

## LM329 Precision Reference

Check for Samples: [LM329](#)

### FEATURES

- 0.6 mA to 15 mA Operating Current
- $0.8\Omega$  Dynamic Impedance at Any Current
- Available With Temperature Coefficient of  $0.01\%/^{\circ}\text{C}$
- $7\mu\text{V}$  Wideband Noise
- 5% Initial Tolerance
- 0.002% Long Term Stability
- Low Cost
- Subsurface Zener

### DESCRIPTION

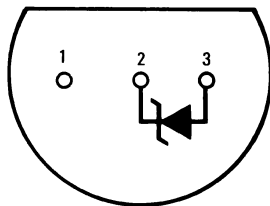
The LM329 is a precision multi-current temperature-compensated 6.9V zener reference with dynamic impedance a factor of 10 to 100 less than discrete diodes. Constructed in a single silicon chip, the LM329 uses active circuitry to buffer the internal zener allowing the device to operate over a 0.5 mA to 15 mA range with virtually no change in performance. The LM329 is available with a temperature coefficients of  $0.01\%/^{\circ}\text{C}$ . This reference also has excellent long term stability and low noise.

A new subsurface breakdown zener used in the LM329 gives lower noise and better long-term stability than conventional IC zeners. Further the zener and temperature compensating transistor are made by a planar process so they are immune to problems that plague ordinary zeners. For example, there is virtually no voltage shift in zener voltage due to temperature cycling and the device is insensitive to stress on the leads.

The LM329 can be used in place of conventional zeners with improved performance. The low dynamic impedance simplifies biasing and the wide operating current allows the replacement of many zener types.

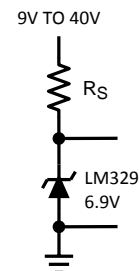
The LM329 for operation over  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$  is available in a TO-92 epoxy package.

### Connection Diagram



**Figure 1. Bottom View  
Plastic Package (TO-92)  
See Package LP**

### Typical Application



**Figure 2. Simple Reference**



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.

All trademarks are the property of their respective owners.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

Copyright © 2000–2013, Texas Instruments Incorporated



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)</sup>

Reverse Breakdown Current		30 mA
Forward Current		2 mA
Operating Temperature Range	LM329	0°C to +70°C
Storage Temperature Range		-55°C to +150°C
Soldering Information	TO-92 package: 10 sec.	260°C

- (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 guarantee specific performance limits.

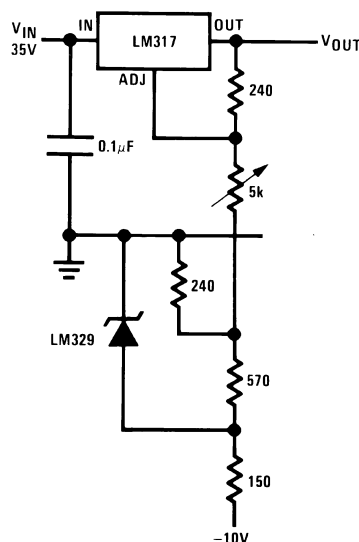
## Electrical Characteristics<sup>(1)</sup>

Parameter	Conditions	Min	Typ	Max	Units
Reverse Breakdown Voltage	$T_A = 25^\circ\text{C}$ , $0.6\text{ mA} \leq I_R \leq 15\text{ mA}$	6.6	6.9	7.25	V
Reverse Breakdown Change $T_A = 25^\circ\text{C}$ , with Current <sup>(2)</sup>	$0.6\text{ mA} \leq I_R \leq 15\text{ mA}$		9	20	mV
Reverse Dynamic Impedance <sup>(2)</sup>	$T_A = 25^\circ\text{C}$ , $I_R = 1\text{ mA}$		0.8	2	$\Omega$
RMS Noise	$T_A = 25^\circ\text{C}$ , $10\text{ Hz} \leq F \leq 10\text{ kHz}$		7	100	$\mu\text{V}$
Long Term Stability (1000 hours)	$T_A = 45^\circ\text{C} \pm 0.1^\circ\text{C}$ , $I_R = 1\text{ mA} \pm 0.3\%$		20		ppm
Temperature Coefficient	$I_R = 1\text{ mA}$		50	100	ppm/°C
Change In Reverse Breakdown Temperature Coefficient	$1\text{ mA} \leq I_R \leq 15\text{ mA}$		1		ppm/°C
Reverse Breakdown Change with Current	$1\text{ mA} \leq I_R \leq 15\text{ mA}$		12		mV
Reverse Dynamic Impedance	$1\text{ mA} \leq I_R \leq 15\text{ mA}$		1		$\Omega$

