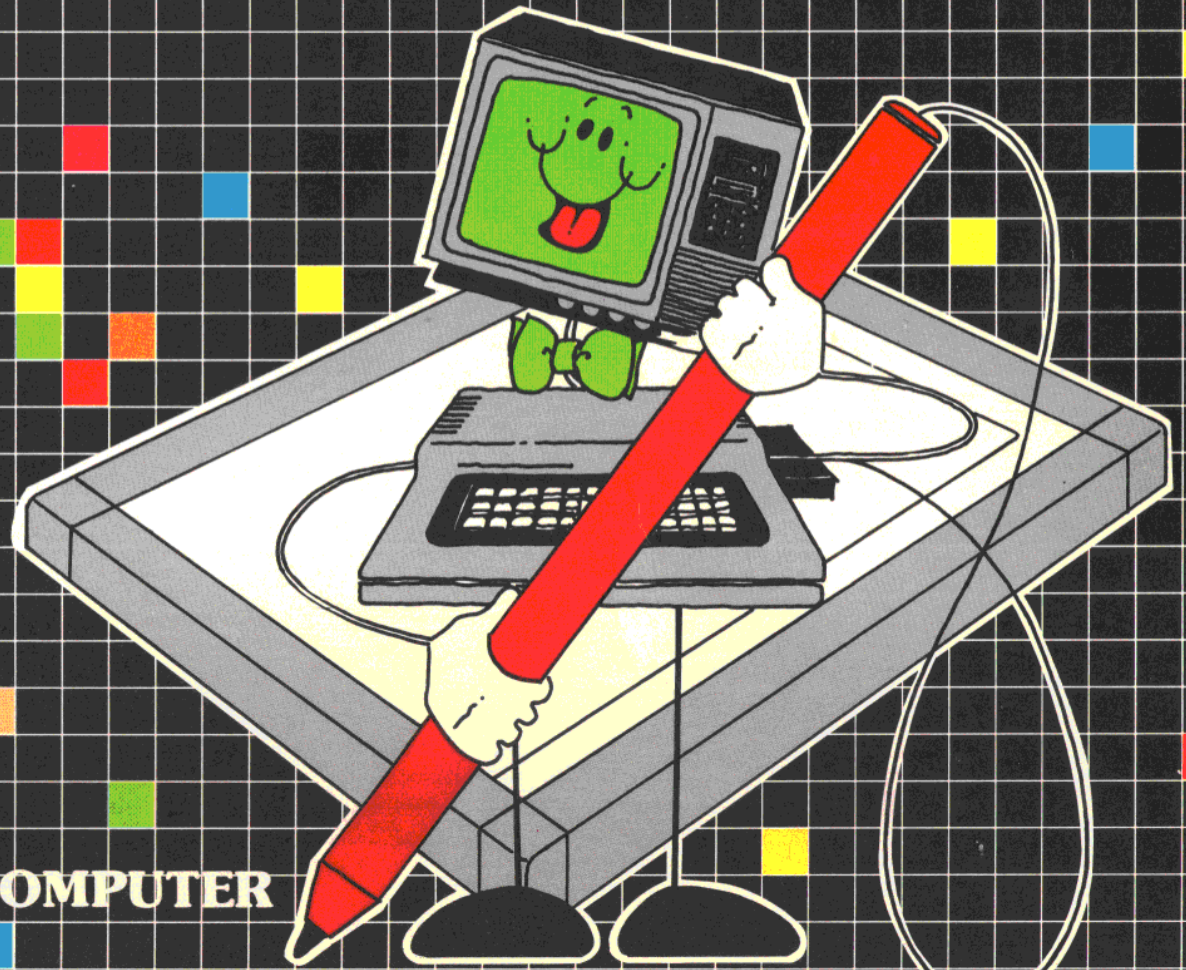**Radio Shack**
TRS-80
COMPUTER PRODUCTS

TRS-80® X-PAD™
MODEL GT-116

Owner's Manual

FOR COLOR COMPUTER

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- reorient the receiving antenna
- relocate the computer with respect to the receiver
- move the computer away from the receiver
- plug the computer into a different outlet so that computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technical for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful: **How to Identify and Resolve Radio-TV Interference Problems,** This booklet is available from the United States Government Printing Office, Washington, DC 20402, Stock No. 004-000-0035-4.

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To Our Customers . . .

The TRS-80® X-Pad (Model GT-116) is a revolutionary way to take advantage of the high-resolution graphic capabilities of your TRS-80 Color Computer.

With a minimum of programming, the X-Pad lets you plot graphics that are displayed on your Color Computer's TV Screen. Furthermore, *all* graphic displays can be saved on cassette tape for later use or printed on a graphics printer for "hard-copy" output.

The X-Pad will open an entire world of graphic applications for you — mapping, graphic displays, statistics, waveform analysis, marketing analysis, and charting, to name just a few. Besides that, it's fun!

To use X-Pad, you'll need a:

- 16K or 32K Color Computer with Extended Color BASIC.
- Color TV.

And while not required, it is extremely convenient to save your programs on cassette; we suggest the CTR-80A Cassette Recorder (Radio Shack Catalog Number 26-1206).

About This Manual . . .

In this manual, we'll be showing you how to program and use your X-Pad.

We're going to follow this course:

- First we'll be describing how to connect the X-Pad.
- Then we'll let you try a few short programs.
- Next we'll discuss the X-Pad, its parts and its functions, in detail.
- We'll also show you a few programs you can use.

You might find it convenient to review the Extended Color BASIC manual (*Going Ahead With Extended Color BASIC*) before using the X-Pad.

TRS-80® X-Pad Owner's Manual
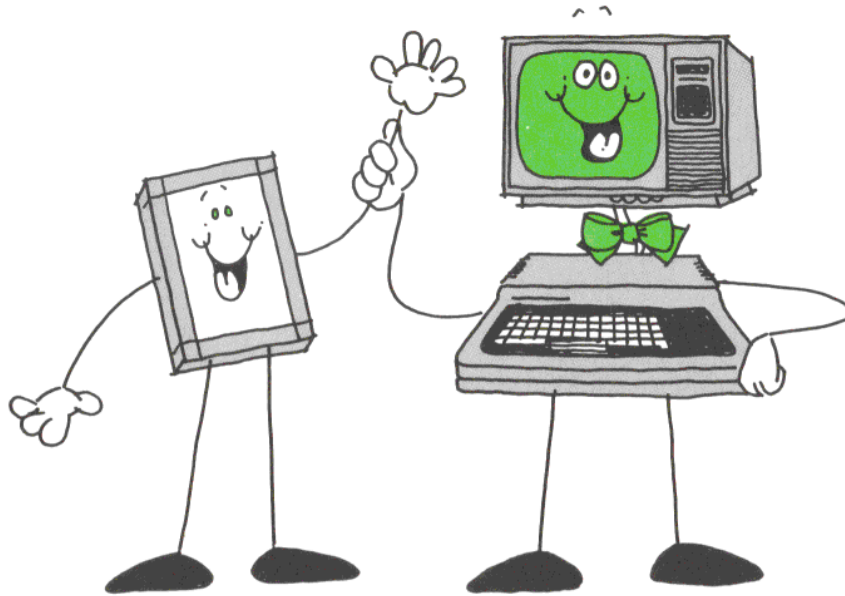
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Important Note!

Be sure your Color Computer is turned OFF *before* you insert or remove the X-Pad's Interface Pak; otherwise, damage to the Color Computer or X-Pad (or both) may occur.

Introduction

The TRS-80 X-Pad is basically an X-Y coordinate digitizer that converts a position on the X-Pad into an equivalent position on the TV Screen of the Color Computer.

After coordinates are digitized by the X-Pad and sent to the Color Computer, the Computer reads the data (e.g., the X-Y coordinates) and interprets that information *according to the program you're currently running*.

Sometimes you might use the X-Pad to calculate the distance between two points or compute the area of a geometric figure. Other times, your program might allow you to draw lines, boxes, circles, or any other graphic display you can imagine.

In other words, the same graphic figures you're drawing on the X-Pad appear on the Color Computer's TV Screen — *but in full color*. As you can imagine, the graphic possibilities are nearly endless!

It's important to remember, however, that the X-Pad does not do this "automatically". *The action of the X-Pad depends upon the program you're running with the Color Computer.*

In this manual, we've included many sample programs you can use, but we're also going to show you how to write your own programs (and we hope you will!).

1/ Getting Started . . .

Before setting up the X-Pad, you'll need to connect your Color Computer to the TV. See your *TRS-80® Color Computer Operation Manual* for details. *Do not* turn the Computer's power ON!
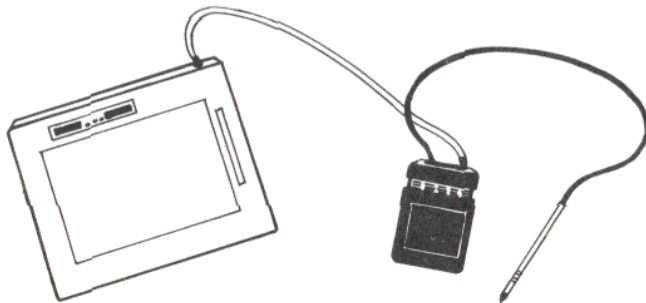
Figure 1. X-Pad

The X-Pad consists of three parts. These are the:

- **Pen** which enables communication between the X-Pad and the Computer.

- **Pad** which is the base of the GT-116 and which has an 8-1/2″ x 11″ Writing Surface. *Do not* write on the Pad! Always be sure to have a sheet of paper covering the Pad's surface.

- **X-Pad Interface Pak** which is inserted into the cartridge slot on the right side of the Color Computer.

