VAXft Systems

Model 810 Service Information

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This manual is intended for use by trained personnel responsible for maintaining VAXft Model 810 systems.

Digital Equipment Corporation

June 1993

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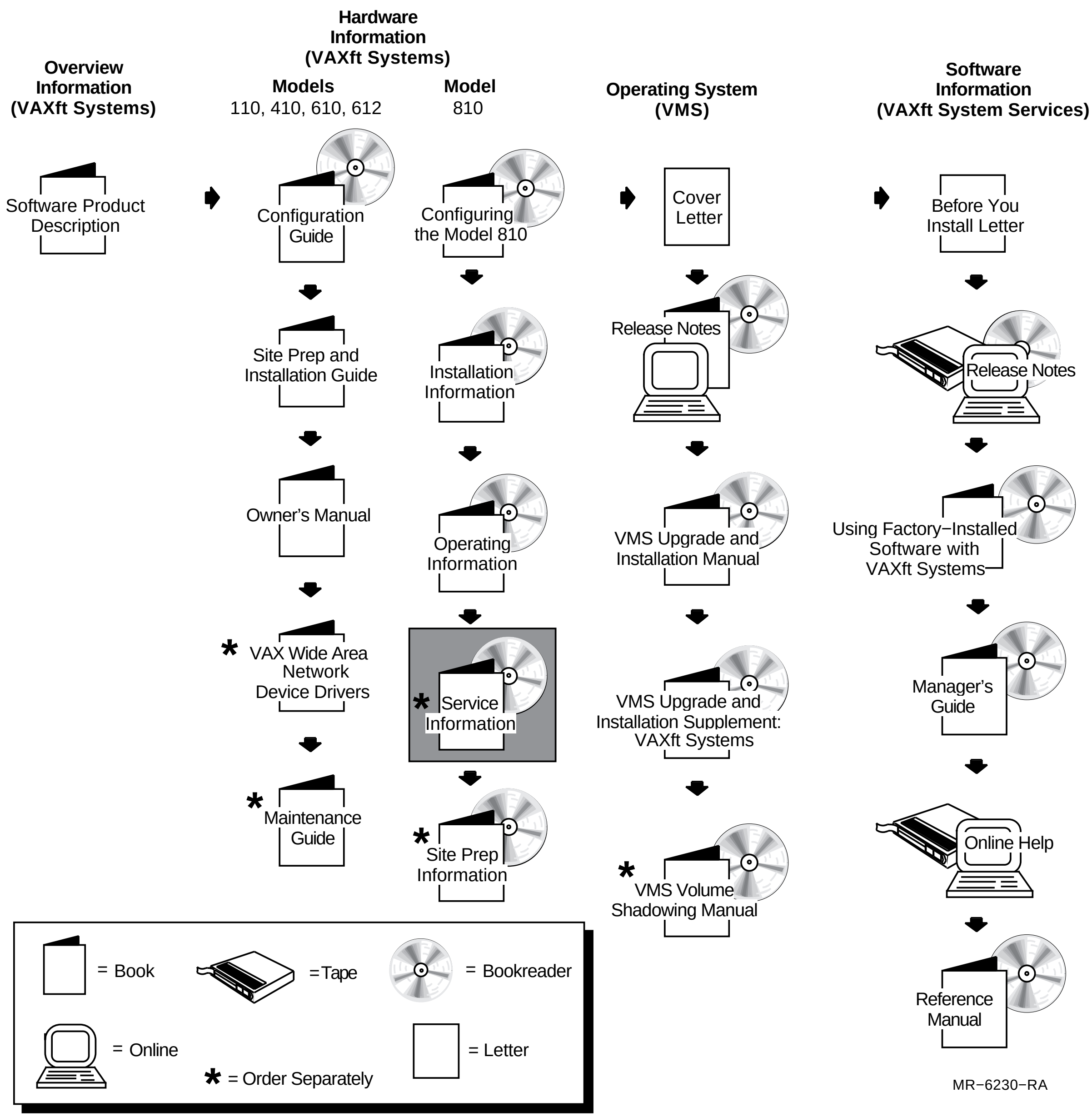
This document is available on CDROM.

Documentation Map



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Cabinet and Component Descriptions

1.1 In This Chapter

This chapter includes descriptions of the:

- CPU and expansion cabinets
- Zone control panel
- Power modules
- Domestic power distribution box
- International power distribution box

1.2 CPU and Expansion Cabinets

Figure 1–1 shows the front layout of an expanded system. Table 1–1 describes the components shown in Figure 1–1. Figure 1–2 shows the rear layout of an expanded system. Table 1–2 describes the components shown in Figure 1–2.

Figure 1–1 Cabinet Layout, Front View

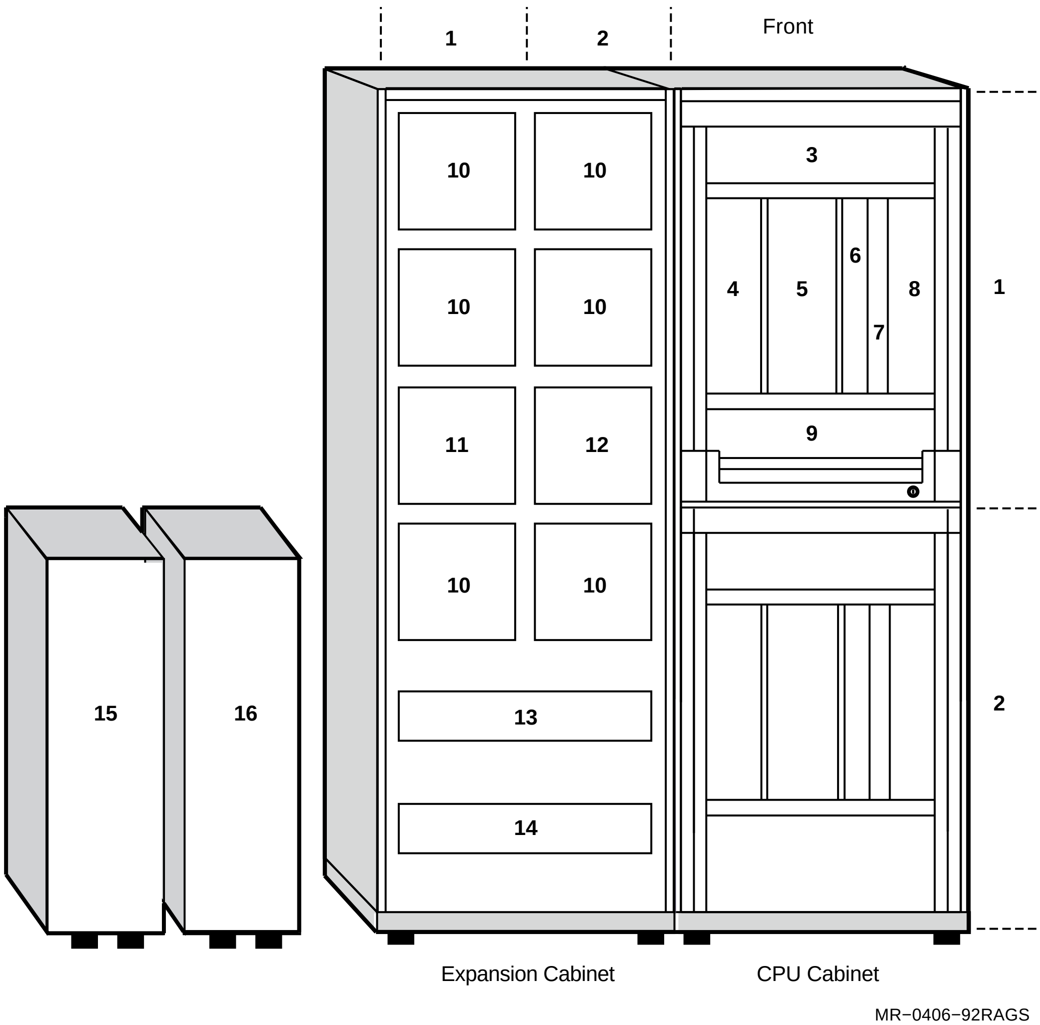


Table 1–1 Key to Figure 1–1, Cabinet Layout, Front View

Item	Component	Description
1	Zone A	Complete computer with enough elements to run an operating system.
2	Zone B	Complete computer with enough elements to run an operating system.
3	Fan assembly	Cooling device.
4	Disk drawer	Optional SF35 disk drive(s).
	System Module Card Cage	
5	Slot 0 - CPU module	Logic chips and memory.
6	Slot 1 - ATM module	I/O logic supporting up to eight interface adapter cards.
7	Slot 2 - Not used	For future expansion.
8	Zone control panel	Zone controls and indicators.
9	Blank panel	Not used.
10	Disk device	Location for disk device.
11	Disk/tape device	Location for disk or tape device.
12	Disk/tape/tape loader	Location for disk, tape, or tape loader device.
13	Power distribution box A	AC power source for Zone A.
14	Power distribution box B	AC power source for Zone B.
15	UPS A	Optional uninterruptible power supply for Zone A.
16	UPS B	Optional uninterruptible power supply for Zone B.

Figure 1–2 Cabinet Layout, Rear View

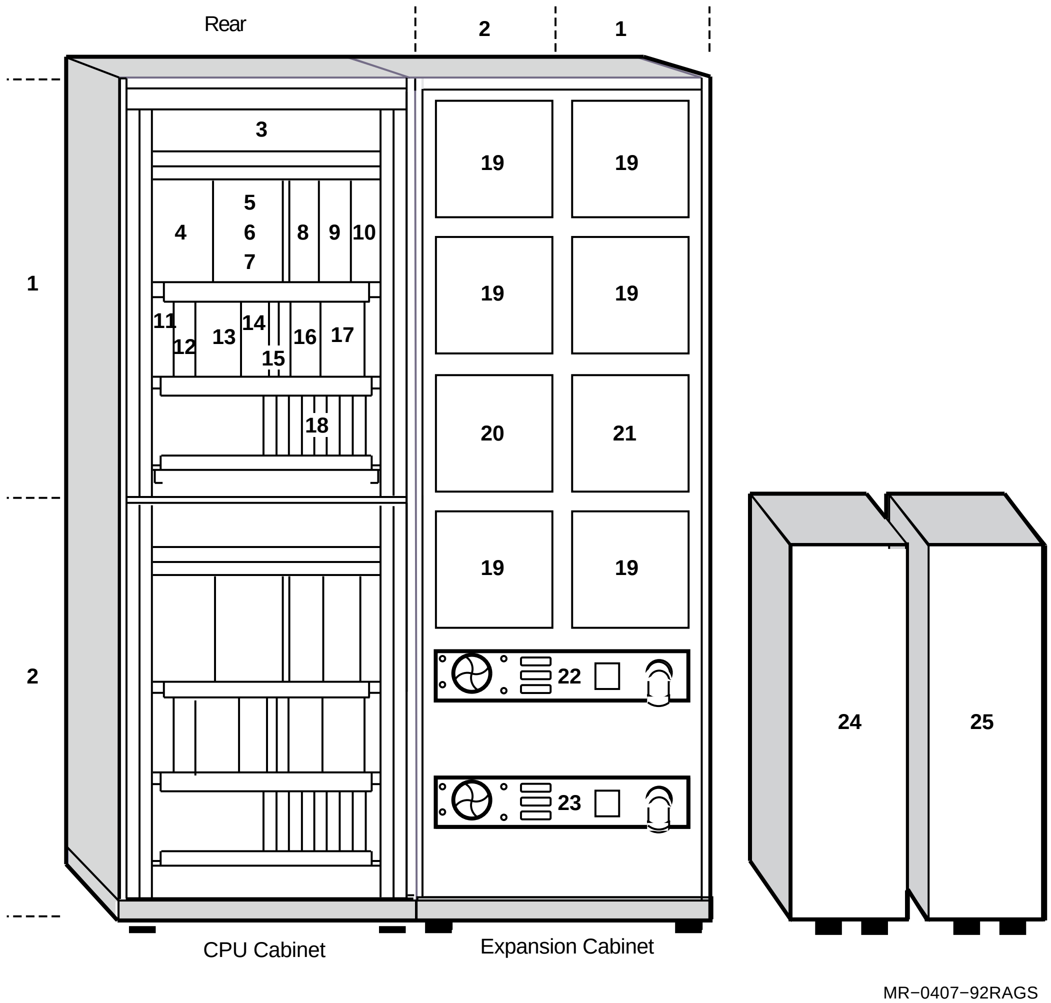


Table 1–2 Key to Figure 1–2, Cabinet Layout, Rear View

Item	Component	Description
1	Zone A	Complete computer with enough elements to run an operating system.
2	Zone B	Complete computer with enough elements to run an operating system.
3	Fan assembly	Cooling device.
4	Blank panel	Not used.
5	Front End Unit (FEU)	AC input circuit breaker.
6	FEU	Converts ac power to 48 Vdc.
7	FEU	AC input connector.
8	Regulator	Provides +3.3 Vdc at 30 A, +12 Vdc at 12.5 A, and bias.
9	Regulator	Provides +5 Vdc at 90 A.
10	Power system controller	Provides interface signals to the ATM module.
	Miscellaneous Module Card Cage	
11	Blank panel	Not used.
12	Slot 0 - Not used	For future expansion.
13	Slot 1 - Cross-link assembly	Connects Zone A and Zone B.
14	Slot 2 - Console module	Module with console port.
15	Slot 3 - Not used	Factory test module.
16	Slot 4 - Disk In/Disk Out module	Permits zone interconnections to access all configured disks.
17	Slot 5 - CAMP module	Provides custom power control circuits.
	Interface Module Card Cage	
18	Slots 10 to 17	DSSI and NI interface modules.
	Slots 20 to 27	For future expansion.
19	Disk device	Location for disk device.
20	Disk/tape/tape loader	Location for disk, tape, or tape loader device.
21	Disk/tape device	Location for disk or tape device.
22	Power distribution box A	AC power source for Zone A.
23	Power distribution box B	AC power source for Zone B.
24	UPS A	Optional uninterruptible power supply for Zone A.
25	UPS B	Optional uninterruptible power supply for Zone B.

1.3 Zone Control Panel

Figure 1–3 shows the layout of the zone control panel. Table 1–3 describes the functions of the zone control panel controls and indicators.

Figure 1–3 Zone Control Panel

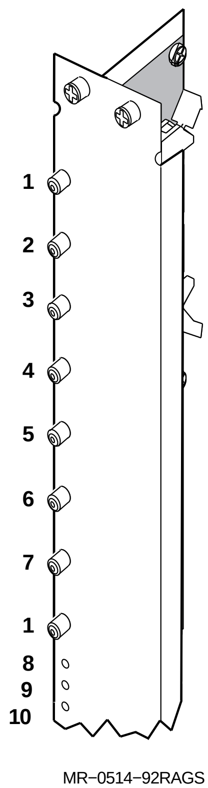


Table 1–3 Key to Figure 1–3, Zone Control Panel

Item	Control/Indicator	Function
1	Logic Power - OFF	Two switches with amber indicators. Pressing the two switches removes 48 V power and disables the zone. Pressing one switch has no effect on the operation of the zone. (CPU cabinet disk power is not affected when logic power is removed by pressing these switches.)
2	Logic Power - ON	One switch with a green indicator. Pressing this switch applies 48 V power to the zone. (CPU cabinet disk power is not affected when logic power is applied by pressing this switch.)
3	Local Console	One switch with a green indicator. Pressing this switch connects the system to the console local port for communication.
4	Remote Console	One switch with a green indicator. Pressing this switch connects the system to the remote port for communication.
5	Secure	One switch with a green indicator. Pressing this switch disables the console Break key function. (You cannot use the console Break key to halt the zone or system.)
6	Zone Halt Enable	One switch with a green indicator. Pressing this switch enables the console Break key function. (You can use the console Break key to halt the zone.)
7	System Halt Enable	One switch with a green indicator. Pressing this switch enables the console Break key function. (You can use the console Break key to halt both zones.)

Note

System Halt Enable is NOT supported in Simplex mode.

Item	Control/Indicator	Function
8	System OK	Green indicator. On when the system power is on and the system is operational.
9	System Fault	Amber indicator. On when the system is not operational.
10	OS Running	Green indicator. On when the system is operational and running a customer or diagnostic application.

1.4 Power Modules

Figure 1–4 shows the location of the power module controls and indicators. Table 1–4 describes their functions.

Figure 1–4 Power Module Controls and Indicators

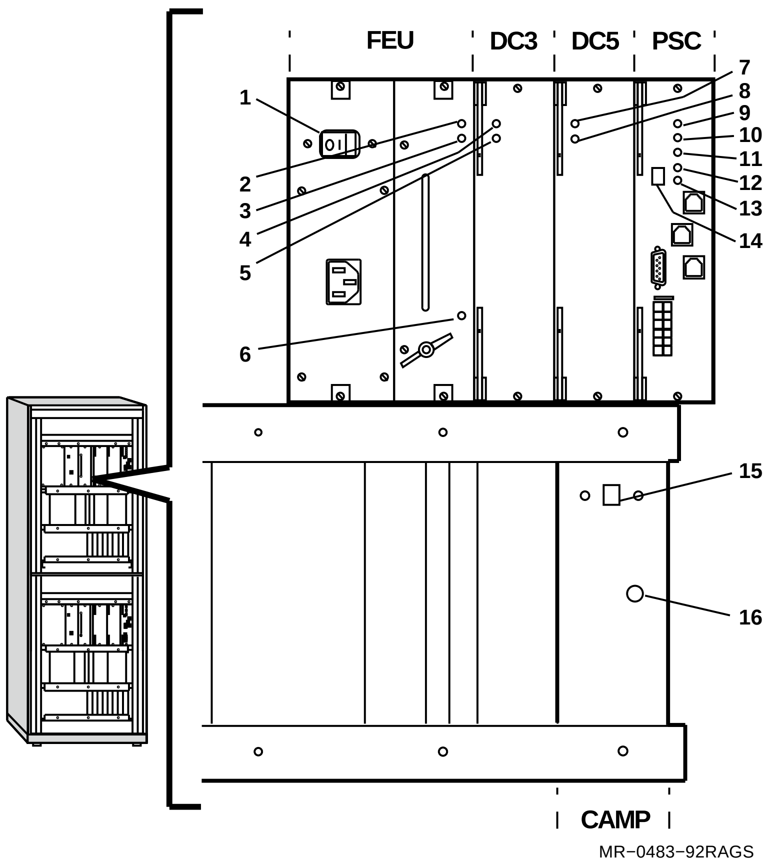


Table 1–4 Key to Figure 1–4, Power Module Controls and Indicators

Item	Control/Indicator	Function
1	AC Circuit Breaker	
2	FEU Failure	When on, indicates the dc output voltages for the FEU are below the specified minimum.
3	FEU OK	When on, indicates the dc output voltages for the FEU are above the specified minimum.
4	DC3 Failure	When on, indicates that one of the +3 Vdc output voltages is not within the specified tolerances.
5	DC3 OK	When on, indicates that the +3 Vdc output voltages are within the specified tolerances.
6	AC Present	When on, indicates ac power is present at the ac input connector, regardless of the position of the circuit breaker.
7	DC5 Failure	When on, indicates that one of the +5 Vdc output voltages is not within the specified tolerances.
8	DC5 OK	When on, indicates that the +5 Vdc output voltages are within the specified tolerances.
9	PSC Failure	When on, indicates a PSC fault.
10	PSC OK	When blinking, indicates the PSC is performing power-on self-tests.
		When on, indicates the PSC is functioning.
11	Over Temperature Shutdown	When on, indicates that the PSC shut down the system because of an internal overtemperature condition.
12	Fan Failure	When on, indicates a fan failure. Use the hexadecimal number in the Fault ID Display to isolate the fan.
13	Disk Power Failure	When on, indicates a disk power failure. Use the hexadecimal number in the Fault ID Display to isolate the storage compartment that houses the disk.
14	Fault ID Display	Displays power subsystem fault codes.
15	PSC Reset Button	When out, indicates a PSC fault condition. Press in to reset.
16	CAMP Fan Fault	When on, indicates that a fan fault caused all disk drives and tape drives to shut down.

1.5 Domestic and International Power Distribution Boxes

The domestic power distribution box (PN 30-24374-01) is shown in Figure 1–5. Table 1–5 describes the components shown in the figure. The international power distribution box (PN 30-35415-02) is shown in Figure 1–6. Table 1–6 describes the components shown in the figure.

Figure 1–5 Domestic Power Distribution Box

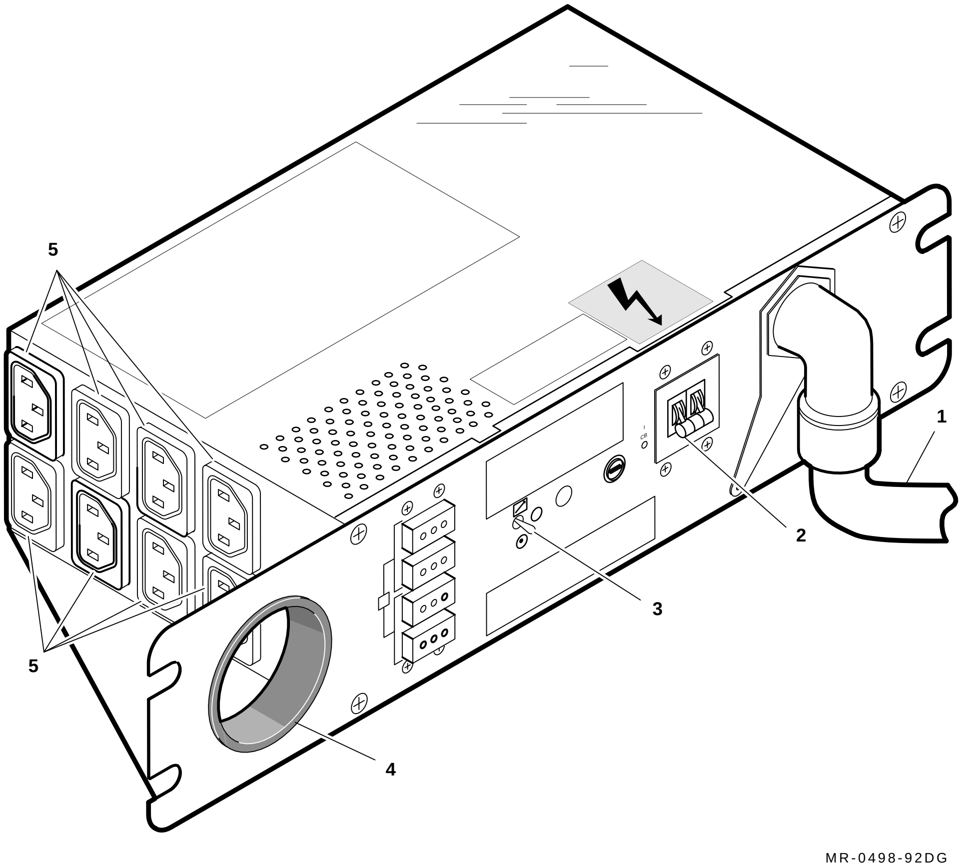


Table 1–5 Key to Figure 1–5, Domestic Power Distribution Box

Item	Component	Description
1	Three-phase power cord	Connects the power distribution box to ac power. The power cord may be repositioned by moving the locking arm.
2	Circuit breaker	When set to on, ac power is applied to the distribution box.
3	Local/Remote switch	The switch has icons representing Remote, Off, and Local. When set to: • Local, the internal bus controls the operation of ac power. • Off, the distribution box is turned off. • Remote, the distribution box is turned on (if the power cord is connected to ac power and the circuit breaker is set to on).
4	For power cords	Used to dress the power cords.
5	Eight ac outlets	Reserved for the FEU and expansion cabinet.

Figure 1–6 International Power Distribution Box

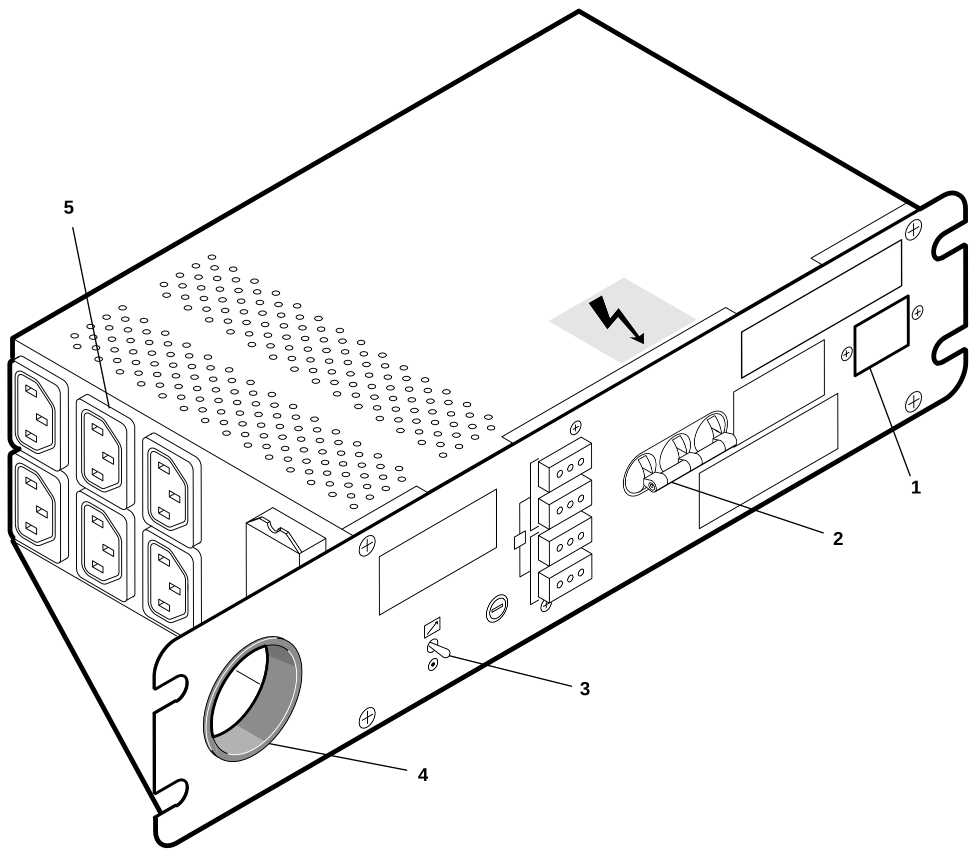


Table 1–6 Key to Figure 1–6, International Power Distribution Box

Item	Component	Description
1	Single-phase power cord	Connects the power distribution box to ac power.
2	Circuit breaker	When set to on, ac power is applied to the distribution box.
3	Local/Remote switch	The switch has icons representing Remote, Off, and Local. When set to: • Local, the internal bus controls the operation of ac power. • Off, the distribution box is turned off. • Remote, the distribution box is turned on (if the power cord is connected to ac power and the circuit breaker is set to on).
4	For power cords	Used to dress the power cords.
5	Six ac outlets	Reserved for the expansion cabinet.

2 Console Operations

2.1 In This Chapter

This chapter describes the console, console operating modes and commands, and booting information.

This chapter includes:

- Console description
- Console operating modes
- Console control characters
- Console command language syntax
- Bootstrap procedures
- Entering CIO mode
- CIO mode console commands

2.2 Console Description

The system architecture (Figure 2–1 and Table 2–1) supports in each zone:

- A local console terminal
- The console firmware (programs located in ROM) residing on:
  - The primary NCIO module
  - The CPU module
- A remote console terminal

The remote console terminal and the local console terminal are connected to the zone through the primary NCIO module.

The console operates a terminal that may be:

- Connected to the CPU serial port
- On the system console port

Figure 2–1 System Components

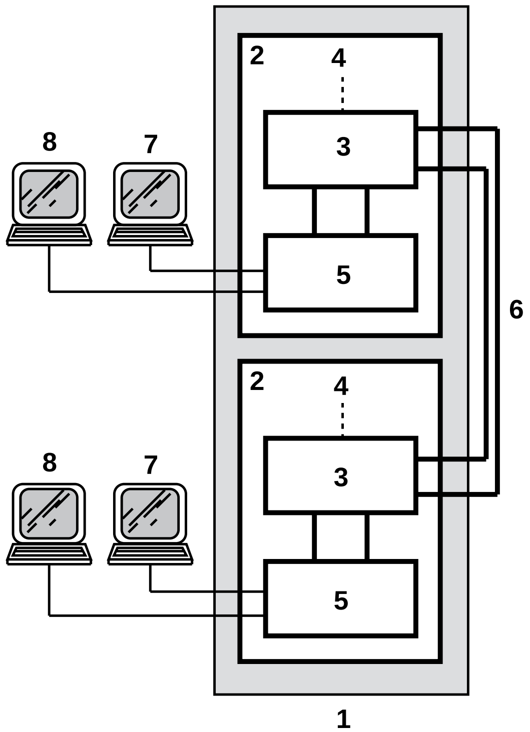


Table 2–1 Key to Figure 2–1, System Components

Number	Component
1	CPU cabinet
2	Zone (A or B)
3	CPU module
4	To memory
5	Primary NCIO module
6	Cross-link cable
7	Local console terminal
8	Remote console terminal (optional)

Table 2–2 describes the function of each console component.

Table 2–2 Function of the Console Components

Part	Function
Local console terminal	Terminal located with the system that is used for console input and display output.
Remote console port	One remote port is available in each zone. The port may be connected to a remote console terminal through a modem. There is no built-in modem control. The remote console port provides the same functions as the local console port.
Console firmware	The console firmware resides on the primary NCIO module and on the CPU module.

You can use any one of the four console terminals (local or remote) for input commands, but use only one terminal at a time. All of the console terminals echo the response of the system to a console command.

If the system is operating with a single zone running, you must use a console terminal (local or remote) that is connected to that zone for input commands.

2.3 Console Operating Modes

Operators communicate with the system in one of the following input/output modes:

- Program I/O (PIO) mode
- Console I/O (CIO) mode

Normal operation takes place in the PIO mode. From PIO mode, the operator uses the console to:

- Log in
- Use the mail facility
- Create and edit files

From CIO mode, the operator executes the console commands. These commands are described in Section 2.8.

2.3.1 Entering CIO Mode

The CIO mode is entered when you turn on system power if:

- The Zone Halt Enable switch is pressed
- A STOP/ZONE instruction is executed
- A severe processor condition occurs
- An external halt is detected

Once entered, the console prompt >>> is displayed and the CIO mode is ready to execute commands entered at the prompt.

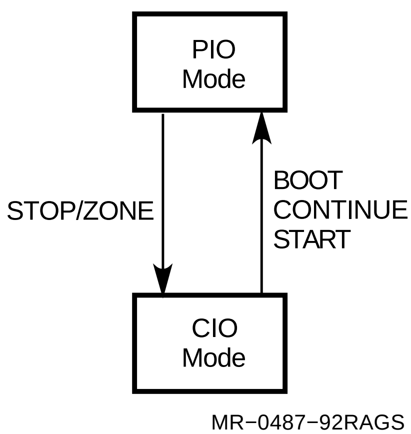
2.3.2 Exiting CIO Mode

The CIO mode is exited by issuing one of the following console commands:

- BOOT
- START
- CONTINUE

These commands are described in Section 2.8. Figure 2–2 shows how to move between PIO and CIO modes.

Figure 2–2 Console Operating Modes



2.4 Console Control Characters

The ASCII control characters and function keys listed in Table 2–3 have special meanings when typed on a console terminal.

Table 2–3 Console Control Characters and Function Keys

Character/Key	Function
Break	In CIO mode, acts like Ctrl/C. In PIO mode, causes the processor to halt and begin running the console program. If the system is in a secure mode when you press the Break key the halt is suppressed. If you press the Zone Halt Enable or System Halt Enable switch, the halt initiated by pressing the Break earlier is enabled.
Ctrl/C	Echoes ^C and causes the console to abort processing of a command, if possible.
Ctrl/O	Alternately enables and disables output.
Ctrl/Q	Resumes output previously suspended by Ctrl/S.
Ctrl/R	Echoes ^R and retypes the command line.
Ctrl/S	Stops transmission until Ctrl/Q is typed.
Ctrl/U	Echoes ^U and ignores the current command line. The console prompt is displayed on the next line. This affects only the entry of the current line. Pressing Ctrl/U does not abort a command that is executing.
<x (delete)	Deletes the character to the left of the cursor. On video terminals, the deleted characters disappear. On hard-copy terminals, the deleted characters are typed within a pair of backslash delimiters as they are deleted.
Esc or Ctrl/[	Suppresses any special meaning associated with a given character.
Return	Terminates a command line and executes the command.

2.5 Console Command Language Syntax

The console commands accept qualifiers. Qualifiers specify a numerical value or select an option from a list of options. Command elements may be abbreviated and any extra tabs or spaces are ignored. Unless otherwise noted, numerical values must be given in hexadecimal notation. The command length may not exceed 80 characters.

Table 2–4 lists the console command language syntax rules. The console commands available for the system are listed in Section 2.8.

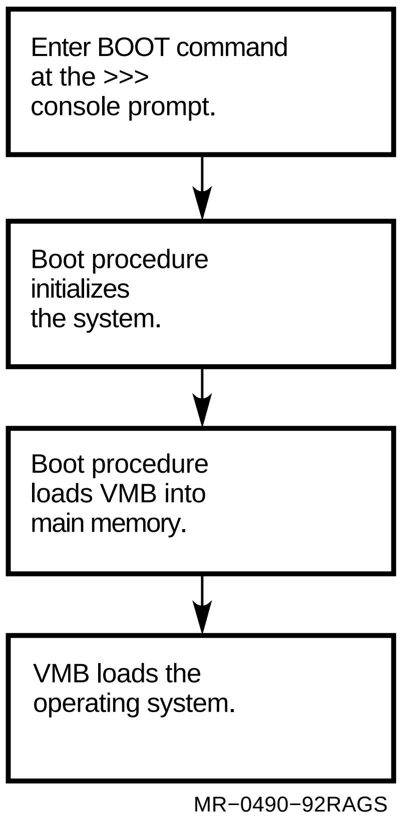
Table 2–4 Console Command Language Syntax

Command Element	Rule
Abbreviations	A command verb or argument may be abbreviated to the extent that it remains unique.
Multiple adjacent spaces and tabs	Are treated as a single space.
Qualifiers	May appear after a command verb, option, or symbol. They must be preceded by a slash (/).
Numbers	Must be hexadecimal.
No characters	Are treated as a null command. No action is taken.

2.6 Bootstrap Procedures

The BOOT command initializes the system and then loads and starts the virtual memory bootstrap (VMB) program from read-only memory (ROM). The VMB program, in turn, loads and starts the operating system from the specified boot device. Figure 2–3 shows the steps in the boot procedure.

Figure 2–3 Boot Procedure



The VMB program is the primary bootstrap program. VMB:

- Resides in ROM on the ATM module.
- Is loaded into memory and initiated by the system console firmware.
- Provides the necessary parameters for successful operation of the OpenVMS secondary bootstraps.
- Allows you to boot from DSSI compatible disk and tape devices over the Ethernet.

2.7 Entering CIO Mode

To recognize and process CIO commands:

- The System Halt Enable switch on both zone control panels must be pressed
- The operating software must be halted
- The processor must be running the console firmware

The example below shows how to use the Break key to enter CIO mode from PIO mode and then return to PIO mode by using the CONTINUE command. The System Halt Enable switch on both zone control panels must be pressed.

Caution

Use CONTINUE to continue from a system halt. Use START/ZONE to continue from a zone halt.

A remote operator can use CIO mode only when full access privileges for the remote console have been set at the local console.

Example

```
$
$                      ! Press the System Halt Enable switch on
$                      ! both zone control panels.
$                      ! From PIO mode, press the Break key once.
$  Break               ! This puts the processor in HALT mode.
>>>                    !
?002 External halt     !
PC = 01E01473          !

>>> CONTINUE           ! This command resumes execution of the
                       ! operating system software.
$                      ! The console returns to PIO mode.
```

Notice that comments (characters following an exclamation point (!)) are allowed on a command line. Comments are ignored by the console when the Return key is pressed. This may be useful when you document a console session on a hardcopy terminal.

Notice also that lowercase characters are accepted, but the console converts all characters to uppercase.

2.8 CIO Mode Console Commands

This section describes the CIO mode console commands. The console commands are listed below with command abbreviations shown in bold capital letters.

Boot	**HE**lp	**SH**ow
CLEAR	**I**nitialize	**S**tart
Continue	**M**ove	**T**est
Deposit	**MATCH_ZONES**	**X**(transfer)
DUP	**R**epeat	**Z**
Examine	**SE**t	**!**(comment)
Find		

2.8.1 BOOT

BOOT initializes the system, loads a program image from a specified boot device, and transfers control to that program image.

When you do not supply a boot-spec, the default boot device is used. When you do not supply flag(s), a value of 0 is assumed.

The console program accepts a terminating colon on the boot-spec, but ignores the colon when the name is processed.

The BOOT syntax is:

```
BOOT[/OVER][[/R5:]<flag(s)> boot-spec]
```

The boot-spec format may be **dduuu**/PATH=path-list . . . **dduuu**/PATH=path-list, where:

dd is a device mnemonic.
uuu is a unit number (0 to 999).
/PATH=path-list is a qualifier. See Table 2–5.

Or, the boot-spec format may be a variable that specifies the boot devices and paths. See Section 2.8.13.1.

Table 2–5 describes the qualifiers. Table 2–6 lists the VMB program /R5:<flag> values.

Table 2–5 Qualifiers for BOOT

Qualifier	Function
/R5:<flag>	Passes parameters to the virtual memory bootstrap (VMB) program. See Table 2–6.
/PATH=path-list	Specifies a path to a boot device. The path-list specifies zones and slot numbers in the path. When the path-list has more than one slot, you separate the slots by commas. The path-list format is **zss**, where: **z** is a zone ID (A or B).[1] **ss** is a slot number (10 to 17, 20 to 27) of an adapter connecting to a boot device.
/OVER	Overrides the results of the bootability test to allow a Simplex mode boot.

[1]The console validates this field before invoking VMB.

Table 2–6 VMB Program /R5:<flag> Values

Bit	Hex Value	Function	Action
0	1	Conversational boot	Returns to the SYSBOOT> prompt.
1	2	Debug	Maps the XDELTA program into the system page table.
2	4	Initial breakpoint	Operating system issues a breakpoint after turning on memory management.
3	8	Secondary boot	Boots from boot block specified in /R4:n.
5	20	Bootstrap breakpoint	Transfers control to the XDELTA program.
8	100	Solicit file name	VMB issues a prompt for the secondary boot procedure.
9	200	Halt before transfer	VMB executes a halt before transferring control to the secondary bootstrap procedure.
31:28	x0000000	Top-level system boot	Specifies the top-level directory number for a system disk with multiple system roots, where x = a hex value from 0 to F.

2.8.2 CLEAR

CLEAR BOOT deletes a boot-spec. CLEAR ERRORS clears the error frame of the previously detected error. If you do not clear the error frame, the next error is not recorded in the error frame. CLEAR BROKE clears the broke bit in EEPROM.

The following CLEAR syntax deletes a boot-spec:

```
CLEAR BOOT <name>
```

The following CLEAR syntax clears the error frame:

```
CLEAR ERRORS
```

The following CLEAR syntax clears the broke bit ID in EEPROM:

```
CLEAR BROKE[/PATH=path-number]
```

Table 2–7 describes the /PATH=path-number qualifier.

Table 2–7 Qualifier for CLEAR

Qualifier	Function
/PATH=path-number	Specifies the zone and slot number of the module to clear. The path-number format is **zss**, where: **z** is the zone ID (A or B). **ss** is the slot number (0 to 2, 10 to 17, 20 to 27) of an adapter connecting to a DSSI device.

CLEAR BROKE clears the module ID EEPROM in the zone that is running.

2.8.3 CONTINUE

CONTINUE exits the CIO mode and returns operation to the PIO mode.

Caution

Use CONTINUE to continue from a system halt. Use START/ZONE to continue from a zone halt.

The CONTINUE syntax is:

```
CONTINUE
```

2.8.4 DEPOSIT

DEPOSIT stores the specified data in the specified address.

When the system is initialized or when any transition from a running to a halted state occurs, the defaults are physical address space 0 and data size longword.

The DEPOSIT syntax is:

```
DEPOSIT[/{B,W,L,Q}][/{G,I,M,P,V,U}][/N:count]address-spec data-spec
```

The address-spec identifies a physical or virtual hexadecimal memory address. A qualifier may be placed before or after an address-spec or data-spec.

The data-spec identifies a hexadecimal number to be stored, unless the default radix has been changed with a %D introducer. When you do not supply a data-spec, a value of 0 is assumed.

Table 2–8 describes the qualifiers. Table 2–9 lists the address-spec symbolic addresses.

Table 2–8 Qualifiers for DEPOSIT

Qualifier	Function
/B	Sets the data size to byte.
/W	Sets the data size to word.
/L	Sets the data size to longword.
/Q	Sets the data size to quadword.
/G	Sets general purpose register address space R0 through PC.
/I	Sets internal processor register (IPR) address space accessed by the MTPR and MFPR instructions.
/P	Sets physical address space.
/V	Sets virtual address space. An EXAMINE to virtual memory returns the translated physical address. A DEPOSIT to virtual memory sets the PTE <M> bit.
/U	Sets access to console private memory. This qualifier must be specified for each command.
/N:*count*	Specifies the number of consecutive locations to modify. The console deposits to the first address, then to the specified number of succeeding addresses. This qualifier must be specified for each command.

Table 2–9 Address-Spec Symbolic Addresses

Symbolic Address	Description
R<n>	General purpose register number *n*, where *n* is a decimal number 0 to 15.
FP	Frame pointer.
AP	Argument pointer.
SP	Stack pointer.
PC	Program counter.
PSL	Program status longword.
+	A location following the last location accessed by an EXAMINE or DEPOSIT. The location is the last address *plus* the size of the last reference (1 for byte, 2 for word, 4 for longword).
-	A location preceding the last location accessed by an EXAMINE or DEPOSIT. The location is the last address *minus* the size of the last reference (1 for byte, 2 for word, 4 for longword).
*	The last location referenced by an EXAMINE or DEPOSIT.
@	Indirect addressing. The address-spec is used as a pointer to the data. The format is @address-spec, where address-spec can be any valid address except another @. See Example 2–1.

Note

Remember that the symbolic addresses from the *previous* command are used for indirect addressing. See Example 2–1.

Example 2–1 Indirect Addressing

```
>>> DEPOSIT R0 200    ! The value 200 is stored directly in R0. The defaults
                      ! are set to longword, general purpose register.

>>> DEPOSIT/P @R0 200 ! The value 200 is stored directly in the address pointed
                      ! to by R0. The /P qualifier tells the parser that the
                      ! value in R0 should be treated as a physical address.
                      ! The defaults are set to longword, physical.

>>> DEPOSIT/V @R0 200 ! The value 200 is stored directly in the address pointed
                      ! to by R0. The /V qualifier tells the parser that the
                      ! value in R0 should be treated as a virtual address.
                      ! The defaults are set to longword, virtual.

>>> DEPOSIT @200      ! The value 200 is stored in the address specified in
                      ! the previous command. The defaults are set to longword,
                      ! virtual.
```

2.8.5 DUP

DUP connects to the DSSI DUP service on a selected node. DUP is used to examine and modify the parameters of a DSSI device.

DUP syntax is:

```
DUP[/PATH:<path-number>] node-id /[TASK:task]
```

The node-spec identifies the node number (0 to 7) of a DSSI device attached to the console. Table 2–10 describes the qualifiers.

Table 2–10 Qualifiers for DUP

Qualifier	Function
/PATH=path-number	Specifies the zone and slot number of an adapter connecting to a DSSI device. The path-number format is **zss**, where: **z** is the zone ID (A or B). **ss** is the slot number (10 to 17, 20 to 27) of an adapter connecting to a DSSI device.
node-id	Specifies the DSSI node connecting to a DSSI device. Valid node-ids are 0 to 5.
TASK:task	Invokes a task from a DSSI device. Valid DUP tasks are: DRVEXR DRVTST HISTRY DIRECT ERASE VERIFY DKUTIL PARAMS

2.8.6 EXAMINE

EXAMINE displays the contents of the specified memory location or register. The display line consists of:

- A single-character address specifier
- The hexadecimal physical address to be examined
- The examined data in hexadecimal

When the system is initialized or when any transition from a running to a halted state occurs, the defaults are physical address space 0 and data size longword.

The EXAMINE syntax is:

```
EXAMINE[/{B,W,L,Q}][/{G,I,M,P,V,U}][/N:count][/A][address-spec]
```

The address-spec identifies a physical or virtual hexadecimal memory address. A qualifier may be placed before or after the address-spec or data-spec.

Table 2–11 describes the qualifiers. Table 2–12 lists the address-spec symbolic addresses.

Table 2–11 Qualifiers for EXAMINE

Qualifier	Function
/B	Sets the data size to byte.
/W	Sets the data size to word.
/L	Sets the data size to longword.
/Q	Sets the data size to quadword.
/G	Sets general purpose register address space R0 through PC.
/I	Sets internal processor register (IPR) address space accessed by the MTPR and MFPR instructions.
/P	Sets physical address space.
/V	Sets virtual address space. An EXAMINE to virtual memory returns the translated physical address. A DEPOSIT to virtual memory sets the PTE <M> bit.
/U	Sets access to console private memory. This qualifier must be specified for each command.
/N:*count*	Specifies the number of consecutive locations to modify. The console deposits to the first address, then to the specified number of succeeding addresses. This qualifier must be specified for each command.
/A	Interprets and displays the data as ASCII characters. Nonprinting characters are displayed as periods.

Table 2–12 Address-Spec Symbolic Addresses

Symbolic Address	Description
R<n>	General purpose register number *n*, where *n* is a decimal number 0 to 15.
FP	Frame pointer.
AP	Argument pointer.
SP	Stack pointer.
PC	Program counter.
PSL	Program status longword.
+	A location following the last location accessed by an EXAMINE or DEPOSIT. The location is the last address *plus* the size of the last reference (1 for byte, 2 for word, 4 for longword).
-	A location preceding the last location accessed by an EXAMINE or DEPOSIT. The location is the last address *minus* the size of the last reference (1 for byte, 2 for word, 4 for longword).
*	The last location referenced by an EXAMINE or DEPOSIT.
@	Indirect addressing. The address-spec is used as a pointer to the data. The format is @address-spec, where address-spec can be any valid address except another @. See Example 2–1.

Note

Remember that the symbolic addresses from the *previous* command are used for indirect addressing. See Example 2–1.

2.8.7 FIND

FIND searches the main memory beginning at physical address space 0 for either a page-aligned 512-Kbyte segment of memory, or a restart parameter block (RPB).

When FIND is successful, it saves the address plus the segment of memory (or RPB) in the stack pointer. When FIND is unsuccessful, an error message is displayed and the contents of the stack pointer are unpredictable.

The FIND syntax is:

```
FIND
```

Table 2–13 describes the qualifiers.

Table 2–13 Qualifiers for FIND

Qualifier	Function
/MEMORY	Searches main memory for a page-aligned 512-Kbyte segment of memory.
/RPB	Searches main memory for a restart parameter block. The search leaves memory unchanged.

2.8.8 HELP

HELP displays a summary of the commands, their arguments, and qualifiers. When you supply a command name, HELP displays the arguments and qualifiers for that command only. HELP does not provide complete descriptions of the commands.

The HELP syntax is:

```
HELP [command]
```

Or:

```
? [command]
```

2.8.9 INITIALIZE

INITIALIZE performs the steps shown in Table 2–14.

Table 2–14 INITIALIZE Steps

Step	Action
1	Do hard reset of zone (the cross-link state is set to off).
2	Do hard reset of all available ATMs.
3	Initialize hardware.
4	Reconfigure the zone and update the device configuration block (DCB) to reflect the zone status.
5	Execute the Duplex Compatibility Test.
6	Load the firmware into the console main loop.

The INITIALIZE syntax is:

```
INITIALIZE
```

2.8.10 MOVE

MOVE transfers the specified number of bytes (count) from the source-address to the destination-address.

The MOVE syntax is:

```
MOVE source-address destination-address count
```

The source-address is the starting address of the data. The destination-address is the starting address of the destination. The count is the number of bytes to be moved.

2.8.11 MATCH_ZONES

MATCH_ZONES copies the system-wide module data EEPROM from the other zone. MATCH_ZONES does not copy the zone-specific module data EEPROM. Use MATCH_ZONES *only* when:

- The cross-link state is set to off, and
- The path to the other zone is available. (The cross-link cables and other zone power is on.)

The MATCH_ZONES syntax is:

```
MATCH_ZONES
```

2.8.12 REPEAT

REPEAT continuously executes the specified command. REPEAT applies to the following commands *only*.

- DEPOSIT
- EXAMINE

REPEAT can be aborted by pressing Ctrl/C at the console keyboard.

The REPEAT syntax is:

```
REPEAT command
```

2.8.13 SET

SET modifies the value of the specified variable.

The SET syntax is:

```
SET variable value [value]
```

Note

SET does not allow abbreviations. You must enter the name of the variable completely.

Table 2–15 lists the variables with the acceptable values.

Table 2–15 SET Variables and Values

Variable	Description	Acceptable Values
BOOT DEFAULT	Default boot specification.	Up to 80 characters of ASCII text
MODE	Boot mode.	FAILSTOP = Simplex mode FAILSAFE = Duplex mode
RESTART	Halt action switch.	HALT = Enter console mode BOOT = Boot RESTART = Restart
BAUD	Console port speed.	300, 600, 1200, 2400, 4800, 9600, 19200, 38400
ZONE	Zone identification.	A = Zone A B = Zone B

2.8.13.1 SET BOOT

SET BOOT saves the values of boot-specs. Space for nine boot-specs is available on the CPU module EEPROM. The first space is reserved for the default boot-spec. The other eight spaces are available to the user.

The SET BOOT syntax is:

```
SET BOOT DEFAULT value
```

Or:

```
SET BOOT boot-spec value
```

The boot-spec may be up to 8 characters of ASCII text. The value is the ASCII text assigned to the boot-spec.

2.8.14 SHOW

SHOW displays information about the specified variable. When the cross-link state is off (Simplex mode), information about the current zone is displayed. When the cross-link state is on (Duplex mode), information about both zones is displayed.

The SHOW syntax is:

```
SHOW variable
```

Table 2–16 lists the variables. You *must* supply a variable.

Table 2–16 SHOW Variables

Variable	Description	Acceptable Values
DEFAULT	Default specification.	Up to 80 characters of ASCII text
MODE	Boot mode.	FAILSTOP = Simplex mode FAILSAFE = Duplex mode
RESTART	Halt action switch.	HALT = Enter console mode BOOT = Boot RESTART = Restart
BAUD	Console port speed.	300, 600, 1200, 2400, 4800, 9600, 19200, 38400
ZONE	Zone identification.	A = Zone A B = Zone B
BOOT	Displays the saved boot specifications.	
CONFIGURATION	Displays the current system configuration, including the identity and status of any modules in the system.	
VERSION	Displays the firmware revision of all ROMs in the system.	

(continued on next page)

Table 2–16 (Cont.) SHOW Variables

Variable	Description	Acceptable Values
DSSI/PATH=path-number	Specifies the zone and slot number of an adapter connecting to a DSSI device. The path-number format is **zss**, where: **z** is the zone ID (A or B). **ss** is the slot number (10 to 17, 20 to 27) of an adapter connecting to a DSSI device.	
ETHERNET	Displays the physical Ethernet addresses.	
MEMORY	Displays system memory information.	
STATE	Displays the state of the cross-link and the system cables.	
ERRORS	Displays the diagnostic error frames. Not allowed if the cross-link state is on.	
ALL	Displays the contents of all variables.	

2.8.15 START

START begins execution of the operating software from the specified address. START is equivalent to DEPOSIT PC followed by CONTINUE.

The START syntax is:

```
START address-spec
```

You *must* supply an address-spec.

