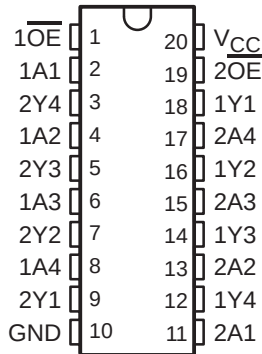


# SN54LVTH244A, SN74LVTH244A 3.3-V ABT OCTAL BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

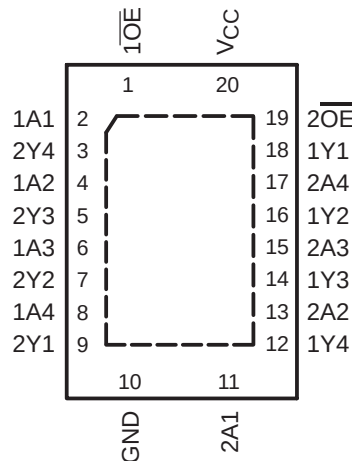
SCAS586J – DECEMBER 1996 – REVISED OCTOBER 2003

- Support Mixed-Mode Signal Operation (5-V Input and Output Voltages With 3.3-V  $V_{CC}$ )
- Typical  $V_{OLP}$  (Output Ground Bounce)  $<0.8$  V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- Support Unregulated Battery Operation Down to 2.7 V
- $I_{off}$  and Power-Up 3-State Support Hot Insertion
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- Latch-Up Performance Exceeds 500 mA Per JESD 17
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)

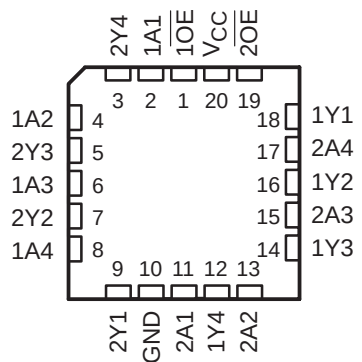
SN54LVTH244A . . . J OR W PACKAGE  
SN74LVTH244A . . . DB, DW, NS,  
OR PW PACKAGE  
(TOP VIEW)



SN74LVTH244A . . . RGY PACKAGE  
(TOP VIEW)



SN54LVTH244A . . . FK PACKAGE  
(TOP VIEW)



## description/ordering information

These octal buffers and line drivers are designed specifically for low-voltage (3.3-V)  $V_{CC}$  operation, but with the capability to provide a TTL interface to a 5-V system environment.

## ORDERING INFORMATION

| $T_A$          | PACKAGE <sup>†</sup>  |               | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|-----------------------|---------------|-----------------------|------------------|
| –40°C to 85°C  | QFN – RGY             | Tape and reel | SN74LVTH244ARGYR      | LXH244A          |
|                | SOIC – DW             | Tube          | SN74LVTH244ADW        | LVTH244A         |
|                |                       | Tape and reel | SN74LVTH244ADWR       |                  |
|                | SOP – NS              | Tape and reel | SN74LVTH244ANSR       | LVTH244A         |
|                | SSOP – DB             | Tape and reel | SN74LVTH244ADBR       | LXH244A          |
|                | TSSOP – PW            | Tape and reel | SN74LVTH244APWR       | LXH244A          |
|                | VFBGA – GQN           | Tape and reel | SN74LVTH244AGQNR      | LXH244A          |
| –55°C to 125°C | VFBGA – ZQN (Pb-free) |               | SN74LVTH244AZQNR      |                  |
|                | CDIP – J              | Tube          | SNJ54LVTH244AJ        | SNJ54LVTH244AJ   |
|                | CFP – W               | Tube          | SNJ54LVTH244AW        | SNJ54LVTH244AW   |
|                | LCCC – FK             | Tube          | SNJ54LVTH244AFK       | SNJ54LVTH244AFK  |

<sup>†</sup> Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://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.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS  
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2003, Texas Instruments Incorporated  
On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

SN54LVTH244A, SN74LVTH244A  
3.3-V ABT OCTAL BUFFERS/DRIVERS  
WITH 3-STATE OUTPUTS

SCAS586J – DECEMBER 1996 – REVISED OCTOBER 2003

description/ordering information (continued)

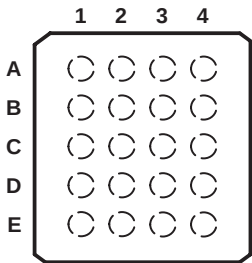
The 'LVTH244A devices are organized as two 4-bit line drivers with separate output-enable ( $\overline{OE}$ ) inputs. When  $\overline{OE}$  is low, the devices pass data from the A inputs to the Y outputs. When  $\overline{OE}$  is high, the outputs are in the high-impedance state.

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.

Active bus-hold circuitry is provided to hold unused or floating data inputs at a valid logic level. Use of pullup or pulldown resistors with the bus-hold circuitry is not recommended.

These devices are fully specified for hot-insertion applications using  $I_{off}$  and power-up 3-state. The  $I_{off}$  circuitry disables the outputs, preventing damaging current backflow through the devices when they are powered down. The power-up 3-state circuitry places the outputs in the high-impedance state during power up and power down, which prevents driver conflict.

SN74LVTH244A . . . GQN OR ZQN PACKAGE  
(TOP VIEW)



terminal assignments

|   | 1   | 2                | 3        | 4                |
|---|-----|------------------|----------|------------------|
| A | 1A1 | $\overline{1OE}$ | $V_{CC}$ | $\overline{2OE}$ |
| B | 1A2 | 2A4              | 2Y4      | 1Y1              |
| C | 1A3 | 2Y3              | 2A3      | 1Y2              |
| D | 1A4 | 2A2              | 2Y2      | 1Y3              |
| E | GND | 2Y1              | 2A1      | 1Y4              |

FUNCTION TABLE  
(each buffer)

| INPUTS          |   | OUTPUT<br>Y |
|-----------------|---|-------------|
| $\overline{OE}$ | A |             |
| L               | H | H           |
| L               | L | L           |
| H               | X | Z           |

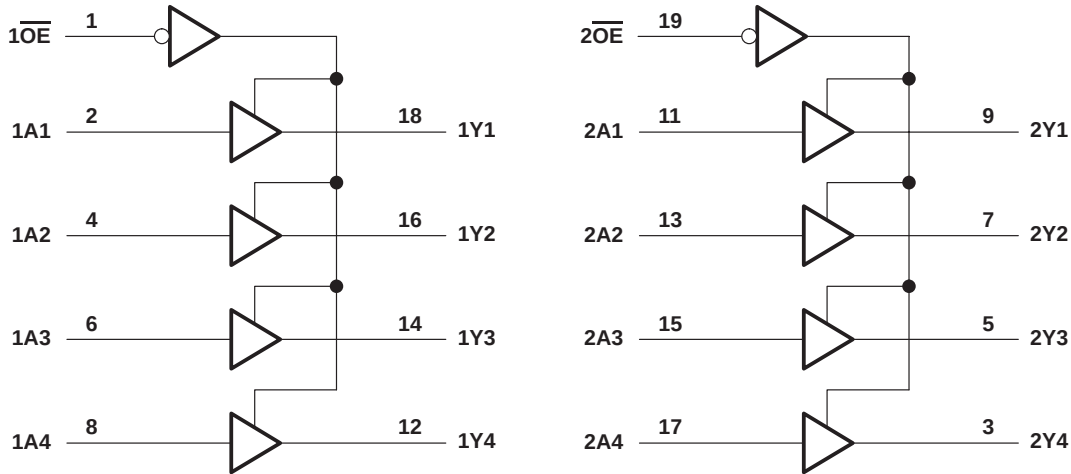
# SN54LVTH244A, SN74LVTH244A

## 3.3-V ABT OCTAL BUFFERS/DRIVERS

### WITH 3-STATE OUTPUTS

SCAS586J – DECEMBER 1996 – REVISED OCTOBER 2003

#### logic diagram (positive logic)



Pin numbers shown are for the DB, DW, FK, J, NS, PW, RGY, and W packages.

#### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

|                                                                                                  |                            |
|--------------------------------------------------------------------------------------------------|----------------------------|
| Supply voltage range, $V_{CC}$                                                                   | –0.5 V to 4.6 V            |
| Input voltage range, $V_I$ (see Note 1)                                                          | –0.5 V to 7 V              |
| Voltage range applied to any output in the high-impedance or power-off state, $V_O$ (see Note 1) | –0.5 V to 7 V              |
| Voltage range applied to any output in the high state, $V_O$ (see Note 1)                        | –0.5 V to $V_{CC} + 0.5$ V |
| Current into any output in the low state, $I_O$ : SN54LVTH244A                                   | 96 mA                      |
| SN74LVTH244A                                                                                     | 128 mA                     |
| Current into any output in the high state, $I_O$ (see Note 2): SN54LVTH244A                      | 48 mA                      |
| SN74LVTH244A                                                                                     | 64 mA                      |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ )                                                      | –50 mA                     |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ )                                                     | –50 mA                     |
| Package thermal impedance, $\theta_{JA}$ (see Note 3): DB package                                | 70°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             |

<sup>†</sup> 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 and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
  2. This current flows only when the output is in the high state and  $V_O > V_{CC}$ .
  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.

# SN54LVTH244A, SN74LVTH244A

## 3.3-V ABT OCTAL BUFFERS/DRIVERS

### WITH 3-STATE OUTPUTS

SCAS586J – DECEMBER 1996 – REVISED OCTOBER 2003

#### recommended operating conditions (see Note 5)

|                     |                                    |                 | SN54LVTH244A |     | SN74LVTH244A |     | UNIT |
|---------------------|------------------------------------|-----------------|--------------|-----|--------------|-----|------|
|                     |                                    |                 | MIN          | MAX | MIN          | MAX |      |
| V <sub>CC</sub>     | Supply voltage                     |                 | 2.7          | 3.6 | 2.7          | 3.6 | V    |
| V <sub>IH</sub>     | High-level input voltage           |                 | 2            |     | 2            |     | V    |
| V <sub>IL</sub>     | Low-level input voltage            |                 |              | 0.8 |              | 0.8 | V    |
| V <sub>I</sub>      | Input voltage                      |                 |              | 5.5 |              | 5.5 | V    |
| I <sub>OH</sub>     | High-level output current          |                 |              | –24 |              | –32 | mA   |
| I <sub>OL</sub>     | Low-level output current           |                 |              | 48  |              | 64  | mA   |
| Δt/Δv               | Input transition rise or fall rate | Outputs enabled |              | 10  |              | 10  | ns/V |
| Δt/ΔV <sub>CC</sub> | Power-up ramp rate                 |                 | 200          |     | 200          |     | μs/V |
| T <sub>A</sub>      | Operating free-air temperature     |                 | –55          | 125 | –40          | 85  | °C   |

NOTE 5: All unused control inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

# SN54LVTH244A, SN74LVTH244A

## 3.3-V ABT OCTAL BUFFERS/DRIVERS

### WITH 3-STATE OUTPUTS

SCAS586J – DECEMBER 1996 – REVISED OCTOBER 2003

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

| PARAMETER             |                | TEST CONDITIONS                                                                                              |                                  | SN54LVTH244A         |      |     | SN74LVTH244A         |      |     | UNIT |    |
|-----------------------|----------------|--------------------------------------------------------------------------------------------------------------|----------------------------------|----------------------|------|-----|----------------------|------|-----|------|----|
|                       |                |                                                                                                              |                                  | MIN                  | TYP† | MAX | MIN                  | TYP† | MAX |      |    |
| V <sub>IK</sub>       |                | V <sub>CC</sub> = 2.7 V, I <sub>I</sub> = -18 mA                                                             |                                  | -1.2                 |      |     | -1.2                 |      |     | V    |    |
| V <sub>OH</sub>       |                | V <sub>CC</sub> = 2.7 V to 3.6 V, I <sub>OH</sub> = -100 μA                                                  |                                  | V <sub>CC</sub> -0.2 |      |     | V <sub>CC</sub> -0.2 |      |     | V    |    |
|                       |                | V <sub>CC</sub> = 2.7 V, I <sub>OH</sub> = -8 mA                                                             |                                  | 2.4                  |      |     | 2.4                  |      |     |      |    |
|                       |                | V <sub>CC</sub> = 3 V                                                                                        | I <sub>OH</sub> = -24 mA         | 2                    |      |     |                      |      |     |      |    |
|                       |                |                                                                                                              | I <sub>OH</sub> = -32 mA         |                      |      |     | 2                    |      |     |      |    |
| V <sub>OL</sub>       |                | V <sub>CC</sub> = 2.7 V                                                                                      | I <sub>OL</sub> = 100 μA         | 0.2                  |      |     | 0.2                  |      |     | V    |    |
|                       |                |                                                                                                              | I <sub>OL</sub> = 24 mA          | 0.5                  |      |     | 0.5                  |      |     |      |    |
|                       |                | V <sub>CC</sub> = 3 V                                                                                        | I <sub>OL</sub> = 16 mA          | 0.4                  |      |     | 0.4                  |      |     |      |    |
|                       |                |                                                                                                              | I <sub>OL</sub> = 32 mA          | 0.5                  |      |     | 0.5                  |      |     |      |    |
|                       |                |                                                                                                              | I <sub>OL</sub> = 48 mA          | 0.55                 |      |     |                      |      |     |      |    |
|                       |                |                                                                                                              | I <sub>OL</sub> = 64 mA          |                      |      |     | 0.55                 |      |     |      |    |
| I <sub>I</sub>        | Control inputs | V <sub>CC</sub> = 0 or 3.6 V, V <sub>I</sub> = 5.5 V                                                         |                                  | 50                   |      |     | 10                   |      |     | μA   |    |
|                       |                | V <sub>CC</sub> = 3.6 V, V <sub>I</sub> = V <sub>CC</sub> or GND                                             |                                  | ±1                   |      |     | ±1                   |      |     |      |    |
|                       | Data inputs    | V <sub>CC</sub> = 3.6 V                                                                                      | V <sub>I</sub> = V <sub>CC</sub> |                      | 1    |     |                      | 1    |     |      |    |
|                       |                |                                                                                                              | V <sub>I</sub> = 0               |                      | -5   |     |                      | -5   |     |      |    |
| I <sub>off</sub>      |                | V <sub>CC</sub> = 0, V <sub>I</sub> or V <sub>O</sub> = 0 to 4.5 V                                           |                                  |                      |      |     | ±100                 |      |     | μA   |    |
| I <sub>I</sub> (hold) | Data inputs    | V <sub>CC</sub> = 3 V                                                                                        | V <sub>I</sub> = 0.8 V           |                      | 75   |     |                      | 75   |     |      | μA |
|                       |                |                                                                                                              | V <sub>I</sub> = 2 V             |                      | -75  |     |                      | -75  |     |      |    |
|                       |                | V <sub>CC</sub> = 3.6 V‡, V <sub>I</sub> = 0 to 3.6 V                                                        |                                  |                      |      |     | 500<br>-750          |      |     |      |    |
| I <sub>OZH</sub>      |                | V <sub>CC</sub> = 3.6 V, V <sub>O</sub> = 3 V                                                                |                                  | 5                    |      |     | 5                    |      |     | μA   |    |
| I <sub>OZL</sub>      |                | V <sub>CC</sub> = 3.6 V, V <sub>O</sub> = 0.5 V                                                              |                                  | -5                   |      |     | -5                   |      |     | μA   |    |
| I <sub>OZPU</sub>     |                | V <sub>CC</sub> = 0 to 1.5 V, V <sub>O</sub> = 0.5 V to 3 V, OE = don't care                                 |                                  | ±100*                |      |     | ±100                 |      |     | μA   |    |
| I <sub>OZPD</sub>     |                | V <sub>CC</sub> = 1.5 V to 0, V <sub>O</sub> = 0.5 V to 3 V, OE = don't care                                 |                                  | ±100*                |      |     | ±100                 |      |     | μA   |    |
| I <sub>CC</sub>       |                | V <sub>CC</sub> = 3.6 V, I <sub>O</sub> = 0, V <sub>I</sub> = V <sub>CC</sub> or GND                         | Outputs high                     |                      | 0.39 |     |                      | 0.19 |     |      | mA |
|                       |                |                                                                                                              | Outputs low                      |                      | 14   |     |                      | 5    |     |      |    |
|                       |                |                                                                                                              | Outputs disabled                 |                      | 0.39 |     |                      | 0.19 |     |      |    |
| ΔI <sub>CC</sub> §    |                | V <sub>CC</sub> = 3 V to 3.6 V, One input at V <sub>CC</sub> - 0.6 V, Other inputs at V <sub>CC</sub> or GND |                                  | 0.2                  |      |     | 0.2                  |      |     | mA   |    |
| C <sub>i</sub>        |                | V <sub>I</sub> = 3 V or 0                                                                                    |                                  | 3                    |      |     | 3                    |      |     | pF   |    |
| C <sub>O</sub>        |                | V <sub>O</sub> = 3 V or 0                                                                                    |                                  | 7                    |      |     | 7                    |      |     | pF   |    |

\* On products compliant to MIL-PRF-38535, this parameter is not production tested.

