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 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.

Features
- 0.6 mA to 15 mA operating current
- 0.6Ω 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
Metal Can Package (T0–46)

Plastic Package (TO-92)

Pin 2 is electrically connected to case

Bottom View
See NS Package H02A

Bottom View
Order Number LM329BZ, LM329CZ or LM329DZ
See NS Package Z03A
Typical Applications

Simple Reference

9V TO 40V

R_s

LM129
6.9V

DS065714-1
### Absolute Maximum Ratings (Note 1)

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

(Nota 3)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse Breakdown Current</td>
<td>≤15 mA</td>
<td>30</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Forward Current</td>
<td></td>
<td>2</td>
<td>mA</td>
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</table>

Soldering Information

### Operating Temperature Range

<table>
<thead>
<tr>
<th>Device</th>
<th>Range</th>
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</thead>
<tbody>
<tr>
<td>LM129</td>
<td>−55˚C to +125˚C</td>
</tr>
<tr>
<td>LM329</td>
<td>0˚C to +70˚C</td>
</tr>
</tbody>
</table>

### Storage Temperature Range

<table>
<thead>
<tr>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>−55˚C to +150˚C</td>
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</table>

### Electrical Characteristics (Note 2)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>LM129A, B, C</th>
<th>LM329A, B, C, D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse Breakdown Voltage</td>
<td>( T_A = 25˚C, ) ( 0.6 \ mA \leq I_R \leq 15 \ mA )</td>
<td>6.7</td>
<td>6.9</td>
</tr>
<tr>
<td>Reverse Breakdown Change</td>
<td>( T_A = 25˚C, ) ( 0.6 \ mA \leq I_R \leq 15 \ mA )</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>Reverse Dynamic Impedance</td>
<td>( T_A = 25˚C, I_R = 1 \ mA )</td>
<td>0.6</td>
<td>1</td>
</tr>
<tr>
<td>RMS Noise</td>
<td>( T_A = 25˚C, ) ( 10 \ Hz \leq F \leq 10 \ kHz )</td>
<td>7</td>
<td>20</td>
</tr>
<tr>
<td>Long Term Stability (1000 hours)</td>
<td>( T_A = 45˚C \pm 0.1˚C, ) ( I_R = 1 \ mA \pm 0.3% )</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Temperature Coefficient</td>
<td>( I_R = 1 \ mA )</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Change in Reverse Breakdown Temperature Coefficient</td>
<td>( 1 \ mA \leq I_R \leq 15 \ mA )</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Reverse Breakdown Change</td>
<td>( 1 \ mA \leq I_R \leq 15 \ mA )</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Reverse Dynamic Impedance</td>
<td>( 1 \ mA \leq I_R \leq 15 \ mA )</td>
<td>0.8</td>
<td></td>
</tr>
</tbody>
</table>

**Note 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 guarantee specific performance limits.

**Note 2:** These specifications apply for −55˚C ≤ \( T_A \) ≤ +125˚C for the LM129 and 0˚C ≤ \( T_A \) ≤ +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 3:** Refer to RETS129H for LM129 family military specifications.

**Note 4:** These changes are tested on a pulsed basis with a low duty-cycle. For changes versus temperature, compute in terms of tempco.
Typical Applications

Low Cost 0–25V Regulator

Adjustable Bipolar Output Reference

www.national.com
Typical Applications (Continued)

0V to 20V Power Reference

External Reference for Temperature Transducer
Typical Applications (Continued)

Positive Current Source

Buffered Reference with Single Supply
**Schematic Diagram**

![Schematic Diagram](image)

**Typical Performance Characteristics**

- **Reverse Characteristics**
  - Reverse Current vs. Reverse Voltage (V)
  - Reverse Voltage Change vs. Reverse Current (mA)

- **Response Time**
  - Voltage Swing vs. Time (μs)

- **Forward Characteristics**
  - Forward Voltage vs. Forward Current (mA)

- **Dynamic Impedance**
  - Dynamic Impedance vs. Frequency (Hz)

- **Zener Noise Voltage**
  - Noise vs. Frequency (Hz)
Typical Performance Characteristics (Continued)

Low Frequency Noise Voltage

![Graph showing low frequency noise voltage](image)

0.01 Hz ≤ f ≤ 1 Hz

DSO65714-5
Physical Dimensions inches (millimeters) unless otherwise noted

Metal Can Package
NS Package H02A

H02A (REV C)
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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.