National Semiconductor

April 10, 2008

LM136A-5.0/LM136-5.0QML 5.0V Reference Diode

General Description

The LM136A-5.0/LM136-5.0 integrated circuits are precision 5.0V shunt regulator diodes. These monolithic IC voltage references operate as a low temperature coefficient 5.0V zener with 0.6Ω dynamic impedance. A third terminal on the LM136-5.0 allows the reference voltage and temperature coefficient to be trimmed easily.

The LM136-5.0 series is useful as a precision 5.0V low voltage reference for digital voltmeters, power supplies or op amp circuitry. The 5.0V makes it convenient to obtain a stable reference from low voltage supplies. Further, since the LM136-5.0 operates as a shunt regulator, it can be used as either a positive or negative voltage reference.

Features

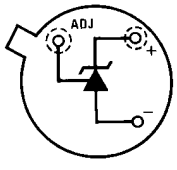
- Adjustable 4V to 6V
- Low temperature coefficient
- Wide operating current of 600 µA to 10 mA
- 0.6Ω dynamic impedance
- Guaranteed temperature stability
- Easily trimmed for minimum temperature drift
- Fast turn-on
- Three lead transistor package

Ordering Information

NS Part Number	SMD Part Number	NS Package Number	Package Description
LM136H-5.0/883		H03H	T0-46, 3LD Metal Can
LM136AH-5.0/883		H03H	T0-46, 3LD Metal Can
LM136AH-5.0-SMD	8418002XA	H03H	T0-46, 3LD Metal Can

