

MEMORY PRODUCTS FOR THE APPLE® IIe™

MegaRamPlus™

An advanced RAM expansion card offering a wide array of hardware features with high-performance software.

User's manual

AST
RESEARCH INC.

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MegaRamPlus™
Auxiliary Memory Expansion
for the
Apple IIe™

User's Manual
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SECTION 1

INTRODUCTION

1.0 Introduction

This user's manual describes the features, configurations, installation procedures, operational and programming information for the AST MegaRamPlus auxiliary memory expansion card. Hardware and software compatibility information is also provided.

The MegaRamPlus is an expandable auxiliary memory card which will significantly enhance the performance of your Apple IIe. The card is installed in the auxiliary slot of the Apple IIe, where the Apple 80-column card or Apple extended 80-column card normally resides. The MegaRamPlus is 100% compatible with software programs designed to use the 80-column display mode or double hi-resolution graphics mode.

The MegaRamPlus goes beyond the capabilities of an extended 80-column card by offering memory expandability (up to 1 megabyte on main board) and powerful software utilities which let you take advantage of the extra memory. An auxiliary slot expansion connector is also provided for future additional RAM expansion and RGB interface option.

The software utilities provided with MegaRamPlus enable the card to be used in one of three ways:

- As an electronic (RAM) disk card. In this mode, the MegaRamPlus can be used as a ProDOS or DOS 3.3 ramdisk.
- As an AppleWorks 1.3 Desktop extender. In this mode, the MegaRamPlus can extend the Desktop space of AppleWorks 1.3 up to 944Kbytes, breaking through the 55Kbyte limit that is normal for AppleWorks.

- As a cache buffer card. In this mode, using AST's exclusive MegaRamCache software, the MegaRamPlus can be used as a cache buffer for your ProDOS disk drives, including 5 1/4" or 3 1/2" floppys, hard disks or tape drives.

Detailed information on each of these modes is provided in the operational sections of this manual.

Without using any of the MegaRamPlus software utilities, the card will operate exactly like the Apple extended 80-column card, with the added benefit that software programs written to recognize auxiliary memory beyond 64Kbytes can take advantage of the extra memory on the MegaRamPlus.

1.1 Features

The MegaRamPlus has the following features:

- Up to 1 Mbyte total RAM on mainboard
- RAM area fully socketed and user upgradeable with 64Kb/256Kb chips
- 100% replacement for extended 80-column card
 - provides 80-column text display
 - double high-resolution graphics
- ProDOS and DOS 3.3 compatible
- Extends AppleWorks desktop space up to 944Kb
- MegaRamCache for fast, user transparent disk caching
- Expansion connector for future additional RAM expansion and RGB interface.
- Quality, four-layer circuit construction

- Software utilities
 - AppleWorks extender
 - ProDOS and DOS 3.3 RamDisk
 - MegaRamCache
 - RAM diagnostics

1.2 Compatibility

This section outlines the compatibility of the MegaRamPlus with some of the commonly used hardware and software products for the Apple IIe computer, including some of the new application programs which have been designed specifically to take advantage of the extra memory on the MegaRamPlus.

The list of third party manufacturers mentioned in this section is not exhaustive; it only indicates the ones with which the MegaRamPlus has been tested. Products not mentioned here cannot be guaranteed to be compatible. Your input as a user or third party developer will certainly be welcomed by AST Research, Inc.

1.2.1 Hardware Compatibility

HARDWARE PRODUCTS COMPATIBLE WITH THE MEGARAMPLUS

AST Research products

- SprintDisk
- MicroStor
- Multi I/O

Apple Computer products

- Apple IIe
- Apple II Memory Expansion Card
- AppleMouse II
- Disk II
- DuoDisk
- Parallel Interface Card
- Profile Super Serial Card
- UniDisk 5-1/4"
- UniDisk 3-1/2"

Microsoft products

- CP/M SoftCard

Titan Technology products

- Accelerator IIe

The above hardware products are trademarks of their respective manufacturer.

1.2.2 Software Compatibility

SOFTWARE PRODUCTS COMPATIBLE WITH THE MEGARAMPLUS

Software compatibility with respect to the MegaRamPlus can be defined at three different levels. At the highest level, there are software programs that upon boot up, recognize the MegaRamPlus as a ramdisk and will automatically load all or a portion of their files into the MegaRamPlus. A second level

of compatibility can be defined as those programs which can be copied from floppy disk to the MegaRamPlus by the user, using Apple ProDOS Filer. A third level of compatibility is defined as copy protected programs that can be copied to the MegaRamPlus using Catalyst 3.1 from Quark, Inc.

The following is a brief list of compatible software with the level of compatibility designated as follows:

- A — The software is automatically loaded into the MegaRamPlus during program loading (booting). (Requires minimum of 256K MegaRamPlus configuration.)
- B — The software can be copied to the MegaRamPlus by the user, using ProDOS Filer.
- C — The software is copy protected but can be copied to the MegaRamPlus using Catalyst 3.0 from Quark, Inc.

SOFTWARE	COMPANY	COMPATIBILITY		
		A	B	C
AppleWorks 1.3	Apple Computer, Inc.		X	
AppleWorks 1.2	Apple Computer, Inc.		X	
AppleWriter II 2.0	Apple Computer, Inc.		X	
BPI Accounting Series	BPI Systems, Inc.			X
BusinessWorks 5.1	Manzanita	X		
Managing Your Money 1.0	MECA		X	
MouseDesk	International Solutions, Inc.		X	
PFS: File (ProDOS)	Software Publishing, Inc.			X
PFS: Plan (ProDOS)	Software Publishing, Inc.			X
PFS: Report (ProDOS)	Software Publishing, Inc.			X
PFS: Write (ProDOS)	Software Publishing, Inc.			X
Pinpoint	Pinpoint, Inc.		X	
ReportWorks	Megahaus			X
Sensible Speller	Sensible Software, Inc.			X
SuperCalc 3a 1.1	Sorcim/IUS		X	

The above software programs are trademarks of their respective manufacturer.

1.3 Expandability

The MegaRamPlus memory area is fully socketed. The card is available in five configurations — 64K, 256K, 512K, 768K, and 1 megabyte. If you have a configuration with less than 1 megabyte, you will find it fairly simple to increase the memory capacity by having your dealer add more RAM chips. You may also obtain AST's RAM kits through your dealer or you may buy the chips from some other sources for installing them yourself. See section 2.2 Memory Expansion Procedure.

1.4 Checklist

Before getting started, check to see that your MegaRamPlus package includes the following items:

- MegaRamPlus Printed Circuit Card with the memory size you purchased.
- MegaRamPlus Utility Diskette.
- MegaRamPlus User's Manual.
- Warranty Card (included in user's manual)

SECTION 2

INSTALLATION

2.0 MegaRamPlus Card Installation

It is easy to install the MegaRamPlus memory card in your Apple IIe. Follow the step by step installation procedure below.

STEP 1

Turn off the Apple IIe power; you do not have to remove the power cord.

STEP 2

Remove the cover from the computer top (refer to the Apple IIe Owner's Manual, Chapter 1, section on "REMOVING THE APPLE IIe COVER").

