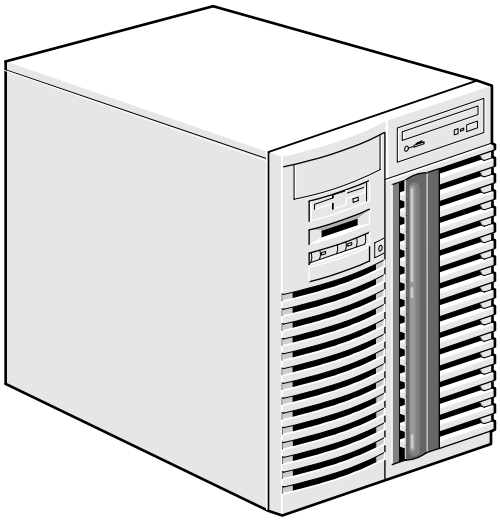
AlphaServer 1200 System

Technical Summary



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AlphaServer 1200 Systems

The DIGITAL AlphaServer 1200 product is a dependable, open system that delivers high productivity for business, technical, and scientific applications at an affordable price. As a high-capacity database server, high-performance application server, Network File System (NFS) server, or Internet server, the AlphaServer 1200 delivers exceptional value and investment protection.

The 64-bit Alpha RISC architecture, at the heart of DIGITAL AlphaServer products, provides fast processing and quick response for today's applications and will run the advanced applications of tomorrow. You can choose from three popular operating environments— DIGITAL UNIX®, Windows NT, and OpenVMS operating systems — as well as thousands of applications. The AlphaServer 1200 system integrates into your current operating environment and anticipates future needs with upgrade capabilities.

More information on the AlphaServer 1200 system is on the World Wide Web: http://www.digital.com/info/alphaserver/products.html.

System Overview

The AlphaServer 1200 pedestal system is designed with a small footprint for the open office environment. It is ideal for growing businesses that are ready to move up to a server that offers high productivity and cost-effective sol utions.

The AlphaServer 1200 is available in 400 MHz and 533 MHz versions with 4 MB ECC cache. Systems can be upgraded to two CPU's and are available with a choice of three popular operating systems: DIGITAL UNIX, OpenVMS, and Microsoft Windows NT Server. The pedestal system offers up to 10 internal storage devices, including a floppy diskette drive, a CD-ROM, one additional 5.25-inch removable media bay, and seven hot-swap StorageWorks wide or narrow disk drives. The system supports up to 30 GB of internal storage using 4.3-GB disks.

The AlphaServer 1200 offers the following high-reliability features: heat sensor, fan failure and power supply sensors, and ECC memory. Integrated on the system motherboard are a fast narrow, single-ended SCSI-2 controller, a diskette controller, two serial ports, one parallel port, and keyboard and mouse controller. Packaged systems also include memory, an UltraSCSI adapter, 10Base-T/100Base-T Ethernet adapter and 4.3 GB of UltraSCSI storage.

Features and Benefits

- **Performance and Price Performance**

The balanced system design delivers leadership performance from the scalable processor power and high-speed system bus to the large memory storage capacity and high-speed 64-bit PCIs.

- **High I/O Bandwidth/Low Memory Latency**

The system bus bandwidth is 1.1 GB/sec with a memory latency of 120 ns.

- **Reliability and Availability**

AlphaServer 1200 products achieve an unparalleled level of reliability and availability through the careful appl ication of technologies, error corre ction, and fault management. The balance between simple error detection and error correction provides high availability for low cost.

Architecture

The system design (see figure) optimizes for low memory latency (120 ns) and high delivered bandwidth (1.1 GB/ sec) by applying emerging synchronous memory technology. The I/O subsystem complements the memory subsystem; it, too, was designed for low-target latencies. For programmed I/O and DMA writes the latencies are the same or better as what can be expected from a high-performance workstation.

