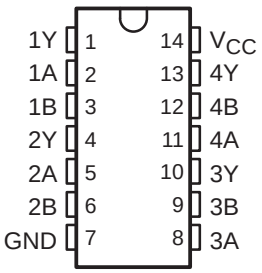
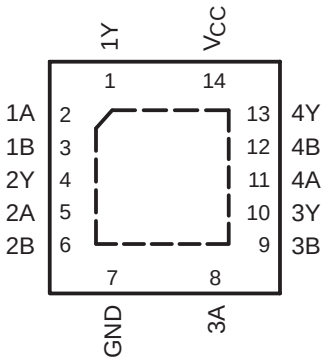
- Operate From 1.65 V to 3.6 V
- Specified From −40°C to 85°C, −40°C to 125°C, and −55°C to 125°C
- Inputs Accept Voltages to 5.5 V
- Max t_{pd} of 4.4 ns at 3.3 V
- Typical V_{OLP} (Output Ground Bounce) <0.8 V at V_{CC} = 3.3 V, T_A = 25°C
- Typical V_{OHV} (Output V_{OH} Undershoot) >2 V at V_{CC} = 3.3 V, T_A = 25°C
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

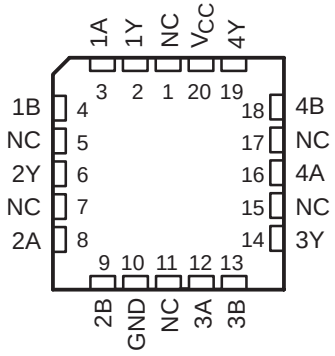
SN54LVC02A . . . J OR W PACKAGE
SN74LVC02A . . . D, DB, NS, OR PW PACKAGE
(TOP VIEW)



SN74LVC02A . . . RGY PACKAGE
(TOP VIEW)



SN54LVC02A . . . FK PACKAGE
(TOP VIEW)



NC − No internal connection

description/ordering information

The SN54LVC02A quadruple 2-input positive-NOR gate is designed for 2.7-V to 3.6-V V_{CC} operation, and the SN74LVC02A quadruple 2-input positive-NOR gate is designed for 1.65-V to 3.6-V V_{CC} operation.

The ’LVC02A devices perform the Boolean function $Y = \overline{A + B}$ or $Y = \overline{A} \bullet \overline{B}$ in positive logic.

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
−40°C to 85°C	QFN − RGY	Reel of 1000	SN74LVC02ARGYR	LC02A
−40°C to 125°C	SOIC − D	Tube of 50	SN74LVC02AD	LVC02A
		Reel of 2500	SN74LVC02ADR	
		Reel of 250	SN74LVC02ADT	
	SOP − NS	Reel of 2000	SN74LVC02ANSR	LVC02A
	SSOP − DB	Reel of 2000	SN74LVC02ADBR	LC02A
	TSSOP − PW	Tube of 90	SN74LVC02APW	LC02A
		Reel of 2000	SN74LVC02APWR	
		Reel of of 250	SN74LVC02APWT	
−55°C to 125°C	CDIP − J	Tube of 25	SNJ54LVC02AJ	SNJ54LVC02AJ
	CFP − W	Tube of 150	SNJ54LVC02AW	SNJ54LVC02AW
	LCCC − FK	Tube of 55	SNJ54LVC02AFK	SNJ54LVC02AFK

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

description/ordering information (continued)

Inputs can be driven from either 3.3-V or 5-V devices. This feature allows the use of these devices as translators in a mixed 3.3-V/5-V system environment.

FUNCTION TABLE
(each gate)

INPUTS		OUTPUT
A	B	Y
H	X	L
X	H	L
L	L	H

logic diagram, each gate (positive logic)

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

Supply-voltage range, V_{CC} . . . . . −0.5 V to 6.5 V
Input-voltage range, V_I (see Note 1) . . . . . −0.5 V to 6.5 V
Output-voltage range, V_O (see Notes 1 and 2) . . . . . −0.5 V to V_{CC} + 0.5 V
Input clamp current, I_{IK} (V_I < 0) . . . . . −50 mA
Output clamp current, I_{OK} (V_O < 0) . . . . . −50 mA
Continuous output current, I_O . . . . . ±50 mA
Continuous current through V_{CC} or GND . . . . . ±100 mA
Package thermal impedance, θ_{JA} (see Note 3): D package . . . . . 86°C/W
(see Note 3): DB package . . . . . 96°C/W
(see Note 3): NS package . . . . . 76°C/W
(see Note 3): PW package . . . . . 113°C/W
(see Note 4): RGY package . . . . . 47°C/W
Storage temperature range, T_{stg} . . . . . −65°C to 150°C
Power dissipation, P_{tot} (T_A = −40°C to 125°C) (see Notes 5 and 6) . . . . . 500 mW

† 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.

