

# CD4011A, CD4012A, CD4023A Types

## CMOS NAND Gates

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

The TI-CD4011A, CD4012A, and CD-4023A 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  $\mu$ A
- Maximum input leakage of 1  $\mu$ A at 15 V (full package-temperature range)
- 1-V noise margin (full package-temperature range)

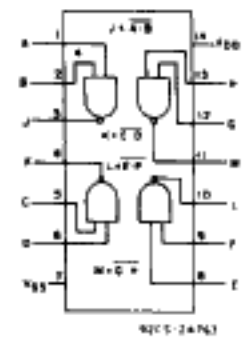
### RECOMMENDED OPERATING CONDITIONS

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

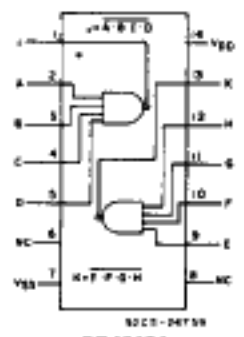
Characteristic	Min.	Max.	Units
Supply Voltage Range (over full package temperature range)	3	12	V

### MAXIMUM RATINGS, Absolute-Maximum Values:

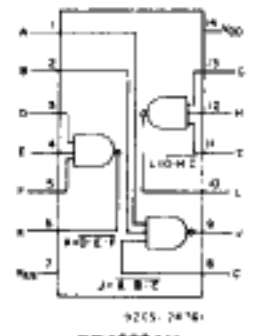
STORAGE-TEMPERATURE RANGE ( $T_{STG}$ )	-85 to +150°C
OPERATING-TEMPERATURE RANGE ( $T_A$ )	
PACKAGE TYPES D, F, K, H	-55 to +125°C
PACKAGE TYPE E	-40 to +85°C
DC SUPPLY-VOLTAGE RANGE, ( $V_{DD}$ )	
(Voltages referenced to $V_{SS}$ Terminal)	-0.5 to +15 V
POWER DISSIPATION PER PACKAGE ( $P_{D(1)}$ )	
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 ± 1/32 inch (1.59 ± 0.79 mm) from case for 10 s max	+265°C



CD4011A

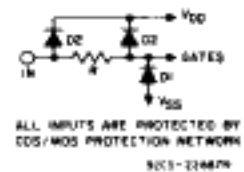


CD4012A



CD4023AH

Fig. 1 – Functional diagrams.



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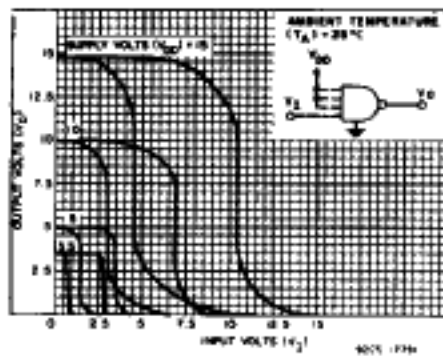


Fig. 2 – Minimum & maximum voltage transfer characteristics.

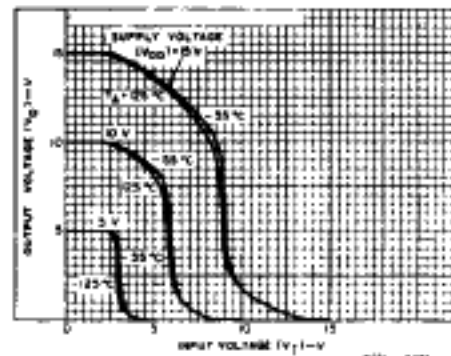


Fig. 3 – Typical voltage transfer characteristics as a function of temperature.

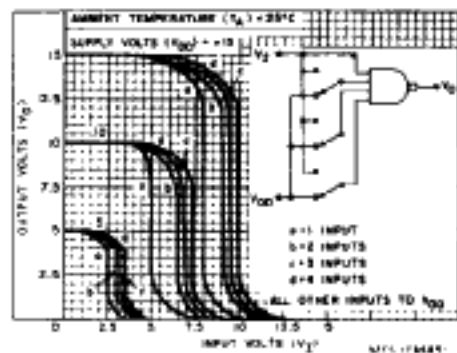


Fig. 4 – Typical multiple input switching transfer characteristics for CD4012A.

