Digital Equipment Corporation

VAXstation 4000 Model 90
Service Information

EK-KA490-SV. A01

Digital Equipment Corporation

First Edition, August 1992

Contents

Examples

Figures

Tables

Preface

Overview

Purpose and Audience

This manual is a support and reference document for Digital Services personnel who perform maintenance work on the VAXstation 4000 Model 90 workstation. It is also intended for Digital customers who have a self-maintenance agreement with Digital.

Organization

This manual is organized as follows:

- Chapter 1, System Module, provides an overview of the Model 90 features, main memory, network interface, and SCSI controller.
- Chapter 2, Firmware, provides information on diagnostic firmware.
- Chapter 3, System Configuration, provides configuration information on the system box.
- Chapter 4, Using the Console, describes system console commands and using alternate consoles.
- Chapter 5, Diagnostic Testing, provides information on diagnostic testing.
- Chapter 6, FRU Removal and Replacement, provides information on how to remove and replace system field replaceable units.

Continued on next page

Organization (continued)

- Appendix A, Diagnostic Error Codes, contains tables listing error codes, error messages, and utilities.
- Appendix B, Reading the Diagnostic LED codes, describes how to read the diagnostic LED codes.
- Appendix C, Troubleshooting, contains troubleshooting information.
- Appendix D, FRU Part Numbers, contains tables that provide part numbers for FRUs.

Related Documentation

The following documents provide additional information about the VAXstation 4000 Model 90 workstation:

Document	Order Number
VAXstation 4000 Quick Installation Card	EK-VAXQC-IN
VAXstation 4000 Options Installation Guide	EK-VAXOP-IN
VAXstation 4000 Model 90 Owner's Installation Guide	EK-VAXOG-IN
VAXstation 3D Graphics Options Maintenance Guide	EK-SCP8P-MG
BA46 Expansion Box Service Information	EK-VBA46-SV

Continued on next page

Overview, Continued

Conventions

This guide uses the following conventions:

Convention	Description
WARNING	Contains important information that relates to personal safety.
CAUTION	Contains information to prevent damage to the equipment.
NOTE	Contains general information.
PN	Part number
Ctrl/C	This type of key sequence means you hold down the first key while you type the letter of the next key.
`THIS TYPEFACE`	Indicates text the system displays.
`THIS TYPEFACE`	Indicates user input.
Return	Text within a box means you press that key.
SHOW ERROR	Commands that you enter are shown in all uppercase text.
❶	A number in a circle in text corresponds to that number in an illustration.

Chapter 1
System Module

Introduction

In this Chapter

This chapter describes the features of the VAXstation 4000 Model 90 system module. The topics covered include:

- System Overview
- Central Processor Unit (CPU)
- Interrupts and Exceptions
- Cache Memory
- Main Memory System
- ROM Memory
- Graphics Controller
- Network Interface Controller
- Serial Line Controller
- Time-of-Year Clock (TOY)
- SCSI Controller
- DSW21 Synchronous Communications Adapter

System Overview

Overview

The KA49 CPU module combines with either the 4-MB or 16-MB (or both) SIM modules to form the CPU/memory subsystem for the VAXstation 4000 Model 90 product. The VAXstation 4000 Model 90 system is housed in a BA46 enclosure. The subsystem uses the SCSI-1 bus to communicate with mass storage devices, and transceiver cable (Thickwire or ThinWire connector) to connect with an Ethernet network. A 16-bit programmed I/O port connection is available to attach synchronous communications or other options. An optional bus adapter can be connected to the module using one of the 32-bit CDAL buses. Four serial lines are supported for a keyboard, pointing device, printer, and asynchronous communication. Audio input and output is supported through the sound generator interface. The KA49 CPU module supports low cost graphics using the LCSPX module or high performance graphics using the SPXg/gt modules.

Main Memory

The KA49 CPU module can support up to eight memory SIM modules to provide main memory configurations of 16, 32, 64, 80, or 128 MB.

Cache Memory

The module uses multiple levels of cache memory to maximize performance. The NVAX CPU contains a 2-KB virtual instruction cache (VIC) and an 8-KB write-through primary cache (Pcache). The KA49 module contains an on board 256-KB backup write secondary cache (Bcache).

Continued on next page

CPU Components

Table 1–1 lists the major hardware components found on the KA49 CPU module.

Table 1–1 Major Components

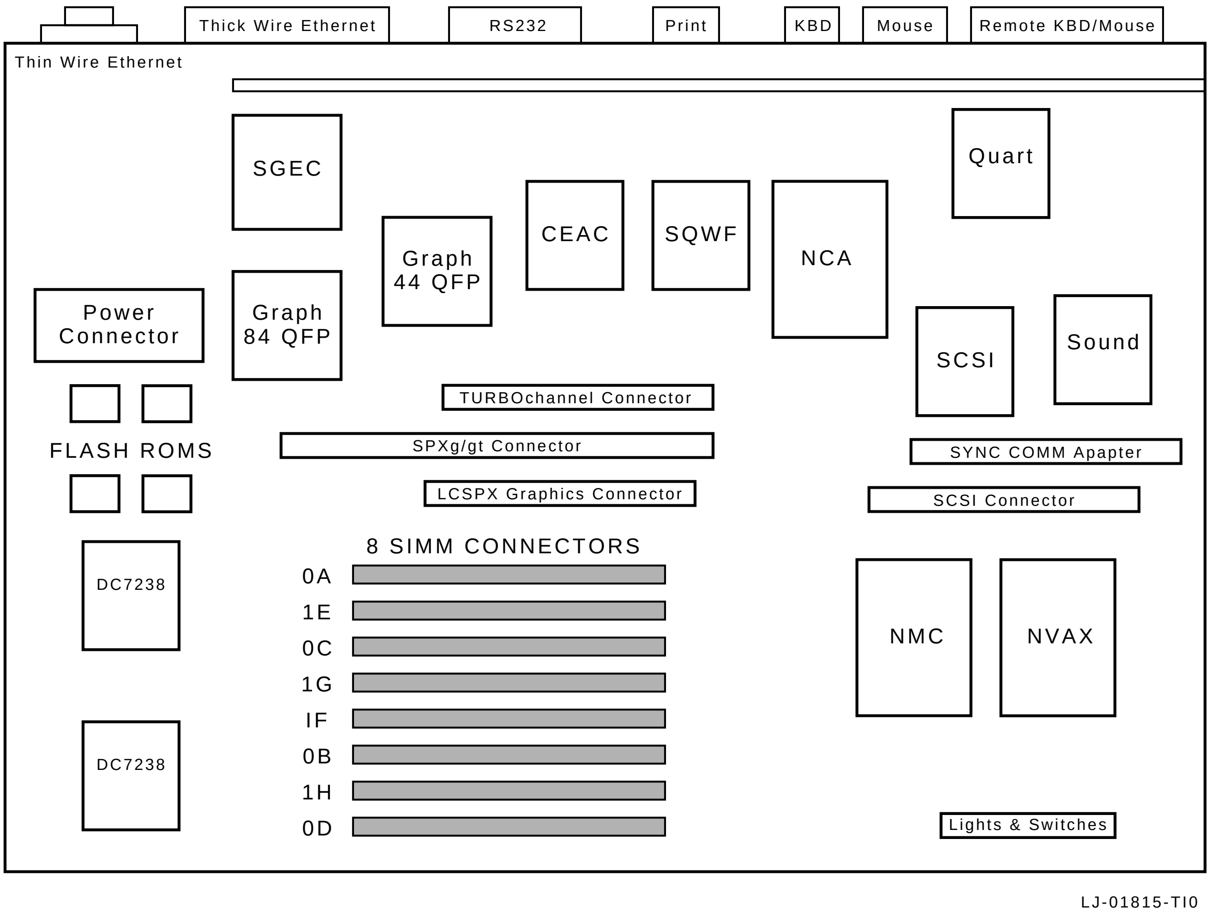
DC246	Central processor	NVAX
Cache RAMs	256-KB Bcache	—
DC243	NDAL to CDAL I/O bus interface chip	NCA
DC244	Main memory controller, with ownership bit control	NMC
NCR 53C94	Advanced SCSI controller	—
DC541	Ethernet interface	SGEC
—	32-Byte network address ROM	socketed
AM79C30A	Sound generator	—
XC3090	CDAL to EDAL chip	CEAC
XC4005	SCSI Quadword FIFO chip	SQWF
DC7085	Quad UART	DZQ11
DC509	Clock	CCLK
DS1287A	Time-of-Year clock	TOY
Firmware ROMs (4)	512 KB; each 128 KB by 8, FLASH programmable	—

Continued on next page

Chip Locations

Figure 1–1 shows the major chip locations on the KA49 CPU module.

Figure 1–1 KA49 CPU Module Components



Central Processor Unit

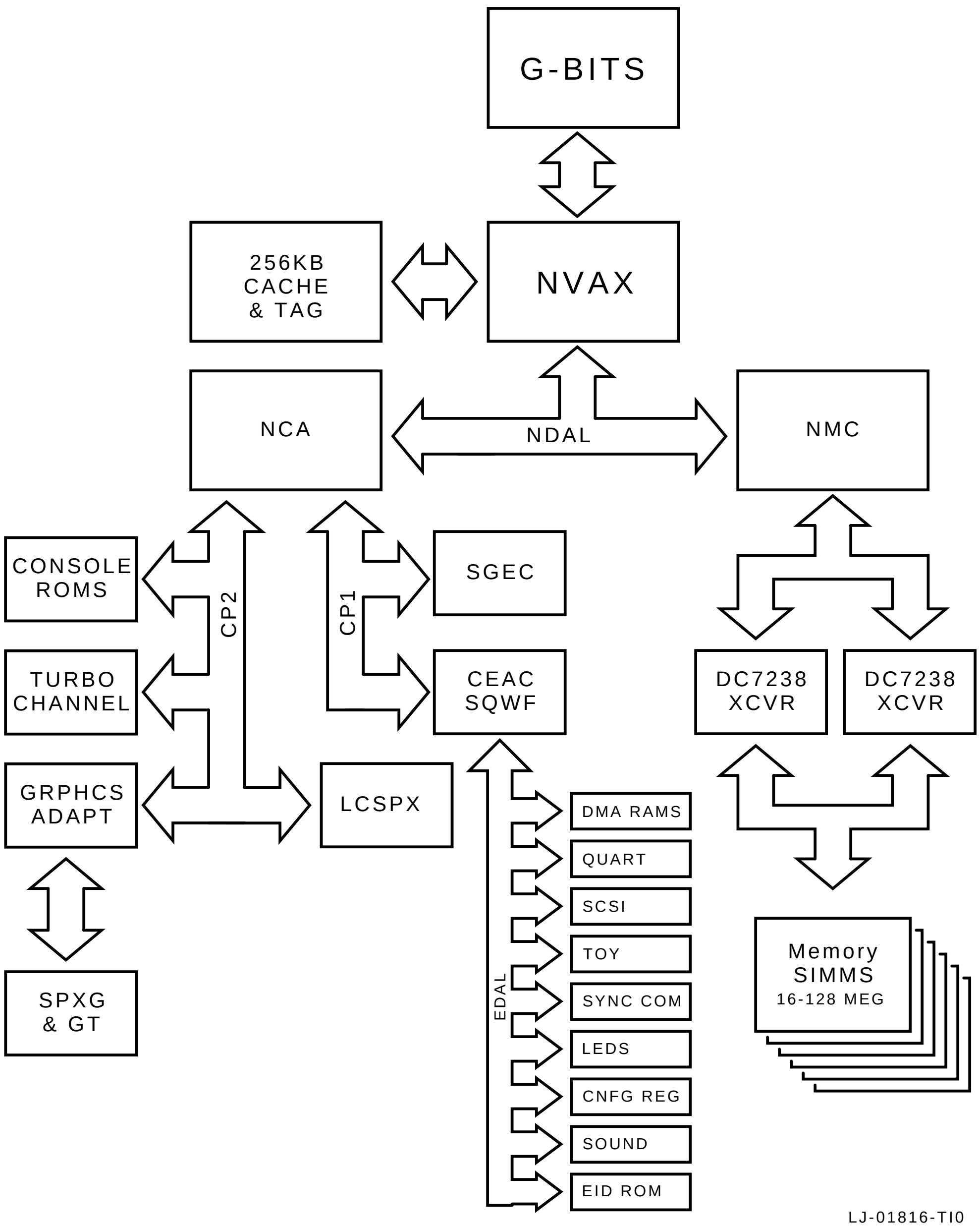
Overview

Figure 1–2 shows how, functionally, the KA49 CPU module is divided into five major areas.

- Central processing subsystem
- Graphics subsystem
- System support subsystem
- I/O Subsystem
- Memory control subsystem

Continued on next page

Figure 1–2 KA49 CPU Module Block Diagram



Continued on next page

Central Processing Subsystem

The NVAX CPU (DC246) chip is the heart of the KA49 CPU module. It executes the VAX base instruction group as defined in the *VAX Architecture Reference Manual* plus the optional VAX vector instructions and the virtual machine instructions. The NVAX processor also supports full VAX memory management with demand paging and a 4-gigabyte virtual address space.

Three Level Cache Architecture

The KA49 CPU module uses a three-level cache architecture to maximize performance. The first level of cache, referred to as the *virtual instruction* cache (VIC), is 2 KB in size, and is located on the CPU chip. This cache handles instructions only (no data references), and deals only with virtual addresses. In this way the CPU can obtain instruction information without the need for virtual to physical address translation, thereby decreasing latency and improving performance.

The second level of cache, referred to as the *primary* cache (Pcache), is 8 KB in size and is located on the CPU chip. This cache implements a write-through instruction and data cache, and helps to reduce latency on access to data and instructions that are not found in the VIC. The Pcache uses physical addresses.

The third level of cache, referred to as the *backup* write cache (Bcache) is 256 KB. The Bcache is controlled by the Bcache controller located in the CPU chip. The data and tag store memory for this cache is located in SRAM chips on the KA49 CPU module. The Bcache uses physical addresses.

Graphics Subsystem

The graphics subsystem consists of either the LCSPX for low cost graphics support or the SPXg/gt modules, which support high performance graphics. Two connectors are provided on the module that provide a unique interface to each.

Continued on next page

System Support Subsystem

The system support subsystem handles the basic functions required to support the console in a system environment. This subsystem contains the firmware ROMs, the firmware ROM controller, the configuration register, and the station address ROM.

Resident firmware ROM is located on four chips, each 128 KB by 8 bits of programmable FLASH EPROM[1], for a total of 512 KB of ROM. The firmware gains control when the CPU halts.

ROM Firmware

ROM firmware provides the following services:

- Board initialization
- Power-up self-testing of the KA49 module
- Emulation of a subset of the VAX standard console (auto or manual bootstrap, auto or manual restart, and a simple command language for examining or altering the state of the processor)
- Booting from supported Ethernet or SCSI devices
- Multilingual translation of key system messages

Configuration Register

The configuration register allows the firmware and the operating system to read KA49 configuration bits. These bits indicate which options are present and the size of the physical memory.

I/O Subsystem

The I/O subsystem contains the following:

- CP-Bus adapter
- SCSI mass storage interface
- Ethernet interface
- Optional bus adapter interface
- Optional synchronous communication interface

[1] A FLASH EPROM is a programmable read-only memory that uses electrical (bulk) erasure rather than ultraviolet erasure.

Continued on next page

- Sound generator
- Four asynchronous lines
- Time-of-Year clock
- Ethernet identification ROM

NVAX CP-Bus Bus Adapter

To provide buffering and connection to the I/O devices, the KA49 contains a DC243, NDAL to CDAL adapter (NCA). The NCA provides an interface between the NVAX NDAL bus and two CP-Buses where the I/O device adapters reside. As a bus adapter, the NCA controls transactions between the higher performance NDAL bus and the lower performance CP-Buses. Each of the NCA's CP-Bus ports provide a CVAX compatible peripheral bus for direct memory access (DMA) by peripheral devices.

Small Computer Systems Interface

NCR 53C94 implements the small computer system interface (SCSI) bus interface. It has a single port, connecting both to devices within the BA46 system box and allowing for expansion externally.

Ethernet Interface

The Ethernet interface handles communications between the CPU module and other nodes on the Ethernet. It is implemented with the second generation Ethernet controller chip (SGEC) onboard network interface. Used in connection with the module backpanel, the SGEC allows the KA49 to connect to either a ThinWire or standard Ethernet. It supports the Ethernet data link layer and provides CP-Bus parity protection.

Optional Bus Adapter Interface

The optional bus adapter provides a translation between one of the CP-Buses and the adapter bus. The VAXstation 4000 Model 90 has direct, transparent access to the bus adapter. The slot appears as a region of memory in the workstation's I/O space. The bus adapter option can perform DMA to any location in the memory space of the VAXstation 4000 Model 90. This DMA can be done either directly to the physical memory of the workstation or

Continued on next page

through a scatter/gather map that allows physically discontiguous pages of data to appear to be contiguous to the bus adapter option.

Sound Generator

Sound output uses the DTMF tone generation capability of the 79C30 chip. Two tone generators may be individually programmed for frequency and amplitude; their outputs appear summed using either the loudspeaker integral to the system unit, or to headphones, or an external loudspeaker if plugged in to the jack at the front of the machine. The resolution of the frequency generators is eight bits, giving a frequency range of 8 Hz to approximately 2 kHz.

Serial Line Controller

The VAXstation 4000 Model 90 system board serial line controller handles four asynchronous serial lines. The controller consists of the DC7085 QUART and a 64 entry FIFO RAM shared by all four receive lines.

Time-Of-Year Clock

The time-of-year (TOY) clock consists of an MC146818BM CMOS watch chip that keeps the date and time of day and contains 50 bytes of general purpose RAM storage. This chip includes a time base oscillator and a lithium battery on-chip. The battery powers the chip logic and oscillator while the system power is off.

Station Address ROM

A 32-byte ROM on the system board contains a unique network address for each system. This ROM is installed in a socket so it can be moved in the event that a system's CPU board is replaced.

Memory Control Subsystem

The memory control subsystem provides support for the KA49 memory subsystem. A key feature of the KA49 memory subsystem is the use of ownership bits to maintain a sense of ownership over each hexaword (32 bytes) of main memory. This ownership mechanism serves the dual function of maintaining coherency between main memory and the NVAX

Continued on next page

cache memory, as well as providing a secure interlock mechanism for synchronization between NVAX and the I/O devices.

The memory controller is implemented by the NVAX memory controller chip (DC244). The NMC is an ECC protected memory controller. The NMC controls transactions between the main memory and the NVAX, and between main memory and any of the I/O devices (through the NCA interface). In addition, the NMC has a key role in maintaining main memory coherency with the NVAX Pcache and Bcache through the use of ownership bits.

The NMC interfaces the NVAX and I/O subsystem to up to 128 MB of main memory. Main memory is comprised of one or two sets of SIM modules. Each set contains either four 4-MB SIM modules or four 16-MB SIM modules. The NMC controls access to shared memory locations through the use of the ownership bits, thereby providing a reliable interlock mechanism for memory that is shared between the NVAX and the I/O devices.

NVAX Data/Address Lines

In order to maximize the bandwidth of the bus connecting the CPU to the memory and I/O controllers, the NVAX chip set (NVAX, NMC, NCA) communicates over a "pended" bus called the NDAL. The main feature of this bus is that devices requesting read data do not tie up the bus while waiting for the return data. Rather, a device issues one of the "read" commands on the NDAL and then relinquishes control of the bus to other devices. This is so other transactions can be performed while the responder to the first device prepares to send back the data associated with the read request. Because of the pended nature of the bus, the NDAL bus command set includes separate transactions for returning data from an earlier read cycle.

Processor State

The processor state consists of that portion of the state of a process that is stored in processor registers rather than in memory. The processor state is composed of 16 general purpose registers (GPRs), the processor status longword (PSL), and the internal processor registers (IPRs).

Continued on next page

Non-privileged software can access the GPRs and the processor status word (bits <15:00> of the PSL). The IPRs and bits <31:16> of the PSL can only be accessed by privileged software. The IPRs are explicitly accessible only by the move-to-processor register (MTPR) and the move-from-processor register (MFPR) instructions which can be executed only while running in kernel mode.

The KA49 implements 16 GPRs, as defined in the *VAX Architecture Reference Manual*. These registers are used for temporary storage, accumulators, and base and index registers for addressing. These registers are denoted R0 - R15. The bits of a register are numbered from the right <0> through <31>. Table 1–2 describes the registers.

Table 1–2 General Purpose Register Descriptions

Register	Register Name	Mnemonic	Description
R15	Program Counter	PC	The PC contains the address of the next instruction byte of the program.
R14	Stack Pointer	SP	The SP contains the address of the top of the processor defined stack.
R13	Frame Pointer	FP	The call convention builds a data structure on the stack called a *stack frame*. The FP contains the address of the base of this data structure.
R12	Argument Pointer	AP	The call convention uses a data structure termed an *argument*. The AP contains the address of the base of this data structure.

Continued on next page

Internal Processor Registers

The internal processor registers (IPRs) that are implemented by the KA49 CPU chip, and those that are required of the system environment, are logically divided into five groups, as follows:

- Normal—Those IPRs that address individual registers in the KA49 CPU chip or system environment
- Bcache Tag IPRs—The read-write block of IPRs that allow direct access to the Bcache tags
- Bcache Deallocate IPRs—The write-only block of IPRs by which a Bcache block may be deallocated
- Pcache Tag IPRs—The read-write block of IPRs that allow direct access to the Pcache tags
- Pcache Data Parity IPRs—The read-write block of IPRs that allow direct access to the Pcache data parity bits

Interrupts and Exceptions

Overview

Both interrupts and exceptions divert execution from the normal flow of control. An *interrupt* is caused by some activity outside the current process and typically transfers control outside the process (for example, an interrupt from an external hardware device). An *exception* is caused by the execution of the current instruction and is typically handled by the current process (for example, an arithmetic overflow).

Nonmaskable Interrupts

Interrupts can be divided into two classes: nonmaskable and maskable. Nonmaskable interrupts cause a halt by way of the hardware halt procedure. The hardware halt procedure does the following:

- Saves the PC, PSL, MAPEN<0> and a halt code in IPRs
- Raises the processor IPL to 1F
- Passes control to the resident firmware

The firmware dispatches the interrupt to the appropriate service routine based on the halt code and hardware event indicators. Nonmaskable interrupts cannot be blocked by raising the processor IPL.

Maskable Interrupts

Maskable interrupts cause the following:

- The PC and PSL are saved.
- The processor IPL is raised to the priority level of the interrupt.
- The interrupt is dispatched to the appropriate service routine through the system control block (SCB).

Continued on next page

Interrupt Priority Levels

Table 1–3 lists KA49 interrupt conditions, associated priority levels, and SCB offsets. Note that Table 1–3 is intended as a quick reference, and may not include all possible causes of the various interrupts.

Table 1–3 Interrupt Priority Levels

Priority Level	Interrupt Condition	SCB Offset
1F	HALT_H asserted (nonmaskable)	**
1E	Unused	
1D	Bcache addressing errors	60
	Bcache uncorrectable data ECC errors on Bcache read for a write that hits valid/owned	60
	NVAX read timeout or read data error on Bread for a write after the requested quadword has arrived	60
	Illegal length write transaction to memory or I/O	60
	Reserved command detected by memory or I/O during write transaction	60
	Pending write times out waiting for disown write	60
	Disown write to unowned memory location	60
	Main memory NXM errors on writes	60
	NDAL parity errors on writes	60
	CP-Bus NXM/TIMEOUT on a write	60
1C	Unused	
1B	Performance monitoring interrupt (internally handled by microcode)	

** These conditions generate a hardware halt procedure with a halt code of 2 (external halt).

Continued on next page

Table 1–3 (Continued) Interrupt Priority Levels

Priority Level	Interrupt Condition	SCB Offset
1A	Correctable main memory errors	54
	Uncorrectable main memory errors	54
	Correctable O-bit memory errors	54
	Pending read times out waiting for disown write	54
	No acknowledgment on returned read data from NMC	54
	NDAL Data parity errors	54
	Pcache tag or data parity errors	54
	VIC tag or data parity errors	54
	Bcache addressing errors	54
	Bcache correctable data ECC errors	54
	Bcache uncorrectable data ECC errors	54
	Bcache correctable tag ECC errors	54
	Bcache uncorrectable data ECC errors	54
	Illegal length transaction to memory or I/O space	54
	Reserved command to memory or I/O space	54
	CP-Bus parity errors on I/O read transactions	54
	CP-Bus ERR_L signal asserted by I/O device during I/O read transaction	54
	CP-Bus NXM/TIMEOUTS errors on I/O reads	54
19:18	Unused	
17	IRQ_H[3] asserted	Unused

** These conditions generate a hardware halt procedure with a halt code of 2 (external halt).

Continued on next page

Table 1–3 (Continued) Interrupt Priority Levels

Priority Level	Interrupt Condition	SCB Offset
16	IRQ_H[2] asserted	Unused
	Interval timer (IRQ_H[2] takes priority)	C0
15	IRQ_H[1] asserted	
14	IRQ_H[0] asserted	
	Network interface	104
13:10	Unused	
0F:01	Software interrupt requests	84-BC

** These conditions generate a hardware halt procedure with a halt code of 2 (external halt).

Exceptions

There are six categories of exceptions.

- Arthimetic
- Memory management
- Operand
- Instruction
- Tracing
- System failure

A list of exceptions, grouped by class, is shown in Table 1–4.

Continued on next page

Table 1–4 Exception Categories

Exception Class	Instances
Arithmetic traps/faults	Integer overflow trap Integer divide-by-zero trap Subscript range trap Floating overflow fault Floating divide-by-zero fault Floating underflow fault
Memory management exceptions	Access control violation fault Translation not valid fault M=0 fault
Operand reference exceptions	Reserved addressing mode fault Reserved operand fault or abort
Instruction execution exceptions	Reserved/Privileged instruction fault Emulated instruction faults XFC fault Change-mode trap Breakpoint fault Vector disabled fault
Tracing exceptions	Trace fault
System failure exceptions	Kernel-Stack-Not-Valid abort Interrupt-Stack-Not-Valid halt Console error halt Machine check abort

Types of Exceptions

There are three types of exceptions.

- Trap
- Fault
- Abort

Continued on next page

Trap Exceptions

A trap is an exception that occurs at the end of the instruction that caused the exception. Therefore, the PC saved on the stack is the address of the next instruction that would normally have been executed.

Fault Exceptions

A fault is an exception that occurs during an instruction and that leaves the registers and memory in a consistent state such that elimination of the fault condition and restarting the instruction will give correct results. After the instruction faults, the PC saved on the stack points to the instruction that faulted.

Abort Exceptions

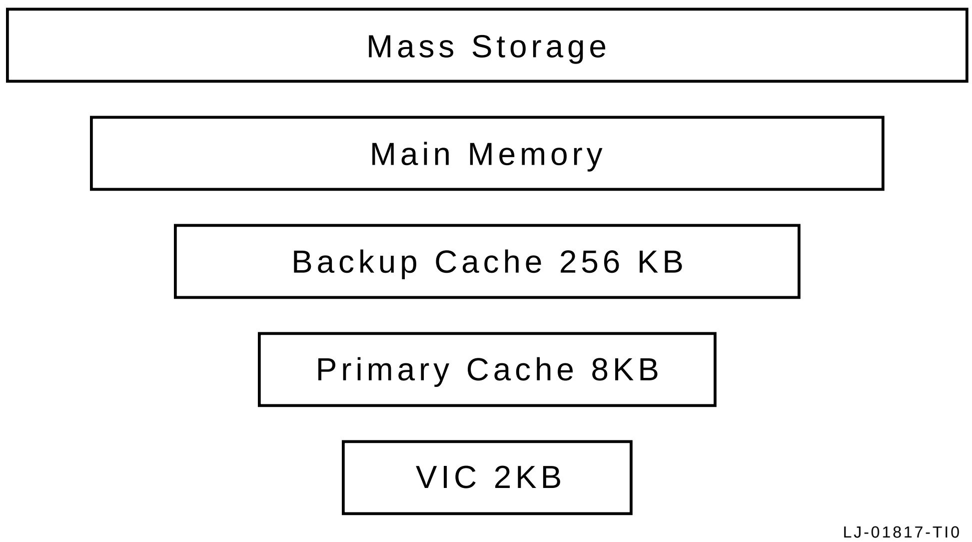
An abort is an exception that occurs during an instruction. An abort leaves the value of registers and memory UNPREDICTABLE such that the instruction cannot necessarily be correctly restarted, completed, simulated, or undone. In most instances, the NVAX microcode attempts to convert an abort into a fault by restoring the state that was present at the start of the instruction that caused the abort.

Cache Memory

Overview

The NVAX memory subsystem follows a hierarchical structure. The VIC, Pcache, Bcache, and finally the main memory form the hierarchical memory subsystem of the KA49. The hierarchical ordering of the various levels of KA49 memory is shown in Figure 1–3. For I-stream references, the memory hierarchy starts with the VIC, whereas for D-stream references the memory hierarchy starts with the Pcache.

Figure 1–3 KA49 Cache/Memory Hierarchy



References generated by the NVAX CPU are issued to the memory subsystem at the first hierarchical level, as determined by the reference type (I-stream or D-stream). The reference then passes up through the hierarchy until it is serviced by one of the layers. References that are serviced at lower layers take less time than references that must pass to higher layers. For this reason, it is the intent of the memory subsystem to service most references within the lower layers, thus maximizing system performance.

By creating successively faster layers of memory hierarchy below the main memory, the KA49 decreases the average amount of time required to access information. Because each layer in the hierarchy tends to be smaller in size than the next higher (slower) layer, there is the problem of allocating space at each

Continued on next page

layer for storing references. Furthermore, care must be taken to ensure that the state of the system is singularly and accurately represented by the combined contents of the caches and main memory.

In the KA49 this issue is most critical between main memory and the Bcache and Pcache, because main memory can be accessed by DMA devices as well as the NVAX CPU. Furthermore, this problem is complicated by the writeback nature of the Bcache. This write-back mechanism, while significantly decreasing the latency of write operations, complicates the problem of maintaining a coherent and consistent representation of main memory in the face of DMA traffic.

Cached References

Any reference that can be stored by the VIC, the Pcache, or the Bcache is called a *cached reference*. The Pcache and Bcache store CPU read references to the VAX memory space (bit <29> of the physical address = 0) only. They do not store references to the VAX I/O space.

Whenever the CPU generates a non-cached reference, or a cached reference not stored in any of the three caches, a single hexaword reference of the same type is generated on the NDAL Bus.

Whenever the CPU generates a cached reference that is stored in one of the caches, no reference is generated on the NDAL Bus.

Virtual Instruction Cache

Before any instruction can be executed, it must first be fetched from memory. The NVAX CPU contains an instruction prefetcher that fetches sequential instructions ahead of the instruction currently being executed. This is done in an attempt to reduce the effective access time of the instruction fetch by pipelining it with decode and instruction execution. The instruction prefetcher maintains an instruction prefetch queue (IPQ) of up to 16 bytes (4 longwords) of I-stream data. In order to fill the IPQ, the prefetcher sends I-stream read requests to the Virtual Instruction Cache (VIC).

Continued on next page

The VIC is a 2-KB, direct-mapped cache for caching I-stream data. The VIC is located within the NVAX CPU chip. In order to reduce the overhead associated with virtual-to-physical address translation, the VIC caches references based on virtual addresses. In the event that the virtual references made by the instruction prefetcher hit in the VIC, the I-stream data is loaded from the VIC directly to the IPQ.

If the references made by the instruction prefetcher miss in the VIC, then the VIC issues an I-stream read request on behalf of the instruction prefetcher to the next level of memory hierarchy, the Pcache.

Primary Cache

The primary cache (Pcache) is a two-way set associative, read allocate, no-write allocate, write through, physical address cache of I-stream and D-stream data. It stores 8192 bytes (8K) of data and 256 tags corresponding to 256 hexaword blocks (1 hexaword = 32 bytes). Each tag is 20 bits wide corresponding to bits <31:12> of the physical address.

There are four quadword subblocks per block with a valid bit associated with each subblock. The access size for both Pcache reads and writes is one quadword. Byte parity is maintained for each byte of data (32 bits per block). One bit of parity is maintained for every tag. The Pcache has a one cycle access and a one cycle repetition rate for both reads and writes.

The Pcache represents the first level of D-stream memory hierarchy and the second level of I-stream memory hierarchy in all NVAX computer systems. Pcache entries must be invalidated in order to maintain cache coherency with higher levels of the memory hierarchy.

The Pcache is located within the NVAX CPU chip. Unlike the VIC, the Pcache is based on physical addresses rather than virtual addresses. The Pcache handles I-stream requests from the VIC, as well as D-stream requests for instruction operands. The Pcache uses a write-through scheme for handling writes to memory locations which are contained in the Pcache. In this

Continued on next page

scheme, the write operation updates the contents of the Pcache, and the write operation is propagated to the next level of memory hierarchy, the Bcache. The Pcache is maintained as a strict subset of the Bcache.

Backup Cache

The backup cache (Bcache) is direct-mapped, with quadword access size, and a hexaword (32 bytes) block size. The Bcache allocates on reads and writes, and uses a write-back protocol. Bcache tags and cache data are stored in static RAMs that reside on the CPU module. The NVAX CPU implements the control for the Bcache tags and data.

The Bcache and Pcache communicate internally to the NVAX CPU in such a way as to maintain the Pcache as a strict subset of the Bcache. This is done through the use of "invalidate" commands sent automatically from the Bcache to the Pcache whenever the Bcache must invalidate a block. The Bcache invalidates a block in response to DMA activity to the corresponding memory location, or to make room in the cache for new data. In the case of Bcache blocks that contain data for NVAX-owned memory locations, the process of invalidating the block involves a write-back of the data contained in the cache to the corresponding memory location. The write-back operation simultaneously relinquishes ownership of the hexaword.

Main Memory System

Overview

The main memory system is implemented in the NVAX memory controller chip (NMC). The NMC communicates with SIM modules over the NVAX memory interconnect (NMI). Up to eight SIM modules are supported, for a maximum of 128 MB of main memory.

The NMC serves as an interface between the NDAL and NVAX memory interconnect. The NMI is comprised of the set of signals leading from the NMC to the memory modules, and provides a 64-bit path to the memory modules. The arbiter for the NDAL is also built into the NMC.

NVAX Memory Subsystem

The NMC controls and passes data to or from, one or two sets of SIM modules using a bank interleaved memory access. It responds to commands from the CPU and the I/O adapter (NCA). The NMC is never a commander on the NDAL.

Each set of memory modules can have either zero or four SIM modules. The memory modules can be either 4 MB (1-MB DRAMs) or 16 MB (4-MB DRAMs). The SIM modules in each set must be homogenous (no mixing of 4-MB and 16-MB SIM modules within a set) although the types of SIM modules can differ between the two sets (for example, a set of 4-MB SIM modules and a set of 16-MB SIM modules). The minimum configuration is 16 MB. Each SIM module consists of fast page mode 100 ns RAS access time DRAMs.

ROM Memory

Overview

The system board ROM contains processor restart, diagnostic and console code, and the primary bootstrap program. Another small ROM is uniquely programmed for each system with its network address.

System Board ROM

The system board ROM contains four 128 KB x 8 FLASH ROM chips that collectively hold 512 KB of data. ROM data appears at physical addresses 2004.0000 through 200B.FFFF. The data path to this ROM is 32 bits wide. Certain physical addresses in the ROM have fixed uses. These fixed uses are listed in Table 1–5.

Table 1–5 ROM Fixed Uses

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 SYS_TYPE. The contents of this longword supplement the internal processor SID register to identify the processor and system type.

Network Address ROM

A 32-byte ROM on the system board contains a unique network address for each system. Data from this ROM is read in the low-order bytes of 32 consecutive longwords at physical addresses 2780.0000 through 2780.007C. The network address occupies the first six bytes (addresses 2780.0000 through 2780.0014). The byte at 2780.0000 is the first byte to be transmitted or received in an address field of an Ethernet packet. Its low-order bit (bit 0) is transmitted or received first in the serial bit stream.

This ROM is installed in a socket so it can be moved in the event that a system board is replaced.

Graphics Controller

Overview

The VAXstation 4000 Model 90 workstation supports three graphics options: LCSPX, SPXg, and SPXgt. The LCSPX module is a low cost graphics module, while the SPXg/gt modules support high performance 3D graphics. The SPXg is an 8-plane graphics module and the SPXgt is a 24-plane graphics module. Note that only one video option can be physically installed into the workstation at a time. All the graphics options share a single interrupt request signal and interrupt vector. The graphics interrupt can be enabled/disabled by a bit in the INT_MSK register. All of the graphics options can be reset with the graphics reset bit in the IORESET register. Two bits in the configuration register allow software to determine if an LCSPX or a SPXg/gt module is installed in the system.

LCSPX

The LCSPX module is a redesign of the VXT 2000 SPX module. This is a cost-reduced SPX module that interfaces directly to the CP2 bus. The LCSPX module is functionally the same as the VXT 2000 SPX module except that two video oscillators are supported using a module switch. The diagnostic ROM/Configuration register on the LCSPX module contains information about the oscillator currently in use. This is the only register that is different from the VXT 2000 SPX module. Table 1–6 shows the bit definitions associated with the diagnostic ROM configuration register.

Continued on next page

Table 1–6 Diagnostic ROM/Configuration Register Bit Definitions

Bit	Name	Definition
<31>	Scanproc Test	This bit is driven by the Scanproc chip during diagnostics.
<30>	Time Out	This bit is set when 2 VRAM refresh pulses occur while DS is low, indicating a hung system.
<29:18>	Reserved	Read as zero.
<17>	MSB	This bit indicates the speed of the oscillator used as timing for the 1280 X 1024 monitor. A zero indicates 66 Hz operation, a one indicates 72 Hz operation.
<16>	Reserved	Read as zero.
<15:0>	ROM Data Field	These bits contain the ROM data that represents the diagnostic code for the video subsystem.

SPXg/gt

The SPXg and SPXgt modules were originally designed to be installed into an LCG frame buffer connector on the Model 60 system. The DC7201 chip in the Model 60 system provided the interface to the SPXg/gt graphics module. The DC7201 chip provided a direct path for the processor to read and write SPXg/gt registers along with support for DMA into the SPXg/gt FIFO. In the Model 90 system, no DMA support for SPXg/gt is provided. The SPXg/gt is accessible using three separate address ranges.

The base address range for SPXg/gt module is 2800.0000 to 29FF.FFFF. In addition, a direct access path to the Brooktree RAMDAC is supported at addresses 2A00.0000 to 2A00.003C. Finally the SPXg/gt diagnostic ROM is located at addresses 2A10.0000 to 2A17.FFFF. The diagnostic ROM is accessible a word at a time on aligned quadword boundaries.

Network Interface Controller

Overview

The KA49 includes a network interface that is implemented by the second generation Ethernet controller (SGEC). This interface allows the KA49 module to be connected to either a ThinWire or standard Ethernet network and supports the Ethernet data link layer. The SGEC also supports CP-Bus parity protection.

Serial Line Controller

Overview

The serial line controller handles four asynchronous serial lines. The DC7085 chip is used as the serial line controller. The DC7085 directly controls an external 64-entry silo shared by all four receive lines. Access to the DC7085 by the CPU and interrupt processing for the DC7085 are controlled by the CEAC. The four serial lines are numbered 0 through 3, and each has a particular primary use, as described in Table 1–7.

Table 1–7 Serial Line Usage

Line	Device	Description
0	Keyboard	Connected to a 15-pin D-sub connector[1] and to a 4-pin modular jack mounted on the system board. Data leads only. Supports the LK401 keyboard.
1	Pointer	Connected to a 15-pin D-sub connector[1] and to a miniature DIN connector mounted on the system board. 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 board, RS423 compatible. Data leads plus modem control signals.
3	Printer	Connected to a 6-pin modified modular jack mounted on the system board. DEC423, data leads only.

[1]Same connector

Line 3 is normally connected to a printer through a BC16E cable. If a switch, accessible from the front of the system enclosure, is set to enable, a received break condition on this line asserts the CPU halt signal, which causes a processor restart with a restart code of 2.

Time-of-Year Clock

Overview

The time-of-year (TOY) clock consists of an MC146818BM CMOS watch chip that keeps the date and time of day and contains 50 bytes of general purpose RAM storage. This chip includes a time base oscillator and a lithium battery on-chip. The battery powers the chip with logic and oscillator while system power is off.

Battery Backup

A lithium battery within the watch chip supplies power to the watch chip and its time base oscillator while system power is off. The battery maintains the clock operation and the data stored in the 50 bytes of RAM for a minimum of 10 years before it becomes exhausted.

Watch Chip Registers

The watch chip contains 64 8-bit registers. Ten of these 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 as shown in the next table.

Each register is accessed as bits <9:2> of a longword. Bits <31:10> and <1:0> are ignored on writing and undefined on reading.

WARNING

Because each register spans two bytes on the system bus, only *word* or *longword* access instructions may be used to manipulate these registers. The effects of using byte access instructions are undefined. In particular, instructions for modifying bits such as BBSS, BBSC, BBCC, and BBCS cannot be used; they generate byte-access read-modify-write cycles that will corrupt the portion of the register that is not in the byte being accessed.

SCSI Controller

Overview

The SCSI interface is a single-ended, bi-directional, 8-bit-wide bus to which up to eight devices can be attached. The KA49 system module is one of those devices, allowing the attachment of up to seven additional devices. Devices may play one of two roles: 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 KA49 module is always the initiator and all other SCSI devices attached to it are targets.

Connecting Devices

Each device attached to the SCSI bus is identified by a unique device ID number in the range 0 through 7. During the arbitration, selection, and reselection bus phases in which an initiator and a target establish a connection, the device IDs of the initiator and target are both placed on the data bus by asserting the data bits corresponding to the device ID numbers. By convention, the ID number of the VAXstation Model 90 system is six (this is controlled by the programs that drive the SCSI interface; it is not fixed in Model 90 hardware).

The electrical interface consists of 18 signal lines. Some of these lines are driven only by initiators, some only by targets, and some by either. The SCSI bus is always terminated at each end. The bus is permanently terminated at the controller (near end). Far end termination can take place in one of two locations:

- At the expansion connector on the rear of the system enclosure
- At the second expansion connector on a storage expansion unit

Continued on next page

SCSI Bus Signals

Table 1–8 describes the SCSI bus signals used by the SCSI controller.

Table 1–8 SCSI Bus Signals

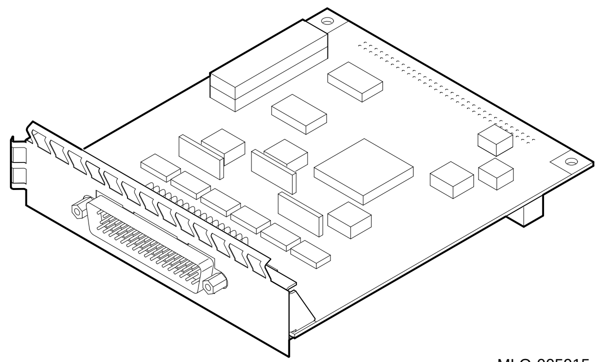
Bus Signal	Description
DB7..0 and DBP	An 8-bit parallel data bus with an associated odd parity bit. The use of the parity bit is optional but strongly encouraged. These lines may be driven by either an initiator or a target, depending upon the direction of data transfer.
RST	Signals all devices on the 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 indiscriminately 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	Used by initiators and targets during the arbitration, selection, and reselection 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..
ATN	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	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.
C/D, I/O and MSG	Collectively indicate one of six possible information transfer phases. These signals are always driven by the target device.

DSW21 Synchronous Communications Adapter

Overview

The DSW21 syncrhonous communications adapter is a synchronous serial communications interface for the VAXstation 4000 Model 90 workstation. It has full modem control and multiple protocol support. Figure 1–4 shows the DSW21 communications adapter.

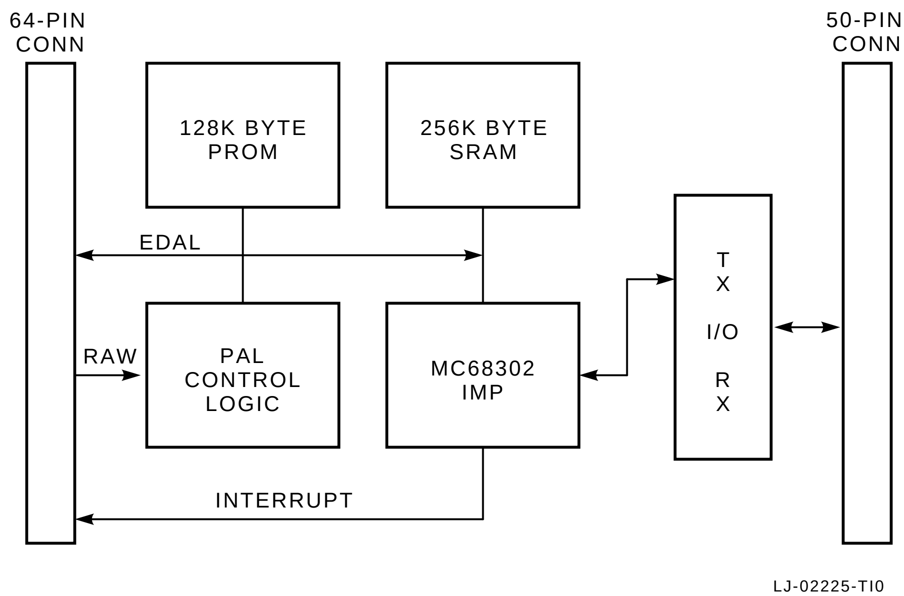
Figure 1–4 Synchronous Communications Adapter



The adapter is an option board that connects internally to the CPU board by a 64-pin option connector. It consists of the EDAL interface, 128 KB UVEPROM, 256 KB static RAM, the MC68302 integrated multi-protocol processor (IMP), and I/O receivers and drivers with static and lightning protection. The communications I/O connector is a 50-pin D-subminiature plug that goes directly through the back of the system cabinet. Figure 1–5 shows the DSW21 connections.

Continued on next page

Figure 1–5 DSW21 Connections



Chapter 2
Firmware

Overview

Introduction

This chapter provides an overview of the VAXstation 4000 Model 90 system firmware. The firmware is located in four EPROMs, which hold a total of 512 KB of data. The system firmware has five distinct areas of operation. This chapter discusses the following topics:

- Power-Up Initialization Code
- Console Mode
- Extended Self-Test
- Utilities
- System Test
- System ROM
- Option ROM
- Configuration Table
- Driver Descriptor
- Interfacing to Diagnostic Drivers
- Console Driver Interface

Power-Up Initialization Code

Overview

The power-up initialization code is executed when power is applied to the VAXstation 4000 Model 90 workstation or any time volatile console data structures are altered.

Power-Up Initialization Sequence

Table 2–1 describes the power-up initialization sequence.

Table 2–1 Power-Up Initialization Sequence

Stage	What the System Does
1	Tests enough memory to bring up the console for building console and device structures.
2	Checks its configuration, identifies optional devices, and identifies the type of monitor connected to the video slot.
3	Tests the TOY clock and the non-volatile RAM. If this test fails, the power-up test stops.
4	Constructs the master configuration table (MCT), device configuration table (DCT), driver descriptor, shared console interface area (SCIA), and a blank page frame map.

Continued on next page

Table 2–1 (Continued) Power-Up Initialization Sequence

Stage	What the System Does
5	Tests the serial lines. If this test fails, the console terminal is not enabled and the only output is the HEX display.

If...	And...	Then...
No video option is present	—	The system defaults to line three of the serial port.
A video option is plugged into the video slot on the CPU and the switch is set to graphics	The test fails	Video drivers are loaded and the system behaves as if a failure occurred.
The alternate console switch is set to alternate console	—	The terminal connected to line three of the serial port is used as the console.

Stage	What the System Does
6	Calls up the console device initialization routine. Console I/O is allowed after this step. The system type and ROM ID are printed out at the console device, followed by the amount of memory and the Ethernet address.

Continued on next page

Table 2–1 (Continued) Power-Up Initialization Sequence

Stage	What the System Does
7	Test dispatcher tests the functional blocks of the system. This test displays a blank ruler on the screen. The length of the ruler is dependent on the devices in the system. The dispatcher runs the tests in the following order: • Non-Volatile RAM (NVR) • Color graphics (LCSPX, SPXg or SPXgt) • Serial line controller (DZ) • Cache memory (SCSI DMA RAM, OBIT RAM, BCACHE) • Memory configuration (MEM) • Floating point unit (FPU) • Interval timer (IT) • Miscellaneous system board (checksums, Ethernet ID ROM) (SYS) • Network controller (NI) • SCSI controller (SCSI) • Sound chip (AUD) • Option board (COMM) • Bus adapter logic If an error occurs 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 not, the system is autobooted using the default device stored in the NVR or the Ethernet if no device is specified.

Console Mode

Overview

The VAXstation 4000 Model 90 console mode allows operation of a console device, which can be one of the following:

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

Console Mode

The console mode can be entered if:

- The HALT parameter is set to halt when power is turned on.
- A HALT instruction is executed with the HALT action set to HALT or a severe processor condition occurs (such as an invalid interrupt stack).
- An external HALT is detected (pressing the halt button on the front panel).

Input and Output

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

- Self-Test
- Extended self-test
- Utilities
- System test
- Virtual memory boot (VMB)

Extended Self-Test

Overview

The extended self-tests are started by entering the TEST command at the console prompt, followed by the test number or numbers you wish to run. The test dispatcher runs the self-test requested until an error occurs or until all tests are completed.

Test Dispatcher

The dispatcher uses the main configuration table (MCT), device configuration table (DCT), and drive descriptor data structures when running a self-test.

Table 2–2 shows the stages of the test dispatcher self-test procedure.

Table 2–2 Test Dispatcher Procedure

Stage	What the Dispatcher Does
1	Uses the device number to index into the MCT.
2	Receives a pointer to the device DCT from the MCT.
3	Finds a pointer to the device directory entries in the DCT.
4	Scans all the directories for a directory type of the self-test directory (=1).
5	Reads the flags field in the DCT to determine if the self-test diagnostic needs to be loaded into RAM. If the diagnostic needs to be loaded into RAM, the dispatcher allocates memory for loading the diagnostic (moving it from ROM to RAM).

