INSTALLATION & PROGRAMMER'S MANUAL

80/64

μ-SCI

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80/64e

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MICRO-SCI 80/64e CARD MANUAL

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CHAPTER 1 INTRODUCTION

1.1 Purpose.

This manual provides instructions explaining how to install, activate and operate the MICRO-SCI 80/64e Card with your particular operating system. We assume you have unpacked and set up your Apple® IIe and have already read the Apple IIe Owner's manual that came with your computer. If you haven't read the manual yet, it is important that you do so before you read any further in this manual. There are things explained in that manual that you must know before you try to install, activate or operate your 80/64e Card. This manual has six purposes:

1. To assist you in the proper installation of your 80/64e Card.

2. To guide Pascal, CP/M®, and BASIC users through the required steps to activate the 80/64e Card.

3. To advise you how some of the Apple IIe display features are affected by the addition of the 80/64e Card.

4. To introduce features and functions available to Apple IIe BASIC users with the addition of the 80/64e Card.

5. To direct you to sections in other manuals that pertain to the operation of the 80/64e Card.

6. To provide programmers with the information required when they use the extra 64K of memory provided by the 80/64e Card.

NOTE: The MICRO-SCI 80/64e Card did not exist when most of the programs for your computer were written. These programs expect to find the 80/64e Card turned off when they begin to run, so you must never turn the card on yourself before you run a program. The programs that use the 80/64e Card will turn the card on themselves. The best way to avoid turning the card on is not to learn how to turn it on; that way you won't do it accidentally. If you are going to run programs only and not write them, read only the parts of the manual that tell you how to install the card; not the parts that tell you how to turn it on.

1.2 Introduction.

The MICRO-SCI 80/64e Card for your Apple IIe computer is a peripheral card that gives you 40 extra characters per line on your display, makes some additional features available to BASIC users and provides an additional 64K memory capacity for your computer. The firmware that supports special features associated with the 80-column display is part of the Apple IIe computer itself, and works the same regardless if the card is installed or not. The standard Apple IIe displays up to 40 columns of text on the video screen. The 80/64e Card enables the Apple IIe to display up to 80 columns of text on the standard 24 line screen. It also allows you to switch back and forth easily between 40- and 80-column displays.

1.3 System Requirements.

The 80/64e Card is designed specifically for the Apple IIe 64K computer with its auxiliary slot (labeled AUX. CONNECTOR). This card cannot be used with the Apple II or Apple II-Plus computers, which do not have this special slot. In the Apple II and Apple II-Plus computers, expansion slot 3 was conventionally used for an 80-Column Text Card. Although there is also an expansion slot 3 inside the Apple IIe, the auxiliary slot effectively replaces and renders this slot inoperable when the 80/64e Card is installed in the AUX CONNECTOR slot.

NOTE: While the 80/64e Card is installed in the AUX. CONNECTOR slot, do not install a peripheral card in slot 3. Nothing will be damaged if cards are installed in both slots, but the card in slot 3 will not work.

Television sets lack the capacity to display 80 columns of text clearly, so you must use a black-and-white video monitor rather than a television set while displaying 80 columns of text. If you want to use a color television set with your Apple IIe, to do color graphics, for instance, while the 80/64e Card is installed, you can do so as long as you switch back to the 40-column display. Switching back and forth from 80- to 40-column display and vice versa is explained in detail in Chapter 6.

1.4 Using Software Developed For The Apple II and Apple II Plus Computers.

A lot of available software was developed for the earlier versions of the Apple II computer and therefore does not take advantage of some of the Apple IIe capabilities. Some

software may not use the UP-ARROW and DOWN-ARROW keys and the capability of displaying lower-case characters on the screen of the Apple IIe. Also, software designed for the 40-column display of the Apple II or Apple II-Plus will not take advantage of the Apple IIe's 80-column capability. Most of this software will work fine with your Apple IIe, but just won't switch the display to 80 columns.

CHAPTER 2 UNPACKING

2.1 The MICRO-SCI 80/64e Card is packed in a protective plastic bubble wrap inside its carton. You should be very careful when you remove it from the bubble wrap. Make sure you do not touch or get the gold fingers of the connector dirty; this will adversely affect the performance of your computer after you install the 80/64e Card. Follow these steps carefully while unpacking your 80/64e Card:

1. Carefully cut open the protective plastic bubble wrap using a shape knife, razor blade or scissors. DO NOT TRY TO TEAR OPEN THE CONTAINER, THE CARD COULD BE DAMAGED.

2. Remove the card from the protective plastic buble wrap, being careful not to touch or contaminate the gold fingers.

3. Set the card aside while you read the installation instructions.

CHAPTER 3 FAMILIARIZATION

3.1 The MICRO-SCI 80/64e Card (see Figure 3-1) is an electronic circuit board with several components mounted on it. You will notice the components are all mounted on one side of the board. This is called the component side. There is also a connector, a row of gold fingers, located on one end of the board. Be very careful not to touch or get anything on these gold fingers. If they become contaminated the performance of your computer could be affected. Take a close look at the circuit board and you will notice that one end is labeled "KEYBOARD END" (on the component side). This end of the board must be toward the keyboard of your computer; in fact the board will not fit if you try to install it any other way.

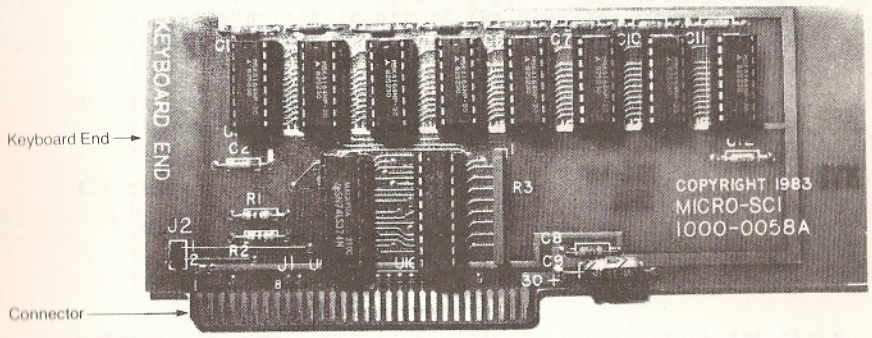

Figure 3-1: 80/64e Card

The 80/64e Card actually performs two functions; the first and most useful being that it allows you to expand the screen to handle 80 characters of text, instead of the 40

characters that is standard with your Apple IIe computer; the second function is that it increases the memory capacity of your Apple IIe to 128K bytes. Let's call this additional 64K bytes of memory (your Apple IIe has a built-in memory of 64K bytes) Auxiliary Memory. Most programs will only use the 64k bytes of main built-in memory. To use the Auxiliary memory, a program must set special switches in the Apple IIe so the auxiliary memory will substitute for the main built-in memory. Neither DOS 3.3 nor Pascal 1.1 will support this memory substitution, therefore your application programs will have to handle it themselves.

CHAPTER 4 INSTALLATION

4.1 During the installation of the MICRO-SCI 80/64e Card you will be instructed when to turn the computer power on and when to turn it off. Keep in mind you should NEVER plug in or unplug the card with power applied to the computer.

4.2 Opening The Computer.

Open the computer as follows:

1. Turn off the computer power switch (located in the left rear corner of the computer). The lower part of the toggle should be pressed in when the power switch is in the off position.

2. Remove the cover of your computer by pulling up on the rear edge at each corner until the cover snaps up. Slide the cover towards the back (away from the keyboard) and lift it off of the computer. Now put the cover in a safe place until you are ready to reinstall it.

3. Touch the power supply cover (see Figure 4-1) to discharge any static electricity you may be carrying on your clothes or body.

4. Check inside the computer to make sure the power switch has been turned off. The little red light (pilot light) should be off; if it is glowing, the power is on. Turn the power off before you proceed any further. Refer to step 1 for instructions on turning the power off.

WARNING: THE SMALL RED LIGHT (PILOT LIGHT) INSIDE THE APPLE IIe GIVES YOU AN EXTRA WARNING IN CASE YOU HAPPEN TO FORGET TO TURN OFF THE POWER SWITCH. IF YOU HAPPEN TO BE FORGETFUL OR GET INTERRUPTED IN THE MIDDLE, IT WILL REMIND YOU THE POWER IS ON.

5. Locate the auxiliary slot inside your Apple IIe (see Figure 4-1); it is labeled "AUX. CONNECTOR". When you are looking inside the computer from the keyboard end, the AUX. CONNECTOR is located on the left side of the main logic board next to the power supply toward the front of the computer.

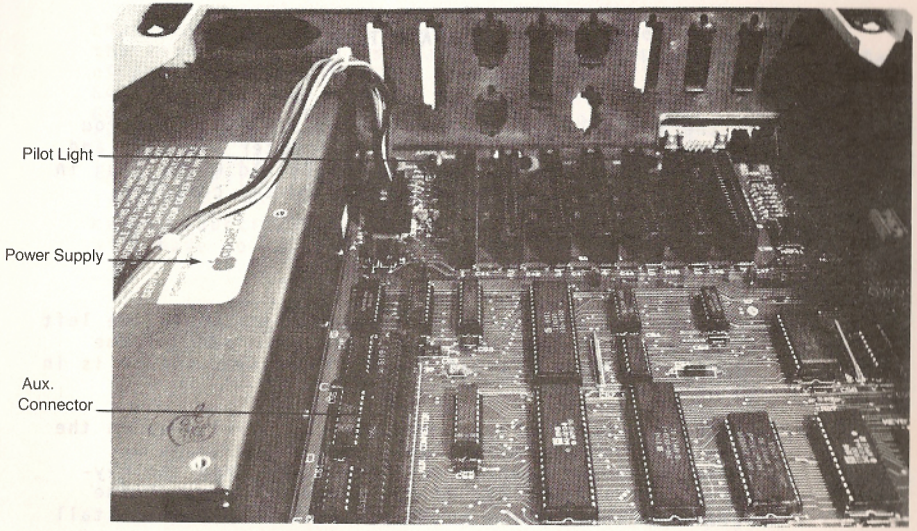

Figure 4-1: Apple IIe With Cover Removed

6. Pick up the 80/64e Card without touching the gold fingers; turn the card so the end labeled "KEYBOARD END" is toward the keyboard of the computer and the component side of the board is facing away from the power supply (see Figure 4-2).

