

# SN74LVC244A OCTAL BUFFER/DRIVER WITH 3-STATE OUTPUTS

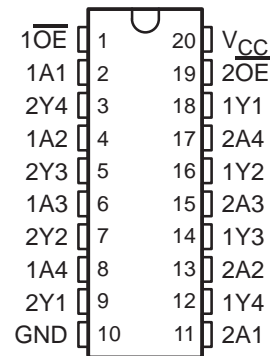
SCAS414W – NOVEMBER 1992 – REVISED MAY 2004

- Operates From 1.65 V to 3.6 V
- Inputs Accept Voltages to 5.5 V
- Specified From  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  and  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$
- Max  $t_{pd}$  of 5.9 ns at 3.3 V
- Typical  $V_{OLP}$  (Output Ground Bounce)  $<0.8$  V at  $V_{CC} = 3.3$  V,  $T_A = 25^{\circ}\text{C}$
- Typical  $V_{OHV}$  (Output  $V_{OH}$  Undershoot)  $>2$  V at  $V_{CC} = 3.3$  V,  $T_A = 25^{\circ}\text{C}$
- 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)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

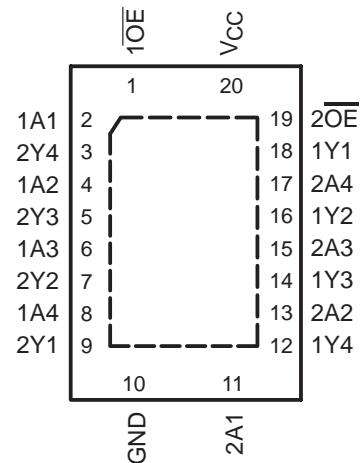
## description/ordering information

This octal buffer/line driver is operational at 1.5-V to 3.6-V  $V_{CC}$ , but is designed specifically for 1.65-V to 3.6-V  $V_{CC}$  operation.

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



RGY PACKAGE  
(TOP VIEW)



## ORDERING INFORMATION

| $T_A$  | PACKAGE†              |                 | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|--|-----------------------|-----------------|-----------------------|------------------|
| $-40^{\circ}\text{C}$ to $85^{\circ}\text{C}$  | QFN – RGY             | Reel of 1000    | SN74LVC244ARGYR       | LC244A           |
|  | VFBGA – GQN           | Reel of 1000    | SN74LVC244AGQNR       | LC244A           |
|  | VFBGA – ZQN (Pb-Free) |                 | SN74LVC244AZQNR       |                  |
| $-40^{\circ}\text{C}$ to $125^{\circ}\text{C}$ | PDIP – N              | Tube of 20      | SN74LVC244AN          | SN74LVC244AN     |
|  | SOIC – DW             | Tube of 25      | SN74LVC244ADW         | LVC244A          |
|  |                       | Reel of 2000    | SN74LVC244ADWR        |                  |
|  | SOP – NS              | Reel of 2000    | SN74LVC244ANSR        | LVC244A          |
|  | SSOP – DB             | Reel of 2000    | SN74LVC244ADBR        | LC244A           |
|  | TSSOP – PW            | Tube of 70      | SN74LVC244APW         | LC244A           |
|  |                       | Reel of 2000    | SN74LVC244APWR        |                  |
| Reel of 250                                    |                       | SN74LVC244APWT  |                       |                  |
| TVSOP – DGV                                    | Reel of 2000          | SN74LVC244ADGVR | LC244A                |                  |

† 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).

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**TEXAS  
INSTRUMENTS**

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# SN74LVC244A

## OCTAL BUFFER/DRIVER

### WITH 3-STATE OUTPUTS

SCAS414W – NOVEMBER 1992 – REVISED MAY 2004

#### description/ordering information (continued)

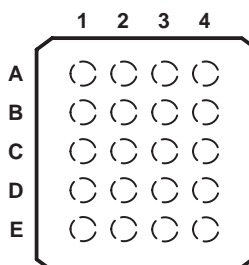
The SN74LVC244A is organized as two 4-bit line drivers with separate output-enable ( $\overline{OE}$ ) inputs. When  $\overline{OE}$  is low, the device passes data from the A inputs to the Y outputs. When  $\overline{OE}$  is high, the outputs are in the high-impedance state.

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.

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.

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.

