

VAX 6000 Model 600 Service Manual

Order Number EK-660EA-MG.001

This manual is intended for Digital customer service engineers and licensed self-maintenance customers. It covers processor-specific and troubleshooting information. This manual is to be used with the *VAX 6000 Platform Service Manual*.

digital equipment corporation
maynard, massachusetts

First Printing, January 1992

The information in this document is subject to change without notice and should not be construed as a commitment by Digital Equipment Corporation.

Digital Equipment Corporation assumes no responsibility for any errors that may appear in this document.

The software, if any, described in this document is furnished under a license and may be used or copied only in accordance with the terms of such license. No responsibility is assumed for the use or reliability of software or equipment that is not supplied by Digital Equipment Corporation or its affiliated companies.

Copyright ©1992 by Digital Equipment Corporation.

All Rights Reserved.
Printed in U.S.A.

The following are trademarks of Digital Equipment Corporation:

DEC	PDP	VAXcluster
DEC LANcontroller	ULTRIX	VAXELN
DECnet	UNIBUS	VMS
DECUS	VAX	XMI
DWMVA	VAXBI	

FCC NOTICE: The equipment described in this manual generates, uses, and may emit radio frequency energy. The equipment has been type tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such radio frequency interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference, in which case the user at his own expense may be required to take measures to correct the interference.

Contents

Preface	xiii
---------	------

Chapter 1 Introduction

1.1 System Functional Description	1-2
1.2 Troubleshooting Flowcharts	1-4

Chapter 2 Diagnostics

2.1 Diagnostic Overview	2-2
2.2 KA66A Self-Test and Power-Up Test	2-4
2.3 Self-Test and Power-Up Test Console Display	2-6
2.4 Diagnostic Display on Module LEDs	2-8
2.4.1 Overview of KA66A LEDs	2-10
2.4.2 Determining Failing Power-Up Test from LEDs	2-12
2.4.3 Determining Failing Console Firmware Test from LEDs	2-14
2.5 Power-Up Test Results in XBER and XGPR Registers	2-16
2.6 Invoking ROM-Based Diagnostics	2-18
2.7 ROM-Based Diagnostics — RBD 0 through 5	2-20
2.7.1 KA66A Processor Self-Test — RBD 0	2-22
2.7.2 CPU/Memory Interaction Diagnostic — RBD 1	2-26
2.7.3 DWMBB and DWMVA/A Diagnostic — RBD 2	2-28
2.7.4 DWMBB and DWMVA/A Diagnostic — RBD 2 Subtests	2-30
2.7.5 MS65A Memory Diagnostic — RBD 3	2-32
2.7.6 KA66A Processor Cache Diagnostic — RBD 4	2-36
2.7.7 Multiprocessor Diagnostic — RBD 5	2-38
2.8 VAX Diagnostic Supervisor Programs	2-40
2.8.1 Running VAX/DS in Standalone Mode	2-42
2.8.2 Running VAX/DS in User Mode	2-44
2.8.3 Sample VAX/DS Standalone Session	2-46

2.8.4	VAX/DS Diagnostics	2-50
-------	------------------------------	------

Chapter 3 KA66A Processor

3.1	KA66A Physical Description and Specifications	3-2
3.2	KA66A Configuration Rules	3-4
3.3	KA66A Functional Description	3-6
3.4	Overview of the NVAX CPU Chip	3-10
3.5	Automatic Boot Processor Selection	3-12
3.6	Power-Up Sequence	3-14
3.7	ROM-Based Diagnostics	3-18
3.8	VAX/DS Diagnostics	3-20
3.9	Console Commands	3-22
3.10	Replacing Defective Processors or Adding New Ones	3-24
3.10.1	How to Replace the Only Processor	3-26
3.10.2	How to Replace or Add Processors in a Multiprocessor System	3-28
3.10.3	Using EVUCA to Apply Current ROM and PCS Patches	3-30
3.11	KA66A Registers	3-38

Chapter 4 MS65A Memory

4.1	MS65A Physical Description	4-2
4.2	MS65A Configuration Rules	4-4
4.3	MS65A Specifications	4-5
4.4	MS65A Functional Description	4-6
4.5	MS65A Interleaving	4-8
4.6	Console Commands for Interleaving	4-10
4.7	MS65A Addressing	4-12
4.8	Memory Self-Test	4-14
4.9	Memory Self-Test Errors	4-16
4.10	MS65A Control and Status Registers	4-18

Chapter 5 DWMBB I/O Adapter

5.1	DWMBB Physical Description	5-2
5.1.1	Physical Layout	5-2
5.1.2	Specifications	5-4
5.2	DWMBB Configuration Rules	5-6
5.3	DWMBB Functional Description	5-8
5.4	DWMBB Registers	5-10

Appendix A ROM-Based Diagnostic Monitor Program

A.1	RBD Monitor Control Characters	A-2
A.2	DEPOSIT and EXAMINE Commands	A-4
A.3	START Command	A-6
A.4	START Command Qualifiers	A-7
A.5	RBD Test Printout, Passing	A-10
A.6	RBD Test Printout, Failing	A-12
A.7	SUMMARY Command	A-14
A.8	Sample RBD Session	A-16
A.9	Running ROM-Based Diagnostics on I/O Devices	A-22

Appendix B Console Error Messages

Appendix C Boot Status and Error Messages

C.1	Ethernet Boot Messages	C-1
C.2	Local Disk Boot Messages	C-2
C.3	Local Tape Boot Messages	C-2
C.4	CI and DSSI Boot Messages	C-3

Appendix D Handling Modules

D.1	Module Handling	D-2
-----	---------------------------	-----

Appendix E VAX 6000 Model 600 Configuration Rules

E.1 Configuration Rules	E-2
-----------------------------------	-----

Appendix F Parse Trees

Appendix G Restoring a Corrupted EEPROM

Appendix H Interpreting the VMS Error Log

H.1 Producing the Listing	H-2
H.2 Types of Error Log Entries for KA66A CPU	H-4
H.2.1 Machine Check Exception Entries	H-4
H.2.2 INT60 (Hard) Error Interrupt Entries	H-5
H.2.3 INT54 (Soft) Error Interrupt Entries	H-5
H.2.4 Lastfail Error Entry	H-5
H.2.5 Memory Soft Error (CRD) Entry	H-5
H.2.6 Memscan Entry	H-5
H.3 Format of Machine Check Error Log Entry	H-6
H.3.1 Header	H-6
H.3.2 Software Flags	H-6
H.3.3 Overview Information	H-8
H.3.4 CPU Error and Status Registers	H-9
H.3.5 Machine Check Stack Frame	H-9
H.3.6 Additional Error Information	H-9
H.3.7 Sample Error Log Entry for a Machine Check	H-12
H.4 Format of INT54 (Soft) Error Log Entry	H-28
H.4.1 Header	H-28
H.4.2 Software Flags	H-28
H.4.3 Overview Information	H-31
H.4.4 CPU Error and Status Registers	H-31
H.4.5 Additional Error Information	H-31
H.4.6 Sample Error Log Entry for an INT54 (Soft) Error	H-32
H.5 Format of INT60 (Hard) Error Log Entry	H-36
H.5.1 Header	H-36

H.5.2	Software Flags	H-36
H.5.3	Overview Information	H-38
H.5.4	CPU Error and Status Registers	H-38
H.5.5	Additional Error Information	H-39
H.5.6	Sample Error Log Entry for an INT60 (Hard) Error	H-40
H.6	Format of Lastfail Error Log Entry	H-44
H.7	Format of Memscan Error Log Entry	H-48
H.8	Format of Memory Soft Error (CRD) Error Log Entry	H-50

Glossary

Index

Examples

2-1	Power-Up Test Display	2-6
2-2	XGPR Register After Power-Up Test Failure	2-16
2-3	Using the TEST Command to Run RBDs	2-18
2-4	Sample START Command	2-19
2-5	KA66A Self-Test (RBD 0) Showing Error	2-22
2-6	Running KA66A Self-Test (RBD 0) on a Secondary Processor	2-23
2-7	CPU/Memory Interaction Diagnostic — RBD 1	2-26
2-8	DWMBB Diagnostic — RBD 2	2-28
2-9	DWMVA/A Diagnostic — RBD 2	2-28
2-10	RBD 3 Test on All Memory Modules	2-32
2-11	RBD 3 Diagnostic on a Memory Module in Slot A	2-32
2-12	RBD 3 Diagnostic with Module Error	2-33
2-13	RBD 3 Diagnostic with Confirm Switch	2-33
2-14	KA66A Cache Tests — RBD 4	2-36
2-15	Multiprocessor Tests — RBD 5	2-38
2-16	Running VAX/DS in Standalone Mode	2-42
2-17	Running VAX/DS in User Mode	2-44
2-18	Sample VAX/DS Session, Part 1 of 2	2-46
2-19	Sample VAX/DS Session, Part 2 of 2	2-48
3-1	Sample Self-Test and Power-Up Test Display	3-8

3-2	VAX/DS Commands for Running Standalone Processor Diagnostics	3-20
3-3	Relevant System Parameters from a SHOW FIELD Display	3-24
3-4	Replacing a Single Processor	3-26
3-5	Replacing Processors in a Multiprocessor System	3-28
3-6	Using VAX/DS to Run EVUCA to Patch EEPROM on All Modules (Part 1)	3-30
3-7	Using VAX/DS to Run EVUCA to Patch EEPROM on All Modules (Part 2)	3-32
3-8	Using VAX/DS to Run EVUCA to Patch EEPROM on All Modules (Part 3)	3-34
3-9	Using VAX/DS to Run EVUCA to Patch EEPROM on All Modules (Part 4)	3-36
4-1	SET MEMORY and INITIALIZE Commands	4-10
4-2	MS65A Memory Module Results in Self-Test	4-14
4-3	MS65A Memory Module Node Exclusion	4-16
A-1	DEPOSIT and EXAMINE Commands	A-4
A-2	START Command	A-6
A-3	RBD Test Printout, Passing	A-10
A-4	RBD Test Printout, Failing	A-12
A-5	SUMMARY Command	A-14
A-6	Sample RBD Session, Part 1 of 3	A-16
A-7	Sample RBD Session, Part 2 of 3	A-18
A-8	Sample RBD Session, Part 3 of 3	A-20
A-9	Running RBDs on I/O Devices	A-22
G-1	Restoring a Corrupted EEPROM, Part 1 of 2	G-2
G-2	Restoring a Corrupted EEPROM, Part 2 of 2	G-4
H-1	Obtaining a Selective Error Log Listing	H-2
H-2	Machine Check Error Log Report	H-12
H-3	Machine Check Error Log Report—Continued	H-14
H-4	Machine Check Error Log Report—Continued	H-16
H-5	Machine Check Error Log Report—Continued	H-18
H-6	Machine Check Error Log Report—Continued	H-20
H-7	Machine Check Error Log Report—Continued	H-22
H-8	Machine Check Error Log Report—Continued	H-24
H-9	Machine Check Error Log Report—Continued	H-26
H-10	INT54 Error Log Report	H-33

H-11	INT60 Error Log Report	H-40
H-12	Lastfail Error Log Entry	H-44
H-13	Lastfail Error Log Entry—Continued	H-46
H-14	Memscan Error Entry	H-48
H-15	Memory Soft Error (CRD) Entry	H-50

Figures

1-1	VAX 6000 Model 600 System Architecture	1-2
1-2	Power-Up	1-4
1-3	Control Panel Lights Do Not Work	1-7
1-4	System Shutdown 30 Seconds After Power-Up	1-8
1-5	No Console Output, Control Panel Fault LED Is On	1-9
1-6	No Console Output, Control Panel Fault LED Is Off	1-10
1-7	DWMBB or DWMVA/A Fails Power-Up Test	1-11
2-1	Module-Resident and Loadable Diagnostics	2-2
2-2	Determining Power-Up Test Results	2-4
2-3	Status LEDs on KA66A and Test-Related Modules	2-8
2-4	KA66A LEDs After Power-Up Tests	2-10
3-1	KA66A Module	3-2
3-2	Typical KA66A Configuration	3-4
3-3	KA66A Block Diagram	3-6
3-4	NVAX Mbox, Cbox, and Primary and Backup Cache	3-10
3-5	Selection of Boot Processor	3-12
3-6	KA66A Power-Up Sequence, Part 1 of 2	3-14
3-7	KA66A Power-Up Sequence, Part 2 of 2	3-16
4-1	MS65A Module	4-2
4-2	MS65A Configuration	4-4
4-3	MS65A Block Diagram	4-6
4-4	MS65A Interleaving	4-8
4-5	MS65A Addressing	4-12
5-1	DWMBB/A XMI Module	5-2
5-2	DWMBB/B VAXBI Module	5-3
5-3	VAX 6000 Slot Numbers	5-6
5-4	DWMBB XMI-to-VAXBI Adapter Block Diagram	5-8
D-1	Inserting and Removing Modules to and from the XMI Card Cage	D-2

E-1	Configuration Rules for VAX 6000 Model 600 Systems	E-2
F-1	Parse Tree for Machine Check Exceptions	F-2
F-2	Parse Tree for INT60 (Hard) Error Interrupts	F-12
F-3	Parse Tree for INT54 (Soft) Error Interrupts	F-17
H-1	Stack Contents for a Machine Check Exception	H-10

Tables

1	VAX 6000 Series Documentation	xiv
2	VAX 6000 Model Level Documentation	xv
3	Associated Documents	xvi
2-1	ROM-Based Diagnostics on the KA66A Module	2-3
2-2	Reading Module Status LEDs	2-9
2-3	KA66A Red LEDs: KA66A Problems	2-12
2-4	KA66A Red LEDs: DWMBB or DWMVA/A Problems	2-13
2-5	KA66A Status LEDs: Console Errors	2-14
2-6	XMI Base Addresses	2-17
2-7	Interpreting XGPR Failing Test Numbers	2-17
2-8	RBD Monitor Commands to Run Tests	2-18
2-9	KA66A ROM-Based Diagnostics	2-20
2-10	Subtests in the KA66A Self-Test — RBD 0	2-23
2-11	Subtests in the CPU/Memory Interaction Diagnostic — RBD 1	2-27
2-12	RBD 2 Subtests — DWMBB and DWMVA/A Diagnostic	2-30
2-13	Subtests in the Memory Diagnostic — RBD 3	2-34
2-14	RBD 3 Parameters	2-35
2-15	Subtests in the KA66A Cache Diagnostic — RBD 4	2-37
2-16	Subtests in the Multiprocessor Diagnostic — RBD 5	2-39
2-17	RBD 5 Parameters	2-39
2-18	VAX Diagnostic Program Levels	2-40
2-19	VAX/DS Documentation	2-40
2-20	VAX Diagnostic Supervisor Programs	2-50
3-1	KA66A Specifications	3-3
3-2	KA66A ROM-Based Diagnostics	3-18
3-3	KA66A VAX/DS Diagnostics	3-20
3-4	Console Commands	3-22
3-5	KA66A Internal Processor Registers	3-38

3-6	KA66A Registers in XMI Private Space	3-43
3-7	XMI Registers for the KA66A	3-43
4-1	MS65A Specifications	4-5
4-2	MS65A Control and Status Registers	4-18
5-1	DWMBB/A Specifications	5-4
5-2	DWMBB/B Specifications	5-5
5-3	DWMBB Cables	5-5
5-4	DWMBB Configuration	5-7
5-5	VAXBI Registers	5-10
5-6	DWMBB XMI Registers	5-11
A-1	RBD Monitor Control Characters	A-2
A-2	DEPOSIT and EXAMINE Command Qualifiers	A-4
A-3	START Command Qualifiers	A-7
B-1	Console Error Messages Indicating Halt	B-1
B-2	Standard Console Error Messages	B-3
H-1	Types of Error Log Entries for KA66A CPU	H-4
H-2	Software Flags for Machine Check Entries	H-6
H-3	Resource Disable Bits	H-9
H-4	Stack Contents for a Machine Check Exception	H-11
H-5	Software Flags for INT54 Errors	H-28
H-6	Resource Disable Bits	H-31
H-7	Software Flags for INT60 Errors	H-36
H-8	Resource Disable Bits	H-38
H-9	ECC Syndrome Code	H-51

Preface

Intended Audience

This manual is written for Digital customer service engineers and licensed self-maintenance customers servicing the VAX 6000 Model 600 system.

Document Structure

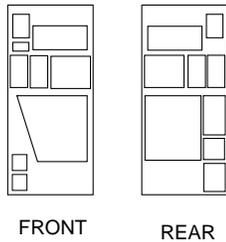
This manual presents information in small units (enough to do one task) on facing pages, so that you do not have to flip pages in the middle of changing a module, for example. The left-hand page begins with an abstract and is followed by a figure or an example. The right-hand page elaborates on the material in the left-hand page. For example, the right-hand page may fully describe the steps in installing a module, where the left-hand page has a drawing showing one part of the process.

This manual has five chapters and eight appendixes, as follows:

- **Chapter 1, Introduction**, gives an overview of the VAX 6000 Model 600 system architecture and flowcharts for troubleshooting the system.
- **Chapter 2, Diagnostics**, describes the VAX 6000 power-up test, ROM-based diagnostics, and software diagnostics that run under the VAX Diagnostic Supervisor.
- **Chapter 3, KA66A Processor, Chapter 4, MS65A Memory, and Chapter 5, DWMBB I/O Adapter**, give information on module specifications, configuration rules, and registers.
- **Appendix A** describes the commands provided by the ROM-Based Diagnostic (RBD) Monitor program. **Appendix B** lists the console error messages. **Appendix C** contains the boot status and error messages. **Appendix D** shows how to handle modules. **Appendix E** gives general configuration rules for the system. **Appendix F** gives the parse trees for the KA66A processor. **Appendix G** is a procedure for restoring a corrupted EEPROM. **Appendix H** tells how to interpret error log printouts. A **Glossary** and **Index** provide additional reference support.

Conventions Used in This Document

The icons shown below are used in illustrations for designating part placement in VAX 6000 series systems. A shaded area in the icon shows the location of the component or part being discussed.



VAX 6000 Series Documents

There are two sets of documentation: manuals that apply to all VAX 6000 series systems and manuals that are specific to a VAX 6000 model. Table 1 lists the manuals in the VAX 6000 series documentation set.

Table 1: VAX 6000 Series Documentation

Title	Order Number
Operation	
<i>VAX 6000 Series Owner's Manual</i>	EK-600EB-OM
<i>VAX 6000 Series Vector Processor Owner's Manual</i>	EK-60VAA-OM
<i>VAX 6000 Vector Processor Programmer's Guide</i>	EK-60VAA-PG
Service and Installation	
<i>VAX 6000 Platform Technical User's Guide</i>	EK-600EA-TM
<i>VAX 6000 Series Installation Guide</i>	EK-600EB-IN
<i>VAX 6000 Installationsanleitung</i>	EK-600GB-IN
<i>VAX 6000 Guide d'installation</i>	EK-600FB-IN
<i>VAX 6000 Guia de instalacion</i>	EK-600SB-IN
<i>VAX 6000 Platform Service Manual</i>	EK-600EA-MG

Table 1 (Cont.): VAX 6000 Series Documentation

Title	Order Number
Options and Upgrades	
<i>VAX 6000: XMI Conversion Manual</i>	EK-650EB-UP
<i>VAX 6000: Installing MS65A Memories</i>	EK-MS65A-UP
<i>VAX 6000: Installing the H7236-A Battery Backup Option</i>	EK-60BBA-IN
<i>VAX 6000: Installing the FV64A Vector Option</i>	EK-60VEA-IN
<i>VAX 6000: Installing the VAXBI Option</i>	EK-60BIA-IN

Manuals specific to models are listed in Table 2.

Table 2: VAX 6000 Model Level Documentation

Title	Order Number
Model 600	
<i>VAX 6000 Model 600 Mini-Reference</i>	EK-660EA-HR
<i>VAX 6000 Model 600 Service Manual</i>	EK-660EA-MG
<i>VAX 6000 Model 600 System Technical User's Guide</i>	EK-660EA-TM
<i>VAX 6000: Installing Model 600 Processors</i>	EK-660EA-UP
Model 500	
<i>VAX 6000 Model 500 Mini-Reference</i>	EK-650EA-HR
<i>VAX 6000 Model 500 Service Manual</i>	EK-650EA-MG
<i>VAX 6000 Model 500 System Technical User's Guide</i>	EK-650EA-TM
<i>VAX 6000: Installing Model 500 Processors</i>	EK-KA65A-UP
Models 200/300/400	
<i>VAX 6000 Model 300 and 400 Service Manual</i>	EK-624EA-MG
<i>VAX 6000: Installing Model 200/300/400 Processors</i>	EK-6234A-UP

Associated Documents

Table 3 lists other documents that you may find useful.

Table 3: Associated Documents

Title	Order Number
System Hardware Options	
<i>VAXBI Expander Cabinet Installation Guide</i>	EK-VBIEA-IN
<i>VAXBI Options Handbook</i>	EB-32255-46
System I/O Options	
<i>CIBCA User Guide</i>	EK-CIBCA-UG
<i>CIXCD Interface User Guide</i>	EK-CIXCD-UG
<i>DEC LANcontroller 200 Installation Guide</i>	EK-DEBNI-IN
<i>DEC LANcontroller 400 Installation Guide</i>	EK-DEMNA-IN
<i>DSSI VAXcluster Installation Guide</i>	EK-DVCLU-IN
<i>InfoServer Installation Guide</i>	EK-DIS1K-IN
<i>KDB50 Disk Controller User's Guide</i>	EK-KDB50-UG
<i>KDM70 Controller User Guide</i>	EK-KDM70-UG
<i>KFMSA Module Installation and User Manual</i>	EK-KFMSA-IM
<i>KFMSA Module Service Guide</i>	EK-KFMSA-SV
<i>RRD42 Disc Drive Owner's Manual</i>	EK-RRD42-OM
<i>RA90/RA92 Disk Drive User Guide</i>	EK-ORA90-UG
<i>RF31/RF72 Integrated Storage Element Installation Manual for BA200-Series Enclosures</i>	EK-RF72D-IM
<i>RF31/RF72 Integrated Storage Element User Guide</i>	EK-RF72D-UF
<i>RF31/RF72 Integrated Storage Element Service Guide</i>	EK-RF72D-SV
<i>SA70 Enclosure User Guide</i>	EK-SA70E-UG
<i>SF2xx Storage Array Installation Guide</i>	EK-SF200-IG

Table 3 (Cont.): Associated Documents

Title	Order Number
System I/O Options	
<i>SF7x Storage Enclosure and SF2xx Storage Array Cabinet Service Guide</i>	EK-SF72S-SG
<i>TF85 Cartridge Tape Subsystem Owner's Manual</i>	EK-OTF85-OM
<i>TF857 Magazine Tape Subsystem Service Manual</i>	EK-TF857-OM
<i>VAX 6000/SF2xx Embedded Storage Installation Guide</i>	EK-EMBED-IN
Operating System Manuals	
<i>Guide to Maintaining a VMS System</i>	AA-LA34B-TE
<i>Guide to Setting Up a VMS System</i>	AA-LA25A-TE
<i>Introduction to VMS System Management</i>	AA-LA24A-TE
<i>ULTRIX-32 Guide to System Exercisers</i>	AA-ME96B-TE
<i>VMS Networking Manual</i>	AA-LA48A-TE
<i>VMS System Manager's Manual</i>	AA-LA00B-TE
<i>VMS Upgrade and Installation Supplement: VAX 6000 Series</i>	AA-LB36C-TE
<i>VMS Version 5.5 Upgrade and Installation Manual</i>	AA-NG61D-TE
VAXclusters and Networking	
<i>DECbridge 500 Installation Guide</i>	EK-DEFEB-IN
<i>DEMFA Installation Guide</i>	EK-DEMFA-IN
<i>Fiber Distributed Data Interface Description</i>	EK-DFSLD-SD
<i>Guidelines for VAXcluster System Configurations</i>	EK-VAXCS-CG
<i>H4000 Digital Ethernet Transceiver Installation Manual</i>	EK-H4000-IN
<i>HSC Installation Manual</i>	EK-HSCMN-IN
<i>VAXcluster Principles</i>	EK-VAXCP-TM
<i>VMS VAXcluster Manual</i>	AA-LA27B-TE

Table 3 (Cont.): Associated Documents

Title	Order Number
Peripherals	
<i>Installing and Using the VT420 Video Terminal</i>	EK-VT420-UG
<i>RV20 Optical Disk Owner's Manual</i>	EK-ORV20-OM
<i>SC008 Star Coupler User's Guide</i>	EK-SC008-UG
<i>TA78 Magnetic Tape Drive User's Guide</i>	EK-OTA78-UG
<i>TA90 Magnetic Tape Subsystem Owner's Manual</i>	EK-OTA90-OM
<i>TK70 Streaming Tape Drive Owner's Manual</i>	EK-OTK70-OM
<i>TU81/TA81 and TU/81 PLUS Subsystem User's Guide</i>	EK-TUA81-UG
VAX Manuals	
<i>VAX Architecture Reference Manual</i>	EY-3459E-DP
<i>VAX Systems Hardware Handbook — VAXBI Systems</i>	EB-31692-46
<i>VAX Vector Processing Handbook</i>	EC-H0739-46

Chapter 1

Introduction

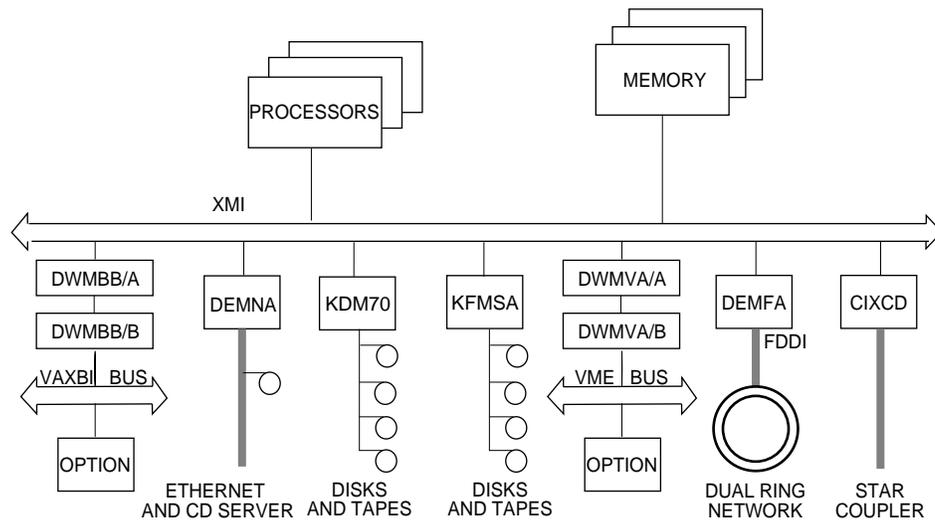
This chapter is an overview of the VAX 6000 Model 600 system. Sections include:

- System Functional Description
- Troubleshooting Flowcharts

1.1 System Functional Description

The VAX 6000 Model 600 system supports multiprocessing with up to six KA66A processors. The system uses the XMI bus as the system and I/O bus. Adapters on the XMI also allow use of the VAXBI and VME I/O buses.

Figure 1-1: VAX 6000 Model 600 System Architecture



msb-0310B-91

The **XMI bus** is the system and I/O bus; the VAXBI and VME bus can also be used for I/O. The XMI bus is a 64-bit bus¹ that interconnects the processors, memory modules, and I/O adapters. The XMI bus has three types of nodes: processor nodes (KA66A), memory nodes (MS65A), and I/O adapter nodes.

A Model 600 **processor node** is a single-board processor called the KA66A. The KA66A offers highly pipelined instruction execution on a single CPU chip, an architecture that significantly increases performance over earlier models in the VAX 6000 series. The system supports symmetric multiprocessing with up to six processors.

A **memory node** is an MS65A module. Memory is a global resource equally accessible by all processors on the XMI bus. Each MS65A module has 32, 64, or 128 Mbytes of memory, consisting of MOS 1-Mbit or 4-Mbit dynamic RAMs, ECC logic, and control logic. Memory access is automatically interleaved between modules. An optional battery backup unit protects memory in case of power failure.

I/O adapters for the XMI bus provide access to I/O devices (KDM70 and KFMSA), other systems in a cluster (CIXCD), other buses (DWMBB and DWMVA), and networks (DEMNA and DEMFA). The system supports two other buses. For a VAXBI bus, the DWMBB adapter is used to connect VAXBI I/O adapters to the XMI bus. For a VMEbus, the DWMVA adapter connects VME I/O adapters to the XMI bus.

¹ The XMI bus has a 64-nanosecond bus cycle, with a maximum throughput of 100 Mbytes per second.

1.2 Troubleshooting Flowcharts

The following flowcharts reference sections in this manual and in the VAX 6000 Platform Service Manual.

Figure 1-2: Power-Up

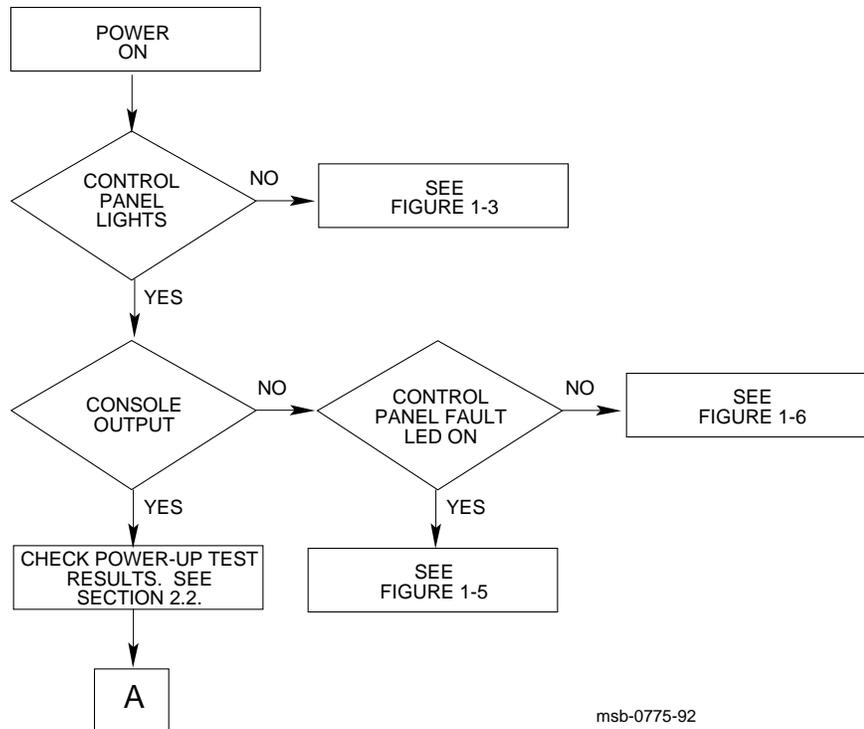
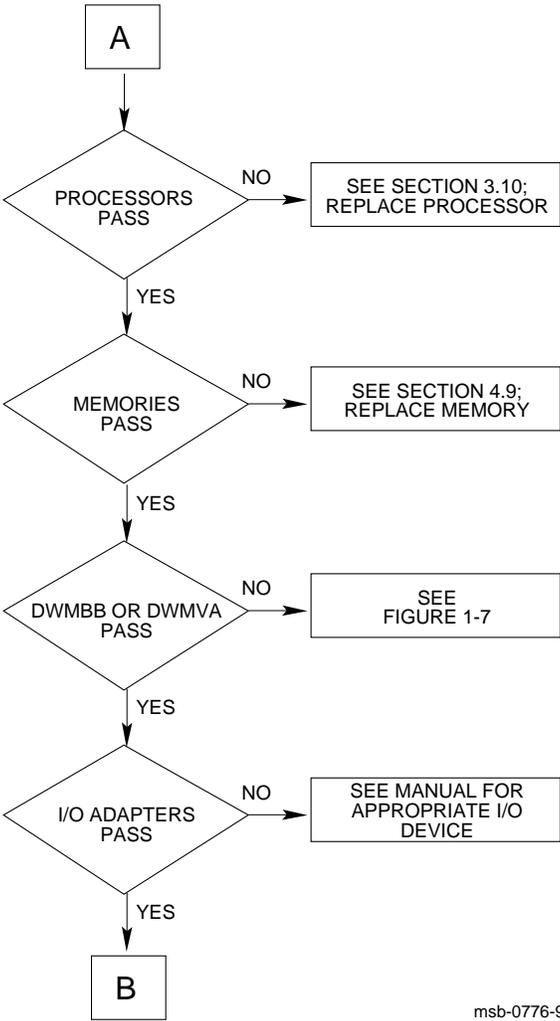


Figure 1-2 Cont'd on next page

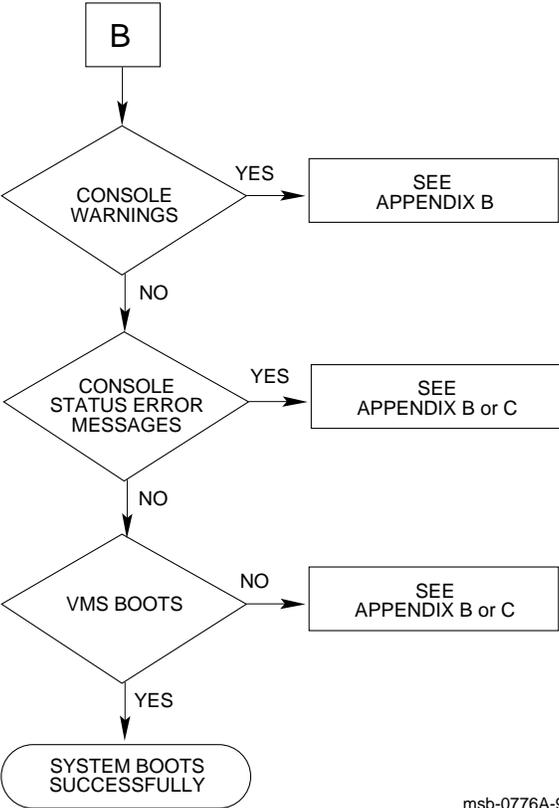
Figure 1-2 (Cont.): Power-Up



msb-0776-92

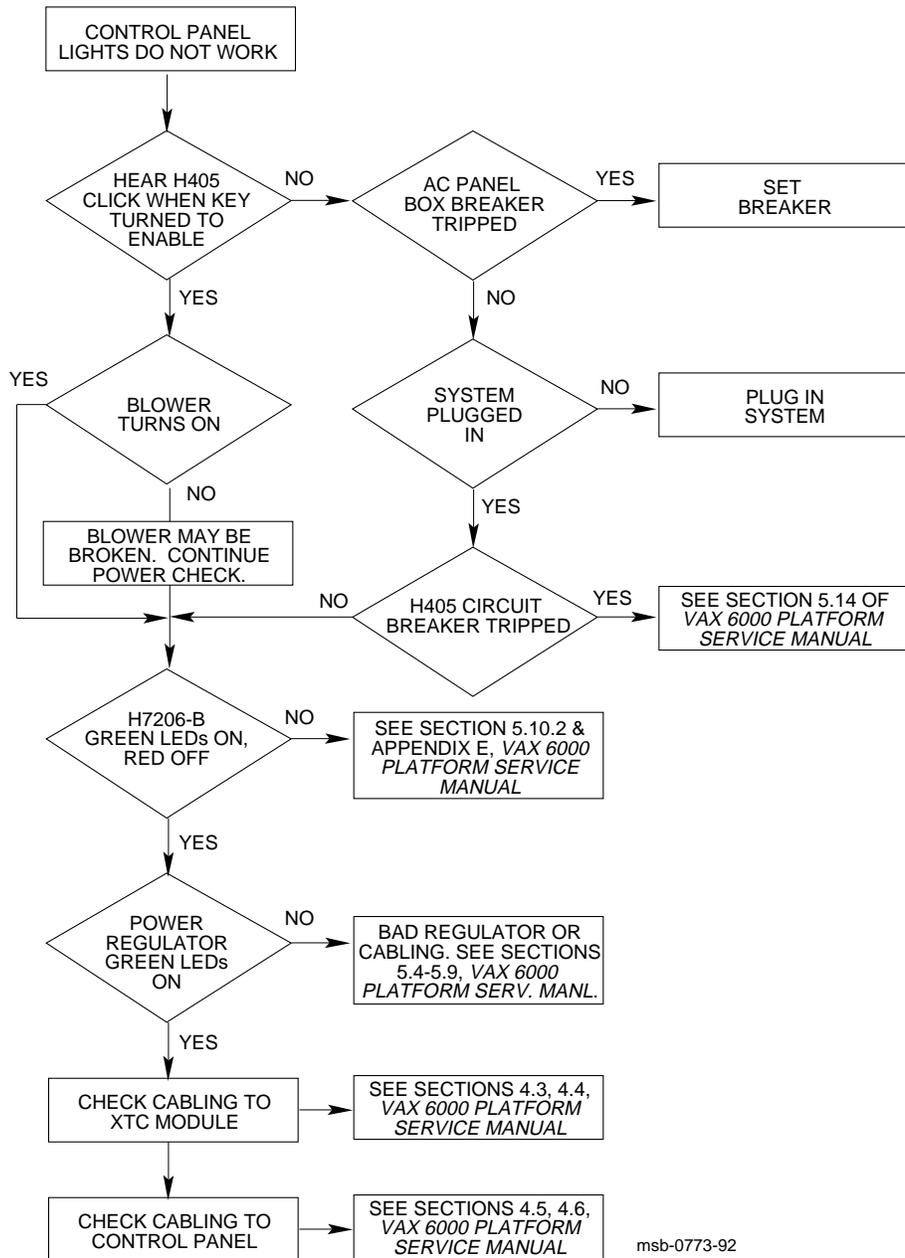
Figure 1-2 Cont'd on next page

Figure 1-2 (Cont.): Power-Up



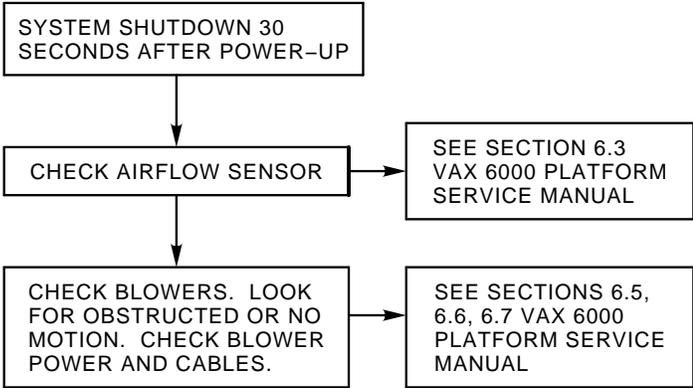
msb-0776A-92

Figure 1-3: Control Panel Lights Do Not Work



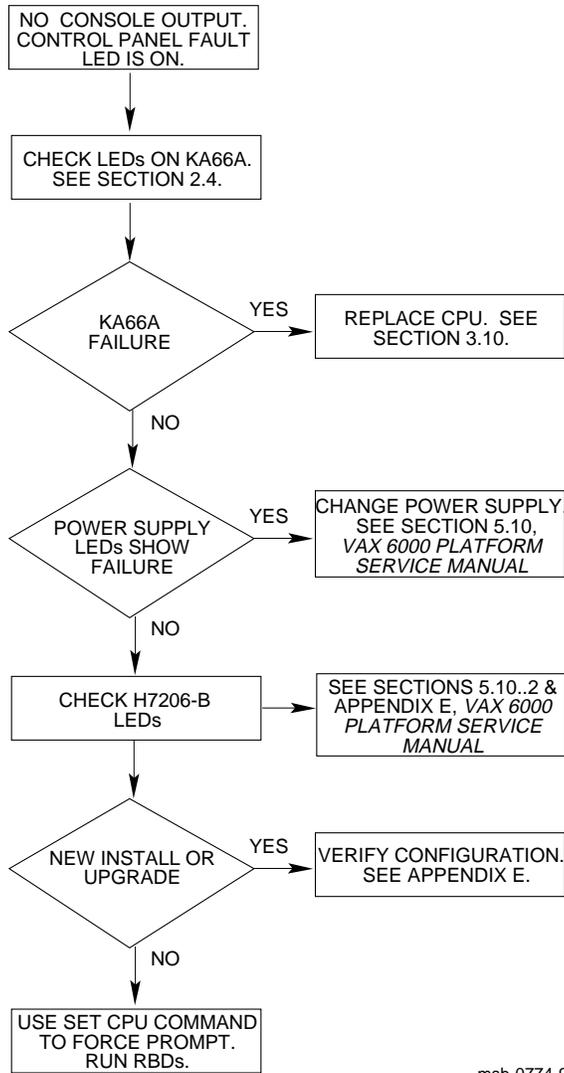
msb-0773-92

Figure 1-4: System Shutdown 30 Seconds After Power-Up



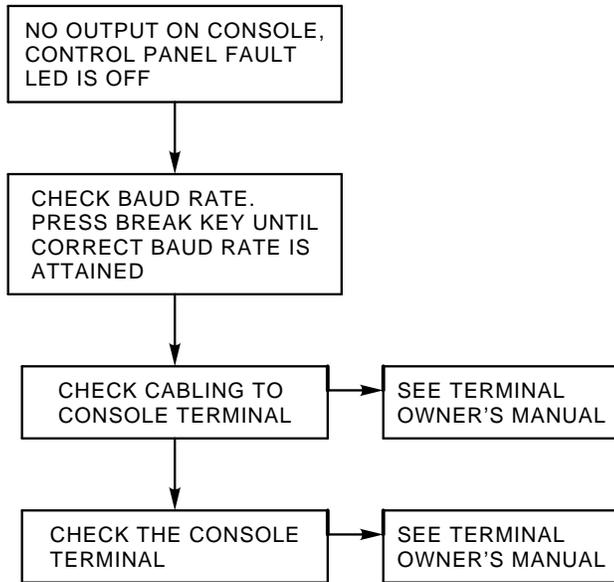
msb-p381-90

Figure 1-5: No Console Output, Control Panel Fault LED Is On



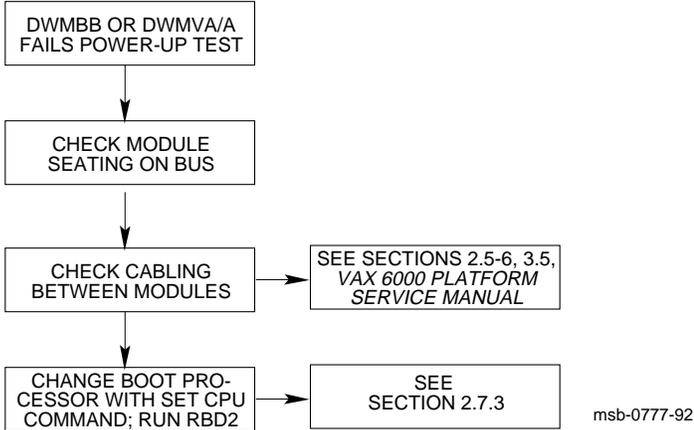
msb-0774-92

Figure 1-6: No Console Output, Control Panel Fault LED Is Off



msb-p383-90

Figure 1-7: DWMBB or DWMVA/A Fails Power-Up Test



Chapter 2

Diagnostics

This chapter describes diagnostics for the VAX 6000 Model 600 system. Sections include:

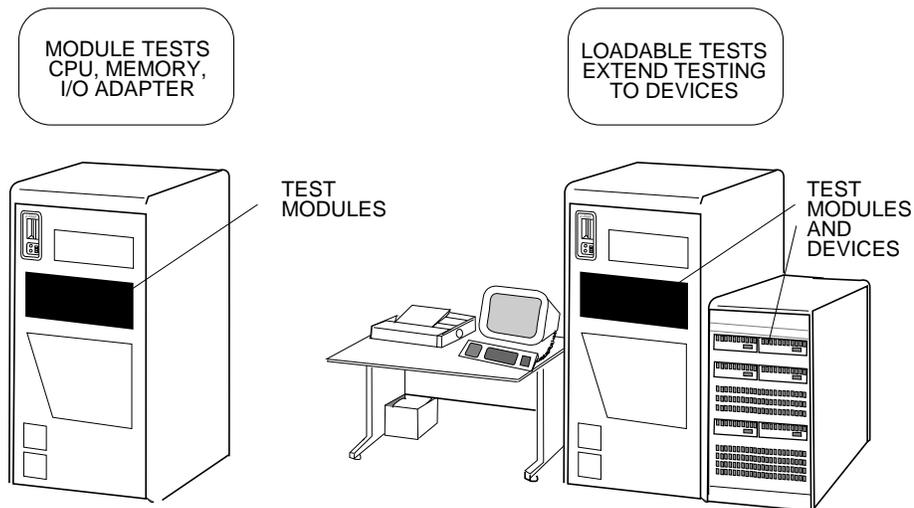
- Diagnostic Overview
- KA66A Self-Test and Power-Up Test
- Self-Test and Power-Up Test Console Display
- Diagnostic Display on Module LEDs
 - Overview of KA66A LEDs
 - Determining Failing Power-Up Test from LEDs
 - Determining Failing Console Test from LEDs
- Power-Up Test Results in XBER and XGPR Registers
- Invoking ROM-Based Diagnostics
- ROM-Based Diagnostics—RBD 0 through 5
 - KA66A Processor Self-Test—RBD 0
 - CPU/Memory Interaction Diagnostic—RBD 1
 - DWMBB and DWMVA/A Diagnostic—RBD 2
 - MS65A Memory Diagnostic—RBD 3
 - KA66A Processor Cache Diagnostic—RBD 4
 - Multiprocessor Diagnostic—RBD 5
- VAX Diagnostic Supervisor Programs
 - Running VAX/DS in Standalone Mode
 - Running VAX/DS in User Mode
 - Sample VAX/DS Standalone Session
 - VAX/DS Diagnostics

2.1 Diagnostic Overview

Diagnostics described in this manual help find problems in the VAX 6000 Model 600 hardware. Some are located on the modules of the XMI and VAXBI; these diagnostics isolate problems in these modules.

Other diagnostics are loadable; they can be run using the VAX Diagnostic Supervisor (VAX/DS), which can run under operating system control or in console mode. These diagnostics extend I/O testing and include exercisers that can help reproduce intermittent problems.

Figure 2-1: Module-Resident and Loadable Diagnostics



msb-0771-91

Module-Resident Diagnostics: Testing Modules on the Buses

Problem modules on the XMI and VAXBI buses can be quickly identified by diagnostics located on the modules themselves.

On the KA66A, six ROM-based diagnostics (RBDs) are available in ROM on the module. Table 2–1 briefly describes which modules the RBDs test and what features or operations are tested. Four RBDs are run automatically whenever the system is powered up, reset, booted, or initialized. All six can be run in console mode using the TEST command.

Table 2–1: ROM-Based Diagnostics on the KA66A Module

Number¹	Run at Power-Up	Description
0	Yes	CPU self-test
1	Yes	CPU/memory interaction test
2	Yes	DWMBB or DWMVA/A test
3	No	Additional memory tests
4	No	CPU cache test
5	Yes	Multiprocessor test

¹This number identifies the diagnostic test when you run the RBD monitor program to execute the diagnostic, as described in Section 2.6.

Loadable Diagnostics: System-Level Testing

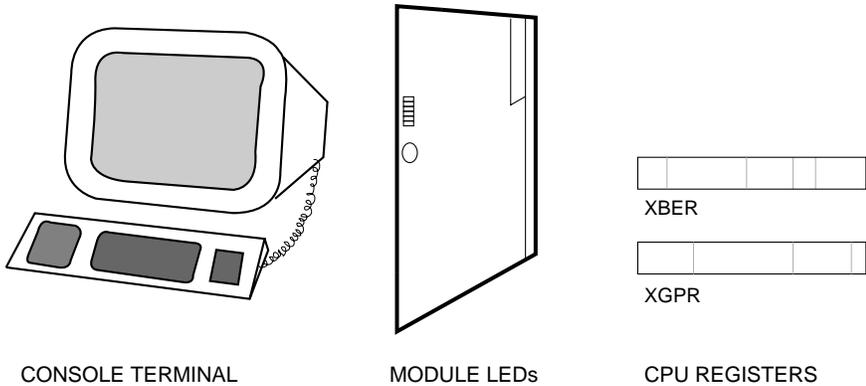
The VAX Diagnostic Supervisor (VAX/DS) program can run under operating system control or from the console prompt, and lets you run tests that help isolate system-level problems.

Like RBDs, the loadable diagnostics test modules, but they also test the logic and function of peripheral devices. These diagnostics include *exercisers*, which help evoke (and diagnose) intermittent faults, occurring only once or twice over a long period of time.

2.2 KA66A Self-Test and Power-Up Test

When the system is powered up, booted, initialized, or reset, a series of tests are run. These tests include individual module self-tests and extended tests in ROM on the KA66A processor. The results of these tests can be determined in three ways.

Figure 2-2: Determining Power-Up Test Results



msb-0770-91

You can see the results of the power-up tests in three places:

- **Console terminal.** A summary report of the power-up tests appears on the console terminal. This summary report is described in Section 2.3.
- **Module LEDs.** The LEDs on the XMI modules also display the results of the tests run at power-up, as described in Section 2.4.
- **XBER and XGPR Registers.** When a failure occurs during power-up and the failing test number cannot be found in the module LEDs, you can check the XBER and XGPR registers, as described in Section 2.5.

Types of Power-Up Tests

Three types of tests run at system power-up:

- **Individual Module Self-Tests.** Each module on the XMI bus (except the DWMBB/A and DWMVA/A) has its own self-test, resident on the module itself. This self-test checks the module's functions independent from its interaction with other modules.

Module self-tests are quick and complete; the processor self-test, for example, tests the module logic, ROMs, EEPROMs, and so forth, within 10 seconds.

- **Module Interaction Tests.** In addition to its self-test, ROMs on the KA66A (CPU) module include tests for module interactions:
 - CPU/memory interaction tests. These tests ensure that the processors can access memory. They also test some CPU logic that can be checked only by accessing memory.
 - Multiprocessing tests. These tests check functions associated with multiprocessing, such as memory interlocks and bus arbitration.
- **DWMBB, DWMVA/A and VAXBI Module Tests.** The XMI module that connects to a VAXBI bus or a VMEbus – called DWMBB/A for the XMI bus and DWMVA/A for the VMEbus – does not contain its own self-test. This logic is included on the KA66A. For a VAXBI bus, this logic tests the DWMBB and then queries the VAXBI options for the results of their self-tests. For a VMEbus, the RBD tests only the DWMVA/A module.

The tests run during power-up can also be run by invoking the RBD monitor program using the TEST console command, as described in Section 2.6. You also use this means to invoke the RBDs not run at power-up.

2.3 Self-Test and Power-Up Test Console Display

The power-up console display includes the results of module self-tests and extended testing.

Example 2-1: Power-Up Test Display

```
#123456789 0123456789 0123456789 0123456789 012345#①
F  E  D  C  B  A  9  8  7  6  5  4  3  2  1  0  NODE #
      A  A  .  .  .  M  M  M  M  A  .  P  P  P      TYP②
      O  +  .  .  .  +  +  +  +  O  .  +  +  +      STF③
      .  .  .  .  .  .  .  .  .  .  .  .  E  D  B      BPD④
      .  .  .  .  .  .  .  .  .  .  .  +  +  -      ETF⑤
      .  .  .  .  .  .  .  .  .  .  .  .  B  D  E      BPD⑥

      .  .  .  .  .  .  .  +  +  +  .  +  .  .  +  .  VME 5 +⑦
      .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  XBI E +
      .  .  .  .  .  .  A4  A3  A2  A1  .  .  .  .  .  ILV
      .  .  .  .  .  .  64  64  64  64  .  .  .  .  .  256 Mb

Console = V1.00  RBDs = V1.00  EEPROM = 1.00/1.00  SN = GA14012345⑧
>>>
```

The console display contains the following information:

- ① The first line of the display is the progress trace. This line prints if a KA66A processor module is in slot 1. The trace line prints as the tests are run, letting you see that something is happening. The numbers correspond to the 45 tests in the KA66A ROM (Section 2.7.1). When these 45 tests pass, the line prints as in Example 2-1. If a test fails, display stops with the failing test number. For example, if test 14 fails, the line is printed as follows:

```
#123456789 01234
```

- ② This line indicates the type (TYP) of module at each XMI node. Processors are type P, memories are type M, and I/O adapters are type A. In this example, processors are at nodes 1, 2, and 3, memories at nodes 6 through 9, and I/O adapters in nodes 5, D, and E.

- ③ This line shows self-test fail status (STF), which are the results of on-board self-test. Possible values for modules are:

- + (pass)
- (fail)

The "o" in slots E and 5 indicates no onboard self-test (a DWMBB/A and DWMVA/A module, respectively). All modules with onboard self-tests passed this phase of testing in this example.

- ④ The BPD line indicates boot processor designation. When the system completes on-board self-test, the processor with the lowest XMI ID number that passes self-test and is eligible is selected as boot processor — in this example, the processor at node 1. The results on the BPD line indicate:

- The boot processor (B)
- Processors eligible to become the boot processor (E)
- Processors ineligible to become the boot processor (D)

- ⑤ During extended test (ETF) all processors run additional tests, which include CPU/memory interaction and multiprocessor tests. On line ETF, results are reported for each processor in the same way as on line STF—a plus sign (+) indicates that extended test passed and a minus sign that extended test failed. In this example, the processor at node 1 (originally selected boot processor) failed the CPU/memory interaction tests.