Connection Diagram

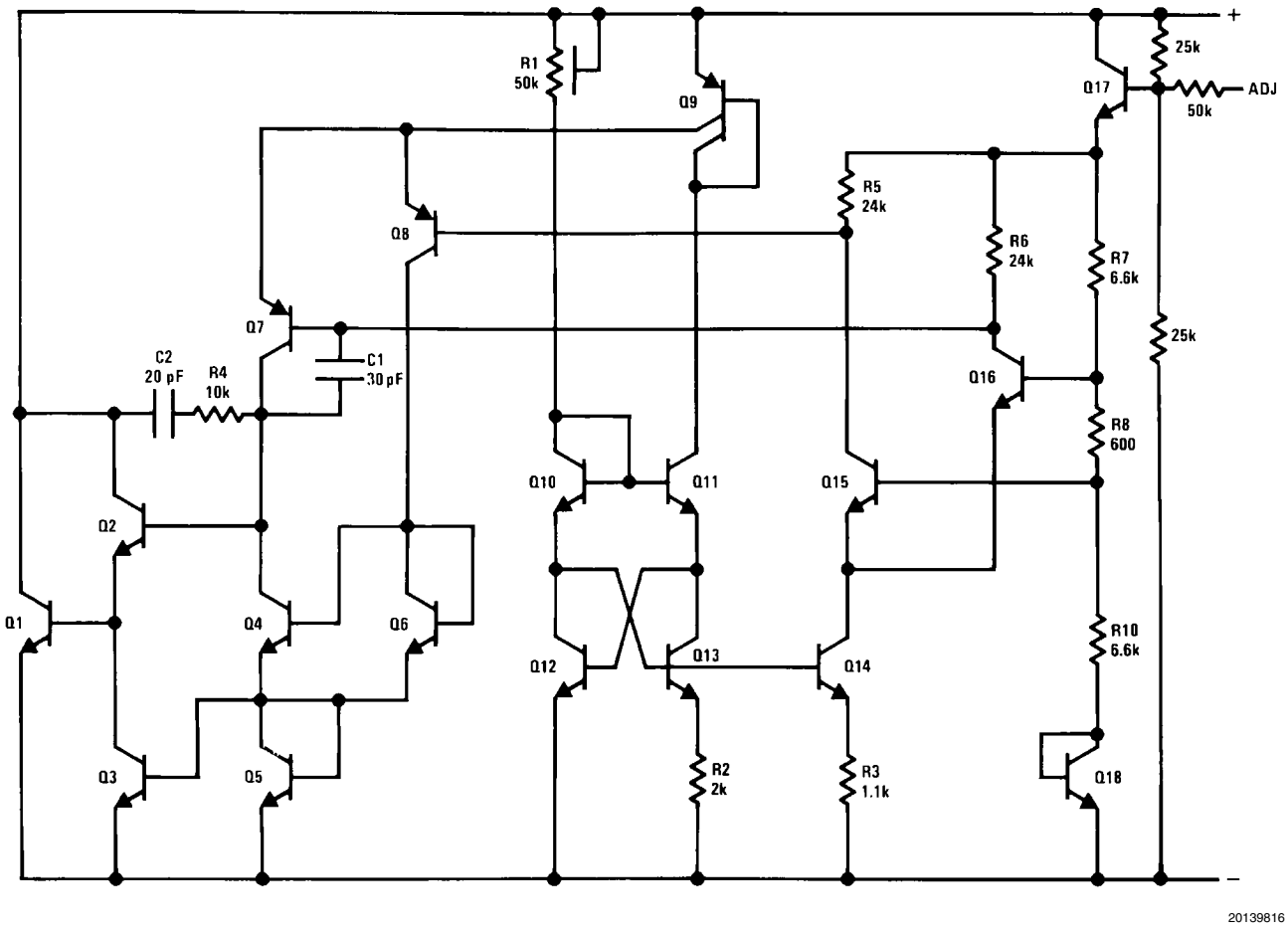
TO-46
Metal Can Package



20139805

Bottom View
See NS Package Number H03H

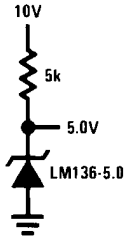
Schematic Diagram



20139816

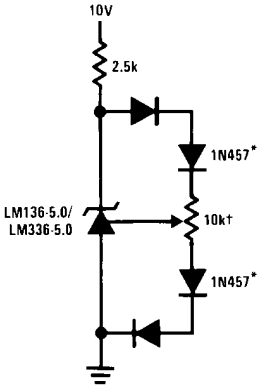
Typical Applications

5.0V Reference



20139801

5.0V Reference with Minimum Temperature Coefficient

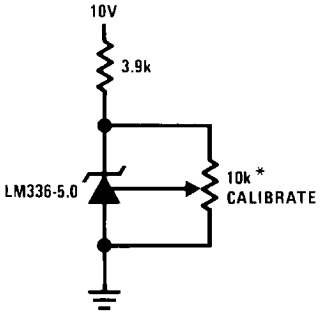


20139815

† Adjust to 5.00V

* Any silicon signal diode

Trimmed 4V to 6V Reference with Temperature Coefficient Independent of Breakdown Voltage



20139803

* Does not affect temperature coefficient

Absolute Maximum Ratings (Note 1)

Reverse Current	15mA
Forward Current	15mA
Storage Temperature	$-60°C \le T_A \le +150°C$
Operating Temperature Range (Note 2)	$-55°C \le T_A \le +125°C$
Soldering Information (10 Seconds)	300°C
Maximum Junction Temperature (T_{Jmax})	150°C
Thermal Resistance	
θ_{JA}	
Still Air Flow	354°C/W
500LF/Min Air Flow	77°C/W
θ_{JC}	46°C/W
ESD Rating (Note 3)	1,000 V

Quality Conformance Inspection

Mil-Std-883, Method 5005 - Group A

Subgroup	Description	Temp°C
1	Static tests at	25
2	Static tests at	125
3	Static tests at	-55
4	Dynamic tests at	25
5	Dynamic tests at	125
6	Dynamic tests at	-55
7	Functional tests at	25
8A	Functional tests at	125
8B	Functional tests at	-55
9	Switching tests at	25
10	Switching tests at	125
11	Switching tests at	-55
12	Settling time at	25
13	Settling time at	125
14	Settling time at	-55

