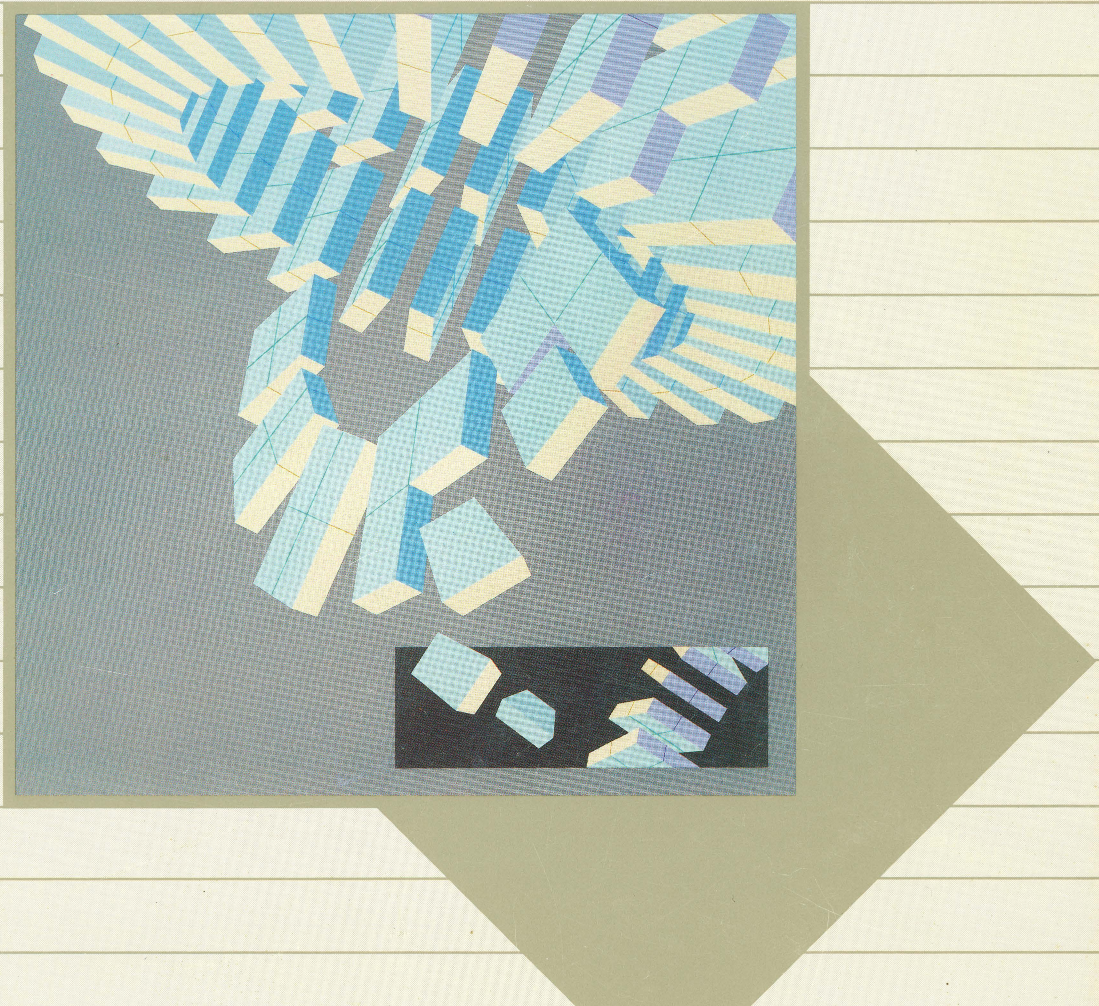
Apple II

BASIC Programming With ProDOS



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Apple *II* BASIC Programming With ProDOS

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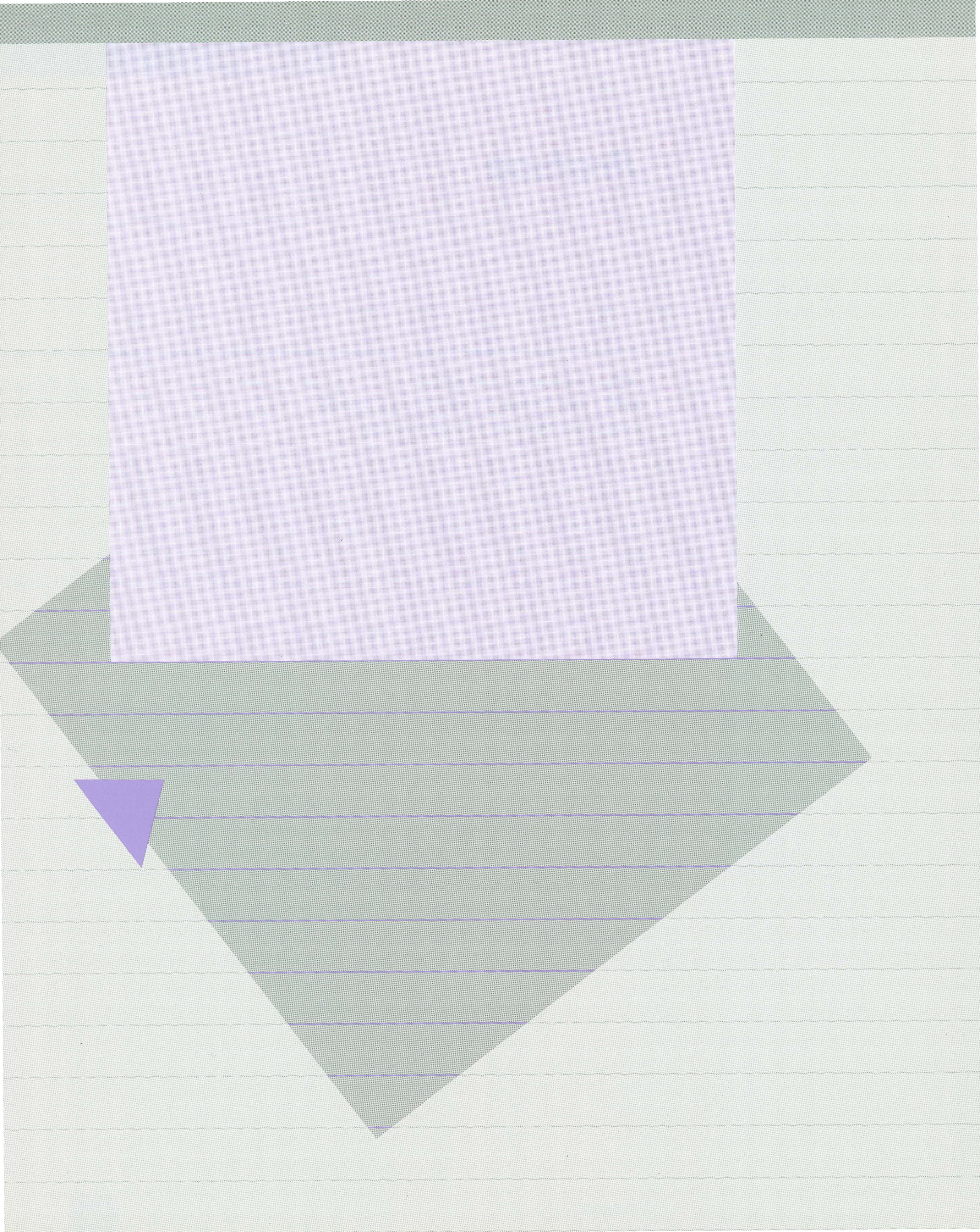


Preface

ProDOS™ is Apple's Professional Disk Operating System. A disk operating system is a computer program that serves as a housekeeper for the information stored on disks. It allows you to place information on disks, rearrange the information that is already on the disks, and retrieve information from the disks. ProDOS lets you organize and use the information stored on all Apple II disks made by Apple Computer, Inc.

The Parts of ProDOS

The ProDOS software, or programs, comes on two disks. The first disk, labeled *ProDOS User's Disk*, contains programs that let you arrange information on a disk and move information from one disk to another. The programs on the *User's Disk* are explained in the *ProDOS User's Manual*.

The second disk, labeled *ProDOS BASIC Programming Examples*, holds the program that lets you run other programs, arrange information that is already on the disk, and write your own BASIC programs that use the disks to store information. This manual explains the program on the *Examples* disk.

The *ProDOS Technical Reference Manual* explains what makes ProDOS tick. An experienced programmer can use this information to write machine-language programs that use ProDOS.

By the Way: The catalog of your *Examples* disk may show dates and times that are not the same as those pictured in this manual. Don't worry—it is just to show you what these catalogs look like.

Requirements for Using ProDOS

To use ProDOS, you must have an Apple II with at least 64K of Random Access Memory (RAM), and with Applesoft in Read Only Memory (ROM). If you have a standard Apple II with Integer BASIC, you must replace the Integer BASIC ROM with an Applesoft ROM. You must also have at least one Disk II drive; in addition, you can have any other combination of disk drives.

By the Way: In this manual, the name *Apple II* implies the Apple II Plus and the Apple IIe. Because ProDOS does not support Integer BASIC, ProDOS will *not* work with BASIC on a standard Apple II.

Before using this manual, you should be familiar with your Apple II, and with the use of Applesoft BASIC. You should also work your way through the *Applesoft Tutorial* before you read this manual. If you have never used files that are grouped into directories, read the *ProDOS User's Manual* chapter on files, filenames, and pathnames.

Remember: Keep the CAPS LOCK key depressed when you are typing any of the ProDOS commands; they must be in uppercase letters. If you type them in lowercase, you will receive a `SYNTAX ERROR` message.

If you are experienced with DOS, the predecessor to ProDOS, read Chapters 1 and 2 of this manual and then skip to the appendix that describes the differences between DOS and ProDOS.

This Manual's Organization

This manual is organized to be useful to as many people as possible. Each chapter begins with a section describing the topics it covers. If a chapter introduces new ProDOS commands, it also has a section called "This Chapter's Commands." Read this section carefully; you can use its command summary to find commands with which you are unfamiliar.

Notice that most of the command descriptions have three sections. The first section tells you why you would want to use the command, shows its form, or syntax, and gives a brief example. The second section, "The Options," gives a precise definition of the different abilities of the command. The third section, "For Example," is a hands-on example of the command. If you learn best by doing, try these examples.

Here is a quick summary of the chapters and appendixes in this manual:

Chapter 1: What you should know before using ProDOS.

Chapter 2: What files are and how they are named. What ProDOS commands are and how they are structured.

Chapter 3: How to keep track of and manipulate the files on a disk.

Chapter 4: How to use programs that are stored on a disk.

Chapter 5: How to write BASIC programs that use ProDOS commands.

Chapter 6: How to write BASIC programs that use sequential text files.

Chapter 7: How to write BASIC programs that use random-access text files.

Chapter 8: How to make files control the operation of your Apple computer.

Chapter 9: How to use binary programs and files, and the Monitor. How to use a clock/calendar card.

Appendix A: A summary of ProDOS.

Appendix B: The differences between DOS and ProDOS.

Appendix C: Error messages.

Appendix D: Extra programs.

Introduction

Introduction

Before You Start

This manual assumes that you already have some experience using your Apple II. You should be familiar with the *Applesoft Tutorial* and at least Chapter 2 of the *ProDOS User's Manual*.

As you read this manual, you should have in front of you:

- An assembled Apple II with at least one disk drive
- The *ProDOS User's Manual*
- The disks labeled *ProDOS User's Disk* and *ProDOS BASIC Programming Examples*, and one blank disk
- The *Applesoft Tutorial* (optional).

Make a Spare Copy of Examples Disk

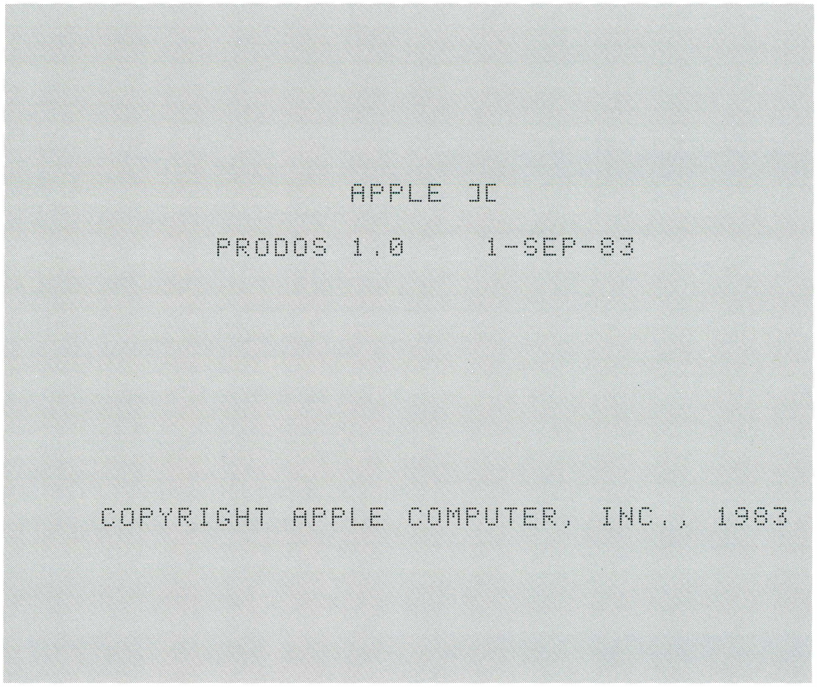
While you learn to work with ProDOS, you are asked to do many things with your *Examples* disk. Because the *Examples* disk that comes with your ProDOS package is write-protected—that is, it does not have a write-enable notch—you cannot do one very important thing to this disk: you can't write information on it.

Following the instructions in the section on backing up disks in the *ProDOS User's Manual*, transfer a copy of the information from the original *Examples* disk to your blank disk, naming the new disk /EXAMPLES . (This is the form that ProDOS recognizes—with a slash before the name. You can use uppercase or lowercase letters when you name a disk.) Write your name and */EXAMPLES* on the disk label; this is your personal copy of ProDOS. Now put the original in a safe place; someday you may want to copy it again.

By the Way: Even if someone else has already made a copy of /EXAMPLES, it is best to make one of your own. Some of the examples in this manual ask you to change the files on the disk; if someone has already done these examples, the disk will not be in its original form.

Starting ProDOS BASIC

Place your copy of /EXAMPLES into drive 1 and close the drive door. If your Apple II is off, reach your left hand around to the back of the case and turn it on. If your Apple II is already on, reach around the back, turn it off, then on again. The display fills up with information that looks something like Figure 1-1.



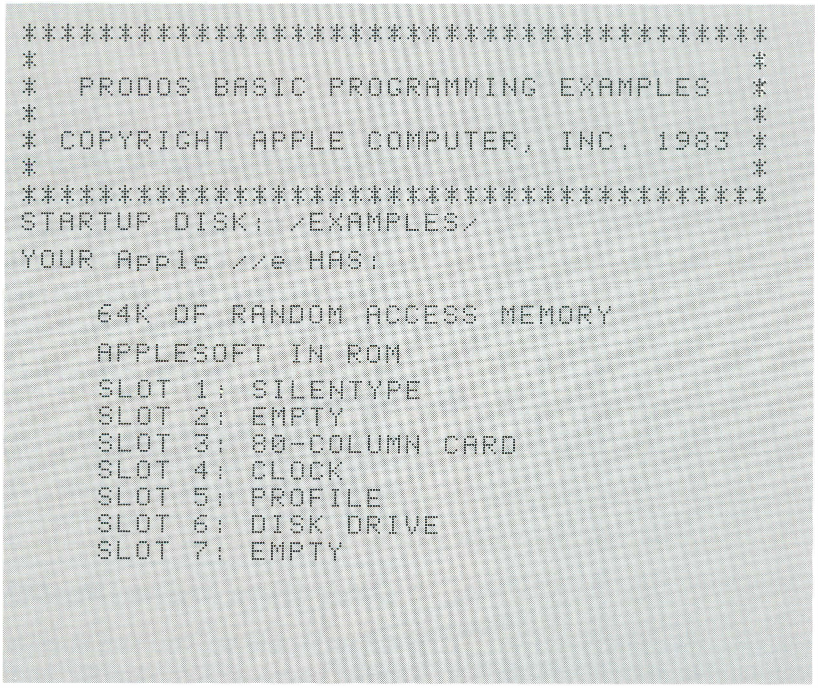
```
                  APPLE ][

         PRODOS 1.0     1-SEP-83




 COPYRIGHT APPLE COMPUTER, INC., 1983
```

Figure 1-1. The ProDOS Title Screen

This display tells you that ProDOS was just placed in memory. Any disk that contains a ProDOS program shows this display when it starts up.

After a few moments more, you see a display that looks something like Figure 1-2. Its exact appearance depends on the type of Apple II system you are using, and the identity of the peripheral cards that are connected to your system.

What the Display Says



```
****************************************
*                                      *
*  PRODOS BASIC PROGRAMMING EXAMPLES   *
*                                      *
* COPYRIGHT APPLE COMPUTER, INC. 1983  *
*                                      *
****************************************
STARTUP DISK: /EXAMPLES/
YOUR Apple //e HAS:

    64K OF RANDOM ACCESS MEMORY

    APPLESOFT IN ROM

    SLOT 1: SILENTYPE
    SLOT 2: EMPTY
    SLOT 3: 80-COLUMN CARD
    SLOT 4: CLOCK
    SLOT 5: PROFILE
    SLOT 6: DISK DRIVE
    SLOT 7: EMPTY
```

Figure 1-2. The ProDOS Title Screen

What It Tells You

The startup disk name.

The type of Apple II.

The amount of RAM in your Apple II.

Applesoft BASIC is in Read Only Memory.

The contents of each of your Apple II's slots.

This single display of text contains a wealth of information. It tells you that the ProDOS program was brought into memory from the disk named /EXAMPLES. This display also describes the setup of your system: how much memory it has, which versions of BASIC you can use, and the type of peripheral card installed in each of your Apple II's peripheral connector slots.

By the Way: ProDOS BASIC requires at least 64K of memory. An Apple IIe always has 64K. Any Apple II must have 48K of RAM and a Language Card to be able to use ProDOS.

The Startup Process

When you turn your Apple II on, it tries to read information from drive 1 of the disk controller card in the highest numbered slot (usually slot 6) inside your Apple II. If the disk is a ProDOS startup disk, the ProDOS program is brought into memory. You see the two displays of information described above, followed by the BASIC prompt:

```
]
```

When you type a few lines of BASIC, you see that your Apple II behaves just as it did without ProDOS or the disk drive—or so it appears. The startup process actually added the ProDOS commands to the BASIC commands to which you are accustomed. There are now 23 new commands that you can type in, and several of the old commands have been enhanced.

▲ **Warning**
Even though the ProDOS commands look like BASIC commands (as you will see), they do not always follow the same rules. For example, multiple ProDOS commands, separated by colons, cannot be put on one line.

Other Ways to Start ProDOS BASIC

A complete explanation of what happens when you start ProDOS is given in Chapter 5, "Programming With ProDOS."

On an Apple IIe, you can always start the system by pressing the three keys—(), (CONTROL), and (RESET)—all at the same time, and then releasing them. On any Apple II computer, you can start the system by turning the computer off and then on again.

When you see one of the prompts (] or *), you can usually restart the program on the disk in drive 1, slot 6, using the command

```
PR# 6
```

If you see the monitor prompt (*), and `PR# 6` doesn't work, try typing

6 CONTROL-P

If your disk controller card is installed in another slot, replace 6 with the slot's number.

These commands are explained later. For now, remember that using them is a good way to start over if things seem to be hopelessly confused. Beware, however—these commands make everything that is in memory disappear.

The HELP Command

If you are using ProDOS and can't quite remember the exact form of a command, you can add the HELP command by typing

```
- /EXAMPLES/HELP
```

while the *Examples* disk is in a drive. You need to type this command only once. The HELP command remains in memory until you turn off your computer or use another program (such as the ProDOS Filer).

After you do this, you can get help with any ProDOS command by simply typing

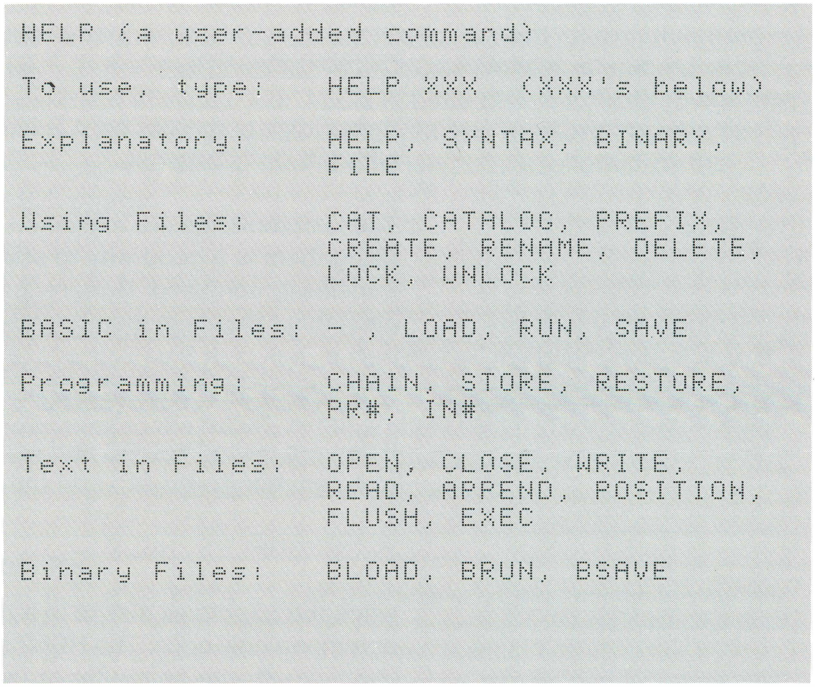
```
HELP command
```

while the *Examples* disk is in a drive. Replace the word *command* with any one of the ProDOS command words (that you're going to learn). If you just type

```
HELP
```

you will see the list of command words shown in Figure 1-3.

What You See



```
HELP (a user-added command)

To use, type:     HELP XXX  (XXX's below)

Explanatory:      HELP, SYNTAX, BINARY,
                  FILE

Using Files:      CAT, CATALOG, PREFIX,
                  CREATE, RENAME, DELETE,
                  LOCK, UNLOCK

BASIC in Files:   - , LOAD, RUN, SAVE

Programming:      CHAIN, STORE, RESTORE,
                  PR#, IN#

Text in Files:    OPEN, CLOSE, WRITE,
                  READ, APPEND, POSITION,
                  FLUSH, EXEC

Binary Files:     BLOAD, BRUN, BSAVE
```

Figure 1-3. The HELP Selection Screen

Where Explained
Explanatory displays.
See Chapters 1, 2, 9.

See Chapter 3.

See Chapter 4.

See Chapter 5.

See Chapters 6, 7, 8.

See Chapter 9.

The left column lists the use for each group of commands. The column on the right lists words you can enter in place of XXX, the name of the command you want to use. The first group of commands is *explanatory* because the commands HELP HELP, HELP SYNTAX, HELP BINARY, and HELP FILE do not give help with specific commands; they display explanatory information.

Each group of commands corresponds to one or more chapters, and within each group, the help commands are listed in the order they appear in this manual.

For the HELP command to work, the files named HELP and HELPSCREENS must be on the same disk. To get them onto a disk other than /EXAMPLES, copy them using the ProDOS Filer. This is explained in more detail later.

For Example

If your Apple II is turned off, make sure /EXAMPLES is in drive 1; then turn on the computer.

As soon as the prompt character appears on the display, type

```
- /EXAMPLES/HELP
```

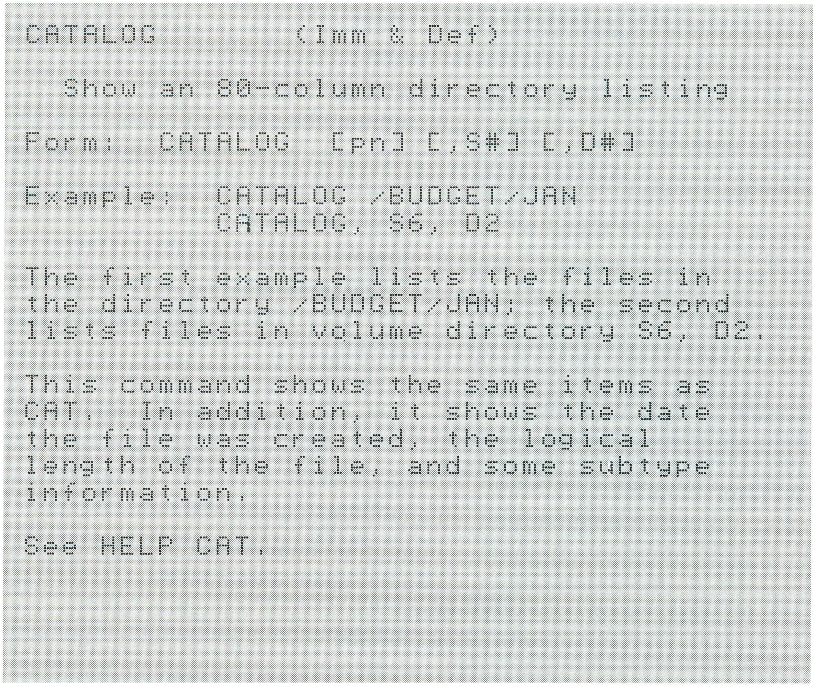
When the BASIC prompt returns, type

```
HELP
```

and you will see the list of commands shown in Figure 1-3. If you want to see a typical help screen, type

```
HELP CATALOG
```

and you see the display shown in Figure 1-4.



```
CATALOG        (Imm & Def)

  Show an 80-column directory listing

Form:  CATALOG  [pn] [,S#] [,D#]

Example:  CATALOG /BUDGET/JAN
          CATALOG, S6, D2

The first example lists the files in
the directory /BUDGET/JAN; the second
lists files in volume directory S6, D2.

This command shows the same items as
CAT.  In addition, it shows the date
the file was created, the logical
length of the file, and some subtype
information.

See HELP CAT.
```

Figure 1-4. The CATALOG Help Screen

At the top of the display is the name of the command, `CATALOG`, followed by the message `(Imm & Def)`. This message tells you that the CATALOG command can be used in immediate mode (as a command typed from the keyboard), and in deferred mode (as a line in a program).

Next is a line that describes what the command does; one more that shows the form, or syntax, of the command; two lines of examples; and then an explanation of the command syntax. All the abbreviations shown in the display will be much clearer after you finish Chapter 2.

All the help screens use this same format with some variations due to the requirements of each individual command.

You can remove the HELP command by typing

```
NOHELP
```

This should be necessary only if you are writing an extremely large BASIC program.

ProDOS and DOS

Because there are many programs available that are written using DOS, it is important that you understand some of the differences between ProDOS and DOS.

When you start up a ProDOS disk, the ProDOS program is placed into memory. The ProDOS program is able to write to and read from all disk drives made for Apple II computers by Apple Computer, Inc.

When you start up a DOS disk, the DOS program is placed into memory. The DOS program can write to and read from Disk II drives only.

Appendix B, which describes the differences between ProDOS and DOS, explains how to convert a program from one format to another.

The information that ProDOS places on a disk cannot be read by DOS; likewise, the information that DOS places on a disk cannot be read by ProDOS. However, in some cases you can use the program CONVERT on the *User's Disk* (/USERS.DISK), described in the *ProDOS User's Manual*, to convert information from one format to the other.

This means that you can use your existing DOS programs only on a DOS-formatted disk unless they can be converted from DOS format to ProDOS format. The general rule is that programs you buy cannot be converted, and that programs you write yourself can be. If a program uses only BASIC and DOS commands, it can be converted. If it does any tricky PEEKs and POKEs, or if it uses machine language at all, then it is likely that it cannot be automatically converted.

Files and Commands

Files and Commands

About This Chapter

The first part of this chapter is about files. It explains how ProDOS arranges files on a disk, how files are named, and the terminology used to refer to files.

The second part of the chapter explains how ProDOS commands are structured. These commands let you make use of your files.

Some of the information in this chapter is explained by example: as you read sections entitled ''For Example,'' try the examples. For these examples to work, ProDOS must be running, as explained in Chapter 1, and the *Examples* disk must be in a drive.

Disks

The purpose of ProDOS is to let you use the information on disks. It can communicate with all disk drives built by Apple Computer, Inc. for Apple II computers. Before ProDOS can use a disk, the disk must be prepared for use, or **formatted**. You can format a disk using the ProDOS Filer.

The *ProDOS User's Manual* explains how to format disks.

You'll find it convenient always to have an adequate supply of empty ProDOS-formatted disks on hand, and to mark each disk so that you know that it is ProDOS-formatted. Disks of other formats (Apple II Pascal, DOS) cannot be used by ProDOS. Apple III SOS-formatted disks can be used by ProDOS (although the programs on them cannot).

See Appendix B for more details on DOS and ProDOS.

Files

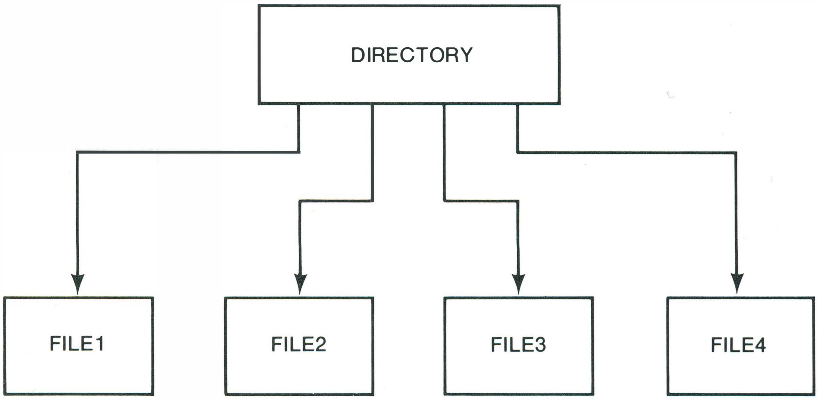
ProDOS lets you organize information into units of disk storage known as **files**. Files can contain numbers, phone lists, letters, pictures, programs, or any other type of information that your Apple II can use.

When a file is placed on a disk, it is assigned a name and a type. When you want access to the information stored in a particular file, refer to that file by its name. The file's type indicates the kind of information that the file contains. For example, there are text files, program files, and a very important file type: **directory files**.

Directory Files

A directory file is just like any other file, but instead of containing a program or text, it contains a list of other files and their locations on the disk.

Figure 2-1. Files in a Directory



The directory shown in Figure 2-1 contains four files: FILE1, FILE2, FILE3, and FILE4. Each of these files can be of any file type; thus all, some, or none of them could be directory files. You can use up to 64 levels of directories on a disk; however, more than five or six levels of directories are difficult to use.

Volume Directory Files

A **volume directory** is the main directory file for the entire disk.

When you format a disk using the ProDOS Filer, a special type of directory file is automatically placed on the disk. It is called a **volume directory**, and it is the main directory file for the entire disk.

A ProDOS volume directory

- is on every ProDOS-formatted disk.
- has a name, assigned when you format the disk. This name, being associated with the entire contents of the disk, is also the disk's name. You should place it on the disk's label.
- can contain up to 51 files.
- is the only file that you cannot create using the CREATE command (or the ProDOS Filer command, MAKE DIRECTORY).
- is the only file that you cannot remove from a disk (although you can remove all the files in it). It is also the only file that you cannot protect using the LOCK command.

If you have an Apple IIe with an Extended 80-Column Text Card, ProDOS places a volume directory file in the alternate 64K of RAM on the card. This volume is named /RAM and it can be used just like a small disk. Unlike a disk, however, the information in /RAM disappears when you turn off your computer. You should use this volume only for temporary storage of information. An example of the use of /RAM is given in the following section.

For Example

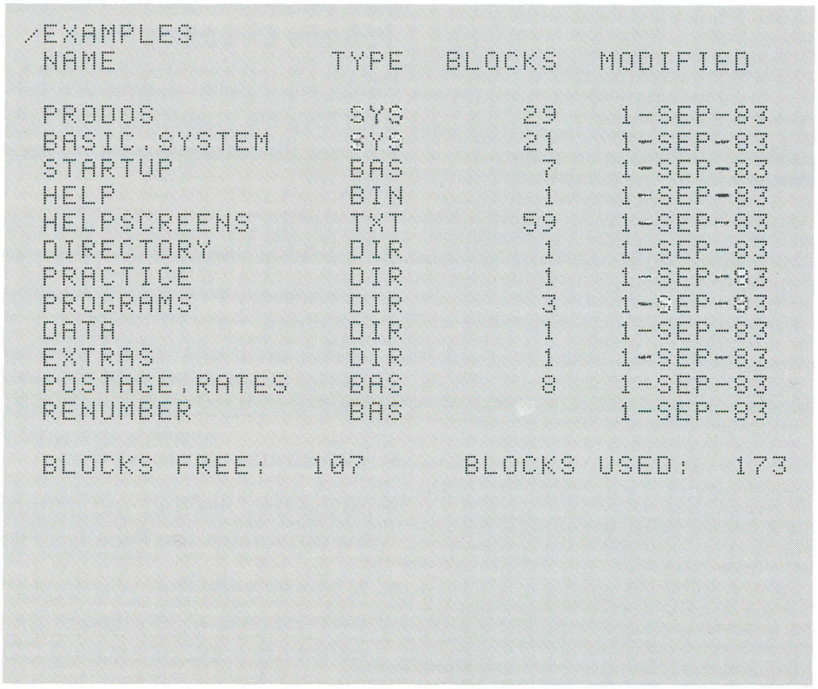
To see the contents of the volume directory of the *Examples* master disk, type the ProDOS command

CAT is the short version of CATALOG.

```
CAT /EXAMPLES
```

and the display shown in Figure 2-2 appears.

By the Way: Your disk catalog may show dates and times that are not the same as those pictured in this manual. Don't worry—they are just to show you what these catalogs look like.



```
/EXAMPLES
 NAME           TYPE  BLOCKS  MODIFIED

 PRODOS          SYS      29   1-SEP-83
 BASIC.SYSTEM    SYS      21   1-SEP-83
 STARTUP         BAS       7   1-SEP-83
 HELP            BIN       1   1-SEP-83
 HELPSCREENS     TXT      59   1-SEP-83
 DIRECTORY       DIR       1   1-SEP-83
 PRACTICE        DIR       1   1-SEP-83
 PROGRAMS        DIR       3   1-SEP-83
 DATA            DIR       1   1-SEP-83
 EXTRAS          DIR       1   1-SEP-83
 POSTAGE.RATES   BAS       8   1-SEP-83
 RENUMBER        BAS           1-SEP-83

 BLOCKS FREE:  107     BLOCKS USED:   173
```

Figure 2-2. The Main Files on /EXAMPLES

Some of these files are directory files: they contain the names and locations of other files on the disk. You can recognize a directory file by the abbreviation `DIR` to the right of its filename in the catalog.

If you have an Apple IIe with an Extended 80-Column Text Card, type the ProDOS command

```
CAT /RAM
```

ProDOS displays information similar to that shown above, but with no filenames listed. /RAM is empty.

Filenames

Several ProDOS commands cause files to be created; each requires that you assign the file a **filename**.

A ProDOS filename

- is composed of up to fifteen characters. The first must be a letter; the rest can be any combination of uppercase or lowercase letters (A-Z), digits (0-9), and periods (.). Lowercase letters are automatically converted to uppercase, thus *A* and *a* are equivalent.
- must be unique within its directory. There can be files by the same name in different directories.

Some Legal Filenames

Here are a few legal filenames (assuming there aren't already files of the same name in the same directory).

A.LONG.FILENAME	longest possible name
Z	shortest possible name
A.1DERFUL.NAME	has letters, number, and periods

Note: Although you can't use spaces in filenames, you can use periods to separate words within a filename.

Some Illegal Filenames

Here are some illegal filenames and the reasons you can't use them.

3.BLIND.MICE	begins with a number
.PRINTER	begins with a period
SPACE RACE	contains a space
BOOP,BETTY	contains a comma
PEANUT.BUTTER.AND.PICKLES	too many characters

Pathnames

To find a file, ProDOS must know the path (from the disk's volume directory to the file) that it must follow to get to the file. The entire path, from the volume directory to the file, is called the file's **pathname**. For example, the pathname of a file STAND in a directory LAST in the volume directory CUSTER is /CUSTER/LAST/STAND .

A ProDOS pathname

- is a series of filenames, preceded and separated by slashes
- has a volume directory filename as its first element
- is no more than 64 characters long, including slashes.

Figure 2-3 represents the structure of a pathname.

Figure 2-3. The Structure of a ProDOS Pathname

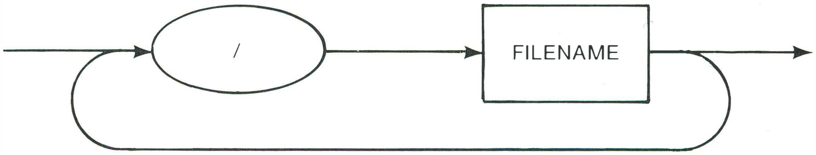


Figure 2-4 displays the directory structure of a disk containing files that document part of the Indo-European family of languages. Below it are a few of the many valid pathnames within this directory structure.

In this example, INDO.EUROPEAN is the name of the disk containing these files and also the name of the disk's volume directory.

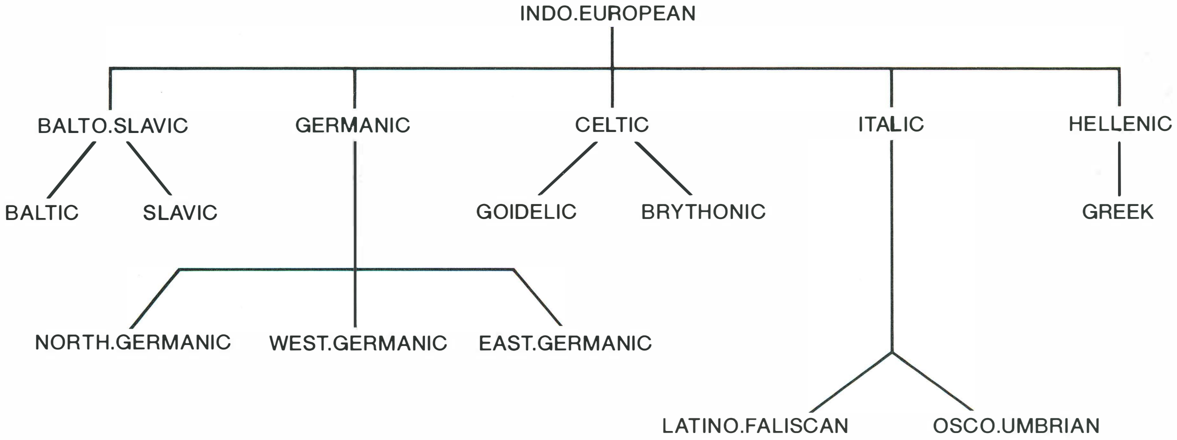
The Prefix and Partial Pathnames

It is very time-consuming to type in an entire pathname every time you use a file. By setting the **prefix**, a pathname that indicates a directory file, you can refer to files in that directory, or to files that can be reached through that directory, by using their **partial pathnames**.

A **partial pathname** is a file's pathname with the prefix removed from the front of it.

Figure 2-4. A Sample Directory Structure

A Directory Structure



And Some Pathnames Within It

/INDO.EUROPEAN/HELLENIC/GREEK
/INDO.EUROPEAN/GERMANIC/WEST.GERMANIC
/INDO.EUROPEAN/ITALIC
/INDO.EUROPEAN/BALTO.SLAVIC/BALTIC

Table 2-1 shows the relationship among pathname, prefix, and partial pathname.

Table 2-1. The Prefix and Pathnames

You Want ProDOS to Find	Current Prefix Is	You Should Type
/CAROL/GHOSTS/XMAS.PAST	/CAROL/	GHOSTS/XMAS.PAST
/CAROL/GHOSTS/XMAS.FUTURE	/CAROL/GHOSTS/	XMAS.FUTURE
/MY.DISK/GAMES	/YOUR.DISK/	/MY.DISK/GAMES

In the third column of Table 2-1, GHOSTS/XMAS.PAST and XMAS.FUTURE are both partial pathnames; a full pathname is formed by adding the current prefix. In the third example you want to use /MY.DISK/, but the prefix is set to /YOUR.DISK/. In cases like this, you must use the file's full pathname (or change the value of the prefix).

Make sure you understand the examples in Table 2-1. Once you do, you will never have trouble with pathnames, partial pathnames, or prefixes.

A ProDOS partial pathname

- is a filename, or a series of filenames separated by slashes
- is a pathname minus the current prefix
- is no more than 64 characters long, including slashes.

You can use the PREFIX command to set the prefix. Follow this command by the pathname of a directory. Thus, before referring to several files that are in the /EXAMPLES/CATALOG directory, you can use the command

```
PREFIX /EXAMPLES/CATALOG/
```

For Example

To set the prefix to the name of the directory /EXAMPLES/CATALOG use the command

```
PREFIX /EXAMPLES/CATALOG/
```

Now look at the contents of the CATALOG directory with the command

```
CAT
```

Without any options, you can use the CAT or CATALOG command to display the contents of the prefix directory. Now examine the contents of the directory /EXAMPLES/CATALOG/DIRECTORY by typing the command

```
CAT DIRECTORY
```

In two commands, you saved 28 keystrokes!

The General Form of ProDOS Commands

This manual describes all the possible forms of each ProDOS command by presenting a one-line description of the command. This one-line description is called the command's general form, or syntax, and it looks something like this:

command [pn] [,S#] [,D#]

The word *command* represents any of the ProDOS commands. The expressions [pn], [,S#], and [,D#] are the command's options. There are many options other than these three.

The three options shown above are called the pathname, slot, and drive options, respectively; together they determine the name and location of the file to be accessed. You can specify a file on any of your disks using only the pathname option. The slot and drive options give you additional control in accessing files.

Here is a specific instance of the CATALOG command that uses the [pn], [,S#], and [,D#] options:

```
CATALOG BOOKS, S6 , D1
```

This command tells ProDOS to display the files contained in the BOOKS directory (in this case *pn* is replaced by a partial pathname), which is in the volume directory of the disk in slot 6, drive 1.

Note the use of commas in the above example. Commas separate the options; you can put spaces before or after the commas if you wish.

Options

Sometimes an option is shown with brackets around it, sometimes not. If an option does *not* have square brackets around it, you must use that option each time you use the command, and you must use it in the order shown by the command's syntax. An option that has square brackets around it may be included or omitted, depending on what you want the command to do. Bracketed options can be used in any order.

Warning
When you use an option, never type in the square brackets; they are only there to tell you that the option is not required.

The characters within the brackets do three things: the comma separates an option from its predecessor, the capital letter identifies which option you are using, and whatever is after the capital letter (usually #) stands for the value you can give that option.

The letters *pn* should be replaced by a pathname or partial pathname, as explained below, and # should be replaced by an integer. The value of # can be a decimal integer or a hexadecimal integer.

By the Way: An additional notation is used later in the manual. Two options separated by a vertical bar, | , are alternates. Use one or the other, not both. You can read a bar as the English word *or*.

Hexadecimal Notation

You are never required to use hexadecimal numbers. The integer in an option, represented by #, can be expressed in hexadecimal notation by preceding the hexadecimal digits with a dollar sign. For example, the decimal integer 254 can be expressed in hexadecimal notation as $FE.

The Pathname Option—[pn]

[pn] This option indicates to ProDOS the name of the file that you want to use. You can replace pn with a pathname or a partial pathname.

If you use a pathname, ProDOS looks for the file with that pathname.

If you use a partial pathname without the [,S#] and [,D#] options, ProDOS looks for the file having the pathname formed by the partial pathname added to the prefix. If the prefix is empty, the name of the volume indicated by the last used values of [,S#] and [,D#] is used in place of the prefix.

By the Way: You can access any file using just its pathname. The [,S#] and [,D#] options are primarily for DOS compatibility. They are also useful if you don't remember a disk's name.

For Example—[pn]

Here are a few ProDOS commands that use the pathname option:

```
CAT /EXAMPLES
PREFIX /EXAMPLES/PROGRAMS/
RUN WHIZBOOM
```

Did you try these commands? If not, try them in the order presented. How they work is explained in later chapters.

The Slot Number Option—[,S#]

[,S#] Include this option to tell ProDOS the slot that connects the disk drive you want to access. Replace # with a slot number from 1 to 7.

When you use this option, the value specified by # becomes the default slot number.

If you use this option without the drive option, drive 1 is assumed.

If this option is used after a pathname, ProDOS first looks for that path in the indicated slot. If this option is used after a partial pathname, ProDOS forms a pathname by adding the volume name of the indicated volume to the partial pathname (the prefix is ignored).

The Drive Number Option—[,D#]

[,D#] Include this option to tell ProDOS the drive that contains the disk you want to access. Replace # with drive number 1 or 2.

When you use this option, the value specified by # becomes the default drive number. If you use the drive number option without a slot number option, ProDOS looks for the drive in the default slot.

If this option is used after a pathname, ProDOS first looks for that path in the indicated drive. If this option is used after a partial pathname, ProDOS forms a pathname by adding the volume name of the disk in the indicated slot and drive to the partial pathname.

Warning

If you use the slot number and drive number options to indicate a drive that is not there, you will get the `NO DEVICE CONNECTED` error message.

For Example—[,S#] [,D#]

Here are some ProDOS commands that use the [,S#] and [,D#] options. Try them in order now with the /EXAMPLES disk in drive 1.

```
CAT PROGRAMS,S6,D1
```

displays the files in the PROGRAM directory of /EXAMPLES, the disk in slot 6, drive 1.

```
PREFIX  , D1 , S6
```

sets the prefix to the name of the volume directory, slot 6, drive 1.

```
RUN /EXAMPLES/PROGRAMS/WHIZBOOM ,S6 ,D2
```

checks first in drive 2 for the /EXAMPLES volume, then in other drives until it finds /EXAMPLES.

In Summary

Table 2-2 shows the pathname that ProDOS seeks for each possible combination of the pathname, slot, and drive options.

