

---

# VAXstation 4000 VLC Service Information

Order Number: EK-V48VB-SV.001

<set\_trademark\_table>(no\_list)

---

**November 1991**

<set\_fcc\_warning>(a)

© Digital Equipment Corporation 1990.

All Rights Reserved.

The following are trademarks of Digital Equipment Corporation: DEC, Digital, the DIGITAL logo, Ethernet, ThinWire, VAX, VAXstation, and VMS.

This document was prepared using VAX DOCUMENT, Version 2.0.

---

# Contents

<b>Preface</b> .....	xi
<b>1 VAXstation 4000 VLC System Components</b>	
1.1 Overview .....	1-1
1.2 Central Processor Unit .....	1-6
1.2.1 Processor Restart .....	1-8
1.2.2 Interrupt Controller .....	1-9
1.2.3 Interrupt Sources and Ranking .....	1-10
1.2.4 Interrupt Vector Generation .....	1-10
1.3 Main Memory .....	1-11
1.3.1 Main Memory Requests .....	1-12
1.3.2 DMA Mapping .....	1-13
1.3.3 Translation .....	1-13
1.4 ROM Memory .....	1-14
1.4.1 System ROM .....	1-14
1.4.2 Network Address ROM .....	1-14
1.5 Graphics Controller .....	1-15
1.5.1 Graphics Controller Screen Formats .....	1-16
1.5.2 Graphics Controller Communication .....	1-16
1.6 Serial Line Controller Feature .....	1-17
1.6.1 Serial Line Controller Registers .....	1-17
1.7 Time-of-Year Clock .....	1-18
1.7.1 Battery Backup .....	1-18
1.7.2 TOY Clock Chip Register .....	1-18
1.8 Network Controller Feature .....	1-20
1.8.1 Packet Format .....	1-20
1.8.2 Network Addresses .....	1-21
1.9 SCSI Controller Feature .....	1-21
1.9.1 SCSI Bus Signals .....	1-22

## 2 VAXstation 4000 VLC System Configuration

2.1	VAXstation 4000 VLC System Box . . . . .	2-1
2.1.1	Mass Storage Device . . . . .	2-3
2.1.2	Power Supply . . . . .	2-3
2.1.2.1	Power Supply Specifications . . . . .	2-4
2.1.3	VAXstation 4000 VLC System Controls . . . . .	2-6
2.1.4	System Box Internal Cabling . . . . .	2-7
2.1.5	VAXstation 4000 VLC I/O Panel . . . . .	2-7
2.1.6	VAXstation 4000 VLC System Box Specifications . . . . .	2-8

## 3 VAXstation 4000 VLC Firmware

3.1	Power-Up Initialization Code . . . . .	3-2
3.2	Console Overview . . . . .	3-3
3.3	Extended Self Test Overview . . . . .	3-4
3.4	Utilities Overview . . . . .	3-5
3.5	System ROM Overview . . . . .	3-6
3.5.1	System ROM Part Format . . . . .	3-6
3.5.2	System ROM Set Format . . . . .	3-7
3.6	Configuration Table Overview . . . . .	3-9
3.6.1	Main Configuration Table . . . . .	3-10
3.6.2	Device Configuration Table . . . . .	3-11
3.7	Driver Descriptor . . . . .	3-15
3.8	Interfacing to Diagnostic Drivers . . . . .	3-17
3.9	Console Driver Interface . . . . .	3-19
3.9.1	Shared Console Interface Area . . . . .	3-20
3.9.2	Console Port Driver . . . . .	3-22

## 4 Diagnostic Testing

4.1	Diagnostic Testing . . . . .	4-1
4.1.1	Power-Up Test . . . . .	4-2
4.1.2	Displaying System Configuration . . . . .	4-4
4.1.3	Displaying System Errors . . . . .	4-6
4.2	Running the Self Test . . . . .	4-7
4.2.0.1	TOY/NVR Self Test . . . . .	4-8
4.2.0.2	LCG Self Tests . . . . .	4-9
4.2.0.3	DZ Self Test . . . . .	4-10
4.2.0.4	Cache Self Test . . . . .	4-11
4.2.0.5	System Self Test . . . . .	4-11
4.2.0.6	Floating Point Unit Self Test . . . . .	4-11
4.2.0.7	Interval Timer Self Test . . . . .	4-12

4.2.0.8	Memory Self Test .....	4-12
4.2.0.9	Network Interconnect Self Test .....	4-13
4.2.0.10	SCSI Self Test .....	4-14
4.2.0.11	Audio Self Test .....	4-14
4.3	Utilities .....	4-15
4.4	System Console .....	4-17
4.4.1	SET and SHOW Commands .....	4-18
4.4.1.1	SET and SHOW Command Syntax .....	4-19
4.4.2	SET and SHOW Parameters .....	4-19
4.4.2.1	BFLG .....	4-19
4.4.2.2	BOOT .....	4-20
4.4.2.3	CONFIG .....	4-20
4.4.2.4	DEVICE .....	4-21
4.4.2.5	DIAGENV .....	4-22
4.4.2.6	ERROR .....	4-23
4.4.2.7	ETHER .....	4-23
4.4.2.8	FBOOT .....	4-24
4.4.2.9	HALT .....	4-24
4.4.2.10	KBD .....	4-25
4.4.2.11	MEM .....	4-25
4.4.2.12	MOP .....	4-26
4.4.2.13	PSE and PSWD .....	4-26
4.4.2.14	SCSI .....	4-27
4.4.2.15	TRIGGER .....	4-27
4.4.2.16	VER .....	4-27
4.4.3	Memory Commands .....	4-28
4.4.3.1	DEPOSIT Commands .....	4-28
4.4.3.2	EXAMINE Commands .....	4-29
4.4.3.3	FIND .....	4-31
4.4.4	Processor Control Commands .....	4-31
4.4.4.1	BOOT .....	4-32
4.4.4.2	CONTINUE .....	4-33
4.4.5	INITIALIZE and UNJAM .....	4-33
4.4.5.1	START .....	4-33
4.4.5.2	Miscellaneous Console Commands .....	4-34
4.4.5.3	HELP or ? .....	4-34
4.4.5.4	LOGIN .....	4-34
4.4.5.5	REPEAT .....	4-34

## 5 Removing and Replacing FRUs

5.1	Cautions and Warnings . . . . .	5-1
5.2	VAXstation 4000 VLC FRUs . . . . .	5-2
5.3	System Preparation . . . . .	5-5
5.4	Mass Storage Drive Removal . . . . .	5-7
5.4.1	Hard Disk Drive Replacement . . . . .	5-9
5.5	Power Supply Removal . . . . .	5-11
5.5.1	Power Supply Replacement . . . . .	5-12
5.6	Removing the LCG Module . . . . .	5-13
5.7	Removing the System Module . . . . .	5-13
5.7.1	System Module (CPU) Replacement . . . . .	5-14
5.8	MS40 Memory Module Removal . . . . .	5-14
5.8.0.1	MS40 Memory Module Replacement . . . . .	5-16
5.9	Clearing the System Password . . . . .	5-17
5.10	Testing the VAXstation 4000 VLC System . . . . .	5-18
5.10.1	Restore the System . . . . .	5-18
5.10.2	Test the System . . . . .	5-19

## A Self-Test Error Codes

A.1	Self-Test Error Codes . . . . .	A-1
A.1.1	NVR Self-Test Error Codes . . . . .	A-1
A.1.2	DZ Self-Test Error Codes . . . . .	A-2
A.1.3	Memory Self-Test Error Codes . . . . .	A-5
A.1.4	Memory Management Unit Self-Test Error Codes . . . . .	A-6
A.1.5	Interval Timer Self-Test Error Codes . . . . .	A-7
A.1.6	System Device Self-Test Error Codes . . . . .	A-7
A.1.7	SCSI Self-Test Error Codes . . . . .	A-8
A.1.8	Audio Self-Test Error Codes . . . . .	A-17
A.1.9	Floating Point Unit (FPU) Self-Test Error Codes . . . . .	A-19
A.1.10	Cache Self-Test Error Codes . . . . .	A-22
A.1.11	LCG Self-Test Error Codes . . . . .	A-23
A.1.12	NI Self-Test Error Codes . . . . .	A-29

## B Diagnostic LED Error Codes

B.1	Reading Diagnostic LED Codes . . . . .	B-1
B.1.1	Powerup/Initialization LED Codes, XXXX zzzz . . . . .	B-2
B.1.2	TOY/NVR LED Codes, OOOX zzzz . . . . .	B-3
B.1.3	DZ LED Codes, OOXX zzzz . . . . .	B-3
B.1.4	Memory LED Codes, OXOX zzzz . . . . .	B-4
B.1.5	System Device LED Codes, XOOO zzzz . . . . .	B-4

B.1.6	SCSI Device LED Codes, XOXO zzzz .....	B-4
B.1.7	LCG LED Codes, OOXO zzzz .....	B-5
B.1.8	NI Device LED Codes, XOOX zzzz .....	B-6
B.1.9	Synchronous Communication Device LED Codes, XXOO zzzz .....	B-6
B.1.10	Cache LED Code, OXOO zzzz .....	B-8

## C Troubleshooting

C.1	Troubleshooting Symptoms and Corrective Actions .....	C-2
-----	---	-----

## D VAXstation 4000 VLC Part Numbers

D.1	Part Numbers .....	D-1
-----	--------------------	-----

## Index

### Examples

4-1	SHOW DEVICE Command .....	4-4
4-2	Sample Show Config Display .....	4-5
4-3	Sample Showing System Errors .....	4-6

### Figures

1-1	System Module Major Components .....	1-3
1-2	System Module Internal Connectors .....	1-5
1-3	VAXstation 4000 VLC System Module Block Diagram .....	1-7
1-4	Command Packet General Format .....	1-16
1-5	Ethernet Packet Format .....	1-20
2-1	VAXstation 4000 VLC System Box .....	2-2
2-2	Cricket Retaining Clip .....	2-3
2-3	Right Side of the System Box .....	2-6
2-4	VAXstation 4000 VLC I/O Panel .....	2-8
3-1	System ROM Format .....	3-6
3-2	Configuration Tables .....	3-9
3-3	Main Configuration Tables .....	3-10
3-4	Device Configuration Table .....	3-12
3-5	Driver Descriptor Data Structure .....	3-16



3-6	Diagnostic Drive Console Support .....	3-17
3-7	Console Structure .....	3-19
3-8	SCIA Data Structure .....	3-21
3-9	Console Port Driver Function Block .....	3-22
4-1	Successful Power-Up .....	4-2
4-2	Unsuccessful Power-Up .....	4-3
4-3	Successful and Unsuccessful Self Test .....	4-7
4-4	Utilities List .....	4-16
5-1	Location of System Box FRUs .....	5-2
5-2	Rear View of the System Box .....	5-3
5-3	Right Side View of the System Box .....	5-4
5-4	Removing the cover .....	5-6
5-5	Removing the RZ23L Hard Disk Drive .....	5-7
5-6	RZ23L SCSI and Power Cables .....	5-8
5-7	RZ23L Disk Drive SCSI ID Jumper Location .....	5-9
5-8	Power Supply Removal .....	5-12
5-9	Password Clearing Points .....	5-17

## Tables

1-1	CPU Restart Codes .....	1-8
1-2	Interrupt Signal Sources .....	1-10
1-3	Interrupt Vectors .....	1-11
1-4	Graphics Controller Screen Formats .....	1-16
1-5	Serial Line Usage .....	1-17
1-6	Serial Line Controller Register Addresses .....	1-18
1-7	TOY Chip Register Addresses .....	1-19
2-1	Devices and Cable Part Numbers .....	2-7
2-2	VAXstation 4000 VLC System Box Operating Conditions ...	2-9
2-3	VAXstation 4000 VLC System Box Electrical Specifications .....	2-9
3-1	Directory Type Definitions .....	3-14
3-2	Data Path Size Definitions .....	3-14
3-3	Flag Definitions .....	3-15
4-1	Running Self Test Using the Test Command .....	4-7
4-2	Device Number and Self-Test Commands .....	4-8
4-3	SET and SHOW Parameters .....	4-18

4-4	Diagnostic Environments .....	4-22
4-5	SET DIAGENV Command .....	4-22
5-1	Hard Disk Drive SCSI Jumper Settings.....	5-10
A-1	TOY/NVR Self-Test Error Codes .....	A-1
A-2	DZ Self-Test Error Codes .....	A-2
A-3	DZ Suberror Codes .....	A-3
A-4	Memory Self-Test Error Codes .....	A-5
A-5	Memory Management Unit Self-Test Error Codes .....	A-6
A-6	Interval Timer Self-Test Error Codes .....	A-7
A-7	System Device Self-Test Error Codes .....	A-7
A-8	SCSI Self-Test Error Codes .....	A-8
A-9	Audio Self-Test Error Codes .....	A-17
A-10	FPU Self-Test Error Codes .....	A-19
A-11	Cache Self-Test Error Codes.....	A-22
A-12	LCG Self-Test Error Codes .....	A-23
A-13	NI Self-Test Error Codes .....	A-29
B-1	Powerup and Initialization LED Codes .....	B-2
B-2	TOY and NVR LED Codes .....	B-3
B-3	DZ LED Codes .....	B-3
B-4	Memory LED Codes .....	B-4
B-5	System Device LED Codes .....	B-4
B-6	SCSI Device LED Codes.....	B-5
B-7	LCG LED Codes.....	B-5
B-8	NI LED Codes .....	B-6
B-9	Synchronous Communication Device LED Codes .....	B-7
B-10	Cache LED Codes .....	B-8
C-1	System Problems .....	C-3
C-2	Monitor Problems .....	C-6
C-3	Mouse and Tablet Problems .....	C-6
C-4	Keyboard Problems .....	C-7
C-5	Drive Problems .....	C-7
C-6	Network Problems .....	C-7
C-7	Expansion Box Problems .....	C-9
D-1	FRU Part Numbers .....	D-2
D-2	Miscellaneous FRU Part Numbers .....	D-3
D-3	System and Expansion Box Cables and Terminators .....	D-3
D-4	Expansion Box (SZ03) FRU Part Numbers .....	D-4

D-5	Expansion Box (SZ16) FRU Part Numbers .....	D-4
D-6	VAXstation 4000 VLC Monitors .....	D-5
D-7	Monitor and Graphic Module Cross Reference .....	D-6

---

## Preface

This manual is a support and reference document for Digital Service personnel who perform maintenance tasks on the VAXstation 4000 VLC workstation. It is also for qualified Digital customers who have a self-maintenance agreement with Digital Equipment Corporation.

### Organization of this Manual

This manual contains the following chapters:

- Chapter 1 - Provides an overview of the VAXstation 4000 VLC system features, main memory, network interface and SCSI controllers.
- Chapter 2 - Provides configuration information for the VAXstation 4000 VLC system.
- Chapter 3 Presents an overview of the VAXstation 4000 VLC diagnostic firmware.
- Chapter 4 - Provides information on diagnostic testing.
- Chapter 5 - Provides information on how to remove and replace system FRUs.
- Appendix A - Contains the Self Test Error tables.
- Appendix B - Contains the Diagnostic LED Error tables.
- Appendix C - Contains the Troubleshooting/Problem Isolation tables.
- Appendix D - Contains the Field Replaceable Unit (FRU) part number tables.

## Associated Documentation

The following documents provide additional information which is closely related to the VAXstation 4000 VLC system:

- *VAXstation 4000 VLC Owner's Manual*  
Part number EK-VAXVL-OG
- *VAXstation 4000 VLC and Model 60 Operation Installation Guide*  
Part number EK-PMARI-IG
- *VAXstation 4000 VLC Pocket Service Guide*  
Part number EK-V466H-PS

## Conventions

The conventions are used in this manual.

<b>Convention</b>	<b>Description</b>
<b>WARNING</b>	Contains important information about personal safety.
<b>CAUTION</b>	Contains information to prevent damage to the equipment.
<b>NOTE</b>	Contain general information.
<b>PN</b>	Part number
<b>SHOW ERRORS</b>	Commands are shown in all capital letters to distinguish them from text.

---

# VAXstation 4000 VLC System Components

This chapter describes the modules and features of the VAXstation 4000 VLC system. Information about the central processor (CPU), main memory, network interface, SCSI controller, and other components of the system are included.

## 1.1 Overview

The VAXstation 4000 VLC system module (PN 54-20768-01) forms the basis of the entire system. The VAXstation 4000 VLC system is a single-user engineering workstation, which includes the following:

- LK401 keyboard
- VSXXX-AA mouse or VSXXX-AB tablet
- Monochrome or color video monitor
- Mass storage device
- SCSI Ethernet controllers

## VAXstation 4000 VLC System Components

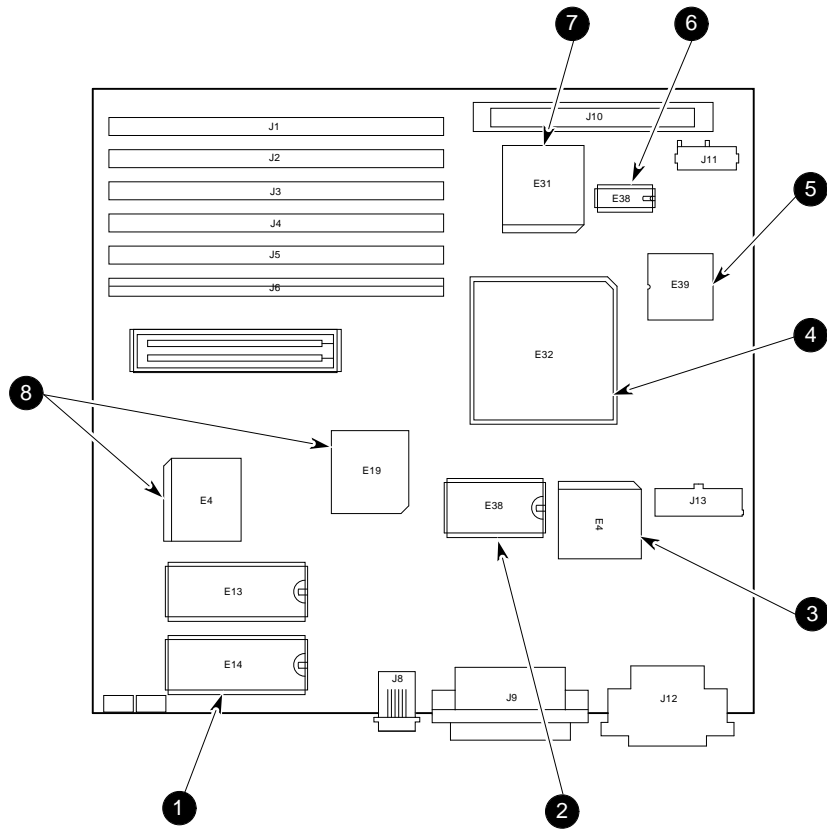
### 1.1 Overview

Figure 1-1 shows the major components of the system module.

- ❶ Base system ROMs
- ❷ TOY clock
- ❸ SCSI controller
- ❹ S-chip
- ❺ SOC chip
- ❻ Ethernet address ROM
- ❼ Ethernet controller
- ❽ VAXstation 4000 VLC ASICs (Application Specific Integrated Circuits)

# VAXstation 4000 VLC System Components 1.1 Overview

Figure 1-1 System Module Major Components



LJ-00963-T10



## VAXstation 4000 VLC System Components

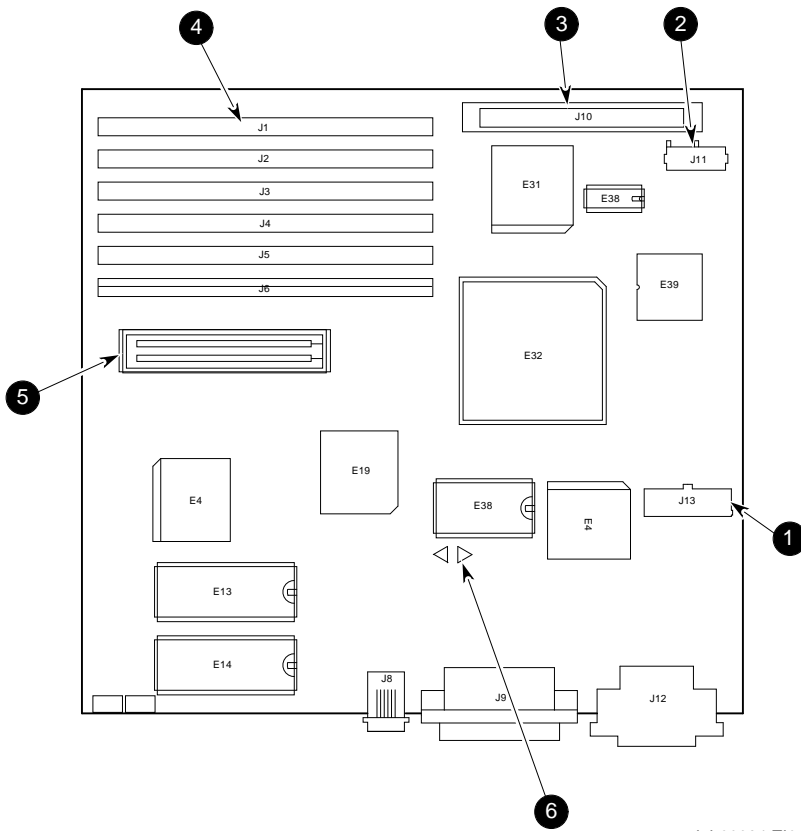
### 1.1 Overview

Figure 1–2 shows the internal connector locations of the system module. Section 2.1.3 and Section 2.1.5 describe the system module external connectors.

- ❶ Power connector
- ❷ Mass storage connector
- ❸ SCSI connector
- ❹ Memory module connectors
- ❺ Graphics module connector
- ❻ NVR reset pads

## VAXstation 4000 VLC System Components 1.1 Overview

Figure 1-2 System Module Internal Connectors



LJ-00964-T10

## VAXstation 4000 VLC System Components

### 1.2 Central Processor Unit

## 1.2 Central Processor Unit

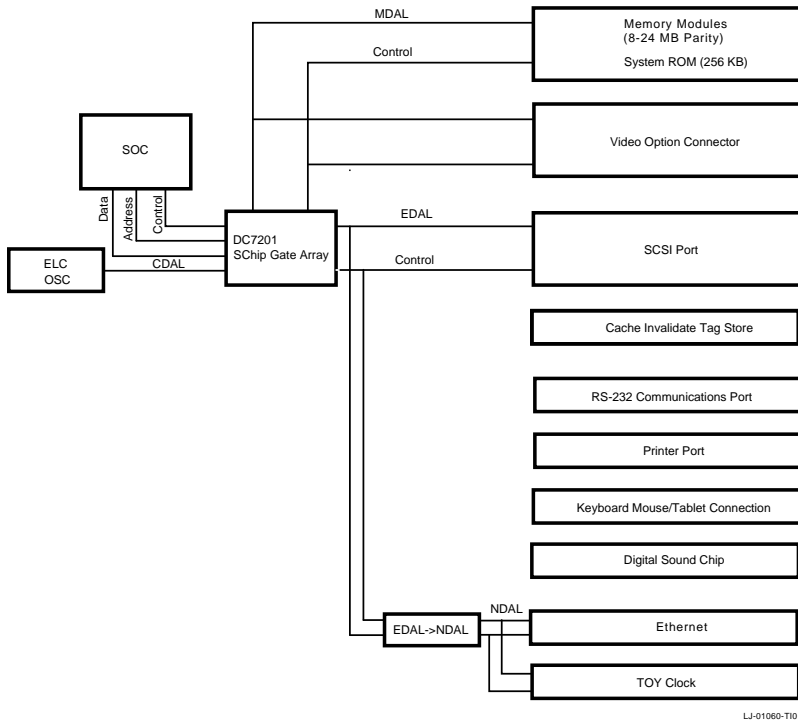
The Central Processor Unit (CPU) chip is a 32-bit virtual memory microprocessor with integral floating point capability and on-chip cache, derived from the CVAX CPU, CFPA floating point unit and CVAX clock chips. The CPU key features are

Feature	Description
Subset of VAX computer data types	Byte, word, longword, quadword, character string, variable-length bit field, and support for <code>f_floating</code> and <code>g_floating</code> point data types.
Full base instruction group	Integer and logical, address, variable-length bit field, control, procedure call, queue, character string instructions CMPC3/CMPC5, LOCC, MOVC3/MOVC5, SCANC, SKPC and SPANC, and operating system support. <code>f_floating</code> , The CFP chip supports <code>d_floating</code> and <code>g_floating</code> point instructions.
Full VAX memory management	Includes a demand paged memory management unit fully compatible with VAX computer memory management. System space addresses are virtually mapped through single-level page tables; process space addresses are virtually mapped through double-level page tables. Supports four gigabits of virtual memory and up to one gigabits of physical memory.
On-chip memory cache	The CPU chip has 8 Kbytes of on-chip cache to improve execution times by minimizing the use of the memory subsystem.

Figure 1–3 is a block diagram of the VAXstation 4000 VLC system module.

## VAXstation 4000 VLC System Components 1.2 Central Processor Unit

**Figure 1-3 VAXstation 4000 VLC System Module Block Diagram**



## VAXstation 4000 VLC System Components

### 1.2 Central Processor Unit

#### 1.2.1 Processor Restart

When the processor is signaled by the SYSRESET\_L or HALT\_L pins, or when it detects a severe corruption of its operating environment, it performs a restart process which saves some context in internal processor registers SAVPC and SEVPSL. The processor changes to the un-mapped mode, and begins to execute from the system ROM at address 2004.0000. The SAVPSL register contains a restart code that indicates the cause of the restart.

The systems console firmware determines which restarts are delivered to the operating system and which are displayed on the operator's console. The restart codes (in hex) are listed in Table 1-1.