2.8.16 TEST

TEST enables the user to test:

- The system
- A zone
- The CPU and memory

Use TEST *only* when the cross-link state is set to off.

The TEST syntax is:

```
TEST [qualifier(s)]
```

Tables 2–17 and 2–18 describe the TEST selection and control qualifiers.

Table 2–17 Qualifiers for TEST Selection

Qualifier	Function
/GROUP:*n*[1]	Specifies a decimal number from 0 to 5 that identifies the group of tests to be run.
/TEST:*n*[1]	Specifies a decimal number from 0 to 32 that identifies the tests to be run.
/SUBTEST:*n*[1]	Specifies a decimal number from 0 to 32 that identifies the subtests to be run.
/VERBOSE	Enables a display of all individual tests during execution.
/NOTRACE	Disables test traces.

[1] *n* can be a:

- Single value
- Range separated by a colon (1:5)
- List separated by commas (1,5,9)
- Combination of range and list (1:6,8,10,11:29)

Table 2–18 Qualifiers for TEST Control

Qualifier	Function
/PASSCOUNT:*n*	*n* is a decimal number from 0 to MAXINT. When *n* is 0, the passcount is infinite.
/NOTRACE	Disables the test traces.
/COE	Continues on error.
/NOCONFIRM	Disables the test confirmation on destructive tests.
/EXTENDED	Enables extended error reports.
/NOSTATUS	Disables status messages and reports.
/LIST	Lists the available tests, but does not run them.

When you do not supply the qualifier(s), TEST runs all the nonextended tests (except those that require confirmation).

2.8.17 X(transfer)

X is used by automatic systems communicating with the console. X is not intended for use by operators.

X loads or unloads the count of bytes beginning at the specified address.

When the high-order bit of the count longword is 1, the data is read from physical memory to the console terminal. When the high-order bit of the count longword is 0, the data is written from the console terminal to physical memory.

The X syntax is:

```
X address-spec count [Return] data-stream checksum
```

The address-spec is a hexadecimal number that specifies a physical address. The count is an 8-bit hexadecimal number that specifies a number of bytes. The data-stream contains the bytes to be transferred by X. The checksum is a 2-digit hexadecimal number that specifies the 2's complement checksum of the data-stream. The checksum verifies the data-stream.

2.8.18 Z

Z connects to the firmware of another module in the system.

The Z syntax is:

```
Z[/PATH=path-number]
```

Table 2–19 describes the qualifier.

Table 2–19 Qualifier for Z

Qualifier	Function
/PATH=path-number	Specifies the zone and slot number of a module. The path-number format is **zss**, where: **z** is the zone ID (A or B). **ss** is the slot number of the module.

When you do not supply a path, Z tries to connect to the module in slot 1 of the zone that is running.

Note

Z performs a hard reset on the ATMs, but you need to issue a programmed reset to load and start the functional firmware. After Z, you *must* issue a BOOT from the same zone, or a START/ZONE from the other zone (if that zone is running the operating system).

2.8.19 !(comment)

The ! (exclamation point) prefixes a comment. The text following the ! is ignored.

The ! syntax is:

```
!(comment)
```

Or:

```
command!(comment)
```

3
System Maintenance

3.1 In This Chapter

This chapter includes:

- Maintenance strategy
- Operating rules and cautions
- General troubleshooting procedure
- Module fault LEDs
- Power system overview
- Power system maintenance
- Device status and fault indicators
- ROM-based diagnostics

3.2 Maintenance Strategy

When a hardware component fails, the Model 810 system uses self-diagnosis through ROM-based diagnostics (RBDs) to isolate the faulty FRU. Once isolated, the system automatically:

- Places the faulty FRU off line
- Reports the error in the error log
- Identifies the faulty FRU on the console terminal
- Turns on the faulty FRU fault LED

3.3 Operating Rules and Cautions

Table 3–1, Table 3–2, and Table 3–3 contain operating rules for use during a service call. Table 3–4 provides cautions.

Table 3–1 Before Stopping a Zone

Step	Action
1.	Do not depend on the accuracy of a zone ID label. Issue SHOW ZONE before STOP/ZONE to check the states of both zones.
2.	Issue SHOW SYSTEM to make sure that the FTSS$SERVER process is running before turning off zone power, or pressing the Break key.
3.	Check both zone control panels. The System Fault indicator in the failing zone should be on.
4.	Check console messages and error log for related problem information.
5.	Always issue SHOW DEV D before STOP/ZONE to make sure that shadow set copying in not in progress.
6.	Issue STOP/ZONE. Wait for the zone to initialize, and then turn off zone power.
7.	Remove the cross-link assembly.

Table 3–2 After a Zone is Repaired

Step	Action
1.	Replace the cross-link assembly.
2.	Turn on zone power.
3.	Issue SHOW MODE to make sure that the zone is set to: MODE = FAILSAFE.
4.	Issue START/ZONE.
5.	Check the running zone console for the following message: % FTSS-S-ZONEAVAIL.
6.	If the message in step 5 does not appear on the console, consider replacing the cross-link assembly.
7.	Monitor the console for the following environmental information messages: "OPERATING ON EXTERNAL POWER" "OPERATING BATTERY POWER" (Life approx 1 hr.) "NORMAL ZONE TEMPERATURE" "YELLOW ZONE TEMPERATURE" "BATTERY TEST PASSED IN CABINET....." "BATTERY TEST FAILED" (Battery not present) FTSS messages....

Table 3–3 Before Leaving the Site

Step **Action**

1. Issue SHOW DEVICE D to make sure that all disks are either shadow set members or in the process of being copied.
2. Issue SHOW DEVICE E to make sure that all EP/EF drivers are on line.
3. Use FTSS$FSM to show the failover set status:

   ```
   MCR FTSS$FSM [Return]
   FSM> SHOW ADAPTER [Return]
   ```

4. Issue SHOW DEV PW to make sure the PW driver is on line.
5. Issue SHOW CLUSTER/CONTINUE (ADD CIRCUITS, CONNECTIONS,LPORT,RPORT) to check for correct DSSI configuration:

   ```
   $ SHOW CLUSTER/CONTINUE [Return]
   COMMAND> ADD CIRCUITS, CONNECTIONS,LPORT,RPORT [Return]

      SYSTEMS      MEMBERS        CIRCUITS              CONNECTIONS
   NODE   SOFTWARE STATUS LPORT RPORT RP_TYP  CIR_STA  LOC_PROC_NAME   CON_STA

   FTSYS  VMS V5.4        PWA0    6   SWIFT   OPEN
                          PWB0    7   SWIFT   OPEN
                          PWF0    6   SWIFT   OPEN
                          PWG0    7   SWIFT   OPEN
                          PWA0    7   SWIFT   OPEN
                          PWB0    6   SWIFT   OPEN
                          PWF0    7   SWIFT   OPEN
                          PWG0    6   SWIFT   OPEN
                                                     SCS$DIRECTORY     LISTEN

                                                     MSCP$TAPE
                                                     MSCP$DISK
   SYSA   RFX V200        PWA0    0   RF35    OPEN  VMS$DISK_CL_DRVROPEN OPEN

                          PWG0    0   RF35    OPEN
   USERS  RFX V200        PWA0    1   RF35    OPEN
                          PWG0    1   RF35    OPEN  VMS$DISK_CL_DRVROPEN OPEN

   FTTA   RFX V246        PWA0    2   RF35    OPEN  VMS$DISK_CL_DRVROPEN OPEN

                          PWG0    2   RF35    OPEN
   SYSB   RFX V200        PWB0    0   RF35    OPEN  VMS$DISK_CL_DRVROPEN OPEN

                          PWF0    0   RF35    OPEN
   DISK1 RFX V200         PWB0    1   RF35    OPEN
                          PWF0    1   RF35    OPEN  VMS$DISK_CL_DRVROPEN OPEN

   FTTB  RFX V246         PWB0    2   RF35    OPEN  VMS$DISK_CL_DRVROPEN OPEN

                          PWF0    2   RF35    OPEN
   ```

6. Make sure that the [Break] keys on both zones are disabled (zone control panel SECURE LED is on).

Table 3–4 Cautions

1.	Do not press ZONE HALT ENABLE and the Break key to stop a running zone. Use STOP/ZONE. If ZONE HALT ENABLE is used, CONTINUE will not resume zone operation.
2.	Do not press the Break key or cycle power during the power on or RBD tests. This action may corrupt the EEPROM.
3.	Do not perform a Simplex boot (MODE = FAILSTOP) from a disk used by the running zone. This action may corrupt the disk.
4.	Do not turn off zone power or halt a zone if the FTSS$SERVER is not loaded and running.

3.4 General Troubleshooting Procedure

Table 3–5 provides a general procedure for isolating and replacing a faulty FRU. While the repair is being performed, the user application continues to run.

Table 3–5 General Troubleshooting Procedure

Step	Action
1.	Check both zone control panels. The System Fault indicator in the failing zone should be on.
2.	If the zone is not already stopped, ask the system manager or other responsible system person to perform a SHOW ZONE and STOP ZONE. After the system manager stops the zone, remove the cross-link assembly. If you are given permission to stop the zone, use the procedure specified in Table 3–1.
3.	Check all fault LEDs and the console messages. To verify that the correct FRU has been isolated, check the error log. If a fault LED is on and/or a console message indicates that an FRU has been removed from service, replace the FRU. (See Chapter 5, FRU Removal and Replacement Procedures.) **Note** Before removing and replacing any module, check the Power Module indicators (Table 3–9) to rule out any potential power problems.
4.	If the replaced FRU **corrected** the problem, turn on zone power.
5.	If the repaired zone passes the power on diagnostics, turn off zone power and reconnect the cross-link assembly.
6.	Turn on zone power. If the power on diagnostics and the duplex compatibility test pass with the cross-link assembly connected, turn the system over to the system manager. The system manager is responsible for synchronizing the system and returning it to duplex operation.

(continued on next page)

Table 3–5 (Cont.) General Troubleshooting Procedure

Step	Action
7.	If the replaced FRU **did not correct** the problem, open the system cabinet front door. Check all module and disk drawer fault LEDs. If any fault LED is on, replace the associated module or device. (See Chapter 5, FRU Removal and Replacement Procedures.)
8.	If no module or disk fault LED is on, open the system cabinet rear door. Check all module LEDs in the miscellaneous and interface module card cages. If a fault LED is on, replace the associated module. (See Chapter 5, FRU Removal and Replacement Procedures.)
9.	If no module fault LED is on, open the expansion cabinet rear door. Check the disk power fault indicators to eliminate any potential power problems. (See Figure 3–7 and Figure 3–9.) If a power fault indicator is on, replace the device. (See Chapter 5, FRU Removal and Replacement Procedures.)
10.	If no power fault indicator is on, open the expansion cabinet front door and check all disk and tape unit fault LEDs and indicators. (See Figure 3–6, Figure 3–8, and Table 3–23.) If any LED or fault indicator is on, replace or repair the failing device. (See Chapter 5, FRU Removal and Replacement Procedures.)
11.	If no fault LEDs or indicators are on, run the error log utility. (See Chapter 4, Error Handling and Analysis.) Use the OpenVMS HELP facility to help you run the utility as shown in the following example. Qualifier examples can be displayed at the **ANALYZE Subtopic?** prompt as shown at the end of the code example.

```
$ HELP ANALYZE/ERROR_LOG

ANALYZE

  /ERROR_LOG

      Invokes the Errorlog Report Formatter (ERF) to selectively report
      the contents of an error log file. The /ERROR_LOG qualifier is
      required. For a complete description of the OpenVMS Analyze Error
      Log Utility, including more information about the ANALYZE/ERROR_LOG
      command and its qualifiers, see the OpenVMS Error Log Utility Reference

      Manual.

      Format:

        ANALYZE/ERROR_LOG  [file-sped[,...]]

    Additional information available:

      Parameters Command_Qualifiers
    /BEFORE    /BINARY    /BRIEF    /ENTRY    /EXCLUDE    /FULL
    /INCLUDE   /LOG       /OUTPUT   /REGISTER_DUMP        /REJECTED
    /SID_REGISTER         /SINCE    /STATISTICS           /SUMMARY
    Examples

ANALYZE /ERROR_LOG Subtopic? Return
ANALYZE Subtopic? Examples Return
```

(continued on next page)

Table 3–5 (Cont.) General Troubleshooting Procedure

Step	Action
12.	If the problem cannot be isolated and repaired, the service call should be escalated to the Customer Service Center for further action.

3.5 Module Fault LEDs

Figure 3–1 shows all module fault LED locations. Table 3–6 identifies each module.

Figure 3–1 Module Fault LEDs

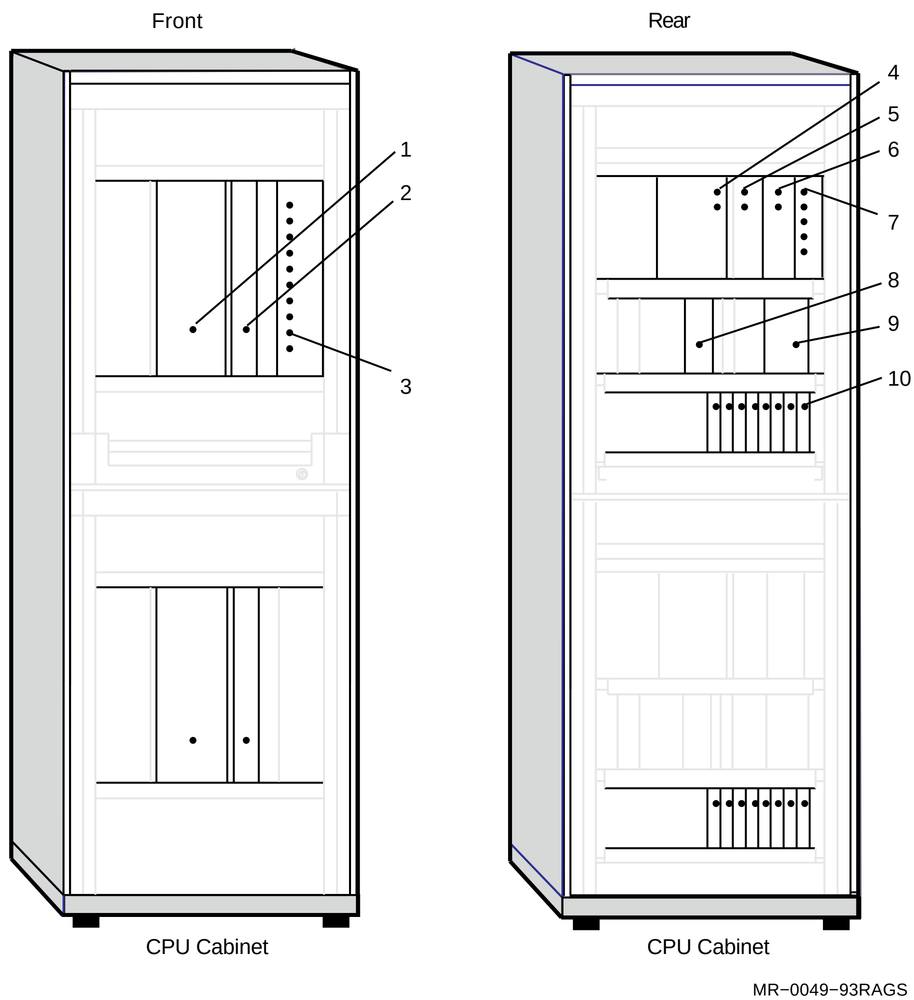


Table 3–6 Key to Figure 3–1, Module Fault LEDs

Key	Module
1	CPU module
2	ATM module
3	System Fault (zone control panel)
4	Front end unit
5	DC3 converter
6	DC5 converter
7	Power system controller
8	Console module
9	CAMP module
10	DSSI and Ethernet interface modules

3.6 Power System Overview

The following sections describe the power distribution and power components. Figure 3–2 and Figure 3–3 are basic block diagrams of the system power and power distribution.

Table 3–7 provides a functional summary of the power components. Table 3–8 is a DC voltage summary.

Figure 3–2 Power System Block Diagram (1 of 2)

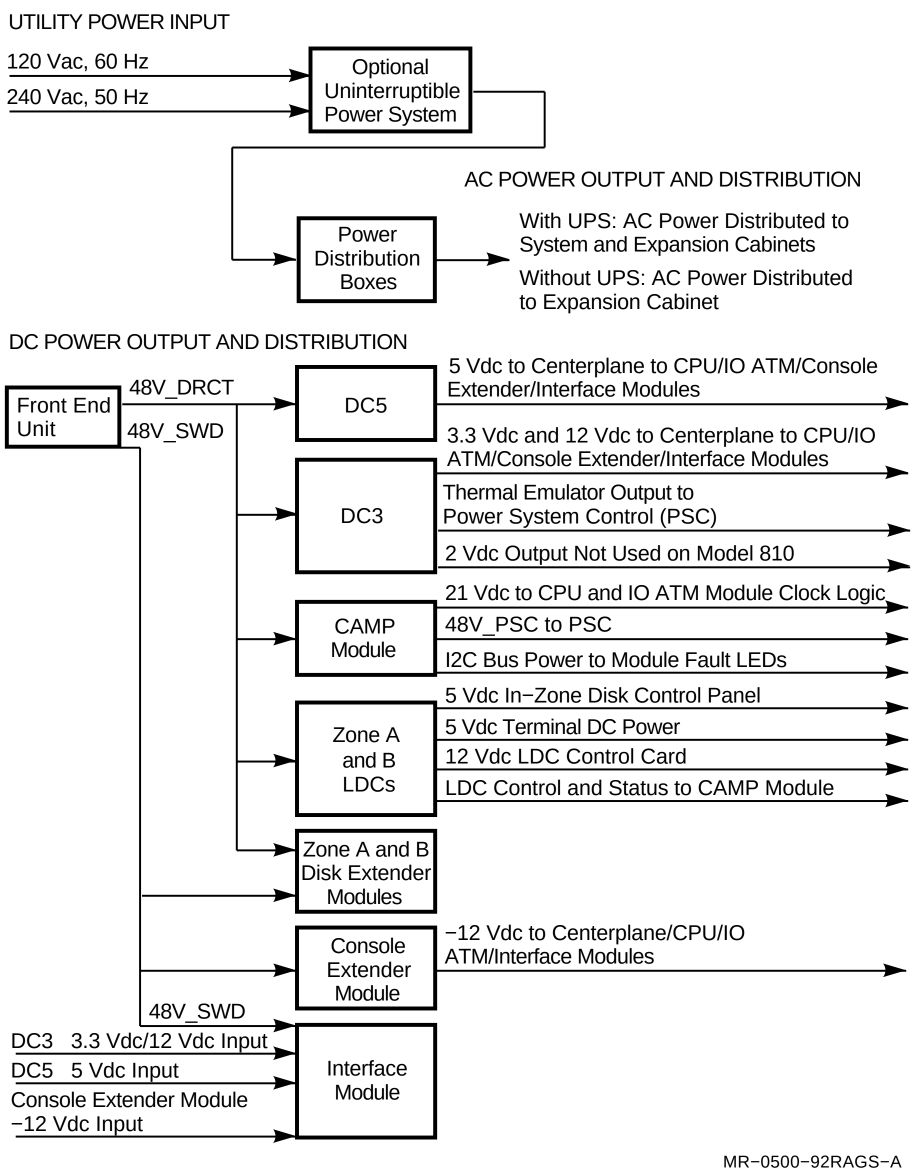


Figure 3–3 Power System Block Diagram (2 of 2)

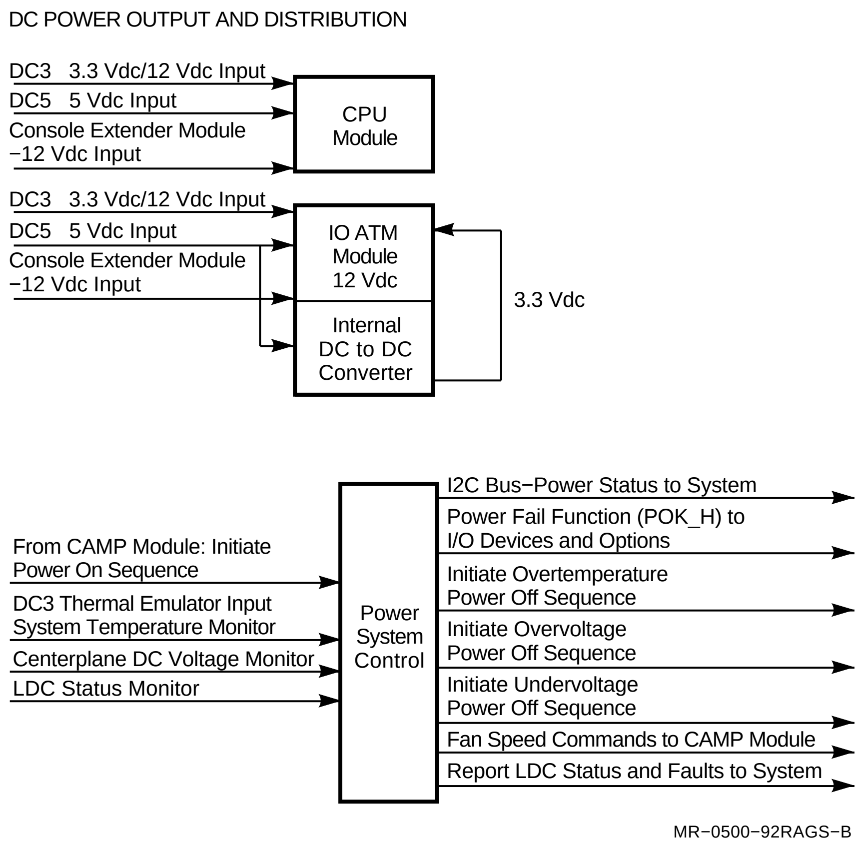


Table 3–7 Power System Functional Summary

FRU	Functional Summary
Local Disk Converter (LDC)	An LDC is located in each in-zone disk drawer. It provides +12 Vdc with fast transit response and tolerance to short-term loading during disk spinup. Also provides +5 Vdc for power logic, and EMI filtering for the 48 V bus. It provides VTERM, which is a 5 V diode isolated output, and current limited for powering the I/O bus terminators. Fusing is included to prevent a fault on one LDC from loading the 48 V bus and crashing the entire power system.
Front End Unit (FEU) H7884-AA	Provides the main ac circuit breaker, and generates two +48 V outputs: • Unswitched (DRCT) which supports the CAMP and Disk Extender modules, LDCs, DC3, and DC5 • Switched (SWD) which supports the interface modules, and Console and Disk extender modules Also provides programmable fan power output from +11 to +27 Vdc which allows the system to adjust the fan speed based on system temperature. The PSC monitors the system temperature through a thermal emulator in DC3, and sends fan speed commands through the CAMP module to the FEU to adjust the fan power output.
Power System Controller (PSC) H7851-AA	An I2C bus allows the PSC to write power status information to the system, and provides a power fail signal (POK_H) to the mass storage devices and I/O options. Receives commands from the CAMP module to initiate the logic power on sequence by commanding the FEU to turn on the +48 V switched output and enable the DC3 and DC5 outputs. The PSC also drives the power system visual status indicators. It monitors system temperature through the thermal emulator in DC3 and sends fan speed commands through the CAMP module to the FEU for fan power and fan speed control. Provides a warning when system temperatures are beyond the normal operating range: Green Zone = 5°C (41°F) to 52°C (126°F) Yellow Zone = 5°C (41°F) to 62°C (144°F) Red Zone = 5°C (41°F) to 75°C (167°F) Initiates the power off sequence when system temperature reaches the red zone. The PSC monitors the centerplane voltages and initiates a power off on an undervoltage fault; fires the crowbar and initiates a power off on an overvoltage fault. Also initiates a power off if the FEU indicates a 48 V output is out of tolerance, or there is less than 4 millisecond of reserve power, and on a fan failure. The PSC monitors the LDC status and reports failures to the system.

(continued on next page)

Table 3–7 (Cont.) Power System Functional Summary

FRU	Functional Summary
DC5 H7179-AA	DC to dc converter which provides +5 Vdc to the CPU, MMB, SIMMs, I/O ATM, interface and console extender modules, as well as +5 Vdc to the I/O ATM internal +5 Vdc to +3.3 Vdc converter for the SOC. Provides EMI filtering on the 48 V bus, and fusing to prevent the power system from crashing due to a short circuit on a converter input. Supports the crowbar SCR on a 5 V overvoltage or undervoltage fault.
DC3 H7178-AA	DC to dc converter which provides +3 Vdc to the CPU, I/O ATM, interface and console extender modules. Provides +12 Vdc to the console extender module +12 V to -12 V converter for the CPU and I/O ATM modules, and the +21 V converter for the CPU and I/O ATM clock logic. Provides EMI filtering on the 48 V bus, and fusing to prevent the power system from crashing due to a short circuit on a converter input. Supports the crowbar SCR on a 3 V or 12 V undervoltage or overvoltage fault. Provides system temperature sensing through the thermal emulator. The emulator provides system temperature information to the PSC for system cooling fan speed control and for power off in the event of an overtemperature condition.
CAMP module	Control and Miscellaneous Power module. Provides miscellaneous custom power control circuits.
Console extender module	Provides local and remote console terminal ports, modem port, and zone control panel interface.
Fan current sense board (FCSB)	Monitors the fan current and rotation, and generates a rotation signal to the CAMP module. The CAMP module in turn generates a tachometer signal to the PSC for fan speed monitoring and control.
Zone A and B power controllers	Provide ac utility power to the peripheral devices. Power controllers are located in the expansion cabinet.
Power I2C bus	Provides serial communication between the PSC, console extender, and I/O ATM modules. The PSC uses the bus to write power status information. The I/O ATM uses the bus to control the zone control panel LEDs through the console extender module. It also writes the Ethernet hardware addresses.

Table 3–8 System DC Voltage Summary

Component	Supplies . . .	To . . .
DC5 (H7179-AA)	+5 Vdc	CPU, I/O ATM, console extender, and interface modules
DC3 (H7178-AA)	+3.3 Vdc	CPU, I/O ATM, console extender, and interface modules
DC3 (H7178-AA)	+12 Vdc	CPU, I/O ATM, console extender, and interface modules
FEU (H7884-AA)	+48V_DRCT (direct)	CAMP and disk extender modules, LDCs, DC3, and DC5
FEU (H7884-AA)	+48V_SWD (switched)	Console extender, disk extender, and interface modules
CAMP 48V_DRCT to 12 V converter	VBIAS12	I2C bus power to drive module fault LEDs
CAMP 48V_DRCT to 12 V converter	VBIAS5	CAMP module internal bias voltage
Console extender module +48_SWD to -12 V converter	-12 Vdc	CPU and I/O ATM modules
CAMP +12 V to +21 V converter	+21 Vdc	CPU and I/O ATM module clock logic
FEU (H7884-AA)	11 Vdc to 27 Vdc	Programmable fan control power
Local disk converter (LDC)	+5 Vdc	In-zone disk control panel
LDC	+12 Vdc	LDC control card
LDC	+5 VTERM	Terminal dc power

3.7 Power System Maintenance

Figure 3–4 shows the location of the power module controls and indicators. Table 3–9 describes module functions and repair action.

Table 3–10, Table 3–11, Table 3–12, Table 3–13, Table 3–14, Table 3–15, Table 3–16, and Table 3–17 describe the Fault ID Display codes of the PSC.

Figure 3–4 Power Module Controls and Indicators

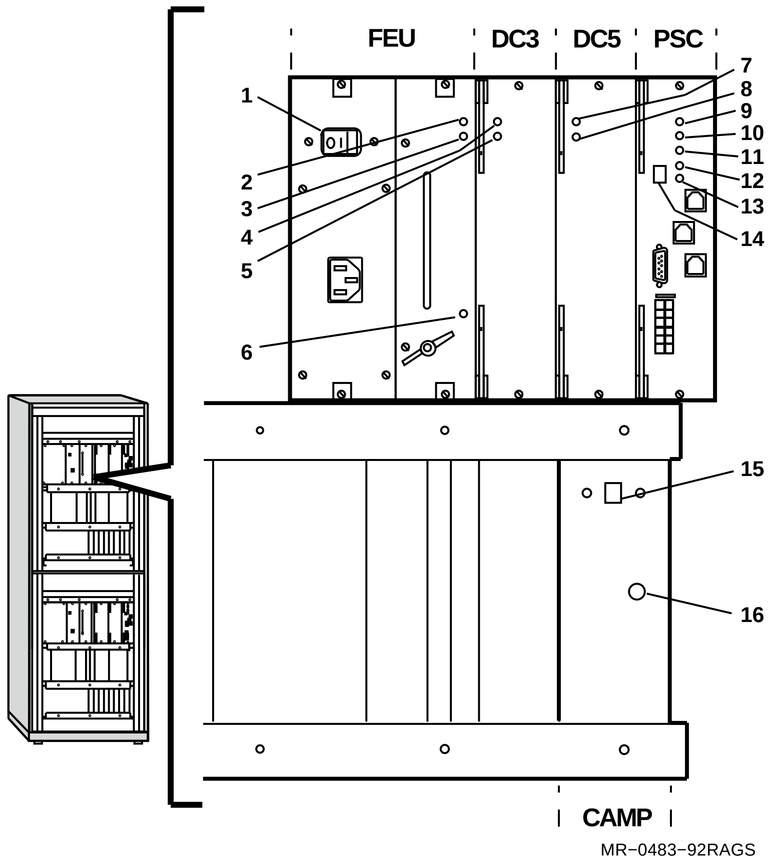


Table 3–9 Key to Figure 3–4, Power Module Controls and Indicators

Item	Control/Indicator	Function	Repair Action
1	AC Circuit Breaker		
2	FEU Failure	When on, indicates the dc output voltages for the FEU are below the specified minimum.	Replace the FEU. See Chapter 5.
3	FEU OK	When on, indicates the dc output voltages for the FEU are above the specified minimum.	
4	DC3 Failure	When on, indicates that one of the output voltages is not within the specified tolerances.	Replace the dc converter. See Chapter 5.

(continued on next page)

Table 3–9 (Cont.) Key to Figure 3–4, Power Module Controls and Indicators

Item	Control/Indicator	Function	Repair Action
5	DC3 OK	When on, indicates that the output voltages are within the specified tolerances.	
6	AC Present	When on, indicates ac power is present at the ac input connector, regardless of the position of the circuit breaker.	If ac power is present, check the power source and power cord. If the system will not power on, and the ac LED is the only LED on, check the circuit breaker.
7	DC5 Failure	When on, indicates that one of the output voltages is not within the specified tolerances.	Replace the dc converter. See Chapter 5.
8	DC5 OK	When on, indicates that the output voltages are within the specified tolerances.	
9	PSC Failure	When on, indicates a PSC fault.	Replace the PSC. See Chapter 5.
10	PSC OK	When blinking, indicates the PSC is performing power-on self-tests. When on, indicates the PSC is functioning.	
11	Over Temperature Shutdown	When on, indicates that the PSC shut down the system because of an internal overtemperature condition.	Set the circuit breaker to off and wait 1 minute before turning system power on. Make sure the air intake is unobstructed and that the room temperature does not exceed the maximum requirement.
12	Fan Failure	When on, indicates a fan failure. Use the hexadecimal number in the Fault ID Display to isolate the fan.	Replace the fan. See Chapter 5.
13	Disk Drive Power Failure	When on, indicates a disk drive power failure. Use the hexadecimal number in the Fault ID Display to isolate the storage compartment that houses the disk drive.	The faulty unit is probably the local disk converter (LDC). To isolate the LDC, disconnect the drives on the specified bus, and turn on system power. If the indicator stays on with the drives disconnected, replace the failing LDC. See Chapter 5. A cable or drive may also be at fault.

(continued on next page)

Table 3–9 (Cont.) Key to Figure 3–4, Power Module Controls and Indicators

Item	Control/Indicator	Function	Repair Action
14	Fault ID Display	Displays the power subsystem fault codes.	
15	PSC Reset Button	When out, indicates a PSC fault condition.	Press in to reset.
16	CAMP Fan Fault	When on, indicates that a fan fault caused all disk drives and tape drives to shut down.	Replace the fan. See Chapter 5.

Table 3–10 Fan, LDC, Temperature Error Codes

Error Code	PSC OK	PSC Failure	LDC Fault	FAN Failure	Error Description
0	On	Off	—[1]	—	Normal operation, displayed after PSC passes self-test
1	—	—	—	On	Fan 1 failed
2	—	—	—	On	Fan 2 failed
3	—	—	—	On	Fan 3 failed
4	—	—	—	On	Fan 4 failed
9	—	—	—	On	Access door opened, or two or more fans failed
A	—	—	On	—	LDCA (LDC0) failed
B	—	—	On	—	LDCB (LDC1) failed
C	—	—	On	—	LDCC (LDC2) failed
D	—	—	On	—	LDCD (LDC3) failed
A	—	—	On	—	LDCE (LDC4) failed
—	—	—	On	—	LDCF (LDC5) failed
—	—	—	On	—	LDCG (LDC6) failed
—	—	—	On	—	LDCH (LDC7) failed
7	Off	On	—	—	Temperature sensor failed, low reading
8	Off	On	—	—	Temperature sensor failed, high reading
—	—	—	On	—	Temperature in red zone

[1]Dash entries = LED state NOT changed by error

The PSC Fault ID Display provides a continuous, 1-character rotating display of the 4-character error codes listed in Tables 3–11 to 3–17. Character display time is approximately 1/2 second.

Table 3–11 FEU Error Codes

Error Code	FEU OK	FEU Failure	Error Description
E200	Off	On	48V_SWITCHED OK before enabling
E201	Off	On	Fan converter operating before enabling
E202	Off	On	HVDC is OK, but POWER is not OK (contradictory status)
E203	Off	On	The ac current is not OK (in idle state/loop)
E204	Off	On	48V_DIRECT is not OK and POWER is OK (IRQ18)
E205	Off	On	48V_SWITCHED is not OK and switched bus requested (IRQ19)
E206	Off	On	HVDC is OK, but POWER is not OK (IRQ20)
E210	Off	On	SWITCHED BUS did not turn on at startup
E211	Off	On	SWITCHED BUS did not turn off at shutdown
E212	Off	On	The ac current is high for the second time (in startup or run loop)
E220	Off	On	Fan converter voltage is low

Table 3–12 PSC Error Codes

Error Code	PSC OK	PSC Failure	Error Description
EFFF	Off	On	Invalid error number (in display_error procedure)
E000	Off	On	Unused error condition
E001	Off	On	PSC bias supply not OK
E002	Off	On	80C196 internal register test failed
E003	Off	On	80C196 operational test failed
E004	Off	On	80C196 on-chip RAM test failed
E005	Off	On	ROM checksum test failed
E006	Off	On	External RAM test failed
E007	Off	On	Port FF20 (PSC/FEU LEDs) not initially zero
E008	Off	On	Port FF22 (Module enable) not initially zero
E009	Off	On	Port FF23 (DC-DC LEDs) not initially zero
E010	Off	On	Port FF24 (LDC enable) not initially zero
E011	Off	On	External interrupt test failed (8259 did not clear test bit)
E012	Off	On	Masked interrupt occurred (A/D conversion complete)
E013	Off	On	Masked interrupt occurred (HSI data available)
E014	Off	On	Masked interrupt occurred (HSO)
E015	Off	On	Masked interrupt occurred (HSI pin 0)
E016	Off	On	Masked interrupt occurred (Serial I/O)
E017	Off	On	Software trap interrupt occurred (F7 instruction executed)

(continued on next page)

Table 3–12 (Cont.) PSC Error Codes

Error Code	PSC OK	PSC Failure	Error Description
E018	Off	On	Unimplemented opcode interrupt occurred (invalid instruction)
E019	Off	On	Masked interrupt occurred (HSI FIFO 4th entry)
E020	Off	On	Masked interrupt occurred (Timer 2 capture)
E021	Off	On	Masked interrupt occurred (Timer 2 overflow)
E022	Off	On	PSC bias supply failed (NMI occurred)
E023	Off	On	Invalid interrupt number (>31) received from 8259
E024	Off	On	IRQ4 occurred (slave 0 to master 8259)
E025	Off	On	IRQ5 occurred (slave 1 to master 8259)
E026	Off	On	IRQ6 occurred (slave 2 to master 8259)
E027	Off	On	Masked IRQ13 occurred (FEU DIRECT 48 became OK)
E028	Off	On	Masked IRQ14 occurred (FEU SWITCHED 48 became OK)
E029	Off	On	Masked IRQ16 occurred (FEU POWER became OK)
E030	Off	On	External interrupt test, not enabled (IRQ22)
E031	Off	On	External interrupt test, bit not set (IRQ22)
E032	Off	On	Masked IRQ25 occurred (OCP DC ON, turned on)
E033	Off	On	Masked IRQ26 occurred (PSC DC ON, turned on)
E034	Off	On	Invalid converter number (start of enable_converter procedure)
E035	Off	On	Invalid converter number (end of enable_converter procedure)
E036	Off	On	Invalid converter number (start of disable_converter procedure)
E037	Off	On	Invalid converter number (end of disable_converter procedure)
E047	Off	On	Unused error condition
E078	Off	On	Unused error condition
E079	Off	On	Unused error condition
E086	Off	On	Unused error condition
E087	Off	On	Unused error condition
E088	Off	On	Unused error condition
E091	Off	On	Unused error condition
E092	Off	On	Unused error condition
E093	Off	On	Unused error condition
E094	Off	On	Unused error condition
E095	Off	On	Unused error condition
E096	Off	On	Unused error condition
E097	Off	On	Unused error condition

(continued on next page)

Table 3–12 (Cont.) PSC Error Codes

Error Code	PSC OK	PSC Failure	Error Description
E098	Off	On	Unused error condition
E099	Off	On	Unused error condition

Table 3–13 12 V DC to DC Converter Error Codes

Error Code	12V OK	12V Fault	5V OK	5V Fault	3V OK	3V Fault	2V OK	2V Fault	Error Description
E010	—[1]	—	Off	On	Off	On	—	—	Delta 0 V
E101	—	—	Off	—	Off	—	Off	—	Indeterminant converter overvoltage (IRQ7)
E102	Off	—	Off	—	Off	—	Off	—	Indeterminant converter overvoltage/ undervoltage (IRQ15)
E103	Off	On	Off	On	Off	On	Off	On	Unknown converter overvoltage/ undervoltage condition

[1]Dash entries = LED state NOT changed by error

Table 3–14 2 V DC to DC Converter Error Codes

Error Code	2V OK	2V Fault	Error Description
E110	Off	On	Out of regulation low
E111	Off	On	Out of regulation high
E112	Off	On	Undervoltage
E113	Off	On	Overvoltage
E114	Off	On	Voltage present when disabled
E115	Off	On	Did not turn off

Note

The 2 V converter output is not used on the Model 810.

Table 3–15 3 V DC to DC Converter Error Codes

Error Code	3V OK	3V Fault	Error Description
E120	Off	On	Out of regulation low
E121	Off	On	Out of regulation high
E122	Off	On	Undervoltage
E123	Off	On	Overvoltage
E124	Off	On	Voltage present when disabled
E125	Off	On	Did not turn off

Table 3–16 5 V DC to DC Converter Error Codes

Error Code	5V OK	5V Fault	Error Description
E130	Off	On	Out of regulation low
E131	Off	On	Out of regulation high
E132	Off	On	Undervoltage
E133	Off	On	Overvoltage
E134	Off	On	Voltage present when disabled
E135	Off	On	Did not turn off

Table 3–17 12 V DC to DC Converter Error Codes

Error Code	12V OK	12V Fault	Error Description
E140	Off	On	Out of regulation low
E141	Off	On	Out of regulation high
E142	Off	On	Undervoltage
E143	Off	On	Overvoltage
E144	Off	On	Voltage present when disabled
E145	Off	On	Did not turn off

3.8 Device Status and Fault Indicators

The following sections describe the device status and fault indicators.

3.8.1 RF35 Disk Drawer

Figure 3–5 shows the RF35 disk drawer controls and indicators. Table 3–18 describes their functions.

Figure 3–5 RF35 Disk Drawer Controls and Indicators

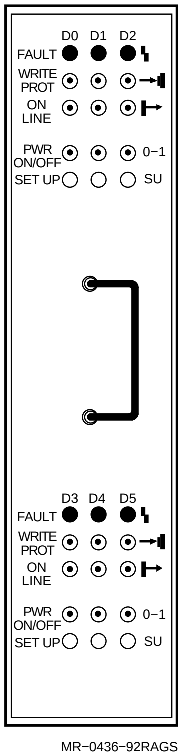


Table 3–18 RF35 Disk Drawer Controls and Indicators

Control/Indicator	Color	State	Operating Condition
Fault	Red	On	Drive is faulty.
		Off	Drive is functioning correctly.
Write Protect	Amber	Out, off	System can read from the disk and write to the disk.
		In, on	System cannot write to the disk, but can read from the disk.
On Line	Green	Out, off	Drive is disabled.
		In, on	Drive is enabled.
Power On/Off	Green	In, on	Power is on.
		Out, off	Power is off.
Set Up Switch		In	Prevents the drive from joining the DSSI cluster. Also allows you to set the DSSI parameters for a new drive or a drive you replace in the system after repair. (If you want to set the DSSI parameters, you press the Set Up switch and the Power On/Off switch at the same time.)
		Out	Has no effect on the drive.

3.8.2 SF35 Storage Array

Figure 3–6 shows the operator control panel. Table 3–19 describes their functions. Figure 3–7 shows the rear of the storage array. Table 3–20 describes the functions of the controls and indicator located at the rear of the storage array.

Figure 3–6 SF35 Operator Control Panel

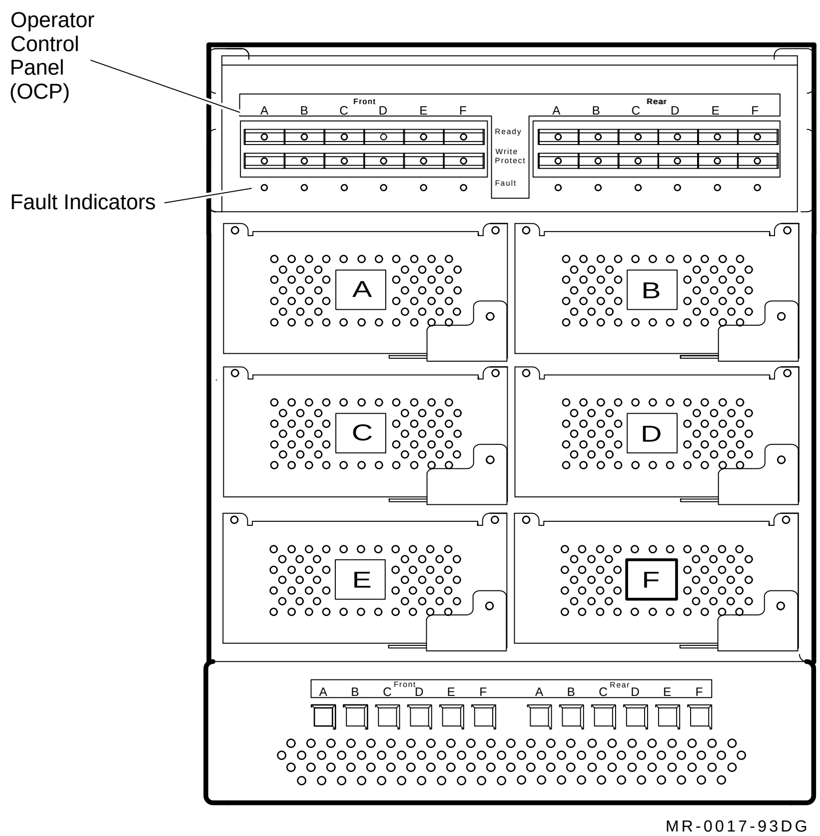


Table 3–19 SF35 Operator Control Panel Description

Control/Indicator	Function
Ready	Push-to-set switch with green indicator. Brings the integrated storage element (ISE) on-line in about 10 seconds. The indicator remains on while the ISE is on-line.
Write Protect	Push-to-set switch with amber indicator. Write protects the data on the ISE. The data cannot be overwritten, nor can new data be written to the ISE.
Fault	Recessed switch with multi-color indicator. Controls the MSCP. This switch is equivalent to the SU switch. The colors indicate the following conditions: Green (in) = MSCP is disabled. Green (out)= MSCP is enabled. Amber = Fault is detected while the MSCP is disabled. Red = ISE fault. Off = Normal MSCP operation.
Drive DC Power Switches	One switch/indicator for each ISE. Apply power to the ISEs. Each ISE spins up and runs a self-test. The indicator shows that nominal power is being applied to the ISE. (If you want to bring the ISE on-line, you press the Ready switch next.)

Figure 3–7 SF35 Rear Panel Fault Indicator

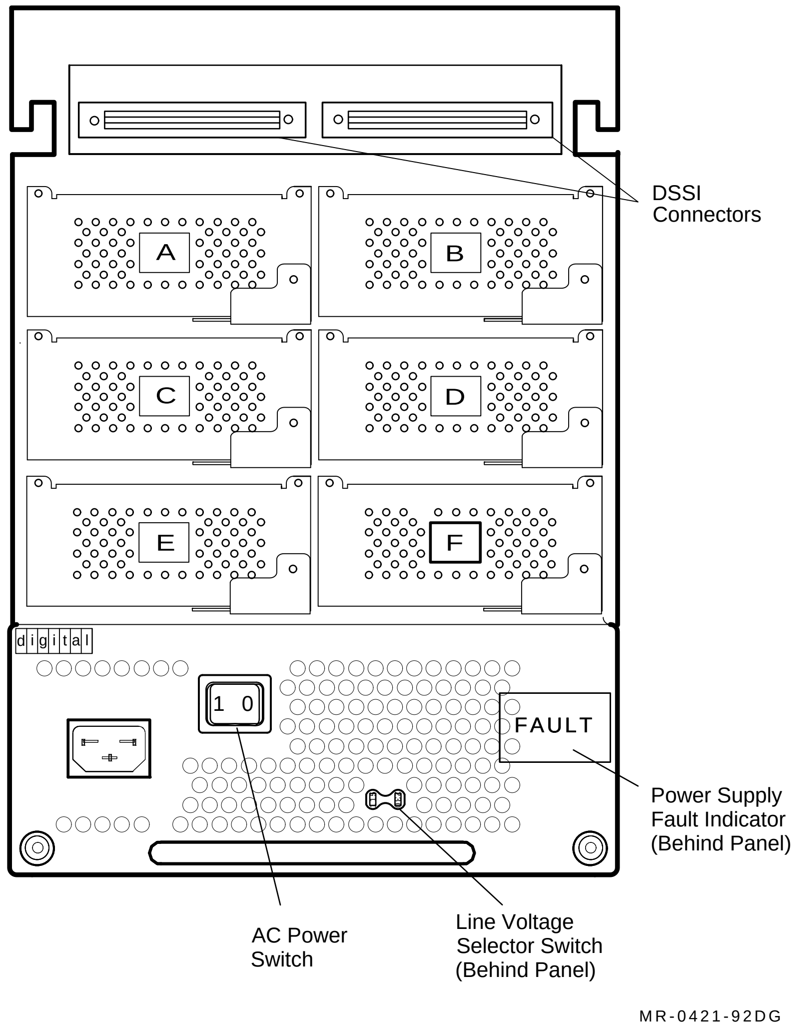


Table 3–20 SF35 Rear Panel Controls and Indicator

Control/Indicator	Function
AC Power Switch	Applies power to the ac power supply.
Line Voltage Selector Switch	Selects 120 Vac (60 Hz) or 240 Vac (50 Hz) line voltage.
Power Supply Fault Indicator	When on, indicates an overtemperature condition.

3.8.3 SF73 Storage Array

Figure 3–8 shows the SF73 storage array status and fault indicators. Table 3–21 descibes their functions. Figure 3–9 shows the controls and indicator located at the rear of the storage array.

Figure 3–8 Location of SF73 Storage Array LEDs and Switchpacks

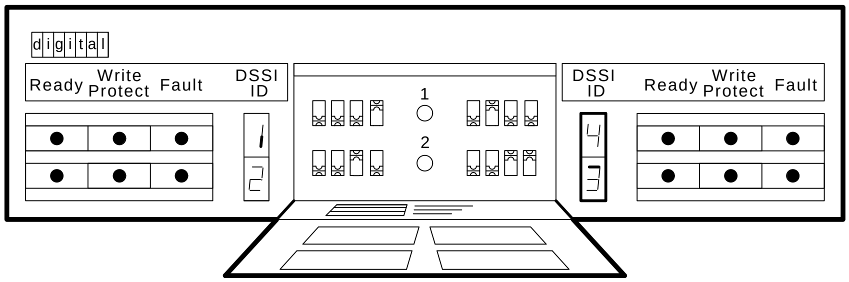
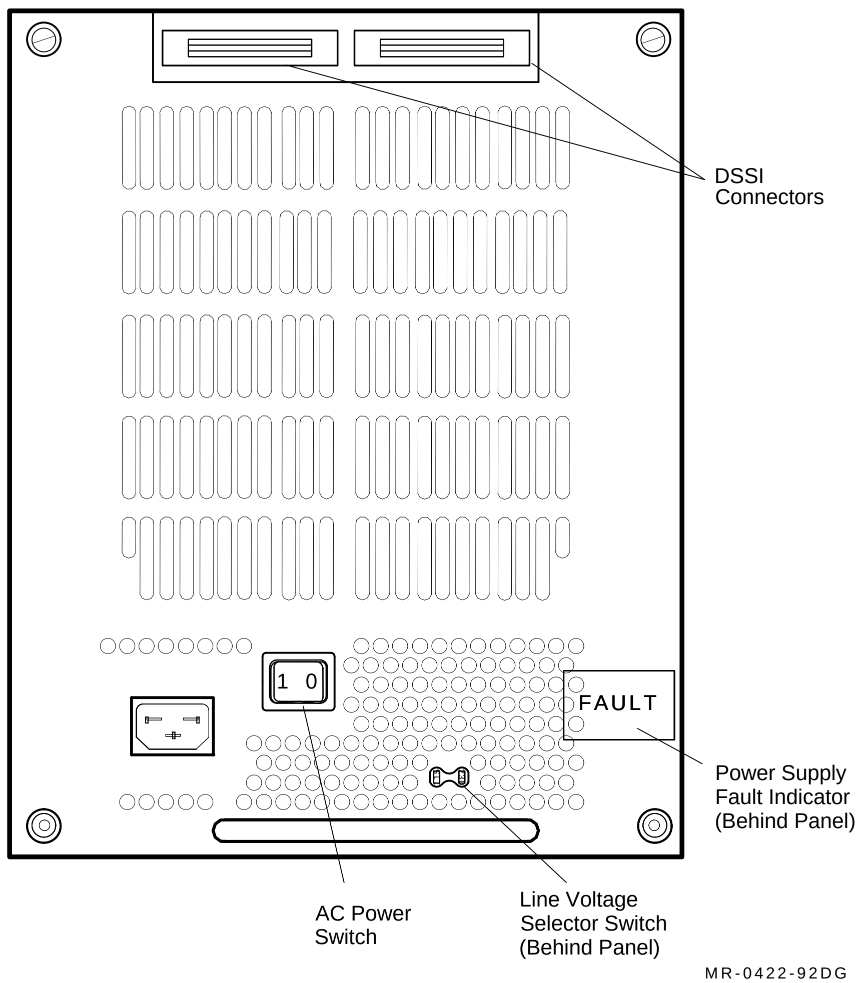


Table 3–21 SF73 Front Panel Controls and Indicators

Control/Indicator	Function
Ready	Push-to-set switch with green indicator. Brings the integrated storage element (ISE) on-line in about 10 seconds. The indicator remains on while the ISE is on-line.
Write Protect	Push-to-set switch with amber indicator. Write protects the data on the ISE. The data cannot be overwritten, nor can new data be written to the ISE.
Fault	Switch with red indicator. When the indicator is on, the ISE failed. Press the switch to display the fault codes and clear the ISE fault. The indicator is off during normal operation.
TERM PWR LED	When on, indicates that the correct termination power is being supplied.
SPLIT LEDs (2)	When on, indicates that the storage array is operating in split-bus mode.
Switchpacks (4)	One for each of the drives in the storage array. Each switchpack is used to set the DSSI ID number. The icon on the front of the door indicates the location of the drive. The three rightmost switches of each switchpack are the DSSI ID switches. The leftmost switch is the SU switch.
Drive DC Power Switches	One switch/indicator for each ISE. Each switch applies power to an ISE. Each ISE spins up and runs a self-test. The indicator shows that nominal power is being applied to the ISE. (If you want to bring the ISE on-line, you press the Ready switch next.)

