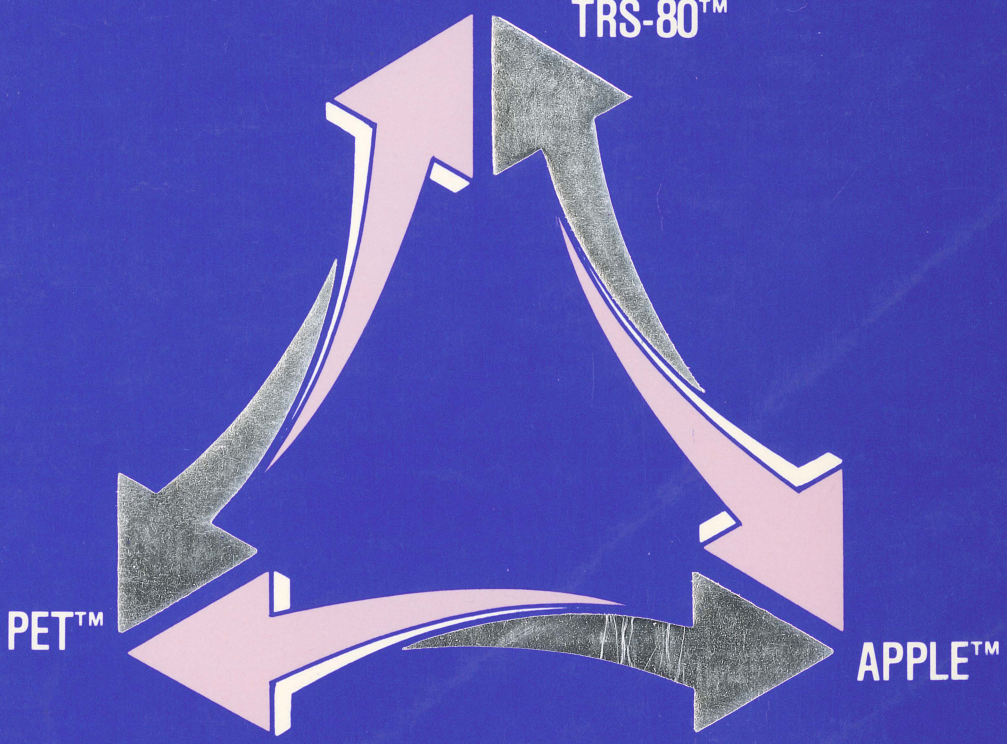
The BASIC Conversions Handbook for Apple™, TRS-80™, and PET™ Users

BRAIN BANK
David A. Brain, Philip R. Oviatt, Paul J. A. Paquin,
and Chandler D. Stone, Jr.



Convert Apple into PET or TRS-80
Convert PET into Apple or TRS-80
Convert TRS-80 into PET or Apple

HAYDEN

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Preface

After purchasing my first computer and spending many hours programming and learning how to make it work, I began writing programs for specific applications.

I realized very quickly that a lot of the programs I needed were already written, but many of them were in various other BASIC languages. It was also obvious not only that BASIC differs from machine to machine but also that each machine might have different versions of their own BASIC (for example, Level I and Level II, Integer and APPLESOFT II)!

With the help of a good friend who owned a different machine, we began to explore the differences between the languages. After a lot of research we found that, even though many commands were different, for the most part they performed similar functions (for example, the command CLS in TRS-80 does exactly the same thing as the command HOME in APPLE II).

As a result of our explorations on many different machines, we put together this guide to help translate programs into a variety of machine "languages." With this guide you will be able to select a program in its listed form and translate it to your particular machine, thus saving you from having to "reinvent the wheel."

There are a few considerations that must be kept in mind while you are translating. First, since the video formats differ from machine to machine, you will have to adjust print statements for the size of the video on your machine. Second, each machine has its own particular graphics capabilities, and, although graphics are discussed briefly in the various chapters, your own imagination will be your best guide to the kind of graphics you will want to use. Third, we have found through experience that most errors occur in our translations as a result of the incorrect formatting of IF . . . THEN statements. Since every machine has its own peculiarities concerning

IF . . . THEN statements, you should take extra care to understand the purpose of these statements and their desired results.

We sincerely hope that this guide will allow you to make better use of your equipment and save you trouble in translating by providing a quick reference to the mysteries of those "other machines."

A lot of effort and time went into the compiling of this book, and its completion was due largely to the patience of Pat and Jane.

D. A. BRAIN

Contents

Chapter 1
METHODS OF TRANSLATION

With the advent of the microcomputer, accessibility to computer technology has increased enormously. Prices are now within the reach of most individuals, and the software support is increasing almost daily.

The major problem in the field of microcomputing today, however, is still software support. The number and variety of programs available to microcomputer owners are virtually infinite, but the types of software available are very limited. This situation has come about for a number of reasons, not the least of which is marketability. If a program does not appear to have a very wide appeal, it will probably not be published on tape or disk for the consumer. A large variety of programs is available, however, in the various magazines for the microcomputing market. It is to these listed programs that we will address our efforts.

The published programs themselves often create another problem. If the program is one that we might want to use, it may or may not be in the correct machine language for us to use it. Each computer has its own strong and weak points, but the major problem is that none of the available languages are compatible (we are able, however, to make the machines compatible). For whatever reason, each manufacturer has its own version of BASIC that runs only on its own machine.

Fortunately, software follows the same sort of logic no matter what brand of machine it is written on. Programs written for one microcomputer will work on just about any other kind if the language differences are compensated for.

The BASIC (Beginner's All-purpose Symbolic Instruction Code) language has been accepted as more-or-less standard for almost all microcomputers, but each manufacturer has

added (or left out) a few commands or used different labels (or commands) to perform the same function (the command CLS in TRS-80, the command HOME in APPLE II, and the command PRINT"□" in PET all do the same thing). Fortunately, there is enough similarity between machines to allow us to translate programs from one machine to another.

In this book, we will consider three of the most popular microcomputers on the market (TRS-80, APPLE II, and PET) and show how you can translate programs for one machine for use on the machine available to you.

When preparing to use a listing made for another machine, you will save a lot of time if you sit down with the listing and try to figure out the flow of the program before starting to translate it. There may be improvements you can make based on your own experience, or you may find specific commands that need subroutines for which you will have to allow additional space. Having an understanding of how the program works will not only speed up the process of translation but also help you format your screen display. Differences in some of the functions of the various machines will create problems if you don't plan ahead and identify them in advance.

The major differences you will encounter are in the area of graphics. Different machines have different graphic capabilities, and any attempt to "translate" will result in extreme frustration. The best course of action is to determine exactly what it is that should be graphically displayed, refer to the screen charts at the back of the book, and use your imagination to create your own graphics. I look upon this part of translating as a challenge, and it usually turns out to be the most interesting part of the program.

Some of the programs you encounter will present problems that are not covered in this book. The most common problem will occur in programs or subroutines written in machine language. Machine-language routines are used primarily to save memory and speed up the execution of a program. Usually, if you understand the flow of a program, you will be able to determine what the machine-language routine is supposed to do. If so, you can probably create a BASIC subroutine to accomplish the same result.

This book has been organized in three major chapters. Each of these deals with a specific machine, and each major

section of each chapter deals with one given language. Some of the functions described are provided for background information only. In each section all the commands you are likely to encounter in a program listing are compared to instructions used on your own machine. The basic format for this guide is:

Listing Command	*Your Machine Command*	*Comments*

Any peculiarities of a machine are listed at the end of each section.

Here is a simple example of how a translation is made from the TRS-80 to APPLESOFT II. Suppose that the program listing in the TRS-80 is

```
10  CLS : PRINT "HELLO" : END
```

Refer to Sec. 3.1 of Chap. 3 to find the equivalent command to CLS in APPLESOFT II . It appears as follows:

CLS	HOME

In your program converting TRS-80 to APPLESOFT II, you would therefore type:

```
10  HOME :
```

Then, in case you aren't sure, look up the commands END and PRINT in the same way. After the line has been completely translated, it will look like this:

```
10  HOME : PRINT "HELLO" : END
```

After studying this book and translating a few programs, you will soon recognize what needs to be changed and what can remain the same.

In case you should need a quick guide to what some of the commands mean, a detailed explanation of APPLE II commands has been provided in the section for translation of APPLE II to TRS-80. Although the intent of the author is not to teach you how to program, this quick reference source may help you if you should come across an unfamiliar command while doing your translation.

Ultimately, the purpose of this book is to expand your access to a much larger variety of software so that you can choose the kind best suited to your needs.

Chapter 2

CONVERSION OF APPLE II AND PET PROGRAMS INTO TRS-80

This chapter is designed for easy conversion of PET and APPLE II programs into TRS-80. On the whole, the commands are in alphabetical order for quick reference. Several subroutines are included to allow you to approximate PET or APPLE II commands that do not directly relate to TRS-80 commands.

Graphics will again be discussed from the standpoint of what can and what cannot be done, but, for the most part, your own imagination will be the best guide in trying to convert APPLE II and PET graphics into TRS-80.

The format for this chapter is as follows:

APPLE II/PET Function	*TRS-80 Function*	*Comments*

Every command with a direct relationship to TRS-80 is included, but a few TRS-80 commands that do not relate to either the PET or APPLE II are not listed. Subroutines and other conversion considerations that allow the TRS-80 to perform a PET or APPLE II function will be found in the comments section at the side of each command.

Notes on TRS-80 Model III

TRS-80 Model III has all the language features of Model I and a few more. The addresses—PEEKS and POKES (see the list below)—are different in some cases, of course, but, for the most part, Model I and III are very similar.

Although there have been hardware modifications, these will not alter the translation of listed programs. Video display addresses and graphics characters (128–191) are identical. In fact, from a translation standpoint, Model I and Model III BASIC are identical except for the addition of TIME$, which relates to the real-time clock.

The video display of Model III uses a different character set: an additional set of 96 special characters.

Although some Model I software will not run on Model III, you will still be able to translate the listings by using the guide to Model I.

