Educational Services

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RF Series
Integrated Storage Element
User Guide

EK–RF72D–UG–007

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About This Guide

Introduction

This user guide is intended for users of the RF Series Integrated Storage Elements (ISEs).

This user guide includes information on the RF31/31F, RF35 /31T, RF72, and RF73 ISEs.

Chapter 1, General Information, describes the RF series ISEs, DSSI bus function, and performance features, and lists specifications.

Chapter 2, Theory of Operation, covers ISE physical descriptions, head-disk assemblies (HDAs), functional descriptions, firmware, and diagnostics and utilities.

Chapter 3, Controls and Indicators, describes the operator control panel (OCP) on the system enclosure and the ISE drive module.

Chapter 4, Local Programs, describes the local programs and how they can be accessed through VMS, from the console, and through MDM.

Chapter 5, Troubleshooting Procedures, describes what to do if an ISE operates incorrectly, failure indications, and internal self-tests.

Chapter 6, Digital Services, describes a range of flexible services offered by Digital Services.

Chapter 1
General Information

Overview

In this Chapter

This chapter covers the following topics:

- Definition of RF31/31F, RF35/31T, RF72, and RF73 Integrated Storage Elements (ISEs)
- DSSI bus function
- Performance features
- Specifications

Introduction

The RF31/31F, RF35/31T, RF72 and RF73 ISEs are disk storage devices based on the Digital storage architecture (DSA) and use the Digital Storage System Interconnect (DSSI) bus and interface. The RF31/31F is a half-height, 5-¼ inch disk storage device. The RF35/31T is a 3-½ inch disk storage device. The RF72 and RF73 are full-height, 5-¼ inch disk storage device.

The RF31F, a high-speed, lower-capacity version of the RF31 ISE is available. Unless otherwise specified, references to the RF31 ISE in this manual apply equally to the RF31F ISE.

The RF31T is a high-speed, lower-capacity version of the RF35. Unless otherwise specified, references to the RF35 ISE in this manual apply equally to the RF31T ISE.

DSSI Bus

The DSSI bus is a logical equivalent to the CI bus used on larger Digital systems. The DSSI bus allows one or more hosts to communicate directly with storage devices, using the systems communications architecture (SCA) protocols. As many as eight nodes (ISEs and adapters) can be connected to one DSSI bus.

The DSSI bus is a 50-conductor cable. Inside an enclosure, the bus may be a flat, ribbon cable or a round bundle of twisted pairs. Between enclosures, the bus is a shielded, round cable approximately one-half inch in diameter.

ISE

An ISE is a DSSI device that contains an embedded, intelligent controller and an on-board Mass Storage Control Protocol (MSCP) server. Each ISE executes commands and transfers data independently of other ISEs attached to the DSSI bus. Commands and data are transferred over the DSSI bus in small packets, so multiple ISE transfers are efficiently multiplexed.

**RF31/31F
Description**

The RF31 ISE (Figure 1–1) is a half-height, 5-¼inch fixed disk storage device. Its dimensions are 20.9 cm (8.21 in) by 14.7 cm (5.79 in) by 4.1 cm (1.62 in).

Figure 1–1   The RF31 ISE
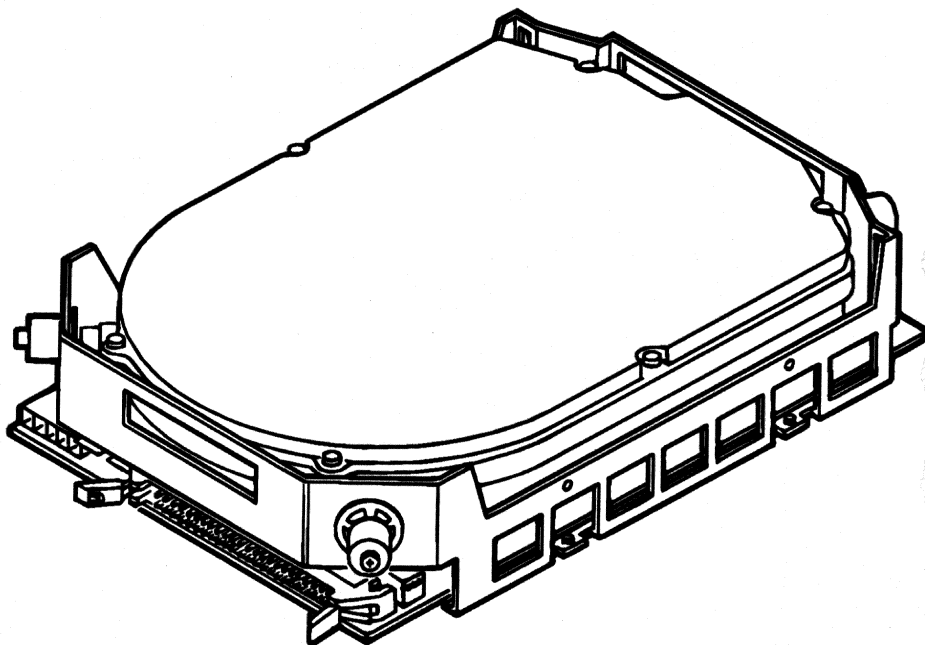
SHR_0073_88SCN
SHR_X1075_89_SCN

Overview, Continued

**RF35/RF31T
Description**

The RF35/RF31T ISE (Figure 1–2) is a 3-½inch fixed disk storage device. Its dimensions are 14.605 cm (5.75 in) by 10.16 cm (4.0 in) by 4.1 cm (1.62 in).

Figure 1–2   RF35/RF31T ISE
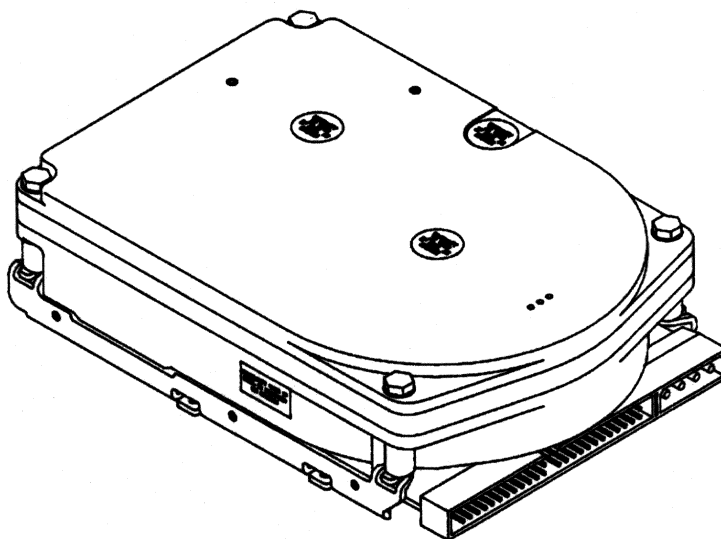
**RF72
and RF73
Description**

The RF72 and RF73 ISEs, shown in one figure, (Figure 1–3),
are full-height, 5-¼inch fixed disk storage devices. The ISEs
dimensions are 20.9 cm (8.21 in) by 14.7 cm (5.79 in) by 8.3 cm
(3.25 in).

Figure 1–3   The RF72 and RF73 ISE
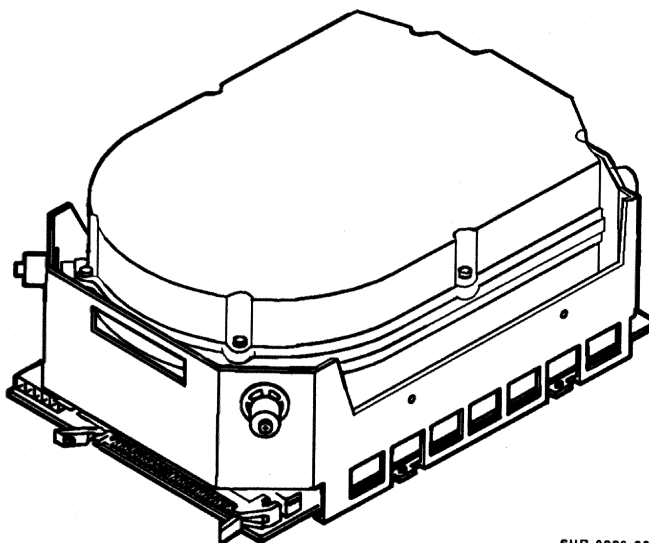
SHR-0226-88
SHR_X1074_89_SCN

Performance Features

The RF31, RF31T, RF35, RF72, and RF73 ISEs offer powerful performance features not typically available on disk storage devices in this form factor. The following table lists some of these features, many of which are described in more detail in Chapter 2.

Feature	Function
Multihost support	This allows a single ISE to be used by two hosts at the same time. For example, two MicroVAX 3800 systems can be booted from a single ISE.
Seek ordering	When more than one I/O command is outstanding, the ISE performs the commands in an order that minimizes seek time. The commands considered for seek ordering include the commands from all hosts.
Request fragmentation	This technique breaks single I/O requests into smaller pieces that may be optimized independently. The result is lower rotational latency and, consequently, faster access time for large requests.

Overview, Continued

Performance Features (continued)

Feature	Function
Quadruplicated headers	The headers preceding each data block are replicated four times to make sure data is not lost because of header errors.
264-bit ECC	DSSI ISEs store a large, 264-bit error correction code (ECC) in each block, capable of correcting up to 120 erroneous bits.
Controller-initiated BBR	With controller-initiated bad block replacement (BBR), the ISE presents the host with a set of logically contiguous blocks, and disk capacity never shrinks because bad blocks are detected and automatically moved to spare blocks.
RCT Cache	DSSI ISEs cache the replacement control table (RCT), allowing replaced blocks to be located without the time required for seeks to and from the RCT stored on the media.
Read-ahead Cache	The ISEs incorporate a multi-track read cache to reduce latency.

RF31/31F ISE Specifications

Introduction

This section lists performance, power, media, and environmental specifications for the RF31 and RF31F ISEs.

Performance Specifications

The following table summarizes the performance specifications of the RF31 and RF31F ISEs.

Specification	Value	
	RF31	**RF31F**
Formatted storage capacity	381 Mbytes	200 Mbytes
Average seek time	15.3 ms	12.2 ms
Average access time	23.6 ms	20.5 ms
Peak transfer rate to DSSI bus	4.0 Mbytes/second	
Total start time	<60 seconds	
Time to attain full r/min	<15 seconds	
Internal diagnostics	<33 seconds	
Spin-down	<15 seconds	

RF31/31F ISE Specifications, Continued

**Current
and Power
Consumption**

The following table summarizes the maximum current and
typical power consumption specifications for the RF31 and
RF31F ISEs.

Specification	Value
5 V supply current	1.2 A max.
12 V supply current	3.0 A (peak, first 3 seconds (nominal) of spin-up)
	0.7 A max. (idle) 1.3 A max. (continuous random seeks)
Total power	12.6 W typical (idle) 18.7 W typical (continuous random seeks)

**Media
Specifications**

The following table summarizes the specifications for the RF31 and RF31F storage media.

Specification	RF31	RF31F
Data tracks per surface	1,861	984
Sectors per track	50 data sectors 1 replacement sector	50 data sectors 1 replacement sector
Data surfaces per drive	8	8
Tracks per inch	1,875	1,875
Bits per inch	30,064	30,064
Areal density	57.35 Mbits/in^2	57.35 Mbits/in^2
Disk type	Thin film	Thin film
Servo	Fully embedded	Fully embedded
Positioner	Rotary	Rotary
R/W code	RLL 1,7	RLL 1,7

RF31/31F ISE Specifications, Continued

Environmental Specifications

The following table summarizes the environmental specifications for the RF31 and RF31F ISEs.

Specification	Value
Temperature operating	10 to 50°C (50 to 122°F), ambient, with a gradient of 11°C (20°F) per hour (as introduced to the drive enclosure)
Non-operating	-40 to 66°C (-40 to 151°F), ambient, with a gradient of 20°C (36°F) per hour
Relative humidity operating	10 to 90% with maximum wet bulb temperature of 28°C (82°F) and a minimum dew point of 2°C (36°F), with no condensation
Non-operating (storage/shipping)	8 to 95%, with no condensation
Altitude operating	2,438 meters (8,000 feet)
Non-operating	4,876 meters (16,000 feet)
Noise (closed office environment)	<5.1 Bels, idle <5.6 Bels, seeking
Air flow	10 ft³/min (minimum)
Agency compliance	UL, CSA, IEC 380, IEC 435, VDE 804

RF35/RF31T ISE Specifications

Introduction

This section lists performance, power, media, and environmental specifications for the RF35/RF31T ISE.

Performance Specifications

The following table summarizes the performance specifications of the RF35/RF31T ISE.

Specification	RF35	RF31T
Formatted storage capacity	852 Mbytes	381 Mbytes
Average seek time	9.5 ms	7.5 ms
Average access time	15.1 ms	13.1 ms
Peak transfer rate to DSSI bus	4.0 Mbytes/s	4.0 Mbytes/s
Total start time	<30 s	<30 s
Time to attain full r/min	<15 s	<15 s
Internal diagnostics	<15 s	<15 s
Spin-down	<15 s	<15 s

**Current
and Power
Consumption**

The following table summarizes the maximum current and typical power consumption specifications for the RF35/RF31T ISE.

Specification	Value
5 V supply current	0.85 A max.
12 V supply current	2.29 A (peak, first 3 seconds (nominal) of spin-up)
	0.74 A max. (idle)
	1.56 A max. peak (continuous random seeks)
	0.96 A max. avg. (continuous random seeks)
Total power	11.3 W typical (idle)
	13.8 W typical (continuous random seeks)

Media Specifications

The following table summarizes the specifications for the RF35 /RF31T storage media.

Specification	RF35	RF31T
Data tracks per surface	2,086	933
Sectors per track	57 data sectors 1 replacement sector	57 data sectors 1 replacement sector
Data surfaces per drive	14	14
Tracks per inch	2,650	2,650
Bits per inch	48,300	48,300
Areal density	128 Mbits/in^2	128 Mbits/in^2
Disk type	Thin film	Thin film
Servo	Fully embedded	Fully embedded
Positioner	Rotary	Rotary
R/W code	RLL 1,7	RLL 1,7

RF35/RF31T ISE Specifications, Continued

Environmental Specifications

The following table summarizes the environmental specifications for the RF35/RF31T ISE.

Specification	Value
Temperature operating	10 to 50°C (50 to 122°F), ambient, with a gradient of 11°C (20°F) per hour (as introduced to the drive enclosure)
Non-operating	-40 to 66°C (-40 to 151°F), ambient, with a gradient of 20°C (36°F) per hour
Relative humidity operating	10 to 90% with maximum wet bulb temperature of 28°C (82°F) and a minimum dew point of 2°C (36°F), with no condensation
Non-operating (storage/shipping)	8 to 95%, with no condensation
Altitude operating	2,438 meters (8,000 feet)
Non-operating	4,876 meters (16,000 feet)
Noise (closed office environment)	<5.4 Bels, idle <5.0 Bels, seeking

**Environmental
Specifications
(continued)**

Specification	Value
Air flow (Figure 1–4)	Airflow to the drive should be sufficient to component case temperatures below the following maximums:
HDA	60°C
E2 CPU	85°C
E5 ADASP	80°C
E13 QTPD	90°C
E14 Apache	80°C
Agency compliance	UL, CSA, IEC 950, TUV

Environmental Specifications (continued)

Figure 1–4 shows the side and bottom views of the RF35 ISE.

Figure 1–4   RF35/RF31T ISE Side and Bottom Views
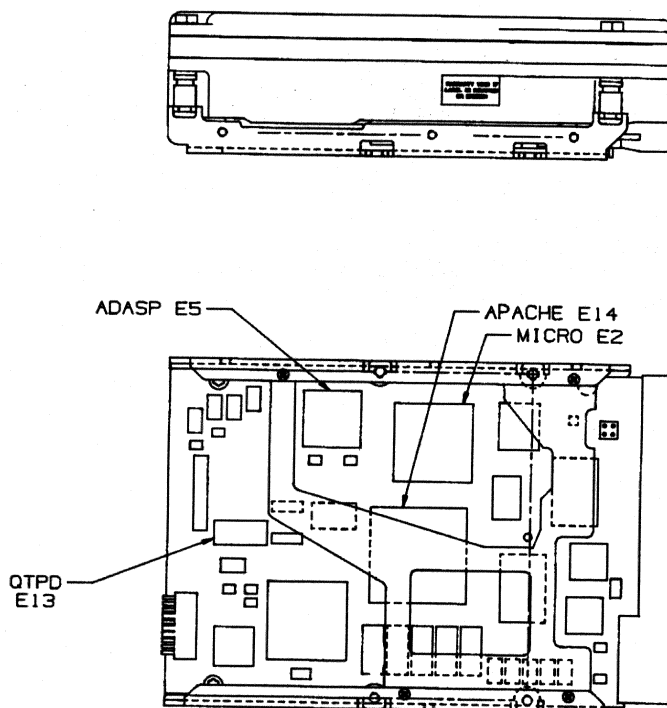
RF72 ISE Specifications

Introduction

This section lists performance, power, media, and environmental specifications for the RF72 ISE.

Performance Specifications

The following table summarizes the performance specifications of the RF72 ISE.

Specification	Value
Data storage capacity	1 Gbyte, formatted
Average seek time	13.3 ms
Average access time	21.6 ms
Peak transfer rate to DSSI bus	4.0 Mbytes/second

Start time
    Time to attain full r/min
    Internal diagnostics
	<60 seconds, total
	    <15 seconds
	    <33 seconds

Spin-down	<15 seconds

RF72 ISE Specifications, Continued

Current and Power Consumption

The following table summarizes the maximum current and typical power consumption specifications for the RF72 ISE.

Specification	Value
5 V supply current	1.5 A
12 V supply current	5.4 A (peak, first 3 seconds (nominal) of spin-up)
	1.1 A (idle)
	2.3 A (continuous random seeks)
Total power	20.7 W (idle)
	34.5 W (continuous random seeks)

RF72 ISE Specifications, Continued

Media Specifications

The following table summarizes the storage media specifications for the RF72 ISE.

Specification	Value
Data tracks per surface	1,861
Sectors per track	50 data sectors 1 replacement sector
Data surfaces per drive	21
Tracks per inch	1,875
Bits per inch	30,064
Areal density	57.35 Mbits/in^2
Disk type	Thin film
Servo	Fully embedded
Positioner	Rotary
R/W code	RLL 1,7

RF72 ISE Specifications, Continued

Environmental Specifications

The following table summarizes the environmental specifications for the RF72 ISE.

