

## LM337L 3-Terminal Adjustable Regulator

Check for Samples: [LM337L](#)

### FEATURES

- Adjustable Output Down to 1.2V
- Ensured 100mA Output Current
- Line Regulation Typically 0.01%/V
- Load Regulation Typically 0.1%
- Current Limit Constant With Temperature
- Eliminates the Need to Stock Many Voltages
- Standard 3-Lead Transistor Package
- 80 dB Ripple Rejection
- Output is Short Circuit Protected
- Available in the 6-Bump DSBGA Package
- See AN-1112 (Literature Number [SNVA009](#)) for DSBGA Considerations

### DESCRIPTION

The LM337L is an adjustable 3-terminal negative voltage regulator capable of supplying 100mA over a 1.2V to 37V output range. It is exceptionally easy to use and requires only two external resistors to set the output voltage. Furthermore, both line and load regulation are better than standard fixed regulators. Also, the LM337L is packaged in a standard TO-92 transistor package which is easy to use.

In addition to higher performance than fixed regulators, the LM337L offers full overload protection. Included on the chip are current limit, thermal overload protection and safe area protection. All overload protection circuitry remains fully functional even if the adjustment terminal is disconnected.

Normally, only a single 1 $\mu$ F solid tantalum output capacitor is needed unless the device is situated more than 6 inches from the input filter capacitors, in which case an input bypass is needed. A larger output capacitor can be added to improve transient response. The adjustment terminal can be bypassed to achieve very high ripple rejection ratios which are difficult to achieve with standard 3-terminal regulators.

Besides replacing fixed regulators, the LM337L is useful in a wide variety of other applications. Since the regulator is “floating” and sees only the input-to-output differential voltage, supplies of several hundred volts can be regulated as long as the maximum input-to-output differential is not exceeded.

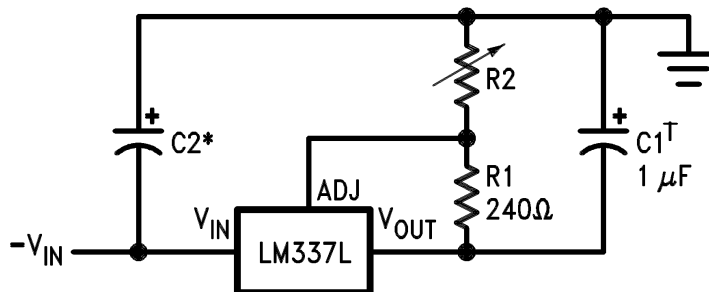
Also, it makes an especially simple adjustable switching regulator, a programmable output regulator, or by connecting a fixed resistor between the adjustment and output, the LM337L can be used as a precision current regulator. Supplies with electronic shutdown can be achieved by clamping the adjustment terminal to ground which programs the output to 1.2V where most loads draw little current.

The LM337L is available in a standard TO-92 transistor package, SO-8 surface mount package, and in our new 12 mil diameter bump DSBGA package. The LM337L is rated for operation over a  $-25^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  range.

For applications requiring greater output current in excess of 0.5A and 1.5A, see LM137 series data sheets. For the positive complement, see series LM117 and LM317L data sheets.

### Typical Application

1.2V-25V Adjustable Regulator



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Connection Diagrams

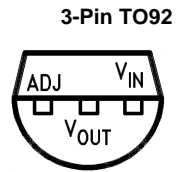


Figure 1. Bottom View

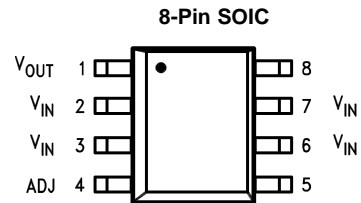
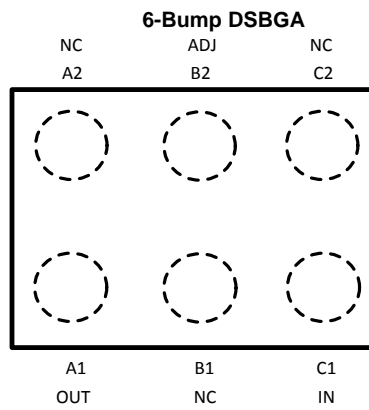


