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 V
- Maximum input leakage of 1 μA at 15 V (full package-temperature range)
- 1-V noise margin (full package-temperature range)

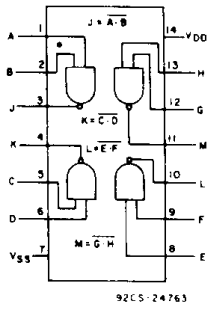
RECOMMENDED OPERATING CONDITIONS

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

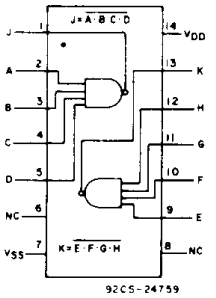
Characteristic	Min.	Max.	Units
Supply Voltage Range (over full package temperature range)	3	12	V

MAXIMUM RATINGS, *Absolute-Maximum Values:*

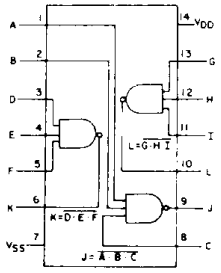
STORAGE-TEMPERATURE RANGE (T_{stg}) . . . . . −65 to +150°C
OPERATING-TEMPERATURE RANGE (T_A):
  PACKAGE TYPES D, F, K, H . . . . . −55 to +125°C
  PACKAGE TYPE E . . . . . −40 to +85°C
DC SUPPLY-VOLTAGE RANGE, (V_{DD})
  (Voltages referenced to V_{SS} Terminal) . . . . . −0.5 to +15 V
POWER DISSIPATION 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 ± 1/32 inch (1.59 ± 0.79 mm) from case for 10 s max . . . . . +265°C



CD4011A

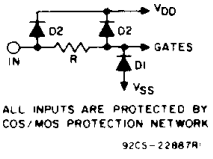


CD4012A



CD4023AH

Fig. 1 – Functional diagrams.



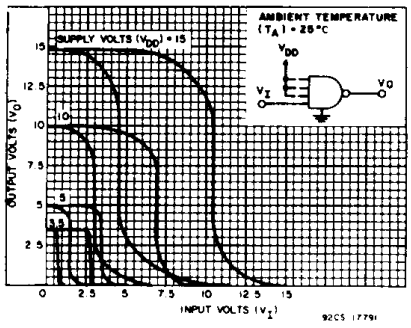


Fig. 2 – Minimum & maximum voltage transfer characteristics.

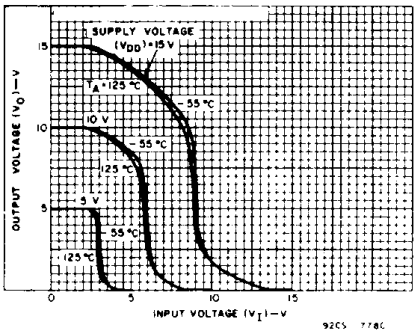


Fig. 3 – Typical voltage transfer characteristics as a function of temperature.

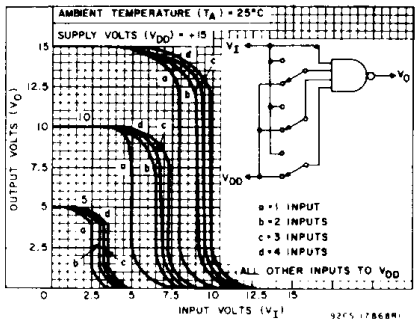


Fig. 4 – Typical multiple input switching transfer characteristics for CD4012A.

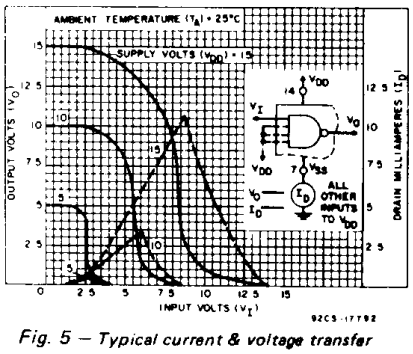


Fig. 5 – Typical current & voltage transfer characteristics.

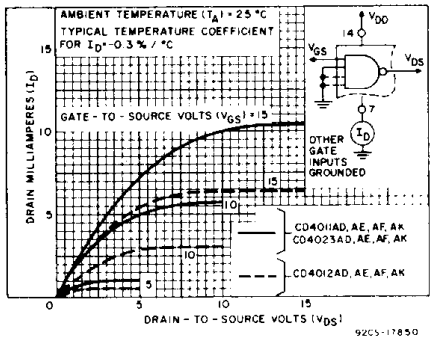


Fig. 6 – Typical n-channel drain characteristics.