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



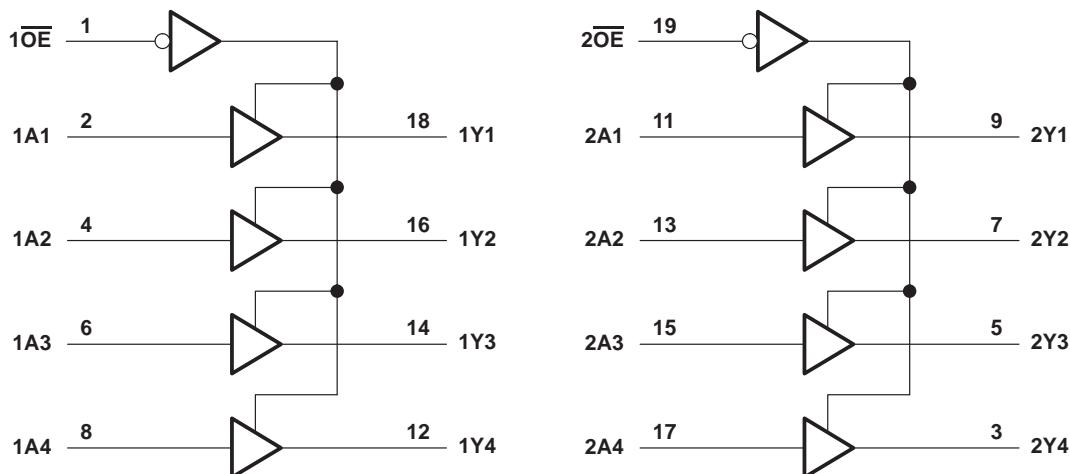
#### terminal assignments

|   | 1   | 2                | 3        | 4                |
|---|-----|------------------|----------|------------------|
| A | 1A1 | $1\overline{OE}$ | $V_{CC}$ | $2\overline{OE}$ |
| 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 |
|-----------------|---|--------|
| $\overline{OE}$ | A | Y      |
| L               | H | H      |
| L               | L | L      |
| H               | X | Z      |

#### logic diagram (positive logic)



Pin numbers shown are for the DB, DGV, DW, N, 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, $V_O$<br>(see Note 1) .....   | -0.5 V to 6.5 V            |
| Voltage range applied to any output in the high or low state, $V_O$<br>(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, $I_O$ .....  | $\pm 50$ mA                |
| Continuous current through $V_{CC}$ or GND .....  | $\pm 100$ mA               |
| Package thermal impedance, $\theta_{JA}$ (see Note 3): DB package .....                                     | 70°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): N package .....   | 69°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             |
| Power dissipation, $P_{tot}$ ( $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ ) (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 and output negative-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 DW package: above 70°C the value of  $P_{tot}$  derates linearly with 8 mW/K.
  6. For the DB, DGV, N, NS, and PW packages: above 60°C the value of  $P_{tot}$  derates linearly with 5.5 mW/K.

# SN74LVC244A

## OCTAL BUFFER/DRIVER

### WITH 3-STATE OUTPUTS

SCAS414W – NOVEMBER 1992 – REVISED MAY 2004

#### recommended operating conditions (see Note 7)

|          |                           | $T_A = 25^\circ\text{C}$                     |                      | $-40 \text{ TO } 85^\circ\text{C}$ |                      | $-40 \text{ TO } 125^\circ\text{C}$ |                      | UNIT |   |
|----------|---------------------------|--|----------------------|------------------------------------|----------------------|-------------------------------------|----------------------|------|---|
|          |                           | 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  | $V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$ | $0.65 \times V_{CC}$ |                                    | $0.65 \times V_{CC}$ |                                     | $0.65 \times V_{CC}$ | V    |   |
|          |                           | $V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$   | 1.7                  |                                    | 1.7                  |                                     | 1.7                  |      |   |
|          |                           | $V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$   | 2                    |                                    | 2                    |                                     | 2                    |      |   |
| $V_{IL}$ | Low-level input voltage   | $V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$ | $0.35 \times V_{CC}$ |                                    | $0.35 \times V_{CC}$ |                                     | $0.35 \times V_{CC}$ | V    |   |
|          |                           | $V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$   | 0.7                  |                                    | 0.7                  |                                     | 0.7                  |      |   |
|          |                           | $V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$   | 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 | $V_{CC} = 1.65 \text{ V}$                    |                      | -4                                 |                      | -4                                  |                      | mA   |   |
|          |                           | $V_{CC} = 2.3 \text{ V}$                     |                      | -8                                 |                      | -8                                  |                      |      |   |
|          |                           | $V_{CC} = 2.7 \text{ V}$                     |                      | -12                                |                      | -12                                 |                      |      |   |
|          |                           | $V_{CC} = 3 \text{ V}$                       |                      | -24                                |                      | -24                                 |                      |      |   |
| $I_{OL}$ | Low-level output current  | $V_{CC} = 1.65 \text{ V}$                    |                      | 4                                  |                      | 4                                   |                      | mA   |   |
|          |                           | $V_{CC} = 2.3 \text{ V}$                     |                      | 8                                  |                      | 8                                   |                      |      |   |
|          |                           | $V_{CC} = 2.7 \text{ V}$                     |                      | 12                                 |                      | 12                                  |                      |      |   |
|          |                           | $V_{CC} = 3 \text{ V}$                       |                      | 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.

