The LT®1078 is a micropower dual op amp in 8-pin packages including the small outline surface mount package. The LT1079 is a micropower quad op amp offered in the standard 14-pin packages. Both devices are optimized for single supply operation at 5V. ±15V specifications are also provided.

Micropower performance of competing devices is achieved at the expense of seriously degrading precision, noise, speed and output drive specifications. The design effort of the LT1078/LT1079 was concentrated on reducing supply current without sacrificing other parameters. The offset voltage achieved is the lowest on any dual or quad nonchopper stabilized op amp—micropower or otherwise. Offset current, voltage and current noise, slew rate and gain bandwidth product are all two to ten times better than on previous micropower op amps.

The 1/f corner of the voltage noise spectrum is at 0.7Hz, at least three times lower than on any monolithic op amp. This results in low frequency (0.1Hz to 10Hz) noise performance which can only be found on devices with an order of magnitude higher supply current.

Both the LT1078 and LT1079 can be operated from a single supply (as low as one lithium cell or two Ni-Cad batteries). The input range goes below ground. The all-NPN output stage swings to within a few millivolts of ground while sinking current—no power consuming pull down resistors are needed.
LT1078/LT1079

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

Supply Voltage .................................................... ±22V
Differential Input Voltage ..................................... ±30V
Input Voltage ................................ Equal to Positive Supply Voltage 
............................................... 5V Below Negative Supply Voltage
Output Short-Circuit Duration ......................... Indefinite
Storage Temperature Range 
All Grades ............................................. –65°C to 150°C

**Operating Temperature Range**
LT1078AM/LT1078M/ 
LT1079AM/LT1079M (OBSOLETE) ...... –55°C to 125°C
LT1078I/LT1079I ........................................ –40°C to 85°C
LT1078AC/LT1078C/LT1078S8/ 
LT1079AC/LT1079C ................................. 0°C to 70°C
Lead Temperature (Soldering, 10 sec) ............ 300°C

**PACKAGE/ORDER INFORMATION**

<table>
<thead>
<tr>
<th>ORDER PART NUMBER</th>
<th>TOP VIEW</th>
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<tbody>
<tr>
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<tr>
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<tr>
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<td>LT1079IN8</td>
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**NOTE:** THIS PIN CONFIGURATION DIFFERS FROM THE 8-LEAD DIP PIN LOCATIONS. INSTEAD, IT FOLLOWS THE INDUSTRY STANDARD LT1013DS8 SO PACKAGE CONFIGURATION. FOR SIMILAR PERFORMANCE WITH TRADITIONAL DIP PINOUT, SEE THE LT2078.

**J PACKAGE**
14-LEAD CERAMIC DIP
$T_{\text{JMAX}} = 150^\circ\text{C}, \theta_{JA} = 100^\circ\text{C}/W (J)$

**N PACKAGE**
14-LEAD PDIP
$T_{\text{JMAX}} = 110^\circ\text{C}, \theta_{JA} = 130^\circ\text{C}/W (N)$

**S8 PACKAGE**
8-LEAD PLASTIC SO
$T_{\text{JMAX}} = 150^\circ\text{C}, \theta_{JA} = 100^\circ\text{C}/W (S8)$

**SW PACKAGE**
16-LEAD PLASTIC SO WIDE
$T_{\text{JMAX}} = 110^\circ\text{C}, \theta_{JA} = 150^\circ\text{C}/W$
### Electrical Characteristics