The POKES in Model III are as follows:

16412,1	Set blinking or solid cursor; can be eliminated
16419,176	Code for cursor character is in this location; can be eliminated
16916,x	Affects scrolling of x lines of screen; can be eliminated
16888	Serial I/O baud rate code
16890	Serial I/O Wait/Don't Wait switch
16872	Character input buffer
16880	Character output buffer
16889	Parity/Word length/Stop bit
16928 to 16931	SOURCE and DESTINATION memory locations; can be eliminated
16919 to 16924	Real-Time clock; can be eliminated

2.1 Conversion of APPLE II into TRS-80

Commands

APPLE II	*TRS-80*	*Comments*
ABS(x)	ABS(x)	Same function. The command ABS (variable) returns the absolute value of the variable x. The command is valid in Integer and Floating-Point BASIC.
AND	AND	Same function. AND is a logical operator. When it is used in an assertion, both elements of the statement on either side of the AND must be true, or the entire statement will be viewed by the computer as false. AND is used in both Integer and Floating-Point BASIC.
ASC("x") or ASC(x)	ASC(x)	Same function. The command ASC(variable) returns the decimal equivalent of standard ASCII code. The operation is valid in Integer and Floating-Point BASIC. In Integer BASIC programs, the "x" may or may not be seen. The quotation marks perform no additional function.
ATN(x)	ATN(x)	Same function. The command ATN(variable) returns a value for the variable or a number expressed in radians. The ATN(variable) function is not available in Level I.
AUTO xxx	AUTO xxx	Same function. The command produces automatic line numbering, in which xxx specifies the starting line number. If no increment is

Commands *(continued)*

APPLE II	*TRS-80*	*Comments*
		entered, the machine will increment each line number by 10. AUTO line numbering is not available in Level I.
AUTO xxx,yy	AUTO xxx,yy	Same function. The command produces automatic line numbering in which xxx designates the starting line number and yy the increment by which the line numbers will increase.
CHR$(7)	None	In an APPLE II program, CHR$(7) will cause the computer's built-in speaker to "beep." There is no direct equivalent operation available to the TRS-80 without modification. In a conversion, it is not necessary to include the function.
CALL x	USR(Ø)	Partially similar function. On APPLE II, the CALL expression will cause the computer to execute a machine-language subroutine beginning at the memory address specified by the expression. There is no equivalent available to Level I. In Level II, the function can be approximated as follows: POKE 16526,y: POKE 16527,z: x=USR(Ø) (Note: y designates the most significant byte and z designates the least significant. See USR command in Level II manual.)

CHR$(x)	CHR$(x)	Same function. CHR$(variable) returns the ASCII equivalent of the decimal within the parentheses. The function is not available in Level I.
CLEAR	CLEAR	Approximately the same function. On APPLE II, CLEAR sets all variables to zero and all strings to null (" "). In Level II, it may be necessary to execute a CLEAR xxx, where xxx indicates the amount of string space to be reserved.
CLR	CLEAR	Same function as described above. CLR is found in Integer BASIC programs. Note that it is not necessary for the APPLE II to reserve string space as this function is performed automatically by the computer.
COLOR=x	None	In all APPLE II graphics, a color must be specified prior to attempting to plot a point or line. In Integer BASIC, x will equal any number from Ø to 15 and will usually be preceded by the command GR. In Floating-Point BASIC, x will equal Ø to 15 (following the command GR:) or Ø to 7 (following the command HGR:). On the TRS-80, no color graphics function is currently available without modification, and hence the command can be ignored.
CON	CONT	Same function. The command causes the program to continue its operation where it was stopped. Variables are not reset.

Commands *(continued)*

APPLE II	*TRS-80*	*Comments*
CONT	CONT	Same function as described above. The command will be found in Floating-Point BASIC.
COS(x)	COS(x)	Same function. The COS(variable) command returns the cosine of the variable x. This function is not available in Level I.
DATAx,y,z	DATAx,y,z	Same function. When a READ command is encountered in a program, DATAx,y,z will be read sequentially.
DIMx(y)	DIMx(y)	Same function. When a DIMx(y) command is executed, the computer will set aside y spaces for an x array of variables.
DIMx$(y)	DIMx$(y)	Same function. When a DIMx$(y) command is executed the computer will set aside y dimensions for an array of x$ variables.
DEF FN x	None	This command in an APPLE II program allows the programmer to define a function and then utilize that function again by using the command FN x. Since there is no equivalent TRS-80 command, it must be specified each time it is needed.
DEL x	DELETE x	Same function. The command DEL x causes the line number x to be deleted from the program.
DEL x,y	DELETE x-y	Same function. The command deletes all line numbers between (and including) x and y from the program.

DRAW x	None	When encountered in a Floating-Point BASIC program, the computer will draw shape number x (previously loaded in machine language) at the next point identified; for example, DRAW x AT y. There is no equivalent function available in the TRS-80. However POKE graphics may be used as an approximate substitute. (See Level II manual.)
END	END	Same function. In all cases, the command END will terminate the execution of a program whenever encountered.
EXP(x)	EXP(x)	Same function. The command EXP(x) will raise a variable to the indicated power x. This function is available in Level II only.
FOR x=y TO z: NEXT	FOR x=y TO z: NEXT	Same function (a common loop). In Level I, NEXT must be followed by the specified variable. (Example: FOR x=y TO z: NEXT x). When the function is used as a timing loop, it should be remembered that the APPLE II operates approximately two and a half times faster than the TRS-80. Timing loops should be reduced by a factor of 2.5.
FLASH	None	The command FLASH causes everything printed (displayed) on the screen to FLASH. Although there is no directly related TRS-80 command, one way to approximate the function is as follows: FOR X=1 TO 20: PRINT @ 936, "HELLO": FOR y=1 TO 50: NEXT Y: PRINT @ 936, " ": NEXT X

Commands *(continued)*

APPLE II	*TRS-80*	*Comments*
FRE(x)	FRE(x)	Approximately same function. The command FRE(x) returns the amount of memory available to the user. It also serves to houseclean the computer of miscellaneous data that has no function within a current program.
GET x$	INKEY$	Similar function. The common GET (variable)$ causes the program to halt and wait for a string variable x to be input. It is not necessary for the ENTER key to be pressed for the input to be accepted. INKEY$ does not cause program flow to halt. You must force it to wait by means of the following: 1Ø IF INKEY$=" " THEN GOTO 1Ø The APPLE II command GET x$ need not be followed by the evaluation and limiting statements needed on the TRS-80.
GOSUB x	GOSUB x	Same function. The branching statement GOSUB (line number) sends the program operation to the subroutine located at the line number specified. The next RETURN command encountered will return the flow of operation to the place in the program where the GOSUB was encountered.
GOTO x	GOTO x	Same function. The branching statement GOTO (line number) will send the program operation to the line number specified.

GR	None	No equivalent function is needed on the TRS-80. The GR command on the APPLE II is needed to switch the screen display to the LO-RES graphics mode, whose screen is normally a 40 by 40 matrix. (See Appendix C for screen conversion.)
HCOLOR=x	None	No equivalent function exists on the TRS-80 without modification. The command is needed on the APPLE II following the HGR command to designate which of the seven HGR colors will be used. A color value (Ø to 7) will be designated. For the purposes of conversion, this command and its elements should be ignored.
HGR or HGR2	None	No equivalent function exists on the TRS-80 or is necessary for conversion. The HGR command on the APPLE II sets the screen to the HI-RES graphics mode. HI-RES graphics are not available on the TRS-80 without modification. The closest TRS-80 procedure available may be the use of POKE graphics (Level II only), which will approximate the desired display. (See Level II manual.)
HIMEM=x	MEMORY SIZE ?	Same function
HLIN x,y AT z	None	The command HLIN is a graphics-related command. It draws a horizontal line from x to y at the vertical position z on the screen. It may be approximated as follows: FOR z=x TO y; SET(Z,Y): NEXTZ

Commands *(continued)*

APPLE II	*TRS-80*	*Comments*
		This will draw a line from x to y at the vertical position Y(z).
HOME	CLS	Same function. This command clears the display screen and returns the cursor to the upper left corner of the screen.
HPLOT x,y	None	This command is the HI-RES graphic equivalent of SET (x,y). No equivalent exists on the TRS-80 without modification. ASCII characters may sometimes be POKED on the screen to approximate the desired results. The TRS-80 command PRINT @ may also serve as an adequate substitute.
HTAB x or HTAB (x)	PRINT @ or TAB(x)	On the APPLE II, HTAB x will move the cursor (and next print location) horizontally to position x of the print line that is currently being displayed.
IF . . . . THEN	IF . . . THEN	Same function. IF . . . THEN is a conditional control statement. In a Floating-Point BASIC program, all commands after this statement will be ignored if the statement is false. In an Integer BASIC program, the statement functions in the same way it does on the TRS-80.
IN# x	None	This command addresses a peripheral slot within the APPLE II designated by x. On a TRS-80, no equivalent exists without an expansion interface and associated equipment.

		Depending on the data being transferred to the computer by the command, it may be possible to approximate the function by the use of the INPUT#-x command and an attached cassette recorder. (See the TRS-80 manual.)
INPUT"...."	INPUT"...."	Same function. Program operation will halt until the requested data is entered in the computer. The command will print whatever is between the quotation marks on the screen and put a ? and cursor after it.
INPUT x	INPUT x	Same function. The program operation will halt and wait for the requested simple variable to be entered.
INPUT x,y,z	INPUT x,y,z	Same function. The program operation will halt until each of the simple variables has been entered. The variables must be numbers only.
INPUT A$	INPUT A$	Same function. The program execution will halt until the requested string variable is entered. Note that TRS-80 Level I will accept only two string variables: A$ and B$.
INT(x)	INT(x)	Same function. The command INT(x) will return the integer of the variable x. In converting some Integer BASIC programs to TRS-80, it may be necessary to check any division performed. Since APPLE II Integer BASIC will automatically return an integer, it may be necessary to insert an INT(x) in a TRS-80 conversion.

Commands *(continued)*

APPLE II	*TRS-80*	*Comments*
INVERSE	None	No equivalent command exists on the TRS-80 for this command, which causes any text printed under it to be displayed as black letters on a white background. Conversion is not needed.
LEFT$(X$,x)	LEFT$(X$,x)	Same function in Level II but not available in Level I. This command causes the computer to recognize (or operate on) x number of characters of X$, starting from the left side of the string.
LEN(X$)	LEN(X$)	Same function. The command LEN(X$) will return a numeric that equals the number of characters within X$. This function is not available in TRS-80 Level I.
LET	LET	Same function. This optional command may be encountered when a simple variable is set equal to some other simple variable. It is not necessary to include it in a conversion.
LIST	LIST	Same function. The command LIST will cause the entire program to be listed sequentially by line number from beginning to end.
LIST x LIST x,y LIST x-y LIST x- LIST, x	LIST x LIST x-y LIST x-y LIST x- LIST=x	Same function. LIST x will display the line number designated by x. LIST x,y will display line numbers x through y as will LIST x-y. LIST x- will display from line number x to the end of the program.

