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# Software Product Description

**PRODUCT NAME: HSJ50 Family Array Controller Operating Software (HSOF), Version 5.0** **SPD 60.68.00**

## DESCRIPTION

The HSJ50 Family Array Controller Operating Firmware (HSOF) is the software component of the HSJ50 array controller. Using Digital Equipment Corporations's CI bus, these array controllers are intelligent mass storage controller that interface among host computer systems and SCSI-attached mass storage devices. HSOF software executes in the HSJ array controller; it processes MSCP I/O requests from hosts, performing the lower-level operations required to execute these requests.

## HSOF Software FUNCTIONS

HSOF software performs the following functions:

- Testing and diagnosis of the HSJ50 array controller
- Host interconnect and protocol services
- SCSI device control
- Subsystem management services
- Local program support
- Write-back cache functions
- Parity RAID (RAID 3/5) functions
- Disk mirroring functions
- Disk partitioning functions

The following sections describe these functions.

### Testing and Diagnosis of the HSJ50 Array Controller

HSOF software internal diagnostics execute automatically when controller power is turned on or when the array controller is reset.

LEDs on the controller's front bezel provide diagnostic information upon controller failure.

*Cache Battery Diagnostic*

HSOF software Version 5.0 checks the condition of the External Cache Batteries (ECB) every 24 hours. If a low capacity or failure is detected, write-back cache data is flushed from cache and depending on the pre-defined cache policy, selected RAIDsets and disk mirrorsets may become inoperative. In dual redundant configurations, failover to the redundant controller occurs. Refer to the *HSJ50 Array Controller Operating System Software Release Notes*, EK–HSJ50–RN. A01, for further information.

### Host Interconnect and Protocol Services

The HSJ50 array controllers attach to host computer systems using the CI bus. The controller may be installed in VMScluster™ configurations that include up to 32 nodes, of which up to 31 nodes may be hosts.

### SCSI Device Control

HSOF spftware converts host I/O requests expressed in the MSCP protocol into device-specific SCSI commands. It supports concurrent commands and data transfers on multiple SCSI device buses to the maximum extent possible for each supported device type.

HSOF software device control functions include the following:

*Error Detection and Recovery*

HSOF software recovers from device errors including bad block replacement for supported disk drives that do not perform this function for themselves.

For errors on the CI interface, HSJ50 array controller hardware and HSOF software cooperate to provide the following:

- Automatic retransmission of data detected as being in error
- Automatic retransmission on an alternate path if a CI path fails
- Automatic detection of internal data path errors
- Automatic failover of attached devices between identically configured HSJ50 controllers installed in the same controller shelf

*Device Integrity Testing*

HSOF software executes Device Integrity Test programs on system manager command. These tests perform the following:

- Verify correct operation of individual devices
- Place the HSJ50 array controller under load to verify correct subsystem operation

*Disk Striping*

HSOF software treats sets of disk drives as stripesets (2 to 14 members) for improved I/O performance through load balancing. A stripeset appears to the OpenVMS™ operating system as a single disk drive.

*Partitioning*

HSOF software allows partitioning of disk drives for improved device management. A partitioned disk appears to the OpenVMS™ operating system as multiple unit numbers which are separately addressable. Up to 4 partitions may be created per disk.

*Error Logging*

HSOF software uses CI messages to report faulty or failing devices and controller faults to all connected hosts that have error logging enabled.

*Save Configuration on Disk*

Saves device, controller configuration information and HSOF software patches on a disk. This improves availability in the event of a software upgrade or controller replacement.

Saves any installed patches on disk initialized with the SAVE_CONFIGURATION option.

*Set SCSI Speed for Devices*

Allows the controller to force a slower data rate when negotiating with the target device. This allows for a longer cable length than that supported by the speed that the controller and target device would normally negotiate. This CLI command can set the maximum data transfer rate between the controller and any device to 10MHz, 5MHz.

*Set CI 4K Packet Capability*

Allows the controller to send and receive 4K packets over the CI interface. This can improve I/O performance to the host. See the *Configuring Your StorageWorks Subsystem HSJ50 Array Controllers HSOF Version 5.0 Software* EK–HSJ50–CG. A01 for supported adapters and OpenVMS™ operating systems.

**Subsystem Management Services**

HSOF software provides the following subsystem management services:

*Alteration of Subsystem Parameters*

HSOF software includes a command language interpreter (CLI) utility that allows a system manager to display and manipulate controller parameters and device configuration information as needed.

