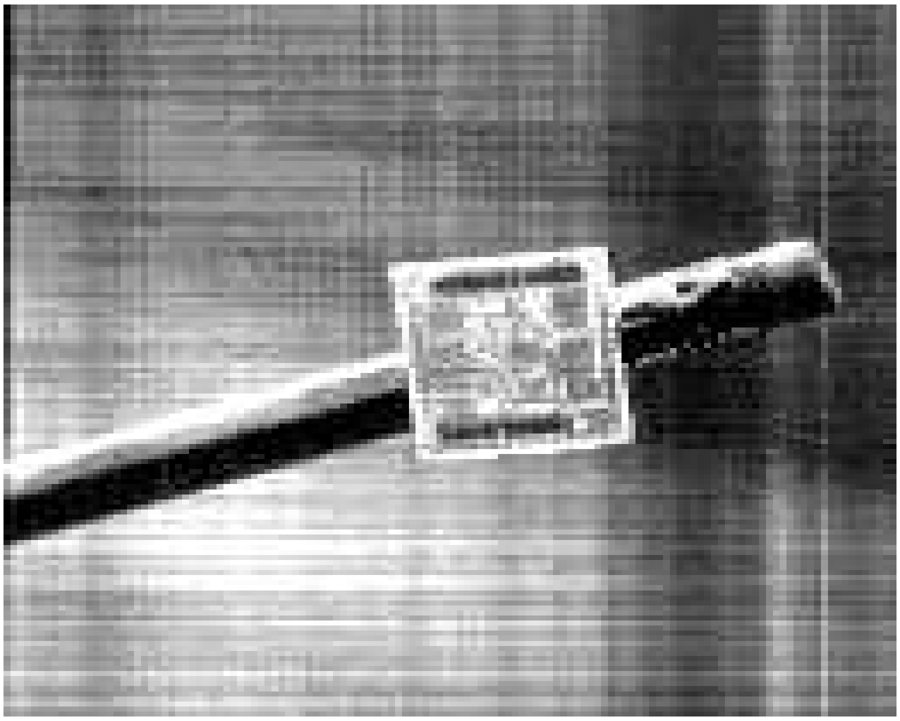
Digital's 21064 Microprocessor

21st Century 64-bit RISC Computing Architecture—Today!



The Highest Performance Microprocessor in the Industry
The 21064 microprocessor is the first product implementing Digital's new 64-bit RISC computing architecture. Digital's internal code name for this architecture is Alpha.

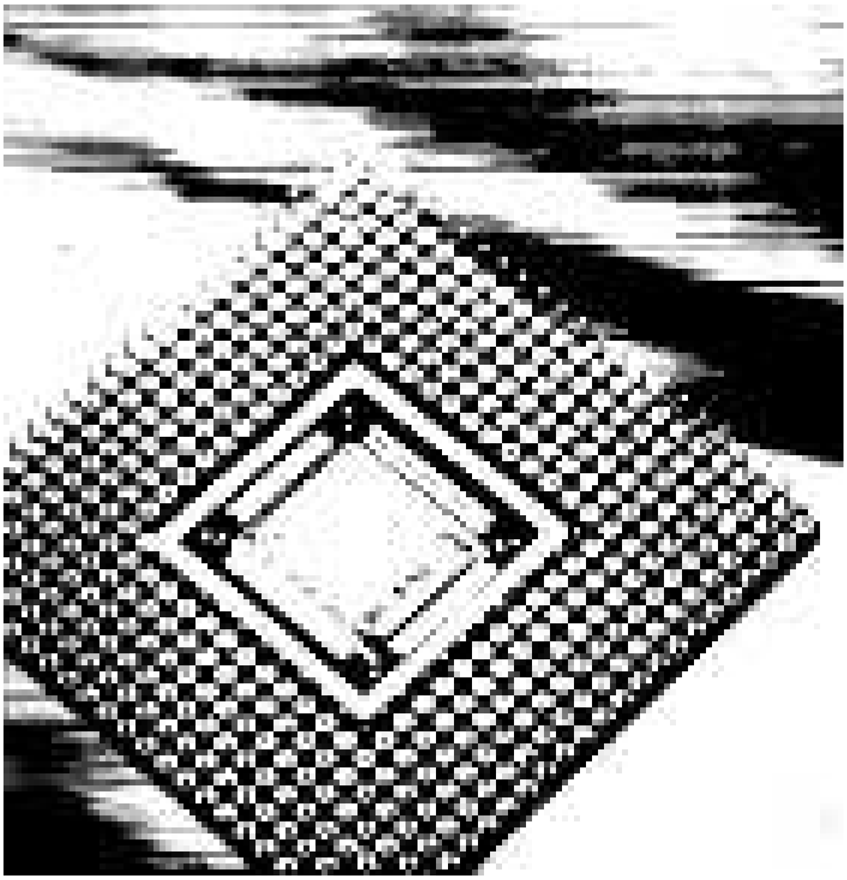
The result of a twelve-year investment in research, design, and fabrication, Digital's 21064 microprocessor has the highest performance of any microprocessor in the industry. The current 150 MHz version offers performance that peaks at 300 million instructions per second (MIPS) and 150 million floating-point operations per second (MFLOPS). Computer systems built around this microprocessor will be part of a new generation—a generation of systems that is setting the standard for computing in the 21st century.

