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National Semiconductor

October 26, 2010

LM136A-2.5QML

2.5V Reference Diode

General Description

The LM136A-2.5QML integrated circuit is a precision 2.5V shunt regulator diode. This monolithic IC voltage reference operates as a low-temperature-coefficient 2.5V zener with 0.2Ω dynamic impedance. A third terminal on the LM136A-2.5QML allows the reference voltage and temperature coefficient to be trimmed easily.

The LM136A-2.5QML is useful as a precision 2.5V low voltage reference for digital voltmeters, power supplies or op amp circuitry. The 2.5V make it convenient to obtain a stable reference from 5V logic supplies. Further, since the LM136A-2.5QML operates as a shunt regulator, it can be used as either a positive or negative voltage reference.

Features

- Available with radiation guarantee
  - — Total Ionizing Dose 100 krad(Si)
  - — ELDRS Free 100 krad(Si)
- Low temperature coefficient
- Wide operating current of 400 µA to 10 mA
- Guaranteed temperature stability
- Easily trimmed for minimum temperature drift
- Fast turn-on
- 3–lead transistor package

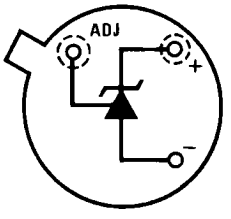
Ordering Information

NS Part Number	SMD Part Number	NS Package Number	Package Description
LM136AH-2.5/883		H03H	T0-46, 3LD Metal Can
LM136AH-2.5RQV (*Note 6*)	5962R0050101VXA 100 krad(Si)	H03H	T0-46, 3LD Metal Can
LM136AH-2.5RLQV (*Note 7*) **ELDRS Free**	5962R0050102VXA 100 krad(Si)	H03H	T0-46, 3LD Metal Can
LM136-2.5 MDE (*Note 7*) **ELDRS Free**	5962R0050102V9A 100 krad(Si)	(*Note 1*)	Bare Die
LM136-2.5 MDR (*Note 6*)	5962R0050101V9A 100 krad(Si)	(*Note 1*)	Bare Die

Note 1: FOR ADDITIONAL DIE INFORMATION, PLEASE VISIT THE HI REL WEB SITE AT: www.national.com/analog/space/level_die

Connection Diagram

TO-46
Metal Can Package



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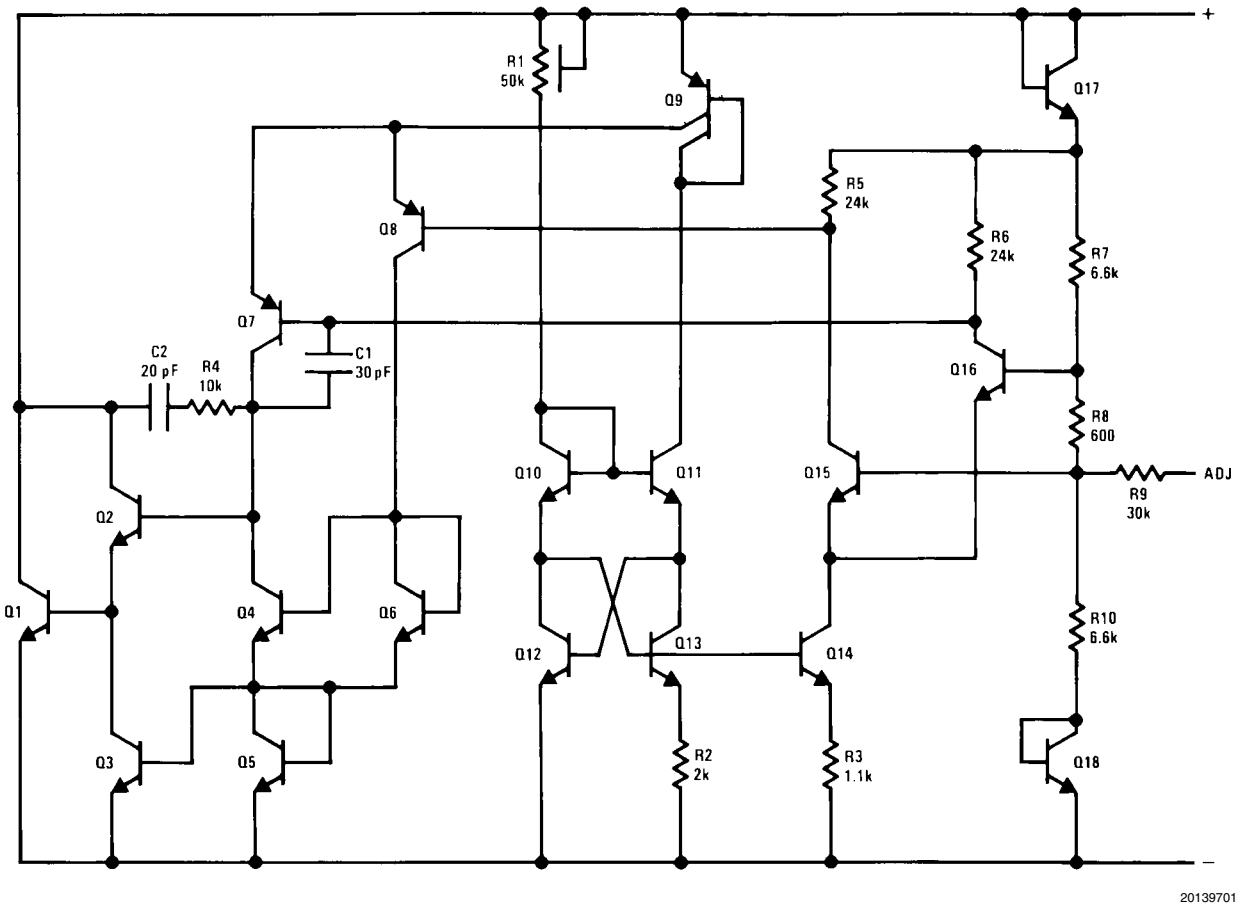
Bottom View
See NS Package Number H03H

