VAX 6000: Installing MS65A Memories

Order Number EK–MS65A–UP–001

This manual is intended for use by Digital customer service engineers and self-maintenance customers installing MS65A memories.

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Preface

Intended Audience

This manual is written for Digital customer service engineers and for self-maintenance customers installing MS65A memories in VAX 6000 systems. MS65A is the memory required by the VAX 6000 Model 500. MS65A memories can be installed in VAX 6000 Model 200, 300, and 400 systems.

Document Structure

This manual uses a structured documentation design. There are many topics, organized into small sections for efficient reference. Each topic begins with an abstract. You can quickly gain a comprehensive overview by reading only the abstracts. Next is an illustration or example, which also provides quick reference. Last in the structure is descriptive text.

This manual has three chapters and two appendixes, as follows:

- **Chapter 1, Overview**, provides MS65A configuration rules and information on ROM upgrades.

- **Chapter 2, Unpacking and Installation**, gives instructions on how to unpack and install the MS65A.

- **Chapter 3, Power-Up and Self-Test**, describes the VAX 6000 self-test with a focus on the MS65A memory modules.

- **Appendix A, ROM Kit Order Numbers**, shows the ROM kit numbers for VAX 6000 systems.

- **Appendix B, Interleaving**, gives an overview of the interleaving process for the MS65A.

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 one 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	
VAX 6000 Series Owner's Manual	EK–600EA–OM
VAX 6000 Series Vector Processor Owner's Manual	EK–60VAA–OM
VAX 6000 Vector Processor Programmer's Guide	EK–60VAA–PG
Service and Installation	
VAX 6000 Platform Technical User's Guide	EK–600EA–TM
VAX 6000 Series Installation Guide	EK–600EA–IN
VAX 6000 Installationsanleitung	EK–600GA–IN
VAX 6000 Guide d'installation	EK–600FA–IN
VAX 6000 Guia de instalacion	EK–600SA–IN
VAX 6000 Platform Service Manual	EK–600EA–MG
Options and Upgrades	
VAX 6000: XMI Conversion Manual	EK–650EA–UP
VAX 6000: Installing MS65A Memories	EK–MS65A–UP
VAX 6000: Installing the H7236-A Battery Backup Option	EK–60BBA–IN
VAX 6000: Installing the FV64A Vector Option	EK–60VEA–IN
VAX 6000: Installing the VAXBI Option	EK–60BIA–IN

Manuals specific to models are listed in Table 2.

Table 2: VAX 6000 Model Level Documentation

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

Associated Documents

Table 3 lists other documents that you may find useful.

Table 3: Associated Documents

Title	Order Number
System Hardware Options	
VAXBI Expander Cabinet Installation Guide	EK–VBIEA–IN
VAXBI Options Handbook	EB–32255–46
System I/O Options	
CIBCA User Guide	EK–CIBCA–UG
CIXCD Interface User Guide	EK–CIXCD–UG
DEC LANcontroller 200 Installation Guide	EK–DEBNI–IN
DEC LANcontroller 400 Installation Guide	EK–DEMNA–IN
InfoServer 100 Installation and Owners Guide	EK–DIS1K–IN
KDB50 Disk Controller User's Guide	EK–KDB50–UG

Table 3 (Cont.): Associated Documents

Title	Order Number
System I/O Options	
KDM70 Controller User Guide	EK–KDM70–UG
RRD40 Disc Drive Owner's Manual	EK–RRD40–OM
RA90/RA92 Disk Drive User Guide	EK–ORA90–UG
SA70 Enclosure User Guide	EK–SA70E–UG
Operating System Manuals	
Guide to Maintaining a VMS System	AA–LA34A–TE
Guide to Setting Up a VMS System	AA–LA25A–TE
Introduction to VMS System Management	AA–LA24A–TE
ULTRIX–32 Guide to System Exercisers	AA–KS95B–TE
VMS Upgrade and Installation Supplement: VAX 6000 Series	AA–LB36C–TE
VMS Networking Manual	AA–LA48A–TE
VMS System Manager's Manual	AA–LA00A–TE
VMS VAXcluster Manual	AA–LA27B–TE
Peripherals	
HSC Installation Manual	EK–HSCMN–IN
H4000 DIGITAL Ethernet Transceiver Installation Manual	EK–H4000–IN
Installing and Using the VT320 Video Terminal	EK–VT320–UG
RV20 Optical Disk Owner's Manual	EK–ORV20–OM
SC008 Star Coupler User's Guide	EK–SC008–UG
TA78 Magnetic Tape Drive User's Guide	EK–OTA78–UG
TA90 Magnetic Tape Subsystem Owner's Manual	EK–OTA90–OM
TK70 Streaming Tape Drive Owner's Manual	EK–OTK70–OM
TU81/TA81 and TU/81 PLUS Subsystem User's Guide	EK–TUA81–UG

