AlphaServer GS60E and GS140 Systems

Technical Summary
Compaq AlphaServer GS60E and GS140 Systems

Today’s Tru64 UNIX and OpenVMS offerings in the high-end enterprise market are the AlphaServer GS60E and GS140 systems, with the fastest processors in the industry. When combined with very large memory (VLM64), the Alpha processors provide unprecedented response times in transaction processing, database access, simulations, and file serving in an open computing environment to tackle the most demanding enterprise applications.

Hardware and software partitioning allows you to run multiple instances or copies of either Tru64 UNIX or OpenVMS on a single AlphaServer GS series platform. This allows you to stage new operating systems, database or application releases; or, combine your production, development, and test environments in a single system; or, support your server consolidation plans and strategies, adding value to your hardware investment.

For more information on these AlphaServer systems, refer to the World Wide Web:

System Overview

The Compaq AlphaServer GS60E and GS140 systems are now available with the 700 MHz Alpha chip. Both systems use the same system bus. The 2.1 Gbyte per second system bus connects multiple PCI I/O buses, very large memory capacities, and up to 14 high-performance Alpha CPUs, and provides the reliability/availability/dependability features normally associated with mainframe systems.

The AlphaServer GS60E bus has 7 slots. You can configure these systems with up to 4 dual processor modules, for a total of 8 CPUs, and up to 8 GB of memory with 2 memory modules and I/O. Or, you can have up to 3 dual processor modules, for a total of 6 CPUs, and up to 12 Gbytes with 3 memory modules and I/O. Up to three I/O port modules supporting up to 132 PCI slots with CPUs and memory increases configuration flexibility with this new entry member of the family.

The AlphaServer GS140 bus has 9 slots. You can configure these systems with up to 7 dual processor modules, for a total of 14 CPUs, or, up to 7 memory modules (28 Gbytes), or, a combination of CPUs and memory with up to three I/O port modules supporting up to 144 PCI slots.

Up to two expander cabinets are supported with AlphaServer GS60E and GS140 systems for more storage or more PCI devices.

Features and Benefits

- **Unbeatable Price/Performance**
  Compaq AlphaServers offer the best value in high-end UNIX servers with the lowest $/tpmC for any midrange and large RISC/UNIX servers in the industry—nearly one-third better value than the SUN UltraEnterprise Server 6500. And, the AlphaServer GS60E provides the best 6-way tpc-c result in the industry with the latest Alpha 21264A 700 MHz microprocessors.

- **Unbeatable Reliability and Availability**
  Built-in self-tests execute on power-up and system reset. Multiple ECC checks provide for single-bit error correction to keep the system running and to provide for better failure isolation. Redundant power supplies ensure that the systems keep operating even when a power supply fails. The GS60E has hot-swappable power supplies with LEDs to indicate status. In addition to LEDs, the GS140 power system can be monitored by software.

Uninterruptible power supplies are available for both systems. Also, clustering (connecting independent systems) maximizes system availability and performance and makes the most of your hardware investment by sharing system resources. And, with partitioning, the GS60E/140 systems allow you to bring all your applications onto one system and run multiple instances of the same operating system. With future AlphaServer GS series systems, you’ll be able to run Tru64 UNIX in one partition and OpenVMS in another.

- **Upgrades**
  In-cabinet upgrades using the latest Alpha microprocessors, memory arrays, I/O systems, and operating systems have been offered and will continue to be made available. Your investment in CPU, memory, and PCI I/O options is protected with Compaq AlphaServer GS series systems.
Third-Generation Alpha Chip

The third generation of the Alpha microprocessor, the Alpha 21264, is a superscalar superpipelined implementation of the Alpha architecture. The first offering of this chip, which was manufactured using the CMOS-6 process, was known as EV6 and now the EV67 chip is available, which uses the CMOS-7 process. Over 15.2 million transistors are on one die.

In our discussion here, the Alpha 21264 designation applies to the EV6 and the EV67 chips, unless we need to distinguish between the two. Designed for performance, the Alpha 21264 achieves this goal by carefully studied and simulated architectural and circuit analysis. The 21264 memory system also enables the high performance levels. On-chip and off-chip caches provide for very low latency data access, which allows for very high bandwidth data access. (With the Alpha 21264A chip the size of the off-chip cache has doubled—8 MB—running at 233 MHz; with the Alpha 21264 chip the off-chip cache is 4 MB running at 200 MHz.)

Internal to each chip is a 64-Kbyte instruction cache (I-cache) and a 64-Kbyte data cache (D-cache).

- **I-cache.** 64 Kbytes, two-way set-associative, virtually addressed cache with 64-byte blocks
- **D-cache.** 64 Kbytes, two-way set-associative, virtually indexed, physically tagged, writeback cache with 64-byte blocks

Chip Operation

Several key design choices were made in the chip architecture to maximize performance: Four instructions are fetched each cycle, and then how those instructions are handled boosts the speed of execution. Register renaming assigns a unique storage location with each write reference to a register, avoiding register dependencies that can be a potential bottleneck to processor performance.

Another design feature, out-of-order execution, permits instructions to execute in an order different from the order that the instructions are fetched. In effect, instructions execute as soon as possible. This allows for faster execution since critical path computations are started and completed as soon as possible.

