



Software Product Description

PRODUCT NAME: HSJ80 Array Controller ACS Version 8.5J-2 **SPD:** 80.30.01

Description

The HSJ80 Array Controller Software (ACS) is the controller-level operating system component for the Compaq StorageWorks HSJ80 Array Controller. The HSJ80 Array Controller product set advances the highly reliable Computer Interconnect (CI) family of controller products for OpenVMS™ CI clustered, mission-critical applications.

ACS V8.5J-2 adds support for two major items:

The MA8000/EMA12000 storage cabinets and associated disk drives: Previously, the HSJ80 was only supported with the StorageWorks 1 cabinets, the SW500 and SW800.

Legacy tape drives and tape libraries: Support is being added to the HSJ80 for the tape drives and tape libraries that are supported by the HSJ50. One new tape library, the ESL9362, has been added. The HSJ80 will support these devices whether it is mounted in SW500/SW800 cabinets or in MA8000/EMA12000 cabinets. However, no tape devices are supported inside the MA8000/EMA12000. The tape devices must be external to the MA8000/EMA12000, either in external tape libraries or StorageWorks I cabinets.

The HSJ80 Array Controller is an intelligent, mass-storage controller that interfaces between host computer systems using the Compaq Computer Corporation Computer Interconnect (CI) bus and Ultra Wide Single-Ended SCSI storage devices. The ACS processes Mass Storage Command Protocol (MSCP) I/O requests from hosts, directing the device-level operations required to satisfy I/O requests.

Supported operating system platforms as of the publication date are listed in Table 1.

Table 1. Supported Operating Systems

Host	Operating System
VAX	OpenVMS V6.2
Alpha	OpenVMS V6.2-1H3
VAX	OpenVMS V7.1
Alpha	OpenVMS V7.1-2
VAX and Alpha	OpenVMS V7.2
Alpha	OpenVMS V7.2-1

HSJ80 Array Controller Software (ACS) Functions

ACS software includes the following capabilities:

- Dual Computer Interconnect (CI) host ports
- Simultaneous multi-cluster storage capability
- OpenVMS cluster capability
- Dual-Redundant controller operations
- Testing and diagnosis of the HSJ80 Array Controller
- Host interconnect and protocol services
- Support for up to 42 SCSI devices
- SCSI device control
- Transparent controller failover
- ACS storage system management services
- Local program support
- 4 KB CI packets

- Cache Features
 - Read
 - Read-ahead (Prefetch)
 - Write-through
 - Write-Back
 - Non-volatile memory
 - Fault tolerance
 - Mirrored
 - Dynamic caching techniques
 - Cache optimizations
- RAID Features
 - Disk mirroring (RAID 1)
 - Disk striping (RAID 0, 0+1)
 - RAID 3 and 5
- Disk partitioning

The following sections describe HSJ80 ACS Version 8.5J-2 capabilities.

Dual Computer Interconnect (CI) host ports

The HSJ80 Array Controller includes two active CI ports resident on each controller. The introduction of two CI ports (four ports per dual redundant pair) doubles the performance (data rate) and connectivity (data paths) of the storage system when connected to two separate Star Couplers.

The HSJ80 controller can be configured to use either one or both host port connections.

Simultaneous multi-cluster storage capability

The dual port capability of the HSJ80 Array Controller can be used to share a common storage system among two separate and distinct OpenVMS clusters. As the storage needs of each cluster evolve, the system manager can further use this feature to reassign disk capacity as business requirements dictate.

An HSJ80 Array Controller storage system implementing multi-cluster storage capability must be configured using dual Star Couplers with both host ports activated on both controllers configured in a dual-redundant configuration.

Multiple cluster configurations must be configured utilizing the procedures provided in the *Compaq StorageWorks HSJ80 Array Controller ACS V8.5J-2 Installation and Configuration Guide*, AA-RN17A-TE.

OpenVMS Cluster capability

The HSJ80 Array Controller is designed for use in an OpenVMS Cluster computing environment. An OpenVMS Cluster is a group of OpenVMS Alpha and/or OpenVMS VAX host systems, storage systems, interconnects, and software that work together as one. Refer to the *Guidelines for OpenVMS Cluster Configurations*, AA-Q28LC-TK, for further detail. This book may be downloaded from the following web site:

<http://www.openvms.digital.com:8000/index.html>

Dual-redundant controller operations

HSJ80 controllers using ACS can operate as a redundant pair of controllers when configured identically and running identical ACS software versions, including patches, and connected in the same DS-BA356-MW controller enclosure. ACS provides facilities to detect controller failure and perform automatic controller failover.

Testing and diagnosis of the HSJ80 Array Controller

ACS internal software diagnostics execute automatically whenever controller power is turned on, whenever the array controller is reset, and periodically during use. The front bezel on the controller contains LEDs that provide diagnostic information if the controller fails.

A local serial connection asynchronous I/O port is provided for configuration and diagnosis.

Host interconnect and protocol services

HSJ80 Array Controllers attach to host computer systems using the Computer Interconnect (CI) bus via Star Couplers. The HSJ80 has two CI host ports resident on each controller and will operate with one or both host ports activated.

NOTE: Unused ports must be de-activated (turned-off).

The controller is designed for installation in OpenVMS Cluster configurations that include up to 32 nodes. Check the *Compaq StorageWorks HSJ80 Array Controller ACS Version 8.5J-2 Configuration Planning Guide*, EK-HSJCP-PA.B01, for full system configuration detail.

Support for up to 42 SCSI devices (StorageWorks I) or up to 72 SCSI devices (StorageWorks II)

StorageWorks I Cabinets (SW500 or SW800)

In StorageWorks I cabinets, the HSJ80 controllers using ACS V8.5J-2 provide support for up to 42 devices in single controller mode and 36 devices in dual-redundant controller mode.

StorageWorks II Cabinets (MA8000/EMA12000)

In StorageWorks II cabinets, the HSJ80 controllers using ACS V8.5J-2 provide support for up to 72 devices (six enclosures with 12 disks per 14-disk enclosure). An enhancement to extend support up to 84 disks is being considered for a later release.

