CD4035B Types

CMOS 4-Stage Parallel In/Parallel Out Shift Register

with J-$\overline{K}$ Serial Inputs and True/Complement Outputs

High-Voltage Types (20-Volt Rating)

■ CD4035B is a four-stage clocked signal serial register with provision for synchronous PARALLEL inputs to each stage and SERIAL inputs to the first stage via JK logic. Register stages 2, 3, and 4 are coupled in a serial D flip-flop configuration when the register is in the serial mode (PARALLEL/SERIAL control low).

Parallel entry into each register stage is permitted when the PARALLEL/SERIAL control is high.

In the parallel or serial mode information is transferred on positive clock transitions.

When the TRUE/COMPLEMENT control is high, the true contents of the register are available at the output terminals. When the TRUE/COMPLEMENT control is low, the outputs are the complements of the data in the register. The TRUE/COMPLEMENT control functions asynchronously with respect to the CLOCK signal.

J$\overline{K}$ input logic is provided on the first stage SERIAL input to minimize logic requirements particularly in counting and sequence-generation applications. With J$\overline{K}$ inputs connected together, the first stage becomes a D flip-flop. An asynchronous common RESET is also provided.

The CD4035B 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).

Features:

■ 4-Stage clocked shift operation
■ Synchronous parallel entry on all 4 stages
■ J$\overline{K}$ inputs on first stage
■ Asynchronous True/Complement control on all outputs
■ Static flip-flop operation; Master-slave configuration
■ Buffered inputs and outputs
■ High speed — 12 MHz (typ.) at V_{DD} = 10 V
■ 100% tested for quiescent current at 20 V
■ Standardized, symmetrical output characteristics
■ 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:

■ Counters, Registers
  Arithmetic-unit registers
  Shift-left — shift right registers
  Serial-to-parallel/parallel-to-serial conversions
■ Sequence generation
■ Control circuits
■ Code conversion

FUNCTIONAL DIAGRAM

FIRST STAGE TRUTH TABLE

| CL	t_{n-1} (INPUTS)				t_n (OUTPUTS)
	J	$\overline{K}$	R	Q_{n-1}	Q_n
⌐	0	X	0	0	0
⌐	1	X	0	0	1
⌐	X	0	0	1	0
⌐	1	0	0	Q_{n-1}	$\overline{Q_{n-1}}$ TOGGLE MODE
⌐	X	1	0	1	1
⌐	X	X	0	Q_{n-1}	Q_{n-1}
X	X	X	X	1	X	0
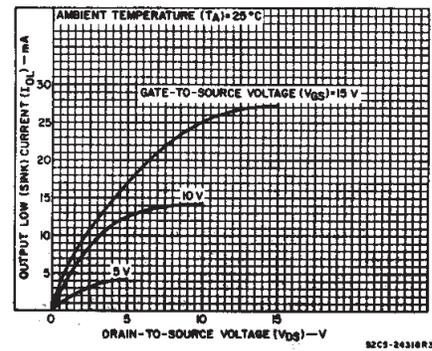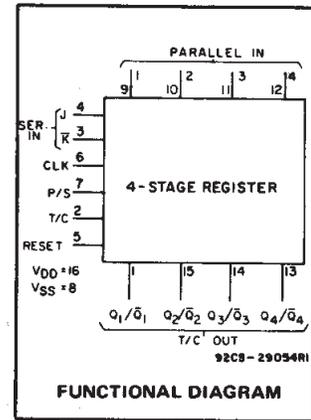
Fig. 1 — Typical output low (sink) current characteristics.
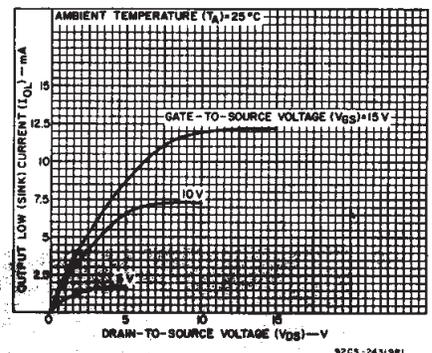
*Fig. 2 — Minimum output low (sink) current characteristics.*
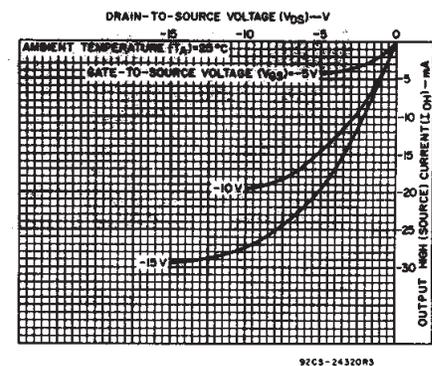
Fig. 3 — Typical output high (source) current characteristics.

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 Linearity 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

Typical Stage Detail Logic

Fig. 4 — Logic diagram.

