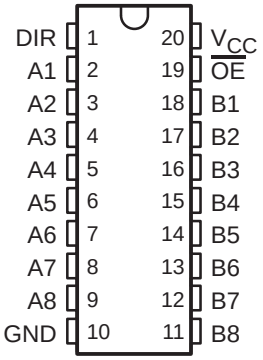
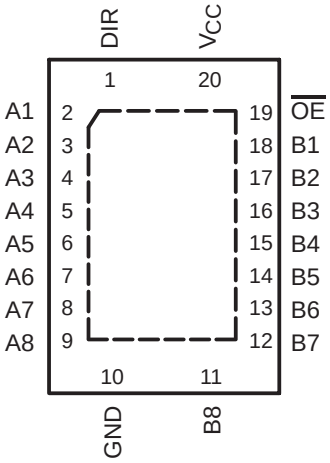
- **Operates From 1.65 V to 3.6 V**
- **Inputs Accept Voltages to 5.5 V**
- **Max $t_{pd}$ of 6.3 ns at 3.3 V**
- **All Outputs Have Equivalent 26-Ω Series Resistors, So No External Resistors Are Required**
- **Typical $V_{OLP}$ (Output Ground Bounce) <0.8 V at $V_{CC}$ = 3.3 V, $T_A$ = 25°C**
- **Typical $V_{OHV}$ (Output $V_{OH}$ Undershoot) >2 V at $V_{CC}$ = 3.3 V, $T_A$ = 25°C**
- **Supports Mixed-Mode Signal Operation on All Ports (5-V Input/Output Voltage With 3.3-V $V_{CC}$)**
- **$I_{off}$ Supports Partial-Power-Down Mode Operation**
- **Latch-Up Performance Exceeds 250 mA Per JESD 17**
- **ESD Protection Exceeds JESD 22**
  - **2000-V Human-Body Model (A114-A)**
  - **1000-V Charged-Device Model (C101)**

**DB, DBQ, DGV, DW, NS, OR PW PACKAGE**
**(TOP VIEW)**




**RGY PACKAGE**
**(TOP VIEW)**




## description/ordering information

**ORDERING INFORMATION**

| $T_A$ | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---|---|---|---|---|
| −40°C to 85°C | QFN − RGY | Reel of 1000 | SN74LVCR2245ARGYR | LER245A |
| | SOIC − DW | Tube of 25 | SN74LVCR2245ADW | LVCR2245A |
| | | Reel of 2000 | SN74LVCR2245ADWR | |
| | SOP − NS | Reel of 2000 | SN74LVCR2245ANSR | LVCR2245A |
| | SSOP − DB | Reel of 2000 | SN74LVCR2245ADBR | LER245A |
| | SSOP (QSOP) − DBQ | Reel of 2500 | SN74LVCR2245ADBQR | LVCR2245A |
| | TSSOP − PW | Tube of 70 | SN74LVCR2245APW | LER245A |
| | | Reel of 2000 | SN74LVCR2245APWR | |
| | | Reel of 250 | SN74LVCR2245APWT | |
| | TVSOP − DGV | Reel of 2000 | SN74LVCR2245ADGVR | LER245A |
| | VFBGA − GQN | Reel of 1000 | SN74LVCR2245AGQNR | LER245A |
| | VFBGA − ZQN (Pb-free) | | SN74LVCR2245AZQNR | |

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

## description/ordering information (continued)

This octal bus transceiver is designed for 1.65-V to 3.6-V $V_{CC}$ operation.

The SN74LVCR2245A is designed for asynchronous communication between data buses. The device transmits data from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable ($\overline{OE}$) input can be used to disable the device so the buses are effectively isolated.

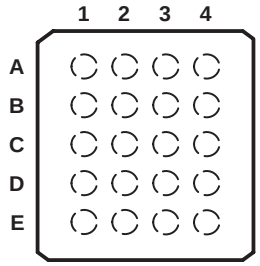
All outputs, which are designed to sink up to 12 mA, include equivalent 26-Ω resistors to reduce overshoot and undershoot.

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.

This device is fully specified for partial-power-down applications using $I_{off}$. The $I_{off}$ circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to $V_{CC}$ through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

**GQN OR ZQN PACKAGE**
**(TOP VIEW)**



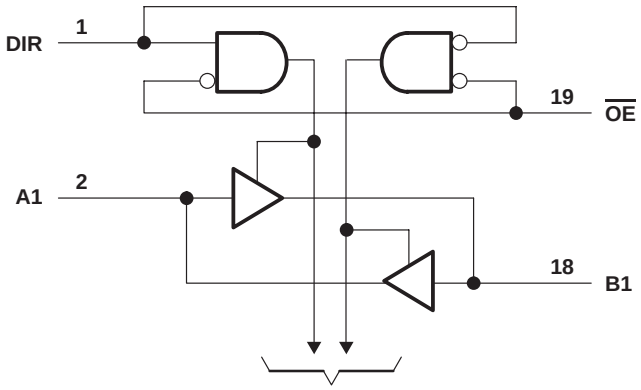

### terminal assignments

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **A** | A1 | DIR | $V_{CC}$ | $\overline{OE}$ |
| **B** | A3 | B2 | A2 | B1 |
| **C** | A5 | A4 | B4 | B3 |
| **D** | A7 | B6 | A6 | B5 |
| **E** | GND | A8 | B8 | B7 |

**FUNCTION TABLE**

| INPUTS | | OPERATION |
|---|---|---|
| $\overline{OE}$ | DIR | |
| L | L | B data to A bus |
| L | H | A data to B bus |
| H | X | Isolation |

## logic diagram (positive logic)




Pin numbers shown are for the DB, DBQ, DGV, DW, 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
Voltage range applied to any output in the high-impedance or power-off state, $V_O$
(see Note 1) . . . . . −0.5 V to 6.5 V
Voltage range applied to any output in the high or low state, $V_O$
(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, $\theta_{JA}$ (see Note 3): DB package . . . . . 70°C/W
(see Note 3): DBQ package . . . . . 68°C/W
(see Note 3): DGV package . . . . . 92°C/W
(see Note 3): DW package . . . . . 58°C/W
(see Note 3): GQN/ZQN package . . . . . 78°C/W
(see Note 3): NS package . . . . . 60°C/W
(see Note 3): PW package . . . . . 83°C/W
(see Note 4): RGY package . . . . . 37°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.

