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Software Product Description

PRODUCT NAME: HSJ Family Array Controller Operating Software (HSOF), Version 2.7 **SPD 47.26.09**

DESCRIPTION

The HSJ Family Array Controller Operating Firmware (HSOF) is the software component of the HSJ40 and HSJ30 array controllers. Using Digital Equipment Corporations's CI bus, these array controllers are intelligent mass storage servers that interface among host computer systems and SCSI-attached mass storage devices. HSOF 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 FUNCTIONS

HSOF performs the following functions:

- Testing and diagnosis of the HSJ array controller
- Host interconnect and protocol services
- SCSI device control
- Subsystem management services
- Local program support

The following sections describe these functions.

Testing and Diagnosis of the HSJ Array Controller

HSOF 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

Software Version 2.7 checks the condition of the optional write-back cache batteries every 24 hours. If a low capacity or failure is detected, write-back cache data is flushed from cache and depending on the predefined cache policy, selected RAIDsets and disk mirrorsets may become inoperative. In dual redundant configurations, the controller with good cache batteries can be set to service the RAIDsets and disk mirrorsets. Refer to the *HSJ Array Controller Operating System Software Release Notes*, EK–HSFAM–RN. N01, for further information.

Host Interconnect and Protocol Services

The HSJ40 and HSJ30 array controllers attach to host computer systems using the CI bus. Either 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 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 device control functions include the following:

Error Detection and Recovery

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

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For errors on the CI interface, HSJ array controller hardware and HSOF 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 HSJ controllers installed in the same controller shelf

Device Integrity Testing

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

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

Disk Striping

HSOF 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.

Error Logging

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

Optional Functionalities

RAID, disk mirroring and write-back cache are available as options. Refer to the *HS Family of Array Controllers Optional Operating Software for HSOF Version 2.7, Software Product Description*, SPD 54.38.01, for further option information.

Subsystem Management Services

HSOF provides the following subsystem management services:

Alteration of Subsystem Parameters

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

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.

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. Refer to the *HSJ40 Array Controller Operating Software Version 2.7 Release Notes*, EK–HSFAM–RN. N01, for further detail. **Local Program Support**

HSOF supports the following local programs:

- 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 optional 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: The C_SWAP implementation procedure for use with HSOF V2.0 and V2.5 was revised in January 1996. Use of the revised C_SWAP procedure is **MANDATORY** when utilizing C_SWAP on controllers running HSOF V2.0 and V2.5. HSOF V2.7 provides a higher level of subsystem availability when utilizing C_SWAP and upgrading systems to V2.7 is recommended. For a copy of the revised C_SWAP procedure contact your local MCS representative.

HARDWARE REQUIREMENTS

HSOF requires an HSJ40–A*x*/C*x* or HSJ30–A*x*/C*x* array controller on which to execute.

The HSJ40 array controller includes six SCSI device buses for connecting storage devices. The HSJ30 includes three such SCSI buses. The specific devices supported by HSOF Version 2.7 are listed in Tables 1 and 2.

The HSJ30/HSJ40 array controller supported configurations are as follows:

HSJ40–AD /CD	StorageWorks Array Controller for 36 (dual-redundant) or 42 (nonredundant) SCSI–2 Disk/Tape/Optical Devices; 16 MB Read Cache
HSJ40–AF /CF	StorageWorks Array Controller for 36 (dual-redundant) or 42 (nonredundant) SCSI–2 Disk/Tape/Optical Devices; 32 MB Read Cache
HSJ30–AA /CA	StorageWorks Array Controller for 18 (dual-redundant) or 21 (nonredundant) SCSI–2 Disk/Tape/Optical Devices; no Read Cache
HSJ30–AD /CD	StorageWorks Array Controller for 18 (dual-redundant) or 21 (nonredundant) SCSI–2 Disk/Tape/Optical Devices; 16 MB Read Cache
HSJ30–AF /CF	StorageWorks Array Controller for 18 (dual-redundant) or 21 (nonredundant) SCSI–2 Disk/Tape/Optical Devices; 32 MB Read Cache