Specification	Value
Temperature	
Operating	10 to 50°C (50 to 122°F), ambient, with a gradient of 11°C (20°F) per hour (as introduced to the drive enclosure)
Non-operating	-40 to 66°C (-40 to 151°F), ambient, with a gradient of 20°C (36°F) per hour
Relative humidity	
Operating	10 to 90% with maximum wet bulb temperature of 28°C (82°F) and a minimum dew point of 2°C (36°F), with no condensation
Non-operating (storage/shipping)	8 to 95%, with no condensation

RF72 ISE Specifications, Continued

Environmental Specifications (continued)

| Specification	Value
Altitude	
Operating	2,438 meters (8,000 feet)
Non-operating	4,876 meters (16,000 feet)
Noise (closed office environment)	<5.1 Bels, idle <5.8 Bels, seeking
Air flow	15 ft³/min (minimum)

RF73 ISE Specifications

Introduction

This section lists performance, power, media, and environmental specifications for the RF73 ISE.

Performance Specifications

The following table summarizes the performance specifications of the RF73 ISE.

Specification	Value
Data storage capacity	2 Gbytes, formatted
Average seek time	12.9 ms
Average access time	21.2 ms
Peak transfer rate to DSSI bus	4.0 Mbytes/second

Start time
   Time to attain full r/min
   Internal diagnostics
	<60 seconds, total
	<15 seconds
	<33 seconds

Spin-down	<15 seconds

RF73 ISE Specifications, Continued

**Current
and Power
Consumption**

The following table summarizes the maximum current and
typical power consumption specifications for the RF73 ISE.

Specification	Value
5 V supply current	1.20 A
12 V supply current	5.00 A (peak, first 3 seconds (nominal) of spin-up)
	1.20 A (idle)
	4.00 A max peak (continuous random seeks)
	1.75 A max avg. (continuous random seeks)
Total power	17.0 W (idle)
	22.9 W (continuous random seeks)

RF73 ISE Specifications, Continued

Media Specifications

The following table summarizes the storage media specifications for the RF73 ISE.

Specification	Value
Data tracks per surface	2,620
Sectors per track	71 data sectors 1 replacement sector
Data surfaces per drive	21
Tracks per inch	2,432
Bits per inch	43,880
Areal density	106.72 Mbits/in^2
Disk type	Thin film
Servo	Fully embedded
Positioner	Rotary
R/W code	RLL 1,7

RF73 ISE Specifications, Continued

Environmental Specifications

The following table summarizes the environmental specifications for the RF73 ISE.

Specification	Value
Temperature	
Operating	10 to 50°C (50 to 122°F), ambient, with a gradient of 11°C (20°F) per hour (as introduced to the drive enclosure)
Non-operating	-40 to 66°C (-40 to 151°F), ambient, with a gradient of 20°C (36°F) per hour
Relative humidity	
Operating	10 to 90% with maximum wet bulb temperature of 28°C (82°F) and a minimum dew point of 2°C (36°F), with no condensation
Non-operating (storage/shipping)	8 to 95%, with no condensation

RF73 ISE Specifications, Continued

Environmental Specifications (continued)

Specification	Value
Altitude	
Operating	2,438 meters (8,000 feet)
Non-operating	4,876 meters (16,000 feet)
Noise (closed office environment)	<4.6 to 4.9 Bels, idle <5.7 Bels, seeking
Air flow	10 ft^3/min (minimum)

Chapter 2
Theory of Operation

Physical Description

In this Chapter

This chapter covers the following topics on RF31/31F, RF35/31T, RF72, and RF73 ISEs:

- Physical descriptions
- Head-disk assemblies (HDAs)
- Functional descriptions
- Firmware
- Diagnostics and Utilities

Overview

The ISE consists of two basic components:

- An HDA that contains the disks and drive mechanisms
- A printed circuit board called the drive module which contains the disk controller and drive electronics

Physical Description, Continued

Overview (continued)

The RF31 and RF31F ISEs use similar drive modules. The RF35 ISE uses a unique drive module. The RF72 and RF73 ISEs use similar drive modules. The HDA is different for each ISE:

- RF31/31F ISEs each have 4 disks
- RF35/RF31T ISE has 7 disks
- RF72 and RF73 ISEs each have 11 disks

Physical Description, Continued

FRUs

Figure 2–1 shows the RF31/31F, RF72, and RF73 ISEs with the field replaceable units (FRUs). The mechanics set consists of the HDA, drive chasis, and shock mount assembly. Note that the RF35 ISE is a single FRU.

Figure 2–1   RF31/31F and RF72/73 ISE Basic Components

MECHANICS SET

MECHANICS SET

DRIVE MODULE

DRIVE MODULE

MA-X0967-88
SHR_X1072_89_SCN
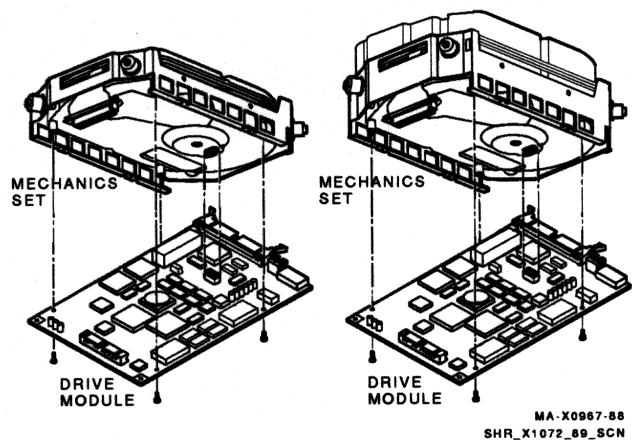
HDA

The HDA contains the:

- Disks
- Heads
- Spindle motor
- Rotary positioner

The RF31/31F HDA has four disks and eight heads. The RF35 /RF31T HDA has seven disks and fourteen heads. The RF72 and RF73 HDAs each have 11 disks and 22 heads. Each ISE uses an embedded digital servo for track following, so there is no dedicated servo surface. All surfaces are used for user data storage.

Physical Description, Continued

RF3x/RF7x Comparison

Table 2–2 compares the amount of data storage among the RF Series ISEs.

Table 2–2

ISE	Usable data surfaces (tracks)	Data tracks /surface (cylinders /spindle)	Sectors per track
RF31	8	1,861	51 (50 data, 1 replacement)
RF31F	8	984	51 (50 data, 1 replacement)
RF35	14	2,086	58 (57 data, 1 replacement)
RF31T	14	933	58 (57 data, 1 replacement)

Continued on next page

**RF3x/RF7x
Comparison
(continued)**

Table 2–2			
RF72[1]	21	1,861	51 (50 data, 1 replacement)
RF73[1]	21	2,620	72 (71 data, 1 replacement)

[1]The RF72 and RF73 ISEs use only 21 of 22 available disk surfaces. The surface with the most media defects is marked unusable at manufacture. Although the unused surface varies from RF72/RF73 to RF72/RF73, this fact is transparent to the user, the operating system, and most utilities.

Drive Module

The drive module combines the functions of disk controller and drive electronics onto a single, surface-mount-technology printed circuit board.

Each drive module has a ready and a fault LED. The RF31/31F drive module uses a green ready LED and a red fault LED. The RF35/RF31T, RF72, and RF73 ISEs use green ready and amber fault surface mounted LEDs on the drive module.

Physical Description, Continued

Interfaces

Figure 2–2 shows the interfaces on the RF31 drive module and Figure 2–3 shows the interfaces on the RF35 drive module.

Figure 2–2   RF31 Drive Module Interfaces

SHR_X1050B_89

2–8
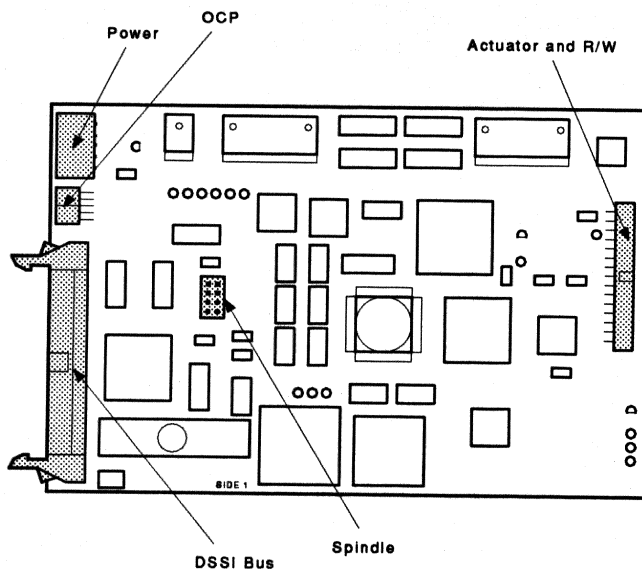
Physical Description, Continued

Interfaces
Figure 2–3   RF35/RF31T Drive Module Interfaces

Bottom View of Drive Module

FLT
(Fault LED)

ROM

RAM

OCP
Connector

DSSI

Disk Controller

RDY
(Ready LED)

Spindle

Buffer

Servo

Power Connector

OCP
Connector

DSSI Connector

R/W

To HDA

To Spindle

Microprocessor
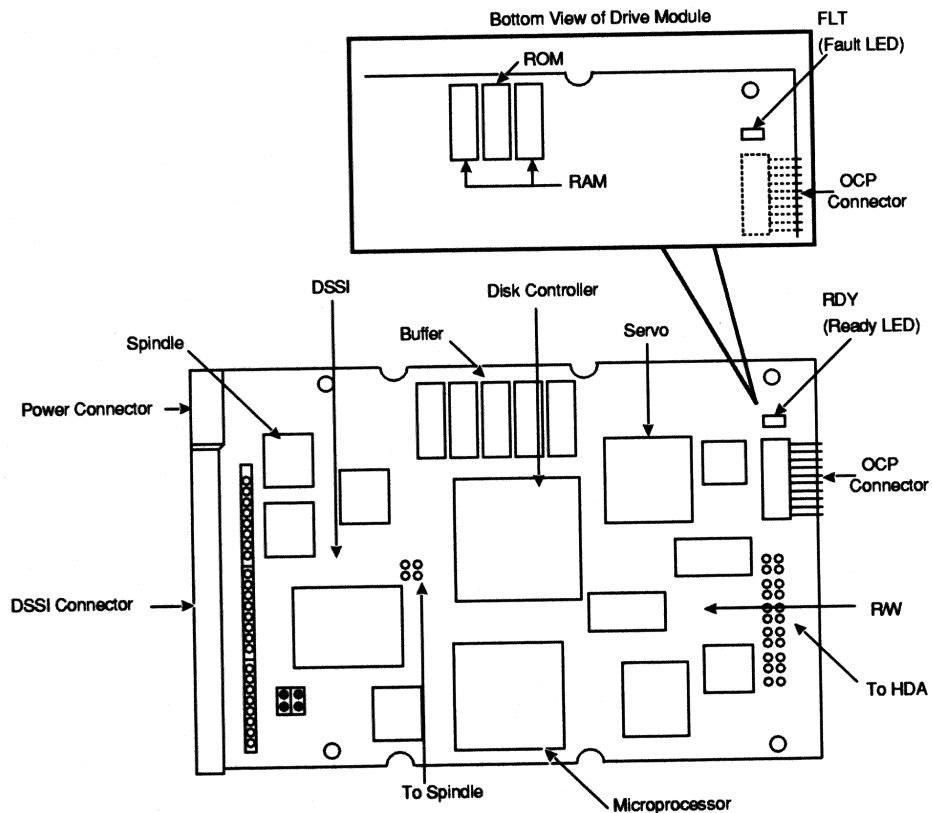
Physical Description, Continued

Interface Functions

As shown in previous figures, each interface is a connector. Table 2–3 describes the function of each RF31 drive module interface.

Table 2–3 RF31 Interfaces

Interface	Description	Function
DSSI bus	50-pin flat cable connector	Connects ISE to DSSI bus
Power	5-pin Molex connector	Connects +5V, +12V, and ACLO to ISE
OCP	10-pin flat cable connector	Connects ISE to operator control panel
Actuator and R/W	34-pin flat cable connector that mates to the flexible circuit strip from the HDA	Connects ISE to read/write preamps and to rotary positioner
Spindle	10-pin DIP connector that mates to the HDA	Connects spindle motor to drive module

Physical Description, Continued

Interface Functions (continued)

Table 2–4 describes the function of each RF35 drive module interface.

Table 2–4   RF35/RF31T Interfaces

Interface	Description	Function
DSSI bus	50-pin flat cable connector	Connects ISE to DSSI bus
Power	5-pin Molex connector	Connects +5V, +12V, and ACLO to ISE
OCP	22-pin bulkhead connector	Connects ISE to operator control panel
Actuator and R/W	22-pin connector	Connects ISE to rotary positioner
Spindle	4-pin DIP connector that mates to the HDA	Connects spindle motor to drive module

Functional Description

Drive Module Electronics

To understand the drive module, think of it as being divided into six major functional areas (Figure 2–4 and Figure 2–5). Large-scale integration is used extensively, so the function of an area typically includes the function of one or a few of the chips in the corresponding area (Figure 2–4 and Figure 2–5).

Figure 2–4   RF31 Drive Module Electronics

SHR_X1050A_89

**Drive Module
Electronics
(continued)**

Figure 2–5   RF35/RF31T Drive Module Electronics
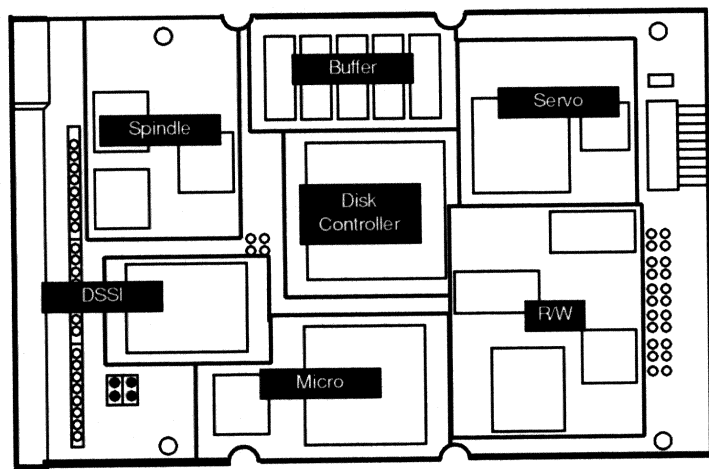
Functional Description, Continued

Divided Area Functions

The following table describes the function of each divided area in Figure 2–4 and Figure 2–5.

Area	Function
Micro	The on-board intelligence resides here, in a firmware driving a MC680x0[1] microprocessor with static scratchpad RAM and of nonvolatile RAM.
DSSI	A single chip (Swift) interfaces the Micro area to the DSSI bus. It provides a queued-packet interface to the Micro area, segregates data from commands, and generates and checks error detection codes.
Buffer	A single chip acts as a 3-port RAM controller, serving the static RAM as a data buffer and read cache for the Micro, R/W, and DSSI areas. Most of the digital R/W tasks, such as ECC generation and checking, are also done by this chip.
Spindle	This circuitry manages the spin-up and speed regulator.
Actuator	This circuitry activates active and passive controls the rotary positioner used to maintain the position of the heads over a track.
R/W	This circuitry handles the remaining digital and analog read /write chain.

Functional Description, Continued

Drive Module Block Diagram

Figure 2–4 and Figure 2–5 show how the drive module is laid out. Figure 2–6 is a block diagram of the same module including interfaces, areas, and functions.

Figure 2–6 Drive Module Block Diagram
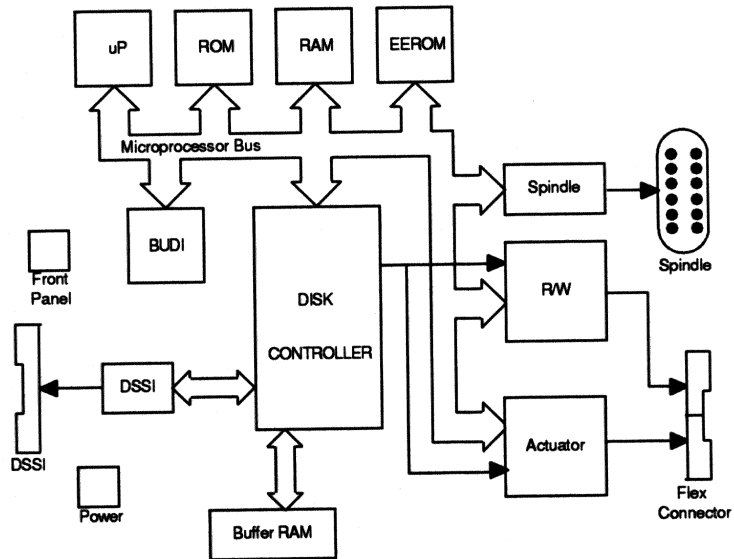
Functional Description, Continued

Data Flow

The microprocessor bus connects almost every functional area (Figure 2–6). However, the microprocessor is not directly involved with the data flow.

The Buffer Ram collects and temporarily stores data. The disk controller chip performs I/O operations using the R/W hardware.

Functional Description, Continued

**Data Flow
(continued)**

Figure 2–7 shows the data flow.

Figure 2–7   Data Flow Through the Drive Module
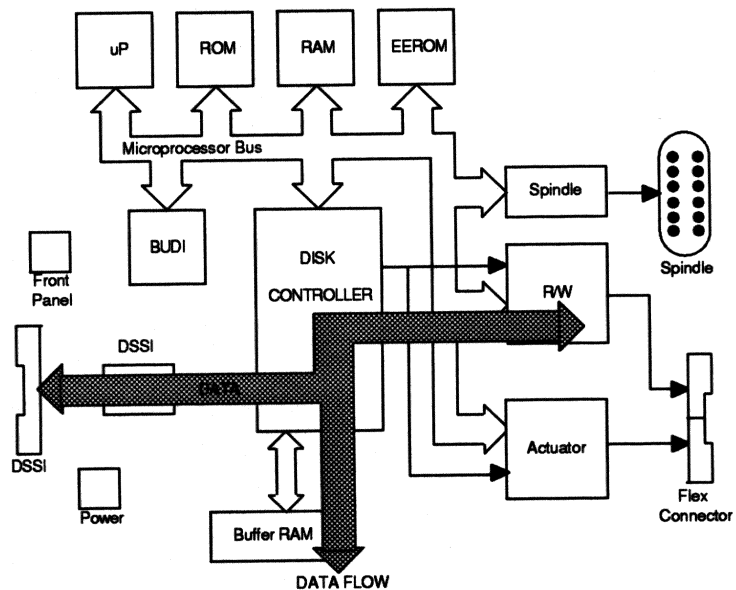
Functional Description, Continued

**Data
Protection**

The following table describes how data is protected while traveling through the drive module.

