The Digital Semiconductor 21164 Alpha microprocessor is a high-performance implementation of the DIGITAL Alpha architecture designed for Windows NT desktop PCs and workstations. The 21164 improves productivity in today’s demanding business world by bringing supercomputer performance to the desktop.

Description
The 21164 has a superscalar design capable of issuing four instructions every clock cycle. The integration of an instruction cache, data cache, and second-level cache offers unrivaled microprocessor performance. The 21164 uses a high-performance interface to access main memory, data buses, and an optional board-level cache.

Benefits
- 100% Windows compatible
  - Thousands of native applications
  - High-performance translation technology for x86 applications
- Highest performance Windows NT systems
- Increased engineering and business productivity
- Host-based DVD playback
- Designed for the future using the 64-bit Alpha architecture
- Designed to meet the needs of the PC industry
  - Standard cooling
  - Lower power
- ATX motherboard turnkey OEM solution is available for quick time to market

Features
- Fully pipelined 64-bit advanced RISC (reduced instruction set computing) architecture
- Superscalar (4-way instruction issue)
- 0.35 µm CMOS technology
- Onchip, 8KB, direct-mapped L1 instruction cache
- Onchip, 8KB, direct-mapped, write-through L1 data cache
- Onchip, 96KB, 3-way, set-associative, write-back L2 unified instruction and data cache
- Memory-management unit
- Serial ROM interface for initialization
- Flexible high-performance interface
  - 128-bit memory data path
  - 3.3-V I/O
  - Selectable parity protection or error correction code (ECC) on data
  - Programmable system interface: one-third to one-fifteenth of clock speed
  - Control for optional offchip L3 cache, with multiple timing options for industry-standard synchronous and asynchronous SRAMs
- Chip- and module-level test supports JTAG (IEEE 1149.1)
- 499-pin ceramic interstitial pin grid array (IPGA) package
- Enhancements:
  - Support for byte and word data types
  - 2.0-V core for reduced power consumption
21164 Functional Block Diagram

The 21164 consists of five independent functional units: the instruction fetch, decode, and branch unit; the integer execution unit; the memory-management unit; the cache control and bus interface unit; and the floating-point unit. There are three onchip caches: the instruction cache, the data cache, and the second-level cache.

Estimated Performance

<table>
<thead>
<tr>
<th>Speed</th>
<th>SPECint95</th>
<th>SPECfp95</th>
<th>BIPS (billions of instructions/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>600 MHz</td>
<td>18.0</td>
<td>27.0</td>
<td>2.4</td>
</tr>
<tr>
<td>500 MHz</td>
<td>15.4</td>
<td>21.1</td>
<td>2.0</td>
</tr>
<tr>
<td>433 MHz</td>
<td>13.3</td>
<td>18.3</td>
<td>1.7</td>
</tr>
<tr>
<td>366 MHz</td>
<td>11.3</td>
<td>15.4</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Characteristics

Electrical

Power supply $V_{ss} = 0.0 \text{ V}$, $V_{dd} = 3.3 \text{ V} \pm 5\%$, $V_{ddi} = 2.5 \text{ V} \pm 0.1 \text{ V}$

Environmental

Operating temperature $T_a = 50^\circ \text{C} \text{ maximum (122}^\circ \text{F})$
$T_j = 85^\circ \text{C} \text{ maximum (185}^\circ \text{F})$

Storage temperature range $-55^\circ \text{C} \text{ to } +125^\circ \text{C} \text{ (} -67^\circ \text{F} \text{ to } +257^\circ \text{F})$

Power dissipation $28 \text{ W maximum}$

For frequencies greater than 366 MHz, add 5 W for every 66 MHz.

For More Information

To learn more about the availability of the 21164, contact your local semiconductor distributor. To learn more about Digital Semiconductor’s product portfolio, visit the Digital Semiconductor World Wide Web Internet site:

http://www.digital.com/semiconductor

or you can contact the Digital Semiconductor Information Line:

United States and Canada 1–800–332–2717
Outside North America 1–510–490–4753

For technical support, contact the Digital Semiconductor Customer Technology Center:

Phone (U.S. and international) 1–508–568–7474
Fax 1–508–568–6698

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