

# LM431 Adjustable Precision Zener Shunt Regulator

 Check for Samples: [LM431](#)

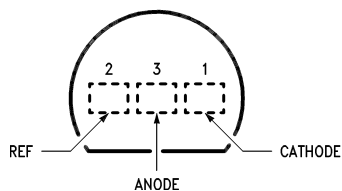
## FEATURES

- Average Temperature Coefficient 50 ppm/°C
- Temperature Compensated for Operation Over the Full Temperature Range
- Programmable Output Voltage
- Fast Turn-On Response
- Low Output Noise

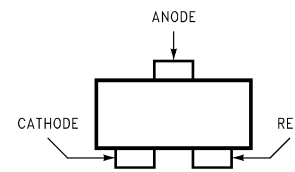
## DESCRIPTION

The LM431 is a 3-terminal adjustable shunt regulator with ensured temperature stability over the entire temperature range of operation. The output voltage may be set at any level greater than 2.5V ( $V_{REF}$ ) up to 36V merely by selecting two external resistors that act as a voltage divided network. Due to the sharp turn-on characteristics this device is an excellent replacement for many zener diode applications.

## Connection Diagram

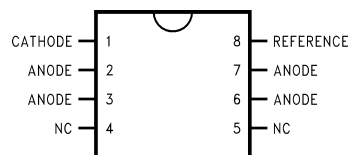


**Figure 1. TO-92: Plastic Package Top View**



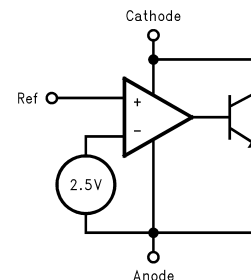
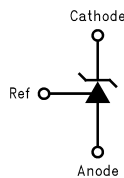
**Figure 2. SOT-23: 3-Lead Small Outline Top View**

A. Note: NC = Not internally connected.



**Figure 3. SOIC: 8-Pin Surface Mount Top view**

## Symbol and Functional Diagrams



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## DC Test Circuits

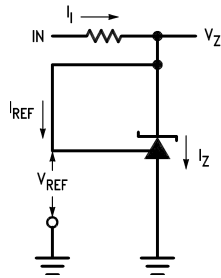


Figure 4. Test Circuit for  $V_Z = V_{REF}$

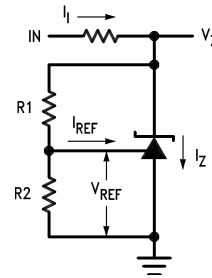


Figure 5. Test Circuit for  $V_Z > V_{REF}$

Note:  $V_Z = V_{REF} (1 + R1/R2) + I_{REF} \cdot R1$

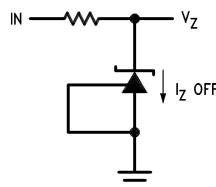


Figure 6. Test Circuit for Off-State Current



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>

|  |                                  |                    |
|--|----------------------------------|--------------------|
| Storage Temperature Range                    |                                  | -65°C to +150°C    |
| Operating Temperature Range                  | Industrial (LM431xI)             | -40°C to +85°C     |
|  | Commercial (LM431xC)             | 0°C to +70°C       |
| Soldering Information                        | Infrared or Convection (20 sec.) | 235°C              |
|  | Wave Soldering (10 sec.)         | 260°C (lead temp.) |
| Cathode Voltage                              |                                  | 37V                |
| Continuous Cathode Current                   |                                  | -10 mA to +150 mA  |
| Reference Voltage                            |                                  | -0.5V              |
| Reference Input Current                      |                                  | 10 mA              |
| Internal Power Dissipation <sup>(3)(4)</sup> | TO-92 Package                    | 0.78W              |
|  | SOIC Package                     | 0.81W              |
|  | SOT-23 Package                   | 0.28W              |

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Electrical specifications do not apply when operating the device beyond its rated operating conditions.
- (2) If Military/Aerospace specified devices are required, please contact the TI Sales Office/ Distributors for availability and specifications.
- (3)  $T_{J \text{ Max}} = 150^\circ\text{C}$ .
- (4) Ratings apply to ambient temperature at 25°C. Above this temperature, derate the TO-92 at 6.2 mW/°C, the SOIC at 6.5 mW/°C, the SOT-23 at 2.2 mW/°C.

## Operating Conditions

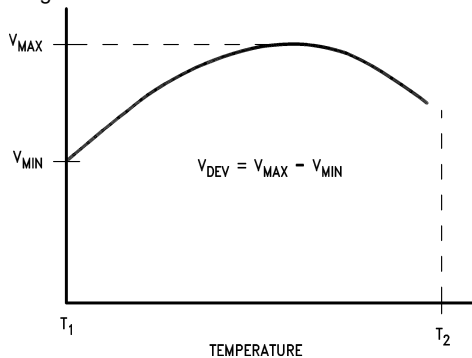
|                 | Min       | Max    |
|-----------------|-----------|--------|
| Cathode Voltage | $V_{REF}$ | 37V    |
| Cathode Current | 1.0 mA    | 100 mA |

## LM431 Electrical Characteristics

T<sub>A</sub> = 25°C unless otherwise specified

| Symbol                             | Parameter   | Conditions  | Min   | Typ   | Max   | Units |      |
|------------------------------------|---|---|---|-------|-------|-------|------|
| V <sub>REF</sub>                   | Reference Voltage   | V <sub>Z</sub> = V <sub>REF</sub> , I <sub>I</sub> = 10 mA<br>LM431A (Figure 4)                               | 2.440                                       | 2.495 | 2.550 | V     |      |
|                                    |   | V <sub>Z</sub> = V <sub>REF</sub> , I <sub>I</sub> = 10 mA<br>LM431B (Figure 4)                               | 2.470                                       | 2.495 | 2.520 | V     |      |
|                                    |   | V <sub>Z</sub> = V <sub>REF</sub> , I <sub>I</sub> = 10 mA<br>LM431C (Figure 4)                               | 2.485                                       | 2.500 | 2.510 | V     |      |
| V <sub>DEV</sub>                   | Deviation of Reference Input Voltage Over Temperature <sup>(1)</sup>      | V <sub>Z</sub> = V <sub>REF</sub> , I <sub>I</sub> = 10 mA,<br>T <sub>A</sub> = Full Range (Figure 4)         |   | 8.0   | 17    | mV    |      |
| ΔV <sub>REF</sub> /ΔV <sub>Z</sub> | Ratio of the Change in Reference Voltage to the Change in Cathode Voltage | I <sub>Z</sub> = 10 mA<br>(Figure 5)  | V <sub>Z</sub> from V <sub>REF</sub> to 10V |       | -1.4  | -2.7  | mV/V |
|                                    |   |   | V <sub>Z</sub> from 10V to 36V              |       | -1.0  | -2.0  |      |
| I <sub>REF</sub>                   | Reference Input Current   | R <sub>1</sub> = 10 kΩ, R <sub>2</sub> = ∞, I <sub>I</sub> = 10 mA<br>(Figure 5)                              |   | 2.0   | 4.0   | μA    |      |
| αI <sub>REF</sub>                  | Deviation of Reference Input Current over Temperature                     | R <sub>1</sub> = 10 kΩ, R <sub>2</sub> = ∞, I <sub>I</sub> = 10 mA,<br>T <sub>A</sub> = Full Range (Figure 5) |   | 0.4   | 1.2   | μA    |      |
| I <sub>Z(MIN)</sub>                | Minimum Cathode Current for Regulation                                    | V <sub>Z</sub> = V <sub>REF</sub> (Figure 4)  |   | 0.4   | 1.0   | mA    |      |
| I <sub>Z(OFF)</sub>                | Off-State Current   | V <sub>Z</sub> = 36V, V <sub>REF</sub> = 0V (Figure 6)  |   | 0.3   | 1.0   | μA    |      |
| r <sub>Z</sub>                     | Dynamic Output Impedance <sup>(2)</sup>                                   | V <sub>Z</sub> = V <sub>REF</sub> , LM431A,<br>Frequency = 0 Hz (Figure 4)                                    |   |       | 0.75  | Ω     |      |
|                                    |   | V <sub>Z</sub> = V <sub>REF</sub> , LM431B, LM431C<br>Frequency = 0 Hz (Figure 4)                             |   |       | 0.50  | Ω     |      |

