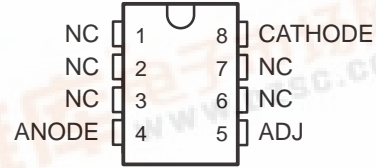


- **Low Temperature Coefficient**
- **Wide Operating Current . . . 400 μ A to 10 mA**
- **0.27- Ω Dynamic Impedance**
- **\pm 1% Tolerance Available**
- **Specified Temperature Stability**
- **Easily Trimmed for Minimum Temperature Drift**
- **Fast Turnon**

**D PACKAGE
(TOP VIEW)**



NC – No internal connection

**LM336-2.5, LM336B-2.5 . . . LP PACKAGE
(TOP VIEW)**



description/ordering information

The LM236-2.5, LM336-2.5, and LM336B-2.5 integrated circuits are precision 2.5-V shunt regulator diodes. These reference circuits operate as low-temperature-coefficient 2.5-V Zener diodes with a 0.2- Ω dynamic impedance. A third terminal provided on the circuit allows the reference voltage and temperature coefficient to be trimmed easily.

The series is useful as precision 2.5-V low-voltage references (V_Z) for digital voltmeters, power supplies, or operational-amplifier circuitry. The 2.5-V voltage reference makes it convenient to obtain a stable reference from 5-V logic supplies. Devices in this series operate as shunt regulators, and can be used as either positive or negative voltage references.

The LM236-2.5 is characterized for operation from -25°C to 85°C . The LM336-2.5 and LM336B-2.5 are characterized for operation from 0°C to 70°C .

ORDERING INFORMATION

| TA | PACKAGE† | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---|---------------------|-----------------------|------------------|
| 0°C to 70°C | SOIC (D) | Tube of 75 | LM336D-2-5 |
| | | Reel of 2500 | LM336DR-2-5 |
| | | Tube of 75 | LM336BD-2-5 |
| | | Reel of 2500 | LM336BDR-2-5 |
| | TO-226 / TO-92 (LP) | Bulk of 1000 | LM336LP-2-5 |
| | | Reel of 2000 | LM336LPR-2-5 |
| | | Bulk of 1000 | LM336BLP-2-5 |
| | | Reel of 2000 | LM336BLPR-2-5 |
| -25°C to 85°C | SOIC (D) | Tube of 75 | LM236D-2-5 |
| | | Reel of 2500 | LM236DR-2-5 |

† 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.



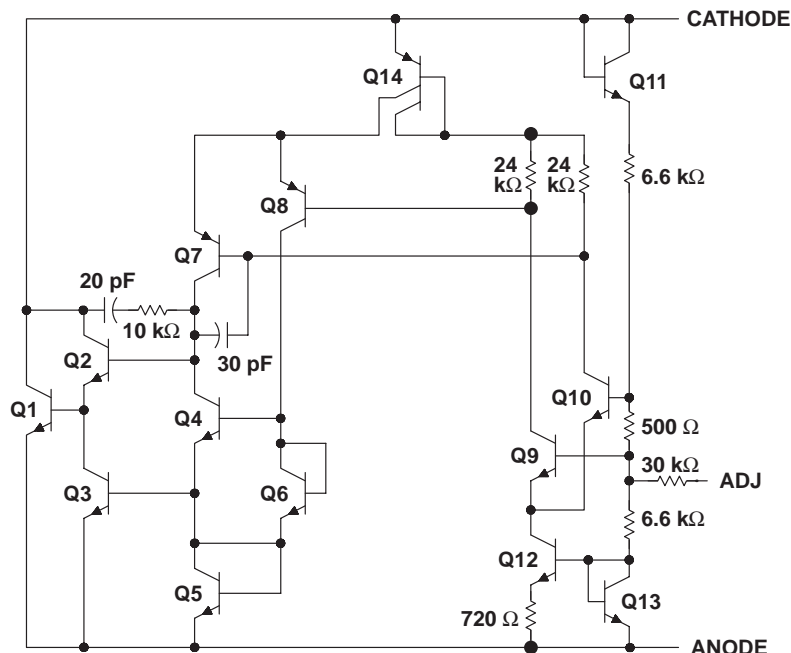
LM236-2.5, LM336-2.5, LM336B-2.5 2.5-V INTEGRATED REFERENCE CIRCUITS

