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**
- **Ensured 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.
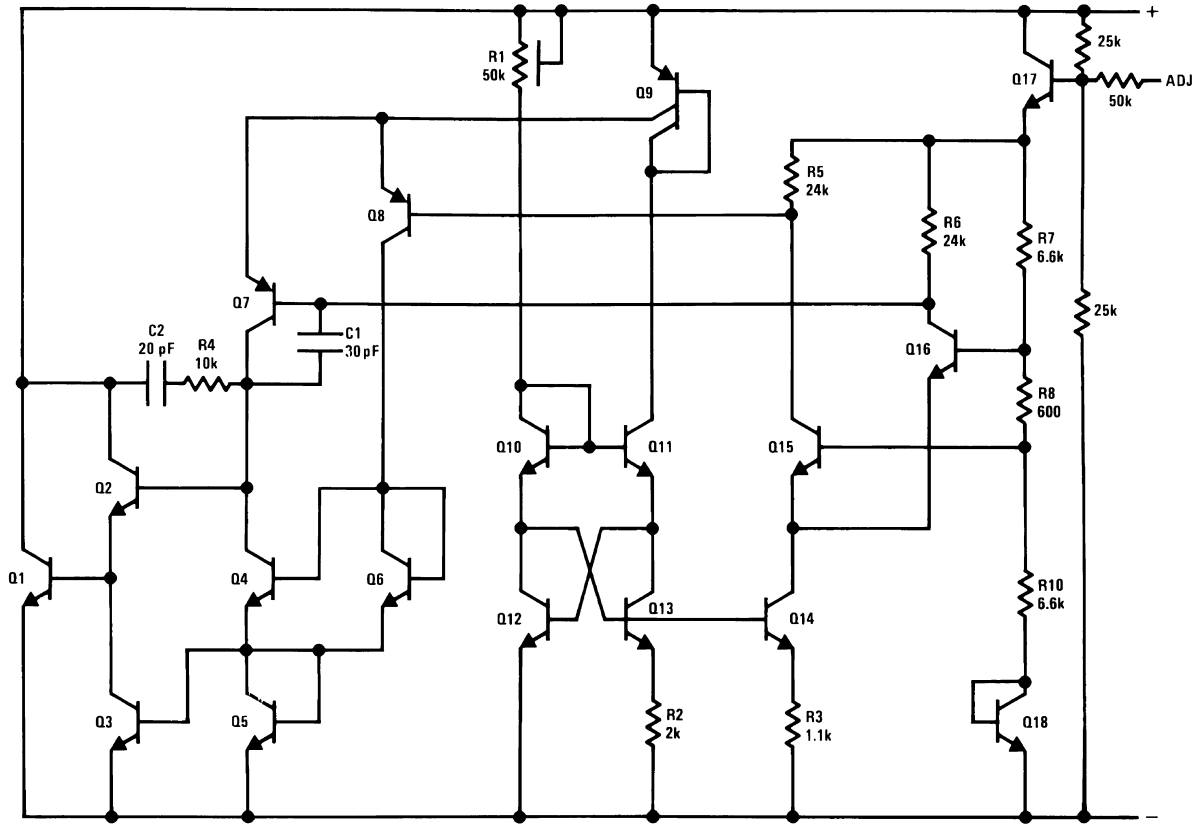
Connection Diagram
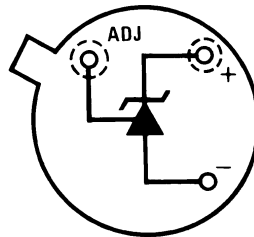
Figure 1. Bottom View
3-Lead TO
Metal Can Package
See NDV0003H Package

