

CMOS Multifunction Expandable 8-Input Gate

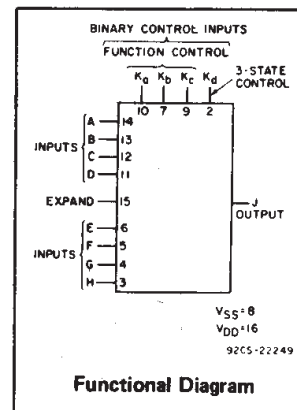
High-Voltage Types (20-Volt Rating)

■ CD4048B is an 8-input gate having four control inputs. Three binary control inputs – Ka, Kb, and Kc – provide the implementation of eight different logic functions. These functions are OR, NOR, AND, NAND, OR/AND, OR/NAND, AND/OR and AND/NOR.

A fourth control input, Kd, provides the user with a 3-state output. When control input Kd is high, the output is either a logic 1 or a logic 0 depending on the inner states. When control input Kd is low, the output is an open circuit. This feature enables the user to connect this device to a common bus line.

In addition to the eight input lines, an EXPAND input is provided that permits the user to increase the number of inputs into a CD4048B (see Fig. 2). For example, two CD4048Bs can be cascaded to provide a 16-input multifunction gate. When the EXPAND input is not used, it should be connected to V_{SS}.

The CD4048B-series types are supplied in 16-lead hermetic dual-in-line ceramic packages (F3A suffix), 16-lead dual-in-line plastic packages (E suffix), 16-lead small-outline packages (M, M96, MT, and NSR suffixes), and 16-lead thin shrink small-outline packages (PW and PWR suffixes).



MAXIMUM RATINGS, Absolute-Maximum Values:

DC SUPPLY-VOLTAGE RANGE, (V_{DD})

Voltages referenced to V_{SS} Terminal) -0.5V to +20V

INPUT VOLTAGE RANGE, ALL INPUTS -0.5V to V_{DD} +0.5V

DC INPUT CURRENT, ANY ONE INPUT ±10mA

POWER DISSIPATION PER PACKAGE (P_D):

For T_A = -55°C to +100°C 500mW

For T_A = +100°C to +125°C Derate Linearly at 12mW/°C to 200mW

DEVICE DISSIPATION PER OUTPUT TRANSISTOR

FOR T_A = FULL PACKAGE-TEMPERATURE RANGE (All Package Types) 100mW

OPERATING-TEMPERATURE RANGE (T_A) -55°C to +125°C

STORAGE TEMPERATURE RANGE (T_{stg}) -65°C to +150°C

LEAD TEMPERATURE (DURING SOLDERING):

At distance 1/16 ± 1/32 inch (1.59 ± 0.79mm) from case for 10s max +265°C

Features:

- Three-state output
- Many logic functions available in one package
- Standardized, symmetrical output characteristics
- 100% tested for quiescent current at 20 V
- Maximum input current of 1 μA at 18 V (full package-temperature range), 100 nA at 18 V and 25°C
- Noise margin (full package-temperature range) = 1 V at V_{DD}=5 V, 2 V at V_{DD}=10 V, 2.5 V at V_{DD}=15 V
- 5-V, 10-V, and 15-V parametric ratings
- Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"

Applications:

- Selection of up to 8 logic functions
- Digital control of logic
- General-purpose gating logic
 - Decoding
 - Encoding

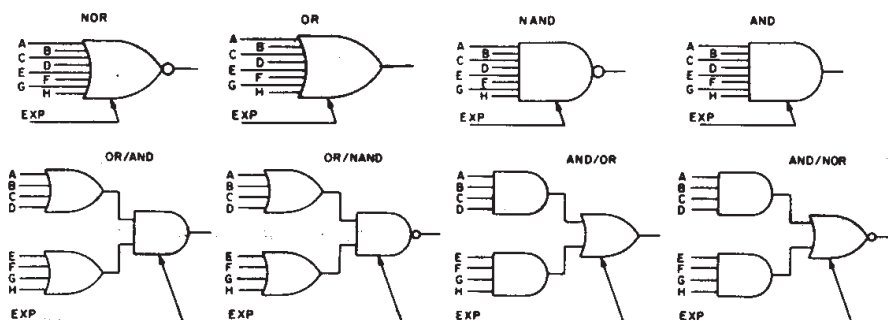
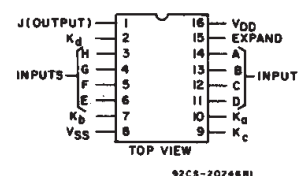


Fig. 1 – Basic logic configurations.

RECOMMENDED OPERATING CONDITIONS

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

CHARACTERISTIC	LIMITS		UNITS
	MIN.	MAX.	
Supply-Voltage Range (For T _A = Full Package Temperature Range)	3	18	V