- (1) Deviation of reference input voltage, V<sub>DEV</sub>, is defined as the maximum variation of the reference input voltage over the full temperature range.



The average temperature coefficient of the reference input voltage, αV<sub>REF</sub>, is defined as:

$$\alpha V_{REF} \frac{\text{ppm}}{^{\circ}\text{C}} = \frac{\pm \left[ \frac{V_{\text{Max}} - V_{\text{Min}}}{V_{REF}(\text{at } 25^{\circ}\text{C})} \right] 10^6}{T_2 - T_1} = \frac{\pm \left[ \frac{V_{DEV}}{V_{REF}(\text{at } 25^{\circ}\text{C})} \right] 10^6}{T_2 - T_1}$$

Where:

T<sub>2</sub> - T<sub>1</sub> = full temperature change (0-70°C).

V<sub>REF</sub> can be positive or negative depending on whether the slope is positive or negative.

Example: V<sub>DEV</sub> = 8.0 mV, V<sub>REF</sub> = 2495 mV, T<sub>2</sub> - T<sub>1</sub> = 70°C, slope is positive.

$$\alpha V_{REF} = \frac{\left[ \frac{8.0 \text{ mV}}{2495 \text{ mV}} \right] 10^6}{70^{\circ}\text{C}} = +46 \text{ ppm}/^{\circ}\text{C}$$

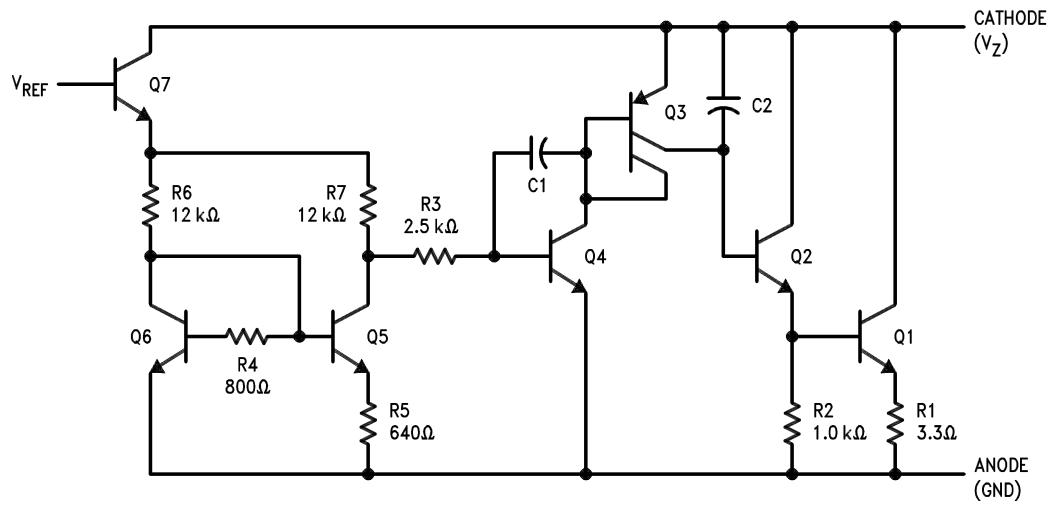
- (2) The dynamic output impedance, r<sub>Z</sub>, is defined as:

$$r_Z = \frac{\Delta V_Z}{\Delta I_Z}$$

When the device is programmed with two external resistors, R<sub>1</sub> and R<sub>2</sub>, (see Figure 5), the dynamic output impedance of the overall circuit, r<sub>Z</sub>, is defined as:

$$r_Z = \frac{\Delta V_Z}{\Delta I_Z} \approx \left[ r_Z \left( 1 + \frac{R_1}{R_2} \right) \right]$$

## Equivalent Circuit



Typical Performance Characteristics

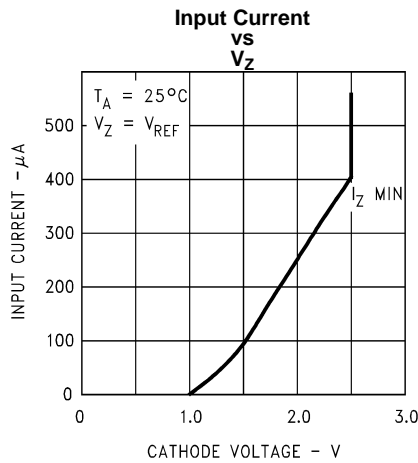


Figure 7.

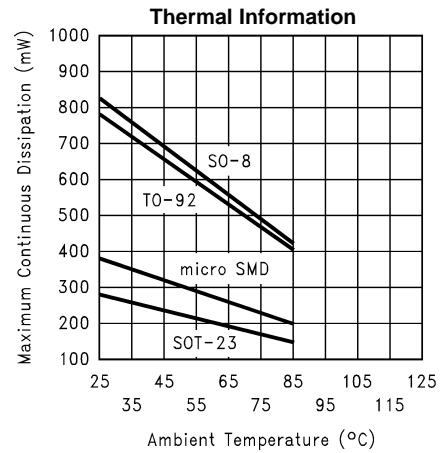


Figure 8.