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

*Dynamic Status Display*

The HSOF VTDPY utility allows a system manager to view the HSJ-based subsystem's state dynamically. This utility can use VT200-, VT300-, and VT400-series video terminals.

Terminal port connections are supported at 4800, 9600,and 19200 BPS only.

*HSUTIL*

The HSUTIL utility provides two functions: device format and device code load. Device format enables the system manager to perform a basic format operation on a disk device. Device code load provides the functionality to download device firmware onto supported disk drives via the controller. Device code load is supported for the following tape devices:

- TZ86
- TZ87
- TZ877
- TZ885
- TLZ09
- TZ867
- TZ88

- TZ887

Refer to the *HSJ50 Array Controller Operating Software Version V5.0 Release Notes*, EK–HSJ50–RN. A01, for further detail.

**Local Program Support**

HSOF software supports the following local programs and commands:

- CFMENU for configuring controller-attached storage devices
- CHVSN support the ability to change volume serial numbers for disk drive devices
- CLONE utility for obtaining snapshot copies of data in concert with disk mirroring software
- Code Patch (CLCP) for controller software changes
- CONFIG for automatically adding new devices to the configuration
- C_SWAP for controller and/or cache module warm swap (for dual-redundant configurations)
- DEFAULT_FORMAT=HOST_SELECTED can be used to set tape density for writes from the host operating system, as well as from the controller CLI
- DILX disk inline exerciser
- TILX tape in-line exerciser
- FLS for enabling and disabling optional licensed features
- FMU for displaying controller last failure and memory system failure information as well as control of spontaneous event logging and last failure logging displays
- MAXIMUM HOSTS allows HSJ controllers to calculate CI credits based on the number of *host* nodes, rather than on the total number of nodes
- VTDPY presents a user display of current controller state and performance data for attached disk drive devices

**NOTE:**

CFMENU cannot be used to partition striped-mirrorsets. The CLI commands may be used to manually partition striped mirrorsets. The Clone Utility cannot be used with partitioned units.

**Write-Back Cache Capability**

The write-back cache capability provides the following functions:

- Stores data to be written temporarily in the controller's write-back cache and 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
- 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 for a defined time
- Consolidates contiguously located data blocks from multiple host write requests into a single device request to reduce average latency
- On recovery from a controller failure (for example, a power outage), detects that unwritten data still exists in cache and writes it to disk media before enabling normal controller operations

**RAID Capability**

The RAID capability provides the following functions:

- Manages up to 14 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. RAIDsets can tolerate the failure of a single member disk without loss of ability to deliver data to hosts.
- Dynamically adjusts between RAID Level 3 and RAID Level 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 it.

For information regarding default chunksize, refer to the *Configuring Your StorageWorks Subsystem HSJ50 Array Controllers HSOF Version 5.0 Software*, part number EK–HSJ50–CG. A01.

**CAUTION:** OpenVMS operating system versions prior to Version 6.0 do not support real or virtual disk devices larger than 8.5 GB as file-structured devices. Using disk devices larger than 8.5 GB with earlier versions of the OpenVMS operating system causes data corruption.

### Disk Mirroring Capability

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 HS array controller.
- Protects data against disk failure by replicating all data on each member of the mirrorset. Disk mirroring offers extremely high data reliability.
- Striping of mirrorsets, for high-performance access to large amounts of highly available data.
- Captures a designated spare (if one exists) in the event of a mirrorset member disk failure and reconstructs the data of the failed member disk onto it.
- Ability to increase or decrease the number of members in a mirrorset as requirements change.
- Flexible policy options for determining both how read requests are satisfied and the speed of copying when a new member is being added.
- HSOF software disk mirroring can utilize the UNMIRROR command to change devices back to a single-disk unit.

*Limits on the Total Number of Storagesets*

The following limits apply to storagesets configured on a single controller or dual-redundant controller configurations:

- A mirrorset can have a maximum of 6 members.
- There can be a maximum of 20 mirrorsets and/or RAIDsets.
- There can be a maximum of 30 storagesets (RAIDsets, mirrorsets, and/or stripesets.)
- There can be no more than 32 physical device members total for a unit.
- There can be a maximum of 4 partitions per disk or storagesets.

## HARDWARE REQUIREMENTS

HSOF software V5.0 requires an HSJ50–A*x* array controller on which to execute.

The HSJ50 array controller includes six SCSI device buses for connecting storage devices. The specific devices supported by HSOF Version Software V5.0 are listed in Tables 1, 2 and 3.