**Table 1-1 CPU Restart Codes**

Code	Reason
2	Halt asserted
3	Power on
4	Interrupt stack not valid during exception
5	Machine check normal exception
6	Halt instruction executed in kernel mode
7	SCB vector bits <1:0>=11
8	SCB vector bits <1:0>=10
A	CHMx executed while on interrupt stack
10	ACV or TNV during machine check exception
11	ACV or TNV during kernel stack not valid exception
12	Machine check during machine check exception
13	Machine check during kernel stack not valid exception
19	PSL<26:24>=101 during interrupt or exception
1A	PSL<26:24>=110 during interrupt or exception
1B	PSL>26:24>=111 during interrupt or exception
1D	PSL<26.24>=101 during REI
1E	PSL<26.24>=110 during REI
1F	PSL<26.24>=111 during REI

## VAXstation 4000 VLC System Components 1.2 Central Processor Unit

The CPU restart process sets the state of the chip as follows:

SAVPC	Saved PC
SAVPSL	Saved PSL <31:16, 7:0> in <31:16, 7:0> Saved MAPEN <0> in <15> Valid stack flag in <14> saved restart code in <13:8>
SP	interrupt stack pointer
PSL	041F 0000 (hex)
PC	2004 0000 (hex)
MAPEN	0
SISR	0 (power-on only)
ASTLVL	4 (power-on only)
ICCS	0 (power-on only)
MSER	0 (power-on only)
CADR	0 (power-on only)
	All else else undefined

### 1.2.2 Interrupt Controller

The interrupt controller section of the S-chip receives eight interrupt request signals from the system I/O devices, and synchronizes and latches them. The eight latched requests are then masked by individual Enable bits and the eight results are read to form a single interrupt. The interrupt is presented to the CPU on IRQ1\_L, interrupt priority level 15 (HEX).

The controller contains three 8-bit registers:

INT_REQ	Holds the latched interrupt requests received from I/O devices (read-only).
INT_MSK	Contains a mask which determines which interrupt requests will generate a processor interrupt (read/write).
INT_CLR	Enables a program to selectively reset interrupt request bits in the INT_REQ register (write-only).

## VAXstation 4000 VLC System Components

### 1.2 Central Processor Unit

#### 1.2.3 Interrupt Sources and Ranking

There are eight interrupt sources, listed in Table 1–2. The interrupt numbers 7:0 indicate their bit positions in the registers and their relative priority when more than one request is pending; 7 is the highest priority.

Interrupts 0, 1, 4, and 5 are dedicated to devices on the VLC system module. Interrupts 2 and 3 come from optional devices.

**Table 1–2 Interrupt Signal Sources**

Number	Name	Source
6	ST	79C30 controller request for service
5	AR	Asynchronous line receiver done or silo full
4	AT	Asynchronous line transmit done
3	G1	Graphics
2	G0	Graphics
1	NI	Network controller
0	SC	Storage controller

#### 1.2.4 Interrupt Vector Generation

When the CPU acknowledges an interrupt from the interrupt controller, the interrupt controller causes a vector number to be placed on the CDAL bus that corresponds to the highest priority pending interrupt. The interrupt controller obtains this vector number from a reserved location in the system module on board ROM. The conventional vector values established by the ROM firmware for the eight devices are listed in Table 1–3.

## VAXstation 4000 VLC System Components

### 1.2 Central Processor Unit

**Table 1–3 Interrupt Vectors**

Number	Name	Vector	P	Source
6	ST	02C4	0	79C30 request for service
5	AR	0250	0	Asynchronous serial line controller receiver done or silo full
4	AT	0254	0	Asynchronous serial line controller transmit done
3	G1	0244	0	Graphics interrupt 1
2	G0	0248	0	Graphics interrupt 0
1	NI	03F8	0	Network controller
0	SC	03FC	0	Storage controller

### 1.3 Main Memory

In the VAXstation 4000 VLC, system memory is not mounted on the system board. Memory requirements are derived from DRAM memory modules that are plugged into the system board. The system requires a minimum of 8 Mbytes (two 4-Mbyte memory modules) and can have as many as six memory modules installed, totaling 24 Mbytes.

When memory is added to a system, it must be added in pairs of memory modules yielding 8 Mbytes per pair. One memory module accommodates the low byte and the other stores the high byte. The system adjusts memory addressing automatically to always present a contiguous address range to the CPU, starting at physical address 0 and extending upwards to 1FF.FFFF.



## VAXstation 4000 VLC System Components

### 1.3 Main Memory

The S-chip arbitrates between, and services requests for, main memory cycles from several sources: the Ethernet Controller (NI), Mass Storage Controller (SCSI), CPU, and Graphics Controller (GC) section of the S-chip. To minimize interaction between the requestors, the S-chip has three buses: the CDAL, which connects to the CPU; the EDAL, which connects to the Ethernet controller and the storage controller; and the MDAL, which connects to the memory system, including Video RAMs.

The S-chip is capable of performing several types of RAM cycles: longword, quadword, and octaword. Buffering between the requestors and the memory allows these cycles to maximize the available memory bandwidth.

The Ethernet controller and SCSI controller are DMA devices. The graphics controller can generate addresses independently. All three of these devices may attempt to write to memory locations that are currently cached. To maintain cache coherency, the CPU cache is checked and, if necessary, the entry is invalidated for writes requested by any of these devices. This could impose a significant load on the CPU to check the potential invalidates. For this reason the S-chip controls a separate invalidated filter that maintains a copy of the CPU cache tags. In this way only those writes that do require a cache invalidate can disturb the CPU.

#### 1.3.1 Main Memory Requests

Main memory requests have a fixed priority as follows (highest to lowest):

- GC - shift register load
- GC - cursor buffer load
- Refresh
- NI Controller
- DC222
- Bus Adapter Controller
- SCSI Controller
- GC Address Generator

## VAXstation 4000 VLC System Components

### 1.3 Main Memory

#### 1.3.2 DMA Mapping

The Ethernet and SCSI controllers access memory using a translation table stored in main memory. A Map Base Address Register (MAP\_BASE) within the S-chip points to this reserved section of memory. The 32,768 longwords extending upwards from MAP\_BASE provide translations for the page address supplied by either DMA device. Each DMA device has a two-entry cache of current translations kept in the S-chip. The operating system allocates entries for each DMA device in the translation table.

#### 1.3.3 Translation

Each DMA controller has a 24-bit address counter for DMA transfers that has a page field (15-bits) and an address-within-page field (9-bits). When a DMA controller presents an address to the S-chip to perform a DMA cycle to or from main memory, the S-chip translates the address supplied using MAP\_BASE and the translation table contained in main memory as follows.

The bits <23:09> of the page field (the DMA controller-supplied address) are compared to the address value held in either the read or write translation cache for that DMA device. If the addresses match and if the entry is marked valid, the associated page address held in a field of the cache entry is connected with the address-within-page field of the supplied address to form the actual address to be used and the DMA cycle proceeds.

If the address match failed, indicating that the DMA transfer is to an address on a different page than the last DMA transfer the device initiated, bits <23:09> of the DMA address supplied are connected with bits <24:17> of MAP\_BASE to form a new 23-bit longword aligned map register address. This address is used to retrieve data from the translation table in main memory. Bits <15:00> of the data that returned from memory are connected with the original address-within-page bits supplied by the controller to form a 25-bit address that is the actual address to be accessed. Bits <15:00> that were retrieved from the translation table are stored as a new value in the appropriate translation cache associated with the DMA device and the valid bit set for the entry.

## VAXstation 4000 VLC System Components

### 1.4 ROM Memory

## 1.4 ROM Memory

The VAXstation 4000 VLC ROM contains the processor restart, diagnostic, console code, and bootstrap programs.

### 1.4.1 System ROM

The system ROM data is stored in two EPROM chips that hold 256 Kbytes of data. The data is in physical addresses 2004.0000 through 2007.FFFF. The ROM data path is 32 bits wide. Some physical addresses in the ROM have fixed use.

2004.0000	Processor restart address. The processor begins execution at this address in non-mapped mode when a processor restart occurs.
2004.0004	System type register <code>SYS_TYPE</code> . The contents of this longword supplement the internal processor <code>SID</code> register to identify the processor and system type.
2004.0020	Interrupt vector numbers. Eleven consecutive longwords starting at this address are automatically referenced by the hardware to supply the interrupt vector numbers for the eleven interrupt sources connected to the interrupt controller plus the three unused hardware interrupts of the CPU.

### 1.4.2 Network Address ROM

A 32-byte ROM on the system module contains the network address for the system. Information from this ROM is read in the low-order bytes of 32 consecutive longwords at physical addresses 2009.0000 through 2009.007C. The network address occupies the first six bytes (addresses 2009.0000 through 2009.0014). The byte at 2009.0000 is the first byte to be transmitted or received in an address field of an Ethernet packet: its low-order bit is transmitted or received first in the serial bit stream.

## VAXstation 4000 VLC System Components

### 1.5 Graphics Controller

## 1.5 Graphics Controller

The graphics controller is a part of the memory control section of the S-chip. The graphics controller competes with other devices for memory cycles. Graphics operations, however, have the lowest priority of all devices requesting memory cycles.

The graphics controller supports both 8-plane and single-plane 2D graphics and can execute the most commonly used primitives of DECwindows. The controller draws by way of linear addressing. The types of operations supported are

- Lines
- One, two, and three operand rasterops
- Text

Rasterops can be

- Solid colored
- Tiled
- Stippled
- Color expanded
- Plane compacted

All operations can be performed to the frame buffer and non-displayable main system memory using virtual addressing with multiple clipping rectangles for overlapping window hardware support.

The VAXstation 4000 VLC workstation has no video frame buffer; one of several video option modules can be added to the system module to provide the frame buffer from which pixels are output to the monitor. The video option modules carry video RAMS, pixel timing, and output digital-to-analog conversion/level sifters. The interface to the system module is at the "nibble" level, one quarter of the pixel rate.

## VAXstation 4000 VLC System Components

### 1.5 Graphics Controller

#### 1.5.1 Graphics Controller Screen Formats

The graphics controller supports several formats, which may not be supported by individual video frame buffer modules. Table 1–4 lists the screen formats supported by the graphics controller.

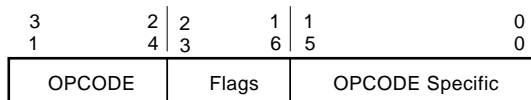
**Table 1–4 Graphics Controller Screen Formats**

Format	Color	Monochrome	Refresh Rate
1280 x 1024	Supported	Supported	66 Hz
1024 x 768	Supported	Supported	TBS
800 x 600	Supported	Not Supported	60 Hz
1024 x 864	Supported	Supported	60 Hz

#### 1.5.2 Graphics Controller Communication

Commands are passed from the CPU to the graphics controller in variable length packets. The controller accepts the command packet data and, if it is not busy and if the Clip List feature is not enabled, loads the command directly into its registers for execution. If the graphics controller is busy, or the Clip List feature is enabled, the command packet data is written by the controller into a circular buffer area in main memory - the LCG Command FIFO. The size and location of the FIFO are two of the setup parameters required by the graphics controller. Figure 1–4 shows a command packet.

**Figure 1–4 Command Packet General Format**



... More Longwords, specified by <23:22> in FLAGS above

LJ-00125-T10

## VAXstation 4000 VLC System Components

### 1.6 Serial Line Controller Feature

## 1.6 Serial Line Controller Feature

The system module serial line controller handles four asynchronous serial lines. The controller and a 48-entry silo shared by all four receive lines are parts of the S-chip. The four serial lines are numbered 0 through 3, and each has a particular primary use, as listed in Table 1-5.

**Table 1-5 Serial Line Usage**

Line	Device
0	Keyboard Connected to 4-pin modular jack (MJ) mounted on the video module. Data leads only. Supports the LK401 Keyboard
1	Pointer Connected to a miniature DIN connector mounted on the video module. Data leads only. Supports VSXXX-AA mouse or VSXXX-AB Tablet.
2	Communications Connected to a 25-pin D-sub connector mounted on the system module, RS423 compatible. Data leads plus modem control signals.
3	Printer Connected to a 6-pin MMJ mounted on the system module. DEC423 data leads only.

Line 3 connects to a printer through a BC16E cable. If a special jumper is installed in 5 on the system module, a break condition sensed on this line triggers the CPU halt signal, restarting the system with a code 2.

### 1.6.1 Serial Line Controller Registers

The serial line controller has eight addressable registers. These registers are listed in Table 1-6 with the addresses and names.

## VAXstation 4000 VLC System Components

### 1.6 Serial Line Controller Feature

**Table 1–6 Serial Line Controller Register Addresses**

Address	Name	Access	Description
200A.0000	SER_CSR	R/W	Control and status register
200A.0004	SER_RBUF	R	Receiver buffer - oldest data in silo
200A.0004	SER_LPR	W	Line parameter register
200A.0008	SER_TCR	R/W	Transmitter control register
200A.000C	SER_MSR	R	Modem status register
200A.000C	SER_TDR	W	Transmitter data register
200A.0010	DZ_LPR0	R	Line parameter register, line 0
200A.0014	DZ_LPR1	R	Line parameter register, line 1
200A.0018	DZ_LPR2	R	Line parameter register, line 2
200A.001C	DZ_LPR3	R	Line parameter register, line 3

## 1.7 Time-of-Year Clock

The time-of-year (TOY) clock is a watch chip that keeps the date and time of day. The chip contains 50 bytes of general purpose RAM storage and a 32.768 KHz time base oscillator. An internal battery powers the chip and oscillator while the system is off.

### 1.7.1 Battery Backup

A battery in the TOY chip supplies power to the clock while system power is off. This battery should last 10 years.

### 1.7.2 TOY Clock Chip Register

The TOY clock chip contains 64 8-bit registers. Ten of the registers contain date and time data, four are control and status registers, and the remaining 50 provide general purpose RAM storage. The registers occupy 64 consecutive longwords of address space, shown in Table 1–7.

Each register is accessed using bit <9:2> of the longword; bits <31:10> and <1:0> are ignored on writing and undefined on reading.

**VAXstation 4000 VLC System Components**  
**1.7 Time-of-Year Clock**

**Table 1–7 TOY Chip Register Addresses**

<b>Address</b>	<b>Name</b>	<b>Description</b>
200B.0000	WAT_SEC	Time seconds, 0...59
200B.0004	WAT_ALMS	Alarm seconds (not used)
200B.0008	WAT_MIN	Time minutes, 0...59
200B.000C	WAT_ALMM	Alarm minutes (not used)
200B.0010	WAT_HOUR	Time hours, 0...23
200B.0014	WAT_ALMH	Alarm hours (not used)
200B.0018	WAT_DOW	Day of week, 1...7
200B.001C	WAT_DAY	Day of month, 1...31
200B.0020	WAT_MON	Month of year, 1...12
200B.0024	WAT_YEAR	Year of century, 0...99
200B.0028	WAT_CSRA	Time base divisor
200B.002C	WAT_CSRB	Date mode and format
200B.0030	WAT_CSRC	Interrupt flag (not used)
200B.0034	WAT_CSRD	Valid RAM and time flag
2008.0038		First byte of RAM data
.		
.		
.		
200B.00FC		Last byte of RAM data



## VAXstation 4000 VLC System Components

### 1.7 Time-of-Year Clock

---

#### Note

---

Because each register spans two bytes on the system bus, only *word* or *longword* instructions can be used to manipulate these registers. Instructions for modifying bits such as BBSS, BBSC, BBCC and BBSCS cannot be used because they generate byte instructions for read-modify-write cycles which corrupt that portion of the register not being accessed.

---

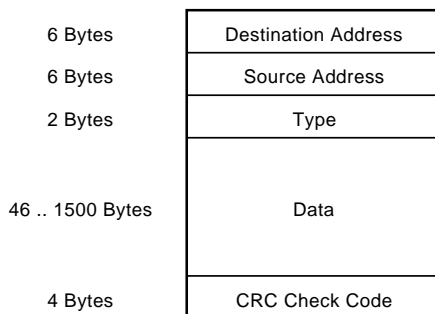
## 1.8 Network Controller Feature

The VAXstation 4000 VLC workstation can be connected to an Ethernet network by connecting a transceiver cable to a standard Ethernet connector. The network controller is part of the system module and consists of a Lance Ethernet controller chip, a serial interface adapter, an Ethernet transceiver chip, and a 15-pin D-sub connector for standard Ethernet transceiver cable.

### 1.8.1 Packet Format

Data is passed over the Ethernet at a serial data rate of 10 million bits per second in variable length packets. Each packet has the format shown in Figure 1-5.

Figure 1-5 Ethernet Packet Format



LJ-00091-T10

The minimum size of a packet is 64 bytes. Packets shorter than this are called *runt packets* and are treated as erroneous when received by the network controller.

## VAXstation 4000 VLC System Components

### 1.8 Network Controller Feature

#### 1.8.2 Network Addresses

Ethernet network addresses are 48 bits (6 bytes) long. There are two types of network addresses.

- **Physical Address:** The unique address associated with a particular workstation on the Ethernet network. Should be different from the physical address of any other workstation on that Ethernet network.
- **Multicast Address:** A multi-destination address associated with one or more workstations on a given Ethernet network (also called a logical address). There are two kinds of multicast addresses.
  - **Multicast-Group Address:** An address associated by higher-level convention with a group of logically related workstations.
  - **Broadcast Address:** A pre-defined multicast address which denotes the set of all workstations on the Ethernet network.

Bit 0 (the least significant bit of the first byte) of an address denotes the type of address.

- 0 = Physical addresses
- 1 = Multicast addresses

For either type of address, the remaining 47 bits form the address value. A value of 48 ones is always treated as the broadcast address.

The physical address of each VAXstation 4000 VLC workstation is determined before the system ships from the factory. The physical address is stored in the Ethernet Address ROM on the system module.

#### 1.9 SCSI Controller Feature

The controller conforms to the ANSI Small Computer System Interface (SCSI) specification. It has a single port, connecting to devices within the system enclosure and allowing for external expansion.

The SCSI controller interface is a single-ended, bi-directional, 8-bit wide bus. In addition to the system module, as many as seven devices can be attached to the controller. Devices can be either an initiator or target. An initiator originates an operation by sending a command to a specific target. A target performs an operation that was requested by an initiator. The VAXstation 4000 VLC workstation is always the initiator and all other SCSI devices attached to it are targets.

## VAXstation 4000 VLC System Components

### 1.9 SCSI Controller Feature

Each device attached to the SCSI bus is identified by a unique device ID number in the range 0 to 7. The device IDs of the initiator and targets are both placed on the data bus by asserting the data bits corresponding to the device ID number. This number is controlled by programs that drive the SCSI interface and is not fixed in the VAXstation 4000 VLC workstation hardware.

The interface consists of 18 signal lines; some are driven by initiators and some by targets. The bus is permanently terminated at the SCSI controller end and must always be terminated at each end. External termination can take place either at

- The expansion connector on the rear of the system enclosure
- The second expansion connector on the last storage expansion unit in the SCSI chain.

#### 1.9.1 SCSI Bus Signals

The following is a brief description of SCSI bus signals.

- DB7..0 and DBP  
Comprise an 8-bit parallel data bus with an associated odd parity bit. The use of the parity bit is optional but strongly encouraged. These lines can be driven by either an initiator or a terminator, depending upon the direction of data transfer.
- RST  
Signals all devices on the SCSI bus to reset to their initial power-on states. Thereafter, it should be asserted only as a last resort during error recovery since it indirectly affects all devices on the bus. An RST signal generated by some other device on the bus causes an internal reset of the 53C94 chip used in this controller and sets the interrupt request bit (INT in register SCS\_STATUS).
- BSY and SEL  
Are used by initiators and targets during the arbitration, selection, and re-selection bus phases to establish or resume a logical connection between an initiator and a target. Once the connection is established, the target asserts BSY and the SEL signal is not driven by anything.
- C/D, I/O and MSG  
Collectively indicate one of six possible information transfer phases, according to the following table. These signals are always driven by the target device.

**VAXstation 4000 VLC System Components  
1.9 SCSI Controller Feature**

<b>MSG</b>	<b>C/D</b>	<b>I/O</b>	<b>Phase name</b>	<b>Transfer direction</b>
0	0	0	Data out	to target
0	0	1	Data in	to initiator
0	1	0	Command	to target
0	1	1	Status	to initiator
1	0	0		(reserved)
1	0	1		(reserved)
1	1	0	Message out	to target
1	1	1	Message in	to initiator

- **ATN**

Is used by an initiator to signal a target that it has a message ready. The target can receive the message by entering the "message out" phase. ATN is always driven by an initiator.

- **REQ and ACK**

Are used to synchronize information transfers over the data bus during any of the six information transfer phases. REQ is always driven by the target. ACK is always driven by the initiator.

# 2

---

## VAXstation 4000 VLC System Configuration

This chapter describes the system box used with the VAXstation 4000 VLC workstation.

### 2.1 VAXstation 4000 VLC System Box

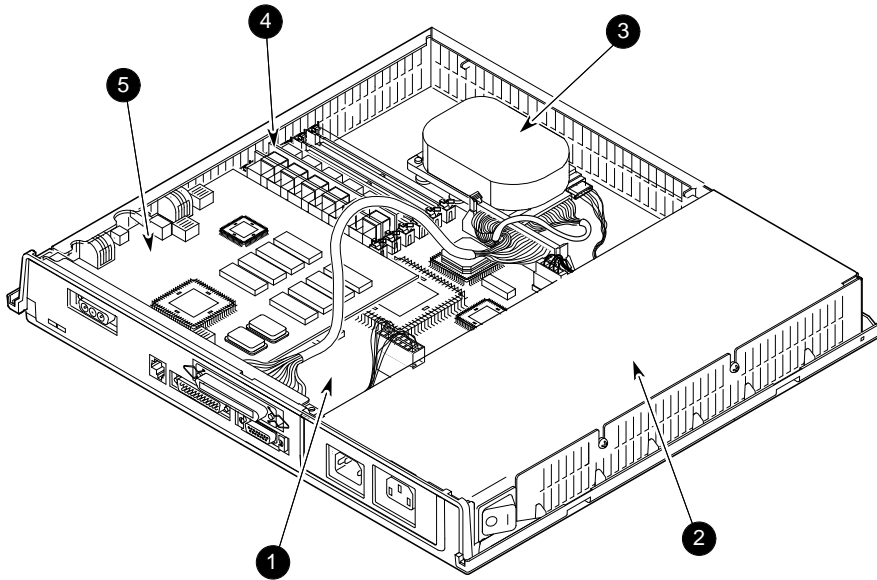
The system box is used for desktop installation of the VAXstation 4000 VLC system. Figure 2-1 shows the system box and its components. Refer to Appendix D for a complete list of field replaceable units and part numbers.

## VAXstation 4000 VLC System Configuration

### 2.1 VAXstation 4000 VLC System Box

- ❶ System module (PN 54-20768-01)
- ❷ Power supply (PN 70-22712-01)
- ❸ RZ23L 121 Mbyte disk drive (PN 70-28115-01)(Optional)
- ❹ Memory modules (PN 20-36110-05)
- ❺ Graphics/Audio modules:
  - Module-1 (PN 54-20772-01)
  - Module-2 (PN 54-20774-01)
  - Module-3 (PN 54-20776-01)
  - Module-4 (PN 54-20776-02)

Figure 2-1 VAXstation 4000 VLC System Box



LJ-00960-T10

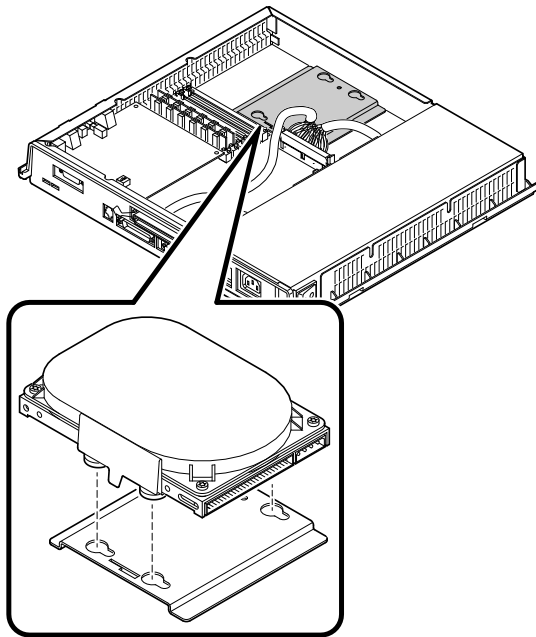
## VAXstation 4000 VLC System Configuration

### 2.1 VAXstation 4000 VLC System Box

#### 2.1.1 Mass Storage Device

The system box holds one RZ23L 121 Mbyte half-height drive. The drive is mounted using a cricket retaining clip on one side of the drive. Figure 2–2 shows the system box with the RZ23L drive removed, revealing the cricket retaining clip.

Figure 2–2 Cricket Retaining Clip



LJ-01386-T10

#### 2.1.2 Power Supply

The VAXstation 4000 VLC system box uses the Model H7109-00 power supply. This power supply has two AC power connectors, located at the rear of the metal container, to connect the system to a wall outlet and to the system monitor. The power switch and power OK LED are located on the side of the unit. There is a -9.0 V LED inside the power supply, which is visible from the outside of the power supply. The power supply also has one 12 V fan for cooling the system.

## VAXstation 4000 VLC System Configuration

### 2.1 VAXstation 4000 VLC System Box

The power supply has an automatic voltage select (AVS ) circuit to automatically select the AC input of either 100 to 120 Vac or 220 to 240 Vac. The supply is a 106 watt (W) unit. It supplies the following voltages:

Volts dc	Ampere
+5.1	10.0
+3.3	1.98
+12.1	3.5
-12.0	0.39

The H7109 supplies power to the following components:

- System module (Supplies power for option modules installed in the system.)
- Mass storage devices
- Cooling fan
- AC Power for system monitor
- LCG Controllor module

#### 2.1.2.1 Power Supply Specifications

The following tables list the power supply specifications.

