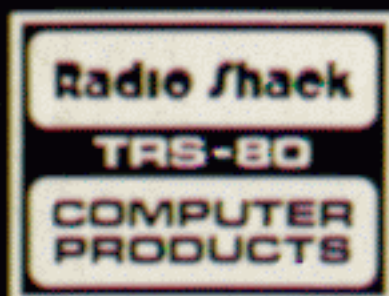
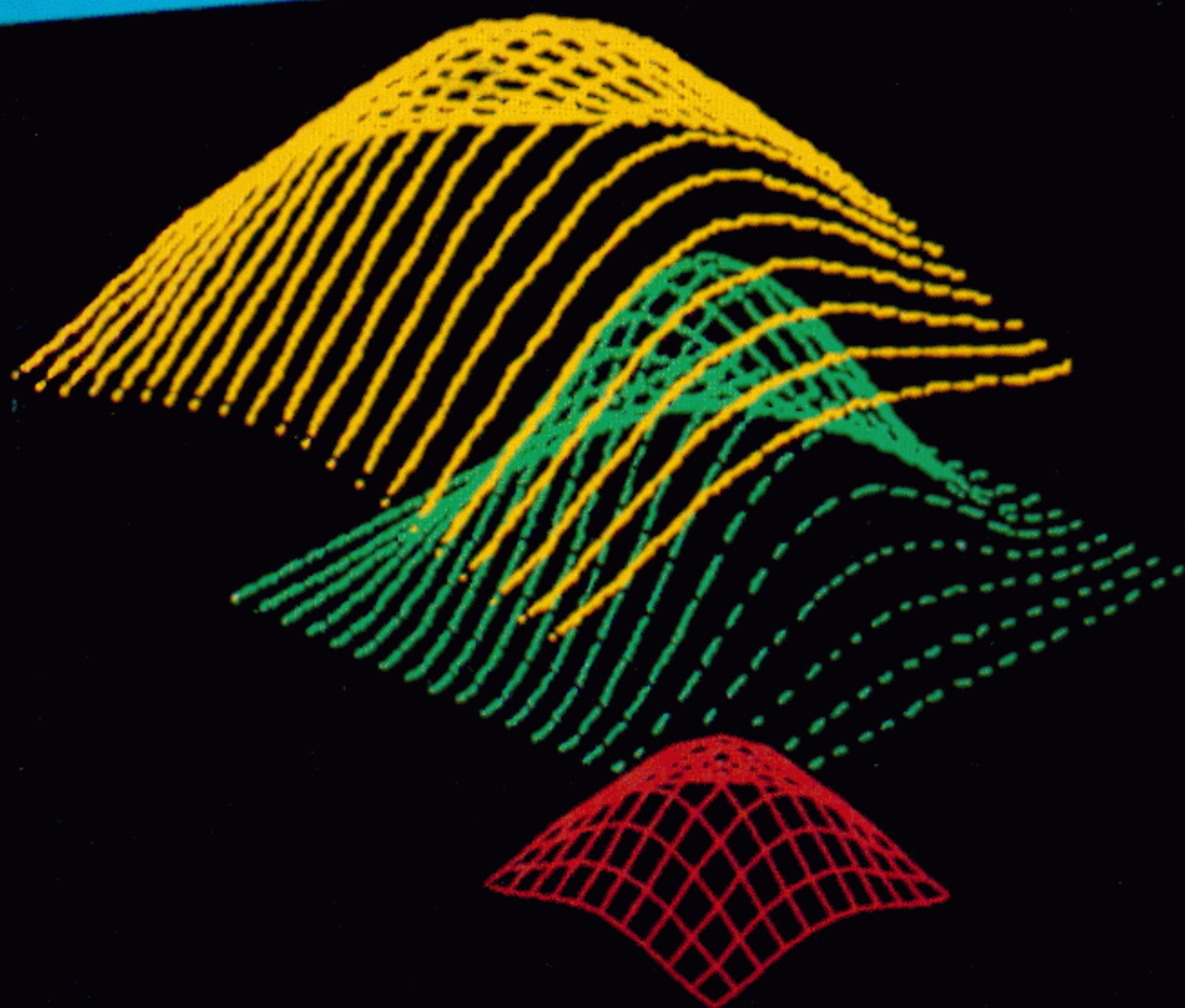


CAT. NO.
26-3711

MATH PLOTTER



PC-2
SOFTWARE
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Math PlotterTM

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FORT WORTH, TEXAS 76102

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Introduction

Math Plotter consists of four programs:

- PLOT2R** Planar Cartesian Plotting. Performs graphic plotting of algebraic functions in planar Cartesian coordinates using the Pocket Computer-2's high-resolution printer/plotter.
 - PLOT2P** Planar Polar Plotting. Graphically plots algebraic functions in three-dimensional Cartesian coordinates.
 - PLOT3R** Three-Dimensional Cartesian Plotting. Performs graphic plotting of algebraic functions in three-dimensional Cartesian coordinates.
 - PLOT3C** Cylindrical Polar Plotting. Graphically plots algebraic functions in cylindrical polar coordinates.
- All four programs feature self-modifying BASIC code that loads user-defined functions through software. You can define the plot limits, and the computer can store previous plot limits in memory. These programs will also display the last function set and give you a summary of function and plot limits on the plot.

