**General Description**

The LM113/LM313 are temperature compensated, low voltage reference diodes. They feature extremely tight regulation over a wide range of operating currents in addition to an unusually low breakdown voltage and good temperature stability.

The diodes are synthesized using transistors and resistors in a monolithic integrated circuit. As such, they have the same low noise and long term stability as modern IC op amps. Further, output voltage of the reference depends only on highly predictable properties of components in the IC; so they can be manufactured and supplied to tight tolerances.

**Features**

- Low breakdown voltage: 1.220V
- Dynamic impedance of 0.3Ω from 500 μA to 20 mA
- Temperature stability typically 1% over –55°C to 125°C range (LM113), 0°C to 70°C (LM313)
- Tight tolerance: ±5%, ±2% or ±1%

The characteristics of this reference recommend it for use in bias-regulation circuitry, in low-voltage power supplies or in battery powered equipment. The fact that the breakdown voltage is equal to a physical property of silicon—the energy-band gap voltage—makes it useful for many temperature-compensation and temperature-measurement functions.

**Typical Applications**

- **Level Detector for Photodiode**
- **Low Voltage Regulator**
Absolute Maximum Ratings

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

(Note 3)

- Power Dissipation (Note 1) 100 mW
- Reverse Current 50 mA
- Forward Current 50 mA

Storage Temperature Range: -65°C to +150°C
Lead Temperature (Soldering, 10 seconds): 300°C
Operating Temperature Range: LM113 -55°C to +125°C, LM313 0°C to +70°C

Electrical Characteristics (Note 2)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse Breakdown Voltage</td>
<td>LM113/LM313</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I_R = 1 mA</td>
<td>1.160</td>
<td>1.220</td>
<td>1.280</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>LM113-1</td>
<td>1.210</td>
<td>1.22</td>
<td>1.232</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>LM113-2</td>
<td>1.195</td>
<td>1.22</td>
<td>1.245</td>
<td>V</td>
</tr>
<tr>
<td>Reverse Breakdown Voltage Change</td>
<td>0.5 mA ≤ I_R ≤ 20 mA</td>
<td></td>
<td></td>
<td>6.0</td>
<td>15 mV</td>
</tr>
<tr>
<td>Reverse Dynamic Impedance</td>
<td>I_R = 1 mA</td>
<td></td>
<td></td>
<td>0.2</td>
<td>Ω</td>
</tr>
<tr>
<td></td>
<td>I_R = 10 mA</td>
<td></td>
<td></td>
<td>1.0</td>
<td>Ω</td>
</tr>
<tr>
<td></td>
<td>I_R = 1 mA</td>
<td></td>
<td></td>
<td>0.25</td>
<td>Ω</td>
</tr>
<tr>
<td></td>
<td>I_R = 10 mA</td>
<td></td>
<td></td>
<td>0.8</td>
<td>Ω</td>
</tr>
<tr>
<td>Forward Voltage Drop</td>
<td>I_F = 1 mA</td>
<td></td>
<td></td>
<td>0.67</td>
<td>1.0 V</td>
</tr>
<tr>
<td>RMS Noise Voltage</td>
<td>10 Hz ≤ f ≤ 10 kHz</td>
<td></td>
<td></td>
<td>5</td>
<td>μV</td>
</tr>
<tr>
<td>Reverse Breakdown Voltage Change with Current</td>
<td>0.5 mA ≤ I_R ≤ 10 mA</td>
<td></td>
<td></td>
<td>15</td>
<td>mV</td>
</tr>
<tr>
<td>Breakdown Voltage Temperature Coefficient</td>
<td>T_MIN ≤ T_A ≤ T_MAX</td>
<td></td>
<td></td>
<td>0.01</td>
<td>%/°C</td>
</tr>
</tbody>
</table>

Note 1: For operating at elevated temperatures, the device must be derated based on a 150°C maximum junction and a thermal resistance of 80°C/W junction to case or 440°C/W junction to ambient.

Note 2: These specifications apply for T_A = 25°C, unless stated otherwise. At high currents, breakdown voltage should be measured with lead lengths less than ¼ inch. Kelvin contact sockets are also recommended. The diode should not be operated with shunt capacitances between 200 pF and 0.1 μF, unless isolated by at least a 100X resistor, as it may oscillate at some currents.

Note 3: Refer to the following RETS drawings for military specifications: RETS113-1X for LM113-1, RETS113-2X for LM113-2 or RETS113X for LM113.

Typical Performance Characteristics

Temperature Drift
Reverse Dynamic Impedance
Reverse Characteristics
Typical Performance Characteristics (Continued)

Reverse Characteristics

Forward Characteristics

Response Time

Maximum Shunt Capacitance

Typical Applications (Continued)

Amplifier Biasing for Constant Gain with Temperature

Constant Current Source

Thermometer

*Adjust for 0V at 0°C
†Adjust for 100 mV/°C
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