   NOTE: If you try to install the card backwards, it will not fit into the connector. The card is too long and will interfere with the computer cabinet.

7. Position the 80/64e Card over the auxiliary slot and engage the gold fingers with the connector on the main logic board. Use your thumb placed on the top of the card to start the card into the slot and gently rock the card back and forth while pushing down on it until it is fully seated in the slot. Look at Figure 4-3 and if your card looks like the one installed in the picture, you have it.

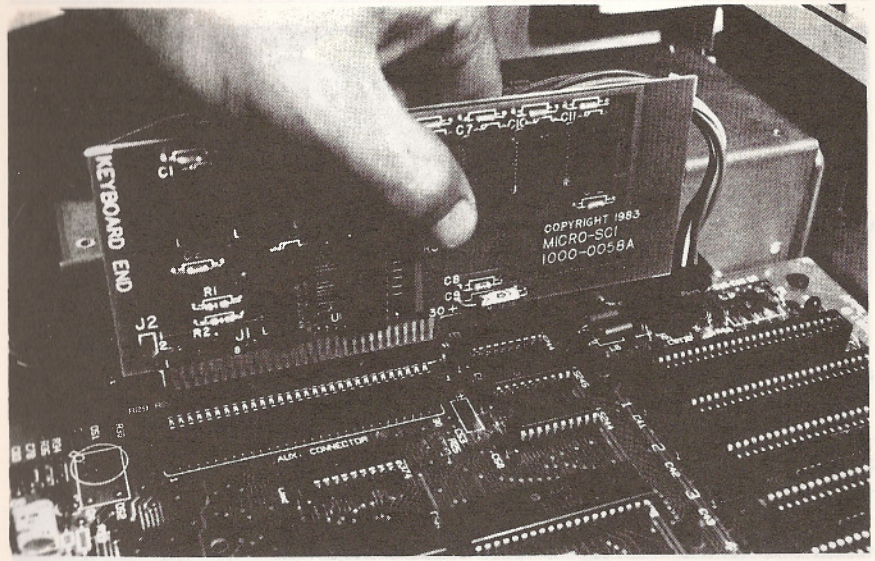

Figure 4-2: Correct 80/64e Card Position

8. You can now reinstall the cover on your Apple IIe. Insert the front edge of the cover under the front of the cabinet just behind the keyboard. Press down firmly at each corner of the back edge of the cover until it snaps into place.

9. Start up (boot) your computer with a startup disk. The terms "start up" and "boot" mean the same thing and will both be used throughout this manual.

10. Now you are all set to start up your 80/64e Card, but you may want to adjust you video monitor. In most cases the video monitor owner's manual will tell you everything you will need to know about good screen resolution. You may want to adjust the brightness, contrast, vertical and horizontal hold even after you have used your system for a while. Your eyes will get used to the screen and you may want to change the contrast or brightness to make it easier on your eyes.

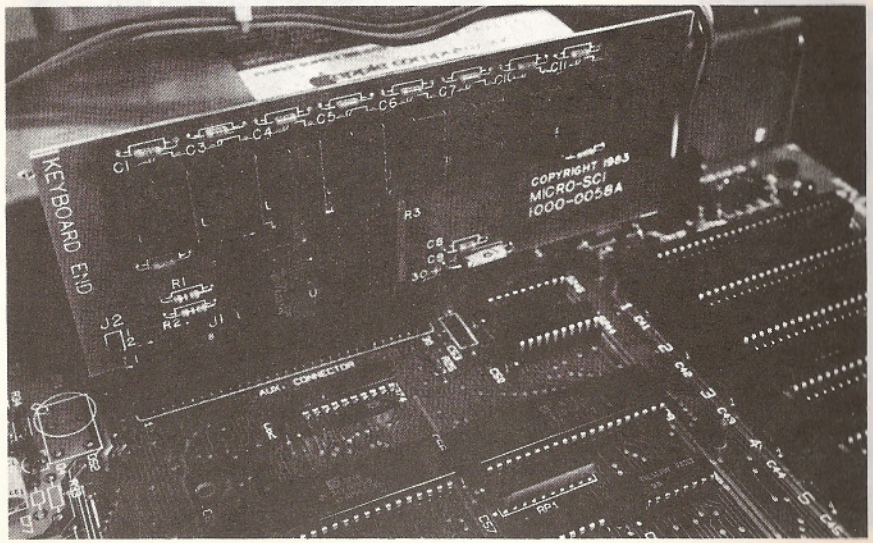

Figure 4-3: An 80/64e Card Correctly Installed

Now that you have installed your 80/64e Card, you can continue to Chapters 5 and 6 to learn how to activate and operate your system with the 80/64e Card. If you are not going to write programs with your computer, this is all you will have to know about the 80/64e Card, except for how to turn off the card if one of the programs you have run leaves the card turned on after the program has finished running. Refer to paragraph 6.3 for instructions about how to turn off your 80/64e Card.

CHAPTER 5 CHECKOUT OF THE 80/64e CARD

5.1 This chapter explains how to start up and check out the 80/64e Card. If you are using Applesoft BASIC or DOS you can choose to leave the 80/64e Card inactive after you install it. This will allow you to run software that does not use the 80-column display feature. One important thing you should be aware of before you startup your 80/64e Card is that the startup procedure for displaying the 80 columns of text depends upon the operating system you are planning to use. It is very easy to start the system with Pascal or CP/M; however the procedure for starting up the computer with BASIC or DOS is a little more complicated, but you will get the hang of it in no time at all.

NOTE: The ESC & CONTROL keys are used in conjunction with other keys to do a variety of things. Throughout this manual there is reference to using the ESC and CONTROL keys. When you are instructed to type "ESC" and "4" for example, this means first press the ESC key and release it, then press the 4 key and release it. When you are instructed to type "CONTROL Q" for example, this means to press the CONTROL key and press the Q key at the same time, without releasing the CONTROL key. When the ESC key is pressed, the computer is in the escape mode and throughout this manual you will see reference to the "escape mode " When the computer is in the escape mode, the cursor will have an inverse plus sign (+) when the 80/64e Card is active; when the 80/64e Card is inactive, the cursor does not change, it remains a blinking checkerboard when in the escape mode.

5.2 Starting Up With PASCAL or CP/M.

If you are using the Pascal program language or the CP/M operating system, the 80 columns of text will be automatically displayed after you have installed the card. The only thing you have to do is start up the system with any Pascal or CP/M startup disk, and the screen will be all set to display 80 columns after about ten seconds of whirring noises from your disk drive. If you want to find out how to write and edit text using Pascal language or the CP/M operating system, see the applicable manual. When using Pascal or CP/M in the 80-column mode, the cursor will be a solid, non-blinking rectangle (see Figure 5-1). You will most likely want to run the SETUP program to make the UP-ARROW

and the DOWN-ARROW keys functional if you are using Pascal. The SETUP program is a self documenting program on the Pascal disk APPLE3. If you would like more information about this, see your Apple Pascal Operating System Reference Manual for Apple II.

Now if you are going to write and program using Pascal or CP/M, you may have learned enough about the 80/64e Card. If this is the case, you can now set this manual aside until you need it, or else you can skim through the rest of the manual.

5.3 Starting Up With BASIC or DOS.

The following is a brief summary of the operating procedures for BASIC and DOS users who are already familiar with how to activate the 80/64e Card and would like to brush up on the essentials to get them started. Startup procedures are explained after this brief summary.

CURSOR	CARD STATUS	LANGUAGE/ OPERATING SYSTEM	WHEN
	Active	Pascal and CP/M	Always

Figure 5-1: Pascal and CP/M Card-Active Cursor

Step 1 - Startup the Apple IIe with a DOS startup disk or if you do not have a disk drive, turn the computer on.

Step 2 - Make sure the CAPS LOCK key is in the down position.

NOTE: The CAPS LOCK key is either in the up or down position. If it is in the up position press it once to place it in the down position.

Step 3 - Type "PR#3" to activate the 80/64e Card.

Now that the 80/64e Card is active, the only thing you have to do to get your 40-column display back is to type "ESC" and "4". This will get you temporarily back to 40 columns; if you want to get back to the 80-column display, type "ESC" and "8" and the system will shift back to the 80-column display.

If you want to deactivate the 80/64e Card, type "ESC" and "CONTROL Q".

Your Apple IIe Owner's Manual describes startup disks and startup procedures for use with DOS. When you start up your computer with the DOS 3.3 SYSTEM MASTER disk, the 80/64e Card will be inactive when you enter the system. The following steps tell you how to activate the 80-column display.

NOTE: If you are using BASIC and you do not have a disk drive connected to your Apple IIe, then the following procedure will apply.