LM136-5.0 Electrical Characteristics

DC Parameters

The following conditions apply, unless otherwise specified. I_R = 1 mA

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
V_R	Reverse Breakdown Voltage	V_{Adj} = 2.5V		4.6	5.4	V	1
				4.8	5.6	V	2, 3
		V_{Adj} = 1.5V		5.4	6.6	V	1
				5.6	6.8	V	2, 3
		V_{Adj} = 3.5V		2.4	4.6	V	1
				2.8	4.8	V	2, 3
		V_{Adj} = Open		4.878	5.081	V	1
				4.83	5.13	V	2, 3
I_{Adj}	Adjust Current	V_{Adj} = 2.5V		-260	260	µA	1
		V_{Adj} = 1.5V		-260	260	µA	1
		V_{Adj} = 3.5V		-260	260	µA	1
Delta V_R	Reverse Breakdown Change with Current	0.6mA ≤ I_R ≤ 15 mA		-12	12	mV	1
				-20	20	mV	2, 3
V_F	Foward Voltage	I_R = -10mA		-1.5	-0.49	V	1
V_{Stab}	Temperature Stability	V_R = Adjusted to 5V			36	mV	2, 3
Z_{RD}	Reverse Dynamic Impedance		(Note 4)		1.6	Ω	1, 2, 3

LM136A–5.0 Electrical Characteristics

DC Parameters

The following conditions apply, unless otherwise specified. I_R = 1 mA

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
V_R	Reverse Breakdown Voltage	V_{Adj} = 2.5V		4.6	5.4	V	1
				4.8	5.6	V	2, 3
		V_{Adj} = 1.5V		5.4	6.6	V	1
				5.6	6.8	V	2, 3
		V_{Adj} = 3.5V		2.4	4.6	V	1
				2.8	4.8	V	2, 3
		V_{Adj} = Open		4.935	5.029	V	1
				4.88	5.08	V	2, 3
I_{Adj}	Adjust Current	V_{Adj} = 2.5V		-260	260	µA	1
		V_{Adj} = 1.5V		-260	260	µA	1
		V_{Adj} = 3.5V		-260	260	µA	1
Delta V_R	Reverse Breakdown Change with Current	0.6mA ≤ I_R ≤ 15 mA		-12	12	mV	1
				-20	20	mV	2, 3
V_F	Foward Voltage	I_R = -10mA		-1.5	-0.49	V	1
V_{Stab}	Temperature Stability	V_R = Adjusted to 5V			36	mV	2, 3
Z_{RD}	Reverse Dynamic Impedance		(Note 4)		1.6	Ω	1, 2, 3

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. For guaranteed specifications and test conditions, see the Electrical Characteristics. The guaranteed specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.

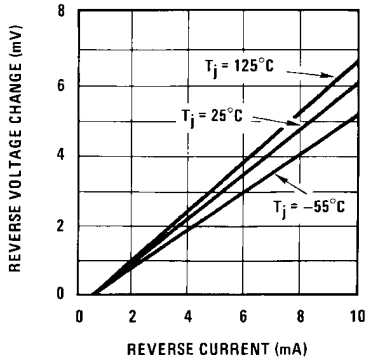
Note 2: The maximum power dissipation must be derated at elevated temperatures and is dictated by T_{Jmax} (maximum junction temperature), θ_{JA} (package junction to ambient thermal resistance), and T_A (ambient temperature). The maximum allowable power dissipation at any temperature is $P_{Dmax} = (T_{Jmax} - T_A)/\theta_{JA}$ or the number given in the Absolute Maximum Ratings, whichever is lower.

Note 3: Human body model, 100pF discharged through 1.5KΩ

Note 4: Guaranteed, not tested.

