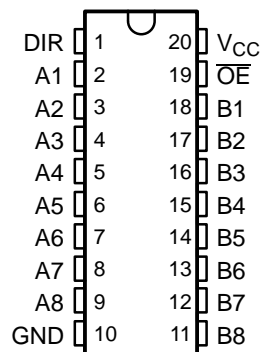


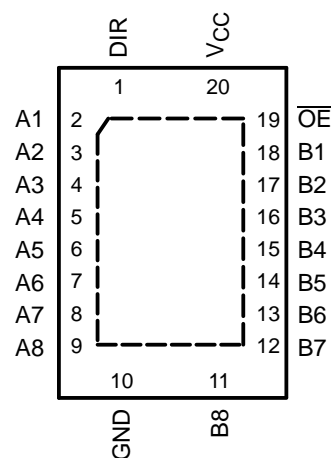
FEATURES

- 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, $T_A = 25^\circ\text{C}$
- 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)
 - 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 ⁽¹⁾ | | 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 |
| | | Tube of 70 | SN74LVCR2245APW | LER245A |
| | TSSOP – PW | 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 | | |

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



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

SN74LVCR2245A OCTAL BUS TRANSCEIVER WITH 3-STATE OUTPUTS

SCAS581M–NOVEMBER 1996–REVISED MARCH 2005

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.

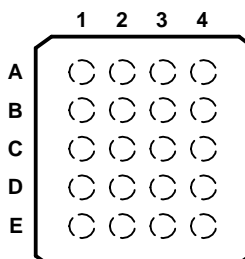
All outputs, which are designed to sink up to 12 mA, include equivalent 26- Ω resistors to reduce overshoot and undershoot.

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)**

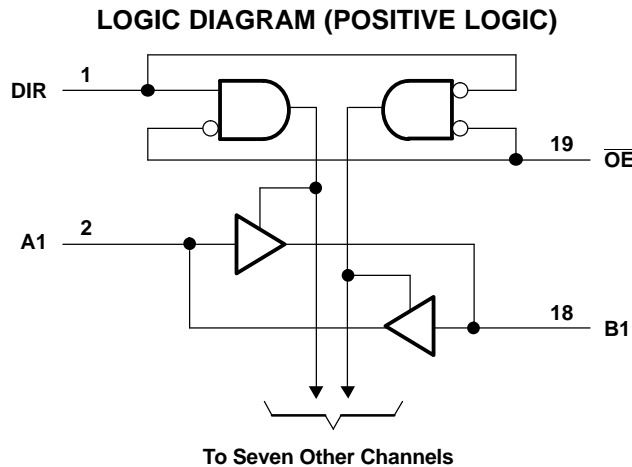


TERMINAL ASSIGNMENTS

| | 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 |



Pin numbers shown are for the DB, DBQ, DGV, DW, NS, PW, and RGY packages.

Absolute Maximum Ratings⁽¹⁾

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

| | | MIN | MAX | UNIT |
|---------------|---|--------------------------------|----------------|------|
| V_{CC} | Supply voltage range | -0.5 | 6.5 | V |
| V_I | Input voltage range ⁽²⁾ | -0.5 | 6.5 | V |
| V_O | Voltage range applied to any output in the high-impedance or power-off state ⁽²⁾ | -0.5 | 6.5 | V |
| V_O | Voltage range applied to any output in the high or low state ⁽²⁾⁽³⁾ | -0.5 | $V_{CC} + 0.5$ | V |
| I_{IK} | Input clamp current | | -50 | mA |
| | | $V_I < 0$ | | |
| I_{OK} | Output clamp current | | -50 | mA |
| | | $V_O < 0$ | | |
| I_O | Continuous output current | | ±50 | mA |
| | Continuous current through V_{CC} or GND | | ±100 | mA |
| θ_{JA} | Package thermal impedance | DB package ⁽⁴⁾ | 70 | °C/W |
| | | DBQ package ⁽⁴⁾ | 68 | |
| | | DGV package ⁽⁴⁾ | 92 | |
| | | DW package ⁽⁴⁾ | 58 | |
| | | GQN/ZQN package ⁽⁴⁾ | 78 | |
| | | NS package ⁽⁴⁾ | 60 | |
| | | PW package ⁽⁴⁾ | 83 | |
| | | RGY package ⁽⁵⁾ | 37 | |
| T_{stg} | Storage temperature range | -65 | 150 | °C |

- (1) 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.
- (2) The input negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) The value of V_{CC} is provided in the recommended operating conditions table.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.
- (5) The package thermal impedance is calculated in accordance with JESD 51-5.