CD4048B Types

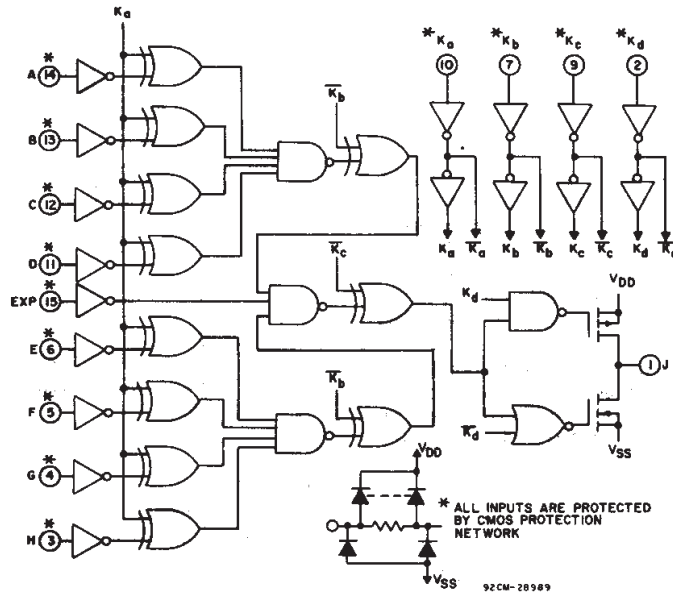


Fig. 2 - Logic diagram.

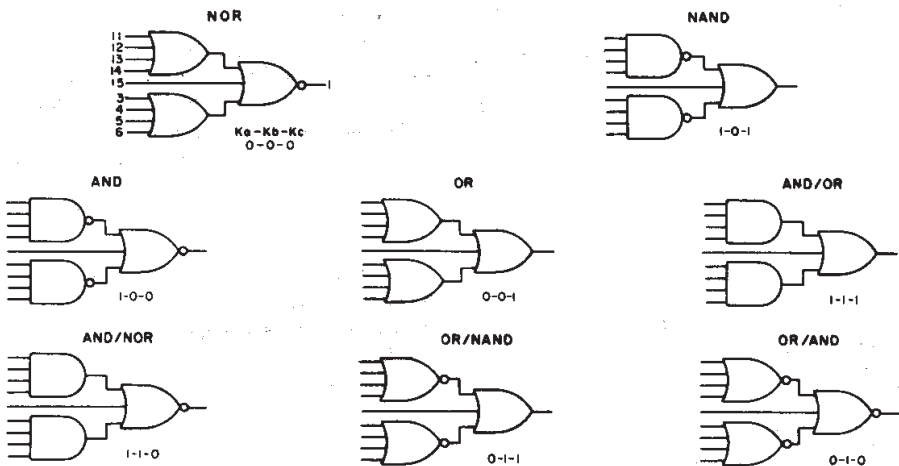


Fig. 3 - Actual-circuit logic configurations.

APPLICATIONS OF EXPAND INPUT

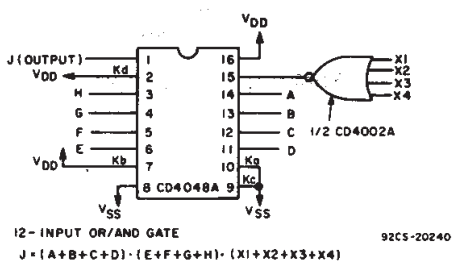


Fig. 4 - 12-input OR/AND gate.

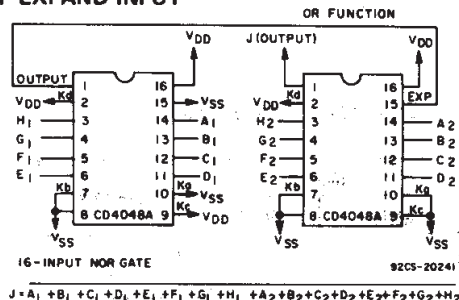


Fig. 5 - 16-input NOR gate.

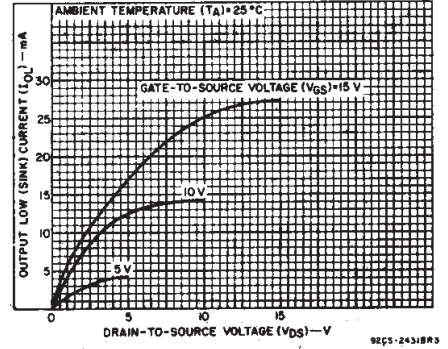


Fig. 6 - Typical output low (sink) current characteristics.

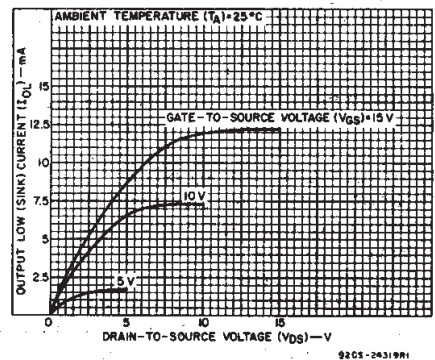


Fig. 7 - Minimum output low (sink) current characteristics.

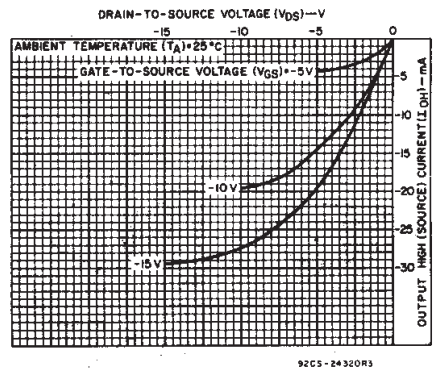


Fig. 8 - Typical output high (source) current characteristics.