CPUs

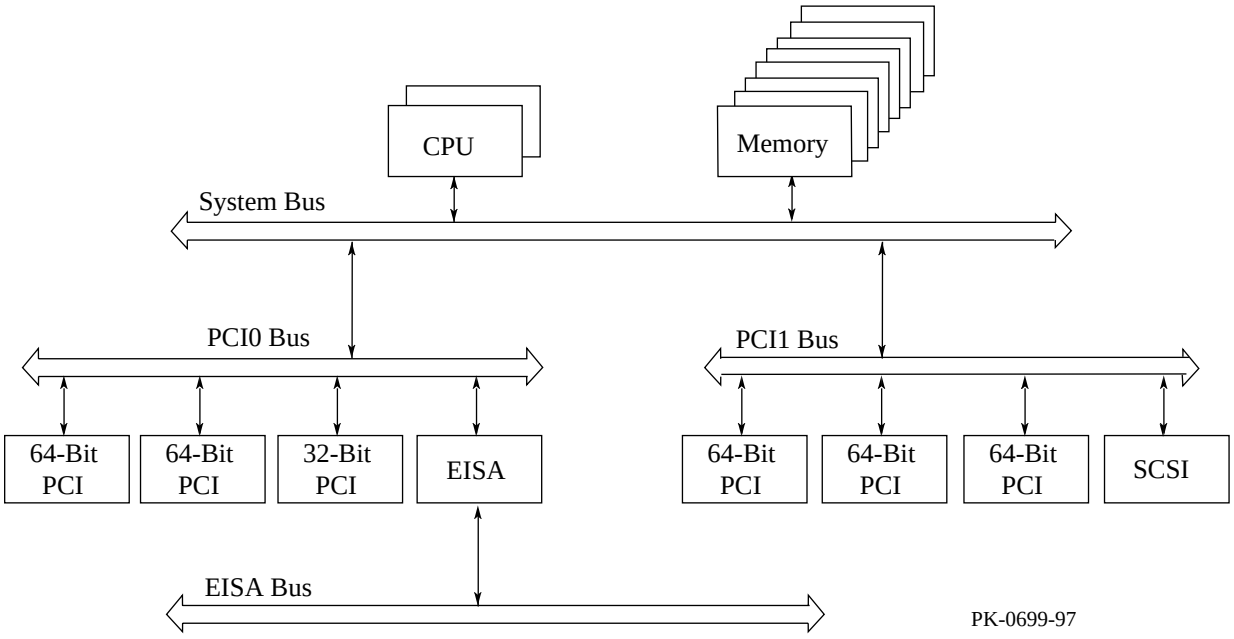
The AlphaServer 1200 system supports up to two CPUs, 400 MHz and 533 MHz. Both CPUs and operating system must be of the same type in each system. A 400 MHz CPU cannot be mixed with a 533 MHz CPU in one enclosure. Similarly, a DIGITAL UNIX operating system and an OpenVMS operating system cannot be mixed in one enclosure.

Memory

The memory DIMMs must be in matched pairs (same size and same type of memory), with the largest pair in MEM 0 Low and MEM 0 High slots. Each DIMM has a hardwired memory address regardless of DIMM size; different DIMM sizes can be mixed for up to 2 GB of memory. All supported operating systems have built-in support for mapping out memory holes.

I/O

A chipset for the system-bus-to-PCI-bus bridge, located on the motherboard, provides the physical and logical bridge between the system bus and the PCI backplane. Each bridge implements the PCI bus bridge logic for two independent 64-bit PCI buses. The first PCI bus (PCI 0) provides an interface to an EISA bus. The bus options are installed on the PCI section of the system motherboard.



System Bus

The system bus is the primary interconnect between CPU, memory, and the I/O subsystems. The AlphaServer 1200 system bus has slots for up to 2 CPUs and 8 memory pairs, and an I/O slot that connects to the I/O subsystem. The system bus consists of a 128-bit data bus and a separate 40-bit command/address bus.

The system bus is designed to reduce memory latency. The bus is synchronously tied to the clock rate of the processor and memory. As the clock speed of the processor increases, the bandwidth of the bus increases. With a 400 MHz processor, the bus bandwidth is 1 GB/sec; with a 533 MHz processor, the bus bandwidth increases to 1.1 GB/sec. The peak memory read bandwidth is 948 MB/sec, and the peak for memory writes is 853 MB/sec. The sustained mixed memory read/write bandwidth is 750 MB/sec.