The following configuration restrictions apply:

- HSJ30/40–A*x* and HSJ30/40–C*x* controllers may be used in a dual-redundant pair with HSOF V2.7 and higher. The HSJ30/40–C*x* is not supported on HSOF V2.5 and lower.
- A maximum of six devices may be attached to a single SCSI device bus on dual-redundant HSJ40 or HSJ30 array controller configurations.
- A maximum of seven devices may be attached to a single SCSI device bus on nonredundant HSJ40 or HSJ30 array controller configurations.
- HSJ40–YC option requires Version 2 Read Cache modules. Refer to the *HS Family of Array Controllers User's Guide*, EK–HSFAM–UG, D01, for information in determining the version type of the Read Cache module.
- A maximum total of 20 disk mirrorsets and RAIDsets are supported by HSOF Version 2.5 or higher.
- A maximum combined total of 30 storagesets (mirrorsets, RAIDsets, and stripesets) are supported by HSOF Version 2.5 or higher.

The RAID and mirroring options require a write-back cache option.

The write-back cache option requires that the HSJ40–Y*x* cache option be installed.

Note: Hardware configuration guidelines for the HSJ40 and HSJ30 array controllers are provided in the *HS Family of Array Controllers User's Guide*, EK–HSFAM–UG. D01.

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.

OPTIONAL HARDWARE

HSOF 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)
- CI780 (for SBI-based systems)
- CIPCA (for PCI-based systems)

HSOF supports the following optional hardware:

- HSJ40–XE upgrades the HSJ40–AD/CD to 32 MB Read Cache; Mandatory return of previously installed cache
- HSJ40–YA upgrades an HSJ40–AD/CD with a Version 1 16 MB Read Cache option to a 16 MB Write-Back Cache option (includes a Version 2 16 MB Read Cache option and an HSJ40–YC Write-Back Cache kit)
- HSJ40–YB upgrades an HSJ40–AD/CD with a Version 1 32 MB Read Cache option to a 32 MB Write-Back Cache option (includes a Version 2 32 MB Read Cache option and an HSJ40–YC Write-Back Cache kit)
- HSJ40–YC HSJ40 Write-Back Cache Kit, includes two batteries, a battery bracket, and a Write-Back Cache option license for HSJ40 controllers with Version 2 Read Cache modules
- HSJ30–XD upgrades the HSJ30–AA/CA option to include a 16 MB Read Cache option
- HSJ30–XE upgrades the HSJ30–AD/CD option's 16 MB Read Cache to a 32 MB Read Cache option
- HSJ30–XF upgrades the HSJ30–AA/CA option to include a 32 MB Read Cache option

- HSJ30–YC HSJ30 Write-Back Cache kit, includes two batteries, a battery bracket, and a Write-Back Cache option license

HSOF software supports the following optional software (HSJ40-YA/YB/YC or HSJ30–YC is a prerequsite to these options):

- QL–4DSA9–AA HSJ Disk Mirroring Software License

- QL–3HZA9–AA HSJ RAID Software License

HSJ40–A*x*/C*x* controllers, mounted in a BA350–MA controller basic shelf, support the following packaging components:

- 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

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 HSJ array controller and HSOF, regardless of the supplier or stated conformance to ANSI SCSI specifications. 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 HSJ array controller itself, or on a Digital system configuration.

Table 1
HSJ 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
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
RZ28M–VA/VW[3]	DD	2.1	466	A01
RZ29B–VA/VW[3]	DD	4.3	0007	B01
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–VW[4]	SSD	0.475	V064	A01
EZ69–VW[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, Tape Library, CD-Rom and Optical Support