Setting Up the X-Pad

Each time you use the X-Pad, you should put a sheet of standard-sized 8-1/2″ x 11″ paper over the Writing Surface of the Pad.

3

Paper on the Writing Surface protects the surface and keeps it clean as well.

Connecting the X-Pad

You must connect the X-Pad to the Color Computer *before* turning the Computer ON!

1. Be sure the Writing Surface is clean and dry.

2. Place a sheet of standard-sized paper (8 1/2″ x 11″) on the Writing Surface. You can tape the paper in place (a piece of tape at each of the Pad's corners will do the trick).

3. Turn the TV ON, select channel 3 or 4, and set the Antenna Switch to COMPUTER.

4. Carefully insert the Interface Pak into the cartridge slot (on the right side of the Computer). Be sure the Pak is firmly connected to the Computer.

5. Turn the Computer ON.

6. The Extended Color BASIC start-up message, followed by OK ⟩ will appear on the TV.

The Computer and the X-Pad are now ready for use.

Using the Pen

When the Pen is on the Writing Surface (or even near!) and you move the tip of the Pen around, a signal which defines an X-Y coordinate is "sent" to the Computer.

What the Computer does with that signal depends on the program you're running.

Some programs will require that you actually have to press the tip of the Pen down on the paper; other programs simply require that you move the Pen from one position to another.

Important Note! Do not use a pencil or felt-tip pen to write on paper that is on the X-Pad surface or inaccuracy may occur.

For consistent repeatability of data, you must maintain a consistent angle when holding the Pen.

☑ *Chapter 1 Checkpoint*

1. The X-Pad works by:
   a. reading points with light.
   b. ultrasound.
   c. digitizing coordinates.
   d. biorhythms.

2. The X-Pad has three parts:
   a. Pen, Interface Pak, and Keyboard.
   b. Pen, Interface Pak, and Pad.
   c. Pen, Keyboard, and Tape Recorder.

2/ Meet your X-Pad

So What's the Point?

The point is — X-Pad is easy and fun to use!

The following Extended Color BASIC program sets individual points on the Color Computer TV Screen.

Before you type in the program:

☑ Be sure your X-Pad is properly connected.

☑ Insert a sheet of paper on the Writing Surface.

☑ Take a ruler, place it horizontally near the center of the paper, and draw a 4″ horizontal line.

Now type in this program:

```
10 PMODE 4,1 :REM POINT PROGRAM
20 PCLS
30 SCREEN 1,1
40 GOSUB 80
50 IF S<>3 THEN 40
60 PSET(X,Y,1)
70 GOTO 40
80 X=PEEK(65376):Y=PEEK(65377):
   S=PEEK(65378):RETURN
```

and RUN it.

Take the Pen and position the tip *over* the left end of the line you drew. Press *down* on the Pen (a light touch is all that's needed). Notice that a dot (point) appears on the Screen.

Next position the Pen's tip over the right end of the line and press down lightly. Note that another dot appears on the Screen.

To create more dots, simply move the Pen to other points on the paper and press the Pen down.

You can set as many points as you want by just running

the program once. To clear the Screen, press (BREAK) and re-run the program.

Let the Pixels Fall Where They May . . .

As a review of the Color Computer Extended BASIC language, this is what happens in the program:

- Line 10 (PMODE 4,1) creates the point size ("resolution") and specifies a two-color "high resolution".
- Line 20 (PCLS) clears the Graphics Screen.
- Line 30 (SCREEN 1,1) selects the Graphics Screen and the Color Set (black and green).
- Line 40 (GOSUB 80) tells the Computer to automatically branch to the subroutine in line 80.
- Line 50 (IF S<>3 THEN 40) decides that, if S (which represents the Pen) is not touching the X-Pad's surface, program control goes to line 40. Since S = 3 when the Pen is on the X-Pad, program control goes to the next program line.
- Line 60 (PSET(X,Y,1)) sets the X-Y coordinates and specifies the points' color.
- Line 70 (GOTO 40) sends the Computer to line 40 so you can set more points.
- Line 80 (X = PEEK(65376):Y = PEEK(65377):S = PEEK (65378):RETURN) accesses each memory location in the X-Pad where digitized data is available. You'll have to include these PEEK statements in each X-Pad program you write.

The Big Cheese — PEEK

After running the program, it should be obvious to you that there aren't any new commands the X-Pad uses.

The only special thing the X-Pad does is to PEEK into certain memory addresses which store information about the current X-Y coordinates of the Pen (see line 80).

You'll have to PEEK into these memory locations in every X-Pad program you write.

Do you want to see what we mean? If so, type in this program:

```
NEW (ENTER)
10 PRINT PEEK(65376);
20 PRINT PEEK(65377);
30 PRINT PEEK(65378)
40 A$=INKEY$: IF A$="" THEN 40
50 GOTO 10
```

Position the Pen above the Writing Surface of the X-Pad and RUN the program. The Screen will display a row of three numbers. For now, all you want to concentrate on is the first two (but don't totally ignore the number on the right. We'll come back to it later). Move the Pen to a different position and press any key on the Keyboard. Three more numbers should appear. Repeat the operation as much as you like.

Are you ready for some answers? *The first column of numbers* (i.e., on the left side of the Screen) contains the X-coordinate value for the current Pen position. Memory location 65376 contains that information.

The second column is the current Y-coordinate value. Memory location 65377 contains that information.

(And the third number is the current Pen Status — but more on that later!)

As you move the Pen from location to location (i.e., "location" defined by an X-Y coordinate value), the X-Y coordinate values change.

- Line 10 of the program continuously returns the current X-coordinate of the Pen. This number will always be between 0 and 255. (Unless you move the Pen into a "margin" where the counting wraps-around.)
- Line 20 continuously returns the current Y-coordinate of the Pen. This number will always be between 0-191. (Unless you move the Pen into a "margin" where the counting wraps-around.)

(And line 30 returns the current Pen Status.)

Color Computer/X-Pad Memory Locations	
Address	Function
65376	Reads the current X-Axis Coordinate on the horizontal axis.
65377	Reads the current Y-Axis Coordinate on the vertical axis.
65378	Reads the current Pen Status.

Table 1

For example, if the Pen is postioned at an X-coordinate reading of 228 and a Y-coordinate of 120 with a Pen Status of 3, the data might be displayed this way:

```
228        120            3
```

And that's really all there is to the X-Pad! Of course, what you do with those X-Y values (and the Pen Status) is where all the fun comes in.

Everything Points In
that Direction

Now run the Dot program again, but first change line 10 to:

```
10 PMODE 2,1
```

Create some dots. Notice that this time the dots are larger since you're using "lower resolution".

Change line 30 to:

```
30 SCREEN 1,0
```

and RUN the program. SCREEN 1,0 changes the Screen to the two-color low resolution mode of black and green.

Gotta Draw the Line Somewhere

In Color Computer graphics, every line you draw has a "startpoint" and an "endpoint".

startpoint   endpoint

Figure 2. Line

This next program draws a line on the Screen after you simply specify a startpoint and an endpoint on the X-Pad (with the Pen).

Place the sheet of paper with the 4″ line on the X-Pad and type this program:

```
5     REM LINE PROGRAM
10    PMODE 4,1
20    PCLS
30    SCREEN 1,1
40    GOSUB 140
50    IF S<>3 THEN 40
60    PSET(X,Y,1)
70    IF PEEK(65378)=3 THEN 70
80    X1=X:Y1=Y
90    GOSUB 140
100   IF S<>3 THEN 90
110   LINE(X1,Y1)-(X,Y),PSET
120   IF PEEK(65378)=3 THEN 120
130   GOTO 40
140   X=PEEK(65376):Y=PEEK(65377)
      :S=PEEK(65378):RETURN
```

RUN the program. Now position the Pen to the left end of the line and press down. Then move it to the right end of the line and press down again. A line will appear on the Screen.

Go ahead — take the Pen by the horns! Specify several points on X-Pad and draw several lines. Now try drawing lines using varying lengths (8″, 10″, 5″, etc.). Be sure to experiment with horizontal, vertical, and diagonal lines. You might also try changing PMODEs (for lower resolution and thicker lines) and SCREEN (for different Color Sets).

What happens is this:

- Line 40 goes to 140 and gets the data.
- Line 50 waits for Pen down.
- Line 60 gets the first point.
- Line 70 waits for Pen up.
- Line 80 saves the first point.
- Line 90 gets the data.
- Line 100 draws the line.
- Line 110 draws the line.
- Line 120 waits for Pen up.
- Line 130 goes back for more data.

To draw a triangle, box, or rectangle, specify a startpoint and endpoint for the first side of the figure. Then use that endpoint as the next startpoint. Repeat this procedure for all the sides of the figure.

☑ *Chapter 2 Checkpoint*

1. (True/False) PEEK addresses X-Pad's memory locations.

2. Before you enter a program:
   a. be sure X-Pad is properly connected.
   b. insert a sheet of paper on the Writing Surface.
   c. be sure the Color Computer is powered-up.
   d. all of the above.
   e. none of the above.
3. A line has:
   a. two endpoints.
   b. a startpoint and an endpoint.
   c. a linear row of points.
   d. all of the above.
   e. none of the above.