- ⑥ Another BPD line is displayed, because it is possible for a different CPU to be designated boot processor before the system actually boots. This occurs in this example, because the processor at node 1 failed the extended test. The lowest-numbered processor that passed both tests is the processor at node 2. However, a previous SET CPU/NOPRIMARY command has made this processor ineligible to be boot processor (indicated by the designation D on the BPD line). Therefore, the processor at node 3 is designated boot processor.

- ⑦ A plus sign at the right of the VME line means the DWMVA/A passed testing. On the XBI line, it means both the DWMBB/A and DWMBB/B modules passed testing. Plus signs to the left of "XBI" mean VAXBI options at those nodes in the VAXBI passed their self-tests.

- ⑧ The bottom line of the power-up test display shows the ROM and EEPROM version numbers and the system serial number.

2.4 Diagnostic Display on Module LEDs

You can check diagnostic results in the lights on the modules. Before module status LEDs can be checked, the control panel switch must be set to Enable.

Figure 2-3: Status LEDs on KA66A and Test-Related Modules

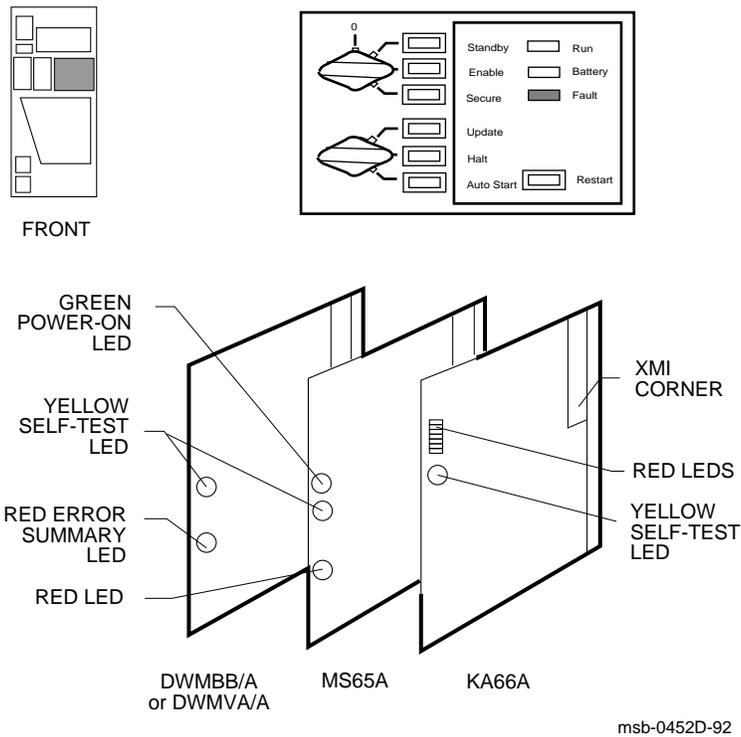


Table 2-2 lists the LED self-test status of the three modules tested by power-up tests on the KA66A processor.

Table 2-2: Reading Module Status LEDs

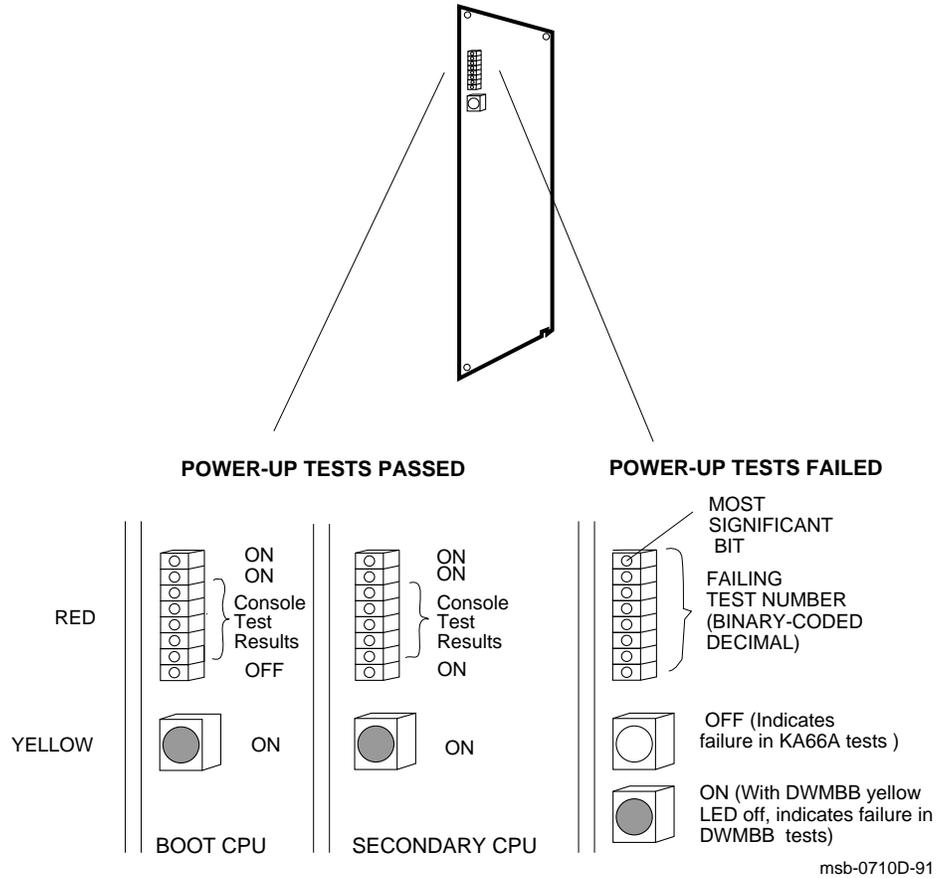
Module	Self-Test Passed	Self-Test Failed
KA66A boot processor	Yellow ON Top two red ON and bottom red OFF	Yellow OFF Some red ON
KA66A secondary processor	Yellow ON Top two red ON and bottom red ON	Yellow OFF Some red ON
MS65A memory	Yellow ON Green ON	Yellow ON ¹ Green ON
DWMBB/A and DWMVA/A adapter	Yellow ON	Yellow OFF

¹The yellow LED on the memory module is used to indicate *only* that self-test has completed, since even when parts of a memory module fail, the parts of memory still working can be used. Problems in memory modules are best identified by examining the detailed RBD displays and by VAX/DS testing.

2.4.1 Overview of KA66A LEDs

System power-up testing and console firmware testing results are displayed on the KA66A and DWMBB LEDs.

Figure 2-4: KA66A LEDs After Power-Up Tests



The large yellow LED at the bottom of the KA66A LEDs lights when the KA66A modules pass the power-up tests, where a CPU module is tested individually (self-test), followed by CPU/memory interaction tests and CPU multiprocessing tests.

The KA66A power-up tests also check DWMBB and DWMVA/A modules, if any. If both DWMBB modules or the DWMVA/A module passes testing, the DWMBB/A or DWMVA/A yellow light and the KA66A yellow light are on. If the DWMBB modules or the DWMVA/A module fails testing, the DWMBB/A or DWMVA/A yellow light is off and the KA66A yellow light is on.

When power-up tests pass, the red lights of the KA66A are set as shown in the left-hand part of Figure 2-4. The bottom red light of the KA66A is off if the KA66A is the boot processor, and on if it is a secondary processor.

If power-up tests fail for the KA66A, DWMBB, or DWMVA/A modules, the eight red LEDs contain an error code that corresponds to the number of the failing test. The test number is represented in binary-coded decimal, with the most significant bit at the top. A bit is ONE if the light is ON.

For example, assume a processor fails power-up tests (yellow LED is OFF) and shows the following pattern in the eight red LEDs:

```

TOP
(MSB) off    0
        off    0 = 3
        on     1
        on     1
        off    0
        off    0
        on     1 = 2
(LSB) off    0
BOTTOM

```

The failing test number decodes to 0011 0010 (binary-coded decimal 32).

Section 2.4.2 gives more detail on the failing power-up tests indicated by the KA66A red LEDs.

When power-up tests run without errors, console firmware tests for conditions necessary to make its environment workable. The results of these tests are described in Section 2.4.3.

2.4.2 Determining Failing Power-Up Test from LEDs

When power-up tests fail, the red LEDs on the KA66A identify the failing test and subtest numbers.

Table 2-3: KA66A Red LEDs: KA66A Problems

KA66A Red LEDs	Diagnostic and Test Number	Device Failing	Power-Up Test Line
1-45	CPU self-test (RBD 0) T0001-T0045	KA66A	STF
51-65	CPU/memory test - Memory 1 (RBD 1) T0001-T0015	KA66A or MS65A 1 (module with lowest XMI node number)	ETF
70	CPU/memory test - Memory 2 (RBD 1) T0003 (equivalent to ST1/T=3)	MS65A 2 (module with next-lowest XMI node number ¹)	ETF
71	CPU/memory test - Memory 3	MS65A 3	ETF
72	CPU/memory test - Memory 4	MS65A 4	ETF
73	CPU/memory test - Memory 5	MS65A 5	ETF
74	CPU/memory test - Memory 6	MS65A 6	ETF
75	CPU/memory test - Memory 7	MS65A 7	ETF
76	CPU/memory test - Memory 8	MS65A 8	ETF
81-87	Multiprocessor test (RBD 5) T0001-T0007	KA66A	ETF

¹Values 70-76 show a failure of RBD 1 Test 3 in a particular memory module. The tests on modules proceed from right to left, so a value of 70 indicates the module with the second-lowest XMI node number; 71, the third-lowest, and so forth.

When you cannot read power-up test results from the console terminal, you can see results from LEDs on the KA66A and DWMBB/A or DWMVA/A.

KA66A Yellow LED Off. If a processor's yellow LED is OFF and the red LEDs show an error code in the range 1–45, the processor's self-test failed and the processor board is bad.

After the self-tests, each processor runs the CPU/memory interaction tests and the multiprocessor tests. The LEDs display error codes for failing CPU/memory tests with numbers ranging from 51 to 65, which is the failing CPU/memory test number (1 through 15) plus 50. For failing multiprocessor tests, the LEDs display numbers ranging from 81 to 87, which is the failing multiprocessor test number (1 through 7) plus 80.

Each processor, after completely testing interaction with the first memory, runs CPU/memory interaction test T0003 on every other good memory module. If a failure occurs, it probably means that the memory module is bad, even though the processor's yellow light is OFF and the memory module's yellow light is ON. The yellow light on a memory module indicates only that its self-test completed, since even when parts of a memory module fail, the parts that are working can still be used.

So, if a processor is running self-test and multiprocessor tests, but failing CPU/memory interaction tests, the chances are that the problem lies with the memory. If several processors fail on the same memory, that memory module is certainly bad. Try using SET MEMORY to configure the bad module out of the interleave set.

KA66A Yellow Led ON, DWMBB/A or DWMVA/A Yellow LED Off. If the DWMBB/A or DWMVA/A yellow LED is off, the module has failed testing. The yellow LED of the KA66A will be on, and the KA66A red LEDs give the number of the failing test, as shown in Table 2–4.

Table 2–4: KA66A Red LEDs: DWMBB or DWMVA/A Problems

KA66A Red LEDs	Diagnostic and Test Number	Device Failing	Power-Up Test Line
1–44	DWMBB test T0001–T0044	DWMBB	XBI
1–19	DWMVA/A test T0001–T0019	DWMVA/A	VME

2.4.3 Determining Failing Console Firmware Test from LEDs

After power-up tests run without errors, console firmware tests for conditions necessary to make its environment workable.

Table 2-5: KA66A Status LEDs: Console Errors

Red LED	No Errors		No	No	No	No
	Primary	Secondary	Primary	Memory	CCA	XMI
8	1	1	1	1	1	1
7	1	1	1	1	1	1
6	0	0	0	0	0	0
5	0	0	0	0	0	1
4	0	0	0	0	1	0
3	0	0	0	1	0	0
2	0	0	1	0	0	0
1	0	1	X ¹	X ¹	X ¹	X ¹

¹X indicates that the LED can be on or off.

KA66A Yellow LED On, DWMBB/A Yellow LED On. After power-up tests run without errors, the red LEDs on the KA66A show either that the console firmware has detected no errors or one of four console-detected errors:

- **No primary.** The console cannot locate any processor that is eligible to be the boot processor. In this case the bottom red LED is invalid; that is, it does not indicate whether a processor is the primary or a secondary.
- **No memory.** The console cannot locate any system memory on the XMI bus.
- **No CCA.** The console cannot locate the console communications area (CCA) in system memory. The CCA is used for communication among the console programs running on each processor in a multiprocessor system.
- **No XMI.** A machine check exception occurred while console error handling code was attempting to access registers on XMI adapters. In this case, the bottom red LED does not indicate whether a processor is the primary or a secondary.

2.5 Power-Up Test Results in XBER and XGPR Registers

You can check power-up test results in the console display, in the lights on the modules, or in the XBER and XGPR registers. Use the XBER and XGPR registers when a failure occurs during power-up and the failing test number cannot be found in the module LEDs.

Example 2-2: XGPR Register After Power-Up Test Failure

```
>>> E/P/L E190000C      ! Examine the longword at physical address
E190000C 30xxxxxx      ! E190000C, the address of the XGPR
                        ! register of the KA66A processor in slot 2.
>>> E/P/L E1900004      ! Then examine the XBER register (bit 10
E1900004 xxxxx4xx      ! set). The result indicates that test 30
                        ! of the KA66A self-test failed. See
                        ! Table 2-7 to interpret the data returned.

>>> E/P/L E188000C      ! Examine the XGPR register of the KA66A
E188000C 13xxxxxx      ! processor in slot 1. Derivation of the
                        ! address is explained below.
>>> E/P/L E1880004      ! Then examine the XBER register (bit 10
E1880004 xxxxx0xx      ! clear). DWMBB or DWMVA/A test 13 failed.
```

When a failure occurs in a power-up test, you can examine the XGPR register to determine the failing test number. The XGPR register of the KA66A processor that failed self-test, CPU/memory interaction testing, or multiprocessor testing (or, if the DWMBB or DWMVA/A test failed, the boot processor) contains the failing test number. If all power-up tests pass (as indicated by the console display or the LEDs on the modules), the XGPR register contains other data and should be ignored.

To examine the XGPR register, first see Table 2-6 to determine the base address (BB) of the KA66A processor's node. Then calculate the address of the XGPR register by adding 0C (hex) to the base address.

The failing test number is derived from the upper byte (bits <31:24>) of the longword returned. For self-test, the upper byte contains the failing test number. If a CPU/memory interaction test fails, this byte contains the failing test number plus 50. If a multiprocessor test fails, this byte contains

the failing test number plus 80. All numbers are expressed in binary-coded decimal (BCD). See Table 2–7.

Table 2–6: XMI Base Addresses

Slot	Node	Base Address (BB)
1	1	E188 0000
2	2	E190 0000
3	3	E198 0000
4	4	E1A0 0000
5	5	E1A8 0000
6	6	E1B0 0000
7	7	E1B8 0000
8	8	E1C0 0000
9	9	E1C8 0000
10	A	E1D0 0000
11	B	E1D8 0000
12	C	E1E0 0000
13	D	E1E8 0000
14	E	E1F0 0000

Table 2–7: Interpreting XGPR Failing Test Numbers

Failing Diagnostic	XBER <10>	XGPR <31:24> (BCD)	Test Numbers
Self-test (RBD 0)	Set	1–45	1–45
CPU/memory interaction test (RBD 1 for Memory 1)	Clear	51–65	1–15
CPU/memory interaction tests (RBD 1 for for Memories 2, 3 ...)	Clear	70–80	3
Multiprocessor test (RBD 5)	Clear	81–87	1–7
DWMBB or DWMVA/A test (RBD 2)	Clear	1–44	1–44

2.6 Invoking ROM-Based Diagnostics

You can run RBDs at any time in console mode. Use the TEST command to invoke the RBD Diagnostic Monitor. You can then type RBD monitor commands that run tests and display test output at the console terminal.

Example 2-3: Using the TEST Command to Run RBDs

```
>>> T/R           ! This is the abbreviation for TEST/RBD.
                    !
RBD1> ST 0        ! RBD1 indicates that the processor running
                    ! the RBD monitor program is in XMI slot 1.
                    ! The user types ST 0 to start RBD 0, the
                    ! CPU self-test.
```

Table 2-8: RBD Monitor Commands to Run Tests

Command	Function														
ST[ART] <i>n</i>	Starts RBD <i>n</i> , where <i>n</i> is the number of the RBD program:														
	<table border="1"><thead><tr><th>n</th><th>Description</th></tr></thead><tbody><tr><td>0</td><td>CPU self-test</td></tr><tr><td>1</td><td>CPU/memory interaction test</td></tr><tr><td>2</td><td>DWMBB or DWMVA/A test</td></tr><tr><td>3</td><td>Additional memory tests</td></tr><tr><td>4</td><td>CPU cache test</td></tr><tr><td>5</td><td>Multiprocessor test</td></tr></tbody></table>	n	Description	0	CPU self-test	1	CPU/memory interaction test	2	DWMBB or DWMVA/A test	3	Additional memory tests	4	CPU cache test	5	Multiprocessor test
n	Description														
0	CPU self-test														
1	CPU/memory interaction test														
2	DWMBB or DWMVA/A test														
3	Additional memory tests														
4	CPU cache test														
5	Multiprocessor test														
SU[MMARY]	Prints a summary report of the last RBD program run														
QU[IT]	Exits the RBD monitor and returns control to the console program														

The Diagnostic Monitor lets you run RBDs¹ whenever it may seem necessary, not just at power-up. You can also run more tests than are run at power-up. To run RBD tests:

- Type T/R to start the RBD monitor program, as shown in Example 2-3.
- At the RBD*n*> prompt, you can type any RBD monitor command. The START, SUMMARY, and QUIT commands outlined in Table 2-8 are the basics for running RBDs.

All START command qualifiers are described in Appendix A. Four helpful ones are outlined here.

- **Trace (/TR) Qualifier.** If you use this qualifier with the START command, a trace of each individual test is displayed.
- **Halt-on-Error (/HE) Qualifier.** By default, the RBDs continue to execute after an error is encountered. Use the /HE qualifier to cause the program to halt when the first error occurs. (You can stop testing at any time by pressing CTRL/C.)
- **Specific-Test (/T=n[:m]) Qualifier.** The RBDs each have a number of subtests (see Section 2.7). You can select subtests with the /T qualifier.
- **Number of Passes (/P=n) Qualifier.** You can request that a test be repeated with this qualifier.

Example 2-4: Sample START Command

```
RBD1 ST2/TR/T=2:4/P=3 E      !Starts RBD 2 for the DWMBB/A at XMI node E
                             !with trace, tests 2-4 only, and 3 passes.
;XBIP TST      1.0
;T0002  T0003  T0004  T0002  T0003  T0004  T0002  T0003  T0004
;      P      1      8087      3
; 00000000 00000000 00000000 00000000 00000000 00000000 00000000
```

¹ The Diagnostic Monitor provides other capabilities, including the capability to set and display registers for interactive debugging. The Diagnostic Monitor is described in full in Appendix A.

2.7 ROM-Based Diagnostics — RBD 0 through 5

The KA66A diagnostic ROM has six diagnostics: RBD 0 tests the processor; RBD 1 tests processor/memory interaction; RBD 2 tests the optional DWMBB or DWMVA/A adapter; RBD 3 tests MS65A memories; RBD 4 tests the KA66A cache; and RBD 5 tests multiprocessor interaction.

Table 2-9: KA66A ROM-Based Diagnostics

RBD Number	Total Tests	Power-Up Default	Callable Default	Description
0	45	45 ¹	45	CPU self-test
1	16	12 ²	16	CPU/memory interaction test
2	44	44	44	DWMBB or DWMVA/A test
3	14	0	7 ³	Additional tests on main memory
4	3	0	0 ⁴	Cache coherency tests
5	7	7	7	Multiprocessor test

¹Although the same number of tests are run for the processor at power-up as when RBD 0 is run, subtest 2, the EEPROM test, is much less comprehensive at power-up than when RBD 0 is called using the Diagnostic Monitor program. At power-up, only the first and last locations are read from EEPROM. When run from the Diagnostic Monitor, all locations are read from EEPROM.

²Tests 1, 2, 13, and 16 of RBD 1 are skipped when the test is run automatically at power-up.

³You must use the /C qualifier to run tests 1, 5, 9, 11-14, as these tests alter memory content.

⁴You have to request specific subtests with the /T=n[m] qualifier for RBD 4.

The following paragraphs summarize the callable ROM-based diagnostics.

RBD 0 — Processor Self-Test

RBD 0 is the KA66A self-test. You may wish to run RBD 0 through several passes (using the /P=*n* qualifier) when a processor fails self-test intermittently. Running RBD 0 executes the diagnostic on the processor currently selected as the boot processor. To test other processors, use the console command SET CPU *n*, where *n* is the hexadecimal number giving the XMI slot location of the desired processor (see Example 2–6).

RBD 1 — CPU/Memory Interaction Test

RBD 1 tests CPU/memory interaction. As with RBD 0, executing several passes of RBD 1 may help pin down intermittent CPU/memory interaction failures. Running RBD 1 also executes more tests than are done at power-up.

RBD 2 — DWMBB or DWMVA/A Test

RBD 2 tests both modules of the DWMBB adapter (for VAXBI connections) or the DWMVA/A adapter (for VMEbus connections). (The DWMBB/A and DWMVA/A have no on-board self-test.) Section 2.7.3 has an example of this diagnostic and a list of tests.

RBD 3 — Additional Memory Tests

RBD 3 is a set of XMI memory tests that sizes and runs extended tests on all of memory. RBD 3 is not run at power-up, since its use requires some care. Section 2.7.5 shows examples of this RBD and lists the tests.

RBD 4 — Processor Cache Coherency Tests

RBD 4 is a set of tests you can run following system crash to check for cache coherency. Section 2.7.6 has an example of this diagnostic and a list of tests.

RBD 5 — Multiprocessing Tests

RBD 5 tests the interaction of multiple KA66A processors. Running multiple passes of RBD 5 can help pinpoint specific multiprocessing errors. Section 2.7.7 includes an example of this RBD and a list of its tests.

2.7.1 KA66A Processor Self-Test — RBD 0

RBD 0 is the KA66A self-test. More EEPROM testing is done in RBD mode than for power-up testing. Otherwise, the tests are the same.

Example 2-5: KA66A Self-Test (RBD 0) Showing Error

```
>>> T/R                ! Command to enter RBD monitor program.
RBD1> ST0/TR/HE        ! Runs the KA66A self-test on boot processor
                        ! Trace prints each test number; halt on error
; XNP_ST                1.00
; T0001 T0002 T0003 T0004 T0005 T0006 T0007 T0008 T0009 T0010
; T0011 T0012 T0013 T0014 T0015 T0016 T0017 T0018 T0019 T0020
; T0021 T0022 T0023 T0024 T0025 T0026 T0027 T0028 T0029❶
;           F❷          1      8087          1❸
;           HE BR_PRED      XX      T0029❶
;           28 5555AAAA A8AAAAAA 00000000 E1008000 E008C410 08
;           F              1      8087          1
; 00000000 00000001 00000000 00000000 00000000 00000000 00000000
RBD1>
```

In Example 2-5:

- ❶ Test 29 failed. The /HE switch causes execution to stop when the error is encountered.
- ❷ F indicates failure.
- ❸ The diagnostic ran for one pass.

Example 2–6: Running KA66A Self-Test (RBD 0) on a Secondary Processor

```

RBD1> QUIT          ❶
>>> SET CPU 2      ❷
>>> T/R
RBD2> ST0/TR       ❸
;XNP                1.00
; T0001 T0002 T0003 T0004 T0005 T0006 T0007 T0008 T0009 T0010
; T0011 T0012 T0013 T0014 T0015 T0016 T0017 T0018 T0019 T0020
; T0021 T0022 T0023 T0024 T0025 T0026 T0027 T0028 T0029 T0030
; T0031 T0032 T0033 T0034 T0035 T0036 T0037 T0038 T0039 T0040
; T0041 T0042 T0043 T0044 T0045
;
; P 2 8087 1
;00000000 00000000 00000000 00000000 00000000 00000000 00000000

```

In Example 2–6:

- ❶ If you are in the RBD monitor, use QUIT to return to the console monitor.
- ❷ The SET CPU command causes the KA66A module at node 2 to become the primary processor.
- ❸ The RBD2> prompt indicates that the CPU at node 2 is now the primary processor. The ST0 command runs RBD 0 on this processor.

Table 2–10: Subtests in the KA66A Self-Test — RBD 0

Test	Function
T0001	KA66A ROM Test
T0002	KA66A PCS logic and EEPROM Test
T0003	Scratchpad RAM Byte Access Test
T0004	Output Ports Test
T0005	Console UART External Loopback Test
T0006	NEXMI Console UART Internal Loopback Interrupt Test
T0007	NEXMI Input Port Test

Table 2–10 (Cont.): Subtests in the KA66A Self-Test — RBD 0

Test	Function
T0008	NEXMI Programmable Interval Clock Test
T0009	NEXMI Time-of-Day Register (TODR) Test
T0010	WATCH Chip Test
T0011	Virtual Instruction Cache Tag Test
T0012	Virtual Instruction Cache Data Test
T0013	Virtual Instruction Cache Parity Error Test
T0014	Primary Cache Tag Store Test
T0015	Primary Cache Data RAM March Test
T0016	Backup Tag Store Test
T0017	Backup Cache Data Line Test
T0018	Backup Cache Data RAM March Test
T0019	Cache Mask Write Test
T0020	Flush Cache Test
T0021	Data Parity Logic Test
T0022	NDAL Parity Error Test
T0023	ECC Logic Test
T0024	ECC RAM March Test
T0025	8KB RAM Test
T0026	XDEV Register Test
T0027	CPUID Register Test
T0028	SID Register Test
T0029	Branch Prediction Register Test
T0030	XBER and XBEER Registers Test
T0031	XFADR and XFAER Registers Test
T0032	XGPR Register Test
T0033	XCR Register Test

Table 2–10 (Cont.): Subtests in the KA66A Self-Test — RBD 0

Test	Function
T0034	NSCSR Register
T0035	CNAK and TTO Read Test
T0036	CNAK and TTO Write Test
T0037	CNAK and TTO IVINTR Test
T0038	Interprocessor IVINTR Test
T0039	Write Error IVINTR Test
T0040	Software Interrupt Test
T0041	Multiple Interrupt Test
T0042	Processor Chip Critical Path Test
T0043	Fbox Test
T0044	Disable Fbox Test
T0045	Fbox Critical Path Test

2.7.2 CPU/Memory Interaction Diagnostic — RBD 1

RBD 1 is the CPU/memory interaction test. Subtests 1, 2, 13, and 16 are not run on power-up. They are only run in callable mode due to the errors they can cause on other processors in the system.

Example 2-7: CPU/Memory Interaction Diagnostic — RBD 1

```
>>> T/R                                ! Command to enter RBD monitor program

RBD3> ST1/TR/HE                          ! Runs the CPU/memory interaction RBD with
                                           ! trace and halt on error.

;CPUMEM          1.00

; T0001 T0002 T0003 T0004 T0005 T0006 T0007 T0008 T0009 T0010
; T0011 T0012 T0013 T0014 T0015 T0016

;          P①          3          8087          1②
;000000000 00000000 00000000 00000000 00000000 00000000 00000000

RBD3>
```

In the example above:

- ① P means that the diagnostic ran successfully.
- ② One pass was completed.

Table 2–11: Subtests in the CPU/Memory Interaction Diagnostic — RBD 1

Test	Function
T0001	Parity Error CNAK Read Test
T0002	Parity Error CNAK Write Test
T0003	Cache Disable Test
T0004	Interlock Instruction Cache Disable Test
T0005	Cache Read Fill Test
T0006	Cache Location Displacement Test
T0007	Interlock Instruction Cache Test
T0008	Invalidate Bus Test
T0009	Error Transition Mode Test
T0010	High-Speed Cache Access Address Bit Test
T0011	Upper Address Bit Test
T0012	Single-Bit ECC Error Test
T0013	Double-Bit ECC Error Test
T0014	Memory Write Merge Test
T0015	Backup Cache Tag Test
T0016	P-cache Critical Path Test

2.7.3 DWMBB and DWMVA/A Diagnostic — RBD 2

For VAXBI connections, RBD 2 checks functions of both DWMBB modules. For VMEbus connections, RBD 2 checks functions only of the DWMVA/A.

Example 2–8: DWMBB Diagnostic — RBD 2

```
RBD1> ST2/TR E ① ! START for RBD 2 requires XMI node number (hex)
;XBI+_RBD 1.00
; T0001 T0002 T0003 T0004 T0005 T0006 T0007 T0008 T0009 T0010
; T0011 T0012 T0013 T0014 T0015 T0016 T0017 T0018 T0019 T0020
; T0021 T0022 T0023 T0024 T0025 T0026 T0027 T0028 T0029 T0030
; T0031 T0032 T0033 T0034 T0035 T0036 T0037 T0038 T0039 T0040
; T0041 T0042 T0043 T0044
; P ② 3 8087 1 ③
;000000000 000000000 000000000 000000000 000000000 000000000 000000000
```

Example 2–9: DWMVA/A Diagnostic — RBD 2

```
RBD1> ST2/TR 5 ① ! START for RBD 2 requires XMI node number (hex)
;XBI+_RBD 1.00
; T0001 T0002 T0003 T0004 T0005 T0006 T0007 T0008 T0009 T0010
; T0011 T0012 T0013 T0014 T0015 T0016 T0017 T0018 T0019
; P ② 3 8087 1 ③
;000000000 000000000 000000000 000000000 000000000 000000000 000000000
```

The DWMBB/A and DWMVA/A are the same module (T2018). When connected to a DWMBB/B in a VAXBI, the module is called a DWMBB/A. When connected to a DWMVA/B module in a VMEbus, the module is called a DWMVA/A.

The DWMBB/A and DWMVA/A modules have no on-board self-test. The boot processor ROM code tests the modules during power-up. It first finds all the DWMBB/A–DWMVA/A modules and then serially tests each one.

On the VAXBI, both DWMBB modules are tested. For the VMEbus, the ROM code only tests to see if the DWMVA/B is there, and then runs tests on the DWMVA/A.

- ❶ When invoking RBD 2, the START command requires a parameter: the XMI node number (in hex) of the DWMBB/A or DWMVA/A to be tested.
- ❷ This diagnostic ran successfully.
- ❸ One pass was completed.

Further information on the DWMBB is given in Chapter 5. The DWMVA is discussed in two manuals: the *DWMVA VME Adapter Installation Guide*, Order No. EK–DWMVA–IN–001, and the *DWMVA VME Adapter Technical Manual*, Order No. EK–DWMVA–TM–001.

2.7.4 DWMBB and DWMVA/A Diagnostic — RBD 2 Subtests

RBD 2 runs test T0001–T0044 for a DWMBB. A subset of these tests (T0001–T0019) are run for a DWMVA/A.

Table 2–12: RBD 2 Subtests — DWMBB and DWMVA/A Diagnostic

Test	Function
T0001	DWMBB/A and DWMVA/A CSR Test
T0002	DWMBB/A and DWMVA/A Loopback Transaction Test
T0003	DWMBB/A and DWMVA/A Loopback DMA Buffer Test
T0004	DWMBB/A and DWMVA/A Loopback Nonexistent Memory Interrupt Test
T0005	XMI Parity Error Test
T0006	Retry Timeout Interrupt Test
T0007	Timeout Disable Test
T0008	Data NO ACK Test
T0009	RER Error Interrupt Test
T0010	ECC Syndrome Test
T0011	PMR ECC Error Interrupt Test
T0012	Quick PMR Memory Test
T0013	DMA ECC Error Interrupt Test
T0014	ECC Disable Test
T0015	Extended Addressing Test
T0016	34-Bit Addressing Test
T0017	Invalid PFN Interrupt Test
T0018	Failing Command and Mask Test
T0019	Responder Request Test
—	(Following tests do not apply to DWMVA/A)
T0020	DWMBB/B CSR Test

Table 2–12 (Cont.): RBD 2 Subtests — DWMBB and DWMVA/A Diagnostic

Test	Function
T0021	BIIC Loopback Transaction Test
T0022	BIIC Transaction Test
T0023	Illegal I/O Command Test
T0024	VAXBI Window Space Test
T0025	DMA Test
T0026	DMA Loopback DMA Buffer Test
T0027	XMI Parity Error Interrupt Test
T0028	Write Sequence Error Interrupt Test
T0029	Return Vector/Multiple Interrupt Test
T0030	I/O Buffer C/A Fetch Parity Error Interrupt Test
T0031	I/O Buffer Data Fetch Parity Error Interrupt Test
T0032	DMA Buffer Data Fetch Parity Error Interrupt Test
T0033	DMA-A Buffer C/A Load Parity Error Interrupt Test
T0034	DMA-A Buffer Data Load Parity Error IVINTR/INTR Test
T0035	DMA-B Buffer Command/Address Load Parity Error Interrupt Test
T0036	DMA-B Buffer Data Load Parity Error IVINTR/INTR Test
T0037	I/O Buffer Data Load Parity Error Interrupt Test
T0038	BCI Parity Error Test
T0039	Nonexistent Memory Interrupt Test
T0040	CRD Error Interrupt Test
T0041	VAXBI Interrupt Test
T0042	VAXBI IP Interrupt Test
T0043	Control Reset Test
T0044	No Stall Timeout Test

2.7.5 MS65A Memory Diagnostic — RBD 3

RBD 3 sizes memory, runs extended memory tests, and indicates any failing tests. Some tests must be explicitly selected, since they alter memory contents.

Example 2–10: RBD 3 Test on All Memory Modules

```
>>> T/R                               ! Command to enter RBD monitor program
RBD3> ST3/TR                           ! Runs the default MS65A RBD
                                           ! test with trace.

;XMA2_RBD          1.00
; T0002 T0003 T0004 T0006 T0007 T0008 T00010
;          P          3      8087          1
;00000000 00000000 00000000 00000000 00000000 00000000 00000000
```

Example 2–11: RBD 3 Diagnostic on a Memory Module in Slot A

```
RBD3> ST3/TR A                          ! Runs the MS65A RBD test
                                           ! on memory module in slot A only.

;XMA2_RBD          1.00
; T0002 T0003 T0004 T0006 T0007 T0008 T00010
;          P          3      8087          1
;00000000 00000000 00000000 00000000 00000000 00000000 00000000
```

Example 2-12: RBD 3 Diagnostic with Module Error

```
RBD3> ST3/TR                                ! Runs the default MS65A RBD
                                           ! test; hard error in memory in slot 8

;XMA2_RBD          1.00
; T0002 T0003 T0004 T0006 T0007 T0008 T0010
;      F          3      8087          1
;      HE XMA2_ERR      08      T0010
;      00 00000000 00000000 00000000 00000000 20073E32 01
;      F          3      8087          1
;00000000 00000001 00000000 00000000 00000000 00000000 00000000
```

Example 2-13: RBD 3 Diagnostic with Confirm Switch

```
RBD3> ST3/TR/T=5:12 A /C                   ! Runs RBD tests T0005 through T0012 on
                                           ! memory module in slot A. Confirm (/C)
                                           ! required on tests T0005, T0009, T0011,
                                           ! and T0012.

;XMA2_RBD          1.00
; T0005 T0006 T0007 T0008 T0009 T0010 T0011
;      S          3      8087          1 ! Test status prints out every
;      XX      RAM      XX      T0011 ! 60 sec until tests are completed;
                                           ! /DS disables test status printout.
; T0012
;      S          3      8087          1
;      XX      RAM      XX      T0012
;      P          3      8087          1
;00000000 00000000 00000000 00000000 00000000 00000000 00000000

RBD3> QUIT                                  ! Exit from RBD monitor program
>>>                                         ! Console prompt returns
```

Table 2–13: Subtests in the Memory Diagnostic — RBD 3

Test	Function	Approximate Run Time (For 32-Mbyte Module)
T0001 ¹	Memory Self-Test	17 sec ²
T0002 ³	CSR Addressability Test	<1 sec
T0003 ³	CSR Read/Write, Write 1 to Clear Test	<1 sec
T0004 ³	SEADR Register Test	<1 sec
T0005 ¹	Parity Error Test	<1 sec
T0006 ³	Error Correction Code Circuit Test	<1 sec
T0007 ³	Data Path Test	<1 sec
T0008 ³	Write Mask Logic Test	<1 sec
T0009 ¹	Block State Test	<1 sec
T0010 ³	EEPROM Update Test	<1 sec
T0011 ¹	Interleave Address and Boundary Test	30 sec
T0012 ¹	ECC RAM March Test	4 min
T0013 ¹	March Test	1.5 min
T0014 ¹	Modified MOVI Test	21 min

¹The /C qualifier is required for these tests.

²If self-test has not completed in 60 seconds, self-test fails.

³Tests T0002–T0004, T0006–T0008, and T0010 are run by default.

Tests T0002, T0003, T0004, T0006, T0007, T0008, and T0010 are run by default. All other tests must be selected by the user, since they alter data in memory.

Tests are performed on all MS65A modules unless the user specifies a single MS65A. Parameters specified in the command line (refer to Table 2–14) allow one or all memory modules to be tested. These parameters also allow RBD tests to be run from main memory or ROM for RBD tests T0013 and T0014.

Table 2–14: RBD 3 Parameters

Parameter¹	Function
00	Run tests T0013 and T0014 from main memory (RAM) and test all memory modules
0 <i>n</i>	Run tests T0013 and T0014 from main memory (RAM) and test memory module <i>n</i> only
10	Run tests T0013 and T0014 from ROM and test all memory modules
1 <i>n</i>	Run tests T0013 and T0014 from ROM and test memory module <i>n</i> only

¹Where *n* is the memory module backplane slot number that is specified in hex parameters 0*n* and 1*n*.

2.7.6 KA66A Processor Cache Diagnostic — RBD 4

RBD 4 tests backup cache on a processor module. A test number must be supplied to run any of the three tests. You can limit the amount of backup cache checked in test 3 by specifying the Mbytes (in hex) to be tested.

Example 2–14: KA66A Cache Tests — RBD 4

```
>>> T/R                                ! Command to enter RBD monitor program
RBD4>                                    ! RBD monitor prompt, where 4 is the hexa-
                                        ! decimal node number of the processor
                                        ! that is currently receiving your input.
RBD4> ST4/TR①
;XNP_BC      1.00
;          S          4      8087      1
;          XX NoTstSel②      XX      T0000
;          P③          4      8087      1
;00000000 00000000 00000000 00000000 00000000 00000000 00000000
RBD4> ST4/TR/T=1④
;XNP_BC      1.00
; T0001⑤
;          P⑥          4      8087      1
;00000000 00000000 00000000 00000000 00000000 00000000 00000000
RBD4>
```

- ❶ RBD 4 is started without specifying a test number.
- ❷ No tests are run, and a status message is given that no test was selected.
- ❸ Since no tests were run, no failures were detected.
- ❹ The command to run RBD 4 is reissued, this time with a test number.
- ❺ Test 1, as requested, is run.
- ❻ Test 1 passes.

Table 2–15: Subtests in the KA66A Cache Diagnostic — RBD 4

Test	Function
T0001	Parity Error Test
T0002	Cache Coherency Checker
T0003	Memory Locked Location Test

2.7.7 Multiprocessor Diagnostic — RBD 5

RBD 5 tests multiprocessor interaction.

Example 2–15: Multiprocessor Tests — RBD 5

```
>>> T/R                ! Command to enter RBD monitor program
RBD3>                  ! RBD monitor prompt, where 3 is the hexa-
                        ! decimal node number of the processor
                        ! that is currently receiving your input.

RBD3> ST5/TR①
;XNP_MP                1.00
; T0001 T0002 T0003 T0004 T0005 T0006 T0007
;          P②          3      8087          1③
;00000000 00000000 00000000 00000000 00000000 00000000 00000000
RBD3>
```

In the example above:

- ① RBD 5 is run with trace set.
- ② The diagnostic ran successfully.
- ③ One pass was completed.

Table 2–16: Subtests in the Multiprocessor Diagnostic — RBD 5

Test	Function
T0001	Interprocessor Interrupt Test
T0002	Write Error Interrupt Test
T0003	Cache Invalidate Test
T0004	XMI Bus Arbitration Test
T0005	XMI Bus Arbiter Collision Test
T0006	XMI Suppress Assertion Test
T0007	Memory Lock and Interrupt Exerciser Test

Table 2–17: RBD 5 Parameters

Parameter	Function
No parameter	When no parameter is specified, all processors that have passed power-up test will be tested.
xxxx	Specifies a hexadecimal bit mask indicating slot positions of the processors to be tested. For example, a parameter of 322 indicates that processors in slots 1, 5, 8, and 9 will be tested. All processors specified are tested, even those that did not pass power-up test.

2.8 VAX Diagnostic Supervisor Programs

The VAX Diagnostic Supervisor (VAX/DS) is a monitor that controls operation of diagnostic programs. You can use VAX/DS in one of two modes: standalone mode (exclusive use of the system) or user mode (under the VMS operating system).

Table 2–18: VAX Diagnostic Program Levels

Level	Type of Test	Run-Time Environment
1	System exercisers	Runs under the VMS operating system without VAX/DS
2R	Function tests of peripheral devices	Runs under the VMS operating system with VAX/DS
2	Exercisers and function tests of peripheral devices and processors	Runs under VAX/DS in user mode and standalone mode
3	Function tests and logic tests of peripheral devices and processors	Runs under VAX/DS in standalone mode

Table 2–19: VAX/DS Documentation

Document	Order Number
<i>VAX Diagnostic Supervisor User's Guide</i>	AA-FK66A-TE
<i>VAX Diagnostic Software Handbook</i>	AA-F152A-TE
<i>VAX Diagnostic Design Guide</i>	AA-FK67A-TE
<i>VAX Systems Hardware Handbook</i>	EB-31692-46

The VAX Diagnostic Supervisor (VAX/DS) can be run in interactive mode. You type commands in response to the VAX/DS program prompt:

DS>

VAX/DS lets you load diagnostic programs into system memory, select devices to be tested, and run the programs. The VAX/DS command language also lets you control the execution of diagnostic programs; you can specify which tests or sections of a program should run, and how many passes it should run. You can also show the current state of parameters that affect the operation of diagnostic programs. The programs report their results through VAX/DS to the terminal.

VAX/DS supports three types of diagnostic programs:

- **Logic tests**
Test a specific section of a device's logic circuitry. Logic tests provide the greatest degree of detail in determining the location of faulty hardware.
- **Function tests**
Test the functions of the device. For example, a function test for a disk drive would test the drive's reading and writing capabilities. Function tests can detect the location of faulty hardware, although the results may be less exact than those of a logic test.
- **Exercisers**
Test entire systems or subsystems and verify that a system can function properly over a period of time. Exercisers can detect both hardware faults resulting from the simultaneous use of a system's numerous devices and intermittent faults occurring only once or twice over a long period of time.

VAX/DS also supports EVUCA, the utility which is used to install EEPROM patches and console boot primitives.

Table 2-20 lists the VAX/DS programs available for the VAX 6000 Model 600 system. Each program has a HELP file available. To access the help files for any diagnostic, at the VAX/DS prompt, type:

```
DS> HELP [VAX/DS diagnostic program name]
```

2.8.1 Running VAX/DS in Standalone Mode

You can use VAX/DS in one of two modes: standalone mode (exclusive use of the system) or user mode (under VMS).

Example 2-16: Running VAX/DS in Standalone Mode

```
>>> BOOT /XMI:A /FILENAME:ISL_LVAX_F /R5:10 EX0 ①
[Initial Display]
Network Initial System Load Function
Version 1.1

FUNCTION          FUNCTION
ID                ID
1 -              Display Menu
2 -              Help
3 -              Choose Service
4 -              Select Options
5 -              Stop

Enter a function ID value: 3 ②

OPTION           OPTION
ID              ID
1 -             Find Services
2 -             Enter known Service Name

Enter an Option ID value: 1 ③

Servers found:: 2

Service Name Format:
Service Name
Server Name
Ethernet ID

#1
NSS_SYSDISK
ESS_08002B15FCE1
08-00-2B-15-FC-E1

#2
6000_DIAG_F ④
ESS_08002B15FCE1
08-00-2B-15-FC-E1

Enter a service number or <CR> for more: 2 ⑤
[Diagnostic Supervisor Banner prints]
DS>
```

- ① Boot VAX/DS from the diagnostic media (part number AG-PDWWx-RE, where *x* is the revision letter). This example shows a boot from an Ethernet-based compact disk (CD) server connected by a DEMNA (indicated by EX0) located at XMI node A. The /FILENAME qualifier identifies the Initial System Load (ISL) program needed for booting from CD servers. The general form for the file name is ISL_LVAX_x, where *x* is the revision letter noted on the diagnostic CD.

For a CD server connected to a DEBNI or DEBNA, an example is:

```
>>> BOOT /XMI:A /FILENAME:ISL_LVAX_F /BI:6/R5:10 ETO
```

- ② The system prompts, *Enter a function ID value.* Enter *3* to choose service.
- ③ The system displays the service options menu and a prompt. Enter *1* see a listing of identification information for each of the CDs on the Ethernet CD server. In this example, two CDs were found.
- ④ The diagnostic disk name is 6000_DIAG_F, where *F* is the revision letter for the CD. (If many CDs were available on the server, and you did not see the right name among those first listed, you could type a carriage return <CR> to continue the listing of CDs available.)
- ⑤ At the prompt, enter the number of the service with the Diagnostic Supervisor CD. If more than one service name of the form 6000_DIAG_* is given, choose the one where the revision letter is the highest. This will be the most recent version of the diagnostic media.

2.8.2 Running VAX/DS in User Mode

You can use VAX/DS in one of two modes: standalone mode (exclusive use of the system) or user mode (under VMS).

Example 2-17: Running VAX/DS in User Mode

```
$                                     ! At the operating system prompt, run
$ RUN EXSAA                          ! the VAX/DS program.
                                     ! [VAX/DS banner prints, as in example above]
DS>                                  ! VAX/DS prompt appears.
                                     ! Run VAX/DS level 2R or 2 programs.
DS> EXIT                             ! Type EXIT to exit VAX/DS
$                                     ! Operating system prompt returns.
```

Table 2-18 describes the levels of VAX/DS programs. Check Table 2-20 for the programs you wish to run, and determine if you will run VAX/DS in standalone or user mode.

In both standalone and user mode, VAX/DS functions the same way. Typically a program running in user mode provides less detailed results than one running in standalone mode. For more information on VAX/DS, see the documents listed in Table 2-19.

2.8.3 Sample VAX/DS Standalone Session

When you run the VAX/DS programs in standalone mode, run the system autosizer program EVSBA first. This program, which takes several minutes to execute, will save you time as you proceed with other tests. Certain conditions cause the generation of an unexpected trap or interrupt. Use the method shown to avoid these conditions.

Example 2-18: Sample VAX/DS Session, Part 1 of 2

```
>>> SET BOOT DIAG /XMI:9/R5:10 DU1
>>> BOOT DIAG ❶
           [self-test results print]
Loading system software
* Initializing adapter
* Specified adapter initialized successfully
* Connecting to boot disk
* Reading bootblock from disk
* Passing control to transfer address

           Copyright Digital Equipment Corporation
           1989, 1990.
           All Rights Reserved.

DIAGNOSTIC SUPERVISOR. ZZ-EXSAA-V14.7-142  14-NOV-1991 11:39:12
DS> LOAD EVSBA ❷
DS> DEATTACH/ADAPTER=HUB ALL
DS> START
           [banner prints]

.. Program: EVSBA - AUTOSIZER level 3, revision 7.0, 3 tests,
   at 11:43:33.20.

.. End of run, 0 errors detected, pass count is 1,
   time is 14-NOV-1991 11:44:59.66
```

- ① The SET BOOT command stores a nickname for a set of parameters to the BOOT command. (The lower key switch on the control panel must be set to Update when this command is issued.) This BOOT command loads VAX/DS from disk. For more information on the BOOT and SET BOOT commands, see the *VAX 6000 Series Owner's Manual*.
- ② The off-line autosizer program EVSBA identifies hardware on your system and builds a database for the VAX Diagnostic Supervisor. The autosizer eliminates the need for you to type in the name and characteristics of the hardware you intend to test under VAX/DS with level 3 diagnostic programs.

Example 2-19: Sample VAX/DS Session, Part 2 of 2

```
DS> SHO DEV ③
_DUA    KDM70    HUB    61C80000  XMI Node Number (1 to E) =00000009(X)
Bus Request Level (4 - 7) =5.
_DUA1   RA70    _DUA    72000000
_KA0    KA66A   HUB    61980000  XMI Node Number (1 to E) =00000003(X)
_DUA2   RA70    _DUA    72000000
_EXA0   DEMNA   HUB    61D80000  XMI Node Number (1 to E) =0000000B(X)
_PAA0   CIXCD   HUB    61E00000  XMI Node Number (1 to E) =0000000C(X)
CI Node Number (0 to 224) =1.
_DW MBA0 DW MBA   HUB    61E80000  XMI Node Number (1 to E) =0000000D(X)
BI Node Number (HEX)=00000002(X)
_TXA    DHB32   _DW MBA0 7A006000  BI Node Number (HEX) =00000003(X)
_SLA    DSB32   _DW MBA0 7A01E000  BI Node Number (HEX) =0000000F(X)
_DW MB B0 DW MB B   HUB    61F00000  XMI Node Number (1 to E) =0000000E(X)
BI Node Number (HEX)=00000001(X)
_BLA0   DW BLA   _DW MB B0 7C004000  BI Node Number (HEX)=00000002(X)
_MUB0   TU81    _BLA0    7C4BF940  CSR=774500(O) VECTOR=000260(O) BR=5.
_TXB    DMB32   _DW MB B0 7C006000  BI Node Number (HEX) =00000003(X)
_DUB    KDB50   _DW MB B0 7C008000  BI Node Number (HEX)=00000004(X)
_DUB0   RA70    _DUB     7C500000
_MUC    TBK70   _DW MB B0 7C00C000  BI Node Number (HEX)=00000006(X)
_MUC6   TK70    _MUC     7C580000
_ETD    DEBNA   _DW MB B0 7C018000  BI Node Number (HEX)=0000000C(X)
_ETD0   LANCE   _ETD     7C700000
DS> SELECT ALL ④
DS> SET TRACE
DS> RUN EVKAQ

                [banner prints]

.. Program: ZZ-EVKAQ, VAX Basic Instructions Exerciser, revision 3.5, 92
tests, at 11:46:11.90.
Testing: _KA0

Test 1: BRB Instruction Test
Test 2: BRW Instruction Test
Test 3: BBC Instruction Test
.
.
.
Test 90: XORL2 Instruction Test
Test 91: XORL3 Instruction Test
Test 92: ROTL Instruction Test
.. End of run, 0 errors detected, pass count is 1,
   time is 14-NOV-1991 11:46:09.88
DS>
```

- ③ You can use the autosizer to print a list of system hardware by running the program EVSBA under VAX/DS and typing the VAX/DS command SHOW DEVICE. The command lists system devices, similar to the SHOW CONFIGURATION command in console mode.
- ④ SELECT ALL selects all devices listed in ③. SET TRACE enables printing of test numbers and names when the diagnostic runs.

2.8.4 VAX/DS Diagnostics

Table 2–20 lists the VAX Diagnostic Supervisor tests currently available for the VAX 6000 Model 600 system.

Table 2–20: VAX Diagnostic Supervisor Programs

Diagnostic	Level	Diagnostic Title
EXSAA ¹		VAX 6000 Model 600 Diagnostic Supervisor
EVSB A	3	VAX Standalone Autosizer
EVUCA	3	VAX 6000 EEPROM Utility
<hr/>		
KA66A-Specific Diagnostic		
<hr/>		
EXKAX ¹	3	Manual Tests
<hr/>		
VAX CPU Cluster Exerciser		
<hr/>		
EVKAQ	2	VAX Basic Instructions Exerciser, Part 1
EVKAR	2	VAX Basic Instructions Exerciser, Part 2
EVKAS	2	VAX Floating-Point Instruction Exerciser, Part 1
EVKAT	2	VAX Floating-Point Instruction Exerciser, Part 2
EVKAU	3	VAX Privileged Architecture Instruction Test, Part 1
EVKAV	3	VAX Privileged Architecture Instruction Test, Part 2
<hr/>		
CIBCA-BA Diagnostics		
<hr/>		
EVGEE	3	CIBCA-B Repair Level Diagnostic, Part 1
EVGEF	3	CIBCA-B Repair Level Diagnostic, Part 2
EVGEG	3	CIBCA-B Repair Level Diagnostic, Part 3
EVGAA	3	CI Functional Diagnostic, Part 1
EVGAB	3	CI Functional Diagnostic, Part 2

¹Diagnostic software with file names beginning with EX are tests created specifically for the VAX 6000 Model 600 system. This software is not transportable.