If you are using the Printer/Cassette Interface with your Pocket Computer-2 for the first time, please refer to the Owner's Manual for instructions on connecting the printer and getting it ready for use.

Use the Backup instructions in Appendix A to make a working copy of the programs. See Appendix B for maintenance instructions.

Planar Cartesian Plotting

This program performs graphic plotting of algebraic functions in planar Cartesian coordinates on the Pocket Computer-2, using the high-resolution printer/plotter of the Printer/Cassette Interface.

To load PLOT2R, set the Remote switch of the Printer/Cassette Interface to the ON position. Insert the tape in the recorder and press the "Play" key. Turn the computer on, make sure the mode is set to RUN, then type:

C L O A D " P L O T 2 R "

and press **ENTER**. When the prompt (**>**) appears, start the program either by pressing **DEF** **SPACE** or by typing: **R U N** and pressing **ENTER**.

The program name and copyright will be displayed, followed by the menu:

PLANAR CARTESIAN PLOTTER
Copr. 1982 Tandy Corp.
Fn Plt Dsp End

Each option corresponds to a function key located directly beneath it on the computer's keyboard. To

choose a function, press the appropriate key: **F1** to set the function to be plotted, **F2** to plot the function, **F3** to display the currently set function, or **F4** to exit the program.

Setting a Function

Press **F1** at the menu. The first display will show: **F(X)=_**. Enter the right portion of the function, exactly as it would be composed in Pocket Computer-2 BASIC. This function may be up to 73 characters long. (Entries beyond 73 characters will be truncated.) You may leave blank spaces in your entry, but characters making up BASIC keywords must be contiguous. Only the following operators and functions are allowed.

+ - * /
exponentiation
parentheses
PI (or PI sign)
SQR (or square-root sign)
SIN, COS, TAN, ASN, ACS, ATN
ABS, INT, SGN, EXP, LOG, LN
AND, OR, NOT, =, >, <
variable X

Note: No variables except X should appear in the function.

After you have typed the function, press **ENTER**. The program will redisplay the function as it is stored, after which the menu will appear.

Plotting a Function

Plotting occurs across the length of a rectangle. The X axis is horizontal and increases toward the right, and the Y axis is vertical and increases upward.

To start plotting, press **F2** at the menu. PLOT2R will ask for six parameters:

XL—The lowest value of X to be plotted, corresponding to the left edge of the rectangular plot area.

XH—The highest value of X to be plotted, corresponding to the right edge of the rectangular plot area.

YL—The lowest value of Y (or $F(X)$) to be plotted, corresponding to the bottom of the rectangular plot area.

YH—The highest value of Y (or $F(X)$) to be plotted, corresponding to the top of the rectangular plot area.

Step %—The number of intervals into which the difference between XL and XH is to be broken down. The actual quantity entered is the width of each interval, in percent of the total difference between XL and XH.

F(error)—The value the program is to assign to Y if, for any reason, $F(X)$ cannot be evaluated at some point.

The program will ask for each parameter by displaying its name, the currently set value, and a question mark. Enter a new value, or press **ENTER** to retain the currently set value.

Once the parameters have been set, the program will plot the specified function. If, at any point, the function lies outside the selected plot boundaries, it will be adjusted to lie on the boundary. If, at any point, the function cannot be evaluated, the program will beep once and assign the default value of F(error) you entered. When the plot is finished, you will return to the menu.

Displaying the Current Function

Press **F3** at the menu. The last function set entered will be displayed until you press **ENTER**. When **ENTER** is pressed, the menu will be displayed.

Example

Suppose the function $F(X) = X^2$ is to be plotted from $X = -2$ to $X = 2$. By inspection, $F(X)$ will lie between 0 and 4 for this interval. The function will be plotted over 20 steps (5% step size). There are no points at which this function is undefined, so $F(\text{error})$ is unimportant.

Computer displays:

>
PLANAR CARTESIAN PLOTTER
Copr. 1982 Tandy Corp.
Fn Plt Dsp End
F(X)=
 X^2
Fn Plt Dsp End
XL = 0?
XH = 0?
YL = 0?

You type:

DEF **SPACE**

F1
X **^** **2** **ENTER**

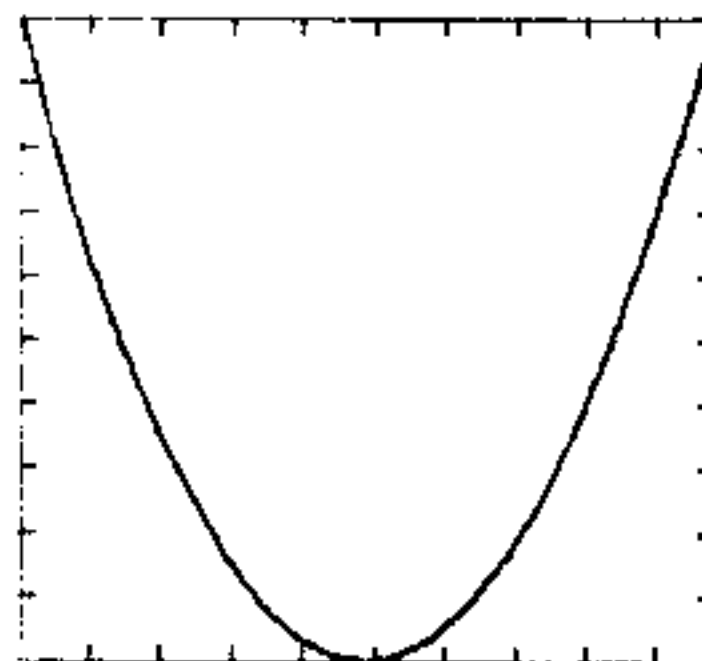
F2
- **2** **ENTER**
2 **ENTER**
ENTER

Computer displays:

YH = 0?
Step % = 0?
F(error) = 0?