Notes
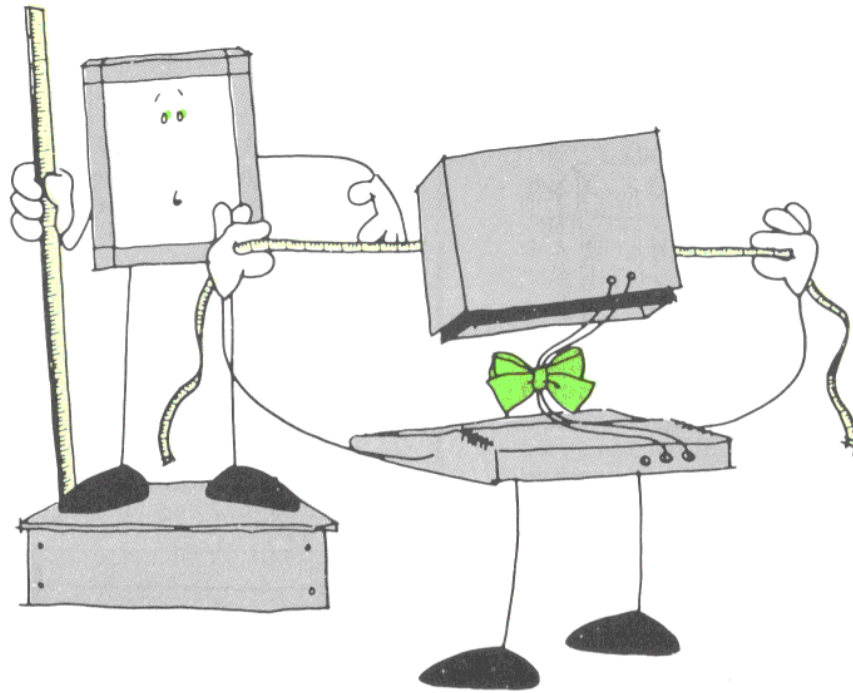
3/ The X-Pad's Surface Area

You should know that there are two areas on the Writing Surface of the Pad. They are the:

- **Display Area**. This area takes up most of the Writing Surface of the Pad. Anytime you move the Pen into this area, a display will appear on the Screen.
- **Menu Area**. This area makes up the "margins" of the Pad. Anytime the Pen moves into this area, the Screen doesn't display anything but something does happen. We'll go into this in more detail later in this section.
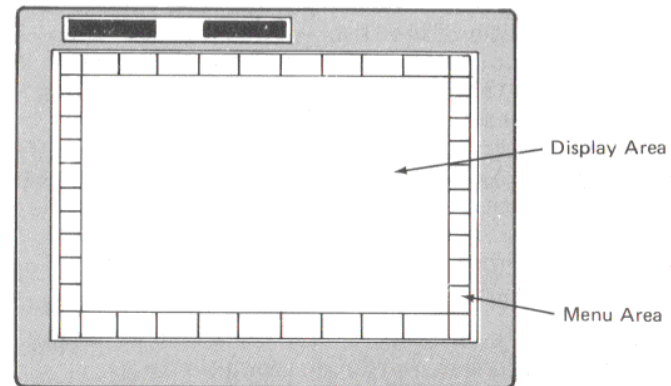

Figure 3. X-Pad Writing Surface

Note that the X-Pad's Display Area is the same size as the Display Area of the Color Computer.
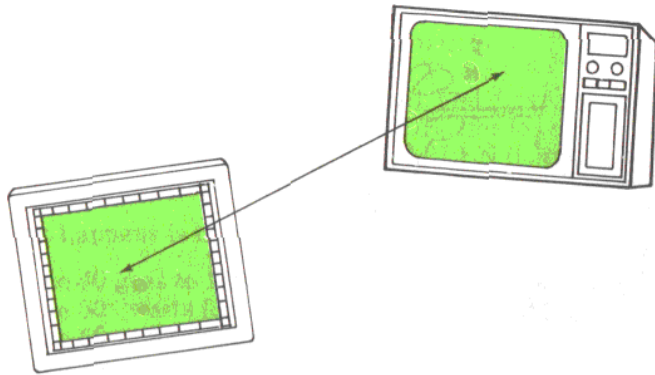
Figure 4. X-Pad Display Area vs. Screen Display Area

Anytime the Pen moves onto the X-Pad's Display Area (see *Figure 6* later in this manual, as well), a graphics display will appear on the Screen. (You can also use this area to create a menu, but it is primarily designed for display only!)

The Menu Area, which is the margin area and which runs around the perimeter of the Display Area (about 1″ from the edge all around), works differently. The X-Pad will send signals from that area but will not display anything on the Screen. Nevertheless, this Area is extremely powerful. For instance, you might assign various Extended Color BASIC commands to sections in the Menu Area. Then, instead of typing in a command (such as PAINT) from the Keyboard, just touch with the Pen that part of Menu assigned to PAINT and that statement will be the next one used.

You can think of the Display Area of the X-Pad as having an imaginary Cartesian coordinate (point-plotting) system. The range for X is 0 to 255 and the range for Y is 0 to 191. The upper-left corner is the origin (0,0), the upper-right corner is (255,0), the lower-left corner is (0,191) and the lower-right corner is (255,191). The centerpoint is (127,95).

On the Writing Surface, X and Y are measured by the

X-Pad in "increments" or individual units of calibration. Each of these increments represents one pixel on the Color Computer's Graphic Screen.

Marginally Speaking . . .

In the Menu Area, there are three types of margins on the Writing Surface of the X-Pad:

- X-Margin, the left and right vertical margins.
- Y-Margin, the top horizontal margin.
- Bottom Margin, the bottom horizontal margin but can be defined by your program.
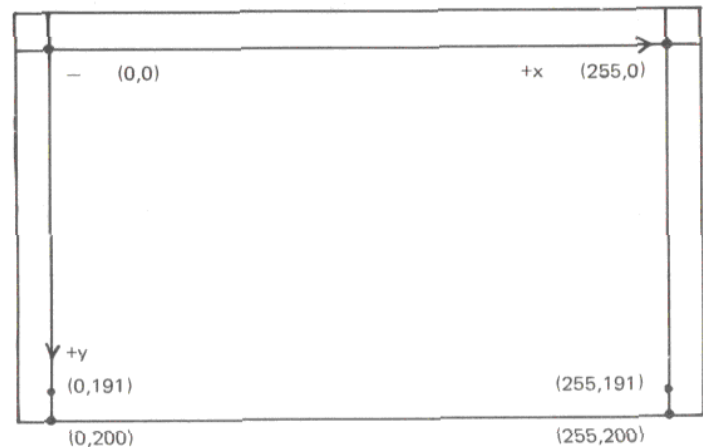

Figure 5. X-Pad's Margins and Cartesian System

The Cartesian System According to X-Pad

We've already talked about the X-Pad Cartesian system. But since you now know about X-Y coordinates, here are some more important facts about X-Pad's plotting system:

- The center of the Cartesian system is (127,95).
- If you move the Pen beyond the range (into a margin,

10

for instance), the counting "wraps-around" or starts over.
- The range for Y is 0 to 191, but you will get greater values for Y because coordinate counting wrap-arounds at the Top margin.

To see how this coordinate wrapping works, try this (**Note:** The coordinates listed below are approximate. Your actual readings will be near these.):

1. Enter the one-line PEEK program and RUN it:

```
10 PRINT PEEK(65376);PEEK(65377);
PEEK(65378):GOTO 10
```

2. Take the Pen and put it down as far to the left of the left margin as you can. Your Screen should display about 240.

3. Now move it horizontally from this point to the furthest point to the right of the right margin. As you move from left to right, the horizontal X coordinate (the only one we're changing since we're moving horizontally) is about 240; then it goes to 255 (end of margin), to 0 (start of the Display Area), to 255 (end of Display Area), to 0, and then begins counting to about 15.

(Pen) Status Conscious

Remember earlier we talked about Pen Status (i.e., the third column of numbers on the Screen)?

Pen Status tells the Computer the current location and condition of the Pen. There are 16 different statuses: 0-15.

Pen Status 3 ("Pen pressed down on Display Area") is the normal operating condition.

Why do you need to worry about Pen Status?

Simple. Programs that you write for the X-Pad will usually incorporate information about Pen Status.

The Pen Status information provides additional capabilities in the use of the X-Pad. Pen Proximity provides a means of disabling data when the Pen is out of range of the Writing Surface. Pen Down tells the Computer when the Pen is touching the Writing Surface. X and Y margins tell when the Pen is beyond the 7″ x 9″ Display Area and defines left, top and right margin areas that can be used for menu or other purposes. A lower margin is not defined. However, a lower margin can be easily created in your program. It should be noted that a menu can be created in the Display Area as well as the Menu Area.

For instance, in the sample programs we've shown you so far, S has been used as a variable representing the Pen's Current Status (S = PEEK(65378)) and we've also tested that current status with an IF/THEN statement (IF S = 3 THEN 40, for instance). What this IF/THEN statement is really saying is, "If the Current Pen Status is 'Pen pressed down on the Display Area', then goto line 40". In all other instances (such as if the Pen were pressed down on the Menu Area), the program would continue execution at the next line.

Other examples include:

```
100 IF S<>3 THEN 90
```

This program line waits until you press the Pen down on the Display Area or on the bottom margin.

```
220 IF S=15 THEN RETURN
```

This program line reads if the Pen is pressed down in the upper-left or upper-right corner of the margins.

There are several Pen Statuses (4-15) that tell you when you are beyond the perimeters of the 7″ x 9″ Display Area.

Three of the Statuses (5, 9, and 13) rarely occur and are difficult to reproduce. However, since these are possible, they are included in the list.

