

LM136-5.0, LM236-5.0, LM336-5.0 5.0V Reference Diode

Check for Samples: [LM136-5.0](#), [LM236-5.0](#), [LM336-5.0](#)

FEATURES

- Adjustable 4V to 6V
- Low Temperature Coefficient
- Wide Operating Current of 600 μ A to 10 mA
- 0.6 Ω Dynamic Impedance
- $\pm 1\%$ Initial Tolerance Available
- Specified Temperature Stability
- Easily Trimmed for Minimum Temperature Drift
- Fast Turn-on
- Three Lead Transistor Package

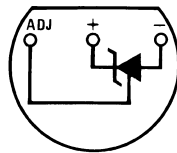
DESCRIPTION

The LM136-5.0/LM236-5.0/LM336-5.0 integrated circuits are precision 5.0V shunt regulator diodes. These monolithic IC voltage references operate as a low temperature coefficient 5.0V zener with 0.6 Ω dynamic impedance. A third terminal on the LM136-5.0 allows the reference voltage and temperature coefficient to be trimmed easily.

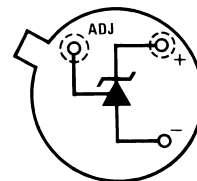
The LM136-5.0 series is useful as a precision 5.0V low voltage reference for digital voltmeters, power supplies or op amp circuitry. The 5.0V makes it convenient to obtain a stable reference from low voltage supplies. Further, since the LM136-5.0 operates as a shunt regulator, it can be used as either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

The LM136-5.0 is rated for operation over -55°C to $+125^{\circ}\text{C}$ while the LM236-5.0 is rated over a -25°C to $+85^{\circ}\text{C}$ temperature range. The LM336-5.0 is rated for operation over a 0°C to $+70^{\circ}\text{C}$ temperature range. See the [Connection Diagrams](#) for available packages. For applications requiring 2.5V see LM136-2.5.

Connection Diagrams



**Figure 1. TO-92 Plastic Package
(Bottom View)**



**Figure 2. TO Metal Can Package
(Bottom View)**

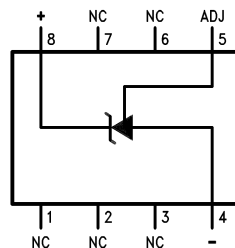


Figure 3. SOIC Package



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

All trademarks are the property of their respective owners.

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.

Copyright © 1999–2013, Texas Instruments Incorporated

Typical Applications

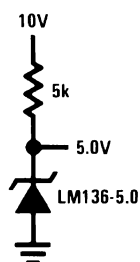
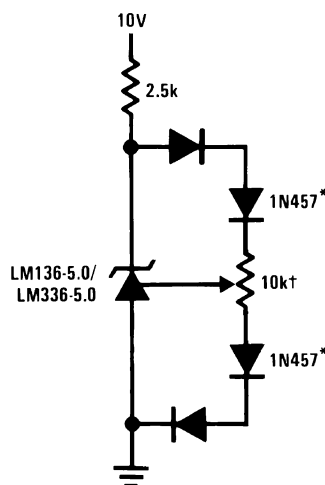


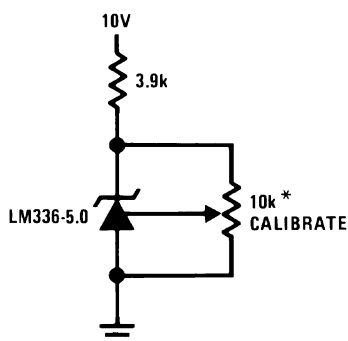
Figure 4. 5.0V Reference



† Adjust to 5.00V

* Any silicon signal diode

Figure 5. 5.0V Reference with Minimum Temperature Coefficient



* Does not affect temperature coefficient

Figure 6. 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.

