FEATURES
- Maximum Initial Tolerance: 0.2%
- Guaranteed Temperature Stability
- Maximum 0.6Ω Dynamic Impedance
- Wide Operating Current Range
- Directly Interchangeable with LM136 for Improved Performance
- No Adjustments Needed for Minimum Temperature Coefficient
- Available in 8-Lead SO and MSOP Packages and 3-Lead TO-92 Package

APPLICATIONS
- Reference for 5V Systems
- 8-Bit A/D and D/A Reference
- Digital Voltmeters
- Current Loop Measurement and Control Systems
- Power Supply Monitor

DESCRIPTION
The LT®1009 is a precision trimmed 2.5V shunt regulator diode featuring a maximum initial tolerance of only ±5mV. The low dynamic impedance and wide operating current range enhances its versatility. The 0.2% reference tolerance is achieved by on-chip trimming which not only minimizes the initial voltage tolerance but also minimizes the temperature drift.

Even though no adjustments are needed with the LT1009, a third terminal allows the reference voltage to be adjusted ±5% to calibrate out system errors. In many applications, the LT1009 can be used as a pin-to-pin replacement of the LM136 and the external trim network eliminated.

For a lower drift 2.5V reference, see the LT1019 data sheet.

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LT1009 Series

ABSOLUTE MAXIMUM RATINGS  (Note 1)
Reverse Current ..................................................... 20mA
Forward Current ..................................................... 10mA
Storage Temperature Range ................... –65°C to 150°C
Lead Temperature (Soldering, 10 sec) ............. 300°C

Operating Temperature Range
LT1009/LT1009C .............................................. 0°C to 70°C
LT1009I ......................................................... –40°C to 85°C
LT1009M (OBSOLETE) ................. –55°C to 125°C

PIN CONFIGURATION

BOTTOM VIEW

H PACKAGE
3-LEAD TO-46 METAL CAN
TJMAX = 150°C, θJA = 440°C/W, θJC = 80°C/W

OBSOLETE PACKAGE
Consider the MS8, S8 or Z Packages for Alternate Source

TOP VIEW

S8 PACKAGE
8-LEAD PLASTIC SO
TJMAX = 150°C, θJA = 190°C/W

MS8 PACKAGE
8-LEAD PLASTIC MSOP
TJMAX = 150°C, θJA = 250°C/W

Z PACKAGE
3-LEAD PLASTIC TO-92
TJMAX = 100°C, θJA = 160°C/W

ORDER INFORMATION

<table>
<thead>
<tr>
<th>LEAD FREE FINISH</th>
<th>TAPE AND REEL</th>
<th>PART MARKING</th>
<th>PACKAGE DESCRIPTION</th>
<th>TEMPERATURE RANGE</th>
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</thead>
<tbody>
<tr>
<td>LT1009MH#PBF</td>
<td>LT1009MH#TRPBF</td>
<td></td>
<td>3-Lead TO-46 Metal Can</td>
<td>–55°C to 125°C</td>
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<tr>
<td>LT1009CH#PBF</td>
<td>LT1009CH#TRPBF</td>
<td></td>
<td>3-Lead TO-46 Metal Can</td>
<td>0°C to 70°C</td>
</tr>
<tr>
<td>LT1009CMS8#PBF</td>
<td>LT1009CMS8#TRPBF</td>
<td>LTOZ</td>
<td>8-Lead Plastic MSOP</td>
<td>0°C to 70°C</td>
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<tr>
<td>LT1009S8#PBF</td>
<td>LT1009S8#TRPBF</td>
<td>1009</td>
<td>8-Lead Plastic SO</td>
<td>0°C to 70°C</td>
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<tr>
<td>LT1009I$S8#PBF</td>
<td>LT1009I$S8#TRPBF</td>
<td>1009I</td>
<td>8-Lead Plastic SO</td>
<td>–40°C to 85°C</td>
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<td>LT1009CZ#PBF</td>
<td>LT1009CZ#TRPBF</td>
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<td>3-Lead Plastic TO-92</td>
<td>0°C to 70°C</td>
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<tr>
<td>LT1009IZ#PBF</td>
<td>LT1009IZ#TRPBF</td>
<td></td>
<td>3-Lead Plastic TO-92</td>
<td>–40°C to 85°C</td>
</tr>
</tbody>
</table>
ORDER INFORMATION