Table 3 (Cont.):   Associated Documents

Title	Order Number
VAX Manuals	
VAX Architecture Reference Manual	EY–3459E–DP
VAX Systems Hardware Handbook — VAXBI Systems	EB–31692–46
VAX Vector Processing Handbook	EC–H0739–46

x

Chapter 1
Overview

MS65A memory modules are used in all VAX 6000 series systems. Model 500 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
Model 500	Yes	No	No
Models 200, 300, 400	Yes	Yes	Yes

This chapter describes the use of MS65A memory modules. Sections include:

- MS65A Description
- Required ROM Upgrades
- MS65A Configurations

1.1 MS65A Description

The MS65A memory module is a metal-oxide semiconductor (MOS), dynamic random access memory (DRAM), which provides up to 128 Mbytes of data storage. The memory module is designed for use with the VAX 6000 through the XMI bus.

Figure 1–1: MS65A Module
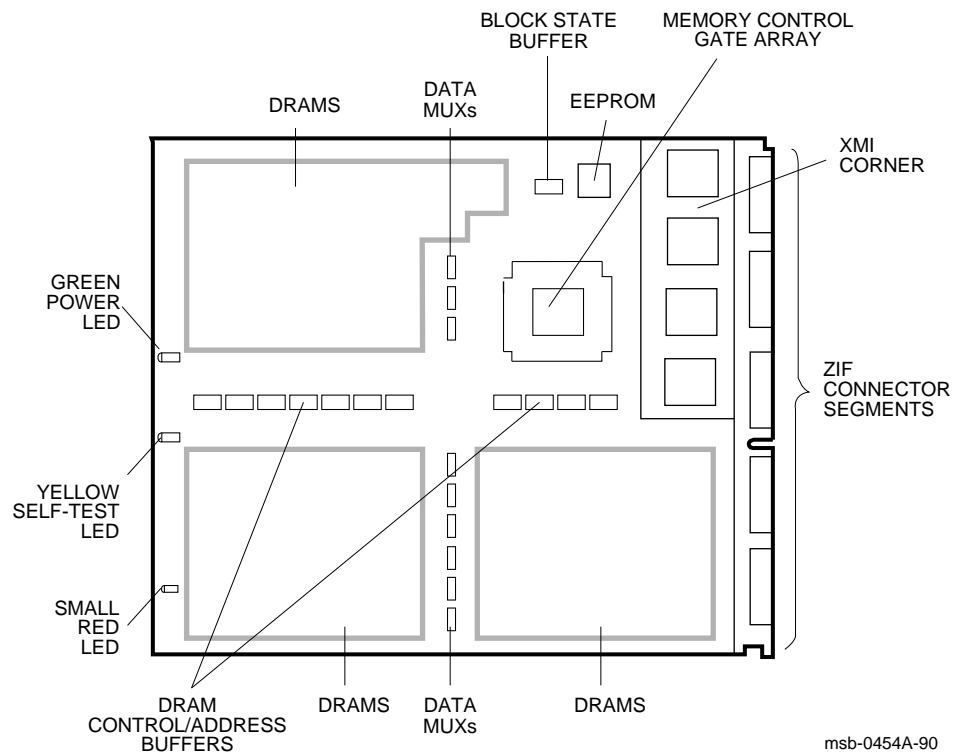
The MS65A memory module has the following features:

- The memory module contains MOS dynamic RAM (DRAM) arrays; 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.

- Storage arrays are made up of two or four banks, either 155 or 299 DRAMs.

- 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.

NOTE: *The MS65A memory is required by VAX 6000 Model 500 and later models since it implements the write-back cache protocol. However, it can be used in Model 200, 300, and 400 systems.*

1.2 Required ROM Upgrades

VAX 6000 Models 200, 300, and 400 require CPU console and diagnostic ROMs at correct revision levels to use MS65A memory modules.

