AMS9491
1.235V VOLTAGE REFERENCE

RoHS compliant

FEATURES
• ±10 mV max. initial tolerance (A grade)
• Operating Current 10µA to 20mA
• Low Voltage Reference 1.235
• Max. 0.6Ω Dynamic Impedance (A grade)
• Low Temperature Coefficient

APPLICATIONS
• Battery Powered Systems
• Instrumentation
• A/D, D/A Converters
• Temperature measurement
• Current sources
• Pagers

GENERAL DESCRIPTION
The AMS9491 is a two-terminal micropower band-gap voltage reference diode. It features a very low dynamic impedance and good temperature coefficient, operating over a 10µA to 20mA current range. On-chip trimming is used to provide tight voltage tolerance. Since the AMS9491 is a band-gap reference, uses only transistors and resistors, low noise and good long-term stability result. Careful design of the AMS9491 has made the device exceptionally tolerant of capacitive loading, making it easy to use in almost any reference application. The wide dynamic operating range allows its use with widely varying supplies with excellent regulation. The extremely low power drain of the AMS9491 makes this reference diode useful for micropower circuitry.

The AMS9491 can be used to make portable meters, regulators or general purpose analog circuitry with battery life approaching shelf life. Further more, the wide operating current allows it to replace older references with a tight tolerance part. The AMS9491 is operating over a 0°C to 70°C temperature range and is available in TO-92 and SO-8 packages.

ORDERING INFORMATION:

<table>
<thead>
<tr>
<th>TOL.</th>
<th>PACKAGE TYPE</th>
<th>OPERATING TEMPERATURE RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>±10mV</td>
<td>AMS9491AN</td>
<td>0 to 70°C</td>
</tr>
<tr>
<td>±20mV</td>
<td>AMS9491BN</td>
<td>0 to 70°C</td>
</tr>
</tbody>
</table>

PIN CONNECTIONS

TO-92
Plastic Package (N)

8L SOIC
SO Package (S)

Bottom View

Top View
ABSOLUTE MAXIMUM RATINGS (Note 1)
Reverse Current 30mA Soldering information (25 sec.) 265°C
Forward Current 10mA
Operating Temperature Range 0°C to 70°C
Storage temperature -55°C to +150°C

ELECTRICAL CHARACTERISTICS
Electrical Characteristics at IR = 100 µA, and TA = +25°C unless otherwise specified.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>AMS9491A</th>
<th>AMS9491B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse Breakdown Voltage (Note 4)</td>
<td>IR = 100 µA</td>
<td>1.215</td>
<td>1.215</td>
</tr>
<tr>
<td>Reverse Dynamic Impedance (Note 4)</td>
<td>IR = 100 µA, f=20Hz</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Reverse Breakdown Voltage Change with current</td>
<td>10µA ≤ IR ≤ 1mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. Operating Current (Note 4)</td>
<td>IR = 100 µA</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Wide Band Noise (Note 5)</td>
<td>IR = 100 µA, 10Hz ≤ f ≤ 10kHz</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Temperature Coeff. (Note 6)</td>
<td></td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Long Term Stability (Note 5)</td>
<td>TA=25°C±1°C</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

Units: V, Ω, mV, µA, μV, ppm/°C

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics. The guaranteed specifications apply only for the test conditions listed.

Note 2: Thermal resistance is as follows:

<table>
<thead>
<tr>
<th>Thermal Resistance</th>
<th>TO-92</th>
<th>SO-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΦJA (junction to ambient)</td>
<td>170°C/W (0.125” leads)</td>
<td>165°C/W</td>
</tr>
</tbody>
</table>

Note 3: Parameters identified with boldface type apply at temperature extremes. All other numbers apply at TA = TJ = 25°C.

Note 4: Guaranteed and 100% production tested.

Note 5: Guaranteed but not 100% production tested. These limits are not used to calculate average outgoing quality levels.

Note 6: The average temperature coefficient is defined as the maximum deviation of reference voltage at all measured temperatures between the operating TMAX and Tmin, divided by TMAX - Tmin. The measured temperatures are 0°C, 25°C, 70°C.
TYPICAL APPLICATIONS

Wide Input Range Reference

Micropower Reference from 9V Battery

Reference from 1.5V Battery

0°C - 100°C Thermometer

Lower Power Thermometer

0°C - 100°C Thermometer

Calibration

1. Short AMS9491, adjust R3 for I_{OUT} = temp at 1\mu A/°K
2. Remove short, adjust R2 for correct reading in °C
   † I_O at 1.3V ≅ 500 \mu A
   † I_O at 1.6V ≅ 2.4mA

Calibration

1. Short AMS9491, adjust R3 for I_{OUT} = temp at 1.8\mu A/°K
2. Remove short, adjust R2 for correct reading in °F
   † I_O at 1.3V ≅ 500 \mu A to 900 \mu A

* 2N3638 or 2N2907 select for inverse H_E ≅ 5
† Select for operation at 1.3V
‡ I_O ≅ 500 \mu A to 900 \mu A
TYPICAL APPLICATIONS (Continued)

Centigrade Thermometer

Calibration
1. Adjust R1 so that V1 = temp at 1mV/°C.
2. Adjust V2 to 273.2mV.

† I0 for 1.3V to 1.6V battery voltage = 50µA to 150µA

Micropower Thermocouple Cold Junction Compensator

Adjustment Procedure
1. Adjust TC ADJ pot until voltage across R1 equals Kelvin temperature multiplied by the thermocouple Seebeck coefficient.
2. Adjust ZERO ADJ pot until voltage across R2 equals the thermocouple Seebeck coefficient multiplied by 273.2.

<table>
<thead>
<tr>
<th>Thermocouple Type</th>
<th>Seebeck Coefficient (mV/°C)</th>
<th>R1 (Ω)</th>
<th>R2 (Ω)</th>
<th>Voltage Across R1 @ 25°C (mV)</th>
<th>Voltage Across R2 (mV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>52.3</td>
<td>523</td>
<td>1.24k</td>
<td>15.60</td>
<td>14.32</td>
</tr>
<tr>
<td>T</td>
<td>42.8</td>
<td>432</td>
<td>1k</td>
<td>12.77</td>
<td>11.78</td>
</tr>
<tr>
<td>K</td>
<td>40.8</td>
<td>408</td>
<td>953Ω</td>
<td>12.17</td>
<td>11.17</td>
</tr>
<tr>
<td>S</td>
<td>6.4</td>
<td>63.4</td>
<td>150Ω</td>
<td>1.908</td>
<td>1.766</td>
</tr>
</tbody>
</table>

Typical supply current 50µA
TYPICAL APPLICATIONS (Continued)

Precision 1µA to 1mA Current Sources

![Circuit Diagram]

\[ I_{\text{OUT}}^* = \frac{1.23V}{R_2} \]
PACKAGE DIMENSIONS inches (millimeters) unless otherwise noted.

3 LEAD TO-92 PLASTIC PACKAGE (N)

8 LEAD SOIC PLASTIC PACKAGE (S)

**DIMENSION DOES NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.036" (0.092mm) PER SIDE**

**DIMENSION DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010" (0.254mm) PER SIDE**