SN54ALS04B, SN54AS04, SN74ALS04B, SN74AS04
HEX INVERTERS

- **Package Options Include Plastic Small-Outline (D) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs**
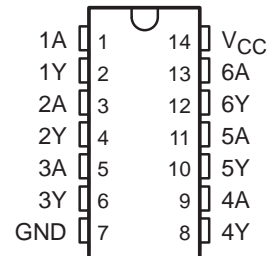
description

These devices contain six independent hex inverters. They perform the Boolean function $Y = \overline{A}$.

The SN54ALS04B and SN54AS04 are characterized for operation over the full military temperature range of $-55°C$ to $125°C$. The SN74ALS04B and SN74AS04 are characterized for operation from $0°C$ to $70°C$.
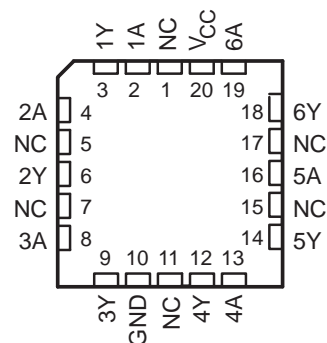
FUNCTION TABLE
(each inverter)

INPUT A	OUTPUT Y
H	L
L	H

SN54ALS04B, SN54AS04 . . . J PACKAGE
SN74ALS04B, SN74AS04 . . . D OR N PACKAGE
(TOP VIEW)

1A	1	14	V_{CC}
1Y	2	13	6A
2A	3	12	6Y
2Y	4	11	5A
3A	5	10	5Y
3Y	6	9	4A
GND	7	8	4Y

SN54ALS04B, SN54AS04 . . . FK PACKAGE
(TOP VIEW)

Top: 1Y (3), 1A (2), NC (1), V_{CC} (20), 6A (19)
Left: 2A (4), NC (5), 2Y (6), NC (7), 3A (8)
Right: 6Y (18), NC (17), 5A (16), NC (15), 5Y (14)
Bottom: 3Y (9), GND (10), NC (11), 4Y (12), 4A (13)

NC – No internal connection

logic symbol†

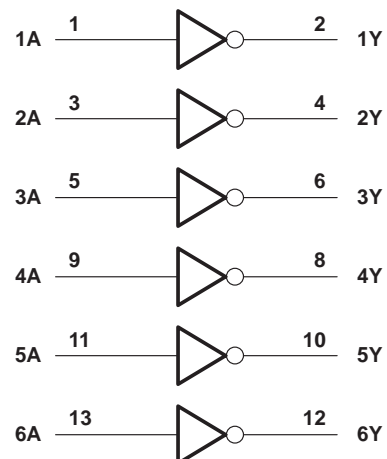|				
1A	1	1	2	1Y
2A	3		4	2Y
3A	5		6	3Y
4A	9		8	4Y
5A	11		10	5Y
6A	13		12	6Y
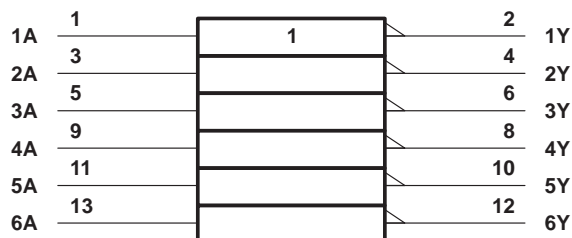
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for the D, J, and N packages.

logic diagram (positive logic)

1A	1	2	1Y
2A	3	4	2Y
3A	5	6	3Y
4A	9	8	4Y
5A	11	10	5Y
6A	13	12	6Y

TEXAS INSTRUMENTS

POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

1

SN54ALS04B, SN54AS04, SN74ALS04B, SN74AS04
HEX INVERTERS

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

Supply voltage, V_{CC} . . . . 7 V
Input voltage, V_I . . . . 7 V
Operating free-air temperature range, T_A: SN54ALS04B . . . . −55°C to 125°C
 SN74ALS04B . . . . 0°C to 70°C
Storage temperature range . . . . −65°C to 150°C

[†] Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

recommended operating conditions

		SN54ALS04B			SN74ALS04B			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage	4.5	5	5.5	4.5	5	5.5	V
V_{IH}	High-level input voltage	2			2			V
V_{IL}	Low-level input voltage			0.8[‡]			0.8	V
				0.7[§]				
I_{OH}	High-level output current			−0.4			−0.4	mA
I_{OL}	Low-level output current			4			8	mA
T_A	Operating free-air temperature	−55		125	0		70	°C

[‡] Applies over −55°C to 70°C temperature range
[§] Applies over 70°C to 125°C temperature range

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS		SN54ALS04B			SN74ALS04B			UNIT
			MIN	TYP[¶]	MAX	MIN	TYP[¶]	MAX	
V_{IK}	V_{CC} = 4.5 V,	I_I = −18 mA			−1.2			−1.2	V
V_{OH}	V_{CC} = 4.5 V to 5.5 V,	I_{OH} = −0.4 mA	V_{CC} −2			V_{CC} −2			V
V_{OL}	V_{CC} = 4.5 V	I_{OL} = 4 mA		0.25	0.4		0.25	0.4	V
		I_{OL} = 8 mA					0.35	0.5	
I_I	V_{CC} = 5.5 V,	V_I = 7 V			0.1			0.1	mA
I_{IH}	V_{CC} = 5.5 V,	V_I = 2.7 V			20			20	µA
I_{IL}	V_{CC} = 5.5 V,	V_I = 0.4 V			−0.1			−0.1	mA
I_O[#]	V_{CC} = 5.5 V,	V_O = 2.25 V	−20		−112	−30		−112	mA
I_{CCH}	V_{CC} = 5.5 V,	V_I = 0		0.65	1.1		0.65	1.1	mA
I_{CCL}	V_{CC} = 5.5 V,	V_I = 4.5 V		2.9	4.4		2.9	4.2	mA

[¶] All typical values are at V_{CC} = 5 V, T_A = 25°C.
[#] The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current, I_{OS}.