Schematic Diagram



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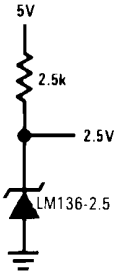
Typical Applications

2.5V Reference



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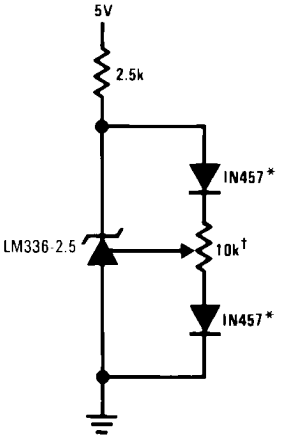
2.5V Reference with Minimum Temperature Coefficient



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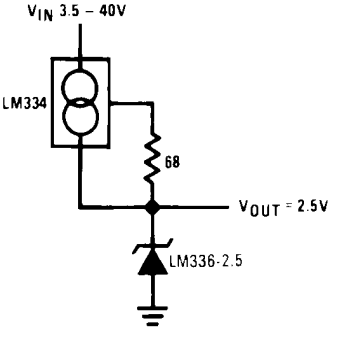
†Adjust to 2.490V

*Any silicon signal diode

Wide Input Range Reference



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Absolute Maximum Ratings (*Note 2*)

Reverse Current	15 mA
Forward Current	10 mA
Storage Temperature	$-60°C \leq T_A \leq +150°C$
Operating Temperature Range (*Note 3*)	$-55°C \leq T_A \leq +125°C$
Maximum Junction Temperature (T_J) (*Note 3*)	+150°C
Lead Temperature (Soldering 10 seconds)	300°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 4*)	1,000V

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

LM136A-2.5QML Electrical Characteristics

DC Parameters

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

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
I_{Adj}	Adjust Current	V_{Adj} = 0.7V		-125	+125	µA	1, 2, 3
ΔV_Z	Delta Zener Voltage	0.4mA ≤ I_Z ≤ 10 mA			6.0	mV	1
					10	mV	2, 3
V_Z	Zener Voltage	V_{Adj} = Open		2.465	2.515	V	1
				2.44	2.54	V	2, 3
		V_{Adj} = 0.7V		2.39	2.49	V	1
				2.29	2.49	V	2, 3
		V_{Adj} = 1.9V		2.49	2.69	V	1, 2, 3
Z_{RD}	Reverse Dynamic Impedance		(*Note 5*)		0.6	Ω	1
			(*Note 5*)		1.0	Ω	2, 3
V_{Stab}	Temperature Stability	V_Z = Adjusted to 2.490V			18	mV	2, 3

DC Drift Parameters

Delta calculations are performed on QMLV devices at Group B, Subgroup 5 only.