NOTES: 1. The input negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. The value of V_{CC} is provided in the recommended operating conditions table.
3. The package thermal impedance is calculated in accordance with JESD 51-7.
4. The package thermal impedance is calculated in accordance with JESD 51-5.
5. For the D package: above 70°C, the value of P_{tot} derates linearly with 8 mW/K.
6. For the DB, NS, and PW packages: above 60°C, the value of P_{tot} derates linearly with 5.5 mW/K.

recommended operating conditions (see Note 7)

			SN54LVC02A		UNIT
			−55 TO 125°C		
			MIN	MAX	
V_{CC}	Supply voltage	Operating	2	3.6	V
		Data retention only	1.5		
V_{IH}	High-level input voltage	V_{CC} = 2.7 V to 3.6 V	2		V
V_{IL}	Low-level input voltage	V_{CC} = 2.7 V to 3.6 V		0.8	V
V_I	Input voltage		0	5.5	V
V_O	Output voltage		0	V_{CC}	V
I_{OH}	High-level output current	V_{CC} = 2.7 V		−12	mA
		V_{CC} = 3 V		−24	
I_{OL}	Low-level output current	V_{CC} = 2.7 V		12	mA
		V_{CC} = 3 V		24	

NOTE 7: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

recommended operating conditions (see Note 7)

			SN74LVC02A						UNIT
			T_A = 25°C		−40 TO 85°C		−40 TO 125°C		
			MIN	MAX	MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage	Operating	1.65	3.6	1.65	3.6	1.65	3.6	V
		Data retention only	1.5		1.5		1.5		
V_{IH}	High-level input voltage	V_{CC} = 1.65 V to 1.95 V	0.65 × V_{CC}		0.65 × V_{CC}		0.65 × V_{CC}		V
		V_{CC} = 2.3 V to 2.7 V	1.7		1.7		1.7		
		V_{CC} = 2.7 V to 3.6 V	2		2		2		
V_{IL}	Low-level input voltage	V_{CC} = 1.65 V to 1.95 V		0.35 × V_{CC}		0.35 × V_{CC}		0.35 × V_{CC}	V
		V_{CC} = 2.3 V to 2.7 V		0.7		0.7		0.7	
		V_{CC} = 2.7 V to 3.6 V		0.8		0.8		0.8	
V_I	Input voltage		0	5.5	0	5.5	0	5.5	V
V_O	Output voltage		0	V_{CC}	0	V_{CC}	0	V_{CC}	V
I_{OH}	High-level output current	V_{CC} = 1.65 V		−4		−4		−4	mA
		V_{CC} = 2.3 V		−8		−8		−8	
		V_{CC} = 2.7 V		−12		−12		−12	
		V_{CC} = 3 V		−24		−24		−24	
I_{OL}	Low-level output current	V_{CC} = 1.65 V		4		4		4	mA
		V_{CC} = 2.3 V		8		8		8	
		V_{CC} = 2.7 V		12		12		12	
		V_{CC} = 3 V		24		24		24	

NOTE 7: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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

PARAMETER	TEST CONDITIONS		V_{CC}	SN54LVC02A −55 TO 125°C			UNIT
				MIN	TYP	MAX	
V_{OH}	I_{OH} = −100 μA		2.7 V to 3.6 V	V_{CC}−0.2			V
	I_{OH} = −12 mA		2.7 V	2.2			
			3 V	2.4			
	I_{OH} = −24 mA		3 V	2.2			
V_{OL}	I_{OL} = 100 μA		2.7 V to 3.6 V			0.2	V
	I_{OL} = 12 mA		2.7 V			0.4	
	I_{OL} = 24 mA		3 V			0.55	
I_I	V_I = 5.5 V or GND		3.6 V			±5	μA
I_{CC}	V_I = V_{CC} or GND	I_O = 0	3.6 V			10	μA
ΔI_{CC}	One input at V_{CC} − 0.6 V, Other inputs at V_{CC} or GND		2.7 V to 3.6 V			500	μA
C_i	V_I = V_{CC} or GND		3.3 V		5†		pF

† T_A = 25°C

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

PARAMETER	TEST CONDITIONS		V_{CC}	SN74LVC02A T_A = 25°C			−40 TO 85°C		−40 TO 125°C		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V_{OH}	I_{OH} = −100 μA		1.65 V to 3.6 V	V_{CC}−0.2			V_{CC}−0.2		V_{CC}−0.3		V
	I_{OH} = −4 mA		1.65 V	1.29			1.2		1.05		
	I_{OH} = −8 mA		2.3 V	1.9			1.7		1.55		
	I_{OH} = −12 mA		2.7 V	2.2			2.2		2.05		
			3 V	2.4			2.4		2.25		
	I_{OH} = −24 mA		3 V	2.3			2.2		2		
V_{OL}	I_{OL} = 100 μA		1.65 V to 3.6 V			0.1		0.2		0.3	V
	I_{OL} = 4 mA		1.65 V			0.24		0.45		0.6	
	I_{OL} = 8 mA		2.3 V			0.3		0.7		0.75	
	I_{OL} = 12 mA		2.7 V			0.4		0.4		0.6	
	I_{OL} = 24 mA		3 V			0.55		0.55		0.8	
I_I	V_I = 5.5 V or GND		3.6 V			±1		±5		±20	μA
I_{CC}	V_I = V_{CC} or GND	I_O = 0	3.6 V			1		10		40	μA
ΔI_{CC}	One input at V_{CC} − 0.6 V, Other inputs at V_{CC} or GND		2.7 V to 3.6 V			500		500		5000	μA
C_i	V_I = V_{CC} or GND		3.3 V		5						pF

switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	SN54LVC02A −55 TO 125°C		UNIT
				MIN	MAX	
t_{pd}	A or B	Y	2.7 V		5.4	ns
			3.3 V ± 0.3 V	1	4.4	