Example 1–1: Checking ROM Levels

```
#123456789 0123456789 0123456789 01234567#  ❶

F   E   D   C   B   A   9   8   7   6   5   4   3   2   1   0   NODE #

    A   .   .   .   .   M   M   M   .   .   P   P   P   P       TYP
    o   .   .   .   .   +   +   +   .   .   +   +   +   +       STF
    .   .   .   .   .   .   .   .   .   .   E   E   E   B       BPD
    .   .   .   .   .   .   .   .   .   .   +   +   +   +       ETF
    .   .   .   .   .   .   .   .   .   .   E   E   E   B       BPD

.   .   .   .   .   .   .   .   .   +   .   +   .   +   +   .   XBI D +
.   .   .   .   .   .   .   .   .   +   .   +   .   +   +   .   XBI E +

    .   .   .   .   .   A2  A2  A1  .   .   .   .   .   .       ILV
    .   .   .   .   .   32  32  64  .   .   .   .   .   .       128 Mb

ROM0 = V3.00  ❷   ROM1 = V3.00  ❷   EEPROM = 2.03/3.00   SN = SG01234567#

?2D For Secondary Processor 3  ❸
?52 ROM revision mismatch.  Secondary processor has revision 2.0
?2D For Secondary Processor 3
?54 EEPROM revision mismatch.  Secondary processor has revision 2.03/2.01
?2D For Secondary Processor 4
?52 ROM revision mismatch.  Secondary processor has revision 1.0
?2D For Secondary Processor 4
?54 EEPROM revision mismatch.  Secondary processor has revision 1.00/1.00
?2D For Secondary Processor 4
?56 Console parameters on secondary processor do not match primary
```

Table 1–1: Minimum ROM Level Required

Model 200	V5.0
Model 300	V6.0
Model 400	V3.00
Model 500	V2.00

NOTE: *Without the correct console ROMs, the system may crash and battery backup will not work correctly.*

Before you install the MS65A memory modules, compare the ROM version with the required version shown in Table 1–1. Example 1–1 shows a Model 400 system with 128 Mbytes of memory.

You can check the ROM level on the last line of the self-test display on each processor module. Power up the system or issue an INITIALIZE command to run self-test.

❶ This example is from a Model 400 system. The progress trace line does not appear for Models 200 and 300.

❷ The ROM information appears in this format for a VAX 6000 Model 400. Examine the ROM version numbers at ❷.

   The ROM information appears in the following format for VAX 6000 Models 200 and 300:

```
ROM = 6.0   EEPROM = 2.0/6.0   SN = SG01234567
```

❸ These are examples of ROM revision mismatch messages indicating that the CPU modules have different ROM versions. The ROMs need to be updated so that the versions are all the same. Refer to Appendix A for ROM kit order numbers for the ROMs specific to your system.

1.3 MS65A Configurations

MS62A memory modules cannot be used in VAX 6000 Model 500 systems. MS62A and MS65A memory modules can be mixed in earlier models. (Figure 1–2 shows the order of placement of MS65A modules in the XMI backplane.)
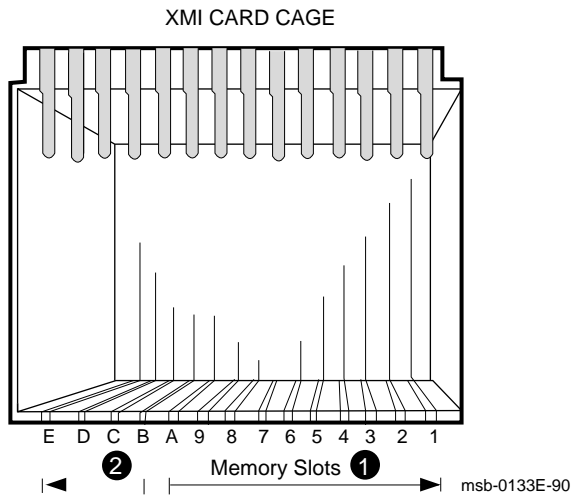
Figure 1–2: MS65A Configuration

XMI CARD CAGE

E D C B A 9 8 7 6 5 4 3 2 1

❷ Memory Slots ❶

msb-0133E-90

Table 1–2: Memory Module Mixing

System	MS65A	MS62A	Both MS65A and MS62A
Model 500	Yes	No	No
Model 400	Yes	Yes	Yes
Model 300	Yes	Yes	Yes
Model 200	Yes	Yes	Yes

If an MS65A memory module or a mix of memory modules is used in Model 200, 300, or 400 systems, ROMs must be upgraded. The console and diagnostic ROMS on the processor modules are replaced so that MS65A memory modules are supported.

