DUAL 2-LINE TO 4-LINE DECODER/DEMULTIPLEXER

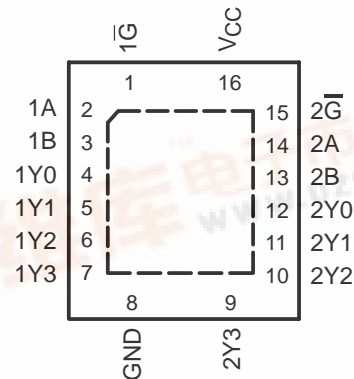- **Operates From 1.65 V to 3.6 V**
- **Inputs Accept Voltages to 5.5 V**
- **Max t_{pd} of 6.2 ns**
- **Typical V_{OLP} (Output Ground Bounce) <0.8 V at V_{CC} = 3.3 V, T_A = 25°C**
- **Typical V_{OHV} (Output V_{OH} Undershoot) >2 V at V_{CC} = 3.3 V, T_A = 25°C**

- **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)

D, DB, DGV, NS, OR PW PACKAGE
(TOP VIEW)

```
     1G̅ [ 1      16 ] V_CC
     1A [ 2      15 ] 2G̅
     1B [ 3      14 ] 2A
    1Y0 [ 4      13 ] 2B
    1Y1 [ 5      12 ] 2Y0
    1Y2 [ 6      11 ] 2Y1
    1Y3 [ 7      10 ] 2Y2
    GND [ 8       9 ] 2Y3
```

RGY PACKAGE
(TOP VIEW)

```
          1G̅   V_CC
           1    16
     1A   2          15   2G̅
     1B   3          14   2A
    1Y0   4          13   2B
    1Y1   5          12   2Y0
    1Y2   6          11   2Y1
    1Y3   7          10   2Y2
           8    9
          GND  2Y3
```
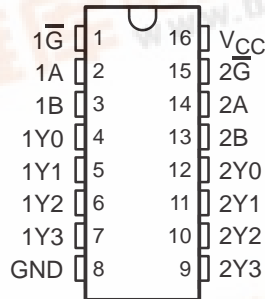
description/ordering information

This dual 2-line to 4-line decoder/demultiplexer is designed for 1.65-V to 3.6-V V_{CC} operation.

The device comprises two individual 2-line to 4-line decoders in a single package. The active-low enable ($\overline{G}$) input can be used as a data line in demultiplexing applications. This decoder/demultiplexer features fully buffered inputs, each of which represents only one normalized load to its driving circuit.

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	QFN – RGY	Reel of 1000	SN74LVC139ARGYR	LC139A
	SOIC – D	Tube of 40	SN74LVC139AD	LVC139A
		Reel of 2500	SN74LVC139ADR	
		Reel of 250	SN74LVC139ADT	
	SOP – NS	Reel of 2000	SN74LVC139ANSR	LVC139A
	SSOP – DB	Reel of 2000	SN74LVC139ADBR	LC139A
	TSSOP – PW	Tube of 90	SN74LVC139APW	LC139A
		Reel of 2000	SN74LVC139APWR	
		Reel of 250	SN74LVC139APWT	
	TVSOP – DGV	Reel of 2000	SN74LVC139ADGVR	LC139A
	VFBGA – GQN	Reel of 1000	SN74LVC139AGQNR	LC139A
	VFBGA – ZQN (Pb-free)		SN74LVC139AZQNR	

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

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.
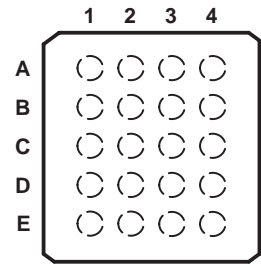
TEXAS INSTRUMENTS

description/ordering information (continued)

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

GQN OR ZQN PACKAGE
(TOP VIEW)

terminal assignments

	1	2	3	4
A	1A	1$\overline{G}$	V$_{CC}$	2$\overline{G}$
B	1B	NC	NC	2A
C	1Y1	1Y0	2Y0	2B
D	1Y2	NC	NC	2Y1
E	GND	1Y3	2Y3	2Y2

NC – No internal connection

FUNCTION TABLE
(each decoder/demultiplexer)

INPUTS			OUTPUTS			
$\overline{G}$	SELECT		Y3	Y2	Y1	Y0
	B	A				
L	L	L	H	H	H	L
L	L	H	H	H	L	H
L	H	L	H	L	H	H
L	H	H	L	H	H	H
H	X	X	H	H	H	H

logic diagram (positive logic)
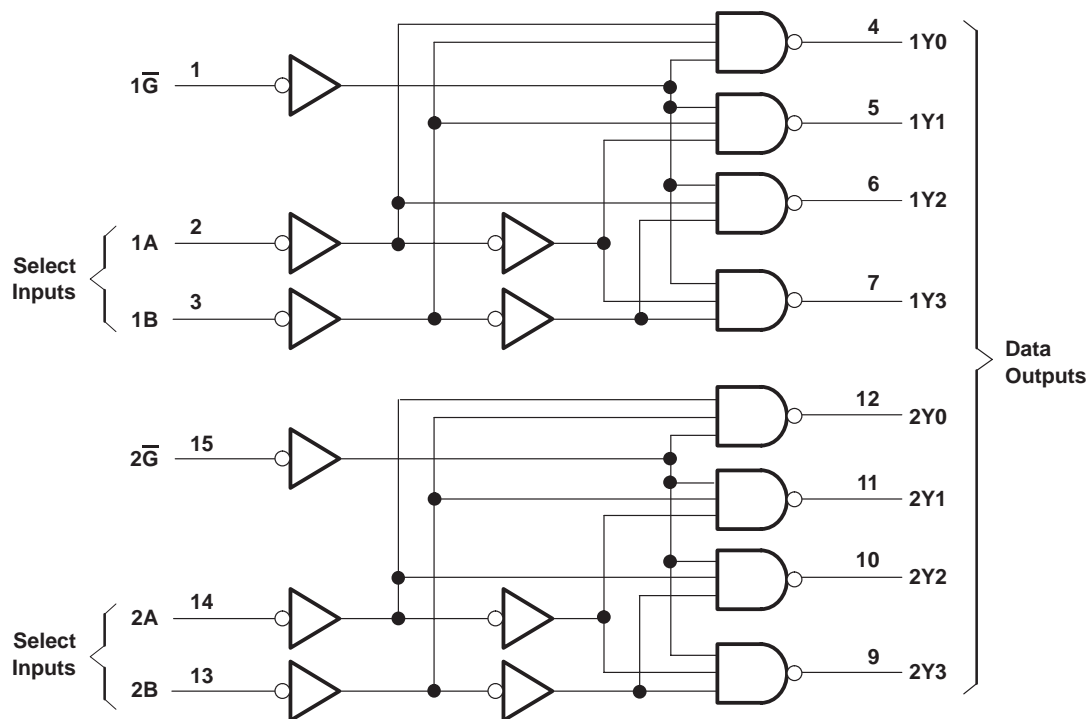
Pin numbers shown are for the D, DB, DGV, NS, PW, and RGY packages.

