**FEATURES**

- Guaranteed 200pA max. input offset current
- Guaranteed 2nA max. input bias current
- Guaranteed 600μA max. supply current
- Guaranteed 0.5mV max. offset voltage
- Guaranteed 5μV/°C max. drift
- Wide supply voltage range: ± 2V to ± 18V

**APPLICATIONS**

- Integrators
- Transducer amplifiers
- Analog memories
- Light meters

**DESCRIPTION**

The LM108 series of precision operational amplifiers are particularly well-suited for high source impedance applications requiring low offset and bias currents as well as low power dissipation. Unlike FET input amplifiers, the offset and bias currents of the LM108 do not change significantly with temperature variations. Advanced design, processing and testing techniques make Linear's LM108 a superior choice over previous devices.

A photodiode sensor application is shown below. For applications requiring higher performance, see the LT1008, and LT1012.
**ABSOLUTE MAXIMUM RATINGS**

Supply Voltage
- LM308A/LM308: ±18V

Differential Input Current (Note 1): ±10mA

Input Voltage (Note 2): ±15V

Output Short Circuit Duration: Indefinite

Operating Temperature Range
- LM108A/LM108: -55°C to 125°C
- LM308A/LM308: 0°C to 70°C

Storage Temperature Range
- All Devices: -65°C to 150°C

Lead Temperature (Soldering, 10 sec.): 300°C

**PACKAGE/ORDER INFORMATION**

<table>
<thead>
<tr>
<th>ORDER PART NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM108AH</td>
</tr>
<tr>
<td>LM108H</td>
</tr>
<tr>
<td>LM308AH</td>
</tr>
<tr>
<td>LM308H</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ORDER PART NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM308AN8</td>
</tr>
<tr>
<td>LM308N8</td>
</tr>
</tbody>
</table>

**ELECTRICAL CHARACTERISTICS**

$\pm 5V \leq V_i \leq \pm 20V$ and $-55^\circ C \leq T_A \leq 125^\circ C$, unless otherwise noted.

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>PARAMETER</th>
<th>CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{os}$</td>
<td>Input Offset Voltage</td>
<td>$T_A = 25^\circ C$</td>
<td>0.3</td>
<td>0.5</td>
<td></td>
<td>0.7</td>
<td>2.0</td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td>$\Delta V_{os} \over \Delta T_{temp}$</td>
<td>Average Temperature Coefficient of Input Offset Voltage</td>
<td></td>
<td>1.0</td>
<td>5.0</td>
<td></td>
<td>3.0</td>
<td>15</td>
<td></td>
<td>$\mu V^\circ C$</td>
</tr>
<tr>
<td>$I_{os}$</td>
<td>Input Offset Current</td>
<td>$T_A = 25^\circ C$</td>
<td>0.05</td>
<td>0.2</td>
<td></td>
<td>0.05</td>
<td>0.2</td>
<td></td>
<td>nA</td>
</tr>
<tr>
<td>$\Delta I_{os} \over \Delta T_{temp}$</td>
<td>Average Temperature Coefficient of Input Offset Current</td>
<td></td>
<td>0.5</td>
<td>2.5</td>
<td></td>
<td>0.5</td>
<td>2.5</td>
<td></td>
<td>pA$^\circ C$</td>
</tr>
<tr>
<td>$I_B$</td>
<td>Input Bias Current</td>
<td>$T_A = 25^\circ C$</td>
<td>0.5</td>
<td>2.0</td>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td></td>
<td>nA</td>
</tr>
<tr>
<td>$A_{voll}$</td>
<td>Large Signal Voltage Gain</td>
<td>$T_A = 25^\circ C, V_0 = \pm 15V, V_{out} = \pm 10V, R_L = 10k\Omega$</td>
<td>80</td>
<td>300</td>
<td></td>
<td>50</td>
<td>300</td>
<td></td>
<td>V/mV</td>
</tr>
<tr>
<td>CMRR</td>
<td>Common Mode Rejection Ratio</td>
<td></td>
<td>96</td>
<td>110</td>
<td></td>
<td>85</td>
<td>100</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>PSRR</td>
<td>Power Supply Rejection Ratio</td>
<td></td>
<td>96</td>
<td>110</td>
<td></td>
<td>80</td>
<td>96</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>$V_{in}$</td>
<td>Input Voltage Range</td>
<td></td>
<td>$\pm 13.5$</td>
<td></td>
<td></td>
<td>$\pm 13.5$</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{out}$</td>
<td>Output Voltage Swing</td>
<td>$V_0 = \pm 15V, R_L = 10k\Omega$</td>
<td>$\pm 13$</td>
<td>$\pm 14$</td>
<td></td>
<td>$\pm 13$</td>
<td>$\pm 14$</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$R_{in}$</td>
<td>Input Resistance</td>
<td>$T_A = 25^\circ C$ (Note 3)</td>
<td>30</td>
<td>70</td>
<td></td>
<td>30</td>
<td>70</td>
<td></td>
<td>kΩ</td>
</tr>
<tr>
<td>$I_S$</td>
<td>Supply Current</td>
<td>$T_A = 25^\circ C$</td>
<td>0.3</td>
<td>0.6</td>
<td></td>
<td>0.3</td>
<td>0.6</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_A = 125^\circ C$</td>
<td>0.15</td>
<td>0.4</td>
<td></td>
<td>0.15</td>
<td>0.4</td>
<td></td>
<td>mA</td>
</tr>
</tbody>
</table>