TEXAS
INSTRUMENTS

POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

switching characteristics (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 4.5 V to 5.5 V, C_L = 50 pF, R_L = 500 Ω, T_A = MIN to MAX†				UNIT
			SN54ALS04B		SN74ALS04B		
			MIN	MAX	MIN	MAX	
t_{PLH}	A	Y	3	17	3	11	ns
t_{PHL}			2	13	2	8	

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)‡

Supply voltage, V_{CC} .... 7 V
Input voltage, V_I .... 7 V
Operating free-air temperature range, T_A: SN54AS04 .... −55°C to 125°C
        SN74AS04 .... 0°C to 70°C
Storage temperature range .... −65°C to 150°C

‡ Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

recommended operating conditions

		SN54AS04			SN74AS04			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage	4.5	5	5.5	4.5	5	5.5	V
V_{IH}	High-level input voltage	2			2			V
V_{IL}	Low-level input voltage			0.8			0.8	V
I_{OH}	High-level output current			−2			−2	mA
I_{OL}	Low-level output current			20			20	mA
T_A	Operating free-air temperature	−55		125	0		70	°C

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS		SN54AS04			SN74AS04			UNIT
			MIN	TYP§	MAX	MIN	TYP§	MAX	
V_{IK}	V_{CC} = 4.5 V,	I_I = −18 mA			−1.2			−1.2	V
V_{OH}	V_{CC} = 4.5 V to 5.5 V,	I_{OH} = −2 mA	V_{CC} −2			V_{CC} −2			V
V_{OL}	V_{CC} = 4.5 V,	I_{OL} = 20 mA		0.35	0.5		0.35	0.5	V
I_I	V_{CC} = 5.5 V,	V_I = 7 V			0.1			0.1	mA
I_{IH}	V_{CC} = 5.5 V,	V_I = 2.7 V			20			20	µA
I_{IL}	V_{CC} = 5.5 V,	V_I = 0.4 V			−0.5			−0.5	mA
I_O¶	V_{CC} = 5.5 V,	V_O = 2.25 V	−30		−112	−30		−112	mA
I_{CCH}	V_{CC} = 5.5 V,	V_I = 0		3	4.8		3	4.8	mA
I_{CCL}	V_{CC} = 5.5 V,	V_I = 4.5 V		14	26.3		14	26.3	mA

§ All typical values are at V_{CC} = 5 V, T_A = 25°C.
¶ The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current, I_{OS}.

TEXAS INSTRUMENTS
POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

SN54ALS04B, SN54AS04, SN74ALS04B, SN74AS04
HEX INVERTERS

switching characteristics (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 4.5 V to 5.5 V, C_L = 50 pF, R_L = 500 Ω, T_A = MIN to MAX[†]				UNIT
			SN54AS04		SN74AS04		
			MIN	MAX	MIN	MAX	
t_{PLH}	A	Y	1	6	1	5	ns
t_{PHL}			1	4.5	1	4	