Step 1 - Make sure the DOS 3.3 SYSTEM MASTER disk is in the startup drive if you are using DOS. Turn the power switch of your Apple IIe and video monitor to the ON positions to startup the system. When the whirring noise from your disk drive stops, you will see a prompt "]" and a blinking checkerboard cursor. The blinking checkerboard cursor indicates the 80/64e Card is inactive and the Apply IIe is in the 40-column display mode. If this cursor is displayed (see Figure 5-2), your Apple IIe can run almost all of the software designed for the earlier models of the Apple II computer.

CURSOR	CARD STATUS	LANGUAGE/ OPERATING SYSTEM	WHEN
	Inactive	BASIC and DOS	Startup

Figure 5-2: BASIC and DOS Card-Inactive Cursor

Step 2 - Make sure the CAPS LOCK key is down. BASIC and DOS commands must be typed in upper-case letters (except strings appearing in PRINT statements) or you will get SYNTAX ERROR messages.

Step 3 - Type "PR#3" and then press the RETURN key. The 80/64e Card is now active and the screen will display 80 columns of text.

NOTE: After you type "PR#3" the 80/64e Card is active and the cursor changes from a blinking checkerboard to a

solid black rectangle half the width of the checkerboard (see Figure 5-3). This tells you the computer is in the 80-column display mode. The clue to knowing if the 80/64e Card is active is if the cursor is solid or blinking; if the cursor is solid, the card is active and if the cursor is a blinking checkerboard, the card is inactive and in the 40-column mode.

NOTE: The reason you type "PR#3" to activate the 80-column display is because the Apple II was designed to have an 80-column card installed in slot number 3. When you type "PR#" followed by a number between 1 and 7, you activate a particular expansion slot inside your computer. The computer treats the 80/64e Card installed in the auxiliary slot as if it were installed in slot number 3. This way, the software written for the Apple II and Apple II-Plus will still run properly on the Apple IIe.

CURSOR	CARD STATUS	LANGUAGE/ OPERATING SYSTEM	WHEN
▮	Active	BASIC or DOS	After you type PR#3

Figure 5-3: BASIC or DOS Card-Active Cursor

5.4 Customizing Your DOS HELLO program.

Right after you start up your computer, it will look for a greeting program. The DOS 3.3 SYSTEM MASTER disk uses the name HELLO for its greeting program. If you plan to use the 80-column display with your DOS all the time, you will probably want to create a new greeting program on your DOS 3.3 SYSTEM MASTER disk or any other DOS startup disk you may have. In this way you will not have to type "PR#3" every time you start up your system; simply change the greeting program once and the job is done for you.

NOTE: If you need a reminder on how to make a copy of a disk, see your Apple IIe Owner's Manual.

If you want to customize your HELLO program, the first thing you want to do is make a copy of the DOS 3.3 SYSTEM MASTER disk; that is if you haven't already done so. You have to do this because the one that comes with your disk drive is

write-protected. That means you cannot add any lines or delete any lines from the existing programs on that disk. The following procedure will customize your greeting program:

Step 1 - Insert the non write-protected copy of the DOS 3.3 SYSTEM MASTER disk in your disk drive and type "LOAD HELLO", making sure the CAPS LOCK key is down.

Step 2 - Type "LIST" and wait until the screen stops scrolling.

Step 3 - Type the following lines into the program:

```
1 D$ = CHR$(4), then press RETURN
2 PRINT D$ ; "PR#3", then press RETURN
UNLOCK HELLO, then press RETURN
SAVE HELLO, then press RETURN
LOCK HELLO, then press RETURN
```

Now you can start up your system with the new disk containing the HELLO program that will automatically set your computer to display 80 columns. What a time saver, and you will not forget to give your system the right instructions. If you want to, you can add these same instructions to any of your DOS startup disks.

This chapter taught you how to activate your 80/64e Card and also how to change your greeting program on your startup disk. The next chapter, Chapter 6, will teach you how to deactivate your 80/64e Card and also how to switch back and forth from 40- to 80-column displays.

CHAPTER 6 OPERATION WITH THE 80/64e CARD

6.1 This chapter describes the use of the 80/64e Card with Applesoft BASIC and give you the following instructions:

(1) How to switch back and forth between 40- and 80-column display,

(2) How to deactivate the 80/64e card,

(3) How to change the way some of the display features work by activating the 80/64e card,

(4) How to use the escape features of the Apple IIe, and

(5) How to use the CONTROL character features of the Apple IIe.

6.2 Switching From 80- to 40-Column Display and Back Again.

If you are using BASIC or DOS with the 80/64e Card active, you will want to switch back to 40-column display if you are going to do one of the following:

* Use the comma method of tabbing, or

* Use a 40-column display with all the CONTROL character functions described in paragraph 6.6.

You may want to switch to 40-column mode simply because some of your BASIC programs look better when displayed on a 40-column display.

Switching Procedure:

To switch from 80-column to 40-column, type "ESC" and "4".
To switch from 40-column to 80-column, type "ESC" and "8".

NOTE: When you type "ESC" and "4", the cursor becomes a solid black square twice the size of the 80 column cursor (See Figure 6-1). The cursor does not change back to the startup checkerboard discussed in paragraph 5.3. When the cursor is a solid rectangle or square with a "+" inside, all of the escape features can be used. Refer to paragraph 6.5 for a discussion of the escape features.

CURSOR	80/64e CARD STATUS	LANGUAGE/ OPERATING SYSTEM	WHEN
	Active	Pascal and CP/M	Always
	Inactive	BASIC/DOS	At system startup
	Active: 80-column display	BASIC/DOS	After you type PR#3 or ESC-8
	Active: 40-column display	BASIC/DOS	After you type ESC-4
	Active: 80-column display	BASIC/DOS	Escape mode
	Active: 40-column display	BASIC/DOS	Escape mode

Figure 6-1: Cursor Chart

6.3 Deactivating the 80/64e Card.

Instead of just switching to 40 columns, as was described in paragraph 6.2, you MUST deactivate the 80/64e Card if:

You are planning to run an application program designed for the Apple II or Apple II-Plus computers, or

You want to switch your output from the screen to a printer or another peripheral device.

NOTE: Make sure you want to deactivate the card, not just switch back to a 40-column display, before you use the procedure described below.

Type "ESC" and "CONTROL Q" and the computer will switch the display back to the 40-column mode, the blinking checkerboard cursor will be displayed at the bottom of the screen, an inverted bracket "]" will appear to the left of the checkerboard and a backward slash "\" will appear on the line above the cursor. To activate the 80/64e Card again, you have to type "PR#3" again (refer to Chapter 5).

NOTE: When you use this method to deactivate the 80/64e Card or if you switch back and forth between 40- and 80-column displays the BASIC program in memory is not affected. You do not have to worry about the escape command "wiping out" your program.

****
* WARNING *
****

IF YOU DO NOT DEACTIVATE THE 80/64e CARD WHEN YOU ARE USING A PERIPHERAL DEVICE (SUCH AS A PRINTER OR DISK CONTROLLER CARD), YOU WILL GET AN UNPREDICTABLE RESULT AND A CONFUSING DISPLAY. REFER TO THE INSTRUCTIONS AT THE BEGINNING OF THIS PARAGRAPH FOR THE STEPS YOU MUST GO THROUGH TO DEACTIVATE THE 80/64e CARD.

6.4 Display Features With The 80/64e Card.

An active 80/64e Card in your Apple IIe will change the way some of the display features are presented. This paragraph explains the way these features are affected.

NOTE: There are several commands available in Applesoft BASIC that affect the appearance of text on the screen. These features are described in the Applesoft BASIC Programmer's Reference Manual.

1. INVERSE instructs the computer to display black characters on a white background instead of white characters on a black background as you will normally see displayed. Normally this instruction is only available in uppercase characters, but with an active 80/64e Card the display will appear with both uppercase and lowercase characters.

2. FLASH causes subsequently displayed characters to blink quickly between inverse and normal characters. You can turn off the FLASH command as soon as your eyes become buggy by typing the NORMAL command. The FLASH command is normally only available with uppercase characters, but it is not available while the 80/64e Card is active.

3. NORMAL instructs the computer to turn off the INVERSE or FLASH command and to subsequently display characters normally. This works the same with the 80/64e Card in the active or inactive mode.

4. HOME clears the screen and returns the cursor to the upper left corner. Both NORMAL HOME and INVERSE HOME are

available while the 80/64e Card is active, but INVERSE HOME works a little differently when the card is inactive.

Table 6-1: INVERSE, FLASH, NORMAL and HOME Commands

COMMAND	CARD ACTIVE	CARD INACTIVE
INVERSE	White screen, black characters, uppercase characters only	White screen, black characters, both upper and lower case characters
FLASH	Characters blink between INVERSE and NORMAL uppercase characters	Not available
NORMAL HOME	Clears to black screen with white characters	Clears to black screen with white characters
INVERSE HOME	Clears to black screen with inverse characters	Clears to white screen with black characters

****
* WARNING *
****

IF YOU ARE USING THE FLASH COMMAND WHILE THE 80/64e CARD IS INACTIVE AND TYPE "PR#3" TO ACTIVATE THE CARD, THE SCREEN WILL TURN WHITE AND THE CURSOR WILL GO TO THE HOME POSITION. WHATEVER YOU TYPE WILL APPEAR IN BLACK CHARACTERS ON THE WHITE SCREEN. IF YOU LIST OR RUN AN APPLESOFT BASIC PROGRAM, SOME OF THE CHARACTERS WILL APPEAR AS GIBBERISH. REMEMBER TO TYPE THE NORMAL OR INVERSE COMMAND BEFORE YOU START PROGRAMMING TO AVOID THIS.