SCSI device control

ACS converts host I/O requests into device-specific SCSI commands. It also processes concurrent commands and data transfers on multiple SCSI device buses. ACS device control functions include the following:

- Error detection and recovery
 - ACS recovers from device errors, including back block replacement for supported disk drives that do not perform this function for themselves.
 - For errors on the CI bus itself, the HSJ80 Array Controller hardware and ACS software cooperate to provide the following:
 - Automatic retransmission of data, if errors are detected in the original transmission
 - Automatic retransmission on an alternate path, if a CI path fails
 - Automatic detection of internal path errors
 - Automatic failover of attached devices between HSJ80 controllers operating as dual-redundant controllers.
- Device integrity testing
 - ACS executes device integrity testing upon system manager command. These tests perform the following functions:
 - Verify correct operation of individual disk devices and units
 - Place the HSJ80 Array Controller under load to verify correct storage system operation.
- Error logging
 - ACS uses SCSI protocol messages to report faulty or failing devices and controller faults to all connected hosts that have error logging enabled.

- Save configuration on disk
ACS can save device configuration information, HSJ80 Array Controller configuration information, and controller software patches on a disk connected to the respective controller storage system. The stored configuration information is used for HSJ80-to-HSJ80 controller replacements in non-redundant configurations and certain Array Controller product upgrades. For additional information refer to the *Compaq StorageWorks HSJ80 Array Controller Configuration Planning Guide*, EK-HSJCP-PA.B01.
- CI 4 KB packet capability
The HSJ80 packet default size is 4 KB to improve I/O performance to the host. In order to properly utilize this functionality, ensure the cluster is configured according to the *Compaq StorageWorks HSJ80 Array Controller ACS V8.5J-2 Installation and Configuration Guide*, AA-RN17A-TE.

Transparent controller failover

ACS supports the configuration of two HSJ80 controllers within the same DS-BA356-MW controller enclosure to operate in dual-redundant mode. This allows both controllers to access the storage devices, providing controller fault-tolerant data processing. If one of the two controllers should fail, the devices and any unwritten cache data attached to the failed controller is written through the other controller.

ACS storage system management services

ACS software provides the following storage system management services:

- Alteration of storage system parameters

ACS includes a Command Line Interpreter (CLI) that allows a system manager to display and manipulate controller parameters and device configuration information as required.

The CLI utility provides type-ahead, recall, and editing features. Any of the last four commands entered may be recalled and edited.

ACS also supports the StorageWorks Command Console (SWCC). The SWCC is a graphical user interface (GUI) providing local and remote management of StorageWorks™ controllers. It is a user-friendly tool for monitoring, configuring, and troubleshooting storage systems. Refer to the SWCC Help Files contained in the *HSJ80 Array Controller Solution Software V8.5J-2 for OpenVMS* kit, QB-6FSAA-SA.

- Dynamic status display

ACS utilizes *VDPY*, a CLI command utility that can be used to display the current controller state, performance data, processor utilization, host port activity and status, device state, logical unit state, cache performance, and I/O performance. Refer to the *Compaq StorageWorks HSJ80 Array Controller ACS Version 8.5J-2 Maintenance and Service Guide*, EK-HSJMS-SA/163134-001, for more utility information.

- Format/download

ACS utilizes *HSUTIL*, a CLI command utility that can be used to format a disk device or to download new firmware to a disk device. Refer to the *Compaq StorageWorks HSJ80 Array Controller ACS Version 8.5J-2 Troubleshooting Resources Guide*, EK-J80TR-SA, for additional utility information.

Local program support

Refer to the *Compaq StorageWorks HSJ80 Array Controller ACS Version 8.5J-2 CLI Reference Guide*, EK-HSJCL-RA/163131-001, for a complete listing of all the commands ACS software supports. Refer to the *Compaq StorageWorks HSJ80 Array Controller ACS Version 8.5J-2 Troubleshooting Resources Guide*, EK-J80-TR-SA, for a complete listing of the local utilities. A partial listing of local utilities follows.

- **CLONE** – A utility that mirrors units to create a physical copy of host unit data. The CLONE utility cannot be used with partitioned units.
- **CONFIG** – A utility that locates and adds devices to the controller configuration. The CONFIG utility may be run whenever new devices are added to the storage system.
- **DILX** – A disk inline exerciser utility that tests and verifies the controller's operation with attached storage devices under a high or low I/O load.
- **FMu** – A utility that displays controller last failure and memory system failure information as well as spontaneous event logging and last failure logging displays.
- **HSUTIL** – A utility that formats a disk device or downloads new firmware to a disk device.
- **VTDPY** – A utility that displays the current controller state, performance data, processor utilization, host port activity and status, device state, logical unit state, cache performance, and I/O performance.

4 KB CI packets

The HSJ80 ACS packet transfer default size is 4 KB. The larger packet size provides an increased throughput to the host. The controller has the capability to use both 4 KB and smaller sized packets simultaneously depending on the capabilities of each host and their adapters.

NOTE: If CIXCD host adapters are installed in the respective cluster, then each of them must have the CIXCD_4K firmware upgrade installed for this feature to work. CIPCA host adapters are already set up to use 4KB packet transfers. In order to properly utilize this functionality, ensure the cluster is configured according to the *Compaq StorageWorks HSJ80 Array Controller ACS V8.5J-2 Installation and Configuration Guide*, AA-RN17A-TE.

Cache features

The standard cache size is 512 MB per HSJ80 controller (up to 1 GB of cache per redundant controller pair) providing more room to store repeatedly-accessed data improving the cache hit-rate. Fewer direct media access requirements result in a corresponding reduction in operational response time.

Read caching

Read caching decreases the storage system response time to a read request by allowing the controller to satisfy the read request from the cache memory rather than from the disk drive. When the controller receives a read request from the host, it reads the data from the disk drive, delivers it to the host, and stores it in the cache memory. If the host requests the same data again, the controller satisfies the read request from the cached data rather than re-reading it from the disk drives. By default, read caching is enabled for all storage units.