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 .... 73°C/W

(see Note 3): DB package .... 82°C/W

(see Note 3): DGV package .... 120°C/W

(see Note 3): GQN/ZQN package .... 78°C/W

(see Note 3): NS package .... 64°C/W

(see Note 3): PW package .... 108°C/W

(see Note 4): RGY package .... 39°C/W

Storage temperature range, T_{stg} .... −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.

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.

**TEXAS
INSTRUMENTS**

recommended operating conditions (see Note 5)

			MIN	MAX	UNIT
V_{CC}	Supply voltage	Operating	1.65	3.6	V
		Data retention only	1.5		
V_{IH}	High-level input voltage	V_{CC} = 1.65 V to 1.95 V	$0.65 \times V_{CC}$		V
		V_{CC} = 2.3 V to 2.7 V	1.7		
		V_{CC} = 2.7 V to 3.6 V	2		
V_{IL}	Low-level input voltage	V_{CC} = 1.65 V to 1.95 V		$0.35 \times V_{CC}$	V
		V_{CC} = 2.3 V to 2.7 V		0.7	
		V_{CC} = 2.7 V to 3.6 V		0.8	
V_I	Input voltage		0	5.5	V
V_O	Output voltage		0	V_{CC}	V
I_{OH}	High-level output current	V_{CC} = 1.65 V		−4	mA
		V_{CC} = 2.3 V		−8	
		V_{CC} = 2.7 V		−12	
		V_{CC} = 3 V		−24	
I_{OL}	Low-level output current	V_{CC} = 1.65 V		4	mA
		V_{CC} = 2.3 V		8	
		V_{CC} = 2.7 V		12	
		V_{CC} = 3 V		24	
Δt/Δv	Input transition rise or fall rate			10	ns/V
T_A	Operating free-air temperature		−40	85	°C

NOTE 5: 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}	MIN	TYP†	MAX	UNIT
V_{OH}		I_{OH} = −100 μA	1.65 V to 3.6 V	V_{CC}−0.2			V
		I_{OH} = −4 mA	1.65 V	1.2			
		I_{OH} = −8 mA	2.3 V	1.7			
		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	1.65 V to 3.6 V			0.2	V
		I_{OL} = 4 mA	1.65 V			0.45	
		I_{OL} = 8 mA	2.3 V			0.7	
		I_{OL} = 12 mA	2.7 V			0.4	
		I_{OL} = 24 mA	3 V			0.55	
I_I	All inputs	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

† All typical values are at V_{CC} = 3.3 V, T_A = 25°C.

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 1.8 V $\pm$ 0.15 V		V_{CC} = 2.5 V $\pm$ 0.2 V		V_{CC} = 2.7 V		V_{CC} = 3.3 V $\pm$ 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A or B	Y	1	20.6	1	9.3	1	7.3	1	6.2	ns
	$\overline{G}$		1	19.5	1	7.2	1	5.2	1	4.7	
$t_{sk(o)}$										1	ns

operating characteristics, T_A = 25°C

PARAMETER	TEST CONDITIONS	V_{CC} = 1.8 V	V_{CC} = 2.5 V	V_{CC} = 3.3 V	UNIT
		TYP	TYP	TYP	
C_{pd} Power dissipation capacitance	f = 10 MHz	28.5	29.5	30.5	pF

PARAMETER MEASUREMENT INFORMATION
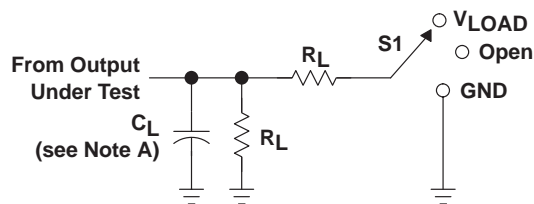
LOAD CIRCUIT