Continued on next page

Table 2–2 (Continued) Test Dispatcher Procedure

<table>
<tr><th>Stage</th><th>What the Dispatcher Does</th></tr>
<tr><td>6</td><td>Reads the flags field in the DCT to determine if the diagnostic uses a shared diagnostic driver.
<table>
<tr><th>If...</th><th>Then...</th></tr>
<tr><td>The self-test diagnostic uses a shared diagnostic driver</td><td>The dispatcher gets the directory entry and the pointer to the driver descriptor from the DCT.</td></tr>
<tr><td>The shared driver needed is not already in RAM</td><td>The dispatcher allocates temporary RAM for the shared driver (loading the driver from ROM to RAM) and fills in the driver descriptor data structure to point to the RAM based shared driver.</td></tr>
</table></td></tr>
<tr><td>7</td><td>Calls the devices self-test interface.</td></tr>
</table>

Utilities

Overview

A utility test is started at the console prompt by entering a command using the following format:

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

Format	Meaning
/UTIL	Instructs the test dispatcher to run a utility
dev_nbr	The device on which the utility operates
util_nbr	The utility number
op1...opn	One to n optional parameters

Running a Utility

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 a utility. Table 2–3 describes the dispatcher process for running a utility.

Table 2–3 Running a Utility Process

Stage	Dispatcher Process
1	Uses the device number to index into the MCT.
2	Receives a pointer to the device DCT from the MCT.
3	Finds a pointer to the device directory entries in the DCT.
4	Scans all the directories for a directory type of the utility directory (=3)
5	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 (moving it from ROM to RAM).

Continued on next page

Table 2–3 (Continued) Running a Utility Process

Stage	Dispatcher Process
6	Reads the flags field in the DCT to determine if the utility uses a shared diagnostic driver.

If...	Then...
The utility uses a shared diagnostic driver	The dispatcher gets the directory entry and the pointer to the driver descriptor from the DCT.
The shared driver needed is *not* already in RAM	The dispatcher allocates temporary RAM for the shared driver (loading the driver from ROM to RAM) and fills in the driver descriptor data structure in the driver descriptor for the shared driver.

Stage	Dispatcher Process
7	Calls the utility entry point.
8	Checks the parameters passed. If the parameters are out of range or too many passed, the dispatcher sends out an illegal parameter message.
9	Prompts the user if more parameters are needed.
10	Prompts the user if the utility is going to destroy any user data.
11	Starts the utility.

System Test

Overview

The system test tests the device interaction in the system by creating maximum DMA and interrupt activity. The test consists of:

- Modified VAXELN kernel
- System test monitor
- System diagnostics
- Shared drivers (if present)

The system test can be run in three environments, selected by the SET DIAGENV command.

- Customer - 1
- Digital Services - 2
- Manufacturing - 3

CAUTION

Do not use the manufacturing mode in the field. Manufacturing mode erases customer data on hard disks, excluding the system disk.

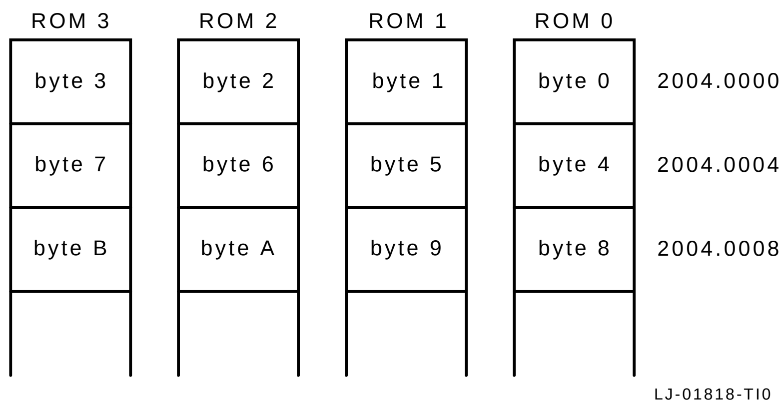
Refer to Table 5–8 for more detailed information on running the system test.

System ROM

Overview

The base VAXstation 4000 Model 90 firmware contains 512 KB of ROM split into four 128-KB wide ROMs. This provides the full 32-bit wide memory data path shown in Figure 2–1.

Figure 2–1 System ROM Format



The system firmware ROMs supply some information on a per byte basis for ease of manufacture and development. Other information (software and tables) is supplied by the set of ROM parts. Figure 2–2 displays the system ROM part formats.

Continued on next page

Figure 2–2 System ROM Part Format

15.. ..8	7.. ..0	
Reserved for ROM set Data	Reserved for ROM set Data	word 0
Reserved for ROM set Data	Reserved for ROM set Data	word 1
Version	Version	word 2
ROM Byte Number	ROM Byte Number	word 3
Manufacturing Check Data (55h)	Manufacturing Check Data (55h)	word 4
Manufacturing Check Data (AAh)	Manufacturing Check Data (AAh)	word 5
Manufacturing Check Data (33h)	Manufacturing Check Data (33h)	word 6
ROM Part Length	ROM Part Length	word 7
Reserved for ROM set data	Reserved for ROM set data	word 8
Checksum	Checksum	Last word

LJ-02219-TI0

Continued on next page

System ROM Part Format

Table 2–4 shows the part formats in the system ROM.

Table 2–4 System ROM Part Formats

Byte	Name	Description
Word 02h	Version	Contains the low 8 bits of the version number of the console code for the Model 90 system firmware.
03h	ROM byte number	Indicates the position of the byte among the set of ROMs used to implement the firmware. This value is equal to the low 2 bits of the physical address of the first byte in the ROM part. The value ranges from 0 to 3.
04h to 06h	Manufacturing check data	Used for a quick check of the ROM. The data are 55h, AAh, and 33h.
07h	ROM part length	Indicates the length of the ROM part divided by the data path width in bytes.
Last byte	Checksum	For each ROM byte contains a simple 8-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.

Continued on next page

System ROM Set Format

Table 2–5 shows the physical addresses in the system ROM. These addresses are fixed.

Table 2–5 System ROM Physical Addresses

Physical Address	Name	Description
2004.0000	Processor restart	The hardware begins execution at this address when: • Power is turned on. • Kernel mode halt instruction executes. • A break signal is received from the console device. • The HALT button is depressed. • The CPU detects a severe corruption of its operating environment.
2004.0004 SYS_TYPE	System Type register	The system type value longword is 0401.0001.
2004.0008	ROM Part data	These 24 bytes are reserved for information contained in each ROM byte.
2004.0020	Interrupt vector numbers	These eight longwords are not used by the Model 90.
2004.0060	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 the area.
2004.0080	Reserved	Reserved so all ROM set data that follows it will be in the same relative position.
2004.0088	System console firmware revision number	This word contains the system console firmware revision number.

Continued on next page

Table 2–5 (Continued) System ROM Physical Addresses

Physical Address	Name	Description
2004.008A	System diagnostic firmware revision number	This word contains the system diagnostic firmware revision number.
2004.008C	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 Model 90 system firmware ROM.
2004.0090	Pointers to keyboard map	These two longwords point to the tables used to translate 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.

Option ROM

Overview

Each option in the Model 90 system has its own ROM firmware. The ROM memory on the option board may be implemented as discussed in the following sections.

Option ROM Part Format

The option ROM part format is provided for each byte in the ROM set. This format is compatible with the system ROM format, with the addition of the data path indicator. Figure 2–3 shows the ROM byte data.

Figure 2–3 Option ROM Byte Data

Data Path Indicator	Byte 0
Reserved	Byte 1
Version	Byte 2
ROM Index Number	Byte 3
Manufacturing Check Data (55h)	Byte 4
Manufacturing Check Data (AAh)	Byte 5
Manufacturing Check Data (33h)	Byte 6
ROM Part Length	Byte 7
Reserved for ROM set Data	Byte 8
Checksum	Last Byte

LJ-00101-TI0

Continued on next page

Byte	Name	Description
00h	Data path indicator	Indicates the size of the ROM data path. The data path must be one of the following: • 1: One byte per longword. Bytes in ROM occupy the low byte of each longword. • 2: Two bytes per longword. Words in ROM occupy the low two bytes of each longword. • 4: Four bytes per longword. Longwords in ROM correspond to longwords in the address space.
02h	Version	Contains the low 8 bits of the version number for the option firmware.
03h	ROM Byte number	Indicates the position of the byte among the set of ROMs used to implement the firmware. This value is equal to the low 2 bits of the physical address of the first byte in the ROM set. Note that this value is always less than the data path indicator.
04h to 06h	Manufacturing check data	Performs quick verify check of the ROM contents. The data are 55h, AAh, and 33h.

Continued on next page

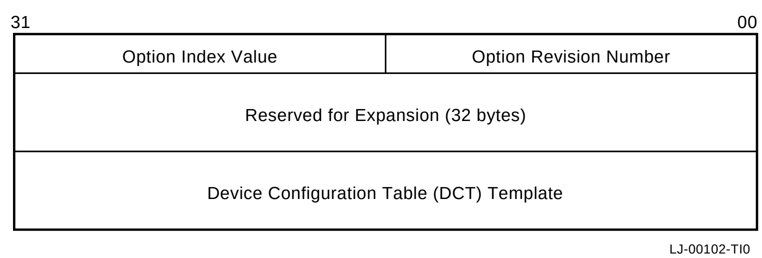
Byte	Name	Description
07h	ROM part length	Indicates the length of each byte address in the set. It is the number of bytes associated with each byte in the ROM in Kbytes. **NOTE** **The number of bytes in the ROM set equals the sum of the number of bytes in each of the ROM parts divided by the data path of each device. Each of the ROM parts on the option board must have the same number of bytes.**
8	Reserved	Reserved for ROM set data.
Last byte	Checksum	Each byte in the ROM set has a simple add and rotate checksum in its last byte.

Option ROM Set Format

For options that have a one-byte or two-byte data path, the data from the ROM set must be moved into RAM. Note that a device cannot have both an 8-bit data path and a 16-bit data path. An option with a full 32-bit data path may not have to be moved. Devices with a 16-bit data path are treated as though each byte of the device is a device in itself.

Figure 2–4 shows option ROM set data.

Figure 2–4 Option ROM Set Data



Continued on next page

Option ROM, Continued

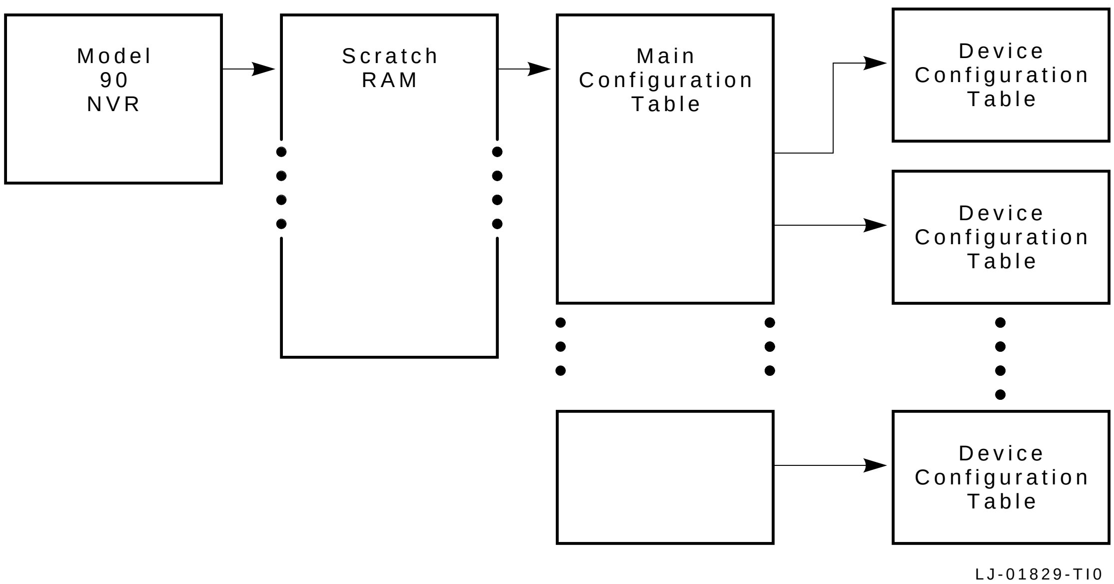
Name	Description
Option revision	This number controls changes in both the option hardware and firmware.
Option index value	An index value of the last DCT entry. A zero in this field indicates a single DCB for the device, a one indicates two device control blocks for this device. An option that occupies the storage option slot can have the values of zero or one. An option that occupies the video option slot can have the values of zero, one, or two.
Reserved for expansion	These 32 bytes are reserved.
Device configuration table template	The device implemented by the option must have an associated device configuration table template. The DCT contains static and dynamic data and pointers to code required for the device.

Configuration Table

Overview

Information on the VAXstation 4000 Model 90 devices is stored in the system configuration tables during the power-up initialization. The initialization code sizes the system by reading the ROM-based device configuration tables (DCT) and builds a memory resident configuration data structure. Figure 2–5 shows how the data structures are linked together.

Figure 2–5 Model 90 Configuration Tables



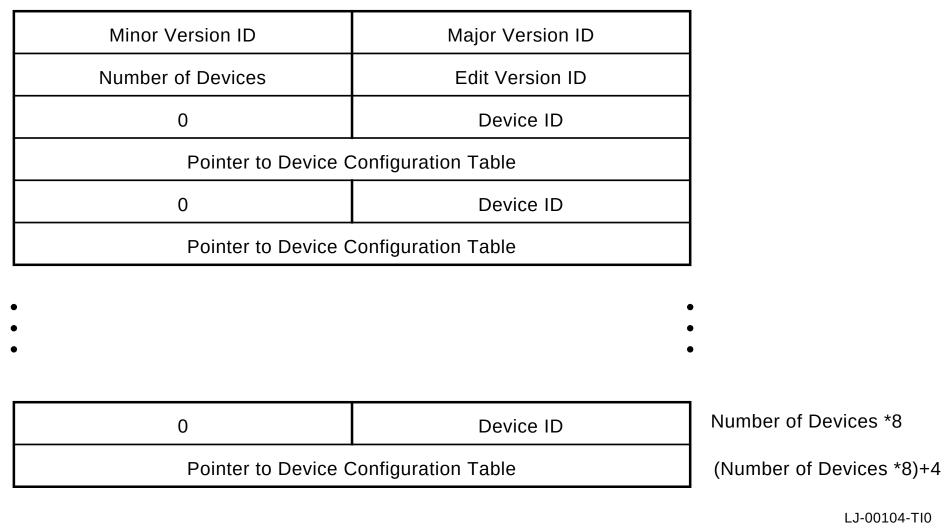
The initialization code saves the pointer to the scratch RAM in the Model 90 NVR in four consecutive bytes. The scratch RAM contains a pointer to the main configuration table (MCT) at its base address. The MCT contains pointers to the DCT.

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 (DCT) for each device. The MCT is built when power is turned on 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 2–6.

Continued on next page

Figure 2–6 Main Configuration Table



The components of the MCT are as follows:

Table 2–6 MCT Components

Name	Description
Major version ID	Tracks major changes in the diagnostic interface
Minor version ID	Tracks minor changes in the diagnostic interface
Edit version ID	Reserved for use by diagnostic developers
Number of devices	Number of entries in the MCT table
Device ID[1]	Device ID number
–[1]	Must be zero reserved for future use

[1]Replicated for each device in the system.

Continued on next page

Table 2–6 (Continued) MCT Components

Name	Description
Pointer to device configuration table[1]	Points to the DCT for the particular device

[1]Replicated for each device in the system.

Device Configuration Table

There is a device configuration table (DCT) entry for each device in the Model 90 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 2–7.

Continued on next page

Figure 2–7 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-TI0

Continued on next page

The components of the DCT are as follows:

Table 2–7 DCT Components

Name	Description
Minor version ID	Tracks minor changes in the device diagnostic routines
Major version ID	Tracks major changes in the devices diagnostic routines
Number of devices	Number of directory entries for the device. A directory entry tells the user where to find a particular component of code for the device.
Edit version ID	Device ID number
Device name	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	Points to the drive descriptor area associated with the device.
Device status	Saved from the last time 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 field replaceable unit (FRU) thought to be faulty.
Pointer to extended status	Points to any extended information that is saved by the device self-test
Size of extended status	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 configuration	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 is displayed when the user enters the SHOW CONFIG command at the console prompt.
Pointer to permanent memory	Points to the permanent memory that has been allocated. The field is filled in by the diagnostic, the first time that it allocates memory.

Continued on next page

Configuration Table, Continued

Table 2–7 (Continued) DCT Components

Name	Description
Size of permanent memory	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	Saved the last time that system test was ran on this device without doing intervening test commands.
Pointer to extended system test status	Points to any extended information that is saved by the device's self-test. The SHOW ESTAT utility uses the extended status to display information about the device.
Size of extended system test status	Length in bytes of the extended system test status.
Flags	Contain flag data associated with the particular device routine.

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.

Continued on next page

Table 2–7 (Continued) DCT Components

Name	Description
DP SIZE	Contains the data path size of the ROM in which the piece of code resides. **Definition** — **Meaning** 1 — ROM Width is one byte wide. 2 — ROM Width is two bytes wide. 4 — ROM Width is four bytes wide.
DIRTYP	Contains the type of directory entry that the previous elements refer to. **Definition** — **Meaning** 1 — Self-Test directory entry 2 — System test directory entry 3 — Utility directory entry 4 — Console routine directory entry 5 — Unjam routine directory entry 6 — Diagnostic driver directory entry
Physical address of module	Contains the physical address for the particular component of the code.
Code length	Contains the length of code in bytes.
Entry point offset	Contains the offset from the beginning of the code to where the entry point is.

Driver Descriptor

Overview

Any device that provides a shared port driver or shared class driver must provide a descriptor that supplies the Model 90 base system firmware, system test monitor, and any other piece of software specific information about the drive. The format for a driver descriptor is shown in Figure 2–8.

Figure 2–8 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-TI0

The fields of the driver descriptor are as follows:

Name	Description
Device ID	Ensures 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 driver	Contains the address of the device driver. This address may be ROM or memory address.

Continued on next page

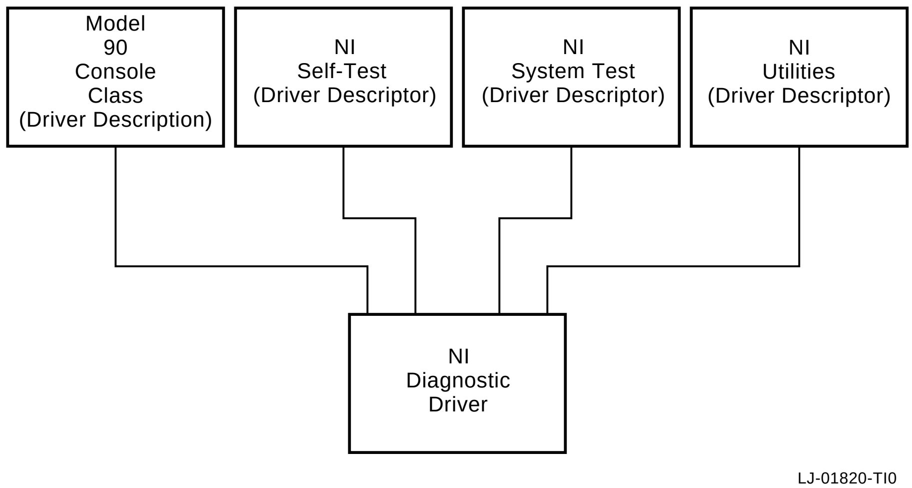
Name	Description
Length of driver	Contains the length of the device driver in bytes. This field is used by both the base system ROM and the system test monitor to determine the amount of code that needs to be loaded into RAM.
Entry point of driver	Contains the number of bytes from the beginning of the device driver to the INIT_DRIVER function.
Size of driver data area	Contains the length in bytes of the amount of memory that a driver needs for its parameters and local data.
Address of driver data area	Contains the address of the device driver data area that is used by the driver to store local data.
Address of I/O segment table	Contains the address of the I/O segment table.

Interfacing to Diagnostic Drivers

Overview

The network device contains routines to UNJAM the device and to run self-test routines, system test routines, console routines, and a shared diagnostic driver routine. Figure 2–9 shows how these pieces of code relate to each other.

Figure 2–9 Diagnostic Driver Console Support



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 do the following:

- Allocate memory for the driver data area.
- Allocate memory for the diagnostic function block or console function block.

Continued on next page

Overview (continued)

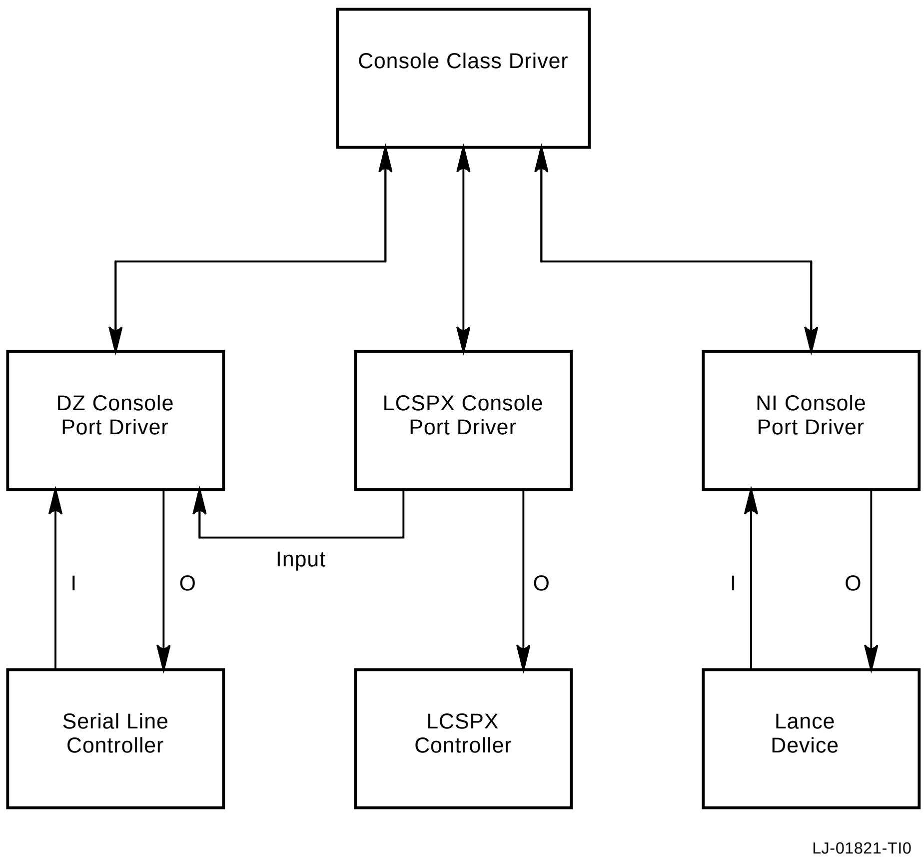
- Call the INIT_DRIVER routine with the following parameters:
  - Pointer to the I/O segment table
  - Pointer to the driver data area
  - Pointer to the driver function block or console function block
  - Pointer to the shared console interface area, or display zero if this is not a console driver
  - As many as two additional device-specific parameters

Console Driver Interface

Overview

The Model 90 console code is split into a class/port driver scheme. The class driver contains the main console functions, such as PUTCHAR and GETCHAR. The port drivers contain the device specific code required to support these functions. Figure 2–10 shows the division of the console function.

Figure 2–10 Model 90 Console Structure



Performing I/O

The console device can require either one channel or two channels to perform I/O to the console device. If the console device is a graphics terminal with a LK401 keyboard, the console program must interface with the serial line device driver for console input and interface with the graphics device driver for output from the console. If the console device is a terminal connected to a serial

Continued on next page

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 user application 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 PUTCHAR or GETCHAR functions, it must interface with the appropriate port driver to perform the needed function.

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 so the console drivers can run in both virtual and physical mode.

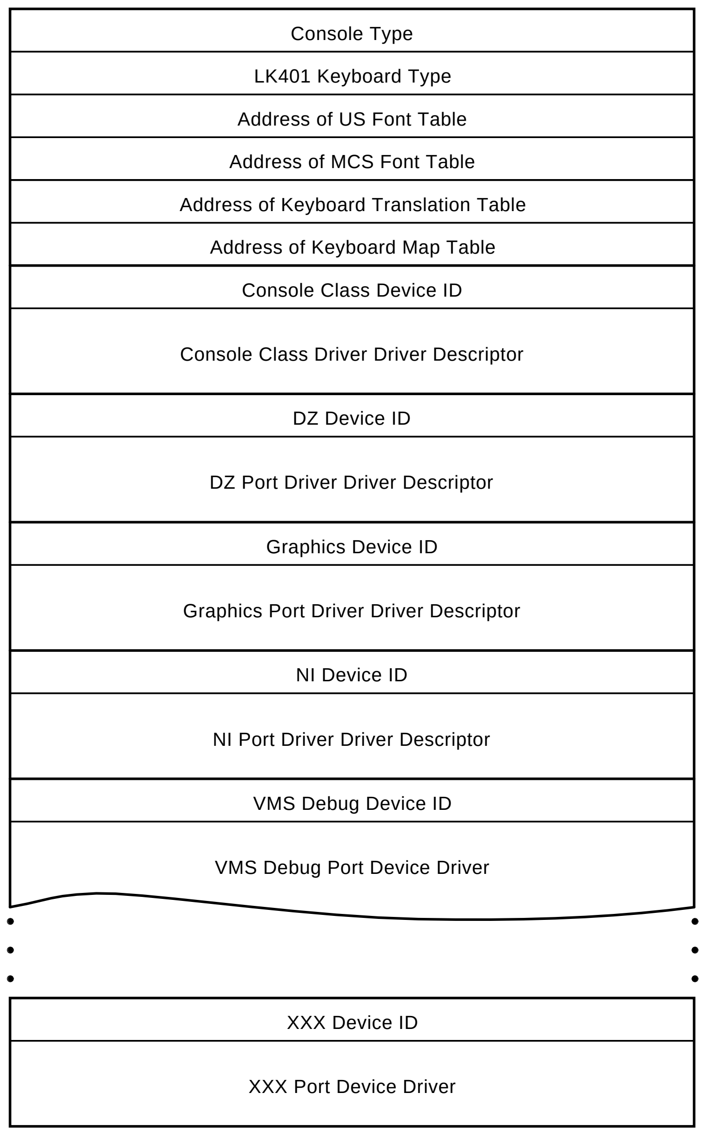
The SCIA is set up by the initialization code. After the SCIA is set up, the software can use this area to interface with the console class driver routine. The shared console performs the following:

- Raw character I/O to 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 to allow system software to map all console code and I/O space references into virtual memory as needed

Continued on next page

The SCIA data structure is shown in Figure 2–11.

Figure 2–11 SCIA Data Structure



LJ-01822-TI0

Continued on next page

Console Port Driver

The fields of the console port drivers driver descriptor are the same as the console class drivers driver descriptor, with one exception: the port driver contains pointers to the console port level routines. The port driver supports all functions whether or not the device supports console output only or console input /output. Figure 2–12 shows the function block of the port driver.

Figure 2–12 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-01823-TI0

Continued on next page

Chapter 3
System Configuration

Overview

In this Chapter

This chapter describes the system box used with the VAXstation 4000 Model 90 workstation and its components, cabling, and specifications. The topics covered in this chapter are:

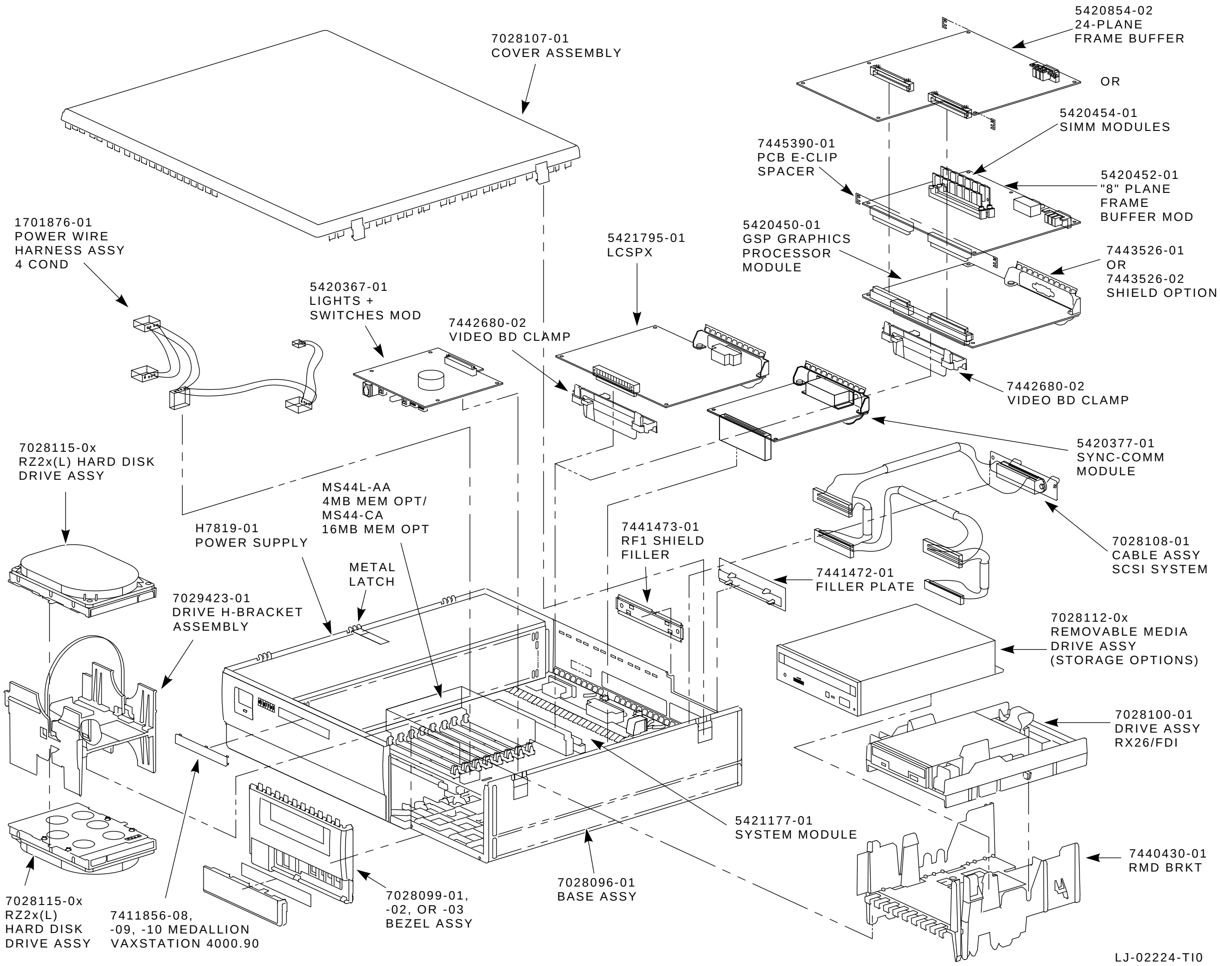
- System Box
- Mass Storage Device Areas
- Power Supply
- Internal Cabling
- System Box Control Panel
- I/O Panel
- System Box Specifications

System Box

Overview

The BA46 enclosure is used for desktop and floorstand installations of the VAXstation 4000 Model 90 system. Figure 3–1 shows the Model 90 system box and its components.

Figure 3–1 Model 90 System Box



Continued on next page

Mass Storage Device Areas

The Model 90 system box can hold two half-height, fixed media drives (8.9 cm [3.5 in]) in the H bracket (front left, Figure 3–1), and one half-height, removable media drive (13.3 cm [5.25 in] or 8.9 cm [3.5 in]) in another bracket (front right, Figure 3–1). The bottom drive in the H bracket is mounted upside down. The H bracket releases by a single latch and the other bracket uses two release points.

Power Supply

The system box has space for one power supply, the H7819-AA. The power supply provides protection against excess voltage, current, and temperature.

The power supply voltage connectors are located at the rear of the unit. The input connector is used to connect to a wall outlet and the output connector connects to the system monitor. The power switch and power OK LED are located on the front of the unit. Inside, is a -9.0 V LED. The supply also has two 12 V fans for cooling the system.

The power supply has an automatic voltage select (AVS) circuit to automatically select the ac input for 100 Vac to 120 Vac or 220 Vac to 240 Vac mode of operation. The power supply is a 174 watt unit.

Voltage (dc)	Ampere
+5.1	19.00
+3.3	4.89
+12.1	3.82
-12.0	0.69
-9.0	0.18

Power is supplied to the following components:

- System module (which supplies power for option modules installed in the system and mass storage devices)
- Cooling fans

Continued on next page

- AC power for system monitor

Power Supply Specifications

The power supply specifications are listed in the following tables.

Input 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	2.9 A (max.) power supply only 4.0 A (max.) AUX only	1.4 A (max.) power supply only 2.0 A (max.) AUX only
Inrush current	45.0 A (max) cold power supply only	45.0 A (max) cold power supply only
Power consumption (max.)	286 W	286 W

Output Specifications

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

Continued on next page

Parameter	Specifications		
	Minimum	Typical	Maximum
+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
-9.0 V (isolated) Long term	-8.55 V	-9.00 V	-9.45 V
+3.3 V Long term	+3.13 V	+3.3 V	+3.46 V
Load range			
	+3.3 V	3.20 A	6.39 A
	+5.1 V	2.8 A	19.52 A
	+12.1 V	0.18 A	3.82 A
	-12.0V	0.26 A	0.69 A
	-9.0 V	0.12 A	0.17 A
Ripple and noise			
1 Hz to 10 Hz	+3.3 V		
	+5.1 V	20.0 mV	30.0 mV
	+12.1 V	30.0 mV	50.0 mV
	-12.0 V	50.0 mV	70.0 mV
	-9.0 V		120.0 mV
			50.0 mV

Continued on next page

Parameter		Specifications	
	Minimum	Typical	Maximum
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 +3.3 V	30 mV 20 mV	50 mV 30 mV

Physical Dimensions

Weight	Height	Width	Depth
14.9 kg (33 lb)	6.99 cm (2.75 in)	11.18 cm (4.4 in)	38.10 cm (15.0 in)

Internal Cabling

The system box internal cabling is shown in Figure 3–2. Note that there is one SCSI cable and one dc power harness connecting to the drives.

NOTE

The power cable for half-height drives must be routed above the SCSI cable, as shown in Figure 3–2.

Table 3–1 lists internal system devices and their cable part numbers.

Continued on next page

Figure 3–2 Internal Cabling

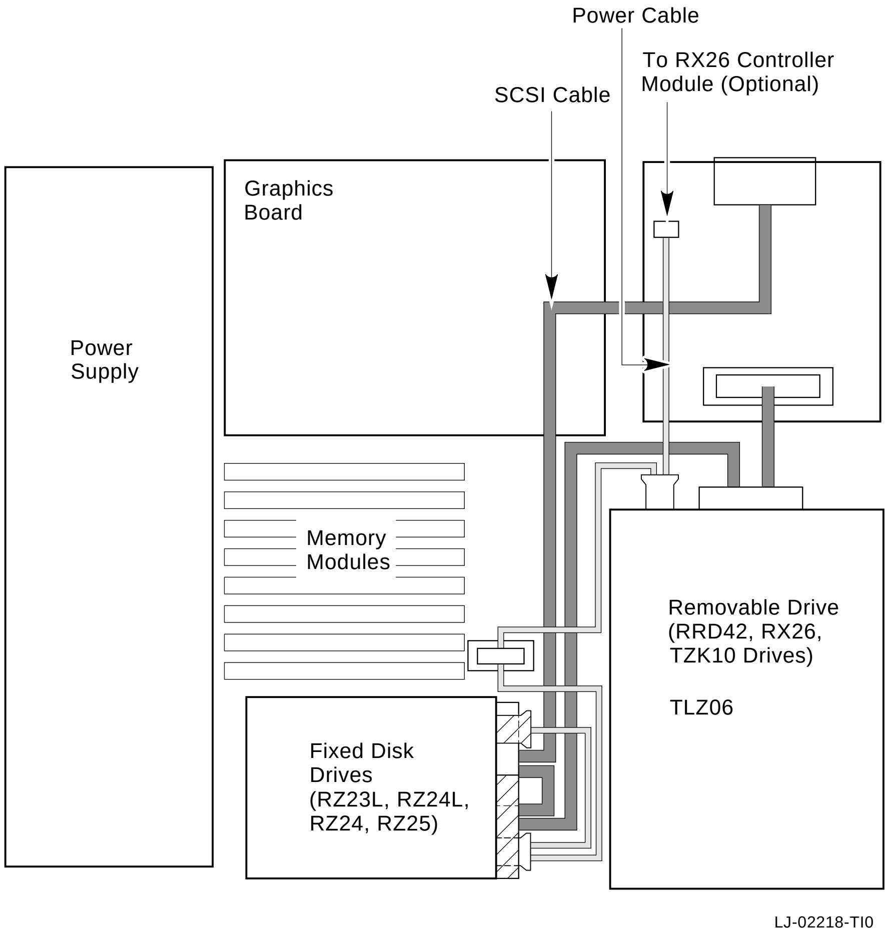


Table 3–1 Internal System Devices and Cables

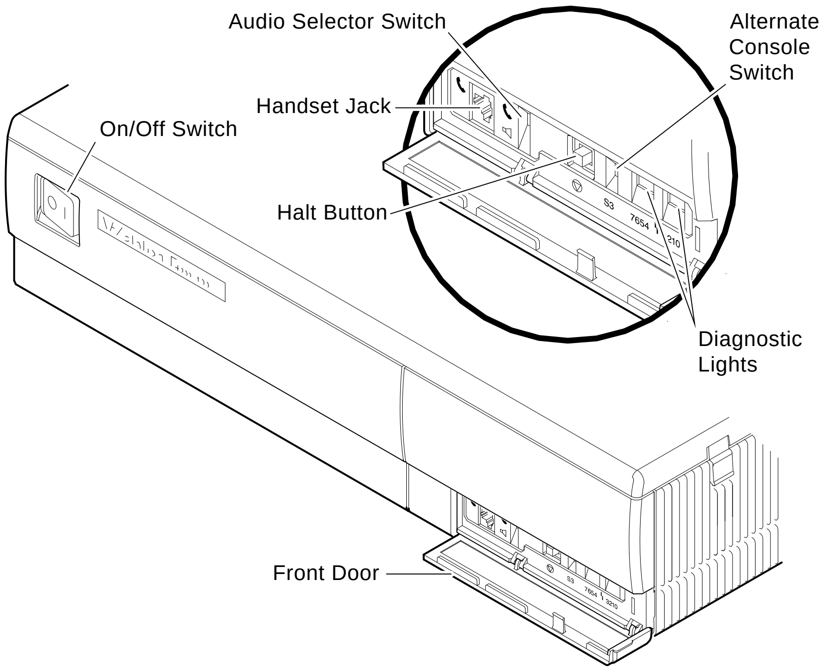
System Device	Cable PN	Description
3 SCSI Devices	17-02875-01	Four 50-pin IDC to 50-pin champ (external)
SCSI Device dc power harness	17-02876-01	Four 4-pin Mat-N-Loks to 4-pin mini

Continued on next page

System Box Control Panel

The controls and indicators for the system box are located behind the flip-down door on the front bezel (Figure 3–3) of the box.

Figure 3–3 System Box Control Panel



ON/OFF Switch This switch, located on the upper left side of the front bezel and labeled O I, controls ac power to the H7819-AA power supply. The switch does not affect the ac power outlet provided for add-on peripherals at the rear of the system box.

Power OK LED This small green indicator is visible on the upper left side of the front bezel. The LED is on when ac power is applied and the correct output voltage levels are present.

Handset jack This is a four-pin, MJ-type connector.

Audio selector switch This switch selects between speaker output and headset output.

Continued on next page

Alternate console switch This switch selects either the graphics terminal or printer/console port to be the system's console.

Halt button When actuated, this button sends a halt signal to the CPU module.

Diagnostic lights These lights are located on the right side of the control panel. These lights display two binary fields, which represent a two-digit hexadecimal diagnostic code.

I/O Panel

The I/O panel provides connectors to devices external to the system. The system configuration determines which external devices are connected to the panel. The external devices, shown in Figure 3–4, are as follows:

❶ Ethernet interface (left to right: standard port, network switch, and ThinWire port)

❷ RS232 communications port

❸ Printer/console port with a DEC423 connector (MMJ)

❹ Keyboard port

❺ Mouse port

❻ Remote keyboard/mouse port

❼ SCSI Port

❽ Option port (for the DSW21 communications device or TURBOchannel adapter option)

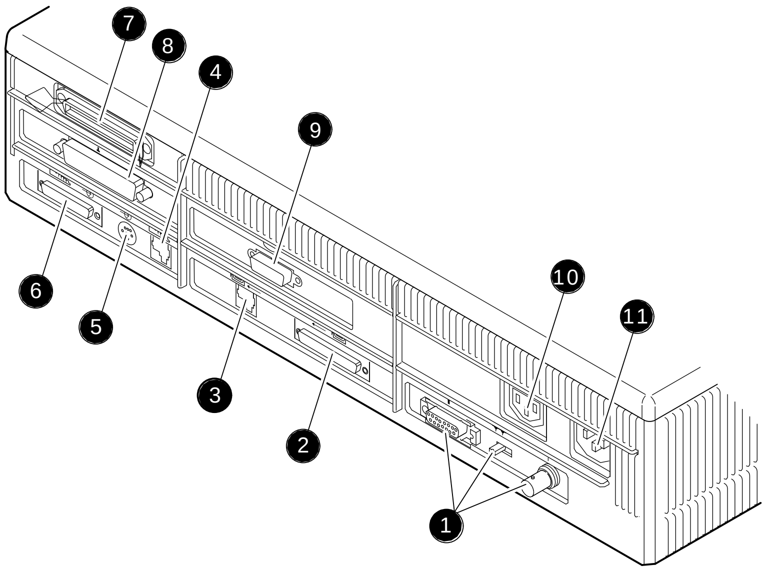
❾ Monitor video port

❿ Monitor power socket

⓫ AC Power socket

Continued on next page

Figure 3–4 Model 90 I/O Panel



Continued on next page

Table 3–2 lists external system devices and their cables.

Table 3–2 External System Devices and Cables

Device/Cable	Cable P/N	Description
System to monitor	BC27R-03	3 coax Dsub. to 3 BNC 39 in (99.1 cm)
Remote video	BC27R-10	3 coax Dsub. to 3 BNC 10 ft (3.0 m)
Remote LK/VSXXX (mouse/keyboard)	17-02640-01	15-pin Dsub. to LK/VSXXX 10 ft (3.0 m)
DSW21 communications device option	BC19x	50-pin Dsub. to x-pin[1] 2 ft (.61 m)
External SCSI	BC19J-03	50-pin champ to 50-pin champ 3 ft (.91 m)
AC Power input (to power supply)	17-00606-10	IEC to 3 prong AC 6 ft (1.83 m)
AC Power output (system to monitor)	17-00442-25	IEC to IEC, 39 in (99.1 cm)
TURBOchannel adapter option	—	FDDI, SCSI, NI, VME
Printer/Hardcopy cable	BC16E	—
Printer/Hardcopy cable adapter	H8571-A	—

[1]x=V=6, W=12, U=16, X=22, Q=24, or 26.
Numbers are the length in feet.

Continued on next page

System Box Specifications

The system box specifications are listed in the following tables. Table 3–3 lists the system box operating conditions and Table 3–4 lists the electrical specifications.

NOTE

The operating clearance is 8.9 cm (3.5 in) minimum on the sides and back of the system box. The service clearance is 15.2 cm (6 in) minimum on all sides of the box.

Table 3–3 System Box Operating Conditions

Temperature range	15° C to 32° C (59° F to 90° F)
Maximum rate of temperature change	11° C (20° F) per hour
Relative humidity	20% to 80% (with disk or tape drive)
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 3–4 System Box Electrical Specifications

Input voltage	100 Vac to 120 Vac 220 Vac to 240 Vac
Frequency range	47 Hz to 63 Hz

Chapter 4
Using the Console

Overview

In this Chapter

This chapter describes the system console commands and how to use alternate consoles. Diagnostic commands used to troubleshoot a system are described in Chapter 5. The following topics are covered in this chapter:

- System Console Commands
- Alternate Consoles

System Console Commands

Standard Console Commands

Standard console commands for the VAXstation 4000 Model 90 are listed by functional groups as follows:

- Operator assistance commands are HELP or the question mark (?), LOGIN, and REPEAT.
- SET/SHOW commands are used to set or examine system parameters and configuration.
- Memory commands include the DEPOSIT and EXAMINE commands.
- Processor control commands are BOOT, CONTINUE, UNJAM, START, and INITIALIZE commands.

Operator Assistance Commands

There are three operator assistance commands.

HELP or ?

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

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.

Continued on next page

Operator Assistance Commands (continued)

REPEAT

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

- BOOT, INIT, and UNJAM cannot be repeated.
- The commands being repeated are terminated by pressing Ctrl C.

Example:

This command repeats the memory test. Entering Ctrl/C terminates the test.

```
>>> REPEAT TEST MEM
    .
    .
    .
    CTRL C
>>>
```

Continued on next page

SET and SHOW Commands

The SET and SHOW commands are used to set and examine system parameters. Table 4–1 lists the SET/SHOW parameters and their meanings.

Table 4–1 SET/SHOW Parameters

Parameter	Meaning	SET	SHOW
BFLG	Default bootflag	X	X
BOOT	Default boot device	X	X
CONFIG	System configuration		X
DEVICE	Ethernet and SCSI devices information	–	X
DIAGENV	Diagnostic environment; must have loopback connector installed and mode set to 2 or 3	X	X
ETHER	Ethernet hardware address	–	X
ERROR	Errors from the last system or self-test	–	X
ESTAT	Status from the last system test	–	X
FBOOT	Power-up memory test flag	X	X
HALT	Halt recovery action	X	X
KBD	Keyboard language	X	X
MEM	Memory address range	–	X
MOP	MOP listener	X	X
PSE	Password enable	X	X
PSWD	Password	X	–

Continued on next page

Table 4–1 (Continued) SET/SHOW Parameters

Parameter	Meaning	SET	SHOW
SCSI	System SCSI ID	X	X
TRIGGER	Enable network console	X	X

SET and SHOW Command Syntax

The following is the syntax for the SET and SHOW commands and parameters:

Syntax:

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

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:

This example sets BFLG to conversational boot.

```
>>> SET BFLG 00000001
    BFLG = 00000001

>>> SHOW BFLG
    BLFG = 00000001
```

Continued on next page

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, type >>> SHOW DEVICE. The first column of the table (VMS/VMB) lists the device names.

Example:

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

>>> SHOW BOOT
    BOOT = DKA200
```

CONFIG

The CONFIG parameter displays the system configuration and device status.

- The SET command does not apply to this parameter.
- Use SHOW CONFIG for more information on SCSI devices.

Continued on next page

Example:

This example shows the information the SHOW CONFIG command displays.

```
>>> SHOW CONFIG
 KA49-A V0.0-051-V4.0
 08-00-2B-F3-31-03
 16 MB
 DEVNBR  DEVNAM  INFO
 ------  ------  ----
     1    NVR    OK
     2    LCSPX  OK
                 Highres - 8 Plane  4MPixel  FB - V1.0

     3    DZ     OK
     4    CACHE  OK
     5    MEM    OK
                 16MB 0A,0B,0C,0D = 4MB,  1E,1F,1G,1H = 0MB

     6    FPU    OK
     7     IT    OK
     8    SYS    OK
     9     NI    OK
     10   SCSI   OK
                 0-RZ24  1-RZ25  2-RRD42  6-INITR

     11   AUD    OK
     12   COMM   OK
```

Response	Meaning
KA49-A V0.0-051-V4.0	System type and firmware revision
08-00-2B-F3-31-03	Ethernet hardware address
16 MB	Total memory
1 NVR OK	Non-volatile RAM
3 DZ OK	Serial line controller
4 CACHE OK	Cache memory
5 MEM OK	Memory configuration
6 FPU OK	Floating point accelerator
7 IT OK	Interval timer
8 SYS OK	Other system functions

Continued on next page

Response	Meaning
9 NI OK	Ethernet
10 SCSI OK	SCSI and drives
11 AUD OK	Sound
12 COMM OK	DSW21 communications device

DEVICE

The DEVICE parameter displays SCSI and Ethernet device information.

The SET command does not apply to this parameter.

Example:

This example shows the information the SHOW DEVICE command displays.

```
>>> SHOW DEVICE
VMS/VMB    ADDR      DEVTYPE  NUMBYTES   RM/FX WP  DEVNAM  REV
-------    ----      -------  --------   ----- --  ------  ---
EZA0       08-00-2B-17-EA-FD
DKA0       A/0/0     DISK     209.81 MB  FX        RZ24    211B
DKA100     A/1/0     DISK     426.25 MB  FX        RZ25    0700
DKA200     A/2/0     RODISK   .........  RM    WP  RRD42   1.1A
..HostID..  A/6       INITR
```

Continued on next page

Response	Meaning
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 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.

Continued on next page

DIAGENV

The DIAGENV parameter determines the diagnostic environment that the diagnostics run under. Table 4–2 lists the diagnostic environments and their use.

Table 4–2 Diagnostic Environments

Mode	Usage
Customer	No setup is required. Default mode on power-up.
Digital Services	Provides a more thorough test than in customer mode. Some tests require loopback connectors for successful completion. Printer/communication port (TTA3) loopback (H3103); communication /printer port (TTA2) (RS232) loopback (29-24795)
Manufacturing	Some tests require loopback connectors for successful completion. **CAUTION** **Do not use this mode in the field. It can erase customer data.**
Loop on error Digital Services	The system loops on a test when an error occurs.
Loop on error Manufacturing	The system loops on a test when an error occurs. **CAUTION** **Do not use this mode in the field. It can erase customer data.**

Continued on next page

Setting the Diagnostic Environment

To set the diagnostic environment, enter a console command listed in Table 4–3. Note that all settings except DIAGENV 1 require a loopback connector be installed.

Table 4–3 SET DIAGENV Command

Command	Result
SET DIAGENV 1	Resets environment to customer mode.
SET DIAGENV 2	Sets environment to Digital Services mode.
SET DIAGENV 3	Sets environment to manufacturing mode.
SET DIAGENV 80000002	Sets environment to loop on error in Digital Services mode.
SET DIAGENV 80000003	Sets environment to loop on error in manufacturing mode.

Example:

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

>>> SHOW DIAGENV
    DIAGENV = 2
```

Continued on next page

ERROR

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

- Initialization (power-up) test
- Extended 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
```

ESTAT

The ESTAT parameter displays status information about the system test at the console prompt.

The SET command does not apply.

The following example shows the information the SHOW ESTAT command displays.

Example:

```
>>> SHOW ESTAT
```

Continued on next page

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
```

FBOOT

The FBOOT (fast boot) parameter determines whether the memory is tested when power is turned on. The test time is reduced when main memory is not tested.