In addition, the Alpha 21264 employs speculative execution to maximize performance. It speculatively fetches and executes instructions even though it may not know immediately whether the instruction will be on the final execution path. This is particularly useful, for instance, when the 21264 predicts branch directions and speculatively executes down the predicted path. The sophisticated branch prediction in the 21264 coupled with the speculative and dynamic execution extracts the most instruction parallelism from applications.

For more information about the chip, see:

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Alpha 21264 Features

- Out-of-order instruction execution
- Large (64 Kbyte) on-chip data and instruction caches
- Improved branch prediction through intuitive execution
- Register renaming
- Increased bandwidth for high-speed access to second-level cache and system memory
- Motion video instructions
- Square root and divide instructions
- All instructions are 32 bits long and have a regular instruction format
- Floating-point unit, supports DIGITAL and IEEE floating-point data types
- 80 integer registers, 64 bits wide
- 72 floating-point registers, 64 bits wide
Architecture

The AlphaServer GS60E and GS140 systems share the same system architecture, as shown in Figures 1 and 2.

The AlphaServer GS140 has a nine-slot system bus. The minimum system configuration is one CPU module (with two CPUs), one memory module, and one I/O adapter. The I/O adapter shown here is the KFTHA. The remaining slots in the backplane can be used for CPU, memory, or I/O adapters, within the following limits:

- Up to 7 CPU modules, for a maximum of 14 CPUs
- Up to 7 memory modules for a maximum of 28 Gbytes
- Up to 3 I/O adapter modules for a total of 12 I/O buses (12-slot PCI bus)

The AlphaServer GS60E system has a seven-slot system bus. The minimum system configuration is one CPU module (with two CPUs), one memory module, and one I/O adapter module. The remaining slots in the backplane can be used for CPU, memory, or I/O adapters, within the following limits:

- Up to 4 CPU modules, for a maximum of 8 CPUs
- Up to 5 memory modules for a maximum of 20 Gbytes
- Up to 3 I/O adapter modules for a total of 11 PCI buses (12-slot PCI bus)

Figure 1  AlphaServer GS140

Figure 2  AlphaServer GS60E

Table 1  Comparison of AlphaServer GS140 and GS60E System Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>GS140 Cabinet</th>
<th>GS60E Cabinet</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPUs</td>
<td>Up to 14 on 7 modules</td>
<td>Up to 8 on 4 modules</td>
</tr>
<tr>
<td>Memory</td>
<td>Up to 28 Gbytes on 7 modules</td>
<td>Up to 20 Gbytes on 5 modules</td>
</tr>
<tr>
<td>I/O slots</td>
<td>Up to 3 I/O modules (KFTHA)</td>
<td>Up to 3 I/O modules (KFTHA)</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>1260 Mbytes/sec</td>
<td>1260 Mbytes/sec</td>
</tr>
<tr>
<td>System bus</td>
<td>9 slots</td>
<td>7 slots</td>
</tr>
<tr>
<td>Peak bandwidth</td>
<td>2.1 Gbytes/sec</td>
<td>2.1 Gbytes/sec</td>
</tr>
<tr>
<td>Sustainable</td>
<td>1.87 Gbytes/sec</td>
<td>1.87 Gbytes/sec</td>
</tr>
<tr>
<td>Internal storage</td>
<td>3.5” disks: 48</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>5.25” FH storage: 16</td>
<td>–</td>
</tr>
<tr>
<td>Cabinets</td>
<td>1 system cabinet</td>
<td>1 system cabinet</td>
</tr>
<tr>
<td></td>
<td>0–2 expander cabinets</td>
<td>0–2 expander cabinets</td>
</tr>
<tr>
<td></td>
<td>Up to 2 battery cabinets</td>
<td></td>
</tr>
<tr>
<td>Power</td>
<td>Three-phase</td>
<td>Three-phase N+1 redundant</td>
</tr>
<tr>
<td></td>
<td>Optional N+1 redundant power regulator</td>
<td>hot-swappable power regulators standard</td>
</tr>
<tr>
<td>Battery backup</td>
<td>Optional</td>
<td>No</td>
</tr>
<tr>
<td>PIUs/shelves</td>
<td>PCI</td>
<td>PCI</td>
</tr>
<tr>
<td></td>
<td>SCSI</td>
<td>SCSI</td>
</tr>
</tbody>
</table>
System Cabinets
Figure 3 shows the components in the AlphaServer GS140 cabinet. The system bus in this cabinet has nine slots. The CPU, memory, and I/O modules used in the system bus are the same as those used in the GS60E system.

Up to two expander cabinets and two battery cabinets can be configured with the system.

Upgrades from VAX/DEC 7000 Systems
The nine-slot AlphaServer GS140 system uses the same DEC/VAX 7000 cabinet, 3-phase power and cooling systems, and I/O options. To upgrade to an AlphaServer GS140 system, you simply change the centerplane (see Figure 4). Pull out the existing card cage and swap in the new AlphaServer system card cage. The new centerplane accommodates the processor, memory, and I/O port modules for the GS60E/140 systems.
Figure 5 shows the components in the AlphaServer GS60E cabinet. The system bus in this cabinet has seven slots. The CPU, memory, and I/O modules used in the system bus are the same as those used in the GS140 system. The system control panel is in the front door.