## 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 | High or low state | 0 | $V_{CC}$ | V |
| | | 3-state | 0 | 5.5 | |
| $I_{OH}$ | High-level output current | $V_{CC}$ = 1.65 V | | −2 | mA |
| | | $V_{CC}$ = 2.3 V | | −4 | |
| | | $V_{CC}$ = 2.7 V | | −8 | |
| | | $V_{CC}$ = 3 V | | −12 | |
| $I_{OL}$ | Low-level output current | $V_{CC}$ = 1.65 V | | 2 | mA |
| | | $V_{CC}$ = 2.3 V | | 4 | |
| | | $V_{CC}$ = 2.7 V | | 8 | |
| | | $V_{CC}$ = 3 V | | 12 | |
| $\Delta t/\Delta v$ | 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 | | | | $V_{CC}$ | MIN | TYP† | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{OH}$ | | $I_{OH}$ = −100 µA | | 1.65 V to 3.6 V | $V_{CC}$−0.2 | | | V |
| | | $I_{OH}$ = −2 mA | | 1.65 V | 1.2 | | | |
| | | $I_{OH}$ = −4 mA | | 2.3 V | 1.7 | | | |
| | | | | 2.7 V | 2.2 | | | |
| | | $I_{OH}$ = −6 mA | | 3 V | 2.4 | | | |
| | | $I_{OH}$ = −8 mA | | 2.7 V | 2 | | | |
| | | $I_{OH}$ = −12 mA | | 3 V | 2 | | | |
| $V_{OL}$ | | $I_{OL}$ = 100 µA | | 1.65 V to 3.6 V | | | 0.2 | V |
| | | $I_{OL}$ = 2 mA | | 1.65 V | | | 0.45 | |
| | | $I_{OL}$ = 4 mA | | 2.3 V | | | 0.7 | |
| | | | | 2.7 V | | | 0.4 | |
| | | $I_{OL}$ = 6 mA | | 3 V | | | 0.55 | |
| | | $I_{OL}$ = 8 mA | | 2.7 V | | | 0.6 | |
| | | $I_{OL}$ = 12 mA | | 3 V | | | 0.8 | |
| $I_I$ | Control inputs | $V_I$ = 0 to 5.5 V | | 3.6 V | | | ±5 | µA |
| $I_{off}$ | | $V_I$ or $V_O$ = 5.5 V | | 0 | | | ±10 | µA |
| $I_{OZ}$‡ | | $V_O$ = 0 to 5.5 V | | 3.6 V | | | ±10 | µA |
| $I_{CC}$ | | $V_I$ = $V_{CC}$ or GND | $I_O$ = 0 | 3.6 V | | | 10 | µA |
| | | 3.6 V ≤ $V_I$ ≤ 5.5 V§ | | | | | 10 | |
| $\Delta I_{CC}$ | | One input at $V_{CC}$ − 0.6 V, Other inputs at $V_{CC}$ or GND | | 2.7 V to 3.6 V | | | 500 | µA |
| $C_i$ | Control inputs | $V_I$ = $V_{CC}$ or GND | | 3.3 V | | 4 | | pF |
| $C_{io}$ | A or B ports | $V_O$ = $V_{CC}$ or GND | | 3.3 V | | 5.5 | | pF |

† All typical values are at $V_{CC}$ = 3.3 V, $T_A$ = 25°C.
‡ For I/O ports, the parameter $I_{OZ}$ includes the input leakage current.
§ This applies in the disabled state only.

## 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 ± 0.15 V | | $V_{CC}$ = 2.5 V ± 0.2 V | | $V_{CC}$ = 2.7 V | | $V_{CC}$ = 3.3 V ± 0.3 V | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| $t_{pd}$ | A or B | B or A | ¶ | ¶ | ¶ | ¶ | | 7.3 | 1.5 | 6.3 | ns |
| $t_{en}$ | $\overline{OE}$ | A or B | ¶ | ¶ | ¶ | ¶ | | 9.5 | 1.5 | 8.2 | ns |
| $t_{dis}$ | $\overline{OE}$ | A or B | ¶ | ¶ | ¶ | ¶ | | 8.5 | 1.7 | 7.8 | ns |
| $t_{sk(o)}$ | | | | | | | | | | 1 | ns |

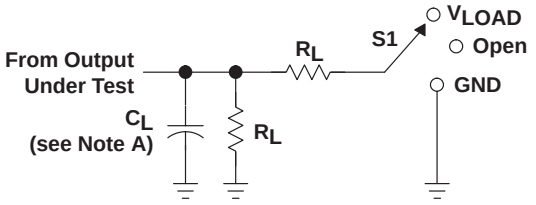
¶ This information was not available at the time of publication.

## 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 per transceiver | Outputs enabled | f = 10 MHz | ¶ | ¶ | 48 | pF |
| | | Outputs disabled | | ¶ | ¶ | 4 | |

¶ This information was not available at the time of publication.