# SN74LVC244A OCTAL BUFFER/DRIVER WITH 3-STATE OUTPUTS

SCAS414W – NOVEMBER 1992 – REVISED MAY 2004

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

| PARAMETER                | TEST CONDITIONS   | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     |     | -40 TO 85°C          |     | -40 TO 125°C         |     | UNIT |
|--------------------------|---|-----------------|-----------------------|-----|-----|----------------------|-----|----------------------|-----|------|
|                          |   |                 | MIN                   | TYP | MAX | MIN                  | MAX | MIN                  | MAX |      |
| V <sub>OH</sub>          | I <sub>OH</sub> = -100 μA   | 1.65 V to 3.6 V | V <sub>CC</sub> -0.2  |     |     | V <sub>CC</sub> -0.2 |     | V <sub>CC</sub> -0.3 |     | V    |
|                          | I <sub>OH</sub> = -4 mA   | 1.65 V          | 1.29                  |     |     | 1.2                  |     | 1.05                 |     |      |
|                          | I <sub>OH</sub> = -8 mA   | 2.3 V           | 1.9                   |     |     | 1.7                  |     | 1.55                 |     |      |
|                          | I <sub>OH</sub> = -12 mA  | 2.7 V           | 2.2                   |     |     | 2.2                  |     | 2.05                 |     |      |
|                          |   | 3 V             | 2.4                   |     |     | 2.4                  |     | 2.25                 |     |      |
| I <sub>OH</sub> = -24 mA | 3 V   | 2.3             |                       |     | 2.2 |                      | 2   |                      |     |      |
| V <sub>OL</sub>          | I <sub>OL</sub> = 100 μA  | 1.65 V to 3.6 V | 0.1                   |     |     | 0.2                  |     | 0.3                  |     | V    |
|                          | I <sub>OL</sub> = 4 mA  | 1.65 V          | 0.24                  |     |     | 0.45                 |     | 0.6                  |     |      |
|                          | I <sub>OL</sub> = 8 mA  | 2.3 V           | 0.3                   |     |     | 0.7                  |     | 0.75                 |     |      |
|                          | I <sub>OL</sub> = 12 mA   | 2.7 V           | 0.4                   |     |     | 0.4                  |     | 0.6                  |     |      |
|                          | I <sub>OL</sub> = 24 mA   | 3 V             | 0.55                  |     |     | 0.55                 |     | 0.8                  |     |      |
| I <sub>I</sub>           | V <sub>I</sub> = 5.5 V or GND   | 3.6 V           | ±1                    |     |     | ±5                   |     | ±20                  |     | μA   |
| I <sub>off</sub>         | V <sub>I</sub> or V <sub>O</sub> = 5.5 V  | 0               | ±1                    |     |     | ±10                  |     | ±20                  |     | μA   |
| I <sub>OZ</sub>          | V <sub>O</sub> = 0 to 5.5 V   | 3.6 V           | ±1                    |     |     | ±10                  |     | ±20                  |     | μA   |
| I <sub>CC</sub>          | V <sub>I</sub> = V <sub>CC</sub> or GND   | 3.6 V           | 1                     |     |     | 10                   |     | 40                   |     | μA   |
|                          | 3.6 V ≤ V <sub>I</sub> ≤ 5.5 V <sup>†</sup>                                     |                 | 1                     |     |     | 10                   |     | 40                   |     |      |
| ΔI <sub>CC</sub>         | One input at V <sub>CC</sub> - 0.6 V,<br>Other inputs at V <sub>CC</sub> or GND | 2.7 V to 3.6 V  | 500                   |     |     | 500                  |     | 5000                 |     | μA   |
| C <sub>i</sub>           | V <sub>I</sub> = V <sub>CC</sub> or GND   | 3.3 V           | 4                     |     |     |                      |     |                      |     | pF   |
| C <sub>o</sub>           | V <sub>O</sub> = V <sub>CC</sub> or GND   | 3.3 V           | 5.5                   |     |     |                      |     |                      |     | pF   |

<sup>†</sup> This applies in the disabled state only.



**SN74LVC244A**  
**OCTAL BUFFER/DRIVER**  
**WITH 3-STATE OUTPUTS**

SCAS414W – NOVEMBER 1992 – REVISED MAY 2004

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

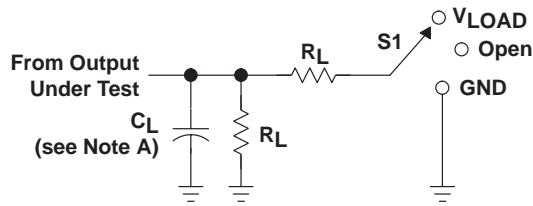
| PARAMETER          | FROM (INPUT)    | TO (OUTPUT) | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     |      | -40 TO 85°C |      | -40 TO 125°C |      | UNIT |
|--------------------|-----------------|-------------|-----------------|-----------------------|-----|------|-------------|------|--------------|------|------|
|                    |                 |             |                 | MIN                   | TYP | MAX  | MIN         | MAX  | MIN          | MAX  |      |
| t <sub>pd</sub>    | A               | Y           | 1.5 V           | 1                     | 7   | 14.4 | 1           | 14.9 | 1            | 16.4 | ns   |
|                    |                 |             | 1.8 V ± 0.15 V  | 1                     | 5.9 | 10.4 | 1           | 10.9 | 1            | 12.4 |      |
|                    |                 |             | 2.5 V ± 0.2 V   | 1                     | 4.2 | 7.4  | 1           | 7.9  | 1            | 10   |      |
|                    |                 |             | 2.7 V           | 1                     | 4.2 | 6.7  | 1           | 6.9  | 1            | 8.2  |      |
| t <sub>en</sub>    | $\overline{OE}$ | Y           | 1.5 V           | 1                     | 8.3 | 17.8 | 1           | 18.3 | 1            | 19.8 | ns   |
|                    |                 |             | 1.8 V ± 0.15 V  | 1                     | 6.4 | 12.1 | 1           | 12.6 | 1            | 14.1 |      |
|                    |                 |             | 2.5 V ± 0.2 V   | 1                     | 4.6 | 9.1  | 1           | 9.6  | 1            | 11.7 |      |
|                    |                 |             | 2.7 V           | 1                     | 5   | 8.4  | 1           | 8.6  | 1            | 10.3 |      |
| t <sub>dis</sub>   | $\overline{OE}$ | Y           | 1.5 V           | 1                     | 7.2 | 15.6 | 1           | 16.1 | 1            | 17.6 | ns   |
|                    |                 |             | 1.8 V ± 0.15 V  | 1                     | 5.8 | 11.6 | 1           | 12.1 | 1            | 13.6 |      |
|                    |                 |             | 2.5 V ± 0.2 V   | 1                     | 3.7 | 7.3  | 1           | 7.8  | 1            | 9.9  |      |
|                    |                 |             | 2.7 V           | 1                     | 3.8 | 6.6  | 1           | 6.8  | 1            | 8.6  |      |
| t <sub>sk(o)</sub> |                 |             | 3.3 V ± 0.3 V   |                       |     |      | 1           |      | 1.5          | ns   |      |