Figure 3–9 Rear of the SF73 Storage Array



3.8.4 TF85C Tape Drive

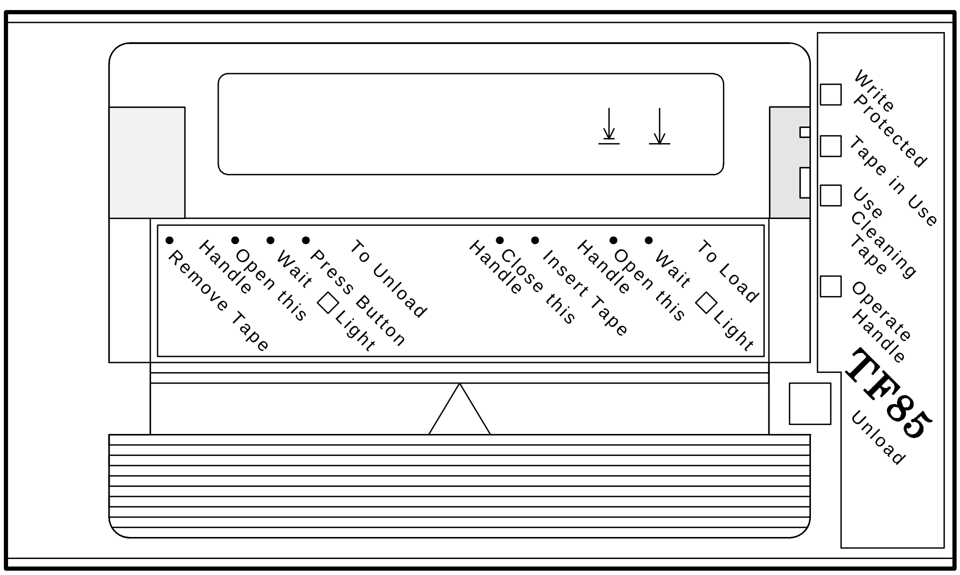
Table 3–22 may help you define and correct TF85C tape drive problems.

Table 3–22 TF85C Tape Drive Problems

Problem	Possible Solution
Correctable failure during operation	If the TF85C drive fails during operation, reset the the drive, then rewind, unload, and remove the cartridge. If all four indicators are blinking, press the Unload button. If the failure is correctable, the tape begins to rewind and the yellow indicator blinks. When the tape is unloaded, the green indicator turns on and the beeper sounds. Then pull the Insert/Remove handle to open the drive and remove the cartridge.
Noncorrectable failure during tape motion	If the tape does not rewind when the Unload button is pushed, and all indicators continue to blink, the failure is not correctable. The drive must be serviced or replaced.
Failure during cartridge insertion	A cartridge failure occurs if a cartridge is damaged or if internal portions of the drive that handle the cartridge are not working. Suspect a cartridge failure if the green indicator blinks, but the tape does not move (the yellow indicator does not blink). Remove the cartridge and try another one, or inspect the tape leader and drive takeup leader.

Figure 3–10 shows the front of the TF85C tape drive. Table 3–23 describes the indicators shown in Figure 3–10.

Figure 3–10 TF85C Cartridge Tape Drive



MR-0471-92DG

Table 3–23 TF85C Cartridge Tape Drive Indicators

Indicator	Color	State	Operating Condition
Write Protected	Orange	On	Tape is write-protected.
		Off	Tape is write-enabled.
Tape in Use	Yellow	Blinking	Tape is moving.
		On	Tape is loaded; ready for use.
Use Cleaning Tape	Orange	On	Drive head needs cleaning or tape is bad.
		If it remains on after you unload the cleaning tape . . .	Then the cleaning was not completed because the tape ended.
		If, after cleaning, it turns on again when the data cartridge is reloaded . . .	Then a data cartridge problem occurred. Try another cartridge.
Operate Handle	Green	On	Okay to operate the Insert/Remove handle.
		Off	Do not operate the Insert/Remove handle.
All four indicators		On	Power-on self-test is in progress.
		Blinking	A fault is occurring. Press the Unload button to unload the cartridge. If the fault is cleared, the yellow indicator blinks while the tape rewinds. When the green indicator turns on, you can move the Insert/Remove handle to remove the cartridge. If the fault is not cleared, all four indicators continue to blink. Do not attempt to remove the cartridge. Refer to the TF85C service guide.

3.8.5 TF857 Tape Loader

This section describes the power on process and the operator control panel (OCP) indicators.

3.8.5.1 Power-On Process

When the TF857 tape loader powers on, all of the indicators on the control panel (OCP) turn on within 15 seconds. The power on self-test (POST) is initializing the subsystem. When POST completes successfully, all OCP indicators, including the Magazine Fault and Loader Fault indicators, turn off — except for Power On. Then the elevator scans the magazine to find slots that contain cartridges.

3.8.5.2 Operator Control Panel Controls and Indicators

Figure 3–11 shows the OCP controls and indicators. Table 3–24 describes their functions.

Figure 3–11 TF857 Operator Control Panel

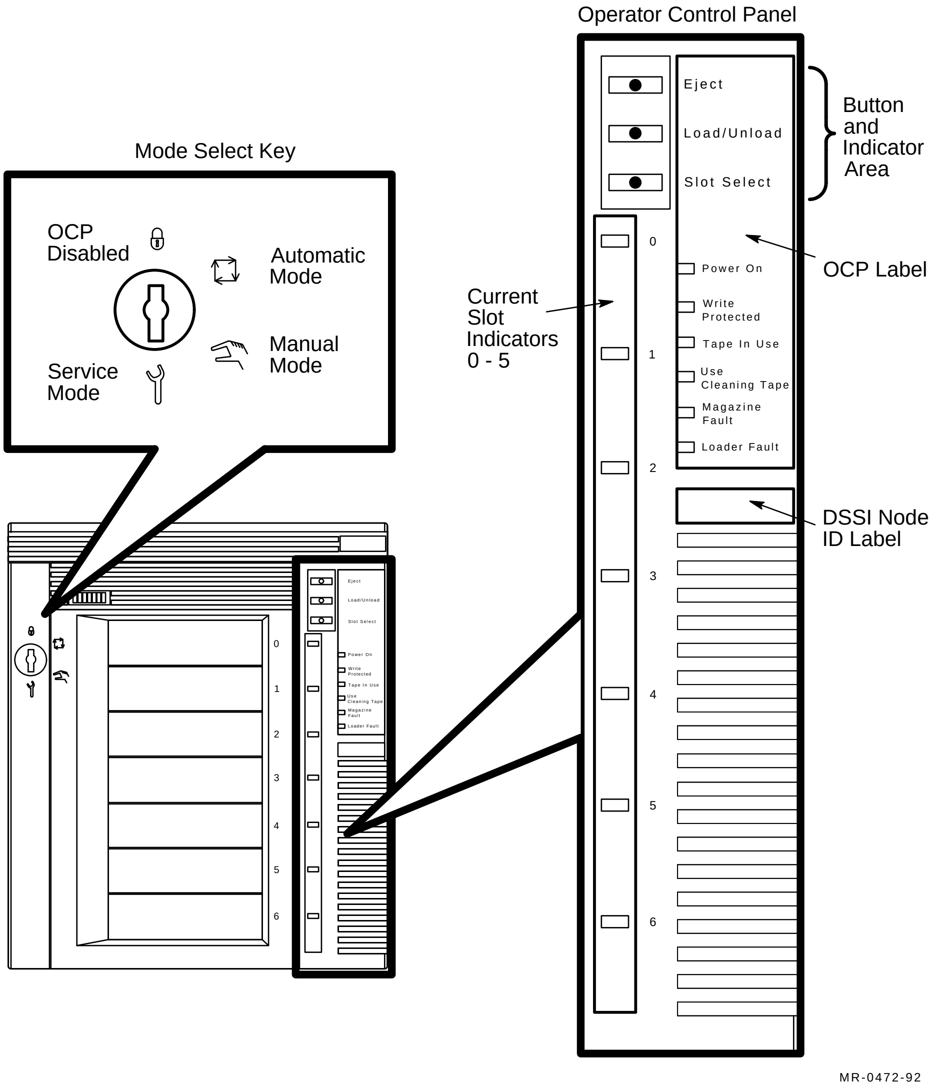


Table 3–24 TF857 OCP Controls and Indicators

Control/Indicator	Color	Function
Eject button	–	Opens the receiver, allowing access to the magazine for removal and insertion of cartridges. Also can be used to unload the tape from the drive to the magazine.
Eject indicator	Green	Indicates that pressing the Eject button opens the receiver. If a cartridge is in the drive, the cartridge unloads to the magazine and the receiver opens. If no cartridge is in the drive, the receiver opens.

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Table 3–24 (Cont.) TF857 OCP Controls and Indicators

Control/Indicator	Color	Function
Load/Unload button	–	Loads the currently selected cartridge into the drive, or unloads the cartridge from the drive to the magazine. If the Loader Fault or Magazine Fault indicators are on, can also be used to reset the subsystem.
Load/Unload indicator	Green	Indicates you can press the Load/Unload button.
Slot Select button	–	When pressed, increments the current slot indicator to the next slot.
Slot Select indicator	Green	Indicates the Slot Select button can be used. Pressing the button increments the current slot indicator to the next slot.
Power On indicator	Green	When on, indicates the TF857-AA tape loader power is on (ac and dc voltages are within tolerance). When off, indicates the tape loader power is off.
Write Protected indicator	Orange	When on, indicates the cartridge in the drive is write protected. When off, indicates the cartridge in the drive is write enabled.
Tape in Use indicator	Yellow	Indicates tape drive activity as follows: • Slow blinking indicates tape is rewinding; rapid blinking indicates tape is reading or writing. • When on steadily, indicates a cartridge is in the drive and the tape is not moving. • When off, indicates no cartridge is in the drive.
Magazine Fault indicator	Red	Indicates a magazine failure.
Use Cleaning Tape indicator	Orange	Indicates the read/write head needs cleaning.
Loader Fault indicator	Red	Indicates a TF857-AA tape loader transfer assembly error or drive error.
Current slot indicators 0–6	Green	Identify the current slot (see Slot Select button). Each current slot indicator blinks when its corresponding cartridge moves to or from the drive. Also used with the Magazine Fault or Loader Fault indicator to indicate the type of fault.

3.9 ROM-Based Diagnostics

The following sections describe how to use the TEST and Z commands and to run the ROM-based diagnostics (RBDs).

3.9.1 TEST

TEST enables the user to test:

- The system
- A zone
- The CPU and memory

Use TEST *only* when the cross-link state is set to off.

The TEST syntax is:

```
TEST [qualifier(s)]
```

Tables 3–25 and 3–26 describe the TEST selection and control qualifiers.

Table 3–25 Qualifiers for TEST Selection

Qualifier	Description
/GROUP:*n*[1]	Specifies a decimal number from 0 to 5 that identifies the group of tests to be run.
/TEST:*n*[1]	Specifies a decimal number from 0 to 32 that identifies the tests to be run.
/SUBTEST:*n*[1]	Specifies a decimal number from 0 to 32 that identifies the subtests to be run.
/VERBOSE	Enables a display of all individual tests during execution.
/NOTRACE	Disables test traces.

[1] *n* can be a:

- Single value
- Range separated by a colon (1:5)
- List separated by commas (1,5,9)
- Combination of range and list (1:6,8,10,11:29)

Table 3–26 Qualifiers for TEST Control

Qualifier	Description
/PASSCOUNT:*n*	*n* is a decimal number from 0 to MAXINT. When *n* is 0, the passcount is infinite.
/NOTRACE	Disables the test traces.
/COE	Continues on error.
/NOCONFIRM	Disables the test confirmation on destructive tests.
/EXTENDED	Enables extended error reports.
/NOSTATUS	Disables status messages and reports.
/LIST	Lists the available tests, but does not run them.

When you do not supply the qualifier(s), TEST runs all the nonextended tests (except those that require confirmation).

3.9.2 Z

Z connects to the firmware of another module in the system. It is also used to initiate I/O ROM-based diagnostics.

The Z syntax is:

```
Z[/PATH=path-number]
```

Table 3–27 describes the qualifier.

Table 3–27 Qualifier for Z

Qualifier	Function
/PATH=path-number	Specifies the zone and slot number of a module. The path-number format is **zss**, where: **z** is the zone ID (A or B). **ss** is the slot number of the module.

When you do not supply a path, Z tries to connect to the module in slot 1 of the zone that is running.

Note

Z performs a hard reset on the ATMs, but you need to issue a programmed reset to load and start the functional firmware. After Z, you *must* issue a BOOT from the same zone, or a START/ZONE from the other zone (if that zone is running the operating system).

3.9.3 CPU ROM-Based Diagnostics

Table 3–28 provides a brief description of the CPU ROM-based diagnostics (RBDs).

Table 3–28 CPU ROM-Based Diagnostic Descriptions

Group	Test	Subtest	Description
G: 0			Self-Test
G: 0	T: 0		NVRAM Test
G: 0	T: 0	S: 0	NVRAM CPU EEPROM Data Integrity Test
G: 0	T: 0	S: 1	NVRAM CPU EEPROM Checksum Test
G: 0	T: 0	S: 2	NVRAM I2C Bus Register Access Test
G: 0	T: 0	S: 3	NVRAM Module-ID PROM Access and Data Integrity R/W Test
G: 0	T: 0	S: 4	NVRAM Module-ID PROM Checksum Test
G: 0	T: 0	S: 5	NVRAM System Ethernet Access Test
G: 0	T: 0	S: 6	NVRAM System Ethernet PROM Checksum Test
G: 0	T: 1		P-CACHE Test

(continued on next page)

Table 3–28 (Cont.) CPU ROM-Based Diagnostic Descriptions

Group	Test	Subtest	Description
G: 0	T: 1	S: 0	P-CACHE Register Bit Test
G: 0	T: 1	S: 1	P-CACHE Tag Integrity Test
G: 0	T: 1	S: 2	P-CACHE Data Integrity Test
G: 0	T: 1	S: 3	P-CACHE Data/Tag Parity Test
G: 0	T: 2		VIC Test
G: 0	T: 2	S: 0	VIC Register Bit Test
G: 0	T: 2	S: 1	VIC Cache Tag Test
G: 0	T: 2	S: 2	VIC Cache Data Test
G: 0	T: 2	S: 3	VIC Cache Data Parity Error Test
G: 0	T: 2	S: 4	VIC Cache Tag Parity Error Test
G: 0	T: 2	S: 5	VIC Branch Prediction Test
G: 0	T: 3		JXD Test
G: 0	T: 4		Memory Test
G: 0	T: 4	S: 0	MEMORY Data Bus & Catastrophic Failure Test
G: 0	T: 4	S: 1	MEMORY Address Uniqueness Test
G: 0	T: 4	S: 2	MEMORY Bank Addressing Test
G: 0	T: 4	S: 3	MEMORY Chip Addressing Test
G: 0	T: 4	S: 4	MEMORY Chip Open Address Lines Test
G: 0	T: 4	S: 5	MEMORY Single-Bit ECC Error Logic Test
G: 0	T: 4	S: 6	MEMORY Double-Bit ECC Error Logic Test
G: 0	T: 4	S: 7	MEMORY ECC Error Logic Test
G: 0	T: 4	S: 8	MEMORY ECC Test
G: 0	T: 4	S: 9	MEMORY ECC Lines Test
G: 0	T: 5		BITMAP Test
G: 0	T: 5	S: 0	BITMAP March Test
G: 0	T: 6		B-CACHE Test
G: 0	T: 6	S: 0	B-CACHE Data RAM Test
G: 0	T: 6	S: 1	B-CACHE Tag RAM Test
G: 0	T: 6	S: 2	B-CACHE ECC RAM Test
G: 0	T: 6	S: 3	B-CACHE Write Test
G: 0	T: 6	S: 4	B-CACHE Data Integrity Test
G: 0	T: 6	S: 5	B-CACHE Data Test (error enabled)
G: 0	T: 7		DMA Test
G: 0	T: 7	S: 0	DMA Powerup State Test
G: 0	T: 7	S: 1	DMA Register Access Test
G: 0	T: 7	S: 2	DMA Address Decode Test
G: 0	T: 7	S: 3	DMA Interlock Access Test
G: 0	T: 7	S: 4	DMA Queue Processing Test

(continued on next page)

Table 3–28 (Cont.) CPU ROM-Based Diagnostic Descriptions

Group	Test	Subtest	Description
G: 0	T: 7	S: 5	DMA Sub-Trasfer Length Test
G: 0	T: 7	S: 6	DMA I/O Byte Alignment Test
G: 0	T: 7	S: 7	DMA Memory Byte Alignment Test
G: 0	T: 7	S: 8	DMA Maximum Transfer Length Test
G: 0	T: 8		XLINK Test
G: 0	T: 8	S: 0	XLINK Serial Cross-link Internal Loopback Test - Part 1
G: 0	T: 8	S: 1	XLINK Serial Cross-link Internal Loopback Request Test
G: 0	T: 8	S: 2	XLINK Serial Cross-link Internal Loopback Reply Test
G: 0	T: 8	S: 3	XLINK Serial Cross-link Internal Loopback Query Test
G: 0	T: 8	S: 4	XLINK Serial Cross-link External Loopback Test
G: 0	T: 8	S: 5	XLINK Serial Cross-link Communication Register Test
G: 0	T: 9		RESET Test
G: 0	T: 9		RESET CPU Module Hard Reset Test
G: 1			Zone Test
G: 1	T: 0		ACCESS Test
G: 1	T: 0	S: 0	ACCESS Parallel Xlink Loopback Test
G: 1	T: 0	S: 1	ACCESS I/O Module PATH ACCESS Test
G: 1	T: 0	S: 2	ACCESS I/O Module SSC Console Uart Test
G: 1	T: 1		DMA Test
G: 1	T: 2		INTERRUPT Test
G: 1	T: 3		ERROR Test
G: 1	T: 3	S: 0	ERROR I/O Crosscheck Test
G: 1	T: 4		RESET Test
G: 1	T: 4	S: 0	RESET CPU Module Zone Reset Test
G: 1	T: 4	S: 1	RESET I/O Module Reset Test
G: 2			System Test
G: 2	T: 0		Cross-link Mode Test
G: 2	T: 0	S: 0	Zone A (MASTER -> RESYNC MASTER -> DUPLEX) Mode Test
G: 2	T: 0	S: 1	Zone B (MASTER -> RESYNC MASTER -> DUPLEX) Mode Test
G: 2	T: 1		Zone A MASTER - Zone B SLAVE Mode Test
G: 2	T: 1	S: 0	ACCESS I/O Module Path Access Test
G: 2	T: 1	S: 1	ACCESS I/O Module SSC Console Uart Test
G: 2	T: 1	S: 2	ERROR I/O Crosscheck Test
G: 2	T: 2		Zone A RESYNC_MASTER - Zone B RESYNC_SLAVE Mode Test

(continued on next page)

Table 3–28 (Cont.) CPU ROM-Based Diagnostic Descriptions

Group	Test	Subtest	Description
G: 2	T: 2	S: 0	ACCESS I/O Module Path Access Test
G: 2	T: 2	S: 1	ACCESS I/O Module SSC Console Uart Test
G: 2	T: 2	S: 2	ERROR I/O Crosscheck Test
G: 2	T: 3		Zone B MASTER - Zone A SLAVE Mode Test
G: 2	T: 3	S: 0	ACCESS I/O Module Path Access Test
G: 2	T: 3	S: 1	ACCESS I/O Module SSC Console Uart Test
G: 2	T: 3	S: 2	ERROR I/O Crosscheck Test
G: 2	T: 4		Zone B RESYNC_MASTER - Zone A RESYNC_SLAVE Mode Test
G: 2	T: 4	S: 0	ACCESS I/O Module Path Access Test
G: 2	T: 4	S: 1	ACCESS I/O Module SSC Console Uart Test
G: 2	T: 4	S: 2	ERROR I/O Crosscheck Test
G: 2	T: 5		DUPLEX Mode Test
G: 2	T: 5	S: 0	ACCESS I/O Module Path Access Test
G: 2	T: 5	S: 1	ACCESS I/O Module SSC Console Uart Test
G: 2	T: 5	S: 2	ERROR I/O Crosscheck Test

The following example shows a CPU RBD error frame.

```
>>> group: 0 test: 1 subtest:2

======================================================================
-----------------------  DIAGNOSTIC TEST ERROR  ----------------------
GROUP: 00     Test: 01   Sub: 02    Error: 01   Pass: 00000001
Addr: 00000000    Exp: 00000000   Rec: 000000ff    Xor: 000000ff
Data Miscompare
=======================================================================
```

The example shows that the P-CACHE Data/Tag Integrity Test was executed and failed. The XOR data specifies a data miscompare.

3.9.4 I/O ROM-Based Diagnostics

Table 3–29 provides a brief description of the I/O ROM-based diagnostics (RBDs).

Table 3–29 I/O ROM-Based Diagnostic Descriptions

Group	Test	Subtest	Description
G: 0			I/O Self-Test
G: 0	T: 0		I/O SSC Test
G: 0	T: 0	S: 0	SSC Toy Clock Test
G: 0	T: 0	S: 1	SSC Storage Uart Test
G: 0	T: 0	S: 2	SSC Bus Timeout Test
G: 0	T: 0	S: 3	SSC Interval Timer Test

(continued on next page)

Table 3–29 (Cont.) I/O ROM-Based Diagnostic Descriptions

Group	Test	Subtest	Description
G: 0	T: 1		I/O VIC Test
G: 0	T: 1	S: 0	VIC Register Test
G: 0	T: 1	S: 1	VIC Interrupt Test
G: 0	T: 2		I/O Firewall Test
G: 0	T: 2	S: 0	Firewall Register Test
G: 0	T: 2	S: 1	Firewall Rail Master Test
G: 0	T: 2	S: 2	Firewall Cross Check Error Test
G: 0	T: 3		I/O Cache Test
G: 0	T: 3	S: 0	CACHE Control Register Bit Test
G: 0	T: 3	S: 1	CACHE Minimum Bank Test
G: 0	T: 3	S: 2	CACHE Data Integrity Test
G: 0	T: 3	S: 3	CACHE Tag Integrity Test
G: 0	T: 3	S: 4	CACHE Tag Parity Detection Test
G: 0	T: 3	S: 5	CACHE Tag Parity Generation Test
G: 0	T: 3	S: 6	CACHE Data Parity Checking Test
G: 0	T: 4		I/O NVRAM Test
G: 0	T: 4	S: 0	Module Data EEPROM Integrity Test
G: 0	T: 4	S: 1	Module I2C EEPROM Integrity Test
G: 0	T: 5		I/O RAM Test
G: 0	T: 5	S: 0	SOC RAM Test
G: 1			I/O Eself Pcard Test
G: 1	T: 0		I/O SLIM Test
G: 1	T: 0	S: 0	SLIM Register Test
G: 1	T: 0	S: 1	SLIM RAM Test
G: 1	T: 1		I/O SWIFT Test
G: 1	T: 1	S: 0	SWIFT Reset Test
G: 1	T: 1	S: 1	SWIFT Register Test
G: 1	T: 1	S: 2	SWIFT Interrupt Test
G: 1	T: 1	S: 3	SWIFT Internal Loopback Test
G: 1	T: 2		I/O LANCE Test
G: 1	T: 2	S: 0	LANCE Register Test
G: 1	T: 2	S: 1	LANCE Internal Loopback Test
G: 1	T: 2	S: 2	LANCE Interrupt Test

The following example shows an I/O RBD error frame.

```
>>> z

Connecting to target...Press Ctrl/P to end connection
I
IO1> group: 0 test: 4 subtest:1

======================================================================
----------------------- DIAGNOSTIC TEST ERROR ----------------------
GROUP: 00     Test: 04   Sub: 01    Error: 03   Pass: 00000001
Addr: 00000000    Exp: 00000000   Rec: 000000ff    Xor: 000000ff
Data Miscompare
=======================================================================
```

The example shows that the Module I2C EEPROM Integrity Test was executed and failed. The XOR data specifies a data miscompare.

4 Error Handling and Analysis

4.1 In This Chapter

This chapter includes:

- Error handling services overview
- Field replaceable units
- OpenVMS error log
- Module NVRAM status and LED indicators
- FTSS error reporting interface
- Firmware interfaces
- Firmware and OpenVMS interface data structures
- Error log analysis

4.2 Error Handling Services Overview

The primary function of the error handling services (EHS) is to handle and recover from high-level system interrupts generated by the hardware when an error is detected. When an error occurs, the EHS is invoked by hardware as an interrupt service routine.

The interrupt service routine isolates the failure by examining various system registers. The isolation process occurs at a high system priority level; it pauses the OpenVMS operating system until it is complete.

After isolating the faulty FRU, the EHS determines the appropriate actions to take. For solid errors, system deconfiguration is performed and the FRU is removed from service. This usually involves performing module resets to invoke diagnostics.

EHS error notification is described in Table 4–1.

Table 4–1 EHS Error Notification

Step	Action
1.	Entries are made into the system error log.
2.	Status information is written to the module ID NVRAM and the DCB, where applicable.
3.	The LED indicator associated with a failed module is set.
4.	A call is issued to the error reporting interface (ERI) which reports the event to the FTSS$SERVER. The server process generates OPCOM messages and reports the events to a mailbox.

4.2.1 Basic Error Isolation and Handling

Figure 4–1 and Table 4–2 describe the error isolation and handling procedure.

Figure 4–1 Hardware Error Handling Flowchart

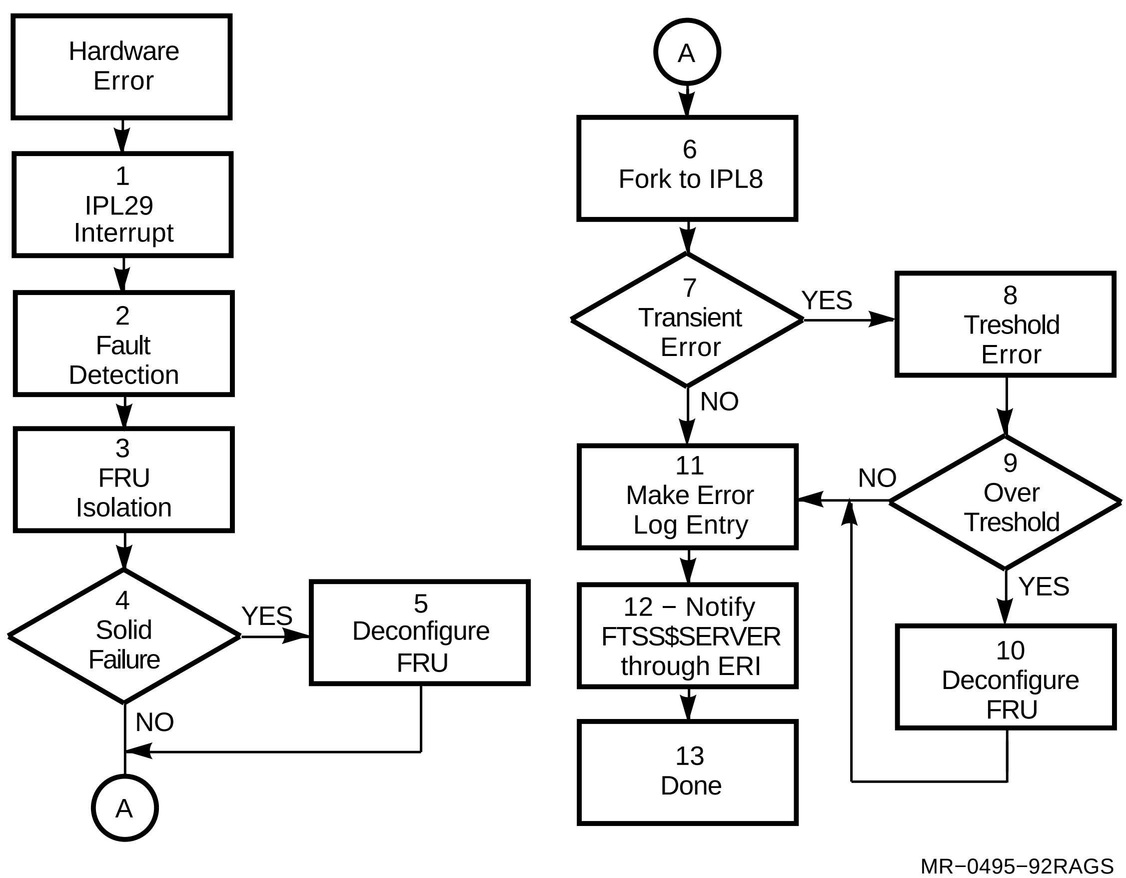


Table 4–2 Error Handling Flowchart Definitions

Event	Definition
1	Hardware reports error through a high-level interrupt and control is transferred to the EHS.
2	The EHS examines system registers to determine the type of failure which has occurred.
3	The EHS identifies the FRU that is the source of the error. FRU isolation is generally accomplished at the module level. In some cases, FRU isolation is to a set of modules. In all cases, the EHS isolates the error to an FRU or set of FRUs in one zone.
4	The EHS determines if the error is solid.
5	If the error is solid, the FRU is deconfigured from the system.
6	The EHS has successfully recovered from the error (either solid or transient) and execution is continued at IPL8.
7 and 8	If the error is transient, it is compared to its error rate threshold.
9	If the error is below the error rate threshold, an entry is made in the error log.
10	If the error is above the error rate threshold, the FRU is deconfigured from the system.
11	An entry is made in the error log.
12	The FTSS$SERVER is notified of the error through the ERI.
13	Error handling is complete.

4.2.2 EHS Structure

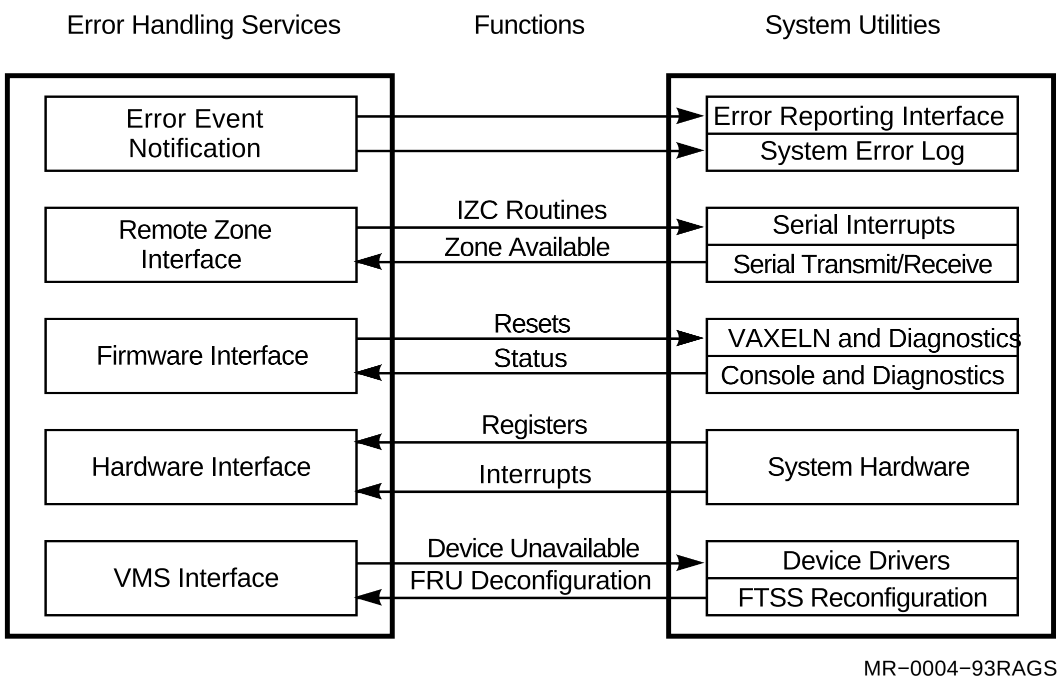
The EHS is packaged as part of the Fault Tolerant System Services (FTSS) execlet (loadable image file). The FTSS execlet is loaded and initialized when FTSS is started after the OpenVMS operating system is booted.

System errors are reported to software through an IPL 29 interrupt. When an interrupt occurs, the hardware fetches the dispatch vector from the System Control Block (SCB) and dispatches to the EHS interrupt service routine.

VAXELN errors are reported to the OpenVMS operating system through an IPL 22 interrupt. The interrupts are vectored by a combination of hardware and software to the EHS interrupt service routine.

Figure 4–2 illustrates the position of the EHS relative to the major hardware, system firmware, and other software components.

Figure 4–2 EHS Architectural Position



4.2.3 System Operating Modes

The error handler recognizes four modes of system operation. Each mode directly relates to the supported hardware modes of the cross-link state as summarized in Table 4–3.

Table 4–3 System Operating Modes

Mode	Definition
Simplex	The cross-link state in one zone is off and the CPU, memory, and I/O subsystem of the other zone are not available for use. However, those components in the other zone may be available and can run the OpenVMS operating system. The system can be booted in this mode if one zone is not physically present or is out of service. The system can also be degraded into this mode after the failure of one zone.
Degraded Duplex	The cross-link state in one zone (the master zone) is set to master and the cross-link state in the other zone is set to slave. The CPU and memory in the master zone are running the OpenVMS operating system and the I/O from the slave zone is configured and in use. However, the slave zone CPU and memory are not in use. This mode can only be achieved as a result of the deconfiguration of a CPU and memory set of one zone due to an error.
Resynch	This mode is similar to Degraded Duplex except that all memory writes in the master zone are duplicated in the slave zone. That is, when a write to memory is performed in the master zone, the same data is written to the same memory location in the slave zone. The cross-link state in one zone is Resynch master and in the other zone, Resynch slave. This mode is used during the synchronization process to copy the master zone memory to the slave zone before entering Duplex mode.

(continued on next page)

Table 4–3 (Cont.) System Operating Modes

Mode	Definition
Duplex	The memories in both zones are identical and both CPUs are running in lockstep. The I/O subsystems of both zones are available and in use. The cross-link state in both zones is Duplex. The system can be booted in this mode, or can transition to this mode as the result of the synchronization process from either Simplex or Degraded Duplex modes.

4.2.4 Error Types

EHS recognizes 11 error types. All errors are classified as one of those described in Table 4–4.

Table 4–4 Error Types

Error Type	Definition
CPU/MEM Faults	All data, ECC codes, and control signals flow over the primary rail. The mirror rail exists primarily for the purpose of performing verification checks against the primary rail. Some checks are performed by hardware between these two rails to detect failures within the boundaries of the CPU module. When such a condition is detected, a CPU/MEM fault is generated by the hardware, and results in the following set of hardware actions: 1. A high-level system interrupt occurs to report the error, causing an entry into the error handler. In some cases, the failure may be severe enough to prevent instructions from executing. 2. If the operating mode at the time of the failure is Duplex, it will be changed to Degraded Duplex mode. In this case, the other zone is interrupted as well by a report that a CPU/MEM fault occurred in the failing zone. 3. Approximately 145 microseconds after the interrupt, the failing CPU module will be reset by hardware, resulting in an entry into the system console. The purpose of this brief delay is to allow the error handler to store the contents of the CPU, JXD, and cross-link registers in the Console Communications Area (CCA). In non-Duplex modes, only one CPU is in use. This failure results in the termination of the OpenVMS operating system. CPU/MEM faults can be caused by solid or transient errors. Since software cannot distinguish between the two, they are all treated as transient. The CPU module requires service only when they exceed the operating system's threshold, when an end action timeout occurs, or when diagnostics fail. In all cases, the FRU identified by software is the CPU module which experienced the failure.

(continued on next page)

Table 4–4 (Cont.) Error Types

Error Type	Definition
Double-Bit memory errors	Hardware reports a double-bit error (DBE) when the ECC checkers detect this condition on a read from a main memory location. This read can occur during a DMA or CPU cycle, with two possible error causes: a memory failure or a programming error. If system software attempts to access a location beyond the bounds of physical memory, hardware will report a double-bit ECC error. This is a programming error in the OpenVMS operating system and the EHS will initiate a system crash. This will be seen as a FATMEMERR bugcheck. If system software attempts to access a valid physical memory location which does not respond, a DBE will be reported by the hardware. In this case, the cause of the problem is failed memory. The CPU with this memory failure is removed from the configuration. If the system is operating in a non-Duplex mode, the OpenVMS operating system is terminated by forcing an entry into the system console. In Duplex, the failed CPU is removed and the system continues to operate in Degraded Duplex mode. DBEs due to memory failures are always treated as solid. The failed CPU will not be reconfigured until the zone with the failure is removed and the memory is repaired. The FRU in most cases will be a pair of SIMMs on a memory mother board (MMB). In all cases, FRU isolation is done at the time of the end action when system registers are recovered from the failed CPU. In the case of an end action timeout, the CPU module will be identified as the FRU.

(continued on next page)

Table 4–4 (Cont.) Error Types

Error Type	Definition
Single-Bit memory errors	Single-Bit Errors (SBEs) can be detected by either the JXD during a DMA read cycle which reads from main memory or the CPU during a memory read. Software action varies depending upon the system operating mode and where the error detection occurs. If the SBE is detected by the JXD during a DMA cycle in any system mode or by the CPU during a CPU cycle in any non-Duplex mode, the actions of the EHS are the same. The error is always transient, and no deconfiguration is performed. A pair of memory SIMM rows on an MMB are isolated and compared to its error rate threshold. In Duplex mode (JXD detected) when the threshold is exceeded, the CPU module on which the memory resides will be removed from service. In non-Duplex mode, since there is only one CPU active and since SBEs are always transient, the CPU is not removed from service when the threshold is exceeded. The SBE is repaired in memory by hardware if detected by the JXD, and by the EHS if detected by the CPU. If the SBE is detected during a CPU cycle while the system is in Duplex mode, the action differs due to hardware constraints. The CPU which experiences the SBE will be removed from service by hardware at the time of the error. An error log will be generated reporting the error, but FRU isolation is done at the time of the end action. The error is then compared to its error rate threshold by the OpenVMS operating system. If the threshold is not exceeded, the CPU will be resynchronized immediately by system software (FTSS$SERVER) at the time of the end action. The process of resynchronization will repair the SBE in physical memory since each location is rewritten during the memory copy. If the failed CPU does not return for resynchronization after being removed in the CPU-detected Duplex mode case, an end action timeout event will be logged which identifies the failed CPU module as the FRU. In most cases, a pair of SIMM rows and a memory mother board (MMB) are identified as the FRU in the error log. However, in some cases, end action data may not contain all the information needed to isolate to a pair of memory SIMM rows. In this case the CPU module will be identified as the FRU and will be subjected to the same threshold as a memory SIMM.
Cable failures	All traffic between the two zones of the system is performed across the cross-link cable. If this cable is detached or broken, the hardware will report a cable loss event to the EHS. This error can only happen in a non-Simplex system, and when it occurs, communication between the zones is lost. In all cases, the system operating mode must be changed to Simplex. If the mode before the error was not Duplex, then the slave zone is removed from service. If the mode was Duplex, then Zone B is removed from service. The EHS indicates in the error log that this error is solid and service is required, and the error is compared to its error rate threshold. If the threshold is not exceeded, the zone will be resynchronized automatically. If the threshold is exceeded, no automatic resynchronization will occur until the cross-link cable is repaired. In all cases, the FRU is the cross-link cable.

(continued on next page)

Table 4–4 (Cont.) Error Types

Error Type	Definition
Power failures	If a zone loses power in a non-Simplex configuration, hardware generates an interrupt to report the event to the EHS. In a non-Duplex mode, software will detect this error only when the slave zone loses power. In this case, the slave zone is removed from the configuration and the system continues to run in Simplex mode. In Duplex mode, the error is detected by software when either zone loses power. Again, the failed zone is removed from the configuration and the system continues in Simplex mode. EHS indicates in the error log that this error is solid and service is required, and the error is compared to its error rate threshold. If the threshold is not exceeded, the zone will be resynchronized automatically. If the threshold is exceeded, no automatic resynchronization will occur until the zone is repaired and resynchronized manually. The failed zone is identified as the FRU for all power failures.
Clock phase errors	If the clocks between zones begin to run out of phase, hardware generates an interrupt to report the event to the EHS. This event can occur only in non-Simplex modes. The cause of this type of failure can be either the oscillator or the clock locking logic. An oscillator failure will prevent the CPU and I/O module clocks in the two zones from running in synchronization and will result in the termination of the OpenVMS operating system on that zone. Failure in the clock lock logic will result in two zones running diverged if the system operating mode had been Duplex. In this case, EHS will select one zone to remove, and the other zone will continue to run the OpenVMS operating system in Simplex mode. (Zone selection is based on timings within the system and could be either zone.) In Degraded Duplex mode, the slave zone is removed from the configuration and the OpenVMS operating system continues in Simplex mode. In all cases of oscillator failure, the ATM in the zone which is removed is identified as the FRU. If the error is caused by clock lock logic failure, software cannot accurately determine in which zone the failure exists. The EHS compares the error to its error rate threshold. An error log is generated at the time of the error which identifies the ATM as the FRU. If the threshold is exceeded, the error log indicates that service is required for the ATM and the zone will not be resynchronized automatically. If the threshold is not exceeded and the diagnostic tests complete successfully, the zone will be resynchronized when it becomes available. If the threshold is not exceeded and the diagnostics report a failure, the end action error log will indicate that the ATM module requires service and the zone will not be resynchronized automatically. If the zone fails to return for service and the threshold had not been exceeded, an end action timeout error log is generated which indicates the ATM requires service.

(continued on next page)

Table 4–4 (Cont.) Error Types

Error Type	Definition
Halt errors	A halt error occurs when the system is operating in Duplex mode, the Zone Halt Enable switch on the zone control panel is pressed, and the Break key is pressed on one of the system consoles, or one zone experiences errors on its halt lines. The zone attached to the console terminal or with the error will be halted and enter the system console. In the other zone, hardware generates an interrupt to the EHS. The system operating mode will be degraded to Simplex and the OpenVMS operating system will be continued after deconfiguring the halted zone. The failed zone is identified as the FRU in the error log. This error is not subjected to thresholding. The halted zone must be resynchronized manually to be returned to service.
Resynch abort errors	During memory resynchronization, all memory writes are mimicked to both zones. The data is driven from the master zone across the resynch bus (also referred to as the cross-link cables) to the slave zone. The incoming data on the slave side is protected by ECC. An ECC failure on the slave side results in a CPU/MEM fault on the slave and is handled as that type of error. The data is protected on the master side by an ECC, a cross-rail ECC comparison and a data cross-check. The failure of any of these checks results in hardware generating an interrupt to the EHS reporting a resynch abort error. Resynch mode is terminated by the hardware and system operation continues in Degraded Duplex mode. Since all resynch abort errors indicate failures on the master side, the master CPU module is isolated as the FRU. This error can occur only when the system is in Resynch mode, so removal of the CPU would result in termination of the OpenVMS operating system. The error log message will indicate the master CPU as the FRU. The EHS compares the error to its error rate threshold. If the threshold is exceeded, the EHS will disable automatic resynchronization of the remote zone. Manual intervention will be required to repair this situation. Since Duplex mode cannot be achieved and the master CPU is the source of this failure, the OpenVMS operating system must be manually terminated to repair the CPU module.
Nonexistent I/O errors	Nonexistent I/O (NXIO) errors occur when a reference to an I/O module times out. Such a timeout can occur during a DMA or CPU cycle. In a CPU cycle, an automatic operation retry is attempted. If the retry succeeds, hardware reports the failure as transient. Otherwise, it is reported as a solid failure. All timeouts during DMA cycles are transient errors. The error log indicates if the error was solid or transient, and if it occurred on a DMA or CPU cycle. In all NXIO error cases, either an I/O or interface module will be identified as the FRU. If the error is solid, the I/O or interface module will be removed from system service by the EHS. If the error is transient, it will be compared to its error rate threshold by the EHS. If the threshold is exceeded and the system operating mode is not Simplex, the I/O or interface module will be removed from system service. No I/O module will be removed due to transient errors from a Simplex system (where alternate I/O paths are not normally available). Additional transient errors on the I/O module will generate further error logs.

(continued on next page)

Table 4–4 (Cont.) Error Types

Error Type	Definition
I/O errors	The ATM module contains a series of checkers that verify consistency between the dual rails of the system during I/O accesses. When discrepancies are detected, the hardware generates an interrupt, invoking the EHS. System registers which reflect the state of the checkers are read and analyzed to determine the source of the error. These miscompare errors can be detected during a DMA operation or a direct CPU I/O access. When miscompares occur on CPU cycles, the hardware automatically retries the operation. If the retry succeeds, hardware reports the error as transient. Otherwise, the error is solid and the EHS deconfigures the system to remove the FRU. The error log will indicate the FRU, describe the error as solid or transient, and list any modules that were deconfigured as a result. If the FRU is a zone or an ATM, the entire zone is removed. These errors result in a CPU, ATM, interface module, or cross-link FRU. Transient errors are compared to their error rate threshold by the EHS. Errors that exceed the threshold may result in the removal of the FRU from service.
Zone divergence	This error type occurs when the two zones begin executing separate code paths while operating in Duplex mode. This situation is detected by hardware when an access to I/O space is performed. At that time, miscompares in the control and data signals will be detected in the cross-link chips on the ATM. This error is reported by hardware as an I/O error or an NXIO error, but software recognizes the special case and identifies it as zone divergence in the error log. When this error is detected, software will remove one zone from service (Zone selection depends on how zone divergence manifested itself). Either zone may be removed. This error is usually due to a programming error or divergence between the NVRAMs of the two zones. The error is treated as transient and the threshold error count for that error is incremented. If the threshold is not exceeded of if the diagnostics on the removed zone complete successfully, the zone will be resynchronized back into the system at end action time. If the threshold is exceeded or if the diagnostics on the removed zone report a failure, the zone will not be resynchronized at end action time. The end action error log will indicate that service is required. If the removed zone fails to return from running diagnostics, an end action timeout error log will be generated which identifies the zone as the FRU and requests service. If the threshold is exceeded, the zone will not be automatically resynchronized. Manual intervention will be required to repair the zone and return it to service.

4.2.5 VAXELN Error Handling

Failures detected by VAXELN software running on the I/O expansion module are reported to the EHS through one of two mechanisms:

- An IPL 22 interrupt from the module error which is dispatched into the EHS.
- The EHS detects the expiration of a watchdog timer maintained by VAXELN signaling a termination of VAXELN execution.

Table 4–5 describes the VAXELN error classes and the actions taken by the EHS.

Table 4–5 VAXELN Error Classes

Error Class	Description	EHS Actions
VAXELN Kernel Fatal	This error is reported when the VAXELN kernel detects a fatal error which prevents it from continuing operation.	The FRU is the I/O expansion module. This is a solid error and is not subjected to a threshold.
VAXELN Kernel Recoverable	A recoverable error was detected and handled by VAXELN software. Currently, this error is reported only when VAXELN software detects a repairable single-bit memory error.	The FRU is the I/O expansion module. The error is compared to its error rate threshold. If the threshold is exceeded, the I/O expansion module and all attached interface modules are deconfigured from the system.
I/O Expansion Module Master Fatal	A fatal error detected by the VAXELN I/O expansion module master job which results in the shutdown of all VAXELN processes.	The FRU is the I/O expansion module. This is considered a solid error; no threshold is applied. The I/O expansion module is deconfigured from the system.
I/O Expansion Module Master Recoverable	An error detected by the VAXELN I/O expansion module master job which resulted from the failure of a VAXELN job to initialize successfully. The Job ID field of the error message indicates which VAXELN job failed.	The FRU in an interface module. The EHS isolates the interface module by checking the Job ID field of the error message. The error is considered solid; no threshold is applied. The module is deconfigured from the system.
I/O Expansion Module Job Fatal	Similar to I/O Expansion Module Master Recoverable, this error indicates that a VAXELN job has experienced a fatal error and has been terminated. The Job ID field of the error message indicates which VAXELN job failed.	The FRU is an interface module. The EHS isolates the interface module by checking the Job ID field of the error message. The error is considered solid; no threshold is applied. The interface module is deconfigured from the system.

VAXELN software implements a watchdog timer which is a cell in the I/O Expansion Module Communication Area (NCA). It is incremented periodically by VAXELN and monitored by the EHS. If the value in the NCA cell stops incrementing, VAXELN has crashed. This is referred to as a VAXELN kernel fatal error.

The EHS examines the VAXELN NCA error log buffer area for a VAXELN error message. When it finds the error message, the EHS identifies the I/O expansion module as the FRU. The error is considered solid; no threshold is applied, and the I/O expansion module is deconfigured from the system.

4.3 Field Replaceable Units (FRUs)

After analyzing error information and determining the error type, the EHS isolates the source of the error to a FRU. If the error was solid, the system is deconfigured to remove the FRU from service. If the error is transient, it is compared against a threshold for the error type and FRU. If the threshold is exceeded, or if the error is solid, the system is deconfigured to remove the FRU from service.

4.3.1 Isolation

Table 4–6 describes the FRUs and lists the error types which could result in a FRU being isolated.

Table 4–6 System FRUs

FRU	Description	Source Error Types
ATM module	I/O attachment module. Performs exchange and verification of I/O control and data signals between zones. The module includes an embedded I/O expansion module.	I/O errors Clock phase errors
CPU module	The CPU module is identified as the FRU when the failure is attributable to a CPU problem or to a problem that cannot be isolated between the CPU and memory.	Resynch abort errors CPU/MEM faults Double-Bit memory errors Single-Bit memory errors
Memory board	A pair of rows of memory SIMMs on a memory mother board (MMB) will be identified as the FRU when the error can be isolated beyond the CPU board to a specific piece of memory.	Double-Bit memory errors Single-Bit memory errors
I/O expansion module	An I/O expansion module can be identified as the FRU as a result of a firewall miscompare during an I/O operation or as a result of a nonexistent I/O error during a reference to the I/O expansion module or an attached interface module.	Nonexistent I/O errors I/O errors VAXELN errors
Interface module	An interface module can be identified as a FRU only as a result of a nonexistent I/O error which occurs during a reference to the interface module. It is also possible that the I/O expansion module will be identified as the FRU.	Nonexistent I/O errors VAXELN errors
Zone	Some error cases involve failures not directly attributable to a single module. The zone FRU is only identified in the case of solid or reproducible errors, so diagnostics should be able to isolate the failure within the zone.	Power failures Halt errors Zone divergence
Cross-link cable	The cross-link cable is the identified FRU for any error which isolates the connections between zones. This includes the resynch and interzone buses, which are packaged into the single physical cable.	Cable failures I/O errors

4.3.2 Deconfiguration

This section describes the actions taken by the EHS when a FRU is identified as the source of a solid error or transient errors which exceed the FRU threshold. A table is provided for each FRU that describes the actions taken by the EHS when the FRU is deconfigured.

In non-Duplex modes, the EHS may respond to excessive transient failures by calling out the FRU but not removing it from service. This action prevents loss of system service due only to transient errors.

4.3.2.1 I/O Attachment Module

Table 4–7 describes the OpenVMS operating system actions taken when the ATM is identified as the FRU and deconfigured by the EHS. Some actions are dependent on the system operating mode.

