LM136-2.5-N, LM236-2.5-N, LM336-2.5-NV Reference Diode

Check for Samples: LM136-2.5-N

FEATURES

- **Low Temperature Coefficient**
- **Wide Operating Current of 400 μA to 10 mA**
- **0.2Ω Dynamic Impedance**
- **±1% Initial Tolerance Available**
- **Specified Temperature Stability**
- **Easily Trimmed for Minimum Temperature Drift**
- **Fast Turn-On**

DESCRIPTION

The LM136-2.5-N/LM236-2.5-N and LM336-2.5-N integrated circuits are precision 2.5V shunt regulator diodes. These monolithic IC voltage references operate as a low-temperature-coefficient 2.5V zener with 0.2Ω dynamic impedance. A third terminal on the LM136-2.5-N allows the reference voltage and temperature coefficient to be trimmed easily.

The LM136-2.5-N series 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 LM136-2.5-N operates as a shunt regulator, it can be used as either a positive or negative voltage reference.

The LM136-2.5-N is rated for operation over −55°C to +125°C while the LM236-2.5-N is rated over a −25°C to +85°C temperature range.

The LM336-2.5-N is rated for operation over a 0°C to +70°C temperature range. See the connection diagrams for available packages.

Connection Diagram

TO-92 Plastic Package

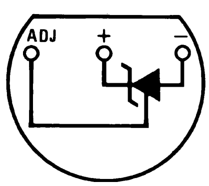


Figure 1. Bottom View
See Package Number LP

TO Metal Can Package

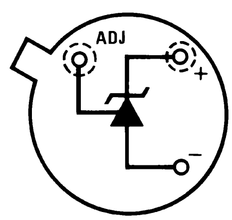


Figure 2. Bottom View
See Package Number NDV

SOIC Package

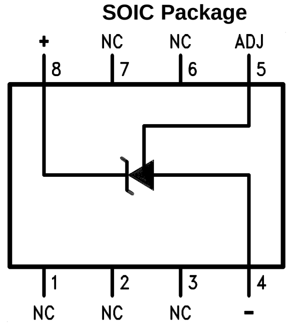


Figure 3. Top View
See Package Number D

Typical Applications

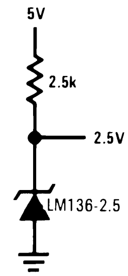
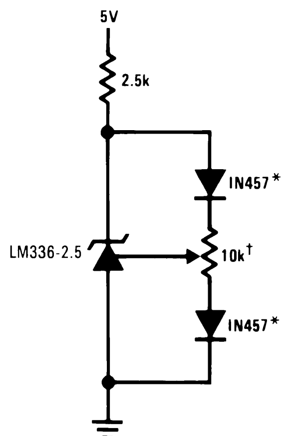


Figure 4. 2.5V Reference



†Adjust to 2.490V
*Any silicon signal diode

Figure 5. 2.5V Reference with Minimum Temperature Coefficient

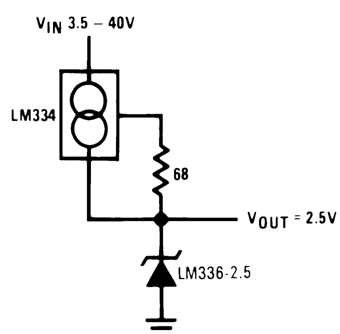


Figure 6. Wide Input Range Reference

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[(1)(2)]

Reverse Current			15 mA
Forward Current			10 mA
Storage Temperature			−60°C to +150°C
Operating Temperature Range[(3)]		LM136	−55°C to +150°C
		LM236	−25°C to +85°C
		LM336	0°C to +70°C
Soldering Information	TO-92 Package (10 sec.)		260°C
	TO Package (10 sec.)		300°C
	SOIC Package	Vapor Phase (60 sec.)	215°C
		Infrared (15 sec.)	220°C