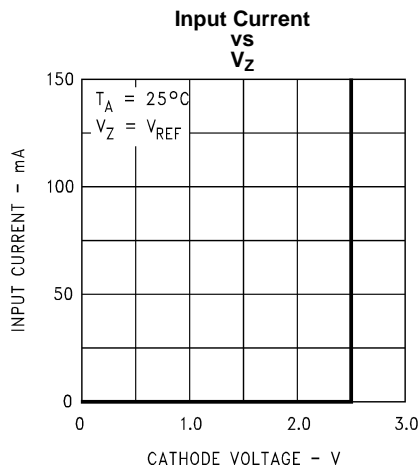


Figure 9.

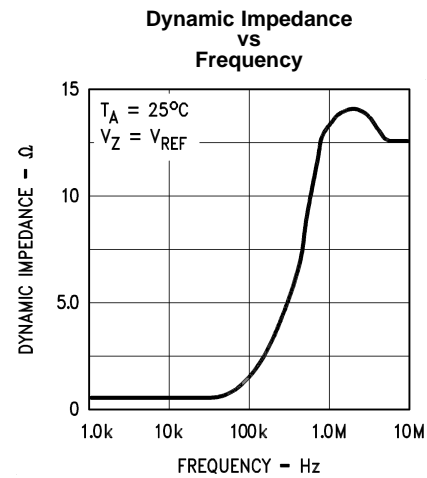


Figure 10.

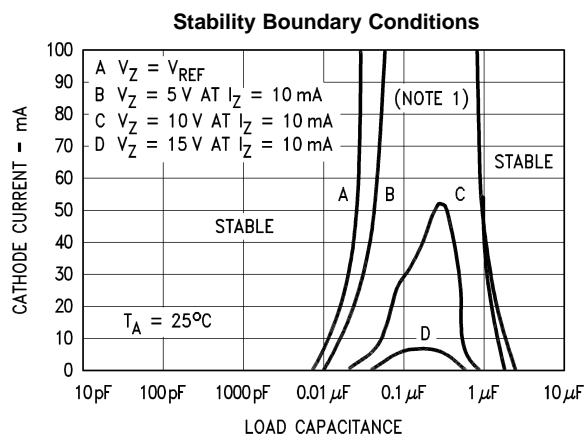


Figure 11.

**Note:** The areas under the curves represent conditions that may cause the device to oscillate. For curves B, C, and D, R2 and V+ were adjusted to establish the initial V<sub>Z</sub> and I<sub>Z</sub> conditions with C<sub>L</sub> = 0. V+ and C<sub>L</sub> were then adjusted to determine the ranges of stability.

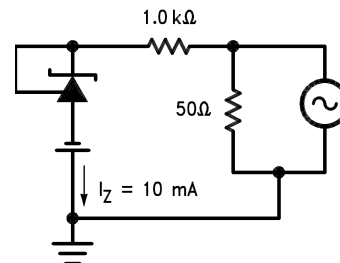


Figure 12.

### Typical Performance Characteristics (continued)

Test Circuit for Curve A Above

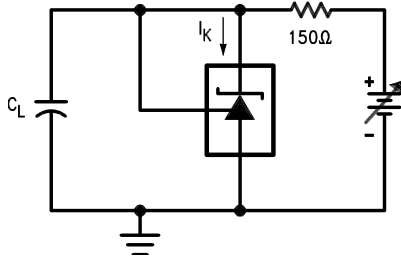


Figure 13.

Test Circuit for Curves B, C and D Above

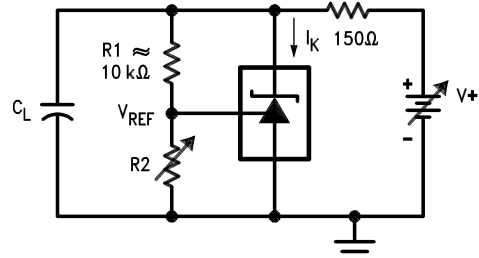


Figure 14.

Typical Applications

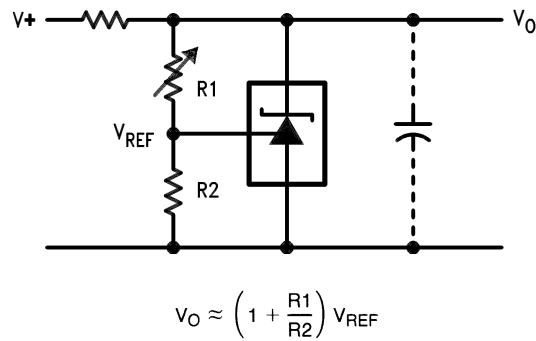


Figure 15. Shunt Regulator

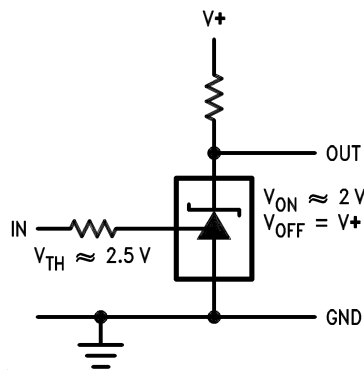


Figure 16. Single Supply Comparator with Temperature Compensated Threshold

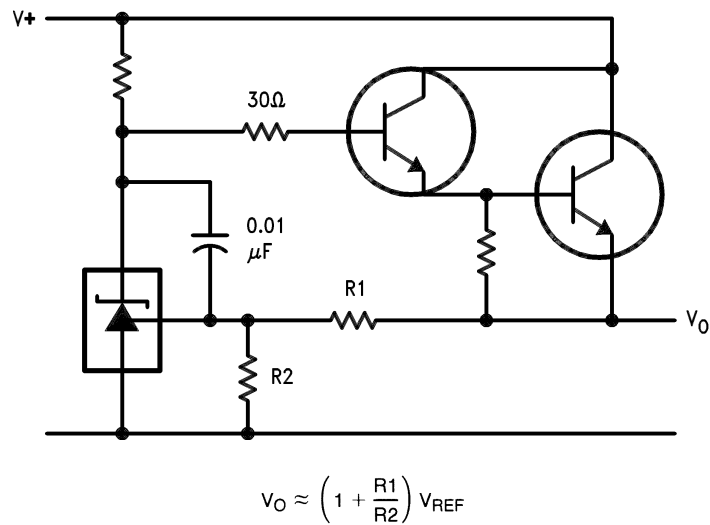
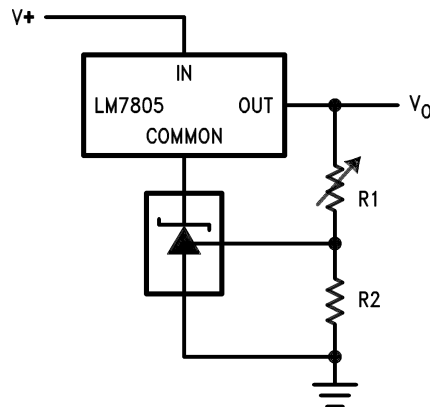