STATIC ELECTRICAL CHARACTERISTICS

Characteristic	Conditions			Limits at Indicated Temperatures (°C)								Units
				D,F,K,H Packages				E Package				
	V_O (V)	V_{IN} (V)	V_{DD} (V)	−55	+25 Typ.	+25 Limit	+125	−40	+25 Typ.	+25 Limit	+85	
Quiescent Device Current, I_L 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
	–	0,10	10	0 Typ.; 0.05 Max.								
High Level, V_{OH}	–	0,5	5	4.95 Min.; 5 Typ.								
	–	0,10	10	9.95 Min.; 10 Typ.								
Noise Immunity: Inputs Low, V_{NL}	3.6	–	5	1.5 Min.; 2.25 Typ.								V
	7.2	–	10	3 Min.; 4.5 Typ.								
Inputs High, V_{NH}	1.4	–	5	1.5 Min.; 2.25 Typ.;								
	2.8	–	10	3 Min.; 4.5 Typ.								
Noise Margin: Inputs Low, V_{NML}	4.5	–	5	1 Min.								V
	9	–	10	1 Min.								
Inputs High, V_{NMH}	0.5	–	5	1 Min.								
	1	–	10	1 Min.								
Output Drive Current: N-Channel (Sink) I_DN 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	
	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. 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	-0.35	-1.2	-0.3	-0.24	
Input Leakage Current, I_{IL}, I_{IH}	Any Input		15	$\pm 10^{-5}$ Typ.; ±1 Max.								μA

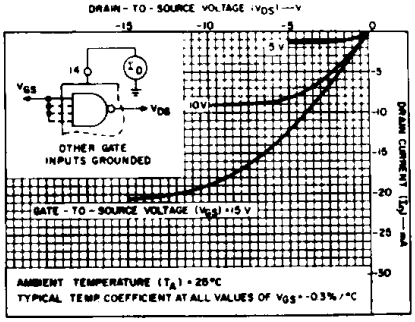


Fig. 7 — Typical p-channel drain characteristics.

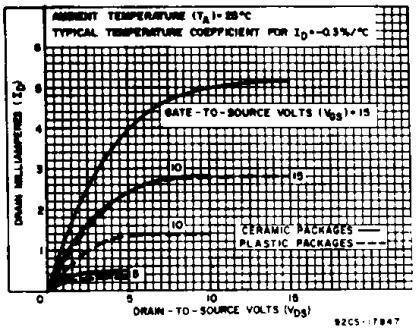


Fig. 8 — Minimum n-channel drain characteristics —CD4011A & CD4023A.

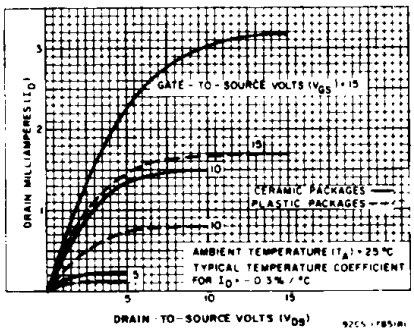


Fig. 9 — Minimum n-channel drain characteristics.

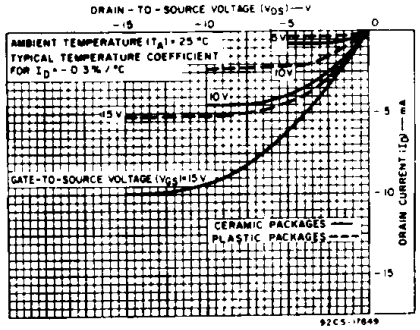


Fig. 10 — Minimum p-channel drain characteristics.

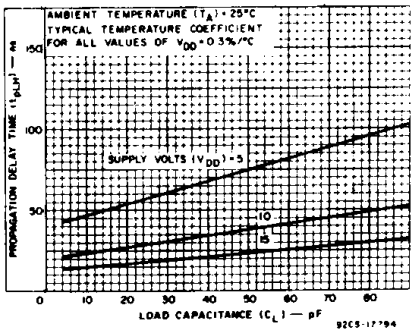


Fig. 11 — Typical low-to-high level propagation delay time vs. C_L.