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Electrical specifications do not apply when operating the device beyond its specified operating conditions.
(2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.
(3) For elevated temperature operation, T_j max is:
LM136 150°C
LM236 125°C
LM336 100°C

Thermal Resistance	TO-92	TO	SOIC
θ_{ja} (Junction to Ambient)	180°C/W (0.4″ leads)	440°C/W	165°C/W
	170°C/W (0.125″ lead)		
θ_{ja} (Junction to Case)	n/a	80°C/W	n/a

Electrical Characteristics [1]

Parameter	Conditions		LM136A-2.5-N/ LM236A-2.5-N LM136-2.5-N/ LM236-2.5-N			LM336B-2.5-N LM336-2.5-N			Units
			Min	Typ	Max	Min	Typ	Max	
Reverse Breakdown Voltage	T_A=25°C, I_R=1 mA	LM136, LM236, LM336	2.440	2.490	2.540	2.390	2.490	2.590	V
		LM136A, LM236A, LM336B	2.465	2.490	2.515	2.440	2.490	2.540	V
Reverse Breakdown Change With Current	T_A=25°C, 400 μA≤I_R≤10 mA			2.6	6		2.6	10	mV
Reverse Dynamic Impedance	T_A=25°C, I_R=1 mA, f = 100 Hz			0.2	0.6		0.2	1	Ω
Temperature Stability [2]	V_R Adjusted to 2.490V I_R=1 mA Figure 15	0°C≤T_A≤70°C (LM336)					1.8	6	mV
		−25°C≤T_A≤+85°C (LM236H, LM236Z)		3.5	9				mV
		−25°C ≤ T_A ≤ +85°C (LM236M)		7.5	18				mV
		−55°C≤T_A≤+125°C (LM136)		12	18				mV
Reverse Breakdown Change With Current	400 μA≤I_R≤10 mA			3	10		3	12	mV
Reverse Dynamic Impedance	I_R=1 mA			0.4	1		0.4	1.4	Ω
Long Term Stability	T_A=25°C ±0.1°C, I_R=1 mA, t = 1000 hrs			20			20		ppm

(1) Unless otherwise specified, the LM136-2.5-N is specified from −55°C ≤ T_A ≤ +125°C, the LM236-2.5-N from −25°C ≤ T_A ≤ +85°C and the LM336-2.5-N from 0°C ≤ T_A ≤ +70°C.

(2) Temperature stability for the LM336 and LM236 family is specified by design. Design limits are ensured (but not 100% production tested) over the indicated temperature and supply voltage ranges. These limits are not used to calculate outgoing quality levels. Stability is defined as the maximum change in V_{ref} from 25°C to T_A (min) or T_A (max).

Typical Performance Characteristics

Reverse Voltage Change

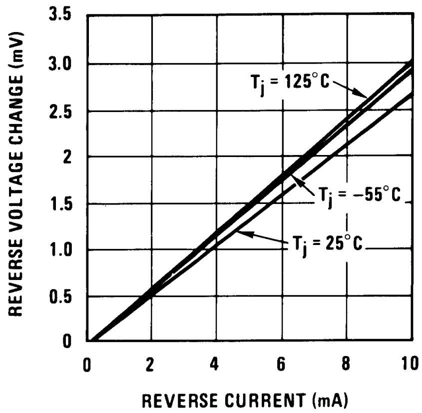


Figure 7.

Zener Noise Voltage

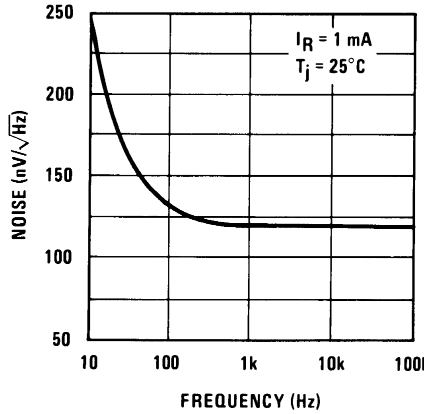


Figure 8.