† All typical values are at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

‡ This is the bus-hold maximum dynamic current. It is the minimum overdrive current required to switch the input from one state to another.

§ This is the increase in supply current for each input that is at the specified TTL voltage level, rather than  $V_{CC}$  or GND.

# SN54LVTH244A, SN74LVTH244A

## 3.3-V ABT OCTAL BUFFERS/DRIVERS

### WITH 3-STATE OUTPUTS

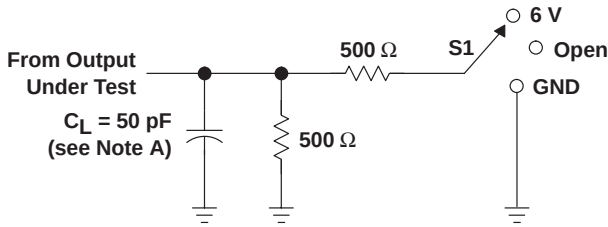
SCAS586J – DECEMBER 1996 – REVISED OCTOBER 2003

switching characteristics over recommended operating free-air temperature range,  $C_L = 50$  pF (unless otherwise noted) (see Figure 1)

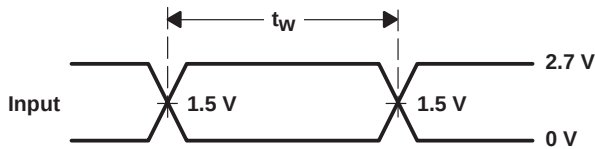
| PARAMETER        | FROM<br>(INPUT)        | TO<br>(OUTPUT) | SN54LVTH244A                       |     |                         |     | SN74LVTH244A                       |      |     |                         | UNIT |     |
|------------------|------------------------|----------------|------------------------------------|-----|-------------------------|-----|------------------------------------|------|-----|-------------------------|------|-----|
|                  |                        |                | V <sub>CC</sub> = 3.3 V<br>± 0.3 V |     | V <sub>CC</sub> = 2.7 V |     | V <sub>CC</sub> = 3.3 V<br>± 0.3 V |      |     | V <sub>CC</sub> = 2.7 V |      |     |
|                  |                        |                | MIN                                | MAX | MIN                     | MAX | MIN                                | TYP† | MAX | MIN                     |      | MAX |
| t <sub>PLH</sub> | A                      | Y              | 0.5                                | 3.8 | 4.1                     |     | 1.1                                | 2.3  | 3.5 | 3.8                     |      | ns  |
| t <sub>PHL</sub> |                        |                | 0.5                                | 3.8 | 3.9                     |     | 1.3                                | 2.1  | 3.3 | 3.6                     |      |     |
| t <sub>PZH</sub> | $\overline{\text{OE}}$ | Y              | 0.8                                | 5   | 6                       |     | 1.1                                | 2.5  | 4.5 | 5.3                     |      | ns  |
| t <sub>PZL</sub> |                        |                | 0.8                                | 5   | 5.4                     |     | 1.4                                | 2.7  | 4.4 | 4.9                     |      |     |
| t <sub>PHZ</sub> | $\overline{\text{OE}}$ | Y              | 1.3                                | 5.5 | 5.8                     |     | 1.9                                | 2.8  | 4.4 | 4.5                     |      | ns  |
| t <sub>PLZ</sub> |                        |                | 1.2                                | 4.7 | 4.8                     |     | 1.8                                | 2.9  | 4.4 | 4.4                     |      |     |

<sup>†</sup> All typical values are at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

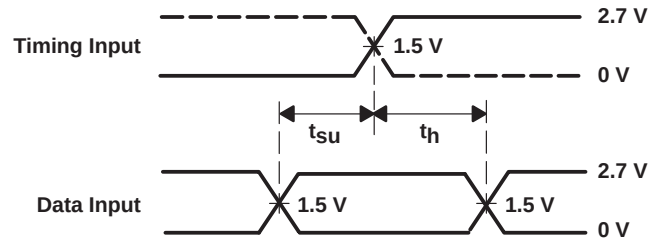
## PARAMETER MEASUREMENT INFORMATION



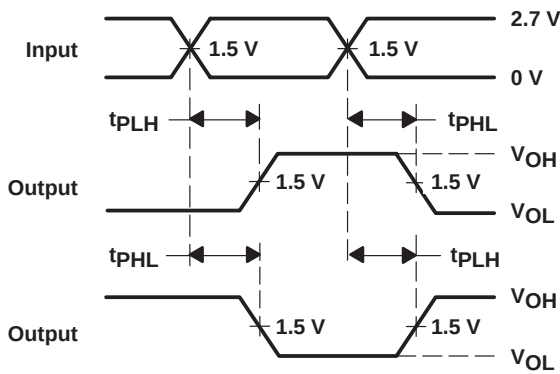
LOAD CIRCUIT



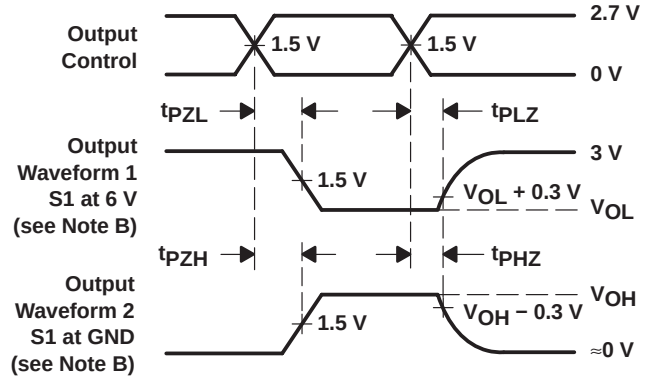
VOLTAGE WAVEFORMS  
PULSE DURATION



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:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .  
D. The outputs are measured one at a time with one transition per measurement.  
E. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup>               |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|--------------------------------------------|
| 5962-9584401Q2A  | ACTIVE                | LCCC         | FK              | 20   | 1           | None                    | Call TI          | Level-NC-NC-NC                             |
| 5962-9584401QRA  | ACTIVE                | CDIP         | J               | 20   | 1           | None                    | Call TI          | Level-NC-NC-NC                             |
| 5962-9584401QSA  | ACTIVE                | CFP          | W               | 20   | 1           | None                    | Call TI          | Level-NC-NC-NC                             |
| 5962-9584401VRA  | ACTIVE                | CDIP         | J               | 20   | 1           | None                    | Call TI          | Level-NC-NC-NC                             |
| 5962-9584401VSA  | ACTIVE                | CFP          | W               | 20   | 1           | None                    | Call TI          | Level-NC-NC-NC                             |
| SN74LVTH244ADBLE | OBSOLETE              | SSOP         | DB              | 20   |             | None                    | Call TI          | Call TI                                    |
| SN74LVTH244ADBR  | ACTIVE                | SSOP         | DB              | 20   | 2000        | Pb-Free (RoHS)          | CU NIPDAU        | Level-2-260C-1 YEAR/<br>Level-1-235C-UNLIM |
| SN74LVTH244ADW   | ACTIVE                | SOIC         | DW              | 20   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | Level-2-250C-1 YEAR/<br>Level-1-235C-UNLIM |
| SN74LVTH244ADWR  | ACTIVE                | SOIC         | DW              | 20   | 2000        | Pb-Free (RoHS)          | CU NIPDAU        | Level-2-250C-1 YEAR/<br>Level-1-235C-UNLIM |
| SN74LVTH244AGQNR | ACTIVE                | VFBGA        | GQN             | 20   | 1000        | None                    | SNPB             | Level-1-240C-UNLIM                         |
| SN74LVTH244ANSR  | ACTIVE                | SO           | NS              | 20   | 2000        | Pb-Free (RoHS)          | CU NIPDAU        | Level-2-260C-1 YEAR/<br>Level-1-235C-UNLIM |
| SN74LVTH244APW   | ACTIVE                | TSSOP        | PW              | 20   | 70          | Pb-Free (RoHS)          | CU NIPDAU        | Level-1-250C-UNLIM                         |
| SN74LVTH244APWLE | OBSOLETE              | TSSOP        | PW              | 20   |             | None                    | Call TI          | Call TI                                    |
| SN74LVTH244APWR  | ACTIVE                | TSSOP        | PW              | 20   | 2000        | Pb-Free (RoHS)          | CU NIPDAU        | Level-1-250C-UNLIM                         |
| SN74LVTH244ARGYR | ACTIVE                | QFN          | RGY             | 20   | 1000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-2-260C-1YEAR                         |
| SN74LVTH244AZQNR | ACTIVE                | VFBGA        | ZQN             | 20   | 1000        | Pb-Free (RoHS)          | SNAGCU           | Level-1-260C-UNLIM                         |
| SNJ54LVTH244AFK  | ACTIVE                | LCCC         | FK              | 20   | 1           | None                    | Call TI          | Level-NC-NC-NC                             |
| SNJ54LVTH244AJ   | ACTIVE                | CDIP         | J               | 20   | 1           | None                    | Call TI          | Level-NC-NC-NC                             |
| SNJ54LVTH244AW   | ACTIVE                | CFP          | W               | 20   | 1           | None                    | Call TI          | Level-NC-NC-NC                             |