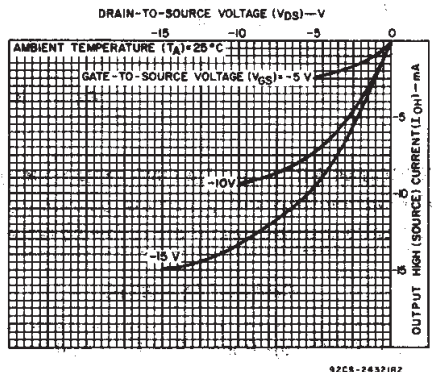


Fig. 9 - Minimum output high (source) current characteristics.

CD4048B Types

STATIC ELECTRICAL CHARACTERISTICS

CHARACTER- ISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
	V _O (V)	V _{IN} (V)	V _{DD} (V)					+25			
				-55	-40	+85	+125	Min.	Typ.	Max.	
Quiescent Device Current, I _{DD} Max.	—	0,5	5	0.25	0.25	7.5	7.5	—	0.01	0.25	μA
	—	0,10	10	0.5	0.5	15	15	—	0.01	0.5	
	—	0,15	15	1	1	30	30	—	0.01	1	
	—	0,20	20	5	5	150	150	—	0.02	5	
Output Low (Sink) Current I _{OL} Min.	0.4	0,5	5	0.64	0.61	0.42	0.36	0.51	1	—	mA
	0.5	0,10	10	1.6	1.5	1.1	0.9	1.3	2.6	—	
	1.5	0,15	15	4.2	4	2.8	2.4	3.4	6.8	—	
Output High (Source) Current, I _{OH} Min.	4.6	0,5	5	-0.64	-0.61	-0.42	-0.36	-0.51	-1	—	mA
	2.5	0,5	5	-2	-1.8	-1.3	-1.15	-1.6	-3.2	—	
	9.5	0,10	10	-1.6	-1.5	-1.1	-0.9	-1.3	-2.6	—	
	13.5	0,15	15	-4.2	-4	-2.8	-2.4	-3.4	-6.8	—	
Output Voltage: Low-Level, V _{OL} Max.	—	0,5	5	0.05				—	0	0.05	V
	—	0,10	10	0.05				—	0	0.05	
	—	0,15	15	0.05				—	0	0.05	
Output Voltage: High-Level, V _{OH} Min.	—	0,5	5	4.95				4.95	5	—	V
	—	0,10	10	9.95				9.95	10	—	
	—	0,15	15	14.95				14.95	15	—	
Input Low Voltage, V _{IL} Max.	0,5,4,5	—	5	1.5				—	—	1.5	V
	1,9	—	10	3				—	—	3	
	1,5,13,5	—	15	4				—	—	4	
Input High Voltage, V _{IH} Min.	0,5,4,5	—	5	3.5				3.5	—	—	V
	1,9	—	10	7				7	—	—	
	1,5,13,5	—	15	11				11	—	—	
Input Current I _{IN} Max.		0,18	18	±0.1	±0.1	±1	±1	—	±10 ⁻⁵	±0.1	μA
3-State Output Current, I _{OUT}	0,18	0,18	18	±0.4	±0.4	±12	±12	—	±10 ⁻⁴	±0.4	μA

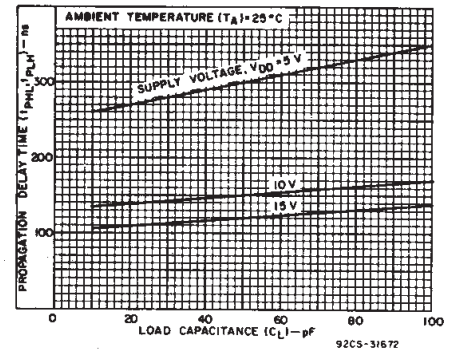


Fig. 10 - Typical propagation delay time (logic inputs to output) as a function of load capacitance.

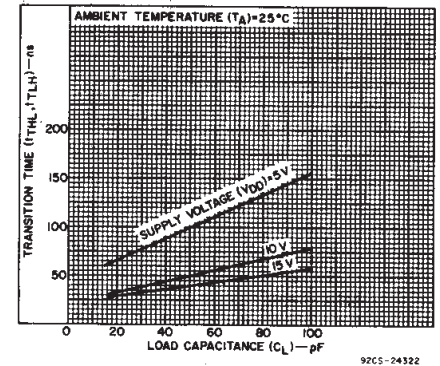


Fig. 11 - Typical transition time vs. load capacitance.

IMPLEMENTATION OF EXPAND INPUT FOR 9 OR MORE INPUTS

OUTPUT FUNCTION	FUNCTION NEEDED AT EXPAND INPUT	OUTPUT BOOLEAN EXPRESSION
NOR	OR	$J = (A+B+C+D+E+F+G+H) + (EXP)$
OR	OR	$J = (A+B+C+D+E+F+G+H) + (EXP)$
AND	NAND	$J = (AB C D E F G H) \cdot (EXP)$
NAND	NAND	$J = (AB C D E F G H) \cdot (EXP)$
OR/AND	NOR	$J = (A+B+C+D) \cdot (E+F+G+H) \cdot (EXP)$
OR/NAND	NOR	$J = (A+B+C+D) \cdot (E+F+G+H) \cdot (EXP)$
AND/NOR	AND	$J = (AB C D) + (E F G H) + (EXP)$
AND/OR	AND	$J = (AB C D) + (E F G H) + (EXP)$

Note: (EXP) designates the EXPAND function (i.e., $X_1 + X_2 + \dots + X_N$).

