RamFactor™

User's Manual

Æ APPLIED ENGINEERING®

Applied Engineering

Telephone Numbers

Technical Support

1-900-884-0123

A $1.50 per minute fee will apply.
Average length of call is 6-7 minutes.
9 AM to 5 PM (CST) Monday Through Friday
BBS System - (214) 241-6677
24 Hours, 7 Days a Week
8 Bit, No Parity, Full Duplex, MNP-5

24 Hours, 7 Days a Week

Do not return any
product for service without a
Return Material Authorization (RMA) number.
An RMA number can be obtained by calling
Technical Support.

Sales

(214) 241-6060

9 AM to 6 PM (CST), Monday - Friday

If it is determined that your product is defective due to a manufacturing defect, your card will be repaired or replaced at Æ's option.

Any misuse, abuse, or non-Æ authorized alteration, modification, and/or repair to the Applied Engineering product will void the warranty. This warranty will also be void if you use the Æ product for any purpose other than its intended use.

Your product will be fully tested before it is shipped back to you, transportation prepaid, via UPS regular delivery.

RamFactor™

User's Manual

Returning a Product

RMA Number , "Attention" Sheet, and Invoice

If your product needs to be returned, the technical support representative will give you a Return Material Authorization (RMA) number.

❑ Record the RMA number for your own records.

❑ Write the RMA number on your package label.

❑ Fill out the Return Form on back of the form marked "Attention!" A complete form will greatly reduce the time it takes to return your package.

❑ Attach a copy of your original invoice to the form.

❖ *Warning:* If you don't include an invoice, products will be treated as out of warranty products and will be returned to you C.O.D. for the amount of the service charge.

When You Ship

If you don't have the original packing material, wrap the board in anti-static material (preferably the anti-static bag in which the card was originally shipped; however, aluminum foil will work fine). Pack it in a sturdy box cushioned with wadded papers (i.e. used computer paper or newspaper).

❖ *Warning:* If your product is damaged due to inadequate packing, your warranty will be void.

Include the return form and invoice.

Send the package, shipping prepaid, to:

**RMA#__?__
Applied Engineering
Technical Support
3210 Belt Line Road, Suite 154
Dallas TX 75234**

You should insure your package. Æ will not assume any responsibility for inadequate packing or loss or damage during shipping.

When We Receive

Our service department will use your completed form in an attempt to duplicate the problem.

APPENDIX F

Getting Help

If you have a technical question relating to your RamFactor card or any other Applied Engineering product <u>that is not covered in the manual</u>, please contact the dealer from whom you purchased the product. If you are experiencing difficulties with one particular program, contact the program's author or publisher.

In the event that the dealer or the publisher's support personnel cannot answer your question, call Applied Engineering Technical Support. The support representatives are experienced in the applications and uses of Applied Engineering products, but in order to provide a quick and effective answer to your question, they will need to know as much as possible about the hardware and software specifically related to your question. Please provide the technical support representative with the following information:

◊ The Applied Engineering product related to your question and its revision number.

◊ The original and current memory configuration of the card (if applicable).

◊ The model and revision of your computer.

◊ What peripherals are being used and what cards are in each slot.

◊ The name, version, and revision level of the software with which you are experiencing problems.

◊ The results of any test programs, diagnostics, or troubleshooting done by you, your dealer, or your software publisher's support department.

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BBS System - (214) 241-6677
24 Hours, 7 Days a Week

Federal Communications Commission
Radio Frequency Interference Statement

The equipment described in this manual generates and uses radio frequency energy. If it is not installed and used properly, that is, in strict accordance with these instructions, it may cause interference to radio or television reception.

FCC I.D. Number: EYW5QGRAMFACTOR

This equipment has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of the FCC Rules. These rules are designed to provide reasonable protection against radio and television interference in residential installation.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

❑ Reposition the receiver's antenna. Also make sure the antenna wires are making good electrical contact.

❑ Use a roof-mounted antenna rather than a "rabbit-ear" antenna or an antenna mounted in the attic.

❑ Make sure that all electrical connections on the computer are secure and any shielded I/O cables are properly fastened.

❑ Move the computer away from the receiver.

❑ Plug the computer and receiver into separate electrical circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful:

"How to Identify and Solve Radio-TV Interference Problems"

This booklet is available from the U.S. Government Printing Office, Washington, D.C. 240402, Stock No. 004-000-00345-4.

Warning: This equipment has been certified to comply with the limits for Class B computing device, pursuant to Subpart J of Part 15 of FCC Rules. Only peripherals (computer input/output devices, terminals, printers, etc.) certified to comply with the Class B limits may be attached to this computer. Operation with non-certified peripherals is likely to result in interference to radio and TV reception.

Applied Engineering is not responsible for any radio or television interference caused by unauthorized modifications to this equipment. It is the responsibility of the user to correct such interference.

Limited Warranty & Disclaimer

Additional Resources

The following books are available through most book stores:

Apple II Owner's Manual (Apple Computer, Inc.) Supplied with your Apple Computer. Take the time to read it.

Basic Programming with ProDOS (Addison-Wesley Publishing) Gives a detailed explanation of how to use ProDOS from AppleSoft Basic.

Beneath Apple ProDOS (Quality Software) Provides information about ProDOS for both the novice Apple user and the advanced programmer.

ProDOS Inside and Out (TAB Books) Very good book for both the beginning and advanced BASIC Programmer.

ProDOS User's Manual (Apple Computer, Inc.) Provides an overview of ProDOS and explains how to use the ProDOS User's Disk.

2) Put files within subdirectories like putting documents in folders

3) Put subdirectories within subdirectories like putting folders within folders.

Pathname

The name of the directory combined with the names of one or more subdirectories is called a pathname. Volume names and subdirectory names are preceded by a slash, "/". (Note that some applications add the slash for you.) For example, you could have a volume named /MY.DISK and a file called MY.FILE on the root directory of that disk. To access that file, you would use the pathname /MY.DISK/MY.FILE. You could also have a file JUL.AUG in a subdirectory (folder) called PHONE on a disk called /BILLS. To access that file, you would use the pathname /BILLS/PHONE/JUL.DEC. Refer to the diagram below.

```
                  ┌ PHONE (subdir.) < JAN.JUN
                 /                    JUL.DEC  (files)
                /
               / ┌ ELEC.(subdir.) < JAN.JUN
              /  /                   JUL.DEC  (files)
.LS (root dir.) ├ ACCOUNT.SYSTEM (file)
              \  \                  ZIPPY.FUEL (subdir.) < JAN.JUN
               \  GAS (subdir.)  <                         JUL.DEC  (files)
                \                   NITRO.NEDS (subdir.) < JAN.JUN
                 \                                         JUL.DEC  (files)
                  └ FAMOUS (subdir.) < WILD
                                       THE.KID   (files)
                                       BO.BAGGINS
```
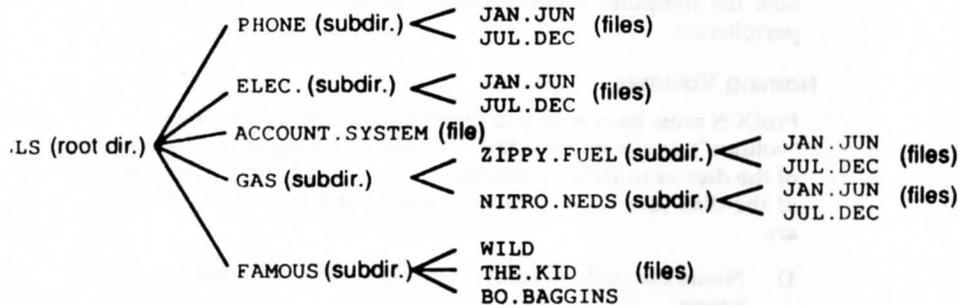
ProDOS Directory Structure

Now when an application asks you for the pathname of a file, you'll have a basic understanding of what it expects.

System Files

A system file is a ProDOS file that starts an application. Typically, these files have the suffix .SYSTEM (e.g. /APLWORKS.SYSTEM, /ACCOUNT.SYSTEM [see above], etc.). When you boot ProDOS, it runs the first system file listed in its directory. So, if BASIC.SYSTEM is the first system file on your ProDOS boot disk, ProDOS will boot and then put you in BASIC.

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A Brief ProDOS Tutorial

This is a brief explanation of the **Pro**fessional **D**isk **O**perating System, **ProDOS**, for those who are completely new to it. All of this information and more is included in your *Apple Owner's Guide*, but we have provided it here for your convenience.

Operating System

ProDOS is one of several operating systems for the Apple. Others include DOS 3.3 and Pascal. Operating systems, as defined in the *Apple Owner's Guides*, are programs that control how information is loaded into memory, how the computer handles the information, how the information is stored on a disk, and how the computer communicates with the printer and other peripherals.

Naming Volumes

ProDOS must have a way to locate which disk (often called "volume") you want to access. Instead of typing in the location of the disk as in DOS 3.3 (ex: S6,D1), you simply type in the name of the disk (the volume name). Some rules for volume names are

1) Name can include letters, numbers, or periods but not spaces
2) Name must begin with a letter
3) Name can be up to 15 characters long

These rules also hold true for subdirectory names.

Root Directory and Subdirectory

The main directory of the volume is called the root directory. The root directory uses the same name as your disk. Subdirectories are ProDOS' way of organizing information on a disk.