[†] For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

4

PARAMETER MEASUREMENT INFORMATION
SERIES 54ALS/74ALS AND 54AS/74AS DEVICES

LOAD CIRCUIT FOR
BI-STATE
TOTEM-POLE OUTPUTS

LOAD CIRCUIT
FOR OPEN-COLLECTOR OUTPUTS

LOAD CIRCUIT
FOR 3-STATE OUTPUTS

VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES

VOLTAGE WAVEFORMS
PULSE DURATIONS

VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES, 3-STATE OUTPUTS

VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
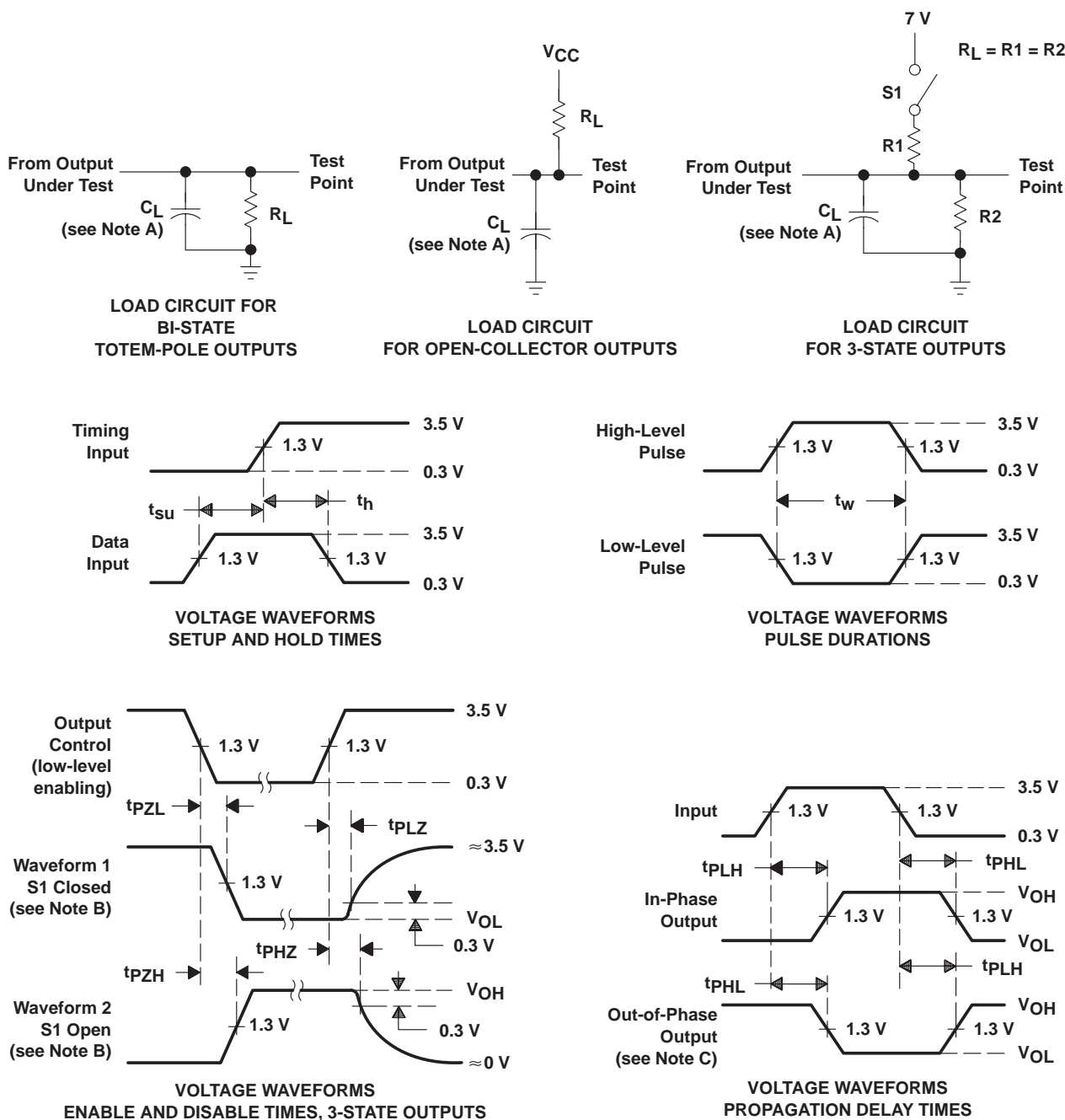
NOTES: A. C_L includes probe and jig capacitance.
B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control.
Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
C. When measuring propagation delay items of 3-state outputs, switch S1 is open.
D. All input pulses have the following characteristics: PRR ≤ 1 MHz, $t_r = t_f = 2$ ns, duty cycle = 50%.
E. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuits and Voltage Waveforms

PACKAGE OPTION ADDENDUM

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
5962-86843012A	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Level-NC-NC-NC
5962-8684301DA	ACTIVE	CFP	W	14	1	TBD	Call TI	Level-NC-NC-NC
JM38510/37006B2A	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Level-NC-NC-NC
JM38510/37006BCA	ACTIVE	CDIP	J	14	1	TBD	Call TI	Level-NC-NC-NC
SN54ALS04BJ	ACTIVE	CDIP	J	14	1	TBD	Call TI	Level-NC-NC-NC
SN54AS04J	ACTIVE	CDIP	J	14	1	TBD	Call TI	Level-NC-NC-NC
SN74ALS04BD	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS04BDBLE	OBSOLETE	SSOP	DB	14		TBD	Call TI	Call TI
SN74ALS04BDBR	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS04BDBRE4	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS04BDE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS04BDR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS04BDRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS04BN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74ALS04BN3	OBSOLETE	PDIP	N	14		TBD	Call TI	Call TI
SN74ALS04BNE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74ALS04BNSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS04BNSRE4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AS04D	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AS04DE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AS04DR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AS04DRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AS04N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74AS04NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74AS04NSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AS04NSRE4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SNJ54ALS04BFK	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Level-NC-NC-NC
SNJ54ALS04BJ	ACTIVE	CDIP	J	14	1	TBD	Call TI	Level-NC-NC-NC
SNJ54ALS04BW	ACTIVE	CFP	W	14	1	TBD	Call TI	Level-NC-NC-NC

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
SNJ54AS04FK	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Level-NC-NC-NC
SNJ54AS04J	ACTIVE	CDIP	J	14	1	TBD	Call TI	Level-NC-NC-NC

[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) 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.
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.

