FEATURES
−3 dB bandwidth of 2.2 GHz for $A_V = 12 \text{ dB}$
Single-resistor programmable gain: $0 \text{ dB} \leq A_V \leq 26 \text{ dB}$
Differential interface
Low noise input stage: $2.70 \text{ nV/Hz}$ at 70 MHz, $A_V = 10 \text{ dB}$
Low harmonic distortion
−79 dBc second at 70 MHz
−81 dBc third at 70 MHz
Output third-order intercept (OIP3) of 31 dBm at 70 MHz
Single-supply operation: 3 V to 5.5 V
Low power dissipation: 28 mA at 5 V
Adjustable output common-mode voltage
Fast settling and overdrive recovery
Slew rate of 13,000 V/µs
Power-down capability

ENHANCED PRODUCT FEATURES
Supports defense and aerospace applications (AQEC standard)
Extended industrial temperature range: −55°C to +105°C
Controlled manufacturing baseline
1 assembly/test site
1 fabrication site
Product change notification
Qualification data available upon request

APPLICATIONS
Differential ADC drivers
Single-ended-to-differential conversion
IF sampling receivers
RF/IF gain blocks
Surface acoustic wave (SAW) filter interfacing

GENERAL DESCRIPTION
The AD8351-EP is a low cost differential amplifier useful in RF and IF applications up to 2.2 GHz. The voltage gain can be set from unity to 26 dB using a single external gain resistor. The AD8351-EP provides a nominal 150 Ω differential output impedance. The excellent distortion performance and low noise characteristics of this device allow a wide range of applications.

The AD8351-EP is designed to satisfy the demanding performance requirements of communications transceiver applications. The device can be used as a general-purpose gain block, an ADC driver, and a high speed data interface driver, among other functions. The AD8351-EP can also be used as a single-ended-to-differential amplifier with similar distortion products as in the differential configuration. The exceptionally good distortion performance makes the AD8351-EP an ideal solution for 12-bit and 14-bit IF sampling receiver designs.

Fabricated in the Analog Devices, Inc., high speed XFCB process, the AD8351-EP has a high bandwidth that provides high frequency performance and low distortion. The quiescent current of the AD8351-EP is 28 mA typically. The AD8351-EP amplifier comes in a 16-lead LFCSP package, and operates over the temperature range of −55°C to +105°C.

Additional application and technical information can be found in the AD8351 datasheet.
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9/2016—Rev. 0 to Rev. A
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7/2016—Revision 0: Initial Version
**SPECIFICATIONS**

$V_S = 5 \text{ V}, R_L = 150 \Omega, R_S = 110 \Omega (A_V = 10 \text{ dB}), f = 70 \text{ MHz}, T = 25^\circ\text{C}$, parameters specified differentially, unless otherwise noted. The gain ($A_V$) can be set to any value between 0 dB and 26 dB.

