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

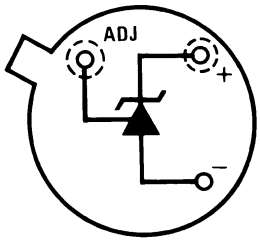
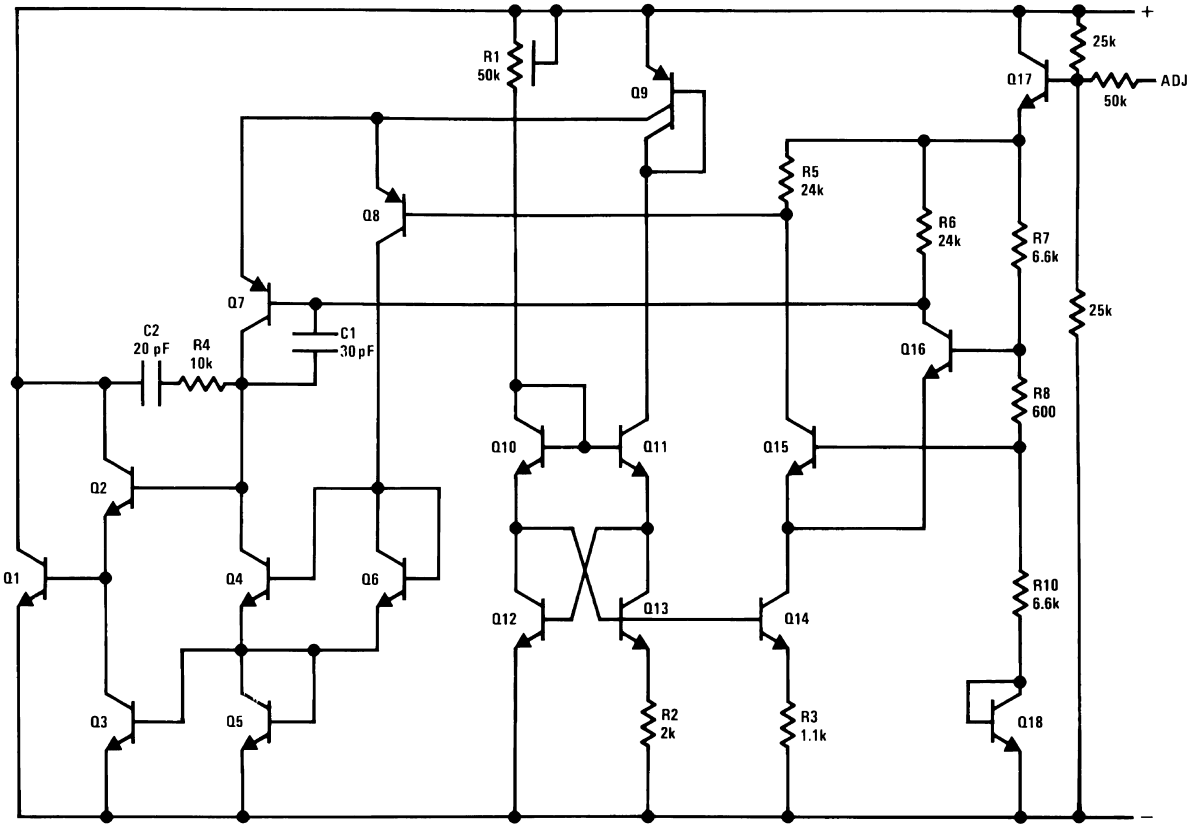