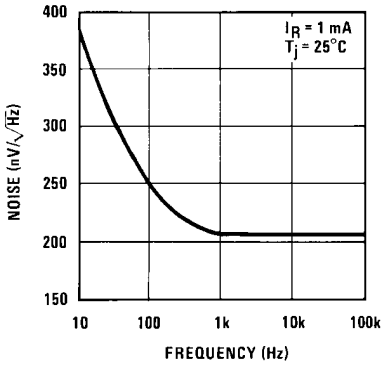
Typical Performance Characteristics

Reverse Voltage Change



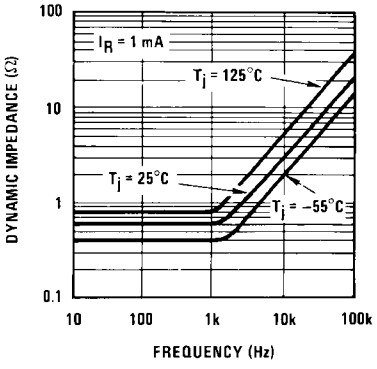
20139817

Zener Noise Voltage



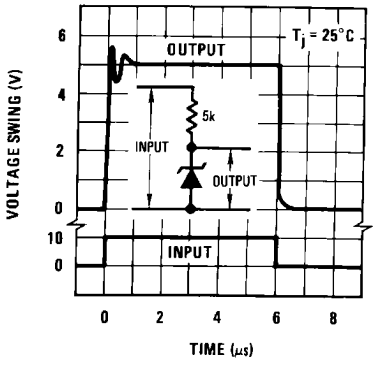
20139818

Dynamic Impedance



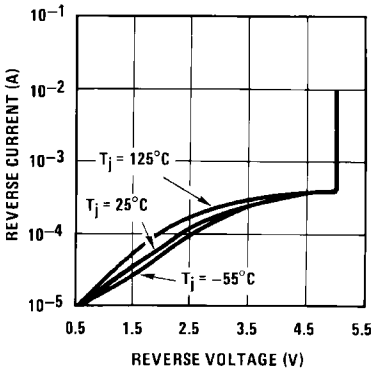
20139819

Response Time



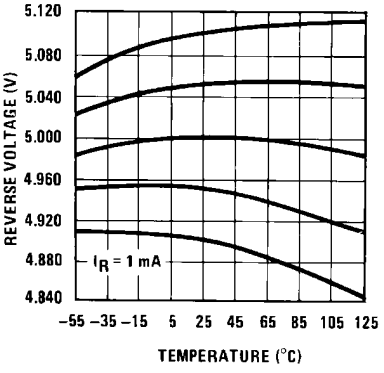
20139820

Reverse Characteristics



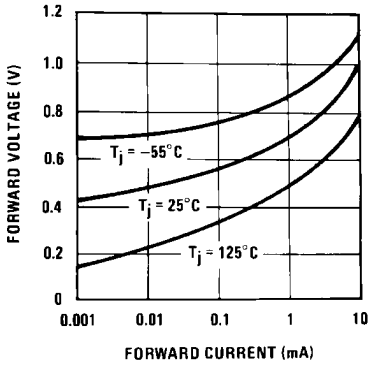
20139821

Temperature Drift



20139822

Forward Characteristics



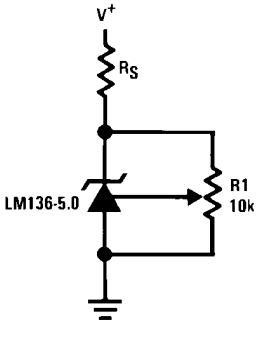
20139823

Application Hints

The LM136-5.0 series voltage references are much easier to use than ordinary zener diodes. Their low impedance and wide operating current range simplify biasing in almost any circuit. Further, either the breakdown voltage or the temperature coefficient can be adjusted to optimize circuit performance.

Figure 1 shows an LM136-5.0 with a 10k potentiometer for adjusting the reverse breakdown voltage. With the addition of R1 the breakdown voltage can be adjusted without affecting the temperature coefficient of the device. The adjustment range is usually sufficient to adjust for both the initial device tolerance and inaccuracies in buffer circuitry.