Table 4–7 ATM Deconfiguration Actions

Action Taken	Description	Comments
Cross-link mode = off	The cross-link mode is set to off. The system will continue in Simplex mode. The action may be taken by the hardware when the error occurs or by software while handling the error.	Done in non-Simplex mode only. Extraneous when the error occurs in Simplex mode.
CPU/MEM fault	A CPU/MEM fault is forced on the zone with the failed ATM module. This results in an entry into the system console.	Done when the error occurs in Duplex, Simplex or in the master zone of a Degraded Duplex configuration.
Zone hard reset	A zone hard reset is issued to the zone with the failed ATM to force diagnostics to run.	Done only when the error occurs in the slave zone of a Degraded Duplex configuration.
Set ATM LED indicator	Use the module I2C bus to turn on the LED indicator for the failed ATM module.	
Set module status in ATM NVRAM and DCB	Update the status_os and status_sum fields in the module ID NVRAM and the DCB to indicate the module has experienced a failure. The code written depends on the failure type.	

The entries in Table 4–7 apply when the module is being removed because of a solid error or excessive transient errors. There is one exception. When an ATM module in a Simplex system experiences excessive transient errors, the module is not fully deconfigured since that would result in the termination of the OpenVMS operating system. In this case, the ATM LED indicators turn on, and the module status is written to the ATM NVRAM and DCB. The OpenVMS operating system continues to run. The module will not be configured when the system is booted, or when the failed zone is synchronized until the module is repaired.

4.3.2.2 CPU Module and Memory

When memory is deconfigured from the system, it is done by removing the CPU module on which the memory resides.

Table 4–8 describes the OpenVMS operating system actions taken when a CPU module or memory is identified as the FRU and is deconfigured by the EHS. These actions are identical for CPU and memory failures. Some actions are dependent on the system operating mode.

Table 4–8 CPU Deconfiguration Actions

Action Taken	Description	Comments
Cross-link mode = Degraded Duplex	The cross-link mode is set to master on the zone with the surviving CPU and slave on the zone with the failed CPU. The action may be taken by the hardware when the error occurs or by software while handling the error.	Done in Duplex mode only.
CPU/MEM fault	A CPU/MEM fault is forced on the failed CPU module. This results in an entry into system console.	
Set CPU LED indicator	The module I2C bus is used to turn on the LED indicator for the failed CPU module.	
Set module status in CPU NVRAM and DCB	The status_os and status_sum fields in the module ID NVRAM and DCB are updated to indicate the module has experienced a failure. The code written depends on the failure type.	

When one CPU is in use (Degraded Duplex, Simplex, or Resynch mode), excessive transient failures will result in the EHS calling out the failed module, but not removing it from service. Removing it from service would cause termination of the OpenVMS operating system. In this case, the CPU module LED is turned on, and the module status is written to the CPU module NVRAM and DCB. The OpenVMS operating system continues to run. The CPU will not be configured when the system is booted or when the failed zone is synchronized unless the CPU is repaired.

4.3.2.3 I/O Expansion Module

Table 4–9 describes the actions taken by the OpenVMS operating system when an I/O expansion module is identified as the FRU and is deconfigured by the OpenVMS operating system.

Table 4–9 I/O Expansion Module Deconfiguration Actions

Action Taken	Description
I/O hard reset	The I/O expansion module which is being deconfigured is reset through the cross-link I/O hard reset register.
Set I/O expansion module LED indicator	The module I2C bus is used to turn on the LED for the failed module.
Set module status in I/O expansion module NVRAM and DCB	The status_os and status_sum fields in the module ID NVRAM and DCB are updated to indicate the module has experienced a failure. The actual code written depends on the failure type.

The entries in Table 4–9 apply when the module is being removed due to a solid error or excessive transient errors. There is one exception. When an I/O expansion module in a Simplex system experiences excessive transient errors, the module is not fully deconfigured since that would likely result in the loss of the only I/O path to a device. In this case, the I/O expansion module LED is turned on and the module status is written to the interface module NVRAM and the DCB.

The I/O expansion module will remain in service. The NVRAM will not be configured when the system is booted or when the failed zone synchronized until the module is repaired.

4.3.2.4 Interface Module

Table 4–10 describes the OpenVMS operating system actions taken when an interface module is identified as the FRU and is deconfigured by the OpenVMS operating system. Some actions are dependent on the system operating mode.

Table 4–10 Interface Module Deconfiguration Actions

Action Taken	Description
Reset interface module	The interface module being deconfigured is reset through the module I2C bus.
Set interface module LED indicator	Use the module I2C bus to turn on the LED indicator for the failed interface module.
Set module status in interface module NVRAM	Update the status_os and status_sum fields in the module ID NVRAM and the DCB to indicate the module has failed. The code written depends on the failure type.

The entries in Table 4–10 apply when the module is being removed because of a solid error or excessive transient errors. There is one exception. When an interface module in a Simplex system experiences excessive transient errors, the module is not fully deconfigured since that would likely result in the loss of the only I/O path to a device. In this case, the interface module LED indicator is turned on, and the module status is written to the interface module NVRAM and the DCB (See Section 4.8.2).

The interface module will remain in service. The module will not be configured when the system is booted or when the failed zone is synchronized until the module is repaired.

4.3.2.5 Zone

Table 4–11 describes the OpenVMS operating system actions taken when an entire zone is identified as the FRU and is deconfigured by the EHS. Note that some actions are dependent on the system operating mode.

Table 4–11 Zone Deconfiguration Actions

Action Taken	Description	Comments
Cross-link mode = off	The cross-link mode is set to off. The system will continue in Simplex mode. The action may be taken by the hardware when the error occurs or by software while handling the error.	Done only in non-Simplex mode.
CPU/MEM fault	A CPU/MEM fault is forced on the failed zone. This results in an entry into system console.	Done when the error occurs in Duplex, Simplex or in the master zone of a Degraded Duplex system.
Zone hard reset	A zone hard reset is issued to the failed zone.	Done only in the slave zone of a Degraded Duplex or Resynch mode system.

4.3.2.6 Cross-Link Cable

Table 4–12 describes the OpenVMS operating system actions taken when the cross-link cable is identified as the FRU and is deconfigured by the EHS. The cross-link cable is active only during non-Simplex modes.

Table 4–12 Cross-Link Cable Deconfiguration Actions

Action Taken	Description	Comments
Cross-link mode = off	The cross-link mode is set to off. The system will continue in Simplex mode. The action may be taken by the hardware when the error occurs or by software while handling the error.	Done only in non-Simplex modes.
CPU/MEM fault	A CPU/MEM fault is forced on Zone B. This results in an entry into system console.	Done only when the error occurs in Duplex mode.
Zone hard reset	A zone hard reset is issued to the slave zone.	Done in the slave zone when the error occurs in Degraded Duplex or Resynch mode.

4.3.3 Application of Thresholds

Application of thresholds by the EHS is rate based. An FRU exceeds its threshold when it accumulates a certain number of a given error type in a specified time period. Table 4–13 lists the thresholds associated with each FRU and error type.

In most cases, more than one type of error can result in the isolation of an FRU. For each FRU and error type, a separate threshold is applied. The threshold for an error type of a specific FRU must be exceeded before the module is deconfigured.

For example, both NXIO and I/O errors may isolate an ATM module. EHS maintains separate thresholds for NXIO and I/O errors for each ATM module. When one of the errors occurs and is isolated to an ATM, the threshold for that error type on that ATM is applied. If the threshold is exceeded, the ATM is deconfigured.

Table 4–13 FRU Thresholds

Error Type	Error Limit	Time Period[1]	Comments
			CPU Module
CPU/MEM faults	3	12	A CPU/MEM fault results in the temporary removal of the CPU module from service. The CPU will be reconfigured into the system if this threshold is not exceeded.
Resynch abort errors	3	1	Resynch abort errors result in the termination of the Resynch operation. When the threshold for this error is exceeded, the CPU module is marked as broken. System downtime must be scheduled to repair the problem since the only CPU module has failed.
			Memory SIMMs
Single-bit memory errors	3	12	Each single-bit memory error is attributed to a row of memory SIMMs on a single MMB. Each SIMM row has an individual threshold. When the threshold for the SIMM row is exceeded, the CPU module on which the SIMM resides will be removed from service if the system operating mode is Duplex.
			I/O ATM Module
Clock phase errors	3	12	Each clock phase error results in the temporary removal from service of a zone. When the zone returns to service, it will be resynchronized automatically if the threshold is not exceeded.
Transient I/O errors	3	12	When this threshold is exceeded, the zone in which the ATM resides is removed from service, except in a Simplex system.
			I/O Expansion Module

[1] In hours

(continued on next page)

Table 4–13 (Cont.) FRU Thresholds

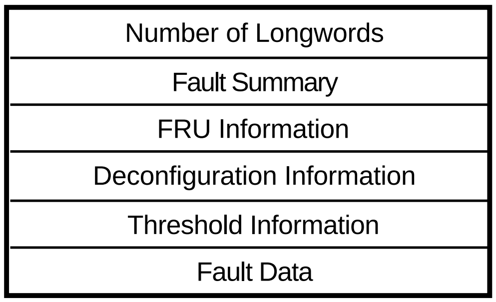
Error Type	Error Limit	Time Period[1]	Comments
			I/O Expansion Module
Transient NXIO errors	3	12	When the threshold is exceeded, the module is deconfigured except in Simplex system.
Transient I/O errors	3	12	When the threshold is exceeded, the module is deconfigured except in Simplex system.
VAXELN kernel recoverable errors	3	24	When the threshold is exceeded, the module is deconfigured except in Simplex system.
			Interface Module
Transient NXIO errors	3	12	When the threshold is exceeded, the interface module is deconfigured, except in a Simplex system.
			Zone
Power failures	3	24	When power is lost, the zone is temporarily removed from service and the error is compared to its error rate threshold. When power is restored, the zone will be resynchronized automatically if the threshold has not been exceeded.
Zone divergence	3	24	When the zones diverge, one zone is temporarily removed from the configuration and the error is compared to its error rate threshold. When the zone returns to service, it will be reconfigured if the threshold is not exceeded. This threshold is not applied directly to any FRU. The selection of which zone to remove is made based on how the error manifests itself within the system.
			Cross-Link
Cable failures	3	24	When the cable between the zones is lost, the zone is temporarily removed from service and the error is compared to its error rate threshold. When the zone returns, it will be resynchronized automatically if the threshold has not been exceeded.
Transient I/O errors	3	12	When the threshold is exceeded, the cross-link is deconfigured, which results in the removal of one of the zones from service.

[1]In hours

4.4 OpenVMS Error Log

The EHS makes entries in the system error log for all system error interrupts. Figure 4–3 shows the format of the error log. With the exception of the Fault Data block, all blocks have fixed length.

Figure 4–3 OpenVMS Error Log Format



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The first longword in the error log contains the count of longwords which follow. This number is based on the fault class of the error log (see Section 4.4.1). Table 4–14 lists the different values which will appear for each of the six different fault classes.

Table 4–14 OpenVMS Error Log Sizes

Class Value	Fault Class	Decimal Size	Hexidecimal Size
1	System Error	40	28
2	End Action	41	29
3	End Action Timeout	13	D
4	VAXELN Error	28	1C
5	Software Detected Error	15	F
6	CPU or Zone Unsynchable	14	E

4.4.1 Fault Summary

The Fault Summary block contains the fault ID, fault flags describing the nature of the fault, the cross-link mode at the time the fault occurred, and the cross-link mode after the error handling was completed. All fields in this block are valid for all error entries. Figure 4–4 identifies each entry in the block and the offset from the start of the block. Table 4–15 describes the content of each field.

Note

The 1-byte FAULT_ID field is composed of two 4-bit subfields. Bits [07:04] indicate the class of the fault. Bits [03:00] identify the error type within the fault class. There are six fault classes. Each class has a different fault data block at the end of the error log. See Section 4.4.5 for a description of each fault class and the fault data provided in the error log.

Figure 4–4 Fault Summary Block

XLINK_MODE_AFTER (Crosslink Mode After)	XLINK_MODE_ERROR (Crosslink Mode Error)	FAULT_FLAGS (Fault Flags)	FAULT_ID (Fault Identification)

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Table 4–15 Fault Summary Block Entry Descriptions

Entry	Contents
FAULT_ID	Fault Identification type. The hexidecimal ID values are defined as: 10 - CPU-detected double-bit error 11 - JXD-detected double-bit error 12 - Cable gone between zones 13 - Power gone in other zone 14 - Clock error 15 - Other zone halted 16 - Resynch abort error 17 - CPU-detected single-bit error 18 - JXD-detected single-bit error 19 - CPU/MEM fault 1A - Nonexistent I/O 1B - I/O miscompare error 1C - Zones divergence 20 - CPU-detected DBE end action 21 - JXD-detected double-bit error end action 22 - Cable gone end action (reserved for future use)

(continued on next page)

Table 4–15 (Cont.) Fault Summary Block Entry Descriptions

Entry	Contents
	23 - Power gone end action (reserved for future use)
	24 - Clock error end action
	25 - Other zone halted end action (reserved for future use)
	26 - Resynch abort error end action (reserved for future use)
	27 - CPU-detected single-bit error end action
	28 - JXD-detected single-bit error end action (reserved for future use)
	29 - CPU/MEM fault end action
	2C - Zone divergence end action timeout
	30 - CPU-detected DBE end action timeout
	31 - JXD-detected DBE end action timeout
	32 - Cable gone end action timeout (reserved for future use)
	33 - Power gone end action timeout (reserved for future use)
	34 - Clock error end action timeout
	35 - Other zone halted end action timeout (reserved for future use)
	36 - Resynch abort error end action timeout (reserved for future use)
	37 - CPU-detected SBE end action timeout
	38 - JXD-detected single-bit error end action timeout (reserved for future use)
	39 - CPU/MEM fault end action timeout
	3C - Zone have diverged end action timeout (reserved for future use)
	40 - VAXELN kernel fatal error
	41 - VAXELN kernel recoverable error
	42 - VAXELN master job fatal error
	43 - VAXELN master job recoverable error
	44 - VAXELN job fatal error
	45 - VAXELN job recoverable error (reserved for future use)
	50 - Software-detected error
	60 - CPU is unsynchable
FAULT_FLAGS	The following fields are defined within FAULT_FLAGS:
	00 - Transient error
	01 - Solid error
	02 - Error threshold exceeded
	03 - Service is required

(continued on next page)

Table 4–15 (Cont.) Fault Summary Block Entry Descriptions

Entry	Contents
	[07:04] - Not used
XLINK_MODE_ ERROR	Cross-link mode at the time of error. The following values are defined:
	0 - Off (Simplex)
	1 - Slave
	2 - Master
	3 - Duplex
	4 - Not used
	5 - RESYNCH_SLAVE
	6 - RESYNCH_MASTER
	7 - Not used
XLINK_MODE_ AFTER	Cross-link mode after error handling. The modes are as defined for XLINK_MODE_ERROR.

4.4.2 FRU Information

This block contains information on the isolated FRU and is valid for all error events. Figure 4–5 identifies each entry in the block and the offset from the start of the block. Table 4–16 describes the content of each entry.

Note

In some cases, an FRU is not identified in the error log for a system error event. All fields in this block will be -1 (FFFFFFFF hexidecimal). In these cases, the FRU will be identified in a subsequent end action or end action timeout error log.

Figure 4–5 FRU Information Block

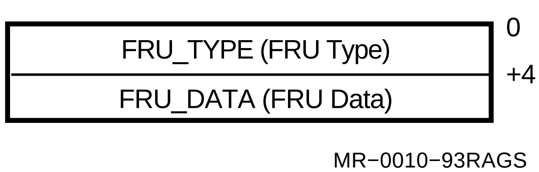

Table 4–16 FRU Information Block Entry Descriptions

Entry	Contents
FRU_TYPE	The following bits are defined:
	01 - The FRU is a module in Zone A (FRU_DATA has slot ID)
	02 - The FRU is a module in Zone B (FRU_DATA has slot ID)
	03 - Zone A is the FRU
	04 - Zone B is the FRU
	05 - The cross-link cable is the FRU
	06 - The FRU is a Zone A SIMM (FRU_DATA has SIMM ID)
	07 - The FRU is a Zone B SIMM (FRU_DATA has SIMM ID)
FRU_DATA	FRU specific data. The following bits are defined for IDs 1 and 2:
	00 - CPU module in slot 0 is the FRU
	01 - ATM module in slot 1 is the FRU
	02 - I/O expansion module in slot 2 is the FRU
	[09:03] - Not used
	10 - Interface module in slot 10 is the FRU
	11 - Interface module in slot 11 is the FRU
	12 - Interface module in slot 12 is the FRU
	13 - Interface module in slot 13 is the FRU
	14 - Interface module in slot 14 is the FRU
	15 - Interface module in slot 15 is the FRU
	16 - Interface module in slot 16 is the FRU
	17 - Interface module in slot 17 is the FRU
	[19:18] - Not used
	20 - Interface module in slot 20 is the FRU
	21 - Interface module in slot 21 is the FRU
	22 - Interface module in slot 22 is the FRU
	23 - Interface module in slot 23 is the FRU
	24 - Interface module in slot 24 is the FRU
	25 - Interface module in slot 25 is the FRU
	26 - Interface module in slot 26 is the FRU
	27 - Interface module in slot 27 is the FRU
	[31:28] - Not used

Note

The following fields define the SIMM ID for FRU_TYPEs 06 and 07:

[15:00] = MMB ID from 0 to 3.

[31:16] = SIMM row ID. Values 1 to 4 represent SIMM rows A to D, respectively.

This field = -1 for all other FRU_TYPE values.

4.4.3 Deconfiguration Information

This error log block contains information about any system deconfiguration performed by the EHS. Figure 4–6 identifies each entry in the block and the offset from the start of the block. Table 4–17 describes the content of each entry.

Note

For errors which require no system deconfiguration, only the FT_FLAGS fields will be filled in. The last two longwords will contain 0.

Figure 4–6 Deconfiguration Information Block

FT_FLAGS_BEFORE (Fault Flags Before)	0
FT_FLAGS_AFTER (Fault Flags After)	+4
DECONFIG_INFO (Entity Deconfigured)	+8
DECONFIG_MODULES (Modules Deconfigured)	+12

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Table 4–17 Deconfiguration Information Block Entry Descriptions

Entry	Contents
FT_FLAGS_ BEFORE	The contents of EXE$GL_FT_FLAGS at the time the system error occurred. The field is valid for all errors.
FT_FLAGS_AFTER	The contents of EXE$GL_FT_FLAGS after error handling is complete. If the EHS performs any system deconfiguration that includes degraded system mode in the cross-link, this field will differ from FT_FLAGS_BEFORE. Otherwise, they are the same. The field is valid for all errors.
DECONFIG_INFO	This field shows the entity which was deconfigured as a result of the error. This is either a module in a given zone or an entire zone. The following bits are defined: 00 - Zone A deconfigured. 01 - Zone B deconfigured. 02 - CPU module in Zone A deconfigured. 03 - CPU module in Zone B deconfigured. 04 - ATM module in Zone A deconfigured. 05 - ATM module in Zone B deconfigured. 06 - I/O expansion module in Zone A deconfigured. 07 - I/O expansion module in Zone B deconfigured. 08 - Interface module in Zone A deconfigured. 09 - Interface module in Zone B deconfigured.

(continued on next page)

Table 4–17 (Cont.) Deconfiguration Information Block Entry Descriptions

Entry	Contents
DECONFIG_ MODULES	This field shows the Zone A modules removed from service as a result of error handling. For example, if the source of a solid or excessive transient error were an I/O expansion module, all attached interface modules have been removed from service. The following bits are defined:
	00 - CPU module in slot 0 has been removed from service.
	01 - I/O expansion module in slot 1 has been removed from service. Set when the expansion module portion of the ATM module in slot 1 is removed from service. Removal of this portion of the ATM module does not require deconfiguring the entire zone.
	02 - I/O expansion module in slot 2 has been removed from service.
	03 - ATM module in slot 1 has been removed from service. Set when the entire ATM module is removed from service. The bits for all other modules present in the zone will also be set. The entire zone is deconfigured.
	[09:04] - Not used.
	10 - Interface module in slot 10 has been removed from service.
	11 - Interface module in slot 11 has been removed from service.
	12 - Interface module in slot 12 has been removed from service.
	13 - Interface module in slot 13 has been removed from service.
	14 - Interface module in slot 14 has been removed from service.
	15 - Interface module in slot 15 has been removed from service.
	16 - Interface module in slot 16 has been removed from service.
	17 - Interface module in slot 17 has been removed from service.
	[19:18] - Not used.
	20 - Interface module in slot 20 has been removed from service.
	21 - Interface module in slot 21 has been removed from service.
	22 - Interface module in slot 22 has been removed from service.
	23 - Interface module in slot 23 has been removed from service.
	24 - Interface module in slot 24 has been removed from service.
	25 - Interface module in slot 25 has been removed from service.
	26 - Interface module in slot 26 has been removed from service.
	27 - Interface module in slot 27 has been removed from service.
	[31:28] - Not used.

4.4.4 Threshold Information

When the Transient Error flag is set in the FAULT_FLAGS field of the Fault Summary block, the isolated FRU error is compared to its error rate threshold.

When threshold is exceeded, the FRU will be removed from the system. In addition, the Excessive Transient Errors flag is set in the FAULT_FLAGS field. When the threshold comparison is completed, the threshold information is written to the error log. Figure 4–7 identifies each entry in the block and the offset from the start of the block. Table 4–18 describes the content of each entry.

Note

For errors which do not require a threshold comparison, all entries in this block will be -1 (FFFFFFFF hex).

Figure 4–7 Threshold Information Block

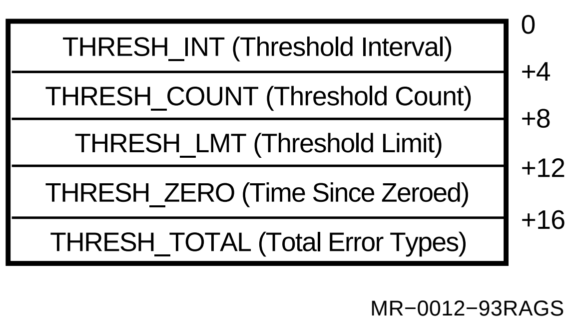


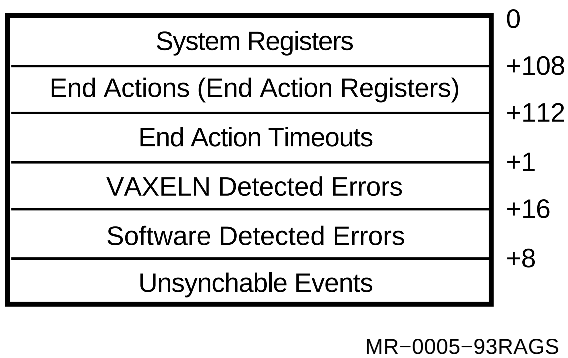
Table 4–18 Threshold Information Block Entry Descriptions

Entry	Content
THRESH_INT	The event threshold interval, expressed in seconds.
THRESH_COUNT	The number of events detected within the threshold interval, expressed in decimal.
THRESH_LMT	The number of events which, if detected within the threshold interval, will cause the event to be treated as a solid error by the EHS. Expressed in decimal.
THRESH_ZERO	Time since the threshold count was last zeroed, expressed in seconds.
THRESH_TOTAL	Total number of this type error since the threshold was zeroed, expressed in decimal.

4.4.5 Fault Data

The Fault Data block has a variable length specific to the class of the fault which occurred. The error class can be determined by the high-order four bits of the FAULT_ID field in the Fault Summary block (see Table 4–15). The six Fault Data types based on these fault classes are shown in Figure 4–8 and described in the following subsections.

Figure 4–8 Fault Data Block



4.4.5.1 System Registers

The EHS gathers system error information in the course of error handling. The content of these registers is written to the error log. Table 4–19 lists each register entry and its offset from the start of the block.

Note

For different system errors, different sets of system registers are collected. A value of -1 (FFFFFFFF hex) in a system register location in the error log indicates that the register was not recorded.

Table 4–19 System Register Entry Descriptions

Entry	Content	Offset
SYSFLT	JXD System Fault Register	0
SYSADR	JXD System Error Address Register	4
DMAADR	DMA Error Address Register	8
DMA_IO_ADDR	DMA Engine I/O Error Address Register	12
JCSR_A	JXD Control and Status Register - Zone A	16
JCSR_B	JXD Control and Status Register - Zone B	20
JDIAG_P_A	JXD Diagnostic Error Register - Zone A, primary rail	24
JDIAG_M_A	JXD Diagnostic Error Register - Zone A, mirror rail	28
JDIAG_P_B	JXD Diagnostic Error Register - Zone B, primary rail	32
JDIAG_M_B	JXD Diagnostic Error Register - Zone B, mirror rail	36
ATMERR0_A	JXD ROM BUS ATM Error Register - Zone A	40
ATMERR0_B	JXD ROM BUS ATM Error Register - Zone B	44
DMASTS_A	DMA Status Register - Zone A	48
DMASTS_B	DMA Status Register - Zone B	52
MMBERR0_A	JXD ROM BUS MMB Error Register 0 - Zone A	56
MMBERR0_B	JXD ROM BUS MMB Error Register 0 - Zone B	60
MMBERR1_A	JXD ROM BUS MMB Error Register 1 - Zone A	64
MMBERR1_B	JXD ROM BUS MMB Error Register 1 - Zone B	68
SERCRS_A	Serial Cross-Link Control and Status Register - Zone A	72
SERCRS_B	Serial Cross-Link Control and Status Register - Zone B	76
SERMODE_A	Serial Cross-Link Mode Register - Zone A	80
SERMODE_B	Serial Cross-Link Mode Register - Zone B	84
BIU_ADDR_A	CPU BIU Address Register - Zone A	88
BIU_ADDR_B	CPU BIU Address Register - Zone B	92
BIU_STAT_A	CPU Fill Syndrome - Zone A	96
BIU_STAT_B	CPU Fill Syndrome - Zone B	100
BIU_CTL_A	CPU Fill Address - Zone A	104
BIU_CTL_B	CPU Fill Address - Zone B	108

4.4.5.2 End Actions

End action data is provided after diagnostics have completed running on a zone or CPU which was removed from service as a result of a system error. It is composed of console and diagnostic status and the contents of registers from the failed zone/CPU at the time the original system error occurred. Table 4–20 lists each register entry and its offset from the start of the data block.

Table 4–20 End Actions Register Descriptions

Entry	Content	Offset
SYSFLT	JXD System Fault Register	0
SYSADR	JXD System Error Address Register	4
JCSR	JXD Control and Status Register	8
JDIAG_P	JXD Diagnostic Error Register - primary rail	12
JDIAG_M	JXD Diagnostic Error Register - mirror rail	16
MMBERR0	JXD ROM BUS MMB Error Register 0	20
MMBERR1	JXD ROM BUS MMB Error Register 1	24
ATMERR0	JXD ROM BUS ATM Error Register	28
DMASTS	DMA Status Register	32
DMAADR	DMA Error Address Register	36
SERCRS	Serial Cross-Link Control and Status Register	40
SERMODE	Serial Cross-Link Mode Register	44
SAVPC	CPU Saved PC - Zone A	48
SAVPSL	CPU Saved PSL	52
ECR	CPU EBox Control Register	56
BIU_CTL	CPU BIU Control Register	60
BC_TAG	CPU B-cache Error Tag	64
BIU_STS	CPU BIU Status Register	68
BIU_ADDR	CPU BIU Address Register	72
FIL_SYN	CPU Fill Syndrome	76
FIL_ADDR	CPU Fill Address	80
VMAR	CPU VIC Memory Address Register	84
ICSR	CPU IBox Control and Status Register	88
TBADR	CPU MBox TB Parity Address	92
TBSTS	CPU MBox TB Parity Status	96
PCSTS	CPU P-cache Status Register	100
PCCTL	CPU P-cache Control Register	104
CONSOLE_STS	System Console Duplex Compatibility Status	108
DIAG_STS	System Diagnostics Status Longword	112

4.4.5.3 End Action Timeouts

This data is provided when a zone or CPU which was temporarily removed from service due to a fault fails to communicate through the interzone communication service (IZC) to the remaining zone after running diagnostics. In many cases, such a situation results in the EHS declaring a solid error for the CPU or zone in this error log.

Figure 4–9 shows the format of this Fault Data block entry and its offset. Table 4–21 contains a brief description of the entry.

Figure 4–9 End Action Timeout Block

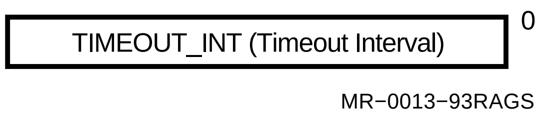


Table 4–21 End Action Timeout Block Entry Description

Entry	Content	Offset
TIMEOUT	End action timeout interval in seconds	0

4.4.5.4 VAXELN Detected Errors

This data is provided for errors detected by VAXELN software running on the I/O expansion module. It is composed of data provided by VAXELN software when the error was detected on the I/O expansion module.

Figure 4–10 shows the format of this Fault Data block and the offset of each entry from the start of the block. Table 4–22 contains a brief description of each entry.

Figure 4–10 VAXELN Detected Error Block

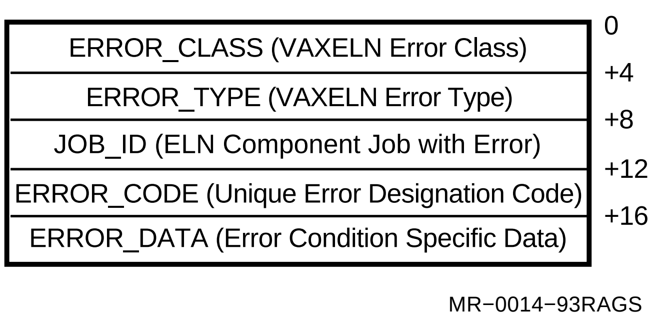


Table 4–22 VAXELN Detected Error Block Entry Descriptions

Entry	Contents
ERROR_CLASS	VAXELN error class:
	1 - VAXELN kernel fatal error
	2 - VAXELN kernel recoverable error
	3 - VAXELN master job fatal error
	4 - VAXELN master job recoverable error

(continued on next page)

Table 4–22 (Cont.) VAXELN Detected Error Block Entry Descriptions

Entry	Contents
	5 - VAXELN job fatal error
	6 - VAXELN job recoverable error (reserved for future use)
ERROR_TYPE	VAXELN error type:
	1 - Hardware error
	2 - Software error
	3 - Unknown error
JOB_ID	VAXELN component job with error:
	0 - Interface module 0 driver job
	1 - Interface module 1 driver job
	2 - Interface module 2 driver job
	3 - Interface module 3 driver job
	4 - Interface module 4 driver job
	5 - Interface module 5 driver job
	6 - Interface module 6 driver job
	7 - Interface module 7 driver job
	8 - UART 0 driver job
	9 - UART 1 driver job
	10 - VAXELN master job
	13 - VAXELN FIST job
	14 - VAXELN background job
	15 - VAXELN I/O expansion module error
	17 - VAXELN kernel error
ERROR_CODE	Unique error designation code (in hexadecimal)
9000	Watchdog timer expired
FA03	Job initialization failed
FA04	Job initialization timeout
CA01	Unexpected command interrupt
CA02	Unexpected interface module interrupt
0	Machine check handler entered with unknown type code
11	Floating point accelerator error
15	Memory management - PTE in P0 space
16	Memory management - PTE in P1 space
17	Memory management - PTE in P0 space on M bit
18	Memory management - PTE in P1 space on M bit
19	Unused interrupt priority level
1A	Microcode detected error
80	Unknown hardware error
10080	Bus timeout error. Read error - normal read

(continued on next page)

Table 4–22 (Cont.) VAXELN Detected Error Block Entry Descriptions

Entry	Contents
20080	DAL parity error. Read error - normal read
30080	Cache parity error. Read error - normal read
40080	Uncorrectable read data error. Read error - normal read
50080	DMA error. Read error - normal read
60080	Firewall SOC miscompare. Read error - normal read
81	Unknown hardware error. Read error - SPTE/PCB/SCB
10081	Read error - SPTE/PCB/SCB
20081	DAL parity error. Read error - SPTE/PCB/SCB
30081	Cache parity error. Read error - SPTE/PCB/SCB
40081	Uncorrectable read data error. Read error - SPTE/PCB/SCB
50081	DMA error. Read error - SPTE/PCB/SCB
60081	Firewall SOC miscompare. Read error - SPTE/PCB/SCB
82	Unknown hardware error. Write error - normal write
10082	Bus timeout error. Write error - normal write
20082	DAL parity error. Write error - normal write
30082	Cache parity error. Write error - normal write
40082	Uncorrectable read data error. Write error - normal write
50082	DMA error. Write error - normal write
60082	Firewall SOC miscompare. Write error - normal write
83	Unknown hardware error. Write error - SPTE/PCB
10083	Bus timeout error. Write error - SPTE/PCB
20083	DAL parity error. Write error - SPTE/PCB
30083	Cache parity error. Write error - SPTE/PCB
40083	Uncorrectable read data error. Write error - SPTE/PCB
50083	DMA error. Write error - SPTE/PCB
60083	Firewall SOC miscompare. Write error - SPTE/PCB
100	Correctable read data error
200	Polled machine bus timeout error
201	Polled machine DAL parity error
202	Polled machine cache parity error
203	Polled machine uncorrectable read data error
204	Polled machine DMA error
205	Polled machine Firewall SOC miscompare
206	Polled machine battery low
400	Fatal system bugcheck
401	Nonfatal system bugcheck
402	Bugcheck from process
800	Bugcheck during boot

(continued on next page)

Table 4–22 (Cont.) VAXELN Detected Error Block Entry Descriptions

Entry	Contents
1	Normal successful completion
7C04	Bad parameter count
7C0C	Bad job or process creation
7C14	Bad string parameter length
7C1C	Bad access mode
7C24	Bad stack
7C2C	Bad object state
7C34	Bad object type
7C3C	Bad parameter value
7C44	Connect circuit completed
7C4C	Connect circuit pending
7C54	Connect circuit timeout
7C5C	Count overflow
7C64	Count underflow
7C6C	Debug signal
7C74	Device already connected
7C7C	Circuit disconnected by partner
7C84	Duplicate name
7C8C	Kernel stack not valid
7C94	Machine check
7C9C	No access to parameter
7CA4	No destination port
7CAC	No job initialization specified
7CB4	No physical memory available
7CBC	No I/O mapping register available
7CC4	No message available
7CCC	No object table entry available
7CD4	No process page table available
7CDC	No data path register available
7CE4	No pool available
7CEC	No port available
7CF4	No exit status value specified
7CFC	No such device
7D04	No such name
7D0C	No such port
7D14	No such program
7D1C	No such service
7D24	No system page table entries available

(continued on next page)

Table 4–22 (Cont.) VAXELN Detected Error Block Entry Descriptions

Entry	Contents
7D2C	No virtual address space available
7D34	Power recovery signal
7D3C	Quit signal
7D44	Remote port value
7D4C	Process exit signal
7D54	Remote system currently unreachable
7D5C	Interprocess signal
7D64	Remote system rejected username or password
7D6C	Bad message size
7D74	Referenced shareable image not present
7D7C	Unsupported program image format
7D84	Internal consistency failure
7D8C	Port on another BI node
7D94	Third party disconnected circuit
7D9C	Network is in the off state
7DA4	No such job
7F01	Time has not been previously set
7F09	Expedited message
7F11	Previous job created area
7F19	Device already exists
ERROR_DATA	Error condition specific data. This entry is reserved for future expansion.

4.4.5.5 Software Detected Errors

This data is provided for errors detected by the OpenVMS operating system components. Such errors are not usually detected by hardware mechanisms. The data is composed of information passed by the operating system component to the EHS.

Figure 4–11 shows the format of this fault data block and the offset of each entry from the start of the block. Table 4–23 contains a brief description of each entry.

Note

If the software component which detects the module failure does not request the setting of the module ID NVRAM status code or does not request a reset of the module, then these fields will contain -1 (FFFFFFFF hexidecimal).

Figure 4–11 Software Detected Error Block

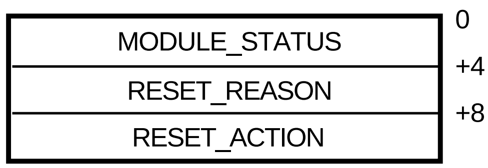


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Table 4–23 Software Detected Error Block Entry Descriptions

Entry	Contents
MODULE_STATUS	Hexidecimal module ID NVRAM status code. The following values are defined:
0F	Excessive CPU/MEM faults
1E	Excessive resynchronization abort errors
2D	Double-bit error
3C	Excessive single-bit errors
4B	Excessive clock phase errors
5A	Excessive CPU I/O errors
69	Solid CPU I/O errors
78	Excessive transient NXIO errors
87	Solid NXIO error
96	VAXELN kernel fatal error
A5	The module is good
B4	Excessive VAXELN kernel recoverable errors
C3	VAXELN master fatal error
D2	VAXELN master recoverable error
E1	VAXELN job fatal error
F0	System software detected module failure
F1	System software detected I/O expansion module primary UART failure
F2	System software detected I/O expansion module auxiliary UART failure
F3	Unexpected VAXELN error detected
RESET_REASON	Hexidecimal OpenVMS reset reason code. The following values are defined:
1	Duplex zones have diverged
2	Fatal cross-link error has occurred
3	Fatal zone error has occurred
4	Fatal ATM module error has occurred
5	Fatal CPU module error has occurred

(continued on next page)

Table 4–23 (Cont.) Software Detected Error Block Entry Descriptions

Entry	Contents
6	Fatal memory error has occurred
7	Single-bit error has occurred
8	User command issued to stop a zone
9	Unexpected machine check has occurred
A	Software detected failure has occurred
B	Solid NXIO error has occurred
C	Excessive transient I/O expansion module errors have occurred
D	A solid I/O error has occurred
E	Excessive transient I/O errors have occurred
F	Excessive VAXELN kernel recoverable errors have occurred
10	A VAXELN master fatal error has occurred
11	A VAXELN job fatal error has occurred
12	Not enough SPTEs could be allocated to boot the OpenVMS operating system
13	Unexpected system error occurred
14	Interface module has occurred
15	Unexpected VAXELN error occurred
16	A VAXELN kernel fatal error has occurred
RESET_ACTION	Hexidecimal console reset action code. The following values are defined:
0	Unexpected CPU reset
1	No diagnostic CPU reset
2	Dispatch request CPU reset
3	Resynchronization reset CPU reset
4	Run diagnostic CPU reset
5	Reconfigure console CPU reset
6	STOP/ZONE CPU reset
10000	Unexpected I/O reset
10001	No diagnostic I/O reset
10002	Dispatch request I/O reset
10003	Z command I/O reset
10004	Load and run (VAXELN) I/O reset
10005	Upgrade flash ROM I/O reset
10006	Run diagnostic I/O reset
10007	Reconfigure console I/O reset

4.4.5.6 Unsynchable Events

This data is provided if the console reports that a zone or CPU is unsynchable when no previous error had been associated with it. The error can occur when diagnostics run on a zone which was not present in the system configuration, or after a zone has been manually removed. The data is composed of console and diagnostic status from the failed zone.

Figure 4–12 shows the format of this Fault Data block and the offset of each field from the start of the block. Table 4–24 contains a brief description of each entry.

Figure 4–12 Unsynchable Event Block

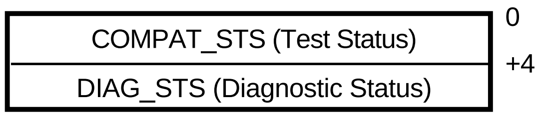

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Table 4–24 Unsynchable Event Block Entry Descriptions

Bit	Description
COMPAT_STS	System console duplex compatibility test status. This field indicates the results of the compatibility test performed by the console after diagnostics have completed. The following bits are defined:
00	Self test failed
01	Zone test failed
02	System test failed
03	ATM module self test failed
04	Both zones have same zone ID
05	CPU ID EEPROM is bad
06	CPU ID EEPROM has bad OpenVMS status
07	CPU ID EEPROM has bad firmware status
08	CPU ID EEPROM module ID mismatches with other zone
09	CPU ID EEPROM module name mismatches with other zone
10	CPU ID EEPROM hardware revision not compatible with other zone
11	CPU ID EEPROM firmware revision not compatible with other zone
12	CPU ID EEPROM software revision not compatible with other zone
13	ATM module ID EEPROM is bad
14	ATM module ID EEPROM has bad OpenVMS status
15	ATM module ID EEPROM has bad firmware status
16	ATM module ID EEPROM module ID mismatches with other zone
17	ATM module ID EEPROM module name mismatches with other zone
18	ATM module ID EEPROM hardware revision not compatible with other zone
19	ATM module ID EEPROM firmware revision not compatible with other zone
20	ATM module ID EEPROM software revision not compatible with other zone
21	CPU data EEPROM is bad
22	CPU data EEPROM system wide data area mismatches with other zone

(continued on next page)

Table 4–24 (Cont.) Unsynchable Event Block Entry Descriptions

Bit	Description
23	CPU memory configuration mismatches with other zone
24	Cables (cross-link/resynchronization)
25	CPU is in burn-in mode
26	Ethernet EEPROM mismatches with other zone
27	CPU console firmware cannot be run in Duplex
[31:28]	Not used
DIAG_STS	System diagnostic status longword. This field is valid when any of bits [03:00] are set in COMPAT_STS. This longword gives additional detail on the diagnostic failure indicated by those bits. The following bits are defined:
[07:00]	Subtest number, expressed in decimal
[15:08]	Test number, expressed in decimal
[23:16]	Group number, expressed in decimal
[27:24]	Diagnostic flags, expressed in hexidecimal
[30:28]	Not used
31	Diagnostic status is valid

4.5 Module NVRAM Status and LED Indicators

There are multiple I2C buses in a Model 810 zone which are used to provide access to NVRAMs and LEDs on each module. The system I2C bus connects all the modules in the primary backplane slots in a zone and has master controllers on the IO ATM module. This I2C bus is used to access the NVRAMs and the LEDs on the CPU and IO ATM modules, and the embedded primary I/O expansion module. The primary I/O expansion module has an I2C bus with a master controller and connections to each interface module to access their NVRAMs and LEDs.

When the EHS identifies a module as the source of solid or excessive transient errors, it removes the module from service. At the same time, it flags the module as failed, turns on the module LED, and writes the error code to the module NVRAM through its I2C bus. When the zone is removed for service, the LED remains on.

When repair is complete and system power is turned on, diagnostics on the CPU or I/O expansion module will examine the error code. If the OpenVMS operating system flagged the module as failed, or diagnostics fail, the diagnostics will not turn off the LED. The LED remains on until the module is replaced or the NVRAM is cleared.

Table 4–25 lists the status codes that the EHS may write into the operating system status field of the module ID NVRAM, as well as symbol names, descriptions, and affected modules. The EHS sets the module LED every time it writes one of these status codes.

Note

In the case of some catastrophic ATM failures, it may not be possible to access the I2C bus for that zone to write the code and set the LED. In such cases, diagnostics on the remote zone are relied on to report the failure.

Table 4–25 Module ID NVRAM/DCB Status Codes

Status Code	Description	Affected Modules
0F	The threshold for CPU/MEM faults for this module has been exceeded.	CPU module
1E	The threshold for resynch abort errors for this module has been exceeded.	CPU module
2D	The module experienced a double-bit memory error.	CPU module
3C	The threshold for single-bit errors for a memory SIMM has been exceeded.	CPU module
4B	The zone in which this module resides has experienced excessive clock phase errors.	ATM module
5A	The module has experienced excessive transient CPU I/O errors.	ATM and I/O expansion modules
69	The module has experienced a solid CPU I/O error.	ATM and I/O expansion modules
78	The module has experienced excessive transient NXIO errors.	ATM, I/O expansion, and Interface modules
87	The module has experienced a solid NXIO error.	ATM, I/O expansion, and Interface modules
96	The module has experienced a VAXELN kernel fatal error.	I/O expansion module
A5	The module is good.	CPU, ATM, I/O expansion, and Interface modules
B4	The module has experienced excessive VAXELN kernel recoverable errors.	I/O expansion module
C3	The module has experienced a VAXELN master fatal error.	I/O expansion module
D2	The module has experienced a VAXELN master recoverable error.	Interface module
E1	The module has experienced a VAXELN job fatal error.	Interface module
F0	A failure of this module has been detected by a system software component.	ATM, I/O expansion, and Interface modules
F1	A failure of the system console UART port in the SSC on the I/O expansion module has been detected by a system software component.	ATM and I/O expansion module
F2	A failure of the auxiliary UART port in the SSC on the I/O expansion module has been detected by a system software component.	ATM and I/O expansion module

4.6 FTSS Event Reporting Interface

The EHS externalizes events by reporting them to the event reporting interface (ERI). The ERI, in turn, passes notification of the event to the FTSS$SERVER process. The server reports the event in one of three ways:

1. Generating messages that are sent to the operator console.
2. Entering additional information into the system error log.
3. Reporting the event to an external mailbox which can be read by a user application.

4.6.1 Event Reporting Interface Routines

The EHS reports events by calling the following ERI routines located in the FTSS$CORE image.

FTSS$ZONE_AVAILABLE is called to report the availability of the other zone or CPU. This occurs when the IZC notifies the EHS that the zone has completed diagnostics and is available for use. A message code is added by the EHS and results in an OPCOM message and an error log being generated by the server.

FTSS$ERROR_REPORT is called by the EHS when a FRU is identified as the error source. This can occur as a result of a hardware or software detected failure. In this call the EHS passes error information through ERI to the server process. The server generates the appropriate messages to the operator console and user applications, and makes entries in the error log.

4.6.2 Error Event Messages

The following messages are passed to OPCOM and the system error log by the server. Each message corresponds to an EHS error event and contains information that identifies the FRU.

FTSS$_CABLEGONE, cross-link cable fault detected

Facility: FTSS

Explanation: The crosslink cable has been isolated as the cause of a system failure. One zone will be removed from service by the operating system. For transient failures, the error will be compared to its error rate threshold. If the threshold is not exceeded, the zone will be resynchronized when it completes diagnostics.

User Action: If the zone is automatically resynchronized, no action is required on the part of the user. If the zone is not automatically resynchronized, the system error log should be examined for entries which correspond to the cross-link cable failure. These entries will identify an FRU.

FTSS$_CLOCK_END, Clock fault end action complete

Facility: FTSS

Explanation: Error processing for a clock fault has been completed and the zone is available to be resynchronized.

User Action: If the zone is automatically resynchronized by FTSS, then no action is needed on the part of the user. If the zone is not resynchronized, the system error log should be examined for entries which correspond to clock fault. These error logs will identify an FRU.

FTSS$_CLOCK_ENDTMO, Clock fault end action timeout on zone [zone_id]

Facility: FTSS

Explanation: When a clock fault occurs in a non-Simplex system, diagnostics normally run on the failed zone and, upon completion, report status back to the zone running the operating system. If this end action does not occur within a reasonable timeout period, the failure will be treated as solid and the zone will not be automatically resynchronized by FTSS.

User Action: The system error log should be examined for entries which correspond to the clock fault and the end action timeout. These entries will indicate an FRU.

FTSS$_CLOCKFLT, Clock fault detected on [module_id] in slot [slot_id], zone [zone_id]

Facility: FTSS

Explanation: The clocks in each of the two zones operate in phase lock. When this synchronization is lost, lockstep operation of the zones is lost. The error is compared to its error rate threshold. If the threshold is exceeded, the zone is not automatically resynchronized by FTSS.

User Action: If the removed zone is automatically resynchronized after running diagnostics, no action is needed on the part of the user. If the zone is not automatically resynchronized, the system error log should be examined for entries which correspond to the clock fault. These entries will identify an FRU which must be replaced.

FTSS$_CPMF_END, CPU/MEM fault end action complete

Facility: FTSS

Explanation: Error processing for a CPU/MEM fault has been completed and the CPU is available to be resynchronized.

User Action: If the CPU is automatically resynchronized by FTSS, then no action is needed on the part of the user. If the CPU is not resynchronized, the system error log should be examined for entries which correspond to the CPU/MEM fault. These error logs will identify an FRU.

FTSS$_CPMF_ENDTMO, CPU/MEM fault end action timed out on zone [zone_id]

Facility: FTSS

Explanation: When a CPU/MEM fault occurs in a Duplex system, diagnostics normally run on the failed CPU and, upon completion, report status back to the zone running the operating system. If this end action does not occur within a reasonable timeout period, the failure will be treated as solid and the CPU will not be automatically resynchronized by FTSS.

User Action: The system error log should be examined for entries which correspond to the CPU/MEM fault and the end action timeout. These entries will indicate an FRU.

FTSS$_CPUDBE, Double-bit memory fault detected on [module_id] in slot [slot_id], zone [zone_id]

Facility: FTSS

Explanation: A double-bit memory error has occurred. This indicates a solid memory failure. This error will only be reported in a Duplex system and a CPU module will be removed from service when it occurs.

User Action: The system error log should be examined for entries which correspond to the double-bit error. These logs will indicate the SIMM memory row which must be replaced.

FTSS$_CPUSBE, A single-bit memory fault detected on [module_id] in slot [slot_id], zone [zone_id]

Facility: FTSS

Explanation: A recoverable single-bit memory error has been detected and handled by the operating system. These transient errors are repaired in memory and compared to their error rate threshold. In a Duplex system, a CPU module will be removed from service if the threshold is exceeded.

User Action: In most cases, no action by the user is necessary. If the rate of single-bit errors becomes excessive, replacement of a SIMM memory row or CPU module will be required. The system error log should be examined for the entries which correspond to the single-bit errors.

FTSS$_CPUMEMFLT, CPU/MEM fault detected on [module_id] in slot [slot_id], zone [zone_id]

Facility: FTSS

Explanation: A CPU/MEM fault in a Duplex system has been detected. This results in the temporary removal of that CPU from service. This error is compared to its error rate threshold. If the threshold is not exceeded and the CPU completes diagnostics successfully, the CPU will be automatically resynchronized. If the threshold is exceeded or diagnostics fail, the CPU will be not be automatically resynchronized.

User Action: If the CPU is automatically resynchronized after the completion of diagnostics, no action is required on the part of the user. If the CPU is not automatically resynchronized, the system error log should be examined for entries which correspond to the CPU/MEM fault. These entries will indicate an FRU.

FTSS$_CPUUNSYNC, [module_id] in slot [slot_id], zone [zone_id] is unsynchable

Facility: FTSS

Explanation: When a CPU completes diagnostics with failure and reports this status to the zone running the operating system, this message is generated. The CPU with the failure will not be automatically resynchronized by FTSS.

User Action: The system error log should be examined for the entry which corresponds to the unsynchable event. This entry will indicate an FRU.

FTSS$_DBE_END, DBE end action complete

Facility: FTSS

Explanation: Error processing for a double-bit memory error has been completed and the CPU is available to be resynchronized.

User Action: The system error log should be examined for entries which correspond to the double-bit error. These error logs will identify an FRU.

FTSS$_DBE_ENDTMO, DBE end action timed out on zone [zone_id]

Facility: FTSS

Explanation: When double-bit memory errors occur in a Duplex system, diagnostics run on the failed CPU and, upon completion, report status back to the zone running the operating system. If this end action does not occur within a reasonable timeout period, the failure will be treated as solid and the CPU will not be automatically resynchronized by FTSS.

User Action: The system error log should be examined for entries which correspond to the double-bit error and the end action timeout. These entries will indicate an FRU.

FTSS$_DIV_END, zone divergence end action complete

Facility: FTSS

Explanation: Error processing for a zone divergence error been completed and the zone is available to be resynchronized.

User Action: If the zone is automatically resynchronized by FTSS, then no action is needed on the part of the user. If the zone is not resynchronized, the system error log should be examined for entries which correspond to zone divergence error. These error logs will identify an FRU.

FTSS$_DIV_ENDTMO, zone divergence end action timed out on zone [zone_id]

Facility: FTSS

Explanation: When zones diverge in a Duplex system, diagnostics run on the removed zone and, on completion, report status to the zone running the OpenVMS operating system. If this end action does not occur within a reasonable timeout period, the failure will be treated as solid and the zone will not be automatically resynchronized by FTSS.