operating characteristics, T<sub>A</sub> = 25°C

| PARAMETER       |   | TEST CONDITIONS  | V <sub>CC</sub> | TYP   | UNIT |    |
|-----------------|---|------------------|-----------------|-------|------|----|
| C <sub>pd</sub> | Power dissipation capacitance per buffer/driver | Outputs enabled  | f = 10 MHz      | 1.8 V | 43   | pF |
|                 |   |                  |                 | 2.5 V | 43   |    |
|                 |   |                  |                 | 3.3 V | 44   |    |
|                 |   | Outputs disabled | f = 10 MHz      | 1.8 V | 1    |    |
|                 |   |                  |                 | 2.5 V | 1    |    |
|                 |   |                  |                 | 3.3 V | 2    |    |



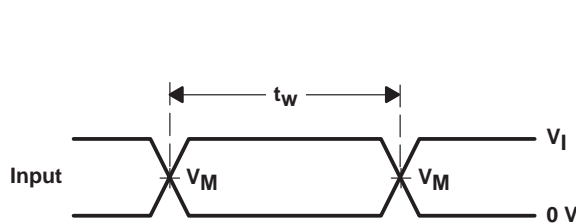
PARAMETER MEASUREMENT INFORMATION



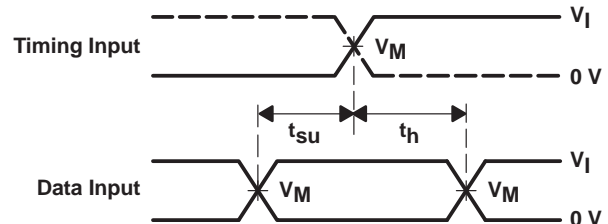
| TEST              | S1         |
|-------------------|------------|
| $t_{PLH}/t_{PHL}$ | Open       |
| $t_{PLZ}/t_{PZL}$ | $V_{LOAD}$ |
| $t_{PHZ}/t_{PZH}$ | GND        |

LOAD CIRCUIT

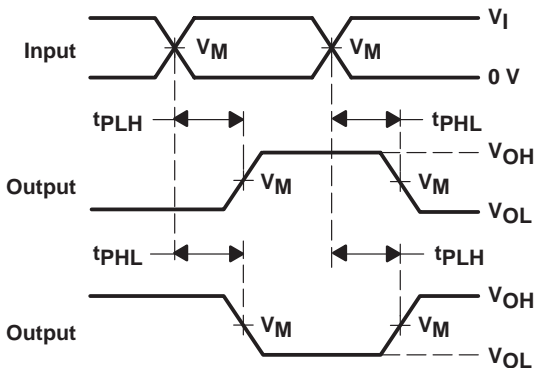
| $V_{CC}$                           | INPUTS   |               | $V_M$      | $V_{LOAD}$        | $C_L$ | $R_L$        | $V_{\Delta}$ |
|------------------------------------|----------|---------------|------------|-------------------|-------|--------------|--------------|
|                                    | $V_I$    | $t_r/t_f$     |            |                   |       |              |              |
| 1.5 V                              | $V_{CC}$ | $\leq 2$ ns   | $V_{CC}/2$ | $2 \times V_{CC}$ | 15 pF | 2 k $\Omega$ | 0.1 V        |
| $1.8 \text{ V} \pm 0.15 \text{ V}$ | $V_{CC}$ | $\leq 2$ ns   | $V_{CC}/2$ | $2 \times V_{CC}$ | 30 pF | 1 k $\Omega$ | 0.15 V       |
| $2.5 \text{ V} \pm 0.2 \text{ V}$  | $V_{CC}$ | $\leq 2$ ns   | $V_{CC}/2$ | $2 \times V_{CC}$ | 30 pF | 500 $\Omega$ | 0.15 V       |
| 2.7 V                              | 2.7 V    | $\leq 2.5$ ns | 1.5 V      | 6 V               | 50 pF | 500 $\Omega$ | 0.3 V        |
| $3.3 \text{ V} \pm 0.3 \text{ V}$  | 2.7 V    | $\leq 2.5$ ns | 1.5 V      | 6 V               | 50 pF | 500 $\Omega$ | 0.3 V        |