Dynamic Impedance

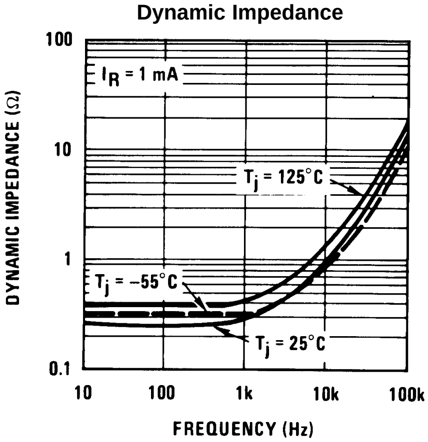


Figure 9.

Response Time

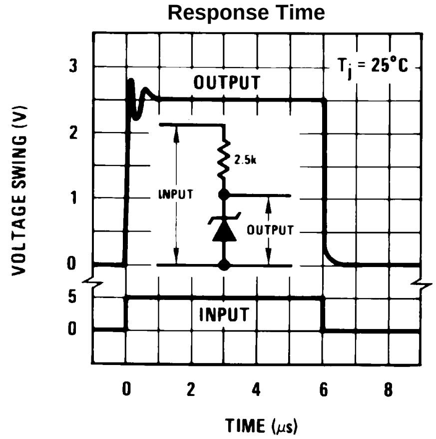


Figure 10.

Reverse Characteristics

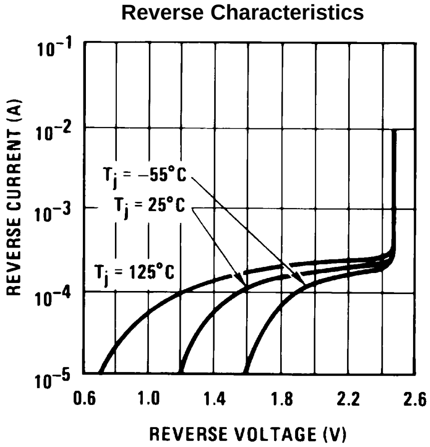


Figure 11.

Forward Characteristics

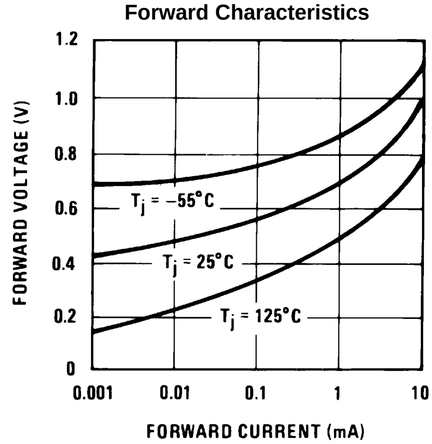


Figure 12.

Typical Performance Characteristics (continued)

Temperature Drift

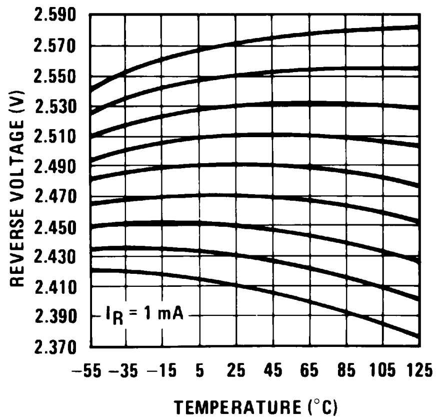


Figure 13.

APPLICATION HINTS

The LM136 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 14 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 15. 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.