SN74LVCR2245A OCTAL BUS TRANSCEIVER WITH 3-STATE OUTPUTS

SCAS581M–NOVEMBER 1996–REVISED MARCH 2005

Recommended Operating Conditions⁽¹⁾

| | | | 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 × 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 × 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 | |
| Δt/Δv | Input transition rise or fall rate | | | 10 | ns/V |
| T _A | Operating free-air temperature | | –40 | 85 | °C |

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

Electrical Characteristics

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

| PARAMETER | | TEST CONDITIONS | V _{CC} | MIN | TYP ⁽¹⁾ | 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} ⁽²⁾ | | V _O = 0 to 5.5 V | 3.6 V | | | ±10 | μA |
| I _{CC} | | V _I = V _{CC} or GND | 3.6 V | I _O = 0 | | 10 | μA |
| | | 3.6 V ≤ V _I ≤ 5.5 V ⁽³⁾ | | | | 10 | |
| ΔI _{CC} | | One input at V _{CC} - 0.6 V, Other inputs at V _{CC} or GND | 2.7 V to 3.6 V | | | 500 | μA |
| C _i | 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 |

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

(2) For I/O ports, the parameter I_{OZ} includes the input leakage current.

(3) 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 | (1) | (1) | (1) | (1) | 7.3 | 1.5 | 6.3 | ns | |
| t _{en} | \overline{OE} | A or B | (1) | (1) | (1) | (1) | 9.5 | 1.5 | 8.2 | ns | |
| t _{dis} | \overline{OE} | A or B | (1) | (1) | (1) | (1) | 8.5 | 1.7 | 7.8 | ns | |
| t _{sk(o)} | | | | | | | | | 1 | ns | |

(1) This information was not available at the time of publication.

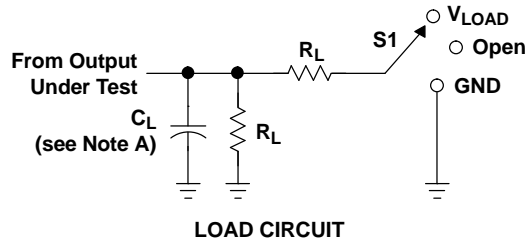
Operating Characteristics

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 | (1) | (1) | 48 | pF |
| | | Outputs disabled | (1) | (1) | 4 | |