Parameter	Specifications	
Line voltage	120 V	240 V
Voltage tolerance	88 V to 132 V	176 V to 264 V
Frequency	60 Hz	50 Hz
Frequency tolerance	47 Hz to 63 Hz	47 Hz to 63 Hz
Input current	2.7 A (max.) 4.0 (max)	1.2 A (max) PS only 2.0 A (max) AUX only
Inrush current	45.0 A PS only (max.) cold	45.0 A PS only (max.) cold
Power consumption (max.)	163 W	163 W



## VAXstation 4000 VLC System Configuration 2.1 VAXstation 4000 VLC System Box

### Power Supply Output Characteristics

Parameter	Specifications		
	Minimum	Typical	Maximum
+5.1 V reg. Short term	4.90 V	5.05 V	5.20 V
+5.1 V reg. Long term	+4.85 V	+5.10 V	+5.25 V
+12.1 V reg. Short term	+11.70 V	+12.10 V	+12.50 V
+12.1 V reg. Long term	+11.50 V	+12.10 V	+12.70 V
-12.0 V reg. Long term	-11.40 V	-12.00 V	-12.60 V
+3.3 V Long term	+3.13 V	+3.3 V	+3.46 V
Load range			
+3.3 V	0.80 A		1.98 A
+5.1 V	1.2 A		10.0 A
+12.1 V	0.18 A		3.5 A
-12.0 V	0.14 A		0.39 A
Ripple and noise 1Hz to 10Hz			
+3.3 V		20.0 mV	30.0 mV
+5.1 V		30.0mV	50.0 mV
+12.1 V		50.0 mV	70.0 mV
-12.0 V			120.0 mV
Ripple and noise (except +5.1 V and +3.3 V) 10 MHz to 50 MHz		1.0%	2.0%
Ripple and noise 10 MHz to 50 MHz			
+5.1 V		30 mV	50 mV
+3.3 V		20 mV	30 mV

## VAXstation 4000 VLC System Configuration

### 2.1 VAXstation 4000 VLC System Box

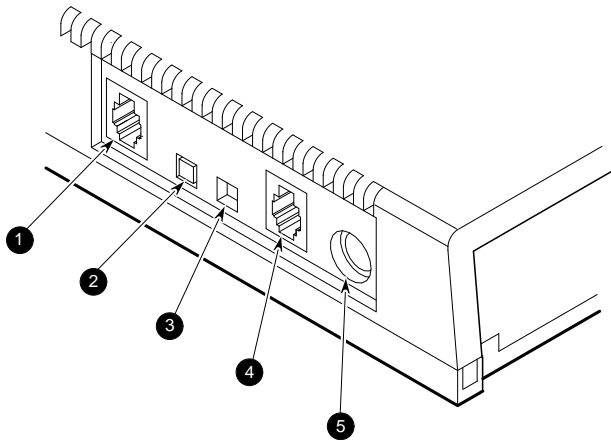
#### 2.1.3 VAXstation 4000 VLC System Controls

The AC power switch is located on the left rear of the system box. The switch controls the AC power to the power supply but does not affect the power outlet provided for add-on peripherals at the rear of the system box.

The power OK LED is a small, green indicator visible at the left front of the system box. The LED is lit when AC power is applied and the correct output voltage levels are present. Some controls and indicators for the VAXstation 4000 VLC system are located on the right rear of the system box. Figure 2-3 shows the right rear side of the system box.

- ❶ Audio In/Out - This jack is a four pin MJ type connector.
- ❷ Halt console switch - When actuated, this momentary switch sends a Halt signal to the CPU module.
- ❸ Console select switch - Use this switch to select either the graphics terminal or printer/console port as the system console.
- ❹ Keyboard connector
- ❺ Mouse connector

Figure 2-3 Right Side of the System Box



LJ-00962-T10

## VAXstation 4000 VLC System Configuration

### 2.1 VAXstation 4000 VLC System Box

#### 2.1.4 System Box Internal Cabling

Table 2–1 lists the system box cabling and cable part numbers.

**Table 2–1 Devices and Cable Part Numbers**

System Device	Cable P/N
Monitor power cable	17-00606-01
System power cable	17-00442-01
Internal power cable	17-02876-01
Internal SCSI cable	17-03191-01

#### 2.1.5 VAXstation 4000 VLC I/O Panel

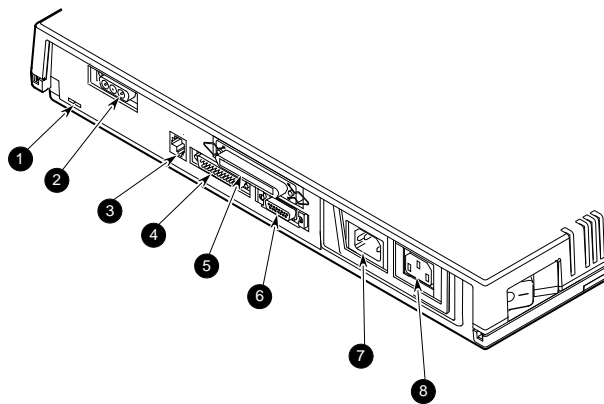
External devices connect to the I/O panel on the back of the system box. Figure 2–4 shows the rear of the system box and the I/O connectors. The system configuration determines which external devices connect to the I/O panel.

- ❶ Diagnostic LEDs
- ❷ Video monitor connector
- ❸ Printer/Console port
- ❹ RS232
- ❺ SCSI connector
- ❻ Thick-wire Ethernet connector
- ❼ AC power to H7109 power supply
- ❽ AC power for video monitor

## VAXstation 4000 VLC System Configuration

### 2.1 VAXstation 4000 VLC System Box

Figure 2-4 VAXstation 4000 VLC I/O Panel



LJ-00961-T10

#### 2.1.6 VAXstation 4000 VLC System Box Specifications

Table 2-2 lists the system box operating conditions and Table 2-3 lists the electrical specifications.

## VAXstation 4000 VLC System Configuration

### 2.1 VAXstation 4000 VLC System Box

**Table 2–2 VAXstation 4000 VLC System Box Operating Conditions**

---

Temperature range	15°C to 32°C (59°F to 90°F) (with tape or floppy) 0°C to 40°C (32°F to 104°F) (without tape or floppy)
Maximum rate of temperature change	11°C (52°F) per hour
Relative humidity	20% to 80%
Altitude	2400 m at 36°C (8000 ft at 96° F)
Maximum wet bulb temperature	28°C (82°F)
Minimum dew point	2°C (36°F)

---

**Table 2–3 VAXstation 4000 VLC System Box Electrical Specifications**

---

Input voltage	88 Vac to 132 Vac 176 Vac to 264 Vac
Frequency range	47 to 63 Hz

---

# 3

---

## VAXstation 4000 VLC Firmware

This chapter is an overview of the VAXstation 4000 VLC system firmware. The firmware is located in two EPROMs that hold a total of 256K bytes of data. The firmware has the following four areas of operation:

- Power-Up initialization code
- Console
- Extended self test code
- Utilities

**VAXstation 4000 VLC Firmware**  
**3.1 Power-Up Initialization Code**

### **3.1 Power-Up Initialization Code**

The power-up initialization code executes when power to the system is turned on. The power-up initialization code sequence is:

1. The system tests enough memory to allow it to bring up the console for building console and device structures.
2. The system checks its configuration for optional devices.
3. The system tests the Time-of-Year (TOY) clock and the non-volatile RAM. If the test fails, the power-up test stops.
4. The system constructs the master configuration table (MCT), the device configuration Table (DCT), driver descriptor, shared console interface area, and a blank page frame map.
5. The system tests the serial lines. If the test fails, the console terminal is not enabled.

---

**Note**

---

If the alternate console switch is set for alternate console, the terminal connected to line three of the serial port is used as the console.

---

6. The system invokes the console device initialization routine.  
The system type and ROM ID are displayed on the console device followed by its memory capacity and the Ethernet address.
7. The system test dispatcher tests the functional blocks of the system. The dispatcher runs the tests in the following order:
  - a. Memory test
  - b. Clock test
  - c. Memory management unit (MMU) test
  - d. Floating point unit (FPU) test
  - e. Interval timer test
  - f. Miscellaneous system board test (checksums, interrupt controller test, Ethernet ID ROM)
  - g. Network controller test
  - h. SCSI Controller test
  - i. Sound chip test

## VAXstation 4000 VLC Firmware

### 3.1 Power-Up Initialization Code

If any device fails during testing, the dispatcher continues to test the remaining devices until all tests are completed.

---

#### Note

---

If halts are enabled the console prompt (>>>) displays. If halts are disabled, the system autoboots using the default device stored in NVR or the Ethernet, if no device is specified.

---

## 3.2 Console Overview

Console mode allows operation of a console device. The console device can be

- A workstation video device and LK401 keyboard and mouse
- A terminal connected to line three of the serial port
- A remote system connected over the Ethernet

Console mode can be entered if

- The console HALT parameter is set to halt (3) at power-up.
- A HALT instruction is executed with the HALT parameter set to halt (3).
- A severe processor condition occurs (such as an invalid interrupt stack).
- An external HALT is detected (pressing the halt button at the front panel)

In console mode input and output (I/O) routines are used by the

- Power-Up self test
- Extended self test
- Utilities
- VMB



**VAXstation 4000 VLC Firmware**  
**3.3 Extended Self Test Overview**

### **3.3 Extended Self Test Overview**

You start the extended self tests by entering the "TEST" command at the console prompt, followed by the number or numbers of the test you wish to run. The test dispatcher runs the self test you request until an error occurs or until all tests have completed.

The test dispatcher uses the main configuration table (MCT), device configuration table (DCT), and drive descriptor data structures when running the self test. The test dispatcher performs the following steps when running the self test:

1. Indexes the MCT using the device number
2. Gets a pointer to the DCT using the MCT
3. Locates the pointer to the device directory entries in the DCT
4. Scans the directories for the self test directory type (=1)
5. Reads the flags field of the DCT to determine if the self test needs to be loaded into RAM. If the diagnostic test needs to be loaded into RAM, the dispatcher allocates the memory space and copies the test from ROM to RAM.
6. Reads the flags field in the DCT to determine if the diagnostic test requires a shared diagnostic driver. If the self test uses a shared diagnostic driver, the dispatcher determines the directory entry and the pointer of the driver descriptor from reading the DCT. If the shared driver is not already in RAM, the dispatcher allocates space and copies the driver from ROM to RAM.
7. Calls the device self-test interface

### 3.4 Utilities Overview

To start a utility test, enter the following command at the console prompt.

```
TEST/UTIL dev_nbr util_nbr op1...opn
```

/UTIL	Tells the test dispatcher to run a utility
dev_nbr	Is the device number on which the utility operates
util_nbr	Is the utility number
op1_opn	Is one to n optional parameters

The console mode passes a list of parameters to the test dispatcher. The test then uses the main configuration table (MCT), device configuration table (DCT), and driver descriptor data structures when running the utility. The dispatcher performs the following when running a utility:

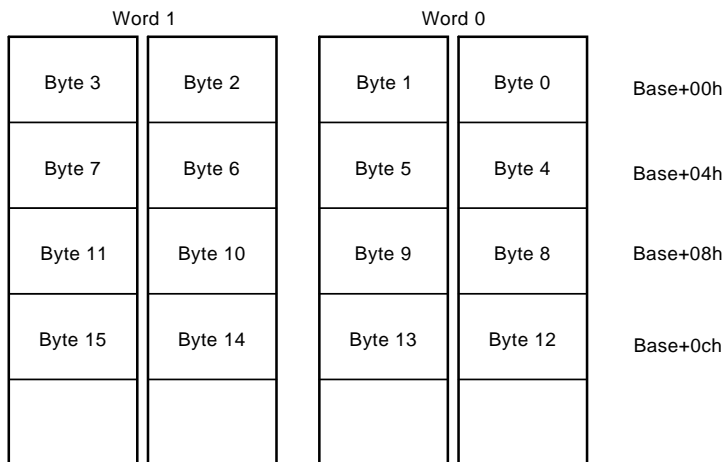
- Indexes into the MCT using the device number
- Gets a pointer to the device DCT from the MCT
- Finds a pointer to the device directory entries in the DCT
- Scans all the directories for the utility directory type (=3)
- Reads the flags field in the DCT to determine if the utility needs to be loaded into RAM. If the utility needs to be loaded into RAM, the dispatcher allocates memory for loading the utility and copies it from ROM to RAM.
- Reads the flags field in the DCT to determine if the utility uses a shared diagnostic driver. If the utility uses a shared diagnostic driver, the dispatcher determines the directory entry and pointer to the driver descriptor from the DCT. If the shared driver is not already in RAM, the dispatcher allocates RAM space and copies the driver from ROM to RAM.
- Calls the utility entry point
- Checks the parameters passed. If they are out of range or if too many are passed, the dispatcher sends an illegal parameter message.
- Prompts the user if more parameters are needed
- Prompts the user if the utility being used will destroy any user data
- Starts the utility

**VAXstation 4000 VLC Firmware**  
**3.5 System ROM Overview**

**3.5 System ROM Overview**

The VAXstation 4000 VLC system firmware contains 256K bytes of ROM split into two 64K byte by sixteen-bit wide ROMs. This provides the 32-bit wide memory data path shown in Figure 3–1.

**Figure 3–1 System ROM Format**



LJ-00092-T10

The firmware ROMs supply some information on a per byte basis for ease of manufacture and development, and other information (software and tables) is supplied by the set of ROM parts.

**3.5.1 System ROM Part Format**

- Version (word 02h)  
 Contains the low eight bits of the version number of the console code for the VAXstation 4000 VLC system firmware.
- ROM byte number (byte 03h)  
 Indicates the position of the byte among the set of ROMs used to implement the firmware. This value is equal to the low two bits of the physical address of the first byte in the ROM part. The value ranges from 0 to 3.

## VAXstation 4000 VLC Firmware 3.5 System ROM Overview

- Manufacturing check data (bytes 04h - 06h)  
Used for a quick check of the ROM. The data are 55h, AAh, and 33h.
- ROM part length (byte 07h)  
Indicates the length of the ROM part divided by the data path width in bytes.
- Checksum (last byte)  
Each ROM byte contains a simple eight-bit add and rotate checksum. In a 16-bit ROM the last two bytes contain a checksum: one checksum for each byte address in the device.

### 3.5.2 System ROM Set Format

The physical addresses in the ROM set are fixed.

- 2004.000 processor restart address  
The VAXstation 4000 VLC hardware begins execution at this address
  - At power-up
  - At the execution of a kernel mode halt instruction
  - When a break signal is received from the console device
  - When the HALT button is depressed
  - When the CPU detects a severe corruption of the operating environment
- 2004.0004 SYS\_TYPE  
This longword is the System Type Register. The VAXstation 4000 VLC system type value is 0401.0102.
- 2004.0008 reserved for ROM part data  
These 24 bytes are reserved for information contained in each ROM byte.
- 2004.0020 interrupt vector numbers  
These eleven longwords are used by the VAXstation 4000 VLC hardware as part of the interrupt process.

## VAXstation 4000 VLC Firmware

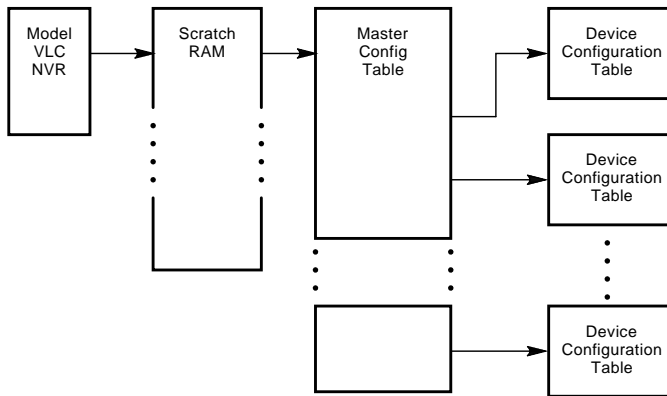
### 3.5 System ROM Overview

- 2004.004C console I/O routines  
There are eight I/O routines provided in the system ROM. Entry points for these routines are located at longword intervals in this area.
- 2004.0070 reserved  
Reserved so all ROM set data that follows is in the same relative position.
- 2004.0078 system console firmware revision number  
This word contains the system console firmware revision number.
- 2004.007A system diagnostic firmware revision number  
This word contains the system diagnostic firmware revision number.
- 2004.007C diagnostic descriptor  
This longword contains the physical address of the beginning of the system level diagnostic boot block. A value of zero indicates that there is no system level diagnostic present in the firmware ROM.
- 2004.0080 pointers to keyboard map  
These two longwords point to the tables used in translating the LK401 main array keycodes to character codes. The first longword contains the physical address of the beginning of the keyboard tables. The second longword contains the physical address of the beginning of the keyboard mapping tables.

### 3.6 Configuration Table Overview

Information about the VAXstation 4000 VLC workstation devices is saved in the system configuration tables by the power-up initialization code. The code sizes the system by reading the ROM-based DCT and builds a memory resident configuration data structure. Figure 3-2 shows how the data structures link together.

Figure 3-2 Configuration Tables



LJ-01075-T10

The power-up initialization code saves a pointer to the scratch RAM in NVR in four consecutive bytes. The scratch RAM contains a pointer to the MCT at its base address. The MCT contains pointers to the DCT.

**VAXstation 4000 VLC Firmware**  
**3.6 Configuration Table Overview**

**3.6.1 Main Configuration Table**

The main configuration table (MCT) contains a list of the devices in the system and a pointer to the device configuration table for each device. The MCT is built at power-up and resides in the diagnostic area in memory. The MCT gives the test dispatcher a single interface into the various components of the system. The MCT is shown in Figure 3–3.

**Figure 3–3 Main Configuration Tables**

Minor Version ID	Major Version ID
Number of Devices	Edit Version ID
0	Device ID
Pointer to Device Configuration Table	
0	Device ID
Pointer to Device Configuration Table	
•	•
•	•
•	•
0	Device ID
Pointer to Device Configuration Table	

Number of Devices \* 8  
 (Number of Devices \* 8) + 4

LJ-00104-T10

The components of the Main Configuration Table are

- **Major version ID**  
 The version number is used to track major changes in the diagnostic interface.
- **Minor version ID**  
 The version number is used to track minor changes in the diagnostic interface.
- **Edit version ID**  
 This is reserved for use by diagnostic developers.
- **Number of devices**  
 This is the number of entries in the MCT table.  
 The next three fields are replicated for each device in the system.

## VAXstation 4000 VLC Firmware 3.6 Configuration Table Overview

- Device ID  
This is the device ID number/
- Must be zero  
This is reserved for future use.
- Pointer-to-Device configuration table  
This points to the DCT for this particular device.

### 3.6.2 Device Configuration Table

There is a device configuration table (DCT) entry for each device in the system. The DCT contains extended information about the device, such as:

- Device name
- Diagnostic code location
- Header information

The test dispatcher and the system test monitor use this data to fetch the appropriate diagnostic code to execute from the ROM or to load into RAM. The DCT is shown in Figure 3–4.

---

#### Note

---

In Figure 3–4 there is reference made to system test in elements 2C, 30 and 34. These elements currently do not exist in the VAXstation 4000 VLC, but may be added in future revisions.

---

The components of the Device Configuration Table are

- Major Version ID  
The version number is used to track major changes in the device diagnostic routines.
- Minor Version ID  
The version number is used to track minor changes in the device diagnostic routines.



## VAXstation 4000 VLC Firmware

### 3.6 Configuration Table Overview

**Figure 3-4 Device Configuration Table**

Minor Version ID	Major Version ID	0	
Number of Devices	Edit Version ID	4	
Device Name		8	
Pointer to Driver Descriptors		10	
Device Status		14	
Pointer to Extended Status		18	
Size of Extended Status		1C	
Pointer to Extended Config		20	
Pointer to Permanent Memory		24	
Size of Permanent Memory		28	
System Test Status		2C	
Pointer to Extended System Test Status		30	
Size of Extended System Test Status		34	
Flags	DPSIZE	DIRTYP	38
Physical Address of Module		3C	
Code Length		40	
Entry Point Offset		44	

Flags	DPSIZE	DIRTYP	$((NBR\_OF\_DIRS-1)*10)+2C$
Physical Address of Module			
Code Length			
Entry Point Offset			

LJ-00105-T10

- **Device ID**  
The device ID number.

## VAXstation 4000 VLC Firmware

### 3.6 Configuration Table Overview

- **Number of directories**

This is the number of directory entries for the device. A directory entry tells the user where to find a particular component of code for the device.
- **Device Name**

The device name is ASCII. This is used by the show configuration utility and the system test to display information about the device.
- **Pointer-to-Driver descriptors**

The pointers to the drive descriptor area associated with the device.
- **Device status**

This is saved from the last time that the self test was run on the device. The show configuration utility uses this field to display information about the device. The device status is split into two words: the lower word is the error field and the upper word is the FRU thought to be faulty.
- **Size of extended device status**

This is the length of the extended device status in bytes. The extended device status can be up to 16 longwords of information. The extended status displays when the user enters the SHOW ERRORS command at the console prompt.
- **Pointer-to-Extended-Device status**

This points to any extended information that is saved by the device self test.
- **Pointer-to-Extended-Configuration data**

This points to extended configuration information about the device. For example, the SCSI self test code uses this field to save a pointer to information about the devices connected to the SCSI bus. The information displays when the user enters the SHOW CONFIG command at the console prompt.
- **Pointer to permanent memory allocated**

This points to the permanent memory that has been allocated. The field is filled in by the diagnostic the first time that it allocates memory.

**VAXstation 4000 VLC Firmware**  
**3.6 Configuration Table Overview**

- Size of permanent memory allocated  
 This is the amount of permanent memory (in pages) that has been allocated. This field is filled in by the diagnostic the first time that it allocates memory.
- System test status  
 Note that the VAXstation 4000 VLC system does not perform a system test.
- Pointer-to-Extended-System-Test status  
 Note that the VAXstation 4000 VLC does not perform a system test.
- Size of Extended System Test Status  
 Note that the VAXstation 4000 VLC does not perform a system test.
- Directory type  
 Contains the type of directory entry that the previous elements refer to. Table 3-1 lists the directory type.

**Table 3-1 Directory Type Definitions**

Definition	Meaning
1	Self test directory entry
2	
3	Utility directory entry
4	Console routine directory entry
5	Unjam routine directory entry
6	Diagnostic driver directory entry

- Data path size  
 This contains the data path size of the ROM in which the piece of code resides. The path size is listed in Table 3-2.

**Table 3-2 Data Path Size Definitions**

Definition	Meaning
1	ROM width is one byte wide
2	ROM width is two bytes wide
4	ROM width is four bytes wide

- Flags

## VAXstation 4000 VLC Firmware 3.6 Configuration Table Overview

This contains flag data associated with the particular device routine. Table 3-3 lists the flag definitions.

**Table 3-3 Flag Definitions**

Definition	Meaning
Bit 15=1	Code must be loaded into RAM at power-up and memory marked as unavailable to the operating system.
Bit 14=1	Code must be loaded into RAM to execute. The memory is released after execution is complete.
Bit 13=1	Code has been loaded into RAM at power-up and memory marked as unavailable to the operating system.
Bit 0=1	Code uses shared diagnostic driver.

- Length of code  
This contains the length of code in bytes.
- Physical address of the module  
This contains the physical address for this particular component of the code.
- Entry point offset  
This contains the offset from the beginning of the code to where the entry point is.

### 3.7 Driver Descriptor

Any device that provides a shared port driver or shared class driver must provide a descriptor that tells the base system firmware, system test monitor, and any other piece of software specific information about the drive. A driver descriptor has the format shown in Figure 3-5.

**VAXstation 4000 VLC Firmware**  
**3.7 Driver Descriptor**

**Figure 3–5 Driver Descriptor Data Structure**

Device ID	0
Address of Driver	4
Length of Driver	8
Entry Point of Driver	C
Size of Driver Data Area	10
Address of Driver Data Area	14
Address of IO Segment Table	18

LJ-00106-T10

The fields of the driver descriptor are

- **Device ID**  
 Use this to ensure that the driver descriptor ID matches the function block ID. This allows a function the ability to determine if it is being used correctly.
- **Address of the driver**  
 This contains the address of the device driver. This address may be a ROM or RAM memory address.
- **Length of the driver**  
 This contains the length of the device driver in bytes. This field is used by both the base system ROM and the system test monitor to determine the amount of code that needs to be loaded into RAM.
- **Entry point offset of the driver**  
 This contains the number of bytes from the beginning of the device driver to the INIT\_DRIVER function.
- **Size of driver data area**  
 This contains the length in bytes of the amount of memory that a driver needs for its parameters and local data.
- **Address of the driver data area**  
 This contains the address of the device driver data area that the driver uses to store local data.
- **Address of the I/O segment table**

## VAXstation 4000 VLC Firmware 3.7 Driver Descriptor

This contains the address of the I/O segment table.

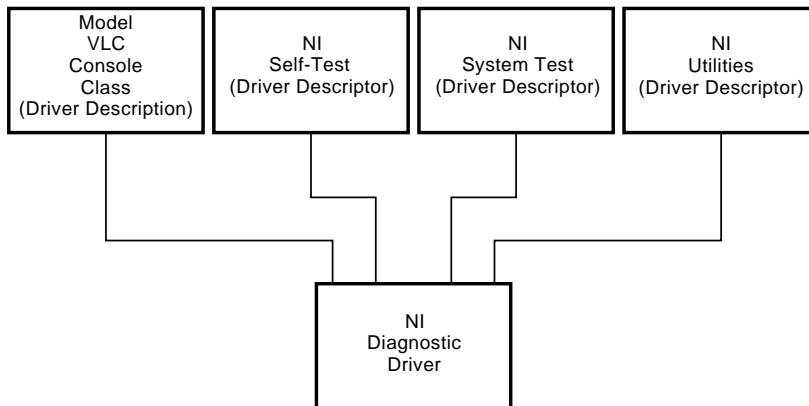
### 3.8 Interfacing to Diagnostic Drivers

The Network device contains

- Routines to UNJAM the device
- Self-test routines
- System test routines
- Console routines
- A shared diagnostic driver routine

Figure 3–6 shows how these pieces of code relate to each other.