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symbol



schematic diagram



NOTE A: All component values are nominal.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

| | |
|---|----------------|
| Reverse current, I_R | 20 mA |
| Forward current, I_F | 10 mA |
| Package thermal impedance, θ_{JA} (see Notes 1 and 2): D package | 97°C/W |
| LP package | 140°C/W |
| Operating virtual junction temperature, T_J | 150°C |
| Storage temperature range, T_{stg} | -65°C to 150°C |

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. Maximum power dissipation is a function of $T_J(max)$, θ_{JA} , and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can impact reliability.
2. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions

| | | MIN | MAX | UNIT |
|--------------------------------------|-----------------------|-----|-----|------|
| T_A Operating free-air temperature | LM236-2.5 | -25 | 85 | °C |
| | LM336-2.5, LM336B-2.5 | 0 | 70 | |

LM236-2.5, LM336-2.5, LM336B-2.5 2.5-V INTEGRATED REFERENCE CIRCUITS

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electrical characteristics at specified free-air temperature (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | T_A † | LM236-2.5 | | | LM336-2.5 | | | UNIT |
|---|--|------------|-----------|------|------|-----------|------|------|---------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| V_Z Reference voltage | $I_Z = 1 \text{ mA}$ LM236, LM336 LM336B | 25°C | 2.44 | 2.49 | 2.54 | 2.39 | 2.49 | 2.59 | V |
| $\Delta V_Z(\Delta T)$ Change in reference voltage with temperature | V_Z adjusted to 2.490 V, $I_Z = 1 \text{ mA}$ | Full range | | 3.5 | 9 | | 1.8 | 6 | mV |
| $\Delta V_Z(\Delta I)$ Change in reference voltage with current | $I_Z = 400 \mu\text{A}$ to 10 mA | 25°C | | 2.6 | 6 | | 2.6 | 10 | mV |
| | | Full range | | 3 | 10 | | 3 | 12 | |
| $\Delta V_Z(\Delta t)$ Long-term change in reference voltage | $I_Z = 1 \text{ mA}$ | 25°C | | 20 | | | 20 | | ppm/khr |
| z_z Reference impedance | $I_Z = 1 \text{ mA}, f = 1 \text{ kHz}$ | 25°C | | 0.2 | 0.6 | | 0.2 | 1 | W |
| | | Full range | | 0.4 | 1 | | 0.4 | 1.4 | |

† Full range is -25°C to 85°C for the LM236-2.5 and 0°C to 70°C for the LM336-2.5 and LM336B-2.5.