LEAD BASED FINISH  TAPE AND REEL  PART MARKING  PACKAGE DESCRIPTION  TEMPERATURE RANGE

LT1009MH  LT1009MH#TR  3-Lead TO-46 Metal Can  -55°C to 125°C
LT1009CH  LT1009CH#TR  3-Lead TO-46 Metal Can  0°C to 70°C
LT1009CMS8  LT1009CMS8#TR  LTQZ  8-Lead Plastic MSOP  0°C to 70°C
LT1009S8  LT1009S8#TR  1009  8-Lead Plastic SO  0°C to 70°C
LT1009IS8  LT1009IS8#TR  1009I  8-Lead Plastic SO  -40°C to 85°C
LT1009CZ  LT1009CZ#TR  3-Lead Plastic TO-92  0°C to 70°C
LT1009IZ  LT1009IZ#TR  3-Lead Plastic TO-92  -40°C to 85°C

Consult LTC Marketing for parts specified with wider operating temperature ranges.
For more information on lead free part marking, go to: http://www.linear.com/leadfree/
For more information on tape and reel specifications, go to: http://www.linear.com/tapeandreel/

AVAILABLE OPTIONS

<table>
<thead>
<tr>
<th>TEMPERATURE</th>
<th>ACCURACY (%)</th>
<th>TEMPERATURE COEFFICIENT (ppm/°C)</th>
<th>TO-46 (H) OBsolete</th>
<th>MSOP-8 (MS8)</th>
<th>SO-8 (S8)</th>
<th>TO-92 (Z)</th>
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</thead>
<tbody>
<tr>
<td>0°C to 70°C</td>
<td>0.20</td>
<td>25</td>
<td>LT1009CH</td>
<td>LT1009CMS8</td>
<td>LT1009S8</td>
<td>LT1009CZ</td>
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<tr>
<td>-40°C to 85°C</td>
<td>0.20</td>
<td>35</td>
<td></td>
<td></td>
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<tr>
<td>-55°C to 125°C</td>
<td>0.20</td>
<td>35</td>
<td></td>
<td></td>
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</table>

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A = 25°C$.