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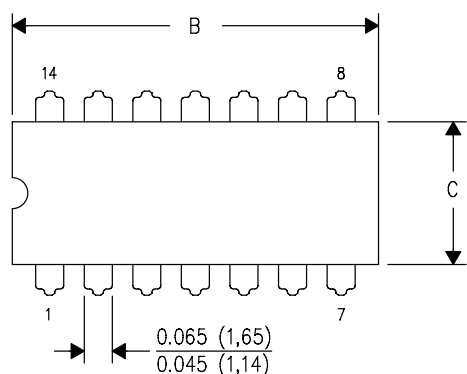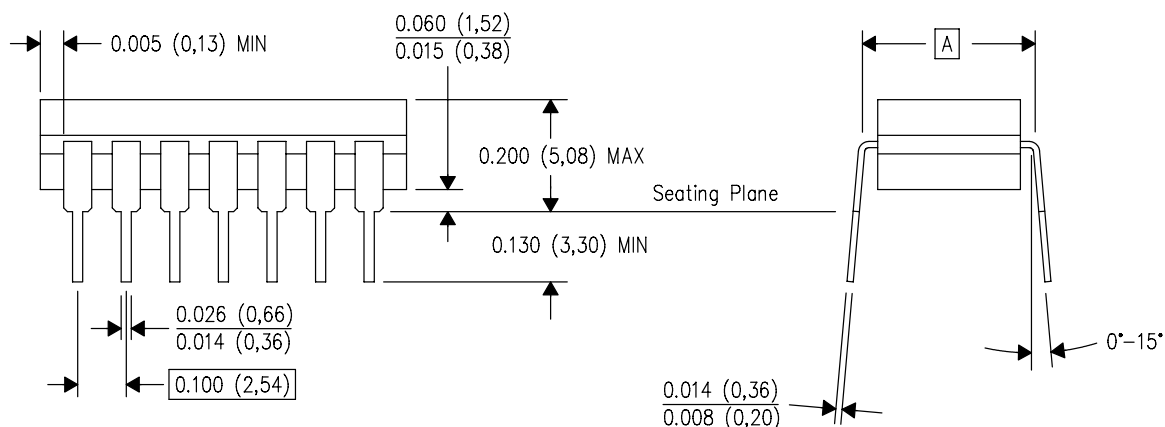
DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	——	——	——	——
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)

B

14   8

C

1   7

$\dfrac{0.065\ (1,65)}{0.045\ (1,14)}$

0.005 (0,13) MIN

$\dfrac{0.060\ (1,52)}{0.015\ (0,38)}$

A

0.200 (5,08) MAX

Seating Plane

0.130 (3,30) MIN

$\dfrac{0.026\ (0,66)}{0.014\ (0,36)}$

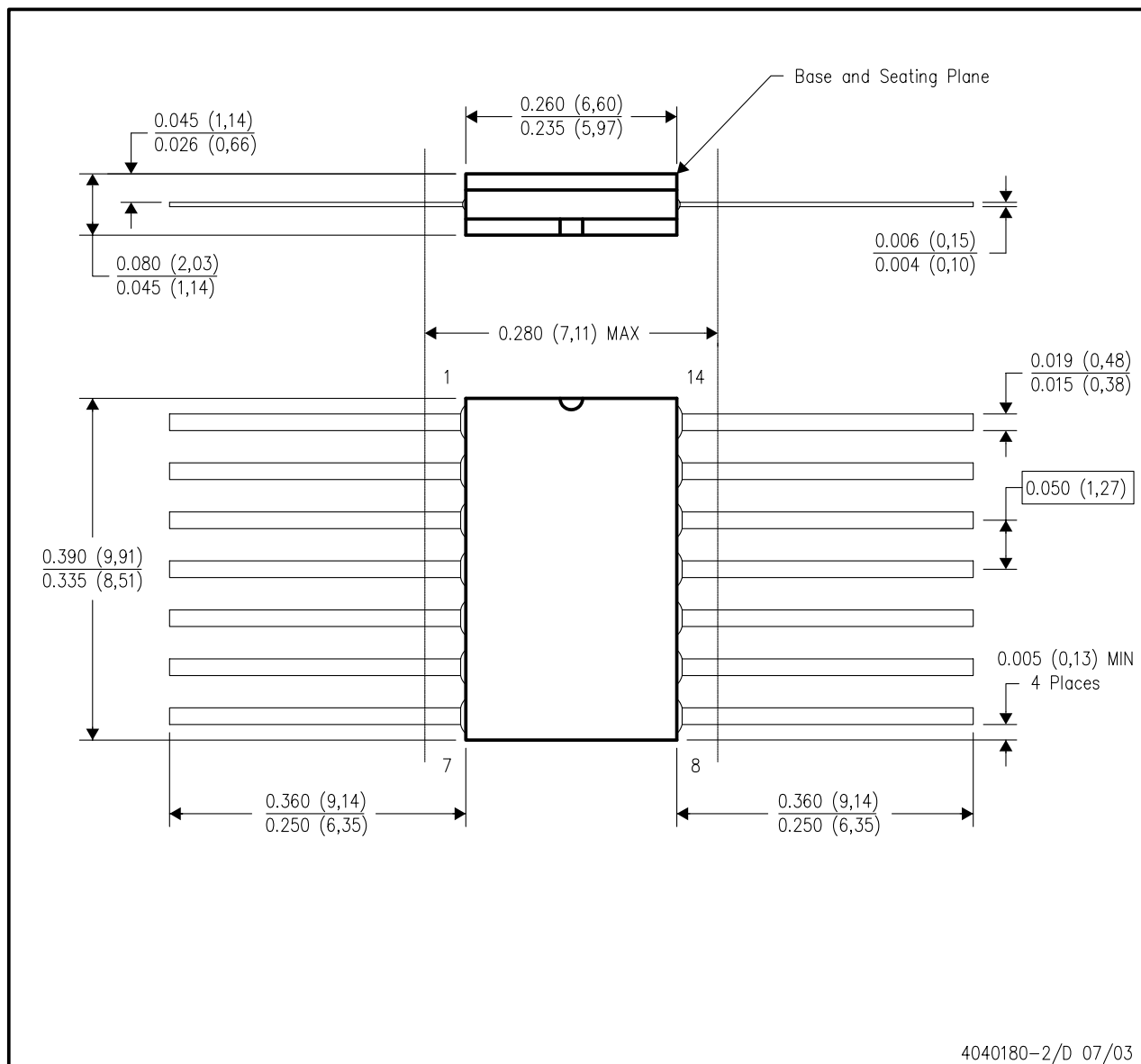0.100 (2,54)

0°—15°

$\dfrac{0.014\ (0,36)}{0.008\ (0,20)}$

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.