Think of the root directory as a file drawer and the subdirectories as folders within the drawer. You can

1) Put files directly into the root directory like putting documents straight into the file drawer

° **Read Bytes (cmd $08):** reads a specified number of bytes starting at a specified RamFactor address into your buffer. The byte count may be as high as $FFFF, but this would obviously wreak havoc inside your Apple. No checks are made inside the protocol firmware for reasonableness of the buffer address or the byte count, so be careful. The RamFactor address may be as high as $7FFFFF. This corresponds to a total of 8 megabytes, which is only half the maximum capacity of a RamFactor card. Apple has arbitrarily limited us to this maximum, because they use the top bit of the card address to specify whether the buffer is in MainMem (bit 23 = 0) or AuxMem (bit 23 = 1). (Bit 23 of the address is bit 7 of the last byte of the parameter block.)

° **Write Bytes (cmd $09):** writes a specified number of bytes from your buffer starting at a specified RamFactor address. The details of byte count, buffer location, and RamFactor address are the same as for the Read Bytes ($08) command.

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RamFactor

○ **RAM Status (cmd $00, unit $01, code $00 or $03):** reads the status of the RamFactor card into your buffer. Code $00 will cause four bytes to be stored: the first is always $F8, and the other three are the number of blocks in the current partition (lo, mid, hi order). (Y,X) will equal ($00,$04) when it is finished. Code $03 will cause 25 bytes to be stored: the first four are the same as code $00 returned; the next 17 are the name of the card in "ProDOS Volume Name" format (length of name in first byte, ASCII characters of name with hi-bit off, padded with blanks); and finally, four zero bytes. The card name is "RAMCARD". (Y,X) will return ($00,$19) when finished. These responses are identical to the response given by Apple's Memory Expansion Card, for compatibility reasons.

○ **Read Block (cmd $01):** reads the specified block from the current RamFactor partition into your buffer. You can read a block into a buffer in //e Auxiliary Memory by calling the Protocol Converter with the RAMWRT soft-switch set to AuxMem.

○ **Write Block (cmd $02):** writes the specified block from your buffer into the current RamFactor partition. If you are careful and follow all the rules, you can write a block from a buffer in //e Auxiliary Memory by calling the Protocol Converter with the RAMRD soft-switch set to AuxMem. You have to put the code that sets the RAMRD switch and calls the Protocol Converter, along with its parameter block, into page zero or one of motherboard RAM ($0000-01FF), or in the language card RAM area. Or, you can have both RAMRD and RAMWRT set for AuxMem and be executing a program from within AuxMem.

○ **Format (cmd $03):** does nothing in a RamFactor card.

○ **Control (cmd $04):** does nothing in a RamFactor card. If the code is not $00, you will get error code $21. The buffer is never accessed.

○ **Init (cmd $05):** does nothing in a RamFactor card.

○ **Open or Close (cmd $06 or $07):** cause error code $01 in a RamFactor card. These commands only apply to character-oriented devices, and RamFactor is a block-oriented device (according to Apple).

	cmd	cnt	unit	+3	+4	+5	+6	+7	+8
PC Status	$00	3	0	buf-lo	buf-hi	code			
PAM Status	$00	3	1	buf-lo	buf-hi	code			
Read Block	$01	3	1	buf-lo	buf-hi	blk-lo	blk-mi	blk-hi	
Write Block	$02	3	1	buf-lo	buf-hi	blk-lo	blk-mi	blk-hi	
Format	$03	1	1						
Control	$04	3	0/1	buf-lo	buf-hi	code			
Init	$05	1	0/1						
Read Bytes	$08	4	1	buf-lo	buf-hi	cnt-lo	cnt-hi	adr-lo	adr-mi	adr-hi
Write Bytes	$09	4	1	buf-lo	buf-hi	cnt-lo	cnt-hi	adr-lo	adr-mi	adr-hi

Error Codes

$01 Command not $00-$05,$08, or $09

$04 Wrong parameter count

$11 Invalid Unit Number

$21 Invalid Status or Control code

$2D Block Number too large

° **PC Status (cmd $00, unit $00, code $00): reads the status** of the Protocol Converter itself into your buffer. The status of the RamFactor is always 8 bytes, with the first byte = $01 and all the others = $00. Also returns with $08 in the X-register and $00 in the Y-register. This is of no value except for compatibility with other devices supporting Protocol Converter firmware.

PREFACE

Getting Started

Introduction

This chapter does just what its title says; it gets you started. It provides a brief introduction to the RamFactor™ card, explains what a RAM disk is, and describes the manual. Please take a few moments to read this chapter thoroughly before installing the RamFactor.

About RamFactor

RamFactor is a plug-in accessory card which expands the Random Access Memory (RAM) capacity of your Apple°][, Apple][Plus, Apple //e, and IIGS° personal computer. But, it is more than just a memory expansion card! The RAM on the RamFactor card expands the computer's storage capacity by emulating a solid-state disk drive, or RAMdisk™. In other words, the computer recognizes the RamFactor card not only as more memory but also as a peripheral device, a disk drive.

Special programs, permanently stored on the RamFactor card (computer jargon: "firmware"), allow you to separate RamFactor's memory into individual ProDOS™, DOS 3.3™, CP/AM 5.1™, and Pascal 1.3™ work areas, or "partitions." This allows you to very quickly exit from one program (or operating system) and boot into another by simply selecting a menu option. And without changing a single disk!

Although RamFactor's expanded memory normally functions as a RAMdisk, it can also be used to enhance the performance of certain application programs specially written to take advantage of its extra RAM. For example, AppleWorks° (1.3, 2.0, and 2.1) uses the memory to expand its Desktop space.

Using RamFactor is not difficult. You don't have to be a programmer or computer whiz, but you must have a basic understanding of the overall operation of your computer system. Learning several new things at one time can be very frustrating, so before jumping into this manual, please read the owner's manual that came with your computer and become familiar with any software you wish to use with RamFactor. Everything you need to know about using RamFactor should be in this manual. We ask you to read it carefully and thoroughly.

What is a RAMdisk?

A conventional (mechanical) floppy drive or hard drive is a peripheral mass storage device capable of storing information on a recording medium, usually a magnetic disk. A RAMdisk uses Random Access Memory to emulate such a peripheral device. The conventional disk drive uses many moving mechanical parts to store and retrieve its recorded information. Because the RAMdisk has no moving parts, it can read and write files up to 20 times faster than a floppy drive or hard drive. Some larger disk-intensive programs, such as AppleWorks, when loaded into and executed from a RAMdisk, run appreciably faster.

About This Manual...

This manual is included with the Applied Engineering RamFactor peripheral accessory card. It explains what RamFactor is, how it can enhance the performance of your software and computer system, and how to install and use it.

How you intend to use RamFactor will determine which chapters you need to read. Use the chapter summary, below, to decide which chapters are applicable to your needs.

Intro.:   *Getting Started* provides an overview of RamFactor, RAMdisks, and the manual.

Chapter 1:   *Installing RamFactor* is a step-by-step guide to inserting the RamFactor card into your computer.

Chapter 2:   *Putting RamFactor to Work* explains how to use RamFactor as a RAMdisk, a solid-state disk drive.

Chapter 3:   *RamFactor Partition Manager* tells you how to divide RamFactor's memory into separate work areas, or partitions for different operating systems including ProDOS, DOS 3.3, and Pascal.

App. A: *Adding Memory to the RamFactor* tells you how to install additional memory chips on your RamFactor card

App. B: *Testing the RamFactor* contains information about using the RamFactor diagnostic programs included in the firmware and on the AW 2 Expander™ disk to check the basic operation and hardware reliability of your RamFactor card..

Apple warns programmers NOT to use any page zero locations when calling the Protocol Converter firmware, saying that some page zero locations are used by that firmware. They do not say which locations they use, but investigations show that they use bytes in the range from $40 to $4F. What they do with those is push them on the stack, put their own data in them, and at the end restore the original contents from the stack. They use a substantial amount of stack, as many as 35 bytes. (The RamFactor firmware uses no more than 17 bytes of stack for Protocol Converter calls, including the two used by your JSR.) It is recommended that you can copy the PCADDR bytes up into your own program. You could even plug them in to every JSR to the Protocol Converter. For example:

```
        jsr    find.pc
        bcs    ...            ...no pc found
        lda    pcaddr
        sta    callp+1
        lda    pcaddr+1
        sta    callpc+2
        ...
        jsr    callpc
        .da    #cmd,parameters
        ...
callpc  jmp *  address filled in
```

Description of Protocol Converter Commands

Apple defines ten commands for the Protocol Converter firmware. These are not necessarily identical in function for all devices which use the Protocol Converter. In fact, Apple's memory card and Apple's UniDisk 3.5 use two of the commands differently. The Protocol Converter firmware in the RamFactor functions exactly the same way as that in the Apple Memory Expansion Card.

The following chart summarizes the ten commands as implemented in the RamFactor firmware.

```
lda             (pcaddr),y    $CsFF
clc
adc #3
sta             pcaddr
rts             carry clear signals pc found
pc.sig  .HS FF.20.FF.00.FF.03.FF.00
```

Once you have the address of the Protocol Converter firmware,
you can call it in a manner similar to ProDOS MLI calls. You
must plug the address of the Protocol Converter firmware into a
"JSR" instruction, which is immediately followed by a one-byte
command and a two-byte address.

The command number is a number from $00 to $09 which
specifies which action you want the Protocol Converter to take.

The address is the address of a parameter block, which provides
additional information for processing the command, or a place
for the information returned by the command.

After the Protocol Converter has finished processing your
command, it returns control to the next byte after the pointer to
the parameter block. If carry is clear, there was no error. If carry
is set, the A-register contains an error code.