ABSOLUTE MAXIMUM RATINGS ⁽¹⁾

Reverse Current	15	mA
Forward Current	10	mA
Storage Temperature	–60 to +150	°C
Operating Temperature Range ⁽²⁾		
LM136-5.0	–55 to +150	°C
LM236-5.0	–25 to +85	°C
LM336-5.0	0 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) For elevated temperature operation, T_j max see [THERMAL CHARACTERISTICS](#)

THERMAL CHARACTERISTICS

over operating free-air temperature range (unless otherwise noted)

	LM136	150°C	
	LM236	125°C	
	LM336	100°C	
Thermal Resistance	TO-92	TO	SOIC-8
θ_{ja} (Junction to Ambient)	180°C/W (0.4" Leads)	440°C/W	165°C/W
	170°C/W (0.125" Leads)		
θ_{ja} (Junction to Case)	N/A	80°C/W	N/A

ELECTRICAL CHARACTERISTICS

		LM136A-5.0/LM236A-5.0			LM336B-5.0			
Parameter	Conditions	LM136-5.0/LM236-5.0			LM336-5.0			Units
		Min	Typ	Max	Min	Typ	Max	
Reverse Breakdown Voltage	T _A =25°C, I _R =1 mA							
	LM136-5.0/LM236-5.0/LM336-5.0	4.9	5.00	5.1	4.8	5.00	5.2	V
	LM136A-5.0/LM236A-5.0, LM336B-5.0	4.95	5.00	5.05	4.90	5.00	5.1	V
Reverse Breakdown Change	T _A =25°C,		6	12		6	20	mV
With Current	600 μA≤I _R ≤10 mA							
Reverse Dynamic Impedance	T _A =25°C, I _R =1 mA, f = 100 Hz		0.6	1.2		0.6	2	Ω
Temperature Stability (²)	V _R Adjusted 5.00V I _R =1 mA, (Figure 15) 0°C≤T _A ≤70°C (LM336-5.0)					4	12	mV

- (1) Unless otherwise specified, the LM136-5.0 is specified from $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$, the LM236-5.0 from $-25^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$ and the LM336-5.0 from $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$.
- (2) Temperature stability for the LM336 and LM236 family is specified by design. Design limits are specified (but not 100% percent 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 $T_A(\text{min})$ or $T_A(\text{max})$.

ELECTRICAL CHARACTERISTICS (continued)

(1)

		LM136A-5.0/LM236A-5.0			LM336B-5.0			
Parameter	Conditions	LM136-5.0/LM236-5.0			LM336-5.0			Units
		Min	Typ	Max	Min	Typ	Max	
	-25°C≤T _A ≤+85°C (LM236-5.0)		7	18				mV
	-55°C≤T _A ≤+125°C (LM136-5.0)		20	36				mV
Reverse Breakdown Change With Current	600 μA≤I _R ≤10 mA		6	17		6	24	mV
Adjustment Range	Circuit of Figure 14		±1			±1		V
Reverse Dynamic Impedance	I _R = 1 mA		0.8	1.6		0.8	2.5	Ω
Long Term Stability	T _A =25°C±0.1°C, I _R =1 mA, t = 1000 hrs		20			20		ppm

TYPICAL PERFORMANCE CHARACTERISTICS

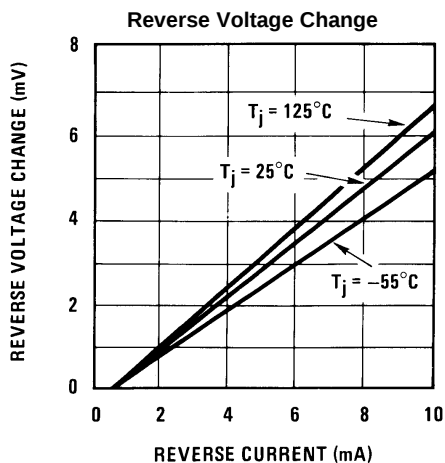


Figure 7.