**Figure 3–6 Diagnostic Drive Console Support**



LJ-01074-T10

A user application performs console input/output to the network by calling the console code which calls the network diagnostic driver. The console, self test, system test, and UNJAM routines interface to the diagnostic driver in similar ways. All diagnostic routines, utilities, and console routines

- Allocate memory for the driver data area
- Allocate memory for the diagnostic function block or console function block
- Call the INIT\_DRIVER routine with the following parameters:
  - Pointer to the I/O Segment Table

## **VAXstation 4000 VLC Firmware**

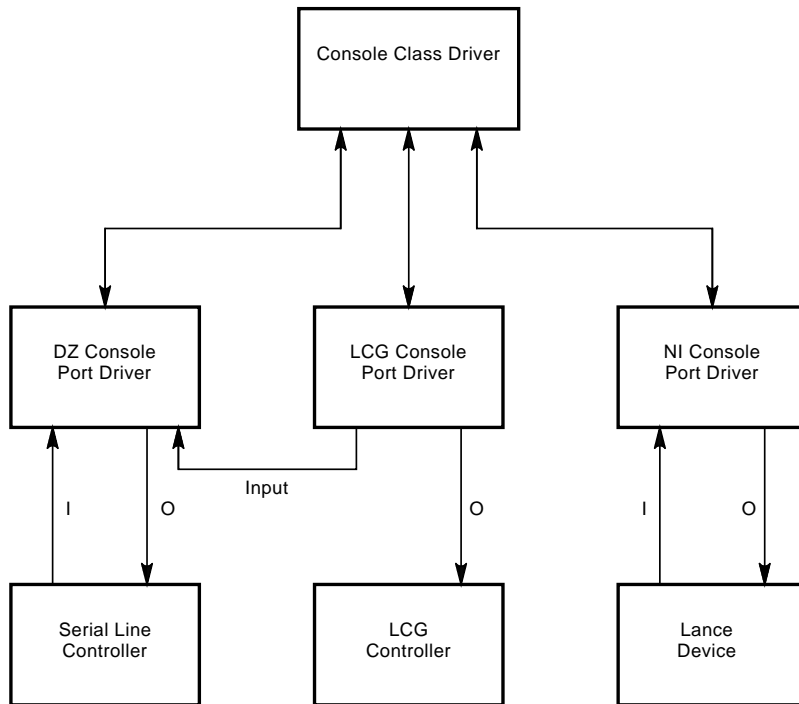
### **3.8 Interfacing to Diagnostic Drivers**

- Pointer to the Driver Data Area
- Pointer to the Driver Function Block or Console Function Block
- Pointer to the Shared Console Interface Area; or add zero if this is not a console driver
- As many as two additional device specific parameters

### 3.9 Console Driver Interface

The VAXstation 4000 VLC system console code is split into a class/port driver scheme. The class driver contains the main console functions, such as PUT\_CHARACTER and GET\_CHARACTER. The port drivers contain the device-specific code required to support this functionality. Figure 3-7 shows the devision of the console functionality.

Figure 3-7 Console Structure



LJ-00108-T10



## VAXstation 4000 VLC Firmware

### 3.9 Console Driver Interface

The console device can require either one or two channels to perform I/O with the console device. If the console device is a graphics terminal with an LK401 keyboard, the console program interfaces with the serial line device driver for ASCII input and with the graphics device driver for output. If the console device is a terminal connected to a serial line, the console responds to the serial line driver for both input and output.

The console class driver contains the generic routines that interface to the console and use applications to perform terminal input and output transactions. The console class driver interfaces with the port driver depending on the current console device.

If the console port driver does not support `PUT_CHARACTER` or `GET_CHARACTER` functionality, it must interface with the appropriate port driver to perform the needed function.

#### 3.9.1 Shared Console Interface Area

The shared console interface area (SCIA) consists of a console class driver descriptor and three port driver descriptors. The port driver descriptors can be associated with a DZ port driver, a graphics output driver, and a network driver.

The SCIA provides an interface to the console terminal that isolates the implementation specifics of accessing the console terminal. It is designed to allow the console drivers to run in both virtual and physical mode.

The SCIA is set up by the power-up initialization code. After it is set up, the software can use this area to interface with the console class driver routine. The shared console performs the following:

- Raw character I/O to the console terminal
- Higher level of I/O functions that handle XON/XOFF flow, ASCII bell character, and LK401 keyboard translation are handled by the DZ driver.
- Data structures that allow the system software to map all console code and I/O space references into virtual memory as needed

The SCIA data structure is shown in Figure 3–8.

**VAXstation 4000 VLC Firmware  
3.9 Console Driver Interface**

**Figure 3–8 SCIA Data Structure**

Console Type
LK401 Keyboard Type
Address of US Font Table
Address of MCS Font Table
Address of Keyboard Translation Table
Address of Keyboard Map Table
Console Class Device ID
Console Class Driver Driver Descriptor
DZ Device ID
DZ Port Driver Driver Descriptor
Graphics Device ID
Graphics Port Driver Driver Descriptor
NI Device ID
NI Port Driver Driver Descriptor
VMS Debug Device ID
VMS Debug Port Device Driver

XXX Device ID
XXX Port Device Driver

LJ-00109-T10

## VAXstation 4000 VLC Firmware

### 3.9 Console Driver Interface

#### 3.9.2 Console Port Driver

The console port driver descriptor fields are the same as the console class driver descriptors except the port driver contains pointers to the console port level routines. The port driver supports all functions whether the device supports console output only, or console I/O. Figure 3–9 shows the functional block of the port driver.

**Figure 3–9 Console Port Driver Function Block**

Device Id
INIT_DRIVER Pointer
GETCHAR Pointer
PUTCHAR Pointer
RESET_INPUT Pointer
INIT_INPUT Pointer
RESET_OUTPUT Pointer
INIT_OUTPUT Pointer

LJ-00110-T10

# 4

---

## Diagnostic Testing

This chapter describes the diagnostic tests, test commands, and error codes provided with the VAXstation 4000 VLC system.

### 4.1 Diagnostic Testing

System troubleshooting involves several types of tests:

- **Power-Up Self Test**  
This test includes initialization and power-up testing of all devices.
- **Extended Self Test**  
This test executes when a user runs a self-test diagnostic by entering a TEST command at the console prompt.
- **Utilities Test**  
This test provides tools to test and align a video monitor and initialize disk drives.

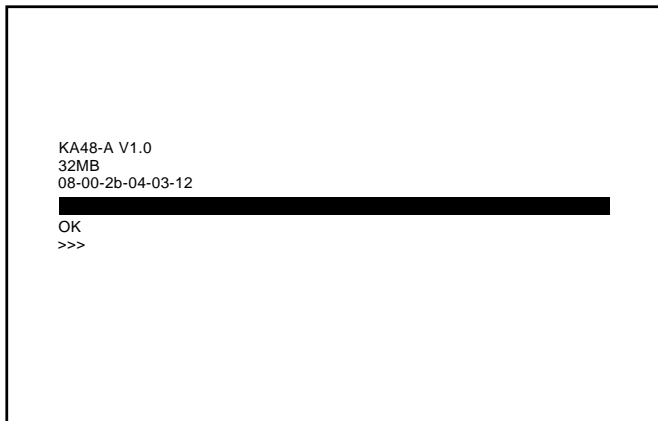
## Diagnostic Testing

### 4.1 Diagnostic Testing

#### 4.1.1 Power-Up Test

Figure 4–1 depicts the console screen after a successful power-up test is completed.

**Figure 4–1 Successful Power-Up**



LJ-001384-T10

Figure 4–2 depicts the console screen after an unsuccessful power-up test is completed.



## Diagnostic Testing

### 4.1 Diagnostic Testing

#### 4.1.2 Displaying System Configuration

The VAXstation 4000 VLC system firmware provides two commands that determine what type of mass storage devices are included in the system and what the overall system configuration is.

To determine the presence of storage devices such as a hard disks, diskette drives, or other drives, at the console prompt enter the `SHOW DEVICE` command.

The `SHOW DEVICE` command results in the information shown in Example 4-1.

#### Example 4-1 `SHOW DEVICE` Command

```
>>> SHOW DEVICE

  VMS/VMB   ADDR      DEVTYPER  NUMBYTES  RM/FX  WP  DEVNAM  REV
  -----   ----      -
  ESA0      08-00-2B-17-EA-FD
  DKA100    A/1/0      DISK      121 MB   FX
  DKA300    A/3/0      RODISK    594 MB   RM      WP  RRD42   1.1A
  MKA500    A/5/0      TAPE
  ..HostID..
  DKA700    A/7/0      DISK      332 MB   FX           RZ55   0900
```

!Column Meanings:

VMS/VMB - The VMS device name, and console boot name for the device.  
ADDR - Ethernet hardware address or SCSI device ID.  
The SCSI device ID has the format:  
A/DEVICE\_ID/LOGICAL\_ID  
The LOGICAL ID is always 0.  
DEVTYPER - Device type, RODISK is a read-only disk (CDROM).  
NUMBYTES - Drive capacity. Capacity is not be displayed for empty  
removable media drives  
RM/FX - Indicates whether the drive has removable or fixed media.  
WP - Indicates whether the drive is write protected.  
DEVNAM - Device name for the drive.  
REV - Firmware revision level for the drive.

## **Diagnostic Testing**

### **4.1 Diagnostic Testing**

To determine the presence of devices other than internal storage devices and to determine the quantity of memory in the system, enter the `SHOW CONFIG` command at the console prompt.

The system presents a configuration table similar to Example 4–2.

#### **Example 4–2 Sample Show Config Display**



## Diagnostic Testing

### 4.1 Diagnostic Testing

#### 4.1.3 Displaying System Errors

To obtain detailed error information about any failing device in the system use the SHOW ERROR utility. To determine if an error has occurred on a particular device, enter the SHOW ERROR command followed by the device number. To show all of the system errors, enter the command without a device number. If errors are present, a message similar to Example 4–3 is presented.

#### Example 4–3 Sample Showing System Errors

Error information is given in the following format:

```
Fru Dev_nbr Dev_nam Err_nbr
```

Message	Meaning
Fru	The name of the failed FRU
Dev_nbr	Device number of the failed device
Dev_nam	Device name of the failed device
Err_nbr	A decimal number that corresponds with a specific device failure. The number refers to specific error tables for problem isolation and repair procedures.

## 4.2 Running the Self Test

Table 4–1 shows the format conventions for running the self test using the TEST command.

**Table 4–1 Running Self Test Using the Test Command**

Command	Action
T d1	Run the self test on device number d1
T d1:d2	Run the self test on devices numbered d1 through d2
T d1,d2	Run the self test on devices d1 and d2

### Example

**T 10:8,6,5:3** tests devices 10 through 8, then device 6, and then devices 5 through 3)

Figure 4–3 is a sample of the console display when a successful and unsuccessful self test has been run.

**Figure 4–3 Successful and Unsuccessful Self Test**



LJ-01382-T10

The error message format is the same as the power-up self-test error message shown in Figure 4–2.

## Diagnostic Testing

### 4.2 Running the Self Test

Table 4–2 lists the VAXstation 4000 VLC system configuration modules and the associated self-test commands.

**Table 4–2 Device Number and Self-Test Commands**

Number	Mnemonic	Name	Self-Test Command
1	NVR	Non-volatile RAM	T1 or T NVR
2	LCG	Low cost graphics	T2 or T LCG
3	DZ	Serial line controller	T3 or T DZ
4	cache	Cache memory	T4 or T CACHE
5	mem	Memory	T5 or T MEM
6	FPU	Floating point unit	T6 or T FPU
7	IT	Interval timer	T7 or T IT
8	SYS	Miscellaneous system board hardware	T8 or T SYS
9	NI	Network interface	T9 or T NI
10	SCSI	Network SCSI controller	T10 or T SCSI
11	AUD	Sound chip	T11 or T AUD

The different self tests are described in the following tables.

#### 4.2.0.1 TOY/NVR Self Test

Self Test	Function
NVR	Checks the non-volital RAM for valid data. If the NVR is not initialized, a register test is performed on all NVR locations and the NVR is initialized. If the NVR is initialized, ONLY the temporary locations in the NVR are tested.
TOY	Determines if the time has been set in the TOY clock. If not, all the TOY registers are tested. This test writes and reads all possible values that a TOY register can hold.

Table 4–1 and Table 4–2 provide information on how to run the TOY and NVR self tests. Refer to Section A.1.1 for a list of the TOY and NVR error codes and Section B.1.2 for a list of the TOY and NVR diagnostic LED codes.

## Diagnostic Testing

### 4.2 Running the Self Test

#### 4.2.0.2 LCG Self Tests

Self Test	Function
Video Test	Tests the communication between the S-chip and VRAM. It initializes the brooktree, sets up the video screen, and sets up the video registers in the S-chip.
Register Test	Uses the longword format to read/write test all LCG S-chip registers.
FIFO Test	Creates a FIFO and clip list in the contiguous physical memory and tests set up packets, int/status bits, put/get pointers, FIFO, and clip control flags, FIFO status bits, and ensures that the FIFO can be reset.
AG Test	Calls all of the LCG address generator-specific self-test routines. These routines test the drawing functions, logic unit functions, and glyph functions.
Virtual Addressing Mode Test	Calls all of the LCG virtual drawing-specific self-test routines.

---

#### Note

---

The LCG self test does not run in user mode (diagenv 1) as it clears the console. Refer to Section 4.4.2.5 for information on Diagenv parameters.

---

Refer to Table 4–1 and Table 4–2 for information on how to run the LCG self test. Refer to Section A.1.11 for a list of the LCG self-test error codes and Section B.1.7 for a list of the LCG diagnostic LED codes.

---

#### Note

---

The low resolution frame buffer clock jumpers must be correctly installed before power-up.

The panel Alternate Console switch must be **down** for graphics console and **up** for the DZ port.

---

## Diagnostic Testing

### 4.2 Running the Self Test

#### 4.2.0.3 DZ Self Test

Self Test	Function
Reset Test	Resets the DZ chip and sets up the lines to default values. An error occurs if the device does not reset or the line parameters are not set up correctly.
Polled Test	Test each line in the internal loopback mode by using the chip in the polled mode. Characters are transmitted out a line and are expected to be looped back.
Interrupt Test	Tests each line by running interrupt driven. If the diagnostic environment is Digital Services or Manufacturing, the lines are tested using an external loopback device on the communication port. Interrupts are disabled and characters are sent out the lines not in use by the console device. The characters are expected to be looped back.
LK401 Test	Checks for the presence of a LK401 keyboard when the console device is a video device.
Mouse Test	Checks for the presence of a mouse when the console device is a video device.

Refer to Table 4–1 and Table 4–2 for information on running the DZ self test. Refer to Section A.1.2 for a list of the DZ self-test error codes and Section B.1.3 for a list of the DZ diagnostic LED codes.

---

#### Note

---

The DZ interrupt test fails in the Customer Service or Manufacturing environments if external loopbacks are not present on the communication port.

The mouse test fails if the mouse is not plugged in and the console is a video device.

---

## Diagnostic Testing

### 4.2 Running the Self Test

#### 4.2.0.4 Cache Self Test

Self Test	Function
DATA Store Test	Tests the data store in the SOC primary cache. A two-pass memory test is performed on the data store. Performs a read/compare/complement/write in forward and reverse directions. The data store is accessed through the I/O address space. Only the cache banks enabled in the BEHR are tested.
TAG Store Test	Tests the tag store in the SOC primary cache. A two-pass memory test is performed on the tag store. Performs a read/compare/complement/write in forward and reverse directions. The tag store is accessed through the I/O address space. Only the cache banks enabled in the BEHR are tested.

Refer to Table 4–1 and Table 4–2 for information on running the cache self test. Refer to Section A.1.10 for a list of the cache self-test error codes and Section B.1.10 for a list of cache self-test diagnostic LED codes.

#### 4.2.0.5 System Self Test

Self Test	Function
System ROM	Checks the system ROMs one byte at a time to ensure that they contain the correct manufacturing check data and correct checksum.
Filter RAM	Makes two passes on the invalidate filter RAMs. The test detects all stuck addressing and data faults.

Refer to Table 4–1 and Table 4–2 for information on how to run the SYS self test. Refer to Section A.1.6 for a list of system self-test error codes and Section B.1.5 for a list of system self-test diagnostic LED codes.

#### 4.2.0.6 Floating Point Unit Self Test

Self Test	Function
Instruction Tests	Performed on the floating point unit (FPU). A failure occurs if the instruction produces unexpected results during execution of the instruction.

Refer to Table 4–1 and Table 4–2 for information on how to run the FPU self test. Refer to Section A.1.9 for a list of FPU self-test error codes.

## Diagnostic Testing

### 4.2 Running the Self Test

#### 4.2.0.7 Interval Timer Self Test

Self Test	Function
Interrupt Test	Enables the interval timer interrupts. It lowers the IPL for 30 ms and counts the number of interrupts. If there are too few or too many interrupts, an error occurs.

Refer to Table 4–1 and Table 4–2 for information on how to run the IT self test. Refer to Section A.1.5 for a list of IT self-test error codes.

#### 4.2.0.8 Memory Self Test

Self Test	Function
Byte Mask Test	Checks the byte mask signals generated by the CPU. This test is performed on each page boundary. Once the test is complete, all free memory is filled with AAh.
Memory Test (forward)	A read/compare/complement/write is performed on the memory in the forward direction. If a page is found to be bad, the appropriate bit in the memory bitmap is cleared.
Memory Test (reverse)	Starts at the last address to be tested and performs a read/compare/complement/write on memory. If a page is found to be bad, the appropriate bit in the memory bitmap is cleared.
Final Parity	Fills all of memory with a pattern of 01h (an odd bit pattern) to verify that the parity bit can be changed. A parity error occurs if the parity bit is not changed. The pattern 01010101h is the known state of unused memory after power-up.

Refer to Table 4–1 and Table 4–2 for information on how to run the Memory self test. Refer to Section A.1.3 for a list of memory self-test error codes and Section B.1.4 for a list of memory self-test diagnostic LED codes.

---

#### Note

---

If memory modules are not configured correctly, the memory self test fails and those modules are not configured.

---

## Diagnostic Testing

### 4.2 Running the Self Test

#### 4.2.0.9 Network Interconnect Self Test

Self Test	Function
Network Address ROM Test	Verifies the 32 byte network address ROM that contains the unique 6-byte network address and the 2-byte checksum and test data byte. It checks for a null or multicast address, calculates/compares the checksum, and verifies the test data bytes.
LANCE Register Test	Tests the address and data paths to the LANCE register address port (RAP) and the register data port (RDP) for each of the four control status registers (CSRs).
LANCE Initialization Test	Sets up the LANCE data structures and initializes the LANCE chip, causing the LANCE to perform a single word DMA read to the system memory.
LANCE Internal Loopback	Verifies the correct operation of the LANCE transmitter and receiver during an internal loopback, and verifies the burst-mode DMA read and write on non-word-aligned data buffers for packets of different lengths and data patterns.
LANCE Interrupt Test	Enables, forces, and services the LANCE interrupts for initialization, transmission, and reception using internal loopback.
LANCE CRC Test	Tests the LANCE CRC generation on transmission. It checks for detection of a bad CRC on reception using internal loopback.
LANCE Receive MISS/BUFF Test	Checks LANCE operation for missed packets and buffer error during reception with internal loopback.
LANCE Collision Test	Verifies collision detection and retry during transmission with internal loopback.
LANCE Address Filtering Test	Tests the LANCE receiver address filtering for broadcast, promiscuous, and null destinations during internal loopback.

Refer to Table 4–1 and Table 4–2 for information on how to run the NI self test. Refer to Section A.1.12 for a complete list of NI self tests and their error codes and Section B.1.8 for a list of NI self-test diagnostic LED codes.

#### Note

You must install an external loopback connector or a network connection (cable) at the selected network port before running the self test.



## Diagnostic Testing

### 4.2 Running the Self Test

#### 4.2.0.10 SCSI Self Test

Self Test	Function
Register Test	Verifies that the 53C94B controller chip registers are fully functional. All read/write bits that can be written are written to. It also verify the bits.
Interrupt Test	Verifies the SCSI bits in the interrupt mask register, interrupt request register, and the interrupt clear register. A SCSI interrupt forced, with the SCSI bit in the interrupt mask first set and then cleared. This is repeated for both a high interrupt priority level and a low priority level.
Data Transfer Test	Verifies SCSI bus communication between the controller and the available peripherals and also verifies the data path of the controller to the S-chip and to memory. A series of four inquiry commands are issued to each device. The commands are issued in the programmed I/O mode, asynchronous mode with DMA, asynchronous mode with the DMA starting on a non-word-aligned boundary and crossing a page boundary, and synchronous mode with DMA.

Refer to Table 4–1 and Table 4–2 for information on how to run the SCSI self test. Refer to Section A.1.7 for a list of SCSI self-test error codes and to Section B.1.6 for a list of SCSI self-test diagnostic LED codes.

#### Note

CDROM devices will fail in extended mode if media is not installed in removable media drive.

If some or all devices do not show up in the configuration display after running the self test, make sure all devices have a unique ID number and that power is supplied to all devices and the system module. Be sure the SCSI cable is connected to the system module and devices, and that the bus is terminated.

#### 4.2.0.11 Audio Self Test

Self Test	Function
Register Tests	Performs a write/read to registers in the 79C30 DSC chip.

## Diagnostic Testing

### 4.2 Running the Self Test

Self Test	Function
Interrupt Test	Enables interrupts, and sends and receives an 8-byte packet by way of internal loopback.
Audio Test	Generates and outputs a sequence of 8 audible tones.

Refer to Table 4–1 and Table 4–2 for information on how to run the Audio self test. Refer to Section A.1.8 for a list of Audio self-test error codes.

## 4.3 Utilities

These test commands run or display the available utilities. Utilities can be run with all parameters input at the command line or the utility prompts for additional input when necessary. The format of a utility run completely from the command line is

```
>>> T [EST]/UT[ility] dev_nbr util_nbr opt_p1,...,opt_pn
```

dev_nbr	The number of the device on which you want to run the utility
util_nbr	The number of the utility that you want to run. The devices can have more than one utility.
opt_p1,...,opt_pn	Optional parameters possibly needed by a utility. For example, a SCSI utility could need to know the target ID of the device to run the utility on.

If you are unfamiliar with the utilities on a particular device, enter the TEST/UTILITY command followed by the device number or name. The utility prompts for additional information if needed. For example, if you want to run an LCG utility, first type enter T/UT 2. The LCG main utility routine displays a list of available utilities (see Figure 4–4). Then the prompt LCG\_util>>> displays. Enter the number of the utility that you want to run. In this example, utility 8 is selected.

## Diagnostic Testing

### 4.3 Utilities

Figure 4-4 Utilities List

```
>>> T/UT 2

0 - LCG-WH-SCRN
1 - LCG-RD-SCRN
2 - LCG-BL-SCRN
3 - LCG-GN-SCRN
4 - LCG-4C-CBAR
5 - LCG-8C-CBAR
6 - LCG-8G-GSCL
7 - LCG-EE-SCRN
8 - LCG-CI-XHCT

LCG_util>>> 8
```

LJ-01383-T10

Control returns to the console if you enter an illegal utility number.

If you run a utility that will destroy the contents of a mass storage device, the following displays:

```
dev_nam OK ?
```

```
dev_nam          Device whose contents will be lost.
```

Enter OK followed by Return to start the utility. If any other combination of keys are entered control is returned to the console.

## **4.4 System Console**

This section describes the standard console commands for the VAXstation 4000 VLC system. The console commands are divided into three functional groups.

- **SET/SHOW Commands**  
Use these commands to set or examine system parameters and configuration.
- **Memory Commands**  
These include the DEPOSIT, EXAMINE, FIND, MOVE, and SEARCH commands.
- **Processor Control Commands**  
These commands are BOOT, CONTINUE, HALT, INIT, START, and UNJAM.
- **Miscellaneous Commands**  
HELP or ?, LOGIN, and REPEAT.

## Diagnostic Testing

### 4.4 System Console

#### 4.4.1 SET and SHOW Commands

Use the SET and SHOW commands to set and examine system parameters. Table 4–3 lists the SET and SHOW parameters and their meanings.

**Table 4–3 SET and SHOW Parameters**

Parameter	Meaning
BFLG	Default bootflag
BOOT	Default boot device
CONFIG	System configuration
DEVICE	Ethernet and SCSI devices information
DIAGENV	Diagnostic environment (mode)
ETHER	Ethernet hardware address
ERROR	Errors from the last system or self test
ESTAT	Status from the last system test
FBOOT	Powerup memory test flag
HALT	Halt recovery action
KBD	Keyboard language
MEM	Memory address range
MOP	MOP listener
PSE	Password enable
PSWD	Password
SCSI	System SCSI ID
TRIGGER	Enable network console
VER	System ROM version

## Diagnostic Testing 4.4 System Console

### 4.4.1.1 SET and SHOW Command Syntax

The SET and SHOW command syntax is

```
>>> SHOW parameter
>>> SET parameter value
```

#### **Example:**

```
>>> SHOW BOOT
>>> SET BOOT DKA200:
```

### 4.4.2 SET and SHOW Parameters

This section describes each of the SET and SHOW parameters.

#### 4.4.2.1 BFLG

The BFLG parameter is the default bootflag. It is equivalent to R5:xxxxxxxx in the boot command. BFLG is normally set to 0.

#### **Example:**

```
>>> SET BFLG 00000001    ! Set BLFG to
                        conversational boot
                        BFLG = 00000001

>>> SHOW BFLG
                        BFLG = 00000001
```

## Diagnostic Testing

### 4.4 System Console

#### 4.4.2.2 BOOT

The BOOT parameter is the default boot device. The boot device can be set to a bootable SCSI drive or the network device. To see the valid device boot names, enter the SHOW DEVICE command. The first column lists the boot names.