The system includes one DWLPB PCI shelf and one StorageWorks shelf. The RRDCD drive is mounted in front of the DWLPB, and an optional floppy can be installed in the same unit. A second StorageWorks shelf can be installed in the rear behind the first storage shelf.

The empty space shown in the system cabinet can be used to add the following:

- One or two StorageWorks shelves
- One DWLPB and if desired a second CD

Up to two expander cabinets can be configured with the system. Each cabinet can hold the following:

- Up to three StorageWorks shelves and up to four PCIs, or
- Up to four StorageWorks shelves and up to three PCIs

**Upgrades from GS60/8200 Systems**

The GS60E uses the same Alpha 21264 processor modules, the same memory modules, and the same I/O port modules as all AlphaServer 8000 and GS systems. You can move your devices from GS60/8200 StorageWorks shelves and all the PCI options. Because the mounting brackets are different (RETMA vs metric), you cannot install the same StorageWorks shelves and DWLPB PCI card cages into the GS60E cabinet. There is also a new variant of the KFE72 option for this cabinet. The GS60E upgrade includes the new system cabinet, the seven-slot system bus, one StorageWorks shelf, and one PCI shelf to move over existing options.
System Bus

The system bus runs synchronously to the CPU chips at a submultiple of the CPU chip clock rate. The bus operates at 87.4 MHz to provide a sustained bandwidth of 1.87 Gbytes/sec.

The system bus has separate paths for the address and data. Data is moved on a 256-bit bus. In addition, there are 32 ECC bits. The command/address bus is a 40-bit bus.

The system bus is a synchronous bus. The address and commands on one bus are linked to the data on a separate bus by a sequence number. The sequence number guarantees that data is driven onto the data bus in the same order as the command/address are driven onto the address bus.

The performance of the system bus makes it possible to have up to three I/O port modules. With up to 12 I/O channels, these systems now provide what amounts to a four-lane superhighway for I/O. The AlphaServer GS140 system bus provides 9 slots for CPU, memory, and I/O modules (4 slots in the front and 5 slots in the rear). The AlphaServer GS60E system bus provides 7 slots for CPU, memory, and I/O modules (3 slots in the front and 4 slots in the rear).

Processor Module

Each processor module has two Alpha microprocessors on-board. (The EV6 microprocessor, the Alpha 21264, runs at 525 MHz, and the EV67 microprocessor, the Alpha 21264A, runs at 700 MHz.) Each microprocessor has its own independent data and address path and its own independent cache. Each chip includes a 64-Kbyte instruction cache and a 64-Kbyte data cache. EV6-based modules have 4-Mbyte of backup cache for each microprocessor, while the faster EV67-based modules have 8-Mbyte of backup cache for each microprocessor.

The Alpha 21264 chips are manufactured using the CMOS-6 process, and the Alpha 21264A chip (EV67) is manufactured using the CMOS-7 process. The chip has over 15.2 million transistors on one die.

An AlphaServer GS140 system can have up to 7 processor modules, for a total of 14 CPUs. An AlphaServer GS60E system can have up to four processor modules, for a total of eight CPUs.

Table 2 Cache Comparison

<table>
<thead>
<tr>
<th>Cache</th>
<th>21264</th>
<th>21264A</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-chip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-cache</td>
<td>64 KB</td>
<td>64 KB</td>
</tr>
<tr>
<td>D-cache</td>
<td>64 KB</td>
<td>64 KB</td>
</tr>
<tr>
<td>On-board/per CPU</td>
<td>4 MB</td>
<td>8 MB</td>
</tr>
</tbody>
</table>

Memory

Up to 28 Gbytes of main memory can be configured using “industry-available” single in-line memory module (SIMM) technology. Up to seven memory modules can be installed on the system bus in the GS140, and up to five in the GS60E system. Memory modules are offered in sizes of 1, 2, and 4 Gbytes. The system console optimizes memory interleaving at power-up.

Interleaving

Each 2-Gbyte or less memory module supports on-board 2-way interleaving. With multiple memory modules installed, you get a minimum of 2-way interleaving and a maximum of 16-way interleaving, depending on the modules installed. The 4-Gbyte memory module is mode-selectable between 4 or 2 memory banks. The 4-Gbyte memory module supports on-board 4-way interleaving, so one 4-Gbyte memory module provides essentially the same memory bandwidth as two 2-Gbyte memory modules when they are 4-way interleaved. With four 4-Gbyte modules you get a maximum of 16-way interleaving.

Two “like-sized” memories will give you 4-way or 8-way interleaving (2-way or 4-way onboard each module times 2-way between modules). Modules of different densities can be interleaved together, provided certain rules are followed. For example:

1 X 4 GB = 4 GB 4-way interleaving
2 X 2 GB + 1 X 4 GB = 8 GB 8-way interleaving
2 X 4 GB = 8 GB 8-way interleaving
4 X 2 GB = 8 GB 8-way interleaving
4 X 4 GB = 16 GB 16-way interleaving

Up to 28 Gbytes of memory is supported; however, optimum interleave performance is achieved with four 4-Gbyte modules.