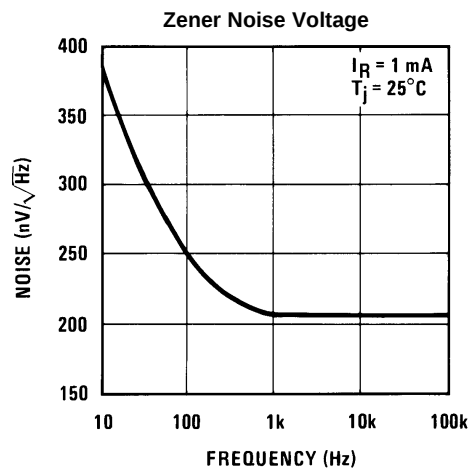


Figure 8.

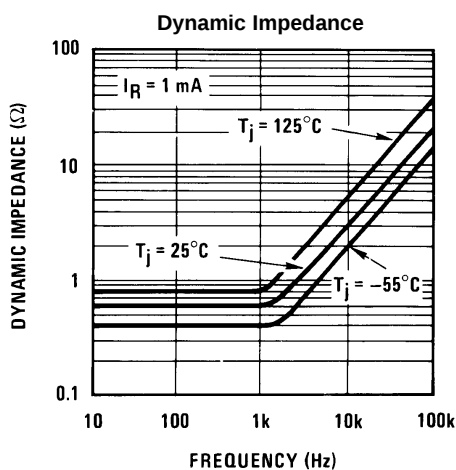


Figure 9.

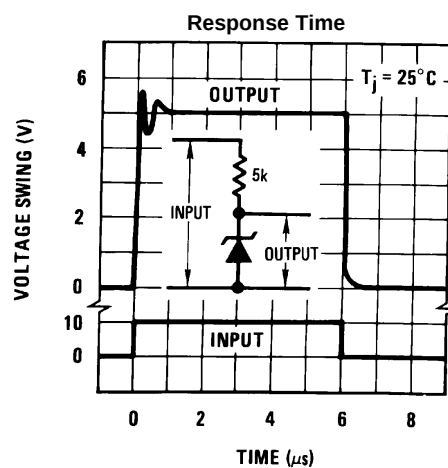


Figure 10.

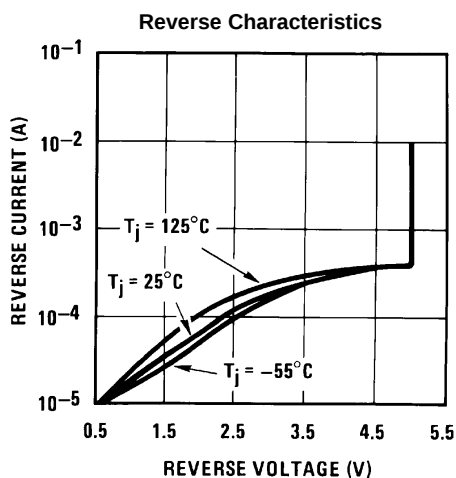


Figure 11.