Table 2-2. How ProDOS Forms a Pathname

[pn]	[,S#]	[,D#]	Pathname Sought
-	-	-	See command description
ppn	-	-	pn = prefix + ppn*
ppn	+	+	pn = vn + ppn
ppn	+	-	pn = vn + ppn**
ppn	-	+	pn = vn + ppn***
pn	-	-	pn = pn
pn	+	+	pn = pn

Key:

+	= option used
-	= option not used
pn	= pathname
ppn	= partial pathname
vn	= volume name of disk at S#, D#

* If the prefix is empty, the last used values of S# and D# are used to determine a volume name.

** When only S# is given, drive 1 is assumed.

*** When only D# is given, the last value of S# is used.

Using Files

Using Files

About This Chapter

This chapter describes the ProDOS commands that let you keep track of and manipulate the files on your disks. You can use these commands

- to see what information is on a disk
- to create more room on a disk by throwing away obsolete information
- to change the name of some information so that it is easier to locate
- to protect some information from being accidentally destroyed.

Because you issue the commands described in this chapter from the keyboard more frequently than from within programs, they are described here before the chapter that explains the technique for using ProDOS commands in programs. Remember that they can all be used in programs.

This Chapter's Commands

The ProDOS commands that let you manipulate files are summarized below; each affects one file at a time. If you want to perform operations on several or all of the files on a disk, use the ProDOS Filer, described in the *ProDOS User's Manual*.

CATALOG List all the files in a directory

Use this command to place a list of all the files in the directory you name onto the screen. It also displays other information about each file.

PREFIX Set a directory to work in

Use this command to set the value of the prefix, that is, the pathname that is automatically added to the beginning of any partial pathname you use. You can also use it to display the prefix.

CREATE Create a new directory (or other file)

Use this command to create a new file with a name and type that you specify. Although there are ways to create other file types, this is the only way you can create a new directory.

RENAME Change a file's name

Use this command to change the name of a file, but you cannot use it to move the file from one directory to another.

DELETE Remove a file from a disk

Use this command to remove a file from its directory. Once you delete a file, it is not possible to get it back.

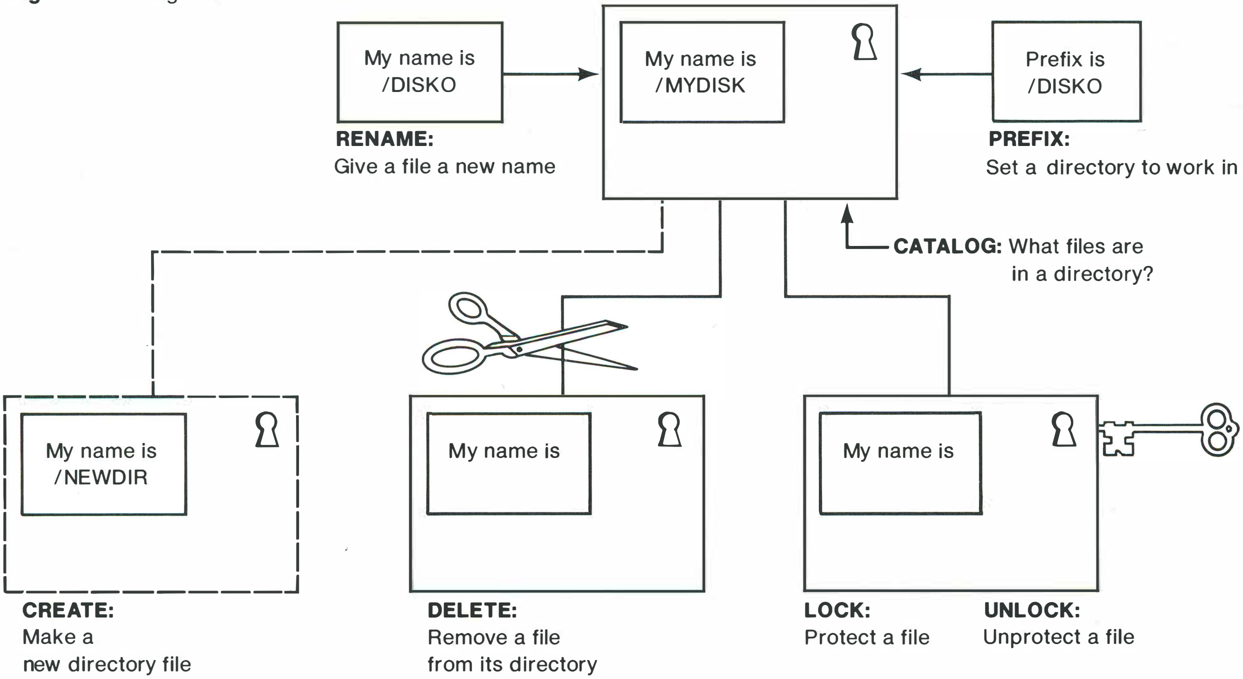
LOCK Protect a file from being destroyed

Use this command to protect a file from being accidentally destroyed. Once you lock a file, it cannot be renamed, deleted, or otherwise changed until it is unlocked.

UNLOCK Unprotect a locked file

Use this command so you can rename, delete or otherwise change a file that is locked.

Figure 3-1. Using Files



The CAT and CATALOG Commands

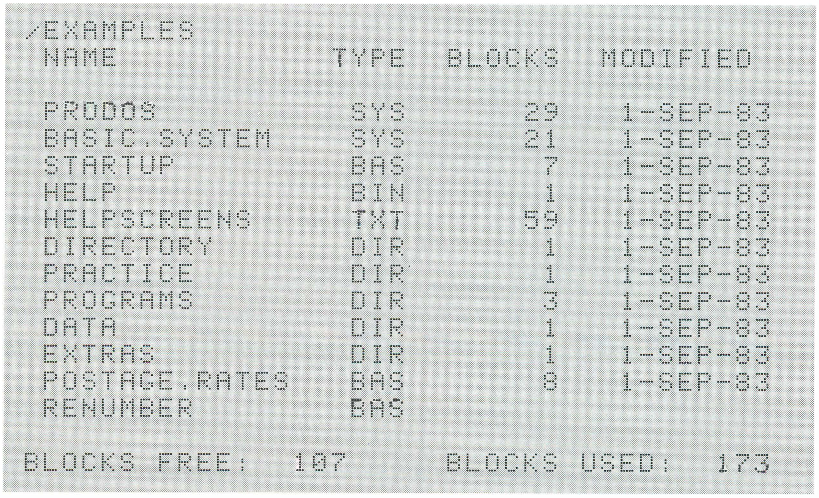
To view the names and other characteristics of all the files in any directory, use one of the two forms of the CATALOG command:

```
CAT [pn] [,S#] [,D#]          Display 40 columns
CATALOG [pn] [,S#] [,D#]      Display 80 columns
```

CAT displays a 40-column wide list of files. It includes the file's name, type, size, and modified date. CATALOG displays an 80-column wide list of files, which includes the same information, plus the date that the file was created, and some technical information. If you display the 80-column list on a 40-column wide screen, each entry in the list takes up two lines. Figure 3-2 is a comparison of the four displays that can be generated by this command.

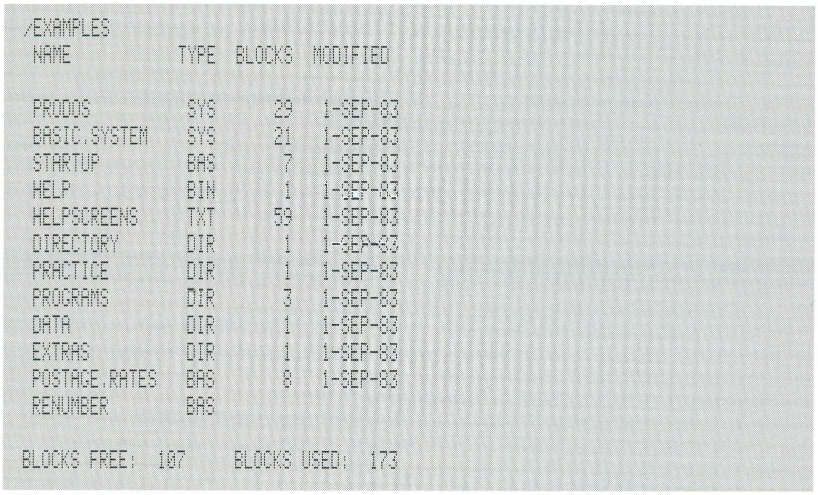
Figure 3-2. CAT and CATALOG

40-column CAT

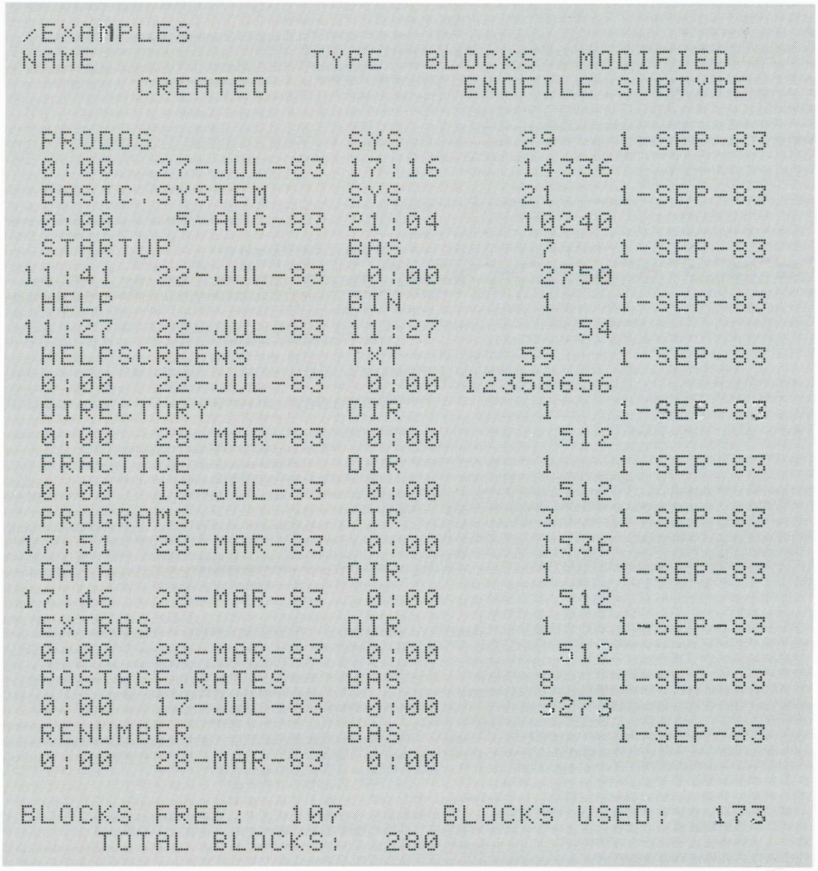


```
/EXAMPLES
 NAME           TYPE  BLOCKS  MODIFIED

 PRODOS          SYS      29   1-SEP-83
 BASIC.SYSTEM    SYS      21   1-SEP-83
 STARTUP         BAS       7   1-SEP-83
 HELP            BIN       1   1-SEP-83
 HELPSCREENS     TXT      59   1-SEP-83
 DIRECTORY       DIR       1   1-SEP-83
 PRACTICE        DIR       1   1-SEP-83
 PROGRAMS        DIR       3   1-SEP-83
 DATA            DIR       1   1-SEP-83
 EXTRAS          DIR       1   1-SEP-83
 POSTAGE.RATES   BAS       8   1-SEP-83
 RENUMBER        BAS

BLOCKS FREE:  107     BLOCKS USED:  173
```

80-column CAT

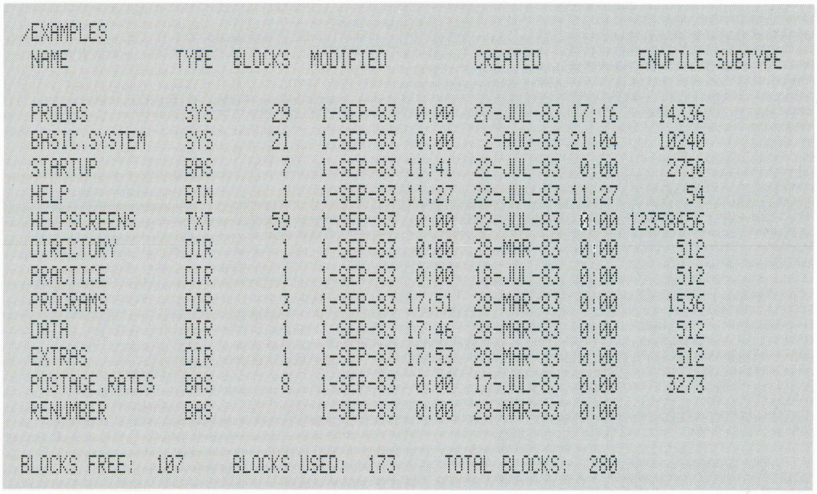


```
/EXAMPLES
 NAME           TYPE  BLOCKS  MODIFIED

 PRODOS          SYS      29   1-SEP-83
 BASIC.SYSTEM    SYS      21   1-SEP-83
 STARTUP         BAS       7   1-SEP-83
 HELP            BIN       1   1-SEP-83
 HELPSCREENS     TXT      59   1-SEP-83
 DIRECTORY       DIR       1   1-SEP-83
 PRACTICE        DIR       1   1-SEP-83
 PROGRAMS        DIR       3   1-SEP-83
 DATA            DIR       1   1-SEP-83
 EXTRAS          DIR       1   1-SEP-83
 POSTAGE.RATES   BAS       8   1-SEP-83
 RENUMBER        BAS

BLOCKS FREE:  107     BLOCKS USED:  173
```



```
/EXAMPLES
NAME           TYPE  BLOCKS  MODIFIED
      CREATED          ENDFILE SUBTYPE

 PRODOS          SYS      29   1-SEP-83
 0:00  27-JUL-83 17:16    14336
 BASIC.SYSTEM    SYS      21   1-SEP-83
 0:00   5-AUG-83 21:04    10240
 STARTUP         BAS       7   1-SEP-83
11:41  22-JUL-83  0:00     2750
 HELP            BIN       1   1-SEP-83
11:27  22-JUL-83 11:27       54
 HELPSCREENS     TXT      59   1-SEP-83
 0:00  22-JUL-83  0:00 12358656
 DIRECTORY       DIR       1   1-SEP-83
 0:00  28-MAR-83  0:00      512
 PRACTICE        DIR       1   1-SEP-83
 0:00  18-JUL-83  0:00      512
 PROGRAMS        DIR       3   1-SEP-83
17:51  28-MAR-83  0:00     1536
 DATA            DIR       1   1-SEP-83
17:46  28-MAR-83  0:00      512
 EXTRAS          DIR       1   1-SEP-83
 0:00  28-MAR-83  0:00      512
 POSTAGE.RATES   BAS       8   1-SEP-83
 0:00  17-JUL-83  0:00     3273
 RENUMBER        BAS           1-SEP-83
 0:00  28-MAR-83  0:00

BLOCKS FREE:  107     BLOCKS USED:  173
    TOTAL BLOCKS:  280
```

40-column CATALOG



```
/EXAMPLES
 NAME          TYPE BLOCKS  MODIFIED       CREATED          ENDFILE SUBTYPE

 PRODOS         SYS     29  1-SEP-83  0:00 27-JUL-83 17:16    14336
 BASIC.SYSTEM   SYS     21  1-SEP-83  0:00  2-AUG-83 21:04    10240
 STARTUP        BAS      7  1-SEP-83 11:41 22-JUL-83  0:00     2750
 HELP           BIN      1  1-SEP-83 11:27 22-JUL-83 11:27       54
 HELPSCREENS    TXT     59  1-SEP-83  0:00 22-JUL-83  0:00 12358656
 DIRECTORY      DIR      1  1-SEP-83  0:00 28-MAR-83  0:00      512
 PRACTICE       DIR      1  1-SEP-83  0:00 18-JUL-83  0:00      512
 PROGRAMS       DIR      3  1-SEP-83 17:51 28-MAR-83  0:00     1536
 DATA           DIR      1  1-SEP-83 17:46 28-MAR-83  0:00      512
 EXTRAS         DIR      1  1-SEP-83 17:53 28-MAR-83  0:00      512
 POSTAGE.RATES  BAS      8  1-SEP-83  0:00 17-JUL-83  0:00     3273
 RENUMBER       BAS         1-SEP-83  0:00 28-MAR-83  0:00

BLOCKS FREE:  107    BLOCKS USED:  173    TOTAL BLOCKS:  280
```

80-column CATALOG

For example, to see the files of jokes in the directory /JOKES/BAD, you can use the command in either of the following forms:

Display 80 columns.

Display 40 columns.

```
CATALOG /JOKES/BAD
CAT /JOKES/BAD
```

The Options

If you give the CAT or CATALOG command without any options, the names and characteristics of all the files in the prefix directory are displayed. If the prefix is empty, all the files in the volume directory indicated by the last used values of [,S#] and [,D#] are displayed.

[pn] The filename used in the command must indicate a directory file or you see the `FILE TYPE MISMATCH` error message.

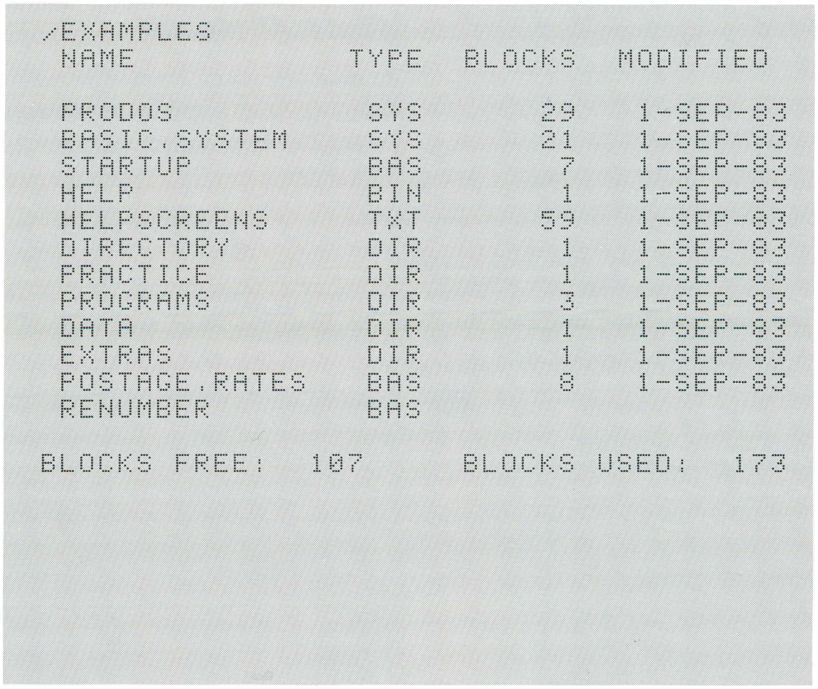
[,S#]
[,D#] If you use the slot and drive options without a filename, ProDOS displays a list of the files in the volume directory of the disk in the specified drive.

For Example

To see a list of the files in the volume directory of the /EXAMPLES disk, type

```
CAT /EXAMPLES
```

and you see the display shown in Figure 3-3.



```
/EXAMPLES
 NAME           TYPE  BLOCKS  MODIFIED

 PRODOS          SYS      29    1-SEP-83
 BASIC.SYSTEM    SYS      21    1-SEP-83
 STARTUP         BAS       7    1-SEP-83
 HELP            BIN       1    1-SEP-83
 HELPSCREENS     TXT      59    1-SEP-83
 DIRECTORY       DIR       1    1-SEP-83
 PRACTICE        DIR       1    1-SEP-83
 PROGRAMS        DIR       3    1-SEP-83
 DATA            DIR       1    1-SEP-83
 EXTRAS          DIR       1    1-SEP-83
 POSTAGE.RATES   BAS       8    1-SEP-83
 RENUMBER        BAS

BLOCKS FREE:  107     BLOCKS USED:  173
```

Figure 3-3. A Catalog of the /EXAMPLES Disk

Now, be sure that your /EXAMPLES disk is in slot 6, drive 1; type

```
CAT,S6,D1
```

and you see a 40-column list of the same directory. The first example causes a display of the files in the volume directory of the volume named /EXAMPLES, no matter which disk drive /EXAMPLES is in. The second example causes a display of the names of the files in the volume directory of any disk that is in the drive connected to slot 6, drive 1.

Now look at the files in another directory. Notice that one of the files displayed on the screen is named PROGRAMS. Type

```
CAT /EXAMPLES/PROGRAMS
```

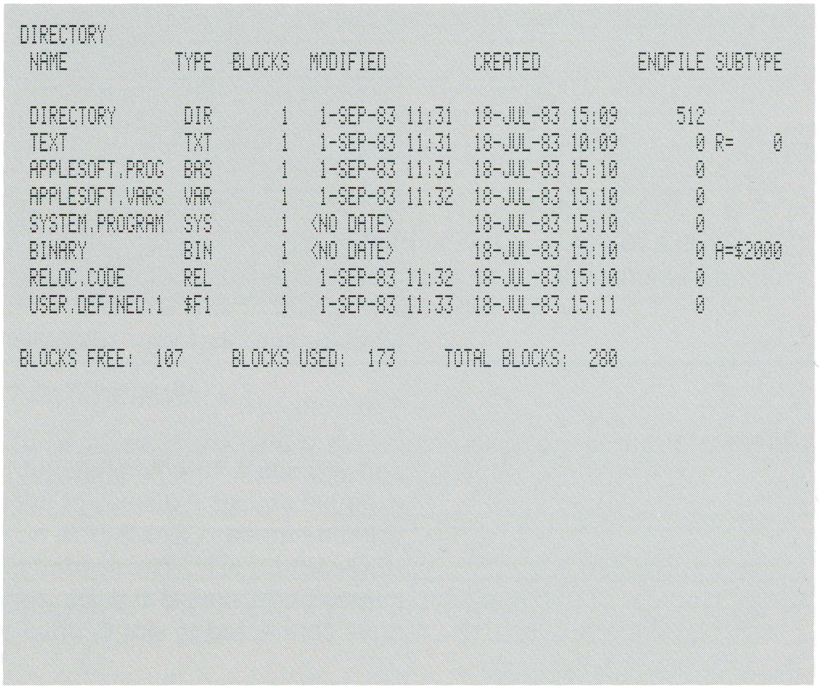
and a new list of files appears on the screen. These are the files stored on the /EXAMPLES disk in the directory named PROGRAMS.

What It All Means

By now you must be a little curious about the meaning of the headings that appear on the screen each time you use the CATALOG command. Wonder no more, for curiosity killed the CAT. Type

```
CATALOG /EXAMPLES/DIRECTORY
```

and, if you have an 80-column display, you see the catalog shown in Figure 3-4.



```
DIRECTORY
 NAME            TYPE  BLOCKS  MODIFIED          CREATED          ENDFILE SUBTYPE

 DIRECTORY        DIR       1   1-SEP-83 11:31  18-JUL-83 15:09      512
 TEXT             TXT       1   1-SEP-83 11:31  18-JUL-83 10:09        0 R=     0
 APPLESOFT.PROG   BAS       1   1-SEP-83 11:31  18-JUL-83 15:10        0
 APPLESOFT.VARS   VAR       1   1-SEP-83 11:32  18-JUL-83 15:10        0
 SYSTEM.PROGRAM   SYS       1  <NO DATE>        18-JUL-83 15:10        0
 BINARY           BIN       1  <NO DATE>        18-JUL-83 15:10        0 A=$2000
 RELOC.CODE       REL       1   1-SEP-83 11:32  18-JUL-83 15:10        0
 USER.DEFINED.1   $F1       1   1-SEP-83 11:33  18-JUL-83 15:11        0

BLOCKS FREE:  107     BLOCKS USED:  173     TOTAL BLOCKS:  280
```

Figure 3-4. A Catalog of /EXAMPLES/DIRECTORY

This is the 80-column version of this command. If you have a 40-column display, you see the same information, but each entry in the list takes up two lines on the screen.

The Directory's Name

The filename of the directory whose files you see in Figure 3-4 appears in the upper-left corner of the catalog. If it is a volume directory, it is preceded by a slash; otherwise it is not.

NAME (Filenames)

The name of each file in the directory is listed beneath the leftmost heading, the one labeled `NAME`. If the named file is locked, its filename is preceded by an asterisk.

TYPE (File Types)

The abbreviations beneath the heading labeled `TYPE` tell you the type of each file in that directory. The file type that corresponds to each abbreviation is shown in Table 3-1.

Table 3-1. The File Type Abbreviations

Abbreviation	**File Type**
DIR	Directory
TXT	Text
BAS	Applesoft Program
VAR	Applesoft Variables
BIN	Binary
REL	Relocatable Code
* $F#	User Defined
SYS	ProDOS System File
SYS	ProDOS System Program

* # is an integer from 1 to 8.

The uses for each file type are explained later in the manual.

Notice that a file of each type is represented in the /EXAMPLES/DIRECTORY directory. With ProDOS started up and the /EXAMPLES disk in drive 1, type

```
HELP FILE
```

to see this list of file type abbreviations.

BLOCKS (File Sizes)

A **block** is a 512-byte unit of disk space.

`BLOCKS` lists the number of blocks of disk space that each file uses.

For directory files, this column lists the number of blocks used by the directory file, but not the blocks used by the files in the directory.

When you catalog a volume directory, the block use of the entire disk is displayed at the bottom of the screen.

MODIFIED and CREATED (File Dates)

These columns contain the dates and times at which you created and last modified your files. The first half of the MODIFIED column is displayed by the CAT command; both columns are displayed by the CATALOG command. These dates and times are correct only if

- you have a Thunderclock™ or
- you have used the TIME program, described in Appendix D, or
- you have some other type of clock/calendar card, and have set it up as explained in Chapter 9.

If there is a Thunderclock interface card in one of the Apple II's slots, ProDOS recognizes the card and sets itself up to read the date and time from the card.

ENDFILE (Maximum File Sizes)

Chapter 7 describes random-access text files and explains how this might happen.

ENDFILE lists the number of bytes that each file will use if all the disk space allotted to that file is filled (sometimes it is not).

SUBTYPE (File Properties)

SUBTYPE lists important properties of some types of files. A single letter precedes each number in this column. The letters used are shown in Table 3-2.

Table 3-2. The SUBTYPE Column

Letter	Meaning
A	Load Address: This is the memory address from which a binary file (BIN) was saved. The address is given in hexadecimal.
R	Record Length: This is the size (in bytes) of each element in a text file (TXT) or user defined file ($F#). The length is in decimal.

For example, binary files are usually placed in the same part of memory each time they are used. For a binary file the property in the SUBTYPE column starts with an A (for load Address) followed by the memory address at which that binary file was last placed. This type of attribute is discussed in Chapter 4, ''BASIC Programs in Files.''

The other type of property begins with an R (for Record length). It specifies the size of each element of the file. This attribute is explained in Chapter 6, "Text in Files."

The Bottom Line

When you display the catalog of a directory, the bottom line of the display describes how space on the volume is used.

`BLOCKS FREE` is the number of unused blocks on the disk, `BLOCKS USED` is the number of full blocks on the disk, and `TOTAL BLOCKS` is the maximum number of blocks of information that the disk can hold.

The PREFIX Command

If you are going to be referring to several files in a single directory, the PREFIX command can save you some time. Use the PREFIX command to set the prefix to the name of the directory the files are in; you can then refer to the files by filename alone.

To assign a new value to the prefix, or to see the current value of the prefix, use the command:

/PREFIX [pn] [,S#] [,D#]

For example, if the prefix is set to /EXAMPLES/, and you want to use the file named /MAMMALS/RODENTS/BEAVER you must refer to it by its full pathname. If you use the command

```
PREFIX /MAMMALS/RODENTS/
```

you can then refer to the file simply as BEAVER, and to the other files in the directory as MOUSE, SQUIRREL, RAT, and so on.

When you start up /EXAMPLES or any other ProDOS disk, the prefix is left empty, and the slot and drive defaults are set to indicate the drive containing that disk. Whenever the prefix is empty, ProDOS looks for files on the disk in the indicated slot and drive.

The Options

If you use the PREFIX command without any options, the current value of the prefix is displayed on the screen.

[pn] pn must be the pathname or partial pathname of a directory file. Unlike a normal pathname or partial pathname, it may end with a slash. If it is not valid, you will get a `FILE TYPE MISMATCH` or `FILE NOT FOUND` error.

If you use a slash instead of a pathname, the value of the prefix is left empty.

[,S#]
[,D#] If you do not specify a filename, but you do use the slot and drive options, the volume name of the indicated disk is assigned to the prefix. If you have a controller for a single disk drive in a slot, refer to it as drive 1 of that slot.

For Example

With ProDOS started up, and the ProDOS disk in drive 1, set the prefix to indicate the /EXAMPLES volume directory using the command

```
PREFIX /EXAMPLES
```

and then make sure the command worked right using the command

```
PREFIX
```

Notice that the value of the prefix is printed out as

```
/EXAMPLES/
```

If the prefix value that you assign doesn't end in a slash, ProDOS automatically adds one. It does this so, when the prefix is attached to a filename or partial pathname, a proper pathname is formed.

Verify that you can enter the prefix with a trailing slash by typing

```
PREFIX /EXAMPLES/
```

and checking the result using the command

```
PREFIX
```

If you want to set the prefix to the name of the volume directory of one of your disks, but you can't quite remember the disk's name, use the slot and drive options to indicate the disk's location. For example,

```
PREFIX, S6, D1
```

sets the prefix to the value /EXAMPLES/. Try it. If your disk has a long name, this form may be shorter than typing in the entire volume name.

If you want to look at or use some of the programs that are supplied with your /EXAMPLES disk, type the command

```
PREFIX /EXAMPLES/PROGRAMS/
```

You can now see a list of the programs in this directory by typing

```
CAT
```

and you can refer to any one of them by filename alone, as in

```
RUN WHIZBOOM
```

When You Use PREFIX in a Program

When you use the PREFIX command with no options from within a program, the value of the prefix is not displayed; it is set up so the next INPUT statement in the program reads it.

Refer to Chapter 5, "Programming With ProDOS," for details on reading the prefix.

The CREATE Command

The primary purpose of the CREATE command is to create directory files within which you can place other files. Although you can use this command to create files of all types, most of the other file types are created automatically by other ProDOS commands.

A volume directory file can store the names and locations of up to 51 files. It isn't really necessary to create more directory files unless your disk will contain more than 51 files. However, a well planned set of directories can make your files much easier to find and use.

> **Be Prepared:** Create your directory files before you have files to place within them. It is much easier to place new files in a directory than to move existing files from one directory to another. If you must do this, use the file copy option of the ProDOS Filer.

You create a file by using the command

CREATE pn [,Ttype] [,S#] [,D#]

Notice that the CREATE command uses a new option, Ttype, that determines the type of file to be created. If you do not use this option, a directory file is created. To create a file of any other type, you must use this option.

For example, you can create a directory file named /BUDGET/CHILDREN by using the command

```
CREATE /BUDGET/CHILDREN
```

Directory File Size

The number of files that fit into a directory other than a volume directory is limited only by the amount of space on the disk. The size of a directory file is determined by the number of files it contains.

The first block of disk space used by a directory can hold up to 12 files. Each subsequent block used by a directory can hold up to 13 files. Thus a directory with 27 files in it is three blocks long (12 files in block 1, 13 in block 2, 2 in block 3).

The Options

pn — pn is the pathname or the partial pathname of the file to be created. The file must not exist.

Chapter 2 discusses the directory file type; the other types are explained as you need to know about them.

[,Ttype] — type is a three-letter abbreviation that determines the type of file to be created. The abbreviations of the various file types are given in Table 3-3. You can see these abbreviations by using the HELP FILE command.

Table 3-3. The File Type Abbreviations

Abbreviation	File Type
DIR	Directory
TXT	Text
BAS	Applesoft Program
VAR	Applesoft Variables
BIN	Binary
REL	Relocatable Code
* $F#	User Defined
SYS	ProDOS System File
SYS	ProDOS System Program

* # is an integer from 1 to 8.

[,S#] — The slot option has its usual meaning.

[,D#] — The drive option has its usual meaning.

For Example

With ProDOS running and the /EXAMPLES disk in drive 1, set the prefix to /EXAMPLES/PRACTICE/ with the command

```
PREFIX /EXAMPLES/PRACTICE/
```

We want to create a directory named /EXAMPLES/PRACTICE/NEWDIR. Type the command

```
CREATE NEWDIR
```

and listen to the /EXAMPLES disk whirring away. Now type

```
CAT
```

to see that the new directory exists. Notice that the catalog of files shows that `NEWDIR` uses up 1 block of disk space.

The RENAME Command

To change the name of a file, use the RENAME command:

RENAME pn1,pn2 [,S#] [,D#]

This command changes the name of a file from the name indicated by pn1 to the name indicated by pn2. The new name must be in the same directory as the old name. Thus you can use the command

```
RENAME/RECIPES/TEST/FUDGE,/RECIPES/TEST
/BROWNIES
```

to change the name of a test recipe from FUDGE to BROWNIES, but you *cannot* use the command

```
RENAME/RECIPES/TEST/BROWNIES,/RECIPES/EDIBLE
/BROWNIES
```

to move your BROWNIES recipe from the TEST directory to the EDIBLE directory. To move a file from one directory to another, use the ProDOS Filer.

You cannot rename a file that is locked. Refer to the section "The LOCK Command" in this chapter for further details.

The Options

pn1,pn2 When you give a file (pn1) a new name (pn2), the new name must be unique. If it already exists, you get the `DUPLICATE FILE` name error message. If pn1 does not exist, you get the `FILE NOT FOUND` error message. If the two pathnames, pn1 and pn2, do not indicate files in the same directory, you get a `SYNTAX ERROR`.

[,S#] The slot option has its usual meaning.

[,D#] The drive option has its usual meaning.

For Example

With the /EXAMPLES disk in drive 1, set the prefix to the name of the directory containing practice files by typing

```
PREFIX /EXAMPLES/PRACTICE/
```

Now look at the files in the directory /EXAMPLES/PRACTICE by typing

```
CAT
```

The list of files displayed on the screen includes the files RENAME.ME.1 , RENAME.ME.2 , and RENAME.ME.3 . To change the name RENAME.ME.1 to RENAME.ME.4 , type

```
RENAME RENAME.ME.1, RENAME.ME.4
```

and ProDOS swiftly and silently changes the file's name. Now type

```
CAT
```

to verify that the name was indeed changed. Now rename the file LOCKED.UP.1 with the command

```
RENAME LOCKED.UP.1,INMATE
```

Whoops! This file is locked; its name cannot be changed until you unlock it. If you have valuable files that you don't want to alter or rename accidentally, lock them. The sections on the LOCK and UNLOCK commands in this chapter describe this method of file protection.

The DELETE Command

To remove a file from a disk, use the command

DELETE pn [,S#] [,D#]

For example, you can remove the file /RESUME/DRAFT12 from its disk with the command

```
DELETE /RESUME/DRAFT12
```

The file indicated by pn must be unlocked, and if it is a directory file, it must be empty. After you delete a file there is no way to get it back again.

The Options

pn — A pathname or partial pathname, pn, must be included in the command; the indicated file must exist or you get a `FILE NOT FOUND` message.

[,S#] — The slot option has its usual meaning.

[,D#] — The drive option has its usual meaning.

For Example

With ProDOS started up, and the /EXAMPLES disk in drive 1, set the prefix to /EXAMPLES/PRACTICE/ with the command

```
PREFIX /EXAMPLES/PRACTICE/
```

To see the files in the PRACTICE directory, type the command

```
CAT
```

Included in the listed files are the files DELETE.ME.1 , DELETE.ME.2 , and DELETE.ME.3 .

Now delete the file /EXAMPLES/PRACTICE/DELETE.ME.1 using the command

```
DELETE DELETE.ME.1
```

Try deleting the other DELETE.ME files using a full pathname, and by setting the prefix to something else, /EXAMPLES/ for example, and using a partial pathname.

Use the CAT command to verify that the deleted files are no longer on the disk.

The LOCK Command

At times you will want to protect individual files from being accidentally renamed, deleted, or altered. You can do this using

LOCK pn [,S#] [,D#]

For example, you can lock the file /INVENTORY/NOTE.PADS by typing

```
LOCK /INVENTORY/NOTE.PADS
```

While a file is locked, it cannot be renamed, deleted, or altered. Any attempt to change a locked file causes the `FILE LOCKED` error message to be displayed. To alter a locked file, you must first unlock it with the UNLOCK command.

When you catalog the files in a directory, the locked files are marked by asterisks to the left of their filenames.

You cannot lock a volume directory file. You can, however, protect an entire flexible disk by covering its write-enable notch.

The Options

pn pn is the pathname or the partial pathname of the file to be locked. You cannot lock a volume directory.

[,S#] The slot option has its usual meaning.

[,D#] The drive option has its usual meaning.

For Example

With ProDOS started up and the /EXAMPLES disk in drive 1, display a list of the files in the PRACTICE file using the command

```
CAT /EXAMPLES/PRACTICE
```

Notice that the files LOCKED.UP.1 and LOCKED.UP.2 both have asterisks by their file types, indicating that they are locked. First set the prefix to /EXAMPLES/PRACTICE using the command

```
PREFIX /EXAMPLES/PRACTICE
```

Next lock the file LOCK.ME.1 in the prefix directory with the command

```
LOCK LOCK.ME.1
```

Use the CAT command to verify that the file is now locked.

The UNLOCK Command

Before you can delete, rename, or otherwise change a locked file, you must UNLOCK it using the command

UNLOCK pn [,S#] [,D#]

For example, to unlock the file /INVENTORY/NOTE.PADS so that you can update the information it contains, use the command

```
UNLOCK /INVENTORY/NOTE.PADS
```

You can UNLOCK any file except a volume directory file. Volume directory files cannot be locked.

The Options

pn pn is the pathname or the partial pathname of the file to be unlocked.

[,S#] The slot option has its usual meaning.

[,D#] The drive option has its usual meaning.

For Example

With ProDOS started up and the /EXAMPLES disk in drive 1, display the list of the files in the PRACTICE file by using the command

```
CAT /EXAMPLES/PRACTICE
```

Notice that the files LOCKED.UP.1 and LOCKED.UP.2 both have asterisks by their file types, indicating that they are locked. First set the prefix to /EXAMPLES/PRACTICE/ using the command

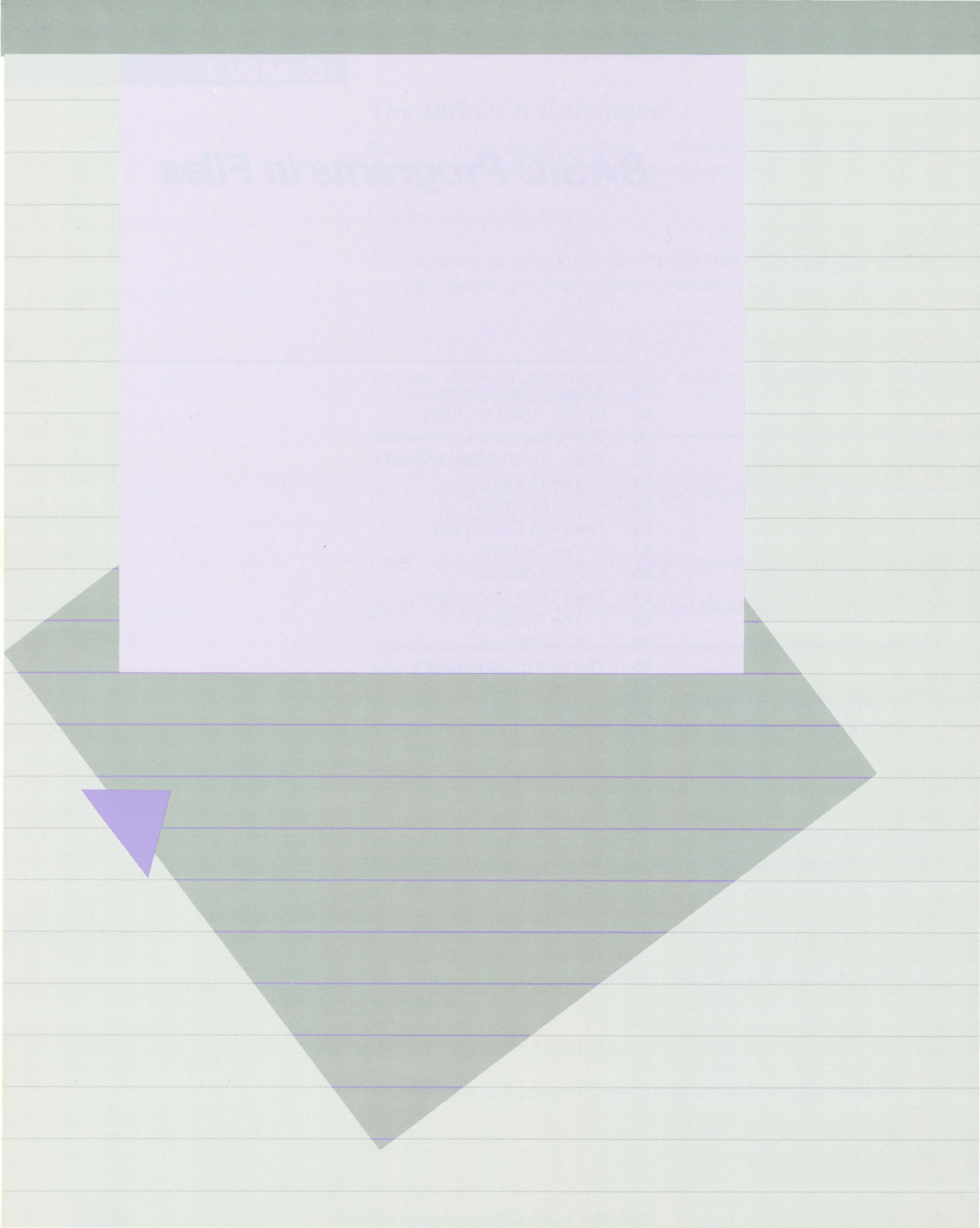
```
PREFIX /EXAMPLES/PRACTICE
```

Next unlock the file LOCKED.UP.1 in the prefix directory with the command

```
UNLOCK LOCKED.UP.1
```

Use the CAT command to verify that the file is now unlocked.

BASIC Programs in Files



BASIC Programs in Files

About This Chapter

This chapter describes the ProDOS commands that let you use the BASIC programs on your disks. If all you want to do is run programs that are already on your disks, pay special attention to the – (DASH) command. This command moves any type of program from a file on a disk into memory, and then starts it running.

You can use the commands in this chapter

- to bring a program into memory and run it
- to bring a program into memory without running it
- to store the program that is currently in memory on a disk.

These commands are most useful when you are writing programs or modifying programs that already exist.

BASIC Program Files

Although the Apple II can use two dialects of the BASIC language—Applesoft and Integer BASIC—ProDOS supports only Applesoft. To use ProDOS, your Apple II must have Applesoft BASIC in Read Only Memory (ROM), and at least 64K of Random Access Memory (RAM).

When you start up /EXAMPLES, it displays the message

```
APPLESOFT IN ROM
```

telling you that the Applsoft language is indeed in Read Only Memory.

This Chapter's Commands

This chapter's commands are summarized below. Each causes the transfer of a program between memory and a disk file; the direction of the transfer and the type of file transferred are determined by the command you use.

– (DASH) Run any type of program

The EXEC command is described in Chapter 8.

Use this command as a short form of the RUN, BRUN, and EXEC commands. It causes a BASIC, binary, EXEC, or system program to be transferred from a disk file into memory and then executed. This is the command you use to run the ProDOS Filer without starting up /USERS.DISK.

RUN Run a BASIC program from a file

Binary program execution: see also the DASH command.

Use this command to copy a BASIC program, type BAS, from a disk file into memory to be executed automatically.

LOAD Get a BASIC program from a file

Use this command to copy a BASIC program, type BAS, from a disk file into memory. Once the program is in memory, you can run it, modify it, or save it in a disk file.

SAVE Save a BASIC program in a file

Use this command to save the BASIC program that is currently in memory as a BASIC disk file, type BAS.

The – (DASH) Command

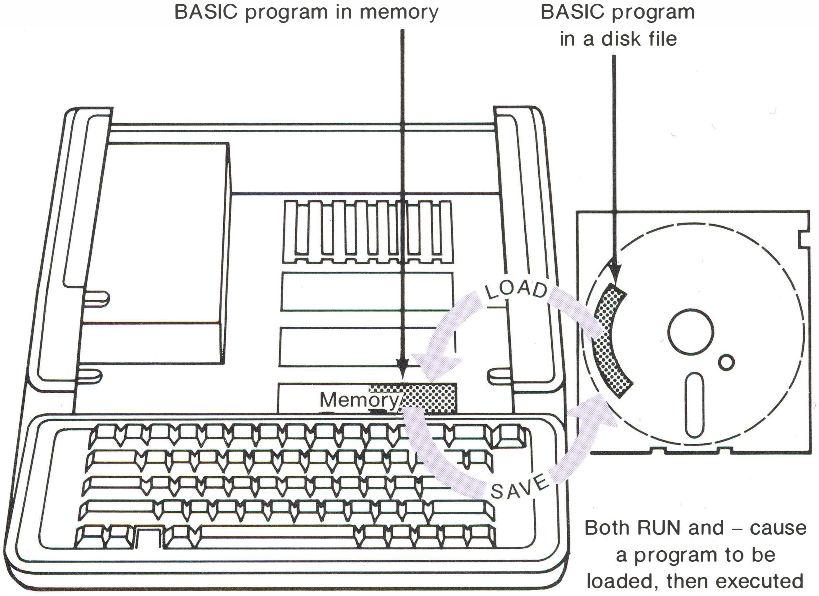
EXEC program: see Chapter 8.

One of the more useful features of ProDOS is the – (DASH) command. With this command you can bring into memory and run: a BASIC program, a machine-language program, an EXEC program, or a system program such as the ProDOS Filer.

To run a program of any one of these types, use the command

```
– pn [,S#] [,D#]
```

Figure 4-1. BASIC in Files


BASIC program in memory
BASIC program in a disk file
LOAD
Memory
SAVE
Both RUN and – cause a program to be loaded, then executed

When you run a system program, everything else in memory is destroyed. If you are writing a BASIC program, be sure to save it before running a system program.