User Action: The system error log should be examined for entries which correspond to the zone divergence and the end action timeout. These entries will indicate an FRU.

FTSS$_DIVERGED, A synchronized, dual zone configuration has diverged

Facility: FTSS

Explanation: Lockstep operation between the two zones of a Duplex system has been lost. One of the zones is temporarily removed from service. The error is compared to its error rate threshold. If the threshold is not exceeded, the zone will be automatically resynchronized by FTSS after successfully completing diagnostics. If the threshold is not exceeded or diagnostics fail, the zone is not automatically resynchronized.

User Action: If the zone is automatically resynchronized, no action is necessary on the part of the user. If the zone if not automatically resynchronized, the system error log should be examined for entries which correspond to the zone divergence error. These entries will indicate an FRU.

FTSS$_ELNJOBFATAL, VAXELN job fatal error detected on [module_id] in slot [slot_id], zone [zone_id]

Facility: FTSS

Explanation: A VAXELN job running on an I/O Expansion module has detected a fatal error and has terminated. This error results in the removal of the associated Interface module from the system.

User Action: The system error log should be examined for entries which correspond to the VAXELN job fatal error. These entries will indicate an FRU.

FTSS$_ELNJOBRECOV, VAXELN job recoverable error detected on [module_id] in slot [slot_id], zone [zone_id]

Facility: FTSS

Explanation: A VAXELN job running on an I/O Expansion module has detected a recoverable error. These errors are compared to their error rate threshold by the operating system. If the threshold is exceeded in a non-Simplex system, the associated Interface module is removed from the system.

User Action: If the threshold is not exceeded, no action is required on the part of the user. If the threshold is exceeded, the system error log should be examined for entries which correspond to the VAXELN job recoverable error. These entries will indicate an FRU.

FTSS$_ELNKERFATAL, VAXELN kernel fatal error detected on [module_id] in slot [slot_id], zone [zone_id]

Facility: FTSS

Explanation: The VAXELN kernel running on an I/O Expansion module has detected a fatal error and has terminated. This error results in the removal of the indicated I/O Expansion module and associated Interface modules from the system configuration.

User Action: The system error log should be examined for entries which correspond to the VAXELN kernel fatal error. These entries will indicate an FRU.

FTSS$_ELNKERRECOV, VAXELN kernel recoverable error detected on [module_id] in slot [slot_id], zone [zone_id]

Facility: FTSS

Explanation: The VAXELN kernel running on an I/O Expansion module has detected a recoverable error. These errors are compared to their error rate threshold by the operating system. If the threshold is exceeded in a non-Simplex system, the indicated I/O Expansion module and associated Interface modules are removed from service.

User Action: If the threshold is not exceeded, no action is required on the part of the user. If the threshold is exceeded, the system error log should be examined for entries which correspond to the VAXELN kernel recoverable errors. These entries will indicate an FRU.

FTSS$_ELNMASFATAL, VAXELN master job fatal error detected on [module_id] in slot [slot_id], zone [zone_id]

Facility: FTSS

Explanation: The VAXELN master job running on an I/O Expansion module has detected a fatal error and has terminated. This error results in the removal of the indicated I/O Expansion module and associated Interface modules from the system configuration.

User Action: The system error log should be examined for entries which correspond to the VAXELN master job fatal error. These entries will indicate an FRU.

FTSS$_ELNMASRECOV, VAXELN master job recoverable error detected on [module_id] in slot [slot_id], zone [zone_id]

Facility: FTSS

Explanation: The VAXELN master job running on an I/O Expansion module has detected a recoverable error. These errors are compare to their threshold by the operating system. If the threshold is exceeded in a non-Simplex system, the indicated I/O Expansion module and associated Interface modules are removed from service.

User Action: If the threshold is not exceeded, no action is required on the part of the user. If the threshold is exceeded, the system error log should be examined for entries which correspond to the VAXELN master job recoverable errors. These entries will indicate an FRU.

FTSS$_JXDDBE, Double-bit memory fault detected on [module_id] in slot [slot_id], zone [zone_id]

Facility: FTSS

Explanation: A double-bit memory error has occurred. This indicates a solid memory failure. In a Duplex system, a CPU module will be removed from service when this error occurs.

User Action: The system error log should be examined for entries which correspond to the double bit error. These logs will indicate the SIMM memory row which must be replaced.

FTSS$_JXDSBE, Single-bit memory fault detected on [module_id] in slot [slot_id], zone [zone_id]

Facility: FTSS

Explanation: A recoverable single-bit memory error has been detected and handled by the operating system. These transient errors are repaired in memory, and the errors are compared to their error rate threshold. In a Duplex system, a CPU module will be removed from service if the threshold is exceeded.

User Action: In most cases, no action by the user is necessary. If the rate of single-bit errors becomes excessive, replacement of a SIMM memory row will be required. The system error log should be examined for the entries which correspond to the single-bit errors.

FTSS$_POWERGONE, Power gone fault detected on zone [zone_id]

Facility: FTSS

Explanation: Power has been lost in one of the zones. This error is compared to its error rate threshold. If the threshold is not exceeded, the zone will be automatically resynchronized when power returns.

User Action: If power is restored and the zone is automatically resynchronized, no action is required on the part of the user. If power is restored and the zone is not automatically resynchronized, the user should examine the external system power source.

FTSS$_RESYNCHFLT, Resynch abort fault detected on [module_type] in slot [slot_id], zone [zone_id]

Facility: FTSS

Explanation: During an attempt to resynchronize a CPU/Memory module, an error occurred on the master CPU module. This error is compared to its error rate threshold by the operating system. If the threshold is not exceeded, FTSS will retry the resynchronization process. When the threshold is exceeded, attempts to resynchronize will be terminated.

User Action: If the resynchronization retry is successful, no action is required on the part of the user. If the threshold for retries is exceeded, the system error log should be examined for entries which correspond to the resynch abort failure. These entries will indicate an FRU.

FTSS$_SBE_END, SBE end action complete

Facility: FTSS

Explanation: Error processing for a single-bit memory error has been completed and the CPU is available to be resynchronized.

User Action: If the CPU is automatically resynchronized by FTSS, then no action is needed on the part of the user. If the CPU is not resynchronized, the system error log should be examined for entries which correspond to single bit error. These error logs will identify an FRU.

FTSS$_SBE_ENDTMO, SBE end action timed out on zone [zone_id]

Facility: FTSS

Explanation: When single-bit memory errors occur in a Duplex system, diagnostics run on the failed CPU and, on completion, report status back to the zone running the operating system. If this end action does not occur within a reasonable timeout period, the failure will be treated as solid and the CPU will not be automatically resynchronized by FTSS.

User Action: The system error log should be examined for entries which correspond to the single-bit error and the end action timeout. These entries will indicate an FRU.

FTSS$_SOLIDIOMOD, Solid I/O fault detected on [module_type] in slot [slot_id], zone [zone_id]

Facility: FTSS

Explanation: A fatal I/O miscompare error was detected and attributed to the indicated module. The module is removed from service by the operating system.

User Action: The system error log should be examined for entries which correspond to the I/O miscompare errors. These entries will indicate an FRU.

FTSS$_SOLIDNXIO, Solid NXIO fault detected on [module_type] in slot [slot_id], zone [zone_id]

Facility: FTSS

Explanation: A fatal nonexistent I/O error has occurred when accessing the indicated I/O module. The module is removed from service by the operating system.

User Action: The system error log should be examined for entries which correspond to the nonexistent I/O error. These entries will indicate an FRU.

FTSS$_SOLIDIOXLNK, Solid I/O fault detected on the cross-link

Facility: FTSS

Explanation: A fatal I/O miscompare error was detected and attributed to the cross-link. One zone is selected and is removed from service by the operating system.

User Action: The system error log should be examined for entries which correspond to the I/O miscompare errors. These entries will indicate an FRU.

FTSS$_SOLIDIOZONE, Solid I/O fault detected on zone [zone_id]

Facility: FTSS

Explanation: A fatal I/O miscompare error was detected and attributed to the indicated zone. The zone is removed from service by the operating system.

User Action: The system error log should be examined for entries which correspond to the I/O miscompare errors. These entries will indicate an FRU.

FTSS$_SWMODERR, Software detected failure on [module_type] in slot [slot_id], zone [zone_id]

Facility: FTSS

Explanation: A system software component has detected the failure of a system module. In most cases, these errors indicate the failure of an I/O module which was detected by a device driver and not reported by a system error interrupt. These errors indicate a fatal failure of the indicated module and it is removed from service.

User Action: The system error log should be examined for entries which correspond to the software detected module failure. These entries will indicate an FRU.

FTSS$_SWZONERR, Software detected failure on zone [zone_id]

Facility: FTSS

Explanation: A system software component has detected the failure of a zone. This error indicates a fatal failure of the indicated zone and it is removed from service.

User Action: The system error log should be examined for entries which correspond to the software detected zone failure. These entries will indicate an FRU.

FTSS$_TRNSIOMOD, Transient I/O fault detected on [module_type] in slot [slot_id], zone [zone_id]

Facility: FTSS

Explanation: A transient I/O miscompare error was detected and attributed to the indicated module. These errors are compared to their error rate threshold. If the threshold is exceeded and the system mode is not Simplex, the module is removed from service.

User Action: If the threshold is not exceeded and the module is not removed from service, no action is needed on the part of the user. If the module is removed from service, the system error log should be examined for entries which correspond to the I/O miscompare errors. These entries will indicate an FRU.

FTSS$_TRNSNXIO, Transient NXIO fault detected on [module_type] in slot [slot_id], zone [zone_id]

Facility: FTSS

Explanation: A transient non-existent I/O error was detected when accessing the indicated module. These errors are compared to their error rate threshold. If the threshold is exceeded and the system mode is not Simplex, the module is removed from service.

User Action: If the threshold is not exceeded and the module is not removed from service, no action is needed on the part of the user. If the module is removed from service, the system error log should be examined for entries which correspond to the non-existent I/O errors. These entries will indicate an FRU.

FTSS$_TRNSIOXLNK, Transient I/O fault detected on the cross-link

Facility: FTSS

Explanation: A transient I/O miscompare error was detected and attributed to the cross-link. These errors are compared to their error rate threshold. If the threshold is exceeded and the system mode is not Simplex, then one zone is removed from service.

User Action: If the threshold is not exceeded and a zone is not removed from service, no action is needed on the part of the user. If a zone is removed from service, the system error log should be examined for entries which correspond to the I/O miscompare errors. These entries will indicate an FRU.

FTSS$_TRNSIOZONE, Transient I/O fault detected on zone [zone_id]

Facility: FTSS

Explanation: A transient I/O miscompare error was detected and attributed to the indicated zone. These errors are compared to their error rate threshold. If the threshold is exceeded and the system mode is not Simplex, the zone is removed from service.

User Action: If the threshold is not exceeded and the zone is not removed from service, no action is needed on the part of the user. If the zone is removed from service, the system error log should be examined for entries which correspond to the I/O miscompare errors. These entries will indicate an FRU.

FTSS$_ZONEHALT, Zone Halt fault detected on zone [zone_id]

Facility: FTSS

Explanation: A single zone of a Duplex system has been halted. This can be caused by a user command on the system console or by a system error.

User Action: If the Halt was caused by a user command on the system console, a START/ZONE command must be executed to restore the zone to service. If the Halt was not caused by a user command, the system error log should be examined for entries which correspond to the zone halt error. These entries will identify an FRU.

FTSS$_ZONEUNSYNC, Zone [zone_id] is unsynchable

Facility: FTSS

Explanation: When a zone completes diagnostics with failure and reports this status to the zone running the operating system, this message is generated. The zone with the failure will not be automatically resynchronized by FTSS.

User Action: The system error log should be examined for the entry which corresponds to the unsynchable event. This entry will indicate an FRU.

4.6.2.1 Deconfiguration Messages

The following messages can be passed to OPCOM and the system error log file by the FTSS$SERVER at the request of EHS. Each message corresponds to a deconfiguration activity performed by EHS. Each message contains information (through FAO arguments) that identifies the entity deconfigured by EHS.

FTSS$_DECONFIG_ATMIO, I/O expansion subsystem on I/O attachment module in slot [slot_id], zone [zone_id] has been removed from service

Facility: FTSS

Explanation: Due to one or more system errors, the I/O expansion subsystem on the indicated I/O ATM and its associated Interface modules have been removed from service.

User Action: The system error log should be examined for entries which correspond to the removal of the I/O expansion subsystem. These entries will indicate an FRU.

FTSS$_DECONFIG_CPUMOD, CPU module in slot [slot_id], zone [zone_id] has been removed from service

Facility: FTSS

Explanation: Due to one or more system errors, the indicated CPU module has been removed from service. In some cases, the CPU may be automatically resynchronized by FTSS when it successfully completes the execution of diagnostics.

User Action: If the CPU is automatically resynchronized by FTSS after completing diagnostics, no action is required on the part of the user. If the CPU is not automatically resynchronized, the system error log should be examined for entries which relate to the removal of the CPU. These entries will indicate an FRU.

FTSS$_DECONFIG_EXMOD, I/O expansion module in slot [slot_id], zone [zone_id] has been removed from service

Facility: FTSS

Explanation: Due to one or more system errors, the indicated I/O Expansion module and its associated Interface modules have been removed from service.

User Action: The system error log should be examined for entries which correspond to the removal of the I/O expansion module. These entries will indicate an FRU.

FTSS$_DECONFIG_INTMOD, Interface module in slot [slot_id], zone [zone_id] has been removed from service

Facility: FTSS

Explanation: Due to one or more system errors, the indicated Interface module has removed from service.

User Action: The system error log should be examined for entries which correspond to the removal of the Interface module. These entries will indicate an FRU.

FTSS$_DECONFIG_ZONE, Zone [zone_id] has been removed from service

Facility: FTSS

Explanation: Due to one or more system errors, the indicated zone has been removed from service. In some cases, the zone may be automatically resynchronized by FTSS when it successfully completes the execution of diagnostics.

User Action: If the zone is automatically resynchronized by FTSS after completing diagnostics, no action is required on the part of the user. If the zone is not automatically resynchronized, the system error log should be examined for entries which relate to the removal of the zone. These entries will indicate an FRU.

4.7 Firmware Interfaces

The EHS interacts with three firmware-based software entities: system console and diagnostics, I/O expansion module console and diagnostics, and the I/O expansion module VAXELN software. The system console and diagnostics and I/O expansion module console and diagnostics interfaces are discussed in the following sections.

4.7.1 System Console and Diagnostics

The EHS communicates with the system console through:

- System hardware resets combined with flags in the console communications area (CCA)
- CCA fields referenced using the IZC service

4.7.1.1 System Resets

When the EHS determines that a zone or CPU should be removed from the configuration, it forces a reset on the CPU. The reset results in the system console being invoked from serial ROM by the hardware. When system console runs, it attempts to determine the reason for the reset, which in turn may determine the actions performed by the console. The EHS uses the fields in the CCA reset dispatch block (at offset CCA560$R_RESET_BLOCK) to pass reset reason codes to the console. The fields are:

RDB$L_RESET_CODE - The reset reason code. This longword field is actually composed of two one-word fields:

- RDB$W_ACTION - The reset action. This word instructs the console on the action that needs to be taken. The reset action codes used by the EHS are described in Table 4–26.
- RDB$W_REASON - The reset reason. This field is additional data supplied by the OpenVMS operating system which indicates the reason for the reset. The code is printed in hex on the operator console after the reset action is completed. The reset reason codes used by the EHS are described in Table 4–27.

RDB$L_REASON_VALID - The 1's complement of the reset reason code longword.

RDB$L_DISPATCH - This field is used only if the system console is to continue the OpenVMS operating system after completing reset actions. In all reset cases by the EHS, it will be 0.

Table 4–26 System Reset Action Codes

Decimal Value	Description
1	This code will cause the system console to enter its halt loop, which will establish IZC to the other zone, without invoking any diagnostics. Currently, this reset action is requested only when the EHS is handling a single-bit error.
4	This code will cause the system console to invoke diagnostics. The diagnostics which run depend on the cross-link mode at the time. Following diagnostics, the system console will enter its halt loop, and establish IZC to the other zone. The code is used when a zone or CPU is being removed due to a system error.
6	This code will cause the same actions as CPURESET$K_DIAGS. This code is used when a zone is being removed by operator action (that is, a user command).

Table 4–27 System Reset Reason Codes

Decimal Value	Description
1	When the EHS detects zone divergence, it selects one zone to continue the OpenVMS operating system and one zone to stop. Note that the OpenVMS operating system is not indicating an error in this zone; it must stop one of the two.
2	When the EHS isolates a failure to the cross-link cable (for example, a cable gone error), it will reset one zone using this reason type.
3	When the EHS detects a fault in a zone that cannot be isolated to a single module, it will reset the zone with this reason type. Usually, such errors are the result of backplane failures.
4	The OpenVMS operating system will use this reset with an IO ATM module failure. Before this reset, the operating system will write an error code to the module ID EEPROM through the I2C bus.
5	The OpenVMS operating system will use this to reset a CPU module after determining that it has failed. Before the reset, the OpenVMS operating system will write an error code to the module ID EEPROM through the I2C bus.
6	The OpenVMS operating system will use this to reset a CPU module after determining that its memory has failed.
7	An SBE was detected by the CPU in Duplex mode. CPU lockstep between zones is lost on this event and it should be reestablished as soon as possible. This code is used in conjunction with the CPURESET$K_NO_DIAGS reset action code.
8	This code is used as a result of a user-issued command to remove a zone from service.
9	A fatal system machine check error has occurred.
10	A system software component detected a failure of this module.

Table 4–28 lists the events which might cause the EHS to issue the reset, and the cross-link modes under which the reset might be issued.

Table 4–28 Error Handler Reset Reasons

Event	Possible Cross-Link Modes
Double-Bit Error	OFF, MASTER
Single-Bit Error	SLAVE
Cross-Link Cable Failure	OFF
Clock Phase Errors	OFF
I/O Errors	OFF, MASTER, SLAVE
Zone Divergence	OFF
Single-Bit Error	SLAVE
User Command	OFF, SLAVE

4.7.1.2 CCA Fields

When a CPU or zone completes diagnostics, it enters its halt loop, which reports its status to the OpenVMS operating system in the other zone through the IZC service. The IZC service will in turn call the OpenVMS operating system to report the availability of the other zone. The operating system requires the following information to be available from the console in the other zone:

- The IZC message to the operating system will contain a synchability status. If the status is unsynchable, the OpenVMS operating system will examine the CCA in the console zone. The field CCA560$L_COMPAT_STATUS will contain a reason mask which describes the reasons that the zone is not synchable. This information will be entered into the system error log.

  If the reason mask indicates a diagnostic failure, the CCA560$Q_DIAG_STATUS field will contain additional information on the failure. The EHS will use the IZC service to read this information for entry into the system error log.

- The EHS uses the IZC service to read system register information from the CCA of the other zone starting at offset CCA560$R_REG_BLOCK. The registers in this block were written by the EHS when the original error occurred. However, the console must preserve this area through all resets and during diagnostic execution, whenever possible (some catastrophic failures will prevent this from working).

4.7.2 I/O Expansion Module Console and Diagnostics

When the EHS determines that an I/O expansion module should be removed from the configuration, it forces an I/O hard reset on the modules. This results in the I/O expansion module console being invoked by hardware. When the console runs, it attempts to determine the reason for the reset, which in turn may determine the actions performed by the diagnostics. The EHS uses two fields in the NCA reset dispatch block (at offset NCA560$L_RESET_BLOCK) to pass reset reason codes to the diagnostics. The fields are:

RDB$L_RESET_CODE **-** The reset reason code. This longword field is actually composed of two 1-word fields:

- RDB$W_ACTION **-** The system reset action. This word instructs the console on the action that needs to be taken. The only reset action code used by the EHS is shown in Table 4–29.
- RDB$W_REASON **-** The reset reason. This field is additional data supplied by the operating system which indicates the reason for the reset. The reset reason codes used by the EHS are shown in Table 4–30.

RDB$L_REASON_VALID **-** The 1's complement of the reset reason code longword.

RDB$L_DISPATCH **-** This field is used only if the console is to continue the operating system after completing reset actions. In all cases of I/O resets by the EHS, it will be 0.

Table 4–29 I/O Reset Action Code Description

Decimal Value	Description
6	This reset code will cause the I/O expansion module console to invoke diagnostics. The diagnostics which run depend upon the mode of the cross-link at the time. After diagnostics, console will enter its halt loop.

Table 4–30 I/O Reset Reason Code Descriptions

Decimal Value	Description
11	The module has experienced a solid NXIO error.
12	The module has experienced excessive transient NXIO errors.
13	The module has experienced a solid I/O miscompare error.
14	The module has experienced excessive transient I/O miscompare errors.
15	The module has experienced excessive VAXELN kernel recoverable errors.
16	The module has experienced a VAXELN master fatal error.

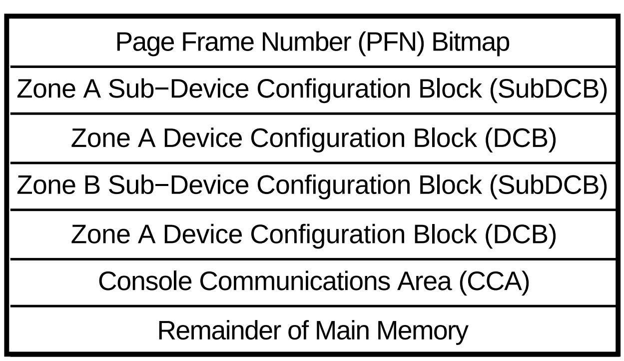
4.8 Firmware and OpenVMS Interface Data Structures

Figure 4–13 shows the OpenVMS operating system and firmware data structure memory map. The following sections describe the data structures used by the console:

- Console Communication Area (CCA)
- Device Configuration Block (DCB)
- Page Frame Number Bitmap (PFN)

The firmware constructs, initializes, and shares the data structures with the OpenVMS operating system.

Figure 4–13 Firmware and OpenVMS Data Structure Memory Map



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4.8.1 Console Communications Area

The console communications area (CCA) is the main data structure used by the console to interface with the OpenVMS operating system. Table 4–31 describes the CCA components.

Table 4–31 CCA Component Descriptions

Parameter	Size	Description
CCA size	2 bytes	Size of the CCA in bytes. Initialized by firmware.
CCA revision	1 byte	Revision of the CCA. Initialized by firmware.
CCA base	4 bytes	Physical address of the CCA. Initialized by firmware.
Header flags	4 bytes	CCA flags. Field breakdown by bit: • 00 = Bootstrap in progress. Set by firmware when bootstrap operation is started. Cleared by the OpenVMS operating system. Used to control the bootstrap operation. • 01 = Restart in progress. Set by firmware when restart operation is started. Cleared by the OpenVMS operating system. Used to control the restart operation. • 02 = Automatic bootstrap. Set by firmware when a manual bootstrap occurred. • 03 = Reboot in progress. Set by the OpenVMS operating system when a bootstrap operation is requested by the operating system using the default boot specification. • 04 = Failsafe mode. Set by firmware to indicate that the zone is in Failsafe mode. (Failesafe mode refers to the method used for bootstrapping.) • 05 = Synchable status. Set by firmware to indicate that the zone is synchable (Duplex compatibility test passed). If bit is clear, test failed. Use the Duplex compatibility test results component to obtain the reason for failure. • 06 = Halted from bootstrap. Set by VMB to indicate to the firmware that it is not to report a bootstrap error. This bit overrides the state of the bootstrap in progress bit 0 with respect to handling errors during the bootstrap operation. • [31:07] = Reserved for firmware use.

(continued on next page)

Table 4–31 (Cont.) CCA Component Descriptions

Parameter	Size	Description
Bootability test results	4 bytes	Results of the bootstrap test. Written by the firmware. Field breakdown by bit: • 00 = CPU/ATM check. Set when the CPU and ATM are good. • 01 = Cable state. Set when cables are present and good. • 02 = Other zone power state. Set when the power is on in the other zone. • 03 = Other zone OpenVMS operating system state. Set when the other zone is running the OpenVMS operating system. • 04 = Other zone CPU/ATM check. Set when the CPU and ATM in the other zone are good. • [31:07] = Reserved for firmware use.
PFN bitmap address	4 bytes	Physical address of the PFN bitmap. Initialized by firmware.
PFN bitmap size	4 bytes	Size of the PFN bitmap in bytes. Initialized by firmware.
PFN bitmap checksum	4 bytes	Checksum of the PFN bitmap. Checksum = integer sum of all bytes in the PFN bitmap.
System serial number	12 bytes	System serial number. 12 ASCII characters. Initialized by firmware. Copied from the CPU module data EEPROM.
Zone A DCB offset	4 bytes	Offset to the Zone A DCB. Offset is the byte offset (signed) from the CCA base. Initialized by firmware.
Zone A DCB size	4 bytes	Size in bytes of the DCB for Zone A. The size includes the DCB and any SubDCBs for Zone A. Initialized by firmware.
Zone B DCB offset	4 bytes	Offset to the Zone B DCB. Offset is the byte offset (signed) from the CCA base. Initialized by firmware.
Zone B DCB size	4 bytes	Size in bytes of the DCB for Zone B. The size includes the DCB and any SubDCBs for Zone B. Initialized by firmware.

(continued on next page)

Table 4–31 (Cont.) CCA Component Descriptions

Parameter	Size	Description
Diagnostic status	8 bytes	Results of the diagnostic tests. Initialized by firmware. Breakdown of the status fields: • [07:00] = Error number • [15:08] = Subtest number • [23:26] = Test number • [27:24] = Group number • [30:28] = Diagnostic flags. For firmware use only. • 31 = Set when bits 27:00 indicate a valid failure code. The high-order four bytes are reserved for firmware.
Duplex compatibility test results	4 bytes	Results of the compatibility test. Written by firmware. See Section 4.8.1.1 for the test descriptions and fault codes.
Reset dispatch block	16 bytes	Used by firmware and the OpenVMS operating system to notify the firmware how to handle a reset entry to firmware. See Section 4.8.1.2 for dispatch block description.
Boot parameter table	164 bytes	Boot parameter table. Initialized by firmware. See Section 4.8.1.3 for the description.
Saved register block	132 bytes	Register block saved by the OpenVMS operating system on a CPU/MEM fault. Initialized and used by the operating system.
Reserved	64 bytes	Reserved for future expansion.

4.8.1.1 Duplex Compatibility Test

On firmware entry, the console program verifies a number of conditions that are required for system operation in Duplex mode. These conditions determine if the zone is synchable, that is, able to join a partner zone in Duplex operation.

The IZC protocol is used by the console program to execute the Duplex compatibility test. Once the console establishes the IZC service, it executes the test and notifies the other zone of the results. A zone is considered synchable if it passes the test.

The compatibility test is responsible for storing the results in the CCA. The following items are test parameters.

- Diagnostic status:

  CPU self-test passes
  CPU zone test passes
  Primary I/O expansion module self-test passes
  CPU system test does not fail (not run assumes a passed condition)

- Zone identification:

  One Zone A, one Zone B.

- CPU module ID EEPROM:

  Valid checksum
  OpenVMS and firmware status byte is good
  Module ID and module name compatible with other zone
  Module hardware revision compatible with other zone (major)
  Firmware and software revisions compatible with other zone (major)

- I/O ATM module ID EEPROM:

  Valid checksum
  OpenVMS and firmware status byte is good
  Module ID and module name compatible with other zone
  Module hardware revision compatible with other zone (major)
  Firmware and software revisions compatible with other zone (major)

- CPU module data EEPROM:

  Valid checksum
  System data area must be the same in both zones

- Memory restrictions for synchronization:

  Same memory configuration on both zones

- Cross-link and resynch cables functional
- Operational modes must be compatible (that is, burnin state)
- Ability of the CPU console firmware to run in cross-link in Duplex mode

Table 4–32 lists the test failure codes. Each bit represents the results of checking the given condition. The test will attempt to check all conditions, and updates the bits as it performs the test (set bit indicates failure).

Table 4–32 Duplex Compatibility Test Failure Codes

Failure Code Bit Number	Code Description
00	CPU self-test failed
01	CPU zone test failed
02	CPU system test failed
03	ATM self-test failed
04	Both zones have the same zone ID
05	CPU ID EEPROM is bad
06	CPU ID EEPROM OpenVMS status field shows module is bad
07	CPU ID EEPROM firmware status field shows module is bad
08	CPU ID EEPROM module type field mismatches between zones
09	CPU ID EEPROM module name field mismatches between zones
10	CPU ID EEPROM hardware revision (major) mismatches between zones
11	CPU ID EEPROM firmware revision (major) mismatches between zones

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Table 4–32 (Cont.) Duplex Compatibility Test Failure Codes

Failure Code Bit Number	Code Description
12	CPU ID EEPROM software revision (major) mismatches between zones
13	ATM ID EEPROM is bad
14	ATM ID EEPROM OpenVMS status field shows module is bad
15	ATM ID EEPROM firmware status field shows module is bad
16	ATM ID EEPROM module type field mismatches between zones
17	ATM ID EEPROM module name field mismatches between zones
18	ATM ID EEPROM hardware revision (major) mismatches between zones
19	ATM ID EEPROM firmware revision (major) mismatches between zones
20	ATM ID EEPROM software revision (major) mismatches between zones
21	CPU data EEPROM is bad
22	CPU data EEPROM system wide area mismatches between zones
23	CPU/memory configuration mismatches between zones
24	Cables (cross-link and/or resynch) are not functional
25	CPU is in burnin state
26	Ethernet EEPROM address mismatches between zones
27	CPU console firmware cannot be synchable (cannot run in Duplex mode)
[31:28]	Reserved for future use

4.8.1.2 Dispatch Block Description

The firmware validates a reset entry using a dispatch block, located in memory, to determine the next operation. Figure 4–14 shows the dispatch block structure. Table 4–33 describes the block components.

Figure 4–14 Dispatch Block Structure

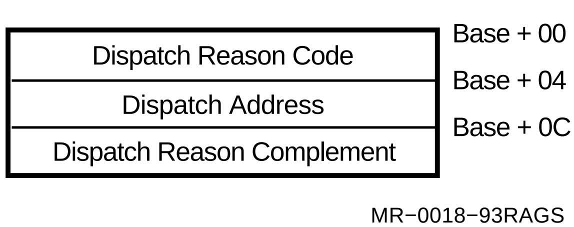


Table 4–33 Dispatch Block Components

Block Content	Offset	Description
Dispatch reason code	Base + 00h 4 bytes	Code identifying reset reason. Bytes 03:02 identify the reason for the reset. Bytes 01:00 identify the end action to be taken by the console as specified below: • 00 = POWERUP. Default or unexpected reset. Run diagnostics and halt (enter the console). • 01 = NO_DIAGS. Halt (enter the console). • 02 = DISPATCH. Dispatch requested. Jump to the dispatch address. • 03 = RESYNCH. Resynch reset. Jump to the dispatch address. • 04 = DIAGS. Run diagnostics and halt (enter the console). • 05 = STOP_ZONE. OpenVMS issued a STOP_ ZONE. Run diagnostics and halt (enter the console). • 06 = RECONFIG. Reconfigure firmware (for firmware use only).
Dispatch address	Base + 04h 8 bytes	Physical address where console will jump. In the Model 810, only the first 4 bytes are used. Upper 4 bytes must be 0.
Dispatch reason complement	Base = 0Ch 4 bytes	The 1's complement of the dispatch reason code. Used for checking the dispatch block validity.

4.8.1.3 Boot Parameter Block Description

The boot parameter block (BPB) is a structure built by firmware to reflect the primary bootstrap code (VMB) of the boot device that is used during the bootstrap sequence. Table 4–34 describes the BPB components. Table 4–35 describes the entry components in the DCB structure.

Table 4–34 BPB Components

Component	Length	Description
Number of entries	4 bytes	Number of entries in the BPB. Written by firmware. Is 0 if no entries are present.
BPB entries	5 bytes per entry	An entry describes a boot path. Written by firmware. Maximum number of entries is 32. (See Table 4–35 for entry description.)

Table 4–35 BPB Entry Components

Component	Length	Description
Unit number	2 bytes	Device unit number. Valid numbers are in the 0 to 999 (decimal) range.
Device	2 bytes	Device name in ASCII (that is, EP and DI).
Path identifier	1 byte	Path to device. Field breakdown is: • [06:00] = Slot number of the adapter module in the 10 to 17 (hex) and 20 to 27 (hex) range. • 07 = Zone identification of the adapter module: 0 = Zone A, 1 = Zone B.

4.8.2 Device Configuration Block

The device configuration block (DCB) reflects the configuration of the available modules in the system. There is a DCB in each zone. The DCB is built by firmware during the power up sequence and updated each time INIT and BOOT are executed. The OpenVMS operating system uses the DCB to configure the system. Table 4–36 describes the DCB components. Table 4–37 describes the DCB entry components.

Table 4–36 DCB Components

Component	Length	Description
Number of entries	4 bytes	Number of entries in the DCB. Initialized by firmware. Is 0 if no entries are present.
DCB entries	168 bytes per entry	An entry describes a module found by the firmware. Initialized by firmware. Maximum number of entries is eight. (See Table 4–37 for entry description.)

Table 4–37 DCB Entry Components

Component	Length	Description
Slot number	1 byte	Physical slot number of the module. Valid slot numbers are: 0 to 2 for CPU and I/O ATM modules 0 to 7 for interface modules attached to the I/O ATM
Module type	1 byte	Code identifying the module. Module types are copied from the module ID EEPROM. Valid module types are: 1 = Not used 2 = SWIFT adapter card 3 = I/O ATM module 4 = DSF module 5 = CPU module 6 = LANCE adapter card 7 = Not used 8 = FDDI adapter card F = Unknown module

(continued on next page)

Table 4–37 (Cont.) DCB Entry Components

Component	Length	Description
Status summary	1 byte	Module status summary. This field is a summary of the OpenVMS and firmware status fields. The field should be updated whenever OpenVMS or firmware status fields are updated. Codes are initially copied from the module ID EEPROM. Valid codes (in hex) are: A5 = Module is good. B4 = Module is bad, marked by OpenVMS. See OpenVMS status field. C3 = Module is bad, marked by firmware. See firmware status field. FF = Module is bad, marked by OpenVMS and firmware.
OpenVMS status	1 byte	Module status as marked by OpenVMS (and maintained by OpenVMS). Codes are initially copied from the module ID EEPROM. Valid codes (in hex) are: A5 = module is good. non A5 = module is bad.
Firmware status	1 byte	Module status as marked by firmware (and maintained by firmware). Codes are initially copied from the module ID EEPROM. Valid codes (in hex) are: A5 = Module is good. non A5 = Module is bad.
Module name	4 bytes	ASCII module name. Copied from the module ID EEPROM.
Module serial number	12 bytes	Module serial in ASCII. Copied from the module ID EEPROM.
Hardware revision	6 bytes	Identifies the module hardware revision. Copied from the module ID EEPROM. Divided in: Minor revision (bytes 02:00) Major revision (bytes 05:03)
Firmware revision	2 bytes	Console/diagnostic firmware revision of the module. Copied from the module ID EEPROM. Divided in: Minor revision (byte 00) Major revision (byte 01)
Software revision	2 bytes	Functional firmware revision of the module. Copied from the module ID EEPROM. Divided in: Minor revision (byte 00) Major revision (byte 01)

(continued on next page)

Table 4–37 (Cont.) DCB Entry Components

Component	Length	Description
Ethernet address	32 bytes	Module Ethernet address. Follows the DEC STD format. Valid only for CPU module and LANCE adapter card. Copied from the Ethernet EEPROM by firmware for the CPU. Copied from the LANCE ROM for the LANCE adapter card.
Extended data	32 bytes	Module-specific data. The field is copied by firmware from the functional firmware ROM.
Memory size	4 bytes	Size of the module's memory in 512 byte segments. For CPU refers to the size of main memory. For I/O ATM refers to the size of local (SOC) memory. For interface modules refers to the size of buffer RAM.
SubDCB	4 bytes	Offset to the module SubDCB (Sub-Device Configuration Block). Offset is the byte offset (signed) from the base of the DCB. Is 0 if no SubDCB available.
Reserved	64 bytes	Reserved for future use.

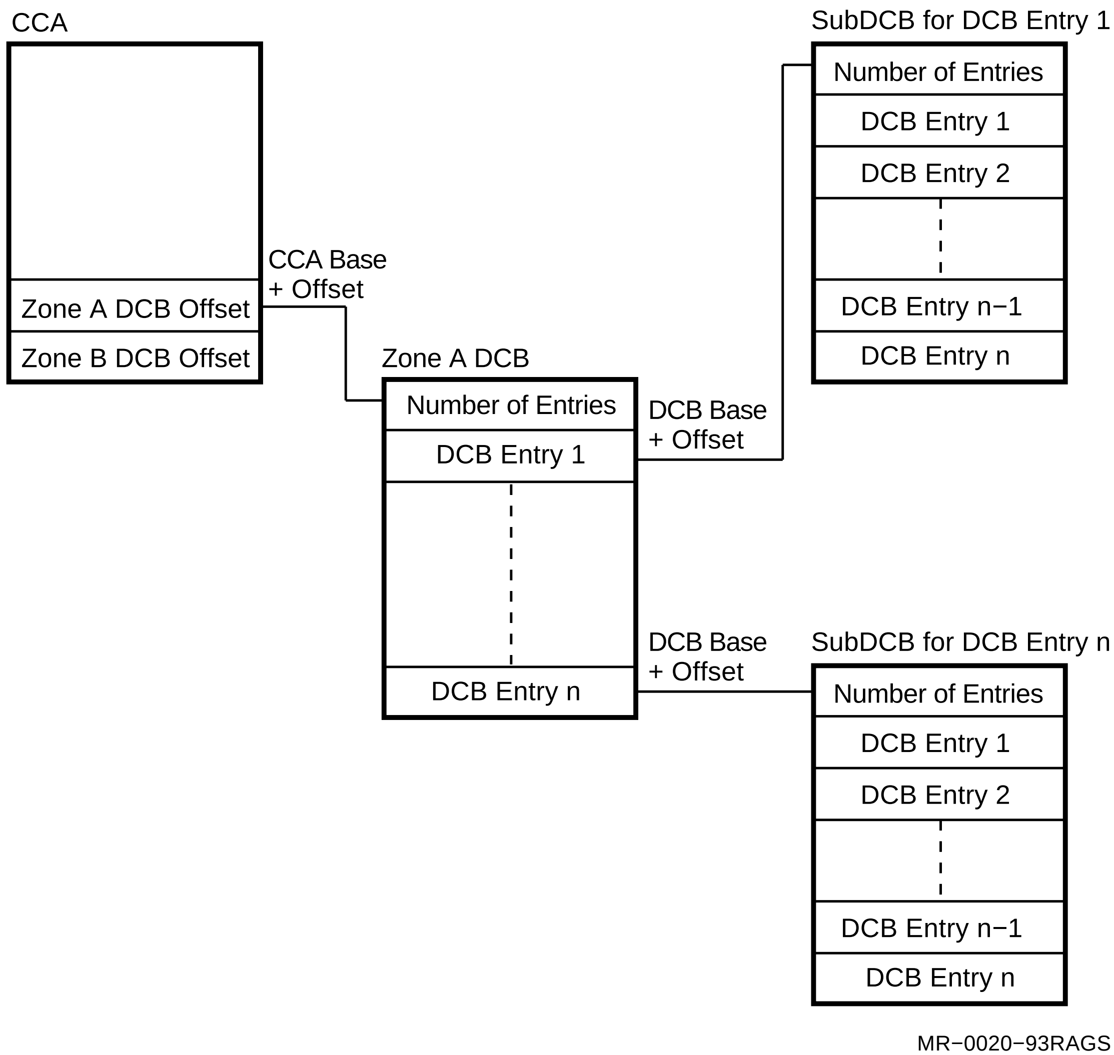
4.8.2.1 Sub-Device Configuration Blocks

The SubDCBs reflect the configuration of the interface or memory modules attached to a module. SubDCBs may be available for the CPU and I/O ATM modules. The SubDCB is built by firmware during the power up sequence and updated each time INIT and BOOT are executed.

A SubDCB is present when there are interface modules attached to a given module and its existence is represented in that module's DCB entry. When the SubDCB offset field on a DCB entry is nonzero, the value is used to calculate the location of its SubDCB block. If the SubDCB offset field on a DCB entry is zero, there is no SubDCB block present (that is, no interface modules are attached to that module).

The format of a SubDCB is the same as for the DCB block. The field containing the number of entries follows the same format as a DCB entry (except the CPU module SubDCB). Figure 4–15 shows how the SubDCBs are linked to the DCB.

Figure 4–15 SubDCB Links to DCB



4.8.2.2 CPU Module SubDCB

The CPU SubDCB is used to represent the memory modules (MMBs) available on the CPU module. Table 4–38 describes the CPU SubDCB components. Table 4–39 describes the CPU SubDCB entry components.

Table 4–38 CPU SubDCB Components

Component	Length	Description
Number of entries	4 bytes	Number of entries in the SubDCB. Initialized by firmware. Is 0 if no entries are present.
SubDCB entries	16 bytes per entry	An entry describes an MMB found by the firmware. Initialized by firmware. Maximum number of entries is four.

Table 4–39 CPU SubDCB Entry Components

Component	Length	Description
SIMM block	16 bytes	MMB SIMM description. This field is an array of eight elements (SIMM0 to SIMM7). Each element is 2 bytes in size and contains: Byte 00 - SIMM size in Mbytes. Byte 01 - SIMM status. Values for SIMM status (in hex) are: A5 = SIMM is good. B4 = SIMM is broken. C3 = SIMM is absent.

4.8.3 Page Frame Number Bitmap

The page frame number (PFN) bitmap is a data structure that indicates which pages in memory are considered usable by the OpenVMS operating system. The bitmap is built by diagnostics as a side effect of the memory tests run during the power up sequence.

The bitmap starts on a page boundary and resides at the top of memory. The bitmap requires 1 Kbyte for each 4 Mbytes of main memory, that is:

- A 32-Mbyte system requires an 8-Kbyte bitmap
- A 512-Mbyte system requires a 128-Kbyte bitmap

The bitmap does not map itself or anything above it. There may be memory above the bitmap which has good and bad pages.

Each bit in the PFN bitmap corresponds to a page in main memory. There is a one-to-one correspondence between a page frame number (origin 0) and a bit index in the bitmap. A 1 in the bitmap indicates that the page is good and can be used. A 0 indicates that the page is bad and should not be used. By default, a page is flagged bad if a multiple bit error occurs when referencing the page. Single-bit errors, regardless of frequency, will not cause a page to be flagged bad.

4.9 Error Log Analysis

4.9.1 CPU/MEM Fault Error Log Entry

```
V A X / V M S       SYSTEM ERROR REPORT        COMPILED  3-FEB-1993 09:33:44
                                                                   PAGE  40.

******************************* ENTRY     686. *******************************
ERROR SEQUENCE 1033.                               LOGGED ON:        SID 17000002
DATE/TIME  2-FEB-1993 18:15:45.55                                SYS_TYPE 02010101
SYSTEM UPTIME: 0 DAYS 01:47:45
SCS NODE: SIXSHL                                                  VAX/VMS T5.5-D34

INT60 ERROR  KA560  CPU FW REV# 2.  CONSOLE FW REV# 0.1

      REGISTER COUNT  00000028

Fault Summary Block ➊

      FAULT ID              19 ➋
                                       CPU/mem fault
      FAULT FLAG            02
                                       Solid error
      XLNK MODE ERROR       03
                                       Duplex
      XLNK MODE AFTER       02
                                       Master ➌

FRU Information Block

      FRU TYPE        00000004
                                       Module in zone B ➍
      FRU DATA        00000001
                                       CPU in slot 0

Deconfiguration Information

      FLT FLGS BEFORE 33003301
                                       Full configuration active
                                       Zone A CPU present
                                       Zone B CPU present
                                       Zone A I/O present
                                       Zone B I/O present
                                       Zone A CPU in use
                                       Zone B CPU in use
                                       Zone A I/O in use
                                       Zone A I/O in use
      FLT FLGS AFTER  33003301
                                       Full configuration active
                                       Zone A CPU present
                                       Zone B CPU present
                                       Zone A I/O present
                                       Zone B I/O present
                                       Zone A CPU in use
                                       Zone B CPU in use
                                       Zone A I/O in use
                                       Zone A I/O in use
      DECONFIG INFO   00000008
                                       Zone B cpu removed from service ➎
      DECONFIG MODULE 00000001
                                       CPU in slot 0 removed from service

Threshold Information Block
```

```
      THRESHOLD INTER.0000A8C0
                                       THRESHOLD INTER. SECONDS = 43200.
      THRESHOLD COUNT 00000001
                                       THRESHOLD COUNT = 1.
      THRESHOLD LIMIT 00000003
                                       THRESHOLD LIMIT = 3.
      THRESHOLD ZEROED0000190E
                                       THRESHOLD ZEROED SECONDS = 6414.
      THRESHOLD TOTAL 00000001
                                       THRESHOLD TOTAL = 1.
```

Fault Data Block ❻

```
      SYSTEM ERROR          19
      SYSFLT          30020010
                                       I/O error, zone A
                                       CPU/memory fault, zone B
                                       XLINK MODE = Duplex
      SYSADR          61200034
                                       SYSADR = 61200034(X)
      DMAADR          0269BC00
                                       DMAADR = 0269BC00(X)
      DMA Address Register Invalid
      JCSR_A CTL/STAT 00000088
                                       System errors enabled
                                       Bcache on
      JCSR_B Register Invalid
      DIAG_P_A REG    CAC00000
                                       DMA most error (non-crc)
                                       Burn-in mode
                                       I/O divide = 6
                                       CPU divide = A
      DIAG_M_A REG    CAC00000
                                       DMA most error (non-crc)
                                       Burn-in mode
                                       I/O divide = 6
                                       CPU divide = A
      DIAG_P_B Register Invalid
      DIAG_M_B Register Invalid
      ATMERR_A REG    00000000
                                       Zone ID = A
      ATMERR_B Register Invalid
      DMA STAT REG A  00000040
                                       CPU I/O error
      DMASTS_B Register Invalid
      MMBERR0_A REG   00000000
      MMBERR0_B Register Invalid
      MMBERR1_A REG   00000000
```

```
MMBERR1_B Register Invalid

SERCSR_A REG    00000080
                                Loopback request
                                Enable query interrupt
SERCSR_B Register Invalid

SERMODE_A REG   00200912
                                Master
                                Operating System is running ❼
                                Clock fault enable
                                Clock select 0 = Master, 1 = Slave
                                Halt source 0 = A, 1 = B
SERMODE_B Register Invalid

BIU_ADDR_A Register Invalid

BIU_ADDR_B Register Invalid

BIU_STAT_A Register Invalid

BIU_STAT_B Register Invalid

BIU_CTL_A Register Invalid

BIU_CTL_B Register Invalid
```

❶ This block reflects the content of the four fields of the Fault Summary Block.

❷ The FAULT ID, FAULT FLAG, FRU TYPE, and FRU DATA fields should always be reviewed. They will generally provide the most immediate FRU information.

❸ The system operating mode has been changed from Duplex to Degraded Duplex, with Zone A as the master.

❹ A solid error has been identified and the FRU removed from service. However, if the CPU has not exceeded its threshold and diagnostics pass, the CPU will be reconfigured into the system.

❺ At this point, the Zone B CPU has not been removed from service.

❻ The Zone B CPU is being removed from service due to the solid error and change in operating mode.

❼ OpenVMS is running in Zone A.

4.9.2 CPU/MEM Fault End Action Error Log Entry

```
V A X / V M S       SYSTEM ERROR REPORT        COMPILED  3-FEB-1993 09:33:46
                                                                   PAGE  56.

******************************* ENTRY     701. *******************************
ERROR SEQUENCE 1048.                          LOGGED ON:        SID 17000002
DATE/TIME  2-FEB-1993 18:16:21.40                           SYS_TYPE 02010101
SYSTEM UPTIME: 0 DAYS 01:48:21
SCS NODE: SIXSHL                                             VAX/VMS T5.5-D34

INT60 ERROR  KA560  CPU FW REV# 2.  CONSOLE FW REV# 0.1

      REGISTER COUNT  00000029

Fault Summary Block ❶

      FAULT ID              29
                                      CPU/mem fault end action ❷
      FAULT FLAG            0A
                                      Solid error
                                      Service is required ❸
      XLNK MODE ERROR       03
                                      Duplex
      XLNK MODE AFTER       02
                                      Master ❹

FRU Information Block

      FRU TYPE        00000004
                                      Module in zone B
      FRU DATA        00000001
                                      CPU in slot 0 ❺

Deconfiguration Information

      FLT FLGS BEFORE 33003301
                                      Full configuration active
                                      Zone A CPU present
                                      Zone B CPU present
                                      Zone A I/O present
                                      Zone B I/O present
                                      Zone A CPU in use
                                      Zone B CPU in use
                                      Zone A I/O in use
                                      Zone A I/O in use
      FLT FLGS AFTER  31003300
                                      Zone A CPU present
                                      Zone B CPU present
                                      Zone A I/O present
                                      Zone B I/O present
                                      Zone A CPU in use ❻
                                      Zone A I/O in use
                                      Zone A I/O in use
      DECONFIG INFO   00000008
                                      Zone B cpu removed from service
      DECONFIG MODULE 00000001
                                      CPU in slot 0 removed from service

Threshold Information Not Valid
```

```
Fault Data Block

      END ACTION              29
      SYSFLT            30020020
                                        I/O error, zone B
                                        CPU/memory fault, zone B
                                        XLINK MODE = Duplex
      SYSADR            61200034
                                        SYSADR = 61200034(X)
      CNTRL/STAT REG    00000008
                                        System errors enabled
      DIAG_P REG        CAC08000
                                        Memory double bit error
                                        DMA most error (non-crc)
                                        Burn-in mode
                                        I/O divide = 6
                                        CPU divide = A
      DIAG_M REG        CAC08000
                                        Memory double bit error
                                        DMA most error (non-crc)
                                        Burn-in mode
                                        I/O divide = 6
                                        CPU divide = A
      MMBERR0 REG       01010101
                                        MMB #3 double bit error ❼
      MMBERR1 REG       00000000
      ATMERR REG        40404040
                                        Zone ID = B
      DMA STAT REG      00000040
                                        CPU I/O error
      DMAADR            0269BC00
                                        DMAADR = 0269BC00(X)
      SERCSR REG        00000080
                                        Loopback request
                                        Enable query interrupt
      SERMODE REG       00002101
                                        Slave
                                        Clock fault enable
                                        Zone ID 0 = A, 1 = B
      PCADR             00000000
      SAVPSL REG        0000B039
                                        C-BIT
                                        N-BIT
                                        T-BIT
                                        INTEGER OVERFLOW TRAP ENABLE
                                        INTERRUPT PRIORITY LEVEL = 00.
                                        PREVIOUS MODE = KERNEL
                                        CURRENT MODE = KERNEL
                                        FIRST PART DONE CLEAR
      ECR               0000004A
                                        fbox enable
                                        fbox st4 bypass enable
                                        timeout clock
                                        pmf pmux   = 00
                                        pmf emux   = 00
```

```
      BIU CTL         DFE0DEF9
                                      Generate/Expect ECC on check_h pins
                                      output enable of cache rams
                                      direct mapped
                                      2X CPU Cycle
                                      IO Map = 1(X)
                                      512 Kbytes
      BC TAG          07913800
                                      tag_match
                                      tag control V
                                      tag control D
                                      tag P
                                      BC TAG = 03C8(X)
      BIU STAT        500E3070
                                      Bits 33,32 BIU Addr Reg = 1(X)
                                      Bits 33,32 Fill Addr Reg = 1(X)
      FILL SYN        00000000
                                      L0 ECC Syn bits Low Longword = 0(X)
                                      Hi ECC Syn bits High Longword = 0(X)
      FILL ADDR       000002A8
                                      FILL ADDR = 000002A8(X)
      VMAR            000007E0
                                      Sub Block Select = 0(X)
                                      Row Index = 3F(X)
                                      Error Address Field = 00000000(X)
      ICSR            00000001
                                      enable VIC
      TBADR           00000000
      TBSTS           00000000
                                      s5 cmd corresp to tb perr  = 00
                                      source of ref causing tb perr  = 00
      PCSTS           00000000
                                      PCSTS.LOCK(0) NOT SET
      PCCTL           00000000
                                      Performance Monitor Mode = 0(X)
      COMPAT/STAT REG 00006008
                                      ATM self test failed
                                      ATM ID EEPROM is bad
                                      ATM ID EEPROM has bad os status
      DIAG STATUS REG 00000000
                                      Register is not "VALID"
```

❶ This block reflects the content of the four fields of the Fault Summary Block.