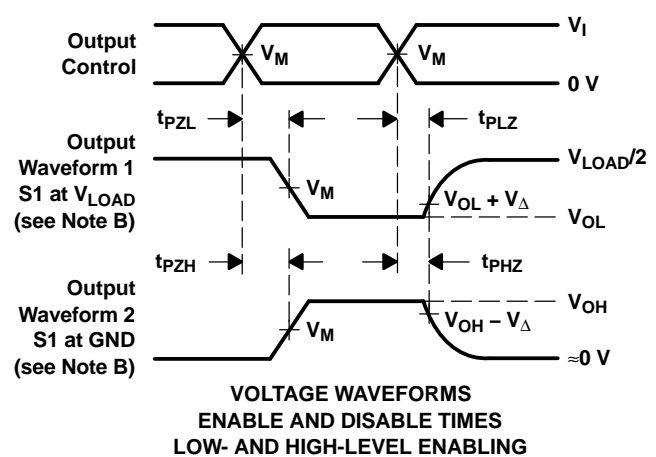
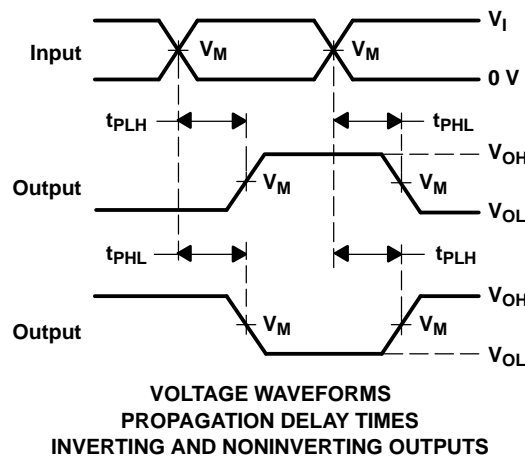
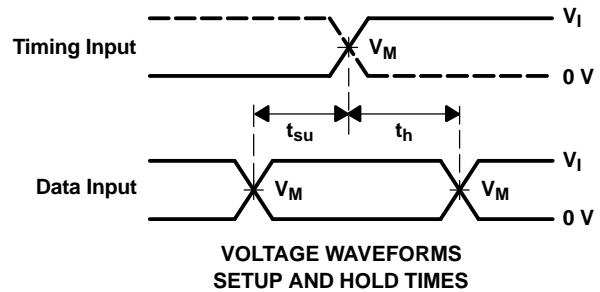
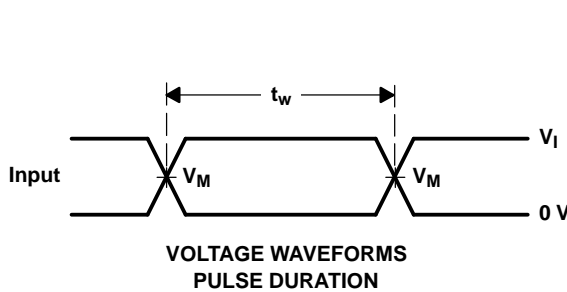
(1) This information was not available at the time of publication.

PARAMETER MEASUREMENT INFORMATION



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

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



- 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 $\leq 10\text{ MHz}$, $Z_O = 50\ \Omega$.
 - 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 ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|--------------------|-----------------------|---------------|-----------------|------|-------------|-------------------------|------------------|--|
| SN74LVCR2245ADBLE | OBSOLETE | SSOP | DB | 20 | | TBD | Call TI | Call TI |
| SN74LVCR2245ADBQR | ACTIVE | SSOP/ QSOP | DBQ | 20 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SN74LVCR2245ADBR | ACTIVE | SSOP | DB | 20 | 2000 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SN74LVCR2245ADGVR | ACTIVE | TVSOP | DGV | 20 | 2000 | Pb-Free (RoHS) | CU NIPDAU | Level-1-250C-UNLIM |
| SN74LVCR2245ADW | ACTIVE | SOIC | DW | 20 | 25 | Pb-Free (RoHS) | CU NIPDAU | Level-2-250C-1 YEAR/ Level-1-235C-UNLIM |
| SN74LVCR2245ADWR | ACTIVE | SOIC | DW | 20 | 2000 | Pb-Free (RoHS) | CU NIPDAU | Level-2-250C-1 YEAR/ Level-1-235C-UNLIM |
| SN74LVCR2245AGQNR | ACTIVE | VFBGA | GQN | 20 | 1000 | TBD | SNPB | Level-1-240C-UNLIM |
| SN74LVCR2245ANSR | ACTIVE | SO | NS | 20 | 2000 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SN74LVCR2245APW | ACTIVE | TSSOP | PW | 20 | 70 | Pb-Free (RoHS) | CU NIPDAU | Level-1-250C-UNLIM |
| SN74LVCR2245APWE4 | ACTIVE | TSSOP | PW | 20 | 70 | Pb-Free (RoHS) | CU NIPDAU | Level-1-250C-UNLIM |
| SN74LVCR2245APWLE | OBSOLETE | TSSOP | PW | 20 | | TBD | Call TI | Call TI |
| SN74LVCR2245APWR | ACTIVE | TSSOP | PW | 20 | 2000 | Pb-Free (RoHS) | CU NIPDAU | Level-1-250C-UNLIM |
| SN74LVCR2245APWRE4 | ACTIVE | TSSOP | PW | 20 | 2000 | Pb-Free (RoHS) | CU NIPDAU | Level-1-250C-UNLIM |
| SN74LVCR2245APWT | ACTIVE | TSSOP | PW | 20 | 250 | Pb-Free (RoHS) | CU NIPDAU | Level-1-250C-UNLIM |
| SN74LVCR2245APWTE4 | ACTIVE | TSSOP | PW | 20 | 250 | Pb-Free (RoHS) | CU NIPDAU | Level-1-250C-UNLIM |
| SN74LVCR2245ARGYR | ACTIVE | QFN | RGY | 20 | 1000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1YEAR |
| SN74LVCR2245AZQNR | ACTIVE | VFBGA | ZQN | 20 | 1000 | Pb-Free (RoHS) | SNAGCU | Level-1-260C-UNLIM |