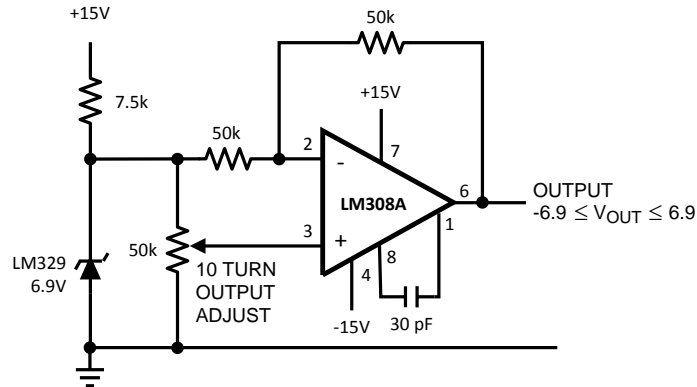
- (1) These specifications apply for  $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$  for the LM329 unless otherwise specified. The maximum junction temperature for a LM329 is  $100^\circ\text{C}$ . For operating at elevated temperature. The TO-92 package, the derating is based on  $180^\circ\text{C/W}$  junction to ambient with 0.4" leads from a PC board and  $160^\circ\text{C/W}$  junction to ambient with 0.125" lead length to a PC board.
- (2) These changes are tested on a pulsed basis with a low duty-cycle. For changes versus temperature, compute in terms of tempco.

## Typical Applications

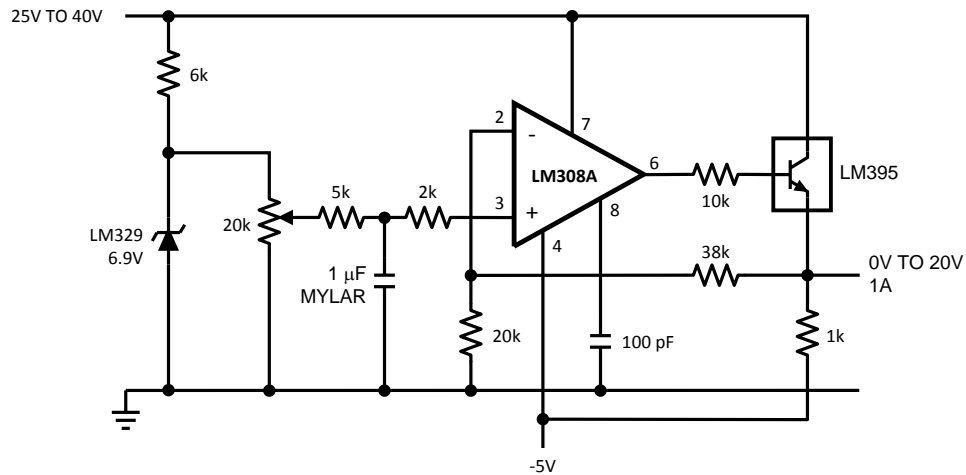
Figure 3. Low Cost 0–25V Regulator



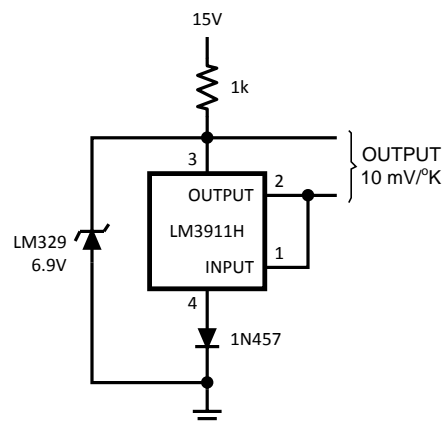
**Figure 4. Adjustable Bipolar Output Reference**