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

Examples:

```
>>> SET FBOOT 1
    FBOOT = 1
>>> SHOW FBOOT
    FBOOT = 1
```

Continued on next page

HALT

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

Value	Meaning
1	System tries to restart the 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
```

KBD

The KBD parameter determines the keyboard language.

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

Example:

```
>>> SHOW KBD
    KBD = 4
```

In this next example, the keyboard language is set to 3, English.

```
>>> SET KBD
```

Continued on next page

```
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
KBD = 3
```

MEM

The MEM parameter displays the memory address range and the unavailable memory address range.

- The unavailable range is memory that is used by the console, 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
    -----------------
    00FBC000:00FFFFFF
```

Continued on next page

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).

Examples:

```
>>> SET MOP 1
    MOP = 00000001

>>> SHOW MOP
    MOP = 00000001
```

PSE and PSWD

The PSE parameter is the enable console password bit. This enables the console password to restrict access to the console.

The PSWD parameter is used to set the console password.

The following are key points to remember about passwords:

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

Example:

```
>>> SET PSWD
    PSDW0>>> xxxxxxxxxxxxxxxx
    PSWD1>>> 1234567890ABCDEF
    PSWD2>>> 1234567890ABCDEF
```

Continued on next page

Response	Meaning
PSDW0>>> xxxxxxxxxxxxxxxx	Old password (only if a password has been previously set)
PSWD1>>> 1234567890ABCDEF	New password
PSWD2>>> 1234567890ABCDEF	Verify new password

Example:

```
>>> SET PSE 1
    PSE = 1
```

NOTE

After PSE is set to 1, type LOGIN at the >>> prompt, and type the password at the PSWD0>>> prompt.

SCSI

This parameter is the SCSI ID for the system.

- The system SCSI ID should be set to 6.
- The system SCSI ID should never be changed.

Example:

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

Continued on next page

TRIGGER

The TRIGGER bit enables the entity-based module (EBM).

- With EBM and the NI listener enabled (TRIGGER = 1, MOP = 1) you can access the console or boot the system from a remote system.

Examples:

```
>>> SHOW TRIGGER
    TRIGGER = 00000000
>>> SET TRIGGER 1

    TRIGGER = 00000001
```

Memory Commands

The following table lists console commands that manipulate memory and registers.

Command	Function
DEPOSIT	Enters values into memory locations or registers.
EXAMINE	Displays the contents of memory locations or registers.

Both DEPOSIT and EXAMINE commands accept IPR names.

Examples:

```
>>> D ICSR 1
    P 0000 00D4   1000 0001
>>> E ICSR
    P 0000 00D4   1000 0001
```

Continued on next page

Deposit

The DEPOSIT command is used to write to memory locations from the console.

Syntax:

```
DEPOSIT /QUALIFIERS ADDRESS DATA
```

Table 4–4 lists the DEPOSIT command qualifiers and what each one specifies.

Table 4–4 DEPOSIT Command Qualifiers

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
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, for example, 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 hexadecimal.

Example:

This example writes the value 01234567 into six longword locations starting at address 00100000.

Continued on next page

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

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

EXAMINE

The EXAMINE command displays specific memory locations from the console.

Syntax:

```
EXAMINE/QUALIFIERS ADDRESS
```

Table 4–5 lists the qualifiers and what each one specifies.

Table 4–5 EXAMINE Command Qualifiers

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
Range of addresses	/N:X - Specifies that the X+1 locations be written.
Protection	/U - Unprotects a protected memory location, For example, the area of memory that the console uses.

Continued on next page

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
```

Processor Control Commands

Table 4–6 lists the processor control commands and their functions.

Table 4–6 Processor Control Commands

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

Continued on next page

Boot

The boot command starts the bootloader, which loads the operating system and starts it. The boot command causes the system to exit console mode and enter program mode. Table 4–7 lists boot commands and their meanings.

Syntax:

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

Table 4–7 BOOT Command Syntax

Term	Meaning
/qualifier	This optional qualifier sets the value for R5 for the bootloader. It is used to select a boot on the disk, or a conversational boot. The qualifier can be specified in either of the following formats: • /R5:XXXXXXXX • /XXXXXXXX
device,	This optional term is the primary boot device. If no device is specified, the system attempts to boot the default device. You can set the default boot device with the SET BOOT command.
second_device	This optional term is the device the bootloader tries to boot if the primary boot device fails.

Example:

This example shows the system performing a conversational boot from DKA200. If the system cannot boot from DKA200, it tries a conversational boot from DKA400.

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

Continued on next page

CONTINUE

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

Example:

```
>>> CONTINUE
```

UNJAM and INITIALIZE

The UNJAM command resets the system devices. The INITIALIZE command resets the processor registers. These commands together reset the system. UNJAM should be entered first.

Example:

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

After running the system exerciser the UNJAM command should be executed before running the self tests.

If the UNJAM command is not executed, the machine may be left in an unknown state. Running the self-test in this unknown state may result in a machine check error, requiring that the halt button be pressed to recover.

Continued on next page

START

The START command sets the program counter (PC) and starts 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
```

TEST

The TEST command invokes standard diagnostics, extended diagnostics, and utilities. Output from the diagnostics running from direct console commands is to the current console display device.

To test ranges of devices, the device number must be separated by a colon (:) or a blank space. A comma (,) or a blank space is used to separate device numbers or ranges of device numbers. A maximum of fifteen tests can be specified.

Either of the following command methods can be used:

```
>>> T 10:8,6,5:3
>>> T NI:IT,MMU,MEM:DZ
```

Alternate Consoles

Description

The Model 90 provides two ways to use alternate consoles if the graphics subsystem fails. Console commands can be entered on a terminal connected to the printer/communications port, communications/printer (RS232) port, or from either Ethernet (standard, ThinWire) network port. The two alternate consoles are described in the following sections.

Printer Port Console

To access the printer/communications port, communications /printer port console, verify that:

- The baud rate of the terminal connected to the printer port is set at 9600 baud.
- The alternate console switch (S3) located on the front panel is in the up position.

NOTE

The state of the alternate console switch is only read at power up. Changing the switch setting when the system is powering up has no effect until the system box is powered down and then powered up again.

Network Console

The system console can be accessed from the network. The network console allows you to remotely troubleshoot the system or provide a console when the other consoles are not available.

Some console tests and commands cause the network connection to be terminated because the commands use the network device, or they cause a connection timeout at the remote node.

To access the console you need:

- The hardware Ethernet address of the VAXstation computer.
- Access to a VMS operating system on the same Ethernet segment as the VAXstation 4000 computer (the systems cannot be separated by a bridge or router).

Continued on next page

- The following VAXstation 4000 computer parameters must be set:
  - A console password
  - MOP, TRIGGER

Once the Model 90 is set up, perform the following steps from the other VMS operating system to connect to the console:

1. Log in to a user account (no special privileges are required).
2. Type the commands as shown in bold type in this next example. An explanation of the system response is included after the exclamation mark.

```
$ MC NCP
NCP>SHOW KNOWN CIRCUITS

Known Circuit Volatile Summary as of 27-MAR-1991 13:50:02

 Circuit       State        Loopback        Adjacent
                              Name         Routing Node

 ISA-0         on                              25.14
NCP>CONNECT VIA ISA-0 SERVICE PASSWORD 1111111111111111 -
_ PHYSICAL ADDRESS AA-00-04-00-81-17
Console connected (press Ctrl/D when finished)

>>>(At the >>> prompt, type LOGIN and [Return] if the PSE was
set to 1.  At the PSWD0>>> prompt, type the password.)

>>> SHOW CONFIG

KA49-A V0.0-051-V4.0      ! System type and firmware revision
08-00-2B-1B-48-E3         ! Ethernet hardware address
16 MB                     ! Total memory

DEVNBR  DEVNAM  INFO
------  ------  ----
    1    NVR    OK        ! Non-volatile RAM
    2    LCSPX  OK
                Highres - 8 Plane  4MPixel  FB - V0.8
    3    DZ     OK        ! Serial line controller
    4    CACHE  OK        ! Cache memory
    5    MEM    OK        ! Memory configuration, 4 MB in
                            location 0A,0B,0C,0D

                 16MB 0A,0B,0C,0D= 4MB,  1E,1F,1G.1H, = 0MB
```

Continued on next page

```
    6    FPU    OK        ! Floating point accelerator
    7     IT    OK        ! Interval timer
    8    SYS    OK        ! Other system functions
    9     NI    OK        ! Ethernet
    10   SCSI   OK        ! SCSI and drives
                0-RZ24  1-RZ25  2-RRD42  6-INITR
    11   AUD    OK        ! Sound
    12   COMM   OK        ! DSW21 communications device
```

Ctrl/D

```
NCP> EXIT
$ LO
```

NOTE

Do not run memory test; it causes the console to hang and you will have to power down the system.

Chapter 5
Diagnostic Testing

Overview

In this Chapter

This chapter describes the diagnostic testing and test commands that are used with the Model 90 system. It includes procedures for setting up the diagnostic environments, running self-tests and system tests, and invoking utilities. The following topics are included in this chapter:

- Diagnostic Functions
- System Power-Up Test
- Displaying System Configuration
- Displaying Additional Error Information
- Setting Up the Diagnostic Environment
- Device Tests
- Self-Test Descriptions
- System Test Environment Configuration
- System Test Monitor
- Utilities
- Product Fault Management
- Using MOP Ethernet Functions
- Using Environmental Test Package
- FEPROM Update
- Updating Firmware by Ethernet
- Updating Firmware by Tape

Continued on next page

- Updating Firmware by Disk

Troubleshooting

For the troubleshooting process, it is assumed that problems are not caused by such things as faulty power cords or loose modules and connectors.

Actual error codes and their meanings are provided in Appendix A.

Diagnostic Functions

The system firmware provides the diagnostic functions listed in Table 5–1.

Table 5–1 Diagnostic Functions

Function	Description
Power-Up test	Tests initialization and all devices.
Extended self-test	Tests devices in the system sequentially with the TEST command.
System test	Tests all devices in the system interactively.
Utilities	Provide functions for visual screen test, mass storage devices, and the network listener.
Error reporting	Displays error messages on the console when errors are found during power-up tests, self-tests, and system tests.

System Power-Up Test

Overview

The system power-up self-test sequentially tests the devices in the system. This test takes about one minute to complete for a 16-MB base system. When the test successfully completes, the console prompt appears. Figure 5–1 shows the prompt.

Factors increasing the test time are:

- Additional memory

  Maximum memory configurations take approximately seven minutes to complete the self-test,

- Additional time is required for SCSI devices.

The time for the system power-up self-test to execute can be reduced by setting the FBOOT parameter to 1. The system then does not test memory on power-up.

Power-Up Sequence

Figure 5–1 and Figure 5–2 show the console screens that display when successful and unsuccessful power-up tests occur.

The following events summarize the power-up sequence:

- If the system finds a fatal error before initializing the console, the error can only be decoded using the eight error LEDs located on the lights and switches board.

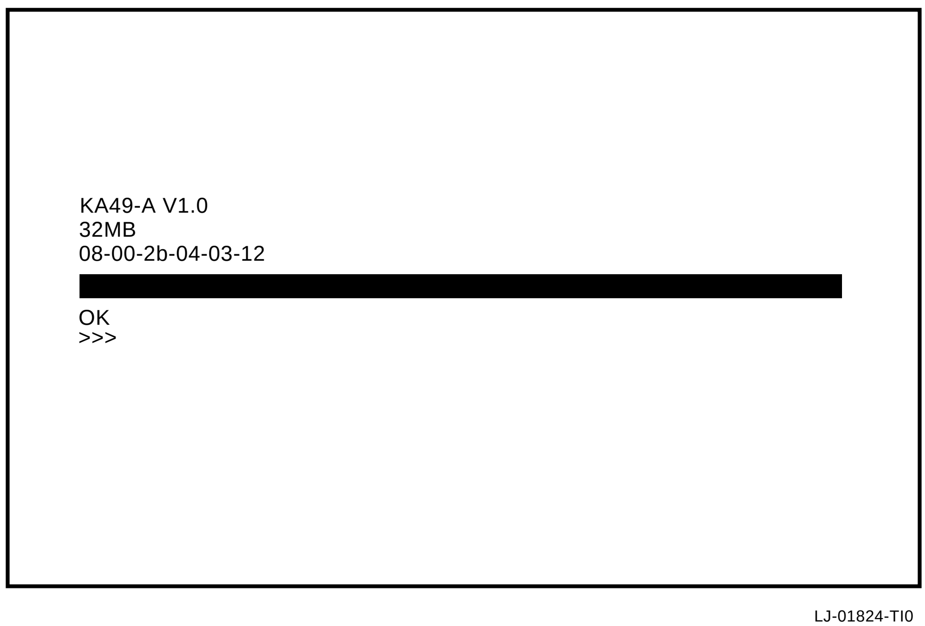
  Refer to Appendix A. If all of the error LEDs remain on, the ROM code did not start.

- If the graphics subsystem fails self-test, the system assumes that a console terminal is connected to the console/printer port.
- If the alternate console switch, located on the light and switches board, is set to alternate console (switch in the up position), the system assumes that a console terminal is connected to the console/printer port.

Continued on next page

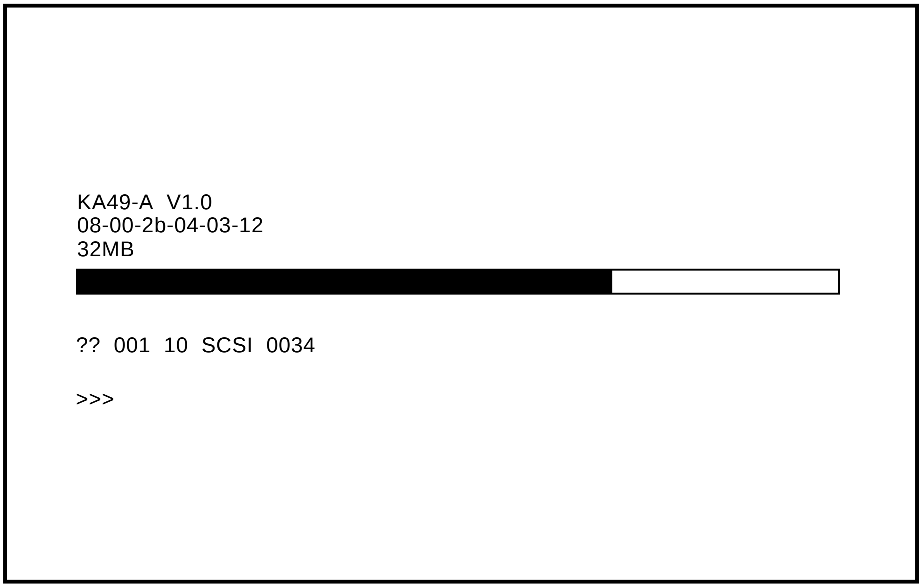
- At the end of the power-up sequence the system enters console mode, as indicated by the **>>>** prompt, if the HALT parameter is set to 3. If the HALT parameter is set to 1 or 2, the system tries to boot the default boot device.
- During initialization, the system is configured by creating the main configuration table (MCT) and the device configuration table (DCT).

Figure 5–1 Successful Power-Up



Continued on next page

Figure 5–2 Unsuccessful Power-Up



LJ-01825-TI0

Continued on next page

Error Information

The general format for error information is:

```
?? Fru  Dev_nbr  Dev_nam  Err_nbr
```

Format	Meaning
??	Two question marks (??) indicate a fatal error; one question mark (?) indicates a non-fatal error.
FRU	Identifies the field replaceable unit of the device that failed
Dev_nbr	The device number of the failing function
Dev_nam	The device mnemonic of the failing function
Err_nbr	A decimal number that corresponds to a specific device failure. This error code number indicates the function or the FRU that caused the error. Refer to Appendix A for error code descriptions.

Displaying System Configuration

Configuration Commands

The Model 90 firmware provides two configuration commands, SHOW DEVICE and SHOW CONFIG.

SHOW DEVICE determines what type of mass storage devices are included in the system.

SHOW CONFIG determines the overall system configuration.

SHOW DEVICE

The SHOW DEVICE command determines the presence of storage devices, such as a hard disk, diskette drives, or other drives.

Syntax:

```
>>>  SHOW DEVICE [Return]
```

The system displays information similar to that shown next.

Example:

```
>>> SHOW DEVICE
 VMS/VMB    ADDR      DEVTYPE  NUMBYTES    RM/FX  WP  DEVNAM  REV
 -------    ----      -------  --------    -----  --  ------  ---
 EZA0       08-00-2B-17-EA-FD
 DKA0       A/0/0     DISK     209.81 MB   FX         RZ24    211B
 DKA100     A/1/0     DISK     426.25 MB   FX         RZ25    0700
 DKA200     A/2/0     RODISK   ..........  RM     WP  RRD42   1.1A
..HostID..  A/6       INITR

                  A/DEVICE_ID/LOGICAL_ID

            The LOGICAL ID is always 0.
```

Column	Meaning
VMS/VMB	The operating system interpretation of what the device is. For example, with a VMS operating system, a fixed media drive with SCSI is interpreted as ID of 3 DKA300.

Continued on next page

Column	Meaning
ADDR	If the device is an Ethernet device, the ADDR column shows the Ethernet address. If the device is a system device, the first character shown is the bus (A or B); the second character represents the device number (3, 5, 6); the third field (00) is not used.
DEVTYPE	Device type, RODISK is a read-only disk (CDROM).
NUMBYTES	Drive capacity. Capacity is not 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.

To display TURBOchannel option configurations, you must use the TURBOchannel utility T/UT TCA.

SHOW CONFIG

The SHOW CONFIG command determines the presence of storage devices, the system type and firmware revision, the Ethernet hardware address, and the quantity of memory in the system.

Syntax:

```
>>> SHOW CONFIG [Return]
```

The system displays a configuration table similar to the one shown next.

Continued on next page

Example:

```
>>> SHOW CONFIG

KA49-A V0.0-051-V4.0
08-00-2B-F3-31-03
16 MB

DEVNBR  DEVNAM  INFO
------  ------  ----
    1    NVR    OK
    2    LCSPX  OK
                Highres - 8 Plane  4MPixel  FB - V0.8
    3    DZ     OK
    4    CACHE  OK
    5    MEM    OK

                 16MB 0A,0B,0C,0D = 4MB,  1E,1F,1G,1H, = 0MB

    6    FPU    OK
    7     IT    OK
    8    SYS    OK
    9     NI    OK
    10   SCSI   OK
                0-RZ24  1-RZ25  2-RRD42  6-INITR
    11   AUD    OK
    12   COMM   OK
```

Response	Meaning
KA49-A V0.0-051-V4.0	System type and firmware revision
08-00-2B-F3-31-03	Ethernet hardware address
16 MB	Total memory
3 DZ OK	Serial line controller
4 CACHE OK	Cache memory
5 MEM OK	Memory configuration
6 FPU OK	Floating point accelerator
7 IT OK	Interval timer
8 SYS OK	Other system functions
9 NI OK	Ethernet
10 SCSI OK	SCSI and drives

Continued on next page

Response	Meaning
11 AUD OK	Sound
12 COMM OK	DSW21 Communications device

To determine the quantity of memory in the system, note line 5, the MEM line, in the example. This line shows 4 Mbytes for each memory module in slots 0A, 0B, 0C, 0D.

TURBOchannel Configuration

The presence of a configuration object is optional. A given TURBOchannel option may or may not have a configuration function. No error occurs if an option has no configuration object. To run the configuration, at the console prompt enter:

```
T TC0 CNFG
```

Example:

The system displays information similar to that shown next.

```
>> t tc0 cnfg
    *emul: t tc0 cnfg
 DEC       PMAF-AA   T5.2P-     (fddi: 08-00-2b-27-4c-91)
>>
```

If, for example, you had a PMAZ SCSI controller, you could also see a list of the devices attached to the SCSI bus. The information provided here is option dependent.

Displaying Additional Error Information

Overview

Use the SHOW ERROR utility to obtain detailed error information about any failing device. To determine if an error has occurred on a particular device, type SHOW ERROR followed by the device number. To show all of the system errors, type SHOW ERROR.

Example:

This is an example of the system response if errors are present.

```
>>> SHOW ERROR
?? 001  03  DZ     0023
        001 0010   00000001 00000001 00003f30 00000001

?? 001  09  NI     0009
        001 0001   200e0000 00005555 00005515

>>>
```

The general format for error information is:

```
FRU  Dev_nbr  Dev_nam  Err_nbr
```

Format	Meaning
FRU	The field replaceable unit of the failed device
Dev_nbr	The number of the failing device
Dev_nam	The mnemonic of the failing device
Err_nbr	A hexadecimal number corresponding to a specific device failure. This number is used to reference various error tables when performing problem isolation and repair procedures.

Setting Up the Diagnostic Environment

Procedure

You must take the following actions before running a self-test:

Step	Action	Comment
1	Put the system in console mode.	Shut down the operating system or power up the system if you do not have the console prompt.
2	Attach loopbacks if required.	See Table 5–4.
3	Select the diagnostic environment.	See Table 5–3.

Selecting a Diagnostic Environment

Table 5–2 lists the three environments in which system diagnostics and utilities can run, and how to access each environment.

Table 5–2 Diagnostic Environments

Environment	To Access	Comment
Customer	Type SET DIAGENV 1 at the >>> prompt.	Requires no setup beyond installation of the system.
Digital Services	Type SET DIAGENV 2 at the >>> prompt.	Requires loopbacks and setup, but provides a more comprehensive test. The key utilities must be run in this environment.
Manufacturing	Type SET DIAGENV 3 at the >>> prompt.	For manufacturing use.

CAUTION Do not use the manufacturing environment for customers; it could destroy customer data.

Continued on next page

Setting the Diagnostic Environment

To set the diagnostic environment, enter one of the console commands listed in Table 5–3. Note that all diagnostic environments except DIAGENV 1 require a loopback connector.

Table 5–3 SET DIAGENV Command

Command	Result
SET DIAGENV 1	Resets environment to customer mode.
SET DIAGENV 2	Sets environment to Digital Services mode.
SET DIAGENV 3	Sets environment to manufacturing mode.
SET DIAGENV 80000001	Sets environment to loop on error in Digital Services mode.
SET DIAGENV 80000002	Sets environment to loop on error in manufacturing mode.

Example:

These are examples of setting and showing the diagnostic environment.

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

>>>SHOW DIAGENV
DIAGENV = 2
```

Device Tests

Device Test IDs and Mnemonics

Table 5–4 lists the device tests and corresponding mnemonics, decimal ID, binary ID, and loopback requirements.

Table 5–4 Device Test IDs and Mnemonics

Device	Mnemonic	Decimal ID	Binary ID	Loop back[1]
Non-Volatile RAM	NVR	1	0001	Yes
2D or Other graphics	LCSPX or xxx	2	0010	Yes
Serial line controller	DZ	3	0011	Yes
Cache system	CACHE	4	0100	Yes
Memory	MEM	5	0101	Yes
Floating point accelerator	FPU	6	0110	Yes
Interval timer	IT	7	0111	Yes
Other system board hardware	SYS	8	1000	Yes
Network interface	NI	9	1001	Yes
SCSI Controller	SCSI	10	1010	Yes
Sound chip	AUD	11	1011	Yes
Synchronous comm or other option	COMM or xxx	12	1100	Yes

[1]A loopback is required when DIAGENV=2

Continued on next page

Running Self-Tests

This section describes the test command interface used to run the self-test on a device. Table 5–4 lists the device IDs and mnemonics.

Device Test Syntax Rules

Table 5–5 describes the syntax used to run device self-tests.

Table 5–5 Device Test Syntax Rules

If you want to...	Then...	Example
Test one device	Type T and only one device number	T 2
Test a range of devices	Type T and the device numbers being tested, separated by a colon (:)	T 8:10
Separate individual tests or ranges of devices	Use a comma or a space	T 6,5
Run a self-test sequence continuously	Use the console REPEAT command. The REPEAT command executes a command continuously until you press Ctrl C at the console or until an error occurs.	>>> REPEAT T 1:4

Continued on next page

To test a range of devices, separate the device numbers being tested by a colon (:). To separate individual tests or ranges of devices, use a comma or a space.

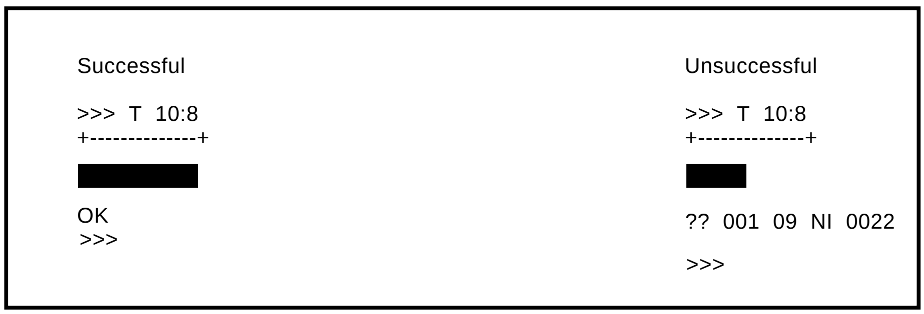
Example:

This example tests devices 8 through 10 device 6, then devices 3 through 5.

```
T 8:10,6,3:5
```

Figure 5–3 is an example of what the console displays when successful and unsuccessful self-tests have been run.

Figure 5–3 Successful and Unsuccessful Self-Test



LJ-01826-TI0

The format of the error message is identical to the power-up self-test error message shown in Figure 5–3.

Continued on next page

Devices can be specified individually, or as a range using the conventions listed in Table 5–5. The following table describes the order of execution for multiple device tests:

Table 5–6 Multiple Device Tests

Example	Description
T 10:8,6,5:3	Tests devices 10 through 8, then device 6, and then devices 5 through 3.

Self-Test Descriptions

This section describes the following self-tests. The test IDs and mnemonics are listed in Table 5–4.

- TOY/NVR
- LCSPX/SPXg/gt
- DZ
- SCSI DMA RAM, OBIT RAM, BCACHE
- Memory
- Floating Point Unit
- System
- Network Interconnect
- SCSI
- Audio
- Synchronous Communication
- TURBOchannel

NOTE

The self-tests are described in order by the decimal ID, contained in parentheses after the text name.

TOY/NVR Self-Test (T 1)

This is the non-volatile RAM and time-of-year clock self-test.

Setup Notes

- There are no extended error messages for the NVR test.
- Non-fatal errors, identified by a single question mark (?), indicate that the time in the NVR has not been set and is not a hardware fault.

The following tests are included:

- NVR Test

Continued on next page

Checks the NVR for valid data. If the NVR is not initialized, a register test is performed on all of the NVR locations and the NVR is initialized. If the NVR is initialized, *only* the temporary locations are tested in the NVR.

- TOY Test

  Checks to see if time has been set in the TOY. If not, a test of all the TOY registers is performed. This test writes/reads all possible values a TOY register can hold.

Refer to Table 5–5 and Table 5–6 for information on running all self-tests.

LCSPX/SPXg/gt Self-Test (T 2)

This is the self-test for 2D graphics or other graphics.

Setup Notes

- DIAGENV = 2 and requires a 29-24795 total loopback connector installed in the communication port.
- The front panel alternate console switch must be in the *down* position for the graphics console, or in the *up* position for the DZ port.
- This test takes approximately 20 seconds. Press HALT to gain control of the console.

The following tests are included:

- Register tests
- Scanproc tests
- VRAM Tests
- FIFO Tests
- Scanproc drawing operation tests
- Video output tests

Continued on next page

DZ Self-Test (T 3)

The DZ self-test tests the serial line controller.

Setup Notes

- The DZ Interrupt test fails in the Digital Services or manufacturing environments if no external loopbacks are present on the communication port.
- The mouse test fails if the mouse is not plugged in and the console is a video device.
- The LK401 test fails if the LK401 is not plugged in and the console is a video device.
- A keyboard and pointing device must be plugged in, or an error is reported.
- When you are in the Digital Services or manufacturing environments, loopbacks must be used on the standard communications port.

The following tests are included:

- Reset test

  Resets the DZ chip and sets up its lines to their default values. An error occurs if the device does not reset or the line parameters do not get set up correctly.
- Polled test

  Tests 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 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 that are not being used by the console device. The characters are expected to be looped back.

Continued on next page

- LK401 Test

  Checks for the presence of an LK401 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.

SCSI DMA RAM, OBIT RAM, BCACHE Tests (T 4)

This is the cache system self-test.

The following tests are included:

- DATA Store test

  Tests the data store in the Model 90 primary cache. A two-pass memory test is performed on the data store. This test performs a read/compare/complement/write in both the forward and reverse directions. The data store is accessed through the IPR address space.

- TAG Store test

  Tests the tag store in the Model 90 primary cache. A two-pass memory test is performed on the tag store. This test performs a read/compare/complement/write in both the forward and reverse directions. The tag store is accessed through the IPR address space.

Memory Self-Test (T 5)

This self-test is for the memory.

Setup Notes

If memory modules are not configured correctly, the memory test fails, and the memory modules are not configured. Memory modules must be installed in sets of 4, with the first set of memory modules in slots 0A, 0B, 0C and 0D, and the second set of memory modules in slots 1E, 1F, 1G and 1H. Refer to Chapter 6 for further information on memory module configuration.

Continued on next page

The following tests are included:

- Byte Mask test

  Checks the byte mask signals that are 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)

  Performs a read/compare/complement/write 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 test

  Fills all of memory with a pattern of 01h (an odd bit pattern) to verify that the parity bit can be changed. This pattern is read and verified. 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 Appendix A for a list of the memory test error codes and Appendix B for a list of the memory test diagnostic LED codes.

Floating Point Unit Self-Test (T 6)

The following tests are included:

- Instruction tests

  These tests are performed on the FPU. A failure occurs if the instruction produces unexpected results or an unexpected exception occurs during the execution of the instruction.

Continued on next page

Self-Test Descriptions, Continued

Interval Timer Self-Test (T 7)

The following test is included:

- 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.

System Self-Test (T 8)

The following test is included:

- System ROM test

  Checks the system ROMs one byte at a time to ensure that they contain the correct manufacturing check data and the correct checksum.

Network Interconnect Self-Test (T 9)

The NI self-test is for the network interface.

Setup Notes

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

The following tests are included:

- Network Address ROM test

  Verifies the 32-byte network address ROM, which contains the unique 6-byte network address along with 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.

- SGEC Register test

  Tests the address and data paths to the SGEC register address port (RAP) and the register data port (RDP) for each of the four control status registers (CSRs).

- SGEC Initialization test

Continued on next page

Sets up the SGEC data structures and initializes the SGEC chip, which causes the SGEC to perform a single word DMA read to the system memory.

- SGEC Internal Loopback test
- Verifies the correct operation of the SGEC transmitter and receiver during an internal loopback. It also verifies the burst-mode DMA read and write on non-word-aligned data buffers for packets of different lengths and data patterns.
- SGEC Interrupt test

  Enables, forces, and services the SGEC interrupts for initialization, transmission, and reception using internal loopback.
- SGEC CRC test

  Tests the SGEC CRC generation on transmission. It checks for detection of a bad CRC on reception using internal loopback.
- SGEC Receive MISS/BUFF test

  Checks SGEC operation for missed packets and buffer error during reception with internal loopback.
- SGEC Collision test

  Verifies collision detection and retry during transmission with internal loopback.
- SGEC Address Filtering test

  Tests the SGEC receiver address filtering for broadcast, promiscuous, and null destinations during internal loopback.

Continued on next page

SCSI Self-Test (T 10)

The SCSI self-test is for the SCSI controller.

Setup Notes

- CDROM devices fail in extended mode if media is not installed in removable media drives.
- If some or all devices do not show up in the configuration display after running the test, ensure that all devices have a unique ID number. Verify that power is supplied to all devices and the system module. Check to ensure that the SCSI cable is connected to the system module and devices, and that the bus is terminated.
- All expansion boxes must have power supplied *before* the system box is powered up, or the expansion box devices will not be configured.
- Common causes of errors or devices missing from the configuration include:

  — SCSI bus is not terminated.

  — All device IDs are not unique.

  — Internal cables to the drives are disconnected.

Continued on next page

The following tests are included:

- Register test

  Verifies that the 53C94A Controller Chip registers are fully functional. All read/write bits that can be written are written to. It also verifies the bits.

- Interrupt test

  Verifies the SCSI bits in the interrupt mask register, interrupt request register, and the interrupt clear register. A SCSI interrupt is 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 the data path of the controller to the 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.

Continued on next page

Audio Self-Test (T 11)

The audio self-test tests the sound chip.

The following tests are included:

- Register test

  Performs a write/read to registers in the 79C30 DSC chip.

- Interrupt test

  Enables interrupts, sends and receives an 8-byte packet by way of internal loopback.

- Audio test

  The tones are only heard if the switch on the front of the system for headphone/speaker is switched to speaker.

Synchronous Communication Self-Test (T 12)

This tests the synchronous communications or other options.

Setup Notes

If the Digital Services environment is used (SET DIAGENV 2), an H3199 loopback must be used.

The following tests are included:

- Checksum test

  Checks the checksum; read 128-KB ROM part and verify checksum.

- Static RAM test

  Checks the static RAM; write, verify, complement, verify 256-KB RAM.

- MC68302 test

  Performs the MC68302 test.

- RAM test

  Checks the RAM dual access; shared RAM bus arbitration.

Continued on next page

- EPROM test

  Checks the EPROM dual access; EPROM bus arbitration.

- Host Interrupt test

  Checks the host interrupt; verifies option can interrupt the CPU.

- Host Loopback test

  Checks the host buffer loopback and interrupt; moves data from the CPU to the communication option, loops it back and waits for an interrupt.

- Reset test

  Resets the communication options and waits for an interrupt.

TURBOchannel Adapter Self-Test (T 13)

Table 5–7 describes the tests executed during power-up TCA self-test. The power-up self-test is automatically invoked during the initial power-up of the VS4000 hardware and tests the TURBOchannel adapter in a sequential manner.

Table 5–7 TURBOchannel Adapter Self-Test (13)

Self-Test	Function
TCA Register	Tests the following functions of the CSR: • RESET (toggle and check bit in CSR) • TURBOchannel Timeout (read the TURBOchannel while holding RESET) • FIFO empty bit set and cleared by writing and reading FIFO • INV by doing an invalid map DMA

Continued on next page

Table 5–7 (Continued) TURBOchannel Adapter Self-Test (13)

Self-Test	Function
TCA Interrupt	Generates an interrupt. Tests to see if the Interrupt Service Routine (ISR) can be reached and then turns off interrupts and makes sure that the ISR is not reached.
TCA FIFO	Loads up the TCA FIFO at longwords with an increasing value, starting at 1 and ending with 512. The FIFO is then emptied and the count is checked against the read values from the FIFO. An error is reported if: • FIFO EMPTY does not get reset to 0 (empty) after reading 512. • The data read does not correspond to its count.
TCA Trigger	Tests DMA functionality through the Read Trigger test and through the Write Trigger test.
TCA Size Bus	Accesses TURBOchannel Slot 0 space to see if a device is there. If a TURBOchannel device is present, no TURBOchannel Timeout occurs. When the SHOW CONFIG is entered at the console prompt, the status of this test is stated as either: • `OPT PRES V1.0` • `NOOPT PRES V1.0`

System Test Environment Configuration

Overview

The system test is a strenuous test of the workstation. All devices are exercised simultaneously to find system interaction problems. The system test can be used to find faults that only occur when the system interaction is high.

The system test can be run in three environments, which you select with the SET DIAGENV command. Refer to Selecting a Diagnostic Environment for information on selecting an environment.

Important points to note about the system test are:

- Runs under a modified VAXELN kernel that is loaded from ROM.
- Causes a worst case environment in terms of system interaction, using maximum DMA and interrupts.

System Test Monitor

Running the System Test

This section describes the test command interface to use to run the system test on a device or on the whole system. Table 5–8 shows the general format for running the system test with the test command.

Table 5–8 Running the System Test Using the Test Command

Command	Action
T 100	Runs system test in the customer environment for two passes.
T 101	Runs system test in the Digital Services environment for two passes.
T 102	Runs system test in the Digital Services environment. Press Ctrl C to exit.
T 103[1]	Runs system test in the manufacturing environment. Press Ctrl C to exit.
T 106	Runs system test for specific devices. System prompts for specific device. 1=Yes, 0=No.

[1]This test writes over data on hard disks. Do not use in the customer system; it erases customer data.

NOTE

Ensure that loopback connectors are installed while in the Digital Services environment. SET DIAGENV 2 to run in Digital Services mode. (Table 4–2 and Table 5–3 contain descriptions and commands for the diagnostic environments.)

Examples:

The following examples show the response to system test commands.

Continued on next page

This example runs two passes of the system test in customer mode.

```
>>>T 100
```

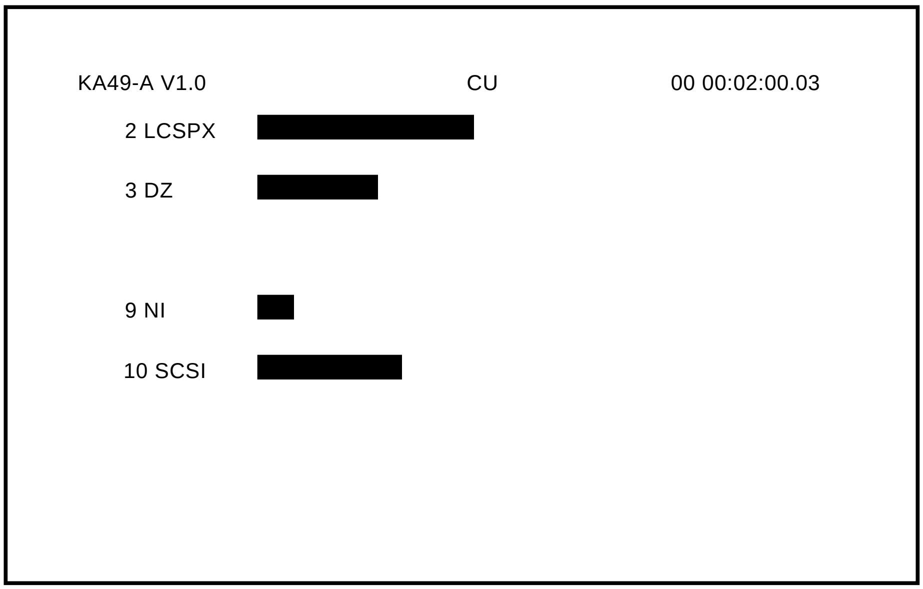
This example runs the system test for specific devices. The system prompts you for a specific device; 1 = yes; 0 = no.

```
>>>T 106
```

Display from the System Test

Figure 5–4 shows the response to a successful system test.

Figure 5–4 Successful System Test



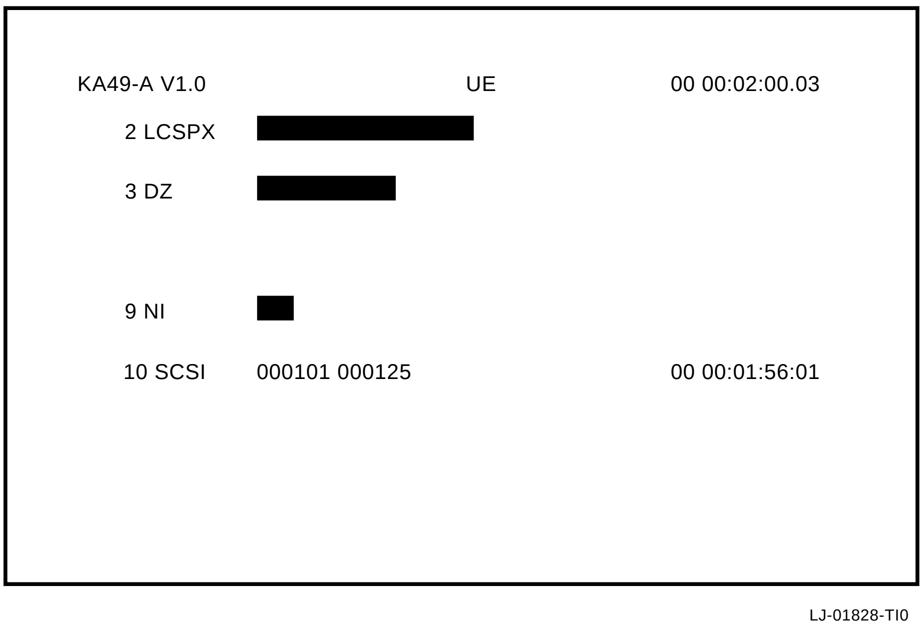
LJ-01827-TI0

Continued on next page

Response	Meaning
KA49-A	The system module ID.
V1.0	The ROM version number.
CU	The environment in which the test is running.
00 00:02:00.03	The CPU time used during testing.

Figure 5–5 shows the system response when the system test is unsuccessful.

Figure 5–5 Unsuccessful System Test



Continued on next page

When a device fails, the device status line in the response becomes the error message. You can get extended error information using the SHOW ERROR command. Interpretation of the error code is explained in Appendix A.

System Test Summary Screens

You can get summary information about the most recent system test using *either* of the following two methods:

Action	Result
Press Ctrl C.	Stops the system test and displays summary screens for the devices. The system prompts for each summary screen. It can take a few moments after you press Ctrl C to view the summary screens. This time is needed to clean up the interrupted system test.
Type >>> **SHOW ESTAT** at the console prompt.	Displays the summary from the most recent system test since power up. The system prompts for each summary screen.

Continued on next page

Each system diagnostic is also able to display extended status and error information on its own summary screen. Figure 5–6 shows an example of the summary screen with a SCSI failure.

Figure 5–6 Summary Screen

10 SCSI 000101 000125 00 00:01:56:01

targ	devnam	rds	wrts	snddia	sfterr
0	RZ24	123	123	35	0
1	RZ56	123	0	34	0
3	RRD42	123	0	35	0

Ext_err

00000045 00301004 45670000 00004543 08003589 98001234

LJ-00120-TI0

DZ System Test

This section describes the two modes used in the DZ System test.

NOTE

Ensure that loopback connectors are installed when in the Digital Services environment.

Functional Mode - Tests all lines other than the lines dedicated to the console. Loopback testing is done in all legal combinations of baud rate, parity, and character width. In Digital Services mode, external loopback testing is performed.

Continued on next page

Burst Mode - Performs in the same way as functional mode except the lines are tested at 19.2K baud, 8-bit characters, and parity is odd.

The following is a example of the DZ System test error. This error code means that not all characters were received on line 1 and line 2.

```
?? 001 3 DZ 0220
```

The following is an example of the DZ system test summary screen. The first column lists the serial line number that corresponds to the following devices:

Line 0	Keyboard port
Line 1	Mouse/Pointing device port
Line 2	Communications port
Line 3	Printer/Console port

```
Line L_Param Chr_Xmt Chr_Rec           Error
---- ------- ------- -------   ---------------------
0     1fc8     25      25        ***** No Err ***
1     1fc9     25      22        ?? Xfr Timedout
2     1fca     25      24        ?? Xfr Timedout
3     1fcd      0       0      * Not Tstd - Cons
```

Continued on next page

Network Interconnect System Test

This section explains the Network Interconnect (NI) System test.

Setup Notes

- The selected NI port must be connected to a network, or have a loopback installed.
- A more thorough test is done if the system is connected to a live network and MOP is enabled.
- Maximum testing of hardware occurs on a live network with MOP enabled.

The network system test tests the network port using external loopback packets. The packets vary in size from 1 byte of data to 32 bytes of data. The pattern for the packets comes from a set of 8 patterns: AA, 55, 34, CB, 99, 66, 43, and BC.

The following is an example of a network system test error; xxxx is the error code.

```
?? 9 NI 0001 xxxx 8:15:02
```

Continued on next page

SCSI System Test

This section describes the SCSI system test.

CAUTION

Do not use manufacturing mode in the field. This erases customer data on hard disks, excluding the system disk.

Setup Notes

- If some or all devices are not in the summary screen after running the system test, verify that all devices have unique ID numbers.
- Ensure that the power cable is connected to the devices and the system module.
- Ensure that the SCSI cable is connected to the system and the devices, and that the SCSI bus is terminated.
- When in Digital Services or manufacturing mode, media must be present in the removable media drives, otherwise an error occurs.
- When in manufacturing mode, removable media must be write protected when present in the drives, otherwise an error occurs.
- In order for destructive testing to be performed in Digital Services mode, a key pattern must be on the removable media disks and tapes.

Continued on next page

The following tests are included:

- Inquiries test

  Performs inquiries to find out which devices are connected to the SCSI bus.

- Size Bus test

  Spins up all the hard disk drives, ensures that the drives are ready (if not in customer mode), forces disk block sizes to 600 bytes, and obtains the capacity of the drives. This test also verifies that removable media are write protected; that the key pattern is present on removable media in Digital Services mode; and that VMS boot block is present on the hard disk drives when in manufacturing mode.

- Data Transfer test

  Verifies SCSI bus communication between the controller and available peripherals. It also verifies the data path of the controller to the memory.

- Device test

  Verifies the peripheral devices attached to the SCSI bus, and the DMA data path. Interrupts are enabled.

Continued on next page

Examples:

The following is an example of a successful SCSI system test message:

```
10 SCSI ################## 4
```

The following example shows an unsuccessful (error) SCSI system test message. The error is on ID 5.

```
?? 10 SCSI 150 0076 8:18:41
```

The following is an example of the SCSI system test summary message:

```
ADR  RDS   WRTS   ERR   FRU  CMD  PHS  INF  LBNSTRT  XFERSIZ
---  ---   ----   ---   ---  ---  ---  ---  -------  -------
1/0  10987   0
3/0  5643  5643                              36   1378      119
4/0  28    28     160   150  28    1
------------------------------------------------------------
4/0 XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
```

Data is destroyed on hard disks in the manufacturing environment, except for disks with factory installed software. Data is not destroyed on hard disks in the Digital Services environment.

All expansion boxes must have power supplied *before* the system box is powered up, or the expansion box devices will not be configured.

Common causes of errors or devices missing from the configuration include:

- SCSI Bus not terminated.
- All device IDs are not unique.
- Internal cables to the drives are disconnected.

The summary screen lists the test results by device ID.

When in the Digital Services environment, media must be present in all removable media devices.

Continued on next page

In order for writes to occur, a key pattern must be installed on writeable removable media (floppies and tapes). The key pattern is put on the media by the SCSI utilities. This is described in SCSI Utilities.

DSW21 Communication System Test

The system test loads and runs 68302 test/scheduler.

The following shows a DSW21 communication system test error:

```
 ?? 12 COMM 020 001E 0 00:00:15.00
```

Example:

The following is an example of the DSW21 communication system test summary:

```
COMM Test Summary Screen.........................................
-----------------------------------------------------------------
SCC1 Tx:         36 Rx:          36 Err:          0 INT-NOCABLE
SCC2 Tx:         36 Rx:          36 Err:          0 EXT-H3199
SCC3 Tx:         36 Rx:          36 Err:          0 INT-NOCABLE
Status Block:
-------------
FRU: 14 FTY: 6
CSR: 30 STA: 1
HWV:  2 SWV: 5
CC1:  F CC2: 0
MOD:  1 CNT: 1
CHN:  2 SEL: 2
PROT: 3 SCM: 9CF
```

Utilities

Overview

TEST commands run or display available utilities. Utilities can either be run with all parameters input at the command line or the utilities prompt for additional input. The format for a utility test that runs completely from the command line is shown next.

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

Format	Meaning
dev_nbr	The number of the device on which you want to run the utility. Only the graphics (2) and SCSI (10) utilities are rerun using this command.
util_nbr	The number of the utility you want to run. The devices can have more than one utility.
opt_p1,...,opt_pn	The optional parameters that could be needed by a utility. For example, a SCSI utility could need to know the target ID of the device on which to run the utility.

Running a Utility

If you are not familiar with the utilities a device has available, enter the TEST/UTILITY command followed by a device number or utility mnemonic (such as graphics or SCSI).

The utility prompts you for additional information, if needed. For example, to run an LCSPX (graphics) utility, follow the steps outlined in the next table.

Continued on next page

Step	Action	Comment
1	Enter T/UTIL 2	The LCSPX main utility routine displays a list of the available utilities (as shown in Figure 5–7) and then displays the prompt SPX_util>>>.
2	Enter the utility number that you want to run.	In Figure 5–7, utility 8 is selected.
3	Press Return at the prompt to exit the utility.	
4	Press the space bar to return to the utility menu after the utility has run.	Control returns to the console if an invalid utility number is entered. (Anything other than a string beginning with 0-9, or A-D).
5	Press Ctrl C or press the spacebar then Return after the test has completed, to exit the utility.	

Continued on next page

Figure 5–7 Utilities List

```
>>>  T/UT 2

0 - SPX-wh-scrn
1 - SPX-rd-scrn
2 - SPX-bl-scrn
3 - SPX-gn-scrn
4 - SPX-4c-cbar
5 - SPX-8c-cbar
6 - SPX-8g-gscl
7 - SPX-ee-scrn
8 - SPX-ci-xhct
9 - SPX-sc-hhhs

A - SPX-wh-half
B - SPX-rd-half
C - SPX-gn-half
D - SPX-bl-half

SPX_util>>>  8
```

LJ-02217-TI0

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

```
dev_nam OK ?
```

dev_nam is the name of the device whose contents will be lost.

Type the letters OK then press Return to start the utility. If you enter any other combination of keys, the control returns to the console.

Continued on next page

The console firmware provides the following utilities:

Utility Group	Functions
LCSPX/SPXg/gt (2)	Provides colored screens and geometric patterns.
NI	Use the SET and SHOW commands for: • MOP - NI listener • Trigger - Entity-Based Module (EBM)
SCSI (10)	Key utilities, floppy formatter, and disk eraser
TCA (13)	TURBOchannel configuration display

LCSPX Utility

The LCSPX utility provides fourteen screens of color bars and geometric programs. The following table describes how to use and exit the LCSPX utility:

Action	Command
Enter the LCSPX utility.	>>> TEST/UTIL 2
Display a screen.	Enter a command number at the LCSPX_util >>> prompt.
Go back to the SPX menu and clear the screen.	Press the space bar.
Exit the LCSPX utility.	Press [Return] at the SPX menu or press [Ctrl] [Y] while a pattern is active.

Continued on next page

LCSPX Utility Menu

The following is an example of the LCSPX utility menu. An explanation of the items is included to the right of the menu. See Figure 5–7.

