The AD9410 is an 10-bit monolithic sampling analog-to-digital converter with an on-chip track-and-hold circuit and is optimized for high speed conversion and ease of use. The product operates at a 200 Msps conversion rate with outstanding dynamic performance over its full operating range.

The ADC requires only a single 5.0V power supply and a 100MHz encode clock for full-performance operation. No external reference or driver components are required for many applications. The digital outputs are TTL/CMOS compatible and a separate output power supply pin supports interfacing with 3.3V logic.

The encode input is differential and TTL/CMOS compatible. The 10-bit digital outputs can be operated from +3.0V (2.5V to 3.6V) supplies. An on-chip clock doubler allows up to 200 Msps conversion rates. Two output buses support demultiplexed data up to 100 Msps rates.

Fabricated on an advanced BiCMOS process, the AD9410 is available in a 64 pin surface mount plastic package (64 LQFP) specified over the industrial temperature range (–40°C to +85°C).

**FEATURES**
- On-Chip clock doubler
- Demultiplexed outputs each at 100 Msps
- On-Chip Reference and Track/Hold
- Target Power: 1.0 W Typical at 200 Msps
- Target: 400 MHz Analog Bandwidth
- Target: SNR = 54dB @ 100MHz
- 1.5 Vp–p Analog Input Range
- Single +5.0V Supply Operation
- +3.3V CMOS/TTL outputs