5. TABBING - When the Apple IIe is displaying text in 80 columns, comma tabbing and HTAB do not work exactly as they do with the 40-column display. Another command, POKE 1403, will enable horizontal tabbing with an 80-column display.

   a. Comma Tabbing. To instruct the computer to display your output, or portions of your output in columns, in BASIC you can use commas in the PRINT statement. This is known as the comma method of tabbing. You can use this method of tabbing as long as the screen is displaying 40 columns. The 80/64e Card must be inactive or "ESC" and "4" typed to switch the display to 40 columns. [This method of tabbing cannot be used with an 80-column display. The program will not run correctly if you try to do so.]

   b. VTAB and HTAB. The VTAB (vertical tab) command works the same in an 80-column display as it does in a 40-column display. The HTAB (horizontal tab) command causes the cursor to wrap around to the next line after it reaches the 40th column, so you can't use this command in the last 40 columns while the screen is displaying 80 columns. The VTAB and HTAB statements are used to place the cursor at specific locations on the screen before displaying the characters. The largest value you can use with the VTAB statement is 24, and the largest value you can use with the HTAB statement is 255. To position a PRINT statement 23 columns from the left side of the screen and 18 lines from the top of the screen, you would use VTAB 18 and HTAB 23 instructions in your print program.

6. POKE 1403 - If you want to HTAB past column 40 while the 80/64e Card is active and the screen is displaying 80 columns, use the following command:

   POKE 1403, and any number between 0 and 79.

   When you use the POKE 1403 command it allows you to horizontally tab across the last 40 columns provided by the 80/64e Card.

   You MUST NOT use POKE 1403 with a 40-column display.

6.5 Escape Features With the 80/64e Card.

There are a number of features available while the computer is in the escape mode. Besides being used to switch from the 40- to 80-column mode and from the 80- to 40-column mode, the escape mode provides the following features:

1. Uppercase-Restrict Feature. "ESC" and "R", and "ESC" and "T" are used to control the uppercase-restrict feature. This feature allows you to easily use lowercase letters within BASIC programs.

   Type "ESC" and "R" to turn on uppercase-restrict mode.
   Type "ESC" and "T" to turn off uppercase-restrict mode.

While in the uppercase-restrict mode all letters you type outside of double quotation marks are converted to uppercase letters. This is done even though the CAPS LOCK key is up. Letters which are typed within double quotation marks are not converted; they are left as you type them - either uppercase or lowercase.

The following example illustrates the usefulness of the uppercase-restrict mode:

Suppose you want to enter the following BASIC statement:

10 PRINT" This is an example of lowercase"

Without the uppercase-restrict feature you would have to:

Type 10 PRINT with the CAPS LOCK key down, then release the CAPS LOCK key. Type "This is an example of lowercase", then press the CAPS LOCK key down.

With the uppercase-restrict feature, you would:

Type 10 PRINT" This is an example of lowercase" with the CAPS LOCK key up, using the SHIFT key for uppercase letters within double quotation marks.

2. Moving The Cursor.

The following editing features are available in the escape mode when the 80/64e Card is active or inactive. The only difference is that when the card is active, the escape mode cursor contains a plus "+" sign; and when the card is inactive, the blinking checkerboard does not change appearance. Since nobody is perfect, you are bound to make mistakes when you write programs using Applesoft BASIC. To make editing easier, the escape mode lets you move the cursor around the screen without affecting the text displayed on the screen. You can move the cursor around the screen without affecting anything on the screen by pressing the ESC key and then pressing one of the following keys:

* A,B,C,D,a,b,c,d (see Figure 6-2 for direction)

* I,J,K,M,i,j,k,m (see Figure 6-2 for direction)

* The four direction arrow keys

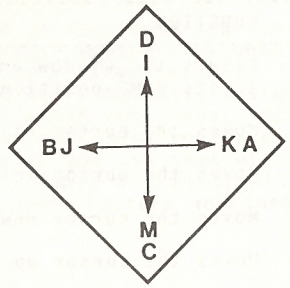

Figure 6-2: Cursor Movement Direction

NOTE: When you want to move the cursor with the A,B,C, and D keys, you must press the ESC key each time you press the A,B,C, and D keys. This is how you have to do it to get the cursor to move: Press "ESC", then press "A", press "ESC", then press "A", press "ESC", then press "A", etc.; otherwise the cursor will only move one space to the right and A's will appear on the screen every time you press the "A" key. See Figure 6-2 for the direction the arrow moves when the different keys are pressed.

When you want to move the cursor with the I,J,K, and M keys or one of the four direction arrow keys, you only have to press the ESC key once and then release it, like this: ESC I I I I I I I I I

The cursor will move up the screen one line at a time until you press the SPACE bar to exit the escape mode.

NOTE: Older models of the Apple II computer have LEFT-ARROW and RIGHT-ARROW keys, but do not have UP-ARROW and DOWN-ARROW keys. Most software written for the Apple II will run on the Apple IIe, but these keys will only work with programs designed to use them. See your Applesoft BASIC Programmer's Reference Manual for information on changing the functions of the UP-ARROW and DOWN-ARROW keys.

When the system is not in the escape mode, the LEFT-ARROW key cause the cursor to backspace and delete the characters it passes over, and the RIGHT-ARROW key recopies or brings back the characters it passes over, leaving the text as it was. Table 6-2 is a summary of the escape features discussed.

Table 6-2: Escape Features

ESCAPE FEATURE	FUNCTION	NOTES
ESC @	Clears the window and moves the cursor to its HOME position.	
ESC A	Moves the cursor right one space.	1
ESC B	Moves the cursor left one space.	1
ESC C	Moves the cursor down one line.	1
ESC D	Moves the cursor up one line.	1
ESC E	Clears to the end of the line.	
ESC F	Clears to the bottom of the window.	
ESC I ESC UP-ARROW	Moves the cursor up one line and turns on escape mode.	2
ESC J ESC LEFT-ARROW	Moves the cursor left one space and turns on escape mode.	2
ESC K ESC RIGHT-ARROW	Moves the cursor right one space and turns on escape mode.	2
ESC M ESC DOWN-ARROW	Moves the cursor down one line and turns on escape mode.	2
ESC R	Turns on uppercase-restrict mode.	3
ESC T	Turns off uppercase-restrict mode.	3
ESC 4	Switches 80-column display to 40-column display.	3
ESC 8	Switches 40-column display to 80-column display.	3
ESC CONTROL Q	Deactivates the 80/64e Card.	3

NOTES:

1. With these cursor direction keys you must press ESC each time.
2. With these cursor direction keys you press ESC only once to turn on escape mode; press the SPACE bar to exit the escape mode.
3. These features are available only when the 80/64e Card is active.

6.6 CONTROL Character Functions With The 80/64e Card.

There are a number of functions you can use by pressing the CONTROL key along with another key when you write programs while the 80/64e Card is active. The functions activated by pressing these two key combinations simultaneously are called CONTROL character functions. Some of these CONTROL character functions work when you type them from the keyboard as well as when you use them within PRINT statements in BASIC programs. Table 6-3 lists all the CONTROL character functions, the code letters and their effects on the display or program.

Table 6-3: CONTROL Character Functions

CONTROL CHARACTER	ASCII NAME	Apple IIe NAME	ASCII DECIMAL CODE	WHAT IS EXECUTED?	NOTES
CONTROL G	BEL	bell	7	Produces a 1000 Hz tone for 0.1 second.	
CONTROL H	BS	backspace	8	Moves cursor position one space to the left; from left edge of window, moves to right end of line above.	
CONTROL J	LF	line feed	10	Moves cursor position down to next line in window; scrolls if needed.	
CONTROL K	VT	clear EOS	11	Clears from cursor position to end of window.	1
CONTROL L	FF	clear	12	Moves cursor position to upper-left corner of window and clears window.	
CONTROL M	CR	return	13	Moves cursor position to left end of next line in window and scrolls if needed.	
CONTROL N	SO	normal	14	Sets display format normal.	1,3

Table 6-3: CONTROL Character Functions (Continued)

CONTROL CHARACTER	ASCII NAME	Apple IIe NAME	ASCII DECIMAL CODE	WHAT IS EXECUTED?	NOTES
CONTROL O	SI	inverse	15	Sets display format inverse.	1,3
CONTROL Q	DC1	40-column	17	Sets display to 40 columns.	1
CONTROL R	DC2	80-column	18	Sets display to 80 columns	1
CONTROL S	DS3	stop list	19	Stops sending characters to the display, until a key is pressed.	2
CONTROL U	NAK	quit	21	Deactivates 80/64e Card.	1,3,5
CONTROL V	SYN	scroll down	22	Scrolls the display down one line, leaving the cursor in the current position.	1
CONTROL W	ETB	scroll up	23	Scrolls the display up one line, leaving the cursor in the current position.	1
CONTROL Y	EM	home	25	Moves cursor position to upper-left corner of window (but doesn't clear window).	1
CONTROL Z	SUB	clear line	26	Clears the line the cursor is on.	1
CONTROL \	FS	forward space	28	Moves cursor position one space to the right; from right edge of window, moves it to left end of line below.	1

Table 6-3: CONTROL Character Functions (Continued)

CONTROL CHARACTER	ASCII NAME	Apple IIe NAME	ASCII DECIMAL CODE	WHAT IS EXECUTED?	NOTES
CONTROL]	GS	clear EOL	29	Clears line from cursor position to the right edge of the window.	1
CONTROL ^	RS	gotoXY	30	Using the next two characters, minus 32, as one-byte X and Y values, moves the cursor position to CH=X, CV=Y.	1,4

NOTES: 1. Only available when 80/64e Card is active.
2. Only works from the keyboard, not in program.
3. Only works in program, not from the keyboard.
4. Supported only under Pascal and CP/M.
5. Must be used as CHR$(21) from BASIC.