Since the FIND.PC program left the address in two page zero
locations, a JMP opcode ($4C) could be placed in front of the
address to make it into a JMP instruction. Then calls to the
Protocol Converter would look like this:

```
callpc  .eq  $00         (just before pcaddr)
        jsr  find.pc
        bcs  ...          ...no pc found
        lda  #$4C         JMP opcode
        sta  callpc
        ...  ...other code
        jsr  callpc
        .da  #cmd,parameters
        ...  ...more code
```

App. C: *RamFactor Accessories* gives a description of the
RamCharger Battery Backup Option as well as
the RamFactor 4 Meg Expander.

App. D: *Programmer's Reference* contains technical
information required only by hard-core
programmers.

App. E: *A Brief ProDOS Tutorial* gives you a short
lesson in the use of the ProDOS operating
system.

App. F: *For More Information* is a list of recommended
books on topics related to your computer's
hardware and software.

App. G: *Getting Help* provides you with information on
what to do if things go wrong.

Comments?

We have tried to make this manual as informative,
understandable, and error-free as possible. If you have any
comments or suggestions regarding this manual or any other Æ
manual, we would be glad to hear from you.

Please address any comments or suggestions to:

Applied Engineering
P.O. Box 5100
Carrollton, Texas 75011
    Attention: Manager, Technical Publications

Apple warns against using the Protocol Converter and states, "using the assembly-language protocol is fairly complicated." Nevertheless, a significant amount of the Apple firmware is used to implement the Protocol Converter features. With this in mind let us proceed.

Using the Protocol Converter

In order to use the Protocol Converter firmware, you need first to find it. The first step in finding it is to find which slot it is in. Cards with Protocol Converter firmware can be identified by four bytes: $Cs01 = $20, $Cs03 = $00, $Cs05 = $03, and $Cs07 = $00. The first three bytes in that list are the same for all disk drive controllers. The zero value at $Cs07 distinguishes it as a disk controller PLUS a Protocol Converter.

The next step is to find the entry point in the firmware for Protocol Converter calls. The byte a $CsFF is the key. That byte is the offset in the firmware page for ProDOS calls. If $CsFF = $45, for example, ProDOS device driver calls should take the form "JSR $Cs45". To get the address of the Protocol Converter entry point, add 3 to the ProDOS entry point. In this example, "JSR $Cs48" would enter the Protocol Converter firmware.

A program to find the slot and build the address of the Protocol Converter could look like this:

```
pcaddr  .eq $01,$02
find.pc
        lda #0
        sta pcaddr
        ldx #$C7        slot = 7 to 1 step -1
.1      stx pcaddr+1
        ldy #7
.2      lda (pcaddr),y
        cmp pc.sig,y
        beq .3
        dex
        cpx             #$c1
        bcs .1          try next slot
        sec             signal could not find pc
        rts.3           dey
        dey
        bpl .2
```

```
00:                $AE
01:                $F4
02:                partition index (24 * part#
                   - 16)
03:                partition index EOR $5A
                   check code
04:                # blocks / 256 in entire
                   card
05-07:             <<<reserved>>>
08-1F:             partition 1 data
20-37:             partition 2 data
.
.
.
C8-DF              partition 9 data
E0-FF              <<<reserved>>>
```

The partition data is laid out like this within each group of 24 bytes:

```
Relative 00:       base address (hi)
01:                base address (mid)
02:                size (hi)
03:                size (mid)
04:                operating system code
05:                operating system check code
06-07:             <<<reserved>>>
08-17:             name of partition
```

Protocol Converter

Description of the Protocol Converter

The Protocol Converter is a set of assembly language routines which turn the //c disk port into a multi-drop peripheral bus capable of supporting up to 127 external I/O devices. The firmware in the Apple Memory Expansion Card and RamFactor provide all the features of the protocol converter for one I/O device, the memory card itself. The interface card for using the UniDisk 3.5 in an Apple //e or IIGS also supports a Protocol Converter.

CHAPTER ONE

RamFactor Installation

This section tells you everything you need to know about installing RamFactor in your computer.

Required

❑ **Computer**

You can install RamFactor in an Apple IIGS, //e (standard or enhanced),][Plus, Laser 128, or Franklin computer. It cannot be installed in the Apple //c or //c Plus.

❑ **80 Column Card**

RamFactor does not function as an 80 column text card. If you wish to run software written for 80 column display, you must have an 80 column card installed in your computer.

    ✏ The Apple //e requires an 80 column text card or extended 80 column text card installed in its auxiliary slot. Of course, an Applied Engineering RamWorks• auxiliary memory expansion/80 column card is recommended!

    ✏ Apple II, Apple][Plus, and Franklin Ace 1000 series computers require an Applied Engineering ViewMaster 80 (-or a Videx-compatible 80 column card.)

    ✏ The Apple IIGS, Laser 128, and the Franklin Ace 2000 series computers have built-in extended 80 column display circuits.

Recommended

❑ **System Saver**

If you have more than 1.5 megabytes of RAM (including RamFactor and auxiliary slot memory expansion cards) installed in your system, Applied Engineering recommends that you protect your Apple system from excessive heat build-up with a cooling fan, such as the System Saver• from Kensington Microware. These specially designed fans are available from many computer dealers.

❑ Power Supply Options

When the Apple power supply was originally designed, it was capable of providing more than adequate power for the memory and accessory cards available at the time. Newer expansion cards with more memory and more features consume more power, possibly taxing the Apple power supply to its limit.

If most of the slots in your computer contain expansion cards or the system has a large amount of RAM, you may overload the original power supply. The power supply has an internal protection circuit which turns the power supply off for a second and then turns it back on to check for the presence of the overload condition. If your computer mysteriously reboots itself intermittently or the power indicator light inside the computer flashes, your system may require more power.

Applied Engineering offers two solutions to the power users:

Solution 1: RamCharger

RamCharger is an Auxiliary Power and Battery Back Up device for the RamFactor. This solution provides constant, uninterruptable power to RamFactor, independent from the Apple power supply. This way, information stored in RamFactor is protected in the event of a power failure. RamCharger also decreases the burden on the Apple power supply. More details on the RamCharger option are given in Appendix C.

Solution 2: Applied Engineering High Output power supply.

The Apple power supply is capable of a maximum output of 35 Watts at 2.5 Amps. The High Output supply, which installs in place of the original supply, has an output rating of 77 Watts at 6 Amps.

Install it!

Installing RamFactor in an Apple or Franklin Ace 1000 series Computer:

1. **TURN OFF THE COMPUTER'S POWER SWITCH.**

   Never install or remove a card while the computer is on. However, you need to leave the computer plugged in throughout the installation to allow the power supply to discharge static electricity from your body.

$478+slot	$4F8+slot
$578+slot	$5F8+slot
$678+slot	$6F8+slot
$778+slot	$7F8+slot

RamFactor puts the current data for the partition size in two of the screen holes:

$678+slot:	# pages (hi-byte)
$6F8+slot:	# pages (lo-byte)

The number of pages divided by two is the number of blocks.

Another screen hole is set up with the size of the entire card. Location $478+slot holds the number of blocks divided by 256 of the entire card. Thus a value of 2 indicates there are 512 blocks, or 256K bytes.

The screen holes are only valid after accessing a partition. The meaning of the other screen holes is as follows:

$4F8+slot:	index to partition data
$578+slot:	partition base address (hi-byte)
$5F8+slot:	partition base address (mid-byte)
$778+slot:	operating system code
$7F8+slot:	operating system check code

Finding Size via RamFactor Memory

The information on card size and partition size is also stored in the RamFactor memory in addresses 000000 through 0000FF. Valid data in the first four bytes indicates the RamFactor memory has been partitioned. The first eight bytes are used for general information. The next nine groups of 24 bytes each are used to describe the partitions.

Below is a subroutine which will jump into the ProDOS firmware entry point. It assumes locations $0042-0047 have been properly set up for a call to the ProDOS firmware.

```
CALL.FIRMWARE
    LDA     $43             GET SLOT * 16
    LSR
    LSR
    LSR
    LSR
    ORA     #$C0
    STA     $01             hi-byte = $Cslot
    LDY     #0
    STY     $00             lo-byte = $00
    DEY                     Y = $FF
    LDA     ($00),Y         Contents of $CsFF
    STA     $00             $00,01 is entry point
    JMP     ($00)
```

To read the status, you have to set up two page zero locations and call the firmware entry point; the size of the partition will be returned in the X- and Y-registers. The following code sets up the proper parameters for reading status and then uses the CALL.FIRMWARE subroutine above to call the ProDOS firmware on the RamFactor card. The example assumes the card is in slot 4:

```
    LDA     #0              command code 0 = status
    STA     $42
    LDA     #$40            slot# of RamFactor * 16
    STA     $43
    JSR     CALL.FIRMWARE
    STY     BLOCKS.HI       # BLOCKS (HI-BYTE)
    STX     BLOCKS.LO       # BLOCKS (LO-BYTE)
```

Finding Size via Screen Holes

Another method for determining the size of the current partition is to examine the "screen-hole" data after the card has been accessed. The "screen-holes" are locations Apple has reserved for use by the firmware for each slot. There are 8 locations reserved for each slot:

2. **Remove the lid of your computer:**

-- Pop the hood of the][,][Plus, //e, and Franklin by pulling up on the cover at the rear edge (the edge farthest from the keyboard) until the two corner fasteners pop apart.

-- The IIGS's lid has two fasteners on the sides of the back panel. Push in on the tops of the fasteners with your forefingers while pushing up with your thumbs and heel of your hands on the side of the lid.