Figure 1. Bottom View
3-Lead TO
Metal Can Package
See NDV0003H Package

Schematic Diagram



Typical Applications

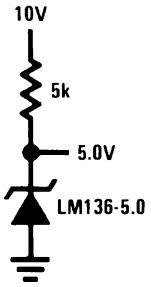
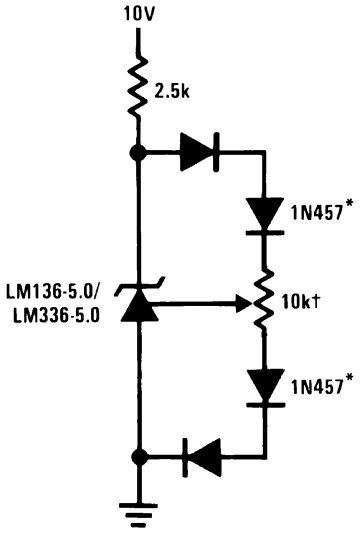
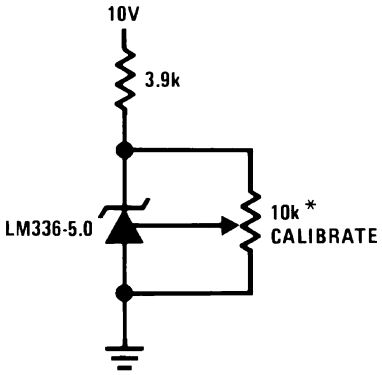


Figure 2. 5.0V Reference



† 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 ≤ 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 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

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) 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 ≤ 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) Specified, not tested.

Typical Performance Characteristics

Reverse Voltage Change

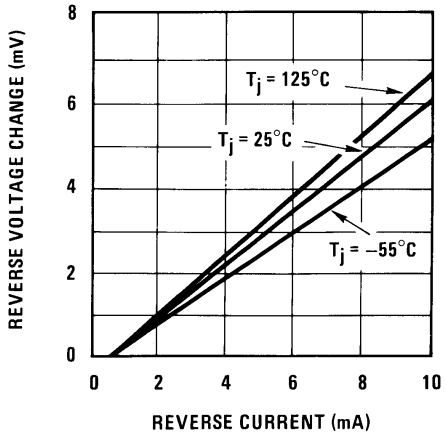


Figure 5.

Zener Noise Voltage

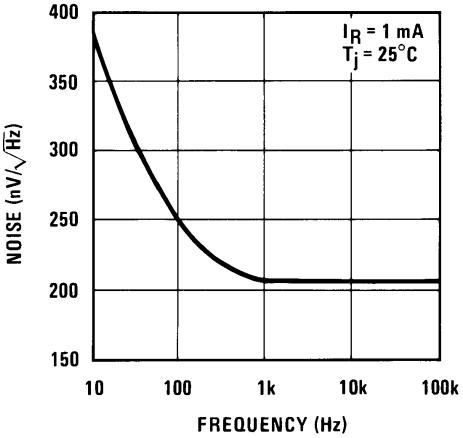


Figure 6.

Dynamic Impedance

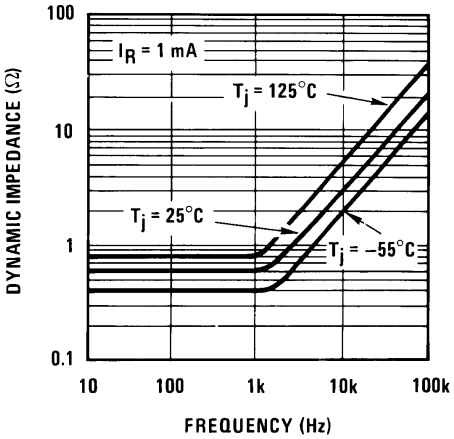


Figure 7.

Response Time

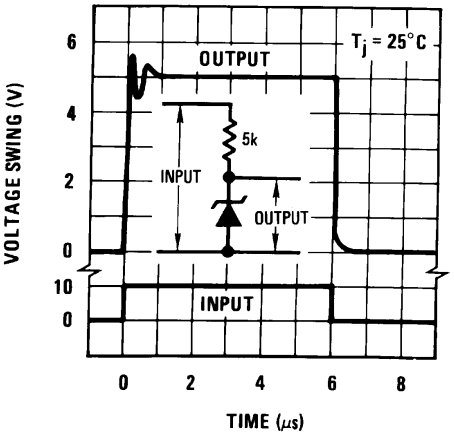


Figure 8.

Reverse Characteristics

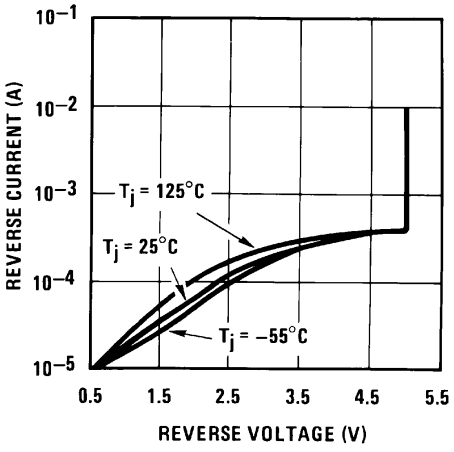


Figure 9.