ASCII is the acronym for the American Standard Code for Information Interchange. See the Applesoft BASIC Reference Manual to learn more about ASCII codes.

6.7 Cursor Positioning Function For Pascal.

When you are using Pascal to write programs and you want to position the cursor in a specific place on the screen, the CONTROL ^ (gotoXY) function is very helpful. This CONTROL character function sends the cursor to a specific position on the screen.

NOTE: This particular CONTROL character function can not be used with BASIC. For more information about the gotoXY function, refer to your Apple Pascal Operating System Reference Manual for Apple II.

APPENDIX A ADDITIONAL 64K BYTES OF MEMORY

A.1 Who Needs To Read This Appendix.

This appendix is intended to inform the following types of users of the features of the 80/64e Cards' additional 64K bytes of memory and how to use them.

1. If you are a user with application programs that take advantage of the auxiliary memory on the 80/64e Card to give you more features or more storage for your data.

2. If you are a developer creating a program, for yourself or others, that will use the auxiliary storage provided by the 80/64e Card.

You should not be reading this appendix if you are only using the 80/64e Card to display 80 columns of text on the screen. All that you need to know about the 80-column display feature is in Chapters 1 through 6 of this manual. This appendix is only for programmers that are interested in using the auxiliary 64K bytes of memory.

For a program to work with the auxiliary memory, special switches must be set by the program. These switches allow the auxiliary memory to substitute for the main memory. Neither DOS 3.3 nor Pascal 1.1 (system programs for Apple II) support this memory substitution, so for now your application programs will have to handle it themselves.

Some programs you run on your Apple IIe use the auxiliary memory of the 80/64e Card automatically, without any action on your part, or they may instruct you to select optional features or data storage. Refer to the instruction manuals for these programs to find out how they use the auxiliary memory.

A.2 Introduction.

The MICRO-SCI 80/64e Card has 64K bytes of additional memory which is referred to in this appendix as auxiliary memory. A 1K byte area of this auxiliary memory is used for the 80-column display and expands the text capacity to 80 columns. The other 63K bytes can be used for auxiliary program and data storage. If you use only the 40 columns for text display, all 64K bytes are available for programs and data. The processor in the Apple IIe computer can only address 64K

bytes of memory. The computer has special circuits that programs can switch to access the auxiliary memory instead of the main memory. Locations in the main memory and auxiliary memory are at the same 64K address space at any one time. Even though you have an 80/64e Card installed in your Apple IIe computer you do not have 128K bytes of programmable memory; it can not be called a 128K byte system. In effect you have 64K bytes of auxiliary memory that can be switched for main memory under program control.

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* WARNING *
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YOU MUST BE CAREFUL WHEN YOU ARE SWITCHING TO THE AUXILIARY MEMORY OR YOU WILL CRASH YOUR PROGRAM. IF YOU WANT TO USE THE AUXILIARY MEMORY IN YOUR OWN PROGRAMS, IT IS IMPERATIVE THAT YOU STUDY THE REMAINDER OF THIS APPENDIX AND ALSO THE RELEVANT INFORMATION IN THE APPLE IIe REFERENCE MANUAL.

A.3 How The Auxiliary Memory Works.

The 6502 microprocessor can address 64K bytes of memory and the Apple IIe microprocessor's entire 64K memory space is taken up by main RAM, ROM, and I/O. There is no memory space available for the added memory on the 80/64e Card. Instead, the address bus is connected to the auxiliary memory in parallel with the main memory. To use the auxiliary memory for programs and data storage, the Apple IIe switches its data bus so that it reads and writes to memory on the card instead of on the main memory. The system takes data both from main memory and from auxiliary memory to use the auxiliary memory to expand the display.

The Memory Management Unit controls the bus switching for program and data storage. The Memory Management Unit is a custom integrated circuit designed for the Apple IIe (refer to Chapter 7 of the Apple IIe Reference Manual). The soft switches set by your program, and the logic circuitry to monitor the address bus and to switch to auxiliary memory for the selected address ranges are contained in the Memory Management Unit.

Figure A-1 is a memory map and if you study it you will see that the auxiliary memory is divided into two large sections and one small section. The largest section is substituted for main memory addresses 512 to 49151 ($200 through $BFFF). This part of memory is sometimes referred to as the 48K memory space, and it is used for storing programs and data. The other large section of auxiliary memory replaces main

memory addresses 52K to 64K ($D000 through $FFFF). This memory space is called the bank-switched memory. Refer to "Bank-switched Memory" in your Apple IIe Reference Manual if you are going the use this part of auxiliary memory. The switching for the ROM and $D000 bank is independent of the auxiliary-RAM switching, so the bank switches have the same effect on the auxiliary RAM that they do on the main RAM. When you switch to the auxiliary memory in the bank-switched memory space, you also get the first two pages of auxiliary memory, from 0 to 511 ($0000 through $01FF). This part of memory contains page zero, which is used for important data and base addresses, and page one, which is the 6502 microprocessor stack.

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* WARNING *
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ADDRESSES IN PAGE ZERO AND THE 6502 STACK SWITCH TO AUXILIARY MEMORY ANY TIME YOU SWITCH THE BANK-SWITCHED MEMORY TO AUXILIARY MEMORY.

A.4 How The 80-Column Display Works.

The following explains how the 80-column display works. Half of the data for the 80-column display is stored in main memory in the normal Text Page 1 (see Figure A-1), and the other half is stored in auxiliary memory on the 80/64e Card. The display circuitry takes bytes of data from these two memory areas simultaneously and displays them as two adjacent characters.

The main memory and the auxiliary memory are connected to the address bus in parallel, so both are activated during the display cycle. The 40-column display uses every other clock cycle and brings data only from the main memory. The 80-column display uses the remaining clock cycle to process the additional display data from auxiliary memory. When the 80/64e Card is active and displaying 80 columns, the data bytes from these buffers are switched onto the video data bus on alternate clock cycles: first the byte from the auxiliary memory, then the byte from the main memory. The auxiliary memory provides the characters in the even columns of the display and the main memory provides the characters in the odd columns of the display. The 80-column display contains twice as many characters as the 40-column display does, so it has to put twice as many dots across the screen. The dots are clocked out at 14MHz instead of 7MHz, making them narrower and therefore dimmer on a normal video monitor. The dot patterns on a television set making up the

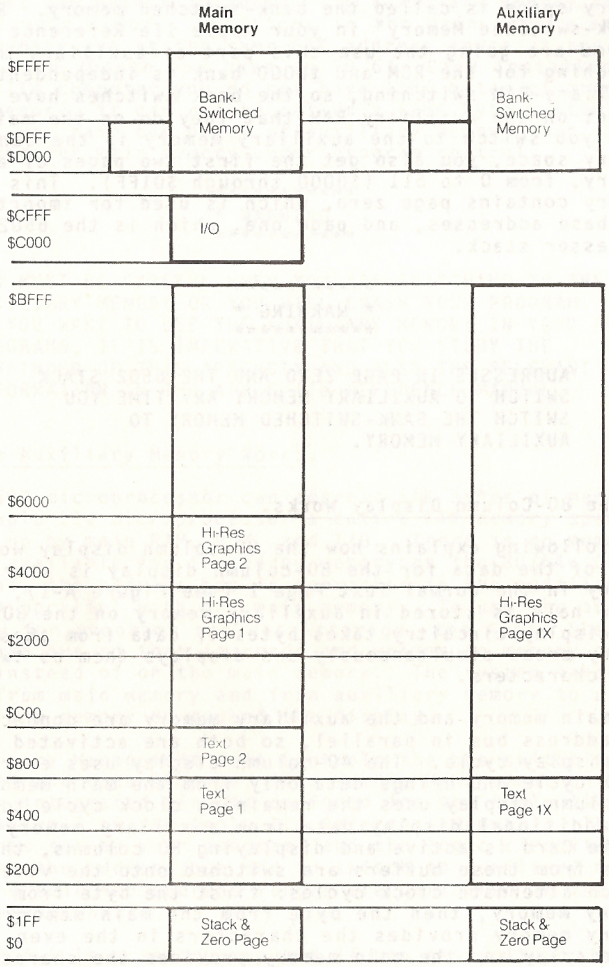

Figure A-1: Memory Map With Auxiliary Memory

A.4 (Continued)

characters are too close together to reproduce clearly. A video monitor with a bandwidth of at least 14MHz should be used to produce a satisfactory 80-column display.

NOTE: Memory pages are 256 bytes long; display pages are either 1024 bytes (Text Page) or 8192 bytes (Hi-Resolution Graphics Page). Refer to Chapters 2 and 4 of your Apple IIe Reference Manual.

The simultaneous-then-sequential switching is applicable only to the video display generation; reading and writing for data storage in auxiliary memory is done by switching the data bus to read or write from the 80/64e Card.

A.5 Double High-Resolution Graphics.

The logic that controls the display for high resolution graphics includes an extra circuit to force the graphics displays to be the same whether you have set the soft switches for 80-column text or 40-column text. This keeps the low resolution graphics from malfunctioning when you select mixed mode graphics with 80-column text.

If you would like to have a graphic Page 1 display with twice the horizontal resolution, there is a way to disable the circuit that forces normal graphics timing with 80-column text. There are two steps you must follow to obtain the double high-resolution display:

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- CAUTION -
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This procedure works only on the Apple IIe with the Rev B (and later) main logic board, identified by a B as the last letter of the part number on the back part of the board.