* ALL INPUTS ARE PROTECTED BY COS/MOS PROTECTION NETWORK

Fig. 5 — Minimum output high (source) current characteristics.
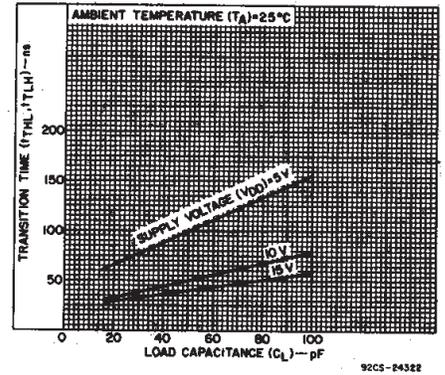
Fig. 6 — Typical transition time as a function of load capacitance.
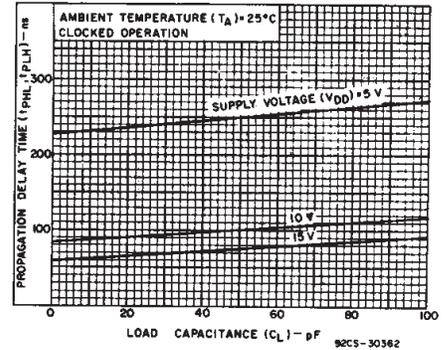
Fig. 7 — Typical propagation delay times as a function of load capacitance (Q output).
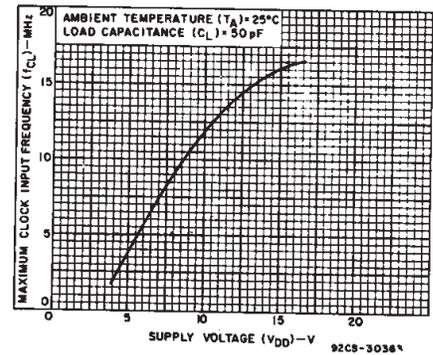
Fig. 8 — Typical maximum clock input frequency as a function of supply voltage.

RECOMMENDED OPERATING CONDITIONS at $T_A = 25°C$, Except as Noted.

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

CHARACTERISTIC	V_{DD} (V)	LIMITS		UNITS
		MIN.	MAX.	
Supply-Voltage Range (For T_A = Full Package-Temperature Range)		3	18	V
Data Setup Time, t_S: J/$\overline{K}$ Lines	5	220	—	
	10	80	—	ns
	15	60	—	
Parallel-In Lines	5	140	—	
	10	50	—	ns
	15	40	—	
Clock Pulse Width, t_W	5	200	—	
	10	90	—	ns
	15	60	—	
Clock Input Frequency, f_{CL}	5		2	
	10	dc	6	MHz
	15		8	
Clock Rise or Fall Time, t_rCL, t_fCL:	5	—	15	
	10	—	15	μs
	15	—	15	
Reset Pulse Width, t_W	5	250	—	
	10	110	—	ns
	15	80	—	

COMMERCIAL CMOS HIGH VOLTAGE ICs

3

STATIC ELECTRICAL CHARACTERISTICS

CHARAC-TERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)				+25			UNITS
	V_O (V)	V_{IN} (V)	V_{DD} (V)	−55	−40	+85	+125	Min.	Typ.	Max.	
Quiescent Device Current, I_{DD} Max.	−	0,5	5	5	5	150	150	−	0.04	5	µA
	−	0,10	10	10	10	300	300	−	0.04	10	
	−	0,15	15	20	20	600	600	−	0.04	20	
	−	0,20	20	100	100	3000	3000	−	0.08	100	
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	−	
	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	−	
	−	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	−	−	
	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
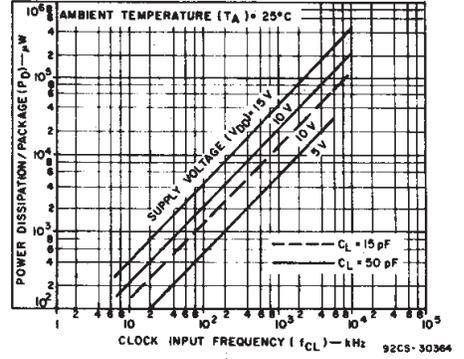
Fig. 9 — Typical dynamic power dissipation as a function of clock input frequency.
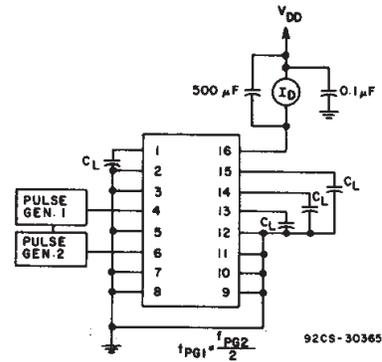

Fig. 10 — Dynamic power dissipation test circuit.
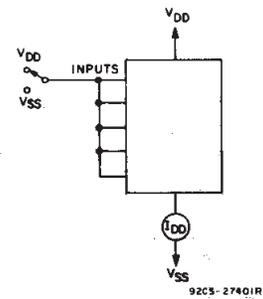
Fig. 11 — Quiescent-device current test circuit.
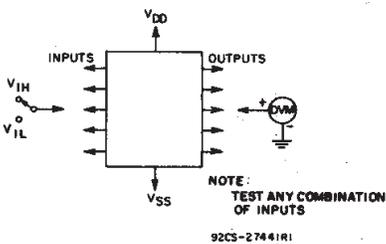
Fig. 12 — Input-voltage test circuit.
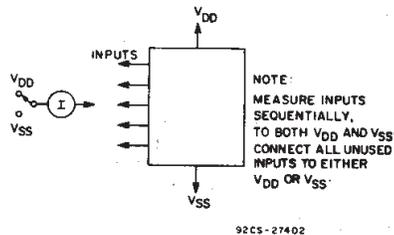
Fig. 13 — Input-current test circuit.