LM236-2.5, LM336-2.5, LM336B-2.5 2.5-V INTEGRATED REFERENCE CIRCUITS

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TYPICAL CHARACTERISTICS

CHANGE IN REFERENCE VOLTAGE
vs
REFERENCE CURRENT

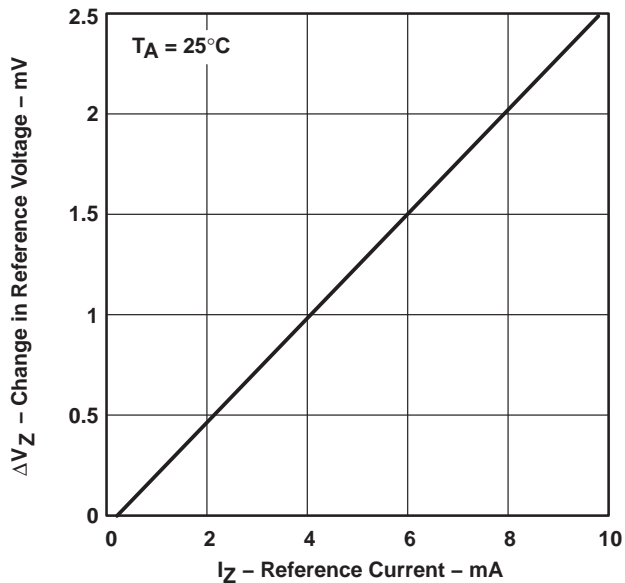


Figure 1

NOISE VOLTAGE
vs
FREQUENCY

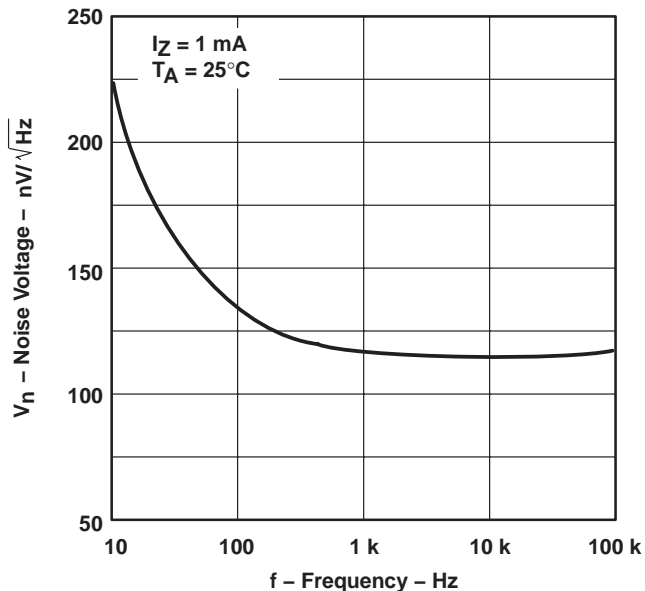


Figure 2

REFERENCE IMPEDANCE
vs
FREQUENCY

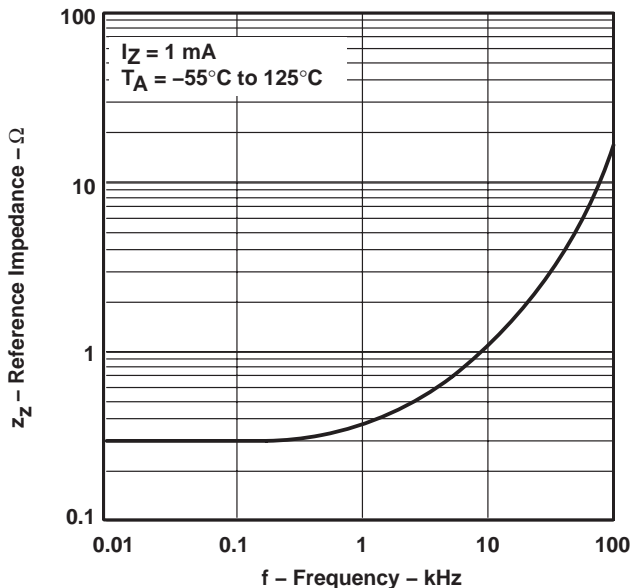


Figure 3

LM236-2.5, LM336-2.5, LM336B-2.5 2.5-V INTEGRATED REFERENCE CIRCUITS

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APPLICATION INFORMATION

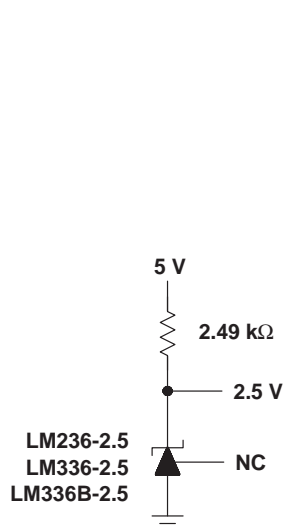
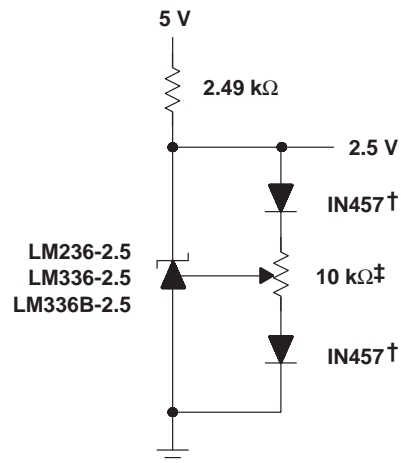


