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

Check for Samples: LM136-5.0QML, LM136A-5.0QML

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**

DESCRIPTION

The LM136A-5.0QML/LM136-5.0QML 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.

Connection Diagram

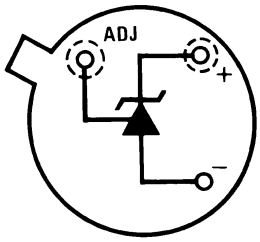

Figure 1. Bottom View
3-Lead TO
Metal Can Package
See NDV0003H Package

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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.

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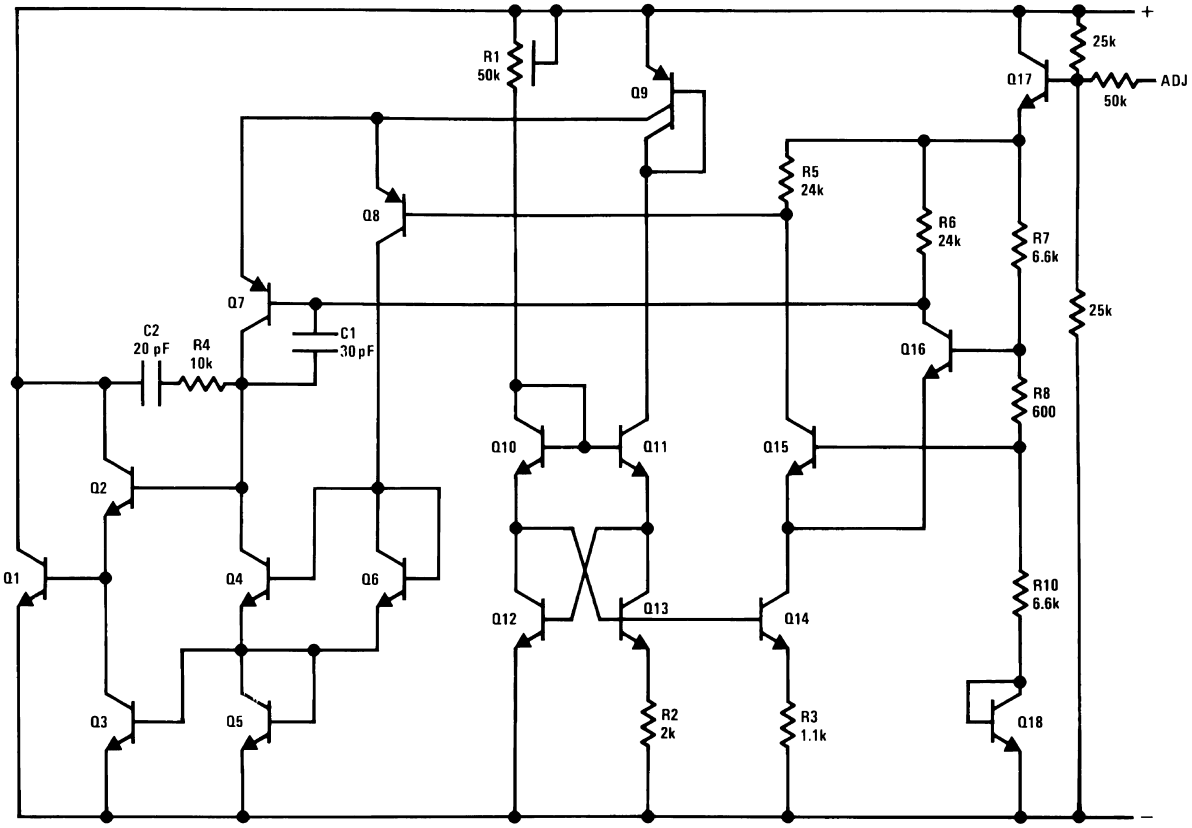
Schematic Diagram