NOTE:

Refer to FUNCTION TRUTH TABLE for connection of unused inputs.

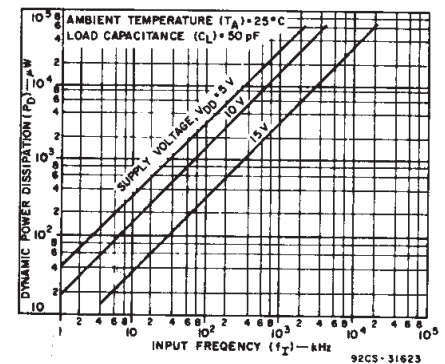


Fig. 12 - Typical power dissipation as a function of input frequency.

CD4048B Types

DYNAMIC CHARACTERISTICS at $T_A=25^\circ\text{C}$, $C_L=50\text{ pF}$, Input $t_r, t_f=20\text{ ns}$,
 $R_L=200\text{ k}\Omega$ unless otherwise specified

CHARACTERISTIC	TEST CONDITIONS	V_{DD} V	LIMITS All Package Types		UNITS
			Typ.	Max.	
Propagation Delay: t_{PHL}, t_{PLH} Inputs to Output and Ka to Output Kb to Output Kc to Output Expand Input to Output		5	300	600	ns
		10	150	300	
		15	120	240	
		5	225	450	
		10	85	170	
		15	55	110	
3-State Propagation Delay: Kd to Output t_{PHZ}, t_{PLZ} t_{PZH}, t_{PZL}	$R_L=1\text{ k}\Omega$ See Fig.21	5	80	160	
		10	35	70	
		15	25	50	
Transition Time: t_{THL}, t_{TLH}		5	100	200	
		10	50	100	
		15	40	80	
Input Capacitance: C_i	Any Input		5	7	pF
3-State Output Capacitance			5	10	

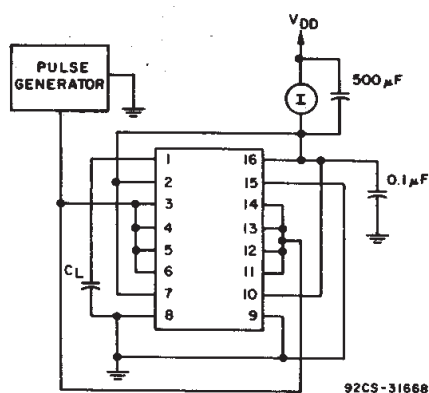


Fig. 13 – Dynamic power dissipation test circuit.

FUNCTION TRUTH TABLE

OUTPUT FUNCTION	BOOLEAN EXPRESSION	K_a	K_b	K_c	UNUSED INPUT*
NOR	$J=A+B+C+D+E+F+G+H$	0	0	0	V_{SS}
OR	$J=A+B+C+D+E+F+G+H$	0	0	1	V_{SS}
OR/AND	$J=(A+B+C+D) \cdot (E+F+G+H)$	0	1	0	V_{SS}
OR/NAND	$J=(A+B+C+D) \cdot (E+F+G+H)$	0	1	1	V_{SS}
AND	$J=ABCDEFGH$	1	0	0	V_{DD}
NAND	$J=\overline{ABCDEFGH}$	1	0	1	V_{DD}
AND/NOR	$J=\overline{ABCD} + \overline{EFGH}$	1	1	0	V_{DD}
AND/OR	$J=ABCD + EFGH$	1	1	1	V_{DD}
$K_d=1$ Normal Inverter Action					
$K_d=0$ High Impedance Output					

EXPAND Input=0

* See Figs. 1,2,3,4, and 5.

TEST CIRCUITS - STATIC MEASUREMENTS

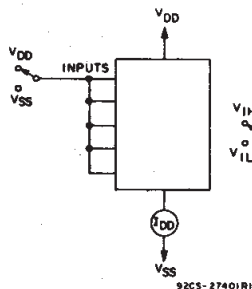


Fig. 14 – Quiescent device current test circuit.

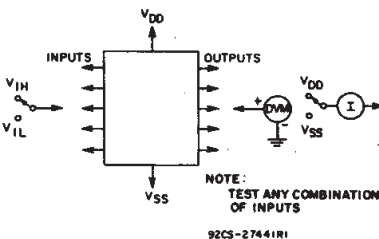


Fig. 15 – Input voltage test circuit.

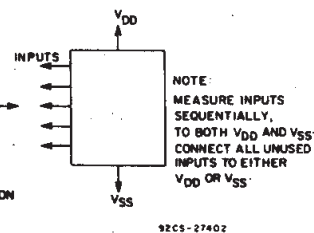


Fig. 16 – Input current test circuit.

CD4048B Types

TEST CIRCUITS - DYNAMIC MEASUREMENTS

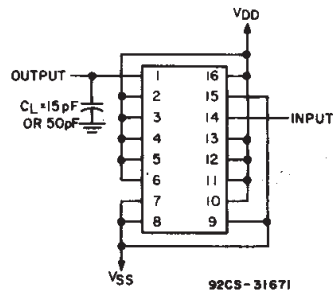


Fig. 17 - Test circuit for t_{PHL} , t_{THL} , and t_{TLH} (AND) measurements.