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
V_Z	Zener Voltage	V_{Adj} = Open		−10	+10	mV	1
		V_{Adj} = 0.7V		−10	+10	mV	1
		V_{Adj} = 1.9V		−10	+10	mV	1

Note 2: 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 3: 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 4: Human body model, 1.5KΩ in series with 100pF.

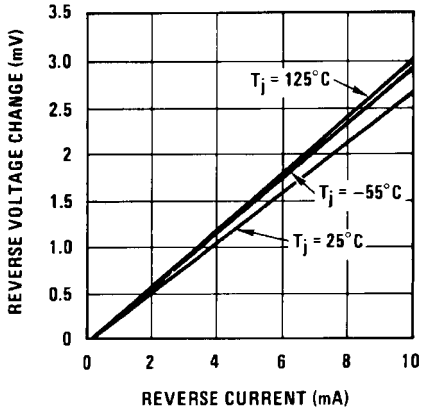
Note 5: Parameter tested go-no-go only.

Note 6: Pre and post irradiation limits are identical to those listed under DC electrical characteristics. These parts may be dose rate sensitive in a space environment and may demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are guaranteed only for the conditions as specified in Mil-Std-883, Method 1019.

Note 7: Low dose rate testing has been performed on a wafer-by-wafer basis, per test method 1019 condition D of MIL-STD-883, with no enhanced low dose rate sensitivity (ELDRS) effect.

Typical Performance Characteristics

Reverse Voltage Change



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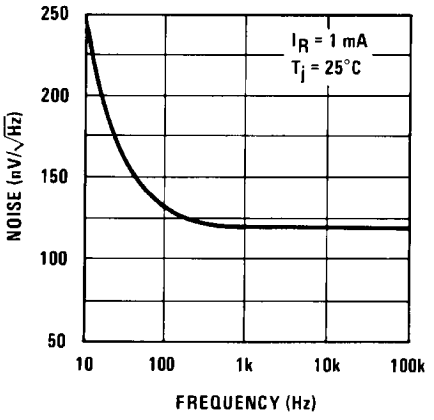
Zener Noise Voltage



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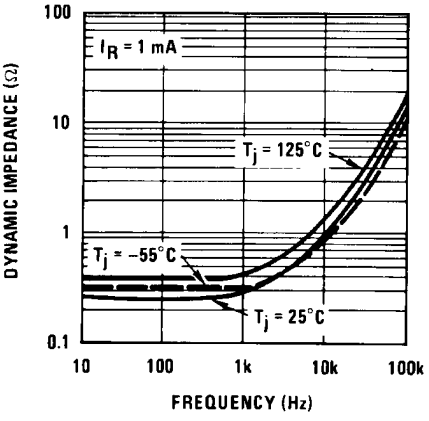
Dynamic Impedance



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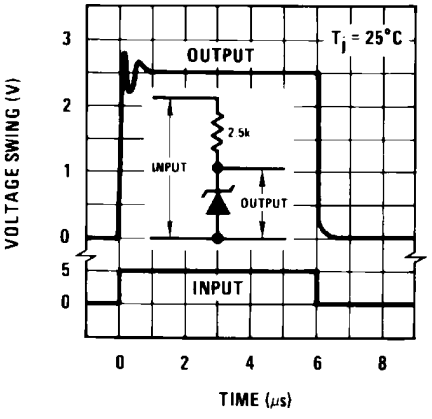
Response Time



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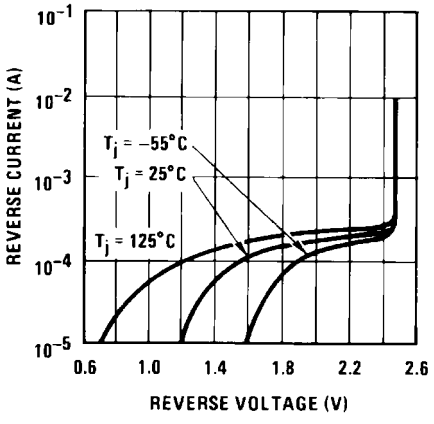
Reverse Characteristics