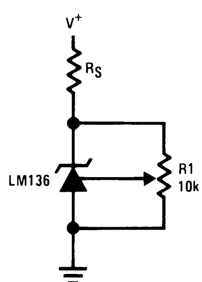


Figure 14. LM136 With Pot for Adjustment of Breakdown Voltage (Trim Range = ±120 mV typical)

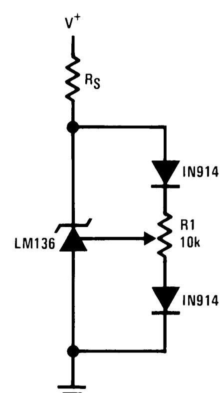
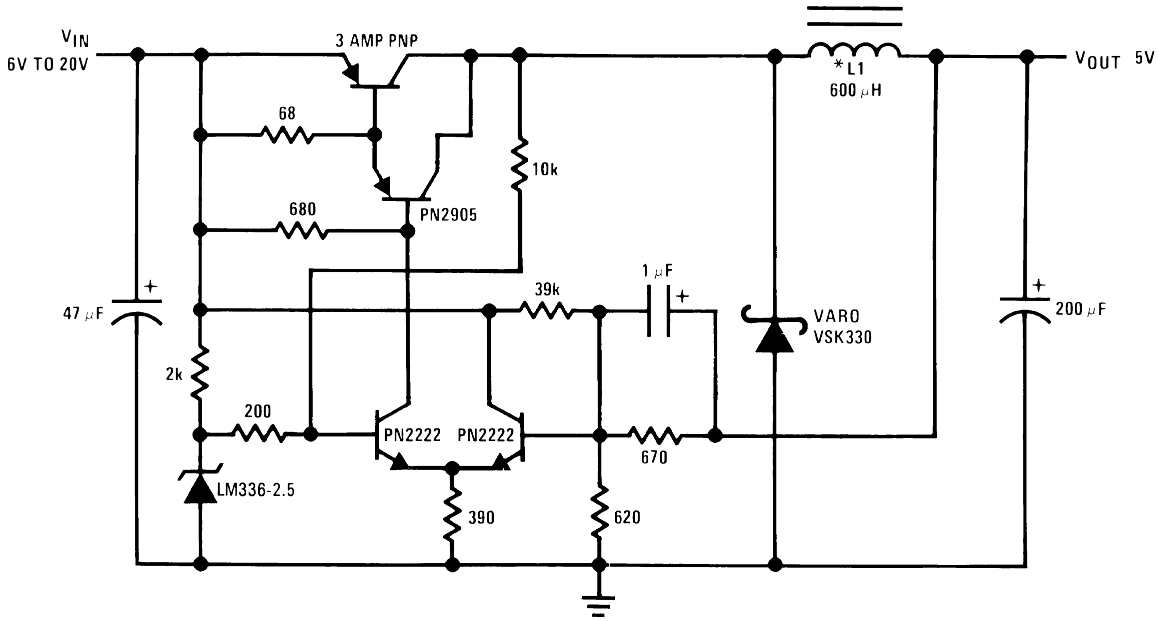


Figure 15. Temperature Coefficient Adjustment (Trim Range = ±70 mV typical)