Figure 2. Top View





These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### Absolute Maximum Ratings<sup>(1)(2)</sup>

|                                       |                      |
|---------------------------------------|----------------------|
| Power Dissipation                     | Internally Limited   |
| Input–Output Voltage Differential     | 40V                  |
| Operating Junction Temperature Range  | –25°C to +125°C      |
| Storage Temperature                   | –55°C to +150°C      |
| Lead Temperature (Soldering, 10 sec.) | 300°C                |
| Plastic Package (Soldering 4 sec.)    | 260°C                |
| ESD Rating                            | 1.5kV <sup>(3)</sup> |

- (1) “Absolute Maximum Ratings” indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not ensure specific performance limits.
- (2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.
- (3) Human body model, 1.5kΩ in series with 100pF.

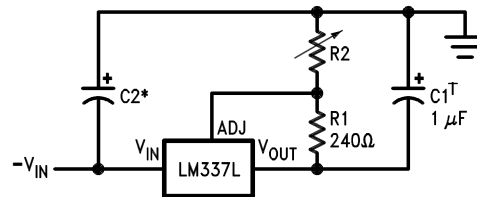
### Electrical Characteristics<sup>(1)</sup>

| Parameter                               | Conditions   | Min  | Typ   | Max  | Units |
|---|--|------|-------|------|-------|
| Line Regulation                         | $T_A = 25^\circ\text{C}$ , $3\text{V} \leq  V_{\text{IN}} - V_{\text{OUT}}  \leq 40\text{V}^{(2)}$   |      | 0.01  | 0.04 | %/V   |
| Load Regulation                         | $T_A = 25^\circ\text{C}$ , $5\text{mA} \leq I_{\text{OUT}} \leq I_{\text{MAX}}^{(2)}$  |      | 0.1   | 0.5  | %     |
| Thermal Regulation                      | $T_A = 25^\circ\text{C}$ , 10ms Pulse  |      | 0.04  | 0.2  | %/W   |
| Adjustment Pin Current                  |  |      | 50    | 100  | μA    |
| Adjustment Pin Current Change           | $5\text{mA} \leq I_L \leq 100\text{mA}$<br>$3\text{V} \leq  V_{\text{IN}} - V_{\text{OUT}}  \leq 40\text{V}$   |      | 0.2   | 5    | μA    |
| Reference Voltage                       | $3\text{V} \leq  V_{\text{IN}} - V_{\text{OUT}}  \leq 40\text{V}^{(3)}$<br>$10\text{mA} \leq I_{\text{OUT}} \leq 100\text{mA}$ , $P \leq 625\text{mW}$ | 1.20 | 1.25  | 1.30 | V     |
| Line Regulation                         | $3\text{V} \leq  V_{\text{IN}} - V_{\text{OUT}}  \leq 40\text{V}^{(2)}$  |      | 0.02  | 0.07 | %/V   |
| Load Regulation                         | $5\text{mA} \leq I_{\text{OUT}} \leq 100\text{mA}^{(2)}$   |      | 0.3   | 1.5  | %     |
| Temperature Stability                   | $T_{\text{MIN}} \leq T_j \leq T_{\text{MAX}}$  |      | 0.65  |      | %     |
| Minimum Load Current                    | $ V_{\text{IN}} - V_{\text{OUT}}  \leq 40\text{V}$   |      | 3.5   | 5    | mA    |
|   | $3\text{V} \leq  V_{\text{IN}} - V_{\text{OUT}}  \leq 15\text{V}$  |      | 2.2   | 3.5  | mA    |
| Current Limit                           | $3\text{V} \leq  V_{\text{IN}} - V_{\text{OUT}}  \leq 13\text{V}$  | 100  | 200   | 320  | mA    |
|   | $ V_{\text{IN}} - V_{\text{OUT}}  = 40\text{V}$  | 25   | 50    | 120  | mA    |
| Rms Output Noise, % of $V_{\text{OUT}}$ | $T_A = 25^\circ\text{C}$ , $10\text{Hz} \leq f \leq 10\text{kHz}$  |      | 0.003 |      | %     |
| Ripple Rejection Ratio                  | $V_{\text{OUT}} = -10\text{V}$ , $F = 120\text{Hz}$ , $C_{\text{ADJ}} = 0$   |      | 65    |      | dB    |
|   | $C_{\text{ADJ}} = 10\mu\text{F}$   | 66   | 80    |      | dB    |
| Long-Term Stability                     | $T_A = 125^\circ\text{C}$  |      | 0.3   | 1    | %     |