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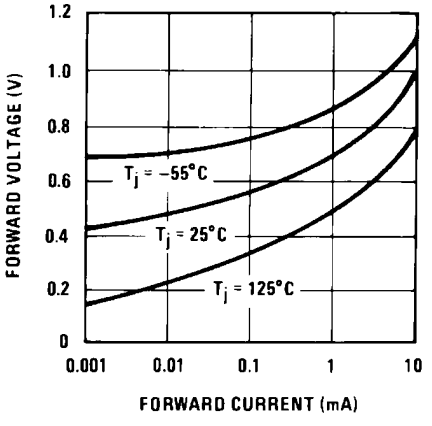
Forward Characteristics



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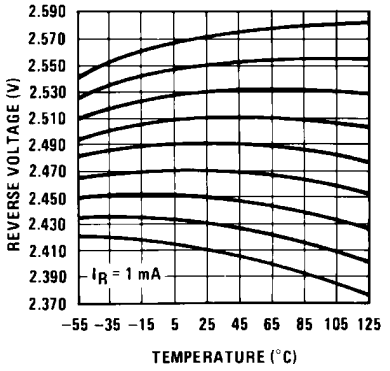
Temperature Drift



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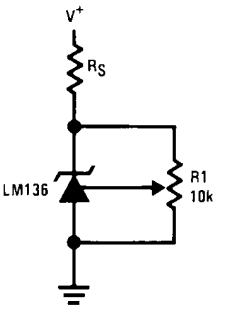

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FIGURE 1. LM136 With Pot for Adjustment of Breakdown Voltage (Trim Range = ±120 mV typical)

Application Hints

The LM136 voltage reference is much easier to use than ordinary zener diodes. It's 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 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, two diodes can be added in series with the adjustment potentiometer as shown in *Figure 2*. When the device is adjusted to 2.490V 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. It is usually sufficient to mount the diodes near the LM136 on the printed circuit board. The absolute resistance of R1 is not critical and any value from 2k to 20k will work.

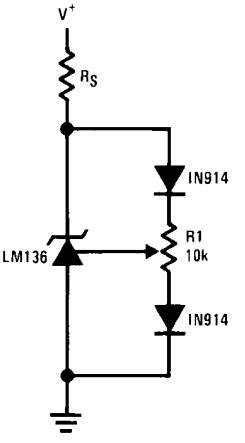

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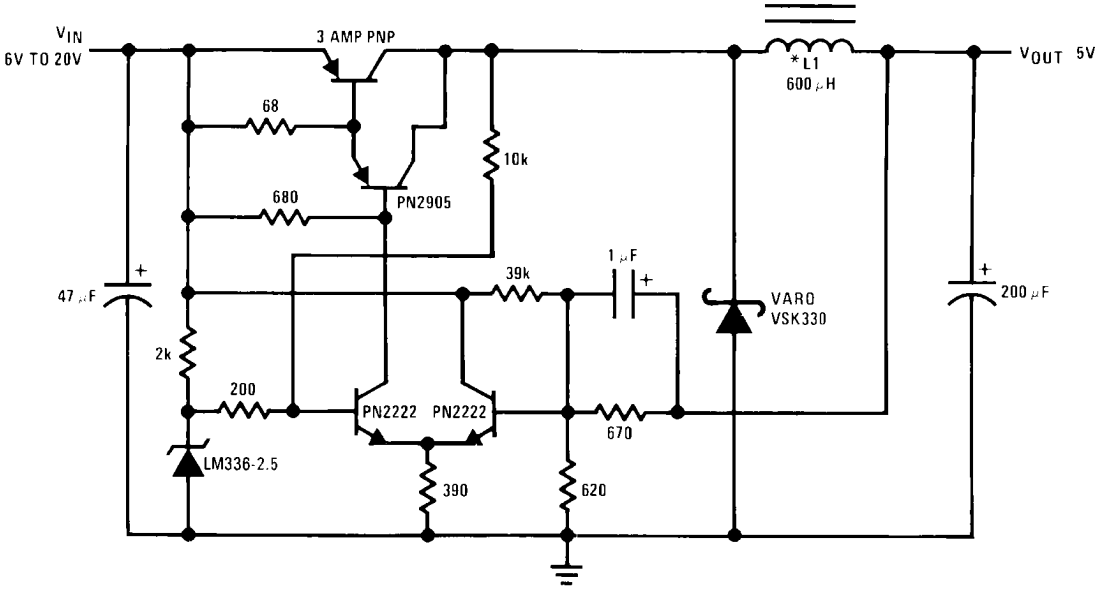
FIGURE 2. Temperature Coefficient Adjustment (Trim Range = ±70 mV typical)