*L1 60 turns #16 wire on Arnold Core A-254168-2
†Efficiency ≈ 80%

Figure 16. Low Cost 2 Amp Switching Regulator†

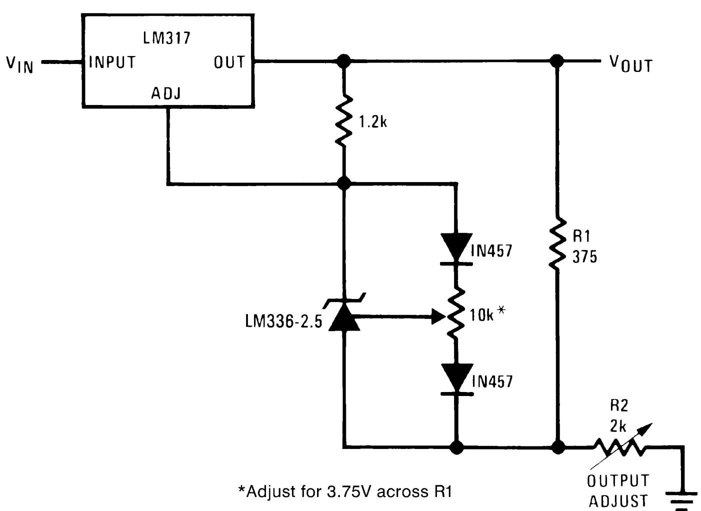


Figure 17. Precision Power Regulator with Low Temperature Coefficient

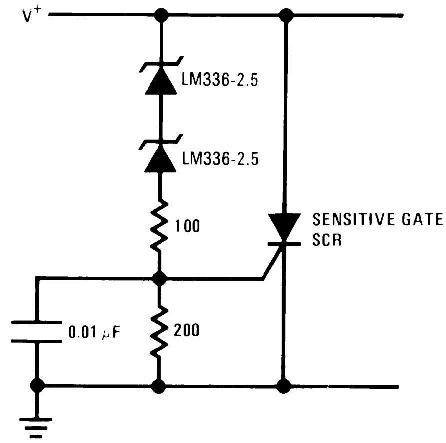
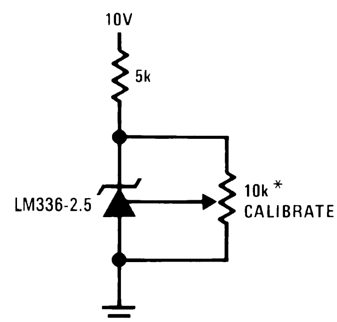


Figure 18. 5V Crowbar



*Does not affect temperature coefficient

Figure 19. Trimmed 2.5V Reference with Temperature Coefficient Independent of Breakdown Voltage