Read-ahead (prefetch) caching

An HSJ80 algorithm monitors the incoming I/O stream for sequential access patterns. If a sequential stream is detected, the controller will begin prefetching data from the disk so that the data will be resident in cache before the host computer requests it. The algorithm is dynamic and adjusts the size of the read-ahead prefetch to minimize cache usage while at the same time attempting to realize 100% cache hits. The read-ahead (prefetch) algorithm has the capability to recognize more than one simultaneous sequential stream to a single unit, and will also handle a sequential stream that has embedded, non-sequential accesses.

Write-through caching

Write-through caching may help decrease storage system response time to a future read request by storing write data in cache as well as writing it to a disk.

When the controller receives a write request from the host, it stores the data in its cache memory, writes the data to the disk drives, and then notifies the host when the write operation is complete. This process is called write-through caching because the data actually passes through, and is stored in, the cache memory on its way to the disk drives. If the host requests the recently written data, the controller satisfies the read request from cache memory rather than from the disk drives.

If read caching is enabled for a storage unit, write-through caching is also enabled. Also, because both caching techniques enhance the controller's read performance, write-through caching is automatically disabled when read caching is disabled.

By default, read caching and write-through caching are enabled for all storage units.

Write-back caching

This caching technique decreases the storage system response time to write requests by allowing the controller to declare the write operation complete as soon as the data reaches its cache memory. The controller performs the slower operation of writing the data to the disk drives at a later, generally more efficient, time.

Non-volatile memory

By default, write-back caching is disabled for all storage sets. The controller will not provide write-back caching to a unit unless the cache memory is non-volatile. A back-up power source to the cache module to preserve unwritten cache data is required in the event of a power failure.

By default, the controller expects to use an external cache battery (DS-HS35X-Bx) as the cache module back-up power source to enable it to be non-volatile. See the *Compaq StorageWorks HSJ80 Array Controller ACS Version 8.5J-2 Troubleshooting Resources Guide*, EK-J80TR-SA, for more information on the external cache battery (ECB) and UPS alternative power sources.

Regardless of the back-up power source type, the cache-memory power LED flashes about once every three seconds to indicate the cache module memory array is receiving power from its primary power source.

The write-back cache with battery backup provides the following functions:

- Stores data to be written temporarily in the controller's write-back cache and if the mirrored option is set, the write-back data is mirrored in the redundant controller cache for fault tolerance. The controller then informs the host that the write request is complete. This allows the host to continue working without waiting for data to be written to disk media.
- Periodically writes the data stored in cache to the disk media based on a least-recently-used cache flushing policy or when a device has been inactive.
- Consolidates contiguously-located data blocks from multiple host write requests into a single device request to reduce average latency.
- On recovery from a single cache failure or power outage, the controller detects that unwritten data still exists in cache and writes it to disk media before enabling normal controller operations.

Fault-tolerance for write-back caching

The cache module supports the following features to protect the availability of its unwritten (write-back) data:

- Non-volatile memory (required for write-back caching)
- Mirrored caching (optional)
- Dynamic caching techniques (automatic).

Mirrored caching

To further ensure the availability of unwritten cache data, a portion of the controller's cache module memory can be assigned to mirror the other cache module's write-back data in a dual-redundant configuration.

Before configuring dual-redundant controllers and enabling mirrored write-back cache, make sure the following conditions are met:

- Both controllers have the same 512 MB cache size
- Diagnostics indicate that both cache modules are good
- Both cache modules have a battery present (unless you have enabled the *CACHE_UPS* switch)
- No unit errors are outstanding
- Both controllers are operational and in failover mode.

For important considerations when replacing memory in a mirrored cache configuration, see the *Compaq StorageWorks HSJ80 Controller ACS Versions 8.5J-2 Troubleshooting Resources Guide*, EK-J80TR-SA.

Dynamic caching techniques

If the controller detects a full or partial failure of its cache module or external cache battery, it automatically reacts to preserve the cached write-back data. Then, depending upon the severity of the failure, the controller chooses an interim caching technique, also called the *cache policy*, to use until the cache module or external cache battery is repaired or replaced.

Additional cache optimizations

The HSJ80 includes additional advanced algorithms for pairing I/O and cache writes as well as partial cache writes during predicted host I/O operation pauses. Under certain conditions, data can be flushed from the write-back cache with a 90% certainty that it will not interfere with ongoing host I/O operations.

RAID features

The HSJ80 Array Controller Software features disk mirroring (RAID 1), striping (RAID 0, RAID 0+1), and RAID 3/5 capabilities. Refer to the *Compaq StorageWorks HSJ80 Array Controller ACS Version 8.5J-2 Configuration Planning Guide*, EK-HSJCP-PA for further RAID detail.

Disk mirroring capability (RAID 1)

Mirrorsets (RAID 1) use redundancy to ensure availability. For each primary disk drive, there is at least one mirror disk drive. If a primary disk drive fails, its mirror drive immediately provides an exact copy of the data.

The disk mirroring capability provides the following functions:

- Real-time maintenance of up to six identical copies of data on mirrorsets of separate disks attached to a single HSJ80 Array Controller.
- Protects data against disk failure by replicating all data on each member of the mirrorset offering extremely high data reliability.
- Captures a designated spare (if one exists) in the event of a mirrorset member disk failure and copies the data of the failed member disk onto the spare

- The ability to increase or decrease the number of members in a mirrorset as requirements change.
- Flexibility policy options for determining both how read requests are satisfied and the speed of copying when a new member is being added.
- ACS disk mirroring can utilize the UNMIRROR command to change devices back to single disk units.

Disk striping (RAID 0, RAID 0+1)

Stripesets (RAID 0) enhance I/O performance by spreading the data across multiple disk drives. Each I/O request is broken into small segments called “chunks.” These chunks are then simultaneously “striped” across the disk drives in the storageset, thereby allowing several disk drives to participate in one I/O request.

ACS supports the creation of sets of disk drives or mirrorsets as stripesets (2-24 members) for improved I/O performance through load distribution. A stripeset appears to the operating systems as a single virtual disk drive.