- (1) Unless otherwise specified, these specifications apply  $-25^\circ\text{C} \leq T_j \leq +125^\circ\text{C}$  for the LM337L;  $|V_{\text{IN}} - V_{\text{OUT}}| = 5\text{V}$  and  $I_{\text{OUT}} = 40\text{mA}$ . Although power dissipation is internally limited, these specifications are applicable for power dissipations up to 625 mW.  $I_{\text{MAX}}$  is 100mA.
- (2) Regulation is measured at constant junction temperature, using pulse testing with a low duty cycle. Changes in output voltage due to heating effects are covered under the specification for thermal regulation.
- (3) Thermal resistance of the TO-92 package is  $180^\circ\text{C}/\text{W}$  junction to ambient with 0.4" leads from a PC board and  $160^\circ\text{C}/\text{W}$  junction to ambient with 0.125" lead length to PC board. The SOIC package  $\theta_{\text{JA}}$  is  $180^\circ\text{C}/\text{W}$  in still air. The 6-Bump DSBGA package  $\theta_{\text{JA}}$  is  $290^\circ\text{C}/\text{W}$  in still air.

## Typical Applications

### 1.2V-25V Adjustable Regulator



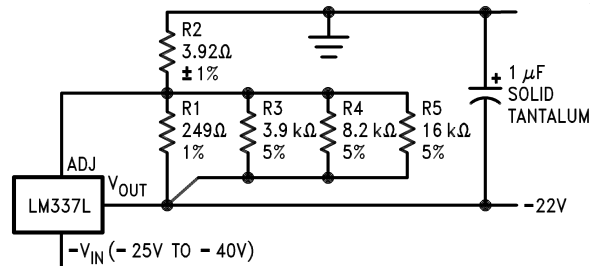
Full output current not available at high input-output voltages

$$-V_{OUT} = -1.25V \left( 1 + \frac{R2}{240\Omega} \right)$$

†C1 = 1μF solid tantalum or 10μF aluminum electrolytic required for stability

\*C2 = 1μF solid tantalum is required only if regulator is more than 4" from power supply filter capacitor

### Regulator with Trimmable Output Voltage



Trim Procedure:

—If  $V_{OUT}$  is  $-23.08V$  or bigger, cut out R3 (if smaller, don't cut it out).

—Then if  $V_{OUT}$  is  $-22.47V$  or bigger, cut out R4 (if smaller, don't).

—Then if  $V_{OUT}$  is  $-22.16V$  or bigger, cut out R5 (if smaller, don't).

This will trim the output to well within 1% of  $-22.00 V_{DC}$ , without any of the expense or trouble of a trim pot (see LB-46). Of course, this technique can be used at any output voltage level.