X-Pad Pen Status	
Signal Sent to Computer	**Meaning**
0	Pen not down, out of range of Pad (Pen out of proximity)
1	Pen down, off Pad
2	Pen near Surface (within 1") (Pen proximity only)
3	Pen down on Display Area or on bottom margin (Pen down and proximity)
4	Pen not within 1" of X-margin (left or right margin)
5	X-margin and Pen down
6	Pen touching paper on X-margin (left or right margin) but Pen not down (X-margin and proximity)
7	Pen down on X-margin (left or right margin) (X-margin, Pen down, and proximity)
8	Pen not within 1" of the Y-margin (top margin)
9	Y-margin and Pen down
10	Pen within 1" of Y-margin (top margin) (Y-margin and proximity)
11	Pen down on Y-margin (top margin) (Y-margin, Pen down, and proximity)
12	X- and Y-margin
13	X- and Y-margin and Pen down
14	Pen touching paper in upper-right or upper-left X-Y corner but Pen not down (X- and Y-margin and proximity)
15	Pen down in upper-right or upper-left X-Y corner (X- and Y-margin, Pen down, and proximity)

Table 2

Status 1 might be confusing ("Pen down, off Pad"). This Status means the tip of the Pen is being held down but the Pen is not on the Pad.

Type this one line program and RUN it:

```
10 PRINT PEEK(65378):GOTO 10
```

The program, which PEEKs the memory address for Pen Status, displays the current Pen Status on the far left side of your Screen.

With the program running:

1. Hold the Pen vertically about 4" *above* the center of the Display Area (with the point of the Pen down). A Pen Status of 0 ("Pen not ready, out of range of Pad") will be in effect.

2. *Slowly* move the Pen downward towards the Display Area. When you are about 1" from the Surface, the Status changes to 2 ("Pen near Display Area").

3. Move the Pen onto the Surface and apply slight pressure. The Pen Status changes to 3 ("Pen down on Display Area or on Bottom Margin").

To show you the Pen Status of the margins, keep the same one-line program (10 PRINT PEEK(65378):GOTO 10).

1. Press the Pen down on the center of X-Pad (reading: 3, "Pen down on Display Area or on Bottom Margin").

2. From the center, move the Pen diagonally to the lower right corner (reading: 7, "Pen down on X margin") and press down.

3. Then move the Pen vertically up the right margin (reading: 7) to the upper right corner (reading: 15, "Pen down in upper right or upper left X-Y corner"). Press down.

4. Move the Pen across the top margin (reading: 11, "Pen down on Y margin") to the upper left corner (reading: 15) and press down.

5. Then move the Pen down the left margin (reading: 7) to the lower left corner (reading: 7). Press down.

6. Move the Pen across the bottom margin (reading: 3) to the lower right corner (reading: 7).

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☑ *Chapter 3 Checkpoint*

1. Name the two areas on the surface of X-Pad.

2. X-Pad can read coordinates when the Pen is:
   a. on the Writing Surface.
   b. on the Active Surface.
   c. anywhere on the Pad.
   d. all of the above.

3. The origin coordinate on X-Pad is located in the:
   a. upper-left corner.
   b. lower-left corner.
   c. upper-right corner.
   d. lower-right corner.
   e. none of the above.

4. (True/False) You set the Working Area using PMODE in your program.

5. The coordinate (255,0) is located in the:
   a. lower-left corner.
   b. upper-right corner.
   c. upper-left corner.
   d. lower-right corner.
   e. none of the above.

Notes

4/ It's a Bird, It's a Plane; No It's . . . X-Pad!

There are 11 types of programming functions we'll be discussing in this manual:

- Display data
- Set a point
- Draw a line
- Draw a box
- Display the Cursor
- "Free-form" drawing
- Finding the length
- Finding the area
- Drawing a circle
- Painting
- Compiling a Menu

Each of these functions requires a separate program which you can type in and save on cassette. While the X-Pad can't leap tall buildings in a single bound, its programs are easy and quick to use (*but not quite as fast as a speeding bullet!*).

We've gone through a few programs with you and perhaps you've seen some programming trends (using GOSUBs, PEEKing memory addresses, using SCREEN, etc.).

We've also shown you how to draw points, lines, boxes, and display data. Next, we're going to show you how to display the Cursor.

This Doesn't Look Like Kansas Anymore, Cursor!

The X-Pad's Cursor appears on the Screen as a small blinking dot. The following Cursor program is especially fun (and useful!) to use because it works by reading the location of the Pen and displaying its equivalent position on the Computer Screen.

If the Pen is within about 6″ of the Writing Surface, the

X-Pad can display the Pen location on the Screen.

The following program will generate the blinking Cursor:

```
5    :REM CURSOR PROGRAM
10   PMODE 3,1
20   PCLS
30   SCREEN 1,1
40   GOSUB 170
50   GOSUB 70
60   IF S<>3 THEN 40
70   A=PPOINT (X,Y)
80   IF A<>5 THEN 130
90   PSET (X,Y,8)
100  FOR W=1 TO 50: NEXT W
110  PRESET (X,Y)
120  RETURN
130  PSET(X,Y,5)
140  FOR W=1 TO 50: NEXT W
150  PSET (X,Y,A)
160  RETURN
170  X=PEEK(65376):Y=PEEK(65377):S=PEEK
     (65378):RETURN
```

RUN the program. Move the Pen over the Surface (but don't touch it!) and you'll see the Cursor displayed on the Screen. As you can see, the Cursor is an orange blinking point on the cyan background.

If you press the Pen down on the Pad when using the Cursor program, Extended Color BASIC will display a **RETURN WITHOUT GOSUB ERROR**. Simply RUN the program again.

What happens is this:

- Line 40   goes to 170 and gets the data.
- Line 70   locates the Pen.
- Line 60   waits for the Pen to enter the Active Area.
- Line 70   gets the color of the point.
- Line 80   tests the point. If the point is set, it resets it.
- Line 90   sets the point to orange.
- Line 100 is a delay.
- Line 110 resets the point to orange.
- Line 130 sets the point to buff.

- Line 150 resets the color.
- Line 160 returns to caller.

If you write your own Cursor Program (go ahead, it's easy!), be sure and set the Cursor to a different color than the background color.

☑ *Chapter 4 Checkpoint*

1. (True/False) X-Pad's cursor moves across the Screen when you press (ENTER).

2. (True/False) X-Pad is totally controlled by programming (software).

3. (True/False) X-Pad can read the Pen (and cursor if included in the program) when the Pen is about 10" above the Writing Surface.
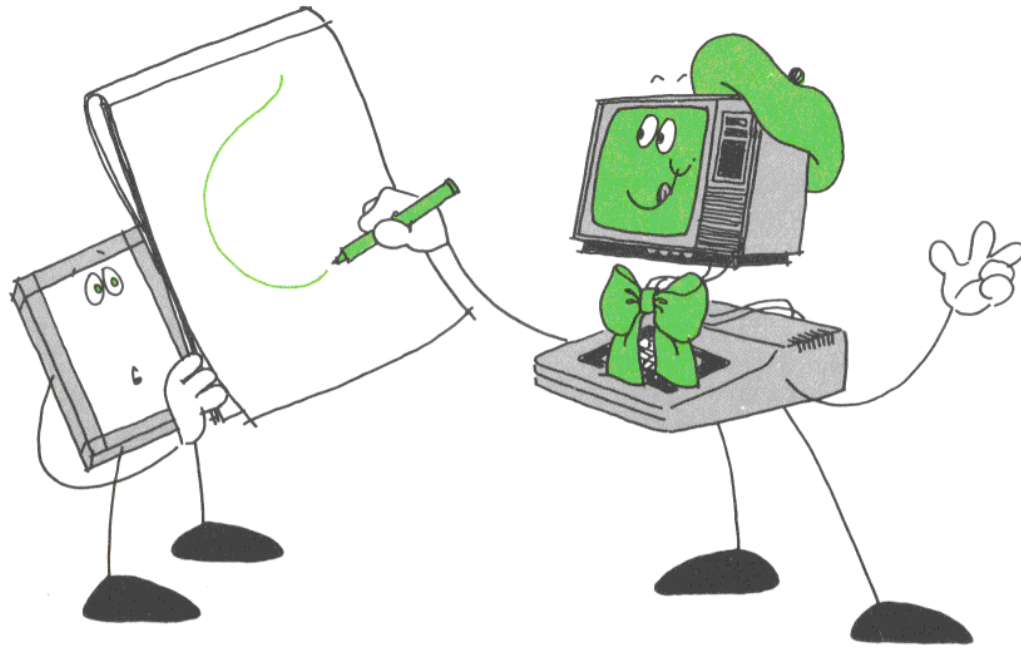
5/ Art for X-Pad's Sake

Perhaps the most exciting feature of your X-Pad is that it lets you "free-form" draw with just the stroke of the Pen.

By entering the drawing program, you can trace or create any figure on your X-Pad and have it displayed on your Color Computer's Screen. (Within minutes, *you too* can become another Picasso!) The only artistic limitation to this program is your imagination, so let the good times flow!

After you've run the program, drawing starts when you press the Pen down on X-Pad and ends when you lift the Pen up from X-Pad's surface.

To free-form draw, enter this program:

```
10    PMODE 4,1:REM DRAWING PROGRAM
20    PCLS
30    SCREEN 1,1
40    GOSUB 120
50    IF S<>3 THEN 40
```

```
60    PSET(X,Y,1)
70    X1=X:Y1=Y
80    GOSUB 120
90    IF S<>3 THEN GOTO 40
100   LINE(X1,Y1)-(X,Y),PSET
110   GOTO 70
120   X=PEEK(65376):Y=PEEK(65377)
      :S=PEEK(65378):RETURN
```

RUN the program, lower the Pen tip to the paper and press down, move it across the paper, and you're drawing! Okay now, let's see some creativity!

Once the Screen is full of graphics (graphics-ful?), simply press (BREAK), re-run the program, and you can continue drawing.