Typical Applications

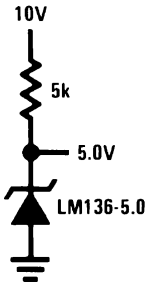


Figure 2. 5.0V Reference

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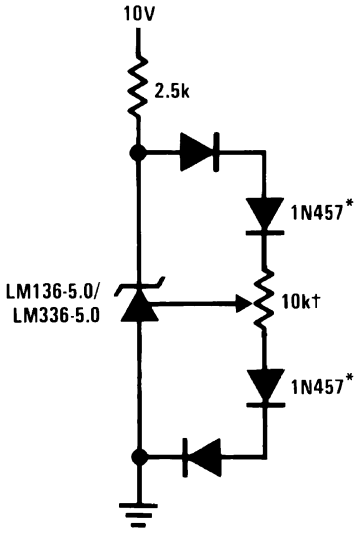
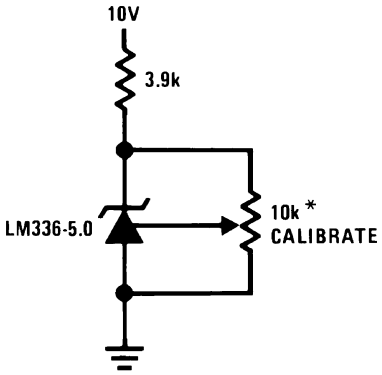


† Adjust to 5.00V
* Any silicon signal diode

Figure 3. 5.0V Reference with Minimum Temperature Coefficient



* Does not affect temperature coefficient

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

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.

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Absolute Maximum Ratings (1)

Reverse Current	15mA
Forward Current	15mA
Storage Temperature	−60°C ≤ T_A ≤ +150°C
Operating Temperature Range (2)	−55°C ≤ T_A ≤ +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 (3)	1,000 V

(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.

(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.

(3) Human body model, 100pF discharged through 1.5KΩ

Table 1. Quality Conformance Inspection (1)

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

(1) Mil-Std-883, Method 5005 - Group A

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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
ΔV_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		(1)		1.6	Ω	1, 2, 3

(1) Guaranteed, not tested.

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
ΔV_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		(1)		1.6	Ω	1, 2, 3

(1) Guaranteed, not tested.

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Typical Performance Characteristics

Reverse Voltage Change

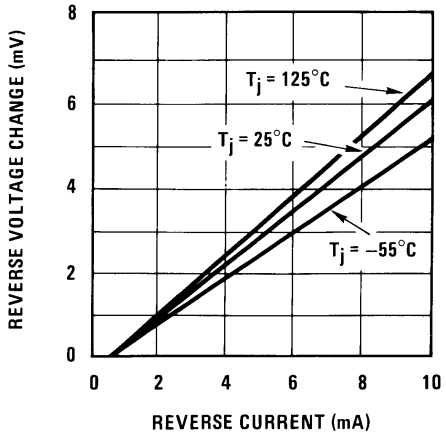

Figure 5.

Zener Noise Voltage

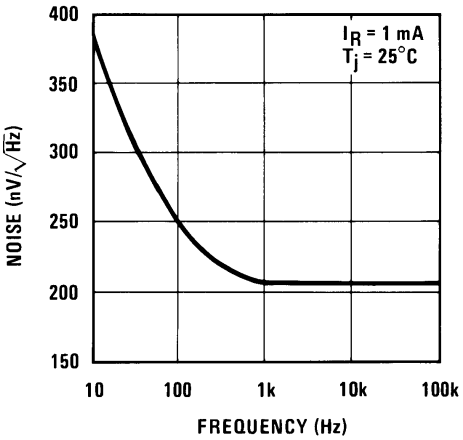

Figure 6.

Dynamic Impedance

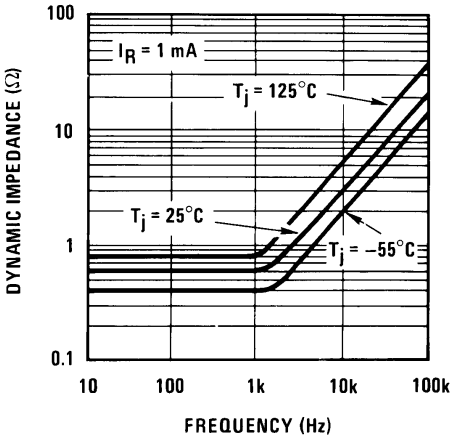

Figure 7.

