

APPLIED TECHNOLOGY LABORATORIES

COPY MASTER II

REFERENCE MANUAL

Version 3.0

**The COPY MASTER II Manual
for the Apple II+ and IIe
Version 3.0**

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FOREWORD

Congratulations! You have just bought an excellent addition to your computer. The COPY MASTER II will provide you with a capability to back-up many valuable protected programs in your personal or club library.

We at Applied Technology Laboratories are proud of our product because we feel that we are helping you to regain much of the freedom that software protection so selfishly took away.

But we also believe in software copyrights. Therefore we deplore piracy and we are marketing this product only for the purpose of making archival copies.

**Management of
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TABLE OF CONTENTS

FOREWORD

TABLE OF CONTENTS

LEGAL NOTICES

1.0 INTRODUCTION

- 1.1 What is a Copy Card?
- 1.2 How does a Copy Card work?

2.0 HARDWARE

- 2.1 System description
- 2.2 Board description
- 2.3 Installation
- 2.4 Operation
- 2.5 Compatibility

3.0 SOFTWARE - THE COPY MASTER PROGRAM

- 3.1 The COPY program
 - 3.1.1 Loading and using the COPY program
 - 3.1.2 Files created by the COPY program
 - 3.1.3 Restoring a copied Program
 - 3.1.4 Errors
 - 3.1.5 Making copies of backed up disks
- 3.2 The CONVERT Program
- 3.3 The STEP/TRACE Program
- 3.4 The FILE WRITER Program
- 3.5 The PAUSE Program
- 3.6 The SYSTEM CONFIGURE Program
- 3.7 The SYSTEM TEST Program
- 3.8 Backing up the COPY MASTER II utility disk
- 3.9 Software synopsis

4.0 SOFTWARE - THE SCREEN DUMP PROGRAM

- 4.1 The TEXT ONLY screen dump
- 4.2 The GRAPHICS dump
- 4.3 Designing a custom interface driver
- 4.4 Software synopsis

- 5.0 CONTROLLING THE ON BOARD RAM
 - 5.1 Memory Mapping
 - 5.2 Softswitches and Registers
- 6.0 NOTES ON COPYING
 - 6.1 Programs that are not entirely memory resident
 - 6.2 Programs that continuously access the disk
 - 6.3 CP/M programs
- 7.0 TROUBLE SHOOTING
 - 7.1 Hardware test
 - 7.2 Software test
 - 7.3 Interfacing with other hardware
 - 7.4 Checklist
- 8.0 WARRANTY

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1.0 INTRODUCTION

1.1 What is a Copy Card?

Since the early days of computers, software publishers have attempted to protect their software against unauthorized duplication. Unfortunately the nature of the protection scheme used made it also difficult to make legitimate software copies for archival purposes. First attempts at defeating software protection appeared in the form of disk copy programs capable of deciphering the non-standard DOS used for protection and copied protected disks virtually bit by bit and track by track. As the copy programs became smarter the software publishers came up with new and more intricate methods of protection in order to stay ahead of the game. The difficulty with all the disk copy programs is the need to discover an often complex set of parameters unique to each piece of protected software in order to make a successful copy. Unfortunately for the user it is much easier for the publisher to change the disk cipher than it is to break the new code.

An alternative to this chase game is to wait until the protected software has been loaded into the memory and then copy the contents of the Apple's memory onto a disk. This is precisely what copy cards do. A piece of hardware (the copy card) is required to gain the control of the machine once the protected software has been loaded. In fact the control of the machine is transferred to a special subroutine that performs the copying. This subroutine must be stored in some location of computer memory that is inaccessible to the protected software. State of the art copy cards usually have a RAM or ROM directly on the peripheral card. When RAM is used it is necessary to load in the copy program from the software utility disk every time the computer has been turned on. While such action is not necessary for the cards storing the subroutine in ROM the benefit of RAM becomes clear since it can hold (one at a time) other different pieces of the utility software which provide the card with greater flexibility and multiple purpose.

1.2 How does a Copy Card work?

The idea behind a Copy Card is rather simple: once the protected software has been loaded into Apple memory, the card will produce an exact image of the memory without any concern about the disk formatting, parameter setting, odd and even tracks or disk segments. In order to make a copy, the card interrupts the execution of the current program at a push of a button and transfers control of the Apple to the Copy Program; in essence a subroutine that moves the content of the memory, byte by byte, onto a DOS initialized disk. After an exact image of Apple's memory has been made on the disk, the card will return control to the program that was copied. It's execution will commence where it stopped before the copy was made.

The disk containing such a copy will now be unprotected and loadable with standard DOS commands. The program itself will be listable and customizable.

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2.0 The COPY MASTER II System

2.1 System description.

The COPY MASTER II System consists of a printed circuit board containing all the necessary hardware to control the Apple computer and a disk containing several utility programs.

The card has 19 IC'S: the 2 large (24 pin) IC's are (combined) 4k of RAM whereas the other 17 IC's perform various driving, controlling or switching functions. Attached to the PCB by a cable is a trigger switch. When depressed, it will activate the board and initiate transfer of machine control to the subroutine in the RAM. The circuit on the board can be roughly divided into several sections: Memory (COPY MASTER RAM), Memory Control Circuit (MCC), Trigger Switch Control (TSC), and a SoftSwitch Register (SSR).

In order for the COPY MASTER II's memory to be operated on by the computer it must be mapped into the 6502's address space. Since this space is already occupied by either the 48k RAM, the ROM and possibly by the 16k card or even the auxilliary memory card, there will be some redundancy in the memory: i.e. some memory in the Apple will share the same address. This is not uncommon to 8 bit machines; in fact in the Apple this is already done for the language card as well as for the auxilliary memory card. The important thing is to keep only one of these 'redundant' memories enabled at a time. This must be done in software using so-called 'Soft Switches'. The COPY MASTER II also uses soft switches and they are a part of the MCC. Using these the COPY MASTER ROM can be turned on or off. In particular, for a COPY MASTER II card installed in slot 'N' reading from $\$CO(N+8)1$ enables the COPY MASTER RAM whereas reading from $\$CO(N+8)2$ disables it. The basic map of COPY MASTER RAM into the Apple's address space is straightforward. Given that both the language card as well as (for the IIe) the auxilliary memory card are turned off while the COPY MASTER RAM is turned on then the 4k of COPY MASTER RAM corresponds to memory block $\$F000$ through $\$FFFF$ - see Figure 1. Note that when the COPY MASTER RAM is enabled accessing the address block $\$F000 - \$FFFF$ will always reach the COPY MASTER RAM and not the Apple's ROM, i.e. this segment of ROM is masked over.

But there is also another rather subtle memory overlay in the COPY MASTER RAM. The 256 bytes of address space associated with each peripheral slot (see Apple manual) can also be mapped into the COPY MASTER RAM. These 256 bytes will be represented by the block $\$CN00 - \$CNFF$ where 'N' is again the number of the slot occupied by the COPY MASTER board and it will be mapped into the area described as $\$FN00$ through $\$FNFF$ under the basic map - see Figure 1.

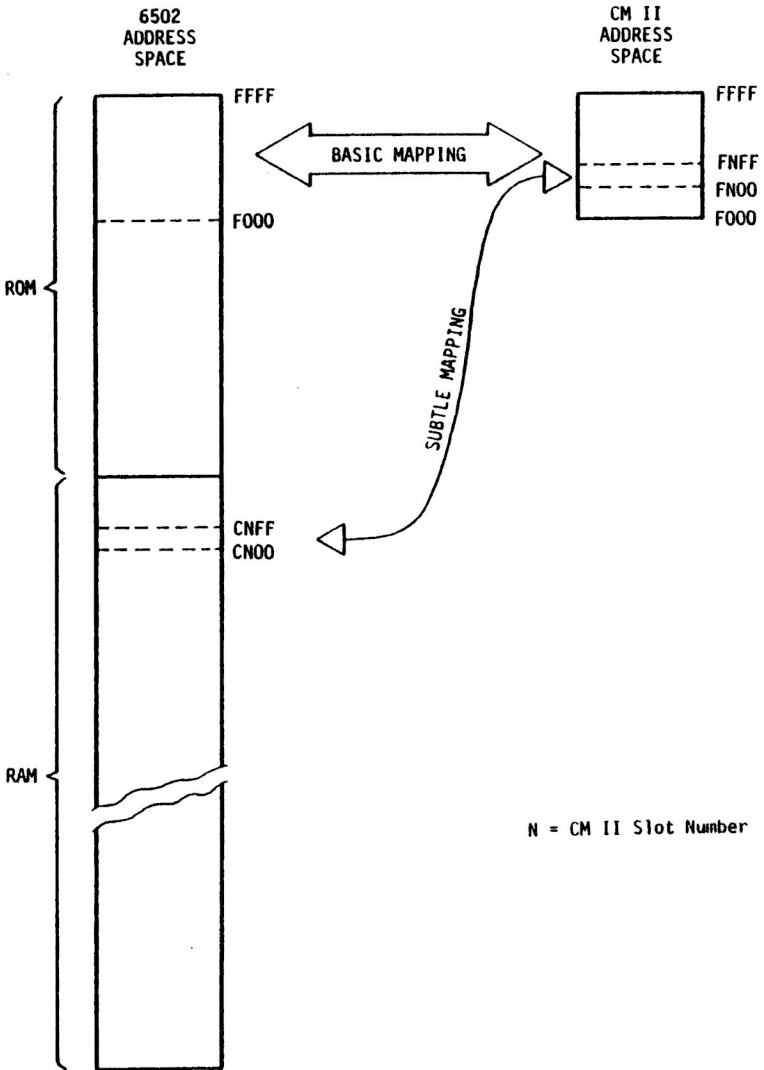


Figure 1: Diagram of Memory Mappings

The main purpose of the TSC is to latch in the trigger switch signal and to avoid false-triggering during subsequent depressions of the switch. The TSC is reset to its original state (trigger switch enabled) by reading from \$FFFC or \$FFFD. The TSC also adds a peculiar function to addresses \$FFFA and \$FFFB. Namely, while TSC is latched-in (i.e. trigger switch is disabled) reading from \$FFFA and \$FFFB will have the same effect as strobing $\$CO(N+8)1$, namely enabling COPY MASTER RAM.

It is important to understand that the TSC can be latched in ONLY by depressing the trigger switch.

Finally, the SSR is a sort of bookkeeping device not available on many other copy cards. It latches-in information about the last 16k card softswitch strobed. In particular if $\$COBx$ was strobed, the hexadecimal X can be read from the SSR, as the last 4 bits, by reading from $\$CO(N+8)4$ where again 'N' is the number of the slot having COPY MASTER II. Pressing the Reset key on the Apple keyboard initializes the data in the SSR to 0.

Softswitch	Meaning
$\$CO(N+8)1$	turn on CM RAM
$\$CO(N+8)2$	turn off CM RAM
$\$CO(N+8)4$	read SSR
\$FFFA	turn on CM RAM (provided TSC is latched in)
\$FFFB	turn on CM RAM (provided TSC is latched in)
\$FFFC	reset TSC
\$FFFD	reset TSC

Fig 2: Table of CM II Softswitches

2.2 Board description:

COPY MASTER is built on a board that interfaces the Apple peripheral I/O connectors (slots) 1 through 7 (Figure 3). The connectors on the board have gold plated fingers to assure high reliability. A total of 19 IC's are used in construction of COPY MASTER. This number is somewhat higher than most other "copy boards" because we do not believe in shortcuts that would limit the capability of our system when faced with up-to-date and future protection schemes. 17 IC's that have no markings are ordinary rugged TTL chips of high quality with small probability of failure. It is our belief that you will never have to be concerned about these and therefore they are soldered directly to the board. The 2 remaining IC's (40 pin) are 2kx8 RAM's in DIP sockets. These RAM's will store the utility program you selected from the menu.