Schematic Diagram

Typical Applications

Figure 2. 5.0V Reference

Product Folder Links: *LM136-5.0QML LM136A-5.0QML*
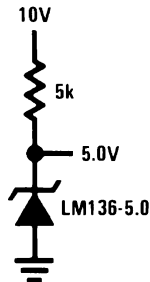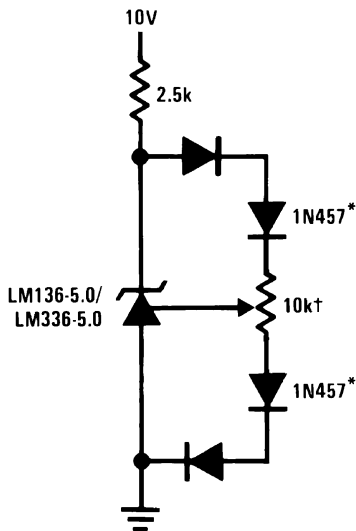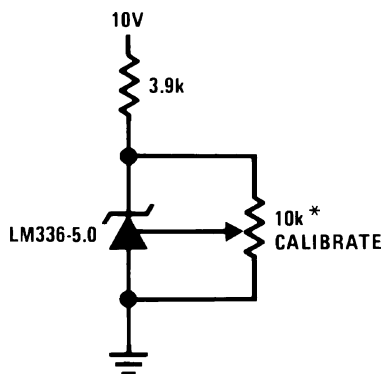
† Adjust to 5.00V
* Any silicon signal diode

**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.

Absolute Maximum Ratings [1]

Reverse Current	15mA
Forward Current	15mA
Storage Temperature	$-60°C \leq T_A \leq +150°C$
Operating Temperature Range[2]	$-55°C \leq T_A \leq +125°C$
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 ensure specific performance limits. For ensured specifications and test conditions, see the Electrical Characteristics. The ensured 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

Product Folder Links: *LM136-5.0QML LM136A-5.0QML*

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	$0.6mA \leq I_R \leq 15$ 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)   Specified, 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	$0.6mA \leq I_R \leq 15$ 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)   Specified, not tested.

Typical Performance Characteristics
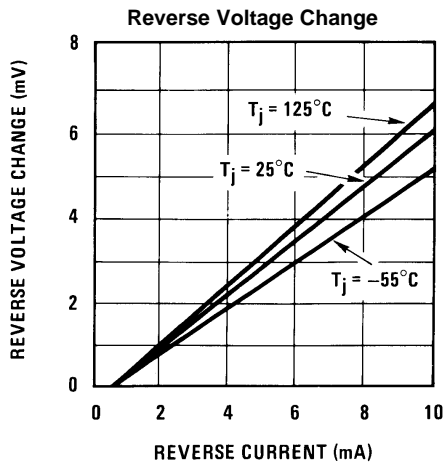
Reverse Voltage Change

Figure 5.

Zener Noise Voltage

Figure 6.

Dynamic Impedance

Figure 7.

Response Time

Figure 8.

Reverse Characteristics

Figure 9.

Temperature Drift

Figure 10.

Product Folder Links: *LM136-5.0QML LM136A-5.0QML*
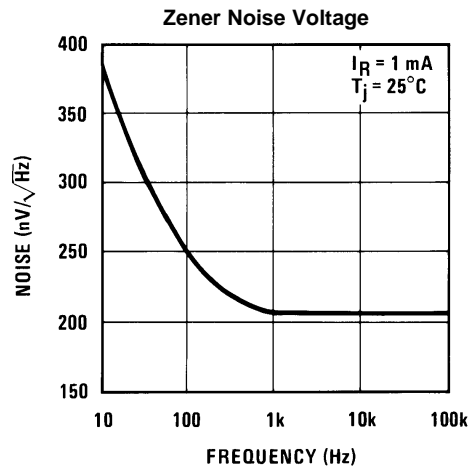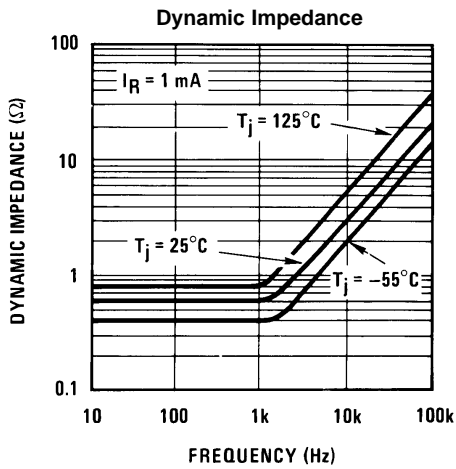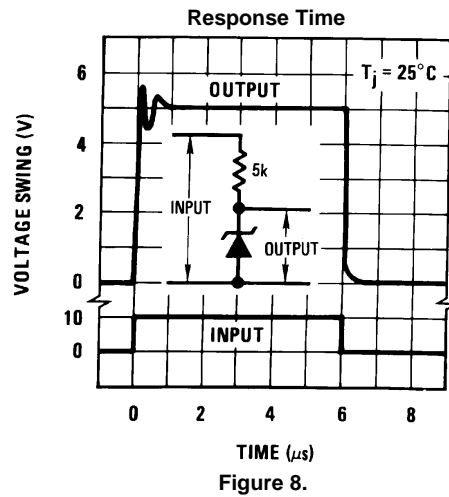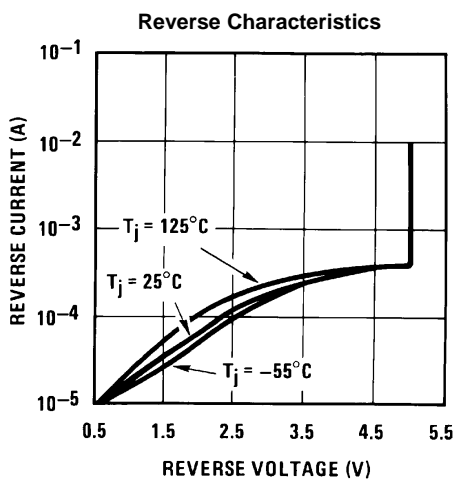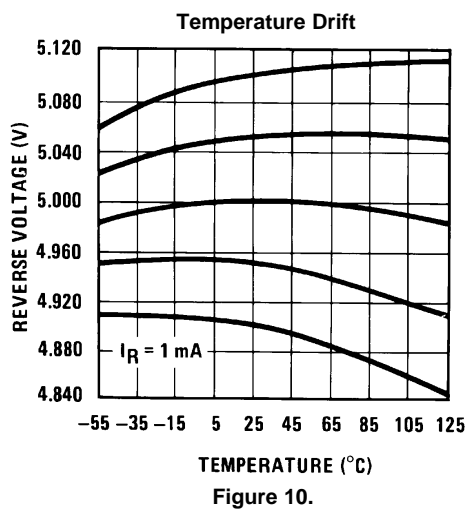
Typical Performance Characteristics (continued)