Striped mirrorsets (RAID 0+1) are a configuration of stripesets whose members are also mirrorsets. Consequently, this kind of storageset combines the performance of striping with the reliability of mirroring. The result is a storageset with very high I/O performance and high data availability.

RAID capability (RAID 3/5)

RAIDsets (RAID 3/5) are enhanced stripesets. They use striping to increase I/O performance and distributed-parity to ensure data availability. The parity data is mathematically derived from the I/O data and enables the controller to reconstruct the I/O data if a single disk drive fails. Thus, it becomes possible to lose a disk drive without losing access to the data it contains.

A write-back cache module is required for RAIDsets. Both cache modules must be the same size.

The RAID (3/5) capability provides the following functions:

- Manages up to 20 sets of between 3 and 14 disks as RAIDsets (limited by controller configuration restrictions). A RAIDset is viewed by the host as a single disk drive. RAIDsets can tolerate the failure of a single member disk without loss of ability to deliver data to hosts
- Dynamically adjusts between RAID 3 and RAID 5-like data protection algorithms, depending on instantaneous workload

- Maintains consistency of data and parity across all member disks in a RAIDset. This includes recovery from media errors
- Detects failure of a single RAIDset member disk and invokes data regeneration algorithms to provide continued data availability to hosts
- Captures a designated spare (if one exists) in the event of a member disk failure and reconstructs the data and parity of the failed member disk onto the spare.

For information regarding default chunk size and other RAID details, refer to the *Compaq StorageWorks HSJ80 Array Controller ACS V8.5J-2 Installation and Configuration Guide*, AA-RN17A-TE.

Disk partitioning

ACS allows for partitioning of disk drives or storage sets for improved device management. A partition appears to the operating system as a single virtual disk.

Up to eight partitions may be created per storage set or disk drive. Each partition has its own unit number so that the host can send I/O requests to the partition just as it would to any unpartitioned storage set or device. Partitions are separately addressable storage units; you can partition a single storage set to service more than one user group or application.

The dual port capability of the HSJ80 can also be used in conjunction with disk partitioning to share a common storage pool among two separate and distinct OpenVMS clusters. As the storage needs of each cluster shrink and expand, the system manager can further use this feature to re-assign disk capacity via partitioning as business requirements dictate.

ACS hardware requirements

ACS requires an HSJ80 Array Controller on which to execute. The HSJ80 Array Controller includes six Ultra Wide Single-Ended device ports supporting up to 36 devices in a dual redundant controller pair. 512 MB of cache is standard with each HSJ80 Array Controller.

Ultra Wide Single-Ended SCSI disks may be attached to the HSJ80 Array Controller. The specific devices supported are listed in Table 2 on page 19.

Hardware configuration restrictions

The following hardware configuration restrictions apply:

- HSJ80 Array Controllers require a minimum ACS revision level of V8.5J-2 for the features stated in this document.
- Two controllers in the same DS-BA356-MW controller enclosure must be configured as a dual-redundant configuration.
- A maximum of 36 devices may be configured with a dual-redundant controller pair.

The HSJ80 Array Controller hardware configuration options for StorageWorks I are as follows:

DS-SWXM2-AA	Dual Compaq StorageWorks HSJ80 Array Controllers each with 512 MB cache in a single DS-BA356-MW controller enclosure. For 36 (dual redundant) Ultra Wide Single-Ended SCSI devices. Prerequisite: Two QB-6FUAA-SA HSJ80 Array Controller Software Kits (one per controller) and one QB-6FSAA-SA HSJ80 Array Controller OpenVMS Solution Kit (one per cluster).
DS-SWXM2-BA	Single Compaq StorageWorks HSJ80 Array Controller with 512 MB cache in a single DS-BA356-MW controller enclosure. For up to 42 (non-redundant) Ultra Wide Single-Ended SCSI devices. Prerequisites: One QB-6FUAA-SA HSJ80 Array Controller Software Kits (one per controller) and one QB-6FSAA-SA HSJ80 Array Controller OpenVMS Solution Kit (one per cluster).
DS-HSJ80-LX	Single Compaq StorageWorks HSJ80 Array Controller with 512 MB cache for expansion of DS-SWXM2-BA single DS-BA356-MW controller enclosure. Prerequisite: One QB-6FUAA-SA HSJ80 Array Controller Software Kits (one per controller).

The HSJ80 Array Controller hardware configuration options for Modular Storage systems are as follows:

- | | |
|------------|---|
| 204305-B21 | Single HSJ80 Array Controller with 512 MB cache for MA8000/EMA12000 Modular Storage cabinets.
Prerequisite: One 203693-B21 HSJ80 Array Controller Software Version 8.5A Kits (one per controller). |
|------------|---|

General configuration rules

For more detailed configuration information, refer to the *Compaq StorageWorks HSJ80 Array Controller ACS Version 8.5J-2 Configuration Planning Guide*, EK-HSJCP-PA and the *Compaq StorageWorks Release Notes for the HSJ80 Array Controller ACS Version 8.5J-2 for OpenVMS*, EK-HSJAA-RA.

- HSJ80 Array Controllers may not be used in a dual-redundant pair with HSJ30/40/50 controllers.
- For dual-redundant controller StorageWorks I (SW500 or SW800) configurations, a maximum of 36 physical storage devices using DS-BA356-S device enclosures and one DS-BA356-MW controller enclosure are supported. A maximum of six devices may be attached to a single SCSI device bus on dual redundant configurations.
- In dual-redundant pairs, ACS software must be at identical revision levels, including patch revisions.
- For single controller configurations, a maximum of 42 physical storage devices using DS-BA356-S device enclosures and one DS-BA356-MW controller enclosure are supported. A maximum of seven devices may be attached to a single SCSI device bus on non-redundant HSJ80 configurations.
- For single or dual-redundant controller Modular Storage (MA8000 or EMA12000) configurations:
 - A maximum of 72 disk drives using Model 4214R or Model 4314R single bus 14 bay drive enclosures and one Model 2200 controller enclosure; or
 - A maximum of 42 disk drives using Model 4254R or Model 4354R dual bus 14 bay drive enclosures and one Model 2200 controller enclosure; or
 - A maximum of 60 disk drives using Model 4310R single bus 10 bay drive enclosures and one Model 2200 controller enclosure; or