LOAD	CLOAD	Same function. The command LOAD causes the computer to accept incoming data from the tape cassette player. Execution of this command may be immediate or deferred.
LOG(x)	LOG(x)	Same function. LOG(expression) will return the natural logarithm of the expression. This function is not available in Level I.
LOMEM	None	No equivalent function is available in the TRS-80. Since LOMEM is used in APPLE II programs to prevent HI-RES graphics from clobbering the variable storage area of the memory, it is not usually required in a conversion.
MID$(". . . . .", y,z) or MID$(X$,y,z)	MID$(". . . . .", y,z) or MID$(X$,y,z)	Same function. In both cases, the command will cause the computer to read the string starting with the y character designated and read the z characters indicated. This function is not available in Level I.
NEW	NEW	Same function. Execution of the command (either immediate or deferred) sets all program pointers to the machine basic program start point and effectually deletes the current program and all previous variables.
NEXT	NEXT	Same function. The command NEXT indicates the "bottom" of a FOR . . . NEXT loop. Depending on the Level (I or II), it may be necessary to specify what variable is NEXT (for example, NEXT x).

Commands *(continued)*

APPLE II	*TRS-80*	*Comments*
NORMAL	None	No equivalent function exists or is needed on the TRS-80. The command terminates the operation of the APPLE II commands FLASH and INVERSE.
NOT	NOT	Same function. The logical operator NOT is usually found in a statement that may include an IF or an AND (see TRS-80 Manual).
NOTRACE	TROFF	Same function. Although not commonly used in programs, this command turns off the line number TRACE function of the computer.
ON ERR GOTO	ON ERROR GOTO	Same function. This command may be inserted in a program if an error is likely to occur at a given point. In a Floating-Point BASIC program, one might also find a POKE 216,Ø in the proximity of the error-handling statement or whereever the program flow has been sent. This POKE command sets the APPLE II's error-detecting flag back to its normal error-handling operation.
ON x GOSUB xx,yy,zz	ON x GOSUB xx,yy,zz	Same function. Each increment of x encountered will cause a branch to the subroutine at its corresponding line number, execute the subroutine, and return to its point of departure within the program.
ON x GOTO xx,yy,zz	ON x GOTO xx,yy,zz	Same function. Each increment of x encountered will cause a branch to its equivalent or specified corresponding line number.

		Program operation will continue from the line number designated.
OR	OR	Same function. OR is a logical operator used in a comparison or relationship.
PDL(x)	None	The PDL(x) function is not available in the TRS-80 without modification. PDL refers to the game controllers that are available on APPLE II computers. The (x) will normally be a value between Ø and 3, indicating which of the controls is to be read.
PEEK(x)	PEEK(x)	Same function. It returns the decimal equivalent of the contents of the memory address specified by (x). This function is not available in Level I.
PLOT x,y	SET(x,y)	Same function. On APPLE II, the command PLOT will turn on a LO-RES graphics block specified by the variables x and y or any expression used to produce a number within the limits of the screen.
POKE x,y	POKE x,y	Same function. It stores the machine-language equivalent of the variable y at memory address x. POKE is not available to Level I.
POS(Ø)	POS(Ø)	Same function. POS(Ø) will return the horizontal position value (Ø to the length of the TAB field) of the current cursor location.
PR#x	None	On APPLE II this command sends computer output to the peripheral slot designated by x. No direct TRS-80 equivalent exists without the expansion interface and associated peripheral hardware. In some cases

Commands *(continued)*

APPLE II	*TRS-80*	*Comments*
		it may be possible to address the output to the cassette recorder with the PRINT#-1 command.
PRINT	PRINT	Same function. This command causes the specified operation to be displayed on the video screen.
READ x	READ x	Same function. The command READ will cause the variable indicated (x) to accept the successive values as they occur in the programs DATA statements. The command may also be followed by a string designator (READ X$). This will cause all the DATA statement elements to be read as strings. Reading strings is not available on Level I.
RECALL x	INPUT#-1	Approximately the same function. In APPLE II programs, the command will cause the computer to input data from the cassette recorder. The data will be in the form of simple numerical variables or a real or integer array. Data "recalled" will be stored in a previously dimensioned array or variable list.
REM	REM	Same function. The command REM allows the programmer to include nonoperational text in the program as remarks. REM statements may be included or ignored. If a REM is left out, be sure that nothing in the program branches to the line number excluded.
RESTORE	RESTORE	Same function. The command RESTORE causes the stack pointer

		of the data list to reset to the beginning of the program's DATA lines. The next READ command encountered will cause DATA to be read from the beginning of the list.
RETURN	RETURN	Same function. RETURN will complete the branching statement initiated by the command GOSUB. Program operation will return to the location where the GOSUB was encountered and begin with the next command or operation (see POP).
RESUME	RESUME	Usually the same function. This command at the end of an error-handling routine (ONERR GOTO) will cause the program operation to continue from the point where the error occurred. All previous variables remain in memory except for those that may have been part of the original error.
RIGHT$(X$,y) or RIGHT$("...", y)	RIGHT$(X$,y) or RIGHT$("...", y)	Same function. This command will cause the computer to read the designated string (X$) from the right end to the character that is y places from the right. Any action performed will be done on the last y characters of the string.
RND (X)	RND(X)	Approximately the same function. RND(X) will return a value between Ø and 1 (.00000001 to .99999999) only, regardless of the value of X.
RND (Ø)	RND(Ø)	Same function. RND(Ø) returns the most recently generated random number between Ø and 1.
RND(-X)	RANDOM	Same function. This command will generate a specific random number

Commands *(continued)*

APPLE II	*TRS-80*	*Comments*
		that will be the same each time the argument is encountered. Positive RND numbers used in conjunction with the negative RND will vary in a particular, repeatable sequence. Any new RND (positive number) used outside the argument will be treated normally (see Level II manual).
ROT	None	No equivalent function exists in the TRS-80. The command ROT is used in conjunction with a HI-RES graphics SHAPE that has been entered in the computer in machine language. Depending on the SHAPE drawn, it may be possible to approximate it with a POKE graphic combination. If so, the shape will have to be re-POKED on the screen to vary its location.
RUN	RUN	Same function. The command sets all variables to Ø or " " (null) and directs program execution to start at the lowest line number of the program.
RUN x	RUN x	Same function. RUN x will set all variables to Ø or " " (null), but program execution will begin at the line number specified by the number x.
SAVE	CSAVE	Same function. This command will cause the computer to store the current program in memory on cassette.

SCALE=x	None	The command SCALE is applied to the commands of DRAW and XDRAW in a Floating-Point BASIC program. SCALE sets the relative size of the machine-language SHAPE to be drawn in HI-RES graphics. No equivalent command is available or needed in the TRS-80. Size will increase from 1 to 255 times. (SCALE=Ø is the largest possible.) To approximate the function, the shape will have to be plotted larger manually or scaled with a subroutine.
SCRN(x,y)	POINT(x,y)	Similar function. In the LO-RES graphics mode, SCRN(x,y) will return the value of the color of the graphics block at the point specified by coordinates x,y.
SGN(x)	SGN(x)	Same mathematical function. SGN(x) will return the sign (−1, Ø, or 1) of the value of the argument (−1 for negative, Ø for value of Ø, and 1 for a positive value).
SHLOAD	None	No equivalent function. This command loads a HI-RES graphics shape from the cassette to just under the HIMEM limit of the memory. In a Floating-Point BASIC program, HIMEM will then be set below the shape to protect it. The closest approximation available on the TRS-80 may be achieved by saving a simple shape as a DIMension and using the INPUT#-1 (and PRINT#-1) command to retrieve a specific shape.
SIN(x)	SIN(x)	Same mathematical function. SIN(x) will return the sine of the number

Commands *(continued)*

APPLE II	*TRS-80*	*Comments*
		specified by x. This command is not available to Level I.
SPC(x)	STRING$(x,32)	Approximately the same function. In an APPLE II program, SPC(x) will be used in a PRINT statement. The command will cause x number of spaces to be inserted between the last PRINT if followed by a semicolon(;) and the next element to be PRINTed if SPC(x) is followed by a semicolon(;).
SPEED=x	None	No equivalent function. The SPEED command in an APPLE II program allows the user to adjust the speed at which characters are displayed on the screen (or peripheral device) from a high of 255 (normal speed) to a low of Ø. To approximate the function, TRS-80 PRINT statements can be slowed down through the use of timing loops and READ-DATA routines where feasible. Otherwise no conversion is available or needed.
SQR(x)	SQR(x)	Same mathematical function. SQR(x) returns the square root of the number or expression specified by x. This command is not available to Level I.
STEP x	STEP x	Same function. Used within a FOR . . . NEXT loop, the command will cause the program operation to increment (count) through the loop in multiples of x.

STEP −x	STEP −x	Same function. Used within a FOR . . . NEXT loop, the command will cause the program operation to decrement the starting value of x by multiples of x.
STOP	STOP	Same function. This command causes the program operation to STOP at the line number where the command is encountered. The computer will display the line number where the program stopped on returning control to the user.
STORE x	PRINT#-1	Generally the same function. The command will write an integer or real array to the cassette. The data stored may then be accessed from a running program by the command INPUT#-1 (RECALL on APPLE II). The handling of data in this manner requires that storage area for the incoming-outgoing data be previously DIMensioned within the program.
STR$(x)	STR$(x)	Same function. This command will take the variables or expressions within the parentheses (x) and return them as a string. This function is not available to TRS-80 Level I.
TAB(x)	TAB(x)	Same function. TAB(x) will cause the cursor to tab x number of positions to the right of the left-hand margin of the screen.
TAN(x)	TAN(x)	Same mathematical function. This command will return the value of the tangent of the argument or expression specified by x, which must be in radians. This function is not available in Level I.