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

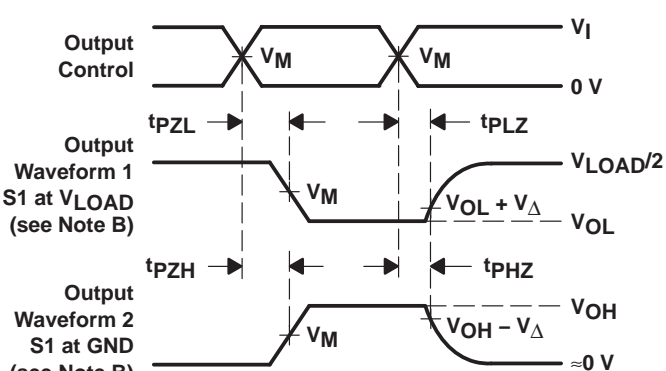| V_{CC}	INPUTS		V_M	V_{LOAD}	C_L	R_L	V_Δ
	V_I	t_r/t_f					
1.8 V ± 0.15 V	V_{CC}	≤2 ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 kΩ	0.15 V
2.5 V ± 0.2 V	V_{CC}	≤2 ns	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 Ω	0.15 V
2.7 V	2.7 V	≤2.5 ns	1.5 V	6 V	50 pF	500 Ω	0.3 V
3.3 V ± 0.3 V	2.7 V	≤2.5 ns	1.5 V	6 V	50 pF	500 Ω	0.3 V
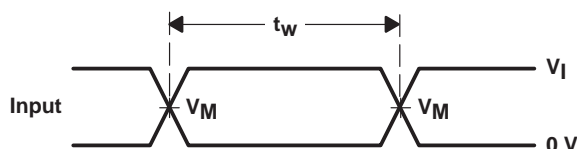
VOLTAGE WAVEFORMS
PULSE DURATION
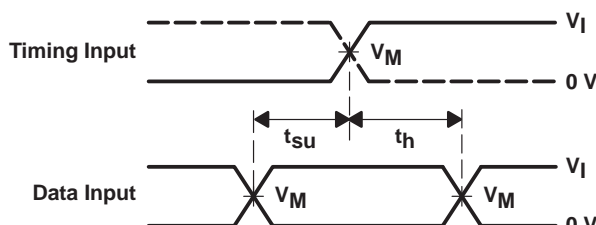
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES
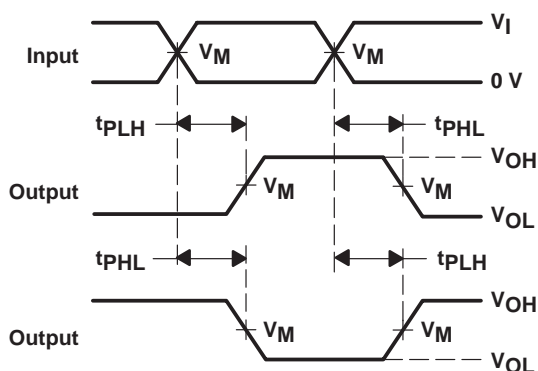
VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS

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}.
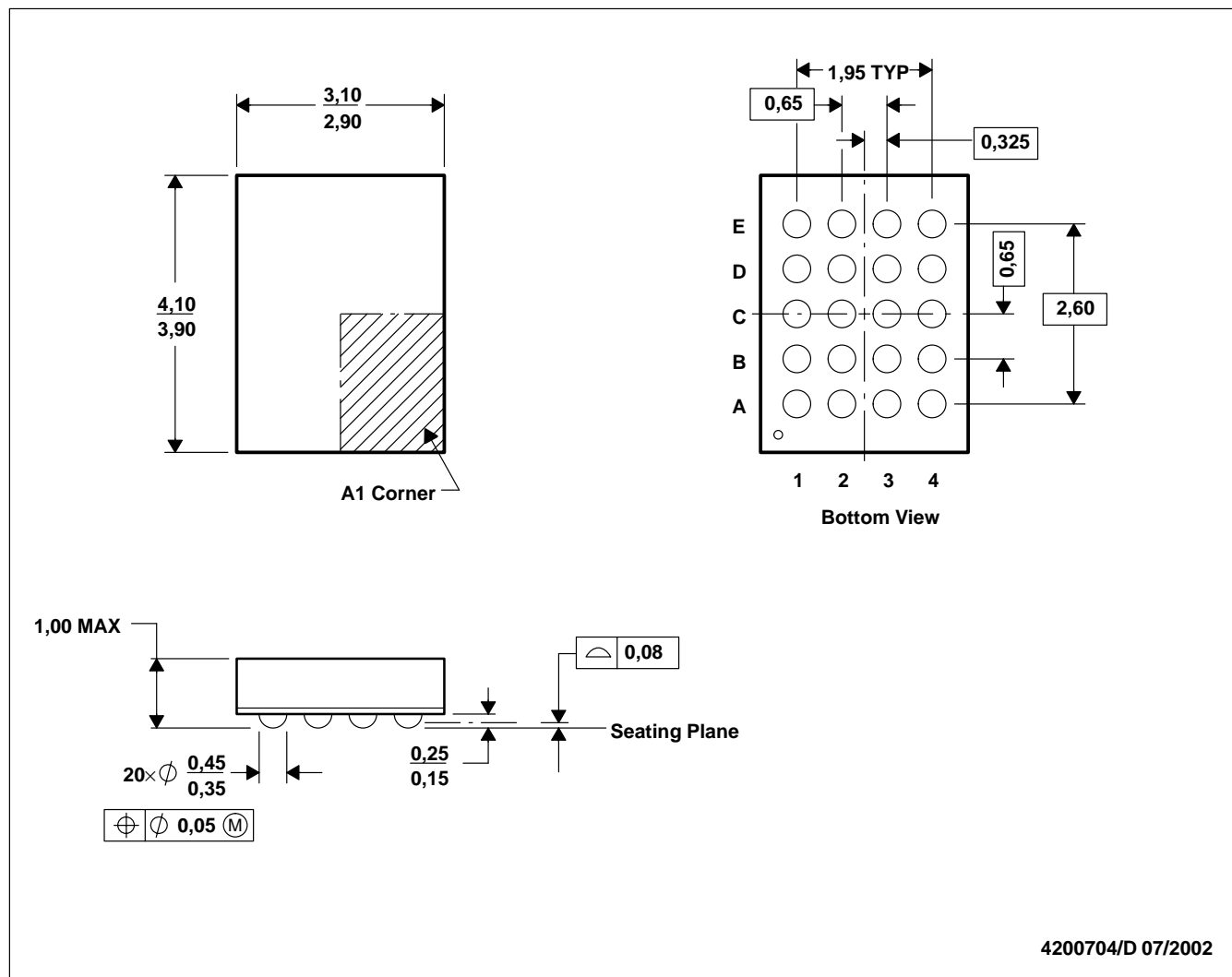   H. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