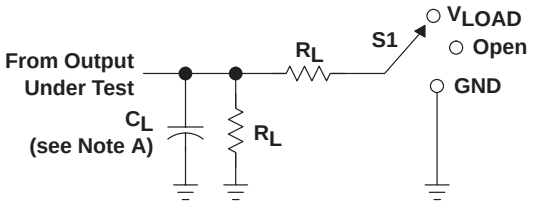
switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	SN74LVC02A							UNIT
				T_A = 25°C			−40 TO 85°C		−40 TO 125°C		
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A or B	Y	1.8 V ± 0.15 V	1	3.8	8.4	1	8.9	1	10.4	ns
			2.5 V ± 0.2 V	1	2.9	6.9	1	7.4	1	9.5	
			2.7 V	1	3	5.2	1	5.4	1	7	
			3.3 V ± 0.3 V	1	3.6	4.2	1	4.4	1	5.5	
$t_{sk(o)}$			3.3 V ± 0.3 V					1		1.5	ns

operating characteristics, T_A = 25°C

PARAMETER		TEST CONDITIONS	V_{CC}	TYP	UNIT
C_{pd}	Power dissipation capacitance per gate	f = 10 MHz	1.8 V	7.5	pF
			2.5 V	8.5	
			3.3 V	9.5	

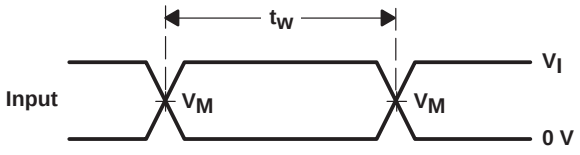
PARAMETER MEASUREMENT INFORMATION



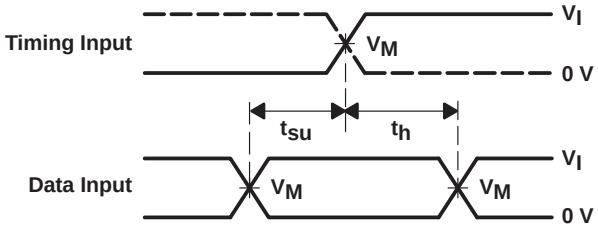
LOAD CIRCUIT

TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_{LOAD}
t_{PHZ}/t_{PZH}	GND

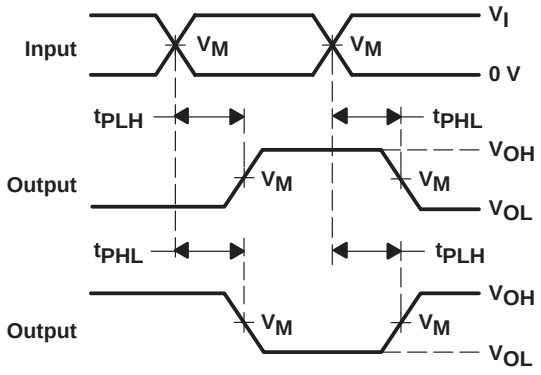
V_{CC}	INPUTS		V_M	V_{LOAD}	C_L	R_L	V_Δ
	V_I	t_r/t_f					
1.8 V ± 0.15 V	V_{CC}	≤2 ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 kΩ	0.15 V
2.5 V ± 0.2 V	V_{CC}	≤2 ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 Ω	0.15 V
2.7 V	2.7 V	≤2.5 ns	1.5 V	6 V	50 pF	500 Ω	0.3 V
3.3 V ± 0.3 V	2.7 V	≤2.5 ns	1.5 V	6 V	50 pF	500 Ω	0.3 V



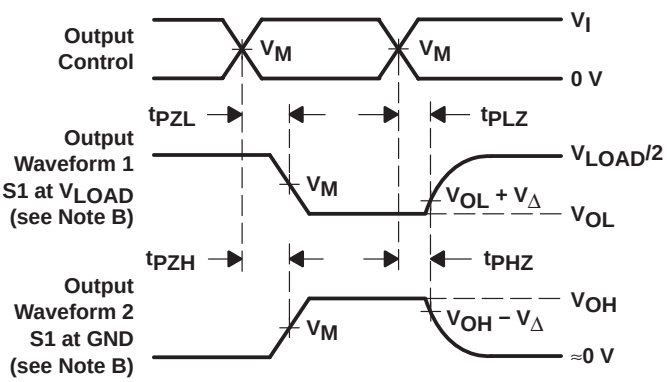
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

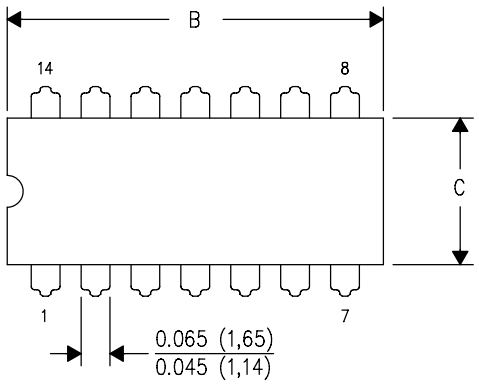
NOTES: A. C_L includes probe and jig capacitance.
B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
C. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50 Ω.
D. The outputs are measured one at a time, with one transition per measurement.
E. t_{PLZ} and t_{PHZ} are the same as t_{dis}.
F. t_{PZL} and t_{PZH} are the same as t_{en}.
G. t_{PLH} and t_{PHL} are the same as t_{pd}.
H. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

