digital™

Software Product Description

PRODUCT NAME: HSD50 Array Controller Operating Software (HSOF), Version 5.0 **SPD 60.69.00**

DESCRIPTION

The HSD50 Array Controller Operating Software (HSOF) is the software component of the HSD50 array controller. This array controller is an intelligent mass storage controller that interfaces among host computer systems and SCSI-attached mass storage devices using Digital Equipment Corporation's DSSI bus. HSOF software executes in the HSD50–A*x* 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 HSD50 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 HSD50 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 *HSD50 Array Controller Operating System Software Release Notes*, EK–HSD50–RN. A01, for further information.

Host Interconnect and Protocol Services

The HSD50 array controller attaches to host computer systems using the DSSI bus. It may be installed in VMScluster™ configurations. Each DSSI bus supports up to eight nodes. Digital supports up to four HSD50 array controllers per DSSI bus.

SCSI Device Control

HSOF software 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 DSSI interface, HSD50 array controller hardware and HSOF software cooperate to provide the following:

- Automatic retransmission of data detected as being in error
- Automatic detection of internal data path errors
- Automatic failover of attached devices between identically configured HSD50 controllers installed within 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 HSD50 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 number which are separately addressable. Up to 4 partitions may be created per disk.

Error Logging

HSOF software uses DSSI protocol 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.

Subsystem Management Services

HSOF software provides the following subsystem management service:

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 HSD50-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 *HSD50 Array Controller Operating Software Version 5.0 Release Notes*, EK–HSD50–RN. A01, for further detail.

Local Program Support

HSOF software supports the following local utilities and commands:

- CFMENU for configuring controller-attached storage devices
- CHVSN supports 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 HSD controllers to calculate 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 HSD50 Array Controllers HSOF Version 5.0*, part number EK–HSD50–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 requires an HSD50 array controller on which to execute.

The HSD50 array controller includes six SCSI device buses for connecting storage devices. The specific devices supported by HSOF software Version 5.0 are listed in Table 2, 3 and 4.

The HSD50–A*x* array controller supported configuration are as follows:

Table 1
HSD50 Configurations

HSD50–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: One HSOF Software kit ordered separately, (1) QB-5C5AA-SA)
HSD50–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-5C5AA-SA)
HSD50–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-5C5AA-SA)
HSD52–AF	One set (two HSD50-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-5C5AA-SA)
HSD52–AH	One set (two HSD50-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-5C5AA-SA)
HSD52–AJ	One set (two HSD50-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-5C5AA-SA)

Controller Configuration Restrictions

The following configuration restrictions apply:

- HSD30–A*x* and HSD30–C*x* controllers may *not* be used in a dual-redundant pair with HSD50-A*x*.
- The HSD50–A*x* Minimum HSOF software revision level is V5.0 software.
- A maximum of six devices may be attached to a single SCSI device bus on dual-redundant HSD50 array controller configurations.
- A maximum of seven devices may be attached to a single SCSI device bus on nonredundant HSD50 array controller configurations.
- Up to four HSD50 array controllers per DSSI host bus are currently supported.
- Separate buses are supported for dual-redundant configurations when using Open VMS Alpha™ Version 6.1 and higher operating system software.
- A maximum total of 20 mirrorsets and RAIDsets are supported by HSD50.
- A maximum combined total of 30 storagesets (mirrorsets, RAIDsets, and stripesets) are supported by HSD50.

Host Node Hardware and Software Required

A valid OpenVMS VAX™, OpenVMS Alpha™, or VMScluster™ configuration with a supported DSSI interface (see SOFTWARE REQUIREMENTS section) is required to run HSOF software.

HSOF software supports the following DSSI adapters:

- SHAC-based embedded/native (for various VAX and DEC systems)
- Embedded/native adapter for DEC 4000® systems
- KFPSA PCI to DSSI adapter
- KFMSA and KFMSB (for XMI-based systems)
- KFESA and KFESB (for EISA based AlphaServers)

HSD50 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

HSOF software supports the following optional hardware:

- HSSIM–AA 32MB SIMM Pack for HS*x*50 controllers, add additional 32MB SIMMs to upgrade HSD50 controllers to the supported HSD50-A*H* 64MB and HSD50–A*J* 128MB configurations. *Note* 96 MB Configurations are not supported
- HS35X-BA Single External Cache Battery (ECB) Replacement
- HS35X-BB Dual External Cache Battery (ECB) Replacement

The following tables represent the **only** devices that are supported. Digital Equipment Corporation neither supports nor recommends any device not listed for use with the HSD50 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 HSD50 array controller itself, or on a Digital system configuration.

Table 2
HSD50 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 3
HSD 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 rob ot/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, OP for magneto-optical disk devices, and OPJ for optical jukebox.

[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 4
HSD 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, OP for magneto-optical disk devices, and OPJ for optical jukebox.

[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.

DEVICE CONFIGURATION RESTRICTIONS

- Disks attached to an HSD50 array controller may not currently be used as initialization devices for VAX 7000® and VAX 10000® processors.
- Controller-attached devices may serve as initialization devices for DEC 7000® and DEC 10000® systems provided the DEC7000/10000 console code is at Version 3.1 or higher.

SOFTWARE REQUIREMENTS

Software Version 5.0 on HSD50-series controllers is supported by the following operating system versions, with the limitations described in the *Configuring Your StorageWorks Subsystem HSD50 Array Controllers HSOF Version 5.0*, EK–HSD50–CG. A01:

- 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 V5.0 Software Kits or Services may order them using the following part numbers:

Table 5
Distribution and Documentation Option

QB–5C5AA–SA	HSOF HSD50 LIC/MCD/DOC KIT
QA–5C5AA–GZ	HSOF HSD50 DOC KIT
QT–5C5**–**	HSOF HSD50 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 are available from Digital. For more information, contact your local Digital office.

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 HSD50 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 HSD50.

™ Alpha, AlphaServer, DEC, Digital, HSD30, MSCP, OpenVMS, RRD42, RZ, StorageWorks, VAX, VAX 7000, VAX 10000, VMS, VMScluster, VT200, VT300, VT400, and the DIGITAL logo are trademarks of Digital Equipment Corporation.

© Digital Equipment Corporation, 1996. All rights reserved.