You type:

4 **ENTER**
5 **ENTER**
ENTER



$F(X) = X^2$

XL = -2
XH = 2
YL = 0
YH = 4
Step % = 5
F(error) = 0

Fn Plt Dsp End

>

F4 (to exit the program)

Planar Polar Plotting

This program performs graphic plotting of algebraic functions in planar polar coordinates on the Pocket Computer-2, using the high-resolution printer/plotter of the Printer/Cassette Interface.

To load PLOT2P, set the Remote switch on the Printer/Cassette Interface to the ON position. Insert the tape in the recorder and press the "Play" key. Turn the computer on, make sure the mode is set to RUN, then type:

`C L O A D " P L O T 2 P "`

and press `ENTER`.

When the prompt (`>`) appears, set the angular mode desired. Start the program either by pressing `DEF` `SPACE` or by typing: `R U N` and pressing `ENTER`. The program name and copyright notice will be displayed, followed by the menu:

PLANAR POLAR PLOTTER
Copr. 1982 Tandy Corp.
Fn Plt Dsp End

Each function corresponds with the key located directly beneath it on the computer's keyboard. To

choose an option, press the appropriate key: `F1` to set the function to be plotted, `F2` to plot the function, `F3` to display the currently set function, or `F4` to exit the program.

Setting a Function

At the menu, press `F1`. The display will show: `F(T)=_`. (PLOT2P calls the angle Theta by the variable name "T".)

Enter the right portion of the function exactly as it would be composed in Pocket Computer-2 BASIC. The function may be up to 73 characters long. (Entries beyond 73 characters will be truncated.) You may use blanks in your entry, but characters making up BASIC keywords must be contiguous. Only the following operators and functions are allowed:

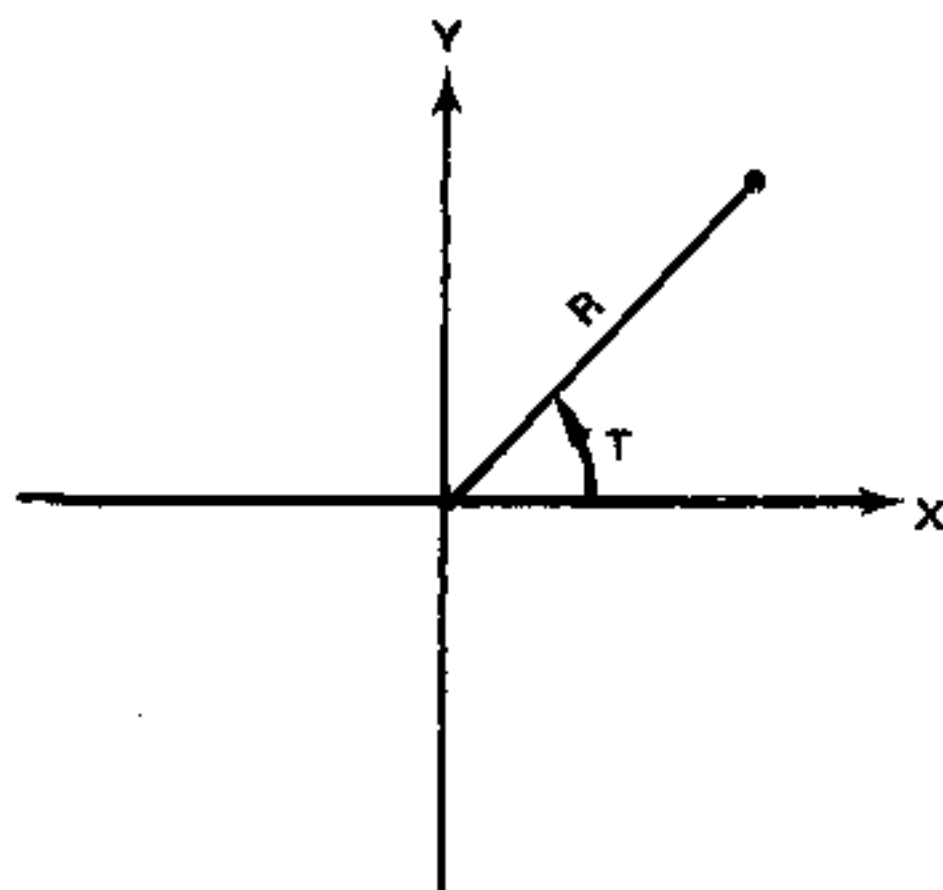
+ - * /
exponentiation
parentheses
PI (or Pi sign)
SQR (or square-root sign)
SIN, COS, TAN, ASN, ACS, ATN
ABS, INT, SGN, EXP, LOG, LN
AND, OR, NOT, =, >, <
variable T

Note: No variables except T should appear in the function.