```
0 - SPX-wh-scrn       !White screen
1 - SPX-rd-scrn       !Red screen
2 - SPX-bl-scrn       !Blue screen
3 - SPX-gr-scrn       !Green screen
4 - SPX-4c-cbar       !4 color bars
5 - SPX-8c-cbar       !8 color bars
6 - SPX-8g-gscl       !8 gray scale bars
7 - SPX-ee-scrn       !Screen of Es
8 - SPX-ci-xhct       !Cross hatch with circle
9 - SPX-sc-hhhs       !Screen of scrolling Hs
A - SPX-wh-half
B - SPX-rd-half
C - SPX-gn-half
D - SPX-bl-half
SPX_util >>>          !SPX utility prompt
```

SPXg/gt Utility Menu

The following example shows the SPXg/gt utility menu.

>>>**t/util 2**

```
 0 - SP3D-wh-scrn
 1 - SP3D-rd-scrn
 2 - SP3D-gn-scrn
 3 - SP3D-bl-scrn
 4 - SP3D-4c-cbar
 5 - SP3D-8c-cbar
 6 - SP3D-8g-gscl
 7 - SP3D-ee-scrn
 8 - SP3D-ci-scrn
 9 - SP3D-sc-hhhs
 SP3D_util >>>
```

Continued on next page

NI Utility

The NI utility is invoked by the SET or SHOW commands, not by the TEST/UTIL command. The NI utility functions are:

- SET/SHOW MOP - Enable/Disable NI listener
- SET/SHOW TRIGGER - Enable/Disable EBM

NI Listener

The NI listener can send and receive messages while the system is in console mode. The operation of the NI listener is transparent to the console, and NI listener errors are not reported. Listener failure can only be detected with the use of a network monitor device. The default is NI listener enabled.

Examples:

To enable the listener, type the following:

```
>>>SET MOP 1
```

To disable the listener, type the following:

```
>>>SET MOP 0
```

EBM

The entity-based module (EBM) is used to enable the remote console and remote boot. Remote boot allows another system to send a boot message to the workstation to start the bootloader.

Examples:

To enable the MOP boot type the following:

```
>>>SET TRIGGER 1
```

To disable the MOP boot type the following:

```
>>>SET TRIGGER 0
```

Continued on next page

SCSI Utilities

The SCSI utilities are described in the next table.

Table 5–9 SCSI Utilities

Utility	Function
SHOW DEVICE	This is a console command that displays information about the Ethernet controller and the SCSI drives attached to the system.
Floppy Key	This utility is used in Digital Services mode. The key utility writes a key on block 0 of the floppy media. The key is used by the System test in Digital Services mode. If the key is found on the media, the System test writes to the media during the test. If the key is not found during the System test, only reads are done to the media.
Tape Key	This utility is used in Digital Services mode. The key utility writes a key at the beginning of the tape media. The key is used by the system test in Digital Services mode. If the key is found on the media, the System Test writes to the media. If the key is not found, only reads are done to the media.
Hard Disk Erase	This utility erases all data from a hard disk. The pattern AA (hexadecimal) is written to all bytes on the disk. Any bad blocks are revectored.
Floppy Formatter	This utility formats a floppy disk and erases it.

Continued on next page

Invoking SCSI Utilities

The next table describes how to invoke the SCSI utilities.

Table 5–10 Invoking SCSI Utilities

Step	Action	Result
1	Enter the T/UT SCSI command.	Displays the SCSI Utility Menu.
2	Enter the utility number.	Selects the utility.
3	Enter the SCSI ID.	Selects the drive.
4	Enter the SCSI LUN (always 0).	Logical unit number (LUN).
5	Enter OK if requested.	Verifies action for formatter and erases the utilities.

SCSI Utility Menu

This section shows a SCSI Utility sample session.

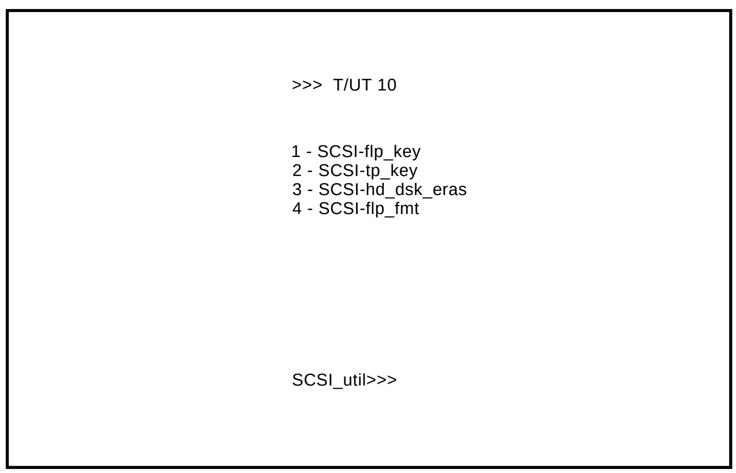
```
>>>T/UT 10

1 - SCSI-flp_key
2 - SCSI-tp_key
3 - SCSI-hd_dis_eras
4 - SCSI-flp_fmt

SCSI_util>>>3
SCSI_id(0-7)>>>5
SCSI_lun(0-7)>>>0

 SCSI HD_DSK_ERAS_UTIL

DKA500 OK ? ok

#############

SCSI_util_succ
```

Continued on next page

Command	Comment
T/UT 10	Enter this command (or T/UT SCSI)
1 - SCSI-flp_key	Floppy key utility.
2 - SCSI-tp_key	Tape key utility.
3 - SCSI-hd_dis_eras	Hard disk erase.
4 - SCSI-flp_fmt	Floppy formatter.
SCSI_util>>> 3	Enter the utility number.
SCSI_id(0-7)>>> 5	Enter the SCSI device ID.
SCSI_lun(0-7)>>> 0	Enter the SCSI logical unit number (always 0).
DKA500 OK ? ok	Confirm the action.
#############	Progress banner on ERASE and FORMAT only.
SCSI_util_succ	Utility finished.

The next figure show the response to the SCSI utility.

Figure 5–8 SCSI Utility Response



LJ-01469-TI0

Continued on next page

SCSI Utility Notes

Follow these guidelines about the SCSI utilities:

- Never run a SCSI utility on the Host ID (ID = 6).
- An error mnemonic of SCSI_E_type indicates you cannot perform the utility on the specified device, for example, running the tape key utility on a fixed disk.
- On the formatter and erase utilities, you must type OK at the DKAxxx OK prompt, or an error appears.
- An error occurs if an invalid device ID and logical unit number (always 0) are entered. Type SHOW DEVICE from the console prompt for the correct IDs.
- If a drive is not listed in the SHOW DEVICE table, verify the SCSI and power connections, and ensure that there are no duplicate device IDs.

See Appendix A for SCSI Utilities Error Messages.

TURBOchannel Adapter Utilities

The MIPS/REX emulator utility executes TURBOchannel option firmware. The emulator functions as follows:

- Each MIPS instruction that would normally be executed by a MIPS processor passes through the emulator software and executes.
- REX callback routines that would normally be provided by the DECstation console are either mapped one-to-one to their VAXstation console equivalents, or support routines are added where functions differ from those provided in the VAXstation computer.
- Allows the execution of canned tests and utilities for specific TURBOchannel options as if the user were sitting in front of a DECstation computer.

MIPS/REX Emulator

Invoking the Emulator

Enter the following command to invoke the MIPS/REX emulator:

```
>>> T/UT TCA
```

The system responds with the following message:

```
**KA49 TURBOCHANNEL REX EMULATOR**
>>
```

Available Option Script Functions

Enter the following command for a list of available script functions:

```
>>T TC0 LS
*emul: t tc0 ls
       28 | boot --> code
       28 | cnfg --> code
       28 | init --> code
       28 | t --> code
       256 | pst-q
       272 | pst-t
       288 | pst-m
       29264 | code*
```

Continued on next page

Option Self-Tests

Enter the following command for self-test availability:

```
>>T TC0/?
flash
eprom
68K
sram
rmap
phycsr
mac
elm
cam
nirom
intlpbk
iplsaf
pmccsr
rmc
pktmem
>>>
```

Invoking the Option Self-Test

The command syntax you use to invoke an individual option self-test is as follows:

Syntax:

```
>> T TC0/[Self-Test Name]
```

Example:

```
>>T TC0/FLASH
```

If the test runs successfully, the test returns you to the prompt.

Continued on next page

Option Error Message Example

The following is an example of an emulator self-test error message.

Example:

```
>> t tc0 flash 10

*emul: t tc0 flash 10
ERR-MIPS - ROM OBJECT REPORTED A SEVERE ERROR
>>
```

NOTE

Consult the option firmware specifications if you receive an error message that is dependent on the device.

Exiting the Emulator

Press Ctrl D to exit the emulator and access the Model 60 console prompt. Ctrl D is not echoed.

Example:

```
>> CTRL/D

bye

>>>
```

Overview

This section describes how errors are handled by the microcode and software, how the errors are logged, and how, through the symptom-directed diagnosis (SDD) tool, VAXsimPLUS, errors are brought to the attention of the user. This section also provides the service theory used to interpret error logs to isolate the FRU. Interpreting error logs to isolate the FRU is the primary method of diagnosis.

General Exception and Interrupt Handling

This section describes the first step of error notification: the errors are first handled by the microcode and then are dispatched to the VMS error handler.

The kernel uses the NVAX core chipset: NVAX CPU, NVAX memory controller (NMC), and NDAL-to-CDAL adapter (NCA).

Internal errors within the NVAX CPU result in machine check exceptions, through system control block (SCB) vector 004, or soft error interrupts at interrupt priority level (IPL) 1A, SCB vector 054 hex.

External errors to the NVAX CPU, which are detected by the NMC NCA, usually result in these chips posting an error condition to the NVAX CPU. The NVAX CPU then generates a machine check exception through SCB vector 004, hard error interrupt, IPL 1D, through SCB vector 060 (hex), or a soft error interrupt through SCB vector 054.

External errors to the NMC and NCA, which are detected by chips on the CDAL busses for transactions that originated by the NVAX CPU, are typically signaled back to the NCA adapter. The NCA adapter posts an error signal back to the NVAX CPU, which generates a machine check or high level interrupt.

In the case of direct memory access (DMA) transactions where the NCA or NMC detects the error, the errors are typically signaled back to the CDAL-Bus device, but not posted to the NVAX CPU. In these cases the CDAL-Bus device typically posts a device level interrupt to the NVAX CPU by way of the NCA. In almost all cases, the error state is latched by the NMC and NCA. Although

Continued on next page

these errors do not result in a machine check exception or high level interrupt (results in device level IPL 14–17 versus error level IPL 1A, 1D), the VMS machine check handler has a polling routine that searches for this state at one second intervals. This results in the host logging a polled error entry.

These conditions cover all of the cases that eventually are handled by the VMS error handler. The VMS error handler generates entries that correspond to the machine check exception, hard or soft error interrupt type, or polled error.

VMS Error Handling

Upon detection of a machine check exception, hard error interrupt, soft error interrupt or polled error, VMS performs the following actions:

- Snapshot the state of the kernel.
- Disable the caches in most entry points.
- Determine if instruction retry is possible if it is a machine check and if the machine check is recoverable.

  Instruction retry is possible if one of the following conditions is true:

  — If PCSTS <10>PTE_ER = 0:

    Verify that (ISTATE2 <07>VR = 1) or (PSL <27> FPD = 1), otherwise crash the system or process depending on PSL <25:24> Current Mode.

  — If PCSTS <10>PTE_ER = 1:

    Verify that (ISTATE2 <07>VR = 1) and (PSL <27>FPD = 0) and (PCSTS <09>PTE_ER_WR = 0), otherwise crash the system.

  ISTATE2 is a longword in the machine check stack frame at offset (SP)+24; PSL is a longword in the machine check stack frame at offset (SP)+32; VR is the VAX restart flag; and FPD is the first part done flag.

Continued on next page

- Determine if the threshold has been exceeded for various errors (typically the threshold is exceeded if three errors occur within a 10 minute interval).
- If the threshold has been exceeded for a particular type of cache error, mark a flag that signifies that this resource is to be disabled (the cache will be disabled in most, but not all, cases).
- Update the SYSTAT software register with results of error /fault handling.
- For memory uncorrectable error correction code (ECC) errors:
  - If machine check, mark page bad and attempt to replace page.
  - Fill in MEMCON software register with memory configuration and error status for use in FRU isolation.
- For memory single-bit correctable ECC errors:
  - Fill in corrected read data (CRD) entry FOOTPRINT with set, bank, and syndrome information for use in FRU isolation.
  - Update the CRD entry for time, address range, and count; fill the MEMCON software register with memory configuration information.
  - Scrub memory location for first occurrence of error within a particular footprint. If second or more occurrence within a footprint, mark page bad in hopes that page will be replaced later. Disable soft error logging for 10 minutes if threshold is exceeded.
  - Signify that CRD buffer be logged for the following events: system shutdown (operator shutdown or crash), hard single-cell address within footprint, multiple addresses within footprint, memory uncorrectable ECC error, or CRD buffer full.
- For ownership memory correctable ECC error, scrub location.
- Log error.

Continued on next page

- Crash process or system, dependent upon PSL (current mode) with a fatal bugcheck for the following situations:
  - Retry is not possible.
  - Memory page could not be replaced for uncorrectable ECC memory error.
  - Uncorrectable tag store ECC errors present in Bcache.
  - Uncorrectable data store ECC errors present in Bcache for marked as OWNED.
  - Most INT60 errors.
  - Threshold is exceeded (except for cache errors).
  - A few other errors of the sort considered nonrecoverable are present.
- Disable cache(s) permanently if error threshold is exceeded.
- Flush and re-enable those caches which have been marked as good.
- Clear the error flags.
- Perform return from exception or interrupt (REI) to recover and restart or continue the instruction stream for the following situations:
  - Most INT54 errors.
  - Those INT60 and INT54 errors which result in bad ECC written to a memory location. (These errors can provide clues that the problem is not memory related.)
  - Machine check conditions where instruction retry is possible.
  - Memory uncorrectable ECC error where page replacement is possible and instruction retry is possible.
  - Threshold exceeded (for cache errors only).
  - Return from subroutine (RSB) and return from all polled errors.

Continued on next page

NOTE

The results of the VMS error handler may be preserved within the operating system session (for example, disabling a cache) but not across reboots.

Although the system can recover with cache disabled, the system performance is degraded because access time increases as available cache decreases.

VMS Error Logging and Event Log Entry Format

The VMS error handler for the kernel can generate six different entry types, as shown in Table 5–11. All error entry types, with the exception of correctable ECC memory errors, are logged immediately.

Table 5–11 VMS Error Handler Entry Types

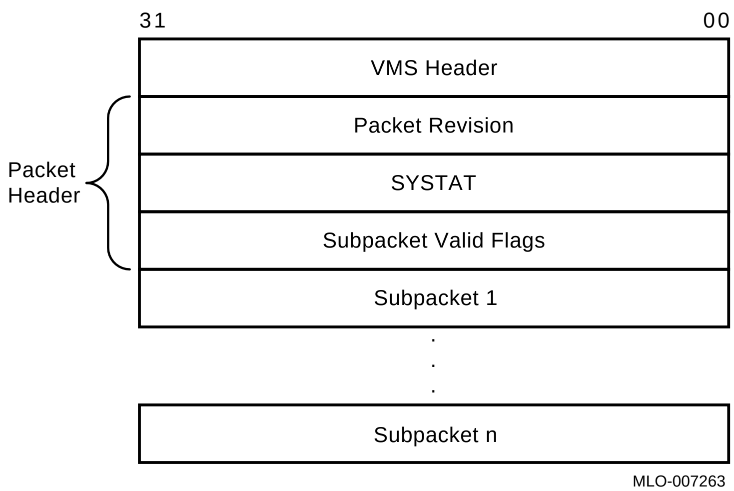
VMS Entry Type	Code	Description
EMB$C_MC	(002.)	Machine Check Exception SCB Vector 4, IPL 1F
EMB$C_SE	(006.)	Soft Error Interrupt Correctable ECC Memory Error SCB Vector 54, IPL 1A
EMB$C_INT54	(026.)	Soft Error Interrupt SCB Vector 54, IPL 1A
EMB$C_INT60	(027.)	Hard Error Interrupt 60 SCB Vector 60, IPL 1D
EMB$C_ POLLED	(044.)	Polled Errors No exception or interrupt generated by hardware.
EMB$C_ BUGCHECK		Fatal bugcheck Bugcheck Types: MACHINECHK ASYNCWRTER BADMCKCOD INCONSTATE UNXINTEXC

Continued on next page

Each entry consists of a VMS header, a packet header, and one or more subpackets (Figure 5–9). Entries can be of variable length based on the number of subpackets within the entry. The FLAGS software register in the packet header shows which subpackets are included within a given entry.

Refer to VMS Event Record Translation in this chapter for actual examples of the error and event logs described throughout this section.

Figure 5–9 Event Log Entry Format



Continued on next page

Machine Check Exception Entries

Machine check exception entries contain, at a minimum, a machine check stack frame subpacket (Figure 5–10).

Figure 5–10 Machine Check Stack Frame Subpacket

31 — 24	23 — 16	15 — 08	07 — 00	
00000018 (hex) byte count (not including this longword, PC or PSL)				0.
AST LVL | xxxxxx	Machine Check Code	xxxxxxxx	CPU ID	4. ISTATE1
INT. SYS register				8.
SAVEPC register				12.
VA register				16.
Q register				20.
RN | xx | Mo-de	Opcode	xxxxxxxx	V R | xxxxxxxx	24. ISTATE2
PC				28.
PSL				32.

MLO-007264

Continued on next page

Processor Register Subpacket

INT54, INT60, polled, and some machine check entries contain a processor register subpacket (Figure 5–11), which consists of some 40-plus hardware registers.

Figure 5–11 Processor Register Subpacket

31–00		
BPCR	(IPR D4)	0.
PAMODE	(IPR E7)	4.
MMEPTE	(IPR E9)	8.
MMESTS	(IPR EA)	12.
PCSCR	(IPR 7C)	16.
ICSR	(IPR D3)	20.
ECR	(IPR 7D)	24.
TBSTS	(IPR ED)	28.
PCCTL	(IPR F8)	32.
PCSTS	(IPR F4)	36.
CCTL	(IPR A0)	40.
BCEDSTS	(IPR A6)	44.
BCETSTS	(IPR A3)	48.
MESR	(2101.8044)	52.
MMCDSR	(2101.8048)	56.
CESR	(2102.0000)	60.
CMCDSR	(2102.0004)	64.
CEFSTS	(IPR AC)	68.
NESTS	(IPR AE)	72.
NEOCMD	(IPR B2)	76.
NEICMD	(IPR B8)	80.

31–00		
MMEADR	(IPR E8)	92.
VMAR	(IPR D0)	96.
TBADR	(IPR EC)	100.
PCADR	(IPR F2)	104.
BCEDIDX	(IPR A7)	108.
BCEDECC	(IPR A8)	112.
BCETIDX	(IPR A4)	116.
BCETAG	(IPR A5)	120.
MEAR	(2101.8040)	124.
MOAMR	(2101.804C)	128.
CSEAR1	(2102.0008)	132.
CSEAR2	(2102.000C)	136.
CIOEAR1	(2102.0010)	140.
CIOEAR2	(2102.0014)	144.
CNEAR	(2102.0018)	148.
CEFDAR	(IPR AB)	152.
NEOADR	(IPR B0)	156.
NEDATHI	(IPR B4)	160.
NEDATLO	(IPR B6)	164.

LJ-02222-TI0

NOTE

The byte count, although part of the stack frame, is not included in the error log entry itself.

Continued on next page

Bugcheck Entries

Bugcheck entries generated by the VMS kernel error handler include the first 23 registers from the Processor register subpacket along with the Time-of-Day register (TODR) and other software context state.

Uncorrect ECC Memory Error Entries

Uncorrectable ECC memory error entries include a memory subpacket (Figure 5–12). The memory subpacket consists of MEMCON, which is a software register containing the memory configuration and error status used for FRU isolation, and MEMCONn, the hardware register that matched the error address in MEAR.

Figure 5–12 Memory Subpacket for ECC Memory Errors

31 — 00	
MEMCON	0.
MEMCONn (one longword from 2101.8000 - 2101.801C)	4.

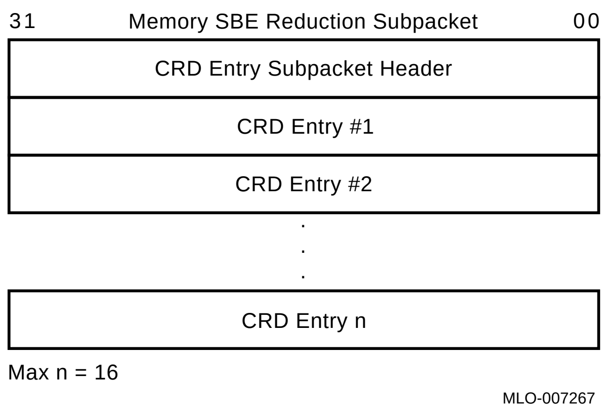
MLO-007266

Continued on next page

Correctable Memory Error Entries

Correctable memory error entries have a memory (single-bit error) SBE reduction subpacket (Figure 5–13). This subpacket, unlike all others, is of variable length. It consists solely of software registers from state maintained by the error handler, as well as hardware state transformed into a more usable format.

Figure 5–13 Memory SBE Reduction Subpacket (Correctable Memory Errors)



Correctable Reset Data Buffer

The VMS error handler maintains a correctable read data (CRD) buffer internally within memory that is flushed asynchronously for high-level events to the error log file. The CRD buffer and resultant error log entry are maintained and organized as follows:

- Each entry has a subpacket header (Figure 5–14) consisting of LOGGING REASON, PAGE MAPOUT CNT, MEMCON, VALID ENTRY CNT, and CURRENT ENTRY. MEMCON contains memory configuration information, but no error status as is done for the memory subpacket.

Continued on next page

Figure 5–14 Correctable Read Data Entry Subpacket Header

31 ... 00	Offset
Logging Reason	0.
Page Mapout CNT	4.
MEMCON	8.
Valid Entry CNT	12.
Current Entry	16.

MLO-007268

- Following the subpacket header are one to 16 fixed-length memory CRD entries (Figure 5–15). The number of memory CRD entries is shown in VALID ENTRY CNT. The entry that caused the report to be generated is in CURRENT ENTRY.

Figure 5–15 Correctable Read Data Entry

31 ... 00	Offset
Footprint	0.
Status	4.
CRD CNT	8.
Pages Marked Bad CNT	12.
First Event	16.
Last Event	24.
Lowest Address	32.
Highest Address	36.

MLO-007269

Continued on next page

Each memory CRD entry represents one unique DRAM within the memory subsystem. A unique set, bank, and syndrome are stored in footprint to construct a unique ID for the DRAM.

Rather than logging an error for each occurrence of a single symbol correctable ECC memory error, the VMS error handler maintains the CRD buffer; it creates a memory CRD entry for new footprints and updates an existing memory CRD entry for errors that occur within the range specified by the ID in FOOTPRINT. This reduces the amount of data logged overall without losing important information—errors are logged per unique failure mode rather than on a per error basis.

Each memory CRD entry consists of a FOOTPRINT, STATUS, CRD CNT, PAGE MAPOUT CNT, FIRST EVENT, LAST EVENT, LOWEST ADDRESS, and HIGHEST ADDRESS.

FIRST EVENT, LAST EVENT, LOWEST ADDRESS and HIGHEST ADDRESS are updated to show the range of time and addresses of errors which have occurred for a DRAM. CRD CNT is the total count per footprint. PAGE MAPOUT CNT is the number of pages that have been marked bad for a particular DRAM.

STATUS contains a record of the failure mode status of a particular DRAM over time. This in turn determines whether the CRD buffer is logged. For the first occurrence of an error within a particular DRAM, the memory location is scrubbed (corrected read data is read, then written back to the memory location) and CRD CNT is set to 1. Since most memory single-bit errors are transient due to alpha particles, logging of the CRD buffer is not done immediately for the first occurrence of an error within a DRAM. The CRD buffer, however, is logged at the time of system shutdown (operator or crash induced), or when a more severe memory subsystem error occurs.

Continued on next page

If the FOOTPRINT/DRAM experiences another error (CRD CNT > 1), VMS sets HARD SINGLE ADDRESS or MULTIPLE ADDRESSES along with SCRUBBED in STATUS. Scrubbing is no longer performed; instead, pages are marked bad. In this case, VMS logs the CRD buffer immediately. The CRD Buffer is also logged immediately if PAGE MAPOUT THRESHOLD EXCEEDED is set in SYSTAT as a result of pages being marked bad. The threshold is reached if more than one page per Mbyte of system memory is marked bad.

NOTE

CURRENT ENTRY is zero in the Memory SBE Reduction subpacket header if the CRD buffer was logged, not as a result of a HARD SINGLE ADDRESS or MULTIPLE ADDRESSES error in STATUS, but as a result of a memory uncorrectable ECC error shown as RELATED ERROR, or as a result of CRD BUFFER FULL or SYSTEM SHUTDOWN, all of which are shown under LOGGING REASON.

VMS Event Record Translation

The kernel error log entries are translated from binary to ASCII using the ANALYZE/ERROR command. To invoke the error log utility, enter the DCL command ANALYZE/ERROR_LOG.

Syntax:

```
ANALYZE_ERROR_LOG [/qualifier(s)] [file-spec] [,...]
```

Example:

```
$ ANALYZE/ERROR_LOG/INCLUDE=(CPU,MEMORY)/SINCE=TODAY
```

The error log utility translates the entry into the traditional three-column format. The first column shows the register mnemonics, the second column depicts the data in hex, and the last column shows the actual English translations.

Continued on next page

As in this example, the VMS error handler also provides support for the /INCLUDE qualifier, such that CPU and MEMORY error entries can be selectively translated.

Since most kernel errors are bounded to either the processor module/system board or memory modules, the individual error flags and fields are not covered by the service theory. Although these flags are generally not required to diagnose a system to the FRU, this information can be useful for component isolation.

ERF bit-to-text translation highlights all error flags that are set, and other significant state—these are displayed in capital letters in the third column. Otherwise, nothing is shown in the translation column. The translation rules also have qualifiers such that if the setting of an error flag causes other registers to be latched, the other registers are translated as well. For example, if a memory ECC error occurs, the syndrome and error address fields are latched as well. If such a field is valid, the translation is shown (for example, MEMORY ERROR ADDRESS); otherwise, no translation is provided.

Continued on next page

Interpreting CPU Faults Using ANALYZE/ERROR

If the following two conditions are satisfied, the most likely FRU is the CPU module.

❶ No memory subpacket is listed in the third column of the FLAGS register.

❷ NCA_CESR register bit <09>, CP2 IO error, is equal to zero in the KA49 register subpacket.

The example on the next page shows an abbreviated error log with numbers to highlight the key registers.

The FLAGS register is located in the packet header, which immediately follows the system identification header; the CESR and DSER registers are listed under the KA49 register subpacket.

CPU errors increment a VMS global counter, which can be viewed using the DCL command SHOW ERROR.

To determine if any resources have been disabled, for example, if cache has been disabled for the duration of the VMS session, examine the flags for the SYSTAT register in the packet header.

In this next example, a translation buffer data parity error latched in the TBSTS register caused a machine check exception error.

Continued on next page

```
V A X / V M S  SYSTEM ERROR REPORT    COMPILED 14-JAN-1992 18:55:52
                                                           PAGE   1.
******************************* ENTRY 1. ****************************
ERROR SEQUENCE 11.                          LOGGED ON:      SID 13000202
DATE/TIME 27-SEP-1991 14:40:10.85                     SYS_TYPE 01390601
SYSTEM UPTIME: 0 DAYS 00:12:12
SCS NODE: COUGAR                                              VAX/VMS V5.5-1

MACHINE CHECK  KA49-A  CPU FW REV# 2.  CONSOLE FW REV# 3.9
      REVISION         00000000
      SYSTAT           00000001
                                          ATTEMPTING RECOVERY
      FLAGS            00000003
                                          machine check stack frame
                                          KA49 subpacket     ❶

 STACK FRAME SUBPACKET

      ISTATE_1         80050000
                                          MACHINE CHECK FAULT CODE = 05(x)
                                          Current AST level  = 4(X)
                                          ASYNCHRONOUS HARDWARE ERROR
      .
      .
      .
      PSL              04140001
                                          c-bit
                                          executing on interrupt stack
                                          PSL previous mode = kernel
                                          PSL current mode = kernel
                                          first part done set

 KA49 REGISTER SUBPACKET

      BPCR             ECC80024
      .
      .
      .
      TBSTS            800001D3
                                          LOCK SET
                                          TRANSLATION BUFFER DATA PARITY
                                          ERROR
                                          em_latch invalid
                                          s5 command  = 1D(X)
                                          valid Ibox specifier ref. error
                                          stored
      .
      .
      .
      NCA_CSR             00000000 ❷
      .
      .
      .
      NEDATLO             E1000110
      .
      .
      .
                           00000020
                                          LOCAL MEMORY EXTERNAL ACCESS
                                          ENABLED
```

Continued on next page

NOTE

Ownership (O-bit) memory correctable or fatal errors (MESR <04> or MESR <03> of the Processor register subpacket set equal to 1 are processor module errors, NOT memory errors.

Next is an example showing the system respone to using the SHOW ERROR command using VMS.

```
$ SHOW ERROR
Device                            Error Count
CPU                                      1
MEMORY                                   1
PAB0:                                    1
PAA0:                                    1
PTA0:                                    1
RTA2:                                    1
$
```

Interpreting Memory Faults Using ANALYZE/ERROR

If "memory subpacket" or "memory sbe reduction subpacket" is listed in the third column of the FLAGS register, there is a problem with one or more of the memory modules or CPU module.

- The memory subpacket message indicates an uncorrectable ECC error.
- The memory SBE reduction subpacket message indicates correctable ECC errors. Refer to Correctable ECC Errors for instructions in isolating correctable ECC error problems.

NOTE

The memory fault interpretation procedures work only if the memory modules have been properly installed and configured. For example, memory modules should be installed in slots 0A, 0B, 0C, 0D or 1E, 1F, 1G, 1H if only one set of memory SIM modules are used, then in the unused slots if a second set of SIM modules are used. Also, if one set is made up of 4-MB SIM modules, and the other set is made up of 16-MB SIM modules, the front 16-MB SIM modules must be installed in SIM module connectors 0A, 0B, 0C, 0D.

Continued on next page

NOTE

Although the VMS error handler has built-in features to aid services in memory repair, good judgment is needed by the Service Engineer. It is essential to understand that in many, if not most cases, correctable ECC errors are transient in nature. No amount of repair will fix them, as generally there is nothing to be fixed.

Uncorrectable ECC Errors

For uncorrectable ECC errors, a memory subpacket is logged as indicated by memory subpacket listed in the third column of the FLAGS software register (❶). Also, the hardware register MESR <11> (❷) of the processor register subpacket is set equal to 1, and MEAR latches the error address (❻).

Examine the MEMCON software register (❸) under the memory subpacket. The MEMCON register provides memory configuration information and a MEMORY ERROR STATUS buffer (❹) that points to the memory module(s) that is the most likely FRU.

Replace the indicated memory module.

The VMS error handler marks each page bad and attempts page replacement, indicated in SYSTAT (❺). The DCL command SHOW MEMORY also indicates the result of VMS page replacement.

Uncorrectable memory errors increment the VMS global counter, which can be viewed using the DCL command SHOW ERROR.

NOTE

If register MESR <11> was set equal to 1, but MESR <19:12> syndrome equals 07, no memory subpacket will be logged as a result of incorrect check bits written to memory because of an NDAL bus parity error detected by the NMC. In short, this indicates a problem with the CPU module, not memory. There should be a previous entry with MESR <22>, NDAL data parity error set equal to 1.

NOTE

An uncorrectable ECC error due to a “disown write” results in a CRD entry like those for correctable ECC

Continued on next page

errors. The FOOTPRINT longword for this entry contains the message "Uncorrectable ECC errors due to disown write". The failing module should be replaced for this error.

```
V A X / V M S    SYSTEM ERROR REPORT     COMPILED  6-NOV-1991 10:16:49
                                                               PAGE   25.
******************************* ENTRY  13. *************************
ERROR SEQUENCE 2.                              LOGGED ON:    SID 13000202
DATE/TIME  4-OCT-1991 09:14:29.86                     SYS_TYPE 01390601
SYSTEM UPTIME: 0 DAYS 00:01:39
SCS NODE: COUGAR                                        VAX/VMS V5.5-1

INT54 ERROR  KA49-A  CPU FW REV# 2.  CONSOLE FW REV# 3.9
       REVISION         00000000
       SYSTAT           00000601
                                           ATTEMPTING RECOVERY
                                           PAGE MARKED BAD
                                           PAGE REPLACED   ❺
       FLAGS            00000006
                                           memory subpacket ❶
                                           KA49 subpacket

KA49 REGISTER SUBPACKET

       BPCR             ECC80000
       .
       .
       .
       MESR             80006800
                                           UNCORRECTABLE MEMORY ECC ERROR
                                           ❷
                                           ERROR SUMMARY
                                           MEMORY ERROR SYNDROME  = 06(X)
       .
       .
       .
       MEAR             02FFDC00
                                           main memory error address  =
                                           0BFF7000 ❻
                                           ndal commander id  = 00(X)
       .
       .
       .
       IPCR0            00000020
                                           LOCAL MEMORY EXTERNAL ACCESS
                                           ENABLED

 MEMORY SUBPACKET
```

Continued on next page

```
MEMCON          00010101
                                        MEMORY CONFIGURATION:
                                        MS44-AA Simm Memory Module (4MB)
                                        Loc 0A
                                        MS44-AA Simm Memory Module (4MB)
                                        Loc 0B
                                        MS44-AA Simm Memory Module (4MB)
                                        Loc 0C
                                        MS44-AA Simm Memory Module (4MB)
                                        Loc 0D
                                        _Total memory = 16MB
                                        _sets enabled = 00000001
                                        MEMORY ERROR STATUS:
                                        SIMM MEMORY MODULES: LOCATIONS 0A
                                        & 0B
                                        Set  = 0(X)
                                        Bank = B
MEMCON3         8B000003
                                       64 bit mode
                                       Base address valid
                                       RAM size = 1MB
                                       base address  = 0B(X)
```

```
$ SHOW MEMORY
               System Memory Resources on 21-FEB-1992 05:58:52.58

Physical Memory Usage (pages):  Total      Free      In Use    Modified
  Main Memory (128.00Mb)         262144    224527      28759     8858

  Bad Pages                        Total     Dynamic  I/O Errors   Static
                                     1          1            0         0

Slot Usage (slots):              Total      Free    Resident     Swapped
  Process Entry Slots             360       347        13            0
  Balance Set Slots               324       313        11            0

Fixed-Size Pool Areas
(packets):                        Total      Free    In Use       Size
  Small Packet (SRP) List         3067      2724       343         128
  I/O Request Packet (IRP) List  2263      2070       193         176
  Large Packet (LRP) List           87        61        26        1856

Dynamic Memory Usage (bytes):   Total      Free    In Use        Largest
  Nonpaged Dynamic Memory        1037824    503920   533904        473184
  Paged Dynamic Memory           1468416    561584   906832        560624

Paging File Usage (pages):                   Free     Reservable   Total
  DISK$VMS054-0:[SYS0.SYSEXE]PAGEFILE.SYS  300000    266070       300000

Of the physical pages in use, 24120 pages are permanently allocated
to VMS.
$
```

Using the VMS command ANALYZE/SYSTEM, you can associate a page that had been replaced (bad pages in SHOW MEMORY display) with the physical address in memory.

Continued on next page

In the next example, 5ffb8 (under the page frame number [PFN] column) is identified as the single page that has been replaced. The command EVAL 5ffb8 * 200 converts the PFN to a physical page address. The result is 0bff7000. (Bits <8:0> of the addresses may differ since the page address from EVAL always shows bits <8:0> as 0.

```
$ ANALYZE/SYSTEM

VAX/VMS System analyzer

SDA> SHOW PFN /BAD

Bad page list
-------------
Count:                    1
Lolimit:                 -1
High limit:     1073741824

PFN      PTE        BAK      REFCNT FLINK    BLINK    TYPE       STATE
         ADDRESS
----     --------- -------- ------ -----    -----    ---------- ------
0005FFB8 00000000  00000000  0     00000000 00000000 20 PROCESS 02
                                                                  BADLIST

SDA> EVAL 5ffb8 * 200
Hex = 0BFF7000   Decimal = 201289728
SDA> EXIT
$
```

Correctable ECC Errors

For correctable ECC errors, a single-bit error (SBE) memory subpacket is logged as indicated by memory SBE reduction subpacket listed in the third column of the FLAGS software register.

The memory SBE reduction subpacket header contains a CURRENT ENTRY register that displays the number of the Memory CRD Entry that caused the error notification. If CURRENT ENTRY > 0, examine which bits are set in the STATUS register for this entry. GENERATE REPORT should be set.

NOTE

If CURRENT ENTRY = 0, then the entry was logged for something other than a single-bit memory correctable error Footprint. You need to examine all of the memory CRD entries and footprints to determine the likely FRU.

Continued on next page

Look for the following:

- SCRUBBED

  If SCRUBBED is the only bit set in the STATUS register, memory modules should *not* generally be replaced.

  The kernel performs memory scrubbing of DRAM memory cells that may flip due to transient alpha particles. Scrubbing reads the corrected data and writes it back to the memory location.

- HARD SINGLE ADDRESS

  If the second occurrence of an error within a footprint is at the same address (LOWEST ADDRESS = HIGHEST ADDRESS then HARD SINGLE ADDRESS is set in STATUS along with SCRUBBED. Scrubbing is not tried after the first occurrence of any error within a particular footprint. The page is marked bad by VMS.

  Unlike uncorrectable ECC errors, the error handling code cannot indicate if the page has been replaced. To make a determination, use the DCL command SHOW MEMORY. If the page mapout threshold has not been reached ("PAGE MAPOUT THRESHOLD EXCEEDED" is not set in SYSTAT packet header register), the system should be restarted at a convenient time to allow the power-up self-test and ROM-based diagnostics to map out these pages. This can be done by entering TEST 0 at the console prompt, running an extended script TEST A9, or by powering down then powering up the system. In all cases, the diagnostic code marks the page bad for hard single address errors, as well as any uncorrectable ECC error by default.

  If there are many locations affected by hard single-cell errors, on the order of one or more pages for each megabyte of system memory, the memory module should be replaced. Use the console command SHOW MEMORY to indicate the number of bad pages for each module. For example, if the system contains 64 MB of main memory and there are 64 or more bad pages, the affected memory should be replaced.

Continued on next page

NOTE

Under VMS, the page mapout threshold is calculated automatically. If "PAGE MAPOUT THRESHOLD EXCEEDED" is set in SYSTAT, the failing memory module should be replaced.

In cases of a new memory module used for repair or as part of system installation, you can elect to replace the module rather than have diagnostics map them out, even if the threshold has not been reached for hard single-address errors.

- MULTIPLE ADDRESSES

  If the second occurrence of an error within a footprint is at a different address (LOWEST ADDRESS not equal to HIGHEST ADDRESS), MULTIPLE ADDRESSES are set in STATUS along with SCRUBBED. Scrubbing is attempted for this situation. In most cases, the failing memory module should be replaced regardless of the page mapout threshold.

If CRD BUFFER FULL is set in LOGGING REASON (located in the subpacket header) or PAGE MAPOUT THRESHOLD EXCEEDED is set in SYSTAT, the failing memory module should be replaced regardless of any thresholds.

For all cases (except when SCRUBBED is the only flag set in STATUS), isolate the offending memory by examining the translation in FOOTPRINT called MEMORY ERROR STATUS: The memory module is identified by its backplane position.

The memory SBE reduction subpacket header translates the MEMCON register for memory subsystem configuration information.

Unlike uncorrectable memory and CPU errors, the VMS global counter, as shown by the DCL command SHOW ERROR, is not incremented for correctable ECC errors unless it results in an error log entry for reasons other than system shutdown.

Continued on next page

NOTE

If footprints are being generated for more than one memory module, especially if they all have the same bit in error, the processor module, backplane, or other component could be the cause.

NOTE

An uncorrectable ECC error due to a “disown write”, results in a CRD entry similar to those for correctable ECC errors. The FOOTPRINT longword for this entry contains the message “Uncorrectable ECC errors due to disown write”. The failing module should be replaced for this error.

```
VAX/VMS    SYSTEM ERROR REPORT           COMPILED 21-NOV-1991 16:55:58
                       PAGE: 1.
**************************** ENTRY  4. *******************************
 ERROR SEQUENCE 2.                         LOGGED ON:        SID 13000202
 DATE/TIME  1-JUL-1992 13:55:10.68                     SYS_TYPE 04010002
 SYSTEM UPTIME: 0 DAYS 00:04:40
 SCS NODE:                                                 VAX/VMS T5.5-1X2

 CORRECTABLE MEMORY ERROR KA49  CPU Microcode Rev # 2.  CONSOLE FW
 REV# 0.1
                        Standard Microcode Patch    Patch Rev # 1.

       REVISION        00000000
       SYSTAT          00000000
       FLAGS           00000008
                                          memory sbe reduction subpacket

  MEMORY SBE REDUCTION SUBPACKET

       LOGGING REASON  00000001
                                          NORMAL REPORT

       PAGE MAPOUT CNT 00000001
       MEMCON          00010101
                                          MEMORY CONFIGURATION:
                                          MS44-AA Simm Memory Module
                                          (4MB) Loc 0A
                                          MS44-AA Simm Memory Module
                                          (4MB) Loc 0B
                                          MS44-AA Simm Memory Module
                                          (4MB) Loc 0C
                                          MS44-AA Simm Memory Module
                                          (4MB) Loc 0D
                                          _Total memory = 16MB
                                          _sets enabled = 00000001
                                          MEMORY ERROR STATUS:
                                          SIMM MEMORY MODULES: LOCATIONS
                                          0A & 0B
                                          Set  = 0(X)
                                          Bank = B
       VALID ENTRY CNT 00000001
                                          1.

       CURRENT ENTRY   00000001
                                          1.
```

Continued on next page

```
MEMORY CRD ENTRY 1.
       FOOTPRINT        0000003D
                                          MEMORY ERROR STATUS:
                                          _SIMM MEMORY MODULE:  LOCATION
                                          0A
                                          _set = 0.
                                          Bank = B
       VALID ENTRY CNT 00000001
                                          1.
       CURRENT ENTRY   00000001
                                          1.
MEMORY CRD ENTRY 1.
       FOOTPRINT        0000003D
                                          MEMORY ERROR STATUS:
                                          _SIMM MEMORY MODULE:  LOCATION
                                          0A
                                          _set = 0.
                                          ECC SYNDROME = 3D(X)
                                          _CORRECTED DATA BIT = 3.
       STATUS           00000059
                                          PAGE MARKED BAD
                                          HARD SINGLE ADDRESS
                                          scrubbed
                                          GENERATE REPORT
       CRD CNT          00000002
                                          2.
       PAGE MAPOUT CNT 00000001
                                          1.
       FIRST EVENT      54886EE0
                         0095CECE
                                           1-JUL-1992 13:55:10.67
       LAST EVENT       5489F580
                         0095CECE
                                           1-JUL-1992 13:55:10.68
       LOWEST ADDRESS  00300000
       HIGHEST ADDRESS 00300000
```

NOTE

Ownership (O-bit) memory correctable or fatal errors (MESR <04> or MESR <03> of the processor Register Subpacket set equal to 1 are processor module errors, NOT memory errors.

Interpreting DMA ⇔ Host Transaction Faults Using ANALYZE/ERROR

Some kernel errors may result in two or more entries being logged. If the SHAC DSSI adapters or the SGEC Ethernet controller or other CDAL device (residing on the processor module) encounter host main memory uncorrectable ECC errors, main memory NXMs or CDAL parity errors or timeouts, more than one entry results. Usually there is one polled error entry

Continued on next page

logged by the host, and one or more device attention and other assorted entries logged by the device drivers.

In these cases the processor module or one of the four memory modules are the most likely cause of the errors. Therefore, it is essential to analyze polled error entries, since a polled entry usually represents the source of the error versus other entries, which are aftereffects of the original error. This example provides an abbreviated error log for a polled error.

```
V A X / V M S   SYSTEM ERROR REPORT     COMPILED 17-FEB-1992 05:32:21
                                                                PAGE   1.
************************* ENTRY   2. ******************************
ERROR SEQUENCE 15.                      LOGGED ON:        SID 13000202
DATE/TIME 17-FEB-1992 05:22:00.90                    SYS_TYPE 01430701
SYSTEM UPTIME: 0 DAYS 00:27:48
SCS NODE:                                                VAX/VMS V5.5-1

POLLED ERROR  KA49-A  CPU FW REV# 2.  CONSOLE FW REV# 4.3
      REVISION        00000000
      SYSTAT          00000001
                                         ATTEMPTING RECOVERY
      FLAGS           00000006
                                         memory subpacket
                      KA49 subpacket

KA49 REGISTER SUBPACKET

      BPCR            ECC80024
      .
      .
      .
      MESR            8001B800
                                         UNCORRECTABLE MEMORY ECC ERROR
                                         ERROR SUMMARY
                                         MEMORY ERROR SYNDROME  = 1B(X)
      .
      .
      .
      MEAR            50000410
                                         main memory error address  =
                                         00001040
                                         ndal commander id  = 05(X)
      .
      .
      .
      IPCR0           00000020
                                  LOCAL MEMORY EXTERNAL ACCESS ENABLED

MEMORY SUBPACKET
```

Continued on next page

```
    MEMCON          00010101
                                          MEMORY CONFIGURATION:
                                          MS44-AA Simm Memory Module (4MB)
                                          Loc 0A
                                          MS44-AA Simm Memory Module (4MB)
                                          Loc 0B
                                          MS44-AA Simm Memory Module (4MB)
                                          Loc 0C
                                          MS44-AA Simm Memory Module (4MB)
                                          Loc 0D
                                          _Total memory = 16MB
                                          _sets enabled = 00000001
                                          MEMORY ERROR STATUS:
                                          SIMM MEMORY MODULES: LOCATIONS
                                          0A & 0B
                                          Set  = 0(X)
                                          Bank = B
     MEMCON0         80000003
                                        64 bit mode
                                        Base address valid
                                        RAM size = 1MB
                                        base address  = 00(X)

ANAL/ERR/OUT=TB1 TB1.ZPD
```

This example provides an example of a device attention entry.

```
V A X / V M S   SYSTEM ERROR REPORT  COMPILED 17-FEB-1992 05:32:21
                                                              PAGE   1.
 ************************** ENTRY   60. ***************************
 ERROR SEQUENCE 2.                        LOGGED ON:        SID 13000202
 DATE/TIME  8-JUL-1992 09:53:55.11                    SYS_TYPE 04010002
 SYSTEM UPTIME: 0 DAYS 00:00:14
 SCS NODE:                                                VAX/VMS T5.5-2X7

 DEVICE ATTENTION KA49  CPU Microcode Rev # 2.  CONSOLE FW REV# 0.1
                        Standard Microcode Patch    Patch Rev # 1.

 SCSI PORT SUB-SYSTEM, UNIT _PKA0:

        ERROR TYPE          0005
                                          PARITY ERROR DETECTED
        SCSI ID               02
                                          SCSI ID = 2.
        SCSI CMD        12000000
                            0000
        SCSI MSG              00
                                          COMMAND COMPLETE
        SCSI STATUS           00
                                          GOOD
        PORT ERROR CNT  00000000
                          00000000
                          00000000
                                          BUS BUSY CNT = 0.
                                          UNSOL RESET CNT = 0.
                                          UNSOL INTRPT CNT = 0.
        CONN ERROR CNT  00000000
                          00000000
                          00000000
                          00000000
                          00000000
```

Continued on next page

```
                      00000000
                      00000000
                                        ARB FAIL CNT = 0.
                                        SEL FAIL CNT = 0.
                                        PARITY ERR CNT = 0.
                                        PHASE ERR CNT = 0.
                                        BUS RESET CNT = 0.
                                        BUS ERROR CNT = 0.
                                        CONTROLLER ERROR CNT = 0.
SCSI RETRY CNT      00000000
                         0000
                                        ARB RETRY CNT = 0.
                                        SEL RETRY CNT = 0.
                                        BUSY RETRY CNT = 0.
PHASE QUEUE            0302
```

Using MOP Ethernet Functions

Console Requester

The console requester can receive LOOPED_DATA messages from the server by sending out a LOOP_DATA message using NCP to set this up.

Examples:

Identify the Ethernet adapter address for the system under test (system 1) and attempt to boot over the network.

```
***system 1 (system under test)***

>>>SHOW ETHERNET
Ethernet Adapter
-EZA0 (08-00-2B-28-18-2C)
>>>BOOT EZA0
(BOOT/R5:2 EZA0)

  2..
-EZA0
Retrying network bootstrap.
```

Unless the system is able to boot, the "Retrying network bootstrap" message displays every eight to 12 minutes.

Continued on next page

Identify the system's Ethernet circuit and circuit state, enter the SHOW KNOWN CIRCUITS command from the system conducting the test (system 2).