MECHANICAL DATA

GQN (R-PBGA-N20)   **PLASTIC BALL GRID ARRAY**

A1 Corner

Bottom View

1,00 MAX

Seating Plane

4200704/D 07/2002
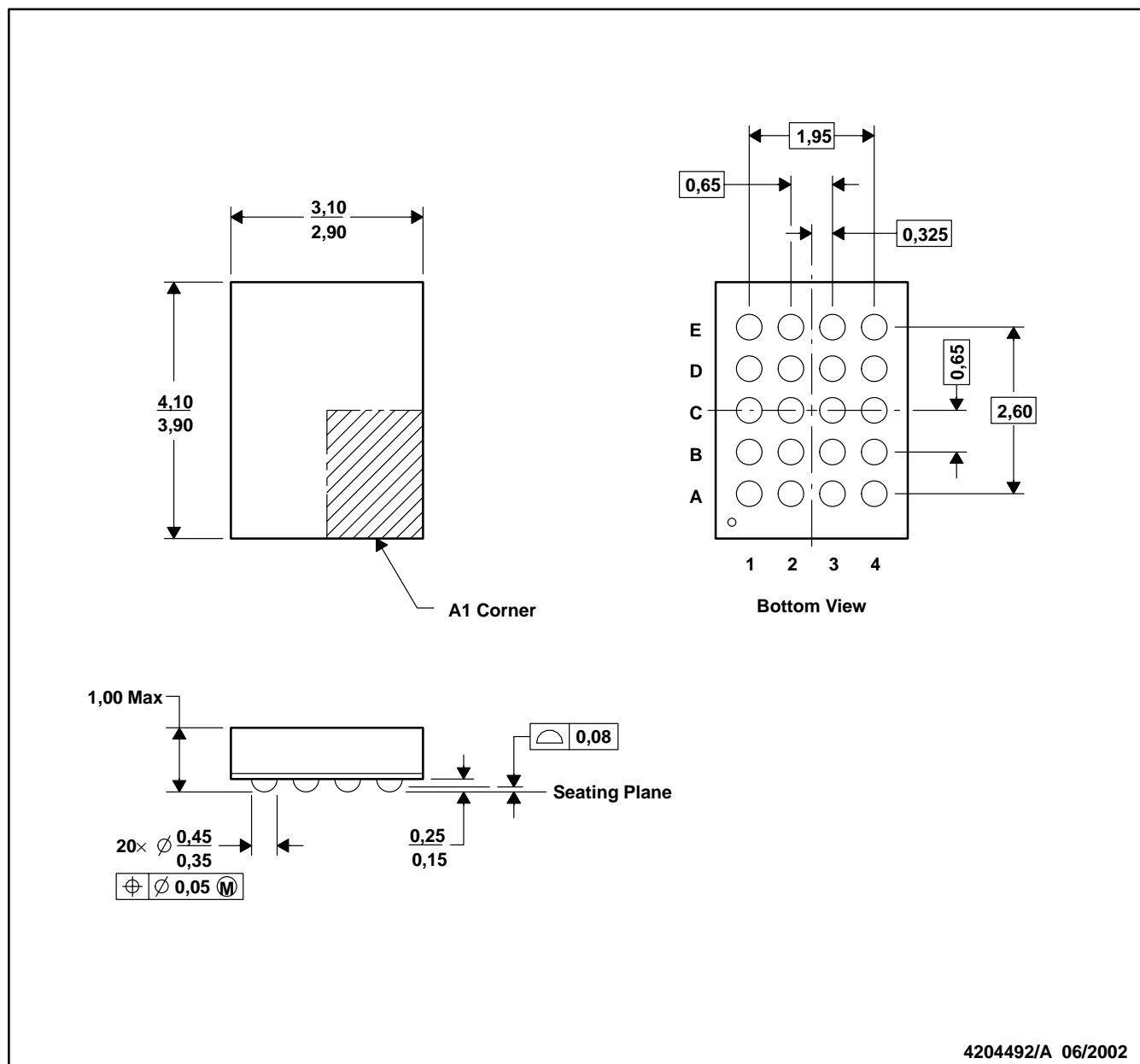
NOTES: A. All linear dimensions are in millimeters.
   B. This drawing is subject to change without notice.
   C. MicroStar Junior™ configuration
   D. Falls within JEDEC MO-225 variation BC.
   E. This package is tin-lead (SnPb). Refer to the 20 ZQN package (drawing 4204492) for lead-free.

MicroStar Junior is a trademark of Texas Instruments.