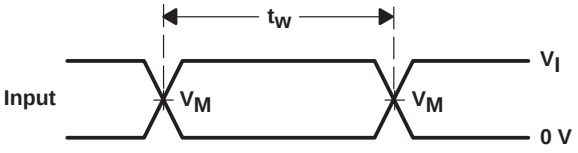
## PARAMETER MEASUREMENT INFORMATION



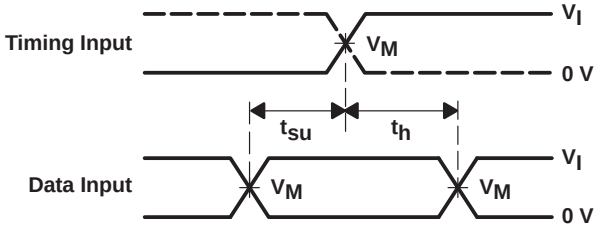

LOAD CIRCUIT

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

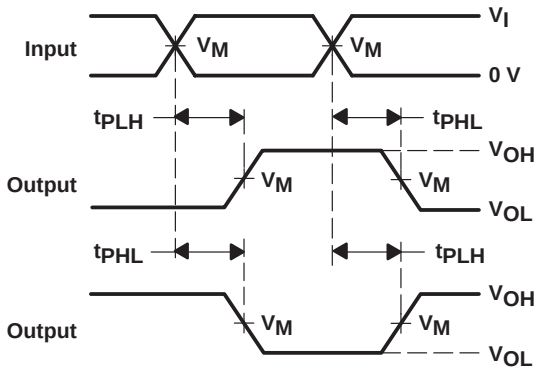
| $V_{CC}$ | INPUTS | | $V_M$ | $V_{LOAD}$ | $C_L$ | $R_L$ | $V_\Delta$ |
|---|---|---|---|---|---|---|---|
| | $V_I$ | $t_r/t_f$ | | | | | |
| 1.8 V ± 0.15 V | $V_{CC}$ | ≤2 ns | $V_{CC}/2$ | $2 \times V_{CC}$ | 30 pF | 1 kΩ | 0.15 V |
| 2.5 V ± 0.2 V | $V_{CC}$ | ≤2 ns | $V_{CC}/2$ | $2 \times V_{CC}$ | 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 |