Figure 4. 2.5-V Reference



† Any silicon signal diode
‡ Adjust to 2.49 V

Figure 5. 2.5-V Reference
With Minimum Temperature Coefficient

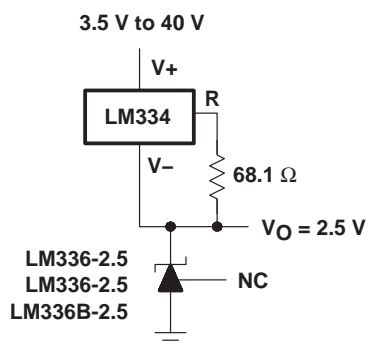


Figure 6. Wide-Input-Range Reference

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|--|
| LM236D-2-5 | ACTIVE | SOIC | D | 8 | 75 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| LM236DR-2-5 | ACTIVE | SOIC | D | 8 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| LM236LP-2-5 | OBSOLETE | TO-92 | LP | 3 | | None | Call TI | Call TI |
| LM336BD-2-5 | ACTIVE | SOIC | D | 8 | 75 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| LM336BDR-2-5 | ACTIVE | SOIC | D | 8 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| LM336BLP-2-5 | ACTIVE | TO-92 | LP | 3 | 1000 | None | CU SNPB | Level-NC-NC-NC |
| LM336BLPR-2-5 | ACTIVE | TO-92 | LP | 3 | 2000 | None | CU SNPB | Level-NC-NC-NC |
| LM336D-2-5 | ACTIVE | SOIC | D | 8 | 75 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| LM336DR-2-5 | ACTIVE | SOIC | D | 8 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| LM336LP-2-5 | ACTIVE | TO-92 | LP | 3 | 1000 | None | CU SNPB | Level-NC-NC-NC |
| LM336LPR-2-5 | ACTIVE | TO-92 | LP | 3 | 2000 | None | CU SNPB | Level-NC-NC-NC |

⁽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 - 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.

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

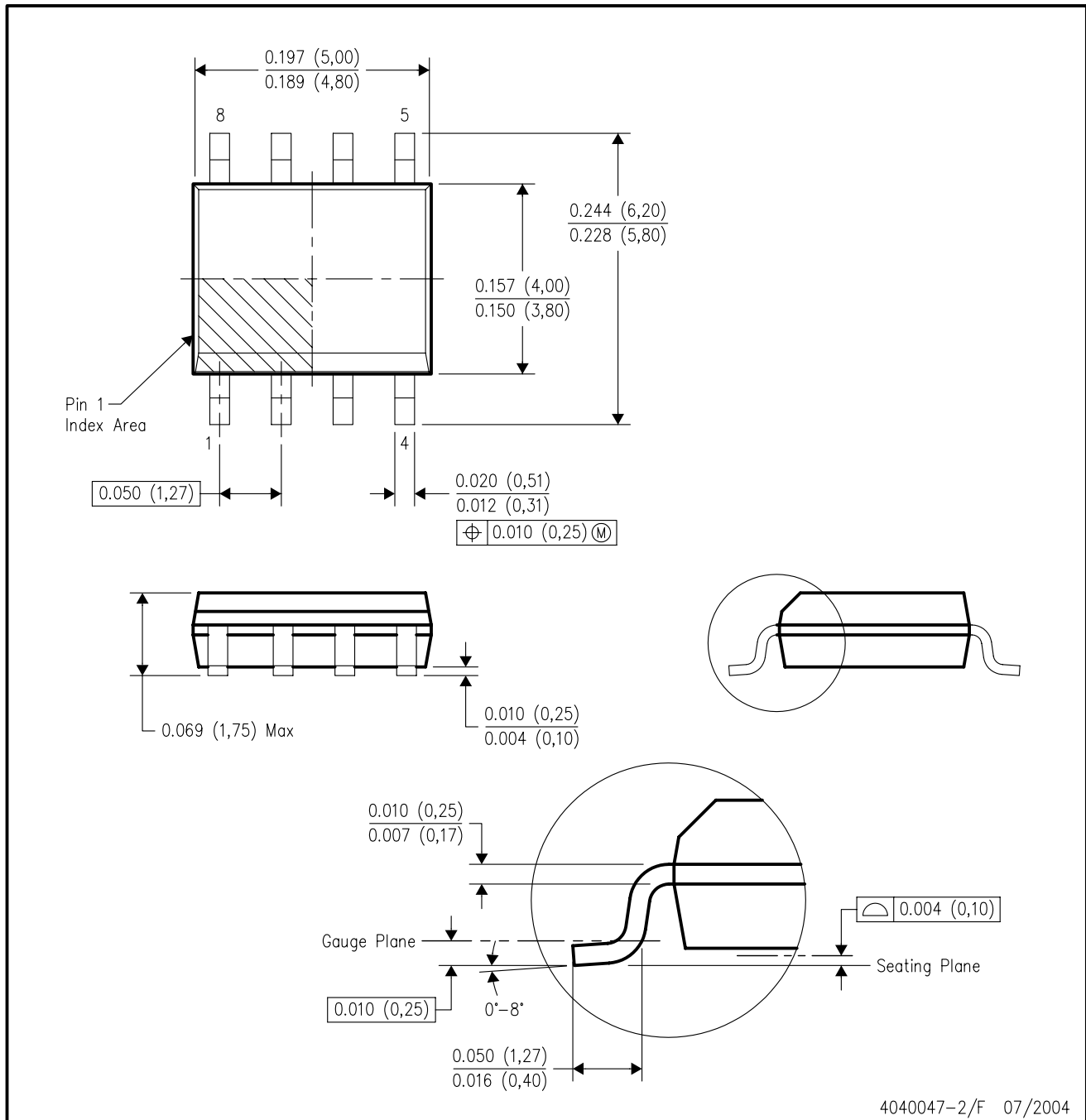
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MECHANICAL DATA