Stage	Description
1	The Swift chip in the DSSI area generates and checks DSSI parity and error detection code (EDC).
2	Another EDC is generated and appended to each 512-byte block of data to protect the data in buffer RAM.
3	This EDC travels with the data through the disk controller chip, where the 264-bit ECC is generated before the data is written to the media.
4	The block number where the data was written is "added" to the Swift-generated EDC, further protecting against media-addressing errors.
5	The ECC is checked as data is being read from the media while the block number, where the data should be located, is "subtracted" from the EDC.
6	The EDC is then checked after the DSSI parity and EDC are generated by the DSSI area, as the data is transmitted onto the DSSI bus.

Command Flow

Commands are segregated into packets by the DSSI area and stored in the buffer RAM. The microprocessor then copies these commands (typically 36 bytes or less) into its local RAM before it acts on them.

As commands are completed, the process is reversed.

Functional Description, Continued

**Command
Flow
(continued)**

Figure 2–8 shows how commands are routed through the drive module.

Figure 2–8   Command Flow Through the Drive Module
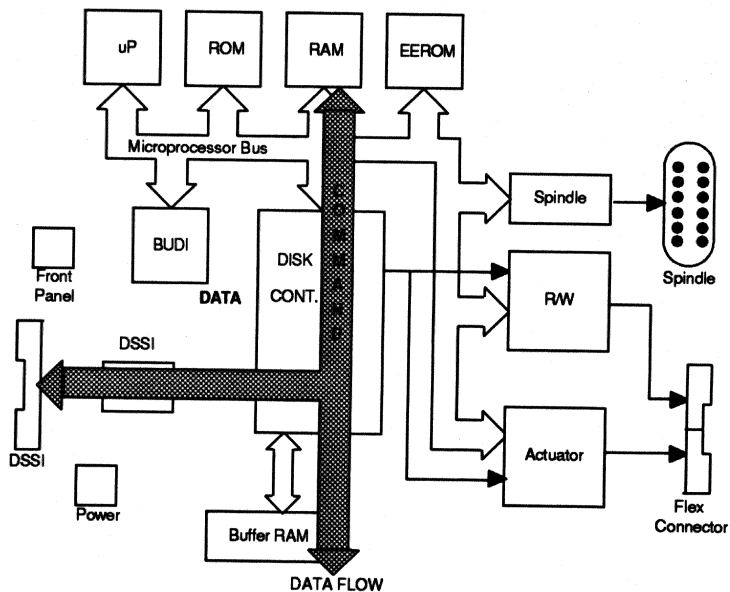
Functional Description, Continued

**Command
Protection**

The following table describes how commands are protected
while traveling through the drive module.

Stage	Description
1	On the DSSI bus, parity and EDC are appended to the commands.
2	The Swift chip in the DSSI area checks and generates DSSI parity and EDC.
3	The Swift chip generates an EDC to protect the commands during their short stay in the buffer RAM.
4	The microprocessor copies the commands to its parity-protected scratchpad RAM, while EDC is generated.
5	After the copy is complete, the microprocessor compares the EDC in the Micro area with the EDC generated by Swift.
6	When commands are transmitted out to the DSSI bus (such as the end packet for an I/O operation), the process is reversed.
7	The EDC is generated by the BUDI chip when the microprocessor copies the command to the buffer RAM.
8	This EDC is checked by the Swift chip after it generates the DSSI bus parity and EDC, as the command is transmitted onto the DSSI bus.

Firmware

Introduction

The ISE is called an integrated storage element because the drive, controller, and even some host functions are all integrated into the same package.

Figure 2–9 shows the firmware structure that makes the integration possible.

Figure 2–9   Firmware Structure
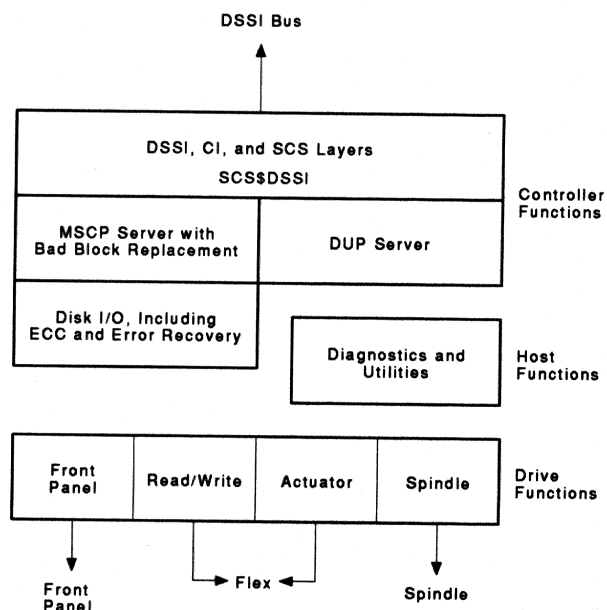
SHR_X1055_89

Firmware, Continued

Firmware Structure

Several aspects of the ISE firmware structure are not shown in Figure 2–9. For example, a mini-operating system runs the multiple programs in the ISE. Most of the firmware is coded in C, and a C run-time library is included.

Initialization

At initialization, power-on self-tests check the various chips on the module, start the spin-up sequence, and so on. Periodic diagnostics and calibrations adjust the servo and R/W systems for changing conditions.

Firmware, Continued

STATUS THREADS Command

The programs that run in the ISEs are displayed when you access the PARAMS local program and type the STATUS THREADS command.

The following is an example of such a display.

```
PARAMS>STATUS THREADS
 Pid   TCB Addr   Process Name   WQ Addr    State Pri       CPU
  0   FFFFB52C   NULL           00000000    RDY  255 0  00:06:49.46
  1   FF840C06   PERIODICS      FFFF9F74    BLK  254 0  00:00:16.10
 65   FF8414A4   PRFMON         FFFFB57A    IDL  130 0  00:00:00.00
 67   FF841544   DRVEXR         FF8415F4    IDL  124 0  00:00:00.00
 68   FF841594   DRVTST         FF841544    IDL  121 0  00:00:00.00
 69   FF8415E4   HISTRY         FF841594    IDL  118 0  00:00:00.00
 70   FF841634   DIRECT         FF8415E4    IDL  115 0  00:00:00.00
 71   FF841684   ERASE          FF841634    IDL  112 0  00:00:00.00
 72   FF8416D4   VERIFY         FF841684    IDL  109 0  00:00:00.00
 73   FF841724   DKUTIL         FF8416D4    IDL  106 0  00:00:00.00
 74   FF841774   PARAMS         FFFFB582    CUR  103 0  00:00:03.54
  2   FF841814   MSCP$DUP       FFFFA3E6    TIM   28 0  00:00:01.17
  3   FF8420C8   SCS$DIRECTORY  FFFFA516    BLK   25 0  00:00:00.07
  5   FF8431AA   MSCP$BBR       FFFFA3CA    BLK   19 0  00:00:00.00
  6   FF8439FA   PPT$DISK       FFFF8B7A    BLK   16 0  00:00:01.37
  7   FF84424A   SCS$DSSI       FFFF9FDE    BLK   13 0  00:00:02.09
  8   FF8488CE   MSCP$DISK      FFFFA17A    BLK   10 0  00:00:00.00
```

Thread Interfaces

The threads listed in the above example correspond to the firmware layers shown in Figure 2–9. For instance, the DSSI, CI, and SCS layers are implemented by the SCS$DSSI thread. The SCS$DSSI thread interfaces the DSSI hardware to the system applications (SYSAPs) that run in the ISE.

Communication Services

For each application, SCS$DSSI provides communication services to the other nodes on the bus. The two important SYSAPs are directly beneath the SCS$DSSI in Figure 2–9: the disk MSCP server described on the next page and the diagnostic and utility protocol (DUP) server, described in the Diagnostics and Utilities section of this chapter.

MSCP Server

The MSCP server is implemented by the MSCP$DISK thread, and the bad block replacement layer is implemented by the MSCP$BBR thread.

Multihost Server

The MSCP server is a multihost server because it can maintain a command dialogue with multiple hosts at the same time. I/O commands received from all hosts are combined to form a seek-ordered list of commands.

**Multihost
Server
(continued)**

Figure 2–10 shows a multihost server.

Figure 2–10   Multihost Server

```
        VAX/VMS CPU 1              VAX/VMS CPU 2

        ┌──────────────┐          ┌──────────────┐
        │   ┌──────┐   │          │   ┌──────┐   │
        │   │ MSCP │   │          │   │ MSCP │   │
        │   │ Class│   │          │   │ Class│   │
        │   │Driver│   │          │   │Driver│   │
        │   └──────┘   │          │   └──────┘   │
        └──────┬───────┘          └──────┬───────┘

     ◁═══════════════ DSSI Bus ════════════════▷

                 ┌────────────────────────────┐
                 │  ┌────────┐   ┌────────┐    │
   Seek Ordered  │  │ Read 1 │   │  MSCP  │    │
   List from     │  ├────────┤   │ Server │    │
   All Hosts     │  │ Read 1 │   └────────┘    │
                 │  ├────────┤                 │
                 │  │ Write 2│                 │
                 │  ├────────┤      ╔═════╗    │
                 │  │ Read 1 │      ║     ║    │
                 │  ├────────┤      ╚═════╝    │
                 │  │ Write 2│                 │
                 │  └────────┘                 │
                 └────────────────────────────┘

               RF31/RF72 ISE
```
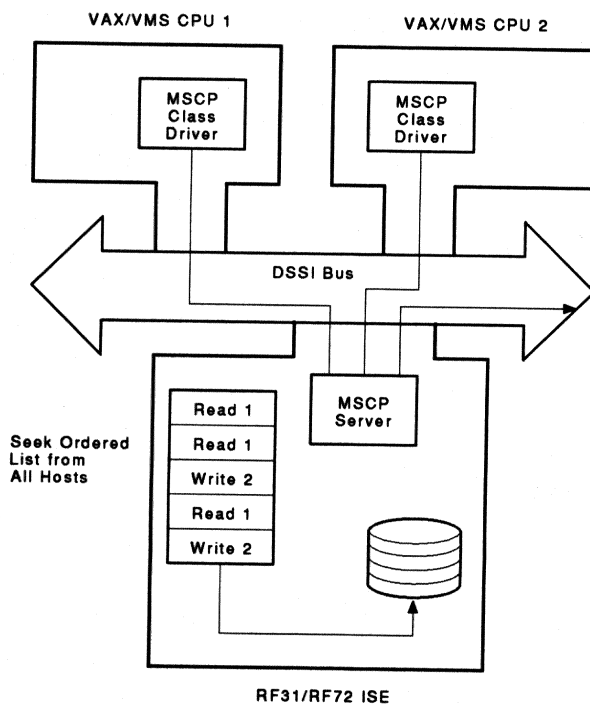
SHR_X1056_89

Firmware, Continued

Seek Ordering

A seek-ordered list of commands determines the order of command execution that minimizes the amount of time the drives spend seeking. Since seek time is typically the largest component of the total access time, seek ordering improves overall performance.

Request Fragmentation

To minimize the effects of rotational latency, the disk I/O firmware uses request fragmentation. Request fragmentation works by cutting up a long transfer into smaller pieces, and then completing the smaller pieces optimally. Although access to data on the disk is serial, DSSI provides random access to buffer memory.

Firmware, Continued

Example Fragmentation

Assume, for example, that a full track read is issued to the ISE. The request is broken up into fragments (Figure 2–11). Each fragment is delivered to the host as it is read, so that the apparent rotational latency is only .07 revolutions, as opposed to the expected .50 revolutions.

Figure 2–11   Request Fragmentation
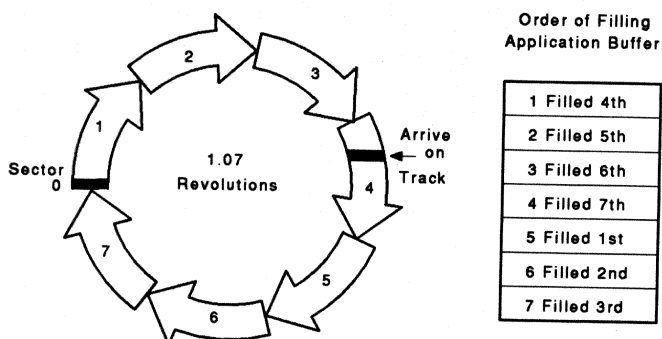
SHR_X1058A_89

Firmware, Continued

Read Cache

To further reduce latency, the disk I/O firmware manages a multi-track read cache. After a request is satisfied, and until a new command pre-empts, the sectors on the current track are read into one of the track lines in the cache. If the firmware detects that contiguous blocks are being read, the next track is also preread. Write requests try to disturb the cache as little as possible by using the least recently used (LRU) track line(s).

RCT Caching

The MSCP server caches the entire replacement control table (RCT). The RCT contains the list of bad blocks and the replacement block numbers (RBNs) that hold the data for each bad block in the list. In the past, tertiary replacements (those made to an RBN not on the track of the defective LBN) caused the controller to seek to the RCT to locate the RBN.

**RCT Caching
(continued)**

With RCT caching, the performance impact of tertiary revectors is greatly reduced (Figure 2–12).

Figure 2–12   RCT is Cached in Controller RAM

Without RCT Caching   With RCT Caching

SHR_X1057_89
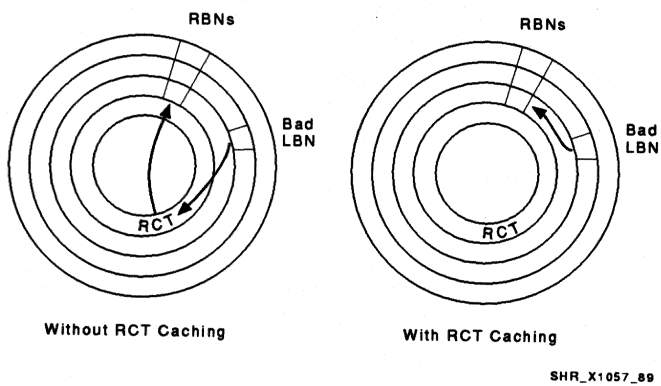
# Sector Format and Error Handling

Introduction

The PPT$DISK also implements many other functions including error recovery and ECC correction.

Disk Sector Format

The format of each disk sector (Figure 2–13) helps explain error handling.

Figure 2–13   RF31 Sector Format
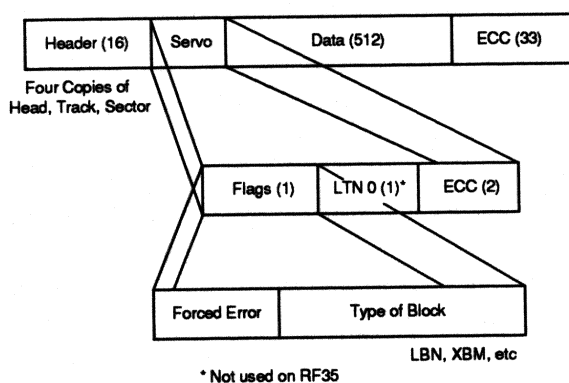
Sector Format and Error Handling, Continued

Sector Header Process

The following table lists the stages of the sector header process.

Stage	Description
1	Each sector header has four copies of its address (head, track, and sector number).
2	Firmware instructs the disk controller chip to match three out of four copies prior to a read or write operation.
3	If the header compare fails on a write operation, the block is replaced.
4	If the header compare fails to match three copies on a read operation, it attempts to match two copies.
5	Once the data is recovered, the block is replaced.
6	Note that the header is read only and represents the physical address of the block.

R/W Portion of Block

The read/write portion of the block starts with the four-byte Flags field, then contains the customer data in 512 bytes, and ends with a 33-byte ECC field.

Flags Field

The flags byte contains the forced error indicator and the type of block. The forced error indicator is a bad data mark. It means that the data is logically "bad" even though the sector it resides in may be defect-free.

LTN0 Field

The LTN0 (RF31/31F only) field is used to compensate for head and track scatter. The heads on the head stack are not aligned above one another. In fact, the tracks themselves are not aligned above one another. This lack of vertical alignment is not a product defect. At 1,875 tracks per inch, the distance between track centers is only 5-1/3 ten thousandths of an inch $(0.53 \times 10^{-3}$ in).

Sector Format and Error Handling, Continued

EDC Field

The value in the EDC field is what is generated by the Swift chip when the data arrives over the DSSI bus with the block address "added" to it. This value is checked when the data is sent to the host.

ECC Field

ECC is one of the error recovery mechanisms. ECC covers both Flags and Data fields and can correct up to 15 bytes in a single sector. However, a much lower error threshold (number of bytes in error in the sector) causes the block to be replaced to ensure that plenty of correction capability remains in the ECC.

Sector Format and Error Handling, Continued

Head and Track Scatter Compensation

Figure 2–14 illustrates head and track scatter compensation in the LTN0 field used in the RF31/31F only.

Figure 2–14   Head and Track Scatter Compensation

Logical Track Zero (LTN0) Corrects This:
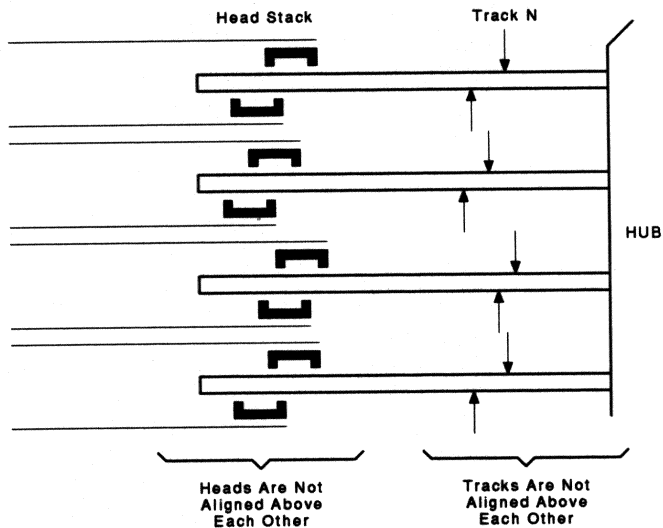
SHR_X1060_89

Sector Format and Error Handling, Continued

**LTN0 Track
Reference
Point**

In the RF31/31F to improve performance and retain the concept of a cylinder (a vertically aligned set of tracks), the value in the LTN0 byte is the physical track number of the head that is directly above or below the LTN0 track for all other heads. This LTN0 track is the reference point for each surface (Figure 2–15).