**APPLICATIONS**
- Communications
- Basestations and 'Zero-IF' subsystems
- Wireless Local Loop (WLL)
- Local Multipoint Distribution Service (LMDS)
### ELECTRICAL CHARACTERISTICS\(^1\) \((V_{DD} = 3.0V, V_0 = 5.0V; \text{external reference}; \text{ENCODER} = 200 \text{ MspS}, \text{unless otherwise noted})\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Temp</th>
<th>Test Level</th>
<th>AD9410BST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RESOLUTION</strong></td>
<td></td>
<td></td>
<td>10</td>
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<tr>
<td><strong>DC ACCURACY</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Differential Nonlinearity</td>
<td>+25°C</td>
<td>I</td>
<td>±0.5</td>
</tr>
<tr>
<td></td>
<td>Full</td>
<td>VI</td>
<td></td>
</tr>
<tr>
<td>Integral Nonlinearity</td>
<td>+25°C</td>
<td>I</td>
<td>±0.75</td>
</tr>
<tr>
<td></td>
<td>Full</td>
<td>VI</td>
<td></td>
</tr>
<tr>
<td>No Missing Codes</td>
<td>Full</td>
<td>VI</td>
<td>Guaranteed</td>
</tr>
<tr>
<td>Gain Error</td>
<td>+25°C</td>
<td>I</td>
<td>±1</td>
</tr>
<tr>
<td></td>
<td>Full</td>
<td>VI</td>
<td></td>
</tr>
<tr>
<td>Gain Tempco</td>
<td>Full</td>
<td>V</td>
<td>150</td>
</tr>
<tr>
<td><strong>ANALOG INPUT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Voltage Range (with respect to (A_{IN}))</td>
<td>Full</td>
<td>V</td>
<td>±750</td>
</tr>
<tr>
<td>Common Mode Voltage</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Input Offset Voltage</td>
<td>+25°C</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Full</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td>Reference Voltage</td>
<td>+25°C</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td>Input Resistance</td>
<td>+25°C</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Full</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Capacitance</td>
<td>+25°C</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Input Bias Current</td>
<td>+25°C</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Full</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td>Analog Bandwidth, Full Power</td>
<td>+25°C</td>
<td>V</td>
<td>400</td>
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<table>
<thead>
<tr>
<th>Parameter</th>
<th>Temp</th>
<th>Test Level</th>
<th>AD9410BST</th>
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<tbody>
<tr>
<td><strong>SWITCHING PERFORMANCE</strong></td>
<td></td>
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</tr>
<tr>
<td>Maximum Conversion Rate</td>
<td>Full</td>
<td>VI</td>
<td>200</td>
</tr>
<tr>
<td>Minimum Conversion Rate</td>
<td>Full</td>
<td>IV</td>
<td>40</td>
</tr>
<tr>
<td>Encode Pulse Width High ((t_{EH}))</td>
<td>+25°C</td>
<td>IV</td>
<td>ns</td>
</tr>
<tr>
<td>Encode Pulse Width Low ((t_{EL}))</td>
<td>+25°C</td>
<td>IV</td>
<td>ns</td>
</tr>
<tr>
<td>Aperture Delay ((t_A))</td>
<td>+25°C</td>
<td>V</td>
<td>2.0</td>
</tr>
<tr>
<td>Aperture Uncertainty (Jitter)</td>
<td>+25°C</td>
<td>V</td>
<td>4.0</td>
</tr>
<tr>
<td>Output Valid Time ((t_{D}))</td>
<td>Full</td>
<td>VI</td>
<td>5.0</td>
</tr>
<tr>
<td>Output Propagation Delay ((t_{PD}))</td>
<td>Full</td>
<td>VI</td>
<td>6.0</td>
</tr>
<tr>
<td>Output Rise Time ((t_{R}))</td>
<td>Full</td>
<td>VI</td>
<td>1.8</td>
</tr>
<tr>
<td>Output Fall Time ((t_{F}))</td>
<td>Full</td>
<td>VI</td>
<td>1.4</td>
</tr>
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<table>
<thead>
<tr>
<th>Parameter</th>
<th>Temp</th>
<th>Test Level</th>
<th>AD9410BST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DIGITAL INPUTS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logic (&quot;1) Voltage</td>
<td>Full</td>
<td>IV</td>
<td></td>
</tr>
<tr>
<td>Logic (&quot;0) Voltage</td>
<td>Full</td>
<td>IV</td>
<td></td>
</tr>
<tr>
<td>Logic (&quot;1) Current</td>
<td>Full</td>
<td>VI</td>
<td>±1</td>
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<tr>
<td>Logic (&quot;0) Current</td>
<td>Full</td>
<td>VI</td>
<td>±1</td>
</tr>
<tr>
<td>Input Capacitance</td>
<td>+25°C</td>
<td>V</td>
<td>4.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Temp</th>
<th>Test Level</th>
<th>AD9410BST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DIGITAL OUTPUTS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logic (&quot;1) Voltage ((V_{DD} = +3.3V))</td>
<td>Full</td>
<td>VI</td>
<td>(V_{DD} &gt; 0.5)</td>
</tr>
<tr>
<td>Logic (&quot;0) Voltage ((V_{DD} = +3.3V))</td>
<td>Full</td>
<td>VI</td>
<td></td>
</tr>
<tr>
<td>Output Coding</td>
<td></td>
<td></td>
<td>Offset</td>
</tr>
<tr>
<td><strong>POWER SUPPLY</strong></td>
<td></td>
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<tr>
<td>Power Dissipation</td>
<td>Full</td>
<td>VI</td>
<td>1250</td>
</tr>
<tr>
<td>Power Supply Rejection Ratio (PSRR) ((+25°C))</td>
<td></td>
<td>I</td>
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## Test AD9410BR