The HSJ50 array controller supported configurations are as follows:

| | |
|---|---|
| HSJ50–AF | StorageWorks array controller for 36 (dual-redundant) or 42 (nonredundant) SCSI–2 disk/tape/optical devices; 32 MB Read/Write-back Cache, RAID, Disk Mirroring and one single External Cache Battery unit (ECB) (Prerequisite: (1) HSOF Software kit ordered separately, (1) QB-5C4AA-SA) |
| HSJ50–AH | StorageWorks array controller for 36 (dual-redundant) or 42 (nonredundant) SCSI–2 disk/tape/optical devices; 64 MB Read /Write-back Cache, RAID, Disk Mirroring and one single External Cache Battery unit (ECB)(Prerequisite: One HSOF Software kit ordered separately, (1) QB-5C4AA-SA) |
| HSJ50–AJ | StorageWorks array controller for 36 (dual-redundant) or 42 (nonredundant) SCSI–2 disk/tape/optical devices; 128 MB Read /Write-back Cache, RAID, Disk Mirroring and one single External Cache Battery unit (ECB)(Prerequisite: One HSOF Software kit ordered separately, (1) QB-5C4AA-SA) |
| HSJ52–AF | One set (two HSJ50-AF controllers) of dual-redundant StorageWorks array controllers for 72 SCSI–2 disk/tape/optical devices; 64MB Read/Write-back Cache, RAID Disk Mirroring and one dual External Cache Battery units (ECB)(Prerequisite: Two HSOF Software kits ordered separately, (2) QB-5C4AA-SA) |
| HSJ52–AH | One set (two HSJ50-AJ controllers) of dual-redundant StorageWorks array controllers for 72 SCSI–2 disk/tape/optical devices; 128MB Read/Write-back Cache, RAID Disk Mirroring and one dual External Cache Battery units (ECB)(Prerequisite: Two HSOF Software kits ordered separately, (2) QB-5C4AA-SA) |
| HSJ52–AJ | One set (two HSJ50-AJ controllers) of dual-redundant StorageWorks array controllers for 72 SCSI–2 disk/tape/optical devices; 256MB Read/Write-back Cache, RAID Disk Mirroring and one dual External Cache Battery units (ECB)(Prerequisite: Two HSOF Software kits ordered separately, (2) QB-5C4AA-SA) |
| HSJ54–AJ | Two sets (four HSJ50-AJ controllers) of dual-redundant Sto rageWorks array controllers for 144 SCSI–2 disk/tape/optical devices; 512MB Read/Write-back Cache, RAID, Disk Mirroring and two dual External Cache Battery units (ECB)(Prerequisite: Four HSOF Software kits ordered separately, (4) QB-5C4AA-SA) |

*Controller Configuration Restrictions*

- HSJ50–A*x* controllers may *not* be used in a dual-redundant pair with HSJ30/40–A*x* or C*x* controllers.
- A maximum of six devices may be attached to a single SCSI device bus on dual-redundant HSJ50 array controller configurations.

- A maximum of seven devices may be attached to a single SCSI device bus on nonredundant HSJ50 array controller configurations.
- The HSJ50–A*x* Minimum HSOF software revision level is V5.0 software.

### Host Node Hardware and Software Required

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

HSOF software supports the following CI host adapters:

- CIXCD–AB (for XMI-based systems)
- CIXCD–AC (for XMI-based systems)
- CIBCA–B*x* (for BI-based systems)
- CIPCA (for PCI-based systems)

HSJ50–A*x* controllers, mounted in a BA350–MA, BA355 or SW300 controller shelf/slots, support the following packaging components (based upon StorageWorks packaging configuration guidelines):

- BA350–S*x* 8-bit SCSI shelf for devices and up to two single-ended buses
- BA356–S*x* 16-bit SCSI shelf for devices and up to two single-ended buses
- BA35*x*–HF 150 Watt, 48 Volt Power Supply in System Building Block (SBB), 3½ inch form factor
- BA35X–MG 8-bit I/O Module

### OPTIONAL HARDWARE

HSJ50 and HSOF Software V5.0 supports the following optional hardware:

- HSSIM–AA 32MB SIMM Pack for HSX50 controllers, add additional 32MB SIMMs to upgrade HSJ50 controllers to the supported HSJ50-AH 64MB and HSJ50–AJ 128MB configurations *Note* 96 MB Configurations are not supported
- HS35X-BA Replacement Single External Cache Battery (ECB)
- HS35X-BB Replacement Dual External Cache Battery (ECB)

The following tables represent the **only** devices that are supported. Digital Equipment Corporation neither supports nor recommends any device not listed for use with either HSJ50 array controller and HSOF software, regardless of the supplier or stated conformance to ANSI SCSI standards. Digital will not assure correct operation of any unqualified device nor assure that such devices will not have impact on other supported devices, on the HSJ50 array controller itself, or on a Digital system configuration.