⁽¹⁾ 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.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

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 (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

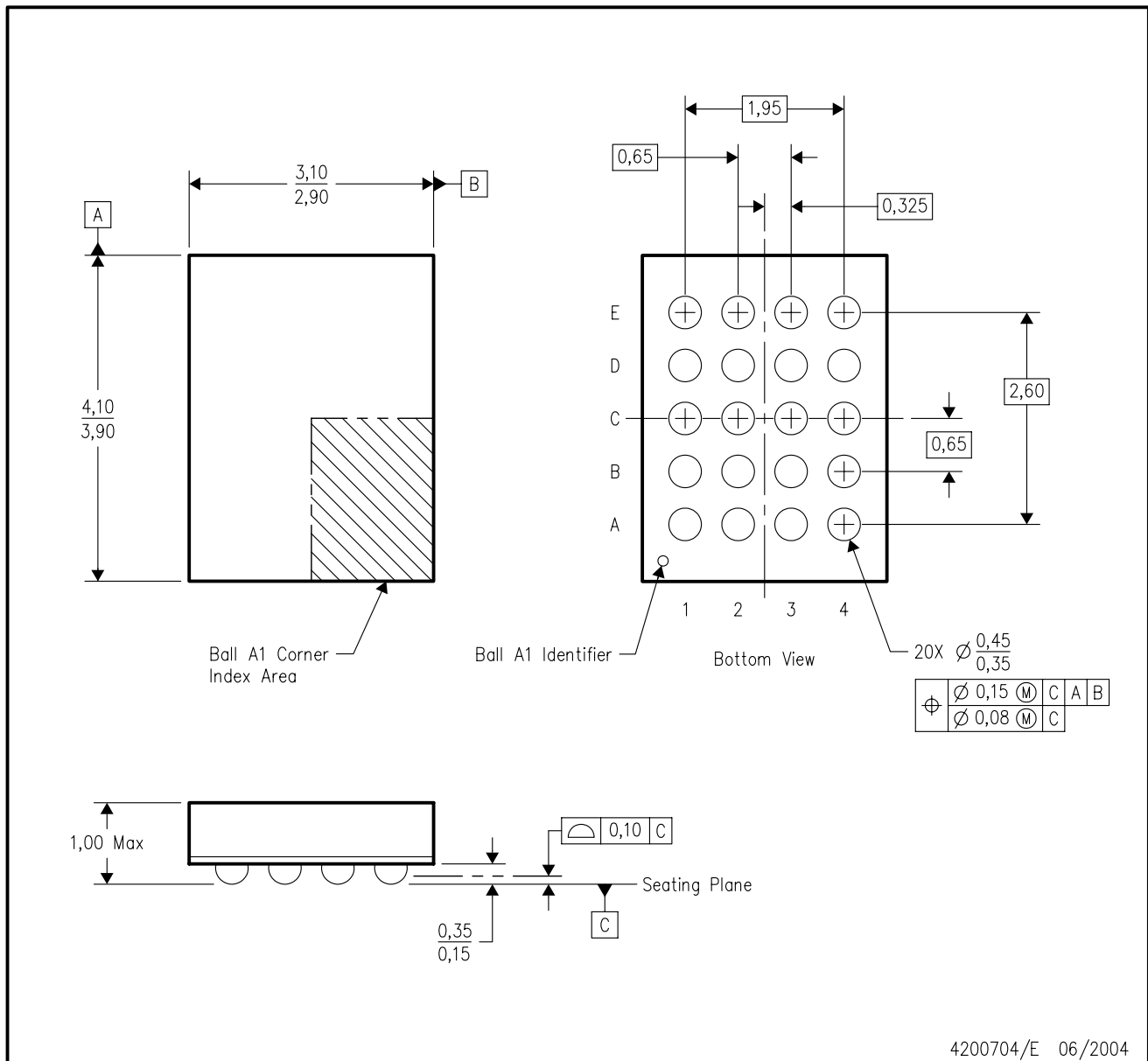
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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GQN (R-PBGA-N20)