Low Cost 2 Amp Switching Regulator†



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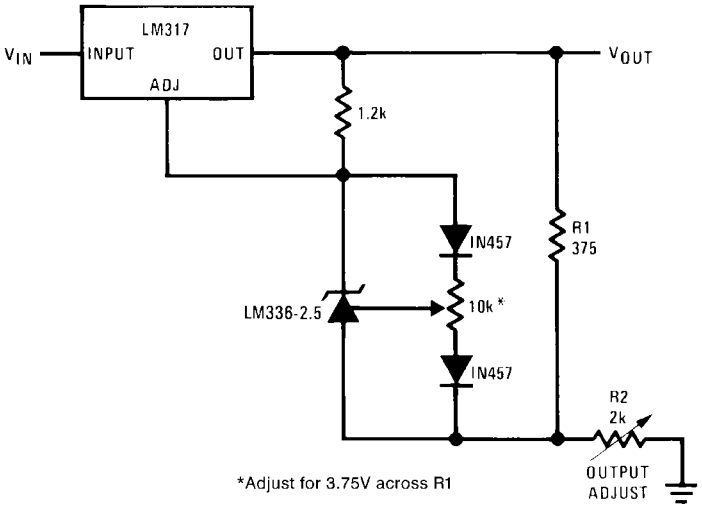
*L1 60 turns #16 wire on Arnold Core A-254168-2

†Efficiency ≈ 80%

Precision Power Regulator with Low Temperature Coefficient



*Adjust for 3.75V across R1

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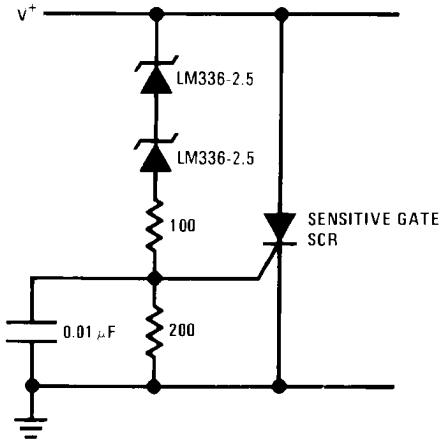
5V Crowbar



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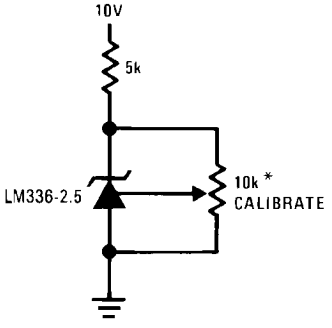
Trimmed 2.5V Reference with Temperature Coefficient Independent of Breakdown Voltage



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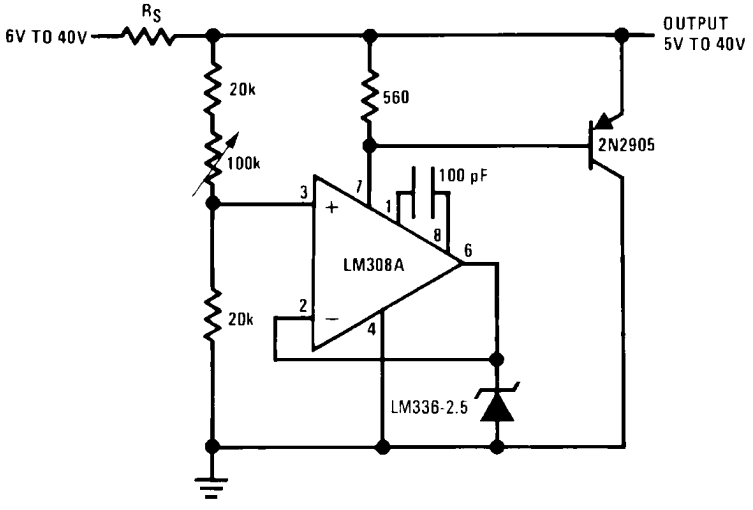
*Does not affect temperature coefficient