Table 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions/Comments</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DYNAMIC PERFORMANCE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>−3 dB Bandwidth</td>
<td>$A_V = 6 \text{ dB}, V_{OUT} \leq 1.0 \text{ V p-p}$</td>
<td>3000</td>
<td></td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td></td>
<td>$A_V = 12 \text{ dB}, V_{OUT} \leq 1.0 \text{ V p-p}$</td>
<td>2200</td>
<td></td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td></td>
<td>$A_V = 18 \text{ dB}, V_{OUT} \leq 1.0 \text{ V p-p}$</td>
<td>600</td>
<td></td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td>Bandwidth for 0.1 dB Flatness</td>
<td>$0 \text{ dB} \leq A_V \leq 20 \text{ dB}, V_{OUT} \leq 1.0 \text{ V p-p}$</td>
<td>200</td>
<td></td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td>Bandwidth for 0.2 dB Flatness</td>
<td>$0 \text{ dB} \leq A_V \leq 20 \text{ dB}, V_{OUT} \leq 1.0 \text{ V p-p}$</td>
<td>400</td>
<td></td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td>Gain Accuracy</td>
<td>Using 1% resistor for $R_S$, $0 \text{ dB} \leq A_V \leq 20 \text{ dB}$</td>
<td>±1</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Gain Supply Sensitivity</td>
<td>$V_S \pm 5%$</td>
<td>0.08</td>
<td></td>
<td></td>
<td>dB/V</td>
</tr>
<tr>
<td>Gain Temperature Sensitivity</td>
<td>−55$^\circ$C to +105$^\circ$C</td>
<td>3.9</td>
<td></td>
<td></td>
<td>dB/C</td>
</tr>
<tr>
<td>Slew Rate</td>
<td>$R_L = 1 \text{k}\Omega, V_{OUT} = 2 \text{V step}$</td>
<td>13,000</td>
<td></td>
<td></td>
<td>V/µs</td>
</tr>
<tr>
<td></td>
<td>$R_L = 150 \Omega, V_S = 2 \text{V step}$</td>
<td>7500</td>
<td></td>
<td></td>
<td>V/µs</td>
</tr>
<tr>
<td>Settling Time</td>
<td>1 V step to 1%</td>
<td>&lt;3</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Overdrive Recovery Time</td>
<td>$V_{IN} = 4 \text{V to 0V step}, V_{OUT} \leq \pm 10 \text{mV}$</td>
<td>&lt;2</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Reverse Isolation (S12)</td>
<td></td>
<td>−67</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td><strong>INPUT/OUTPUT CHARACTERISTICS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Common-Mode Voltage Adjustment Range</td>
<td></td>
<td>1.2 to 3.8</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Maximum Output Voltage Swing</td>
<td>1 dB compressed</td>
<td>4.75</td>
<td></td>
<td></td>
<td>V p-p</td>
</tr>
<tr>
<td>Output Common-Mode Offset</td>
<td></td>
<td>40</td>
<td></td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td>Output Common-Mode Drift</td>
<td>−55$^\circ$C to +105$^\circ$C</td>
<td>0.24</td>
<td></td>
<td></td>
<td>mV/C</td>
</tr>
<tr>
<td>Output Differential Offset Voltage</td>
<td></td>
<td>20</td>
<td></td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td>Output Differential Offset Drift</td>
<td>−55$^\circ$C to +105$^\circ$C</td>
<td>0.13</td>
<td></td>
<td></td>
<td>mV/C</td>
</tr>
<tr>
<td>Input Bias Current</td>