**VS = 5V, VCM = 0.1V, VO = 1.4V, TA = 25°C unless otherwise noted.**

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>PARAMETER</th>
<th>CONDITIONS (NOTE 2)</th>
<th>LT1078C/LT1079C&lt;br&gt;LT1078AM/LT1079AM&lt;br&gt;MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>LT1078/LT1079&lt;br&gt;LT1078IS8/LT1078S8&lt;br&gt;LT1079&lt;br&gt;LT1079ISW/LT1079SW&lt;br&gt;MIN</th>
<th>TYP</th>
<th>MAX</th>
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<tr>
<td>VOS</td>
<td>Input Offset Voltage</td>
<td>LT1078&lt;br&gt;LT1078IS8/LT1078S8&lt;br&gt;LT1079&lt;br&gt;LT1079ISW/LT1079SW</td>
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<td>ΔVOS/ΔTime</td>
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<td>e_n</td>
<td>Input Noise Voltage</td>
<td>0.1Hz to 10Hz (Note 3)</td>
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<td>Input Noise Voltage Density</td>
<td>f_o = 10Hz (Note 3)</td>
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<td>f_o = 1000Hz (Note 3)</td>
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<td>28</td>
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<td>INO</td>
<td>Input Noise Current</td>
<td>0.1Hz to 10Hz (Note 3)</td>
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<td>Input Resistance</td>
<td>Differential Mode</td>
<td>(Note 4)</td>
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<td>Common Mode</td>
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<td>CMRR</td>
<td>Common Mode Rejection Ratio</td>
<td>VCM = 0V to 3.5V</td>
<td>97</td>
<td>110</td>
<td>94</td>
<td>108</td>
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<tr>
<td>PSRR</td>
<td>Power Supply Rejection Ratio</td>
<td>VS = 2.3V to 12V</td>
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<td>114</td>
<td>100</td>
<td>114</td>
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<td>AVOL</td>
<td>Large-Signal Voltage Gain</td>
<td>V0 = 0.03V to 4V, No Load</td>
<td>200</td>
<td>1000</td>
<td>150</td>
<td>600</td>
<td>150</td>
<td>1000</td>
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<td></td>
<td>V0 = 0.03V to 3.5V, RL = 50k</td>
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<td>Maximum Output Voltage Swing</td>
<td>Output Low, No Load</td>
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<td>3.5</td>
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<td>Output Low, 2k to GND</td>
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<td>Output Low, I_SINK = 100μA</td>
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<td>130</td>
<td>95</td>
<td>130</td>
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<td>Output High, No Load</td>
<td>4.2</td>
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<td>4.4</td>
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<td>Output High, 2k to GND</td>
<td>3.5</td>
<td>3.9</td>
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<td>SR</td>
<td>Slew Rate</td>
<td>A_V = 1, V_S = ±2.5V</td>
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<td>0.07</td>
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<td>0.07</td>
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<td>Gain Bandwidth Product</td>
<td>f_o = 20kHz</td>
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<td>50</td>
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<td>Channel Separation</td>
<td>ΔVIN = 3V, RL = 10k</td>
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<td>Minimum Supply Voltage</td>
<td>(Note 5)</td>
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</table>

10789fE
### LT1078/LT1079

**ELECTRICAL CHARACTERISTICS** The ● denotes the specifications which apply over the temperature range −40°C ≤ TA ≤ 85°C for I grades, −55°C ≤ TA ≤ 125°C for AM/M grades. VS = 5V, 0V, VCM = 0.1V, VO = 1.4V unless otherwise noted.

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>PARAMETER</th>
<th>CONDITIONS</th>
<th>LT1078/LT1079AM/LT1079AM</th>
<th>LT1078I/LT1079I/LT1078AM/LT1079AM</th>
<th>UNITS</th>
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<td>LT1078IS8/LT1079</td>
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<td>80</td>
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<td>LT1079ISW</td>
<td>●</td>
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<tr>
<td>ΔVOS</td>
<td>Input Offset Voltage Drift (Note 6)</td>
<td>LT1078IS8</td>
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<td>0.4</td>
<td>1.8</td>
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<tr>
<td></td>
<td></td>
<td>LT1079ISW</td>
<td>●</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>LT1078ISW</td>
<td>●</td>
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<td>IOS</td>
<td>Input Offset Current</td>
<td>LT1078I/LT1079I</td>
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<td>0.07</td>
<td>0.50</td>
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<td>IB</td>
<td>Input Bias Current</td>
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<tr>
<td>CMRR</td>
<td>Common Mode Rejection Ratio</td>
<td>VCM = 0.05V to 3.2V</td>
<td>●</td>
<td>92</td>
<td>106</td>
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<tr>
<td>PSRR</td>
<td>Power Supply Rejection Ratio</td>
<td>VS = 3.1V to 12V</td>
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<td>110</td>
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<tr>
<td>AVOL</td>
<td>Large-Signal Voltage Gain</td>
<td>VO = 0.05V to 4V, No Load</td>
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<td>600</td>
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<td></td>
<td>VO = 0.05V to 3.5V, RL = 50k</td>
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<td>Output Low, ISINK = 100µA</td>
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<td>Output High, No Load</td>
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<td>4.2</td>
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<td>Output High, 2k to GND</td>
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<td>IS</td>
<td>Supply Current per Amplifier</td>
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<td>60</td>
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The ● denotes the specifications which apply over the temperature range 0°C ≤ TA ≤ 70°C. VS = 5V, 0V, VCM = 0.1V, VO = 1.4V unless otherwise noted.