Response Time

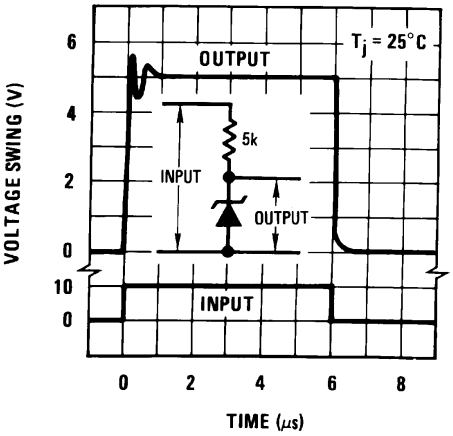

Figure 8.

Reverse Characteristics

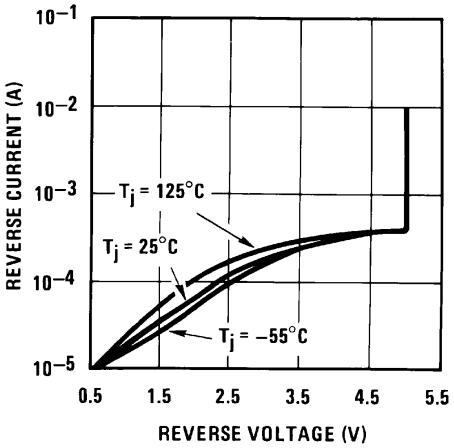

Figure 9.

Temperature Drift

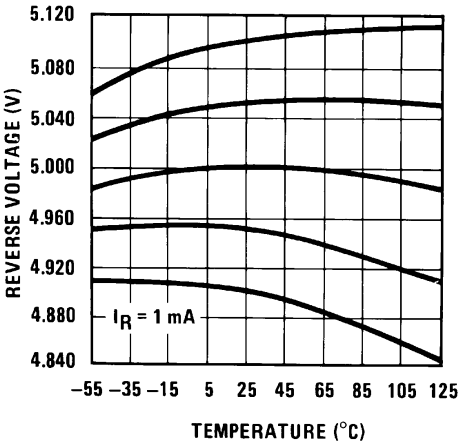

Figure 10.

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Typical Performance Characteristics (continued)

Forward Characteristics

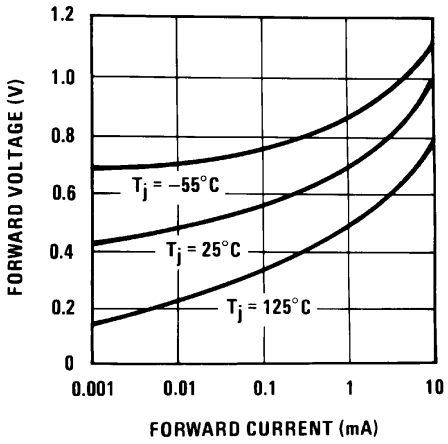

Figure 11.

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 12 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 13. 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.

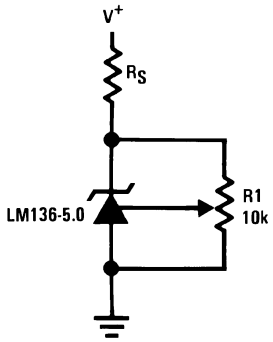

Figure 12. LM136-5.0 with Pot for Adjustment of Breakdown Voltage (Trim Range = ±1.0V Typical)

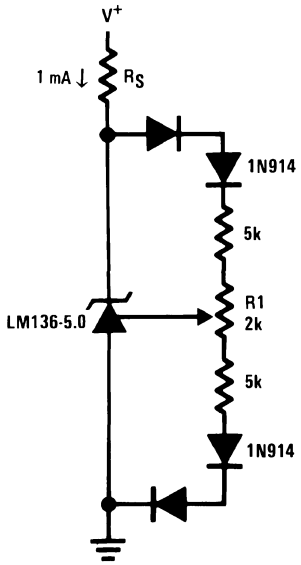

Figure 13. Temperature Coefficient Adjustment (Trim Range = ±0.5V Typical)