**Table 1**
**HSJ50 Disk and Solid State Disk Support**

| Device | Type[1] | Capacity GB | Minimum Microcode Version | Min H/W Rev[2] |
|---|---|---|---|---|
| RZ25–VA | DD | 0.426 | 0900 | B01 |
| RZ26–VA | DD | 1.05 | T392 | D02 |
| RZ26L–VA/VW[3] | DD | 1.05 | 440C | A01 |
| RZ26N–VA/VW[3] | DD | 1.05 | 446 | A01 |
| SWXD3-SF/WF[3] | DD | 1.05 | 446 | A01 |
| RZ28–VA/VW[3] | DD | 2.1 | 435E | B01 |
| RZ28B–VA | DD | 2.1 | 0003 | A01 |
| RZ28D–VA/VW[3] | DD | 2.1 | 0008 | A01 |
| SWXD3-SG/WG[3] | DD | 2.1 | 0008 | A01 |
| RZ28M–VA/VW[3] | DD | 2.1 | 466 | A01 |
| SWXD3-SH/WH[3] | DD | 2.1 | 466 | A01 |
| RZ29B–VA/VW[3] | DD | 4.3 | 0007 | B01 |
| SWXD3-SE/WE[3] | DD | 4.3 | 0007 | C02/A01 |
| RZ74–VA | DD | 3.57 | T427B | B07 |
| EZ31–VW[4] | SSD | 0.134 | V064 | A01 |
| EZ32–VW[4] | SSD | 0.268 | V064 | A01 |
| EZ51R–VA[4] | SSD | 0.10 | V096 | D01 |
| EZ54R–VA[4] | SSD | 0.42 | V096 | A01 |
| EZ58R–VA[4] | SSD | 0.85 | V109 | C01 |
| EZ64–VA[4] | SSD | 0.475 | V064 | A01 |
| EZ69–VA[4] | SSD | 0.950 | V064 | A01 |

[1] Device types are indicated as follows: DD for disk drive and SSD for solid state devices.

[2] Minimum hardware revision supported with BA350 shelf.

[3] VW models require BA356 wide device shelves and 8-bit I/O modules.

[4] Do not warm swap solid state devices. Make sure the device shelf power is off when inserting or removing a solid state disk device.

**Table 2**
**HSJ Tape, and Tape Library**

| Device | Type[1] | Capacity GB | Minimum Microcode Version | Min H/W Rev[2] |
|---|---|---|---|---|
| TKZ60-EC[6] | TDL | .440 | 111 | B01 |
| TKZ61[36] | TDL | 6.0 | 0611 | A01 |
| TKZ62[36] | TDL | 24.0[5] | 0611 | A01 |
| TL810[34] | TLB | 1000[5] | 1.10 robot /v40 drive | A01 |
| TL812[34] | TLB | 1040/2080 | 1.2 robot /CC33 drive | A01 |
| TL820, Rev A01[34] | TLB | 5200[5] | 1d3M robot /v40 drive | L1 |
| TL822 [34] | TLB | 5080/10560 | 1g4F robot /CC33 drive | A01 |
| TL826 [34] | TLB | 3520/7040 | 1g4F robot /CC33 drive | A01 |
| TLZ06–VA | TD | 4[5] | 0491 | A04 |
| TLZ07–VA | TD | 8[5] | 04AQ | AX01 |
| TLZ09–VA | TD | 4/8 | v165 | |
| TLZ6L–VA[6] | TDL | 16[5] | 0491 | A01 |
| TLZ7L–VA[6] | TDL | 8[5] | 4BQE | A02 |
| TSZ07–AA[3] | TD | 0.140 | 0309 | A01 |
| TZ86–VA | TD | 6 | 430B | A02 |
| TZ87–VA | TD | 20[5] | 930A | A01 |
| TZ87N–VA[7] | TD | 20[5] | 930A | A01 |
| TZ87–TA[34] | TD | 20[5] | 9514 | B02 |
| TZ867-AE/AF[3] | TDL | 42 | 430B | A01 |
| TZ875–NT[3] | TDL | 100[5] | 930A | A01 |
| TZ875–TA[3] | TDL | 100[5] | 930A | A01 |
| TZ877–AE/AF[3] | TDL | 140 | 930A | A01 |
| TZ88N–VA/TD[7] | TD | 20/40 | CC33 | A01 |
| TZ885–NT[37] | TDL | 100/200 | CC33 | A01 |
| TZ885–TA[37] | TDL | 100/200 | CC33 | A01 |
| TZ887–AE[37] | TDL | 140/280 | CC33 | A01 |

[1]Device types are indicated as follows: TD for tape drive, TDL for tape drive loader, TLB for tape library, CD for CD–ROM, and OP for magneto-optical disk devices.