3. **Touch the power supply.**

Don't worry, it's safe! This will discharge any static electricity that may be on your body. Static electricity may damage your computer and card. This is a quick and easy safety precaution—don't blow it.

4. **Remove the RamFactor from its anti-static bag.**

Do not touch the gold edge connectors.

5. **Insert the RamFactor's gold edge connector in any expansion slot *except* slot 3.**

-- If you have an Enhanced Apple //e and wish to boot from the RamFactor card when a Control-Reset is executed, install the RamFactor in slot 7. If you will be using Pascal 1.3, install the RamFactor in slots 4, 5, or 6. Do not attempt to install the RamFactor card in the auxiliary slot.

-- IIGS users can boot from the RamFactor in any slot (except 3 and the Memory Expansion slot) by accessing the Slots option in the Control Panel Menu and setting the Startup option to the correct slot (described in the IIGS Owner's Manual).

◆ *Note:* While you can put the RamFactor into slot 4 or slot 5 of the GS, most users access the mouse and the 3.5" drives (respectively) through these ports.

6. **Replace the computer's top cover.**

Installing RamFactor in a Franklin Ace 2000 series Computer:

1. **TURN OFF THE COMPUTER'S POWER SWITCH.**

Never install or remove a card while the computer is on. However, you need to leave the computer plugged in throughout the installation to allow the power supply to discharge static electricity from your body.

2. **Remove the cover.**

   Refer to the instructions provided in your Franklin's User's Reference Manual.

3. **Remove the RamFactor from its anti-static bag.**

   Do not touch the gold edge connectors.

4. **Install into slot S4/S7.**

   Refer again to the User's Reference Manual for instructions on installing an expansion card in expansion slot S4/S7. Configure the jumper-clip to emulate either slot 4 or 7.

5. **Replace the computer's top cover.**

Installing RamFactor in a Laser 128 Computer:

1. **TURN OFF THE COMPUTER'S POWER SWITCH.**

   Never install or remove a card while the computer is on. However, you need to leave the computer plugged in throughout the installation to allow the power supply to discharge static electricity from your body.

2. **Remove the RamFactor from its anti-static bag.**

   Do not touch the gold edge connectors.

3. **Insert the gold edge connector into the desired slot.**

   Refer to the instructions provided in your Laser's User's Reference Manual.

   We recommend that you use the Laser 128 two-slot expansion box. If you wish to install RamFactor directly into the Laser 128, position the RamFactor card component side up and insert the gold edge connector into the expansion slot on the left side of the Laser 128 computer. Be very careful not to touch the exposed RamFactor card when the computer's power is on!

Hardware installation is complete! *Congratulations!*

What Next?

You don't have to test your RamFactor card, but if you'd like to, Appendix B tells you how.

When you read or write the data byte, the address automatically increments. Some 6502 address modes cause two accesses at the same location, which in this case can cause double incrementing. To avoid double incrementing, use either absolute addressing, or an indexed form with the base in a different page. For example, with the RamFactor in slot 4, you could use:

```
LDA   $C0C3        absolute addressing
      or
LDY   #$C8         slot * 16 +$88
STA   $BFFB,Y      $C083-$88,Y
```

Whenever the lower or middle address byte changes from a value with bit 7 = 1 to one with bit 7 = 0, the next higher byte increments automatically. This means that you should always load the bytes in the order low-middle-high, and always load all three of them. (Unless, of course, you are sure of the previous contents and can be sure you will get predictably correct results.)

Finding the RamFactor Card

A program can search the slots for a RamFactor card by looking for a unique pattern in various firmware locations. The bytes at $Cs00-Cs07 are standard for both the Apple Memory Expansion Card and the RamFactor card. They are:

```
$Cs00:C9  20  C9  00  C9  03  C9  00
```

In addition, the byte at $CsFB on a card of this type has bit 0 = 1. For RamFactor, the whole byte = $01. The byte at $CsFA distinguishes between the various brands of memory expansion cards. RamFactor has $AE at this location.

Finding RamFactor's Size

There are several ways a program can find out the size of the RamFactor card, or the size of the current partition.

Finding Size via ProDOS Status Call

If you are using ProDOS, the ProDOS status call can be used. The methods for finding the ProDOS firmware entry point, and for making a status call, are explained on pages 112-115 of Apple's "ProDOS Technical Reference Manual" and on pages 6-6 through 6-11 of Quality Software's "Beneath Apple ProDOS". Briefly, the firmware entry point will be $Csxx, where s is the slot number and xx is the contents of $CsFF in the firmware.

If for some reason you wish to remove the firmware link without re-booting DOS 3.3, you can do so by restoring the original contents of the three bytes at $BD12-BD14. For example, the monitor command "BD12:AA A0 0F" will do so. From inside Applesoft, you can POKE the values:

```
POKE 48402,176 : POKE 48403,160 : POKE 48404,15
```

If you use the INIT command to initialize a floppy disk after installing the RamFactor firmware link (with the IN#s command), the DOS image written on the floppy disk will include the firmware link. This means that the RamFactor card will have to be installed (and in the same slot) for that floppy to successfully boot. (If you have a Sider Hard Disk, you may have already discovered a similar fact about the Sider firmware link.)

Operating System Identification

The RamFactor firmware determines which operating system is in use by examining the contents of location $BF00. This technique was chosen to be compatible with the Apple Memory Expansion Card.

```
($BF00) = $00 -- Pascal
($BF00) = $4C -- ProDOS
($BF00) = $33 -- DOS 3.3
```

RamFactor Hardware

The RamFactor card has five addressable registers, which are addressed according to the slot number the card is in:

```
$C080+slot*16       low byte of RAM address
$C081+slot*16       middle byte of RAM address
$C082+slot*16       high byte of RAM address
$C083+slot*16       data at addressed location
$C08F+slot*16       Firmware Bank Select
```

After power up or Control-Reset, the registers on the card are all in a disabled state. They will be enabled by addressing any address in the firmware page $Cs00-CsFF.

The three address bytes can be both written into and read from. If the card has one Megabyte or less, reading the high address byte will always return a value in the range $F0-FF. The top nibble can be any value when you write it, but it will always be "F" when you read it. If the card has more than one Megabyte of RAM, the top nibble will be a meaningful part of the address.

What you should read next in this manual depends on how you will use RamFactor.

❑   If you will be using RamFactor only to improve the performance of a program written specifically for RamFactor or the Apple Memory Expansion Card, you may stop right here.

❑   If you want to use RamFactor and the AW 2 Expander disk to enhance the performance of AppleWorks, read the AW 2 Expander User's Manual included with the RamFactor package.

❑   Go on to Chapter 2 for details on using RamFactor as a RAMdisk.

Æ
RamFactor

The first volume is accessible as Drive 1, the second as Drive 2. The smaller volumes are exactly the same size as standard Apple floppy disks. These are 35 tracks, with 16 sectors per track. Each sectors holds 256 bytes. This computes to 143,360 bytes, which is called 140K (where "K" stands for a multiplier of 1024). The larger volumes have 50 tracks with 32 sectors per track, giving 400K bytes. In both cases, track 17 ($11) is used for the catalog information. A small volume can catalog up to 105 files. A large volume can catalog up to 217 files.

RamFactor initializes a DOS volume like a "data" disk. That is, there is no bootable DOS image in tracks 0, 1, and 2. You can make any DOS partition bootable by selecting that partition and using the binary program, INSTALL DOS, to copy the DOS image from memory into the first 32 sectors of the current partition. In addition, a short boot routine is written at the beginning of the very first sector. INSTALL DOS does not have any effect on the previous contents of the rest of the partition, so any files you had on the partition will still be there. INSTALL DOS assumes the file name of the startup program will be "HELLO".

Patches Made to DOS 3.3

When you boot standard DOS 3.3, it has no way of telling that your RamFactor is present. You inform DOS 3.3 of the presence of a RamFactor card in slot s with the command IN#s. When the IN#s command is executed, RamFactor firmware installs a three-byte patch inside DOS. This patch, placed at $BD12-BD14, jumps to a special entry point inside the RamFactor firmware whenever RWTS is called. The patch was carefully designed so as not to conflict with the method used by various hard disk systems to link to DOS 3.3 (such as Corvus and Sider).

Once the RamFactor patch is installed, all DOS commands may be used with the DOS volumes in the current partition. You can switch to a different partition by using the PR#s command, which brings up the RamFactor partition menu.

Note that only one RamFactor card can be linked into DOS 3.3 at any given time. However, if you have more than one card, you can use the IN#s command to link any card just prior to accessing it. The IN#s command has no other effect than patching the firmware link at $BD12.

When the RamFactor Partition Manager is accessed, the firmware downloads a program from the RamFactor firmware to regular Apple RAM. The partition menu program uses memory from $800 to $EFF, so any Applesoft program currently in RAM will be over-written. (Normally you will be changing programs anyway, so this is not a problem.) The same thing happens when you use PR#s from a regular disk drive.

ProDOS

When you boot ProDOS or ProDOS-based applications, the currently selected partition of the RamFactor card is automatically linked in as a ProDOS RAMdisk with a volume directory name /RAMs. If you have previously set up partitions on the RamFactor card, it will use the currently selected partition. To make the ProDOS RAMdisk a bootable device, it must first be formatted and loaded with the necessary startup files, just like any ProDOS mass storage device.

Pascal 1.3

Pascal 1.3 automatically recognizes a blank RamFactor RAMdisk as a formatted Pascal storage volume with the name RAMs, where s is the number of the slot containing the RamFactor card. Pascal requires that the RamFactor be installed in slot 4, 5, or 6. (Earlier versions of Pascal do not support the ProDOS block device protocol or the Protocol Converter required to interface with the RamFactor.)