STEP 3

Before handling the MegaRamPlus (or any RAM devices) you should discharge any static electricity that may be accumulated on your clothes/body. One way to do that is to touch a metal surface that is connected to Earth ground, such as a printer case or the power supply in the computer.

STEP 4

If you have a non-enhanced IIe computer, you need to identify the revision of the Apple motherboard. Behind the I/O connectors near the middle of the motherboard is a serial number followed by the letter A,B,or C. If the letter on your non-enhanced IIe is A, you will need to remove the jumper block J1 located on the MegaRamPlus board before installing the board in the computer.

STEP 4

Locate the auxiliary memory slot on the Apple IIe mother board. The auxiliary slot is the 60 pin connector located closest to the computer's power supply.

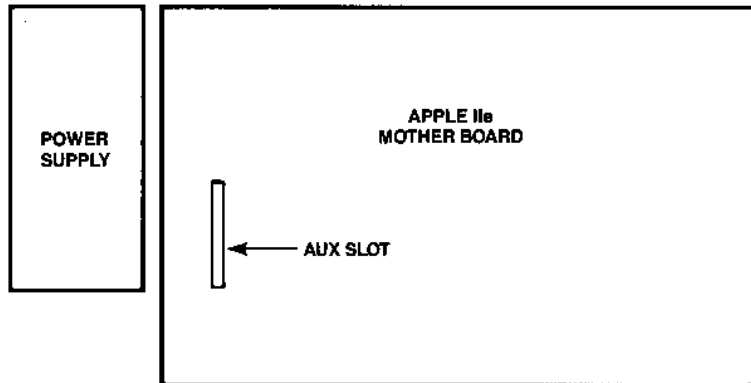


Figure 1. Auxiliary Slot Location

STEP 5

Remove any card resident in the auxiliary slot by gently lifting straight up on the card while rocking it back and forth. Install the MegaRamPlus card in the auxiliary slot with the component side of the card facing away from the power supply.

STEP 6

Replace the Apple computer cover. You are now ready to turn on the power and go!

PLEASE FILL OUT AND MAIL IN YOUR WARRANTY REGISTRATION CARD TO HELP US PROVIDE YOU WITH CONTINUOUS SUPPORT AND SERVICE.

2.1 Memory Diagnostics

The MegaRamPlus card comes with software utilities which include memory test diagnostics. This test program allows you to test all the installed RAM and other circuitry. If you have added the "piggyback" option, the RAM on that will also be tested.

The memory test should be run when you first install the MegaRamPlus in your Apple IIe, and subsequently if you add RAMs to your board or if you suspect that your card is not functioning properly. Note: Before using your MegaRamPlus utilities diskette, you should make a backup copy to use as a working diskette, and keep your original in a safe place.

IMPORTANT NOTE:

THE MEMORY TEST PROGRAM WILL ERASE ANY INFORMATION STORED IN THE CARD.

The step by step procedure below describes how to run the MegaRamPlus memory test.

STEP 1

Boot up the MegaRamPlus utilities diskette. The MegaRamPlus utilities screen will appear.

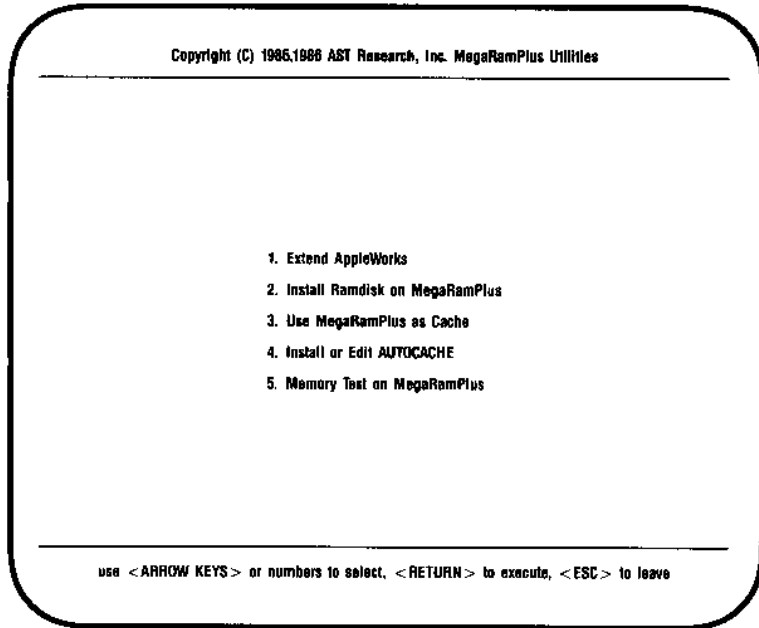


Figure 2. MegaRamPlus Utilities Screen

STEP 2

Select option 5, Memory test on MegaRamPlus, and press RETURN. The Memory Test Screen will appear, and the memory test will begin. You will see a graphic representation of the MegaRamPlus on the screen.

Figure 3 below shows the screen display during the memory test. Information at the bottom of the screen shows the total memory installed, the current test cycle, and the current bank under test.

In this example, the card has 1024K Bytes of RAM installed, is in cycle 1 of the test (Pass 1) and is testing bank #0.

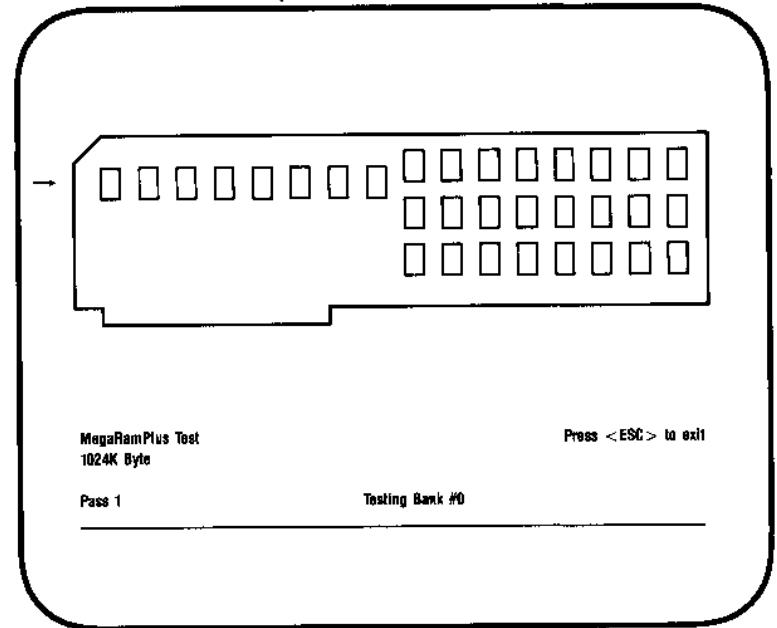


Figure 3. Memory Test Screen

The memory test is continuous so that extensive testing can be done. The test can be interrupted at any time by pressing the <ESC> key. You should allow the test to complete at least one pass before pressing the <ESC> key.