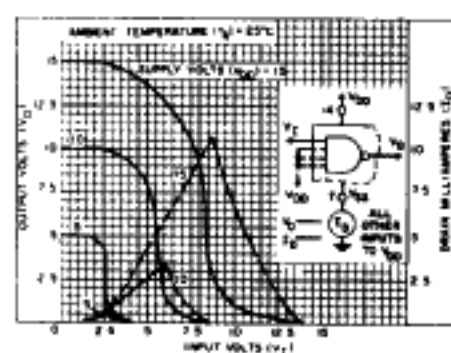


Fig. 5 – Typical current & voltage transfer characteristics.

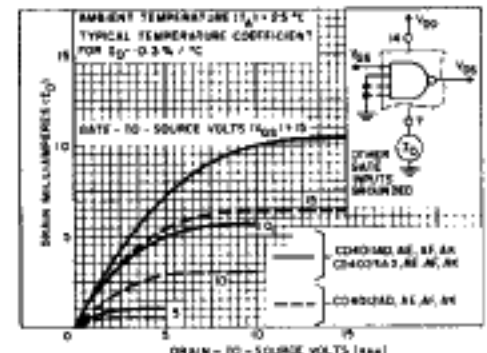


Fig. 6 – Typical n-channel drain characteristics.

# CD4011A, CD4012A, CD4023A Types

## STATIC ELECTRICAL CHARACTERISTICS

Characteristic	Conditions			Limits at Indicated Temperatures (°C)								Units
	V <sub>O</sub> (V)	V <sub>IN</sub> (V)	V <sub>DD</sub> (V)	D, F, K, H Packages				E Package				
				-55	+25		+125	-40	+25		+85	
				Typ.	Limit			Typ.	Limit			
Quiescent Device Current, I <sub>L</sub> 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 <sub>OL</sub>	-	0.5	5	0 Typ.; 0.05 Max.								V
	-	0.10	10	0 Typ.; 0.05 Max.								
High Level, V <sub>OH</sub>	-	0.5	5	4.95 Min.; 5 Typ.								V
	-	0.10	10	8.95 Min.; 10 Typ.								
Noise Immunity: Inputs Low, V <sub>NL</sub>	3.6	-	5	1.5 Min.; 2.25 Typ.								V
	7.2	-	10	3 Min.; 4.5 Typ.								
Inputs High, V <sub>NH</sub>	1.4	-	5	1.5 Min.; 2.25 Typ.								V
	2.8	-	10	3 Min.; 4.5 Typ.								
Noise Margin: Inputs Low, V <sub>NML</sub>	4.5	-	5	1 Min.								V
	9	-	10	1 Min.								
Inputs High, V <sub>NMH</sub>	0.5	-	5	1 Min.								
	1	-	10	1 Min.								
Output Drive Current: N-Channel (Sink) I <sub>DN</sub> Min.												mA
CD4011A	0.5	-	5	0.31	0.5	0.25	0.175	0.145	0.5	0.12	0.095	
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	
	0.5	-	10	0.31	0.6	0.25	0.175	0.155	0.6	0.13	0.105	
P-Channel (Source), I <sub>DP</sub> Min. All Types	4.5	-	5	-0.31	-0.5	-0.25	-0.175	-0.145	-0.5	-0.12	-0.095	
	9.5	-	10	-0.75	-1.2	-0.6	-0.4	-0.36	-1.2	-0.3	-0.24	
Input Leakage Current, I <sub>IL</sub> , I <sub>IH</sub>	Any Input		15	±10 <sup>-5</sup> Typ.; ±1 Max.								μA

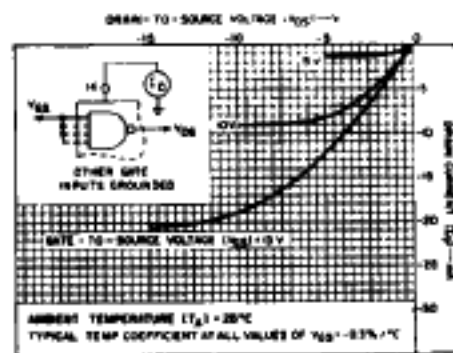


Fig. 7 - Typical p-channel drain characteristics.