Permanently attached to the board is a cable terminated with a push button switch. When the board is inserted in one of the Apple peripheral slots this cable should be passed through an opening in the back of the Apple and the switch brought within your reach. Depressing the button activates the software stored on the 4k bytes of RAM on the board and COPY MASTER will gain control of the Apple.

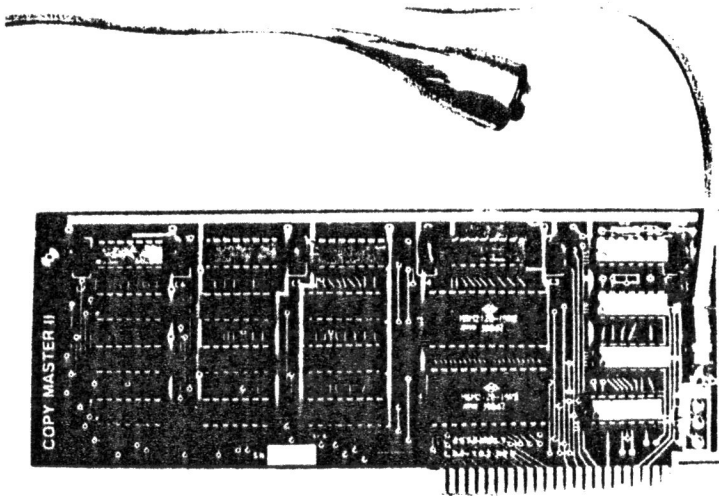


Figure 3: The COPY MASTER Board

2.3 Installation

The COPY MASTER board will operate in any Apple II or Apple II+ peripheral I/O slot except slot 0. If the user has an unused slot in his machine he may be able to devote it solely to the COPY MASTER. Since, when unactivated, COPY MASTER is transparent to both the host machine as well as to all peripherals under normal conditions this may be the most convenient approach.

The installation procedure of the COPY MASTER board is quite easy. Since improper installation can cause damage to the board as well as to your Apple, please follow carefully the steps described below. It should not take more than a few minutes to perform this installation.

INSTALLATION INSTRUCTIONS

1. Remove the power cord from the back of your Apple.
2. Unplug power cords from all peripherals connected to your Apple (i.e. printer, video monitor).
3. Remove the lid from the Apple by pulling up on the rear until both sides release. Be careful not to let the front edge dip too far down. Carefully slide the cover to the rear of the unit, and lift it up until the front edge of the cover is clear.
4. Select the peripheral I/O slot in which you wish COPY MASTER to operate. (Any of the 7 I/O slots 1 through 7 can be used.)
5. Carefully remove the COPY MASTER board from its protective plastic bag. During this procedure as well as any other times you should avoid touching the gold plated connector pins with your fingers.
6. Hold the COPY MASTER board over the empty I/O connector slot you have selected and slowly insert it. You should ease the board into the slot with all the pins at once. Make sure the board is fully and evenly seated in the slot. An improperly seated board can result in damage to both the board and your Apple computer.
7. Reconnect all the power cables and turn the system on. If the system does not function, turn the power off, disconnect all the power cables and reseal the board. If your system still does not function properly, consult your dealer.

Once the board has been inserted, the user should RUN the COPY MASTER Program to perform a system check. Insert the COPY MASTER II disk into the disk drive and RUN COPY MASTER. When the program ask

PLEASE SELECT (1-8)

press '7'. This initiates the SYSTEM TEST program. See section 3.7 of the manual.

2.4 Operation

Let us assume that a copy is to be made. As noted earlier the copying subroutine has to be loaded into the COPY MASTER RAM. This is performed by selecting the correct program from the COPY MASTER Menu. In detail, the driving program will open the COPY MASTER RAM by reading from $\$CO(N+8)1$, load in the utility program and close it by reading from $\$CO(N+8)2$. Now the user may load protected software to be copied into the Apple's memory. The protected software 'knows nothing' about the copy subroutine ready to ambush it and will not attempt to tamper with the COPY MASTER II soft switches. At a suitable moment (practically any time during the program execution) depression of the trigger switch starts the copying process. First the trigger signal will be latched in and the switch disabled. Subsequently the COPY MASTER RAM will be opened automatically. Third COPY MASTER II will close the 16k card by reading $\$CO(N+8)2$. (This 'extraordinary' softswitch access will not be recorded by the SSR however). Finally the actual copying commences. Assuming that the user has a fresh DOS 3.3 initialized disk in the drive the memory contents will be copied to this disk. About half way through the copying process (7 to 10 seconds) the TSC will be reset and the trigger switch enabled. Therefore the user should not keep holding the button down past this point as that will be recognized as a new button depression and the system will malfunction. In fact it is advisable to let the button go quickly after the depression. When the subroutine finishes copying the Apple memory it will turn off the COPY MASTER II RAM and transfer control back to the software whose execution has been interrupted.

2.5 Interfacing and Compatibility

COPY MASTER II uses NMI and DMA, neither of which is daisy chained. However, full compatibility with standard peripherals is still insured:

NMI: When COPY MASTER II is inactive, i.e. before the trigger button is depressed, the card is virtually transparent to the Apple and its peripherals. On the other hand, when activated, the COPY MASTER II will have a quasi-priority among all the peripherals, (i.e. it will interrupt an interrupt subroutine servicing another peripheral), but when itself being interrupted it will not (under most circumstances) yield control to other peripherals although the copying process may be foiled. We discourage the user from operating a peripheral that may generate an interrupt during the copying process or for that matter any time that protected software is in the machine because a part of some protection schemes is to point the interrupt vectors to a subroutine that will immediately erase the disk in the drive.

DMA: The DMA is used by COPY MASTER II only inside of the NMI subroutine. Standard peripherals using DMA such as Z80 card or other cards with microprocessors (e.g. Fast Card) are compatible with Apple NMI and when it is signalled they relinquish the address and data busses. COPY MASTER II compatibility is then insured. If the user is not sure whether his peripheral that uses DMA is standard in this respect he should remove it from I/O socket while using COPY MASTER II. (Disk drives, printers, language cards, 80 column cards and auxiliary memory cards are known not to use DMA at all. If you are not sure about your peripheral see if pin 22 on the peripheral is connected.)

3.0 SOFTWARE - THE COPY MASTER PROGRAM

The heart of the COPY MASTER software is the COPY MASTER program. The COPY MASTER program contains the system menu and must be run first in order to load any of the other COPY MASTER programs.

To run either COPY MASTER program insert the COPY MASTER disk into the disk drive and then type in:

```
    RUN COPY MASTER (carriage return)
```

The screen will clear and display the following:

```
          COPY MASTER II
          (VERS. 3.0)
    COPYRIGHT 1984 BY
    APPLIED TECHNOLOGY LABORATORIES
```

MENU:

- 1) LOAD THE COPY PROGRAM
- 2) RUN THE CONVERT PROGRAM
- 3) LOAD THE STEP/TRACE PROGRAM
- 4) LOAD THE FILE WRITER PROGRAM
- 5) LOAD THE PAUSE PROGRAM
- 6) RUN THE SYSTEM CONFIGURE PROGRAM
- 7) RUN THE SYSTEM CHECK PROGRAM
- 8) EXIT

PLEASE SELECT (1-8)

Each of the above choices will be described in more detail in the following chapters.

The user should note the following: the COPY MASTER program alters itself depending both on what slot it is located in as well as on what utility program has been selected. Therefore, the COPY MASTER program should be loaded from disk each time it is run. For example, if the user has selected the STEP/TRACE program and then decides to load the PAUSE program instead, he must reload the COPY MASTER program from disk before rerunning it.

3.1 The COPY program.

The work horse of the COPY MASTER system is the COPY program. With it the user can copy any memory resident program onto a standard DOS initialized disk and then re-run it anytime he wishes. ('Memory resident' means that the whole program is always in memory.) This class includes almost all arcade games, most other games (a notable exception is 'adventure' type games that constantly load in different segments (or overlays) from disk) and certain business software. Since the copy made using the COPY program is in the form of standard DOS binary files, code can be examined, either by using the monitor disassembler or some other program and, if desirable, customized to the user's needs. The following is a precise description of how to use the COPY program to make back-up copies.

3.1.1 Loading and using the COPY program

The COPY program runs in COPY MASTER's on board RAM. To load the COPY program into this RAM, run the COPY MASTER program. When the system menu is displayed, enter '1' in response to the question

PLEASE SELECT (1-8)

The disk will whirl and the COPY program will be loaded into COPY MASTER's on board RAM. That is all there is to it. Since this memory, like most of Apple's memory, is volatile, the user must re-load the COPY program every time that the Apple is turned on. ('Volatile' means that the program disappears whenever the power is turned off.) Additionally, the user must re-load the COPY program whenever some other COPY MASTER utility program has been loaded, for example the STEP/TRACE program or the PAUSE program. The advantage of using RAM is its flexibility. The RAM can store successively all of the utility software options. Furthermore, future updates or revisions of the Copy Master software can operate with the same hardware (unlike ROM based systems that would require some hardware replacement.)

Once the COPY program has been loaded into RAM it can be used to make an unlimited number of copies without reloading, unless either of the following occurs: 1) another COPY MASTER utility is loaded into RAM, or 2) the Apple's power is turned off. There is a third case that may require the reloading of the COPY program: after the pressing of the RESET key. When this key is depressed, certain soft switches may be altered. One way to restore these switches to their correct state is to re-load the COPY program. For this reason, the user should initiate programs using the RUN, BRUN, PR# or IN# commands whenever possible.

To make a copy of any memory-resident program, 2 things are necessary. The first the user has just done: load the COPY program into the COPY MASTER'S on board RAM. The second is to have a freshly DOS initialized disk on hand. This is the disk that COPY MASTER will use to write the program image on. (To review how to initialize a disk, see page 13 in the Apple DOS reference manual.) There should be no other files or data on this disk except for the 'HELLO' program. Indeed, the COPY program will refuse to make a copy (and signify this refusal by beeping at the user) if there is more than this one file on the disk. This is for the user's protection since the 64k version of the COPY program will write over approximately 1/2 of this disk, and if more than one file were present there would be the chance of destroying valuable data or programs. The 128k version uses all of the disk when making a copy, so there is never any room for any other programs or data.

A few words about the 'HELLO' program mentioned above. When a disk is DOS initialized, it requires that an Applesoft file be named in the initialization process. This is the program that will be run when the disk is first 'booted', either by turning on the Apple or by, for example, transferring control to the disk by the IN# or PR# commands. This program is traditionally but not necessarily called the 'HELLO' program. For example, the HELLO

program might be called 'SPACE GAME', 'SPREAD SHEET' or any other file name acceptable to DOS. When the user initiates the Copy process, it doesn't matter what the name of this file is, nor even what it is (since the COPY program will write its own file under this name, destroying the already existing file), however the name of this file will be the one used whenever the user wants to re-run the copied program without booting the system. For example, if the HELLO program was called 'SPACE GAME' the user could rerun the copied game by 1) turning on the Apple's power, 2) booting the system or by 3) typing in

RUN SPACE GAME

from the Apple's keyboard.

Now that the user has loaded the COPY program into the COPY MASTER's RAM, and has a freshly initialized disk at hand, he is ready to make a copy of any memory resident program. The program to be copied can now be loaded. When the program is ready to be copied insert the freshly initialized disk. Upon depression of the trigger switch COPY MASTER will then make an exact copy of all 64k of memory (or 128k of memory if using the 128k version). Only one copy may be made on any one disk, and as mentioned above, there must be no other files on the disk except the HELLO program. If the user wishes to make another copy he must use another disk. However it is not necessary to reload the COPY program.

The copy made by the COPY program is an exact copy of the state of the program when the trigger was depressed. If it is a game, the game will be restored to exactly the same state when the program is reloaded. If it is a business program, all data will be intact - exactly as it was when the program was copied.