For example, to run the ProDOS Filer, place the disk /USERS.DISK in one of your disk drives and type

To learn more about the way programs run, read the sections "The RUN Command" in this chapter and "The BRUN Command" in Chapter 9.

```
- /USERS.DISK/FILER
```

The Options

pn pn is the pathname or partial pathname of the file containing the program you want to run. The file must be of type BAS, BIN, TXT, or SYS. If the file is a binary file, it is loaded to the address from which it was last saved. All other file types cause the `FILE TYPE MISMATCH` error.

[,S#] The slot option has its usual meaning.

[,D#] The drive option has its usual meaning.

For Example

With ProDOS running, set the prefix to indicate the PROGRAMS directory with the command

```
PREFIX /EXAMPLES/PROGRAMS/
```

Look at the programs it contains by typing

```
CAT
```

Now try running a binary program (type BIN), a BASIC program (type BAS), and an EXEC program (type TXT) by typing a dash (–) followed by the filename of the program you want to run.

To run the Filer program (type SYS), place /USERS.DISK in a drive and type

```
- /USERS.DISK/FILER
```

To return to ProDOS from the Filer, be sure that /EXAMPLES is in a drive, type Q from the main menu, type the pathname `/EXAMPLES/BASIC`, and press RETURN.

By the Way: If you want easy access to the Filer, use the Filer program to copy the file /USERS.DISK/FILER to a disk that you usually have in a drive. Then you can use the Filer by typing the DASH command rather than starting up /USERS.DISK.

The RUN Command

To run an Applesoft program that is stored on a disk, use either of the commands

RUN pn [,@#] [,S#] [,D#]
– pn [,S#] [,D#]

The – (DASH) command is described earlier in this chapter.

Only the RUN command is described here.

When ProDOS sees the RUN command, it finds the file indicated by pn, brings it into memory, and then runs it (beginning with line @# if you use that option). For example, to run the BASIC program named CHECKBOOK on a disk named /ACCOUNTS , use the command

```
RUN /ACCOUNTS/CHECKBOOK
```

When a program ends, you can run it again by using the BASIC command

```
RUN
```

Notice that in the general form of the RUN command, the filename is not optional. When you type in a command, ProDOS checks to see if it is a ProDOS command. If it isn't, ProDOS gives the command to BASIC. In this case, RUN without a filename is not a valid ProDOS command; the command is passed to BASIC, and BASIC runs the program in memory.

The Options

pn — pn indicates the file to be run. The file to be run must be of type BAS (Applesoft BASIC).

[,@#] — If you use this option, the program begins running at the line number specified by #. If you omit this option, execution begins at the lowest numbered line in the program.

[,S#] — The slot option has its usual meaning.

[,D#] — The drive option has its usual meaning.

For Example

With ProDOS started up, and the /EXAMPLES disk in drive 1, set the prefix to indicate the /EXAMPLES/PROGRAMS volume directory using the command

```
PREFIX /EXAMPLES/PROGRAMS/
```

Look at the files in the PROGRAMS directory with the command

```
CAT
```

Do you see a program named `TWO.LINER` ? Run the program by typing

```
RUN TWO.LINER
```

and the screen displays the words

```
I'M LINE 10. I'M LINE 20.
```

But if you run part of the program using the command

```
RUN TWO.LINER ,@20
```

you just see

```
I'M LINE 20.
```

If you examine the program by typing

```
LIST
```

you'll discover that line 20 contains that sentence.

The LOAD Command

To transfer a BASIC program from a file to memory, use the command

LOAD pn [,S#] [,D#]

This command is useful if you want to examine or modify a program. It is not necessary to load a program before you run it; the RUN command automatically loads a program into memory.

Warning
When a new program is loaded into memory, all records of the previous program are erased from the Apple II's memory. If you want to save the variables that were set by a previous program, use the STORE command.

The STORE command is described in Chapter 5.

When you LOAD the contents of a file into memory, the file on the disk remains unchanged.

Once a program is loaded into memory, you can run it by simply typing `RUN`.

The Options

pn pn must indicate an Applesoft program file (type BAS).

[,S#] The slot option has its usual meaning.

[,D#] The drive option has its usual meaning.

For Example

With ProDOS started up, and the /EXAMPLES disk in drive 1, set the prefix to indicate the /EXAMPLES/PROGRAMS volume directory using the command

```
PREFIX /EXAMPLES/PROGRAMS/
```

Type `NEW` to remove any BASIC program from memory, then type `LIST` just to prove that there is no BASIC program in memory. Now, bring a new program into memory with the command

```
LOAD WHIZBOOM
```

You hear the disk drive working away, then the BASIC prompt returns. To see the program that was just loaded, type

```
LIST
```

It is important to realize that when you load a file, a copy of the file is transferred from the disk to memory, but the original copy of the file remains unchanged on the disk. For example, even though you have already loaded WHIZBOOM, type the command

```
CAT
```

and you see that the file is still on the disk. To place the BASIC program that is currently in memory into a file, use the SAVE command.

The SAVE Command

To transfer the BASIC program that is currently in memory to a file on a disk, use the command

SAVE pn [,S#] [,D#]

The file is saved as an Applesoft file (type BAS).

For example, to save the current program in a file named /BEDTIME.STORIES/A.FRIENDLY.OGRE , use the command

```
SAVE /BEDTIME.STORIES/A.FRIENDLY.OGRE
```

If you save a program to a filename that already exists, the file must not be locked, and it must be of the same type as the program (type BAS).

Warning
If you are working with several different program files at once, and there is a chance you will save a program to the wrong file, LOCK each file after you save to it, and then UNLOCK it before you save to it again. This is the best way to protect valuable BASIC programs.

By the Way: You can use the SAVE command to rearrange program files. If you use the LOAD command to bring a program into memory, you can then use the SAVE command to save it on a different disk (you would then have two copies of the same file). Remember that when you load a BASIC program from a file, the file itself does not change.

The Options

pn pn is the pathname or the partial pathname of the file in which you want to save the current program. If pn already exists, it must be unlocked.

[,S#] The slot option has its usual meaning.

[,D#] The drive option has its usual meaning.

For Example

With ProDOS started up, and the /EXAMPLES disk in drive 1, set the prefix to /EXAMPLES/PROGRAMS with the command

```
PREFIX /EXAMPLES/PROGRAMS/
```

Now load a very short program into memory with the command

```
LOAD VERY.SHORT
```

To see how short this program is, type the command

```
LIST
```

and you see before you a single line of program which reads

```
10 PRINT "A VERY SHORT PROGRAM"
```

Even if you aren't a programmer, you might guess that this program does one and only one thing: it prints the words A VERY SHORT PROGRAM onto the screen. To see it do its very short thing, type

```
RUN
```

Remember that the RUN command without a filename is not a ProDOS command; it is a BASIC command that causes the program that is currently in memory to be run.

Now for the fun part. Save the program to a different disk file, say /EXAMPLES/PROGRAMS/ONE.LINER, with the command

```
SAVE ONE.LINER
```

You can see that the program has found its new home by typing

```
CAT
```

Notice that the first copy of the program, VERY.SHORT, is still on the disk. Notice also that a program, even after a SAVE, remains in memory. Use RUN or LIST to see that the program is still there.

If you have an Apple IIe with an Extended 80-Column Text Card, you can also save this program to a file on the volume named /RAM. Type the command

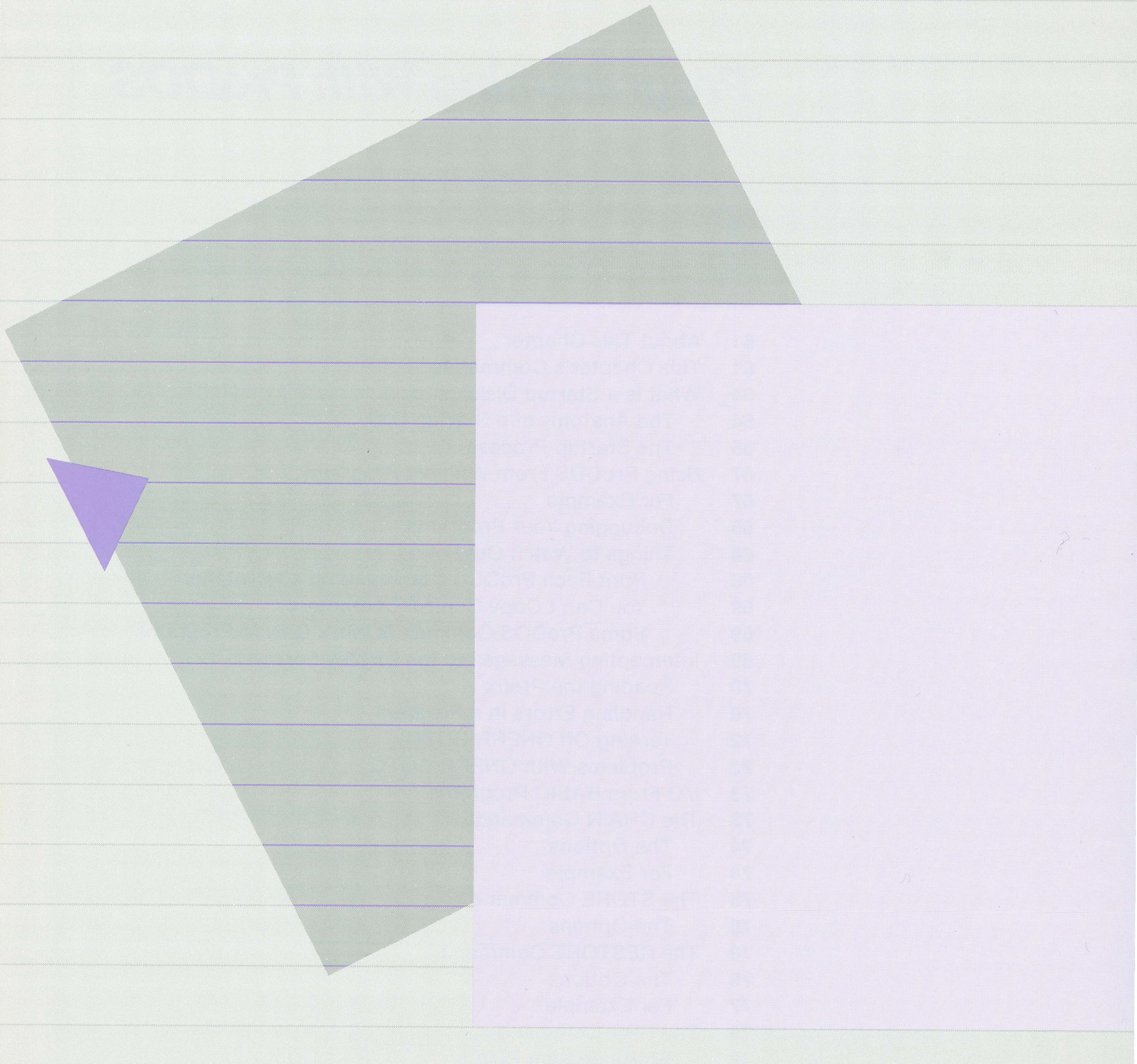
```
SAVE /RAM/ONE.LINER
```

You can see that this version of the program has been saved by using the command

```
CAT /RAM
```

Notice how much faster /RAM is than a normal disk volume. It is most useful when you are developing a large BASIC program and you wish to save intermediate versions of it frequently.

Programming With ProDOS



Programming With ProDOS

About This Chapter

This chapter contains an overview of programming with ProDOS. It describes

- the startup process and how to make a startup disk
- how to use ProDOS commands from within a program
- how to read the prefix from within a program
- how a program can handle errors
- how your programs can communicate with devices in slots.

You should have some experience with Applesoft BASIC. If you did all the examples in the *Applesoft Tutorial*, you know enough. If you didn't, you should work your way through it before continuing with this manual.

If you know Integer BASIC, but not Applesoft, read the appendix in the *Applesoft BASIC Programmer's Reference Manual* that summarizes the differences between the two.

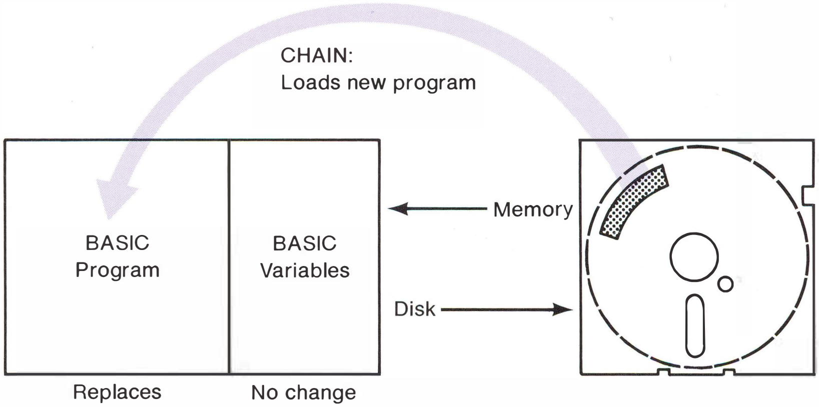
This Chapter's Commands

The commands described in this chapter are summarized below. This is not meant to be a complete description of each command; it simply gives you an idea of the use of each command and of the way the commands are interrelated.

CHAIN Run a program, but save the variables

Use this command to run a new program. Unlike RUN, it does not cause the variables that are already in memory to be thrown away.

Figure 5-1. CHAIN



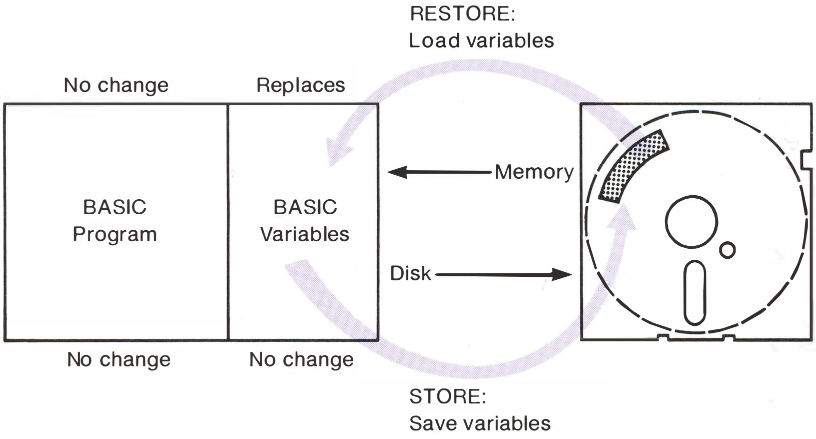
STORE Save the variables in memory to a file

Use this command to save in a file all the BASIC variables that are currently in memory. You can retrieve these variables by using the RESTORE command.

RESTORE Get BASIC variables from a file

Use this command to discard the variables that are currently in memory, and to bring in new variables from a file.

Figure 5-2. STORE and RESTORE



PR# Send output to a slot

Chapter 9 explains how to use PR# to send output to a program.

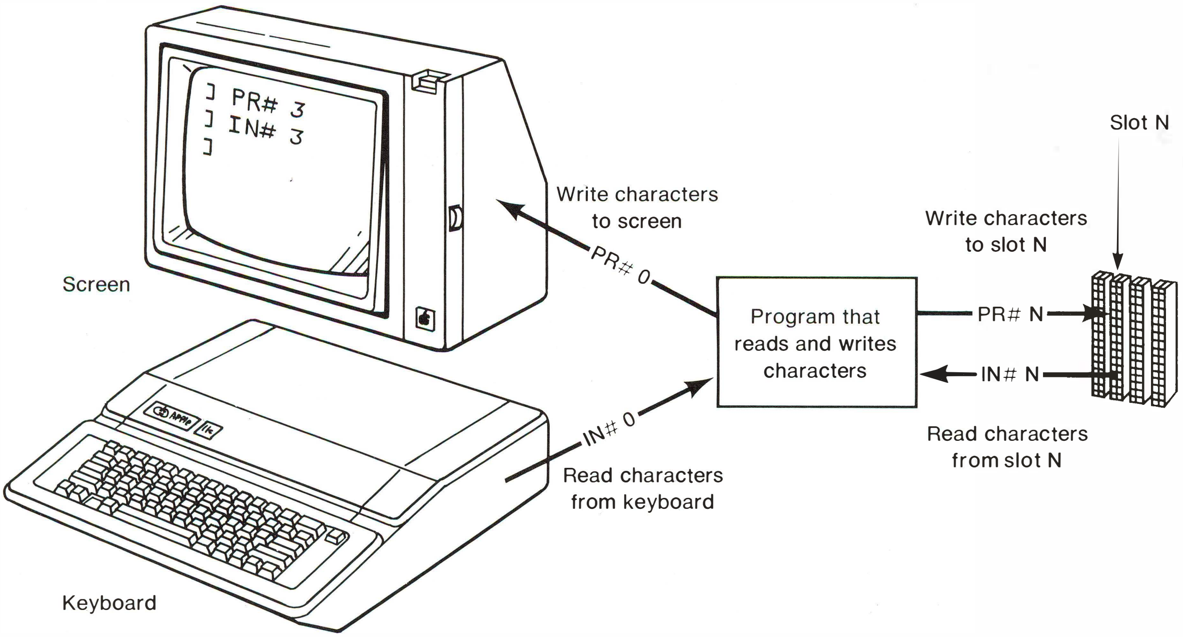
Use this command to cause the characters that are normally printed on the screen to be sent to a device, such as a printer, in a slot.

IN# Get input from a slot

Chapter 9 explains how to use IN# to get input from a program.

Use this command to cause characters to be read from a device, such as an external terminal, in a slot instead of from the keyboard.

Figure 5-3. PR# and IN#



] PR# 3
] IN# 3
]
Screen
Keyboard
Write characters to screen
PR# 0
IN# 0
Read characters from keyboard
Program that reads and writes characters
Slot N
Write characters to slot N
PR# N
IN# N
Read characters from slot N

What Is a Startup Disk?

Every Apple II system has a particular disk drive known as the system's **startup drive**. The startup drive is connected to drive 1 of the disk controller card in the highest numbered slot. This chapter assumes that your startup drive is connected to slot 6.

A **ProDOS startup disk** contains all the information needed to bring ProDOS into memory and start it running.

When you place a disk in the startup drive and turn on your Apple II, some disks cause the system to start up, other disks just spin. The disks that cause the system to start up are known as **startup disks**. A startup disk contains all the crucial information that the Apple II needs to bring a program from a disk into the Apple II's memory and start a program running.

To make any ProDOS-formatted disk into a ProDOS startup disk, you must copy the files containing the ProDOS program onto that disk. When you turn on the Apple II (or type `PR# 6` from BASIC) with a ProDOS startup disk in the startup drive, the ProDOS program is automatically transferred from disk to memory and run.

Once you have made other startup disks, you will no longer need to use the /EXAMPLES disk each time you use ProDOS. All the vital parts of ProDOS are stored on each startup disk. In addition, by copying the files HELP and HELPSCREENS onto the startup disk, you can use the help feature with other startup disks.

Examples of STARTUP programs are given later in this chapter.

You can designate any program to be automatically run when a ProDOS disk is started. You do so by putting the program in a file named STARTUP. This file, which may contain a binary, BASIC, or EXEC program, can contain a program that places a greeting message on the screen, a favorite game, budgeting program, or other program of your choice.

The Anatomy of a Startup Disk

A ProDOS' startup disk has three characteristics:

- It is formatted using the ProDOS Filer.
- It has the file PRODOS in its volume directory.
- It has a file named BASIC.SYSTEM in its volume directory.

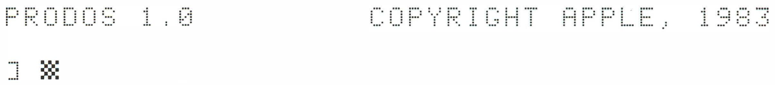
To make a ProDOS startup disk:

1. Use the ProDOS Filer to format a disk.
2. Use the ProDOS Filer to copy the files PRODOS and BASIC.SYSTEM from the /EXAMPLES disk to the newly formatted disk.
3. If you want a specific program to be run when you start up that disk, place it on the startup disk and name it STARTUP.
4. If you wish to use the help commands after you start up from that disk, copy the files HELP and HELPSCREENS from the /EXAMPLES disk to the new startup disk.

The Startup Process

When you start up your Apple II with a proper ProDOS startup disk, here is what happens:

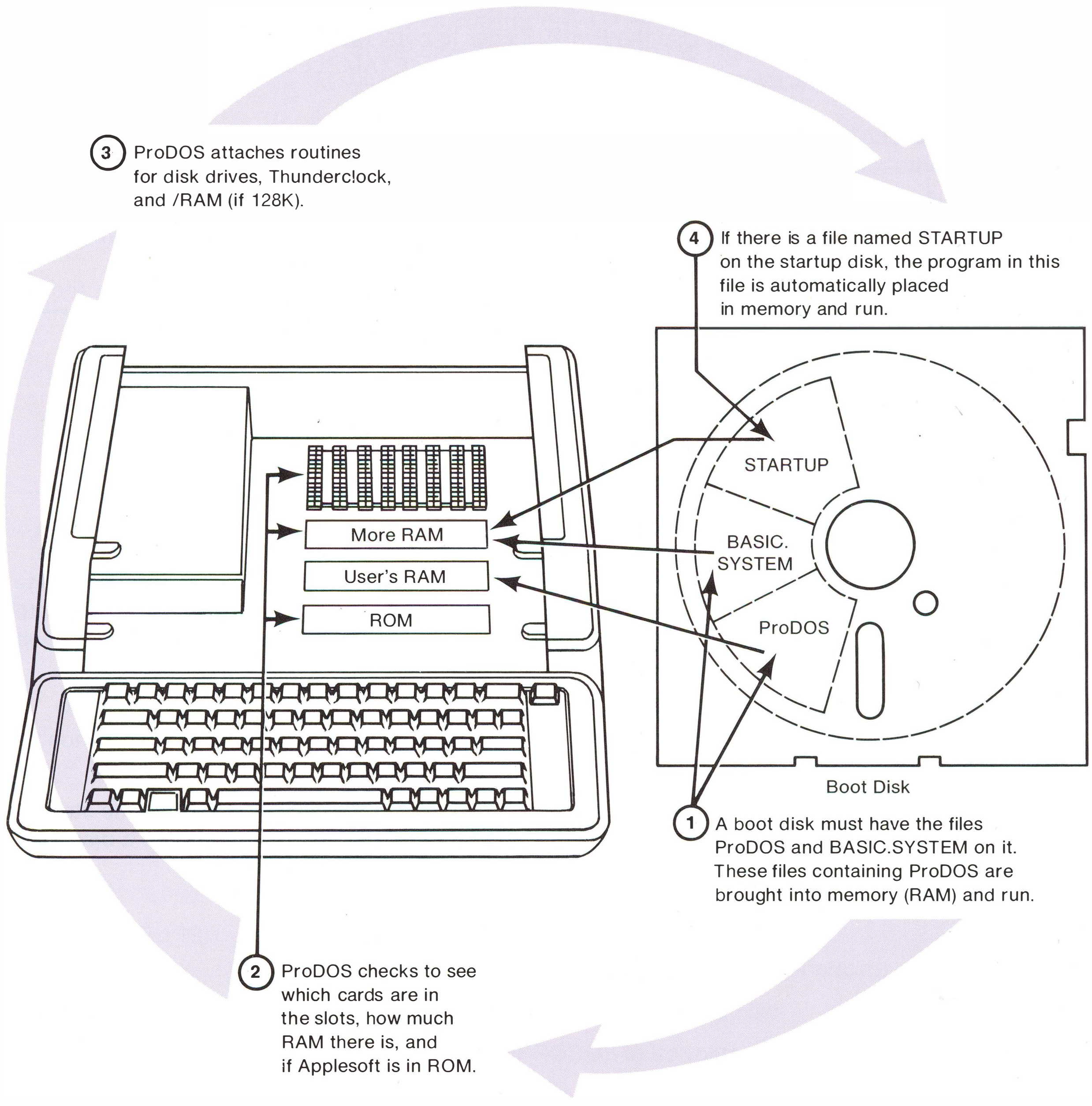
1. The file named PRODOS, containing the most sophisticated parts of ProDOS, is transferred from the startup disk into memory and run.
2. ProDOS examines the peripheral connector slots and tries to identify the type of device in each slot. It does this to determine which slots contain disk drives that it may need to communicate with. If one of the devices is a Thunderclock, ProDOS sets itself up to read from the Thunderclock.
3. It then loads the program in the file named BASIC.SYSTEM. This portion of ProDOS contains all the ProDOS commands. This part of the program is run.
4. ProDOS BASIC looks for a file named STARTUP on the startup disk. If it finds one, it runs it. If it does not find one, it displays the following message:



```
PRODOS 1.0          COPYRIGHT APPLE, 1983

] ▒
```

Figure 5-4. The Startup Process

Figure 5-4 illustrates the steps in the startup process.



1 A boot disk must have the files ProDOS and BASIC.SYSTEM on it. These files containing ProDOS are brought into memory (RAM) and run.

2 ProDOS checks to see which cards are in the slots, how much RAM there is, and if Applesoft is in ROM.

3 ProDOS attaches routines for disk drives, Thunderclock, and /RAM (if 128K).

4 If there is a file named STARTUP on the startup disk, the program in this file is automatically placed in memory and run.

Using ProDOS From Within a Program

Very often it's useful to be able to use a ProDOS command from within a BASIC program. For example, you can use ProDOS commands in a program

- to print out a disk's catalog from a STARTUP program
- to save your budget records in a file
- to save the condition of a game program for next time.

To use a ProDOS command from within a program, you must print a string consisting of a CONTROL-D as the first thing on a printed line, followed by the command. Using the CATALOG command as an example, here is one way to put CONTROL-D in a string:

There is a CONTROL-D between " and C.

```
10  PRINT "CATALOG"
```

Right after you type the first quotation mark, type CONTROL-D. Although you can't see it, it's there.

Here is another way to put CONTROL-D in a string:

CHR$ (4) returns CONTROL-D.

```
10  PRINT CHR$ (4);"CATALOG"
```

In this example, CHR$ is an Applesoft function that returns the character whose code is in parentheses. The number 4 is the Apple II's code for CONTROL-D. Note the semicolon after CHR$ (4). It is an optional separator between elements of a PRINT list, and you may leave it out if you want.

If you set the value of a string variable, say D$, to CONTROL-D at the beginning of a program, simply print `D$` before each ProDOS command in the program. This is the method used throughout the manual (see line 40 in the example below).

For Example

Here is a version of a STARTUP program that prints a message on the screen, and then prints out a list of the files on that disk. Type `NEW`, and then enter this program.

D$ contains CONTROL-D.
Print a title.
Print a date.
Then list the volume directory.

```
5  REM  APPLESOFT STARTUP
10 D$ = CHR$ (4)
20  PRINT "PRODOS TEST PROGRAMS"
30  PRINT " 26 NOVEMBER 1985"
40  PRINT D$;"CATALOG"
50  END
```

Now type RUN to see how it works. If you want to preserve this program, put a ProDOS-formatted disk in drive 1, and type

```
SAVE STARTUP
```

Debugging Your Programs

If you are a former DOS user, you will be pleased to discover that the Applesoft commands TRACE and NOTRACE work with ProDOS.

Use the TRACE command to cause the line number of each BASIC program line that is executed to be printed on the screen. Use the NOTRACE command to stop the printing of line numbers.

Things to Watch Out For

Three things you should watch out for while using ProDOS are described in the following sections.

Print Each ProDOS Command on a New Line

In a ProDOS command given from within a program, CONTROL-D must be preceded by RETURN; that is, CONTROL-D must be the first character on a printed line. Thus, the following program will not work.

D$ is CONTROL-D.
Semicolon prevents RETURN.
So this doesn't work.

```
30 D$ = CHR$ (4)
40  PRINT "AUTUMN ";
50  PRINT D$;"CATALOG"
```

Instead of listing the volume directory, this program prints

```
AUTUMN CATALOG
```

If your program is unexpectedly printing ProDOS commands on the screen—and never at the beginning of a new line—this is probably why.

Notice: If your program contains a statement like this, with RETURN preceding CONTROL-D:

```
D$ = CHR$ (13) + CHR$ (4)
```

your program will only work with DOS and not with ProDOS. Remember that CONTROL-D must be the first thing on a printed line.

You Can't Copy Control Characters

When you use → to copy a BASIC statement, invisible control characters are not copied.

Some ProDOS Commands Work Only In Programs

Most ProDOS commands can be given from the keyboard as immediate commands or from within programs as deferred commands. Some can only be used from within programs. They are

APPEND
OPEN
POSITION
READ
WRITE

If you aren't sure if a ProDOS command can be used from immediate mode, simply use the HELP command. The upper-right corner of each help screen tells how that command can be used (as IMM[ediate] or DEF[erred] commands). For example, type

Display WRITE help screen.

```
HELP WRITE
```

and you see that this command can only be used in a program.

Intercepting Messages to the Display Screen

You can use several ProDOS commands to cause ProDOS to send information to the screen. The CATALOG command produces a list of files, the PREFIX command without options displays the prefix, and, if you use any command incorrectly, an error message is sent to the screen.

ProDOS provides a way for your program to read the value of the prefix or the number of an error message; these are explained below.

Directory files can be opened and read as explained in Appendix D.

Reading the Prefix

When you give the PREFIX command without options from the keyboard, the current value of the prefix is displayed. When you use the PREFIX command from within a program, ProDOS does not display the value of the prefix. Instead, ProDOS places the value of the prefix so the next INPUT statement in your program will read it.

You might use this feature, for example, if your program changes the value of the prefix, and you want to restore the prefix to its former value before the program ends. Here is a program portion that does that.

CHR$(4) is CONTROL-D.
Command to display prefix.
Read the prefix into PR$.

```
10 D$ = CHR$ (4)
20  PRINT D$;"PREFIX"
30  INPUT PR$
```

Rest of program which changes the value of the prefix

Restore prefix to original value.

```
200  PRINT D$;"PREFIX ";PR$
```

Notice the way this feature works: You give the prefix command without any options, and input the prefix into any string variable, in this case, PR$. When you want to restore the prefix, the old value is in the string.

Handling Errors in a Program

An error in an Applesoft program normally causes an error message to appear on the display screen. If your program uses the ONERR GOTO statement, Applesoft puts an error number in memory, and then goes to the line specified in the ONERR GOTO statement.

ProDOS follows the same procedure. When it encounters an error, it places the error number in memory, and then tells Applesoft that it found an error. ProDOS uses error numbers not used by Applesoft. Table 5-1 lists the numbers that are useful to a program trying to catch ProDOS or Applesoft errors.

Table 5-1. Memory Locations for Error Handling

Number	How to Read It
Error Number	PEEK (222)
Line Number	PEEK (218) + PEEK (219) * 256

For example, you cannot rename a file if it is locked. The error number for FILE LOCKED is 10. This small program lets you rename a file whether or not it is locked. Using ONERR GOTO, it detects the FILE LOCKED error, gives you a chance to unlock the file, then it tries to rename the file again. It also displays the error number and line number of any other error that might occur.

D$ is CONTROL-D.
Error handled at line 100.
Read a filename into F$.
Read the new name into N$.
Give the RENAME command.
No error; program ends.

```
5   REM   ONERR.DEMO
10  D$ = CHR$ (4)
20   ONERR GOTO 100
30   INPUT "FILE TO RENAME? ";F$
40   INPUT "NEW NAME? ";N$
50   PRINT D$;"RENAME ";F$;",";N$
60   END
```

Line 20 causes line 100 to be called if there is any error.

If it is not a FILE LOCKED error (10), go to line 200.

```
100  IF PEEK (222) <> 10 THEN 200
```

No, don't rename the file.
Yes, unlock the file, rename it, and then lock it again.

```
110  INPUT "FILE IS LOCKED. RENAME ANYWAY? (Y/N) ";Y$
120  IF Y$ <> "Y" AND Y$ <> "y" THEN END
130  PRINT D$;"UNLOCK ";F$

140  PRINT D$;"RENAME ";F$;",";N$
150  PRINT D$;"LOCK ";N$
160  END
```

All done.

Line 100 calls line 200 if there's an error other than FILE LOCKED.

```
200  PRINT "ERROR #";PEEK (222);" DETECTED"
210  PRINT "AT LINE ";PEEK (218) + PEEK (219) * 256
220  END
```

This program is saved with the name /EXAMPLES/PROGRAMS/ONERR.DEMO . Try it on a few of your locked files.

Its operation is quite simple. Line 30 reads the name of a file to be renamed into F$. In line 40 it reads the new name into N$. In line 50 the RENAME command is given. If there is no error, the file is renamed, and the program ends. If there is an error, the ONERR statement in line 20 says that the program should look to line 100 for the part of the program that treats the error.

Line 100 checks location 222 to make sure that a `FILE LOCKED` error (error number 10) occurred. If it was not a `FILE LOCKED` error, the program goes to lines 200 and 210, which display the number of the error and the number of the line where it occurred.

If the file was locked, line 130 unlocks it, line 140 renames it, and line 150 locks it up again—under its new name.

A complete list of the ProDOS and Applesoft errors is in Appendix C.

Turning Off ONERR GOTO

On occasion you will use ONERR GOTO to detect one error, and it will be triggered by another error. To prevent this, you must turn off the ONERR GOTO feature. To do this, use the statement

Refer to the *Applesoft BASIC Programmer's Reference Manual* for more details on ONERR GOTO.

```
POKE 216,0
```

in your program when you want ONERR GOTO to be disabled. It is a good idea to use ONERR GOTO in the statement preceding the one that might generate the error, and to turn it off in the following statement.

Problems With ONERR GOTO

As described in the *Applesoft BASIC Programmer's Reference Manual*, ONERR GOTO does not work quite as it should. If you encounter apparent problems with ONERR GOTO, include the following lines in your program:

This ONERR fixing routine is more fully explained in the *Applesoft BASIC Programmer's Reference Manual*.

```
1 FOR I = 0 TO 9 : READ ZZ : POKE
   768+I,ZZ : NEXT I

9999 DATA 104,168,104,166,223,154,
     72,152,72,96
```

Then, within your error-handling routine, use the call

```
200 CALL 768
```

to activate this little ONERR fixer. Of course, you can change the numbers of any of these lines. Just make sure that line 1 is run before line 200 is.

I/O From BASIC Programs

The remainder of the commands in this chapter enhance your Apple II's ability to communicate with other BASIC programs and with devices such as printers and disk drives that are in the Apple II's peripheral connector slots. Such communication is referred to as the input of information and the output of information, collectively known as input/output or, more simply, I/O.

You can use the CHAIN command to let one program run another without destroying the variables that are currently in memory. Using CHAIN, two programs in separate files can use the same set of variables, or one very large program can be divided into more than one part.

With the STORE command you can save the names and values of all your program's variables. If a program stores all its variables before ending, the next time you run it you can use RESTORE to start up exactly where it left off.

You can use the PR# and IN# commands to let BASIC communicate with devices that are in any of the Apple II's slots.

Finally, you can use the FRE command to access the fast housekeeping routines that ProDOS has.

The CHAIN Command

If a BASIC program is too big to fit entirely in memory, you can use the CHAIN command to bring parts of the program into memory and then run each part, one at a time. All variables used, and all files opened (see the next chapter) by the current part of the program are available to the parts of the program connected by the CHAIN command.

To run part of a program without throwing away the current variables or closing the open files, use the command

```
CHAIN pn [,@#] [,S#] [,D#]
```

When you chain from one part of a program to another, the first part of the program is removed from memory. To use the first part of the program again, use the CHAIN command again.

Execution of the second program begins at the line indicated by [,@#], the line number parameter. If you don't use [,@#], execution begins at the lowest numbered line in the program.

Warning
A chained portion of the program cannot dimension an array used by a previous part of the program.

The Options

pn   pn indicates the file containing the BASIC program you want to run next.

[,@#]   If you use this option, the new program begins running at the line number specified by #. If the specified line does not exist, the next highest line in the program is run. If you omit this option, execution begins at the lowest numbered line in the program.

[,S#]   The slot option has its usual meaning.

[,D#]   The drive option has its usual meaning.

For Example

Here is an example of a program, PART1 , that uses the CHAIN command with the line number option to connect a second program part, PART2 . Both parts are already typed in for you. Set the prefix to /EXAMPLES/PROGRAMS using the command

```
PREFIX /EXAMPLES/PROGRAMS/
```

Look at PART1 and list it using the commands

Bring PART1 into memory.
Display it.

```
LOAD PART1
LIST
```

You see

D$ is (CONTROL)-(D).
Set the prefix.
Set a string value
   and say that it's been set.
Chain to line 35 of PART2.

```
5  REM  PART1
10 D$=CHR$(4)
20  PRINT D$;"PREFIX /EXAMPLES/PROGRAMS"
30 I$="THE STRING I$ IS PRESERVED."
40  PRINT"PART1:  I$ HAS BEEN SET."
50  PRINT D$;"CHAIN PART2 ,@35"
```

The experiment here is to see if the variable I$ retains the value set by PART1 when it is printed out by PART2 . Now type

Bring PART2 into memory.
Display it.

```
LOAD PART2
LIST
```

and you see

This shouldn't be printed.
If it is, skip 35.
This should be printed
and so should this.

```
5  REM  PART2
15  PRINT"PART2:  WRONG LINE NUMBER."
25  GOTO 45
35  PRINT"PART2:  RIGHT LINE NUMBER."
45  PRINT"PART2:  ";I$
```

If the CHAIN command in line 50 of PART1 works properly, line 35 should be the first line that is executed, and the statement PART2: RIGHT LINE NUMBER. should be printed on the screen. If the line number option does not work properly, the first line in the program (line 15) will be executed first, and the statement, PART2: WRONG LINE NUMBER. will be displayed.

Line 45 displays the line PART2: THE STRING I$ IS PRESERVED if the variables are preserved, and simply displays PART2: if the variable I$ is not preserved.

Place your bets on what will be printed out, and then type

```
RUN PART1
```

The STORE Command

The STORE command allows you to save to a disk file the names and values of all the variables that are used by a BASIC program. You can retrieve the variables using the RESTORE command.

An example using the STORE command is at the end of the section on the RESTORE command.

A game program, for example, can contain the STORE command to save the condition of a game when you stop playing. The next time you play the game, the program can RESTORE the variables from the file, and you can continue where you left off. You can also use the STORE command to create a set of information that is used by more than one program.

To store the current variables in a file use the command

STORE pn [,S#] [,D#]

The STORE command creates and places the variables in a file of type VAR.

Warning
Because ProDOS puts the variables in a compact form before it stores them, there may be a considerable time delay from when you issue the STORE command to when the disk drive starts spinning.

The Options

pn pn is the pathname or partial pathname of the file in which to store the variables. If the file doesn't already exist, a file of type VAR is created.

[,S#] The slot option has its usual meaning.

[,D#] The drive option has its usual meaning.

The RESTORE Command

The RESTORE command allows you to get from a disk file the names and values of a set of variables to be used by a BASIC program. Only a file created by the STORE command can be retrieved by the RESTORE command.

To retrieve a set of variables from a file, use the command

```
RESTORE pn [,S#] [,D#]
```

This command clears all currently defined variables from memory before bringing in the new ones.

The Options

pn pn is the pathname or partial pathname of the file containing the BASIC variables. The file must be of type VAR.

[,S#] The slot option has its usual meaning.

[,D#] The drive option has its usual meaning.

For Example

Your /EXAMPLES disk has a number guessing program called E.S.P. on it. Set the prefix to /EXAMPLES/PROGRAMS by typing

```
PREFIX /EXAMPLES/PROGRAMS
```

Then run the program by typing

```
RUN E.S.P.
```

Play with it for a while, and then type Q to quit. Type

```
RUN
```

again, and guess a number. Notice that the overall score starts at 0 again. You are going to use the STORE and RESTORE commands to make this program remember your overall score from one game to the next. Type Q to exit the game.

Display the program on the screen using the BASIC command

```
LIST
```

Your task is to add the STORE and RESTORE commands to the program. Since RESTORE clears all the variables that are currently defined, it is a good idea to use this command as the first line in a program. However, before including the RESTORE command in the program, you must create a file from which it can read variables.

Look at the last line in the program

```
200 END
```

This, the last line executed before the program ends, is the best place to place a STORE command. Type

```
200 PRINT D$;"STORE/EXAMPLES/DATA/ESPVARIABLES"
210 END
```

and then list the program again to be sure that the new lines are correct. Now when you run the program, the STORE command will create the new file ESPVARIABLES. Then you can add the RESTORE command to the program. Type

```
RUN
```

and play the game for as long as you like; then press Q. Notice that the disk drive whirs as the variable file is placed on the disk. Type

```
CAT
```

to verify that the new file was created. Now look at the first few lines of the program by typing

```
LIST -30
```

Add the line

```
30 PRINT D$;"RESTORE/EXAMPLES/DATA/ESPVARIABLES
```

Once again type

```
RUN
```

to play the game. Press any number, then look at the overall score. The game now remembers the total score of all the previous times you played the game. To save this game in the PROGRAMS directory, use the command

```
SAVE NEWESP
```

Do you have ESP?

The PR# Command

Your Apple II usually sends characters to the display screen. You can use the PR# command to change the destination of characters, sending them to a device in one of the Apple II's peripheral connector slots instead of to the screen. The syntax is

PR# snum

in which snum is a slot number from 0 to 7. For example, if your Apple II has an interface card for a printer installed in slot 1, the command

```
PR# 1
```

causes subsequent printed characters to be sent to the printer. To restore the screen as the destination for printed characters, use the command

```
PR# 0
```

Warning
If you are using an 80-column card, make sure it is turned off before you issue another PR# command. On an Apple IIe, type ESC CONTROL-Q to turn off the 80-column card. For other types of 80-column cards, refer to the card's documentation to discover how to turn it off.

Warning
Always remember to precede the PR# command with a CONTROL-D when you use it in a program. If you don't, ProDOS ignores the command entirely. If you think that your program isn't carrying out the PR# and IN# commands correctly, this could be the reason.

Starting Using PR#

If your Apple II has a disk controller card in one of its slots, you can start up the disk in that card's drive 1 with the command

PR# snum

in which snum is the number of the slot containing the card. It may seem to you that this command only sets up the disk to receive future characters, but PR# actually does a little more.

When you use the PR# command to send output to a peripheral card in a slot, ProDOS tries to run the program in that card's Read Only Memory chip (most cards have them). The program in the ROM of a disk controller card automatically tries to read information from the disk; this is, of course, exactly what starting up the system is.

Refer to Chapter 9 for more details on using the PR# command to output characters.

You can also use the PR# command to call a machine-language program that is to perform the output of characters.

The Options

snum snum is the number of the slot to which you want to write. If snum is in the range 1 to 7, inclusive, future characters are sent to the device in that slot. If snum is 0, future characters are sent to the screen. All other values of snum are invalid and must not be used.

For Example

First save any BASIC program that might be in memory, then place your /EXAMPLES disk in drive 1, close the door, and type

```
PR# snum
```

replacing snum with the number of the slot (probably 6) to which your Disk II controller card is connected. Disk drive 1 whirs and clicks and then ProDOS starts up as if you just turned the Apple II on.

If a printer is connected to one of the Apple II's slots, you can try this example too. First, turn on the printer. Then, replacing snum with the number of the slot to which your printer is connected, type

```
PR# snum
```

The printer makes a little clicking noise. Like the disk controller card, the printer's card has a ROM chip that contains an initialization program. The printer card's program initializes the printer to a previously set condition, placing the head or printwheel to the beginning of the line, and doing whatever else needs to be done. Now type

```
CATALOG
```

and the contents of the /EXAMPLES volume directory are printed. Play around with a few BASIC commands. You will find that everything that is normally printed to the screen is now printed on the printer. To return output of characters to the screen, type

```
PR# 0
```

If your system has an 80-column card, you can now turn it back on.

The IN# Command

Your Apple II usually reads characters from the keyboard. You can use the IN# command to change the source of characters from the keyboard to a device in one of the Apple II's peripheral connector slots. The syntax of the command is

IN# snum

in which snum is a slot number from 0 to 7. For example, if your Apple II has an external terminal connected through slot 3, the command

```
IN# 3
```

causes subsequent characters to be read from the terminal. To restore the Apple II's keyboard as the source for input characters, use the command

```
IN# 0
```

Warning

Always remember to precede the IN# command with a CONTROL-D when you use it in a program. If you don't, ProDOS ignores the command entirely.

You can start up the disk in drive 1 of slot snum by typing the command

```
IN# snum
```

IN# can also be used to call a machine-language program that is to perform the character input operation.

Refer to the section on PR# for more details on starting up. Chapter 9 contains an explanation of using IN# to input characters.

The Options

snum snum is the number of the slot from which you want to read. If snum is in the range 1 to 7, inclusive, future characters are read from the device in that slot. If snum is 0, future characters are read from the Apple II's keyboard. All other values of snum are invalid and must not be used.