Table 2–20 (Cont.): VAX Diagnostic Supervisor Programs

Diagnostic	Level	Diagnostic Title
CIBCA-BA Diagnostics		
EVGAC	3	Standalone CI Exerciser
EVGDA	3	CIBCA EEPROM Update Utility
CIE100	1	VAX CI Exerciser
CIXCD Diagnostics		
EVGAA	3	CI Functional Test, Part 1
EVGAB	3	CI Functional Test, Part 2
EVGAC	3	Standalone CI Exerciser
CIE100	1	VAX CI Exerciser
EVGEA	3	XCD Repair Level Diagnostic
EVGEB	3	XCD Firmware Loader Program
DEC LANcontroller 200 Diagnostics		
EVDYD	2R	DEBNI Online Functional Diagnostic
EVDWC	2R	VAX NI Exerciser
DEC LANcontroller 400 Diagnostics		
EVDYE	2R	DEMNA NI Functional Diagnostic
EVGDB	2	DEMNA EEPROM Update Utility
EVDWC	2R	VAX NI Exerciser
DHB32 Diagnostics		
EVDAR	3	DHB32 Diagnostic
EVDAS	2R	DMB32/DHB32 Asynchronous Diagnostic
DMB32 Diagnostics		

Table 2–20 (Cont.): VAX Diagnostic Supervisor Programs

Diagnostic	Level	Diagnostic Title
DMB32 Diagnostics		
EVDAJ	2R	DMB32 Online Asynchronous Port Test
EVDAK	3	DMB32 Standalone Functional Verification
EVDAL	2R	DMB32 Online Synchronous Port Test
EVDAN	2R	DMB32 Online Data Communications Link
DRB32 Diagnostics		
EVDRH	3	DRB32-M, -E Functional Diagnostic
EVDRI	3	DRB32-W Functional Diagnostic
DSB32 Diagnostics		
EVDAP	3	DSB32 Level 3 Diagnostic
EVDAQ	2R	DSB32 Level 2R Diagnostic
DWMVA Diagnostics		
EVCLA	3	VAX DWMVA Level 3 Diagnostic
EVCLC	3	DWMVA Radstone Diagnostic
KDB50 Diagnostics		
EVRLF	3	UDA50/KDB50 Basic Subsystem Diagnostic
EVRLG	3	UDA50/KDB50 Disk Drive Exerciser
EVRLB	3	UDA/KDB50 Basic Disk Formatter
EURLJ	3	VAX UDA50-A/KDB50/KDM70 Exerciser
EURLK	3	VAX Bad Block Replace Utility
EVRLL	3	VAX Disk Resident Error Log Utility
EVRAE	2R	Generic MSCP Disk Exerciser

Table 2–20 (Cont.): VAX Diagnostic Supervisor Programs

Diagnostic	Level	Diagnostic Title
KDM70 Diagnostics		
EVRAE	2R	Generic MSCP Disk Exerciser
EURLJ	3	VAX UDA50/KDB50/KDM70 Exerciser
EURLN	3	DUP Control Program
KFMSA Diagnostics		
EVRAE	2R	Generic MSCP Disk Exerciser
EVMDA	2R	VAX Generic Tape Exerciser
EVCXD	3	DSSI Repair Level Diagnostic
EVCXE	3	Customer DSSI Configuration and DUP Utility
EVCXF	3	DSSI Configuration and DUP Diagnostic
EVUCM	3	KFMSA Code Update Utility
KLESI-B/TU81 Diagnostics		
EVMBB	3	VAX Front-End/Host Functional Diagnostic
EVMBB	3	VAX Front-End/Host Functional Diagnostic
MS65A Online Memory Diagnostic		
EVKAM	2R	VAX Memory User Mode Test
RV20 Diagnostics		
EVRVA	3	RV20 Level 3 Functional Diagnostic
EVRVB	2R	RV20 Level 2R Diagnostic
EVRVC	2R	RV60/20 Level 2R DUP Diagnostic
EVRVG	3	VAX RV64 Level 3 Diagnostic
TBK Diagnostic		
EVMDA	2R	VAX TK50/TK70/TF83/TF85 Exerciser

Table 2–20 (Cont.): VAX Diagnostic Supervisor Programs

Diagnostic	Level	Diagnostic Title
TM32 Diagnostics		
EVMEA	2R	TM32 L2R Reliability Diagnostic
EMMEB	3	TM32 L3 Functional Diagnostic Part 1
EMMEC	3	TM32 L3 Functional Diagnostic Part 2

Chapter 3

KA66A Processor

This chapter contains the following sections:

- KA66A Physical Description and Specifications
- KA66A Configuration Rules
- KA66A Functional Description
- Overview of the NVAX CPU Chip
- Automatic Boot Processor Selection
- Power-Up Sequence
- ROM-Based Diagnostics
- VAX/DS Diagnostics
- Console Commands
- Replacing Defective Processors or Adding New Ones
 - How to Replace the Only Processor
 - How to Replace or Add Processors in a Multiprocessor System
 - Using EVUCA to Apply Current ROM and PCS patches
- KA66A Registers

3.1 KA66A Physical Description and Specifications

The KA66A is a single-module VAX processor. The module designation is T2054. VAX 6000 Model 600 systems include up to six KA66A processors, which use the 100 Mbyte/second XMI system bus to communicate with memory. Figure 3-1 shows the KA66A module.

Figure 3-1: KA66A Module

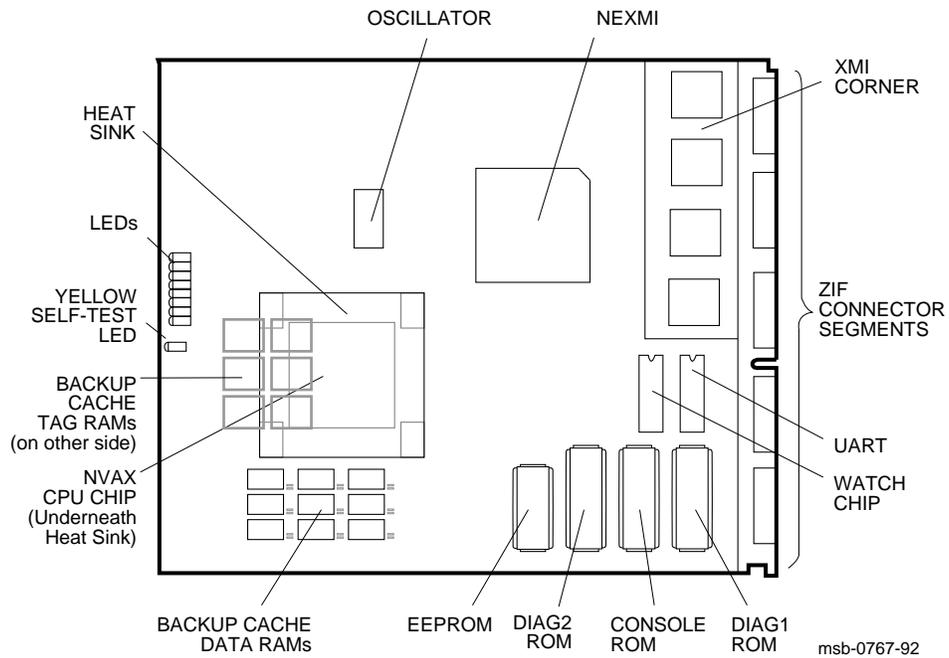


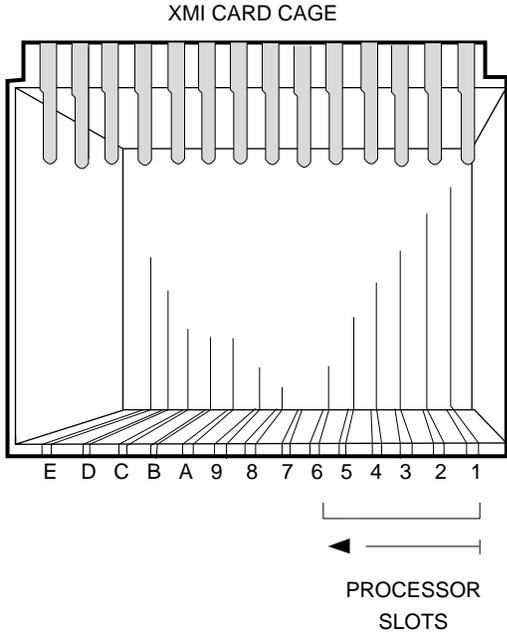
Table 3–1: KA66A Specifications

Parameter	Description
Module Number:	T2054
Dimensions:	23.3 cm (9.2") H x 28.0 cm (11.0") D x 0.23 cm (0.093") W
Temperature:	
Storage Range	-40°C to 70°C (-40°F to 151°F)
Operating Range	15°C to 32°C (59°F to 90°F)
Relative Humidity:	
Storage	10% to 95% noncondensing
Operating	10% to 95% noncondensing
Altitude:	
Storage	Up to 9 km (30,000 ft)
Operating	Up to 2.4 km (8000 ft)
Current:	8.3A at +5.0V 6.7A at +3.3V
Power:	63.4W
Diagnostics:	ROM-based diagnostics 0, 1, 4, and 5 VAX/DS diagnostics, see Section 3.8

3.2 KA66A Configuration Rules

KA66A modules will operate in any slot of the XMI card cage; however, processors usually go on the right, beginning with slot 1.

Figure 3-2: Typical KA66A Configuration



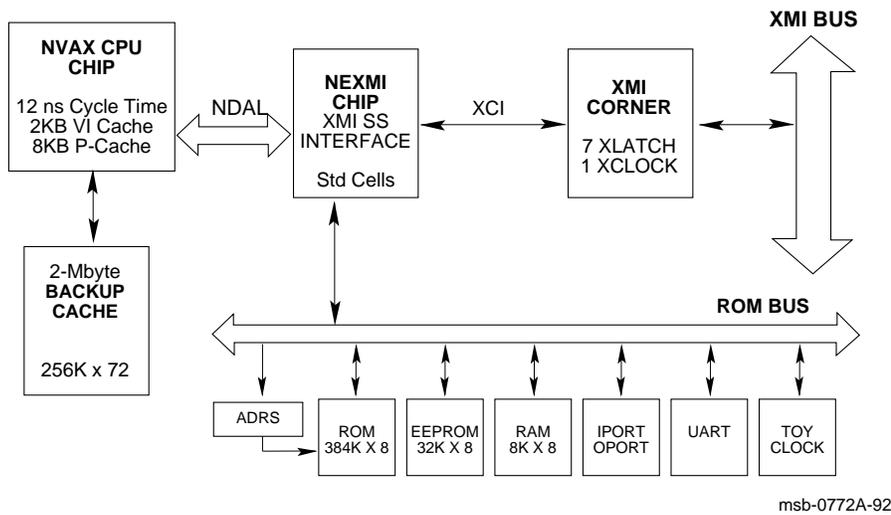
msb-0054-88

KA66A modules are generally installed right to left, beginning with the first available slot on the right. If the system is an H9657-CX upgrade, the T2019 module must be in slot 2, and slot 1 must be empty. Thus, KA66A modules would begin in slot 3 and proceed to the left.

3.3 KA66A Functional Description

The KA66A processor has three functional sections (see Figure 3-3): the CPU section, the backup cache, and the NEXMI chip and its associated XMI interface and system support sections.

Figure 3-3: KA66A Block Diagram



The KA66A processor module consists of three major sections:

- NVAX central processing unit (CPU) chip
- Backup cache
- NVAX-to-XMI (NEXMI) chip and its associated XMI interface and system support sections

NVAX Central Processing Unit (CPU)

The NVAX CPU chip is a VAX CPU which implements the 242-instruction VAX base instruction group and associated data types, full VAX memory management, and a 4-Gbyte virtual address space, which, when 32-bit addressing is enabled and handled by the software, translates to a maximum of 3.5 Gbytes of physical memory and .5 Gbyte of I/O space. Otherwise, 30-bit addressing is used, translating to .5 Gbyte of physical memory.

High-speed execution in the NVAX results from its implementation of *micropipelining* and *macropipelining*, the means by which a VAX instruction can be split into separate subtasks that can be executed in parallel with succeeding instructions' subtasks. The processor chip, and how it implements micropipelining and macropipelining in separate logic boxes, is described in more detail in Section 3.4. On-chip caches, which also improve execution speed by reducing memory access time, are also discussed in that section.

Backup (Secondary) Cache

The backup cache (sometimes called secondary cache) is a 2-Mbyte writeback cache, which holds data being passed between primary cache (on the CPU chip itself) and memory.

Unlike a writethrough cache, where data is always written through to its ultimate destination, memory, data is only written from the KA66A *writeback* backup cache to memory when it is needed (when the memory location is read by another node on the XMI) or when the block is displaced from the cache (when the cache space is needed for more recent data transfers).

NVAX-to-XMI (NEXMI) Interface

The NVAX-to-XMI (NEXMI) interface chip controls the transfer of data between the CPU and the XMI bus. Data transfer between the NVAX CPU chip and the NEXMI chip is made over an internal data bus called the NDAL. The NEXMI also interfaces to a system support section, described on the next page.

Example 3–1: Sample Self-Test and Power-Up Test Display

```

#123456789 0123456789 0123456789 0123456789 012345#
F  E  D  C  B  A  9  8  7  6  5  4  3  2  1  0  NODE #
  A  .  A  A  A  M  M  M  M  .  P  P  P  P  TYP
  O  .  +  +  +  +  +  +  +  .  +  +  +  +  STF
  .  .  .  .  .  .  .  .  .  .  E  E  E  B  BPD
  .  .  .  .  .  .  .  .  .  .  +  +  +  +  ETF
  .  .  .  .  .  .  .  .  .  .  E  E  E  B  BPD
.  +  .  .  +  +  .  .  +  +  .  .  .  .  +  .  XBI E +
  .  .  .  .  .  A4 A3 A2 A1  .  .  .  .  .  ILV
  .  .  .  .  .  64 64 64 64  .  .  .  .  .  256 Mb

Console = V2.00 RBDs = V1.00 EEPROM = 1.00/2.01 SN = GA140123456
    ①                               ②

```

The KA66A CPU module contains the following system support features:

- **ROM.** Three 128-Kbyte read-only memories (ROMs) contain the onboard firmware for the KA66A. This code provides the fundamental user interface when the system is not running under control of an operating system. It provides basic functions such as booting and diagnostic aids that can be requested from the console terminal.

Two of the ROMs, called the diagnostic ROMs, contain the ROM-based diagnostics and the Diagnostic Monitor program described in Chapter 2 and Appendix A. The other ROM, called the console ROM, contains the console program, which handles initializing, executing console commands, and bootstrapping the system.

Major revisions to ROMs are handled by physically replacing the ROM units on the module. Example 3–1 shows a power-up test display in which the console ROM has been replaced (see ①, showing `Console = v2.0`).

- **EEPROM.** One 32-Kbyte electrically erasable programmable ROM (EEPROM) is provided to hold information that can change, including parameters for the console, such as the system serial number, bootstrap information, and loadable bootstrap primitives.

In addition, EEPROM is designed to hold changes (patches) for the diagnostic and console ROMs and PCS. When changes are needed to any of these components, a console patch image will be distributed on console storage device media containing the most recent revision of all

three components. The EVUCA program (see Section 3.10.3) is used to update the EEPROM.

Callout ② shows two EEPROM version numbers separated by a slash (/). The first is the format version of the EEPROM. This version is changed only when the internal structure of the EEPROM is modified.

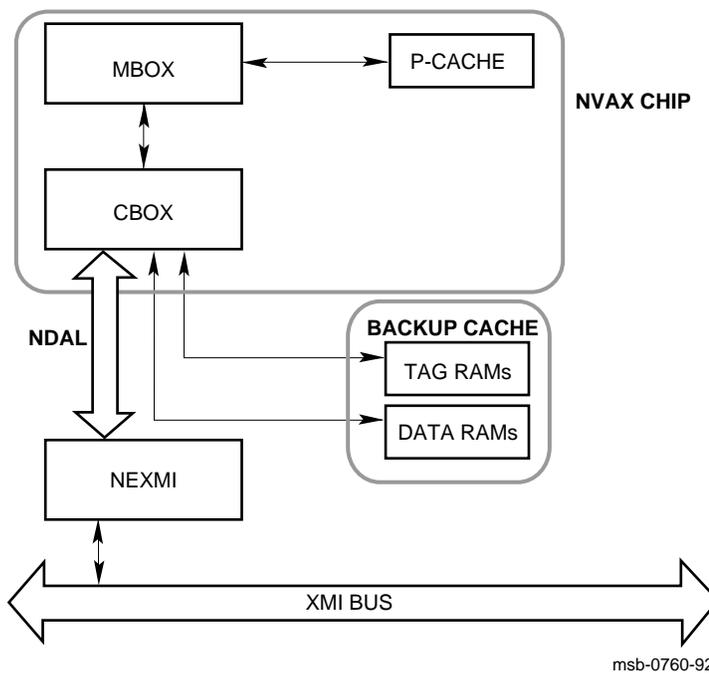
The second number is the revision of ROM patches that have been applied to the EEPROM. The major number in this revision (before the decimal point) corresponds to the major number of the ROM revision ①. The minor number indicates the actual patch revision. In this example, the EEPROM has been patched to V2.01.

- **RAM.** The KA66A contains 8 Kbytes of random-access memory (RAM), used for local storage and stack by the console and diagnostics code and VMS error handling.
- **Iport/Oport.** These are registers used to control the KA66A LEDs, to pass information to the user when the console terminal is not available for output.
- **UART.** The Universal Asynchronous Receiver Transmitter (UART) is a separate chip that runs the console terminal.
- **TOY Clock.** The Time-of-Year (TOY) clock consists of a “watch” chip that enables the NVAX CPU chip to keep time through a power outage or system shutdown that lasts up to 100 hours. Then, in normal operation, software reads the watch chip during the bootstrap operation.

3.4 Overview of the NVAX CPU Chip

The NVAX CPU chip has five logic boxes that implement macropipelining of the VAX instruction set and instruction and data transfer between caches on the chip and backup cache over the internal NDAL bus. Figure 3-4 shows the interaction between some of these elements.

Figure 3-4: NVAX Mbox, Cbox, and Primary and Backup Cache



The NVAX is a *macropipelined* design. That is, VAX macroinstructions are decoded into segments such as operand fetch, execute, and result store. These segments can then be executed in parallel with succeeding macroinstruction segments. Separate logic units, or *boxes*, handle this macropipelining.

Where possible, *micropipelining* is implemented within the individual boxes. For example, the Mbox (see below) performs address translation and cache lookup in two cycles that are pipelined for greater efficiency.

The NVAX instruction boxes are listed and described briefly below. Figure 3–4 illustrates the interaction between the Mbox, Cbox, primary and backup cache, and memory.

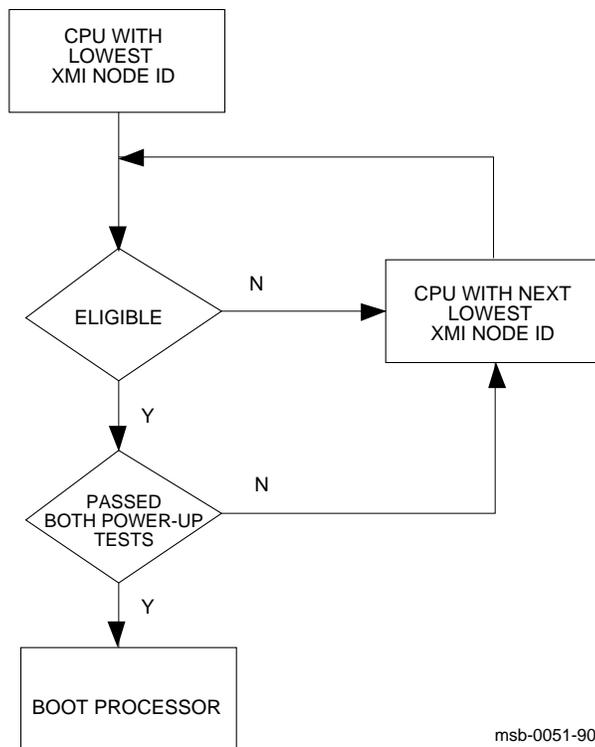
- The **Ibox**, or instruction box, decodes VAX instructions and parses operand specifiers, prefetching instruction stream data for the Ebox into a prefetch queue using a 2-Kbyte dedicated instruction-stream only cache called the *virtual instruction cache* (VIC). If the Ibox cannot find the instruction in the VIC, it sends a request to the Mbox. Data stream requests are sent directly to the Mbox.
- The **Ebox**, or execution box, and the **Microsequencer** do the actual work involved in executing an instruction (an add operation, for instance). They dequeue instruction and operand information provided by the Ibox. The microsequencer handles fetches of the microinstructions constituting a VAX macroinstruction for execution by the Ebox.
- The **Fbox**, or floating-point box, implements a four-stage micropipelined execution unit for the floating-point and longword-length integer multiply instructions. Operands are supplied from and returned to the Ebox.
- The **Mbox**, or memory box, arbitrates read requests from the Ibox (both instructions and data) and read and write requests from the Ebox (data only), queueing those that cannot be filled. The Mbox houses an 8-Kbyte, write-through *primary cache*, or P-cache, holding instructions and data transferred from the backup cache (see Figure 3–4). Being on the chip, P-cache provides even faster access for the Ibox and Ebox. The Mbox also uses a 96-entry *translation buffer* to remember—and reuse—recent virtual-to-physical address translations.
- The **Cbox**, or cache control box, controls data flow between the backup cache and memory, providing the interface to the NDAL, the internal bus connecting the NVAX chip to the NEXMI chip, where data requests for the XMI are handled.

The NVAX also includes a special maintenance feature: a storage area to allow patches to the chip itself. This area is called the patchable control store, or PCS.

3.5 Automatic Boot Processor Selection

In the VAX 6000 Model 600 system all KA66A processors share system resources equally. The processor controlling the console at any given time is designated as the primary or boot processor. The others are called secondary processors. The system selects the boot processor automatically during the power-up sequence.

Figure 3-5: Selection of Boot Processor



Using boot code stored in its ROM or EEPROM, the boot processor reads the boot block from a specified device. Booting may be triggered by a command issued to the boot processor from the console, or by a system reset with the bottom key switch in the Auto Start position.

The boot processor also communicates with the system console terminal, using the common console lines on the backplane. When you change system parameters in the EEPROM using SET commands, the boot processor automatically copies some of the new values to the EEPROMs on the secondary processors. (It does not copy those parameters set with “hidden” commands, preceded by `[ESC] [DEL]`.) If you swap in a new KA66A module, it should be configured as a secondary processor. Then you can use the UPDATE command to copy the boot processor’s EEPROM¹ to the new secondary. See the *VAX 6000 Series Owner’s Manual* for a description of the UPDATE command.

Usually the processor with the lowest XMI node number (which is also the lowest slot number) is selected as the boot processor. However, if this processor does not pass all its power-up tests, the next higher-numbered processor is selected. This is one way the boot processor can change.

The user can also use the SET CPU command to select a boot processor explicitly. SET CPU can also declare a processor ineligible for selection as boot processor. See the *VAX 6000 Series Owner’s Manual* for a description of the SET CPU command.

You can see the boot processor selection three ways:

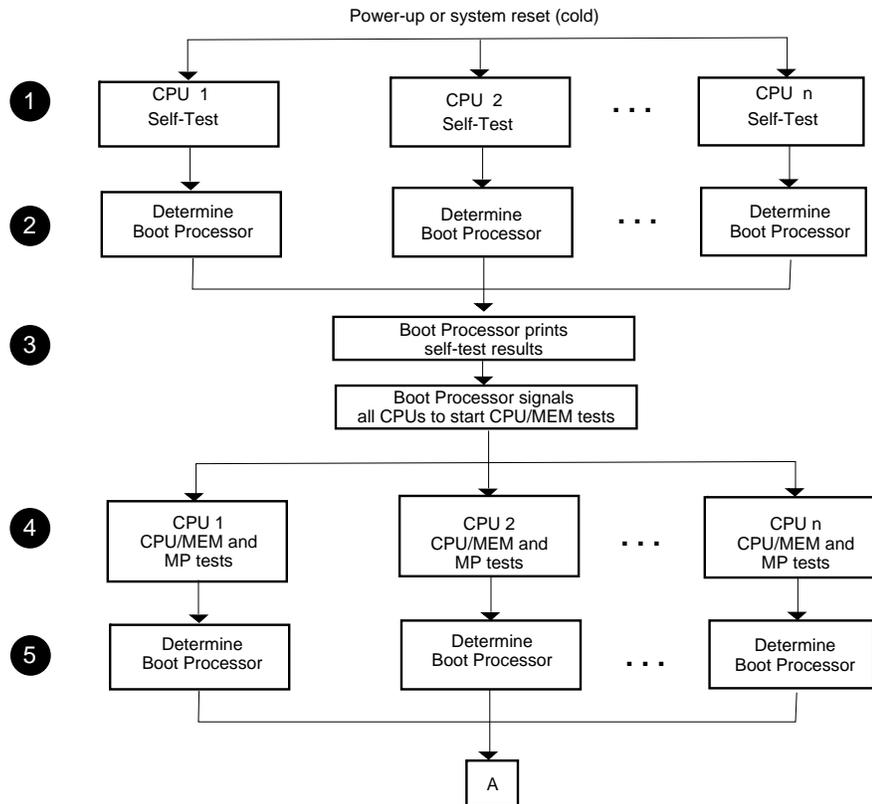
- In the self-test and power-up display, the boot processor is indicated by a **B** on the second line labeled **BPD**.
- In console mode, the command SHOW CPU displays the boot processor as "Current primary."
- The bottom red LED is off on the boot processor module. It is lit on secondary processors.

¹ UPDATE does not copy information specific to a particular EEPROM, such as its repair history, diagnostic errors, and so forth.

3.6 Power-Up Sequence

During power-up for KA66A processors, all processors execute two phases of testing, and a boot processor is selected. The boot processor tests the DWMBB or DWMVA/A adapter and prints the power-up test display.

Figure 3-6: KA66A Power-Up Sequence, Part 1 of 2



NOTE: The second determination of the boot processor occurs even if the original boot processor passes all memory and multiprocessor tests.

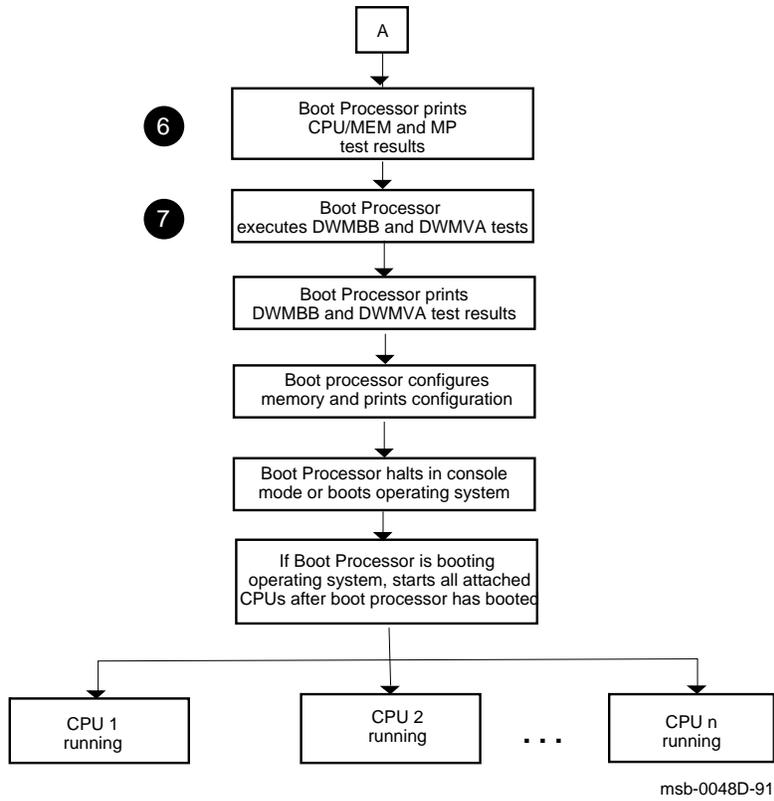
msb-0047A-90

- ① All CPUs execute their on-board self-tests at the beginning of the power-up tests. On line **STF** of the power-up test display, a plus sign (+) is shown for every module whose self-test passes (see Section 2.3).
- ② The boot processor is determined as described in Section 3.5. On the first **BPD** line, the letter **B** corresponds to the processor selected as boot processor. Because the processors have not yet completed their power-up tests, the designated processor may later be disqualified from being boot processor. For this reason, line **BPD** appears twice in the power-up test display.
- ③ The boot processor prints the results of self-test, lines **NODE**, **TYP**, **STF**, and **BPD** on the power-up test display. The boot processor then signals all CPUs to start running the extended test.
- ④ All CPUs execute an extended test using the memories. On line **ETF** of the power-up test display, a plus sign (+) is shown for every module that passes extended test.
- ⑤ If all CPUs pass the extended test, the original boot processor selection is still valid. Lines **STF** and **ETF** would be identical for all the processors.

The yellow LED and the top two red LEDs are lit on all processor modules that pass both power-up tests. On the secondary processors, the bottom red LED is also lit. On the boot processor, this red LED is off (see Figure 2-4).

If the original boot processor fails the extended test (indicated by a minus sign (-) on line **ETF**), a new boot processor is selected. On the second **BPD** line, the letter **B** corresponds to the processor finally selected as boot processor.

Figure 3-7: KA66A Power-Up Sequence, Part 2 of 2



- ⑥ The boot processor prints line **ETF** and the second **BPD** line of the power-up test display. If none of the processors is successfully selected as the boot processor, no power-up test results are displayed and the console hangs for a minute. You can identify this hung state by examining the LEDs on the processor modules (see Section 2.4.1). All yellow LEDs will be OFF. The eight red LEDs indicate the failing test number in binary-coded decimal. After a minute has passed, you can force selection of a boot processor by typing

>>n

where n is the XMI node number of the processor to be selected. You will then get the console prompt (>>>) from that processor.

- ⑦ The boot processor tests the DWMBB or DWMVA/A and queries VAXBI modules for their self-test results.

For VAXBI, test results are indicated on the lines labeled **XBI** on the power-up test display. A plus sign (+) at the extreme right means that the DWMBB/A adapter test passed; a minus sign (-) means that the DWMBB/A adapter test failed. Self-test results for VAXBI modules are shown as plus or minus signs on the rest of the **XBI** line. In this case, the node numbers under which the plus or minus signs appear refer to the VAXBI, rather than the XMI.

For the VMEbus, DWMVA/A test results are displayed by a plus or minus sign at the extreme right of the **VME** line.

3.7 ROM-Based Diagnostics

The ROM-based diagnostics that test the KA66A processors are listed in Table 3-2. See Sections 2.6 and 2.7 for instructions on running RBDs.

Table 3-2: KA66A ROM-Based Diagnostics

Diagnostic	Description
0	CPU self-test
1	CPU/memory interaction test
4	Cache coherency test
5	Multiprocessor interaction test

The KA66A diagnostic ROM contains six diagnostics, four of which test the KA66A. (The other two test the DWMBB I/O adapter and MS65A memory.) You can run these diagnostics using the boot processor's RBD monitor program, as described in Section 2.6 and Appendix A. Descriptions of these diagnostics are in Section 2.7.

3.8 VAX/DS Diagnostics

The KA66A software diagnostics that run under the VAX Diagnostic Supervisor (VAX/DS) are listed in Table 3-3. An example follows. See Section 2.8 for instructions on running the supervisor.

Table 3-3: KA66A VAX/DS Diagnostics

Program	Description
EVSB A	VAX Standalone Autosizer
EVKAQ	VAX Basic Instructions Exerciser, Part 1
EVKAR	VAX Basic Instructions Exerciser, Part 2
EVKAS	VAX Floating Point Instruction Exerciser, Part 1
EVKAT	VAX Floating Point Instruction Exerciser, Part 2
EVKAU	VAX Privileged Architecture Instruction Test, Part 1
EVKAV	VAX Privileged Architecture Instruction Test, Part 2
EVUCA	VAX 6000 EEPROM Update Utility
EXKAX	Manual Tests

Example 3-2: VAX/DS Commands for Running Standalone Processor Diagnostics

```
DS> RUN EVSBA ①  
DS> SEL KA0 ②  
DS> RUN EXKAX ③  
DS> EXIT ④
```

The callouts in Example 3-2 are explained below:

- ① Run the standalone autosizer; then you do not need to attach devices to the supervisor explicitly. However, if you want to know how to use the ATTACH command for a specific diagnostic, enter:

```
DS> HELP diagnostic_name ATTACH
```

- ② The instruction and manual tests run on the boot processor. If the boot processor is the CPU with the lowest XMI node number (which is usually the case), issue the command to select KA0. The Diagnostic Supervisor numbers the processors consecutively. For example, if the KA66A module with the second-lowest XMI node number were boot processor, you would select KA1.
- ③ This example runs the manual tests (EXKAX), which include powerfail, machine check, restart, and EEPROM functions. The diagnostic prints messages, and you must manually intervene using console switches.
- ④ Exit from VAX/DS.

3.9 Console Commands

Table 3-4 summarizes the console commands. The VAX 6000 Series Owner's Manual gives a full description of these commands, their qualifiers, and examples.

Table 3-4: Console Commands

Command	Function
BOOT	Initializes the system, causing power-up tests to run, and begins the boot program.
CLEAR EXCEPTION	Cleans up error state in XBER, XBEER, and CEFSTS registers.
CONTINUE	Begins processing at the address where processing was interrupted by a CTRL/P console command.
DEPOSIT	Stores data in a specified address.
EXAMINE	Displays the contents of a specified address.
FIND	Searches main memory for a page-aligned 256-Kbyte block of good memory or for a restart parameter block.
HALT	Null command; no action is taken since the processor has already halted in order to enter console mode.
HELP	Prints explanation of console commands.
INITIALIZE	Performs a system reset, including power-up tests.
REPEAT	Executes the command passed as its argument.
RESTORE EEPROM	Copies the TK tape's EEPROM contents to the EEPROM of the processor executing the command. (Valid only for systems that have a TK tape.)
SAVE EEPROM	Copies to the TK tape the contents of the EEPROM of the processor executing the command. (Valid only for systems that have a TK tape.)
SET BOOT	Stores a boot command by a nickname.
SET CPU	Specifies eligibility of processors to become the boot processor.
SET LANGUAGE	Changes the output of the console error messages between numeric code only (international mode) and code plus explanation (English mode).

Table 3–4 (Cont.): Console Commands

Command	Function
SET MEMORY	Designates the method of interleaving the memory modules; supersedes the console program's default interleaving.
SET TERMINAL	Sets console terminal characteristics.
SHOW ALL	Displays the current value of parameters set.
SHOW BOOT	Displays all boot commands and nicknames that have been saved using SET BOOT.
SHOW CONFIGURATION	Displays the hardware device type and revision level for each XMI and VAXBI node and indicates self-test status.
SHOW CPU	Identifies the primary processor and the status of other processors.
SHOW ETHERNET	Locates all Ethernet adapters on the system and displays their addresses.
SHOW FIELD	Displays saved boot commands, console terminal parameters, console language mode, memory configuration, type of power system, and system serial number.
SHOW LANGUAGE	Displays the mode currently set for console error messages, international or English.
SHOW MEMORY	Displays the memory lines from the system self-test and power-up test display, showing interleave and memory size.
SHOW TERMINAL	Displays the baud rate and terminal characteristics functioning on the console terminal.
START	Begins execution of an instruction at the address specified in the command string.
STOP	Halts the specified node.
TEST	Passes control to the power-up test diagnostics; /RBD qualifier invokes ROM-based diagnostics.
UPDATE	Copies contents of the EEPROM on the processor executing the command to the EEPROM of another processor. This command will not work if the console ROMs are not all of the same revision level.
Z	Logically connects the console terminal to another processor on the XMI bus or to a VAXBI node.
!	Introduces a comment.

3.10 Replacing Defective Processors or Adding New Ones

Replacing or adding processors requires that system parameters be set on the new processors, and recent patches be installed.

Example 3-3: Relevant System Parameters from a SHOW FIELD Display

```
>>> SHOW FIELD
Saved boot specifications:
  DEFAULT /XMI: E /BI: 4 DU0      ❶
  DIAG /XMI: E /BI: 4 /R5:10 DU0

Console terminal parameters:
  /SCOPE /SPEED: 9600 /BREAK     ❷

Console error message language mode:
  English                         ❸

Memory configuration:
F  E  D  C  B  A   9  8  7  6  5  4  3  2  1  0  NODE #
.  .  .  .  .  .  A2 A1 .  .  .  .  .  .  .  ILV
.  .  .  .  .  .  64 64 .  .  .  .  .  .  .  128 Mb
  /INTERLEAVE:DEFAULT

Power system: C                   ❹

System serial number: SG01234567  ❺
```

When you add a new processor or replace a defective processor in a system, you must set certain system parameters in the new processor's EEPROM. The steps for accomplishing this vary slightly according to whether you are replacing the only processor in the system, the boot processor, a secondary processor, or adding a new processor.

Also, in multiprocessor systems, once you have used SET commands to update console parameters on one processor, you can then choose to repeat the SET commands for other processors, or you can use UPDATE. SET will always work, but you must issue a separate SET command for each parameter, and for each parameter on each new or added processor. UPDATE will copy all the parameters (indeed all the EEPROM, except for information specific to a particular EEPROM, such as its repair history

and diagnostic errors) for an existing processor to a new one. UPDATE will not work, however, if the ROM revision levels are different on the boot processor and the new processor.

Major new capabilities or fixes are included in revisions to the ROM code, so ideally all processors *should* have the latest (highest-numbered) ROM revisions. However, the console code does not inhibit running processors with different ROM revisions.

If you decide to bring the system up with processors with different ROM revisions, you will then have to use individual SET commands to set the system serial number and other parameters on each newly installed processor.

The relevant parameters that need to be set on newly installed processors should be available from a previously stored printout of a SHOW FIELD command for the old system, saved in the *Site Management Guide*. A SHOW FIELD output is shown in Example 3-3. Specifically, you will need to set the following parameters:

- ① **Boot specifications.** To make the new processor consistent with the system, these specifications should be defined as shown in the SHOW FIELD.
- ② **Console terminal speed.** If other than the default of 1200 baud, this is another parameter that must be set to be consistent across processors in a system.
- ③ **Console error message language.** If other than the default of English, it too must be set for the new processor(s).
- ④ **Power system.** If the system has been upgraded to a VAX 6000 Model 600 system using an H9657-CX or -CU upgrade kit, you must set the power conversion information in EEPROM. The SET POWER command accepts three options:
 - A—Power system upgraded with an H9657-CX kit
 - B—Power system includes a battery backup system
 - C—Power system upgraded with an H9657-CU kit (default)
- ⑤ **System serial number.** This must also be set for the new processor(s).

Sections 3.10.1 and 3.10.2 tell how to set parameters when you are replacing or adding a new processor.

In addition to setting system parameters, you should install the latest EEPROM patches on the new processors, as described in Section 3.10.3.

3.10.1 How to Replace the Only Processor

When replacing the processor in a single-processor system, you must use the SET command to set parameters in the EEPROM of the new processor.

Example 3-4: Replacing a Single Processor

```
#123456789 0123456789 0123456789 0123456789 012345#
F E D C B A 9 8 7 6 5 4 3 2 1 0 NODE #
      A A . . . M M . . . . . P TYP
      O + . . . + + . . . . . + STF 7
      . . . . . . . . . . . B BPD
      . . . . . . . . . . . + ETF 7
      . . . . . . . . . . . B BPD
. . . . . . . + + + . + . . + . XBI E +
      . . . . . A2 A1 . . . . . ILV
      . . . . . 64 64 . . . . . 128 Mb

Console = V1.00 RBDs = V1.00 EEPROM = 1.00/1.00 SN = 0000000000

?004F System serial number has not been initialized
>>> SET TERMINAL/SPEED:9600 9
>>> SET LANGUAGE ENGLISH
>>> [ESC][DEL] SET POWER
Power system>>> C
Power system read as: C

Update EEPROM? (Y or N) >>> Y
?011B Power system identification updated
>>> [ESC][DEL] SET SYSTEM SERIAL
System Serial Number>>> GA14012345
Serial number read as: GA14012345

Update EEPROM? (Y or N) >>> Y
?0073 System serial number updated

>>> SET BOOT DEFAULT XMI:E /BI:4 DU0
>>> SET BOOT DIAG /XMI:E /BI:4 /R5:10 DU0

[Run EVUCA to install patches]

>>> BOOT
```

1. Turn the upper key switch to the Off position (0).
2. Set the console terminal baud rate to 1200, the default when the console program comes up with the new processor.

CAUTION: See *Appendix D for KA66A module handling procedures.*

3. Remove the defective processor module and temporarily insert it in an unused XMI slot or place it on an ESD mat.
4. Remove the new processor module from the ESD box and insert it in the XMI card cage. Place the old processor module in the ESD box.
5. Close the clear XMI door and front cabinet door.
6. Turn the lower key switch to Halt. Turn the upper key switch to Enable.
7. Check the power-up display for the processor (see Example 3–4). If the processor (shown by a P on the TYP line) shows a plus sign (+) on both lines STF and ETF, it passed the power-up tests. See 7.
8. Turn the lower key switch to Update.
9. Use SET commands to enter the console terminal speed, language, and system serial number (see 9). If the system is an H9657-CX or -CU upgrade, you will also need to use the SET POWER command. You also need to define any boot paths that were recorded in the EEPROM of the old processor.

A hard copy of this information from a SHOW FIELD printout should have been saved in the *Site Management Guide*.

10. Run EVUCA to install any EEPROM patches. See Section 3.10.3.
11. Turn the lower key switch to the Auto Start position.
12. Boot the operating system.

3.10.2 How to Replace or Add Processors in a Multiprocessor System

When replacing or adding a processor in a multiprocessor system, use SET or UPDATE to set necessary parameters, depending on whether the processors have different ROM revisions.

Example 3-5: Replacing Processors in a Multiprocessor System

```
#123456789 0123456789 0123456789 0123456789 012345#
F  E  D  C  B  A  9  8  7  6  5  4  3  2  1  0  NODE #
      A  A  .  .  .  M  M  M  M  .  P  P  P  P      TYP
      O  +  .  .  .  +  +  +  +  .  +  +  +  +      STF ⑥
      .  .  .  .  .  .  .  .  .  .  E  E  E  B      BPD
      .  .  .  .  .  .  .  .  .  .  +  +  +  +      ETF ⑥
      .  .  .  .  .  .  .  .  .  .  E  E  E  B      BPD
```

[Continued power-up display and console messages]

```

>>> SET CPU 3 ! Set boot to replaced processor so SETs apply
>>> SET TERMINAL SPEED: 9600
>>> SET LANGUAGE ENGLISH
>>> ESCDEL SET POWER
Power system>>> C
Power System read as C

Update EEPROM? (Y or N) >>> Y
?011B Power system updated
⑦ >>> ESCDEL SET SYSTEM SERIAL
System Serial Number>>> GA14012345
Serial number read as: GA14012345

Update EEPROM? (Y or N) >>> Y
?0073 System serial number updated

>>> SET BOOT DEFAULT /XMI:E /BI:4 DU0
>>> SET BOOT DIAG /XMI:E /BI:4 /R5:10 DU0

>>> SET CPU 2 ! Only if you are replacing the boot processor
⑧ >>> UPDATE 1
[ Run EVUCA to install patches ]
>>> BOOT
```

1. Turn the upper key switch straight up to the Off position (0).
2. **If you are replacing the boot processor**, set the console terminal baud rate to 1200 (the console default with the new boot processor).

CAUTION: See *Appendix D for KA66A module handling procedures*.

3. Remove the defective processor and temporarily put it in an unused XMI slot or on a static pad. Remove the new processor from the ESD box and insert it in the XMI card cage. Put the old processor in the ESD box.
4. Close the clear XMI door and front cabinet door.
5. Turn the lower key switch to Halt and the upper key switch to Enable.
6. Check the power-up test display for the new processor (see ⑥). A plus sign (+) on the STF and ETF lines means that the processor you installed passed self-test and extended testing. If you see the ?0052 console message, there is a ROM revision mismatch. Proceed with Step 7. Otherwise, go to Step 8.
7. **ROM Revisions Mismatch:** If you are replacing a secondary processor, use the SET CPU command to set the boot processor to the one you just replaced, so the following SET commands apply to that processor. Turn the lower key switch to Update. Then use SET commands to enter the console terminal speed, language, power, system serial number, and boot paths for the new CPU (see ⑦). This information from a SHOW FIELD command should have been saved in the *Site Management Guide*. Go to Step 11.
8. **ROM Revisions Match:** If you are replacing the boot processor, make one of the secondary processors the boot processor temporarily, using the SET CPU command. See ⑧.
9. Turn the lower key switch to Update.
10. Use UPDATE to copy the EEPROM for the new module from the temporary boot processor. See ⑧. UPDATE takes several minutes.
11. Run EVUCA to install any EEPROM patches. See Section 3.10.3.
12. Turn the lower key switch to the Auto Start position.
13. Boot the operating system.

3.10.3 Using EVUCA to Apply Current ROM and PCS Patches

You must run EVUCA to ensure that all modules are up to the latest patch revision. Boot the VAX Diagnostic Supervisor (VAX/DS), run the autosizer EVSBA, and load and run the EVUCA program.

Example 3-6: Using VAX/DS to Run EVUCA to Patch EEPROM on All Modules (Part 1)

```
>>> BOOT /XMI:A /R5:10 /FILENAME:ISL_LVAX_B EX0 ①
```

```
[Initial Display]
```

```
Network Initial System Load Function ②  
Version 1.1
```

FUNCTION ID		FUNCTION
1	-	Display Menu
2	-	Help
3	-	Choose Service
4	-	Select Options
5	-	Stop

```
Enter a function ID value: 3 ③
```

OPTION ID		OPTION
1	-	Find Services
2	-	Enter known Service Name

```
Enter an Option ID value: 1 ④
```

```
Working
```

EVUCA Functions

EVUCA checks the patch revision level on the latest diagnostic CD or tape against the EEPROM patch revision level on the processors in the system that you select for such checking.

If EVUCA finds different patch revision levels, it prompts you to ask if the patches should be made; that is, if the revisions on the diagnostic media should be written to EEPROM on the processors where it will be used to augment or correct code in the console and diagnostic ROMs and PCS (patchable control store) on the processor chip itself.

A higher patch number means a later revision. For example, Revision 1.06 is a later version than 1.01, and includes the most complete changes.

This section shows a sample console session, starting with booting the VAX Diagnostic Supervisor (VAX/DS) from the console prompt. EVUCA runs under VAX/DS.

- 1 Boot VAX/DS from the diagnostic media. This example shows a boot from an Ethernet-based compact disk (CD) server connected to a DEMNA (indicated by EX0) located at XMI node A. The /FILENAME qualifier identifies the Initial System Load (ISL) program needed for booting from CD servers. The general form for the file name is ISL_LVAX_x, where x is the revision letter noted on the diagnostic CD.

For a CD server connected to a DEBNI or DEBNA, an example is:

```
>>> BOOT/XMI:m/FILENAME:ISL_LVAX_B/BI:n/R5:10 ET0
```

An example of booting from a TK50, TK70, or TF85 console load device is:

```
>>> BOOT/R5:10 CSA1
```

- 2 For CD servers only: the ISL program prompts for responses to load and run VAX/DS. These prompts are discussed in items 3 through 6. If you boot from another device, VAX/DS is booted and run immediately; go to Step 7.
- 3 The ISL program presents options; type 3 to select a service.
- 4 You can select a service in two ways: Option 1 lists the services available. Option 2 lets you enter a known service name.

Example 3-7: Using VAX/DS to Run EVUCA to Patch EEPROM on All Modules (Part 2)

Servers found:: 6 ⑤

Service Name Format:
Service Number
Service Name
Server Name
Ethernet ID

#1
NSS_SYSDISK
ESS_08002B15FCE1
08-00-2B-15-FC-E1

#2
6000_DIAG_B
ESS-08002B15FCE1
08-00-2B-15-FC-E1

Enter a Service Number or <CR> for more: 2 ⑥

Copyright Digital Equipment Corporation
1991.
All Rights Reserved.

DIAGNOSTIC SUPERVISOR. ZZ-EXSAA-X15.0-191 1-JAN-1991 00:00:13

DS> RUN EVSBA ⑦

```
*****  
Copyright Digital Equipment Corporation  
1981, 1989, 1990, 1991.  
All Rights Reserved.  
*****
```

```
.. Program: EVSBA - AUTOSIZER level 3, revision 7.65, 3 tests,  
at 00:02:04.68.  
.. End of run, 0 errors detected, pass count is 1,  
time is 1-JAN-1991 00:02:54.36
```

- ⑤ In this example, the ISL program finds six CDs on the Ethernet CD server. ISL then lists identification information for each CD. In this example, two of the six CDs are listed and a prompt asks you to choose between selecting one of the two CDs listed or seeing more identification information for the remaining CDs. The diagnostic disk name in this example is 6000_DIAG_B, where *B* is the revision letter for the CD. So, the user typed "2" to select 6000_DIAG_B. (If no name beginning 6000_DIAG_n had yet been displayed, the correct response would have been a carriage return, to see the rest of the CD names.)
- ⑥ The ISL program loads the VAX Diagnostic Supervisor (VAX/DS) and runs it. VAX/DS displays its diagnostic banner.
- ⑦ Type RUN EVSBA (the autosizer program) to tell VAX/DS how the system is configured.

Example 3-8: Using VAX/DS to Run EVUCA to Patch EEPROM on All Modules (Part 3)

DS> LOAD EVUCA ⑧

[Copyright banner prints]

DS> SELECT ALL ⑨
DS> SET TRACE ⑩
DS> START ⑪

.. Program: EVUCA - VAX 6000 EEPROM Update Utility, revision 2.0, 5 tests,
at 00:04:03.27.
Testing: _KA0

Please put the front panel switch in the update position. ⑫
Press <RET> when ready.

Test 2: Load data from media

Data file? <EXUCA.BIN> ⑬

Searching for data file...
Data file loaded.

Looking for patch for CPU 01 - ROM 1.00 EEPROM 1.00.
Patch image is revision 01.01

Do you really want to apply this patch [(No), Yes] YES ⑭

Test 3: Determine Typecodes Updated

Test 4: Update EEPROM data

Getting selectable boot primitives for CPU 01, ROM 1.00
Updating CPU 01
Primary CPU 01 Done

- ⑧ Load the EVUCA program to check for patch revision and request patch updates.
- ⑨ Type `SELECT ALL` to request that all processors be checked. In this case, there is only one at XMI node 1, as will appear later in the listing.
- ⑩ The `SET TRACE` command requests that VAX/DS display information on the console terminal so that you can tell when a test is running.
- ⑪ Type `START` to begin execution of the EVUCA program.
- ⑫ This request only appears if the front panel switch is not in the Update position. The program waits until you turn the switch, and then press `RETURN` to continue the program.
- ⑬ Press `RETURN` to select `EXUCA.BIN`, the name of the file on the diagnostic media containing the patches for the processors. The file is loaded, and its information checked against current information in EEPROM. In this case, the EEPROM revision is 1.00 and the patch on the diagnostic media is 01.01, a later revision.
- ⑭ EVUCA prompts to see if you want to apply the patch. The default is No. Type *Yes* to apply the patch.

In the example, the patch is made to CPU 01 (the only one in this example), and EVUCA displays status information to that effect.

Example 3-9: Using VAX/DS to Run EVUCA to Patch EEPROM on All Modules (Part 4)

```
Test 5: Show Boot primitives 15
ROM boot primitives for CPU 01, revision 01.01 are:
1      This boot primitive supports the following:
      - boot primitive designation DU
        Device KDB50, device type 010E
        Device KDM70, device type 0C22
2      This boot primitive supports the following:
      - boot primitive designation ET
        Device DEBNI, device type 0118
        Device DEBNA, device type 410F
3      This boot primitive supports the following:
      - boot primitive designation EX
        Device DEMNA, device type 0C03
4      This boot primitive supports the following:
      - boot primitive designation FX
        Device DEMFA, device type 0823
No boot primitives found in EEPROM for CPU 01
The primary cpu was succesfully updated.

Current ROM and EEPROM revisions for each CPU are: 16
CPU 01 - ROM 1.00 EEPROM 01.01
.. End of run, 0 errors detected, pass count is 1,
   time is 1-JAN-1991 00:07:10.93
DS> EXIT 17
```

- ⑮ The EVUCA listing shows the boot primitives available in ROM and EEPROM for the system. A boot primitive is a routine to read the system bootstrap program, VMB, from a particular device into memory and start it running.

This information, then, tells what devices you can boot from with a particular CPU. In this example, four boot primitives exist in ROM on CPU 01 and none in EEPROM.

- ⑯ EVUCA displays the current ROM and EEPROM revisions. Note that the EEPROM has been patched; the revision level is 1.01.
- ⑰ Type EXIT to terminate VAX/DS and return to console mode.

3.11 KA66A Registers

The KA66A processor registers are listed in Table 3-5 and Table 3-6. XMI registers are in Table 3-7.

The IPRs are explicitly accessible to software only by the Move To Processor Register (MTPR) and Move From Processor Register (MFPR) instructions, which require kernel mode privileges. From the console, EXAMINE/I and DEPOSIT/I commands read and write the IPRs.

Table 3-5: KA66A Internal Processor Registers

Address Dec (Hex)	Register	Mnemonic	Type ¹	Class ²	I/O Address
0 (0)	Kernel Stack Pointer	KSP	R/W	1	
1 (1)	Executive Stack Pointer	ESP	R/W	1	
2 (2)	Supervisor Stack Pointer	SSP	R/W	1	
3 (3)	User Stack Pointer	USP	R/W	1	
4 (4)	Interrupt Stack Pointer	ISP	R/W	1	
8 (8)	P0 Base	P0BR	R/W	1	
9 (9)	P0 Length	P0LR	R/W	1	
10 (A)	P1 Base	P1BR	R/W	1	
11 (B)	P1 Length	P1LR	R/W	1	

¹Register access: R/W=read/write, RO = read only, WO = write only

²Key to Classes:

1 = Implemented by the KA66A CPU module as specified in the *VAX Architecture Reference Manual*.