NOTE: MEASURE INPUTS SEQUENTIALLY, TO BOTH V_{DD} AND V_{SS} CONNECT ALL UNUSED INPUTS TO EITHER V_{DD} OR V_{SS}.
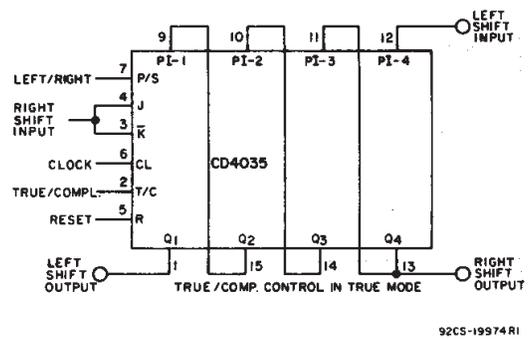

Fig. 14 — Shift left/shift right register.
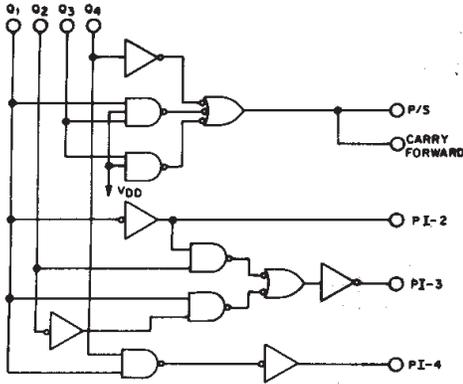
Using Couleur's Technique (BIDEC)▲, a binary number (most significant bit, MSB) first is shifted and processed, such that the BCD equivalent is obtained when the last binary bit is clocked into the register. The CD4035B, with the correct conversion logic, can also be used as a BCD-to-binary converter.

▲The basic rule is: If a 4 or less is in a decade, shift with the next clock pulse; if a 5 or greater is in a decade, add 3 and then shift at the next clock pulse. For more information refer to "IRE TRANSACTIONS ON ELECTRONIC COMPUTERS", Dec. 1958, Pages 313–316.

Fig. 15 — BIDEC logic.
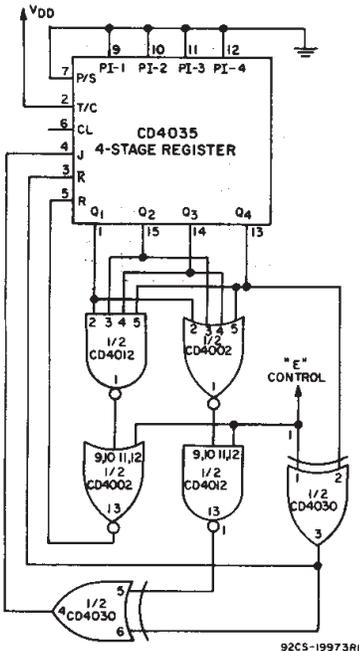
Fig. 16(a) — Double sequence generator.

DYNAMIC ELECTRICAL CHARACTERISTICS

At $T_A = 25°C$, Input t_r, $t_f = 20\,ns$, $C_L = 50\,pF$, $R_L = 200\,k\Omega$

CHARACTERISTICS	TEST CONDITIONS V_{DD} (V)	LIMITS Min.	Typ.	Max.	UNITS
CLOCKED OPERATION					
Propagation Delay Time: t_{PHL}, t_{PLH}	5	—	250	500	
	10	—	100	200	ns
	15	—	75	150	
Transition Time: t_{THL}, t_{TLH}	5	—	100	200	
	10	—	50	100	ns
	15	—	40	80	
Minimum Clock Pulse Width, t_W	5	—	100	200	
	10	—	45	90	ns
	15	—	30	60	
Clock Rise or Fall Time, t_rCL, t_fCL*	5,10, 15	—	—	15	μs
Minimum Setup Time: J/$\overline{K}$ Lines	5	—	110	220	
	10	—	40	80	ns
	15	—	30	60	
Parallel-In-Lines	5	—	70	140	
	10	—	25	50	ns
	15	—	20	40	
Maximum Clock Frequency, f_{CL}	5	2	4	—	
	10	6	12	—	MHz
	15	8	16	—	
Input Capacitance, C_{IN}	Any Input	—	5	7.5	pF
RESET OPERATION					
Propagation Delay Time: t_{PHL}, t_{PLH}	5	—	230	460	
	10	—	100	200	ns
	15	—	80	160	
Minimum Reset Pulse Width, t_W	5	—	125	250	
	10	—	55	110	ns
	15	—	40	40	

*If more than one unit is cascaded t_rCL should be made less than or equal to the sum of the transition time and the fixed propagation delay of the output of the driving stage for the estimated capacitive load.