Temperature Drift

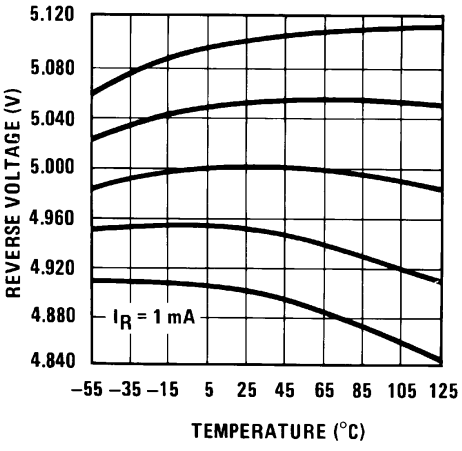


Figure 10.

Typical Performance Characteristics (continued)

Forward Characteristics

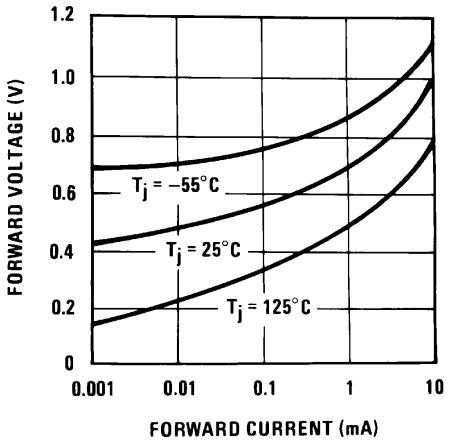


Figure 11.

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.

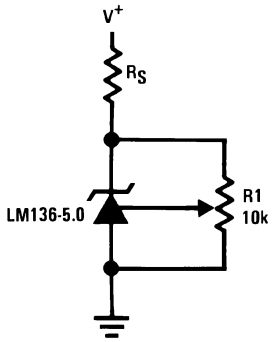


Figure 12. LM136-5.0 with Pot for Adjustment of Breakdown Voltage (Trim Range = ±1.0V Typical)

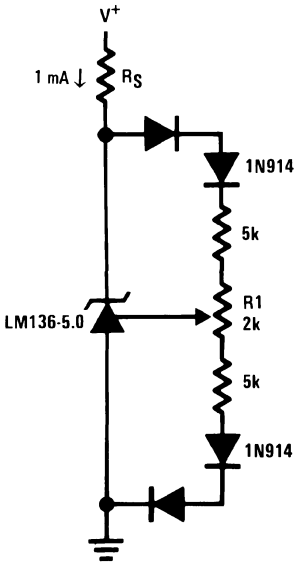
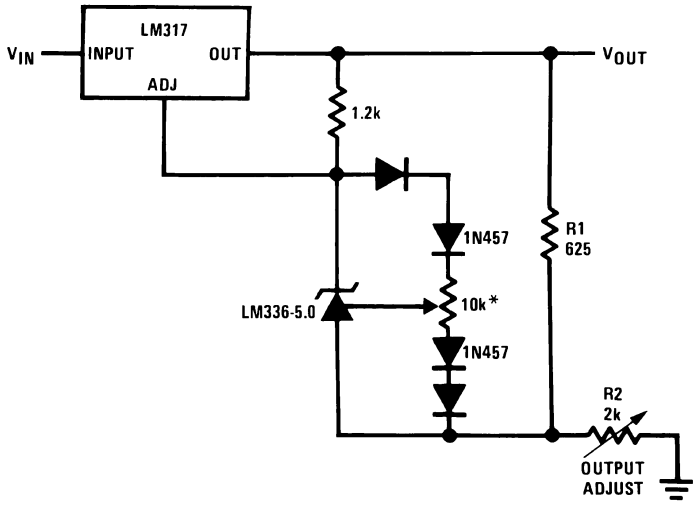


Figure 13. Temperature Coefficient Adjustment (Trim Range = ±0.5V Typical)