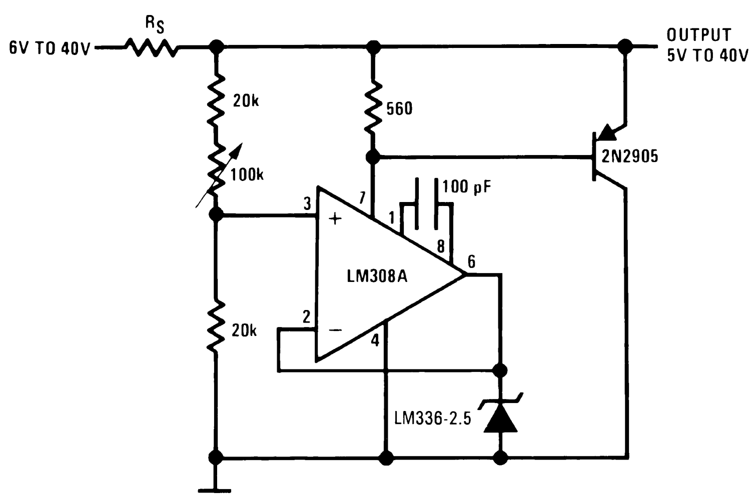


Figure 20. Adjustable Shunt Regulator

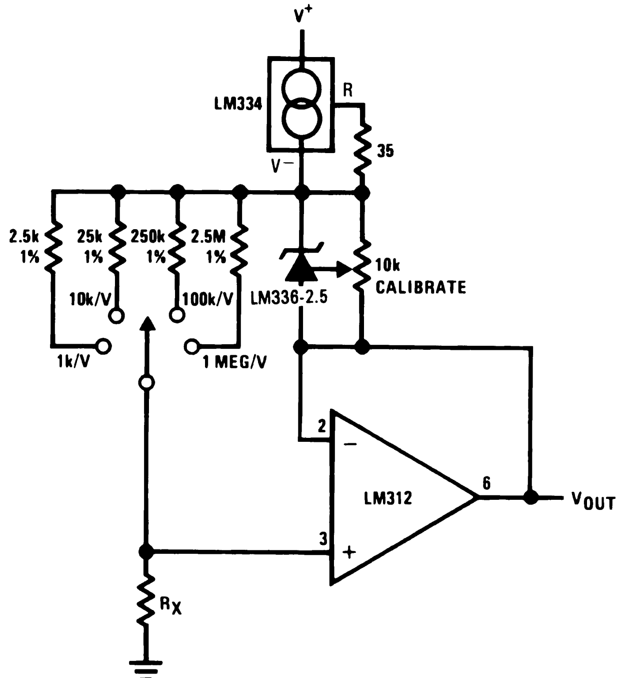


Figure 21. Linear Ohmmeter

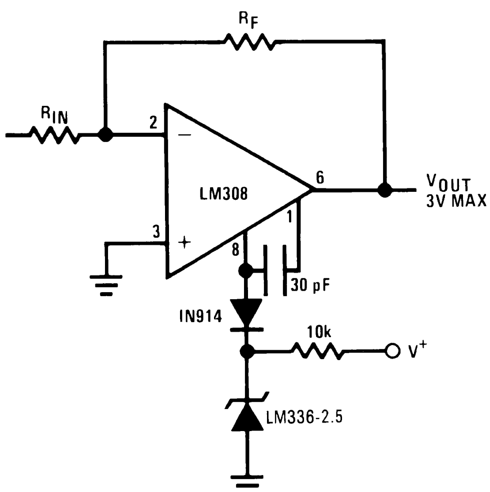


Figure 22. Op Amp with Output Clamped

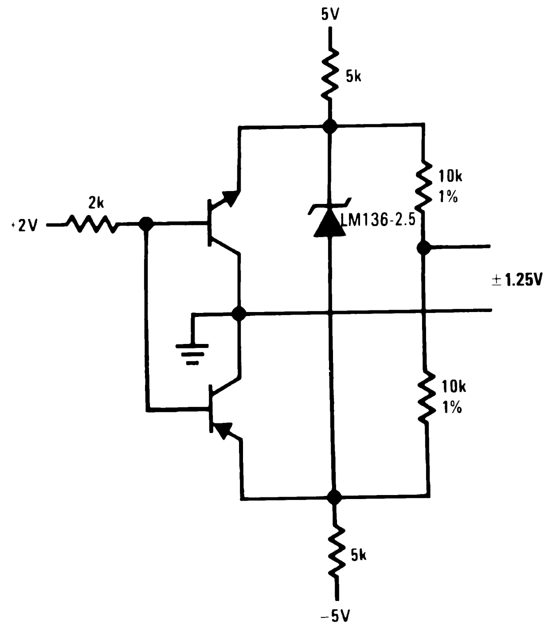