**Example:**

```
>>> SET BOOT DKA200
      BOOT = DKA200

>>> SHOW BOOT
      BOOT = DKA200
```

#### 4.4.2.3 CONFIG

The CONFIG parameter displays the system configuration and device status. The SET command does not apply to this parameter. Use the SHOW DEVICE command for more information on SCSI devices.

**Example:**

```
>>> SHOW CONFIG
KA48-A BL3-186-B3.1
08-00-2B-F3-31-03
16 MB

DEVNBR  DEVNAM  INFO
-----  -
      1  NVR      OK
      2  LCG      HR - 8 PLN FB - 2.7
      3  DZ       OK
      4  CACHE    OK
      5  MEM      OK

                          16MB = SY=8MB, S0/S1=8MB, S2/S3=0MB, S4/S5=0MB

      6  FPU     OK
      7  IT      OK
      8  SYS     OK
      9  NI      OK
     10  SCSI    OK
                          1-RZ23L 6-INITR
     11  AUD     OK
```

## Diagnostic Testing 4.4 System Console

### 4.4.2.4 DEVICE

The DEVICE parameter displays SCSI and Ethernet device information. The SET command does not apply to this parameter.

#### Example:

```
>>> SHOW DEVICE
```

VMS/VMB	ADDR	DEVTYPE	NUMBYTES	RM/FX	WP	DEVNAM	REV
-----	-----	-----	-----	-----	---	-----	---
ESAO	08-00-2B-17-EA-FD						
DKA100	A/1/0	DISK	121 MB	FX		RZ23L	1F25
DKA300	A/3/0	RODISK	594 MB	RM	WP	RRD42	1.1A
MKA500	A/5/0	TAPE		RM		TZK10	00AD
..HostID..		INITR					
DKA700	A/7/0	DISK	332 MB	FX		RZ55	0900

!Column Meanings:

VMS/VMB - The VMS device name, and console boot name for the device.  
ADDR - Ethernet hardware address or SCSI device ID.  
The SCSI device ID has the format:  
A/DEVICE\_ID/LOGICAL\_ID  
The LOGICAL ID is always 0.

DEVTYPE - Device type, RODISK is a read-only disk (CDROM).  
NUMBYTES - Drive capacity. Capacity is not be displayed for empty removable media drives  
RM/FX - Indicates whether the drive has removable or fixed media.  
WP - Indicates whether the drive is write protected.  
DEVNAM - Device name for the drive.  
REV - Firmware revision level for the drive.



## Diagnostic Testing

### 4.4 System Console

#### 4.4.2.5 DIAGENV

The DIAGENV parameter determines the diagnostic environment that the diagnostics run under. Table 4–4 lists the diagnostic environments and their usage.

**Table 4–4 Diagnostic Environments**

Mode	Usage
Customer	No setup is required. Default mode on powerup.
Customer Service	Provides a more thorough test than in customer mode. Some tests require loopback connectors for successful completion.
Manufacturing	Some tests require loopback connectors for successful completion.
Loop on error; Customer Service	The system loops on a test when an error occurs.
Loop on error; Manufacturing	The system loops on a test when an error occurs.

To set the diagnostic environment, enter a console command listed in Table 4–5.

**Table 4–5 SET DIAGENV Command**

Command	Result
SET DIAGENV 1	Resets environment to Customer mode.
SET DIAGENV 2	Sets environment to Customer Service mode.
SET DIAGENV 3	Sets environment to Manufacturing mode.
SET DIAGENV 80000001	Sets environment to loop on error in Customer Service mode.
SET DIAGENV 80000002	Sets environment to loop on error in Manufacturing mode.

## Diagnostic Testing 4.4 System Console

### Example:

```
>>> SET DIAGENV 2
      DIAGENV = 2
>>> SHOW DIAGENV
      DIAGENV = 2
```

### 4.4.2.6 ERROR

The ERROR parameter displays extended error information about any errors that occur during the last execution of:

- Powerup self test
- Extended self test
- System test.

The SET command does not apply.

### Example:

```
>>> SHOW ERROR
?? 150 10 SCSI 0032
150 000E 00000005 001D001D 03200000 00000024
(cont.) 00000002 00000000 00000004
```

### 4.4.2.7 ETHER

The ETHER parameter displays the Ethernet hardware address. The SET command does not apply.

### Example:

```
>>> SHOW ETHER
ETHERNET = 08-00-2B-1B-48-E3
```

## Diagnostic Testing

### 4.4 System Console

#### 4.4.2.8 FBOOT

The FBOOT (fast boot) parameter determines whether the memory is tested on powerup. The powerup test time is reduced when main memory and FB memory are not tested.

- When FBOOT = 0 the memory is tested on powerup.
- When FBOOT = 1 the memory test is not done on powerup.
- The setting only affects the powerup test.
- FBOOT should only be set to 1 when troubleshooting requires a number of power cycles and memory is not the suspected fault.

**Example:**

```
>>> SET FBOOT 1    ! Enables fast powerup test.
      FBOOT = 1
>>> SHOW FBOOT
      FBOOT = 1
```

#### 4.4.2.9 HALT

The HALT parameter determines the recovery action that the system takes after powerup, system crash, or halt. The following table lists the HALT parameter values and their meanings:

Value	Meaning
1	Systems tries to restart operating system. If restart fails, then the system tries to reboot.
2	System tries to reboot.
3	System halts and enters console mode.

**Example:**

```
>>> SET HALT 2
      HALT = 2
>>> SHOW HALT
      HALT = 2
```

## Diagnostic Testing 4.4 System Console

### 4.4.2.10 KBD

The KBD parameter determines the keyboard language.

- The SHOW KBD command displays the numeric keyboard code only.
- The SET KBD command displays the language choices and the numeric code.

#### Example:

```
>>> SET KBD

0) Dansk                      8) Francais (Suisse Romande)
1) Deutsch                    9) Italiano
2) Deutsch (Schweiz)         10) Nederlands
3) English                    11) Norsk
4) English (British/Irish)   12) Portugues
5) Espanol                    13) Suomi
6) Francais                   14) Svenska
7) Francais (Canadian)      15) Vlaams

    3 >>> 4          ! Enter numeric code

>>> SHOW KBD

KBD = 4
```

### 4.4.2.11 MEM

The MEM parameter displays the memory address range and the unavailable memory address range. The unavailable range is memory the console uses, and memory that is marked unavailable by the diagnostics. The SET command does not apply.

#### Example:

```
>>> SHOW MEM

MEM_TOP = 01000000
MEM_BOT = 00000000

MEM_NOT_AVAIL
-----
00FC0800:00FFFFFF
```

## Diagnostic Testing

### 4.4 System Console

#### 4.4.2.12 MOP

The MOP bit enables the NI (Ethernet) listener while the system is in console mode. The listener can send and receive messages on the network. The default mode is listener enabled (MOP = 1).

**Example:**

```
>>> SET MOP 1
MOP = 1
>>> SHOW MOP
MOP = 1
```

#### 4.4.2.13 PSE and PSWD

The PSE parameter is the enable console password bit. This enables the console password to restrict access to the console. You use the PSWD parameter to set the console password.

Remember these key points.

- The password must be exactly 16 characters.
- Valid password characters are numbers 0 through 9 and letters A through F only.
- The password feature is enabled when PSE = 1.
- The password feature is disabled when PSE = 0.
- SHOW PSWD does not apply.

**Example:**

```
>>> SET PSWD
PSWD0>>> xxxxxxxxxxxxxxxxxxxx ! Old password (only if a
                                password has been
                                previously set)
PSWD1>>> 1234567890ABCDEF ! New password
PSWD2>>> 1234567890ABCDEF ! Verify new password
>>> SET PSE 1
PSE = 1
```

## Diagnostic Testing 4.4 System Console

### 4.4.2.14 SCSI

This parameter is the SCSI ID for the system; it should be set to 6. The system SCSI ID should never be changed.

**Example:**

```
>>> SHOW SCSI
SCSI = 6
```

### 4.4.2.15 TRIGGER

The TRIGGER bit enables the Entity-Based Module (EMB). With EMB and the NI listener enabled (TRIGGER = 1, MOP = 1) you can access the console or boot the system from a remote system.

**Example:**

```
>>> SHOW TRIGGER
TRIGGER = 0
>>> SET TRIGGER 1
TRIGGER = 1
```

### 4.4.2.16 VER

The VER parameter displays the system ROM version. The SET command does not apply.

**Example:**

```
>>> SHOW VER
VER = V1.0
```

## Diagnostic Testing

### 4.4 System Console

#### 4.4.3 Memory Commands

There are three memory commands you use to manipulate memory and registers. They are essentially the same as other VAX workstation commands.

Command	Function
DEPOSIT	Enter a value(s) into memory location(s) or register(s).
EXAMINE	Display the contents of memory location(s) or register(s).
FIND	Finds a good section of memory or restart parameter block.

##### 4.4.3.1 DEPOSIT Commands

Use the DEPOSIT command to write to memory locations from the console.

**Syntax:**

```
DEPOSIT /QUALIFIERS ADDRESS DATA
```

The qualifiers can specify the following:

- Data size:
  - /B - byte (8 bits)
  - /W - word (16 bits)
  - /L - longword (32 bits)
  - /Q - quadword (64 bits)
- Address type:
  - /V - virtual address
  - /P - physical address
  - /I - internal processor register
  - /G - general purpose register
  - /M - machine register

## Diagnostic Testing 4.4 System Console

- Range of addresses:  
/N:X specifies that the X+1 locations be written with the value specified by DATA.
- Protection:  
/U unprotects a protected memory location. An example of a protected area is the area of memory that the console uses.

The ADDRESS specifies the address (or first address) to be written.

DATA values must be given in HEX.

### Example:

```
!This example writes the value 01234567 into 6 longword  
!locations starting at address 00100000.
```

```
>>> DEPOSIT/P/N:5 00100000 01234567
```

```
P 00100000 01234567  
P 00100004 01234567  
P 00100008 01234567  
P 0010000C 01234567  
P 00100010 01234567  
P 00100014 01234567
```

### 4.4.3.2 EXAMINE Commands

Use the EXAMINE command to display specific memory locations from the console.

#### Syntax:

```
EXAMINE /QUALIFIERS ADDRESS
```

The qualifiers can specify the following:

- Data size:
  - /B - byte (8 bits)
  - /W - word (16 bits)
  - /L - longword (32 bits)
  - /Q - quadword (64 bits)
- Address type:
  - /V - virtual address
  - /P - physical address



## Diagnostic Testing

### 4.4 System Console

- /I - internal processor register
- /G - general purpose register
- /M - machine register
- Range of addresses:  
/N:X specifies that the X+1 locations be written.
- Protection:  
/U unprotects a protected memory location. An example of a protected area is the area of memory that the console uses.

The ADDRESS specifies the address (or first address) to be read.

#### **Example:**

!This example reads the Ethernet hardware address.

```
>>> EXAMINE/P/N:5 20090000
```

```
P 20090000 0000FF08
P 20090004 0000FF00
P 20090008 0000FF2B
P 2009000C 0000FF1B
P 20090010 0000FF48
P 20090014 0000FFE3
```

#### 4.4.3.3 FIND

Use the FIND command to search memory for either:

- A page-aligned 128KB segment of good memory
- A restart parameter block (RPB)

If the segment is found, the starting address plus 512 is left in the stack pointer (SP)

If the segment is not found an error message displays.

**Syntax:**

```
>>> FIND /qualifier
```

Qualifier	Meaning
/MEMORY	128 kb section of memory
/RPB	restart parameter block

#### 4.4.4 Processor Control Commands

The following are the processor control commands. The commands are essentially the same as other VAX workstations commands.

Command	Function
BOOT	Bootstraps the operating system
CONTINUE	Starts the CPU running at the current program counter (PC)
HALT	Stops the CPU
INITIALIZE	Initializes processor registers
START	Starts the CPU at a given address
UNJAM	Sets devices to an initial state

## Diagnostic Testing

### 4.4 System Console

#### 4.4.4.1 BOOT

The boot command starts the bootloader that loads the operating system and starts it. The boot command causes the system to exit console mode and enter program mode.

**Syntax:**

```
>>> boot /qualifier device, second_device
```

The following table describes the command syntax.

Term	Meaning
/qualifier	Sets the value for R5 for the bootloader. Used to select a boot on the disk, or a conversational boot. The qualifier can be specified in either of the following formats: <ul style="list-style-type: none"><li>• /R5:XXXXXXXX</li><li>• /XXXXXXXX</li></ul>
device	The primary boot device. If no device is specified, the system attempts to boot the default device. Set the default boot device with the SET BOOT command.
second_device	The device the bootloader tries to boot if the primary boot device fails.

**Example:**

```
>>> BOOT /R5:00000001 DKA200, DKA400
```

In the example, the system tries to perform a conversational boot from DKA200. If the system cannot boot from DKA200, it tries a conversational boot from DKA400.

## Diagnostic Testing 4.4 System Console

### 4.4.4.2 CONTINUE

The CONTINUE command switches the system from console mode to program mode. The CPU starts running at the current program counter.

**Example:**

```
>>> CONTINUE
```

### 4.4.5 INITIALIZE and UNJAM

UNJAM resets the system devices. The INITIALIZE command resets the processor registers. Together these commands reset the system. UNJAM must be entered first.

**Example:**

```
>>>UNJAM  
>>>INITIALIZE
```

#### 4.4.5.1 START

Use the Start command to set the program counter and start the CPU. The command causes the system to exit console mode and enter program mode.

**Syntax:**

```
>>> START ADDRESS  
! ADDRESS is the value loaded into the PC.
```

**Example:**

```
!This example starts the bootloader.  
>>> START 200
```

## Diagnostic Testing

### 4.4 System Console

#### 4.4.5.2 Miscellaneous Console Commands

The following are miscellaneous console commands.

Command	Function
HELP or ?	Lists console commands and syntax.
LOGIN	Enables restricted console commands when PSE and PSWD are set.
REPEAT	Continuously repeats a console command.

#### 4.4.5.3 HELP or ?

The HELP command or the question mark (?) list the console commands and the syntax allowed with each command.

#### 4.4.5.4 LOGIN

The LOGIN command enables restricted console commands when the PSE bit is set. Enter the console password on the line following the LOGIN command.

#### 4.4.5.5 REPEAT

The REPEAT command repeats a console command entered on the same line as and following REPEAT.

- BOOT, INIT, and UNJAM cannot be repeated.
- The command is terminated by CTRL C.

#### Example:

```
>>> REPEAT TEST MEM ! Repeats the memory test.
      .
      .
      .
CTRL C ! Terminates test.
>>>
```

# 5

---

## Removing and Replacing FRUs

This chapter describes how to remove and replace the field replaceable units (FRUs) in the VAXstation 4000 VLC system box. Table D-1 lists the VLC FRUs and their part numbers.

Each section describes the removal procedure for the FRU. Unless otherwise specified, you install a FRU by reversing the steps in the removal procedure.

### 5.1 Cautions and Warnings

Removing and replacing FRUs must be done by only Digital Services personnel or maintenance personnel trained specifically by Digital.

---

#### Note

It is the customer's responsibility to back up all software before the Digital Services Representative arrives. This ensures that data is not lost during the service process. The customer should also shut down the workstation software. Before performing any maintenance work, Digital Services personnel must confirm that the customer has completed both of these tasks.

---

#### caution

Electrostatic discharge (ESD) can damage integrated circuits. Always use a grounded wrist strap (part number 29-11762-00) and work-surface-to-earth ground when removing and replacing any FRU.

---

#### warning

Turn power to the maintoir off, then disconnect the power cord from the power source before performing any of these procedures.

---

## Removing and Replacing FRUs

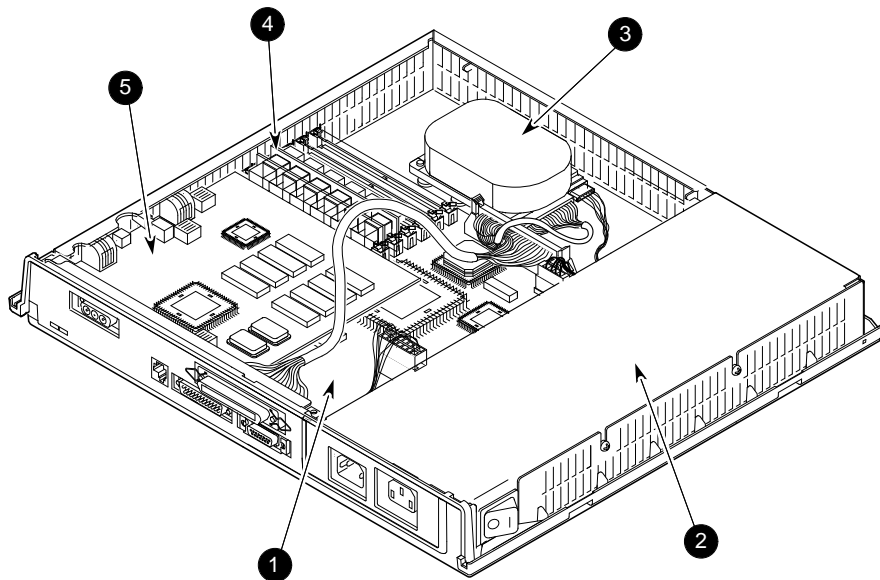
### 5.1 Cautions and Warnings

### 5.2 VAXstation 4000 VLC FRUs

Figure 5–1 shows the location of the VAXstation 4000 VLC system FRUs.

- ❶ CPU module (PN 54-20768-01)
- ❷ Power supply (PN H7109-00)
- ❸ RZ23L 121Mbyte disk drive (PN RZ23-E)
- ❹ Memory modules (PN 20-36110-05)
- ❺ LCG Graphics/Audio module (PN 54-20772-01)

Figure 5–1 Location of System Box FRUs



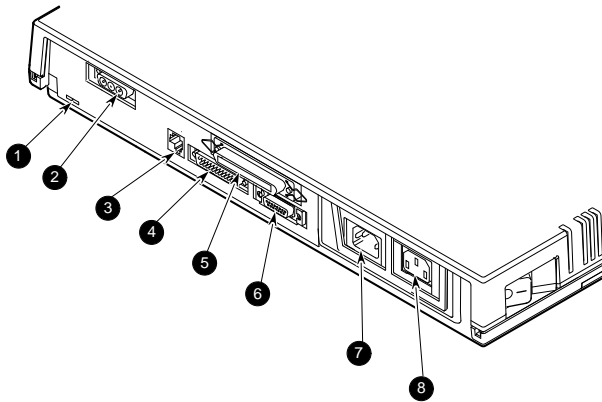
LJ-00960-T10

## Removing and Replacing FRUs 5.2 VAXstation 4000 VLC FRUs

The I/O panel located at the rear of the system box provides for connection of external devices to the system. Figure 5–2 shows the rear of the system box and its I/O connectors.

- ❶ Diagnostic LEDs
- ❷ Video monitor connector
- ❸ Printer/Console port
- ❹ RS232 Communications port
- ❺ SCSI connector
- ❻ Thickwire Ethernet connector
- ❼ AC power to H7109 power supply
- ❽ AC power for video monitor

**Figure 5–2 Rear View of the System Box**



LJ-00961-T10



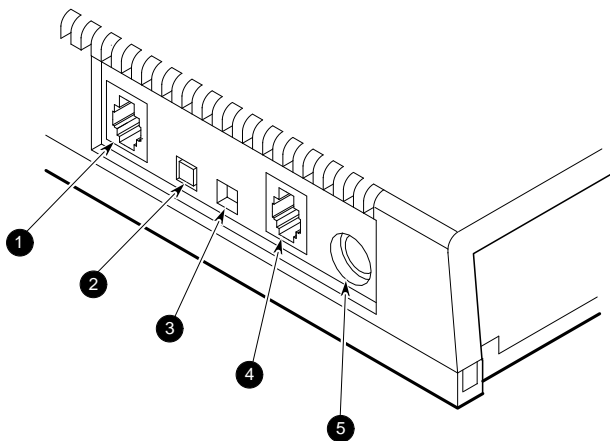
## Removing and Replacing FRUs

### 5.2 VAXstation 4000 VLC FRUs

Figure 5-3 shows the connectors and controls located on the right side of the VAXstation 4000 VLC system box.

- ❶ Audio in/out  
This is a four-pin, MJ-type connector.
- ❷ Halt console switch  
When actuated, this momentary switch sends a Halt signal to the CPU module.
- ❸ Console select switch  
This switch selects either the graphics terminal or printer/console port as the system console.
- ❹ Keyboard connector
- ❺ Mouse connector

**Figure 5-3 Right Side View of the System Box**



LJ-00962-T10

## Removing and Replacing FRUs 5.3 System Preparation

### 5.3 System Preparation

Perform the following to prepare the system for removing or replacing FRUs.

1. Turn power to the operating system off.
2. Enter console mode by pressing the halt button (Figure 5–3) located on the right rear of the system box.
3. After adding a new device or module to the system, halt the system after the power-up test so diagnostics can be run to determine if the new device or module is connected correctly. At the console prompt, type:

```
>>> SET HALT 3   
>>>
```

4. Before adding a new device or module, review the current system configuration. After adding the new device or module, compare the old configuration with the current one to help verify that all devices are present and functioning correctly. Record the current system configuration information for reference.
  - To determine the presence of devices, test status, and to determine the quantity of memory inside the system, enter:

```
>>>SHOW CONFIG 
```

A configuration appears similar to the following:

```
KA48-A BL3-186-B3.1  
80-00-2B-F3-31-03  
16 MB  
  
DEVNBR  DEVNAM  INFO  
-----  -  
1      NVR      OK  
2      LCG      HR - 8 PLN FB - 2.7  
3      DZ       OK  
4      CACHE  OK  
5      MEM      OK  
  
16MB = S0/S1=8MB, S2/S3=0MB, S4/S5=0MB  
  
6      FPU      OK  
7      IT       OK  
8      SYS      OK  
9      NI       OK  
10     SCSI     OK  
11     AUD      OK  
1-RZ23L 6-INITR
```

To determine the quantity of memory in the system, refer to line 5 of the configuration display.

## Removing and Replacing FRUs

### 5.3 System Preparation

5. Turn the system off (0).

---

#### Warning

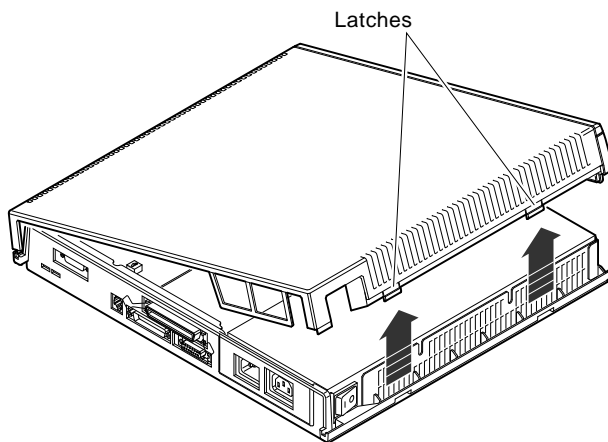
---

Turn power to the monitor off for at least three minutes before removing the power cord. Remove the power cord from the monitor before moving the monitor. The monitor is heavy and may require two people to lift it.

---

6. Disconnect the system power cord from the wall outlet and then from the system.
7. Disconnect the monitor power cord from the back of the system.
8. Remove the monitor from the top of the system and set it aside.
9. Remove the system cover by gently pushing in on the tabs located on left side of the cover. Lift the cover up and away. (Figure 5–4). Releasing the cover could be easier if the system box is turned on the side to access the release tabs easier.

**Figure 5–4** Removing the cover



MLO-007012

## Removing and Replacing FRUs 5.4 Mass Storage Drive Removal

### 5.4 Mass Storage Drive Removal

---

**Note**

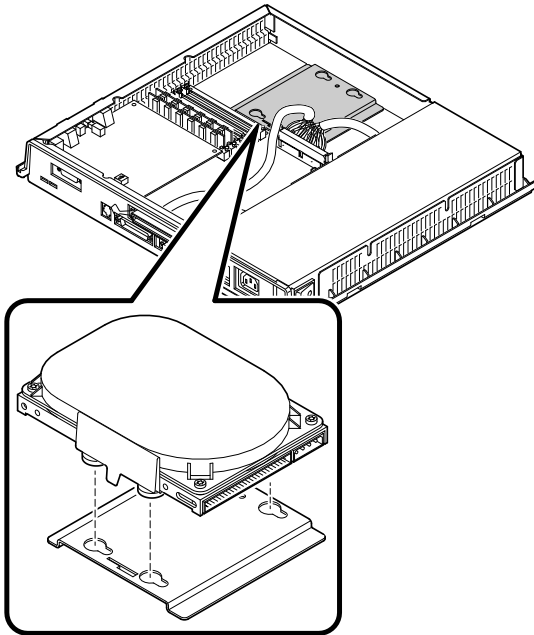
---

Refer to Section 5.3 before removing or replacing a device or module.

---

This section describes how to remove the mass storage device from the VAXstation 4000 VLC workstation. Figure 5-5 shows the RZ23L drive with its cricket retaining clip in the foreground and skid plate with mounting bolt holes underneath the drive.

**Figure 5-5 Removing the RZ23L Hard Disk Drive**



LJ-01386-T10

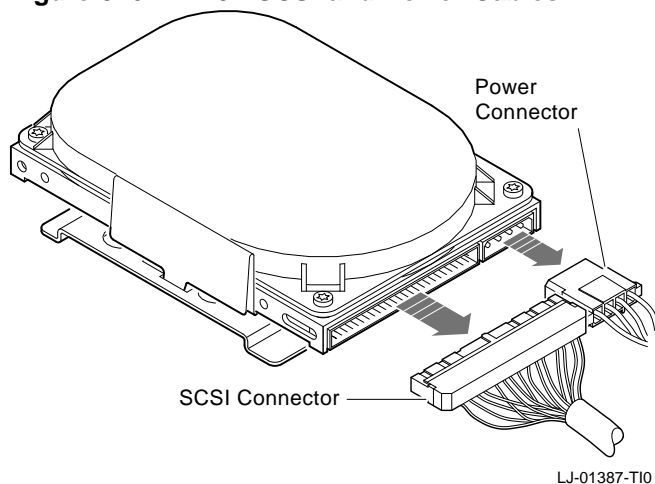
## Removing and Replacing FRUs

### 5.4 Mass Storage Drive Removal

To remove the hard disk drive, perform the following steps:

1. Depress the cricket clip on the side of the drive and slide the drive back until the metal pegs (on the bottom of the drive) are aligned with the mounting holes on the skid plate.
2. Disconnect both the SCSI and dc power cables from the drive (Figure 5–6).