Memory ROM-based diagnostics function with both types of memory modules. However, the ROM-based diagnostic does not test functions of the EEPROM on the MS65A memory module on VAX 6000 Models 200, 300, and 400.

Memory modules are configured after I/O adapter and processor modules. Install memory modules next to vector processors first, then install additional memories as follows:

❶ Install the first memory module in slot 9. Fill all available slots left to right from slot 9 to slot 2.

❷ Install any additional memory modules right to left in available slots from slot A to slot D.

NOTE: *VAX 6000 systems with FV64A vector modules are an exception to these configuration rules. Memory is first installed to the left of each vector processor module, since only memory modules are permitted in these slots.*

Chapter 2
Unpacking and Installation

This chapter discusses the unpacking and installation procedures for the MS65A memory module. Sections include:

- Unpacking and Inspection Procedures

- Memory Installation in Systems Without a Vector Processor

- Memory Installation in Systems with a Vector Processor

2.1 Unpacking and Inspection Procedures

MS65A memory modules are shipped in special packing cases to ensure maximum protection for each module. Each module should be inspected before installation.

Table 2–1: MS65A Memory Modules

Option Number	Module Number	Memory Size (Mbytes)
MS65A-BA	T2053-BA	32
MS65A-CA	T2053-CA	64
MS65A-DA	T2053-DA	128

CAUTION: *The MS65A module is static sensitive. ESD precautions must be taken when handling the module outside of its protective case. Use an antistatic wrist strap when handling the module. Use a Velostat Kit (CD kit number A2-W0299-10) to lay the modules on if many modules are removed and installed.*

The MS65A memory module is shipped in a special electrostatic discharge (ESD) case to protect it from mechanical shock, electrical shock, and vibration.

MS65A memory modules are available in three sizes. Table 2–1 lists the three MS65A memory modules.

To unpack and inspect the memory module, do the following:

1. Put the antistatic wrist strap on.

2. Open the case and remove any packing materials.

3. Visually inspect the module for any damage such as bent pins.

2.2 Memory Installation in Systems Without a Vector Processor

Before adding memory modules, check the interleave set. If the default interleave is not being used, return the system to the default, so that new memory modules will be interleaved by the system. Install new memory modules in the appropriate slots. Refer to the configuration rules in Section 1.3.

Example 2–1: Existing Memory Interleave

```
>>> SHOW MEMORY                      ! Displays the memory lines from the
                                     ! system self-test
F   E   D   C   B   A   9   8   7   6   5   4   3   2   1   0   NODE #

    .   .   .   .   B1  A1  .   .   .   .   .   .   .   .       ILV
    .   .   .   .   32  32  .   .   .   .   .   .   .   .       64 Mb
        /INTERLEAVE:(9, A)

>>> SET MEMORY /INTERLEAVE:DEFAULT ! Command to cancel any previous
                                   ! interleave instruction
```

Example 2–2: Default Memory Interleave with MS65A Installed

```
#123456789 0123456789 0123456789 01234567#

F   E   D   C   B   A   9   8   7   6   5   4   3   2   1   0   NODE #

    A   A   .   .   M   M   M   .   .   .   P   P   P   P       TYP
    o   o   .   .   +   +   +   .   .   .   +   +   +   +       STF
    .   .   .   .   .   .   .   .   .   .   E   E   E   B       BPD
    .   .   .   .   .   .   .   .   .   .   +   +   +   +       ETF
    .   .   .   .   .   .   .   .   .   .   E   E   E   B       BPD

.   .   .   .   .   .   .   .   .   +   .   +   +   .   +   .   XBI D +
.   .   .   .   .   .   .   .   .   +   .   +   .   +   +   .   XBI E +

    .   .   .   .   A2  A2  A1  .   .   .   .   .   .   .       ILV
    .   .   .   .   32  32  64  .   .   .   .   .   .   .       128 Mb

ROM0 = V3.00  ROM1 = V3.00  EEPROM = 2.03/3.00    SN = SG01234567
```

Before you add memory modules to a system, check to see that the system is set to the default interleave (see Example 2–1). If the interleave is not set to default, record the current setting and then set interleaving to default. Default interleaving is recommended because it provides the optimum memory configuration. See Appendix B for information on how the console program interleaves memory.