Control # E =		0				1			
	Q_1	Q_2	Q_3	Q_4		Q_1	Q_2	Q_3	Q_4
	A	B	C	D		A	B	C	D
0	0	0	0	0	15	1	1	1	1
1	1	0	0	0	14	0	1	1	1
2	0	1	0	0	13	1	0	1	1
5	1	0	1	0	10	0	1	0	1
10	0	1	0	1	5	1	0	1	0
4	0	0	1	0	11	1	1	0	1
9	1	0	0	1	6	0	1	1	0
3	1	1	0	0	12	0	0	1	1
6	0	1	1	0	9	1	0	0	1
13	1	0	1	1	2	0	1	0	0
11	1	1	0	1	4	0	0	1	0
7	1	1	1	0	8	0	0	0	1
14	0	1	1	1	1	1	0	0	0
12	0	0	1	1	3	1	1	0	0
8	0	0	0	1	7	1	1	1	0

Using a control line (E) two different state sequences can be generated. For example, suppose the following two sequences are desired on command (control line E)

Fig. 16(b) — State sequences.

3

COMMERCIAL CMOS HIGH VOLTAGE ICs
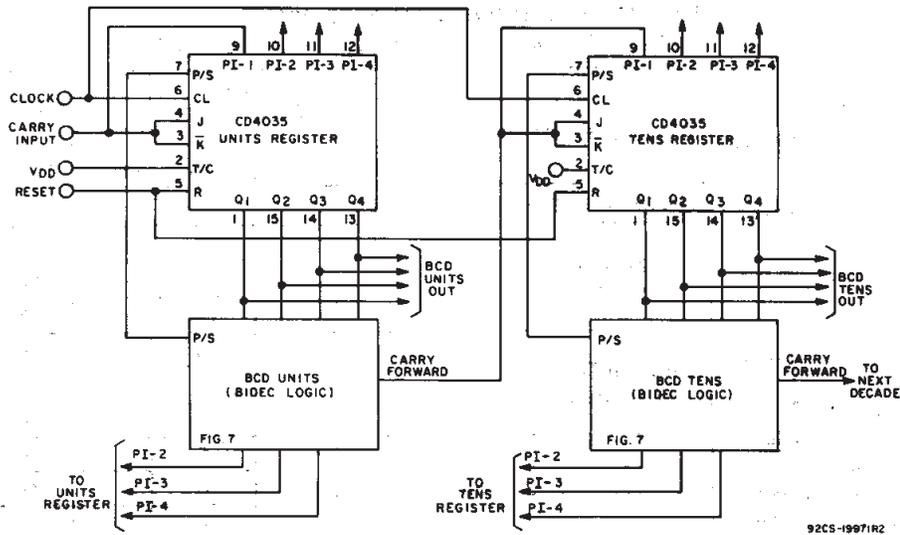
Fig. 17 — Binary-to-BCD converter.

92CS-1997IR2

83-91
(2.109-2.311)

4-10
(0.102-0.254)

89-97
(2.261-2.463)

92CS-35056
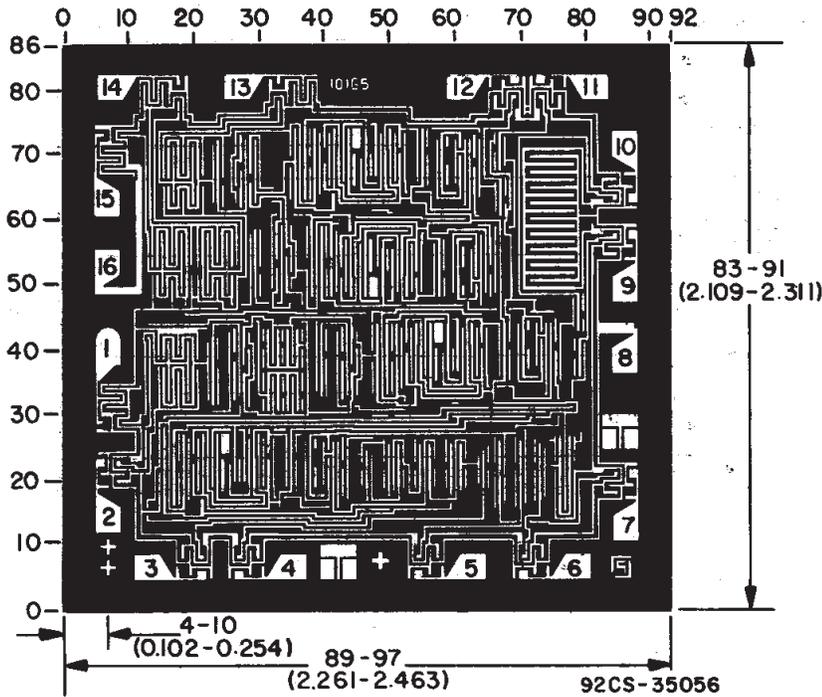
TERMINAL DIAGRAM
Top View

Q1/Q̄1 — 1		16 — V_DD
TRUE/COMP — 2		15 — Q2/Q̄2
K̄ — 3		14 — Q3/Q̄3
J — 4		13 — Q4/Q̄4
RESET — 5		12 — PI-4
CLOCK — 6		11 — PI-3
P/S — 7		10 — PI-2
V_SS — 8		9 — PI-1
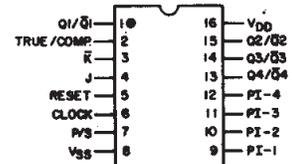
92CS-20745R1

Dimensions and pad layout for CD4035BH.