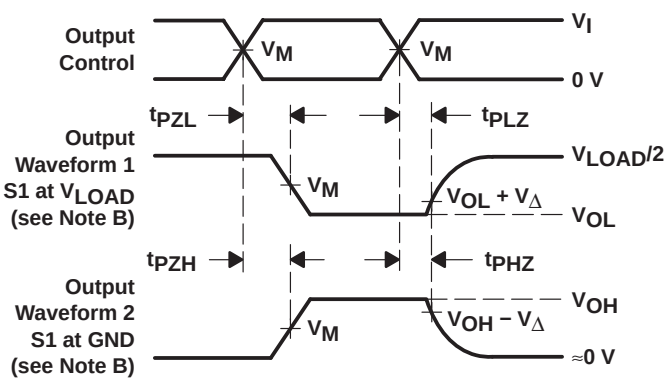

VOLTAGE WAVEFORMS
PULSE DURATION




VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES




VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS

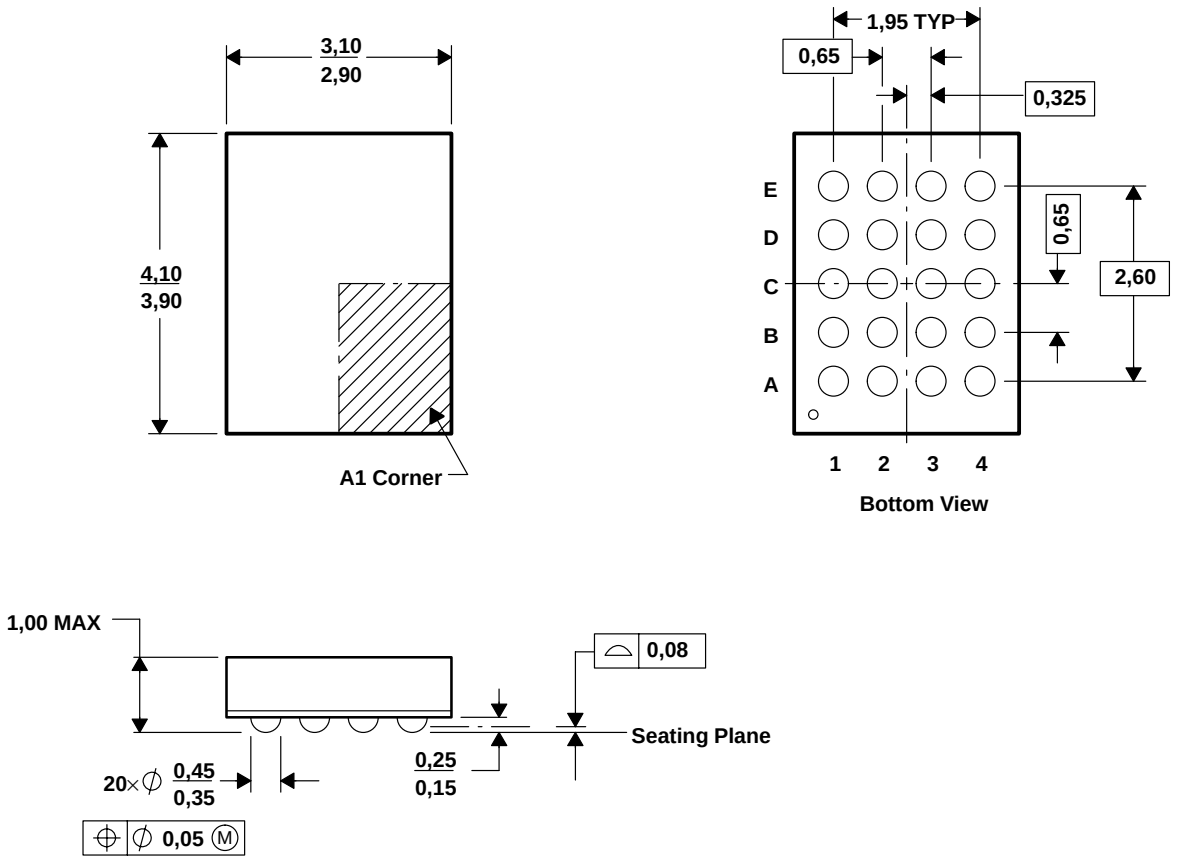



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

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**

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

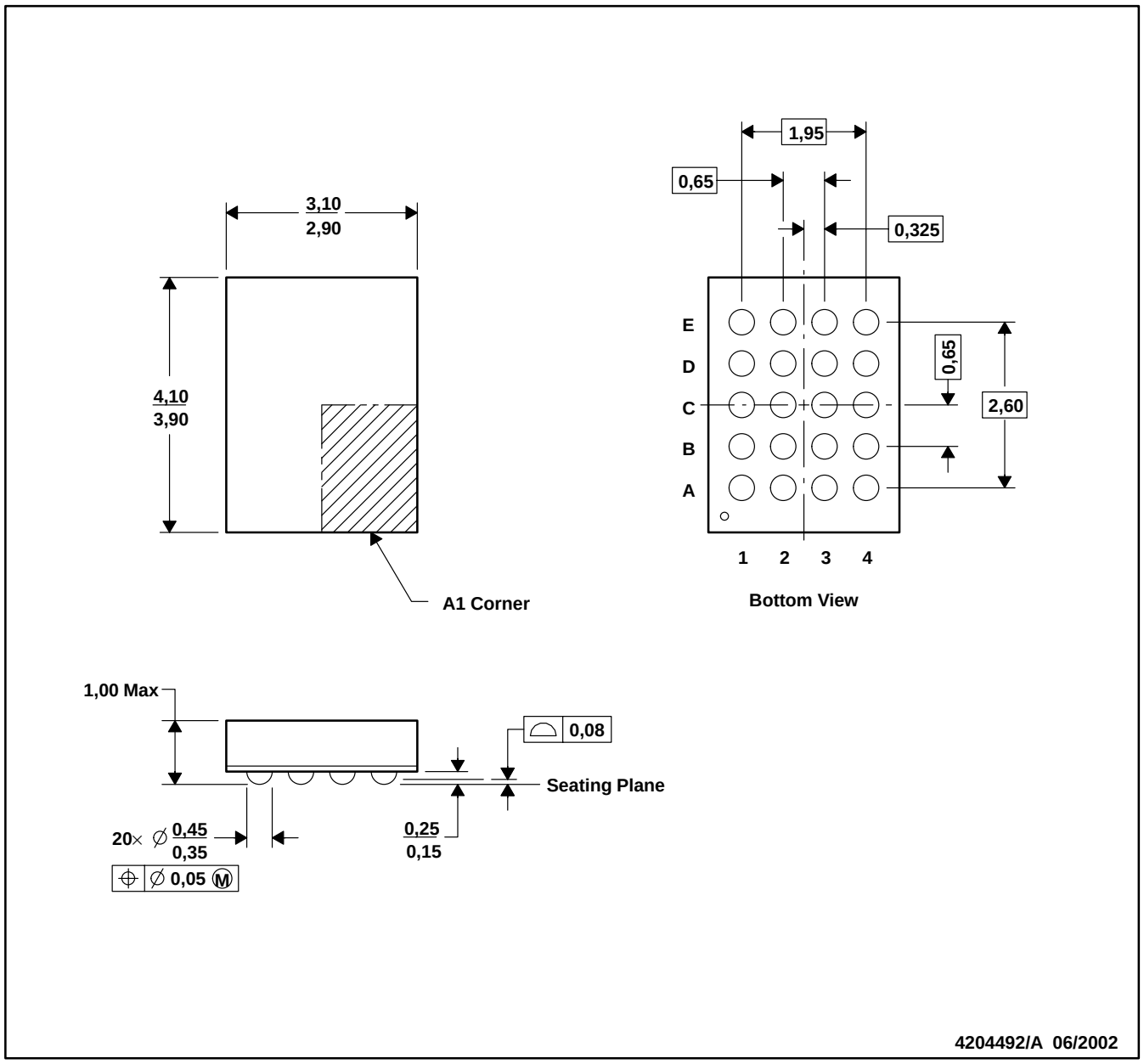



NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. MicroStar Junior™ configuration
D. Falls within JEDEC MO-225 variation BC.
E. This package is tin-lead (SnPb). Refer to the 20 ZQN package (drawing 4204492) for lead-free.

MicroStar Junior is a trademark of Texas Instruments.

MPBG297 – JULY 2002

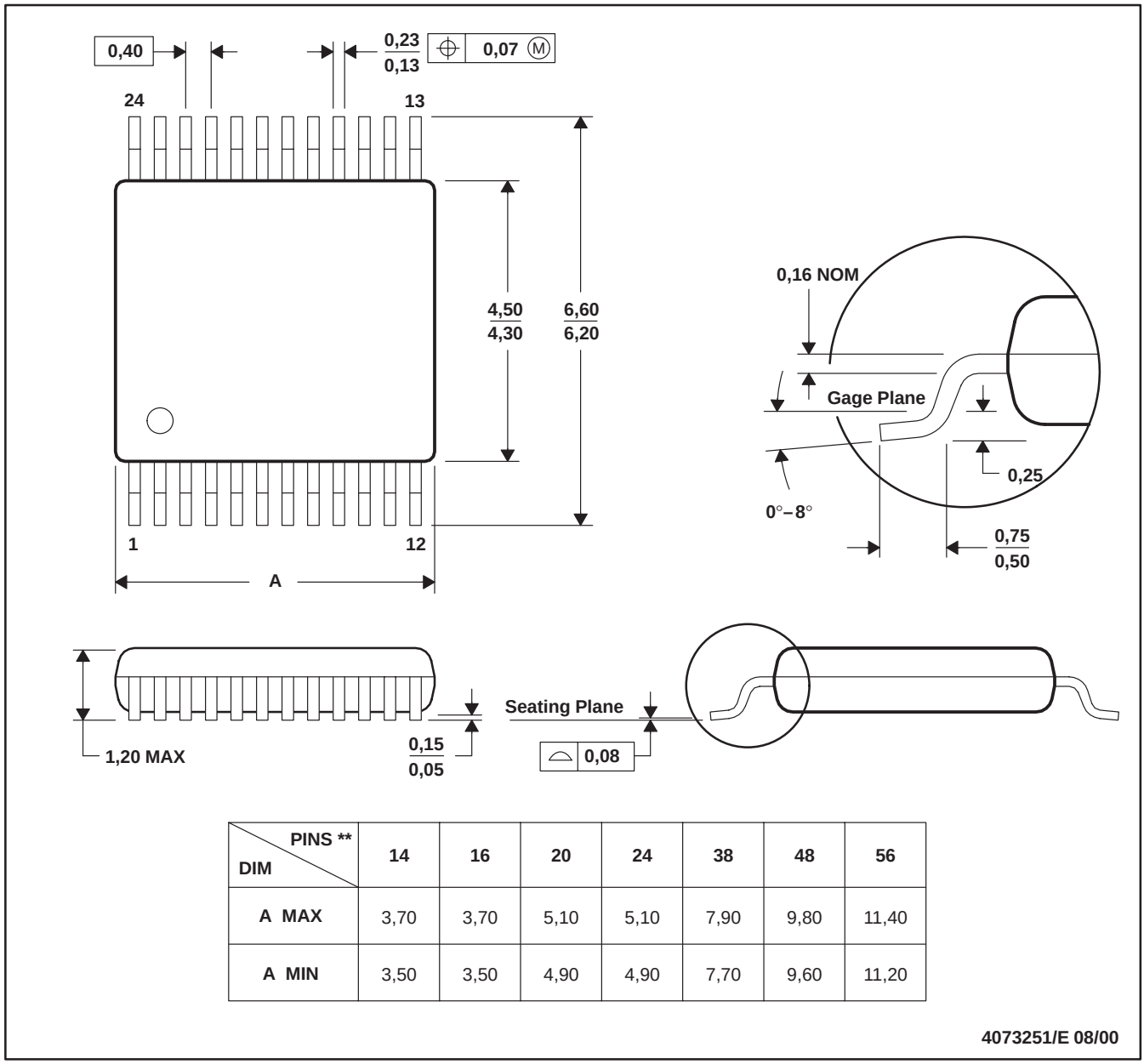
**ZQN (R-PBGA-N20)** **PLASTIC BALL GRID ARRAY**