After typing the function, press **ENTER**. The program will redisplay the function as it is stored, after which the menu will be displayed.

Plotting a Function

Plotting takes place about an angle Theta. Theta is the angle measured counterclockwise from the positive X axis to the plot vector.



The actual plot is drawn in a square, with $R=0$ at the center. To start plotting, press **F2** at the menu. The program will ask for five parameters:

Radius—The radius of the plot circle, and the greatest magnitude of $F(T)$ to be plotted.

TL—The lowest value of Theta to be plotted.

TH—The highest value of Theta to be plotted.

Step/1000—The number of intervals into which the difference between TL and TH will be broken down. The actual quantity entered is the width of each interval, in thousandths of the total difference between TL and TH.

F(error)—The value the program is to assign to R if, for any reason, $F(T)$ cannot be evaluated at some point.

PLOT2P will ask for each parameter by displaying its name, its currently set value, and a question mark. Enter a new value, or press **ENTER** to retain the currently set value.

Once the parameters have been set, the program will plot the specified function. If, at any point, the function lies outside the selected plot boundaries, it will be adjusted to lie on the boundary. If, at any

point, the function cannot be evaluated, the program will beep once and assign the default value you entered for F(error). When the plot is finished, the menu will be displayed.

Displaying the Current Function

Press **F3** at the menu. The last function set entered will be displayed until you press **ENTER**. When **ENTER** is pressed, the menu will be displayed.

Example

Suppose the function $F(T) = \cosine(2T)$ is to be plotted from $T = 0$ to $T = 360$ degrees. By inspection, $F(T)$ will lie between -1 and 1 for this interval. The function will be plotted over 100 steps (10/1000 step size). There are no points at which this function is undefined, so $F(\text{error})$ is unimportant. Since degrees are to be used, make sure that the Pocket Computer-2 is set to Deg mode before starting the example.

Computer displays:

Fn Plt Dsp End
F(T)=__

You type:

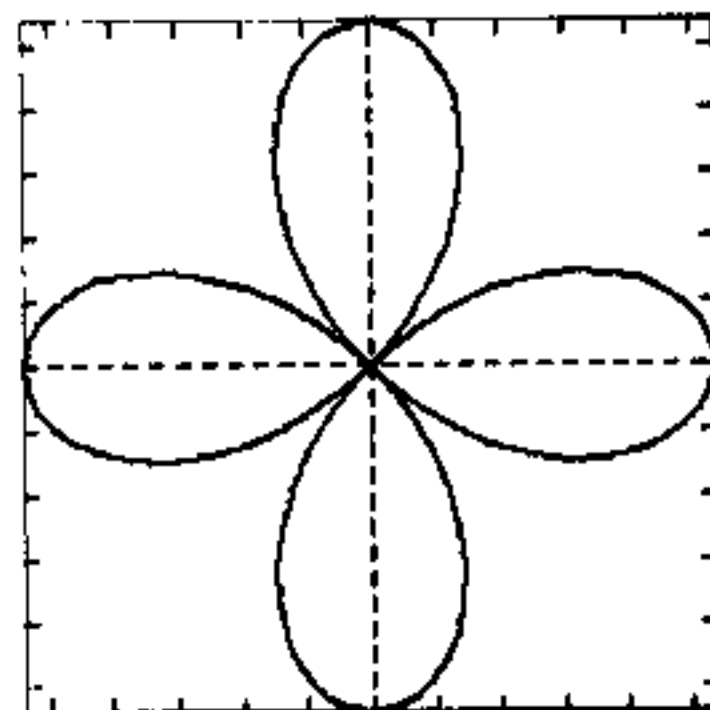
F1
C O S (2
*** T) ENTER**

Computer displays:

COS (2*T)
Fn Plt Dsp End
Radius = 0?__
TL = 0__
TH = 0?__
Step/1000 = 0?__
F(error) = 0?__

You type:

F2
1 ENTER
ENTER
3 6 0 ENTER
1 0 ENTER
ENTER



F(T)=COS(2*T)

Radius = 1
TL = 0
TH = 360
Step/1000 = 10
F(error) = 0

Computer displays:

Fn Plt Dsp End

>

You type:

F4 (to exit the
program)

Three-Dimensional Cartesian Plotting

This program performs graphic plotting of algebraic functions in three-dimensional Cartesian coordinates on the Pocket Computer-2, using the high-resolution printer/plotter of the Printer/Cassette Interface.

To load PLOT3R, set the Remote switch of the Printer/Cassette Interface to the ON position. Insert the tape in the recorder and press the "Play" key. Turn the computer on, make sure the mode is set to RUN, then type:

`C L O A D " P L O T 3 R "`

and press `ENTER`. When the prompt (`>`) appears, start the program either by pressing `DEF` `SPACE` or by typing: `R U N` and pressing `ENTER`.