TEXAS INSTRUMENTS

ZQN (R-PBGA-N20)   **PLASTIC BALL GRID ARRAY**

A1 Corner

Bottom View

1,00 Max

0,08

Seating Plane

20× ∅ $\frac{0,45}{0,35}$

$\frac{0,25}{0,15}$

⊕ ∅ 0,05 Ⓜ

1,95

0,65

0,325

$\frac{3,10}{2,90}$

$\frac{4,10}{3,90}$

0,65

2,60

E D C B A

1 2 3 4

4204492/A 06/2002

NOTES: A.   All linear dimensions are in millimeters.
         B.   This drawing is subject to change without notice.
         C.   MicroStar Junior™ configuration.
         D.   Fall within JEDEC MO-225 variation BC.
         E.   This package is lead-free. Refer to the 20 GQN package (drawing 4200704) for tin-lead)SnPb).
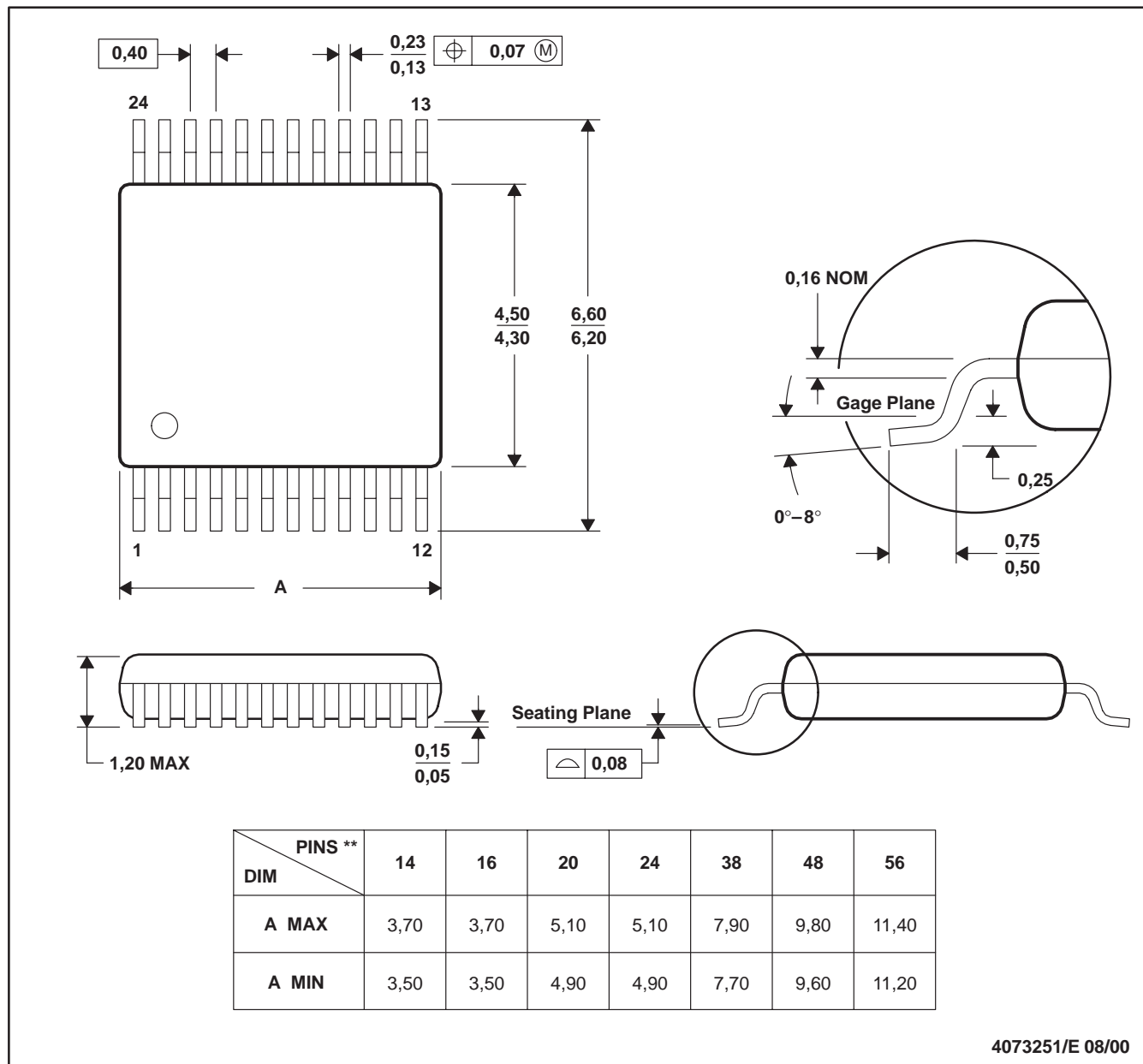
MicroStar Junior is a trademark of Texas Instruments.

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

24 PINS SHOWN

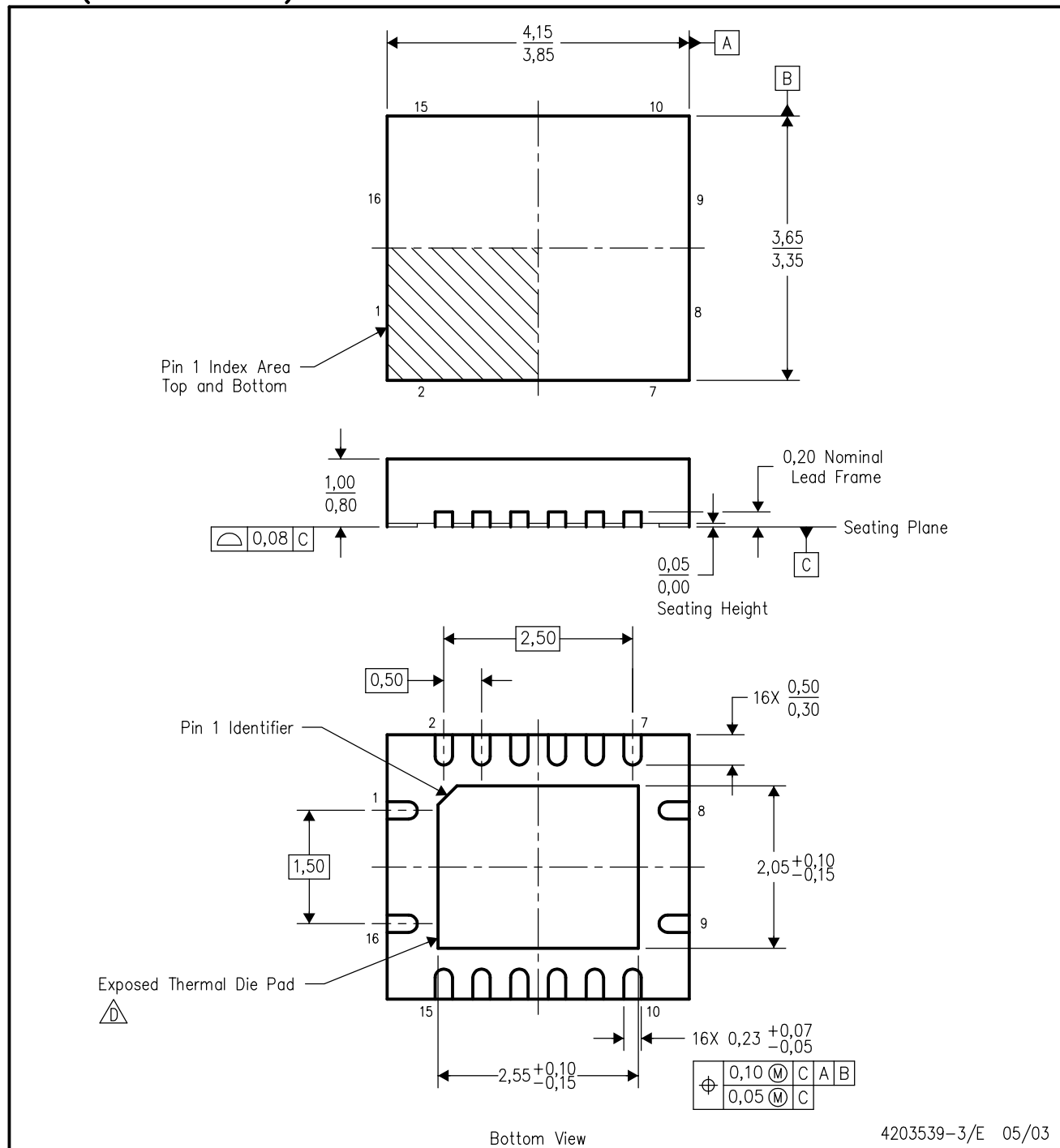| PINS ** DIM	14	16	20	24	38	48	56
A MAX	3,70	3,70	5,10	5,10	7,90	9,80	11,40
A MIN	3,50	3,50	4,90	4,90	7,70	9,60	11,20