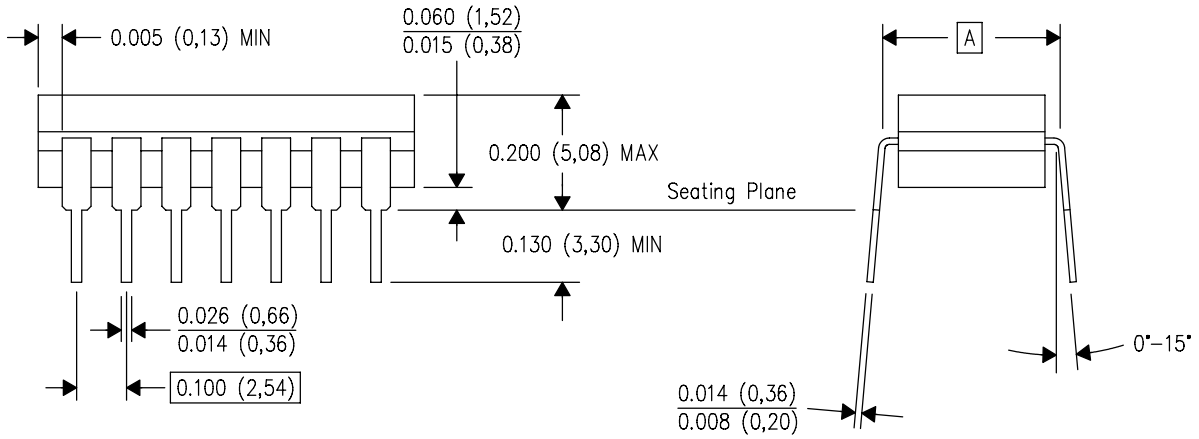
J (R–GDIP–T**)

14 LEADS SHOWN

CERAMIC DUAL IN–LINE PACKAGE



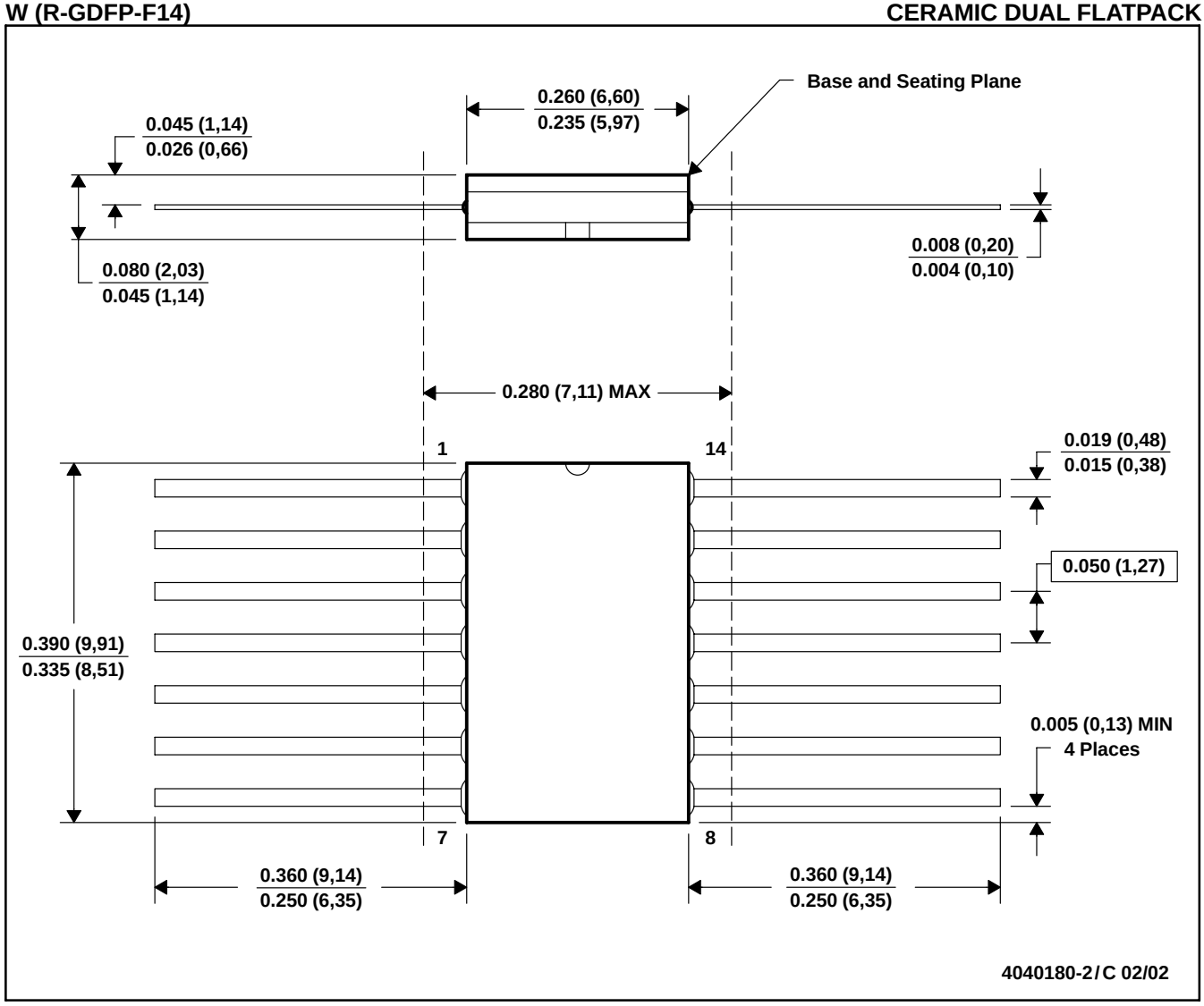
DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



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.