- A maximum of 30 disk drives using Model 4350R dual bus 10 bay drive enclosures and one Model 2200 controller enclosure.
- A maximum of 2 host ports per HSJ80 controller.
- A maximum of 32 nodes per cluster. 32 nodes are supported only when a Computer Interconnect (CI) Star Coupler extender (CISCE) is installed in the cluster; otherwise 16 nodes is the maximum.
- A maximum of 512 GB unit capacity.
- A maximum of 8 partitions per storage set or individual drives.
- General storage set maximums:
 - 30 RAID-1 storage sets
 - 20 RAID-5 storage sets
 - 45 RAID-0/1/5 storage sets
 - 30 RAID-1/5 storage sets
 - 20 RAID-5 and RAID-1 storage sets for single controller configurations
 - Up to 6 members per mirror set (RAID-1)
 - From 2-24 members per stripe set (RAID-0)
 - From 3-14 members per RAID set (RAID-3/5)
 - 42 devices per mirrored stripe set (21 devices X 2)

Host Node Hardware

A valid OpenVMS™, OpenVMS Alpha™ or VMScluster™ configuration with a supported CI interface host adapter, as identified in the following section, is required to run ACS software.

ACS software supports the following CI host adapters:

- CIPCA for Alpha hosts that use the PCI bus
- CIXCD for Alpha and VAX hosts that use the XMI bus

NOTE: All CIXCD adapter firmware should be upgraded to accommodate the HSJ80 Array Controller 4 KB packet data transfer default. Refer to the *Compaq StorageWorks HSJ80 Array Controller ACS V8.5J-2 Installation and Configuration Guide*, AA-RN17A-TE, for further details.

Device Support Tables

Tables 2 through 7 list the devices that are supported by the HSJ80 Array Controller storage system running ACS V8.5J-2. Compaq Computer Corporation neither supports nor recommends any device not listed for use with either the HSJ80 Array Controller or ACS software regardless of the supplier or stated conformance to ANSI SCSI standards. Compaq will not assure correct operation of any unqualified device nor assure that such devices will not have impact on other supported devices on the HSJ80 Array Controller itself or on other Compaq systems.

Table 2. Supported Disk Devices

Part Number	Device	Size (GB)	Microcode Min Version	H/W Min Revision
176494-B21 ¹	3R-A1491-AA	72.8	BDC7	A01
147599-001	DS-RZ1FB-VW	36.4	3B05/3B07	A01
176496-B22 ¹	3R-A0919-AA	36.4	3B05/BDC4/B012	A01
Unavailable	DS-RZ1FC-VW	36.4	3B02/B012/BDC4	A01
142673-B22 ¹	3R-A0585-AA	18.2	BCJE/B007	A01
128418-B22 ¹	3R-A0561-AA	18.2	B016	A01
388144-B22 ¹	3R-A0527-AA	18.2	3B05	A01
147598-001	DS-RZ1EA-VW	18.2	MH1/0306	A01
380589-B21	DS-RZ1ED-VW	18.2	0305/BDC4/B012/ 3B07	A01
380694-B21	DS-RZ1EF-VA/VW	18.2	0372/N1H1	A01
142671-B22 ¹	3R-A0584-AA	9.1	BCJE/B007	A01
328939-B22 ¹	3R-A0526-AA	9.1	3B07	A01
123065-B22 ¹	3R-A0525-AA	9.1	3B05	A01
147597-001	DS-RZ1DA-VW	9.1	N1H1	A01
380588-B21	DS-RZ1DD-VW	9.1	0305/BDC4/B012 /3B07	A01
380595-B21	DS-RZ1DF-VA/VW	9.1	0372/N1H1/2143	A01
Unavailable	DS-RZ1DB-VW	9.1	LYJ0/307	A01

Table 2. Supported Disk Devices

Part Number	Device	Size (GB)	Microcode Min Version	H/W Min Revision
Unavailable	DS-RZ40-VA	9.1	LYG0	A01
380691-B21	DS-RZ1CF-VA/VW	4.3	0372/N1H1/1214	A01
Unavailable	DS-RZ1CB-VA/VW	4.3	LYJ0/0635	A01
Unavailable	DS-RZ1CD-VA/VW	4.3	0306	A01
Unavailable	RZ29B-VA/VW	4.3	0007	A01
Unavailable	SWXD3-SE/WE	4.3	0007	B01
Unavailable	RZ74-VA	3.57	T427B	B07
Unavailable	RZ28D-VA/VW	2.1	0008	A01
Unavailable	RZ28-VA/VW	2.1	435E	B01
Unavailable	RZ28B-VA	2.1	0003	A01
Unavailable	RZ28M-VA/VW	2.1	0466	A01
Unavailable	RZ28M-VZ	2.1	1003	A01
Unavailable	DS-RZ1BB-VW	2.1	LYJ0/0656	A01
Unavailable	SWXD3-SG/WG	2.1	0008	A01
Unavailable	SWXD3-SH/WH	2.1	0466	A01
¹ StorageWorks II (MA8000/EMA12000) disks				

Table 3. Supported Solid State Disks (StorageWorks I only)

Part Number	Device	Size (GB)	Microcode Min Version	H/W Min Revision
Unavailable	EZ31-VW	0.134	V064	A01
Unavailable	EZ32-VW	0.268	V064	A01
Unavailable	EZ51R-VA	0.10	V096	D01
Unavailable	EZ54R-VA	0.42	V096	A01
Unavailable	EZ58R-VA	0.58	V109	C01
Unavailable	EZ64-VA	0.475	V064	A01

Table 3. Supported Solid State Disks (StorageWorks I only)

Part Number	Device	Size (GB)	Microcode Min Version	H/W Min Revision
Unavailable	EZ64-VW	0.475	V070	A01
Unavailable	EZ69-VA	0.950	V064	A01
Unavailable	EZ69-VW	0.950	V070	A01
Unavailable	EZ454-VA	0.536	Y018	A01
Unavailable	EZ716-VW	1.7	Y018	A01
Unavailable	EZ832-VW	3.2	Y018	A01