❷ This entry type (end action) is provided after diagnostics have completed running on a zone or CPU which has been removed from service as a result of a system error.

This is the end action for the previous example (CPU/MEM Fault Error Log Entry).

❸ This message specifies that a physical FRU replacement is required.

❹ The system operating mode has been changed from Duplex to Degraded Duplex with Zone A as the master.

❺ The FRU may be one of five items: CPU module, or one of the four MMBs.

❻ The Zone B CPU has been removed from service.

❼ Double-bit errors are always treated as solid faults. The failed CPU will not be reconfigured until Zone B memory is repaired. MMB 3 is the most likely FRU.

4.9.3 CPU or Zone Unsynchable Error Log Entry

```
V A X / V M S       SYSTEM ERROR REPORT       COMPILED  3-FEB-1993 09:33:46
                                                                  PAGE  56.

******************************* ENTRY     743. *******************************
ERROR SEQUENCE 1099.                           LOGGED ON:        SID 17000002
DATE/TIME  2-FEB-1993 18:16:21.40                          SYS_TYPE 02010101
SYSTEM UPTIME: 0 DAYS 01:48:21
SCS NODE: SIXSHL                                             VAX/VMS T5.5-D34

INT60 ERROR  KA560  CPU FW REV# 2.  CONSOLE FW REV# 0.1

      REGISTER COUNT  0000000E

Fault Summary Block ❶

      FAULT ID              60
                                      CPU or zone unsynchable
      FAULT FLAG            0A
                                      Solid error
                                      Service is required
      XLNK MODE ERROR       02
                                      Master
      XLNK MODE AFTER       02
                                      Master ❷

FRU Information Block

      FRU TYPE        00000004
                                      Module in zone B
      FRU DATA        00000001
                                      CPU in slot 0

Deconfiguration Information

      FLT FLGS BEFORE 31003300
                                      Zone A CPU present
                                      Zone B CPU present
                                      Zone A I/O present
                                      Zone B I/O present
                                      Zone A CPU in use ❸
                                      Zone A I/O in use
                                      Zone A I/O in use
      FLT FLGS AFTER  31003301
                                      Zone A CPU present
                                      Zone B CPU present
                                      Zone A I/O present
                                      Zone A CPU in use
                                      Zone A I/O in use
                                      Zone A I/O in use
      DECONFIG INFO   00000008
                                      Zone B cpu removed from service ❹
      DECONFIG MODULE 00000001
                                      CPU in slot 0 removed from service

Threshold Information Not Valid

Fault Data Block
```

```
CUP or ZONE UNSYNCHABLE EVENTS

COMPAR/STAT REG 02000000
                                CPU is in burnin mode
DIAG STATUS REG FFFFFFFF
                                Diagnostic status is valid
DIAG ERR NUM          FF
                                DIAG ERR NUM = 255
DIAG SUBTEST NUM      FF
                                DIAG SUBTEST NUM = 255
DIAG TEST NUM         FF
                                DIAG TEST NUM = 255
DIAG GROUP NUM        0F
                                DIAG GROUP NUM = 15.
                                Diag Flag = 7(X)
```

❶ This block reflects the content of the four fields of the Fault Summary Block.

❷ The system was unable to synchronize and reach Duplex mode. Consequently, the before and after XLINK_MODE fields (Fault Summary Block) reflect Degraded Duplex mode.

❸ Since the Zone B CPU was unsynchable, it is not in use.

❹ The Zone B CPU was removed from service, and will remain out of service until it is repaired.

5

FRU Removal and Replacement Procedures

5.1 In This Chapter

This chapter includes:

- Field replaceable unit list
- Before you begin
- FRU removal and replacement

5.2 Field Replaceable Unit List

A complete list of field replaceable units (FRUs) is given in Table 5–1.

Table 5–1 Model 810 FRUs

FRU	Part Number
Modules:	
CPU	54-21075-01
Memory mother board (MMB)	54-21085-01
Single-sided SIMMs (4 Mbytes per SIMM)	54-21139-CA
Double-sided SIMMs (8 Mbytes per SIMM)	54-21139-DA
I/O attachment module (ATM)	54-21083-01
Zone control panel	54-22130-01
Fan current sense board (FCSB)	54-22126-01
Console extender module	54-21067-01
Cross-link assembly	70-03710-01
Fan	12-27848-01
Power:	
AC front end unit (FEU)	H7884-AA
5V regulator (DC5)	H7179-AA
3.3V regulator (DC3)	H7178-AA
Power system controller (PSC)	H7851-AA
Domestic power distribution box	BA22J-AE
International power distribution box	BA22J-AJ

(continued on next page)

Table 5–1 (Cont.) Model 810 FRUs

FRU	Part Number
Control and miscellaneous power module (CAMP)	54-21073-01
Options:	
Ethernet interface module (EIM)	54-21081-01
DSSI extender module	54-21063-01
DSSI interface module (DIM)	54-21065-01
DSSI disk drawer assembly	70-30569-01
Storage:	
18.2 Gbyte magazine tape subsystem	TF857-AA/AB
2.6 Gbyte cartridge tape drive	TF85C-BA
2 Gbyte disk drive	RF73-EA
852 Mbyte disk drive	RF35-EA
2.6 Gbyte cartridge tabletop tape drive	TF85-TA
Cable kit for the TF85-TA drive	CK-KDXDA-BA
4 Gbyte half-rack storage array with two RF73 drives and one SF73-HK assembly	
1.7 Gbyte half-rack storage array with two SF35 drives and one SF35-HK assembly	
Cables:	
DIM to storage device with terminator (84 inches)	17-03537-03
DIM to storage device with terminator (62 inches)	17-03537-02
DIM to storage device with terminator (24 inches)	17-03537-01
Fan to fan tray	17-03514-01
Fan tray to FCSB	17-03513-01
FCSB to centerplane	17-03512-01
VT420 to UPS (power cable)	17-00442-17
Zone control panel to centerplane	17-01148-03
DSSI disk drawer to centerplane	17-03805-01
DSSI disk drawer power/signal to centerplane	17-03806-01

5.3 Before You Begin

Warning

Hazadous voltages exist within the system. Bodily injury or equipment damage can result when service procedures are performed incorrectly.

Note

FRUs should be handled only by qualified maintenance personnel.

You do not need to shut down the entire system to remove and replace a FRU. You can shut down the zone that houses the faulty FRU while the other zone continues to operate. Section 5.3.2 explains how to shut down a zone.

There are two types of FRU removal and replacement procedures:

- Cold swaps
- Warm swaps

During a cold swap, you shut down the zone that houses the faulty FRU while the operating system continues to run in the other zone. FRUs that require cold swaps include:

Logic modules
Fan modules
Power supplies
DIM modules
EIM modules
Zone control panel

During a warm swap, the power remains on in both zones. The operating system continues to run in both zones while the faulty FRU is replaced. FRUs that allow a warm swap include:

RF35 disk drives
RF73 disk drives
SF35 disk drives
SF73 disk drives
TF85 tape drives
TF857 tape subsystems
DSSI disk drawer assemblies

Chapter 6 explains how to perform a warm swap procedure.

5.3.1 Handling FRUs

Static electricity can damage FRUs. When you handle FRUs, follow the rules in Table 5–2.

Table 5–2 Handling FRUs

Rule	Action
1	Wear an electrostatic discharge (ESD) wrist strap.
2	When possible, use a grounded ESD workmat.
3	Attach both the wrist strap and the workmat to the system chassis.
4	Before you remove the FRU from the antistatic box, be sure you ground the box to the system chassis.
5	Wear an ESD wrist strap when you remove the FRU from the antistatic box.
6	Ask the operator or system manager to shut down the zone you will be working in.

5.3.2 Shutting Down a Zone

Typically, the shutdown is performed by the operator or the system manager.

1. Enter the SHOW ZONE command to see the status of each zone.
   - Active — The zone is running.
   - Stopped — The zone is not running the operating system. It may be running diagnostics or is available for synchronizing.
   - Absent — The zone is not available.
   - Synchronizing — The zone is synchronizing with the other zone.
   - Providing I/O only — The zone has detected a CPU/MEM fault, and has placed the CPU and memory off line.
2. Enter the STOP/ZONE *zone-id* command.
3. At the zone control panel (A or B), simultaneously press both Logic Power - OFF switches to remove logic power from the zone.

Note

Pressing the Logic Power - OFF switches does not affect the fan or the expansion cabinet power unless the drives (disk or tape) are turned off. If the drives are turned off, the fan will run for about 30 seconds after you press the switches.

Example 5–1 How to Shut Down a Zone

```
$ SHOW ZONE                          ! Displays the status of each zone.
  Zone A is ACTIVE                   ! Zone A is running.
  Zone B is PROVIDING I/O ONLY       ! Zone B has a faulty component.
$ STOP/ZONE B                        ! Stops zone B.
```

At the console terminal of the zone that continues to run (in this case, zone A), the OPCOM messages show that zone synchronization has been lost and virtual circuits are closed.

5.3.3 Verifying Zone Shutdown

The SHOW ZONE command may be used to verify that the STOP/ZONE *zone-id* command was successful.

Example 5–2 How to Verify Zone Shutdown

```
$ SHOW ZONE                          ! Displays the status of each zone.
  Zone A is ACTIVE                   ! Zone A is running.
  Zone B is ABSENT                   ! Zone B has been shut down.
```

5.3.4 Starting Up a Zone

Typically, the startup is performed by the operator or the system manager.

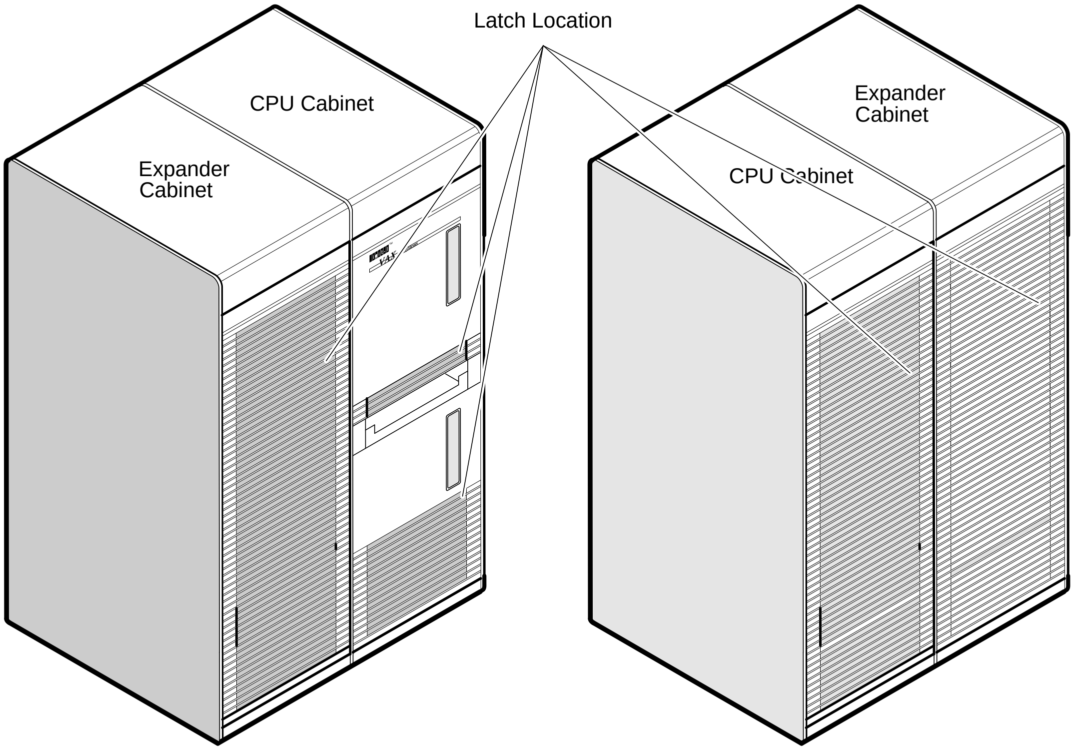
1. At the zone control panel (A or B), press the Logic Power - ON switch.
2. Enter the SHOW ZONE command to verify that the zone is shut down.
3. Enter the START/ZONE command to start up the zone.

5.3.5 Accessing the FRUs

Figure 5–1 shows the latches at the front and rear of the system. To open a door, pull the latch.

The electrostatic discharge (ESD) kit and module extraction tool are located inside the rear door of the CPU cabinet.

Figure 5–1 Latches



5.4 FRU Removal and Replacement

The following sections contain FRU removal and replacement procedures.

Caution

Service procedures may be performed only by qualified personnel. They must be familiar with ESD procedures and power procedures for the Model 810 system. Excessive shock or incorrect handling can damage the logic modules.

Note

When specific replacement procedures are not given, replace the FRU by reversing the steps in the removal procedure.

5.4.1 CPU and ATM Modules

You use the same steps to remove the CPU and ATM modules. Figure 5–2 shows the locations of the modules. Table 5–3 describes the removal procedure.

Figure 5–2 CPU Module and ATM Module Locations

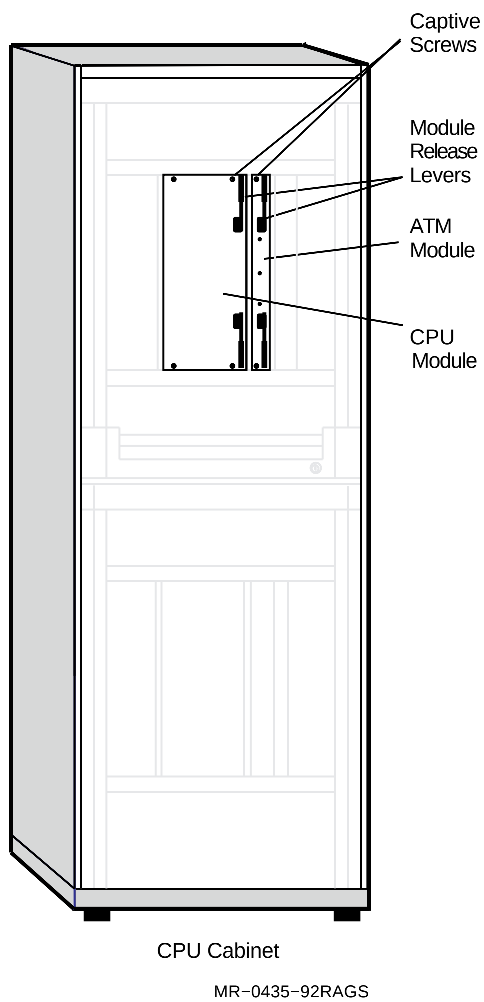


Table 5–3 CPU Module and ATM Module Removal Procedure

Step	Action
1	Ask the operator or system manager to shut down the zone using the procedure in Section 5.3.2.
2	Open the front door of the cabinet.
3	Loosen the captive screws on the module. The CPU module has four captive screws; the ATM module has two captive screws.
4	Open the module release levers and slide the module out.

5.4.2 SIMMs

Figure 5–3 shows the locations of the SIMMs. Table 5–4 describes the removal procedure.

Note

SIMMs are configured on the MMBs in rows, with a pair of SIMMs (two) in each row. You always replace a pair of SIMMs (a two-SIMM row).

Figure 5–3 SIMM Locations

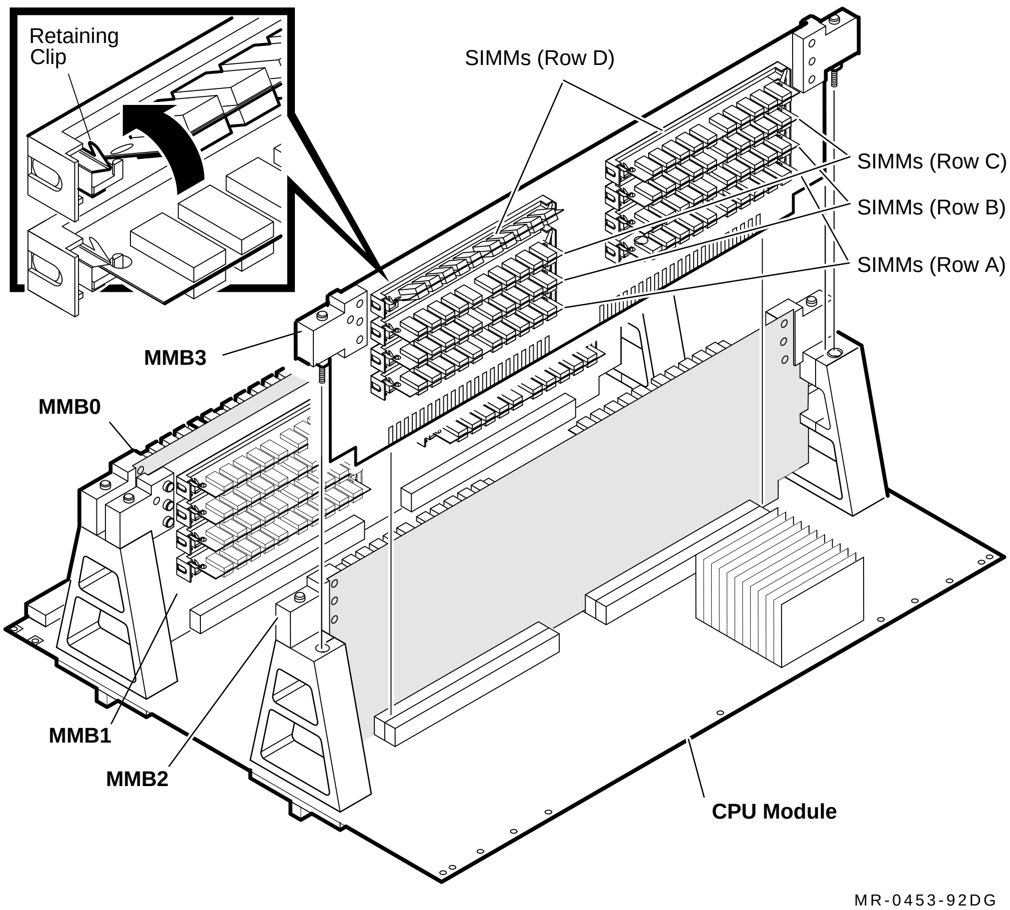


Table 5–4 SIMM Removal Procedure

Step	Action
1	Ask the operator or system manager to shut down the zone using the procedure in Section 5.3.2.
2	Open the front door of the cabinet.
3	Remove the CPU module using the procedure in Table 5–3.
4	Press the two retaining clips until the SIMM pops up at a 45-degree angle.
5	Remove the pair of SIMMs (a two-SIMM row) from the MMB.

5.4.3 MMBs

Figure 5–4 shows the locations of the MMBs. Table 5–5 describes the removal procedure.

Figure 5–4 MMB Locations

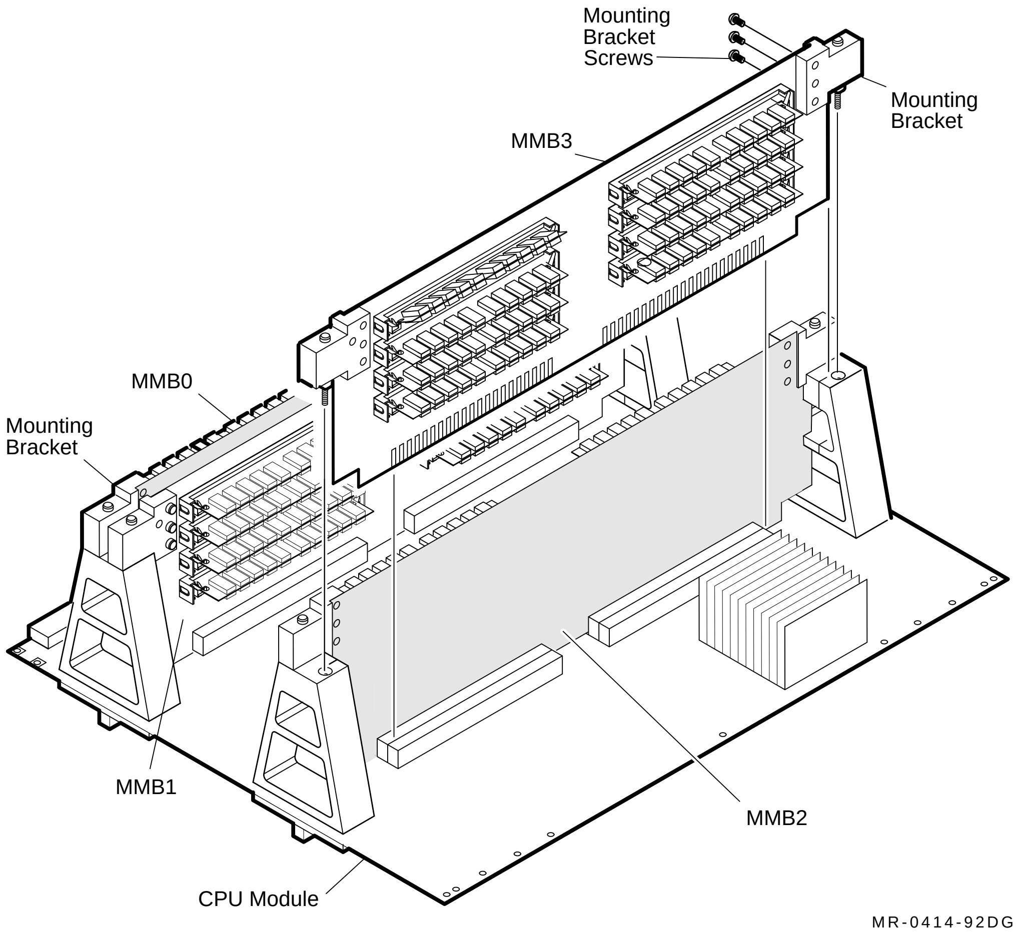


Table 5–5 MMB Removal Procedure

Step	Action
1	Ask the operator or system manager to shut down the zone using the procedure in Section 5.3.2.
2	Open the front door of the cabinet.
3	Remove the CPU module using the procedure in Table 5–3.
4	The MMBs are tension mounted on the CPU module with two screws. These screws are located on the MMB mounting brackets. Loosen one screw by turning it two or three times. Then loosen the other screw the same way. Alternate between the two screws until the MMB is free from the CPU module.

(continued on next page)

Table 5–5 (Cont.) MMB Removal Procedure

Step	Action
5	Remove the three screws that secure each of the mounting brackets on the MMB.
6	Note the configuration of the SIMMs on the MMB. They must be removed from the faulty MMB and installed in the same locations on the replacement MMB.
7	Remove the SIMMs from the MMB using the procedure in Table 5–4.

5.4.4 Fan and FCSB

Figure 5–5 shows the location of the fan. Figure 5–6 shows the location of the FCSB. Table 5–6 describes the removal procedure.

Figure 5–5 Fan Location

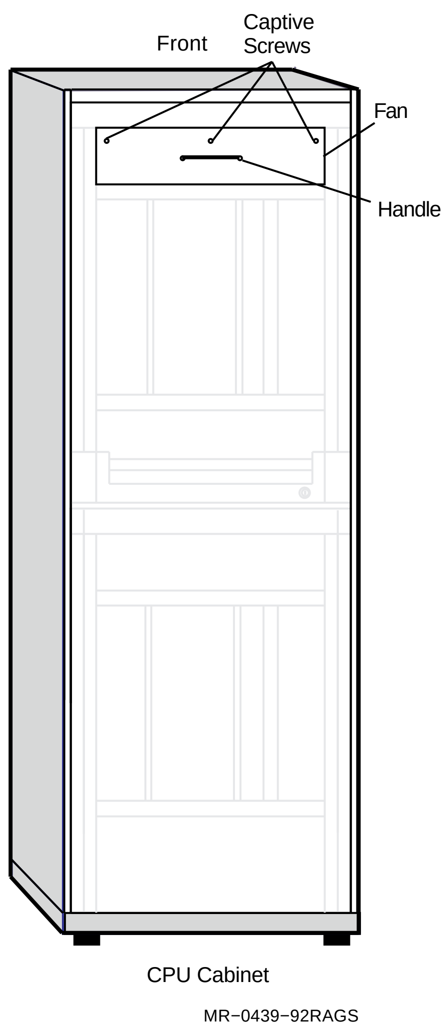
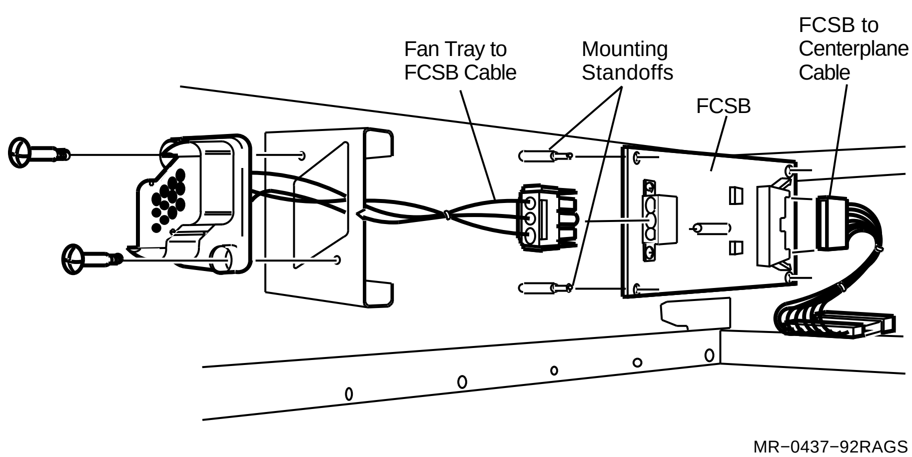


Table 5–6 Fan and FCSB Removal Procedure

Step	Action
1	Ask the operator or system manager to shut down the zone using the procedure in Section 5.3.2.
2	Open the rear door of the cabinet.
3	Set the FEU circuit breaker to the off position.
4	Open the front door of the cabinet.
5	Loosen the three captive screws that secure the fan in the CPU cabinet.
6	Grasp the handle and pull the fan out of the cabinet.
7	Locate the FCSB inside the fan assembly.
8	Disconnect the FCSB from the fan tray to FCSB cable. See Figure 5–6.
9	Disconnect the FCSB from the FCSB to centerplane cable. See Figure 5–6.
10	Remove the FCSB from the four mounting standoffs. See Figure 5–6.

Figure 5–6 FCSB Location



5.4.5 RF35 Disk Drive Removal and Replacement

Figure 5–7 shows an RF35 disk drive in the DSSI disk drawer. Table 5–7 describes the RF35 disk drive removal procedure.

Figure 5–7 RF35 Disk Drive Location

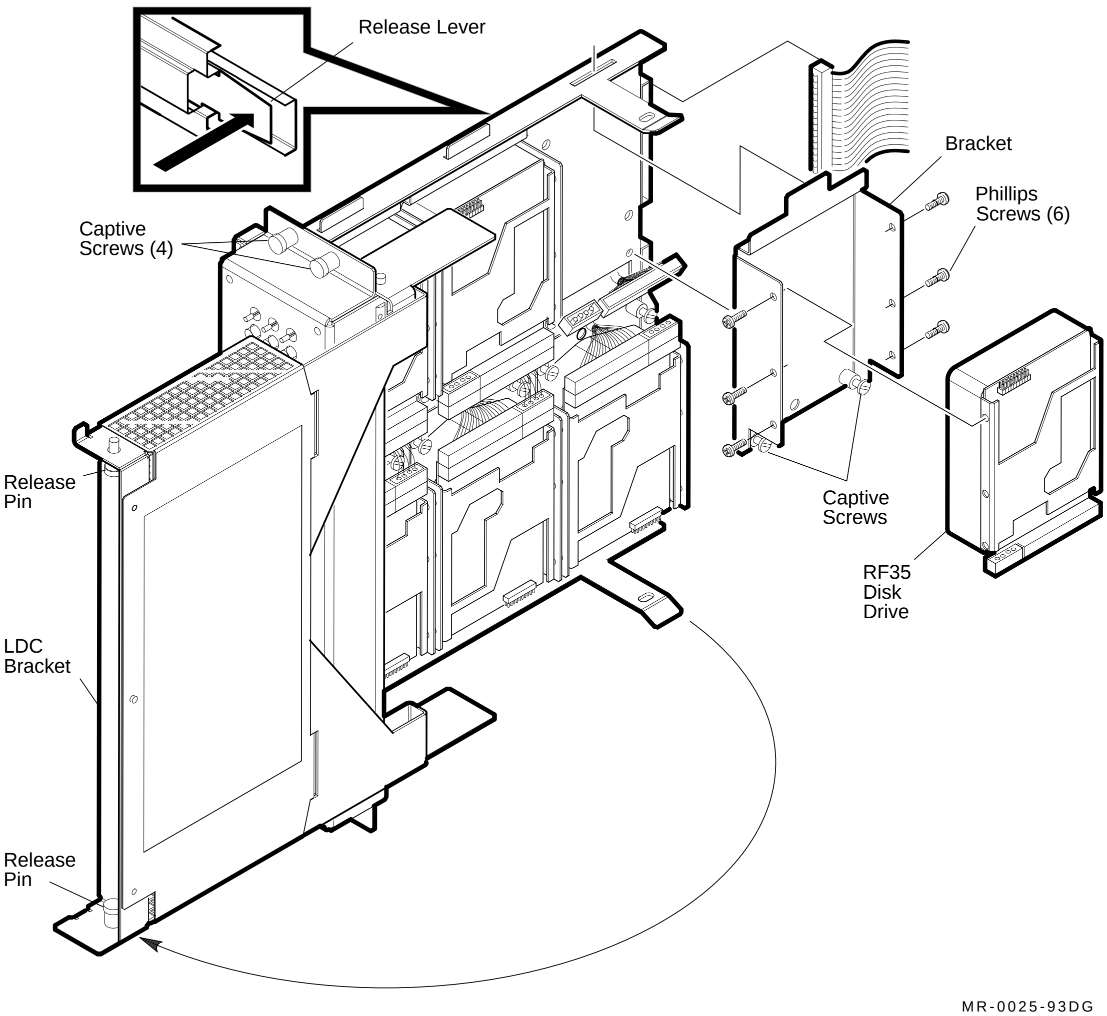


Table 5–7 RF35 Disk Drive Removal Procedure

Step	Action
1	Ask the operator or system manager to shut down the zone using the procedure in Section 5.3.2.
2	Open the front door of the cabinet.
3	Turn off the RF35 disk drive.
4	Loosen the four screws that secure the DSSI disk drive rack in the CPU cabinet.
5	Pull the DSSI disk drive rack out until it locks in place.
6	Swing the LDC bracket out until you can see the disk drives. See Figure 5–7.
7	Label the DSSI, power, and disk signal cables, and disconnect them from the RF35 drive you are removing.
8	Loosen the captive screws at the bottom of the drive.
9	Remove the drive and bracket.
10	Remove the six Phillips screws that secure the bracket on the drive.

5.4.6 DSSI Disk Drawer

Figure 5–7 shows the components in the DSSI disk drawer. Table 5–8 describes the DSSI disk drawer removal procedure.

Table 5–8 DSSI Disk Drawer Removal Procedure

Step	Action
1	Ask the operator or system manager to dismount the drive.
2	Open the rear door of the cabinet.
3	Set the FEU circuit breaker to the off position.
4	Open the front door of the cabinet.
5	Turn off all the RF35 disk drives.
6	Loosen the four screws that secure the DSSI disk drive rack in the CPU cabinet.
7	Pull the DSSI disk drive rack out until it locks in place.
8	Swing the LDC bracket out until you can see the disk drives. See Figure 5–7.
9	Label each of the RF35 disk drives.[1]
10	Label the DSSI, power, and disk signal cables, and disconnect them from each of the RF35 drives.
11	Loosen the captive screws at the bottom of each of the drives.
12	Remove all the drives from the DSSI disk drawer.
13	At the rear of the DSSI disk drawer, label the two DSSI cables and the power cable. Then disconnect them.
14	Press the release lever on the left side of the DSSI disk drawer and slide the drawer out of the cabinet.

[1]Label each drive before you remove it. The RF35 disk drives must be removed from the DSSI disk drawer and installed in the same locations in the replacement DSSI disk drawer.

5.4.7 Zone Control Panel

Figure 5–8 shows the zone control panel. Table 5–9 describes the removal procedure.

Figure 5–8 Zone Control Panel

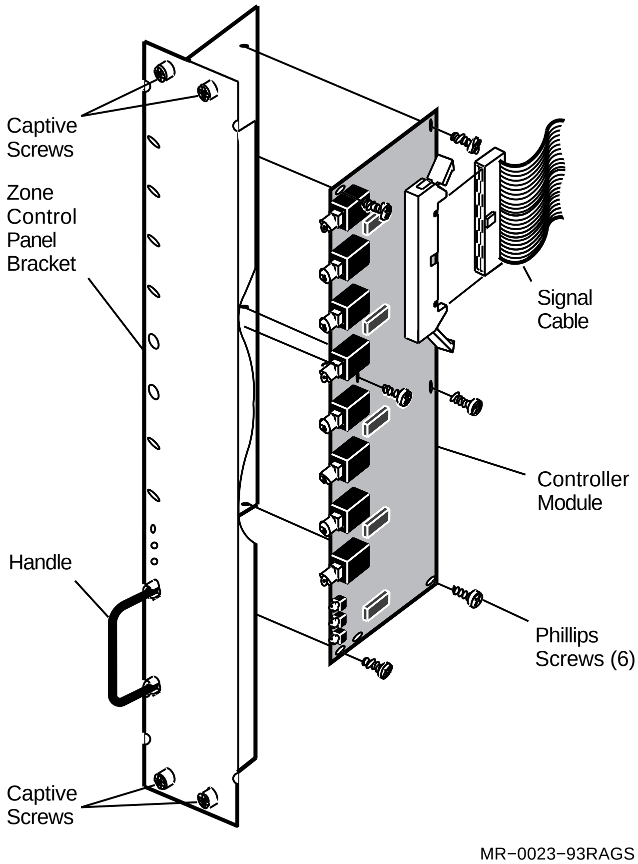


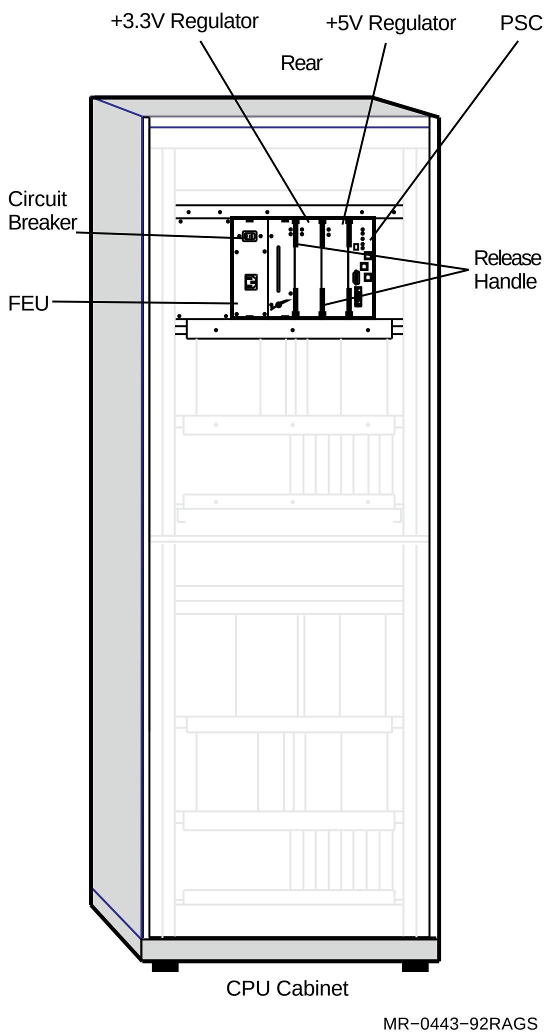
Table 5–9 Zone Control Panel Removal Procedure

Step	Action
1	Ask the operator or system manager to shut down the zone using the procedure in Section 5.3.2.
2	Open the front door of the cabinet.
3	Loosen the four captive screws that secure the zone control panel on the cabinet.
4	Grasp the handle and pull the zone control panel out until you can access the controller module signal cable.
5	Disconnect the signal cable from the controller module.
6	Remove the six Phillips screws that secure the controller module on the zone control panel bracket.

5.4.8 FEU, 3.3V Regulator, 5V Regulator, PSC Modules

You use the same steps to remove these four FRUs. Figure 5–9 shows the locations of the modules. Table 5–10 describes the removal procedure.

Figure 5–9 FEU, 3.3V Regulator, 5V Regulator, and PSC Locations



Caution

Removing/replacing these four modules without shutting down 48V_DRCT may cause damage to the power components.

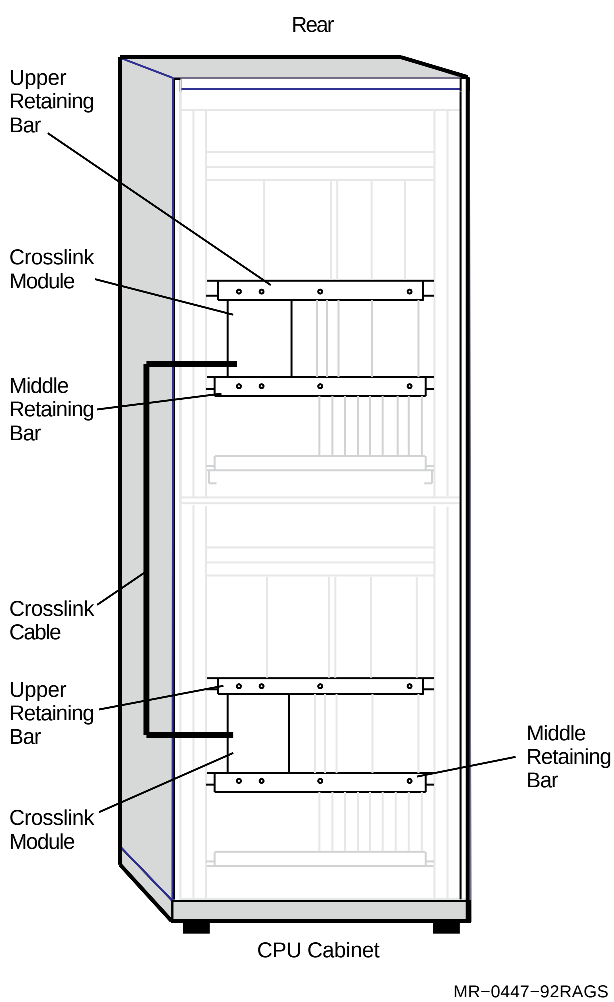
Table 5–10 FEU, 3.3V Regulator, 5V Regulator, and PSC Removal Procedure

Step	Action
1	Ask the operator or system manager to shut down the zone using the procedure in Section 5.3.2.
2	Open the rear door of the cabinet.
3	Set the FEU circuit breaker to the off position.
4	If you are removing the FEU, disconnect the ac power cable from the FEU.
5	Loosen the screws that secure the module in the cabinet. The FEU is secured with four screws. The 3.3V regulator, 5V regulator, and PSC are secured with two screws.
6	Grasp the module release handles and pull the power module out of the cabinet.

5.4.9 Cross-Link Assembly

Figure 5–10 shows the location of the cross-link assembly. Table 5–11 describes the removal procedure. Figure 5–11 shows you how to use the module extraction tool.

Figure 5–10 Cross-Link Assembly



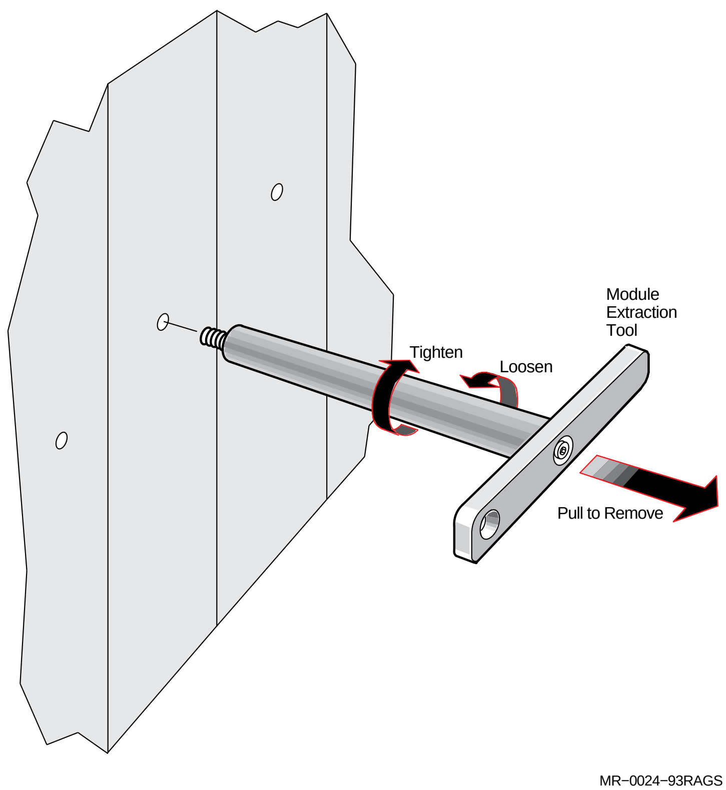
Note

The cross-link assembly consists of two cross-link modules (one per zone) and one cross-link cable. These three parts are considered to be one FRU.

Table 5–11 Cross-Link Assembly Removal Procedure

Step	Action
1	Ask the operator or system manager to shut down the zone using the procedure in Section 5.3.2.
2	Open the rear door of the cabinet.
3	Remove the four screws from the upper retaining bar.
4	Remove the four screws from the middle retaining bar.
5	Insert the module extraction tool into the hole in the cross-link module. Turn the module extraction tool to the right until it is fastened to the module. See Figure 5–11.
6	Pull the cross-link module out of the cabinet.
7	Repeat steps 3 through 6 for the other zone.

Figure 5–11 Module Extraction Tool



5.4.10 Console Extender Module

Figure 5–12 shows the location of the console extender module. Figure 5–13 shows the layout of the console extender module. Table 5–12 describes the removal procedure.

Figure 5–12 Console Extender Module Location

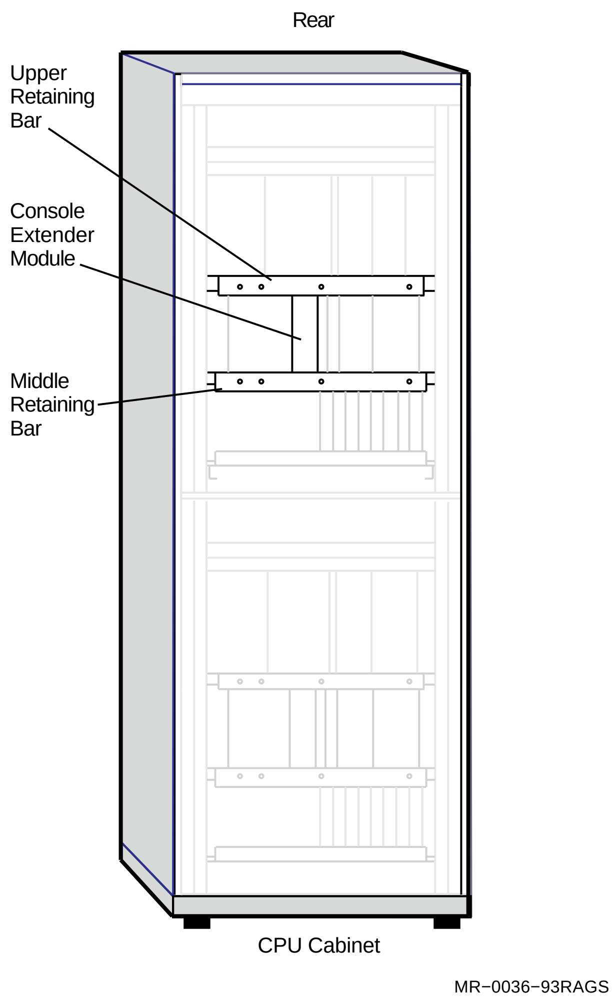
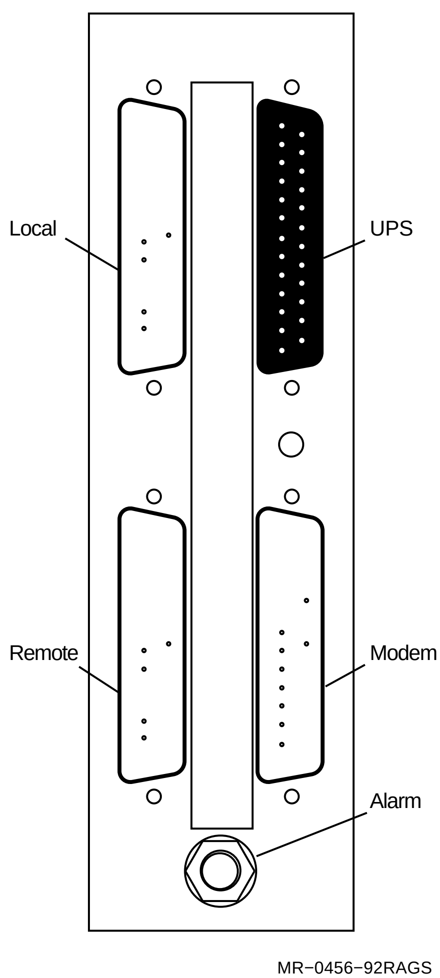


Table 5–12 Console Extender Module Removal Procedure

Step	Action
1	Ask the operator or system manager to shut down the zone using the procedure in Section 5.3.2.
2	Open the rear door of the cabinet.
3	Remove the four screws from the upper retaining bar.
4	Remove the four screws from the middle retaining bar.
5	Turn off any devices connected to the console extender module.
6	Label any cables connected to the console extender module. Then disconnect them. See Figure 5–13.
7	Insert the module extraction tool into the hole in the console extender module. Turn the tool to the right until it is fastened to the module. See Figure 5–11.
8	Pull the console extender module out of the cabinet.

Figure 5–13 Console Extender Module Layout



5.4.11 DSSI Extender Module

Figure 5–14 shows the locations of the DSSI extender modules. Table 5–13 describes the removal procedure.

Figure 5–14 DSSI Extender Module Locations

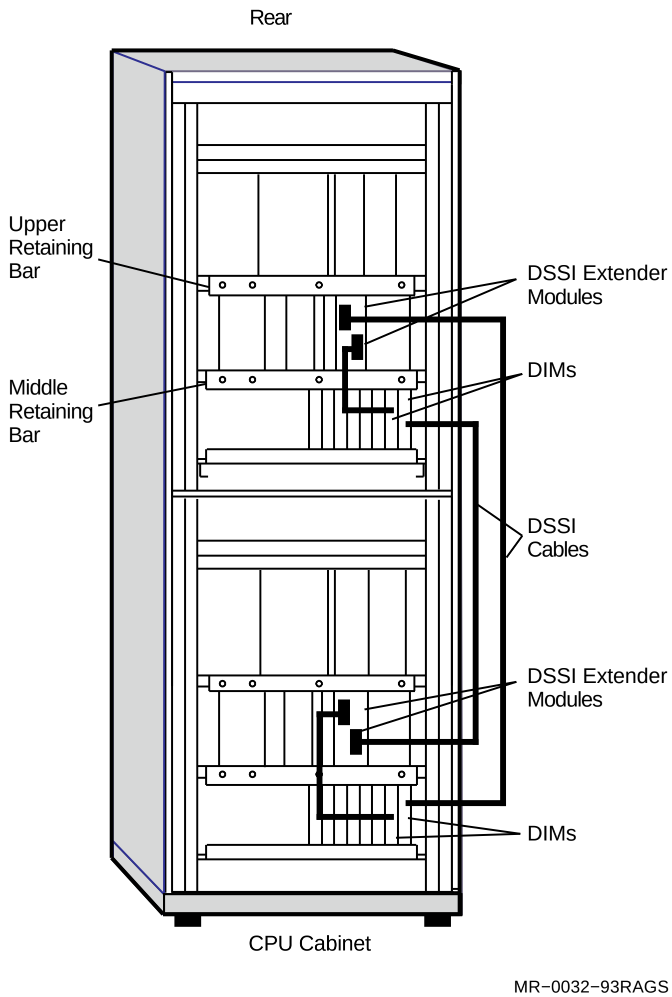


Table 5–13 DSSI Extender Module Removal Procedure

Step	Action
1	Ask the operator or system manager to shut down the zone using the procedure in Section 5.3.2.
2	Open the rear door of the cabinet.
3	Remove the four screws from the upper retaining bar.
4	Remove the four screws from the middle retaining bar.
5	Turn off all the devices connected to the console extender module.
6	Label the two DSSI cables and disconnect them from the module. See Figure 5–14.
7	Insert the module extraction tool into the hole in the DSSI extender module. Turn the tool to the right until it is fastened to the module. See Figure 5–11.
8	Pull the DSSI extender module out of the cabinet.

5.4.12 CAMP Module

Figure 5–15 shows the locations of the CAMP modules. Table 5–14 describes the removal procedure.

Caution

Removing/replacing the CAMP module without shutting down 48V_DRCT may cause damage to the CAMP module.

Figure 5–15 CAMP Module Locations

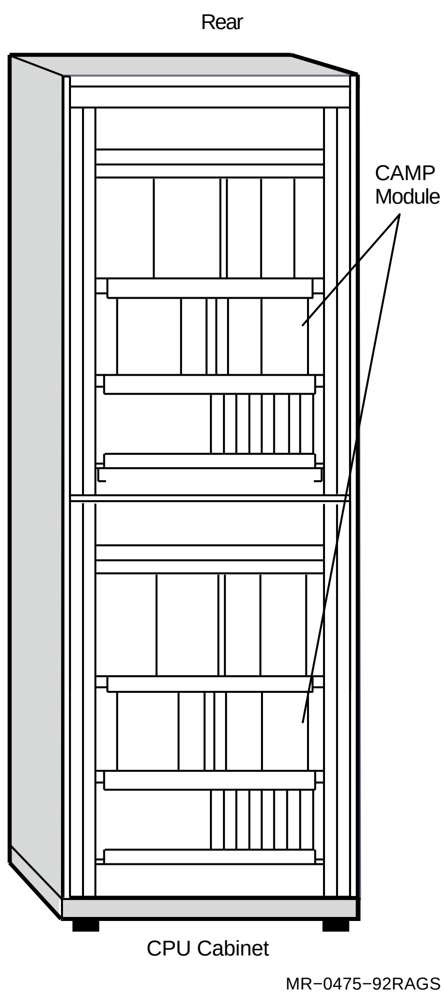


Table 5–14 CAMP Module Removal Procedure

Step	Action
1	Ask the operator or system manager to shut down the zone using the procedure in Section 5.3.2.
2	Open the rear door of the cabinet.
3	Set the FEU circuit breaker to the off position.
4	Remove the four screws from the upper retaining bar.
5	Remove the four screws from the middle retaining bar.
6	Turn off all the devices connected to the CAMP module.
7	Insert the module extraction tool into the hole in the CAMP module. Turn the tool to the right until it is fastened to the module. See Figure 5–11.
8	Pull the CAMP module out of the cabinet.