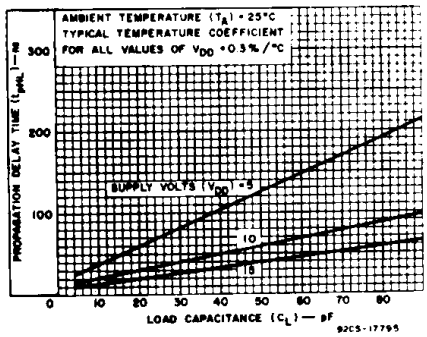


Fig. 12 — Typical high-to-low level propagation delay time vs. C_L — CD4011A, & CD4023A.

CD4011A, CD4012A, CD4023A Types

DYNAMIC ELECTRICAL CHARACTERISTICS at T_A = 25°C, C_L = 15 pF, Input t_r, t_f = 20 ns, R_L = 200 KΩ

CHARACTERISTICS	TEST CONDITIONS		LIMITS				UNITS
			D, F, K, H Packages		E Package		
		V_{DD} (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

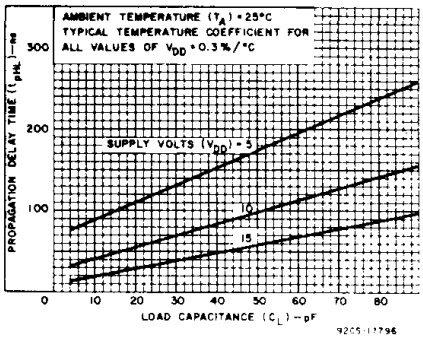


Fig. 13 – Typical high-to-low level propagation delay time vs. C_L – CD4012A.

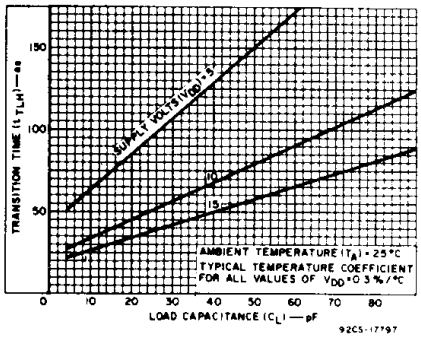


Fig. 14 – Typical low-to-high transition time vs. C_L.

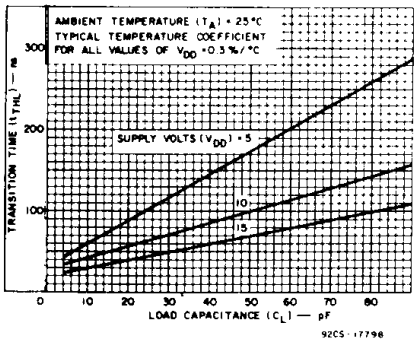


Fig. 15 – Typical high-to-low level transition time vs. C_L – CD4011A & CD4023A.

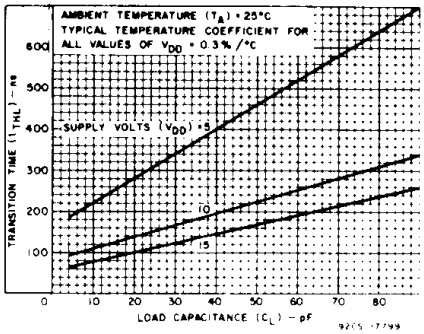


Fig. 16 – Typical high-to-low level transition time vs. C_L – CD4012A.

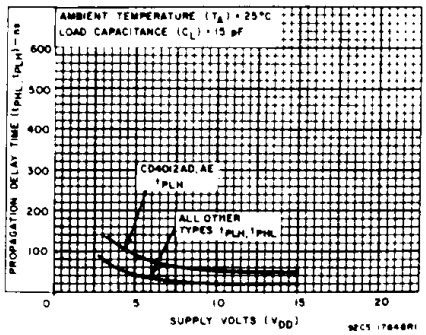


Fig. 17 – Minimum propagation delay time vs. V_{DD}.

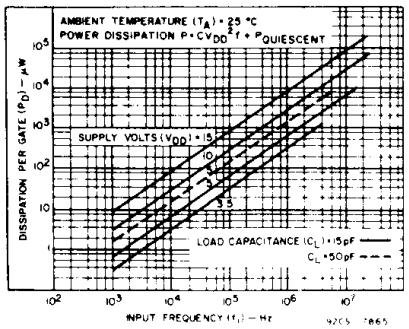


Fig. 18 – Typical dissipation characteristics.

