

LM329

Precision Reference

General 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 coefficient of 0.01%/°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 simpli-

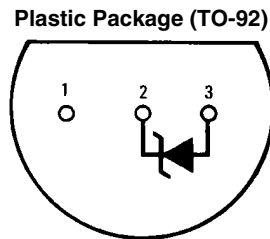
fies biasing and the wide operating current allows the replacement of many zener types.

The LM329 for operation over 0°C to 70°C is available in a TO-92 epoxy package.

Features

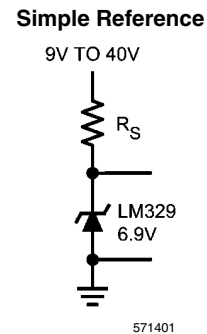
- 0.6 mA to 15 mA operating current
- 0.8Ω dynamic impedance at any current
- Available with temperature coefficient of 0.01%/°C
- 7μV wideband noise
- 5% initial tolerance
- 0.002% long term stability
- Low cost
- Subsurface zener

Connection Diagram



571404
Bottom View
Order Number LM329DZ
See NS Package Z03A

Typical Applications



Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

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

Reverse Breakdown Current 30 mA

Forward Current 2 mA

Electrical Characteristics (Note 2)

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 with Current (Note 3)	$T_A = 25^\circ\text{C}$, $0.6\text{ mA} \leq I_R \leq 15\text{ mA}$		9	20	mV
Reverse Dynamic Impedance (Note 3)	$T_A = 25^\circ\text{C}$, $I_R = 1\text{ mA}$		0.8	2	Ω
RMS Noise	$T_A = 25^\circ\text{C}$, $10\text{ Hz} \leq F \leq 10\text{ kHz}$		7	100	μV
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		Ω

Note 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.

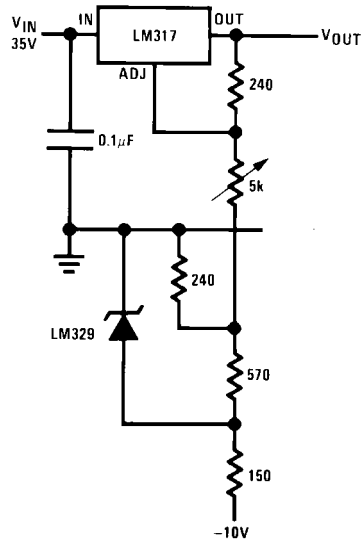
Note 2: These specifications apply for $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$ for the LM329 unless otherwise specified. The maximum junction temperature for a LM329 is 100°C . For operating at elevated temperature. The TO-92 package, the derating is based on 180°C/W junction to ambient with 0.4 leads from a PC board and 160°C/W junction to ambient with 0.125 lead length to a PC board.

Note 3: These changes are tested on a pulsed basis with a low duty-cycle. For changes versus temperature, compute in terms of tempco.

Note 4:

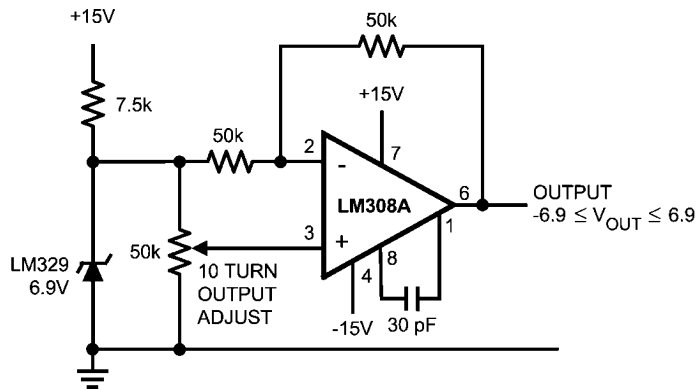
Typical Applications

Low Cost 0–25V Regulator



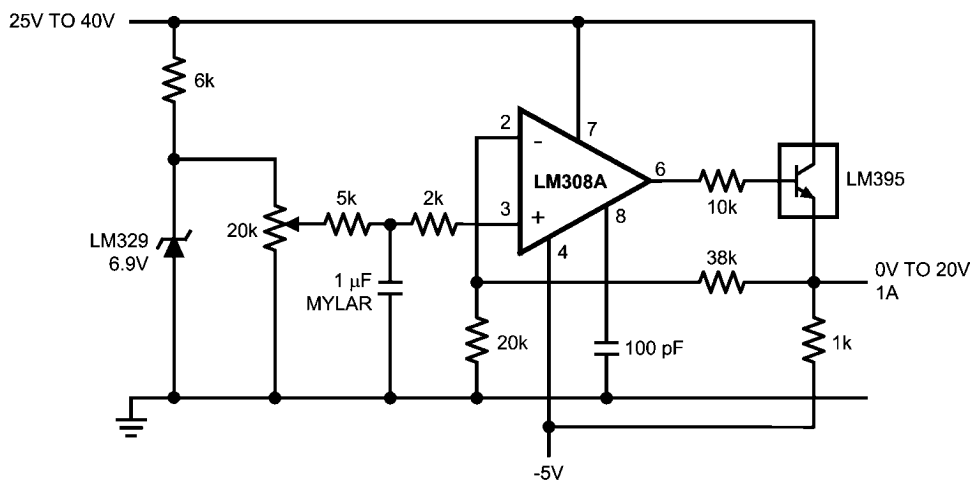
571407

Adjustable Bipolar Output Reference



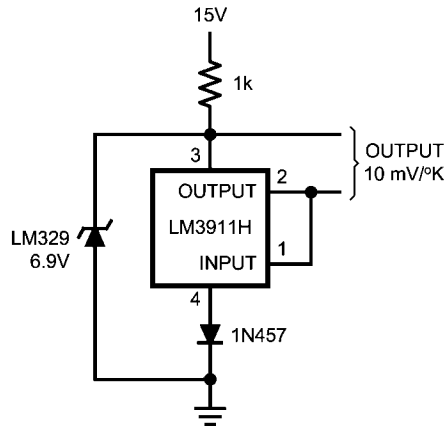
571408

0V to 20V Power Reference



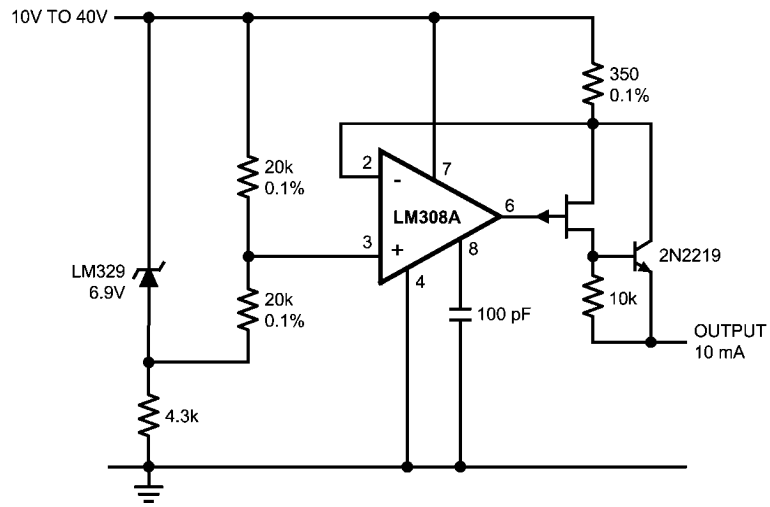
571409

External Reference for Temperature Transducer



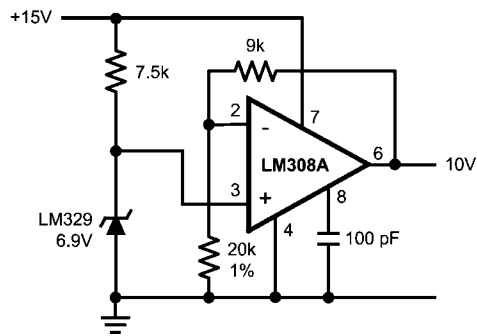
571402