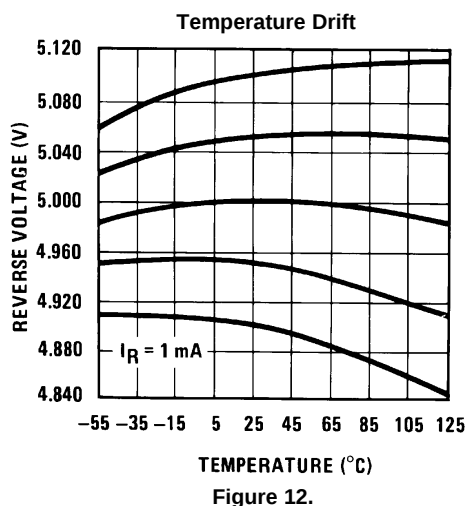


Figure 12.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

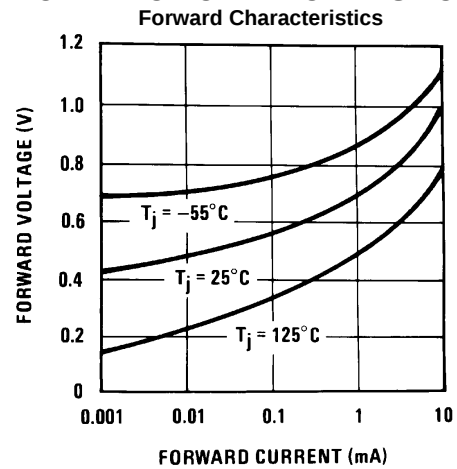


Figure 13.

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 14 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 15. 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.

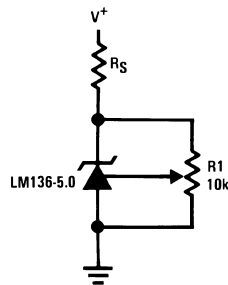


Figure 14. LM136-5.0 with Pot for Adjustment of Breakdown Voltage (Trim Range = $\pm 1.0\text{V}$ Typical)

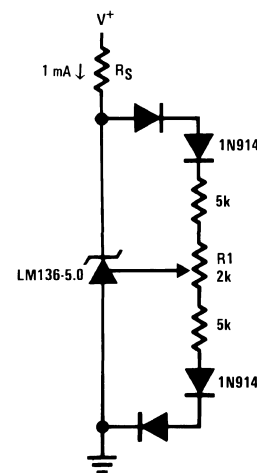
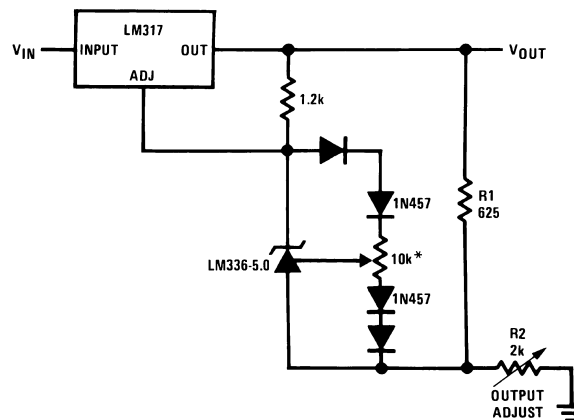


Figure 15. Temperature Coefficient Adjustment (Trim Range = $\pm 0.5\text{V}$ Typical)