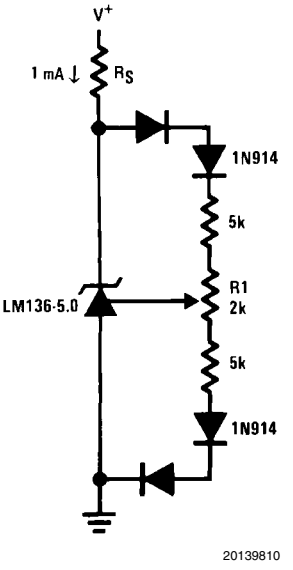
If minimum temperature coefficient is desired, four diodes can be added in series with the adjustment potentiometer as shown in *Figure 2*. When the device is adjusted to 5.00V the temperature coefficient is minimized. Almost any silicon signal diode can be used for this purpose such as a 1N914, 1N4148 or a 1N457. For proper temperature compensation the diodes should be in the same thermal environment as the LM136-5.0. It is usually sufficient to mount the diodes near the LM136-5.0 on the printed circuit board. The absolute resistance of the network is not critical and any value from 2k to 20k will work. Because of the wide adjustment range, fixed resistors should be connected in series with the pot to make pot setting less critical.



20139809

FIGURE 1. LM136-5.0 with Pot for Adjustment of

Breakdown Voltage (Trim Range = ±1.0V Typical)

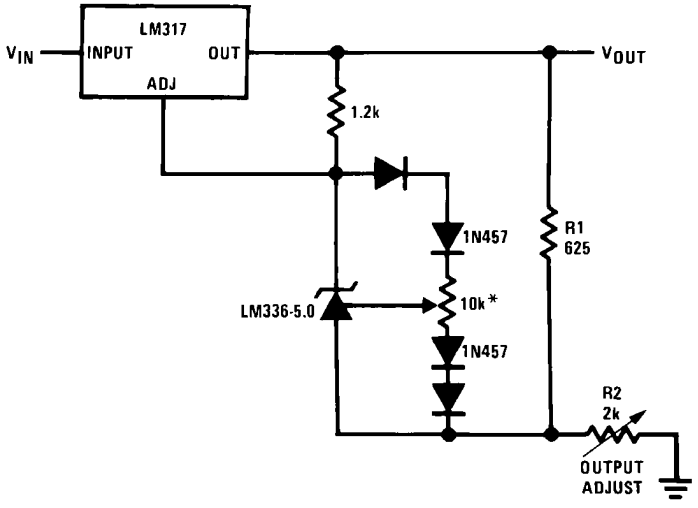


20139810

FIGURE 2. Temperature Coefficient Adjustment (Trim Range = ±0.5V Typical)

Typical Applications

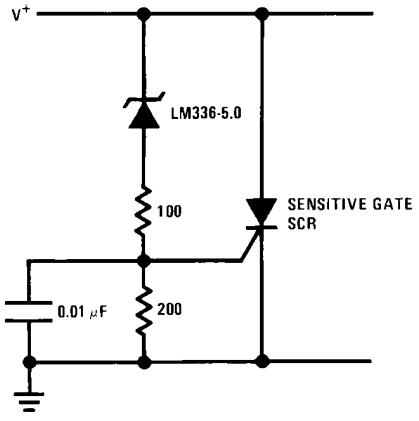
Precision Power Regulator with Low Temperature Coefficient