The procedure for making the RamFactor RAMdisk a Pascal startup volume is the same as for any other Pascal volume.

DOS 3.3

When RamFactor initializes a DOS partition, the size of the partition or the amount of memory affects how the volumes will be established:

Partition Size	DOS 3.3 Volumes
less than 140K	will not format for DOS
140K-279K	one 140K volume
280K-399K	two 140K volumes
400K-799K	one 400K volume
800K or more	two 400K volumes

CHAPTER TWO

Putting RamFactor to Work

Introduction

This chapter explains how to use RamFactor as a RAMdisk. It will explain how to create a RAMdisk in the operating system of your choice, how to copy files to the RAMdisk, and how to execute programs from the RamFactor RAMdisk. Although you don't have to be an experienced programmer to use the RAMdisk feature of RamFactor, you should have a working knowledge of the applicable operating system.

❖ *Note:* We've included "A Brief ProDOS Tutorial" in Appendix E of this manual to help those who are new to ProDOS understand it a little better.

Remember that a RAMdisk is a volatile data storage medium! If the power is turned off, all information stored in the RAMdisk disappears. Be careful how you use the RAMdisk feature. Back up your data often and consider RamCharger™, the battery backup option for RamFactor. (See Appendix A.)

How RamFactor emulates a solid-state RAMdisk depends on the operating system booted into the computer. The following sections describe how RamFactor is used with these different operating systems: ProDOS, DOS 3.3, CP/AM 5.1, and Pascal 1.3.

❖ *WARNING!* Don't try to boot an unformatted RamFactor RAMdisk using the PR# command! If you do, you'll find yourself in the RamFactor Partition Manager program. Chapter 3 has the details on the accessing and using the Partition Manager.

ProDOS RAMdisk

When a ProDOS based startup disk is booted, ProDOS automatically recognizes the RamFactor card as a DATA disk with the volume name /RAMs, where s is the number of the slot containing the RamFactor card. You can store your data files in the ProDOS DATA disk or load programs to it and run them, but you can't start up from (boot) the DATA disk. To create a PROGRAM RAMdisk, or one that can be booted, you must first format the ProDOS RAMdisk.

Formatting a ProDOS RAMdisk

You can use Apple Computer's FILER program to format the RAMdisk as instructed below. Any other program that will format large volumes will also work. For your convenience, FILER is provided on the AppleWorks Expander disk. Complete Filer instructions are in the ProDOS User's Manual and tutorial HELP screens are also available from within the program. Here's an outline of the FILER's format procedure:

1. **Load Filer**

    Either

    Boot the AppleWorks Expander disk and then select the Copy Files option from the Main Menu

    or

    At the AppleSoft BASIC prompt ( ]), use the ProDOS dash command, -FILER.

2. **Select option "V" from the FILER main menu.**

3. **Select option "F" from the Volume Commands menu.**

4. **Enter the number of the slot containing the RamFactor card.** For the new volume name enter: RAMs, where s is the RamFactor slot number. (- or name it anything you like.)

5. **Answer "Y" to the "DESTROY 'RAMs'?(Y/N)" prompt.** Your RamFactor RAMdisk is formatted in less than a second.

6. **Press the ESC key twice to return to the FILER main menu.**

7. **Press "Q" to Quit Filer.**

If you booted the AW 2 Expander disk to run Filer, you will be left in Bird's Better 'Bye. (Instructions on screen and in AW 2 Expander User's Manual.) If you run Filer from another launcher program, you'll be returned to that launcher.

Copying files to a ProDOS RAMdisk.

Treat the ProDOS RAMdisk just like any other ProDOS volume. Files can be copied to or from it by using a file-copy utility program, such as Apple's FILER, Central Point Software's Copy II Plus (version 6.5 or later), or Applied Engineering's AUTOCOPY2 (AUTOCOPY2 is described in the AW 2 Expander User's Manual).

When an Enhanced Apple //e system is cold booted, the RamFactor firmware (ROM) determines whether the card has been formatted and is bootable. If it is bootable, it will boot into the appropriate operating system. If not, the Apple ROM will continue with the slot search for the next bootable device. Apples with non-enhanced firmware will not support either the RamFactor or the Apple II Memory Expansion card as a cold-bootable device.

Whenever a PR#s command is issued or execution starts at Cs00, the RamFactor ROM again determines whether the card is bootable. If the RAMdisk is bootable the ROM will boot into the appropriate operating system. If a non-bootable RAMdisk is encountered, the ROM will enter the RamFactor Partition Manager firmware. Since an unpartitioned, bootable RamFactor RAMdisk will not allow access to the RPM firmware using the PR#s command, use the Cs10G command to force the activation of the RPM firmware. But remember, this will cause the entire contents of the RamFactor to be cleared.

Whenever the IN#s command is issued, the RamFactor ROM checks for the presence of the DOS 3.3 operating system. If DOS 3.3 is not found, the IN#s command has the same effect as the PR#s command. That is, if a bootable non-DOS 3.3 RAMdisk is present, it will boot; if not, it will access the RPM firmware. If DOS 3.3 is found, the RamFactor firmware will patch the RWTS routine, allowing access to the RAMdisk.

By activating the RamFactor Partition Manager firmware, the card is divided into nine partitions, with all of the available memory in the first partition, except for 1024 bytes which the RPM reserves for its own use. The other eight partitions are initially empty. For example, a one Megabyte RamFactor first accessed by ProDOS would yield a 1024K RAMdisk. When the Partition Manager is called, the first partition would then yield 1023K.

Once the card has been formatted into the nine partitions, access through DOS, ProDOS, or the Protocol Converter will deal with the currently selected partition. To recall the RPM menu to select another partition, use the PR#s command. The PR#s command does not boot a bootable partition.

Appendix D

Programmer's Reference

Introduction

This chapter is intended for heavy-duty programmers interested in developing application software for the RamFactor card.

Description of RamFactor

The RamFactor is a peripheral expansion card which functions primarily as a mass storage device. It works with ProDOS, Pascal 1.3, and DOS 3.3. RamFactor was designed to be totally compatible with virtually all software written for the Apple II Memory Expansion Card. It also provides some additional useful features not available on the Apple card. These features include:

❏ RamFactor Partition Manager firmware, which enables RamFactor memory to be subdivided into partitions, with each partition totally isolated from the others.

❏ Expansion port for addressing additional memory beyond the 1 Megabyte available on the main RamFactor circuit card.

❏ Connector for RamCharger, an optional uninterruptable power source for RamFactor RAM.

RamFactor Partition Manager Firmware

When a blank RamFactor is first accessed by either ProDOS or Pascal 1.3, the RamFactor firmware dedicates all of RamFactor's RAM to that operating system as a formatted data disk. The RamFactor Partition Manager firmware remains inactive until called by a PR#s from BASIC or a Cs10G command from the Monitor. (This feature allows RamFactor to be fully Apple II Memory Expansion Card compatible, until the RPM firmware is called.) Once the RamFactor RAMdisk has been configured as a bootable device, the only way to access the RPM firmware without powering down is by the Cs10G command.

Do not use volume-copy options to copy another disk to a RAMdisk - use only the file-copy options. Remember that you are copying the contents of one disk to another; you are not duplicating a disk.

❖ *Note:* Only files which are not copy-protected can be copied to a ProDOS RAMdisk, although some copy protection schemes will allow files to be copied from a floppy disk to a hard disk or RAMdisk but not another floppy disk.

Once PRODOS and the required system file (e.g. BASIC.SYSTEM) are copied to the RAMdisk, it can be booted with the PR#s command, where s is the number of the slot containing the RamFactor card.

Enhanced Apple //e users: If RamFactor is installed in slot 7 the RAMdisk can be booted using the Control-Open Apple-Reset method. Or if you have RamCharger, your enhanced //e will be able to boot from the RAMdisk at power-up!

IIGS users: If you have a RamCharger connected to your RamFactor, you can boot from the RamFactor at power up. Set the Startup Slot option in the Slots menu of the Control Panel to the RamFactor's slot. See your IIGS owner's manual for more information on setting the startup slot.

Any attempt to access or format a RamFactor RAMdisk that has already been formatted under a different operating system will result in a "WRITE PROTECT" error message. To clear the RAMdisk, remove power from the RamFactor card by turning the computer and battery backup option switch OFF.

DOS 3.3 RAMdisk

❖ *Remember:* When in DOS 3.3, you must use all caps.

To create a DOS 3.3 RamFactor RAMdisk:

1) Boot an Apple DOS 3.3 System disk.

2) At the BASIC prompt ( ]), type IN#s where s is the number of the slot containing the RamFactor card.

3) Press Return.

The RamFactor card is now linked to the DOS 3.3 operating system in memory.

The number and sizes of the emulated DOS 3.3 volumes (disks) created by the IN#s command depends on the amount of RAM available on the RamFactor card. Use the chart, below, to determine the number and size of your DOS 3.3 RAMdisk volumes.

RamFactor Memory Size	Number of Drives	Drive Size	Maximum Files Per Drive
256K	1	140K	105
512K	1	400K	217
768K	1	400K	217
1024K	2	400K	217

These RAMdisk volumes are just like initialized DOS 3.3 DATA disks. They can contain information, even programs, but they can't be booted until you copy the DOS 3.3 operating system to them as described next.

Booting from the DOS 3.3 RAMdisk

Install the DOS 3.3 operating system to the RAMdisk(s) using the INSTALL DOS program on the RamFactor DOS 3.3 Utilities disk.