If the memory test completes successfully, the following message will appear: Press <ANY KEY> when ready.

Pressing "any key" will return you to Applesoft BASIC and display an Applesoft BASIC prompt (>). Trying to run programs at this point that rely on auxiliary memory will "crash" because the memory test has left the auxiliary memory filled with unusable test data. It is recommended that following a memory test operation that you re-boot the system before trying to run your next application program.

If the memory test finds a defective RAM chip, it will mark an X inside the outline of the chip. If during a test cycle a failure is encountered, the test cycle will be completed to determine all the defects and will then automatically terminate the test with the following message:

WITH X MARKED CHIPS ARE PROBABLY BAD

If you or your dealer have added RAM chips to the MegaRamPlus, and the memory test has located a failure, check first for bent pins (pins not seated properly in their respective RAM sockets) on the added RAM chips.

2.2 Memory Expansion Procedure

Expanding the memory of the MegaRamPlus is easy and simple. Step by step instructions are described in this section. The figure below shows the memory bank arrangement of the RAMs on the MegaRamPlus.

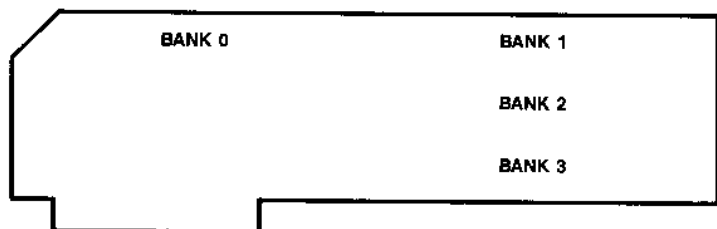


Figure 4. Memory Bank Arrangement

There are four banks of RAM, designated as bank 0 through bank 3. Each bank is made up eight RAM chips. You can use 64K or 256K dynamic RAMs (DRAMs) in any bank, however you cannot mix 64K and 256K chips within the same bank. Bank 0 is the lowest bank and must be filled first. Bank 1 is the next bank and must be filled next, ect. The minimum configuration MegaRamPlus available is 64K with bank 0 filled with eight 64K chips. By adding 64K chips to the other banks, the following configurations are possible:

64K	Bank 0 Filled
128K	Bank 0,1 Filled
192K	Bank 0,1,2 Filled
256K	Bank 0,1,2,3 Filled

If 256K chips are used, the following configurations are possible:

256K	Bank 0 Filled
512K	Bank 0,1 Filled
768K	Bank 0,1,2 Filled
1024K	Bank 0,1,2,3 Filled

When adding RAM chips, you must use RAMs that have an access time of 150 nanoseconds (ns) or faster (i.e., shorter access time). You can obtain RAM chips for expanding your MegaRamPlus from your dealer or direct from a component supplier. If you have an Extended 80-Column Card with socketed RAMs, you can remove the RAMs from that board and add them to your MegaRamPlus.

To install the RAM chips, follow the instructions given below.

STEP 1

When adding RAMs to the MegaRamPlus, the card must be outside of the computer so that the card's RAM sockets are easily accessible. Remember that when removing or installing cards in your computer, the computer's power must be off. Be sure that you have the correct quantity and type of RAM chips. Lay the MegaRamPlus card on a smooth, flat, dry, static free surface. Note the memory bank locations 0 through 3.

Installation

At the very minimum, bank 0 will already be filled. Note also that the RAM chips are all oriented with their notch pointing down.

STEP 2

Start with the lowest unused bank number. Insert the RAM chips with the notch in the correct direction. Special care must be taken so that all legs on the RAM chip are lined up properly with their corresponding socket holes. AST Research does not assume any liability for damage done to the memory chips, the MegaRamPlus, or the Apple IIe computer due to improper installation of the RAMs.

STEP 3

You may expand as many banks as you wish following the above procedure.

STEP 4

After installing all the required RAMs, install the MegaRamPlus in your computer (section 2.0) and run the MegaRamPlus Memory Test (section 2.1) to verify that the RAMs are good and that they have been installed properly.

SECTION 3

EXTENDING APPLEWORKS

3.0 Overview

The MegaRamPlus software utilities allow you to extend the Desktop space of AppleWorks (version 1.3 or later) up to 944K bytes, breaking through the 55Kbyte barrier that is normal for AppleWorks. If you have an earlier version of AppleWorks, you will not be able to expand its Desktop space using the MegaRamPlus software utilities. However you can generally upgrade to the latest version of AppleWorks through your dealer for a nominal cost.

The amount of desktop expansion depends on the amount of memory installed on the MegaRamPlus. The following shows the amount of desktop expansion for four popular board configurations:

MegaRamPlus Configuration	Available Desktop
1 Mbyte	944K
768 Kbyte	692K
512 Kbyte	436K
256 Kbyte	182K

The extender software utility modifies your AppleWorks program on your floppy disk or hard disk so that when ever you boot the modified AppleWorks, it automatically recognizes the extra memory on the MegaRamPlus and expands the desktop accordingly. You only have to modify AppleWorks once. Your modified version will then always be ready to recognize the extra memory of MegaRamPlus. Even if you later add more memory to your MegaRamPlus, your modified version of AppleWorks will find the extra memory and use it for added desktop space.

If you are using the MegaRamPlus to extend the desktop space of AppleWorks, you will not be able to use it at the same time as a ramdisk to store other files or programs. This is because the modified version of AppleWorks sets up its own special ramdisk in the MegaRamPlus.

As stated earlier, you can modify AppleWorks on a floppy disk or a hard disk. If you are going to modify AppleWorks on a floppy disk, you should make the modifications on a backup copy of AppleWorks, and keep your original unmodified version in a safe place. If you are going to modify AppleWorks on a hard disk, you may want to set up a special pathname leading to the modified version to distinguish it from a non-modified version stored on the same hard disk.

You will need a minimum of 128K bytes installed on the MegaRamPlus in order to take advantage of the AppleWorks extender program.

3.1 How to Extend AppleWorks

Follow this step by step procedure to extend your AppleWorks desktop space.

STEP 1

Make a backup copy of your AppleWorks Startup and Program disk. Use the backup copy to make the modifications. The extender program will permanently modify your AppleWorks program (version 1.3 or later) to use all of the memory on the MegaRamPlus.

If you need to make any configuration changes on your AppleWorks program (i.e., printer setup, etc.), make these modifications on the backup copy of AppleWorks BEFORE you extend AppleWorks with this program. However, if you want to attach functions to AppleWorks (with programs like Pinpoint etc.), attach them AFTER you extend AppleWorks.

STEP 2

Boot up the MegaRamPlus utilities diskette. The MegaRamPlus Utilities screen will appear as shown previously in figure 2.

STEP 3

Select item number 1, Extend AppleWorks. The item selected will be highlighted. Press RETURN to run the selected item. The AppleWorks Extender introductory screen will appear as shown in figure 5.