High Bandwidth/High Performance

Design decisions relating to the memory modules were made in support of quality and speed, characteristics that undergird the reliability of these AlphaServer systems that depend upon Very Large Memory. And because all memory is shared, the investment in memory delivers better price/performance than that of competing systems in which memory is not shared.
**System I/O**

The interface from the system bus (the TLSB) to the I/O subsystems (DWLPB PCI card cages) is provided by an I/O port module. The KFTHA I/O port module has four channels to external I/O (see Figure 6). Up to three I/O adapter modules can be installed on the system bus.

The I/O port module multiplexes the data between the high-speed I/O buses and the system bus, so that these systems can handle large amounts of data at very high speeds.

The GS140 system supports up to 12 I/O channels. The GS60E system supports a maximum of 11 I/O channels, if no channels are used for internal storage; otherwise, 10 I/O channels are supported with internal storage.

**PCI I/O Subsystem**

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.

The DWLPB PCI adapter, a 32-bit adapter, provides the connection to PCI devices. The PCI adapter is implemented electrically as three 4-slot PCI buses, but these appear logically to software as one 12-slot PCI bus, sharing the same address space. The PCI adapter provides 12 PCI option slots, plus a special slot for a KFE72 bridge module. The bridge module is required to provide *Tru64 UNIX* graphics, as well as serial console ports for partitions. With a bridge module installed, the number of PCI I/O slots is limited to eight.

A maximum of three DWLPBs can be in the GS60E system cabinet, and a maximum of four can be in the GS140 system cabinet.

**Figure 6  KFTHA Module**
Storage

With these AlphaServer systems, you can build enormous amounts of storage using the system cabinet and expander cabinets. Over 85 terabytes of storage can be configured.

The StorageWorks shelves are 16-bit (wide) UltraSCSI; (BA36R-RC/RD) with GS60E systems and BA670/671 PIUs with GS140 systems). StorageWorks building blocks enable you to configure the amount of storage you need. Each shelf can hold up to seven SCSI disks (FAST-10 SCSI configurations require that a DWZZA or DWZZB bus adapter be installed in each shelf, taking the place of one disk). The UltraSCSI building blocks include embedded DWZZC, thus allowing a full complement of up to seven UltraSCSI drives per shelf.

Up to eight StorageWorks shelves can be internally mounted in AlphaServer GS140 systems and up to four shelves in a GS60E system. Therefore, with UltraSCSI and 36.4-Gbyte disks, in the system cabinet you can have:

- Up to 28 internal 3.5” disk drives (GS60E system) (1,019 Gbytes)
- Up to 48 internal 3.5” disk drives (GS140 system) (1,747 Gbytes)

Figures 7 and 8 show the storage possible in each system cabinet and in the expander cabinet that goes with that system.

These systems also support DSSI. DSSI subsystems are configured by using one of these optional devices:

- A KFPSA PCI option
- The HSDxx controller, which converts DSSI to single-ended SCSI and back to DSSI

The cabling for the DSSI controller is attached to one of the DSSI ports on the HSDxx. The other port can be terminated or fed to another DSSI system for multihost configurations.

RAID (Redundant Array of Independent Disks)

The system 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

Fibre Channel

Available on these AlphaServer systems is the next storage interface, Fibre Channel, which eliminates issues with today’s SCSI interfaces such as issues of distance, bandwidth, scalability, and reliability. Fibre Channel (FC) is the answer to not only server-to-storage connections but also to server-to-server networking, because multiple protocols are supported. SCSI, TCP/IP, video, or raw data can all take advantage of high-performance, reliable Fibre Channel technology.

With the KGPSA PCI Fibre Channel adapter, the GS140 and GS60E systems provide a storage interconnect that is 2.5 times as fast as UltraSCSI: 100 vs 40 Mbytes/sec data throughput. The KGPSA adapter allows you to manage storage including the HSG80 RAID controller in a switched FC topology.
Hardware and Software Partitioning

The AlphaServer GS60E and GS140 systems support partitioning, which allows you to run multiple instances of either the Tru64 UNIX or OpenVMS operating systems on one hardware platform. This feature can help you consolidate several different computing resources into one hardware system, thereby reducing floor space requirements, power consumption, and heat dissipation—or it can allow you to reallocate your resources to separate environments. The GS60E can have up to two partitions, and the GS140 can have up to three partitions.

Since it is the console program that lets you manage the operating system, you must have a separate console terminal for each partition. With the OpenVMS operating system, some system resources can be shared. For example, memory and CPUs can be dynamically reallocated as applications running on different partitions change their requirements.

With Tru64 UNIX, each partition must have a minimum of one processor module, one memory module, one I/O port module, and one DWLPB. The second partition must have a KFE72-DA for its serial console port (GS140 or GS60E) or a 3X-KFE72-LA (GS60E) if a floppy is required. Figure 9 shows the location of the second CD in a GS60E system when required for partitioning.

Clustering

A cluster is a loosely coupled set of systems that behaves (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, meaning 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 our traditional interconnects and using the newest technology.

The primary means of clustering systems depends on the operating system.
- CI clusters, OpenVMS only
- Memory Channel, Compaq Tru64 UNIX and OpenVMS
- SCSI clusters, Compaq Tru64 UNIX and OpenVMS
- DSSI clusters, OpenVMS only
- FDDI clusters, OpenVMS only

Under Compaq Tru64 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 CCMAB 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 will result in automatic hardware updates to memory regions in other nodes. One node’s write is “reflected” to other nodes as a direct 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.