For the Apple IIe, this is the end of the copy process and the rest of this section can be skipped. For Apple II+ machines the following applies.

When the COPY MASTER trigger switch is depressed, the disk will whirl for a few seconds and then the screen will clear and the screen will display several questions. The first is:

T(TEXT), L(O-RES) OR H(I-RES)

The program is asking the user to indicate what is being displayed on the Apple's screen. It is usually fairly easy to decide whether the screen is in TEXT mode, LO-RES graphics mode or HI-RES graphics mode. Enter the key corresponding to the correct mode (no carriage return necessary).

If the user has entered 'L' for LO-RES graphics or 'H' for HI-RES graphics, then the next question asked by the COPY program will be:

F(ULL) OR M(IXED SCREEN)

If the screen shows only graphics, whether LO-RES or HI-RES, then enter 'F' for Full screen graphics. If the screen has some text

on the bottom with graphics on top, then enter 'M' for mixed graphics and text. If the user has entered 'T' in response to the first question, signifying a text screen, then the COPY program will skip this question.

The third question asked by the Copy program is:

(PAGE) 1 (OR PAGE) 2

Unfortunately on this question the user must usually guess. If text was displayed then it will almost always be page 1, and the user will have to enter '1' in response to this question. For LO- and HI-RES modes, it will generally be page 1, but not always. After COPY MASTER has made the copy of the program, it will return to the display mode defined by the above 3 questions. If the screen is different after the copy, then the user has answered one of these questions incorrectly (probably the page question). Thus it is recommended that the COPY procedure be practiced several times for a particular program to determine the correct screen setting before attempting to copy valuable work data.

3.1.2 Files created by the COPY program

The COPY program creates 7 files (or 13 files in the 128k version) in standard DOS 3.3 format. The first of these files is the Applesoft program that loads in the remaining 6 files (12 for 128k version) that are a copy of the 64k (128k) that was in memory when the copy was made. These last files are DOS binary type files, and can be loaded into memory with the standard DOS BLOAD command. As mentioned above, the name of this Applesoft file will be the same as that used when the disk was initialized with the DOS INIT command, for example, 'SPACE GAME' or 'SPREAD SHEET', and this is the program that the user will RUN if he wants to restore the copied program without booting the system (if he boots the system or turns on the power with this disk in the disk drive this program will automatically run, restoring the copied program). This last characteristic is sometimes called 'auto-booting'. The 6 (or 12) remaining files, however, always have the same name, regardless of the name of the HELLO program. They are called, prosaically, 'FILE1', 'FILE2', 'FILE3', 'FILE4', 'FILE5' and 'FILE6'. Each file corresponds to a particular range in memory. The names of the files and their associated memory range is as follows:

NAME	RANGE (HEX)	RANGE (DEC)
FILE1	\$ 0 - 1FF	0 - 511
FILE2	\$ 200 - 3FFF	512 - 16383
FILE3	\$4000 - 7FFF	16384 - 32767
FILE4	\$8000 - BFFF	32768 - 49151
FILE5	\$D000 - DFFF	53248 - 57343
FILE6	\$D000 - FFFF	53248 - 65535

Note that 'FILE5' and 'FILE6' appear to contain some of the same memory area, namely \$D000 through \$DFFF. This is due to the way that the RAM (LANGUAGE) card works. 'FILE5' contains Bank 1 on the RAM card while 'FILE6' contains Bank 2. Note also that memory \$C000 - \$CFFF (49152 - 53247) is missing. This area corresponds to I/O switches, latches and peripheral PROM or RAM and therefore is not copied.

For a 128k copy, there are 6 additional files. These are called 'FILE1X', 'FILE2X' and so on through 'FILE6X'. Their memory ranges are identical to the 6 files listed above, except that they contain an image of auxiliary memory.

The 6 (or 12) files discussed above are standard DOS binary type files, signified by a B in a catalog listing of a disk. This means that they may be reloaded seperately any place in memory and either examined (using the monitor Disassembler for example) or changed. For example, to examine the range \$4000 through \$7FFF of a programs code, one might enter

```
BLOAD FILE3,A$2000
```

from the keyboard. However, if the user decides to modify the code, he cannot resave this code to the disk using the standard DOS binary file save commands. THE FILE WRITER PROGRAM MUST BE USED TO DO THIS. (See the discussion of this process in the

chapter on the FILE WRITER program.)

3.1.3 Restoring a copied program.

Copied programs can be restored in two ways, either by running the associate HELLO program (which might be called 'SPACE GAME for example) or by re-booting the Apple (e.g., by entering PR #6 if the disk controller card is in slot 6). If the disk is in the drive when the machine is turned on, this happens automatically.

3.1.4 Errors.

Occasionally when using the COPY program there may occur some typical DOS error, for example, an attempt to write to a disk that has a write protect tab in place. If this happens the COPY program will beep and then return control to the program in memory, without printing an error message. This beep is lower in tone and longer than the typical Apple beep. Besides a DOS error there is another error that the user may encounter, namely attempting to copy to a disk that contains more than the HELLO program used to initialize the disk. As mentioned above, this is a safety feature for the user's protection: the COPY program uses more than 1/2 of a disk (all of a disk for the 128k version) to make a copy of a 64k program. If more data or files existed than just the HELLO program they might be destroyed. For the 64k copies, however, once the user has made a copy of memory, he is free to fill the remaining disk area with whatever additional files and data that he wishes.

Under no case can any of the COPY files (the HELLO file or any of 'FILE1' through 'FILE6') be altered without using the FILE WRITER program.

The use of this program is described in a following chapter.

3.1.5 Making copies of the backed up disk.

It is possible to make copies of the backed up disk at any time. However, the user must use the COPYA program on the DOS SYSTEM MASTER disk or some other copy program that makes an EXACT COPY of the disk. He cannot use the FID program. The reason for this is that both the COPY program and the CONVERT program load specific tracks/sectors from disk, not DOS files. Therefore, to work correctly, the COPY MASTER files must be on exactly the same track/sector for all copies. FID, which copies files rather than track/sectors reproduces the same data but not in the same location.

Both the COPY and the CONVERT programs assume that the disk drive used is drive number 1. It is not possible to use the Copy or Convert with drive number 2.

As noted elsewhere in this manual (see the discussion under Technical Operation in the Introduction section), pressing the RESET key reinitializes the SoftSwitch Register (SSR). The state the SSR is initialized to may not be the same as the machine state. Therefore, after pressing the RESET key, the user must make sure that a language card memory softswitch (\$C0B2 through \$C0B8) is thrown. One way of doing this is to use the COPY MASTER program to reload the COPY program. This is not always necessary, since the program is still intact on the COPY MASTER II board, it is just the setting of the SSR that may be incorrect. Many programs designed to run in 64k (or 128k) throw these switches automatically.

3.2 The CONVERT program.

While the user can restore any copied program exactly, this requires the presence of the COPY MASTER board in the Apple. This is sometimes inconvenient, for example as when there is not a spare slot that can be constantly dedicated to the COPY MASTER board. It is possible, however, to run most programs created with the COPY program without the COPY MASTER board in place by using the CONVERT program. This is the only one of the COPY MASTER programs that requires some technical expertise, and so the user is urged to read the following very carefully. As is usual in all Apple documentation, and also in this manual, a "\$" sign in front of a "number" means that it is in hexadecimal notation, i.e., in base 16; for example, \$8000 means $8*(16*16*16)+0*(16*16)+0*(16)+0 = 32768$ in decimal notation.

The main requirement of the CONVERT program is a 512 (\$200) byte "work area" in which to store the code necessary to load the remainder of the program that has been copied. This "work area" may be determined by using the Apple's monitor commands to examine the binary files created by the COPY program (i.e., FILE1 through FILE6 for a 64k copy). To do this, first get into the monitor by typing "CALL -151 (carriage return)" from Applesoft. The prompt character will change from the right bracket character to the "*" character, showing that the user is now in the monitor rather than in Applesoft.

Once in the monitor, it is still possible to issue standard DOS commands to load COPY MASTER files. For example, to examine "FILE4" (which contains the memory range \$8000 through \$BFFF; see page 19 in this manual for a list of these ranges) type in "BLOAD FILE4,A\$2000 (carriage return)". This will load "FILE4" into the Apple's memory at location \$2000. There is nothing special about this location; any convenient free memory range in the Apple may be used. It just happens that most of the memory following \$2000 is generally unused.

The best way to examine this memory once it has been loaded into the Apple's memory is to use the monitor's dump or list commands. See pages 89-90 in the Apple IIe reference manual for a discussion of the dump command and pages 108-109 for a discussion of the list command. Look for either a range of memory with no code (the monitor list command will display multiple "???" marks when you ask it to list such a range) or a range with a pattern that repeats (for example, all "0"s). Be careful, however, since sometimes such ranges contains data used by the program. If you find an area that is unused, you can use the "partial restore" (criterion 1 below). If all of memory is used by the program you have just copied, either as machine code or as data, then you must do a "full restore" (criterion 2 below). In either case you will need \$200 ($2*(16*16)+0*(16)+0*(16) = 512$) bytes of contiguous memory. An additional requirement is that this memory start on a page boundary, i.e., on an even multiple of 256 (this works out great in hex notation - page boundaries are at \$0, \$100, \$200 and so on). This \$200 bytes is the "work area" mentioned above. If you do a "full restore", then you must find a second \$200 (512) bytes in memory that exactly duplicates this

"work area" (e.g., all "0"s if the work area is all "0"s). The first half of the \$200 area will be called the first page, and the second half, starting \$100 (256) bytes later, will be called the second page. Like the \$200 byte "work area", this area must start on a page boundary (i.e., must start on an even multiple of 256 bytes).

Sometimes it is possible to run the CONVERT program without examining memory. Many programs do not initially use the following ranges in memory and the user may be able to use these areas as his "work area"; the ranges are: \$9600 through \$97FF; \$D000 through \$D1FF; and \$F000 through \$FEFF. One word of caution: once the user has run the CONVERT program, it is not possible to make further modifications; in particular, he cannot later rerun the CONVERT program on the same disk. Therefore if the above memory areas are used without first examining them to determine if they are free the user should first make a back up copy of the unconverted copied program's disk.

With the above discussion out of the way, we now proceed with a precise definition of the requirements of the CONVERT program.

To use the CONVERT program, the user must first satisfy one of the following 2 conditions:

- 1) he must find 512 (\$200) bytes somewhere in memory whose value does not matter to the program being copied. This is the "work area" discussed above. Such an area might be an uninitialized data area or the TEXT or LO- or HI-RES graphics area if the program copied has the ability to refresh these areas. (The TEXT and LO-RES memory areas are from \$400 through \$7FF; the HI-RES areas are \$2000 through \$3FFF and \$4000 through \$5FFF.) This area may be anywhere in memory except for the first 512 bytes (\$0.1FF) or anywhere on the 16k RAM board's bank 1 (\$D000.DFFF). Additionally, this area must start on a page boundary, i.e., must start on some even multiple of 256 (\$100), for example, at 1536 (\$600). As mentioned above, it may even be on the RAM board (assuming the user has one in the Apple) with the exception of bank 1 (\$D000.DFFF) although this area is acceptable if it is in bank 2. Also, since there is no wrap around, it cannot start at \$FF00. If the user can satisfy this first criterion, then he will also need to dedicate 10 bytes on the stack to the program. If for some reason such a 512 byte area cannot be found, then it is still possible to use the CONVERT program by satisfying the next criterion.
- 2) the user must find 2 pages (i.e., two 256 byte areas starting on an address that is an even multiple of 256) that are identical to 2 other contiguous pages. In the CONVERT program, these 2 contiguous pages are called the 'WORK AREA'. For example, the user might define \$3000 through \$31FF as his 512 byte 'work area' and then determine that \$D000.D0FF is identical to the first half of this work area (\$3000.30FF) and \$E000.E0FF is identical to the second half (\$3100.31FF). In this example, \$D000 through \$D0FF will be called the 'FIRST PAGE' by the CONVERT program and \$E000 through \$E0FF will be called the

'SECOND PAGE'. If he is able to satisfy this second criterion then he must be able to dedicate 22 bytes of the stack to the program (the CONVERT program does this automatically).