Typical Applications



* Adjust for 6.25V across R1

Figure 16. Precision Power Regulator with Low Temperature Coefficient

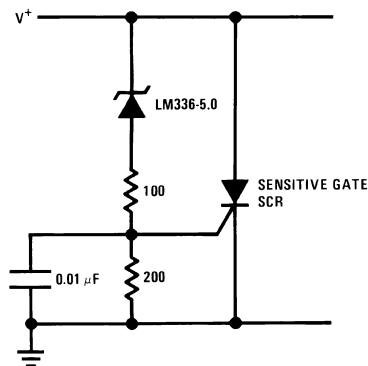


Figure 17. 5V Crowbar

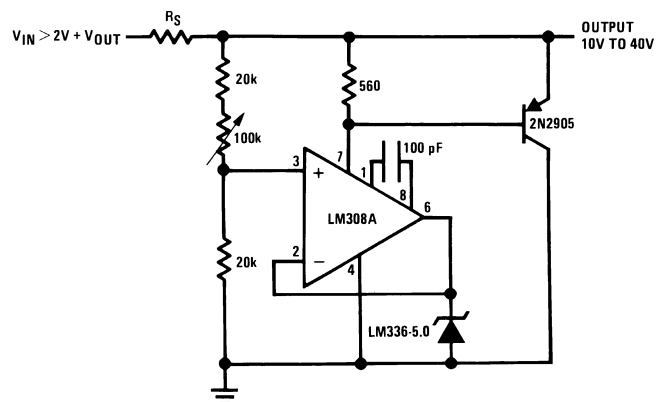


Figure 18. Adjustable Shunt Regulator

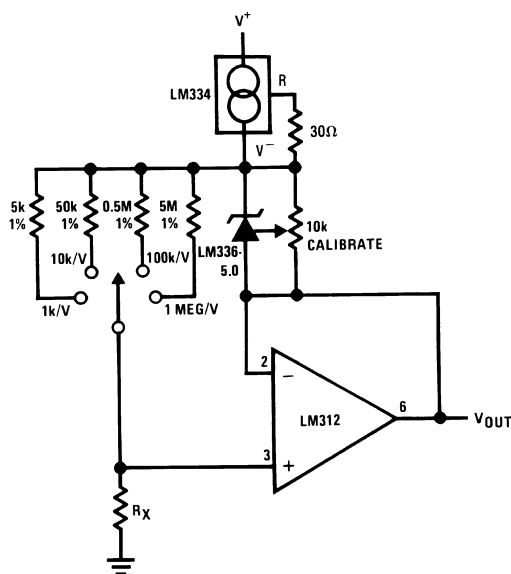


Figure 19. Linear Ohmmeter

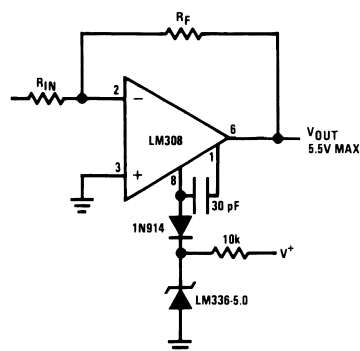


Figure 20. Op Amp with Output Clamped

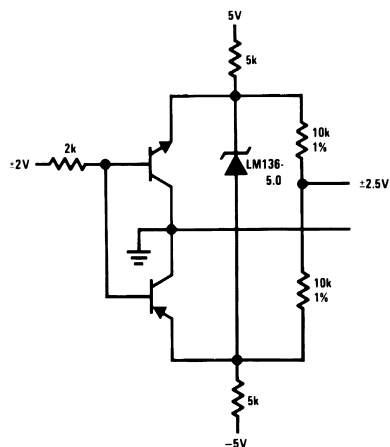


Figure 21. Bipolar Output Reference

