LM129/LM329 Precision Reference

General Description
The LM129 and LM329 family are precision multi-current temperature-compensated 6.9V zener references with dynamic impedances a factor of 10 to 100 less than discrete diodes. Constructed in a single silicon chip, the LM129 uses active circuitry to buffer the internal zener allowing the device to operate over a 0.5 mA to 15 mA range with virtually no change in performance. The LM129 and LM329 are available with selected temperature coefficients of 0.001, 0.002, 0.005 and 0.01%/°C. These new references also have excellent long term stability and low noise.

A new subsurface breakdown zener used in the LM129 gives lower noise and better long-term stability than conventional IC zeners. Further the zener and temperature compensating transistor are made by a planar process so they are immune to problems that plague ordinary zeners. For example, there is virtually no voltage shift in zener voltage due to temperature cycling and the device is insensitive to stress on the leads.

The LM129 can be used in place of conventional zeners with improved performance. The low dynamic impedance simplifies biasing and the wide operating current allows the replacement of many zener types.

The LM129 is packaged in a 2-lead TO-46 package and is rated for operation over a −55°C to +125°C temperature range. The LM329 for operation over 0°C to 70°C is available in both a hermetic TO-46 package and a TO-92 epoxy package.

Features
- 0.6 mA to 15 mA operating current
- 0.001% dynamic impedance at any current
- Available with temperature coefficients of 0.001%/°C
- 7μV wideband noise
- 5% initial tolerance
- 0.002% long term stability
- Low cost
- Subsurface zener

Connection Diagrams

Typical Applications

Simple Reference

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## Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications. (Note 2)

- Reverse Breakdown Current: 30 mA
- Forward Current: 2 mA
- Operating Temperature Range:
  - LM129: -55°C to +125°C
  - LM329: 0°C to +70°C

## Storage Temperature Range
- -55°C to +150°C

## Soldering Information
- TO-92 package: 10 sec. 260°C
- TO-46 package: 10 sec. 300°C

## Electrical Characteristics (Note 1)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>LM129A, B, C</th>
<th>LM329A, B, C, D</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse Breakdown Voltage</td>
<td>TA = 25°C, 0.6 mA ≤ IR ≤ 15 mA</td>
<td>6.7, 6.9</td>
<td>7.2, 6.6, 6.9</td>
<td>7.25 V</td>
</tr>
<tr>
<td>Reverse Breakdown Change with Current</td>
<td>TA = 25°C, 0.6 mA ≤ IR ≤ 15 mA</td>
<td>9, 14</td>
<td>9, 20</td>
<td>mV</td>
</tr>
<tr>
<td>Reverse Dynamic Impedance</td>
<td>TA = 25°C, IR = 1 mA</td>
<td>0.6, 1</td>
<td>0.8, 2</td>
<td>Ω</td>
</tr>
<tr>
<td>RMS Noise</td>
<td>TA = 25°C, 10 Hz ≤ F ≤ 10 kHz, IR = 1 mA</td>
<td>7, 20</td>
<td>7, 100</td>
<td>μV</td>
</tr>
<tr>
<td>Long Term Stability (1000 hours)</td>
<td>TA = 45°C ± 0.1°C, IR = 1 mA ± 0.3%</td>
<td>20</td>
<td>20</td>
<td>ppm</td>
</tr>
<tr>
<td>Temperature Coefficient</td>
<td></td>
<td>6, 10</td>
<td>6, 10</td>
<td>ppm/°C</td>
</tr>
<tr>
<td>LM129C, LM329C, LM329D</td>
<td></td>
<td>30, 50</td>
<td>30, 50</td>
<td>ppm/°C</td>
</tr>
<tr>
<td>Change in Reverse Breakdown</td>
<td>1 mA ≤ IR ≤ 15 mA</td>
<td>1</td>
<td>1</td>
<td>ppm/°C</td>
</tr>
<tr>
<td>Temperature Coefficient</td>
<td></td>
<td>12</td>
<td>12</td>
<td>mV</td>
</tr>
<tr>
<td>Reverse Breakdown Change with Current</td>
<td>1 mA ≤ IR ≤ 15 mA</td>
<td>0.8</td>
<td>1</td>
<td>Ω</td>
</tr>
</tbody>
</table>

Note 1: These specifications apply for -55°C ≤ TA ≤ +125°C for the LM129 and 0°C ≤ TA ≤ +70°C for the LM329 unless otherwise specified. The maximum junction temperature for an LM129 is 150°C and LM329 is 100°C. For operating at elevated temperature, devices in TO-46 package must be derated based on a thermal resistance of 440°C/W junction to ambient or 80°C/W junction to case. For the TO-92 package, the derating is based on 180°C/W junction to ambient with 0.4" leads from a PC board and 160°C/W junction to ambient with 0.125" lead length to a PC board.

Note 2: Refer to RETS129H for LM129 family military specifications.

Note 3: These changes are tested on a pulsed basis with a low duty-cycle. For changes versus temperature, compute in terms of tempco.
Typical Applications (Continued)

Low Cost 0–25V Regulator

Adjustable Bipolar Output Reference

0V to 20V Power Reference

External Reference for Temperature Transducer
Typical Applications (Continued)

Positive Current Source

Schematic Diagram
Typical Performance Characteristics

Reverse Characteristics

Dynamic Impedance

Response Time

Reverse Voltage Change

Forward Characteristics

Zener Noise Voltage

Low Frequency Noise Voltage
Physical Dimensions  inches (millimeters)

[Diagram showing physical dimensions with values and annotations]

Metal Can Package
NS Package H02A
**Physical Dimensions** inches (millimeters) (Continued)

![Physical Dimensions Diagram](image)

**Plastic Package**
Order Number LM329BZ, LM329CZ, or LM329DZ
NS Package 203A

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