Typical Applications



* Adjust for 6.25V across R1

Figure 14. Precision Power Regulator with Low Temperature Coefficient

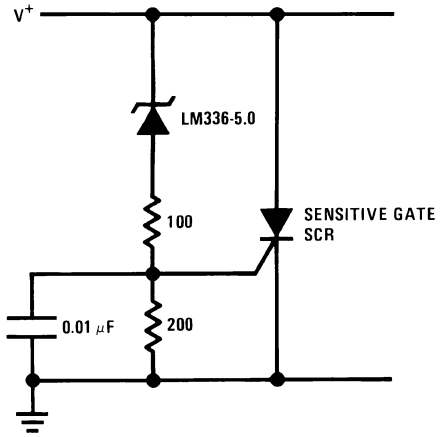


Figure 15. 5V Crowbar

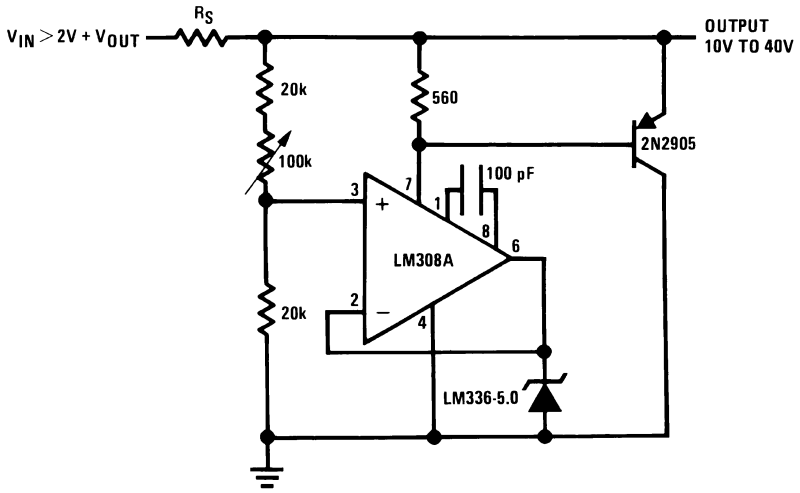


Figure 16. Adjustable Shunt Regulator

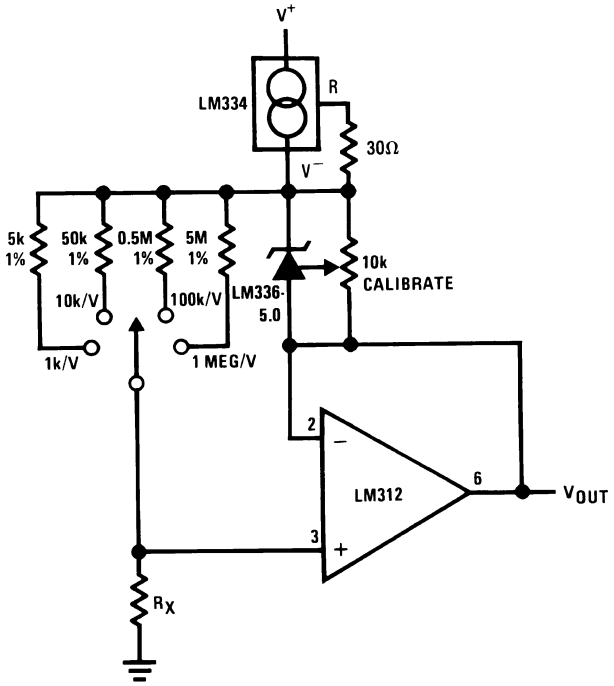


Figure 17. Linear Ohmmeter

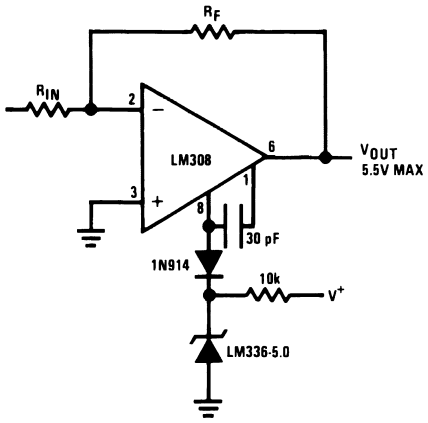


Figure 18. Bipolar Output Reference

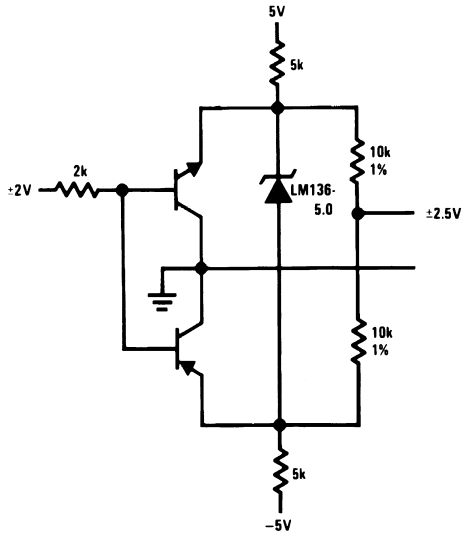


Figure 19. Bipolar Output Reference

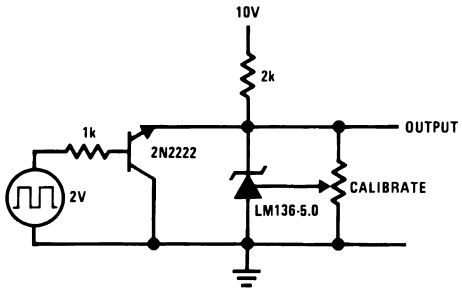


Figure 20. 5.0V Square Wave Calibrator

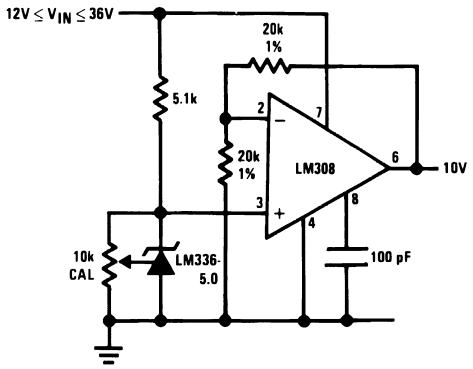


Figure 21. 10V Buffered Reference

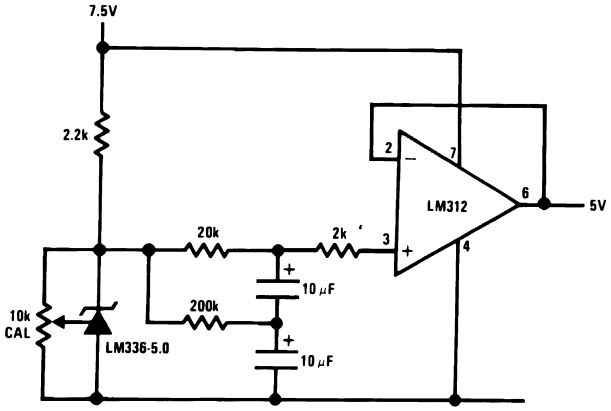


Figure 22. Low Noise Buffered Reference

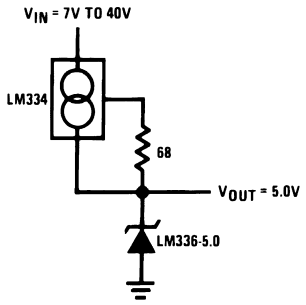


Figure 23. Wide Input Range Reference

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.

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

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
8418002XA	Active	Production	TO (NDV) | 3	20 | JEDEC TRAY (10+1)	Yes	Call TI	Level-1-NA-UNLIM	-55 to 125	8418002XA Q
LM136AH-5.0-SMD	Active	Production	TO (NDV) | 3	20 | JEDEC TRAY (10+1)	Yes	Call TI	Level-1-NA-UNLIM	-55 to 125	8418002XA Q
LM136AH-5.0/883	Active	Production	TO (NDV) | 3	20 | JEDEC TRAY (10+1)	Yes	Call TI	Level-1-NA-UNLIM	-55 to 125	LM136A-5.0 Q
LM136H-5.0/883	Active	Production	TO (NDV) | 3	20 | JEDEC TRAY (10+1)	Yes	Call TI	Level-1-NA-UNLIM	-55 to 125	LM136-5.0 Q