5.4.13 DSSI Interface Module (DIM)

Figure 5–16 shows the location of the interface logic modules. Figure 5–17 shows how to remove the DIMs. Table 5–15 describes the removal procedure.

Figure 5–16 DIM Location

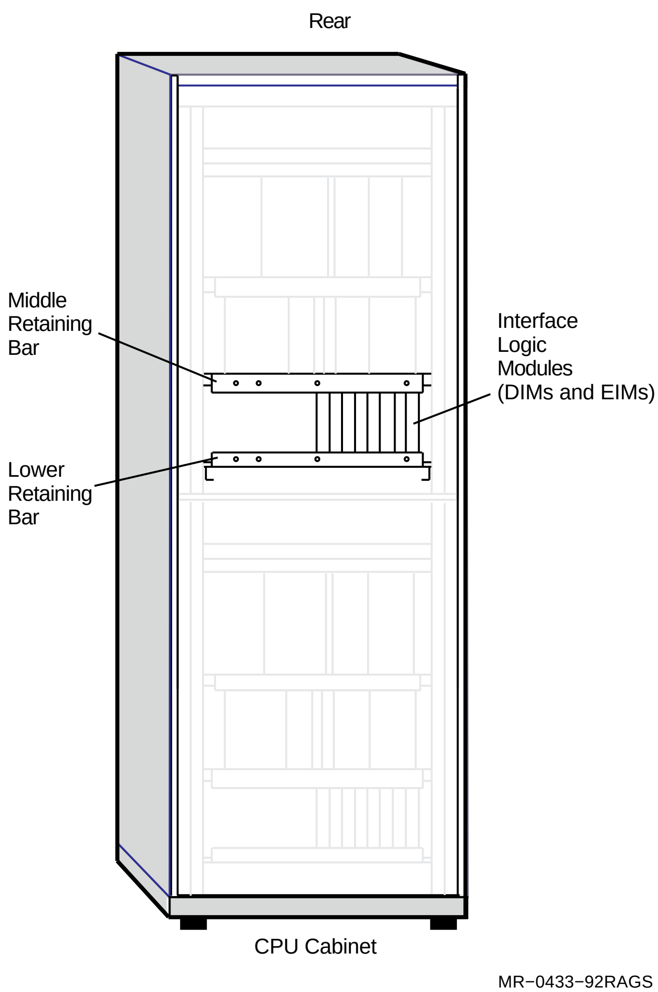


Figure 5–17 DIM Removal

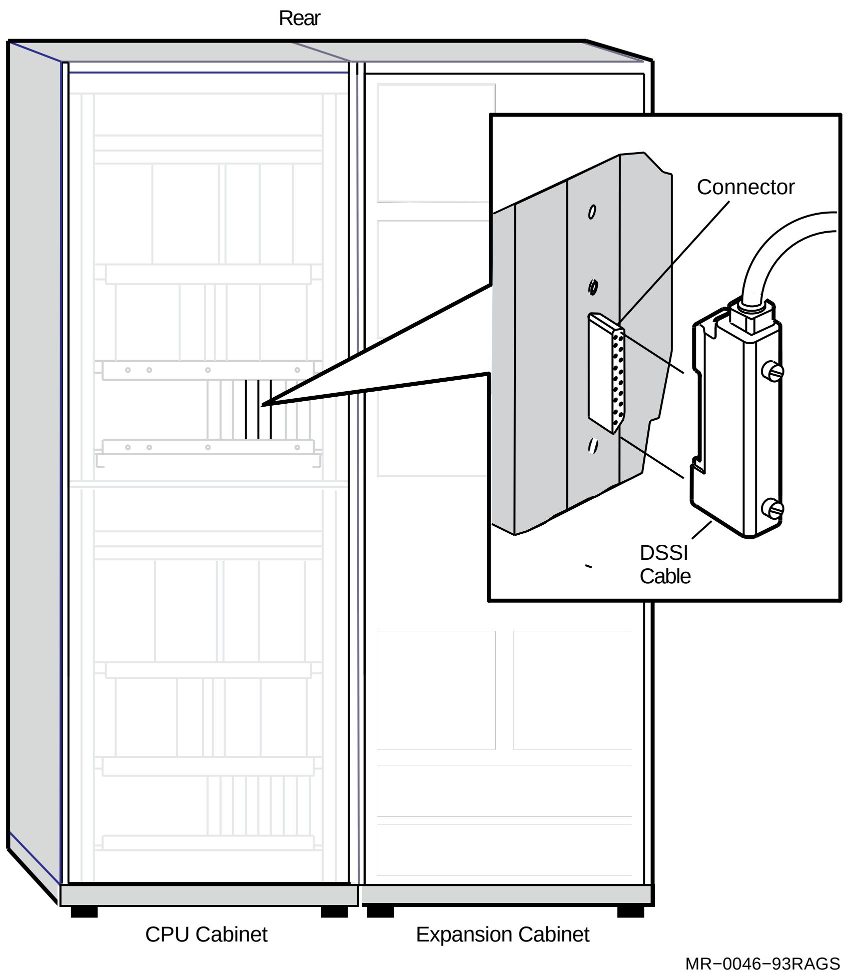


Table 5–15 DIM Removal Procedure

Step	Action
1	Ask the operator or system manager to shut down the zone using the procedure in Section 5.3.2.
2	Open the rear door of the cabinet.
3	Remove the four screws from the middle retaining bar.
4	Remove the four screws from the lower retaining bar.
5	Turn off all the devices connected to the DIM you are removing.
6	Disconnect the DSSI cable from the DIM by loosening the two thumb screws. See Figure 5–17.
7	Insert the module extraction tool into the hole in the DIM. Turn the tool to the right until it is fastened to the module. See Figure 5–11.
8	Pull the DIM out of the cabinet.

5.4.14 Ethernet Interface Module (EIM)

Figure 5–16 shows the location of the interface logic modules. Figure 5–18 shows how to remove the EIMs. Table 5–16 describes the removal procedure.

Figure 5–18 EIM Removal

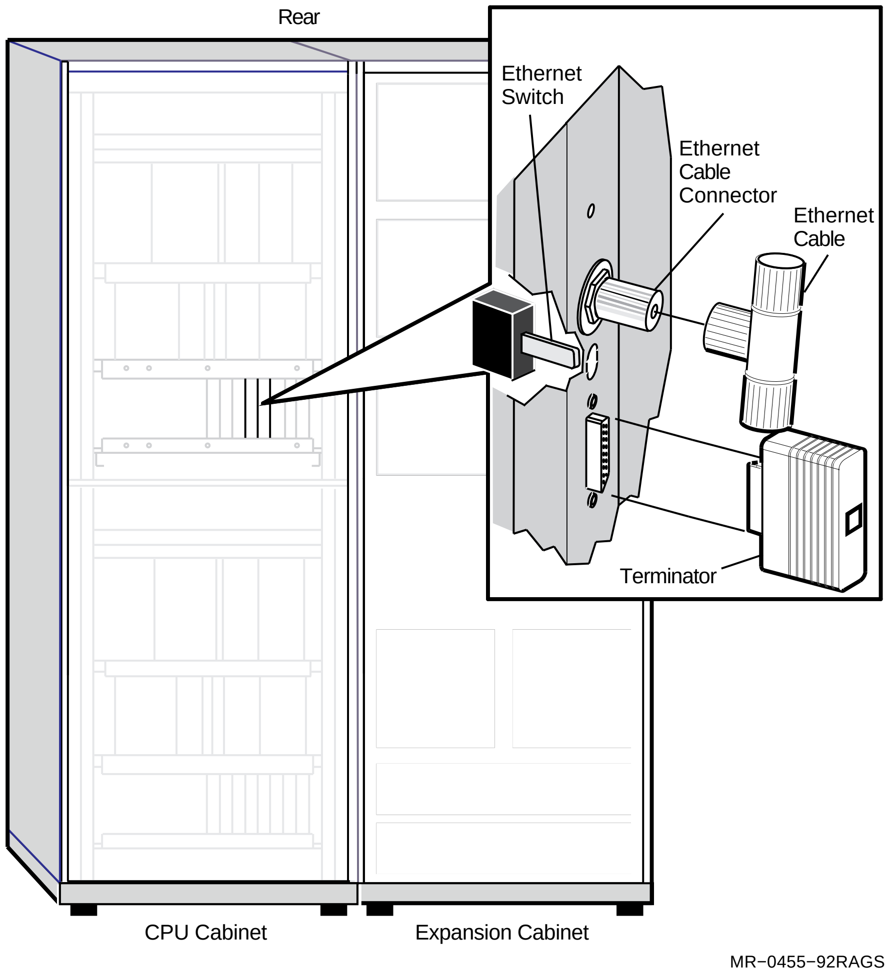


Table 5–16 EIM Removal Procedure

Step	Action
1	Ask the operator or system manager to shut down the zone using the procedure in Section 5.3.2.
2	Open the rear door of the cabinet.
3	Remove the four screws from the middle retaining bar.
4	Remove the four screws from the lower retaining bar.
5	Turn off all the devices connected to the EIM you are removing.
6	Disconnect the Ethernet cable from the EIM. See Figure 5–18.
7	Disconnect the terminator from the EIM, if one is present. See Figure 5–18.
8	Insert the module extraction tool into the hole in the EIM. Turn the tool to the right until it is fastened to the module. See Figure 5–11.
9	Pull the EIM out of the cabinet.

5.4.15 DSSI Cable Removal and Replacement

Table 5–17 describes the removal procedure.

Table 5–17 DSSI Cable Removal Procedure

Step	Action
1	Ask the operator or system manager to shut down the zone using the procedure in Section 5.3.2.
2	Open the rear door of the cabinet.
3	Turn off all the devices connected to the DSSI cable you are removing.
4	Disconnect one end of the DSSI cable from the device by loosening the two screws on the DSSI connector.
5	Route the DSSI cable through the access hole between the system cabinets.
6	Disconnect the other end of the DSSI cable from the DIM by loosening the two screws on the DSSI connector.

5.4.16 TF85C-BA Tape Drive

Figure 5–19 and Figure 5–20 show how to remove an TF85C-BA tape drive from the system. Table 5–18 describes the removal procedure.

Warning

Two people are required to lift and carry the TF85C-BA tape drive enclosure.

Figure 5–19 TF85C-BA Tape Drive, Rear View

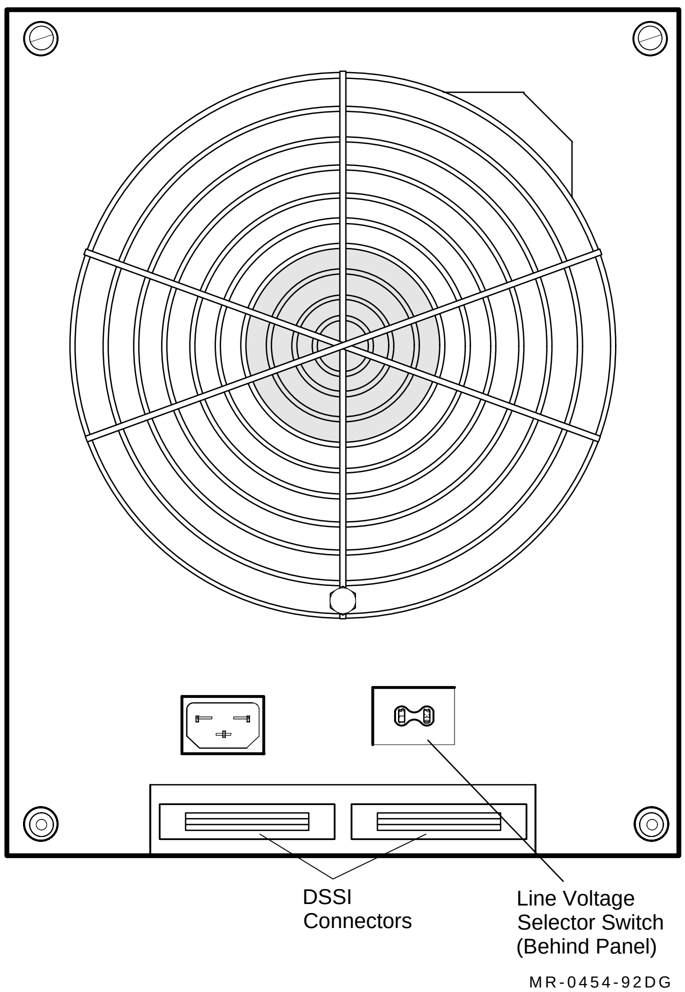


Figure 5–20 TF85C-BA Tape Drive Removal

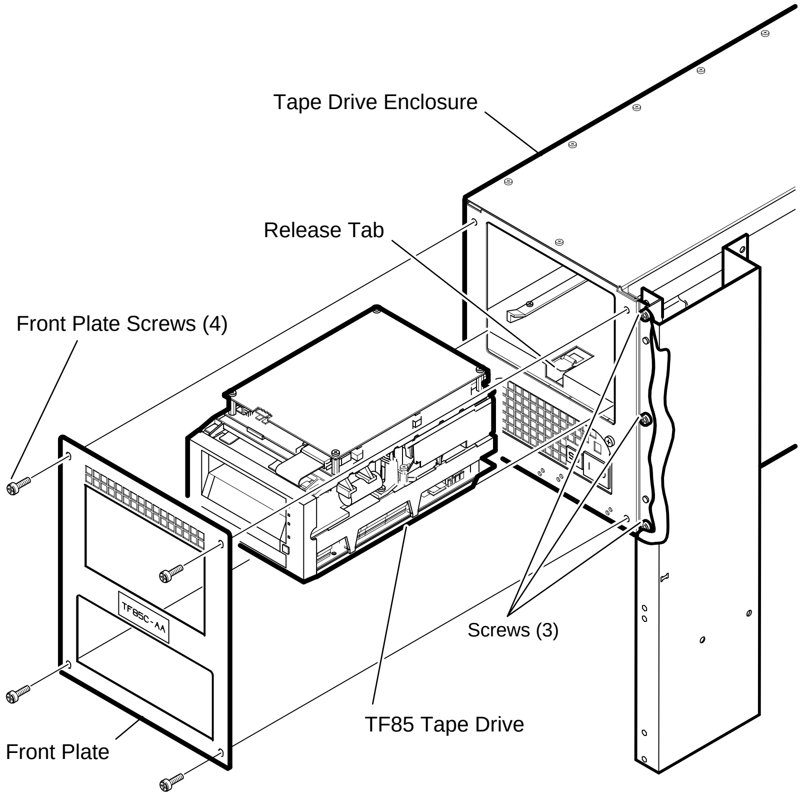


Table 5–18 TF85C-BA Tape Drive Removal Procedure

Step	Action
1	Ask the operator or system manager to dismount the tape.
2	Ask the operator or system manager to dismount the tape drive.
3	Unload the tape magazine, if one is present.
4	At the front of the drive, set the power switch to off (0). All the indicators should be off.
5	Disconnect the power cable from the rear of the drive. See Figure 5–19.
6	Disconnect the two DSSI cables from the rear of the drive. See Figure 5–19.
7	At the front of the drive, remove the three screws that secure the tape drive enclosure in the cabinet. See Figure 5–20.
8	Slide the tape drive enclosure out of the expansion cabinet.
9	Remove the four screws that secure the front plate on the tape drive enclosure.
10	Push the release tab down and pull the drive straight out of the slot.

5.4.17 SF73 Disk Drive

Figure 5–21 and Figure 5–22 show how to remove the SF73 disk drives from the system. Figure 5–23 shows how to remove an SF73 disk drive enclosure from the system. Figure 5–24 shows how to remove an SF73 disk ISE from a drive. Table 5–19 describes the removal procedure.

Warning

Two people are required to lift and carry the SF73 disk drive enclosure.

Figure 5–21 SF73 Disk Drive, Rear View

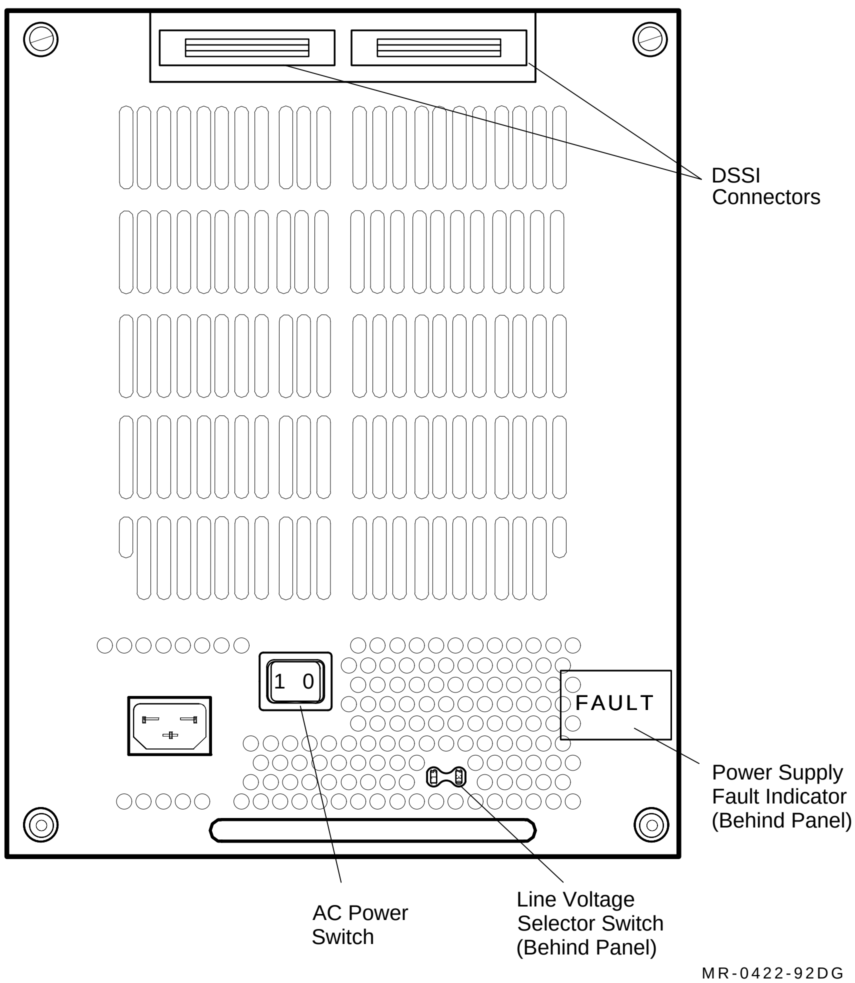


Figure 5–22 SF73 Disk Drive, Front View

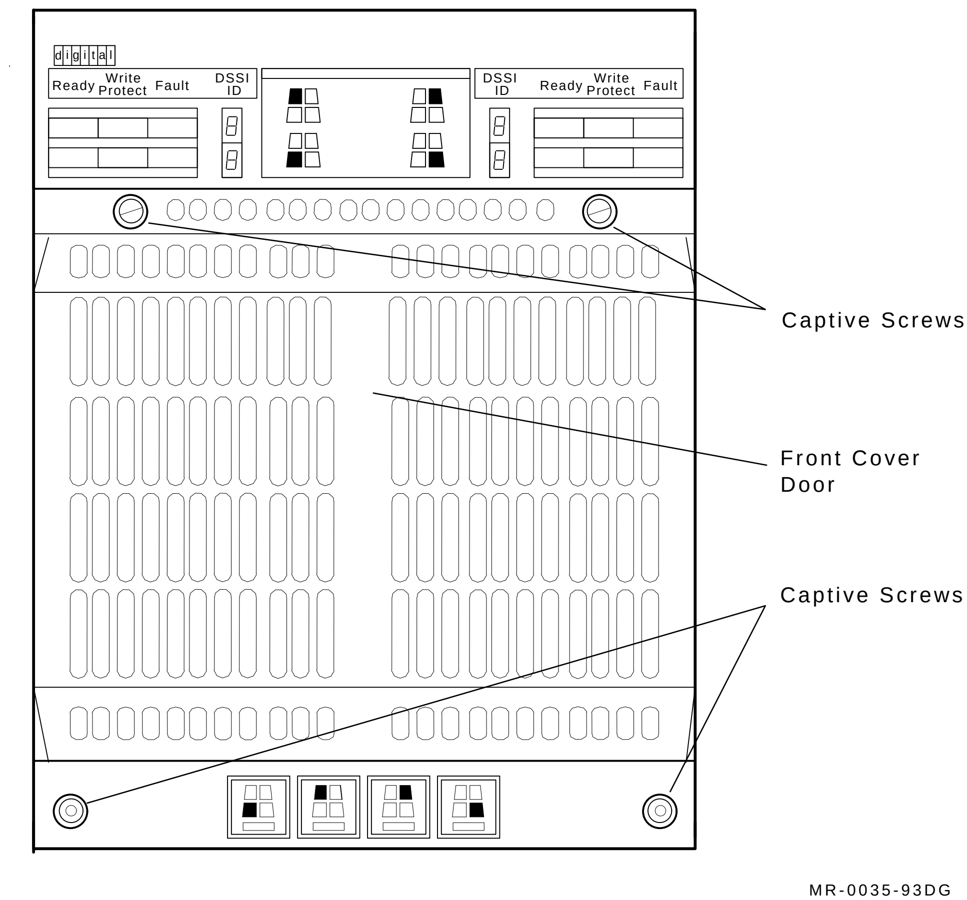


Table 5–19 SF73 Disk Drive Enclosure Removal Procedure

Step	Action
1	Ask the operator or system manager to dismount the drive.
2	Turn off the disk drive enclosure.
3	Disconnect the power cable from the rear of the drive. See Figure 3–9.
4	Disconnect the two DSSI cables from the rear of the drive. See Figure 3–9.
5	Remove the mounting screws from the retainers that secure the drive enclosure in the cabinet. See Figure 5–23.
6	Slide the disk drive enclosure out of the expansion cabinet.
7	Remove the retainer screws that secure the retainers on the disk drive enclosure. See Figure 5–23.
8	Loosen the captive screws that secure the front cover on the disk drive enclosure. See Figure 5–22.
9	Disconnect all cables from the disk ISE. Slide the disk ISE out of the disk drive enclosure. See Figure 5–24.

Figure 5–23 SF73 Disk Drive Enclosure Removal

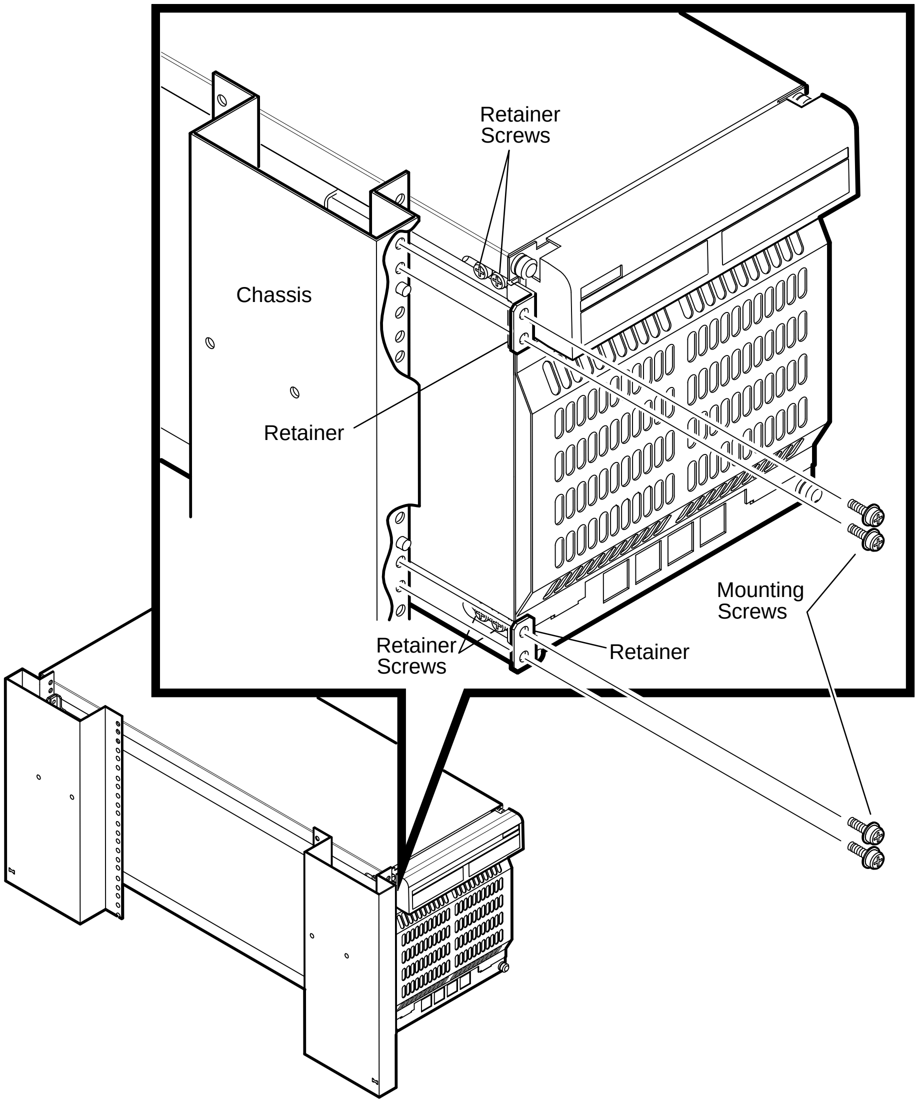
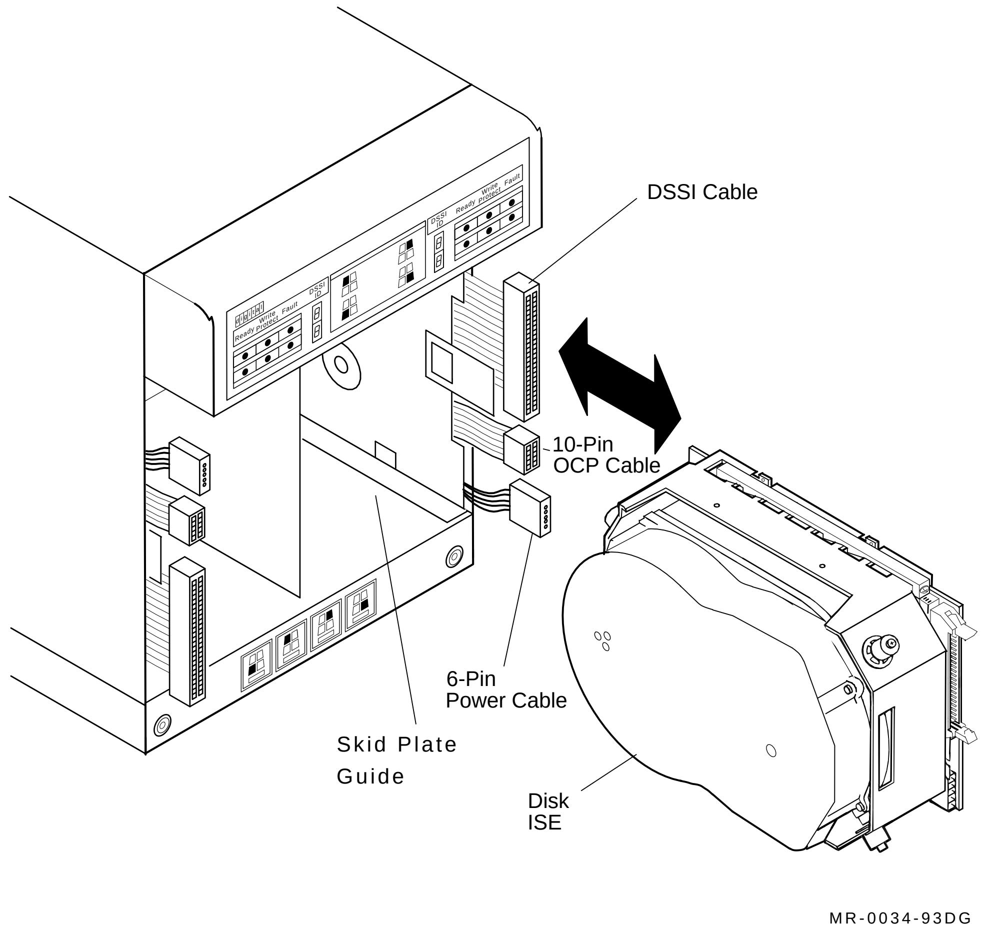


Figure 5–24 SF73 Disk ISE Removal



5.4.18 SF35 Storage Array

Figure 5–23 shows how to remove an SF35 storage array from the system. Figure 3–7 and Figure 5–26 show the rear and front views of the SF35 storage array. Figure 5–27 shows how to remove an SF35 disk ISE from the storage array. Table 5–20 describes the removal procedure.

Warning

Two people are required to lift and carry the SF35 storage array.

Figure 5–25 SF35 Storage Array, Rear View

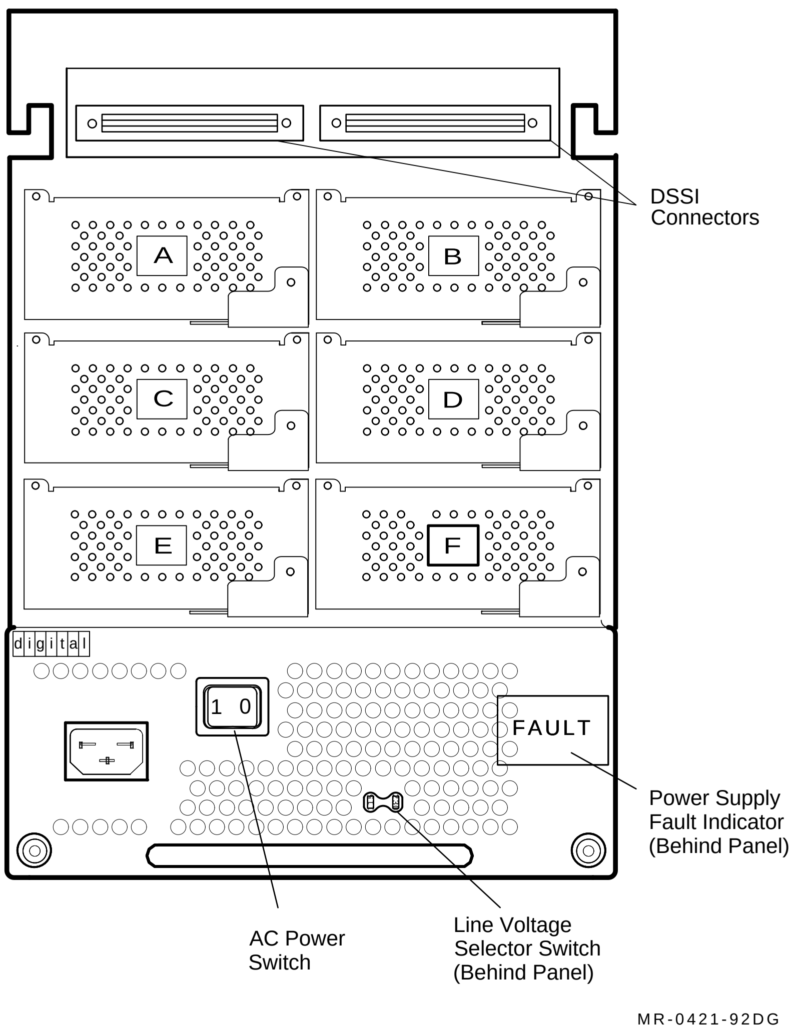


Figure 5–26 SF35 Storage Array, Front View

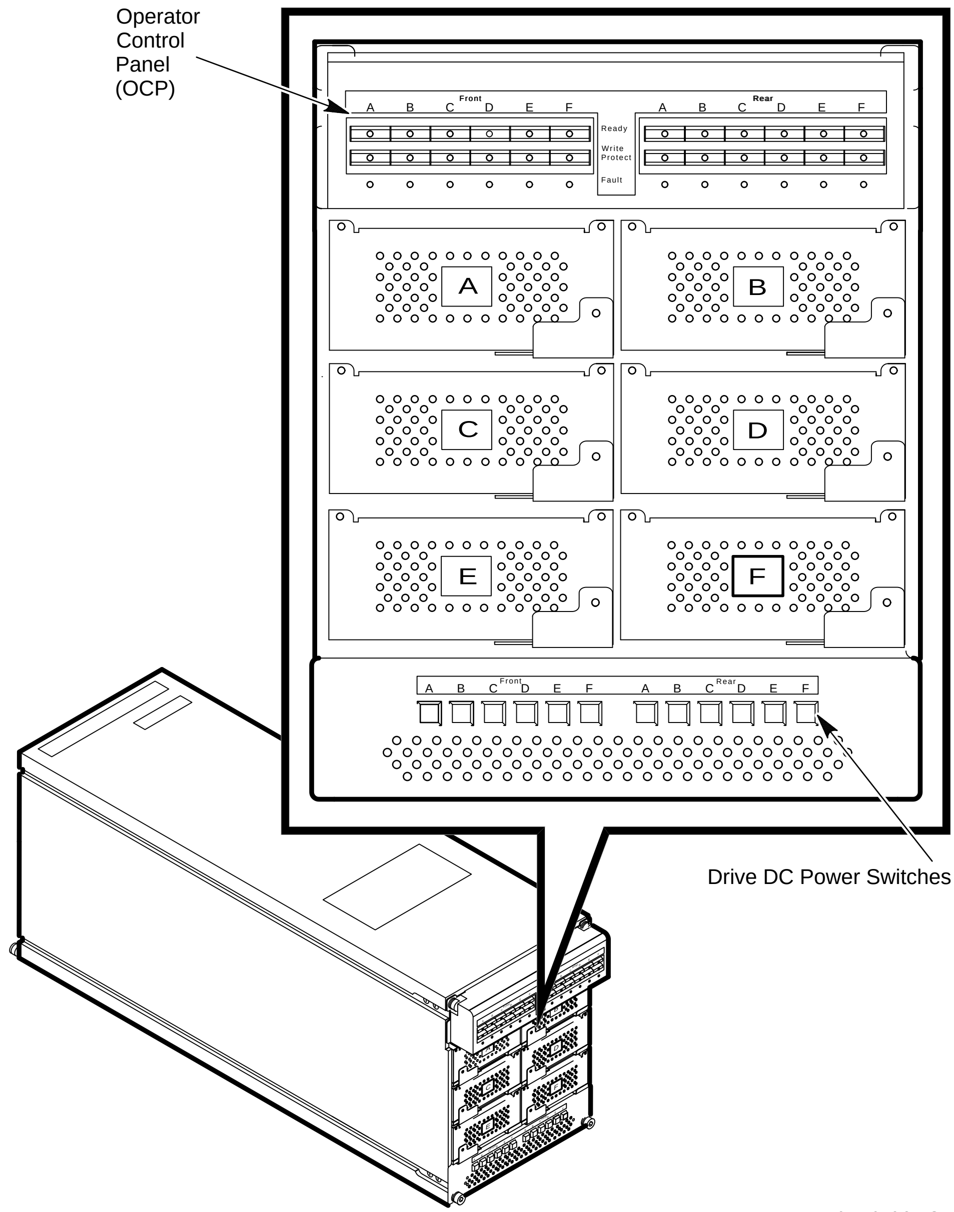


Figure 5–27 SF35 Disk ISE Removal

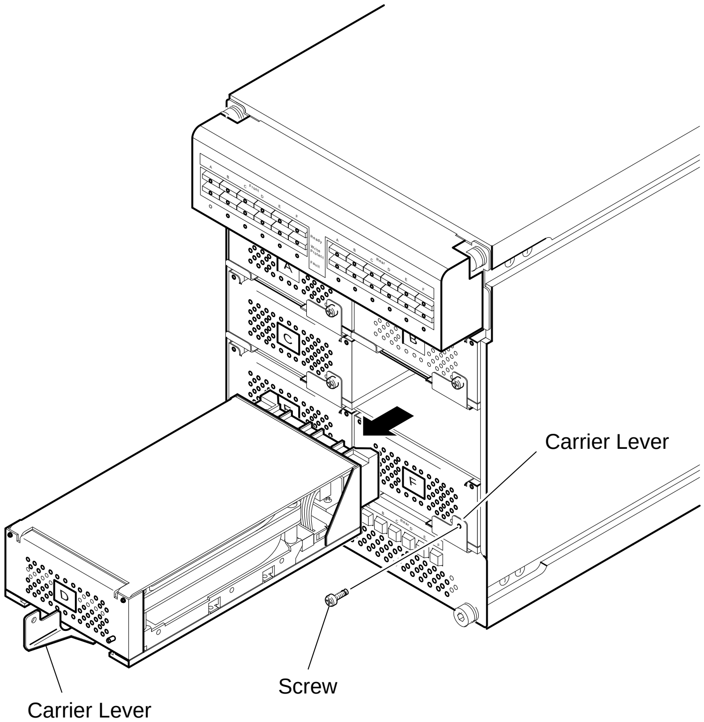


Table 5–20 SF35 Storage Array Removal Procedure

Step	Action
1	Ask the operator or system manager to dismount the disk.
2	Turn off the storage array.
3	Disconnect the power cable from the rear of the storage array. See Figure 3–7.
4	Disconnect the two DSSI cables from the rear of the storage array. See Figure 3–7.
5	Remove the mounting screws from the retainers that secure the storage array in the cabinet. See Figure 5–23.
6	Slide the disk drive enclosure out of the expansion cabinet.
7	Remove the retainer screws that secure the retainers on the storage array. See Figure 5–23.
8	Remove the screw from the carrier lever. See Figure 5–27.
9	Pull the carrier lever forward and slide the disk ISE out of the slot. See Figure 5–27.

5.4.19 TF857-CA Tape Drive

Figure 5–28 shows how to remove the TF857-CA tape drive from the system. Table 5–21 describes the removal procedure.

Warning

Two people are required to lift and carry the TF857-CA tape drive enclosure.

Figure 5–28 TF857-CA Tape Drive, Rear View

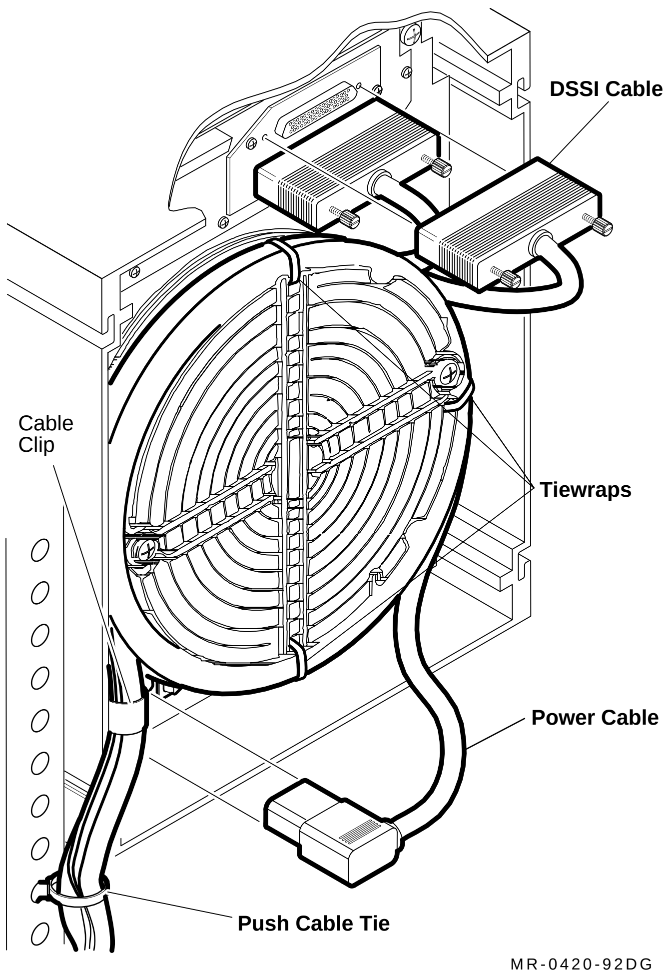
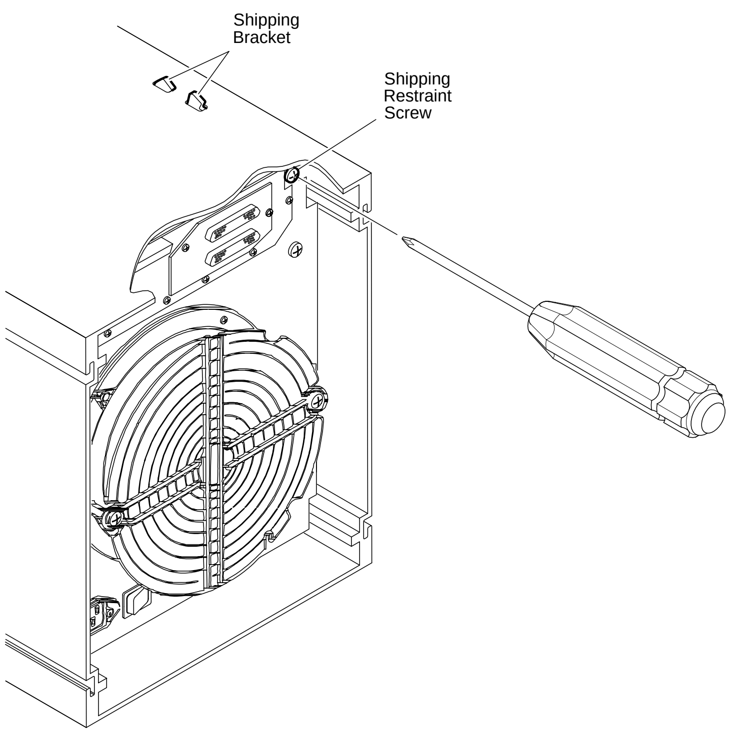


Table 5–21 TF857-CA Tape Drive Removal Procedure

Step	Action
1	Ask the operator or system manager to shut down the zone using the procedure in Section 5.3.2.
2	Ask the operator or system manager to dismount the tape drive.
3	Unload the tape magazine, if one is present.
4	At the front of the drive, set the power switch to off (0). All the indicators should be off.
5	Disconnect the power cable from the rear of the drive. See Figure 5–28.
6	Disconnect the two DSSI cables from the rear of the drive. See Figure 5–28.
7	Remove the mounting screws from the retainers that secure the drive enclosure in the cabinet. See Figure 5–23.
8	Slide the tape drive enclosure out of the expansion cabinet.
9	Loosen the shipping restraint screw until the shipping bracket drops. See Figure 5–29. If the shipping bracket does not drop when you loosen the shipping restraint screw, push the shipping bracket down with a screwdriver.
10	Slide the tape drive enclosure out of the expansion cabinet.

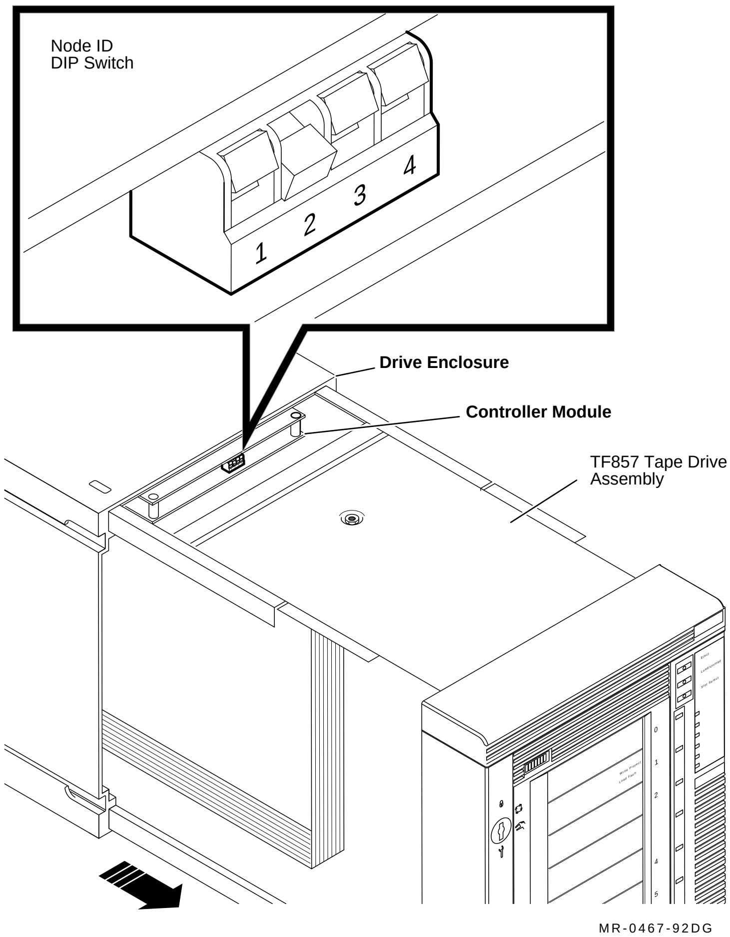
Figure 5–29 Loosening the Shipping Restraint Screw



Note

If you are replacing the TF857 tape loader, you must set the node ID. Refer to Figure 5–30 for the node ID DIP switch location.

Figure 5–30 Setting the TF857 Tape Loader Node ID



5.4.20 Power Distribution Box

Figure 5–31 shows a domestic power distribution box. Figure 5–32 shows an international power distribution box. Table 5–22 describes the removal procedure.

Figure 5–31 Domestic Power Distribution Box

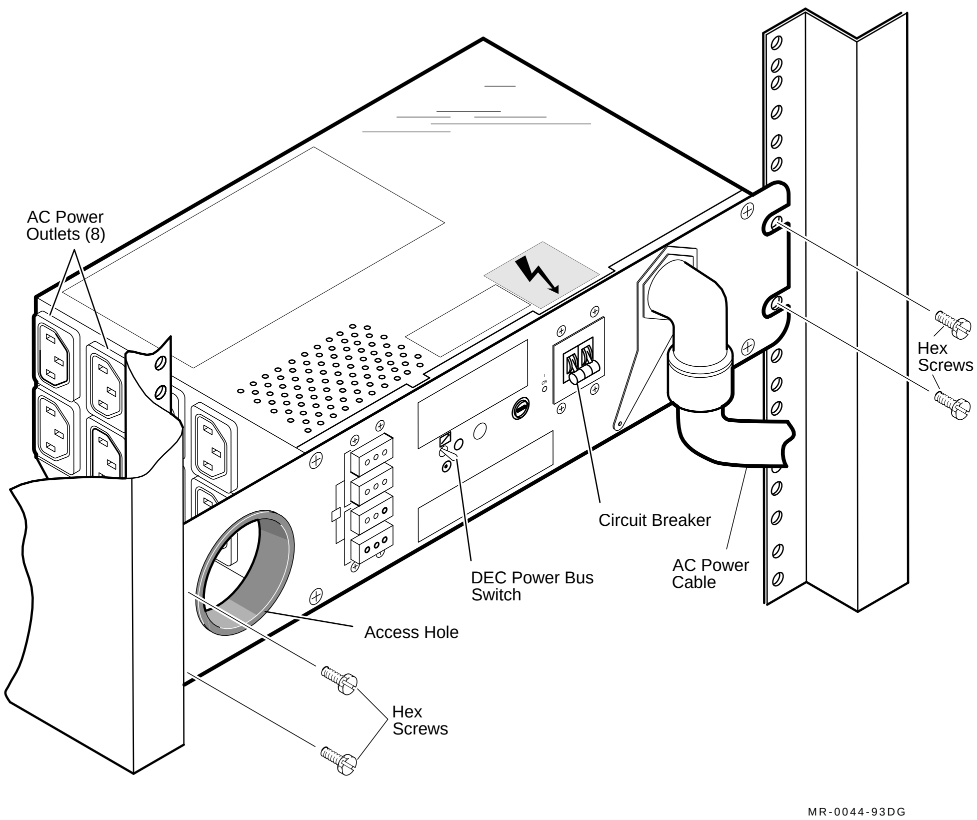


Figure 5–32 International Power Distribution Box

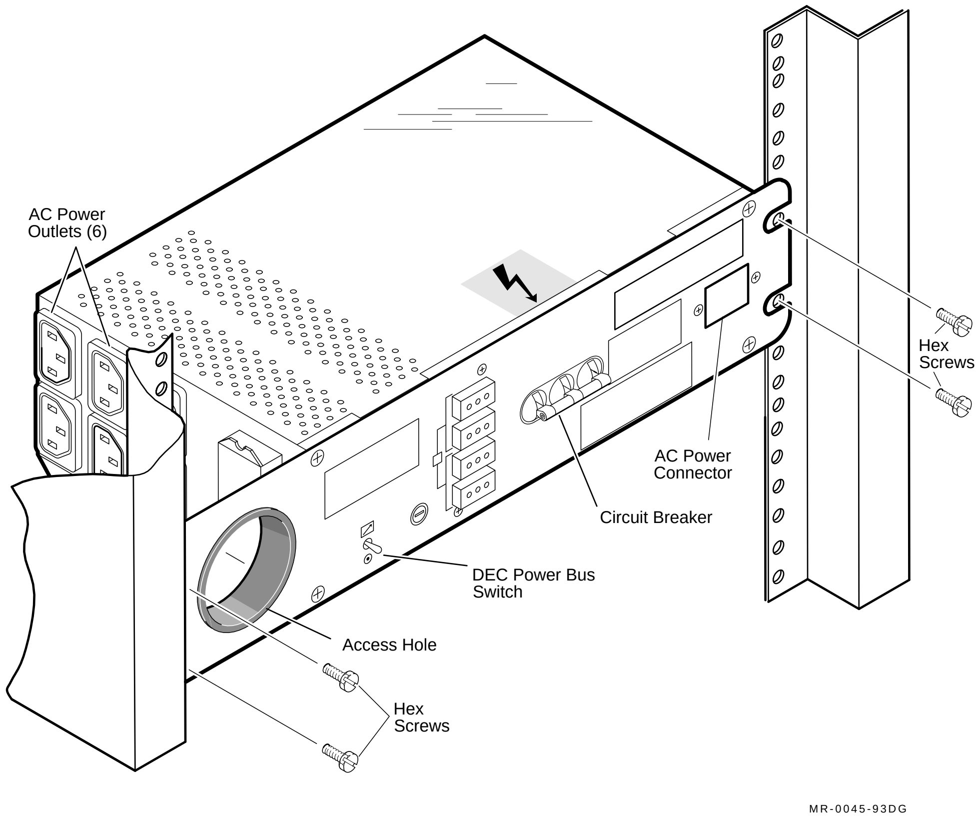


Table 5–22 Power Distribution Box Removal Procedure

Step	Action
1	Turn off any devices connected to the power distribution box.
2	Set the circuit breaker to the off position. See Figure 5–31 or Figure 5–32.
3	Set the DEC power bus switch to the local position. See Figure 5–31 or Figure 5–32.
4	If you are removing a domestic power distribution box, disconnect the ac power cable from facility power. See Figure 5–31. If you are removing an international power distribution box, disconnect the ac power cable from the ac power connector and from facility power. See Figure 5–32.
5	Disconnect any ac power cables connected to the ac power outlets and route the cables through the access hole. See Figure 5–31 or Figure 5–32.
6	Remove the four hex screws that secure the power distribution box in the cabinet. See Figure 5–31 or Figure 5–32.
7	Remove the power distribution box from the cabinet.

6
Managing Integrated Storage Elements

6.1 In This Chapter

This chapter includes:

- Loading the DUP driver
- Using VMS DUP
- Using the server setup switch
- Assigning DSSI unit numbers
- Warm swapping an ISE

6.2 Loading the DUP Driver

If the VMS diagnostic utility protocol (DUP) class driver is not loaded, load it as follows:

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

6.3 Using VMS DUP

Use the VMS DUP to change configuration data on mass storage devices. With DUP, you can connect the terminal to a storage controller with the following DCL command:

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

where:

taskname	–	is the utility or diagnostic program name to be executed on the target storage system
nodename	–	is the node name of the ISE

You can use SET HOST/DUP to create a virtual terminal connection to the MSCP$DUP server and to execute a utility or diagnostic program on the MSCP storage controller that uses the DUP standard dialogue.