In the parlance of the CONVERT program the first criterion described above will be called a 'partial' memory restore since only part of memory is restored (precisely 119 parts in 120), while the second method will be called a 'full' memory restore, since all non-stack memory will be restored.

If the user is converting a 128k copy, all of the above areas must be in auxiliary memory. This area has been chosen as being the least likely to be used by the copied program.

Once the user has decided which of the above methods is best suited to his needs, he must run the CONVERT program to change his original board-dependent copy to a board-independent copy. This is done by:

RUN COPY MASTER

and selecting option 2:

2) RUN CONVERT PROGRAM

The CONVERT program does not use the COPY MASTER board, so that this program can be run without the board in the Apple. After the user has entered '2' in response to the question

PLEASE SELECT (1-8)

the screen will clear and ask several questions. The first of these questions will be

ENTER START OF WORK AREA

The user should then enter the start of the work area that he has selected. He may use either decimal or hexadecimal notation as long as he precedes all hex numbers with a '\$' sign, as per standard DOS convention. If the user enters some number that is not a multiple of 256, or enters something that cannot be interpreted as either a correct decimal or hex number, then the CONVERT program will re-display the question.

The second question asked will be:

ENTER F(ULL) OR P(ARTIAL) RESTORE

This refers to the two criterion discussed above for using the CONVERT program. Either 'F' or 'P' as appropriate should be entered.

If a full restore has been selected by entering 'F' in response to the above question (i.e., 2 x 256 byte areas were found that are identical to a 512 byte area) then the convert program will ask 2 additional questions:

ENTER START OF PAGE 1

and

ENTER START OF PAGE 2

The user must enter the start of the two 256 byte areas mentioned above. These areas must start on a page boundary, i.e., must start with an even multiple of 256. Once again either decimal or hex notation may be used as long as the hex notation is preceded with the '\$' sign.

After the above questions have been answered, the following

```
INSERT DISK TO BE CONVERTED
PRESS C(ONTINUE), R(EDO) OR X(IT)
```

will be displayed. If a mistake was made, entering 'R' will restart the whole process. If the user is happy with his responses, then he may enter 'C' to continue with the CONVERT program. If the user is tired of the whole thing press 'X' to exit without doing anything.

If 'C' has been selected, the disk drive will whirl and load the CONVERT program. The screen will then display

```
INSERT COPY DISK AND PRESS ANY KEY
```

The original, unconverted disk must now be loaded. This is done by inserting the disk in the disk drive and then pressing any key except the shift or control keys. Should some other disk besides an unconverted COPY disk be in the drive (in particular, a disk that has already been converted) the CONVERT program will beep and then exit. This is a safety precaution to prevent destruction of a valuable disk. If the CONVERT program decides that the disk is indeed an unconverted COPY disk it will then proceed to convert it to a COPY MASTER board-independent disk. Thereafter, it is not necessary to have the COPY MASTER board in the Apple to rerun the copied program. In order to convert another disk, the CONVERT program must be rerun using the COPY MASTER program.

Upon doing a CATALOG of the converted disk it will be noticeable that the 7 files (13 files for 128k) written by the COPY program have now been reduced to 2: a file with the name of the original HELLO program (for example 'SPACE GAME') and a file with the name 'FILE1'. Although this last file has the name of one of the original files created, it is a special file and instead of being marked with a 'B' (for binary file) in the CATALOG is marked with a 'S'. This file is NOT accessible with standard DOS commands so the user should be sure that he is done examining and changing the copied programs memory before he runs the CONVERT program. Note also that this file appears to have a length of 1 sector. This is due to the way that DOS formats a file length: modulo 256. Actually this files length is 257 sectors, which is equal to 1 (modulo 256). This is just a peculiarity of the DOS CATALOG command; DOS still recognizes these sectors as being allocated to FILE1.

3.3 The STEP/TRACE program

The STEP/TRACE program is a powerful debugging and examination tool and can be of use almost anywhere in any program, not necessarily a copy protected one. To run the STEP/TRACE program, first run the COPY MASTER program and select option 4

4) LOAD THE STEP/TRACE PROGRAM

Once this is done the user can run any program and, at any time he wishes, press the COPY MASTER button to follow program execution.

WARNING the STEP/TRACE program slows down program execution by a factor of at least 4000, so it should not be used during any time critical operation such as a disk access.

Once the STEP/TRACE program has been loaded onto the COPY MASTER's on board RAM, and the program that the user wishes to examine is in memory and running, the user can initiate the STEP/TRACE process by pressing the COPY MASTER button. Since the STEP/TRACE program uses the COPY MASTER's on board RAM, it will not be able to load a copied program and then use the STEP/TRACE program. However, a converted copied program can be loaded. Because the converted programs do not use the on board RAM, the STEP/TRACE program can occupy this space and will work just fine.

Since the STEP/TRACE program must be able to use part of the text screen to display what is happening, programs that use LO- or HI-RES graphics will be switched to a mixed text and graphics mode. The part of the text screen use to display the disassembled code is the last 4 lines on the text screen.

After pressing the COPY MASTER switch, a single disassembled line will be displayed. Press any key to continue.

Once the STEP/TRACE program has been initiated (by pressing the COPY MASTER button) it will ask the user to set the initial values of the 5 registers by displaying the following question:

SET A X Y P S:

If the user wishes to set these registers to some particular value, he must enter the appropriate hex code in response to this question. Unlike most of COPY MASTER, this question can only be answered using hexadecimal notation. No '\$' sign is allowed. The registers must be set in the order described above, namely A-register first, then the X-register, Y-register, Status register and finally Stack pointer. To set any register, all previous registers must either be assigned hex values or must be assigned the '*' token, which means 'leave as is'. Blanks are ignored and a delimiter between values is any non-hex digit (i.e., the digits 0 through 9 and the letters A through F). A blank is the recommended delimiter. Thus, for example, to set the A-register to \$FF and the status register to \$0, and to leave all remaining registers unaffected, enter

FF * * 0 (carriage return)

As mentioned above, if the user wishes to leave any of the registers unaffected, he should enter a '*' character as its value for the above question.

The STEP/TRACE program will execute a program instruction code by instruction code and display the last four associated disassembled code on the bottom of the screen along with the values of the accumulator, x-register, y-register, status register and stack pointer. A typical example might be

```
8000: 09 FF   ORA #FF 80 FF 23 71 EC
                A  X  Y  P  S
```

This line means that the instruction currently being executed is at memory location \$8000, that the instruction consists of the 2 bytes 09 FF (hex), which (in 6502 machine code) means 'ORA #FF', and that the value of the accumulator, x register, y register, status register and stack pointer after the instruction is executed are \$80, \$FF, \$23, \$71 and \$EC respectively.

As mentioned above, the STEP/TRACE program is initiated by pressing the COPY MASTER button. The code in the memory resident program that is first executed depends on where the program is when this button is pushed. Thereafter the STEP/TRACE program will follow the normal flow of the program.

There are two methods available to control program execution. The first is to use the game paddle 1 and the second is to use the keyboard. If the user chooses to control the program via the game paddle 1, then the speed of execution is controlled by the setting of the paddle: at one extreme the program will be stopped. As the user turns the paddle, the program will speed up until, at the other extreme, the disassembled lines will be a blur on the screen.

If the user chooses to use the keyboard to control program execution (for example for a game that requires the use of the paddles or of a joystick) then pressing any key will cause the program to execute a single instruction and then pause. By holding down any key along with the REPEAT key, the program execution will commence at the rate of 10 instructions a second (the repeat rate of the Apple). The program selects whether to use the keyboard or the game paddle by answering the second question ask by the STEP/TRACE program:

PRESS K(EYBOARD) OR P(ADDLE)

Press 'K' or 'P' as appropriate.

The STEP/TRACE mode can be exited by pressing the game paddle button (if using the paddles) or by pressing the 'X' key (if using the keyboard). Before restoring the program, the STEP/TRACE program will ask a final question:

PRESS M(MIXED) OR F(FULL SCREEN)

The user should press 'F' if he wants to restore a full graphics mode, or 'M' to leave the screen as it is, namely in mixed mode.

If the screen is in text mode, the answer to this question does not matter. Depressing any key except the 'M' or 'F' keys causes the question to repeat until either the 'M' or 'F' key is pressed.

3.4 The FILE WRITER program

One of the real advantages of copy boards such as COPY MASTER II over bit copiers is that the code can be examined and customized if the user wishes. Loading and examining code has already been described in the discussion of the COPY program above. This chapter will describe how to use the FILE WRITER program to rewrite such customized code to the disk already produced by the Copy program.

To load the FILE WRITER program the user should first run the COPY MASTER program and select

4) LOAD FILE WRITER

This will load the FILE WRITER program onto the COPY MASTER board. After the user has loaded the FILE WRITER program he can then load and change any code that he wishes. Once he has made all of the changes to the code that he desires, he presses the COPY MASTER trigger switch to initiate the FILE WRITER program. The FILE WRITER program will jump to the bottom of the screen and ask 4 questions.

The first question is:

PLEASE ENTER ORIGIN

The FILE WRITER program is asking the start of the address where the modified code is designed to be run.

The second question is:

PLEASE ENTER OBJECT BUFFER

This is the beginning of the area where the modified program code is stored. As in most addresses for COPY MASTER, the answer may be entered in either decimal or hex notation, providing that all hex addresses are preceded with a '\$' sign. This address may be anywhere in memory that the user finds convenient, with the exception of the first bank of RAM on the language card (\$D000.\$DFFF).

The third question asked by the FILE WRITER program will be:

PLEASE ENTER LENGTH

Once more this length may be in either decimal or hex notation.

If the use has the 128k version of COPY MASTER, then a forth question will be asked:

ENTER M(AIN OR) A(UXILIARY MEMORY).

Press 'M' or 'A' as appropriate.

The final question asked will be the familiar

ENTER C(ONT) R(EDO) OR X(IT)

If the user is happy with his answers, he should enter 'C' to continue with the FILE WRITER program. If he has made some mistake in the above responses, then he should enter 'R' to start the processes from the beginning. If the user has changed his mind and now wishes to exit the FILE WRITER program, he should press 'X'.

Once 'C' has been entered in response to the above question, the FILE WRITER program will display the following:

```
INSERT DISK TO CONVERT
PRESS C(ONT) OR X(IT)
```

This is the cue to insert the disk that he wishes to modify. Such disk must be the original, unconverted copied disk (i.e., unmodified by the CONVERT program) or the FILE WRITER program will beep and refuse to continue.

Once the correct disk has been inserted, the FILE WRITER program will replace the code on the copied disk with the new code from memory.

Since the FILE WRITER must read from and write to disk, ordinary DOS errors will also cause the FILE WRITER program to beep and return control to the user. If there is some disk error, for example if the disk has a write protect tab in place or has already been converted from the original copied disk, then the FILE WRITER program will beep and exit. The user should correct the problem and depress the COPY MASTER trigger switch to reactivate the FILE WRITER program.

The user can use the FILE WRITER program on any copied program as often as he wishes, even modifying code that has already been modified. However, once the program has been 'CONVERTED' to a board independent version (by using the CONVERT program), FILE WRITER will refuse to make any further changes. It is possible to still modify 'CONVERTED' programs, but not directly. Such programs must be re-copied (using the COPY program) in order to become modifiable again.

The FILE WRITER program uses the bottom 4 lines of Text page 1 for display. At the end of the FILE WRITER these 4 lines are not restored. In particular, if the flashing cursor was on one of these lines, it may be missing at the end of FILE WRITER. Pressing any key will cause it to reappear.