```
***system 2 (system conducting test)***

$ MCR NCP
NCP>SHOW KNOWN CIRCUITS

Known Circuit Volatile Summary as of 14-NOV-1991 16:01:53

   Circuit          State            Loopback     Adjacent
                                       Name      Routing Node

  ISA-0             on                          25.1023 (LAR25)

NCP>SET CIRCUIT ISA-0 STATE OFF
NCP>SET CIRCUIT ISA-0 SERVICE ENABLED
NCP>SET CIRCUIT ISA-0 STATE ON
NCP>LOOP CIRCUIT ISA-0 PHYSICAL ADDRESS 08-00-2B-28-18-2C
WITH ZEROES
NCP>EXIT
$
```

If the loopback message was received successfully, the NCP prompt reappears with no messages.

Loopback Assist Function

The following two examples show how to perform the loopback assist function using another node on the network as an assistant (system 3) and the system under test as the destination. Both the assistant and the system under test are attempting to boot from the network. You also need the physical address of the assistant node.

Examples:

```
***system #3 (loopback assistant)***

>>>SHOW ETHERNET
Ethernet Adapter
-EZA0 (08-00-2B-1E-76-9E)
>>>b eza0
(BOOT/R5:2 EZA0)

  2..
-EZA0
Retrying network bootstrap.

***system 2***
```

Continued on next page

```
NCP>LOOP CIRCUIT ISA-0 PHYSICAL ADDRESS 08-00-2b-28-18-2C
ASSISTANT PHYSICAL
ADDRESS 08-00-2B-1E-76-9E WITH MIXED COUNT 20 LENGTH 200 HELP FULL
NCP>
```

Instead of using the physical address, you could use the assistant node’s area address. When using the area address, system 3 is running VMS.

```
***system 3***
$MCR NCP

NCP>SHOW NODE KLATCH

Node Volatile Summary as of 27-FEB-1992 21:04:11

Executor node = 25.900 (KLATCH)

State                    = on
Identification           = DECnet-VAX V5.4-1,  VMS V5.4-2
Active links             = 2

NCP>SHOW KNOWN LINES CHARACTERISTICS

Known Line Volatile Characteristics as of 27-FEB-1992 11:20:50

Line = ISA-0

Receive buffers          = 6
Controller               = normal
Protocol                 = Ethernet
Service timer            = 4000
Hardware address         = 08-00-2B-1E-76-9E
Device buffer size       = 1498

NCP>SET CIRCUIT ISA-0 STATE OFF
NCP>SET CIRCUIT ISA-0 SERVICE ENABLED
NCP>SET CIRCUIT ISA-0 STATE ON
NCP>EXIT
$

***system 2***
$ MCR NCP
NCP>LOOP CIRCUIT ISA-0 PHYSICAL ADDRESS 08-00-2B-28-18-2C
ASSISTANT NODE 25.900
WITH MIXED COUNT 20 LENGTH 200 HELP FULL
NCP>EXIT
$
```

NOTE

The kernel’s Ethernet buffer is 1024 bytes deep for the LOOP functions and does not support the maximum 1500-byte transfer length.

To verify that the address is reaching this node, a remote node can examine the status of the periodic SYSTEM_IDs sent by the KA49 Ethernet server. The SYSTEM_ID is sent every 8–12 minutes using NCP as in the following example:

Continued on next page

```
***system 2***

$ MCR NCP
NCP>SET MODULE CONFIGURATOR CIRCUIT ISA-0 SURVEILLANCE ENABLED
NCP>SHOW MODULE CONFIGURATOR KNOWN CIRCUITS STATUS TO ETHER.LIS
NCP>EXIT
$ TYPE ETHER.LIS

Circuit name              = ISA-0
Surveillance flag         = enabled
Elapsed time              = 00:09:37
Physical address          = 08-00-2B-28-18-2C
Time of last report       = 27-Feb 11:50:34
Maintenance version       = V4.0.0
Function list             = Loop, Multi-block loader, Boot, Data link
                               counters
Hardware address          = 08-00-2B-28-18-2C
Device type               = ISA
```

Depending on your network, the file used to receive the output from the SHOW MODULE CONFIGURATOR command may contain many entries, most of which do not apply to the system you are testing. It is helpful to use an editor to search the file for the Ethernet hardware address of the system under test. Existence of the hardware address verifies that you are able to receive the address from the system under test.

User Environmental Test Package

Overview

When the user environmental test package (UETP) encounters an error, it reacts like a user program. It either returns an error message and continues, or it reports a fatal error and terminates the image or phase. In either case, UETP assumes the hardware is operating properly and it does not attempt to diagnose the error.

If the cause of an error is not readily apparent, use the following methods to diagnose the error:

- VMS Error Log Utility

  Run the error log utility to obtain a detailed report of hardware and system errors. Error log reports provide information about the state of the hardware device and I/O request at the time of each error.

- Diagnostic facilities

  Use the diagnostic facilities to test exhaustively a device or medium to isolate the source of the error.

Interpreting UETP Output

You can monitor the progress of UETP tests at the terminal from which they were started. This terminal always displays status information, such as messages that announce the beginning and end of each phase and messages that signal an error.

The tests send other types of output to various log files, depending on how you started the tests. The log files contain output generated by the test procedures. Even if UETP completes successfully, with no errors displayed at the terminal, it is good practice to check these log files for errors. Furthermore, when errors are displayed at the terminal, check the log files for more information about their origin and nature.

Continued on next page

UETP Log Files

UETP stores all information generated by all UETP tests and phases from its current run in one or more UETP.LOG files, and it stores the information from the previous run in one or more OLDUETP.LOG files. If a run of UETP involves multiple passes, there is one UETP.LOG or one OLDUETP.LOG file for each pass.

At the beginning of a run, UETP deletes all OLDUETP.LOG files, and renames any UETP.LOG files to OLDUETP.LOG. Then UETP creates a new UETP.LOG file and stores the information from the current pass in the new file. Subsequent passes of UETP create higher versions of UETP.LOG. Thus, at the end of a run of UETP that involves multiple passes, there is one UETP.LOG file for each pass. In producing the files UETP.LOG and OLDUETP.LOG, UETP provides the output from the two most recent runs.

If the run involves multiple passes, UETP.LOG contains information from all the passes. However, only information from the latest run is stored in this file. Information from the previous run is stored in a file named OLDUETP.LOG. Using these two files, UETP provides the output from its tests and phases from the two most recent runs.

The cluster test creates a NETSERVER.LOG file in SYS$TEST for each pass on each system included in the run. If the test is unable to report errors (for example, if the connection to another node is lost), the NETSERVER.LOG file on that node contains the result of the test run on that node. UETP does not purge or delete NETSERVER.LOG files; therefore, you must delete them occasionally to recover disk space.

If a UETP run does not complete normally, SYS$TEST might contain other log files. Ordinarily these log files are concatenated and placed within UETP.LOG. You can use any log files that appear on the system disk for error checking, but you must delete these log files before you run any new tests. You may delete these log files yourself or rerun the entire UETP, which checks for old UETP.LOG files and deletes them.

Continued on next page

Possible UETP Errors

This section lists some problems you might encounter while running UETP.

The following are the most common failures encountered while running UETP:

- Wrong quotas, privileges, or account
- UETINIT01 failure
- Ethernet device allocated or in use by another application
- Insufficient disk space
- Incorrect VAXcluster setup
- Problems during the load test
- DECnet–VAX error
- Lack of default access for the FAL object
- Errors logged but not displayed
- No PCB or swap slots
- Hangs
- Bug checks and machine checks

For more information refer to the *VAX 3520, 3540 VMS Installation and Operations (ZKS166)* manual.

FEPROM Firmware Update

Overview

KA49 firmware is located on four chips, each 128 KB by 8 bits of FLASH programmable EPROMs, for a total of 512 KB of ROM. (A FLASH EPROM [FEPROM] is a programmable read-only memory that uses electrical [bulk] erasure rather than ultraviolet erasure.)

FEPROMs provide nonvolatile storage of the CPU power-up diagnostics, console interface, and operating system primary bootstrap (VMB). An advantage of this technology is that the entire image in the FEPROMs may be erased, reprogrammed, and verified in place without removing the CPU module or replacing components.

A slight disadvantage to the FEPROM technology is that the entire part must be erased before reprogramming. Hence, there is a small "window of vulnerability" when the CPU has inoperable firmware. Normally, this window is less than 30 seconds. Nonetheless, an update should be allowed to execute undisturbed.

Firmware Update Utility

Firmware updates are provided through a package called the firmware update utility. A firmware update utility contains a bootable image, which can be booted from tape or Ethernet, that performs the FEPROM update.

NOTE

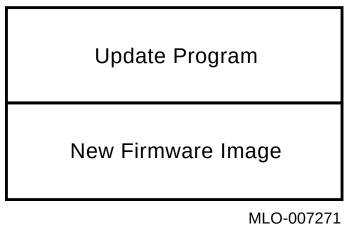
The NVAX CPU chip has an area called the patchable control store (PCS), which can be used to update the microcode for the CPU chip.

Updates to the PCS require a new version of the firmware. The utility may be run from either the alternate console or the graphics console. The output text will vary depending on the console used.

Continued on next page

A firmware update utility image consists of two parts: the update program and the new firmware, as shown in Figure 5–16. The update program uniformly programs, erases, reprograms, and verifies the entire FEPROM.

Figure 5–16 Firmware Update Utility Layout



Once the update has completed successfully, normal operation of the system may continue. The operator may then either halt or reset the system and reboot the operating system.

Preparing the Processor for an FEPROM Update

Complete the following steps to prepare the processor for an FEPROM update:

1. The system manager should shutdown the operating system.
2. Enter console mode by pressing the Halt button twice: in to halt the system, and out to enter console mode (>>>).

Continued on next page

Updating Firmware by Ethernet

To update firmware across the Ethernet, the “client” system (the target system to be updated) and the “server” system (the system that serves boot requests) must be on the same Ethernet segment. The maintenance operation protocol (MOP) is the transport used to copy the network image.

Use the following procedure to update firmware across the Ethernet:

Step	Action	Comment
1	Enable the server system’s NCP circuit. Use the following VMS commands: Line>	<circuit> is the system Ethernet circuit. Use the SHOW KNOWN CIRCUITS command to find the name of the circuit. **NOTE** **The SET CIRCUIT STATE OFF command brings down the system’s network.**

```
$ MCR NCP
NCP>SET CIRCUIT <circuit> STATE OFF

NCP>SET CIRCUIT <circuit> SERVICE ENABLED

NCP>SET CIRCUIT <circuit> STATE ON
```

Step	Action	Comment
2	Copy the file containing the updated code to the MOM$LOAD area on the server. Use the following command:	This procedure may require system privileges. <filename> is the Ethernet bootable filename provided in the release notes.

```
$ COPY <filename>.SYS MOM$LOAD:*.*
```

Continued on next page

Step	Action	Comment
3	On the client system, enter the command BOOT/100 EZ at the console prompt (>>>).	The system then prompts you for the file name. **NOTE Do *not* type the .SYS file extension when entering the Ethernet bootfile name. The MOP load protocol only supports 15-character filenames.**
4	After the FEPROM upgrade program is loaded, press Y at the prompt to start the FEPROM blast.	**CAUTION** **Once you enter the bootfile name, do not interrupt the FEPROM blasting program, as this can damage the CPU module. The program takes several minutes to complete.** **NOTE On systems with a VCB02 terminal, an abbreviated form of the following example appears.**
5	Power cycle the machine.	

Continued on next page

```
***** On Server System *****

$ MCR NCP
NCP>SET CIRCUIT ISA-0 STATE OFF
NCP>SET CIRCUIT ISA-0 SERVICE ENABLED
NCP>SET CIRCUIT ISA-0 STATE ON
NCP>EXIT
$
$ COPY KA680_V41_EZ.SYS MOM$LOAD:*.*
$

***** On Client System *****

>>> BOOT/100 EZA0
(BOOT/R5:100 EZA0)

  2..
Bootfile: K680_V41_EZ

>>> b eza0

-EZA0

                        ---CAUTION---

--- EXECUTING THIS PROGRAM WILL CHANGE YOUR CURRENT ROM ---

Do you really want to continue [Y/N] ? : Y

 DO NOT ATTEMPT TO INTERRUPT PROGRAM EXECUTION!

 DOING SO WILL RESULT IN LOSS OF OPERABLE STATE!

 The program will take at most several minutes.

 led codes display info

 0111 0***          -   in process of programming FEPROM to 0's

 1000 0***          -   in process of programming FEPROM to 1's

 1001 0***          -   in process of programming new ROM image

 DO NOT TOUCH THE HALT BUTTON, OR YOU WILL DAMAGE THE CPU MODULE!!!!

 !!!! THE SYSTEM WILL THEN DO A POWERUP RESTART and HALT at the
console !!!!

FEPROM Programming successful

>>>
```

Continued on next page

Updating Firmware on Disk

This table describes how to update firmware on disk.

Step	Action
1	Create a top level directory on the disk. **CREATE/DIR** **DKA100:[FIRMWARE]**
2	Copy the firmware update savesets to the directory. Use the following command: $ **COPY <filename>:[FIRMWARE]*.***
3	On the client system, enter this command at the console prompt: **b/100 dka100** The system then prompts you for the name of the file.

Continued on next page

Example 5–1 FEPROM Update by Disk

```
>>> b/100 dka100

 Bootfile: [firmware]bl9.sys

-DKA100
 FEPROM BLASTING PROGRAM

                           ---CAUTION---
 EXECUTING THIS PROGRAM WILL CHANGE YOUR CURRENT ROM ---

Do you really want to continue [Y/N] ? : Y

 DO NOT ATTEMPT TO INTERRUPT PROGRAM EXECUTION!
 DOING SO WILL RESULT IN LOSS OF OPERABLE STATE!
 The program will take at most several minutes.
 led codes display info
 0111 0***          -   in process of programming FEPROM to 0's
 1000 0***          -   in process of programming FEPROM to 1's
 1001 0***          -   in process of programming new ROM image

 DO NOT TOUCH THE HALT BUTTON, OR YOU WILL DAMAGE THE CPU MODULE!!!!

 !!!! THE SYSTEM WILL THEN DO A POWERUP RESTART and HALT at the console !!!!
```

Updating Firmware On Tape

Overview

To update firmware on tape, the system must have a TZ30 tape drive.

If you need to make a bootable tape, copy the bootable image file to a tape as shown in the following example. Refer to the release notes for the name of the file.

NOTE

There are different files for booting from tape/disk or Ethernet.

```
$ INIT MIA5:"VOLUME_NAME"
$ MOUNT/BLOCK_SIZE = 512  MIA5:"VOLUME_NAME"
$ COPY/CONTIG <file_name> MIA5:<file_name>
$ DISMOUNT MIA5
$
```

Use the following procedure to update firmware on tape:

Step	Action	Comment
1	Enter the BOOT device name command for the tape device at the console prompt (>>>)	Example: **BOOT/100 MKA500** Use the SHOW DEVICE command if you are not sure of the device name for the tape drive.
2	Enter the bootfile name when the system prompts you.	

Continued on next page

Step	Action	Comment
3	After the FEPROM upgrade program is loaded, press Y at the prompt to start the FEPROM blast.	**CAUTION** **Once you enter the bootfile name, do not interrupt the FEPROM blasting program, as this can damage the CPU module. The program takes several minutes to complete.** **NOTE** **On systems with a VCB02 terminal, you will see an abbreviated form.**
4	At the console prompt (>>>), enter: `T 100`	

```
>>> BOOT MKA500

  2..
Bootfile: KA49_V41_EZ
-MKA500

  1..0..

 FEPROM BLASTING PROGRAM
 blasting in V4.1...

                          ---CAUTION---
 EXECUTING THIS PROGRAM WILL CHANGE YOUR CURRENT ROM ---
Do you really want to continue [Y/N] ? : Y

  DO NOT ATTEMPT TO INTERRUPT PROGRAM EXECUTION!

  DOING SO MAY RESULT IN LOSS OF OPERABLE STATE!

  The program will take at most several minutes.


starting uniform_program...

 byte 00070000 has been written with 0's...
 byte 00060000 has been written with 0's...
 byte 00050000 has been written with 0's...
 byte 00040000 has been written with 0's...
 byte 00030000 has been written with 0's...
 byte 00020000 has been written with 0's...
 byte 00010000 has been written with 0's...
 byte 00000000 has been written with 0's...
starting erase...

 byte 00070000 has been erased...
 byte 00060000 has been erased...
 byte 00050000 has been erased...
 byte 00040000 has been erased...
 byte 00030000 has been erased...
 byte 00020000 has been erased...
 byte 00010000 has been erased...
 byte 00000000 has been erased...
starting program...

 byte 00070000 has been reprogrammed...
 byte 00060000 has been reprogrammed...
 byte 00050000 has been reprogrammed...
 byte 00040000 has been reprogrammed...
 byte 00030000 has been reprogrammed...
 byte 00020000 has been reprogrammed...
 byte 00010000 has been reprogrammed...
 byte 00000000 has been reprogrammed...

FEPROM Programming successful

>>>
```

Continued on next page

FEPROM Update Error Messages

The next table lists the error messages generated by the FEPROM update program and the actions to take if the errors occur.

Message	Action
update enable jumper is disconnected unable to blast ROMs...	Reposition update enable jumper (Preparing the Processor for an FEPROM Update).
ROM programming error-expected byte: xx actual byte: xx at address: xxxxxxxx	Replace the CPU module.
ROM uniform programming error-expected byte: 00 actual byte: xx at address: xxxxxxxx	Turn off the system, then turn it on. If you see the banner message as expected, re-enter console mode and try booting the update program again. If you do not see the usual banner message, replace the CPU module.
ROM erase error-expected byte: ff actual byte: xx at address: xxxxxxxx	Replace the CPU module.

Continued on next page

Patchable Control Store Loading Error Messages

The next table lists the error messages that may appear if there is a problem with the PCS. The PCS is loaded as part of the power-up stream (before ROM-based diagnostics are executed).

Message	Comment
CPU is not an NVAX	CPU_TYPE as read in NVAX SID is not = 19 (decimal), as is should be for an NVAX processor.
Microcode patch/CPU rev mismatch	Header in microcode patch does not match MICROCODE_REV as read in NVAX SID.
PCS Diagnostic failed	Something is wrong with the PCS. Replace the NVAX chip (or CPU module).
Unexpected SIE	SYS_TYPE as read in the ROM SIE does not reflect that an NVAX CPU is present.

Chapter 6
FRUs Removal and Replacement

Overview

Introduction

This chapter describes how to remove and replace the field replaceable units (FRUs) in the Model 90 system box. Appendix D lists the Model 90 FRUs and their part numbers.

Each section describes the removal procedure for the FRU. Unless otherwise specified, you can install a FRU by reversing the steps in the removal procedure. The topics covered in this module are:

- Precautions
- System Preparation
- Mass Storage Drive Removal
- Power Supply Removal
- Module Removal
- SPXg 8-Plane Option
- SPXgt 24-Plane Option
- CPU Module
- DSW21 Removal and Replacement
- Bezel Removal
- Clearing System Password
- Testing the VAXstation 4000 Model 90 System
- TURBOchannel Option
- TURBOchannel Adapter/Option Removal and Replacement

Precautions

Removing and Installing FRUs

Only qualified service personnel should remove or install FRUs.

NOTE

It is the customer's responsibility to back up the software before Digital Services personnel arrive at the site. This is important to ensure 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 working with the internal parts of the workstation.

System FRU Removal

Before Starting

Perform these preliminary steps before removing and replacing a FRU.

Step	Action
1	Verify that the symptom is not caused by improper configuration or a loose cable.
2	Confirm with the customer that data has been backed up. If not, the data could be lost (when a hard disk is at fault).
3	Ensure that the operating system is shut down before turning off the system or halting the CPU.
4	Enter the SHOW CONFIG command and write down the following information: — System ROM version — Graphics type — Memory configuration Verify that the configuration agrees with the amount and type of memory modules present. If the configuration does not agree, verify that the memory modules are installed correctly. — SCSI devices and IDs Verify that the configuration agrees with the actual hardware. If the configuration does not agree, ensure that the following are true: SCSI IDs are all unique. Cables are correctly installed. The expansion box power is turned on first.
5	Wait three minutes after turning off a monitor before you move or service it.

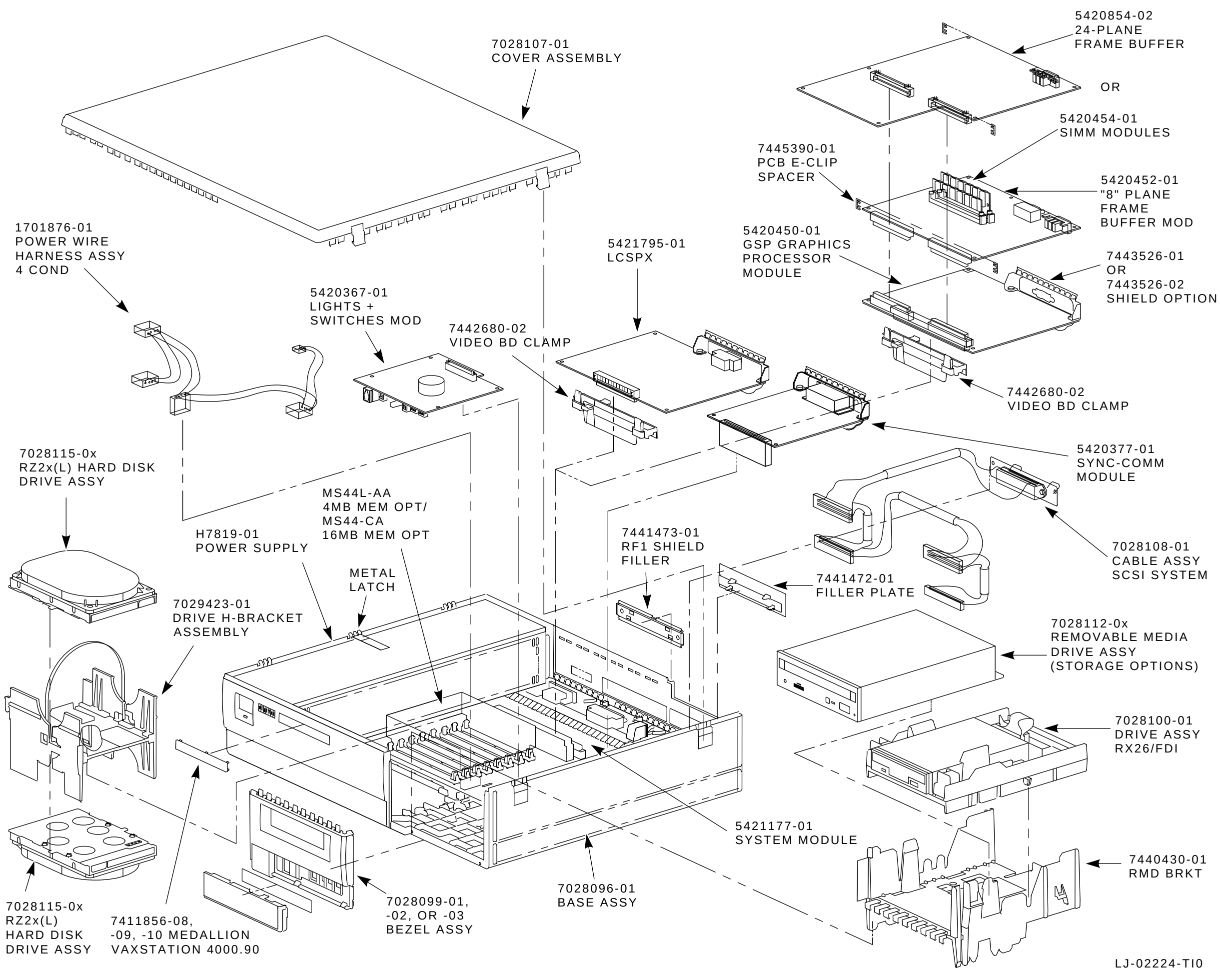
Continued on next page

System FRU Removal, Continued

System FRU Locations

Figure 6–1 shows the location of the system FRUs.

Figure 6–1 System FRU Locations



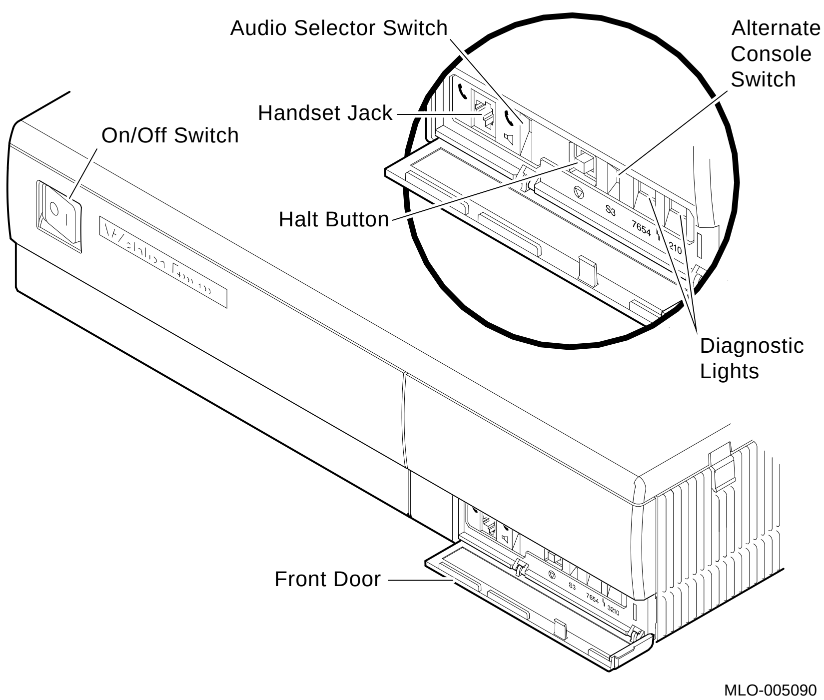
System Preparation

Prepare the System

Prepare the system for removing or replacing FRUs by following these next steps.

1. Shut down the operating system.
2. Enter console mode by pressing the halt button (Figure 6–2) on the front of the system box behind the door on the lower right. The console prompt (>>>) appears.

Figure 6–2 Halt Button



3. At the console prompt, set the system to halt on future power-ups. Self-tests are completed by typing:

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

Continued on next page

NOTE

After adding the new device or module, halt the system when you first turn it on. Use the diagnostic tests described in Chapter 5 to determine if the new device or module is connected correctly.

4. Before adding a new device or module, review the current system configuration. Record the current system configuration information for reference. After adding the new device or module, compare the new configuration with the previous one to help verify that all devices are present and functioning correctly.

To determine the presence of devices, test status, and the quantity of memory inside the system, enter the following command:

```
>>> SHOW CONFIG [Return]
```

Configuration information similar to the following appears. An explanation of the response is provided next to each line.

```
KA49-A V0.0-051-V4.0      ! System type and firmware revision
08-00-2B-F3-31-03         ! Ethernet hardware address
80 MB                     ! Total memory

DEVNBR  DEVNAM  INFO
------  ------  ----
    1    NVR    OK        ! Non-volatile RAM
    2    LCSPX  OK
                Highres - 8 Plane  4MPixel  FB - V0.8
    3    DZ     OK        ! Serial line controller
    4    CACHE  OK        ! Cache memory
    5    MEM    OK        ! Memory configuration