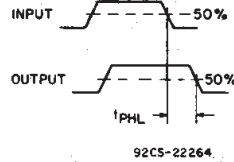


Fig. 18 - Waveforms for t_{PHL} and t_{PHL} (AND).

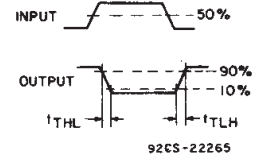


Fig. 19 - Waveforms for t_{THL} and t_{TLH} (AND).

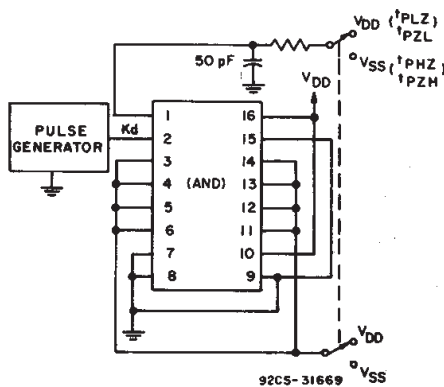


Fig. 20 - Test circuit for t_{PZL} , t_{PZH} , t_{PLZ} , and t_{PHZ} (AND).

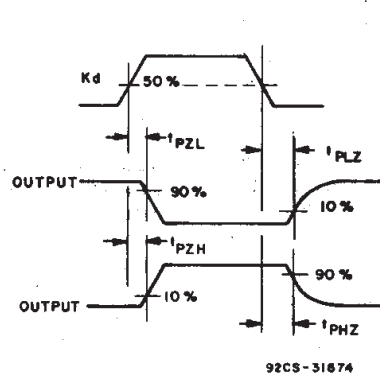
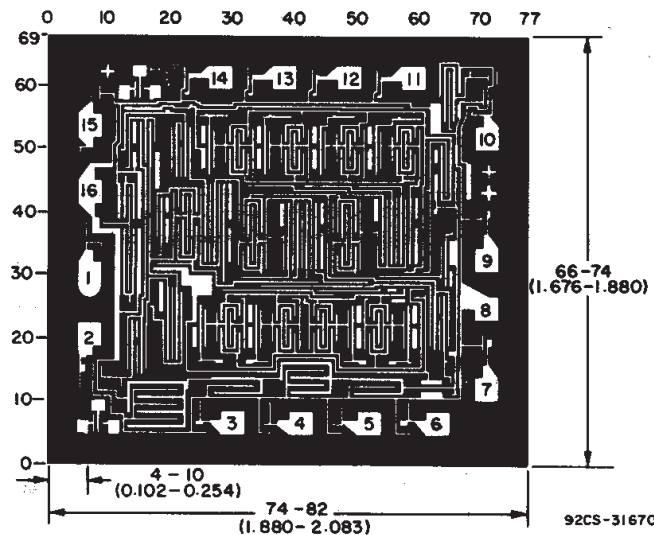


Fig. 21 - Waveforms for t_{PZL} , t_{PZH} , t_{PLZ} , and t_{PHZ} (AND).



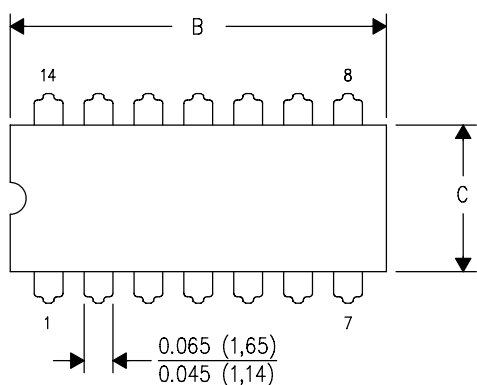
Dimensions and pad layout for CD4048BH.

Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils (10^{-3} inch).

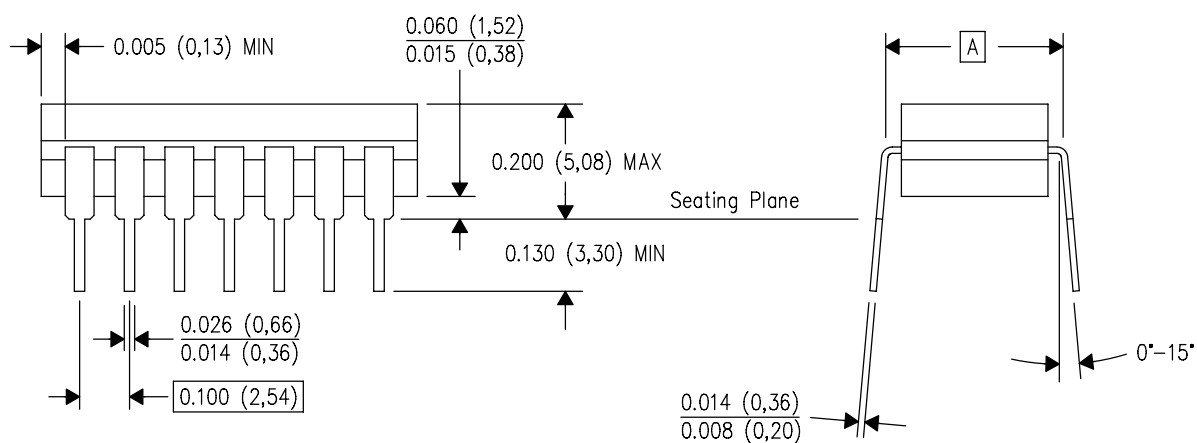
J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