<sup>(1)</sup> 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.

<sup>(2)</sup> Eco Plan - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**None:** Not yet available Lead (Pb-Free).

**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" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take



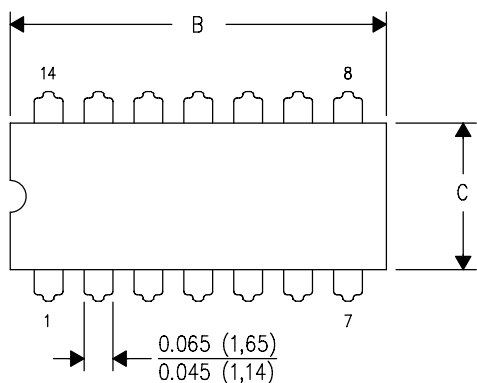
reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

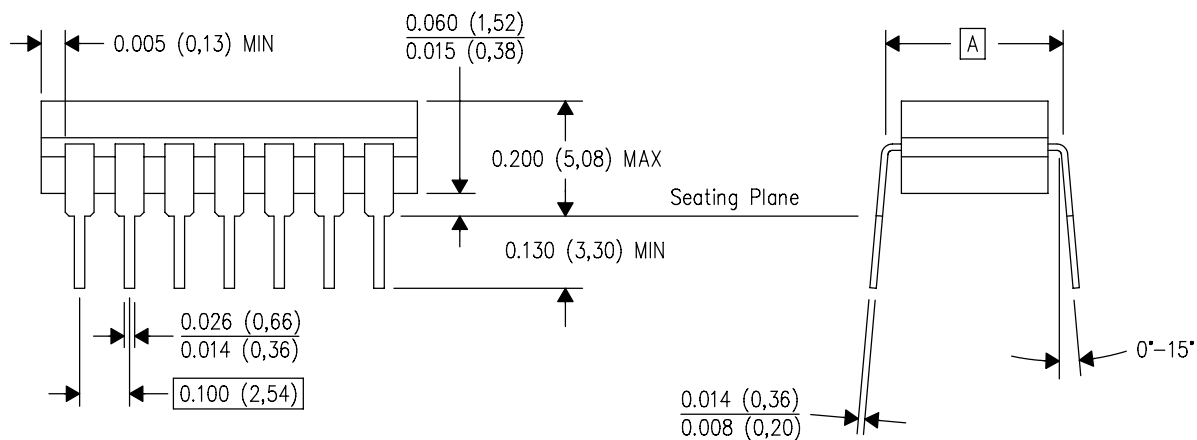
J (R-GDIP-T\*\*)

14 LEADS SHOWN

# CERAMIC DUAL IN-LINE PACKAGE



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

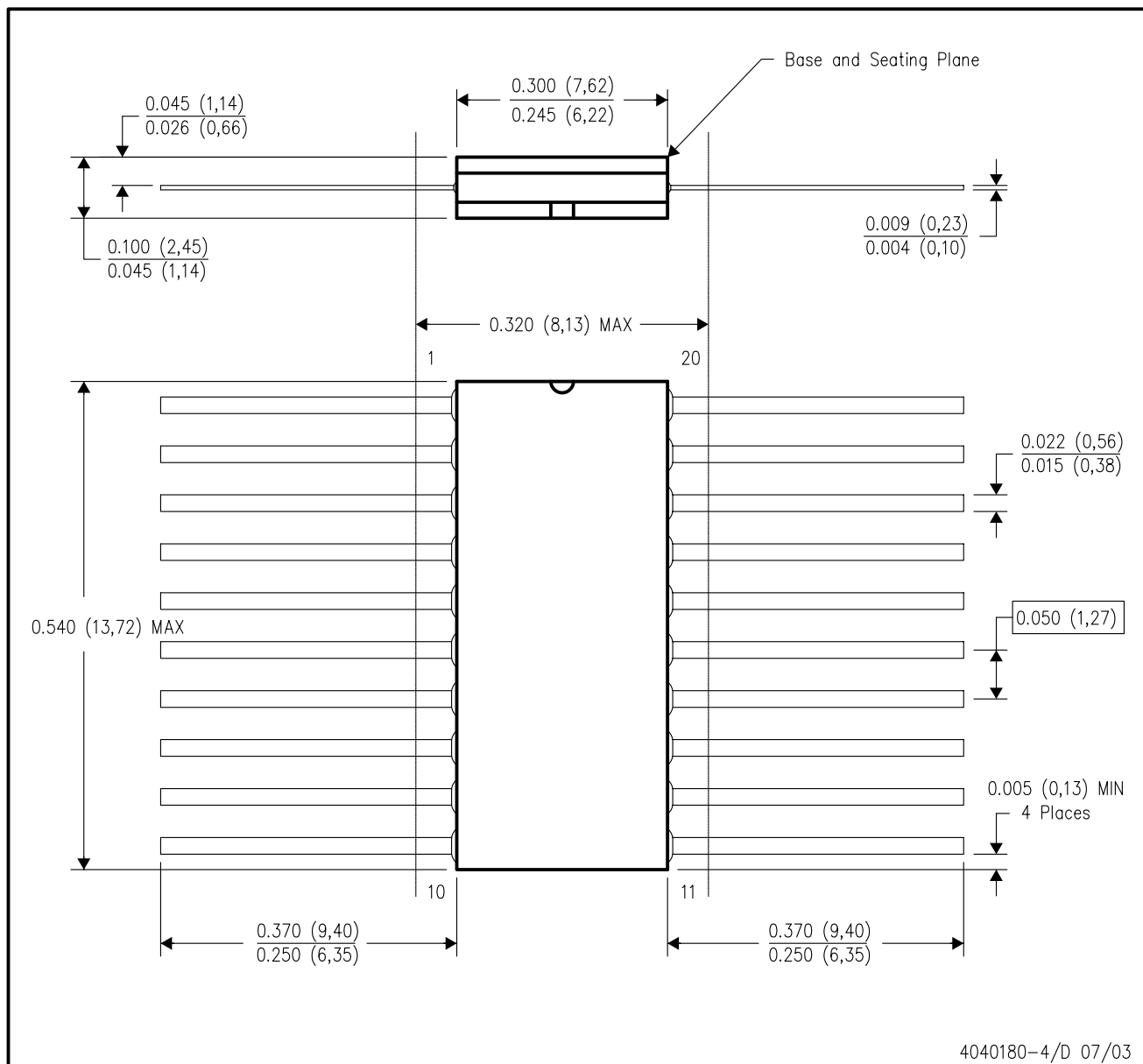


4040083/F 03/03

- 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-F20)