Commands *(continued)*

APPLE II	*TRS-80*	*Comments*
TEXT	None	No equivalent function. The TEXT command in APPLE II programs is required to switch from a graphics display mode (both HI-RES and LO-RES) to an all-text mode of display. No similar command is needed in the TRS-80.
TRACE	TRON	Same function. The command causes the line number of program operation to be displayed on the screen along with the operation being performed by the computer (see NOTRACE). The TRON feature is not available in Level I.
USR(x)	USR(Ø)	Similar function. The command allows the user to place the value of the expression within the parentheses in a specific memory address where it may be accessed by machine-language routines. The machine-language routine must have been previously POKEd or directly entered into the computer (see CALL). This function is not available to Level I. (See also Level II manual.)
VAL("xyz") or VAL(X$)	VAL("xyz") or VAL(X$)	Same function. This command will cause the computer to try to evaluate the designated string in numeric terms. It will read the string up to the first nonnumeric character and return the value of the numbers read as a real or integer. If the first characters are letters or nonnumeric symbols, the string will be read as

		having a value of Ø. This function is not available to Level I.
VLIN a,b AT c	None	No direct equivalent exists in the TRS-80. The function draws a vertical line from point a to point b at the horizontal position c. The function can be approximated by the routine: FOR y=a TO b: SET(c,y):NEXTy
VTAB x or VTAB (x)	PRINT@ x	On the APPLE II, the command VTAB will move the cursor to the horizontal row (or tab vertically) to the position specified by the variable x. On the TRS-80, the PRINT @ command specifying the appropriate left-margin position will duplicate the function well.
WAIT xxxxx,yyy,z or WAIT xxxxx,yyy	None	No equivalent function exists in the TRS-80. The command WAIT permits the programmer to use a conditional pause within an operating program. The computer will wait until the bit state of the address specified by xxxxx matches the binary equivalent of the decimal number specified by yyy. If a third expression is present (z), it will equal 1 or Ø. The 1 indicates that you are waiting for the corresponding bit state to be low, Ø for the corresponding bit state to be high. (Ø is assumed if no third expression is stated.) When the designated conditions are met, the operation will continue. (See APPLESOFT II Basic Programming Reference Manual.)

Commands *(continued)*

APPLE II	*TRS-80*	*Comments*
XDRAW z AT x,y	None	This command will draw the same shape previously drawn by the command DRAW z AT x,y in the complement of the COLOR previously used. It has the effect of "erasing" the shape drawn if the background color is the complement of the color used to draw the shape. No equivalent for this series of functions exists in the TRS-80 without modification. A shape approximated on the TRS-80 may be removed from the screen by POKing the addresses used previously in the DRAW approximation to Ø (see DRAW).

APPLE II PEEK, POKE, and CALL Statements and TRS-80 Approximations

APPLE II	*TRS-80*	*Comments*
CALL −936	CLS	Clears all characters and moves the cursor to the top left-most printing position
CALL −958	PRINT CHR$(31)	Clears all characters from the current cursor position to the bottom of the screen
CALL −868	PRINT CHR$(30)	Clears all characters to the right of the cursor
X=PEEK (−16384)	NONE	Reads keyboard for the value of X. If X>127, then the key has been pressed, and X will be the ASCII value of the key that was pressed

		plus 128. Use: A$=INKEY$:X=ASC(A$)+128
POKE−16368, Ø	NONE	Resets keyboard strobe (not needed in translation)
X=PEEK(36)	X=POS(Ø)	Returns a number indicating the position of the cursor

APPLE II POKES Ignorable During a Translation into TRS-80

POKE 22, x	Sets text window width
POKE 32, x	Sets left margin of display
POKE 33, x	Sets width of display
POKE 34, x	Sets top margin of display
POKE 35, x	Sets bottom margin of display
POKE 36, x	Moves cursor to horizontal position x+1 from left of margin
POKE 37,x	Moves cursor to absolute vertical position specified by x
POKE 50, 127	Sets inverse mode in Integer BASIC
POKE 50, 255	Sets normal mode in Integer BASIC
POKE−16303, Ø	Switches from color graphics to text without resetting scrolling window
POKE−16304, Ø	Switches display mode to graphics without clearing screen to black
POKE−16368, Ø	Resets keyboard strobe [after PEEK(−16384)]
POKE−16302, Ø	Switches from mixed text and graphics to full graphics
POKE−16301, Ø	Switches from full graphics to mixed graphics and text

APPLE II POKES Ignorable During a Translation into TRS-80 *(continued)*

POKE–16300, Ø	Switches from page 2 to page 1
POKE–16299, Ø	Switches from page 1 to page 2
POKE–16298, Ø	Switches from HI-RES graphics to text
POKE–16297, Ø	Switches from text to same page of HI-RES graphics
POKE–16296, Ø to POKE –16289, Ø	Commands dealing with GAME paddles
POKE 216, Ø	Resets error flag after error-handling routine
POKE–16336, Ø	Toggles speaker (Integer BASIC)

2.2 Conversion of PET into TRS-80

Commands

PET	*TRS-80*	*Comments*
ABS(x)	ABS(x)	Same function
AND	AND	Same function
ASC(string)	ASC(string)	Same function
CHR$(x)	CHR$(x)	Same function
CLOSE	NONE	Used to close logical file; not needed when inputting data from TRS-80 tapes
CLR	CLEAR	Same function
CMD	NONE	Similar to the TRS-80 IN command; reads IEEE port for input
CONT	CONT	Same function
COS(x)	COS(x)	Same function
DATA	DATA	Same function
DEF FN	NONE	Not available in Level II; each function will have to be calculated individually
DIM	DIM	Same function
END	END	Same function (usually optional)
EXP(x)	EXP(x)	Same function
FOR	FOR	Same function
FRE(x)	FRE(x)	Same function
GET#	NONE	Reads data tape; not needed with TRS-80

Commands *(continued)*

PET	*TRS-80*	*Comments*
GET A	NONE	Reads keyboard for variable input; use A$=INKEY$:A=VAL(A$)
GET A$	A$=INKEY$	Same function
GOSUB n	GOSUB n	Same function
GOTO n	GOTO n	Same function
IF	IF	Same function
INPUT	INPUT	Same function
INPUT#	INPUT#– n	Same function (reads input from tape)
INT(x)	INT(x)	Same function
LEFT$	LEFT$	Same function
LEN(string)	LEN(string)	Same function
LET	LET	Same function
LIST	LIST	Same function
LOAD	LOAD	Same function
LOAD "file name"	LOAD "x"	Same function except that PET file names may contain 16 characters or more, and TRS-80 file labels can contain only one character.
MID$	MID$	Same function
NEW	NEW	Same function
NEXT	NEXT	Same function
ON x GOSUB	ON x GOSUB	Same function
ON x GOTO	ON x GOTO	Same function
OPEN	NONE	Opens logical file (similar to TRS-80 INPUT#); reads data from tape file.
OR	OR	Same function

PEEK(addr)	PEEK(addr)	Same function except that the addresses will be different
POKE(addr)	POKE(addr)	Same function except that the addresses will be different
POS(x)	POS(x)	Same function
PRINT	PRINT	Same function
PRINT#	PRINT#–	Same function
READ	READ	Same function
REM	REM	Same function
RESTORE	RESTORE	Same function
RETURN	RETURN	Same function
RIGHT$	RIGHT$	Same function
RND(x)	RND(x)	Same function
RUN	RUN	Same function
SAVE	CSAVE"x"	Same function except that the TRS-80 needs a file label
SAVE"file name"	CSAVE"x"	Same function except that PET allows several characters and the TRS-80 allows only one
SGN(x)	SGN(x)	Same function
SIN(x)	SIN(x)	Same function
SPC(x)	STRING$ (x,32)	Same function with the extra use of the STRING$ function (32 is the ASCII code for space). The SPC(x) function places x spaces on the screen.
SQR(x)	SQR(x)	Same function
STOP	STOP	Same function
STR$	STR$	Same function

***Commands** (continued)*

PET	*TRS-80*	*Comments*
SYS(addr)	SYSTEM	Similar function since the SYS function provides access to previously stored machine-language routines as does the SYSTEM command [USR(Ø) may also be used]
TAB(x)	TAB(x)	Same function
TAN(x)	TAN(x)	Same function
THEN	THEN	Same function
TI$	NONE	Returns time recorded on PET internal clock; sometimes used to time input for program functions
USR(x)	USR(Ø)	Same function except that the TRS-80 will have only one USR available in Level II
VAL(string)	VAL(string)	Same function
VERIFY"file name"	CLOAD?"x"	Same function except that the TRS-80 allows only one character for a label
WAIT	NONE	Causes execution of a program to halt until a nonzero result of the argument in the WAIT statement is achieved

Other Indications

PET/APPLE II	*TRS-80*	*Comments*
%	%	Designated variables as INTEGERS
π	NONE	The value of PI must be inserted (3.1428) in programs using a variable

Pet Graphics

The PET has built-in graphics characters in ROM that are often printed on the screen by using PRINT CHR$(x), (x being the ASCII representation of the graphics character); these graphics characters are not available on the TRS-80. In order to compensate for them in a program, refer to Chart 4 in Appendix C, and replace the character with POKE graphics in the TRS-80.

Cursor Control Characters

Each cursor control character is preceded by a PRINT command or used as a CHR$. The cursor control characters are listed in Section 3.2 (Chap. 3).

Chapter 3

CONVERSION OF TRS-80 AND PET PROGRAMS INTO APPLE II

This chapter is designed for easy conversion of TRS-80 and PET programs into APPLE II programs. The commands are listed in alphabetical order for quick reference. Several subroutines have been included so that you can approximate TRS-80 or PET commands that do not directly relate to APPLE II commands.

Graphics will be discussed from the standpoint of what can be done and what cannot be done, but for the most part, your imagination will be the best guide in trying to convert TRS-80 and PET graphics to APPLE II since APPLE II will allow you much more variety.

The format for this chapter is as follows:

TRS-80/PET Function	*APPLE II Function*	*Comments*

Every command with a direct relationship to APPLE II is included. Some APPLE II commands are not included, however, since nothing in a TRS-80 or PET listing will relate to them (for example, CALL, POP, and the like). Subroutines and other conversion indicators that allow the APPLE II to perform a TRS-80 or PET function are included in the comments section of each command.

Sample program conversions appear in Appendix B.