Compaq Tru64 UNIX

For clustered Compaq Tru64 UNIX systems, TruCluster Software solutions allow users access to network services and provide further failover recovery from server, network, or I/O failures. Compaq Tru64 UNIX cluster systems use the SCSI bus and/or PCI to Memory Channel interconnect bus between disks and systems.
Reliability, Availability, and Maintainability

AlphaServer GS60E and GS140 systems have numerous features that improve the reliability and availability of the system. The overall system reliability benefits from extensive use of CMOS technology in the design. The improvements are gained by having high circuit density, less interconnect and overall less heat dissipation than other technologies. Availability is improved by having more error detection and retry of error conditions.

System Features

- Built-in self-test and console ROM-based diagnostics at system level
- Console messages reflecting the status of booting
- Parity and error correction (ECC) on the system bus, all secondary caches, and memory
- Test-directed diagnostics and symptom-directed diagnostics
- System fault management
- Ease of repair
- Online system exercisers
- Modular power components on both systems, and redundant, hot-swappable power supplies on the GS60E
- N+1 redundant power supplies decrease system failure rates. An external UPS eliminates downtime caused by external power outages. And, the wide allowable voltage range decreases sensitivity to brownouts.
- Systems with multiple CPU or memory modules automatically recover from failures of those modules, by rebooting to exclude those failed modules. Thus, a hard fault is transformed into a transient outage, followed by continued operation with degraded performance.

Parity and Error Correction

Multiple ECC checks provide for better failure isolation. Each checkpoint within the system preserves error information, assisting software in determining where in the system the error originated.

Parity protection is used on the address bus, and on the data bus an 8-bit ECC check code protects each 64 bits of data. Single-bit errors are corrected, and double-bit errors are detected.

For optimal performance and integrity, the memory modules do not correct the data when single-bit errors are detected. When they are detected, the system firmware will scrub them to prevent reoccurrence. Only CPU and I/O port modules correct single-bit ECC errors. Any errors are logged in the system error log, and the console program can then identify a failing SIMM, so that it can be replaced if the same error occurs repeatedly.

Diagnostics

Processor modules and I/O modules include an extensive self-test to verify their functionality. Testing is executed on system power-up and can be executed on every system boot if desired. The console also provides a command for users to execute the self-tests.

Since self-test is normally executed concurrently on most system components, extensive testing is done quickly. Typical Compaq Tru64 UNIX configurations will boot up to the single-user prompt in 1 to 2 minutes, with another minute or so to get to the multi-user prompt. Very large memories increase testing times by approximately 30 seconds. Booting from remote storage servers, particularly booting into active OpenVMS clusters from an HSJ40, can increase boot time by another minute or two.

Firmware Upgrades

The Loadable Firmware Update Utility (LFU) is used to check the revision of firmware on all modules and to upgrade firmware as new revisions are required. LFU is distributed on CD-ROM.
The GS60E system comes with three hot-swappable 48 VDC power supplies and provides N+1 redundancy. Should one supply fail, the system continues to operate; the LEDs on the system control panel blink to signal that a power supply has failed and should be replaced. Each power supply also has status LEDs, so that the failed power supply can be quickly located and replaced without disturbing system operation.

### Table 3 Power Systems

<table>
<thead>
<tr>
<th>Feature</th>
<th>Three-Phase GS140</th>
<th>Three-Phase GS60E</th>
</tr>
</thead>
<tbody>
<tr>
<td>N+1 regulators</td>
<td>Optional (3 max.)</td>
<td>Yes; hot swappable (3 max.)</td>
</tr>
<tr>
<td>Battery backup</td>
<td>Optional (60 mins.)</td>
<td>No</td>
</tr>
<tr>
<td>Power monitoring by</td>
<td>Software; LEDs</td>
<td>LEDs</td>
</tr>
</tbody>
</table>

The GS140 system comes with two three-phase power regulators, and a third can be added to provide redundancy or increased power capacity on highly configured systems. There are two variants of the three-phase regulator; one supports battery backup, and the other does not. The power regulators are variants of those used in VAX/DEC 7000 systems, so on-site upgrades from those systems require no change to the power system.

The GS140 system offers battery plug-in units (PIUs) installed in the system cabinet to back up components in that cabinet, or in a battery cabinet to back up components in an expander cabinet. Also, an external system can be used to provide an uninterruptible power supply (UPS) for either system.

### Installation and Upgrades

These systems are not customer installable or upgradable. System installations and upgrades must be performed by qualified customer service technicians. Even the most complex upgrade, the swapping of the TLSB card cage, which is required to move from a VAX or DEC system to an AlphaServer GS140 system can be done in a few hours.

The operating systems are factory installed; software upgrades are customer installable.

### Server Management

The AlphaServer products support important operational and platform management requirements.

### Operational Management

ServerWORKS Manager software is included with each system to provide advanced server and network management capabilities. SNMP (Simple Network Management Protocol) enables information to pass from the managed system to the console. Using ServerWORKS, the system manager can build and view topological maps of the network. Detailed server information is viewable, including system, network, storage, and environmental information. All AlphaServer systems are also supplied with management tools to complement ServerWORKS Manager. These include StorageWORKS Command Console for storage management.