1) Boot the disk in your startup drive

2) Select the "Install DOS 3.3 to RamFactor" option.

❖ *Note:* (The INSTALL DOS program can also be executed from Applesoft BASIC by typing BRUN INSTALL DOS at the BASIC prompt.)

The program automatically finds the RamFactor card and installs the DOS 3.3 "boot tracks."

After DOS 3.3 is installed, the RAMdisk can be booted just like any DOS 3.3 volume. Use the PR#s command from the BASIC prompt.

If you have an Enhanced Apple //e and your RamFactor is in slot 7, use can use either PR#7 or Control-Open-Apple-Reset to reboot the DOS 3.3 RAMdisk. (Non-enhanced Apples will not boot from a RAMdisk card using the Control-Open-Apple-Reset method.)

❖ *Note to IIGS and Enhanced //e Users*: One of the features of the Apple IIGS and Enhanced Apple //e enables it to boot from a RamFactor card. When you turn the computer on, you can automatically boot into your favorite program in the wink of a eye.

//e Users: If the RamFactor card is installed in a slot numerically higher than the first disk drive interface card (i.e. slot 7), the active bootable partition can be booted just like a conventional disk drive.

IIGS Users: Boot from the RamFactor in any slot (except 3 and the Memory Expansion Slot) by setting your startup slot in the Control Panel Menu. (See your *Apple IIGS Owner's Guide* for details.)

RamFactor 4 Meg Expander

The RamFactor 4 Meg Expander connects directly to the RamFactor board "piggyback" fashion. Its sole purpose is to add memory to the RamFactor card; it is not a stand-alone card. The Expander can hold 1, 2, 3, or 4 Megs of memory. It's about the same size as the RamFactor card but can hold more memory because it uses 1 Meg DRAM chips instead of 256K chips.

Call Applied Engineering Sales (214-241-6060) or contact your Æ dealer to order or for more information.

Appendix C

RamFactor Accessories

RamCharger
— RamFactor Battery Backup Option

By now you have probably witnessed the impressive speed of the RamFactor card when used as a RAMdisk. Remember that one of the major disadvantages of a RAMdisk is its volatility. Even a brief power interruption will completely erase the contents of a RAMdisk. The RamCharger Battery Backup Option eliminates this disadvantage and turns the RamFactor into a non-volatile, bootable storage device. Not only does the RamCharger protect the contents of RamFactor's memory during momentary power outages, it provides extended protection against loss of data during long power failures.

RamCharger installation is simple. Plug the AC power cord into any grounded 120 volt wall socket (240v model available) and connect the RamFactor power cable to the RamFactor's power socket.

The RamCharger battery and charger are entirely contained within an attractive case similar to the Disk II case. During normal operation, RamCharger charges its internal battery and supplies power to the RamFactor memory chips. When the AC power to RamCharger is interrupted, RamCharger instantly switches to battery power until the AC power is restored. RamCharger's heavy duty battery can maintain memory on a 1 megabyte RamFactor for about 12 hours. It will keep a 1 Meg RamFactor with a fully loaded 4 Meg Expander attached for up to 7 hours. AC power will maintain RamFactor memory continuously!

RamFactor Size	Power Source	Mem. Maintained
1 Meg Board	RamCharger	Up to 12 hours
5 Meg Board (1 Meg w/ 4 Meg Expander)	RamCharger	Up to 7 hours
1-5 Meg	AC Power	Continuous

If you reboot using Control Open-Apple Reset or if another standard DOS 3.3 startup disk is booted while the RamFactor DOS 3.3 RAMdisk is active, the new operating system will have to be linked to the RAMdisk with the IN#s command. All files stored in the RAMdisk will still be intact. Any attempt to access or format a RamFactor RAMdisk that has already been formatted under a different operating system will result in a "WRITE PROTECT" error message. To clear the RAMdisk, remove power from the RamFactor card. (i.e. turn the computer and battery backup option switch OFF.)

When you use the INIT command with the modified DOS 3.3 in memory, keep this in mind: The image of DOS written on the initialized floppy disk will be the patched RAMdisk version DOS. The initialized disk will be "tied" to the RamFactor card and its current slot. For the floppy disk to successfully boot, the RamFactor card will have to be installed in the same slot as when the disk was initialized.

Copying Files to the DOS 3.3 RAMdisk

Standard (not copy-protected) DOS 3.3 files can be copied to the RamFactor's RAMdisk using the Apple File Developer program (FID). The FID program is particularly useful for transferring all types of DOS 3.3 files. For your convenience, we've included the FID program on RamFactor's DOS 3.3 Utilities disk. You can also find FID on the Apple DOS 3.3 System Master disk.

To run FID from RamFactor's DOS 3.3 Utilities disk:

1) Boot the utility disk.

2) Select COPY FILES from the menu.

◆ *Note:* FID is a binary program which can also be executed by typing BRUN FID at the BASIC prompt.

3) Follow the on-screen instructions to copy files.

Automatic File Copying at Boot

FID can be used in combination with a text file to create a *turnkey* file copy utility program. The turnkey program (examples following) is a quick way to transfer a selected list of files to the DOS 3.3 RAMdisk. The text file contains a list of commands used to run the FID program, set up the source and destination disks, and instruct FID which files to copy. The EXEC command is used to start processing the text file's commands. (See the DOS Users Manual for more information on EXECuting text files.)

An example EXEC (text) file, COPYM, is included on the RamFactor's DOS 3.3 Utilities disk. This sample file instructs the FID program to copy certain files on the disk to the RAMdisk.

❖ *Important:* COPYM is a sample text file; it assumes the RamFactor is in slot 7 and the floppy disk interface is in slot 6. If your setup is different, use a word processor to change the slot and drive as described later in this section.

To use this sample file, boot the disk and select the "Copy Files to RamFactor" option. This menu option will automatically link the RAMdisk to DOS and EXECute the COPYM text file, which will copy INSTALL DOS and FID to a RAMdisk.

❖ *Note:* This program can also be executed by typing EXEC COPYM from the BASIC prompt.

You must customize COPYM for every desired combination of source and destination slots and drives. You can customize the program easily using any DOS 3.3 based word processor program which saves files to disk in text file format (like DOS 3.3 AppleWriter™ II). The text file listing, below, provides a line by line description of the sample COPYM file. When creating an EXECutable text file for FID, be sure that none of your filenames contain any DOS 3.3 commands (e.g. READING.1; CATALOG LIST). Each line must end with a carriage return.

Contents of
Text file	Comments
BRUN INSTALL DOS	Installs the modified image of DOS 3.3 on the RAMdisk.
MON C,I,O	Use this line to monitor the program execution sequence on the screen.
BRUN FID	Executes the FID program.
1	Select option 1 (Copy Files) from the FID main menu.
6	Specify slot 6 as the source slot.
1	Specify drive 1 as the source drive
7	Specify slot 7 as the destination slot.
1	Specify drive 1 as the destination drive.
INSTALL DOS	Filename of first file to copy.

3) Remove the RamFactor card.

4) Check chip part numbers. Compare these numbers with the list on page 24.

5) Ensure that all of the socketed memory chips and connectors are correctly installed (all legs in sockets, notch (or dot) toward top) and securely seated.

Often, just reseating the chips and connectors has a magical healing effect on a "sick" computer!

6) Reinsert the RamFactor card.

7) Turn the system on.

8) Run the memory test **again**.

   ○ If the board passes this time, you're in business!

   ○ If the board still shows bad chips:

9) Replace any chips that are shown to be bad.

If one chip is bad, the entire bank of chips (set of 8) and any higher banks will not work. Contact your Æ dealer or Æ Sales for replacement chips.

10) If it still fails, refer to the Getting Help section at the end of this manual.

After eight successful passes, the program displays the message "Card Passed," indicating that the circuitry on the card has passed. After this message is displayed, you can quit the test. The program will repeat the memory test indefinitely. In the lower left corner of the screen, a "pass indicator" will show how many times the program has run the memory test. Press any key to terminate the RAM test.

Test in Firmware

The other test is contained in the RamFactor's firmware. To run this test:

1) Get into BASIC.

2) Type Call-151.

3) Press Return. You'll see ✳

4) Type Cs0AG where s is equal to the slot containing your RamFactor. (0 is the number zero, not the letter O.)

   The test will begin running. The number of times the test has run is displayed in hexadecimal notation. You can stop it any time after the first pass.

5) To stop this test, press Control-Reset.

If the RamFactor firmware test fails, it sends an error message to the screen. Should you get an error message, run the disk based test to locate the origin of the problem.

If the Tests Pass but the Problems Continue

If the tests pass (no error messages sent to the screen) and you still experience problems with your program, the next step will be to eliminate the software as a possible source of the problem. Try to run different software packages or another copy of the program you are having problems with. Our experience shows that a large majority of "program crashes" are not necessarily caused by hardware failures but by software problems. Many software publishers offer technical support for software related problems.

If the Tests Fail

If any of the sockets containing chips show the XX when running the disk-based test, you'll need to:

1) Turn the system off.

2) Touch the power supply to remove any static electricity from you body.

S	Press any key to continue.
1	Select option 1 (Copy Files) from the FID main menu.
FID	Filename of next file to copy.
S	Press any key to continue.
9	Select option 9 (Quit) from the FID main menu.
CATALOG	DOS command to list the directory of the destination disk.