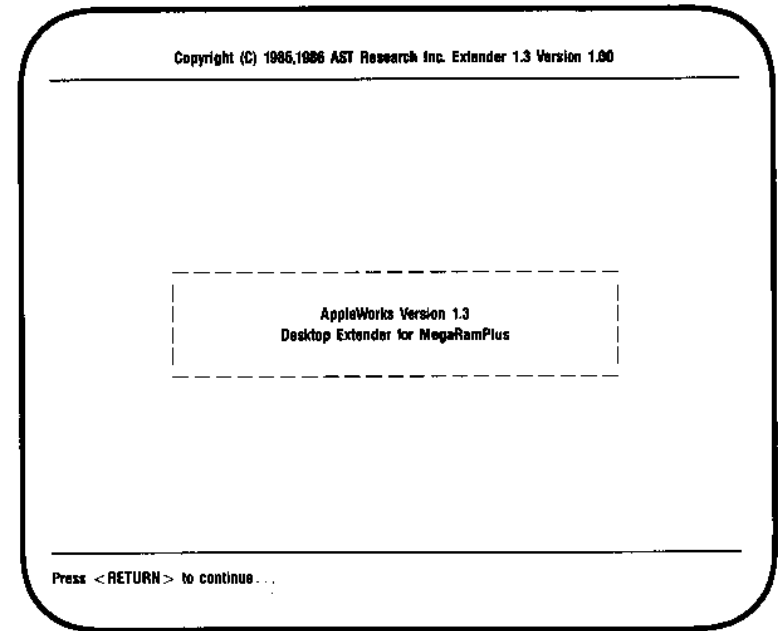


Figure 5. AppleWorks Extender Introductory Screen

STEP 4

Press RETURN to continue. Instructions about configuring your AppleWorks program will appear on the screen. Press RETURN to continue.

STEP 5

If you are using AppleWorks on a floppy disk, press RETURN to continue. If you are using AppleWorks on a hard disk, enter the pathname leading to a copy of the file APLWORKS.SYSTEM that you want to modify. Press RETURN after you have entered the pathname. AppleWorks will automatically be modified on the hard disk in approximately 10 seconds. When complete, the message "AppleWorks Modified" will appear on the screen. Continue with step 7.

STEP 6

If you are using AppleWorks on a floppy disk, insert your backup copy of the AppleWorks Startup diskette in drive 1 and press RETURN. The modification will take about 20 seconds. When complete, the message "AppleWorks Modified" will appear on the screen. Note: If you started the MegaRamPlus Utilities from a disk drive other than floppy disk drive 1, you will need to enter the pathname leading to the file APLWORKS.SYSTEM on drive 1.

STEP 7

Your AppleWorks program is now ready to recognize the extra memory on your MegaRamPlus. Pressing RETURN at this point will result in the Applesoft Basic prompt (>) appearing. From here you can run another application by typing in the pathname to the desired application. For example, if you wanted to run your newly modified version of AppleWorks, you would type in the pathname leading to the modified version of

APLWORKS.SYSTEM. Example:

~/APPLEWORKS/APLWORKS.SYSTEM. If you have a 1 Mbyte card, the AppleWorks 1.3 introductory screen will appear as follows:

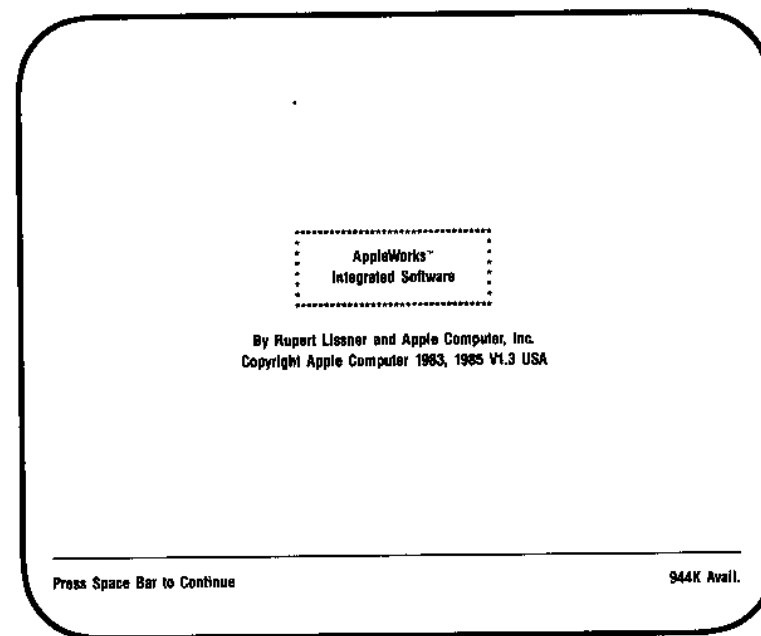


Figure 6. AppleWorks 1.3 Introductory Screen

SECTION 4

OPERATION AS A RAMDISK

4.0 How a Ramdisk Works

A ramdisk is RAM that simulates a disk. Generally, an area of RAM is allocated to simulate the operation of a disk, like a floppy disk or a hard disk. Any programs that access normal disk drives can access a ramdisk. A ramdisk is used to improve the performance of a computer. This improvement is achieved by eliminating mechanical disk access. Programs can be copied from a floppy disk or hard disk to a ramdisk, then can be accessed from the ramdisk. Since the data is accessed from ramdisk, which works as fast as system memory, very high performance is realized. The maximum performance that can be obtained would require that the ramdisk size be as large as the disk(s) capacity that includes all the files to be used.

An important point to remember when using a ramdisk is that when you power off your computer, the contents of the ramdisk will be erased. Therefore you must save the contents of the ramdisk to a "non-volatile" disk, (a floppy disk or a hard disk), before you power off, if you want the data in the ramdisk to be saved.

The MegaRamPlus includes software utilities that allow you to use the MegaRamPlus as a ProDOS ramdisk or a DOS 3.3 ramdisk. You will need a minimum of 128K bytes installed on your MegaRamPlus in order to take advantage of the ramdisk utility.

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4.1 Using MegaRamPlus as a ProDOS Ramdisk

You can create one ProDOS volume named "/RAM", located in slot 3 drive 1. The size of the volume depends on the amount of memory installed on the MegaRamPlus. With 1.megabyte installed, the volume size would be approximately 980K bytes.

To create a ProDOS ramdisk, follow the step by step instructions.

STEP 1

Boot up the MegaRamPlus utilities diskette. The MegaRamPlus utilities screen will appear as shown previously in figure 2.

STEP 2

Select item 2, Install Ramdisk on MegaRamPlus, and press return. The following message will appear:

```
Ramdisk Installation Complete
type <ANY KEY> to continue ...
```

The ProDOS ramdisk is now installed and ready to use. It is automatically assigned the volume name /RAM. At this point it is essentially a blank formatted disk. You can now operate on this volume just like you would any other ProDOS volume.