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

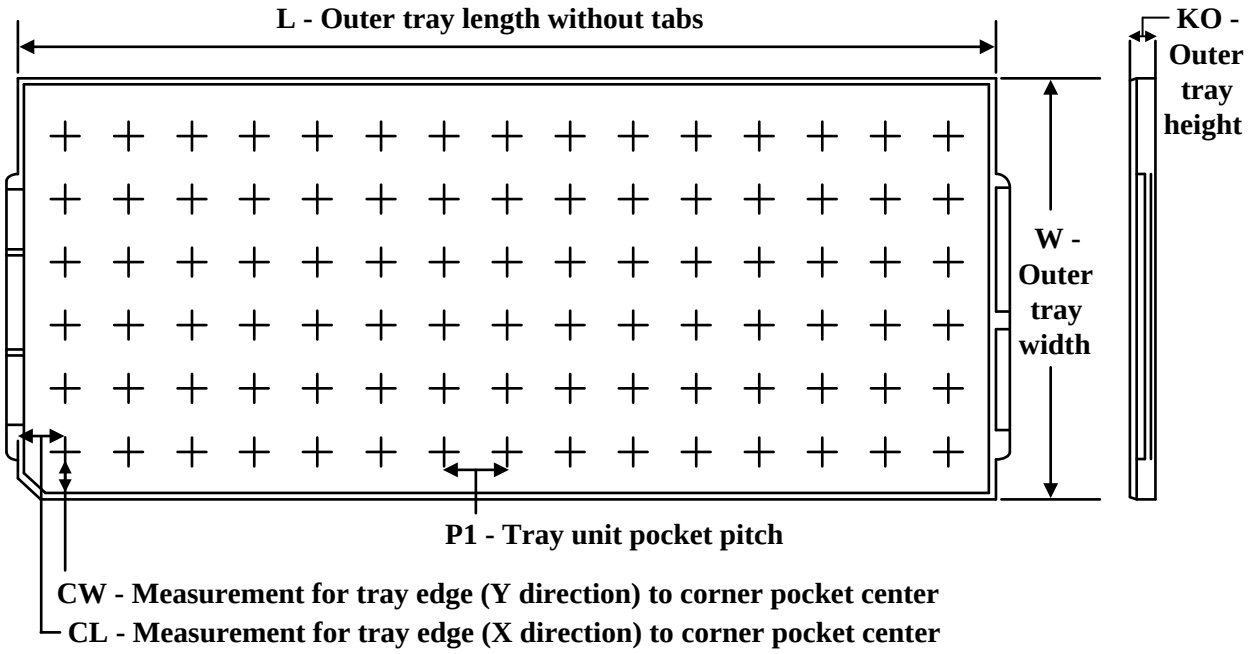
(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