Following is another example text file. This one will copy all files on the source disk to the destination disk:

Contents of Text file	Comments
BRUN INSTALL DOS	Installs the modified image of DOS 3.3 on the RAMdisk.
MON C,I,O	Use this line to monitor the program execution sequence on the screen.
BRUN FID	Executes the FID program.
1	Selects option 1 (Copy Files) from the FID main menu.
6	Specifies slot 6 as the source slot.
1	Specifies drive 1 as the source drive
7	Specifies slot 7 as the destination slot.
1	Specifies drive 1 as the destination drive.
=	Wildcard character; copies all files on the source disk.
N	Cancels individual file prompting.

After customizing your own COPYM text file, save the file to a disk containing all the files you want to copy to the RAMdisk. Be sure to include FID. Then create the following 'HELLO' program:

❖ *Note:* The program must be called HELLO.

```
10 REM Turnkey HELLO program
20 PRINT CHR$(4);"EXEC COPYM"
30 END
```

The turnkey startup disk will automatically run the EXEC file when booted.

Pascal 1.3 RAMdisk

The Pascal 1.3 operating system automatically recognizes the RamFactor card, when installed in slot 4, 5, or 6, as a Pascal volume with the name RAMs, where s is the number of the slot containing the RamFactor card. Programs written under Pascal 1.1 or 1.2 are not compatible with RamFactor. Please contact your authorized Apple dealer for upgrade information.

This RAMdisk volume can be used and accessed just like any other Pascal 1.3 volume. To create a bootable Pascal RAMdisk, use the Pascal FILER to determine the volume number of the RAMdisk and format it using the FORMATTER program (APPLE 3). Then, using FILER again, copy SYSTEM.PASCAL and SYSTEM.APPLE to the RamFactor volume.

CP/AM 5.1 RAMdisk

To use RamFactor or a RamFactor partition as a CP/AM RAMdisk, Applied Engineering's Z-80 Plus™ coprocessor card and the CP/AM 5.1 operating system are mandatory requirements. The previous version of the operating system, CP/AM 4.0B, will not recognize the RamFactor card.

All utility programs needed to create and use the RamFactor as a CP/AM RAMdisk are supplied on the CP/AM 5.1 System Master disk and full documentation is provided in the CP/AM 5.1 User's Guide. These products are included with the Z-80 Plus card and can be purchased separately from Applied Engineering.

APPENDIX B

Testing the RamFactor

❖ *Warning!* The RamFactor Diagnostic programs are destructive memory tests. They will erase anything stored in RamFactor memory.

There are actually two different tests included with your RamFactor. Use either RamFactor Memory Test to verify the basic operation and hardware reliability of the RamFactor card. If you encounter problems when running a program that you feel relate to RamFactor memory, these tests are a good first step in diagnosing the problem.

DO NOT attempt to repair your RamFactor card! It could void your warranty.

Test on AW 2 Expander Disk

One test the RamFactor is included on the AW 2 Expander disk. To run this test program:

1) Turn the computer off.
2) Insert the AW 2 Expander disk in your startup drive.
3) Turn the computer on.
4) When the main menu appears, select the "RamFactor Memory Test" option.
5) Select the appropriate option from the memory-test options menu.

    If you hold the Open-Apple key (⌂) down momentarily while you select the memory test, it will execute a longer, more thorough memory test.

A graphic representation of the RamFactor will appear on the screen. The test indicates any defective RAM chips or empty RAM sockets with a "XX" in the corresponding chip location on the graphic display.

Checksum $F9BC when Unformatted,
After a test.

Position notches
(or dots)
UP
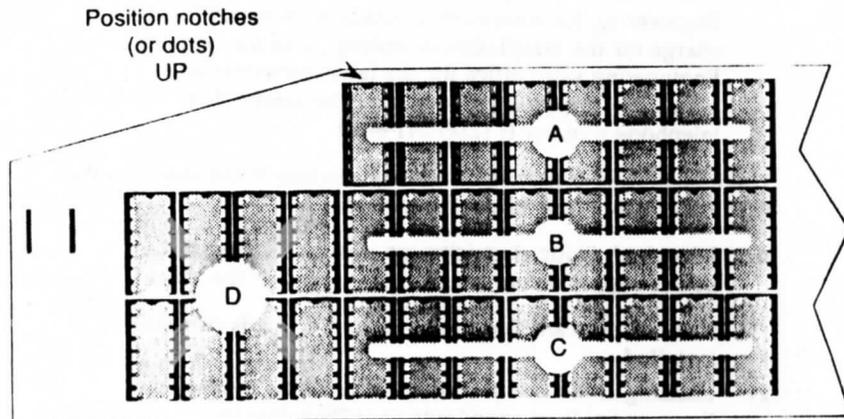
Adding the Chips

4) **Align each leg (pin) of the chip with its socket hole.** You may have to bend the pins slightly to align them with the holes. Do this by holding the chip on edge so that one of the rows of feet are against the table's surface. Now apply downward pressure to the chip while rolling it toward the bottom of the pins. This will bend the pins uniformly.

5) **Press down firmly on each chip** to ensure that it is fully seated in its socket. Check closely for bent pins.

6) **Reinstall the card** following the installation instructions.

7) **Test it.**

The RamFactor memory test, included on the AW 2 Expander disk, as well as the built-in diagnostics test are described in the next appendix.

CHAPTER THREE

RamFactor Partition Manager

About the Partition Manager

The RamFactor Partition Manager (RPM) is actually a program permanently stored in in ROM (Read Only Memory) on the RamFactor card. This menu-driven program enables you to organize RamFactor's memory into multiple work areas, or partitions. From one to nine partitions can be created, each partition functioning as an independent RAMdisk. Each RAMdisk partition can be dedicated to one of the operating systems supported by RamFactor. Be sure you've read Chapter 2, "Putting RamFactor to Work." It tells you how to prepare the RAMdisk (the active partition) for data storage and make it a bootable device.

Accessing the RamFactor Partition Manager (RPM) menus

To enter the RamFactor Partition Manager main menu:

1) **Get into Applesoft Basic.**

The Basic mode is indicated by the left bracket ( ]).

2) **Type PR#s from the Applesoft BASIC prompt.**

"s" is the number of the slot containing the RamFactor card.

Before the RamFactor Partition Manager program can be initially activated, the RamFactor RAMdisk must be CLEAR and unformatted. If your RAMdisk is currently formatted, the PR#s command will cause the computer to boot into the RAMdisk instead of the RPM program. The easiest way to clear a RAMdisk is to turn off the computer (and disconnect the RamCharger if connected) for about 5 seconds. Another way is to force the computer to access the RPM program by using a special Monitor command:

1) **At the BASIC prompt, type CALL -151.**

2) **Press Return.**

This will place the computer in Monitor command mode, indicated by the asterisk (*) prompt.

3) **Enter Cs10G**

"s" is the number of the slot containing the RamFactor card. "0" is the number zero, not the letter O.

4) **Press Return.**

   This message will appear:

   WARNING- INSTALLING PARTITIONS DESTROYS
   THE DIRECTORY- GO AHEAD?

5) **Press Y for yes or any other key to abort and boot from another slot.**

Once the RPM program is activated, the RPM main menu, shown in Figure 3-1, will allow you to select RamFactor partitions and configure them to suit your needs.

Figure 3-1 RamFactor Partition Manager Main Menu

```
RAMFACTOR PARTITIONS              SLOT = 5

███████████████████████       CLEAR
2                         0K   CLEAR
3                         0K   CLEAR
4                         0K   CLEAR
5                         0K   CLEAR
6                         0K   CLEAR
7                         0K   CLEAR
8                         0K   CLEAR
9                         0K   CLEAR

USE ARROWS OR 1-9 TO SELECT A PARTITION

RET=BOOT THE PARTITION    R=RECONFIGURE
ESC=QUIT ■
```
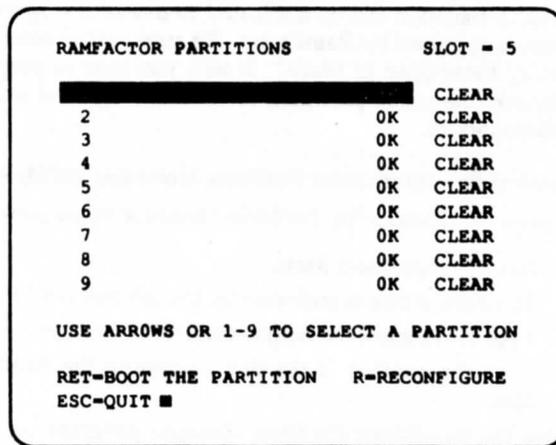
Notice that when first accessing the RPM, all of the available memory, except 1K, is dedicated to the first partition. (The RPM manager reserves 1K for its own use.) All other partitions are empty (0K) and CLEAR.

Selecting a RAMdisk Partition

The currently selected partition is highlighted on the RPM main menu by the inverse video bar. The arrow keys can be used to move the highlight bar up or down to select a different partition. Pressing the Esc (Escape) key will exit the RPM program and return to the operating system (if any) previously loaded. The highlighted partition then becomes the current, or active, partition.

Installing the Memory Chips

❖ *Reminder:* You may return your RamFactor to Applied Engineering for a memory upgrade with no additional charge for the installation or testing. Call the Applied Engineering sales office for the latest memory-chip prices and shipping instructions. The sales office telephone number is (214) 241-6060.

There is nothing complicated about installing RAM chips on the RamFactor card. Just follow these steps:

❖ *Warning!* Static electricity can ruin chips. Touch the power supply before handling the board or the chips.

1) **Remove the card from your computer** if it is currently installed.