STEP 3

Typing any key at this point will result in the Applesoft Basic prompt (]) appearing. You can now run another application by entering the pathname leading to the desired application. For example, to run a program named "file" on a diskette whose volume name is "volume", you would enter the following at the prompt (]):

```
-/volume/file (RETURN)
```

You can copy files to and from the ProDOS ramdisk using ProDOS FILER. ProDOS FILER is an Apple disk utility provided on Apple's ProDOS Users Disk (not part of the

MegaRamPlus utilities). Follow the step by step instructions given below:

STEP 1

Place the ProDOS User's Disk in disk drive 1 and start the FILER program. One way to do this from the Applesoft Basic prompt (]) is to enter: -/USERS.DISK/FILER (RETURN). The FILER menu will appear.

STEP 2

Press F for FILE COMMANDS. The FILE COMMAND menu will appear.

STEP 3

Press C for COPY FILES. You will be prompted to enter the pathname of the source file and then the pathname of the destination file.

STEP 4

At the prompts, enter the appropriate pathnames. For example, if you wanted to copy the file FILER from the ProDOS User's Disk (whose volume name is USERS.DISK) to the MegaRamPlus ramdisk, you would enter for the source pathname:

```
/USERS.DISK/FILER (RETURN).
```

For the destination pathname you would enter:

```
/RAM/FILER (RETURN).
```

If you wanted to copy all the files on the User's Disk, you would enter for the source pathname:

```
/USERS.DISK/ = (RETURN).
```

For the destination pathname enter:

```
/RAM/ = (RETURN).
```

When all the files have been copied, you'll see the message:

```
COPY COMPLETE
```

You can copy files from the MegaRamPlus ramdisk to other ProDOS disks following steps 1 through 4 above, except now you would use /RAM as the source volume.

Remember, the MegaRamPlus ramdisk's storage is temporary. It is important to save your data to floppy or hard disks at regular intervals or at least before you turn off your computer.

4.2 Using MegaRamPlus as a DOS 3.3 Ramdisk

You can create up to two DOS 3.3 volumes, residing in slot 3 drive 1 and 2. The number and size of the volumes depends on the amount of RAM installed on MegaRamPlus. For example, if you have a MegaRamPlus with 256K memory you will create a single volume of that size in slot 3 drive 1. With 512K memory you will create a single 400K volume in slot 3 drive 1. With 768K you will create two volumes as drive 1 ⁹ 400K and drive 2 ⁹ 368K. You will get two full 400K volumes as drives 1 and 2 with a 1Mbyte MegaRamPlus.

The MegaRamPlus utility diskette has a DOS 3.3 file on it named RAMDISK. (The utility diskette is not bootable in DOS 3.3.) Follow the step by step instructions to create a DOS 3.3 ramdisk:

STEP 1

Boot up your computer into the DOS 3.3 operating system using Apple's DOS 3.3 System Master diskette or some other appropriate bootable DOS 3.3 diskette.

STEP 2

Remove the DOS 3.3 diskette and insert the MegaRamPlus utility diskette.

STEP 2

At the Applesoft Basic prompt (|) enter: BRUN RAMDISK and press RETURN. A message will appear:

RAMDISK IS INSTALLED

The ramdisk is now installed. All DOS 3.3 commands will work with the ramdisk except the INIT command. You can now copy files to and from the ramdisk and run programs from the

ramdisk. To copy files to and from the ramdisk you can use the DOS 3.3 disk utility program FID found on Apple's DOS 3.3 System Master diskette. The program COPYA will not work with the MegaRamPlus.

Three important things to remember when using a ramdisk: First, any data on the ramdisk that you want saved must be saved to a floppy or hard disk before you turn off your computer. Second, when using DOS 3.3, don't create files larger than the disk to which you can save it. A standard Apple diskette can save 128K of data with DOS on it, or 140K without DOS. Third, programs that are copy protected will not allow you to copy them to the ramdisk.

SECTION 5

OPERATION AS A CACHE BUFFER

5.0 How Caching Works

This section is intended to help understand what caching is and how it is used to obtain the high performance from the Apple IIe computer that most users want. Section 5.1 later summarizes the pros and cons of ramdisk and cache.

Cache (pronounced "Kash") is a french word meaning "a hiding place" or something that is stored in a hiding place. The term cache, as applied to computers, refers to a high speed memory buffer which stores data from slower memory devices, for subsequent fast access by the computer's CPU. Caching has been used in main/mini computers such as the IBM 370 and DEC PDP 11/70. Although initial reasons for employing caching may have changed, the end result then, as today, remain the same: improvement in performance of disk based computers.

There are two fundamental ways to get higher performance from your personal computer. One is to make it run faster by using devices such as co-processors and accelerator cards. This is always a hardware solution, relatively expensive and often not truly 100% compatible.

The other way is to speed up its slowest operation. This is normally the disk I/O. In small computers such as the Apple IIe, the mass storage is the critical path. The mechanical access and latency of disk drives, floppy or hard disk, can be aggravating to a user, especially when combined with a large program or data file and a small main memory space. Even though a hard disk will provide the user significantly higher throughput than a floppy, the speed of data access is not comparable to that of directly addressable RAM.

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Caching is a clever software technique that speeds up the access to disk data.

Cache software is a utility program which upon installation, allocates RAM space as a cache buffer. The cache program then maintains copies of selected data on disk drives in its cache buffer. Whenever the data needed by the CPU can be found in this cache buffer, it can be accessed at the RAM speed, otherwise it will be a normal disk speed operation.

The chances of the data being found by the CPU in the cache buffer depends upon the size of the buffer and the formulae used by the cache program in "selecting" the data to be copied from the disk into the cache buffer.

In earlier days, cache buffers were relatively small due to the high cost of RAM. The small size of the buffer required that algorithms be developed that increase the "chances" of the CPU finding the data in cache. Today, it is possible to have RAM equal in size, if not bigger, than the capacity of the 5-1/4" diskette in the Apple IIe, for a lesser cost.

If the cache buffer is the same size as the disk it is caching, then the need for it to "select" does not arise and the behavior is pretty much like that of a ramdisk.

MegaRamCache is AST's caching software that was provided to you with the MegaRamPlus memory card. It allows you to use the card as a cache buffer option. Please note that you cannot use the MegaRamPlus as a ramdisk and a cache memory at the same time; you will have to select one or the other. Comparison of the two modes is made in the next section.

Some of the important features of the MegaRamCache that you should know about are described here.

- The program is totally transparent. Once you have installed it no further intervention will be required on your part. You do not have to copy data from a disk, nor save it after use.

- The MegaRamCache program can cache up to fourteen ProDOS devices. And this includes all floppies, hard disks, and tape drives identifiable under ProDOS.
- Caching can be used with ProDOS only.
- To increase the "chances" of the Apple IIe CPU "finding" the data in the cache buffer, and hence the performance of your system, the MegaRamCache uses a combination of caching algorithms optimized for the Apple IIe computer.

The algorithms used include "write-through" for caching write operations, and a combination of "least recently used (LRU)" and modified prefetch methods for caching read operations.

When the cache is initially installed, it is empty. When a read access is made to a ProDOS disk drive (which has been assigned as a cached device), the data read from the disk drives is brought into the Apples main memory, and is also written into the cache buffer (one block at a time). For any subsequent disk drive read accesses, the Apple CPU will first look in the cache buffer to see if the data it is requesting is resident in the cache buffer. If it is, the CPU will read it from the cache buffer into main memory, bypassing the mechanical access to the disk drive. This results in a much faster access time since the CPU is reading data from fast RAM (i.e., the cache buffer) rather than doing a read from a mechanical disk drive.