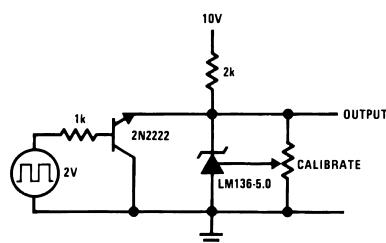


Figure 22. 5.0V Square Wave Calibrator

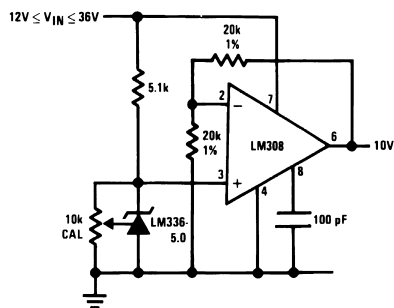


Figure 23. 10V Buffered Reference

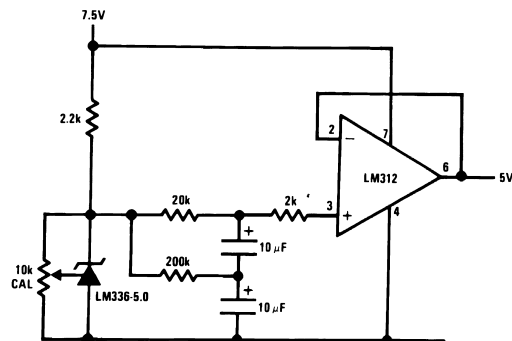


Figure 24. Low Noise Buffered Reference

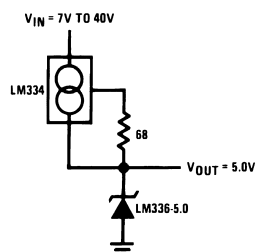
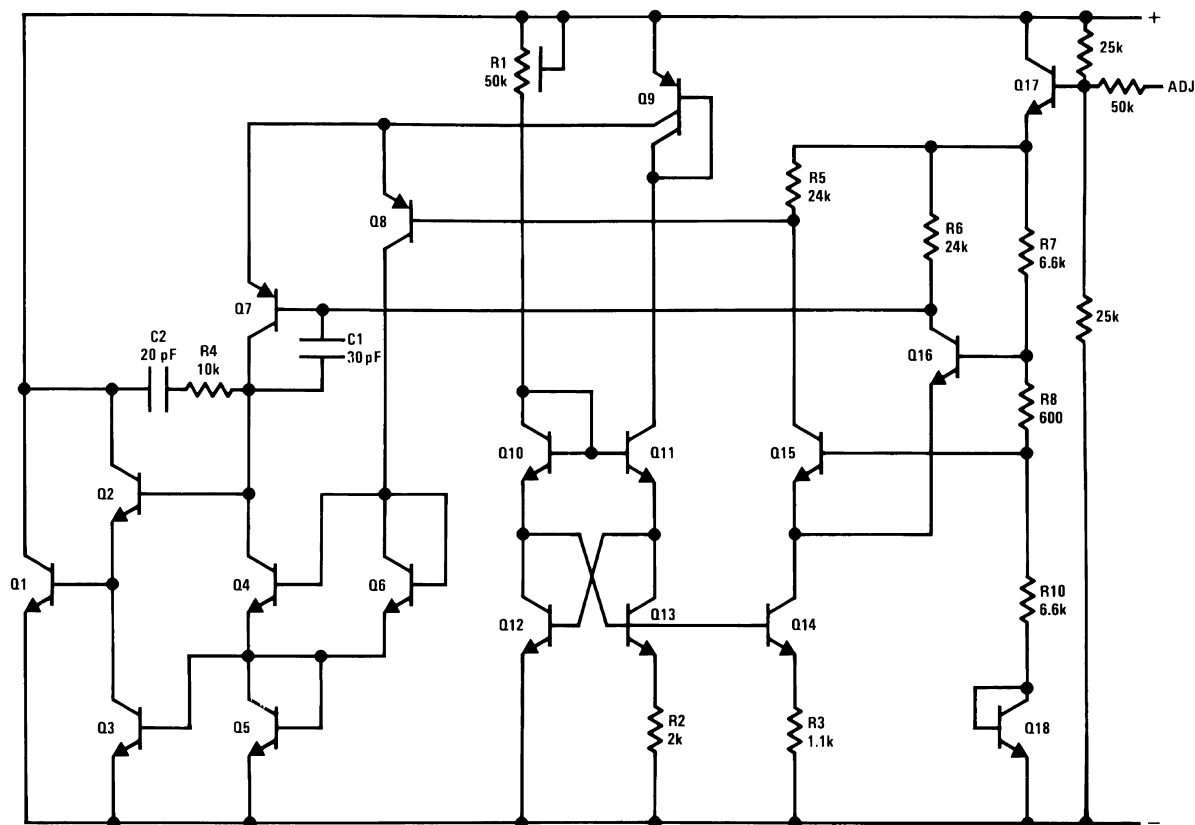


Figure 25. Wide Input Range Reference

Schematic Diagram



REVISION HISTORY

Changes from Revision C (March 2013) to Revision D

Page

- Changed layout of National Data Sheet to TI format [9](#)