Figure 2–15   On-Disk Format Anchored at LTN0 on Each Surface (RF31/31F)

SHR_X1061_89
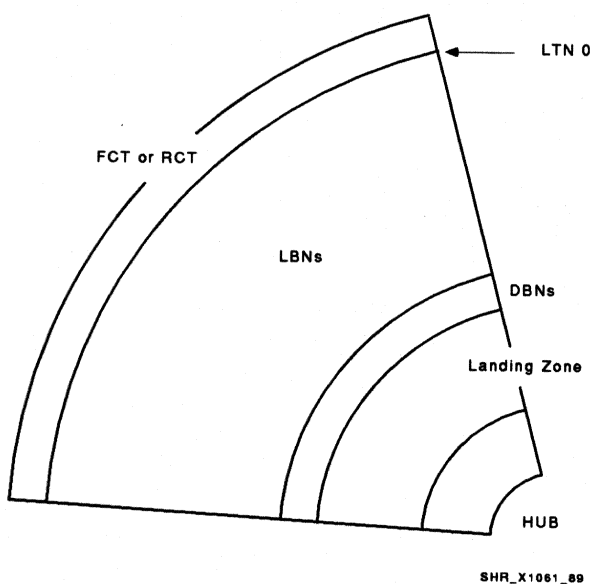
Diagnostics and Utilities

Introduction

The rectangle labeled "Diagnostics and Utilities" in represents those user-accessible programs that run under the diagnostic and utility protocol (DUP) server. These programs are listed later in this section, and are described in greater detail.

POST

The other diagnostic program that runs at system initialization is called power-on self-test (POST). The POST firmware tests the hardware on the drive module and in the HDA, and achieves almost complete coverage.

POST Coverage

The only hardware not verified by the POST is a small part of the DSSI area (shaded part of Figure 2–16). This part of the module is verified by the ISE's ability to communicate with the host.

Figure 2–16   POST Coverage (RF31 shown)
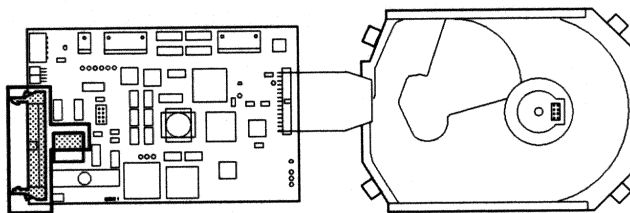
SHR_X1062_89

Diagnostics and Utilities, Continued

POST Verifications

POST, and the diagnostics and calibrations that run after head load, verify:

- That each head in the HDA works
- That the drive can seek across all tracks
- That each head can read and write correctly

Once POST has run successfully, you need only access the drive over the DSSI bus to achieve full diagnostic coverage.

After POST

After POST runs, the diagnostic tasks are picked up by the PERIODICS thread and by the DUP server (MSCP$DUP thread). The PERIODICS thread invokes POST diagnostics and runs calibrations on the drive periodically. This process is automatic, running as the lowest priority thread in the system.

DUP Server

You can think of the DUP server as a window into the ISE-resident diagnostic and utility programs. Like the MSCP server, the DUP server is a multihost server, allowing several diagnostic and utility programs to run in the ISE at the same time (Figure 2–17). The RF31, RF35, RF72, and RF73 ISEs include nine diagnostic and utility programs.

**DUP Server
(continued)**

Figure 2-17   Multihost DUP Server
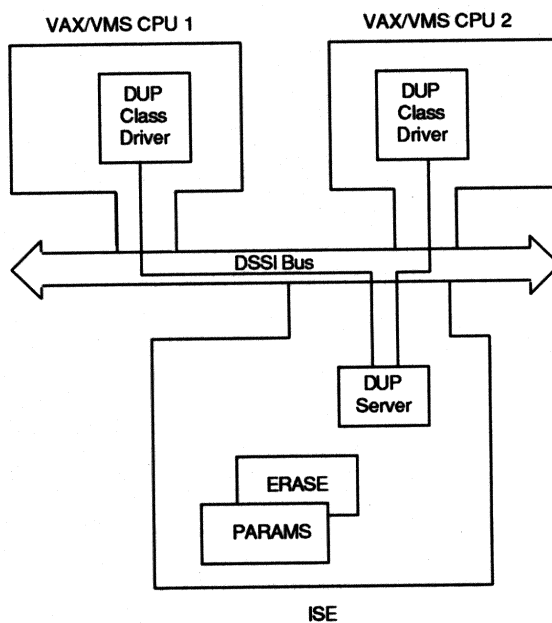
Diagnostics and Utilities, Continued

Diagnostic and Utility Programs

The nine diagnostic and utility programs resident in each ISE can be broken down into three categories:

- Management utilities
- Diagnostics
- System-level utilities

Figure 2–18 shows how the programs are categorized.

Figure 2–18   Diagnostics and Utilities
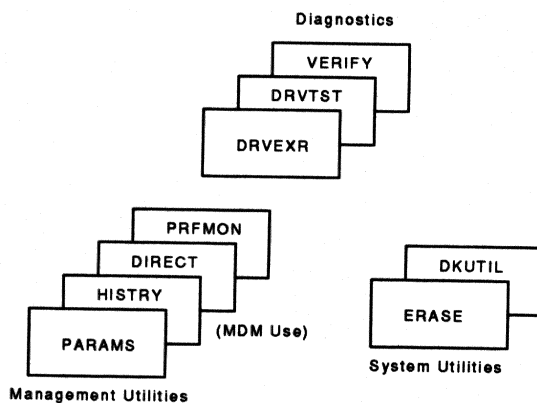
```
                        Diagnostics

                    ┌──────────────┐
                    │   VERIFY     │
                  ┌─┴────────────┐ │
                  │   DRVTST     │ │
                ┌─┴────────────┐ │ │
                │   DRVEXR     │ │ │
                │              │ ┘ ┘
                └──────────────┘


              ┌──────────────┐
              │   PRFMON     │
            ┌─┴────────────┐ │            ┌──────────────┐
            │   DIRECT     │ │            │   DKUTIL     │
          ┌─┴────────────┐ │ │          ┌─┴────────────┐ │
          │   HISTRY     │ │ │          │   ERASE      │ │
        ┌─┴────────────┐ │ │ │          │              │ ┘
        │   PARAMS     │ │ │ │          └──────────────┘
        │              │ (MDM Use)        System Utilities
        └──────────────┘
      Management Utilities
```

SHR_X1064_89

Diagnostics and Utilities, Continued

Program Descriptions

The following table briefly describes each program.

Category	Program	Description
Management utilities	PARAMS	A SYSGEN-like parameter editor and interactive query utility used to view ISE and DSSI bus status.
	HISTRY	An abbreviated version of a portion of PARAMS. HISTRY is used by host-level software such as MDM.
	DIRECT	A directory program, output only, that lists the available diagnostic and utility programs.
	PRFMON	An abbreviated version of a portion of PARAMS. PRFMON can be used by host-level software such as the VAX performance analyzer (VPA).

Diagnostics and Utilities, Continued

**Program
Descriptions
(continued)**

Category	Program	Description
Diagnostics	DRVEXR	A comprehensive drive exerciser.
	DRVTST	A quick pass/fail test of the drive.
	VERIFY	A complete read check of the disk and verification of the DSDF[1] on-disk structure.
System-level utilities	ERASE	A data "scrubber" utility that writes alternating patterns to each LBN, including the second sector of the RCT and the previous locations of the bad blocks, and then verifies that the scrubbing process succeeded.
	DKUTIL	An interactive block display and replace utility. Typically used to confirm ERASE scrubbing.

[1]DEC Standard Device Format specification

Detecting Errors

The ISE makes errors visible in a variety of ways. Knowing where to look for errors helps you to communicate with Digital Services personnel.

If the controller portion of the ISE is not functioning, the fault LED on the drive module and the fault LED on the operator control panel turn on (Figure 2–19). Also, the ISE is not visible on the DSSI bus. The failing component, in this case, is the drive module itself, because it houses the controller electronics.

Detecting Errors (continued)

Figure 2–19 Location of the Fault LEDs (RF31 Shown)
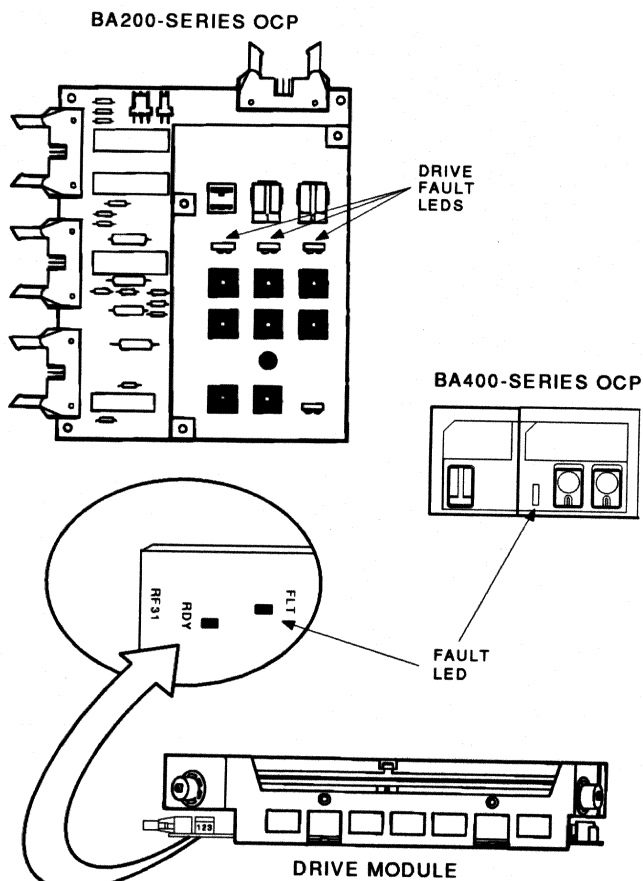
BA200-SERIES OCP

DRIVE FAULT LEDS

BA400-SERIES OCP

RF31 RDY FLT

FAULT LED

DRIVE MODULE

SHR-X0059-90

**Detecting
Errors Using
PARAMS**

If the controller portion of the ISE passes diagnostics but the unit portion does not, the fault LED still turns on. However, (because the controller is operational), the ISE *is* visible on the DSSI bus and can be queried to further resolve the error condition. At this point, the fault may be within the unit electronics or the HDA.

Error Codes

To obtain an error code, use the PARAMS utility program as shown in the following example.

```
PARAMS> STAT CONF
  Node R1WSRA is an RF31 controller
  Software RFX X200 built on 8-AUG-1989 03:38:51
  Electronics module name is EN83804656
  Unit is inoperative, error code 9802(X)
  Last known unit failure 9802(X)
  In 1275 power-on hours, power has cycled 767 times
  System time is 19-AUG-1989 18:13:33
```

In the example, the unit error code is 9802(X). This is also shown as the last known error (stored in nonvolatile RAM). These error codes are defined in the service guide. Your Customer Services representative uses them to determine the field replaceable unit (FRU) most likely to have failed.

Fatal Error

The errors described above are usually fatal. That is, once the error occurs, the fault LED remains lit and the ISE is not usable until the error condition is corrected.

Diagnostics and Utilities, Continued

Transient Errors

Transient errors, however, can also occur. For example, a bit in RAM can flip, or an address collision can occur on the DSSI bus. The most recent transient errors (up to 11) are kept in a log in nonvolatile RAM, which is accessible though the PARAMS utility program.

Error History

To access this error history, use the STAT LOG command as shown in the following example.

```
PARAMS> STAT LOG
Log History:

Log #000-2B-73-07/0000 21-AUG-1989 13:22:04
FFFF8450 FFFFB354 4E554E55 4E554E55 4E554E55 4E554E55 4E554E55 0000AA01
FF80C1B0 FF80C1B0 000029F6 4E554E55 FF817D5E FFFF83BE 4E554E55 FFFF96BC
5CABF380 009239C1 00002EA0
```

The primary users of the error history are module repair personnel. The error history may also serve as an indication to Customer Services personnel that the system is configured incorrectly or that the drive module should be replaced.

Detecting Soft Errors

Introduction

Soft errors may be caused by external environmental factors (for instance, temperature or shock) or errors that are expected to occur throughout the lifetime of the product (such as an infrequent bad block replacement). These errors are reported in MSCP error logs.

MSCP Error Logs

MSCP error logs are displayed by the error log report generators of many different operating systems. These logs are analyzed by the VAXsimPLUS program to predict failures.

Error Log Summary

The ISE produces three kinds of error logs, as summarized in the following table.

MSCP Error Log	Reason Generated
Read/Write Error Log	Any failure to read or write (above certain thresholds).
Bad Block Replacement Summary	Any time a read/write error log is generated, this log summarizes the attempt to replace the "bad" block.
Servo Performance Warning	If, during the past hour, the servo system suffered more than its threshold of performance hits.

Detecting Soft Errors, Continued

**Soft Errors
not Reported**

Certain soft errors are not reported in logs. For example, a single symbol (byte) error on a read is corrected, but not reported.

The threshold for reporting an error (and replacing the block) in the case of an ECC error on a read command is three. This means that until three or more symbols are corrected in a block, the block is not replaced. Three symbols in error is well within the safety margin of the ECC. The ECC can correct up to 15 symbols in error in a single block.

Chapter 3
Controls and Indicators

Introduction

In this Chapter

This chapter describes the controls and indicators associated with ISE operation. The controls and indicators are located in two places:

- Operator control panel on the system enclosure
- ISE drive module

OCP

The operator control panel (OCP) is a set of controls on the enclosure that overrides the ISE's switches or jumpers and enables the operator to set the DSSI node ID and write-protect mode for the ISE. The OCP also contains a fault LED that indicates if the ISE is malfunctioning.

**OCP
(continued)**

The following table compares the OCPs in the BA200 and
BA400 series enclosures.

In the ...	an OCP ...
BA200 series enclosures	contains three identical sets of controls and indicators, one set for each ISE that may be connected to it.
BA400 series enclosures	is contained on each ISE and is mounted to a panel in front of the ISE.

BA200 Series Controls and Indicators

OCP

The BA200 series enclosures each have a standard DSSI OCP. Figure 3–1 shows controls and indicators on the OCP.

Figure 3–1   BA200 Series DSSI Operator Control Panel
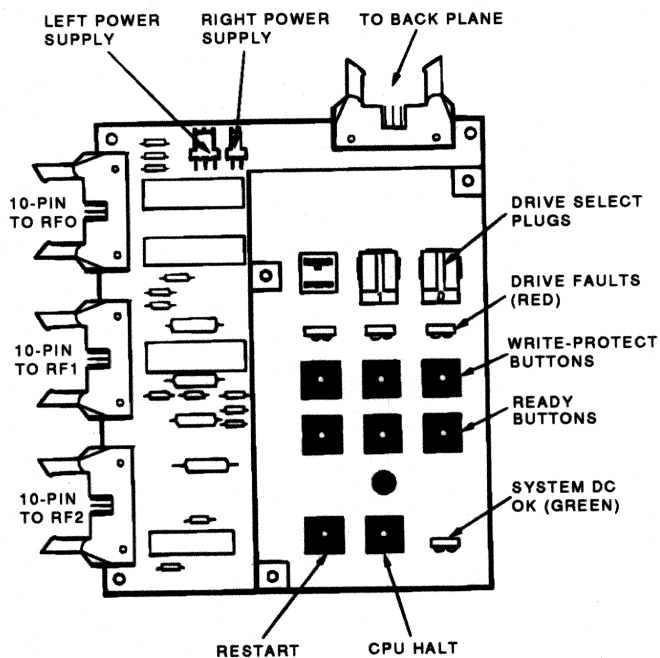

```
MA-X0965-88
SHR_X1053_88_SCN
```

BA200 Series Controls and Indicators, Continued

OCP Controls

The following table describes the function of the three controls on the BA200 Series DSSI operator control panel.

Control	Status	Function
Drive Select Plug	Installed	Sets the DSSI node ID to the number specified on the plug. A drive select plug must be installed for every ISE connected to the OCP.
	Removed	Causes a fault condition. The drive fault LED flashes at 10 Hz. DSSI node ID is undefined.
Write-Protect Button	Out	Enables the system to read and write to the media (normal operating position).
	In	Causes the system to be write-locked, the system can only read from the media.
Ready Button	Out	Puts the ISE on-line (normal operating position).
	In	Puts the ISE offline.

BA200 Series Controls and Indicators, Continued

OCP Indicators

The following table gives the meaning of each indicator on the BA200 series DSSI operator control panel.

| Indicator	Status	Meaning
Fault LED	On	Fault condition present (except during POST).
	Off	No fault present (normal operating condition).
	Slow flash (5 Hz)	Internal ISE calibrations are being performed.
	Quick flash (10 Hz)	OCP failure, or drive select plug is missing.
Write-Protect LED	On	Write-protect enabled.
	Off	Write-protect disabled.
Ready LED	On	ISE is on-line and ready.
	Off	ISE is off-line.

BA400 Series Controls and Indicators

OCP

Each ISE installed in a BA400 series enclosure has a front panel with the following controls and indicators.

- DSSI bus node ID plug
- Fault LED
- Write-protect button (not for RF35 ISE)
- Run/Ready button (not for RF35 ISE)

Figure 3–2 shows the front panel of a BA400 series enclosure. The front panel shown is not for the RF35/RF31T.

Figure 3–2   BA400 Series OCP for DSSI ISEs
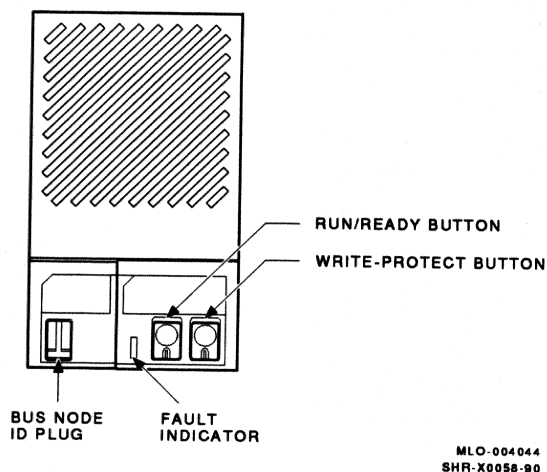
RUN/READY BUTTON
WRITE-PROTECT BUTTON
BUS NODE ID PLUG
FAULT INDICATOR

MLO-004044
SHR-X0058-90

Control and Indicator Functions

The following table describes the function of the controls and indicators on the BA400 series DSSI operator control panel.