3.1 Conversion of TRS-80 into APPLE II

Commands

TRS-80	*APPLE II*	*Comments*
ABS(x)	ABS(x)	Same function
AND	AND	Same function
ASC(string)	ASC(string)	Same function
ATN(x)	ATN(x)	Same function
AUTO	AUTO	AUTO line numbering, available only in Integer BASIC
BREAK	CONTROL C	Same function
CDBL	None	Returns double-precision representation of a number
CHR$	CHR$	Same function
CINT	None	Returns integer of number
CLEAR	CLEAR	Same function
CLEAR nn	None	Reserves string space; not necessary in APPLE II
CLOAD	LOAD	Same function
CLOAD"X"	None	APPLE II does not load by label
CLOAD?"X"	None	Used to verify transfer of a program; not available in APPLE II
CLS	HOME	Same function
CONT	CONT	Same function
COS(x)	COS(x)	Same function
CSAVE	SAVE	Same function
CSAVE"X"	None	APPLE II does not save by label
CSNG	None	Returns a single-precision number

Commands *(continued)*

TRS-80	*APPLE II*	*Comments*
D	None	Defines variable as a double-precision number
DATA	DATA	Same function
DEFDBL	None	Defines a variable as double precision
DEFINT	None	Defines a variable as an integer (use % after a variable to approximate this function)
DEFSNG	None	Defines a variable as single precision
DELETE	DEL	Same function (deletes program lines)
DIM	DIM	Same function
E	E	Same function (scientific notation)
EDIT	None	EDIT mode not available in APPLE II
ELSE	None	ELSE is used in IF . . . THEN statements. Use separate IF . . . THEN statements when this command is encountered. For example: 10 IFA=BTHENGOTO1000ELSE200 (TRS-80) 10 IFA=BTHENGOTO1000 15 IFA<>BTHENGOTO200
END	END	Same function
ERL	None	Returns line number of error; use X=PEEK(218)+PEEK(219)*256 to return line number of error
ERR/2+1	PEEK(222)	Returns error code of error
EXP(x)	EXP(x)	Same function
FIX(x)	INT(x)	Same function

FOR	FOR	Same function
FRE(string)	FRE(Ø)	Same function. Returns a negative number on a 48K machine; otherwise returns the amount of memory left available for programming
GOSUB	GOSUB	Same function
GOTO	GOTO	Same function
IF	IF	Same function
INKEY$	GET(string)	Same function except that GET(string) stops program flow until key is pressed. INKEY$ does not wait for key input. If the very same function is desired, use the following: X=PEEK(−16384);IF X>127 THEN GOTO xxxx (If X>127, it means that a key was pressed)
INP(port)	IN# x	Inputs data from port [APPLE II is limited to Ø through 7 (Ø is keyboard)]
INPUT	INPUT	Same function
INPUT #	RECALL x	Same function when used with variables; use subroutine 3 in Appendix A for recalling strings
INT	INT	Same function
LEFT$	LEFT$	Same function
LEN(string)	LEN(string)	Same function
LET	LET	Same function
LIST	LIST	Same function
LLIST	None	Causes LIST to be output to printer; use PR#1 (if printer card is in slot 1) and then LIST

Commands *(continued)*

TRS-80	*APPLE II*	*Comments*
LOG(x)	LOG(x)	Same function
LPRINT	None	Causes display to be output to printer; use PR#1 to transfer printing to printer
MEM	FRE(Ø)	Returns amount of free memory
MID$	MID$	Same function
NEW	NEW	Same function
NEXT	NEXT	Same function
NOT	NOT	Same function
ON ERROR GOTO	ON ERR GOTO	Same function
ON . . GOSUB	ON . . GOSUB	Same function
ON . . GOTO	ON . . GOTO	Same function
OR	OR	Same function
OUT(port)	PR# x	Although PR# x is similar to OUT, *all* output is transferred to slot x, not just a specific byte as with OUT (x must be a number from Ø to 7); if no device is connected, computer will "hang"
PEEK(addr)	PEEK(addr)	Same function, but addresses are different (see list of common PEEKs)
POINT(x,y)	None	No direct function relates to this command; its purpose is to check whether a point on the screen is "ON." It can be approximated by using the SCRN(x,y) function. The SCRN(x,y) function returns a color

		code of the spot on the screen to allow you to evaluate the color code and determine whether the graphics block is on.
POKE(addr,x)	POKE(addr,x)	Same function, but addresses are different
POS(x)	POS(x)	Same function
PRINT	PRINT	Same function
PRINT @	None	Causes output to be placed on the screen at a specific point (see Chart 1 in Appendix C)
PRINT#−1	STORE A	See Subroutine 2 in Appendix A
PRINT USING	None	See Subroutine 1 in Appendix A
RANDOM	None	Reseeds random numbers; not necessary with APPLE II
READ	READ	Same function
REM	REM	Same function
RESET(x,y)	PLOT(x,y)	To reset a block of graphics in both HI-RES and LO-RES, simply PLOT the same coordinates in the background color
RESTORE	RESTORE	Same function
RESUME	RESUME	Same function
RETURN	RETURN	Same function
RIGHT$	RIGHT$	Same function
RND(x)	RND(x)	RND(Ø) is the same, but if the RND number is greater than 1, use Subroutine 5 in Appendix A
RUN	RUN	Same function
SET(x,y)	PLOT(x,y)	Same function except that field limits are: X=39, Y=47 (instead of

Commands *(continued)*

TRS-80	*APPLE II*	*Comments*
		X=127, Y=45). "GR" or "HGR" must be used before a PLOT.
SGN(x)	SGN(x)	Same function
SIN(x)	SIN(x)	Same function
SQR(x)	SQR(x)	Same function
STOP	STOP	Same function
STR$	STR$	Same function
STRING$	None	See Subroutine 4
SYSTEM	None	This command allows access to machine-language programs; use CALL-151 or press the RESET key
TAB	TAB	Same function
TAN(x)	TAN(x)	Same function
THEN	THEN	Same function
TROFF	NOTRACE	Same function
TRON	TRACE	Same function
USR(x)	USR(x)	Same function (address for the USR function on the TRS-80 is POKED into addresses 16526 and 16527). Only one USR(x) call is allowed in TRS-80 Level II.
VAL(string)	VAL(string)	Same function
VARPTR	None	Returns decimal location of a variable stored in memory

Special Characters and Abbreviations

TRS-80	*APPLE II*	*Comments*
ENTER	RETURN	Same function
←	←	Backspace and delete last character
:	:	Same function (statement delimiter)
CLEAR	CLEAR	Resets all variables and strings to NULL; arrays have to be redimensioned after CLEAR
SHIFT@	CONTROL S	Interrupts program or listing; pressing any key will cause program or listing to resume (CONTROL S is available only with the AUTOSTART ROM; other models use CONTROL C)
BREAK	CONTROL C	Stops program or listing and returns to BASIC; type CONT to continue
RESET	RESET	Causes program execution to cease and places computer in MONITOR mode (CONTROL C will return you to BASIC)
?	?	Same function (abbreviation for PRINT)

Type Declaration Characters

Character	*Type*	*Example*
$	String	A$, AF$
%	Integer	A%, AF%
E	Exponential	1.23E+1Ø

Arithmetic Operators

+ Add − Subtract * Multiply
/ Divide ∧ Exponentiate (2∧3 = 8)

String Operators

+ Concatenate (string together)

Relational Operators

Symbol	*Meaning in Numerics*	*Meaning in Strings*
<	Is less than	Precedes
>	Is greater than	Follows
=	Is equal to	Equals
<= or =<	Is less than or equal	Precedes or equals
>= or =>	Is greater than or equal	Follows or equals
<> or ><	Does not equal	Does not equal

Order of Operation

∧	Exponentiation
*, /	Multiplication, division
+, −	Addition, subtraction
AND	
OR	

3.2 Translation of PET into APPLE II

Commands

PET	*APPLE II*	*Comments*
ABS(x)	ABS(x)	Same function
AND	AND	Same function
ASC(string)	ASC(string)	Same function
CHR$(x)	CHR$(x)	Same function
CLOSE	None	Used to close a logical file but not needed when reading data from APPLE II tapes
CLR	CLEAR	Same function
CMD	None	Similar to APPLE II IN#; reads IEEE port for input
CONT	CONT	Same function
COS(x)	COS(x)	Same function
DATA	DATA	Same function
DEF FN	DEF FN	Same function (string functions cannot be defined)
DIM	DIM	Same function
END	END	Same function (optional in APPLE II, mandatory in INTEGER)
EXP(X)	EXP(X)	Same function
FOR	FOR	Same function
FRE(x)	FRE(x)	Same function. Returns a negative number on a 48k machine; otherwise returns the amount of memory left available for programming

Commands *(continued)*

PET	*APPLE II*	*Comments*
GET#	None	Used to read a character from data tape, but not needed with APPLE II
GET A	GET A	Same function, but APPLE II recommends using the keyboard strobe [X=PEEK(–16384)] to avoid errors
GET A$	GET A$	Same function except that APPLE II program execution halts until a key is pressed and PET program execution continues unless a key is pressed.
GOSUB n	GOSUB n	Same function
GOTO n	GOTO n	Same function
IF	IF	Same function
INPUT	INPUT	Same function
INPUT#	RECALL n	Same function except that conversion of data stored as strings must be handled in accordance with Subroutine 3 in Appendix A
INT(x)	INT(x)	Same function
LEFT$	LEFT$	Same function
LEN(string)	LEN(string)	Same function
LET	LET	Same function (optional)
LIST	LIST	Same function
LOAD	LOAD	Same function (loads tape when file name is not present)
LOAD "file name"	None	APPLE II does not store programs by file name except on disk

MID$	MID$	Same function
NEW	NEW	Same function
NEXT	NEXT	Same function
ON x GOSUB	ON x GOSUB	Same function
ON x GOTO	ON x GOTO	Same function
OPEN	None	Opens logical file, but not necessary in APPLE II
OR	OR	Same function
PEEK(addr)	PEEK(addr)	Same function, but addresses are different
POKE(addr)	POKE(addr)	Same function, but addresses are different
POS(x)	POS(x)	Same function
PRINT	PRINT	Same function
PRINT #	STORE A	Same function (stores data on tape). String storage must be handled in accordance with Subroutine 2 in Appendix A
READ	READ	Same function
REM	REM	Same function
RESTORE	RESTORE	Same function
RETURN	RETURN	Same function
RIGHT$	RIGHT$	Same function
RND(x)	RND(x)	Same function
RUN	RUN	Same function
SAVE	SAVE	Same function (saves files on tape when file name is not used)
SAVE "file name"	None	APPLE II does not save programs by file name except on disk

Commands *(continued)*

PET	*APPLE II*	*Comments*
SGN(x)	SGN(x)	Same function
SIN(x)	SIN(x)	Same function
SPC(x)	SPC(x)	Same function
SQR(x)	SQR(x)	Same function
STOP	STOP	Same function (causes bell to sound in APPLE II)
STR$	STR$	Same function
SYS(addr)	CALL addr	Generally the same function, but addresses will differ. (This command branches from a BASIC program to a machine-language routine.)
TAB(x)	TAB(x)	Same function
TAN(x)	TAN(x)	Same function
THEN	THEN	Same function
TI$	None	Returns time recorded on PET internal clock; sometimes used to time input for program functions
USR(x)	USR(x)	Same function (note that addresses are not the same)
VAL(string)	VAL(string)	Same function
VERIFY "file name"	None	Used to verify program dump on tape but not available or necessary on APPLE II
WAIT	WAIT	Same function, but since timing in the PET and APPLE II is different, make note of the approximate timing desired for the program and adjust accordingly

Other Indications

PET	*APPLE II*	*Comments*
%	%	Designates a variable as an integer
π	PI=3.1428	The value of pi must be substituted for the symbol π

PET Graphics

The PET has a built-in character ROM for various graphic characters. In order to compensate for this feature, you must create your own graphic version of the symbols provided on the PET. Chart 4 in Appendix C gives the character set and the ASCII equivalents. If you encounter POKE graphics, refer to this character set to determine what is intended in the program.