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<thead>
<tr>
<th>SYMBOL</th>
<th>PARAMETER</th>
<th>CONDITIONS</th>
<th>LT1078C/LT1079C</th>
<th>LT1078S8/LT1079S8</th>
<th>UNITS</th>
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<td>VOS</td>
<td>Input Offset Voltage</td>
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<td>LT1078S8</td>
<td>●</td>
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<td></td>
<td></td>
<td>LT1079S8</td>
<td>●</td>
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<tr>
<td>ΔVOS</td>
<td>Input Offset Voltage Drift (Note 6)</td>
<td>LT1078S8</td>
<td>●</td>
<td>0.4</td>
<td>1.8</td>
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<td>LT1079S8</td>
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<td>LT1078S8</td>
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<td>CMRR</td>
<td>Common Mode Rejection Ratio</td>
<td>VCM = 0V to 3.4V</td>
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<td>108</td>
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<td>PSRR</td>
<td>Power Supply Rejection Ratio</td>
<td>VS = 2.6V to 12V</td>
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<td>AVOL</td>
<td>Large-Signal Voltage Gain</td>
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<td>Output Low, ISINK = 100µA</td>
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<td>Output High, No Load</td>
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<td>Output High, 2k to GND</td>
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<td>IS</td>
<td>Supply Current per Amplifier</td>
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The ● denotes the specifications which apply over the temperature range 0°C ≤ TA ≤ 70°C. VS = 5V, 0V, VCM = 0.1V, VO = 1.4V unless otherwise noted.
## ELECTRICAL CHARACTERISTICS

$V_S = \pm 15V$, $T_A = 25^\circ C$ unless otherwise noted.

| SYMBOL | PARAMETER | CONDITIONS | LT1078C/LT1079C
|        |           | MIN | TYP | MAX | LT1078C/LT1079C
|        |           | MIN | TYP | MAX | LT1078C/LT1079C
|        |           | MIN | TYP | MAX | LT1078C/LT1079C

| SYMBOL | PARAMETER | CONDITIONS | LT1078AM/LT1079AM
|        |           | MIN | TYP | MAX | LT1078AM/LT1079AM
|        |           | MIN | TYP | MAX | LT1078AM/LT1079AM

| SYMBOL | PARAMETER | CONDITIONS | LT1078C/LT1079C
|        |           | MIN | TYP | MAX | LT1078C/LT1079C
|        |           | MIN | TYP | MAX | LT1078C/LT1079C

### SYMBOL | PARAMETER | CONDITIONS | LT1078AM/LT1079AM

### SYMBOL | PARAMETER | CONDITIONS | LT1078AM/LT1079AM

| SYMBOL | PARAMETER | CONDITIONS | LT1078AM/LT1079AM
|        |           | MIN | TYP | MAX | LT1078AM/LT1079AM
|        |           | MIN | TYP | MAX | LT1078AM/LT1079AM

The ● denotes the specifications which apply over the temperature range $-40^\circ C \leq T_A \leq 85^\circ C$ for I grades, $-55^\circ C \leq T_A \leq 125^\circ C$ for AM/M grades.  $V_S = \pm 15V$ unless otherwise noted.
### Electrical Characteristics

The ● denotes the specifications which apply over the temperature range 0°C ≤ TA ≤ 70°C. VS = ±15V unless otherwise noted.