Table 4. Supported Optical Devices (StorageWorks I only)

Part Number	Device	Size (GB)	Microcode Min Version	H/W Min Revision
Unavailable	RRD42-VB/VU	0.6	1.1a	A01
Unavailable	RRD43-VA	0.6	0064	A02
Unavailable	RRD44-VA	0.6	3493	A02
Unavailable	RRD45-VA/VU	0.6	1645	A01
Unavailable	RRD46-VA	0.6	1337	A01
Unavailable	RRD47-VA	0.6	1206	A01
Unavailable	RW524	19	1.37 juke box/ 3404 drive	A01
Unavailable	RW525	19	2.17 juke box/ 3404 drive	A01
Unavailable	RW530	38	6.15 juke box/ 3404 drive	A01
Unavailable	RW531	38	0.35 juke box/ 3404 drive	A01
Unavailable	RW532	83.2	0.35 juke box/ 3404 drive	A01

Table 4. Supported Optical Devices (StorageWorks I only)

Part Number	Device	Size (GB)	Microcode Min Version	H/W Min Revision
Unavailable	RW534	114.4	5.20 juke box/ 3404 drive	A01
Unavailable	RW536	187.2	5.20 juke box/ 3404 drive	A01
Unavailable	RW546	36.8	1.36 juke box/ 3404 drive	A01
Unavailable	RW551	73.6	1.36 juke box/ 3404 drive	A01
Unavailable	RW552	147.2	1.36 juke box/ 3404 drive	A01
Unavailable	RW555	200	1.36 juke box/ 3404 drive	A01
Unavailable	RW557	600	1.36 juke box/ 3404 drive	A01
Unavailable	RWZ52-VA	0.6 per side	3403	A01
Unavailable	RWZ53-VA	2.3/2.6	1.35	AX02

Table 5. Supported Tape Drives (Storageworks I only)

Part Number	Device / Description	Size (GB)	Microcode Min Version ²	H/W Min Revision
Unavailable	TLZ06-VA / 4GB 4mm DAT	4 ⁵	0491	A04
Unavailable	TLZ07-VA / 4/8GB 4mm DAT	8 ⁵	04AQ	AX01
Unavailable	TLZ09-VA / 4/8GB 4mm DAT	4/8 ⁵	v165	A01
Unavailable	TSZ07-AA ³ / 1600/6250 PE/GCR reel-to-reel	0.140 ⁵	0309	A01
Unavailable	TZ86-VA ¹⁰ / 6GB DLT	6 ⁵	430B	A02
Unavailable	TZ87-VA ¹⁰ / 10/20GB DLT	10/20 ⁵	930A	A01
Unavailable	TZ87N-VA ^{7,10} / 10/20GB DLT	10/20 ⁵	930A	A01
Unavailable	TZ87-TA ^{3,4,10} / 10/20GB DLT	10/20 ⁵	9514	B02
Unavailable	TZ87N-TA ^{3,4,10} / 10/20GB DLT	10/20 ⁵	930A	A01
Unavailable	TZ88N-VA/TA ^{7,10} / 20/40GB DLT	20/40 ⁵	CC33	A01
Unavailable	TZ88N-VW ^{7,10} / 20/40GB DLT	20/40 ⁵	V135	A01
Unavailable	DS-TZ89N-VW ^{7,9,10} / 35/70GB DLT	35/70 ⁵	V80	A01
Unavailable	DS-TZ89N-TA ^{3,9,10} / 35/70GB DLT	35/70 ⁵	141F	A01

Table 5. Supported Tape Drives (Storageworks I only)

Part Number	Device / Description	Size (GB)	Microcode Min Version ²	H/W Min Revision
Unavailable	DS-TZS20-VW ^{3,7,10} / 25/50GB AIT	25/50 ⁵	01Aj	A01
Unavailable	DS-AIT35-VW ^{9,10} / 35/70GB AIT	35/70 ⁵	4.03	A01
Unavailable	TKZ60-EC ³ / IBM 3480 Compatible	0.44	111	B01
Unavailable	TKZ61 ³ / IBM 3480 Compatible	4.4	0611	A01
Unavailable	TKZ62 ³ / IBM 34980E Compatible	24.0 ⁵	0616	A01
Unavailable	TKZ63 ³ / IBM 3480/3490/3490E Compatible	2.4 ⁵	0616	A01

Table 5 Notes

- ² Minimum microcode version and hardware revision supported
- ³ Requires 0.2 meter SCSI-1 to SCSI-2 transition cable, Compaq internal part number 17-03831-01 for DWZZA-AA, and Compaq part number 17-04367-01 for SBB DWZZA-VA and DWZZB-VW
- ⁴ Requires DWZZA/DWZZB single-ended to differential SCSI signal converter
- ⁵ Values represent compressed data. The compression factor is device dependent based on individual device algorithms.
- ⁷ Cannot read TK50, TK70 or TZ30 format tapes
- ⁹ Wide Tape Devices require BA356 with 8-bit I/O module.
- ¹⁰ Tape Device Code load is supported.