Cursor and Control Characters

Each cursor and control character is preceded by a PRINT command or is used as a CHR$. The cursor and control characters, their functions, and the corresponding ASCII characters and APPLE II commands are as follows:

Character	*Function*	*ASCII Value*	*APPLE II Command*
	Clear screen and home cursor	147	HOME
	Cursor right	29	PRINT CHR$(9)
	Cursor up	145	Not available
	Cursor down	17	Not available
	Home cursor	19	CALL −936 or HOME
	Cursor left	157	
	Reverse field	18	INVERSE
	Reset normal field	146	NORMAL
	Insert character	148	Not used
	Delete character	20	Not used

Chapter 4

CONVERSION OF TRS-80 AND APPLE II PROGRAMS INTO PET

This chapter is designed for easy conversion of TRS-80 and APPLE II programs into PET. The commands are in alphabetical order for quick reference. Moreover, several subroutines are included in the comments column to allow you to approximate PET commands that do not directly relate to APPLE II commands.

Graphics will be discussed from the standpoint of what can be done and what cannot be done, but for the most part your imagination will be the best guide in trying to convert TRS-80 and APPLE II graphics to PET.

The format for this chapter is as follows:

TRS-80/APPLE II Function	*PET Function*	*Comments*

Every command that has a direct relationship to PET is included. Some PET commands have been omitted if they do not relate to the functions of either the TRS-80 or APPLE II. Subroutines and other conversion indicators that allow the PET to perform a TRS-80 or APPLE II function are mentioned in the comments section at the side of each command.

4.1 Conversion of TRS-80 into PET

This section is designed for easy conversion of TRS-80 programs into PET. In general, the commands are in the order they are found in the TRS-80 Level II manual. Several sub-

routines are included to allow you to approximate TRS-80 commands that do not directly relate to PET commands.

Graphics will be discussed from the standpoint of what can be done and what can't be done, but, for the most part, your own imagination will serve you best in trying to convert the TRS-80 graphics.

The format for this guide is as follows:

TRS-80 Function *PET Function* *Comments*

Each TRS-80 command that has a direct relationship to PET is included. Subroutines and other conversion indicators that allow the PET to perform a TRS-80 function are listed in the comments section at the side of each command.

Sample programs with conversions are included in Appendix B.

Since timing loops work faster for the PET by a factor of about two, you will need to change a statement such as FOR X=1 TO 1000:NEXT, for example, to FOR X=1 to 2000 NEXT to maintain approximately the same timing.

Commands

TRS-80	*PET*	*Comments*
AUTO	None	
CLEAR	CLR	Sets numeric variables to zero, strings to NULL, and arrays to zero; arrays must be redimensioned.
CLEAR n	None	PET reserves space for strings by itself
CONT	CONT	Continue after STOP
DELETE mm-nn	None	Deletes line mm to nn
EDIT	None	
LIST mm-nn	LIST mm-nn	LIST linenum to linenum

LIST nn	LIST nn	LIST linenum
LIST nn-	LIST nn-	LIST from linenum to end of program
LIST	LIST	LIST entire program
NEW	NEW	Deletes entire program and resets all variables
RUN	RUN	Executes program from beginning
RUNnn	RUNnn	RUN program from line nn
TRON	None	Turns on TRACE mode
TROFF	None	Turns off TRACE mode
SYSTEM	SYS	Used to load machine-language programs (use MONITOR commands)
CLOAD	LOAD	Loads programs from cassette
CLOAD "name"	LOAD "name"	LOAD (name) program
CLOAD? "name"	VERIFY "name"	VERIFY (name) program
CSAVE	SAVE	SAVE program on cassette
CSAVE "name"	SAVE "name"	SAVE (name) program

Input/Output

TRS-80	*PET*	*Comments*
PRINT	PRINT	Same function
PRINT @	None	See Chart 1 in Appendix C
PRINT TAB (n)	PRINT TAB (n)	Same function except that the maximum TAB field is 39 instead of 63
PRINT USING	None	See Subroutine 1 in Appendix A
INPUT	INPUT	Same function
DATA	DATA	Same function
READ	READ	Same function
RESTORE	RESTORE	Same function
PRINT #-1	PRINT # 1	Prints data on tape
INPUT #-1	INPUT # 1	Recalls data previously stored on tape

Program Statements

TRS-80	*PET*	*Comments*
DEFINT	None	Each variable to be used as an integer must be labeled with the % sign (that is, a%, c%)
DEFSNG	None	Designates a number as single-precision
DEFDBL	None	Designates a number as double-precision
DEFSTR	None	Defines variable to be treated as a string variable
DIM	DIM	Same function, but variables may be used for DIM statements rather than constants: for example, 10 INPUT

		"HOW MANY DIMENSIONS"; X and 20 DIM A(X), B(X)
LET	LET	Same function (optional)
END	END	Same function
STOP	STOP	Same function; STOPs execution in program and prints BREAK IN linenum
GOTO nn	GOTO nn	Causes program to branch to linenum nn; can also be used in the IMMEDIATE mode to cause the program to begin at a specified point without resetting all variables (used instead of RUN)
GOSUB nn	GOSUB nn	Same function
RETURN	RETURN	Same function
On n GOTO nn	ON n GOTO nn	Same function
ON n GOSUB nn	Same function	
FOR name =expTOexpSTEPn		Same function
NEXT name	NEXT name	Same function (name is optional)
ERROR code	None	
On ERROR GOTO	None	
RESUME	None	
REM	REM	Same function
IF true/false	IFtrue/false	Same function
THEN	THEN	Same function (optional in most situations)
ELSE	None	Another "IF" statement must be used in PET

String Input/Output

TRS-80	*PET*	*Comments*
ASC (string)	ASC (string)	Same function
CHR$(exp)	CHR$(exp)	Same function
FRE(string)	FRE(exp)	Same function [FRE(exp) performs housecleaning; see PET manual]
INKEY$	GETexp$	Same function
LEFT$(string,n)	LEFT$(string,n)	Same function
LEN(string)	LEN(string)	Same function
MID$(string,p,n)	MID$(string,p,n)	Same function
RIGHT$(string,n)	RIGHT$(string,n)	Same function
STR$(exp)	STR$(exp)	Same function
STRING$ (n,char or number)	None	See Subroutine 4 in Appendix A
VAL(string)		Same function

Arithmetic Functions

TRS-80	*PET*	*Comments*
ABS(x)	ABS(x)	Same function
ATN(x)	ATN(x)	Same function
CDBL(x)	None	
CINT(x)	None	
COS(x)	COS(x)	Same function
CSNG(x)	None	
EXP(x)	EXP(x)	Same function

FIX(x)	INT(x)	Same function except that if x is negative, FIX(x)=INT(x)+1
INT(x)	INT(x)	Same function
LOG(x)	LOG(x)	Same function
RANDOM	None	
RND(Ø)	RND(Ø)	Same function
RND(x)	None	See Subroutine 5 in Appendix A
SGN(x)	SGN(x)	Same function
SIN(x)	SIN(x)	Same function
TAN(x)	TAN(x)	Same function

Special Features

TRS-80	*PET*	*Comments*
SET(x,y)	None	
RESET(x,y)	None	
CLS	PRINT "♡"	Clears screen and homes cursor
POINT(x,y)	None	
ERL	None	
ERR/2+1	None	
INP(port)	INPUT #	IN# x is limited to numbers from Ø to 3Ø (Ø is keyboard
MEM	FRE(Ø)	Same function
OUT port, value	PR# x	PR# x is similar to OUT except that *all* output is transferred to slot x, not just a specific byte (x must be a number from Ø to 3Ø). PR# Ø is output to screen. If no device is connected to the specified slot, the computer will "hang."

Special Features (continued)

PEEK(addr)	PEEK(addr)	Same function, but the addresses are different
POKE(addr)	POKE(addr)	Same function, but the addresses are different
POS(x)	POS(x)	Same function; returns the current position of the cursor (number within the parentheses is a dummy number)
USR(x)	USR(x)	Same function
VARPTR (variable name)	None	Returns location in memory where (variable name) is stored

Special Characters and Abbreviations

TRS-80	*PET*	*Comments*
ENTER	RETURN	Same function
←	INST DEL	Backspaces and deletes last character Same function (statement delimiter)
CLEAR	CLR	Resets all variables and strings to NULL; arrays have to be redimensioned after CLEAR
SHIFT@	RUN STOP	Stops program execution, but requires CONT to continue
BREAK	RUN STOP	Stops program execution, but requires CONT to continue
RESET	None	
?	?	Abbreviation for PRINT

Type Declaration Characters

Character	*Type*	*Examples*
$	String	A$, AF$
%	Integer	A%, AF%
E	Exponential	1.23E+Ø

Arithmetic Operators

+ Add − Subtract * Multiply
/ Divide ↑ Exponentiate (2 ↑ 3 = 8)

String Operators

+ Concatenate (string together)

Relational Operators

Symbol	*Meaning in Numerics*	*Meaning in Strings*
>	Is less than	Precedes
<	Is greater than	Follows
=	Is equal to	Equals
>= or =>	Is less than or equal	Precedes or equals
<= or =<	Is greater than or equal	Follows or equals
<> or ><	Does not equal	Does not equal

Order of Operation

( )	Parentheses
↑	Exponentiation
*, /	Multiplication, division
+, −	Addition, subtraction
AND	
OR	

4.2 Conversion of APPLE II into PET

This section is designed for easy conversion of APPLE II programs into PET. In general, the commands are in the order they are found in the APPLE II manual. Several subroutines are included in the comments column to allow you to approximate PET commands that do not directly relate to APPLE II commands.