Forward Characteristics

Figure 11.

7

Product Folder Links: *LM136-5.0QML LM136A-5.0QML*
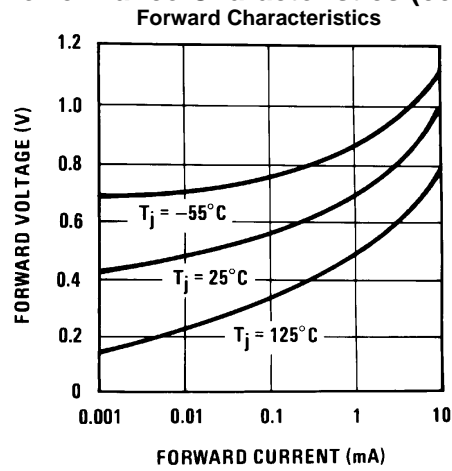
APPLICATION HINTS

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.
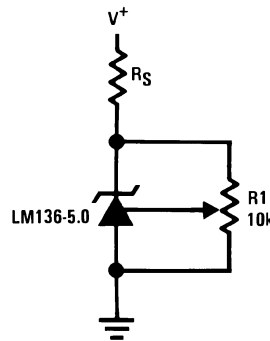

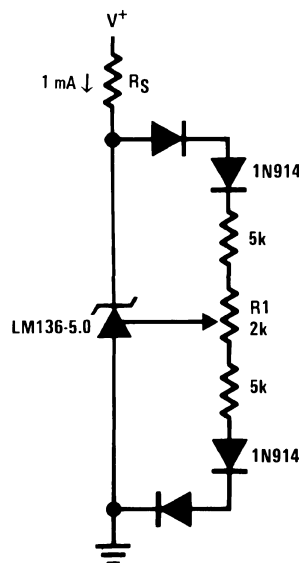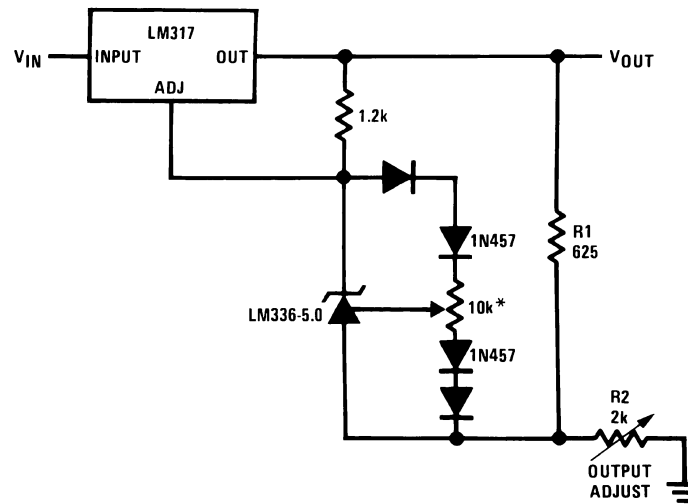**Figure 12. LM136-5.0 with Pot for Adjustment of Breakdown Voltage (Trim Range = ±1.0V Typical)**