20139811

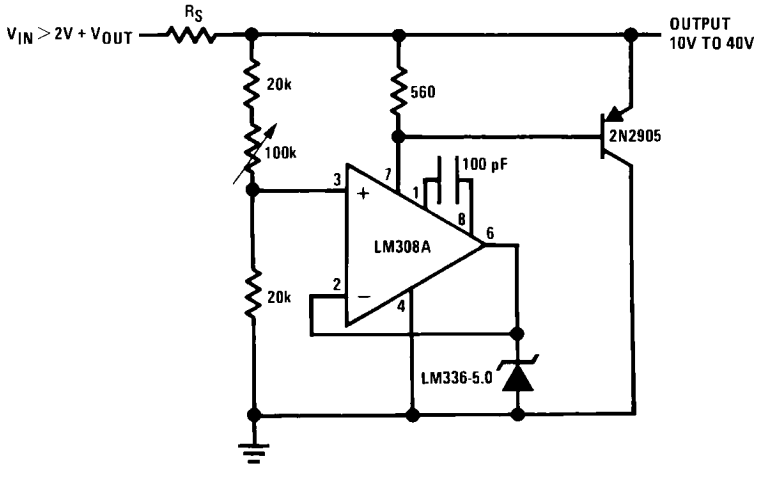
* Adjust for 6.25V across R1

5V Crowbar



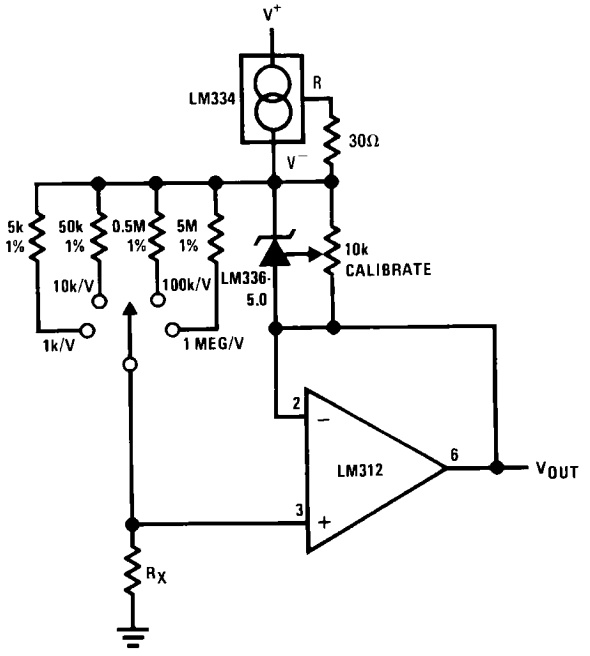
20139812

Adjustable Shunt Regulator



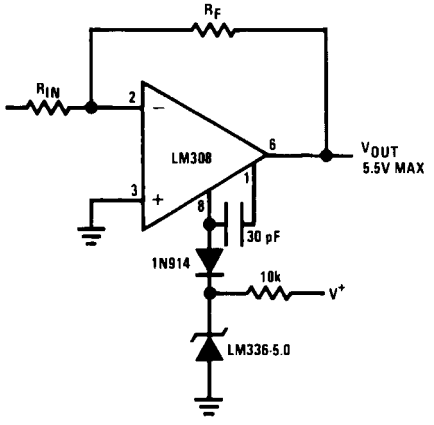
20139813

Linear Ohmmeter



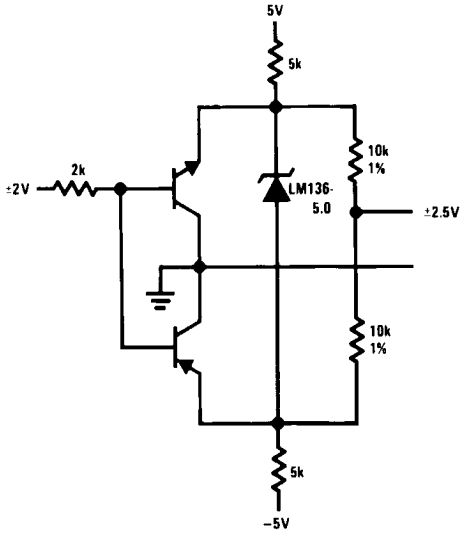
20139814

Op Amp with Output Clamped



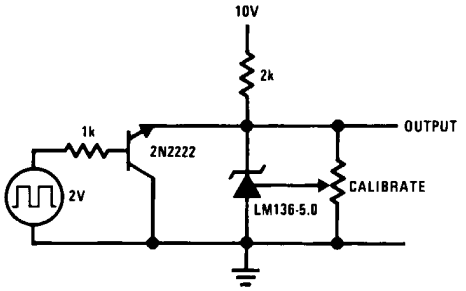
20139824

Bipolar Output Reference



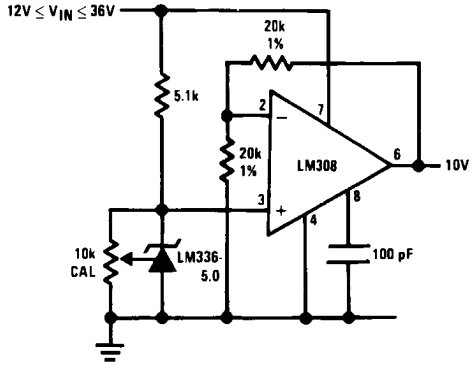
20139825

5.0V Square Wave Calibrator



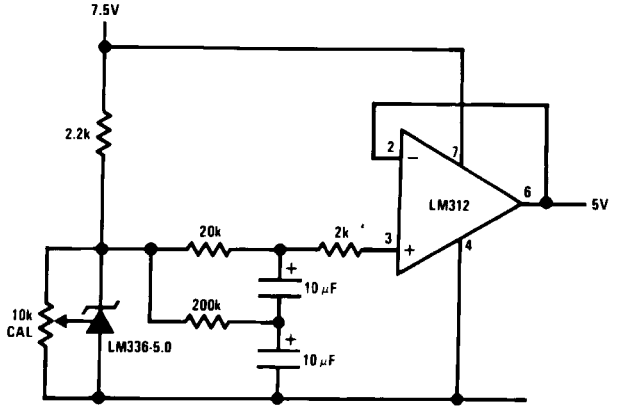
20139826

10V Buffered Reference



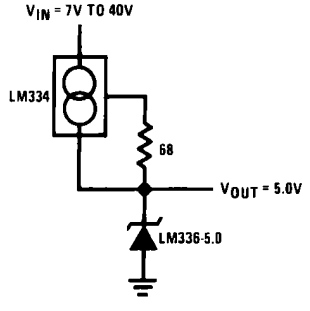
20139827

Low Noise Buffered Reference



20139828

Wide Input Range Reference