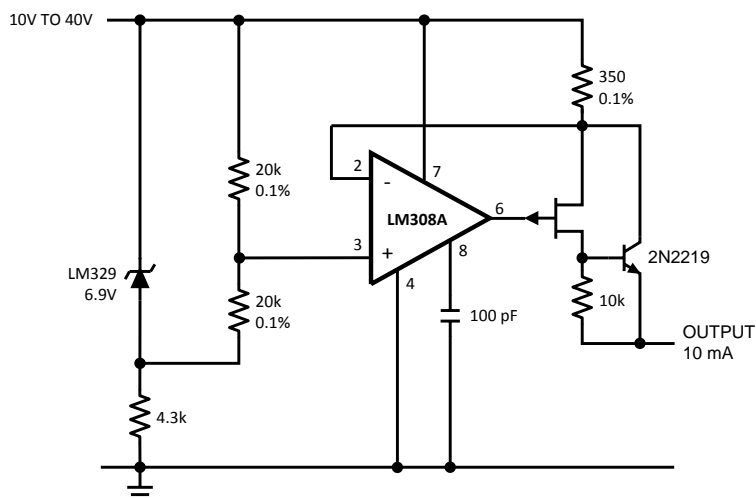
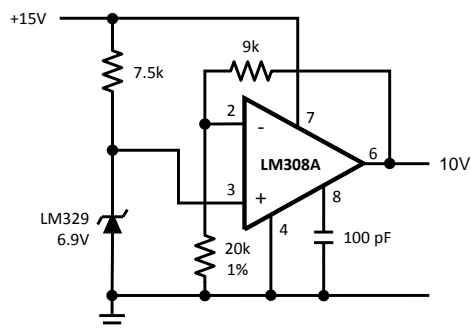
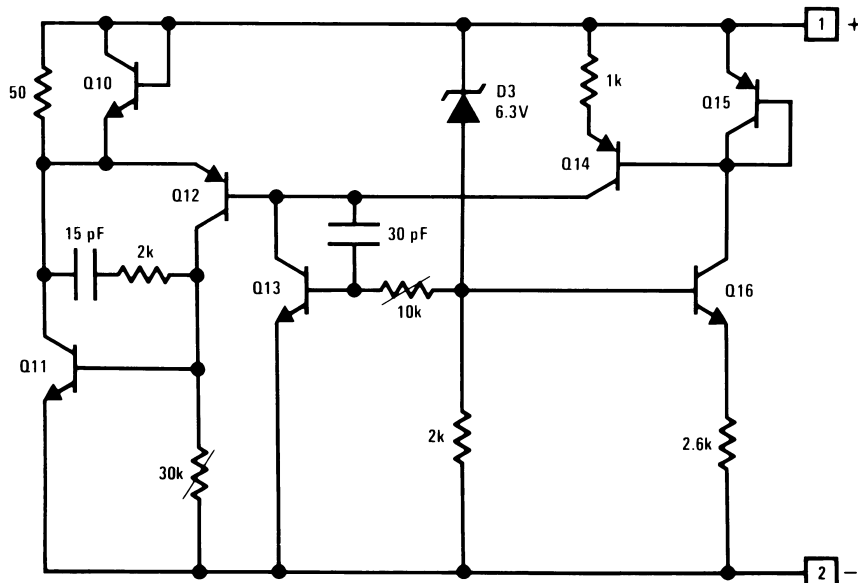


**Figure 5. 0V to 20V Power Reference**



**Figure 6. External Reference for Temperature Transducer**



**Figure 7. Positive Current Source****Figure 8. Buffered Reference with Single Supply****Schematic Diagram**

## Typical Performance Characteristics

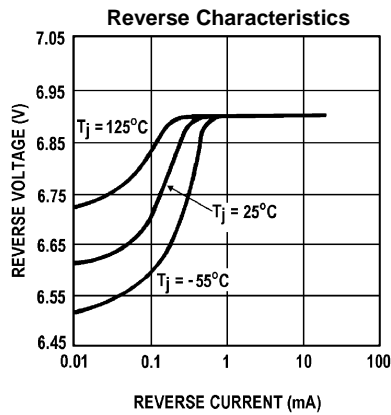


Figure 9.