Positive Current Source



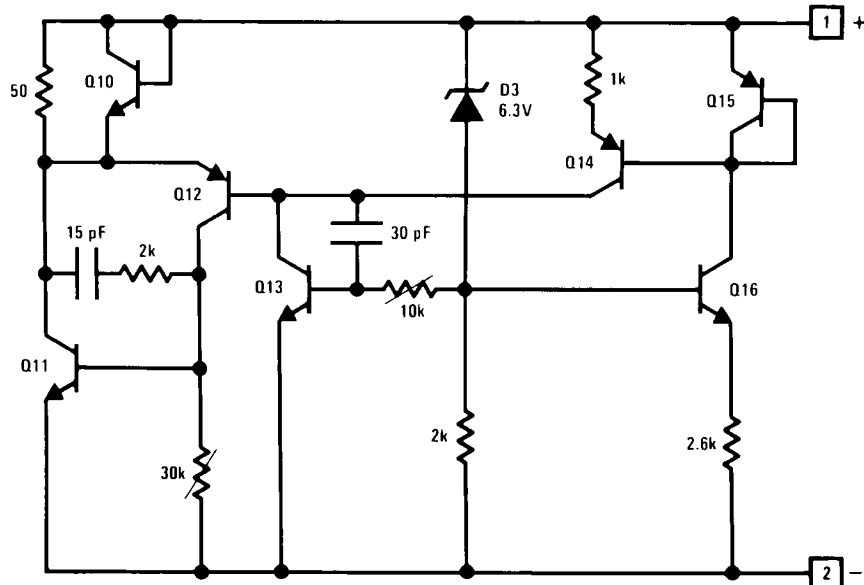
571411

Buffered Reference with Single Supply



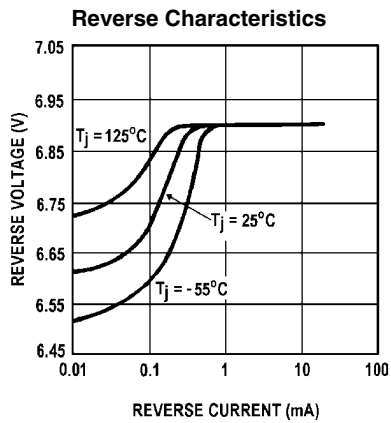
571403

Schematic Diagram

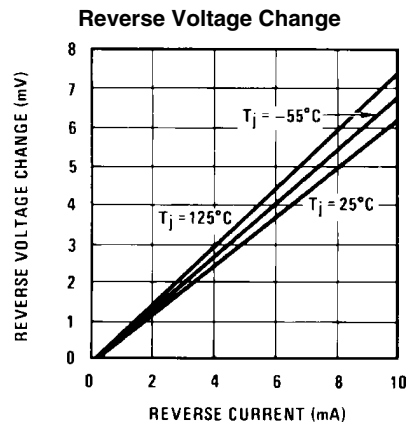


571410

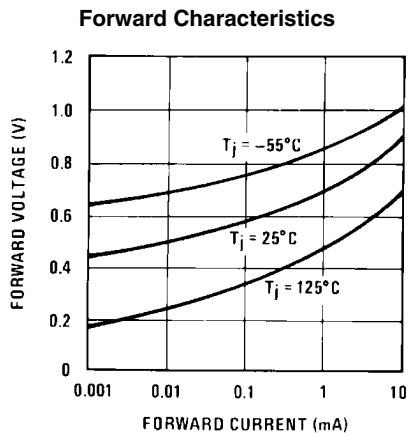
Typical Performance Characteristics



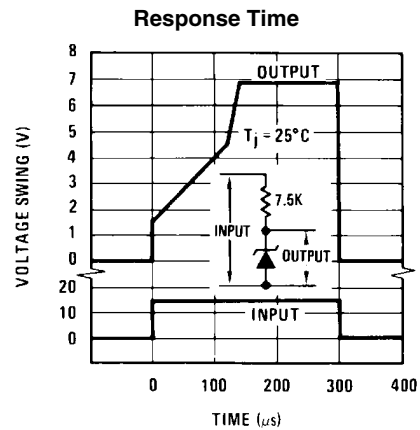
571413



571417

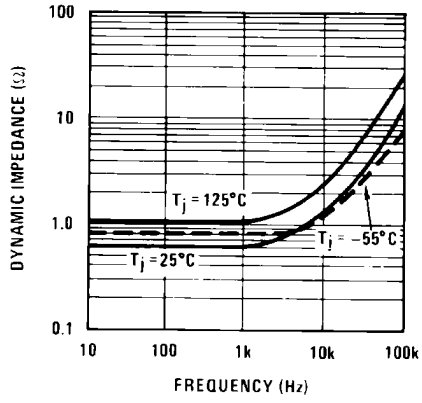