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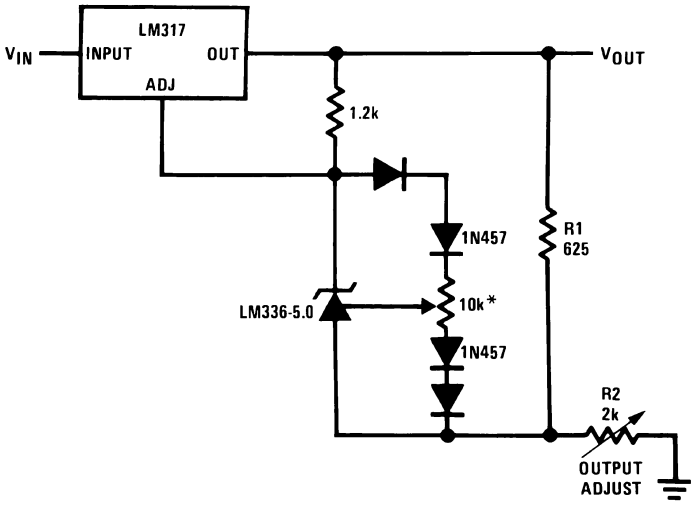
Typical Applications



* Adjust for 6.25V across R1

Figure 14. Precision Power Regulator with Low Temperature Coefficient

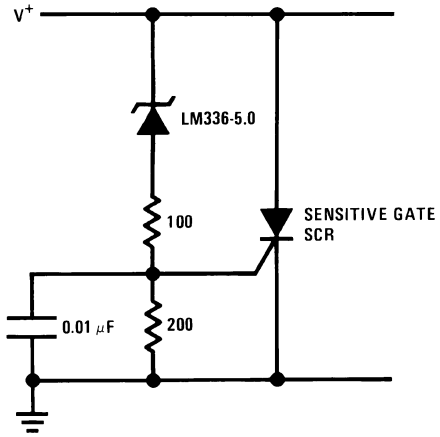


Figure 15. 5V Crowbar

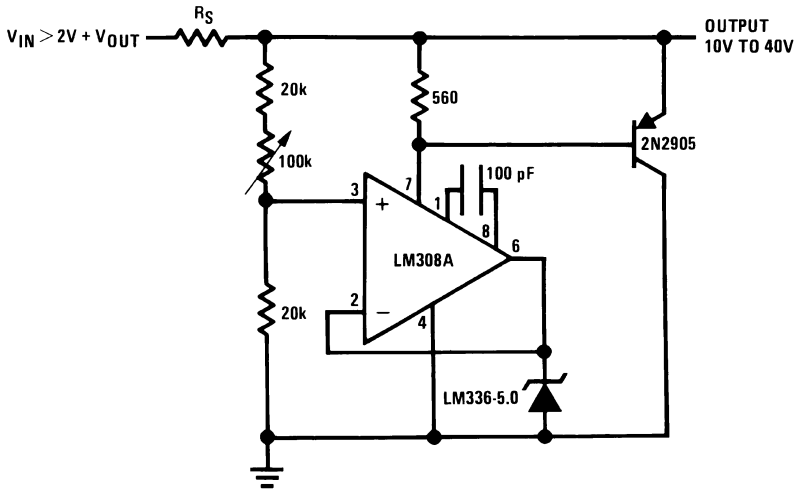


Figure 16. Adjustable Shunt Regulator

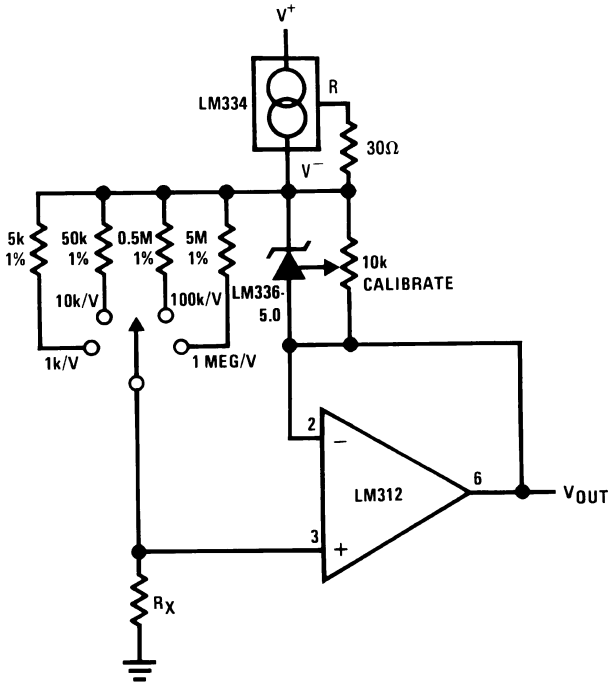


Figure 17. Linear Ohmmeter

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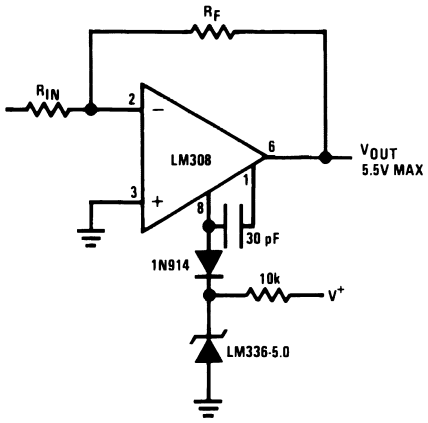

Figure 18. Bipolar Output Reference

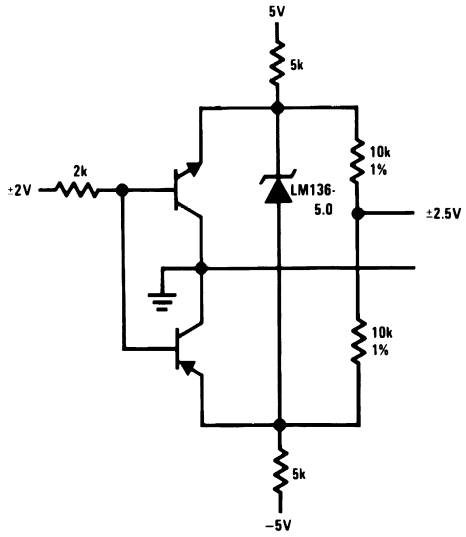

Figure 19. Bipolar Output Reference