2 = Implemented uniquely by the KA66A CPU module.

3 = Accessible, but not fully implemented; accesses yield UNPREDICTABLE results.

n Init = The register is initialized on a KA66A CPU module reset (power-up, system reset, and node reset).

NOTE: Per-process registers, loaded by LDPCTX (load process context instruction), are the following IPRs (in decimal): 0, 1, 2, 3, 8, 9, 10, 11, 19, and 61. The remainder of the registers are not affected by LDPCTX.

Table 3–5 (Cont.): KA66A Internal Processor Registers

Address Dec (Hex)	Register	Mnemonic	Type¹	Class²	I/O Address
12 (C)	System Base	SBR	R/W	1	
13 (D)	System Length	SLR	R/W	1	
14 (E)	CPU Identification	CPUID	R/W	2 Init	
16 (10)	Process Control Block Base	PCBB	R/W	1	
17 (11)	System Control Block Base	SCBB	R/W	1	
18 (12)	Interrupt Priority Level	IPL	R/W	1 Init	
19 (13)	AST Level	ASTLVL	R/W	1 Init	
20 (14)	Software Interrupt Request	SIRR	WO	1	
21 (15)	Software Interrupt Summary	SISR	R/W	1 Init	
24 (18)	Interval Clock Control and Status ³	ICCS	R/W	1 Init	E1000060
25 (19)	Next Interval Count ³	NICR	WO	2	E1000064
26 (1A)	Interval Count ³	ICR	RO	2	E1000068
27 (1B)	Time-of-Day ⁴	TODR	R/W	1	E100006C
28 (1C)	Console Storage Receiver Status	CSRS	R/W	3 Init	E1000070
29 (1D)	Console Storage Receiver Data	CSRD	RO	3 Init	E1000074
30 (1E)	Console Storage Transmitter Status	CSTS	R/W	3 Init	E1000078
31 (1F)	Console Storage Transmitter Data	CSTD	WO	3 Init	E100007C

¹Register access: R/W=read/write, RO = read only, WO = write only

²Key to Classes:

1 = Implemented by the KA66A CPU module as specified in the *VAX Architecture Reference Manual*.

2 = Implemented uniquely by the KA66A CPU module.

3 = Accessible, but not fully implemented; accesses yield UNPREDICTABLE results.

n Init = The register is initialized on a KA66A CPU module reset (power-up, system reset, and node reset).

³Interval timer requests are posted at IPL 16 with a vector of C0 (hex). The interval timer is the lowest priority device at the IPL. A subset of ICCS is implemented in the NVAX chip. NICR and ICR can be used, depending on the settings in the Ebox Control Register.

⁴TODR is maintained during power failure by the XMI TOY BBU PWR line on the XMI backplane.

Table 3–5 (Cont.): KA66A Internal Processor Registers

Address Dec (Hex)	Register	Mnemonic	Type¹	Class²	I/O Address
32 (20)	Console Receiver Control and Status	RXCS	R/W	2 Init	E1000080
33 (21)	Console Receiver Data Buffer	RXDB	RO	2 Init	E1000084
34 (22)	Console Transmitter Control and Status	TXCS	R/W	2 Init	E1000088
35 (23)	Console Transmitter Data Buffer	TXDB	WO	2 Init	E100008C
38 (26)	Machine Check Error Summary	MCESR	WO	2	
42 (2A)	Console Saved Program Counter	SAVPC	RO	2	
43 (2B)	Console Saved Processor Status Longword	SAVPSL	RO	2	
55 (37)	I/O Reset	IORESET	WO	2	E10000DC
56 (38)	Memory Management Enable	MAPEN	R/W	1 Init	
57 (39)	Translation Buffer Invalidate All	TBIA	WO	1	
58 (3A)	Translation Buffer Invalidate Single	TBIS	WO	1	
62 (3E)	System Identification	SID	RO	2	
63 (3F)	Translation Buffer Check	TBCHK	WO	1	
64 (40)	IPL 14 Interrupt ACK	IAK14	RO	1	E1000100
65 (41)	IPL 15 Interrupt ACK	IAK15	RO	1	E1000104
66 (42)	IPL 16 Interrupt ACK	IAK16	RO	1	E1000108
67 (43)	IPL 17 Interrupt ACK	IAK17	RO	1	E100010C
68 (44)	Clear Write Buffer	CWB	R/W	1	E1000110

¹Register access: R/W=read/write, RO = read only, WO = write only

²Key to Classes:

1 = Implemented by the KA66A CPU module as specified in the *VAX Architecture Reference Manual*.

2 = Implemented uniquely by the KA66A CPU module.

3 = Accessible, but not fully implemented; accesses yield UNPREDICTABLE results.

n Init = The register is initialized on a KA66A CPU module reset (power-up, system reset, and node reset).

Table 3–5 (Cont.): KA66A Internal Processor Registers

Address Dec (Hex)	Register	Mnemonic	Type¹	Class²	I/O Address
122 (7A)	Interrupt System Status	INTSYS	R/W	2	
124 (7C)	Patchable Control Store Control	PCSCR	R/W	2	
125 (7D)	Ebox Control Register	ECR	R/W	2	
160 (A0)	Cbox Control	CCTL	R/W	2 Init	
162 (A2)	Backup Cache Data ECC	BCDECC	WO	2 Init	
163 (A3)	Backup Cache Error Tag Status	BCETSTS	R/W	2	
164 (A4)	Backup Cache Error Tag Index	BCETIDX	RO	2	
165 (A5)	Backup Cache Error Tag	BCETAG	RO	2	
166 (A6)	Backup Cache Error Data Status	BCEDSTS	R/W	2	
167 (A7)	Backup Cache Error Data Index	BCEDIDX	RO	2	
168 (A8)	Backup Cache Error Data ECC	BCEDECC	RO	2	
171 (AB)	Cbox Error Fill Address	CEFADR	RO	2	
172 (AC)	Cbox Error Fill Status	CEFSTS	R/W	2	
174 (AE)	NDAL Error Status	NESTS	R/W	2	
176 (B0)	NDAL Error Output Address	NEOADR	RO	2	
178 (B2)	NDAL Error Output Command	NEOCMD	RO	2	
180 (B4)	NDAL Error Data High	NEDATHI	RO	2	
182 (B6)	NDAL Error Data Low	NEDATLO	RO	2	

¹Register access: R/W=read/write, RO = read only, WO = write only

²Key to Classes:

1 = Implemented by the KA66A CPU module as specified in the *VAX Architecture Reference Manual*.

2 = Implemented uniquely by the KA66A CPU module.

3 = Accessible, but not fully implemented; accesses yield UNPREDICTABLE results.

n Init = The register is initialized on a KA66A CPU module reset (power-up, system reset, and node reset).

Table 3–5 (Cont.): KA66A Internal Processor Registers

Address Dec (Hex)	Register	Mnemonic	Type¹	Class²	I/O Address
184 (B8)	NDAL Error Input Command	NEICMD	RO	2	
208 (D0)	VIC Memory Address	VMAR	R/W	2	
209 (D1)	VIC Tag	VTAG	R/W	2	
210 (D2)	VIC Data	VDATA	R/W	2	
211 (D3)	Ibox Control and Status	ICSR	R/W	2	
212 (D4)	Ibox Branch Prediction Control	BPCR	R/W	2	
214 (D6)	Ibox Backup PC	BPC	RO	2	
215 (D7)	Ibox Backup PC with RLOG Unwind	BPCUNW	RO	2	
231 (E7)	Physical Address Mode	PAMODE	R/W	2	
232 (E8)	Memory Management Exception Address	MMEADR	RO	2	
233 (E9)	Memory Management Exception PTE Address	MMEPTE	RO	2	
234 (EA)	Memory Management Exception Status	MMESTS	RO	2	
236 (EC)	TB Parity Address	TBADR	RO	2	
237 (ED)	TB Parity Status	TBSTS	R/W	2	
242 (F2)	P-Cache Parity Address	PCADR	RO	2	
244 (F4)	P-Cache Status	PCSTS	R/W	2	
248 (F8)	P-Cache Control	PCCTL	R/W	2	

¹Register access: R/W=read/write, RO = read only, WO = write only

²Key to Classes:

1 = Implemented by the KA66A CPU module as specified in the *VAX Architecture Reference Manual*.

2 = Implemented uniquely by the KA66A CPU module.

3 = Accessible, but not fully implemented; accesses yield UNPREDICTABLE results.

n Init = The register is initialized on a KA66A CPU module reset (power-up, system reset, and node reset).

Table 3–6: KA66A Registers in XMI Private Space

Register	Mnemonic	Address
NDAL Control and Status	NCSR	E000 0000
TOY Clock Registers		E018 3000 – E018 300D
BBU RAM		E018 300E – E018 303F
NEXMI Input Port	IPOINT	E018 4000
NEXMI Output Port0	OPOINT0	E018 5000
NEXMI Output Port1	OPOINT1	E018 6000
UART Registers		E018 7000 – E018 700F
IPR Address Space		E100 0000 – E100 03FF
IP IVINTR Generation	IPINTR	E101 0000 – E101 FFFF
WE IVINTR Generation	WEINTR	E102 0000 – E102 FFFF

Table 3–7: XMI Registers for the KA66A

Register	Mnemonic	Address
Device Register	XDEV	BB ¹ + 00
Bus Error	XBER	BB + 04
Failing Address	XFADR	BB + 08
XMI General Purpose	XGPR	BB + 0C
Node-Specific Control and Status	NCSR	BB + 1C
XMI Control Register	XCR	BB + 24
Failing Address Extension	XFAER	BB + 2C
Bus Error Extension	XBEER	BB + 34
Writeback 0 Failing Address	WFADR0	BB + 40
Writeback 1 Failing Address	WFADR1	BB + 44

¹BB = base address of a node, which is the address of the first location in nodespace.

Chapter 4

MS65A Memory

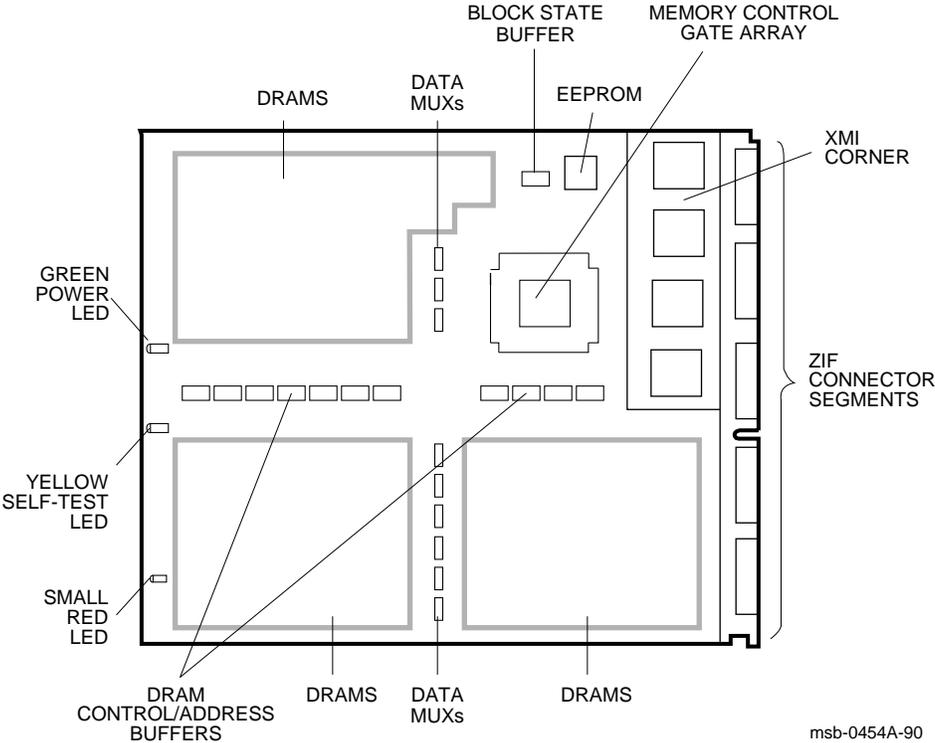
This chapter discusses the MS65A memory module. Sections include:

- MS65A Physical Description
- Specifications
- Functional Description
- Configuration Rules
- Interleaving
- Console Commands for Interleaving
- Addressing
- Memory Self-Test
- Memory Self-Test Errors
- Control and Status Registers

4.1 MS65A Physical Description

The MS65A memory module is a metal-oxide semiconductor (MOS), dynamic random access memory (DRAM). The memory module is designed for use with the VAX 6000 through the XMI bus.

Figure 4-1: MS65A Module



The MS65A memory module has the following features:

- The memory module contains MOS dynamic RAM (DRAM) arrays which provide up to 128 Mbytes of storage; a CMOS memory control gate array that contains error correction code (ECC) logic and control logic; an EEPROM storage element; and an XMI interface known as the XMI Corner.
- ECC logic detects single-bit and double-bit errors and corrects single-bit errors on 64-bit words.
- Memory self-test checks all RAMs, the data path, and control logic on power-up.
- Quadwords, octawords, and hexwords can be read from or written to memory.
- Memory is configured by the console program for 2-, 4-, 8-way or no interleaving.

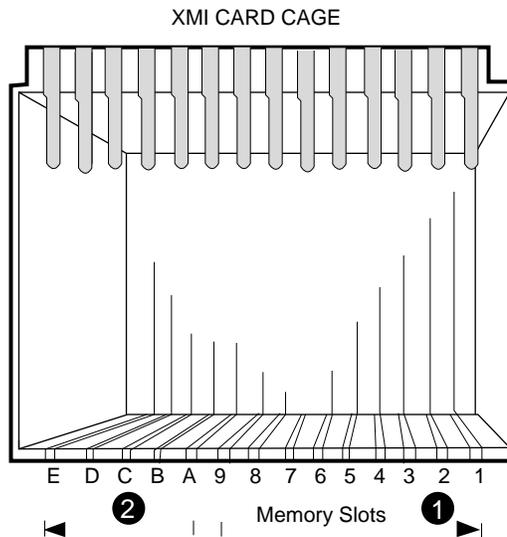
MS65A memory modules are used in all VAX 6000 series systems. Model 500 and 600 systems *require* the MS65A. Earlier model systems can use the MS65A along with the MS62A memory modules. MS65A memory modules used in Model 200, 300, or 400 systems provide higher density memory modules with a capacity of up to 128 Mbytes per module.

VAX 6000	MS65A	MS62A	Both MS65A and MS62A
Models 500, 600	Yes	No	No
Models 200, 300, 400	Yes	Yes	Yes

4.2 MS65A Configuration Rules

Figure 4-2 shows the order of placement of MS65A modules in the XMI backplane.

Figure 4-2: MS65A Configuration



msb-0133D-90

Memory modules are configured after I/O adapter and processor modules.

- ① Install the first memory module in slot 9. Fill all available slots left to right from slot 9 to slot 1.
- ② Install any additional memory modules right to left in available slots from slot A to slot E.

4.3 MS65A Specifications

Table 4–1 gives the MS65A memory module specifications.

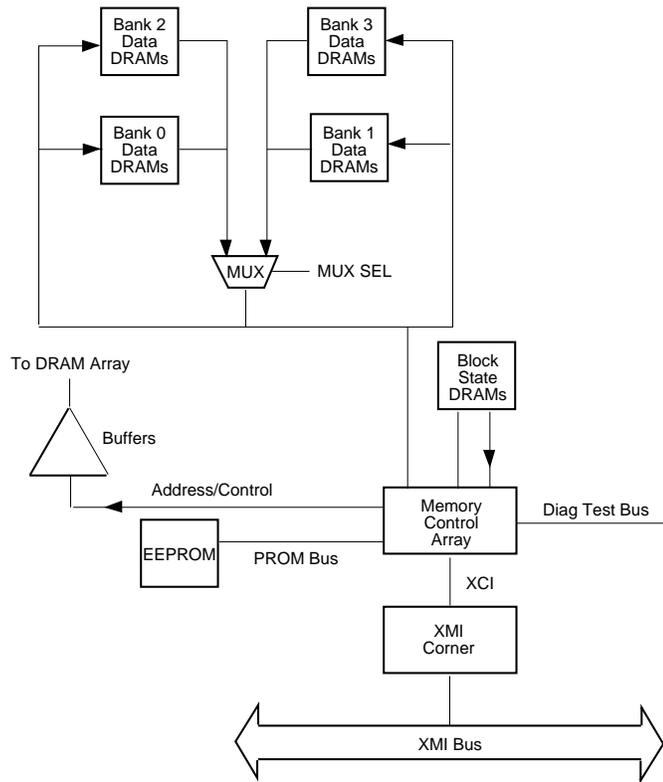
Table 4–1: MS65A Specifications

Parameter	Description
Module Number:	T2053
Dimensions:	23.3 cm (9.2") H x 28.0 cm (11.0") D x 0.23 cm (0.093") W
Memory Size:	MS65A-BA 32 Mbytes MS65A-CA 64 Mbytes MS65A-DA 128 Mbytes
Addresses:	16-Mbyte boundaries
Starting Address	0 to 512 Gbytes
Ending Address	0 to 512 Gbytes
Technology:	
DRAMs	1 or 4 Mbit dynamic RAMs
Gate Arrays	CMOS gate array
Interleave:	2-, 4-, 8-way or none
Error Correction Code:	Detects single- and double-bit errors and corrects single-bit errors
Temperature:	
Storage Range	–40°C to 70°C (–40°F to 151°F)
Operating Range	15°C to 32°C (59°F to 90°F)
Relative Humidity:	
Storage and Operating	10% to 95% noncondensing
Altitude:	
Storage	Up to 9 km (30,000 ft)
Operating	Up to 2.4 km (8000 ft)
Current:	10A active, 3.8A standby, max.
Power:	50W active, 19W standby, max.

4.4 MS65A Functional Description

The MS65A module consists of an XMI Corner, a memory control gate array, address and control drivers, block state DRAMs, DRAM arrays, and an EEPROM.

Figure 4-3: MS65A Block Diagram



msb-0730-90

The XMI Corner is located on the MS65A module and contains interface logic.

The memory control gate array transfers data between the XMI Corner and the DRAMs. The memory control gate array also controls address multiplexing, command decoding, arbitration, and CSR logic functions.

Address and control logic modifies address bits received from the XMI Corner. These modified address bits are used to control the selection of the DRAMs during reading and writing.

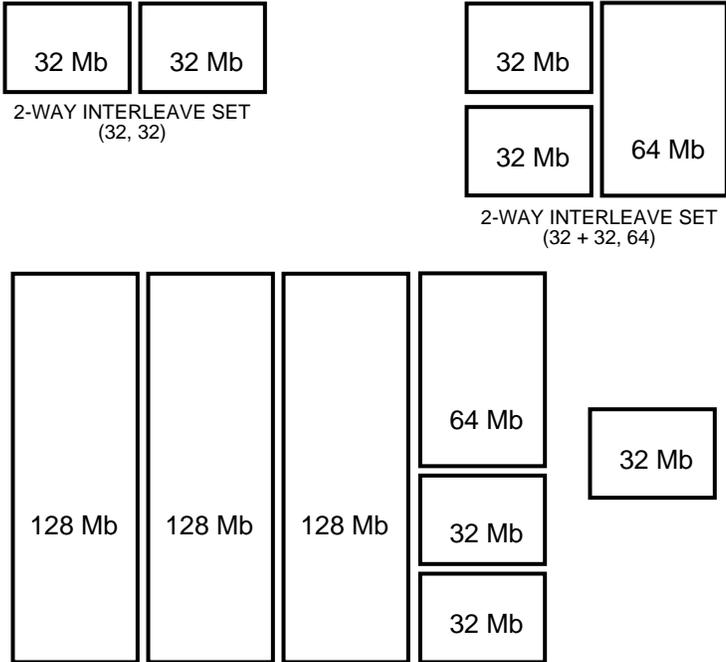
Memory is arranged in four (fully populated) or two (half populated) banks of DRAMs. A fully populated MS65A contains 299 DRAMs, and a half populated MS65A contains 155 DRAMs.

The data in the memory EEPROM is used to initialize the memory control gate array. After a power-up or system reset, the data in the EEPROM is loaded into the memory control gate array, which contains logic that controls access to and transfer of data to and from the memory module.

4.5 MS65A Interleaving

Interleaving optimizes memory access time and increases the effective memory transfer rate by operating memory modules in parallel.

Figure 4-4: MS65A Interleaving



4-WAY INTERLEAVE SET WITH ONE MEMORY NOT INTERLEAVED
 (128, 128, 128, 64 + 32+32) interleaved and (32) not interleaved

msb-0717A-91

Memory supports 2-, 4-, 8-way or no interleaving. Up to eight memory modules of the same size can be interleaved. Memory modules of different sizes can also be interleaved. Figure 4-4 shows three examples of interleaving. The first is a two-way set (32, 32); two arrays of the same size are interleaved. The second two-way set (32 + 32, 64) consists of different size arrays. The interleave set at the bottom of Figure 4-4 is a four-way set consisting of several array sizes.

Interleaving is done on hexword boundaries. Interleaving addresses are set in the Starting and Ending Address Registers by the console program (see Section 4.7). The MS65A does not check for valid or invalid interleaving configurations.

NOTE: *Memory modules that fail self-test due to multiple bit errors are not included in the interleave set.*

When different sizes of memory modules are installed in a Model 600 system, the console interleaves the memory modules according to size and sets as follows.

- Sorts memory modules into groups by size.
- Interleaves the largest size memory modules first.
- Stacks remaining sets of modules into sets that equal the largest size memory modules and interleaves them with the largest size memory modules.
- Stacks remaining modules into sets of the next largest size memory modules and interleaves them.
- Continues stacking and interleaving memory modules until all memory modules have been configured (including noninterleaved modules).

Unless the system requires a specific, dedicated memory use, you should run the default interleave rather than setting interleaving manually. In default, the console program chooses the optimal configuration for the system. Manual interleaving requires more operator attention.

4.6 Console Commands for Interleaving

The **SET MEMORY** and **SHOW MEMORY** commands are useful for setting the interleave to a memory configuration other than the default interleave. This is not usually advisable, but occasional customer use will warrant overriding the original console setting of the interleave. The **INITIALIZE** command causes the VAX 6000 Model 600 system to execute MS65A self-tests.

Example 4-1: SET MEMORY and INITIALIZE Commands

```
>>> SET MEMORY /INTERLEAVE:DEFAULT ❶
! For a system with one 64-Mbyte and two
! 32-Mbyte memory modules, it creates a 2-way
! interleave of 64-Mbyte memory modules
! (1x64-Mbyte and 2x32-Mbyte memory modules)
! located at XMI nodes 9, 8, and 7.

>>> SHOW MEMORY ❷ ! Displays the memory lines from self-test.
F E D C B A 9 8 7 6 5 4 3 2 1 0 NODE #
. . . . . A2 A2 A1 . . . . . ILV
. . . . . 32 32 64 . . . . . 128Mb

/INTERLEAVE:DEFAULT

>>> SET MEMORY /INTERLEAVE:(7, 8+9) ❸
! Explicitly specifies what is created
! as requested by the user (two interleave
! sets with modules in nodes 7, 8, and 9).

>>> INITIALIZE ❹ ! Initializes the system.

>>> SHOW MEMORY ❺ ! Displays the memory lines from self-test.
F E D C B A 9 8 7 6 5 4 3 2 1 0 NODE #
. . . . . B2 B1 A1 . . . . . ILV
. . . . . 32 32 64 . . . . . 128Mb

/INTERLEAVE:(7, 8+9)
>>>
```

The callouts in Example 4-1 are explained below.

- ❶ Shows the SET MEMORY command that configures interleaving with the console program. This command invokes the default interleaving configuration. It is recommended that this default be used, rather than trying to interleave memory manually.
- ❷ The SHOW MEMORY command displays the node number (node #), interleave (ILV), and total usable memory (xxMb) lines from the self-test results.
- ❸ Shows the SET MEMORY command that creates a 2-way interleave as requested by the user. In this example the user explicitly specified how to interleave the memory modules. Each interleaving set must contain the node number of the memory module. If there is more than one memory module in a set, they are joined by a + sign. Each set of interleaved memory modules must be separated by a comma.
- ❹ The system is initialized, self-test is run, and the >>> prompt returns. Section 4.8 describes the memory self-test and shows test results.
- ❺ The SHOW MEMORY command displays the configuration set in ❸.

NOTE: Refer to Chapter 5 of the VAX 6000 Series Owner's Manual for detailed information on the SET MEMORY and SHOW MEMORY commands.

The SET MEMORY command does not change memory interleaving; it just modifies the memory configuration in the EEPROM. The memory configuration specified by the SET MEMORY command takes place when the system is initialized (by a power-up or INITIALIZE command).

4.7 MS65A Addressing

Memory addressing is set on hexword boundaries and depends on the interleaving sets organized by the console. Starting and ending addresses are determined by the console regardless of how interleaving is done (by the user or by the console).

Figure 4-5: MS65A Addressing

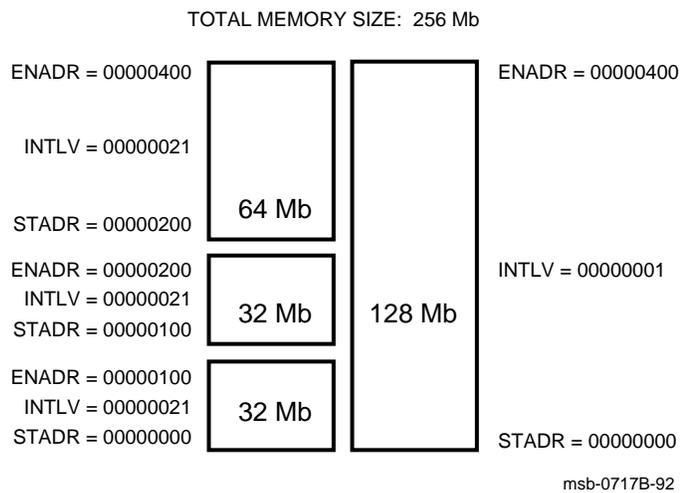


Figure 4–5 shows the starting address (STADR), ending address (ENADR), and interleave (INTLV) registers of a sample interleave set. The contents of these registers are set by the console.

The memory shown in Figure 4–5 is divided into two interleaving sets and totals 256 Mbytes. Set 0 consists of one 128-Mbyte array. Set 2 consists of two 32-Mbyte arrays and one 64-Mbyte array.

The starting address of the first array is 0. The ending address is determined by multiplying the density of the array by the interleave factor (number of sets). For example, the starting address of the first array in set 0 is 0, and the ending address is 100 hex (64 decimal, which is equal to 32 multiplied by 2). The starting address of the second array is the same as the ending address of the first.

Each array's interleave register indicates the set it belongs to (bits <7:5>) and the total number of interleave sets (bits <1:0>). The interleave register for the 128-Mbyte array indicates that the array is set 0 (bits <7:5>=000) of two interleave sets (bits <1:0>=01).

4.8 Memory Self-Test

The MS65A performs an initialization and self-test sequence on power-up or when the sequence is requested by a console command. During memory self-test the array chip is initialized, all memory locations are tested, and the control and status registers are initialized.

Example 4-2: MS65A Memory Module Results in Self-Test

```
#123456789 0123456789 0123456789 0123456789 012345#
F  E  D  C  B  A  9  8  7  6  5  4  3  2  1  0  NODE #
  A  A  .  .  .  M  M  M  M  .  .  P  P  P  TYP  ①
  +  +  .  .  .  +  +  +  +  .  .  +  +  +  STF  ②
  .  .  .  .  .  .  .  .  .  .  .  .  E  E  B  BPD
  .  .  .  .  .  .  .  .  .  .  .  +  +  +  ETF
  .  .  .  .  .  .  .  .  .  .  .  E  E  B  BPD
  .  .  .  .  .  A4 A3 A2 A1 .  .  .  .  ILV  ③
  .  .  .  .  .  64 64 64 64 .  .  .  .  256Mb ④

Console = V1.00  RBDs = V1.00  EEPROM = 1.00/1.00  SN = GA14012345
>>>
```

The callouts in Example 4-2 are explained below.

- ❶ The **TYP** line shows that memory modules are installed in XMI slots 6 through 9 as indicated by the M in this row.
- ❷ The **STF** line shows if memory modules pass self-test, as indicated by the + in this row. If a module fails self-test, a – is indicated, but the console still tests all pages within the module. The failing module is included in the configuration, and the addresses that fail self-test are not used by the system.
- ❸ The **ILV** line indicates the memory array modules are 4-way interleaved.
- ❹ This system contains a total usable memory of 256 Mbytes (four 64-Mbyte memory modules).

If all MS65A nodes pass self-test, CPU/memory interaction tests are performed on the MS65A by the CPU, and reported on the ETF line of the power-up test display. The console executes a simple read/write test to a small portion of memory. Since there are no errors from the self-test, the memory bitmap is set with all pages as good.

4.9 Memory Self-Test Errors

If an MS65A node fails self-test, an explicit memory test is run on the failing module and console error messages are displayed. The failing module is still included in the memory configuration.

Example 4–3: MS65A Memory Module Node Exclusion

```
>>> SET MEMORY /INTERLEAVE:(7+8, 9)
>>> INITIALIZE
      [Self-test display prints]
>>> SHOW MEMORY

F  E  D  C  B  A  9  8  7  6  5  4  3  2  1  0  NODE #
.  .  .  .  .  .  B1 A2 A1 -  .  .  .  .  .  ILV
.  .  .  .  .  .  64 64 64 .  .  .  .  .  192Mb
/INTERLEAVE:(7+8, 9)
```

If an MS65A node fails self-test, then the console executes an explicit memory test during the building of the bitmap. Failing memory modules are included in the configuration, although they are interleaved by themselves. The only way to exclude a memory module from interleaving is to use the SET MEMORY command without designating the node you want to exclude. Example 4–3 shows how to exclude the memory module at node 6.

During the explicit memory test, any number of the following console messages might be displayed to aid the customer service engineer in diagnosing the problem.

```
?0037 Explicit interleave list is bad. Configuring
      all arrays uninterleaved.
```

This means that the explicit set of memory arrays for the explicit interleave includes no nodes that contain memory array. All memory arrays found in the system are unconfigured (the SET MEMORY command may have specified nodes that did not contain memory modules).

```
?0046 Memory interleave set is inconsistent: n n ...
```

This means that the listed nodes (*nn*) do not form a valid memory interleave set. One or more of the nodes might not be a memory array or the set contains an invalid number of memory arrays. Each listed memory array

that is valid will be configured uninterleaved; any memory array that is not included in the set will not be interleaved.

```
?0047  Insufficient working memory for normal operation.
```

This means that less than 256 Kbytes per processor of working memory were found. There may be insufficient memory for the console to function or for the operating system to boot.

```
?011E  Uncorrectable memory errors discovered -- long memory
       test must be performed on node n
```

This means that a memory array contains an unrecoverable error. The console must perform a slow test to locate all the failing locations.

```
?004A  Memories not interleaved due to uncorrectable errors.
```

This means that the listed arrays would normally have been interleaved (by default or an explicit request). Because one or more arrays contained unrecoverable errors, this interleave set will not be constructed.

NOTE: *Refer to Appendix B for a list of console error messages. See also Section 6.6 in the VAX 6000 Series Owner's Manual for more information on these errors.*

When self-test has finished running on the module, the yellow LED (located at the center of the module's edge farthest from the XMI backplane) lights. After self-test, starting and ending addresses are set by the boot processor.

4.10 MS65A Control and Status Registers

The memory contains 19 control and status registers (CSRs) to control the memory and log errors. All CSRs are 32 bits long and respond only to longword read and write transactions. Only full writes are performed to the CSRs. If a parity error occurs during a write operation, the operation is aborted and the contents of the CSRs are unchanged.

The CSRs start at an address dependent upon the node ID. All CSR addresses are designated as $BB + n$, where n is the relative offset of the register.

Table 4–2: MS65A Control and Status Registers

Register	Mnemonic	Address
Device Register	XDEV	$BB^1 + 00$
Bus Error Register	XBER	$BB + 04$
Memory Control Register 1	MCTL1	$BB + 14$
Memory ECC Error Register	MECER	$BB + 18$
Memory ECC Address Register	MECEA	$BB + 1C$
Memory Control Register 2	MCTL2	$BB + 30$
TCY Tester Register	TCY	$BB + 34$
Block State ECC Error Register	BECER	$BB + 38$
Block State ECC Address Register	BECEA	$BB + 3C$
Starting Address Register	STADR	$BB + 50$
Ending Address Register	ENADR	$BB + 54$
Segment/Interleave Control Register	INTLV	$BB + 58$
Memory Control Register 3	MCTL3	$BB + 5C$
Memory Control Register 4	MCTL4	$BB + 60$
Block State Control Register	BSCTL	$BB + 68$
Block State Address Register	BSADR	$BB + 6C$

¹"BB" refers to the base address of an XMI node ($2180\ 0000 + (\text{node ID} \times 8000)$)

Table 4–2 (Cont.): MS65A Control and Status Registers

Register	Mnemonic	Address
EEPROM Control Register	EECTL	BB + 70
Timeout Control/Status Register	TMOER	BB + 74

Chapter 5

DWMBB I/O Adapter

This chapter discusses the DWMBB adapter, the interface to an optional VAXBI I/O channel. Sections include:

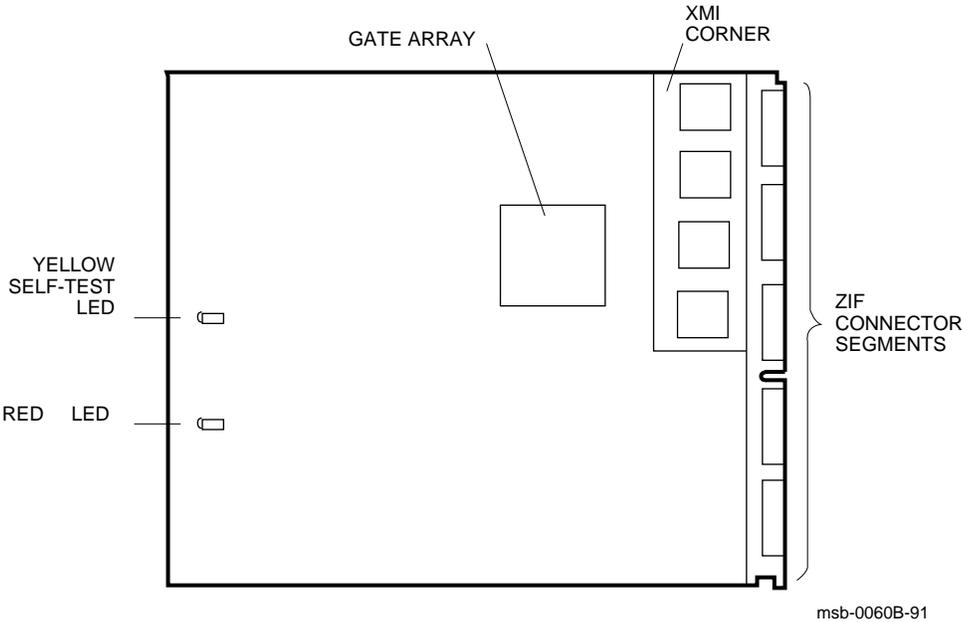
- DWMBB Physical Description
 - Physical Layout
 - Specifications
- Configuration Rules
- Functional Description
- Registers

5.1 DWMBB Physical Description

5.1.1 Physical Layout

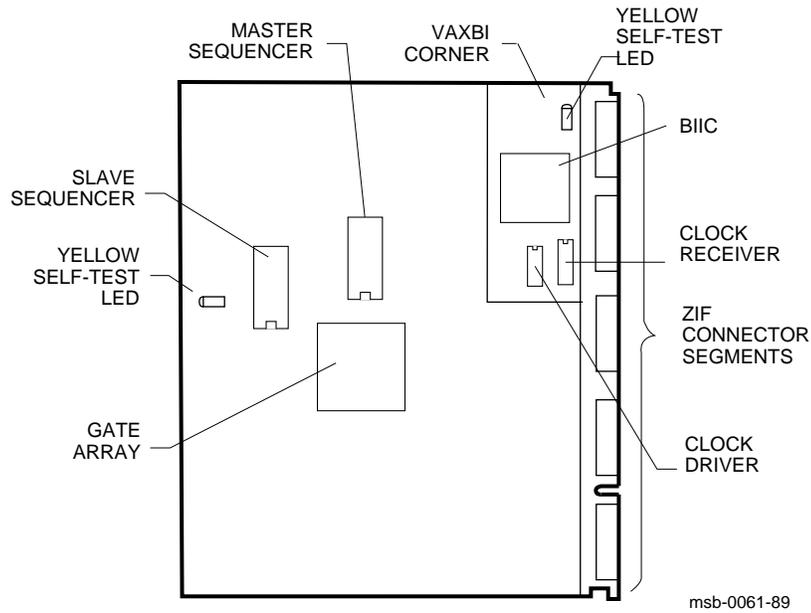
The DWMBB/A is an XMI module (T2018) with the standard XMI Corner, an XMI self-test OK LED indicator, IBUS drivers/receivers and transceivers, timeout logic, and a gate array that controls the DWMBB/A. Most of the components on the DWMBB/A are surface-mounted.

Figure 5-1: DWMBB/A XMI Module



The DWMBB/B is a standard VAXBI (T1043) module with a VAXBI Corner, including a BIIC interface chip, the primary interface between the VAXBI bus and the DWMBB/B node logic, a clock driver, and a clock receiver. The DWMBB/B gate array is used mostly for data path logic. The VAXBI self-test OK LED is on the VAXBI Corner, and the module self-test OK LED is at the module edge opposite the connector edge.

Figure 5-2: DWMBB/B VAXBI Module



5.1.2 Specifications

The following specifications apply to the DWMBB modules.

Table 5–1: DWMBB/A Specifications

Parameter	Description
Module Number:	T2018
Dimensions:	23.3 cm (9.2") H x 28.0 cm (11.0") D x 0.23 cm (0.093") W
Temperature:	
Storage Range	-40°C to 70°C (-40°F to 151°F)
Operating Range	15°C to 32°C (59°F to 90°F)
Relative Humidity:	
Storage and operating	10% to 95% noncondensing
Altitude:	
Storage	Up to 9 km (30,000 ft)
Operating	Up to 2.4 km (8000 ft)
Current:	6A at +5V
Power:	16W

Table 5–2: DWMBB/B Specifications

Parameter	Description
Module Number:	T1043
Dimensions:	20.3 cm (8") H x 23.3 cm (9.2") D x 0.23 cm (0.093") W
Temperature:	
Storage Range	-40°C to 66°C (-40°F to 151°F)
Operating Range	5°C to 50°C (41°F to 122°F)
Relative Humidity:	
Storage and operating	10% to 95% noncondensing
Altitude:	
Storage	Up to 4.8 km (16,000 ft)
Operating	Up to 2.4 km (8000 ft)
Current:	6A at +5V 10mA at -12V
Power:	30W

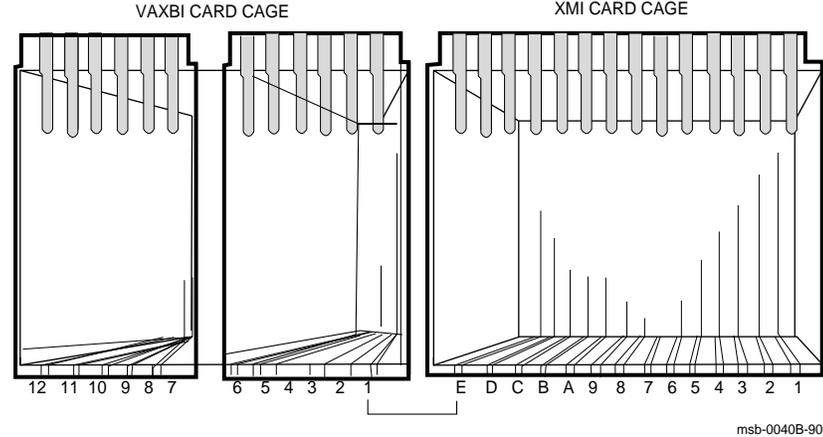
Table 5–3: DWMBB Cables

Part Number	Description
17-01569-01	DWMBB to H7206-B power OK cable
17-01897-01	15' DWMBB cables for expander cabinet, from XMI slots 1, 2, 3, and 4 as needed (segments D and E) to VAXBI cages 2, 3, 4, and 5 (segments D and E). Two per DWMBB.
17-01897-02	7" DWMBB cables, from XMI slot E (segments D and E) to VAXBI cage 1 slot 1 (segments D and E). Two per DWMBB.

5.2 DWMBB Configuration Rules

This section describes the configuration rules for the DWMBB/A module in the XMI card cage and for the DWMBB/B module in the VAXBI card cage.

Figure 5-3: VAX 6000 Slot Numbers



DWMBB/A modules are placed in the order shown in Table 5-4.

Table 5-4: DWMBB Configuration

XMI Node No.	VAXBI Channel	Location
E	1	System cabinet
1	2	Expander cabinet
2	3	Expander cabinet
3	4	Expander cabinet
4	5	Expander cabinet

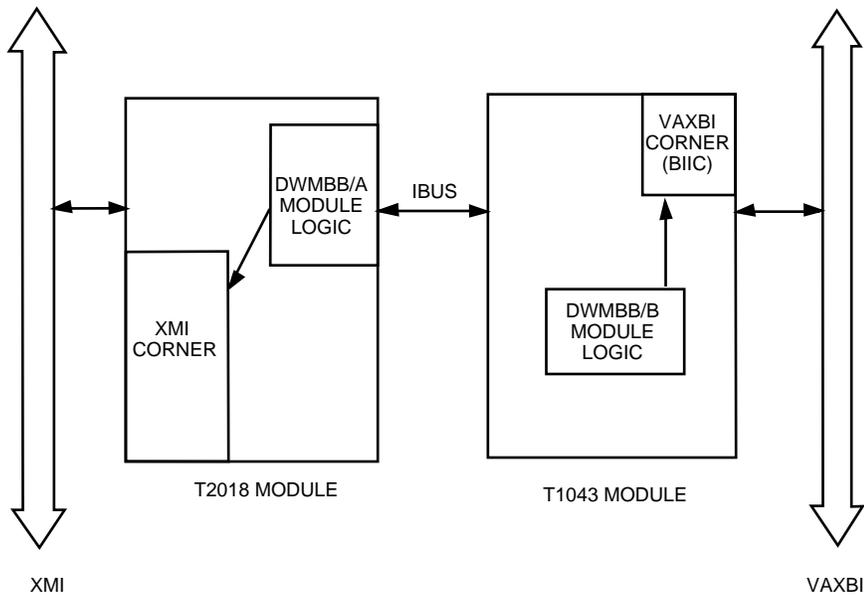
Configuration rules are as follows:

- The first VAXBI channel is the 12-slot channel in the system cabinet. The DWMBB/A module is placed in XMI slot E; the corresponding DWMBB/B module is placed in the system VAXBI cage, slot 1 (the rightmost slot). See Figure 5-3.
- Any additional VAXBI channels are 6-slot channels in the expander cabinet. The DWMBB/B module is placed in slot 1 of each. The corresponding DWMBB/A module is placed in the XMI slot listed in Table 5-4.

5.3 DWMBB Functional Description

The DWMBB adapter provides an information path between the XMI bus and I/O devices on the VAXBI bus. The DWMBB consists of two modules: the DWMBB/A and the DWMBB/B. The DWMBB/A resides on the XMI bus, and the DWMBB/B resides on the VAXBI bus. Four 30-pin cables, which make up the IBUS, connect the two modules.

Figure 5-4: DWMBB XMI-to-VAXBI Adapter Block Diagram



msb-0062A-90

The DWMBB/A contains the XMI Corner, the register files, XMI required registers, DWMBB/A-specific registers, page map registers, and the control sequencers for the XMI interface.

The DWMBB/B contains the BIIC interface chip, interconnect drivers, control sequencers to handle the control of the data transfer, status bits to and from the DWMBB/A module's register files and the BIIC, DWMBB/B-specific registers, decode logic for direct memory access (DMA) operation, and VAXBI clock-generation circuitry.

The DWMBB/A and DWMBB/B modules are connected by four cables of 30 wires each. These 120 wires make up the IBUS, which transfers data and control information between the two modules.

The DWMBB uses I/O and DMA transactions to exchange information. I/O transactions originate from the KA66A modules and are presented to the DWMBB from the XMI bus with the processor as the XMI commander and the DWMBB as the XMI responder.

DMA transactions originate from VAXBI nodes that select the DWMBB as the VAXBI slave. These are read or write transactions targeted to XMI memory space or are VAXBI-generated interrupt transactions that target a KA66A processor module module. For DMA transactions, the DWMBB is the XMI commander, and the MS65A module is the XMI responder.

The DWMBB can be both a master and a slave on the VAXBI. As a master, it carries out transactions requested by its XMI devices. As a slave, it responds to VAXBI transactions that select its node.

5.4 DWMBB Registers

Two sets of registers are used by the DWMBB adapter: VAXBI registers (residing in the BIIC) and DWMBB registers (residing on both modules of the DWMBB). The DWMBB registers include the XMI required registers and DWMBB-specific registers addressed in DWMBB private space.

Table 5–5: VAXBI Registers

Name	Mnemonic	Address¹
Device Register	DTYPE	bb+00
VAXBI Control and Status Register	VAXBICSR	bb+04
Bus Error Register	BER	bb+08
Error Interrupt Control Register	EINTRSCR	bb+0C
Interrupt Destination Register	INTRDES	bb+10
IPINTR Mask Register	IPINTRMSK	bb+14
Force-Bit IPINTR/STOP Destination Register	FIPSEDES	bb+18
IPINTR Source Register	IPINTRSRC	bb+1C
Starting Address Register	SADR	bb+20
Ending Address Register	EADR	bb+24
BCI Control and Status Register	BCICSR	bb+28
Write Status Register	WSTAT	bb+2C
Force-Bit IPINTR/STOP Command Register	FIPSCMD	bb+30
User Interface Interrupt Control Register	UINTRCSR	bb+40
General Purpose Register 0	GPR0	bb+F0
General Purpose Register 1	GPR1	bb+F4
General Purpose Register 2	GPR2	bb+F8
General Purpose Register 3	GPR3	bb+FC

¹The abbreviation "bb" refers to the base address of a VAXBI node (the address of the first location of nodespace).

Table 5–5 lists the VAXBI registers. The VAXBI registers are described in Chapter 5 of the *VAXBI Options Handbook*. Table 5–6 lists the DWMBB registers.

Table 5–6: DWMBB XMI Registers

Name	Mnemonic¹	Address²
Device Register	XDEV	BB+00
Bus Error Register	XBER	BB+04
Failing Address Register	XFADR	BB+08
Responder Error Address Register	AREAR	BB+0C
Error Summary Register	AESR	BB+10
Interrupt Mask Register	AIMR	BB+14
Implied Vector Interrupt Destination/Diagnostic Register	AIVINTR	BB+18
Diagnostic 1 Register	ADG1	BB+1C
Utility Register	AUTLR	BB+20
Control and Status Register	ACSR	BB+24
Return Vector Register	ARVR	BB+28
Failing Address Extension Register	XFAER	BB+2C
VAXBI Error Address Register	ABEAR	BB+30
Control and Status Register	BCSR	BB+40
Error Summary Register	BESR	BB+44
Interrupt Destination Register	BIDR	BB+48
Timeout Address Register	BTIM	BB+4C
Vector Offset Register	BVOR	BB+50
Vector Register	BVR	BB+54
Diagnostic Control Register 1	BDCR1	BB+58
Reserved Register	BRSVD	BB+5C

¹If the first letter of the mnemonic is "X" or "A," it indicates that the register resides on the DWMBB/A module; a first letter of "B" indicates that the register resides on the DWMBB/B module.

²The abbreviation "BB" refers to the base address of an XMI node (the address of the first location of nodespace).

Table 5–6 (Cont.): DWMBB XMI Registers

Name	Mnemonic¹	Address²
Page Map Register (first location)	PMR	BB+200
.		
.		
Page Map Register (last location)	PMR	BB+401FC

Appendix A

ROM-Based Diagnostic Monitor Program

This appendix describes the RBD monitor program, in the following sections:

- RBD Monitor Control Characters
- DEPOSIT and EXAMINE Commands
- START Command
- START Command Qualifiers
- RBD Test Printout, Passing
- RBD Test Printout, Failing
- SUMMARY Command
- Sample RBD Session
- Running ROM-Based Diagnostics on I/O Devices

A.1 RBD Monitor Control Characters

Several control characters are supported by the RBD monitor program. These characters manage the program process as shown in Table A-1.

Table A-1: RBD Monitor Control Characters

Character	Environment	Function
<code>CTRL/C</code>	Test running	Stops the execution of an RBD test and executes cleanup code.
<code>DELETE</code>	RBD command line	Use for deleting erroneous characters entered on the command line.
<code>CTRL/Q</code>	Test running	Resumes output to terminal that was suspended with <code>CTRL/S</code> .
<code>CTRL/R</code>	At RBD prompt	Refreshes the command line; useful when characters are deleted.
<code>CTRL/S</code>	Test running	Suspends output to the terminal until <code>CTRL/Q</code> is typed.
<code>CTRL/T</code>	Test running	Displays informational status line about currently running diagnostic.
<code>CTRL/U</code>	At RBD prompt	Disregards previous input.
<code>CTRL/Y</code>	Test running	Stops the execution of an RBD test and does not execute any cleanup code.
<code>CTRL/Z</code>	At RBD prompt	Exits RBD monitor program and enters console program; same effect as the QUIT command.

When CTRL/C is entered from the console terminal that began execution of the RBD test, the diagnostic stops execution, runs cleanup code, and returns control to the RBD monitor program. This happens immediately when running RBD 0, RBD 1, or RBD 2; there may be a wait of up to one minute for a response when RBD 3 is running. If CTRL/C is typed at the RBD monitor prompt, it has the same effect as CTRL/U.

When you use the DELETE key (or rubout key), characters being deleted are preceded by a backslash (\) and print as they are rubbed out. When the next valid character is typed, it is preceded by a backslash (\) to delineate the deleted characters. You can use CTRL/R to refresh the line.

When a CTRL/T is received by the RBD monitor program from the console terminal that began execution of the RBD test, the diagnostic displays an informational status line and continues test execution. A CTRL/T entered at the RBD prompt is ignored.

When the RBD monitor program receives a CTRL/U, the program disregards all previous input typed and returns the RBD prompt. If a test is running when CTRL/U is entered, CTRL/U is ignored.

When a CTRL/Y is received by the RBD monitor program from the console terminal that began execution of the RBD test, the diagnostic stops execution and returns control to the RBD monitor program. No cleanup code is run, and the unit under test is left in an indeterminate state. A CTRL/Y entered at the RBD monitor prompt has the same effect as CTRL/U.

When the RBD monitor program receives a CTRL/Z, the program exits and control is returned to the console program. The next prompt is the console prompt. CTRL/Z has the same effect as the QUIT command. If CTRL/Z is entered while an RBD test is running, CTRL/Z has the same effect as CTRL/C: it halts the test and executes cleanup code.

A.2 DEPOSIT and EXAMINE Commands

The DEPOSIT command deposits data to the address specified, and the EXAMINE command displays the data stored at the specified address.

Example A-1: DEPOSIT and EXAMINE Commands

```
>>> T/R                ! Command to enter RBD monitor program.
RBD2> D 20 0           ! Deposit the value zero to address 20; the
                        ! boot processor is at node 2.
RBD2> E/G A           ! Examine GPR R10.
0000000A 00000000
RBD2> E/W 300         ! Examine a word of data starting at address
                        ! 300. (/W changes default to word length.)
00000300 FFFF
RBD2> E               ! Examine a word of data starting at address
                        ! 302. (The previous address is incremented
00000302 FFFF         ! by the default length.)
RBD2> D/W * 1234      ! Deposit the word-length hexadecimal value
                        ! 1234 starting at the last requested address,
                        ! in this case 302.
RBD2> D/L + 5678AABB ! Deposit the longword-length hexadecimal value
                        ! 5678AABB starting at the last requested
                        ! address incremented by the default length (in
                        ! this case, the address is 304).
```

Table A-2: DEPOSIT and EXAMINE Command Qualifiers

Qualifier	Meaning
/B	Defines data size as a byte.
/G	For the EXAMINE command only; shows a copy of the contents of general registers R0 through R11 when the diagnostic halted.
/L	Defines data size as a longword.
/W	Defines data size as a word.

The command syntax is:

```
D[/qualifier] <address> <data>  
E[/qualifier] <address>
```

The qualifiers must be placed immediately following the command.

The variable <data> is a numeric value to be stored. The value must fit in the data size to be deposited. In the RBD program, addresses are always considered to be physical addresses, not register references. You can only examine the register contents (using E/G in RBD mode); you cannot deposit to the registers.

The variable <address> is a 1- to 8-digit hexadecimal value or one of the following:

- +, the location immediately following the last location you referenced in an E or D command. For memory, the referenced location is the last location plus the size of the reference (1 for byte, 2 for word, 4 for longword). When examining general purpose registers (GPRs), the location is incremented by 1.
- –, the location immediately preceding the last location you referenced in an E or D command. For memory, the referenced location is the last location minus the size of the reference (1 for byte, 2 for word, 4 for longword). When examining GPRs, the location is decremented by 1.
- *, the last location you referenced in an E or D command.