Device	Type[1]	Capacity GB	Minimum Microcode Version	Min H/W Rev[2]
TKZ60–EC[3]	TDL	0.44	111	B01
TL810[34]	TLB	1000[5]	1.10	A01
TL820 Rev A01[34]	TLB	5200[5]	1d3M	L1
TLZ06–VA	TD	4[5]	0491	A04
TLZ6L–VA[6]	TDL	16[5]	0491	A01
TLZ7L–VA[6]	TDL	8[5]	4BQE	A02
TLZ07–VA	TD	8[5]	04AQ	AX01
TSZ07–AA[3]	TD	0.14	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	20/40	CC33	A01
TZ885–NT[3]	TDL	100/200	CC33	A01
TZ885–TA[3]	TDL	100/200	CC33	A01
TZ887–AE[3]	TDL	140/280	CC33	A01
RRD42–VB/VU	CD	0.6	1.1a	A01
RRD43–VA	CD	0.6	0064	A02
RRD44–VA	CD	0.6	3493	A02
RRD45–VA/VU	CD	0.6	1645	A01
RWZ52–VA[8]	OP	0.6 per side	3403	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.

[4] Requires DWZZA–AA 8-bit single-ended to 16-bit 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.

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

SOFTWARE REQUIREMENTS

HSOF software Version 2.7 on HSJ-series controllers is supported by the following operating system versions, with the limitations described in the *HS Family of Array Controllers User's Guide*, EK–HSFAM–UG. D01 and current release notes.

- OpenVMS Alpha Version 1.5 or higher
- OpenVMS VAX Version 5.5–2 or higher
- VAX VMS™ Version 5.5–1 or higher

CONFIGURATION RESTRICTIONS

Disks attached to an HSJ 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.

Disks attached to an HSJ array controller may be used as manual *and* automatic initialization devices for VAX 7000® or VAX 10000® processors provided the following conditions are met:

- VAX 7000 and VAX 10000 console code must be at Version 3.2 and include the "Single Path" patch. Later versions of the console code include the patch.
- HSOF must be at Version 1.1J or higher for HSJ40 array controllers and Version 1.4 or higher for HSJ30 array controllers.

DISTRIBUTION MEDIA

HSOF is shipped on PCMCIA program card media only.

ORDERING INFORMATION

HSOF software is shipped preinstalled with every hardware configuration that includes an HSJ40 or HSJ30 array controller.

For self-maintenance customers or others who require separate ordering of software, HSOF for the HSJ array controllers may be ordered separately as follows:

Table 3
Distribution and Documentation Option

QL–0W9A9–AA	SWKS HSJ MSC TRAD LIC
QL–0W9A9–RA	SWKS HSJ MSC TRAD UPD LIC
QA–0W9AB–HS	SWKS HSJ MSC PCRM KIT
QA–0W9AA–GZ	SWKS HSJ MSC DOC KIT
QT–0W9A*–**	HSOF Software Product Services

OPTIONAL SOFTWARE

Refer to the *HS Family of Array Controllers Optional Operating Software (HSOF), Version 2.7*, SPD 54.38.01, for further information regarding the following optional software products.

RAID (RAIDsets)

HSOF treats sets of disk drives as RAIDsets (3 to 14 members) when the separately licensed RAID option is installed. Each RAIDset is presented to the hosts as a single large virtual disk.

Disk Mirroring

HSOF treats sets of disk drives as mirrorsets (2 to 6 members) when the separately licensed Mirroring option is installed. Each mirrorset is presented to the hosts as a single large virtual disk.

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.

Write-Back Cache

When the separately licensed write-back cache option is installed, HSOF can provide improved I/O performance by supporting write-back cache for user selected disks, stripesets, RAIDsets, and mirrorsets.

SOFTWARE LICENSING

An HSOF license is shipped with every hardware configuration that includes an HSJ40 or HSJ30 array controller.

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

The RAID, write-back cache, and disk mirroring options require separate licenses and require that a license key be installed for correct operation. Refer to the *HS Family of Array Controllers Optional Operating Software (HSOF) Version 2.7*, SPD 54.38.01 for further option licensing information.

SOFTWARE PRODUCT SERVICES

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

Multivendor Customer Services for the HSJ controller and HSOF 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

Warranty for this software product is provided by Digital as defined in the Software Warranty Addendum of this SPD.

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