To add memory modules, perform the following steps:

1. Perform an orderly shutdown of the system.

2. Turn the upper key switch on the front control panel to the Off position.

3. Open the front cabinet door.

4. Remove the clear plastic door in front of the XMI cage.

   CAUTION: *You must wear an antistatic wrist strap attached to the cabinet when you handle any modules.*

5. Install memory modules in slots adjacent to existing memory modules Hold the lever up until the module is in place and then press the lever down to close the connectors.

6. Replace the clear door.

7. Follow the power-up and self-test procedure in Chapter 3.

In Example 2–2 one 64-Mbyte memory module was added to a Model 400 system. By convention (for a VAX 6000 Model 400), memory begins at slot A and expands to the right, so the new module is inserted in slot 8.

2.3 Memory Installation in Systems with a Vector Processor

Memory installation in a VAX 6000 Model 400 or later system with the FV64A vector processor requires a special configuration. Install new memory modules in the appropriate slots.

Example 2–3: MS65A Installed in a Vector System

```
#123456789 0123456789 0123456789 0123456789 0123456789 01234567#

F   E   D   C   B   A   9   8   7   6   5   4   3   2   1   0   NODE #

    A   A   .   .   .   M   M   M   M   V-  -P  M   V-  -P      TYP
    +   +   .   .   .   +   +   +   +   +   +   +   +   +       STF
    .   .   .   .   .   .   .   .   .   E   E   .   E   B       BPD
    .   .   .   .   .   .   .   .   .   +   +   +   +   +       ETF
    .   .   .   .   .   .   .   .   .   E   E   .   E   B       BPD

    .   .   .   .   .   A3  A2  A1  A4  .   .   A4  .   .       ILV
    .   .   .   .   .   64  64  64  32  .   .   32  .   .       256 Mb

CONSOLE = V2.00   RBDs = V2.00   EEPROM = 2.03/2.00   SN = SG01234567

>>>
```

Before you add memory modules to a system, the system must be set to the default interleave. In a system with vector processors, memory modules are first installed to the left of the FV64A vector modules.

To add memory modules, perform the following steps:

1. Perform an orderly shutdown of the system.

2. Turn the upper key switch on the front control panel to the Off position.

3. Open the front cabinet door.

4. Remove the clear plastic door in front of the XMI cage.

   CAUTION: *You must wear an antistatic wrist strap attached to the cabinet when you handle any modules.*

5. Install memory modules in the appropriate slots. Hold the lever up until the module is in place and then press the lever down to close the connectors.

6. Replace the clear door.

7. Follow the power-up and self-test procedure in Chapter 3.

In Example 2–3 three more memory modules were added to a Model 500 system. Memory begins at slot 9 and expands to the right, so the three new modules were inserted in slots 9, 8, and 7.

Chapter 3

Power-Up and Self-Test

This chapter provides the power-up procedure and explains the operation of self-test and self-test errors.

- Power-Up
- Self-Test Errors

3.1 Power-Up

Power up the system and check the self-test display for the new memory modules. Check the interleaving and any error messages. The self-test display shows that the console program configured the additional memory into the system.

Example 3–1: Model 500 Power-Up

```
#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   .   .   .   P   P   P   P       TYP❶
    +   +   .   .   +   +   +   .   .   .   +   +   +   +       STF❷
    .   .   .   .   .   .   .   .   .   .   E   E   E   B       BPD
    .   .   .   .   .   .   .   .   .   .   +   +   +   +       ETF
    .   .   .   .   .   .   .   .   .   .   E   E   E   B       BPD

    .   .   .   .   A2  A2  A1  .   .   .   .   .   .   .       ILV❸
    .   .   .   .   32  32  64  .   .   .   .   .   .   .       128 Mb

CONSOLE = V2.00  RBDs = V=2.00  EEPROM = 2.00/2.00   SN = SG01234567

>>> ❹
```

Power up the system by turning the lower key switch to Halt and the upper key switch to Enable.

Check the self-test display as follows:

❶ The memory modules are indicated by an M on the TYP line, as shown in Example 3–1. The memory module in slot 8 has been added.

❷ All three memories passed self-test, as indicated by plus signs (+) on the STF line.

❸ All memories are represented on the ILV line; in this case all three are in one interleave set (the default).