<td></td>
<td>±15</td>
<td></td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>Input Resistance$^1$</td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td>kΩ</td>
</tr>
<tr>
<td>Input Capacitance$^1$</td>
<td></td>
<td>0.8</td>
<td></td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>Common-Mode Rejection Ratio (CMRR)</td>
<td></td>
<td>43</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Output Resistance$^1$</td>
<td></td>
<td>150</td>
<td></td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td>Output Capacitance$^1$</td>
<td></td>
<td>0.8</td>
<td></td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td><strong>POWER INTERFACE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply Voltage</td>
<td></td>
<td>3</td>
<td></td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>PWUP Threshold</td>
<td></td>
<td>1.3</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>PWUP Input Bias Current</td>
<td>PWUP at 5 V</td>
<td>100</td>
<td></td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td></td>
<td>PWUP at 0 V</td>
<td>25</td>
<td></td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>Quiescent Current</td>
<td>−55$^\circ$C to +105$^\circ$C</td>
<td>28</td>
<td></td>
<td>35</td>
<td>mA</td>
</tr>
<tr>
<td><strong>NOISE/DISTORTION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 MHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second/Third Harmonic Distortion$^2$</td>
<td>$R_L = 1 \text{k}\Omega, V_{OUT} = 2 \text{V p-p}$</td>
<td>−95/−93</td>
<td></td>
<td></td>
<td>dBc</td>
</tr>
<tr>
<td></td>
<td>$R_L = 150 \Omega, V_{OUT} = 2 \text{V p-p}$</td>
<td>−80/−69</td>
<td></td>
<td></td>
<td>dBc</td>
</tr>
<tr>
<td>Third-Order Intermodulation Distortion (IMD)</td>
<td>$R_L = 1 \text{k}\Omega, f_1 = 9.5 \text{MHz}, f_2 = 10.5 \text{MHz}$</td>
<td>−90</td>
<td></td>
<td></td>
<td>dBc</td>
</tr>
<tr>
<td></td>
<td>$V_{OUT} = 2 \text{V p-p composite}$</td>
<td>−70</td>
<td></td>
<td></td>
<td>dBc</td>
</tr>
<tr>
<td>Output Third-Order Intercept</td>
<td>$f_1 = 9.5 \text{MHz}, f_2 = 10.5 \text{MHz}$</td>
<td>33</td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Noise Spectral Density (Referred to Input (RTI))</td>
<td>$f_1 = 9.5 \text{MHz}, f_2 = 10.5 \text{MHz}$</td>
<td>2.65</td>
<td></td>
<td></td>
<td>nV/√Hz</td>
</tr>
<tr>
<td>1 dB Compression Point</td>
<td></td>
<td>13.5</td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions/Comments</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>70 MHz</strong></td>
<td><strong>Second/Third Harmonic Distortion</strong>&lt;sup&gt;2&lt;/sup&gt; RL = 1 kΩ, V&lt;sub&gt;OUT&lt;/sub&gt; = 2 V p-p</td>
<td></td>
<td></td>
<td>−79/−81</td>
<td>dBC</td>
</tr>
<tr>
<td></td>
<td>RL = 150 Ω, V&lt;sub&gt;OUT&lt;/sub&gt; = 2 V p-p</td>
<td></td>
<td></td>
<td>−65/−66</td>
<td>dBC</td>
</tr>
<tr>
<td>Third-Order IMD</td>
<td>RL = 1 kΩ, f&lt;sub&gt;1&lt;/sub&gt; = 69.5 MHz, f&lt;sub&gt;2&lt;/sub&gt; = 70.5 MHz, V&lt;sub&gt;OUT&lt;/sub&gt; = 2 V p-p composite</td>