PLASTIC BALL GRID ARRAY

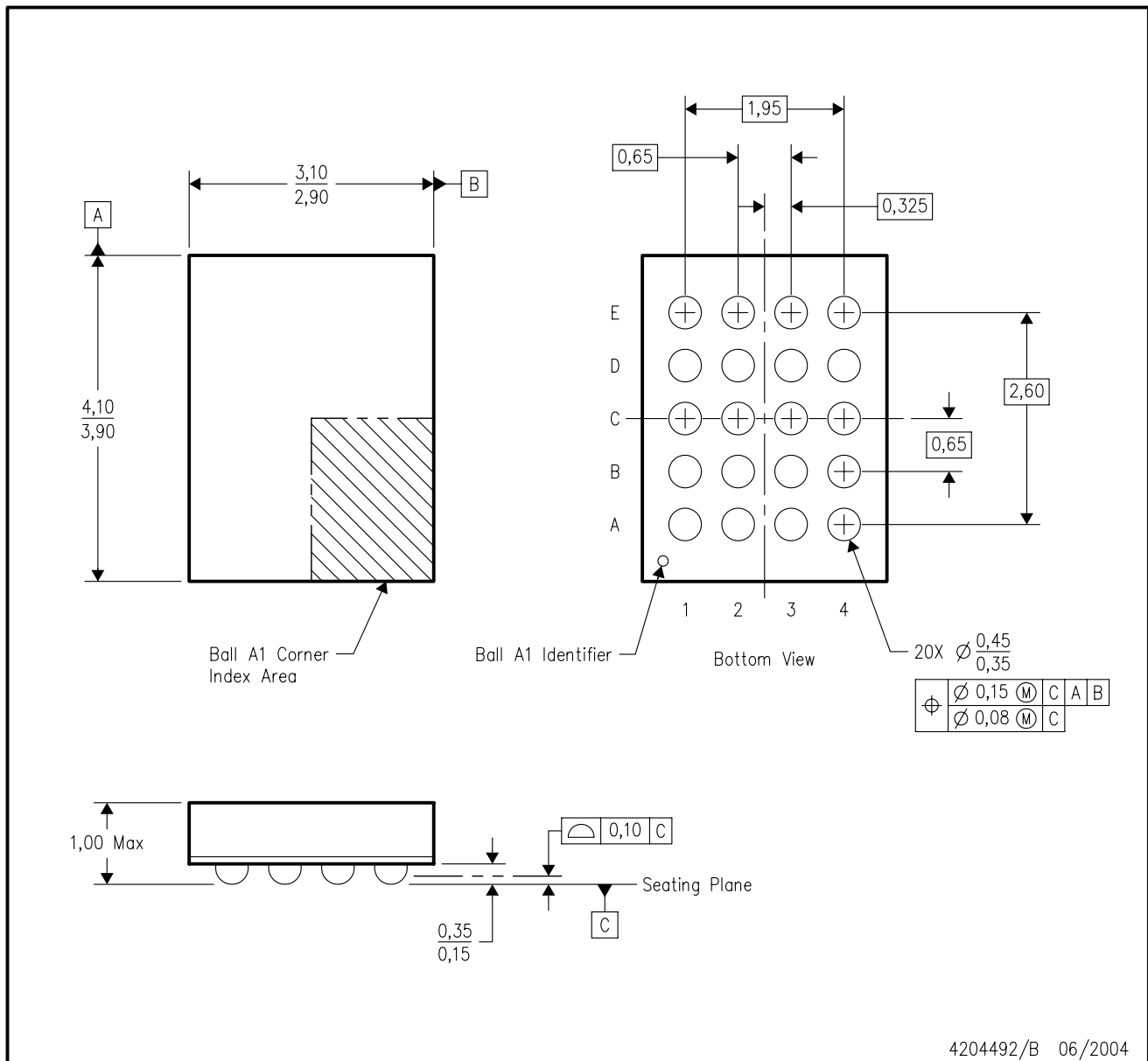


4200704/E 06/2004

- 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 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).