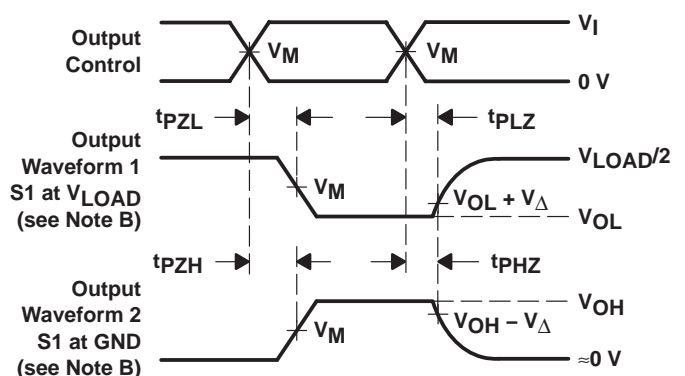
VOLTAGE WAVEFORMS  
PULSE DURATION



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  $\leq 10$  MHz,  $Z_O = 50 \Omega$ .  
 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

**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>               |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|--|
| SN74LVC244ADBLE  | OBSOLETE              | SSOP         | DB              | 20   |             | None                    | Call TI          | Call TI                                    |
| SN74LVC244ADBR   | ACTIVE                | SSOP         | DB              | 20   | 2000        | Pb-Free (RoHS)          | CU NIPDAU        | Level-2-260C-1 YEAR/<br>Level-1-235C-UNLIM |
| SN74LVC244ADGVR  | ACTIVE                | TVSOP        | DGV             | 20   | 2000        | Pb-Free (RoHS)          | CU NIPDAU        | Level-1-250C-UNLIM                         |
| SN74LVC244ADW    | ACTIVE                | SOIC         | DW              | 20   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | Level-2-250C-1 YEAR/<br>Level-1-235C-UNLIM |
| SN74LVC244ADWR   | ACTIVE                | SOIC         | DW              | 20   | 2000        | Pb-Free (RoHS)          | CU NIPDAU        | Level-2-250C-1 YEAR/<br>Level-1-235C-UNLIM |
| SN74LVC244AGQNR  | ACTIVE                | VFBGA        | GQN             | 20   | 1000        | None                    | SNPB             | Level-1-240C-UNLIM                         |
| SN74LVC244AN     | ACTIVE                | PDIP         | N               | 20   | 20          | Pb-Free (RoHS)          | CU NIPDAU        | Level-NC-NC-NC                             |
| SN74LVC244ANSR   | ACTIVE                | SO           | NS              | 20   | 2000        | Pb-Free (RoHS)          | CU NIPDAU        | Level-2-260C-1 YEAR/<br>Level-1-235C-UNLIM |
| SN74LVC244APW    | ACTIVE                | TSSOP        | PW              | 20   | 70          | Pb-Free (RoHS)          | CU NIPDAU        | Level-1-250C-UNLIM                         |
| SN74LVC244APWLE  | OBSOLETE              | TSSOP        | PW              | 20   |             | None                    | Call TI          | Call TI                                    |
| SN74LVC244APWR   | ACTIVE                | TSSOP        | PW              | 20   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM                         |
| SN74LVC244APWT   | ACTIVE                | TSSOP        | PW              | 20   | 250         | Pb-Free (RoHS)          | CU NIPDAU        | Level-1-250C-UNLIM                         |
| SN74LVC244ARGYR  | ACTIVE                | QFN          | RGY             | 20   | 1000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-2-260C-1YEAR                         |
| SN74LVC244AZQNR  | ACTIVE                | VFBGA        | ZQN             | 20   | 1000        | Pb-Free (RoHS)          | SNAGCU           | Level-1-260C-UNLIM                         |

<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.