The following is very important. If the user wishes to modify any code created by the Copy program he must use the FILE WRITER program. HE CANNOT USE ORDINARY DOS COMMANDS TO REPLACE THE FILES CREATED BY THE COPY PROGRAM. As discussed in the COPY program section, the reason for this is that the COPY program expects to find particular data at particular track/sectors: it is not enough for the data just to be somewhere on the disk.

3.5 The PAUSE program

The PAUSE program is designed to unconditionally halt program execution and then resume execution after some period of time. It is certainly the simplest of the COPY MASTER programs to use. Once the PAUSE program has been loaded onto the COPY MASTER II's on board memory the user just presses the COPY MASTER II's button once to halt any program. To resume program execution, press either any key on the keyboard or game paddle 1's pushbutton.

The PAUSE program is loaded into the on board RAM by selecting '5' when the COPY MASTER program requests

PLEASE SELECT (1-8)

WARNING: tasks that are time dependent will not function properly when either the PAUSE or the STEP/TRACE programs are executing. This is particularly true of DOS routines. The user should be aware that he risks, among other things, the loss of valuable data when he attempts to run the PAUSE or the STEP/TRACE program during a DOS read or write operation.

3.6 The SYSTEM CONFIGURE Program

The COPY MASTER programs must know the addresses of 2 peripherals to make copies, write files, etc.: the slot number of the disk drive used and the slot number of the COPY MASTER board. When the user first receives COPY MASTER II these 2 addresses are already defined: the disk is assumed to be in slot 6 and the COPY MASTER board in slot 4. If the user wishes to use other slots he must first run the system configure program. This program is invoked by running the COPY MASTER program and choosing option 6:

6) RUN SYSTEM CONFIGURE

The SYSTEM CONFIGURE program will first display the current values of the disk drive and COPY MASTER II slot and then ask which slot the user wants to configure the COPY MASTER utility software for. Enter the appropriate responses. COPY MASTER will then read, modify and rewrite to disk each of the COPY MASTER utilities. If a DOS error occurs (for example, if the disk is write protected) then the SYSTEM CONFIGURE will beep and return control to the user. Correct the condition and rerun the SYSTEM CONFIGURE program.

Note: If an error does occur part way through the SYSTEM CONFIGURE program, only some of the COPY MASTER utility software may be modified. Therefore, the error must be corrected and the SYSTEM CONFIGURE program rerun (by loading from disk the COPY MASTER program and rerunning it) to insure the correct setting of all program variables. For this and other reasons, the user should use only copies of his original COPY MASTER utility disk when running the SYSTEM CONFIGURE program (or for that matter, for any other purpose except making backups.)

3.7 The SYSTEM TEST Program

The SYSTEM TEST program is designed to perform a thorough check of your COPY MASTER II board. To run the System Check program, press '7' in response to the COPY MASTER programs request to

PLEASE SELECT (1-8).

Once the SYSTEM TEST program is loaded, the first thing it does is test the COPY MASTER on board RAM. This takes approximately 50 seconds. If memory checks out OK then the System Check Program will flash on the screen 'MEMORY OK' and go on to the second test. If there is some problem with the memory, the SYSTEM TEST program will print an error message along with an error number and a memory address. The number will be between 1 and 4 and has the following meaning:

- 1: the indicated memory location cannot store a \$0.
- 2: the " " " " retain a \$0.
- 3: the " " " " store a \$FF.
- 4: error in one of the bits of the memory location.

The second test performed by the System Check program requires some user participation. The user will be asked to press the COPY MASTER trigger switch 16 times. (32 times for the 128k version; 16 times for main memory and 16 times for auxiliary memory.) The depression should always be followed by a quick release. This is done during the execution of an Applesoft program. This program does nothing but write the word "FAILURE" on the screen and then continuously loop depending on the value of a program variable. When the COPY MASTER button is pressed, software stored on the RAM changes the value of this variable and the Applesoft program exits the loop and prints the word "SUCCESS". If your COPY MASTER board made it this far, you can be sure that it is functioning properly.

Note: for the 128k version only, when the SYSTEM TEST program is finished, the Apple will be reading and writing from auxiliary memory. The user should press 'CONTROL' RESET to return to main memory.

3.8 Backing up the COPY MASTER II utility disk

The COPY MASTER II utility disk can be backed up using almost any copy program. Both FID and COPYA on the DOS SYSTEM MASTER Disk may be used.

3.9 Software Synopsis.

The following is a short summary of the steps required to use each of the COPY MASTER utility programs.

The COPY program.

1. Run the COPY MASTER program and select "1".
2. Run the program to be copied (preferable by using RUN, BRUN, PR# or IN#).
3. Insert a freshly initialized disk into drive #1.
4. Press the COPY MASTER trigger switch.

If using the II+ version then:

5. Enter T(EXT), L(O-RES) OR H(I-RES).
6. Enter F(ULL) OR M(IXED) graphics.
7. Enter (PAGE) 1 or (PAGE) 2.

The CONVERT program.

1. Run the COPY MASTER program and select "2".
2. Enter the work buffer area (512 bytes).
3. Choose F(ULL) or P(PARTIAL) restore.
4. If FULL restore, enter page 1 and page 2 (256 bytes each).
5. Insert disk to be converted into drive #1.

The STEP/TRACE program.

1. Run the COPY MASTER program and select "3".
2. Run the program to be traced.
3. Press the COPY MASTER trigger switch.
4. (Optional) set A, X, Y, P and S registers.
5. Select keyboard or paddle control.
6. After exiting, select F(ULL) or M(IXED) graphics.

The FILE WRITER program.

1. Run the COPY MASTER program and select "4".
2. Press the COPY MASTER trigger switch.
3. Enter origin of code to modify (address where code is designed to be).
4. Enter address where code is currently stored.
5. Enter length of code.
- 5a. (128k version only) Specify main or auxiliary memory.
6. Insert original copied disk to be modified into drive #1.

The PAUSE program.

1. Run the COPY MASTER program and select "5".
2. Run any other program.
3. Press the COPY MASTER trigger switch.
4. Press any key or game paddle #1 button to exit.

The SYSTEM CONFIGURE program.

1. Run the COPY MASTER program and select "6".
2. Specify disk slot.
3. Specify COPY MASTER II slot.

The SYSTEM TEST program.

1. Run the COPY MASTER program and select "7".
2. Specify COPY MASTER II slot.

4.0 SOFTWARE - THE SCREEN DUMP PROGRAM

There are two screen dump programs available for Copy Master II. The program you should use depends on whether you want to dump text or graphics and also what type of printer you have.

TEXT ONLY SCREEN DUMP -- This program will print the 40-column text screen (page 1 or 2) on an Apple II, II+, or IIe. It will also print the 80-column text screen on an Apple IIe with an 80-column card in the auxiliary slot. It will work with any printer (letter-quality, dot-matrix, etc.) and any interface card that uses standard Apple slot protocol (i.e. PR#n to turn on slot #n).

GRAPHICS SCREEN DUMP -- This program is available only for certain dot-matrix printers. It will print the 40-column and 80-column text screens as described above, plus either page 1 or 2 of hi-res graphics in either a full-screen mode or mixed with 4 lines of 40-column text. On an Apple IIe with the extended 80-column card, it will also print double hi-res graphics in either a full-screen mode or mixed with 4 lines of 80-column text. Text dumps can be printed using any DOS 3.3 TOOLKIT compatible character font. Both graphics and text may be printed in normal mode (black on white) or inverse mode (white on black). Boldface (emphasized) printing may also be used on those printers which support it.

When either of these programs is loaded into the Copy Master card, you may print the selected screen at any time by simply pressing the Copy Master trigger switch. Both programs are very flexible and offer a number of user-selectable configuration options which must be set before the programs can be used. A complete description of each option in the configuration process is given in the remainder of these instructions, which are divided into two separate sections, one for each of the dump programs. At this point you should turn to the section describing whichever program you wish to run. Note particularly that Option F in the Graphics Screen Dump must be selected to specify your printer interface card the first time the dump is used.

4.1 The TEXT ONLY screen dump

The Copy Master II Text Only Screen Dump can be used with a Copy Master card in an Apple II, II+, or IIE, to print page 1 or 2 of 40-column text (or 80-column text on an Apple IIE with an Apple 80-column card). It will work with any printer interface card that recognizes the standard Apple slot protocol (i.e. "PR#n" to turn on slot #n). Because it is so flexible, it must first be configured to work with your computer and printer, and to dump the text screen that you desire. The configuration process requires only a few minutes, and for convenience, is contained in the same program that loads the dump into the Copy Master card. You may re-configure the dump each time you load it, or save an often-used configuration to disk to shorten loading time in the future.

To load or configure the dump, simply RUN the Applesoft program called "TEXT ONLY SCREEN DUMP LOADER". The screen dump software will be read from the disk and its current configuration will be displayed on the screen along with a number of options, as shown below:

```

COPY MASTER II TEXT ONLY SCREEN DUMP
VERSION X.X/X.X
COPYRIGHT 1984 APPLIED TECHNOLOGY LABS

CURRENT CONFIGURATION:
1. APPLE II/II+ OR IIE?......II/II+
2. COPY MASTER SLOT NUMBER (1-7)....4
3. PRINTER SLOT NUMBER (1-7).....1
4. DUMP 40 OR 80 COLUMNS?.....40
5. DUMP PAGE 1 OR PAGE 2?.....1
6. LEFT MARGIN WIDTH (0-255).....20
7. END-OF-LINE SEQUENCE.....CR ONLY
8. SET HIGH BIT ON OUTPUT?.....Y
9. PRINTER INITIALIZATION STRING
   (0-16 CHARACTERS).....I81N

OPTIONS:
A. LOAD DUMP INTO CM II RAM (& EXIT)
B. RE-CONFIGURE THE SCREEN DUMP
C. SAVE RE-CONFIGURED DUMP ON DISK
D. EXIT WITHOUT LOADING COPY MASTER

ENTER A, B, C, OR D:

```

Each of these options is described below in detail. In general, you will probably want to select Option B several times to change the configuration, then possibly save it to disk (Option C), and finally load it into the Copy Master card with Option A. In the future, if you have saved your re-configured dump on disk, you may simply choose Option A to load it immediately. Once the dump is loaded into the card, you may print the selected screen at any time by pressing the Copy Master button. The dump may be executed any number of times without re-loading the card as long

as the Apple has not been turned off and another Copy Master program has not been loaded into the card. You may re-configure the dump, as described below, as often as you like without losing any of its features.

When using the configuration and loading program, note that a single keystroke is usually the only response necessary to select an option or set a parameter. In most cases, the program will process keystrokes immediately without waiting for the RETURN key to be pressed. The only times you will need to use the RETURN key are after entering the left margin width (Parameter 6) and the number of characters in the printer initialization string (Parameter 9).

Option A: LOAD DUMP INTO CM II RAM (& EXIT)

If the parameters displayed on the screen under "Current Configuration" are correct for your hardware set-up and screen choice, then select this option. The screen dump software will be loaded into your Copy Master card and the configuration and loading program will be exited. This is the usual way in which you will end the configuration and loading process. The configuration that is loaded into the card will be that which is currently in memory. If you have made changes to some parameter (Option B) and wish to save the changes to disk for future use, you must select Option C (Save Re-configured Dump on Disk) before you select Option A.

Option B: RE-CONFIGURE THE SCREEN DUMP

If you wish to change any of the parameters displayed on the screen under "Current Configuration", then select this option. You will be prompted to enter the number of the parameter you wish to change and then its new value. To change additional parameters, simply select this option repeatedly. You should continue to change parameters until the "Current Configuration" is correct for your hardware set-up and choice of screen. If you should select a parameter and then decide not to change it, either set it to the same value that is shown under "Current Configuration" or else press the Escape key (ESC) to return to the options menu. If you are not sure about the value of some parameter, check your printer or interface card manual. If, after running the screen dump, you find that you have set some parameter incorrectly, you can easily correct it by re-configuring. A description of each parameter is given below.