A Little Inside Information

There are three important tips about free-form drawing:

- Apply steady pressure — keep pressure on the Pen's tip so your drawing is contiguous.
- Contiguous drawing — X-Pad sets points in a contiguous fashion. For example, draw a line in the lower-left corner of X-Pad and then draw one in the upper-right corner.
- Use a slow hand — If you want to "shade" (shading in an area by moving the Pen over and over the area), you'll have to move the Pen slowly over the area to be shaded. You must also keep the Pen perpendicular so the Pen's signals are evenly sent.

X-Pad-Oma! — Where the Pen Comes Sweeping Down the Pad

To get you started, we've got some drawing ideas for you:

- Write your name in longhand, looking at your paper as you move the Pen. After you've done that, try it again by just looking at the Screen as you write your name (pretty hard to cross those t's and dot those i's).
- Draw a four-leaf clover.
- Draw a five-pointed star.
- Draw a big "dreamhouse" with a garage, driveway, and smokestack with billowing smoke.
- Take a map or drawing from a magazine, newspaper, etc., place it on the Writing Surface and trace all or part of it with the X-Pad.
- Draw the following geometric figures by only looking at the paper (no cheating, now!): circle, triangle, rectangle, pentagon, hexagon, square, and octagon.
- Draw a three-dimensional box.

☑ *Chapter 5 Checkpoint*

1. (True/False) When drawing, use light, rapid strokes.

2. (True/False) X-Pad sets points in a contiguous fashion.

3. (True/False) If your display is full of graphics, press (ENTER).

4. (True/False) Drawing starts when you press the Pen's tip down on the X-Pad and ends when you remove the Pen from X-Pad's surface.
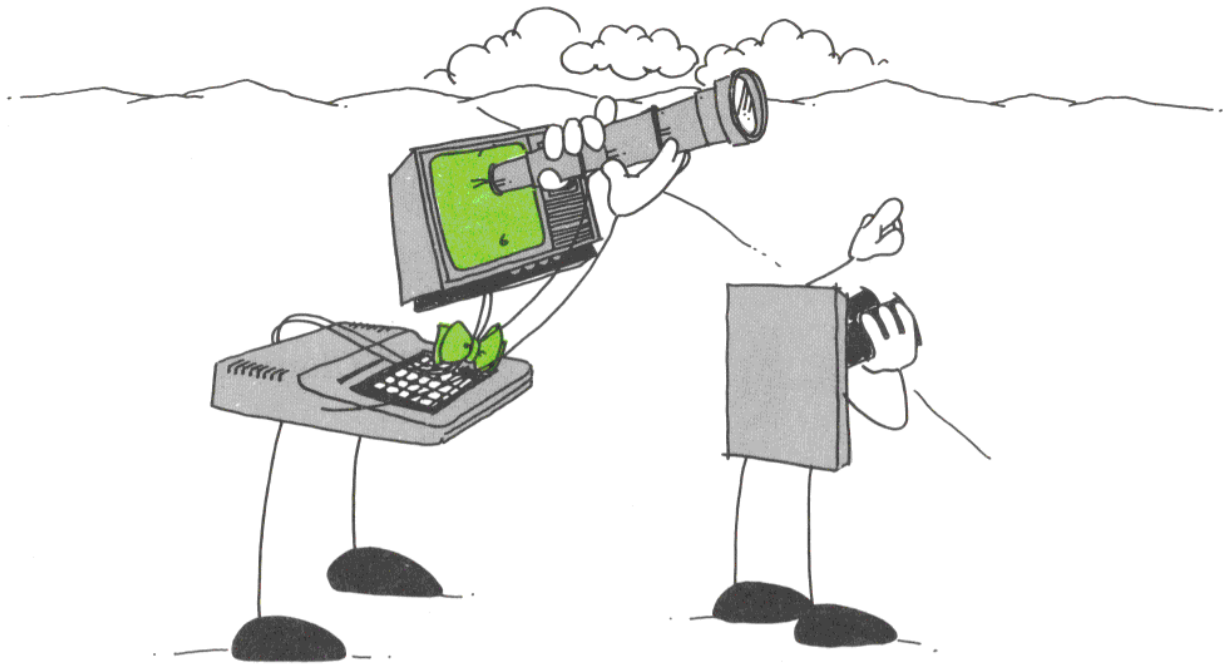
6/ From Here to Eternity

If you use a program similar to the one in this section, measuring the length of a line is easy with the X-Pad. Simply position the Pen over the line's startpoint and press down, then position the Pen over the endpoint and press again.

The distance between these two points will be displayed on the Screen in 3-significant-digit inches (e.g., 3.14″). Your Color Computer doesn't display the last digit if it's a 0 (but don't be alarmed, the X-Pad and Color Computer know it's still there!). For example, if length is 7.20, 7.2 will be displayed on the Screen.

To measure length:

1. Type (or load from cassette) and RUN the program.

2. Press the Pen down where you want to begin measuring length (startpoint) and then press the Pen down where you want to stop measuring length (endpoint).

The length will be immediately displayed on your Screen.

Length Routine

```
5    CLS :REM LENGTH
10   PRINT "GET FIRST POINT"
20   GOSUB 150
30   IF S<>3 THEN 20
40   PRINT"GET SECOND POINT"
50   X1=X:Y1=Y
60   GOSUB 150
70   IF S=3 THEN 60
80   GOSUB 150:IF S<>3 THEN 80
90   B=ABS(X1-X):C=ABS(Y1-Y)
95   REM VALUE OF EACH INCREMENT ON
     BOTH AXIS
100  L=SQR((B*B)+(C*C))/28.4
110  L=INT(L*100)/100
120  CLS:PRINT"LENGTH IS";L
130  GOSUB 150:IF S=3 THEN 130
```

```
140 GOTO 10
150 X=PEEK(65376):=PEEK(65377)
    :S=PEEK(65378):RETURN
```

RUN the program. The first prompt will be Displayed on the Screen:

```
GET FIRST POINT
```

Take the Pen and move to a startpoint on the Surface. The second prompt will appear:

```
GET SECOND POINT
```

As soon as you specify an endpoint, the length (the distance between the startpoint and endpoint) will be displayed on the Screen:

```
LENGTH IS 1.18
```

(*or close to it!*) When you release pressure on the Pen tip, the prompt appears again:

```
GET FIRST POINT
```

You can now go on and find another length.

What happens is this:

- Line 20   goes to 150 and gets the data.
- Line 30   waits for Pen down.
- Line 50   gets the first point.
- Line 70   waits for Pen up.
- Line 80   gets the second points.
- Line 90   computes the absolute value.
- Line 100 figures the length.
- Line 110 rounds the sum.
- Line 130 waits for Pen up.

To measure figures that you have drawn on X-Pad's paper (like lines, rectangles, circles, etc.), use the same procedure. If you are measuring the length of objects (credit card, piece of paper, etc.), follow this procedure:

1. Place the object on the surface (be sure to use only non-metal, non-conductive items) and decide which side you want to measure.

2. On one end of the object, specify the startpoint by gently pressing down on the Pen's tip, then lift the Pen.

3. On the other end of the object, press the Pen down (endpoint), then lift it. The length of that object's side will be displayed on the Screen.

☑ *Chapter 6 Checkpoint*

1. (True/False) To measure the length of a line, press down on the Pen's tip at the line's startpoint and endpoint with the Pen.

2. (True/False) Length is displayed in millimeters.

3. (True/False) Only measure the length of non-conductive items.

7/ Plenty of Air and Plenty of Room

The X-Pad can figure the area of any geometric figure. After you trace the perimeter of the figure, the area will be displayed in 3-significant-digit inches on the Computer's Screen.

To find the area of a figure:

1. Type in the program that's listed in this section.

2. RUN the program.

3. Draw a figure on the paper with a pen (to make sure you have plenty of room, draw the figure in the middle of your paper).

4. Take the Pen, press down, and start tracing the figure. As soon as you press the Pen's tip down on the paper to begin tracing:

   TRACING

   appears on your Screen, telling you that the X-Pad is

hard at work, figuring the area of your geometric figure. The Computer calculates the area as the Pen moves (rather than the time-consuming alternative of doing it all at the end). When you lift the Pen from the paper, the area is displayed on the Screen. For example: AREA IS 1.24

Tippecanoe and Two-Dimensional Area, Too!

When you find area with the X-Pad, you are actually finding the surface area (a two-dimensional calculation, as in length x width) of the figure. So, if you are finding the area of a three-dimensional object that you place on X-Pad (a soft drink bottle, for example) you are actually finding the surface area of one of the bottle's sides.

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Area Routine

```
10   CLS:REM AREA PROGRAM
20   A2=0:AT=0:GOSUB 200
30   IF S<>3 THEN 20
40   X0=X:Y0=Y:X1=X:Y1=Y
50   PRINT "TRACING"
60   GOSUB 200
70   IF S<>3 THEN 110
80   A1=((Y+Y1)/2)*(X1-X)
90   X1=X:Y1=Y
100. AT=AT+A1:GOTO 60
110  X=X0:Y=Y0
120  A1=((Y+Y1)/2)*(X1-X)
130  AT=INT(AT+A1)
140  A2=INT(AT/2):A2=ABS(A2/373.84)
150  A2=INT(A2*100)/100
160  CLS:PRINT"AREA IS ";A2
170  GOSUB 200
180  IF S<>3 THEN 170
190  GOTO 10
200  X=PEEK(65376):Y=PEEK(65377)
     :S=PEEK(65378):RETURN
```

RUN the program. Draw some figures on your paper and then figure each area.