CERAMIC DUAL FLATPACK

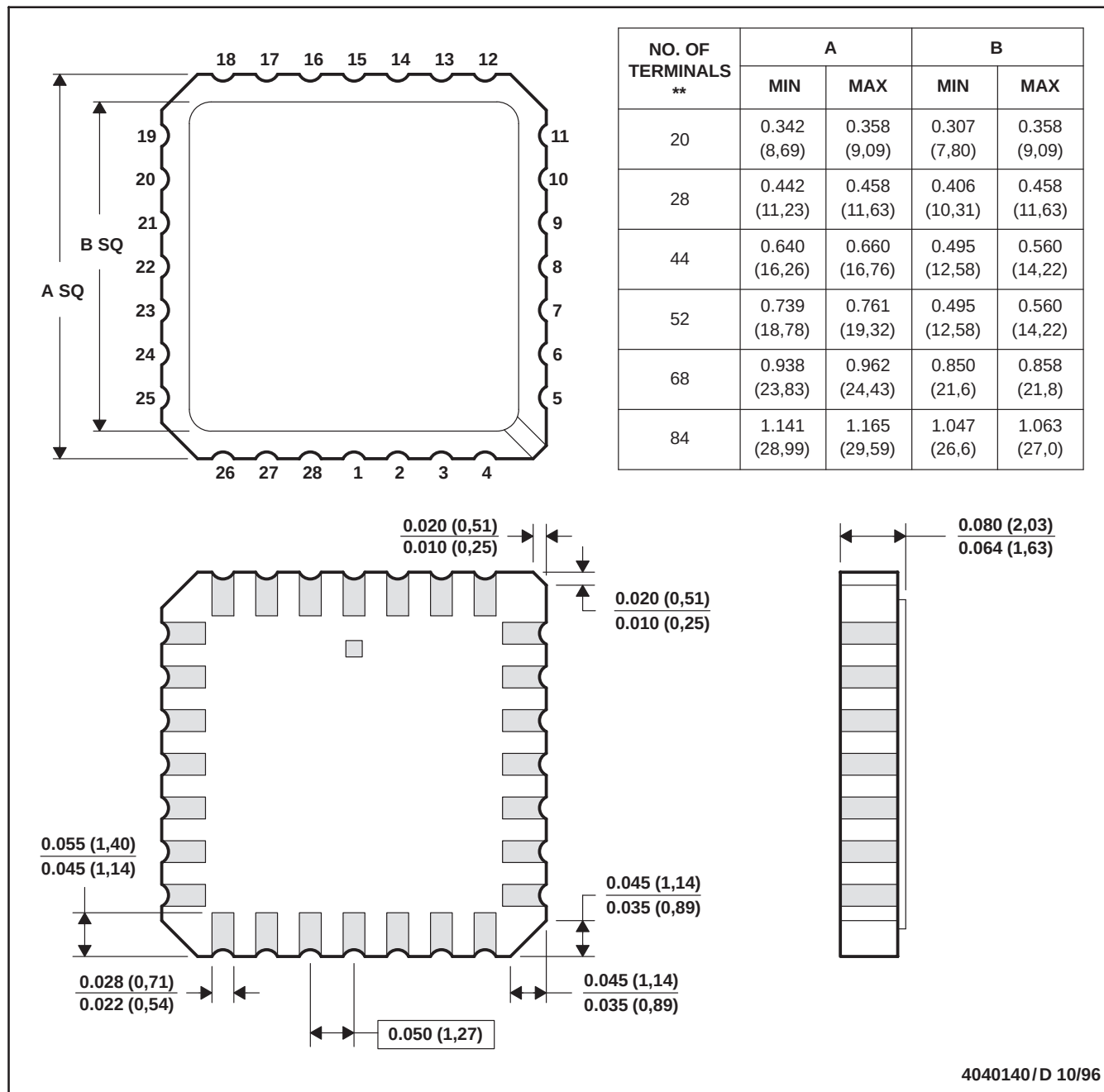


- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification only.
  - Falls within Mil-Std 1835 GDFP2-F20

FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

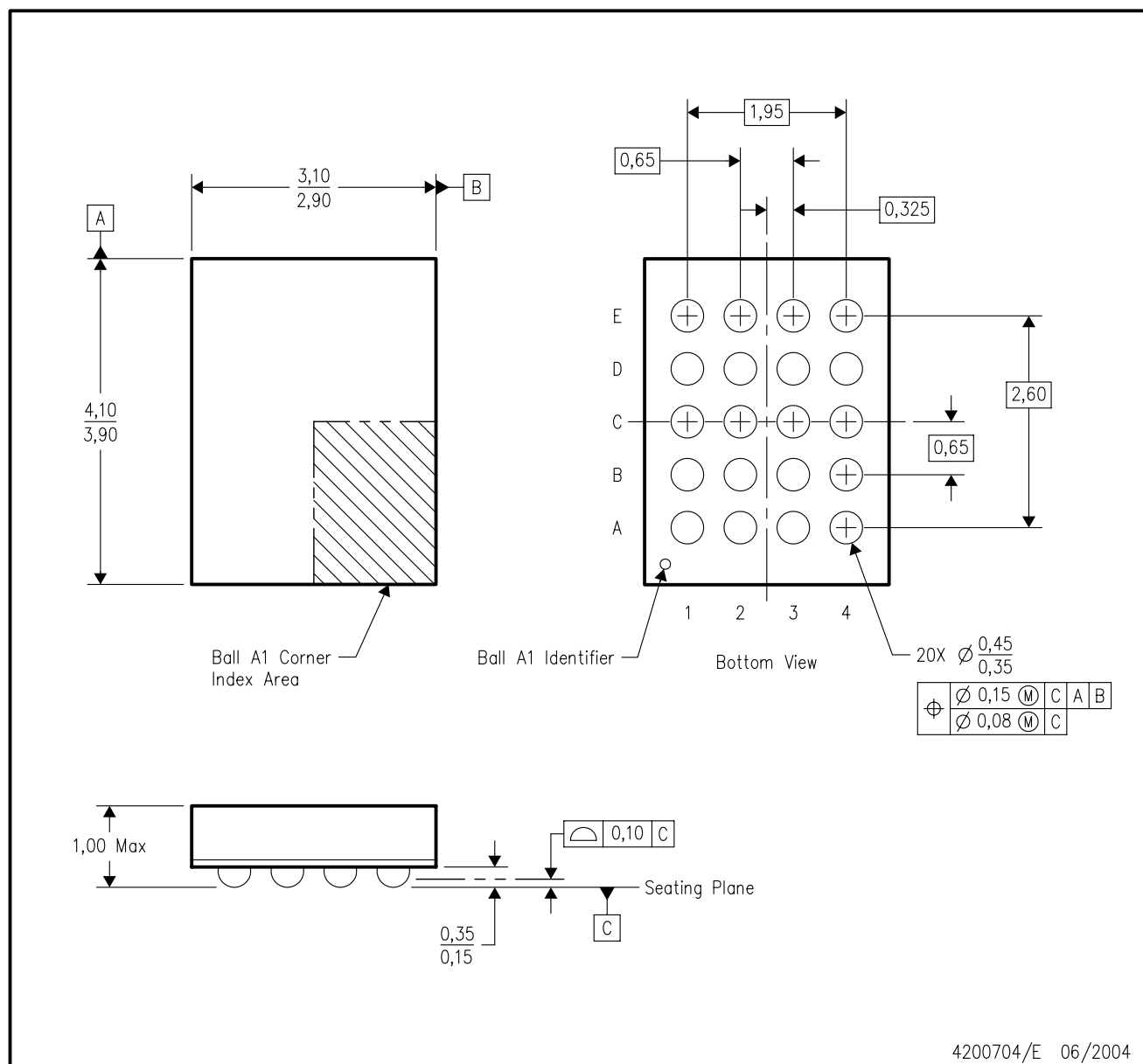
28 TERMINAL SHOWN



- 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

**GQN (R-PBGA-N20)**

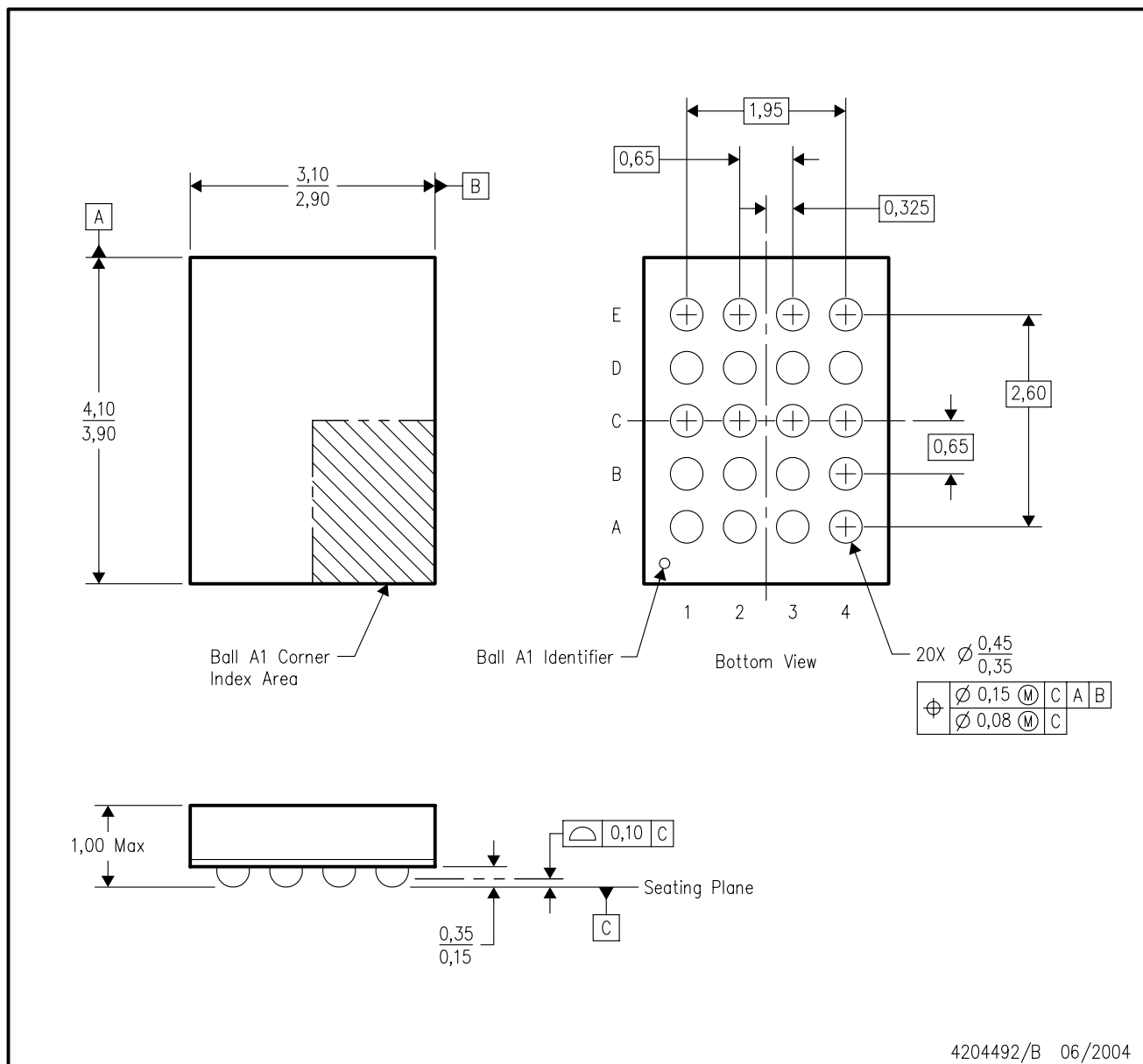
## PLASTIC BALL GRID ARRAY



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

## ZQN (R-PBGA-N20)

## PLASTIC BALL GRID ARRAY

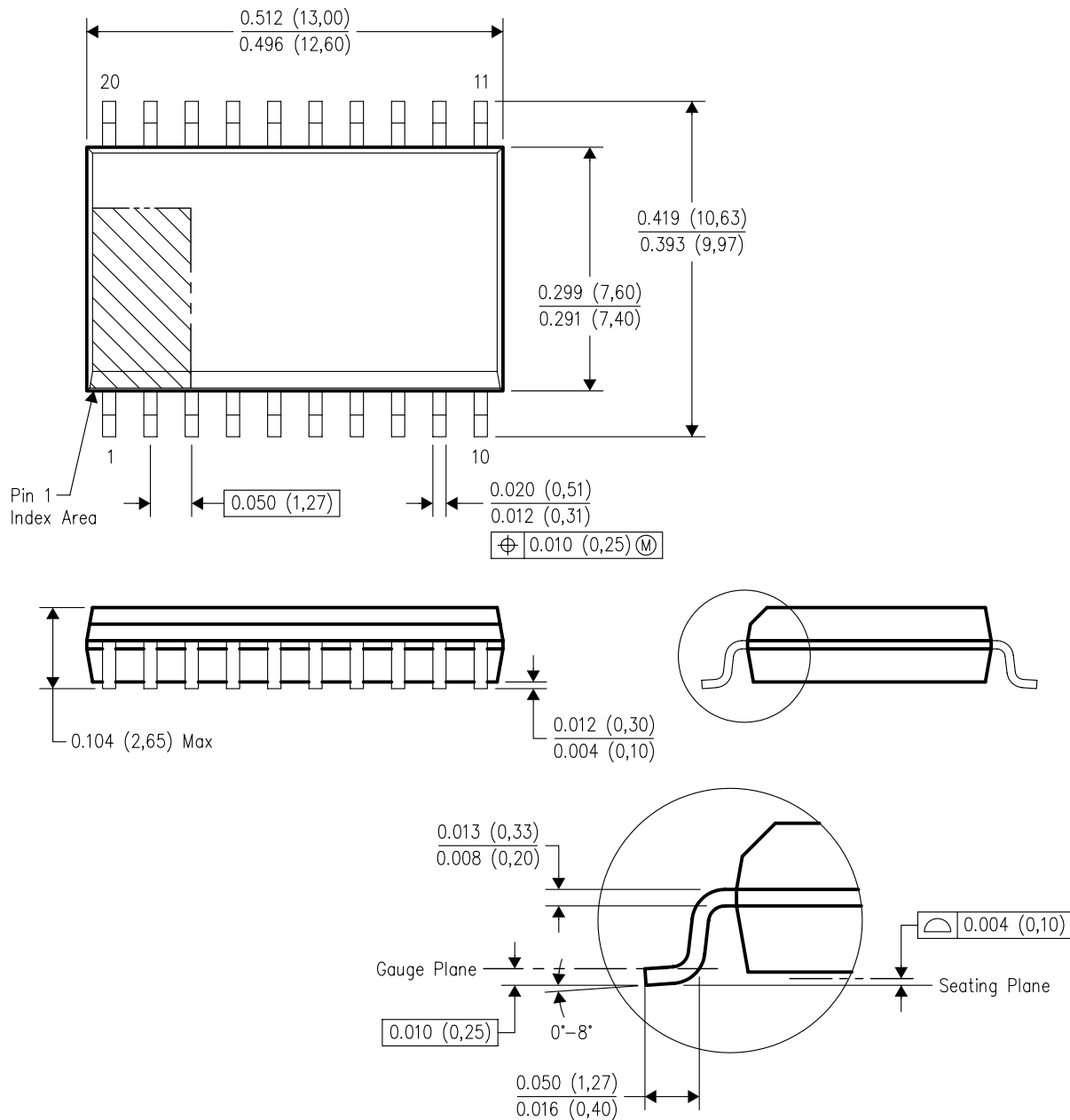


4204492/B 06/2004

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Falls within JEDEC MO-225 variation BC.
  - D. This package is lead-free. Refer to the 20 GQN package (drawing 4200704) for tin-lead (SnPb).