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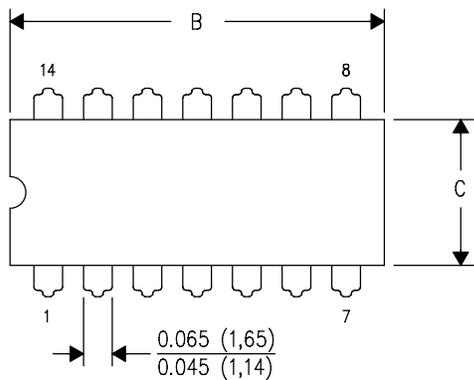
DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	——	——	——	——
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)

0.065 (1,65)
0.045 (1,14)

0.005 (0,13) MIN

0.060 (1,52)
0.015 (0,38)

0.200 (5,08) MAX

Seating Plane

0.130 (3,30) MIN

0.026 (0,66)
0.014 (0,36)

0.100 (2,54)

A

0°-15°

0.014 (0,36)
0.008 (0,20)
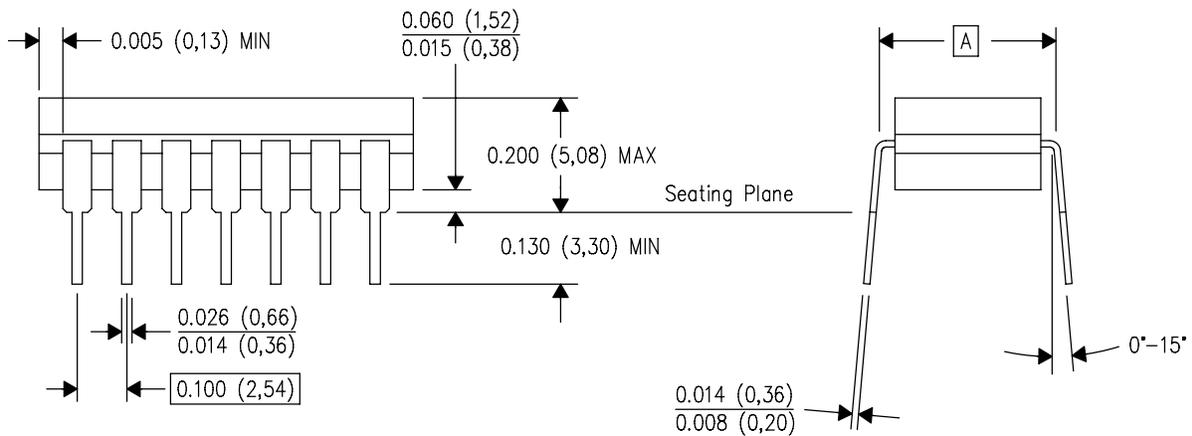
4040083/F 03/03

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**) PLASTIC DUAL−IN−LINE PACKAGE

16 PINS SHOWN
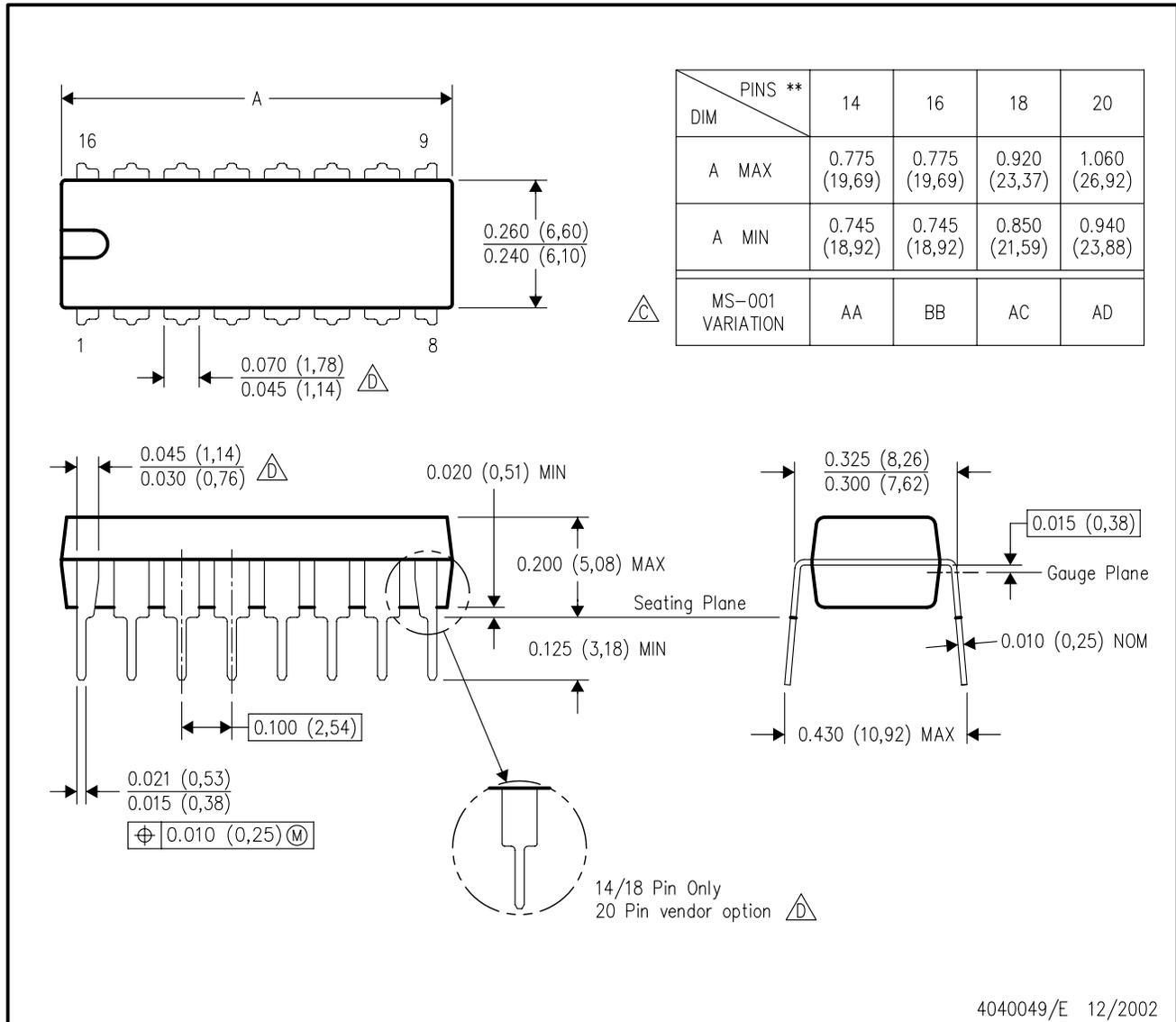
DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS−001 VARIATION	AA	BB	AC	AD