Greater Metropolitan Areas

Ready to charge right in? How about trying these examples:

To find the area of a square, follow these steps:

1. Draw a 1″ square (four sides equal) with your pen and a ruler on the paper of your X-Pad.

2. RUN the program, trace around the square with the Pen while applying pressure (trace the square only once!), and then lift the Pen from the paper. You might want to put your ruler next to the Pen so the lines are straight and accurate.

3. If you traced very close to the square's sides, you should have an area of about 1″ (i.e., 1.27, 1.56, etc.) since the area for a square is length x width and both the length and width of this square is 1″: 1 x 1 = 1. Note: The closer you trace to the square's sides, the closer your area is to 1″ square.

To find the area of a circle, follow these steps:

1. Draw a circle with a 1″ radius (same as a 2″ diameter).

2. Trace around the circle with the Pen while applying slight pressure to the tip, and then lift the Pen from the paper.

3. Area should be about 3.1″ since the area of a circle is $\pi(r)^2$: 3.14159265 x (1) = 3.14 (rounded to three significant digits).

☑ *Chapter 7 Checkpoint*

1. (True/False) Area is a two-dimensional measurement within a joined set of points.

2. (True/False) X-Pad can figure the area of only boxes.

3. (True/False) When you find the area with X-Pad, you are actually finding the surface area of the figure.
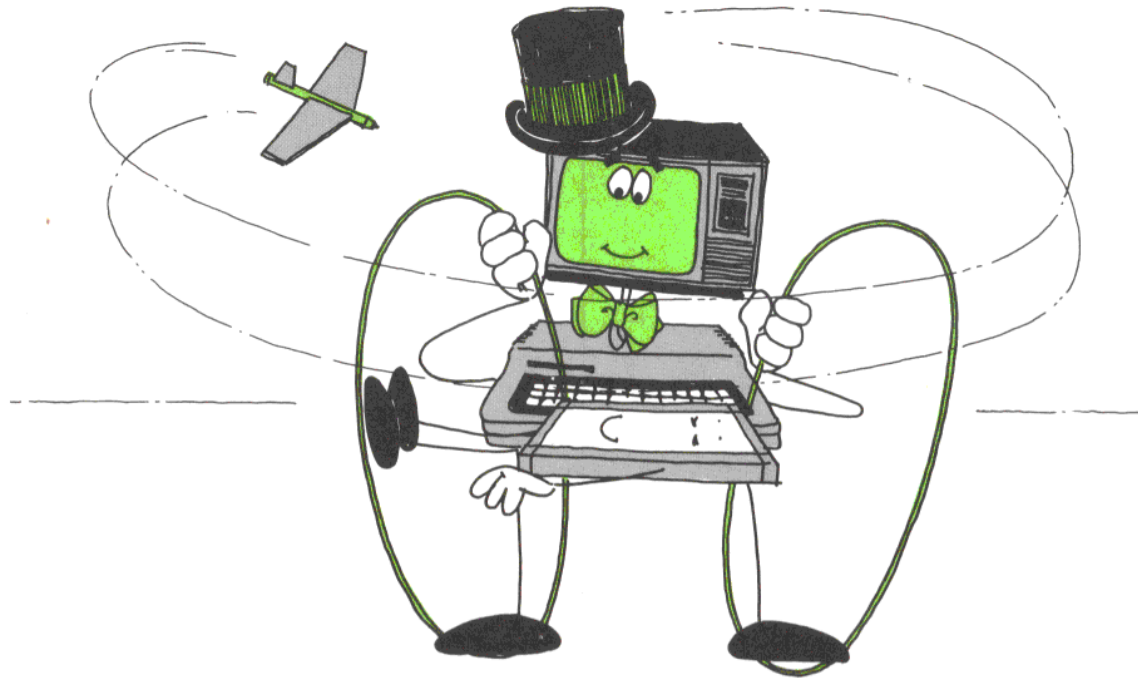
8/ Circling the Landing X-Pad

There are three easy steps in drawing a circle with your X-Pad:

1. Type (or load from cassette) the circle program and RUN it.

2. Place the Pen where you want the circle's centerpoint to be (the centerpoint is the middle of a circle) and press down on the Pen.

3. Lift the Pen and move it to a place away from the centerpoint, then lower it and press down. The distance from the centerpoint to this point is the circle's radius. The X-Pad draws the circumference of the circle around the radius. (The radius is the distance between the centerpoint and the circumference.)

Circle Routine

```
10   PMODE 4,1
20   PCLS
30   SCREEN 1,1
40   GOSUB 150
50   IF S<>3 THEN 40
60   PSET(X,Y,1)
70   IF PEEK(65378)=3 THEN GOTO 70
80   X1=X:Y1=Y
90   GOSUB 150
100  IF S<>3 THEN GOTO 90
110  L=ABS(X1-X)+1:C=ABS(Y1-Y)+1:R
     =SQR((L*L)+(C*C))
115  REM COMPUTES CIRCLE'S SIZE
120  CIRCLE (X1,Y1),R
130  IF PEEK(65378)=3 THEN 130
140  GOTO 40
150  X=PEEK(65376):Y=PEEK(65377)
     :S=PEEK(65378):RETURN
```

RUN the program and begin drawing circles.

What happens is this:

- Line 40   goes to 150 and gets the data.
- Line 50   waits for Pen down.
- Line 60   lights the point.
- Line 70   waits for Pen up.
- Line 80   sets the first point.
- Line 90   gets the second point.
- Line 100 waits for Pen down.
- Line 110 compute the circles's size.
- Line 120 draws the circle.
- Line 130 waits for Pen up.
- Line 140 gets the next point.

☑ *Chapter 8 Checkpoint*

1. (True/False) The radius of a circle is the distance from the circle's centerpoint to a point on the circle's circumference.

2. (True/False) To draw concentric circles, use the same centerpoint but vary the radius.

3. (True/False) The centerpoint is located on the circumference of the circle.

Notes
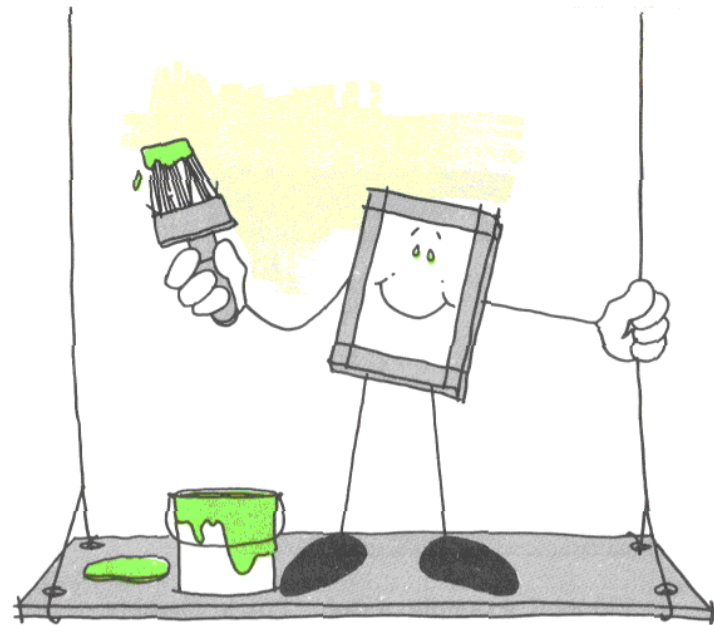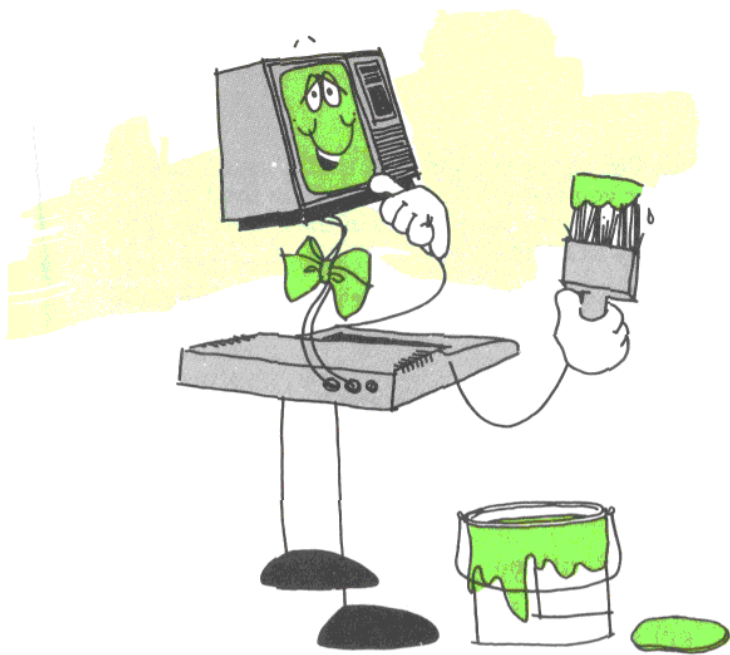
9/ Brushing on the First Coat

A paint program lets you paint a certain figure you have just drawn on the X-Pad. Before using the X-Pad's PAINT routine, read Chapter 6 of *Going Ahead With Extended Color BASIC* carefully!

For instance, when you specify two diagonal points with the Pen, the following program draws a box and then paints the box when you move and press down the Pen in a part of the margin which has been defined as a "color-coded menu". (Actually, we're jumping a little ahead of ourselves but bear with us — you'll like what's about to follow!)

Whenever you want to clear the Screen, just move the Pen to the bottom margin.