The program name and copyright notice will be displayed, followed by the menu:

3-D CARTESIAN PLOTTER
Copr. 1982 Tandy Corp.
Fn Plt Dsp End

Each option corresponds to a function key located directly beneath it on the computer's keyboard. To

choose a function, press the appropriate key: `F1` to set the function to be plotted, `F2` to plot the function, `F3` to display the currently set function, or `F4` to exit the program.

Setting a Function

Press `F1` at the menu. The first display will show: `F(X,Y)=_`. Enter the right portion of the function exactly as it would be composed in Pocket Computer-2 BASIC. This function may be up to 72 characters long. (Entries beyond 72 characters will be truncated.) You may leave blank spaces in your entry, but characters making up BASIC keywords must be contiguous. Only the following operators and functions are allowed:

+ - * /
exponentiation
parentheses
PI (or PI sign)
SQR (or square-root sign)
SIN, COS, TAN, ASN, ACS, ATN
ABS, INT, SGN, EXP, LOG, LN
AND, OR, NOT, =, >, <
variables X and Y

Note: No variables except X and Y should appear in the function.

After typing the function, press **ENTER**. The program will redisplay the function as it is stored, after which the menu will appear.

Plotting a Function

To start plotting, press **F2** at the menu. PLOT3R will ask for eight parameters:

XL—The lowest value of X to be plotted.

XH—The highest value of X to be plotted.

YL—The lowest value of Y to be plotted.

YH—The highest value of Y to be plotted.

ZL—The lowest value of Z (or $F(X,Y)$) to be plotted.

ZH—The highest value of Z (or $F(X,Y)$) to be plotted.

Step %—The number of intervals into which the difference between XL and XH, and YL and YH, is to be broken down. The actual quantity entered is the width of each interval, in percent of the total difference between XL and XH or YL and YH.

F(error)—The value the program is to assign to Z if,

for any reason, $F(X,Y)$ cannot be evaluated at some point.

The program will ask for each parameter by displaying its name, the currently set value, and a question mark. Enter a new value, or press **ENTER** to retain the currently set value.

Finally, the program will ask: 1 or 2 passes?__. Answer with **1** if you wish to have the function plane drawn as a series of parallel lines, or with **2** if you wish it to be drawn as a grid. The default is 1.

Once the parameters have been set, the program will plot the specified function. If, at any point, the function lies outside the selected plot boundaries, it will be adjusted to lie on the boundary. If, at any point, the function cannot be evaluated, the program will beep once and assign the default value of F(error) you entered. When the plot is finished, you will return to the menu.

Displaying the Current Function

Press **F3** at the menu. The last function set entered will be displayed until you press **ENTER**. When **ENTER** is pressed, the menu will be displayed.

Example

Suppose the function $F(X,Y) = \text{EXP}(X * Y)$ is to be plotted from $X = -1$ to $X = 1$ and $Y = -1$ to $Y = 1$. By inspection, $F(X,Y)$ will lie roughly between 0 and 3 for this interval. Step size will be at 5%, which will plot $F(X,Y)$ at 441 points. There are no points at which this function is undefined, so $F(\text{error})$ is unimportant.

Computer displays:

Fn Plt Dsp End

$F(X,Y) = \underline{\hspace{1cm}}$

$\text{EXP}(X*Y)$

Fn Plt Dsp End

XL = 0?__

XH = 0?__

YL = 0?__

YH = 0?__

ZL = 0?__

ZH = 0?__

Step % = 0?__

$F(\text{error}) = 0?__$

1 or 2 passes?__

You type:

[F1]

[E][X][P][][X]

[*][Y][)][ENTER]

[F2]

[-][1][ENTER]

[1][ENTER]

[-][ENTER]

[1][ENTER]

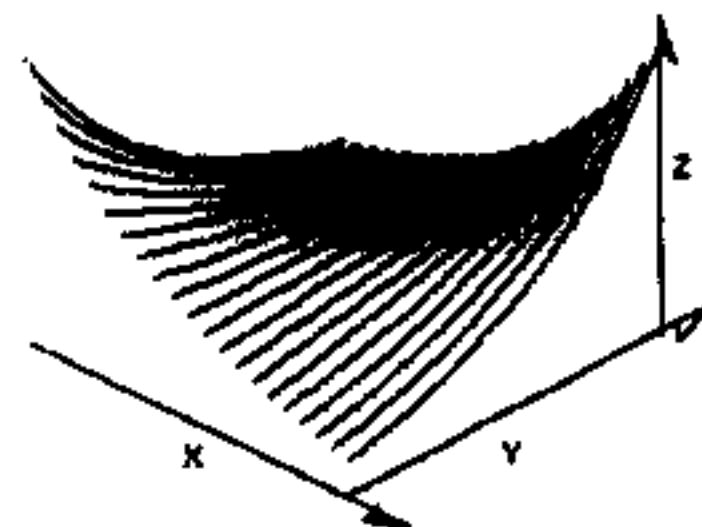
[ENTER]

[3][ENTER]

[5][ENTER]

[ENTER]

[ENTER]



$F(X,Y) = \text{EXP}(X*Y)$

XL = -1

XH = 1

YL = -1

YH = 1

ZL = 0

ZH = 3

Step % = 5

$F(\text{error}) = 0$

Computer displays:

Fn Plt Dsp End

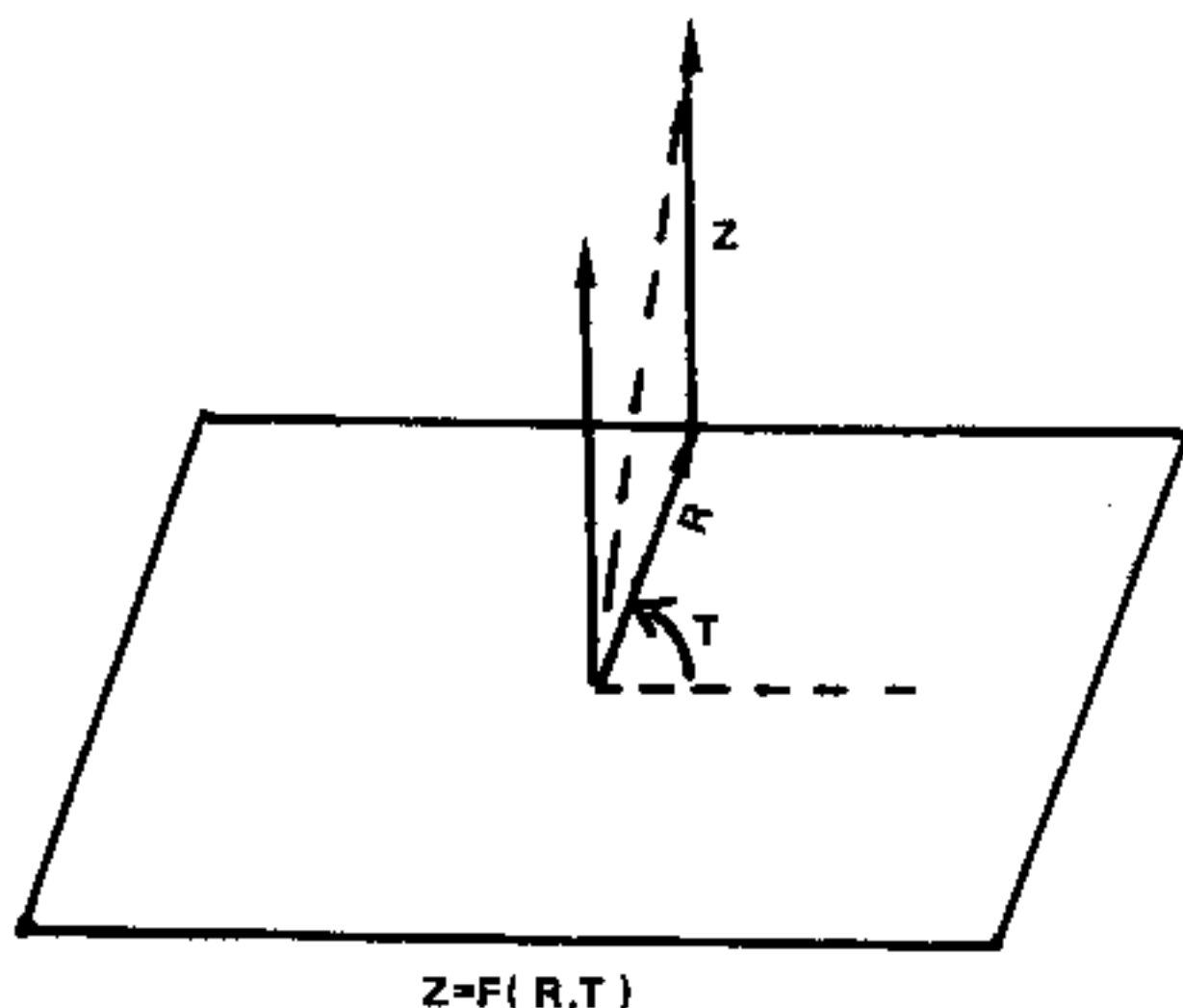
>

You type:

[F4] (to exit the program)

Three-Dimensional Cylindrical Plotting

This program performs graphic plotting of algebraic functions in three-dimensional cylindrical coordinates on the Pocket Computer-2, using the high-resolution printer/plotter of the Printer/Cassette Interface.



To load PLOT3C, set the Remote switch of the Printer/Cassette Interface to the ON position. Insert the tape in the recorder and press the "Play" key. Turn the computer on, make sure the mode is set to RUN, then type:

`C L O A D * P L O T 3 C *`

and press `ENTER`. When the prompt ($>$) appears, set the angular mode desired. Start the program either by pressing `DEF SPACE` or by typing: `R U N` and pressing `ENTER`.

The program name and copyright notice will be displayed, followed by the menu:

3-D CYLINDRICAL PLOTTER
Copr. 1982 Tandy Corp.
Fn Plt Dsp End

Each function corresponds with the key located directly beneath it on the computer's keyboard. To choose an option, press the appropriate key: `F1` to set the function to be plotted, `F2` to plot the function, `F3` to display the currently set function, or `F4` to exit the program.