<td></td>
<td>−85</td>
<td></td>
<td>dBC</td>
</tr>
<tr>
<td></td>
<td>RL = 150 Ω, f&lt;sub&gt;1&lt;/sub&gt; = 69.5 MHz, f&lt;sub&gt;2&lt;/sub&gt; = 70.5 MHz, V&lt;sub&gt;OUT&lt;/sub&gt; = 2 V p-p composite</td>
<td></td>
<td>−69</td>
<td></td>
<td>dBC</td>
</tr>
<tr>
<td>Output Third-Order Intercept</td>
<td>f1 = 69.5 MHz, f2 = 70.5 MHz</td>
<td></td>
<td>31</td>
<td></td>
<td>dBM</td>
</tr>
<tr>
<td>Noise Spectral Density (RTI)</td>
<td></td>
<td>2.70</td>
<td></td>
<td></td>
<td>nV/√Hz</td>
</tr>
<tr>
<td>1 dB Compression Point</td>
<td></td>
<td>13.3</td>
<td></td>
<td></td>
<td>dBM</td>
</tr>
<tr>
<td><strong>140 MHz</strong></td>
<td><strong>Second/Third Harmonic Distortion</strong>&lt;sup&gt;2&lt;/sup&gt; RL = 1 kΩ, V&lt;sub&gt;OUT&lt;/sub&gt; = 2 V p-p</td>
<td></td>
<td></td>
<td>−69/−69</td>
<td>dBC</td>
</tr>
<tr>
<td></td>
<td>RL = 150 Ω, V&lt;sub&gt;OUT&lt;/sub&gt; = 2 V p-p</td>
<td></td>
<td></td>
<td>−54/−53</td>
<td>dBC</td>
</tr>
<tr>
<td>Third-Order IMD</td>
<td>RL = 1 kΩ, f&lt;sub&gt;1&lt;/sub&gt; = 139.5 MHz, f&lt;sub&gt;2&lt;/sub&gt; = 140.5 MHz, V&lt;sub&gt;OUT&lt;/sub&gt; = 2 V p-p composite</td>
<td></td>
<td>−79</td>
<td></td>
<td>dBC</td>
</tr>
<tr>
<td></td>
<td>RL = 150 Ω, f&lt;sub&gt;1&lt;/sub&gt; = 139.5 MHz, f&lt;sub&gt;2&lt;/sub&gt; = 140.5 MHz, V&lt;sub&gt;OUT&lt;/sub&gt; = 2 V p-p composite</td>
<td></td>
<td>−67</td>
<td></td>
<td>dBC</td>
</tr>
<tr>
<td>Output Third-Order Intercept</td>
<td>f1 = 139.5 MHz, f2 = 140.5 MHz</td>
<td></td>
<td>29</td>
<td></td>
<td>dBM</td>
</tr>
<tr>
<td>Noise Spectral Density (RTI)</td>
<td></td>
<td>2.75</td>
<td></td>
<td></td>
<td>nV/√Hz</td>
</tr>
<tr>
<td>1 dB Compression Point</td>
<td></td>
<td>13</td>
<td></td>
<td></td>
<td>dBM</td>
</tr>
<tr>
<td><strong>240 MHz</strong></td>
<td><strong>Second/Third Harmonic Distortion</strong>&lt;sup&gt;2&lt;/sup&gt; RL = 1 kΩ, V&lt;sub&gt;OUT&lt;/sub&gt; = 2 V p-p</td>
<td></td>
<td></td>
<td>−60/−66</td>
<td>dBC</td>
</tr>
<tr>
<td></td>
<td>RL = 150 Ω, V&lt;sub&gt;OUT&lt;/sub&gt; = 2 V p-p</td>
<td></td>
<td></td>
<td>−46/−50</td>
<td>dBC</td>
</tr>
<tr>
<td>Third-Order IMD</td>
<td>RL = 1 kΩ, f&lt;sub&gt;1&lt;/sub&gt; = 239.5 MHz, f&lt;sub&gt;2&lt;/sub&gt; = 240.5 MHz, V&lt;sub&gt;OUT&lt;/sub&gt; = 2 V p-p composite</td>
<td></td>
<td>−76</td>
<td></td>
<td>dBC</td>
</tr>
<tr>
<td></td>
<td>RL = 150 Ω, f&lt;sub&gt;1&lt;/sub&gt; = 239.5 MHz, f&lt;sub&gt;2&lt;/sub&gt; = 240.5 MHz, V&lt;sub&gt;OUT&lt;/sub&gt; = 2 V p-p composite</td>
<td></td>
<td>−62</td>
<td></td>
<td>dBC</td>
</tr>
<tr>
<td>Output Third-Order Intercept</td>
<td>f1 = 239.5 MHz, f2 = 240.5 MHz</td>
<td></td>
<td>27</td>
<td></td>
<td>dBM</td>
</tr>
<tr>
<td>Noise Spectral Density (RTI)</td>
<td></td>
<td>2.90</td>
<td></td>
<td></td>
<td>nV/√Hz</td>
</tr>
<tr>
<td>1 dB Compression Point</td>
<td></td>
<td>13</td>
<td></td>
<td></td>
<td>dBM</td>
</tr>
</tbody>
</table>