Adjustable Shunt Regulator



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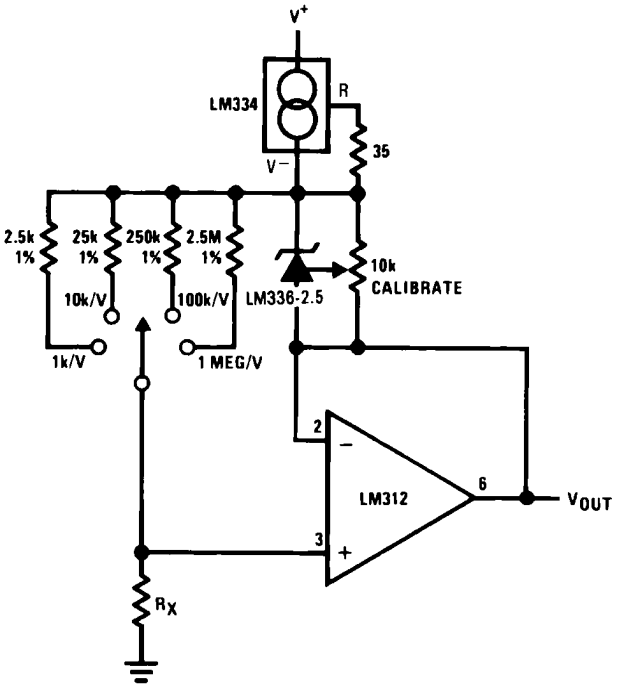
Linear Ohmmeter



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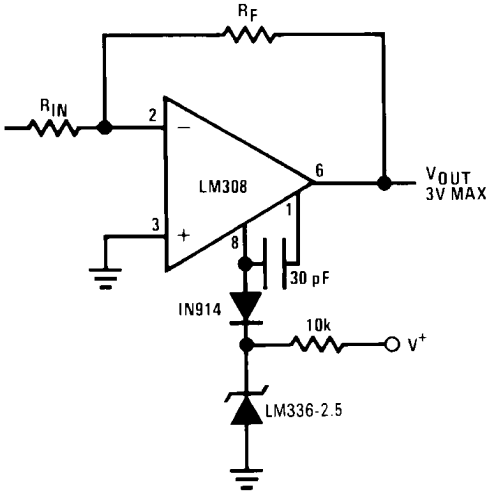
Op Amp with Output Clamped



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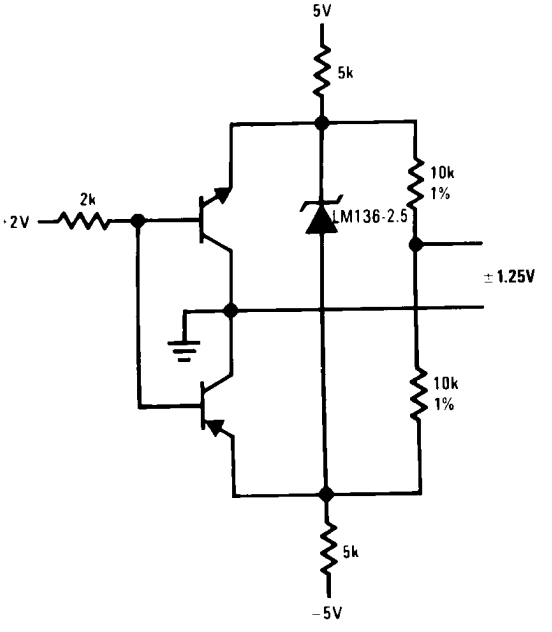
Bipolar Output Reference



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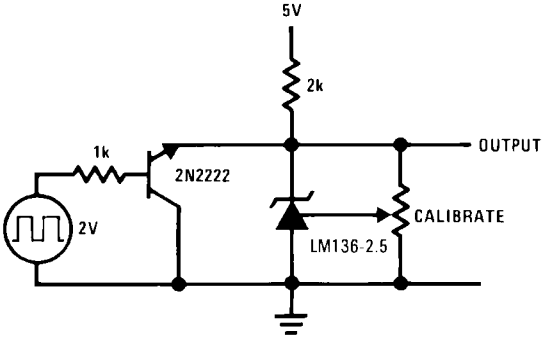
2.5V Square Wave Calibrator