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

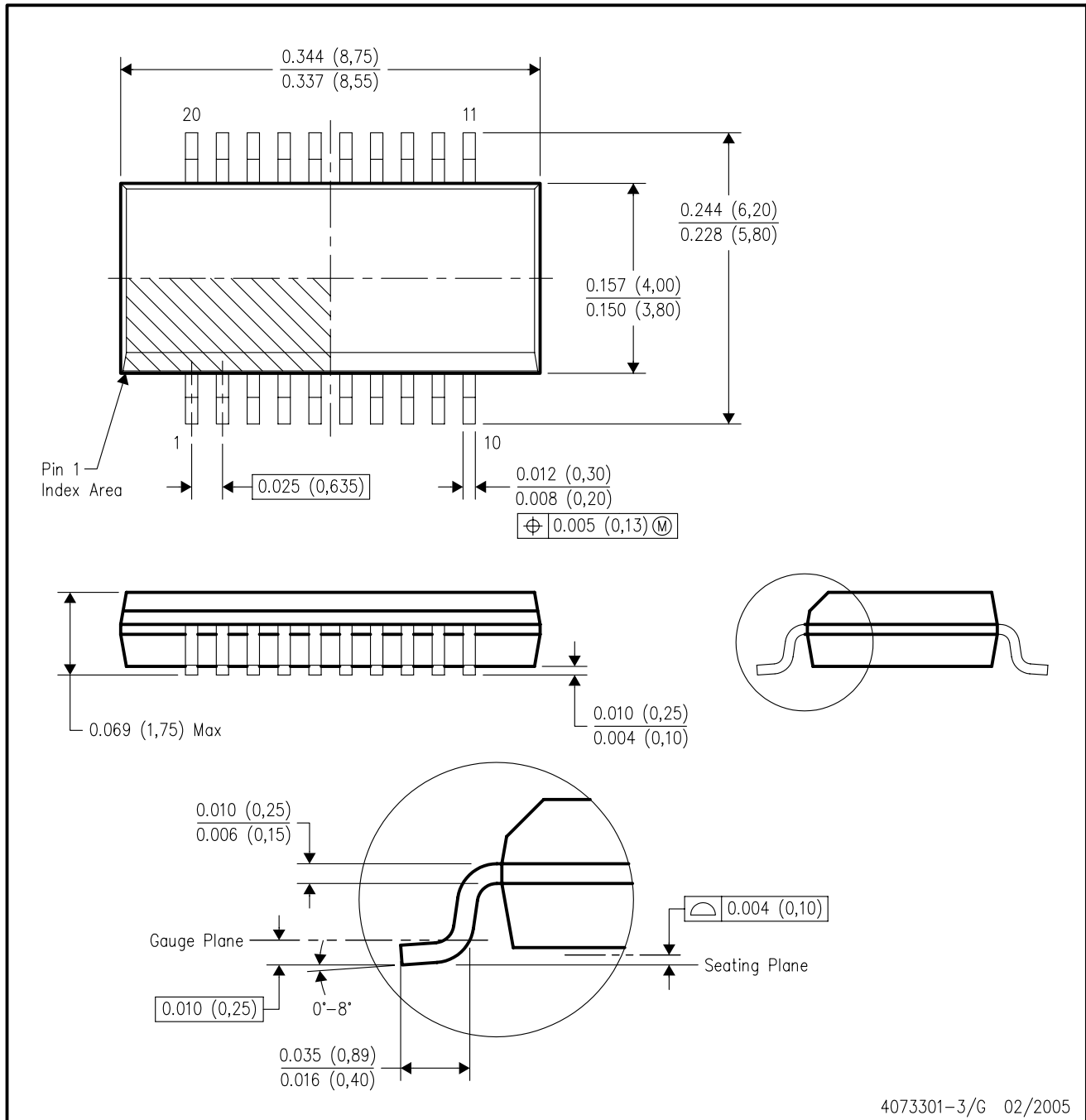
24 PINS SHOWN



- 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

DBQ (R-PDSO-G20)