PINS ** DIM	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)



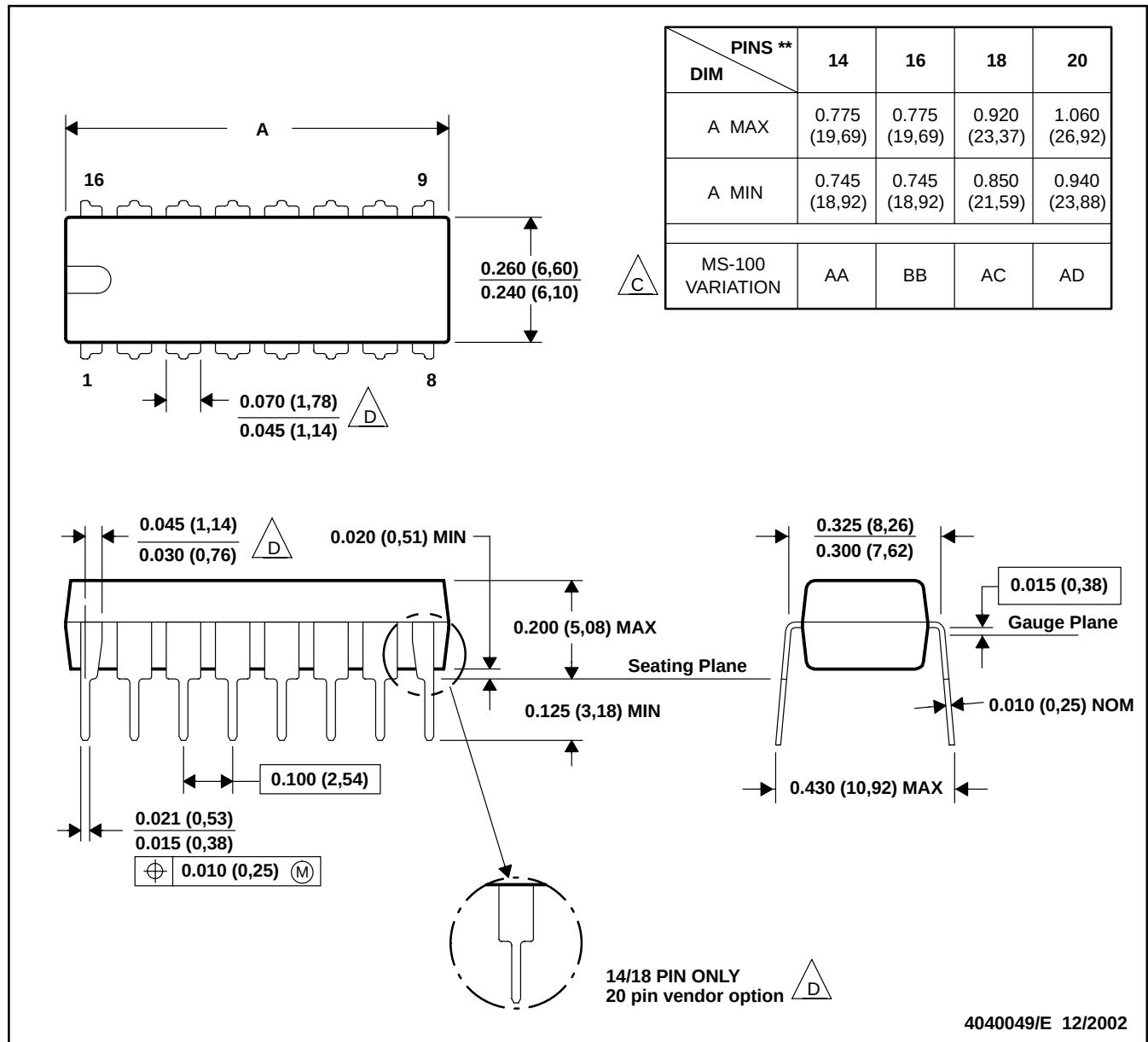
4040083/F 03/03

- 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.

N (R-PDIP-T**)