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).

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

**24 PINS SHOWN**

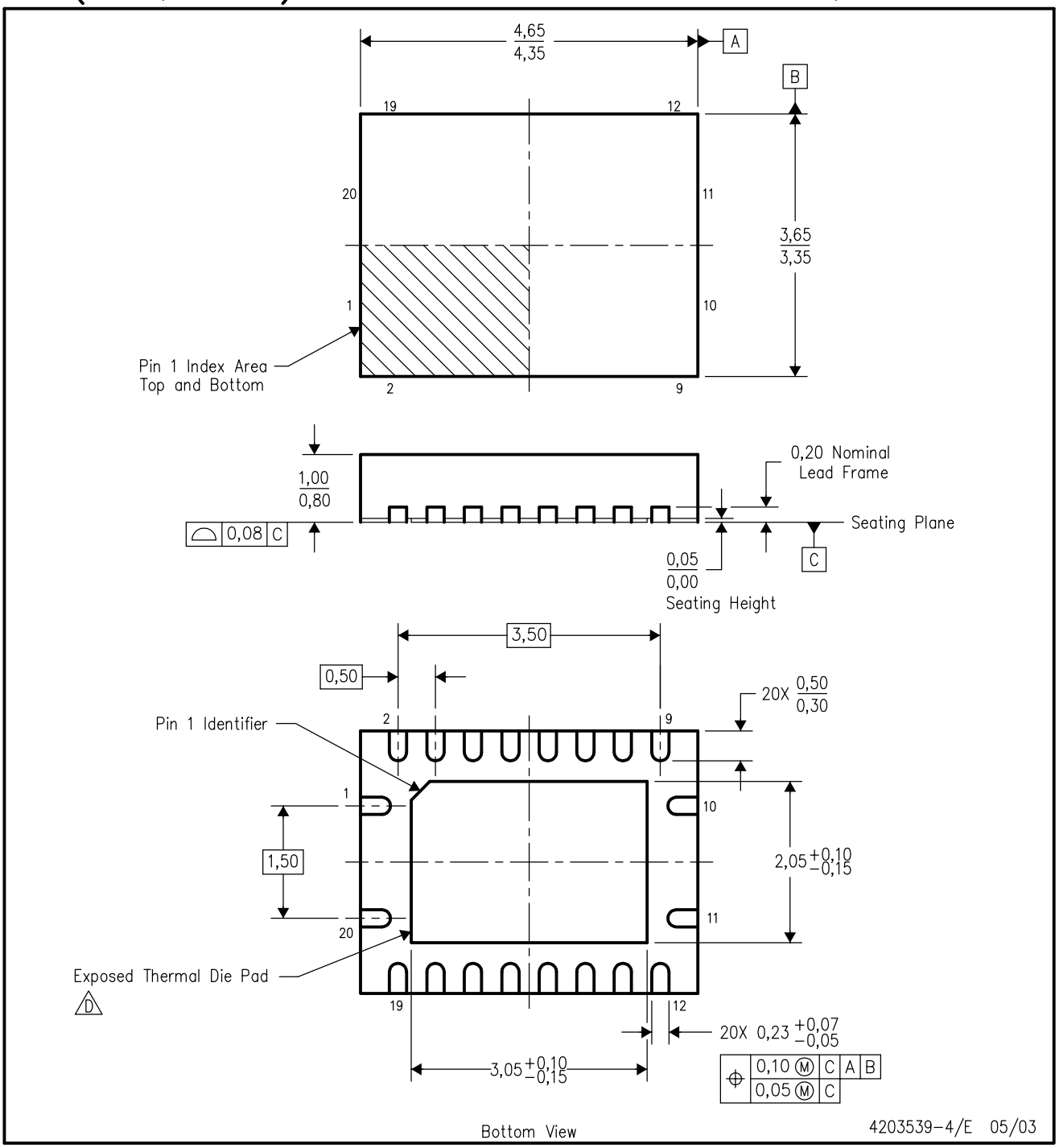



| DIM \ PINS ** | 14 | 16 | 20 | 24 | 38 | 48 | 56 |
|---|---|---|---|---|---|---|---|
| A MAX | 3,70 | 3,70 | 5,10 | 5,10 | 7,90 | 9,80 | 11,40 |
| A MIN | 3,50 | 3,50 | 4,90 | 4,90 | 7,70 | 9,60 | 11,20 |