The bus is completely ECC protected, so that all memory, processor caches, and data are constantly checked for data integrity. Commands and addresses are parity protected.

Processor Module

The AlphaServer 1200 system uses an Alpha microprocessor on the processor module. The microprocessor is a superscalar (quad-instruction issue), superpipelined implementation of the Alpha architecture. The Alpha 21164 chips are manufactured according to DIGITAL's state-of-the-art CMOS-6 process, using a feature size of 0.35 micron. Over 9 million transistors are on one die. As new generations of Alpha chips become available, you can upgrade your system through a simple, cost-effective processor board swap.

Alpha Microprocessor Features

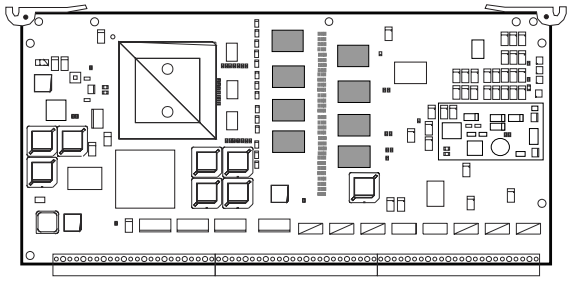
Alpha microprocessors have the following features:

- All instructions are 32 bits long and have a regular instruction format
- Floating-point unit, supports DIGITAL and IEEE floating-point data types
- 32 integer registers, 64 bits wide
- 32 floating-point registers, 64 bits wide
- On-chip, direct mapped, write-through physical data cache
- On-chip, direct mapped, read-only virtual instruction cache
- On-chip I-stream translation buffer
- On-chip D-stream translation buffer

Each chip has an 8-Kbyte instruction cache, an 8-Kbyte data cache, and a 96-Kbyte three-way, set-associative write-back second-level cache.

Processor Module Variants

- 400 MHz Alpha microprocessor with a 4-MB cache
- 533 MHz Alpha microprocessor with a 4-MB cache



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Memory

Memory throughput in this system is maximized by the following features:

- Very low memory latency (120 ns) with 15 ns system bus
- Numerous reliability and availability features, such as ECC memory and command/address parity

Memory Options

Each memory option consists of two identical modules. Each system supports two memory options, for a total of 2GB of memory. The following memory options are su pported:

- 64 MB (2 32-MB DIMMs)
- 256 MB (2 128-MB DIMMs)

Memory Technology

Both memory options use a synchronous memory that is relatively new to the industry. Synchronous DRAMs afford high performance, so even with the smallest amount of memory, the full memory bandwidth is available. For reads the bandwidth is 948 MB/sec, and for writes 853 MB/sec. All interleaving is internal to the DRAM.

Memory Configuration Rules

- Both DIMMs in a memory pair must be the same size.
- DIMMs must be installed in consecutive slots, beginning with slot 0.
- Install all the larger DIMMs before installing smaller DIMMs.
- If a 64 MB option is installed in slot 0, you ;may install a second 64 MB option in slot 1, but no additional memory. If a 256 MB option is installed in slot 0, all memory slots are useable.

System I/O

Each PCI motherboard provides two separate 64-bit PCI buses. Industry-standard PCI and EISA I/O buses allow you to use inexpensive, widely available I/O options. Both 32-bit and 64-bit PCI options can be used.

PCI Bus

For options that require high performance, the systems implement a 64-bit PCI (peripheral component interconnect) bus. The industry-standard PCI bus is the number one choice for high-performance I/O options, such as disk storage and high-performance video applications. DIGITAL is the first company to offer the new 64-bit PCI in its servers.