Parameter 1: APPLE II/II+ OR IIE?

Set this parameter to indicate the type of computer you have. Because of hardware differences between the older Apple II/II+ and the newer Apple IIE, it is very important that this be set correctly. Otherwise, the screen dump will not work.

Parameter 2: COPY MASTER SLOT NUMBER

This is simply the number of the slot (1-7) containing your Copy Master card.

Parameter 3: PRINTER SLOT NUMBER

This is the number of the slot (1-7) containing your printer interface card. Printer cards are most often placed in slot #1, but any of the slots #1 through #7 is acceptable.

Parameter 4: DUMP 40 OR 80 COLUMNS?

If you have an Apple IIe with an Apple 80-column text card (or an extended 80-column card) in the auxiliary slot, you may select either a 40-column or 80-column text dump. Note that the screen dump is not compatible with other 80-column cards such as those used on the Apple II and II+, or in slots of the IIe other than the auxiliary slot. For this reason, the configuration program will not let you select an 80-column dump if you are configuring it for an Apple II/II+.

Parameter 5: DUMP PAGE 1 OR PAGE 2?

All text displayed on the Apple's 40-column screen comes from one of two areas of memory, called "text page one" and "text page two". Most programs use only page one but some may use page two as well, especially to display an on-line help screen. If your screen dump prints okay but consists of random characters unrelated to what you see on the screen, you have probably set the wrong page. Re-configure the dump and try it again. If you have an Apple IIe and have selected the 80-column dump, note that the configuration program will not let you select Page 2 because there is only one 80-column text page.

Parameter 6: LEFT MARGIN WIDTH

This parameter allows you to control the horizontal positioning of the screen dump on the printed page. It specifies the number of blank spaces that will be printed to the left of each line in the screen dump. For example, a value of 20 will center a 40-column dump on an 80-column printer. A value of 0 (i.e. no margin) will place the dump at the left side of the page. For this parameter, values ranging from 0 through 255 will be accepted during configuration, but note that large values may make the screen dump output look strange. For instance, on most printers, if the margin width plus the screen width (40 or 80) is larger than the printer width in columns, then each line of the text will break and wrap around to the line below it. This means that to print an 80-column dump on an 80-column printer, the

margin must be set to zero. Note also that certain printers or interface cards may need special initialization strings to allow them to print beyond a certain column width (i.e. 40 or 80). If the lines of your screen dump break before reaching the rightmost column of your printer, then check your interface card manual and read the description of initialization strings below.

Parameter 7: END-OF-LINE SEQUENCE

This parameter gives you a choice of the character sequence sent to the printer interface after each line of characters is dumped from the screen. The choices are: carriage return (CR) plus line feed (LF), carriage return only, or nothing (no characters). Most printers require both CR and LF to advance to the next print line. However, many interface cards automatically generate LF after each CR they receive. If the software also sent LF, the output would be double-spaced. For these interface cards, the choice "CR ONLY" is appropriate. If, however, your interface card does not generate LF after each CR, you may see the entire dump printed on a single line. In this case, you need to select "CR & LF". A further complication may occur if the sum of left margin and screen width exactly equals the printer width in columns, i.e. an 80-column dump on an 80-column printer with margin set to zero. In this case, the printer itself may generate its own CR and LF after it receives 80 characters. An additional CR, or CR and LF, from the software may produce double or triple-spaced printing. If you experience this problem, you may need to set the end-of-line sequence to "NOTHING". There is one final item which may influence line spacing of the printed output. Some interface cards automatically generate a CR and LF after a certain number of characters, especially if given an initialization string such as "(control-I)-80N". For example, if you are trying to dump 80 columns to an 80-column printer and cannot get rid of double spacing any other way, try using a different initialization string, perhaps "(control-I)-81N".

Parameter 8: SET HIGH BIT ON OUTPUT?

If this parameter is set to "Yes" ("Y"), the most significant bit (MSB) of each character sent to the printer (including the initialization string and end-of-line sequence) will be turned on (set to "1"). Otherwise, the MSB will be turned off. For virtually all interface cards, "Y" is the appropriate value for this parameter, since the standard character output of the Apple has the MSB on. However, there may be some interface cards that prefer it to be off. If your printer appears to be printing in an unusual font, or producing strange graphic symbols instead of characters, you may need to set this parameter to "No" ("N").

Parameter 9: PRINTER INITIALIZATION STRING

This parameter allows you to specify an optional string of 16 or fewer characters that will be sent to the printer interface at the beginning of each screen dump. This string may be composed of any combination of commands for your printer and/or interface card. Useful printer commands might be those which select a specific printer font, turn on boldface or emphasized print (if you have an old ribbon), or change to condensed type for printing more columns on the page. You should look at your printer manual for the exact syntax of these or other commands. Some interface cards may also accept or require initialization strings, to enable printing beyond a certain column, or turn on certain special features. (Note that "PR#1" is NOT needed in the initialization string.) If you elect to enter or change an initialization string, the configuration program will first ask how many characters are in the new string. Note that control characters (such as "CTRL-I") count as a single character even though they require two keys to enter. The escape key (often written as "ESC") also counts as one character. (To specify no string or delete an existing string, enter zero for the number of characters.) If you enter a non-zero number of characters, you will be asked to enter the string itself. Type each character in order, including any control characters, or escape keys. Any key on the Apple keyboard may be included in the string (except RESET), even the RETURN key if it is needed within the string. If you have an Apple IIe, note that most printer commands require capital letters rather than lower case. If a null character (CHR\$(0)) is needed, it can be entered as "CTRL-@". Once you enter the correct number of characters, the program will return to the option menu, so it is not necessary to press RETURN after entering the string. Control characters will be displayed on the screen with inverse video. The escape key will appear as an inverse left square bracket. If you make a mistake while entering the string, you may not back up with the left-arrow key because this key also generates a valid character code (control-H). Instead, you must finish out the string and select the re-configure option again to correct it.

There is one very important initialization string which you may have to use if you experience problems with the screen dump. This is the string which tells your interface card to turn off printing to the video screen. For some interfaces, this is a command of the form "(control-I)-xxN", where "xx" is a decimal number specifying the printer line length. Most interface cards will attempt to echo each character back to the video screen after it has gone to the printer. This is a bad thing to do during a screen dump because the echoed character may not appear on the screen where it originally was, thus marring the text. Hence, the Copy Master screen dump software tries to prevent this echo from taking place. It should be successful with virtually all interface cards, but if the card does not attempt the echo in the first place, there is nothing to worry about. If your computer seems to hang up when you attempt a dump, and

you are sure the printer is on and the dump is otherwise configured correctly, then look in your interface card manual to determine what command will keep the card from trying to send characters to the video screen, and enter it as part of your initialization string.

Option C: SAVE RE-CONFIGURED DUMP ON DISK

If you have changed any of the screen dump parameters via Option B above, you will probably also want to select this option, which writes the screen dump software back onto disk with the new parameter values shown under "Current Configuration". This will allow you to skip the re-configuration steps (Option B) when loading the screen dump in the future. Although this disk save must be performed to preserve your configuration for future use, you may re-configure and load the Copy Master card (Option A) without saving to disk. This is because Option A loads the card using the current parameter values stored in memory without regard to the configuration on disk.

Note that the previous configuration stored on the disk will be over-written when the new one is saved. However, there is no reason to save the old configuration because it can be re-created (if needed) at any time simply by re-configuring. Make sure that the disk is not write-protected (i.e. remove the tab) when you select this option. After the current configuration is saved to disk, you will be returned to the options menu, where you may load the Copy Master card (Option A) or exit without loading the card (Option D).

Option D: EXIT WITHOUT LOADING COPY MASTER

This option exits the configuration and loading program without loading the screen dump into the Copy Master card.

4.2 The GRAPHICS DUMP

The Copy Master II Graphics Screen Dump can be used with a Copy Master card in an Apple II, II+, or IIe, to print page 1 or 2 of hi-res graphics, 40-column text, or hi-res graphics mixed with 40-column text. On an Apple IIe, it will also print the 80-column text screen, double hi-res graphics, or double hi-res graphics mixed with 80-column text. Because it is so flexible, it must first be configured to work with your computer and printer, and to dump the screen that you desire. The configuration process requires only a few minutes, and for convenience, is contained in the same program that loads the dump into the Copy Master card. You may re-configure the dump each time you load it, or save an often-used configuration to disk to shorten loading time in the future.

To load or configure the dump, look at the CATALOG of the enclosed disk. You should see an Applesoft program with a name consisting of the words "GRAPHICS DUMP LOADER" followed by a period and the name of your printer, e.g. "GRAPHICS DUMP LOADER.EPSON" for Epson printers. RUN this program. The screen dump software will be read from the disk and its current configuration will be displayed on the screen along with a number of options, as shown below:

```
COPY MASTER II GRAPHICS SCREEN DUMP
VERSION X.X/X.X
COPYRIGHT 1984 APPLIED TECHNOLOGY LABS
```

CURRENT CONFIGURATION:

1. APPLE II/II+ OR IIe?.....II/II+
2. COPY MASTER SLOT NUMBER (1-7)....4
3. PRINTER SLOT NUMBER (1-7).....1
4. GRAPHICS(G), TEXT(T), MIXED(M)?..T
5. 40-COLUMN/HI-RES OR 80/DOUBLE?..40
6. DUMP PAGE 1 OR PAGE 2?.....1
7. INVERSE GRAPHICS?.....N
8. INVERSE TEXT?.....N
9. EMPHASIZED PRINTING.....N

OPTIONS:

- A. LOAD DUMP INTO CM II RAM (& EXIT)
- B. RE-CONFIGURE THE SCREEN DUMP
- C. SAVE RE-CONFIGURED DUMP ON DISK
- D. EXIT WITHOUT LOADING COPY MASTER
- E. CHANGE CHARACTER FONT
- F. CHANGE PRINTER INTERFACE CARD

ENTER A, B, C, D, E, OR F:

Each of these options is described below in detail. When using the graphics dump for the FIRST time, it is VERY IMPORTANT that you select Option F to load the appropriate driver routine for your printer interface card. Otherwise, the dump will not work. After that, you will probably want to select Option B several

times to change the configuration, then save it to disk (Option C), and finally load it into the Copy Master card with Option A. In the future, if you have saved your re-configured dump on disk, you may simply choose Option A to load it immediately. Once the dump is loaded into the card, you may print the selected screen at any time by pressing the Copy Master button. The dump may be executed any number of times without re-loading the card as long as the Apple has not been turned off and another Copy Master program has not been loaded into the card. You may re-configure the dump, as described below, as often as you like without losing any of its features.

When using the configuration and loading program, note that a single keystroke is usually the only response necessary to select an option or set a parameter. In most cases, the program will process keystrokes immediately without waiting for the RETURN key to be pressed. The only times you will need to use the RETURN key are after entering the filenames in Options E and F. If you have an Apple IIe, note also that the filenames must be entered in upper-case.

Option A: LOAD DUMP INTO CM II RAM (& EXIT)

If the parameters displayed on the screen under "Current Configuration" are correct for your hardware set-up and screen choice, and you have loaded the appropriate driver routine for your printer interface card (Option F), then select this option. The screen dump software will be loaded into your Copy Master card and the configuration and loading program will be exited. This is the usual way in which you will end the configuration and loading process. The configuration that is loaded into the card will be that which is currently in memory. If you have made changes to some parameter (Option B, D, or E) and wish to save the changes to disk for future use, you must select Option C (Save Re-configured Dump on Disk) before you select Option A.