As the cache buffer becomes full, the caching algorithm begins to purge the Least Recently Used (LRU) blocks from the cache buffer, and brings in the most recently accessed blocks of data. Therefore, the contents of the cache buffer are continually and dynamically changing, depending on disk drive I/O activity, keeping data that is most often and most recently used.

Caching will not speed up disk drive write operations. When a write access is made to a cached disk drive, the data is actually written to the disk drive. This eliminates the need to do a separate "save cache" operation because the data is already saved to disk. However, to keep the cache contents current, during a disk write operation, the caching software checks to see if the block it is about to write to is in the cache buffer. If it is, it updates the cache block and then writes to the disk drive. This way the contents of the cache always represent the corresponding contents of the disk.

Anytime there is a disk drive read operation that involves reading the disk directory, the caching software will read the disk directory and compare it to the directory it is holding in the cache buffer. If they do not match, then the caching software knows that the disk has been changed since the last directory read, and will erase the contents of the cache buffer for that disk drive.

5.1 Comparison of Ramdisk and Cache.

- Ease of use.

Cache is user transparent. Once the program is installed the user can forget about it. You do not have to copy disk files into ramdisk nor do you have to remember to save them before shutting down the system.

- Performance difference.

(a) Using single file/disk.

If the MegaRamPlus memory size is same as the disk or file then no perceptible difference should be noticed between the ramdisk and cache modes.

(b) Using multiple files/drives.

In this case you would need large ramdisk space to create as many disks you wish to emulate. Under MegaRamCache all available memory on the card (up to 1 megabyte) will be dynamically allocated to as many devices as you select (up to 14 under ProDOS). If you use the Apple IIe with more than just one storage device, then the cache mode of the MegaRamPlus will be most advantageous.

5.2 Using MegaRamPlus as a Cache Buffer

There are two ways to set the MegaRamPlus into the cache mode. One way is to manually define the MegaRamPlus as a cache buffer by selecting item 3 from the MegaRamPlus utilities screen "Use MegaRamPlus as Cache". This will put the MegaRamPlus into the cache mode and give you a menu of available ProDOS disks that you can select to be cached. This provides flexibility but requires you to re-do the operation every time you do a cold or warm boot on your computer.

The other way to enable the cache mode is to select item 4 from the MegaRamPlus utilities screen "Install or Edit AUTOCACHE". This lets you install and/or edit an automatic startup program on a boot diskette or your hard disk.

The automatic startup program is called AUTOMC.SYSTEM and is installed as the first file in the directory of the boot diskette. (Note, caching applies to a device and not to the files on the device.)

AUTOMC.SYSTEM is executed automatically when the diskette (on which it has been installed) is booted and switches caching ON for all mass storage devices you had defined in the selection menu.

The boot diskette will always be cached. Caching status of other storage devices will also be as defined from the selection menu. If the slot configuration of storage devices were changed, re-editing will be necessary.

After AUTOMC.SYSTEM has switched on the caching it will search for a second system file whose name ends with .SYSTEM and will execute it so that you still have the same turnkey system as before. AUTOMC.SYSTEM will always be the first .SYSTEM file in the directory.

AUTOMC.SYSTEM uses 8 blocks of diskette space. Of course the utility program will determine if you have space available on your diskette.

The procedures for manually enabling the cache mode and for installing the autocache mode are described below.

Follow the step by step procedure for manually enabling the cache mode.

CAUTION:

IF YOU USED THE MEGARAMPLUS IN THE RAMDISK MODE PRIOR TO CACHE MODE, ALL PREVIOUS RAMDISK DATA WILL BE DESTROYED.

STEP 1

Boot up the MegaRamPlus utilities diskette. The MegaRamPlus utilities screen will appear as shown previously in figure 2.

STEP 2

Select item 3, "Use MegaRamPlus as Cache", and press RETURN. The MegaRamCache configuration menu will appear

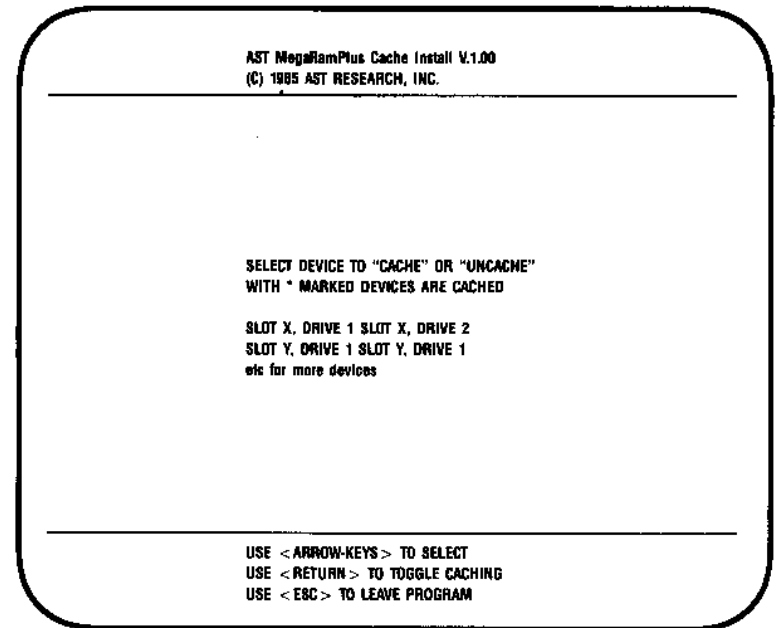


Figure 7. MegaRamPlus Configuration Menu

The default or currently selected device will be highlighted. You can select a device by moving the highlight cursor using the arrow keys. The RETURN key toggles cache on/off for a device. Device(s) that are selected to be cached are indicated by an asterisk to the left. Leave the program by using the <ESC> key.

Follow the step by step procedure to automate the MegaRamPlus cache mode.

STEP 1

Boot up the MegaRamPlus utilities diskette. The MegaRamPlus utilities screen will appear as previously shown in figure 2.

STEP 2

Select item 4, "Install or Edit AUTOCACHE", and press RETURN. The AutoCache Editor will appear.