**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

RGY (R–PQFP–N20) PLASTIC QUAD FLATPACK

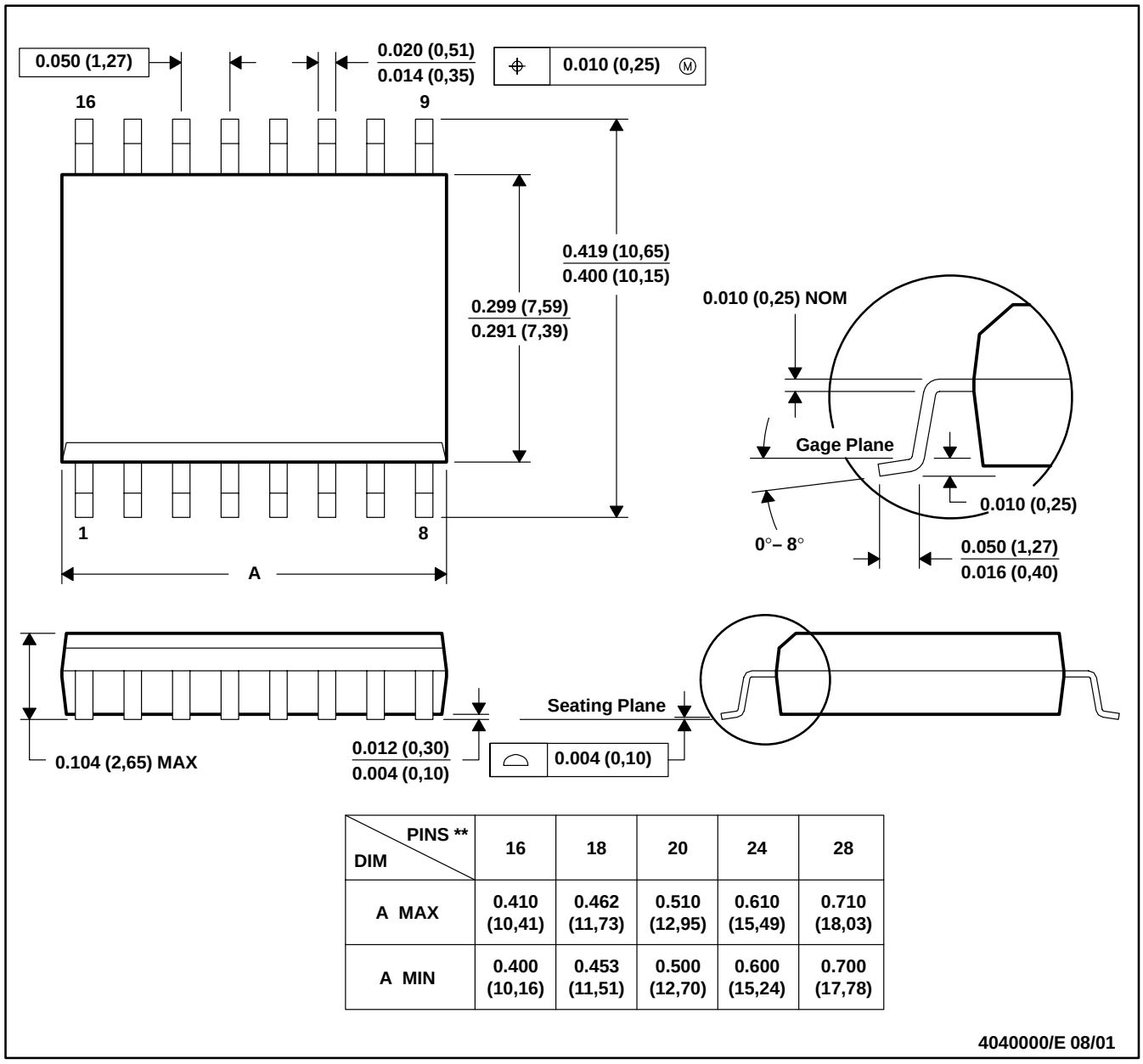



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. QFN (Quad Flatpack No–Lead) package configuration.
D. The package thermal performance may be enhanced by bonding the thermal die pad to an external thermal plane. This pad is electrically and thermally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