                80 MB 0A,0B,0C,0D = 4 MB,  1E,1F,1G,1H = 16 MB

    6    FPU    OK        ! Floating point accelerator
    7     IT    OK        ! Interval timer
    8    SYS    OK        ! Other system functions
    9     NI    OK        ! Ethernet
    10   SCSI   OK        ! SCSI and drives
                0-RZ24  1-RZ25  2-RRD42  6-INITR
    11   AUD    OK        ! Sound
    12   COMM   OK        ! DSW21 communications device
```

Continued on next page

To determine the quantity of memory in the system, look at the MEM line. The memory line (line 5) shows that there is 80 MB of system memory. There are 4-MB memory modules in each of 0A, 0B, 0C, 0D and 16-MB memory modules in each of 1E, 1F, 1G, 1H.

5. Turn power to the system off (0).

WARNING

Turn the monitor power off for at least three minutes before removing the power cord. Remove the power cord 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. Remove the monitor from the top of the system and set it aside.

8. Remove the system cover by gently pulling out on the tabs on right side of the cover, and lift the cover up and off (Figure 6–1).

Mass Storage Drive Removal

Overview

This section describes how to remove mass storage devices from the VAXstation 4000 Model 90 workstation.

Mass storage devices installed in the system share the same SCSI and dc power cable. Each device has its own connector on the power cable.

NOTE

Refer to the System Preparation section before removing or replacing a device or module.

Hard Disk Drive Removal

This section describes how to remove a hard disk drive from its bracket. Figure 6–1 shows the mounting areas for drives.

Step	Action	Comment
1	Pull the colored tab on the drive bracket toward the front of the system.	The tab is located at the upper left corner of the bracket.
2	Lift the drive(s) and bracket from the system box.	
3	Disconnect both the SCSI and dc power cable from the drive(s).	
4	Push down on the plastic tab at the end of the bracket.	The tab is opposite where the SCSI and power cables connect to the drive.
5	Slide the drive over the plastic tab until the metal peg on each side of the drive is aligned with the vertical slot on the bracket.	

Continued on next page

Step	Action	Comment
6	Lift the drive from the bracket.	
7	Match the SCSI ID with the error code to verify that the failed drive was removed.	Figure 6–3 and Figure 6–4 show the disk drive ID jumper locations. Table 6–1 contains the SCSI jumper settings.
8	Remove the drive mounting plate.	
9	Remove the second hard disk drive from the bracket if one is present.	

Hard Disk Drive Replacement

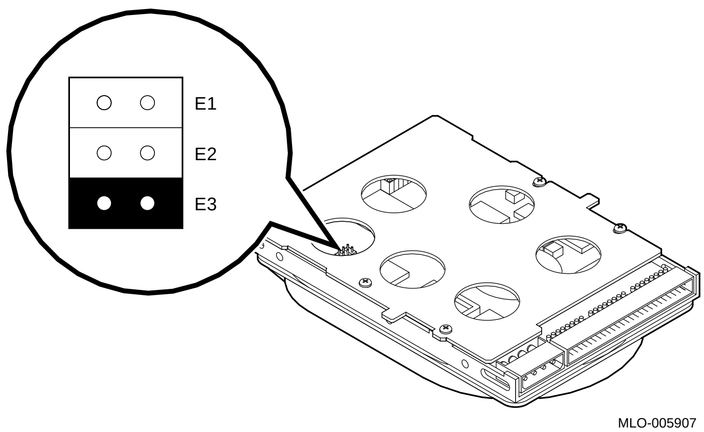
Use the following procedure to replace hard disk drives in the system box:

Step	Action	Comment
1	Verify the SCSI ID setting on the drive.	The SCSI jumpers allow you to select a distinct ID number for each SCSI device. It is essential that each device have a unique SCSI ID (0-7). Figure 6–3 shows the location of the RZ23L hard disk drive SCSI ID jumpers (ID number 4 selected). Figure 6–4 shows the location of the RZ24 disk drive SCSI ID jumpers.

Continued on next page

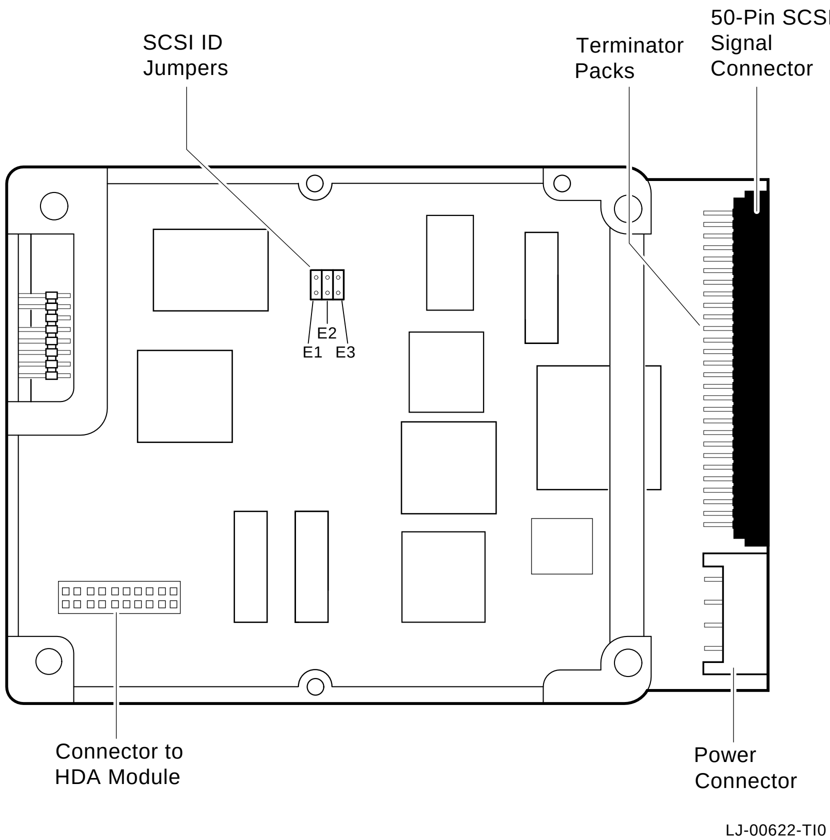
Step	Action	Comment
2	Set the SCSI ID jumpers of the top disk drive as specified in Table 6–1.	The jumpers are used in the following manner: • Install the jumper for IN • Remove the jumper for OUT
3	Install a new drive by reversing the steps in the Hard Disk Drive Removal procedure.	**Note:** When installing a drive into the bracket, you must apply pressure on the drive for it to seat properly.

Figure 6–3 RZ23L Disk Drive SCSI ID Jumper Location



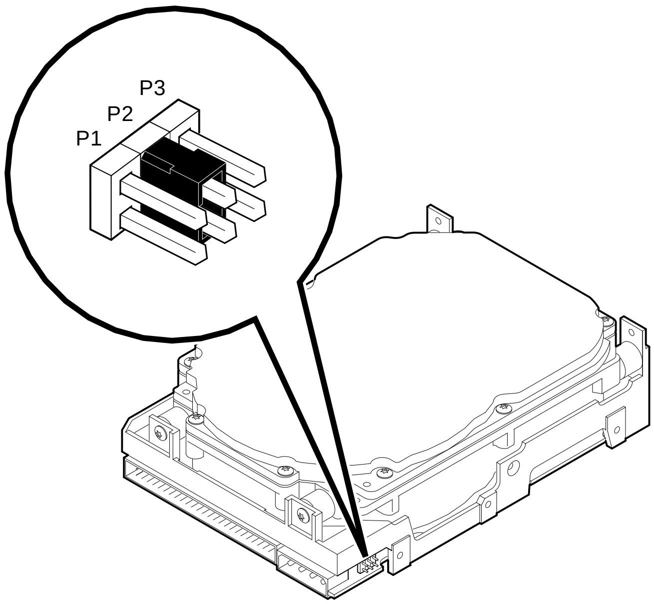
Continued on next page

Figure 6–4 RZ24 Disk Drive SCSI ID Jumper Location



Continued on next page

Figure 6–5 RZ25 Disk Drive SCSI ID Jumper Location



Continued on next page

The following table lists the hard disk drive SCSI jumper settings.

Table 6–1 Hard Disk Drive SCSI Jumper Settings

SCSI ID	P1	P2	P3	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	

The following table lists the standard ID numbers for the SCSI devices.

Table 6–2 Standard IDs for SCSI Devices

ID Number	Device Type	Example
0 to 3	Hard disk	RZ2xL, RZ2x, RZ5x
4	CDROM	RRD42
5	Tape or floppy	RX26, TLZ04, TZK10
6	Reserved for the system	KA49 SCSI Controller
7	Any drive	Second tape or floppy

Continued on next page

RRD42 CDROM Drive Removal

This section describes how to remove an RRD42 CDROM drive. Figure 6–1 shows the RRD42 CDROM drive.

Step	Action
1	Remove the hard disk drive.
2	Push the colored tab at the right upper front of the bracket toward the power supply, and push the tab behind the screw hole at the bottom left center of the bracket to the right.
3	Lift the drive and drive bracket from the system box.
4	Disconnect the SCSI and dc power cables from the drive.
5	Remove the drive from the bracket by releasing the latches on each side of the bracket and lifting the drive from the bracket.
6	Match up the SCSI ID with the error code to verify that the failed drive was removed. Refer to Figure 6–3 and Figure 6–4 for the disk drive ID jumper locations. Refer to Table 6–1 for the SCSI jumper settings.
7	Remove the drive mounting plate.

RRD42 CDROM Drive Replacement

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

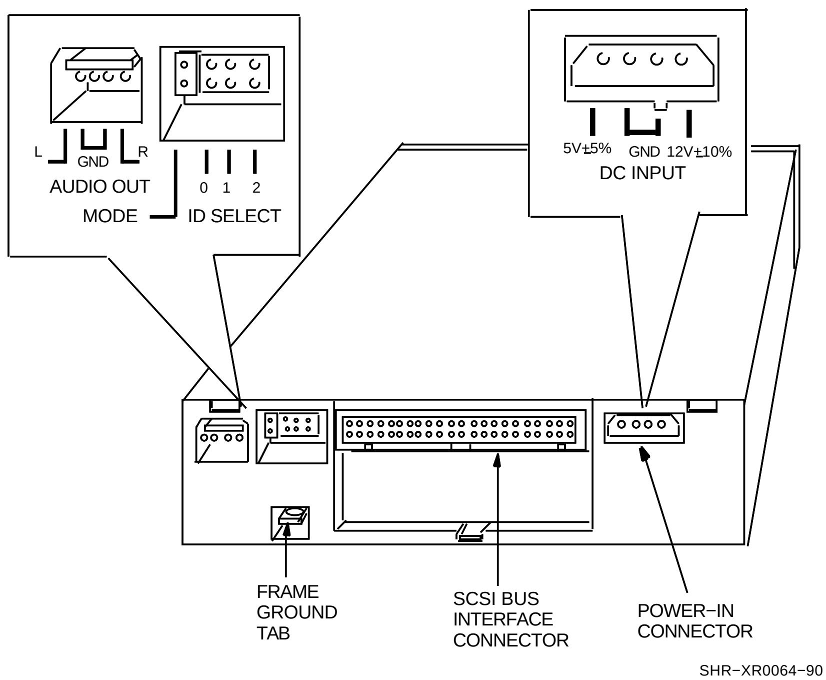
Use the following procedure to verify or set the SCSI ID jumpers on the drive:

Step	Action
1	Locate the set of SCSI ID jumpers 0, 1, and 2 at the rear of the drive. The jumpers should be to the left side of the drive as shown in Figure 6–6. The jumpers are removable electrical connectors on the ID settings.

Continued on next page

Step	Action
2	The SCSI ID jumpers should be in the factory-set positions for SCSI ID 4. This is the default SCSI ID setting for the drive. Verify that the jumpers are set to the following positions (left to right) for SCSI ID 4: OFF, OFF, ON. To set the SCSI ID jumper in the OFF position, remove the jumper from its seating. To set a jumper in the ON position, leave the jumper in place.

Figure 6–6 RRD42 CDROM Jumper Settings



NOTE

Never set two devices to the same SCSI ID; the system cannot service devices with identical IDs.

Continued on next page

Installing a New Drive

To install a new drive, reverse the steps in RRD42 CDROM Drive Removal. You do not need to push the tabs to insert the bracket. The bracket snaps into place if positioned correctly.

RX26 (Diskette) Drive Removal

This section describes how to remove the RX26 diskette drive. Figure 6–1 shows the drive location.

Step	Action
1	You need to release two tabs. The first tab is located at the upper right front of the bracket. The second tab is located behind the screw hole at the bottom left center of the bracket. Simultaneously pull the first colored tab on the drive bracket toward the power supply of the system and push the second tab to the right.
2	Remove the hard drive.
3	Lift the drive and drive bracket from the system box.
4	Disconnect the SCSI and dc power cables from the drive.
5	Remove the drive from the removable media bracket by releasing the latches on each side of the bracket. Remove the drive from the secondary bracket by removing the four screws from the underside of the RX26 bracket.

RX26 (Diskette) Drive Replacement

Before installing the new drive, verify the drive type number setting on the drive. The number settings are as follows:

- RX26, Setting is 0
- RX23, Setting is 1
- RX33, Setting is 2

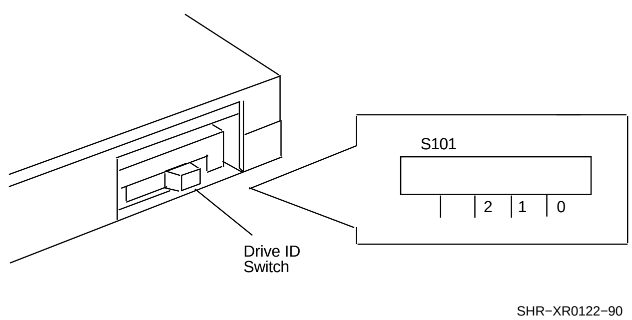
Figure 6–7 shows the drive type switch location for the diskette drive. Figure 6–8 shows the diskette drive SCSI ID switch locations.

Continued on next page

Use the following procedure to verify or set the drive type number switches and the SCSI ID settings.

Step	Action
1	Locate the type number switches 0, 1, and 2 on the drive, as shown in Figure 6–7.
2	Use a pen or small pointed object to move the switches side to side. The switch should be set to 0. Figure 6–8 shows the SCSI ID switch location for an RX26 drive.
3	The SCSI ID switches should be in the factory-set positions for SCSI ID 5. This is the default SCSI ID setting for the drive. Verify that the switches are set to the following positions (left to right) for SCSI ID 5: 1 = DOWN, 2 = UP, 3 = DOWN. To set the SCSI ID switch in the OFF position, move the switch to the UP position. To set a switch to the ON position, move the switch to the DOWN position. **CAUTION Do not use a pencil. Graphite particles can damage the switches.**

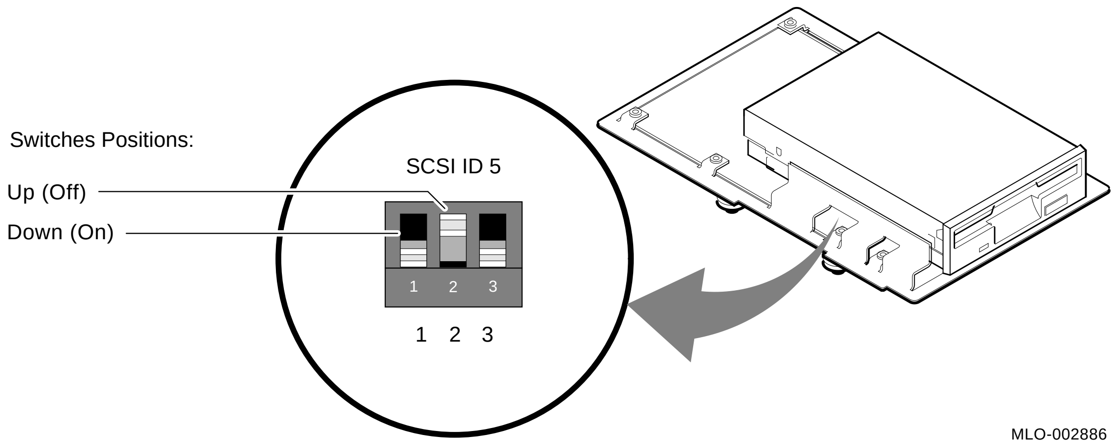
Figure 6–7 RX26 Diskette Type Number



To install a new drive, reverse the steps in the RX26 (Diskette) Drive Removal procedure. You do not need to push the tabs to insert the bracket. The bracket snaps into place if positioned correctly.

Continued on next page

Figure 6–8 RX26 (Diskette) Drive SCSI ID Switch Location



TZK10 QIC Tape Drive Removal

This section describes how to remove a TZK10 QIC tape drive. Figure 6–1 shows the drive location.

Step	Action
1	You need to release two tabs. The first tab is located at the upper right front of the bracket. The second tab is located behind the screw hole at the bottom left center of the bracket. Simultaneously pull the first colored tab on the drive bracket toward the power supply of the system and push the second tab to the right.
2	Remove the hard drive.
3	Lift the drive and drive bracket from the system box.
4	Disconnect the SCSI and dc power cables from the drive.
5	Remove the drive from the removable media bracket by releasing the latches on each side of the bracket. Lift the drive from the bracket.

Continued on next page

TZK10 (Tape) Drive Replacement

Before installing the new drive, verify the drive ID setting. Figure 6–9 shows the drive SCSI ID switch locations for the tape drive.

Use the following procedure to verify or set the drive SCSI ID jumpers.

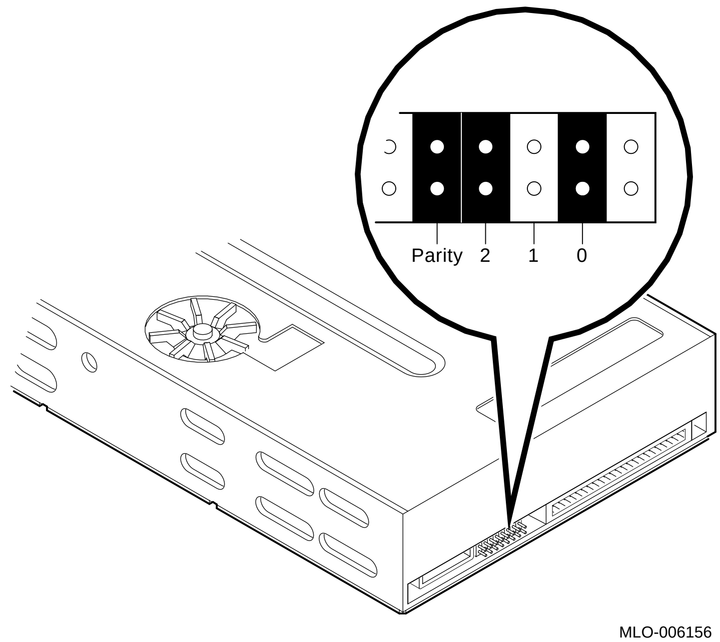
Step	Action
1	Locate the set of SCSI ID jumpers 0, 1, and 2 at the rear of the drive. The jumpers should be to the left side of the drive. The jumpers are removable electrical connectors on the ID settings.
2	The SCSI ID jumpers should be in the factory-set positions for SCSI ID 4. This is the default SCSI ID setting for the drive. Verify that the jumpers are set to the following positions (left to right) for SCSI ID 5: 2=ON, 1=OFF, 0=ON. To set the SCSI ID jumper in the OFF position, remove the jumper from its seating. To set a jumper in the ON position, leave the jumper in place.

Continued on next page

Installing a New Drive

To install a new drive, reverse the steps in the TZK10 QIC Tape Drive Removal procedure. You do not need to push the tabs to insert the bracket. The bracket snaps into place if positioned properly.

Figure 6–9 TZK10 (QIC) Tape Drive SCSI ID Jumper Location



Power Supply Removal

Removing the Power Supply

This section describes how to remove the system power supply (H7819-AA) from the system box. Figure 6–1 shows the system power supply.

NOTE

Refer to System Preparation before removing or replacing a device or module.

WARNING

Do not attempt to open the power supply. There are dangerous voltages inside the power supply, and there are no user-serviceable parts.

To remove the power supply, follow the next procedure.

Step	Action
1	Disconnect the power cords (monitor and power supply) from the two ac connectors at the rear of the unit.
2	Remove the bracket for the RZ drives to gain access to the power supply tab.
3	Release the metal latch on the left of the power supply.
4	Pull forward on the blue tab (on the right, in front of the CPU module) just under the power supply and lift the front of the supply slightly.
5	Lift the rear of the power supply and remove the power supply from the system box.

Continued on next page

Power Supply Replacement

To install a new power supply, reverse the steps in the Power Supply Removal procedure. You do not need to pull the tab.

When replacing the power supply, ensure that you also do the following:

- Install an H7819-AA power supply.
- Align the two guides (one on the right front of the supply, and one on the right rear) with the slots on the system box.
- Push the supply down into place. The power supply snaps into place if positioned properly.

Module Removal

Overview

The following sections describe how to remove and replace the VAXstation 4000 Model 90 system modules.

NOTE

Refer to System Preparation before removing or replacing a device or module.

CAUTION

Wear an anti-static wrist strap and place modules on an anti-static mat when removing and replacing system modules.

Light and Switches Module Removal

This section describes how to remove the light and switches module from the system.

NOTE

Refer to System Preparation before removing or replacing a device or module.

Step	Action
1	Perform the steps in the Hard Disk Drive Removal and the RRD42 CDROM Drive Removal procedures, or the RX26 (Diskette) Drive Removal and the TZK10 QIC Tape Drive Removal procedures.
2	Disconnect the module connector from the system module by lifting up on the module where it overlaps the system module.
3	Lift the module away from the front of the system.

Continued on next page

Light and Switches Module Replacement

To replace the light and switches module, perform the following steps:

Step	Action
1	Align the switches with their respective holes in the front bezel.
2	Align the connector on the lower side of the module with the connector on the system module and seat the connector.

Memory Module Identification

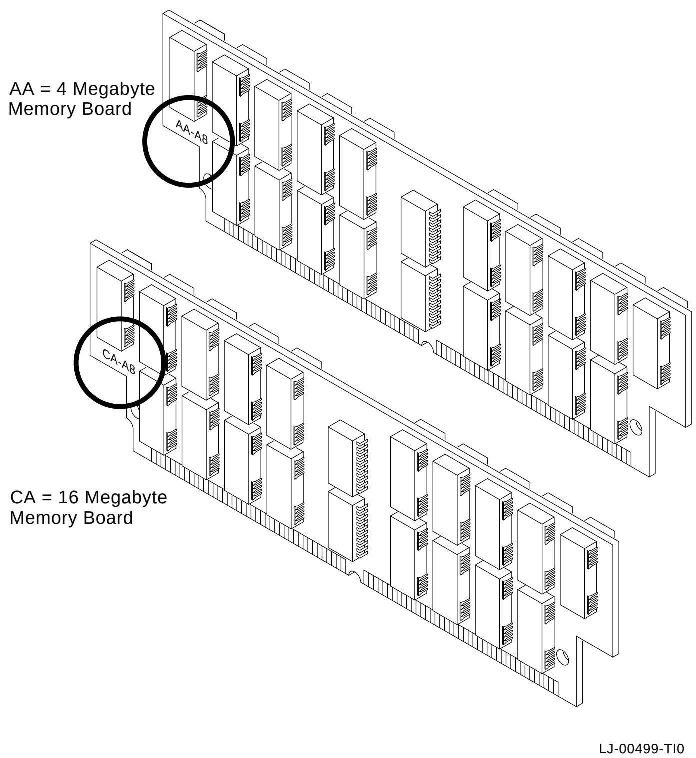
Three types of memory modules are available: 4 MB (MS44-AA), 4 MB reduced cost (MS44L), and 16 MB (MS44-CA). The VAXstation 4000 Model 90 can use any of the three memory modules. Memory modules must be installed in sets of four 4-MB modules, or four 16-MB modules.

Ensure that you have the correct memory module before installation. To identify a memory module, locate the etch on the left side of the memory module. The 4-MB modules have AA or AL on the etch board, and the 16-MB modules have CA on the etch board. Figure 6–10 shows the location of the memory module ID number.

When installing four 4-MB memory modules and four 16-MB memory modules, the 4-MB memory modules must be installed in memory locations 0A, 0B, 0C, 0D.

Continued on next page

Figure 6–10 Memory Module Identification



MS44 Memory Module Removal

This section describes how to remove the MS44 memory modules from the system.

CAUTION

Memory components are easily damaged with static electricity. An antistatic wrist strap should always be worn when installing or removing memory components.

CAUTION

The memory modules are keyed and can be installed in only one direction. Excessive force applied to the modules when they are not correctly aligned with the connector can cause permanent damage to either the modules or to the connector.

Continued on next page

NOTE

Memory modules must always be removed starting from the front of the system. For example, to replace the module at the rear of the system board, you must remove any modules at the front of the board and work toward the rear. Memory module locations are numbered on the right edge of the memory connectors located on the system board.

The location of the memory modules is shown in Figure 6–1.

To remove the MS44 memory modules, perform the following steps:

Step	Action
1	Remove the hard disk drive.
2	Starting with the forward-most module, release the two metal retainers at each end of the memory module connector.
3	Rotate the module forward approximately 55 degrees to the front of the unit and lift it out of the slot. **CAUTION Failure to release the two module retainers will permanently damage the module connector located on the system board.**

Continued on next page

MS44 Memory Module Replacement

To install a new MS44 memory module, perform the following steps.

NOTE

When installing memory modules (sets of four), each set must be installed in the slots identified for a particular set. These designators are to the right of each slot and identified with a 0x (where x=A1x [where x=E,F,G,H] for set 1.

Step	Action
1	Look for the double grove at end of the SIM module connector.
2	Install the module with the grove towards the right side of CPU module, looking from the front.
3	Start with the rear-most connector.
4	Place the memory module in the connector and tilt the module approximately 55 degrees forward. Make sure the double notched lower corner of the memory module is away from the power supply.
5	Pivot the memory module upward until the metal tabs connect with the memory module.

Graphics Module Removal

The SPXg 8-plane or SPXgt 24-plane graphics module is located towards the rear of the system box, next to the power supply. Figure 6–1 shows its location in the system box. To remove these modules from the system box, use the procedures described next.

SPXg 8-Plane Option

Overview

The SPXg 8-plane option includes the following:

- One graphics subsystem processor module
- One 8-plane frame buffer module
- Two 2-MB single in-line memory modules (SIM modules)
- Video connector bracket (attached to graphics subsystem processor module)

NOTE
The video connector is mounted upside down compared to the LCSPX.

- Radio frequency interference (RFI) gasket

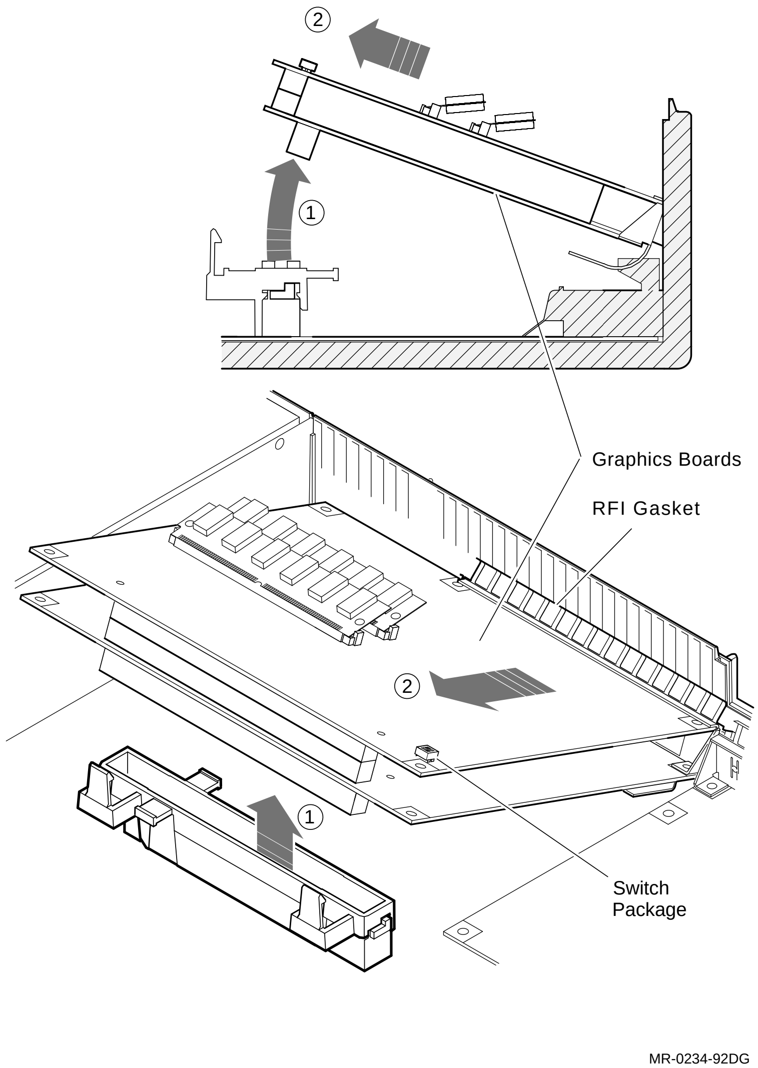
Removing the SPXg 8-plane Option

Follow this procedure and refer to Figure 6–11 to remove the SPXg option.

Step	Action
1	Release the board latches ➊.
2	Lift the option assembly free of the system module connector and remove it from the system box ➋.
3	Remove the failed FRU.

Continued on next page

Figure 6–11 Removing the SPXg 8-Plane Option



Continued on next page

Installing the SPXg 8-plane Option

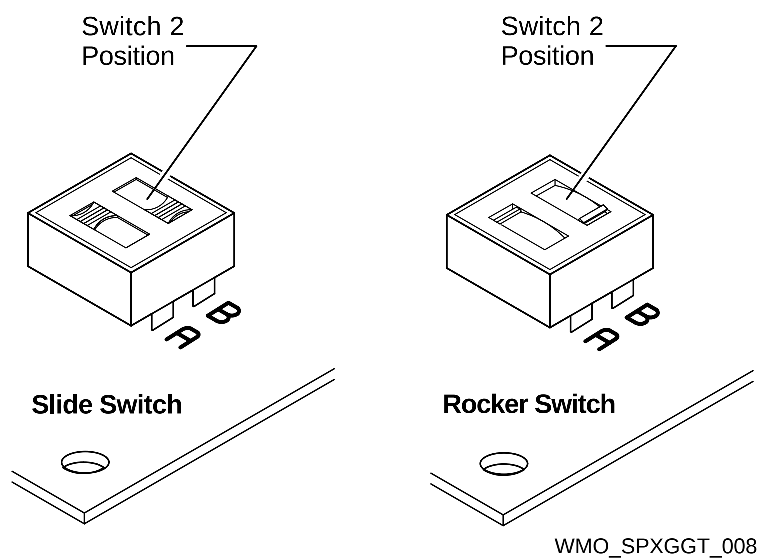
Reassemble the option assembly with the new FRU as follows:

Step	Action	Comment
1	If the new FRU is a SIM module, install it on the frame buffer module.	
2	Set switch 2 towards the B marker on the frame buffer module. This setting is at 66 Hz. If switch 2 is set towards the opposite side of the frame buffer module, the setting is at 72 Hz.	Before installing the SPXg, ensure that switch 2 of the two-switch package on the frame buffer module is in the position shown in Figure 6–12. The switch may be a slide switch or rocker switch. The switch package is located as shown in Figure 6–14. The switch labels A and B are on the module. Ignore any switch identifiers on the switch package. Switch 1 is inactive and can be in either position.
3	Align the graphics module and system module intermodule connectors.	Mate the connectors by pressing down. The module latches should snap into place to secure the module.
4	Align and mate the frame buffer module with the graphics module.	
5	Install the RFI gasket.	See Figure 6–13. Press the RFI gasket over the video connector on the graphics subsystem processor module. The angled top and sides of the gasket face away from the connector bracket. This compresses the gasket between the connector and system box when the option is installed.

Continued on next page

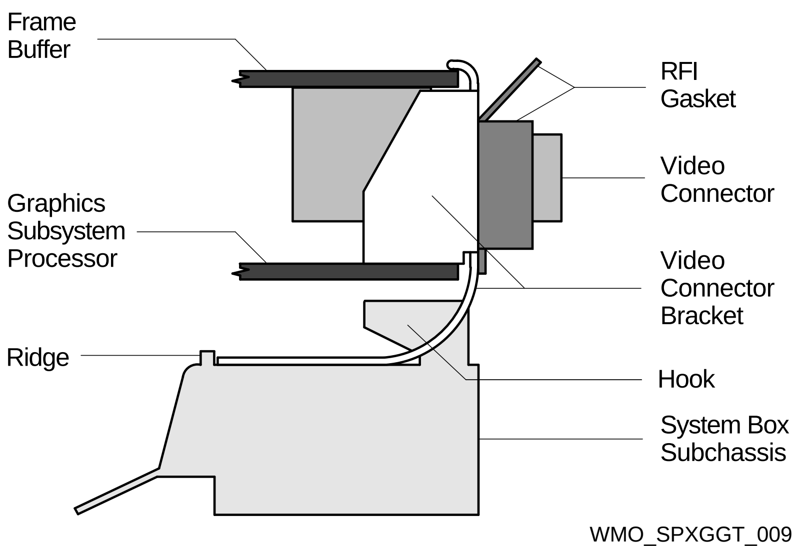
6	See Figure 6–14. Carefully tilt the assembly into position ❶.	The two hooks on the system box subchassis slip through the square holes in the lower curve of the connector bracket.
7	Insert the assembly.	With the assembly in position, align the graphics subsystem processor and system module inter-module connectors ❷. Mate the connectors by pressing down on the frame buffer module above the inter-module connectors. The board latches should snap into place to secure the 3D graphics option assembly. The bottom surface of the connector bracket sits on the subchassis, held in place by the hooks and the square ridge on the subchassis. Figure 6–13 is a detailed side view.

Figure 6–12 Switch 2 Position



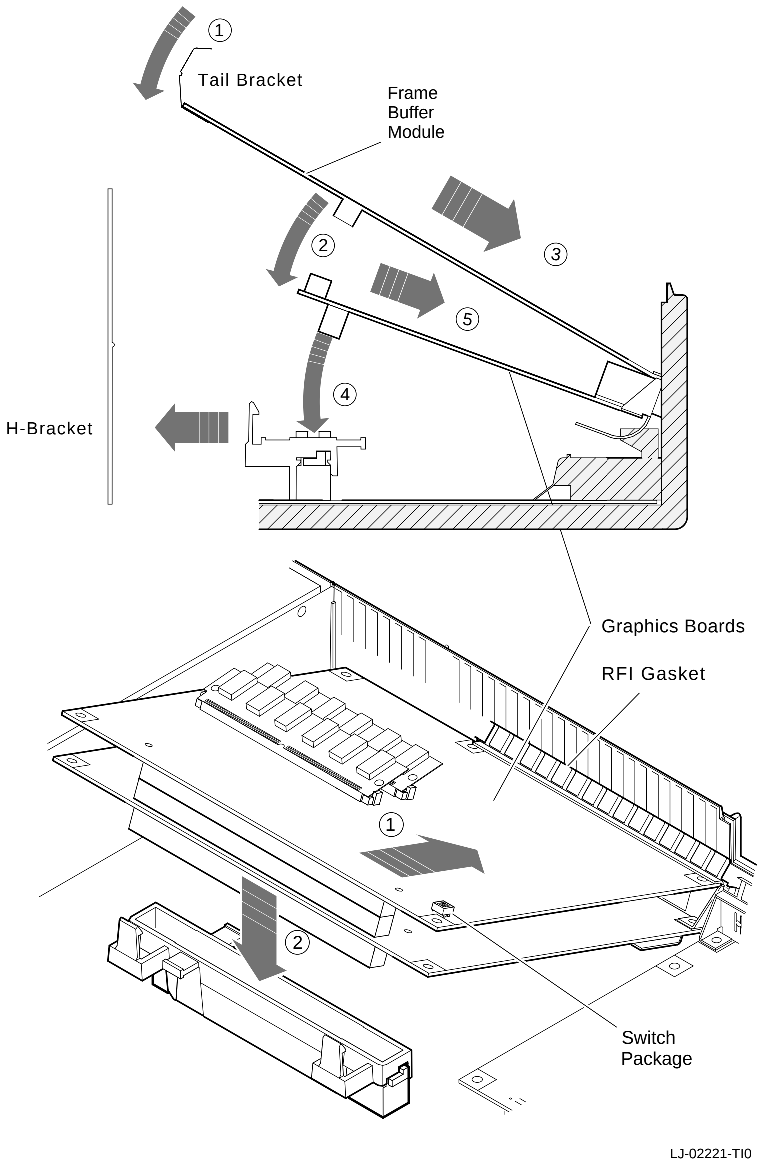
Continued on next page

Figure 6–13 Installation Details



Continued on next page

Figure 6–14 Installing the SPXg 8-plane Option



SPXgt 24-Plane Option

Overview

The SPXgt 24-plane option includes the following:

- One graphics subsystem processor module
- One 24-plane frame buffer module
- Plastic module clip (attached to graphics subsystem processor and frame buffer modules)
- Video connector bracket (attached to graphics subsystem processor module)

  NOTE

  This connector is mounted upside down compared to the LCSPX.

- Frame buffer module tail bracket (attached to the frame buffer module)
- Radio frequency interference (RFI) gasket
- Board latch

The modules, connector bracket, and tail bracket are pre-assembled.

Continued on next page

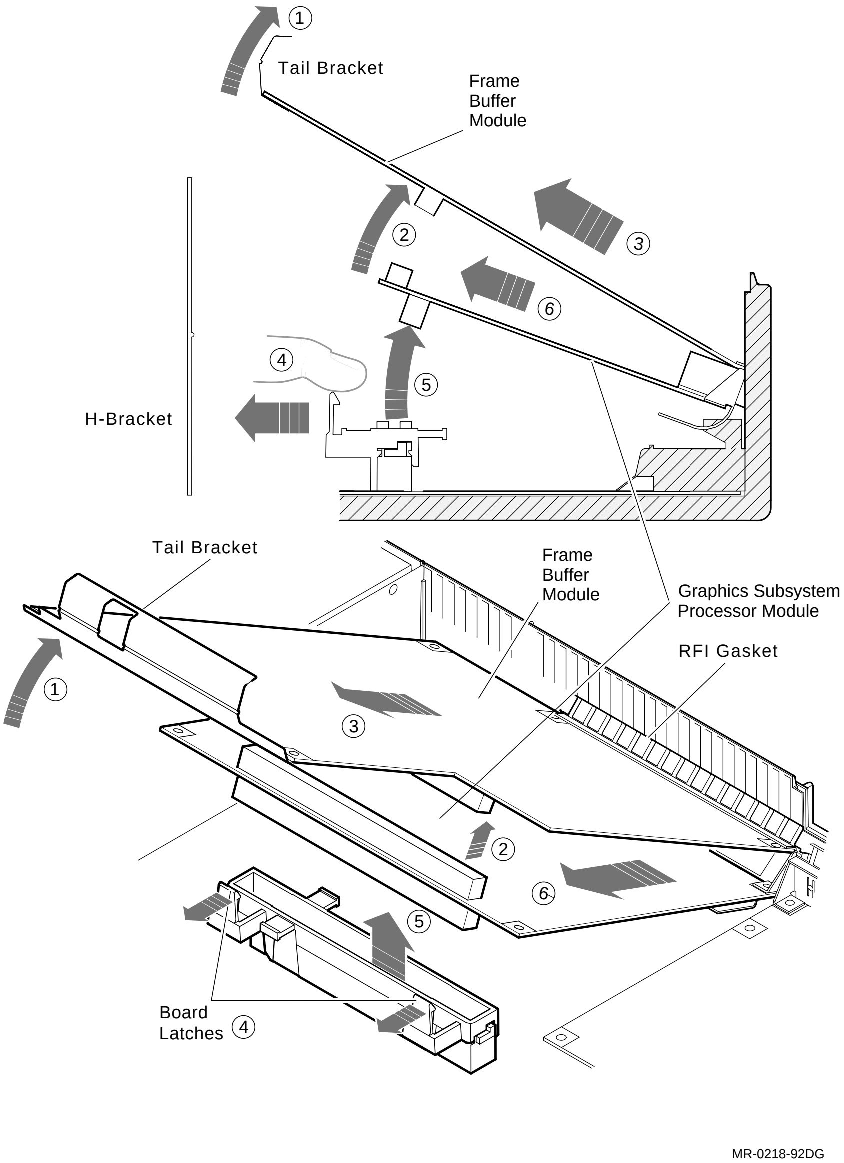
Removing the SPXgt 24-Plane Option

The shape and size of the 24-plane frame buffer module prohibits removing the SPXgt as an assembly. See Figure 6–15 and remove the components as follows:

Step	Action
1	Turn off the system power, move the monitor, and open the system unit cover as described in System Preparation .
2	Remove the plastic clip (not shown) that holds the graphics subsystem processor module to the frame buffer module. **NOTE** **To prevent the 24-plane frame buffer from bending, reform Step 4 by grasping the module just to the front of ❷ in Figure 6–15.**
3	Lift the frame buffer tail bracket just enough to free it from the ridge on the disk drive H-bracket ❶.
4	Gently work the frame buffer module loose from the graphics subsystem processor inter-module connectors ❷. The graphics subsystem processor module remains connected to the system module.
5	Pull the frame buffer free of the RFI gasket ❸. The gasket remains in place, held by the video connector bracket on the graphics subsystem processor module.
6	Release the board latches ❹ and lift the graphics subsystem processor module free of the system module connector ❺.
7	Remove the graphics subsystem processor module from the system box ❻.
8	Remove the failed FRU.

Continued on next page

Figure 6–15 Removing the SPXgt 24-Plane Option



Continued on next page

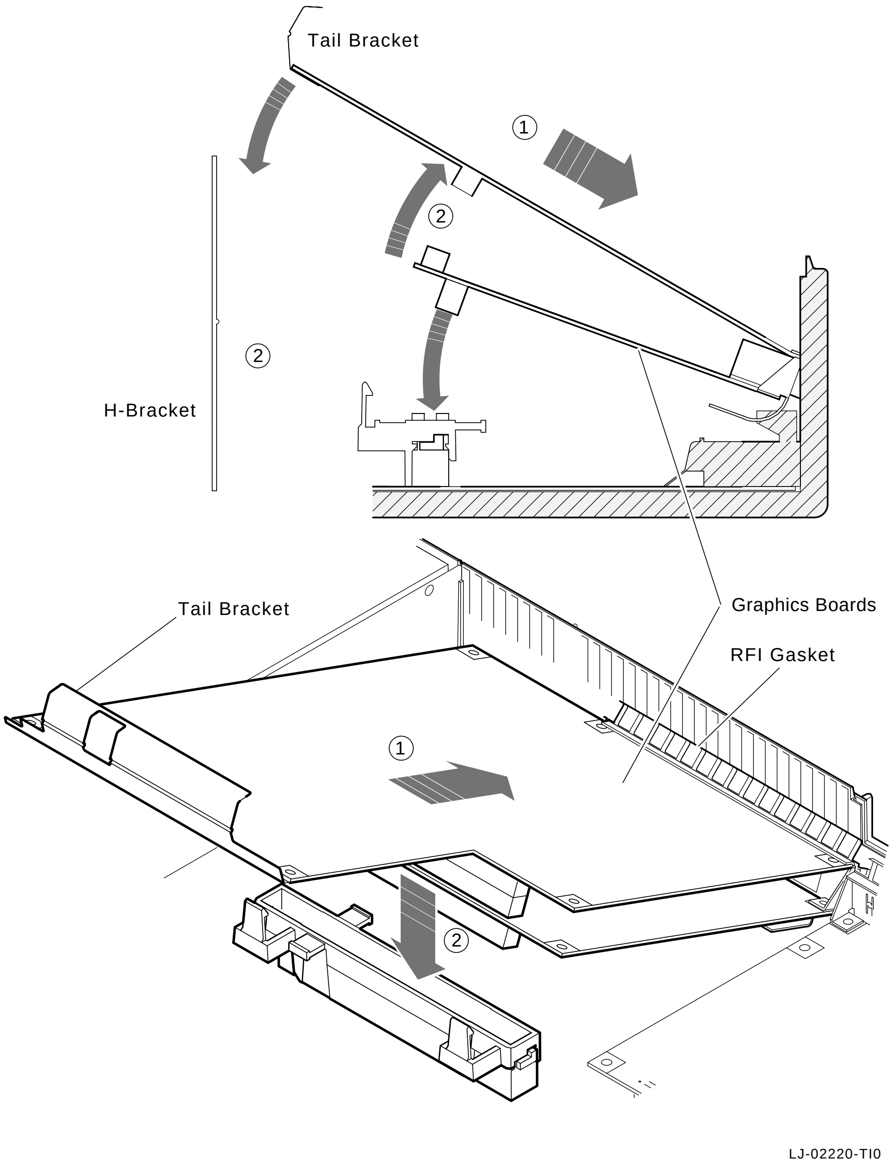
Installing the SPXgt 24-Plane Option

Reassemble the option assembly with the new FRU as follows:

Step	Action
1	Align the graphics module and system module inter-module connectors. Mate the connectors by pressing down on the module. The module latches should snap into place to secure the module.
2	Align and mate the frame buffer with the graphics module. The frame buffer module tail bracket should snap over the ridge on the disk drive H-bracket.
3	Install the RFI gasket. See Figure 6–13. Press the RFI gasket over the video connector on the graphics subsystem processor module. The angled top and sides of the gasket face away from the connector bracket. This compresses the gasket between the connector and system box when the option is installed.
4	See Figure 6–16. Carefully tilt the assembly into position ❶. The two hooks on the system box subchassis slip through the square holes in the lower curve of the connector bracket. The bottom surface of the connector bracket sits on the subchassis, held in place by the hooks and the square ridge on the subchassis. Figure 6–13 is a detailed side view.
5	With the assembly is position, align the graphics subsystem processor and system module intermodule connectors. Mate the connectors by pressing down on the frame buffer module above the intermodule connectors ❷. The board latches should snap into place and the frame buffer module tail bracket should snap over the ridge on the disk drive H-bracket to secure the 3D graphics assembly.

Continued on next page

Figure 6–16 Installing the SPXgt 24-Plane Option



CPU Module

System Module (CPU) Removal

This section describes how to remove 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:

Step	Action
1	Disconnect the cables attached to the module at the rear of the system.
2	Remove the optional graphics module (if applicable). Refer to the Graphics Module Removal procedure.
3	Remove the MS44 memory modules. Refer to the MS44 Memory Module Removal procedure.
4	Remove the optional synchronous communications module (if applicable). Refer to the DSW21 Removal and Replacement procedure.
5	Remove the optional bus adapter module (TURBOchannel adapter) (if applicable).
6	Remove the hard disk bracket, with drives. Refer to the Hard Disk Drive Removal procedure.
7	Remove the removable media bracket, with drives. Refer to the RRD42 CDROM Drive Removal or the RX26 (Diskette) Drive Removal procedures.
8	Remove the lights and switches module. Refer to the Light and Switches Module Removal procedure.
9	Remove the power supply. Refer to the Power Supply Removal procedure.
10	Remove the system module (CPU) by lifting the front slightly, so that it clears the two stops at the front right and left of the module.
11	Using the large center connector, pull the module toward the front of the system box and lift the module out.

Continued on next page

NOTE

When the system module is replaced, the Ethernet ROM must be removed and installed on the new system module, otherwise, the Ethernet hardware address is lost on system module replacement.

System Module (CPU) Replacement

To install a new system module (CPU), reverse the steps in the System Module (CPU) Removal procedure. Ensure that the five slots in the module are aligned with the five latches on the base of the system box.

DSW21 Removal and Replacement

DSW21 Removal

To remove the DSW21 from the system box, perform the following steps:

Step	Action
1	Remove the system box cover.
2	Disconnect the SCSI cable, located directly in front of the DSW21.
3	Disconnect the communications cable or terminator from the back of the system box.
4	Lift and remove the DSW21 (directly behind the SCSI connector), front end first.

DSW21 Replacement

Replace the DSW21 as described in the following table.

NOTE

Before replacing the DSW21, make sure the SCSI cable has been disconnected.

Step	Action
1	Place the DSW21 in the right rear corner of the system box.
2	Apply pressure to the connector underneath the DSW21 and push the DSW21 down toward the rear of the system box until it clears the SCSI cable connector and aligns with the communications connector on the system module.
3	Reconnect the SCSI cable in the SCSI connector.
4	Reconnect the communications cable or terminator.

Bezel Removal

System Bezel Removal

Use the next procedure and refer to Figure 6–1 to remove the system bezel.

Step	Action
1	Remove the cover.
2	Remove the removable media bracket, with drives. See the RRD42 CDROM Drive Removal or RX26 (Diskette) Drive Removal procedures.
3	Remove the lights and switches module. See the Light and Switches Module Removal procedure.
4	Slide the bezel up and out of its guides.

Bezel Replacement

To install a new bezel, reverse the steps in the System Bezel Removal procedure.

Continued on next page

Synchronous Communications Adapter Cables

Adapter cables for the synchronous communications adapter vary according to the option. Table 6–3 lists the adapter cable variations.

Table 6–3 Synchronous Communications Adapter Cables

DSW21 Model	Adapter Cables
DSW21-AA	1 Line sync comm BC19V EIA-232/V.24
DSW21-AB	1 Line sync comm BC19W EIA-449/423/V.10
DSW21-AC	1 Line sync comm BC19U EIA-449/422/V.36
DSW21-AD	1 Line sync comm BC19X
DSW21-AE	1 Line sync comm BC19Q EIA-530
DSW21-AF	1 Line sync comm BC20Q X.21
DSW21-M	1 Line sync comm controller, no adapter cable

Continued on next page

Installing the Synchronous Communications Adapter

This section describes how to install the synchronous communications adapter interface in the system unit.

NOTE

Refer to the system preparation instructions before installing any module in the workstation.

To install the communications interface, do the following:

Step	Action
1	Remove any rear panels or shields (if applicable) from the I/O panel.
2	Mount the adapter internally to the Model 90 using the 64-pin option connector. There are no clips or screws to hold the option connector.
3	Attach the 50-pin data connector, which protrudes through the rear of the enclosure and is held in place by the metal bracket.
4	Restore the system. Test the new configuration.

Continued on next page

Environmental Specifications

Table 6–4 lists the synchronous communications model environmental specifications.

Table 6–4 Environmental Specifications

Operating temperature	5°C to 50° C (41°F to 122 °F)
Nonoperating temperature	-40°C to 66° C (-40°F to 155°F)
Relative humidity (operating)	10% to 95% (noncondensing)
Maximum wet bulb temperature (operating)	32 °C (90°F)
Maximum wet bulb temperature (nonoperating)	46 °C (115°F)
Minimum dew point temperature (operating)	2 °C (36°F)
Head dissipation	6.75 W to 8.10 W Btu/h
Altitude (operating)	2400 m (8000 ft)
Altitude (nonoperating)	4900 m (16000 ft)

Continued on next page

NOTE

De-rate the maximum operating temperature by 1.82 degrees Celsius for each 1000 meters of altitude above sea level.

This device is to operate in a non-caustic environment.

Physical Specifications

The synchronous communications adapter is a four-layer circuit board assembly. Table 6–5 shows its specifications.

Table 6–5 Physical Specifications

Height	4.3 cm (1.7 in)
Width	12.4 cm (4.9 in)
Depth	14 cm (5.5 in)
Weight	.45 kg (1 lb)

Clearing System Password

NOTE

Power to the system must be off to perform this procedure.

To clear the system password, short the two triangles on the system module with a screwdriver. The triangles are located at the rear to the right of the CPU module, and to the right of the large TOY IC with the alarm clock emblem on it.

Testing the VAXstation 4000 Model 90 System

Testing the System

This section describes how to test the system after completing the removal or replacement process.

Restoring 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:

Step	Action
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	If you disconnected cables at the rear of the system, reconnect them.
3	Plug the system power cord into the wall outlet.
4	Reconnect the monitor.
5	Power up the system.

Testing the System

Test the system to confirm that all devices and modules are connected correctly. You can verify system operation by running any tests or procedures that exhibited the failure symptoms. In the course of testing the system, do the following:

Step	Action
1	Note any power-up error or status messages on the monitor screen.

Continued on next page

Step	Action
2	Display the system device configuration by using the SHOW CONFIG command (see the System Preparation section). Compare the latest configuration display with the configuration display you viewed during system preparation. You should see the new device and the other devices present in the system. Verify that no error messages appear on the monitor screen.
3	Verify that all devices are interacting correctly by using the TEST 100 command to run the system exerciser.
4	Verify that drives are set to the correct SCSI IDs using the SHOW DEVICE command.
5	If problems occur, be sure that: All cables inside and outside the system are connected. All modules are fully seated in their connectors. SCSI IDs are set correctly. There should not be any duplicate SCSI IDs. Refer to Table 6–2 for standard SCSI ID settings.

Continued on next page

TURBOchannel Option

Overview

The TURBOchannel option is a high-performance input/output interconnection that provides a data communications path. It allows you to install additional options, such as the following, in your system:

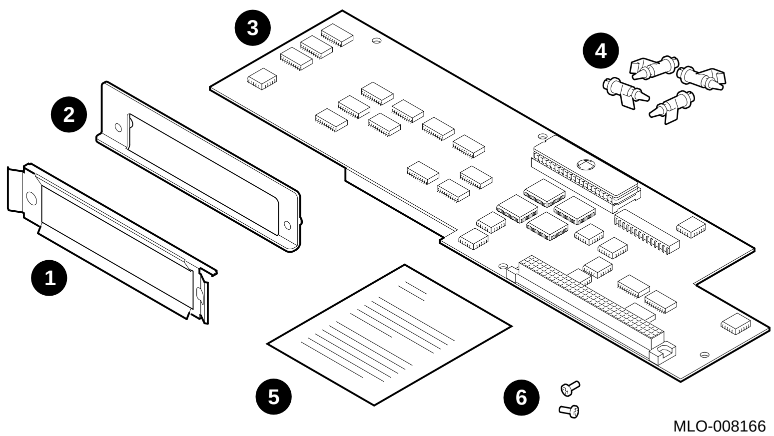
- A second Ethernet connection
- A second SCSI channel
- An FDDI network
- A VME adapter
- A third-party TURBOchannel device

Shipping Contents

TURBOchannel Adapter Components

Figure 6–17 shows the components that ship with the TURBOchannel adapter.

Figure 6–17 TURBOchannel Adapter Components



Continued on next page

Adapter Component Descriptions

Table 6–6 describes the TURBOchannel adapter components shown in Figure 6–17.

Table 6–6 TURBOchannel Adapter Components

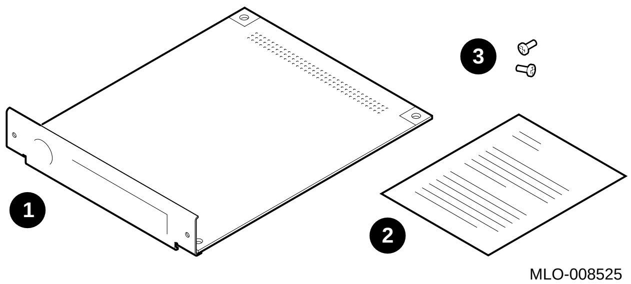
Number	Component	Function
❶	FCC Shield	Seals the opening
❷	Metal option plate	Helps to mount the option
❸	TURBOchannel adapter board	Converts bus
❹	Four plastic standoffs	Hold the adapter board in place
❺	Documentation	Explains how to install the TURBOchannel adapter and the option
❻	Two Phillips screws	Secures the metal bracket on the TURBOchannel option to the system unit

Continued on next page

TURBOchannel Option Components

Figure 6–18 shows the components that ship with the TURBOchannel option.

Figure 6–18 TURBOchannel Option Components



Important

Use the option guide and the screws in the adapter shipping package when installing the TURBOchannel option ❶.

The document ❷ and the two screws ❸ that ship with this option package are not necessary. You can discard them.

TURBOchannel Adapter and Option Modules

TURBOchannel Adapter and Option Removal

Table 6–7 provides an overview of how to remove and replace the TURBOchannel adapter and the TURBOchannel option.

Table 6–7 TURBOchannel Adapter/Option Removal

Step	Action
1	Disconnect the TURBOchannel option cable.
2	Remove the two screws that hold the option plate over the outside of the TURBOchannel option.
3	Disconnect and remove the SCSI cable from the system board and from the opening over the external TURBOchannel port.
4	Remove the graphics module.
5	Pivot the TURBOchannel option upward and lift it out.
6	Remove the TURBOchannel adapter from the four plastic standoffs.
7	Replace in reverse order.

Installing the TURBOchannel Option

Installation Overview

Table 6–8 provides an overview of the TURBOchannel option installation procedure. Each step is explained in more detail in the following sections.

Table 6–8 TURBOchannel Option Installation Procedure

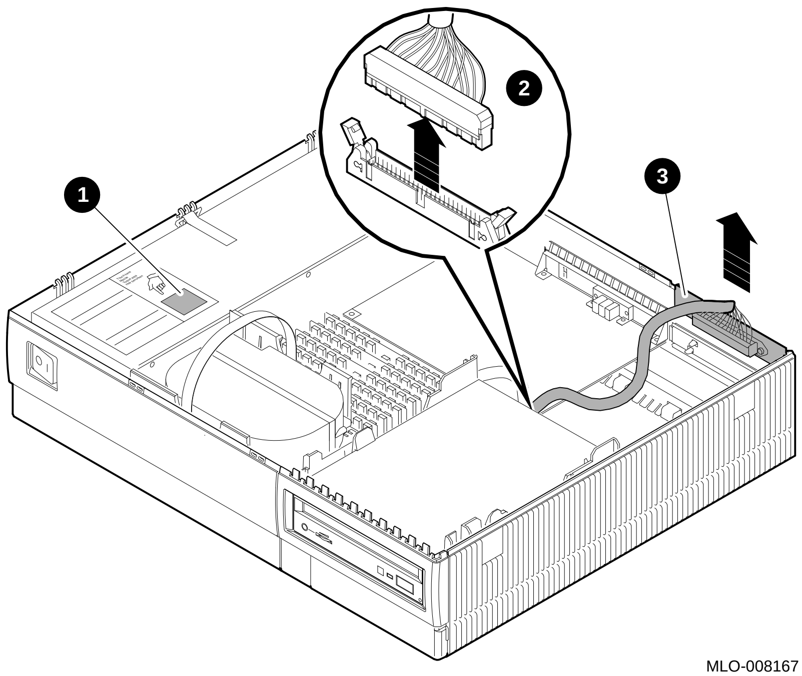
Step	Action
1	Touch the TOUCH HERE space on the power supply.
2	Disconnect the SCSI cable.
3	Remove the option plate.
4	Remove the graphics board (if applicable).
5	Insert the TURBOchannel adapter board.
6	Replace the graphics board.
7	Attach the FCC shield.
8	Reconnect the SCSI cable.
9	Install the TURBOchannel option.
10	Attach the option plate.

Continued on next page

TOUCH HERE Space

As soon as you remove the cover, and before you remove anything else, touch the space labeled TOUCH HERE (Figure 6–19 ❶), to avoid damage from static discharge.

Figure 6–19 Inside the System Box



Disconnect the SCSI Cable

Disconnect the SCSI cable from the system unit by pushing the two side clips out, then lifting the cable off.

Disconnect the other end of the SCSI cable that rests in the opening over the TURBOchannel connector.

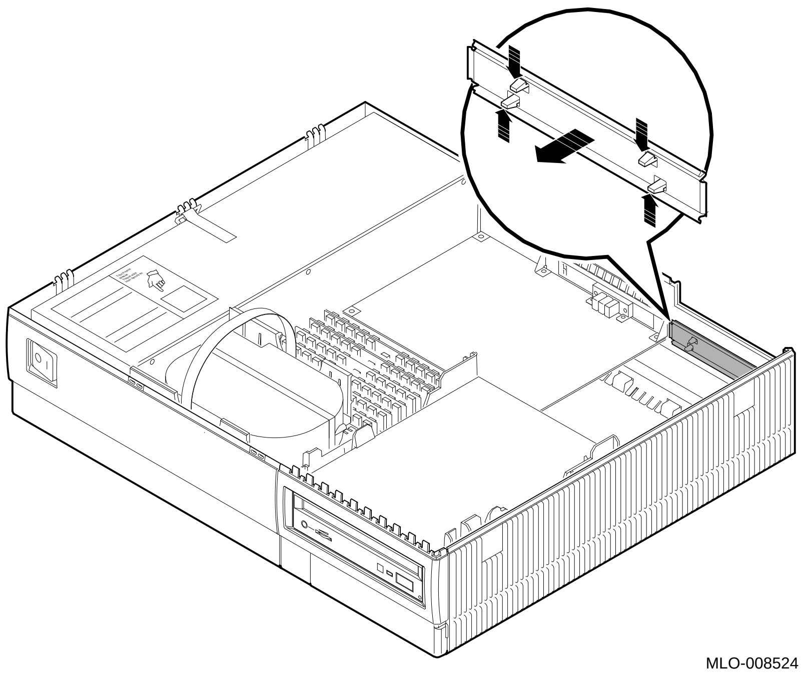
Continued on next page

Remove the Option Plate

Remove the option plate that covers the TURBOchannel option port opening.

Squeeze the tabs together, then pull the plate out, as shown by the arrows in Figure 6–20.

Figure 6–20 Removing the Filler Plate



Remove the Graphics Board

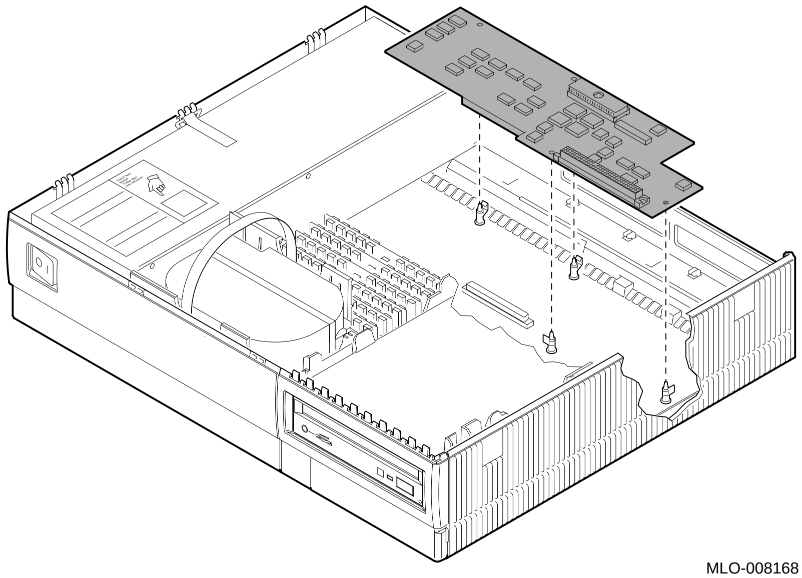
If there is a a graphics board present, you need to remove it. Follow the steps shown in the Removing the SPXg 8-plane Option procedure.

Insert the Adapter Board

Insert the four plastic standoffs in the correct location, then align the TURBOchannel adapter board holes over the standoffs, as shown in Figure 6–21. Press the board down, snapping the board down over each standoff to secure it.

Continued on next page

Figure 6–21 Inserting the TURBOchannel Adapter Board



Replace the Graphics Board

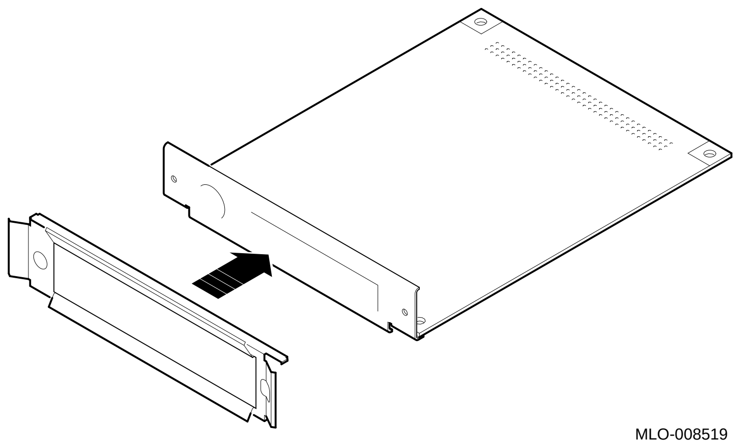
Replace the graphics board in your system unit. Refer to the Installing the SPXg 8-plane Option procedure.

Continued on next page

Attaching the FCC Shield

Attach the FCC shield to the front of the TURBOchannel option module, over the metal bracket, as shown in Figure 6–22.

Figure 6–22 Attaching the FCC Shield



Reconnect the SCSI Cable

Reconnect the SCSI cable to the port slot above the TURBOchannel option port.

Continued on next page

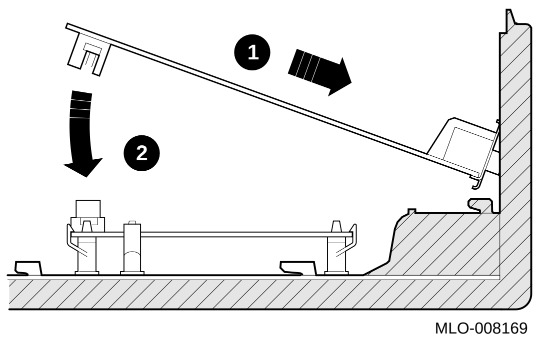
Install the TURBOchannel Option

Install the TURBOchannel option module to the right of the graphics board.

❶ Slide the TURBOchannel option module firmly towards the front.

❷ Press the rear of the module so that the connector underneath slides into the connector on the TURBOchannel adapter board.

Figure 6–23 Inserting the TURBOchannel Option



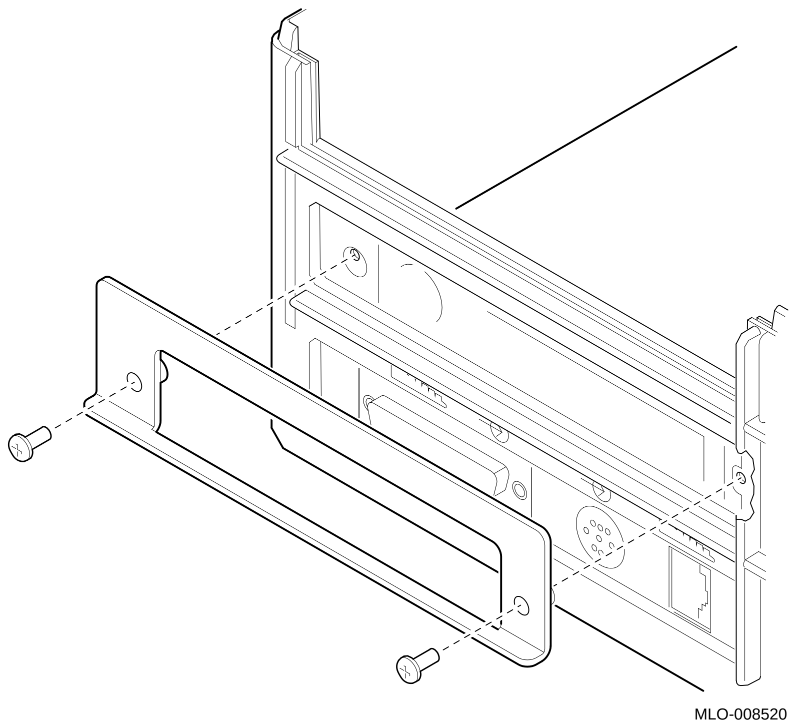
Continued on next page

Attach the Option Plate

Place the metal option plate over the outside of the TURBOchannel option, as shown in Figure 6–24.

Screw the option plate into the TURBOchannel option module using the two Phillips screws, as shown in Figure 6–24.

Figure 6–24 Screwing on the Option Plate



This completes the TURBOchannel option installation. You now need to test the installation.

Continued on next page

Testing the Installation

To test your TURBOchannel option installation, follow the instructions in Testing the VAXstation 4000 Model 90 System.

Callout ❶ of Figure 6–25 shows the line in the SHOW CONFIG display that indicates a successful TURBOchannel option installation.

Figure 6–25 Testing the TURBOchannel Option Installation

```
>>> SHOW CONFIG

KA49-A V0.0-051-V4.0
08-00-2B-F3-31-03
16MB

DEVNBR  DEVNAM   INFO
------  ------   --------------------------------
  1      NVR      OK
  2      LCSPX    OK
                  Highres - 8 plane 4mPixel FB-V0.8
  3      DZ       OK
  4      CACHE    OK
  5      MEM      OK
                  16MB=0A,0B,0C,0D=4MB,IE,IF,IG,IH=0MB
  6      FPU      OK
  7      IT       OK
  8      SYS      OK
  9      NI       OK
 10      SCSI     OK
                  1-RZ25  2-RRD42  6-INTR
 11      AUD      OK
 12      COMM     OK
 13      TCA      OK
                  OPT  PRS  T0.2
>>>
```

LJ-02223-TI0

TURBOchannel Specifications

Specifications

Table 6–9 provides the specifications for the TURBOchannel option.

Table 6–9 TURBOchannel Specifications

Air flow	150 LFM
Connector	96-pin DIN
Data path	32-bit multiplexed address/data
Nonoperating storage temperature	0 to 50°C (32 to 89.6°F)
Operating temperature	10 to 40°C (50 to 104°F)
Operating temperature *With tape or floppy*	15 to 32°C (59 to 90°F)
Protocol	Synchronous, 12.5 MHz
Relative humidity	10% to 90%, noncondensing

Appendix A
Diagnostic Error Codes

Overview

In this Chapter

The system firmware always tries to report any detected hardware errors to the console device and to the LEDs located on the front of the system box. Errors are reported as a result of failures during the power-up tests or during user initiated tests. The error codes identify the device and the test that failed.

The topics covered in this chapter include:

- Error Messages
  - Extended Error Messages
  - FRU Codes
- Self-Test Error Messages
  - TOY/NVR
  - DZ
  - SCSI DMA
  - OBIT
  - CACHE
  - Memory
  - FPU
  - SYS Device
  - Network Interface
  - SCSI
  - Audio
  - DSW21 Synch Communications

Continued on next page

Overview, Continued

  - TURBOchannel Adapter
  - LCSPX
- System Test Error Messages
  - SCSI
  - DSW21 Communications Device
- Utility Error Messages
  - SCSI
  - LCSPX
  - SPXg/gt

Error Messages

Overview

The system reports two kinds of self-test errors.

- Errors that display on the console immediately after running the self test

  These error messages consist of one or two question marks to indicate a nonfatal or fatal error, the failing FRU, the device that failed, and a general error code.

- Extended test errors

  These error messages display more detailed information. To view an extended error message, enter the SHOW ERROR command at the console prompt, after the test has reported an error.

Immediate Error Message Format

The following example shows the format for immediate error messages:

```
?? 150 10 SCSI 0050
```

Message	Meaning
??	Indicates whether the failure is fatal or non-fatal. — A double question mark (??) indicates a fatal error. — A single question mark (?) indicates a non-fatal error.
150	The field replaceable unit (FRU). See Table A–1. In this case it is a SCSI drive with the device ID set to 5.

Continued on next page

Message	Meaning
10	The device identification (decimal). This value corresponds to the left bank of four LEDs (hexadecimal). This ID also corresponds to the mnemonic in the next field. Use Table 5–4 to correlate the error code to a device.
SCSI	The mnemonic of the device ID.
50	The error code that displays following the test is in decimal. The extended message error codes have a hexadecimal format. When you look up an error code in the error code tables, you must know whether the code is in hexadecimal or decimal.

Extended Error Messages

You can display the extended error messages by entering the SHOW ERROR command at the console prompt following the completion of a test. The extended error message has two lines.

- An error line similar to the immediate error code. The error code (last field of the first line) is in hexadecimal.
- A second line with up to eight longwords of error information.

Extended Error Message Format

The extended error messages appear in the following format:

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

Continued on next page

Message	Meaning
First line of error message	
??	Indicates whether the failure is fatal or non-fatal. • A double question mark (??) indicates a fatal error. • A single question mark (?) indicates a non-fatal error.
150	Field replaceable unit (FRU). See Table A–1.
10	Device identification (Value is given in decimal. Translates to SCSI)
SCSI	Mnemonic of failed module
32	Error Code in hexadecimal
Second line of error message	
150	Field replaceable unit (FRU)
000E	Error code format. The format dictates the meaning of the remaining longwords of error information. This remaining information is not normally required for service.

Continued on next page

FRU Codes

The FRU code identifies the field replaceable unit that failed. The FRU codes and their names are listed in the following table.

Table A–1 FRU Codes

Code	FRU
001	System module. The mnemonic identifies the device.
002	Keyboard
003	Mouse
004	Monitor #1
005	Monitor #2
010-019	Graphics modules
020-029	COMM options
030-039	BUS adapters

Memory Module Codes 040-049

Code	Module Location
040	0A
041	1E
042	0C
043	1G
044	1F
045	0B
046	1H
047	0D

Continued on next page

Table A–1 (Continued) FRU Codes

Code	FRU
SCSI Drive Codes 100-199	
Code	**Drive with ID**
100	0
110	1
120	2
130	3
140	4
150	5
160	6
170	7

Self-Test Error Messages

TOY/NVR

Table A–2 lists the TOY/NVR self-test decimal and hexadecimal error messages and their meanings.

Table A–2 TOY/NVR Self-Test Error Messages

Decimal	Hexadecimal	Meaning
4	4	Battery faulty.
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 faulty.
44	2c	Battery down, VRT failure, and NVR test has failed.
48	30	TOY Register test and VRT have failed.
64	40	Battery Check test has failed; hard error.
65	41	Battery Check test has failed; soft error.
72	48	Battery Check test and NVR Register test have failed.
96	60	VRT Bit failure and Battery Check test has failed.
104	68	Battery Check test, VRT, and NVR test have failed.
128	80	Update in progress has failed to clear; hard error.

Continued on next page

Table A–2 (Continued) TOY/NVR Self-Test Error Messages

Decimal	Hexadecimal	Meaning
129	81	Update in progress has failed to clear; soft error.
160	A0	Update in progress has failed and VRT bit failure.

DZ

Table A–3 lists the error messages in decimal and hexadecimal format that are returned by the DZ self-test.

Table A–3 DZ Self-Test Error Codes

Decimal	Hexadecimal	Meaning
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 displays extended error information when an error occurs. Enter the SHOW ERROR command to view the extended error information. The extended error code format is shown in the following examples.

This extended error code is returned by the DZ Read LPR test or if a character comparison error occurs in the other DZ tests.

Continued on next page

Extended Error Format

```
001 000A ssssssss cccccccc lprlprlp llllllll rrrrrrrr eeeeeeee
```

Format	Meaning
ssssssss	The sub-error code
cccccccc	The value of the DZ CSR
lprlprlp	The contents of the line parameter register
llllllll	The line number
rrrrrrrr	The data read back
eeeeeeee	The data expected

The extended error code messages in the following formats are returned by polled and interrupt test when a transfer times out.