Table 6 Supported Tape Loaders

Part Number	Device / Description	Size (GB)	Microcode Min Version ²	H/W Min Revision
Unavailable	2T-TKZ64 ³ / IBM 3480/3490/3480E Compatible with 60 cartridge loader	144 ⁵	0616	A01
Unavailable	TLZ6L-VA ⁶ / TLZ06 with 4 cartridge loader	16 ⁵	0491	A01
Unavailable	TLZ7L-VA ⁶ / TLZ07 with 4 cartridge loader	8 ⁵	4BQE	A02
Unavailable	TLZ9L-VA ⁶ / TLZ87 with 8 cartridge loader	32 ⁵	A020	AX01
Unavailable	TZ867-AE/AF ^{3,10} / TZ86 with 7 cartridge loader	42	430B	A01
Unavailable	TZ875-NE ^{3,10} / TLZ87 with 5 cartridge loader	50/100 ⁵	930A	A01
Unavailable	TZ875-AE/AF ^{3,10} / TLZ87 with 5 cartridge loader	50/100 ⁵	930A	A01
Unavailable	TZ875-NT ^{3,10} / TLZ87 with 5 cartridge loader	50/100 ⁵	930A	A01
Unavailable	TZ875-TA ^{3,10} / TLZ87 with 5 cartridge loader	50/100 ⁵	930A	A01

Table 6 Notes
² Minimum microcode version and hardware revision supported
³ Requires 0.2 meter SCSI-1 to SCSI-2 transition cable, Compaq internal part number 17-03831-01 for DWZZA-AA, and Compaq part number 17-04367-01 for SBB DWZZA-VA and DWZZB-VW
⁴ Requires DWZZA/DWZZB single-ended to differential SCSI signal converter
⁵ Values represent compressed data. The compression factor is device dependent based on individual device algorithms.
⁶ Loaders operate in sequential mode only.
⁷ Cannot read TK50, TK70 or TZ30 format tapes
⁹ Wide Tape Devices require BA356 with 8-bit I/O module.
¹⁰ Tape Device Code load is supported.

Table 7. Supported Tape Libraries

Part Number	Device / Description	Size (GB)	Microcode Min Version ²	H/W Min Revision
Unavailable	TZ877-NE ^{3,10} / TZ87 with 7 cartridge mini-library	70/140 ⁵	930A	A01
Unavailable	TZ877-AE/AF ^{3,10} / TZ87 with 7 cartridge mini-library	70/140 ⁵	930A	A01
Unavailable	TZ885-NE/NT ^{3,7,10} / TZ88 with 5 cartridge mini-library	100/200 ⁵	CC33	A01
Unavailable	TZ887-NE/NT ^{3,7,10} / TZ88 with 7 cartridge mini-library	140/280 ⁵	CC33	A01
Unavailable	TL810 ^{3,4} / (4) TZ87 - 52 cartridge	480/960 ⁵	1.10 robot/ V40drive	A01

Table 7. Supported Tape Libraries

Part Number	Device / Description	Size (GB)	Microcode Min Version ²	H/W Min Revision
Unavailable	TL812 ^{3,4,7} / (4) TZ88 – 52 cartridge	960/1920 ⁵	1.2 robot/ CC33drive	A01
Unavailable	TL820, Rev A01 ^{3,4} / (3) TZ87 – 264 cartridge	2640/ 5280 ⁵	1d3M robot/ v40drive	L1
Unavailable	TL822 ^{3,4,7} / (3) TZ88 – 264 cartridge	5280/ 10560 ⁵	1g4F robot/ CC33drive	A01
Unavailable	TL826 ^{3,4,7} / (6) TZ88 – 176 cartridge	3520/ 7040 ⁵	1g4F robot/ CC33drive	A01
Unavailable	DS-TL890 ^{3,4,7,8} / Expansion unit for TL891 series – 16 cartridges, no drives	560/1.12T ⁵	3.23 robot/ V55drive	A01
Unavailable	DS-TL891 ^{3,4,7,8} / (1) TZ89 - 10 cartridges	350/700 ⁵	3.23 robot/V55 drive	A02
Unavailable	DS-TL892 ^{3,4,7,8} / (2) TZ89 – 10 cartridges	350/700 ⁵	3.23 robot/V55 drive	A02
Unavailable	DS-TL893 ^{3,4,7,8} / (3) TZ89 – 264 cartridges	9.24/ 18.48T ⁵	V2A/5A	A01
Unavailable	DS-TL894 ^{3,4,7,8} / (4) TZ89 – 52 cartridges	1.69/ 3.36 ⁵	V1.24	A01
Unavailable	DS-TL895 / (5) TZ89 – 100 cartridges	3.1/6.2	230	A01
Unavailable	DS-TL896 ^{3,4,7,8} / (6) TZ89 – 176 cartridges	6.1/ 2.32T ⁵	V2A/5A	A01

Table 7. Supported Tape Libraries

Part Number	Device / Description	Size (GB)	Microcode Min Version ²	H/W Min Revision
Unavailable	161268-B21 (ESL9326D) / (6 to 16) TZ89 – 326 cartridges	11.41/ 22.82T	1.42/ V55 drive	A01

Table 7 Notes

- ² Minimum microcode version and hardware revision supported
- ³ Requires 0.2 meter SCSI-1 to SCSI-2 transition cable, Compaq internal part number 17-03831-01 for DWZZA-AA, and Compaq part number 17-04367-01 for SBB DWZZA-VA and DWZZB-VW
- ⁴ Requires DWZZA/DWZZB single-ended to differential SCSI signal converter
- ⁵ Values represent compressed data. The compression factor is device dependent based on individual device algorithms.
- ⁶ Loaders operate in sequential mode only.
- ⁷ Cannot read TK50, TK70 or TZ30 format tapes
- ⁹ Wide Tape Devices require BA356 with 8-bit I/O module.
- ¹⁰ Tape Device Code load is supported.

Software Requirements

Supported operating system platforms as of the publication date are listed in Table 8.

Table 8. Supported Operating Systems

Host	Operating System
VAX	OpenVMS V6.2
Alpha	OpenVMS V6.2-1H3
VAX	OpenVMS V7.1
Alpha	OpenVMS V7.1-2
VAX and Alpha	OpenVMS V7.2
Alpha	OpenVMS V7.2-1

OpenVMS cluster environment

The HSJ80 Array Controller is designed for use in an OpenVMS Cluster computing environment. An OpenVMS cluster is a group of OpenVMS Alpha and/or OpenVMS VAX systems, storage systems, interconnects, and software that work together as one virtual system. Refer to the *Guidelines for OpenVMS Cluster Configurations*, AA-Q28LC-TK, for further detail. This book may be downloaded from the following web site:

<http://www.openvms.digital.com:8000/index.html>

Growth considerations

The minimum hardware and software requirements for any future version of this product may be different than the requirements for the current version.

Distribution media

The HSJ80 Array Controller Software (ACS) is available on PCMCIA distribution media.