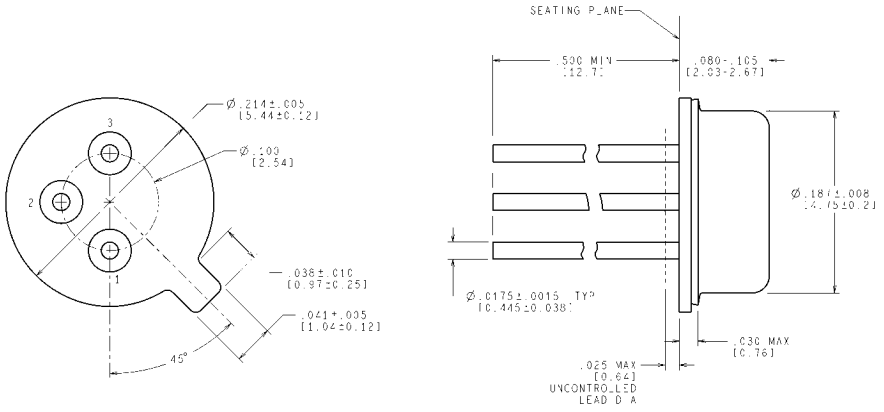


20139829

Revision History

Date Released	Revision	Section	Originator	Changes
04/10/08	A	New Release, Corporate format.	L. Lytle	2 MDS datasheets were converted into one Corporate datasheet format. MNLM136A-5.0-X Rev 0B0 & LM136-5.0-X Rev 0A0 MDS Data Sheets will be archived.

Physical Dimensions inches (millimeters) unless otherwise noted



CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE IN MILLIMETERS

H03H (Rev F)

TO-46 Metal Can Package (H)
NS Package Number H03H

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/ldo		
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		

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