High Level, V _{OH}	-	0.5	5	4.95 Min.; 5 Typ.									
High Level, V _{OH}	-	0.10	10	9.95 Min.; 10 Typ.									
Noise Immunity: Inputs Low, V _{NL}	3.6	-	5	1.5 Min.; 2.25 Typ.									V
Inputs High, V _{NH}	7.2	-	10	3 Min.; 4.5 Typ.									
Noise Margin: Inputs Low, V _{NML}	1.4	-	5	1.5 Min.; 2.25 Typ.;									
Inputs High, V _{NMH}	2.8	-	10	3 Min.; 4.5 Typ.									
Noise Margin: Inputs Low, V _{NML}	4.5	-	5	1 Min.									V
Inputs High, V _{NMH}	9	-	10	1 Min.									
Output Drive Current: N-Channel (Sink) I _{DN} Min.	0.5	-	5	1 Min.									
CD4011A	0.5	-	5	0.31	0.5	0.25	0.175	0.145	0.5	0.12	0.095	mA	
CD4023A	0.5	-	10	0.62	0.6	0.5	0.35	0.3	0.6	0.25	0.2		
CD4012A	0.5	-	5	0.15	0.25	0.12	0.085	0.072	0.25	0.06	0.05		
CD4012A	0.5	-	10	0.31	0.6	0.25	0.175	0.155	0.6	0.13	0.105		
P-Channel (Source), I _{DP} Min.	4.5	-	5	-0.31	-0.5	-0.25	-0.175	-0.145	-0.5	-0.12	-0.095	mA	
All Types	9.5	-	10	-0.75	-1.2	-0.6	-0.4	-0.35	-1.2	-0.3	-0.24		
Input Leakage Current, I _{IL} , I _{IH}	Any Input		15	±10 ⁻⁵ Typ.; ±1 Max.									μA

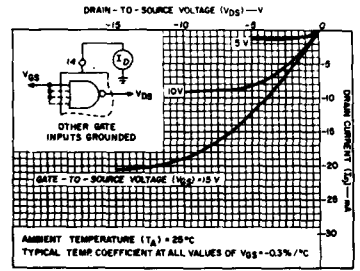


Fig. 7 - Typical p-channel drain characteristics.

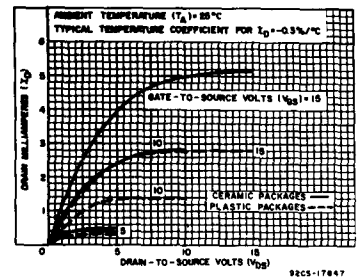


Fig. 8 - Minimum n-channel drain characteristics - CD4011A & CD4023A.

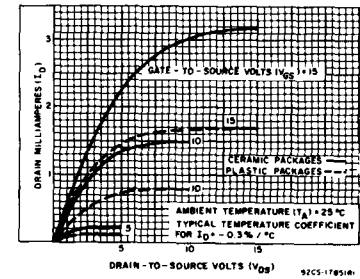


Fig. 9 - Minimum n-channel drain characteristics.

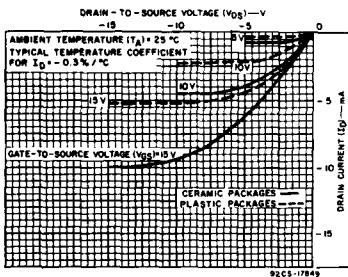


Fig. 10 - Minimum p-channel drain characteristics.

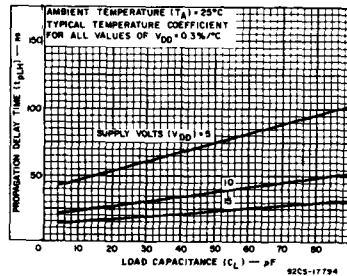


Fig. 11 - Typical low-to-high level propagation delay time vs. C_L.

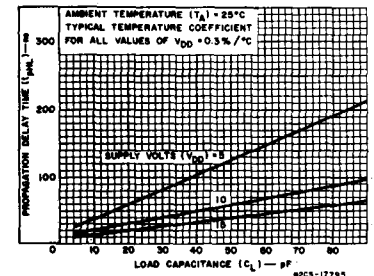


Fig. 12 - Typical high-to-low level propagation delay time vs. C_L - CD4011A, & CD4023A.