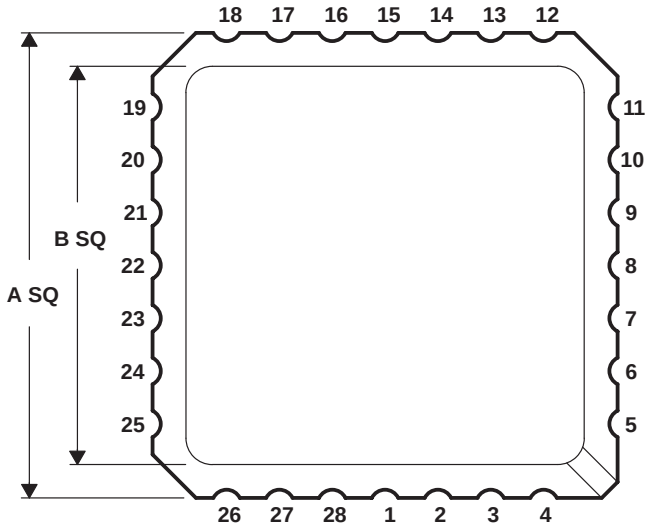
W (R-GDFP-F14) **CERAMIC DUAL FLATPACK**



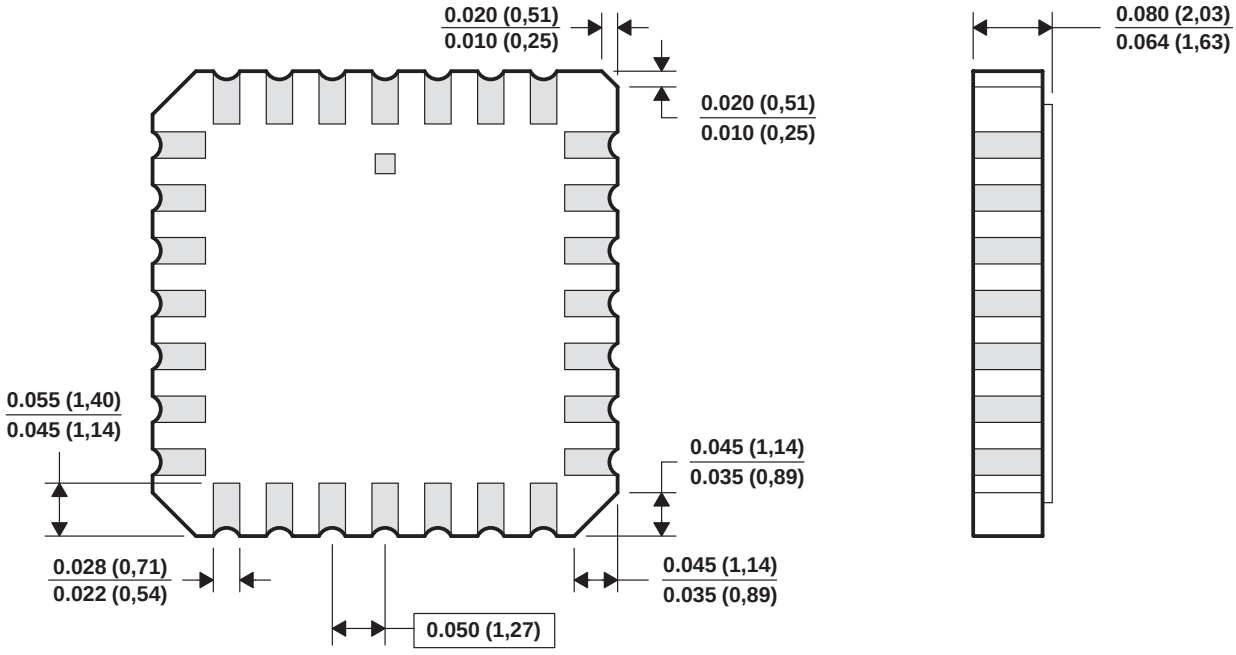
NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only.
E. Falls within MIL STD 1835 GDFP1-F14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