The D command directs data into the specified address. If you do not specify any address or data size qualifiers, the defaults are based on the last address or data size specified in a D or E command. After processor initialization, the default address space is physical memory, the default data size is longword, and the default address is zero. Data cannot be deposited into a GPR.

The address and data must be entered as hexadecimal characters. The data specified must be able to fit into the current data length: 2 hex digits for byte length, 4 for word length, and 8 for longword length.

If an E command is followed by a Return (E<CR>), the RBD program interprets it as an E+ command.

When using the /G qualifier with a /B, /W, or /L qualifier, the /G must be first.

A.3 START Command

The RBD monitor START command invokes a specific RBD program. It takes an argument indicating the RBD program to be run and can take any of 13 qualifiers.

Example A-2: START Command

```
>>> T/R                ! Command to enter RBD monitor program.
RBD3>                  ! RBD monitor prompt, where 3 is the hexa-
                        ! decimal node number of the processor
                        ! that is currently receiving your input.
RBD3> ST0/TR           ! Runs the CPU tests, testing the KA66A
                        ! at XMI node number 3. Test results
                        ! are written to the console terminal.
RBD3> ST1/HE/IE/BE     ! Runs the default tests in the CPU/memory
                        ! interaction RBD, halting on the first
                        ! error encountered, inhibiting error output,
                        ! ringing the bell when the first error is
                        ! encountered.
```

The START command syntax is:

```
STn[/qualifier] [parameter]
```

where:

- *n* is the RBD to be run (see Table 2-9).
- [/qualifier] is one of those listed in Section A.4.
- [parameter] is a program-specific value used in RBD 2, 3, or 4. (For the meaning of this parameter, see Section 2.7.4, Section 2.7.5, or Section 2.7.6.)

A.4 START Command Qualifiers

The START command has qualifiers that allow you to control the output of the tests—to run portions of a test, to run nondefault tests, and to loop on tests.

Table A–3: START Command Qualifiers

Qualifier	Default	Function
/BE	Disabled	Bell sounds when an error is encountered
/C	Disabled	Destructive test confirmation
/DS	Disabled	Disable status reports
/HE	Disabled	Halt on the test that incurs a hard error
/HS	Disabled	Halt on the test that incurs a soft error
/IC	Disabled	Inhibit cleanup
/IE	Disabled	Inhibit all error output
/IS	Disabled	Inhibit summary reports
/LE	Disabled	Loop on the test that incurs a hard error
/LS	Disabled	Loop on the test that incurs a soft error
/P= <i>n</i>	Enabled	Make <i>n</i> passes of the test or tests indicated
/QV	Disabled	Quick verify mode
/T= <i>n</i> [: <i>m</i>]	Enabled	/T= <i>n</i> runs test <i>n</i> ; /T= <i>n</i> : <i>m</i> runs a range of tests from <i>n</i> through <i>m</i>
/TR	Disabled	Print a trace of test numbers, as they run

NOTE: *A qualifier is valid only for the command with which it is issued. Qualifiers do not remain in effect for the session once they are issued.*

See Example A–2 for examples and a description of the START command syntax.

With /BE, the RBD monitor program rings the bell on the console terminal whenever an error is encountered. This is useful when error printout is inhibited and a loop is being performed on an intermittent error (/LE).

`/C` enables execution of destructive tests. See Section 2.7.5 for information on the destructive tests.

`/DS` disables printout of the diagnostics test results. The summary report is run, unless it is specifically disabled.

`/HE` halts on hard error and stops execution of tests as soon as the first hard error is encountered. (In this context, a hard error is defined as a recoverable, repeatable error, for example, a ROM checksum error. This differs from a fatal error, which is an unrecoverable fault, for example, an unexpected interrupt or exception. A fatal error is always cause for program abortion, regardless of the state of the `/HE` or `/LE` qualifier.) The test number is printed, and a summary indicating failure of the RBD is printed to the console terminal. Also the RBD monitor prompt is returned. Continue on error is the default condition, so if you want to halt on error, you must specifically invoke it in your command line.

`/HS` halts on soft error and stops execution of tests as soon as the first soft error is encountered. (In this context, a soft error is defined as a recoverable error that goes away after retry, for example, a corrected read data memory error.) The test number is printed, and a summary indicating failure of the RBD is printed to the console terminal. Also the RBD monitor prompt is returned. Continue on soft error is the default condition, so if you want to halt on soft error, you must specifically invoke it in your command line.

`/IC` inhibits the cleanup code that normally executes after an RBD has completed. This is useful during debugging to prevent the cleanup of error bits in registers.

`/IE` inhibits all error output, suppressing printing of RBD results. This qualifier is used primarily for module repair, in conjunction with the `/LE` or `/LS` qualifier. Errors are counted even when the printing is disabled.

`/IS` suppresses printout of RBD summary after the end of the last pass performed by the RBD.

`/LE` loops on the test where the first hard error is detected. Even if the error is intermittent, looping continues on the test indicated. To terminate `/LE`, enter `CTRL/C`, `CTRL/Z`, or `CTRL/Y`. After entering one of these control characters, a summary report is printed. A fatal error causes the program to abort, regardless of the state of this qualifier.

`/LS` loops on the test where the first soft error is detected. Even if the error is intermittent, looping continues on the test indicated. To terminate `/LS`, enter `CTRL/C`, `CTRL/Z`, or `CTRL/Y`. After entering one of these control characters, a summary report is printed.

`/P=n` runs *n* number of passes of the RBD test invoked, where *n* is a decimal number. If *n* is 0, all selected tests run for an infinite number of passes.

If the /P qualifier is not used, the program defaults to one pass of the test invoked. When used with the /T=*n:m* qualifier, you run a range of tests. To terminate /P=*n*, enter CTRL/C, CTRL/Z, or CTRL/Y. After entering one of these control characters, a summary report prints out and the RBD monitor prompt returns.

/QV selects the quick verify version of any selected test that supports this mode.

/T=*n[:m]* selects individual tests (/T=*n*) or a range of tests (/T=*n:m*) where *n* and *m* are decimal numbers. For example, to run tests T0005 through T0008, use /T=5:8. If no /T qualifier is used, the diagnostic runs its default suite of tests.

/TR prints each test number as it is completed. This qualifier allows you to trace the progress of the diagnostic as it runs. Without the /TR qualifier, just the summary line is printed.

One parameter field can be appended to the START command string to control aspects of the diagnostic that are not covered by the qualifiers. The parameter must be appended after any qualifiers specified and separated from the qualifiers by a space. The format of the parameter field is one to four hexadecimal characters.

A.5 RBD Test Printout, Passing

The RBD printout results are different when the RBD tests pass and when they fail. Example A-3 shows a passing printout, and Example A-4 is a sample failure printout.

Example A-3: RBD Test Printout, Passing

```
>>> T/R                                     ! Command to enter RBD monitor program at
                                           ! console prompt.
RBD3>                                       ! RBD monitor prompt, where 3 is the hexa-
                                           ! decimal node number of the processor
                                           ! that is currently receiving your input.

RBD3> ST2/TR E                               ! Runs the XBI self-test, testing the DWMBB
                                           ! at XMI node number E. Test results
                                           ! written to the console terminal:

; XBI+_RBD1                                1.002

; T0001 T0002 T0003 T0004 T0005 T0006 T0007 T0008 T0009 T00103
; T0011 T0012 T0013 T0014 T0015 T0016 T0017 T0018 T0019 T0020
; T0021 T0022 T0023 T0024 T0025 T0026 T0027 T0028 T0029 T0030
; T0031 T0032 T0033 T0034 T0035 T0036 T0037 T0038 T0039 T0040
; T0041 T0042 T0043 T0044

;      P4      35      80876      17
; 00000000 00000000 00000000 00000000 00000000 00000000 000000008

RBD3> QU9                                   ! RBD prompt returns; test ran successfully.
                                           ! Exit RBD program.

>>>
```

The callouts in Example A-3 are explained below.

- ¹ This entry designates which test is being run. Here it is XBI+_RBD, the test for the DWMBB or DWMVA/A.

XNP_ST indicates RBD 0, the CPU tests
CPUMEM indicates RBD 1, the CPU/memory interaction tests
XBI+_RBD indicates RBD 2, the DWMBB and DWMVA/A tests
XMA2_RBD indicates RBD 3, the Memory tests
XNP_BC indicates RBD 4, the cache tests
XNP_MP indicates RBD 5, the multiprocessor tests

- ² This field lists the revision number of the RBD program.

- ③ These T00nn fields appear only with the /TR qualifier; each entry corresponds to a test being run and prints out as the test starts running. In a passing RBD, the final T00nn number corresponds to the last test run.
- ④ This field indicates whether the RBD passed or failed; P for passed, F for failed.
- ⑤ This field is the XMI node number of the boot processor executing the RBD. It matches the number in your RBD prompt.
- ⑥ This field is always 8087—the device type of the boot processor.
- ⑦ This field displays the total number of passes (in decimal) executed by the RBD. The default number of passes is 1. If you use the START command with the qualifier /P=5, for example, then this field will show 5, indicating 5 passes were completed.
- ⑧ This line contains the summary of the RBD failures. In a successful RBD run, the line will contain all zeros as shown here. Currently only the second and third fields are used. The second field contains the number of hard errors detected during the run. The third field contains the number of soft errors detected during the run.
- ⑨ The console prompt is usually returned in response to the RBD QUIT command, as shown in this example. However, when tests that cause parity errors are run, the response to QUIT is a system reset. The power-up test is then run, and the results are printed. The tests that cause a system reset are tests 1, 2, and 4 of RBD 1; tests 2, 3, 4, 30, and 31 of RBD 2; and tests 5 and 9 of RBD 3.

A.6 RBD Test Printout, Failing

The RBD printout results are different when the RBD passes and when it fails. Example A-4 is a sample failure printout, and Example A-3 shows a passing printout.

Example A-4: RBD Test Printout, Failing

```
>>> T/R                               ! Command to enter RBD monitor program at
                                       ! console prompt.
RBD2>                                  ! RBD monitor prompt, where 2 is the hexa-
                                       ! decimal node number of the processor
                                       ! that is currently receiving your input.
RBD2> ST0/TR                           ! Execute RBD 0 (CPU test) and trace results.

; XNP_ST                               1.00

; T0001 T0002 T0003 T0004 T0005 T0006 T0007 T0008 T0009 T0010
; T0011 T0012 T0013 T0014 T0015 T0016 T0017 T0018 T0019 T0020
; T0021 T0022 T0023 T0024 T0025 T0026 T0027 T0028 T0029 ❶

;      F ❷          2 ❸      8087 ❹          1 ❺
;      HE ❻ BR_PRED ❼      XX ❽      T0029 ❾
;      28 ❿ 5555AAAA ⓫ A8AAAAAA ❹ 00000000 ❸ E1008000 ❷ E008C410 ❺ 08 ❻
; T0030 T0031 T0032 T0033 T0034 T0035 T0036 T0037 T0038 T0039
; T0040 T0041 T0042 T0043 T0044 T0045 ❹

;      F          1          8087          1 ❹
; 00000000 00000001 ❸ 00000000 00000000 00000000 00000000 00000000

RBD2>                                  ! RBD prompt returns; test completed.
RBD2> QUIT                              ! Exit RBD program.
>>>                                     ! Console prompt reappears.
```

The callouts in Example A-4 are explained below. (See also Example A-3 for explanation of other fields of the printout.)

- ❶ These T00nn fields appear only with the /TR qualifier; each entry corresponds to a test being run. The entry prints out as the test starts running. This T00nn number is the number of the failing test and is followed by a failure report. In this example, test 29 failed. The /HE qualifier was not used, so testing continues.
- ❷ F indicates failure of the previous test listed, test 29.

- ③ This field is the XMI node number of the boot processor executing the RBD. It matches the number in your RBD prompt.
- ④ This field is always 8087—the device type of the boot processor.
- ⑤ This field displays the total number of passes (in decimal) executed by the RBD. The default number of passes is 1.
- ⑥ The class of error is displayed here. *HE* indicates that the error was a hard error. *SE* means the error was a soft error, and *FE* indicates a fatal error. (See Section A.4 for a definition of these errors.)
- ⑦ This field describes the failing logic. Here, the branch prediction logic has failed.
- ⑧ This field is the unit number used in memory, multiprocessing, and DWMBB and DWMVA/A tests.
- ⑨ This field lists the number of the test that failed; test 29 failed here.
- ⑩ This is a two-digit (decimal) generic error code.
- ⑪ The expected data is listed here. 5555AAAA is the data test 29 expected.
- ⑫ The received data is listed here. A8AAAAAA is the data test 29 received.
- ⑬ This field shows any unexpected interrupt vectors.
- ⑭ This is the address in memory where the referenced error is found.
- ⑮ This is the address of the failing PC at the time of error.
- ⑯ This is the error number within the failing test. In this example, the failure was detected at failure point 8 in T0029. This is a decimal field.
- ⑰ This final T00*nn* number corresponds to the last test run.
- ⑱ This entire line is the summary line, and a repeat of the failure summary. It lists the pass/fail code (P or F), the node number and device type number of the boot processor executing the RBD, and the number of passes of the RBD.
- ⑲ This is the number of hard errors detected.

A.7 SUMMARY Command

The RBD monitor SUMMARY command displays a summary of the last diagnostic run.

Example A-5: SUMMARY Command

```
>>> T/R                                ! Command to enter RBD monitor program
RBD1> ST0/IE/IS/P=100                  ! Execute RBD 0 (CPU test), inhibiting
                                        ! error outputs and summary report.
; XNP_ST      1.00
RBD1> SU                                ! Request a summary.
; XNP_ST      1.00
;          P①      1②    8087③      100④
; 00000000 00000000 00000000 00000000 00000000 00000000 00000000⑤
RBD1>
```

The callouts in Example A-5 are explained below.

- ① This field indicates whether the RBD passed or failed; P for passed, F for failed.
- ② This field is the XMI node number of the boot processor executing the RBD. It will match the number in your RBD prompt, which also indicates the node number of your boot processor.
- ③ This field is always 8087, the device type number for the KA66A processor; in this case the boot processor.
- ④ This field displays the total number of passes executed by the RBD.
- ⑤ This line contains the summary of the RBD failures. Presently only the second and third fields are used. The second field contains the number of hard errors detected during the run. The third field contains the number of soft errors detected during the run.

A.8 Sample RBD Session

Examples A-6, A-7, and A-8 show a sample RBD session.

Example A-6: Sample RBD Session, Part 1 of 3

```
>>> T/R ①
RBD1> ST0/TR ②
;XNP_ST      1.00

; T0001 T0002 T0003 T0004 T0005 T0006 T0007 T0008 T0009 T0010
; T0011 T0012 T0013 T0014 T0015 T0016 T0017 T0018 T0019 T0020
; T0021 T0022 T0023 T0024 T0025 T0026 T0027 T0028 T0029 T0030
; T0031 T0032 T0033 T0034 T0035 T0036 T0037 T0038 T0039 T0040
; T0041 T0042 T0043 T0044 T0045

;          P          1      8087          1
;00000000 00000000 00000000 00000000 00000000 00000000 00000000

RBD1> ST1/TR/HE ③
;CPUMEM      1.00

; T0001 T0002 T0003 T0004 T0005 T0006 T0007 T0008 T0009 T0010
; T0011 T0012 T0013 T0014 T0015 T0016

;          P          1      8087          1
;00000000 00000000 00000000 00000000 00000000 00000000 00000000

RBD1> ST2/TR 5 ④
;XBI+_RBD    1.00

;          F          1      8087          1
;          HE NO_UNIT          XX      T0000
;          52 00000000 00000000 00000000 E1880000 E007AF8E 01

;          F          1      8087          1
;00000000 00000001 00000000 00000000 00000000 00000000 00000000
```

- ① Enter RBD mode from console mode. The RBD prompt appears and indicates you are operating from the boot processor at node 1.
- ② Run RBD 0 and trace the tests. The CPU test runs all 45 tests successfully.
- ③ Run RBD 1, trace it, and halt on the first hard error found. All CPU/memory interaction RBD tests run and pass.
- ④ Run RBD 2, testing the DWMBB at XMI node 5. The value NO_UNIT on the third line of output indicates that the node value of node 5 is not correct; no DWMBB was found at this node.

Example A-7: Sample RBD Session, Part 2 of 3

```
RBD1> ST2/TR/T=2:4/P=3 E5
;XBI+_RBD      1.00
; T0002 T0003 T0004 T0002 T0003 T0004 T0002 T0003 T0004
;          P          1      8087          3
;00000000 00000000 00000000 00000000 00000000 00000000 00000000
RBD1> ST3/TR/T=16
RBD1> ST3/TR/T=1
RBD1> ST3/TR/T=1 /C7
;XMA2_RBD      0.80
; T0001
;          P          1      8087          1
;00000000 00000000 00000000 00000000 00000000 00000000 00000000
RBD1> ST4/TR/T=18
;XNP_BC        1.00
; T0001
;          P          1      8087          1
;00000000 00000000 00000000 00000000 00000000 00000000 00000000
RBD1> ST5/TR9
;XNP_MP        1.00
; T0001 T0002 T0003 T0004 T0005 T0006 T0007
;          P          1      8087          1
;00000000 00000000 00000000 00000000 00000000 00000000 00000000
RBD1> QUIT10
      [power-up test results may be displayed here]
```

- ⑤ Run RBD 2, testing the DWMBB at XMI node E; trace the tests as they run, and run tests 2 through 4 of RBD 2; make 3 passes over these selected tests.

Note that the *T00nn* line lists each of the three tests three times, since the */P=3* called for 3 passes of the tests. And the final parameter in the summary line is a 3, indicating that 3 passes completed.

- ⑥ Run RBD 3, trace it, and run only test 1 of this RBD. This test is one of the memory tests that is not part of the default suite of tests. This test corrupts memory. You must add a */C* qualifier to the *START* command, to indicate that you do indeed intend to run this destructive test.

The */C* qualifier was not given in this example. The command line is echoed, waiting for */C* to be typed.

At this point you can press Return to return to the command prompt (RBD1>), or you can type the */C* qualifier followed by Return.

- ⑦ Run RBD 3, trace the tests as they run, run only test 1, and */C* allows the test to run. In this example, the test completed with no errors.
- ⑧ Run RBD 4, test 1, with trace set.
- ⑨ Run RBD 5 and trace the tests. All tests pass.
- ⑩ Exit from RBD mode and enter console mode. The console prompt is usually returned in response to the *RBD QUIT* command; however, when tests that cause parity errors are run, the response to *QUIT* is a system reset. The power-up test is then run, and the results are printed. The tests that cause a system reset are tests 1, 2, and 4 of RBD 1; tests 2, 3, 4, 30, and 31 of RBD 2; and tests 5 and 9 of RBD 3.

Example A-8: Sample RBD Session, Part 3 of 3

```
>>> SET CPU 211
>>> T/R

RBD2> ST0/TR12
;XNP_ST      1.00

; T0001 T0002 T0003 T0004 T0005 T0006 T0007 T0008 T0009 T0010
; T0011 T0012 T0013 T0014 T0015 T0016 T0017 T0018 T0019 T0020
; T0021 T0022 T0023 T0024 T0025 T0026 T0027 T0028 T0029 T0030
; T0031 T0032 T0033 T0034 T0035 T0036 T0037 T0038 T0039 T0040
; T0041 T0042 T0043 T0044 T0045

;          P          1          8087          1
;00000000 00000000 00000000 00000000 00000000 00000000 00000000
```

- ⑪ Make another processor the primary processor so that RBD 0 can be run on it.
- ⑫ Run RBD 0 and trace the tests. All 45 tests run successfully.

A.9 Running ROM-Based Diagnostics on I/O Devices

Some XMI and VAXBI devices can be tested from the console terminal with their on-board ROM-based diagnostics. The Z console command is used to send commands to these nodes.

Example A-9: Running RBDs on I/O Devices

```
>>> SHOW CONFIGURATION1
      Type          Rev
1+ KA66A (8087) 0006
2+ KA66A (8087) 0006
4+ MS65A (4001) 0084
8+ MS65A (4001) 0084
D+ DEMNA (0C03) 0601
E+ DWMBB/A (2002) 0001

XBI E
1+ DWMBB/B (210F) 000A
4+ KDB50 (010E) 132E
6+ TBK70 (410B) 0307
8+ CIBCA-B (0108) 41C2
>>> Z D2
?0033 Z connection successfully started
T/R3

RBDD> ST0/TR4

;Selftest      3.00

; T0001 T0002 T0003 T0004 T0005 T0006 T0007 T0008 T0009 T0010
; T0011 T0012 T0013 T0014 T0015 T0016 T0017 T0018

;          P          D          0C03          1
;00000000 00000000 00000000 00000000 00000000 00000000 00000000

RBDD> QUIT5
^P
?0031 Z connection terminated by ^P

>>> Z/BI:6 E6
?0033 Z connection successfully started

T/R

RBDD6> ST 0/TR7

;T1035_St      1.00
```

Example A-9 Cont'd on next page

Example A-9 (Cont.): Running RBDs on I/O Devices

```
; T01 T02 T03 T04 T05 T06 T07 T08 T09 T10 T11 T12 T13 T14
; T15 T16 T17

;      P      6      410B 00000001
;00000000 00000000 00000000 00000000 00000000 00000000 00000000

;  PUDR: 5FF43FDF8

RBD6> QUIT
^P
?0031 Z connection terminated by ^P

>>>
```

The callouts in Example A-9 are explained below.

- ① The SHOW CONFIGURATION console command shows that this system includes a DEMNA at node D of the XMI bus and a TBK70 at node 6 of the VAXBI attached at XMI node E. (See *VAX 6000 Series Owner's Manual* for more information on the SHOW CONFIGURATION command.)
- ② The Z command is typed at the console prompt. A connection is established to XMI node D. The console returns a message confirming that the connection has been made.
- ③ After the console message is returned in ②, no prompt is printed. Typing T/R invokes the RBD monitor on the adapter being tested and returns the RBD monitor prompt. Note that the D in the RBD prompt refers to the XMI node.
- ④ The RBD is started with trace set.
- ⑤ The QUIT command exits the RBD monitor. The Z connection remains until CTRL/P is entered.
- ⑥ Steps ② through ⑤ are repeated to run the RBD of the TBK70 at node 6 of the VAXBI attached at XMI node E.
- ⑦ The START command for VAXBI RBDs requires a space before the 0. When run with the /TR qualifier, test traces are printed.
- ⑧ The last line of the summary report indicates the contents of the Power-Up Diagnostic Register. To interpret the contents of this register, refer to the technical manual for the device being tested.

Appendix B

Console Error Messages

Table B-1 lists messages that appear when the processor halts and the console gains control. Most messages are followed by:

- PC = xxxxxxxx — program counter = address at which the processor halted or the exception occurred
- PSL = xxxxxxxx — processor status longword = contents of the register
- -SP = xxxxxxxx — -SP is one of the following:
 - ESP executive stack pointer
 - ISP interrupt stack pointer
 - KSP kernel stack pointer
 - SSP supervisor stack pointer
 - USP user stack pointer

Table B-2 lists other console error messages.

Table B-1: Console Error Messages Indicating Halt

Error Message	Meaning
?0002 External halt (CTRL/P, break, or external halt).	CTRL/P or STOP command.
?0003 Power-up halt.	System has powered up, had a system reset, or an XMI node reset.
?0004 Interrupt stack not valid during exception processing.	Interrupt stack pointer contained an invalid address.
?0005 Machine check occurred during exception processing.	A machine check occurred while handling another error condition.
?0006 Halt instruction executed in kernel mode.	The CPU executed a Halt instruction.

Table B-1 (Cont.): Console Error Messages Indicating Halt

Error Message	Meaning
?0007 SCB vector bits <1:0> = 11.	An interrupt or exception vector in the System Control Block contained an invalid address.
?0008 SCB vector bits <1:0> = 10.	An interrupt or exception vector in the System Control Block contained an invalid address.
?000A CHMx executed while on interrupt stack.	A change-mode instruction was issued while executing on the interrupt stack.
?0010 ACV/TNV occurred during machine check processing.	An access violation or translation-not-valid error occurred while handling another error condition.
?0011 ACV/TNV occurred during kernel-stack-not-valid processing.	An access violation or translation-not-valid error occurred while handling another error condition.
?0012 Machine check occurred during machine check processing.	A machine check occurred while processing a machine check.
?0013 Machine check occurred during kernel-stack-not-valid processing.	A machine check occurred while handling another error condition.
?0019 PSL <26:24>= 101 during interrupt or exception.	An exception or interrupt occurred while on the interrupt stack but not in kernel mode.
?001A PSL <26:24>= 110 during interrupt or exception.	An exception or interrupt occurred while on the interrupt stack but not in kernel mode.
?001B PSL <26:24>= 111 during interrupt or exception.	An exception or interrupt occurred while on the interrupt stack but not in kernel mode.
?001D PSL <26:24> = 101 during REI.	An REI instruction attempted to restore a PSL with an invalid combination of access mode and interrupt stack bits.
?001E PSL <26:24> = 110 during REI.	An REI instruction attempted to restore a PSL with an invalid combination of access mode and interrupt stack bits.
?001F PSL <26:24> = 111 during REI.	An REI instruction attempted to restore a PSL with an invalid combination of access mode and interrupt stack bits.

Table B–2: Standard Console Error Messages

Error Message	Meaning
?0020 Illegal memory reference.	An attempt was made to reference a virtual address (V) that is either unmapped or is protected against access under the current PSL.
?0021 Illegal command.	The command was not recognized, contained the wrong number of parameters, or contained unrecognized or inappropriate qualifiers.
?0022 Illegal address.	The specified address was recognized as being invalid, for example, a general purpose register number greater than 15.
?0023 Value is too large.	A parameter or qualifier value contained too many digits.
?0024 Conflicting qualifiers.	A command specified recognized qualifiers that are illegal in combination.
?0025 Checksum did not match.	The checksum calculated for a block of X command data did not match the checksum received.
?0026 Halted.	The processor is currently halted.
?0027 Item was not found.	The item requested in a FIND command could not be found.
?0028 Timeout while waiting for characters.	The X command failed to receive a full block of data within the timeout period.
?0029 Machine check accessing memory.	Either the specified address is not implemented by any hardware in the system, or an attempt was made to write a read-only address, for example, the address of the 33rd Mbyte of memory on a 32-Mbyte system.
?002A Unexpected machine check or interrupt.	A valid operation within the console caused a machine check or interrupt.
?002B Command is not implemented.	The command is not implemented by this console.
?002C Unexpected exception.	An attempt was made to examine either a nonexistent IPR or an unimplemented register in RSSC address range (20140000—20140800).

Table B-2 (Cont.): Standard Console Error Messages

Error Message	Meaning
?002D For Secondary Processor <i>n</i> .	This message is a preface to second message describing some error related to a secondary processor. This message indicates which secondary processor is involved.
?002E Specified node is not an I/O adapter.	The referenced node is incapable of performing I/O or did not pass its self-test.
?0030 Write to Z command target has timed out.	The target node of the Z command is not responding.
?0031 Z connection terminated by ^P.	A CTRL/P was typed on the keyboard to terminate a Z command.
?0032 Your node is already part of a Z connection.	You cannot issue a Z command while executing a Z command.
?0033 Z connection successfully started.	You have requested a Z connection to a valid node.
?0034 Specified target already has a Z connection.	The target node was the target of a previous Z connection that was improperly terminated. Reset the system to clear this condition.
?0036 Command too long.	The command length exceeds 80 characters.
?0037 Bad explicit interleave list — configuring all arrays uninterleaved.	The list of memory arrays for explicit interleave includes no nodes that are actually memory arrays. All arrays found in the system are configured.
?0039 Console patches are not usable.	The console patch area in EEPROM is corrupted or contains a patch revision that is incompatible with the console ROM.
?003B Error encountered during I/O operation.	An I/O adapter returned an error status while the console boot primitive was performing I/O.
?003C Secondary processor not in console mode.	The primary processor console needed to communicate with a secondary processor, but the secondary processor was not in console mode. STOP the node or reset the system to clear this condition.

Table B-2 (Cont.): Standard Console Error Messages

Error Message	Meaning
?003D Error initializing I/O device.	A console boot primitive needed to perform I/O, but could not initialize the I/O adapter.
?003E Timeout while sending message to secondary processor.	A secondary processor failed to respond to a message sent from the primary. The primary sends such messages to perform console functions on secondary processors.
?0040 Key switch must be at "Update" to update EEPROM.	A SET command was issued, but the key switch was not set to allow updates to the EEPROM.
?0041 Specified node is not a bus adapter.	A command to access a VAXBI node specified an XMI node that was not a bus adapter.
?0042 Invalid terminal speed.	The SET TERMINAL command specified an unsupported baud rate.
?0043 Unable to initialize node.	The INITIALIZE command failed to reset the specified node.
?0044 Processor is not enabled to BOOT or START.	As a result of a SET CPU/NOENABLE command, the processor is disabled from leaving console mode.
?0045 Unable to stop node.	The STOP command failed to halt the specified node.
?0046 Memory interleave set is inconsistent: <i>n n ...</i>	The listed nodes do not form a valid memory interleave set. One or more of the nodes might not be a memory array or might be of a different size, or the set could contain an invalid number of members. Each listed array that is a valid memory will be configured uninterleaved.
?0047 Insufficient working memory for normal operation.	Less than 256 Kbytes per processor of working memory were found. There is insufficient memory for the console to function normally or for the operating system to boot.
?0049 Memory cannot be initialized.	The specified operation was attempted and prevented.

Table B-2 (Cont.): Standard Console Error Messages

Error Message	Meaning
?004A Memories not interleaved due to uncorrectable errors:	The listed arrays would normally have been interleaved (by default or explicit request). Because one or more of them contained unrecoverable errors, this interleave set will not be constructed.
?004B Internal logic error in console.	The console encountered a theoretically impossible condition.
?004C Invalid node for Z command.	The target of a Z command must be a CPU or an I/O adapter and must not be the primary processor.
?004D Invalid node for new primary.	The SET CPU command failed when attempting to make the specified node the primary processor.
?004E Specified node is not a processor.	The specified node is not a processor, as required by the command.
?004F System serial number has not been initialized.	No CPU in the system contains a valid system serial number.
?0050 System serial number not initialized on primary processor.	The primary processor has an uninitialized system serial number. All other processors in the system contain a valid serial number.
?0051 Secondary processor returned bad response message.	A secondary processor returned an unintelligible response to a request made by the console on the primary processor.
?0052 ROM revision mismatch. Secondary processor has revision <i>x.xx</i> .	The revision of console ROM of a secondary processor does not match that of the primary.
?0053 EEPROM header is corrupted.	The EEPROM header has been corrupted. The EEPROM must be restored from the TK tape drive.
?0054 EEPROM revision mismatch. Secondary processor has revision <i>x.xx/y.yy</i> .	A secondary processor has a different revision of EEPROM or has a different set of EEPROM patches installed.
?0055 Failed to locate EEPROM area.	The EEPROM did not contain a set of data required by the console. The EEPROM may be corrupted.

Table B-2 (Cont.): Standard Console Error Messages

Error Message	Meaning
?0056 Console parameters on secondary processor do not match primary.	The console parameters are not the same for all processors .
?0057 EEPROM area checksum error.	A portion of the EEPROM is corrupted. It may be necessary to reload the EEPROM from the TK tape drive.
?0058 Saved boot specifications on secondary processor do not match primary.	The saved boot specifications are not the same for all processors.
?0059 Invalid unit number.	A BOOT or SET BOOT command specified a unit number that is not a valid hexadecimal number between 0 and FF.
?005A System serial number mismatch. Secondary processor has xxxxxxxx.	The indicated serial number of a secondary processor does not match that of the primary.
?005B Unknown type of boot device.	The console program does not have a boot primitive to support the specified type of device or the device could not be accessed to determine its type.
?005C No HELP is available.	The HELP command is not supported when the console language is set to International.
?005D No such boot spec found.	The specified boot specification was not found in the EEPROM.
?005E Saved boot spec table full.	The maximum number of saved boot specifications has already been stored.
?005F EEPROM header version mismatch.	Processors have different versions of EEPROMs.
?0061 EEPROM header or area has bad format.	All or part of the EEPROM contains inconsistent data and is probably corrupted. Reload the EEPROM from the TK tape.
?0062 Illegal node number.	The specified node number is invalid.
?0063 Unable to locate console tape device.	The console could not locate the I/O adapter that controls the TK tape.
?0064 Operation only applies to secondary processors.	The command can only be directed at a secondary processor.
?0065 Operation not allowed from secondary processor.	A secondary processor cannot perform this operation.

Table B-2 (Cont.): Standard Console Error Messages

Error Message	Meaning
?0066 Validation of EEPROM tape image failed.	The image on tape is corrupted or is not the result of a SAVE EEPROM command. The image cannot be restored.
?0067 Read of EEPROM image from tape failed.	The EEPROM image was not successfully read from tape.
?0068 Validation of local EEPROM failed.	For a PATCH EEPROM operation, the EEPROM must first contain a valid image before it can be patched. For a RESTORE EEPROM operation, the image was written back to EEPROM but could not be read back successfully.
?0069 EEPROM not changed.	The EEPROM contents were not changed.
?006A EEPROM changed successfully.	The EEPROM contents were successfully patched or restored.
?006B Error changing EEPROM.	An error occurred in writing to the EEPROM. The EEPROM contents may be corrupted.
?006C EEPROM saved to tape successfully.	The EEPROM contents were successfully written to the TK tape.
?006D EEPROM not saved to tape.	The EEPROM contents were not completely written to the TK tape.
?006E EEPROM Revision = <i>x.xx/y.yy</i> .	The EEPROM contents are at revision <i>x.xx</i> with revision <i>y.yy</i> patches.
?006F Major revision mismatch between tape image and EEPROM.	The major revision of tape and EEPROM do not match. The requested operation cannot be performed.
?0070 Tape image Revision = <i>x.xx/y.yy</i> .	The EEPROM image on the TK tape is at revision <i>x.xx</i> with revision <i>y.yy</i> patches.
?0073 System serial number updated.	The EEPROM has been updated with the correct system serial number.
?0074 System serial number not updated.	The EEPROM has not been changed.
?0075 /CONSOLE_LIMIT value too small for proper operation. Value ignored.	No change has been made.
?0076 Error writing to tape. Tape may be write-locked.	Tape has not been written. Check to see if tape is write-locked.

Table B–2 (Cont.): Standard Console Error Messages

Error Message	Meaning
?0077 CCA not accessible or corrupted.	Attempt to find the console communications area (CCA) failed. The console then builds a local CCA, which does not allow for interprocessor communication.
?007C I/O adapter configuration error at node <i>n</i>	The I/O adapter at node <i>n</i> is configured improperly.
?0083 Loading system software. ¹	The console is attempting to load the operating system in response to a BOOT command, power-up, or restart failure.
?0084 Failure. ¹	An operation did not complete successfully. Should be issued with another message to clarify failure.
?0085 Restarting system software. ¹	The console is attempting to restart the in-memory copy of the operating system following a power-up or serious error.
?00A0 Initializing system. ¹	The console is resetting the system in response to a BOOT command.
?00A1 Now updating the EEPROM of node <i>n</i> ¹	The console is updating the EEPROM.
?00A6 Console halting after unexpected machine check or exception. ¹	The console executed a Halt instruction to reset the console state after processing an unexpected machine check.
?00A7 RCSR <WD> is set. Local CCA must be built. ¹	When the <WD> bit is set, writes to memory are disabled.
?00A8 Bootstrap failed due to previous error. ¹	The previous attempt to bootstrap the system failed.
?00A9 Restart failed due to previous error. ¹	The previous attempt to restart the system failed.
Node <i>n</i> : ? <i>xxxx</i>	Error message ? <i>xxxx</i> was generated on secondary processor <i>n</i> and was passed to the primary processor to be displayed.
?0104 Filename format error.	Period and semicolon characters are improperly used within the filename specified for a MOP boot.

¹No numbered prefix appears with these messages in English language mode. These numbers are used for these messages in International mode.

Table B-2 (Cont.): Standard Console Error Messages

Error Message	Meaning
?0105 Illegal character(s) in filename.	For filename specified in a MOP boot.
?0106 Filename cannot contain nested blanks or tabs.	For filename specified in a MOP boot.
?0107 Filename can be no longer than 16 characters.	For filename specified in a MOP boot.
?011E Uncorrectable memory errors discovered - long memory test must be performed on node <i>n</i>	Memory array in node <i>n</i> contains an uncorrectable error. The console must perform a full test to locate all the failing locations.
?0120 Unsupported memory module found, will not be configured.	One or more MS62A memory modules are installed but will not be used. Only MS65A memory modules are compatible with Model 500 and higher.
?0121 Patch command no longer implemented—use the diagnostic utility EVUCA.	An invalid PATCH command was issued; use the EVUCA program to update the EEPROM.
?0201 One or more power-up tests have been bypassed.	A test normally run by the processor at power-up has been bypassed.
?0203 Hardware compatibility group mismatch—secondary/primary: <i>x/y</i> .	Hardware version mismatch between the primary CPU and an indicated secondary CPU.
?0205 Error locating ROM boot code, run diagnostics.	The console had a problem reading the CPU's ROM code.
?0206 EEPROM in error or contains unsupported PCS, processor disabled.	The EEPROM image is the wrong version or is faulty. Use the EVUCA program to upgrade the EEPROM for the indicated CPU.

Appendix C

Boot Status and Error Messages

This appendix lists status and error messages for Ethernet boots, local disk and tape boots, and cluster boots. Status messages are shown in the order they would appear after the boot command is issued. Listed after each status message are the error messages that could appear during each boot subprocess.

C.1 Ethernet Boot Messages

1. [Start boot]
 - ?002E Specified node is not an I/O adapter
 - ?0100 Specified adapter failed self-test
 - ?010B Illegal adapter specified for NI boot
2. * Initializing adapter
 - ?0119 Failure to initialize specified adapter
3. * Specified adapter initialized successfully
4. * "Request Program" MOP message sent—waiting for service from remote node
 - ?0113 No traffic was detected on the Ethernet—aborting boot procedure
 - ?0115 Aborting boot process—adapter failed attempting to execute port command
 - ?011F Aborting boot process—adapter failed attempting to execute boot command
5. * Still waiting for assistance—reissuing "Request Program" message
6. * Remote service link established
7. * Reading boot image from remote node
 - ?010F Failed to receive image from remote server
8. * Passing control to transfer address

C.2 Local Disk Boot Messages

1. [Start Boot]
 - ?002E Specified node is not an I/O adapter
 - ?0100 Specified adapter failed self-test
 - ?010A Illegal adapter specified for disk boot
2. * Initializing adapter
 - ?0119 Failure to initialize specified adapter
3. * Specified adapter initialized successfully
4. * Connecting to boot disk *or*
 - * Reading bootblock from disk
 - ?0102 Controller error detected—aborting
 - ?0103 Drive error detected—aborting
 - ?010E Specified unit offline — No media mounted or disabled via RUN/STOP switch setting
 - ?0114 Serious exception reported—aborting
 - ?0116 Specified unit is inoperative
 - ?0117 Specified unit offline
 - ?0118 Specified unit offline—Unit unknown, online to another controller or port disabled via A,B switches
5. * Passing control to transfer address

C.3 Local Tape Boot Messages

1. [Start boot]
 - ?002E Specified node is not an I/O adapter
 - ?0100 Specified adapter failed self-test
 - ?010C Illegal adapter specified for tape use
2. * Initializing adapter
 - ?0119 Failure to initialize specified adapter
3. * Specified adapter initialized successfully
4. * Connecting to tape *or*
 - * Reading bootblock from tape *or*
 - * Rewinding tape
 - ?0101 BVP port error reported—aborting
 - ?0102 Controller error detected—aborting
 - ?0103 Drive error detected—aborting

?010E Specified unit offline—No media mounted or disabled via RUN/STOP switch setting
?0114 Serious exception reported—aborting
?0116 Specified unit is inoperative
?0117 Specified unit offline
?0118 Specified unit offline—Unit unknown, online to another controller or port disabled via A,B switches

5. * Passing control to transfer address

C.4 CI and DSSI Boot Messages

1. [Start boot]
 - ?002E Specified node is not an I/O adapter
 - ?0109 Illegal adapter specified for CI boot
 - ?011A Illegal adapter specified for DSSI boot
2. * Initializing adapter
 - ?0119 Failure to initialize specified adapter
3. * Specified adapter initialized successfully
4. * Connecting to storage controller
5. * Previous operation failed—retrying CI boot
6. * Previous operation failed—retrying DSSI boot
7. * Port received a "no path" error—retrying the init sequence
 - ?0110 Port received a "no path" error after 6 retries—aborting the boot process
8. * Connecting to MSCP server layer
9. * Previous operation failed—retrying CI boot
10. * Connecting to boot disk *or*
 - * Connecting to shadow unit—will fail over to physical after 6 attempts.
 - ?0102 Controller error detected—aborting
 - ?0103 Drive error detected—aborting
 - ?010E Specified unit offline—No media mounted or disabled via RUN/STOP switch setting
 - ?0114 Serious exception reported—aborting
 - ?0116 Specified unit is inoperative
 - ?0117 Specified unit offline

- ?0118 Specified unit offline—Unit unknown, online to another controller or port disabled via A,B switches
- 11. * Failure to connect to shadow unit—retrying on physical unit
- 12. * Reading bootblock from disk
 - ?0102 Controller error detected—aborting
 - ?0103 Drive error detected—aborting
 - ?010E Specified unit offline—No media mounted or disabled via RUN/STOP switch setting
 - ?0114 Serious exception reported—aborting
 - ?0116 Specified unit is inoperative
 - ?0117 Specified unit offline
 - ?0118 Specified unit offline—Unit unknown, online to another controller or port disabled via A,B switches
- 13. * Passing control to transfer address

Appendix D

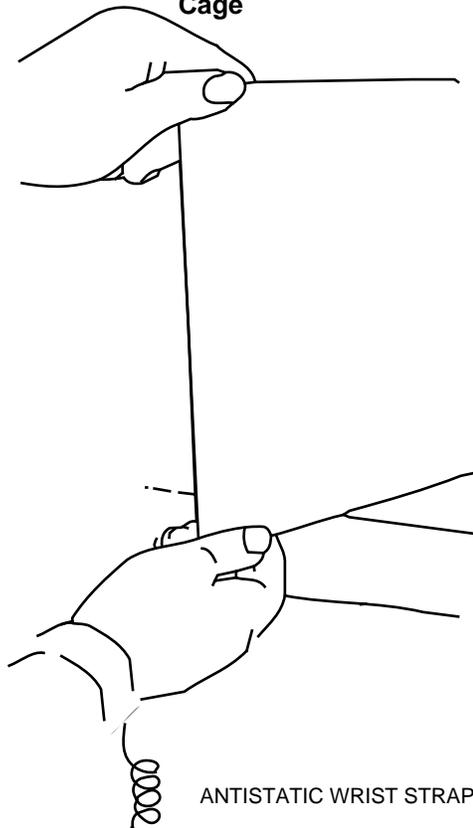
Handling Modules

This appendix tells how to handle a module so as not to damage the components on the module.

D.1 Module Handling

Use an antistatic wrist strap and take as much care as possible to not touch components when handling the processor, memory, and I/O modules.

Figure D-1: Inserting and Removing Modules to and from the XMI Card Cage



msb-0762B-91

To insert or remove modules in the XMI card cage:

1. **Always** wear an antistatic wrist strap.
2. Raise the XMI card cage lever on the appropriate slot and make sure it is set firmly in the up position.
3. Do not let any module touch other modules or cables when you are putting it in or taking it out of the XMI card cage.

When you swap out an old module, you can temporarily place it in an unused XMI slot, if one is available, or put it in an ESD box or on an ESD mat before you install the new module.

CAUTION: *If you temporarily leave a module in an unused XMI slot, be sure to remove the module before powering up the system.*

If you put the module on an ESD mat, make sure the mat is on a stable, uncluttered surface. Do not put it on the top of the system cabinet. And never slide the module across any surface.

4. Before removing the new module from its ESD box, place the box on a clean, stable surface.
5. To remove a module from the ESD box, grasp it firmly by the back corners, lift it and rotate it to vertical, and insert it in the slot in the XMI card cage, as shown in Figure D-1.
6. Make sure that the module is seated firmly in the XMI slot and engaged with the XMI backplane. Then lower the lever to close the connector.

Appendix E

VAX 6000 Model 600 Configuration Rules

This appendix gives general configuration rules for the installation of VAX 6000 Model 600 modules. It does not include rules for systems using the H9657-CX upgrade. See the manual *VAX 6000: Installing Model 600 Processors* for configuration rules for systems using the H9657-CX kit.

E.1 Configuration Rules

Figure E-1 gives the general XMI configuration rules for VAX 6000 Model 600 systems.

Figure E-1: Configuration Rules for VAX 6000 Model 600 Systems

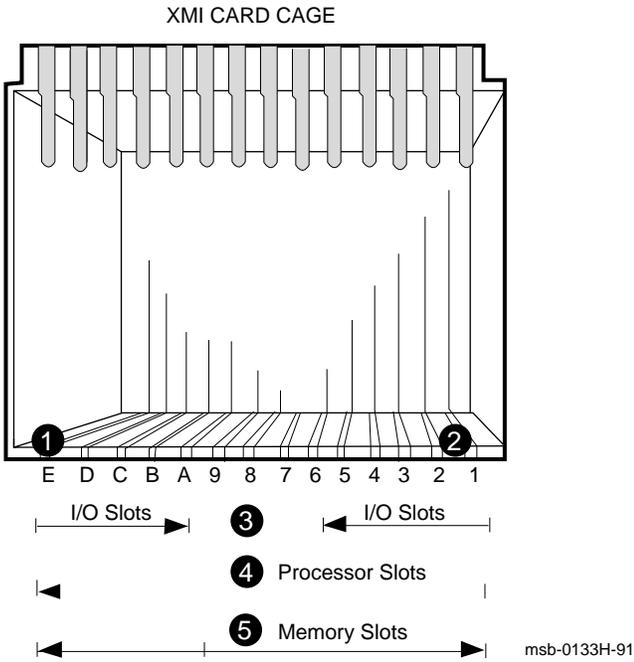


Figure E-1 gives an overview of the general rules for installing modules in the XMI card cage.

- ① ② An XMI module must be in either slot E or slot 1 for electrical reasons (to provide XMI termination). See Figure E-1, at callouts ① and ②. Note that the KDM70 adapter cannot be in slots D and E if slot 1 is empty, because the T2023 module of the KDM70 does not provide XMI termination.
- ③ I/O adapters should be configured first, from left to right, in I/O slots E through A and then in slots 1 through 5.
- ④ Processors should be configured next. Start with the rightmost available slot and continue right to left, installing each processor in the next available slot.
- ⑤ Memories are installed last. Fill available slots from left to right, slots 9 through 1, and then right to left, slots A through E.