1. Install a jumper to connect the two pins of J2 on the 80/64e Card.

2. Turn off the Annunciator 3 soft switch ($C05E); turn on the switches that select the 80-column display ($C00D) and high-resolution graphics ($C050 and $C057).

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* WARNING *
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IF YOU INSTALL THE JUMPER IN A REV A APPLE IIe, YOU WILL MAKE THE COMPUTER INOPERABLE.

A.6 How To Use The Auxiliary Memory.

The following describes the soft switches and built-in subroutines that control the operation of the auxiliary memory. To use the additional memory offered with the auxiliary memory, you must set up your programs to operate in one part of the memory while they switch the other part between main and auxiliary RAM. The soft switches that cause the memory switching are describes in sub-paragraph 2, or you can use the AUXMOVE and XFER subroutines which will be described later in this appendix. Except for these subroutines, most existing Apple II system software (DOS 3.3, Pascal 1.1) do not support the auxiliary memory.

There are some high-level languages, such as BASIC, that can set the soft switches directly, but your programs must use assembly-language subroutines to control the auxiliary memory. Small assembly-language subroutines can be accessed from a BASIC program using a CALL statement, or they can be linked to a Pascal program as procedures or functions.

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* WARNING *
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IF YOU TRY TO USE THE AUXILIARY MEMORY DIRECTLY FROM A PROGRAM IN AN INTERPRETER LANGUAGE SUCH AS BASIC OR PASCAL, THE INTERPRETER WILL CRASH. WHEN YOU RESET THE SYSTEM TO START OVER YOU WILL LOSE YOUR PROGRAM AND DATA.

One function of the 80/64e Card is to generate an 80-column display and there is a complete set of soft switches that perform this function. Other switches used for program and data storage in the auxiliary memory are described later in this appendix.

1. Display Pages (see Table A-1)

The video displays of the Apple IIe are generated from data stored in specific areas in memory called display pages. The 40-column-text and low-resolution-graphics modes use Text Page 1 and Text Page 2 (see Figure A-1), located at 1024-2047 (hexadecimal $400-$7FF) and 2048-3071 ($800-$BFF) in main memory.

The 80-column text display uses a combination of Text Pages 1 in main memory and the same page in auxiliary memory (Text Page 1X). Text Page 1X uses the same address space as Text Page 1, except in auxiliary memory instead of main memory. You must use a soft switch to store data in Text Page 1X. Chapter 3 of your Apple IIe Reference Manual describes the built-in 80-column display routines. You should use these routines for all

Table A-1: Video Display Page Locations

DISPLAY MODE	PAGE	LOWEST ADDRESS		HIGHEST ADDRESS	
40-Column Text, Low-Resolution Graphics	1	$400	1024	$7FF	2047
	2	$800	2048	$BFF	3071
80-Column Text*	1	$400	1024	$7FF	2047
Normal 280-Dot High-Resolution Graphics	1	$2000	8192	$3FFF	16383
	2	$4000	16384	$5FFF	24575
Optional 560-Dot High-Resolution Graphics*	1	$2000	8192	$3FFF	16383

* These modes use locations in both main and auxiliary memory. The PAGE2 switch is used to select one or the other for storing data (see subparagraph 2, Display Mode Switching).

your normal 80-column text output because these routines takes care of this switching automatically.

2. Display Mode Switching

The display mode that is appropriate for your application is selected by reading or writing to the soft switches. The majority of the soft switches have three memory locations: one for turning the switch on, one for turning the switch off, and the other for reading the state of the switch. Table A-2 shows the locations of the soft switches that control the display modes. The switch location is given in three different forms: hexadecimal, decimal, and negative decimal. Use the hexadecimal values in your machine-language programs, use the decimal values in PEEK or POKE commands in Applesoft BASIC, and use the negative values for Integer BASIC.

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* WARNING *
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TO MANIPULATE THE SOFT SWITCHES MAKE SURE YOU USE ONLY THE INDICATED OPERATION. IF YOU READ FROM A SWITCH MARKED WRITE, YOU WON'T GET THE CORRECT DATA ;IF YOU WRITE TO A SWITCH MARKED READ, YOU WON'T SET THE CORRECT SWITCH AND YOU MAY CHANGE SOME OTHER SWITCH AND CAUSE YOUR PROGRAM TO MALFUNCTION.

Soft switches in Table A-2 that are marked "Read" or "Write" share their locations with the keyboard data and strobe functions. To perform the FUNCTION listed in the table, use only the operation listed. Soft switches that are not marked "Read" or "Write" may be accessed by either a read or a write. When you write to a soft switch, it doesn't matter what value you write; the switch function occurs when you address the location, and the value is ignored.

NOTE: Refer to Chapter 2 of the Apple IIe Reference Manual for information about the keyboard data and strobe functions.

When you read a soft switch, you get a byte with the state of the switch in bit 7, the high-order bit. The other bits in the byte are unpredictable. If you are programming in machine language, this bit is the sign bit. If you read a soft switch from a BASIC program, you get a value between 0 and 255. Bit 7 has a value of 128, so if the switch is on, the value will be equal to or greater than 128; if the switch is off the value will be less than 128.

A.7 Addressing The 80-Column Display Directly.

Half of the data is stored in Text Page 1 in the main memory, and the other half is stored in Text Page 1X in the auxiliary memory. Figure A-2 graphically shows how the data is stored in the main and auxiliary memories and how it is then displayed on the screen. The display circuitry fetches bytes from the two memory areas and displays them sequentially on the screen; first the byte from the auxiliary memory, then the byte from the main memory. The auxiliary memory displays characters in the even columns of the screen and the main memory displays characters in the odd columns. Refer to Chapters 2 and 7 of the Apple IIe Reference Manual for a full description of the way the Apple IIe handles display memory.

Table A-2: Display Soft Switches

NAME	FUNCTION	LOCATION HEXA-DECIMAL	LOCATION DECIMAL	NEGATIVE DECIMAL	NOTES
TEXT	On: Display Text	$C051	49233	-16303	
	Off:Display Graphics	$C050	49232	-16304	
	Read TEXT Switch	$C01A	49178	-16358	Read
MIXED	On: Text With Graphics	$C053	49235	-16301	1
	Off:Full Graphics	$C052	49234	-16302	1
	Read MIXED Switch	$C01B	49179	-16357	Read
PAGE2	On: Display Page 2	$C055	49237	-16299	2
	Off:Display Page 1	$C054	49236	-16300	2
	Read PAGE2 Switch	$C01C	49180	-16356	Read
HIRES	On: Graphics = High-Resolution	$C057	49239	-16297	1
	Off:Graphics = Low-Resolution	$C056	49238	-16298	1
	Read HIRES Switch	$C01D	49181	-16355	Read
80COL	On: Display 80 Columns	$C00D	49165	-16371	Write
	Off:Display 40 Columns	$C00C	49164	-16372	Write
	Read 80COL Switch	$C01F	49183	-16353	Read
80STORE	On: Store in Auxiliary Page	$C001	49153	-16383	Write,3
	Off:Store in Main Page	$C000	49152	-16384	Write,3
	Read 80STORE Switch	$C018	49176	-16360	Read

NOTES:
1. This mode is only effective when TEXT Switch is off.
2. This switch has a different function when 80STORE is on; refer to paragraph A.7, Addressing the 80-Column Display Directly.
3. This switch changes the function of the PAGE2 switch for addressing the display memory on the 80/64e Card; refer to paragraph A.7, Addressing the 80-Column Display Directly.

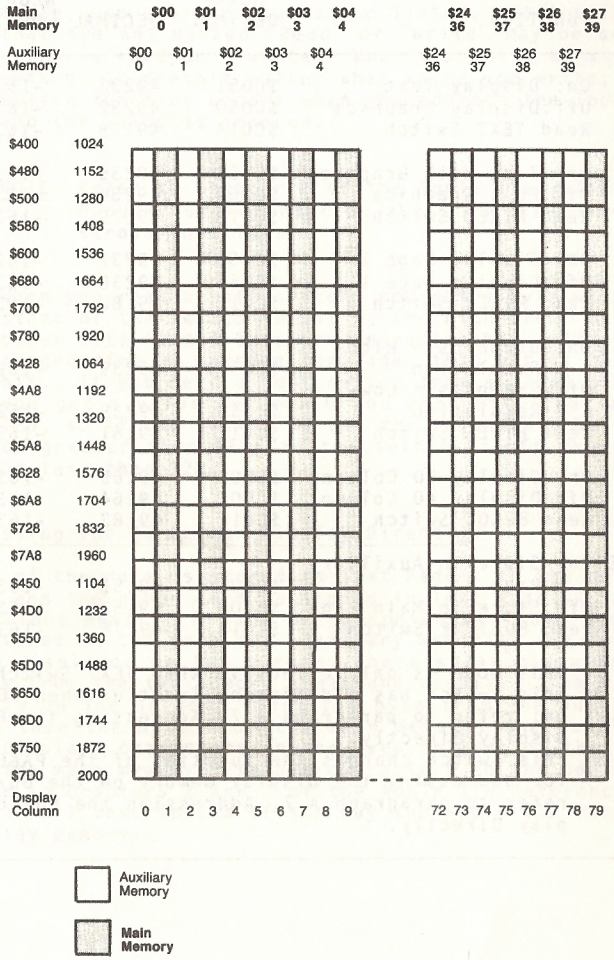

Figure A-2: Map of 80-Column Text Storage and Display

A.7 (Continued)

To store data directly into the display page on the 80/64e Card turn on the 80STORE soft switch by writing to location 49153 [decimal], -16383 [negative decimal], or $C001 [hexadecimal] (see Table A-2). With 80STORE turned on, the page select switch PAGE2 switches between the portion of the 80-column display stored in main memory and the portion stored in Page 1X in auxiliary memory. To select Page 1X, turn on PAGE2 soft switch by reading or writing to location 49237, -16299, or $C055.