These 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. These tools are usable in a highly distributed environment.

### Platform Management

The AlphaServer GS60E and GS140 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. Other software can be used to analyze and diagnose such errors.

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. Also, the console provides inventory support and configuration management by giving access to serial numbers and revisions of hardware and firmware.

### Error Reporting

DECevent is a proprietary service tool that provides critical event translation and analysis for these systems, under both operating systems. It provides the following functionality: translation (binary to text), reporting, analysis, notification, and graphical user interface. The analysis and notification portions of DECevent are protected functionality and require a Product Authorization Key (PAK); however, binary to text translations can be done without a PAK installed.

### Performance Monitoring

A system monitoring tool called Monitoring Performance History (MPH) collects error log entries, crash dump footprints, and configuration information from the monitored systems. The information is collected weekly and is sent back to us by either e-mail or the DIGITAL Services Network Link (DSNLink) transport mechanisms. We highly recommend that MPH be installed on all these systems.

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Performance and Benchmarking
Compaq has an ongoing program of performance engineering, using industry-standard benchmarks that allow comparisons across major vendors’ systems. These benchmarks against competitive systems are based on comparable or close CPU performance, coupled with comparable memory and disk expandability.

The benchmarks demonstrate that these systems deliver unsurpassed computing performance and price/performance. See Table 7 for 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
Performance information is available on the Internet.

- World Wide Web
- FTP. Access performance documents from
  ftp://gatekeeper.dec.com/index.html
  The directory is pub/DEC/DECinfo/performance/sys.

Information for Compaq Partners
Compaq and its partners and customers can register with DIGITAL Business Link to access information needed to purchase and sell Compaq products and services; including access to pricing, product, sales, and marketing information.

Also see the Alliances and Partners Web site located at
http://www.digital.com/other-servers.html

and the Compaq Partner Network (CPN):
http://CPN.compaq.com

Service and Support
Compaq provides a comprehensive set of services that range from migration, consulting, and training, to direct support of Alpha systems, software, and applications. For information on Compaq Services, point your Web browser to http://www.compaq.com/services.

Hardware Warranty
AlphaServer GS60E and GS140 systems and embedded components, including CPU, memory, PCI controllers, and power supplies, have a 1-year on-site, 5-day per week, 9-hour per day hardware warranty with 4-hour response time.

StorageWorks components are supported by the comprehensive StorageWorks warranty: five years for disks, three years for controllers, two years for tape devices, and one year for other components. The first year includes onsite next-day response time. Network products carry the network products warranty.

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

Software Warranty
The warranty for Compaq Tru64 UNIX and OpenVMS is conformance to SPD with advisory telephone support for a period of 90 days. Users can upgrade to higher levels of service through a variety of software supplemental services.
1. CD-ROM with space for optional diskette drive
2. Cabinet control system
3. 9-slot system bus (four front, five rear)
4. Power system
5. Cooling system
6. Plug-in units/ I/O, disks or battery (two front, two rear)
1. CPU module (front)
2. Memory module (front/rear)
3. I/O module (rear)
4. Fan
5. CD-ROM and optional diskette drive
6. PCI box (rear mount)
7. Space for second PCI shelf or two StorageWorks shelves
8. StorageWorks shelf
9. Space for second StorageWorks shelf
10. 48 VDC power supply (3)
11. AC input box
12. Door and operator control panel (OCP)
Physical Characteristics and Operating Environment

Table 4 lists the physical characteristics and the operating environment for the AlphaServer GS60E and GS140 systems.

### Table 4 Physical and Environmental Specifications

<table>
<thead>
<tr>
<th>Cabinet Type</th>
<th>AlphaServer GS140</th>
<th>AlphaServer GS60E</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Dimensions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height</td>
<td>170.0 cm (67.0 in)</td>
<td>170.0 cm (67.0 in)</td>
</tr>
<tr>
<td>Width</td>
<td>80.0 cm (31.5 in)</td>
<td>60.0 cm (23.6 in)</td>
</tr>
<tr>
<td>Depth</td>
<td>87.5 cm (34.4 in)</td>
<td>100 cm (39.4 in)</td>
</tr>
<tr>
<td>Approx. weight</td>
<td>408 kg (900 lbs) without batteries</td>
<td>272 kg (650 lbs) with batteries</td>
</tr>
<tr>
<td>Service clearance, front</td>
<td>1.5 m (59 in)</td>
<td>1.0 m (40 in)</td>
</tr>
<tr>
<td>Service clearance, rear</td>
<td>1.0 m (40 in)</td>
<td>.75 m (29.5 in)</td>
</tr>
<tr>
<td><strong>Environmental Requirements</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>15°–28°C (59°–82°F)</td>
<td>15°–28°C (59°–82°F)</td>
</tr>
<tr>
<td>Humidity</td>
<td>20–80%</td>
<td>20–80%</td>
</tr>
</tbody>
</table>

Electrical Characteristics

Tables 5 and 6 summarize the electrical characteristics of the systems.