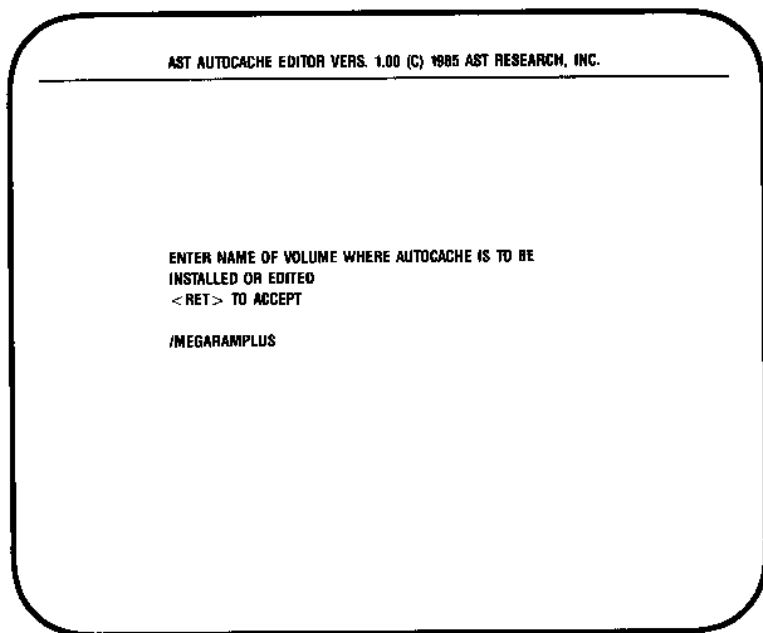


Figure 8. AutoCache Editor

STEP 3

Insert the diskette on which you wish to install AUTOMC.SYSTEM file in a disk drive and enter the volume name of the diskette. If you are installing AUTOMC.SYSTEM on a hard disk, enter the volume name of the hard disk. Press RETURN. The AutoCache Configuration menu will appear.

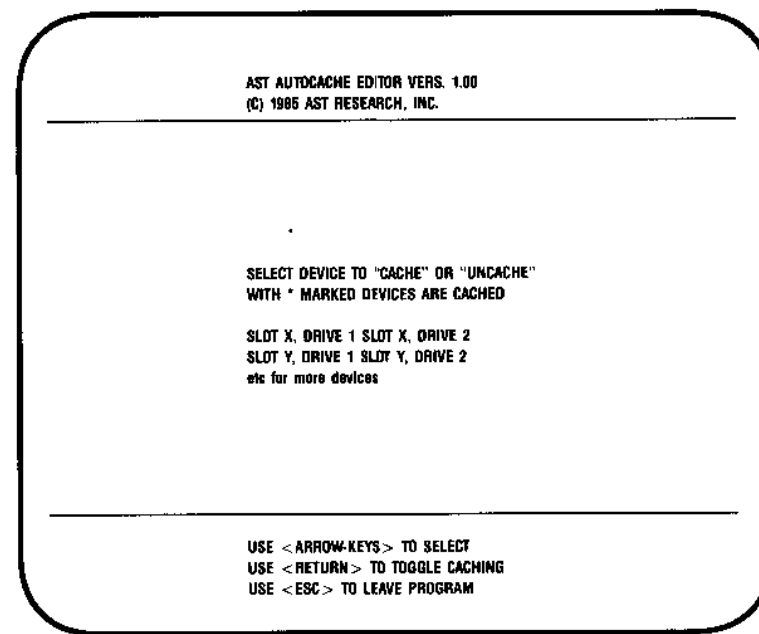


Figure 9. AutoCache Configuration Menu

STEP 4

Edit the cache configuration and leave the program by using the <ESC> key. This will create a file named AUTOMC.SYSTEM on your target diskette, hard disk or tape. Any previous AUTOMC.SYSTEM file will be over written.

NOTE

If you are using a diskette or hard disk with AUTOMC.SYSTEM installed all you are doing is avoiding reconfiguration every time you use the program. However with MCACHE.SYSTEM you can always turn on/off caching of storage devices at any time.

Some application programs may automatically create a ramdisk on MegaRamPlus when they are booted up. If you have the MegaRamPlus in the cache mode, these programs will cause the MegaRamPlus to leave the cache mode. One example of this is the extended AppleWorks program you can create with the MegaRamPlus utilities. When this program boots up, it automatically creates a special ramdisk for use as extended desktop space.

SECTION 6

DEVELOPERS GUIDE TO MEGARAMPLUS

6.0 80 Column-Display

Control of 80-column displays from keyboard and program control are the same as for the standard Apple 80-column text card. For detailed information on this refer to Apple's 80-column text card manual.

6.1 Bank Switching

The Apple IIe with its 6502 microprocessor is only capable of directly addressing 64K bytes of memory. To allow the 6502 to gain access to memory beyond this 64K limit, the MegaRamPlus uses a technique called bank switching. The MegaRamPlus expands memory in the Apple the same way as Apple's Extended 80-column Text Card. All procedures to access the expanded memory apply as described in Apple's Extended 80-Column Text Card Supplement manual. The real difference lies in the fact that the MegaRamPlus simulates multiple auxiliary cards, each with its own 64K. For this discussion we will refer to these 64K partitions as 64K blocks. These blocks are numbered from 0 to N, depending on the capacity of the MegaRamPlus card.

To switch between 64K blocks, write the number of the requested block into address:

\$C07X (X = don't care)

NOTE

Whenever you switch between 64K blocks on the MegaRamPlus, make sure to switch 64K block 0 back in before your routine returns to its calling program. Otherwise, 80-column text output and/or double hires graphics routines can get messed up.

Depending on what chips are used on the card, not all of the 64K blocks may be available. The following table provides a means of finding out which 64K blocks are available in which configuration. Memory banks 0 through 3 are located on the main MegaRamPlus board. Memory banks 4 and 5 are located on the future optional piggyback expansion card.

Table of available 64K blocks

Bank	64K Chips	256K Chips
0	0	0, 4, 8, 12
1	1	1, 5, 9, 13
2	2	2, 6, 10, 14
3	3	3, 7, 11, 15
4	16	16, 20, 24, 28
5	17	17, 21, 25, 29

The following is an example program on how to find out through software which 64K blocks are available. It creates a block list of 32 byte length. Each byte in this list represents a 64K block. The byte is 0 if the corresponding block is not available.

```

AUXZP      .EQU $C009      ;Auxiliary Zero Page Switch
MAINZP     .EQU $C008      ;Main Zero Page Switch
BLKSELECT  .EQU $C073      ;Block Select Register
MARK       .EQU $00        ;Marker used to check Bank
TEST       .EQU $01        ;Check Byte

FINDBLKS   STA  AUXZP      ;Switch to Auxiliary Zero Page
LDY        #$1F           ;Start with highest possible number
LOOP1      STY  BLKSELECT  ;Select the Block
STY        MARK           ;Set a Marker
TYA
EOR        $FF            ;Create the Check Byte
STA        TEST           ;Dec Counter, Loop if not done
DEY
BPL        LOOP1

;Now Test for Blocks

LOOP2      LDY  #$1F           ;Start at highest possible number
STY        BLKSELECT      ;Select the Block
CPY        MARK           ;Is this Block there?
BNE        NOTHERE        ;Branch if not there
TYA
EOR        $FF            ;Test the Check Byte
CMP        TEST
BNE        NOTHERE        ;Branch if not found
LDA        #01            ;Get 1 to mark list as Block There
BNE        CONT           ;Branch always
NOTHERE    LDA        #00    ;Get 0 to mark list as Not There
CONT       STA        BLKLISTY ;Mark in List
DEY
BPL        LOOP2          ;Loop back if not done
STA        MAINZP         ;Switch to main Zero Page if done
RTS        ;And return to calling program
    
```

6.2 Ramdisk

When the MegaRamPlus ProDOS ramdisk is installed, the built in ramdisk of ProDOS, named /RAM, is replaced by the bigger ramdisk of MegaRamPlus. Access the MegaRamPlus ramdisk as you would the built in ProDOS ramdisk. Here is a list of differences between the MegaRamPlus ramdisk and the ProDOS built in ramdisk.