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>PARAMETER</th>
<th>CONDITIONS</th>
<th>LT1009M</th>
<th>LT1009I</th>
<th>LT1009/LT1009C</th>
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<tbody>
<tr>
<td>$V_Z$</td>
<td>Reverse Breakdown Voltage</td>
<td>$T_A = 25°C$, $I_R = 1mA$</td>
<td>H, Z Pkg</td>
<td>H, Z Pkg</td>
<td>H, Z Pkg</td>
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<tr>
<td></td>
<td></td>
<td>25°C</td>
<td>2.495</td>
<td>2.500</td>
<td>2.505</td>
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<tr>
<td></td>
<td></td>
<td>70°C</td>
<td>2.505</td>
<td>2.505</td>
<td>2.505</td>
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<tr>
<td>$\Delta V_Z$</td>
<td>Reverse Breakdown Change with Current</td>
<td>400μA ≤ $I_R ≤ 10mA$</td>
<td>2.495</td>
<td>2.500</td>
<td>2.505</td>
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<td></td>
<td></td>
<td>25°C</td>
<td>2.6</td>
<td>6</td>
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<td>70°C</td>
<td>2.6</td>
<td>12</td>
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<tr>
<td>$r_Z$</td>
<td>Reverse Dynamic Impedance</td>
<td>$I_R = 1mA$</td>
<td>0.1</td>
<td>0.6</td>
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<tr>
<td></td>
<td></td>
<td>25°C</td>
<td>0.2</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>70°C</td>
<td>0.2</td>
<td>1.0</td>
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<tr>
<td></td>
<td></td>
<td>25°C</td>
<td>0.4</td>
<td>1.4</td>
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<tr>
<td></td>
<td></td>
<td>70°C</td>
<td>0.4</td>
<td>1.4</td>
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<tr>
<td>$\Delta V_Z$</td>
<td>Temperature Stability</td>
<td>$T_{MIN} ≤ T_A ≤ T_{MAX}$</td>
<td>15</td>
<td>15</td>
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<tr>
<td></td>
<td></td>
<td>25°C</td>
<td>15</td>
<td>15</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>70°C</td>
<td>15</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25°C</td>
<td>1.8</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>70°C</td>
<td>1.8</td>
<td>4</td>
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<tr>
<td>$\Delta V_Z$</td>
<td>Average Temperature Coefficient (Notes 2, 3)</td>
<td>$0°C ≤ T_A ≤ 70°C$</td>
<td>15</td>
<td>25</td>
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<tr>
<td></td>
<td></td>
<td>$-40°C ≤ T_A ≤ 85°C$</td>
<td>15</td>
<td>25</td>
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<tr>
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<td>$-55°C ≤ T_A ≤ 125°C$</td>
<td>15</td>
<td>25</td>
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<tr>
<td></td>
<td></td>
<td>ppm/°C</td>
<td>15</td>
<td>25</td>
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<tr>
<td>$\Delta V_Z$</td>
<td>Long-Term Stability</td>
<td>$T_A = 25°C ±0.1°C$, $I_R = 1mA$</td>
<td>20</td>
<td>20</td>
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<tr>
<td></td>
<td></td>
<td>ppm/kHr</td>
<td>20</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Note 2: Guaranteed by Design.

Note 3: Average temperature coefficient is defined as the total voltage change divided by the specified temperature change.
**TYPICAL PERFORMANCE CHARACTERISTICS**

**Reverse Characteristics**
- **Reverse Voltage (V):** 0.5, 2.2
- **Reverse Current (A):** 10⁻¹, 10⁻², 10⁻³, 10⁻⁴, 10⁻⁵

**Forward Characteristics**
- **Forward Voltage (V):** 0, 0.2, 0.4, 0.6, 0.8, 1.0, 1.2
- **Forward Current (mA):** 0.001, 0.01, 0.1, 1, 10

**Reverse Voltage Change**
- **Reverse Current (mA):** 0
- **Reverse Voltage Change (mV):** 0, 1, 2, 3, 4, 5

**Dynamic Impedance**
- **Frequency (Hz):** 10, 100, 1k, 10k, 100k
- **Dynamic Impedance (Ω):** 0.1, 1, 10, 100, 1k, 10k

**Output Noise Voltage**
- **Frequency (Hz):** 10, 100, 1k, 10k, 100k
- **Noise (nV/√Hz):** 50, 100, 150, 200

**Response Time**
- **Input Voltage Swing (V):** 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5
- **Output Voltage Swing (V):** 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5
- **Time (μs):** 0, 1, 2, 4, 10, 20

**Notes:**
- IR = 1mA, -55°C ≤ TJ ≤ 125°C
- TJ = 25°C

-TJ = 125°C
-TJ = -55°C
**TYPICAL APPLICATIONS**

**Wide Supply Range, Adjustable Reference**

3.6V TO 40V

**Low Temperature Coefficient Power Regulator**

VIN VOUT

**Switchable ±1.25V Bipolar Reference**

5V

-5V
LT1009 Series

PACKAGE DESCRIPTION

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

- Lead Diameter is uncontrolled between the Reference Plane and .050" below the Reference Plane
- For solder dip lead finish, lead diameter is .016 – .024 .0406 – .0610

MS8 Package
8-Lead Plastic MSOP
(Reference LTC DWG # 05-08-1660)

- Recommended solder pad layout
- Details "A"