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**REVISION HISTORY**

| <b>Changes from Revision C (May 2013) to Revision D</b>  | <b>Page</b>          |
|--|----------------------|
| <hr/> <ul style="list-style-type: none"><li>• Changed layout of National Data Sheet to TI format .....</li></ul> <hr/> | <hr/> <b>4</b> <hr/> |

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|---------|
| LM337LM          | NRND          | SOIC         | D               | 8    | 95          | TBD                        | Call TI                 | Call TI              | -25 to 100   | LM337<br>LM             |         |
| LM337LM/NOPB     | ACTIVE        | SOIC         | D               | 8    | 95          | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -25 to 100   | LM337<br>LM             | Samples |
| LM337LMX         | NRND          | SOIC         | D               | 8    | 2500        | TBD                        | Call TI                 | Call TI              | -25 to 100   | LM337<br>LM             |         |
| LM337LMX/NOPB    | ACTIVE        | SOIC         | D               | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -25 to 100   | LM337<br>LM             | Samples |
| LM337LZ/LFT3     | ACTIVE        | TO-92        | LP              | 3    | 2000        | Green (RoHS<br>& no Sb/Br) | CU SN                   | N / A for Pkg Type   |              | LM337<br>LZ             | Samples |
| LM337LZ/NOPB     | ACTIVE        | TO-92        | LP              | 3    | 1800        | Green (RoHS<br>& no Sb/Br) | CU SN                   | N / A for Pkg Type   | -25 to 100   | LM337<br>LZ             | Samples |

(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.

**OBSELETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), 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.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**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.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

<sup>(6)</sup> Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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## TAPE AND REEL INFORMATION

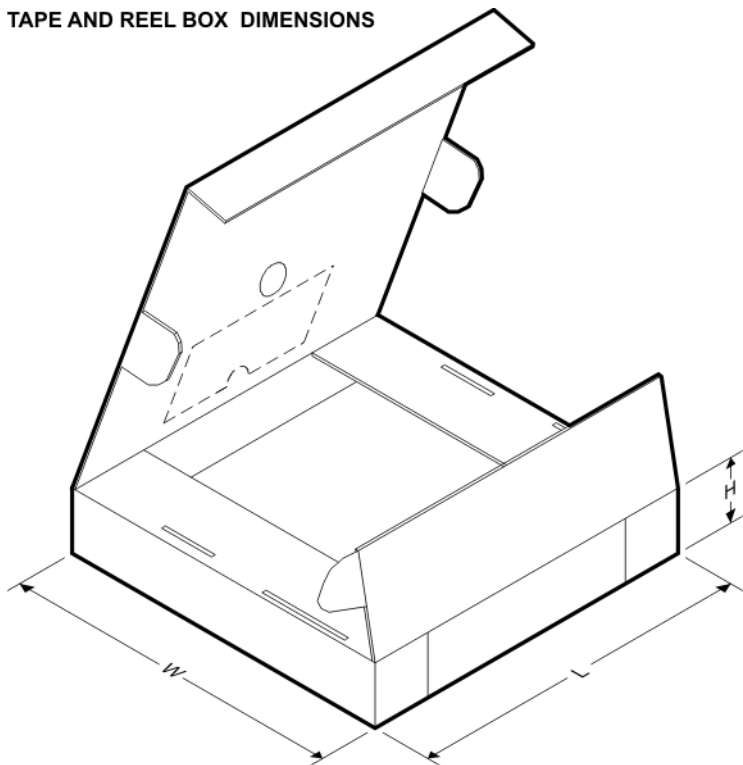


### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*All dimensions are nominal

| Device        | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM337LMX      | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM337LMX/NOPB | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |

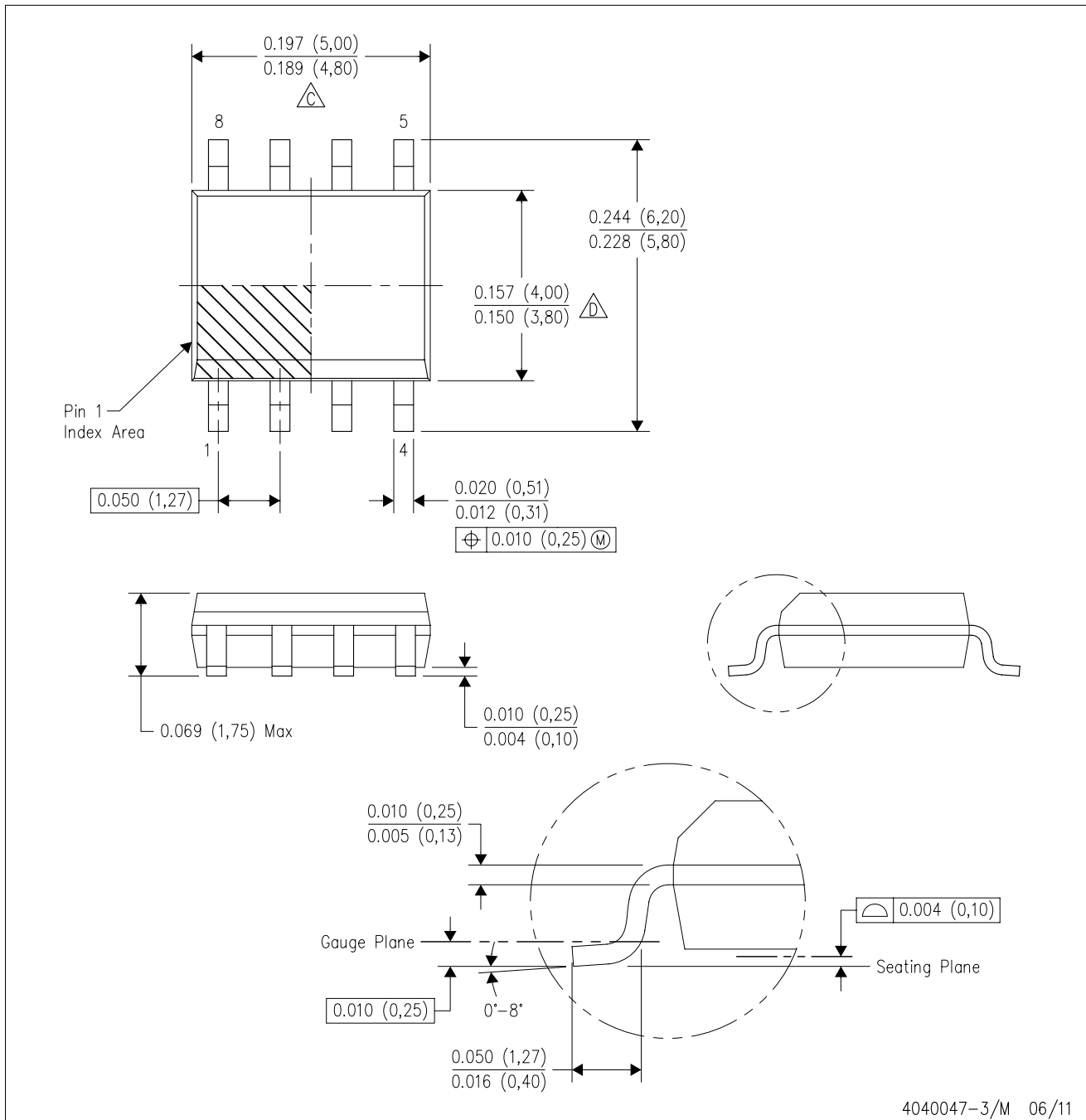
**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

| Device        | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM337LMX      | SOIC         | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LM337LMX/NOPB | SOIC         | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |

D (R-PDSO-G8)