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

Product Folder Links: *LM136-5.0QML LM136A-5.0QML*

Typical Applications

* Adjust for 6.25V across R1

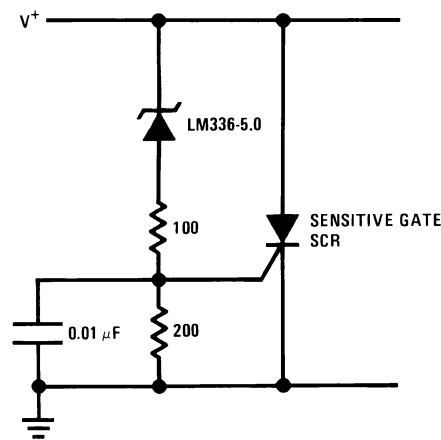**Figure 14. Precision Power Regulator with Low Temperature Coefficient**
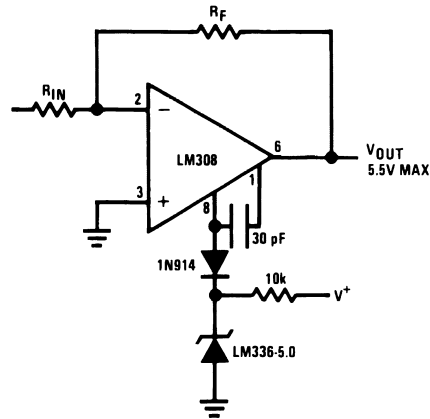

Figure 15. 5V Crowbar

Figure 16. Adjustable Shunt Regulator

Figure 17. Linear Ohmmeter

Product Folder Links: *LM136-5.0QML LM136A-5.0QML*
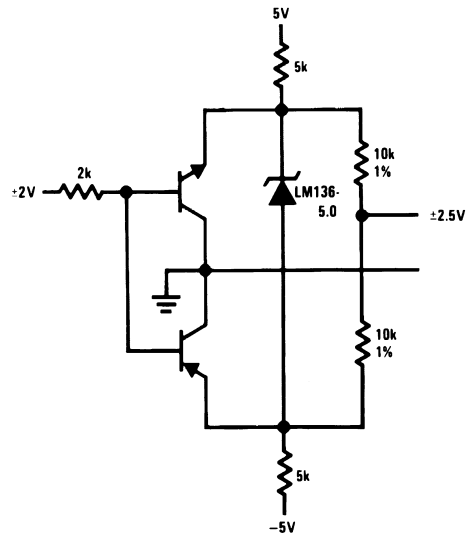
Figure 18. Bipolar Output Reference