**LINEAR TECHNOLOGY**

2-304
ELECTRICAL CHARACTERISTICS

\[ \pm 5V \leq V_i \leq \pm 15V \text{ and } 0^\circ C \leq T_A \leq 70^\circ C, \text{ unless otherwise noted.} \]

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>PARAMETER</th>
<th>CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(V_{OS})</td>
<td>Input Offset Voltage</td>
<td>T(_A) = 25^\circ C)</td>
<td>0.3</td>
<td>0.73</td>
<td></td>
<td></td>
<td>2.0</td>
<td>7.5</td>
<td>mV</td>
</tr>
<tr>
<td>(\Delta V_{OS} / \Delta \text{Temp})</td>
<td>Average Temperature Coefficient of Input Offset Voltage</td>
<td>(\bullet)</td>
<td>2.0</td>
<td>5.0</td>
<td>6.0</td>
<td>30</td>
<td>(\mu V/^\circ C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(I_{OS})</td>
<td>Input Offset Current</td>
<td>T(_A) = 25^\circ C)</td>
<td>0.2</td>
<td>1.5</td>
<td></td>
<td></td>
<td>0.2</td>
<td>1.0</td>
<td>nA</td>
</tr>
<tr>
<td>(\Delta I_{OS} / \Delta \text{Temp})</td>
<td>Average Temperature Coefficient of Input Offset Current</td>
<td>(\bullet)</td>
<td>2.0</td>
<td>10</td>
<td>2.0</td>
<td>10</td>
<td>(\mu A/^\circ C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(I_b)</td>
<td>Input Bias Current</td>
<td>T(_A) = 25^\circ C)</td>
<td>1.5</td>
<td>10</td>
<td></td>
<td></td>
<td>1.5</td>
<td>10</td>
<td>nA</td>
</tr>
<tr>
<td>(A_{VOL})</td>
<td>Large Signal Voltage Gain</td>
<td>T(<em>A) = 25^\circ C), (V_2 \leq \pm 15V), (V</em>{\text{OUT}} = \pm 10V), (R_2 \geq 10k\Omega)</td>
<td>60</td>
<td>300</td>
<td></td>
<td></td>
<td>25</td>
<td>300</td>
<td>V/mV</td>
</tr>
<tr>
<td>CMRR</td>
<td>Common Mode Rejection Ratio</td>
<td>(\bullet)</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>V/mV</td>
</tr>
<tr>
<td>PSRR</td>
<td>Power Supply Rejection Ratio</td>
<td>(\bullet)</td>
<td>96</td>
<td>110</td>
<td></td>
<td></td>
<td>80</td>
<td>100</td>
<td>dB</td>
</tr>
<tr>
<td>(I_s)</td>
<td>Input Voltage Range</td>
<td>(V_s \leq \pm 15V)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>(V_{OUT})</td>
<td>Output Voltage Swing</td>
<td>(V_{OUT} = \pm 15V), (R_2 = 10k\Omega)</td>
<td>(\bullet)</td>
<td>13</td>
<td></td>
<td></td>
<td>13</td>
<td>14</td>
<td>V</td>
</tr>
<tr>
<td>(R_{IN})</td>
<td>Input Resistance</td>
<td>T(_A) = 25^\circ C) (Note 3)</td>
<td>10</td>
<td>40</td>
<td></td>
<td></td>
<td>10</td>
<td>40</td>
<td>M(\Omega)</td>
</tr>
<tr>
<td>(I_g)</td>
<td>Supply Current</td>
<td>T(_A) = 25^\circ C)</td>
<td>0.3</td>
<td>0.8</td>
<td></td>
<td></td>
<td>0.3</td>
<td>0.8</td>
<td>mA</td>
</tr>
</tbody>
</table>

The \(\bullet\) denotes the specifications which apply over the full operating temperature range.