D (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



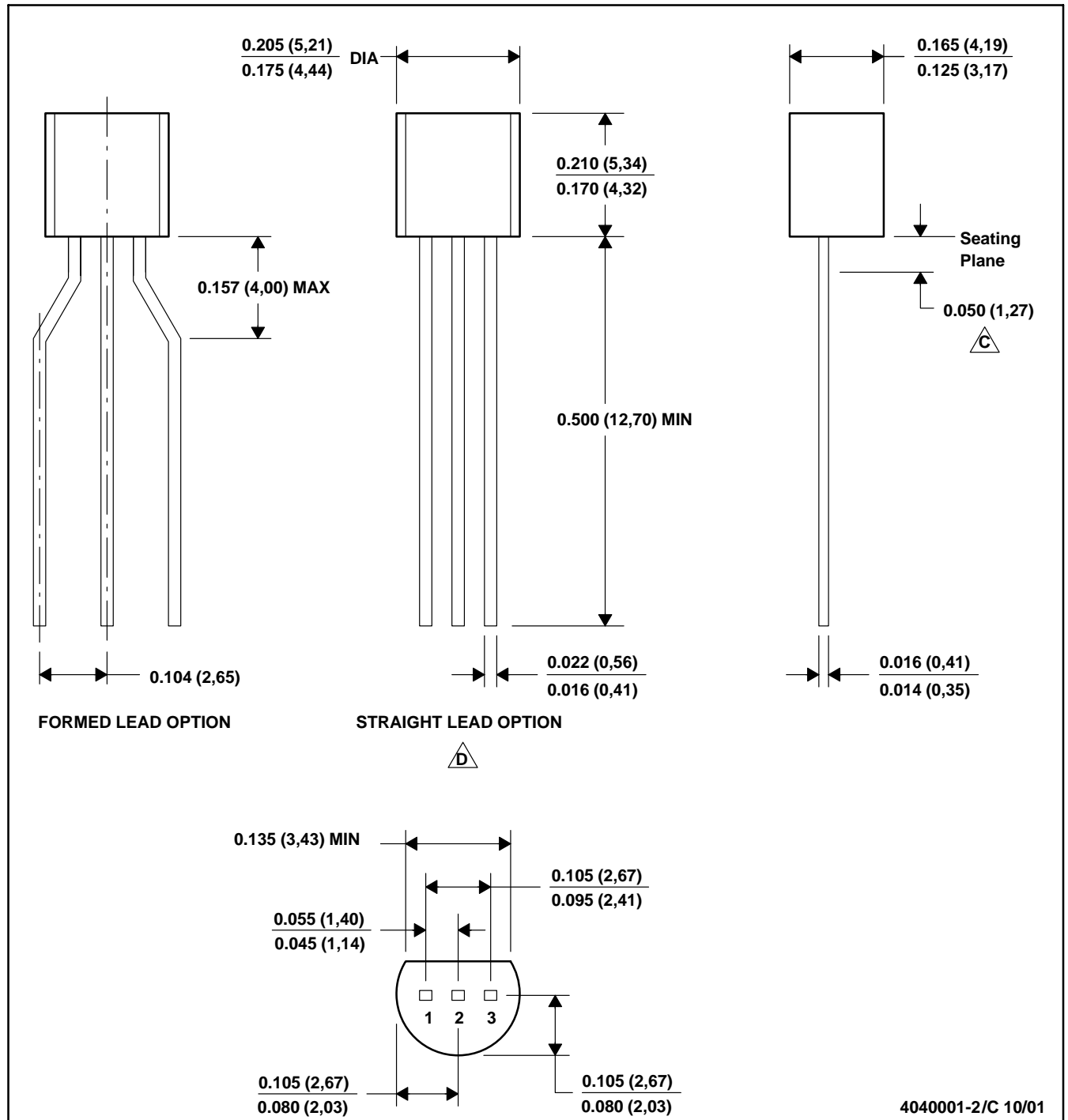
- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - Falls within JEDEC MS-012 variation AA.