## DW (R-PDSO-G20)

## PLASTIC SMALL-OUTLINE PACKAGE

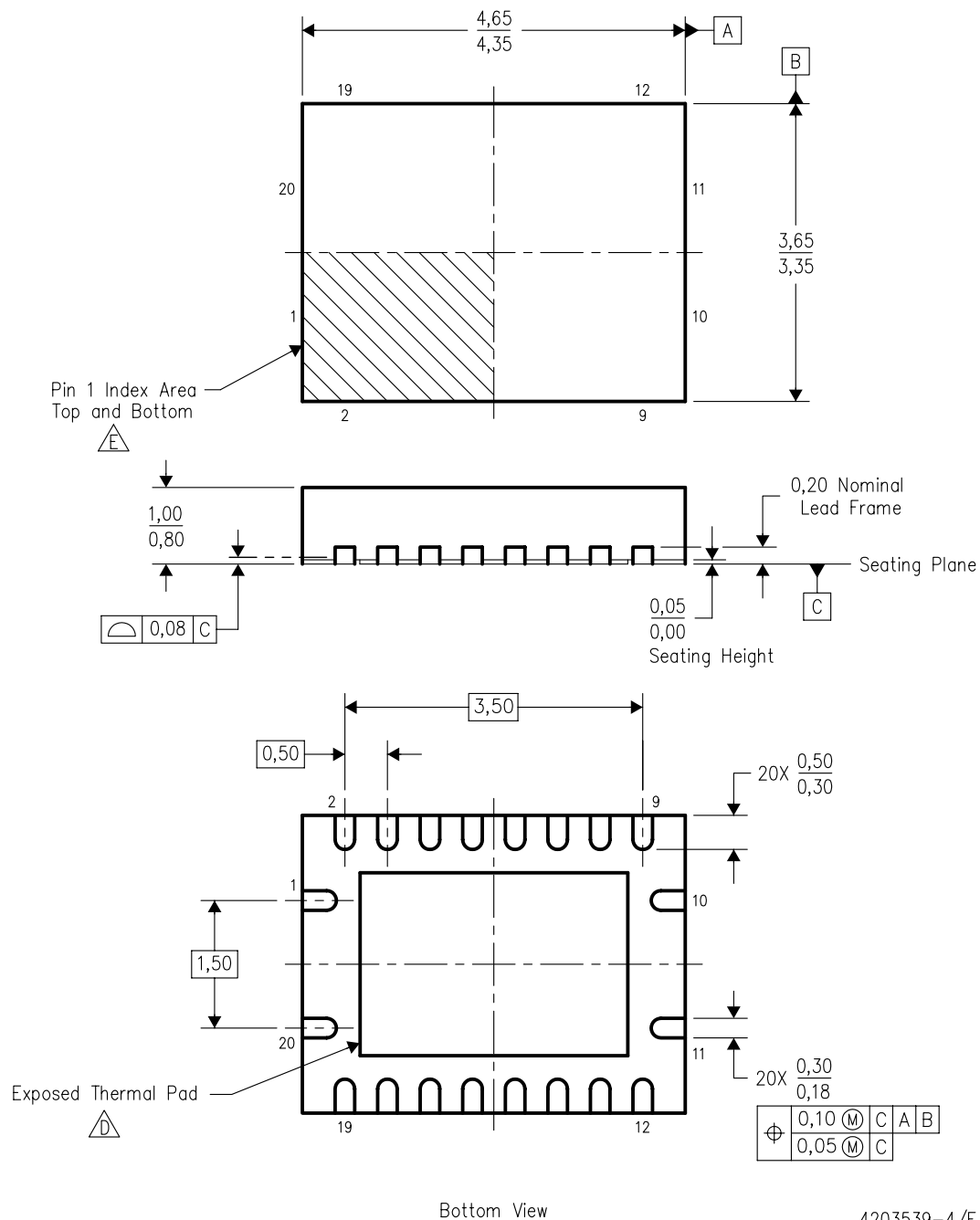


4040000-4/F 06/2004

- 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-013 variation AC.

RGY (R-PQFP-N20)

PLASTIC QUAD FLATPACK



Bottom View

4203539-4/F 02/2005

- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - This drawing is subject to change without notice.
  - QFN (Quad Flatpack No-Lead) package configuration.
  - The package thermal pad must be soldered to the board for thermal and mechanical performance. See the Product Data Sheet for details regarding the exposed thermal pad dimensions.
  - Pin 1 identifiers are located on both top and bottom of the package and within the zone indicated. The Pin 1 identifiers are either a molded, marked, or metal feature.
  - Package complies to JEDEC MO-241 variation BC.