Figure 23. Bipolar Output Reference

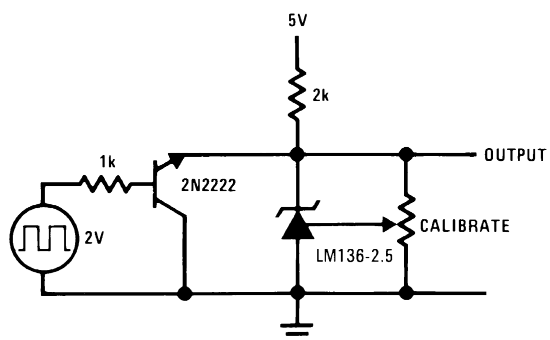


Figure 24. 2.5V Square Wave Calibrator

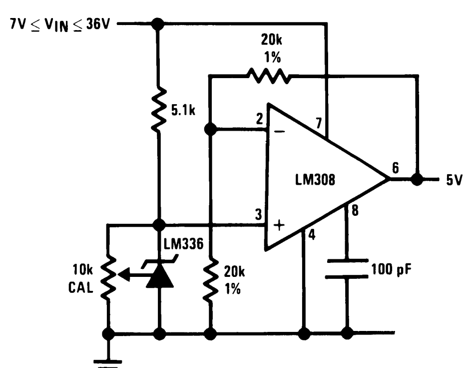


Figure 25. 5V Buffered Reference

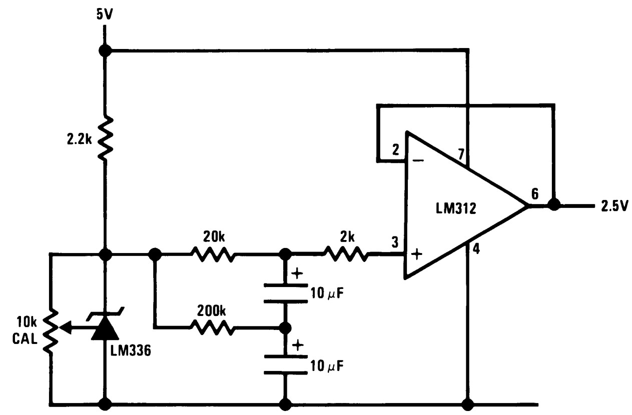
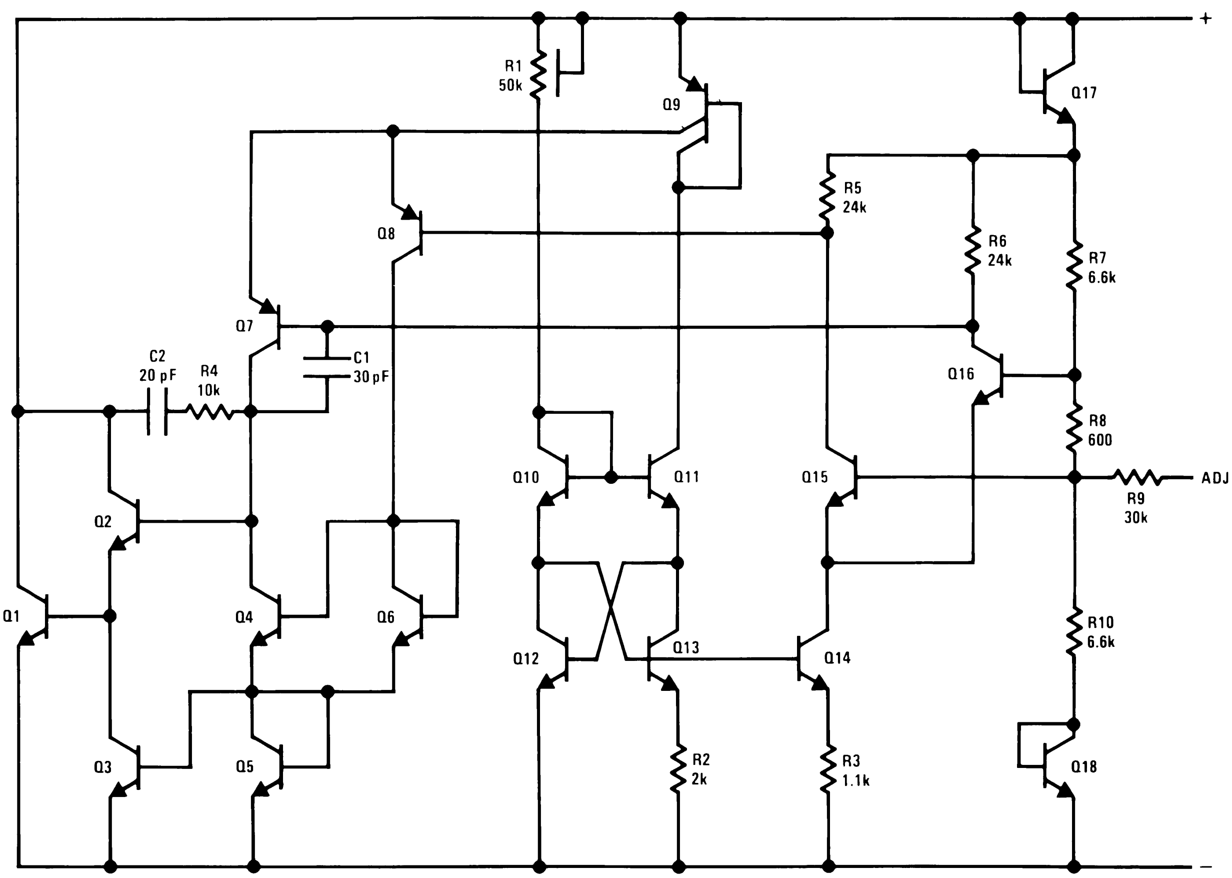