FK (S-CQCC-N)** **LEADLESS CERAMIC CHIP CARRIER**

28 TERMINAL SHOWN



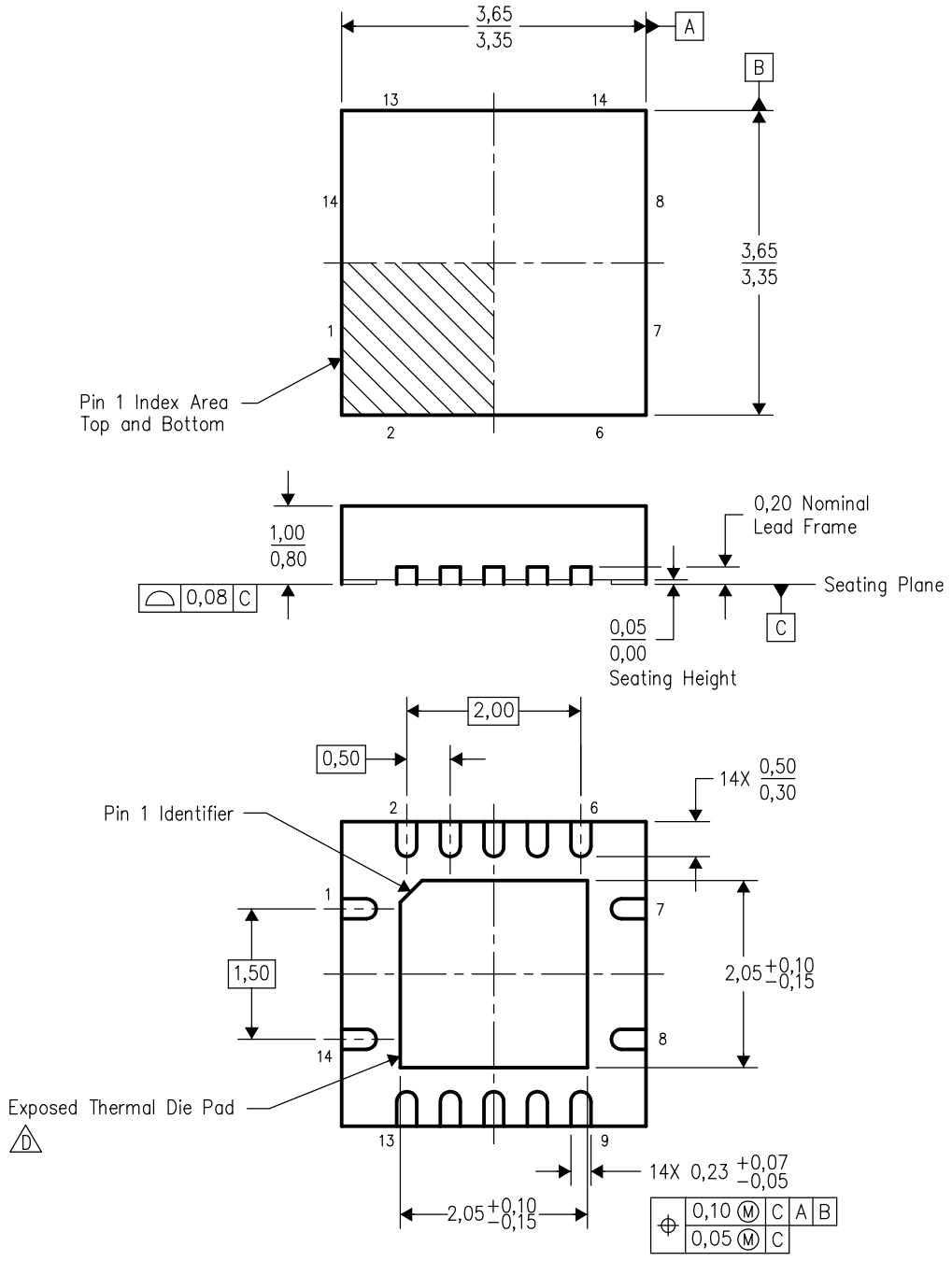
NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.739 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	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)



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

RGY (S–PQFP–N14) PLASTIC QUAD FLATPACK



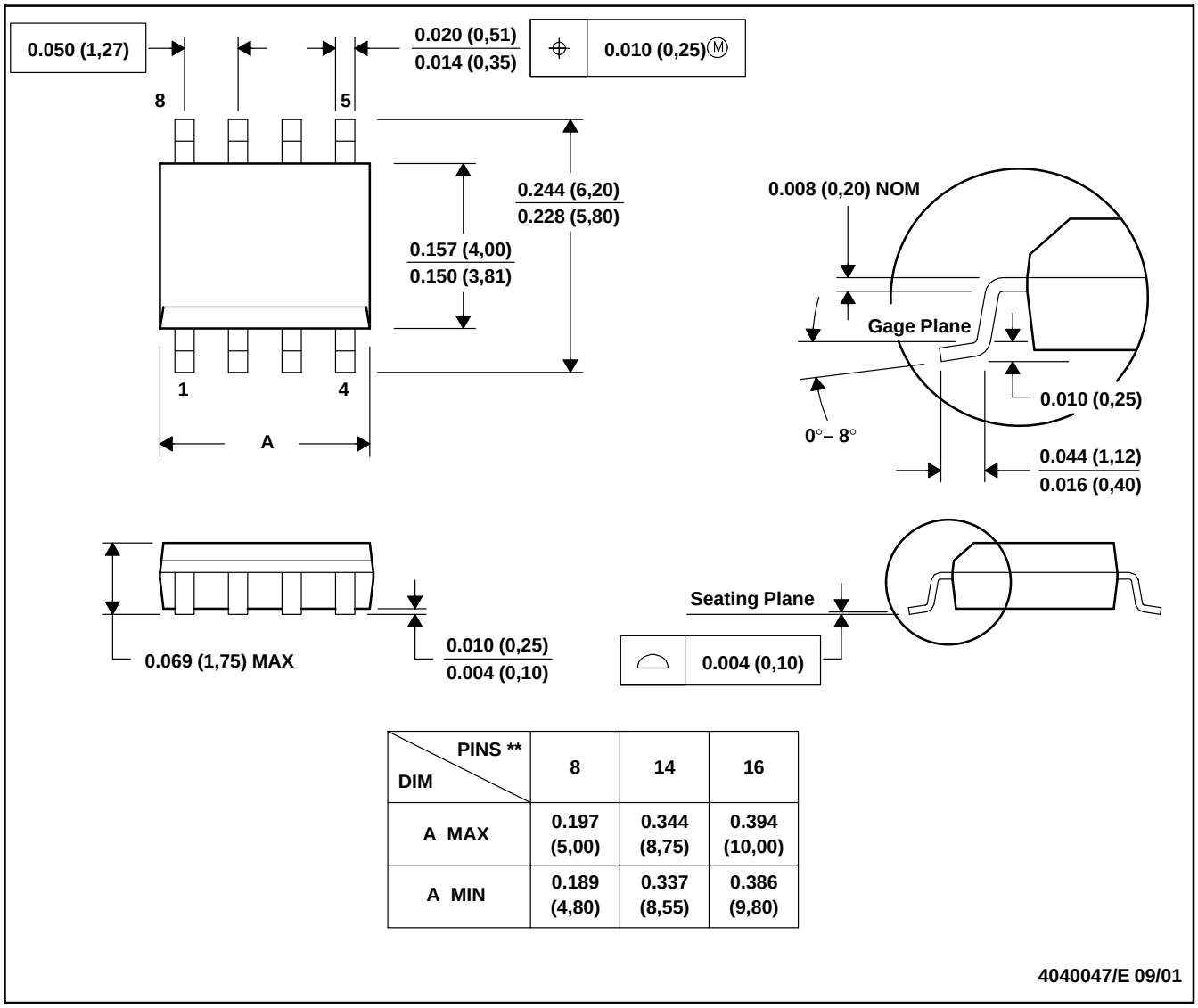
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. QFN (Quad Flatpack No–Lead) package configuration.
D. The package thermal performance may be enhanced by bonding the thermal die pad to an external thermal plane. This pad is electrically and thermally connected to the backside of the die and possibly selected ground leads.
E. Package complies to JEDEC MO–241 variation BA.