Appendix F

Parse Trees

This appendix shows parse trees for the following:

- KA66A Machine Checks
- KA66A Hard Error Interrupts
- KA66A Soft Error Interrupts

Figure F-1: Parse Tree for Machine Check Exceptions

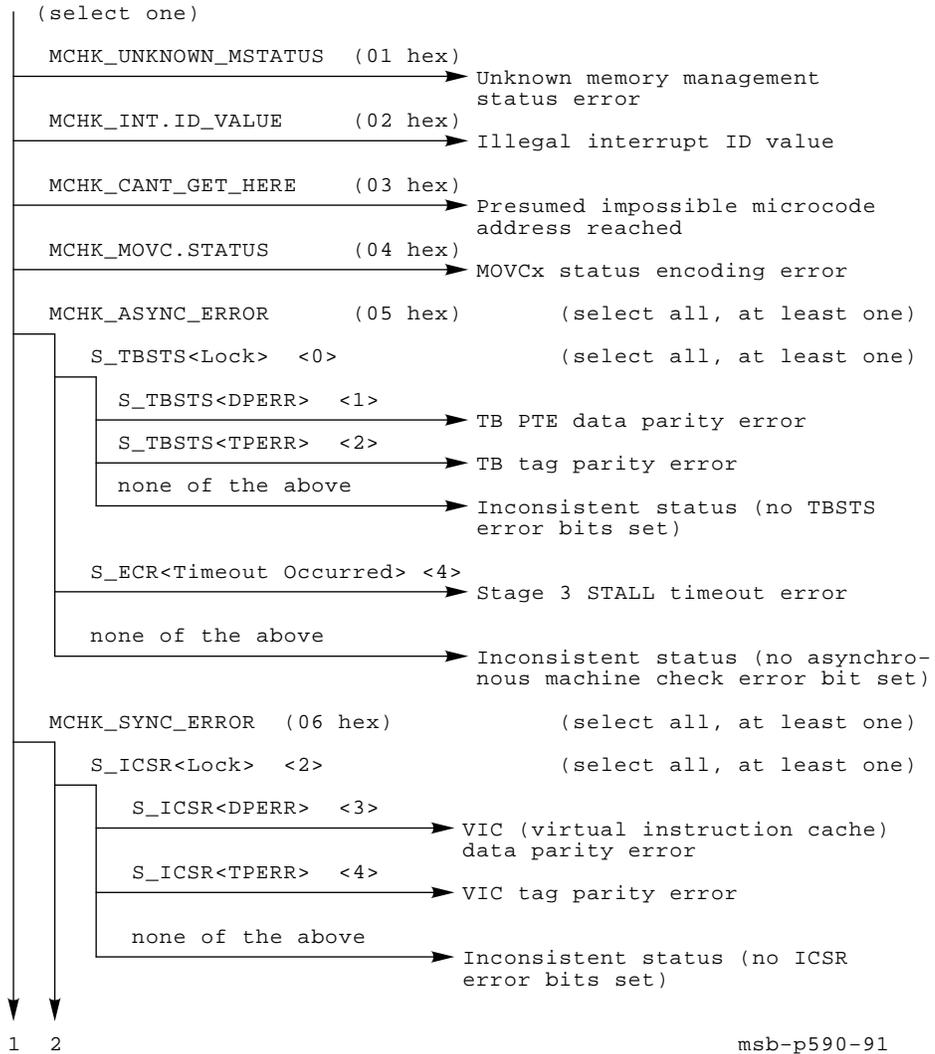


Figure F-1 Cont'd on next page

Figure F-1 (Cont.): Parse Tree for Machine Check Exceptions

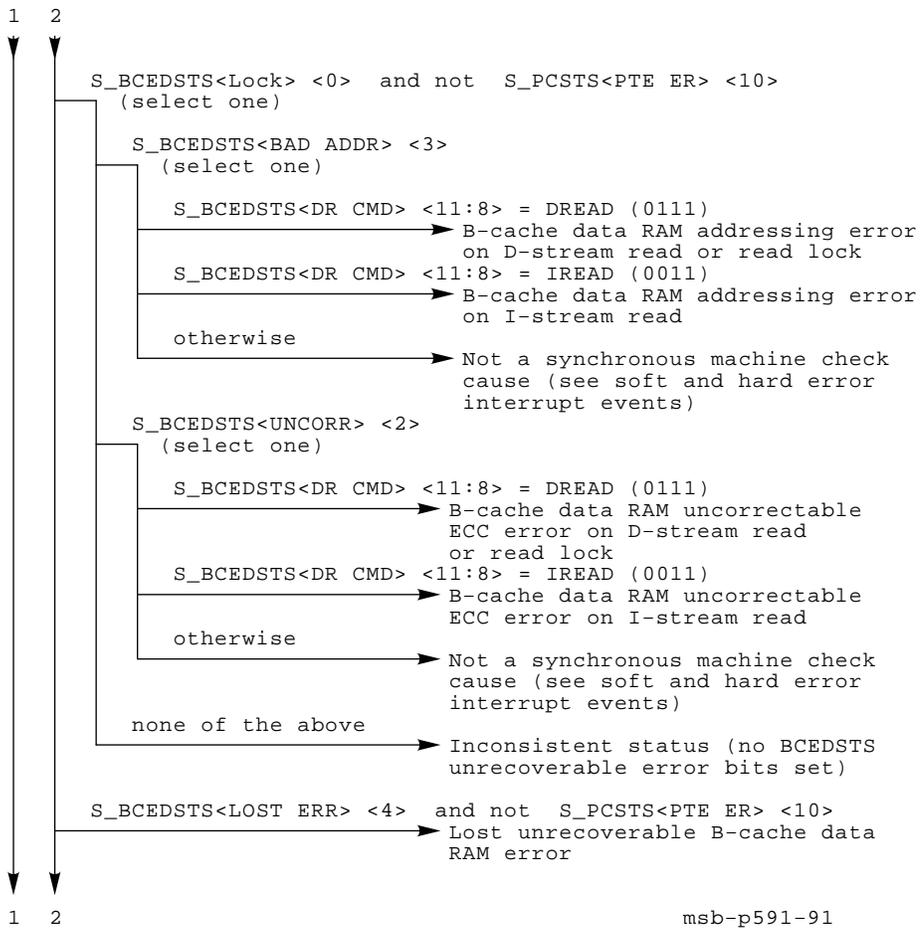


Figure F-1 Cont'd on next page

Figure F-1 (Cont.): Parse Tree for Machine Check Exceptions

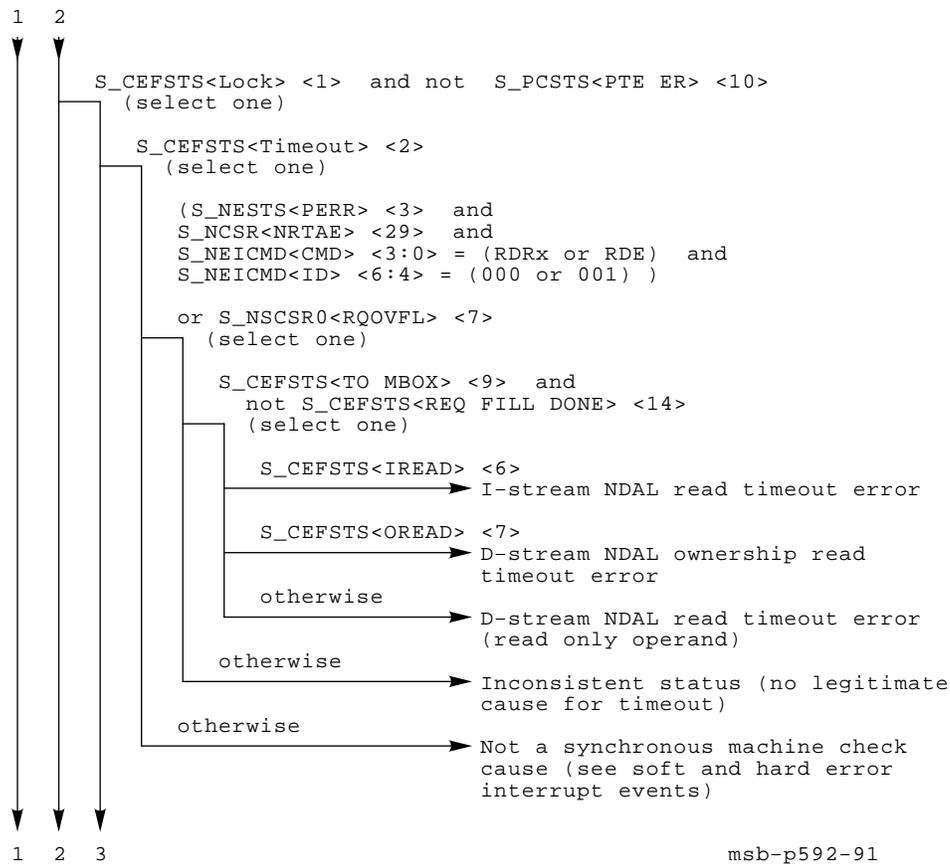


Figure F-1 Cont'd on next page

Figure F-1 (Cont.): Parse Tree for Machine Check Exceptions

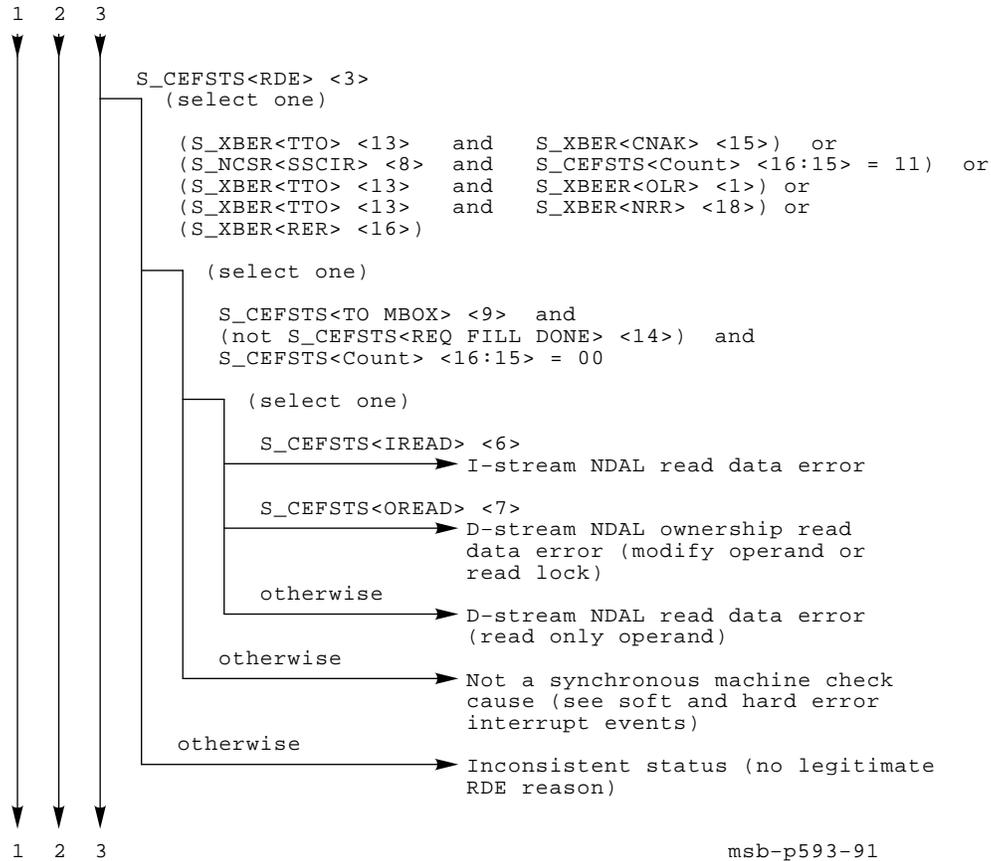


Figure F-1 Cont'd on next page

Figure F-1 (Cont.): Parse Tree for Machine Check Exceptions



Figure F-1 Cont'd on next page

Figure F-1 (Cont.): Parse Tree for Machine Check Exceptions

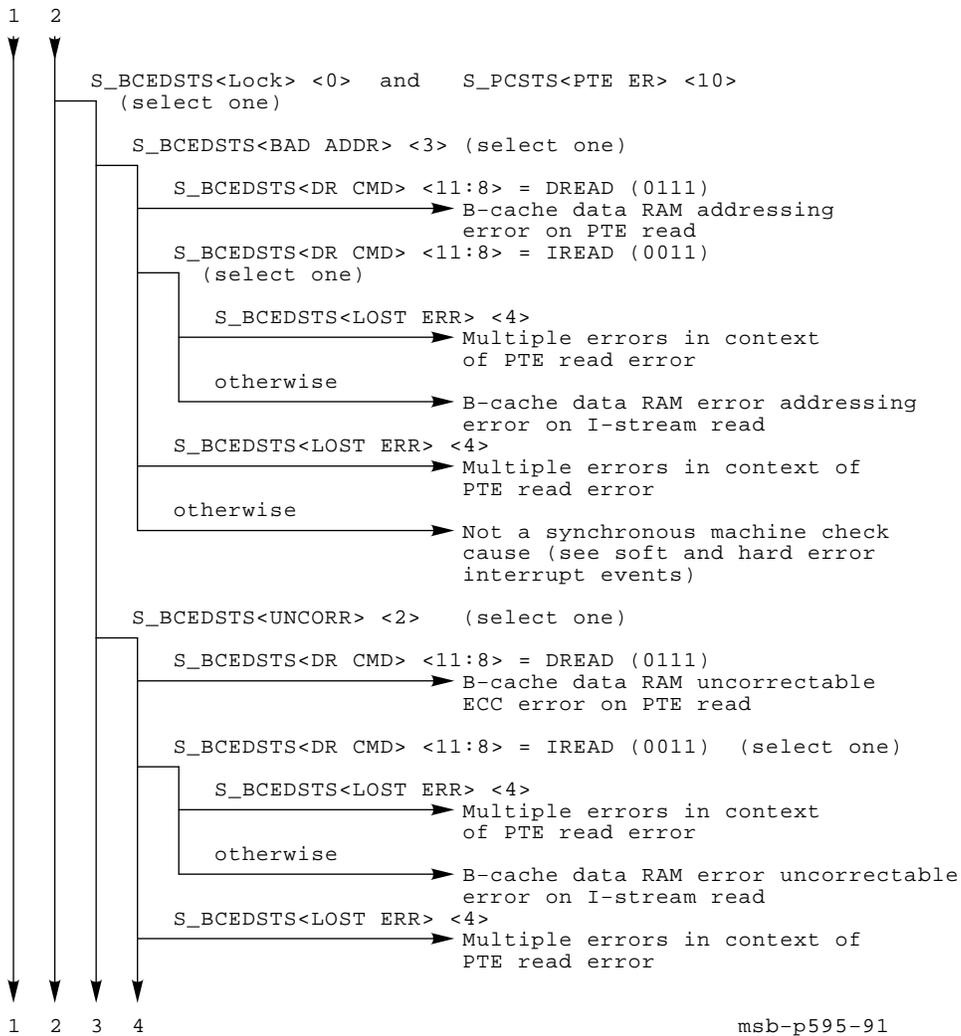


Figure F-1 Cont'd on next page

Figure F-1 (Cont.): Parse Tree for Machine Check Exceptions

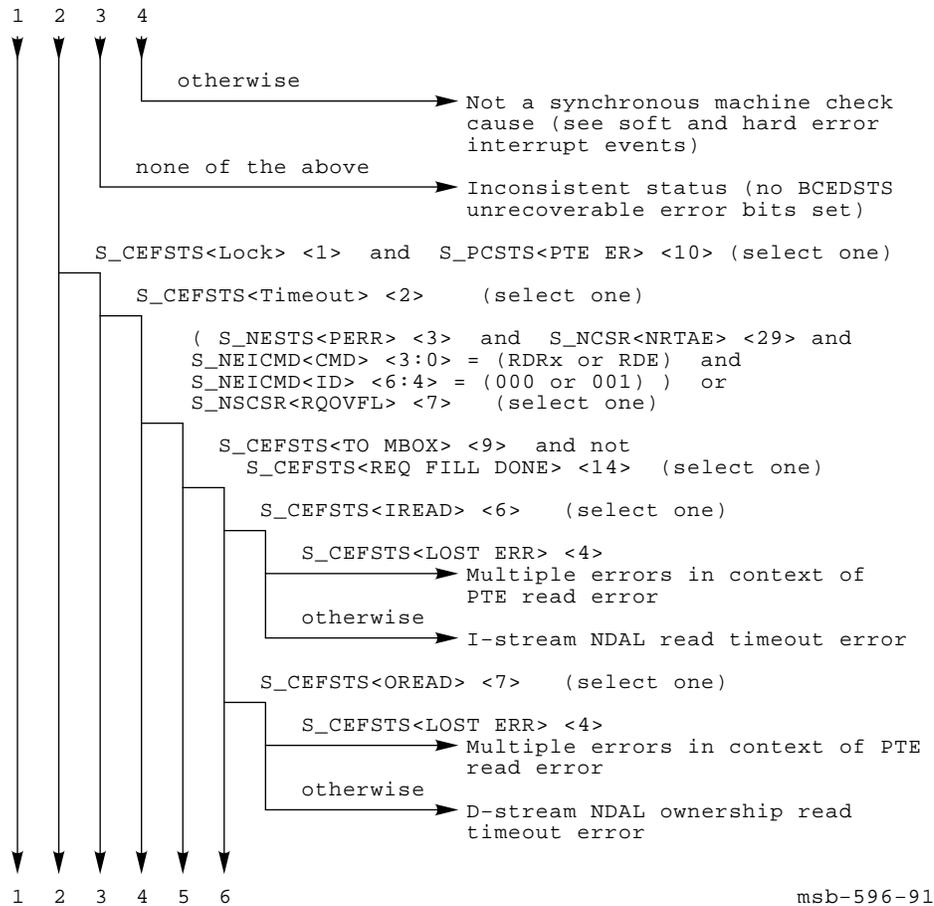


Figure F-1 Cont'd on next page

Figure F-1 (Cont.): Parse Tree for Machine Check Exceptions

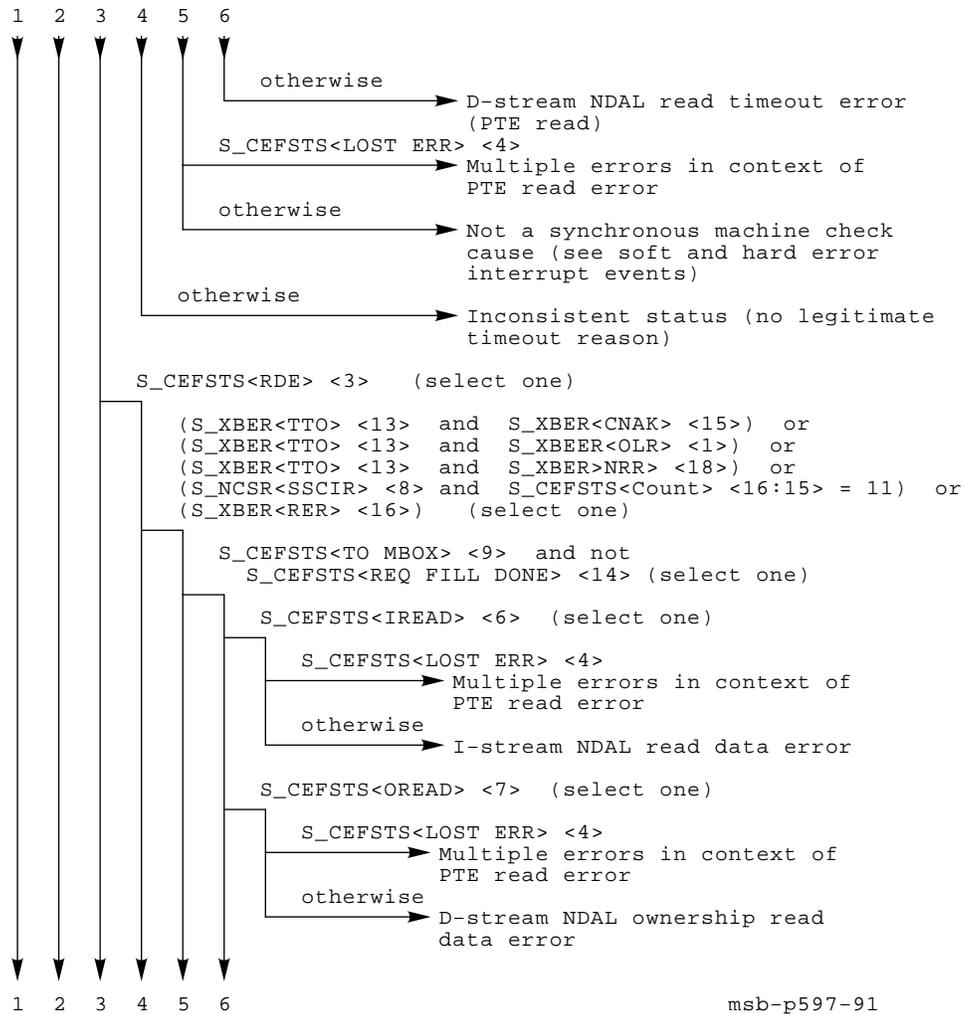


Figure F-1 Cont'd on next page

Figure F-1 (Cont.): Parse Tree for Machine Check Exceptions

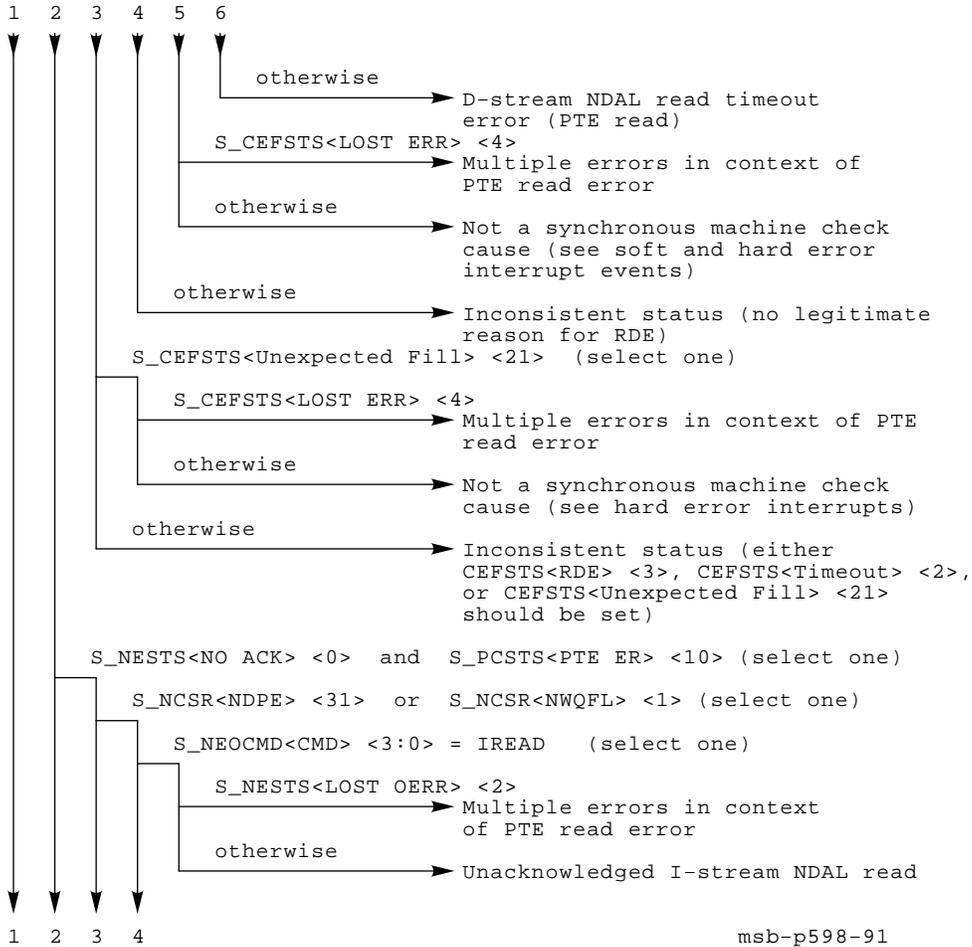


Figure F-1 Cont'd on next page

Figure F-1 (Cont.): Parse Tree for Machine Check Exceptions

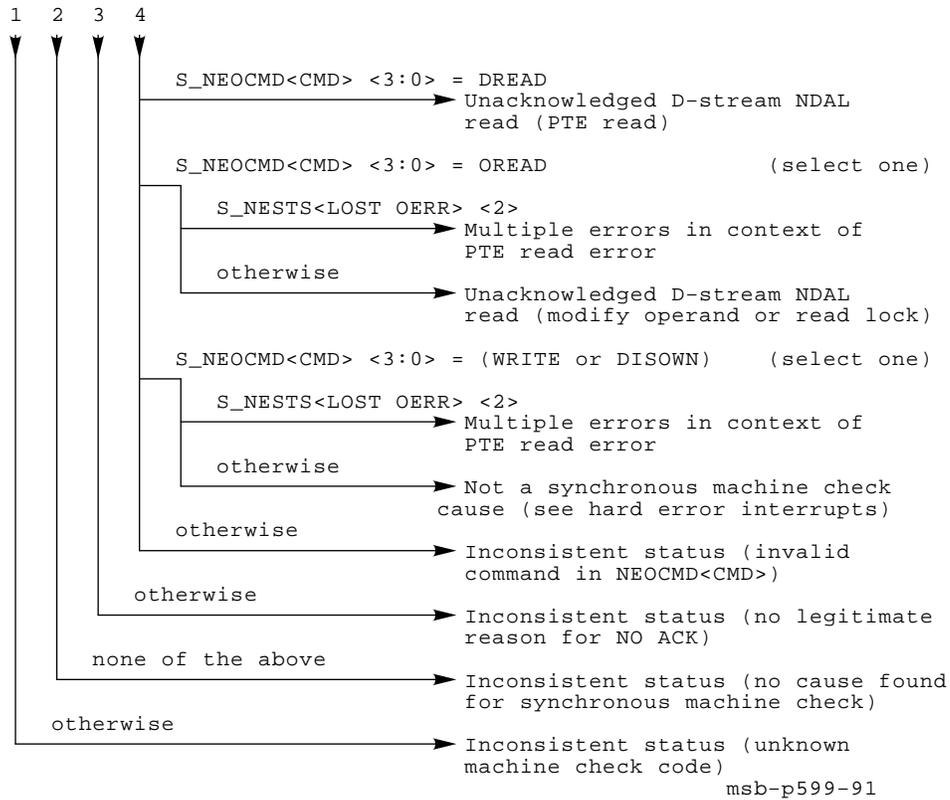


Figure F-2: Parse Tree for INT60 (Hard) Error Interrupts

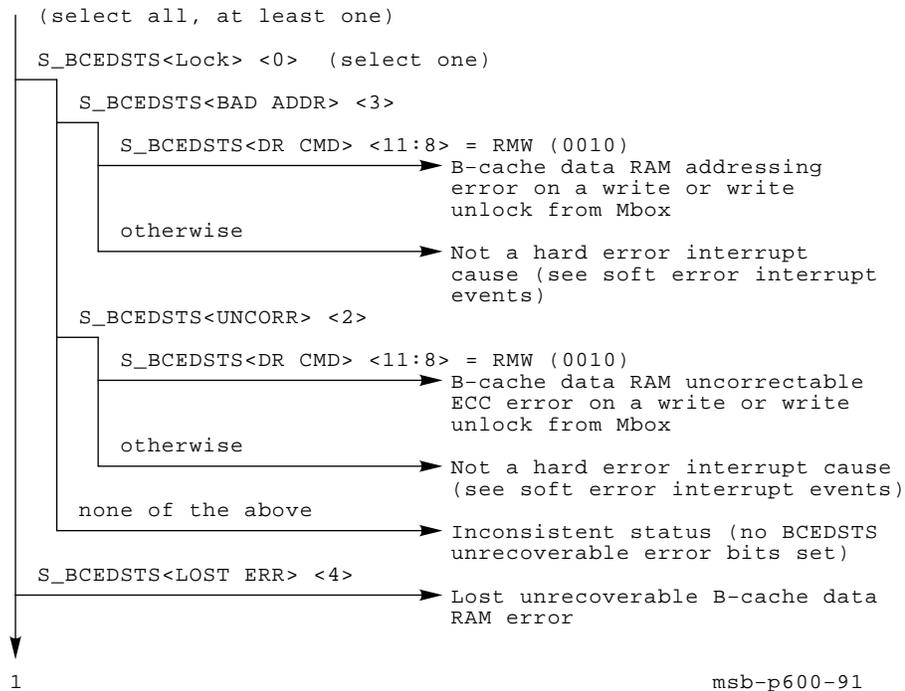


Figure F-2 Cont'd on next page

Figure F-2 (Cont.): Parse Tree for INT60 (Hard) Error Interrupts

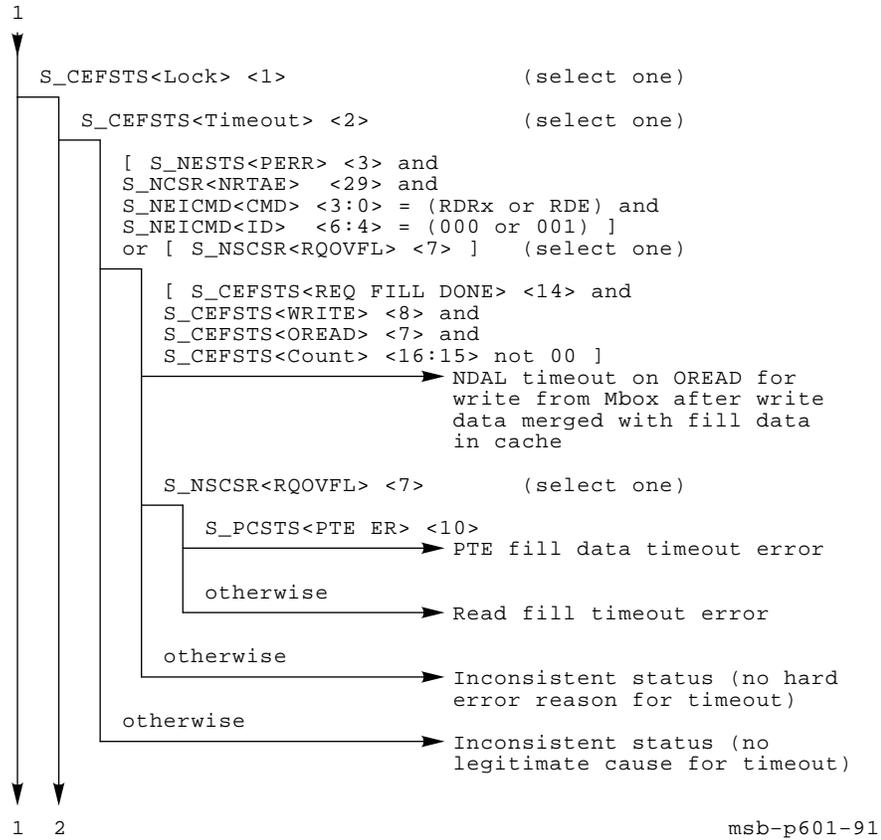


Figure F-2 Cont'd on next page

Figure F-2 (Cont.): Parse Tree for INT60 (Hard) Error Interrupts

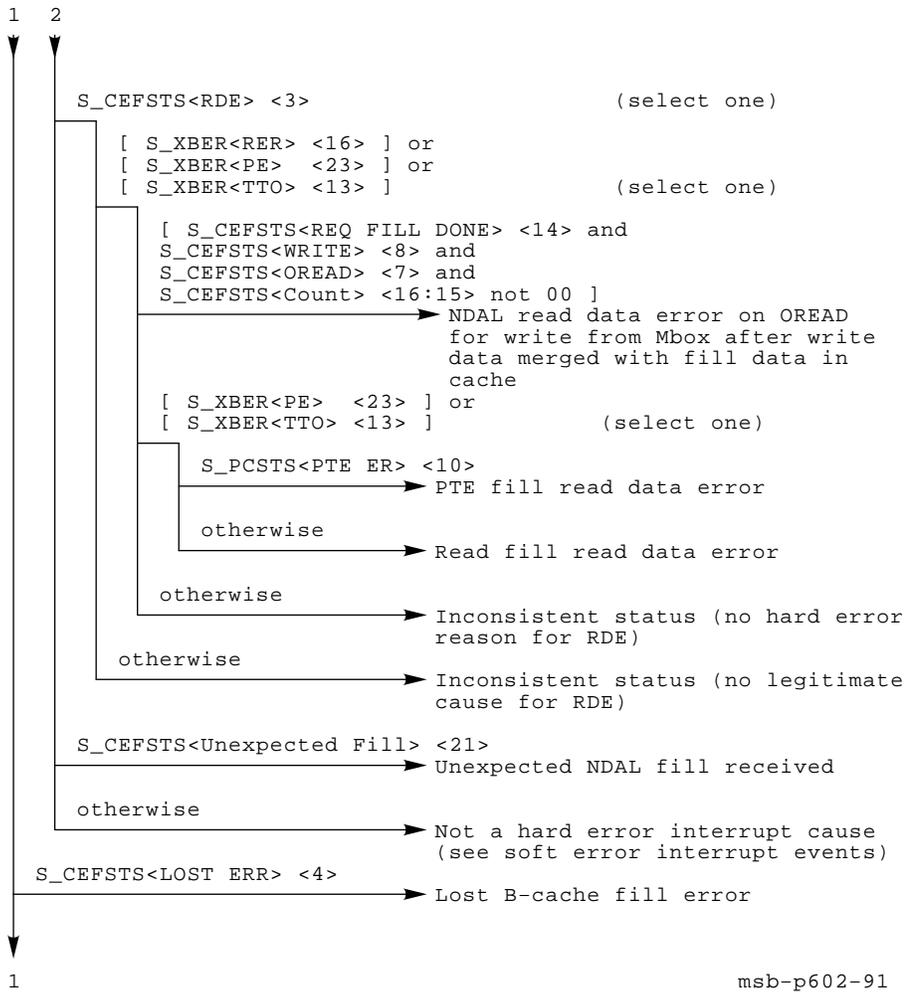


Figure F-2 Cont'd on next page

Figure F-2 (Cont.): Parse Tree for INT60 (Hard) Error Interrupts

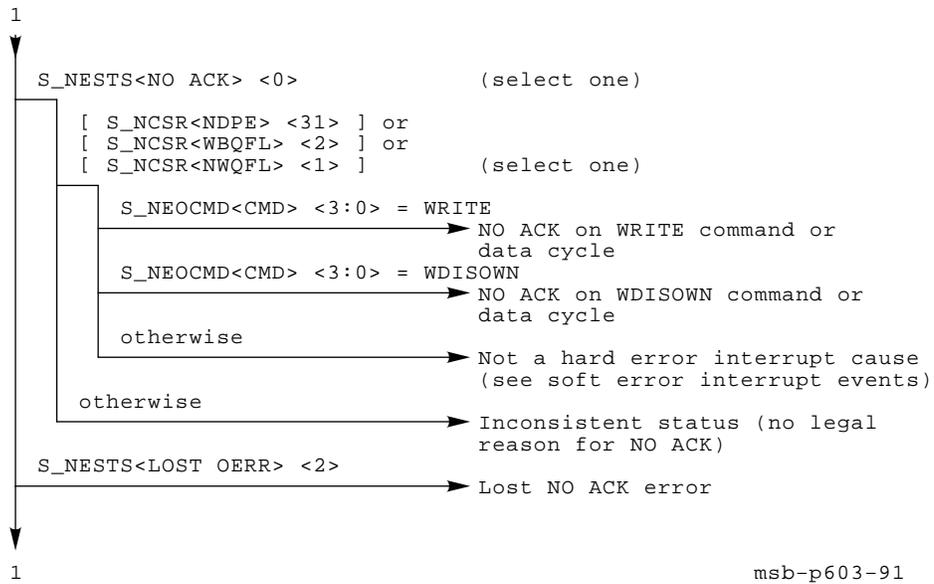
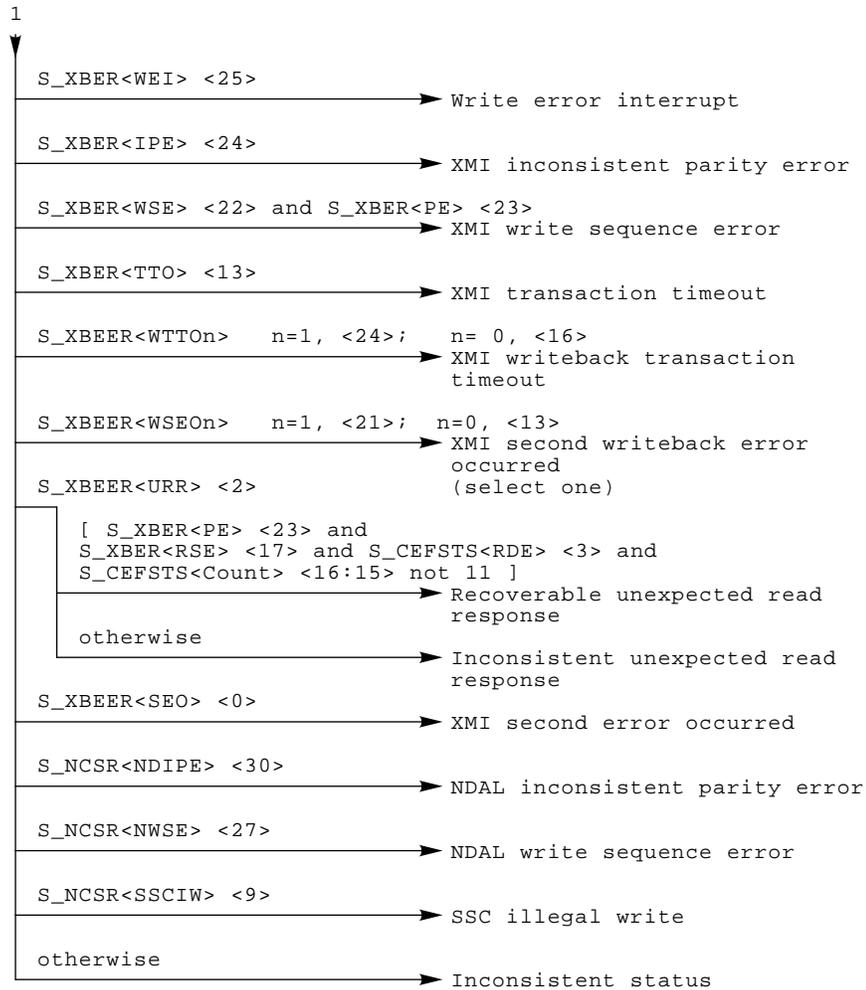