**Figure 5–6 RZ23L SCSI and Power Cables**



3. Lift the drive and bracket from the system box.
4. Remove the drive bracket from the drive.

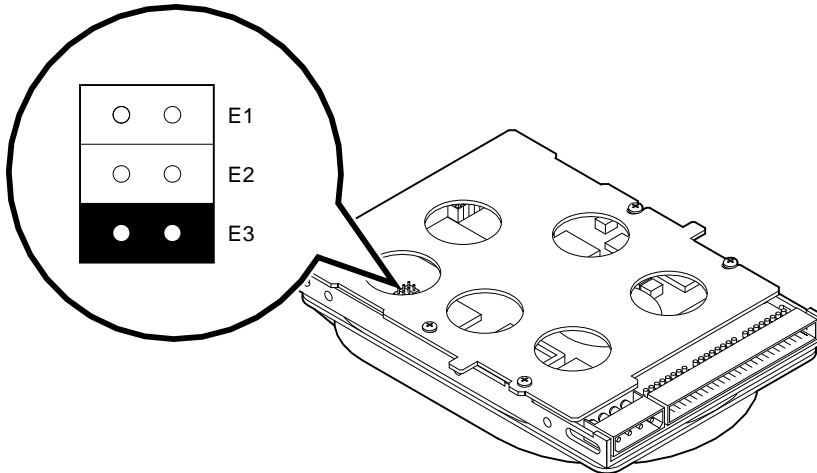
## Removing and Replacing FRUs 5.4 Mass Storage Drive Removal

### 5.4.1 Hard Disk Drive Replacement

Before installing the new hard disk drive, verify the SCSI ID setting on the drive.

The SCSI jumpers allow you to select a distinct unit number for each SCSI device. It is essential that each device have a unique number (0-7, octal). Figure 5-7 shows the location of the hard disk drive SCSI ID jumpers (ID number 4 selected).

**Figure 5-7 RZ23L Disk Drive SCSI ID Jumper Location**



MLO-005907

## Removing and Replacing FRUs

### 5.4 Mass Storage Drive Removal

Set the SCSI ID jumpers of the top disk drive as specified in Table 5–1. The jumpers are used in the following manner:

- Install the jumper for ON.
- Remove the jumper for OFF.

---

**Note**

---

Disk drives are normally assigned address numbers 0-3. Other devices, such as tape drives, are assigned higher numbers (5 and higher). The unique SCSI ID number must be set for each SCSI device installed in the system.

---

**Table 5–1 Hard Disk Drive SCSI Jumper Settings**

SCSI ID	E1	E2	E3	Comment
0	Out	Out	Out	
1	In	Out	Out	
2	Out	In	Out	
3	In	In	Out	
4	Out	Out	In	
5	In	Out	In	
6	Out	In	In	Usually reserved for SCSI controller
7	In	In	In	

To install a new drive, reverse the steps in Section 5.4.1. However, when replacing the drive it is easier when the cables are attached to the drive before mounting the drive in the system box.

---

**Note**

---

When installing the hard disk drive into the bracket, you must apply pressure on the drive to seat it properly.

---

## Removing and Replacing FRUs

### 5.5 Power Supply Removal

## 5.5 Power Supply Removal

---

### CAUTION

---

Wear an antistatic wrist strap and place an antistatic mat under the system when removing and replacing any modules.

---

This section describes how to remove the power supply from the VAXstation 4000 VLC system box. Figure 5-1 shows the location of the power supply. To remove the power supply perform the following steps:

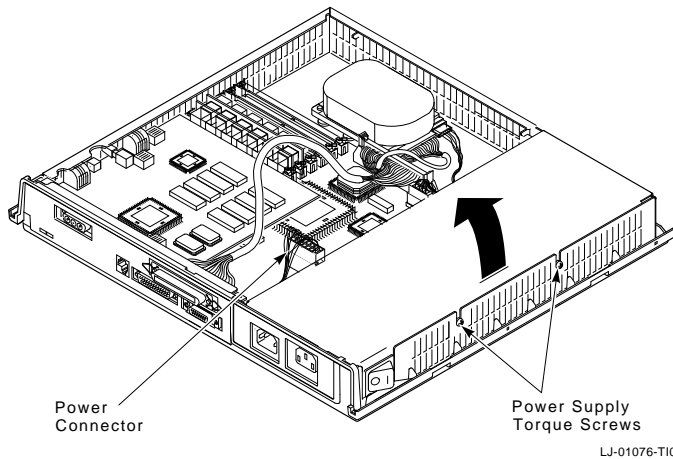
1. Disconnect the monitor and power supply power cords from the ac connectors at the rear of the unit.
2. Remove the top cover (Section 5.3, Figure 5-4).
3. Disconnect the power supply power cable from the J13 connector of the system module (Figure 5-8).
4. Loosen the two torque screws holding the power supply against the left side of the system box. Figure 5-8 shows the location of the torque screws as seen from the rear of the system box.
5. Tilt the power supply up until the bottom clears the system box, then lift the power supply up and out.



## Removing and Replacing FRUs

### 5.5 Power Supply Removal

Figure 5–8 Power Supply Removal



#### 5.5.1 Power Supply Replacement

---

**Note**

---

Refer to Section 5.3 before removing or replacing a device or module.

---

When replacing the power supply, ensure that the power supply you are installing is identical to the one you remove from the system. When installing a power supply into a VAXstation 4000 VLC workstation, install the H7109 power supply.

---

**Note**

---

Use care when handling the power supply. Do not attempt to open the power supply.

---

To install a new power supply, reverse the steps in Section 5.5.

## Removing and Replacing FRUs

### 5.6 Removing the LCG Module

## 5.6 Removing the LCG Module

---

### CAUTION

---

Wear an antistatic wrist strap and place an antistatic mat under the system when removing and replacing any modules.

---

To remove the LCG module perform the following steps:

1. Disconnect the power cords (monitor and power supply) from the two ac connectors at the rear of the unit.
2. Locate and remove the two mounting screws of the LCG module.
3. Lift the LCG module up and to the rear until the video jack has cleared the plastic system box enclosure.

To install a new LCG module, reverse the steps in Section 5.6.

## 5.7 Removing the System Module

---

### CAUTION

---

Wear an antistatic wrist strap and place an antistatic mat under the system when removing and replacing any modules.

---

To remove the system module (CPU), perform the following steps:

1. Remove the LCG graphics/audio module.
2. Disconnect the cables attached to the CPU module at the rear of the system.
3. Remove the MS40 memory modules.
4. Remove the five rivets and three screws from the front of the CPU module.
5. Remove the system module (CPU) by lifting it enough so that it clears the two guides at the right front and left of the module.
6. Using the large center connector, pull the module toward the front of the system box and lift it out.

---

### Note

---

The Ethernet ROM must be removed and installed on the new system module or the NVR settings will be lost.

---

## Removing and Replacing FRUs

### 5.7 Removing the System Module

#### 5.7.1 System Module (CPU) Replacement

Be sure to protect the system module from damage due to static charge when replacing or removing the system module.

To install a new system module (CPU), reverse the steps in Section 5.7.

## 5.8 MS40 Memory Module Removal

---

### Note

---

There must always be at least two memory modules in a VAXstation 4000 VLC workstation.

---

---

### CAUTION 1

---

Memory module components are easily damaged by static electricity. An antistatic wriststrap should always be worn when installing or removing memory components.

---

---

### CAUTION 2

---

The memory modules are keyed and should be installed in only one direction. Excessive force applied to a module when it is not properly aligned with the connector can cause permanent damage to either the memory module or the connector.

---

---

### CAUTION 3

---

Wear an antistatic wrist strap and place an antistatic mat under the system when removing and replacing any modules.

---

---

### Note

---

Memory modules must always be removed starting from the front of the system. For example, if you are going to replace the module towards the rear of the system board, you must remove any modules starting at the front and working toward the back. Memory modules

## **Removing and Replacing FRUs**

### **5.8 MS40 Memory Module Removal**

are numbered on the right edge of the memory connectors located on the system board.

---

## Removing and Replacing FRUs

### 5.8 MS40 Memory Module Removal

This section describes how to remove the MS40 memory module from the system. The memory modules are shown in Figure 5–1. To remove the MS40 memory modules perform the following steps:

1. Release the two metal retainers at each end of the memory module connector.
2. Rotate the module backward approximately 55 degrees to the rear of the unit and lift it out of the slot.

---

**Note**

---

Failure to release the two module retainers will permanently damage the module connector located on the system board.

---

#### 5.8.0.1 MS40 Memory Module Replacement

---

**Note**

---

There is only one type of memory module available for the VAXstation 4000 VLC workstation, the 4 Mbyte (MS40-AA). Be sure that you have the correct module before installation. To identify the module locate the etch on the left side of the memory module.

---

To install a new MS40 memory module perform the following steps:

1. Place the module in the connector with it tilted at approximately 55 degrees backwards. Be sure the double notched lower corner of the module is away from the power supply.
2. Pivot the module upwards until the metal tabs connect with the module and latch it into place.

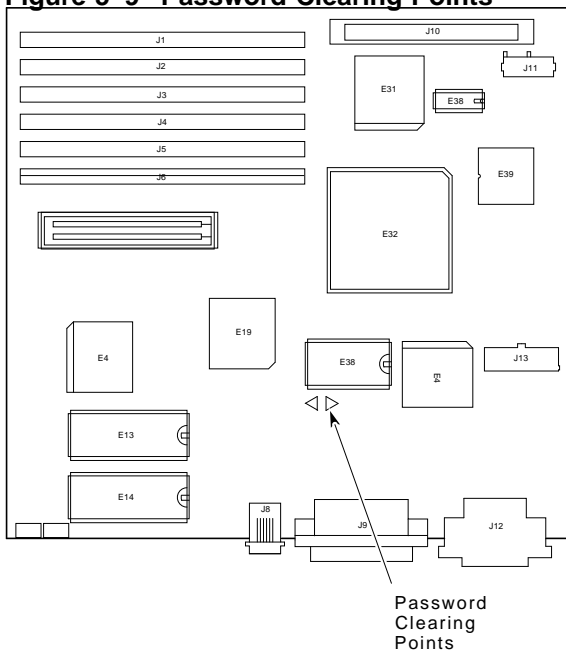
## Removing and Replacing FRUs 5.9 Clearing the System Password

### 5.9 Clearing the System Password

To clear the system password

1. Turn power to the system off.
2. Ground the two triangles onto the system module using a screwdriver.  
Figure 5–9 shows the grounding points on the CPU module.

**Figure 5–9 Password Clearing Points**



LJ-01077-T10

## Removing and Replacing FRUs

### 5.10 Testing the VAXstation 4000 VLC System

## 5.10 Testing the VAXstation 4000 VLC System

This section describes how to test the system after removing or replacing any FRUs.

### 5.10.1 Restore the System

Before you can test the system, you must restore the system to its previous operating state. To restore the system, perform the following steps:

1. Replace the system cover. Align the teeth of the cover with the teeth on the side of the system enclosure and lower the cover until it clicks into place.
2. Reconnect any cables that you disconnected from the rear of the system.
3. Reconnect the monitor.
4. Plug the system power cord into the wall outlet.
5. Turn power to the system on.

## Removing and Replacing FRUs

### 5.10 Testing the VAXstation 4000 VLC System

#### 5.10.2 Test the System

Test the system to confirm that all devices and modules are connected correctly. Do the following to test the system:

1. Note any power-up error or status messages on the monitor screen.
2. Display the system device configuration by using the `SHOW CONFIG` command. (See Section 5.3.) Compare the latest configuration display with the configuration display you viewed during site preparation. You should see the new device and the other devices present in the system. Verify that no error messages appears on the monitor screen.
3. Verify that all devices are interacting properly by using the `TEST 1:11` command to run the expanded self test.
4. Verify that drives are set to the correct SCSI IDs using the `SHOW DEVICE` command.
5. If problems occur, check the following to ensure that
  - a. All cables inside and outside the system are connected.
  - b. All modules are fully seated in the connectors.
  - c. SCSI IDs are set correctly. Each drive should have a different SCSI Id.



# A

---

## Self-Test Error Codes

### A.1 Self-Test Error Codes

The system reports two kinds of self-test errors: those that display on the console immediately after running the self test, and extended self test errors. The first type consists of one or two question marks to indicate a nonfatal or fatal error, the failing FRU, the failed device, and a general error code. The second type of error (extended), displays more detailed information. To view an extended error, you must type SHOW ERROR at the console prompt, after the self test has reported an error.

#### A.1.1 NVR Self-Test Error Codes

Table A-1 lists the TOY/NVR self-test error codes.

**Table A-1 TOY/NVR Self-Test Error Codes**

<b>Error-DEC</b>	<b>Error-HEX</b>	<b>Meaning</b>
1	1	Self test was successful
4	4	Battery was found to be bad
8	8	NVR register test has failed
12	C	Battery down and NVR register test has failed
16	10	TOY register test has failed
32	20	Valid RAM and time bit has failed to set
36	24	VRT bit failure and battery was found to be bad
44	2C	Battery down, VRT failure, and NVR test has failed
48	30	TOY register test and VRT has failed
64	40	Battery check test has failed

(continued on next page)

**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

**Table A-1 (Cont.) TOY/NVR Self-Test Error Codes**

<b>Error-DEC</b>	<b>Error-HEX</b>	<b>Meaning</b>
72	48	Battery check test has failed and NVR register test has failed
96	60	VRT bit failure and battery check test has failed
104	68	Battery check, VRT, and NVR test has failed
128	80	Update in progress has failed to clear; hard error
129	81	Update in progress has failed to clear; soft error
160	A0	Update in progress has failed and VRT bit has failed

**A.1.2 DZ Self-Test Error Codes**

Table A-2 lists the DZ error codes.

**Table A-2 DZ Self-Test Error Codes**

<b>Error-DEC</b>	<b>Error-HEX</b>	<b>Meaning</b>
16	10	DZ reset test has failed
32	20	DZ read LPR test has failed
48	30	DZ Modem test has failed
64	40	DZ polled test has failed
80	50	DZ interrupt driver transfer test has failed
96	60	DZ LK401 test has failed
112	70	DZ mouse test has failed
128	80	DZ INIT DRIVER has failed
144	90	No memory to use for data area

The DZ self test does not display extended error information when an error occurs. Use the SHOW ERROR command to view the extended error information.

**Extended Error Format 0010 :**

## Self-Test Error Codes

### A.1 Self-Test Error Codes

001 0010 ssssssss cccccccc llllllll rrrrrrrr eeeeeeee

Message	Meaning
sssssss	Suberror code
ccccccc	Value of the DZ CSR
lllllll	Line number
rrrrrrr	Data read back
eeeeeee	Expected data

This format is used by the DZ read LPR test.

Table A-3 lists the DZ suberror codes.

**Table A-3 DZ Suberror Codes**

Suberror-HEX	Meaning
<b>Read LPR</b>	
21	READ LPR Baud rate is incorrectly set
22	READ LPR Character width is incorrectly set
23	READ LPR Parity bit is incorrectly set
24	READ LPR Receiver on bit is incorrectly set
<b>DZ Modem Test</b>	
31	Failed RTS <-> CTS loopback
32	Failed DSRS <-> DSR & CD loopback
33	Failed LLBK <-> SPDMI loopback
34	Failed DTR <-> RI loopback

(continued on next page)

**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

**Table A-3 (Cont.) DZ Suberror Codes**

<b>Suberror-HEX</b>	<b>Meaning</b>
<b>DZ Polled Test</b>	
41	Transfer has timed out
42	Data is invalid
43	Parity error
44	Framing error
45	Overrun error
46	Character received != Character transmitted
<b>DZ Interrupt Test</b>	
51	Transfer has timed out
52	Data is invalid
53	Parity Error
54	Framing Error
55	Overrun Error
56	Character received != Character transmitted
<b>DZ LK401 Test</b>	
61	Transfer has timed out
62	LK401 has failed self test
<b>DZ Mouse test</b>	
71	Transfer has timed out
72	Mouse has failed self test

**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

**A.1.3 Memory Self-Test Error Codes**

Table A–4 lists the memory self-test error codes.

**Table A–4 Memory Self-Test Error Codes**

<b>Error-DEC</b>	<b>Error-HEX</b>	<b>Meaning</b>
64	40h	16 MB memory modules are mismatched
66	42h	Gap found between memory module pairs
68	44h	16 MB memory module found on a PVAX2
70	46h	4 MB module found after 16 MB module
72	48h	Memory modules not plugged in pairs
256	100h	Failure has occurred in the byte mask test
260	104h	Parity error occurred during the byte mask test
514	202h	Data compare error occurred during the forward pass
516	204h	Parity error occurred during the forward pass
770	302h	Data compare error occurred during the reverse pass
772	304h	Parity error occurred during the reverse pass
1028	404h	Parity error occurred during parity test #1
1288	504h	Parity error occurred during parity test #2

The memory self test does not display extended error information when an error occurs. Use the **SHOW ERROR** command to view the extended error information. The extended error code can be as shown.

## Self-Test Error Codes

### A.1 Self-Test Error Codes

#### Extended Error Format:

```
xxx 4 MEM yyyy
xxx 00a bbbbbbbb cccccccc dddddddd eeeeeeee
```

Message	Meaning
xxx	The failed FRU
yyyy	The error code in HEX
00a	Extended error information format type
bbbbbbbb	The contents of the memory system error register (MSER)
ccccccc	The failing address
ddddddd	The expected data
eeeeeee	The data that was read

#### A.1.4 Memory Management Unit Self-Test Error Codes

Table A–5 lists the memory management unit (MMU) self-test error codes.

**Table A–5 Memory Management Unit Self-Test Error Codes**

Error-DEC	Error-HEX	Meaning
2	2	Could not find 64 Kbyte of memory for the test
4	4	Failure in the MMU
8	8	Illegal vector during MMU test

**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

**A.1.5 Interval Timer Self-Test Error Codes**

Table A–6 lists the interval timer self-test error codes.

**Table A–6 Interval Timer Self-Test Error Codes**

Error-DEC	Error-HEX	Meaning
2	2	Interval timer is not interrupting at the correct rate

**A.1.6 System Device Self-Test Error Codes**

Table A–7 lists the system device self-test error codes.

**Table A–7 System Device Self-Test Error Codes**

Error-DEC	Error-HEX	Meaning
2	2	System ROM test has failed
128	80	Invalidate filter RAM error

The SYS self test does not display extended error information when an error occurs. Use the SHOW ERROR command to view the extended error information. The extended error code format is shown next.

**Extended Error Format 0010 :**

This format displays when there is an invalidate filter ram error.

```
001 0010 aaaaaaaaa rrrrrrrr eeeeeeee
```

Message	Meaning
001	The FRU number (system board)
0010	The format number
aaaaaaaa	The failing invalidate filter address
rrrrrrrr	The data read
eeeeeeee	The data expected

**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

**A.1.7 SCSI Self-Test Error Codes**

Table A–8 lists the SCSI self-test error codes.

**Table A–8 SCSI Self-Test Error Codes**

<b>Error-DEC</b>	<b>Error-HEX</b>	<b>Meaning</b>
2	2	SCSI Reset Register Test has failed
4	4	SCSI Configuration Registers Test has failed
6	6	SCSI Fifo Register Test has failed
8	8	SCSI Transfer Count Registers Test has failed
10	A	SCSI Interrupt, Status Registers Test has failed
20	14	SCSI Interrupt Test No Cause has failed
22	16	SCSI Interrupt Test High Ipl, Mask Disabled has failed
24	18	SCSI Interrupt Test High Ipl, Mask Enabled has failed
26	1A	SCSI Interrupt Test Low Ipl, Mask Disabled has failed
28	1C	SCSI Interrupt Test Low Ipl, Mask Enabled has failed
30	1E	SCSI Data Transfer Test, Prom Function has failed
32	20	SCSI Data Transfer Test, DMA Mapping has failed
34	22	SCSI Data Transfer Test, Non-DMA Inquiry has failed
36	24	SCSI Data Transfer Test, Not Enough Data Returned
38	26	SCSI Data Transfer Test, DMA Inquiry has failed
40	28	SCSI Data Transfer Test, Non-DMA/DMA Miscompare
42	2A	SCSI Data Transfer Test, DMA Inquiry Nonaligned has failed
44	2C	SCSI Data Transfer Test, Non-DMA/DMA Nonaligned Miscompare
46	2E	SCSI Data Transfer Test, Synchronous Inquiry has failed

(continued on next page)



**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

**Table A–8 (Cont.) SCSI Self-Test Error Codes**

<b>Error-DEC</b>	<b>Error-HEX</b>	<b>Meaning</b>
48	30	SCSI Data Transfer Test, Non-DMA/Synchronous Miscompare
50	32	SCSI Minimal Device Test has failed
60	3C	SCSI Map Error Test, DMA Mapping has failed
62	3E	SCSI Map Error Test, DMA Inquiry has failed
64	40	SCSI Map Error Test, Map Error Will Not Clear
66	42	SCSI Map Error Test, Map Error Will Not Set
68	44	SCSI Map Error Test, Parity Error Will Not Clear
70	46	SCSI Map Error Test, Prom Function has Failed
80	50	SCSI Prom Function has failed
82	52	SCSI Init Driver has failed

The SCSI self test does not display extended error information when an error occurs. Use the SHOW ERROR command to view the extended error information. The extended error code can be as shown.

**Extended Error Format 0001 :**

This format is used by the register test.

```
001 0001 aaaaaaaaa bbbbbbbb ccccccc ddddddd
```

<b>Message</b>	<b>Meaning</b>
aaaaaaaa	The error code
bbbbbbbb	The address of the register or location being accessed
ccccccc	The expected data or data written
ddddddd	The actual data or data read

## Self-Test Error Codes

### A.1 Self-Test Error Codes

#### Extended Error Format 000B :

This format is used by the register test.

001 000B aaaaaaaaa bbbbbbbb ccccccc

Message	Meaning
aaaaaaaa	The error code
bbbbbbb	The address of the register or location being accessed
ccccccc	Information about the error

#### Extended Error Format 000C :

This format is used by the interrupt test.

001 000C aaaaaaaaa bbbbbbbb ccccccc ddddddd eeeeeee ffffffff

Message	Meaning
aaaaaaaa	The error code
bbbbbbb	Information about the error
ccccccc	Contents of interrupt mask register
ddddddd	Contents of interrupt request register
eeeeeee	Contents of controller status register
fffffff	Contents of the controller interrupt register

## Self-Test Error Codes A.1 Self-Test Error Codes

### Extended Error Format 000D :

This format is used when not enough data is returned to the self test after a SCSI command is executed.

aaa 000D bbbbcccc ddddeeee ffffgggg hhhhhhhh

Message	Meaning
aaa	The FRU
bbbb	The logical unit number
cccc	The device ID
dddd	The actual command opcode
eeee	The current command opcode
ffff	The error code
gggg	The mode of operation
hhhhhhh	the number of data bytes received

### Extended Error Format 000E :

This format is used when execution of a SCSI command fails.

aaa 000E bbbbcccc ddddeeee ffffgggg hhhhiiii jjjjjjjj kkkkl1111 mmmmmmmm

Message	Meaning
aaa	The FRU
bbbb	The logical unit number
cccc	The device ID
dddd	The actual command opcode
eeee	The current command opcode
ffff	The error code
gggg	The mode of operation
hhhh	Byte 14 of the request sense packet (device FRU)
iiii	Information about the error
jjjjjjj	SCSI bus phase at the time of the error
kkkk	The contents of the controller status register at the time of the error

**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

<b>Message</b>	<b>Meaning</b>
llll	The contents of the controller interrupt register at the time of the error
mmmmmmmm	The request sense key

**Extended Error Format 000F :**

This format is used when the status phase returns a bad status, or when a bad sense key is seen after a request sense.

aaa 000F bbbbcccc ddddeeee ffffgggg hhhhiiii jjjjjjjj kkkkkkkk

<b>Message</b>	<b>Meaning</b>
aaa	The FRU
bbbb	Logical unit number
cccc	Device ID
dddd	Actual command opcode
eeee	Current command opcode
fff	Error code
gggg	Mode of operation
hhhh	Byte 14 of the request sense packet (device FRU)
iiii	Information about the error
jjjjjjj	Status byte returned in the status phase
kkkkkkkk	Request sense key

## Self-Test Error Codes A.1 Self-Test Error Codes

### Extended Error Format 0010 :

This format is used when a request sense command is executed, but not enough sense bytes are received.

aaa 0010 bbbbcccc ddddeeee ffffgggg hhhhiiii jjjjjjjj kkkkkkkk

Message	Meaning
aaa	The FRU
bbbb	Logical unit number
cccc	Device ID
dddd	Actual command opcode
eeee	Current command opcode
ffff	Error code
gggg	Mode of operation
hhhh	Byte 14 of the request sense packet (device FRU)
iiii	Information about the error
jjjjjjjj	Number of bytes of sense data returned from the request sense
kkkkkkkk	Request sense key

### Extended Error Format 0011 :

This format is used when the data out phase sends less bytes than expected.

aaa 0011 bbbbcccc ddddeeee ffffgggg hhhhiiii jjjjkkkk llllllll mmmmmmmm

Message	Meaning
aaa	The FRU
bbbb	Logical unit number
cccc	Device ID
dddd	Actual command opcode
eeee	Current command opcode
ffff	Error code
gggg	Mode of operation
hhhh	Byte 14 of the request sense packet (device FRU)
iiii	Information about the error

**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

Message	Meaning
jjjj	Contents of the controller status register at the time of the error
kkkk	Contents of the controller interrupt register at the time of the error
lllllll	Number of bytes actually sent in the data in/out phase
mmmmmmmm	Number of bytes that should have been sent in the data in/out phase

**Extended Error Format 0012 :**

This format is used when an unsupported message is seen.

aaa 0012 bbbbcccc ddddeeee ffffgggg hhhhhiii jjjjjjjj kkkkl111l mmmmmmmmm

Message	Meaning
aaa	The FRU
bbbb	Logical unit number
cccc	Device ID
dddd	Actual command opcode
eeee	Current command opcode
ffff	Error code
gggg	Mode of operation
hhhh	Byte 14 of the request sense packet (device FRU)
iiii	Information about the error
jjjjjjj	First message byte of the message in the phase that the error occurred
kkkk	Contents of the controller interrupt register at the time of the error
llll	Contents of the controller status register at the time of the error
mmmmmmmm	Request sense key

**Extended Error Format 0013 :**

This format is used by the map error test.

aaa 0013 bbbbcccc dddddd eeeeeeee ffffffff gggggggg hhhhhhhh iiiiiiiii

Message	Meaning
aaa	The FRU

## Self-Test Error Codes

### A.1 Self-Test Error Codes

<b>Message</b>	<b>Meaning</b>
bbbb	Logical unit number
cccc	Device ID
ddddddd	DMA address where the SCSI command is located
eeeeeee	DMA address where the SCSI data is located
ffffff	Contents of the parity control register
ggggggg	Map register address
hhhhhhh	Contents of the map register
iiiiiii	Error code

## Self-Test Error Codes

### A.1 Self-Test Error Codes

#### Extended Error Format 14 :

This format is used by the data transfer test when the number of bytes received from two transfers are different.

aaa 0014 bbbbbbbb ccccccc dddddddd

Message	Meaning
aaa	The FRU
bbbbbbb	First number of the bytes
ccccccc	Second number of the bytes
ddddddd	Error code

#### Extended Error Format 0015 :

This format is used by the data transfer test when the data bytes received from two transfers are compared and found to be different.

aaa 0015 bbbbbbbb ccccccc

Message	Meaning
aaa	The FRU
bbbbbbb	Number of the byte that failed
ccccccc	Error code



**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

**A.1.8 Audio Self-Test Error Codes**

Table A–9 lists the audio self-test error codes.