The PCI bus implementation has the following characteristics:

- Fully compliant with the PCI Version 2.1 Specification
- Operates at 30 ns, delivering a peak bandwidth of 1 GB/sec; over 250 MB/sec for each PCI bus
- Supports 6 option slots
- Supports peer-to-peer I/O operations
- Supports three address spaces: PCI I/O, PCI memory, and PCI configuration space
- Supports byteword, tri-byte, and longword operations
- Exists in noncached address space only

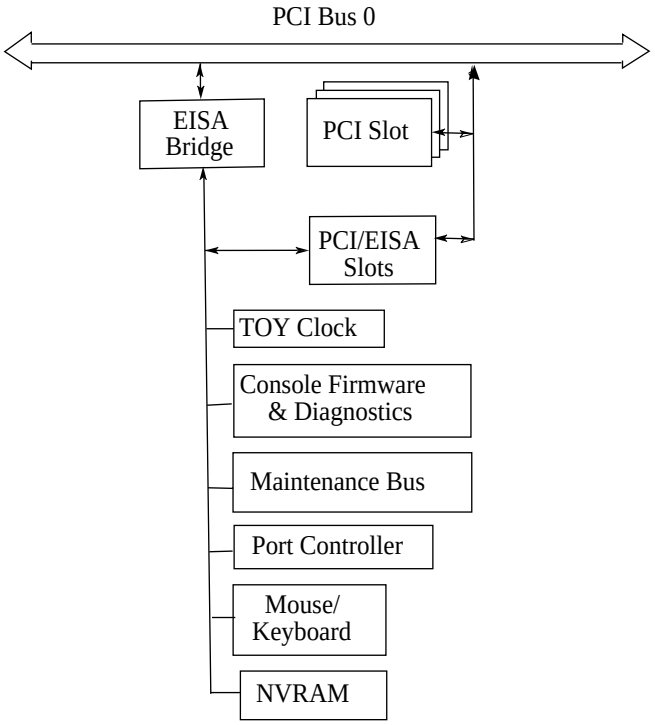
EISA Bus

The EISA bus is provided for compatibility with other AlphaServer systems. The EISA bus implementation has the following characteristics:

- One EISA slot
- 8.33 MHz operating speed, delivering a peak bandwidth of 33 MB/sec with no wait states
- All slots are bus master slots
- A two-device chipset provides a bridge from the PCI bus to EISA

I/O Implementation

The PCI motherboard has two PCI buses. The upper slots, PCI bus 0, include a 32-bit PCI slot and two 64-bit PCI slots. The lower slots, PCI bus 1, provide three PCI slots (one a PCI/EISA) and an integrated SCSI controller that supports the system CD-ROM and optional tape drive.



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One slot can instead be used for EISA options.
The EISA bus is used to implement a number of system functions. For example, the system console firmware and diagnostics use the EISA bus. The firmware and diagnostics are located on the PCI motherboard. The location of the code therefore requires that much of the system hardware be functional.

Already installed in three PCI slots are the following:

- Ethernet controller
- SCSI controller
- Graphics adapter (optional)

At the rear of the system drawer are connectors offering access to two serial communications ports, one parallel port, a modem connection, and ports for the keyboard and mouse.

Pedestal Disk Storage

The pedestal system offers up to 10 internal storage devices including a floppy diskette drive, a CD-ROM, one additional 5.25-inch removable media bay, and seven hot-swap StorageWorks wide or narrow disk drives. The system supports up to 30 GB of internal storage with seven 4.3 GB disks.

RAID (Redundant Array of Independent Disks)

The systems can be configured with optional PCI RAID controllers to organize disk data cost-effectively, improve performance, and provide high levels of storage integrity.

The optional RAID controllers have the following features:

- Support for hot-swap drives
- Automatic rebuild after hot swap
- Console support for booting system from RAID
- RAID levels 0, 1, 0+1, 5
- Optional write cache
- Optional read cache
- Support for command queuing

Additional Expansion

The AlphaServer 1200 products support optional external SCSI expansion, allowing large numbers of disks to be configured with the system. A system can support up to 7.5 TB in other enclosures with arrays (HSZ50s).

Clustering

A cluster is a loosely coupled set of systems that is addressed and managed like a single system, but provides high levels of availability through redundant CPUs, storage, and data paths. Clusters are also highly scalable in that CPU, I/O, storage, and application resources can be added incrementally to efficiently grow capacity. For customers, this translates to reliable access to system resources and data, and investment protection of both hardware and software.