571415



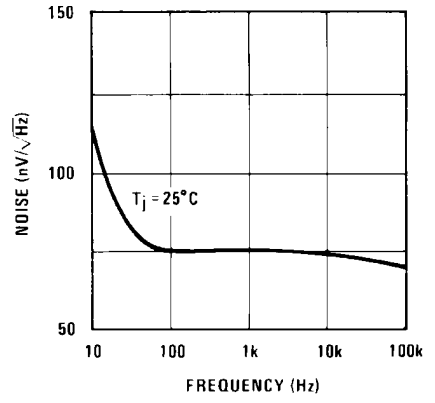
571414

Dynamic Impedance



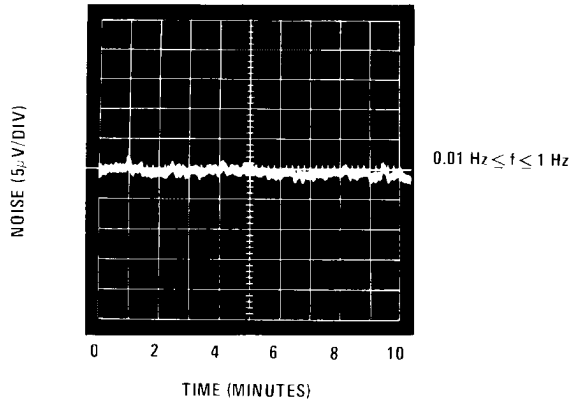
571416

Zener Noise Voltage



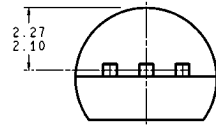
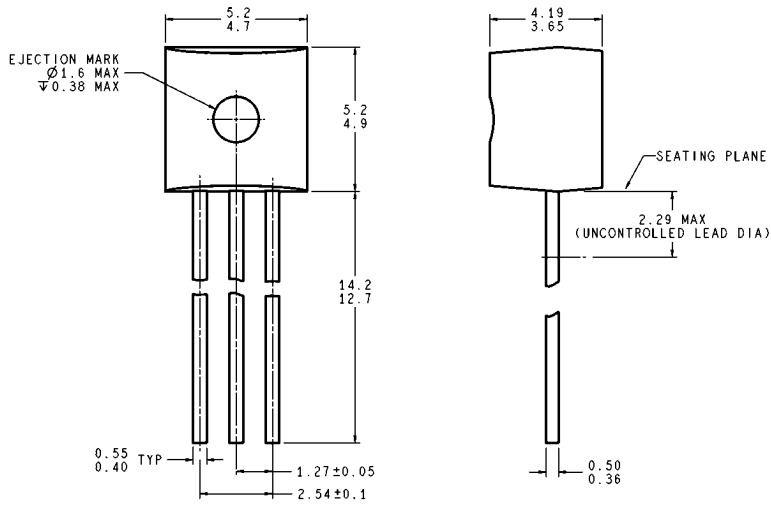
571418

Low Frequency Noise Voltage



571405

Physical Dimensions inches (millimeters) unless otherwise noted



DIMENSIONS ARE IN MILLIMETERS

Z03A (Rev. G)