1. MegaRamPlus must have at least a capacity of 128K to run its ramdisk.
2. MegaRamPlus' ramdisk does not, unlike the built in ProDOS ramdisk, use the first 64K of expanded memory. So you can use programs like AppleWorks, which use the first 64K of expanded memory for their own purposes, together with the MegaRamPlus ramdisk.
3. MegaRamPlus acts as a ramdisk in slot 3, drive 1, while the ProDOS built in ramdisk acts as a ramdisk in slot 3, drive 2.

6.3 Cache

The following protocol has been defined to let programmers access the functions of the MegaRamCache. Application programs can thereby cache or uncache storage devices at their own discretion.

To cache a storage device you do a ProDOS write call to the MegaRamCache. Calls have the following form:

```
JSR M          (MLI is ProDos command entry $BF00)
BYTE 81
WORD PARAMET (Address of Parameter block)
...
```

A-Reg contains error code after execution. C is set if error occurred, otherwise not. The Parameter block has the following form:

```
$03
$30          (MegaRamCache slot number)
$00
$20
$00
$X0          (X has the form 'dsss'
              d = drive number [0,1]
              sss = slot of cached device)
```

If the specified storage device was already cached, this call will clear the cache of all prior data, requiring the cache to reload from that device.

To uncache a storage device you do a ProDOS read call to the MegaRamCache. Calls have the following form:

```
JSR MLI          (MLI is ProDos command entry $BF00)
BYTE 80
WORD PARAMETER (Address of Parameter block)
...
```

A-Reg contains error code after execution. C is set if error occurred, otherwise not. The Parameter block has the following form:

```
$03
$30          (MegaRamCache slot number)
$00
$20
$00
$X0          (X has the form 'dsss'
              d = drive number [0,1]
              sss = slot of uncached device)
```

If the specified storage device was not cached, this call has no effect.

To determine if a device is cached or not read the following address:

- drive 1: \$BF11 + n (n = device slot # * 2)
- drive 2: \$BF21 + n (n = device slot # * 2)

The byte in this address contains a \$FF when this device is currently cached

SECTION 7

TECHNICAL SPECIFICATIONS

7.0 Mechanical

Board Dimensions
Height: 2.75 inches Length: 7.75 inches

7.1 Electrical

Voltage Requirement
5.00 VDC +/- 5%

Current Requirements

<i>Board Configuration</i>	<i>Typical Current</i>
1MB	0.83A
768K	0.65A
512K	0.45A
256K	0.30A
64K	0.14A

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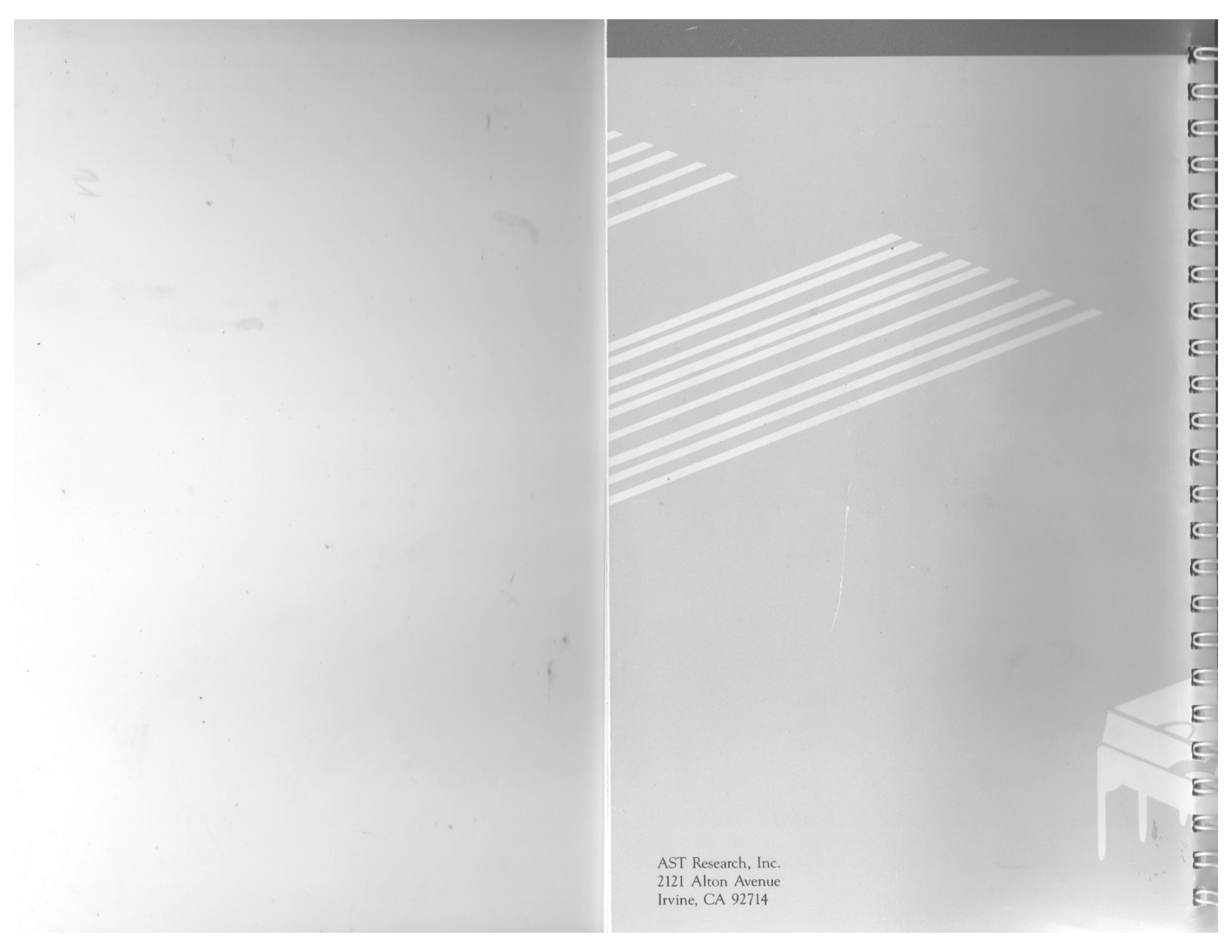
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The image shows the cover of a spiral-bound notebook. The cover is a light, neutral color, possibly off-white or light gray. It features several sets of parallel white lines that create a sense of depth and perspective. One set of lines is in the upper left, another set is in the center, and a third set is in the lower right. The lines appear to be part of a larger, three-dimensional structure, possibly a staircase or a series of planes. The spiral binding is visible on the right edge of the notebook. In the bottom right corner, there is a small, stylized graphic of a chair or a similar object. The overall aesthetic is clean and modern.

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