Control	Status	Function
Fault LED	Lit	Indicates an error condition within the ISE.
	Not lit	Indicates an error-free condition within the ISE.
Run/Ready Button	In (lit)	The ISE is on-line. When the ISE is available for use, the green LED is lit. When the ISE is being used, the green LED flickers.
	Out (not lit)	The ISE is off-line and cannot be accessed. The green LED cannot be lit when the Run/Ready button is out.
Write-Protect Button[1]	In (lit)	The ISE is write-protected. System software cannot write to the ISE.
	Out (not lit)	The ISE is not write-protected. This is the normal position for software operation. System software is free to read or write to the ISE.

[1]For RF35, refer to RF35/RF31T Write-Protection

RF35/RF31T Write-Protection

In a BA400 series enclosure . . .

You may want to write-protect an ISE containing sensitive data you do not want changed or accidentally erased.

Your system disk (the ISE containing system software) and ISEs containing work areas for users should be write-enabled, the normal operating setting.

For the RF35/RF31T ISE, you set write-protection through VMS commands or through firmware commands in console mode. This information is explained later in this section. The BA400 series OCP for the RF35/31T does not have a write-protect button.

Software Write-Protect for RF35/RF31T ISEs

The software write-protect is available through VMS using the MOUNT utility with the /NOWRITE qualifier.

To software write-protect an ISE, enter the following DCL command from the VMS operating system.

MOUNT <device_name> <volume_label>/SYSTEM/NOWRITE

where:

<device_name> is the device name, as shown using the VMS DCL command SHOW DEVICE DI, and <volume_label> is the volume label for the device. For example,

$ **MOUNT 1DIA1 OMEGA/SYSTEM/NOWRITE**

will software write-protect device 1DIA1.

Dismounting, and then remounting the device (without using the /NOWRITE qualifier), will write-enable the device.

RF35/RF31T
Write-Protection
(continued)

Use the VMS DCL command SHOW DEVICE DI to check the protection status of the drive. A write-protected drive will show a device status of "Mounted wrtlck". Refer to your VMS documentation for more information on using the MOUNT Utility.

CAUTION
When you dismount, then mount the device again, it
will no longer be write-protected.

Hardware Write-Protect for RF35 ISEs

The hardware write-protect provides a more permanent write-protection than the software write-protect. Once you hardware write-protect an RF35 ISE, the ISE remains write-protected regardless of the availability of the operating system or if the system is powered-down.

In addition, a hardware write-protect can not be removed using the MOUNT command. The hardware write-protect simply provides the same degree of write-protection available to RF-series ISEs with write-protect buttons.

Consider hardware write-protecting an RF35 ISE in the following situations:

- If you want to write-protect an RF35 ISE when the VMS operating system is unavailable, such as before running the MicroVAX Diagnostic Monitor (MDM).

- If you want to ensure that an RF35 ISE remains write-protected, since the hardware write-protect cannot be removed using the VMS command MOUNT and will remain in effect even if the operating system is brought down.

RF35/RF31T Write-Protection (continued)

You can hardware write-protect an RF35 ISE from VMS or through firmware commands entered at the console prompt (>>>). Use the following instructions:

1. Access the Diagnostic and Utility Program (DUP) driver for the device you want to write-protect.

   • To access the DUP driver from console mode:

   a. Enter console mode by pressing the halt button or powering up the system with the break enable /disable switch set to enable (up, position 1).

   > **CAUTION**
   > **Halting your system without following the shutdown procedure described in your system software manuals may result in loss of data.**

   b. Access the DUP driver by setting host to the specific device you want to write protect.

   Use the following command for embedded DSSI:

   ```
   SET HOST/DUP/DSSI/BUS:<bus_number>
   <node_number> PARAMS
   ```

   where:

   <bus_number> is the DSSI bus number (0 or 1), and <node_number> is the bus node ID (0–6) for the device on the bus (bus number and node number are listed in the SHOW DSSI display).

   Use the following command for KFQSA-based DSSI:

   ```
   SET HOST/DUP/UQSSP/DISK <controller_number>
   PARAMS
   ```

   where:

<controller_number> is the controller number (listed in the SHOW UQSSP display) for the device on the bus.

**RF35/RF31T
Write-Protection
(continued)**

- To access the DUP driver from VMS:
  a. Connect to the DUP and load its driver using the VMS System Generation Utility (SYSGEN) as shown below:

```
$ MCR SYSGEN
SYSGEN> CONNECT/NOADAPTER FYA0
SYSGEN> EXIT
$
```

  b. Access the DUP driver by setting host to the specific device you want to write protect. Use the following command:

```
SET HOST/DUP/SERVER=MSCP$DUP/TASK=PARAMS
<node_name>
```

  where:

  <node_name> is the device node name (the node name, in parentheses, is listed in the SHOW DEVICE DI display).

2. At the PARAMS> prompt, enter SET WRT_PROT 1 to write-protect the ISE to which you are currently connected.

NOTE
To verify that you have set host to the intended drive, you can enter the command LOCATE at the PARAMS> prompt. The LOCATE command causes the drive's fault indicator to blink momentarily.

**RF35/RF31T
Write-Protection
(continued)**

3. Enter SHOW WRT_PROT to verify the WRT_PROT parameter is set to 1.

4. After you have finished setting and examining the WRT_ PROT device parameter, enter the WRITE command at the PARAMS> prompt to save the device parameter. The change is recorded to nonvolatile memory.

5. Enter the EXIT command at the PARAMS> prompt to exit the DUP driver utility for the specified device.

Example 3–1 shows setting a hardware write-protect through firmware. Example 3–2 shows setting a hardware write-protect through VMS.

RF35/RF31T Write-Protection (continued)

Example 3–1 Setting Hardware Write-Protection Through Firmware

```
>>>SET HOST/DUP/DSSI/BUS:0 1 PARAMS
Starting DUP server...
Copyright (c) 1992  Digital Equipment Corporation
PARAMS>SET WRT_PROT 1
PARAMS>WRITE
PARAMS>SHOW WRT_PROT
Parameter      Current              Default          Type      Radix
---------  ----------------   ----------------   --------   -----
WRT_PROT                 1                    0   Boolean     0/1
PARAMS>EXIT
Exiting...
Stopping DUP server...
>>>
```

Example 3–2 Setting Hardware Write-Protection Through VMS

```
$ MCR SYSGEN
SYSGEN> CONNECT/NOADAPTER FYA0
SYSGEN> EXIT
$ SET HOST/DUP/SERVER=MSCP$DUP/TASK=PARAMS R35F3C
Starting DUP server...
Copyright (c) 1992  Digital Equipment Corporation
PARAMS>SET WRT_PROT 1
PARAMS>WRITE
PARAMS>SHOW WRT_PROT
Parameter      Current              Default          Type      Radix
---------  ----------------   ----------------   --------   -----
WRT_PROT                 1                    0   Boolean     0/1
PARAMS>EXIT
Exiting...
Stopping DUP server...
$
```

**RF35/RF31T
Write-Protection
(continued)**

To remove the hardware write-protection, repeat the procedure, only set the WRT_PROT value to 0.

You can verify that the device is write-protected while running VMS. When you issue the VMS DCL command SHOW DEVICE DI, a write-protected drive will show a device status of "Mounted wrtlck". If you issue the VMS command SHOW DEVICE/FULL, a write-protected drive will be listed as "software write-locked".

NOTE
You cannot remove hardware write-protection using the VMS MOUNT utility.

SF7x Enclosure Controls and Indicators

OCP

Each ISE in the SF7x storage enclosure is represented by an icon on the door located on the OCP. Each set of controls and indicators is dedicated to one of the four storage compartments in the enclosure (Figure 3–3).

Figure 3–3 SF7x Controls and Indicators

SHR_X1128_89

3–16
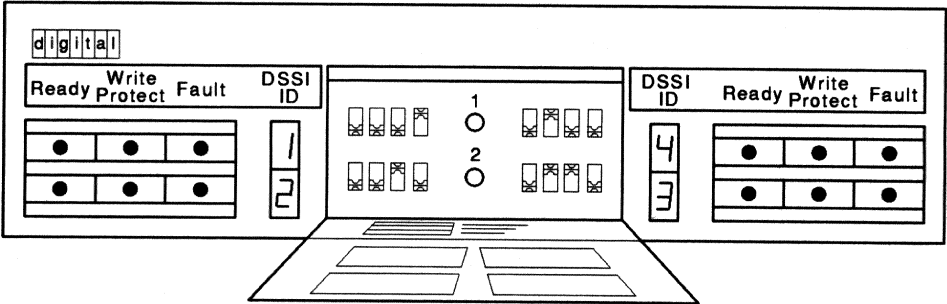
SF7x Enclosure Controls and Indicators, Continued

Control and Indicator Functions

The following table describes the functions of the controls and indicators on the SF7x enclosure DSSI OCP.

Control/ Indicator	Color	Function
READY	Green	Illuminates when ISE is on line and read/write ready.
Fault	Red	Illuminates when fault is detected.
DSSI Node ID	Green	Displays ISE DSSI Node ID.
Write Protect	Yellow	Commands write protect mode. Shows write protect enabled.
Terminator Power	Green	On while when Terminator Power is being supplied.
Split Bus	Green	On when enclosure is in Split Bus mode.
DSSI Node ID Select	N/A	3 bits, selects DSSI node ID number.
MSCP Enable/Disable	N/A	1 bit, enables or disables the ISE MSCP server.
DC power switches (4)	Green	Applies DC power to ISE. Shows power status.

Changing the DSSI Node ID Plugs (BA200 and BA400 Series OCPs)

Spare Plugs

Spare DSSI node ID plugs are supplied with your system. Use these spare plugs to renumber your DSSI system should you:

- Need to reconfigure because of adding or removing ISEs
- Create a multihost configuration

Removal

The DSSI node ID plugs have prongs on the back that indicate the bus node number (and by default, the unit number) of the ISE. To remove a DSSI node ID plug, grasp it firmly and pull it straight out.

Insertion

To insert a new plug, align the two center prongs with the two center slots and press the plug into the slots.

Renumbering ISEs

Use the following rules to renumber your ISEs:

- For each DSSI bus, do not use duplicate DSSI node IDs.
- By convention, ISEs are numbered in increasing order from right to left and top to bottom.
- Use a blank DSSI node ID plug where no ISE is present.

NOTE
If you change the bus node ID plugs while the system is operating, you must turn off the system and then turn it back on for the new plug positions to take effect.

ISE Controls and Indicators

Description

The RF31/31F ISEs each have two LEDs and a DIP switchpack containing three switches mounted on the edge of the drive module. The RF35, RF72, and RF73 ISEs each have two LEDs and an options connector mounted on the edge of the drive module. Jumpers are inserted into this connector. On the RF35 ISE, this connector is located at the opposite end of the DSSI connector. On the RF72/73 ISEs, this connector is located next to the power connector.

The switches (on the RF31/31F ISEs) and option connector (on the RF35/72/73 ISEs) provide a means of setting the DSSI node ID if an OCP is not connected to the drive, or if the OCP fails.

The following two LEDs indicate drive status:

- READY LED
- FAULT LED

ISE Controls and Indicators, Continued

Description (continued)

Figure 3–4 shows the location of the switches and LEDs on the drive module for the RF31/31F ISEs.

**Figure 3–4 RF31/31F Drive Module Switch and LED Locations**
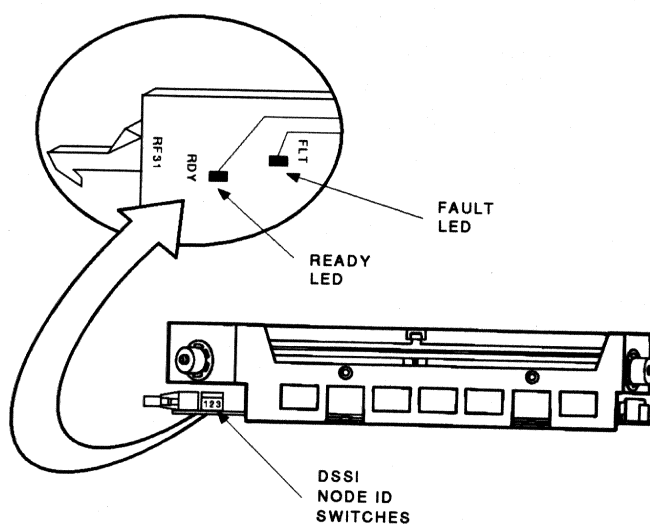
MA-X0967-88
SHR_X1065_89

Figure 3–5 shows the location of the options connector and LEDs on the drive module for the RF35/72/73 ISEs.

Description (continued)

Figure 3–5   RF35/31T/72/73 Drive Module Options and LED Locations

FRONT VIEW OF A RF35 DISK DRIVE

Option Connector
2   20

Busy LED

Fault LED

1   19

DSSI ID 0 1 2
FLT LED   BSY LED
(Optional connections)

REAR VIEW OF A RF72/73 DISK DRIVE

(Differential and Single–Ended Connectors)

Power   19 Remote Panel 1   DSSI Interface Connector

12V
5V   2 1 0 1   1   1
GND   DSSI ID   Terminator Resistor Packs

Single Ended
DSSI Interface Connector

1   1   1
Terminator Resistor Packs

NOTE: The three resistor packs must be inserted with
their pin 1 correctly aligned with the connector.

rf357273_opt_conns.rags

Continued on next page

3–21

ISE Controls and Indicators, Continued

Assigning DSSI Node ID

Assignment of the DSSI node ID is done by setting the three switches to the binary equivalent of the selected ID number, as shown in the following tables. These switches are ignored when an OCP is connected to the ISE.

Table 3–1   RF31/31F DSSI IDs

| DSSI Node ID | Switch Positions[1] | | |
Address	1	2	3
0	Down	Down	Down
1	Down	Down	Up
2	Down	Up	Down
3	Down	Up	Up
4	Up	Down	Down
5	Up	Down	Up
6	Up	Up	Down
7[2]	Up	Up	Up

[1]Up is toward the HDA, down is toward the module.

[2]DSSI address 7 is normally assigned to a host adapter.

Assigning DSSI Node ID (continued)

Table 3–2 RF35/72/73 DSSI IDs

DSSI Node ID Address	Jumper[1] 1	2	3
0	Out	Out	Out
1	Out	Out	In
2	Out	In	Out
3	Out	In	In
4	In	Out	Out
5	In	Out	In
6	In	In	Out
7[2]	In	In	In

[1]In = inserted, Out = removed

[2]DSSI address 7 is normally assigned to a host adapter.

**Drive Module
LEDs**

The two LEDs mounted on the drive module monitor ISE status during operation. The following table describes the state of these two LEDs during the various phases of ISE operation.

When ...	The green LED is ...	And the Fault LED is ...
The ISE is first powered up	On	On
POST has run successfully	Off	Off
The read/write heads are on-cylinder and ready	On	Off
Drive active	Flickering	Off
A read/write or serious physical error is detected	Off	On

Chapter 4
Local Programs

Accessing Local Programs

In this Chapter	This chapter covers the following topics:
	• Accessing local programs through VMS, from the console, and through MDM
	• Local programs that can be accessed

Overview	Local programs are diagnostics and utilities internal to the ISE. They are accessed in one of the following three ways, depending on the system you are using.

To access local programs ...	See Page
Through VMS, using the SET HOST command,	4-3
From the console, using the SET HOST command,	4-4
Through MDM, using the Device Resident Programs menu,	4-6

Overview (continued)

Once a connection is established, operations are performed under the control of the local program. The following is a list of local programs found in this chapter:

Programs	See Page
DIRECT	4-8
DRVEXR	4-9
DRVTST	4-13
HISTRY	4-16
ERASE	4-17
VERIFY	4-22
DKUTIL	4-30
PARAMS	4-48

When the program ends, control is returned to the system. To abort the program and return control to the system, press Ctrl/C or Ctrl/Y.

Using VMS

To access a local program from a MicroVAX system running VMS version 5.3-2 or greater, the command is:

```
$ SET HOST/DUP/SERVER=MSCP$DUP/TASK=taskname nodename
```

The following table defines taskname and nodename:

Term	Meaning	How to find
Taskname	Name of the local program	Descriptions found in this chapter
Nodename	Node name of the ISE	To find the node name of an ISE, type SHOW DEVICES or SHOW CLUSTER at the $ prompt and press Return

You may create a file in your directory of what appears on the screen, by appending the qualifier:

```
/log=filename.ext
```

to:

```
$ SET HOST/DUP/SERVER=MSCP$DUP/TASK=taskname nodename
```

(Where "filename.ext" is, insert name of file and extension.)

Accessing Local Programs, Continued

Using Console Commands

Some systems allow you to access the local programs using console commands. The command you use depends on whether your system uses a Q–bus adapter like the KFQSA module, or an embedded adapter such as the KA640 module.

Q–bus Adapters

To access a local program from a system with a Q–bus adapter, the command is:

```
>>> SET HOST/UQSSP/DUP/DISK # taskname
```

    taskname = name of the local program
    # = controller number of the ISE

To find the controller number, type SHOW UQSSP at the console prompt (>>>). An example of the SHOW UQSSP command is:

```
>>> show uqssp
UQSSP Disk Controller 0 (772150)
-DUA0 (RF31)

UQSSP Disk Controller 1 (760334)
-DUB1 (RF31)

UQSSP Disk Controller 2 (760340)
-DUC2 (RF31)

UQSSP Tape Controller 0 (774500)
-MUA0 (TK70)
>>>
```

Embedded Adapters

To access a local program from a system with an embedded adapter, the command is:

```
>>> SET HOST/DUP/DSSI/BUS:n #
```

n = bus number where the ISE is located
# = DSSI node number of the ISE

Then, the system prompts you for the name of the local program you want to run.

To find the DSSI node number and node name, type SHOW DSSI at the >>> prompt. To see a list of the devices on the Q–bus, type SHOW QBUS or SHOW UQSSP at the >>> prompt.

To abort the program and return control to the system, press Ctrl/C or Ctrl/Y.

