** FEATURES **
- Guaranteed ±4mV Initial Accuracy LT1004-1.2
- Guaranteed ±20mV Accuracy LT1004-2.5
- Guaranteed 10μA Operating Current
- Guaranteed Temperature Performance
- Operates up to 20mA
- Very Low Dynamic Impedance

** APPLICATIONS **
- Portable Meter References
- Portable Test Instruments
- Battery-Operated Systems
- Current Loop Instrumentation

** DESCRIPTION **

The LT1004 micropower voltage reference is a 2-terminal bandgap reference diode designed to provide high accuracy and excellent temperature characteristics at very low operating currents. Optimization of the key parameters in the design, processing and testing of the device results in accuracy specifications previously attainable only with selected units. Below is a distribution plot of reference voltage for a typical lot of LT1004-1.2. Virtually all of the units fall well within the prescribed limits of ±4mV.

The LT1004 is a pin-for-pin replacement for the LM185/LM385 series of references with improved accuracy specifications. More important, the LT1004 is an attractive device for use in systems where accuracy was previously obtained at the expense of power consumption and trimming.

For a low drift micropower reference with guaranteed temperature coefficient, see the LT1034 data sheet.

** TYPICAL APPLICATION **

Micropower Cold Junction Compensation for Thermocouples

![Diagram of micropower cold junction compensation for thermocouples](image)

** Typical Distribution of Reference Voltage (LT1004-1.2) **

![Graph showing typical distribution of reference voltage](image)
LT1004

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

Reverse Breakdown Current ................................ 30mA
Forward Current ........................................... 10mA
Storage Temperature Range ................ –65°C to 150°C
Lead Temperature (Soldering, 10 sec) .............. 300°C

**PACKAGE/ORDER INFORMATION**

<table>
<thead>
<tr>
<th>ORDER PART NUMBER</th>
<th>ORDER PART NUMBER</th>
<th>S8 PART MARKING</th>
<th>ORDER PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>LT1004MH-1.2</td>
<td>LT1004CH-1.2</td>
<td>0412</td>
<td>LT1004CZ-1.2</td>
</tr>
<tr>
<td>LT1004MH-2.5</td>
<td>LT1004CH-2.5</td>
<td>0425</td>
<td>LT1004CZ-2.5</td>
</tr>
<tr>
<td>LT1004I</td>
<td>LT1004IS8-1.2</td>
<td>0412I</td>
<td>LT1004IZ-1.2</td>
</tr>
<tr>
<td>LT1004C</td>
<td>LT1004IS8-2.5</td>
<td>0425I</td>
<td>LT1004IZ-2.5</td>
</tr>
</tbody>
</table>

Consult LTC Marketing for parts specified with wider operating temperature ranges.

**ELECTRICAL CHARACTERISTICS**

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at TA = 25°C. (Note 2)

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>PARAMETER</th>
<th>CONDITIONS</th>
<th>LT1004-1.2</th>
<th>LT1004-2.5</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>●VZ</td>
<td>Reverse Breakdown Voltage</td>
<td>IR = 100μA</td>
<td>1.231</td>
<td>2.480</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>●LT1004M: –55°C ≤ TA ≤ 125°C</td>
<td></td>
<td>1.235</td>
<td>2.500</td>
<td></td>
</tr>
<tr>
<td></td>
<td>●LT1004C: 0°C ≤ TA ≤ 70°C</td>
<td></td>
<td>1.239</td>
<td>2.520</td>
<td></td>
</tr>
<tr>
<td></td>
<td>●LT1004I: –40°C ≤ TA ≤ 85°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>●1.220 1.230 1.245 2.460</td>
<td></td>
<td>2.500</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>●1.225 1.235 1.245 2.470</td>
<td></td>
<td>2.530</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>●1.220 1.230 1.245 2.460</td>
<td></td>
<td>2.530</td>
<td></td>
<td></td>
</tr>
<tr>
<td>●AVZ</td>
<td>Average Temperature Coefficient</td>
<td>IMIN ≤ IR ≤ 20mA (Note 3)</td>
<td>20</td>
<td>20</td>
<td>ppm/°C</td>
</tr>
<tr>
<td>●I_MIN</td>
<td>Minimum Operating Current</td>
<td>●9 10 12 20</td>
<td>8</td>
<td>10</td>
<td>μA</td>
</tr>
<tr>
<td>●AVZ</td>
<td>Reverse Breakdown Voltage</td>
<td>I_MIN ≤ IR ≤ 1mA</td>
<td>1.0</td>
<td>1.0</td>
<td>mV</td>
</tr>
<tr>
<td>●IR</td>
<td>Change with Current</td>
<td>●1.5</td>
<td>1.5</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td></td>
<td>●1mA ≤ IR ≤ 20mA</td>
<td>●10</td>
<td>10</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td></td>
<td>●20</td>
<td>●20</td>
<td>20</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td>●t_Z</td>
<td>Reverse Dynamic Impedance</td>
<td>IR = 100μA</td>
<td>0.2</td>
<td>0.2</td>
<td>Ω</td>
</tr>
<tr>
<td></td>
<td>●0.6</td>
<td></td>
<td>0.6</td>
<td>Ω</td>
<td></td>
</tr>
<tr>
<td></td>
<td>●1.5</td>
<td></td>
<td>1.5</td>
<td>Ω</td>
<td></td>
</tr>
<tr>
<td>●v_n</td>
<td>Wide Band Noise (RMS)</td>
<td>IR = 100μA, 10Hz ≤ f ≤ 10kHz</td>
<td>60</td>
<td>120</td>
<td>μV</td>
</tr>
<tr>
<td>●AVZ</td>
<td>Long Term Stability</td>
<td>IR = 100μA, TA = 25°C ± 0.1°C</td>
<td>20</td>
<td>20</td>
<td>ppm/kHr</td>
</tr>
</tbody>
</table>