MSOI003E – JANUARY 1995 – REVISED SEPTEMBER 2001

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

**16 PINS SHOWN**



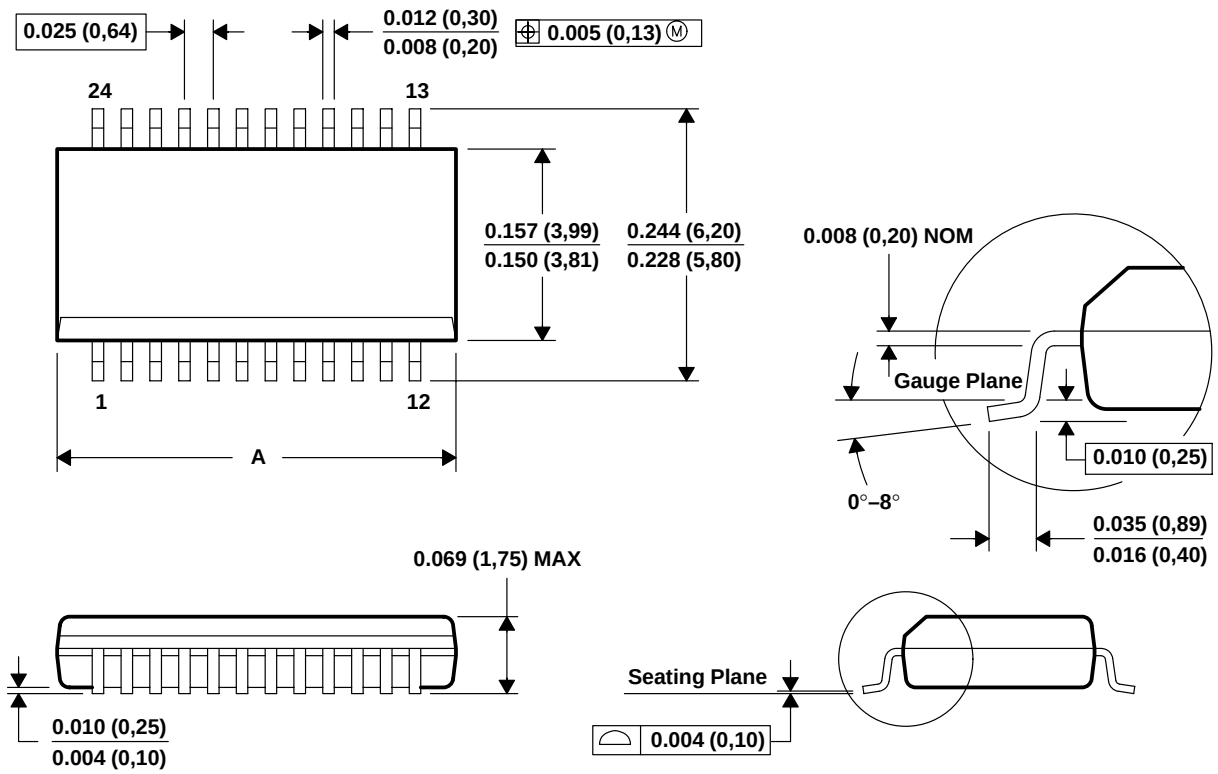

| DIM \ PINS ** | 16 | 18 | 20 | 24 | 28 |
|---|---|---|---|---|---|
| A MAX | 0.410 (10,41) | 0.462 (11,73) | 0.510 (12,95) | 0.610 (15,49) | 0.710 (18,03) |
| A MIN | 0.400 (10,16) | 0.453 (11,51) | 0.500 (12,70) | 0.600 (15,24) | 0.700 (17,78) |

**4040000/E 08/01**

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-013

MSOI004E JANUARY 1995 – REVISED MAY 2002

**DBQ (R–PDSO–G**)** **PLASTIC SMALL–OUTLINE PACKAGE**




| DIM \ PINS ** | 16 | 20 | 24 | 28 |
|---|---|---|---|---|
| A MAX | 0.197 (5,00) | 0.344 (8,74) | 0.344 (8,74) | 0.394 (10,01) |
| A MIN | 0.189 (4,80) | 0.337 (8,56) | 0.337 (8,56) | 0.386 (9,80) |
| M0–137 VARIATION | AB | AD | AE | AF |

D

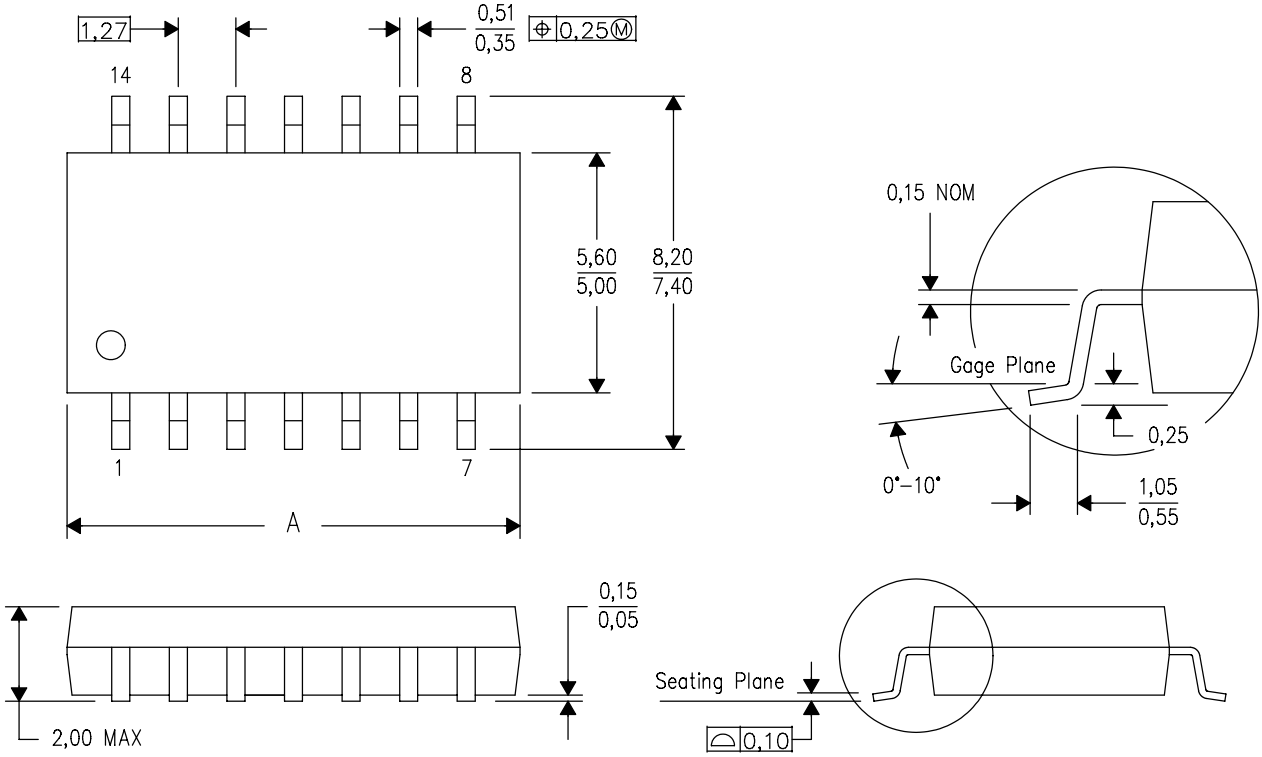
4073301/F 02/02

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 0.006 (0,15).
D. Falls within JEDEC MO–137.