The FRE Command

To give access to the fast housekeeping routines that ProDOS has, you can use the FRE command in this form

```
FRE
```

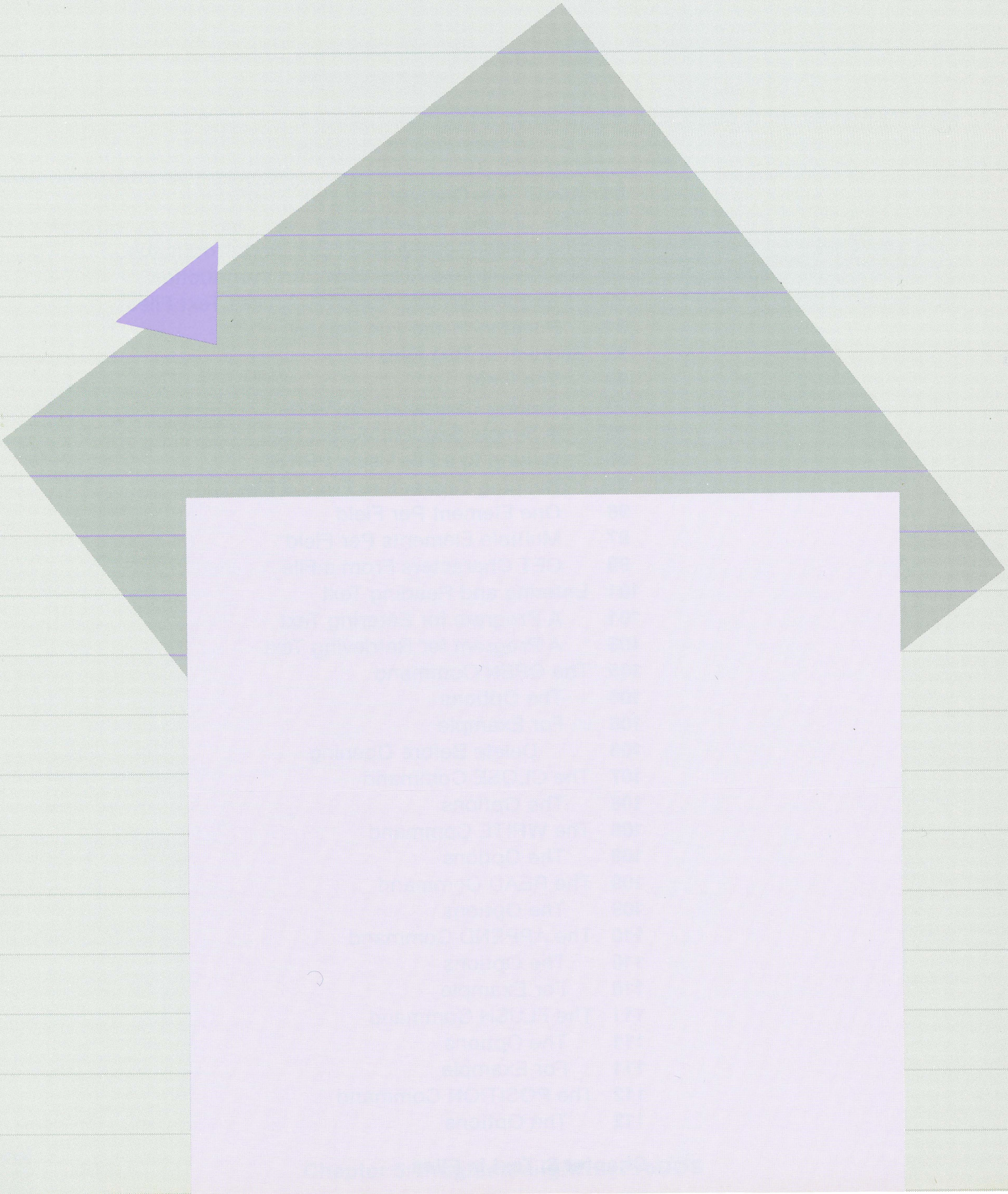
For Example

You can use the FRE command in a program in the same format as any disk I/O command

```
PRINT CHR$ (4);"FRE"
```

By the Way: The Applesoft command `PRINT FRE(X)` still works, but it uses the slow Applesoft housekeeping routines instead of the faster ProDOS routines.

Text in Files



Text in Files

About This Chapter

This chapter introduces you to the use of ProDOS text files. It describes how to create them, how to place information in them, and how to take information from them.

The first part of the chapter is an introduction to the two types of text files: **sequential-access** text files, and **random-access** text files. The next part of the chapter teaches you how to write programs that use sequential-access text files. The last part of the chapter is a description of the text file commands as used with sequential-access text files.

The next chapter teaches you how to write programs that use random-access text files. It is a continuation of this chapter, so read this chapter first.

You might use the commands described in this chapter

- in a program that keeps a list of words for a guessing game
- in a program that saves and retrieves text
- in a program that saves and analyzes experimental data.

This Chapter's Commands

The commands in this chapter are summarized below. These are all the commands you need to use ProDOS text files.

OPEN Prepare to use a file

You must use this command before you use a text file. If the file mentioned does not exist, a text file is created. If the file does exist, OPEN checks to see that the file is a text file.

CLOSE Stop using a file

Use this command to tell ProDOS that you have finished reading from and writing to a file. Before ending, your program must close all the files that it opened.

WRITE Prepare a file for writing

Use this command to tell ProDOS the file you want to write to and where in the file you want to start writing. You can use the WRITE command only after the file is opened; it remains in effect until you give the next ProDOS command.

READ Prepare a file for reading

Use this command to tell ProDOS the file you want to read and where in the file you want to start reading. You can use the READ command only after the file is opened; it remains in effect until you give the next ProDOS command.

APPEND Prepare to write to the end of a file

Use this command to write data starting at the end of a text file. It opens the file, positions to the end of the file, and then writes to the file.

FLUSH Send all unwritten data to the file

ProDOS writes characters to files in groups, not one by one. FLUSH causes all characters that are not yet written to a file to be sent. After you use FLUSH, you can be sure that the characters in the file are identical to those that the program has printed. The CLOSE command does a FLUSH before it actually closes a file.

POSITION Read and discard fields in a file

A **field** is a sequence of characters that ends with a carriage return.

This command lets you skip a specified number of fields in the text file before you read or write more information.

Of These Commands: *Only CLOSE and FLUSH can be used in immediate mode.* All can be used in programs.

Sequential-Access Text Files: An Introduction

You can think of a disk full of sequential-access text files as a collection of scrolls. Each scroll, like the sequential text file it models, can contain an unlimited number of lines of text. The analogy is appropriate because in both cases you must search through line by line to locate a particular line of text—there are no pages or markers to make the search faster.

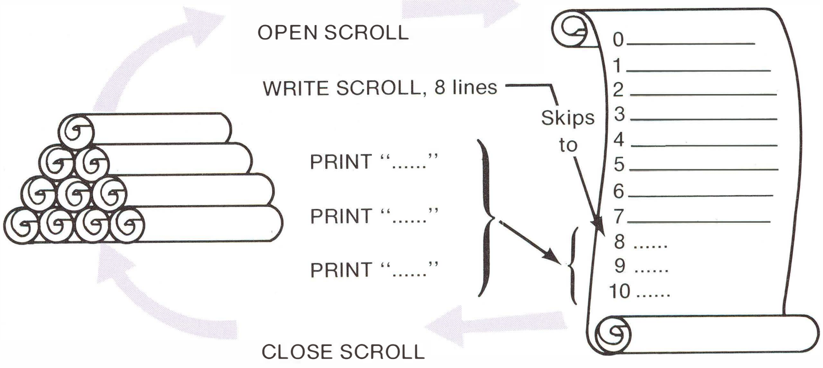
In this section, a *scroll* models a **sequential text file**.

As you read these rules, bear in mind that a scroll represents a sequential text file, the scroll's name represents the file's name, and a line on the scroll represents one line, or field, of text within the text file. A field is simply a string of characters that ends with a carriage return. There is also a pointer to keep track of your current position in the scroll.

To print new lines onto a scroll, use these commands in this order:

1. OPEN name. This selects the named scroll, opens it, and points the pointer to the first line. If a scroll by that name is not in the collection, one is created. You must use OPEN before you can read from or write to a scroll.
2. WRITE name [,number of lines]. This starts at the pointer of the named scroll, and skips lines, one by one, until it has skipped number of lines. You must use WRITE before you can use PRINT (step 3).
3. PRINT phrase. This places phrase on the line pointed to. Phrase can be a character, a number, a word, or an entire line. Phrases are printed one after another unless you use WRITE to select a new line number. PRINT destroys anything that was previously on the line. You can repeat this step as often as necessary.
4. CLOSE name. This rolls the scroll back up, and returns it to the collection.

Figure 6-1. Printing to a Scroll



Here are the commands you use to read lines from a scroll:

1. OPEN name. This selects the named scroll, opens it, and points the pointer to the first line. If a scroll by that name is not in the collection, one is created. You must use OPEN before you can read from or write to a scroll.
2. READ name [,number of lines]. This starts at the pointer of the named scroll, and skips lines, one by one, until it has skipped number of lines. You must use READ before you can INPUT phrases from the scroll (step 3).
3. INPUT phrase. This reads a phrase from the current line of the scroll. If there are no more phrases on the current line, it reads the first phrase from the next line. You can repeat this step as often as necessary.
4. CLOSE name. This rolls the scroll back up, and returns it to the collection.

You can have up to eight scrolls simultaneously open. That is why you must always refer to them by name.

The phrase used with the PRINT and INPUT statements can be any expression or list of expressions allowed by BASIC.

Random-Access Text Files: An Introduction

You can think of a disk containing random-access text files as a collection of notebooks. Each notebook, like the text file it models, has a name and an unlimited number of pages. Each of a notebook's pages holds the same number of characters, but since lines can be of differing lengths, there is no specific number of lines on a page.

In this section, a *notebook* models a **random-access text file**.

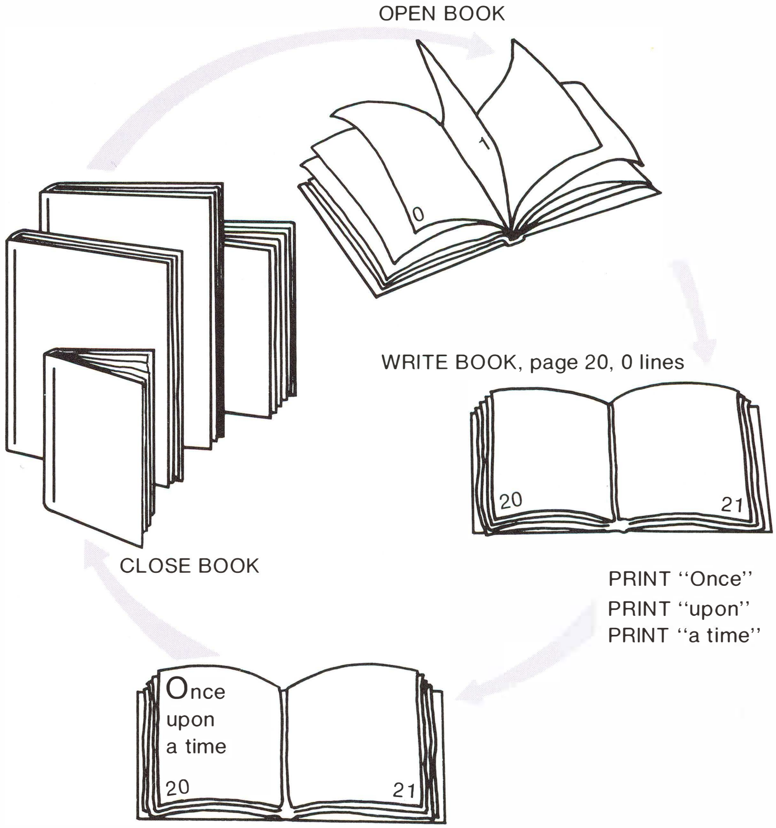
This analogy is appropriate because in both cases you can *flip* to a certain page before reading or writing lines of text.

As you look through these rules, remember that a notebook represents a random-access text file; the notebook's name represents the file's name; each page in the notebook represents one record in the file (each record in a file holds the same number of characters); and a line on a page represents a field in a record. There is also a pointer to keep track of your current position on the current page of the notebook.

To write information on a page of a notebook, you use these commands in this order:

1. OPEN name. This selects the named notebook, opens it, and points the pointer to the first line of the first page. If no notebook by that name exists, one is created. You must use OPEN before you can read from or write to a notebook.
2. WRITE name [,page number] [,number of lines]. This quickly opens the named notebook to page number. If the page with that number is not yet in the notebook, that page is added to the notebook. If a number of lines is given, that many lines are skipped, one by one. You must use WRITE before you can use PRINT (step 3).
3. PRINT phrase. This adds phrase to the current line on the current page. Phrase can be a character, a number, a word, or a line. Phrases are placed one after another until you use WRITE again, so you must be careful not to print past the end of the page. You can repeat this step as often as necessary.
4. CLOSE name. This closes the named notebook and returns it to the collection.

Figure 6-2. Printing to a Notebook



To read from a page in one of your notebooks, use these commands in the following order:

1. OPEN name. This selects the named notebook, opens it, and points the pointer to the first line of the first page. If no notebook by that name exists, one is created. You must use OPEN before you can write to or read from a notebook.
2. READ name [,page number] [,number of lines]. If you use page number, this quickly opens the named notebook to page number. If a number of lines is given, that many lines are skipped, one by one. You can next use INPUT to read from that page.
3. INPUT phrase. You read each phrase from the page with an INPUT statement. Phrases and characters are read sequentially from the page until you use READ again, so you must be careful not to read past the end of the page. You can repeat this step as often as necessary.
4. CLOSE name. This closes the named notebook and returns it to the collection.

You can have up to eight notebooks open at any given time. That is why you must always refer to them by name.

A random-access text file has an unlimited number of **records** (pages); each holds a fixed number of characters. Within each record, you can print as many fields (lines) as will fit. As mentioned above, a **field** is a string of characters that ends with a carriage return.

Sequential- and Random-Access Text Files

As the scroll analogy illustrates, you can use the information in a sequential-access text file in a sequential manner only, that is, starting at the beginning of the file and working towards the end. Because of this, sequential files are best suited for applications that read the entire contents of the file at the beginning of the program, and that write the modified contents back to the file at the end of the program.

The records (pages of a notebook) in a random-access text file, however, can be used in any order; a program can modify a single record of the file without affecting the others. Thus random-access text files are best for programs that keep track of a large number of pieces of information that are about the same size.

So how do you decide which type of text file to use? It is a matter of preference, but you might want to consider the following aspects of text file use:

Disk space: The first time you write to a record in a random-access text file, the entire record is placed on the disk. Thus if your records are each 200 characters in size, and if you write only one character to each of them, you are wasting 199 characters of disk space per record. Because records aren't usually entirely filled, random-access text files use up more disk space than do sequential text files.

Amount of data: If you are going to read all the information into memory at the beginning of the program, it is faster to read it, field by field, from a sequential text file.

Use of data: If the information won't all fit in memory, and you won't use it in any particular order, it is much faster to use a random-access text file.

Sequential text files are best for lists of variable length information, such as lists of words or lines of text. In fact, many word processors store their text in sequential text files. Later in the chapter you will write programs that place text in, and read text from, sequential text files.

Random-access text files are best for storing many pieces of information that are of the same size, and that will change frequently. You might use random-access files to store monthly inventory records, a list of names and addresses, or even a file of help screens (the text for each ProDOS help screen is stored in one record of a random-access text file). You will write a program that uses random-access files to keep a list of names and addresses.

Position-in-the-File Pointer

In the scroll and notebook analogies there was a pointer that kept track of the current position. Every open text file has one too. As you read from a file, the current position is the character following the last character read. Likewise, when you write to a file, the current position becomes the spot in the file immediately following the last character written. When you first open a file, the pointer indicates the first character position in the file.

In the rest of this manual, the position-in-the-file pointer is referred to as the **current position**.

The **current position** is the character following the last read or written character.

Sequential Text Files

The text file commands have many options. Because you will use a few of them most of the time, and most of them only once in a while, the commands and their options are explained by example, with emphasis on the most frequently used options.

To see a complete description of the text file commands and their options, refer to Appendix B, the summary of ProDOS commands.

Work through the examples in the order given. Explanations of concepts that have already been presented will be brief.

The Field

The basic unit of a sequential text file is a **field**. A field, like a line of text on the screen, is a series of characters that ends with a carriage return character. When you print a line to the screen using the BASIC statement PRINT, without a terminating semicolon, the line is ended with a carriage return, and the cursor goes to the next line. Likewise, when you print to a file using the BASIC statement PRINT, without a terminating semicolon, the field is terminated with a carriage return; subsequent printed characters go into the next field in the file.

The following BASIC statement could be used to write a line to the screen, or a field to a text file.

```
50 PRINT "THIS CREATES A FIELD"
```

The following line, however, writes just part of a line to the screen, or part of a field to a file; the semicolon at the end prevents a carriage return character from ending the current field.

```
100 PRINT "THIS MAKES PART OF A FIELD";
```

A subsequent PRINT statement adds characters to the same line on the screen, or to the same field in a text file. A sequential text file can contain any number of fields.

Storing Characters in Fields

Here is an example that shows the way characters are stored in the fields of a sequential text file. Assume that you have already given the OPEN and WRITE commands. You can place six fields in an open sequential text file using these BASIC statements.

```
40 PRINT "GREEN"
50 PRINT "YELLOW"
60 PRINT "ORANGE"
70 PRINT "RED"
80 PRINT "VIOLET"
90 PRINT "BLUE"
```

A program would normally use the CLOSE command to close the file. Here is how the characters generated by lines 40 through 90 would be stored in a file. A carriage return is represented by the symbol > .

```
Character sequence:   GREEN> YELLOW> ORANGE> RED> VIOLET> BLUE>
Field number:         {  F0  }{  F1   }{  F2   }{ F3 }{  F4  }{ F5 }
```

This sequential text file has six fields, and contains 36 characters.

Note the Fact: The first field in a sequential text file is field number 0.

A Simple Sequential Text File

To create a new sequential text file, use the OPEN command with a filename that does not yet exist. Here is a short program that places each of its lines in a sequential text file.

```
5   REM PROGRAM LISTSELF
10  D$ = CHR$ (4)
20   PRINT D$;"PREFIX /EXAMPLES/DATA"

30   PRINT D$;"OPEN LISTFILE"

40   PRINT D$;"WRITE LISTFILE"
50   LIST

60   PRINT D$;"CLOSE"
```

D$ is CONTROL-D.

Set the prefix to indicate the /EXAMPLES/DATA directory.

Open LISTFILE; create it if it doesn't yet exist.

Prepare LISTFILE for writing.

Put the program's listing in LISTFILE; line 40 directs it there.

CLOSE all open files.

This program is very simple. It opens LISTFILE (line 30), uses WRITE so that LISTFILE can be written to (line 40), and then gives the BASIC command LIST. Notice that LIST is not a ProDOS command, and is not preceded by a CONTROL-D. Because the WRITE command redirects output to a file, the LIST command places the lines of the program, one by one, into the sequential text file named LISTFILE , rather than on the screen. The last line of the program closes the file.

Type in the program, and with the /EXAMPLES disk in a drive, type

```
RUN
```

The disk drive whirs as the text file is placed on the disk. When a new prompt appears on the screen, type

```
CAT /EXAMPLES/DATA
```

and look for LISTFILE in the DATA directory.

EXEC command: see Chapter 8.

How can you check to see what is in the new file? Here's a little secret. The EXEC command tells your Apple II to take commands from a sequential text file rather than from the keyboard. When you type in lines of a BASIC program from the keyboard, they are entered as a BASIC program. Thus, if you use the EXEC command to enter lines of a program from a sequential text file, they too must be entered as a BASIC program. Type

```
NEW
```

to remove the program from memory. Now type the command

```
EXEC /EXAMPLES/DATA/LISTFILE
```

One prompt symbol appears on the screen for each line in the BASIC program. When the disk stops spinning, and the prompts stop prompting, type

```
LIST
```

and you'll see that the program has reappeared in memory. The EXEC program is described in Chapter 8; there you will see that this technique of listing a program to a file is a valuable tool.

Writing to a File Using PRINT

A carriage return is represented by the symbol > .

There are several ways that the PRINT command can be used to place characters into a text file. In the examples in Table 6-1 A$ has the value *DOG*, and B$ has the value *CAT*.

Table 6-1. Printing to a Text File

PRINT Statement	Adds Characters	Comments
PRINT "TEXT"	TEXT>	Completes current field.
PRINT "TEXT";	TEXT	Adds to current field.
PRINT A$;B$;	DOGCAT	Adds to current field.
PRINT A$,B$	DOGCAT>	Unlike PRINT to the screen, spaces are not added between elements separated by commas. Completes current field.
PRINT A$;",";B$	DOG,CAT>	Adds two elements to the current field, and completes the field. See second example, Table 6-2.

The examples in Table 6-1 are intended to show three basic techniques: adding characters to the current field, completing the current field (subsequent characters will go to the next field), and adding elements to a field.

Elements, each written and read by a single variable, are strings of characters that are separated by commas. They deserve special mention because you may need to use some special techniques to retrieve them intact from files.

Reading Characters From a File

There are several ways to read characters from a text file: INPUT is best for some types of data, and GET is better for others. Table 6-2 shows some of the ways to read characters.

Table 6-2. Reading From a Text File

Input Statement	Effect
INPUT A$	Reads one element of a field. If there is more than one element in the field, the rest of the field is discarded.
INPUT A$,B$	Reads two elements of a field. If there are more than two elements in the field, the rest of the field is discarded. If there are not two elements in the field, elements are read from the next field.
GET C$	Reads the next character from the file. The GET statement reads all characters, including commas and colons. This is a good way to read fields with varying numbers of elements.

As illustrated by the first two examples in Table 6-2, an INPUT statement must contain one variable for each element in a field if it is to read all the elements from the field. If a carriage return is read before characters are assigned to all variables, characters are automatically taken from the next field.

One Element Per Field

Here is a program that writes four fields, each containing one element, to a sequential text file.

D$ is CONTROL-D.

Set the prefix to /EXAMPLES/DATA.

Create the file FOUR.FRUITS, if necessary, and OPEN it.

Before WRITE is used, characters still go to the screen.

Prepare FOUR.FRUITS for writing.

Put field 0 in the file.

Put field 1 in the file.

Put field 2 in the file.

Put field 3 in the file.

Close FOUR.FRUITS.

```
5  REM MAKE.FRUIT
10 D$ = CHR$ (4)
20  PRINT D$;"PREFIX /EXAMPLES/DATA"
30  PRINT D$;"OPEN FOUR.FRUITS"

40  PRINT "THIS GOES TO THE SCREEN"

50  PRINT D$;"WRITE FOUR.FRUITS"
60  PRINT "APPLE"
70  PRINT "BANANA"
80  PRINT "CANTALOUPE"
90  PRINT "DATE"
100  PRINT D$;"CLOSE FOUR.FRUITS"
```

Notice that even after FOUR.FRUITS is open, you can still PRINT to the screen (line 40). However, after the WRITE statement in line 50, all PRINT statements send their characters to the file. Here is how the characters are stored in FOUR.FRUITS .

The symbol > means RETURN.

Character sequence:
Field number:

```
APPLE>BANANA>CANTALOUPE>DATE>
{  F0  }{   F1   }{     F2     }{ F3 }
```

Here is a program that reads the four fields out of the sequential text file FOUR.FRUITS , and into successive elements of an array. It also prints them onto the screen so you can see that it's working.

D$ is CONTROL-D.
R$ is Carriage Return.
Set the prefix to /EXAMPLES/DATA.
Prepare FOUR.FRUITS for use.
Prepare FOUR.FRUITS for reading.
For fields 0 through 3, read field I from the file, and print it on the screen.
Then do the next field.
Close FOUR.FRUITS when done.

```
5   REM   GET.FRUIT
10  D$ = CHR$ (4)
20  R$ = CHR$ (13)
30   PRINT D$;"PREFIX /EXAMPLES/DATA"
40   PRINT D$;"OPEN FOUR.FRUITS"
50   PRINT D$;"READ FOUR.FRUITS"
60   FOR I = 0 TO 3

70  :  INPUT A$(I)
80  :  PRINT A$(I)
90   NEXT I
100   PRINT D$;"CLOSE FOUR.FRUITS"
```

This program uses the INPUT statement once for each field it reads from the file. If you wanted to read all four fields with a single INPUT statement, you could replace lines 60 through 90 with:

When there are no elements left in a field, INPUT reads from the next field.
Print the four fruits on the screen, one fruit per line.

```
60   INPUT A0$,A1$,A2$,A3$

70
80
90   PRINT A0$,R$,A1$,R$,A2$,R$,A3$
```

The string variable R$ was set to carriage return in line 20. When it is printed, a carriage return is printed on the screen.

Multiple Elements Per Field

Here is a program that places three elements in each of two fields. Following it are programs that read the elements in different ways.

D$ is CONTROL-D.
Set the prefix to /EXAMPLES/DATA.
Create the file VERB.LIST, if necessary, and prepare to use it.
Prepare to write to VERB.LIST.
Print three elements in field 0.
Print three elements in field 1.
Close VERB.LIST.

```
5   REM CONJUGATE
10  D$ = CHR$ (4)
20   PRINT D$;"PREFIX /EXAMPLES/DATA"
30   PRINT D$;"OPEN VERB.LIST"

40   PRINT D$;"WRITE VERB.LIST"
50   PRINT "DRINK,DRANK,DRUNK"
60   PRINT "THINK,THANK,THUNK"
70   PRINT D$;"CLOSE VERB.LIST"
```

The commas between the verbs in lines 50 and 60 are actually written to the file. When an INPUT statement with multiple variables reads these commas, it treats them as markers for the end of the element currently being read. Here is the character sequence for the file VERB.LIST (The symbol > means (RETURN)).

Character sequence: DRINK,DRANK,DRUNK> THINK,THANK,THUNK>

Field number:

```
{          F0         }{         F1         }
```

Here is a program that reads each verb from the file into a separate variable.

D$ is (CONTROL)-(D).
R$ is Carriage Return.
C$ is Comma.
Set the prefix to /EXAMPLES/DATA.
Prepare to use VERB.LIST.
Prepare to read from VERB.LIST.
Read three elements from field 0, and three elements from field 1.
Print all six elements
on two separate lines.
Close VERB.LIST.

```
5  REM CONJUGEATEN
10 D$ = CHR$ (4)
20 R$ = CHR$ (13)
30 C$ = ","
40  PRINT D$;"PREFIX /EXAMPLES/DATA"
50  PRINT D$;"OPEN VERB.LIST"
60  PRINT D$;"READ VERB.LIST"
70  INPUT A1$,A2$,A3$,A4$,A5$,A6$

80  PRINT A1$;C$;A2$;C$;A3$;R$;
          A4$;C$;A5$;C$;A6$
90  PRINT D$;"CLOSE VERB.LIST"
```

Notice that line 70 simply reads consecutive elements from the file. When all the elements are read from one field, elements are automatically taken from the next.

Line 80 prints out the elements so that they look just like they did in the original program. Note the use of C$ to print a comma, and R$ to print a carriage return.

The next program reads only the present tense verbs.

D$ is (CONTROL)-(D).
R$ is Carriage Return.
Set the prefix to /EXAMPLES/DATA.
Prepare to use VERB.LIST.
Prepare to read from VERB.LIST.
Read first element from field 0.
Read first element from field 1.
Display the two verbs.
Close VERB.LIST.

```
5  REM CONJUGEAT
10 D$ = CHR$ (4)
20 R$ = CHR$ (13)
30  PRINT D$;"PREFIX /EXAMPLES/DATA"
40  PRINT D$;"OPEN VERB.LIST"
50  PRINT D$;"READ VERB.LIST"
60  INPUT A1$
70  INPUT A2$
80  PRINT A1$;R$;A2$
90  PRINT D$;"CLOSE VERB.LIST"
```

In this example, as explained in Table 6-2, each INPUT statement causes an entire field to be read, regardless of the number of elements used in the INPUT statement. Thus line 60 causes the string "DRINK" to be assigned to A1$, and line 70 causes the string "THINK" to be assigned to A2$. Finally, the verbs DRINK and THINK are displayed.

GET Characters From a File

Data element: A string of characters separated by commas.

The INPUT statement has its limitations. It is designed to read **data elements**—strings of characters separated by commas. If you want to read in strings of characters that may contain commas, colons, or other control characters, or if you want to detect particular characters as they are read, you must use the GET statement to read the characters one by one.

The GET statement works the same whether you are reading information from the keyboard or from a text file.

You can use the GET statement to read a variable number of elements from a field. If you have been working through the examples, you have already used the program CONJUGATE to create the file VERB.LIST . If you haven't done this, use the command

```
RUN /EXAMPLES/PROGRAMS/CONJUGATE
```

and a text file named /EXAMPLES/DATA/VERB.LIST is created.

Although we know that there are three elements in each field of VERB.LIST , there are situations in which your program will not know how many elements to read from a field. Let's write a subroutine that uses the GET statement to read any number of elements, separated by commas, from one field of a file.

The following subroutine reads elements, separated by commas, and then places them into consecutive elements of string array A$. The element in use at any time is indicated by A$(I).

The GET statement returns one character. This subroutine reads a character into the variable C$, and if the character is not a comma or a carriage return, adds it to A$(I). Because a comma separates two elements, the subroutine upon reading a comma adds 1 to the variable I, causing I to indicate the next element of the array, and then continues reading characters. It repeats this process until it reads a carriage return, which marks the end of the field.

R$ is Carriage Return.

Start with array element 0.

Use next array element.

Read the next character.

If comma, use next element.

If carriage return, you're done.

Otherwise, add C$ to element.

```
20 R$ = CHR$ (13)
999  REM READ A FIELD
1000 I = 0
1010 I = I + 1
1020  GET C$
1030  IF C$ = "," THEN GOTO 1010
1040  IF C$ = R$ THEN RETURN
1050  A$(I) = A$(I) + C$
1060  GOTO 1020
```

The next program uses this subroutine to retrieve the elements from the first field of the file VERB.LIST . Recall that you use a subroutine by saying GOSUB followed by the number of the line on which the subroutine starts (see line 60 below). When the RETURN statement in the subroutine is executed (line 1040 above), the line following the GOSUB statement is executed (line 70 below).

D$ is (CONTROL)-(D).

Set the prefix to /EXAMPLES/DATA.

Prepare VERB.LIST for use.

Prepare VERB.LIST for reading.

Read all elements from a field.

Close VERB.LIST.

Now print the I elements of A$ onto the screen.

```
5  REM USE SUBROUTINE
10 D$ = CHR$ (4)
30  PRINT D$;"PREFIX /EXAMPLES/DATA"
40  PRINT D$;"OPEN VERB.LIST"
50  PRINT D$;"READ VERB.LIST"
60  GOSUB 1000
70  PRINT D$;"CLOSE VERB.LIST"
80  FOR J = 1 TO I

90 : PRINT A$(J)
100  NEXT J
110  END
```

To test this program, type in the lines of the program and the lines of the subroutine, and then type

```
RUN
```

You see the three words in the first field of the file VERB.LIST printed on the screen, one word per line.

In this example only the first field was read from the file. A technique for reading a variable number of fields from a file is in the program GET.TEXT below.

Entering and Reading Text

You are now going to write two short programs: one that reads text from the keyboard and then saves it to a file, and another that reads text from a file and then prints it on the screen.

As you read through the following explanations of the programs, don't bother typing in the lines of the programs. You can find these programs in the /EXAMPLES/PROGRAMS/ directory as the files MAKE.TEXT and GET.TEXT.

A Program for Entering Text

This program is stored in the file /EXAMPLES/PROGRAMS/MAKE.TEXT . It lets you type in up to one hundred lines of text and save them in a file. It asks for lines of text, reads them from the keyboard, and places them into consecutive elements of the array A$. The program stops reading lines as soon as it encounters an empty line. This portion of the program is:

Allow enough room for 100 lines of text.

Ask for next line of text with a line number followed by a colon.

Call a subroutine that reads a line of characters into array element A$(I).

If A$(I) is not empty, then go to line 110, which prompts for the next line of text.

```
10   DIM A$(100)
110 I = I + 1: PRINT I;": ";

120  GOSUB 1000

130  IF A$(I) <  > "" GOTO 110
```

This part of the program uses a couple of little tricks. Since the value of a variable is 0 the first time it is used, the first time line 110 is executed, I is set to 1, and the prompt

```
1:
```

is printed on the screen. Next, line 120 reads a line of text into array element I. Thus the Ith line of text is placed in array element I. If that array element is not empty—that is, if it does not have a length of zero—then line 130 goes to line 110, which asks for the next line of text.

Once all the text is in the array, the program asks you for the name of the file in which it is to place the text:

```
140  PRINT D$;"PREFIX /EXAMPLES/DATA"
150  INPUT "SAVE TO WHAT FILE? ";N$
160  IF LEN (N$) = 0 THEN GOTO 230
```

and reads that name into the variable N$. Line 160 gives you a chance to end the program without saving the text to a file. If the name of the file has a length of zero—that is, if you pressed RETURN before typing any other characters—the program goes to line 230 which is the end of the program. (Notice the different techniques used by lines 160 and 130 to detect empty strings.)

Next comes the task of saving the contents of the array to the named file. The last line that the program read in is line I, and it is an empty one (used to indicate the end of the text). Therefore, now print lines 1 through I - 1 to the file. Do this as follows:

D$ is CONTROL-D.
Open the named file (N$).
Prepare to write to the file.
For each line of text,
print the line to the file
and continue to the next line.
Close the file when done.

```
20 D$ = CHR$ (4)
170  PRINT D$;"OPEN ";N$
180  PRINT D$;"WRITE ";N$
190  FOR J = 1 TO I - 1
200 : PRINT A$(J)
210  NEXT J
220  PRINT D$;"CLOSE ";N$
```

Finally, end the program with the line

```
230 TEXT : END
```

The purpose of the TEXT command is explained below.

If you type in the program as presented so far, it works. The following lines print the instructions for using the program onto the screen, and freeze them there.

```
40  TEXT : HOME
50  PRINT "            TEXT FILE CREATOR"
60  INVERSE : PRINT "TO ADD A LINE:"
70  NORMAL : PRINT "    ENTER CHARACTERS,
   AND PRESS RETURN"
80  INVERSE : PRINT "TO END:"
90  NORMAL : PRINT "    PRESS RETURN ON AN
   EMPTY LINE"
100  PRINT : POKE 34,6
```

Line 40 causes the Apple II to switch the display to full screen text mode, to clear all characters from the screen, and to move the cursor to the upper-left corner of the screen. Lines 50 through 90 place the instructions for the program on the screen, some in normal letters, and some in inverse letters. Line 100 freezes the upper six lines of the screen so they remain on the screen even if you enter more lines than the screen can hold. This is called **setting the text window**.

Setting the text window is discussed in an appendix of the *Applesoft BASIC Programmer's Reference Manual*.

Run this program a few times, creating text files of different lengths. Experiment with the different features of the program to become familiar with the way they work.

> **For example:** You can enter a blank line of text by putting spaces on that line; since the line contains characters, the length of the line is not 0.

A Program for Retrieving Text

This program is in the file /EXAMPLES/PROGRAMS/GET.TEXT . Load the program so you can look at the lines as they are described below.

First the program sets up the variables it is going to use. It dimensions the array A$ to hold up to 100 elements, and it assigns the values RETURN and CONTROL-D to R$ and D$, respectively.

Allow enough room for 100 lines of text.

D$ is CONTROL-D.

R$ is Carriage Return.

```
20  DIM A$(100)
30 D$ = CHR$ (4)
40 R$ = CHR$ (13)
```

In line 60, the program asks for the name of the file from which it is to read text, and reads the filename into the variable N$.

```
50 TEXT : HOME
55 PRINT D$;"PREFIX /EXAMPLES/DATA"
60 INPUT "LIST WHAT TEXT FILE? ";N$
```

Having read the name of the text file, the program can now read consecutive lines from the file:

Open the text file.

Prepare to read from the file.

For each line that could be in the text file,

read the line into array element I and then print it on the screen.

Then do the next line.

Close the file.

Restore text mode, and end.

```
100  PRINT D$;"OPEN ";N$
110  PRINT D$;"READ ";N$
120  FOR I = 1 TO 100

130 : PRINT I;": ";: GOSUB 1000

140  NEXT I
150  PRINT : PRINT D$;"CLOSE ";N$
160  TEXT : END
```

There is a small problem with this part of the program. If the text file contains fewer than 100 lines, the program reads the last line of the text file, and then has no more characters to read. The program tries to read a character anyway, fails, and prints out the error message

```
END OF DATA

BREAK IN 130
```

To prevent this occurrence, use the ONERR GOTO statement described in Chapter 5. If you include the line

```
10 ONERR GOTO 150
```

the program, upon encountering an error, simply closes the file (line 160) and ends.

Note: This is not the best way to use the ONERR GOTO statement. Before taking any action, a better version of this program would check to see which error occurred . Refer to the section on the ONERR GOTO statement in Chapter 5 to see how to do this.

The subroutine that reads lines of text is, as before

```
1000 GET C$: PRINT C$
1010 IF C$ = R$ THEN RETURN
1020 A$(I) = A$(I) + C$
1030 GOTO 1000
```

The lines presented so far comprise a complete program; if you type them in, they will run. As before, you can add a few lines that permanently place instructions for using the program on the screen.

```
70 PRINT : PRINT "TYPE: CONTROL-S
  TO STOP LISTING"
80 PRINT " ANY KEY TO CONTINUE"
90 PRINT : PRINT : POKE 34,6
```

Line 50 causes the Apple II to switch to full screen text mode, to clear all characters from the screen, and to move the cursor to the upper-left corner of the screen. Lines 70 and 80 place instructions for the program on the screen. Line 90 freezes the upper six lines of the display so they remain on the screen even if you enter more lines than the screen can hold.

The OPEN Command

You can use the OPEN command only in deferred mode.

Before your program can write to or read from a sequential text file, it must open the text file using this command

OPEN pn [,S#] [,D#]

Files that you open must be closed (usually at the end of the program). If you don't close a file that you open and write to, you may lose some of the written data.

When a program opens a text file, ProDOS designates a space in memory, called the **file buffer**, to hold all important information about the file, and prepares the system to read or write starting at the beginning of that file. Up to eight files can be open at once.

If the file designated by pn does not yet exist, a file with that name is created, and is added to the proper directory. If the file exists, and is already open, you get the `FILE BUSY` error. You (or the program) must close the file before opening it again.

Warning
When you open a file, the pathname or partial pathname with which you opened the file becomes that file's **identifier**. In all subsequent references to that file, you must use exactly the same pn—even if you change the prefix. See the example which follows.

Assume the prefix is currently set to /APPLE/ (a popular fruit). If you open the file /APPLE/STRUDEL using the BASIC line

```
10 PRINT D$;"OPEN STRUDEL"
```

you must always use the name STRUDEL when referring to that file. For example, if you subsequently use the commands

```
20 PRINT D$;"PREFIX /STRAWBERRY/"
30 PRINT D$;"WRITE /APPLE/STRUDEL"
```

you get the `FILE NOT OPEN` error. Even though the prefix has changed, you should still use the same file identifier:

```
30 PRINT D$;"WRITE STRUDEL"
```

The OPEN command has other options that are not applicable to sequential text files. They are discussed elsewhere.

The Options

pn — pn indicates the name of the file to be opened. If the file already exists, it must not be open. If the file does not yet exist, a file of type text (TXT) is created.

[,S#] — The slot option has its usual meaning.

[,D#] — The drive option has its usual meaning.

For Example

Several examples of the OPEN command have already been presented. The following section explains a new aspect of OPEN.

Delete Before Opening

Suppose your program routinely replaces an old text file with a new one with the same name. If the new one is shorter than the old one, then unless the program deletes the old file first, the new one has part of the old file hanging on the end. If you don't want all this extra text at the end of the file, you must delete the old file before writing to the new one. This is usually easy, but what if it is the first time you have run the program, and the *old file* doesn't yet exist?

For example, suppose a game creates and uses the file /GAMES/DINGER , and you wish your program to delete that file at the start of each new game. The line

```
950 PRINT D$;"DELETE /GAMES/DINGER"
```

causes the error message

```
FILE NOT FOUND
```

if the file doesn't exist, and the program halts. Here's a quick way to delete a file and open it for new data, whether or not the file already exists:

```
10 D$ = CHR$ (4)
20 N$ = "/GAMES/DINGER"
30  PRINT D$;"OPEN ";N$

40  PRINT D$;"CLOSE ";N$
50  PRINT D$;"DELETE ";N$

60  PRINT D$;"OPEN
```

D$ is CONTROL-D.

N$ is the name of the file.

Open the file. If it does not already exist, it is created.

Close the file before deleting it.

Since the file definitely exists, the file can be deleted.

The rest of the program goes here.

Simply open and close the file before deleting it. This ensures that the file exists and can be deleted.

The CLOSE Command

You can use the CLOSE command in either immediate or deferred mode.

After a program finishes writing to or reading from a file, it must close the file. Proper closure of every file is necessary to ensure that all characters are written to their files, and that the file buffers are properly released. CLOSE takes the form

CLOSE [pn]

Warning
A program must always close a file that it opened. In some circumstances, however, a program that contains an error will stop before it can close all open files. When this happens, issue the CLOSE command from the keyboard to close all open files.

The Options

The CLOSE command without any options closes all open files.

[pn]   pn indicates the name with which the file was opened.

The WRITE Command

You can use the WRITE command in deferred mode only.

You must use the WRITE command before you can use the PRINT statement to place characters in a file. The WRITE command identifies to ProDOS the file to which you want to write characters, and the position in the file where the first character will be placed. The WRITE command remains in effect until the next ProDOS command is given. This command takes the form

WRITE pn [,F#] [,B#]

The Options

Use the F# and B# options to choose the position of the first character to be written to the file. If you don't use these options, the first character is written to the file's current position.

pn   pn indicates the name of the file to be written to. It must be identical to the name with which the file was opened.

[,F#]   # is the number of fields past the current position that ProDOS is to read and discard. ProDOS does this by reading characters, starting at the current position, until it has read the specified number of carriage returns. This option changes the file's current position.

[,B#]   # is the number of bytes, or characters, that ProDOS must read and discard. The new current position is the sum of # and the previous current position.

The READ Command

You can use the READ command only in deferred mode.

You must use the READ statement before you can use the INPUT and GET statements to read characters from a file. The READ command identifies to ProDOS the file from which to read characters and the position in the file from which to read the first character. The READ command remains in effect until the next ProDOS command is given. This command takes the form

READ pn [,F#] [,B#]

The Options

Each time you use the READ command you must identify a file by name (pn).

Use the F# and B# options to choose the position of the first character to read from the file. If you don't use these options, the first character is read from the file's current position.

pn pn indicates the pathname or partial pathname of the file you want to read from. It must be identical to the value of pn with which the file was opened.

[,F#] # is the number of fields which ProDOS is to read and discard. ProDOS does this by reading characters, starting at the current position, until it reads the specified number of carriage returns. This option changes the file's current position.

[,B#] # is the number of bytes, or characters, that ProDOS is to read and discard. The new current position is the sum of # and the previous current position.

The APPEND Command

Use the APPEND command only in deferred mode.

See the descriptions of the OPEN, POSITION, and WRITE commands for more information on the operation and use of the APPEND command.

The APPEND command lets you add data to the end of a sequential text file. It is like three commands in one: it opens the file (see the OPEN command), positions to the end of the file (see the POSITION command), and then writes to that file (see the WRITE command). This command has the form

APPEND pn [,S#] [,D#]

After giving the APPEND command, your program can send data to the file using the PRINT command.

The Options

pn pn indicates the file to be appended. It must not be open. If the indicated file does not yet exist, the file is created.

[,S#] The slot option has its usual meaning.

[,D#] The drive option has its usual meaning.

For Example

You can modify the program MAKE.TEXT—which creates a sequential text file—so it adds lines to the end of a text file.

With the /EXAMPLES disk in drive 1, and with ProDOS started up, load /EXAMPLES/PROGRAMS/MAKE.TEXT into memory and display it on the screen with the commands

```
LOAD /EXAMPLES/PROGRAMS/MAKE.TEXT
LIST
```

Do you remember how MAKE.TEXT works? First it reads lines of text into the array A$, then it asks you for a filename, and then it opens the file and prints the lines of text to the file.

To append lines of text to the end of a file, all you need to do is replace the OPEN and WRITE statements with an APPEND statement. Replace lines 50, 170, and 180 by entering the following lines:

```
50 PRINT "           TEXT FILE APPENDER"
160 PRINT D$;"APPEND ";N$
170
```

If you want to keep this program, you can save it by typing

```
SAVE /EXAMPLES/PROGRAMS/APPEND.TEXT
```

The APPEND command, like the OPEN command, creates a new file if the file you try to append does not already exist.

The FLUSH Command

Use the FLUSH command in either immediate or deferred mode.

As a program writes to a text file, ProDOS stores a block of 512 bytes, or characters, of data before any of the data is placed on the disk. If you use the FLUSH command, all the characters that are currently stored are transferred to the file. After you use the FLUSH command, you can be sure that every character written to a file is actually placed in that file. The FLUSH command takes the form

FLUSH [pn]

The Options

The FLUSH command without any options flushes all open files.

[pn] pn indicates the file to be flushed. It must be identical to the pn with which the file was opened.

For Example

This command can be useful if you wanted to make a program absolutely foolproof. If you use the FLUSH command after each statement that prints to a file, you can be sure that every character actually reaches the file. Your programs will be a little longer and a little slower, but a lot more reliable.

This command is also of great value for data collection applications in which there are frequent power outages. If your application program is named STARTUP, the program will restart after each power outage. Using FLUSH, you can maximize the amount of data collected.

Note: Frequent use of the FLUSH command slows down your program. You must decide the importance of speed versus data integrity.

The POSITION Command

Use the POSITION command in deferred mode only.

With the POSITION command, you can access the information in any field or byte within a file. This command, which takes the form

```
POSITION pn,F#
```

starts at the current position, and reads and discards the number of fields mentioned in F#. The file must be open.

For example, if the current position is within the fourth field of a file, and you want to read from the tenth field in the file, skip six fields using the POSITION command with the option ,F6.

The Options

pn pn indicates the file whose current position is to be altered. It must be identical to the pn with which the file was opened.

,F# # indicates the number of fields to be read and discarded. If you try to position past the end of the file, you get the `END OF DATA` error message.

Random-Access Text Files

Random-Access Text Files

About This Chapter

This chapter introduces you to the use of ProDOS random-access text files. It describes how to create them, how to place information in them, and how to take information out of them.

Because random-access text files are so similar to sequential-access text files, this chapter assumes that you are already familiar with the material in the preceding chapter.

The first part of this chapter explains the structure of random-access text files and how you can make use of it. The next part of the chapter leads you through a typical program that uses random-access text files. The remainder of the chapter contains a description of the commands you use to manipulate random-access text files.

By the Way: Notice that although the commands described in this chapter are the same as those in Chapter 6, the options that accompany them are different. Appendix A contains a summary of the commands with all their options.

Random-Access Text Files

As illustrated by the scroll versus notebook analogy in Chapter 6, there is a fundamental difference between sequential and random-access text files: a sequential text file is a single unit, composed of a series of fields; a random-access text file consists of multiple units, or records, all the same size, each composed of a series of fields. Figure 7-1 illustrates this comparison.