[2]Minimum hardware revision supported.

[3]Requires 0.2 meter SCSI–1 to SCSI–2 transition cable, Digital internal part number 17–03831–01 for DWZZA-AA, and Digital 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.

**Table 3**
**HSJ CD-Rom and Optical Support**

| Device | Type[1] | Capacity GB | Minimum Microcode Version | Min H/W Rev[2] |
|---|---|---|---|---|
| RRD42–VB/VU[8] | CD | 0.6 | 1.1a | A01 |
| RRD43–VA[8] | CD | 0.6 | 0064 | A02 |
| RRD44–VA[8] | CD | 0.6 | 3493 | A02 |
| RRD45–VA/VU[8] | CD | 0.6 | 1645 | A01 |
| RWZ52–VA[8] | OP | 0.6 per side | 3403 | A01 |
| RW524[8] | OPJ | 19 | 1.37 juke box/3404 drive | A01 |
| RW525[8] | OPJ | 19 | 2.17 juke box/3404 drive | A01 |
| RW530[8] | OPJ | 38 | 6.15 juke box/3404 drive | A01 |
| RW531[8] | OPJ | 38 | 0.35 juke box/3404 drive | A01 |
| RW532[8] | OPJ | 76 | 0.35 juke box/3404 drive | A01 |
| RW534[8] | OPJ | 104 | 5.20 juke box/3404 drive | A01 |
| RW536[89] | OPJ | 170 | 5.20 juke box/3404 drive | A01 |

[1]Device types are indicated as follows: TD for tape drive, TDL for tape drive loader, TLB for tape library, CD for CD–ROM, and OP for magneto-optical disk devices.

[2]Minimum hardware revision supported.

[8]Do not warm swap this device. Make sure that the device shelf power is off when inserting or removing this device.

[9]To add this device to your configuration you must do the following: Set Optical container-name PTL TRANSFER_RATE_REQUESTED= ASYNC.

## CONFIGURATION RESTRICTIONS

Disks attached to an HSJ50 array controller may be used as initialization devices for DEC 7000® or DEC 10000® processors provided the following condition is met:

- The DEC 7000 or DEC 10000 processor console code is at Version 3.1 or higher.

## SOFTWARE REQUIREMENTS

HSOF software Version 5.0 on HSJ50 controllers is supported by the following operating system versions, with the limitations described in the *Configuring Your StorageWorks Subsystem HSJ50 Array Controllers HSOF Software V5.0*, part number EK–HSJ50–CG. A01 and current release notes.

- OpenVMS Alpha™ Version 6.1 or higher
- OpenVMS VAX™ Version 5.5–2 or higher

## DISTRIBUTION MEDIA

HSOF software is shipped on PCMCIA program card media only.

## ORDERING INFORMATION

Customers wishing to purchase HSOF Software V5.0 Software Kits or Services may order them using the following part numbers:

**Table 4**
**Distribution and Documentation Option**

| | |
|---|---|
| QB–5C4AA–SA | HSOF HSJ50 LIC/MCD/DOC KIT |
| QA–5C4AA–GZ | HSOF HSJ50 DOC KIT |
| QT–5C4**–** | HSOF HSJ50 Software Product Services |

## SOFTWARE LICENSING

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

## SOFTWARE PRODUCT SERVICES

A variety of service options is available from Digital. For more information, contact your local Digital office or distributor.

Software service for HSOF software is covered under the terms and conditions of the Integrated Hardware and Software Customer Service contracts.

Multivendor Customer Services for the HSJ50 controller and HSOF software are covered under the terms and conditions of the following:

- Hardware Customer Service contract
- Software Customer Service contract
- Media and Documentation Distribution Service (MDDS) contract

## SOFTWARE WARRANTY

A 90 day Telephone Support and one year conformance to SPD Software Warranty is provided with HSOF Software V5.0. HSOF Software V5.0 is ordered and shipped separately from the HSJ50.

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