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<tr>
<th>SYMBOL</th>
<th>PARAMETER</th>
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<th>LT1078S8/LT1079SW</th>
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<td>MIN</td>
<td>TYP</td>
<td>MAX</td>
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<td>LT1079SW</td>
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<td></td>
<td></td>
<td></td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔVOS/ΔT</td>
<td>Input Offset Voltage Drift (Note 6)</td>
<td>LT1078S8</td>
<td>●</td>
<td>0.5</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LT1079SW</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IOS</td>
<td>Input Offset Current</td>
<td>●</td>
<td>0.06</td>
<td>0.35</td>
<td>0.06</td>
</tr>
<tr>
<td>IB</td>
<td>Input Bias Current</td>
<td>●</td>
<td>6</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>AVOL</td>
<td>Large-Signal Voltage Gain</td>
<td>V_O = ±10V, R_L = 5k</td>
<td>●</td>
<td>300</td>
<td>1200</td>
</tr>
<tr>
<td>CMRR</td>
<td>Common Mode Rejection Ratio</td>
<td>V_CM = 13V, –15V</td>
<td>●</td>
<td>97</td>
<td>112</td>
</tr>
<tr>
<td>PSRR</td>
<td>Power Supply Rejection Ratio</td>
<td>V_S = 5V, 0V to ±18V</td>
<td>●</td>
<td>100</td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>Maximum Output Voltage Swing</td>
<td>R_L = 5k</td>
<td>●</td>
<td>±11.0</td>
<td>±13.6</td>
</tr>
<tr>
<td>I_S</td>
<td>Supply Current per Amplifier</td>
<td>●</td>
<td>49</td>
<td>73</td>
<td>50</td>
</tr>
</tbody>
</table>

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

**Note 2:** Typical parameters are defined as the 60% yield of parameter distributions of individual amplifiers, i.e., out of 100 LT1079s (or 100 LT1078s) typically 240 op amps (or 120) will be better than the indicated specification.

**Note 3:** This parameter is tested on a sample basis only. All noise parameters are tested with V_S = ±2.5V, V_O = 0V.

**Note 4:** This parameter is guaranteed by design and is not tested.

**Note 5:** Power supply rejection ratio is measured at the minimum supply voltage. The op amps actually work at 1.8V supply but with a typical offset skew of –300µV.

**Note 6:** This parameter is not 100% tested.
TYPICAL PERFORMANCE CHARACTERISTICS

Supply Current vs Temperature

Input Bias and Offset Currents vs Temperature

Input Bias Current vs Common Mode Voltage

0.1Hz to 10Hz Noise

0.01Hz to 10Hz Noise

Noise Spectrum

10Hz Voltage Noise Distribution

Distribution of Offset Voltage Drift with Temperature (In All Packages Except Surface Mount)

Long Term Stability of Two Representative Units (LT1078)
TYPICAL PERFORMANCE CHARACTERISTICS

Output Saturation vs Temperature vs Sink Current

Output Voltage Swing vs Load Current

Distribution of Input Offset Voltage (LT1078 in 8-Pin SO Package)

Common Mode Range vs Temperature

Undistorted Output Swing vs Frequency

Closed Loop Output Impedance

Common Mode Rejection Ratio vs Frequency

Power Supply Rejection Ratio vs Frequency

Channel Separation vs Frequency
TYPICAL PERFORMANCE CHARACTERISTICS

Small-Signal Transient Response

**VS = 5V, 0V**

![Small-Signal Transient Response](image1)

**VS = ±2.5V**

![Small-Signal Transient Response](image2)

**VS = ±15V**

![Small-Signal Transient Response](image3)

APPLICATIONS INFORMATION

The LT1078/LT1079 devices are fully specified with \( V^+ = 5V, V^- = 0V, V_{CM} = 0.1V \). This set of operating conditions appears to be the most representative for battery-powered micropower circuits. Offset voltage is internally trimmed to a minimum value at these supply voltages. When 9V or 3V batteries or ±2.5V dual supplies are used, bias and offset current changes will be minimal. Offset voltage changes will be just a few microvolts as given by the PSRR and CMRR specifications. For example, if PSRR = 114dB (= 2\( \mu \)V/V), at 9V the offset voltage change will be 8\( \mu \)V. Similarly, \( V_S = ±2.5V, V_{CM} = 0V \) is equivalent to a common mode voltage change of 2.4V or a \( V_{OS} \) change of 7\( \mu \)V if CMRR = 110dB (3\( \mu \)V/V).

A full set of specifications is also provided at ±15V supply voltages for comparison with other devices and for completeness.