MECHANICAL DATA

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LP (O-PBCY-W3)

PLASTIC CYLINDRICAL PACKAGE



4040001-2/C 10/01

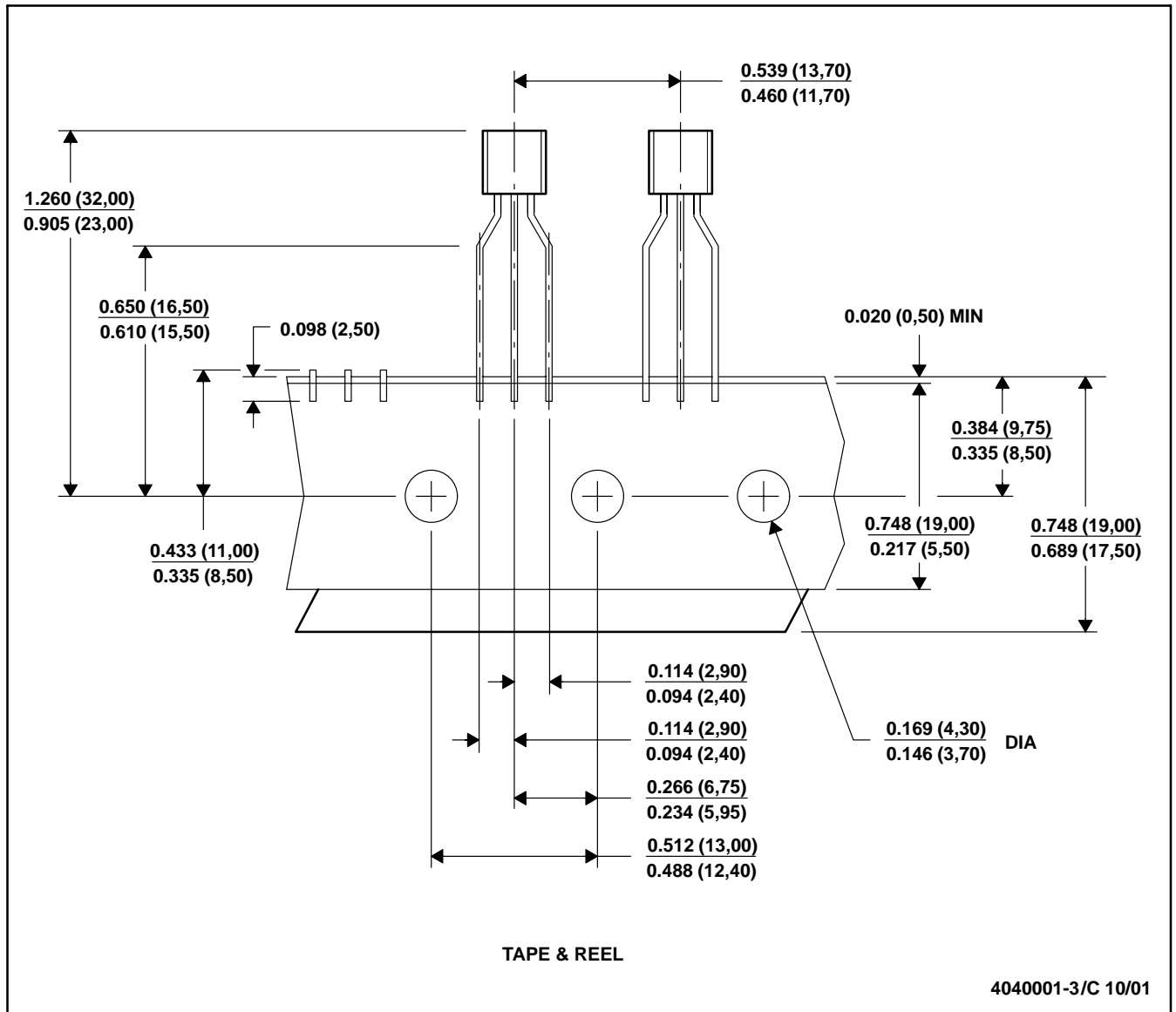
- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Lead dimensions are not controlled within this area
 D. Falls within JEDEC TO -226 Variation AA (TO-226 replaces TO-92)
 E. Shipping Method:
 Straight lead option available in bulk pack only.
 Formed lead option available in tape & reel or ammo pack.

MECHANICAL DATA

MSOT002A – OCTOBER 1994 – REVISED NOVEMBER 2001

LP (O-PBCY-W3)

PLASTIC CYLINDRICAL PACKAGE



- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Tape and Reel information for the Format Lead Option package.

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