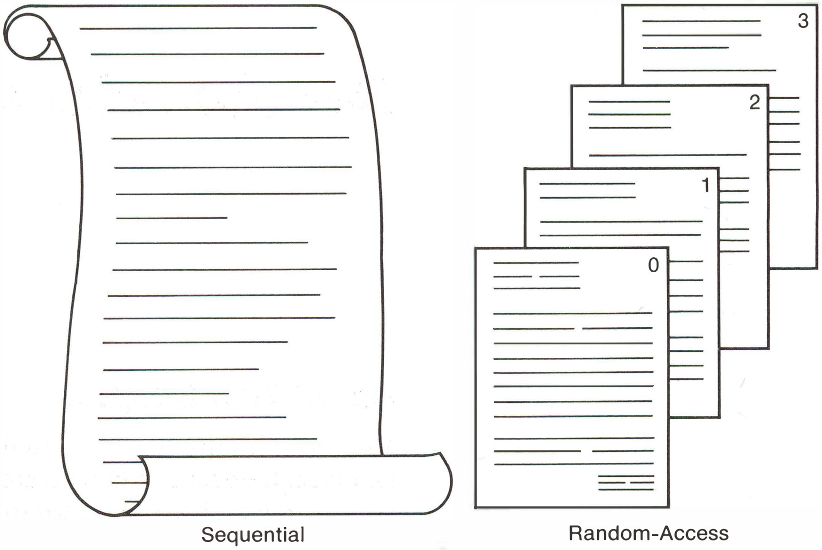


Figure 7-1. Sequential and Random-Access Text Files

Record Length

Record length is the number of characters a record can hold. All records in a single random-access text file are the same length.

When you open a random-access text file for the first time, you must assign it a **record length**. For example, to open a random-access text file named /MUSIC/CLASSICAL that has a record length of 33, use the command

```
30 PRINT D$;"OPEN /MUSIC/CLASSICAL ,L33"
```

The length of a record is the number of characters it can hold. Each record in the file /MUSIC/CLASSICAL is 33 characters long.

Notice that when you open a random-access text file, you don't need to specify the number of records that the file is going to hold. ProDOS takes care of such details for you.

Writing to a Record

When you use the WRITE command with a random-access text file, you must specify the number of the record to which you are going to write (just like writing to a page of a notebook). If the specified record does not yet exist, ProDOS reserves enough space on the disk for that entire record. Thus, even if you are only going to place one character in a record of the CLASSICAL file, that record will use 33 characters' worth of disk space.

For example, before writing to record 10 of the file you just opened, use the command

```
50 PRINT D$;"WRITE /MUSIC/CLASSICAL ,R10"
```

The subsequent PRINT statements you use place characters into record 10 of this file.

Inside a Record

The storage of characters in a record is just like the storage of characters in a sequential text file. The difference is that there is a maximum number of characters that will fit into each record.

Storing characters is explained in the section on fields in Chapter 6.

Warning
You must be careful not to print more characters to a record than it can hold. If you do, ProDOS simply prints the extra characters into the beginning of the next record. For this reason, a file's record size must be at least as great as the largest number of characters to be stored in any of its records. Don't forget that the carriage return at the end of each field is counted as a character too.

Reading From a Record

When you use the READ command with a random-access text file, you must specify the number of the record from which you want to read. For example, to read the seventh record from the CLASSICAL file, use the command

```
90 PRINT D$;"READ /MUSIC/CLASSICAL,R7"
```

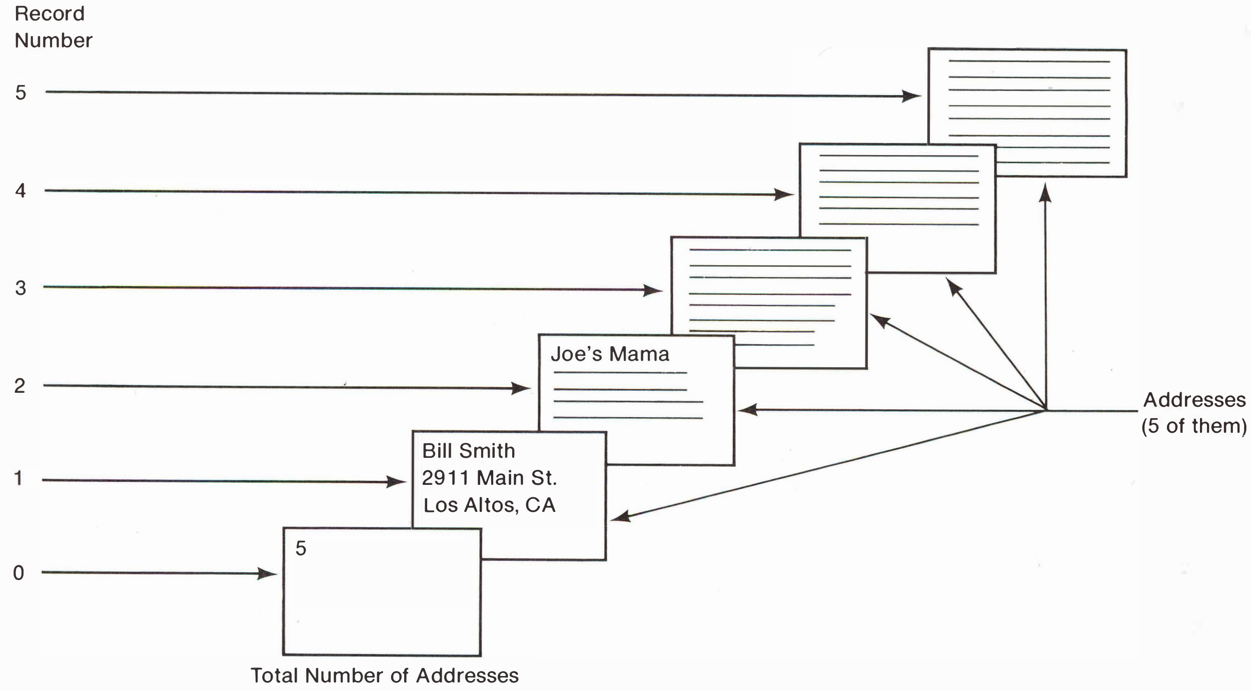
followed by the appropriate INPUT or GET statements. If the record does not exist, the READ statement is allowed, but the first INPUT or GET statement causes the END OF DATA error message.

A Sample Program

To illustrate the use of random-access text files, here is a short program that you can use to keep track of an address list. The program has two main tasks: to enter new addresses and to look up addresses that are already entered. Each of these two parts is a subroutine; a main program calls these subroutines as needed.

The first address you give the program is stored in record one of the file, the second in record two, and so on. The total number of records in the file is stored in record zero of the file. Figure 7-2 represents the structure of the file when it contains five addresses.

Figure 7-2. Five Addresses in the File



The total number of addresses in the file is initially 0. First write and run a little program that places the initial total number in record 0.

D$ is (CONTROL)-(D).
Open the file.
Write to record 0.
Put a 0 there.
Close all files.

```
5   REM CREATE FILE, WRITE RECORD 0
10  D$ = CHR$ (4)
20  PRINT D$;"OPEN /EXAMPLES/DATA/BLACK.BOOK,L200"
30  PRINT D$;"WRITE /EXAMPLES/DATA/BLACK.BOOK,R0"
40  PRINT 0
50  PRINT D$;"CLOSE"
```

Line 20 opens the file BLACK.BOOK, in which addresses are to be kept, with a record length of 200. Thus, addresses stored by the program can have no more that 200 characters in them. Line 30 specifies that data will be written to record 0 of the file. Line 40 prints a 0 to that record, and line 50 closes the file.

Type in this program and run it. The disk drive spins as the new file BLACK.BOOK is created (OPEN causes a new file to be created if it does not already exist), and the 0 is placed in it. Then type

```
NEW
```

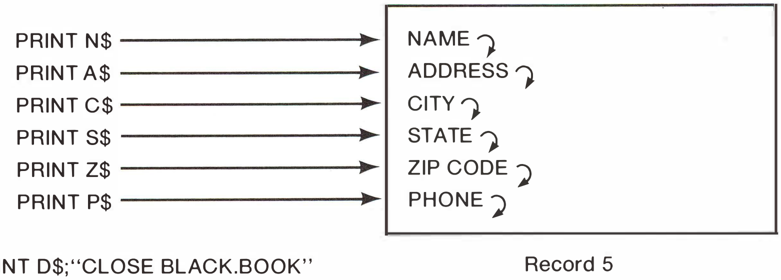
to remove this program from memory. You no longer need it.

Writing a Record

You must now decide how information is arranged within each record. Each record contains a name, an address, a city, a state, a zip code, and a phone number. Place each piece of information in a separate field; that is, use a separate print statement to place each piece in the record. To improve the clarity of the program, use a separate variable for each piece of the address. Figure 7-3 shows the BASIC statements that place an address in record five of a file named BLACK.BOOK .

Figure 7-3. Writing an Address to Record Five

```
PRINT D$;“OPEN BLACK.BOOK,L200”

PRINT D$,“WRITE BLACK.BOOK,R5”

    PRINT N$
    PRINT A$
    PRINT C$
    PRINT S$
    PRINT Z$
    PRINT P$

PRINT D$;“CLOSE BLACK.BOOK”
```



To write a new record to a file

1. Read in the new address to be entered. Store it in the variables N$,A$,C$,S$,Z$,P$.
2. Add 1 to the total number of records stored (TR=TR+1). This is the number of the new record.
3. Use OPEN and WRITE to prepare that record to be written.
4. Print the new information to the file.
5. Print the new total number to record 0.
6. Close the file.

Here is a subroutine that does this. Lines 1010 through 1060 gather the information for an address.

Read name to be entered.

Read address.

Read city.

Read state.

Read zip code.

Read phone number.

```
1000  REM  READ NEW INFO
1010  INPUT "NAME:          ";N$
1020  INPUT "ADDRESS:       ";A$
1030  INPUT "CITY:          ";C$
1040  INPUT "STATE:         ";S$
1050  INPUT "ZIP CODE:      ";Z$
1060  INPUT "PHONE:         ";P$
```

Lines 1070 through 1120 open the file whose name is stored in F$ and write information to a new record (record TR) in that file.

Open the file with record length of 200.

Read total records.

Get total records; add 1.

Prepare to write to record number TR.

Place each part of address in a separate field.

```
1070  PRINT D$;"OPEN ";F$;",L200"
1080  PRINT D$;"READ ";F$;",R0"
1090  INPUT TR:TR = TR + 1
1100  PRINT D$;"WRITE ";F$;",R";TR
1110  PRINT N$: PRINT A$: PRINT C$

1120  PRINT S$: PRINT Z$: PRINT P$
```

Lines 1130 through 1160 print to record 0 the total number of address records that are now in the file, close the file, and end the subroutine.

Prepare to write record number in record 0.

Print new record number.

Close the file.

End of subroutine.

```
1130  PRINT D$;"WRITE ";F$;",R0"

1140  PRINT TR
1150  PRINT D$;"CLOSE ";F$
1160  RETURN
```

These lines are already typed in and stored as part of the program in the file /EXAMPLES/PROGRAMS/ADDRESS . If you want to test just this subroutine, load /EXAMPLES/PROGRAMS/ADDRESS , and add the lines

Store records in file /EXAMPLES/DATA/BLACK.BOOK.

Call the subroutine, over and over again.

```
11  F$ = "/EXAMPLES/DATA/BLACK.BOOK"

12  GOSUB 1000

13  GOTO 12
```

When you want to stop the program, press CONTROL-C and then press RETURN. These keystrokes, as described in the *Applesoft Tutorial*, stop almost any program. If you typed in lines 11-13, type

```
11
12
13
```

to remove them from the program.

Reading a Record

You already know how information is stored in the records. Your new task is to find a way to ask which record (address) is to be displayed. To do this, display the name from each record, together with its record number, and then ask for the number of the desired address. Figure 7-4 shows the BASIC statements that read an address from record five of the file BLACK.BOOK .

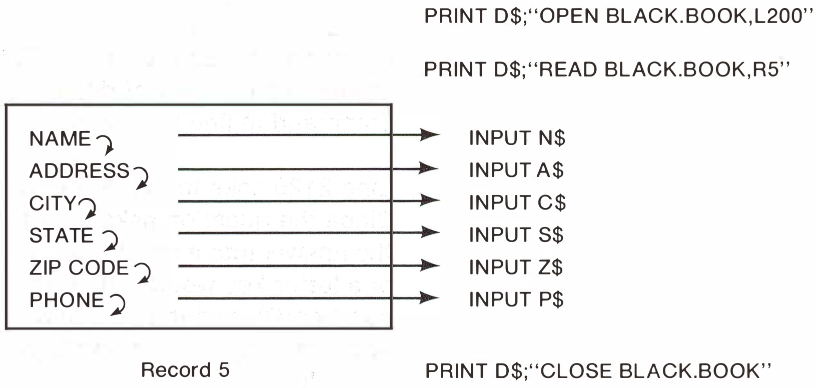


Figure 7-4. Reading an Address From Record Five

```
PRINT D$;"OPEN BLACK.BOOK,L200"
PRINT D$;"READ BLACK.BOOK,R5"
INPUT N$
INPUT A$
INPUT C$
INPUT S$
INPUT Z$
INPUT P$
PRINT D$;"CLOSE BLACK.BOOK"
```

To read a record from the file

1. Use OPEN and READ to prepare the file to be read.
2. Read the total number of entries from the file.
3. Print a numbered list of the entries on the screen.
4. Find out which entry to display.
5. Print the selected record on the screen.
6. Close the file.

Here is a subroutine that does all these things. First it reads the total number of addresses from record 0 of the file. Then it reads the name from each address and prints all of them on the screen.

Open the file.	`2000  PRINT D$;"OPEN ";F$;",L200"`
Read from record 0.	`2010  PRINT D$;"READ ";F$;",R0"`
Get the number of records.	`2020  INPUT TR`
Check for no records.	`2030  IF TR = 0 THEN GOTO 2210`
Clear the screen.	`2040  HOME`
	`2050  PRINT "WHOSE ADDRESS DO YOU WANT? ": PRINT`
For each record I, position to record I, and read the stored name.	`2060  FOR I = 1 TO TR`
	`2070 : PRINT D$;"READ ";F$;",R";I`
	`2080 : INPUT N$`
Print the record number and the name on the screen.	`2090 : PRINT I,N$`
Repeat for all records.	`2100  NEXT I`

Because the READ statement causes ProDOS to read characters from the file rather than from the keyboard, you must cancel the READ statement's action before reading anything from the keyboard. A READ or a WRITE is canceled by a ProDOS command; one way of doing this is by using the empty ProDOS command in line 2110 below.

Line 2120 asks for a number and then reads it into the string R$. Since the question asks for a numeric answer, it could have read the answer into a regular variable, but then the accidental pressing of a letter key would cause an error. Line 2130 converts R$ to a number (R), and the next line compares the number to the valid address numbers. An invalid response causes the question to be redisplayed.

Empty ProDOS command; turns off READ.	`2110  PRINT D$: PRINT`
	`2120  INPUT "TYPE A NUMBER AND PRESS RETURN ";R$`
Get numeric value of answer.	`2130 R = VAL (R$)`
If bad number, try again.	`2140  IF R < 1 OR R > TR THEN GOTO 2120`

The last part of this subroutine places an address on the screen. It uses READ to position to the requested record and uses INPUT to read the six fields from the record. Then it prints the six fields on the screen. Line 2230 prevents the address from being erased before you have a chance to read it.

Clear the screen.
Prepare to read record R.
Read address.
Print name and address.
Put city and state on the same line.
Print zip code and phone number.
Close the file.
Position the cursor.
Preserve the screen.

```
2150  HOME
2160  PRINT D$;"READ ";F$;",R";R
2170  INPUT N$,A$,C$,S$,Z$,P$
2180  PRINT N$: PRINT A$
2190  PRINT C$, PRINT S$
2200  PRINT Z$: PRINT P$
2210  PRINT D$;"CLOSE ";F$
2220  VTAB 23: HTAB 8
2230  INPUT "PRESS RETURN TO CONTINUE";T$
2240  RETURN
```

Controlling the Program

The remainder of the program is simple. Here is the main part of the program that lets you choose between entering a new address, reading an existing address, or ending.

D$ is CONTROL-D.
F$ is the file of addresses.
Clear the screen.
Convert response to number.
If bad entry, try again.
Enter a new address.
Look up an address.

```
10 D$ = CHR$ (4)
20 F$ = "/EXAMPLES/DATA/BLACK.BOOK"
30  HOME
40  PRINT "WHAT WOULD YOU LIKE TO DO?": PRINT
50  PRINT "  1  ENTER A NEW ADDRESS"
60  PRINT "  2  LOOK UP AN ADDRESS"
70  PRINT "  3  END": PRINT
80  INPUT "TYPE A NUMBER AND PRESS RETURN ";C$
90 C = VAL (C$)
100  IF C < 1 OR C > 3 THEN GOTO 30
110  IF C = 1 THEN GOSUB 1000
120  IF C = 2 THEN GOSUB 2000
130  IF C = 3 THEN END
140  GOTO 30
```

Lines 80 through 100 use the same technique that you used earlier to choose a record to be displayed. They read in a letter, convert it to a number, and then check to see that the number falls in the expected range. If it is a bad entry, the program repeats the question. A good entry causes the proper subroutine to be called.

See if you can modify the program to delete and change entries.

The OPEN Command

Use the OPEN command in deferred mode only.

Before a program can write to or read from a random-access text file, it must open the text file using this command

```
OPEN pn [,L#] [,S#] [,D#]
```

When you open a random-access text file for the first time, you must open it with the length option, L#. # is the number of bytes, or characters, that each record can hold. Each subsequent time you open the file, the original record length is assumed.

If you open a random-access text file with a record length other than that with which it was created, the new record length is used as long as the file is open, but the original record length remains as the default.

Files that are opened must be closed, usually at the end of the program. If you don't close a file that you open and write to, you may lose some of the written data.

When a program opens a text file, ProDOS designates a space in memory, called the **file buffer**, to hold all important information about the file. It also prepares the system to read or write starting at the beginning of the file. Up to eight files can be open at a time.

Warning
ProDOS uses the name with which you opened the file as the file's identifier. Always use the exact same name, even if you change the prefix.

The Options

pn pn indicates the name of the file to be opened. If the file already exists, it must not be open. If the file does not yet exist, it is created as a text file.

[,L#] You must use the length option the first time you open the file, that is, when the file is created. If you create a file without the length option, the file is given a record length of one. The record length, #, must be in the range 1 to 65535.

Warning
Be sure that a file's record length is greater than the maximum number of characters that you will ever put in one of the file's records. If you accidentally write past the end of a record, data is written onto the beginning of the next record in the file, destroying any data that might be in that next record.

[,S#] The slot option has its usual meaning.

[,D#] The drive option has its usual meaning.

The CLOSE Command

Use the CLOSE command in either immediate or deferred mode.

After a program finishes writing to or reading from a file, it must close the file. Proper closure of every file is necessary to ensure that all characters are written to their files, and that the file buffers are properly released. CLOSE takes the form

```
CLOSE [pn]
```

Warning
A program must always close a file that it opened. In some circumstances, however, a program contains an error and stops before it can close all open files. When this happens, issue the CLOSE command from the keyboard to close all open files.

The Options

The CLOSE command without any options closes all open files.

[pn] pn indicates the name of the file to be closed. It must be identical to the name with which you opened the file.

The WRITE Command

Use the WRITE command only in deferred mode.

You must use the WRITE statement before you can use the PRINT statement to place characters in a record of a random-access file. The WRITE command tells ProDOS the file, the number of the record, and the position within the record of the first character to be written. The WRITE command remains in effect until another ProDOS command is given. This command takes the form

WRITE pn [,R#] [,F#] [,B#]

You must use the WRITE command each time you want to write to a record other than the current record. If you use the WRITE command without the R# option, ProDOS defaults to record 0.

The Options

pn — pn indicates the file to be written to. It must be identical to the name with which the file was opened.

[,R#] — # is the number of the record to which characters are to be sent. If this option is omitted, record 0 is assumed. The maximum record number is 16 megabytes divided by the file's record length, or 65535, whichever is smaller.

If # is larger than any previous record number, the `ENDFILE` column in the catalog changes. Refer to the section on the End of File for more details.

[,F#] — # is the number of fields that ProDOS is to read and discard. ProDOS does this by reading characters, starting at the current position, until it has read the specified number of carriage returns. This option changes the file's current position.

[,B#] — # is the number of bytes, or characters, that ProDOS is to read and discard. This new current position is the sum of # and the previous current position.

The End of File

Each file listed by the CATALOG command has a number under the ENDFILE heading. For all types of files except random-access, this number indicates the number of bytes in the file. For random-access files, this number represents the number of bytes that would be in the file if every record, from 0 to the highest numbered record written to, were used.

For example, assume that a random-access text file has a record length of 50, and that data is written to records 0, 156, 756, and 1890. This file has data stored in four blocks on the disk. However, ENDFILE is calculated by multiplying the total possible number of records by the record length (1891 * 50 = 94550). This number is used by ProDOS to determine the location on the disk of the last record in the file—needed, for example, if you want to append a record to the file.

The READ Command

Use the READ command only in deferred mode.

Before you can read from a record, you must use the READ command to indicate the number of the record you want to read.

This command takes the form

```
READ pn [,R#] [,F#] [,B#]
```

When used with random-access text files, the READ command tells ProDOS the file from which the next INPUT or GET statements will take characters (pn), the record within the file from which characters are to be read (R#), and the position within the record from which the first character is to be read (F# and B#). The READ command remains in effect until the next ProDOS command is given.

The Options

pn pn indicates the name of the file to be read. It must be identical to the name with which you opened the file.

[,R#] # is the number of the record from which you are going to read. If you don't use this option, record 0 is assumed. If R# indicates a record that doesn't exist, you don't get an error; the first INPUT or GET statement from a non-existent record causes an error. The maximum allowable record number is 16 megabytes divided by the record length or 65535, whichever is smaller.

[,F#] # is the number of fields past the beginning of the indicated record which ProDOS is to read and discard. ProDOS does this by reading characters, starting at the current position, until it has read the specified number of carriage returns. This option changes the file's current position.

[,B#] # is the number of bytes, or characters, that ProDOS is to read and discard. The new current position is the sum of # and the previous current position.

The APPEND Command

Use the APPEND command in deferred mode only.

You can use the APPEND command to add data to the end of a random-access text file. It is like three commands in one: it opens the file, positions to the beginning of the record that follows the last record in the file, then it writes to that file. This command has the form

```
APPEND pn [,L#] [,S#] [,D#]
```

After giving the APPEND command, your program can send data to the file using the PRINT command.

The Options

pn pn indicates the file to be appended. It must be open. If the indicated file does not yet exist, it is created.

[,L#] # indicates the length of the file's records. If # is the same as the record length assigned when the file was created, the next character written is the first character following the last record in the file. If not, see the following description.

First ProDOS positions to the last character in the file (the character indicated in the `ENDFILE` column in a CATALOG). It divides `ENDFILE` by the record length; the remainder is the offset into the current record. Finally it uses `ENDFILE` to find the position of the first character in the next record (`ENDFILE` - Offset + Record Length + 1). Thus, if you use a record length of 1 when appending to a random-access text file, the next character written is the character following `ENDFILE`; that is, it is the same as appending a sequential text file.

[,S#] The slot option has its usual meaning.

[,D#] The drive option has its usual meaning.

For Example

You can change the ADDRESS program so it uses APPEND in the subroutine that writes new records.

With the /EXAMPLES disk in drive 1, and with ProDOS started up, set the prefix to the /EXAMPLES/DATA/ directory

```
PREFIX /EXAMPLES/DATA/
```

Now load ADDRESS into memory and display part of it on the screen with the command

```
LOAD /EXAMPLES/PROGRAMS/MAKE.TEXT LIST
1070,1160
```

You now see these lines:

Open the file with record length of 200.	`1070  PRINT D$;"OPEN ";F$;",L200"`
Read total records.	`1080  PRINT D$;"READ ";F$;",R0"`
Get total records; add 1.	`1090  INPUT TR:TR = TR + 1`
Prepare to write to record number TR.	`1100  PRINT D$;"WRITE ";F$;",R";TR`
Place each part of address in a separate field.	`1110  PRINT N$: PRINT A$: PRINT C$`
	`1120  PRINT S$: PRINT Z$: PRINT P$`
Prepare to write record number in record 0.	`1130  PRINT D$;"WRITE ";F$;",R0"`
Print new record number.	`1140  PRINT TR`
Close the file.	`1150  PRINT D$;"CLOSE ";F$`
End of subroutine.	`1160  RETURN`

The purpose of lines 1070 through 1100 is to discover the number of the last record, and to prepare to write to it. The APPEND command does just that. Replace those four lines with

Add after last record.	`1070  PRINT D$;"APPEND";F$;",L200"`

Delete these lines.	`1080`
	`1090`
	`1100`

After the subroutine writes the new address to the record (lines 1110 and 1120), it saves the new number of records in record 0 of the file. Before the program can do this it must discover the total number of records, as was previously done in lines 1080 and 1090. Just place the same two lines somewhere between 1120 and 1130 (say, 1124 and 1126), as shown below, and the revision of the subroutine is complete. It should now look like this:

Put new address at end.	`1070  PRINT D$;"APPEND";F$;",L200"`
Place each part of address in a separate field.	`1110  PRINT N$: PRINT A$: PRINT C$`
	`1120  PRINT S$: PRINT Z$: PRINT P$`
Read total records.	`1124  PRINT D$;"READ ";F$;",R0"`
Get total records; add 1.	`1126  INPUT TR:TR = TR + 1`
Prepare to write record number in record 0.	`1130  PRINT D$;"WRITE ";F$;",R0"`
Print new record number.	`1140  PRINT TR`
Close the file.	`1150  PRINT D$;"CLOSE ";F$`
End of subroutine.	`1160  RETURN`

The FLUSH Command

Use the FLUSH command in either immediate or deferred mode.

As a program writes to a text file, ProDOS stores a block of 512 bytes, or characters, of data before any of the data is placed on the disk. If you use the FLUSH command, all the characters that are currently stored are transferred to the file. After you use the FLUSH command, you can be sure that every character written to a file is actually placed in that file. The FLUSH command takes the form

FLUSH [pn]

The Options

The FLUSH command without any options flushes all open files.

[pn] pn indicates the file to be flushed. It must be identical to the name with which the file was opened.

The POSITION Command

Use the POSITION command only in deferred mode.

When used with random-access text files, the POSITION command works exactly as it does with sequential text files. You can use it to skip fields within the current record; you *cannot* use it to position to another record. This command takes the form

POSITION pn [,F#] [,B#]

Starting at the current position, ProDOS reads and discards the number of fields specified in F#, then it reads and discards the number of fields specified in B#. The file must be open.

For example, if the current position is within the fourth field of a record, and you want to read from the tenth field in that record, skip six fields using the POSITION command with the option ,F6.

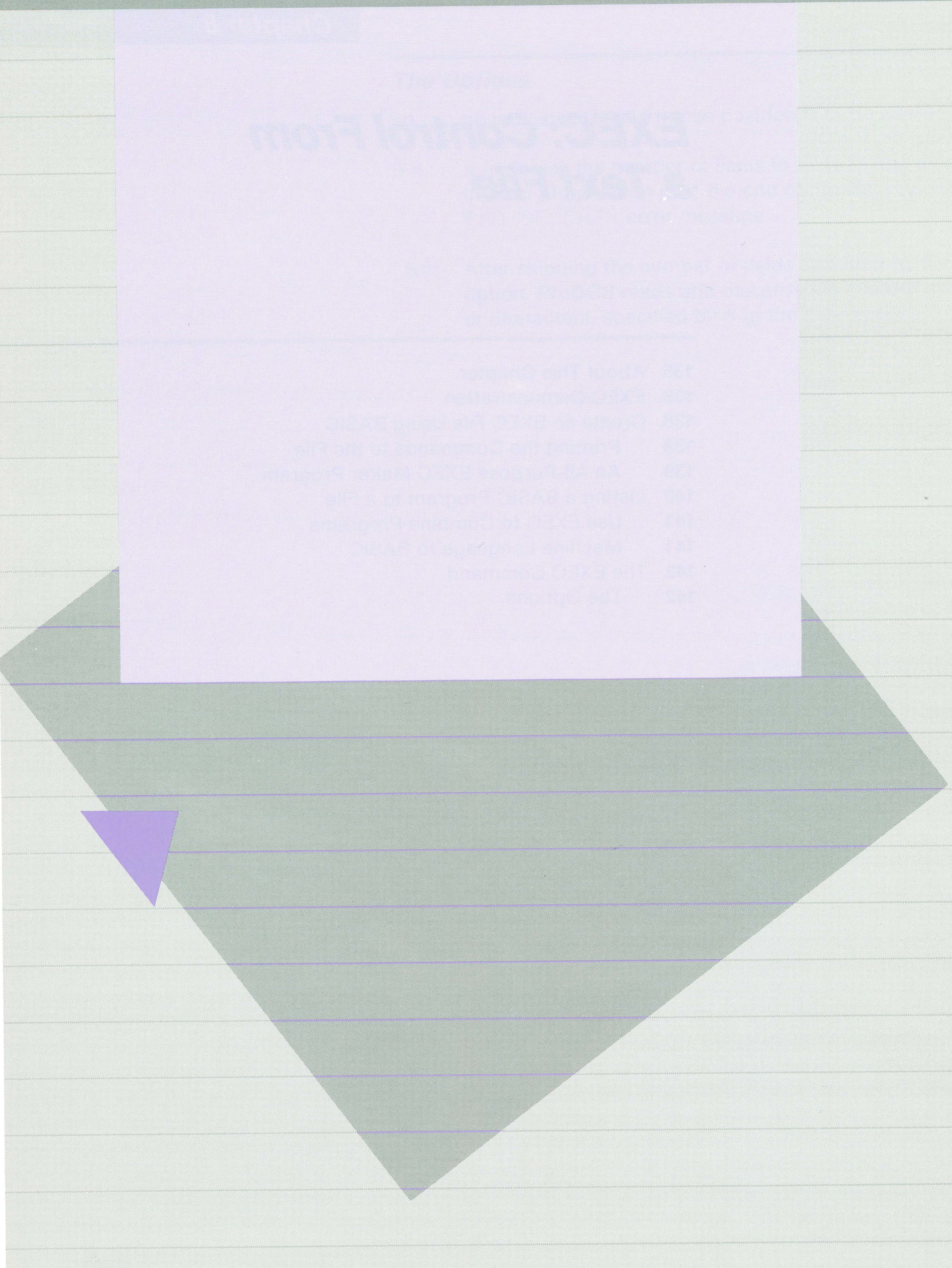
The Options

pn pn indicates the file whose position is to be altered.

,F# # indicates the number of fields to be read and discarded. If you try to position past the end of the file, you get the END OF DATA error message.

[,B#] After skipping the number of fields specified by the field option, ProDOS reads and discards the number of bytes, or characters, specified by # in the byte option.

EXEC: Control From a Text File



EXEC: Control From a Text File

About This Chapter

This chapter explains how you can use the EXEC command to cause the Apple II to take its commands from a sequential text file rather than from the keyboard. This sequential text file can contain ProDOS commands, lines of BASIC program, or even lines of input to a BASIC program—nearly any command that you can type from the keyboard.

Because the various uses of EXEC are not always obvious, examples are given to show how the EXEC command can be used. This chapter provides several diverse examples; this may give you some ideas for using it in new and different ways.

Throughout this chapter, a text file that is to be used with the EXEC command is called an EXEC file, and the contents of an EXEC file are called an EXEC program.

Because EXEC files are externally identical to all other text files, you'll find it useful to place the ending *.EXEC* on all EXEC filenames. This convention is used throughout this chapter.

You can use an EXEC file

- to give automatically a frequently used set of commands
- to use instead of repeatedly typing the same inputs into a program
- to combine BASIC programs or subroutines
- to put a machine-language routine in a BASIC program.

This chapter first gives you a demonstration of the EXEC command, then a few different ways to create EXEC files, and finally some sample applications of the EXEC command. The section that describes the EXEC command in detail is at the end of the chapter.

EXEC Demonstration

There are two steps to the EXEC demonstration. In the first step you run a BASIC program that creates an EXEC file, and in the second step you use the EXEC command to tell your Apple II to take its commands from the EXEC file.

With your /EXAMPLES disk in drive 1, set the prefix by typing

```
PREFIX /EXAMPLES/PROGRAMS/
```

and then type

```
RUN EXEC.DEMO
```

to see this page of instructions

```
       << EXEC DEMONSTRATION >>

THIS PROGRAM CREATES A SEQUENTIAL TEXT
FILE NAMED "SHOWOFF.EXEC".  EACH STRING
THAT IS PLACED IN SHOWOFF.EXEC BY THIS
PROGRAM IS A LEGAL APPLE II COMMAND.

WHEN YOU TYPE
     EXEC SHOWOFF.EXEC
THE COMMANDS IN THE FILE SHOWOFF.EXEC
TAKE CONTROL OF YOUR COMPUTER.  EACH
COMMAND IS EXECUTED JUST AS IF IT HAD
BEEN TYPED IN FROM THE KEYBOARD.
"BASIC PROGRAMMING WITH PRODOS"
DESCRIBES THE PROGRAM IN MORE DETAIL.

         << HAPPY EXECUTING >>

PRESS THE SPACE BAR TO MAKE THIS
PROGRAM CREATE THE FILE SHOWOFF.EXEC.

PRESS Q TO STOP THIS PROGRAM NOW.
```

Press SPACE. The screen goes blank, the message

```
CREATING SHOWOFF.EXEC ...
```

appears on the screen, and the disk drive's IN USE light glows as the program writes the SHOWOFF file onto the disk. When the program finishes, you see this message

```
IT'S DONE!!!

YOUR APPLE IS READY TO SHOWOFF A LITTLE
BIT.  ALL YOU HAVE TO DO IS TYPE

     EXEC /EXAMPLES/PROGRAMS/SHOWOFF.EXEC

PRESS THE RETURN KEY, AND ENJOY.

OH, BY THE WAY.  IF YOU WANT TO SEE THE
COMMANDS IN THE FILE SHOWOFF, USE
GET.TEXT FROM CHAPTER 6.  TYPE

     RUN GET.TEXT

AND WHEN IT ASKS FOR A FILENAME, JUST
TYPE IN

     /EXAMPLES/PROGRAMS/SHOWOFF.EXEC
```

Before you actually run the EXEC program, take a look at SHOWOFF.EXEC using the GET.TEXT program from Chapter 6. Type

```
RUN GET.TEXT
```

then choose the file SHOWOFF.EXEC . Notice the wide variety of commands, that can all be typed from the keyboard. Set this command file into action by typing

```
EXEC /EXAMPLES/PROGRAMS/SHOWOFF.EXEC
```

As SHOWOFF.EXEC is running, it describes everything it is doing. Surprised? Don't be, showoffs are hardly ever modest.

Create an EXEC File Using BASIC

A BASIC program that creates an EXEC file must

1. Use the OPEN command to open the text file.
2. Use the WRITE or APPEND command to prepare the file to be written to.
3. Use the PRINT or LIST command to place commands in the text file.
4. Then use the CLOSE command to close the text file.

Printing the Commands to the File

Here is a step by step example that illustrates how to create an EXEC file named DOIT.EXEC that contains these commands

```
PREFIX /EXAMPLES/PROGRAMS/
CAT
RUN AWAY
LIST
```

First enter and use the SAVE command to save an Applesoft program called /EXAMPLES/PROGRAMS/AWAY to be run by the EXEC program.

```
5 REM AWAY
10 PRINT "A WAY TO JOURNEY,"
20 PRINT "A WHALER JOE."
30 PRINT "AWEIGH THE ANCHOR,"
40 PRINT "AWAY WE GO."
```

Next write and save the following program, called MAKE.DOIT , which, when run, creates a text file called /EXAMPLES/PROGRAMS/DOIT.EXEC . The PRINT statements that begin with D$ are ProDOS commands; they are executed when the program is run. The other PRINT statements are written to the EXEC file, to be used later. Notice that ProDOS commands in an EXEC file, such as `RUN AWAY`, should *not* be preceded by a CONTROL-D.

D$ is CONTROL-D.

Set the prefix.

Prepare the file to be written to.

Put these four commands into the EXEC file DOIT.

Close the file.

```
5   REM MAKE.DOIT
10 D$ = CHR$ (4)
20  PRINT D$;"PREFIX /EXAMPLES/PROGRAMS"
30  PRINT D$;"OPEN DOIT.EXEC"
40  PRINT D$;"WRITE DOIT.EXEC"
50  PRINT "PREFIX /EXAMPLES/PROGRAMS/"
60  PRINT "CAT"
70  PRINT "RUN AWAY"
80  PRINT "LIST"
90  PRINT D$;"CLOSE DOIT.EXEC"
```

After you have MAKE.DOIT and AWAY both saved in the /EXAMPLES/PROGRAMS directory, type the command

```
RUN MAKE.DOIT
```

to create the sequential text file named DOIT.EXEC . To see the contents of DOIT.EXEC , you can once again use the program GET.TEXT.

Now type the command

```
EXEC DOIT.EXEC
```

to cause the commands in the file DOIT.EXEC to be executed one by one, just as if you were typing them—very quickly—from the keyboard. This EXEC program displays the files in the /EXAMPLES/PROGRAMS directory, which should include the files MAKE.DOIT , DOIT.EXEC , and AWAY ; it displays the sentences printed out by AWAY; and finally it displays a listing of the program AWAY.

An All-Purpose EXEC Maker Program

Just as you can use GET.TEXT to look at an EXEC program, you can use the program MAKE.TEXT to create one. The only problem with this program is if you enter an erroneous line, there is no way to change it. Just make sure each line is correct before you press RETURN.

Listing a BASIC Program to a File

A far more useful application of the EXEC command is to capture the listing of a BASIC program as a text file. Such a program can be used

- to edit a program using a word processor
- to place part of a program anywhere in another program
- to insert subroutines from a subroutine file into a program
- to connect two programs.

The following version of the CAPTURE program captures lines 2270 through 5130 of the program that is currently in memory in a text file named LISTING.EXEC. Replace the line numbers in line 5 of the program with the lines that you want to save, and replace the filename LISTING.EXEC with the name of the file in which you want the listing saved.

D$ is CONTROL-D.

Prepare to write to the file LISTING.EXEC.

List the lines to the file.

Close the file.

End the program.

```
1   REM CAPTURE
2   D$ = CHR$ (4)
3   PRINT D$; "OPEN LISTING.EXEC"
4   PRINT D$; "WRITE LISTING.EXEC"
5   LIST 2270,5130
6   PRINT D$; "CLOSE LISTING.EXEC"
7   END
```

To use this program, you must already have a program in memory. Add these lines to those of the program in memory. If your program begins with line 10, you can add these lines with the same line numbers; alternately, you can change the line numbers so that they are all greater than the highest numbered line in your program.

If you placed CAPTURE at the beginning of your program, run it by typing

```
RUN
```

If CAPTURE is elsewhere in your program, type

```
RUN linenum
```

where linenum is the number of CAPTURE's first line.

Use EXEC to Combine Programs

Executing (EXEC) a file does not delete the program that is already in memory. Therefore, if you have a program in memory, and you EXEC a file that was created using CAPTURE, the lines from the text file program are added to the lines that are already in memory. This is a good way to combine programs or subroutines.

Machine Language to BASIC

Here's a program that reads (PEEKs) consecutive bytes of a machine-language program, and for each byte places a POKE statement into an EXEC program (POKER.EXEC). When the EXEC program is run, a BASIC program containing these POKE statements is entered into memory. You can use EXEC to place these lines into an existing BASIC program, or you can use EXEC to put them into memory when no other program is present and save it as a separate BASIC program.

```
5  REM  MACHINE LANGUAGE POKER
10 D$ = CHR$ (4)
20  PRINT D$;"PREFIX /EXAMPLES/PROGRAMS"
30  PRINT D$;"OPEN POKER.EXEC"
40  PRINT D$;"CLOSE POKER.EXEC"
50  PRINT D$;"DELETE POKER.EXEC"
60  PRINT D$;"OPEN POKER.EXEC"
70  PRINT D$;"WRITE POKER.EXEC"
80 LINENUMBER = 7000
90  FOR PLACE = 768 TO 783
100 :COUNTER = COUNTER + 1
110 : IF COUNTER = 10 THEN COUNTER = 1
120 : IF COUNTER < > 1 THEN 150
130 : PRINT : PRINT LINENUMBER;
140 :LINENUMBER = LINENUMBER + 1
150 : PRINT " POKE ";PLACE;","; PEEK (PLACE);" :";
160  NEXT PLACE
170  PRINT
180  PRINT D$;"CLOSE POKER.EXEC"
190  END
```

D$ is CONTROL-D.
Set the prefix.
Open, close, and delete
deletes POKER.EXEC
even if it didn't exist.
Open POKER.EXEC.
Prepare to write to it.
First line number of program.
For each memory location,
increment counter.
Put 10 POKES on each line.
For first POKE on a line,
print the line number,
then increment line number.
Poke a byte.
Do next location.
New line for ProDOS command.
Then close POKER.EXEC.
All done.

To use this program, put the proper memory locations in line 90, change the line number in line 80 if you wish, and then run it. It creates the EXEC program POKER.EXEC (in the prefix directory). Next type

```
EXEC POKER.EXEC
```

and the lines containing the pokes are added to whatever BASIC lines are already in memory.

The EXEC Command

Use the EXEC command to take commands or data (all non-file input) from a sequential text file instead of the keyboard. It has the form

EXEC pn [,F#] [,S#] [,D#]

The F# option allows you to skip the first # lines of the text file.

The EXEC program currently in memory is not affected by the NEW command or the CLOSE command. An EXEC program cannot be stopped by CONTROL-C. If an EXEC program uses the EXEC command to call another EXEC program, the second program replaces the first.

If an EXEC program runs a BASIC program, and the BASIC program contains a (non-file) INPUT statement, that input request is satisfied by data from the EXEC file. If you interrupt a running BASIC progam with CONTROL-C, the remainder of the EXEC program usually is not executed.

Monitor commands cannot be executed from within EXEC programs.

The Options

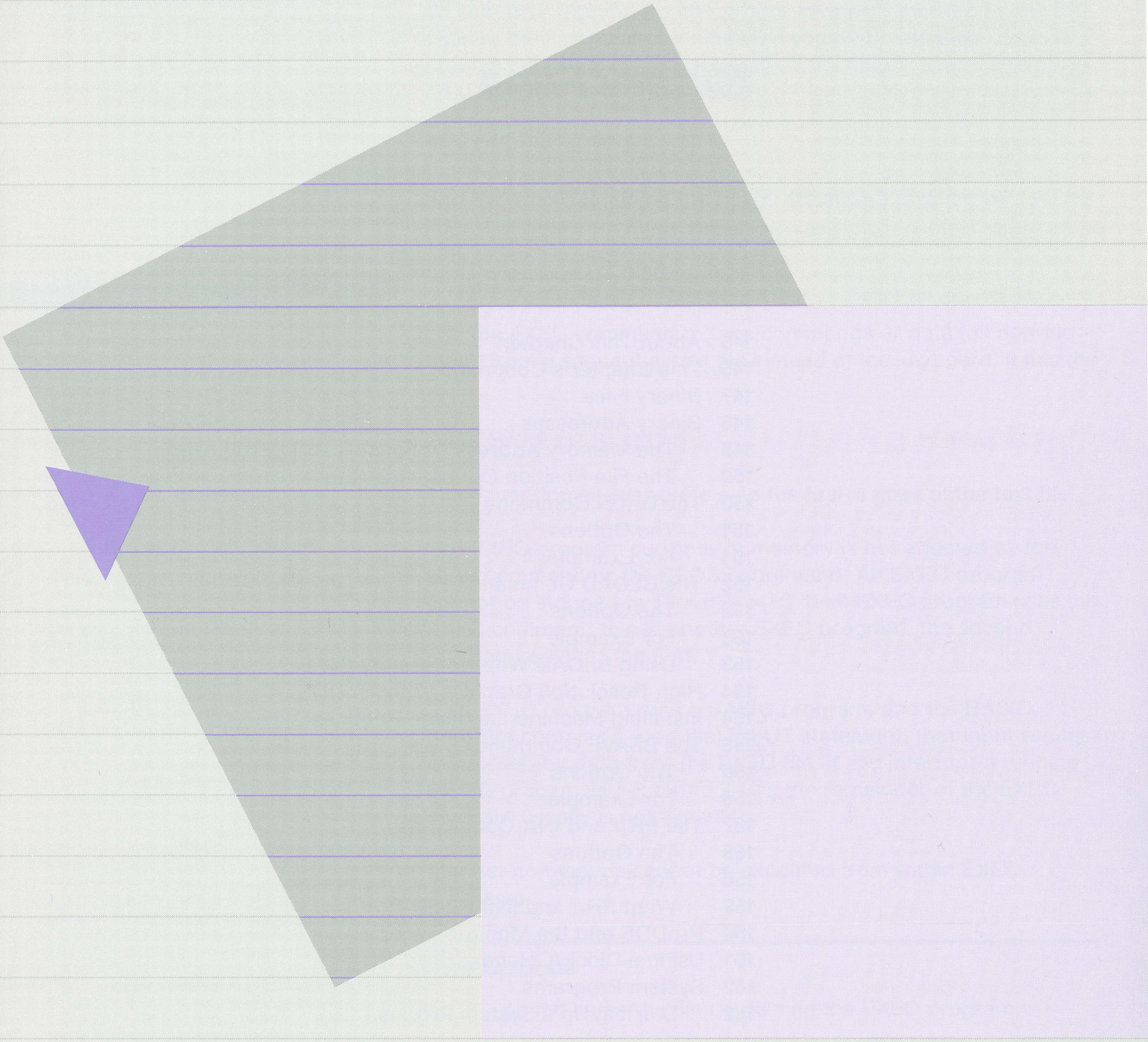
pn pn indicates the file containing the EXEC program.

[,F#] # is the number of fields to skip at the beginning of the EXEC file.

[,S#] The slot option has its usual meaning.