❹ No error messages are displayed. Error messages are listed in the *VAX 6000 Series Owner's Manual.*

3.2 Self-Test Errors

If an MS65A memory module fails self-test, the console runs an explicit memory test on the failing module. Any console error messages are displayed. The failing module is included in the memory configuration. Example 3–2 shows how a failing memory module can be excluded from the configuration.

Example 3–2: MS65A Memory Module Exclusion

```
>>>  INITIALIZE

#123456789 0123456789 0123456789 01234567#

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   o   .   .   -   +   +   +   .   .   +   +   +   +       STF
    .   .   .   .   .   .   .   .   .   .   E   E   E   B       BPD
    .   .   .   .   .   .   .   .   .   .   +   +   +   +       ETF
    .   .   .   .   .   .   .   .   .   .   E   E   E   B       BPD

.   .   .   .   .   .   .   .   .   +   .   +   +   .   +   .   XBI D +
.   .   .   .   .   .   .   .   .   +   .   +   .   +   +   .   XBI E +

        .   .   .   .   C1  B1  A2  A1  .   .   .   .   .   .   ILV
        .   .   .   .   32  32  64  64  .   .   .   .   .   .   192 Mb

ROM0 = V3.00  ROM1 = V3.00  EEPROM = 2.03/3.00   SN = SG01234567

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

If an MS65A node fails self-test, as indicated by a – in the STF line, the console executes an explicit memory test during the building of the bitmap. The failing memory module is included in the configuration, but the addresses that failed self-test are not used. Since the memory at node A failed self-test, it would be included in the configuration, but would not interleaved with node 9. Use the SET MEMORY command without designating the node you want to exclude.

During the explicit memory test, a number of console messages might be displayed to aid in diagnosing the problem. Console error messages pertaining to memory are shown in Table 3–1.

Table 3–1: Console Error Messages for Memory (Models 400 and 500)

Error Message	Meaning
?0037 Explicit interleave list is bad. 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.
?0046 Memory interleave set is inconsistent: *n n ...*	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 Insuffcent 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.
?0048 Uncorrectable memory errors—long memory test must be performed.	A Model 400 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:	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.

When all testing is done, the yellow self-test LED on the memory module indicates *only* that the self-test has completed. After self-test, starting and ending addresses are set by the boot processor.

NOTE: *If self-test fails, see the VAX 6000 Model 500 Service Manual and the VAX 6000 Model 300 and 400 Service Manual.*

Appendix A
ROM Kit Order Numbers

This appendix lists the ROM kit order numbers to upgrade VAX Models 200, 300, and 400 systems to support MS65A memory modules. ROM replacement instructions are included in each ROM kit.

Table A–1: ROM Kit Numbers

System	Required ROM Level	Model	ROM Kit Number
Model 200	V5.0 or later	Model 210	62X00-AA
		Model 220	62X00–AB
		Model 230	62X00–AC
		Model 240	62X00–AD
Model 300	V6.0 or later	Model 310	63X00–AA
		Model 320	63X00–AB
		Model 330	63X00–AC
		Model 340	63X00–AD
		Model 350	63X00–AE
		Model 360	63X00–AF
		VAXserver 310	63X00–BA
		VAXserver 320	63X00–BB
Model 400	V3.00 or later	Model 410	64X00–AA
		Model 420	64X00–AB
		Model 430	64X00–AC
		Model 440	64X00–AD

Table A–1 (Cont.): ROM Kit Numbers

System	Required ROM Level	Model	ROM Kit Number
		Model 450	64X00–AE
		Model 460	64X00–AF
		VAXserver 410	64X00–BA
		VAXserver 420	64X00–BB
Model 500	No ROM change is required.		

Appendix B
Interleaving

Interleaving optimizes memory access time and is automatically performed by the console program. Console commands associated with interleaving can be used to interleave memories, but this is not recommended.
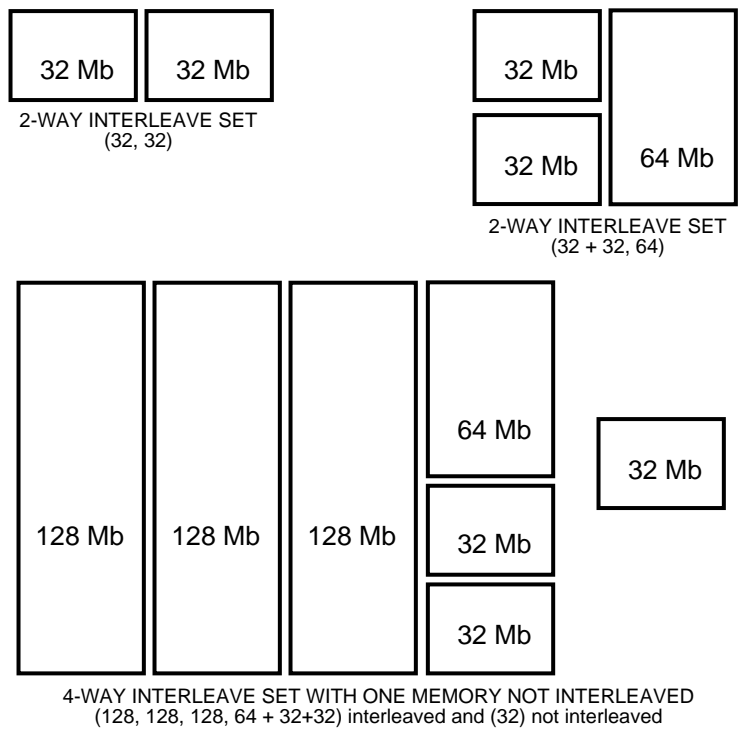
This appendix contains the following information on interleaving:

• Overview

• Console Commands

B.1 Overview

Memory supports 2-, 4-, 8-way or no interleaving. Up to eight memory modules can be interleaved. Memory should be interleaved by using the default interleave rather than with console commands.

Figure B–1: MS65A Interleaving