The 21064 microprocessor is the first implementation of an architecture designed with the capacity and performance potential to last at least 25 years. In keeping with the growing needs of users everywhere, Digital designed the architecture so that future implementations can realize this potential through increased chip speed, advances in multiple instruction issue, and multiprocessor configurations.

With the 21064 microprocessor, everyone wins. *Current Digital customers* know that the applications they use today will migrate easily and cost-effectively to the new architecture. *Software developers* will find that the software they wrote for VAX and DECsystem computers can migrate easily to 21064-based systems. Any software they design to take advantage of the Alpha architecture will have a variety of platforms that will provide industry-leading performance into the 21st century. And *hardware developers* will win when they create products that use the 21064 microprocessor.

Highlights

- The 21064 microprocessor implements the full 64-bit Alpha architecture using Digital's state-of-the-art CMOS technology.
- The current 150 MHz implementation provides the highest CPU performance in the industry — 300 peak MIPS and 150 peak MFLOPS.
- Its single-chip implementation provides higher performance, improved reliability, and significantly lower cost.
- Full application and development support is available.



Alpha — An Architecture for the 21st Century

The Alpha architecture is a full RISC architecture without compromises in its short- or long-term performance. This is not a 32-bit architecture expanded to 64 bits. Alpha was designed to be a 64-bit architecture right from the very start.

Why 64 bits? A full 64-bit system gives you an extended address space for truly demanding applications. This is particularly important for applications such as molecular modeling, advanced CAD, and weather forecasting — which are expected to reach performance limitations with 32-bit technology in the near future.

Designed for Speed

The initial chip implementation is based on Digital's leadership 0.75 micron CMOS VLSI technology, which has produced the fastest chip in the industry. This technology is the result of more than twelve continuous years of investment in quality, design, and process improvements. The result: the first-pass chips were fully functional and worked at full speed — a stunning achievement considering the complexity involved in integrating 1.7 million discrete devices.

When you look at the 21064 microprocessor, you are looking at a technology that will continue to improve as the years go by. Digital's long-term investment in semiconductor technology ensures ongoing performance improvements. The Alpha architecture has been designed so that it can cater not only to increased multiple instruction-issue implementations, but also to the needs of massively parallel processing (MPP).

One of the reasons the 21064 microprocessor is so fast is that it is a single-chip implementation of the architecture. In addition to the performance edge, single-chip implementations offer other advantages that make them cheaper to produce than multiple-chip implementations. They use less power, generate less heat, and require less space on the circuit board. Also, fewer components usually mean a more reliable product.

The 21064 is a super-scalar, super-pipelined implementation of the Alpha architecture. Super-pipelined means that an instruction is issued to the functional units at every clock tick and the results are pipelined. Being super-scalar, the architecture allows the instruction unit to issue two instructions per clock tick, resulting in significantly higher throughput and performance.

The Founding Member of a Large Extended Family

The 21064 is the first in a family of microprocessor implementations of the Alpha architecture. This family of devices will provide optimized solutions for systems from the desktop to the datacenter. This is unlike many competitors' RISC implementations, which are oriented to only one style of system, such as workstations. Like the VAX family, all implementations of the Alpha architecture will be capable of running the same system and application software.