With this program, you can color-code three of the four margins on the X-Pad. The colors available depend on the color set currently in use:

If the Color Set is 0, then . . .	green/yellow/blue/red (green is the background color and you can set the three margins to the other three colors)
If the Color Set is 1, then . . .	buff/cyan/magenta/orange (buff is the background color)

You can then define each margin with a color. For example:

left = 3 (blue)
right = 2 (yellow)
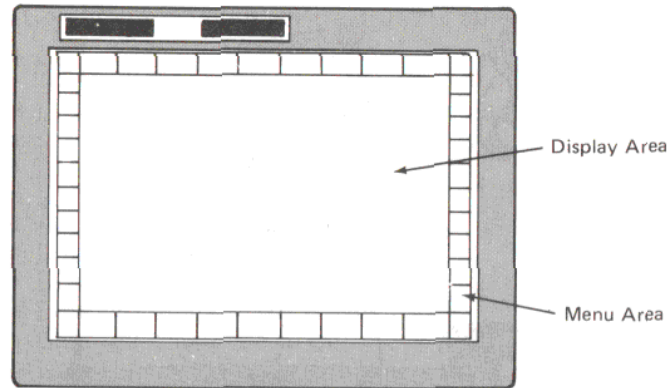top = 4 (red)
bottom = clears the Screen

Figure 6. Example of Color-Coded Margins

Painting the Town,. . . .er, Screen Red (Blue, Orange, etc.)

While the following program paints a box, you'll be able to see a small, pixel-like "bouncing cursor". This Cursor indicates the current position of your Pen. (**Note:** The Cursor is easiest to see when you are in Screen Set 0. Change the Screen to any color *except* green to see the Cursor.)

A Cursor is helpful when you are painting because you can see where your Pen is located. This way, you always can see if the Pen is "inside" the figure you want to be painted.

To paint, follow this procedure:

1. Type (or load) the respective program (for a box or circle) and RUN it.

2. Draw the figure by gently pressing the Pen's tip against the surface of the Display Area to specify one diagonal point of the box. Then press the Pen down on another point to specify the other corner. The box will be created when the second point is specified.

3. Press the Pen in the margin area that's been defined as the color you want. You can see where the Pen is currently located by the position of the Cursor on the Screen (only in PMODE 1).

4. Press the Pen inside the figure for painting to begin. (**Note:** It must be inside the figure or you'll paint the background.)

5. To paint the background, move the Pen to a margin and press slightly. Then move the Pen to the background (which surrounds your figure) and press down again. The background is now painted in the color you chose!

Painting Box Routine

```
10   PMODE 3,1:REM PAINT PROGRAM
20   PCLS
30   SCREEN 1,0
40   GOSUB 400
50   IF S=7 OR S=11 THEN GOTO 170
60   GOSUB 300
70   IF S<>3 THEN 40
80   IF Y>191 THEN 220
90   PSET(X,Y,8):X1=X:Y1=Y
100  IF PEEK(65378)=3 THEN 100
110  GOSUB 400
120  GOSUB 300
130  IF S<>3 THEN 110
140  LINE(X1,Y1)-(X,Y),PSET,B
150  IF PEEK(65378)=3 THEN 150
160  GOTO 40
170  IF S=11 THEN 210
180  IF X<128 THEN 200
190  C=3:GOTO 230
200  C=2:GOTO 230
210  C=4:GOTO 230
220  PCLS:GOTO 40
230  IF PEEK(65378)=3 THEN 230
240  GOSUB 400
250  GOSUB 300
260  IF S=7 OR S=11 THEN 170
270  IF S<>3 THEN 240
```

```
280  IF Y>191 THEN 220
290  PAINT(X,Y),C,8:GOTO 240
300  A=PPOINT(X,Y)
310  IF A<>5 THEN 360
320  PSET(X,Y,8)
330  FOR W=1 TO 50:NEXT W
340  PRESET(X,Y)
350  RETURN
360  PSET(X,Y,5)
370  FOR W=1 TO 50:NEXT W
380  PSET(X,Y,A)
390  RETURN
400  X=PEEK(65376):Y=PEEK(65377):S=PEEK
     (65378):RETURN
```

RUN the program and draw a box. To paint this figure:

1. Move the Pen to a color-coded Menu, press down and then lift the Pen, and bring it back to the box.

2. Move the Pen within the boundaries of the box and press down on the tip. *Presto* — your figure is painted in the color you chose!

3. Move the Pen to the bottom margin to clear the Screen. Draw two more boxes and paint the boxes with the two remaining color choices. (Congratulations, you're quite a painter!)

'Fore and Aft Paintin'

When you painted the figure, you painted the "foreground". Painting the rest of the scene ("aft" or behind) is called "background painting". You can paint the foreground and the background the same color and still keep an outline of your figure on the Screen. The figure is outlined in the remaining colors of the Screen Set.

To paint the background of your figure:

1. Draw the figure.

2. Move the Pen to the margin that is color-coded in the color you want the box's background to be painted and

press down. Then press the Pen somewhere on the Display Area but outside of the boundaries of the figure. The outline of the figure is still visible.

You can paint the background either before or after you paint the foreground.

Mode-Us Operandi

In the painting box program, PMODE 3 set the resolution and the four-color mode. Look at line 30 (SCREEN 1,0). The first number (1) in this command sets the Graphics Screen, and the second number (0) sets the four colors of the mode:

green/yellow/red/blue

Look at our program again. In lines 190 (3, left margin is blue), 200 (2, right margin is yellow), and 210 (4, top margin is red), we set the color for our margins. In this program, the margins are listed in this order:

- Left.
- Right.
- Top.

Why are the margins set to blue, yellow, and red? Since we are in Screen Set 0 and four-color mode, the only color choices are blue, yellow, and red (since the background is green).

You can change the order of these color-coded margins by simply changing the order of the color codes in the program:

```
190  C=2:GOTO 230   (2, left margin is now yellow)
200  C=4:GOTO 230   (4, right margin is now red)
210  C=3:GOTO 230   (3, top margin is now blue)
```

RUN the program and paint with these new color-coded margins.

Now change to Screen Set 1 by changing line 30 to:

```
30  SCREEN 1,1
```

This changes the color set of our four-color mode screen to

buff/cyan/magenta/orange (from green/yellow/blue/red). Buff is the new background color.

Since you are in a new color set, you'll have to also change the colors in our program. Since the background is buff, the color choices are cyan, magenta, and orange. Change the color of the margins for this new color set:

```
190 C=6:GOTO 230
200 C=7:GOTO 230
210 C=8:GOTO 230
310 IF A <> 1 THEN 360
```

RUN the program. The Cursor shows up well on the buff background and looks like an orange-colored pixel. The Cursor moves across the Screen as you move the Pen. Experiment with the Cursor by moving the Pen just above the Display Area.

Experiment with the new color-coded margins. Now, change the order of the margins again:

```
190 C=7:GOTO 230
200 C=8:GOTO 230
210 C=6:GOTO 230
```

Try painting with these new color-coded margins. Change the order again:

```
190 C=8:GOTO 230
200 C=6:GOTO 230
210 C=7:GOTO 230
```

Say, you're quite a programmer (*and you thought programming was hard*)!

Painting In Circles

To draw and paint circles (instead of boxes), change line 140 in the paint program to:

```
140 L=ABS(X1-X):C=ABS(Y1-Y):R=SQR
((L*L)+(C*C))
```

and add line 145:

```
145 CIRCLE(X1,Y1),R
```

Hints and Tips On Painting with the X-Pad . . .

- Four-color mode — You can only paint in a PMODE that has a four-color mode (i.e., PMODE 3 or 1).
- Move to the center — When using Screen Set 0 (background color: green), it is nearly impossible to see the green Cursor. To be sure you paint the right figure, move the Pen as near the figure's center as possible.
- Last margin default — The PAINT statement uses the color of the last margin specified. Once you move the Pen to a margin, you can paint all the figures and the background in that same color. To use another color, just specify that color-coded margin. Try this for yourself. Draw five circles and press the margin for a color. Paint the five circles, and then the background, with this color.
- Re-painting — If you paint a figure with the same foreground and background color, you won't be able to repaint the figure or draw another figure until you clear the Screen. To see this for yourself, paint a figure and the background the same color.
- Stops at boundary — Paint works the same with background painting as it does with foreground painting — it stops when it reaches a boundary of a figure on the Screen. To paint this unpainted area, you'll have to press the Pen down in that area. Draw two adjoining figures and try this yourself.
- Important! Because of characteristics of the Color Computer, once you have chosen red or orange, the only way to change color sets is to clear the Screen and start over. See pages 48-51 of your Extended Color BASIC manual.

☑ *Chapter 9 Checkpoint*

1. (True/False) Through your program, you can color-code three of the four margins on X-Pad.

2. (True/False) Whenever you want to clear the Screen, just move the Pen to the bottom margin.

3. (True/False) A Cursor is helpful when you are painting because you can see where your Pen is currently located.

4. (True/False) PAINT keeps painting after it reaches a boundary of a figure on the Screen.

5. (True/False) PAINT uses the color of the last margin specified.

6. (True/False) When painting, move the Pen within the figure-to-be-painted's boundary.

Notes
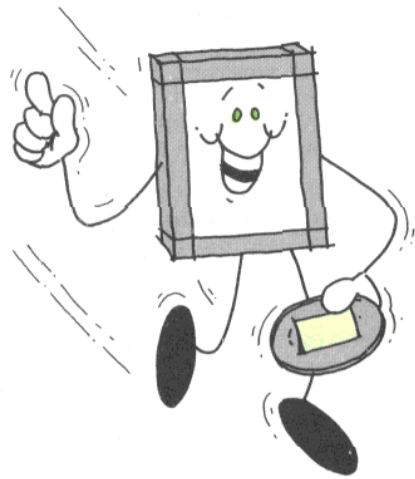
10/ Menu or Ala Carte?