MSOI002B – JANUARY 1995 – REVISED SEPTEMBER 2001

D (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

8 PINS SHOWN



DIM \ PINS **	8	14	16
A MAX	0.197 (5,00)	0.344 (8,75)	0.394 (10,00)
A MIN	0.189 (4,80)	0.337 (8,55)	0.386 (9,80)

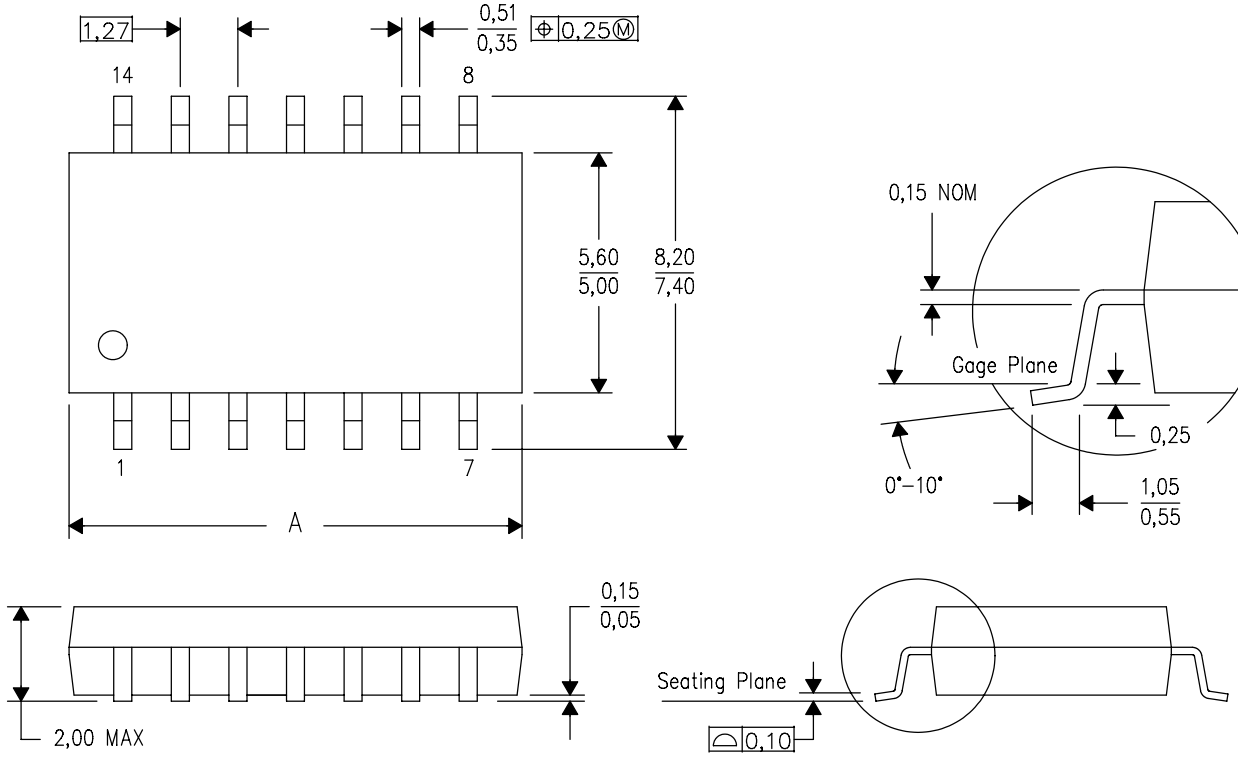
4040047/E 09/01

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



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.