Graphics will be discussed from the standpoint of what can be done and what can't be done, but for the most part your imagination will serve you best in trying to convert the PET graphics, since APPLE II graphics allow much more variety.

The format for this guide is as follows:

APPLE II Function *PET Function* *Comments*

Each APPLE II command that has a direct relationship to PET is included. Subroutines and other conversion indicators to allow the PET to perform an APPLE II function are listed in the comments section at the side of each command.

Sample programs with conversions are included in Appendix B.

Timing loops work faster for the APPLE II by a factor of about two. You will need to change a statement such as FOR X=1 TO 2000:NEXT, for example, to FOR X=1 TO 1000:NEXT to maintain approximately the same timing.

Commands

APPLE II	*PET*	*Comments*
ABS(x)	ABS(x)	Same function
Arrow keys	None	Use cursor control keys
ASC(string)	ASC(string)	Same function
ATN	ATN	Same function
CALL	None	See common calls at end of section
CHR$(x)	CHR$(x)	Same function
CLEAR	CLR	Clears all variables, arrays, and strings to zero
COLOR	None	No color is available on PET
CONT	CONT	Same function
COS	COS	Same function
ctrl C	RUN STOP	Stops program execution but requires CONT to continue
ctrl X	None	Not available in PET
DATA	DATA	Same function
DEF FN(x)	DEF FN(x)	Same function (string functions cannot be defined)
DEL	None	Deletes lines from program
DIM	DIM	Same function
DRAW	None	Not necessary in PET
END	END	Same function
EXP	EXP	Same function
FLASH	None	Blinks words on screen; not applicable in PET

***Commands** (continued)*

APPLE II	*PET*	*Comments*
FOR. . . TO. . . STEP	FOR. . . TO. . . STEP	Same function
FRE(x)	FRE(x)	Same function
GET	GET	Same function
GOSUB	GOSUB	Same function
GOTO	GOTO	Same function
GR	None	Sets graphics mode in APPLE II; not necessary in PET
HCOLOR	None	Sets color in APPLE II graphics; not necessary in PET
HGR	None	Sets high-resolution graphics mode; not necessary in PET
HGR2	None	Sets high-resolution graphics; not necessary in PET
HIMEM:	None	Sets a point in memory above which machine operation will not interfere; not necessary in PET
HLIN	None	Draws a horizontal line between points x and y; not available in PET
HOME	Print "□"	Same function
HPLOT	None	Plots a point (x,y) on screen. Use POKE x (32768 to 33792)
HTABx	None	Sets horizontal position of cursor on a specific line; not available in PET
IF. . . GOTO	IF. . . GOTO	Same function

IF. . . THEN	IF. . . THEN	Same function
INPUT	INPUT	Same function
INT(x)	INT(x)	Same function
INVERSE	PRINT " R "	Same function
IN#	INPUT#	Reads DATA from I/O device; device numbers will differ
LEFT$	LEFT$	Same function
←	SHIFT CRSR	Backspace over last character
LEN	LEN	Same function
LET	LET	Same function (optional)
LIST	LIST	Same function
LIST x-y	LIST x-y	Same function
LOAD	LOAD	Same function
LOG	LOG	Same function
LOMEM	None	Sets a point in memory below which machine operation will not interfere; not necessary in PET
MID$	MID$	Same function
NEW	NEW	Same function
NEXT	NEXT	Same function
NORMAL	PRINT " ■ "	Same function
NOTRACE	None	Turns trace off; not available in PET
ON. . . GOSUB	ON. . GOSUB	Same function
ON. . . GOTO	ON. . . GOTO	Same function
ONERR GOTO	None	On encountering an error program, branches to specific line; not available in PET

Commands *(continued)*

APPLE II	*PET*	*Comments*
PDL	None	Reads paddle functions on APPLE II; not available in PET
PEEK(x)	PEEK(x)	Same function, but addresses will differ
PLOT	None	See HPLOT
POKE(addr,x)	POKE(addr,x)	Same function, but POKE addresses will differ
POP	None	Retrieves return addresses from "stack" of returns; not necessary in PET
POS(X)	POS(X)	Same function
PRINT	PRINT	Same function
PR#	PRINT#	Writes data to I/O device; device numbers will differ
READ	READ	Same function
RECALL	GET# or INPUT#	Same function
REM	REM	Same function
REPEAT	None	
REPEAT	None	
RESTORE	RESTORE	Same function
RESUME	None	After "ONERR GOTO," program function continues; not available in PET
RETURN	RETURN	Same function
RIGHT$	RIGHT$	Same function
→		Same function

ROT	None	Rotates a shape on machine; not available in PET
RND	RND	Same function
RUN	RUN	Same function
SAVE	SAVE	Same function
SCALE	None	Sets size of shape on screen
SCRN (x,y)	None	Returns color code of coordinates x,y; used to test point on screen; correlates to PEEK (ADDR) in PET
SGN	SGN	Same function
SHLOAD	None	Loads shape from tape stored data; not available in PET
SIN	SIN	Same function
SPC	SPC	Same function
SPEED	None	Adjust rate at which characters are displayed on the screen; not available in PET
SQR	SQR	Same function
STEP	STEP	Same function
STOP	STOP	Same function
STORE	PRINT #	Same function
STR$	STR$	Same function
TAB	TAB	Same function
TAN	TAN	Same function
TEXT	None	Returns program to text mode and turns off graphics; not necessary in PET
TRACE	None	Turns trace on
USR(X)	USR(X)	Same function

Commands *(continued)*

APPLE II	*PET*	*Comments*
VAL(string)	VAL(string)	Same function
VLIN	None	Draws vertical line; not available in PET
VTAB(X)	None	Moves cursor X vertical spaces (uses cursor down characters with PET)
WAIT	WAIT	Same function
XDRAW	None	Erases shapes previously designed by a draw command or changes colors of a shape; not available in PET

Common APPLE II CALLS or POKES and PET Functions

APPLE II	*Comments*
PEEK (addr)	Same function as PEEK (addr) in PET, but the addresses are different
POKE (addr)	Same function as POKE (addr) in PET, but the addresses are different
POKE 32,X) POKE 33,X) POKE 34,X) POKE 35,X)	These four commands relate to setting text window; not necessary in PET
POKE −16289 through POKE −16296	Commands dealing with game control; not necessary in PET
POKE −16297 through POKE −16304	Commands related to graphics and text screens; not necessary in PET
POKE −16368,0	Resets keyboard stroke; not necessary in PET
X = PEEK (−16384)	Reads keyboard; PET uses GET A for this function
CALL −936	Clears all characters on screen; same as PRINT "♡" on PET

Appendix A:
SUBROUTINES

SUBROUTINE No. 1
(PRINT USING Function)

The PRINT USING command is used to format output in a specific manner. The following subroutine allows you to indicate what output you want.

```
5000  A$=STR$(N):FORX=1TOLEN(A$)
5010  IFMID$(A$,X,1)="."THENGOTO5040
5020  NEXTX:AA$=A$
5030  RETURN
5040  A$=A$+"000000000000":AA$=LEFT$(A$,X+Z)
5050  RETURN
```

Sample Program

```
10    PRINT:INPUT"INPUT NUMBER OF DECIMAL PLACES";Z
20    INPUT"ENTER NUMBER TO BE FORMATTED";N
30    GOSUB5000
40    PRINT AA$
50    GOTO10
```

The program must have a predetermined value for the number of decimal places, Z, before the subroutine is entered.

SUBROUTINE No. 2
(STRING STORAGE)

To save strings, you must first convert them to variables. The following subroutine will do this for you:

```
10  DIM R(258)
20  R(Ø) = N :REM ** N IS THE NUMBER OF STRINGS TO BE
    STORED
```

```
30  FOR X =1 TO N
40  R(1) = X
50  R(2) = LEN(A$(X)) :REM ** A$ IS STRING TO BE SAVED
60  FOR Y = 3 TO LEN(A$(X))+2
70  R(Y) = ASC(MID$(A$(X),Y-2,1))
80  NEXT : STORE R : NEXT
```

Make sure that you DIMension an array large enough to accommodate the string being saved (in the program above, the array is set to 258, which is the maximum string size allowed).

SUBROUTINE No. 3
(STRING RECALL AND CONVERT)

To recall strings that have been previously stored as variables, use the following subroutine:

```
 90  PRINT"PRESS RETURN TO RECALL DATA ":GETZS
100  DIM S(26Ø)
110  RECALL S
120  FOR Y = 3 TO S(2)+2
130  Y$ = CHR$(S(Y)):A$(1)=A$(1)+Y$
140  NEXT
150  FOR X = 2 TO S(Ø)
160  RECALL S
170  FOR Y = 3 TO S(2)+2
180  Y$ = CHR$(S(Y)):A$(X)=A$(X)+Y$
190  NEXT : NEXT
```

Make sure that you DIMension an array to carry A$(x).

SUBROUTINE No. 4
(STRING$ Function)

The STRING$ function allows you to print a number of characters or symbols in a row [that is, STRING$("*",3Ø) returns a string of 30 asterisks]. To simulate this function, use the following:

```
10  INPUT X$ : REM *** X$=CHARACTER OR SYMBOL TO BE
    PRINTED
20  INPUT X : REM *** X =NUMBER OF TIMES TO REPEAT THE
    CHARACTER
30  FOR Y = 1 TO X
40  PRINT X$;
50  NEXT Y
```

or:

```
10  X$= "*" :X=30:FORTY=1TOX:PRINTX$;:NEXT
```

This program line exactly simulates the STRING$ function.