W (R–GDFP–F14)   CERAMIC DUAL FLATPACK

Base and Seating Plane

0.260 (6,60)
0.235 (5,97)

0.045 (1,14)
0.026 (0,66)

0.006 (0,15)
0.004 (0,10)

0.080 (2,03)
0.045 (1,14)

0.280 (7,11) MAX

1   14

0.019 (0,48)
0.015 (0,38)

0.050 (1,27)

0.390 (9,91)
0.335 (8,51)

0.005 (0,13) MIN
4 Places

7   8

0.360 (9,14)
0.250 (6,35)

0.360 (9,14)
0.250 (6,35)

4040180–2/D 07/03

NOTES: A.   All linear dimensions are in inches (millimeters).
         B.   This drawing is subject to change without notice.
         C.   This package can be hermetically sealed with a ceramic lid using glass frit.
         D.   Index point is provided on cap for terminal identification only.
         E.   Falls within MIL STD 1835 GDFP1–F14 and JEDEC MO–092AB

FK (S-CQCC-N**)

28 TERMINAL SHOWN

LEADLESS CERAMIC CHIP CARRIER
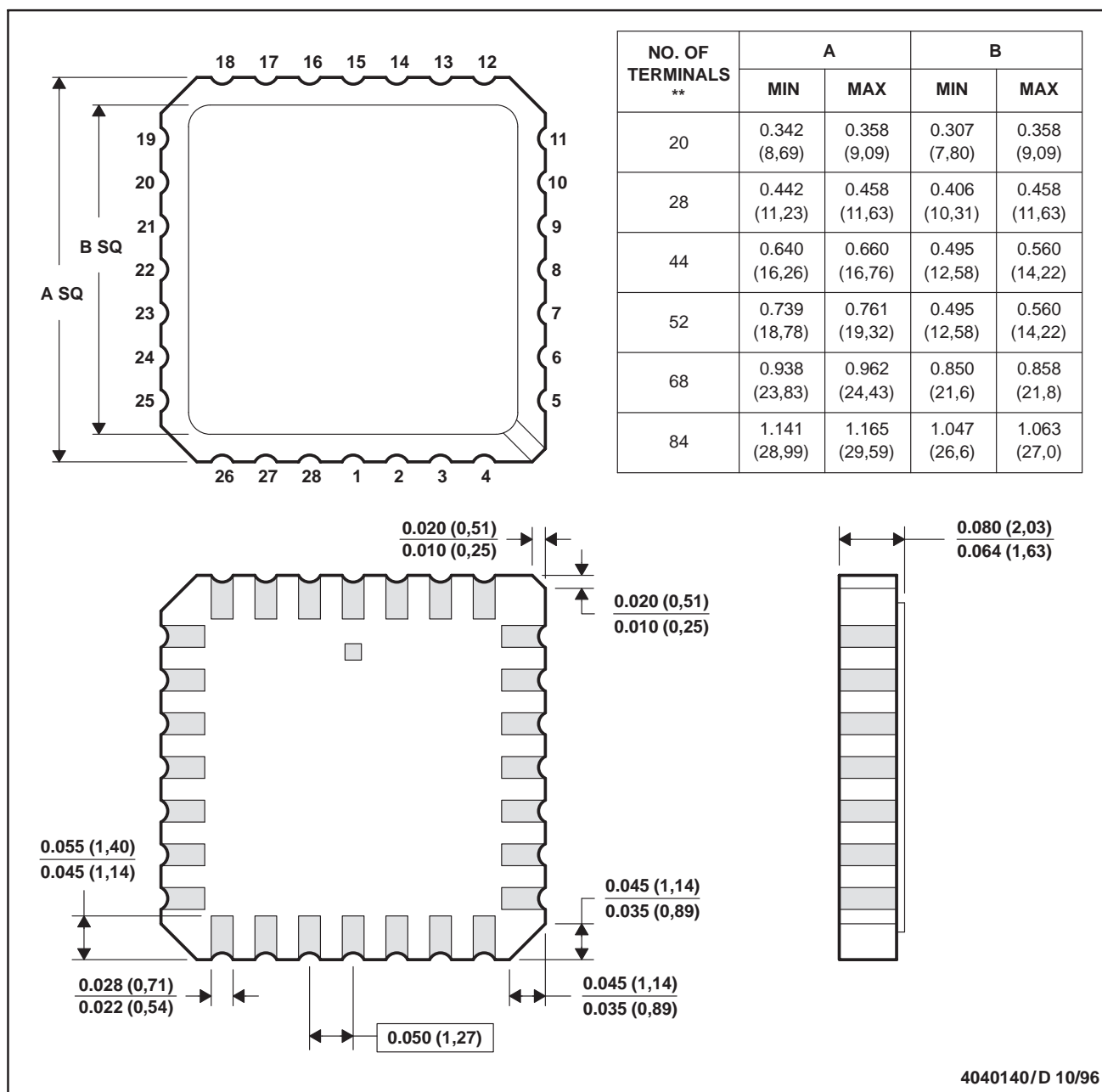
NO. OF TERMINALS **	A		B	
	MIN	**MAX**	**MIN**	**MAX**
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.739 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)

0.020 (0,51) / 0.010 (0,25)

0.020 (0,51) / 0.010 (0,25)

0.080 (2,03) / 0.064 (1,63)