Clustering allows multiple computer systems to communicate over a common interface, share disks, and spread the computing load across multiple CPUs. Clustering is implemented using DIGITAL's traditional interconnects and the newest technology.

UNIX cluster systems use TruCluster Software solutions, which give users access to network services and provide further failover recovery from server, network, or I/O failures. UNIX cluster systems use the SCSI bus and/or PCI-to-MEMORY CHANNEL interconnect bus between disks and systems.

OpenVMS cluster systems use the CI, SCSI, Ethernet, FDDI, DSSI, or MEMORY CHANNEL as the interconnect between disks and systems. OpenVMS systems can be configured into DSSI clusters using the following two options:

- The KFPSA DSSI adapter, which gives the system the capability of creating DSSI clusters
- The HSD family of storage controllers

Windows NT cluster systems use SCSI buses, Ethernet, or FDDI.

The primary means of clustering AlphaServer 1200 systems depends on the operating system.

- CI clusters, OpenVMS only
- MEMORY CHANNEL, DIGITAL UNIX and OpenVMS
- SCSI clusters, DIGITAL UNIX and OpenVMS
- DSSI clusters, OpenVMS only

PCI to MEMORY CHANNEL™ Interconnect

Under DIGITAL UNIX and OpenVMS, you can build high-availability clusters using the PCI-to-MEMORY CHANNEL interconnect. The MEMORY CHANNEL interconnect is a high-bandwidth, low-latency PCI-based communications interconnect for up to eight AlphaServer systems. Data written to one computer's memory is shared by other computers on the MEMORY CHANNEL bus.

The PCI CCMAA adapter is the interface between a PCI and a MEMORY CHANNEL bus. This bus is a memory-to-memory computer system interconnect that permits I/O space writes in one computing node to be replicated into the memories of all other nodes on the MEMORY CHANNEL bus. A write performed by any CPU to its reflected address region results in automatic hardware updates to memory regions in other nodes. One node's write is "reflected" to other nodes as a side effect of the local write. This provides a memory region with properties similar to a high-performance shared memory across a group of nodes.

Reliability and Availability Features

The AlphaServer 1200 products achieve an unparalleled level of reliability and availability through the careful application of technologies that balance redundancy, error correction, and fault management. Reliability and availability features are built into the CPU, memory, and I/O, and are implemented at the system level.

Processor Features

- Parity protection on CPU cache tag store.
- CPU data cache provides error correction code (ECC) protection.
- Multi-tiered power-up diagnostics to verify the functionality of the hardware.

On multiprocessor systems, when you power up or reset the system, each CPU, in parallel, runs a set of diagnostic tests. If any tests fail, the failing CPU is configured out of the system. Responsibility for initializing memory and booting the console firmware is transferred to the next higher working CPU, and the boot process continues. This feature ensures that a multiprocessor system can still power up and boot the operating system in case of a CPU failure. Messages on the operator control panel power-up/diagnostic display indicate the status of failed components.

Memory Features

- The memory ECC scheme is designed to provide maximum protection for user data. The memory scheme corrects for single-bit errors, most double-bit errors, and total DRAM failure. It also detects numerous other types of failures, such as RAM address errors.
- Memory failover. The power-up diagnostics are designed to provide the largest amount of usable memory, configuring around errors.

I/O Features

- Parity protection on system bus, PCI, and SCSI buses.
- Extensive error correction built into disk drives.
- Optional internal RAID (redundant array of independent disks) improves reliability and data security.
- Disk hot swap on systems configured with RAID.
- UltraSCSI StorageWorks components offer an increase in maximum transfer from 20 MB/sec to 40 MB/sec. Use an UltraSCSI disk such as DS-RZ1CB-VW or an UltraSCSI controller such as KZPBA-CA.

System Features

Auto reboot. On systems running DIGITAL UNIX or OpenVMS, a firmware environment variable lets you set the default action the system takes on power-up, reset, or after an operating system crash. For maximum system availability, the variable can be set to cause the system to automatically reboot the operating system after most system failures. Windows NT auto reboots by default, but lets you specify a countdown value so you can stop the system from booting if you need to carry out other tasks from the console firmware.