Using MDM

If neither VMS nor console commands are available on your system, you can run local programs using MDM. Use the following procedure:

1. Boot MDM.
2. Enter the date and time.
3. Select the menus in the following order:

    Service menu
    Device menu
    KFQSAA-KFQSA subsystem menu
    Device Utilities menu
    Device Resident Programs menu

    When you select the Device Resident Programs menu, the following is displayed:

```
RUNNING A UTILITY SERVICE TEST

To halt the test at any time and return to the previous menu,
type CTRL-C by holding down the CTRL key and pressing the C key.

KFQSAA started.
KFQSAA pass 1 test number 3 started.
Copyright 1988 Digital Equipment Corporation
Completed.
EXIT                        DRVEXR                    DRVTST
HISTRY                      ERASE                     PARAMS
DIRECT                      DKUTIL                    PRFMON
VERIFY

Please choose a local program or press <RETURN> to continue.
```

4. Type in the name of the local program you want to run and press ⟨Return⟩. For information about the available local programs, refer to the program descriptions on the following pages.
5. To exit MDM, press the ⟨Break⟩ key.

Local Programs

Overview

The rest of the chapter describes the local programs you can access.

DIRECT

Description

DIRECT provides a directory of local programs resident in the ISE.

Example

The following is an example of what is displayed when you run the DIRECT program.

```
Copyright © 1989 Digital Equipment Corporation
PRFMON    V1.0    D    21-AUG-1989    13:39:09
DRVEXR    V2.0    D    21-AUG-1989    13:39:09
DRVTST    V2.0    D    21-AUG-1989    13:39:09
HISTRY    V1.1    D    21-AUG-1989    13:39:09
DIRECT    V1.0    D    21-AUG-1989    13:39:09
ERASE     V2.0    D    21-AUG-1989    13:39:09
VERIFY    V1.0    D    21-AUG-1989    13:39:09
DKUTIL    V1.0    D    21-AUG-1989    13:39:09
PARAMS    V2.0    D    21-AUG-1989    13:39:09
Total of 9 programs.
```

DRVEXR

Description

DRVEXR is a diagnostic that applies several types of stress to the ISE.

DRVEXR is accessed in the same way as are the other local programs. Once a connection is established, the user is prompted to answer a series of questions. The responses determine the mode and test duration.

Stopping DRVEXR

To stop DRVEXR in progress, press Ctrl/C, Ctrl/Y, or Ctrl/Z. When DRVEXR stops, a short report is printed.

Dialogue

To run DRVEXR, you must respond to the following dialogue messages first:

Message	Explanation
Copyright © 1989 Digital Equipment Corporation	No response is expected.
Write/read anywhere on the medium? [1=Yes/(0=No)]	Do you want to write to the media?
User data will be corrupted. Proceed? [1=Yes/(0=No)] (This question is omitted if you typed 0 to answer the previous question.)	Do you really want to overwrite existing data on the media?

Dialogue (continued)

Message	Explanation
Test time in minutes? [(10)-100]	Your response determines the length of the test, in minutes.
Number of sectors to transfer at a time? [0 - 50]	Your response determines the length of each I/O issued. If you type 0, this is a seek-only test.
Compare after each transfer? [1=Yes /(0=No)] (This question is omitted if you typed 0 to answer the previous question.)	Your response determines whether the processor "manually" compares the results of the read with the expected data (if writing is enabled) or the hardware does the compares after each read.
Test the DBN area? [2=DBN only/(1=DBN and LBN) /0=LBN only]:	Your response determines how to include the DBN area in the test. If you type 2, the test always includes writes, even if you answered the first question with 0.

DRVEXR, Continued

DRVEXR Modes

DRVEXR can be run in one of the following modes, depending on your responses to the dialogue questions:

Mode	Function
Read/Write	Writes and reads as many blocks as possible in the given amount of time.
Data Integrity	Similar to Read/Write mode, but with a "manual" check of data buffers done by the ISE processor.
Seek Intensive	Only seeks are performed in this mode.
Max Stress	Reads the inner DBNs and outer DBNs alternately.

Mode/Dialogue Relationship

The following table shows the relationship between the four test modes and the responses to the six questions in the dialogue.

Modes	Response to Question					
	1	2	3	4	5	6
Read/Write	1	1	Any	Any	0	Any
Data Integrity	1	1	Any	Any	1	Any
Seek Intensive	0	N/A	Any	0	N/A	0 or 1
Max Stress	0	N/A	Any	0	N/A	2

Example

The following is an example of what is displayed when you run DRVEXR.

```
Copyright © 1989 Digital Equipment Corporation
Write/read anywhere on the medium? [1=Yes/(0=No)] 1
User data will be corrupted. Proceed? [1=Yes/(0=No)] 1
Test time in minutes? [(10)-100] 10
Number of sectors to transfer at a time? [0 - 50] 18
Compare after each transfer? [1=Yes/(0=No)]: 0
Test the DBN area? [2=DBN only/(1=DBN and LBN)/0=LBN only]:

    73990 blocks (512 bytes) read.
    73990 blocks (512 bytes) written.
    18666 DBN blocks (512 bytes) read.
    18666 DBN blocks (512 bytes) written.

Complete.
```

DRVTST

Description

DRVTST provides a comprehensive test of the ISE hardware. Errors detected by this program can be isolated to the FRU level.

Dialogue

The following table describes the DRVTST dialogue.

Message	Explanation
Copyright © 1989 Digital Equipment Corporation	No response is expected.
Write/read anywhere on the medium? [1=Yes/(0=No)]	Do you want to write to the media? If you type 0, this is a read-only test. DRVTST does, however, write to a diagnostic area on the disk.
User data will be corrupted. Proceed? [1=Yes/(0=No)]	Do you really want to overwrite existing data on the media? If you type 0, this is a read-only test.
5 minutes to complete.	No response is expected.
Test passed.	The test was successful. Choose another local program or return control to the system.

Error Messages

The following table describes DRVTST error messages.

Message	Description
Unit is currently in use.	This can mean that the ISE unit is inoperative, in use by a host, or is currently running another local program.
Operation aborted by user.	This message appears if the user stops the program while it is in progress.
Soft read error on head xx track yyyy. Soft write error on head xx track yyyy. Soft compare error on head xx track yyyy.	These are soft error messages which indicate that an operation succeeded, but that the error recovery firmware was invoked. These messages may indicate a forced-error flag or correctable ECC error, or that the read/write head was temporarily off-track. These are corrected during normal operation.
xxxx - Unit diagnostics failed.	This is a fatal error message where xxxx is the MSCP error code. Call Digital Services.
xxxx - Unit read/write test failed.	This is also a fatal error message where xxxx is the MSCP error code. Call Digital Services.

**DRVTST
Examples**

The following is an example of what is displayed when DRVTST
runs successfully.

```
Copyright © 1989 Digital Equipment Corporation
Write/read anywhere on the medium? [1=Yes/(0=No)] 1
User data will be corrupted. Proceed? [1=Yes/(0=No)] 1
  5 minutes to complete.
Test passed.
```

The following is an example of what is displayed when DRVTST
has failed.

```
Copyright © 1989 Digital Equipment Corporation
Write/read anywhere on medium? [1=Yes/(0=No)]
0106 - Unit read/write test failed.
```

HISTRY

Description

HISTRY displays ISE information that is used by programs running in the host (such as MDM).

The information is displayed in the following order:

> copyright notice
> product name
> serial number
> node name
> allocation class
> firmware revision level
> hardware revision level
> power-on hours
> power cycles
> last bug check codes (up to 11)

Example

The following is an example of what is displayed when you run the HISTRY program.

```
Copyright © 1989 Digital Equipment Corporation
RF31
EN92300124
R1EJAA
0
RFX X201
RF31 PCB-3/ECO-00
1
45
Complete.
```

ERASE

Description

ERASE is a utility that overwrites data on each ISE. Every writeable LBN and RBN block on the ISE is written several times with a complementary data pattern, and finally is overwritten with zeros.

LBN and RBN

ERASE writes every block in the LBN and RBN space twice the specified number of times: once with the pattern 99(X), and once with the complement pattern 66(X). These two values were selected because they are bit complements of each other in both decoded and encoded formats.

That is, the bits toggle in controller memory and the fixed frequency pulse trains on the disk are 180 degrees out of phase with one another, assuming the pulse trains start together.

ERASE Process

Stage	Description
1	After the specified number of write/write-complement operations have been performed, a final pattern of all zeros is written on each block.
2	A failure to write these patterns or to read back all zeros means that the block is "bad" and was previously replaced.
3	The failure and the status of each such block is displayed.
4	If the block is marked bad in the FCT, the user may inhibit this output.

ERASE
Process
(continued)

Stage	Description
5	The following is repeated to the second block of each RCT copy: • write/write complement • write of zeros • read back of zeros
6	The second block of the RCT is: • used as an intermediate holding area for data during bad block replacement • treated as an extension of the user data area by ERASE

Accessing
ERASE

ERASE is accessed in the same way as the other local programs. Once a connection is established, the user is prompted to answer a series of questions.

Stopping
ERASE

To stop an ERASE in progress, press Ctrl/C, Ctrl/Y, or Ctrl/Z.

ERASE, Continued

Dialogue

The following table explains the ERASE dialogue.

Message	Explanation
Copyright © 1989 Digital Equipment Corporation	No response is expected.
Write/read anywhere on medium? [1=Yes/(0=No)]	Do you want to write to the media?
User data will be corrupted. Proceed? [1=Yes/(0=No)]	Do you really want to overwrite existing data on the media?
How many times should the disk be pre-written before erasing? [0-99]	Specify the number of passes ERASE should make on each sector. A pass is a write with a pattern followed by a write with the pattern complement. A message is displayed indicating your choice.

Dialogue (continued)

Message	Explanation
Display errors erasing known bad blocks? [(1=Yes)/0=No]:	Do you want a list of all ERASE errors in the RCT and the FCT? A message is displayed indicating your choice.
Is this information correct? [(1=Yes) /0=No]:	If you type 0, you are asked the following question.
Do you wish to continue? [1=Yes /(0=No)]:	If you type 1, you are once again prompted to specify the number of passes, and so on. If you type 0, the session ends.
n minutes to complete.	This lists the number of minutes (n) until completion of the erase operation. This number is a function of the number of passes you specified and the ISE type. No response is expected.
Erase complete.	This message indicates that the erase operation is complete. The program stops automatically.

ERASE, Continued

Example

The following is an example of the ERASE utility.

The blocks listed in this example are the blocks that either did not write, or did not contain an all-zeros pattern when ERASE read back each track on the LBN/RBN space. In most cases, the failing blocks are listed as "bad" in the FCT.

```
Copyright © 1989 Digital Equipment Corporation
Write/read anywhere on medium? [1=Yes/(0=No)] 1
User data will be corrupted.  Proceed? [1=Yes/(0=No)] 1
How many times should the disk pre-written before erasing? [1-99]:
Display errors erasing known bad blocks? [(1=Yes)/0=No]:
The disk will be pre-written 3 times.
All errors will be reported, including FCT bad blocks.
Is this information correct? [(1=Yes)/0=No]:

   58 minutes to complete.

          ERASE BAD BLOCK LIST

   LBN   Head  Track  Sector  Block Status
  -----  ----  -----  ------  ------------
  14602   4     132     19    Unable to write sector (marked bad in FCT)
  14603   4     132     20    Unable to read sector (marked bad in FCT)
  14604   4     132     21    Unable to write sector (marked bad in FCT)
  14605   4     132     22    Unable to write sector (not found in FCT)
 629079   5    1661     12    Non-zero data in sector (marked bad in FCT)
 629080   5    1661     13    Unable to write sector (marked bad in FCT)

Erase complete.
```

VERIFY

Description

VERIFY is a utility that is used to determine the amount of "margin" remaining in on-disk structures (for instance, the number of bad blocks in the RCT and thus the number of RBNs consumed). VERIFY is useful when you verify an installation.

The VERIFY utility is read only. It does not overwrite user data and does not perform bad block replacement.

Accessing VERIFY

VERIFY is accessed in the same way as are the other local programs. Once a connection is established, you are prompted to answer a series of questions.

Dialogue

The following table describes the VERIFY dialogue.

Message	Explanation
Copyright © 1989 Digital Equipment Corporation	No response is expected.
Print informational (non-warning) messages? [1=Yes/(0=No)]	Your response controls the amount of output produced by VERIFY. Type 1 if you want informational messages displayed.

**Dialogue
(continued)**

Message	Explanation
Report transient error by block? [1=Yes/(0=No)]	Again, your response controls the amount of output produced by VERIFY. By default, a transient, correctable error in a block is not displayed as blocks are read. Type 1 if you want transient errors reported.

Example

The following is an example of VERIFY run on an RF31 ISE. The example is interrupted several times by text that describes the next part of the example.

The first part of this example contains the VERIFY dialogue and the FCT header dump. The FCT header dump provides basic information, such as the serial number and the date of last format (typically the date the HDA was manufactured).

```
Copyright © 1989 Digital Equipment Corporation
Print informational (non-warning) messages? [1=Yes/(0=No)] 1
Report transient error by block? [1=Yes/(0=No)] 1

***      FCT Block 0 Information     ***

    Serial Number:          0000123400000000
    Mode:                    ADDE(X)
    First Formatted:        22-MAY-1989 11:58:26
    Date Formatted:         22-MAY-1989 11:58:26
    Format Instance:        1
    FCT:                     VALID
    Bad PBNs in FCT:        34

    Scratch Area Offset:    30032
    Size (Not Last):        2480
    Size (Last):            2480

    Flags:                   0000(X)
    Format Version:         1
```

The next part of the example contains the RCT header dump. A read check of the RCT follows. Note: One sector of one copy of the RCT (the 5th copy, block 68) is unusable.

**Example
(continued)**

```
***      RCT Block 0 Information     ***
  Serial Number:          0000123400000000
  Flags:                  0000(X)
  LBN Being Replaced:     0
  Replacement RBN:        0
  Bad RBN:                     0
*****     Revector Control Table for R1VJAA$DIA3     *****
Copy 5 of RCT block 68 (LBN 745103.) is bad.
```

After the read check of the RCT, each bad block in the RCT is displayed. In this abbreviated syntax, the symbol *-> means that a bad LBN is replaced by an RBN not on its track. The symbol -> means that the bad LBN is replaced by its primary (on-track) RBN.

```
      2 -->         0,    2083 -->        41,    3569 -->        71,
   9566 *->       190,    9564 -->       191,    9563 *->       192,
  14603 -->       292,   15361 -->       307,   15398 *->       308,
  18762 -->       375,   19403 -->       388,   21198 -->       423,
  22695 -->       453,   22788 *->       454,   22791 -->       455,
  22790 *->       457,   22789 *->       458,   23183 *->       462,
  23182 *->       464,   28081 -->       561,   31026 *->       619,
  31027 *->       621,   33589 -->       671,   35495 -->       709,
  45046 -->       900,   45339 -->       906,   48484 -->       969,
  57875 -->      1157,   63818 -->      1276,   70125 -->      1402,
       :            :         :            :         :            :
(many lines have been deleted from this example)
       :            :         :            :         :            :
Bad RBN:        12041,  602527 -->     12050, Bad RBN:        12073,
 609475 -->     12189, Bad RBN:       12217,  613875 -->     12277,
 645331 -->     12906,  645330 *->     12907,  645885 -->     12917,
 652795 -->     13055,  656745 -->     13134,  657589 -->     13151,
 664108 -->     13282,  675509 -->     13510,  679607 -->     13592,
 693585 -->     13871,  694130 -->     13882,  694129 *->     13883,
 707101 -->     14142,  707100 *->     14143,  711501 -->     14230,
 711607 -->     14232,  717484 -->     14349,  721878 -->     14437,
 722237 -->     14444,  723439 -->     14468,  729597 -->     14591,
 732140 -->     14642,  732372 -->     14647,  735723 -->     14714,
 737467 -->     14749,  739349 -->     14786,  742125 -->     14842,
```

**Example
(continued)**

The next part of this example summarizes the contents and
state of the RCT.

```
RCT Statistics:
                        47 Bad RBNs
                       185 Bad LBNs
                       140 Primary Revectors
                        45 Non-Primary Revectors
                         1 Bad RCT Blocks
                         0 Bad First Copy RCT Blocks
```

Then a similar scan of the FCT follows. Each bad block in the
FCT is displayed. Entries in this display are physical blocks.
The syntax DKUTIL uses for PBNs is also used here: h:t:s:,
where h is the head number, t is the track number, and s is the
sector number. If the bad block is used by the disk format, the
corresponding block number is displayed in parentheses.

```
*****     Factory Control Table for R1VJAA$DIA3     *****

1:   96:50(LBN    2083) 1: 161:48(LBN   28081) 1: 181: 0(LBN   36084)
1: 212: 0(LBN   48484) 2: 259: 8(LBN   70125) 1: 374: 0(LBN  113284)
3: 452:23(LBN 142973) 1: 558: 0(LBN  186884) 5: 564:17(LBN  188684)
5: 565:17(LBN 189084) 3: 630:38(LBN 214188) 3: 634:16(LBN 215766)
2: 673:43(LBN 235709) 6: 822: 0(LBN 293100) 3: 938:25(LBN 337375)
1:1009:40(LBN 367273) 5:1160:30(LBN 427097) 7:1208: 1(LBN 447185)
5:1321: 8(LBN 491475) 3:1440: 8(LBN 538158) 3:1442: 8(LBN 538958)
5:1449: 8(LBN 542675) 3:1454: 8(LBN 543758) 3:1459: 8(LBN 545758)
6:1471:40(LBN 552740) 5:1532: 8(LBN 575875) 5:1546: 8(LBN 581475)
5:1559: 8(LBN 586675) 0:1556:20(LBN 587620) 5:1616: 8(LBN 609475)
5:1627: 8(LBN 613875) 6:1731:45(LBN 656745) 6:1778: 9(LBN 675509)
0:1786: 7(LBN 679607)
```

**Example
(continued)**

The state of the FCT is displayed next.

```
FCT Statistics:
                        0 Bad FCT Blocks
                        0 Bad First Copy FCT Blocks
```

In the last part of this example, the LBN area is scanned. Each LBN block is read, some LBN statistics are displayed, and VERIFY ends. In this example, transient error reporting was enabled so the transients are displayed.

```
*****     Scan of LBN Area     *****

LBN    2740. has a transient (5 out of 6) error.
LBN    7904. has a transient (3 out of 6) error.
LBN   77100. has a transient (4 out of 6) error.
LBN   95831. has a transient (1 out of 6) error.
LBN  577712. has a transient (1 out of 6) error.
LBN  730484. has a transient (1 out of 6) error.

LBN Statistics:          6 Block(s) with a Transient error.
                         6 Total Block(s) in error.

Complete.
```

**Error
Messages**

The following table describes the VERIFY error messages.