Once the connection is established, operations are under the control of the utility or diagnostic program. When the utility or program ends, control returns to the local system.

PARAMS is the DUP management utility to examine and change ISE parameters such as node name, allocation class, and unit number. PARAMS is also used to display the state of the ISE and performance statistics maintained by the ISE.

PARAMS prompts for a command with the PARAMS> prompt. Once you enter a command, PARAMS executes it, and prompts you for another command.

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

Table 6–1 lists PARAMS commands.

Table 6–1 PARAMS Commands

Command	Description
EXIT	Stops the PARAMS utility
HELP	Displays information on how to use PARAMS commands
SET	Changes internal ISE parameters
SHOW	Displays the setting of a parameter or a class of parameters
WRITE	Records in nonvolatile RAM the device parameter changes you made with SET

Additional information is available on ISE tasks and commands in the RF/TF-series installation guides.

6.4 Using the Server Setup Switch

The server setup (SU) switch facilitates the installation of a new or incorrectly initialized ISE on a running system. Use SET HOST and configure parameters for the ISE with DUP, before VMS recognizes the ISE as an available resource. Table 6–2 explains how to disable RF-series and SF35, SF73, and SF72 disks.

Table 6–2 Switches For Disabling the MSCP

Disks	To Disable	More information in
RF-Series	Press the SU switch to disable the MSCP/TMSCP server within the ISE	*VAXft Systems Owner's Manual*
SF72 or SF 73	Set the drive positions DSSI ID number and the left-most MSCP to disable the ISE. The icon on the front of the door indicates the location of the drive.	*VAXft Systems Operating Information*
SF35	Press the MSCP switch to disable the ISE. The MSCP switch is located on the Operator Control Panel.	*VAXft Systems Operating Information*

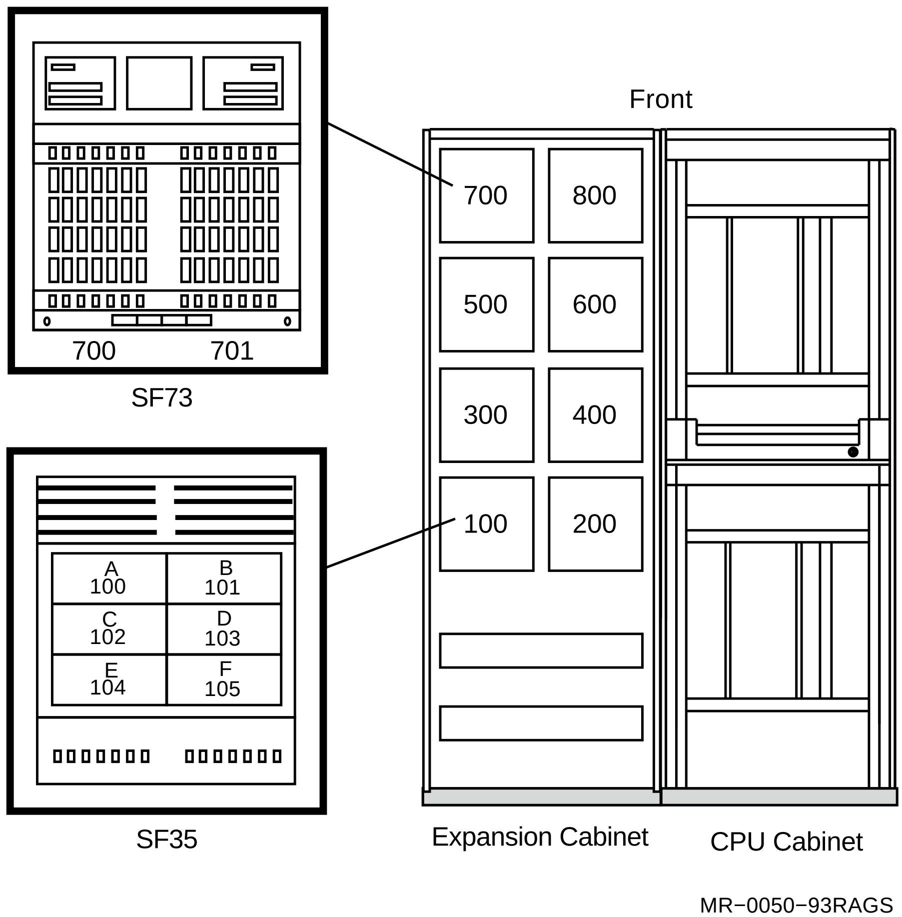
6.5 Assigning DSSI Unit Numbers

By default, the disk drive forces the unit number to the same value as the DSSI node address for the drive. Since the drives in zone A and zone B initially have the same DSSI unit number, reassign unit numbers to remove configuration conflicts and improve system management.

All unit numbers must be unique within an allocation class. Change the UNITNUM and FORCEUNI ISE parameters (see Table 6–3) to override the default values that assign the unit the same value as its node address.

Reassign unit numbers so that they have values greater than 99. For example, Figure 6–1 and Figure 6–2 use a 100-, 200-, 300-, 400-, 500-, and 600- numbering scheme for SF35s and SF73s.

Figure 6–1 VAXft Model 810 Front View



6.6 Warm Swapping an ISE

Warm swapping is the procedure by which an ISE can be replaced or added to a running system without interrupting system operations.

Caution

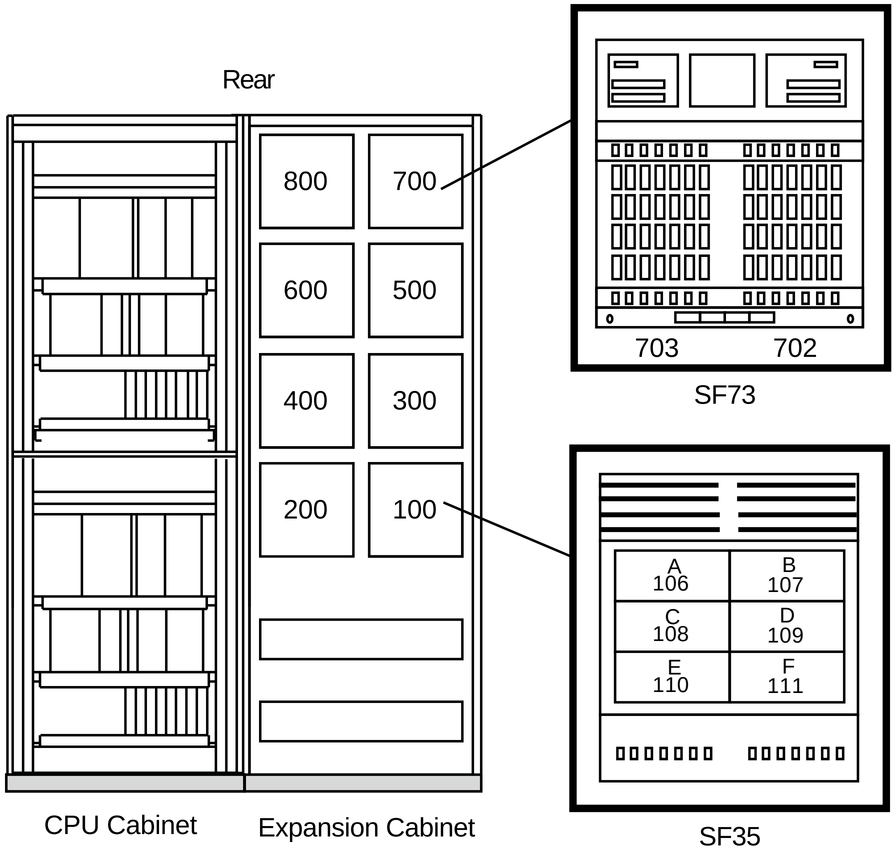
The procedure must be followed carefully. If a parameter is not entered correctly, then a system reboot is necessary or the ISE (and possibly the system) is rendered unusable.

The VMS operating system recognizes an ISE by its unique values for the NODENAME and SYSTEMID parameters. If only one of these parameters is changed, VMS inhibits connections to the old and new parameters for the ISE.

Variations of this procedure depend on the purpose for the warm swap. An ISE can be warm swapped for the following reasons:

- Removal and replacement for storage

Figure 6–2 VAXft Model 810 Rear View



- Replacement in a system that is running
- Installation in a system that is running

When replacing an ISE or installing a new ISE, determine the parameter values for the ISE **before** performing the warm swap procedure. Assign values for **each** of the ISE parameters described in Table 6–3.

Table 6–3 ISE Parameters

Parameter	Description
ALLCLASS[1]	Allocation class. The default value is 0. Set the ALLCLASS value to the allocation class chosen for the system. Note that shadowed disk devices must be set to a nonzero allocation class.
FORCENAM	Force name parameter. Determines if the ISE is to use the NODENAME parameter value instead of the manufacturing name given to the ISE. The value must be 0. If the value is 1, the ISE uses a generic device name such as RF31**x**.
FORCEUNI	Force unit parameter. To use UNITNUM as the device unit number, set the FORCEUNI parameter to 0. The factory default value of 1 uses the DSSI node address (hardwired on the backplane) as the unit number.
NODENAME	Node name for an ISE. Each ISE has a node name that is stored in EEPROM. The node name is determined in the manufacturing process and is unique to each ISE. The node name can be changed depending on the needs of the site.
SYSTEMID	System identification number. All SYSTEMIDs must be unique within the system. Do not change this parameter when introducing a new ISE to the system.
UNITNUM	Unit number. Specifies a numeric value for the device name. Use a unit number that is unique within the allocation class to which you are configuring the unit. Follow the unit numbering scheme described in Section 6.5 or use one that meets the requirements.

[1] RF-series devices only

More information is available on ISE parameters in the RF/TF-series installation guides.

6.6.1 Setting ISE Parameters

Digital Equipment Corporation recommends maintaining a worksheet of the parameters for all ISEs, as well as the serial number of each ISE. This is especially important at sites that maintain a set of spare drives that may be stored for some time before they are used.

The worksheet aids in:

- Preventing duplicate parameters, which render an ISE unusable until the duplication is isolated and corrected
- Finding the parameter settings of a non-operational ISE to create a replacement unit with identical parameters

Use the ISE parameter worksheets in Appendix B to identify and record critical parameter names and values. When installing a new ISE, select parameter values that meet the site ISE configuration or guidelines. Then continue with Section 6.6.4. When replacing an ISE, make sure the parameters selected are not being used for another ISE in the configuration.

If the parameter values were not recorded, perform the following steps to extract the information required from your system:

1. Enter SHOW DEVICE DI to display the following information:
   - Device name

     The device names in the sample output below are 1DIA22 and 1DIA21.
   - NODENAME

The node name is shown in parentheses. In the following sample output, the node names are RIRRBA and RICYAA.

- ALLCLASS

  The allocation class is found in the device name between the dollar signs ($). In 1DIA21, the ISE has an allocation class of 1. If the allocation class was 0, the node name would display as RICYAA$DIA21.

- UNITNUM

  The unit number is the number following the DIA. In 1DIA21, the UNITNUM is 21. It is the MSCP unit number.

- FORCENAM

  The force unit name is set to 0 if NODENAME is anything other than an RF31**x**. The **x** corresponds to a DSSI node ID (A = 0, B = 1, and so on).

- FORCEUNI

  The force unit parameter is not shown in the sample, but it should be 0 if the configuration rules given in the *VAXft Systems Configuration Guide* were followed.

2. Determine whether the VMS DUP class driver is loaded by entering the following DCL command:

   ```
   $ SHOW DEVICE FYA0  Return
   ```

   If the driver is not loaded, load it as follows:

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

3. Enter SET HOST/DUP to establish a DUP connection with the ISE as follows:

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

   This invokes DUP on the ISE and runs the PARAMS utility. If a connection can not be established with the ISE DUP, use ANALYZE/SYSTEM to find information on some of the parameters.

   In the following sample output, the SYSTEMID is 94100302 and the ALLCLASS is 1.

   ```
   $ ANALYZE/SYSTEM Return

   VMS System Analyzer
   SDA> SHOW DEVICE $1$DIA21

   I/O data structures
   -------------------
   $1$DIA21    RF31         UCB address: 802D65D0

   Device status:   00021810 online,valid,unload,lcl_valid
   Characteristics: 1C4D4108 dir,rct,fod,shr,avl,mnt,elg,idv,odv,rnd
                    000022A1 clu,mscp,srv,nnm,loc
   ```

```
Owner UIC [000010,000001]  Operation count    1116   ORB address  802D6700
      PID        00000000  Error count           0   DDB address  804DA680
Alloc. lock ID   00B000E5  Reference count       1   DDT address  80308BD8
Alloc. class            1  Online count          2   VCB address  802E2750
Class/Type          01/38  BOFF               0000   CRB address  8048C250
Def buf. size         512  Byte count         0000   PDT address  802A5F80
DEVDEPEND        00000000  SVAPTE         00000000   CDDB address 802D6410
DEVDEPND2        00000000  DEVSTS             0004   I/O wait queue  empty
FLCK index             34  RWAITCNT           0000
DLCK address     00000000

    Press RETURN for more.
SDA> Return

I/O data structures
-------------------

   --- Primary Class Driver Data Block (CDDB) 802D6410 ---

Status:           0040 alcls_set
Controller Flags  80D4 icf_mlths,cf_this,cf_misc,cf_attn,cf_replc

Allocation class        1  CDRP Queue        empty   DDB address  804DA860
System ID        94100302  Restart Queue     empty   CRB address  8048C250
                     4041  DAP count             3   CDDB link    80344C30
Contrl. ID       94100302  Contr. timeout       60   PDT address  802A5F80
                 01644041  Reinit Count          0   Original OCB 00000000
Response ID      00000000  Wait UCB Count        0   UCB chain    802D65D0
MSCP Cmd status FFFFFFFF

  *** I/O request queue is empty ***

    Press RETURN for more.
SDA> EXIT Return

$
```

```
$ SHOW DEVICE DI Return

Device                 Device     Error   Volume  Free  Trans Mnt
 Name                  Status     Count    Label Blocks Count Cnt
$1$DIA22   (RIRRBA)   Mounted       0    DISK22 744282    1    1
$1$DIA21   (RICYAA)   Online        5
```

6.6.2 ISE Removal

When you replace an ISE, initialize the new ISE with the same parameters as the ISE being replaced. Refer to the worksheet maintained for that ISE. (See Section 6.6.1.)

You can turn off power and replace an ISE in a running system without interrupting system services or users. When the ISE is replaced, the new ISE must be correctly initialized to:

- Supersede pre-set manufacturing values
- Store the modified values in EEPROM

To replace an ISE in a system that is running, perform the following steps:

Caution

You must use an ESD wrist strap, ground clip, and grounded ESD workmat whenever you handle ISEs. Use the static protective service kit (PN 29-262446).

Use great care when you handle an ISE; excessive shock can damage the head-disk-assembly (HDA).

---

1. If the ISE is mounted, logically dismount it from the system.
2. Make the device unavailable to the system by entering the following DCL command:

   ```
   $ SET DEVICE/NOAVAILABLE devicename Return
   ```

3. Verify that the device has been marked as unavailable by entering the following DCL command:

   ```
   $ SHOW DEVICE $1$DIA21  Return

   Device                 Device     Error   Volume  Free  Trans Mnt
    Name                  Status     Count    Label Blocks Count Cnt
   $1$DIA21    (RICYAA)   Unavailable    5
   ```

4. Set the ISE power switch to off (0). Wait 45 seconds for drive to stop spinning (and for RF-disks, the interlock solenoid to release).
5. Remove the ISE from the slot. Follow the steps in the device owner's manual, and observe all FRU handling procedures.

6.6.3 ISE Replacement

When you replace an ISE in a system that is running, use the following steps to restore the parameters from the ISE being replaced. When you install a new ISE in a system that is running, use the steps described in Section 6.6.4.

Caution

You must use an ESD wrist strap, ground clip, and grounded ESD workmat whenever you handle ISEs. Use the static protective service kit (PN 29-262446).

Use great care when handling an ISE. Excessive shock can damage the HDA.

---

1. Disable the MSCP server as described in Table 6–4.

Table 6–4 Disabling the MSCP

Disks	Action
RF-series	Press and hold the SU switch/button
SF72 or SF72-series	Set the MSCP enable switch
SF35	Press the MSCP/Fault switch (LED is green when enabled)

2. Set the ISE power switch to on (1). Wait for the drive to start spinning (and, on RF-series disks, the interlock solenoid to lock).
3. If you have an RF-series disk, release the server setup switch. If you have an SF-series disk, continue with Step 4.
4. Verify that the device has been marked as available by entering the following DCL command:

   ```
   $ SHOW DEVICE devicename Return
   ```

5. Find the NODENAME parameter for the replacement ISE by entering SHOW CLUSTER. (SHOW DEVICE will not work at this time.) In the sample output below, R1QSAA is the replacement ISE.

   ```
   $ SHOW CLUSTER   Return

   View of Cluster from system ID 63973 node CLOUDS
   +----------------------------+
   |      SYSTEMS      | MEMBERS |
   +----------------------------+
   | NODE   | SOFTWARE | STATUS  |
   +----------------------------+
   | CLOUDS | VMS V5.4 | MEMBER  |
   | RICYAA | RFX V200¹|         |
   | RIRRBA | RFX V200 |         |
   | R1QSAA | RFX V200 |         |
   +----------------------------+
   ```

6. Determine whether the VMS DUP class driver is loaded by entering the following DCL command:

   ```
   $ SHOW DEVICE FYA0   Return
   ```

   If the driver is not loaded, load it by entering the following:

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

7. Enter SET HOST/DUP to establish a DUP connection with the ISE as follows:

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

   This invokes DUP on the ISE and runs the PARAMS utility.

8. Refer to the parameters listed in Table 6–3, and enter the SET command to set appropriate values for the parameters. Be sure to record the new parameters on the worksheet for the ISE.

[1] Firmware version number

For example:

```
$ SET HOST/DUP/SERVER=MSCP$DUP/TASK=PARAMS R1QSAA  Return
  %HSCPAD-I-LOCPROGEXE, Local program executing - type ^\ to exit
  Copyright (C) 1993 Digital Equipment Corporation

  PARAMS> SHOW NODENAME  Return
  Parameter     Current       Default      Type      Radix
  ---------- -------------  -------------- ---------- ---------
  NODENAME      R1QSAA          RF31      String     Ascii

PARAMS> SET NODENAME RICYAA  Return

PARAMS> SHOW SYSTEMID  Return
Parameter     Current       Default      Type      Radix
---------- -------------  -------------- ---------- ---------
SYSTEMID    593200495860  0000000000000  Quadword    Hex       B

PARAMS> SET SYSTEMID 0404194100302  Return

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

PARAMS> SET ALLCLASS 1  Return

PARAMS> SHOW FORCENAM  Return
Parameter     Current       Default      Type      Radix
---------- -------------  -------------- ---------- ---------
FORCENAM               0             0   Boolean     0/1      B

PARAMS> SHOW UNITNUM  Return
Parameter     Current       Default      Type      Radix
---------- -------------  -------------- ---------- ---------
UNITNUM                 0              0    Word       Dec     U

PARAMS> SET UNITNUM 21  Return

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

PARAMS> SET FORCEUNI 0  Return


PARAMS> WRITE  Return

Changes require controller initialization, ok? [Y/(N)] Y
Initializing...

HSCPAD-S-REMPGMEND, Remote program terminated - message number 3
%HSCPAD-S-END, Control returned to CLOUDS
$
```

9. Make the device available to the system by entering the following DCL command:

   `$ SET DEVICE/AVAILABLE` *devicename* Return

10. Mount the ISE in the system and restore the shadow sets.

11. On SF-series drives, enable the MSCP switch.

When initialization is complete, the replacement ISE and its parameters are made available to the VMS operating system.

Note

The SHOW CLUSTER command continues to show the name of the ISE replaced. This does not harm the system. After the next reboot, the replacement ISE name appears.

Note also that the following message is displayed if another node is already assigned the same SYSTEMID and NODENAME:

```
%PWA0-REMOTE SYSTEM CONFLICTS WITH KNOWN SYSTEM
```

In this case, shut down the new node and issue a unique SYSTEMID and NODENAME for the new node.

6.6.4 Installing an ISE in a Running System

When you install a new ISE in a system that is running, perform the following steps to initialize the new ISE parameters:

1. Disable the MSCP server as described in Table 6–5.

Table 6–5 Disabling the MSCP

Disks	Action
RF-series	Press and hold the SU switch/button
SF 72 or SF73	Set the MSCP enable switch
SF35	Press the MSCP/Fault switch (LED is green when enabled)

2. Set the ISE power switch to on (1). Wait for the drive to start spinning (and on RF-series disks, the interlock solenoid to lock.
3. If you have an RF-series disk, release the server setup switch. If you have an SF disk, continue with Step 4.
4. Refer to Table 6–3 and Section 6.6.1, and select values for the following parameters:
   - ALLCLASS
   - FORCENAM
   - FORCEUNI
   - NODENAME
   - UNITNUM
5. Determine whether the VMS DUP class driver is loaded by entering the following DCL command:

   ```
   $ SHOW DEVICE FYA0  Return
   ```

   If the driver is not loaded, load it by entering the following:

   ```
   $ MCR SYSGEN  Return
   SYSGEN> CONNECT FY0/NOADAPTER  Return
   SYSGEN> EXIT  Return
   ```
6. Enter SET HOST/DUP to establish a DUP connection with the ISE as follows:

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

This invokes DUP on the ISE and runs the PARAMS utility.

7. Use SET to assign appropriate values for the parameters. Be sure to record the new parameters on the worksheet for the ISE.

   In the following sample output, the new ISE is configured to be device 1DIA22. The device is initialized with these parameters:

   - ALLCLASS — 1
   - FORCENAM — 0
   - FORCEUNI — 0
   - NODENAME — DISK22
   - SYSTEMID — no change
   - UNITNUM — 22

```
$ SET HOST/DUP/SERVER=MSCP$DUP/TASK=PARAMS R1QSAA  [Return]
%HSCPAD-I-LOCPROGEXE, Local program executing - type ^\ to exit
Copyright (C) 1990 Digital Equipment Corporation

PARAMS> SHOW NODENAME  [Return]
Parameter     Current       Default      Type       Radix
---------- ------------  ------------- ---------- ---------
NODENAME      R1QSAA              RF31     String     Ascii

PARAMS> SET NODENAME DISK22  [Return]

PARAMS> SHOW ALLCLASS  [Return]
Parameter     Current       Default      Type       Radix
---------- ------------  ------------- ---------- ---------
ALLCLASS               0              0    Byte       Dec     B

PARAMS> SET ALLCLASS 1  [Return]

PARAMS> SHOW FORCENAM [Return]
Parameter     Current       Default      Type       Radix
---------- ------------  ------------- ---------- ---------
FORCENAM               0             0   Boolean     0/1      B

PARAMS> SHOW UNITNUM [Return]
Parameter     Current       Default      Type       Radix
---------- ------------  ------------- ---------- ---------
UNITNUM                0             0    Word       Dec      U

PARAMS> SET UNITNUM 22  [Return]

PARAMS> SHOW FORCEUNI [Return]
Parameter     Current       Default      Type       Radix
---------- ------------  ------------- ---------- ---------
FORCEUNI               1             1   Boolean     0/1      U

PARAMS> SET FORCEUNI 0  [Return]


PARAMS> WRITE  [Return]

Changes require controller initialization, ok? [Y/(N)] Y
Initializing...

HSCPAD-S-REMPGMEND, Remote program terminated - message number 3
%HSCPAD-S-END, Control returned to CLOUDS
$
```

When initialization is complete, the new ISE and its parameters are made available to the VMS operating system.

8. On SF-series drives, enable the MSCP switch.

Note

The SHOW CLUSTER command continues to show the name of the ISE you replaced. This does not harm the system. After the next reboot, the new ISE name appears.

A

Miscellaneous System Information

A.1 In This Appendix

This appendix includes:

- Processor Halt codes
- Console Halt codes
- Error register descriptions
- I/O physical address space
- System control block description

A.2 Processor Halt Codes

Table A–1 provides the processor Halt code definitions.

Table A–1 Processor Halt Code Definitions

Halt Code	Number	Definition
CPM$K_EXT_HALT	?02	External halt
CPM$K_RESET	?03	Reset
CPM$K_BAD_ISP	?04	Interrupt stack not valid
CPM$K_DBL_ERR1	?05	Machine check during execution
CPM$K_HALT	?06	Halt instruction executed
CPM$K_SCB_ERR3	?07	SCB vector bits [01:00] = 11
CPM$K_SCB_ERR2	?08	SCB vector bits [01:00] = 10
CPM$K_CHM_FRM_ISTK	?0A	CHMx executed while on interrupt stack
CPM$K_CHM_TO_ISTK	?0B	CHMx to interrupt stack
CPM$K_SCB_READ_ERR	?0C	SCB read error
CPM$K_MERR_V	?10	ACV or TNV during machine check
CPM$K_KSP_V	?11	ACV or TNV during KSP exception
CPM$K_DBL_ERR2	?12	Machine check during machine check
CPM$K_DBL_ERR3	?13	Machine check during KSP not valid
CPM$K_PSL_EXC5	?19	PSL [26:24] = 101 during interrupt or exception
CPM$K_PSL_EXC6	?1A	PSL [26:24] = 110 during interrupt or exception

(continued on next page)

Table A–1 (Cont.) Processor Halt Code Definitions

Halt Code	Number	Definition
CPM$K_PSL_EXC7	?1B	PSL [26:24] = 111 during interrupt or exception
CPM$K_PSL_REI5	?1D	PSL [26:24] = 101 during REI
CPM$K_PSL_REI6	?1E	PSL [26:24] = 110 during REI
CPM$K_PSL_REI7	?1F	PSL [26:24] = 111 during REI

The following example shows a processor Halt code output. Table A–2 defines the Halt Reason fields.

```
>>>
?03 Reset (Reason = 0017)
  PC= 01E00000 PSL= 041F0300
```

Table A–2 Processor Halt Reason Code Definitions

Reason Code (Hex)	Definition
0001	Duplex zones have diverged
0002	Fatal cross-link error has occurred
0003	Fatal zone error has occurred
0004	Fatal ATM error has occurred
0005	Fatal CPU module error has occurred
0006	Fatal memory error has occurred
0007	Single bit memory error has occurred
0008	User command issued to stop a zone
0009	Unexpected machine check has occurred
000A	Software detected failure has occurred
000B	Solid NXIO error has occurred
000C	Excessive transient NCIO errors have occurred
000D	A solid IO error has occurred
000E	Excessive transient IO errors have occurred
000F	Excessive VAXELN kernel recoverable errors have occurred
0010	A VAXELN master fatal error has occurred
0011	A VAXELN job fatal error has occurred
0012	Not enough SPTEs could be allocated to boot OpenVMS
0013	Unexpected system error occurred [1]
0014	Interface module failure has occurred
0015	Unexpected VAXELN error occurred

[1] Reset reason 0013 indicates that an unexpected system error occurred. The contents of the SYSFLT, SYSADR, and DMAADR registers will be saved in the CCA area. See Figure A–4 for the CCA offsets of these registers. Use the register bitmaps and description in Section A.4 to determine the cause of the error.

(continued on next page)

Table A–2 (Cont.) Processor Halt Reason Code Definitions

Reason Code (Hex)	Definition
0016	A VAXELN kernel fatal error has occurred
0017	Initializing VAXELN before starting reconfiguration

A.3 Console Halt Codes

The following example shows a console Halt code output. Table A–3 defines the Halt Reason fields.

```
>>>
?03 Reset (Reason = 0013)
  PC= 01E00000 PSL= 041F0300
```

Table A–3 Console Halt Reason Code Definitions

Reason Code (Hex)	Definition
0000	Power-up reset
0001	Duplex zones have diverged
0002	Fatal cross-link error has occurred
0003	Fatal zone error has occurred
0004	Fatal ATM error has occurred
0005	Fatal CPU module error has occurred
0006	Fatal memory error has occurred
0007	Single bit memory error has occurred
0008	User command issued to stop a zone
0009	Unexpected machine check has occurred
000A	Software detected failure has occurred
000B	Solid NXIO error has occurred
000C	Excessive transient NCIO errors have occurred
000D	A solid IO error has occurred
000E	Excessive transient IO errors have occurred
000F	Excessive VAXELN kernel recoverable errors have occurred
0010	A VAXELN master fatal error has occurred
0011	A VAXELN job fatal error has occurred
0012	Not enough SPTEs could be allocated to boot OpenVMS
0013	Unexpected system error occurred[1]
0014	Interface module failure has occurred

[1]Reset reason 0013 indicates that an unexpected system error occurred. The contents of the SYSFLT, SYSADR, and DMAADR registers will be saved in the CCA area. See Figure A–4 for the CCA offsets of these registers. Use the register bitmaps and description in Section A.4 to determine the cause of the error.

(continued on next page)

Table A–3 (Cont.) Console Halt Reason Code Definitions

Reason Code (Hex)	Definition
0015	Unexpected VAXELN error occurred
0016	A VAXELN kernel fatal error has occurred
0017	Initializing VAXELN before starting reconfiguration

A.4 Error Register Descriptions

A.4.1 System Fault (SYSFLT) Register

This register is not rail or zone unique (Figure A–1). Software does not take special precautions when reading this register. In addition, the register is continuously updated. The setting of one error bit does not prevent other bits from being set. The register contains bits which cause IPL29 interrupts.

All bits in this register have the following characteristics: default = 0, type = ro, reset = hr.

Figure A–1 System Fault Register

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
SFB		XLM				LCK	RSA	CBG	PWG	CPB	CPA	HTB	HTA	MFB	MFA

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
MDB	MDA	MSB	MSA	JDB	JDA	JSB	JSA	NXB	NXA	IOB	IOA	DNB	DNA	DMB	DMA

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Register Address: CPU = E110 1100 (CCA offset = 15C)

[31]: SFB - Solid Fault Bit. Latched when an automatic retry on an I/O operation fails to complete properly.

[30:28]: XLM - Xlink Mode [2:0]. This field, sourced by the Xlink, is read-only and indicates the Xlink mode specified in Table A–4.

Table A–4 Xlink Mode Coding

Code	Mode
000	Xlink Off
001	Xlink Slave
010	Xlink Master
011	Xlink Duplex
100	Not Used

(continued on next page)

Table A–4 (Cont.) Xlink Mode Coding

Code	Mode
101	Resync Slave
110	Resync Master
111	Not Used

[27:26]: - Not used.

[25]: LCK - Lock. Latched when an error occurs during an interlock I/O access. (Interlock access refers to the special I/O access mode.)

[24]: RSA - Resync Abort. Latched when an error occurs during resync mode. Resync mode is automatically canceled.

[23]: CBG - Cable Gone. Latched when a cable gone signal is detected. CBG set will force the Xlink to the off mode.

[22]: PWG - Power Gone. Set when the other zone power gone signal is detected. PWG set will force the Xlink to the off mode.

[21]: CPB - Clock Phase Error (Zone B). Latches a high level assertion on the Clock Phase Error line coming from the Xlink. The high level will remain until a 1 is written to the bit. If the Clock Phase Error signal line is still high after the write 1 to clear, the bit is again set to 1.

[20]: CPA - Clock Phase Error (Zone A). Latches a high level assertion on the Clock Phase Error line coming from the Xlink. The high level will remain until a 1 is written to the bit. If the Clock Phase Error signal line is still high after the write 1 to clear, the bit is again set to 1.

[19]: HTB - Halt Error (Zone B). Latches a high level assertion on the Halt Request line coming from the Xlink. The high level will remain until a 1 is written to the bit. If the Halt Error signal line is still high after the write 1 to clear, the bit is again set to 1.

[18]: HTA - Halt Error (Zone A). Latches a high level assertion on the Halt Request line coming from the Xlink. The high level will remain until a 1 is written to the bit. If the Halt Error signal line is still high after the write 1 to clear, the bit is again set to a 1.

[17]: MFB - CPMF (Zone B). Set when the error logic determines that a CPMF is required.

[16]: MFA - CPMF (Zone A). Set when the error logic determines that a CPMF is required.

[15]: MDB - Memory Double-Bit Error (Zone B). Set when a double-bit ECC error or single-bit ECC error is detected during memory writes on the internal Jet Bus ECC checker. This causes a CPMF.

[14]: MDA - Memory Double-Bit Error (Zone A). Set when a double-bit ECC error or single-bit ECC error is detected during memory writes on the internal Jet Bus ECC checker. This causes a CPMF.

[13]: MSB - Memory Single-Bit Error (Zone B). Set when a single-bit ECC error is detected in memory during a read and the JXD was not the requester of the data. The bit is set regardless of the state of the Error Enable bit. The error is automatically corrected at the CPU. An IPL26 interrupt is generated causing a two-zone system to diverge. Hardware generates an IPL29 interrupt to both zones within three clock cycles.

[12]: MSA - Memory Single-Bit Error (Zone A). Set when a single-bit ECC error is detected in memory during a read and the JXD was not the requester of the data. The bit is set regardless of the state of the Error Enable bit. The error is automatically corrected at the CPU. An IPL26 interrupt is generated causing a two-zone system to diverge. Hardware generates an IPL29 interrupt to both zones within three clock cycles.

[11]: JDB - JXD Double-Bit Error (Zone B). Set when a double-bit ECC error is detected on the internal Jet Bus ECC checker.

[10]: JDA - JXD Double-Bit Error (Zone A). Set when a double-bit ECC error is detected on the internal Jet Bus ECC checker.

[09]: JSB - JXD Single-Bit Error (Zone B). Set when a single-bit ECC error is detected on the internal Jet Bus ECC checker and is detected in memory. The check operation is triggered during Jet Bus transactions. The bit is set regardless of the state of the Error Enable bit. The error is automatically corrected on JXD reads from memory. Detection of this error causes the current DMA address to be latched. The DMA operation is allowed to complete. When finished, the DMA driver will check this bit, and if set will force a mini resync by reading the location pointed to by the DMA Error Address register.

[08]: JSA - JXD Single-Bit Error (Zone A). Set when a single-bit ECC error is detected on the internal Jet Bus ECC checker and is detected in memory. The check operation is only triggered during Jet Bus transactions. The bit is set regardless of the state of the Error Enable bit. The error is automatically corrected on JXD reads from memory. Detection of this error causes the current DMA address to be latched. The DMA operation is allowed to complete. When finished, the DMA driver will check this bit, and if set will force a mini resync by reading the location pointed to by the DMA Error Address register.

[07]: NXB - Nonexistent I/O (Zone B). Set after any bus timeout. If the retry passes, the Solid Fault bit will not be set.

[06]: NXA - Nonexistent I/O (Zone A). Set after any bus timeout. If the retry passes, the Solid Fault bit will not be set.

[05]: IOB - I/O Error (Zone B). Set by errors that occur from nonfatal or recoverable CPU initiated transactions. Errors resulting from CPU to I/O transactions are retried.

[04]: IOA - I/O Error (Zone A). Set by errors that occur from nonfatal or recoverable CPU initiated transactions. Errors resulting from CPU to I/O transactions are retried.

[03]: DNB - DMA NXIO (Zone B). Set when a bus timeout occurs and the CROME bus is performing a DMA operation.

[02]: DNA - DMA NXIO (Zone A). Set when a bus timeout occurs and the CROME bus is performing a DMA operation.

[01]: DMB - DMA Error (Zone B). Set by DMA errors. If the bit is set, the DMA is aborted. A DMA error may generate a CPMF.

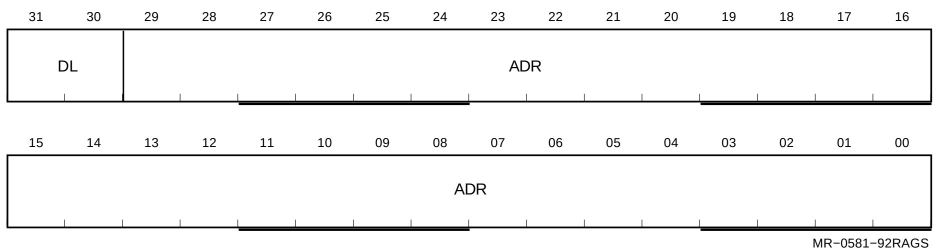
[00]: DMA - DMA Error (Zone A). Set by DMA errors. If the bit is set, the DMA is aborted. A DMA error may generate a CPMF.

A.4.2 System Error Address (SYSADR) Register

This register latches when any error is detected at the JXD Jet Bus and below (Figure A–2). It contains the address the CPU was accessing at the time the error occurred. The register is read only and cleared by clearing errors.

All bits in this register have the following characteristics: default = 0, type = ro, reset = hr.

Figure A–2 JXD System Error Address Register



Register Address: CPU = E110 1030 (CCA_BASE+160)

[31:30]: DL - Data length:

00 - Hexword
01 - Longword
10 - Quadword
11 - Octaword

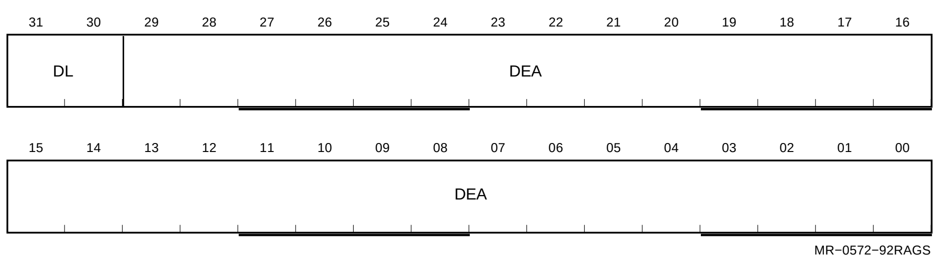
[29:00] ADR - 30-bit error address latched on CPU operations to the JXD.

A.4.3 DMA Error Address (DMAADR) Register

When a single-bit ECC error is detected at the JXD, the current DMA sub-transfer address into main memory is latched in this register and an IPL29 interrupt is generated. Software allows the DMA to complete and later use this information to fix the bad location in memory (Figure A–3).

All bits in this register have the following characteristics: default = 0, type = ro, reset = hr.

Figure A–3 JXD DMA Error Address Register



Register Address: CPU = E110 1040 (CCA_BASE+180)

[31:30]: DL - DMA data length:

00 - Hexword
01 - Longword
10 - Quadword
11 - Octaword

[29:00]: DEA - DMA 30-bit address latched during error.

A.4.4 Reset Reason 0013 Fault Analysis

The following example shows the content of the SYSFLT and SYSADR registers after a Reset Halt. The following paragraph analyzes the register content and identifies the faulty FRU.

```
?03 Reset (Reason = 0013)

  PC= 01E00000 PSL= 041F0300

>>> E/P 1E9AD5C             ! examine saved SYSFLT register contents
                            ! from CCA_BASE+15C
P 01E9AD5C   300000C0       ! NXIO, Zone A (bus timeout)
                            ! NXIO, Zone B (bus timeout)
                            ! XLINK MODE = Duplex

>>> E/P 1E9AD60             ! examine saved SYSADR register contents
                            ! from CCA_BASE+160
P 01E9AD60   799F0000       ! Zone B, slot 17 P-card address

                                     CCA Base Address
                               MEMORY SIZE       CCA_BASE
                               --------------------------
                                32-Mbyte         1E9AC00
                                64-Mbyte         3E9AC00
                                96-Mbyte         5E9AC00
                               128-Mbyte         7E9AC00
                               160-Mbyte         9E9AC00
                               192-Mbyte         BE9AC00
                               224-Mbyte         DE9AC00

                               256-Mbyte         FE9AC00
```

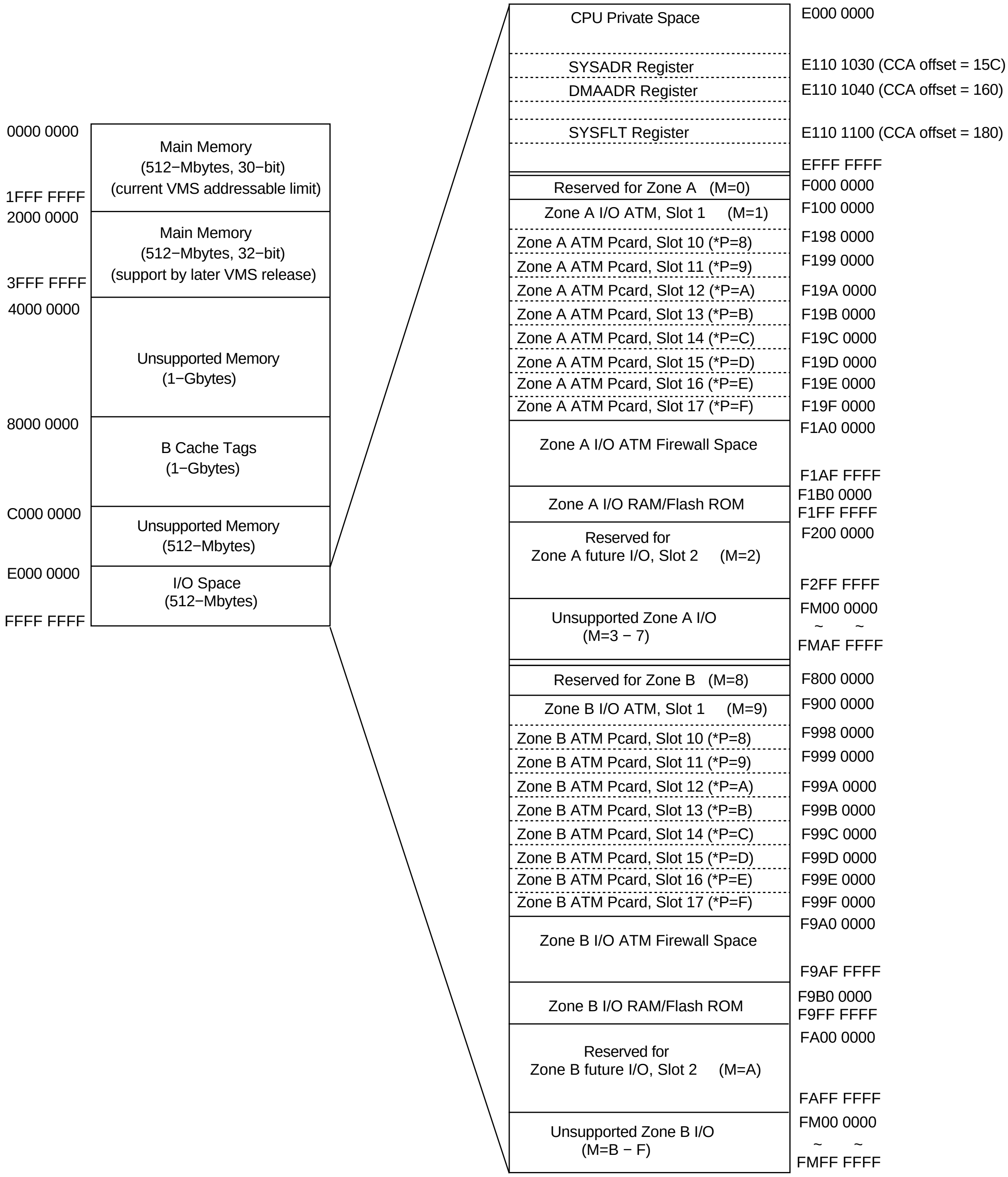
The SYSFLT register indicates a NXIO (nonexistent I/O) error. The SYSADR register contains a 30-bit address of 399F0000. However, after sign extended to 32 bits the address is translated to F99F0000.

Figure A–4 shows that F99F0000 is the address of an interface module in Zone B, slot 17. The module failed to respond to its address causing a bus timeout. Replace the module.

A.5 I/O Physical Address Space

Figure A–4 shows the I/O physical address space.

Figure A–4 I/O Physical Address Space



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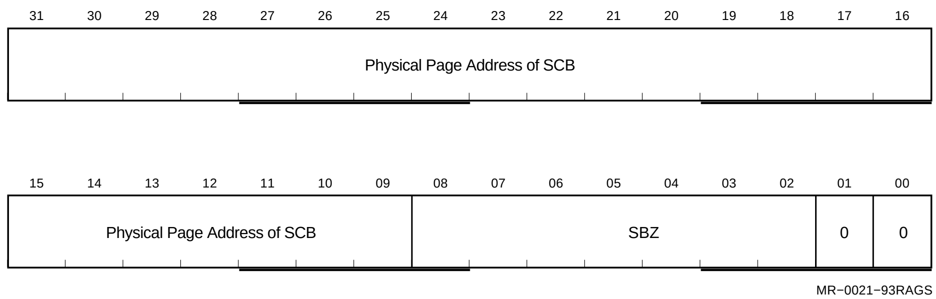
A.6 System Control Block Description

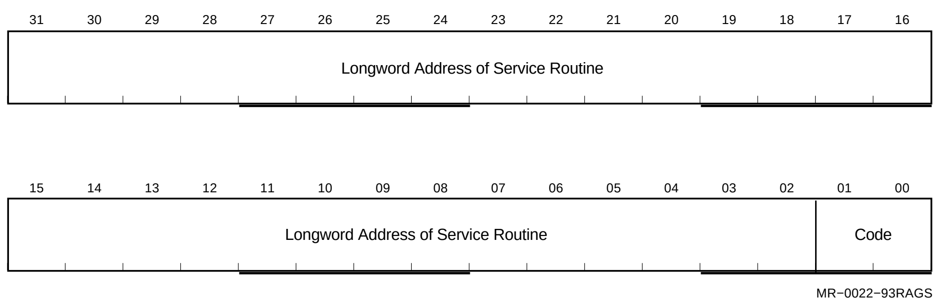
The System Control Block (SCB) contains vectors for servicing interrupts and exceptions. The SCB address should be aligned on a page boundary. The SCB address is contained in the System Control Block Base register (SCBB) (Figure A–5). Microcode forces a longword-aligned SCBB by clearing bits [01:00] of the new value before loading the register.

Figure A–5 System Control Block Base Register



An SCB vector is an aligned longword in the SCB through which the CPU microcode dispatches interrupts and exceptions. Each SCB vector has the format shown in Figure A–6.

Figure A–6 System Control Block Vector Format



[31:02]: Longword Address - Virtual address of the service routine for the interrupt or exception. The routine must be longword aligned since the microcode forces the two low-order bits to 0.

[01:00]: Code - The code field is defined in Table A–5.

Table A–5 Code Field Definition

Code	Definition
00	The event is to be serviced on the kernel stack unless the CPU is already on the interrupt stack, in which case the event is serviced on the interrupt stack.

(continued on next page)

Table A–5 (Cont.) Code Field Definition

Code	Definition
01	The event is to be serviced on the interrupt stack. If the event is an exception, the IPL is raised to 1F (hex).
10	Unimplemented, results in a console error halt.
11	Unimplemented, results in a console error halt.

The SCB content is specified in Table A–6.

Table A–6 SCB Layout

Vector	Name	Type	Parameter	Notes
00	Unused	—	—	—
04	Unused	—	—	—
08	Machine check	Abort	6	Parameters reflect machine state; must be serviced on the interrupt stack
0C	Unused	—	—	—
10	Reserved privileged instruction	Fault	0	—
14	Customer reserved instruction	Fault	0	XFC instruction
18	Reserved operand	Fault/abort	0	Not always recoverable
1C	Reserved addressing mode	Fault	0	—
20	Access control violation/ vector alignment fault	Fault	2	Parameters are virtual address and status code
24	Translation not valid	Fault	2	Parameters are virtual address and status code
28	Trace pending	Fault	0	—
2C	Breakpoint instruction	Fault	0	—
30	Unused	—	—	Compatibility mode in other VAX systems
34	Arithmetic trap	Fault	1	Parameter is type code
38 to 3C	Unused	—	—	—
40	CHMK	Trap	1	Parameter is sign-extended operand word
44	CHME	Trap	1	Parameter is sign-extended operand word

(continued on next page)

Table A–6 (Cont.) SCB Layout

Vector	Name	Type	Parameter	Notes
48	CHMS	Trap	1	Parameter is sign-extended operand word
4C	CHMU	Trap	1	Parameter is sign-extended operand word
50	Unused	—	—	—
54	Soft error notification	Interrupt	0	IPL is 1A (hex)
58 to 5C	Unused	—	—	—
60	Hard error notification	Interrupt	0	IPL is 1D (hex)
64	Unused	—	—	—
68	Vector unit disabled	Fault	0	Vector instructions
6C to 80	Unused	—	—	—
84	Software level 1	Interrupt	0	
88	Software level 2	Interrupt	0	Ordinarily used for AST delivery
8C	Software level 3	Interrupt	0	Ordinarily used for process scheduling
90 to BC	Software levels 4 to 15	Interrupt	0	—
C0	Interval timer	Interrupt	0	IPL is 16 (hex)
C4	Unused	—	—	—
C8	Emulation start	Fault	10	Same mode exception, FPD=0; parameters are opcode, PC, specifiers
CC	Emulation continue	Fault	0	Same mode exception, FPD=1; parameters are opcode, PC, specifiers
D0	Device vector	Interrupt	0	IPL is 14 (hex)
D4	Device vector	Interrupt	0	IPL is 15 (hex), includes console interrupts
D8	Device vector	Interrupt	0	IPL is 16 (hex), includes interprocessor interrupts
DC	Device vector	Interrupt	0	IPL is 17 (hex)
E0 to F4	Unused	—	—	—
F8 to FC	Unused	—	—	—
100 to FFCC	Unused	—	—	—

B

ISE Parameter Worksheets

B.1 In This Appendix

This appendix includes:

- Individual ISE parameter worksheets
- ISE zone parameter worksheets

B.2 Individual ISE Parameter Worksheets

Use the following worksheets to record parameters for each ISE.

Serial Number: ______________________________

NODENAME: ______________________________

SYSTEMID: ______________________________

ALLCLASS: ______________________________

UNITNUM: ______________________________

FORCEUNI: ______________________________

FORCENUM: ______________________________

Serial Number: ______________________________

NODENAME: ______________________________

SYSTEMID: ______________________________

ALLCLASS: ______________________________

UNITNUM: ______________________________

FORCEUNI: ______________________________

FORCENUM: ______________________________

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Serial Number: ____________________

NODENAME: ____________________

SYSTEMID: ____________________

ALLCLASS: ____________________

UNITNUM: ____________________

FORCEUNI: ____________________

FORCENUM: ____________________

Serial Number: ____________________

NODENAME: ____________________

SYSTEMID: ____________________

ALLCLASS: ____________________

UNITNUM: ____________________

FORCEUNI: ____________________

FORCENUM: ____________________

Serial Number: ____________________

NODENAME: ____________________

SYSTEMID: ____________________

ALLCLASS: ____________________

UNITNUM: ____________________

FORCEUNI: ____________________

FORCENUM: ____________________

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B.3 ISE Zone Parameter Worksheets

Use the following worksheets to record parameters for each ISE.

Serial No: ________ ***NODENAME:*** ________ ***UNITNUM:*** ________	***Serial No:*** ________ ***NODENAME:*** ________ ***UNITNUM:*** ________
Serial No: ________ ***NODENAME:*** ________ ***UNITNUM:*** ________	***Serial No:*** ________ ***NODENAME:*** ________ ***UNITNUM:*** ________
Serial No: ________ ***NODENAME:*** ________ ***UNITNUM:*** ________	***Serial No:*** ________ ***NODENAME:*** ________ ***UNITNUM:*** ________
Serial No: ________ ***NODENAME:*** ________ ***UNITNUM:*** ________	***Serial No:*** ________ ***NODENAME:*** ________ ***UNITNUM:*** ________
Serial No: ________ ***NODENAME:*** ________ ***UNITNUM:*** ________	***Serial No:*** ________ ***NODENAME:*** ________ ***UNITNUM:*** ________
Serial No: ________ ***NODENAME:*** ________ ***UNITNUM:*** ________	***Serial No:*** ________ ***NODENAME:*** ________ ***UNITNUM:*** ________

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Serial No:
NODENAME:
UNITNUM:

Serial No:
NODENAME:
UNITNUM:

Serial No:
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