0.055 (1,40) / 0.045 (1,14)

0.045 (1,14) / 0.035 (0,89)

0.028 (0,71) / 0.022 (0,54)

0.045 (1,14) / 0.035 (0,89)

0.050 (1,27)

4040140 / D 10/96

NOTES: A. All linear dimensions are in inches (millimeters).
   B. This drawing is subject to change without notice.
   C. This package can be hermetically sealed with a metal lid.
   D. The terminals are gold plated.
   E. Falls within JEDEC MS-004

TEXAS
INSTRUMENTS
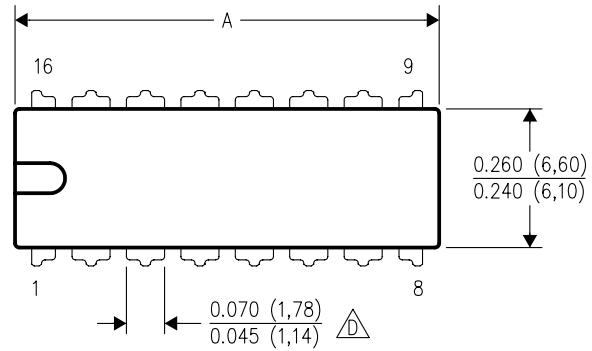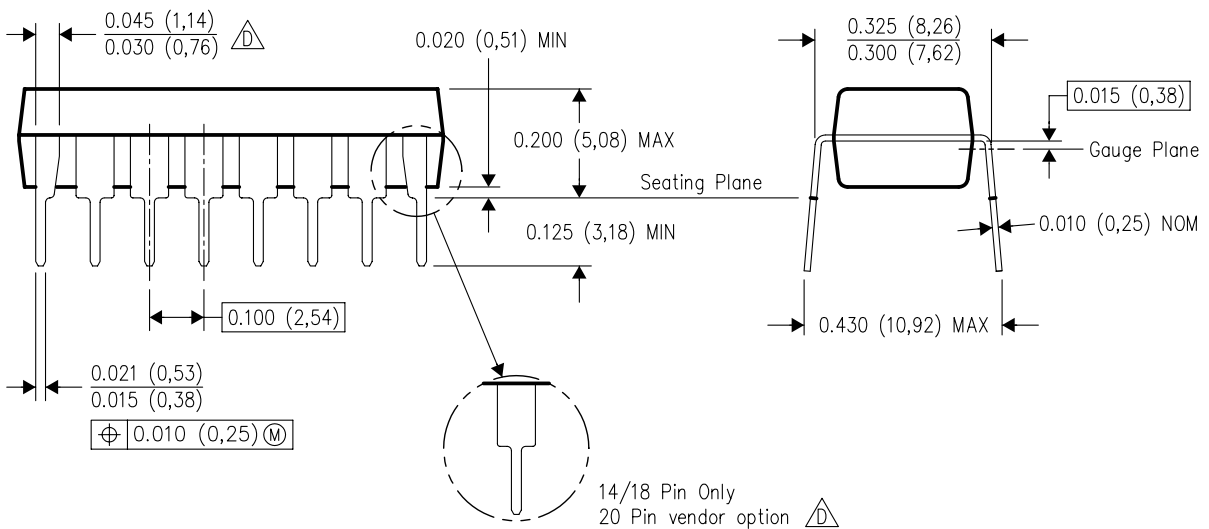POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

N (R−PDIP−T**)   PLASTIC DUAL−IN−LINE PACKAGE

16 PINS SHOWN

PINS ** DIM	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

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

0.070 (1,78)
0.045 (1,14)

0.045 (1,14)
0.030 (0,76)

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

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

0.015 (0,38)