Message	Description
00C5 - Unit diagnostics failed.	The ISE unit diagnostics failed and VERIFY cannot run.
xxxx - Multicopy read operation of xCT block n failed.	Block n of a multicopy structure, the FCT, or the RCT, is not readable. xxxx is the MSCP error code.

Error Messages (continued)

Message	Description
Copy n of RCT block m (LBN x) is bad.	Copy n of RCT block m, corresponding to LBN block x, is bad.
xBN n has a forced error.	While scanning the LBN, DBN, or XBN space, block n was marked with a forced error flag.
xBN n has an invalid header error.	While scanning the LBN, DBN, or XBN space, block n had a problem with its header.
xBN n has a data sync timeout error.	While scanning the LBN, DBN, or XBN space, block n had problems syncing up to the data bits.
xBN n has an ECC field correctable error.	While scanning the LBN, DBN, or XBN space, block n suffered an error, but only in the ECC field.
xBN n has an uncorrectable ECC error.	While scanning the LBN, DBN, or XBN space, block n was unreadable due to an uncorrectable ECC error.
xBN n received error status : xxxx(X).	While scanning the LBN, DBN, or XBN space, block n has some other error. The MSCP error code is xxxx.

**Warning
Messages**

The following table describes the VERIFY warning messages.

Message	Description
xCT block n used copy m.	The first copy of block n of a multicopy structure, the FCT, or the RCT, is not readable. Copy m of that block was used instead.
xBN n has a transient (e out of six) error.	While scanning the LBN, DBN, or XBN space, block n suffered a transient error. Out of six reads, the transient error happened e times.
xBN n has a k symbol correctable ECC error.	While scanning the LBN, DBN, or XBN space, block n suffered a correctable ECC error of k bytes.
Table is empty (NO BAD PBNs).	This message is very rare, and indicates that no blocks are marked bad in the FCT. The media was perfect when the ISE unit was formatted.

DKUTIL

Description	DKUTIL is a utility that displays disk structures and disk data. The utility can be used to verify that an ERASE worked correctly. DKUTIL is also useful in problem diagnosis and manual bad block replacement.

Accessing DKUTIL	DKUTIL is accessed in the same way as are the other local programs. Once a connection is established, all interaction occurs through the use of commands and responses. DKUTIL has its own command line interpreter. It has a command syntax similar to the hierarchical storage controller (HSC) DKUTIL utility.

DKUTIL Process	• DKUTIL prompts the user for a command with the DKUTIL> prompt • In most cases, the user issues a GET command to acquire an ISE unit to which subsequent commands are applied • DKUTIL acquires the unit and then returns to the command mode, prompting for a command, executing it, and prompting for another command.

Stopping DKUTIL	To stop DKUTIL, press Ctrl/C, Ctrl/Y, Ctrl/Z, or type EXIT at the DKUTIL> prompt.

DKUTIL Commands

The following table lists the available DKUTIL commands. You do not need to type the entire command because the program is set up to recognize the matching command from the abbreviated command. The abbreviated command is shown in uppercase bold letters.

Command	Definition
DEfault	Changes the default modifiers for subsequent DKUTIL commands.
DIsplay	Displays characteristics, error history, and RCT/FCT information.
DUmp	Dumps the contents of a sector on the disk or the contents of the current buffer.
Exit	Stops the DKUTIL utility.
Get	Acquires the ISE unit from the MSCP server.
Help	Displays information on how to use the DKUTIL commands.
POp	Restores the save buffer to the current buffer.
PUsh	Stores the current buffer in the save buffer.
REplace	Replaces a specified LBN.
Set size	Changes the block size of the ISE unit.

**DKUTIL
Command
Modifiers**

A number of modifiers are used with the DKUTIL GET, DISPLAY, and DUMP commands. These modifiers can be typed with the command or they can be stored using the DEFAULT command. The following tables describe the modifiers and their functions.

GET Modifier	Default Setting	Function
IMF	/NOIMF	Ignore media format. If this modifier is specified, the unit is acquired for physical (PBN) access only.
WP	/WP	Write protect. If this modifier is specified, the media is write protected. This inhibits replacements.

DISPLAY Modifier	Default Setting	Function
FULL	/NOFULL	Display full. If this modifier is specified, a full dump of the RCT or FCT header is displayed.
ITEMS	/NOITEMS	Display items. If this modifier is specified, the items in the RCT or FCT are displayed.

**DKUTIL
Command
Modifiers
(continued)**

DUMP Modifier	Default Setting	Function
HEADER	/HEADER	Display header. If this modifier is specified, the block type and LTN0 fields of the block are displayed.
EDC	/EDC	Display the EDC. If this modifier is specified, the EDC and the expected EDC of the block are displayed.
DATA	/DATA	Display data. If this modifier is specified, the data in the block is displayed.
ECC	/NOECC	Display ECC. If this modifier is specified, the ECC residue of the block is displayed.
ALL	/NOALL	Display all fields. Use of this modifier is equivalent to specifying the modifiers /HEADER /EDC/DATA/ECC.
RAW	/NORAW	Display the raw LBN. If this modifier is specified, the original LBN that was replaced is used instead of the RBN. This modifier affects only the replaced LBNs.
NZ	/NONZ	Display nonzero data. If this modifier is specified, the data field is displayed if it contains all nonzero data. This modifier has no effect if /NODATA is also specified.

DEFAULT

The DEFAULT command changes the default modifiers for subsequent DKUTIL commands. This command "remembers" modifiers so they do not have to be typed each time a command is issued. Modifiers that do not apply to a command are ignored when that command is issued. So, you can specify modifiers that apply to GET, DUMP, and DISPLAY at the same time.

DEFAULT Syntax

The syntax for the DEFAULT command is:

DEFAULT [*modifiers*]

The available *modifiers* are described in the tables on the preceding two pages.

DEFAULT Example

The following example shows how to access the DKUTIL program on an ISE with the unit name R1EJAA.

Once DKUTIL is accessed, the DEFAULT command is issued to set new default values for subsequent commands. GET will apply /NOWP; DUMP will apply /NZ; and DISPLAY will apply /FULL and /ITEMS.

Note that both the DEFAULT command and the /ITEMS modifier are abbreviated.

```
$ SET HOST/DUP/SERVER=MSCP$DUP/TASK=DKUTIL R1EJAA
%HSCPAD-I-LOCPROGEXE, Local program executing
Copyright © 1989 Digital Equipment Corporation

DKUTIL> DE/NOWP/NZ/FULL/ITE
```

DISPLAY

The DISPLAY command displays characteristics, error history, and RCT/FCT information.

DISPLAY Syntax

There are three basic variations to the DISPLAY command:

- DISPLAY CHARACTERISTICS DISK

  This displays the characteristics of the ISE unit.

- DISPLAY [/FULL][/ITEMS] {RCT,FCT}

  This displays the header of the RCT or the FCT. The /FULL modifier controls the amount of RCT or FCT header information displayed. If the /ITEMS modifier is specified, the contents of the RCT or FCT is also displayed.

- DISPLAY ALL

  This is equivalent to typing DISPLAY RCT, DISPLAY FCT, and DISPLAY CHARACTERISTICS DISK.

DISPLAY Modifiers

The following table describes the modifiers used with the DISPLAY command.

Modifier	Default	Function
FULL	/NOFULL	Display full. If this modifier is specified, a full dump of the RCT or FCT header is displayed.
ITEMS	/NOITEMS	Display items. If this modifier is specified, the items in the RCT or FCT are displayed.

DISPLAY Example

The following example shows how the DISPLAY command lists the ISE unit characteristics.

```
DKUTIL> DISP CHA DIS
       Drive characteristics for drive R1EJAA$DIA1

  Type:          RF31 (512 byte mode only)
  Media:         Fixed
  Cylinders:     1861 LBN, 5 XBN, 5 DBN
  Geometry:      1 tracks/group, 8 groups/cylinder,
                 8 tracks/cylinder, 50 LBNs/track,
                 1 RBNs/track, 51 sectors/track,
                 51 XBNs/track, 408 XBNs/cylinder,
                 400 LBNs/cylinder, 8 RBNs/cylinder
  Group Offset: 17 (LBN), 0 (XBN)
  LBNs:          744400 (host), 745416 (total)
  RBNs:          14888
  XBNs:          2040
  DBNs:          1632 (read/write), 408 (read only)
  PBNs:          838032
  RCT:           127 (size), 8 (copies)
  FCT:           127 (size), 8 (copies)
  Retry Limits: 8 (retry), 3 (badblk)
  ECC Threshold:3/2 (normal), 0/0 (format)
  Revision:      4 (hardware), 32 (firmware)
  Drive ID:      124923040310000
```

DUMP

The DUMP command displays the contents of a sector on the disk or the contents of the current buffer. The amount of information displayed can be controlled with modifiers.

DUMP Syntax

There are four basic variations to the DUMP command:

- DUMP BUFFER

  This dumps the contents of the current buffer.

- DUMP {DBN,LBN,RBN,XBN} *block#*

  This dumps the contents of the specified *block#*. The LBN space extends into the RCT, and the XBN space spans all copies of the FCT. These methods of reading the RCT and FCT allow a specific copy to be read.

- DUMP {RCT,FCT} *block#*

  This dumps the contents of the specified *block#*. The block is read using the multiread algorithm. This command also shows you which copy was used to obtain the information.

- DUMP PBN *head#:track#:sector#*

  This dumps the contents of the specified block by giving the physical location of the sector not adjusted by LTN0.

DUMP Modifiers

The following describes modifiers used with DUMP.

Modifier	Default	Function
HEADER	/HEADER	Display header. If this modifier is specified, the block type and LTN0 fields of the block are displayed.
EDC	/EDC	Display the EDC. If this modifier is specified, the EDC and the expected EDC of the block are displayed.
DATA	/DATA	Display data. If this modifier is specified, the data in the block is displayed.
ECC	/NOECC	Display ECC. If this modifier is specified, the ECC residue of the block is displayed.
ALL	/NOALL	Display all fields. Use of this modifier is equivalent to specifying the modifiers /HEADER /EDC/DATA/ECC.
RAW	/NORAW	Display the raw LBN. If this modifier is specified, the original LBN that was replaced is used instead of the RBN. This modifier affects only the replaced LBNs.
NZ	/NONZ	Display nonzero data. If this modifier is specified, the data field is displayed if it contains all nonzero data. This modifier has no effect if /NODATA is also specified.

DUMP
Example

The following example shows how the DUMP command displays the contents of a block of the RCT.

Note that the first copy of this RCT block was used. Also note that LBN 0 is replaced by RBN 0.

```
DKUTIL> DUMP RCT 2

*** Buffer for RCT block 2 (LBN 744402 used), MSCP Status: 0000
    LTN 0 =   90        Type = 47 (X)
    EDC = 032F(X)        Calculated EDC Difference = 14B3(X)
 Data = 3000 0000 0000 0000 0000 0000 0000 0000
 + 16   0000 0000 0000 0000 0000 0000 0000 0000
 + 32   0000 0000 0000 0000 0000 0000 0000 0000
 + 48   0000 0000 0000 0000 0000 0000 0000 0000
 + 64   0000 0000 0000 0000 0000 0000 0000 0000
 + 80   0000 0000 0000 0000 0000 0000 0000 0000
 + 96   0000 0000 0000 0000 0000 0000 0000 0000
 +112   0000 0000 0000 0000 0000 0000 0000 0000
 +128   0000 0000 0000 0000 0000 0000 0000 0000
 +144   0000 0000 0000 0000 0000 0000 0000 0000
 +160   0000 0000 0000 0000 0000 0000 0000 0000
 +176   0000 0000 0000 0000 0000 0000 0000 0000
 +192   0000 0000 0000 0000 0000 0000 0000 0000
 +208   0000 0000 0000 0000 0000 0000 0000 0000
 +224   0000 0000 0000 0000 0000 0000 0000 0000
 +240   0000 0000 0000 0000 0000 0000 0000 0000
 +256   0000 0000 0000 0000 0000 0000 0000 0000
 +272   0000 0000 0000 0000 0000 0000 0000 0000
 +288   0000 0000 0000 0000 0000 0000 0000 0000
 +304   0000 0000 0000 0000 0000 0000 0000 0000
 +320   0000 0000 0000 0000 0000 0000 0000 0000
 +336   0000 0000 0000 0000 0000 0000 0000 0000
 +352   0000 0000 0000 0000 0000 0000 0000 0000
 +368   0000 0000 0000 0000 0000 0000 0000 0000
 +384   0000 0000 0000 0000 0000 0000 0000 0000
 +400   0000 0000 0000 0000 0000 0000 0000 0000
 +416   0000 0000 0000 0000 0000 0000 0000 0000
 +432   0000 0000 0000 0000 0000 0000 0000 0000
 +448   0000 0000 0000 0000 0000 0000 0000 0000
 +464   0000 0000 0000 0000 0000 0000 0000 0000
 +480   0000 0000 0000 0000 0000 0000 0000 0000
 +496   0000 0000 0000 0000 0000 0000 0000 0000
```

DKUTIL, Continued

EXIT

The EXIT command stops the DKUTIL utility. If the ISE unit was acquired, the unit is released to the MSCP server.

EXIT Syntax

The syntax for this command is:

EXIT

EXIT Example

The following is an example of what appears on the screen when you EXIT DKUTIL.

```
DKUTIL> EXIT

%HSCPAD-S-REMPGMEND, Remote program terminated - message code 3.
%HSCPAD-S-END, Control returned to node ISMINE
```

GET

The GET command acquires the ISE unit from the MSCP server (if possible). Most DKUTIL commands work only after the GET command succeeds.

The GET command cannot succeed if the ISE unit is online to any host.

GET Syntax

The syntax for the GET command is:

GET [*modifier*]

The specified *modifier* controls how the unit is acquired.

GET Modifiers

The following table describes the modifiers used with the GET command.

Modifier	Default	Function
IMF	/NOIMF	Ignore media format. If this modifier is specified, the unit is acquired for physical (PBN) access only.
WP	/WP	Write protect. If this modifier is specified, the media is write protected. This inhibits replacements.

GET Example

The following example shows the outcome of a successful GET command. The unit is acquired from the MSCP server and the unit FCT status is displayed. In this example, /NOWP was previously set by the DEFAULT command and /NOIMF was the default upon entry to DKUTIL.

```
DKUTIL> GET
    Serial Number:          0000000000000000
    Mode:                   ADDE(X)
    First Formatted:        9-AUG-1989 13:25:10
    Date Formatted:         9-AUG-1989 13:25:10
    Format Instance:        1
    FCT:                     VALID
```

HELP

The HELP command displays information on how to use the DKUTIL commands. <endblock>

HELP Syntax

The syntax for the HELP command is:

HELP

HELP Example

Typing HELP produces the following display.

```
DKUTIL> HELP
    DEFAULT [/qualifiers]
    DISPLAY [/qualifiers] {ALL|FCT|RCT|CHAR DISK}
        /FULL       /ITEMS
    DUMP [/qualifiers] {BUFFER|type n|PBN h:t:s}
        /HEADER    /EDC        /DATA
        /NZ        /ECC        /ALL
        /RAW
    EXIT
    GET [/qualifiers]
        /IMF       /WP
    HELP
    POP
    PUSH
    REPLACE lbn
    SET SIZE 512

DKUTIL>
```

POP

The POP command restores the save buffer to the current buffer.

DKUTIL maintains two I/O buffers while it runs: the current buffer and the save buffer. The DUMP command always uses the current buffer. Use the PUSH command to save data before subsequent DUMPs. Use the POP command, followed by the DUMP BUFFER command, to view the saved data.

POP Syntax

The syntax for this command is:

POP

POP Example

In this example, the contents of the buffer saved by the most recent PUSH command is restored to the current buffer.

```
DKUTIL> POP
```

PUSH

The PUSH command stores the current buffer in the save buffer.

DKUTIL maintains two I/O buffers while it runs: the current buffer and the save buffer. The DUMP command always uses the current buffer. Use the PUSH command to save data before subsequent DUMPs. Use the POP command, followed by the DUMP BUFFER command, to view the saved data.

PUSH Syntax

The syntax for this command is:

PUSH

PUSH Example

In this example, the contents of the buffer loaded by the most recent DUMP command is stored to the save buffer.

```
DKUTIL> PUSH
```

REPLACE

The REPLACE command replaces a specified LBN. The results of the REPLACE command are displayed. The display contains the last few longwords of a Bad Block Replacement Summary error log packet.

REPLACE cannot succeed if the unit is write protected (GET /WP), or if the unit was acquired for physical (PBN) access only (GET/IMF).

REPLACE Syntax

The syntax for the REPLACE command is:

REPLACE *lbn#*

The specified *lbn#* is replaced.

REPLACE Example

In the following example, LBN0 is replaced.

```
DKUTIL> REPLACE 0
Replace summary log packet:
      Flags: 60(X)
      Event: 0014(X)
  Rep flags: 8000(X)
        LBN: 0
    Old RBN: 0
    New RBN: 0
```

SET SIZE

The SET SIZE command changes the block size of the ISE unit. Only 512-byte block sizes are supported. This command is for compatibility with the HSC implementation of DKUTIL.

**SET SIZE
Syntax**

The syntax for the SET SIZE command is:

SET SIZE *blocksize#*

Presently, the only acceptable *blocksize#* is 512.

**SET SIZE
Example**

This example shows the block size of the unit set to 512 bytes.

```
DKUTIL> S S 512
```

PARAMS

Description

PARAMS is a utility that allows you to examine and change internal ISE parameters such as node name, allocation class, and MSCP unit number. PARAMS is also used to display the state of the ISE and performance statistics maintained by the ISE.

Accessing PARAMS

PARAMS is accessed in the same way as the other local programs. Once a connection is established, all interaction occurs through the use of commands and responses. PARAMS has its own command line interpreter. It has a command syntax similar to the VMS SYSGEN utility.

PARAMS Process

- PARAMS prompts the user for a command with the PARAMS> prompt.
- Once a command is entered, PARAMS executes it and then prompts for another command.

Stopping PARAMS

To stop PARAMS, press Ctrl/C, Ctrl/Y, Ctrl/Z, or type EXIT at the PARAMS> prompt.