**Single Supply Operation**

The LT1078/LT1079 are fully specified for single supply operation, i.e., when the negative supply is 0V. Input common mode range goes below ground and the output swings within a few millivolts of ground while sinking current. All competing micropower op amps either cannot swing to within 600mV of ground (OP-20, OP-220, OP-420) or need a pull-down resistor connected to the output to swing to ground (OP-90, OP-290, OP-490, HA5141/42/44). This
APPLICATIONS INFORMATION

difference is critical because in many applications these competing devices cannot be operated as micropower op amps and swing to ground simultaneously.

As an example, consider the instrumentation amplifier shown on the front page. When the common mode signal is low and the output is high, amplifier A has to sink current. When the common mode signal is high and the output low, amplifier B has to sink current. The competing devices require a 12k pull-down resistor at the output of amplifier A and a 15k at the output of B to handle the specified signals. (The LT1078 does not need pull-down resistors.) When the common mode input is high and the output is high these pull-down resistors draw 300μA (150μA each), which is excessive for micropower applications.

The instrumentation amplifier is by no means the only application requiring current sinking capability. In seven of the nine single supply applications shown in this data sheet the op amps have to be able to sink current. In two of the applications the first amplifier has to sink only the 6nA input bias current of the second op amp. The competing devices, however, cannot even sink 6nA without a pull-down resistor

Since the output of the LT1078/LT1079 cannot go exactly to ground, but can only approach ground to within a few millivolts, care should be exercised to ensure that the output is not saturated. For example, a 1mV input signal will cause the amplifier to set up in its linear region in the gain 100 configuration shown in Figure 1a, but is not enough to make the amplifier function properly in the voltage follower mode, Figure 1b.

Single supply operation can also create difficulties at the input. The driving signal can fall below 0V — inadvertently or on a transient basis. If the input is more than a few hundred millivolts below ground, two distinct problems can occur on previous single supply designs, such as the LM124, LM158, OP-20, OP-21, OP-220, OP-221, OP-420 (1 and 2), OP-90/290/490 (2 only):

1. When the input is more than a diode drop below ground, unlimited current will flow from the substrate (V− terminal) to the input. This can destroy the unit. On the LT1078/LT1079, resistors in series with the input protect the devices even when the input is 5V below ground.

2. When the input is more than 400mV below ground (at 25°C), the input stage saturates and phase reversal occurs at the output. This can cause lockup in servo systems. Due to a unique phase reversal protection circuitry, the LT1078/LT1079 output does not reverse, as illustrated in Figure 2, even when the inputs are at −1V.

![Figure 1a. Gain 100 Amplifier](image1)  
![Figure 1b. Voltage Follower](image2)  

![Figure 2. Voltage Follower with Input Exceeding the Negative Common Mode Range (V_s = 5V, 0V)](image3)
Matching Specifications

In many applications the performance of a system depends on the matching between two op amps, rather than the individual characteristics of the two devices. The two and three op amp instrumentation amplifier configurations shown in this data sheet are examples. Matching characteristics are not 100% tested on the LT1078/LT1079.

Some specifications are guaranteed by definition. For example, 70μV maximum offset voltage implies that mismatch cannot be more than 140μV. 97dB (= 14μV/V) CMRR means that worst-case CMRR match is 91dB (= 28μV/V). However, Table 1 can be used to estimate the expected matching performance at $V_S = 5V, 0V$ between the two sides of the LT1078, and between amplifiers A and D, and between amplifiers B and C of the LT1079.

Table 1

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>LT1078AC/LT1079AC/LT1078AM/LT1079AM</th>
<th>LT1078C/LT1079C/LT1078M/LT1079M</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{OS}$ Match, $\Delta V_{OS}$</td>
<td>LT1078 30 110 50 190</td>
<td>LT1079 40 150 50 250</td>
<td>μV</td>
</tr>
<tr>
<td>Temperature Coefficient $\Delta V_{OS}$</td>
<td>0.5 1.2 0.6 1.8</td>
<td></td>
<td>μV/°C</td>
</tr>
<tr>
<td>Average Noninverting $I_B$</td>
<td>6 8 6 10</td>
<td></td>
<td>nA</td>
</tr>
<tr>
<td>Match of Noninverting $I_B$</td>
<td>0.12 0.4 0.15 0.5</td>
<td></td>
<td>nA</td>
</tr>
<tr>
<td>CMRR Match</td>
<td>120 100 117 97</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>PSRR Match</td>
<td>117 105 117 102</td>
<td></td>
<td>dB</td>
</tr>
</tbody>
</table>