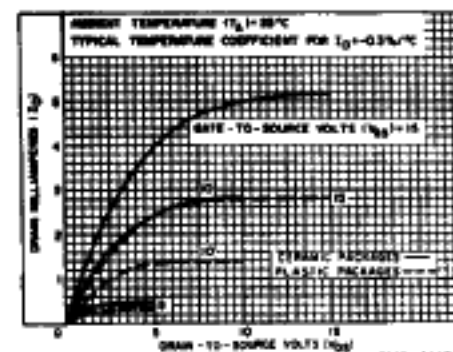


Fig. 8 - Minimum n-channel drain characteristics - CD4011A & CD4023A.

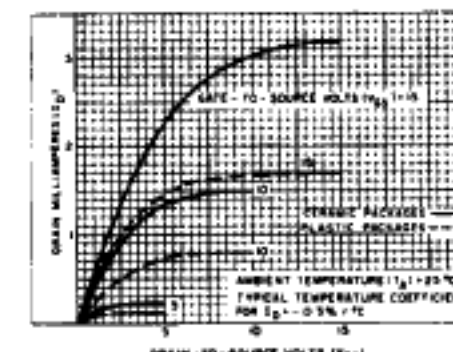


Fig. 9 - Minimum n-channel drain characteristics.

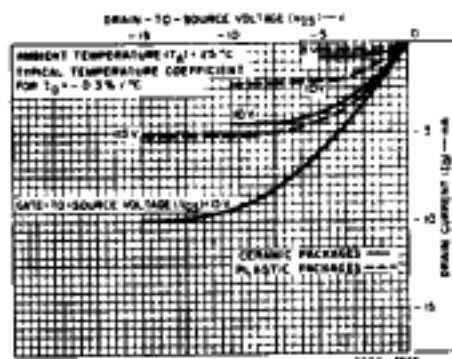


Fig. 10 - Minimum p-channel drain characteristics.

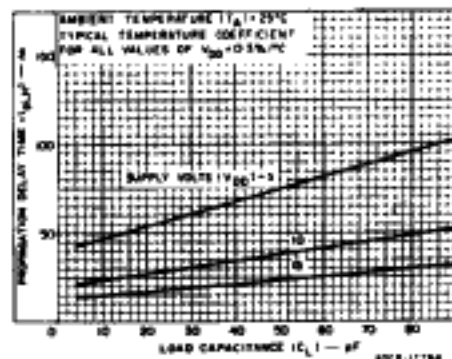


Fig. 11 - Typical low-to-high level propagation delay time vs. C<sub>L</sub>.

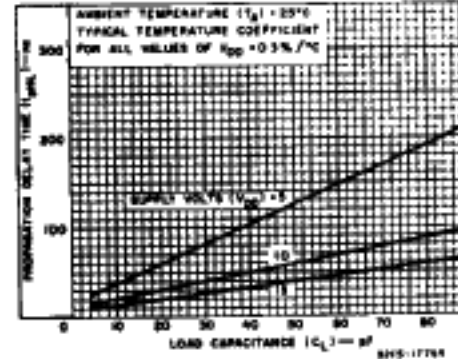


Fig. 12 - Typical high-to-low level propagation delay time vs. C<sub>L</sub> - CD4011A, & CD4023A.

# CD4011A, CD4012A, CD4023A Types

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	
		D, F, K, H Packages		E Package			
		V <sub>DD</sub> (V)	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

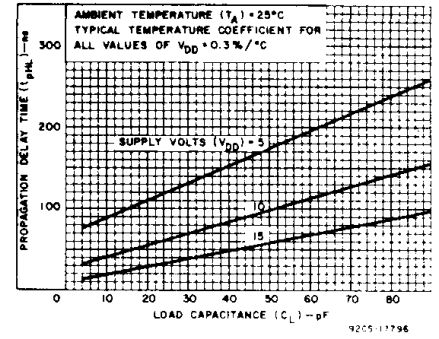


Fig. 13 — Typical high-to-low level propagation delay time vs.  $C_L$  — CD4012A.