NOTE: When you try to change the 80STORE and PAGE2 soft switches by using the Monitor program, it changes them back in the process of displaying the commands you type. You will have to write a short program to try out these soft switches.

If you want to use the optional double high resolution display, you can store data directly into high resolution graphics Page 1X in auxiliary memory in a manner similar to that described above by turning on both 80STORE and HIRES, and then use PAGE2 to switch from Page 1 in main memory to Page 1X in auxiliary memory. The memory mapping for double high resolution graphics is similiar to the normal high resolution mapping described in Chapter 2 of the Apple IIe Reference Manual, with the addition of the column doubling produced by the 80-column display. Like the 80-column text mode, the double high resolution graphics mode displays two bytes in the time normally required to display one, but it uses the high-resolution graphics Page 1 and Page 1X instead of text Page 1 and Page 1X (see Figure A-1).

The double high resolution graphics mode displays each pair of data bytes as 14 adjacent dots, seven dots from each byte. The high order bit (color-select bit) of each byte is not displayed. The auxiliary memory byte is displayed first, so data from auxiliary memory appears in columns 0-6, 14-20, etc., up to columns 547-552. Data from main memory appears in columns 7-13, 21-27, and so on up to 553-559.

NOTE: Refer to Chapters 2 & 7 of The Apple IIe Reference Manual for a description of the way the high-order bit acts as the color-select bit in high-resolution displays.

A.8 Auxiliary Memory Switching.

The following describes the switches used to access the auxiliary memory for storing programs and data.

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* WARNING *
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THE DISPLAY SOFT SWITCHES 80STORE, PAGE 2, AND HIRES ARE USED PRIMARILY FOR ADDRESSING DISPLAY DATA. THESE SWITCHES OVERRIDE THE GENERAL-PURPOSE SWITCHES DESCRIBED IN THIS PARAGRAPH, SO YOU MUST SET THE DISPLAY SOFT SWITCHES CORRECTLY EVEN IF YOUR PROGRAM DOES NOT USE THEM.

Switching The 48K Bank.

Two soft switches, RAMRD and RAMWRT are used to switch the 48K byte section of memory. RAMRD selects main or auxiliary memory for reading and RAMWRT selects main or auxiliary memory for writing. Refer to Table A-3 and you will see that each switch has a pair of memory locations assigned to it, one to select main memory, and the other to select auxiliary memory. Setting the read and write functions independently makes it possible for a program whose instructions are being fetched from one 48K byte memory space to store data into the other 48K byte memory space.

****
* WARNING *
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BEFORE YOU USE THESE SWITCHES, YOU MUST FULLY UNDERSTAND THE EFFECTS OF SWITCHING TO AUXILIARY MEMORY. FOR EXAMPLE, AN APPLICATION PROGRAM RUNNING IN THE 48K BANK OF AUXILIARY MEMORY THAT TRIES TO USE THE BUILT-IN I/O ROUTINES BY CALLING THE STANDARD I/O LINK WILL CRASH EVEN THOUGH THE MAIN ROM, WHICH CONTAINS THE BUILT-IN I/O ROUTINES, HAS BEEN SELECTED. THIS IS BECAUSE THE STANDARD LINKS CALL DOS ROUTINES, AND DOS IS IN THE 48K BANK OF MAIN MEMORY, WHICH IS LOCKED OUT WHILE THE APPLICATION PROGRAM IS RUNNING IN AUXILIARY MEMORY.

NOTE: When RAMRD and RAMWRT are on auxiliary memory is used, and when they are off main memory is used.

To turn on RAMRD, you write to the soft switch at location $C003 which enables auxiliary memory for reading and to turn off the RAMRD you write to location $C002 which enables main memory for reading. To turn on RAMWRT you write to location $C005 which enables auxiliary memory for writing, and to turn off RAMWRT you write to location $C004 which enables main memory for writing. By setting these switches indepentently, you can use any of the four combinations of reading and writing in main or auxiliary memory.

Auxiliary memory corresponding to text Page 1 and high-resolution graphics Page 1 can be used as part of the 48K bank by using RAMRD and RAMWRT. These areas in auxiliary memory can also be controlled separately by using the display-page switches 80STORE, PAGE2 and HIRES described in paragraph A.7, Addressing The 80-Column Display Directly.

The 80STORE soft switch functions as an enable switch (refer to Table A-3): when it is on, the PAGE2 soft switch selects main memory or auxiliary memory. When the HIRES soft switch is off, the PAGE2 soft switch selects main memory or auxiliary memory in the text display Page 1, $0400 to $07FF; with HIRES on, the PAGE2 soft switch selects main memory or auxiliary memory in both text Page 1 and high-resolution graphics Page 1, $2000 to $3FFF.

If you are using both the 48K-bank control switches and the display-page control switches, the display-page control switches take priority. If 80STORE is off, RAMRD and RAMWRT work for the entire memory space from $0200 to $BFFF, but if 80STORE is on, RAMRD and RAMWRT have no effect on the display page. Specifically, if 80STORE is on and HIRES is off, PAGE2 controls text Page 1 regardless of the settings of RAMRD and RAMWRT. Similiarly, if 80STORE and HIRES are both on, PAGE2 controls both text Page 1 and high-resolution graphics Page 1, regardless of the settings of RAMRD and RAMWRT.

The settings of these soft switches can be determined by reading from two other locations. The byte you read at location $C013 has its high bit (the sign bit) set to 1 if RAMRD is on (auxiliary memory is enabled for reading), or 0 if RAMRD is off (the 48K block of main memory is enabled for reading). The byte at location $C014 has its high bit set to 1 if RAMWRT is on (auxiliary memory is enabled for writing), or 0 if RAMWRT is off (the 48K block of main memory is enabled for writing).

Switching High Memory, Stack, And Zero Page.

The single soft switch ALTZP (alternate zero page) switches the bank-switched memory and the associated stack and zero page area between main and auxiliary memory. Refer to Table A-3 and you will see that writing to location $C009 turns on ALTZP and selects auxiliary memory stack and zero page, and writing to the soft switch at location $C008 turns off ALTZP and selects main memory stack and zero page for reading and writing. Paragraph A.9, Auxilairy Memory Subroutines, describes firmware that you can call to help you switch between main and auxiliary memory.

Table A-3: Auxiliary Memory Select Switches

NAME	FUNCTION	LOCATION HEXA-DECIMAL	LOCATION DECIMAL	LOCATION NEGATIVE DECIMAL	NOTES
RAMRD	On: Read Aux. 48K	$C003	49155	-16381	Write
	Off:Read Main 48K	$C002	49154	-16382	Write
	Read RAMRD Switch	$C013	49171	-16365	Read
RAMWRT	On: Write Aux. 48K	$C005	49157	-16379	Write
	Off:Write Main 48K	$C004	49156	-16380	Write
	Read RAMWRT Switch	$C014	49172	-16364	Read
ALTZP	On: Aux. Stack, Zero Page, and Bank-Switched Memory	$C009	49161	-16375	Write
	Off:Main Stack, Zero Page, and Bank-Switched Memory	$C008	49160	-16376	Write
	Read ALTZP Switch	$C016	49174	-16362	Read
80STORE	On: Access Page 1X	$C001	49153	-16383	Write
	Off:Use RAMRD, RAMWRT	$C000	49152	-16384	Write
	Read 80STORE Switch	$C018	49176	-16360	Read
PAGE2	On: Access Aux. Memory	$C055	49237	-16299	1
	Off:Access Main Memory	$C054	49236	-16300	1
	Read PAGE2 Switch	$C01C	49180	-16356	Read
HIRES	On: Access High-Resolution Page 1X	$C057	49239	-16297	2
	Off:Use RAMRD, RAMWRT	$C056	49238	-16298	2
	Read HIRES Switch	$C01D	49181	-16355	Read

NOTES: 1. When 80STORE is on, the PAGE2 switch works as shown; when 80STORE is off, the PAGE2 switch does not affect the auxiliary memory.

2. When 80STORE is on, the HIRES switch enables you to use the PAGE2 switch to select between high-resolution Page 1 areas in main memory and auxiliary memory.