Setting a Function

At the menu, press **F1**. The display will show: $F(R,T)=$ _. Enter the right portion of the function exactly as it would be composed in Pocket Computer-2 BASIC. The function may be up to 72 characters long. (Entries beyond 72 characters will be truncated.) You may use blanks in your entry, but characters making up BASIC keywords must be contiguous. Only the following operators and functions are allowed:

+ - * /
exponentiation
parentheses
PI (or PI sign)
SQR (or square-root sign)
SIN, COS, TAN, ASN, ACS, ATN
ABS, INT, SGN, EXP, LOG, LN
AND, OR, NOT, =, >, <
variables R and T

Note: No variables except R and T should appear in the function.

After typing the function, press **ENTER**. The program will redisplay the function as it is stored, after which the menu will be displayed.

Plotting a Function

To start plotting, press **F2** at the menu. The program will ask for five parameters:

Radius—The radius of the cylinder.

ZL—The lowest value of Z (or $F(R,T)$) to be plotted.

ZH—The highest value of Z (or $F(R,T)$) to be plotted.

Step %—The number of intervals into which the plot cylinder's diameter will be divided. The actual quantity entered is the width of each interval, in percent of the diameter (2R).

F(error)—The value the program is to assign to Z if, for any reason, $F(R,T)$ cannot be evaluated at some point.

PLOT3P will ask for each parameter by displaying its name, its currently set value, and a question mark. Enter a new value, or press **ENTER** to retain the currently set value.

Finally you will be asked: 1 or 2 passes?_. Reply with **1** or **2**. (The default is 1.) If the function is plotted in a single pass, the plane defined by $F(R,T)$ will be drawn as a group of parallel lines. If plotting is done using two passes, the plane will be drawn as a grid.

Once the parameters have been set, the program will plot the specified function. If, at any point, the function lies outside the selected plot boundaries, it will be adjusted to lie on the boundary. If, at any point, the function cannot be evaluated, the program will beep once and assign the default value you entered for F(error). When the plot is finished, the menu will be displayed.

Displaying the Current Function

Press **F3** at the menu. The last function set entered will be displayed until you press **ENTER**. When **ENTER** is pressed, the menu will be displayed.

Example

Suppose the functions $F(R,T) = 1/R$ and $F(R,T) = R + \cos(4T + 45)$ are to be plotted. Each plot will be made with a 5% step size. $1/R$ goes to Infinity at $R=0$, so F(error) must be set. Place it at the top of the cylindrical plot volume.

Computer displays:

Fn Plt Dsp End
 $F(R,T) =$
 $1/R$
 Fn Plt Dsp End

You type:

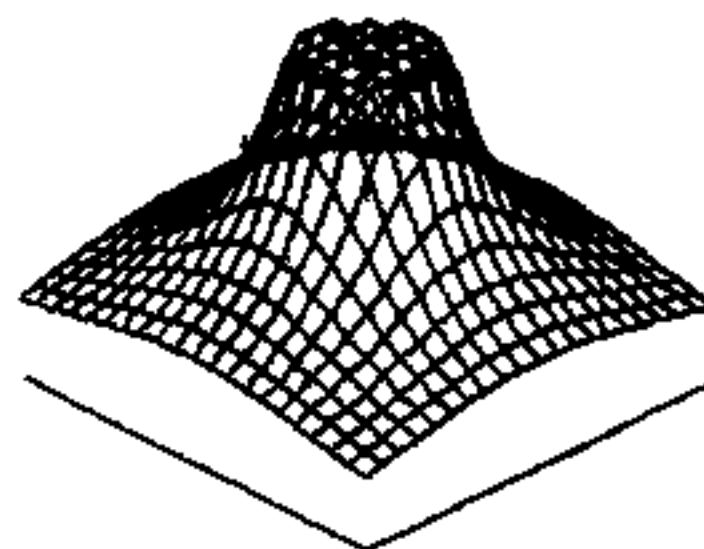
F1
1 / R ENTER
F2

Computer displays:

Radius = 0?
 ZL = 0?
 ZH = 0?
 Step % = 0?
 F(error) = 0?
 1 or 2 passes?

You type:

1 ENTER
ENTER
3 ENTER
5 ENTER
3 ENTER
2 ENTER



$F(R,T) = 1/R$

Radius = 1
 ZL = 0
 ZH = 3
 Step % = 5
 F(error) = 3

Fn Plt Dsp End

For this second function, the vertical scale will deliberately be set larger than needed to reduce the apparent relief of the resulting plot. Since degrees are to be used, make sure that the Pocket Computer-2 is set to Deg mode before starting this example.

Computer displays:

Fn Plt Dsp End
F(R,T)=__

R•COS(4•T+45)

Fn Plt Dsp End

Radius = 1?__

ZL = 0?__

ZH = 3?__

Step % = 5?__

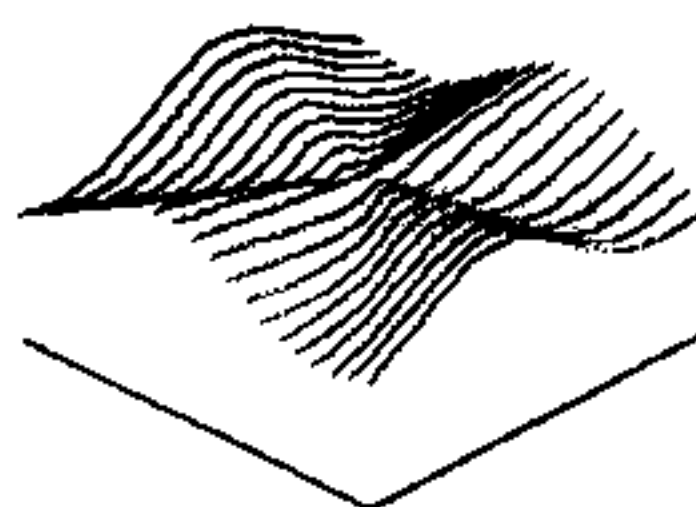
F(error) = 3?__

1 or 2 passes?__

You type:

(F1)
(R)(*)(C)(O)(S)
()(4)(*)(T)(+)
(4)(5)() (ENTER)

(F2)
(ENTER)
(-)(4)(-)(5)
(ENTER)
(4)(-)(5) (ENTER)
(ENTER)
(0) (ENTER)
(1) (ENTER)



$F(R, T) = R \cdot \cos(4T + 45)$

Radius = 1
ZL = -4.5
ZH = 4.5
Step % = 5
F(error) = 8

Fn Plt Dsp End

>

(F4) (to exit the program)

Appendix A—Making a Backup

A Backup is a tape copy of a program and is an extremely effective method of insuring that an accident or equipment fault will not result in the loss of software. Your first action as owner of the Math Plotter package should be to make working copies of the original cassette(s) and then put the original(s) away in a safe place.

Although it may be possible to make direct copies using two cassette recorders or on cassette duplicating equipment, the most reliable method is to use the computer itself to make the Backups. Also, for frequently used programs, you may wish to put them on separate cassettes for easier loading. Here are step-by-step instructions for making a Backup:

1. Install the computer in the Printer/Cassette Interface, and connect the Printer/Cassette Interface to the cassette recorder. Make sure the Remote switch is OFF.
2. Place the cassette containing the program(s) to be copied in the recorder and either rewind the tape to the beginning or position the tape to a blank area just prior to the desired program. Make a note of the counter number where your saved information will begin, and turn the Remote switch

ON. Place the recorder in the "Play" mode. It is recommended that the volume control setting be between 8 and 10 on your recorder (or between 5 and 7 on a Minisette-9). If your recorder has a tone control, set it at maximum treble.

3. Turn on the computer, make sure that it is in RUN mode, and type: `CLOAD name` and press `ENTER`. (Name refers to the name of the program to be copied.)
4. When the program has been loaded into the computer and the cassette has stopped, turn the Remote switch OFF, and rewind the recorder to the blank space just prior to the program. Turn the Remote switch ON, and put the recorder into the "Play" mode. Type: `CLOAD? name` and press `ENTER`.

This is the computer's verifying function. The recorder will compare the cassette program with the program in the computer's memory. If the load is good, the recorder will stop at the end of the program and the prompt sign (>) will reappear on the display. If an error occurred during the load verification, the display will show: ERROR 43. This means that the format of data to be loaded does not match the file format.

If the error message appears on the display, check the recorder volume setting, try the CLOAD function again, and verify the load.

5. When the program has been loaded successfully, remove the cassette and replace it with the cassette that is to receive the program copy. Turn the Remote switch OFF, and either rewind the tape to the beginning, or position it to the point where the copy is to start. Make a note of the counter number where your saved information begins. You should leave from 5-10 seconds of blank space if the copy is to follow another program on the same cassette. Turn the Remote switch ON, and place the recorder in "Record" mode.
6. Make sure that the computer is in the RUN mode. Type: **C S A V E** name and press **ENTER**. The recorder will save your program.
7. To make absolutely sure that the program has been saved correctly, use the verification procedure as described in the fourth instruction of this appendix. If the error message appears on the display, check the recorder volume setting and try the CLOAD? function once more. If you still get an error, the tape copy is probably damaged. Use the CSAVE function once more and verify the load. It is recommended that you use Radio Shack Supertape

or TRS-80 certified cassettes for backing up your Pocket Computer-2 programs.

8. Back up each program using steps 1 through 7 above.
9. Put the original cassettes away in a safe place and use them only for making working copies.

Appendix B—Maintenance

Maintenance of your Pocket Computer-2 system is not difficult. Attention to the simplest points listed below should provide the best reliability and satisfaction:

1. Keep your program cassettes in their boxes when not in use. Do not expose cassettes to temperature extremes or magnetic fields. **Never** touch the exposed surface of the tape on the front edge of the cassette.
2. Clean and demagnetize the tape heads in the recorder at regular intervals. Follow the recommendations in the cassette recorder's manual.
3. The most reliable loading and saving is achieved by operating the cassette recorder on AC current, rather than batteries.
4. Use only fresh alkaline-type batteries in the recorder when operating your system away from AC current.
5. Always press the recorder's "Stop" key immediately after loading or saving a program. This will release the pressure on the rubber roller

which pulls the tape and prevent the roller from damaging the tape at the point of contact.

6. Always turn the computer "OFF" before installing it in or removing it from the **Printer/Cassette Interface**.
7. After removing the computer from the **Printer/Cassette Interface**, be sure to reinstall the protective plug to keep dirt out of the connector on the computer. **Never** touch the exposed parts on the **Printer/Cassette Interface**.

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