**Table A–9 Audio Self-Test Error Codes**

<b>Error-DEC</b>	<b>Error-HEX</b>	<b>Meaning</b>
2	2	AUD\$LIU_LSR_SAE Register Test has failed
4	4	AUD\$LIU_LPR_SAE Register Test has failed
6	6	AUD\$LIU_LPR_NZE Register Test has failed
8	8	AUD\$LIU_LMR1_SAE Register Test has failed
10	A	AUD\$LIU_LMR2_SAE Register Test has failed
16	10	AUD\$MUX_MCR1_SAE Register Test has failed
18	12	AUD\$MUX_MCR2_SAE Register Test has failed
20	14	AUD\$MUX_MCR3_SAE Register Test has failed
32	20	AUD\$MAP_MMR1_SAE Register Test has failed
34	22	AUD\$MAP_MMR2_SAE Register Test has failed
36	24	AUD\$MAP_DIGITAL_LOOPBACK1 Test has failed
38	26	AUD\$MAP_DIGITAL_LOOPBACK2 Test has failed
40	28	AUD\$MAP_DIGITAL_LOOPBACK3 Test has failed
48	30	AUD\$INTR_RECEIVE_BYTE_AVAILABLE Test has failed
50	32	AUD\$INTR_BAD_DLC_LOOPBACK_DATA Test has failed
52	34	AUD\$INTR_TIME_OUT Test has failed
56	36	AUD\$INTR_INVALID_IR_VALUE Test has failed
58	38	AUD\$INTR_NO_INT_GENERATED Test has failed
60	3A	AUD\$INTR_NOT_ALL_INTS_RCVD Test has failed
62	3C	AUD\$INTR_INT_NOT_DISABLED Test has failed

The AUD self test does not display extended error information in decimal when an error occurs. Use the SHOW ERROR command to view the extended error information in HEX. The extended error codes can be of several types as shown.

**Extended Error Format 0010 :**

## Self-Test Error Codes

### A.1 Self-Test Error Codes

This format is used by all of the audio register test.

aaa 0010 bbbbbbbb cccccc ddddddd

Message	Meaning
aaa	The FRU
bbbbbbb	Error number
ccccc	Contents of data register (DR)
dddddd	TBS

## Self-Test Error Codes A.1 Self-Test Error Codes

### Extended Error Format 0011 :

This format is used by all of the audio register test.

aaa 0011 bbbbbbbb ccccccc dddddddd

Message	Meaning
aaa	The FRU
bbbbbbb	Error number
ccccccc	Contents of D channel status register 2 (DSR2)
ddddddd	TBS

### Extended Error Format 0012 :

This format is used by all of the audio register test.

aaa 0012 bbbbbbbb ccccccc dddddddd

Message	Meaning
aaa	The FRU
bbbbbbb	Error number
ccccccc	0
ddddddd	TBS

## A.1.9 Floating Point Unit (FPU) Self-Test Error Codes

Table A–10 lists the FPU self-test error codes.

**Table A–10 FPU Self-Test Error Codes**

Error-DEC	Error-HEX	Meaning
258	102	MOVF instruction test has failed
260	104	Unexpected Exception has occurred during MOVF test
514	202	MNEGF instruction test has failed
516	204	Unexpected Exception has occurred during MNEGF test

(continued on next page)

**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

**Table A–10 (Cont.) FPU Self-Test Error Codes**

<b>Error-DEC</b>	<b>Error-HEX</b>	<b>Meaning</b>
770	302	ACBF instruction test has failed
772	304	Unexpected Exception has occurred during ACBF test
1026	402	ADDF2/ADDF3 instruction test has failed
1028	404	Unexpected Exception has occurred during ADDFx test
1282	502	CMPF instruction test has failed
1284	504	Unexpected Exception has occurred during CMPF test
1538	602	CVTFD/CVTFG instruction test has failed
1540	604	Unexpected Exception has occurred during CVTFD /CVTFG test
1794	702	CVTFx instruction test has failed
1796	704	Unexpected Exception has occurred during CVTFx test
2050	802	CVTxF instruction test has failed
2052	804	Unexpected Exception has occurred during CVTxF test
2306	902	DIVF2/DIVF3 instruction test has failed
2308	904	Unexpected Exception has occurred during DIVFx test
2562	A02	EMODF instruction test has failed
2564	A04	Unexpected Exception has occurred during EMODF test
2818	B02	MULF2/MULF3 instruction test has failed
2820	B04	Unexpected Exception has occurred during MULFx test
3074	C02	POLYF instruction test has failed
3076	C04	Unexpected Exception has occurred during POLYF test
3330	D02	SUBF2/SUBF3 instruction test has failed

(continued on next page)

**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

**Table A–10 (Cont.) FPU Self-Test Error Codes**

<b>Error-DEC</b>	<b>Error-HEX</b>	<b>Meaning</b>
3332	D04	Unexpected Exception has occurred during SUBFx test
3586	E02	TSTF instruction test has failed
3588	E04	Unexpected Exception has occurred during TSTF test

The FPU self test displays extended error information when an error occurs. Use the SHOW ERROR command to view the extended error information. The extended error code can be as shown.

**Extended Error Format:**

This format is used by the FPU self test when it receives an exception while running one of the floating point tests.

```
001 000 VVVVVVVV EEEEEEEE EEEEEEEE EEEEEEEE EEEEEEEE EEEEEEEE EEEEEEEE
```

<b>Message</b>	<b>Meaning</b>
VVVVVVVV	Vector of the unexpected interrupt
EEEEEEEE	Other exception data; ONLY prints out on machine checks and arithmetic traps

## Self-Test Error Codes

### A.1 Self-Test Error Codes

#### A.1.10 Cache Self-Test Error Codes

Table A–11 lists the Cache self-test error codes.

**Table A–11 Cache Self-Test Error Codes**

Error-DEC	Error-HEX	Meaning
512	200	Error in write/read to the DATA store
768	300	Error in write/read to the TAG store
1024	400	Valid bit is not set when it should be
1280	500	TAG does not contain TAG for Diagnostic space
1536	600	Unexpected TAG parity error
1792	700	Cache did not provide expected data during a cache hit
2048	800	Cache Data parity error
2304	900	Tag not valid during cache hit testing
2560	a00	Data not valid during cache hit testing
2816	B00	cache data write through test has failed because of invalid data in the cache data store
3072	C00	cache data write through test has failed because of invalid data in memory

The Cache self test displays extended error information when an error occurs. Use the `SHOW ERROR` command to view the extended error information. The extended error can be as shown.

## Self-Test Error Codes A.1 Self-Test Error Codes

### Extended Error Format 000a :

This format is use by Cache test.

001 000a aaaaaaaaa eeeeeeee rrrrrrrr

Message	Meaning
aaaaaaaa	Address within the DATA or TAG store that failed
eeeeeeee	Expected value of the data pattern
rrrrrrrr	Data that was read from the failing address

### A.1.11 LCG Self-Test Error Codes

Table A–12 lists the LCG self-test error codes.

**Table A–12 LCG Self-Test Error Codes**

Error-DEC	Error-HEX	Meaning
2	2	LCG register test has failed
<b>LCG Fifo Test Failures</b>		
16	10	Fifo status bits error
18	12	Fifo setup packet error
20	14	Fifo interrupt status bit error
22	16	Fifo control status bit error
24	18	Fifo memory pointers error
26	1A	Fifo data flow error
28	1C	Fifo clip list pointers error

(continued on next page)

**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

**Table A–12 (Cont.) LCG Self-Test Error Codes**

<b>Error-DEC</b>	<b>Error-HEX</b>	<b>Meaning</b>
<b>LCG Interrupt Test Failures</b>		
32	20	Write protect not set
34	22	Write protect not cleared
36	24	Bad opcode interrupt not set
38	26	Bad opcode interrupt not cleared
40	28	Clip list wrap interrupt not set
42	2A	Clip list wrap interrupt not cleared
44	2C	Packet breakpoint interrupt not set
46	2E	Packet breakpoint interrupt not cleared
48	30	Packet breakpoint single step
50	32	Address breakpoint not set
52	34	Address breakpoint not cleared
54	36	Address breakpoint not cancelled
56	38	Access breakpoint not set
58	3A	Access breakpoint not cleared
60	3C	Access breakpoint single step
62	3E	Nop interrupt not set
64	40	Nop interrupt not cleared
66	42	Halt interrupt not set
68	44	Halt interrupt not cleared
70	46	LCG interrupt line
72	48	LCG memory error interrupt

(continued on next page)



**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

**Table A–12 (Cont.) LCG Self-Test Error Codes**

<b>Error-DEC</b>	<b>Error-HEX</b>	<b>Meaning</b>
<b>Video Option Board VRAM Test Failures</b>		
80	50	Pass 1 failed
82	52	Pass 2 failed
84	54	Pass 3 failed
86	56	Address pass test failed
<b>Video Option Board Brooktree Test Failures</b>		
88	58	BT read mask register
90	5A	BT blink mask register
92	5C	BT command register
94	5E	BT test register
96	60	BT palette red entry
98	62	BT palette green entry
100	64	BT palette blue entry
102	66	BT overlay red entry
104	68	BT overlay green entry
106	6A	BT overlay blue entry
108	6C	Video option board of unknown type
110	6E	Video option board video readback test failed
<b>LCG Video Timing Test Failures</b>		
112	70	Verticle retrace never detected
114	72	LCG video counters not counting
116	74	Active video never detected
118	76	LCG plane mask error

(continued on next page)

**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

**Table A–12 (Cont.) LCG Self-Test Error Codes**

<b>Error-DEC</b>	<b>Error-HEX</b>	<b>Meaning</b>
<b>LCG Virtual Drawing Test Failures</b>		
128	80	Virtual status bits error
130	82	Virtual translation error
132	84	Virtual rasterop error
134	86	Virtual falut error
136	88	Virtual invalidate error
<b>LCG Physical Drawing Test Failures</b>		
144	90	Physical reaterop error
146	92	Logical function error
148	94	Action code error

The LCG self test displays extended error information when an error occurs. Use the SHOW ERROR command to view the extended error information. The extended error codes can be of several types as shown.

**Extended Error Format 0001 :**

This format is used by the LCG register test, LCG fifo test, LCG video test, and the LCG virtual test.

xxx 0001 aaaaaaaaa bbbbbbbb ccccccc dddddddd

<b>Message</b>	<b>Meaning</b>
xxx	The FRU
aaaaaaaa	Error code
bbbbbbbb	Address of the register or location being accessed
ccccccc	Expected data or data written
ddddddd	Actual data or data read

## Self-Test Error Codes

### A.1 Self-Test Error Codes

#### Extended Error Format 000B :

This format is used by the LCG fifo test.

010 000B aaaaaaaaa bbbbbbbb ccccccc ddddddd eeeeeee

Message	Meaning
aaaaaaaa	The error code
bbbbbbb	Fifo control flag being tested
cccccc	Address of the register
ddddddd	Expected register content
eeeeeee	Register content

#### Extended Error Format 000C :

This format is used by the LCG fifo test.

010 000C aaaaaaaaa bbbbbbbb ccccccc ddddddd eeeeeee

Message	Meaning
aaaaaaaa	Error code
bbbbbbb	LCG command packet being tested
cccccc	Address of the register
ddddddd	The expected register content
eeeeeee	Register content

#### Extended Error Format 000D :

This format is used by the LCG fifo test, LCG interrupt test, LCG video test and the LCG virtual drawing test.

xxx 000D aaaaaaaaa bbbbbbbb ccccccc ddddddd

Message	Meaning
xxx	The FRU
aaaaaaaa	Error code
bbbbbbb	LCG status bit of interest
cccccc	Address of the register LCG status register

## Self-Test Error Codes

### A.1 Self-Test Error Codes

Message	Meaning
ddddddd	LCG status register content

#### Extended Error Format 000E :

This format is used by the LCG fifo test and the LCG virtual drawing test.

```
010 000E aaaaaaaa bbbbbbbb cccccccc dddddddd eeeeeeee ffffffff
```

Message	Meaning
aaaaaaa	Error code
bbbbbbb	LCG fifo control flag
ccccccc	LCG status bit
ddddddd	LCG status register address
eeeeeee	LCG status register contents
fffffff	Expected state of status bits

#### Extended Error Format 000F :

This format is used by the video option board readback test.

```
xxx 000F aaaaaaaa bbbbbbbb cccccccc dddddddd
```

Message	Meaning
xxx	The FRU
aaaaaaa	Error code
bbbbbbb	Color the Brooktree is programmed
ccccccc	Value of the video option board readback register
ddddddd	Expected value of the video board readback register

## Self-Test Error Codes A.1 Self-Test Error Codes

### Extended Error Format 0010 :

This format is used by the LCG virtual drawing test and the LCG physical drawing test.

001 0010 aaaaaaaaa bbbbbbbb ccccccc dddddddd eeeeeeee ffffffff gggggggg

Message	Meaning
aaaaaaaa	Error code
bbbbbbbb	LCG-drawing opcode and opcode flags
ccccccc	Physical address for operation
ddddddd	Expected pixel value
eeeeeee	Pixel value read
fffffff	LCG-LU function
ggggggg	LCG-action code

### A.1.12 NI Self-Test Error Codes

Table A–13 lists the NI self-test error codes for the system.

**Table A–13 NI Self-Test Error Codes**

Error-DEC	Error-HEX	Meaning
<b>Network Address ROM Test Failure</b>		
16	10	read access failed
18	12	null address
20	14	bad group address
22	16	bad checksum
24	18	bad group 2
26	1A	bad group 3
28	1C	bad test patterns

(continued on next page)

**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

**Table A–13 (Cont.) NI Self-Test Error Codes**

<b>Error-DEC</b>	<b>Error-HEX</b>	<b>Meaning</b>
<b>Lance CSR Test Failures</b>		
32	20	LANCE Register Address Port R/W error
34	22	Lance CSR0 r/w error
36	24	Lance CSR1 r/w error
38	26	Lance CSR2 r/w error
40	28	Lance CSR3 r/w error
<b>Lance Initialization Test Failures</b>		
48	30	Initialization failed
50	32	Receiver disabled
52	34	Transmitter disabled
54	36	Receiver enabled
56	38	Transmitter enabled
<b>Lance Internal Loopback/DMA Test Failures</b>		
64	40	Initialization failed
66	42	Transmit failed
68	44	Receive failed
70	46	Packet comparsion failed
72	48	Initialization DMA error
74	4A	Transmit DMA error
76	4C	Receive DMA error
78	4E	Unknown tx of rx error

(continued on next page)

**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

**Table A–13 (Cont.) NI Self-Test Error Codes**

<b>Error-DEC</b>	<b>Error-HEX</b>	<b>Meaning</b>
<b>Lance Interrupt Test Failures</b>		
80	50	Initialization failed
82	52	Transmit failed
84	54	Receive failed
86	56	Packet comparison failed
88	58	NI bit in INT_REQ register not set
90	5A	NI bit in INT_REQ register not clear
92	5C	NI ISR not entered
94	5E	NI ISR entered multiple times
<b>Lance CRC Test Failures</b>		
96	60	Initialization failed
98	62	Transmit failed
100	64	Receive failed
102	66	Packet comparison failed
104	68	Lance generated bad CRC
106	6A	Lance rejected good CRC
108	6C	Lance accepted bad CRC
110	6E	Other error
<b>Lance rx MISS/BUFF Test Failures</b>		
112	70	Initialization failed
114	72	Transmit failed
116	74	Unknown receive error
118	76	MISS error not flagged
120	78	BUFF error not flagged

(continued on next page)

**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

**Table A–13 (Cont.) NI Self-Test Error Codes**

<b>Error-DEC</b>	<b>Error-HEX</b>	<b>Meaning</b>
<b>Lance Collision Test Failures</b>		
128	80	Initialization failed
130	82	Unknown transmit error
132	84	RETRY not flagged
134	86	Transmitter disabled
<b>Lance Address Filtering Test Failures</b>		
144	90	Initialization failed
146	92	Transmit failed
148	94	Receive failed
150	96	Packet comparison failed
152	98	Broadcast filtering failed
154	9A	Promiscuous mode failed
156	9C	Null destination accepted
158	9E	Good logical address rejected
<b>Lance External Loopback Test Failures</b>		
160	A0	Initialization failed
162	A2	Transmit failed
164	A4	Receive failed
166	A6	Packet comparison failed
168	A8	Unknown transmit error
170	AA	Unknown receive error
172	AC	Check NI port lpbk connector

(continued on next page)



**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

**Table A–13 (Cont.) NI Self-Test Error Codes**

<b>Error-DEC</b>	<b>Error-HEX</b>	<b>Meaning</b>
<b>Lance tx BUFF Test Failures</b>		
176	B0	Initialization failed
178	B2	BUFF error not flagged
180	B4	Transmitter enabled
182	B6	Unknown transmit error
<b>DMA Registers Test Failures</b>		
208	D0	MAP_BASE register error
210	D2	I/O write access to map registers failed
212	D4	I/O read access to map registers failed
214	D6	Parity error not flagged
<b>Lance DMA Test Failures</b>		
224	E0	Non-existent DMA not flagged
226	E2	Invalid DMA not flagged
228	E4	Valid DMA failed
230	E6	DMA failed during initialization
232	E8	DMA failed during transmit
234	EA	DMA failed during receive

The NI self test displays extended error information when an error occurs. Use the `SHOW ERROR` command to view the extended error information. The extended error code can be as shown.

**Self-Test Error Codes**  
**A.1 Self-Test Error Codes**

**Extended Error Format 0001 :**

This format is used by the register test.

0001 0001 aaaaaaaaa bbbbbbbb ccccccc

Message	Meaning
aaaaaaaa	Register address
bbbbbbbb	Expected data or data written
ccccccc	Actual data or data read

**Extended Error Format 0002 :**

This format is used when there is a DMA error.

0001 0002 0000aaaa bbbbbbbb ccccccc dddddddd eeeeeeee

Message	Meaning
aaaa	Actual value of the Lance CSR0
bbbbbbbb	Contents of the parity control register
ccccccc	Device DMA address (24 bits)
ddddddd	Map register physical address
eeeeeee	Map register contents

## Self-Test Error Codes A.1 Self-Test Error Codes

### Extended Error Format 000B :

This format is used when there is a network address ROM address group error.

0001 000B aaaaaaaaa bbbbbbbb cccccc 0000dddd

Message	Meaning
aaaaaaaa	Base address of the network address ROM
bbbbbbb	First four bytes of the network address
ccccc	Next two bytes of the network address and the two byte checksum
dddd	Calculated checksum

### Extended Error Format 000C :

This format is used when there is a network address ROM test pattern error.

0001 000C aaaaaaaaa bbbbbbbb cccccc

Message	Meaning
aaaaaaaa	Base address of the network address ROM test pattern
bbbbbbb	First four bytes of the test patterns
ccccc	Last four bytes of the test paktterns

## Self-Test Error Codes

### A.1 Self-Test Error Codes

#### Extended Error Format 000D :

This format is used when there is an initialization error.

0001 000D 0000aaaa bbbbbbbb 0000cccc dddddddd eeeeeeee

Message	Meaning
aaaa	Actual value of the Lance CSR0
bbbbbbbb	Physical address of the initialization block
cccc	Initialization block mode
ddddddd	Upper longword of the logical address filter
eeeeeee	Lower longword of the logical address filter

#### Extended Error Format 000E :

This format is used when there is a transmit error.

0001 000E 0000aaaa bbbbbbbb ccccccc dddddddd

Message	Meaning
aaaa	The actual value of Lance CSR0
bbbbbbbb	Physical address of the current transmit descriptor
ccccccc	First longword of the transmit descriptor
ddddddd	Second longword of the transmit descriptor

## Self-Test Error Codes A.1 Self-Test Error Codes

### Extended Error Format 000F :

This format is used when there is a receive error.

0001 000F 0000aaaa bbbbbbbb ccccccc dddddddd

Message	Meaning
aaaa	Actual value of Lance CSR0
bbbbbbb	Physical address of the current receive descriptor
ccccccc	First longword of the receive descriptor
ddddddd	second longword of the receive descriptor

### Extended Error Format 0010 :

This format is used when there is a packet error.

0001 0010 0000aaaa bbbbbbbb ccccccc dddddddd

Message	Meaning
aaaa	Actual value of Lance CSR0
bbbbbbb	Packet length
ccccccc	Packet pattern or packet index
ddddddd	Packet CRC

### Extended Error Format 0011 :

This format is used when there is an interrupt error.

0001 0011 0000aaaa bbbbbbbb ccccccc

Message	Meaning
aaaa	Actual value of Lance CSR0
bbbbbbb	Contents of the interrupt mask register
ccccccc	Contents of the interrupt request register

# B

---

## Diagnostic LED Error Codes

### B.1 Reading Diagnostic LED Codes

The system uses the eight LEDs on the control panel to indicate the current executing test. At power-up, all the LEDs turn on (LED code is FF(h)), and then display different codes as the devices are tested.

The LED codes are broken into two fields. The left most four LEDs represent the function pointer to the LED error table that should be referenced when interpreting the second (right most) field of LEDs, which represents a particular test category. LED codes E0h - FFh are reserved for the console.

Each LED error table is preceded by a section header that includes the LED code pointing to that table. Each table header includes the column titled *LED Depiction*. In the description, field X indicates that the LED is on, the letter O indicates the LED is off, and Z is either.

## Diagnostic LED Error Codes

### B.1 Reading Diagnostic LED Codes

#### B.1.1 Powerup/Initialization LED Codes, XXXX zzzz

Table B–1 lists the system powerup and initialization LED codes.

**Table B–1 Powerup and Initialization LED Codes**

LED Depiction <sup>1</sup>	LED Code	Description	FRU
xxxx xxxx	FFh	Power has been applied but no instruction has been run	CPU
xxxx xxx0	FEh	ROM has been entered and initialization and testing have started	CPU
xxxx xx0x	FDh	Waiting for memory to initialize	CPU, memory modules
xxxx xx00	FCh	Sizing memory in the system	CPU, memory modules
xxxx x0xx	FBh	Running a byte mask test on the memory needed by the console	CPU, memory modules
xxxx x0x0	FAh	A full memory data path test is being performed on the memory needed by the console	CPU, memory modules
xxxx x00x	F9h	Initializing the console data structures	CPU
xxxx x000	F8h	Performing auto configuration on the machine	CPU
xxxx 0xxx	F7h	Testing the NVR device	CPU
xxxx 0xx0	F6h	Testing the DZ device	System, mouse, keyboard
xxxx 0x0x	F5h	Testing the graphic output device	System, graphics
xxxx 0x00	F4h	Initializing the console device	System, graphics
xxxx 00xx	F3h	Entering the console program	System

<sup>1</sup>In this column, x indicates the LED is on; o indicates the LED is off and z indicates either.

## Diagnostic LED Error Codes

### B.1 Reading Diagnostic LED Codes

#### B.1.2 TOY/NVR LED Codes, OOOX zzzz

Table B-2 lists the TOY and NVR LED codes.

**Table B-2 TOY and NVR LED Codes**

LED Depiction	LED Code	Description	FRU
00xx 0000	10h	TOY and NVR clock test has failed	System
00xx 000x	11h	TOY and NVR test has failed	System

#### B.1.3 DZ LED Codes, OOXx zzzz

Table B-3 lists the DZ LED codes.

**Table B-3 DZ LED Codes**

LED Depiction	LED Code	Description	FRU
00xx 0000	30h	DZ test has been entered	System
00xx 000x	31h	DZ reset test has failed	System
00xx 00x0	32h	DZ modem test has failed	System
00xx 00xx	33h	DZ polled test has failed	System
00xx 00x0	34h	DZ interrupt test has failed	System
00xx 0x0x	35h	LK401 test has failed	Keyboard, system
00xx 0xx0	36h	Mouse test has failed	Keyboard, system



**Diagnostic LED Error Codes**  
**B.1 Reading Diagnostic LED Codes**

**B.1.4 Memory LED Codes, OXOX zzzz**

Table B–4 lists the memory LED codes.