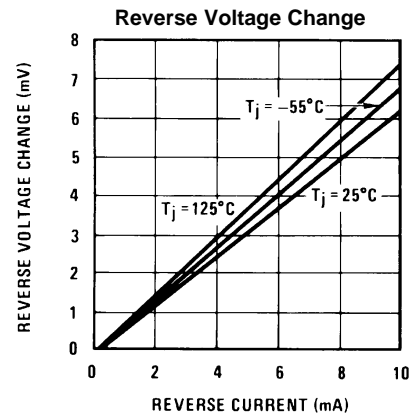


Figure 10.

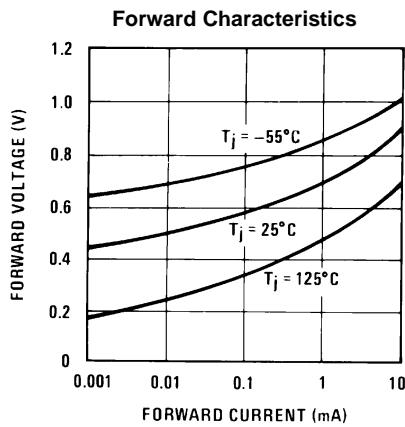


Figure 11.

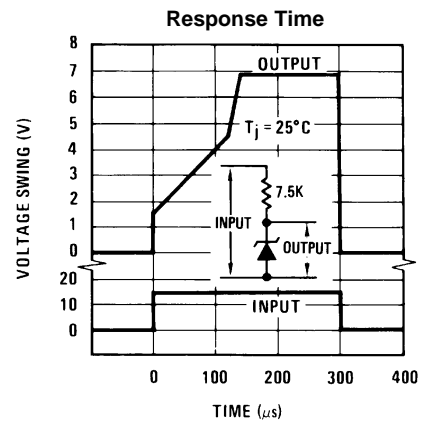


Figure 12.

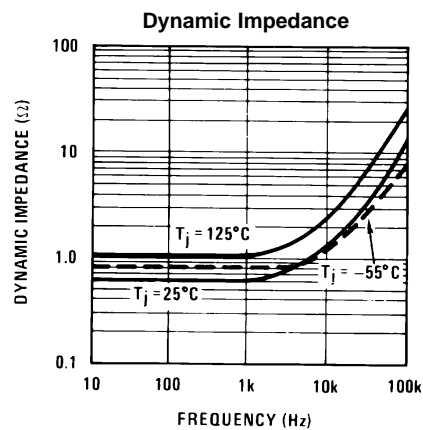
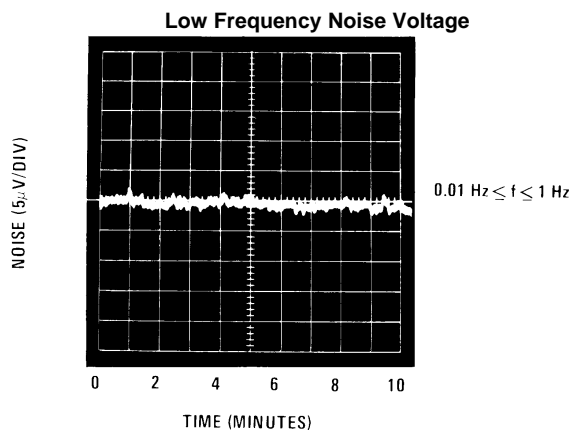
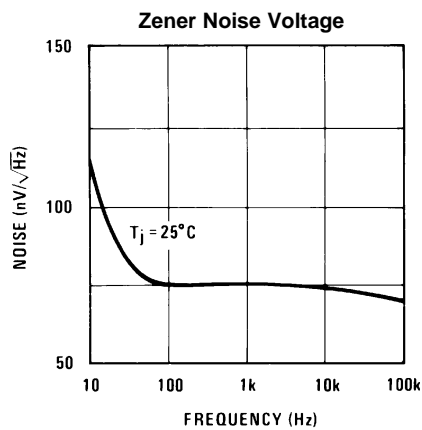


Figure 13.

**Typical Performance Characteristics (continued)**



## REVISION HISTORY

Changes from Revision E (April 2013) to Revision F	Page
• Changed layout of National Data Sheet to TI format .....	<a href="#">6</a>

## PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM329DZ/NOPB	ACTIVE	TO-92	LP	3	1800	Green (RoHS & no Sb/Br)	SN   CU SN	N / A for Pkg Type	0 to 70	LM329 DZ	<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)

(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.