Gauge Plane

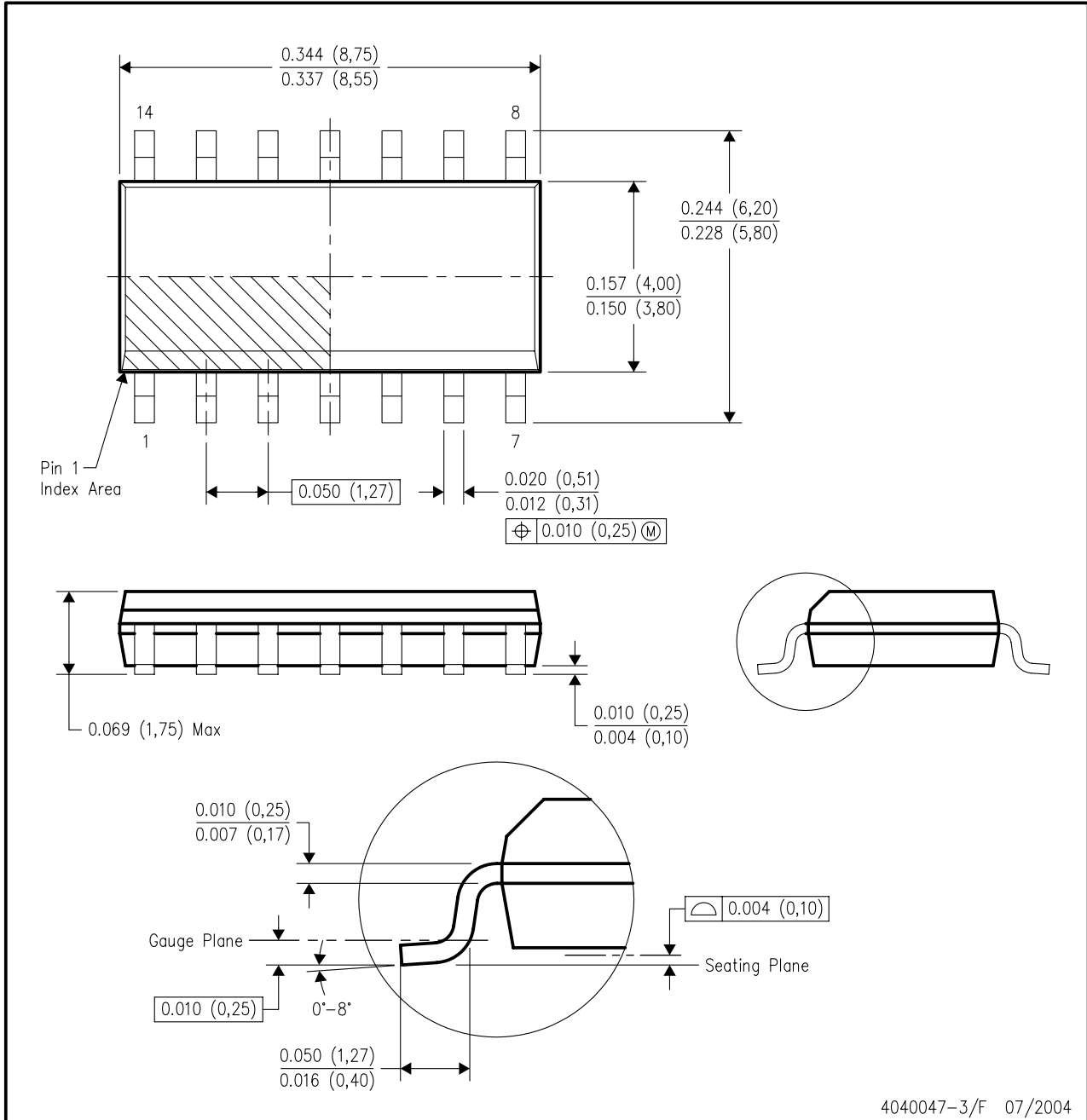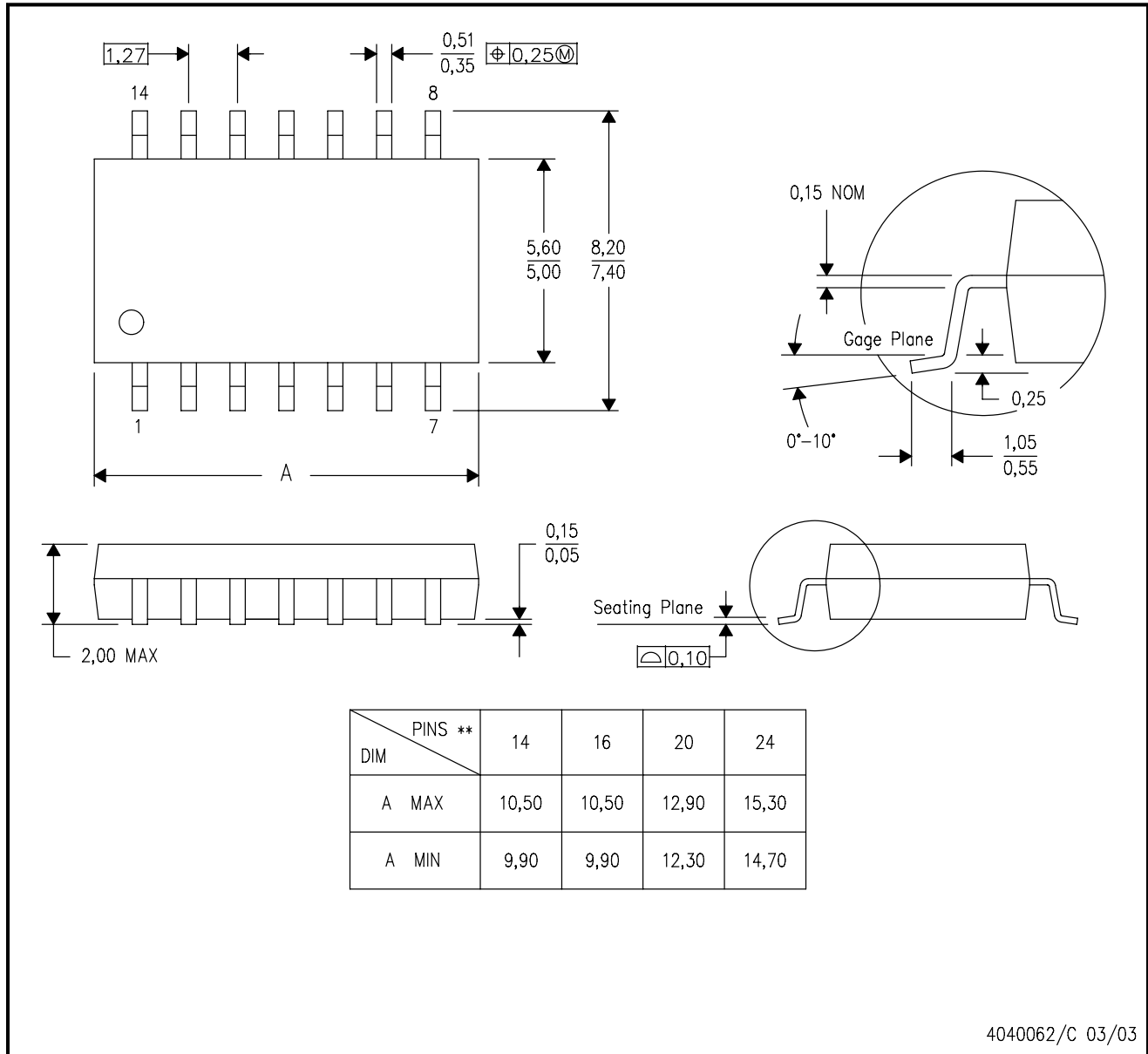0.010 (0,25) NOM

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.