Software installation. The operating systems are factory installed. Factory installed software (FIS) allows you to boot and use your system in a shorter time than if you install the software from a distribution kit.

Diagnostics. During the power-up process, diagnostics are run to achieve several goals:

- Provide a robust hardware platform for the operating system by ensuring that any faulty hardware does not participate in the operating system session. This maximizes system uptime by reducing the risk of system failure.
- Enable efficient, timely repair.

The system has a built-in firmware update utility (LFU) that provides update capability for console and PCI I/O adapter firmware. A fail-safe loader provides a means of reaching the console in the event of corrupted firmware.

Thermal management. The air temperature and fan operation are monitored to protect against overheating and possible hardware destruction.

Error handling. Parity errors are detected on the high-speed system bus, the PCI and EISA buses, as well as in memory. Multiple ECC corrections to single-bit errors help in determining where in the system the error originated. Errors are logged for analysis.

Disk hot swap. The hardware is designed to enable hot swap of disks within optional RAID configurations. Hot swap is the removal of a disk or disks from any of the storage compartments while the rest of the system remains powered on and continues to operate. This feature contributes significantly to system availability. Since many disk problems can be fixed without shutting down the entire system, users lose access only to the disks that are removed.

Each StorageWorks shelf also has its own power supply, and a second power supply can be added to provide redundant power to the shelf. Doing this reduces the number of devices that can be installed in the shelf to six.

An external UPS can be used to support critical customer configurations. Because power is maintained for the entire system (CPU, memory, I/O, disks, tapes, and bus interface options), power interruptions are completely transparent to users.

Server Management

The AlphaServer products support important operational and platform management requirements.

Operational Management

Server/Network Management. ServerWORKS Manager software is included with each system. This software utilizes the Simple Network Management Protocol (SNMP) environment to assist the network or server administrator by constantly monitoring the network for problems, thus avoiding expensive downtime. The software monitors vital server information, such as CPU and file system utilization, as well as the condition of the network supported by the management console.

Remote Server Management. An integral remote console monitor (RCM) lets the administrator perform several tasks from a serial console located at a remote site: monitor the power supplies, temperature, and fans, and reset, halt, and power the system on or off, regardless of the operating system or hardware state.

AlphaServer 1200 systems support all the management tools and features provided by the operating systems to manipulate and monitor system resources such as disks, printers, networks, and backups.

Platform Management

AlphaServer 1200 systems support platform management tasks such as manipulating and monitoring hardware performance, configuration, and errors. For example, the operating systems provide a number of tools to characterize system performance and display errors logged in the system error log file.

In addition, system console firmware provides hardware configuration tools and diagnostics to facilitate quick hardware installation and troubleshooting. The system operator can use simple console commands to show the system configuration, devices, boot and operational flags, and recorded errors.

Error Reporting

DECevent is a proprietary service tool that provides critical event translation and analysis for systems running the OpenVMS and DIGITAL UNIX operating systems. It provides the following functionality: translation (binary to text), reporting, analysis, and notification. The analysis and notification portions of DECevent are protected functionality and require a Product Authorization Key (PAK), available free to customers who have a service contract. Binary-to-text translations can be done without a PAK installed.

Installation and Maintenance

The systems are designed for easy hardware, software, and option installation. Installation of the pedestal system is relatively simple, and may take only 30 minutes. Options ordered with a system are preinstalled and tested at the factory. The operating systems are also installed at the factory.

The modularity of the components contributes to ease of maintenance. The internal mass storage elements set the SCSI IDs directly on installation. The power supplies are replaceable, modular units.

Performance

DIGITAL has an ongoing program of performance engineering, using industry-standard benchmarks that allow comparisons to major vendors' systems. These benchmarks against competitive systems are based on comparable CPU performance, coupled with comparable memory and disk expandability.

The AlphaServer 1200 offers record-breaking workgroup performance. However, what really counts is application performance. These systems provide industry-leading application performance; for example:

- Lotus Domino—4,000 mail users on a two-processor AlphaServer 1200 5/533.
- SPECweb96 Internet Server—2,258 operations per second, using an AlphaServer 1200 UNIX system with two processors, and 1,631 ops/sec with a single processor.