(6) 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.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

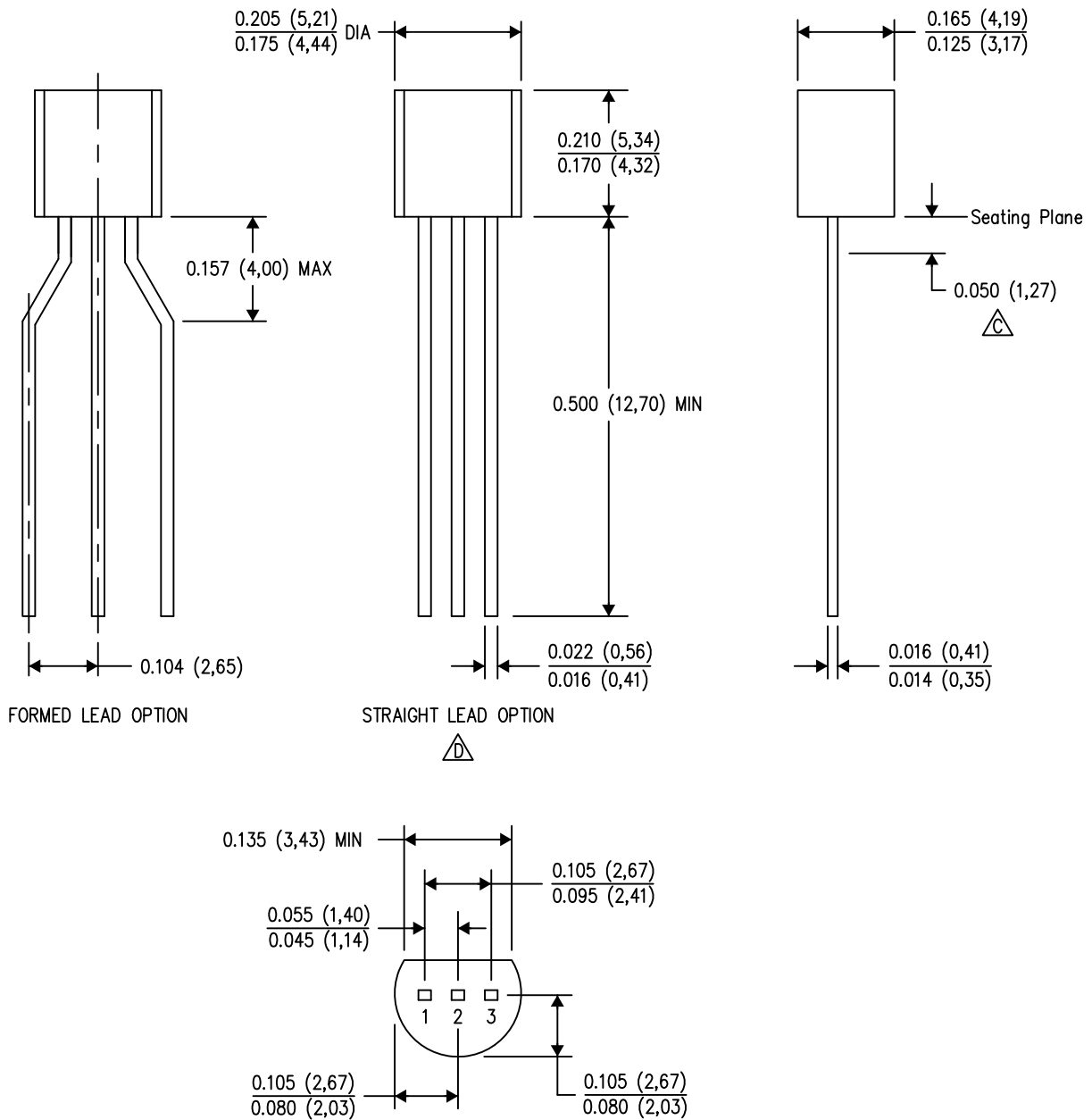
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.