Option B: RE-CONFIGURE THE SCREEN DUMP

If you wish to change any of the parameters displayed on the screen under "Current Configuration", then select this option. You will be prompted to enter the number of the parameter you wish to change and then its new value. A description of each parameter is given below. To change additional parameters, simply select this option repeatedly. You should continue to change parameters until the "Current Configuration" is correct for your hardware set-up and choice of screen. If you should select a parameter and then decide not to change it, either set it to the same value that is shown under "Current Configuration" or else press the Escape key (ESC) to return to the options menu. If, after running the screen dump, you find that you have set some parameter incorrectly, you can easily correct it by re-configuring. To change the character font or interface card driver, see Options E and F below.

Parameter 1: APPLE II/II+ OR IIE?

Set this parameter to indicate the type of computer you have. Because of hardware differences between the older Apple II/II+ and the newer Apple IIE, it is very important that this be set correctly. Otherwise, the screen dump will not work.

Parameter 2: COPY MASTER SLOT NUMBER

This is simply the number of the slot (1-7) containing your Copy Master card.

Parameter 3: PRINTER SLOT NUMBER

This is the number of the slot (1-7) containing your printer interface card. Printer cards are most often placed in slot #1, but any of the slots #1 through #7 is acceptable.

Parameter 4: GRAPHICS(G), TEXT(T), OR MIXED(M)?

This parameter selects the type of screen dump desired. Set it to "G" for a full-screen graphics dump (192 hi-res lines), "T" for a text-only dump (24 lines of text), or "M" for a mixed dump (160 hi-res lines plus 4 lines of text). In setting this parameter, note that some programs use the hi-res screen to display text, so if you see text characters, it does not always mean you are viewing the Apple's "text screen". To select between the 40 and 80 column text screens, see Parameter 5.

Parameter 5: 40-COLUMNS/HI-RES OR 80-COLUMNS/DOUBLE HI-RES?

This parameter selects the width of the screen dump. If you set it to "40", you will get either a 40-column text dump, a normal full-screen hi-res dump (192 lines of 280 dots each), or a normal hi-res mixed dump (160 lines of 280 dots plus 4 lines of 40-column text), depending on how you set Parameter 4. These are the only graphics dump modes available for an Apple II or II+. If you have an Apple IIE with 80-column hardware, you may select all of these plus a number of additional modes. Setting Parameter 5 to "80" will change the 40-column text dump to an 80-column dump, the full-screen hi-res dump to a double hi-res dump (192 lines of 560 dots each), and the mixed dump to a double hi-res mixed dump (160 lines of 560 dots plus 4 lines of 80-column text). Note that double hi-res graphics requires an Extended 80-Column Text Card in the Apple IIE auxiliary slot. Due to printer limitations, the double hi-res dump will be printed with a somewhat distorted aspect ratio. The Copy Master screen dump software does not currently support lo-res or double lo-res dumps or the mixing of normal hi-res with 80-column text. Also, the 80-column text dump is only

compatible with 80-column text (or extended text) cards which fit in the IIe auxiliary slot. Other 80-column cards, such as those used on the Apple II or II+ or in other slots of the IIe, are not supported. For this reason, the configuration program will not let you select an 80-column or double hi-res dump if you are configuring it for an Apple II/II+.

Parameter 6: DUMP PAGE 1 OR PAGE 2?

The Apple contains two areas of memory devoted to 40-column text, hi-res graphics, and mixed hi-res graphics, called "page one" and "page two". You may dump either one. For text and mixed graphics, most programs use only page one, but some may use page two as well. For full-screen graphics, programs may use either page. If your screen dump prints okay but does not agree with what you see on the screen, you have probably set the wrong page. Re-configure the dump and try it again. If you have an Apple IIe and have selected the 80-column or double hi-res dumps, note that the configuration program will not let you select Page 2 because there is only one page of 80-column text and double hi-res graphics.

Parameter 7: INVERSE GRAPHICS?

If this parameter is set to "No" ("N"), then each dot that is turned on (i.e. white, green, amber, etc., depending on you monitor or TV), in the graphics portion of the screen, will appear as a black dot on the printed page. Dark areas of the screen will be left unprinted (i.e. white). For most screen images, this is the desired type of dump. However, if the image is mostly white or if it looks like a photographic negative when you dump it, you may wish to set this parameter to "Yes" ("Y"), in which case dark areas of the screen will be printed as black dots and white areas will be left white. This parameter affects a full-screen graphics dump or the graphics portion of a mixed dump, but is ignored if you have selected a text-only dump.

Parameter 8: INVERSE TEXT?

This parameter is analogous to Parameter 7 above, except that it affects only the text portion of the screen. If it is set to "No" ("N"), text is printed using black dots on a white background. If it is set to "Yes" ("Y"), then each character appears on the page as a pattern of white dots inside a solid rectangle of black dots. This uses a lot of ink but can be useful if you need to see the edges of the screen on your text dump, for example. This parameter affects a text-only dump or the text portion of a mixed dump, but is ignored if you have selected a full-screen graphics dump.

Parameter 9: EMPHASIZED PRINTING?

Set this parameter to "Yes" ("Y") if you want the screen dump to appear in emphasized (boldface) print. Otherwise, set it to "No" ("N"). Emphasized print is useful if your printer ribbon is old and needs re-inking. The setting of this parameter affects both the graphics and text portions of the screen dump. Note that some printers may not support emphasized print, in which case this parameter will be ignored.

Option C: SAVE RE-CONFIGURED DUMP ON DISK

If you have changed any of the screen dump parameters via Option B above or Options E and F below, you will probably also want to select this option. It writes the screen dump software back onto disk with the new parameter values shown under "Current Configuration" and the most recently loaded character font and interface driver. This will allow you to skip the re-configuration steps when loading the screen dump in the future. Although this disk save must be performed to preserve your configuration for future use, you may re-configure and load the Copy Master card (Option A) without saving to disk. This is because Option A loads the card using the current parameter values stored in memory without regard to the configuration on disk.

Note that the previous configuration stored on the disk will be over-written when the new one is saved. However, there is no reason to save the old configuration because it can be re-created (if needed) at any time simply by re-configuring. Make sure that the disk is not write-protected (i.e. remove the tab) when you select this option. After the current configuration is saved to disk, you will be returned to the options menu, where you may load the Copy Master card (Option A) or exit without loading the card (Option D).

Option D: EXIT WITHOUT LOADING COPY MASTER

This option exits the configuration and loading program without loading the screen dump into the Copy Master card.

Option E: CHANGE CHARACTER FONT

The graphics dump program prints each text character as a string of graphics bytes. This makes it very easy to change the character font, which is just a table of these bytes. The font table contains 8 consecutive bytes for each of the 96 printable ASCII characters, in order from the "space" (ASCII code \$20) through the "delete" character (ASCII code \$7F), for a total of 768 (\$300) bytes. The seven least significant bits of each byte are printed and the eighth bit is ignored. This table arrangement is the same as that used by the hi-res character generator program (HROG) in the DOS 3.3 TOOLKIT, sold by Apple Computer, Inc. The DOS 3.3 TOOLKIT comes with about 20 different

character fonts. Any of them, or any other compatible font, may be substituted for the default font in the graphics dump by selecting Option E.

If you select this option, you will be asked to enter the filename of your font and then insert the disk containing it. The font should be stored as a binary file and its length should be exactly \$300 bytes. If it is any longer, it may overwrite part of the screen dump program. (All fonts included with the DOS 3.3 TOOLKIT are of this length.) The new font will be read from the disk and will replace the current font in the graphics dump. When you load the dump into the Copy Master card (Option A), it will contain the new font. If you want to keep the new font as a part of the dump, you should save the dump to disk (Option C), before loading the Copy Master card. Then, in the future, you will not have to re-load the font each time you load the dump. If you want to return to the original font, note that it is supplied on the screen dump disk in a file named "DEFAULT FONT.SET". Simply select this option again and load it back in.

Option F: CHANGE PRINTER INTERFACE CARD

When you first receive the graphics dump, you MUST select this option to load in a driver routine for the type of printer interface card you are using. Otherwise, the dump will not work. You may also select it later if you change to a new interface card. A list of interface cards will be displayed and you will be asked to select one. If your card is on the list, enter the letter beside it and the appropriate driver routine will be loaded from disk. You will then be returned to the options menu, where you should IMMEDIATELY select Option C to save the re-configured dump to disk. It will then contain the appropriate driver the next time it is loaded.

If your interface card is not listed, you may either try to write your own driver routine (see the next section for details), or else contact Applied Technology Laboratories. We will try to supply you with a driver routine for your interface card.

If you have written your own driver or have obtained a driver from us for a card not on the list, you should select the last entry on the list, which is "OTHER". You will be asked to enter the filename of the driver and insert the disk containing it. The driver will be read from disk and incorporated into the screen dump. You will then be asked if the driver contains an "initialization section". If you have written your own driver from the technical information below, you will know what to answer here. If you obtained the driver from us, we will have provided you with the appropriate answer. In any event, after answering this question, you will be returned to the options menu, where you should IMMEDIATELY select Option C to save the re-configured dump to disk. It will then contain the correct driver the next time it is loaded.

4.3 Designing a custom interface driver

(NOTE: The following information is supplied to aid advanced programmers in writing their own driver routines. Such drivers must be written in 6502 assembly language. If you need a driver for your interface card but have no familiarity with assembly language, then DON'T bother to read this section. Instead, contact Applied Technology Laboratories and we will attempt to provide a driver for your card.)

If you know some assembly language, it is not difficult to write a printer interface driver routine. The purpose of such a routine is to pass a graphics byte to your printer. This is usually done by writing it to some memory location that is not in memory at all but is wired to the hardware on your interface card. This location, and others that are used to read printer status, unfortunately vary from card to card so no single driver routine can be used for all cards. Most interface cards contain driver routines in on-board ROM memory chips but these can not be used with the graphics dump because they will filter out certain bytes which they interpret as control commands (such as CTRL-I).

Most interface cards from reputable companies will have documentation containing a sample assembly language driver or else contain enough information to write one easily. Look in your interface card manual for a PRINTER STATUS address and which bits should be checked to determine if the printer is busy or not selected. Also look for the address that the output byte should be written to, and whether any additional STROBE locations need to be written after the output location.

To work with the Copy Master graphics dump, your driver must either be written as relocatable machine code or else be assembled to run at \$FF60. It may be no more than \$90 (144) bytes in length. The driver will be called at location \$FF60 with a JSR instruction, so it should end with RTS. On entry, the accumulator will contain the byte to be output, with the MSB set to zero, the X register will contain \$CN (i.e. 192 + N), and the Y register will contain \$N0 (i.e. 16 * N), where N is the printer slot number, as specified by Parameter 3 in the configuration menu. Your routine should output the byte in the accumulator and then return. It does not need to preserve any of the 6502 registers. The driver may be written for the specific slot your printer interface is in, or it may be slot-independent and use the slot information passed to it in the X and Y registers.

Some interface cards require software initialization the first time they are used. You may include an initialization section in your driver if needed. If you specify in Option F that your driver contains such a section, then the initialization will be called once and only once at the beginning of each screen dump (when the trigger switch is pressed). It will be called at location \$FF63 with a JSR. The accumulator will contain the printer slot number N, the X register will contain \$CN, and the Y register will contain \$N0. The initialization section may

perform whatever action you desire, subject to the limitations in the next paragraph. It should end with RTS, and does not need to preserve any of the 6502 registers. Obviously, if you include an initialization section at \$FF63, then the main driver entry at \$FF60 will have to begin with an instruction to jump over the initialization code. An example of this is given below. If you answer "No" ("N") to the initialization question in Option F, then no call will be made to location \$FF63, so the JMP will not be needed.

If your driver needs temporary storage locations, you may use the memory area from \$FF60 through \$FFEF, the 6502 stack (via PHA and PLA instructions), and the upper half of page zero (locations \$80 through \$FF). Do not use any other locations. Neither your driver nor its initialization routine should call any routines in the Apple's ROM memory because when the Copy Master card is on, the ROMs are not accessible. You should also avoid calling any routines in the printer interface card ROM because they may write to other memory locations which may mess up the graphics dump or the program that has been interrupted by Copy Master.