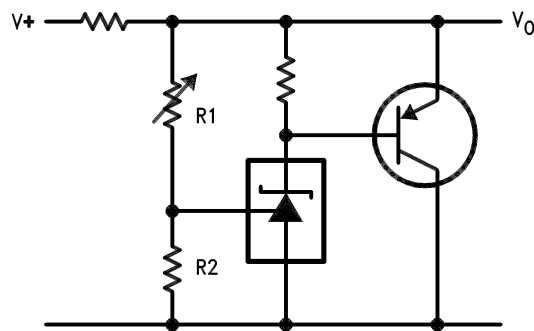
Figure 17. Series Regulator



$$V_O = \left(1 + \frac{R_1}{R_2}\right) V_{REF}$$

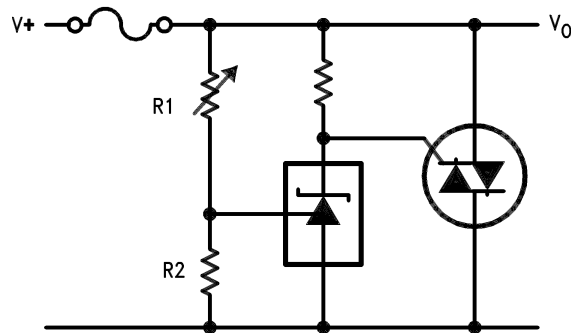
$$V_{O\ MIN} = V_{REF} + 5V$$

Figure 18. Output Control of a Three Terminal Fixed Regulator



$$V_O \approx \left(1 + \frac{R_1}{R_2}\right) V_{REF}$$

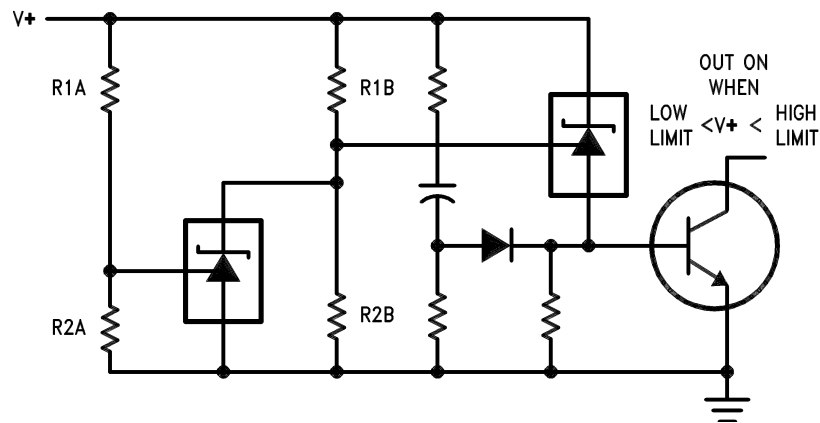
Figure 19. Higher Current Shunt Regulator



$$V_{LIMIT} \approx \left(1 + \frac{R_1}{R_2}\right) V_{REF}$$

Figure 20. Crow Bar

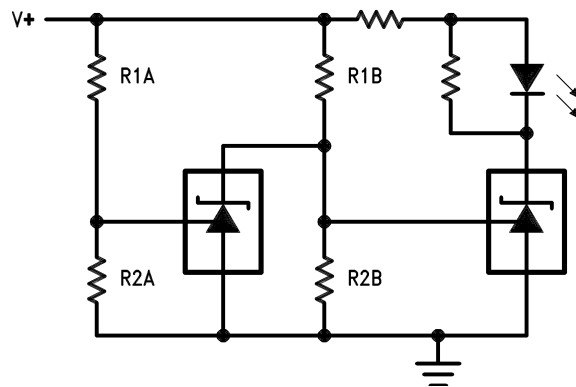




$$\text{LOW LIMIT} \approx V_{\text{REF}} \left( 1 + \frac{R1B}{R2B} \right) + V_{\text{BE}}$$

$$\text{HIGH LIMIT} \approx V_{\text{REF}} \left( 1 + \frac{R1A}{R2A} \right)$$

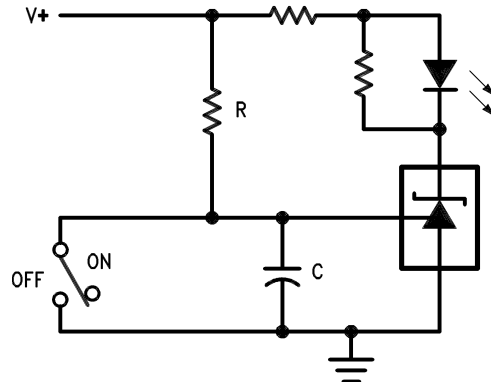
Figure 21. Over Voltage/Under Voltage Protection Circuit



$$\text{LOW LIMIT} \approx V_{\text{REF}} \left( 1 + \frac{R1B}{R2B} \right) \quad \text{LED ON WHEN} \\ \text{LOW LIMIT} < V^+ < \text{HIGH LIMIT}$$

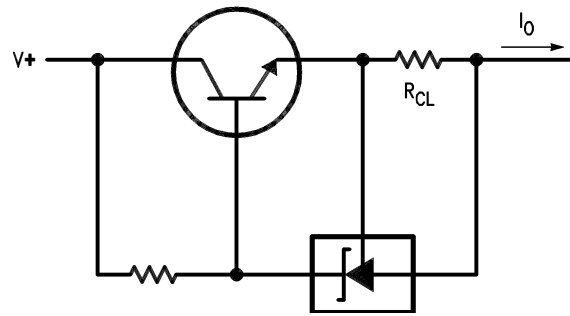
$$\text{HIGH LIMIT} \approx V_{\text{REF}} \left( 1 + \frac{R1A}{R2A} \right)$$

Figure 22. Voltage Monitor



$$\text{DELAY} = R \cdot C \cdot \ln \frac{V+}{(V+) - V_{\text{REF}}}$$

Figure 23. Delay Timer



$$I_o = \frac{V_{\text{REF}}}{R_{\text{CL}}}$$

Figure 24. Current Limiter or Current Source

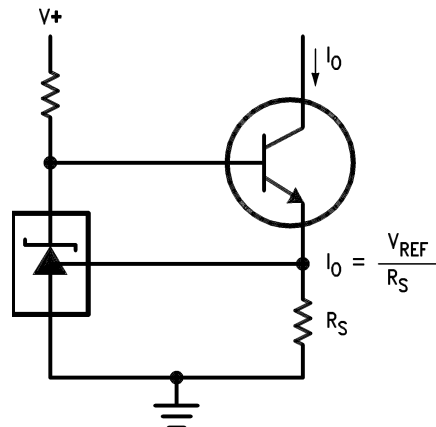


Figure 25. Constant Current Sink

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**REVISION HISTORY**

| <b>Changes from Revision F (April 2013) to Revision G</b>  | <b>Page</b>        |
|--|--------------------|
| • Changed layout of National Data Sheet to TI format ..... | <a href="#">10</a> |