Figure F-2 Cont'd on next page

Figure F-2 (Cont.): Parse Tree for INT60 (Hard) Error Interrupts



msb-p604-91

Figure F-3: Parse Tree for INT54 (Soft) Error Interrupts

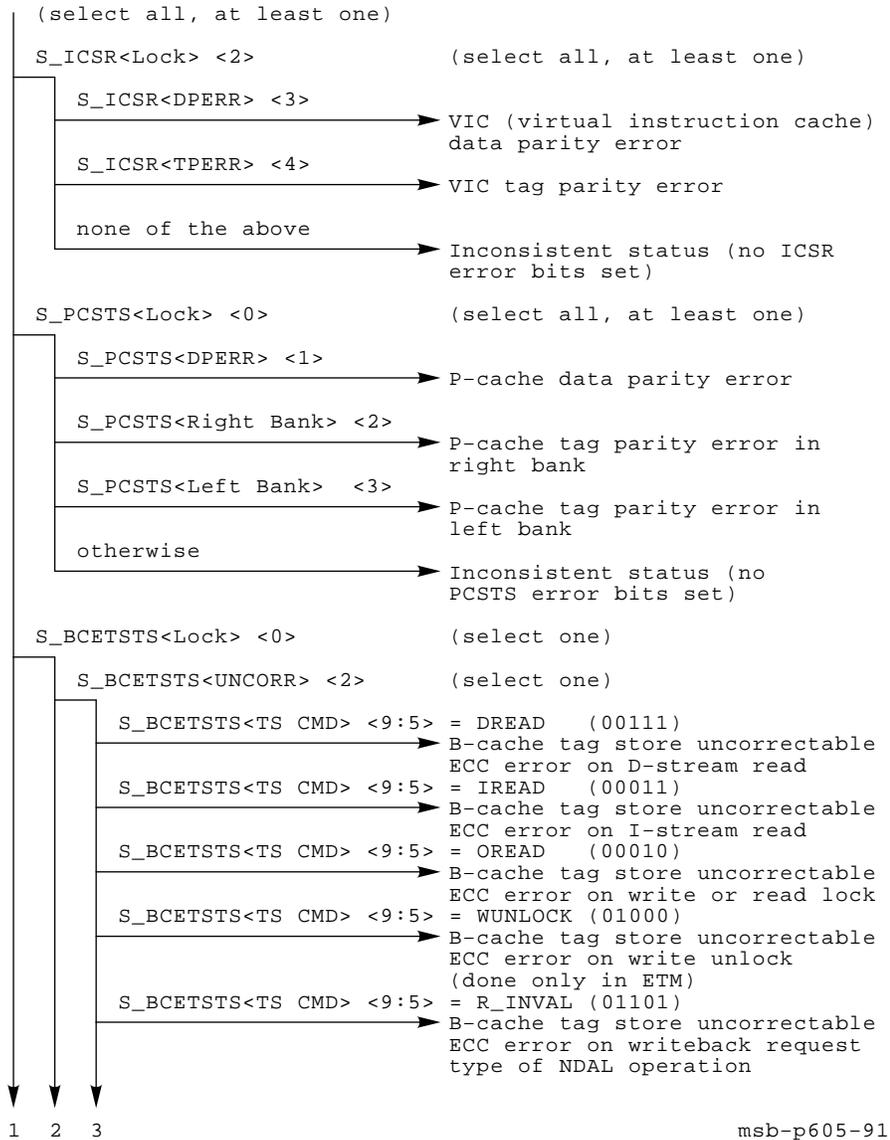


Figure F-3 Cont'd on next page

Figure F-3 (Cont.): Parse Tree for INT54 (Soft) Error Interrupts

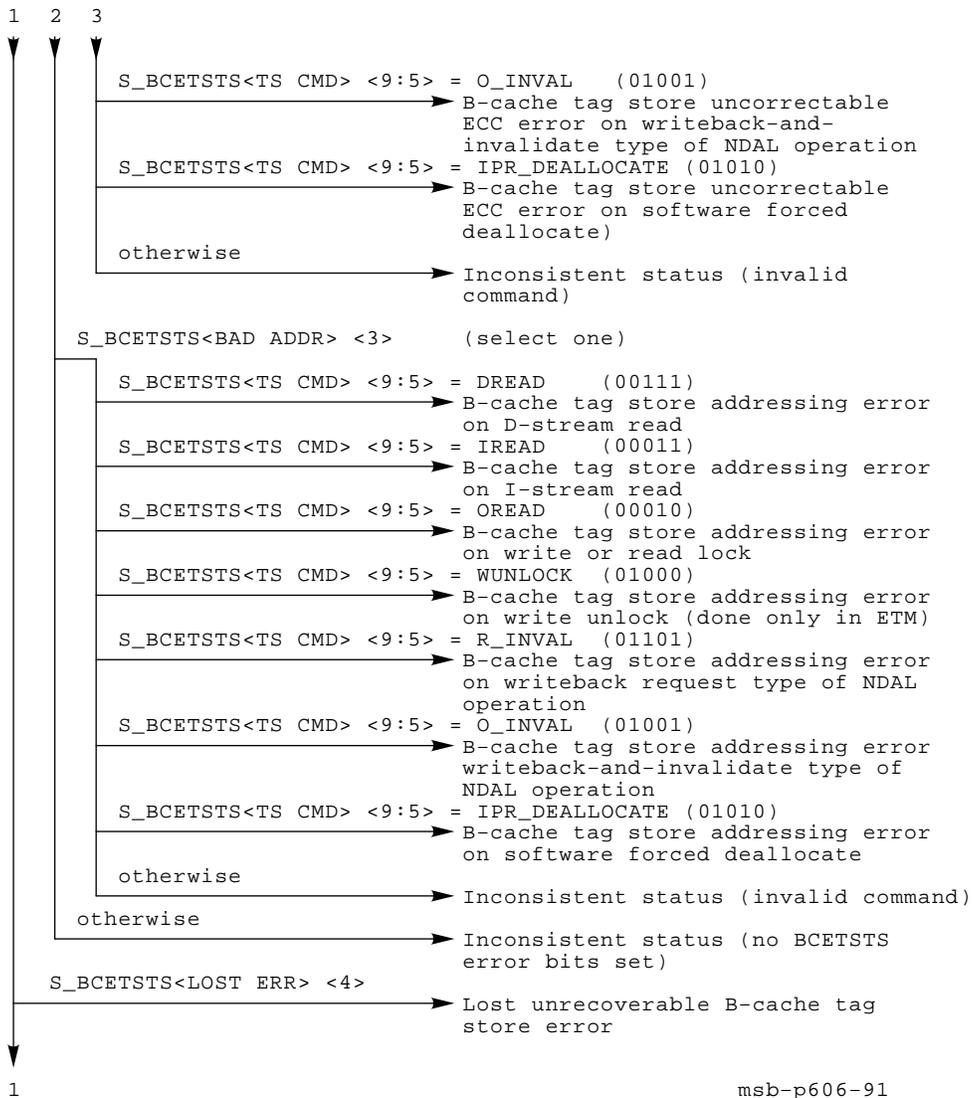


Figure F-3 Cont'd on next page

Figure F-3 (Cont.): Parse Tree for INT54 (Soft) Error Interrupts

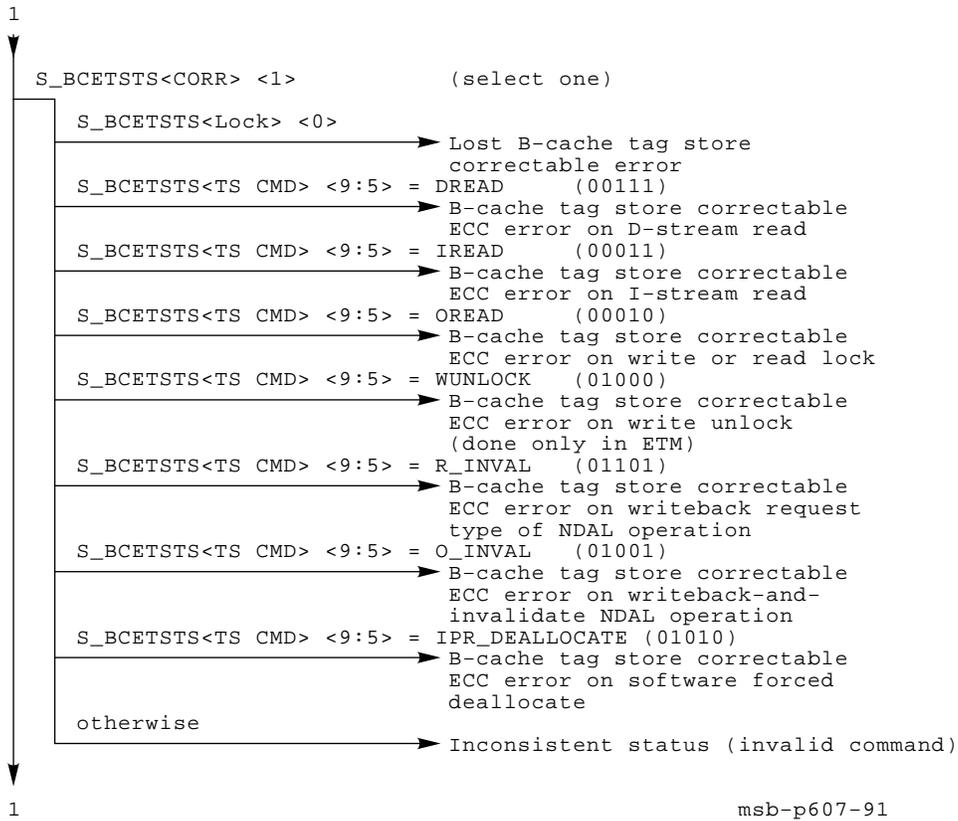


Figure F-3 Cont'd on next page

Figure F-3 (Cont.): Parse Tree for INT54 (Soft) Error Interrupts

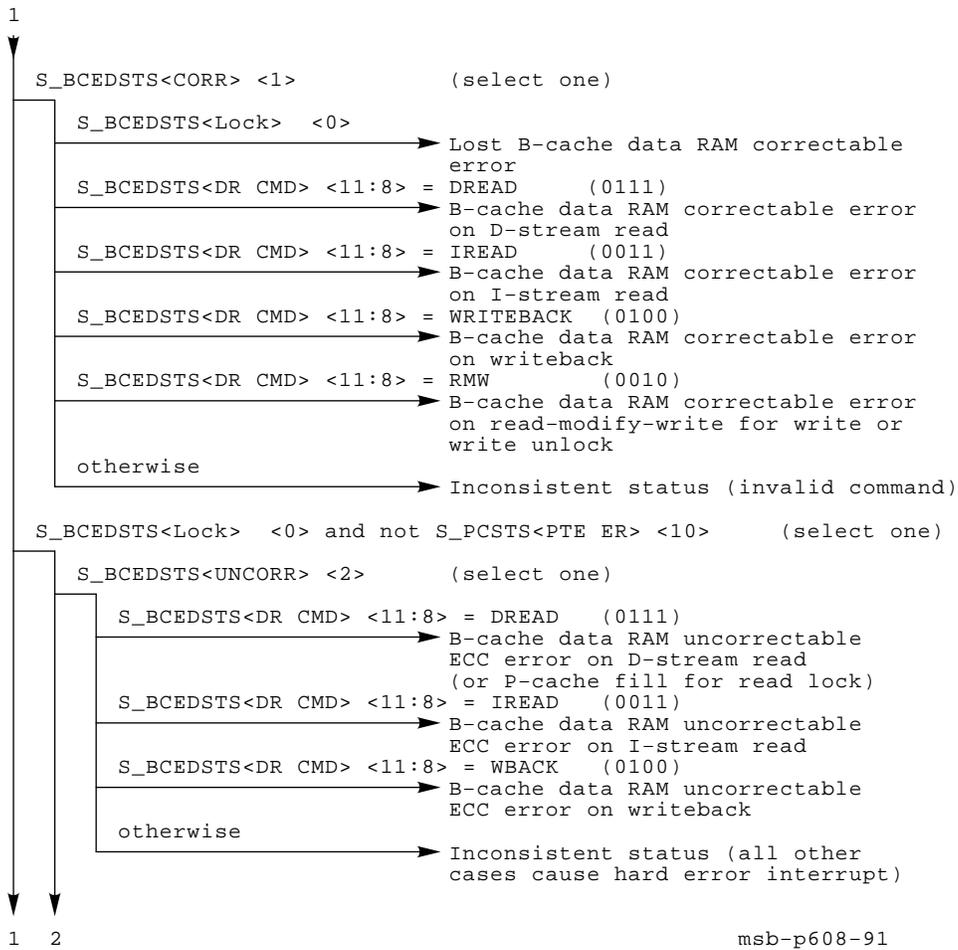


Figure F-3 Cont'd on next page

Figure F-3 (Cont.): Parse Tree for INT54 (Soft) Error Interrupts

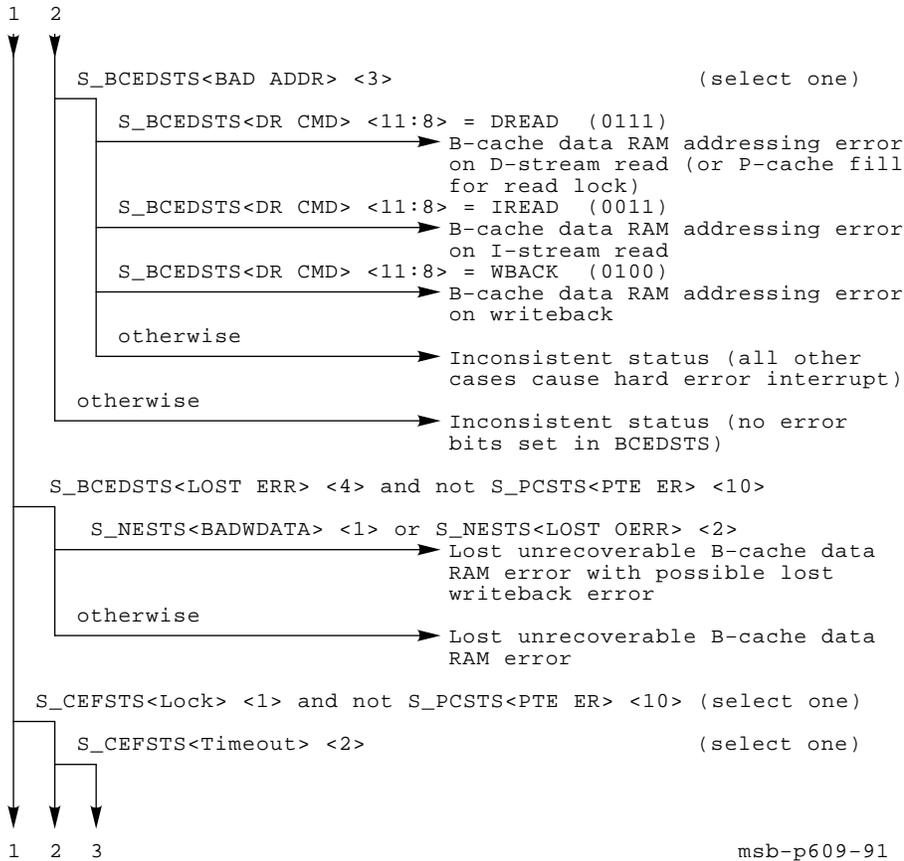


Figure F-3 Cont'd on next page

Figure F-3 (Cont.): Parse Tree for INT54 (Soft) Error Interrupts

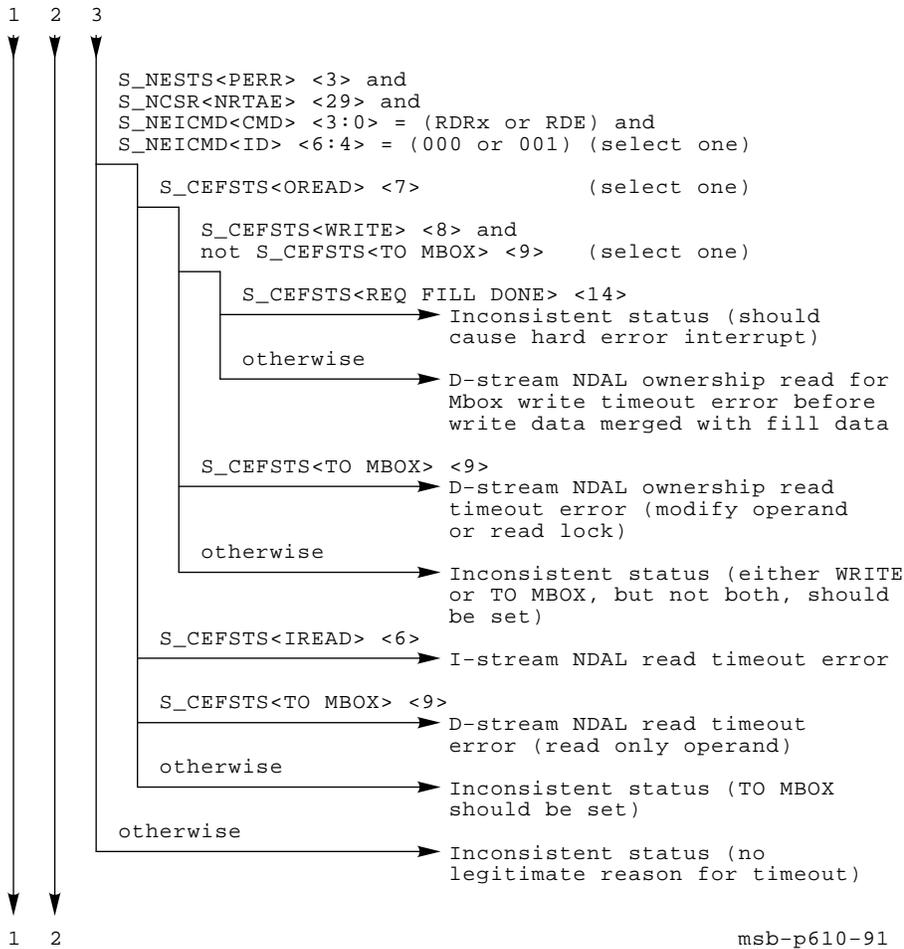


Figure F-3 Cont'd on next page

Figure F-3 (Cont.): Parse Tree for INT54 (Soft) Error Interrupts

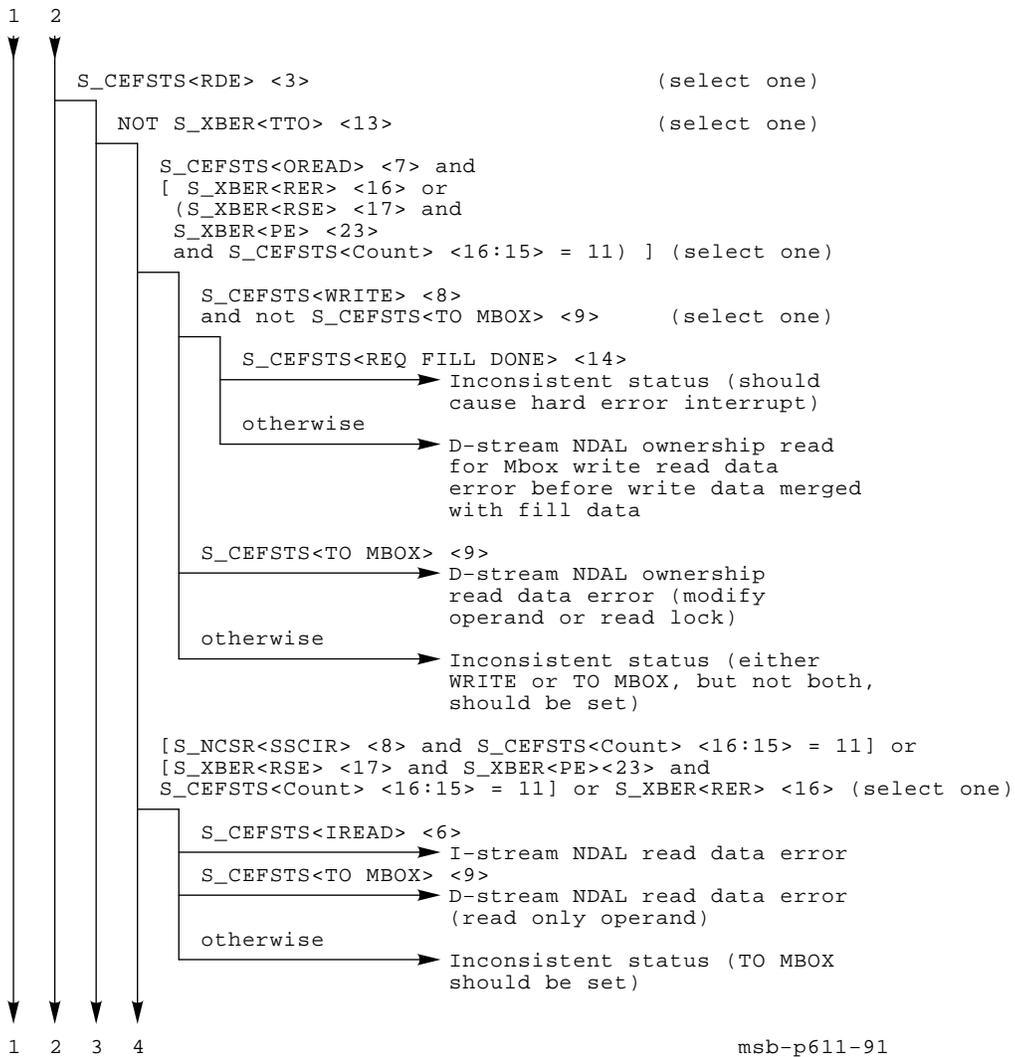


Figure F-3 Cont'd on next page

Figure F-3 (Cont.): Parse Tree for INT54 (Soft) Error Interrupts

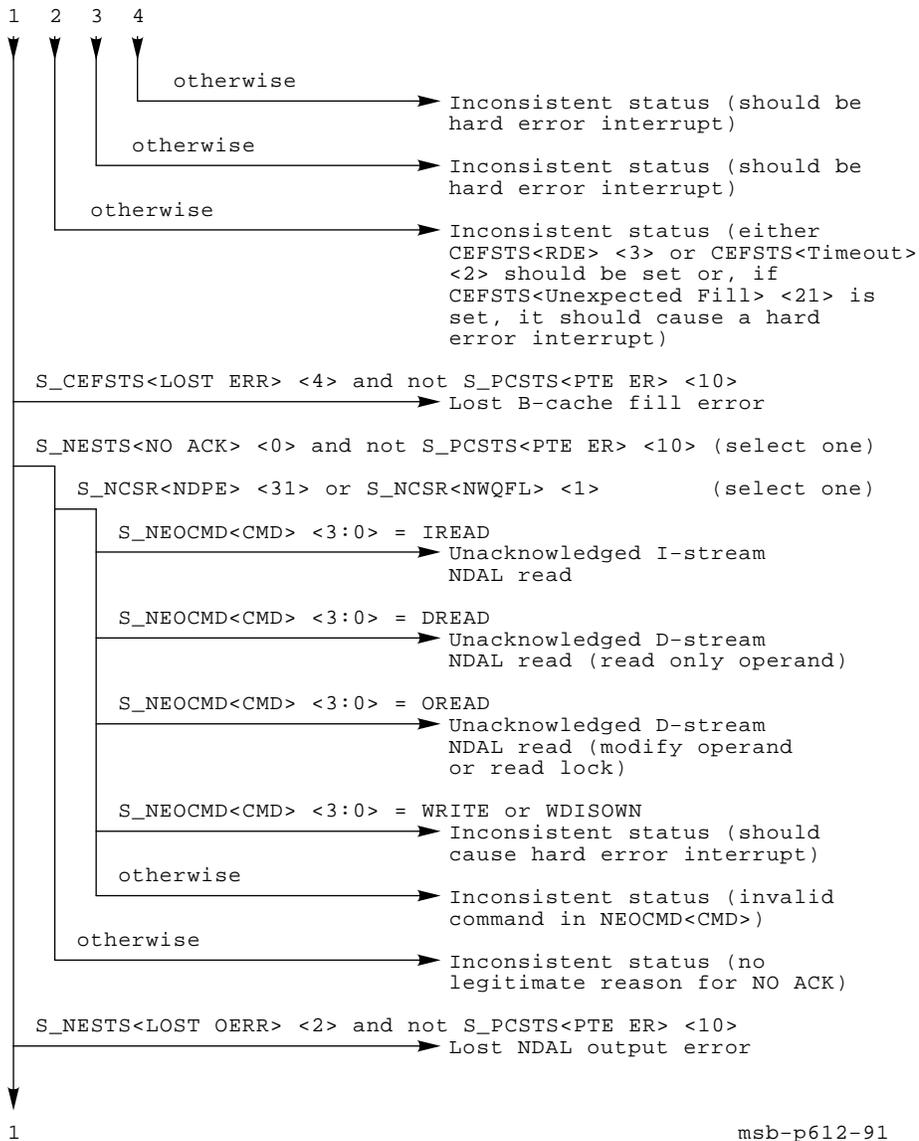


Figure F-3 Cont'd on next page

Figure F-3 (Cont.): Parse Tree for INT54 (Soft) Error Interrupts

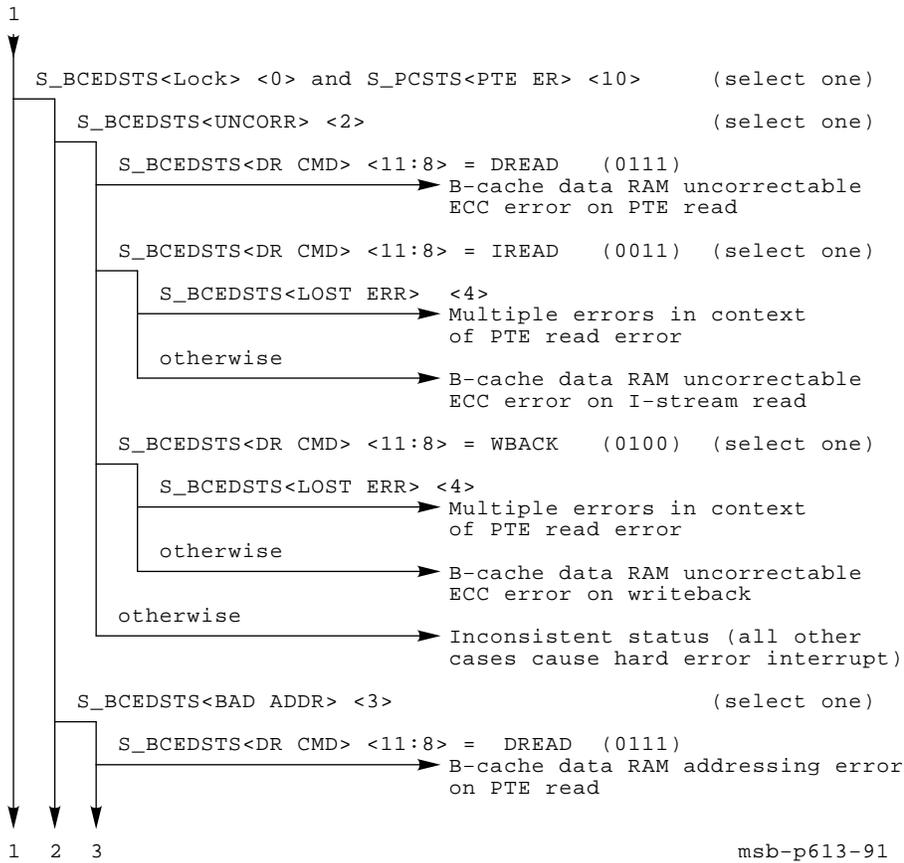


Figure F-3 Cont'd on next page

Figure F-3 (Cont.): Parse Tree for INT54 (Soft) Error Interrupts

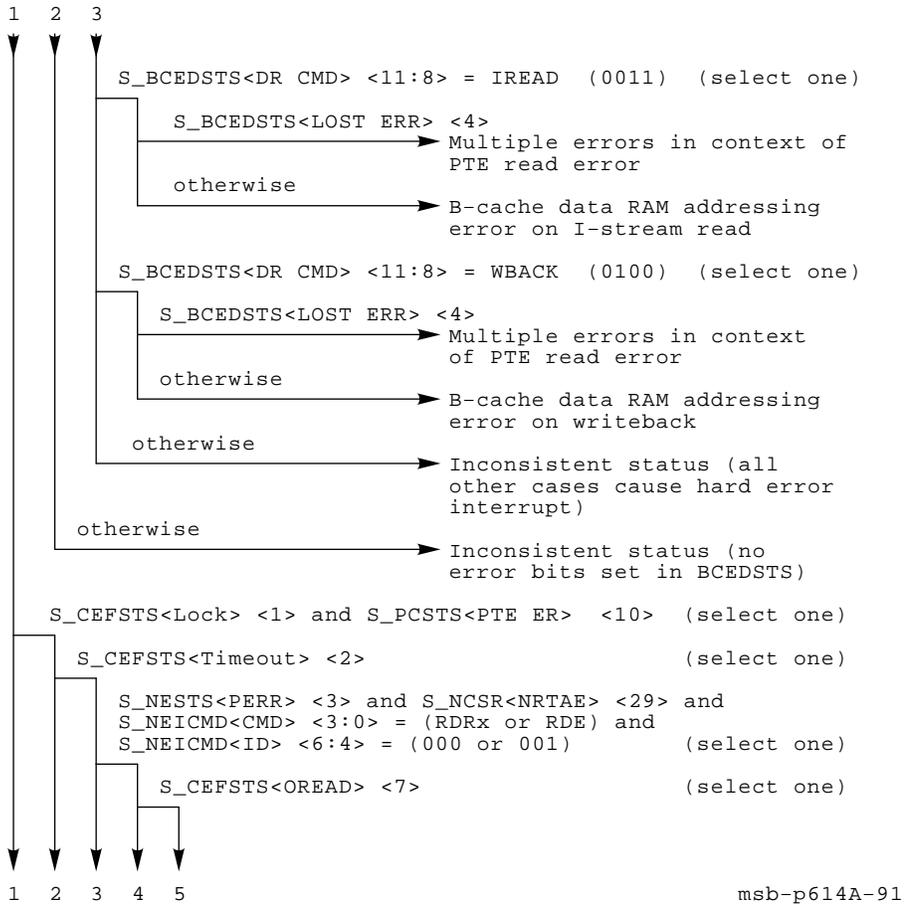


Figure F-3 Cont'd on next page

Figure F-3 (Cont.): Parse Tree for INT54 (Soft) Error Interrupts

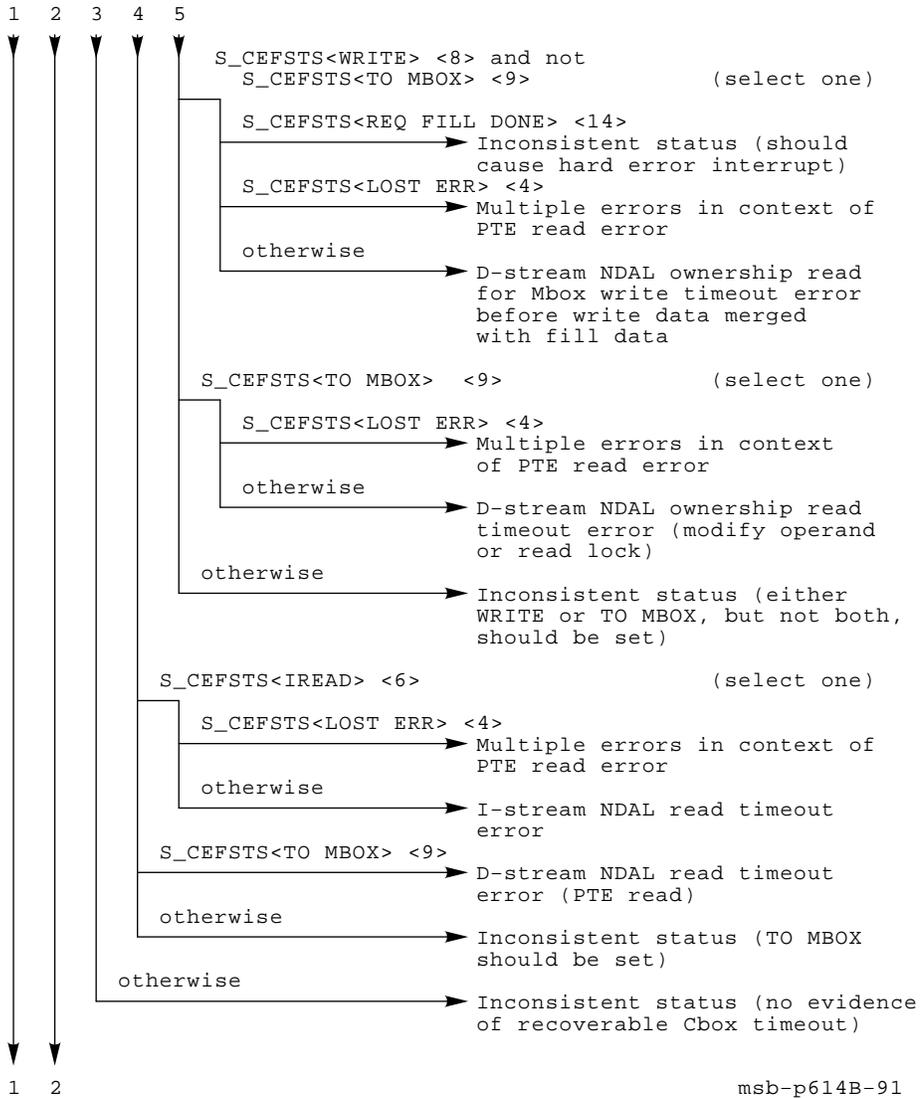


Figure F-3 Cont'd on next page

Figure F-3 (Cont.): Parse Tree for INT54 (Soft) Error Interrupts

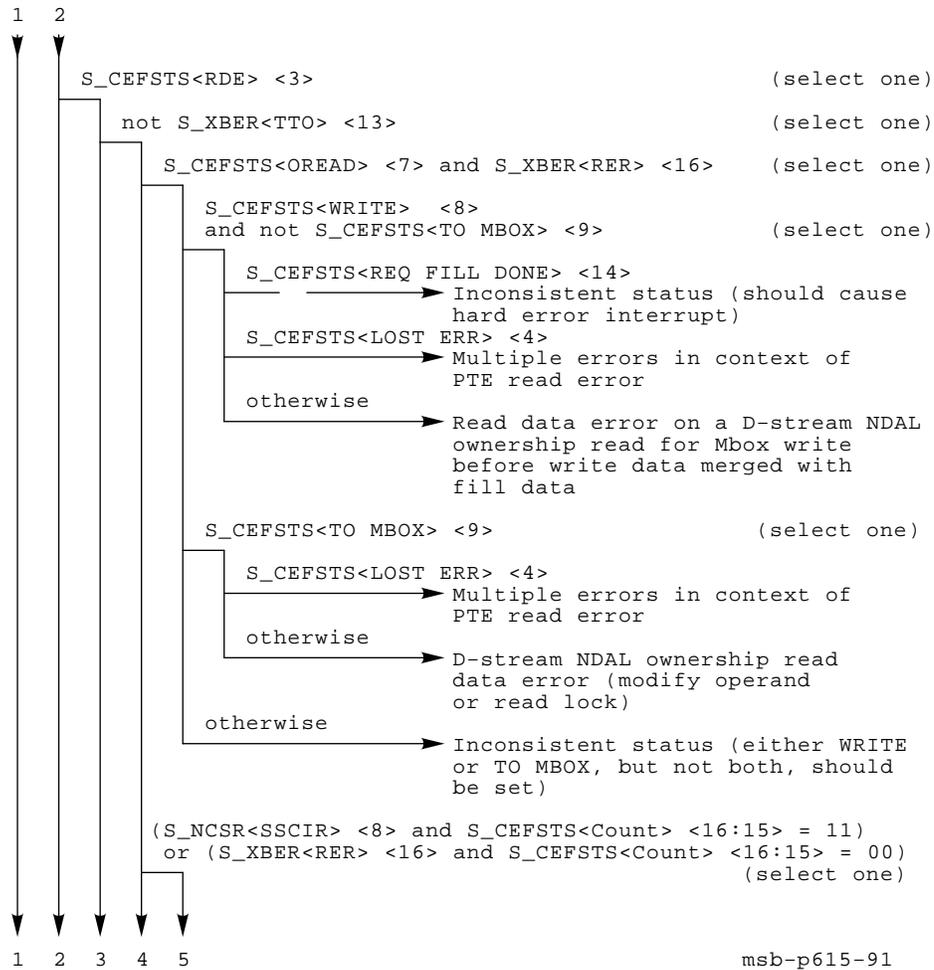


Figure F-3 Cont'd on next page

Figure F-3 (Cont.): Parse Tree for INT54 (Soft) Error Interrupts

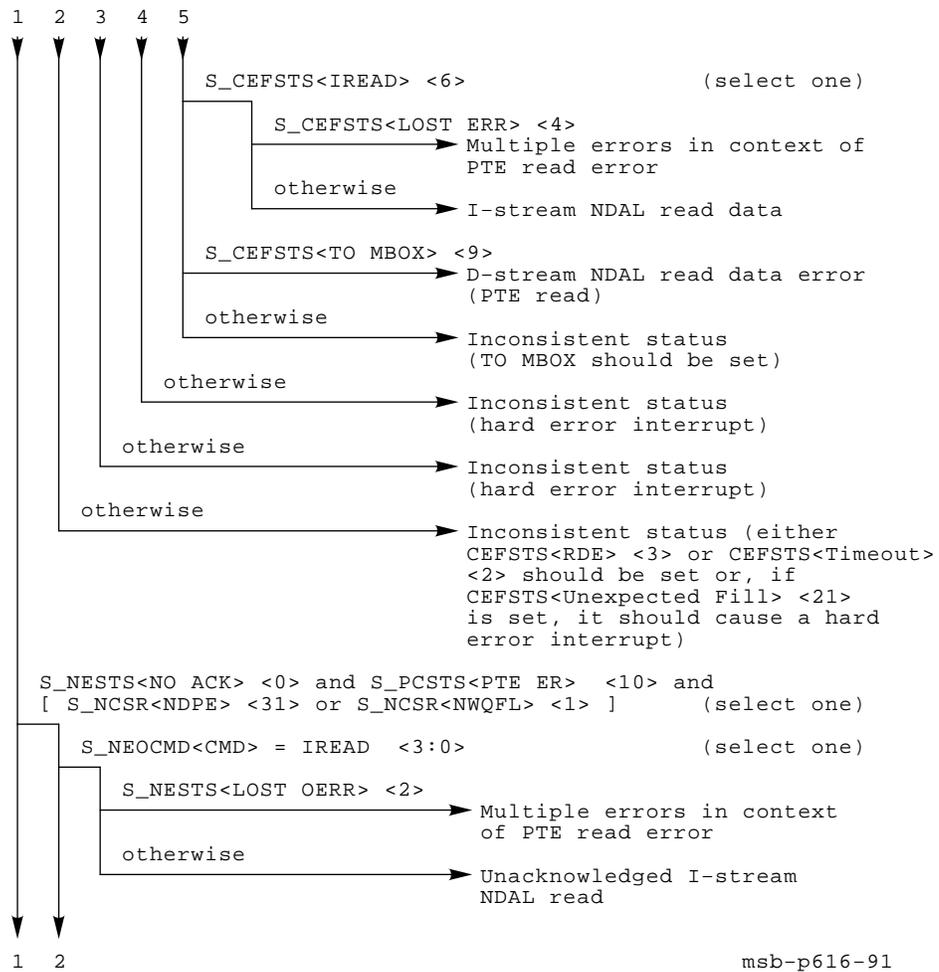
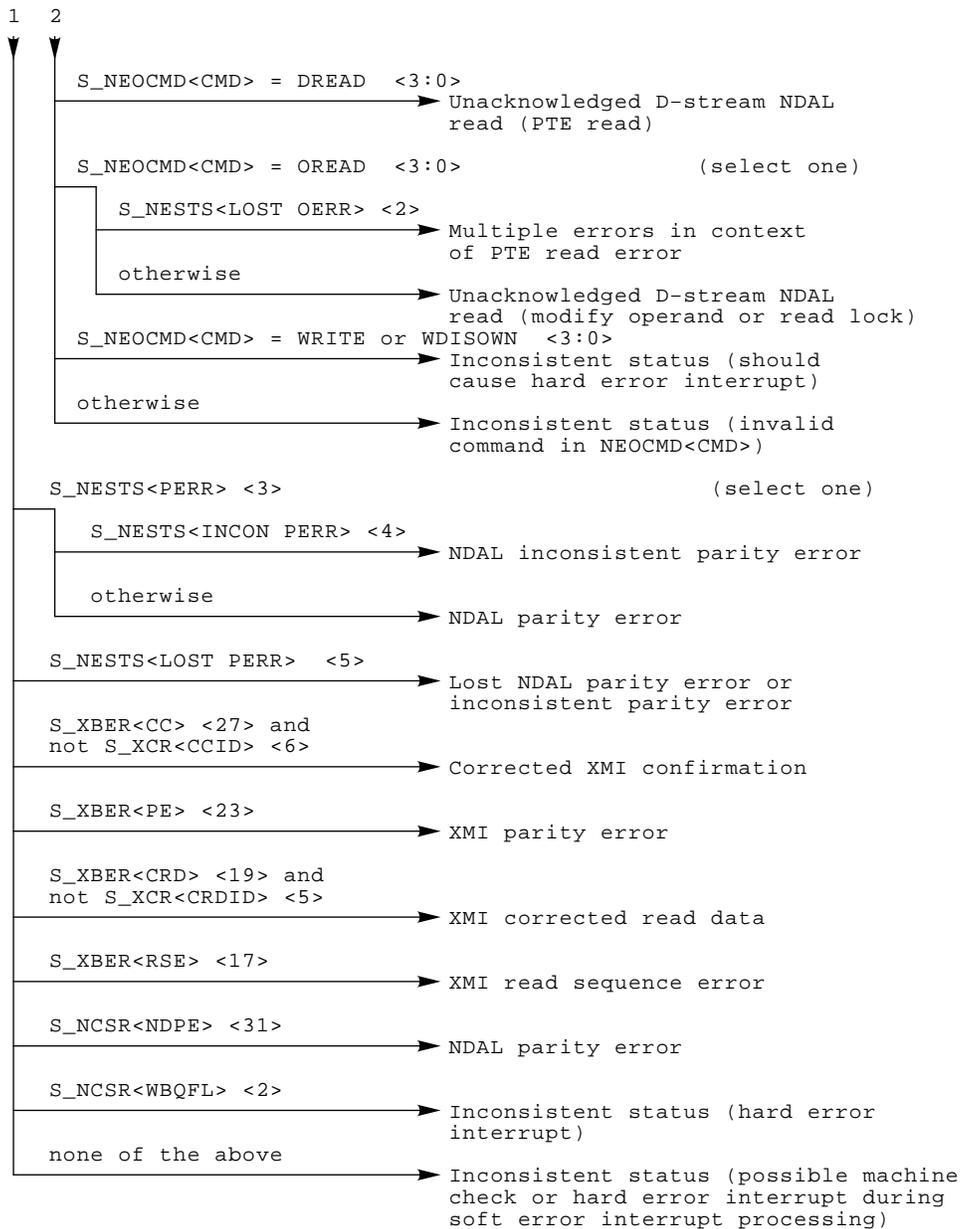


Figure F-3 Cont'd on next page

Figure F-3 (Cont.): Parse Tree for INT54 (Soft) Error Interrupts



msb-p617-92

Appendix G

Restoring a Corrupted EEPROM

Use this procedure to restore a corrupted EEPROM. A corrupted EEPROM is indicated by any of the following console errors:

```
?0053 EEPROM header is corrupted.  
?0055 Failed to locate EEPROM area.  
?0057 EEPROM area checksum error.  
?0061 EEPROM header or area has bad format.  
?006B Error changing EEPROM.
```

CAUTION: *You must wear an antistatic wrist strap attached to the cabinet when you handle any modules. See Appendix D for processor module handling instructions.*

1. Use the commands `SET CPU n` and `[ESC][DEL] SHOW MANUFACTURING` for each CPU module in the system, noting the module serial number and revision level of each CPU module.
2. Turn the control panel's lower key switch to Update.
3. If the console terminal is set to a speed other than the default speed of 1200 baud, press `[BREAK]` until the `>>>` prompt prints. Alternatively, set the console terminal to 1200 baud.
4. Follow the steps shown in Examples G-1 and G-2.

Example G-1: Restoring a Corrupted EEPROM, Part 1 of 2

```
>>> SET CPU 1 ①  
>>> JSB E0040044 ②
```

This procedure will format the EEPROM on the primary processor, destroying the system serial number, saved boot specifications, terminal characteristics, console and diagnostic patches, etc.

Do you want to format the EEPROM [No]? Y ③

Zeroing EEPROM (approximately 15 seconds)

Writing data to EEPROM (approximately 15 seconds)

Move lower keyswitch from UPDATE to write-protect EEPROM ④

```
>>> SET CPU 2 ⑤  
>>> JSB E0040044
```

```
.  
.  
.
```

```
>>> SET CPU 1 ⑥  
>>> ESCDEL SET MANUFACTURING ⑦  
Module Serial Number>>> NI000200007  
Module Revision>>> D02  
DC595 Revision>>>  
FPU Revision>>>  
SSC Revision>>>  
Fields are as follows:  
Module serial number:  
Module revision:  
DC595 revision:  
FPU revision:  
SSC revision:
```

```
Update EEPROM? (Y or N) >>> Y  
?0071 Manufacturing parameters updated
```

```
>>> ESCDEL SET POWER ⑧  
Power system>>> A  
Power system read as: A
```

```
Update EEPROM? (Y or N) >>> Y  
?011B Power system identification updated
```

```
>>> ESCDEL SET SYSTEM SERIAL ⑨  
System Serial Number>>> AG02915081  
Serial number read as: AG02915081
```

```
Update EEPROM? (Y or N) >>> Y  
?0073 System serial number updated
```

```
>>> SET CPU 2 ⑩
```

- ① Make the CPU in the lowest-numbered slot the primary processor.
- ② Enter the command `JSB E0040044`. This command blasts the default EEPROM image into the current primary's EEPROM.
- ③ Type *Y* in response to the question. You do not need to press `[RETURN]` or `[ENTER]`.
- ④ Leave the key switch in the Update position until this procedure is finished.
- ⑤ Make each CPU in turn the primary processor and repeat ② and ③.
- ⑥ Again make the first CPU the primary processor.
- ⑦ The `[ESC] [DEL] SET MANUFACTURING` command prompts you for information. Enter the module serial number and module revision in response to the first two prompts. (You noted this information before starting this procedure.) Press `[RETURN]` in response to the rest of the prompts. Type *Y* to terminate the command.
- ⑧ The `[ESC] [DEL] SET POWER` prompts for the power system type. You can find this information in the SHOW FIELD listing that was saved for this system in the *Site Management Guide* or in another safe place. Type *Y* to terminate the command.
- ⑨ Enter the `[ESC] [DEL] SET SYSTEM SERIAL` command. The system serial number is also in the SHOW FIELD listing. Type *Y* to terminate the command.
- ⑩ Make each CPU in turn the primary processor and repeat ⑦, ⑧, and ⑨. The SET commands that are preceded by `[ESC] [DEL]` do not propagate to other processors, so they must be entered for each processor in the system.

Example G-2: Restoring a Corrupted EEPROM, Part 2 of 2

```
>>> SET CPU 1 11
>>> SET BOOT DEFAULT /XMI:E/BI:2 DU0 12
>>> SET BOOT NIDI /XMI:C/FILENAME:ISL_LVAX_D /R5:10 EX0
>>> SET BOOT TK70 /XMI:E/BI:C MU0
>>> SET CPU /PRIMARY/ALL 13
>>> SET LANGUAGE INTERNATIONAL
>>> SET TERMINAL /SCOPE/SPEED:9600
>>> SET MEMORY /INTERLEAVE:DEFAULT
>>> BOOT /XMI:C/R5:110 EX0 14
.
.
.
>>> INITIALIZE 15
#123456789 0123456789 0123456789 0123456789 012345#
F  E  D  C  B  A  9  8  7  6  5  4  3  2  1  0  NODE #
  A  .  A  .  .  M  M  .  .  .  .  P  P  P  TYP
  O  .  +  .  .  +  +  .  .  .  .  +  +  +  STF
  .  .  .  .  .  .  .  .  .  .  .  E  E  B  BPD
  .  .  .  .  .  .  .  .  .  .  .  +  +  +  ETF
  .  .  .  .  .  .  .  .  .  .  .  E  E  B  BPD
.  .  .  +  .  .  .  .  +  .  +  .  .  +  .  XBI E +
.  .  .  .  .  A2 A1  .  .  .  .  .  .  .  ILV
.  .  .  .  .  32 32  .  .  .  .  .  .  .  64 Mb

Console = V2.00 RBDs = V2.00 EEPROM = 2.00/2.00 SN = GA140123456
```

- ⑪ Make the first CPU the primary processor.
- ⑫ Use the SET BOOT command to set the boot specifications entered in the *Site Management Guide*.
- ⑬ Enter the rest of the information saved in the *Site Management Guide*.
- ⑭ Use the EVUCA utility to update all the processors' EEPROMs. See Section 3.10.3.
- ⑮ Initialize the system and verify there are no messages regarding console patches, corrupt EEPROMs, or system number mismatches. If the console prints any of these messages, verify that you installed the latest revision of patches. If they are the latest revision, follow the troubleshooting flowchart in Figure 1-2.

Appendix H

Interpreting the VMS Error Log

This appendix tells how to produce and interpret the VMS error log entries produced for the KA66A CPU.

Sections include:

- Producing the Listing
- Types of Error Log Entries for the KA66A CPU
- Format of Machine Check Error Log Entry
- Format of INT54 (Soft) Error Log Entry
- Format of INT60 (Hard) Error Log Entry
- Format of Lastfail Error Log Entry
- Format of Memscan Error Log Entry
- Format of Memory Soft Error (CRD) Error Log Entry

There are three components of the VMS system error logging facility:

- Various error logging software routines, such as SYSLOA in the executive and routines within device drivers, that handle errors and events and write relevant information into error log buffers.
- The ERRFMT process, which periodically empties the error log buffers, writing the information to the error log file on the system disk.
- The Error Log Utility, which invokes the Error Log Report Formatter (ERF), which prints selected reports using information from the error log file.

H.1 Producing the Listing

Copy the existing error log file to avoid interference with current logging. Use the ANALYZE/ERROR_LOG command with options to produce a listing selecting displays for suspected types of errors.

Example H-1: Obtaining a Selective Error Log Listing

```
$ COPY ERRLOG.SYS ERR11_12_91.SYS ❶  
$ ANALYZE/ERROR_LOG/SINCE=10-NOV-1991/OUTPUT= ERR.TXT ERR11_12_91.SYS ❷  
.  
.  
$ ANALYZE/ERR/INCLUDE=(CPU_ENTRIES, MACHINE_CHECKS) ERR11_12_91.SYS ❸
```

In general, the VMS error logging facility logs errors and system events to an error log file named SYSS\$ERRORLOG:ERRLOG.SYS. The types of events logged include:

- Errors—Device errors, device timeouts, machine checks, bus errors, memory errors, asynchronous write errors, undefined interrupts, and bugchecks
- Volume changes—Volume mounts and dismounts
- System events—Cold start-ups, warm start-ups, system failure (crash) start-ups, messages from the Send Message to Error Logger (SSNDERR) system service, and time stamps

The operating system will continue writing to this file indefinitely, so regular maintenance procedures involve periodically renaming the error log file. (The new file names should use some kind of record-keeping conventions, such as including the date the file was renamed.) The renamed file can then be archived for whatever period is deemed to be relevant. In this way, the current error log file always contains the most timely information.

The practices used in maintaining error log files will vary from site to site, so it is useful to know how to limit the information produced in an error log report. Otherwise, you could get a listing of entries many inches thick.

Example H-1 shows how to limit the entries produced to a certain time period or by the type of entries recorded.

- ❶ Copy the error log file to another location, so that the system file can be used to log new errors while you are working. If you do not, error entries may be lost while you are working with the system error log file. In the example, ERRLOG.SYS is copied to ERR11_12_91.SYS.
- ❷ The ANALYZE/ERROR_LOG command produces the error log display. In the example, the ERR11_12_91.SYS file is the binary file to be analyzed.

The /SINCE qualifier is useful to limit the time period for the errors displayed. You may want to examine only the errors for recent days or even hours, depending on your understanding of what has happened at the site.

The /OUTPUT qualifier directs the error log output text to the file you name. Without it, the display is directed to the terminal you are working on.

- ❸ You may want to restrict the listing to certain types of entries. In the example, the user selects CPU entries and machine check errors for the error log display. The display will appear on the terminal since no /OUTPUT qualifier was used.

For a discussion of how to maintain an error log file, see the VMS manual *Guide to Maintaining a VMS System*. The *VMS Error Log Utility Manual* describes the ANALYZE/ERROR_LOG command and all its qualifiers.

H.2 Types of Error Log Entries for KA66A CPU

There are six types of KA66A error log entries: machine check report, INT60 report, INT54 report, lastfail report, memory soft error (CRD) report, and memscan report.

Table H-1 lists the types of error log entries produced for the KA66A. Succeeding sections describe the entries in more detail.

Table H-1: Types of Error Log Entries for KA66A CPU

Type	Description
Machine check	Produced when a CPU machine check exception occurs.
INT60	Produced when a CPU interrupt 60 occurs.
INT54	Produced when a CPU interrupt 54 occurs.
Lastfail	Last error(s) detected before the system terminates the session.
Memory soft error (CRD)	Produced at shutdown or when error buffers are full; a summary of all CRD errors.
Memscan	Produced when operating system poll of memory adapter error registers shows an error.

H.2.1 Machine Check Exception Entries

A machine check exception occurs when the processor detects an error in the context of the instruction currently being executed. Depending on the severity of the error, the operating system code that handles machine check exceptions may correct the error, abort the executing process, or crash the system. An error log entry will appear in all cases.

In addition to the hardware-specific information logged for the error, the machine check exception entry also contains what is called the machine check stack frame, which contains information about the software executing at the time the exception occurred. The type of error as well as the contents of the PC and PSL registers and other contextual information are given in the machine check stack frame. Section H.3.5 describes the contents of the stack frame; item 25 in Example H-5 shows this portion of the machine check entry.

H.2.2 INT60 (Hard) Error Interrupt Entries

An INT60 (hard) error interrupt indicates an error occurred asynchronously with instruction execution. Typically, this type of error is of such a magnitude that machine state has been corrupted and that retry is not possible. The error handling routines log the condition and crash the system.

H.2.3 INT54 (Soft) Error Interrupt Entries

INT54 (soft) error interrupts report errors that were detected but did not affect instruction execution. An example is a CRD (corrected read data) error. Such single-bit data errors can be detected and corrected by hardware; however, an error entry noting the error is logged for examination.

H.2.4 Lastfail Error Entry

The lastfail error entry displays the last errors detected before the system terminates a session. If, for example, an error occurs that requires the session to be terminated, the system will log the error and, before shutting down, will perform one last check of the registers on the XMI modules. If the system discovers that an error or errors have occurred since the fatal error, it will format the error registers for the XMI adapter(s) and log them as a lastfail error entry.

H.2.5 Memory Soft Error (CRD) Entry

The memory soft error (CRD) entry is a summary of all the corrected read data (CRD) errors that the system experienced during the session. This report is produced when the system shuts down or when CRD buffers are full. This information can reveal that a significant number of corrected errors occurred on a particular memory module, and you can then check previous entries for further indications of problems with this module.

H.2.6 Memscan Entry

Memory modules cannot themselves interrupt, but some memory errors are noted within the registers on the memory module. So, the operating system error handling code periodically polls memory modules (hence the name “memscan”), checking error registers and logging memory errors detected. This error log entry, called memory controller error, is produced for such an error.

H.3 Format of Machine Check Error Log Entry

The machine check error log entry contains the following information.

H.3.1 Header

The header to the error log entry gives the entry number (there can be many errors logged in any given error log file) and other general information about the system, date and time, and so forth. Item ❶ in Example H-2 shows the format and typical content of the header for an error log entry.

H.3.2 Software Flags

The software flags are longwords whose bit settings indicate the particular conditions detected by the error handler. Item ❷ in Example H-2 shows a sample: four longwords for machine check errors. The formatter presents a synopsis of the error flags set in a particular entry, as shown in ❸ of Example H-2. Table H-2 gives the software flags for machine check entries.

Table H-2: Software Flags for Machine Check Entries

Bit	Definition
0	Inconsistent. Multiple error signals with overlapping syndromes.
1-5	Used internally by the VMS error handling routines; used for debug purposes.
18	Asynchronous errors were not found in conjunction with this machine check exception.
19	Synchronous errors were not found in conjunction with this machine check exception.
20	An unknown machine check code, not in the range 1-6.
21	Machine check code 1. Unknown memory management fault.
22	Machine check code 2. Illegal interrupt ID value.
23	Machine check code 3. Illegal microcode dispatch.
24	Machine check code 4. Illegal combination of state bits detected during string instruction.
25	Machine check code 5. Asynchronous hardware error.
26	Machine check code 6. Synchronous hardware error.
27	Translation buffer data parity error.

Table H-2 (Cont.): Software Flags for Machine Check Entries

Bit	Definition
28	Translation buffer tag parity error.
32	Virtual instruction cache (VIC) data parity error.
33	Virtual instruction cache (VIC) tag parity error.
34	B-cache data uncorrectable data error.
35	B-cache data recoverable error lost. A second uncorrectable error or bad address error occurred for which state was not saved. (BCEDIDX and BCEDECC were locked by the first error.)
36	B-cache data uncorrectable error during a PTE reference.
37	B-cache data uncorrectable error during which a PTE was lost.
38	B-cache data bad address.
39	B-cache data bad address PTE.
40	B-cache data bad address lost PTE.
48	Cache fill error timeout.
49	Cache fill error IDENT read data error.
50	Cache fill error read data error.
51	Cache fill error lost.
53	Cache fill error timeout PTE.
54	Cache fill error read data error PTE.
55	NDAL NO ACK error.
56	NDAL OLOST error.
57	NDAL NO ACK PTE.
95	Reserved last error.
96	XMI information on all adapters present.
97	Detailed MS65A (memory) register information present.
98	Detailed log adapter register information present.
99	Disabled list present (see Table H-3).
101	P-cache tag present.
102	P-cache data present.

Table H-2 (Cont.): Software Flags for Machine Check Entries

Bit	Definition
103	I-cache (VIC) tag present.
104	I-cache (VIC) data present.
105	Unlock fail. Error bits in CPU error registers could not be re-set.
106	Memory unlock fail. Error bits in memory error registers could not be re-set.
107	Log adapter (LA) not locked.
108	The adapter at fault did not have a log adapter routine coded.
109	Adapter does not exist.
110	All enabled. No features of error logging have been disabled.
111	No XMI errors occurred.
112	No memory errors occurred.
116	Memory does not exist.
117	RDS (Read Data Substitute) page replaceable.
118	RDS (Read Data Substitute) page found.
119	Recovery block.
120	Double machine check error occurred.
122	Log a memory soft error (CRD) report.
123	Inhibit logging.
124	Remove CPU.
125	Loop.
126	Abort.
127	Bugcheck.

H.3.3 Overview Information

After the software flags, some overview information is presented, such as the node name and system serial number (see 5 in Example H-2). Most of the information in this region is self-explanatory. However, one word of resource disable bits tells what facilities have been disabled as a result of an error. Table H-3 gives these bit settings.

Table H-3: Resource Disable Bits

Bit	Meaning
0	CPU disabled
1	VIC disabled
2	P-cache disabled
3	B-cache disabled
4	Corrected read data interrupts disabled
5	Single-bit error correction disabled
6-11	Unused
12-14	Reserved
15	CPU not started

H.3.4 CPU Error and Status Registers

CPU error and status register contents are displayed, along with explanatory text. The particular registers presented depend on the type of entry. In Examples H-3 through H-5, items ⑥ through ⑭ illustrate this section of error log output.

NOTE: *In this section, uppercase letters in explanatory text is used to draw attention to error conditions. Lowercase letters indicate status information. To spot problems, then, you can scan this section of the report for uppercase information. (The XDEV, XBE, XFADR, and XFAER register information is an exception to this rule.)*

H.3.5 Machine Check Stack Frame

The next information displayed in the machine check error log entry is the machine check stack frame. Item ⑮ in Example H-5 shows an example of the information displayed in the error log entry. Figure H-1 and Table H-4 briefly describe values placed on the stack and consequently displayed in the error log entry when a machine check exception occurs.

H.3.6 Additional Error Information

Depending on the error found, additional information is presented in the machine check error log entry:

- **Error Counters.** The entry report includes counters showing the total number of errors (of the type flagged in the first 95 bits software flags) logged since this operating system session began.
- **P-cache and VIC Tag and Data Parity Errors.** If parity errors occurred in the P-cache or VIC data or tag areas, the operating system attempts to find the good and bad data. A short display of the good and bad data will appear next if applicable. No such error occurred in Example H-2.
- **XMI Node Data.** General register contents on individual XMI bus adapter modules. An example is shown in ②7 in Example H-6.
- **XMA Node Data.** Contents of MS65A memory module error registers. An example is shown in ③5 in Example H-8.
- **Log Adapter Data.** Contents of the error registers on an XMI module showing errors. This log adapter information will usually help isolate the reason for the failure(s) detected. An example for a KDM70 adapter is shown in ④9 in Example H-9.

Figure H-1: Stack Contents for a Machine Check Exception

3 1	2 4	2 3	1 6	1 5	8 7	0	
Parameter Byte Count (18 hex)							:SP
AST	x	MCHK Code	x	CPUID			:SP + 4
INT.SYS Register							:SP + 8
SAVEPC Register							:SP + 12
VA Register							:SP + 16
Q Register							:SP + 20
Rn	x	Mod	Opcode	x	V	x	:SP + 24
PC							:SP + 28
PSL							:SP + 32

msb-p503A-92

Table H-4: Stack Contents for a Machine Check Exception

Location	Value (hex) or <bit range>	Description
(SP)	18	Size of stack frame in bytes, not including PSL, PC, or byte count longword
(SP)+4	<31:29>	Current value of the ASTLVL register
	<23:16>	Machine check code. Possible values (hex): 01—Unknown memory management fault 02—Illegal interrupt ID value 03—Illegal microcode dispatch 04—Illegal combination of state bits detected during string instruction 05—Asynchronous hardware error 06—Synchronous hardware error
	<7:0>	Current value of the CPUID register
(SP)+8	<31:0>	Current value of the INT.SYS register
(SP)+12	<31:0>	Current value of the SAVEPC register
(SP)+16	<31:0>	Current value of the Ebox VA register
(SP)+20	<31:0>	Current value of the Ebox Q register
(SP)+24	<31:28>	Current value of the Rn register.
	<25:24>	Mode; a copy of PSL<CUR_MOD>
	<23:16>	Bits <7:0> of the instruction opcode. The FD bit is not included.
	<7>	VAX Restart bit. If set, no architectural state has been changed by the instruction that was executing when the error was detected. If this bit is not set, the architectural state was modified by the instruction.
(SP)+28		Contents of the program counter (PC) when the exception occurred
(SP)+32		Contents of the processor status longword (PSL) when the exception occurred

H.3.7 Sample Error Log Entry for a Machine Check

A machine check exception occurs when an error is detected in the context of the instruction currently being executed.

Example H-2: Machine Check Error Log Report

```
V A X / V M S      SYSTEM ERROR REPORT      COMPILED 25-OCT-1991 11:08:22
                                           PAGE 1.
❶
***** ENTRY 1. *****
ERROR SEQUENCE 49.          LOGGED ON:      SID 13001401
DATE/TIME 9-OCT-1991 08:08:59.97          SYS_TYPE 02060101
SYSTEM UPTIME: 0 DAYS 00:14:21
SCS NODE: MTBF                      VAX/VMS V5.5

MACHINE CHECK KA66 CPU FW REV# 1.  CONSOLE FW REV# 0.6
XMI NODE # 8.

❷      SW FLAGS      04000000
                00040000
                00000000
                00004007

                machine check code 6 bit<26> ❸
                cfe rde bit<50>
                xmi present bit<96>
                xma present bit<97>
                adapter present bit<98>
                all enabled bit<110>

❹      LOGGING OFF  00000000
                00000000
                00000000
                00000000

❺      ACTIVE CPUS  00000300
HW REVISION  08000000
                30303030
SYS SERIAL NUM 20202020
                544D2020
                4642

                SYS SERIAL NUM =      MTBF

SERIAL NUMBER 30303030
                30303030
                3030

                SERIAL NUMBER = 0000000000

RESRC DISABLE      0000

PHYS ADDRESS      E1C00000
```

This machine check error log example was chosen because it shows several of the additional sections (Section H.3.6) that can appear when error conditions indicate such information would be useful. In addition to the header and general CPU register information, the XMI, memory, and log adapter sections are included in this report. There are two basic problems with this machine: many memory CRD errors and a failed KDM70 adapter. The following discussions describe the report, and show how you might examine the report and discover the problems.

- ❶ All error log entries begin with a self-explanatory header section. See the *VMS Error Log Utility Manual* for more detail. The last two lines name the type of error (machine check in this case), the module handling the error (KA66) and its current firmware revision levels, and the XMI node number of the module.
- ❷ The first device-specific information given for machine check errors are the “software flags,” four longwords whose bits indicate that specific problems have been diagnosed. Each bit set is spelled out in the column to the right (see ❸). Table H-2 defines the possible software flags in a machine check error report. In general, for machine check errors, the first three longwords summarize problems that can be further pinpointed by examining the contents of the CPU and XMI error registers (see ❹ through ❺ on following pages). A bit set in the last longword indicates that more information on the error was compiled and appears at the end of the error report (see ❻ through ❽).
- ❸ This column briefly describes the problems noted by the bit settings in the software flag longwords. In general, this section serves as a roadmap to other parts of the error log that pinpoint the cause of the error. In this case, the error is a machine check error, code 6, a synchronous hardware error.

The next bit set indicates a cache fill error (cfe) read data error (rde). The read data error indicates a problem on an XMI transfer; the XMI section of the error log provides further information on the problem.
- ❹ Not currently used.
- ❺ Identifying information on the KA66A module is presented here: hardware revision, system serial number, resource disable, and physical address (for this XMI node). The resource disable field bits are defined in Table H-3.

Example H-3: Machine Check Error Log Report—Continued

V A X / V M S SYSTEM ERROR REPORT COMPILED 25-OCT-1991 11:08:22
PAGE 2.

⑥	XDEV	00008087	KA66A DEVICE REV = 0.
	XBE	9008A200	TRANSACTION TIMEOUT ⑦ COMMAND NOACK CORRECTED READ DATA XMI BAD ERROR DETECTED
	XFADR	61980004	FAILING ADDR = 8001980004(X) ⑧ FAILING LENGTH = 1.
	XFAER	100000F0	TRANSACTION BYTE MASK = 00F0(X) READ CMD ⑨
	XGPR	00000000	
	NSCSR0	00000020	boot processor NVAX rev = 00
	XCR0	00000020	crd interrupt disabled ⑩
	XBEER0	00000000	
	WFADR0	01ADC7C0	
⑥	WFADR1	01ADC7C0	
	NCSR	00000801	
⑪			SECURE CONSOLE set cntrol-p enable
	ICSR	00000001	enable VIC
	VMAR	000007E0	longword select = 00 sub_block select = 00 row index = 1F Bank Select = 01 Tag = 00
	VTAG	80504672	
	VDATA	D65756F2	
	ECR	00000080	iccs ext pmf pmux = 00 pmf emux = 00
⑪			

Next, the error log lists the pertinent registers of the CPU module experiencing the machine check error. Registers are defined in detail in the *VAX 6000 Model 600 System Technical User's Guide*.

Note that the register section of the reports show explanatory text for errors in uppercase letters, to draw your attention to the errors. Status and other information is shown in lowercase letters. (The XDEV, XBE, XFADR, and XFAER register information is the exception to this rule.)

- ⑥ The first group of CPU registers listed in a machine check error log are NEXMI status and error registers. This example shows problems with XMI transactions.
 - ⑦ The XBE (XMI Bus Error Register) shows “transaction timeout” and “command noack” indicating an incomplete XMI transaction. (The failing address can be found in the XFADR register (see ⑧, below.) “Corrected read data” indicates that a data read required correction.
 - ⑧ The XFADR (XMI Failing Address Register) shows a failing address in I/O space (bit <29> = 1). This address is associated with XMI node 3.
 - ⑨ The XFAER (XMI Failing Address Extension Register) shows the failing command was a read.
 - ⑩ The XCR0 (XMI Control Register) shows that the corrected read data interrupt has been disabled. That is, the operating system has handled an excess of these errors and has disabled corrected read data interrupts.
- ⑪ The Ibox registers appear next in the error log. A quick scan shows no problems are indicated here.

Example H-4: Machine Check Error Log Report—Continued

```

V A X / V M S      SYSTEM ERROR REPORT      COMPILED 25-OCT-1991 11:08:22
                                           PAGE 3.

12 PAMODE          00000000                30 bit physical address mode

MMEADR          8037EFFF 13
MMEPTE          00000000
MMESTS          1C008004

corresp ref had write/mod intent
lock 0
tnv fault

TBADR          00000000
TBSTS          800001D0 14

s5 cmd corresp to tb perr = 1D
source of ref causing tb perr = 04

PCADR          FFFFFFF8 15
PCSTS          FFFFF800

no operation

PCCTL          FFFFFC13

d-stream enabled
i-stream enabled
parity checking enabled
tb hit rate, p0/p1 sp i-stream reads

12
16 CCTL          00000037

bcache enabled 17
tag speed = 01
data speed = 01
size = 03
bcache coherency access
bcache hit

BCETSTS        00000000 18

tag store cmd being processed = 00

BCETIDX        00000000
BCETAG         00000000

ecc = 00
tag = 0000

BCEDSTS        00000000 19

data rams cmd at time of err = 00

BCEDIDX        00000000
BCEDECC       00000000

ecclo = 00
ecchi = 00

CEFADR         E1980000 20
CEFSTS         0001920A

REGISTER LOCKED
READ DATA ERROR, FILL FAILED
data returned to mbox
do not fill
count = 03

16

```

- ⑫ The next group of registers relate to the Mbox, including P-cache and translation buffer information.
 - ⑬ The MMEADR, MMEPTE, and MMESTS (memory management exception registers) indicate no problems. The lock bits <31:29> in MMESTS are 0, indicating that these registers are not locked. (If they were locked, they would contain valid error information that should not be written over.)
 - ⑭ Likewise, the TBADR and TBSTS (translation buffer registers) do not indicate problems; the lock bit <0> of TBSTS is 0.
 - ⑮ The P-cache registers (PCADR, PCSTS, and PCCTL) do not indicate any problems in this area. The lock bit <0> of PCSTS is 0, and PCCTL simply indicates the settings that control the functions of the primary cache.
- ⑯ The next group of registers in the error log relate to the Cbox (the control box for the backup cache).
 - ⑰ The CCTL (Cbox Control Register) in this example shows status only; neither hardware nor software has disabled the backup cache due to uncorrectable errors, which would be the case if bits <31> or <30> were set.
 - ⑱ The BCETSTS, BCETIDX, and BCETAG (backup cache error tag registers) are clear, indicating no errors in the B-cache tag store.
 - ⑲ Likewise, the BCEDSTS, BCEDIDX and BCEDECC (backup cache error data registers) are clear, indicating no errors in the B-cache data RAM transactions.
 - ⑳ The CEFADR (Cbox Error Fill Address Register) and CEFSTS (Cbox Error Fill Status Register) indicate problems with an outstanding read in I/O space.

Example H-5: Machine Check Error Log Report—Continued

V A X / V M S SYSTEM ERROR REPORT COMPILED 25-OCT-1991 11:08:22
 PAGE 4.

<p>21</p> <hr/> <p>NESTS 00000000 22</p> <p>NEOADR 01AE08E0 23</p> <p>NEOCMD 00000F05</p> <p>NEDATHI 00000000 24</p> <p>NEDATLO 00000000</p> <p>NEICMD 00000000</p> <p>21</p> <hr/> <p>STACK FRAME 25</p> <p> BYTE COUNT 00000018</p> <p> MCHK TYPE 80060008</p> <p> INT SYS REG 000001C1</p> <p> SAVEPC REG 801DAF20</p> <p> VA REG 0000035C</p> <p> Q REG 805A5D79</p> <p> OPCODE 00050080</p> <p> PC REG 805A5D79</p> <p> ERROR PSL 041F0008</p> <p> ERROR COUNTERS 26</p> <p> code_6 04</p> <p> cfe_ident_rde 03</p> <p> cfe_rde 01</p>	<p>ndal command = 05</p> <p>commander id = 00</p> <p>byte enable = 0F</p> <p>length of ndal transaction = 00</p> <p>byte enable = 0000</p> <p>length = 00</p> <p>ndal command = 00</p> <p>commander id = 00</p> <p>parity = 00</p> <p>AST LEVEL = 00(x)</p> <p>06 sync hardware error occurred</p> <p>vax restart bit</p> <p>OPCODE = 05(x)</p> <p>N-BIT</p> <p>INTERRUPT PRIORITY LEVEL = 31.</p> <p>PREVIOUS MODE = KERNEL</p> <p>CURRENT MODE = KERNEL</p> <p>INTERRUPT STACK</p> <p>FIRST PART DONE CLEAR</p>
---	--

- ②① The NDAL error registers appear next in the machine check error log.
- ②② The NESTS (NDAL Error Status) register is clear; none of the six errors recognized and flagged here have occurred.
- ②③ The NEOADR (NDAL Error Output Address) register is non-zero, but this signifies an error address only when the NO ACK bit <0> in the NESTS register is set. The NEOCMD (NDAL Error Output Command) register is set in the same fashion, so the data logged in this case does not indicate an error.
- ②④ The next three registers are loaded when a parity error occurs. No parity error has occurred; if there had, the PERR bit <3> in the NESTS register would be set.
- ②⑤ The machine check stack frame is shown here.
- ②⑥ These error counters show the total number of errors logged since this operating system session began (not just this entry).

Example H-6: Machine Check Error Log Report—Continued

V A X / V M S SYSTEM ERROR REPORT COMPILED 25-OCT-1991 11:08:22
PAGE 5.