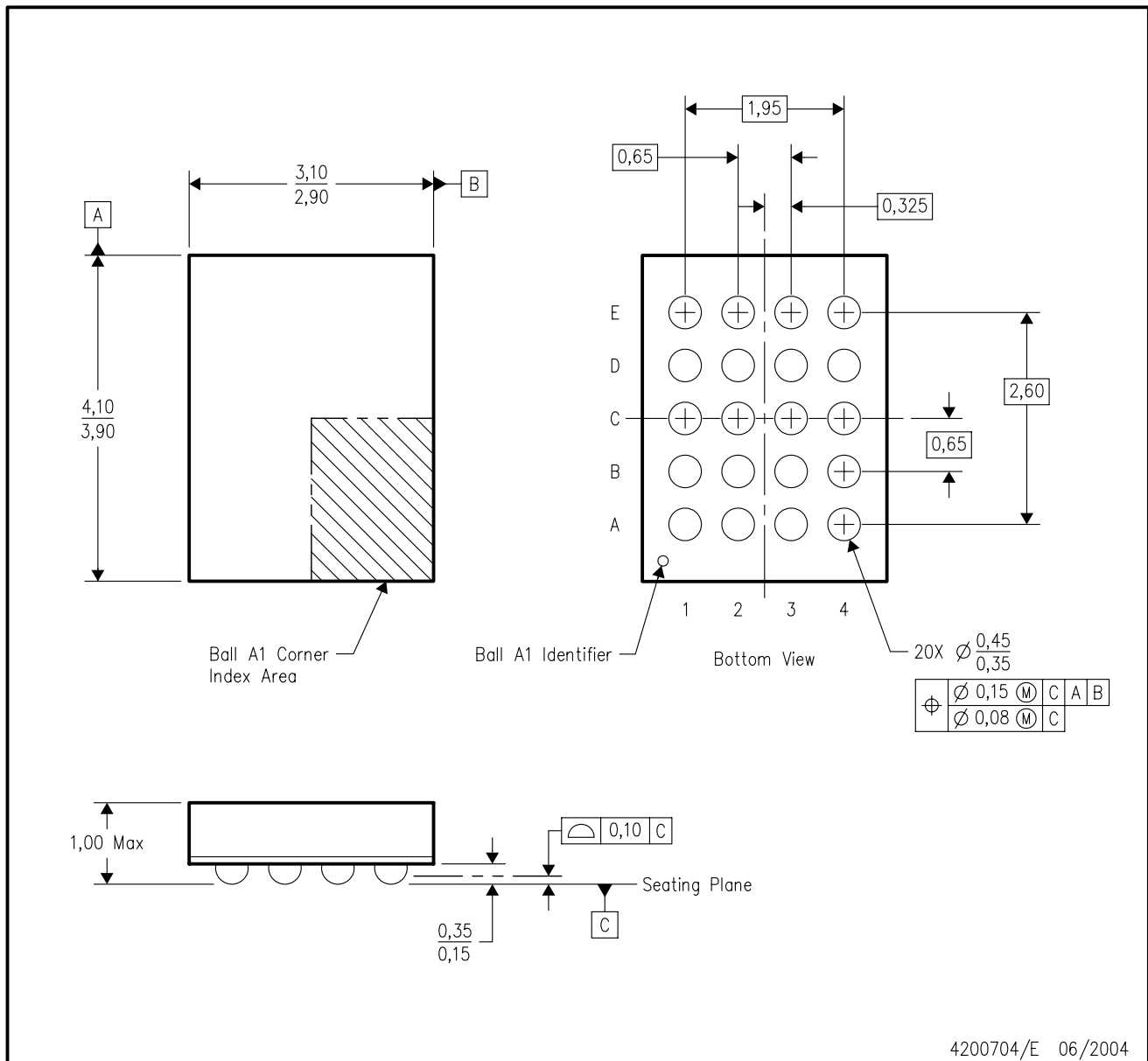
<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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GQN (R-PBGA-N20)