Comparator Applications

The single supply operation of the LT1078/LT1079 and its ability to swing close to ground while sinking current lends itself to use as a precision comparator with TTL compatible output.
TYPICAL APPLICATIONS

**Micropower, 10ppm/°C, ±5V Reference**

- **LT1078/LT1079•TA03**

**Gain of 10 Difference Amplifier**

- **LT1078/79 • TA04**

**Picoampere Input Current, Triple Op Amp Instrumentation Amplifier with Bias Current Cancellation**

- **LT1078/79 • TA05**

---

**Micropower, 10ppm/°C, ±5V Reference**

- 1/2 LT1078
- 1/2 LT1078
- 1/2 LT1078

**Gain of 10 Difference Amplifier**

- 1/2 LT1078

**Picoampere Input Current, Triple Op Amp Instrumentation Amplifier with Bias Current Cancellation**

- 1/4 LT1079
- 1/4 LT1079
- 1/4 LT1079

---

**TYPICAL APPLICATIONS**

- **Micropower, 10ppm/°C, ±5V Reference**
  - **LT1078/LT1079•TA03**
  - **Gain of 10 Difference Amplifier**
    - **LT1078/79 • TA04**
  - **Picoampere Input Current, Triple Op Amp Instrumentation Amplifier with Bias Current Cancellation**
    - **LT1078/79 • TA05**

---

**Micropower, 10ppm/°C, ±5V Reference**

- **LT1078/LT1079•TA03**

**Gain of 10 Difference Amplifier**

- **LT1078/79 • TA04**

**Picoampere Input Current, Triple Op Amp Instrumentation Amplifier with Bias Current Cancellation**

- **LT1078/79 • TA05**

---

**Micropower, 10ppm/°C, ±5V Reference**

- **LT1078/LT1079•TA03**

**Gain of 10 Difference Amplifier**

- **LT1078/79 • TA04**

**Picoampere Input Current, Triple Op Amp Instrumentation Amplifier with Bias Current Cancellation**

- **LT1078/79 • TA05**

---

**Micropower, 10ppm/°C, ±5V Reference**

- **LT1078/LT1079•TA03**

**Gain of 10 Difference Amplifier**

- **LT1078/79 • TA04**

**Picoampere Input Current, Triple Op Amp Instrumentation Amplifier with Bias Current Cancellation**

- **LT1078/79 • TA05**

---

**Micropower, 10ppm/°C, ±5V Reference**

- **LT1078/LT1079•TA03**

**Gain of 10 Difference Amplifier**

- **LT1078/79 • TA04**

**Picoampere Input Current, Triple Op Amp Instrumentation Amplifier with Bias Current Cancellation**

- **LT1078/79 • TA05**

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**Picoampere Input Current, Triple Op Amp Instrumentation Amplifier with Bias Current Cancellation**

- **LT1078/79 • TA05**

---

**Micropower, 10ppm/°C, ±5V Reference**

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**Gain of 10 Difference Amplifier**

- **LT1078/79 • TA04**

**Picoampere Input Current, Triple Op Amp Instrumentation Amplifier with Bias Current Cancellation**

- **LT1078/79 • TA05**

---

**Micropower, 10ppm/°C, ±5V Reference**

- **LT1078/LT1079•TA03**

**Gain of 10 Difference Amplifier**

- **LT1078/79 • TA04**

**Picoampere Input Current, Triple Op Amp Instrumentation Amplifier with Bias Current Cancellation**

- **LT1078/79 • TA05**

---

**Micropower, 10ppm/°C, ±5V Reference**

- **LT1078/LT1079•TA03**

**Gain of 10 Difference Amplifier**

- **LT1078/79 • TA04**

**Picoampere Input Current, Triple Op Amp Instrumentation Amplifier with Bias Current Cancellation**

- **LT1078/79 • TA05**

---
TYPICAL APPLICATIONS

85V, –100V Common Mode Range Instrumentation Amplifier (AV = 10)