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

**Note 1:** Differential input voltages greater than 1V will cause excessive current to flow through the input protection diodes unless current limiting resistance is used.

**Note 2:** For supply voltages less than \(\pm 15V\), the maximum input voltage is equal to the supply voltage.

**Note 3:** Guaranteed by design.

TYPICAL APPLICATIONS

**Standard Compensation Circuit**

**Alternate* Frequency Compensation**

**Feedforward Compensation**

**Compensation Circuits**

* **BANDWIDTH AND SLEW RATE ARE PROPORTIONAL TO** \(1/C_1\)

* **BANDWIDTH AND SLEW RATE ARE PROPORTIONAL TO** \(1/C_2\)

* **IMPROVES REJECTION OF POWER SUPPLY NOISE BY A FACTOR OF TEN.**
TYPICAL PERFORMANCE CHARACTERISTICS

Closed Loop Output Impedance

```
<table>
<thead>
<tr>
<th>FREQUENCY (Hz)</th>
<th>OUTPUT IMPEDANCE (Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>10^3</td>
</tr>
<tr>
<td>100</td>
<td>10^2</td>
</tr>
<tr>
<td>1k</td>
<td>10^1</td>
</tr>
<tr>
<td>10k</td>
<td>1</td>
</tr>
<tr>
<td>100k</td>
<td>10^0</td>
</tr>
<tr>
<td>1M</td>
<td>10^-1</td>
</tr>
<tr>
<td>10M</td>
<td>10^-2</td>
</tr>
</tbody>
</table>
```

- \( A_v = 1 \), \( C_f = 30 \text{ pF} \)
- \( A_v = 10000 \), \( C_f = 0 \text{ pF} \)
- \( A_v = 1000 \), \( C_f = 30 \text{ pF} \)
- \( T_A = 25°C \)
- \( I_{out} = \pm 1 \text{mA} \)
- \( V_S = \pm 15V \)

Power Supply Rejection

```
<table>
<thead>
<tr>
<th>FREQUENCY (Hz)</th>
<th>SUPPLY REJECTION (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>1k</td>
<td>100</td>
</tr>
<tr>
<td>10k</td>
<td>80</td>
</tr>
<tr>
<td>100k</td>
<td>60</td>
</tr>
<tr>
<td>1M</td>
<td>40</td>
</tr>
<tr>
<td>10M</td>
<td>20</td>
</tr>
</tbody>
</table>
```

- \( V_S = 15V \)
- \( T_A = 25°C \)
- \( A_v = 1 \)

POSITIVE SUPPLY

NEGATIVE SUPPLY

\( C_f = 30 \text{ pF} \)

\( C_f = 100 \text{ pF} \)

TYPICAL APPLICATIONS

Low Drift Integrator With Reset

```
R2
100k
R1
20M
R3
10k
C1
1μF
Q1*

Q2
RESET

INPUT

R4
20M
C2
1μF

Q3*

LM108

3
1

1

2
C3
30 pF

Q3*

* Q1 AND Q3 SHOULD NOT HAVE INTERNAL GATE-PROTECTION DIODES.
```

Inverting Amplifier With High Input Resistance

```
R5
1M
C1
100 pF

R2
2M
1%

R3
50k
1%

R4
50k
1%

INPUT

2
R2 > R1
R2 > R3

A_v = \frac{R2 (R3 + R4)}{R1 R3}

OUTPUT

3

6

8

LM108

```

2-307
TYPICAL APPLICATIONS

Amplifier For Piezoelectric Transducers

Amplifier For Bridge Transducers

Fast* Summing Amplifier

Bilateral Current Source

Sample and Hold

Differential Input Instrumentation Amplifier

* Teflon, polyethylene or polycarbonate dielectric capacitor.
  Worst case drift less than 2.5 mV/sec.
APPLICATIONS INFORMATION

Input guarding
Input guarding is used to reduce surface leakage. Guarding both sides of the board is required. Bulk leakage reduction is less and depends on the guard ring width.

The guard ring is connected to a low impedance point at same potential as the sensitive input leads. Connections for various op amp configurations are shown below.

Input protection
Current is limited by R2 even when input is connected to a voltage source outside the common mode range. If one supply reverses, current is controlled by R1. These resistors do not affect normal operation.

The input resistor controls the current when the input exceeds the supply voltages, when the power for the op amp is turned off, or when the output is shorted.

Offset Voltage Test Circuit†

† THIS CIRCUIT IS ALSO USED AS THE BURN-IN CONFIGURATION WITH SUPPLY VOLTAGES EQUAL TO ±20V, R1 = R3 = 10k, R2 = 2000, A\textsubscript{V} = 100.