The SPECweb96 benchmark focuses on server performance for static Web pages, measuring the ability of the server to service HTTP requests or "gets." One or more clients are used by SPECweb96 to send the HTTP requests to the Web server. The software then measures the response time for each request. At the end of the benchmark run, SPECweb96 calculates a metric based on overall throughput, measured as maximum benchmark operations per second.

Table 1 shows industry-standard benchmarks. System performance, however, is highly dependent upon application characteristics. Thus, benchmark information is one helpful "data point" to be used in conjunction with other purchase criteria such as features, service, and price.

Sources of Performance Information

You can access performance information from DIGITAL using your fax machine as well as from several on-line sources.

- *InstaFACTS.* The InstaFACTS fax service delivers information directly to your fax machine. Call 1-800-DIGITAL (via a touch-tone phone in the U.S.A. and Canada) and 908-885-6426 (outside the U.S.A. and Canada). A catalog of documents is available from which you can order an abbreviated table of performance information, including DIGITAL performance briefs and flashes, TPC results, AIM results, and graphics results.
- *FTP*. Access performance documents from ftp://gatekeeper.dec.com/index.html. The directory is pub/DEC/DECinfo/performance/sys.
- *World Wide Web*. The document URL (Uniform Resource Locator) is http://www.digital.com/info/performance.html.

Information for DIGITAL Partners

DIGITAL partners can access DIGITAL's Integrated Repository from DECGenisys V1.2. *DIGITAL Today, Business Partner Edition*, occasionally contains articles on performance of Alpha systems and announcements of available documents.

Service and Support

DIGITAL provides a comprehensive set of services, from migration, consulting, and training to direct support of Alpha systems, software, and applications. For information on DIGITAL Services, point your World Wide Web browser to http://www.service.digital.com/.

Hardware Warranty

The AlphaServer 1200 system and components, including CPU, memory, PCI controllers, and power supplies, have a 3-year on-site, 5-day per week, 9-hour per day hardware warranty with next-day response time.

Users can upgrade to higher levels of service through a variety of hardware supplemental services.

Software Warranty

The warranty for DIGITAL UNIX and OpenVMS is conformance to SPD with advisory telephone support for a period of 90 days. The warranty for Windows NT is conformance to the written material accompanying the software. Users can upgrade to higher levels of service through a variety of software supplemental services.

System Features at a Glance

Table 1 provides a quick reference to features of the AlphaServer 1200 systems.

Table 1 AlphaServer 1200 Features

CPU Features		
Symmetric multiprocessing		1–2 processors
Processor		Alpha 21164
CPU clock speed		400, 533 MHz
Cache on chip		
I-cache/D-cache		8 KB/8 KB
Secondary cache		96 KB, 3-way set associative
On-board cache		4 MB
Upgradable in pedestal and cabinet		CPU, memory, I/O, storage
Memory (maximum)		2GB
Performance		
SPECint95	16.3	
SPECfp95 1 CPU	21.9	
SPECfp95 SMP	30.5 (2 CPU)	
SPECint_rate95	291 (2 CPU)	
SPECfp_rate95	342 (2 CPU)	
SPECweb96	2258 (2 CPU)	
Standard Features		1.44 MB diskette drive, CD-ROM drive, 10/100 Mbit Ethernet controller, Ultrawide SCSI-2 adapter, integral FNSE SCSI-2 bus for removable media (CD-ROM and tape), 2 serial ports, 1 parallel port, keyboard and mouse, integral remote system console, operating system license and customer documentation, Internet software
Internal Storage		
Removable media		CD-ROM, floppy diskette, one additional 5.25-inch removable media bay
Maximum StorageWorks shelves		7
Maximum internal storage		7 hot swap disks (30 GB)
Total storage		>7.5 TB
I/O slots		6 PCI slots (5 PCI and 1 PCI/EISA)
Maximum PCI throughput		250 MB/sec
Availability Features		
System		System auto reboot, thermal management, remote system ma nagement, RAID 0, 1, 0+1, 5, disk hot swap, memory failover, ECC memory, ECC cache, ECC system bus, SMP CPU failover, error logging, optional uninterruptible power supply
OpenVMS clusters		CI, Ethernet, DSSI, SCSI, FDDI, PCI to MEMORY CHANNEL Interconnect
UNIX TruClusters Solutions		SCSI, PCI to MEMORY CHANNEL Interconnect
Windows NT cluster		Ethernet, FDDI, SCSI
Operating Systems		DIGITAL UNIX, OpenVMS, Microsoft Windows NT Server
Warranty		
Hardware		3-year, on-site
Software		90-day telephone advisory support for OpenVMS and DIGITAL UNIX