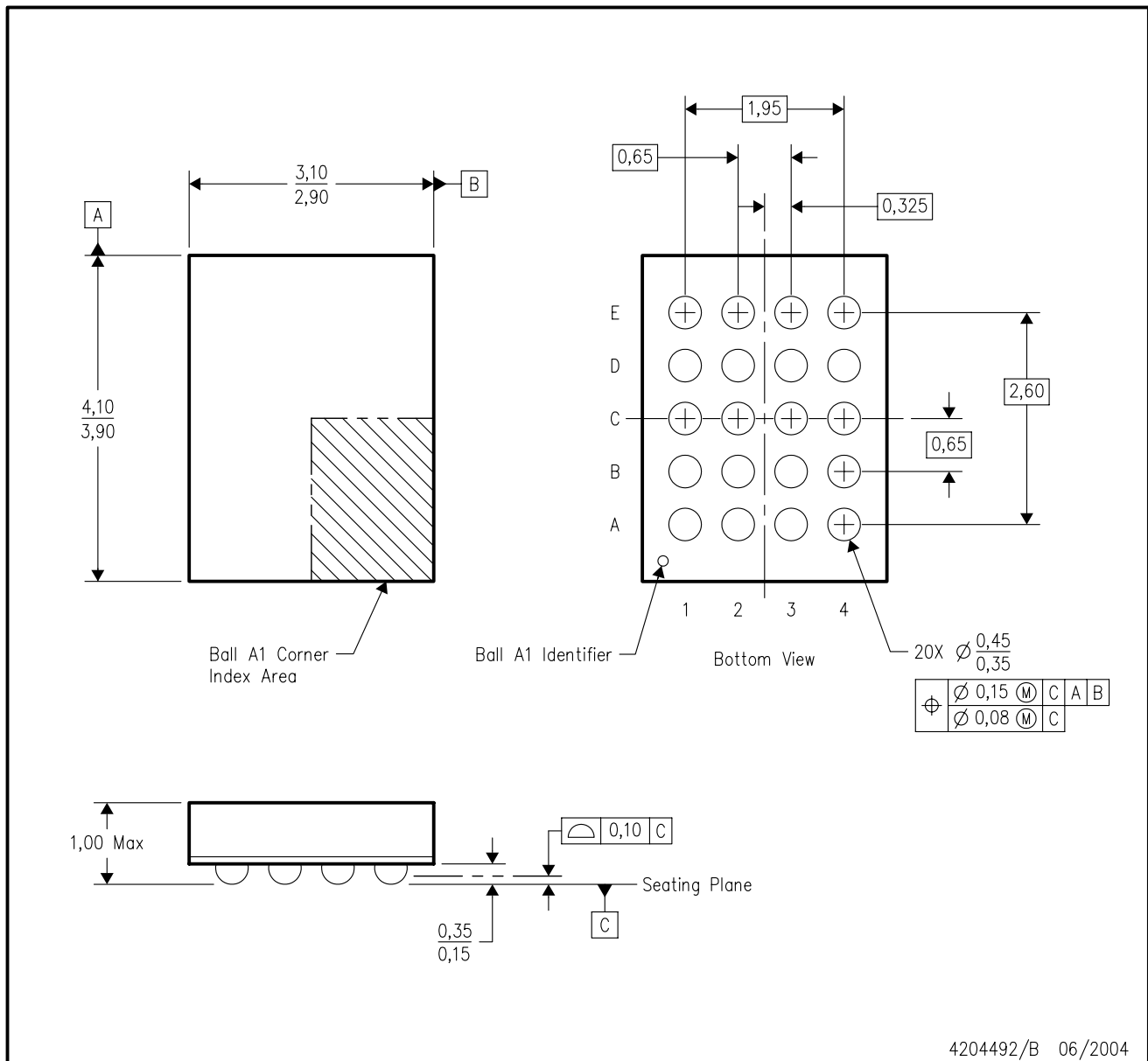
PLASTIC BALL GRID ARRAY



- 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

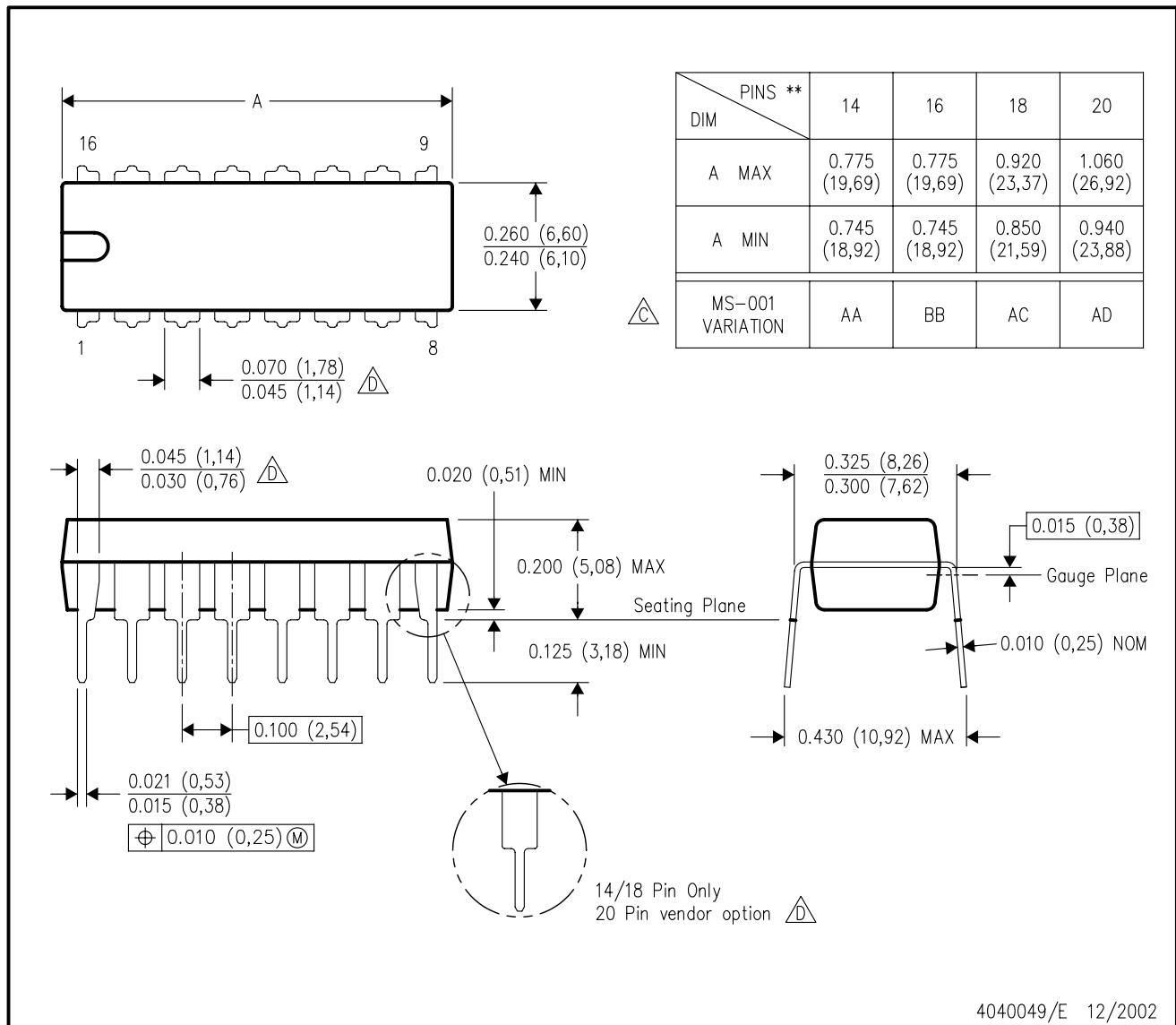


- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Falls within JEDEC MO-225 variation BC.
  - D. This package is lead-free. Refer to the 20 GQN package (drawing 4200704) for tin-lead (SnPb).

N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - $\triangle C$  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - $\triangle D$  The 20 pin end lead shoulder width is a vendor option, either half or full width.

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