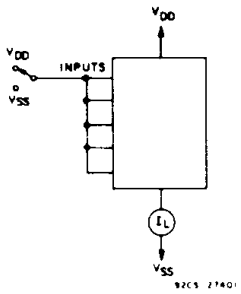


Fig. 19 – Quiescent device current test circuit.

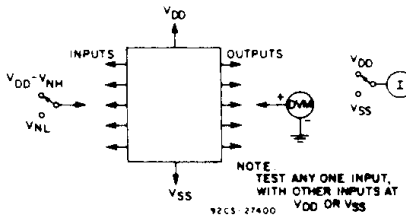


Fig. 20 – Noise immunity test circuit.

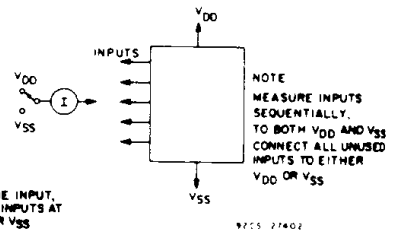


Fig. 21 – Input leakage current test circuit.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
CD4011AD3	ACTIVE	CDIP SB	JD	14	1	TBD	POST-PLATE	N / A for Pkg Type
CD4023AFB	OBSOLETE	CDIP	J	14		TBD	Call TI	Call TI
JM38510/05001BCA	ACTIVE	CDIP	J	14	1	TBD	A42	N / A for Pkg Type
JM38510/05003BCA	OBSOLETE	CDIP	J	14		TBD	Call TI	Call TI
M/05003BCA	OBSOLETE	CDIP	J	14		TBD	Call TI	Call TI

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

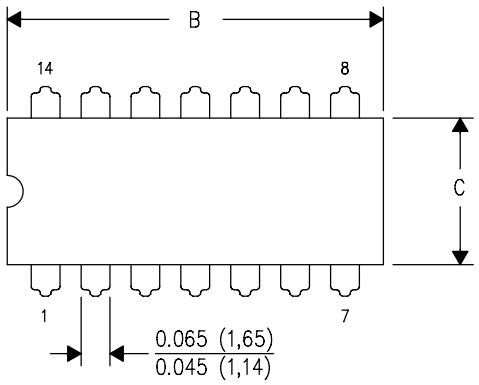
(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

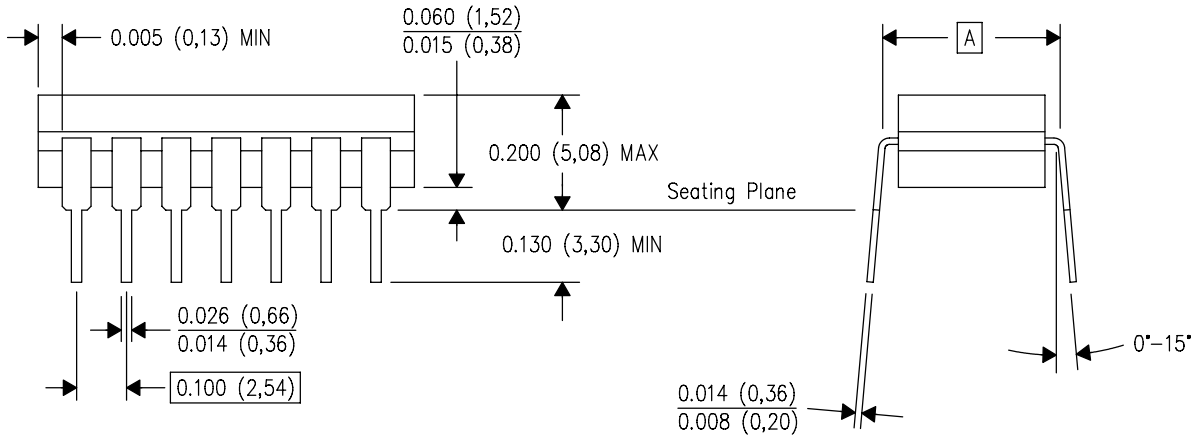
J (R–GDIP–T**)