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Temp</th>
<th>Test Level</th>
<th>Min</th>
<th>Typical</th>
<th>Max</th>
<th>Units</th>
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<tbody>
<tr>
<td><strong>DYNAMIC PERFORMANCE</strong></td>
<td></td>
<td></td>
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<tr>
<td>Transient Response</td>
<td>+25°C</td>
<td>V</td>
<td>5</td>
<td>ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overvoltage Recovery Time</td>
<td>+25°C</td>
<td>V</td>
<td>6</td>
<td>ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Signal–to–Noise Ratio (SNR)</strong> (Without Harmonics)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f&lt;sub&gt;In&lt;/sub&gt; = 41 MHz</td>
<td>+25°C</td>
<td>I</td>
<td>57</td>
<td>dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f&lt;sub&gt;In&lt;/sub&gt; = 100 MHz</td>
<td>+25°C</td>
<td>I</td>
<td>54</td>
<td>dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Signal–to–Noise Ratio (SINAD)</strong> (With Harmonics)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f&lt;sub&gt;In&lt;/sub&gt; = 41 MHz</td>
<td>+25°C</td>
<td>I</td>
<td>55</td>
<td>dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f&lt;sub&gt;In&lt;/sub&gt; = 100 MHz</td>
<td>+25°C</td>
<td>I</td>
<td>52</td>
<td>dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effective Number of Bits</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f&lt;sub&gt;In&lt;/sub&gt; = 41 MHz</td>
<td>+25°C</td>
<td>I</td>
<td>9.2</td>
<td>bits</td>
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<td></td>
</tr>
<tr>
<td>f&lt;sub&gt;In&lt;/sub&gt; = 100 MHz</td>
<td>+25°C</td>
<td>I</td>
<td>8.5</td>
<td>bits</td>
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<tr>
<td><strong>2nd Harmonic Distortion</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f&lt;sub&gt;In&lt;/sub&gt; = 41 MHz</td>
<td>+25°C</td>
<td>I</td>
<td>70</td>
<td>dBc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f&lt;sub&gt;In&lt;/sub&gt; = 100 MHz</td>
<td>+25°C</td>
<td>I</td>
<td>65</td>
<td>dBc</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3rd Harmonic Distortion</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f&lt;sub&gt;In&lt;/sub&gt; = 41 MHz</td>
<td>+25°C</td>
<td>I</td>
<td>70</td>
<td>dBc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f&lt;sub&gt;In&lt;/sub&gt; = 100 MHz</td>
<td>+25°C</td>
<td>I</td>
<td>65</td>
<td>dBc</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Two–Tone Intermod Distortion (IMD)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f&lt;sub&gt;In&lt;/sub&gt; = 41 MHz</td>
<td>+25°C</td>
<td>V</td>
<td>68</td>
<td>dBc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f&lt;sub&gt;In&lt;/sub&gt; = 100 MHz</td>
<td>+25°C</td>
<td>V</td>
<td>58</td>
<td>dBc</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### NOTES
1. Target Specifications only for product development purposes.

### ORDERING GUIDE

<table>
<thead>
<tr>
<th>Model</th>
<th>Temperature Range</th>
<th>Package Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD9410BST</td>
<td>–40°C to +85°C</td>
<td>Evaluation Board</td>
</tr>
<tr>
<td>AD9410/PCB</td>
<td>+25°C</td>
<td>Evaluation Board</td>
</tr>
</tbody>
</table>

### EXPLANATION OF TEST LEVELS

**Test Level**

I 100% production tested.

II 100% production tested at +25°C and sample tested at specified temperatures.

III Sample tested only.

IV Parameter is guaranteed by design and characterization testing.

V Parameter is a typical value only.

VI 100% production tested at +25°C; guaranteed by design and characterization testing for industrial temperature range.

### ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V&lt;sub&gt;ID&lt;/sub&gt;</td>
<td>+6 V</td>
</tr>
<tr>
<td>V&lt;sub&gt;DD&lt;/sub&gt;</td>
<td>+4 V</td>
</tr>
<tr>
<td>Analog Inputs</td>
<td>-0.5V to V&lt;sub&gt;ID&lt;/sub&gt; + 0.5 V</td>
</tr>
<tr>
<td>Digital Inputs</td>
<td>-0.5V to V&lt;sub&gt;DD&lt;/sub&gt; + 0.5 V</td>
</tr>
<tr>
<td>V&lt;sub&gt;REF IN&lt;/sub&gt;</td>
<td>-0.5V to V&lt;sub&gt;ID&lt;/sub&gt; + 0.5 V</td>
</tr>
<tr>
<td>Digital Output Current</td>
<td>20 mA</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>–55°C to +125°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>–65°C to +150°C</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>+175°C</td>
</tr>
<tr>
<td>Maximum Case Temperature</td>
<td>+150°C</td>
</tr>
</tbody>
</table>

* Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions outside of those indicated in the operation sections of this specification is not implied. Exposure to absolute maximum ratings for extended periods may affect device reliability.

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REV. 0.10 – 3 – AD9410 Preliminary Technical Information – 9/21/1998
AD9410

PACKAGE DRAWING

64 Pin LQFP (1.4mm)