A   0.260 (6,60) / 0.240 (6,10)

0.070 (1,78) / 0.045 (1,14) ⚠D

0.045 (1,14) / 0.030 (0,76) ⚠D

0.020 (0,51) MIN

0.200 (5,08) MAX

Seating Plane

0.125 (3,18) MIN

0.100 (2,54)

0.021 (0,53) / 0.015 (0,38)

⊕ 0.010 (0,25) Ⓜ

14/18 Pin Only
20 Pin vendor option ⚠D

0.325 (8,26) / 0.300 (7,62)

0.015 (0,38)

Gauge Plane

0.010 (0,25) NOM

0.430 (10,92) MAX

4040049/E   12/2002

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.

TEXAS
INSTRUMENTS
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D (R−PDSO−G16) PLASTIC SMALL−OUTLINE PACKAGE
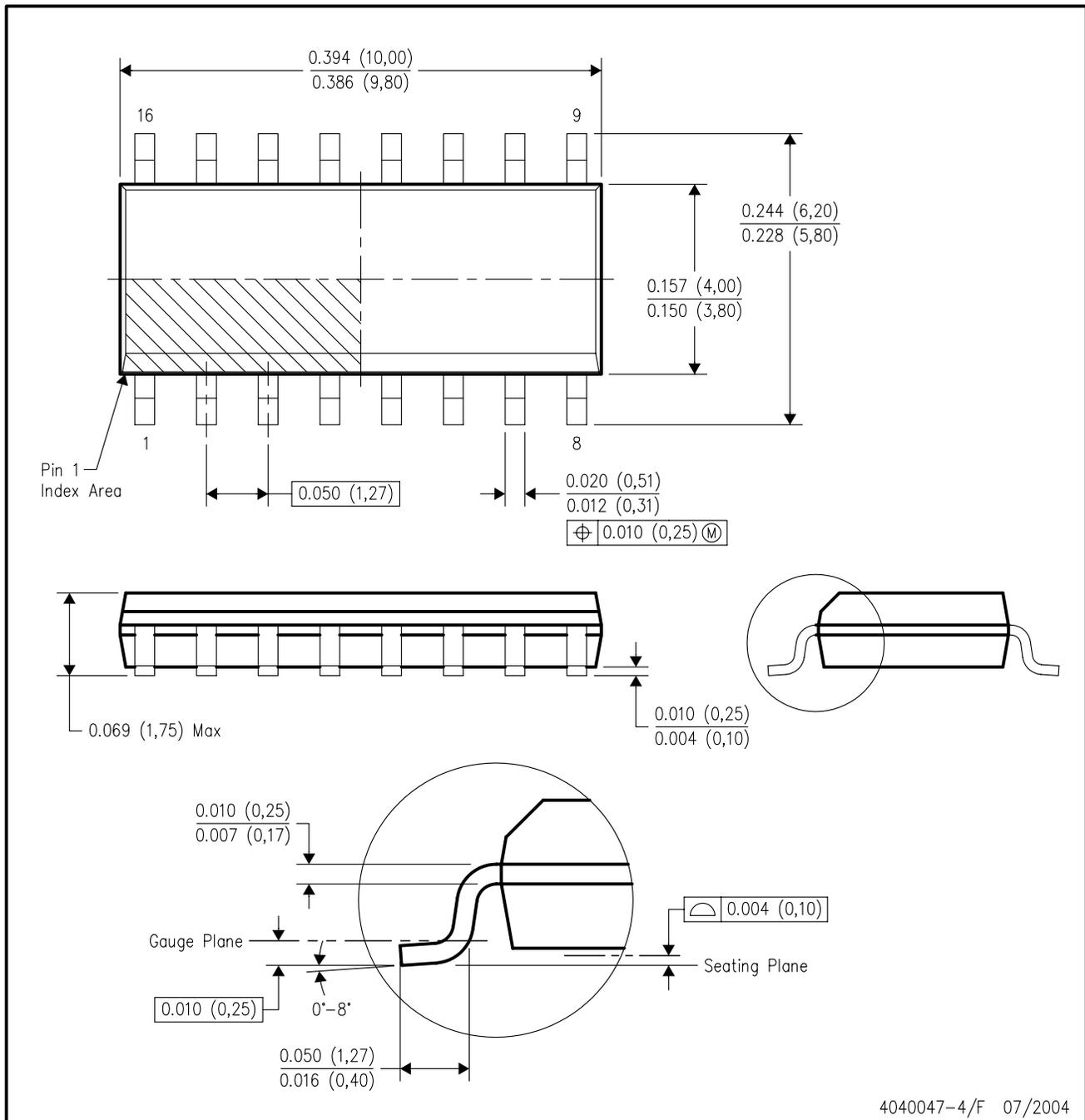
0.394 (10,00)
0.386 (9,80)