4073251/E 08/00

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 per side.
D. Falls within JEDEC: 24/48 Pins – MO-153
                                    14/16/20/56 Pins – MO-194

![Texas Instruments logo] **TEXAS INSTRUMENTS**

RGY (R−PQFP−N16)   PLASTIC QUAD FLATPACK

4,15
3,85   A

B

15   10

16   9

3,65
3,35

1   8

Pin 1 Index Area
Top and Bottom
2   7

0,20 Nominal
Lead Frame

1,00
0,80

Seating Plane

0,08 C

0,05
0,00
Seating Height

C

2,50

0,50

16X 0,50
0,30

Pin 1 Identifier
2   7

1   8

1,50

2,05 +0,10
−0,15

16   9

Exposed Thermal Die Pad

15   10

16X 0,23 +0,07
−0,05

2,55 +0,10
−0,15

⊕ 0,10 Ⓜ C A B
     0,05 Ⓜ C

Bottom View   4203539−3/E   05/03

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.
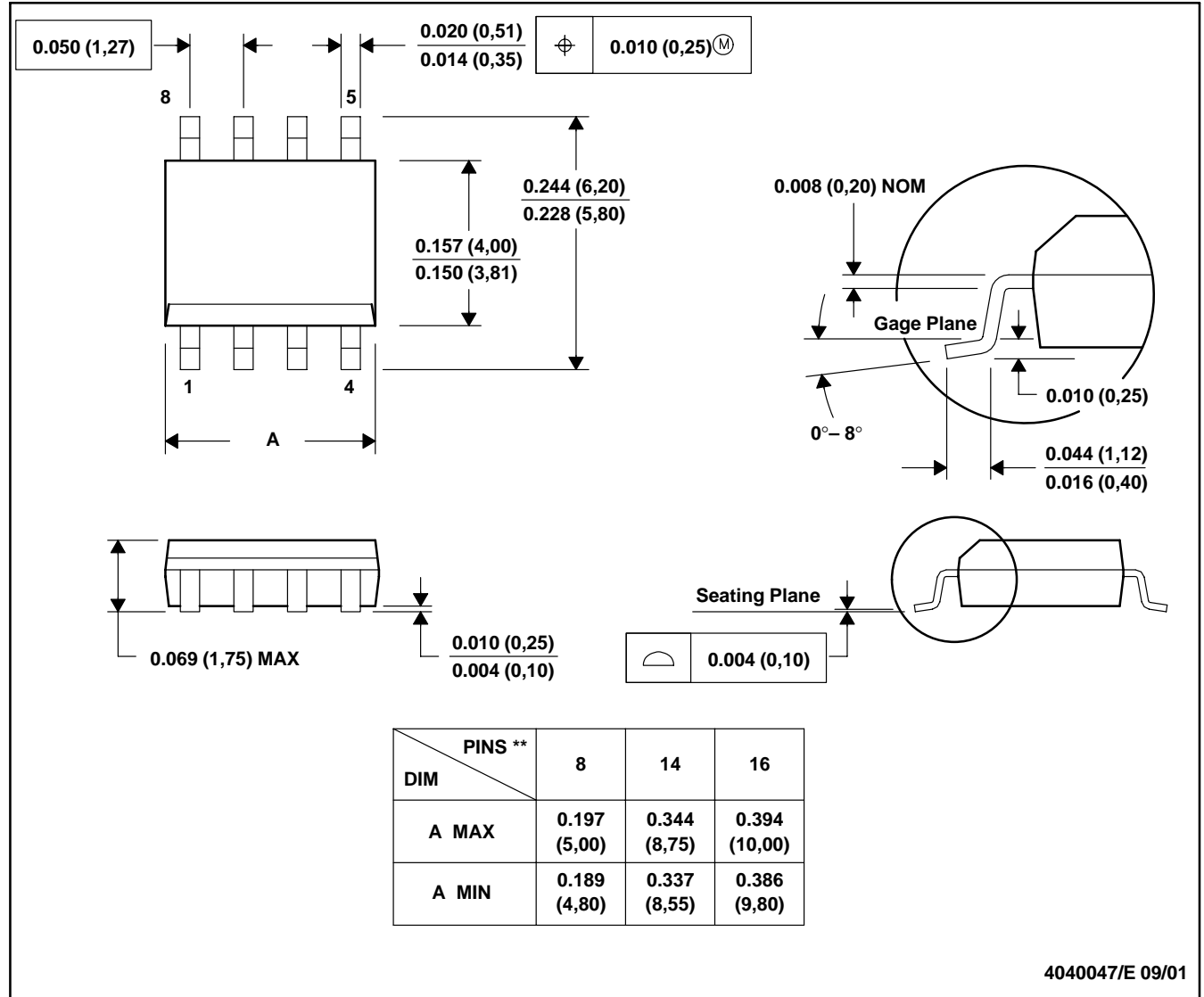   E.   Package complies to JEDEC MO−241 variation BB.