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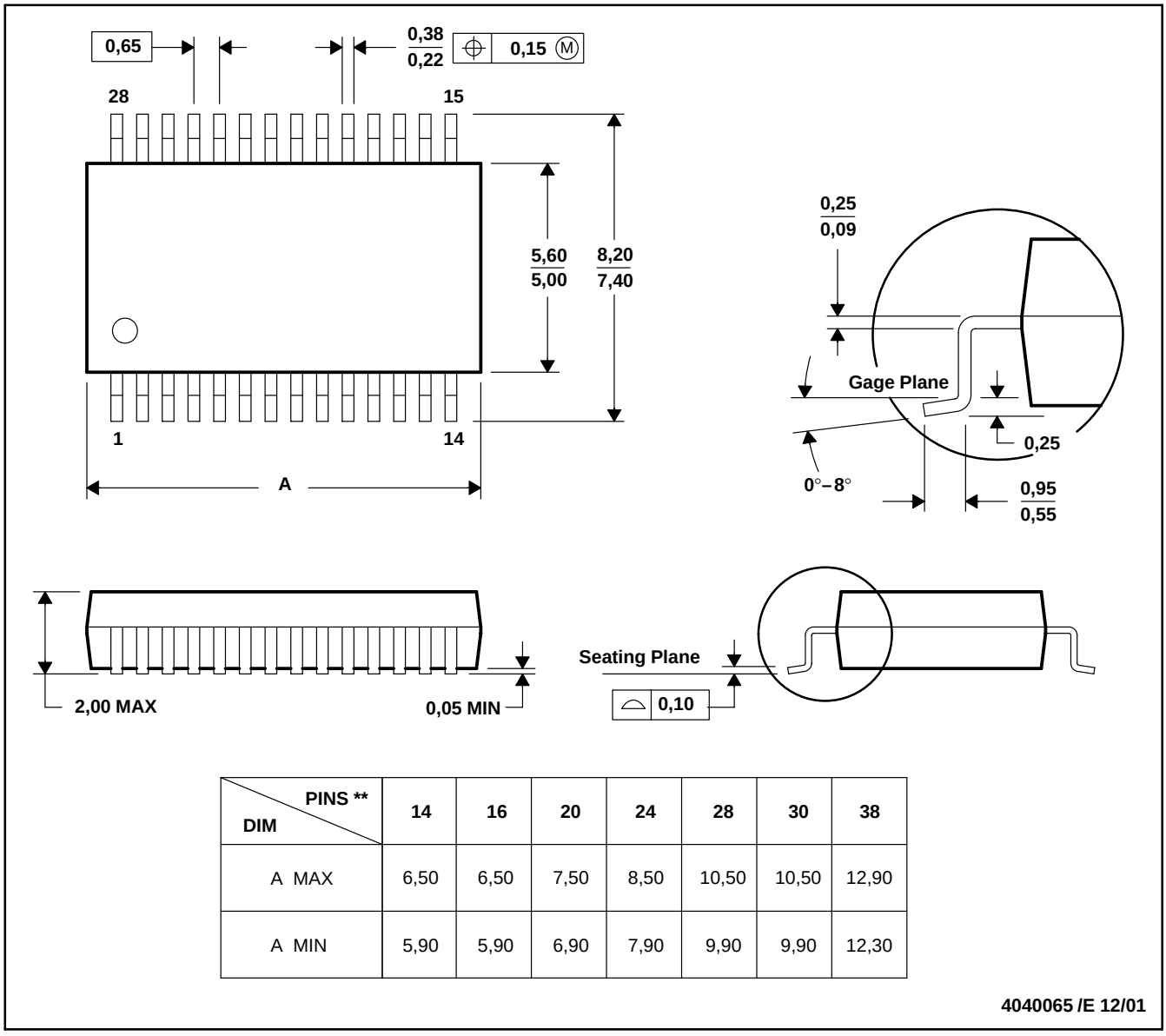
DB (R-PDSO-G)** **PLASTIC SMALL-OUTLINE**

28 PINS SHOWN



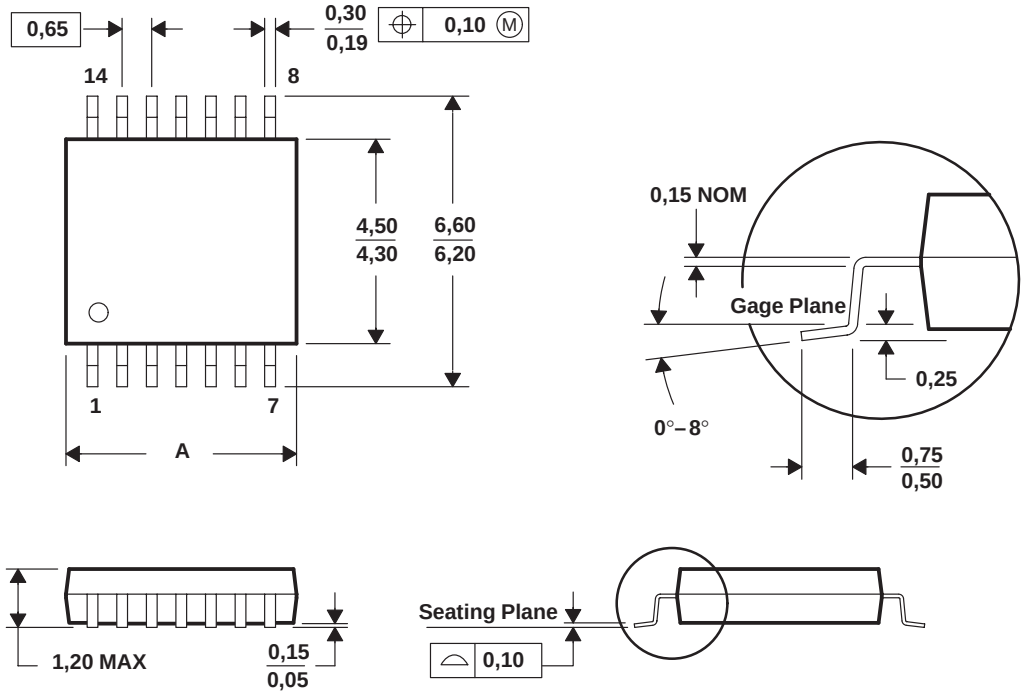
DIM \ PINS **	14	16	20	24	28	30	38
A MAX	6,50	6,50	7,50	8,50	10,50	10,50	12,90
A MIN	5,90	5,90	6,90	7,90	9,90	9,90	12,30

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

PW (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14 PINS SHOWN



DIM \ PINS **	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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Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265