14 LEADS SHOWN

CERAMIC DUAL IN–LINE PACKAGE



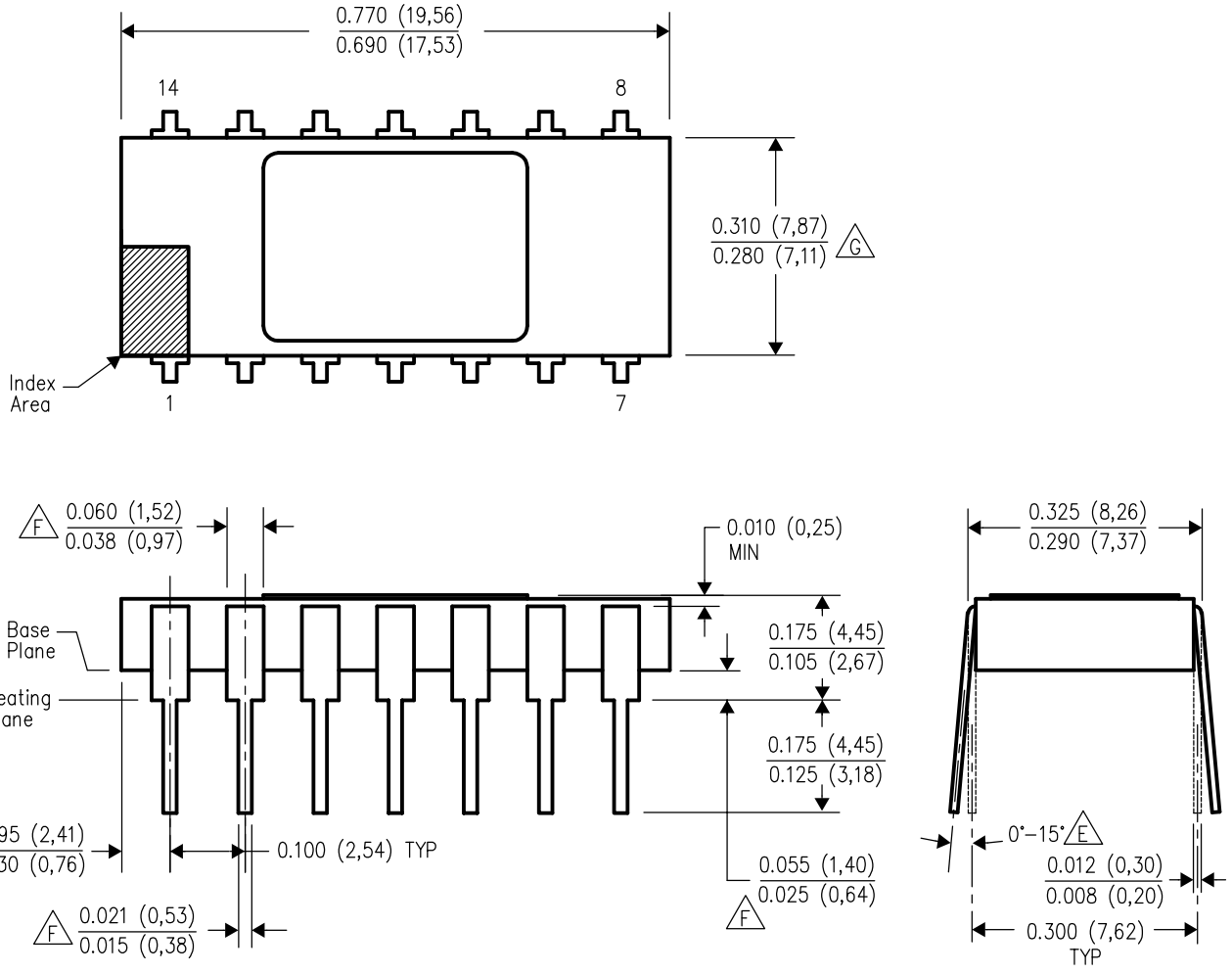
DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package is hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
E. Falls within MIL STD 1835 GDIP1–T14, GDIP1–T16, GDIP1–T18 and GDIP1–T20.

JD (R–CDIP–T14) CERAMIC SIDE–BRAZE DUAL–IN–LINE



NOTES:
- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. Controlling dimension: inch.
- D. Leads within 0.005 (0,13) radius of true position (TP) at gage plane with maximum material condition and unit installed.
- E Angle applies to spread leads prior to installation.
- F Outlines on which the seating plane is coincident with the plane (standoff = 0), terminals lead standoffs are not required, and lead shoulder may equal lead width along any part of the lead above the seating/base plane.
- G Body width does not include particles of packing materials.
- H. A visual index feature must be located within the cross–hatched area.

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