**Plastic Package
Order Number LM329DZ,
NS Package Z03A**

Notes

For more National Semiconductor product information and proven design tools, visit the following Web sites at:

Products		Design Support	
Amplifiers	www.national.com/amplifiers	WEBENCH	www.national.com/webench
Audio	www.national.com/audio	Analog University	www.national.com/AU
Clock Conditioners	www.national.com/timing	App Notes	www.national.com/appnotes
Data Converters	www.national.com/adc	Distributors	www.national.com/contacts
Displays	www.national.com/displays	Green Compliance	www.national.com/quality/green
Ethernet	www.national.com/ethernet	Packaging	www.national.com/packaging
Interface	www.national.com/interface	Quality and Reliability	www.national.com/quality
LVDS	www.national.com/lvds	Reference Designs	www.national.com/refdesigns
Power Management	www.national.com/power	Feedback	www.national.com/feedback
Switching Regulators	www.national.com/switchers		
LDOs	www.national.com/lido		
LED Lighting	www.national.com/led		
PowerWise	www.national.com/powerwise		
Serial Digital Interface (SDI)	www.national.com/sdi		
Temperature Sensors	www.national.com/tempsensors		
Wireless (PLL/VCO)	www.national.com/wireless		

THE CONTENTS OF THIS DOCUMENT ARE PROVIDED IN CONNECTION WITH NATIONAL SEMICONDUCTOR CORPORATION ("NATIONAL") PRODUCTS. NATIONAL MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO THE ACCURACY OR COMPLETENESS OF THE CONTENTS OF THIS PUBLICATION AND RESERVES THE RIGHT TO MAKE CHANGES TO SPECIFICATIONS AND PRODUCT DESCRIPTIONS AT ANY TIME WITHOUT NOTICE. NO LICENSE, WHETHER EXPRESS, IMPLIED, ARISING BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT.

TESTING AND OTHER QUALITY CONTROLS ARE USED TO THE EXTENT NATIONAL DEEMS NECESSARY TO SUPPORT NATIONAL'S PRODUCT WARRANTY. EXCEPT WHERE MANDATED BY GOVERNMENT REQUIREMENTS, TESTING OF ALL PARAMETERS OF EACH PRODUCT IS NOT NECESSARILY PERFORMED. NATIONAL ASSUMES NO LIABILITY FOR APPLICATIONS ASSISTANCE OR BUYER PRODUCT DESIGN. BUYERS ARE RESPONSIBLE FOR THEIR PRODUCTS AND APPLICATIONS USING NATIONAL COMPONENTS. PRIOR TO USING OR DISTRIBUTING ANY PRODUCTS THAT INCLUDE NATIONAL COMPONENTS, BUYERS SHOULD PROVIDE ADEQUATE DESIGN, TESTING AND OPERATING SAFEGUARDS.

EXCEPT AS PROVIDED IN NATIONAL'S TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, NATIONAL ASSUMES NO LIABILITY WHATSOEVER, AND NATIONAL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY RELATING TO THE SALE AND/OR USE OF NATIONAL PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS PRIOR WRITTEN APPROVAL OF THE CHIEF EXECUTIVE OFFICER AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

Life support devices or systems are devices which (a) are intended for surgical implant into the body, or (b) support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in a significant injury to the user. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system or to affect its safety or effectiveness.

National Semiconductor and the National Semiconductor logo are registered trademarks of National Semiconductor Corporation. All other brand or product names may be trademarks or registered trademarks of their respective holders.

Copyright© 2008 National Semiconductor Corporation

For the most current product information visit us at www.national.com



**National Semiconductor
Americas Technical
Support Center**
Email:
new.feedback@nsc.com
Tel: 1-800-272-9959

**National Semiconductor Europe
Technical Support Center**
Email: europe.support@nsc.com
German Tel: +49 (0) 180 5010 771
English Tel: +44 (0) 870 850 4288

**National Semiconductor Asia
Pacific Technical Support Center**
Email: ap.support@nsc.com

**National Semiconductor Japan
Technical Support Center**
Email: jpn.feedback@nsc.com