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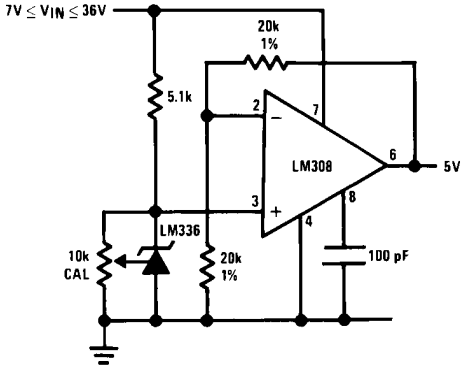
5V Buffered Reference



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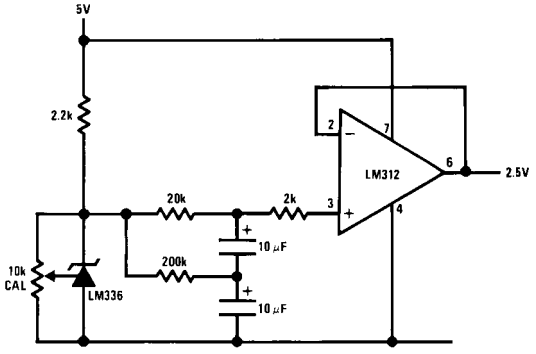
Low Noise Buffered Reference



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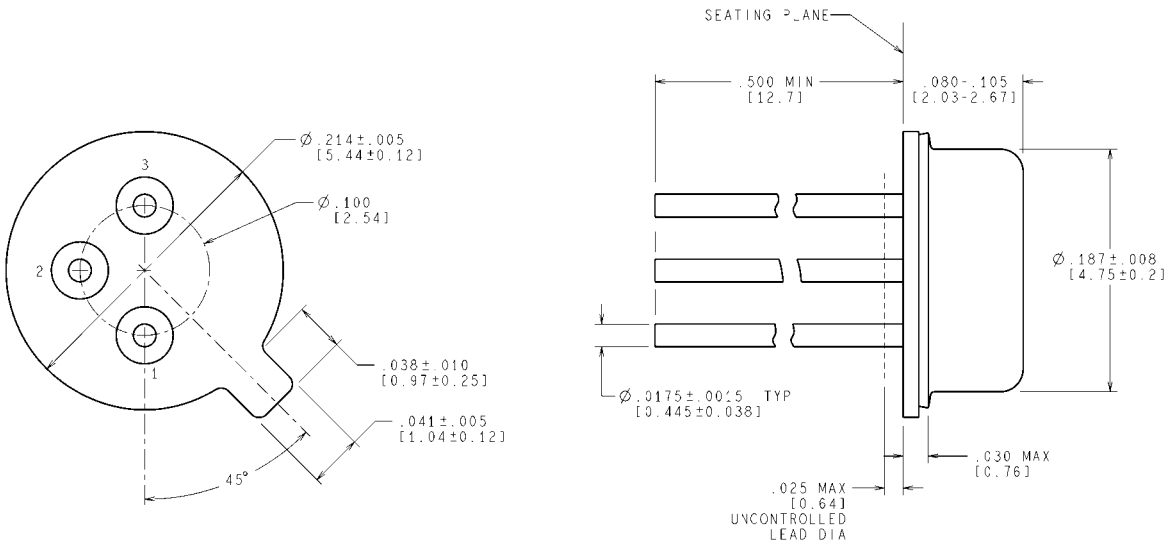
Revision History

Date Released	Revision	Section	Changes
07/06/07	A	New Release, Corporate format	2 MDS datasheets converted into one corporate datasheet format. MNLM136–2.5–X Rev 0A0 and MNLM136A-2.5–X-RH. The ELDRS Part has also been added. Rev. 0E0 will be archived.
10/16/2010	B	Data Sheet Title, General Description, Order Information, Electrical Characteristics, Application Hints	Update with current device information and format. Removed all references to the LM136-2.5 Non “A” package NSID no longer offered. Added Die NSID's to data sheet. Revision A will be Archived.

Physical Dimensions inches (millimeters) unless otherwise noted



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H03H (Rev F)

NS Package Number H03H

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