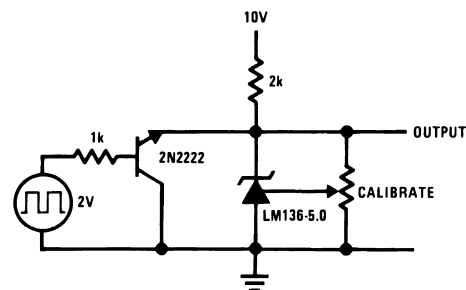**Figure 19. Bipolar Output Reference**

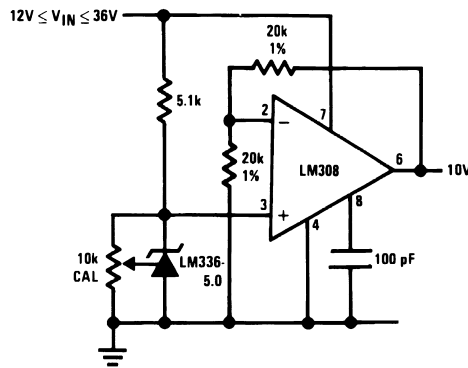**Figure 20. 5.0V Square Wave Calibrator**
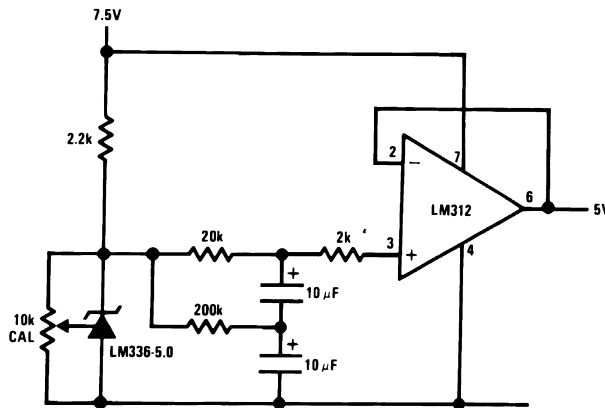
Figure 21. 10V Buffered Reference

Figure 22. Low Noise Buffered Reference
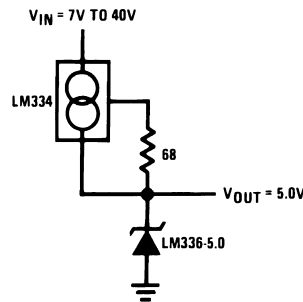
Figure 23. Wide Input Range Reference

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.

Product Folder Links: *LM136-5.0QML LM136A-5.0QML*

Date Released	Revision	Section	Changes
03/20/2013	B	All Sections	Changed layout of National Data Sheet to TI format

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
8418002XA	ACTIVE	TO	NDV	3	20	RoHS & Green	Call TI	Level-1-NA-UNLIM	-55 to 125	8418002XA Q	Samples
LM136AH-5.0-SMD	ACTIVE	TO	NDV	3	20	RoHS & Green	Call TI	Level-1-NA-UNLIM	-55 to 125	8418002XA Q	Samples
LM136AH-5.0/883	ACTIVE	TO	NDV	3	20	RoHS & Green	Call TI	Level-1-NA-UNLIM	-55 to 125	LM136A-5.0 Q	Samples
LM136H-5.0/883	ACTIVE	TO	NDV	3	20	RoHS & Green	Call TI	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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device 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 Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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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.

TRAY

L - Outer tray length without tabs

W - Outer tray width

KO - Outer tray height

P1 - Tray unit pocket pitch

CW - Measurement for tray edge (Y direction) to corner pocket center

CL - Measurement for tray edge (X direction) to corner pocket center

Chamfer on Tray corner indicates Pin 1 orientation of packed units.

*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	Unit array matrix	Max temperature (°C)	L (mm)	W (mm)	K0 (µm)	P1 (mm)	CL (mm)	CW (mm)
8418002XA	NDV	TO-CAN	3	20	2 X 10	150	126.49	61.98	10922	11.43	11.81	19.2
LM136AH-5.0-SMD	NDV	TO-CAN	3	20	2 X 10	150	126.49	61.98	10922	11.43	11.81	19.2
LM136AH-5.0/883	NDV	TO-CAN	3	20	2 X 10	150	126.49	61.98	10922	11.43	11.81	19.2
LM136H-5.0/883	NDV	TO-CAN	3	20	2 X 10	150	126.49	61.98	10922	11.43	11.81	19.2

Ø 4.95 / 4.55

0.76 MAX

2.67 MAX

UNCONTROLLED LEAD DIA
0.64 MAX
(MIL/AERO)
1.397 MAX
(COMMERCIAL)

3X 12.7 MIN

3X Ø 0.483 / 0.407

Ø 5.32-5.56

2

1   3

(Ø 2.54)