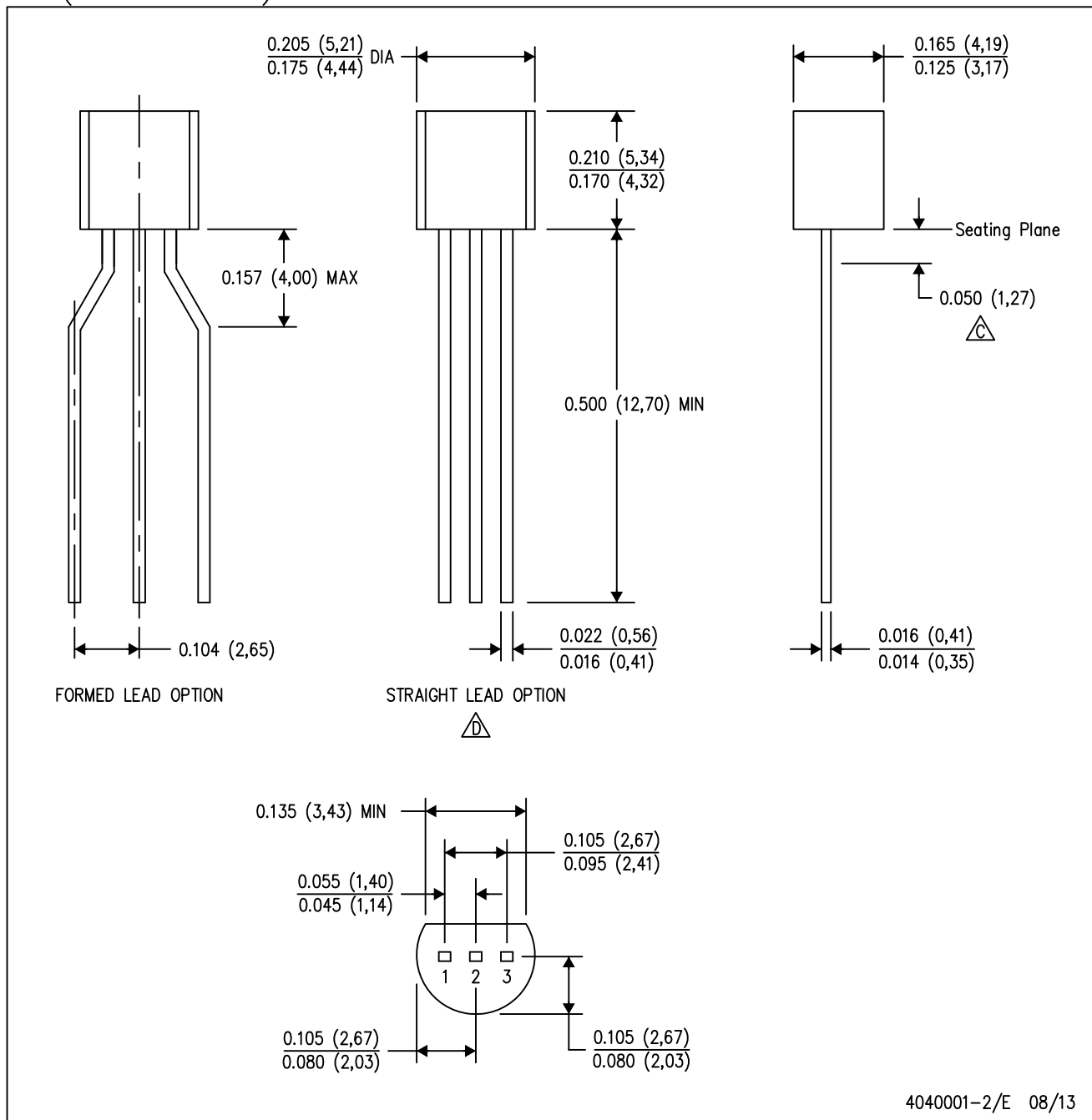
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AA.

LP (O-PBCY-W3)