Below is an example of an interface driver for the parallel interface card sold by Apple Computer Inc., showing an initialization section. Here the initialization is not needed by the card, but is used to configure the rest of the driver for a specific slot.

```

ORG $FF60

ENTRY JMP DRIVER ;JUMP OVER INITIALIZATION

INIT STX BUSY?+2 ;INITIALIZATION: STORE $CN
RTS ; FOR BUSY TEST & RETURN.

DRIVER PHA ;SAVE CHARACTER ON STACK.
BUSY? LDA $C0C1 ;LOOP HERE IF
BMI BUSY? ; PRINTER IS BUSY.
PLA ;RETRIEVE OUTPUT CHARACTER.
STA $C080,Y ;STORE TO OUTPUT LATCH.
RTS ;RETURN TO CALLER.

```

4.4 Software synopsis

Here is a summary of the steps necessary to use the COPY MASTER screen dump.

The TEXT ONLY screen dump.

1. RUN the TEXT ONLY SCREEN DUMP loader program.
2. Select OPTION B repeatedly to configure parameters for your hardware set-up and the screen you want to dump.
3. Select OPTION C to save re-configured dump on disk. (This is optional but will shorten loading time in the future.)
4. Select OPTION A to load the dump into the COPY MASTER card.
5. Run the program whose screen is to be dumped. (Use RUN, BRUN OR PR#6.)
6. Press the COPY MASTER trigger switch whenever you want the screen printed.

GRAPHICS SCREEN DUMP

1. RUN the program whose name is "GRAPHICS DUMP LOADER" followed by a period and the name of your printer, e.g. "GRAPHICS DUMP LOADER.EPSON"
2. Select OPTION F to configure the dump for your printer interface card.
3. Select OPTION B repeatedly to configure parameters for the screen you want to dump.
4. Select OPTION C to save re-configured dump on disk. (This is optional but will shorten loading time in the future.)
5. Select OPTION A to load the dump into the COPY MASTER card.
6. Run the program whose screen is to be dumped. (Use RUN, BRUN OR PR#6.)
7. Press the COPY MASTER trigger switch whenever you want the screen printed.

5.0 Controlling the on board RAM from software.

5.1 Memory mapping

The COPY MASTER II's on board RAM is mapped into the address range \$F000 through \$FFFF. This range can be enabled or disabled using the softswitches described below. Before enabling the COPY MASTER RAM however, the language card must be disabled (by strobing memory locations \$C082 or \$C08A) immediately before activating the COPY MASTER RAM or memory conflicts will result. Additionally, after disabling the COPY MASTER RAM, the user must restore the correct read/write status for the language card by strobing one of the addresses in the range \$C080 through \$C08B. The COPY MASTER softswitch register can help the user determine which address to strobe (see below).

The 4k bytes of COPY MASTER RAM can be activated and deactivated by throwing certain softswitches, just as in the language card. There are, however, 256 bytes of this space that are never deactivated. These 256 bytes share the same data space as the 256 bytes associated with the slot the COPY MASTER board is in. For example, suppose the COPY MASTER board was in slot 4. The 256 (\$100) bytes associated with this slot have addresses \$C400 through \$C4FF, and there is a one to one mapping between this area and \$F400.\$F4FF: that is, reading and writing to \$C4XY is equivalent (provided the COPY MASTER RAM is enabled) to reading and writing from \$F4XY (where "X" and "Y" are any hex digits). The difference between these address ranges is that the \$C400 range is never deactivated, while the \$F400 range is either active or inactive depending on which COPY MASTER softswitch was thrown last. The memory mappings are also described in section 2.1 where Figure 1 illustrates this unusual situation.

5.0 Controlling the on board RAM from software.

5.1 Memory mapping

The COPY MASTER II's on board RAM is mapped into the address range \$F000 through \$FFFF. This range can be enabled or disabled using the softswitches described below. Before enabling the COPY MASTER RAM however, the language card must be disabled (by strobing memory locations \$C082 or \$C08A) immediately before activating the COPY MASTER RAM or memory conflicts will result. Additionally, after disabling the COPY MASTER RAM, the user must restore the correct read/write status for the language card by strobing one of the addresses in the range \$C080 through \$C08B. The COPY MASTER softswitch register can help the user determine which address to strobe (see below).

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5.2 Softswitches and registers.

There are 2 soft softswitches and 1 Soft Switch Register (SSR) associated with the COPY MASTER II board. These are located in the 16 bytes of Device Select space associated with the slot containing the COPY MASTER II board. These locations will always have an address of the form $\$CO(S+8)X$, where 'S' stands for the slot number and 'X' is either 1, 2 or 4. Suppose the COPY MASTER board is in slot 5. Then the following addresses produce the described result:

$\$COD1$	disables COPY MASTER RAM
$\$COD2$	enables COPY MASTER RAM
$\$COD4$	contains the status of the last language card softswitch strobed. For example, if the last such softswitch was $\$COB2$, then $\$COD4$ would contain the value R2, where 'R' was undetermined

WARNING: Before enabling the COPY MASTER RAM, the language card softswitch must be pointing toward ROM read, auxiliary memory protect (i.e., the last language card softswitch accessed must have been either $\$COB2$ or $\$COB4$).

There are 2 additional pairs of memory addresses associated with the COPY MASTER board: $\$FFFA.\$FFFB$ and $\$FFFC.\$FFFD$. The first pair ($\$FFFA.\$FFFB$) contain the NMI vector. This is the address from which the COPY MASTER will get its NMI vector when the COPY MASTER trigger switch is pushed. The second pair of memory addresses ($\$FFFC.\$FFFD$) are the COPY MASTER II board reset vectors. When the COPY MASTER trigger switch is first pressed, it immediately disables itself. Reading or writing from $\$FFFA.\$FFFB$ will reenable this switch, while reading from $\$FFFC.\$FFFD$ will disable it.

6.0 Notes on copying.

6.1 Programs that are not entirely memory resident.

Large programs cannot be efficiently loaded without leaving the user with little or no memory left to store data. Therefore only the part of the program which is currently in use is inside the machine while the rest is kept on disk. Since all copy cards copy only the memory content copying such programs with COPY MASTER II will produce only a partial image.

Sometimes segmented programs can be successfully copied, however, by copying each part separately. For example, suppose a text editor has 2 parts: an editor and a printer formatter. Make 2 copies, a copy when the editor is in memory and another copy when the printer formatter is in memory. The success of this method depends upon each part being able to write data files that the other part can then read.

6.2 Programs that constantly verify presence of original disk.

This is a copy-protection scheme which can be often defeated with a trick. The copy you make will not initially run because the program will not "see" a familiar disk in the drive. By using the STEP/TRACE program it is possible to find the subroutine that performs the disk verification. Since the copy is modifiable, then inserting RTS (ReTurn from Subroutine) at the beginning of this subroutine will cause the program to jump into the subroutine and then jump out again without ever getting to the "looking" part of it.

6.3 Copying CP/M programs.

The vast majority of CP/M programs are unprotected. However COPY MASTER II can often be used to produce a copy whenever disk copying under CP/M fails. The difficulty in reproducing CP/M software lies in the incompatibility of the 6502 operating system and the Z80 operating system. Such an obstacle can be sometimes circumvented if a copy is made while the 6502 processor is operating (under CP/M), e.g., during disk access.

The following scenario describes the process:

- 1) Initialize COPY MASTER II with the COPY program.
- 2) Load CP/M program into memory.
- 3) Put the CP/M disk in drive #2.
- 4) Insert a freshly DOS initialized disk into drive #1.
- 5) Attempt to read from the disk in drive #2.
- 6) push the COPY MASTER pushbutton while drive #2 is spinning.

Copy programs produced by this method will (when loaded) start where the original program left out, e.g. reading a disk in drive #1.

The strange thing about this seems to be that CP/M programs are copied onto DOS initialized disks and loaded into the machine under DOS. However, the CP/M to DOS "conversion" is only a manifestation that the copying process simply makes a reproduction of memory content without any concern about how it got there or its meaning.

7.0 Trouble Shooting.

In the case of malfunction it is always helpful to perform trouble shooting to identify the nature of the problem and to bring about a corrective action. This section is intended to give the user a comprehensive list of tests and remedies.

In order for the COPY MASTER II system to operate correctly the following criteria must be satisfied:

- 1) Hardware must function correctly.
- 2) Software must function correctly.
- 3) Software must be correctly initialized.
- 4) There must not be any interference with other peripherals or customizations to the Apple.

7.1 Hardware Test.

A hardware test can be performed easiest with the SYSTEM TEST program. This program checks not only the memory but also COPY MASTER II's ability to take control of the computer. Whenever a problem is suspected this program should be run several times to verify the consistency of results. Failing the memory test could be an indication of bad memory chips or, if the chips have been recently replaced, improperly inserted pins. Stuck trigger switches are often responsible for missing some depressions; working the switch a little usually solves the problem in this area. SYSTEM TEST is also likely to fail if there is a hardware incompatibility with the computer and/or its peripherals.

7.2 Software Test.

The user should always have a back up copy of COPY MASTER II programs. The most common problem apart from blown disks is the configuring parameters. The COPY MASTER II program must be configured correctly for both the slot where the COPY MASTER II board is installed as well as for the slot where the disk controller card is installed. Also, to avoid memory conflicts, the slot 3 on IIE machines cannot be used for COPY MASTER II. By a similar token the I/O space associated with the slot where COPY MASTER II resides may not be assigned to other peripherals. If the system fails to function properly after it has been successfully used in the past, it is useful to check whether the past performance can still be achieved.

7.3 Interference with other Hardware.

Nonstandard peripherals and customizations to the Apple could adversely affect the function of the COPY MASTER II. Whenever such interference is suspected these peripherals should be removed and customizations reversed if possible. By far the most common problems are the peripherals that can claim some of the 256 bytes allocated to the slot assigned to COPY MASTER II. This could be the case, for example, with some clock and calendar cards. Such conflicts must be removed.

7.4 Check List.

1. Is the card seated properly and in a permissible slot? (Slots 0 and 3 (IIE only) are not permissible.)
2. Is the software a correct version for your machine (e.g. II+, IIE, 64k, 128k etc.)?
3. Is the software properly initialized for the correct COPY MASTER II slot and disk slot?
4. Is the software disk good (unblown)?
5. Is the I/O space for COPY MASTER II slot assigned to other cards?
6. Is the trigger switch stuck?
7. Is there any interference with other peripherals?
8. Can the card pass the SYSTEM TEST program?
9. Can the card now copy the software that it copied before?

8.0 Warranty.

COPY MASTER II is warranted against manufacturing defects in material and workmanship for the period of 90 days from the date of purchase from Applied Technology Laboratories (herein identified as ATL) or its authorized representatives. Within this period ATL will repair this product without charge for parts or labor. This warranty does not cover damage or failure caused by or attributable to abuse, misuse, improper or abnormal usage, faulty installation, improper maintenance or any repairs other than those provided by ATL, or transportation cost.

ATL is not responsible or liable for indirect, special, or consequential damages arising from or in connection with the use or performance of the product or other damages with respect to any economic loss, loss of property, loss of revenues or profit, or costs or removal, installation or reinstallation.

Except as provided herein, ATL makes no express warranties, and any implied warranty of merchantability or fitness for a particular purpose is limited in its duration to the duration of written limited warranties set forth herein.

Some states do not allow the limitation or exclusion of incidental or consequential damages and some states do not allow limitation or exclusion of implied warranties; therefore, the aforesaid limitation(s) or exclusion(s) may not apply to the purchaser.

There will be charges rendered for repairs to the product made after the expiration of the aforesaid 90 days warranty period.

This warranty extends only to the original purchaser and is not assignable or transferrable.

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