LP (O-PBCY-W3)

PLASTIC CYLINDRICAL PACKAGE



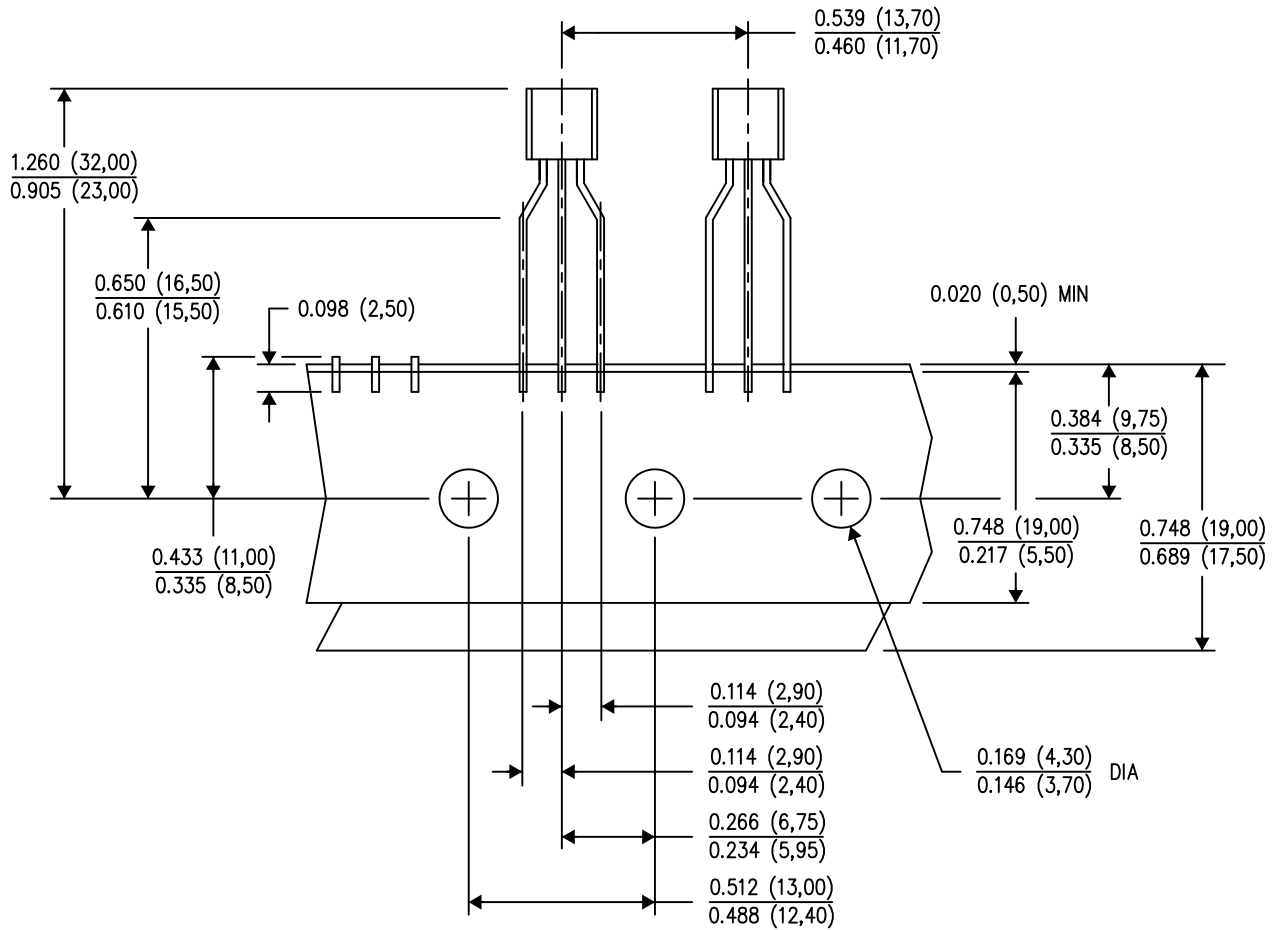
4040001-2/E 08/13

- 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 (0-PBCY-W3)

## PLASTIC CYLINDRICAL PACKAGE



TAPE &amp; REEL

4040001-3/E 08/13

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.

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
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>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)