TRAY



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

*All dimensions are nominal

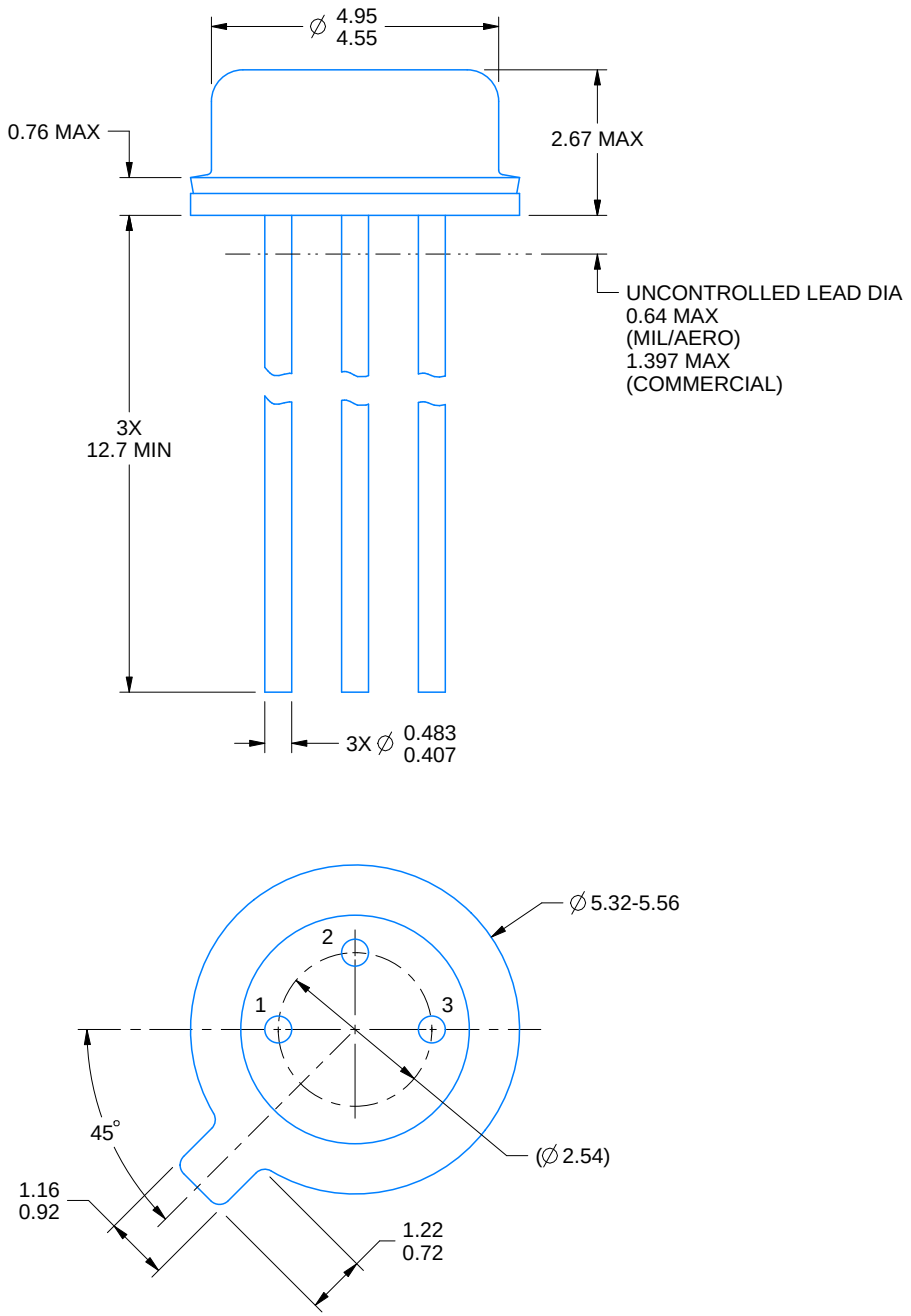
Device	Package Name	Package Type	Pins	SPQ	Unit array matrix	Max temperature (°C)	L (mm)	W (mm)	K0 (µm)	P1 (mm)	CL (mm)	CW (mm)
8418002XA	NDV	TO-CAN	3	20	2 X 10	150	126.49	61.98	10922	11.43	11.81	19.2
LM136AH-5.0-SMD	NDV	TO-CAN	3	20	2 X 10	150	126.49	61.98	10922	11.43	11.81	19.2
LM136AH-5.0/883	NDV	TO-CAN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

NDV0003H

PACKAGE OUTLINE

TO-CAN - 2.67 mm max height

TRANSISTOR OUTLINE



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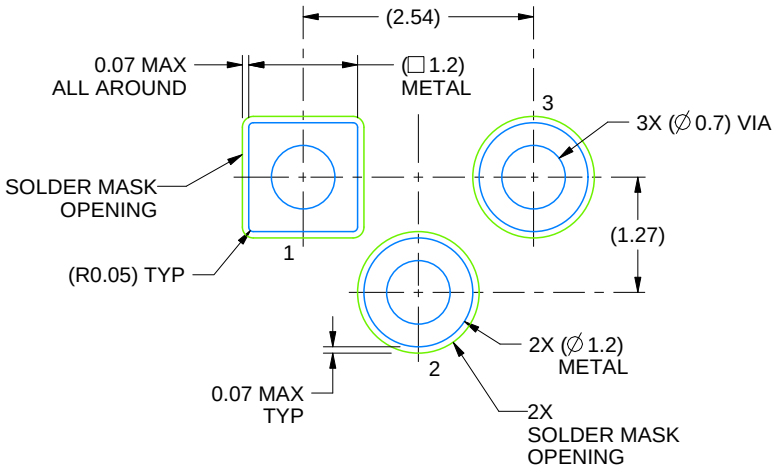
NOTES:

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.



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

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