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-5.0	ACTIVE	TO	NDV	3	1000	TBD	Call TI	Call TI	-40 to 125	LM136AH5.0	Samples
LM136AH-5.0/NOPB	ACTIVE	TO	NDV	3	1000	Green (RoHS & no Sb/Br)	POST-PLATE	Level-1-NA-UNLIM	-40 to 125	LM136AH5.0	Samples
LM136H-5.0	ACTIVE	TO	NDV	3	1000	TBD	Call TI	Call TI	-55 to 125	LM136H5.0	Samples
LM136H-5.0/NOPB	ACTIVE	TO	NDV	3	1000	Green (RoHS & no Sb/Br)	POST-PLATE	Level-1-NA-UNLIM	-55 to 125	LM136H5.0	Samples
LM236AH-5.0	ACTIVE	TO	NDV	3	1000	TBD	Call TI	Call TI	-55 to 125	LM236AH5.0	Samples
LM236AH-5.0/NOPB	ACTIVE	TO	NDV	3	1000	Green (RoHS & no Sb/Br)	POST-PLATE	Level-1-NA-UNLIM	-55 to 125	LM236AH5.0	Samples
LM236H-5.0	ACTIVE	TO	NDV	3	1000	TBD	Call TI	Call TI	-25 to 85	LM236H5.0	Samples
LM236H-5.0/NOPB	ACTIVE	TO	NDV	3	1000	Green (RoHS & no Sb/Br)	POST-PLATE	Level-1-NA-UNLIM	-25 to 85	LM236H5.0	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)

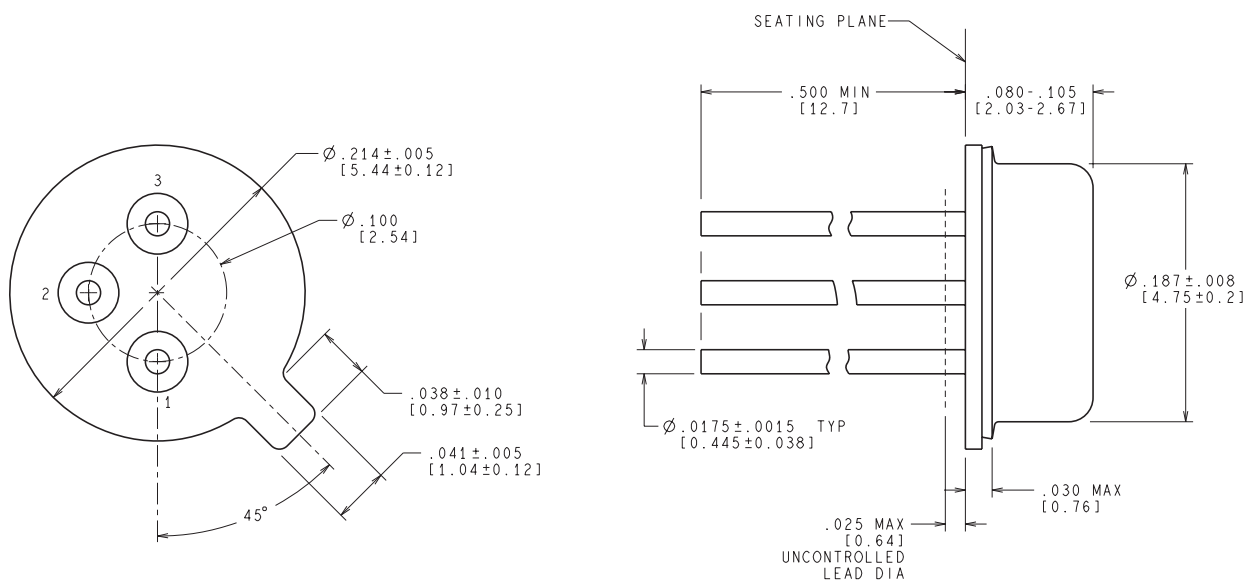
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side Marking for that device.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

NDV0003H



CONTROLLING DIMENSION IS INCH
VALUES IN [] ARE IN MILLIMETERS

H03H (Rev F)

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com