16   9

0.244 (6,20)
0.228 (5,80)

0.157 (4,00)
0.150 (3,80)

1   8

Pin 1
Index Area

0.050 (1,27)

0.020 (0,51)
0.012 (0,31)

⊕ 0.010 (0,25) Ⓜ

0.069 (1,75) Max

0.010 (0,25)
0.004 (0,10)

0.010 (0,25)
0.007 (0,17)

0.004 (0,10)

Gauge Plane

Seating Plane

0.010 (0,25)   0°−8°

0.050 (1,27)
0.016 (0,40)

4040047−4/F 07/2004

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 variation AC.

NS (R-PDSO-G**)   **PLASTIC SMALL-OUTLINE PACKAGE**
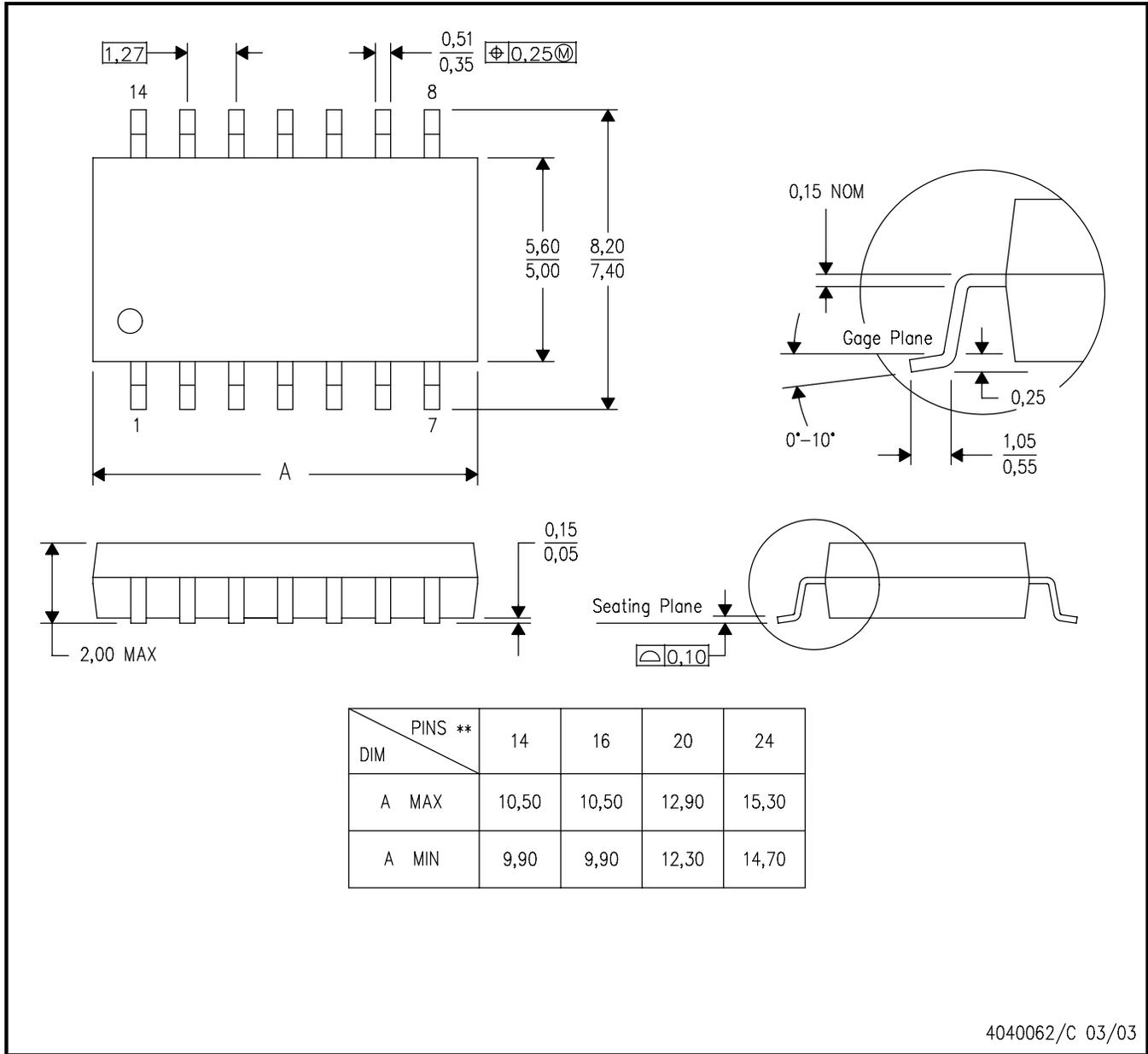
14-PINS SHOWN