Physical Characteristics

Table 2 AlphaServer 1200 Physical Characteristics

Shipping Dimension		
Height	60 cm (23.8 in.)	
Width	43 cm (16.9 in)	
Depth	65 cm (25.6 in)	
Weight	43 kg (95 lb) typical 71 kg (156 lb) maximum	
Installed Dimensions		
Height	46 cm (18.1 in.)	
Width	35.8 cm (14.1 in.)	
Depth	58.6 cm (23.1 in.)	
Weight	39 kg (86 lb) typical 51 kg (113 lb) maximum	
Clearances	**Operating**	**Service**
Front	75 cm (29.5 in.)	75 cm (29.5 in.)
Rear	15 cm (6 in.)	75 cm (29.5 in.)
Sides	None	75 cm (29.5 in.)
Environmental		
Temperature	Operating*	10–40° C (50–104° F)
	Rate of change	11° C/hr (20° F/hr)
	Nonoperating	-40–66° C (-40–151° F)
	Storage (60 days)	-40–66° C (-40–151° F)
	Rate of change	20° C/hr (36° F/hr)
Relative humidity	Operating	10–90%
	Nonoperating	10–95%
	Storage (60 days)	10–95%
	Rate of change	20%/hr
Maximum wet bulb temperature	Operating	28° C (82° F)
	Storage (60 days)	46° C (115°F)
Minimum dew point temperature	Operating	2° C (36° F)
	Storage (60 days)	Not tested
Maximum heat dissipation	Current	
Single supply	2390 Btu/hr	
Dual supply	4097 Btu/hr	
Air flow and quality	Intake location	Front
	Exhaust location	Rear
	Particle size	N/A
	Concentration	N/A
Altitude	Operating†	3048 m (10,000 ft)
	Nonoperating	12192 m (40,000 ft)
Mechanical shock	Operating	10 G 10 ms
	Nonoperating	20 G peak 30 ms
Vibration	Operating	10-500 Hz .1 G peak
	Nonoperating	1.03 Grms 5-300Hz
Acoustics		Average Declared
	Operating	5.7 L^{wA}, B 38 L^{pAm}, dba
	Idle	5.6 L^{wA}, B 37 L^{pAm}, dba
Electrical—Power Supplies are universal 120/240 Vac		
Nominal ac voltage	100-120 Vac	220-240 Vac
Operating Voltage range	90-128 Vac	180-256 Vac
Power source phase	Single	Single
Nominal frequency	60 Hz	50 Hz
Frequency range	59-61 Hz	49-51 Hz
Maximum inrush current	50 Amps	50 Amps
RMS current at nominal voltage (steady state)		
Single power supply	8.0 Amps	4.0 Amps
Dual power supply	4.6 Amps each supply	2.2 Amps each supply
Power cord	Type	IEC 320 C13
	Length	190 cm (75 in.)
	U.S. plug	NEMA 5-15
Regulatory		
Agency approvals	UL Listed to UL1950 (2nd edition) CSA Certified to CAN/CSA-C22.2 No. 950-M89 TUV EN 60950 VDE 0805 GS marked ZH1/618 FCC 15J Part 15 Class A CE:EN55022, EN50082 VCCI Class II ITE	

	BCIQ: CISPR22, CNS13438 C-Tick: CISPR22, AS/NZS 3548
Reviewed to	Australian Standard NZS 6661:1989 New Zealand Standard EN 60 950: 1992 European Norm IEC 950 (2nd edition)

Features may differ among operating environments. Performance may vary depending on configuration, application, and operating environment.

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