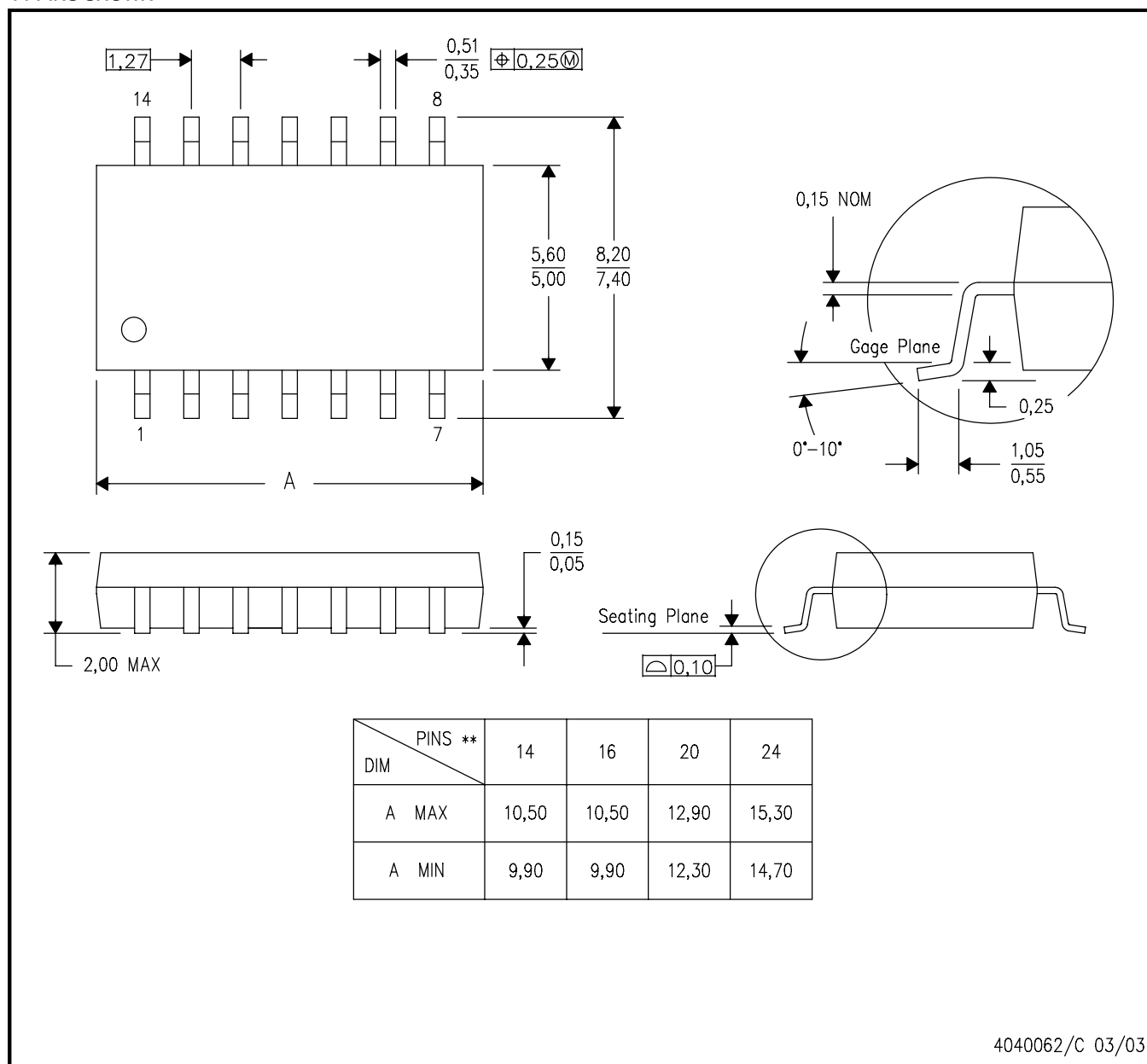


# MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN

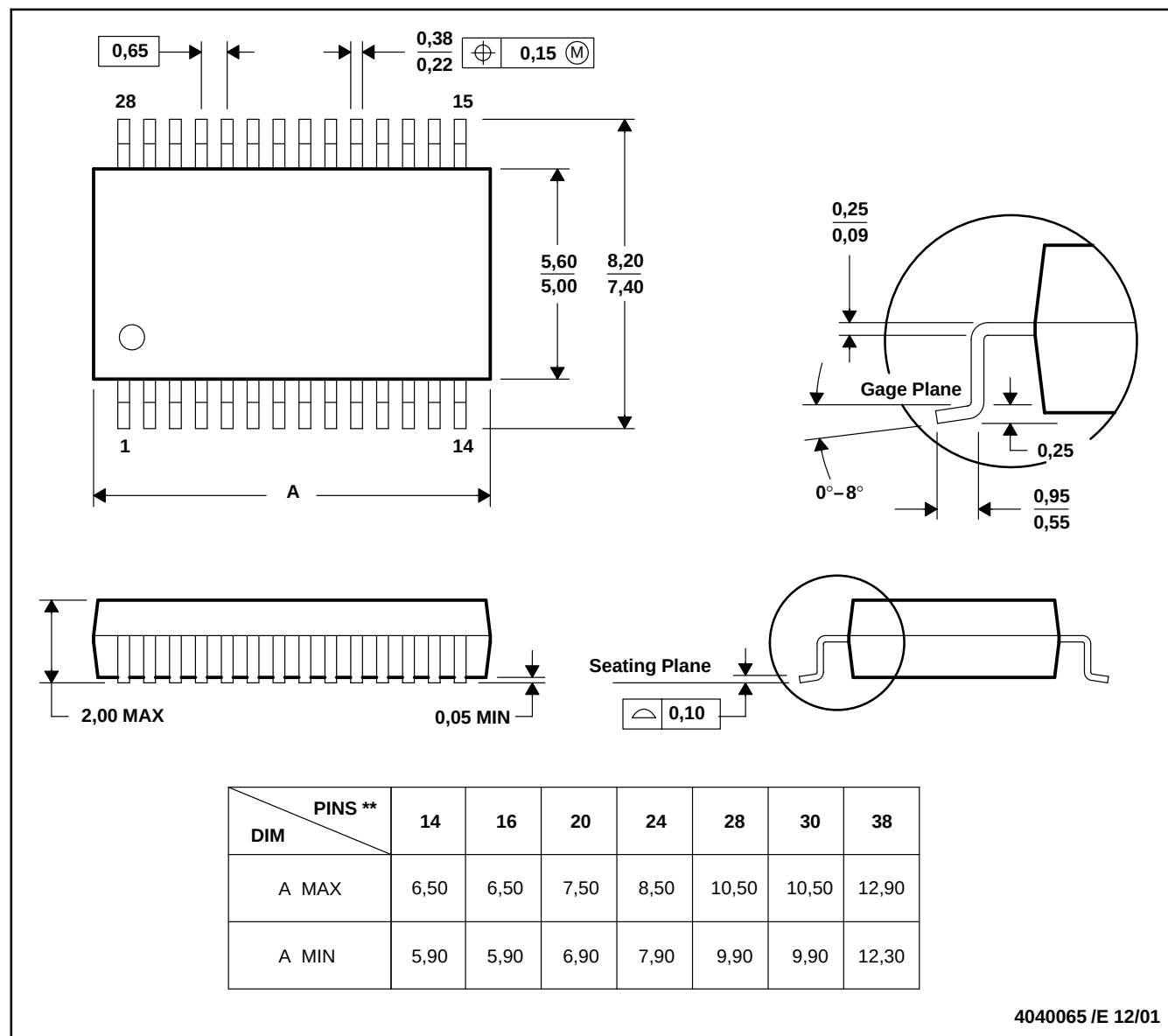


- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

## DB (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE

28 PINS SHOWN

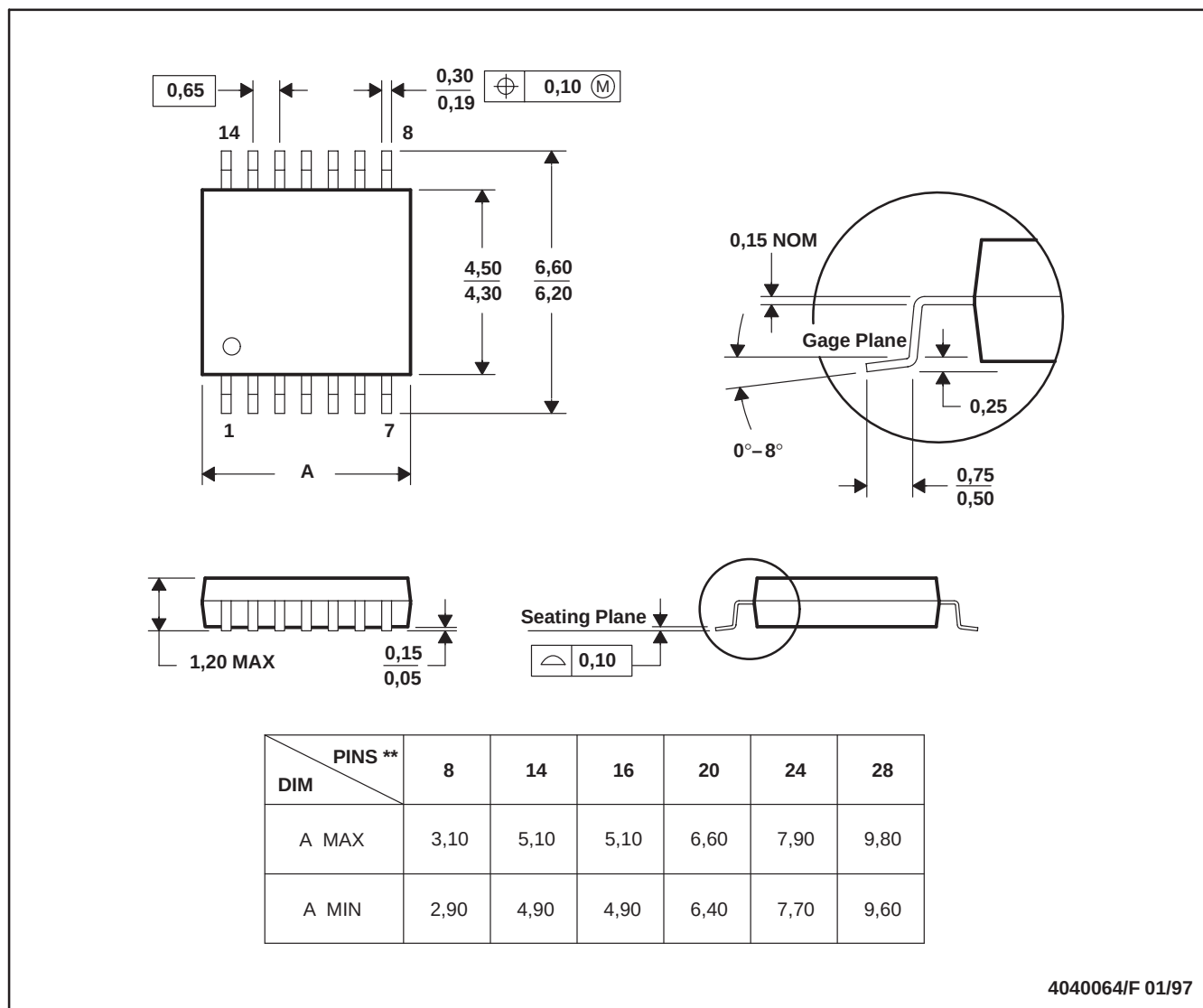


- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-150

## PW (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



- 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

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

| <b>Products</b>  |                                                                    | <b>Applications</b> |                                                                          |
|------------------|--------------------------------------------------------------------|---------------------|--------------------------------------------------------------------------|
| Amplifiers       | <a href="http://amplifier.ti.com">amplifier.ti.com</a>             | Audio               | <a href="http://www.ti.com/audio">www.ti.com/audio</a>                   |
| Data Converters  | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>     | Automotive          | <a href="http://www.ti.com/automotive">www.ti.com/automotive</a>         |
| DSP              | <a href="http://dsp.ti.com">dsp.ti.com</a>                         | Broadband           | <a href="http://www.ti.com/broadband">www.ti.com/broadband</a>           |
| Interface        | <a href="http://interface.ti.com">interface.ti.com</a>             | Digital Control     | <a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a> |
| Logic            | <a href="http://logic.ti.com">logic.ti.com</a>                     | Military            | <a href="http://www.ti.com/military">www.ti.com/military</a>             |
| Power Mgmt       | <a href="http://power.ti.com">power.ti.com</a>                     | Optical Networking  | <a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a> |
| Microcontrollers | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a> | Security            | <a href="http://www.ti.com/security">www.ti.com/security</a>             |
|                  |                                                                    | Telephony           | <a href="http://www.ti.com/telephony">www.ti.com/telephony</a>           |
|                  |                                                                    | Video & Imaging     | <a href="http://www.ti.com/video">www.ti.com/video</a>                   |
|                  |                                                                    | Wireless            | <a href="http://www.ti.com/wireless">www.ti.com/wireless</a>             |

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

Copyright © 2005, Texas Instruments Incorporated

Copyright © Each Manufacturing Company.

All Datasheets cannot be modified without permission.

This datasheet has been download from :

[www.AllDataSheet.com](http://www.AllDataSheet.com)

100% Free DataSheet Search Site.

Free Download.

No Register.

Fast Search System.

[www.AllDataSheet.com](http://www.AllDataSheet.com)