DIM \ PINS **	14	16	20	24
A MAX	10,50	10,50	12,90	15,30
A MIN	9,90	9,90	12,30	14,70

4040062/C 03/03

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

PINS ** DIM	8	14	16	20	24	28
A MAX	3,10	5,10	5,10	6,60	7,90	9,80
A MIN	2,90	4,90	4,90	6,40	7,70	9,60
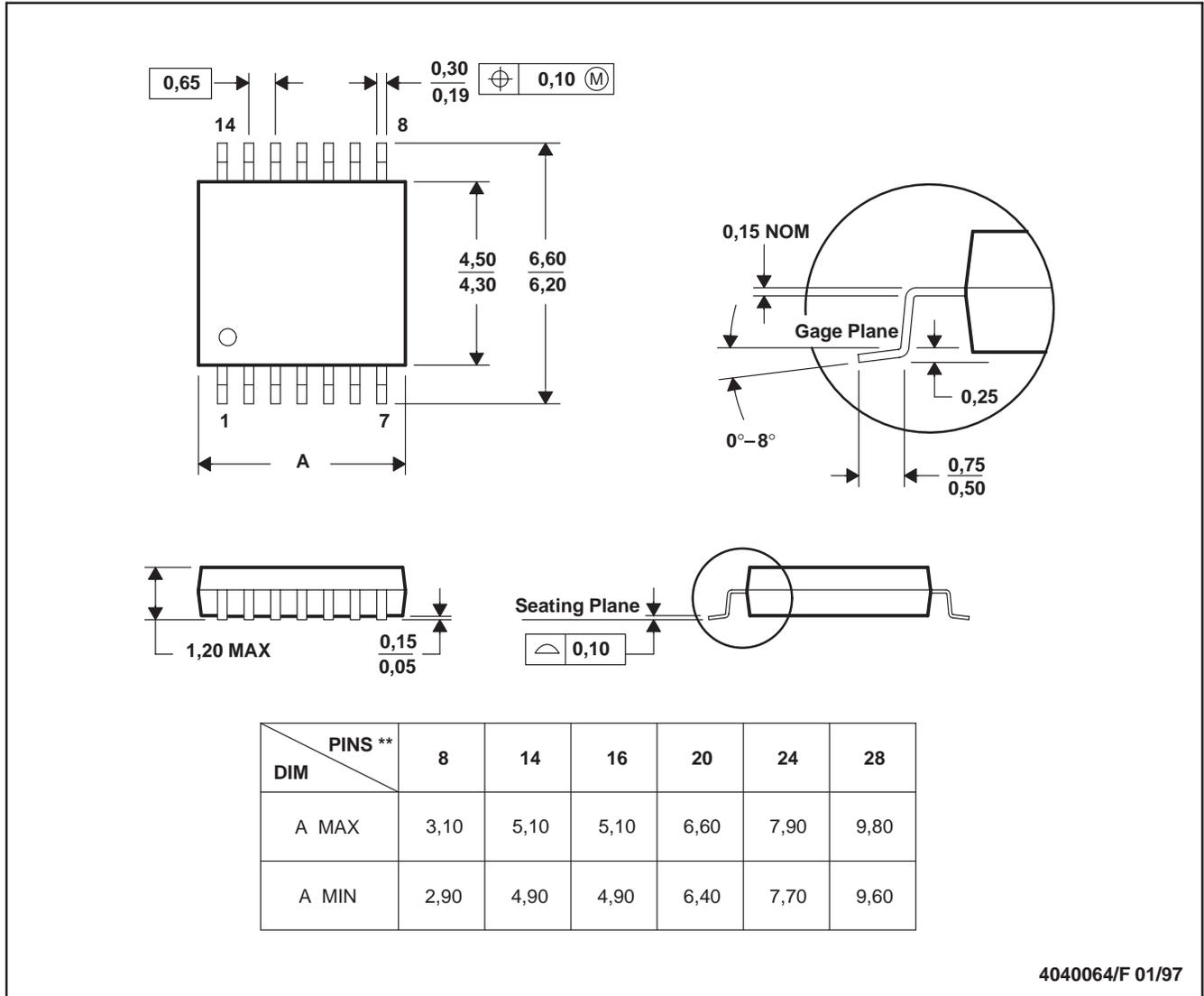
4040064/F 01/97

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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