SUBROUTINE No. 5
(RANDOM Function)

The RND(Ø) function returns a number from .000000 to .999999 in both languages. The RND(x) function in the TRS-80, however, returns a random number from 0 to x. To simulate this function in APPLESOFT II, use the following:

```
10000  Y = INT(RND(1)*X+.5)
```

where:

X = random number limit
Y = random number

Appendix B:

SAMPLE PROGRAM CONVERSION

TRS-80 Program	*APPLE II Conversion*
10 CLS-PRINT@Ø," ";	10 HOME:HTAB1:VTAB1: PRINT" ";
20 PRINT"TRS-80 SAMPLE"	20 PRINT"APPLE II SAMPLE"
30 A$="CENTER"	30 A$="CENTER"
40 X=544−LEN(A$)/2)	40 X=20−(LEN(A$)/2)
50 PRINT@X,A$	50 VTAB12:HTABX:PRINTA$
52 FORL=1TO800:NEXT	52 FORL=1TO2400:NEXT
	55 GR:COLOR=1
60 FORX=1TO127	60 FORX=ØTO39
70 Y=25	70 Y=12
80 SET(X,Y)	80 PLOT X,Y
90 NEXT	90 NEXT
100 FORX=1TO1000:NEXT	100 FORX=1TO3000:NEXT
110 PRINT"PRESS ENTER TO CONT"	110 PRINT"PRESS RETURN TO CONT"
120 X$=INKEY$:IFX$=" " GOTO120	120 GETX$:IFX$=" " GOTO120
130 GOTO10	130 TEXT:GOTO10

TRS-80 Program	*APPLE II Conversion*
10 CLS	10 HOME:GR:COLOR=1
20 FORX=1TO127	20 FORX=ØTO39
30 Y=25	30 Y=12
40 SET(X,Y):NEXT	40 PLOT X,Y:NEXT
50 FOR L=1TO1000:NEXT	50 FOR L=1TO3000:NEXT
60 FOR X=1TO127	60 FOR X=ØTO39
70 RESET(X,Y):NEXT	70 COLOR=Ø:PLOT X,Y:NEXT
80 GOTO 80	80 GOTO 80

APPLE II Program

```
10 HOME: HTAB 1:VTAB
     1:PRINT" ";
20 PRINT "APPLESOFT II
     SAMPLE"
30 A$="CENTER"
40 X=20-(LEN(A$)/2)
50 VTAB 6:HTABX:PRINT A$
52 FORL=2TO1400:NEXT
60 FORX=ØTO39
65 ?TAB(x);"*";:NEXT
70 FORX=1TO1000
80 PRINT"PRESS RETURN
     TO CONT"
90 GETX$:IFX$=" "GOTO90
100 GOTO10
```

PET Conversion

```
10 ?"■":PRINT"";
20 PRINT"PET SAMPLE"
30 A$="CENTER"
40 X=20-(LEN(A$)/2)
50 ?"QQQQQQ"; TAB(x);A$
52 FORL=1TO1600:NEXT
60 FORX=ØTO39
65 ?TAB(x);"*";:NEXT
70 FORX=1TO2000
80 PRINT"PRESS RETURN
     TO CONT"
90 GETX$:IFX$=" "GOTO90
100 GOTO10
```

TRS-80 Program

```
10 CLS:PRINT@Ø," ";
20 PRINT"TRS-80SAMPLE"
30 A$="CENTER"
40 X=544-(LEN(A$)/2)
50 PRINT @X,A$
60 FORX=1TO63
65 ?TAB(x);"*";:NEXT
70 FORX=1TO1000:NEXT
80 PRINT"PRESS ENTER TO
     CONT"
90 X$=INKEY$:IFX$=" "
     GOTO90
100 GOTO10
```

PET Conversion

```
10 ?"■":PRINT" ";
20 PRINT"PET SAMPLE"
30 A$="CENTER"
40 X=20-(LEN(A$)/2)
50 ?"QQQQQQQQQQQQ";
     TAB(X);A$
60 FORX=ØTO39
65 ?TAB(X);"*";:NEXT
70 FORX=1TO2000:NEXT
80 PRINT"PRESS RETURN
     TO CONT"
90 GET X$:IFX$=" "GOTO90
100 GOTO10
```

Appendix C:
CHARTS

CHART 1

Screen Coordinate Conversion from TRS-80 to APPLE II

Left Margin			*Center of Screen*		
PRINT@	*HTAB*	*VTAB*	*PRINT@*	*HTAB*	*VTAB*
Ø	1	1	32	20	1
64	1	2	96	20	2
128	1	3	160	20	3
192	1	4	224	20	4
256	1	5	288	20	5
320	1	6	352	20	6
384	1	7	416	20	7
448	1	8	480	20	8
512	1	9	544	20	9
576	1	10	608	20	10
640	1	11	672	20	11
704	1	12	736	20	12
768	1	13	800	20	13
832	1	14	864	20	14
896	1	15	928	20	15
960	1	16	992	20	16
1024	(Beyond screen limits)				

PRINT@ 544 HTAB20:VTAB12

HTAB and VTAB function with variables for numbers; for example:

```
10 VTAB Ø:X=LEN(A$)/2:Y=20-X
20 HTAB Y
30 PRINT A$
```

The APPLE II has fewer characters allowed (40) on each line, but has nine extra vertical lines to accommodate printing (VTAB 1—25).

CHART 2

Screen Coordinate Conversion from TRS-80 to PET

Left Margin			*Center of screen*		
PRINT@:	*TAB( );*	*No. CURSORS DOWN*	*PRINT@:*	*TAB( );*	*No. CURSORS DOWN*
Ø	1	1	32	20	1
64	1	2	96	20	2
128	1	3	160	20	3
192	1	4	224	20	4
256	1	5	288	20	5
320	1	6	352	20	6
384	1	7	416	20	7
448	1	8	480	20	8
512	1	9	544	20	9
576	1	10	608	20	10
640	1	11	672	20	11
704	1	12	736	20	12
768	1	13	800	20	13
832	1	14	864	20	14
896	1	15	928	20	15
960	1	16	992	20	16
1024	(Beyond screen limits)				

TAB functions with variables for numbers; for example:

```
10 A$="HELLO"
20 PRINT "■": X=LEN(A$)/2:Y=20-X
30 PRINT TAB (Y);
40 PRINT A$
```

The PET has less characters allowed (40) on each line, but you have nine extra vertical lines to accommodate printing.

CHART 3

Screen Coordinate Conversion from APPLE II to PET

Left Margin				*Center of Screen*			
HTAB	*VTAB*	*TAB( );*	*No. CURSORS DOWN*	*HTAB*	*VTAB*	*TAB( );*	*No. CURSORS DOWN*
1	1	1	1	20	1	20	1
1	2	1	2	20	2	20	2
1	3	1	3	20	3	20	3
1	4	1	4	20	4	20	4
1	5	1	5	20	5	20	5
1	6	1	6	20	6	20	6
1	7	1	7	20	7	20	7
1	8	1	8	20	8	20	8
1	9	1	9	20	9	20	9
1	10	1	10	20	10	20	10
1	11	1	11	20	11	20	11
1	12	1	12	20	12	20	12
1	13	1	13	20	13	20	13
1	14	1	14	20	14	20	14
1	15	1	15	20	15	20	15
1	16	1	16	20	16	20	16

TAB functions with variables for numbers; for example:

```
10 A$="HELLO"
20 PRINT "S": X=LEN(A$)/2:Y=20-X
30 PRINT TAB (Y);
40 PRINT A$
```

CHART 4

Pet Graphic Set

B 6 / I 5 / T 4 / 3210	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
0000	@	P		0	─	┐		┌
0001	A	Q	!	1	♠	●	▌	┴
0010	B	R	"	2	▌	─	▬	┬
0011	C	S	#	3	─	●		┤
0100	D	T	$	4		▏	▁	▏
0101	E	U	%	5		▗	▏	▌
0110	F	V	&	6	─	╳	▒	▐
0111	G	W	'	7	▏	O	▏	▔
1000	H	X	(	8	▏	♠	▒	▬
1001	I	Y	)	9	╲	▏	◤	▬
1010	J	Z	*	:	╲	♣	▏	▟
1011	K	[	+	;	▗	┼	┣	▪
1100	L	\	,	<	└	▒	▪	▗
1101	M	]	-	=	╲	▏	▖	▪
1110	N	↑	.	>	╱	π	┐	▚
1111	O	←	/	?	┌	◥	▁	▚

Character	Screen Memory Location
@	0000000
A	0000001
B	0000010
C	0000011
D	0000100
E	0000101
F	0000110
G	0000111
H	0001000
I	0001001
J	0001010
K	0001011
L	0001100
M	0001101
N	0001110
O	0001111
P	0001000
Q	0001001
R	0010001
S	0011001
T	0100001
U	0101001
V	0110001
W	0111001
X	1000001
Y	1001001
Z	1010001
[	1011001

Character	Screen Memory Location
\	1100001
]	1101001
↑	1110001
←	1111001
	0000010
!	0001010
"	0010010
#	0011010
$	0100010
%	0101010
&	0110010
'	0111010
(	1000010
)	1001010
*	1010010
+	1011010
,	1100010
-	1101010
.	1110010
/	1111010
0	0000011
1	0001011
2	0010011
3	0011011
4	0100011
5	0101011
6	0110011
7	0111011

Character	Screen Memory Location
8	1000011
9	1001011
:	1010011
;	1011011
<	1100011
=	1101011
>	1110011
?	1111011
—	0000100
♠	0001100
▌	0010100
—	0011100
	0100100
	0101100
—	0110100
▏	0111100
▏	1000100
╲	1001100
╲	1010100
╲	1011100
└	1100100
╲	1101100
╱	1110100
┌	1111100
┐	0000101
●	0001101
—	0010101
♠	0011101

Character	Screen Memory Location
▏	0100101
╱	0101101
╳	0110101
○	0111101
♠	1000101
▏	1001101
♠	1010101
+	1011101
▒	1100101
▏	1101101
π	1110101
◥	1111101
	0000110
▌	0001110
▬	0010110
	0011110
—	0100110
▏	0101110
▒	0110110
▏	0111110
▒	1000110
◤	1001110
▏	1010110
├	1011110
▪	1100110
└	1101110
┐	1110110
▬	1111110

Character	Screen Memory Location	Character	Screen Memory Location
┌	0000111	─	1000111
┴	0001111	▀	1001111
┬	0010111	┘	1010111
┤	0011111	▘	1011111
│	0100111	▝	1100111
▌	0101111	└	1101111
▐	0110111	▗	1110111
▄	0111111	▚	1111111

Any questions concerning this book or inquiries about professional translation service should be referred to:

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