D (R-PDSO-G14)   PLASTIC SMALL-OUTLINE PACKAGE

0.344 (8,75)
0.337 (8,55)

14

8

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

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

Pin 1
Index Area

1

7

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)

4040047-3/F   07/2004
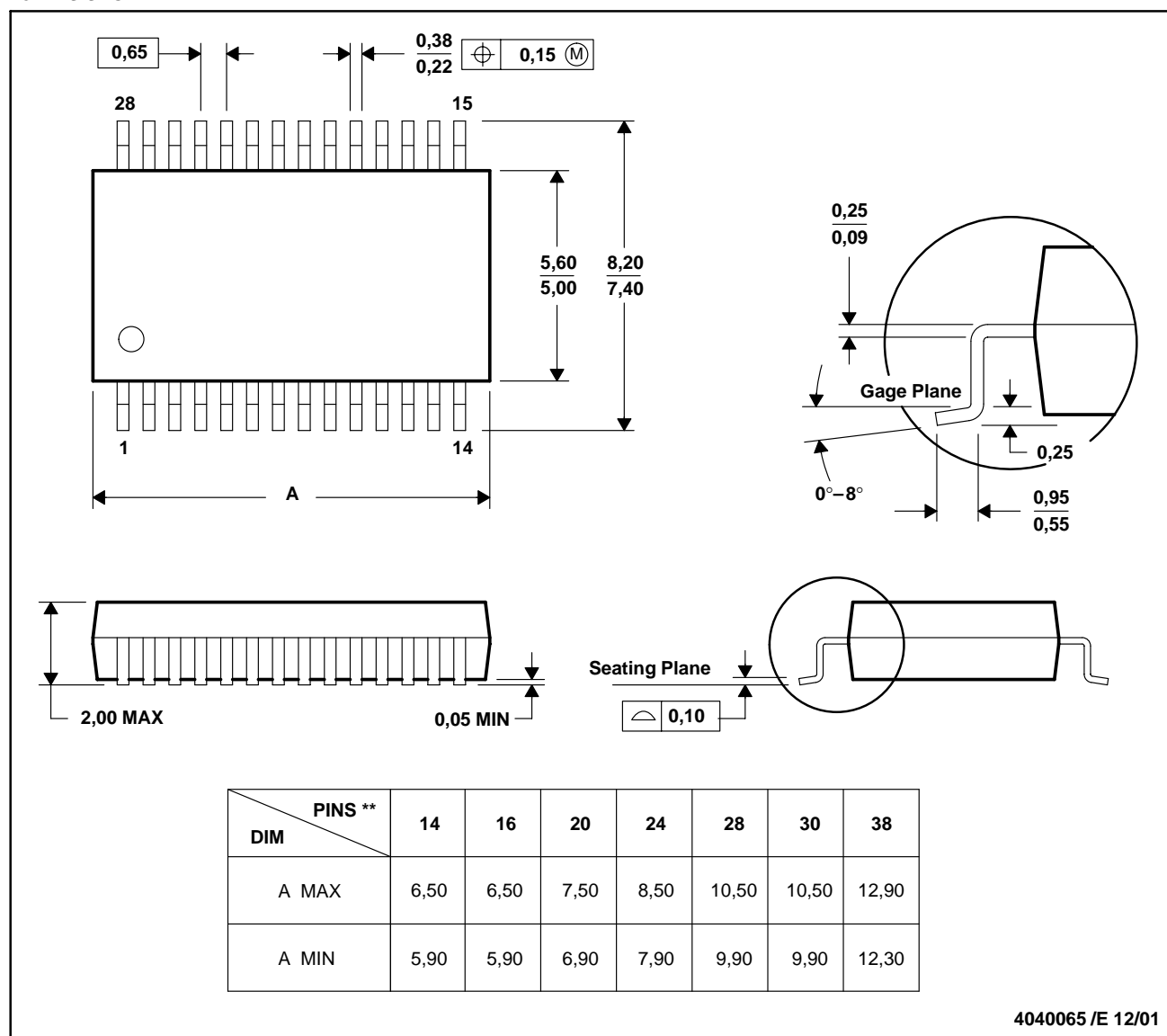
NOTES: A.   All linear dimensions are in inches (millimeters).
           B.   This drawing is subject to change without notice.
           C.   Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
           D.   Falls within JEDEC MS-012 variation AB.

MECHANICAL DATA

NS (R-PDSO-G**)
14-PINS SHOWN

PLASTIC SMALL-OUTLINE PACKAGE

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.

DB (R-PDSO-G**)   **PLASTIC SMALL-OUTLINE**

28 PINS SHOWN

PINS ** DIM	14	16	20	24	28	30	38
A MAX	6,50	6,50	7,50	8,50	10,50	10,50	12,90
A MIN	5,90	5,90	6,90	7,90	9,90	9,90	12,30

4040065 /E 12/01

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-150

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Mailing Address: Texas Instruments
                    Post Office Box 655303 Dallas, Texas 75265