16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE

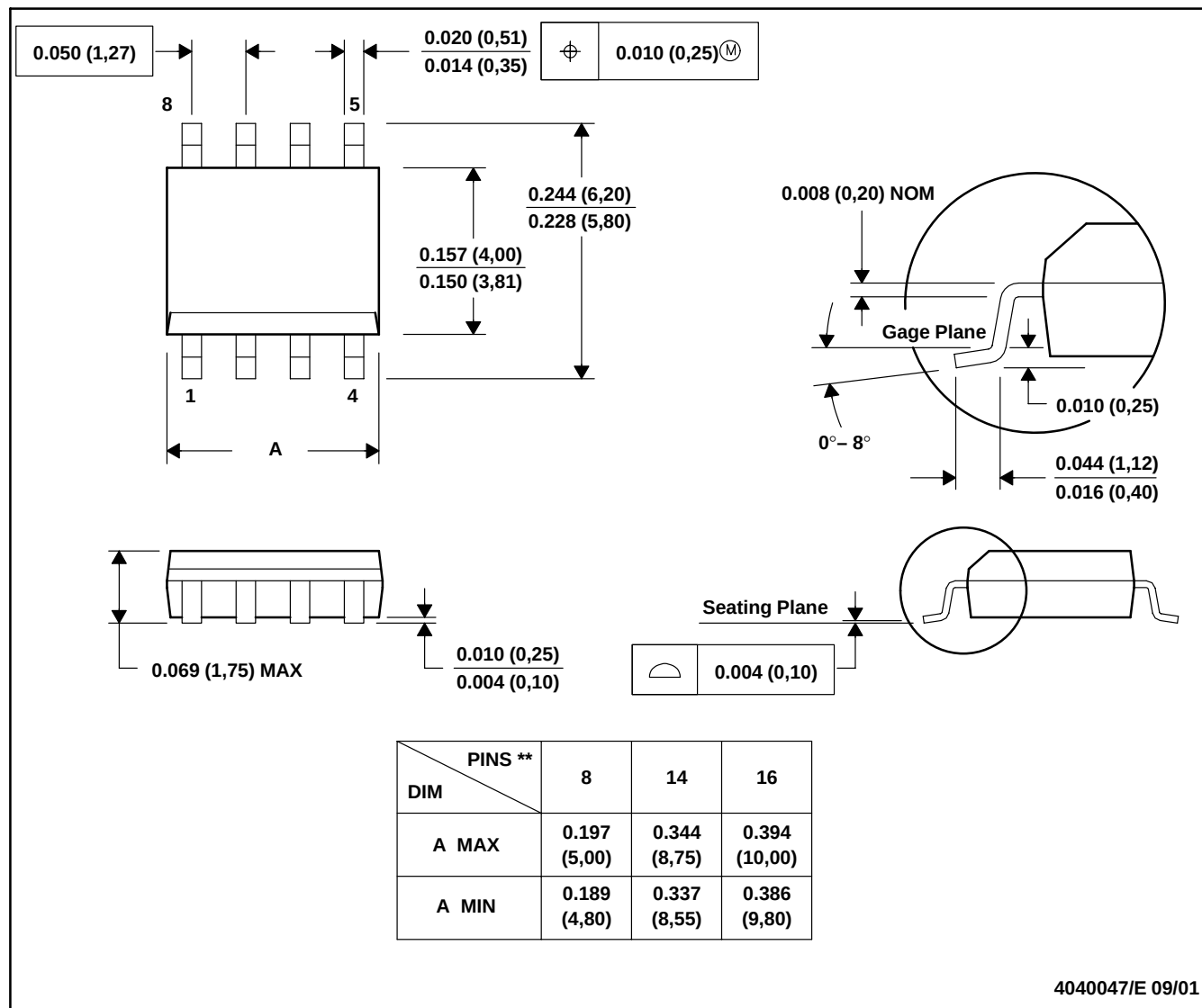


NOTES: A. All linear dimensions are in inches (millimeters).

B. This drawing is subject to change without notice.

C Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).

D The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R-PDSO-G)****PLASTIC SMALL-OUTLINE PACKAGE****8 PINS SHOWN**

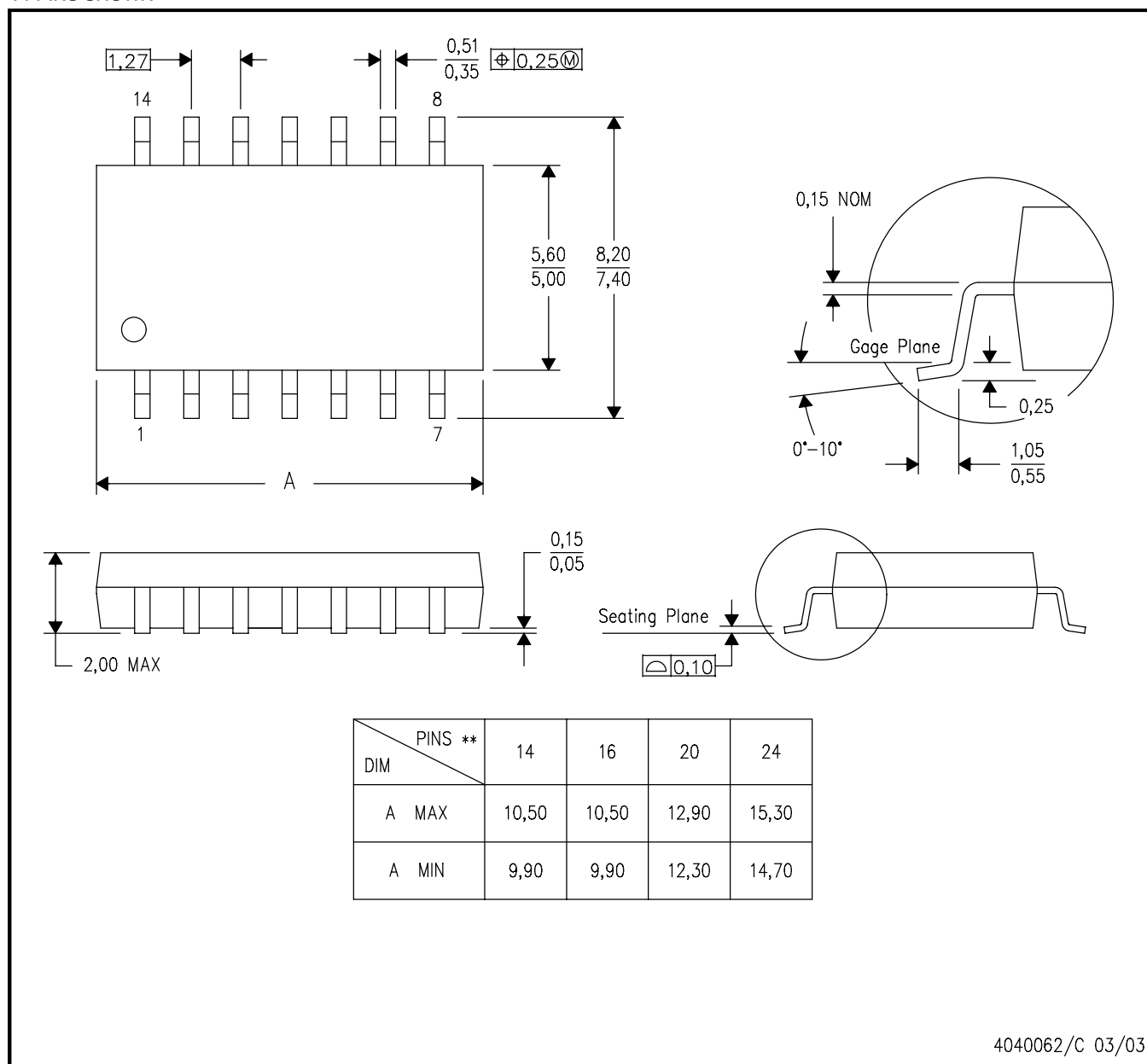
- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0.006 (0,15).
 D. Falls within JEDEC MS-012