```
┌────────┐ ┌────────┐          ┌────────┐ ┌────────┐
│ 32 Mb  │ │ 32 Mb  │          │ 32 Mb  │ │        │
└────────┘ └────────┘          └────────┘ │        │
2-WAY INTERLEAVE SET           ┌────────┐ │ 64 Mb  │
       (32, 32)                │ 32 Mb  │ │        │
                               └────────┘ └────────┘
                                2-WAY INTERLEAVE SET
                                     (32 + 32, 64)
```

32 Mb   32 Mb

2-WAY INTERLEAVE SET
(32, 32)

32 Mb
32 Mb   64 Mb

2-WAY INTERLEAVE SET
(32 + 32, 64)

128 Mb   128 Mb   128 Mb   64 Mb   32 Mb

32 Mb

32 Mb

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

msb-0717A-91

Figure B–1 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. At the bottom of Figure B–1 is a system with a a four-way set made up of six modules and one 32 Mbyte module that is not interleaved.

When different sizes of memory modules are installed, 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).

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

B.2 Console Commands

The SET MEMORY command is used for setting the interleave to a memory configuration other than the default interleave. The SET MEMORY command does not change memory interleaving; it just modifies the memory configuration in the EEPROM.

NOTE: *It is not advisable to use console commands to interleave memory modules, but occasional customer use will warrant overriding the original console setting of the interleave.*

Example B–1:   SET MEMORY and SHOW MEMORY Commands

```
>>> SET MEMORY  /INTERLEAVE:DEFAULT ❶
                        ! For a system with one 64-Mbyte and two
                        ! 32-Mbyte memory modules, interleaving
                        ! creates two sets of 64-Mbyte memories
                        ! (1x64-Mbyte memory and 2x32-Mbyte memory)
                        ! located at XMI nodes A, 9, and 8.
>>> 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  .   .   .   .   .   .   .       128 Mb

    /INTERLEAVE:DEFAULT
>>> SET MEMORY  /INTERLEAVE:(8, 9+A) ❸
                        ! The user explicitly specifies
                        ! the interleave sets (two interleave
                        ! sets with modules in nodes 8, 9, and A).
>>> 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  .   .   .   .   .   .   .       128 Mb

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

The callouts in Example B–1 are explained below.

❶ The SET MEMORY command (as shown here) returns the system to the default interleaving configuration.

❷ The SHOW MEMORY command displays the node number (node #), interleave (ILV), and total usable memory (xxMb) lines from the self-test results.

❸ This SET MEMORY command creates a 2-way interleave. In this example the user explicitly specifies how to interleave the memory modules. Each interleaving set must contain the node number of the memory module. If more than one memory module is 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 to put the new memory interleave into effect.

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.*

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