<sup>1</sup> Values are specified differentially.

<sup>2</sup> See the AD8351 data sheet for information about single-ended to differential operation.
**ABSOLUTE MAXIMUM RATINGS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage, VPOS</td>
<td>6 V</td>
</tr>
<tr>
<td>PWUP Voltage</td>
<td>VPOS</td>
</tr>
<tr>
<td>Internal Power Dissipation</td>
<td>320 mW</td>
</tr>
<tr>
<td>θJA</td>
<td>79.1°C/W</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>125°C</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>-55°C to +105°C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>-65°C to +150°C</td>
</tr>
<tr>
<td>Lead Temperature Range (Soldering, 60 sec)</td>
<td>300°C</td>
</tr>
</tbody>
</table>

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

**MAXIMUM POWER DISSIPATION**

The maximum power that can be safely dissipated by this device is limited by the associated rise in junction temperature. Exceeding a junction temperature of 125°C for an extended period can result in device failure.

To ensure proper operation of the AD8351-EP, it is necessary to observe the maximum power derating curve (see Figure 2) to guarantee that the maximum junction temperature (125°C) is not exceeded under all conditions.

![Figure 2. Maximum Power Dissipation vs. Temperature](image)

**ESD CAUTION**

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.
**PIN CONFIGURATION AND FUNCTION DESCRIPTIONS**

![PIN CONFIGURATION AND FUNCTION DESCRIPTIONS](image)

**Table 3. Pin Function Descriptions**

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Mnemonic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RGP1</td>
<td>Gain Resistor Input 1.</td>
</tr>
<tr>
<td>2</td>
<td>INHI</td>
<td>Balanced Differential Input, High. Biased to midsupply, typically ac-coupled.</td>
</tr>
<tr>
<td>3</td>
<td>INLO</td>
<td>Balanced Differential Input, Low. Biased to midsupply, typically ac-coupled.</td>
</tr>
<tr>
<td>4</td>
<td>RGP2</td>
<td>Gain Resistor Input 2.</td>
</tr>
<tr>
<td>5, 6, 7, 8, 14, 15</td>
<td>NC</td>
<td>No Connect. Do not connect to this pin.</td>
</tr>
<tr>
<td>9</td>
<td>COMM</td>
<td>Device Common. Connect this pin to a low impedance ground.</td>
</tr>
<tr>
<td>10</td>
<td>OPLO</td>
<td>Balanced Differential Output, Low. Biased to VOCM, typically ac-coupled.</td>
</tr>
<tr>
<td>11</td>
<td>OPHI</td>
<td>Balanced Differential Output, High. Biased to VOCM, typically ac-coupled.</td>
</tr>
<tr>
<td>12</td>
<td>VPOS</td>
<td>Positive Supply Voltage. 3 V to 5.5 V.</td>
</tr>
<tr>
<td>13</td>
<td>VOCM</td>
<td>Input/Output Common-Mode Voltage. The voltage applied to this pin sets the common-mode voltage at both the input and output. This pin is typically decoupled to ground with a 0.1 μF capacitor.</td>
</tr>
<tr>
<td>16</td>
<td>PWUP</td>
<td>Apply a positive voltage (1.3 V ≤ VPWUP ≤ VPOS) to activate the device.</td>
</tr>
<tr>
<td></td>
<td>EPAD</td>
<td>Exposed Pad. The exposed pad is internally connected to GND and must be soldered to a low impedance ground plane.</td>
</tr>
</tbody>
</table>
TYPICAL PERFORMANCE CHARACTERISTICS

$V_s = 5\, \text{V}, \, T = 25^\circ\text{C}$, unless otherwise noted.

- **Figure 4.** Gain vs. Frequency for a 150 $\Omega$ Differential Load $(A_v = 6\, \text{dB}, 12\, \text{dB}, \text{and } 18\, \text{dB})$
- **Figure 5.** Gain vs. Gain Resistor, $R_G$ $(f = 100\, \text{MHz}, \, R_L = 150\, \Omega, \, 1\, \text{k}\Omega, \text{and Open})$
- **Figure 6.** Gain vs. Temperature at 100 MHz $(A_v = 10\, \text{dB})$
- **Figure 7.** Gain vs. Frequency for a 1 k$\Omega$ Differential Load $(A_v = 10\, \text{dB}, 18\, \text{dB}, \text{and } 26\, \text{dB})$
- **Figure 8.** Gain Flatness vs. Frequency $(R_L = 150\, \Omega \text{and } 1\, \text{k}\Omega, \, A_v = 10\, \text{dB})$
- **Figure 9.** Isolation vs. Frequency $(A_v = 10\, \text{dB})$
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Dimensions shown in millimeters

ORDERING GUIDE

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1 Z = RoHS Compliant Part.