27

XMI NODE DATA

PHYS ADDR	E1C00000	28
XDEV VALID	5F00	
XBE VALID	5F00	
XFADR VALID	5300	
XFAER VALID	1300	
NODE PRESENT	5F08	

XMI NODE #3. 29

XDEV	00000C22	
------	----------	--

KDM70
DEVICE REV = 0.
ADAPTER registers not readable

XMI NODE #8. 30

XDEV	00008087	
XBE	9008B200	
XFADR	61980004	
XFAER	100000F0	

KA66A
DEVICE REV = 0.
FAILING ADDR = 8001980004(X)
FAILING LENGTH = 1.
TRANSACTION BYTE MASK = 00F0(X)
READ CMD

XMI NODE #9. 30

XDEV	00028087	
XBE	90080240	
XFADR	01ADC7DC	
XFAER	100000FF	

KA66A
DEVICE REV = 2.
FAILING ADDR = 0001ADC7DC(X)
FAILING LENGTH = 0.
TRANSACTION BYTE MASK = 00FF(X)
READ CMD

27 -- [continues on next page]

- 27 This section contains the XMI subpacket information, provided when XMI-related errors occur.

XMI modules contain four consistently formatted registers: XDEV (XMI Device Register), XBE (XMI Bus Error Register), XFADR (XMI Failing Address Register), and XFAER (XMI Failing Address Extension Register). If errors occur here, the VMS error handling routines create and store error information for all the XMI nodes, to help pinpoint XMI problems.

- 28 First, the error log displays the physical I/O address of the CPU that called the routine to log the XMI subpacket resulting in this section of the report. The error log displays general information on the modules present on the XMI and the validity of the register information. The NODE PRESENT line indicates which XMI slots contained modules at boot time. In this case, 5F08 (hex) translates to 0101 1111 0000 1000 (binary), indicating nodes 3, 8, 9, 10, 11, 12, and 14 are filled.

The preceding four lines indicate the validity of the various error register information for these nodes. Basically, this tells whether the error register could be read. For example, the XDEV and XBE registers are shown as valid for node 10, but memory modules do not support the XFADR and XFAER registers. So, the valid bits are not set, and the detailed listings in 29 do not show these registers.

The XDEV valid bits are an exception. If an XDEV register is not readable, a memory-resident copy of its contents will be used so that the error log can show what type of module is at that XMI node. So, even when the XDEV valid bit for that node is 0, the device type given in the error log is accurate. The device revision will not be included, as that information is not available in the memory-resident copy. XMI node 3 represents this case (see 29).

- 29 XMI node 3 was shown to be present in the NODE PRESENT LINE of 28, but not valid in the XDEV VALID line. Here, the device name is shown from information stored in memory, but remaining registers were not readable and hence are not displayed.
- 30 This system is a dual-processor system; two KA66As are in XMI nodes 8 and 9. Both indicate read errors.

Example H-7: Machine Check Error Log Report—Continued

V A X / V M S SYSTEM ERROR REPORT COMPILED 25-OCT-1991 11:08:22
PAGE 6.

27 [continued from previous page]

XMI NODE #10	31		
XDEV	00834001		MS65A
			DEVICE REV = 131.
XBE	80001000		
XMI NODE #11	32		
XDEV	06A20C05		CIXCD
			HW REV = L2
			FW REV = V0.6
XBE	000002C0		
XMI NODE #12	33		
XDEV	06060C03		DEMNA
			HW REV = F
			EEPROM FW REV = 6.
XBE	80080304		
XFADR	80008F40		FAILING ADDR = 000008F40(X)
			FAILING LENGTH = 2.
XFAER	700000FF		TRANSACTION BYTE MASK = 00FF(X)
			WRITE MASKED CMD
XMI NODE #14	34		
XDEV	00022001		DWMB
			DEVICE REV = 2.
XBE	80080388		
XFADR	00020100		FAILING ADDR = 0000020100(X)
			FAILING LENGTH = 0.
XFAER	00000000		
			TRANSACTION BYTE MASK = 0000(X)

- ① The XBE register for the MS65A memory at node 10 shows that bit <31> is set, indicating that errors have occurred. Bit <12> is also set, indicating that further information is contained in the memory error status registers, presented in the next subpacket of information in the error log. (The XFADR and XFAER registers are not present in the MS65A, since this module is not a commander node on the XMI.)
- ② The CIXCD at node 11 shows no XMI errors, thus XFADR and XFAER are not locked and hence are not shown in the display.
- ③ XMI node 12 is a DEMNA adapter; the XBE register shows the corrected read data (CRD) bit <19> set, indicating the DEMNA received corrected read data from the memory, indicating that the memory detected and corrected a single-bit error.
- ④ Likewise, the DWMBA at node 14 shows a CRD.

Example H-8: Machine Check Error Log Report—Continued

```
V A X / V M S      SYSTEM ERROR REPORT      COMPILED 25-OCT-1991 11:08:22
                                           PAGE 7.
```

35

XMA	NODE # 10.		
	PHYS ADR	E1D00000	
	XDEV	00834001	NODE 10.
	XBE	80001000	MS65A DEVICE REV = 131.
	SEADR	02000000	NODE SPECIFIC ERROR DETECTED 36 ERROR DETECTED
	MCTL1	82024000	NO INTERLEAVE STARTING ADR = 0. MByte ENDING ADR = 32. MByte
	MECER	60243073	MEMORY VALID ERROR DETECTED 37 MEMORY SIZE = 0. MB ARRAY RAM TYPE = 1MB
	MECEA	00004120	CMD = OWNERSHIP READ COMMANDER ID = 36. DATA CRD ERROR 38 SECOND DATA ERROR OCCURRED
	MCTL2	00000005	ERROR ADDRESS = 00000824(X)
	TCY	00000000	SUP ASSERTION WHEN < 5 FREE ENTRIES
	BECER	00000000	REFRESH RATE = 15.6uS ENABLE HOLD FOR EACH SINGLE DATA PKT
	BECEA	00000000	BLOCK SYNDROME = 0. BLOCK STATE ID = 0. BLOCK STATE CODE = 0. CMD CODE = 0. COMMANDER ID = 0.
	STADR	00000000	BLOCK ERROR ADDR = 00000000(X)
	ENADR	00000080	STARTING ADR = 0. MByte ENDING ADR = 32. MByte

35 -- [continues on next page]

- ③⑤ This section contains memory module error register information. During the process of finding the reason for the machine check error, the VMS error handling routines examined the XBE register in all the XMI modules. In addition to the XMI I/O space read error found in the CPU XBE and XFADR register (see ⑦ and ⑧), errors were found in the memory module at XMI node 10, and this information was logged.
- ③⑥ The XBE register shows a node specific error was detected, and that the nature of the error can be determined by examining the error registers.
- ③⑦ The MCTL1 register is an error summary register; bit <31> is set, indicating that an error was detected.
- ③⑧ The Memory ECC Error Register (MECER) indicates a data CRD error, and a second data error occurred before the previous one was cleared from the buffer.

The remaining memory registers, shown here and continuing on the next page, show status information and no other errors. This memory is causing the CRD errors.

Example H-9: Machine Check Error Log Report—Continued

```
V A X / V M S      SYSTEM ERROR REPORT      COMPILED 25-OCT-1991 11:08:22
                                                    PAGE    8.

35 -- [continued from previous page]
    INTLV          00000000
                                INTERLEAVE MODE = 0.
                                INTERLEAVE ADDR = 0.
                                SEGMENT = 0.

    MCTL3          00000000
    MCTL4          00008000
                                MODULE POPULATION
                                MEMORY SIZE = 32. MByte
                                FREE STATE

    BSCTL          40000000
    BSADR          00000000
    EECTL          05030000
    TMOER          00000000

35

39
LOG ADAPTER DATA

XMI NODE #3.

    PHYS ADR      E1980000
                                NODE 3.
    XDEV          00000C22
                                KDM70
                                DEVICE REV = 0.
    XBE           00000000
                                COMMANDER ID = NODE #00(X)
    XFADR         00000000
    XFAER         00000000
                                TRANSACTION BYTE MASK = 0000(X)
    XCOMM         00000000
    SSP_IP        0000
    SSP_SA        0000
    PDR           00000000
    PER           0000

39
ANAL/ERR/OUT=ERRLOG.TXT ERRLOG.SYS
```

- ③ This is an example of a log adapter subsection in an error entry. This information is displayed when an XMI error shows a problem with a specific adapter node. The contents of the adapter registers are displayed.

In this case, the KDM70 module is broken; the error log routine could not read the contents of the registers on the adapter module. The device name was taken from information stored in memory, as described in item ②. This further substantiates the problem reported in the CPU registers (see ⑧) of not being able to read node 3's XBE CSR register.

H.4 Format of INT54 (Soft) Error Log Entry

The format of an error log entry for an INT54 error is similar to a machine check error log entry. The major differences are in the software error flags, which indicate the different conditions causing INT54 errors, and that there is no machine check stack frame.

H.4.1 Header

The header to the error log entry gives the entry number (there can be many errors logged in any given error log file) and other general information about the system, date and time, and so forth. Item ❶ in Example H-10 shows the format and typical content of the header for an error log entry.

H.4.2 Software Flags

As with machine check errors, the software flags are longwords whose bit settings indicate the particular conditions detected by the error handler. Example H-10 gives the software flags for INT54 entries. Item ❷ in Example H-10 shows an example of this type of output.

Table H-5: Software Flags for INT54 Errors

Bit	Definition
0	Inconsistent. Multiple error signals with overlapping syndromes.
1-10	Used internally by the VMS error handling routines; used for debug purposes.
17	The error formatter cannot find a recognizable error condition from its interpretation of the module registers.
18	Error syndrome not found.
24	CRD (corrected read data) error detected on the XMI.
25	XMI CC (corrected confirmation); a single-bit CC error on an XMI transfer was corrected.
26	XMI parity error detected.
32	VIC data parity error.
33	VIC tag parity error.
36	P-cache data parity error.
37	P-cache right bank tag parity error.
38	P-cache left bank tag parity error.

Table H-5 (Cont.): Software Flags for INT54 Errors

Bit	Definition
40	B-cache data addressing error.
41	B-cache data addressing error during a PTE (page table entry) reference.
42	B-cache data addressing error during which a PTE was lost.
43	B-cache data correctable data error.
44	B-cache data correctable data error lost. A correctable data error occurred, but an uncorrectable error occurred before it could be corrected, and the data that would determine the location of the correctable error (BCE-DIDX) has been overwritten.
45	B-cache data uncorrectable data error.
46	B-cache data unrecoverable error lost. A second uncorrectable error or bad address error occurred for which state was not saved. (BCEDIDX and BCEDECC were locked by the first error.)
47	B-cache data uncorrectable error during a PTE reference.
48	B-cache data uncorrectable error during which a PTE was lost.
56	B-cache tag addressing error.
57	B-cache tag correctable data error.
58	B-cache tag correctable data error lost. A correctable tag error occurred, but an uncorrectable error occurred before it could be corrected, and the data that would determine the location of the correctable error has been overwritten.
59	B-cache tag uncorrectable error.
60	B-cache tag unrecoverable error lost. A second uncorrectable error or bad address occurred for which state was not saved.
64	Cache fill error timeout.
65	Cache fill error timeout during a PTE reference.
66	Cache fill error read data error.
67	Cache fill error read data error during a PTE reference.
68	Cache fill error lost.
80	NO ACK on the NDAL internal data bus.
81	NO ACK on the NDAL internal data bus during a PTE reference.
82	Parity error on an NDAL transfer.

Table H-5 (Cont.): Software Flags for INT54 Errors

Bit	Definition
83	Inconsistent parity errors on an NDAL transfer.
84	NDAL parity error lost.
85	NDAL OLOST error.
95	Reserved last error.
96	XMI information present in the error log entry.
97	Memory information present in the error log entry.
98	Log adapter information present in the error log entry.
99	Disabled list present.
101	P-cache tag information present in the entry.
102	P-cache data information present in the entry.
103	VIC tag information present in the entry.
104	VIC data information present in the entry.
105	Unlock fail. Error bits in CPU error registers could not be reset.
106	Memory unlock fail. Error bits in memory error registers could not be reset.
107	Log adapter (LA) not locked.
108	No log adapter routine. The adapter at fault did not have a routine to log register contents.
109	Adapter does not exist.
110	All enabled. No features of error logging have been disabled.
111	No XMI errors occurred.
112	No memory errors occurred.
122	Log a memory soft error (CRD) entry report.
123	Inhibit logging.
124	Remove CPU.
125	Loop.
126	Abort.
127	Bugcheck.

H.4.3 Overview Information

After the software flags, some overview information is presented, such as the node name and system serial number (see ④ in Example H-10). Most of the information in this region is self-explanatory. However, one word of resource disable bits tells what facilities have been disabled as a result of an error. These bit settings are given in Table H-6.

Table H-6: Resource Disable Bits

Bit	Meaning
0	CPU disabled
1	VIC disabled
2	P-cache disabled
3	B-cache disabled
4	Corrected read data interrupts disabled
5	Single-bit error correction disabled
6-11	Unused
12-14	Reserved
15	CPU not started

H.4.4 CPU Error and Status Registers

CPU error and status register contents are displayed, along with explanatory text. The particular registers presented depend on the type of entry. The format of this information is the same as for machine check errors. In Example H-10, item ⑤ shows this section of error log output.

NOTE: *In this section, uppercase letters in explanatory text is used to draw attention to error conditions. Lowercase letters indicate status information. To spot problems, then, you can scan this section of the report for uppercase information. (The XDEV, XBE, XFADR, and XFAER register information is an exception to this rule.)*

H.4.5 Additional Error Information

Depending on the error found, additional information is presented in the INT54 error log entry:

- **Error Counters.** The entry report includes counters showing the total number of errors (of the type flagged in the first 95 bits of the software flags) logged since this operating system session began.
- **P-cache and VIC Tag and Data Parity Errors.** If parity errors occurred in the P-cache or VIC data or tag areas, the operating system attempts to find the good and bad data. A short display of the good and bad data will appear next if applicable. No such error occurred in Example H-10.
- **XMI Node Data.** General register contents on individual XMI bus adapter modules. The format of this information is the same as for machine check entries.
- **XMA Node Data.** Contents of MS65A memory module error registers. The format of this information is the same as for machine check entries.
- **Log Adapter Data.** Contents of the error registers on an XMI module showing errors. This log adapter information will usually help isolate the reason for the failure(s) detected. The format of this information is the same as for machine check entries.

H.4.6 Sample Error Log Entry for an INT54 (Soft) Error

Example H-10 shows an INT54 error log entry. The report format is similar to that for machine checks. At ❶, the header for the INT54 error is shown. Items ❷, ❸, and ❹ show the software flags, the unused “logging off” region, and the overview information.

Region ❺ shows the CPU registers. A quick scan of this area (looking for the uppercase letters) shows that a B-cache data correctable ECC error occurred (❻). In this error case, the operating system has determined an excess of B-cache ECC errors has occurred and has disabled the B-cache. The resource disable bits indicate this condition. Item ❼ shows the error counters for this session.

Example H-10: INT54 Error Log Report

```
V A X / V M S      SYSTEM ERROR REPORT      COMPILED 25-OCT-1991 08:58:44
                                                    PAGE 1.

① ***** ENTRY 1. *****
ERROR SEQUENCE 304.          LOGGED ON:      SID 13001401
DATE/TIME 29-AUG-1990 14:04:31.95      SYS_TYPE 02060101
SYSTEM UPTIME: 0 DAYS 02:21:35
SCS NODE: THERUT                      VAX/VMS V5.5

INT54 ERROR KA66 CPU FW REV# 1.  CONSOLE FW REV# 0.6
      XMI NODE # 1.

②  SW FLAGS          00000000
      00000800
      00000000
      00004000

      bdata corr bit<43>
      all enabled bit<110>

③  LOGGING OFF      00000000
      00000000
      00000000
      00000000

④  ACTIVE CPUS      00000042
      HW REVISION    08000000
      33304220
      SYS SERIAL NUM 30303030
      30303030
      3030

      SERIAL NUMBER  33314147
      31303033
      3431

      RESRC DISABLE  0008

      SERIAL NUMBER = 0000000000

      SERIAL NUMBER = GA13300114

      scache disabled

      PHYS ADDRESS   E1880000

⑤  XDEV              00028987      KA66A
      DEVICE REV = 2.

      XBE              000001C0
      XFADR            61B80008

      FAILING ADDR = 8001B80008(X)
      FAILING LENGTH = 1.

⑤ -- [continued on next page]
```

Example H-10 Cont'd on next page

Example H-10 (Cont.): INT54 Error Log Report

```
V A X / V M S      SYSTEM ERROR REPORT      COMPILED 25-OCT-1991 08:58:44
                                                    PAGE 2.

5 -- [continued from previous page]
XFAER              100000F0
                    TRANSACTION BYTE MASK = 00F0(X)
                    READ CMD

XGPR               00000000
NSCSR0            00000000
                    NVAX rev = 00

XCR0              00000000
XBEER0           00000000
WFADR0           038D8DA0
WFADR1           038D8D80
NCSR             00000801
                    SECURE CONSOLE
                    set cntrol-p enable

ICSR             00000000
VMAR             000007E0
                    longword select = 00
                    sub_block select = 00
                    row index = 1F
                    Bank Select = 01
                    Tag = 00

VTAG             8021FEB0
VDATA           D0051351
ECR             00000082
                    fbox enable
                    iccs ext
                    pmf pmux = 00
                    pmf emux = 00

PAMODE           00000000
                    30 bit physical address mode

MMEADR           80000EF4
MMEPTE          0000000C
MMESTS          1C00C004
                    corresp ref had write/mod intent
                    lock 0
                    m=0 fault

TBADR           00000000
TBSTS           800001D0
                    s5 cmd corresp to tb perr = 1D
                    source of ref causing tb perr = 04

PCADR           FFFFFFFF8
PCSTS           FFFFF800
                    no operation

PCCTL           FFFFFC00
                    tb hit rate, p0/p1 sp i-stream reads
                    tag speed = 01
                    data speed = 01

5 --[continued on next page]
```

Example H-10 Cont'd on next page

Example H-10 (Cont.): INT54 Error Log Report

V A X / V M S SYSTEM ERROR REPORT COMPILED 25-OCT-1991 08:58:44
 PAGE 3.

5 -- [continued from previous page]

		size = 03
		bcache coherency access
		bcache hit
BCETSTS	00000140	tag store cmd being processed = 0A
BCETIDX	01400020	
BCETAG	81C16E00	valid
		owned
		ecc = 2D
		tag = 040E
BCEDSTS	00000702	BCACHE DATA CORRECTABLE ECC ERROR 6
		data rams cmd at time of err = 07
BCEDIDX	001E8DC0	
BCEDECC	03000200	ecclo = 08
		ecchi = 0C
CEFADR	E1880000	
CEFSTS	00019220	ndal identification
		data returned to mbox
		do not fill
		count = 03
NESTS	00000000	
NEOADR	03E0A4EC	ndal command = 05
NEOCMD	00000F15	commander id = 01
		byte enable = 0F
		length of ndal transaction = 00
NEDATHI	00018001	byte enable = 0180
		length = 00
NEDATLO	00018001	
NEICMD	0000000C	ndal command = 0C
		commander id = 00
		parity = 00

5

ERROR COUNTERS 7

bdata_corr 10
 ANAL/ERR/OUT=TEST29.TXT TEST29.SYS

H.5 Format of INT60 (Hard) Error Log Entry

The format of an error log entry for a INT60 error is similar to a Machine Check error log entry. The major differences are the software error flags, which indicate the different conditions causing INT60 errors, and that there is no machine check stack frame.

H.5.1 Header

The header to the error log entry gives the entry number (there can be many errors logged in any given error log file) and other general information about the system, date and time, and so forth. Item ❶ in Example H-11 shows the format and typical content of the header for an error log entry.

H.5.2 Software Flags

As with machine check errors, the software flags are longwords whose bit settings indicate the particular conditions detected by the error handler. Table H-7 gives the software flags for INT60 entries. Item ❷ in Example H-11 shows an example of this type of output.

Table H-7: Software Flags for INT60 Errors

Bit	Definition
0	Inconsistent. Multiple error signals with overlapping syndromes.
1-5	Used internally by the VMS error handling routines; used for debug purposes.
17	The error formatter cannot find a recognizable error condition from its interpretation of the module registers.
18	Error syndrome not found.
32	B-cache data uncorrectable error.
33	B-cache data addressing error.
34	B-cache data unrecoverable error lost. A second uncorrectable error or bad address error occurred for which state was not saved. (BCEDIDX and BCEDECC were locked by the first error.)
48	Cache fill error timeout.
49	Cache fill error read data error.
50	Cache fill error unexpected fill.
64	NO ACK on the NDAL internal data bus.

Table H-7 (Cont.): Software Flags for INT60 Errors

Bit	Definition
65	OLOST on the NDAL internal data bus.
66	NDAL IPE error.
67	NDAL WSE error.
68	NDAL SSCIW error.
80	XMI WEI error.
81	XMI IPE error.
82	XMI WSE error.
84	XMI TTO error.
85	XMI URR error.
86	XMI SEO error.
87	Writeback failure.
95	Reserved last error.
96	XMI information present in the error log entry.
97	Memory information present in the error log entry.
98	Log adapter information present in the error log entry.
105	Unlock fail. Error bits in CPU error registers could not be reset.
107	Log adapter (LA) not locked.
108	No log adapter routine. The adapter at fault did not have a routine to log register contents.
109	Adapter does not exist.
110	All enabled. No features of error logging have been disabled.
111	No XMI errors occurred.
112	No memory errors occurred.
120	Imbedded vector interrupt not found.
123	Inhibit logging.
124	Remove CPU.
125	Loop.

Table H-7 (Cont.): Software Flags for INT60 Errors

Bit	Definition
126	Abort.
127	Bugcheck.

H.5.3 Overview Information

After the software flags, some overview information is presented, such as the node name and system serial number (see ④ in Example H-11.) Most of the information in this region is self-explanatory. However, one word of resource disable bits tells what facilities have been disabled as a result of an error. These bit settings are given in Table H-8.

Table H-8: Resource Disable Bits

Bit	Meaning
0	CPU disabled
1	VIC disabled
2	P-cache disabled
3	B-cache disabled
4	Corrected read data interrupts disabled
5	Single-bit error correction disabled
6-11	Unused
12-14	Reserved
15	CPU not started

H.5.4 CPU Error and Status Registers

CPU error and status register contents are displayed, along with explanatory text. The format of this information is the same as for machine check errors. In Example H-11, item ⑤ shows this section of error log output.

NOTE: *In this section, uppercase letters in explanatory text are used to draw attention to error conditions. Lowercase letters indicate status information. To spot problems, then, you can scan this section of the report for uppercase*

information. (The XDEV, XBE, XFADR, and XFAER register information is an exception to this rule.)

H.5.5 Additional Error Information

Depending on the error found, additional information is presented in the INT60 error log entry:

- **Error Counters.** The entry report includes counters showing the total number of errors (of the type flagged in the first 95 bits of the software flags) logged since this operating system session began.
- **XMI Node Data.** General register contents on individual XMI bus adapter modules. The format of this information is the same as for machine check entries.
- **XMA Node Data.** Contents of MS65A memory module error registers. The format of this information is the same as for machine check entries.
- **Log Adapter Data.** Contents of the error registers on an XMI module showing errors. This log adapter information will usually help isolate the reason for the failure(s) detected. The format of this information is the same as for machine check entries.

H.5.6 Sample Error Log Entry for an INT60 (Hard) Error

Example H-11 shows an INT60 error log entry. We will not go into the detailed analysis of individual registers that was done for the machine check example (Example H-2). The report formats are similar. At ❶, the header for the INT60 error is shown. Items ❷, ❸, and ❹ show the software flags, the unused “logging off” region, and the overview information.

Region ❺ shows the CPU registers. A quick scan of this area (looking for the uppercase letters) shows that an error occurred on an XMI writeback transaction: a transaction timeout caused by a command NO ACK (see ❻). This is a hard error. For this error, the CPU or memory can be at fault. The WFADR0 register ❼ shows the failing address. In this case, the address (1FFFFFFE0) is far out of range for the available memory, indicating that the processor is probably causing the problem.

Example H-11: INT60 Error Log Report

```
V A X / V M S      SYSTEM ERROR REPORT      COMPILED 25-OCT-1991 08:58:07
                                                    PAGE 1.
❶ ***** ENTRY 1. *****
ERROR SEQUENCE 24.          LOGGED ON:      SID 13001401
DATE/TIME 15-AUG-1991 14:35:51.87      SYS_TYPE 02060101
SYSTEM UPTIME: 0 DAYS 00:09:42
SCS NODE: THERUT          VAX/VMS V5.5

INT60 ERROR KA66 CPU FW REV# 1.  CONSOLE FW REV# 0.6
          XMI NODE # 1.

❷  SW FLAGS          00000000
          00000000
          00800000
          80004000
                                writeback failure bit<87>
                                all enabled bit<110>
                                bugcheck bit<127>

❸  LOGGING OFF      00000000
          00000000
          00000000
          00000000

❹  ACTIVE CPUS      00000002
          HW REVISION 08000000
          32304220
```

Example H-11 Cont'd on next page

Example H-11 (Cont.): INT60 Error Log Report

```
V A X / V M S      SYSTEM ERROR REPORT      COMPILED 25-OCT-1991 08:58:07
                                           PAGE 2.

SYS SERIAL NUM  20202020
                46464F43
                4545

SERIAL NUMBER   32314147
                30303030
                3135

RESRC DISABLE   0000

PHYS ADDRESS    E1880000
5 XDEV          00028087

XBE             80001040

XFADR           61880008

XFAER           100000F0

XGPR            00000036
NSCSR0         00000020

XCRO            00000020

XBEE0          00014000

WFADR0          1FFFFFFE0 7
WFADR1          03873BC0
NCSR            00000801

ICSR            00000001

VMAR            000007E0

SYS SERIAL NUM =      COFFEE

SERIAL NUMBER = GA12000051

KA66A
DEVICE REV = 2.

NODE SPECIFIC ERROR DETECTED
ERROR DETECTED

FAILING ADDR = 8001880008(X)
FAILING LENGTH = 1.

TRANSACTION BYTE MASK = 00F0(X)
READ CMD

boot processor
NVAX rev = 00

crd interrupt disabled

WBACK0 COMMAND NOACK 6
WBACK0 TRANSACTION TMO

SECURE CONSOLE
set cntrol-p enable

enable VIC

longword select = 00
sub_block select = 00
row index = 1F
Bank Select = 01
Tag = 00

5 -- [continued on next page]
```

Example H-11 Cont'd on next page

Example H-11 (Cont.): INT60 Error Log Report

```

V A X / V M S      SYSTEM ERROR REPORT      COMPILED 25-OCT-1991 08:58:07
5  PAGE          3.

VTAG                8051C600
VDATA               D655D600
ECR                  00000082

                                fbox enable
                                iccs ext
                                pmf pmux   = 00
                                pmf emux   = 00

PAMODE               00000000

                                30 bit physical address mode

MMEADR               00077DF0
MMEPTE               0000000C
MMESTS               1C00C004

                                corresp ref had write/mod intent
                                lock 0
                                m=0 fault

TBADR                00000000
TBSTS                800001D0

                                s5 cmd corresp to tb perr = 1D
                                source of ref causing tb perr = 04

PCADR                FFFFFFFF8
PCSTS                FFFFF800

                                no operation

PCCTL                FFFFFC13

                                d-stream enabled
                                i-stream enabled
                                parity checking enabled
                                tb hit rate, p0/pl sp i-stream reads

CCTL                 00000037

                                bcache enabled
                                tag speed = 01
                                data speed = 01
                                size = 03
                                bcache coherency access
                                bcache hit

BCETSTS              00000140

                                tag store cmd being processed = 0A

BCETIDX              01400020
BCETAG               8040F600

                                valid
                                owned
                                ecc = 1E
                                tag = 0402

BCEDSTS              00000400

                                data rams cmd at time of err = 04

5  -- [continued on next page]

```

Example H-11 Cont'd on next page

Example H-11 (Cont.): INT60 Error Log Report

V A X / V M S SYSTEM ERROR REPORT COMPILED 25-OCT-1991 08:58:07
PAGE 4.

```
5 -- [continued from previous page]
  BCEDIDX            00000020
  BCEDECC            03800000
                                     ecclo = 00
                                     ecchi = 0E
  CEFADR            E1F80000
  CEFSTS            00019200
                                     data returned to mbox
                                     do not fill
                                     count = 03
  NESTS             00000000
  NEOADR            03E6F1E0
  NEOCMD            00000F06
                                     ndal command = 06
                                     commander id = 00
                                     byte enable = 0F
                                     length of ndal transaction = 00
  NEDATHI           00018001
                                     byte enable = 0180
                                     length = 00
  NEDATLO           00018001
  NEICMD            0000000C
                                     ndal command = 0C
                                     commander id = 00
                                     parity = 00
```

ERROR COUNTERS

```
writeback_failur        01
ANAL/ERR/OUT-TEST20.TXT TEST20.SYS
```

H.6 Format of Lastfail Error Log Entry

The Lastfail error entry displays the errors found in XMI module registers before the system terminates a session.

The lastfail error log entry resembles log adapter data in machine check, INT54, and INT60 entries, and can have data from one or many XMI nodes. Here, two nodes are shown with XMI corrected read data (CRD) latched.

Example H-12: Lastfail Error Log Entry

```
V A X / V M S      SYSTEM ERROR REPORT      COMPILED 25-OCT-1991 10:03:45
                                                    PAGE 1.
❶
***** ENTRY 1. *****
ERROR SEQUENCE 32.          LOGGED ON:      SID 13001401
DATE/TIME 9-OCT-1991 07:48:34.36      SYS_TYPE 02060101
SYSTEM UPTIME: 0 DAYS 00:06:49
SCS NODE: INT54                      VAX/VMS V5.5

CPU LASTFAIL KA66 CPU FW REV# 1.  CONSOLE FW REV# 0.6
XMI NODE # 8.

XMI NODE #3. ❷
    PHYS ADR      E1980000
    XDEV          18110C22
    XBE           800800C0
    XFADR         C00074D4
    XFAER         C00075D4
    XCOMM         00000000
    SSP_IP        0000
    SSP_SA        0000
    PDR           00020100
    PER           0000

    NODE 3.
    KDM70 ❸
    DEVICE REV = 6161.
    COMMANDER ID = NODE #03(X)
    CORRECTED READ DATA ❹
    ERROR DETECTED
    FAILING ADDR = 00000074D4(X)
    FAILING LENGTH = 3.
    TRANSACTION BYTE MASK = 75D4(X)
    GET VAX LOCK CMD
```

- ❶ The header of the lastfail report contains the same general information as the other KA66A reports.
- ❷ XMI node 3 experienced an error after the error causing the shutdown to occur.
- ❸ The adapter experiencing the problem is a KDM70.
- ❹ The error is a corrected read data error. Note that corrected read data errors do not latch the XFADR. For more information on CRD errors, look for the CRD entries in the error log (described in Section H.8).

Example H-13: Lastfail Error Log Entry—Continued

```
V A X / V M S      SYSTEM ERROR REPORT      COMPILED 25-OCT-1991 10:03:45
                                                    PAGE 2.
XMI NODE #8. ⑥
    PHYS ADDRESS    E1C00000
    XDEV            00008087
                                Device type = KA66A ⑦
                                Device revision = 0000
    XBE            80080200
                                CORRECTED READ DATA ⑧
                                ERROR DETECTED
    XFADR          61C00008
                                FAILING ADDR = 8001C00008(X)
                                FAILING LENGTH = 1.
    XFAER          100000F0
                                TRANSACTION BYTE MASK = 00F0(X)
                                READ CMD
    NSCSR0         00000020
                                boot processor
                                NVAX rev = 00
    XBEER0         00000000
    WFADR0         01ADD4E0
    WFADR1         01ADD4E0
    NCSR           00000801
                                SECURE CONSOLE
                                set cntrol-p enable
    ICSR           00000000
    ECR            00000080
                                iccs ext
                                pmf pmux = 00
                                pmf emux = 00
    TBADR          00000000
    TBSTS          800001D0
                                s5 cmd corresp to tb perr = 1D
                                source of ref causing tb perr = 04
    PCSTS          FFFFF830
                                d-stream quadword pcache fill
    PCCTL          FFFFFC00
                                tb hit rate, p0/p1 sp i-stream reads
    CCTL           00000036
                                tag speed = 01
                                data speed = 01
                                size = 03
                                bcache coherency access
                                bcache hit
    BCETSTS        00000000
                                tag store cmd being processed = 00
    BCEDSTS        00000000
                                data rams cmd at time of err = 00
    CEFSTS         00019200
```

Example H-13 Cont'd on next page

Example H-13 (Cont.): Lastfail Error Log Entry—Continued

```
data returned to mbox
do not fill
count = 03
NESTS          00000000
ANAL/ERR/OUT=TEST_LASTFAIL3.TXT TEST_LASTFAIL3.SYS
```

- ⑥ XMI node 8 also experienced an error after the shutdown error.
- ⑦ The node was a KA66A. Note that the list of registers here is a subset of the CPU list of registers printed for a machine check, INT54, or INT60 error.
- ⑧ The error is a CRD error. Note that the CRD does not latch the XFADR register. For more information on CRD errors, look for CRD error entries (described in Section H.8).

H.7 Format of Memscan Error Log Entry

The Memscan error entry displays error registers of memory modules showing errors discovered when the operating system polls memory.

As shown in Example H-14, the memscan error log entry resembles the XMA node data information that can appear in machine check, INT54, and INT60 error log entries.

In this particular case, the error shows up at ❶, an ownership sequence error. Bit <11> of MCTL4 is set; this indicates that an UWMASK (Unlock Write Mask) command was sent to memory when the block state status was inappropriate for such an action. (The block was either free, owned, or tagged bad, none of which allow for an Unlock Write.) This is a system protocol problem.

Example H-14: Memscan Error Entry

```
V A X / V M S      SYSTEM ERROR REPORT      COMPILED 25-OCT-1991 09:00:36
                                                    PAGE 1.

***** ENTRY 1. *****
ERROR SEQUENCE 28.          LOGGED ON:      SID 13001401
DATE/TIME 15-AUG-1991 14:45:44.97      SYS_TYPE 02060101
SYSTEM UPTIME: 0 DAYS 00:07:01
SCS NODE: THERUT          VAX/VMS V5.5

MEMORY CONTROLLER ERROR KA66 CPU FW REV# 1.  CONSOLE FW REV# 0.6
                        XMI NODE # 1.

XMA NODE # 5.
  PHYS ADR      E1A80000
  XDEV          00844001      NODE 5.
  XBE          80001000      MS65A
                               DEVICE REV = 132.
  SEADR        02000000      NODE SPECIFIC ERROR DETECTED
                               ERROR DETECTED
  MCTL1        0202C000      NO INTERLEAVE
                               STARTING ADR = 0. MByte
                               ENDING ADR = 32. MByte
  MECER        00000000      MEMORY VALID
                               INHIBIT CRD STATUS
                               MEMORY SIZE = 0. MB ARRAY
                               RAM TYPE = 1MB
                               CMD = NULL
```

Example H-14 Cont'd on next page

Example H-14 (Cont.): Memscan Error Entry

```
MECEA          00000000          COMMANDER ID = 0.
MCTL2          00000005          ERROR ADDRESS = 00000000(X)
TCY            00000000
BECER         00000000          SUP ASSERTION WHEN < 5 FREE ENTRIES
                                     REFRESH RATE = 15.6uS
                                     ENABLE HOLD FOR EACH SINGLE DATA PKT
BECEA          00000000          BLOCK SYNDROME = 0.
                                     BLOCK STATE ID = 0.
                                     BLOCK STATE CODE = 0.
                                     CMD CODE = 0.
                                     COMMANDER ID = 0.
STADR          00000000          BLOCK ERROR ADDR = 00000000(X)
ENADR          00000080          STARTING ADR = 0. MByte
INTLV          00000000          ENDING ADR = 32. MByte
MCTL3          00000000          INTERLEAVE MODE = 0.
MCTL4          80008800          INTERLEAVE ADDR = 0.
                                     SEGMENT = 0.
                                     OWNERSHIP SEQUENCE ERR ①
                                     MODULE POPULATION
                                     ERROR SUMMARY
                                     MEMORY SIZE = 32. MByte
                                     FREE STATE
BSCTL          40000000
BSADR          00000000
EECTL          02EF0000
TMOER         00000000
ANAL/ERR/OUT=TEST_MEMSCAN.TXT TEST_MEMSCAN.SYS
```

H.8 Format of Memory Soft Error (CRD) Error Log Entry

The memory soft error (CRD) entry is a summary of all the corrected read data (CRD) errors that the system experienced during the session. It is produced when the system shuts down or when the CRD buffers are full.)

Example H-15: Memory Soft Error (CRD) Entry

```
V A X / V M S      SYSTEM ERROR REPORT      COMPILED  9-JAN-1992 15:21:47
                                           PAGE  1.

***** ENTRY 1. *****
ERROR SEQUENCE 44.          LOGGED ON:      SID 13001401
DATE/TIME  2-OCT-1991 17:29:37.43        SYS_TYPE 02060101
SYSTEM UPTIME: 0 DAYS 00:35:24
SCS NODE: THERUT                                           VAX/VMS V5.5

CORRECTABLE MEMORY ERROR KA66 CPU FW REV# 1.  CONSOLE FW REV# 0.6
XMI NODE # 1.

XMI NODE 12. ①
  MEMORY BANK      01 ②
  ECC SYND        8073 ③
                                     MS65A
                                     data ecc syndrome

  LOWEST ADR      0000DEA0 ④
  HIGHEST ADR     0000DEA0
  CRD COUNT       00000001 ⑤
                                     CRD COUNT = 1.

XMI NODE 12.
  MEMORY BANK      00
  ECC SYND        8073
                                     MS65A
                                     data ecc syndrome

  LOWEST ADR      00010000 ④
  HIGHEST ADR     00A00000
  CRD COUNT       00000009 ⑤
                                     CRD COUNT = 9.

ANAL/ERR/OUTPUT=229.TXT 229.SYS
```

- ❶ This is the node experiencing the error.
- ❷ This item identifies the memory bank within the node experiencing the error.
- ❸ The ECC syndrome word is formatted as shown in Table H-9.

Table H-9: ECC Syndrome Code

Bit	Meaning
0-13	Syndrome code. In this case, a data ecc syndrome.
14	Indicates block state ECC (bit 14=1) or memory data state ECC (bit 14 = 0)
15	Indicates the type of memory; 1 indicates a MS65A memory. A 0 would indicate a MS62A memory.

- ❹ The lowest/highest address fields represent an address window where errors have occurred within this module during this operating system session. If the lowest and highest addresses are identical, a single memory cell had a CRD error. If the lowest and highest addresses show a range, a series of locations are experiencing CRD errors.
- ❺ For XMI node 12, one location (0000DEA0) experienced one CRD error. The next entry shows that nine CRD errors occurred in a series of cells ranging from locations 00010000 through 00A00000.

Glossary

Adapter

A node that interfaces other buses, communication lines, or peripheral devices to the XMI bus or the VAXBI bus.

Address space

The 1 terabyte of physical address space that the XMI bus is capable of supporting; currently the XMI bus supports 1 gigabyte of physical memory.

Asymmetric multiprocessing

A multiprocessing configuration in which the processors are not equal in their ability to execute operating system code. In general, a single processor is designated as the primary, or master, processor; other processors are the slaves. The slave processors are limited to performing certain tasks, whereas the master processor can perform all system tasks. Contrast with *Symmetric multiprocessing*.

Bandwidth

The data transfer rate measured in information units transferred per unit of time (for example, Mbytes per second).

Boot device

Contains the bootblock and typically also contains the virtual memory boot program (VMB). A VAX 6000 series system can be booted from one of four boot devices: the console load device, a local system disk, a disk connected to the system through a CI adapter, or a disk connected to the system through the Ethernet.

Boot primitives

Small programs stored in ROM on each processor with the console program. Boot primitives read the bootblock from boot devices. There is a boot primitive for each type of boot device.

Boot processor

The CPU module that boots the operating system and communicates with the console.

Bootblock

Block zero on the system disk; it contains the block number where the virtual memory boot (VMB) program is located on the system disk and contains a program that, with the boot primitive, reads VMB from the system load device into memory.

CIBCA

VAXBI CI port interface; connects a system to a Star Coupler.

CIXCD

XMI CI port interface; connects a system to a Star Coupler.

Cold start

An attempt by the primary processor to boot a new copy of the operating system.

Compact disk server

Ethernet-based CD server; provides access to CD-ROMs for software installation, diagnostics, and on-line documentation.

Console communications area (CCA)

Segment of system main memory reserved by the console program.

Console mode

A mode of operation where the processor is not running the operating system but allows a console terminal operator to communicate with nodes on the XMI bus.

DEBNI

VAXBI adapter; Ethernet port interface.

DEMFA

XMI adapter to the FDDI (fiber distributed data interface).

DEMNA

XMI adapter; Ethernet port interface.

DHB32

VAXBI adapter communication device; supports up to 16 terminals.

DMB32

VAXBI adapter interface for 8-channel asynchronous communications for terminals, one synchronous channel, and a parallel port for a line printer.

Glossary-2

DRB32

VAXBI adapter; parallel port.

DSB32

VAXBI adapter communication device; provides two synchronous lines.

DSSI

Digital Storage System Interconnect. A Digital Storage Architecture interconnect used by the KFMSA adapter and RF and TF series integrated storage elements to transfer data and to communicate with each other.

DWMBB

The XMI-to-VAXBI adapter; a 2-module adapter that allows data transfer from the XMI to the VAXBI; DWMBB/A is the module in the XMI card cage, and DWMBB/B is the VAXBI module. Every VAXBI on a VAX 6000 series system must have a DWMBB adapter.

Ethernet-based compact disk server

The RRD compact disk drive, a console load device, functions as a server on the Ethernet.

Interleaving memory

See Memory interleaving.

KDB50

VAXBI adapter for RA disks; enables connection to disk drives.

KDM70

XMI adapter for RA disks; enables connection to disk drives.

KFMSA

XMI adapter for RF disks and TF tapes; enables connection to nodes on a DSSI bus. Each KFMSA adapter supports two DSSI buses.

ISE (integrated storage element)

All DSSI storage devices, such as RF disks and TF tapes, are ISEs.

Memory interleaving

Method to optimize memory access time; the VAX 6000 series console program automatically interleaves the memories in the system unless the SET MEMORY command is used to set a specific interleave or no interleave (which would result in serial access to each memory module). Interleaving causes a number of memories to operate in parallel.

Memory node

Also called the MS65A. Memory is a global resource equally accessible by all processors on the XMI. See also *MS65A*.

Module

A single XMI or VAXBI card that is housed in a single slot in its respective card cage. XMI modules (11.02" x 9.18") are larger than VAXBI modules (8.0" x 9.18").

MS65A

XMI memory array; a memory subsystem of the XMI. Memory is a global resource equally accessible by all processors on the XMI. A memory module can have 32, 64, or 128 Mbytes of memory, consisting of MOS 1-Mbit or MOS 4-Mbit dynamic RAMs, ECC logic, and control logic.

Node

An XMI node is a single module that occupies one of the 14 logical and physical slots on the XMI bus. A VAXBI node consists of one or more VAXBI modules that form a single functional unit.

Node ID

A hexadecimal number that identifies the node location. On the XMI bus, the node ID is the same as the physical location. On the VAXBI, the source of the node ID is an ID plug attached to the backplane.

Pended bus

A bus protocol in which the transfer of command/address and the transfer of data are separate operations. The XMI bus is a pended bus.

Primary processor

See *Boot processor*.

Processor node

A VAX processor that contains a central processor unit (CPU), executes instructions, and manipulates data contained in memory.

RBD

ROM-based diagnostics.

RBV20/RBV64

VAXBI adapter for write-once-read-many (WORM) optical disk drive. The RBV20 and RBV64 controllers use the KLESI-B adapter.

Secured terminal

Console terminal in program mode while the machine is processing.

Shadow set

Two disks functioning as one disk, each shadowing the information contained on the other, controlled by an HSC controller under the VMS operating system.

Symmetric multiprocessing

A multiprocessing system configuration in which all processors have equal access to operating system code residing in shared memory and can perform all, or almost all, system tasks.

System root

In a BOOT command, the argument to the /R5 qualifier.

TBK70

VAXBI adapter connecting the TK tape drive to the system.

TU81E

VAXBI adapter for a local (nonclustered) tape subsystem. The TU81E controller uses the KLESI-B adapter.

VAX Diagnostic Supervisor (VAX/DS)

Software that loads and runs diagnostic and utility programs.

VAXBI bus

The 32-bit bus used for I/O.

VAXBI Corner

The portion of a VAXBI module that connects to the backplane and provides an electrically identical interface for every VAXBI node.

VMB

The virtual memory boot program (VMB.EXE) that boots the operating system. VMB is the primary bootstrap program and is stored on the boot device. The goal of booting is to read VMB from the boot device and load the operating system.

XBI

Lines in the self-test display that show the status of DWMBB adapters and of VAXBI nodes. See also *DWMBB*.

XMI

The 64-bit, high-speed system bus.

XMI Corner

The portion of an XMI module that connects to the backplane and provides an electrically identical interface for every XMI node.

A

Architecture, 1-2
Autosizer program, 2-46, 3-33

B

Backup cache, 3-7
Booting
 boot error messages, C-1 to C-4
 boot status messages, C-1 to C-4
 from CD server, 3-31
 from console load device, 3-31
 over Ethernet, 2-42
Booting VAX/DS, 3-30
Boot primitives, 3-37
Boot processor, 3-12 to 3-13
 how to replace, 3-28
BPD
 in power-up test display, 2-6
Buffers
 error log, H-1

C

Cache
 backup, 3-7
 primary, 3-11
 secondary, 3-7
 virtual instruction cache, 3-11
 writeback, 3-7
 writethrough, 3-7
CCA, 2-15
CD server, 2-43
CIXCD adapter, 1-3
Configuration rules
 DWMBB/A adapter, 5-6 to 5-7

Configuration rules (Cont.)
 general, E-1 to E-3
 memory, 4-4
 processor, 3-4 to 3-5, E-2
Console commands, 3-22 to 3-23
 for interleaving, 4-10 to 4-11
Console Communications Area (CCA), 2-15
Console display, 2-6 to 2-7
Console errors, 2-14
CPU chip, 3-7, 3-10

D

DEMFA adapter, 1-3
DEMNA adapter, 1-3
Diagnostics
 design, 2-2
 overview, 2-2 to 2-3
 ROM-based, 2-2, 2-20 to 2-39
 VAX/DS, 2-2, 3-20
Diagnostic Supervisor, 3-30 to 3-37
 See VAX/DS
DWMBB/A adapter
 configuration rules, 5-7
DWMBB adapter, 1-3, 5-1 to 5-12
 configuration rules, 5-6
 functional description, 5-8 to 5-9
 physical description, 5-2 to 5-3
 registers, 5-10 to 5-12
 ROM-based diagnostic, 2-28
 specifications, 5-4 to 5-5
DWMVA/A adapter
 ROM-based diagnostic, 2-28
DWMVA adapter, 1-3

E

- EEPROM, 3-8
 - patching, 3-31
 - restoring corrupted, G-1 to G-5
 - using EVUCA to install patches, 3-31
 - version number, 3-9
- ERF
 - See Error Log Report Formatter, H-1
- ERRFMT, H-1
- Error log buffers, H-1
- Error Log Report Formatter (ERF), H-1
- Error Log Utility, H-1
- Error messages
 - console, B-1
- ETF
 - in power-up test display, 2-6
- EVSBA, 2-46, 3-33
- EVUCA, 2-41, 3-30
 - functions, 3-31
- Exception
 - machine check, H-12
- Extended test, 3-15

F

- Fatal error, defined, A-8

H

- Hard error, defined, A-8

I

- I/O adapters, 1-3
- Initial System Load (ISL) program, 3-31
- Interleaving, 4-8 to 4-11
 - default, 4-9
 - manual, 4-9
- Iport/Oport, 3-9
- ISL program, 3-31

K

- KA66A processor, 3-1 to 3-43
 - LEDs, 2-15
 - See also Processor, 1-3
- KDM70 adapter, 1-3
- KFMSA adapter, 1-3

L

- LEDs
 - processor error, 2-15
 - status, 2-8 to 2-9

M

- Machine check exceptions, H-12
- Machine check stack contents, H-9
- Memory
 - See MS65A memory
- Module handling, D-1 to D-3
- MS65A memory, 1-3, 4-1 to 4-19
 - addressing, 4-12 to 4-13
 - configuration rules, 4-4
 - features, 4-3
 - functional description, 4-6 to 4-7
 - good and bad memory pages, 4-17
 - interleaving, 4-8 to 4-11
 - physical description, 4-2 to 4-3
 - power-up, 4-14
 - registers, 4-18 to 4-19
 - self-test, 4-14 to 4-17
 - self-test errors, 4-16 to 4-17
 - specifications, 4-5
 - yellow LED, 4-17
- MTPR/MFPR instructions, 3-38

N

- NDAL data bus, 3-7
- NEXMI, 3-7
- NVAX CPU chip, 3-10

P

- Parse trees, F-1 to G-1
- Patchable control store
 - See PCS
- Patching ROM and PCS, 3-30
- P-cache, 3-11
- PCS, 3-11
- PCS patching, 3-30
- Power-up
 - processor, 3-14 to 3-17
 - sequence, 3-14
 - test, 3-14
- Power-up test
 - console display, 2-6
 - general definition, 2-4
 - module LEDs display, 2-8
 - results in XBER and XGPR
 - registers, 2-16
- Primary cache, 3-11
- Primary processor
 - See Boot processor
- Processor, 1-3, 3-1 to 3-43
 - boot, 3-12 to 3-13
 - configuration rules, 3-4 to 3-5,
E-2
 - console commands, 3-22 to 3-23
 - functional description, 3-6 to
3-11
 - how to add, 3-24
 - how to replace, 3-24
 - how to replace boot, 3-28
 - how to replace only, 3-26
 - LEDs, 2-8 to 2-9, 2-15
 - machine checks, H-9
 - physical description, 3-2
 - power-up, 3-14 to 3-17
 - registers, 3-38 to 3-43
 - self-test, 3-15
 - specifications, 3-3
 - XMI interface, 3-7
- Processor chip, 3-7
- Progress trace, 2-6

R

- RAM, 3-9
- RBDs
 - See ROM-based diagnostics
- Registers
 - DWMBB adapter, 5-10 to 5-12
 - MS65A memory, 4-18 to 4-19
 - processor, 3-38 to 3-43
 - VAXBI, 5-10
- Reset, A-11
- ROM, 3-8
- ROM-based diagnostics, 2-20 to
2-39, 3-18
 - cache tests, 2-36 to 2-37
 - callable tests, 2-18, 2-20
 - commands, 2-18
 - DEPOSIT, A-4 to A-5
 - EXAMINE, A-4 to A-5
 - QUIT, A-11
 - START, A-6 to A-9
 - SUMMARY, A-14 to A-15
 - control characters, A-2 to A-3
 - CPU/memory interaction tests,
2-26 to 2-27
 - DWMBB adapter, 2-28 to 2-31
 - DWMVA/A adapter, 2-28
 - entering RBD mode, 2-19
 - I/O devices, A-22 to A-23
 - memory, 2-32 to 2-35
 - multiprocessor tests, 2-38 to
2-39
 - operator-invoked, 2-20 to 2-21
 - overview, 2-2
 - program, 2-18
 - run at power-up, 2-17
 - sample session, A-16 to A-21
 - self-test, 2-22 to 2-25
 - system reset in, A-11
 - test printout
 - explanation, A-10 to A-13
 - failing, A-12 to A-13
 - passing, A-10 to A-11
 - sample, A-16 to A-21

S

Secondary cache, 3-7

Self-test

- console display, 2-6
- display, 3-15
- general definition, 2-5
- processor, 3-15

Serial number, 3-26

SET MANUFACTURING command, G-2

SET POWER command, G-2

SET SYSTEM SERIAL command, G-2

Single processor

- how to replace, 3-26

Soft error, defined, A-8

Specifications

- processor, 3-3

Stack contents

- on machine check, H-9

STF

- in power-up test display, 2-6

System

- architecture, 1-2
- functional description, 1-2 to 1-3
- serial number, 3-26

System reset, A-11

T

Troubleshooting flowcharts, 1-4 to 1-11

TYP

- in power-up test display, 2-6

U

UART, 3-9

UPDATE command, 3-13

V

VAX/DS, 2-3, 2-40 to 2-54, 3-30 to 3-37

- description, 2-41

VAX/DS (Cont.)

- diagnostics, 2-50 to 2-54, 3-20
- documentation, 2-40
- exerciser tests, 2-41
- explanation of levels, 2-40
- function tests, 2-41
- HELP in, 2-41
- logic tests, 2-41
- running in user mode, 2-44 to 2-45
- running standalone, 2-42 to 2-43
- sample session, 2-46 to 2-49
- types of diagnostic programs, 2-41

VAXBI nodes, running RBD, A-22

VAXBI registers, 5-10

VAX Diagnostic Supervisor, 3-30 to 3-37

- See VAX/DS

VIC, 3-11

Virtual instruction cache

- See VIC

VMEbus

- See DWMVA adapter

W

Writeback cache, 3-7

Write-through cache, 3-7

X

XBER register, 2-16 to 2-17

XGPR register, 2-16 to 2-17

XMI configuration rules, E-2 to E-3

XMI interface, 3-7

XMI nodes, running RBD, A-22

XMI-to-VAXBI adapter, 1-3

- See also DWMBB adapter