```
001 000B ssssssss cccccccc lprlprlp llllllll xxxxxxxx tttttttt
```

Format	Meaning
ssssssss	The sub-error code
cccccccc	The value of the DZ CSR
lprlprlp	The contents of the line parameter register
llllllll	The line number
xxxxxxxx	The number of characters transmitted
tttttttt	The value of the DZ transmit control register

Continued on next page

Self-Test Error Messages, Continued

The suberror codes reported by the DZ self-test are as follows:

Table A–4 DZ Suberror codes

Suberror (hexadecimal)	Meaning
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
31	DZ Modem test - Failed RTS <-> CTS loopback
32	DZ Modem test - Failed DSRS <-> DSR & CD loopback
33	DZ Modem test - Failed LLBK <-> SPDMI loopback
34	DZ Modem test - Failed DTR <-> RI loopback
41	DZ Polled test - transfer has timed out
42	DZ Polled test - data is not valid
43	DZ Polled test - Parity Error
44	DZ Polled test - Framing Error
45	DZ Polled test - Overrun Error
46	DZ Polled test - Character received != Character transmitted
51	DZ Interrupt test - transfer has timed out
52	DZ Interrupt test - data is not valid
53	DZ Interrupt test - Parity Error
54	DZ Interrupt test - Framing Error
55	DZ Interrupt test - Overrun Error

Continued on next page

Table A–4 (Continued) DZ Suberror codes

Suberror (hexadecimal)	Meaning
56	DZ Interrupt test - Character received != Character transmitted
61	DZ LK401 test - transfer has timed out
62	DZ LK401 test - LK401 has failed self-test
71	DZ Mouse test - transfer has timed out
72	DZ Mouse test - Mouse has failed self-test

SCSI DMA

This table lists the SCSI DMA self-test error codes.

Table A–5 SCSI DMA Self-Test Error Codes

Error		
Decimal	Hexadecimal	Meaning
2	2	Data and Parity test
4	4	SCSI MAP RAM Address/Shorts tests

Continued on next page

OBIT

Table A–6 lists the OBIT self-test decimal and hexadecimal error codes.

Table A–6 OBIT Self-Test error codes

Decimal	Hexadecimal	Meaning
6	6	Failed floating 1s and 0s data test
8	8	Failed verify background pattern = AAAAAA, write 555555
10	A	Failed verify second pattern = 555555, write 0
12	C	Failed verify background pattern = 0, then write FFFFFF
14	E	Failed verify second pattern = FFFFFF, write 0 and good ECC

Continued on next page

CACHE

Table A–7 lists the CACHE self-test decimal and hexadecimal error codes.

Table A–7 CACHE Self-Test Error codes

Decimal	Hexadecimal	Meaning
16	10	Backup Tag Store was not written correctly
32	20	Backup Cache Data Line Test Error
48	30	Backup Cache Data RAM March Test Error
64	40	Backup Cache Mask Write Error byte
65	41	Backup Cache Mask Write Error word
66	42	Backup Cache Mask Write Error lw
67	43	Backup Cache Mask Write Error lw
68	44	Backup Cache Mask Write Error lw, entire subblock
69	45	Unaligned LW Write Within a Block Error
70	46	Unaligned LW Write Within a Block Error
71	47	Unaligned LW Write Across 2 Blocks error
72	48	Unaligned LW Write Across 2 Blocks error
80	50	Data store ECC syndrome does not match
81	51	Cache tag bits, ECC bits, are incorrect
96	60	Syndrome bits do not match
97	61	Syndrome bits do not match

Continued on next page

Extended errors reported by the SCSI DMA, OBIT, and BCACHE tests are formatted as follows:

```
001 000a aaaaaaaa bbbbbbbb cccccccc dddddddd
```

Format	Meaning
aaaaaaaa	BCTAG IPR address that failed the test
bbbbbbbb	Expected value of the data pattern
cccccccc	Data that was read from the failing address
dddddddd	CCTL register contents

```
001 000b aaaaaaaa bbbbbbbb cccccccc dddddddd
```

Format	Meaning
aaaaaaaa	Address that failed the test
bbbbbbbb	Expected value of the data pattern
cccccccc	Data that was read from the failing address
dddddddd	ObitMode(NMC_CSR19) OBIT test only

Memory

This section contains information on the error codes returned by the memory self-test. Table A–8 list the decimal and hexadecimal error codes that can be returned by the memory self-test.

Continued on next page

Table A–8 MEM Self-Test Error Codes

Decimal	Hexadecimal	Meaning
64	40h	Bank 0 1 or more SIM modules missing.
66	42h	Bank 0 SIM modules not all same size.
68	44h	Bank 2 1 or more SIM modules missing.
70	40h	Bank 2 SIM modules not all same size.
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 test displays extended error information when an error occurs. Enter the SHOW ERROR command to view the extended error information. The extended error code format is shown next.

Continued on next page

Extended Error Format:

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

Format	Meaning
xxx	The FRU where the failure occurred
yyyy	The error code in Hexadecimal
00a	Extended error information format type
bbbbbbbb	The contents of the Memory System Error register (MSER)
cccccccc	The failing address
dddddddd	The expected data
eeeeeeee	The data that was read

MEM SIM Module FRU Values

Table A–9 lists the MEM SIM module FRU values.

Table A–9 MEM SIM Module FRU Values

FRU (decimal)	SIM Module	BANK
040	0A	0
041	1E	1
042	0C	0
043	1G	1
044	1F	1
045	0B	0

Continued on next page

Table A–9 (Continued) MEM SIM Module FRU Values

FRU (decimal)	SIM Module	BANK
046	1H	1
047	0D	0

FPU

Table A–10 lists the floating point diagnostic decimal and hexadecimal error codes.

Table A–10 FPU Self-Test Error Codes

Decimal	Hexadecimal	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.
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.

Continued on next page

Self-Test Error Messages, Continued

Table A–10 (Continued) FPU Self-Test Error Codes

Decimal	Hexadecimal	Meaning
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.
3332	D04	Unexpected Exception has occurred during SUBFx test.

Continued on next page

Table A–10 (Continued) FPU Self-Test Error Codes

Decimal	Hexadecimal	Meaning
3586	E02	TSTF Instruction test has failed.
3588	E04	Unexpected Exception has occurred during TSTF test.

The FPU test displays extended error information when an error occurs. Enter the SHOW ERROR Command to view the extended error information. The extended error formats are shown in the following examples.

Extended Error Format:

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

Format	Meaning
VVVVVVVV	The vector of the unexpected interrupt
EEEEEEEE	Other exception data. This is only printed on machine checks and arithmetic traps.

Table A–11 lists the vectors that the floating point test detect unexpected interrupts.

Table A–11 FP Exception Vectors

Vector	Description
004	Machine check vector number
010	Privileged instruction vector
014	Customer reserved instruction vector

Continued on next page

Table A–11 (Continued) FP Exception Vectors

Vector	Description
018	Reserved operand vector
01c	Reserved Addressing mode vector
034	Arithmetic Trap vector

Interval Timer

Table A–12 lists the interval timer self-test decimal and hexadecimal error codes and their meanings.

Table A–12 IT Self-Test Error Codes

Decimal	Hexadecimal	Meaning
2	2	Interval Timer is not interrupting at the correct rate

SYS Device

Table A–13 lists the SYS Device error codes and their meanings

Table A–13 SYS Self-Test error codes

Decimal	Hexadecimal	Meaning
2	2	System ROM Test has failed

If the invalidate filter RAM error occurs, an extended error message displays. The extended error code format is shown in the next example.

Continued on next page

Extended Error Format:

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

```
001 0010 aaaaaaaa rrrrrrrr eeeeeeee
```

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

Network Interface

Table A–14 lists the decimal and hexadecimal error codes returned by the network interface (NI) self-test. If an NI error occurs, first verify that a loopback connector is installed on the selected network port on the back of the system box or that the network cable is firmly connected. Re-execute the NI self-test, if necessary.

Table A–14 NI Self-Test Error Codes

Decimal	Hexadecimal	Meaning
16	10	Network Address ROM: read access failed
18	12	Network Address ROM: null address
20	14	Network Address ROM: bad group address
22	16	Network Address ROM: bad checksum
24	18	Network Address ROM: bad group 2
26	1A	Network Address ROM: bad group 3

Continued on next page

Table A–14 (Continued) NI Self-Test Error Codes

Decimal	Hexadecimal	Meaning
28	1C	Network Address ROM: bad test patterns
30	1E	SGEC CSR0 R/W error
32	20	SGEC CSR1 R/W error
34	22	SGEC CSR2 R/W error
36	24	SGEC CSR3 R/W error
38	26	SGEC CSR4 R/W error
40	28	SGEC CSR5 R/W error
42	2A	SGEC CSR6 R/W error
44	2C	SGEC CSR7 R/W error
46	2E	SGEC CSR8 R/W error
48	30	SGEC CSR9 R/W error
50	32	SGEC CSR10 R/W error
52	34	SGEC CSR11 R/W error
54	36	SGEC CSR12 R/W error
56	38	SGEC CSR13 R/W error
58	3A	SGEC CSR14 R/W error
60	3C	SGEC CSR15 R/W error
62	3E	SGEC Chip self-test: ROM error
64	40	SGEC Chip self-test: RAM error
66	42	SGEC Chip self-test: Address filter RAM error
68	44	SGEC Chip self-test: Transmit FIFO error
70	46	SGEC Chip self-test: Receive FIFO error

Continued on next page

Table A–14 (Continued) NI Self-Test Error Codes

Decimal	Hexadecimal	Meaning
72	48	SGEC Chip self-test: Self-Test loopback error
74	4A	SGEC Initialization: Setup frame send failure
76	4C	SGEC Interrupts: initialization failed
78	4E	SGEC Interrupts: transmit failed
80	50	SGEC Interrupts: receive failed
82	52	SGEC Interrupts: packet comparison failed
84	54	SGEC Interrupts: NI ISR not entered
86	56	SGEC Interrupts: NI ISR entered multiple times
88	58	SGEC CRC: initialization failed
90	5A	SGEC CRC: transmit failed
92	5C	SGEC CRC: receive failed
94	5E	SGEC CRC: packet comparison failed
96	60	SGEC CRC: SGEC generated bad CRC
98	62	SGEC CRC: SGEC rejected good CRC
100	64	SGEC CRC: SGEC accepted bad CRC
102	66	SGEC CRC: Other error
104	68	SGEC Collision: initialization failed
106	6A	SGEC Collision: unknown transmit error
108	6C	SGEC Collision: RETRY not flagged
110	6E	SGEC Collision: transmitter disabled

Continued on next page

Table A–14 (Continued) NI Self-Test Error Codes

Decimal	Hexadecimal	Meaning
112	70	SGEC Address filtering: initialization failed
114	72	SGEC Address filtering: transmit failed
116	74	SGEC Address filtering: receive failed
118	76	SGEC Address filtering: packet comparison failed
120	78	SGEC Address filtering: broadcast filtering failed
122	7A	SGEC Address filtering: promiscuous mode failed
124	7C	SGEC Address filtering: null destination accepted
126	7E	SGEC Address filtering: good logical address rejected
128	80	SGEC External loopback: initialization failed
130	82	SGEC External loopback: packet comparison failed
132	84	SGEC External loopback: check NI port connector

The NI self-test also returns extended error information when an error occurs. This information is available by entering the SHOW ERROR command. The first value is the FRU; the second value is the extended error format number in hexadecimal. The remaining values are in hexadecimal. The extended error format can be one of several types.

Continued on next page

NI EXTENDED ERROR FORMAT 1h: Register Error

```
0001 0001 aaaaaaaa bbbbbbbb cccccccc
```

Format	Meaning
aaaaaaaa	The register number
bbbbbbbb	The expected data - data written
cccccccc	The actual data - data read

NI EXTENDED ERROR FORMAT Bh: Network Address ROM Address Group Error

```
0001 000B aaaaaaaa bbbbbbbb cccccccc 0000dddd
```

Format	Meaning
aaaaaaaa	Base address of the Network Address ROM
bbbbbbb	First four bytes of the network address
cccccccc	Next two bytes of the network address and the two byte checksum
dddd	Calculated checksum

NI EXTENDED ERROR FORMAT Ch: Network Address ROM Test Pattern Error

```
0001 000C aaaaaaaa bbbbbbbb cccccccc
```

Format	Meaning
aaaaaaaa	Base address of the Network Address ROM test patterns
bbbbbbbb	First four bytes of test patterns
cccccccc	Last four bytes of test patterns

Continued on next page

NI EXTENDED ERROR FORMAT Eh: Transmit Error

```
0001 000E aaaaaaaa bbbbbbbb cccccccc dddddddd
```

Format	Meaning
aaaaaaaa	Actual value of SGEC CSR5
bbbbbbbb	Physical address of current transmit descriptor
cccccccc	First longword of the transmit descriptor
dddddddd	Second longword of transmit descriptor

NI EXTENDED ERROR FORMAT Fh: Receive Error

```
0001 000F aaaaaaaa bbbbbbbb cccccccc dddddddd
```

Format	Meaning
aaaaaaaa	Actual value of SGEC CSR5
bbbbbbbb	Physical address of current receive descriptor
cccccccc	First longword of the receive descriptor
dddddddd	Second longword of receive descriptor

NI EXTENDED ERROR FORMAT 10h: Packet Error

```
0001 0010 00000000 bbbbbbbb cccccccc dddddddd
```

Format	Meaning
bbbbbbbb	Packet length
cccccccc	Packet pattern or packet index
dddddddd	A number from 0-4

Continued on next page

NI EXTENDED ERROR FORMAT 11h: Interrupt Error

`0001 0011 aaaaaaaa`

Format	Meaning
aaaaaaaa	Actual value of SGEC CSR5

SCSI

Table A–15 lists the decimal and hexadecimal error codes returned by the SCSI self-test.

Table A–15 SCSI Self-Test Error Codes

Decimal	Hexadecimal	Meaning
2	2	SCSI Reset Register test has failed.
4	4	SCSI Configuration Register test has failed.
6	6	SCSI FIFO register test has failed.
8	8	SCSI Transfer Count Register 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.

Continued on next page

Table A–15 (Continued) SCSI Self-Test Error Codes

Decimal	Hexadecimal	Meaning
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.
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.

Continued on next page

Table A–15 (Continued) SCSI Self-Test Error Codes

Decimal	Hexadecimal	Meaning
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 also returns extended error information when an error occurs. This information is available by entering the SHOW ERROR command. The extended error codes can be of the following types:

EXTENDED ERROR FORMAT 1(h):

This error format is used by the register test.

```
001 0001 aaaaaaaa bbbbbbbb cccccccc dddddddd
```

Format	Meaning
aaaaaaaa	The error code
bbbbbbbb	Address of register or location being accessed
cccccccc	Expected data or data written
dddddddd	Actual data or data read

Continued on next page

EXTENDED ERROR FORMAT B(h):

This error format is used by the register test.

```
001 000B aaaaaaaa bbbbbbbb cccccccc
```

Format	Meaning
aaaaaaaa	The error code
bbbbbbbb	The address of register or location being accessed
cccccccc	Information about the error

EXTENDED ERROR FORMAT C(h):

This error format is used by the interrupt test.

```
001 000C aaaaaaaa bbbbbbbb cccccccc dddddddd eeeeeeee ffffffff
```

Format	Meaning
aaaaaaaa	The error code
bbbbbbbb	Information about the error
cccccccc	Contents of interrupt mask register
dddddddd	Contents of interrupt request register
eeeeeeee	Contents of controller status register
ffffffff	Contents of controller interrupt register

Continued on next page

EXTENDED ERROR FORMAT D(h):

This error 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
```

Format	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
hhhhhhhh	Number of data bytes received

EXTENDED ERROR FORMAT E(h):

This error format is used when execution of a SCSI command fails for some reason.

```
aaa 000E bbbbcccc ddddeeee ffffgggg hhhhiiii jjjjjjjj kkkkllll
mmmmmmmm
```

Format	Meaning
aaa	FRU
bbbb	Logical unit number
cccc	Device ID
dddd	Actual command opcode
eeee	Current command opcode
ffff	Error code

Continued on next page

Format	Meaning
gggg	Mode of operation
hhhh	Byte 14 of the request sense packet (device FRU)
iiii	Information about the error
jjjjjjjj	SCSI Bus phase at the time of the error
kkkk	Contents of the Controller Status register at the time of error
llll	Contents of the Controller Interrupt register at the time of error
mmmmmmmm	Request sense key

EXTENDED ERROR FORMAT F(h):

This error format is used when 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
```

Format	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	Status byte returned in status phase

Continued on next page

Format	Meaning
kkkkkkkk	Request sense key

EXTENDED ERROR FORMAT 10(h):

This error 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
```

Format	Meaning
aaa	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 request sense
kkkkkkkk	Request sense key

Continued on next page

EXTENDED ERROR FORMAT 11(h):

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

```
aaa 0011 bbbbcccc ddddeeee ffffgggg hhhhiiii jjjjkkkk llllllll
mmmmmmmm
```

Format	Meaning
aaa	The FRU
bbbb	The 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
jjjj	Contents of the Controller Status register at the time of error
kkkk	Contents of the Controller Interrupt register at the time of error
llllllll	Number of bytes actually sent in data in/out phase
mmmmmmmm	Number of bytes that should have been sent in data in/out

Continued on next page

EXTENDED ERROR FORMAT 12(h):

This error format is used when an unsupported message is seen.

```
aaa 0012 bbbbcccc ddddeeee ffffgggg hhhhiiii jjjjjjjj kkkkllll
mmmmmmmm
```

Format	Meaning
aaa	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	First message byte of message in phase that error occurred in
kkkk	Contents of the Controller Interrupt register at the time of error
llll	Contents of the Controller Status register at the time of error
mmmmmmmm	Request sense key

Continued on next page

EXTENDED ERROR FORMAT 13(h):

This error format is used by the Map Error test.

```
aaa 0013 bbbbcccc dddddddd eeeeeeee ffffffff gggggggg hhhhhhhh
iiiiiiii
```

Format	Meaning
aaa	The FRU
bbbb	Logical unit number
cccc	Device ID
dddddddd	DMA Address where the SCSI command is located
eeeeeeee	DMA Address where the SCSI data is located
ffffffff	Contents of the parity control register
gggggggg	Map register address
hhhhhhhh	Contents of the map register
iiiiiiii	Error code

Continued on next page

EXTENDED ERROR FORMAT 14(h):

This error format is used by the Data Transfer test when the number of bytes received from two transfers is different.

```
aaa 0014 bbbbbbbb cccccccc dddddddd
```

Format	Meaning
aaa	The FRU
bbbbbbbb	The first number of bytes
cccccccc	The second number of bytes
dddddddd	Error code

EXTENDED ERROR FORMAT 15(h):

This error 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 cccccccc
```

Format	Meaning
aaa	The FRU
bbbbbbbb	The number of the byte that failed
cccccccc	The error code

Continued on next page

The FRU reported by all error formats is either 1 for the system board FRU, or (100 + device_id*10 + logical unit number.

Table A–16 lists the information values reported by some extended SCSI self-test errors. Hexadecimal values are used for self-test.

Table A–16 SCSI Information Values

Information Decimal	Information Hexadecimal	Meaning
1	1	Valid group code bit clear in Controller status register
2	2	Valid group code bit set in Controller status register
3	3	Terminal count bit clear in Controller status register
4	4	Terminal count bit set in Controller status register
5	5	Parity error bit clear in Controller status register
6	6	Parity error bit set in Controller status register
7	7	Gross error bit clear in Controller status register
8	8	Gross error bit set in Controller status register
9	9	Interrupt bit clear in Controller status register
10	A	Interrupt bit set in Controller status register
11	B	Selected bit clear in Controller Interrupt register

Continued on next page

Table A–16 (Continued) SCSI Information Values

Information Decimal	Hexadecimal	Meaning
12	C	Selected bit set in Controller Interrupt register
13	D	Select with attention bit clear in Controller Interrupt register
14	E	Select with attention bit set in Controller Interrupt register
15	F	Reselected bit clear in Controller Interrupt register
16	10	Reselected bit set in Controller Interrupt register
17	11	Function complete bit clear in Controller Interrupt register
18	12	Function complete bit set in Controller Interrupt register
19	13	Bus service bit clear in Controller Interrupt register
20	14	Bus service bit set in Controller Interrupt register
21	15	Disconnect bit clear in Controller Interrupt register
22	16	Disconnect bit set in Controller Interrupt register
23	17	Illegal command bit clear in Controller Interrupt register
24	18	Illegal command bit set in Controller Interrupt register
25	19	SCSI Reset bit clear in Controller Interrupt register

Continued on next page

Table A–16 (Continued) SCSI Information Values

Information Decimal	Hexadecimal	Meaning
26	1A	SCSI Reset bit set in Controller Interrupt register
27	1B	Arbitration not won
28	1C	Selection timeout
29	1D	Invalid sequence in Sequence Step register
30	1E	FIFO flags are not clear
31	1F	FIFO flags are clear
32	20	Unexpected ISR hit
33	21	SCSI Interrupt request set in system interrupt request register
34	22	SCSI Bit set unexpectedly in Controller status register
35	23	Interrupt service routine was not entered
36	24	No SCSI interrupt request was seen
37	25	Interrupt bit in Controller status register will not clear
38	26	SCSI Bit in system interrupt request register will not clear
39	27	Bad request sense key
40	28	Bad status returned from status phase
41	29	Not enough sense data returned from a request sense command
42	2A	Phase did not go to command phase
43	2B	Phase did not go to message out phase

Continued on next page

Table A–16 (Continued) SCSI Information Values

Information Decimal	Hexadecimal	Meaning
44	2C	Phase did not go to message in phase
45	2D	Command phase changed too soon
46	2E	Data out phase changed too soon
47	2F	Message in phase changed too soon
48	30	Message out phase changed too soon
49	31	Stuck in command phase
50	32	Stuck in message in phase
51	33	Stuck in message out phase
52	34	Stuck in data out phase
53	35	Stuck in data in phase
54	36	Should not be in message out phase
55	37	No interrupt after sending SCSI command
56	38	No interrupt after sending command complete
57	39	No interrupt after sending message accepted
58	3A	No interrupt after sending transfer information
59	3B	All data out bytes were not sent
60	3C	Command complete message was sent but device didn't drop off bus

Continued on next page

Table A–16 (Continued) SCSI Information Values

Information Decimal	Hexadecimal	Meaning
61	3D	Unexpected message reject from device
62	3E	FIFO flag count is wrong
63	3F	Message is unsupported
64	40	Bus device reset was sent, but device didn't drop off bus
65	41	Illegal phase
66	42	Should not be in data in phase
67	43	Problem with a device trying to reconnect
68	44	Unexpected disconnect message received
69	45	Device not seen before is trying to reconnect
70	46	Bad identify message received on reconnection
71	47	Out of retries for this command
72	48	Too many bytes sent in data out phase
73	49	Too many bytes received in data in phase
74	4A	Reconnection timeout
75	4B	SCSI Parity error
76	4C	SCSI Map error

Continued on next page

Mode Values

The mode values reported by some extended SCSI self-test errors are as follows:

Table A–17 SCSI mode values

Mode (hexadecimal)	Meaning
0	Asynchronous mode with programmed I/O
1	Asynchronous mode with DMA
2	Synchronous mode with DMA

Overview

The audio self-test (AUD) is divided into three major sections.

- Register tests
- Audio tests
- Interrupt tests

Registers are tested by writing data then reading back the data, or reading the READ_ONLY registers.

The audio test generates a sequence of eight tones and sends them to the speaker. It also performs an internal digital loopback through the MAP. This tests the three MUX channels and corresponds to the three AUD$MAP_DIGITAL_LOOPBACK errors.

The interrupt test generates interrupts by loading 8 bytes into the D-channel transmit buffer and reading them back through the receiver buffer (eight interrupts are generated).

Continued on next page

Audio

Table A–18 lists the decimal and hexadecimal error codes returned by the AUD self-test.

Table A–18 AUD Self-Test Error Codes

Decimal	Hexadecimal	Meaning
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.

Continued on next page

Table A–18 (Continued) AUD Self-Test Error Codes

Decimal	Hexadecimal	Meaning
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.

Extended Error Information

The AUD test displays extended error information in decimal when an error occurs. Enter the SHOW ERROR command to view the extended error information in hexadecimal. The extended error codes can be of several types as shown in the following examples.

EXTENDED ERROR FORMAT 10(h):

This error format is used by all audio register tests.

```
aaa 0010 bbbbbbbb cccccccc dddddddd
```

Format	Meaning
aaa	The FRU
bbbbbbbb	The error number

Continued on next page

Format	Meaning
cccccccc	The contents of data register (DR)
dddddddd	TBS

EXTENDED ERROR FORMAT 11(h):

This error format is used by all audio interrupt tests.

```
aaa 0011 bbbbbbbb cccccccc dddddddd
```

Format	Meaning
aaa	The FRU
bbbbbbbb	The error number
cccccccc	The contents of D channel status register 2 (DSR2)
dddddddd	TBS

EXTENDED ERROR FORMAT 12(h):

This error format is used by all audio tests.

```
aaa 0012 bbbbbbbb cccccccc dddddddd
```

Format	Meaning
aaa	The FRU
bbbbbbbb	The error number
cccccccc	0
dddddddd	TBS

Continued on next page

DSW21 Synch Communications Test Error Codes

Table A–19 lists the DSW21 Synch communications test error codes.

Table A–19 Synch Comm Device Test Error Codes

Decimal	Hexadecimal	Meaning
1	1	Self-Test was unsuccessful
2	2	Transmit underflow
4	4	Transmitter busy
6	6	Receiver busy
8	8	Transmitter error
10	A	Carrier detect loss
Sync Comm Receive Failures		
12	C	Receive overflow
14	E	Receive CRC error
16	10	Receive abort
18	12	Receive non-octet aligned
20	14	Receive parity error
22	16	Receive frame error
24	18	Receive length too large
26	1C	Receive DLE follow
30	1E	No external loopback connector
32	20	Invalid test specified
34	22	Timeout waiting for response
36	24	Comm module timeout waiting

Continued on next page

Table A–19 (Continued) Synch Comm Device Test Error Codes

Decimal	Hexadecimal	Meaning
38	26	Invalid test
Synch Comm. Device Failures		
40	28	Comm option test failure
42	2A	Comm option copy to RAM failed
44	2C	Comm option RAM test failed
46	2E	Comm option dual RAM access test
48	30	Comm option interrupt test
50	32	Comm option reset test
52	34	Comm option internal loopback
54	36	Comm option external loopback
56	38	Comm option modem signal test
58	3A	Comm option H3199 failure
60	3C	Comm option H3248 failure
62	3E	Comm option H3250 failure
64	40	Comm option H3047 failure
66	42	Comm option host internal buffer failure
68	44	Comm option external buffer loop
70	46	Data compare error

Continued on next page

Table A–19 (Continued) Synch Comm Device Test Error Codes

Decimal	Hexadecimal	Meaning
Synch Comm. IMP Failures		
128	80	IMP IDMA Timeout
130	82	IMP SCC Transmit timeout
132	84	IMP SCC Receive timeout
134	86	IMP Command timeout
136	88	IMP ERR Timeout
138	8A	IMP PB8 Timeout
140	8C	IMP SMC2 Timeout
142	8E	IMP SMC1 Timeout
144	90	IMP Watchdog timeout
146	92	IMP SCP Timeout

Continued on next page

Table A–19 (Continued) Synch Comm Device Test Error Codes

Decimal	Hexadecimal	Meaning
Synch Comm. IMP Failures		
148	94	IMP Timer 2 timeout
150	96	IMP SCC3 Timeout
152	98	IMP PB9 Timeout
154	9A	IMP Timer 1 timeout
156	9C	IMP SCC2 Timeout
158	9E	IMP IDMA Timeout
160	A0	IMP SDMA Timeout
162	A2	IMP SCC1 Timeout
164	A4	IMP PB10 Timeout
166	A6	IMP PB11 Timeout
168	A8	IMP Internal loopback system test
170	AA	IMP External loopback system test
172	AC	IMP Timer 1 timeout

Continued on next page

Table A–19 (Continued) Synch Comm Device Test Error Codes

Decimal	Hexadecimal	Meaning
Synch Comm. IMP Failures		
174	AE	IMP Timer 2 timeout
176	B0	IMP Transmit ready timeout
178	B2	IMP Receive ready timeout
180	B4	IMP Invalid SCC channel
182	B6	Data Compare error
184	B8	IMP Carrier detect asset timeout
186	BA	IMP Carrier detect deassert timeout
188	BC	IMP CTS Assert timeout
190	BE	IMP CTS Deassert timeout
192	C0	IMP IDL Assert timeout
194	C2	IMP IDL Deassert timeout
196	C4	IMP Invalid cable attached
198	C6	IMP No test indicator
200	C8	IMP No data set ready
202	CA	IMP No ring indicator
204	CC	IMP No speed indicator
206	CE	IMP No carrier detect
208	D0	IMP No clear to send
210	D4	IMP Power up block initialization
212	D6	IMP DSR Assert timeout
214	D6	IMP DSR Deassert timeout
216	D8	IMP Reset error
218	DA	IMP Mode initialization error
220	DC	Memory allocation error

Continued on next page

Table A–19 (Continued) Synch Comm Device Test Error Codes

Decimal	Hexadecimal	Meaning
222	DE	Memory free error
224	E0	UTIL Invalid utility number
226	E2	UTIL Invalid cable code
DSW21 Comm. Timeout Failures		
228	E4	Timeout comm option set response RA
230	E6	Timeout comm option clear command CA
232	E8	Timeout comm option set scheduler run SR
234	EA	Timeout comm option set transmit ready TR
236	EC	Timeout comm option set receive ready RR
238	EE	Comm option exception occurred
240	F0	Comm option command register timeout
242	F2	Comm option transmit clear to send lost
244	F4	Test memory allocation error
246	F6	Test memory free error
248	F8	Comm option reported invalid configuration

Continued on next page

Table A–19 (Continued) Synch Comm Device Test Error Codes

Decimal	Hexadecimal	Meaning
250	FA	ROM Test
252	FC	ROM Checksum error
254	FE	Ctrl C entered at console
256	100	Comm option receive error-CRC follow error
258	102	Comm option MC68302 component is not REV B
260	104	Test request sequence error
262	106	IMP Timeout waiting for host to clear RA
264	108	IMP Timeout waiting for host to clear SR

Continued on next page

Table A–19 (Continued) Synch Comm Device Test Error Codes		
Decimal	**Hexadecimal**	**Meaning**
266	10A	ROM Test error
268	10C	FBUG Secure error-reserved operation
270	10E	Port PB3 Signal stuck high
272	110	Timer 3 not counting
274	112	Comm option diagnostics did not complete
276	114	Comm option SDMA bus error occurred
278	116	Timeout waiting for IRQ assertion
280	118	Transmit restart of 10 exceeded

TURBOchannel Adapter Self-Test Error Codes

Table A–20 describes the TURBOchannel adapter decimal and hexadecimal self-test error codes.

Table A–20 TURBOchannel Adapter Self-Test Error Codes

Decimal	Hexadecimal	Meaning
0002	0002	TURBOchannel Reset bit stuck at 1
0004	0004	Forced TURBOchannel Timeout not seen
0006	0006	Timeout bit stuck at 1
0008	0008	FIFO Is empty after loading data

Continued on next page

Table A–20 (Continued) TURBOchannel Adapter Self-Test Error Codes

Decimal	Hexadecimal	Meaning
0010	000A	FIFO Not empty after retrieving data
0012	000C	Data read from FIFO does not match loaded data
0014	000E	Forced invalid reference error not seen
0016	0010	Forced ERROR condition not seen
0018	0012	TCA Interrupt at VAX INT_REG not set
0020	0014	Interrupt bit on TCA not set
0022	0016	ISR Was not entered on interrupt
0024	0018	FIFO Data was bad after DMA TRIGGER read operation
0026	001A	FIFO Data does not match loaded data after DMA TRIGGER write

The TURBOchannel adapter self-test does not display extended error information when an error occurs. Enter the SHOW ERROR command to view the extended error information.

TURBOchannel error codes appear in the following format:

```
?? 013 13 TCA XXXX
```

The XXXX refers to the error code format.

- Errors reported directly from the console are in decimal format.
- Errors displayed in response to the SHOW ERROR command are in hexadecimal format.

Continued on next page

Decimal Format

The following example shows a TCA decimal error code.

```
>>>T TCA
|  |
?? 013 13 TCA    0026
```

Hexadecimal Format

The following example shows a TCA hexadecimal error code.

```
>>>SHOW ERROR

?? 013 13 TCA    001A
```

TURBOchannel Adapter System Test Error Codes

There is no system test for the TURBOchannel adapter.

TURBOchannel Adapter MIPS/REX Emulator Utility Commands

The MIPS/REX Emulator utility allows you to execute TURBOchannel option firmware.

Help Command

The following is the syntax to use to display the commands required to invoke the available TURBOchannel options.

Syntax:

```
T TC0 ?
```

Continued on next page

Example:

```
>> T TC0 ?
REX CMDS:
T TC0 / <tstnam> | ?
T TC0 SCRIPT <scriptnam>
T TC0 INIT
T TC0 CNFG
T TC0 LS
T TC0 CAT <scriptnam>
>>
```

The examples are for the single-width DEFZA TURBOchannel FDDI option.

ROM Object List

ROM objects reside on the TURBOchannel option card.

Type the following to display all ROM objects for the TURBOchannel device.

Syntax

```
T TC0 LS
```

Example:

```
>> T TC0 LS
   *emul: t tc0 ls
          28 | boot --> code
          28 | cnfg --> code
          28 | init --> code
          28 | t --> code
          256 | pst-q
          272 | pst-t
          288 | pst-m
          29264 | code*
>>
```

Each line is in the format: [size_in_bytes] | [object_name]

Continued on next page

ROM Object Symbols

The following table defines the ROM object symbols.

Symbol	Meaning
`-->`	Symbolic link
`*`	Executable image
`|`	Separator between the two parameters
`pst-q`, `pst-t`, `pst-m`	Scripts (built-in tests to be executed one after the other) Use these tests with the `T TC0 CAT [SCRIPTNAM]` and `T TC0 SCRIPT [SCRIPTNAM]` commands.

NOTE

After entering T TC0 LS, it is not always safe to run tests which do not appear in any script. Refer to the *TURBOchannel Option User's Guide* before you run any tests individually.

Script Contents

The following is the syntax to use to display the contents of a script.

Syntax:

```
T TC0 CAT [SCRIPTNAM]
```

Example:

```
>> T TC0 CAT PST-M
   *emul: t tc0 cat pst-m
          pst-m:
          t ${#}/flash
          t ${#}/eprom
          t ${#}/68K
          t ${#}/sram
          t ${#}/rmap
          t ${#}/phycsr
          t ${#}/mac
          t ${#}/elm
          t ${#}/cam
          t ${#}/nirom
          t ${#}/intlpbk
          t ${#}/iplsaf
          t ${#}/pmccsr
          t ${#}/rmc
          t ${#}/pktmem
```

Continued on next page

```
        t ${#}/rtostim
        t ${#}/botim
        t ${#}/extlpbk
        t ${#}/extmemtst
        t ${#}/dmatst
>>
```

DEFINITION

${#} is script language for "substitute the slot number here." When the emulator executes each test in a script, it automatically substitutes the slot number for ${#}. The slot number is always zero (0) for the VAXstation 4000 Model 60.

Option Tests

Type the following to display all the option tests.

Syntax:

```
T TC0 / ?
```

Example:

```
>> T TC0 /?
    *emul: t tc0/?
      flash
      eprom
      68K
      sram
      rmap
      phycsr
      mac
      elm
      cam
      nirom
      intlpbk
      iplsaf
      pmccsr
      rmc
      pktmem
      rtostim
      botim
      extlpbk
      extmemtst
      dmatst
      enablerem
      disablerem
>>
```

Continued on next page

The option test results are option dependent. TURBOchannel options can display the tests differently. Some options show only the <tstnam> strings. Also, some options do not have a HELP feature, therefor the T TC0 /? command does not display (it could even cause an error to be reported by some options).

NOTE

Read the specific *TURBOchannel Option User's Guide* to properly test the option.

Running an Option Test

Enter the following to run an option test.

Syntax:

```
T TC0 / [TSTNAM]
```

Example:

```
>> T TC0/SRAM
>>
```

The DEFZA STATIC RAM is now tested. The SRAM option is listed in the TURBOchannel option test display.

NOTE

If some devices have qualifiers to a particular subtest, you can add these onto the end of the command line as outlined in the option's firmware specification or user's guide.

Executing a Script

Enter the following to execute a script.

Syntax:

```
T TC0 SCRIPT [SCRIPTNAM]
```

Continued on next page

Example:

```
>> T TC0 SCRIPT PST-Q
    *emul: t tc0 pst-q
    t 0/flash
    t 0/eprom
    t 0/68K
    t 0/sram
    t 0/rmap
    t 0/phycsr
           t 0/mac
    t 0/elm
    t 0/cam
    t 0/nirom
    t 0/intlpbk
    t 0/iplsaf
    t 0/pmccsr
    t 0/rmc
    t 0/pktmem
    t 0/rtostim
    t 0/botim
    t 0/dmatst
>>
```

The emulator shows each test within the script as it is executed. Also, error status is checked after each test completes and is saved for the end of the script.

NOTE

Standard scripts pst-q, pst-t, and pst-m can be run as single tests. SCRIPT can be omitted on the command line for these scripts. The presence of standard scripts is optional.

Initialization

Enter the following to run the initialization function provided by the object ROM.

Syntax:

T TC0 INIT

Example:

```
>> TC0 INIT
>>
```

Continued on next page

The initialization object is optional, therefore a TURBOchannel option may or may not have an initialization function. No error occurs if an option does not have an initialization object.

MIPS/REX Emulator Errors

The emulator's function is to execute the tests. While an error status code is maintained during testing, the emulator does not diagnose TURBOchannel hardware failures. Error messages should be printed by the option, using the format:

```
?TFL: #/test [message]
```

Emulator Error Messages

Presently, there are only three MIPS/REX Emulator error messages. Each message, a description, and recommended corrective action follow.

Message

```
ERR-MIPS - DID NOT FIND ROM IN SLOT nn
```

Description

Emulator cannot read the ROM header in slot nn.

Continued on next page

Corrective Action

Check the option seating, and the option connector and option ROM for bent pins.

Message

`ERR-MIPS - ROM OBJECT REPORTED A SEVERE ERROR`

Description

The emulator received a *severe error status* code back from a TURBOchannel object.

Corrective Action

Check whether a `?TFL` error message displayed before this message. Refer to the option user's guide.

Message

`ERR-MIPS - BAD ADDRESS DETECTED (ADDR address), CODE = mm`

Description

Indicates that the TURBOchannel ROM code has gone outside the expected range of addresses permitted by the TURBOchannel firmware specification.

Corrective Action

Check whether the module is supported or is running a test not supported by the emulator.

DSW21 Communications Device Test Numbers

Table A–21 lists the test sequence numbers reported by the DSW21 during self-test. The sequence number is reported in location 2C02F604 of the status block. The table also lists the test routines in addition to those of the MC8302.

Continued on next page

Table A–21 Synch Communications Self-Test Sequence Numbers

Test Number Decimal	Hexadecimal	Routine	Description
01	01	imp_exc	Exception vector initialization
02	02	imp_vec	User interrupt vector initialization
03	03	imp_rdb	Local register RDB initialization
04	04	imp_pub_init	Up block initialization
05	05	imp_op_init	Option register initialization
06	06	imp_br_init	Base register initialization
07	07	imp_cs_switch	Power-up switch initialization
08	08	imp_cfg	Get hardware configuration
09	09	imp_scr_init	System Control register initialization
10	0A	imp_core	MC68302 Core confidence test
11	0B	imp_dwcn	Watchdog timer counter clear
12	0C	imp_aport_init	Port A initialization
13	0D	imp_bport_init	Port B initialization
14	0E	imp_cisdn	ISDN Configuration

Continued on next page

Table A–21 (Continued) Synch Communications Self-Test Sequence Numbers

Test Number			
Decimal	**Hexadecimal**	**Routine**	**Description**
15	0F	imp_loc_ init	Local scratch RAM SCR initialization
16	10	imp_idb_ init	Interrupt data block initialization
17	11	imp_pcb_ init	Process control block initialization
18	12	imp_ic_init	Interrupt controller initialization
19	13	imp_cable_ code	Read cable code
20	14	imp_dma_ test	IDMA Transfers test
21	15	imp_rings	Initialize rings
22	16	imp_s1_ inte	SCC1 ISR Enable
23	17	imp_s2_ inte	SCC2 ISR Enable
24	18	imp_s3_ inte	SCC3 ISR Enable
25	19	imp_it1_ test	Timer 1 test
26	1A	imp_it2_ test	Timer 2 test
27	1B	imp_imode	Initialize mode
28	1C	imp_reset	Initialize CP
29	1D	imp_ilb_ test	SCC Internal loop

Continued on next page

Table A–21 (Continued) Synch Communications Self-Test Sequence Numbers

Test Number			
Decimal	**Hexadecimal**	**Routine**	**Description**
30	1E	imp_modem_test	Modem signal test
31	1F	imp_elb_test	SCC External loop
32	20	imp_isdn_test	ISDN test
33	21	imp_rdb	Runtime register RDB initialization
34	22	imp_loc_init	Runtime SCR RAM initialization
35	23	imp_cable_code	Runtime read adapter cable code
36	24	imp_ic_init	Runtime interrupt controller initialization
37	25	imp_idb_init	Runtime IDB initialization
38	26	imp_pcb_init	Runtime PCB initialization
39	27	imp_reset	Runtime communication processor initialization
40	28	imp_rings	Runtime initialize transmit and receive rings
41	29	imp_s1_inte	Runtime SCC1 ISR
42	2A	imp_s2_inte	Runtime SCC2 ISR

Continued on next page

Table A–21 (Continued) Synch Communications Self-Test Sequence Numbers

Test Number Decimal	Hexadecimal	Routine	Description
43	2B	imp_s3_ inte	Runtime SCC3 ISR
44	2C	imp_t1_ start	Runtime timer 1 start
45	2D	imp_t2_ start	Runtime timer 2 start
46	2E	imp_t3_ start	Runtime timer 3 start
47	2F	imp_dainit	Runtime RAM dual access initialization
48	30	imp_xvec	Runtime transfer vector initialization

The DSW21 Communications Device test displays extended error information in decimal when an error occurs. Enter the SHOW ERROR command to view the extended error information in hexadecimal. The extended error codes can be of several types as shown in the following example.

Extended Error Format 0001:

This format is used by the synchronous communication option RAM test.

```
 020 0001 aaaa0000 00000000 00000000 00000000 bbbb0000 ccccdddd
eeeeffff
```

Format	Meaning
020	The FRU for the communications option
0001	Format type for the RAM test

Continued on next page

Format	Meaning
aaaa	Test status
bbbb	Data size (1=byte access, 2=word access, 4=long access)
cccc	Address low
dddd	Address high
eeee	Actual data
ffff	Expected data

Extended Error Format 0002:

This format is used by the DSW21 communications device self-tests.

```
  020 0002 aaaabbbb ccddeeff gghhiijj kkkkllll mmmmnnnn oooopppp
qqqqrrrr
```

Format	Meaning
020	FRU for the communications option
0002	Format type for the test
aaaa	Test status
bbbb	MC68302 Diagnostic test number
cc	Cable code for channel 1 SCC1
dd	Cable code for channel 2 SCC2
ee	Current hardware revision
ff	Current software revision
gg	Current channel under test (1, 2, 3)
hh	Current electrical interface
ii	Internal loopback mode (0=internal, 1=external)
jj	External channel count

Continued on next page

Format	Meaning
kkkk	Current SCC mode
llll	Current protocol
mmmm	Data size
nnnn	Current channel speed
oooo	Address low
pppp	Address high
qqqq	Expected data
rrrr	Actual data

Extended Error Format 0003:

This format is used by the DSW21 communications device dual access tests.

```
 020 0003 aaaabbbb ccddeeff gghhiijj kkkkllll mmmmnnnn oooopppp
qqqqrrrr
```

Format	Meaning
020	FRU for the DSW21 communications device
0003	Format type for the test
aaaa	Test status
bbbb	MC68302 diagnostic test number
cc	Cable code for channel 1 SCC1
dd	Cable code for channel 2 SCC2
ee	Current hardware revision
ff	Current software revision
gg	Current channel under test (1, 2, 3)
hh	Current electrical interface
ii	Internal loopback mode (0=internal, 1=external)

Continued on next page

Format	Meaning
jj	External channel count
kkkk	Current SCC mode
llll	Current protocol
mmmm	Data size
nnnn	Current channel speed
oooo	Address low
pppp	Address high
qqqq	Expected data
rrrr	Actual data

Extended Error Format 0004:

This format is used by the DSW21 communications device interrupt test.

```
 020 0004 aaaabbbb ccddeeff gghhiijj kkkkllll mmmmnnnn oooopppp
qqqqrrrr
```

Format	Meaning
020	The FRU for the DSW21 communications device
0004	Format type for the self-test
aaaa	Test status
bbbb	MC68302 diagnostic test number
cc	Cable code for channel 1 SCC1
dd	Cable code for channel 2 SCC2
ee	Current hardware revision
ff	Current software revision
gg	Current channel under test (1, 2, 3)
hh	Current electrical interface

Continued on next page

Format	Meaning
ii	Internal loopback mode (0=internal, 1=external)
jj	External channel count
kkkk	Current SCC mode
llll	Current protocol
mmmm	Data size
nnnn	Current channel speed
oooo	Address low
pppp	Address high
qqqq	Expected data
rrrr	Actual data

Extended Error Format 0005:

This format is used by the DSW21 communications device modem signal tests.

```
 020 0005 aaaabbbb ccddeeff gghhiijj kkkkllll mmmmnnnn oooopppp
qqqqrrrr
```

Format	Meaning
020	The FRU for the DSW21 communications device
0005	Format type for the test
aaaa	Test status
bbbb	MC68302 diagnostic test number
cc	Cable code for channel 1 SCC1
dd	Cable code for channel 2 SCC2
ee	Current hardware revision
ff	Current software revision

Continued on next page

Format	Meaning
gg	Current channel under test (1, 2, 3)
hh	Current electrical interface
ii	Internal loopback mode (0=internal, 1=external)
jj	External channel count
kkkk	Current SCC mode
llll	Current protocol
mmmm	Data size
nnnn	Current channel speed
oooo	Address low
pppp	Address high
qqqq	Expected data
rrrr	Actual data

Extended Error Format 0006:

This format is used by the DSW21 communications device loopback tests.

```
 020 0006 aaaabbbb ccddeeff gghhiijj kkkkllll mmmmnnnn oooopppp
qqqqrrrr
```

Format	Meaning
020	FRU for the DSW21 communications device
0006	Format type for the self-test
aaaa	Test status
bbbb	MC68302 diagnostic test number
cc	Cable code for channel 1 SCC1
dd	Cable code for channel 2 SCC2
ee	Current hardware revision

Continued on next page

Format	Meaning
ff	Current software revision
gg	Current channel under test (1, 2, 3)
hh	Current electrical interface
ii	Internal loopback mode (0=internal, 1=external)
jj	External channel count
kkkk	Current SCC mode
llll	Current protocol
mmmm	Data size
nnnn	Current channel speed
oooo	Address low
pppp	Address high
qqqq	Expected data
rrrr	Actual data

Extended Error Format 0007:

This format is used by the DSW21 communications device reset test. The reset test only returns a timeout status if it does not get a posted interrupt controller.