2) **Looking at the card and the picture below, notice that the memory is arranged into four 256K blocks.**

   Each block consists of eight 256K RAM chips (it takes eight chips for each additional 256K of memory).

❖ *Note:* You will fill the memory blocks in alphabetical order (i.e. fill block A, then block B, then C, then D).

3) **Orient the chips so that the notch (or dot, on some chips) points UP,** away from the gold edge-connector on the bottom of the card.

❖ *Warning!* If you install a chip upside down it could possibly damage the chip. Be sure to double check the orientation notch (or dot).

APPENDIX A

Adding Memory to the RamFactor

Introduction

The RamFactor card can contain up to 1024K (1 Megabyte) of Random Access Memory. You can also add the RamFactor 4 Meg Expander to give your RamFactor up to 4 more Megabytes of memory for a possible total of 5 Meg. (See Appendix C for more information about the 4 Meg Expander.)

This appendix provides the information required to add memory to your RamFactor. It contains the specifications for the RAM (Random Access Memory) chips, tells where you can get them and how to install them.

Where to Get Chips

Selection of the proper memory chips for your RamFactor can be a little tricky; there are several chip manufacturers and many different types and specifications of RAM chips available.

You may be able to find memory chips with the proper specifications at some computer or electronics-parts stores. Applied Engineering has the correct chips in stock and warrants them for five years from date of purchase. (Most chip vendors sell their chips "as is.") We will not warrant chips purchased from other vendors.

Approved manufacturers and chips are:

Hitachi	HM50256-15
Mitsubishi	M5M4256P-15
Fujitsu	MB81256-15
OKI	MSM41256A-15AS/RS
Intel	P21256-15
Samsung	KM41256-15
Micron Tech.	MT1259-15
Toshiba	TMM41257-15

Only one partition at a time can be active. The active partition RAMdisk can be accessed without affecting the contents of the other partitions and the inactive partitions are totally invisible to the system.

Configuring a RAMdisk Partition

Pressing the R key from the RPM main menu will display the configuration options, shown in Figure 3-2.

Figure 3-2 RPM partition configuration options

```
┌──────────────────────────────────────────────┐
│  RAMFACTOR PARTITIONS            SLOT = 5      │
│                                                │
│  ████████████████████████████████   CLEAR     │
│  2                            OK    CLEAR      │
│  3                            OK    CLEAR      │
│  4                            OK    CLEAR      │
│  5                            OK    CLEAR      │
│  6                            OK    CLEAR      │
│  7                            OK    CLEAR      │
│  8                            OK    CLEAR      │
│  9                            OK    CLEAR      │
│                                                │
│  USE ARROWS OR 1-9 TO SELECT A PARTITION       │
│                                                │
│  N-NAME CHANGE        RET-INSTALL CHANGES      │
│  S-SIZE CHANGE        ESC-FORGET CHANGES       │
│  C-CLEAR PARTITION ■                           │
└──────────────────────────────────────────────┘
```

Naming a Partition

Selecting the N option will allow you to name the highlighted partition. Each name, which can contain up to 16 characters, is stored in RamFactor's memory. The partition name has no meaning to the partition's operating system, it is just a label for your convenience. A partition name can be erased by reselecting the N option, then pressing Return.

Clearing a Partition

The C option will completely erase the previous contents of the selected partition. A cleared partition is indicated by CLEAR in the status column on the right side of the RPM screen.

Sizing the Partitions

Pressing the S key will enable you to change the size of the currently selected CLEAR partition. To create more than one partition, you must first change the size of the first partition. Any remaining available memory will be added to the size of the next (numerically) partition. Move the selection bar to the next partition, select the S option, and enter the desired size. If you are re-configuring existing partitions, the partitions to be changed must be cleared before they can be re-sized.

❖ *Note:* Remember that changing the size of an existing partition will affect the size of the next partition, which will also need to be cleared prior to re-sizing.

As stated earlier, the partitioned memory is 1K less than the total amount of RamFactor memory. When a blank RamFactor is accessed for the first time, all of the available RamFactor memory is dedicated to one RAMdisk. Regardless of the amount RamFactor memory available, 1K is reserved for use by the RPM program.

ProDOS, Pascal 1.3, and CP/AM Partition Sizes

Partitions to be formatted under ProDOS, Pascal 1.3, and CP/AM can be set to any size limited only by available memory.

Dos 3.3 Partition Sizes

The sizes allowed for DOS 3.3 partitions have certain restrictions, shown in the chart, below. The number and storage capacity of DOS 3.3 emulated drives depends on the the size of the partition.

Partition Size	DOS 3.3 Volumes
less than 140K	will not format for DOS
140K-279K	one 140K volume
280K-399K	two 140K volumes
400K-799K	one 400K volume
800K or more	two 400K volumes

The first volume is accessed as drive 1, the second as drive 2.

Example Partition Sizes

The sample video screen shown in Figure 3-3 gives an example of four partitions named, configured, and ready for formatting. Once the desired changes have been made, press the Return key to accept the changes and return to the main menu. Or press Esc to cancel any changes and revert to the previous partition settings.

APPENDICES

The following appendices are included for further reference and reading enjoyment:

A -- Adding Memory to the RamFactor

B -- Testing the RamFactor

C -- RamFactor Accessories

D -- Programmer's Reference

E -- A Brief ProDOS Tutorial

F -- Getting Help

Figure 3-3 Example partition configuration

```
┌─────────────────────────────────────────────────┐
│                                                   │
│   RAMFACTOR PARTITIONS              SLOT = 5       │
│                                                   │
│   1   APPLEWORKS 2.1        300K    CLEAR          │
│   2   DOS 3.3 PROGRAMS      400K    CLEAR          │
│   ███████████████████████████████   CLEAR          │
│   4   PASCAL GOODIES        123K    CLEAR          │
│   5                          0K     CLEAR          │
│   6                          0K     CLEAR          │
│   7                          0K     CLEAR          │
│   8                          0K     CLEAR          │
│   9                          0K     CLEAR          │
│                                                   │
│   USE ARROWS OR 1-9 TO SELECT A PARTITION          │
│                                                   │
│   N=NAME CHANGE         RET=INSTALL CHANGES        │
│   S=SIZE CHANGE         ESC=FORGET CHANGES         │
│   C=CLEAR PARTITION ▩                              │
└─────────────────────────────────────────────────┘
```

Booting a Partition

To boot from the active partition, its RAMdisk must contain a bootable operating system and any required startup files. Please refer to Chapter 2, *Putting RamFactor to Work*, for details on creating a bootable RAMdisk.

Once you have copied the operating system to the partition's RAMdisk, boot that RAMdisk:

1) Access the RPM menu
2) Press the numeric key representing the desired partition.
   The partition will boot automatically.

Pressing the Return key from the main menu will attempt to boot the highlighted partition.

If a partition is not bootable, RPM will prompt you for the slot number of your boot drive, as shown in Figure 3-4. When this happens you simply enter the slot number of a disk drive containing a bootable disk and press Return.

Æ
RamFactor

Figure 3-4 RPM unable to boot from partition selected

```
RAMFACTOR PARTITIONS              SLOT = 5

       1                    1024K   CLEAR
       2                      0K    CLEAR
       3                      0K    CLEAR
       4                      0K    CLEAR
       5                      0K    CLEAR
       6                      0K    CLEAR
       7                      0K    CLEAR
       8                      0K    CLEAR
       9                      0K    CLEAR

USE ARROWS OR 1-9 TO SELECT A PARTITION

RET=BOOT THE PARTITION    R=RECONFIGURE
ESC=QUIT

CANNOT BOOT THAT RAMFACTOR PARTITION
BOOT FROM SLOT = ■
```
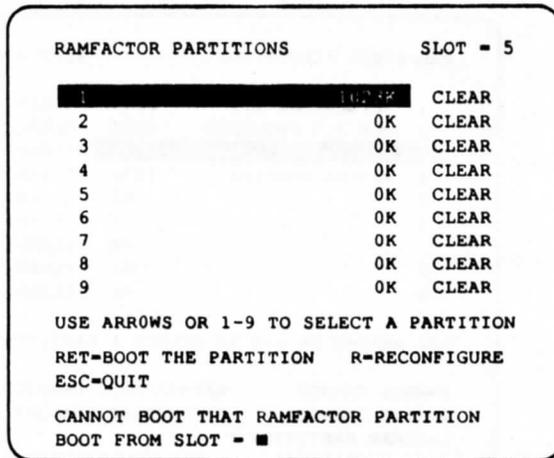
❖ *Enhanced Apple //e Users*: If RamFactor is the first device in the boot sequence (e.g. slot 7) a Control-Open Apple-Reset command will attempt to boot the active partition, bypassing the RPM menu. If the current partition is not bootable, the next device in the boot sequence is accessed (e.g. slot 6).

Changing Partitions

To enter a different partition:

1) Reboot (PR#s) the RamFactor Partition Manager.

2) Select the new partition.

3) Boot the new partition or simply exit the RPM program.

    This can be compared to removing a floppy disk from the boot drive and booting or accessing a different program disk.

Since the active partition must be deselected to select another, files cannot be transferred directly from one partition to another.

Any attempt to access or format a partition formatted under an operating system different from the one currently in memory will result in a "WRITE PROTECTED" error message.

To reformat a partition it must first be cleared, using RPM configuration menu option C, then formatted under an active operating system.

❖ *Note*: Any programs which use RamFactor memory directly to enhance their performance must be executed from the first partition only. AppleWorks (1.3, 2.0, and 2.1) is such a program. It uses whatever RamFactor memory is available in the first partition area to expand the AppleWorks Desktop space.