Figure 26. Low Noise Buffered Reference

Schematic Diagram



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
LM136AH-2.5	ACTIVE	TO	NDV	3	1000	TBD	Call TI	Call TI	-40 to 125	LM136AH2.5	Samples
LM136AH-2.5/NOPB	ACTIVE	TO	NDV	3	1000	Green (RoHS & no Sb/Br)	POST-PLATE	Level-1-NA-UNLIM	-40 to 125	LM136AH2.5	Samples
LM136H-2.5	ACTIVE	TO	NDV	3	1000	TBD	Call TI	Call TI	-55 to 125	LM136H2.5	Samples
LM136H-2.5/NOPB	ACTIVE	TO	NDV	3	1000	Green (RoHS & no Sb/Br)	POST-PLATE	Level-1-NA-UNLIM	-55 to 125	LM136H2.5	Samples
LM236H-2.5	ACTIVE	TO	NDV	3	1000	TBD	Call TI	Call TI	-25 to 85	LM236H2.5	Samples
LM236H-2.5/NOPB	ACTIVE	TO	NDV	3	1000	Green (RoHS & no Sb/Br)	POST-PLATE	Level-1-NA-UNLIM	-25 to 85	LM236H2.5	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.
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] Only one of markings shown within the brackets will appear on the physical device.

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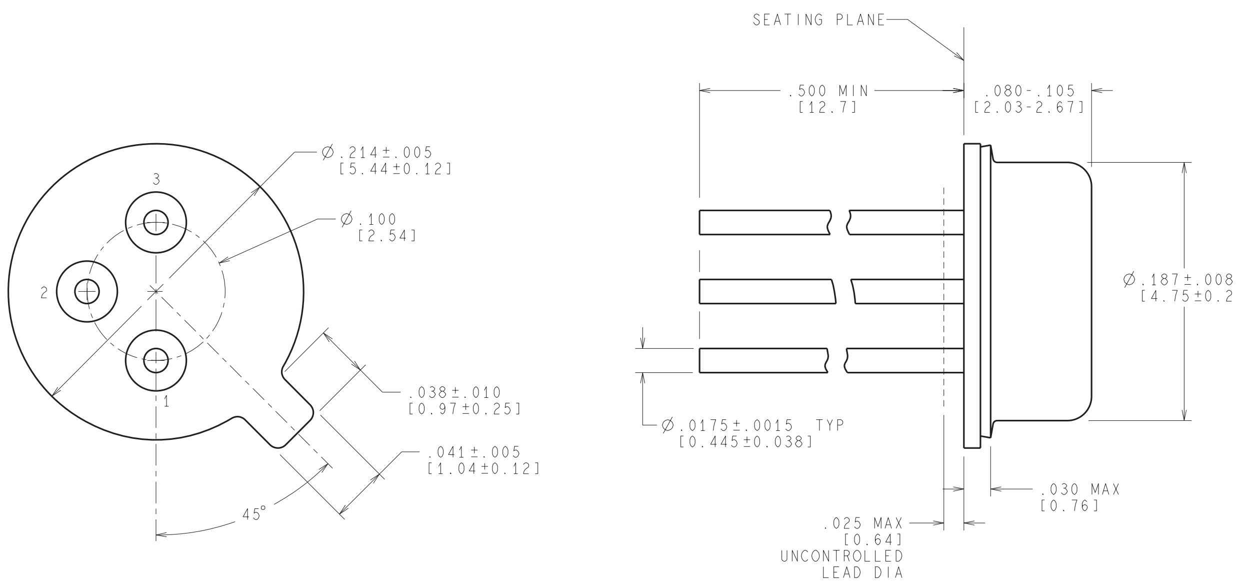

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