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

8 PINS SHOWN

0.050 (1,27)

0.020 (0,51) / 0.014 (0,35)

⊕ | 0.010 (0,25)Ⓜ

8   5

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

0.157 (4,00) / 0.150 (3,81)

0.008 (0,20) NOM

Gage Plane

1   4

A

0°– 8°

0.010 (0,25)

0.044 (1,12) / 0.016 (0,40)

0.069 (1,75) MAX

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

Seating Plane

⌒ | 0.004 (0,10)

| 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

TEXAS INSTRUMENTS

MECHANICAL DATA

PLASTIC SMALL-OUTLINE PACKAGE

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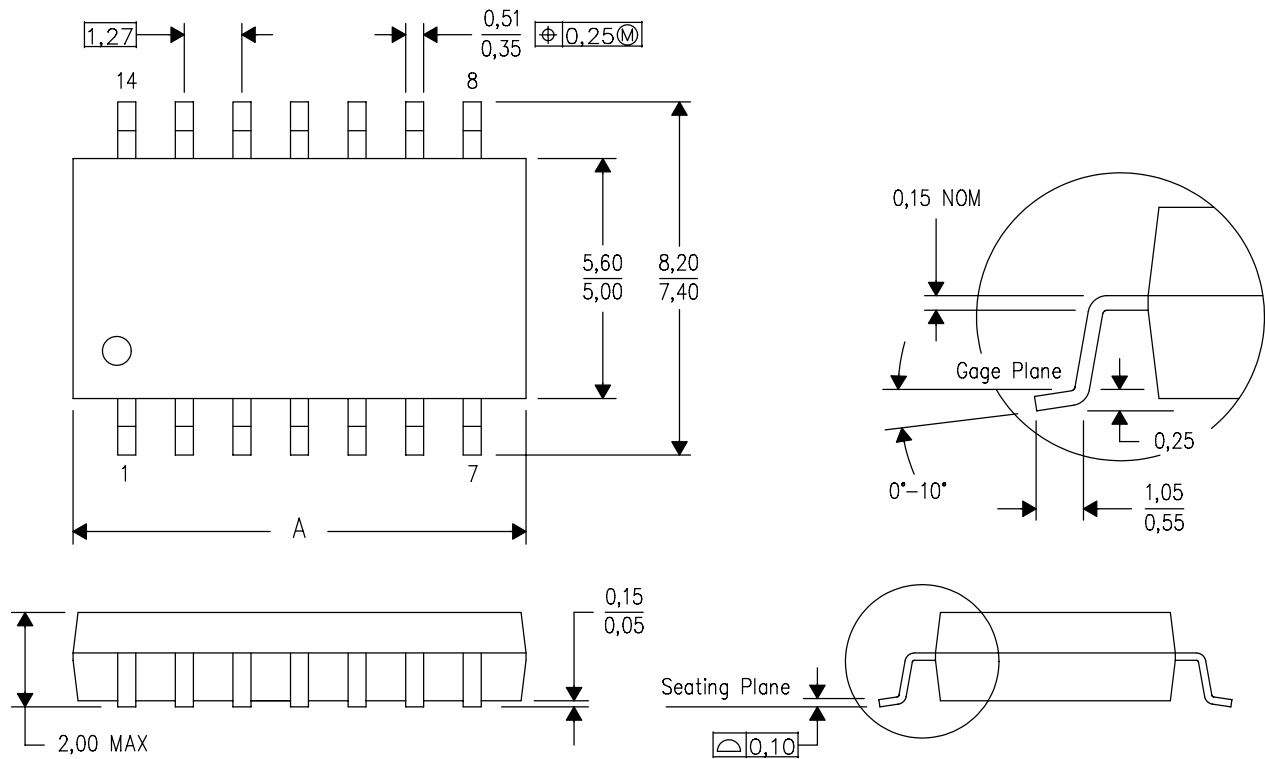
DIM \ PINS **	14	16	20	24
A MAX	10,50	10,50	12,90	15,30
A MIN	9,90	9,90	12,30	14,70