Ordering information

The HSJ80 Array Controller Software (ACS) is ordered and shipped separately from the HSJ80 Array Controller hardware. A separate ACS kit is required for each HSJ80 Array Controller. Table 9 contains the ACS ordering information.

Table 9. ACS Ordering Information

Order No.	6-3 P/N	Contents
QB-6FUAA-SA	203693-B21	HSJ80 ACS 8.5J-2 license, PCMCIA media, Documentation

A co-requisite software solution kit is an operating system platform kit containing the SWCC and the appropriate installation information for the OpenVMS operating system. One software solution kit is required per each OpenVMS Cluster. Table 10 contains the Software Solution Kit ordering information.

Table 10. Software Solution Kit Ordering Info

Order No.	6-3 P/N	Contents
QB-6FSAA-SA	203694-001	HSJ80 Array Controller OpenVMS Solution Kit, V8.5A

For additional information on available licenses, services, and media, refer to the appropriate price book.

Documentation

The Compaq StorageWorks HSJ80 Array Controller documentation set includes the following guides and Release Notes identified in the following table. Documentation is also provided on the distribution CD in PDF format. You may print the electronic software documentation accompanying the software as reasonably necessary to support your use of the software. Table 11 lists and describes the documentation supplied with the Software Solution Kit.

Table 11. Documentation Supplied with Software Solution Kit

Name	2-5-2 P/N	6-3 P/N	Description
HSJ80 Array Controller ACS Version 8.5J-2 CLI Reference Guide	EK-HSJCL-RA. B01	N/A	Descriptions of all the CLI commands, Parameters, and Switches.
HSJ80 Array Controller ACS Version 8.5J-2 Configuration Planning Guide	EK-HSJCP-PA. B01	N/A	Storage system planning and storageset planning.
HSJ80 Array Controller ACS Version 8.5J-2 Installation and Configuration Guide	AA-RN17A-TE	N/A	Procedures to modify a current storageset configuration, and the configuration procedure from startup.
HSJ80 Array Controller ACS Version 8.5J-2 Maintenance and Service Guide	EK-J80MS-SA. A01	N/A	Removal and replacement procedures of the field-replaceable components.
HSJ80 Array Controller ACS Version 8.5J-2 Troubleshooting Resources Guide	EK-J80TR-SA. A01	N/A	Troubleshooting the storage system, a functional description of the HSJ80 Storage System
HSJ80 Array Controller ACS V8.5J-2 Release Notes	EK-HSJAA-RA. B01	N/A	Changes to the software from the documentation's description, what's new to this release.
DS-BA356-MW Controller Enclosure Upgrade/Add-On Kit Quick Setup Guide	EK-356MW-QA. B01	N/A	Informs the customer of the process to follow during the upgrade/add-on process. Roadmaps the entire installation/upgrade process.

Table 11. Documentation Supplied with Software Solution Kit

Name	2-5-2 P/N	6-3 P/N	Description
HSJ80 Array Controller ACS V8.5J-2 Software Solution Overview	EK-HSJSO-OA. B01	N/A	Informs the customer of the process to follow during the configuration process. Roadmaps the entire configuration process.
DS-BA356-MW Controller Enclosure Upgrade/Add-On Kit Installation Guide	EK-356MW-IA. B01	N/A	Descriptions of how to install the storage system upgrade that the customer ordered. How to backup and then restore the storage system configuration; how to install an add-on enclosure.
DS-BA356-MW Controller Enclosure User Guide	EK-356MW-UA. A01	N/A	Descriptions of the controller enclosure and how to operate it. Descriptions of the various controller enclosure elements
SWCC Online Help	N/A	N/A	Descriptions of the SWCC menus and commands contained within the SWCC HELP pull-down menu.

Software licensing

This software is furnished only under a license. For more information about Compaq Computer Corporation's licensing terms and policies, contact your local Compaq office.

Software product services

A variety of service options are available from Compaq. For more information, contact your local Compaq office.

Software service for the HSJ80 Array Controller OpenVMS Solution Kit, V8.5J, is covered under the terms and conditions of the Integrated Hardware and Software Customer Service contracts.

Multivendor Customer Services for the HSJ80 controller and solution software are covered under the terms and conditions of the following:

- Hardware Customer Service Contract
- Software Customer Service Contract
- Media Distribution Service (MDS) contract

Software warranty

Compaq Computer Corporation provides this software with a 90-day telephone support and 90-day conformance warranty in accordance with the Compaq warranty terms applicable to the license purchase.

The above information is valid at time of release. Contact your local Compaq office for the most up-to-date information.

© 2000 Compaq Computer Corporation

COMPAQ, the Compaq logo, and StorageWorks Registered in U.S. Patent and Trademark Office.

All other product names mentioned herein may be trademarks of their respective companies.

Confidential Computer Software. Valid license from Compaq required for possession, use, or copying. Consistent with FAR 12.211 and 12.212, Commercial Computer Software, Computer Software Documentation, and Technical Data for Commercial Items are licensed to the U.S. Government under vendor's standard commercial license.

Compaq shall not be liable for technical or editorial errors or omissions contained herein. The information in this document is subject to change without notice.

THE INFORMATION IN THIS PUBLICATION IS PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND. THE ENTIRE RISK ARISING OUT OF THE USE OF THIS INFORMATION REMAINS WITH THE RECIPIENT. IN NO EVENT SHALL COMPAQ BE LIABLE FOR ANY DIRECT, CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE, OR OTHER DAMAGES WHATSOEVER (INCLUDING WITHOUT LIMITATION, DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION, OR LOSS OF BUSINESS INFORMATION), EVEN IF COMPAQ HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES AND WHETHER IN AN ACTION OF CONTRACT OR TORT, INCLUDING NEGLIGENCE.

The limited warranties for Compaq products are exclusively set forth in the documentation accompanying such products. Nothing herein should be construed as constituting a further or additional warranty.

Printed in the U.S.A.

Software Product Description
HSJ80 Array Controller ACS Version 8.5J-2
Second Edition (September 2000)
Part Number AE-RKVDB-TE