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DYNAMIC ELECTRICAL CHARACTERISTICS at $T_A = 25^\circ\text{C}$, $C_L = 15\text{ pF}$, Input $t_r, t_f = 20\text{ ns}$, $R_L = 200\text{ k}\Omega$

CHARACTERISTICS	TEST CONDITIONS	LIMITS				UNITS	
		VDD (V)	D, F, K, H Packages		E Package		
			Typ.	Max.	Typ.		Max.
Propagation Delay Time: Low-to-High Level, t_{PLH}		5	50	75	50	100	ns
		10	25	40	25	50	
High-to-Low Level, t_{PHL} CD4011A and CD4023A		5	50	75	50	100	ns
		10	25	40	25	50	
CD4012A		5	100	150	100	200	ns
		10	50	75	50	100	
Transition Time: Low-to-High Level, t_{TLH}		5	75	100	75	125	ns
		10	40	60	40	75	
High-to-Low Level, t_{THL} CD4011A and CD4023A		5	75	125	75	150	ns
		10	50	75	50	100	
CD4012A		5	250	375	250	500	ns
		10	125	200	125	250	
Input Capacitance, C_i	Any Input	5	-	5	-	pF	

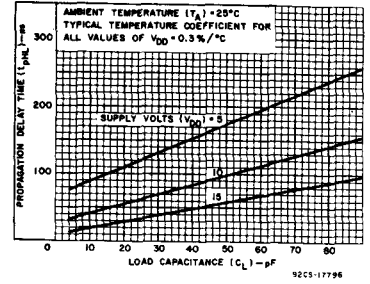


Fig. 13 - Typical high-to-low level propagation delay time vs. C_L - CD4012A.

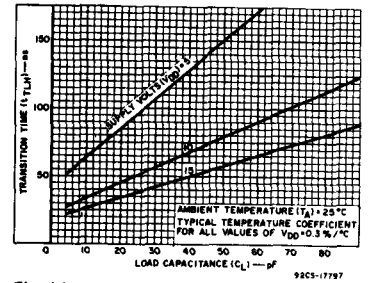


Fig. 14 - Typical low-to-high transition time vs. C_L .

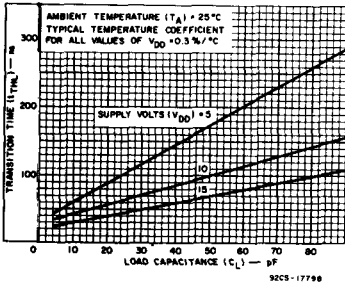


Fig. 15 - Typical high-to-low level transition time vs. C_L - CD4011A & CD4023A.

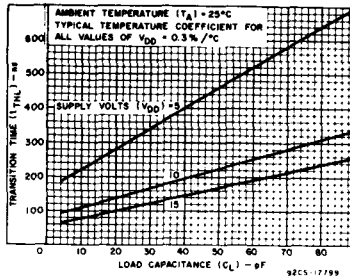


Fig. 16 - Typical high-to-low level transition time vs. C_L - CD4012A.

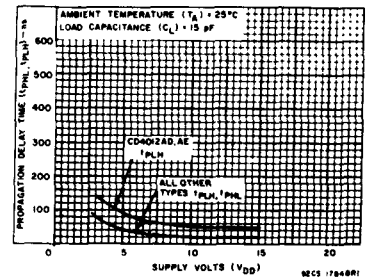


Fig. 17 - Minimum propagation delay time vs. V_{DD} .

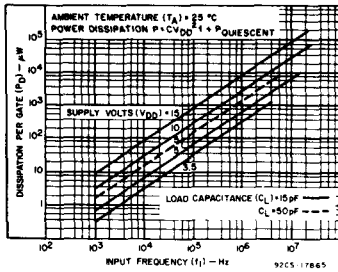


Fig. 18 - Typical dissipation characteristics.

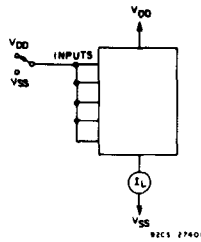


Fig. 19 - Quiescent device current test circuit.

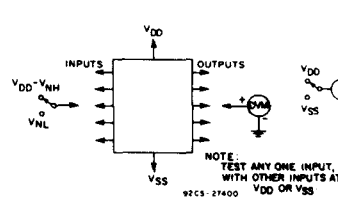


Fig. 20 - Noise immunity test circuit.

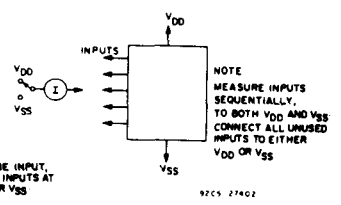


Fig. 21 - Input leakage current test circuit.