### Table 5 AlphaServer GS140 Electrical Characteristics

<table>
<thead>
<tr>
<th>Electrical</th>
<th>U.S./Canada</th>
<th>Europe/AP</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage</td>
<td>120/208 V</td>
<td>380–415 V</td>
<td>202 V</td>
</tr>
<tr>
<td>Frequency range</td>
<td>50–60 Hz</td>
<td>50–60 Hz</td>
<td>50–60 Hz</td>
</tr>
<tr>
<td>Phases</td>
<td>3-phase star</td>
<td>3-phase star</td>
<td>3-phase delta</td>
</tr>
<tr>
<td>Max. input current/phase</td>
<td>24 A rms</td>
<td>12.8 A rms</td>
<td>24 A rms</td>
</tr>
<tr>
<td>Surge current</td>
<td>50 A peak</td>
<td>50 A peak</td>
<td>50 A peak</td>
</tr>
<tr>
<td>Rating</td>
<td>30 A</td>
<td>16 A</td>
<td>30 A</td>
</tr>
</tbody>
</table>

### Table 6 AlphaServer GS60E Electrical Characteristics

<table>
<thead>
<tr>
<th>Electrical</th>
<th>U.S./Canada</th>
<th>Europe/AP</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage</td>
<td>120/208 V</td>
<td>380–415 V</td>
<td>202 V</td>
</tr>
<tr>
<td>Frequency range</td>
<td>50–60 Hz</td>
<td>50–60 Hz</td>
<td>50–60 Hz</td>
</tr>
<tr>
<td>Phases</td>
<td>3-phase star</td>
<td>3-phase star</td>
<td>3-phase delta</td>
</tr>
<tr>
<td>Max. input current/phase</td>
<td>17 A rms</td>
<td>9 A rms</td>
<td>17 A rms</td>
</tr>
<tr>
<td>Surge current</td>
<td>210 A peak</td>
<td>215 A peak</td>
<td>210 A peak</td>
</tr>
<tr>
<td>Rating</td>
<td>30 A</td>
<td>32 A</td>
<td>30 A</td>
</tr>
</tbody>
</table>
## System Features at a Glance

Table 7 provides a quick reference to the features of the AlphaServer GS60E and GS140 systems.