PLASTIC CYLINDRICAL PACKAGE



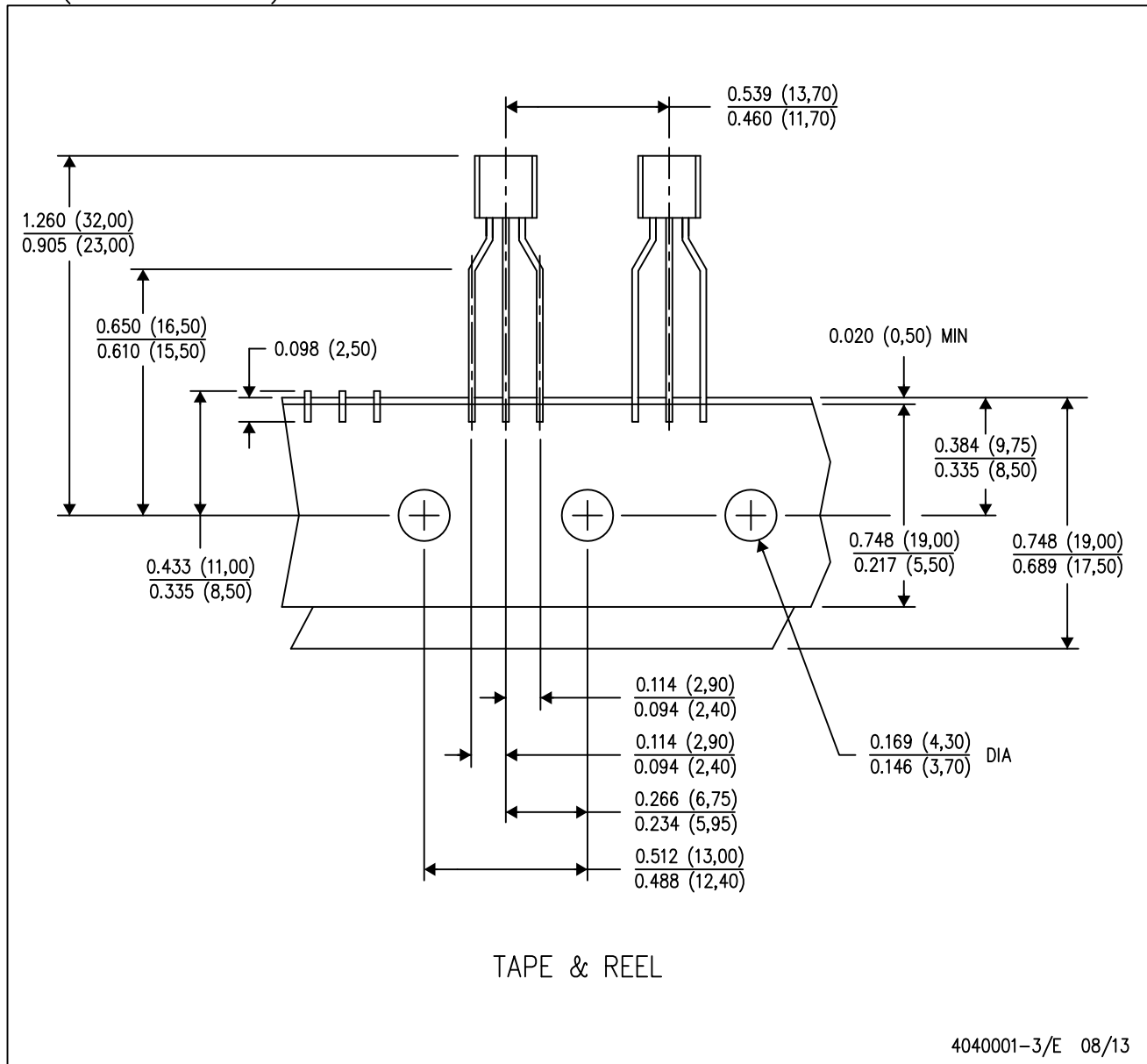
4040001-2/E 08/13

- 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.  
 Specific products can be offered in limited combinations of shipping mediums and lead options.  
 Consult product folder for more information on available options.

# MECHANICAL DATA

LP (O-PBCY-W3)

PLASTIC CYLINDRICAL PACKAGE



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

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| Computers and Peripherals     | <a href="http://www.ti.com/computers">www.ti.com/computers</a>                           |
| Consumer Electronics          | <a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>                   |
| Energy and Lighting           | <a href="http://www.ti.com/energy">www.ti.com/energy</a>                                 |
| Industrial                    | <a href="http://www.ti.com/industrial">www.ti.com/industrial</a>                         |
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