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PACKAGING INFORMATION

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)            | Lead/Ball Finish | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|----------------------------|------------------|----------------------|--------------|-------------------------|-------------------------|
| LM431ACM         | ACTIVE        | SOIC         | D               | 8    | 95          | TBD                        | Call TI          | Call TI              | -40 to 85    | LM431<br>ACM            | <a href="#">Samples</a> |
| LM431ACM/NOPB    | ACTIVE        | SOIC         | D               | 8    | 95          | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 85    | LM431<br>ACM            | <a href="#">Samples</a> |
| LM431ACM3        | ACTIVE        | SOT-23       | DBZ             | 3    | 1000        | TBD                        | Call TI          | Call TI              | -40 to 85    | N1F                     | <a href="#">Samples</a> |
| LM431ACM3/NOPB   | ACTIVE        | SOT-23       | DBZ             | 3    | 1000        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 85    | N1F                     | <a href="#">Samples</a> |
| LM431ACM3X       | ACTIVE        | SOT-23       | DBZ             | 3    | 3000        | TBD                        | Call TI          | Call TI              | -40 to 85    | N1F                     | <a href="#">Samples</a> |
| LM431ACM3X/NOPB  | ACTIVE        | SOT-23       | DBZ             | 3    | 3000        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 85    | N1F                     | <a href="#">Samples</a> |
| LM431ACMX        | ACTIVE        | SOIC         | D               | 8    | 2500        | TBD                        | Call TI          | Call TI              | -40 to 85    | LM431<br>ACM            | <a href="#">Samples</a> |
| LM431ACMX/NOPB   | ACTIVE        | SOIC         | D               | 8    | 2500        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 85    | LM431<br>ACM            | <a href="#">Samples</a> |
| LM431ACZ/LFT3    | ACTIVE        | TO-92        | LP              | 3    | 2000        | Green (RoHS<br>& no Sb/Br) | SNCU             | Level-1-NA-UNLIM     |              | LM431<br>ACZ            | <a href="#">Samples</a> |
| LM431ACZ/LFT4    | ACTIVE        | TO-92        | LP              | 3    | 2000        | Green (RoHS<br>& no Sb/Br) | SNCU             | Level-1-NA-UNLIM     |              | LM431<br>ACZ            | <a href="#">Samples</a> |
| LM431ACZ/NOPB    | ACTIVE        | TO-92        | LP              | 3    | 1800        | Green (RoHS<br>& no Sb/Br) | SNCU             | Level-1-NA-UNLIM     | -40 to 85    | LM431<br>ACZ            | <a href="#">Samples</a> |
| LM431AIM         | ACTIVE        | SOIC         | D               | 8    | 95          | TBD                        | Call TI          | Call TI              | -40 to 85    | LM431<br>AIM            | <a href="#">Samples</a> |
| LM431AIM/NOPB    | ACTIVE        | SOIC         | D               | 8    | 95          | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 85    | LM431<br>AIM            | <a href="#">Samples</a> |
| LM431AIM3        | ACTIVE        | SOT-23       | DBZ             | 3    | 1000        | TBD                        | Call TI          | Call TI              | -40 to 85    | N1E                     | <a href="#">Samples</a> |
| LM431AIM3/NOPB   | ACTIVE        | SOT-23       | DBZ             | 3    | 1000        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 85    | N1E                     | <a href="#">Samples</a> |
| LM431AIM3X       | ACTIVE        | SOT-23       | DBZ             | 3    | 3000        | TBD                        | Call TI          | Call TI              | -40 to 85    | N1E                     | <a href="#">Samples</a> |
| LM431AIM3X/NOPB  | ACTIVE        | SOT-23       | DBZ             | 3    | 3000        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 85    | N1E                     | <a href="#">Samples</a> |
| LM431AIMX        | ACTIVE        | SOIC         | D               | 8    | 2500        | TBD                        | Call TI          | Call TI              | -40 to 85    | LM431<br>AIM            | <a href="#">Samples</a> |



| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)         | Lead/Ball Finish | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|------------------|----------------------|--------------|-------------------------|-------------------------|
| LM431CCM/NOPB    | ACTIVE        | SOIC         | D               | 8    | 95          | Green (RoHS & no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 85    | 431 CCM                 | <a href="#">Samples</a> |
| LM431CCM3        | ACTIVE        | SOT-23       | DBZ             | 3    | 1000        | TBD                     | Call TI          | Call TI              | -40 to 85    | N1B                     | <a href="#">Samples</a> |
| LM431CCM3/NOPB   | ACTIVE        | SOT-23       | DBZ             | 3    | 1000        | Green (RoHS & no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 85    | N1B                     | <a href="#">Samples</a> |
| LM431CCM3X       | ACTIVE        | SOT-23       | DBZ             | 3    | 3000        | TBD                     | Call TI          | Call TI              | -40 to 85    | N1B                     | <a href="#">Samples</a> |
| LM431CCM3X/NOPB  | ACTIVE        | SOT-23       | DBZ             | 3    | 3000        | Green (RoHS & no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 85    | N1B                     | <a href="#">Samples</a> |
| LM431CCZ/NOPB    | ACTIVE        | TO-92        | LP              | 3    | 1800        | Green (RoHS & no Sb/Br) | SNCU             | Level-1-NA-UNLIM     | -40 to 85    | LM431 CCZ               | <a href="#">Samples</a> |
| LM431CIM         | ACTIVE        | SOIC         | D               | 8    | 95          | TBD                     | Call TI          | Call TI              | -40 to 85    | 431 CIM                 | <a href="#">Samples</a> |
| LM431CIM/NOPB    | ACTIVE        | SOIC         | D               | 8    | 95          | Green (RoHS & no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 85    | 431 CIM                 | <a href="#">Samples</a> |
| LM431CIM3        | ACTIVE        | SOT-23       | DBZ             | 3    | 1000        | TBD                     | Call TI          | Call TI              | -40 to 85    | N1A                     | <a href="#">Samples</a> |
| LM431CIM3/NOPB   | ACTIVE        | SOT-23       | DBZ             | 3    | 1000        | Green (RoHS & no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 85    | N1A                     | <a href="#">Samples</a> |
| LM431CIM3X       | ACTIVE        | SOT-23       | DBZ             | 3    | 3000        | TBD                     | Call TI          | Call TI              | -40 to 85    | N1A                     | <a href="#">Samples</a> |
| LM431CIM3X/NOPB  | ACTIVE        | SOT-23       | DBZ             | 3    | 3000        | Green (RoHS & no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 85    | N1A                     | <a href="#">Samples</a> |
| LM431CIZ/LFT1    | ACTIVE        | TO-92        | LP              | 3    | 2000        | Green (RoHS & no Sb/Br) | SNCU             | Level-1-NA-UNLIM     |              | LM431 CIZ               | <a href="#">Samples</a> |
| LM431CIZ/NOPB    | ACTIVE        | TO-92        | LP              | 3    | 1800        | Green (RoHS & no Sb/Br) | SNCU             | Level-1-NA-UNLIM     | -40 to 85    | LM431 CIZ               | <a href="#">Samples</a> |

(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)

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

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

<sup>(5)</sup> 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.