<table>
<thead>
<tr>
<th>System Features</th>
<th>AlphaServer GS60E</th>
<th>AlphaServer GS60E</th>
<th>AlphaServer GS140</th>
<th>AlphaServer GS140</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU Features</td>
<td>6/525</td>
<td>6/700</td>
<td>6/525</td>
<td>6/700</td>
</tr>
<tr>
<td>Symmetric multiprocessing</td>
<td>Up to 8</td>
<td>Up to 8</td>
<td>Up to 14</td>
<td>Up to 14</td>
</tr>
<tr>
<td>CPU clock speed (MHz)</td>
<td>21264 / 525 MHz</td>
<td>21264A / 700 MHz</td>
<td>21264 / 525 MHz</td>
<td>21264A / 700 MHz</td>
</tr>
<tr>
<td>Cache size (on chip/on board)</td>
<td>64 KB I, 64 KB D /</td>
<td>64 KB I, 64 KB D /</td>
<td>64 KB I, 64 KB D /</td>
<td>64 KB I, 64 KB D /</td>
</tr>
<tr>
<td>per processor</td>
<td>4 MB ECC</td>
<td>8 MB ECC</td>
<td>4 MB ECC</td>
<td>8 MB ECC</td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPC-C @ $/tpmC/availability</td>
<td>-</td>
<td>32.515@ $51.95</td>
<td>37.540@ $79.43</td>
<td>42.437@ $55.00</td>
</tr>
<tr>
<td>SPECint95</td>
<td>27.9</td>
<td>39.1</td>
<td>27.9</td>
<td>39.1</td>
</tr>
<tr>
<td>SPECfp95 (1 CPU)</td>
<td>45.2</td>
<td>68.1</td>
<td>45.2</td>
<td>68.1</td>
</tr>
<tr>
<td>SPECfp95 SMP</td>
<td>-</td>
<td>-</td>
<td>105 (8 CPU)</td>
<td>-</td>
</tr>
<tr>
<td>SPECint_rate95</td>
<td>1,423 (6 CPU)</td>
<td>2,532 (8 CPU)</td>
<td>1,901 (8 CPU)</td>
<td>4,155 (14 CPU)</td>
</tr>
<tr>
<td>SPECfp_rate95</td>
<td>1,013 (4 CPU)</td>
<td>2,826 (8 CPU)</td>
<td>1,600 (8 CPU)</td>
<td>3,134 (8 CPU)</td>
</tr>
<tr>
<td>SPECweb96</td>
<td>-</td>
<td>-</td>
<td>14,263 (10 CPU)</td>
<td>-</td>
</tr>
<tr>
<td>LINPACK n x n</td>
<td>-</td>
<td>3,804 (4 CPU)</td>
<td>4,755 (8 CPU)</td>
<td>6,158 (8 CPU)</td>
</tr>
<tr>
<td><strong>Configurations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max memory</td>
<td>20 GB ECC</td>
<td>20 GB ECC</td>
<td>28 GB ECC</td>
<td>28 GB ECC</td>
</tr>
<tr>
<td>Max disk (in cabinet/total)</td>
<td>1,019 GB / 85 TB</td>
<td>1,019 GB / 85 TB</td>
<td>1,747 GB / 85 TB</td>
<td>1,747 GB / 85 TB</td>
</tr>
<tr>
<td>Max I/O bandwidth</td>
<td>1.2 GB/s</td>
<td>1.2 GB/s</td>
<td>1.2 GB/s</td>
<td>1.2 GB/s</td>
</tr>
<tr>
<td>I/O support</td>
<td>Up to 132 PCI slots</td>
<td>Up to 132 PCI slots</td>
<td>Up to 144 PCI slots</td>
<td>Up to 144 PCI slots</td>
</tr>
<tr>
<td><strong>Reliability/High Availability Features</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compaq OpenVMS Clusters</td>
<td>Ethernet, DSSI, FDDI, FDDI, CI, Memory Channel Interconnect</td>
<td>Ethernet, DSSI, FDDI, FDDI, CI, Memory Channel Interconnect</td>
<td>Ethernet, DSSI, FDDI, FDDI, CI, Memory Channel Interconnect</td>
<td>Ethernet, DSSI, FDDI, FDDI, CI, Memory Channel Interconnect</td>
</tr>
<tr>
<td>High availability and system management features</td>
<td>ECC on critical data and memory paths, built-in self-tests and system fault management, auto reboot, standard N+1 redundant power system, disk and power hot swap, memory failover, SMP CPU failover, error logging, optional RAID, optional uninterruptible power supply (UPS)</td>
<td>ECC on critical data and memory paths, built-in self-tests and system fault management, power and cooling system monitoring, auto reboot, disk hot swap, memory failover, SMP CPU failover, error logging, optional RAID, optional N+1 redundant power system, optional battery backup, optional uninterruptible power supply (UPS)</td>
<td>ECC on critical data and memory paths, built-in self-tests and system fault management, power and cooling system monitoring, auto reboot, disk hot swap, memory failover, SMP CPU failover, error logging, optional RAID, optional N+1 redundant power system, optional battery backup, optional uninterruptible power supply (UPS)</td>
<td>ECC on critical data and memory paths, built-in self-tests and system fault management, power and cooling system monitoring, auto reboot, disk hot swap, memory failover, SMP CPU failover, error logging, optional RAID, optional N+1 redundant power system, optional battery backup, optional uninterruptible power supply (UPS)</td>
</tr>
<tr>
<td>I/O options</td>
<td>Ethernet, Fast Ethernet, Gigabit Ethernet, FDDI, Token Ring, sync. comm., async. comm., RAID, FWD SCSI-2, UltraSCSI, CI, DSSI (OpenVMS), Prestoserve, ATM, HiPPI, Fibre Channel, IPI, Mainframe Channel Connect</td>
<td>Ethernet, Fast Ethernet, Gigabit Ethernet, FDDI, Token Ring, sync. comm., async. comm., RAID, FWD SCSI-2, UltraSCSI, CI, DSSI (OpenVMS), Prestoserve, ATM, HiPPI, Fibre Channel, IPI, Mainframe Channel Connect</td>
<td>Ethernet, Fast Ethernet, Gigabit Ethernet, FDDI, Token Ring, sync. comm., async. comm., RAID, FWD SCSI-2, UltraSCSI, CI, DSSI (OpenVMS), Prestoserve, ATM, HiPPI, Fibre Channel, IPI, Mainframe Channel Connect</td>
<td>Ethernet, Fast Ethernet, Gigabit Ethernet, FDDI, Token Ring, sync. comm., async. comm., RAID, FWD SCSI-2, UltraSCSI, CI, DSSI (OpenVMS), Prestoserve, ATM, HiPPI, Fibre Channel, IPI, Mainframe Channel Connect</td>
</tr>
<tr>
<td>Software features</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating systems</td>
<td>Tru64 UNIX, OpenVMS</td>
<td>Tru64 UNIX, OpenVMS</td>
<td>Tru64 UNIX, OpenVMS</td>
<td>Tru64 UNIX, OpenVMS</td>
</tr>
<tr>
<td>Standard software</td>
<td>Internet-Energized, server management software, UPS Power Management</td>
<td>Internet-Energized, server management software, UPS Power Management</td>
<td>Internet-Energized, server management software, UPS Power Management</td>
<td>Internet-Energized, server management software, UPS Power Management</td>
</tr>
<tr>
<td>Packaging</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height, width, depth,</td>
<td>170 x 60 x 100 cm (67 x 23.6 x 39.4 in.)</td>
<td>170 x 80 x 87.5 cm (67 x 31.5 x 34.4 in.)</td>
<td>170 x 80 x 87.5 cm (67 x 31.5 x 34.4 in.)</td>
<td>170 x 80 x 87.5 cm (67 x 31.5 x 34.4 in.)</td>
</tr>
<tr>
<td>Weight</td>
<td>352 kg (775 lbs)</td>
<td>408 kg (900 lbs)</td>
<td>408 kg (900 lbs)</td>
<td>408 kg (900 lbs)</td>
</tr>
</tbody>
</table>
Features may differ among operating environments. Performance may vary depending on configuration, application, and operating environment.

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