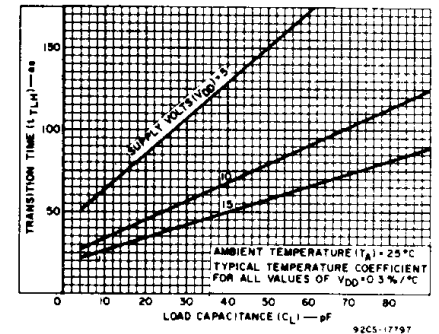


Fig. 14 — Typical low-to-high transition time vs.  $C_L$ .

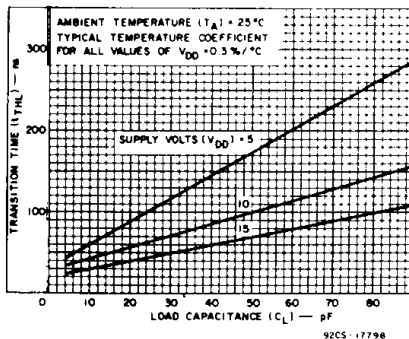


Fig. 15 — Typical high-to-low level transition time vs.  $C_L$  — CD4011A & CD4023A.

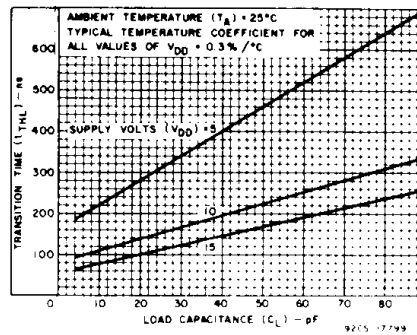


Fig. 16 — Typical high-to-low level transition time vs.  $C_L$  — CD4012A.

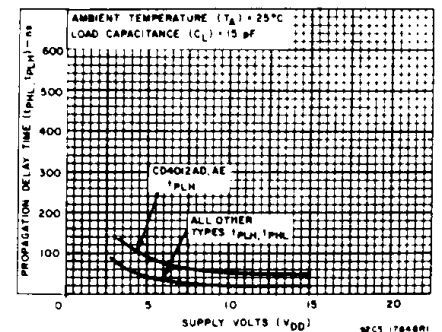


Fig. 17 — Minimum propagation delay time vs.  $V_{DD}$ .

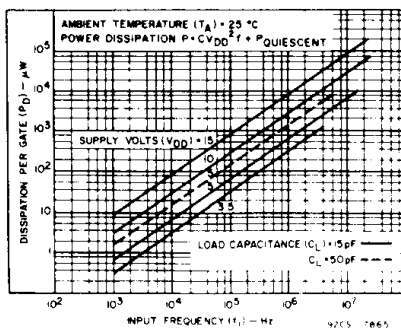


Fig. 18 — Typical dissipation characteristics.

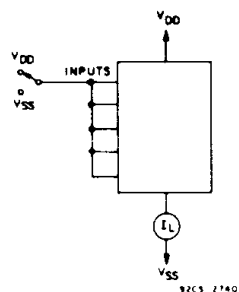


Fig. 19 — Quiescent device current test circuit.

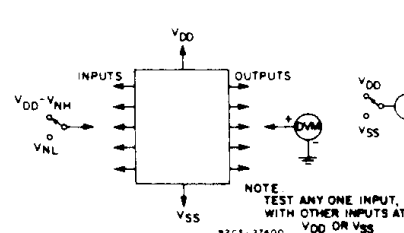


Fig. 20 — Noise immunity test circuit.

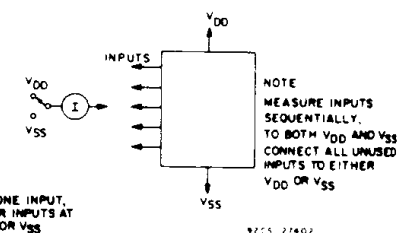


Fig. 21 — Input leakage current test circuit.

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### Mailing Address:

Texas Instruments  
Post Office Box 655303  
Dallas, Texas 75265