PARAMS Commands

The following table lists the available PARAMS commands. You do not need to type the entire command because the program is set up to recognize the matching command from the abbreviated command. The abbreviated command is shown in uppercase bold letters.

Command	Definition
Exit	Stops the PARAMS utility.
Help	Displays information on how to use PARAMS commands.
Locate	Causes a soft fault in the ISE to help you locate it.
SEt	Changes internal ISE parameters.
SHow	Displays the setting of a parameter or a class of parameters.
STatus	Displays module configuration, history, performance counters, and so on.
Write	Records the device parameter changes you make using the SET command in nonvolatile RAM.
Zero	Clears a block of counters or all known blocks of counters.

EXIT

The EXIT command stops the PARAMS utility.

EXIT Syntax

The syntax for the EXIT command is:

EXIT

EXIT Example

The following is an example of what appears on the screen when you EXIT PARAMS.

```
PARAMS> EXIT
Exiting ...

%HSCPAD-S-REMPGMEND, Remote program terminated
%HSCPAD-S-END, Control returned to node ISMINE
```

HELP

The HELP command displays information on how to use PARAMS commands. It is not a substitute for this document, but is useful as a quick reference.

HELP Syntax

The syntax for the HELP command is:

HELP

HELP Example

The following is what appears on the screen when you type HELP.

```
PARAMS> help
  ENABLE MSCP
  EXIT
  HELP
  LOCATE
  SET {parameter | .} value
  SHOW {parameter | . | /class}
    /ALL      /CONST    /DRIVE
    /SERVO    /SCS      /MSCP
    /DUP
  STATUS [type]
    CONFIG    LOGS      DATALINK
    PATHS     SYSTEM    SEEKS
    MSCP      THREADS
  WRITE
  ZERO counter
    ALL       MSCP      SEEKS

PARAMS>
```

LOCATE

The LOCATE command causes a soft fault in the ISE to help you locate it. The soft fault does not affect its current operation or state. The fault LED on the drive module and the fault LED on the operator control panel turn on and stay on until you press Return at the PARAMS> prompt.

LOCATE Syntax

The syntax for the LOCATE command is:

LOCATE

LOCATE Example

The following is what appears on the screen when you type LOCATE.

```
PARAMS> LOCATE
Drive has been soft faulted to help locate it
Press RETURN to continue:
PARAMS>
```

SET

The SET command changes internal ISE parameters. The changes are made to a working copy of the ISE parameters and do not take effect until a WRITE command is successful.

SET Syntax

The syntax for the SET command is: SET *parameter value*

The *parameter* is the name of the parameter to be set, or the special symbol . (period), which means the last SET or SHOWn parameter. The *value* is the new value you want to assign to the parameter.

The available parameters are listed on the following page. If the parameter name is abbreviated, the first matching parameter is used without regard to uniqueness. We recommend that you use SHOW before you use SET.

SET Example

The following example changes the node name from the default (R1EJAA) to the new string "SUSAN". When entering ASCII strings, you may use single quotes, double quotes, or no quotes at all.

```
PARAMS> SHOW NODE
Parameter       Current          Default      Type      Radix
---------    -------------    -----------   -------    -----
NODENAME         R1EJAA           RF31       String    Ascii    B

PARAMS> SET . "SUSAN"
PARAMS> SHOW .
Parameter       Current          Default      Type      Radix
---------    -------------    -----------   -------    -----
NODENAME         SUSAN            RF31       String    Ascii    B

PARAMS>
```

SET and SHOW Parameters

The following tables describe the SET and SHOW command parameters and their functions.

MSCP Parameter	Function
ALLCLASS	Sets or shows the allocation class of the disk MSCP server.
UNITNUM	Sets or shows the MSCP unit number.
FORCEUNI	Determines whether the parameter UNITNUM or the DSSI node ID is used as the MSCP unit number. The factory setting for this parameter is 1 (true), and the DSSI node ID is used. Until set to 0 (false), the UNITNUM parameter is ignored.
HISPEED[1]	If set to 1 (true), only half of the ISE capacity is presented to hosts. This reduces the stroke of the seek, and thus improves performance at the expense of capacity. Average seek time is reduced by approximately 3 ms. The factory setting for this parameter is 0 (false).
SEEKALG	Selects one of three seek algorithms. The factory setting is the C-scan algorithm (2). You can also select the shortest distance algorithm (0), or the elevator algorithm (1).
FIVEDIME	Determines whether the MSCP server should support five concurrent connections (the factory default of true, or 1) or seven connections with reduced resources allocated to each (false, or 0).

[1]This option is only available on the RF31.

**SET and
SHOW
Parameters
(continued)**

DRIVE Parameter	Function
VOLSERNO	Shows the volume serial number of the HDA.

DUP Parameter	Function
ADD_CR	Appends a Return character after each message. The factory setting is 0 (false).
ADD_LF	Appends a Line Feed to each message. The factory setting is 0 (false).

SCS Parameter	Function
SYSTEMID	Sets or shows the 48-bit SCS system ID of the ISE.
NODENAME	Sets or shows the SCS node name of the ISE.
FORCENAM	Determines whether the value set by the NODENAME parameter or the string RFYYx[1] is returned as the SCS node name. The letter x corresponds to the DSSI node ID (A = 0, B = 1, and so on). The factory setting is 0 (false), and the value set by NODENAME is used.

[1]RFYYx is returned as the SCS nodename where; YY represents the ISE type, either 31, 35, 72, or 73 and x corresponds to the DSSI node ID (A = 0, B = 1, and so on).

SHOW

Displays the setting of a parameter or a class of parameters. The full name of the parameter, its current value, default value, radix and type, and any flags associated with the parameter are displayed.

SHOW Syntax

The syntax for the SHOW command is:

SHOW *parameter_or_class*

The *parameter_or_class* is a parameter name, the special symbol . (period), which means the last SET or SHOWn parameter, or a SHOW class preceded by a / (slash).

If an abbreviation is used, the first matching parameter or class is displayed.

PARAMS, Continued

SHOW Classes

The following table describes the available SHOW classes.

Class	Description
/ALL	All SHOW classes are displayed.
/CONST	ISE constants are grouped in this class.
/DRIVE	Drive parameters, typically those governing drive calibrations, thresholds, and retries, are grouped in this class.
/SERVO	Servo parameters, typically the results of drive calibrations, are grouped in this class.
/SCS	Systems communication services (SCS) parameters are grouped in this class. The node name and system ID are in this class.
/MSCP	Mass Storage Control Protocol (MSCP) parameters are grouped in this class. The parameters that control the unit number are in this class.
/DUP	Diagnostic and utility protocol (DUP) parameters are grouped in this class.

PARAMS, Continued

SHOW Example

The following example shows various forms of the SHOW command and how they are used to change the MSCP unit number from the default (DSSI bus ID) to a new value of 8402.

```
$ SET HOST/DUP/SERVER=MSCP$DUP/TASK=PARAMS R1EJAA
%HSCPAD-I-LOCPROGEXE, Local program executing
Copyright © 1989 Digital Equipment Corporation

PARAMS> SHOW FORCEUNI
Parameter        Current           Default          Type     Radix
---------   ---------------   ---------------   -------   -----
FORCUNI                  1                  1   Boolean    0/1   U

PARAMS> SET . 0
PARAMS> SHOW UNITN
Parameter        Current           Default          Type     Radix
---------   ---------------   ---------------   -------   -----
UNITNUM                  0                  0   Boolean    Dec   U

PARAMS> SET . 8402
PARAMS> SHOW /MSCP
Parameter        Current           Default          Type     Radix
---------   ---------------   ---------------   -------   -----
MSCPNVR     2020202020202020  2020202020202020
            2020202020202020  2020202020202020
            2020202020202020  2020202020202020
            2020202020202020  2020202020202020   String    Hex   RO
WRTLOGSZ                 2                  2      Word     Dec   RO
UNITID      1B02403192300124     0000000000000  Quadword    Hex   RO
ALLCLASS                 0                  0      Byte     Dec   B
MEDIAID           2264601F           2264601F  Longword    Hex   RO U
HISPEED                  0                  0   Boolean    0/1   U
UNITNUM               8402                  0      Word     Dec   U
FORCEUNI                 0                  1   Boolean    0/1   U
FORCEID                  1                  1   Boolean    0/1   RO
FIVEDIME                 1                  1   Boolean    0/1   B
SEEKALG                  2                  2      Byte     Dec
CNT_TMO                 60                 60      Word     Dec   RO

PARAMS>
```

STATUS

The STATUS command displays a variety of information including module configuration, transient and unit error history, performance counters, and so on. The STATUS type you select determines the type of information displayed.

STATUS Syntax

The syntax for the STATUS command is:

STATUS [*type*]

The *type* is an option that corresponds to a type of information. If omitted, all available types of status information are displayed.

If the *type* is abbreviated, all matching types are displayed.

STATUS Types
The following table describes the available STATUS types.

Type	Function
CONFIG	Displays module configuration information and some system information such as power-on hours and the system time.
LOGS	Displays the last 11 transient errors recorded in nonvolatile RAM. In VMS terms, these are the last 11 machine checks and bug checks known to the controller.
DATALINK	Displays the DSSI data link counters. These include the number of packets received and transmitted, the number of NAKs sent and received, and so on.
PATHS	Displays the topology of the DSSI bus on which this ISE resides by displaying open virtual circuits to other nodes on the bus and related packet counters.
SYSTEM	Displays system statistics and counters.
SEEKS	Displays seek statistics such as average seek times and a seek length histogram.
MSCP	Displays MSCP statistics such as the number and type of I/O commands and various histograms.
THREADS	Displays the known programs in the system, the amount of CPU time consumed, and other information.

STATUS Examples

The following examples show the use of three STATUS commands.

```
PARAMS> STAT CONFIG

Configuration:
 Node R1EJAA is an RF31 controller
 Software RFX V200 built on 22-AUG-1989 13:39:09
 Electronics module name is EN92300124
 In 26 power-on hours, power has cycled 45 times
 System up time is 1 01:25:07.90
 System time is 26-AUG-1989 15:00:12


PARAMS> STATUS DATALINK
Datalink Counters:
      Interval:  91593 seconds
   Pkts Rcv'd:      121535:*******************************
   Pkts Xmt'd:      121536:*******************************
   Naks Rcv'd:      23665:**********
   Nakd Xmt'd:          0:
 Resets Rcv'd:     45713:******************
 Resets Xmt'd:     21369:********
  No response:      2290:*
   Duplicates:         0:
     Unrecogs:         0:


PARAMS> STATUS PATHS
 ID  Path Block   Remote Node        DG_S   DG_S   MSGS_S   MSGS_S
 --  -----------  ----------------   -----  -----  -------  -------
  1 PB FF84517A   Internal Path        0      0        0         0
  0 PB FF8452A6 R3QZTI RFX V103         0      0        0         0
  3 PB FF8453D2 R7ZIAA RFX V103         0      0        0         0
  4 PB FF8454FE R7ZJBA RFX V103         0      0        0         0
  5 PB FF84562A R7ULBA RFX V103         0      0        0         0
  6 PB FF845756 LEDS13 VMS V5.2         0      0    27497     27497
  7 PB FF845882 ISMINE VMS V5.2         0      0    32636     32636

PARAMS>
```

WRITE

The WRITE command records the device parameter changes you make using the SET command in nonvolatile memory. The WRITE command is similar to the VMS SYSGEN WRITE command, although no parameters are available.

Reasons for Failure

When using the WRITE command, you must be aware of system and/or ISE requirements and use the command accordingly or it may not succeed. The WRITE command may fail for one of the following reasons:

- **Unit not Acquired**

  You altered a parameter that required the unit, and the unit could not be acquired (it was not in the available state with respect to all hosts). Changing the unit number is an example of a parameter that requires the unit.

  A parameter requires the unit if the flag U appears at the right of the SHOW display (refer to the SHOW example).

Reasons for Failure (continued)	• **Unit not Initialized**

• **Unit not Initialized**

You altered a parameter that required controller initialization, and you replied negatively to the request for reboot. Changing the node name or the allocation class are examples of parameters that require controller initialization.

A parameter requires controller initialization if the flag B appears at the right of the SHOW display (refer to the SHOW example).

• **Calibrations in Progress**

Initial drive calibrations were in progress on the unit. The use of the WRITE command is inhibited while these calibrations are running. In this case, the message "Drive calibration in progress, please try later" is displayed.

WRITE Syntax

The syntax for the WRITE command is:

WRITE

WRITE Example

The following is an example of how you use the WRITE command.

```
PARAMS> SHOW ALL
Parameter       Current           Default        Type    Radix
---------    ----------------  ----------------  -------  -----
ALLCLASS                  0                  0   Byte     Dec   B

PARAMS> SET . 4
PARAMS> WRITE
Changes require controller initialization, ok? [Y/(N)] Y

Initializing...
```

NOTE
It will take approximately one minute before the following message is printed.

```
%HSCPAD-S-REMPGMEND, Remote program terminated - message number 3.
%HSCPAD-S-END, Control returned to node R1EJAA
```

ZERO

The ZERO command clears a block of counters or all known blocks of counters.

ZERO Syntax

The syntax for the ZERO command is:

ZERO *counter*

The *counter* is a block of performance counters or all known counters.

Counter Types

The following table describes the available counter values.

Counter	Function
ALL	Clears all performance counter blocks.
MSCP	Clears the MSCP performance counters and histograms.
SEEKS	Clears the seek performance counters and histograms.

ZERO
Example

The following example of the ZERO command can clear the MSCP performance counters and histograms.

```
PARAMS> STATUS MSCP
MSCP statistics:
         Interval:   92715 seconds
    I/O Commands:   0
 Max Queue Depth:   0
 Queue Depth Histogram:
 Commands Processed Histogram:
  GetUnit          1546:***********************************
   SetCon:            2:*
 Blocks Accessed Histogram (cylinder ranges):
 Read Lengths Histogram (block count ranges):
 Write Lengths Histogram (block count ranges):

PARAMS> ZERO MSCP
PARAMS> STATUS MSCP
MSCP statistics:
         Interval:   2 seconds
    I/O Commands:   0
 Max Queue Depth:   0
 Queue Depth Histogram:
 Commands Processed Histogram:
 Blocks Accessed Histogram (cylinder ranges):
 Read Lengths Histogram (block count ranges):
 Write Lengths Histogram (block count ranges):

PARAMS>
```

Chapter 5
Troubleshooting Procedures

Performing Troubleshooting Procedures

In this Chapter

This chapter covers the following topics:

- What to do if the ISE operates incorrectly
- Failure indications
- Internal self-tests

Introduction

This chapter describes what you should do if your ISE operates incorrectly. Also described in this chapter are failure indications and internal self-tests.

NOTE
Remember that repairs to the ISE should be attempted only by qualified Digital Services engineers.

Self-Tests

POST

The ISE automatically performs a self-test whenever power is applied. This power-on self-test (POST) is designed to detect most faults that occur in the ISE. More information on POST is found in Chapter 2.

Internal Tests and Calibrations

Periodic internal tests and calibrations are performed as a normal part of the operation of the ISE. These tests are run automatically on a periodic basis and cause the device to appear active (although there may be no system activity at the time). This is normal, and does not indicate a problem.

Performing Troubleshooting Procedures, Continued

Failure Indications

An ISE may fail during initial power-up or during normal operation. The following table describes the states of the LEDs, what these states mean, and what actions you should take.

When ...	It means ...	And you ...
The READY LED is on and the FAULT LED is off	the operating condition is normal	may use the ISE.
The FAULT and READY LEDs turn on and stay on	the ISE is unable to execute the POST	power down the system, check DSSI cable, and try again. If failure persists, call Digital Services.
Neither LED turns on	proper amount of power may not be getting to the ISE	check power supply and DSSI cable. If failure persists, call Digital Services.
The FAULT LED turns on and stays on	a fault condition exists	run local programs, as described in Chapter 4, to isolate failure. If unable to access local programs, check DSSI node ID. If failure persists, call Digital Services.

Before Calling Digital Services

If a failure occurs with the ISE, make sure:

- The ISE has the correct DSSI node ID
- No other device on the DSSI bus has the same node ID

Refer to Chapter 3 to make sure the DSSI node ID is set correctly. If the ID is set correctly and the ISE still fails, call Digital Services.

Chapter 6
Digital Services

Types of Service Plans

In this Chapter	This chapter describes a range of flexible services offered by Digital Services.
On-Site Service	On-site service offers the convenience of service at your site and insurance against unplanned repair bills. For a monthly fee, you receive personal service from our service specialists. Within a few hours, the specialist is dispatched to your site with equipment and parts to give you fast and dependable maintenance.
BASIC Service	BASIC service offers full coverage from 8 a.m. to 5 p.m., Monday through Friday. Options are available to extend your coverage to 12-, 16-, or 24-hour periods, and to include Saturdays, Sundays, and holidays. Under the basic service plan all parts, materials, and labor are covered in full.

Types of Service Plans, Continued

DECservice

DECservice offers a premium, on-site service providing committed response to remedial service requests made during contracted hours of coverage. Remedial maintenance will be performed continuously until the problem is resolved, which makes this service ideal for customers requiring maximum service performance. Under DECservice all parts, materials, and labor are covered in full.

Carry-In service

Carry-in service offers fast, personalized response, and the ability to plan your maintenance costs for a smaller monthly fee than On-Site Service. When you bring your unit to one of 160 Digital SERVICenters worldwide, factory-trained personnel repair your unit within 2 days. This service is available on selected terminals and systems. Contact your local Digital Services office to see if this service is available for your unit.

Digital SERVICenters are open during normal business hours, Monday through Friday.

DECmailer

DECmailer offers expert repair at a per use charge. This service is designed for users who have the technical resources to troubleshoot, identify, and isolate the module causing the problem. Mail the faulty module to our Customer Returns Center where the module is repaired and mailed back to you within 5 days.

Types of Service Plans, Continued

Per Call Service

Per call service offers a maintenance program on a noncontractual, time-and-materials-cost basis. This service is appropriate for customers who have the expertise to perform first-line maintenance, but may occasionally need in-depth support from Digital Services.

Per call service is available as a supplement to three of our service plans, as shown in the table below.

Service Plan	Turnaround Time	Coverage is Available ...
Basic	ASAP	12-, 16-, or 24-hours a day including weekends and holidays, depending on option chosen
On-Site	2 to 3 days	24 hours a day, 7 days a week
Carry-In	2 to 3 days	During normal business hours

For More Information

For more information on these Digital Services plans, prices, and special rates for volume customers, call the Digital Services office nearest you.

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