PLASTIC SMALL-OUTLINE

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

DW (R-PDSO-G20)

PLASTIC SMALL-OUTLINE PACKAGE

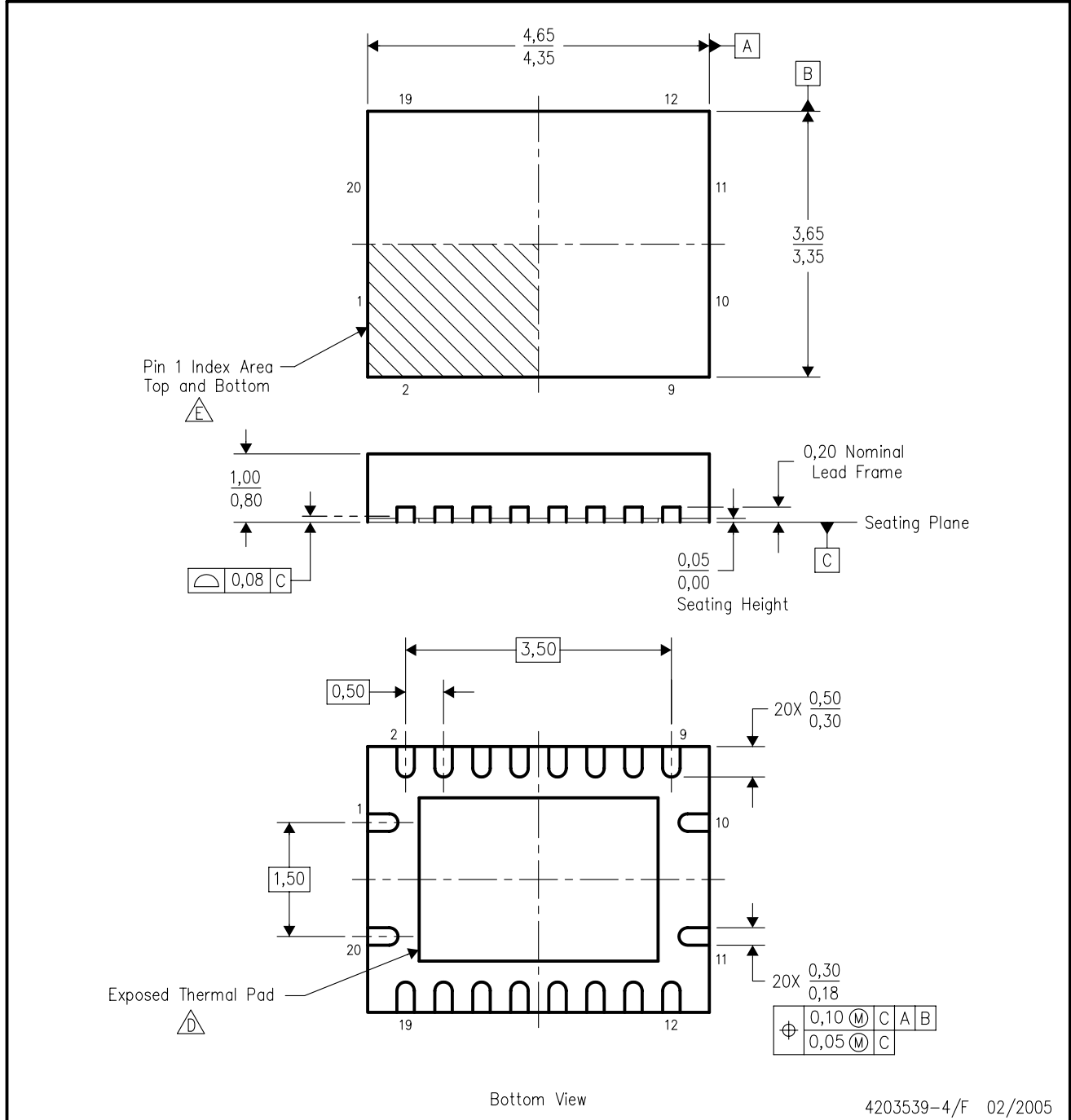


4040000-4/F 06/2004

- 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



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. 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.
  - F. 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.



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

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



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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