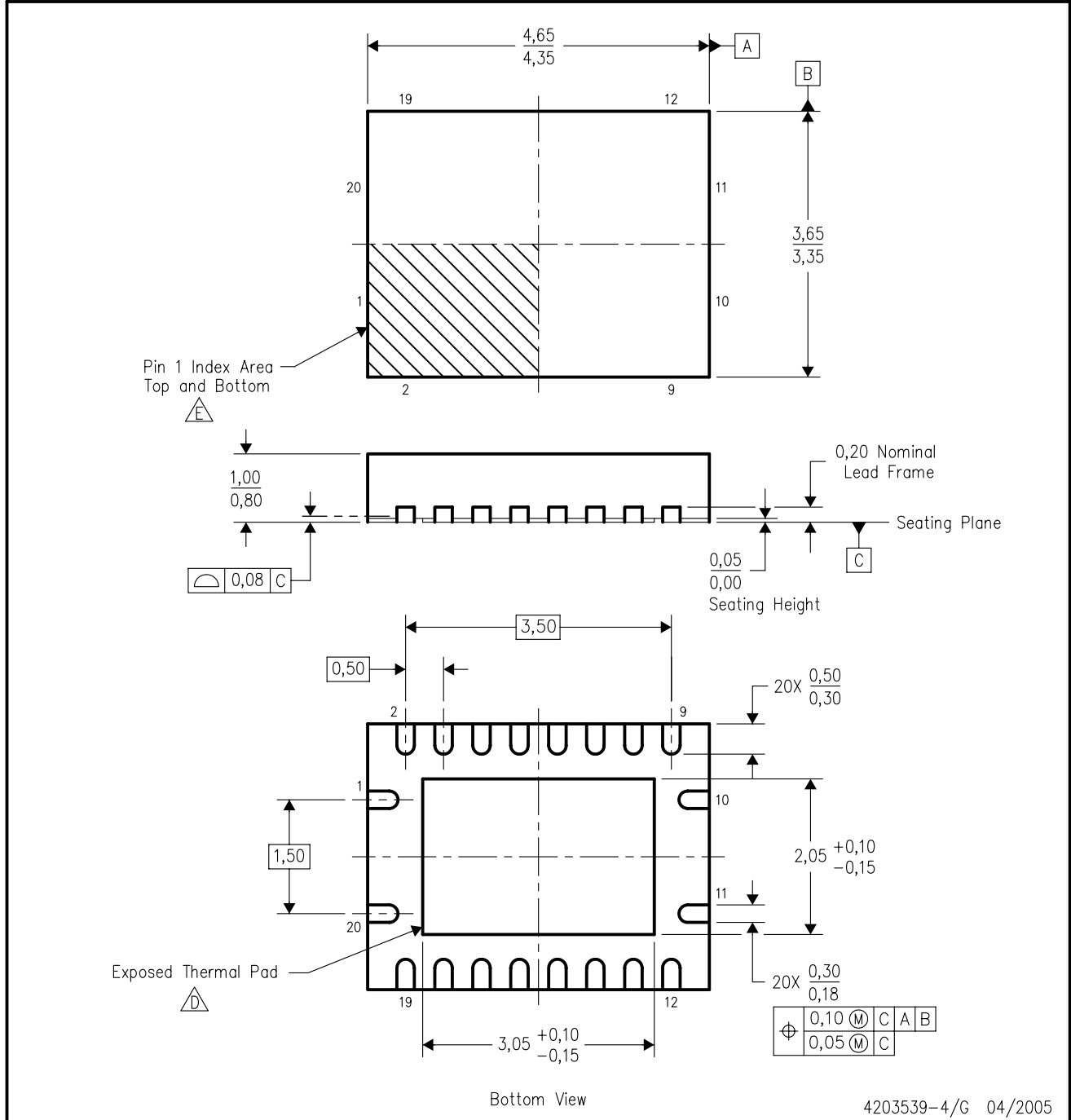
PLASTIC SMALL-OUTLINE PACKAGE



- 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) per side.
 - D. Falls within JEDEC MO-137 variation AD.

RGY (R-PQFP-N20)

PLASTIC QUAD FLATPACK



4203539-4/G 04/2005

- 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.
 - 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.

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



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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