```
 020 0007 00070000 00000000 00000000 00000000 00000000 00000000
000000000
```

Format	Meaning
020	The FRU for the DSW21 communications device
0007	The format type
00070000	The currently running reset test

Continued on next page

Extended Error Format 0008:

This format is used by the synchronous communication option null request.

```
 020 0008 0008 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000
```

Format	Meaning
020	The FRU for the DSW21 communications device
0008	Format type
0008	The currently running null request

Extended Error Format 0009:

This format is used by the DSW21 communications device when an exception occurs.

```
 020 0009 00EEaaaa bbbbcccc dddd0000 00000000 0000eeee ffffgggg
00000000
```

Format	Meaning
020	The FRU for the DSW21 communications device
0009	Format type
aaaa	Command status register
bbbb	Stack pointer high
cccc	Exception vector
dddd	Stack pointer low
eeee	Status register
ffff	PC low
gggg	PC high

Continued on next page

Extended Error Format 10:

This format is used by the DSW21 communications device when it first executes code, and is used to verify that the 68K is executing instructions.

```
 020 000A 00040003 00060005 00080007 00100009 00120011 00140013
00160015
```

Format	Meaning
020	The FRU for the DSW21 communications device
000A	Format type

DSW21 Communications Utilities Error Codes

Table A–22 lists the DSW21 utilities error codes.

Table A–22 DSW21 Communications Utilities Error Codes

224	E0	Invalid utility request
226	E2	Invalid test request
255	FF	Control C entered

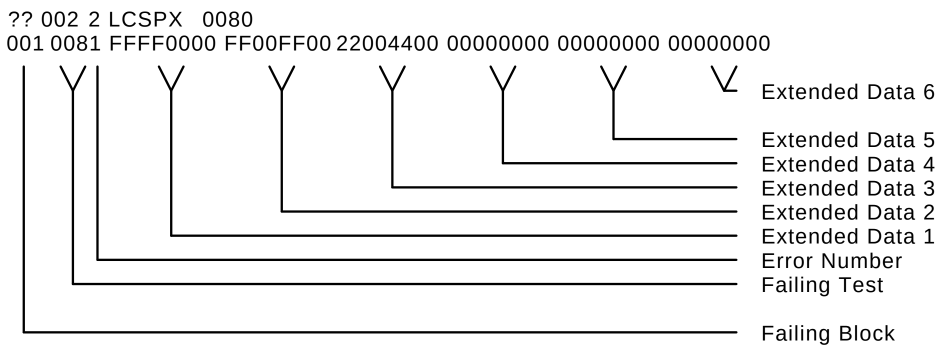
Continued on next page

LCSPX

The LCSPX module provides error information that can be utilized to identify faults down to a logical block. The following is a break down of the error information provided in the power-up error code format by the LCSPX diagnostic ROM.

```
?? 001  2  LCSPX  0128
    |   |    |     +------------- Failure Code
    |   |    +------------------- Option Mnemonic
    |   +------------------------ Device Number
    +---------------------------- FRU
                                  0 - NO FAILURE
                                  1 - FAILURE
```

In addition to this normal error code, the diagnostic also provides extended error information. This extended error information can only be displayed with the system error summary command (>>> SHOW ERROR) entered on the console keyboard. The following is an example of a typical error report for the LCSPX module.



Continued on next page

Failing Logical Block Field

The failing logical block field points in an area that can be used as a starting point for diagnosing the fault. This does not mean that it is the actual fault but the error was detected at that point.

Table A–23 lists the failing logical blocks.

Table A–23 Failing Logical Block Summary

Number	Logical Block Description
001	Timing Buffer Chip
002	ScanProc Chip
003	ScanProc0 Chip
004	ScanProc1 Chip
005	ScanProc2 Chip
006	ScanProc3 Chip
007	ScanProc4 Chip
008	ScanProc5 Chip
009	ScanProc6 Chip
010	ScanProc7 Chip
011	ScanProc8 Chip
012	VRAM Section of the module
013	DRAM Section of the module
014	FIFO Section of the module
015	Brooktree DAC
016-999	TBD

Test Numbers

The following table lists all the tests provided in the LCSPX ROM. The test number is found in the test number field of the 32 bit error code.

Continued on next page

Table A–24 Test Number Summary

Test Number Hexadecimal/Decimal	Test
01/01	TBC Register
02/02	TBC Horizontal Timing
03/03	TBC Vertical Timing
04/04	TBC LEGO Load
05/05	Brooktree Register
06/06	Brooktree Memory
07/07	ScanProc Register
08/08	ScanProc Scratch RAM
09/09	ScanProc Microcode RAM
0A/10	FIFO Direct Access
0B/11	FIFO Auto Increment Location
0C/12	FIFO Auto Increment Buffer Load
0D/13	FIFO Auto Increment Buffer Execution
0E/14	Frame Buffer Address/Data
0F/15	Frame Buffer 4Mega Pixel
10/16	Frame Buffer Write/Read Mask
11/17	ScanProc Basic Rectangle
12/18	ScanProc Clipping Rectangle
13/19	ScanProc Copy Rectangle
14/20	ScanProc Fill Rectangle Masking
15/21	ScanProc Draw Rectangle Logical OP
16/22	ScanProc Copy Rectangle Logical OP
17/23	ScanProc Copy Rectangle Masking
18/24	ScanProc Copy Stipple Rectangle

Continued on next page

Table A–24 (Continued) Test Number Summary

Test Number Hexadecimal/Decimal	Test
19/25	ScanProc Copy Opaque Rectangle
1A/26	ScanProc Basic Trapezoid
1B/27	ScanProc Basic Vector
1C/28	Frame Buffer Stream Write
1D/29	Frame Buffer Stream Read
1E/30	VRAM Serial Shift
1F/31	Brooktree LEGO Load
20/32	Brooktree Analog Compare

SPXg/gt Self-Test Error Codes

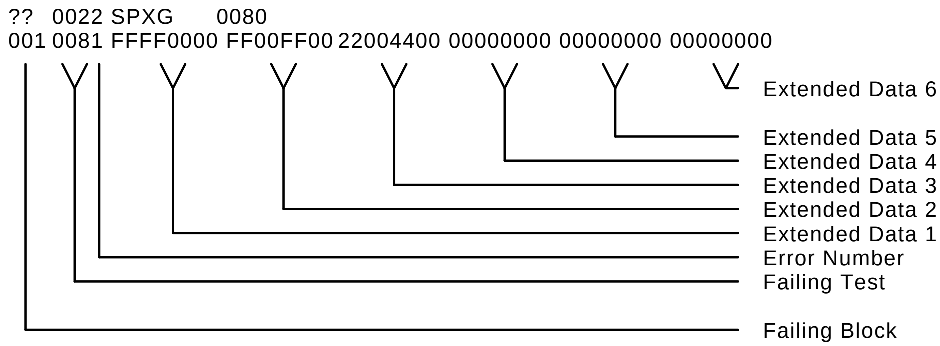
The SPXG module provides error information that can be utilized to identify faults down to a logical block.

The following is a break down of the error information provided in the power-up error code format by the SPXG diagnostic ROM.

```
?? 002 2 SP3D 0128
    |  |   |    +------- Decimal Failure Code
    |  |   +------------ Option Mnemonic
    |  +---------------- Device Number
    +------------------- FRU (These bits can be ored)
                         0 - NO FAILURE
                         1 - GSP MODULE
                         2 - FRAME BUFFER MODULE
                         4 - SIMM 1
                         8 - SIMM 2
```

In addition to this normal error code, the diagnostic also provides extended error information. This extended error information can only be displayed by enter the system error summary command SHOW ERROR from the console keyboard. The following is an example of a typical error report for the SPXG module.

Continued on next page



Failing Logical Block Field

The failing logical block field points in an area that can be used as a starting point for diagnosing the fault. This does not mean that it is the actual fault, but that the error was detected at that point. The following table is a summary of the failing logical blocks.

Table A–25 Failing Logical Block Summary

Number	Logical Block Description
001	Scanproc
002	VRAM
003	SIMM1
004	SIMM2
005	JChip
006	i860
007	Cursor Generator 0
008	Cursor Generator 1
009	SRAM
010	VDAC

Continued on next page

Test Numbers

The following table lists all the tests provided in the SPXG self-test ROM. The test number is found in the failing test field of the error code.

Table A–26 Test Number Summary

Test Number Hexadecimal /Decimal		LED Codes (Hexadecimal)
0010/0016	JCHIP Register	21
0020/0032	SRAM	21
0030/0048	FIFO Register	21
0040/0064	FIFO Auto Increment Location	21
0050/0080	FIFO Auto Increment Buffer	21
0060/0096	i860 Doorbell	22
0070/0112	Brooktree Register	22
0080/0128	Scanproc Register	22
0090/0144	ScanProc SRAM	22
00A0/0160	i860 ScanProc Register	22
00B0/0176	VRAM	22
00C0/0192	Scanproc Basic Rectangle	23
00D0/0208	Scanproc Clip Rectangle	23
00E0/0224	Scanproc Fill Rectangle Mask	23
00F0/0242	Scanproc Draw Logical Ops	23
0100/0256	Scanproc Copy Rectangle	23
0110/0272	Scanproc Copy Rectangle Logical Ops	23
0120/0288	Scanproc Copy Rectangle Mask	23
0130/0304	ScanProc Copy Stipple	23
0140/0320	ScanProc Copy Opaque	23

Continued on next page

Table A–26 (Continued) Test Number Summary

Test Number Hexadecimal /Decimal		LED Codes (Hexadecimal)
0150/0336	ScanProc Stream Write	23
0160/0352	FIFO Transfer	24
0170/0368	ScanProc External Write	24
0180/0384	ScanProc Stream Read	24
0190/0400	LCG DMA	25
01A0/0416	LCG OTF	25
01B0/0432	DMA Stream	25
01C0/0448	OTF Stream	25
01D0/0464	Auto Increment Location Stream	25
01E0/0480	Command FIFO OTF Stream	25
01F0/0496	Command FIFO External Stream	25
0200/0512	Brooktree Plane Walk	26
0210/0528	Brooktree Output Signature	26
0220/0544	Brooktree Off Screen	26
0230/0560	Brooktree Input Signature	26
0240/0576	Brooktree Cursor Window	26
0250/0592	JCHIP Window	26
0260/0608	Brooktree Analog Compare	26
0270/0624	Set/Clear Interrupt	27

System Test Error Messages

SCSI

Table A–27 lists the error codes returned by the SCSI system test.

Table A–27 SCSI System Test Error Codes

Decimal	Hexadecimal	Meaning
90	5A	WST Call failed
92	5C	ELN Call failed
100	64	Inquiry failed when sizing bus
102	66	Not enough inquiry data returned when sizing bus
104	68	Start unit failed when sizing bus
106	6A	Test unit ready failed when sizing bus
108	6C	Mode select failed when sizing bus
110	6E	Read capacity failed when sizing bus
112	70	Mode sense failed when sizing bus
114	72	Media is write protected in manufacturing mode
116	74	Not enough mode sense data returned when sizing bus
118	76	Read failed when sizing bus
120	78	Not enough read data when sizing bus
122	7A	Verify failed when sizing bus
130	82	Read failed when checking for key
132	84	Rewind failed when checking for key
134	86	Wrong number bytes read when checking for key
140	8C	Read failed when checking for boot block

Continued on next page

Table A–27 (Continued) SCSI System Test Error Codes

Decimal	Hexadecimal	Meaning
142	8E	Wrong number bytes read when checking for boot block
150	96	Non-DMA inquiry failed in data transfer test
152	98	Synchronous DMA inquiry failed in data transfer test
154	9A	Number bytes miscompare in data transfer test
156	9C	Data miscompare in data transfer test
160	A0	Device test failed
162	A2	Wrong number bytes read in device test
164	A4	Wrong number bytes written in device test
166	A6	Data miscompare in device test
168	A8	Reselection timeout in device test

SCSI System Test Summary Screen

The SCSI summary screen displays the following information:

```
ADR  RDS  WRTS  ERR FRU  CMD  PHS  INF  LBNSTRT  XFERSIZ
```

Format	Meaning
ADR	ID and logical unit number
RDS	Number of reads performed on this device
WRTS	Number of writes performed on this device
ERR	Error code (hexadecimal)

Continued on next page

Format	Meaning
FRU	Field replaceable unit (hexadecimal if FRU gotten from request sense packet)
CMD	SCSI command that failed (hexadecimal)
PHS	SCSI Bus phase at time or error
INF	Informational value (same as those reported by the self-test...hexadecimal)
LBNSTRT	Starting logical block number of failed transfer (hexadecimal)
XFERSIZ	Transfer size in blocks of failed transfer (hexadecimal)

This information is followed by any available request sense data.

Synch Communications Device

Errors reported for the system test are the same as those reported for the extended self-test, in addition to errors that may be reported by the VAXeln kernel service.

COMM

Errors reported for the system test are the same reported for extended test in addition to errors that may be reported by the VAXeln kernel service.

DZ

The following is the DZ error message format.

```
?? 3 DZ 0     ABCD          0 00:00:00:00
```

- ABCD are the four DZ lines. The error codes are identical for each line.
  - A (line 3) printer port
  - B (line 2) 25 pin connector
  - C (line 1) Mouse
  - D (line 0) Keyboard
  - 0 00:00:00:00 test run time

Continued on next page

- There are 9 error codes possible for each line:
    - 1 - not all characters transmitted
    - 2 - 1st character not received
    - 3 - timeout
    - 4 - more characters received than expected
    - 5 - parity error
    - 6 - framing error
    - 7 - overrun error
    - 8 - data compare error These errors are translated by the summary screen.

The summary screen for the DZ module has the following format for each line:

```
Line    L_Param    Chr_Xmt   Chr_Rec             Error
```

Format	Meaning
Line	Line number
L_Param	Line parameters
Chr_Xmt	Last character transmitted
Chr_Rec	Last character received
Error	Text message for error code from main screen for this line

Network Interface

The following is an example of the NI error message format.

```
?? 9 NI    X     00YY          0 00:00:00:00
```

- X is the source of the error:
    - 1 - Test
    - 2 - System Test Monitor
    - 3 - Device Driver

Continued on next page

  - 4 - VAXELN
  - 5 - System
  - 0 00:00:00:00 test run time
- YY is the specific error code.

Table A–28 list the NI system test error codes and their meanings.

Table A–28 NI System Test Error Codes

Error Source (X)	Error Code (YY)	Meaning
1	02	Init failed
1	04	SGEC Underflow reported
1	06	DMA Transmit failed
1	08	Unknown transmit error
1	0A	Receive failed
1	12	DMA Receive failed
1	14	Unknown receive error
1	16	Data compare error
2	02	WST$INIT Failed
4	02	Bad memory allocation
4	04	Create device failed
4	06	Create area failed
5	02	Unknown transmit error
5	04	Bad transmit status
5	06	Transmit descriptor own bit says SGEC
5	08	Bad receive status from SGEC

Continued on next page

Table A–28 (Continued) NI System Test Error Codes

Error Source (X)	Error Code (YY)	Meaning
5	0A	Timeout waiting for receive interrupt
5	0C	Memory error on init
5	0E	BABL Error on init
5	10	MISS Error on init
5	12	Parity error on init
5	14	MAP Error on init
5	16	Memory error on receive
5	18	BABL Error on receive
5	1A	MISS Error on receive
5	1C	Parity error on receive
5	1E	MAP Error on receive
5	20	Memory error on transmit
5	22	BABL Error on transmit
5	24	MISS Error on transmit
5	26	Parity error on transmit
5	28	MAP Error on transmit

Utility Error Messages

SCSI

Table A–29 describes the errors returned by a SCSI utility. All SCSI utility errors have the format:

```
text_message  information_value.
```

Table A–29 Text Messages for SCSI Utilities

Text Message	Meaning
SCSI_E_badparam	Bad parameter entered by the user
SCSI_E_err	Generic utility error
SCSI_E_devtyp	Wrong device type for this utility
SCSI_E_media	Problem with the media
SCSI_E_lun	Logical unit is not present
SCSI_E_inq_err	Error in inquiry command
SCSI_E_modsns_err	Error in mode sense command
SCSI_E_modsel_err	Error in mode select command
SCSI_E_tur_err	Error in test unit ready command
SCSI_E_rwnd_err	Error in rewind command
SCSI_E_wrt_err	Error in write command
SCSI_E_rd_err	Error in read command
SCSI_E_rdcap_err	Error in read capacity command
SCSI_E_st_unt_err	Error in start unit command
SCSI_E_ver_err	Error in verify command
SCSI_E_fmt_unt_err	Error in format unit command
SCSI_E_reass_err	Error in reassign command

The information values are reported in decimal. These values are the same as the information values reported by the extended SCSI self-test errors, in addition to the following values:

Continued on next page

Table A–30 Additional SCSI Information Values for Utilities

Information Decimal	Meaning
176	Bad utility number received from the user
177	Bad device number received from the user
178	Bad logical unit number received from the user
179	Wrong number of parameters entered by the user
180	Device number entered by the user is the same as the controller
181	Utility cannot be executed in this mode of operation
182	Not enough data was returned from a SCSI command
183	Device is not a disk
184	Device is not a tape
185	Media is not removable
186	Media is removable
187	Media is write protected
188	Device is not ready
189	Wrong data read back from a SCSI command
190	Logical unit is not present
191	Initialize driver failed
192	Error in format page
193	Error in flexible page
194	Prom function error
195	Disk capacity is too small
196	Error receiving character from console

Continued on next page

Table A–30 (Continued) Additional SCSI Information Values for Utilities

Information Decimal	Meaning
197	Illegal floppy drive
198	Illegal floppy media

LCSPX

The LCSPX utilities provide some test patterns that can be used to visually verify the video output and the monitor quality. Enter T/UTIL 2 to access the utilities menu.

Example:

```
>>>t/util 2
   0 - SP3D-wh-scrn
   1 - SP3D-rd-scrn
   2 - SP3D-gn-scrn
   3 - SP3D-bl-scrn
   4 - SP3D-4c-cbar
   5 - SP3D-8c-cbar
   6 - SP3D-8g-gscl
   7 - SP3D-ee-scrn
   8 - SP3D-ci-xhct
   9 - SP3D-sc-hhhs
   SP3D_util >>>
```

Individual tests are chosen by typing a number then pressing Return.

Continued on next page

Table A–31 Menu Item Meanings

Menu Item	Action
0	Draws a full white screen
1	Draws a full red screen
2	Draws a full green screen
3	Draws a full blue screen
4	Draws four color bars to the screen
5	Draws eight color bars to the screen
6	Draws eight gray scale bars to the screen
7	Draws a screen of Es
8	Draws a screen of squares with a dot in the center of each square. A circle with a diameter equal to the screen length is then drawn on the screen
9	Draws a screen of Hs to the screen then scrolls the screen until the space bar is hit

All tests can be terminated by pressing the space bar on the keyboard. If you press either Ctrl Y or Ctrl C, the test terminates and the system displays the chevron prompt.

Continued on next page

SPXg/gt

The SPXg utilities provide some test patterns that can be used to visually verify the video output and the monitor quality. Enter T/UTIL 2 to access the utilities menu. The console device or the alternate console connected to the Model 90 serial port can be used.

Example:

```
>>>t/util 2
     0 - SP3D-wh-scrn
     1 - SP3D-rd-scrn
     2 - SP3D-gn-scrn
     3 - SP3D-bl-scrn
     4 - SP3D-4c-cbar
     5 - SP3D-8c-cbar
     6 - SP3D-8g-gscl
     7 - SP3D-ee-scrn
     8 - SP3D-ci-xhct
     9 - SP3D-sc-hhhs
     SP3D_util >>>
```

Individual tests are chosen by typing a number then pressing Return.

Table A–32 Menu Item Meanings

Menu Item	Action
0	Draws a full white screen
1	Draws a full red screen
2	Draws a full green screen
3	Draws a full blue screen
4	Draws four color bars on the screen
5	Draws eight color bars on the screen
6	Draws eight gray-scale bars on the screen
7	Draws a screen of Es on the screen

Continued on next page

Table A–32 (Continued) Menu Item Meanings

Menu Item	Action
8	Draws a screen of squares with a dot in the center of each square. A circle with a diameter equal to the screen length is then drawn on the screen
9	Draws a screen of Hs on the screen

All test can be terminated by pressing the space bar on the keyboard. If you press either Ctrl Y or Ctrl >box>(C), the test terminates and and the system displays the chevron prompt.

COMM

Table A–33 COMM Utility Error Numbers

224	E0	Invalid Utility Request
226	E2	Invalid Test Request
255	FF	Ctrl C Entered

Appendix B
Reading the Diagnostic LED Codes

Overview

In this Appendix

This appendix describes how to interpret the diagnostic LEDs on the console control panel. The LED codes covered in this module are:

- Diagnostic LED Codes
- LED Error Codes
- Power-Up/Initialization LED Codes
- TOY/NVR LED Codes
- LCSPX LED Codes
- SPXg/gt LED Codes
- DZ LED Codes
- CACHE LED Codes
- Memory LED Codes
- System Device LED Codes
- NI Device LED Codes
- SCSI Device FRU LED Codes
- Audio Device LED Codes
- DSW21 Communications Device LED Codes
- TURBOchannel Adapter LED Codes

Diagnostic LED Codes

Overview

The system uses the eight LEDs on the control panel to indicate the currently executing test. When power is turned on, all the LEDs come on (LED code is FF(h)), and then display different codes as the devices are tested.

The LED codes are divided into two fields.

- The left-most four LEDs represent the device number.
- The right-most four LEDs represent a substate that the device test is currently in. LED codes E0h - FFh are reserved for the console.

Translating Error Codes

The eight LEDs on the lights and switches board can be translated into two hexadecimal or binary digits in the form:

X X X X   Y Y Y Y

- X X X X is the device number (binary) currently under test. Use Table 5–4 to match the code from the LEDs to a device.
- Y Y Y Y is the subtest at which the diagnostic hung.

The LEDs can be used for troubleshooting when the console device is inoperable.

Continued on next page

Error Code Tables

The rest of this chapter contains tables listing the LED codes, descriptions, and corresponding FRU.

Table B–1 Power-up and Initialization LED Codes (1111 XXXX)

LED Depiction[1]	Code	Description	FRU
1111 1111	FFh	Power has been applied but no instruction has been run	System module
1111 1110	FEh	ROM has been entered and initialization and testing have started	System module
1111 1101	FDh	Waiting for memory to initialize	System module, memory modules
1111 1100	FCh	Sizing memory in the system	System module, memory modules
1111 1011	FBh	Running a byte mask test on the memory needed by the console	System module, memory modules
1111 1010	FAh	A full memory data path test is being performed on the memory needed by the console	System module, memory modules

[1]In this column,
1 indicates the LED is on;
0 indicates the LED is off;
X indicates either 1 or 0.

Continued on next page

Table B–1 (Continued) Power-up and Initialization LED Codes (1111 XXXX)

LED Depiction[1]	Code	Description	FRU
1111 1001	F9h	Initializing the console data structures	System module
1111 1000	F8h	Performing auto configuration on the machine	System module
1111 0111	F7h	Testing the NVR device	System module
1111 0110	F6h	Testing the DZ device	System module, mouse, keyboard
1111 0101	F5h	Testing the graphics output device	System module, Graphics
1111 0100	F4h	Initializing the console device	System module, Graphics
1111 0011	F3h	Entering the console program	System module

[1]In this column,
1 indicates the LED is on;
0 indicates the LED is off;
X indicates either 1 or 0.

Continued on next page

TOY/NVR LED Codes

Table B–2 TOY and NVR LED Codes (0001 XXXX)

LED Depiction	Code	Description	FRU
0001 0000	10h	TOY and NVR clock test has failed	System module
0001 0001	11h	TOY and NVR test has failed	System module

LCSPX LED Codes

Table B–3 LCSPX LED Codes (0010 XXXX)

LED Depiction	Code	Description	FRU
0010 0000	20h	LCSPX test has been entered	System module, graphics
0010 0001	21h	LCSPX video RAM test has failed	System module, graphics
0010 0010	22h	LCSPX register test has failed	System module, graphics
0010 0011	23h	LCSPX FIFO test has failed	System module, graphics
0010 0100	24h	LCSPX interrupt test has failed	System module, graphics
0010 0101	25h	LCSPX address generator test has failed	System module, graphics
0010 0110	26h	LCSPX virtual test has failed	System module, graphics

Continued on next page

If the graphics option fails, the system may not display a console error message. In this case you must use the error LEDs on the lights and switches module to isolate the fault.

SPXg/gt LED Codes

Table B–4 SPXg/gt LED Codes (0010 XXXX)

LED Depiction	Code	Description	FRU
0010 0001	21h	JChip and SRAM have failed.	GSP
0010 0010	22h	i860, RAMDAC, SCANPROC, frame buffer have failed	GSP, Frame buffer
0010 0011	23h	SCANPROC drawing ops failed	Frame buffer
0010 0100	24h	Stream transfers failed	GSP, Frame buffer
0010 0101	25h	OTF and normal DMA failed	GSP
	26h	Interrupts failed	GSP

Continued on next page

DZ LED Codes

Table B–5 DZ LED Codes (0011 XXXX)

LED Depiction	Code	Description	FRU
0011 0000	30h	DZ Test has been entered	System module
0011 0001	31h	DZ Reset test has failed	System module
0011 0010	32h	DZ Modem test has failed	System module
0011 0011	33h	DZ Polled test has failed	System module
0011 0010	34h	DZ Interrupt test has failed	System module
0011 0101	35h	LK401 Test has failed	Keyboard, system module
0011 0110	36h	Mouse test has failed	Keyboard, system module

Continued on next page

CACHE LED Codes

Table B–6 Cache LED Codes (0100 XXXX)

LED Depiction	Code	Description	FRU
0100 0001	41h	Error in the data store read /write	System module
0100 0010	42h	Error in the read/write to the tag area	System module
0100 0011	43h	The cache did not contain the correct state of the valid bit	System module
0100 0100	44h	Error during the cache tag validation	System module
0100 0101	45h	Unexpected TAG parity error	System module
0100 0110	46h	Cache did not provide the expected data during cache hit testing	System module

Continued on next page

Memory LED Codes

Table B–7 Memory FRU LED Codes (0101 XXXX)

LED Depiction	Code	Description	FRU
0101 0000	50h	Memory byte mask test has failed	System module or memory modules
0101 0001	51h	Memory error occurred in the forward pass	System module or memory modules
0101 0010	52h	Memory error occurred in the reverse pass	System module or memory modules
0101 0011	53h	Memory error in parity test 1	System module or memory modules
0101 0100	54h	Memory error in parity test 2	System module or memory modules

Continued on next page

System Device LED Codes

Table B–8 System Device LED Codes (1000 XXXX)

LED Depiction	Code	Description	FRU
1000 0000	80h	ROM Verify test has failed	System module
1000 0001	81h	Interrupt controller test has failed	System module

NI Device LED Codes

Table B–9 NI LED Codes (1001 XXXX)

LED Depiction	Code	Description	FRU
1001 0000	90h	NI Test has been entered	System module
1001 0001	91h	Network address test has failed	System module
1001 0010	92h	NI Register test has failed	System module
1001 0011	93h	NI Initialization test has failed	System module
1001 0100	94h	NI Internal loopback/DMA test has failed	System module
1001 0101	95h	NI Interrupt test has failed	System module
1001 0110	96h	NI CRC Test has failed	System module

Continued on next page

Diagnostic LED Codes, Continued

Table B–9 (Continued) NI LED Codes (1001 XXXX)

LED Depiction	Code	Description	FRU
1001 0111	97h	NI Receive MISS /BUFFER test has failed	System module
1001 1000	98h	NI Collision test has failed	System module
1001 1001	99h	NI Address filtering test has failed	System module
1001 1010	9Ah	NI External loopback test has failed	Network, loopback, system module
1001 1011	9Bh	NI Transmit buffer test has failed	System module

SCSI Device FRU LED Codes

Table B–10 SCSI Device LED Codes (1010 XXXX)

LED Depiction	Code	Description	FRU
1010 0000	A0h	SCSI Test has been entered	System module
1010 0001	A1h	SCSI Register test has failed	System module
1010 0010	A2h	SCSI Interrupt test has failed	System module
1010 0011	A3h	SCSI Data transfer test has failed	System module

Continued on next page

Table B–10 (Continued) SCSI Device LED Codes (1010 XXXX)

LED Depiction	Code	Description	FRU
1010 0100	A4h	SCSI Map error test has failed	System module
1010 0101	A5h	SCSI Minimal device test has failed	Device, System module

Audio Device LED Codes

Table B–11 Audio Device LED Codes (1011 XXXX)

LED Depiction	Code	Description
1011 0000	B0h	Audio test has been entered
1011 0001	B1h	Audio LIU test has failed
1011 0010	B2h	Audio MU1 Register test has failed
1011 0011	B3h	Audio MAP register test has failed
1011 0100	B4h	Audio DLC Register test has failed
1011 0101	B5h	Audio test generating an interrupt
1011 0110	B6h	Audio test verifying interrupts
1011 0111	B7h	Audio test disabling interrupts
1011 1000	B8h	Audio Internal loopback test has failed
1011 1001	B9h	Audio test is sending out an audio signal
1011 1010	BAh	Audio test is evaluating audio input

Continued on next page

DSW21 Communications Device LED Codes

Table B–12 DSW21 Communication Device LED Codes (1100 XXXX)

LED Depiction	Code	Description	FRU
1100 0000	C0h	Comm option code entered	DSW21, System module
1100 0001	C1h	Comm option ROM test has failed	DSW21, System module
1100 0010	C2h	Comm option RAM test has failed	DSW21, System module
1100 0011	C3h	Comm option self-test has failed	DSW21, System module
1100 0100	C4h	Comm option Dual RAM access test has failed	DSW21, System module
1100 0101	C5h	Comm option Dual ROM_ RAM access test has failed	DSW21, System module
1100 0110	C6h	Comm option Interrupt test has failed	DSW21, System module
1100 0111	C7h	Comm option Integrated loopback test has failed	DSW21, System module
1100 1000	C8h	Comm option Reset test has failed	DSW21, System module

Continued on next page

TURBOchannel Adapter LED Codes

Table B–13 lists the TURBOchannel adapter LED codes.

Table B–13 TURBOchannel Adapter LED Codes (1100 XXXX)

LED Depiction[1]	Code	Description	FRU
1101 0000	D0h	Entry into test	TCA module, TCA option
1101.0001	D1h	TCA Register test	TCA module, TCA option
1101.0010	D2h	TCA Interrupt test	TCA module, TCA option
1101.0011	D3h	TCA FIFO Test	TCA module, TCA option
1101.0100	D4h	TCA DMA Trigger test	TCA module, TCA option
1101.0110	D5h	TCA Size Bus test	TCA module, TCA option

[1]In this column, 1 indicates the LED is on; 0 indicates the LED is off.

Appendix C
Troubleshooting

Overview

In this Appendix

The tables in this appendix contain information to help you diagnose problems. The tables list the symptoms, possible causes, and suggest corrective action, as follows:

- Table C–1, System Problems
- Table C–2, Monitor Problems
- Table C–3, Mouse/Tablet Problems
- Table C–4, Keyboard Problems
- Table C–5, Drive Problems
- Table C–6, Network Problems
- Table C–7, Audio Problems
- Table C–8, Expansion Box Problems

Troubleshooting

Overview

Troubleshooting is the process of isolating and diagnosing problems with the system. When the system does not operate as described in the *VAXstation 4000 Model 90 Owner's Guide* (EK-PVAX2-OM), use the information in this section to help diagnose the problem.

If the power-up tests complete, you can use the console error messages to identify the failed FRU, or you can run the self-test, system test, and utility tests in Digital Services mode to help isolate the failing FRU. The console error messages are interpreted in Appendix A.

Use the diagnostic LEDs (listed in Appendix B) on the front of the system to help diagnose problems when the system is unable to set up the console.

The troubleshooting techniques described in Table C–1 do not identify all possible problems with the system, nor do the suggested corrective actions remedy all problems.

System Problems

Table C–1 System Problems

Symptom	Possible Cause	Corrective Action
System fan is off	Power cord is not connected.	Check the power cord connections at both ends.
	Faulty power cord.	Replace power cord.
	Power supply fan has failed.	Replace the power supply.
Power light is off.	Power cord is not connected.	Check the power cord connections at both ends.

Continued on next page

Table C–1 (Continued) System Problems

Symptom	Possible Cause	Corrective Action
	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 the system off for 10 seconds. Then turn the system on and then off again. Disconnect the video, communication, and printer cables from the power source, then reconnect securely at both ends and turn the power on to the system.
	Defective power supply.	Replace the power supply.
Power-up display does not show after two minutes.	Monitor is not turned on.	Turn on the monitor.
	Monitor brightness and contrast controls are set incorrectly.	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 securely connected at both ends.

Continued on next page

Table C–1 (Continued) System Problems

Symptom	Possible Cause	Corrective Action
	Alternate console switch is in wrong position.	Turn the power off. Move the alternate console switch to the down (off) position. Use a small pointed object. Do NOT use a pencil to set the switch. Turn the power back on.
	Monitor fuse is blown.	See the monitor guide for fuse replacement instructions.
	Wall socket may not be operative.	Try a different wall socket, or try an electrical device that you know works in the wall socket.
		Check the diagnostic LED code. Compare the code to the LED error code tables in the *VAXstation 4000 Service Information Kit Model 90 Base System* manual. Replace the monitor failed FRU. Refer to the monitor service manual for instructions on how to replace the FRU.
	Color monitor is installed, but the color graphics board is not installed.	Verify the graphic module part number, and that the monitor is designed to work with that graphics module.

Continued on next page

Table C–1 (Continued) System Problems

Symptom	Possible Cause	Corrective Action
	Power supply connector to system module is not seated correctly.	Correctly connect power source to CPU module.
Power-up display contains an error message.	Possible system error.	Enter the SHOW ERROR command. Refer to the error code tables in the *VAXstation 4000 Service Information Kit Model 90 Base System* to interpret the error code.
		Interpret the diagnostic LEDs at the front of the system. Refer to the LED error code tables in *VAXstation 4000 Service Information Kit Model 90 Base System* 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.

Continued on next page

Table C–1 (Continued) System Problems

Symptom	Possible Cause	Corrective Action
	Incorrect boot device was specified.	Change the default recovery action to boot the system from the system disk.
	Expansion boxes were not powered on first.	Turn the system box off, make sure the expansion boxes are on, and then turn on the system box.
	Boot device is not properly configured.	Enter the SHOW DEVICE command and ensure that all devices are configured correctly. If not, check SCSI IDs and SCSI cables
	Faulty boot device.	Run system exerciser, replace drive if defective.
	Unable to boot from the network (EZA0).	Refer to Table C–6.

Monitor Problems

Table C–2 Monitor Problems

Symptom	Possible Cause	Corrective Action
Screen is blank.	Monitor is not turned on.	Turn the monitor on. Ensure that the switch is working correctly and that the monitor power cord is connected at both ends.

Continued on next page

Table C–2 (Continued) Monitor Problems

Symptom	Possible Cause	Corrective Action
	Contrast and brightness controls are set incorrectly.	Adjust the contrast and brightness controls. Refer to the monitor guide for more information.
	Alternate console switch is not set correctly.	Turn off the system. Change the alternate console switch to the down (off) position. Use a small pointed object. Do NOT use a pencil to set the switch. Turn on the system. Turn on the system box last.
	System board or graphics board failure.	Use the diagnostics LEDs on the front to interpret the error code and identify the failed FRU.

Continued on next page

Mouse/Tablet Problems

Table C–3 Mouse/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. Disconnect then reconnect the cable to rest the device. Turn on the system.
	The system is halted; no pointer appears on the screen.	Reboot the system.
	Pointing device is faulty.	Replace the pointing device.

Keyboard Problems

Table C–4 Keyboard Problems

Symptom	Possible Cause	Corrective Action
Keys do not work.	Hold Screen key is active. Hold screen light is on.	Press the Hold Screen key to release hold on screen.
	Keyboard cable is loose or not connected.	Ensure that the keyboard cable is securely connected at both ends.

Continued on next page

Table C–4 (Continued) Keyboard Problems

Symptom	Possible Cause	Corrective Action
Keyboard strokes are inconsistent.	–	Disconnect then reconnect in the keyboard.
	Keyboard has failed.	Replace the keyboard.

Drive problems

Table C–5 Drive Problems

Symptom	Possible Cause	Corrective Action
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. Use the instruction in the software documentation.
	Diskette was inserted incorrectly.	Check that the write-protect notch on the diskette is to your left when you insert the diskette and that the label is up.
	Diskette is damaged or does not contain software.	Try another diskette that contains software.

Continued on next page

Table C–5 (Continued) Drive Problems

Symptom	Possible Cause	Corrective Action
	Two SCSI identifiers are set to the same ID number.	Reset each SCSI ID to a unique number.
	Loose cables.	Verify that all cables are securely connected.
	Defective drive.	Run diagnostics to isolate fault. Replace FRU.
Drive does not work.	Two SCSI identifiers are set to the same ID number.	Reset each SCSI ID to a unique number.
	Loose cables.	Verify that all cables are securely connected.
	Defective drive.	Run diagnostics to isolate fault. Replace FRU.

Network Problems

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.

Continued on next page

Table C–6 (Continued) Network Problems

Symptom	Possible Cause	Corrective Action
	Network switch is not set correctly.	If Ethernet is not being used, move the network switch to the left, toward standard Ethernet.
	Terminator is missing from network.	Determine if a ThinWire cable was removed. If so, replace the cable with a terminator.
	Cable connection is loose.	Verify that all connections on the Ethernet segment are secure.
	Power supply failure.	Replace the power supply.
Lights 7, 4, 3, and 0 on the front of the system are on.	The T-connector is disconnected.	Ensure that the T-connector is connected to an operating ThinWire Ethernet segment.
Cannot 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.

Continued on next page

Audio Problems

Table C–7 Audio Problems

Symptom	Possible Cause	Corrective Action
No audio tone (beep) when the system is turned on.	Speaker is turned off.	Turn on speaker using the switch located on the front of the system box.
	Audio speaker is not working.	Turn off the system. Plug in the headset and turn the system on. If you hear an audio tone from the headset, then there is a problem with the speaker. Replace the lights and switches module.
	Defective sound chip.	Run diagnostics. Replace failed FRU.

Expansion Box Problems

Table C–8 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 at both ends.
	Faulty power cord.	Replace power cord.
	Power supply fan has failed.	Replace the power supply.

Continued on next page

Table C–8 (Continued) Expansion Box Problems

Symptom	Possible Cause	Corrective Action
Power light is off.	Power cord is not connected.	Ensure that the power cord is connected at both ends.
	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 the system off for 10 seconds and then back on. Turn the system off.
	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.	Reset each SCSI ID to a unique number. (See *BA46 Storage Expansion Box Owner's Guide* for SCSI settings.)
	Defective drive.	Run diagnostics to isolate fault. Replace FRU.

Appendix D
FRU Part Numbers

Overview

In this Appendix

The tables in this chapter provide the names and part numbers for the field replaceable units (FRUs) for the Model 90 system box.

The tables in this chapter are organized as follows:

- Table D-1, System Box FRUs
- Table D-2, System Monitors
- Table D-3, Miscellaneous Hardware
- Table D-4, Cables and Terminators
- Table D-5, TURBOchannel Option Cables
- Table D-6, Stand Alone Tabletop Devices
- Table D-7, SZ16 Expansion Box FRUs
- Table D-8, SZ16 Expansion Box Miscellaneous Hardware
- Table D-9, SZ16 Expansion Box Cables and Terminators
- Table D-10, SZ03 Sidecar
- Table D-11, SZ03 Miscellaneous Hardware
- Table D-12, SZ03 Cables and Terminators

Refer to Chapter 6 for instructions on removing and replacing FRUs.

Precautions

Overview

Only qualified service personnel should remove or install FRUs.

Electrostatic discharge (ESD) can damage integrated circuits. Always use a grounded wrist strap (part number 29-11762-00) and grounded work surface when working with the internal parts of the workstation.

NOTE

It is the customer's responsibility to back up the software before Digital Services personnel arrive at the site. This is important to ensure 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.

Refer to Figure 6–1 for the location of the system FRUs.

Model 90 System Box FRUs

Table D–1 contains the part numbers for the Model 90 FRUs.

Table D–1 System Box FRUs

Part Number	Description
Modules	
54-21177-01	KA49 System board
54-20377-01	Lights and switches module
54-20377-01	DSW21 Communications module PV21X-DA
54-20430-01	TURBOchannel Adapter DWCTX-BX
54-20764-02	SCSI-FDI Control module (forRX26)
PMAD-AB	Thickwire Ethernet TURBOchannel option
PMAZ-AB	SCSI Controller TURBOchannel option
DEFZA-AA	FDDI Fiber TURBOchannel option
Graphics Modules	
54-20450-01	SPXg/gt GSP Module
54-20452-01	(PV71G-BA) SPXg Frame Buffer (8-plane)
54-20454-01	2 MB Video SIM Module (for SPXg 8-plane graphics)
54-20854-01	SPXgt Frame buffer (24-plane 66 Hz)
54-20854-02	SPXgt Frame buffer (24-plane 72 Hz)
54-21795-01	LCSPX (66/72 Hz)

Continued on next page

Model 90 System Box FRUs, Continued

Table D–1 (Continued) System Box FRUs

Part Number	Description
Memory Modules	
54-19145-AA	(MS44L-AA) 4-MB cost-reduced SIM module
54-19103-AA	(MS44-AA) 4-MB SIM module
54-19103-CA	(MS44-CA) 16-MB SIM module
Internal Storage	
*RZ23-E	RZ23 104-MB Drive with logic module
RZ23L-E	RZ23L 121-MB Drive (70-28115-01)
RZ24-E	RZ24 Disk 209-MB Drive
RZ24L-E	RZ24L Disk 245-MB drive
RZ25-E	RZ25 420-MB drive
TZK10-AA	TZK10 QIC Tape drive
RRD42-AA	RRD42 CD ROM reader
RX26-AA	RX26 FLOPPY @ 5% D.C.
TLZ06-AA	TLZ06 Half-Height RDAT 5 1/4 inch drive

Table D–2 System Monitors

Part Number	Description
VRT16-(DA,D4),HA,H4	16" Color
VR319-DA,D4,CA,C4	19" Monochrome
VRM20-HA,H4	20" Monochrome
VR320-CA,C4,DA,D4	19" Color

Continued on next page

Model 90 System Box FRUs, Continued

Table D–2 (Continued) System Monitors

Part Number	Description
VRT19-(DA,*D3,D4),HA,H4	19" Color
VRM17-HA,H4,(AA,A4)	17" Color
*VR297-DA,D3,D4	19" Color
*VR299-DA,D3,D4	19" Color
*VR319-CA/C4	19" Monochrome

Table D–3 Miscellaneous Hardware

Part Number	Description
BC13M-10	Remote keyboard and mouse kit
LK401-AA	Keyboard
VSXXA-DA	3-D Graphics dial box
VSXXA-KA	Lighted programmable keyboard
VSXXX-AB	Tablet
VSXXX-EA	Gray mouse pad
VSXXX-GA	Three-Button Logitec mouse
VSXXX-JA	Audio headset
BA46X-AA	Vertical stand
H9855-AA	Multiple box stand
70-28099-01	Front bezel, blank
70-28099-03	Front bezel opening for 3 1/2 in drive
70-28096-01	Base plastic assembly
70-29423-01	Plastic H-bracket for mounting half-height 3 1/2 in drives

Continued on next page

Table D–3 (Continued) Miscellaneous Hardware

Part Number	Description
70-28107-01	Top plastic cover
74-40430-01	Bracket for mounting 5 1/4 in half-height drives
74-41127-01	Bracket for mounting RX26 half-height removable media and FDI module
74-41128-01	Bracket for mounting half-height 3 1/2 in drives
74-41128-02	Bracket for mounting RZ25 only 3 1/2 in drive mounting bracket
74-41472-01	Rear opening filler
74-41473-01	Rear opening RFI shield filler
74-41734-01	Mounting plate, removable media drives
74-42419-01	Cover, diagnostic ports
74-42497-01	Power supply metal wire form
74-42662-01	Plastic handle for half-height hard disk drive bracket
74-42680-02	Clamp, LCG and SPXg/gt video board
74-43526-01	Shield, option
74-43526-02	Shield, option
74-45390-01	PCB Spacer clip
*LK201	Keyboard

Table D–4 Cables and Terminators

Part Number	Description
12-30552-01	SCSI Terminator

Continued on next page

Table D–4 (Continued) Cables and Terminators

Part Number	Description
17-02876-01	Internal wire harness power cable
17-02906-01	Cable assembly, high res 10 ft monitor cable (BC29G-09)
17-03345-01	External audio adapter cable
17-00285-00	SCSI Signal cable (from FDI to RX26)
70-28108-01	Internal SCSI Data Cable Assembly
70-26209-01	Thickwire and ThinWire Ethernet Kit
BC16M-xx	ThinWire Ethernet cable xx = 6, 15, 30 refers to length in feet
BNE3H-xx	Thickwire transceiver cable with straight connector (PVC) xx = 5, 10, 20, 40 refers to length in meters
BNE3K-xx	Thickwire transceiver cable with right-angle connector (PVC) xx = 5, 10, 20, 40 refers to length in meters
BNE3L-xx	Thick wire transceiver cable with straight connector (Teflon) xx = 5, 10, 20, 40 refers to length in meters
BNE3M-xx	Thickwire transceiver cable with right-angle connector (Teflon) xx = 5, 10, 20, 40 refers to length in meters
BNE4C-xx	Ethernet cable
BC19x	DSW21 Synch communications option cable x = V, W, U, X, Q
BC20Q	DSW21 Communication option cable

Continued on next page

Model 90 System Box FRUs, Continued

Table D–4 (Continued) Cables and Terminators

Part Number	Description
17-00606-10	System power cable (IEC to 3-prong ac 6-ft cable)
17-00365-19	System power cable for Europe
17-00442-25	System-to-monitor power cable (IEC to IEC 39-inch cable)
17-02446-02	External SCSI cable

Table D–5 TURBOchannel Option Cables

Part Number	Description
BZOD-03, 06, 12	
H8578-AA	Terminator
H4082-AA	10BaseT Terminator

Expansion Box FRUs

Table D–6 contains the part numbers for the expansion box.

Table D–6 Stand-Alone Tabletop Devices

Part Number	Description
RWZ01-AA	Optical disk
RRD42-DA	RRD42 CD ROM Reader

Table D–7 SZ16 Expansion Box FRUs

Part Number	Description
29-27889-01	RZ56 PCB
29-27890-01	RZ56 HDA
RZ57-E	RZ57 (70-28158-01 + 29-28159-01)
36-34745-01	Label for metal bracket screw hole locations
54-19325-02	Expansion box SCSI ID select switch module
54-20422-01	Expansion box load board
H7819-AA	(30-34690-01) power supply
RRD42-AA	RRD42 CD ROM Reader
*RZ55-E	RZ55 Whole drive
RZ58-E	RZ58 Whole option swap
TLZ04-GG	RDAT Drive @ 12% D.C.
TZ30-AX	TZ30 Tape drive
TZK10-AA	TZK10 QIC Tape drive
TLZ06-AA	TLZ06 Half-Height RDAT 3 1/2 inch drive

Continued on next page

Table D–8 SZ16 Expansion Box Miscellaneous Hardware

Part Number	Description
BA46X-AA	(70-28107-01) Vertical stand
BA46X-AB	Double removable media drive bracket kit
H9855-AA	Multiple box stand
70-28097-01	SCSI Bracket Assembly
70-28099-01	Front bezel, blank
70-28099-02	Front bezel opening for 5 1/4 in drive
70-28099-03	Front bezel opening for 3 1/2 in drive
70-28096-01	Base plastic assembly
70-28106-01	Enclosure assembly
70-28107-01	Top plastic cover
74-40966-01	Middle RFI shield between half-height removable media drives
74-40967-01	Bottom RFI shield when TZ30 installed
74-41948-01	Plastic handle for half-height removable media drive bracket
74-42497-01	Power supply metal wire form
74-40430-01	Half-Height drive mounting bracket for single 5 1/4 inch drives
74-41175-01	Half-Height metal mounting bracket for dual or single 5 1/4 inch drive
74-41472-01	Rear opening filler
74-41473-01	Rear opening RFI shield filler
74-41939-01	Bezel, RDAT/DUAL half-height
74-42419-01	Cover, diagnostic ports

Continued on next page

Expansion Box FRUs, Continued

Table D–9 SZ16 Expansion Box Cables and Terminators

Part Number	Description
12-30552-01	SCSI Terminator
17-00606-10	Power cable (IEC to 3-prong ac 6-ft cable)
17-02445-01	Internal SCSI ID select cable
17-02446-02	External SCSI cable
17-02876-02	Internal wire harness power cable
17-00365-19	Power Cable for Europe
70-28109-01	Internal SCSI data cable Assembly
70-28109-01	Internal SCSI data cable

Table D–10 SZ03 Sidecar

Part Number	Description
30-36532-01	Chassis and PS (W/open bezel)
54-20764-03	SCSI-FDI Control module
RX26-AA	RX26 Floppy @ 5% D.C.
RZ23L-E	RZ23L 121-MB Drive
RZ24-E	RZ24 209-MB Drive
RZ24L-E	RZ24L 245-MB Drive
RZ25 -E	RZ25 425-MB Drive

Continued on next page

Expansion Box FRUs, Continued

Table D–11 SZ03 Miscellaneous Hardware

Part Number	Description
12-30934-01	Screw, sems 6-32 PAN .250 TORX
74-43972-01	Bracket, RX26 drive
90-00001-49	Standoff, male/female for mounting disk drives
90-00049-47 B	Screw,sems 6-32 pan
90-07801-00	Washer, helical split SST
90-11187-01 C	Screw, sems, drive position

Table D–12 SZ03 Cables and Terminators

Part Number	Description
12-30552-01	SCSI Terminator
17-02446-02	External SCSI cable
70-29498-01	Switch harness, ID, SCSI, RZ23L
70-29499-01	Switch harness, ID, SCSI, RZ24, RX24L
70-29500-01	Switch harness, ID, SCSI, RZ25
17-00606-10	System power cable (IEC to 3-prong ac 6-ft cable)
17-00365-19	System power cable for Europe

Index

D

E

K

L

M

N

O