[,D#] The drive option has its usual meaning.

Binary Files



Binary Files

About This Chapter

This chapter describes the ProDOS commands that let you use binary programs and binary files on your disks. If you want only to run binary programs that are already on your disks, refer to the DASH (–) command in Chapter 4. This command moves any type of program from a disk file into memory and then starts it running.

The commands in this chapter can be used

- to load, run, and save binary programs
- to use binary programs to read and write characters.

This chapter also explains about system files and programs that are written in machine language. The end of this chapter has a section on ProDOS and the Monitor, and another section that explains how you can connect ProDOS to a clock/calendar chip so that files can be dated.

This Chapter's Commands

This chapter's commands are summarized below.

BRUN Run a binary program from a file

Use this command to transfer binary data from a binary disk file (type BIN) to a specified portion of memory; the program then executes automatically.

The BRUN command: see also the DASH command, Chapter 4.

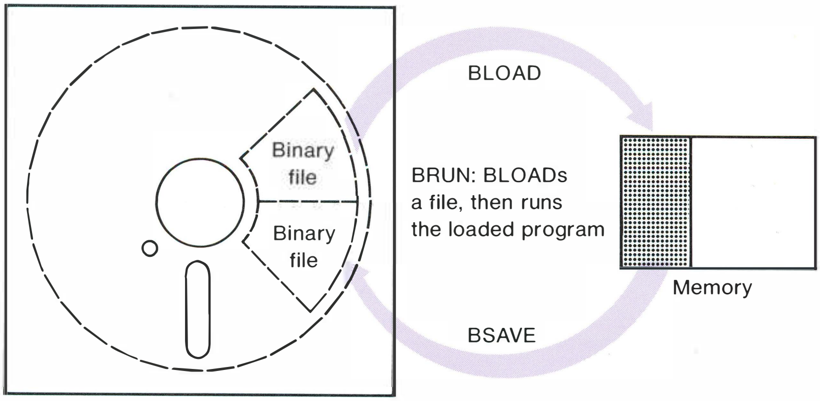
BLOAD Read binary data from a file

Use this command to transfer binary data from any disk file to a specified portion of memory. Binary data is typically a machine-language program or a picture for one of the graphics screens.

BSAVE Save binary data in a file

Use this command to transfer binary data from a specified portion of memory to any type of file. Data anywhere in the Apple II's memory can be transferred to a file.

Figure 9-1. BRUN, BLOAD, and BSAVE



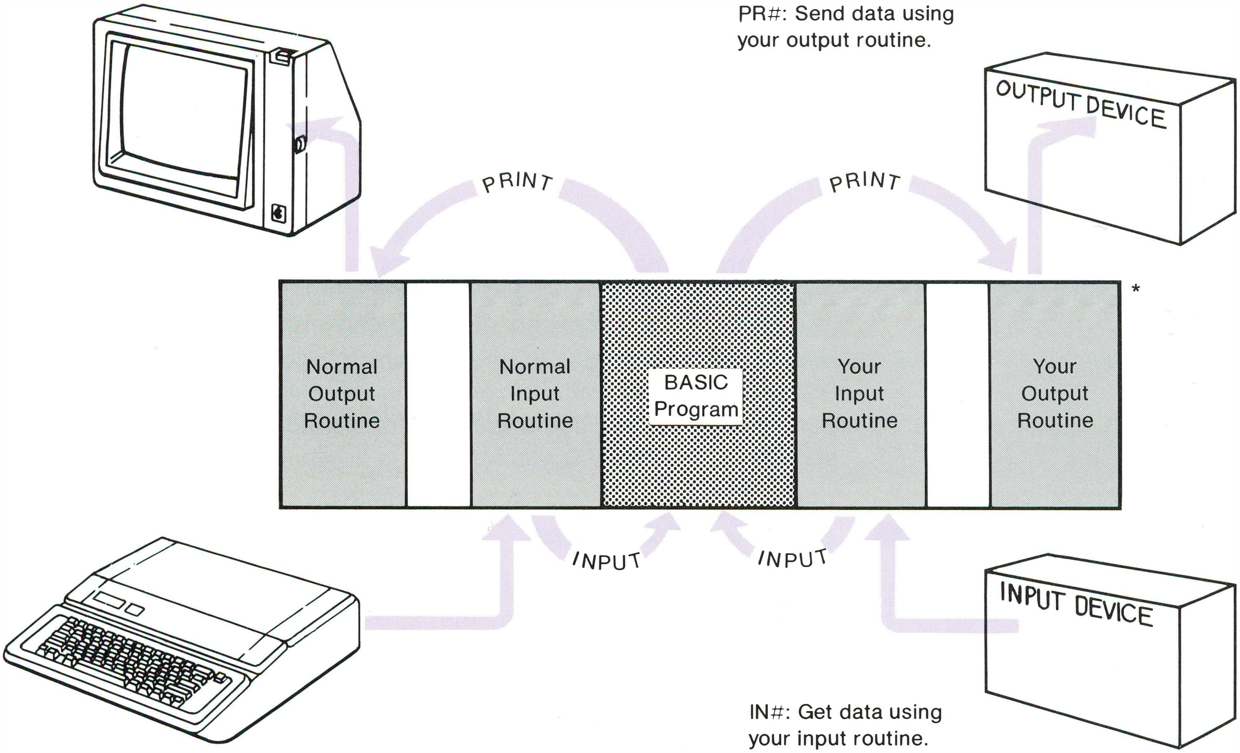
PR# Use a binary program to print characters

You use this command most often to send output to a device in a slot. You can also use it so a binary program is used in place of the normal character output routine.

IN# Use a binary program to read characters

You use this command most often to read characters from a device in a slot. You can also use it so a binary program is used in place of the normal character input routine.

Figure 9-2. PR# and IN#



PR#: Send data using your output routine.

IN#: Get data using your input routine.

*Memory arrangement is arbitrary.

Binary Files

ProDOS allows you to store on disk, and retrieve from disk, the information in your Apple II's memory. You have already seen the ProDOS commands RUN, LOAD, and SAVE: these commands deal with the contents of the BASIC program memory, interpreted as BASIC programs. The ProDOS commands discussed in the next three sections—BRUN, BLOAD, and BSAVE—perform similar functions, but they deal with the information in any part of the Apple II's memory, in its uninterpreted form.

The *B* before the commands BRUN, BLOAD, and BSAVE, stands for binary. Each command transfers binary information, zero-for-zero, and one-for-one, between memory and a file. From now on these commands are called the binary commands. The information that the binary commands transfer is often a machine-language program or a high-resolution picture from one of the Apple II's graphics screens, but it can be any information that is in memory or on a disk.

The DASH command: see Chapter 4.

The two most common uses of the binary commands are: running binary programs, and bringing binary images into memory for display. You can run a binary program using the DASH (–) command. If you have a file that contains a binary picture, you can move it to the graphics page from which it was transferred by the BSAVE command without having to understand the memory addresses involved. If you want to do this, use the example in the section on the BLOAD command.

Binary Addresses

If you are going to be using the binary commands only to run machine-language programs that already exist, you don't have to understand the organization of the Apple II's memory. If, however, you want to save a graphics screen to a file, or if you want to work directly with the binary information in memory or in a file, you need to know a little about memory addresses.

Your Apple II's memory is a continuous sequence of memory locations, or bytes, each having an address. The address of the first memory location is 0 (written as $0000 in hexadecimal), the address of the second memory location is 1 ($0001), and so on. If your Apple II has 64K of memory, the address of the last memory location is 65535 ($FFFF).

The Memory Address Options—[,A#] [,E#] [,L#]

When you use a binary command to save binary information, you must give the address of the first memory location that contains information to be saved. The starting memory address is determined by the address option, A#.

You must also give the number of memory locations to be saved. You can do this using the length option, L#, which is the number of memory locations, or bytes, to be saved; or you can do it using the end address option, E#, the address of the last memory location to be saved.

For example, if you want to save high-resolution graphics screen 1 in a file, you must save the information that is in memory locations 8192 through 16383 ($2000 through $3FFF). Thus, to specify the start address, you can give the address option in decimal or hexadecimal

`,A8192` or `,A$2000`

and you can give the address of the last byte to be transferred using the end address option, as in

`,E16383` or `,E$3FFF`

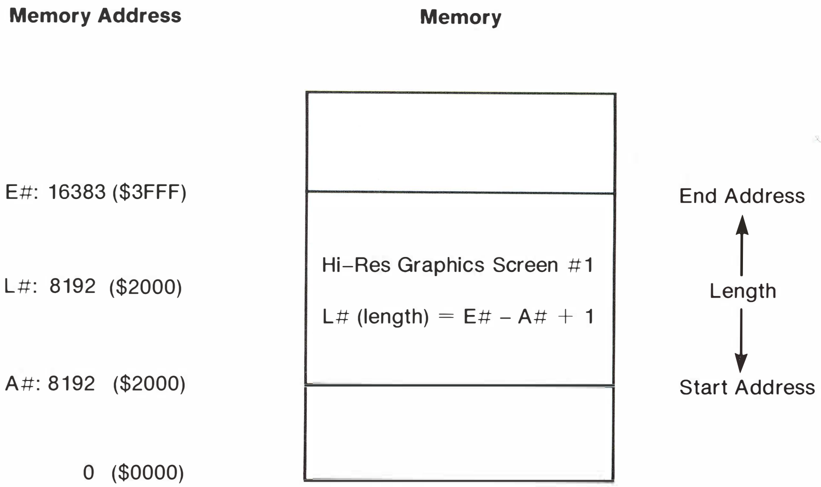
Alternately, if you like subtraction, you can use the length option to give the number of bytes to be transferred, as in

`,L8192` or `,L$2000`

You can calculate the value for the length option by subtracting the start address from the end address and adding one.

The relationship between these three options for high-resolution graphics screen 1 is shown in Figure 9-3.

Figure 9-3. Memory Address Options A#, E#, and L#



The File Position Option—[,B#]

If you don't want to start the transfer of information with the first byte in a file, you can use the byte option, B#, to indicate the number of the first byte to be transferred.

For example, if you have two high-resolution pictures in a binary file, the first picture starts at byte 0 ($0000) in the file, and the second picture starts at byte 8192 ($2000) in the file. To address the second picture in the file, use the byte option

```
,B8192  or  ,B$2000
```

If you use the byte option, you must also use the length option, L#, or end option, E#, to specify the number of bytes to be transferred. If you don't, the entire file is transferred.

The BRUN Command

To run a binary program that is stored in a binary disk file (type BIN), use the command

```
BRUN pn [,A#] [,B#] [,L# | ,E#] [,S#] [,D#]
```

When ProDOS sees this command, it transfers the file indicated by pn into memory, as determined by the options, and then runs the program. If the A# option is not used, the program is placed in memory starting at the address from which it was transferred using BSAVE.

Warning
ProDOS cannot tell the difference between a binary program and binary data such as a picture file. If you give names to binary files that indicate their contents, such as adding .PIC to the end of all picture files, it is less likely that you will accidentally run a non-program file. If you ever run a non-program file, parts of ProDOS might change; if this happens, it is a good idea to restart ProDOS.

See Chapter 4 for the DASH command.

You can also run a binary program using the DASH command.

The Options

pn

pn must indicate a binary file (type BIN). If you use only this option, the entire contents of the binary file indicated by pn are placed into memory starting at the address from which they were transferred using BSAVE.

You can see the address from which a file was transferred by BSAVE if you use the CATALOG command. This address is given, in hexadecimal, in the column labeled `SUBTYPE`, and it has an A in front of it.

[,A#]

is the memory address into which the first byte of the program is to be transferred. It is not useful to use an address that is greater than the maximum memory address of your Apple II.

[,B#]

is the number of the first byte in the file to be transferred. If you don't use this option, the first byte transferred is the first byte in the file, byte 0 ($0000).

[,L# | ,E#]

To load and run a portion of a file, use *one* of these options. L# is the number of bytes to be transferred; E# is the last memory address into which the program is to be transferred. If you include both of these options, the last in the list is used.

[,S#]

The slot option has its usual meaning.

[,D#]

The drive option has its usual meaning.

For Example

With ProDOS started up, and the /EXAMPLES disk in drive 1, run the binary program /EXAMPLES/PROGRAMS/SURPRISE using the command

```
BRUN /EXAMPLES/PROGRAMS/SURPRISE
```

Now try running it using the address option

```
BRUN /EXAMPLES/PROGRAMS/SURPRISE,A$300
```

The BLOAD Command

To transfer binary information from a disk file to your Apple II's memory, use the command

```
BLOAD pn [,A#] [,B#] [,L# | ,E#] [,Ttype] [,S#] [,D#]
```

You can transfer information from any file type (the Ttype option), starting at any position in the file (the B# option), to any part of the Apple II's memory (the A#, L#, and E# options).

You can use the BLOAD command

- to transfer a machine-language program from a file to memory
- to move a picture from a file to a graphics screen
- to move the binary image of any type of file into memory.

Moving a binary image of any type of file into memory is discussed in the section "Using BLOAD With Non-Binary Files."

If you plan to write programs that use machine-language routines or high-resolution pictures, you need to take special precautions. The sections "High-Resolution Graphics With ProDOS" and "Installing Machine-Language Routines" address these issues.

The Options

If you give this command using only the filename option, the file indicated by pn must be a binary file (type BIN). The entire contents of this file are placed into memory starting at the address from which it was transferred by BSAVE.

pn — Unless you use the Ttype option, pn must indicate a binary file. If you use Ttype, pn can indicate any type of file. If you use the BLOAD command to transfer a non-binary file into memory, you *must* use the A# option.

[,A#] — # is the memory address into which the first byte of the binary data is to be transferred. You must use this option if you use BLOAD to load a non-binary file. If you use the BLOAD command to load a binary file without this option, the file is placed in memory starting at the address from which it was transferred by BSAVE.

[,B#] — # is the number of the first byte in the file to be transferred. If you don't use this option, the first byte transferred is the first byte in the file, byte 0 ($0000).

[,Ttype] type is the three-letter abbreviation that indicates the type of file to be transferred. If no type is specified, the file must be of type BIN.

[,L# | ,E#] To transfer a portion of a file into memory, use one of these options. L# is the number of bytes to be transferred. E# is the last memory address into which the data are to be transferred. You cannot use both these options in the same command.

[,S#] The slot option has its usual meaning.

[,D#] The drive option has its usual meaning.

For Example

With ProDOS started up, and the /EXAMPLES disk in drive 1, set the prefix to /EXAMPLES/DATA using the command

```
PREFIX /EXAMPLES/DATA
```

Now display high-resolution Page 1 and load in a picture by typing and running this program:

D$ is CONTROL-D.
Display Page 1.
Load picture.
Restore text.

```
10 D$ = CHR$(4)
20  HGR
30  PRINT D$;"BLOAD PICTURE ,A8192 ,E16383"
40  GET A$ : TEXT
```

To display text again (and to clear the graphics page), simply press RETURN.

To clear the graphics page: see the section "High-Resolution Graphics With ProDOS."

Using BLOAD With Non-Binary Files

When ProDOS places information in a file, the command that you use to save the information determines the format of the information in the file. For example, a BASIC program is saved as a set of BASIC **tokens**.

Token: an encoded element that represents a BASIC keyword.

To see how a file is stored, and to work with the file in its uninterpreted form, use the BLOAD command with the Ttype option. For example, instead of manually changing every instance of a variable in a BASIC program, write a program that does it for you. Let the program use the BLOAD command to bring a BASIC program into memory, change all references to the variable, then save the program back to its BASIC file using BSAVE (with Ttype).

High-Resolution Graphics With ProDOS

Refer to the *Applesoft BASIC Programmer's Reference Manual* to see how to use HIMEM and LOMEM to protect the graphics page.

ProDOS does not ever prevent BASIC programs from overlapping the high-resolution graphics pages. To use high-resolution graphics Page 1 for graphics, use the HGR command; to use high-resolution Page 2 for graphics, use the HGR2 command.

Warning

On an Apple IIe, you cannot BLOAD data into high-resolution graphics page 2 while 80-column text is being displayed.

When you finish using the graphics pages, use the TEXT command: the BASIC program moves back down into place. When you use the TEXT command, the contents of the graphics pages are lost.

By the Way: If you want to go from high-resolution mode to text mode and back again without affecting the contents of the graphics pages, use the POKEs described in an appendix of the *Applesoft BASIC Programmer's Reference Manual.*

Warning

If your program halts—due to a STOP statement, an error, or a CONTROL-C typed from the keyboard—while you are using HGR or HGR2, do not attempt to continue the program using the CONT command. Type the CLOSE command, and run the program again.

Installing Machine-Language Routines

Refer to the *ProDOS Technical Reference Manual* for more details on machine language.

Because of the way ProDOS uses memory, it is difficult to predict which parts of memory are free to hold machine-language routines.

When ProDOS opens a file, it moves HIMEM down 1K and places a 1K file buffer where HIMEM used to be. It then marks that 1024-byte portion of memory as used in the system bit map.

To place a routine in memory, you must do the same thing: move HIMEM down by a multiple of 256 bytes, transfer the routine by using BLOAD, and then mark the used portions in the system bit map.

Warning

You must do this before any files are opened. This ensures that ProDOS places all file buffers below your routine, so your routine won't be closed instead of a file.

The BSAVE Command

To transfer binary information from your Apple II's memory to a disk file, use the command

```
BSAVE pn ,A# ,L# | ,E# [,B#] [,Ttype] [,S#] [,D#]
```

You can transfer information from any part of memory (the A#, L#, and E# options) to any type of file (the Ttype option), starting at any position in the file (the B# option).

You can use the BSAVE command

- to transfer a machine-language program from memory to a file
- to move a picture from a graphics screen to a file
- to move any portion of memory into any type of file.

The Options

When you use this command, you must use the pn, A#, and either the L# or the E# options.

pn — Unless you use the Ttype option, pn must indicate a binary file. If you use Ttype, pn can indicate any type of file.

,A# — You must use this option every time you use the BSAVE command. A# is the memory address from which the first byte of data is to be transferred.

,L# | ,E# — You must use one of these two options every time you use the BSAVE command. L# is the number of bytes of memory to be transferred. E# is the last memory address from which data are to be transferred.

[,B#] — B# indicates the first byte in the file to which data is to be transferred. If you don't use this option, the first byte is transferred to the first byte in the file, byte 0 ($0000).

[,Ttype] — type is the three-letter abbreviation that indicates the type of file to be transferred. If no type is specified, the file must be of type BIN.

[,S#] — The slot option has its usual meaning.

[,D#] — The drive option has its usual meaning.

For Example

This example loads a picture into graphics Page 1 and then saves it back into the same file. With ProDOS started up and the /EXAMPLES disk in drive 1, set the prefix using the command

```
PREFIX /EXAMPLES/DATA
```

Now, load the picture into high-resolution Page 1 and then save it using these commands

Turn on Page 1.

Load PICTURE.

Save PICTURE.

```
HGR
BLOAD PICTURE ,A16384 ,L8192
BSAVE PICTURE ,A16384, L8192
```

As a slightly more sophisticated example, here is how to move the files PRODOS and BASIC.SYSTEM from one disk to another using BLOAD and BSAVE. Assume that you are transferring the files from the volume /EXAMPLES to the volume /NEW.BOOT .

First type `CATALOG /EXAMPLES` to see how long the two files are. This is just part of the first two lines of a sample catalog:

```
/EXAMPLES
 NAME          TYPE    BLOCKS  ....   ENDFILE  SUBTYPE

*PRODOS        SYS         29  ....     14336
*BASIC.SYSTEM  SYS         19  ....      9216
```

Here is how to perform the transfer:

BLOAD the system program starting at 8192.

Create a new system file.

BSAVE the data from 8192 to the ENDFILE shown by CATALOG.

BLOAD the BASIC.SYSTEM file.

Create a new system file.

BSAVE the data.

```
BLOAD /EXAMPLES/PRODOS,TSYS,A8192

CREATE /NEW.BOOT/PRODOS,TSYS
BSAVE /NEW.BOOT/PRODOS,TSYS,A8192,L14336

BLOAD /EXAMPLES/BASIC.SYSTEM,TSYS,A8192
CREATE /NEW.BOOT/BASIC.SYSTEM,TSYS
BSAVE /NEW.BOOT/BASIC.SYSTEM,TSYS,A8192,L9216
```

The start address, A8192, was chosen arbitrarily.

Warning

Beware, however—this process destroys anything that was in the region of memory into which the BLOAD command placed the data.

The PR# and IN# Commands

Refer to the *Apple II* or *Apple IIe Reference Manual* for more details about accessory-card ROM space.

In addition to setting up the Apple II to do input or output with a slot, the PR# and IN# commands are also used to send characters to a machine-language program. The entire syntax of these commands is

PR# snum [,A#] or PR# A#
IN# snum or IN# A#

in which the option can either be the slot number (snum), the slot number followed by the address of the routine to be associated with that slot (A#), or just the address of a routine to be used (A#).

For example, if a character output routine is stored starting at memory location $300, you can use this command to activate the routine for subsequent output:

Output routine at location $300.

```
PR# A$300
```

The first byte of the routine starting at location $300 must be a 6502 CLD instruction (216, $D8). When you want to stop using this routine, you can use this command to restore output to the console:

Restore output to console.

```
PR#0
```

In addition, this same output routine can be associated with slot 2 using this command:

```
PR# 2,A$300
```

Subsequent references to slot 2 are actually directed to the routine at $300. To restore slot 2 to normal operation, use the command

```
PR# 2,A$C200
```

Use this form of the PR# command to remap physical slots from one slot number to another. For example, if you have printers in slots 1 and 2, and a program that expects the printer to be in slot 1, you can use the printer in slot 2 with your program by using the command

Assign slot 2 to slot 1.

```
PR# 1,A$C200
```

before running the program.

Warning
PR# and IN# are both ProDOS commands. When used from within a program, they must be preceded by a CONTROL-D. Failure to do so causes the commands to be ignored.

The Options

snum snum can have any value from 0 to 7. If snum is 0, normal input or output to the console (keyboard and screen) is restored. If snum is from 1 to 7, the Apple II does subsequent input or output operations with the device in that slot.

A# # is the address of the routine that you want to use as the character input or output routine. The first byte of the input or output routine must be a 6502 CLD instruction.

For Example

The first instruction of the input or output routine to be used must be a 6502 CLD instruction. As an example, put a two-line output routine starting at memory location $300. It consists of a jump to the normal Monitor output routine, located at memory address $FDF0.

With ProDOS started up, enter the Monitor with the command

```
CALL -151
```

and type

```
300: D8 4C F0 FD
```

0300: CLD
0301: JMP $FDF0

Now re-enter BASIC by pressing

CONTROL-C

Continue BASIC,

and then pressing RETURN. Enter the ProDOS command

```
PR# $300
```

Output routine at $300.

and all subsequent output will be sent by the routine at location $300. This routine jumps into the normal character output routine, so characters are printed in their normal fashion. Type a few lines of BASIC, such as

```
PRINT "IT DOESN'T LOOK ANY DIFFERENT"
```

and you see that characters are indeed printed on the screen.

What PR# and IN# Really Do

This section explains the way the Apple II normally sends and receives characters; thus you will see how PR# and IN# work. The Apple II has two memory locations, named CSWH and CSWL, in which it stores the memory address of the routine that outputs characters. Together, these locations are called the **monitor output link**—they link the monitor to an output routine. It also has two memory locations, named KSWH and KSWL, in which it stores the memory address of the routine that inputs characters. These are called the **monitor input link**.

The monitor output link normally contains the address of the Apple II's standard output routine, COUT1; the monitor input link normally contains the address of the Apple II's standard input routine, KEYIN. These two routines send characters to the screen and read them from the keyboard, respectively. When you use PR# or IN# from BASIC, without ProDOS, the monitor links are set to indicate the ROM on the card in the indicated slot ($Cn00 for slot n). Thus, when the Apple II inputs or outputs a character, it calls the input or output routine in the card's ROM to perform the transfer.

While ProDOS is running, the monitor I/O links, instead of containing the addresses of the standard input and output routines, contain the addresses of the ProDOS input and output routines. ProDOS keeps the addresses of the standard input and output routines in the ProDOS input and output links. As you might expect, the ProDOS input and output links normally contain the addresses of the Apple II's standard input and output routines, KEYIN and COUT1.

When you use PR# or IN# with a slot number, ProDOS replaces the contents of the proper ProDOS link with the address of the ROM on the card in the indicated slot ($Cn00 for slot n). When you use PR# or IN# with an address, ProDOS simply places that address in the proper ProDOS link. When the Apple II tries to output or input a character, the monitor output or input links indicate the proper ProDOS routine, then the ProDOS routine does a two-stage transfer:

1. It moves the addresses of the current I/O routines from the ProDOS I/O links to the monitor I/O links. Then ProDOS calls the Apple II's normal I/O routines which use the current routines to perform the transfer.
2. ProDOS reconnects itself by placing the addresses of its I/O routines into the monitor I/O links.

Not only does ProDOS have input and output links for normal I/O, it also has them for each of the slots. When you use the PR# or IN# command with snum and A#, the specified address is placed in the links for that address.

ProDOS and the Monitor

If you like to play around with the Apple II's internals, you occasionally find yourself (intentionally or otherwise) in the Monitor. The Monitor is the program within the Apple II's Read Only Memory that controls many of the Apple II's vital functions.

First, to enter the Monitor from BASIC, type

```
CALL -151
```

and you see the monitor prompt

```
*
```

All ProDOS commands still work from within the Monitor. For example, type

```
CAT
```

and you see a normal catalog displayed on the screen. Likewise, the PR# command still starts up a disk from the Monitor. An error in a ProDOS command issued from the Monitor returns control to BASIC.

Re-enter BASIC by pressing

CONTROL-C

and then pressing RETURN.

Using a Clock/Calendar Card

Each time you update a file, ProDOS performs a JSR (jump subroutine) to memory location 48902 ($BF06). This is the entry into the DATETIME routine. If there is no DATETIME routine installed, there is an RTS in this location.

If, however, ProDOS sees a Thunderclock in one of the slots, it sets up a routine and places a jump into the routine for you. If you want to use another type of clock/calendar card with ProDOS, you have to write your own routine, and place it in memory each time you start up ProDOS.

The routine must read the date and time from the card and place this data in bytes 49040 through 49043 ($BF90 through $BF93) using the following format:

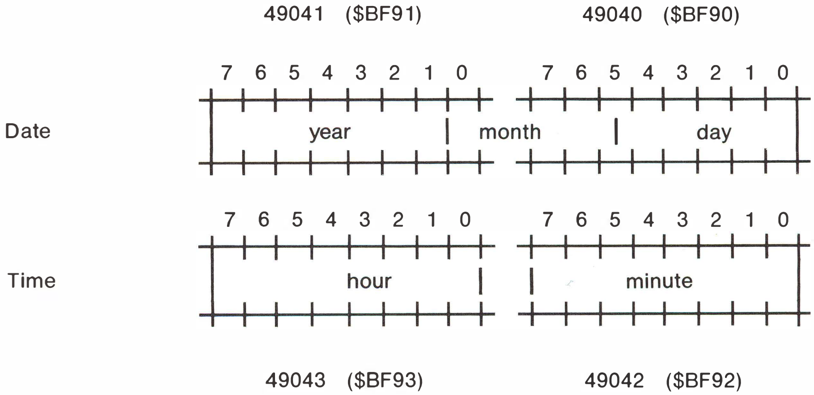


Figure 9-4. ProDOS Date and Time Locations

A jump to the starting address of the routine must be stored in the entry to the DATETIME routine (48902) $BF06.

By the Way: The TIME program described in Appendix D does not change the time indicated by a clock/calendar card. It merely changes the system date and time locations described above.

System Programs

By now you have undoubtedly wondered why ProDOS is divided into two files—PRODOS and BASIC.SYSTEM—and what the relationship is between these two files.

The file PRODOS contains the most essential parts of ProDOS: routines that perform communication with disk drives in a compact and versatile way. The BASIC.SYSTEM file contains routines that let you communicate with disk drives through BASIC programs. When you use ProDOS BASIC, both these files are in memory and in use.

It is possible for other assembly-language programs to make use of the versatile routines in the PRODOS file without the overhead of having the BASIC.SYSTEM file in memory. Such programs are known as system programs. ProDOS BASIC, the ProDOS Filer, and the DOS-ProDOS Conversion Program are all system programs.

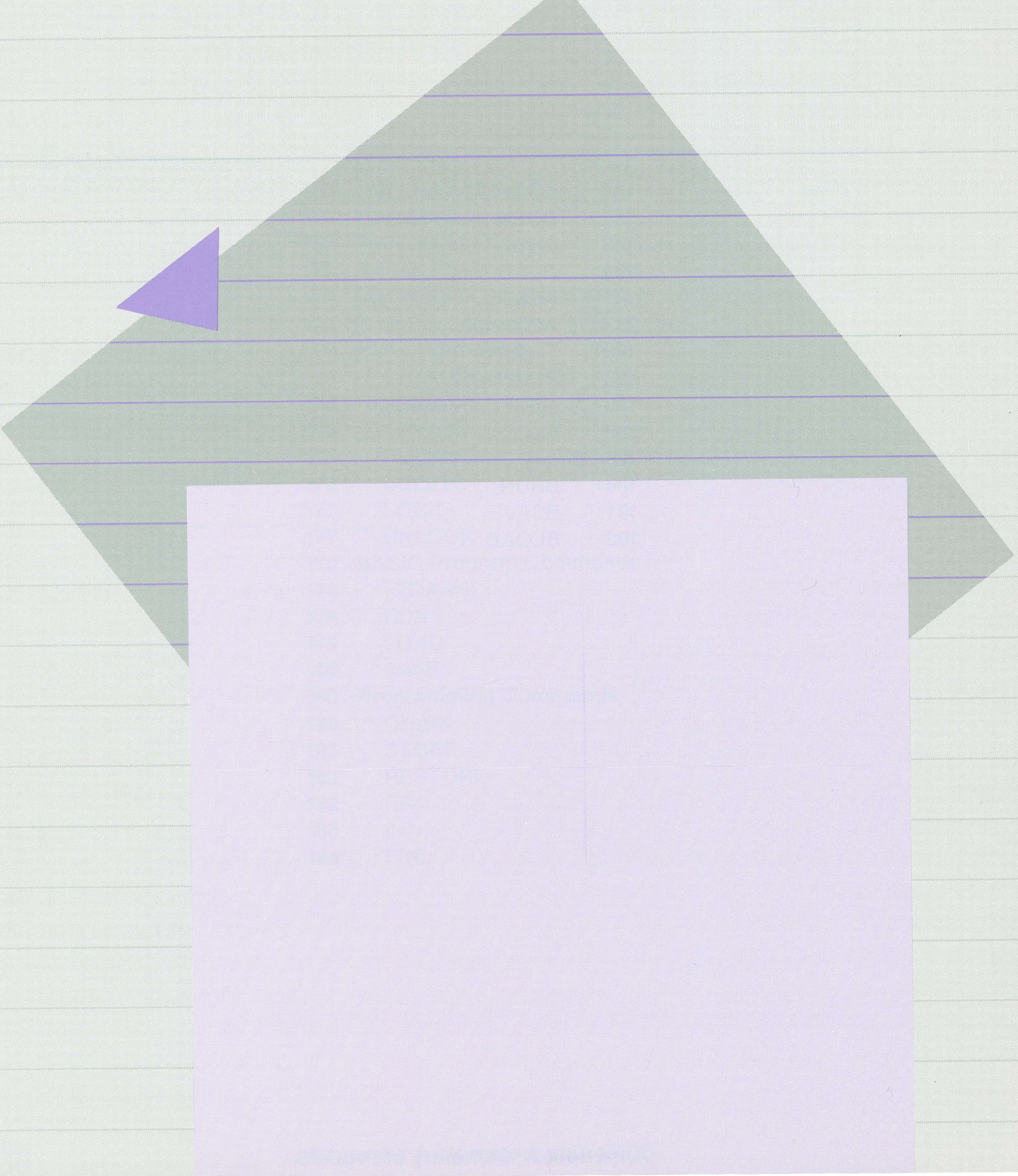
You can recognize a system program by its file type, SYS, displayed by the CAT or CATALOG command. Every system program provides some way to switch from itself to another system program. From ProDOS BASIC, you run another system program using the DASH (–) command. From other system programs, you usually switch to another system program by using the Quit command.

Starting Up a System Program

When a disk starts up, the PRODOS file is first loaded into memory. Next a system program is loaded into memory. Then ProDOS scans the disk for the first file having the name XXX.SYSTEM (XXX can be combinations of letters and numbers that form a valid ProDOS filename). If it finds such a file, it loads it into memory and runs it. Otherwise it loads the first file of type SYS on the disk and runs it.

If there is no program of type SYS on the disk, an error message is displayed.

Summary of ProDOS



Summary of ProDOS

Features of ProDOS

Here is a list of some of the features of the ProDOS machine-language interface. These features are fully discussed in the *ProDOS Technical Reference Manual*. They are the basis upon which ProDOS is built.

- A directory-based filing system
- Up to 51 files in a volume directory; the number of files in other directories is limited only by space on the disk.
- Up to 32 megabytes per volume
- Up to 16 megabytes per file
- 20 different file types (ten of them user-defined)
- Up to eight files can be open at a time
- A defined, usable machine-language interface
- A defined interrupt protocol
- File structures compatible with Apple III SOS
- Fast transfer rate—reads about 8K per second from Disk II
- Supports all Apple II disk devices

An understanding of these features is not essential to the summary of ProDOS that follows.

Filenames

A ProDOS **filename** is up to 15 characters long. It can contain uppercase and lowercase letters (A-Z), digits (0-9), and periods (.), and it must begin with a letter. Lowercase letters are automatically converted to uppercase.

A filename must be unique within its directory. Some examples are

ANGLOFILE
BALLOON
LETTER.TEXT

Pathnames

A ProDOS **pathname** is a series of filenames, each preceded by a slash (/). The first filename in a pathname is the name of a **volume directory**. Successive filenames indicate the path, from volume directory to the file, that ProDOS must follow to find that particular file. The maximum length for a pathname used in a command is 64 characters, including slashes.

Examples:

/EMPLOYEES/MARKETING/DIVISION.1
/SPORTS/FOOTBALL/THE.49ERS/QUARTERBACKS/MONTANA
/BIGDISK/RECORDS/MAY/JELLY.BEANS

Any command that requires you to name a file will accept a pathname or a partial pathname. A **partial pathname** is a portion of a pathname that doesn't begin with a slash. The maximum length of a partial pathname is 64 characters, including slashes.

These partial pathnames are all derived from the sample pathnames above:

MARKETING/DIVISION.1
DIVISION.1
THE.49ERS/QUARTERBACKS/MONTANA

When you use a partial pathname, ProDOS does one of two things. It usually adds the **prefix**, a pathname that indicates a directory, to the front of the partial pathname to form a complete pathname. But if the prefix is empty, or if you use either the slot option or the drive option (described in the section ''Syntax'') in the command, the name of the volume specified by the slot and drive options is used instead of the prefix.

For the partial pathnames listed above to indicate valid files, the prefix should be set to /EMPLOYEES/, /EMPLOYEES/MARKETING/, and /SPORTS/FOOTBALL/, respectively. The maximum length for a prefix is 64 characters. You set the prefix using the PREFIX command.

Syntax

The syntax, or structure, of each ProDOS command is a command word followed by a list of options, as in

SAVE pn [,S#] [,D#]

The command word (SAVE in this example) is followed by a list of options. Unbracketed options must be included each time the command is used. Options in square brackets, [and] , are optional, and can be used in any order. Options separated by a vertical bar are alternates: use one or the other, not both (if both are entered, ProDOS uses the second in the list).

Uppercase letters and commas indicate characters that must be typed as shown; lowercase letters and the number symbol, #, stand for items that you supply.

Table A-1 is a summary of the command options. The next section contains a description of each of the options.

Table A-1. ProDOS Command Options

Name	Syntax	Minimum	Maximum	Examples	
Pathname	pn	*	*	/DISK/RECORDS/JAN	
Slot Number	,S#	1	7	,S1	,S3
Drive Number	,D#	1	2	,D1	,D2
Number of Fields	,F#	0*	65535	,F2	,F10
Record Number	,R#	0	*	,R59	,R3982
Number of Bytes	,B#	0	*	,B2	,B7
Address in RAM	,A#	0	65535	,A512	,A4096
Length in Bytes	,L#	1	65535	,L10	,L16384
End Address in RAM	,E#	1	65535	,E776	,E32768
At Line Number	,@#	0	65535	,@10	,@322
Slot Number	snum	0	7	1	3
File Type	,Ttype	*	*	,TDIR	,TTXT

* See the description below

Summary of the Options

#	Decimal or Hexadecimal Integer. # can be replaced by a decimal integer, or it can be replaced by a hexadecimal number by preceding the hexadecimal digits with a dollar sign. The permitted values of # depend on the option.
pn	Pathname or Partial Pathname. See the section "Pathnames."
,S#	Slot Number. # specifies an Apple II slot that contains a disk controller card. # initially defaults to the slot from which ProDOS was started up. It subsequently defaults to the last value specified for this parameter. # must be in the range 1 through 7. If # refers to a slot which does not contain a disk controller card, you will get the NO DEVICE CONNECTED error message.
,D#	Drive Number (either 1 or 2). # initially defaults to one. It subsequently defaults to the latest value specified for this parameter. If ,S# is used without this option, ,D# defaults to one. If # refers to a drive that doesn't exist on the controller card in the indicated slot, you get the NO DEVICE CONNECTED error.
,F#	Number of Fields. Used with sequential and random-access text files. # specifies a field whose position in the file is # fields ahead of the current file position. # defaults to 0, which does not change the file position. Note: EXEC always sets the pointer to the start of the named file, so # is always relative to 0 when used with EXEC. Although # has a maximum value of 65535, if # specifies a position past the end of the record or the end of the file, the position pointer stops at the end of the record or file, and the OUT OF DATA error message is returned. For DOS compatibility, both the options ,F# and ,R# indicate a number of fields when used with the EXEC or POSITION commands.

,R# Record Number. Used with the READ and WRITE commands for random-access text files. # defaults to 0 after OPEN. Thereafter, it defaults to the last record specified. # points to an absolute record within a random-access file. The maximum record number is 16 megabytes divided by the file's record length, or 65535, whichever is smaller.

,B# Number of Bytes. # defaults to 0. # indicates a position in a file whose position is # bytes ahead of the current position. For READ and WRITE it is evaluated after the ,F# option, and the maximum byte number is record length minus one. If it indicates a position past the end of record or file, the position is left at the end of the record or file, and the END OF DATA error message is returned.

For BRUN, BLOAD, and BSAVE, it is always used relative to the beginning of the file. If it indicates a position past the end of the file, the RANGE ERROR error message is returned.

,A# Address in RAM. For BRUN, BLOAD, and BSAVE, # indicates a starting memory address for the transfer of binary information. If BLOAD does not specify this parameter, the value of A# defaults to that used when the binary file was transferred using the BSAVE command. For PR# and IN#, # specifies the memory address of a machine-language driver routine. # must be in the range 0 through 65535.

,L# Length in Bytes. # defaults to 1. In the OPEN and APPEND commands with random-access files, ,L# is required and specifies the record length in bytes. When used with the BRUN, BLOAD, and BSAVE commands, # specifies the number of bytes to be transferred between the Apple II's memory and a file. # must be in the range 0 through 65535. With the binary commands ,E# can be used instead of ,L#.

,E# End Address in RAM. This is an alternative to the ,L# option for BRUN, BLOAD, and BSAVE. # indicates the last memory address for the transfer of binary data. Either ,L# or ,E# is required for BSAVE. If neither is used with BRUN or BSAVE, bytes are transferred until the end of the file. # must be in the range 0 through 65535.

,@# At Line Number. # indicates the number of the first program line to be executed by the RUN or CHAIN command. The default is the first line in the program. If there is no line with the number #, an error is returned.

snum Slot Number. snum is used with the IN# and PR# commands. It can have any value from 0 through 7. snum is the slot number of the device with which subsequent data (either input or output) is to be transferred. An snum of 0 specifies the Apple II's normal routines for I/O.

,Ttype File Type. type is a three-letter abbreviation that indicates the type of file specified by the command. The possible values for type are given in Table A-2.

Table A-2. The File Type Abbreviations

Abbreviation	**File Type**
DIR	Directory
TXT	Text
BAS	Applesoft Program
VAR	Applesoft Variables
BIN	Binary
REL	Relocatable Code
* $F#	User Defined
SYS	ProDOS System File
SYS	ProDOS System Program

* # is an integer from 1 to 8.

As an example, the ProDOS command that has the syntax

READ pn [,R#] [,F#] [,B#]

can be interpreted as

```
READ /BIGDISK/MEMOS ,R100 ,F2
```

by the following process. The command word *READ* is in uppercase, and must be typed exactly as shown. The symbol for the pathname *pn* is in lowercase; it is replaced by the pathname /BIGDISK/MEMOS. The option ,R# becomes ,R100 indicating that data is to be read from record number 100 of the random-access text file /BIGDISK/MEMOS, which must already be open. The option ,F# is replaced by ,F2 indicating that the first two fields in record 100 are to be read and discarded before any data is taken from the record. The ,B# option is not used.

ProDOS Commands in Programs

You can give all ProDOS commands from within programs, and you can issue all except OPEN, WRITE, READ, APPEND, and POSITION from the keyboard. If any ProDOS command in a program is to be printed, it must be preceded by a printed CONTROL-D, and the CONTROL-D must be the first character on the printed line. Here is the most common way of printing a ProDOS command preceded by a CONTROL-D.

D$ is set to CONTROL-D.

Print the command preceded by CONTROL-D.

```
10 D$ = CHR$(4)
20 PRINT D$;"PRODOSCOMMAND"
```

The WRITE, READ, and APPEND commands are terminated by the next ProDOS command given. If you want to terminate one of these commands without using a ProDOS command, you can use the null ProDOS command

Null ProDOS command.

D$ is CONTROL-D.

```
50 PRINT D$
```

Filing Commands

This section contains a brief description of each ProDOS filing command.

CATALOG and CAT [pn][,S#][,D#]

Use the CATALOG and CAT commands in either immediate or deferred mode.

Examples:

List files in named directory.

List files in prefix directory.

List files in volume directory of slot 6, drive 1.

```
CAT /DATABASE/PHOTOFILES
CATALOG
CAT ,S6
```

The CAT and CATALOG commands display a list of the files in the directory indicated by pn, S#, and D#. If pn is not used, a catalog of the prefix directory is displayed unless the prefix is empty or S# or D# is used. In these cases the volume name indicated by S# and D# is used instead of the prefix.

CAT displays a 40-column list containing the first five items explained below, while CATALOG displays an 80-column list with all eight items.

For each file in the directory these commands display from left to right on the screen

- an asterisk if the file is locked (see the LOCK command)
- the file's name
- a three-letter abbreviation of the file's type (see Table A-2)
- the number of 512-byte blocks that the file occupies
- the date the file was last modified (Mo/Da/Yr Hr:Mn:Sc) (only Mo/Da/Yr is displayed by CAT)
- the date the file was created (Mo/Da/Yr Hr:Mn:Sc)
- the *logical* end of file [see section "ENDFILE (Maximum File Sizes)" in Chapter 3 and section "The End of File" in Chapter 7]
- the file's load address (in hexadecimal) if it is a binary file, or its record length (in decimal) if it is a random-access text file.

When you catalog a volume directory, the number of free blocks, used blocks, and total available blocks on that volume are displayed.

Possible Errors:

```
RANGE ERROR              NO DEVICE CONNECTED
PATH NOT FOUND           I/O ERROR
INVALID OPTION           NO BUFFERS AVAILABLE
FILE TYPE MISMATCH       SYNTAX ERROR
FILE BUSY
```

PREFIX [pn] [,S#] [,D#]

Use the PREFIX command in either immediate or deferred mode.

Examples:

Set prefix to /PROFILE/WORKFILES/.	`PREFIX /PROFILE/WORKFILES/`
Set prefix to name of volume in slot 6, drive 1.	`PREFIX ,D1 ,S6`
Make prefix empty.	`PREFIX /`
Display the prefix.	`PREFIX`

This command normally sets the value of the prefix, but if no options are used, the value of the prefix is displayed. If the command is used without options in a program, the next INPUT statement reads the value of the prefix. If a slash is used in place of pn, the prefix is set to empty; the volume specified by the default slot and drive is then used as prefix. Otherwise the standard rules for pn and the slot and drive options hold. The maximum length for the prefix is 64 characters, including slashes.

Possible Errors:

```
RANGE ERROR              NO DEVICE CONNECTED
PATH NOT FOUND           I/O ERROR
INVALID OPTION           FILE TYPE MISMATCH
SYNTAX ERROR
```

CREATE pn [,Ttype] [,S#] [,D#]

Use the CREATE command in either immediate or deferred mode.

Examples:

Create a new directory.

Create a binary file in volume directory, S6, D2.

```
CREATE /PHONE/NEWDIR ,TDIR
CREATE FOTO ,D2 ,S6 ,TBIN
```

Creates a file of the indicated type and name. Table A-2 shows the different file types. This command is primarily used for directory files. You must create a directory before saving a file in it.

Possible Errors:

```
RANGE ERROR              NO DEVICE CONNECTED
WRITE PROTECTED          PATH NOT FOUND
I/O ERROR                DISK FULL
INVALID OPTION           SYNTAX ERROR
DIRECTORY FULL           DUPLICATE FILENAME
```

RENAME pn1,pn2 [,S#] [,D#]

Use the RENAME command in either immediate or deferred mode.

Example:

```
RENAME SEPERATE, SEPARATE, S4, D1
```

Changes the name of the file indicated by pn1, S#, and D# to the name indicated by pn2, S#, and D#. This command cannot move a file from one directory to another; it can only change the name of a file within its directory. You cannot rename a file that is locked.

Possible Errors:

```
RANGE ERROR              NO DEVICE CONNECTED
WRITE PROTECTED          PATH NOT FOUND
I/O ERROR                FILE LOCKED
INVALID OPTION           SYNTAX ERROR
DUPLICATE FILENAME       FILE BUSY
```

DELETE pn [,S#] [,D#]

Use the DELETE command in either immediate or deferred mode.