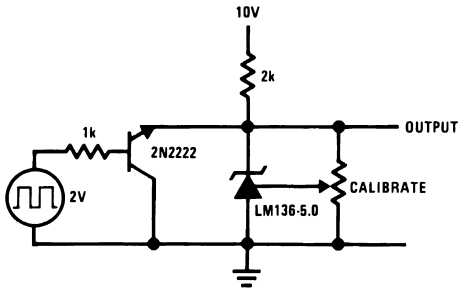

Figure 20. 5.0V Square Wave Calibrator

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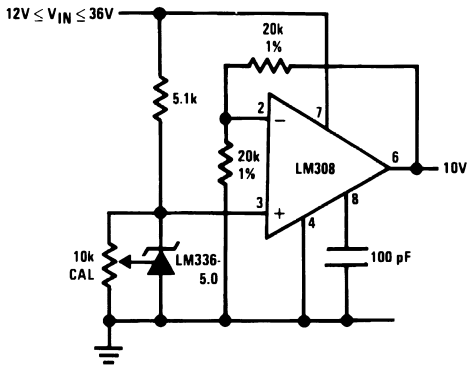

Figure 21. 10V Buffered Reference

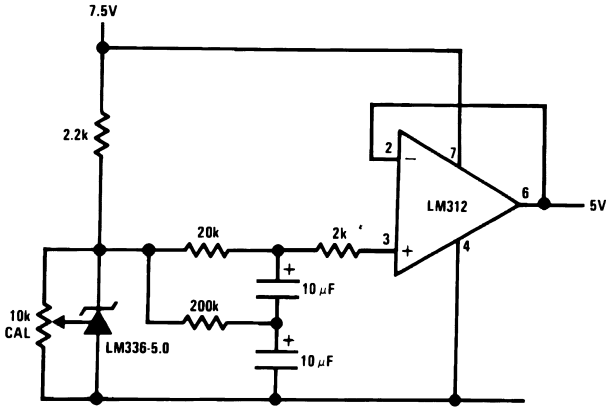

Figure 22. Low Noise Buffered Reference

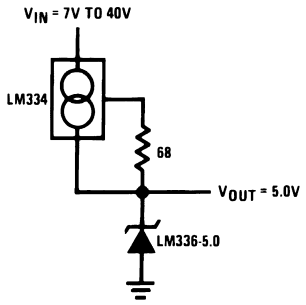

Figure 23. Wide Input Range Reference

Revision History

Date Released	Revision	Section	Changes
04/10/08	A	New Release, Corporate format	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.
10/26/2010	B	Data Sheet Title	Changed Title from LM136A-5.0/LM136–5.0QML to LM136A-5.0QML/LM136–5.0QML. Revision A will be Archived.