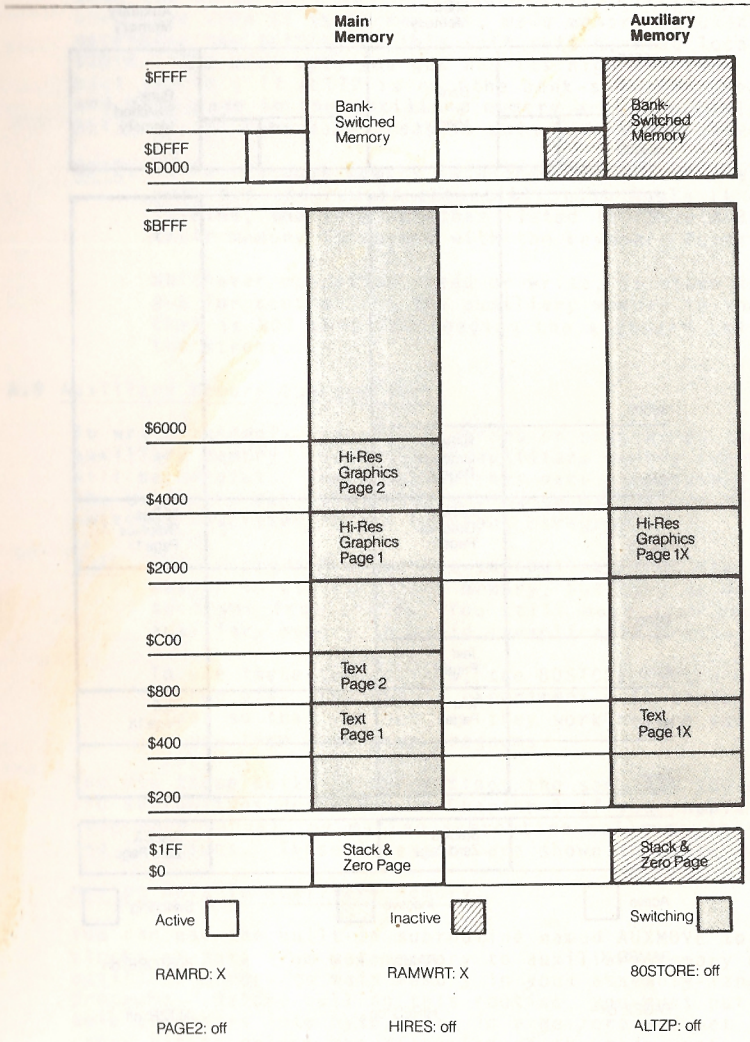

Figure A-3: Effect of Switching RAMRD and RAMWRT With 80STORE Off

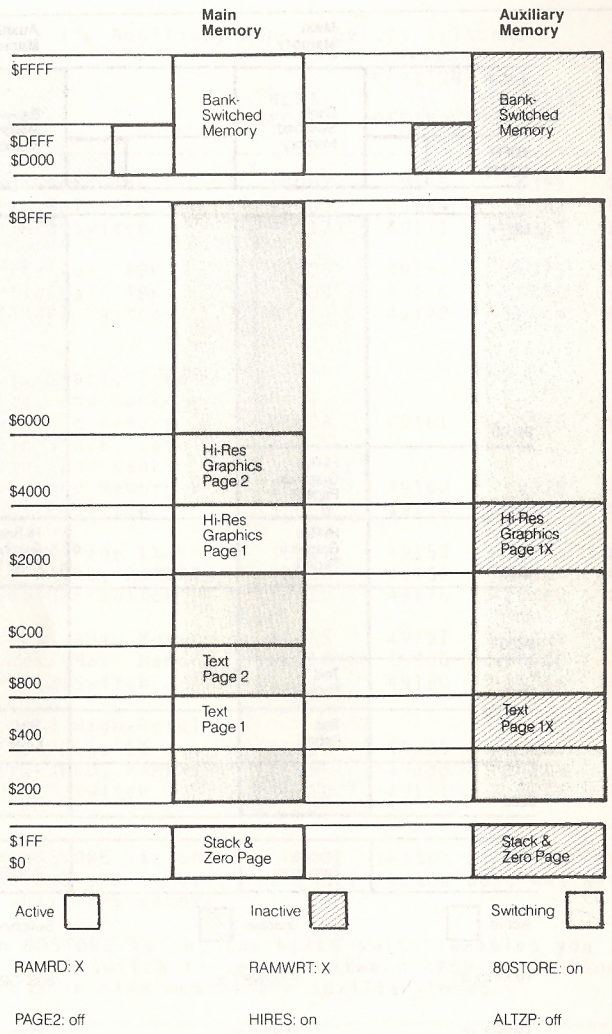

Figure A-4: Effect of Switching RAMRD and RAMWRT With 80STORE And HIRES On

A.8 (Continued)

When the ALTZP soft switch is turned on, auxiliary memory is used, and when it is turned off, main memory is used. To determine the setting of this soft switch, read location $C016. The data byte you get has its high bit (the sign bit) set to 1 if ALTZP is on (the bank-switched area, stack, and zero page in the auxiliary memory are selected), or 0 if ALTZP is off (the same areas in main memory are selected).

NOTE: To have enough memory locations for all of the soft switches and remain compatible with Apple II and Apple II-Plus, the soft switches listed in Table A-3 share their memory locations with the keyboard functions

Whichever operation, read or write, is shown in Table A-3 for controlling the auxiliary memory is the one that is NOT used for reading the keyboard and clearing the strobe.

A.9 Auxiliary Memory Subroutines.

To write assembly-language programs or procedures that use auxiliary memory, the built-in auxiliary memory subroutines will be helpful. These subroutines make it possible to use the auxiliary memory without having to manipulate the soft switches described in the previous paragraphs.

NOTE: This paragraph describes subroutines that make it easier to use auxiliary memory, but they do not protect you from errors. You still must plan your use of auxiliary memory to avoid inexplicable crashes.

To use these subroutines, the 80STORE switch must be turned off. You should experiment with these subroutines so that you see how they work before you start to use them with your programs.

You use these built-in subroutines the same way you use the I/O subroutines described in Chapter 3 of your Apple IIe Reference Manual, by making subroutine calls to their starting locations. Those locations are shown in Table A-4.

Moving Data To Auxiliary Memory.

You can use the built-in subroutine named AUXMOVE to copy blocks of data from main memory to auxiliary memory or from auxiliary memory to main memory in your assembly-language programs. Before calling this routine, you must put the data addresses into byte pairs in page zero and set the carry bit to select the direction of the move, main to auxiliary or auxiliary to main. The carry bit is bit 0 in the processor status word, use the SEC instruction to set it and the CLC instruction to clear it.

Table A-4: Auxiliary Memory Routines

SUBROUTINE NAME	LOCATION	DESCRIPTION
AUXMOVE	$C311	Moves data blocks between main and auxiliary memory
XFER	$C314	Transfers program control between main and auxiliary memory

****
* WARNING *
****

DO NOT ATTEMPT TO USE AUXMOVE TO COPY DATA IN PAGE ZERO, PAGE ONE (THE 6502 STACK), OR IN THE BANK-SWITCHED MEMORY ($D000 TO $FFFF). AUXMOVE USES PAGE ZERO WHILE IT IS COPYING, SO IT CAN'T HANDLE MOVES IN THE MEMORY SPACE SWITCHED BY ALTZP.

NOTE: Remember that Pascal also uses page zero, so you can't use AUXMOVE from a Pascal procedure without saving the contents of page zero first, and restoring them afterward.

The pairs of bytes you use for passing addresses to this subroutine are called "A1, A2 and A4"; they are used for passing parameters to several of the Apple IIe's built-in routines. The addresses of these byte pairs are shown in Table A-5.

Place the addresses of the first and last bytes of the block of memory you want to copy into A1 and A2. Place the starting address of the block of memory you want to copy the data to into A4.

The AUXMOVE routine uses the carry bit to select the direction the data will be copied. To copy data from main memory to auxiliary memory, set the carry bit (SEC); to copy data from auxiliary memory to main memory, clear the carry bit (CLC).

When you make the subroutine call to AUXMOVE, the subroutine copies the block of data as specified by the A registers and the carry bit. When it is finished, the accumulator and the X and Y registers are just as they were when you called it.

Table A-5: Parameters For AUXMOVE Routine

NAME	LOCATION	PARAMETER PASSED
Carry Bit		1 = Move from main to auxiliary memory 0 = Move from auxiliary to main memory
A1L A1H	$3C $3D	Source starting address, low-order byte Source starting address, high-order byte
A2L A2H	$3E $3F	Source ending address, low-order byte Source ending address, high-order byte
A4L A4H	$42 $43	Destination starting address, low-order byte Destination starting address, high-order byte

Transferring Control To Auxiliary Memory.

The built-in routine, XFER, is used to transfer control to and from program segments in auxiliary memory. You must set up three parameters before using XFER: 1. the address of the routine you are transferring to, 2. the direction of the transfer (main to auxiliary or auxiliary to main), and 3. which zero page and stack you want to use. See Table A-6 for the parameters for XFER routine.

Place the transfer address into the two bytes at locations $3ED and $3EE, with the low-order byte first, as usual. The direction of the transfer is controlled by the carry bit: set the carry bit to transfer to a program in auxiliary memory; clear the carry bit to transfer to a program in main memory. Use the overflow bit to select which page zero and stack you want to use: clear the overflow bit to use the main memory; set the overflow bit to use auxiliary memory. The overflow bit is bit 6 in the processor status word; use the CLV instruction to clear it. To set it, execute a BIT instruction with a location containing a $60.

****
* WARNING *
****

THE PROGRAMMER SHOULD SAVE THE CURRENT STACK POINTER SOMEWHERE IN THE CURRENT MEMORY SPACE BEFORE USING XFER AND TO RESTORE IT AFTER REGAINING CONTROL. FAILURE TO DO THIS WILL CAUSE PROGRAM ERRORS.

Table A-6: Parameters For XFER Routine

NAME OR LOCATION	PARAMETER PASSED
Carry Bit	1 = Transfer from main memory to auxiliary memory 0 = Transfer from auxiliary memory to main memory
Overflow Bit	1 = Use page zero and stack in auxiliary memory 0 = Use page zero and stack in main memory
$3ED	Program starting address, low-order byte
$3EE	Program starting address, high-order byte

When you have set up the parameters, pass control to the XFER routine by a jump instruction, instead of a subroutine call. XFER saves the accumulator and the transfer address on the current stack, then sets up the soft switches for the parameters you have selected and jumps to the new program.

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