**Note 1:** Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

**Note 2:** All specifications are for TA = 25°C unless otherwise noted.

**Note 3:** Selected devices with guaranteed maximum temperature coefficient are available upon request.

For MIL-STD components, please refer to LTC 883C data sheet for test listing and parameters.
LT1004

TYPICAL PERFORMANCE CHARACTERISTICS (2.5V)

Reverse Characteristics

Forward Characteristics

Temperature Drift

Reverse Dynamic Impedance

Reverse Dynamic Impedance

Noise Voltage

Filtered Output Noise

Response Time

Downloaded from Arrow.com.
TYPICAL APPLICATIONS

High Stability 5V Regulator

Variable Output Supply

Constant Gain Amplifier Over Temperature

Micropower 5V Reference

Lead Acid Low-Battery Detector

Ground Referenced Current Source

†R1 SETS TRIP POINT, 60.4k PER CELL FOR 1.8V/CELL

*MAY BE INCREASED FOR SMALL OUTPUT CURRENTS
**TYPICAL APPLICATIONS**

- **VPP Generator for Eproms — No Trim Required**
  - LT1004-1.2
  - 24V
  - 22k
  - LT1004-1.2
  - 12k
  - 2N3904
  - 0.05µF
  - LM301A
  - 24V
  - 100pF
  - 600µs RC PER INTEL SPEC
  - OUT
  - 21V

- **1.2V Reference from 1.5V Battery**
  - LT1004-1.2
  - 1.9V*
  - 3k
  - LT1004-1.2
  - 1.235V
  - *OUTPUT REGULATES DOWN TO 1.285V FOR IOUT = 0

- **Micropower Reference from 9V Battery**
  - 9V
  - 510k
  - LT1004-1.2
  - 1.235V

- **2.5V Reference**
  - 5V
  - 50k
  - LT1004-2.5
  - 2.500V

- **Low Noise Reference**
  - VIN ≥ 5V
  - 100µA
  - OUTPUT
  - 50µF

**SCHEMATIC DIAGRAMS**

- **LT1004-1.2**
  - Q1
  - Q5
  - 20µF
  - 20k
  - 200k
  - 200k
  - 200k
  - Q11
  - Q10
  - 600k
  - 50k
  - 300k
  - 500k

- **LT1004-2.5**
  - Q1
  - Q5
  - 20µF
  - 20k
  - 200k
  - 200k
  - 200k
  - Q11
  - Q10
  - 600k
  - 50k
  - 300k
  - 500k
Information furnished by Linear Technology Corporation is believed to be accurate and reliable. However, no responsibility is assumed for its use. Linear Technology Corporation makes no representation that the interconnection of its circuits as described herein will not infringe on existing patent rights.

H Package
2-Lead and 3-Lead TO-46 Metal Can
(Reference LTC DWG # 05-08-1340)

S8 Package
8-Lead Plastic Small Outline (Narrow .150 Inch)
(Reference LTC DWG # 05-08-1610)

Z Package
3-Lead Plastic TO-92 (Similar to TO-226)
(Reference LTC DWG # 05-08-1410)
TYPICAL APPLICATIONS

0°C to 100°C Linear Output Thermometer

Low Temperature Coefficient 2-Terminal Current Source

RELATED PARTS

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>DESCRIPTION</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LT1634</td>
<td>Micropower Precision Shunt Reference</td>
<td>10μA Operating Current, 10ppm/°C Maximum Drift, 0.05% Initial Accuracy</td>
</tr>
<tr>
<td>LT1460S3-2.5</td>
<td>Micropower Series Reference in SOT-23</td>
<td>100μA Operating Current, 20ppm/°C Maximum Drift, 0.2% Initial Accuracy</td>
</tr>
<tr>
<td>LT1790</td>
<td>Precision Micropower LDO Reference in SOT-23</td>
<td>10ppm/°C Max Drift, 0.05% Initial Accuracy</td>
</tr>
</tbody>
</table>