45°

1.16 / 0.92

1.22 / 0.72
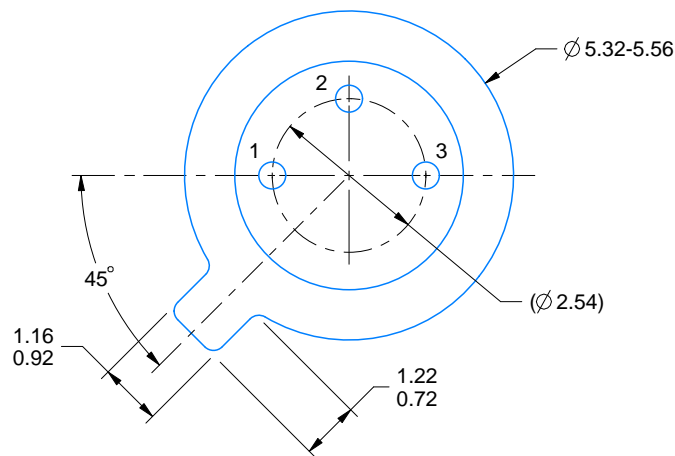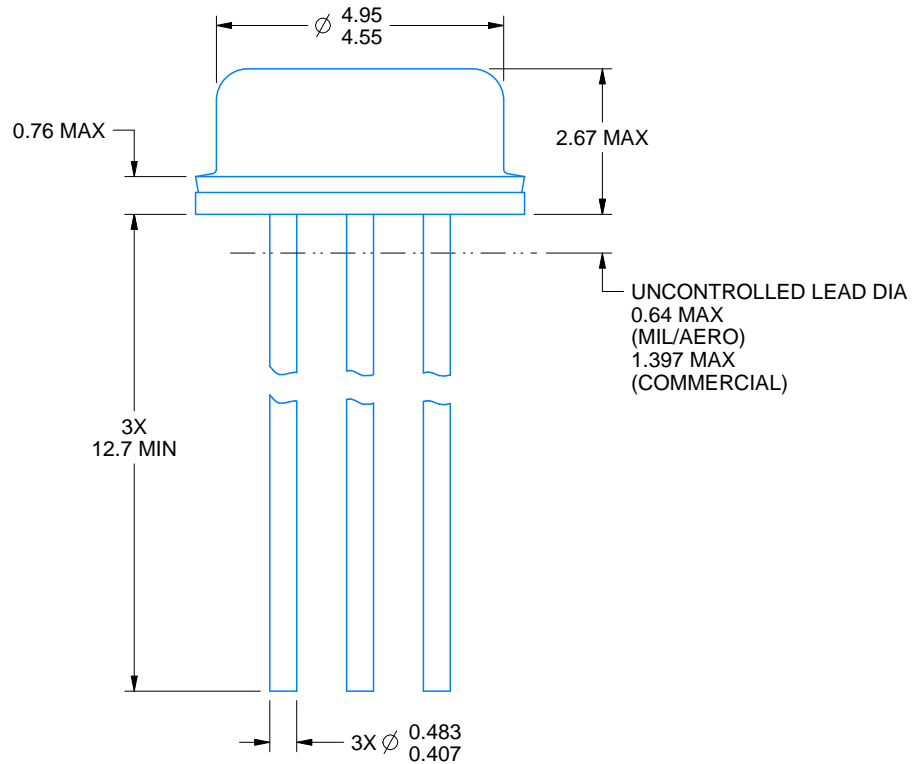
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NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC registration TO-46.

(2.54)

0.07 MAX
ALL AROUND

(□ 1.2)
METAL

3

3X (∅ 0.7) VIA

SOLDER MASK
OPENING

1

(1.27)

(R0.05) TYP

2

2X (∅ 1.2)
METAL

0.07 MAX
TYP

2X
SOLDER MASK
OPENING
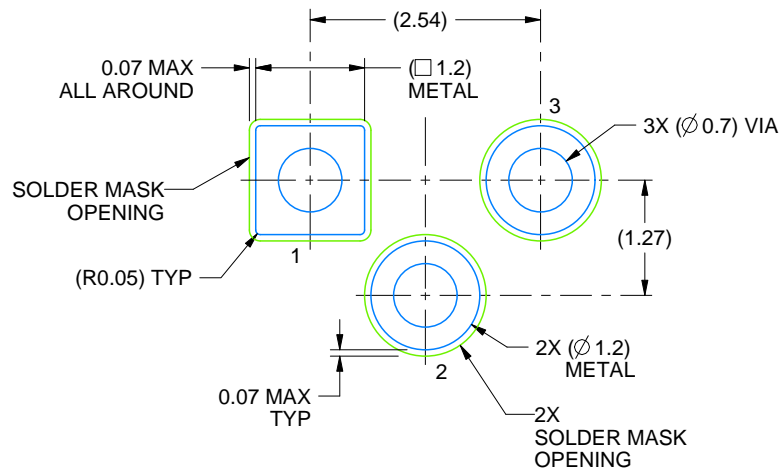
LAND PATTERN EXAMPLE
NON-SOLDER MASK DEFINED
SCALE:12X

4219876/B   09/2024

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