Example:

Delete EXPLETIVE file.

```
DELETE EXPLETIVE
```

Removes the file indicated by pn, S#, and D# from its directory. The file must not be open or locked. If the file is a directory file, it must be empty. You cannot delete a volume directory.

If a program tries to delete a nonexistent file, ProDOS returns the `PATH NOT FOUND` error message. To prevent this, open the file (which creates it if it doesn't yet exist), close it, then delete it.

Possible Errors:

```
RANGE ERROR              NO DEVICE CONNECTED
WRITE PROTECTED          PATH NOT FOUND
I/O ERROR                FILE LOCKED
INVALID OPTION           SYNTAX ERROR
FILE BUSY
```

LOCK pn [,S#] [,D#]

Use the LOCK command in either immediate or deferred mode.

Example:

```
LOCK /GATES/PEARLY
```

This command protects the file indicated by pn, S#, and D# from being accidentally deleted, renamed, or changed. A locked file is indicated in the catalog by an asterisk (*).

Possible Errors:

```
RANGE ERROR                NO DEVICE CONNECTED
WRITE PROTECTED            PATH NOT FOUND
I/O ERROR                  INVALID OPTION
SYNTAX ERROR
```

UNLOCK pn [,S#] [,D#]

Use the UNLOCK command in either immediate or deferred mode.

Example:

```
UNLOCK RECIPES, S5
```

If the file indicated by pn, S#, and D# is locked, you must unlock it before you can alter, rename, or remove it.

Possible Errors:

```
RANGE ERROR                NO DEVICE CONNECTED
WRITE PROTECTED            PATH NOT FOUND
I/O ERROR                  INVALID OPTION
SYNTAX ERROR
```

BASIC Program Commands

This section contains a brief description of the BASIC program commands.

– (DASH) pn [,S#] [,D#]

Use the DASH command in either immediate or deferred mode.

Example:

Run program in file /ANY/PROGRAM, regardless of program type.

```
- /ANY/PROGRAM
```

This command, called the DASH command, can be used in place of RUN, BRUN, and EXEC; it is the only command that runs a system program. Thus, it can be used to run programs of types BAS, BIN, TXT, and SYS (XXX.SYSTEM files). Note that everything currently in memory is lost when a system program is invoked. (See the RUN, BRUN, and EXEC commands for more details.)

Possible Errors:

```
PROGRAM TOO LARGE         RANGE ERROR
NO DEVICE CONNECTED       PATH NOT FOUND
I/O ERROR                 INVALID OPTION
NO BUFFERS AVAILABLE      FILE TYPE MISMATCH
SYNTAX ERROR              FILE(S) STILL OPEN
```

RUN pn [,@#] [,S#] [,D#]

Use the RUN command in either immediate or deferred mode.

Examples:

Load BASIC program from file AMOK in prefix directory and run it.

```
RUN AMOK
```

Load BASIC program from file TWO.IN.ONE in prefix directory, and run it starting at line 1000.

```
RUN TWO.IN.ONE, @1000
```

Loads the Applesoft program in the file indicated by pn, S#, and D# (see the discussion of LOAD, below), and then runs it. If @# is used, then the program starts running at the specified line; if that line is not found, the next highest line is run. Without @#, execution starts at the program's first line.

The RUN command, without any parameters, causes the BASIC program currently in memory to be run.

Possible Errors:

```
RANGE ERROR                 NO DEVICE CONNECTED
PATH NOT FOUND              I/O ERROR
INVALID OPTION              FILE TYPE MISMATCH
PROGRAM TOO LARGE           SYNTAX ERROR
```

BASIC Error:

```
UNDEF'D STATEMENT ERROR
```

LOAD pn [,S#] [,D#]

Use the LOAD command in either immediate or deferred mode.

Example:

Bring BASIC program in file DOW.JONES in prefix directory into memory.

```
LOAD DOW.JONES
```

This command tells ProDOS to search for the Applesoft program file (type BAS) with the name indicated by pn, S#, and D#. If there is such a file, its program is loaded into the Apple II's memory. The program can then be changed, listed, run, or saved. LOAD closes any open files (except EXEC files), and erases any BASIC program in memory before placing the new program in the Apple II's memory.

The instruction LOAD, without any parameters, attempts to load a program from cassette tape.

Possible Errors:

```
RANGE ERROR                 NO DEVICE CONNECTED
PATH NOT FOUND              I/O ERROR
INVALID OPTION              FILE TYPE MISMATCH
PROGRAM TOO LARGE           SYNTAX ERROR
```

SAVE pn [,S#] [,D#]

Use the SAVE command in either immediate or deferred mode.

Example:

Save current BASIC program in file BABY.SEALS.

```
SAVE BABY.SEALS
```

If the indicated file does not exist, a file with the pathname indicated by pn, S#, and D# is created, and the current Applesoft program is stored in that file. If the file is locked, the `FILE LOCKED` error is returned.

Warning
If a file with the indicated pathname already exists, its contents are replaced without warning by the current BASIC program. *Always lock all valuable files.*

The instruction SAVE, without any parameters, attempts to save a program onto cassette tape.

Possible Errors:

```
RANGE ERROR                  NO DEVICE CONNECTED
WRITE PROTECTED              PATH NOT FOUND
I/O ERROR                    DISK FULL
FILE LOCKED                  INVALID OPTION
FILE TYPE MISMATCH           SYNTAX ERROR
DIRECTORY FULL
```

Programming Commands

This section provides a brief description of each of the BASIC programming commands.

CHAIN pn [,@#] [,S#] [,D#]

Use the CHAIN command in either immediate or deferred mode.

Example:

```
CHAIN /EXAMPLES/PART.TWO
```

Used from within a BASIC program, it loads and runs the BASIC program specified by pn, S#, and D#, leaving the names and values of all the current variables in memory. This means that a program can operate on the results of the previous program, and it can leave data for any subsequently chained program.

If the @# option is used, execution of the indicated file begins at the specified line; if that line does not exist, the next highest line is run.

Possible Errors:

```
RANGE ERROR                 NO DEVICE CONNECTED
PATH NOT FOUND              I/O ERROR
INVALID OPTION              FILE TYPE MISMATCH
PROGRAM TOO LARGE           SYNTAX ERROR
```

BASIC Error:

```
UNDEF'D STATEMENT ERROR
```

STORE pn [,S#] [,D#]

Use the STORE command in either immediate or deferred mode.

Example:

Store all BASIC variables.

```
STORE /GAMES/BINGO.VARS
```

This command packs all the currently defined BASIC variables, and writes them to the file (type VAR) indicated by pn, S#, and D#. These variables may be returned to memory using the RESTORE command.

Before storing Applesoft variables, ProDOS compacts the Applesoft string space. This may result in a delay of two to four seconds before the disk is actually accessed.

Possible Errors:

```
RANGE ERROR                 NO DEVICE CONNECTED
WRITE PROTECTED             PATH NOT FOUND
I/O ERROR                   DISK FULL
FILE LOCKED                 INVALID OPTION
FILE TYPE MISMATCH          SYNTAX ERROR
DIRECTORY FULL
```

RESTORE pn [,S#] [,D#]

Use the RESTORE command in either immediate or deferred mode.

Example:

Load BASIC variables.

```
RESTORE /GAMES/BINGO.VARS
```

This command clears the current BASIC variables from memory, unpacks the variables stored in the variable file (type VAR) indicated by pn, S#, and D#, and puts the variables in the BASIC variable storage space in memory.

Possible Errors:

```
RANGE ERROR                 NO DEVICE CONNECTED
PATH NOT FOUND              I/O ERROR
INVALID OPTION              FILE TYPE MISMATCH
PROGRAM TOO LARGE           SYNTAX ERROR
```

PR# snum | A# | snum ,A#

Use the PR# command in either immediate or deferred mode.

Examples:

Send output to slot 1.

```
PR# 1
```

Send output using routine at $300.

```
PR# A$300
```

Designate the ROM in slot 2 as the output routine for slot 1. Does not redirect output.

```
PR#1,A$C200
```

This command is used to send output to a slot; to send ouput to an address in memory; or to reassign the output address associated with a slot. It operates by changing the address of the current output routine (stored in memory locations $36 and $37). All subsequent non-file output is sent, a character at a time, by the routine at the specified address. If snum (a slot number) is used, the address of the current output routine is set to indicate the first byte of ROM on the card in that slot ($Csnum00). If A# is used, the address is changed to #, and the byte at this address must be a 6502 CLD (clear decimal) instruction.

Once the address of the output routine is changed, ProDOS performs a jump to this new address. The first portion of the code at that address normally performs initialization (such as starting up the disk in that slot). The code then resets the output routine address to indicate the true address of its output routine.

If both snum and A# are used, the specified address is assigned as the output address for that slot. It does not redirect output: a subsequent PR# snum must be used for this purpose.

See the description of PR# in Chapters 5 and 9 for more details; also see the *Apple II Reference Manual*.

Possible Errors:

```
RANGE ERROR                NO DEVICE CONNECTED
INVALID OPTION             SYNTAX ERROR
```

IN# snum | A#

Use the IN# command in either immediate or deferred mode.

Examples:

Get input from slot 2.

Get input using routine at $300.

```
IN# 2
IN# A$300
```

This command tells the Apple II to take its input from a slot or from an address in memory. It operates by changing the address of the current input routine (stored in memory locations $38 and $39). All subsequent non-file input is taken, a character at a time, by the routine at the specified address. If snum (a slot number) is used, the address of the current input routine is set to indicate the first byte of ROM on the card in that slot ($Csnum00). If A# is used, the address is changed to #, and the byte at this address must be a 6502 CLD (clear decimal) instruction.

Once the address of the input routine is changed, ProDOS performs a jump to this new address. The first portion of the code at that address normally performs initialization (such as starting up the disk in that slot). The code then resets the input routine address to indicate the true address of its input routine.

See the description of IN# in Chapters 5 and 9 for more details; also see the *Apple II Reference Manual*.

Possible Errors:

```
RANGE ERROR                NO DEVICE CONNECTED
INVALID OPTION             SYNTAX ERROR
```

FRE

Use the FRE command in either immediate or deferred mode.

Example:

```
PRINT CHR$ (4);"FRE"
```

This command removes any data remaining from former programs from the memory area used to store your program's string variables; that is, it cleans house.

Possible Error:

```
SYNTAX ERROR
```

Text File Commands

This section contains a brief description of each text file command.

OPEN pn [,L#] [,Ttype] [,S#] [,D#]

Use the OPEN command only in deferred mode.

Examples:

Open sequential file on drive 2 in default slot.

```
OPEN SESAME/SEED, D2
```

Open random-access file with record length of 100.

```
OPEN /X/RECORDS,L100
```

Open a directory file.

```
OPEN DOOR,TDIR
```

This command allocates a memory buffer to the file indicated by pn, S#, and D#, and prepares the system to write or read from the beginning of the file. If the file did not previously exist, a text file is created. L# specifies the file's record length; if omitted, the record length defaults to the record length with which the file was opened, or to 1 for a new file.

Using Ttype you can open non-text files for reading and writing. Non-text files must be created before they can be opened. You must be careful when using this feature: the contents of non-text files can be difficult to deal with when using BASIC strings.

Up to eight files can be open at a time. The commands OPEN, CAT, CATALOG, and EXEC—and – (DASH) when you use it to execute (EXEC command) a file—all open a file. Only OPEN leaves the file open.

The memory buffer for an open file is 1024 bytes long. If there is not enough free memory for a file's buffer to be allocated, the file cannot be opened.

Warning
A program must close all the files it opens. If it doesn't, data written to the file may be lost.

Possible Errors:

```
RANGE ERROR                 NO DEVICE CONNECTED
WRITE PROTECTED             PATH NOT FOUND
I/O ERROR                   DISK FULL
INVALID OPTION              NO BUFFERS AVAILABLE
FILE TYPE MISMATCH          NOT DIRECT COMMAND
SYNTAX ERROR                DIRECTORY FULL
```

CLOSE [pn]

Use the CLOSE command in either immediate or deferred mode.

Examples:

Close all open files.

Close /P/NOSE.

```
CLOSE
CLOSE /P/NOSE
```

The effect of CLOSE on an EXEC file: see the section "The EXEC Command." For comparison, see the FLUSH command.

The CLOSE command without options closes all open files (with the exception of EXEC files: see EXEC). If pn is used, only the specified file is closed. When a file is closed, any characters in the output part of the file buffer are written to that file, and its file buffer memory is released for other uses.

Warning
A program must close all files it opens. Failure to close an open file can result in loss of data. If a program terminates because of an error, because a CONTROL-C was pressed, or for any other reason, enter the CLOSE command from the keyboard before you do anything else.

Possible Errors:

```
I/O ERROR                   INVALID OPTION
SYNTAX ERROR
```

READ pn [,R#] [,F#] [,B#]

Use the READ command in deferred mode only.

Examples:

Prepare to read record 10 from /EXAMPLES/HELPERS.

```
READ /EXAMPLES/HELPERS,R10
```

Skip 100 fields of the file BOOK and prepare to read.

```
READ BOOK, F100
```

This command alters the current position and prepares input to be taken from the indicated file. If R# is used, the current file position is moved to the beginning of the specified record. If F# or B# is used, the current position is moved forward the specified number of fields and bytes.

Once this command is given, all characters asked for by INPUT or GET statements in the program are taken from the specified file starting at the file's current position. Each INPUT statement is ended by a carriage return character (ASCII code 13) or 224 bytes, whichever comes first. The READ command is terminated by the next ProDOS command, or by the null ProDOS command, that is, printing CONTROL-D.

Warning

Due to the limitations of BASIC strings, the reading of non-text files may not work as you expect it to.

If you open and read a directory file, you get back strings that are identical in format to the lines returned by CATALOG.

For more details on READ, see the section "Reading From ProDOS Directories," Appendix D.

Possible Errors:

```
RANGE ERROR                 END OF DATA
I/O ERROR                   INVALID OPTION
NOT DIRECT COMMAND          SYNTAX ERROR
FILE NOT OPEN
```

WRITE pn [,R#] [,F#] [,B#]

Use the WRITE command only in deferred mode.

Examples:

Prepare to write to start of record 29.

```
WRITE /MYDISK/ADDRESS,R29
```

Prepare to write to current position in file.

```
WRITE SOON
```

This command alters the current position, and prepares output to be sent to the indicated file. If R# is used, the current file position is moved to the beginning of the specified record. If F# or B# is used, the current position is moved forward the specified number of fields and bytes.

Once this command is given, all characters output by the program or by BASIC are placed in the specified file starting at the file's current position. The WRITE command is terminated by the next ProDOS command.

Although you can open directory files (type CAT), and read from them, you *cannot* write to them.

Possible Errors:

```
RANGE ERROR                 WRITE PROTECTED
I/O ERROR                   DISK FULL
FILE LOCKED                 INVALID OPTION
NOT DIRECT COMMAND          SYNTAX ERROR
FILE NOT OPEN
```

APPEND pn [,Ttype] [,L#] [,S#] [,D#]

Use the APPEND command only in deferred mode.

Example:

```
APPEND MORE.INFO
```

Prepare to write to end of file MORE.INFO.

This command opens the file specified by pn, S#, and D#, moves the current position to the end of the file, and issues a WRITE to that file. If L# is used (and is the same as the file's original record length), the current position is set to the beginning of the record immediately following the last record in the file.

Once this command is given, all characters output by the program or by BASIC are placed in the specified file starting at the file's current position. The WRITE part of the APPEND command is terminated by the next ProDOS command.

Warning

Be sure that your program closes all appended files. Failure to do so may result in loss of data.

Possible Errors:

```
RANGE ERROR                 NO DEVICE CONNECTED
WRITE PROTECTED             PATH NOT FOUND
I/O ERROR                   FILE LOCKED
INVALID OPTION              FILE TYPE MISMATCH
NO BUFFERS AVAILABLE        NOT DIRECT COMMAND
SYNTAX ERROR
```

FLUSH [pn]

Use the FLUSH command in either immediate or deferred mode.

Example:

```
FLUSH /WITH/DELIGHT
```

The FLUSH command without options causes all open files (with the exception of EXEC files: see EXEC) to be flushed. If pn is used, only the specified file is flushed. When a file is flushed, any characters in the output part of the file buffer are written to that file, and updated index and allocation buffers are copied to the file's directory.

Warning
The FLUSH command is useful for preserving the integrity of the data on a disk. A program that may stop unexpectedly—whether due to power surges or little kids—should flush its buffers frequently. This way you can prevent much data from being lost.

Possible Errors:

```
RANGE ERROR                 I/O ERROR
INVALID OPTION              SYNTAX ERROR
```

POSITION pn ,F#|,R#

Use the POSITION command only in deferred mode.

Example:

Read and discard 227 fields.

```
POSITION ADDRESS.DATA, F277
```

POSITION causes # fields to be read and discarded. For compatibility with DOS 3.3, the F# and R# options are functionally equivalent.

POSITION scans forward from the current position, character by character, until it encounters the #-th (RETURN) character following the current position. It then places the current position at the first byte following this (RETURN) character. If, in this search, it finds any byte in which no character has ever been stored (normally an end of record or end of file), the message `END OF DATA` is given.

Possible Errors:

```
RANGE ERROR                   END OF DATA
I/O ERROR                     INVALID OPTION
NOT DIRECT COMMAND            SYNTAX ERROR
FILE NOT OPEN
```

The EXEC Command

The format and a description of the EXEC command are given in the section below.

EXEC pn [,F#|,R#] [,S#] [,D#]

Use the EXEC command in either immediate or deferred mode.

Example:

Execute commands starting with the fourth field of the file PRIVILEGE.

```
EXEC PRIVILEGE,F3
```

This command causes the Apple II to take all (non-file) input from a sequential text file instead of from the keyboard. This allows you to use a text file containing BASIC or ProDOS commands, or input to a running program to control the operation of your Apple II.

Other uses of EXEC are explained in Chapter 8.

The file indicated by pn, S#, and D# must be a sequential text file (hereafter referred to as an EXEC file). ProDOS opens the EXEC file, reads and discards the number of fields specified by F# or R#, and then starts reading commands at that position. When the end of file is reached, the EXEC file is closed.

There can only be one EXEC command in effect at a time. If the EXEC file contains an EXEC command, the original EXEC file is closed and the new EXEC file is opened and executed. The CLOSE command, when issued from within an EXEC file, does not cause the EXEC file to close. If an EXEC file contains a RUN command, EXEC waits until the program ends; then the next command in the EXEC file is executed.

Warning
If a program is running while an EXEC file is open, an INPUT statement in the program reads its input from the EXEC file. Worse yet, if that response is an immediate-execution ProDOS command, the command is executed before the program continues.

By the Way: If you type CONTROL-C to stop an Applesoft program that is running while an EXEC file is still open, the remaining commands in the EXEC file are usually not executed.

For compatibility with DOS 3.3, the F# and R# options are functionally equivalent.

Possible Errors:

```
RANGE ERROR                 NO DEVICE CONNECTED
PATH NOT FOUND              I/O ERROR
INVALID OPTION              NO BUFFERS AVAILABLE
FILE TYPE MISMATCH          SYNTAX ERROR
```

Binary Commands

The binary commands are briefly described in the next sections.

BRUN pn [,A#][,B#][,L#|,E#][,S#][,D#]

Use the BRUN command in either immediate or deferred mode.

Example:

```
BRUN SUPER, A$C0A
```

The BRUN command loads the binary file (type BIN) indicated by pn, S#, and D# into the Apple II's memory as specified by A#, B#, and L# or E#. B# is the number of the first byte in the file to be loaded. A# is the first memory address into which data is to be loaded; L# is the number of bytes to be loaded, and E# is the last memory address into which data is to be loaded (either L# or E# should be used, not both). If A# is omitted, the file is loaded starting at the address from which it was saved. Once loaded, the file (which must be a machine-language program) is started by a machine-language jump (JMP) to address A#.

BASIC and ProDOS continue functioning if the machine-language program ends with a 6502 RTS instruction.

Possible Errors:

```
RANGE ERROR                 NO DEVICE CONNECTED
PATH NOT FOUND              I/O ERROR
INVALID OPTION              FILE TYPE MISMATCH
SYNTAX ERROR
```

BSAVE pn ,A# ,L#|,E# [,B#] [,Ttype] [,S#] [,D#]

Use the BSAVE command in either immediate or deferred mode.

Examples:

```
BSAVE PICTURE, A16384, L8192
BSAVE PICTURE, A$4000, E$5FFF
```

The BSAVE command stores the contents of a segment of the Apple II's memory into a file with the name indicated by pn, S#, and D#, and the type indicated by Ttype. The default file type is binary (BIN). If the file does not yet exist, it is created. The segment is specified by the starting address A#, and either the number of bytes to be stored L# or the end address E#. B# specifies the starting file position.

The examples shown above both store a high-resolution picture from the second high-resolution picture area of memory. They have the same effect, but the second example uses hexadecimal notation and the E# option instead of the L# option.

Possible Errors:

```
RANGE ERROR                 NO DEVICE CONNECTED
PATH NOT FOUND              WRITE PROTECTED
I/O ERROR                   DISK FULL
FILE LOCKED                 INVALID OPTION
FILE TYPE MISMATCH          SYNTAX ERROR
DIRECTORY FULL
```

BLOAD pn [,A#] [,B#] [,L#\,E#] [,Ttype] [,S#] [,D#]

Use the BLOAD commmand in either immediate or deferred mode.

Examples:

```
BLOAD PICTURE, A8192, L8192
BLOAD PICTURE, B$2000,A$4000,E$5FFF
```

The BLOAD command fills a segment of memory with data taken from the file with the name indicated by pn, S#, and D#, and with the type indicated by Ttype. The data is taken starting at file position B#, and is placed in memory starting at address A#. L# is the number of bytes transferred, and E# is the end address; one or the other, but not both, can be used. If A# is omitted, the first byte is placed at the address from which the file was originally saved (using BSAVE). If L# and E# are omitted, the last byte transferred is the last byte in the file.

For the examples, assume the file PICTURE has at least two high-resolution pictures in it, each 8192 bytes long. The first example shown above places the first 8192 bytes of PICTURE into the first high-resolution picture area, which starts at memory location 8192 (decimal). The second example moves the second picture, starting at byte position $2000 (8192) in the file, into the second high-resolution picture area, which starts at memory location $4000 (16384), and ends at memory location $5FFF (24575).

See the sections ''High-Resolution Graphics With ProDOS'' and ''Installing Machine-Language Routines'' in Chapter 9 for some important restrictions on memory usage.

Possible Errors:

```
RANGE ERROR           NO DEVICE CONNECTED
PATH NOT FOUND        I/O ERROR
INVALID OPTION        FILE TYPE MISMATCH
PROGRAM TOO LARGE     SYNTAX ERROR
```

DOS, ProDOS, and Applesoft

DOS, ProDOS, and Applesoft

About This Appendix

This appendix summarizes the differences between DOS and ProDOS. In so doing, it responds to three particular queries:

- How do I tell what types of disks each of my programs can use?
- How do I tell which files can be converted from DOS to ProDOS and which can be converted from ProDOS to DOS?
- I already know about DOS. What's so different about ProDOS?

The *ProDOS Technical Reference Manual* explains the many similarities between ProDOS and Apple III SOS (Sophisticated Operating System).

The final part of this appendix lists the effects of ProDOS upon some of the Applesoft commands.

DOS Disks and ProDOS Disks

The first question, "How do I tell what types of disks each of my programs can use?" is a good one. It is not the program, but the way the program is stored on a disk, that determines the types of disk drives the program can use.

If a disk is formatted using the DOS command INIT, the programs on that disk use DOS, and DOS can use only Disk II Drives.

If a disk is formatted using the ProDOS Filer, the programs on that disk use ProDOS, and ProDOS can use all disk drives made by Apple Computer, Inc. for the Apple II.

The question becomes: "How do I tell if a disk is DOS-formatted, ProDOS-formatted, or other?"

This problem only exists for Disk II disks: a Disk II disk could be formatted for ProDOS, DOS 3.3, DOS 3.2.1 (or an earlier version), Apple II Pascal, or it could be unformatted. (If you have an Apple III, the disk could be SOS-formatted. In this case it is interchangeable with ProDOS disks.)

- If it is a Disk II disk, and the name on the label begins with a slash, it is ProDOS-formatted.
- If it is a Disk II disk, and the name on the label doesn't begin with a slash, follow the procedure given below.

Run the ProDOS Filer and try the option `LIST PRODOS DIRECTORY`. If that works, it is a ProDOS-formatted disk. If it doesn't work, try using the DOS-ProDOS Conversion Program. Set the direction to DOS→ProDOS and then try to transfer files. If the program reads in a list of files, it is a DOS disk. If that doesn't work, the disk could be blank, copy-protected, or it could be an old version of DOS that used yet another method of storage.

If you can't list or catalog the files, try starting up the disk. If it doesn't start up, the program was probably stored on the disk using an old version of DOS. To use this disk, you need to use the DOS 3.3 disk labeled *BASICS* (which you get when you buy DOS) and follow the instructions in *The DOS Manual*. If the disk still doesn't start up, either the disk isn't formatted, or the information on the disk is damaged and is not readable.

If you aren't able to list a disk's files, but the disk starts up, the disk could be an Apple II Pascal disk, some other language, or it could be copy-protected. You probably have an instruction manual that tells about the filenames the program can use. If it mentions pathnames or prefixes, it is written using ProDOS; if it uses single filenames, it could be a DOS disk.

By the Way: Once you determine a disk's type, label the disk with its type for future reference. Always use a soft-tipped pen when writing on a disk's label.

Converting Files

ProDOS programs and data can use all types of disks made by Apple Computer, Inc. for Apple II computers, whereas DOS programs can use only Disk II disks. In addition, programs written using ProDOS read information from disks and write information to disks considerably faster than their DOS equivalents.

Using the DOS-ProDOS Conversion Program, described in the *ProDOS User's Manual*, you can convert files from DOS format to ProDOS format, and back again. Table B-1 shows the correspondence between DOS and ProDOS files.

Table B-1. File Conversion

Contents of File	DOS Type		ProDOS Type
Text	T	↔	TXT
Binary	B	↔	BIN
Applesoft Program	A	↔	BAS
Integer BASIC Program	I	↔	INT
Relocatable Code File	R	↔	REL
Other (ProDOS only)	B	←	XXX

When converted, text and binary files are immediately usable by programs of the other type. Applesoft files usually have to be modified before they can be used. The following sections explain the changes you must make when modifying a DOS program.

The Differences Between DOS and ProDOS

There are three main areas of difference between DOS and ProDOS. First, ProDOS is an entirely different program from DOS: it uses different code and different parts of the Apple II's memory. Any DOS program that makes use of specific locations or routines in DOS will not work if converted. Likewise, programs that place assembly-language routines in memory may have to be changed so they don't overwrite parts of memory used by ProDOS. Details on the parts of memory used by ProDOS, and on the use of all the ProDOS routines, are given in the *ProDOS Technical Reference Manual*.

The second major difference is the conflicting filename conventions and file organizations used by DOS and ProDOS. It is likely that you will have to modify both when converting a program. In addition, ProDOS does not support volume numbers. If your program uses them, you will have to modify it to use volume names instead.

The third difference is the command structure. Six DOS commands no longer exist, fourteen DOS commands have been improved, and eight ProDOS commands are new. Of these changes, only the commands that have been eliminated will affect the programs that you are converting.

File Organization and Names

This section assumes that you are familiar with the organization and names of ProDOS files. If you are not, read Chapter 2 of this manual.

If a program refers to other files — for example, if it creates and uses a random-access text file, or if it chains to another program — then it is likely that you will need to change the way that the program names these files.

First, the filenames in a converted program must all be changed to ProDOS filenames: they can be no more than 15 characters long, consist only of letters, digits, and periods, and must begin with a letter.

Second, when the prefix is empty, ProDOS and DOS can use filenames in exactly the same way: each file has a filename, and the disk containing that file can be specified using the slot and drive options. Thus, if a converted program uses ProDOS filenames, it can work without further modification to the filenames, but only if the prefix is empty. The prefix is empty immediately after you start up ProDOS, and it also is empty after you use the command

The PREFIX command is explained in Chapter 3.

```
PREFIX /
```

However, it is preferable not to write or use programs that use files in this manner. Such programs place all files into a disk's volume directory. Because a disk's volume directory can hold no more than 51 files, it soon fills up if programs don't use directories of their own. You should revise each program so that it, and all its files, are stored in a separate directory.

DOS lets you assign a volume number to a disk when you initialize it. ProDOS does not support volume numbers. To modify a program that uses volume numbers, identify each disk by its volume name, not number.

DOS Commands That Went Away

Six DOS commands are not supported by ProDOS. They are

FP
INT
INIT
MAXFILES
MON
NOMON

FP and INT

Because ProDOS supports only Applesoft BASIC, it has no need for commands that switch from one version of BASIC to another. If you use these commands, you get a SYNTAX ERROR.

INIT

Because of the different types of disks that must be initialized, it would take up too much memory space for ProDOS to have a built-in formatting command like INIT. Thus, INIT is replaced by a command in the ProDOS Filer. Because you can no longer format a disk from within a program, it is now essential that you always have an adequate supply of blank formatted disks.

Using INIT you could assign any name to the greeting program on a disk; with ProDOS, a greeting program must be named STARTUP. However, ProDOS lets you use a BASIC, machine-language, or EXEC program as the STARTUP program; with DOS, only BASIC greetings were possible.

If ProDOS encounters the INIT command in a program, it gives you a SYNTAX ERROR.

MAXFILES

With DOS, the maximum number of files that could be open at once was three by default; this could be raised as high as 16 by using the MAXFILES command. With ProDOS, any program can have up to eight files open simultaneously. A 1024-byte file buffer is allocated to each file (or 512 bytes to a directory file) when it is opened.

See the *ProDOS Technical Reference Manual* for more details on open files.

The MAXFILES command is not supported by ProDOS, but it will not cause an error.

The maximum BASIC program size for a 64K Apple II is

```
$A000 - $400 * Maximum number of open files
```

MON and NOMON

With DOS, the commands MON and NOMON allowed you to display all disk commands, disk input, and disk output without printing them. These commands are not supported by ProDOS. MON has been completely removed. If your program uses MON, you will get a `SYNTAX ERROR`. NOMON is ignored by ProDOS, but will not cause an error.

Improved DOS Commands

Fourteen DOS commands received facelifts. All can be used in the same manner as with DOS, so you don't have to change them when converting a program, but each has added features. The following sections describe the new capabilities of these commands.

Refer to the specific command summary in Appendix A for the new syntax.

The improved commands are

APPEND	BLOAD	BRUN	BSAVE
CATALOG	CHAIN	CLOSE	IN#
PR#	OPEN	POSITION	READ
RUN	WRITE		

APPEND

The APPEND command has two new uses. You can now use it to append new data to any type of file. You can use it also to append data starting at the beginning of the record immediately following the last logical record in a random-access text file.

BLOAD

The BLOAD command has three enhancements. You can now use it to load the binary image of any type of file, not just binary files. With DOS you had to load an entire binary file into memory. With ProDOS you can load any portion of a file. In addition, you have the option of specifying the number of bytes to be transferred as a start address and an end address in memory, or as a start address and the number of bytes to be transferred.

BRUN

As with BLOAD, you can load any portion of a binary file into memory and run it. The number of bytes can be specified using a start and an end address, or as a start address and the number of bytes to be transferred.

BSAVE

You can now transfer (using BSAVE) information stored in memory into any type of file. The number of bytes to be saved can be specified using a start address and an end address, or as a start address and the number of bytes to be transferred.

CATALOG

You can now abbreviate the CATALOG command as CAT. CATALOG shows you an 80-column display of file information, and CAT shows you a 40-column display of information. Both show you the contents of a single directory; thus you must specify the name of the directory whose contents interest you. If you omit a filename, you see the contents of the prefix directory.

In addition, CATALOG now displays information about the file's logical end of file, the file's record length (random-access text files); the file's last load address (binary files); and the dates when the file was created and last modified.

CHAIN

The CHAIN command now works for Applesoft programs (with DOS it did not). In addition, one program can chain to any line of another program, not just to the beginning of a program as before.

CLOSE

Now you *must* close a file from within a program. Failure to do so can result in loss of data.

IN# and PR#

You can now use these commands to designate machine-language routines stored in memory as the character input and output routines. You can also use them to set the address of a slot's I/O routines.

OPEN

You can now use the OPEN command to open any type of file for access. File buffers are now allocated when the file is opened, instead of in response to the MAXFILES command, as with DOS.

POSITION

The POSITION command now uses either the F# option or the R# option to read and discard the specified number (#) of fields from a file. The F# option is consistent with the ProDOS definition of fields; the R# option is for DOS compatibility.

The ProDOS versions of READ and WRITE allow you to specify the number of fields and bytes to be read and discarded. Thus, the POSITION command is not required by ProDOS; it is retained for compatibility with DOS.

READ

With DOS, the READ command allowed you to use the B# option to position forward a number of bytes before performing a read. The ProDOS version of READ allows you to use the F# and B# options to position forward a number of fields and bytes. This makes the POSITION command unnecessary for READ (and also for WRITE).

RUN

The ProDOS version of the RUN command allows you to specify the line number at which the program is to start running.

WRITE

The ProDOS version of the WRITE command allows you to use the F# and B# options to position forward a number of fields and bytes.

New ProDOS Commands

In addition to the usual DOS commands, ProDOS supports eight new commands. They are

CAT CREATE FLUSH PREFIX
STORE RESTORE – (DASH) FRE

The following sections give brief summaries of each of these new commands.

Appendix A contains summaries of these commands.

CAT

CAT displays 40 columns of directory file information, while CATALOG displays 80 columns. Both commands display filenames, their types, lengths, and last modified dates. CATALOG additionally displays the date the file was created, each file's logical end of file, and additional storage information (record length for random-access text files, and last load address for binary files).

CREATE

The CREATE command allows you to create a file of any type, but it is primarily used to create directory files. BASIC (type BAS), text (type TXT), and binary (type BIN) files are automatically created by the SAVE, OPEN, and BSAVE commands, respectively. Text files can also be created by the APPEND command. Variable files (type VAR) are created by the STORE command.

> You do not have to specify the size of a created file. Additional blocks are added to a file as they are needed.

FLUSH

The FLUSH command causes all data that may be temporarily stored in a file's buffer to be written to the file. Using the FLUSH command after every statement that prints data to a file ensures that no data will be lost if the program is accidentally stopped. It also slows down a program significantly.

PREFIX

The PREFIX command allows you to set the name of the directory that contains the files with which you are working. With the prefix set, all files you name are assumed to be in that directory.

If the prefix is empty, files are assumed to be in the main directory of the disk in the last referenced slot and drive. In this case, ProDOS filenames work exactly like DOS filenames.

STORE and RESTORE

The STORE command places the names and values of all the variables currently defined by a BASIC program into a variable file (type VAR). The RESTORE command adds the contents of a variable file to the variables that are currently in memory.

– (DASH)

This command, consisting of a single character, is called the DASH command. It is a generic RUN command, allowing you to run a BASIC, binary, EXEC, or system program. It does not let you use any of the specific options afforded by the RUN, BRUN, or EXEC commands.

FRE

FRE command: see the section "Changes to Applesoft."

The FRE command lets you use the fast housekeeping routines that ProDOS has.

Changes to Applesoft

In order to keep a congenial working relationship between ProDOS and Applesoft, it is necessary for ProDOS to intercept and perform some of the commands usually performed by Applesoft. The following sections explain the new enhancements or restrictions upon these ten commands:

HIMEM	HGR	HGR2	TEXT
INPUT	IN#	PR#	TRACE
NOTRACE	FRE		

HIMEM

Using HIMEM to place machine-language routines safely in memory: see the *ProDOS Technical Reference Manual*.

Each time a file is opened, ProDOS uses the HIMEM setting to determine where it should place the file's I/O buffer. Because ProDOS manages memory in 256-byte chunks, you must always make sure that HIMEM indicates a 256-byte ($100) boundary in memory.

HGR, HGR2, and TEXT

Refer to the section "High-Resolution Graphics With ProDOS" in Chapter 9.

Because the Apple II's two high-resolution pages take up a considerable portion of the Apple II's memory, ProDOS normally uses them as Applesoft program memory. If, however, you use the HGR or HGR2 command (or both), the Applesoft program (if any) is cleared out of the corresponding graphics page. The graphics pages remain reserved for graphics until the TEXT command is issued.

INPUT

The Applesoft INPUT command has been made more useful. This command always reads an entire line of text, from either the keyboard or a file. As before, multiple variables in an INPUT statement are assigned strings of characters that are separated by commas in the input string. When you use ProDOS, the last variable in the INPUT list is assigned all the remaining characters in the line, including commas and colons. This means that you can now use a single INPUT statement, such as

```
10 INPUT XX$
```

to read in any arbitrary string of characters.

IN# and PR#

If you use one of these commands from immediate mode, it is a ProDOS command. Likewise, if you use one from within a program, preceded by CONTROL-D, it is also a ProDOS command. If you use IN# or PR# from within a program without a leading CONTROL-D, it is an Applesoft command, and would cause ProDOS to become disconnected if it were executed. Thus, ProDOS intercepts these Applesoft commands and ignores them.

If you find that a PR# or IN# command from within a program is not having the proper effect, you probably forgot the CONTROL-D.

TRACE and NOTRACE

These Applesoft commands did not work with DOS. They now have their normal effect, described in the *Applesoft BASIC Programmer's Reference Manual*, on ProDOS commands as well as Applesoft commands.

FRE

If you use the FRE command within a program preceded by a CONTROL-D, it is a ProDOS command. It is an Applesoft command if you use it in a program without the leading CONTROL-D. In this case, housekeeping takes place using the slow Applesoft routines.

Error Messages

Error Messages

When ProDOS detects an error caused by one of its commands, it normally stops the program that is running and displays a message describing the error. These messages are in addition to the usual messages generated by Applesoft. The source of an error messages is indicated by the character that precedes the message. Table C-1 illustrates these characters.

Table C-1. Error Message Formats

Applesoft Message	ProDOS Message
`?SYNTAX ERROR`	`SYNTAX ERROR`

If a ProDOS message occurs when you are using the Monitor, the system is reset to BASIC before the message is displayed.

Handling Errors From Applesoft

Refer to Chapter 5 of this manual and to the *Applesoft BASIC Programmer's Reference Manual* for more details about ONERR GOTO.

Using Applesoft's ONERR GOTO command, you can write Applesoft error-handling routines to correct ProDOS and Applesoft errors that would normally interrupt your program.

When a ProDOS or Applesoft error occurs following an ONERR GOTO command in an Applesoft program, a code number for the type of error is stored in decimal memory location 222. The statement

```
E = PEEK (222)
```

sets the value of `E` to the code of the offending error. The number of the Applesoft program line being executed at the time of the error can be found in decimal locations 218 and 219. The statement

```
L = PEEK (218) + PEEK (219) * 256
```

sets the value of `L` to that line number.

The ProDOS error messages, their codes, and the most common cause for each are described in Table C-2. Table C-3 shows which error messages are caused by each of the ProDOS commands. The ProDOS error messages are discussed in greater detail later in this appendix. The Applesoft error codes and their corresponding messages are shown in Table C-4.

Table C-2. ProDOS Error Codes

Code	ProDOS Message	Most Common Cause
2	RANGE ERROR	Command option too small or large.
3	NO DEVICE CONNECTED	No device found in specified slot.
4	WRITE PROTECTED	Write-protect tab on disk.
5	END OF DATA	Read beyond end of file or record.
6	PATH NOT FOUND	No file with indicated pathname.
7	PATH NOT FOUND	No file with indicated pathname.
8	I/O ERROR	Door open, or disk not formatted.
9	DISK FULL	Too many files on a disk.
10	FILE LOCKED	Attempt to write to a locked file.
11	INVALID OPTION	Option inappropriate for command.
12	NO BUFFERS AVAILABLE	Memory full, file can't be opened.
13	FILE TYPE MISMATCH	Disk file wrong type for command.
14	PROGRAM TOO LARGE	Apple II's memory too small (CHAIN).
15	NOT DIRECT COMMAND	Command must be in a program.
16	SYNTAX ERROR	Bad filename, option, or comma.
17	DIRECTORY FULL	Volume directory has 51 files.
18	FILE NOT OPEN	Attempt to access a closed file.
19	DUPLICATE FILENAME	RENAME, CREATE name already used.
20	FILE BUSY	File already open.
21	FILE(S) STILL OPEN	Last program didn't close file(s).

Table C-3. Errors by ProDOS Command

	RANGE ERROR	NO DEVICE CONNECTED	WRITE PROTECTED	END OF DATA	PATH NOT FOUND	PATH NOT FOUND	I/O ERROR	DISK FULL	FILE LOCKED	INVALID OPTION	NO BUFFERS AVAILABLE	FILE TYPE MISMATCH	PROGRAM TOO LARGE	NOT DIRECT COMMAND	SYNTAX ERROR	DIRECTORY FULL	FILE NOT OPEN	DUPLICATE FILENAME	FILE BUSY	FILE(S) STILL OPEN	UNDEF'D STATEMENT ERROR	BAD BRANCH ERROR
	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21		
APPEND	x	x	x		x	x	x		x	x	x	x		x	x							
BLOAD	x	x			x	x	x			x		x	x		x							
BRUN	x	x			x	x	x			x		x			x							
BSAVE	x	x	x		x	x	x	x	x	x		x			x	x						
CAT	x	x			x	x	x			x	x	x			x				x			
CATALOG	x	x			x	x	x			x	x	x			x				x			
CHAIN	x	x			x	x	x			x		x	x		x						x	x
CLOSE							x			x					x							
CREATE	x	x	x		x	x	x	x		x					x	x		x				
DELETE	x	x	x		x	x	x		x	x					x				x			
EXEC	x	x			x	x	x			x	x	x			x							
FLUSH	x						x			x					x							
FP															x					x		
FRE															x							
INT															x					x		
IN#	x	x								x					x							
LOAD	x	x			x	x	x			x		x	x		x							
LOCK	x	x	x		x	x	x			x					x							
OPEN	x	x	x		x	x	x	x		x	x	x		x	x	x						
POSITION	x			x			x			x				x	x		x					
PREFIX	x	x			x	x	x			x		x			x							
PR#	x	x								x					x							
READ	x			x			x			x				x	x		x					
RENAME	x	x	x		x	x	x		x	x					x			x	x			
RESTORE	x	x			x	x	x			x		x	x		x							
RUN	x	x			x	x	x			x		x	x		x						x	x
SAVE	x	x	x		x	x	x	x	x	x		x			x	x						
STORE	x	x	x		x	x	x	x	x	x		x			x	x						
UNLOCK	x	x	x		x	x	x			x					x							
WRITE	x		x				x	x	x	x				x	x		x					
—	x	x			x	x	x			x	x	x	x		x				x	x	x	

Table C-4. Applesoft Error Codes

Code	Error Message or Description
0	NEXT WITHOUT FOR
16	SYNTAX ERROR
22	RETURN WITHOUT GOSUB
42	OUT OF DATA
53	ILLEGAL QUANTITY
69	OVERFLOW
77	OUT OF MEMORY
90	UNDEF'D STATEMENT
107	BAD SUBSCRIPT
120	REDIM'D ARRAY
133	DIVISION BY ZERO
163	TYPE MISMATCH
176	STRING TOO LONG
191	FORMULA TOO COMPLEX
224	UNDEF'D FUNCTION
254	Bad response to an INPUT statement.
255	CONTROL-C interrupt attempted.

Refer to the *Applesoft BASIC Programmer's Reference Manual* for more information about the Applesoft error codes.

Discussion of ProDOS Errors

The following sections list the ProDOS errors, their probable causes, and possible cures.

RANGE ERROR (Code 2)

Occurs when the value of an ProDOS command option is too large or too small. Table A-1 shows the maximum and minimum values for each option.

Note: The use of values outside the indicated ranges does not always cause the RANGE ERROR message. Any ProDOS command option that is less than 0 or greater than 65535 causes the SYNTAX ERROR message, not the RANGE ERROR message.

NO DEVICE CONNECTED (Code 3)

Occurs when you specify a slot that doesn't contain a card; a slot that contains a card not connected to its device; or if there is no disk in the drive (some drives only).

If you get this error when using a device for the first time, go through the device's installation instructions again. If you have used the device before and you get this error:

1. You might have specified the wrong slot; try the command again.
2. Turn off your Apple II, open it, and gently rock the device's card back and forth until it is firmly seated. Close the Apple II, start up ProDOS, and try again.
3. If the problem persists, consult your dealer.

WRITE PROTECTED (Code 4)

Occurs when ProDOS attempts to store information on a disk, and the disk drive does not detect a **write-enable** notch or cutout on the disk's outer case. These are the most likely causes:

- There is an adhesive label placed over the disk's write-enable notch to prevent the writing or deletion of information on the disk. Remove this label, and the disk is no longer protected.
- There is no write-enable notch on the disk. This is true of the original copy of the /EXAMPLES disk, for example. If you are sure you no longer need the original disk, you can cut a notch in the disk's case yourself. Use another disk's notch as a template.

END OF DATA (Code 5)

Occurs when you try to retrieve information from a portion of a text file where no information has ever been stored. Any byte beyond the last field in a sequential text file, or beyond the last field of any record of a random-access text file contains the value 0. Zero is the ASCII code for a null character, a *nothing*; any command that causes the retrieval of this character results in the `END OF DATA` message. The message usually occurs after an INPUT or a GET command; it can arise in several different ways:

- Too many successive INPUTs or an INPUT with too many variables. Each INPUT statement causes at least one additional adjacent field to be read into the Apple II. Each INPUT variable causes one additional adjacent element to be read into the Apple II.
- Too many successive GETs. Each GET reads one additional adjacent byte or character into the Apple II.

- The B# (Byte) option in a READ or POSITION command is too large. In sequential files, this option must not specify a byte beyond the last RETURN character in the file. In random-access files, the B# option must not specify a byte beyond the last RETURN character in the currently selected record. Remember, the first byte in a file or a record is byte 0.

- The F# (Field) option in a READ or POSITION command is too large. In sequential files, this option must not specify a field beyond the last existing field in the file. In random-access files, POSITION's F# option must not specify a field beyond the last existing field in the currently selected record.