Bandwidth = 2kHz
Output Offset = 8mV
Output Noise = 0.8mVp-p (0.1Hz TO 10Hz)
= 1.4mVRMS OVER FULL BANDWIDTH (DOMINATED BY RESISTOR NOISE)
Input Resistance = 10M

Half-Wave Rectifier

V_{MIN} = 6mV
NO DISTORTION TO 100Hz

Absolute Value Circuit (Full-Wave Rectifier)

V_{MIN} = 4mV
NO DISTORTION TO 100Hz

Programmable Gain Amplifier (Single Supply)

Error due to switch on resistance, leakage current, noise and transients are eliminated
TYPICAL APPLICATIONS

Single Supply, Micropower, Second Order Lowpass Filter with 60Hz Notch

Micropower Multiplier/Divider

Q1, Q2, Q3, Q4 = MAT-04
TYPICAL LINEARITY = 0.01% OF FULL-SCALE OUTPUT

OUTPUT = \( \frac{X+Y}{Z} \), POSITIVE INPUTS ONLY

NEGATIVE SUPPLY CURRENT = 165\( \mu \)A + \( X + Y + Z + \text{OUT} \)

POSITIVE SUPPLY CURRENT = 165\( \mu \)A + \( \text{OUT} \)

BANDWIDTH (< 3Vp-p SIGNAL): X AND Y INPUTS = 10kHz
Z INPUT = 4kHz
Micropower Dead Zone Generator

Bipolar symmetry is excellent because one device, Q2, sets both limits. Supply current = 240µA. Bandwidth = 150kHz.
**TYPICAL APPLICATIONS**

**Lead-Acid Low-Battery Detector with System Shutdown**

![Circuit Diagram](image)

- **BATTERY OUTPUT**
- **12V**
- **LO = BATTERY LOW**
- (IF $V_S < 10.90V$)
- **LO = SYSTEM SHUTDOWN**
- (IF $V_S < 10.05V$)

**TOTAL SUPPLY CURRENT = 105µA**

**Platinum RTD Signal Conditioner with Curvature Correction**

![Circuit Diagram](image)

- **3V (LITHIUM)**
- **LT1004-1.2**
- **1/2 LT1078**
- **13k**
- **12.3k**

- **Rp = ROSEMOUNT 118MF**
- *** = TRW MAR-6 0.1%**
- **** = 1% METAL FILM

- **0.02V TO 2.2VOUT = 2°C TO 220°C ±0.1°C**

**LT1078/79 • TA13**

**LT1078/79 • TA14**

**Lead-Acid Low-Battery Detector with System Shutdown**

- **2M 1%**
- **2M 1%**
- **910k 5%**
- **3**
- **1/2 LT1078**
- **1**
- **2**
- **5**
- **8**
- **7**
- **1/2 LT1078**
- **4**

**LT1004-1.2**

**105µA**

**Platinum RTD Signal Conditioner with Curvature Correction**

- **LT1004-1.2**
- **1/2 LT1078**
- **13k**
- **12.3k**
- **10k**
- **50k**
- **5°C TRIM**
- **1k**
- **1k**

**1µF**

**1µF**

**5k 220°C TRIM**

**1.21M**

**(SELECT AT 110°C)**
LT1078/LT1079

SIMPLIFIED SCHEMATIC

1/2 LT1078, 1/4 LT1079

H Package
8-Lead TO-5 Metal Can (.230 Inch PCD)
(Reference LTC DWG # 05-08-1321)

OBsolete PACKAGE
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.
**PACKAGE DESCRIPTION**

**N Package**
14-Lead PDIP (Narrow .300 Inch)
(Reference LTC DWG # 05-08-1510)

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

**SW Package**
16-Lead Plastic Small Outline (Wide .300 Inch)
(Reference LTC DWG # 05-08-1620)

*These dimensions do not include mold flash or protrusions.
Mold flash or protrusions shall not exceed 0.010 inch (0.254mm)

**NOTE: 1. PIN 1 IDENT, NOTCH ON TOP AND CAVITIES ON THE BOTTOM OF PACKAGES ARE THE MANUFACTURING OPTIONS.
The PART MAY BE SUPPLIED WITH OR WITHOUT ANY OF THE OPTIONS
*DIMENSION DOES NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE
**DIMENSION DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010" (0.254mm) PER SIDE

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