Multiprocessing Supports the Biggest Workloads

The 21064 has been designed to support multiple-processor configurations. When processing demands are especially high, multiple processors can be linked to share massive workloads. With multiprocessing, systems implementing the 21064 can range from single-chip computers to massively parallel processor systems. As years of success with multiprocessing on Digital's VAX systems have proven, this kind of flexibility is a must for high-performance systems.

Choose the Best Operating System for the Job

Several characteristics of the Alpha architecture set new standards for comparison in the industry. The Alpha architecture has been designed from the start to be unbiased towards operating systems. For example, the architecture is being introduced to support both the OSF/1 and VMS operating systems — with few compromises in speed or functionality.

The architecture is new, but users' investments in VAX and DECsystem applications is protected with technology like the binary translator, which allows existing applications to run on 21064-based systems. The binary translator technology is state-of-the-art and is not limited to only VAX or DECsystem computers — other translators can be built.

The 21064 microprocessor also includes both VAX and IEEE floating data types. This is consistent with the VAX architecture and supports the most widely accepted industry standards.

The architecture includes a very flexible, privileged library of software for optimizing the performance of specific operating systems. One version of this software allows the architecture to run a full version of the VMS operating system that mirrors many of the VAX operating system features. Another version of the software supports a version of the OSF/1 operating system that mirrors all of the DECsystem operating system features. Other versions could be tailored for real-time, teaching, or other special uses. This library makes it possible for virtually any operating system to run efficiently on Alpha systems.

The Open Advantage

The 21064 microprocessor is strong testimony to Digital's commitment to delivering the Open Advantage to our customers. Openness also requires open business practices. So, in addition to selling systems built around the 21064 microprocessor, Digital will license the technology and form partnerships with vendors who want to use the architecture in their systems or embed the microprocessor in special-purpose products. To complement the open technology and open business practices, open service offerings range from simple requirements such as replacing spare Digital or non-Digital parts to actually outsourcing and managing complex information centers.

Specifications

Process Technology	.75 micron CMOS
Cycle Time	150 MHz (6.6 ns)
Die Size	13.9mm x 16.8mm
Transistor Count	1.68 million
Package	431 pin PGA
Number of Signal Pins	291
Power Dissipation	23 W at 6.6 ns cycle
Power Supply	3.3 volts
Clocking Input	300 MHz differential
On-chip D-cache	8 Kbyte, physical, direct-mapped, write-through, 32-byte line, 32-byte fill
On-chip I-cache	8 Kbyte, physical, direct-mapped, 32-byte line, 32-byte fill, 64 ASNs
On-chip DTB	32-entry; fully-associative; 8-Kbyte, 64-Kbyte, 256-Kbyte, 4-Mbyte page sizes
On-chip ITB	8-entry, fully associative, 8-Kbyte page plus 4-entry, fully-associative, 4-Mbyte page
Floating Point Unit	On-chip FPU supports both IEEE and VAX floating point
Bus	Separate data and address bus; 128-bit/64-bit data bus
Serial ROM Interface	Allows the chip to directly access serial ROM
Virtual Address Size	64 bits checked; 43 bits implemented
Physical Address Size	34 bits implemented
Page Size	8 Kbytes
Issue Rate	2 instructions per cycle to A-box, E-box, or F-box
Integer Pipeline	7-stage pipeline
Floating Pipeline	10-stage pipeline

Service and Support

Twenty-four hours a day, 365 days a year, Digital's Customer Support Centers around the world offer state-of-the-art hardware, software, and network solutions. Besides supporting our own equipment, Digital provides first-class service for other vendors' equipment.

More than 40,000 professionals in 450 locations worldwide deliver a wide range of services. These include services for developing information systems solutions and integrating them with your business, organization, technical environment, and architecture.

Digital is committed to providing a wide range of services designed specifically for vendors who are incorporating the 21064 microprocessor into their own products. Services range from training, telephone support, and design-in services, to service partnerships and private-label service offerings for vendors' end customers.

For More Information

To learn more about pricing and availability of the 21064 microprocessor in its 150 MHz or faster clock rate versions, contact your local Digital sales representative. Or, in the United States, dial 1-800-DEC-2717; 1-800-DEC-2515 TTY.