## 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 |

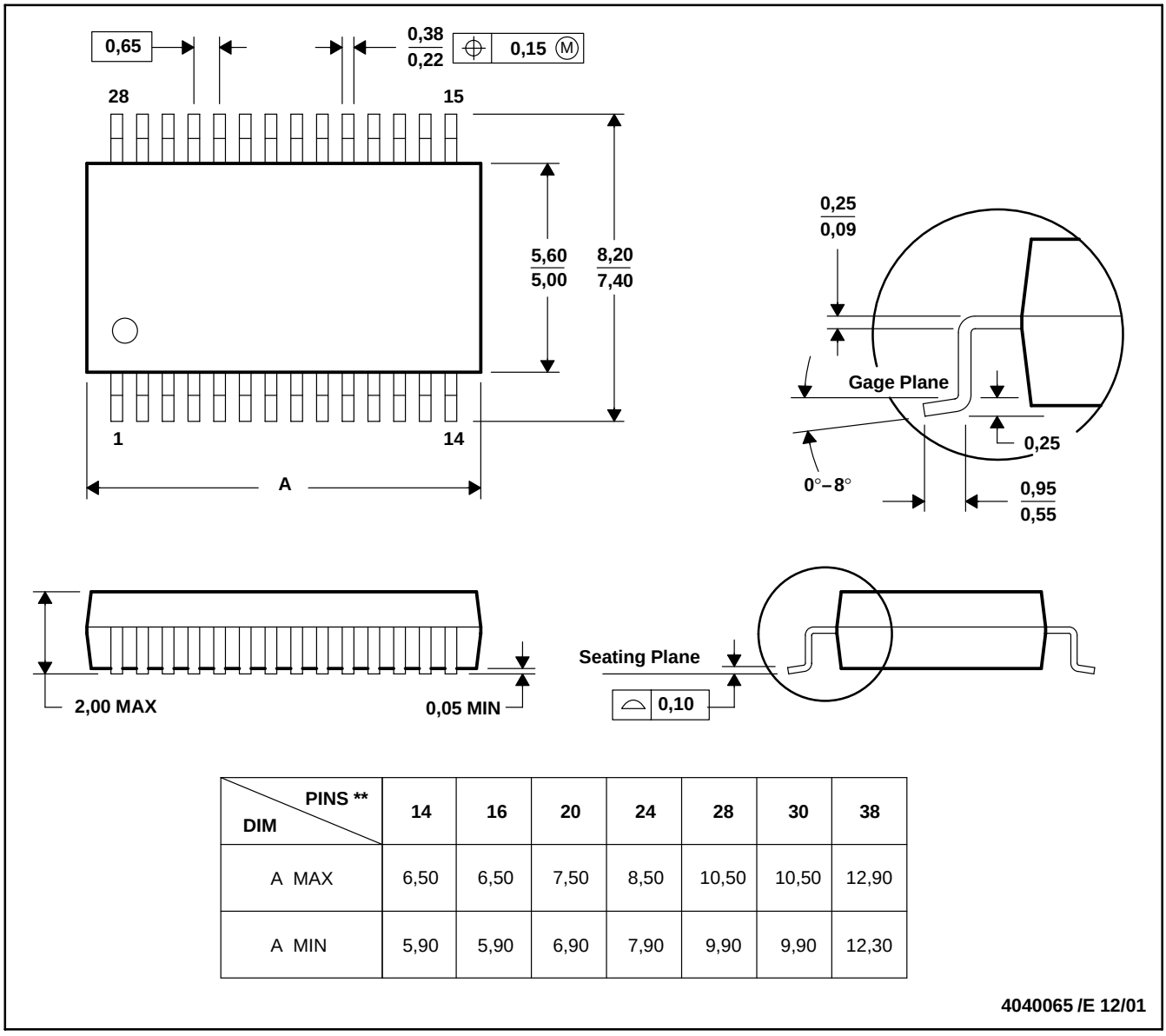
4040062/C 03/03

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.

MSSO002E – JANUARY 1995 – REVISED DECEMBER 2001

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

**28 PINS SHOWN**



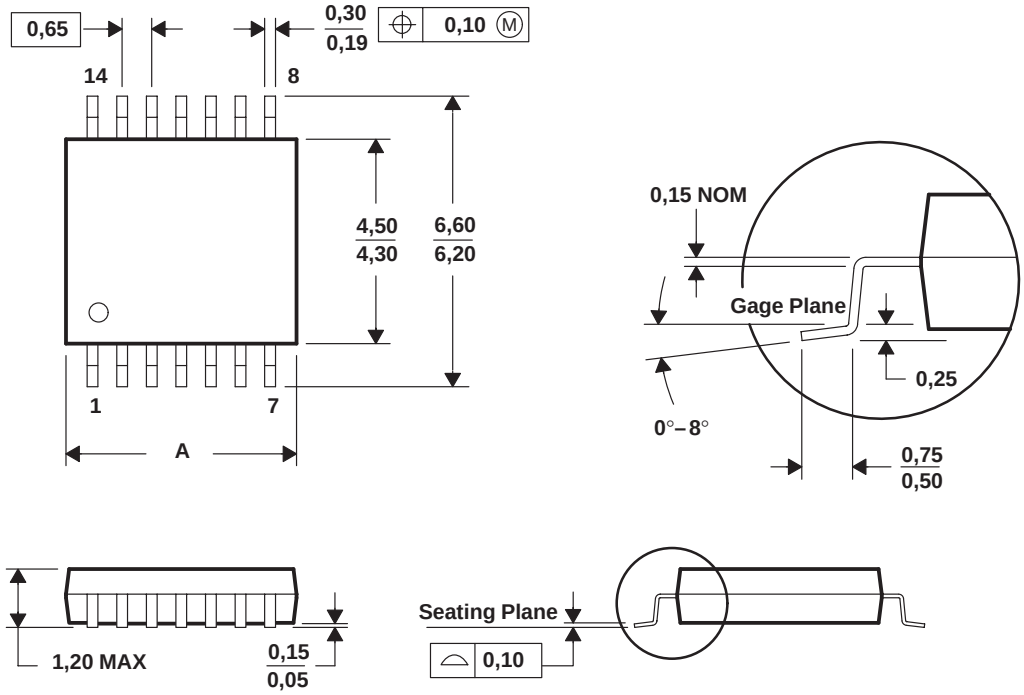

| DIM \ PINS ** | 14 | 16 | 20 | 24 | 28 | 30 | 38 |
|---|---|---|---|---|---|---|---|
| A MAX | 6,50 | 6,50 | 7,50 | 8,50 | 10,50 | 10,50 | 12,90 |
| A MIN | 5,90 | 5,90 | 6,90 | 7,90 | 9,90 | 9,90 | 12,30 |

**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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