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PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
8418002XA	ACTIVE	TO	NDV	3	20	TBD	POST-PLATE	Level-1-NA-UNLIM	-55 to 125	8418002XA Q	Samples
LM136AH-5.0-SMD	ACTIVE	TO	NDV	3	20	TBD	POST-PLATE	Level-1-NA-UNLIM	-55 to 125	8418002XA Q	Samples
LM136AH-5.0/883	ACTIVE	TO	NDV	3	20	TBD	POST-PLATE	Level-1-NA-UNLIM	-55 to 125	LM136A-5.0 Q	Samples
LM136H-5.0/883	ACTIVE	TO	NDV	3	20	TBD	POST-PLATE	Level-1-NA-UNLIM	-55 to 125	LM136-5.0 Q	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.
OBSOLETE: 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.
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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) Only one of markings shown within the brackets will appear on the physical device.

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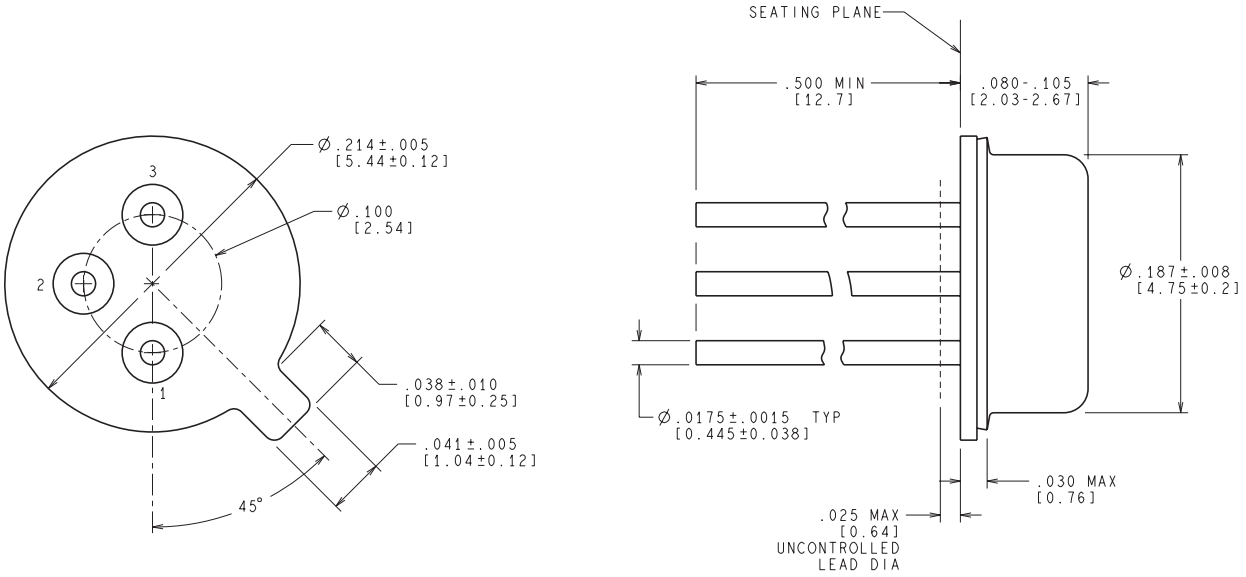
OTHER QUALIFIED VERSIONS OF LM136-5.0QML, LM136-5.0QML-SP :

- Military: LM136-5.0QML
- Space: LM136-5.0QML-SP

NOTE: Qualified Version Definitions:

- Military - QML certified for Military and Defense Applications
- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

NDV0003H



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