4040062/C 03/03

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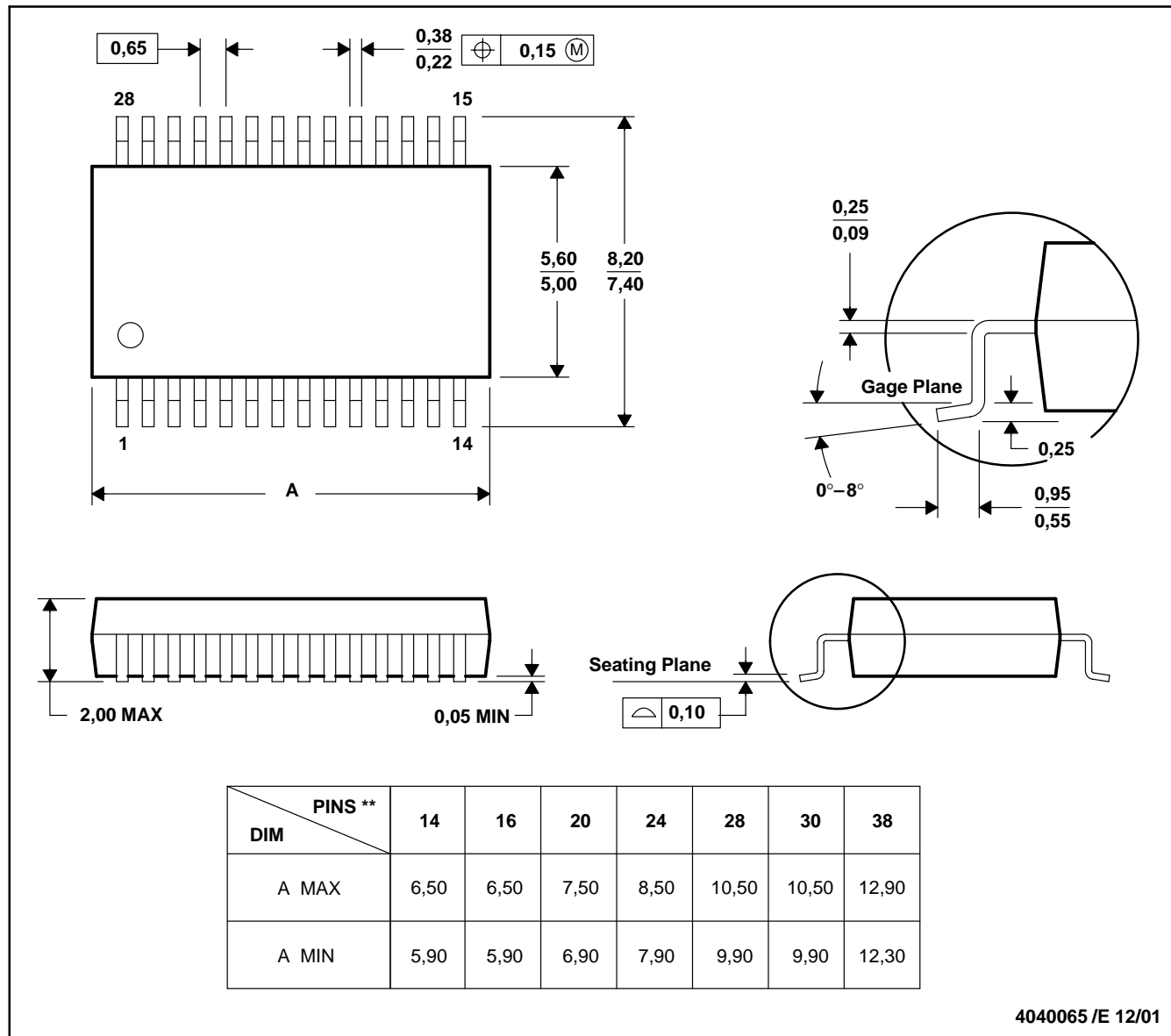C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

TEXAS
INSTRUMENTS

MECHANICAL DATA

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.
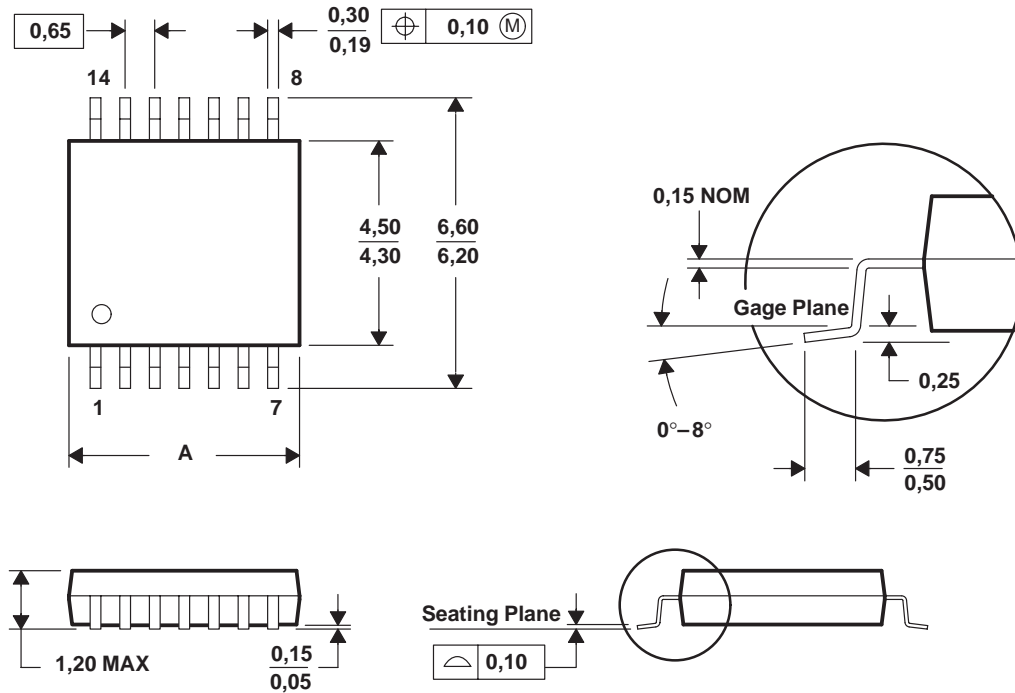   D. Falls within JEDEC MO-150

TEXAS INSTRUMENTS

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN

0,65

0,30 / 0,19

⊕ | 0,10 Ⓜ

14   8

4,50 / 4,30

6,60 / 6,20

1   7

A

0,15 NOM

Gage Plane

0°–8°

0,25

0,75 / 0,50

1,20 MAX

0,15 / 0,05

Seating Plane

◁ | 0,10

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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