  READ and POSITION scan forward through the contents of the file, byte by byte, looking for the F#-th RETURN character. If either encounters a 0 byte (the null character) before finding the required RETURN character, the END OF DATA message is given immediately: it is not necessary actually to INPUT or GET the null character.

- The F# (Field) option in an EXEC command is too large. This option can specify the first field beyond the last existing field in a file, but attempting to specify the second field beyond the file's end causes the END OF DATA message. Remember, R0 specifies the first field in a file.

- The R# (Record) option in a READ command specified a random-access file record in which nothing is yet stored. Before you can READ from a particular record in a random-access file, you must first WRITE some information into that record. R0 is the file's first record, and so on.

ProDOS uses the OPEN command's L# option for calculating where the R#-th record begins, so the OPEN preceding READ must use the same L# option value as the OPEN that preceded WRITE for that file. If no L# option is specified, the L# with which the file was originally opened is used.

PATH NOT FOUND (Code 6 or 7)

Occurs when a ProDOS command specifies a valid pathname that does not indicate an existing file, or when it specifies an invalid pathname.

This message may arise in various ways:

- You accidentally misspelled an element of the pathname.
- You used a partial pathname that doesn't apply to the current prefix.
- You used a partial pathname, and the disk indicated by the prefix is no longer on line.
- The specified file does not yet exist.

I/O ERROR (Code 8)

Occurs after an unsuccessful attempt to store data or retrieve data (ProDOS tries 96 times, then gives up). This message can occur in the following ways:

- The selected or default drive's door is open. Close the door of the disk drive.
- There is no disk in the disk drive indicated by S# and D#. Put a disk into the drive and close the drive door.
- The disk in the selected or default disk drive is not formatted. Use the ProDOS Filer to format the disk.
- The disk is incorrectly seated in the disk drive. Open the drive door, pull the disk out, put it back in, close the door, and try again.
- The ProDOS command's D# (Drive) option specified a non-existent disk drive. The default drive is now the non-existent drive. Just specify the correct D# option with the next ProDOS command to reset the default.
- The system is trying to access a 13-sector disk. Use the DOS 3.3 program MUFFIN to update your disk to 16 sectors.
- A ProDOS command's S# (Slot) option specified a slot that does not contain a disk controller card, or the snum option of PR# or IN# specified a slot that contains no card.

The default value of S# now indicates a slot that doesn't exist. First, you must get a prompt back, then you must reset S#. To reset the slot correctly:

1. Press CONTROL-RESET.
2. If you see a Monitor prompt (*), press CONTROL-C RETURN.
3. Type `CATALOG S#, D#`. This time use a valid slot number.

DISK FULL (Code 9)

Occurs when ProDOS attempts to store information on a disk and finds that no more storage space is available on that disk. The number of free blocks on a disk is indicated when you display the catalog of the disk's volume directory. If you receive the `DISK FULL` message, rest assured that all files are closed, and that ProDOS saved for you all it could (leaving you with some portion of your file not on the disk). If you receive this message while saving a file called STUFF, the first thing you should do is

```
DELETE STUFF
```

and then save your program on another disk that has unused room.

FILE LOCKED (Code 10)

Occurs when you try to APPEND, BSAVE, DELETE, RENAME, SAVE, STORE, or WRITE a locked file. Check the CATALOG display: the names of locked files are preceded by an asterisk (*). Files are locked to prevent their being accidentally overwritten. Use another disk or unlock the desired file.

INVALID OPTION (Code 11)

Refer to Appendix A to see what options go with which commands.

Occurs when you use an option that is either non-existent or that is inappropriate for the given command.

NO BUFFERS AVAILABLE (Code 12)

When a file is opened by the APPEND, CAT, CATALOG, EXEC, OPEN, or - (DASH) command, a 1K buffer in memory is assigned for the temporary storage of data and file information. There can be a maximum of eight files open at a time. This error can occur if one of these commands is used when eight files are already open, or if there is not enough free memory for a buffer to be assigned.

The CATALOG, EXEC, and - commands allocate buffers, use them, and then release them; the OPEN command creates a buffer that exists until it is released by a CLOSE command. Files are not automatically closed when a program comes to an end.

If you get this error, you cannot use any of these commands until you close one of the open files.

This error also occurs if you try to BLOAD a file into the portion of memory used by the system (above HIMEM or below LOMEM).

FILE TYPE MISMATCH (Code 13)

Occurs when a ProDOS command expects to use one type of file, and the specified file is of another type. This message arises from several different incorrect combinations of ProDOS commands with existing file types. Here are the correct combinations:

Command	**File Type**
CATALOG pn, PREFIX pn	pn must be a directory file (DIR).
LOAD pn, RUN pn, SAVE pn, CHAIN pn	pn must be an Applesoft program file (BAS).
RESTORE pn, STORE pn	pn must be an Applesoft variable file (VAR).
EXEC pn	pn must be a text file (TXT).
OPEN pn, APPEND pn	pn must be a text file (TXT) unless Ttype is used, then file type must match Ttype.
BRUN pn	pn must be a binary file (BIN).
BLOAD pn, BSAVE pn	pn must be a binary file (BIN) unless Ttype is used, then file type must match Ttype.
- pn	pn must be type BAS, BIN, TXT, or SYS.

The file named STARTUP in the volume directory of a startup disk must be of type BAS, BIN, TXT.

PROGRAM TOO LARGE (Code 14)

Occurs when a ProDOS command attempts to place a disk file into the Apple II's memory, and finds the available memory insufficient to contain the entire file. This error can be caused by the CHAIN, LOAD, RESTORE, RUN, or - commands. You (or a previous program) may have set HIMEM too low for the new program to fit.

If you get this error, you can split the program into smaller portions and use the CHAIN command to transfer between one portion of the program and the other.

Remember that a program requires an additional 1K of memory for each file that is simultaneously open.

NOT DIRECT COMMAND (Code 15)

Occurs when you try to use one of the text file commands APPEND, OPEN, POSITION, READ, or WRITE from immediate-execution mode. These ProDOS commands can be used only from within PRINT statements in program lines.

SYNTAX ERROR (Code 16)

Occurs when ProDOS encounters a syntax error in a ProDOS command. Check the manual or the help screens for the exact syntax required for the command in question. The problem may be a pathname with illegal characters in it, an incorrect option symbol, a missing option, or a missing or incorrect separator (usually a comma). This message also arises if an option value or command quantity is a negative number or is greater than 65535.

If all ProDOS commands inexplicably cause the `SYNTAX ERROR` message, ProDOS is not started up or is "disconnected" from input and output. To restore, type `CALL 1002` from BASIC (from the Monitor, press CONTROL-C to enter BASIC, then type `CALL 1002`). If this doesn't work, start up the disk again.

DIRECTORY FULL (Code 17)

A ProDOS volume directory file can hold up to 51 files. If a BSAVE, CREATE, OPEN, SAVE, or STORE command indicates a file in a volume directory that already contains 51 files, you get this error. To correct the error, save the file into another directory or onto another disk, then use the Copy File utility to move some files from the volume directory into another directory.

FILE NOT OPEN (Code 18)

Occurs when a command is issued that can only act upon an open file. This error can be caused by the POSITION, READ, and WRITE commands. You must open a file before using any of these commands.

DUPLICATE FILENAME (Code 19)

Occurs when you CREATE or RENAME a file using a pathname that already exists.

FILE BUSY (Code 20)

Occurs when you CAT, CATALOG, DELETE, or RENAME a file that is already open. You must close a file before using one of these commands on that file.

FILE(S) STILL OPEN (Code 21)

Occurs when program execution is interrupted while one or more files are still open (for example, by another error or CONTROL-C). You must close all open files before you issue another LOAD or RUN statement.

Extras

Extras

About This Appendix

This appendix describes the useful programs that are stored in the directory /EXAMPLES/EXTRAS. They perform the following functions:

- TIME allows you to read and set the system date and time so that your files are marked with the proper date.
- READ.DIRECTORY is an example of how to read from a directory file.

Using the System Date and Time

ProDOS has two memory locations that contain the current date and time. If you have a clock/calendar card, instructions for making it work with ProDOS are in the section ''Using a Clock/Calendar Card'' in Chapter 9.

If you don't have a clock/calendar card, ProDOS takes whatever date and time are stored in the system date and time locations, and marks all created and modified files with that time. The program TIME is an Applesoft program that allows you to read and set the system date and time locations so that your files are marked with the current date and time.

Using TIME

With the /EXAMPLES disk in any drive, type the command

```
RUN /EXAMPLES/EXTRAS/TIME
```

and the values of the date and time locations in memory are displayed. If there is no time currently set, the messages `<NO DATE>` and `<NO TIME>` are displayed. The program asks you if you want to update the system date and time. If you say yes, you must enter the date in the form

```
DD-MMM-YY
```

(where DD = 01 to 31, MMM = JAN to DEC, YY = 00 to 99)

and the time in the form

```
HH:MM AM
```

(where HH = 01 to 12, MM = 00 to 59, AM = AM or PM)

When entering days, hours, or minutes less than 10, you must type in the leading 0.

If you have a clock/calendar card, this program does not set the time on the card.

To set the time on a clock/calendar card, refer to the manual for the card.

Reading From ProDOS Directories

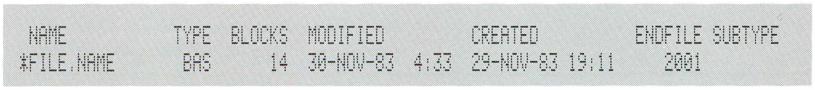
Like all other ProDOS files, directory files can be opened and read. When you read from a directory file, ProDOS automatically interprets the information in that file, and passes it to you in an understandable and familiar form—it gives you the same lines of text displayed by the CATALOG command. For example, to list the /EXAMPLES directory, you can use

```
5 D$=CHR$(4)
10  PRINT D$;"OPEN /EXAMPLES,TDIR"
20  PRINT D$;"READ /EXAMPLES"
30  INPUT L1$: PRINT L1$
40  INPUT L2$: PRINT L2$
50  INPUT L3$: PRINT L3$
60  INPUT L4$: PRINT L4$
70  IF L4$ < > "" THEN GOTO 60
80  INPUT L5$: PRINT L5$
90  PRINT D$;"CLOSE /EXAMPLES"
```

D$ is CONTROL-D.
Open directory.
Prepare to read
directory name,
title line,
blank line,
lines of directory,
until a blank is read.
Print block use and close directory.

The first line returned is the name of the directory being read. If it is a volume directory, it is preceded by a slash. The next line read is the title line, shown below. The third line is always empty. Subsequent lines, until the next blank line, are the files in the directory. The block count is the last line read. This program is stored in the file /EXAMPLES/EXTRAS/READ.DIRECTORY.

If you want to do interesting things with the string you have just read (such as write a program that lets you look through a disk's directories), you need to know the exact format of the returned string. A sample line from a directory looks like this



```
 NAME           TYPE  BLOCKS  MODIFIED         CREATED          ENDFILE SUBTYPE
*FILE.NAME       BAS      14  30-NOV-83  4:33  29-NOV-83 19:11    2001
```

The specific contents of each character of a line read from a directory are listed in Table D-1.

Table D-1. Directory Line Composition

Column	**Use**
1	Locked or unlocked
2-16	Filename
18-20	File type
23-28	Blocks used by file
31-39	Date file was last modified
41-45	Time of last modification (24 hour clock)
48-56	Date file was created
58-62	Time file was created (24 hour clock)
64-71	Logical end of file
73	Subtype identifier: A = load Address R = Record length
75-79	Load address (hexadecimal)
76-79	Record length (decimal)

The Applesoft Programmer's Assistant (APA)

The Applesoft Programmer's Assistant is a binary program named APA. It is in the EXTRAS subdirectory on the *ProDOS BASIC Programming Examples* disk.

APA can save a lot of time when you write or change Applesoft programs. The table below lists APA's functions and the commands you use to perform them. Each command is discussed on the pages that follow.

Function	Command
Automatic Line Numbering	AUTO
Turning Off Automatic Line Numbering	MANUAL
Renumbering a Program	RENUMBER
Putting a Program On Hold	HOLD
Merging Two Programs Into One	MERGE
Deleting Remarks From a Program	COMPRESS
Displaying Control Characters	SHOW
Suppressing Control Characters	NOSHOW
Calculating a Program's Length	LENGTH
Producing a Cross-Reference Listing	XREF
Converting Decimal to Hex and Hex to Decimal	CONVERT
Clearing the APA Program From Memory	EXIT

Starting APA

Here is how to start up the APA program:

1. Insert the *ProDOS BASIC Programming Examples* disk in drive 1, and close the drive door.
2. If the computer's power is not yet on, turn it on and go to Step 3.

   OR

   If the computer's power is already on, press ()(CONTROL)-(RESET).
3. When the disk drive's light goes out and the ProDOS BASIC Programming Examples startup display appears, type

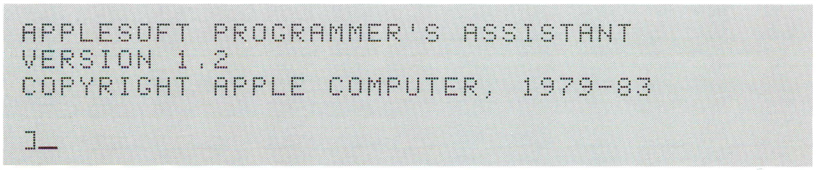
   ```
   -EXTRAS/APA
   ```

   and press (RETURN).

The drive whirs for a moment, while ProDOS relocates, loads, and initializes APA.

By the Way: APA is loaded just below HIMEM, and HIMEM is reset to just below APA. Although they are both in memory at the same time, APA and any Applesoft program you load are kept separate and can't interfere with each other. If your program is extremely large, you may need some of the memory taken up by the APA, but this will rarely be a problem.

After APA is loaded, the APA startup display appears:



```
APPLESOFT PROGRAMMER'S ASSISTANT
VERSION 1.2
COPYRIGHT APPLE COMPUTER, 1979-83

]_
```

With the Applesoft] prompt on the screen, you can use any of APA's commands. APA's commands can be used only in immediate mode—they cannot be part of another program.

Automatic Line Numbering

The AUTO command makes it easier and faster to enter programs. It lets you specify

- what line number to begin with
- the increment between line numbers.

To specify a starting line number of 100 and an increment of 10, type

The space after `AUTO` is optional. The starting line number and increment must be numeric integers in the range from 1 to 63999.

```
AUTO 100, 10
```

and press RETURN. When you then press SPACE, the line number `100` appears automatically.

After you type the rest of the Applesoft program line and press RETURN and SPACE, the next line number, `110`, appears.

To specify a starting line number of 100, without specifying an increment, simply type

```
AUTO 100
```

and press RETURN. The APA sets the increment to 10.

If you wish to leave a line number unused, press RETURN and then SPACE without typing an Applesoft program line—the next line number appears, and no statement is entered under the previous one.

If you want to use a line number that the AUTO function doesn't provide (for example, to use the line number 15 when the starting line number is 10 and the increment is 10), just type `15` instead of pressing SPACE.

If you change your mind about a statement while you are typing it, press CONTROL-X. When you then press SPACE, the same number reappears without the statement.

A line number appears only if you press SPACE after the] prompt, so you can type a run-time command any time you see the prompt, as long as you don't begin it with a space. This means you can RUN or LIST your program, or SAVE it and LOAD another, clear the screen with HOME, or see the CATalog—just as if APA weren't there.

Warning

It is possible to overwrite APA with run-time commands. When APA is loaded, don't run a program that changes HIMEM or the I/O hooks. And don't press RESET.

Turning Off Automatic Line Numbering

To turn off automatic line numbering, type

```
MANUAL
```

and press RETURN. MANUAL is the default when you load APA. To get automatic line numbering, you must use the AUTO command.

Renumbering a Program

The RENUMBER command renumbers the lines in all or part of a program in memory. You specify the starting line number and increment.

Even better, this command also changes line references in GOTO, GOSUB, and ONERR statements! So if the program runs correctly before renumbering, it runs correctly after renumbering—unless you change the order of the lines. RENUMBER does not, however, change line references in REM statements, so check these yourself.

By the Way: If a RENUMBER command would cause interleaving of lines or duplication of line numbers, APA does not execute it. This would happen if a range of lines were renumbered so that its new numbers overlapped the numbers of another range of lines. The resulting error message is `INTERLEAVED OR DUPLICATE LINE NUMBER`.

Let's start with an example. First, type `NEW` to clear memory (this won't affect the APA program). Then enter this simple program at the keyboard:

```
10 PRINT "S"
20 PRINT "A"
30 PRINT "M"
40 PRINT "P"
50 PRINT "L"
60 PRINT "E"
```

SAVE the program by typing `SAVE SAMPLE` and press RETURN.

To renumber your SAMPLE program, type

```
RENUMBER
```

and press RETURN. Your whole program is renumbered, starting with line number 100 and incrementing by 10. Try LISTing it:

```
100 PRINT "S"
110 PRINT "A"
120 PRINT "M"
130 PRINT "P"
140 PRINT "L"
150 PRINT "E"
```

If you don't want to start with line number 100 and increment by 10, type, say:

```
RENUMBER 1000, 50
```

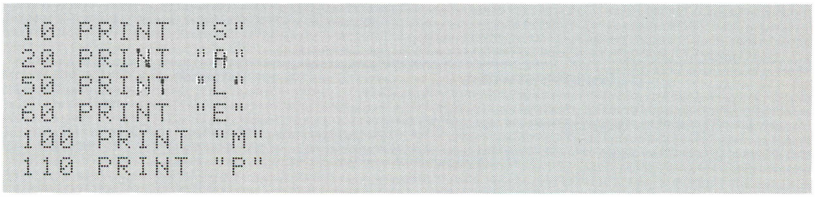
This results in

```
1000 PRINT "S"
1050 PRINT "A"
1100 PRINT "M"
1150 PRINT "P"
1200 PRINT "L"
1250 PRINT "E"
```

Load the SAMPLE program you saved earlier. To renumber only part of this program, you can specify the first and last old line numbers to be changed. For example, if you type

```
RENUMBER 100, 10, 30, 40
```

(where the starting line number is 100, the increment is 10, and the first and last old line numbers are 30 and 40), the result is



```
10 PRINT "S"
20 PRINT "A"
50 PRINT "L"
60 PRINT "E"
100 PRINT "M"
110 PRINT "P"
```

Only the lines previously numbered 30 and 40 have been renumbered. Notice that the lines are in a new sequence, in keeping with their new line numbers. You can use RENUMBER to move subroutines around in a program.

You can specify the first one, the first two, the first three, or all four RENUMBER parameters. RENUMBER uses a default value for omitted parameters. The default values are:

<starting line number>	100
<increment>	10
<first line>	0
<last line>	63999

Thus, these two lines are equivalent:

```
RENUMBER 20, 20

RENUMBER 20, 20, 0, 63999
```

The RENUMBER command does not let you give two lines the same number or interleave two sets of lines. Instead, you see the message INTERLEAVED OR DUPLICATE LINE NUMBER. For example, if you load SAMPLE and type

```
RENUMBER 10, 5, 40
```

you see the error message: this command would not only put line 50 between lines 10 and 20, but it would also put lines 40 and 60 on top of lines 10 and 20.

Putting a Program On Hold

Use the HOLD command to shelter a program above HIMEM, where it can't be erased by the loading of another program. This lets you load a second program into memory, then use the MERGE command (described in the next section) to combine the two programs.

With a program in memory, type

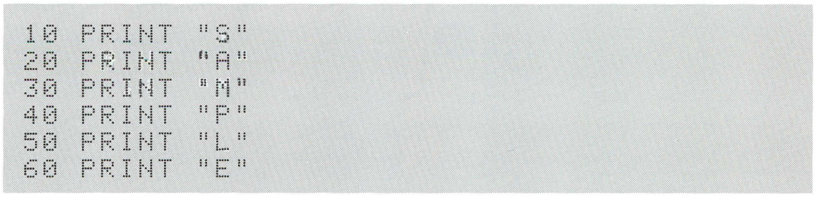
```
HOLD
```

and press (RETURN). You see the message `PROGRAM ON HOLD`.

Merging Two Programs Into One

After putting one program on hold, you can use the MERGE command to combine it with another.

Let's work with the SAMPLE program you created earlier. First, load SAMPLE and list it on the screen:



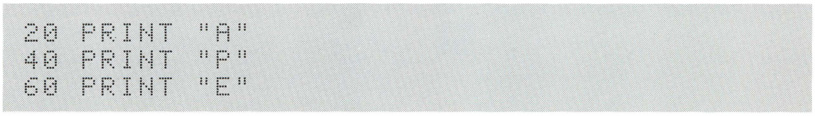
```
10 PRINT "S"
20 PRINT "A"
30 PRINT "M"
40 PRINT "P"
50 PRINT "L"
60 PRINT "E"
```

Now delete lines 10, 30, and 50 by typing

```
10
30
50
```

and pressing (RETURN) after each line number.

When you list the program, you have



```
20 PRINT "A"
40 PRINT "P"
60 PRINT "E"
```

Save this shorter program under the name APE. Now type

```
HOLD
```

to put APE on hold.

Now reload SAMPLE, and delete lines 20, 40, and 60 from it. This lists as

```
10 PRINT "S"
30 PRINT "M"
50 PRINT "L"
```

Save this program under the name SML. Now type

```
MERGE
```

and press RETURN; then type

```
LIST
```

and press RETURN. The result:

```
10 PRINT "S"
20 PRINT "A"
30 PRINT "M"
40 PRINT "P"
50 PRINT "L"
60 PRINT "E"
```

Presto! The program you carved up so diligently is now whole again, and sorted by line number.

If you had renumbered SML before merging, for example, by typing

```
RENUMBER 100, 200
```

so that SML looked like this

```
100 PRINT "S"
300 PRINT "M"
500 PRINT "L"
```

you would have gotten a different result. If you typed

```
MERGE
```

you'd get

```
20 PRINT "A"
40 PRINT "P"
60 PRINT "E"
100 PRINT "S"
300 PRINT "M"
500 PRINT "L"
```

The MERGE command, unlike the RENUMBER command, can create duplicate line numbers. For example, put APE on HOLD, then LOAD SML. Renumber it by typing

```
RENUMBER 20, 10
```

and the listing is:

```
20 PRINT "S"
30 PRINT "M"
40 PRINT "L"
```

Both APE and SML now contain lines numbered 20 and 40. Now type

```
MERGE
```

and you see the message

```
DUPLICATE LINE NUMBER
20
40

CONTINUE?
```

If you press Y to continue in spite of the duplicate line numbers, the line from the HOLD area has priority, and the other line with the same number is deleted. The listing is then:

```
20 PRINT "A"
30 PRINT "M"
40 PRINT "P"
60 PRINT "E"
```

If you try to use MERGE when there is no program on hold, you get the message `NO HOLD FILE`.

The MERGE command can perform wonders, and save you a lot of time. But it can also wreak havoc. Before typing the MERGE command, SAVE each of the programs to be merged.

Deleting Remarks From a Program

The COMPRESS command removes documentation remarks (program lines that begin with REM) from the program in memory. COMPRESS lets you maintain two versions of a program. The one that contains REM lines is easier to maintain, and the compressed version runs faster and uses less memory.

To use this feature, load a documented program, then type

```
COMPRESS
```

and press (RETURN). The program in memory is compressed, and you can then save it under a different name. A message tells you how many bytes are saved. If you later revise the program, change the documented version and make a new compressed version from it.

Displaying Control Characters

Use the SHOW command to make the control characters in your program visible. Type

```
  SHOW
```

Control characters are characters produced when you press (CONTROL) together with some other key.

and press (RETURN). If the program contains any control characters, they are displayed in inverse video when you LIST.

Suppressing Control Characters

After using SHOW to make control characters visible, use the NOSHOW command to make them invisible again. Type

```
  NOSHOW
```

and press (RETURN). Control characters are no longer displayed.

Calculating a Program's Length

Use APA's LENGTH command to determine the length of the program in memory. Type

```
LENGTH
```

and press RETURN. The program's length in bytes is displayed, in both decimal and hexadecimal form.

Producing a Cross-Reference Listing

The XREF command produces an alphabetical cross-reference listing of the Applesoft program in memory. The listing shows each variable in the program, together with the numbers of all lines in which the variable appears.

Load the program you wish to cross-reference; then type

```
XREF
```

and press RETURN. After a pause that depends on the length of the program, the variables and their line numbers are listed on the screen. Note that all variable names are shortened to two characters (Applesoft distinguishes only the first two characters of a variable name).

Five kinds of variables are identified by a suffix:

`$`	represents a string
`(`	represents an array
`$(`	represents a string array
`%`	represents an integer variable
`%(`	represents an integer array

You can interrupt the cross-reference listing by pressing CONTROL-S. To resume an interrupted listing, press CONTROL-S again.

Converting Decimal to Hex and Hex to Decimal

Use the CONVERT command to convert decimal numbers to hexadecimal and hexadecimal numbers to decimal.

For example, to convert decimal 255 to hexadecimal, type

```
CONVERT 255
```

and press (RETURN). The program immediately responds by displaying

```
255 ($00FF)
```

where `00FF` is the hex equivalent of decimal 255.

To convert hexadecimal 2B to decimal, type

```
CONVERT $2B
```

and press (RETURN). The program responds with

```
43 ($002B)
```

where `43` is the decimal equivalent of hex 2B.

Clearing the APA Program From Memory

To unlink APA commands and return to the system all the memory that was being used by APA, type

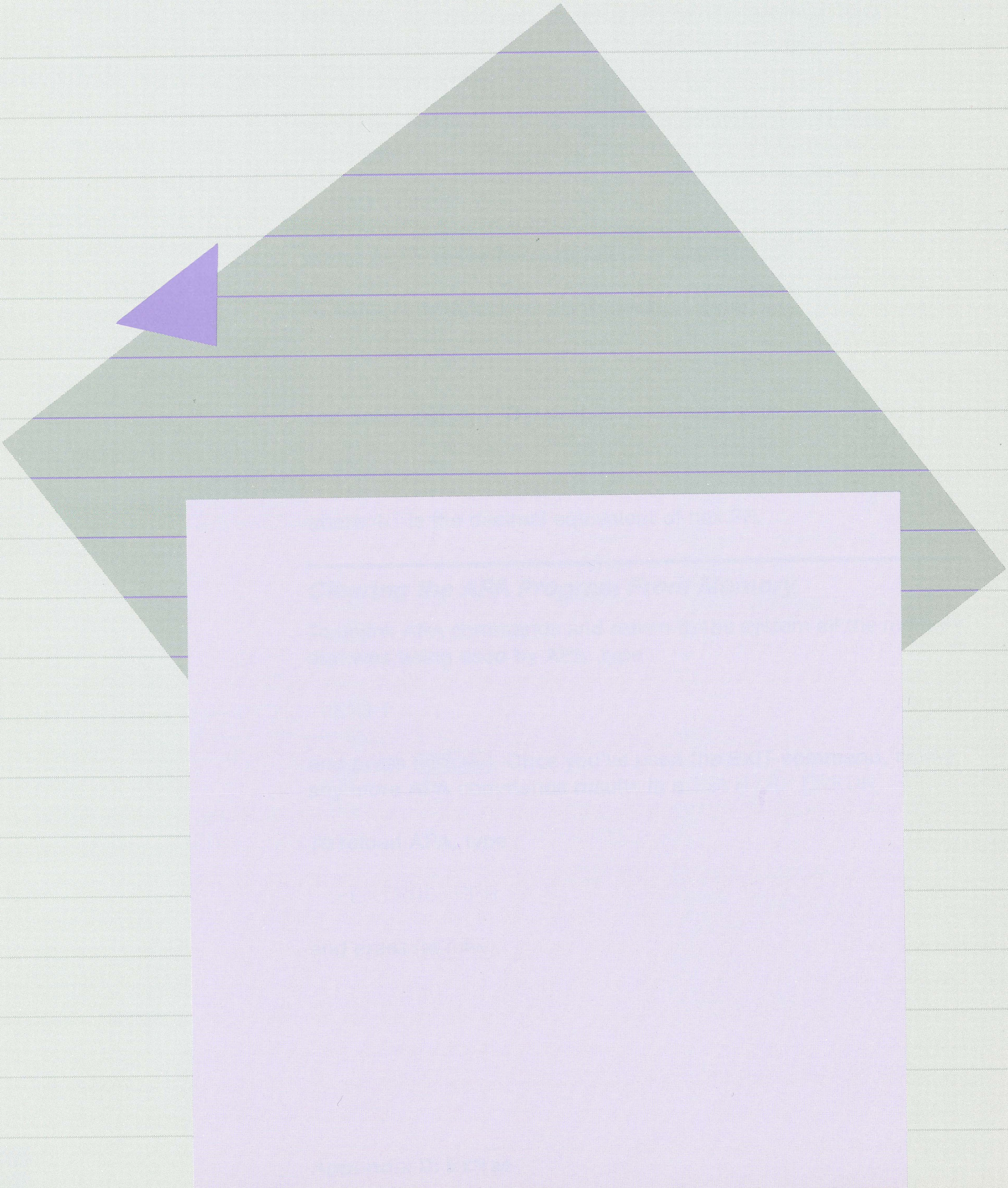
```
EXIT
```

and press (RETURN). Once you've used the EXIT command, typing any more APA commands results in a `?SYNTAX ERROR`.

To reload APA, type

```
-EXTRAS/APA
```

and press (RETURN).



Glossary

This glossary defines the terms used in this manual as they apply to ProDOS. Refer to other sources for more complete definitions.

address A number that specifies a single byte of memory. Addresses can be given as decimal integers or as hexadecimal integers. A 64K system has addresses ranging from 0 to 65535 (in decimal) or from $0000 to $FFFF (in hexadecimal).

APPEND Attach to the end of. The APPEND command is used to write new data to the end of an existing file.

ASCII An acronym for the American Standard Code for Information Interchange. This code assigns a unique value from 0 to 127 to each of 128 numbers, letters, special characters, and control characters. It is the code with which the Apple II represents the characters entered at the keyboard.

back up To make a spare copy of. It is a good habit to back up important files and disks frequently.

binary Encoded using the base-two numbering system consisting of the two digits, 0 and 1. A single binary digit, a 0 or a 1, is called a **bit**.

binary file A file whose data are to be interpreted in binary form. Machine-language programs and pictures are stored in binary files. In comparison, the data in a text file are interpreted as a set of characters. A ProDOS binary file is indicated in a catalog by the abbreviation **BIN**.

BLOAD Binary load. The BLOAD command causes the binary form of a file to be placed in memory. If the file is not a binary file, its uninterpreted image is placed in memory.

block 512 bytes of data. This is the unit of storage used by ProDOS. ProDOS regards the information stored on disk and in memory as collections of blocks.

BLOCKS When you use the CAT or CATALOG command, the column on the screen labeled `BLOCKS` lists the number of blocks of disk space occupied by each file in that directory.

BRUN Binary run. The BRUN command causes a binary program to be brought into memory and run.

BSAVE Binary save. The BSAVE command causes the binary data in a portion of memory to be saved in a disk file. If the file is not a binary file, the data is not automatically encoded before being placed in that file.

buffer A temporary storage area. ProDOS uses a file buffer as a temporary resting place for the characters being read from or written to the file.

byte A unit of computer memory. A byte is eight bits (Binary digITS) long, and is thus capable of expressing a range of numbers from 0 to 255 (2 to the 8th power is 256). Each character in the ASCII code is represented within a single byte.

CAT or **CATALOG** These commands cause a list of the names and characteristics of all the files in a directory to be displayed. Both are identical. This display of information is often referred to as a catalog. CAT displays a 40-column list; CATALOG, 80.

CHAIN The CHAIN command runs a BASIC program without first erasing the variables currently in memory.

**CHR$** This Applesoft function, when given an ASCII code, returns the character represented by that code. CHR$(4) returns a CONTROL-D.

CLOSE This command must be issued when you finish using a file. It writes all unwritten data to the file, and it releases the file buffers allocated to that file.

CREATE This command creates a new file. When used, it places a new file of a designated type into a designated directory.

CONTROL-D This character must precede every ProDOS command used in a program. CONTROL-D has the ASCII code 4, thus it can be generated using the Applesoft function call, CHR$(4).

CONTROL-RESET This combination of keystrokes usually causes an Applesoft program or command to stop immediately. If a program disables the CONTROL-RESET feature, you need to turn the Apple II off to get the program to stop.

DASH (–) This command runs a BASIC, machine-language, EXEC, or system program.

DELETE This command removes a file from its directory. A deleted file cannot be recovered.

directory file (type DIR) A file that contains the names and locations on the disk of other files. Related files should be grouped together into a single directory file. See also **volume directory**.

disk A flat circular piece of plastic or metal, dipped into glue and coated with a fine metallic powder, onto which information is magnetically recorded.

disk drive A device that can read information from and record information on a disk. ProDOS lets the Apple II communicate with all disk drives manufactured by Apple Computer, Inc. for the Apple II.

element As defined in this manual, a string of characters, terminated by a comma or a carriage return, that can be read using the BASIC INPUT statement. For example, INPUT A$,B$ reads two elements.

ENDFILE End of file. When you display a disk's catalog, the column of information labeled `ENDFILE` tells the number of bytes that each file would occupy if all the disk space allocated to that file were filled. Refer to Chapter 3 for more details.

/EXAMPLES The volume name of the disk that contains the ProDOS program and the examples for this manual. This disk contains the version of the system file that must be on every ProDOS startup disk.

EXEC This command causes input to be taken from a sequential text file rather than from the keyboard. When you use EXEC, you control the operation of the Apple II by using commands that are stored in a text file.

field In a file, a string of characters preceded by a carriage return character, and terminated by a carriage return character. A field is written to a file by each PRINT statement not terminated by a semicolon. The INPUT command reads an entire field from a file.

file A file is a named, ordered collection of information on a disk. When you use ProDOS to place information on a disk, you give the file a name and a type. The file's type determines how information is encoded in that file.

filename The name that identifies a file. A ProDOS filename has a maximum of 15 characters. It can contain letters, digits, and periods, but it must begin with a letter.

FLUSH Send unwritten data to its file. Use this command to ensure that the data in a file is identical to the data written to the file. FLUSH is like CLOSE, except the file remains open.

format To prepare the magnetic surface of a disk for the storage of information. The ProDOS Filer lets you format all types of disks. This utility replaces the DOS command INIT, which was used to format Disk II disks.

FRE This command is used to access the ProDOS fast housekeeping routines.

HELPSCREENS A file, stored on the /EXAMPLES disk, that contains all the help screens. Each screen is stored in a single 512-byte record of a random-access text file. For the HELP command to be usable, this file must be on the disk from which ProDOS was started up, and the command `- HELP` must have been previously issued.

hexadecimal Encoded using the base-16 numbering system. Hexadecimal numbers are formed using the ten digits 0 through 9 and the six capital letters A through F. All hexadecimal numbers used with ProDOS must be preceded by the symbol $.

IN# This command designates the source of subsequent input characters. It can be used to designate a device in a slot or a machine-language routine as the source of input.

input routine A machine-language routine that performs the reading of characters. The standard input routine reads characters from the keyboard. A different input routine might, for example, read them from an external terminal.

language card An Apple II interface card that, when placed in slot 0 of a 48K Apple II, gives the Apple II access to a total of 64K of memory. If you have an Apple II or Apple II Plus, you need a language card, or the equivalent, to use ProDOS.

LOAD This command brings a BASIC program into memory from a file. It clears the current BASIC program and variables from memory and brings in the new program.

load address The first address in memory from which data was BSAVEd into a file. When that file is BLOADed or BRUN, it is placed in memory starting at the load address unless you specify otherwise. The load address of a binary file is listed in the column labeled `SUBTYPE` when you display a catalog of files.

LOCK This command protects a file from being accidentally renamed, deleted, or altered.

machine-language interface (MLI) The set of machine-language routines, stored in the file named PRODOS, with which ProDOS talks to disk drives. The *ProDOS Technical Reference Manual* contains a full explanation of the ProDOS machine-language interface.

NAME When a catalog of files is displayed on the screen, the NAME column contains the names of the files in the listed directory.

OPEN This command allocates space in memory for a file's buffers, and it sets the file position pointer to the beginning of the file. The next file-related command to be issued must be a READ or a WRITE. All files opened must be closed.

option An item in the syntax of a ProDOS command that determines a single aspect of the command's action, such as a pathname or a file type. Unbracketed options must be included each time the command is used, bracketed options can be specified as needed, and two options separated by a vertical line are alternates.

output routine A machine-language routine that performs the sending of characters. The standard output routine writes characters to the screen. A different output routine might, for example, send them to a printer.

partial pathname A portion of a pathname. A partial pathname does not begin with a slash, and it does not have to (but may) begin with the name of a volume directory. When you use a partial pathname in a command, the prefix is usually attached to the front to form a full pathname. A partial pathname can be no more than 64 characters long.

pathname A series of filenames, preceded and separated by slashes, that indicates the entire path, from volume directory to file, that ProDOS must follow to find that file. A pathname used in a command can contain no more than 64 characters, slashes included. (The pathname formed by the prefix and a partial pathname can be up to 128 characters long.)

POSITION This command causes a specified number of fields to be read and discarded from an open file. It is used to move the position of the file pointer forward in the file.

PR# This command sends output to a slot or to a machine-language program. It specifies an output routine in the ROM on a peripheral card or in a machine-language routine in RAM by changing the address of the standard output routine used by the Apple II.

prefix A pathname set to indicate a specific directory file. When you use a partial pathname, the prefix is added to the front of it. You set the value of the prefix using the PREFIX command. A prefix can be no more than 64 characters long, including slashes.

ProDOS command Any one of the 28 commands recognized by ProDOS. Each has its own syntax, all can be used within programs, and all but five (text file commands) can be used from immediate mode. ProDOS commands used from within programs must be issued as part of a PRINTed string, and must be preceded by CONTROL-D.

/RAM The volume name of a small volume automatically placed by ProDOS in the alternate 64K of an Apple IIe with an Extended 80-Column Text Card. It can be used just like a disk volume; however, the information stored on it disappears when the computer is turned off.

Random Access Memory (RAM) This is the readable and writable memory of the Apple II. Its contents are usually filled with programs from a disk, and they are lost when the Apple II is turned off. An Apple II must have 64K of RAM to use ProDOS.

random-access text file A text file that is partitioned into an unlimited number of uniform-length compartments called records. When you open a random-access text file for the first time you must specify its record length. No record is placed in the file until written to. Each record can be individually read from or written to, hence the name, random-access.

READ This command, when used after the OPEN command, prepares a file to be read. It can also select the position in the file (record, field, and byte) of the next piece of information to be read. Until the next ProDOS command is issued, subsequent INPUT statements are satisfied by data from the file.

Read Only Memory (ROM) In the context of this manual, ROM refers to semiconductor chips in the Apple II or on peripheral cards that contain programs essential to the system's operation. The contents of ROM are permanent and unalterable. The Apple II comes with ROM chips that contain the system Monitor and a version of BASIC, and the ROM on a disk controller card contains programs that let the Apple II communicate with one or two disk drives.

record A unit of storage in a random-access text file. Every random-access text file can contain a very large number of records; each record holds the exact same number of characters. A program specifies a file's record length (in bytes) when the file is first opened; it must subsequently read and write data into specific records within the file.

record length The length of a random-access text file's records in bytes. The maximum record length is 65535 bytes; the minimum is 1.

RENAME This command allows you to change the name of a file. You cannot use this command to move the file from one directory to another, only to change its name *within* a directory. A file must be unlocked to be renamed.

RESTORE This command clears the BASIC variables currently in memory, and it reads in a new set of variables from a variable file (type VAR). See also **STORE**.

RUN This command clears the current BASIC program and variables from memory, brings a BASIC program into memory from a file, and runs it. An option lets you specify the first program line to be run.

SAVE This command lets you save the BASIC program currently in memory as a BASIC program file (type BAS).

sequential-access text file A text file made up of a sequence of fields. A field is a string of characters terminated by a carriage return character. Sequential text files are best used for types of data that will be stored and retrieved sequentially.

start up To get the system running. In the context of ProDOS, starting up is the process of reading the ProDOS program (in the files PRODOS and BASIC.SYSTEM) from the disk, and running it.

startup disk A disk that contains all the information needed to get the computer running. A ProDOS startup disk must be formatted using the ProDOS Filer, and it must contain the files PRODOS and BASIC.SYSTEM.

STORE This command causes the BASIC variables currently in memory to be arranged in a compact form and then placed in a BASIC variable file (type VAR). The variables so stored can be returned to memory using the RESTORE command.

SUBTYPE In a catalog, the column labeled `SUBTYPE` contains two types of information: for a random-access text file, the file's record length (R) in decimal; and for a binary file, the file's load address (L) in hexadecimal.

syntax A representation of a command that specifies all the possible forms the command can take. The syntax of each ProDOS command is given as a command word followed by a list of options.

SYSTEM A file with a name of the form XXX.SYSTEM must be in the volume directory of every startup disk; it contains the system program that is run when the disk is started up. On the /EXAMPLES disk, BASIC.SYSTEM contains the ProDOS BASIC program; on the disk named /USERS.DISK, FILER.SYSTEM contains the ProDOS Filer.

text file (type TXT) A file whose contents are interpreted as characters encoded using the ASCII format. ProDOS defines two types of text files: sequential, a grouping of sequentially accessible fields of text; and random-access, a collection of equal-sized, and independently accessible, groups of characters.

TYPE In a catalog, the column with this heading names the type of each file listed. Types are given as three-letter abbreviations. There is a list of file type abbreviations in Table A-2.

UNLOCK This command reverses the effect of the LOCK command. A file must be unlocked if it is to be renamed, deleted, or altered.

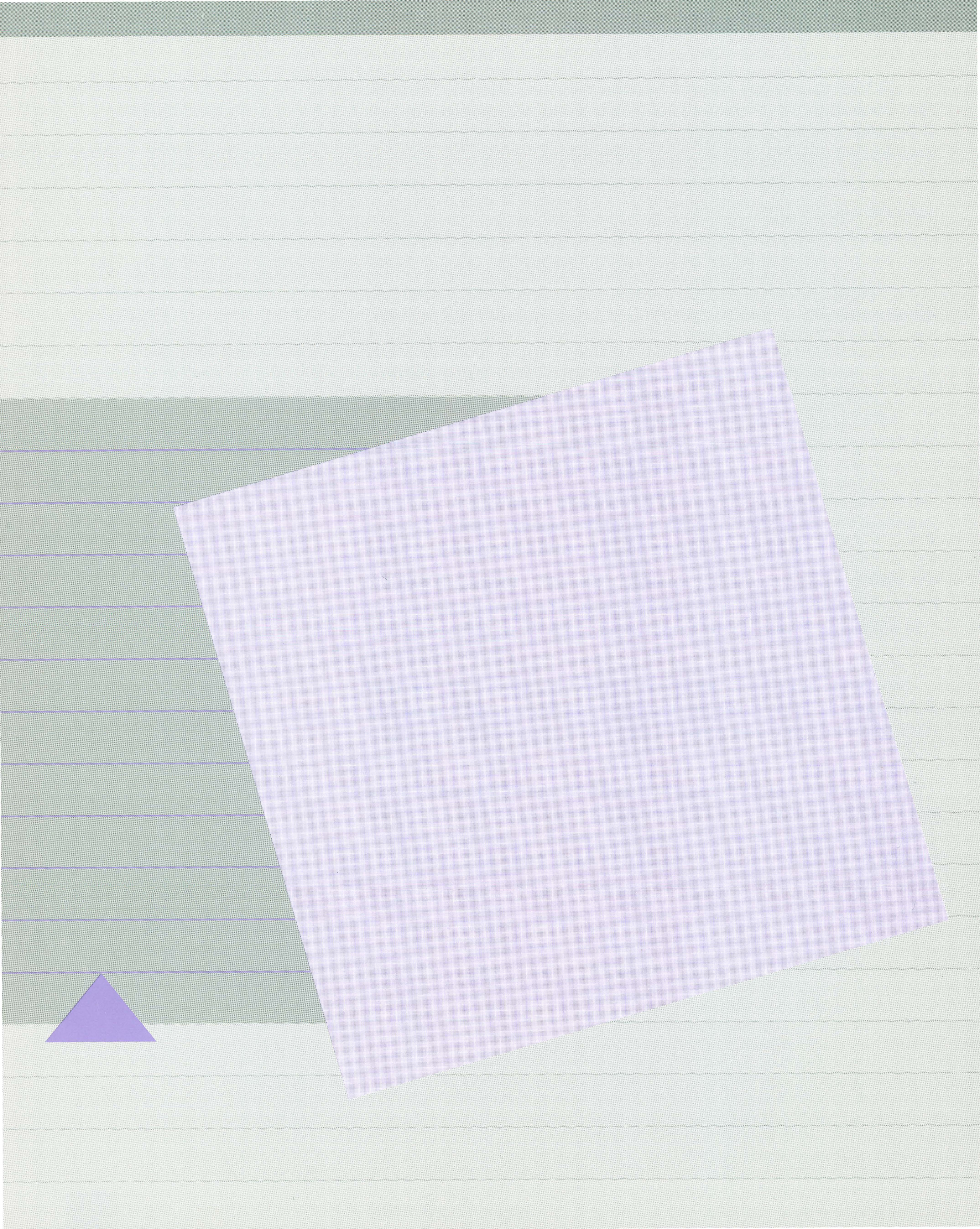
/USERS.DISK The /USERS.DISK disk contains utilities programs with which you can format disks, perform all file maintenance (create, rename, delete, copy), and convert files between DOS 3.3 format and ProDOS format. These programs are explained in the *ProDOS User's Manual*.

volume A source or destination of information. As used in this manual, volume always refers to a disk. It could also, for example, refer to a magnetic tape or a location in a network.

volume directory The main directory of a volume. On a disk, the volume directory is a file that contains the names and locations on that disk of up to 51 other files, any of which may themselves be directory files.

WRITE This command, when used after the OPEN command, prepares a file to be written to. Until the next ProDOS command is issued, all subsequent PRINT statements send characters to this file.

write-protected A disk drive that uses flexible disks can only write on a disk that has a small notch in the proper location. If this notch is covered, or if the notch does not exist, the disk is write-protected. The notch itself is referred to as a write-enable notch.



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Apple II

BASIC Programming With ProDOS

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