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN

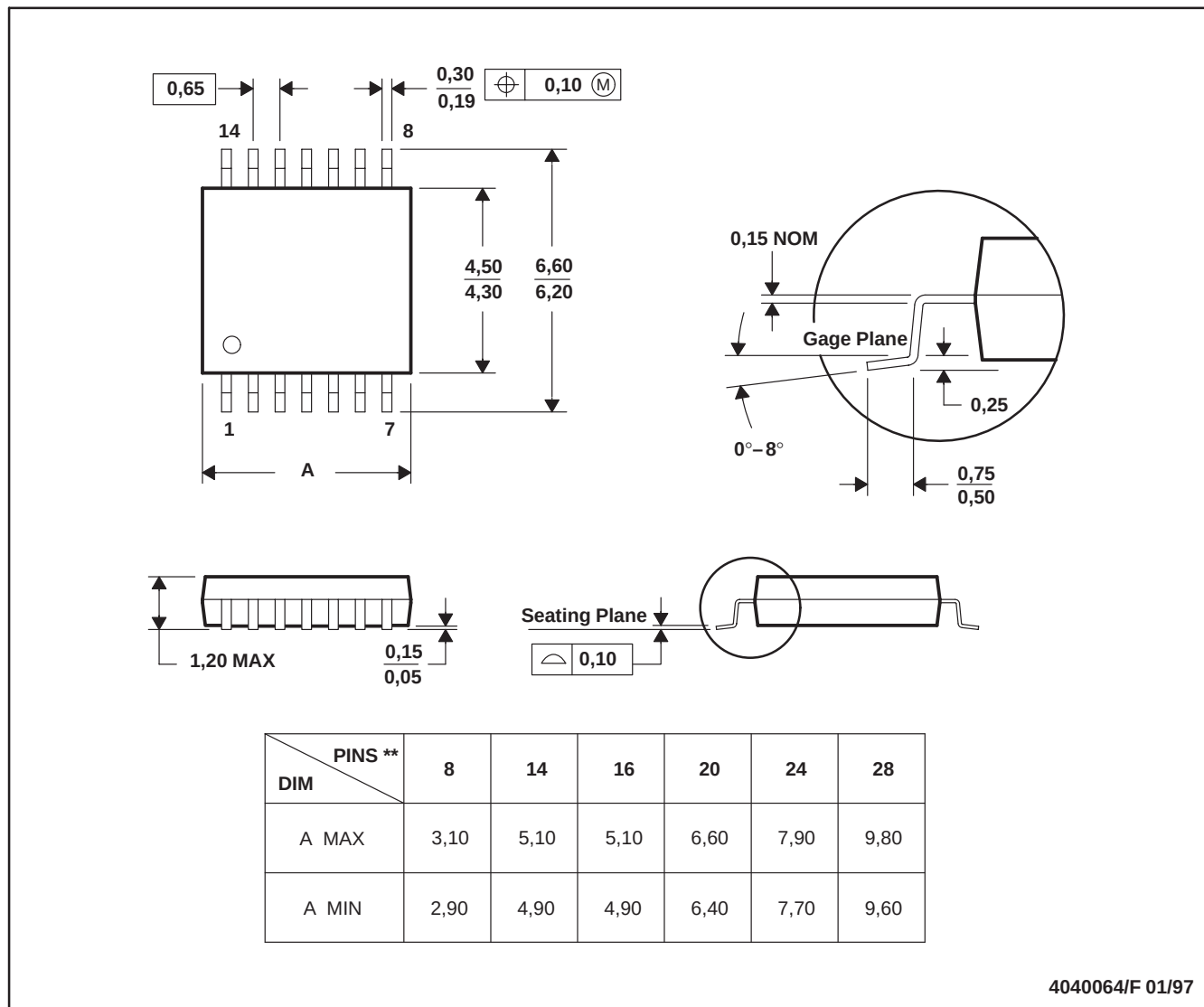


- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-153

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