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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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM431ACM3       | SOT-23       | DBZ             | 3    | 1000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431ACM3/NOPB  | SOT-23       | DBZ             | 3    | 1000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431ACM3X      | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431ACM3X/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431ACMX       | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM431ACMX/NOPB  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM431AIM3       | SOT-23       | DBZ             | 3    | 1000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431AIM3/NOPB  | SOT-23       | DBZ             | 3    | 1000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431AIM3X      | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431AIM3X/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431AIMX       | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM431AIMX/NOPB  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM431BCM3       | SOT-23       | DBZ             | 3    | 1000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431BCM3/NOPB  | SOT-23       | DBZ             | 3    | 1000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431BCM3X/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431BCMX       | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM431BCMX/NOPB  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM431BIM3       | SOT-23       | DBZ             | 3    | 1000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |



| 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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM431BIM3/NOPB  | SOT-23       | DBZ             | 3    | 1000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431BIM3X      | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431BIM3X/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431BIMX/NOPB  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM431CCM3       | SOT-23       | DBZ             | 3    | 1000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431CCM3/NOPB  | SOT-23       | DBZ             | 3    | 1000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431CCM3X      | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431CCM3X/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431CIM3       | SOT-23       | DBZ             | 3    | 1000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431CIM3/NOPB  | SOT-23       | DBZ             | 3    | 1000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431CIM3X      | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM431CIM3X/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |

**TAPE AND REEL BOX DIMENSIONS**

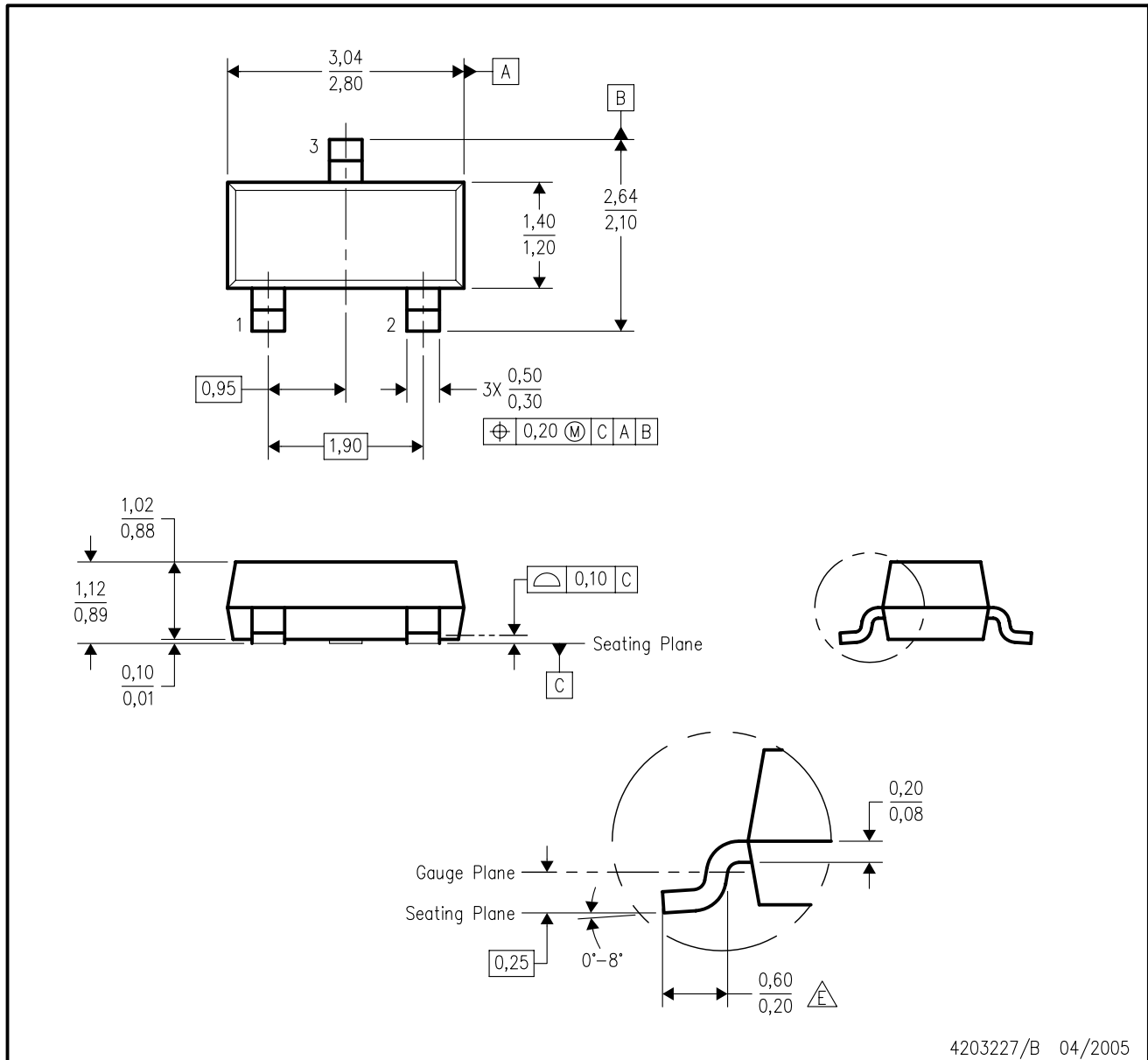

\*All dimensions are nominal

| Device          | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM431ACM3       | SOT-23       | DBZ             | 3    | 1000 | 210.0       | 185.0      | 35.0        |
| LM431ACM3/NOPB  | SOT-23       | DBZ             | 3    | 1000 | 210.0       | 185.0      | 35.0        |
| LM431ACM3X      | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM431ACM3X/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM431ACMX       | SOIC         | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |

| Device          | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM431ACMX/NOPB  | SOIC         | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LM431AIM3       | SOT-23       | DBZ             | 3    | 1000 | 210.0       | 185.0      | 35.0        |
| LM431AIM3/NOPB  | SOT-23       | DBZ             | 3    | 1000 | 210.0       | 185.0      | 35.0        |
| LM431AIM3X      | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM431AIM3X/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM431AIMX       | SOIC         | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LM431AIMX/NOPB  | SOIC         | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LM431BCM3       | SOT-23       | DBZ             | 3    | 1000 | 210.0       | 185.0      | 35.0        |
| LM431BCM3/NOPB  | SOT-23       | DBZ             | 3    | 1000 | 210.0       | 185.0      | 35.0        |
| LM431BCM3X/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM431BCM3X      | SOIC         | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LM431BCM3X/NOPB | SOIC         | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LM431BIM3       | SOT-23       | DBZ             | 3    | 1000 | 210.0       | 185.0      | 35.0        |
| LM431BIM3/NOPB  | SOT-23       | DBZ             | 3    | 1000 | 210.0       | 185.0      | 35.0        |
| LM431BIM3X      | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM431BIM3X/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM431BIMX/NOPB  | SOIC         | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LM431CCM3       | SOT-23       | DBZ             | 3    | 1000 | 210.0       | 185.0      | 35.0        |
| LM431CCM3/NOPB  | SOT-23       | DBZ             | 3    | 1000 | 210.0       | 185.0      | 35.0        |
| LM431CCM3X      | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM431CCM3X/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM431CIM3       | SOT-23       | DBZ             | 3    | 1000 | 210.0       | 185.0      | 35.0        |
| LM431CIM3/NOPB  | SOT-23       | DBZ             | 3    | 1000 | 210.0       | 185.0      | 35.0        |
| LM431CIM3X      | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM431CIM3X/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |

DBZ (R-PDSO-G3)

PLASTIC SMALL-OUTLINE

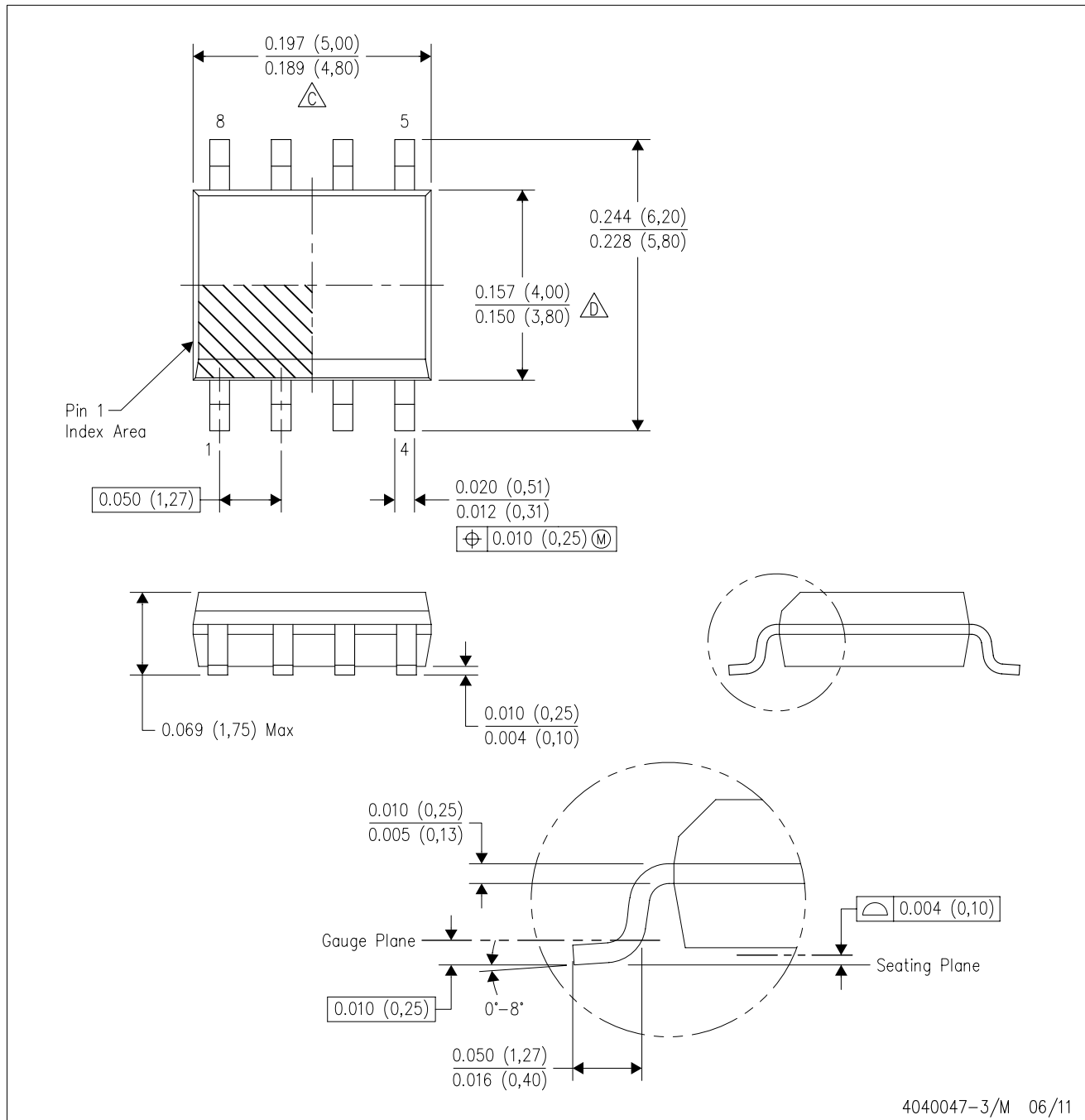


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

- 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. Lead dimensions are inclusive of plating.
  - D. Body dimensions are exclusive of mold flash and protrusion. Mold flash and protrusion not to exceed 0.25 per side.
  - Falls within JEDEC TO-236 variation AB, except minimum foot length.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE

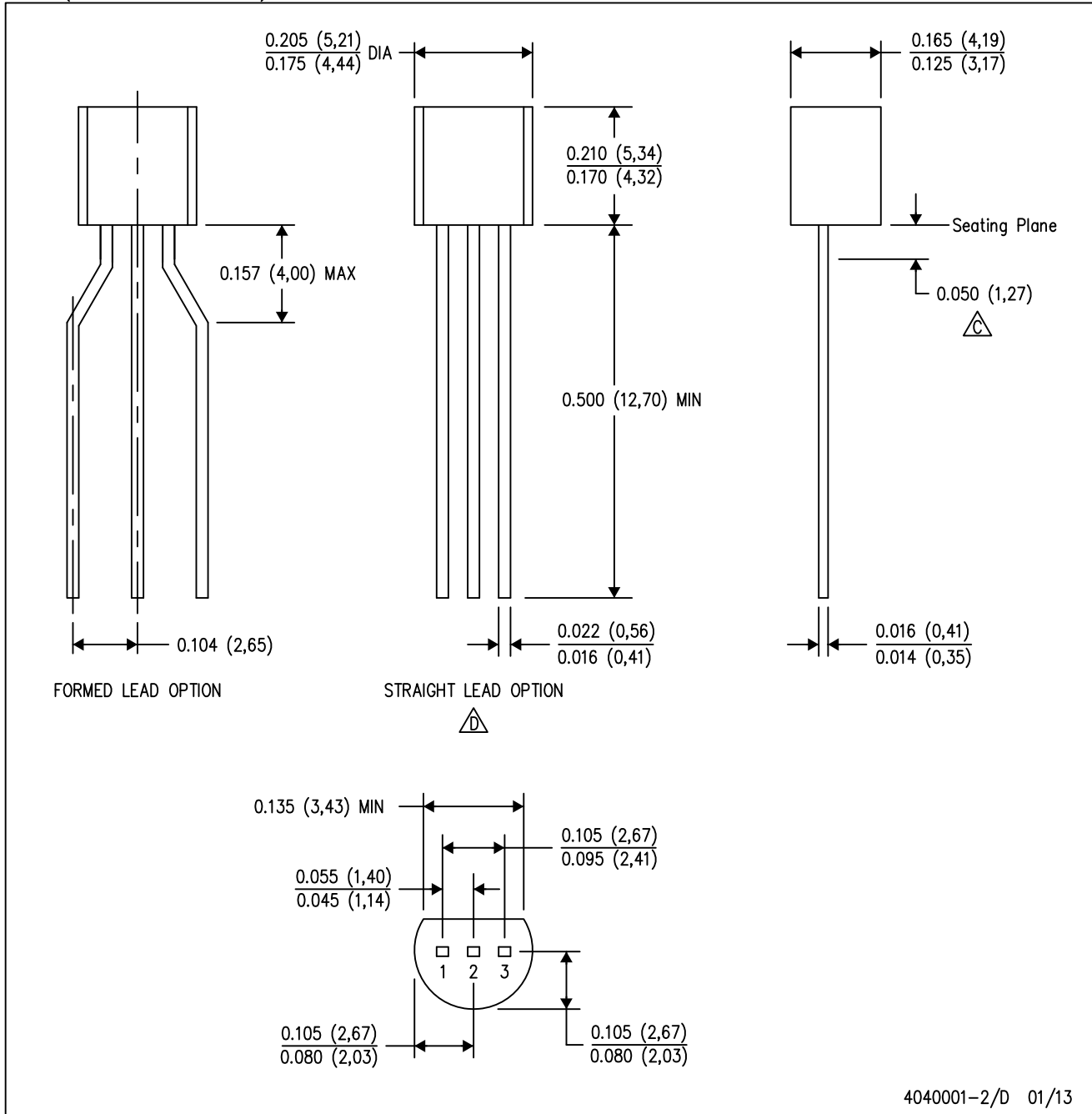


4040047-3/M 06/11

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  -  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.
  -  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)

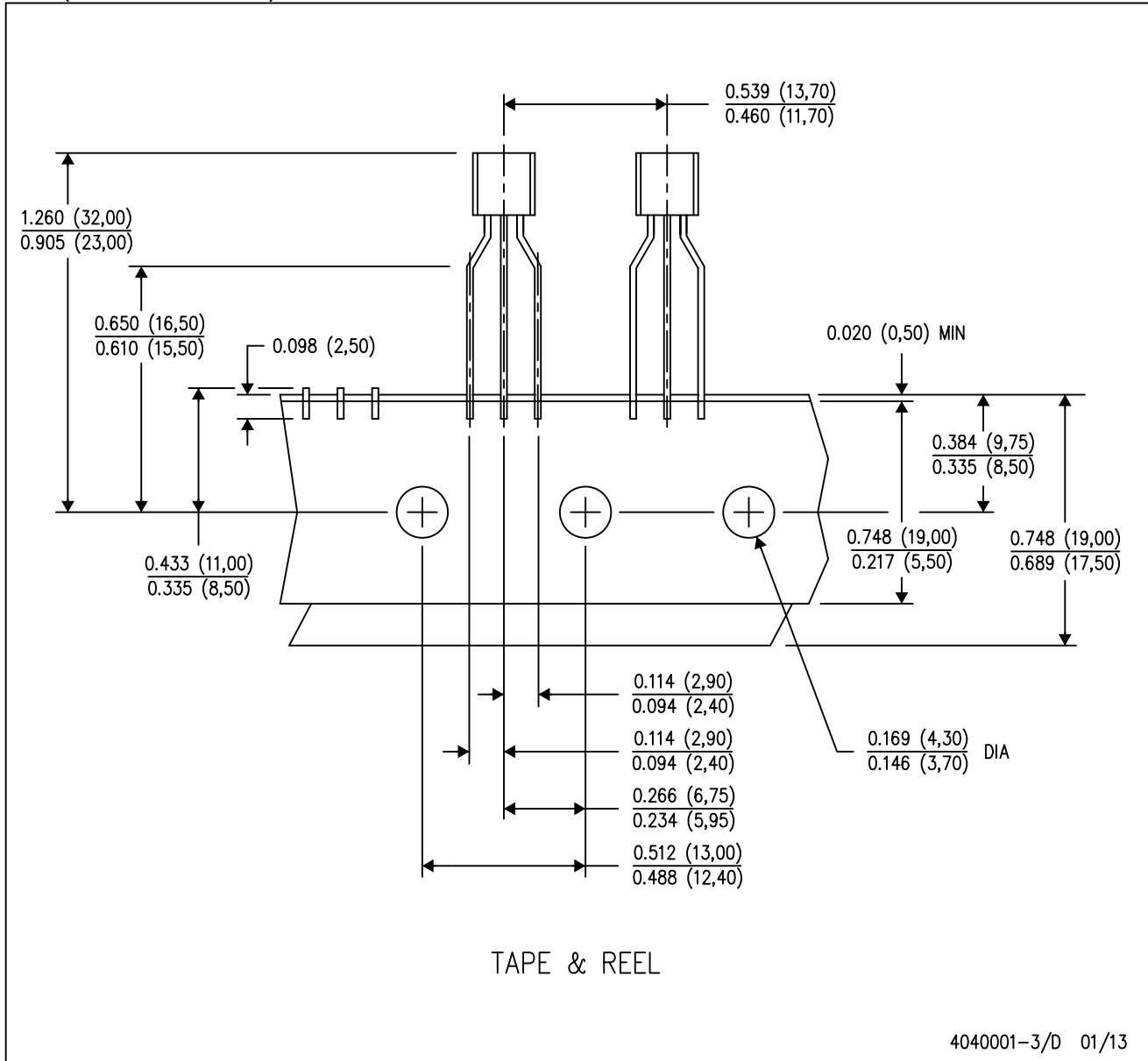
PLASTIC CYLINDRICAL PACKAGE



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

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 Formed Lead Option package.

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