**Table B–4 Memory LED Codes**

LED Depiction	LED Code	Description	FRU
OXOX 0000	50h	Memory byte mask test has failed	System or memory modules
OXOX 000X	51h	Memory error occurred in the forward pass	System or memory modules
OXOX 00X0	52h	Memory error occurred in the reverse pass	System or memory modules
OXOX 00XX	53h	Memory error in parity test 1	System or memory modules
OXOX 0X00	54h	Memory error in parity test 2	System or memory modules

**B.1.5 System Device LED Codes, X000 zzzz**

Table B–5 lists the system device LED codes.

**Table B–5 System Device LED Codes**

LED Depiction	LED Code	Description	FRU
X000 0000	80h	ROM verify test has failed	System
X000 000X	81h	Interrupt controller test has failed	System
X000 00X0	82h	Invalidate filter test has failed	System

**B.1.6 SCSI Device LED Codes, XOXO zzzz**

Table B–6 lists the SCSI device LED codes.

## Diagnostic LED Error Codes

### B.1 Reading Diagnostic LED Codes

**Table B–6 SCSI Device LED Codes**

LED Depiction	LED Code	Description	FRU
x0x0 0000	A0h	SCSI test has been entered	System
x0x0 000X	A1h	SCSI register test has failed	System
x0x0 00x0	A2h	SCSI interrupt test has failed	System
x0x0 00XX	A3h	SCSI data transfer test has failed	System
x0x0 0x00	A4h	SCSI map error test has failed	System
x0x0 0x0X	A5h	SCSI minimal device test has failed	Device, system

#### B.1.7 LCG LED Codes, 00X0 zzzz

Table B–7 lists the LCG LED codes.

**Table B–7 LCG LED Codes**

LED Depiction	LED Code	Description	FRU
00x0 0000	20h	LCG self test has been entered	System, graphics
00x0 000X	21h	LCG video RAM test has failed	System, graphics
00x0 00x0	22h	LCG register test has failed	System, graphics
00x0 00XX	23h	LCG FIFO test has failed	System, graphics
00x0 0x00	24h	LCG interrupt test has failed	System, graphics
00x0 0x0X	25h	LCG address generator test has failed	System, graphics
00x0 0xx0	26h	LCG virtual test has failed	System, graphics

**Diagnostic LED Error Codes**  
**B.1 Reading Diagnostic LED Codes**

**B.1.8 NI Device LED Codes, XOOX zzzz**

Table B–8 lists the NI LED codes.

**Table B–8 NI LED Codes**

LED Depiction	LED Code	Description	FRU
x00x 0000	90h	NI self test has been entered	System
x00x 000x	91h	Network address test has failed	System
x00x 00x0	92h	NI register test has failed	System
x00x 00xx	93h	NI initialization test has failed	System
x00x 0x00	94h	NI internal loopback /DMA test has failed	System
x00x 0x0x	95h	NI interrupt test has failed	System
x00x 0xx0	96h	NI CRC test has failed	System
x00x 0xxx	97h	NI receive MIS?BUFFER test has failed	System
x00x x000	98h	NI collision test has failed	System
x00x x00x	99h	NI external loopback test has failed	Network, loopback, system
x00x x0x0	9Ah	NI address filtering test has failed	System
x00x x0xx	9Bh	NI transmit buffer test has failed	System

**B.1.9 Synchronous Communication Device LED Codes, XXOO zzzz**

Table B–9 lists the synchronous communication device LED codes.

## Diagnostic LED Error Codes B.1 Reading Diagnostic LED Codes

**Table B–9 Synchronous Communication Device LED Codes**

LED Depiction	LED Code	Description	FRU
xx00 0000	C0h	Comm option code entered	Sync. comm., system
xx00 000X	C1h	Comm option ROM test has failed	Sync. comm., system
xx00 00X0	C2h	Comm option RAM test has failed	Sync. comm., system
xx00 00XX	C3h	Comm option self test has failed	Sync. comm., system
xx00 0X00	C4h	Comm option dual RAM access test has failed	Sync. comm., system
xx00 0X0X	C5h	Comm option dual ROM_RAM access test has failed	Sync. comm., system
xx00 0XX0	C6h	Comm option interrupt test has failed	Sync. comm., system
xx00 0XXX	C7h	Comm option integrated loopback test has failed	Sync. comm., system
xx00 X000	C8h	Comm option reset test has failed	Sync. comm., system

**Diagnostic LED Error Codes**  
**B.1 Reading Diagnostic LED Codes**

**B.1.10 Cache LED Code, OXOO zzzz**

Table B–10 lists the cache LED codes.

**Table B–10 Cache LED Codes**

LED Depiction	LED Code	Description	FRU
0x00 000x	41h	Error in the data store read /write	System
0x00 00x0	42h	Error in the read/write to the tag area	System
0x00 00xx	43h	The cache did not contain the proper state of the valid bit	System
0x00 0x00	44h	Error during the cache tag validation	System
0x00 0x0x	45h	Unexpected TAG parity error	System
0x00 0xxx	46h	Cache did not provide the expected data during cache hit testing	System
0x00 0xxx	47h	Parity not what was expected	System
0x00 x000	48h	Tag not valid during cache hit test	System
0x00 x00x	49h	Data not expected during cache hit test	System
0x00 x0x0	4Ah	Cache write through test failed. The information in the data store did not agree with the information it was to receive.	System
0x00 x0xx	4Bh	Cache write through test failed. The information in the memory did not agree with the information it was to receive.	System
0x00 x0xx	4Ch	Write miss failed	System

# C

---

## Troubleshooting

The troubleshooting techniques described in Appendix C do not identify all possible problems that may occur nor do the actions suggested remedy all problems. If the powerup tests complete, the error message displayed on the console can be used to identify a failed FRU, or you can run the self test, system test, or utility tests in Customer Service mode to help isolate failing FRUs. Information on interpreting self test error messages is in Appendix A.

Use the diagnostic LEDs on the front of the system to help diagnose problems where the system is unable to setup the console. Information on interpreting diagnostic LED codes is in Appendix B.

## **Troubleshooting**

### **C.1 Troubleshooting Symptoms and Corrective Actions**

#### **C.1 Troubleshooting Symptoms and Corrective Actions**

This section provides problem isolation and repair recommendations. The VAXstation 4000 VLC system is broken down into the following operating areas and troubleshooting tables for each area are provided.

- System problems
- Monitor problems
- Mouse/Tablet problems
- Keyboard problems
- Drive problems
- Network problems
- Audio Problems
- Expansion box problems

## Troubleshooting

### C.1 Troubleshooting Symptoms and Corrective Actions

Use the following tables to help isolate a failing FRU in the VAXstation 4000 VLC system. Examine the possible symptoms in each table and review the possible causes. When you have found a match to the symptoms demonstrated by the problem system, implement the recommended corrective action.

**Table C-1 System Problems**

Symptom	Possible Cause	Corrective Action
System fan is off	Power cord is not connected.	Ensure that the power cord is connected correctly.
	Faulty power cord.	Replace the power cord.
	Power supply fan has failed.	Replace the power supply.
Power light is off.	Power cord is not connected.	Ensure that the power cord is connected correctly.
	Wall socket may not be operative.	Try a different wall socket, or try an electrical device that you know works in the wall socket.  Turn power to the system off for 10 seconds and then back on. Turn the system off. Unplug the video cable, communication cable, and printer. Then plug all cables back in and turn power to the system on again.
Power-up display does not show after 2 minutes.	Defective power supply	Replace the power supply.
	Power to the monitor is not on.	Turn power to the monitor on.
	Brightness and contrast settings need adjusting.	Adjust the monitor brightness and contrast controls. Verify that the monitor power switch is on (1).
	Monitor cable or video cable is not connected.	Ensure that the monitor cable and video cable are connected correctly.
	Alternate console switch is in wrong position.	Turn the power off. Change alternate console switch to down (off) position. Use a small pointed object. Do NOT use a pencil to set the switch. Turn the power back on.

(continued on next page)



## Troubleshooting

### C.1 Troubleshooting Symptoms and Corrective Actions

**Table C–1 (Cont.) System Problems**

Symptom	Possible Cause	Corrective Action
	Monitor fuse is blown.	See the monitor guide for fuse replacement instructions.
	Wall outlet may not be operative.	Try a different wall outlet or try an electrical device that you know works in the same wall outlet.  Check the diagnostic LED code. Compare the code to the LED error code tables in Appendix B. Replace monitor failed FRU. Reference the monitor service manual for instructions on how to replace the FRU.
	VRC 16 is powered up before system.	Power down both VRC 16 and the system, then re-apply power, turning power to the system on first.
Power-up display contains an error message.	Possible system error.	Enter the SHOW ERROR command. Refer to Section 4.1.3 for information on interpreting the error code.  Interpret the diagnostic LEDs at the front of the system. Refer to Appendix B for the diagnostic LED error code meanings.
System does not boot on power-up.	Software is not installed.	Install the system software. Refer to the software documentation for installation instructions.
	Default recovery action is set to halt	Change the default recovery action to boot the system from the system disk.
	Incorrect boot device was specified.	Change the default recovery action to boot the system from the system disk.
	Power to the expansion boxes was not supplied first.	Turn power to the system box off, ensuring that power to the expansion boxes is on, and then turn power to the system box on again..
	Boot device is not properly configured	Enter the SHOW DEVICE command and ensure that all devices are configured properly. If not, check the SCSI IDs and SCSI cables.
	Faulty boot device	Run the system exerciser and replace the drive if defective.

(continued on next page)

**Troubleshooting**

**C.1 Troubleshooting Symptoms and Corrective Actions**

**Table C-1 (Cont.) System Problems**

<b>Symptom</b>	<b>Possible Cause</b>	<b>Corrective Action</b>
	Unable to boot off the network (ESA0).	See Table C-6

## Troubleshooting

### C.1 Troubleshooting Symptoms and Corrective Actions

**Table C–2 Monitor Problems**

Symptom	Possible Cause	Corrective Action
No display appears on the monitor screen.	Monitor is not turned on.	Check the monitor on/off switch. Ensure that the monitor power cord is connected correctly at both ends.
	Contrast and brightness controls are not adjusted correctly.	Adjust the contrast and brightness controls. Refer to the monitor guide for more information.
	Alternate console switch is not set correctly.	Turn the power off. Using a small, pointed object, change the alternate console switch to the off (down) position. Do not use pencil. Turn power to the system on again.
	System board or graphics board failure.	Use the diagnostics LEDs on the front to interpret the error code and identify the failed FRU.
	VRC 16 is powered up before system.	Turn power to VRC 16 and the system off, then re-apply power, powering up the system first.

**Table C–3 Mouse and Tablet Problems**

Symptom	Possible Cause	Corrective Action
System boots but mouse or optional tablet pointer does not appear on the screen, or monitor does not respond to pointing device commands.	Pointing device cable is installed incorrectly or is loose.	Turn off the system. Unplug and then replug the cable to rest the device. Turn power to the system on again.
	The system is halted; no pointer appears on the screen.	Reboot the system.
	Pointing device is faulty.	Replace the pointing device.

## Troubleshooting

### C.1 Troubleshooting Symptoms and Corrective Actions

**Table C–4 Keyboard Problems**

Symptom	Possible Cause	Corrective Action
Keys do not work.	The hold screen key function is active and the hold screen light is on.	Press the hold screen key to release the function.
	Keyboard cable is loose or not connected.	Ensure that the keyboard cable is connected correctly.
	Keyboard has failed.	Replace the keyboard.

**Table C–5 Drive Problems**

Symptom	Possible Cause	Corrective Action
Internal drive does not work.	Two SCSI identifiers are set to the same ID number.	Reset the SCSI IDs to a unique number.
	Loose cables.	Ensure that all cables are connected correctly.
	Defective drive.	Run thje diagnostics to isolate the fault. Replace the FRU.

**Table C–6 Network Problems**

Symptom	Possible Cause	Corrective Action
NI error message displays when verifying Ethernet.	No ThinWire or ThickWire terminator or cable was installed.	Attach a ThinWire or Standard Ethernet terminator.
	Network switch is not set properly.	If Ethernet is not being used, move the network switch to the left, toward standard Ethernet.
	Terminator is missing from network.	If a ThinWire cable was removed, replace the cable with a terminator.

(continued on next page)

## Troubleshooting

### C.1 Troubleshooting Symptoms and Corrective Actions

**Table C–6 (Cont.) Network Problems**

Symptom	Possible Cause	Corrective Action
LEDs 7,4,3, and 0 on the back of the system are on.	Cable connection is loose.	Check that all connections on the Ethernet segment are secure.
	Power supply failure.	Replace the power supply.
	T-connector is disconnected.	Make sure that the T-connector is disconnected to an operating ThinWire Ethernet segment.
Can not boot from the network.	Local network problem.	Problem is most likely caused by the customer server system or the network
	Defective NI interface	Run diagnostics (TEST NI command) with terminators attached. Replace faulty FRU if test fails.

## Troubleshooting

### C.1 Troubleshooting Symptoms and Corrective Actions

**Table C-7 Expansion Box Problems**

Symptom	Possible Cause	Corrective Action
Expansion box fan is off	Power cord is not connected.	Ensure that the power cord is connected correctly.
	Faulty power cord.	Replace power cord.
	Power supply fan has failed.	Replace the power supply.
Power light is off.	Power cord is not connected.	Ensure that the power cord is connected correctly.
	Wall socket may not be operative.	Try a different wall socket, or try an electrical device that you know works in the wall socket.  Turn power to the system off for about 10 seconds and then back on. Turn the system off again.
	Defective power supply	Replace the power supply.
Drive does not work.	Loose cables.	Ensure that all cables are connected.
	Two SCSI identifiers are set to the same ID number.	Reset the SCSI IDs to a unique number. (See <i>BA46 Storage Expansion Box Owner's Guide</i> for SCSI settings.)
	Defective drive.	Run the diagnostics to isolate the fault. Replace the FRU.
Software does not work from the diskette drive, or a diskette read or write error message displays.	No diskette is in the diskette drive.	Insert a diskette with software following the instructions in the software documentation.
	Diskette was inserted incorrectly.	Ensure that the write-protect notch on the diskette is to your left when you insert the diskette and that the label faces up.

(continued on next page)

## Troubleshooting

### C.1 Troubleshooting Symptoms and Corrective Actions

**Table C-7 (Cont.) Expansion Box Problems**

<b>Symptom</b>	<b>Possible Cause</b>	<b>Corrective Action</b>
	Diskette is damaged or does not contain software.	Try another diskette that contains software.
	Two SCSI identifiers are set to the same ID number.	Reset the SCSI IDs to an unique number.
	Loose cables.	Check to make sure all cables are connected.
	Defective drive.	Run diagnostics to isolate fault. Replace FRU.

# D

---

## VAXstation 4000 VLC Part Numbers

### D.1 Part Numbers

Table D-1 contains the part numbers for the VAXstation 4000 VLC workstation field replaceable units. These FRUs can be ordered through Digital Services.



## VAXstation 4000 VLC Part Numbers

### D.1 Part Numbers

**Table D-1 FRU Part Numbers**

<b>FRU</b>	<b>Part Number</b>
Power supply	H7109-00
Internal power cable	17-02876-01
VS4000 VLC System module	54-20768-01
Graphics module 1 1024 x 768 @ 60 Hz	54-20772-01
Graphics module 1 1024 x 864 @ 72 Hz	54-20772-01
Graphics module 2 1024 X 786 @ 60 Hz	54-20774-01
Graphics module 2 640 x 480 @ 60 Hz	54-20774-01
Graphics module 3 1280 x 1024 @ 72 Hz	54-20776-01
Graphics module 4 1280 x 1024 @ 66 Hz	54-20776-02
Graphics Module 5 10245 x 788 @ 66 Hz	54-20776-03
Internal SCSI data cable	17-03191-01
RZ23L 121MB drive	RZ23L-E
Memory module 4MEG (20-36110-05)	MS40-AA

## VAXstation 4000 VLC Part Numbers D.1 Part Numbers

Table D–2 and Table D–3 contain miscellaneous VAXstation 4000 VLC workstation FRUs. These FRUs can be ordered through manufacturing.

**Table D–2 Miscellaneous FRU Part Numbers**

<b>FRU</b>	<b>Part Number</b>
LK401-AA Keyboard	LK401-AA
LKXXX-AA Tablet	LKXXX-AB
VSXXX-AA Mouse	VSXXX-AA
Hanging device	BA10X-AA
Metal enclosure	70-29792-01
Cricket clip	74-43478-01
Plastic rivet	12-36064-01

**Table D–3 System and Expansion Box Cables and Terminators**

<b>FRU</b>	<b>Part Number</b>
Ethernet terminator (Thickwire)	12-22196-01/02
Ethernet terminator (ThinWire)	12-25869-01
Thick/Thin Wire Ethernet Kit	70-26209-01
Printer port	H3103
External SCSI port	H8574A
Cable, high resolution 10'	17-02720-01
Cable, high resolution 3'	17-02720-02

**VAXstation 4000 VLC Part Numbers**  
**D.1 Part Numbers**

**Table D-4 Expansion Box (SZ03) FRU Part Numbers**

FRU	Part Number
SCSI-FDI Controller W/RX26 Support	54-20764-03
RX26 Diskette drive	RX26-AA
RZ225	RZ225-E
RZ03 Chassie and power supply	30-36532-01
RZ26 Ribbon cable	17-00285-00

**Table D-5 Expansion Box (SZ16) FRU Part Numbers**

Expansion box wire harness power cable	17-02876-02
Expansion box internal SCSI data cable	70-28109-01
Expansion box SCSI ID select cable	17-02445-01
Expansion box SCSI ID select switch module	54-19325-02
Expansion box load module	54-20422-01
H7819-AA Power supply	30-34690-01
TZK10 QIC Tape drive	TZK10-AA
RX33-A Floppy drive	RX33-A
RX26 Floppy drive @ 5% D.C.	70-28100-01
SCSI-FDI Control module	54-20764-01
TL204 Tape drive	TL204-AA
RZ55 Whole drive	RZ55-E
RZ56 PCB	29-27889-01
RZ56 HDA	29-27890-01
RZ57 PCB	29-28159-01
RZ57 HDA	70-28158-01
Vertical stand	BA46X-AA
Multiple box stand	H9855-AA
SCSI bracket assembly	70-28097-01
Front bezel blank	70-28099-01
Front bezel opening for 5 1/4" drive	70-28099-02

(continued on next page)

## VAXstation 4000 VLC Part Numbers D.1 Part Numbers

**Table D-5 (Cont.) Expansion Box (SZ16) FRU Part Numbers**

Front bezel opening for 3 1/2" drive	70-28099-03
Base plastic assembly	70-28096-01
Top plastic cover	70-28107-01
Internal SCSI data cable assembly	70-28109-01
Half-high 3 1/2" drive mounting bracket	74-40429-01
5 1/4" Drive mounting bracket	74-40430-01
Various drive mounting bracket	74-40431-01
Rear opening filler	74-41472-01
Rear opening RFI shield filler	74-41473-01

Table D-6 list the available VAXstation 4000 VLC workstation monitors and part numbers.

**Table D-6 VAXstation 4000 VLC Monitors**

<b>FRU</b>	<b>Part Number</b>
14" Monochrome	PC4XV-A2
19" Monochrome	VR262
19" Color	VR299
13" Color	VRT13-DA,D3,D4
16" Color	VRT16-DA,D4,HA,H4
19" Monochrome	VR319-DA,D4
19" Color	VR320-CA,C4
19" Color	VRT19-DA,D3,D4,HA,H4
17" Color	VRM17-AA,A3,A4

Table D-7 is a cross reference of each monitor and graphic module available with the VAXstation 4000 VLC workstation.

**VAXstation 4000 VLC Part Numbers**  
**D.1 Part Numbers**

**Table D-7 Monitor and Graphic Module Cross Reference**

<b>Monitor</b>	<b>Graphic Module</b>
Monochrome 8-plane greyscale graphic systems	
17" Monitor (VRM17)	PV200-BA/BB/BC
19" Monitor (VR319)	PV211-B3/BD/BE
Color 8-plane graphic systems	
13" Trinitron monitor (VRT13)	PV211-DN/DP/DR
16" Trinitron monitor (VRT16)	PV200-CF/CH/CJ
Monochrome 8-plane greyscale graphic systems	
17" Monitor (VRM17)	PV21A-AE/AF/AH
19" Monitor (VR319)	PV21A-AB/AC/AD
Color 8-plane graphic systems	
13" Trinitron Monitor (VRT13)	PV21A-AJ/AK/AL
16" Trinitron Monitor (VRT16)	PV21A-AM/AN/AP
19" Trinitron Monitor (VRT19)	PV21A-AR/AS/AT

---

# Index

## A

---

- Audio Self Test, 4–14
- AUD Self Test
  - see audio self test, 4–14
- AVS
  - see voltage select, 2–4

## B

---

- Battery Backup, 1–18
- Broadcast Address, 1–21

## C

---

- Cache Self Test, 4–11
- Configuration Table, 3–9
  - device, 3–11
  - main, 3–10
- Console Driver Interface, 3–19
- Console Mode, 3–3
- Console Overview, 3–3
- Console Port Driver, 3–22
- CPU, 1–6
- Cricket Clip, 2–3

## D

---

- Diagnostic LED Codes, B–1
  - cache, B–8
  - DZ, B–3
  - LCG, B–5
  - memory, B–4
  - NI, B–6
  - SCSI device, B–4

- Diagnostic LED Codes (cont'd)
  - sysnc comm device, B–6
  - system device, B–4
  - TOY and NVR, B–3
- Diagnostic LEDs Codes
  - powerup/initialization, B–2
- Diagnostic Test, 4–1
- DMA Mapping, 1–13
- Driver Descriptor, 3–15
- Drive Removal, 5–7
- DZ Self Test, 4–10

## E

---

- Error Codes, A–1
  - audio, A–17
  - audio extended codes, A–17
  - cache, A–22
  - cache extended codes, A–22
  - DZ, A–2
  - DZ suberror, A–3
  - floating point unit (FPU), A–19
  - FPU extended code, A–21
  - interval timer, A–7
  - LCG, A–23
  - LCG extended codes, A–26
  - memory, A–5
  - memory extended code, A–5
  - memory management unit (MMU), A–6
  - NI, A–29
  - NI extended code, A–33
  - SCSI, A–8
  - SCSI extended code, A–9
  - SYS self-test extended code, A–7
  - system device, A–7

Error Codes (cont'd)  
TOY/NVR, A-1  
Extended Self Test, 3-4, 4-1

## F

---

Field Replaceable Units, 5-1  
firmware, 3-1  
Floating Point Unit Self Test, 4-11  
FPU Self Test  
see floating point unit self test, 4-11  
FRUs  
see field replaceable units, 5-1

## G

---

Graphics Controller, 1-15

## H

---

Halt, 3-3  
Hard Disk Drive Replacement, 5-9

## I

---

I/O Panel, 2-7, 2-8  
Interfacing Diagnostic Drivers, 3-17  
Internal Cabling, 2-7  
Interrupt Sources, 1-10  
Interrupt Vector, 1-10  
Interval Timer Self Test, 4-12  
IT Self Test  
see interval timer self test, 4-12

## L

---

LCG Removal, 5-13  
LCG Self Test, 4-9

## M

---

Main Memory, 1-11  
Main Memory Requests, 1-12  
Mass Storage, 2-3  
Memorr Module Identification, 5-16

Memory Self Test, 4-12  
Module Removal  
MS44 memory module, 5-14  
Multicast Address, 1-21  
Multicast-group Address, 1-21

## N

---

Network Addresses, 1-21  
Network Controller, 1-20  
Network Interconnect Self Test, 4-13  
NI Self Test  
see network interconnect self test, 4-13  
NVR Self Test, 4-8

## P

---

Packet Format, 1-20  
Physical Address, 1-21  
Power Supply, 2-3, 5-11  
removal, 5-11  
Power Supply Specifications, 2-4  
Power-Up Initialization Code  
power-up sequence, 3-2  
Power-Up Initialization Code Overview, 3-2  
Power-UP Self Test, 4-1

## R

---

Removing and Replacing, 5-1

## S

---

Screen Formats  
graphics controller, 1-16  
SCSI Bus Signals, 1-22  
SCSI Self Test, 4-14  
Serial Line Controller, 1-17  
Shared Console Interface Area, 3-20  
SYS Self Test  
see system self test, 4-11  
System Box, 2-1, 2-2  
System Box right side, 2-6  
System Console Commands  
Memory, 4-28  
DEPOSIT, 4-28

System Console Commands

Memory (cont'd)

EXAMINE, 4-29  
FIND, 4-30  
MOVE, 4-31

Miscellaneous Commands, 4-33

HELP or ?, 4-34  
LOGIN, 4-34  
REPEAT, 4-34

Processor Control, 4-31

BOOT, 4-31  
CONTINUE, 4-32  
START, 4-33

SET/SHOW, 4-17, 4-19, 4-23

BFLG, 4-19  
BOOT, 4-19  
CONFIG, 4-20  
DEVICE, 4-20  
DIAGENV, 4-21  
ERROR, 4-23  
ETHER, 4-23  
FBOOT, 4-24  
HALT, 4-24  
KBD, 4-25  
MEM, 4-25  
MOP, 4-26  
PSE and PWS, 4-26  
SCSI, 4-27

TRIGGER, 4-27

VER, 4-27

System Controls, 2-6

System Cover

removal, 5-6

System Devices, 2-7

System Module Removal, 5-13

System ROM

overview, 3-6

part Format, 3-6

set format, 3-7

System Self Test, 4-11

---

## T

Time-of-Year Clock, 1-18

TOY Self Test, 4-8

Troubleshooting

table, C-2

---

## U

Utilities Test, 4-1

Utility Test, 3-5

---

## V

Voltage Select, 2-4