NOTE:
1. Dimensions in millimeter/inch
2. Drawing not to scale
3. Dimension does not include mold flash, protrusions or gate burrs.
4. Dimension does not include interlead flash or protrusions.
5. Lead coplanarity (bottom of leads after forming) shall be 0.102mm (.004") max

RECOMMEND SOLDER PAD LAYOUT

0.16 – 0.19" (0.406 – 0.483) DIA

LEAD DIAMETER IS UNCONTROLLED BETWEEN THE REFERENCE PLANE AND .050" BELOW THE REFERENCE PLANE
** FOR SOLDER DIP LEAD FINISH, LEAD DIAMETER IS .016 – .024 (.0406 – .0610)

REFERENCES

SEATING PLANE

LEAD DIAMETER IS UNCONTROLLED BETWEEN THE REFERENCE PLANE AND .050" BELOW THE REFERENCE PLANE
** FOR SOLDER DIP LEAD FINISH, LEAD DIAMETER IS .016 – .024 (.0406 – .0610)

0.102mm (.004") MAX

NOTE:
1. Dimensions in millimeter/inch
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3. Dimension does not include mold flash, protrusions or gate burrs.
4. Dimension does not include interlead flash or protrusions.
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** FOR SOLDER DIP LEAD FINISH, LEAD DIAMETER IS .016 – .024 (.0406 – .0610)

REFERENCES

SEATING PLANE

LEAD DIAMETER IS UNCONTROLLED BETWEEN THE REFERENCE PLANE AND .050" BELOW THE REFERENCE PLANE
** FOR SOLDER DIP LEAD FINISH, LEAD DIAMETER IS .016 – .024 (.0406 – .0610)
PACKAGE DESCRIPTION

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

0.016 – 0.050
(0.406 – 1.270)
0.010 – 0.020
(0.254 – 0.508)
× 45°

0.000 – 0.025
(0.000 – 0.063)
× 45°

0.050 – 0.069
(1.346 – 1.752)

0.000 – 0.016
(0.000 – 0.041)

RECOMMENDED SOLDER PAD LAYOUT

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

BULK PACK
0.040 ± 0.010
(1.016 ± 0.025)

NOTE 3
8 7 6 5
1 2 3 4

2 PLCS
TO-92 TAPE AND REEL
REFER TO TAPE AND REEL SECTION OF
LTC DATA BOOK FOR ADDITIONAL INFORMATION

INCHES

MILLIMETERS

NOTE:
1. DIMENSIONS IN
2. DRAWING NOT TO SCALE
3. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .006” (0.15mm)

UNCONTROLLED
LEAD DIMENSION
MAX

NOM

MIN

MAX

UNCONTROLLED
LEAD DIMENSION
MAX

NOM

MIN

MAX
# LT1009 Series

## TYPICAL APPLICATION

**Low Noise 2.5V Buffered Reference**

![Circuit Diagram](image)

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<th>PART NUMBER</th>
<th>DESCRIPTION</th>
<th>COMMENTS</th>
</tr>
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<td>LT1019</td>
<td>Precision Series Reference</td>
<td>Bandgap, 0.05%, 5ppm/°C</td>
</tr>
<tr>
<td>LT1236</td>
<td>Precision Series Reference</td>
<td>5V and 10V Zener-Based 5ppm/°C, SO-8 Package</td>
</tr>
<tr>
<td>LTC®1798</td>
<td>Micropower Low Dropout Series Reference</td>
<td>0.15% Max, 6.5μA Supply Current</td>
</tr>
<tr>
<td>LT1460</td>
<td>Micropower Precision Series Reference</td>
<td>Bandgap, 130μA Supply Current 10ppm/°C, Available in SOT-23</td>
</tr>
<tr>
<td>LT1634</td>
<td>Micropower Precision Shunt Voltage Reference</td>
<td>Bandgap 0.05%, 10ppm/°C, 10μA Supply Current</td>
</tr>
<tr>
<td>LT1461</td>
<td>Micropower Precision Series Reference</td>
<td>0.04% Max, 3ppm/°C Max, 35μA Supply Current</td>
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