An X-Pad Menu lets you define certain areas of the Writing Surface for special purposes. When you select one of the pre-defined Menu areas, the routine assigned to that area is executed.

A Menu can be located in the Display Area or Menu Area on the X-Pad. The following program sets up a Menu in the Display Area. This Menu resembles the keyboard on a push-button telephone:
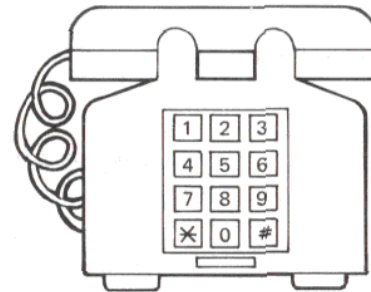
Figure 7. Telephone Keyboard

Menu Routine

```
10    CLS:REM MENU PROGRAM
20    GOSUB 250
30    IF S<>3 THEN 20
40    R=INT(Y/28)+1:C=INT(X/28)+1
50    IF R>4 OR C>3 THEN 230
```

```
60   ON R GOTO 70,80,90,100
70   ON C GOTO 110,120,130
80   ON C GOTO 140,150,160
90   ON C GOTO 170,180,190
100  ON C GOTO 200,210,220
110  PRINT "1";:GOTO 260
120  PRINT "2";:GOTO 260
130  PRINT "3";:GOTO 260
140  PRINT "4";:GOTO 260
150  PRINT "5";:GOTO 260
160  PRINT "6";:GOTO 260
170  PRINT "7";:GOTO 260
180  PRINT "8";:GOTO 260
190  PRINT "9";:GOTO 260
200  PRINT "*";:GOTO 260
210  PRINT "0";:GOTO 260
220  CLS:GOTO 260
230  PRINT "*PEN IS NOT ON MENU*"
240  GOTO 260
250  X=PEEK(65376):Y=PEEK(65377)
     :S=PEEK(65378):RETURN
260  IF PEEK(65378)=3 THEN 260
270  GOTO 20
```

The Menu is located in the upper-left corner of the Display Area and looks like this:

Display Area

Row 1 = 123
Row 2 = 456
Row 3 = 789
Row 4 = *0#

"Telephone Keypad" menu
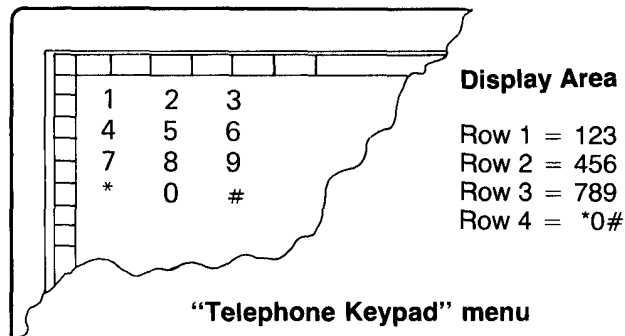
Column 1	Column 2	Column 3
1	2	3
4	5	6
7	8	9
*	0	# (clears Screen)

All Systems Go!

Now RUN the program. To use the program:

1. Move the Pen to the upper-left corner, press down, and a 1 will be displayed on the Screen.

2. Lift the Pen, move it to the right, and press it down again. As you move the Pen to the right, 1's will be displayed, then 2's, and then 3's (1, 2, and 3 are the Menu characters in the first row). Any point within the 3" x 4-1/4" boundary of this Menu returns a value on your Screen. When you go beyond the boundary of the Menu, the following message is displayed on the Screen telling you that you are off the menu:

    PEN IS NOT ON MENU

3. Move the Pen to the next line and press down at the left margin; a 4 is displayed. Move the Pen to the right and press down; 4's, 5's, and 6's will be displayed.

4. Move the Pen down the left margin to the next line; as you move the Pen across the Display Area, 7's, 8's, and 9's will be displayed.

5. Move the Pen further down the left margin, and begin moving it to the right (*'s and 0's appear). When you move it further, the Screen is cleared ("#" is assigned this area in the Menu program and "#" means CLS).

Menu — Through the Looking Glass

This Menu program can be a little hard to understand, so take a closer look.

Each time you write a Menu program, you must decide the size of each menu character (e.g., the size of the area defined). In this program, we decided we wanted the size of a Menu character to be about 1" x 1". Since there are 256 increments on the 9" X-axis, divide to find out how many increments are in 1" horizontal (the size of one

Menu character):

$$256/9 = 28.44 \text{ increments on X-axis}$$

Since there are 191 increments on the 7″ Y-axis, divide to find out how many increments are in 1″ vertical:

$$191/7 = 27.29 \text{ increments on Y-axis}$$

For convenience, go ahead and round both figures off to 28.

Picking On a Menu Your Own Size

The size of this telephone keyboard menu is 3″ wide x 4″ long. Why? Because in this program we decided each menu character would be 1″ x 1″. So, there are three characters in a row (3″ wide) and there are four characters in a column (4″ long).

Givin' the Menu the Third Degree

Take a closer look at some of the lines in the Menu program:

- In line 20, X-Pad data (stored in the memory addresses in line 250) is read: `20 GOSUB 250`

- In line 30, the Menu only displays information on the Screen when the Pen is down: `30 IF S<>3 THEN 20`

- In line 40, the row and column are found by dividing X and Y by 28. R is for row and C is for column:
  `40 R=INT(Y/28)+1:C+INT(X/28)+1`

This line means there are 28 increments on the Display Area until you come to another menu character. INT in this line tells the Computer to look only at the whole

portion (the "integer") of the number and ignore the decimal part.

- In lines 50, 230, and 240, conditions are set up if the Pen is on the X-Pad but off the Menu:

  ```
  50 IF R>4 OR C>3 THEN 230
  230 PRINT "*PEN IS NOT ON MENU*"
  240 GOTO 260
  ```

- Row 1 is at lines 110, 120, and 130; Row 2 at lines 140, 150, and 160; and Row 3 at lines 170, 180, and 190; Row 4 at lines 200, 210, and 220. In line 70, Row 1 causes the program to go to the desired line number:
  `70 ON C GOTO 110,120,130`

  In lines 80, 90, and 100, Rows 2, 3, and 4 are set respectively:

  ```
  80 ON C GOTO 140,150,160
  90 ON C GOTO 170,180,190
  100 ON C GOTO 200,210,220
  ```

- In lines 110 through 220, values are inserted for each Menu character along with a GOTO (the specified line) statement:

  ```
  110 PRINT "1";:GOTO 260
  120 PRINT "2";:GOTO 260
  130 PRINT "3";:GOTO 260
  140 PRINT "4";:GOTO 260
  150 PRINT "5";:GOTO 260
  160 PRINT "6";:GOTO 260
  170 PRINT "7";:GOTO 260
  180 PRINT "8";:GOTO 260
  190 PRINT "9";:GOTO 260
  200 PRINT "*";:GOTO 260
  210 PRINT "0";:GOTO 260
  220 CLS:GOTO 260
  ```

- Line 250 accesses the X-Pad memory addresses:
  ```
  250 X=PEEK(65376):Y=PEEK(65377)
      :S=PEEK(65378):RETURN
  ```

- In line 260, the Menu is to output only one Menu

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character at a time when the Pen is pressed down on the Menu: 260 IF PEEK(65376)=3 THEN 260

- Line 270 sends the program in a loop: 270 GOTO 20

The Menu Is In Your Court

You can easily alter this Menu program by simply changing the menu characters. Enter these lines in the program:

```
110 PRINT "A";:GOTO 260
120 PRINT "B";:GOTO 260
130 PRINT "C";:GOTO 260
140 PRINT "D";:GOTO 260
150 PRINT "E";:GOTO 260
160 PRINT "F";:GOTO 260
170 PRINT "G";:GOTO 260
180 PRINT "H";:GOTO 260
190 PRINT "I";:GOTO 260
200 PRINT "J";:GOTO 260
210 PRINT "K";:GOTO 260
```

You can vary the size of each row and column in your Menu by varying the row/column statement in your program. For example: R=INT(Y/50)+1:C=INT(X/50)+1

Here each Menu character is 50 increments wide and 50 increments long. R=INT(Y/15)+1:C=INT(X/20)+1

This statement sets each Menu character at 20 increments wide (X) and 15 increments long (Y). R=INT(Y/25)+1:C=INT(X/30)+1

In this statement, each Menu character is 30 increments wide and 25 increments long.

Go ahead and write your own Menu program.

☑ *Chapter 10 Checkpoint*

1. (True/False) Menu sets up a special pre-defined area to which you can assign values.

2. (True/False) A Menu can only be located in the margin area.

3. (True/False) Each time you write a Menu program, you must decide the size of the Menu character.

4. The values for each Menu character are chosen:
   a. by the Computer.
   b. by you in your program.
   c. randomly in memory.
   d. by the X-Pad.

11/ A Display Saved. . .

Feast your eyes on this: X-Pad has a quick, easy way to save your graphic displays on cassette for permanent storage.

If you're drawing a display and would like to take a break (even Rome wasn't built in a day), you can save the display on cassette, load it back later, and then finish drawing the display.

The concept of memory storage is easy to understand. When you save the display, the memory contents of the display are saved on cassette. This gives you a permanent copy of your display. (When the display is saved, it also stays on the Screen.)

There are two commands involved with memory storage:

- **CSAVEM** (saving memory).
- **CLOADM** (loading memory).

The CSAVEM command stores the graphic display as a machine-language file. CLOADM loads this machine-language file back into your Color Computer's memory and displays it on the Screen.

The following program is the "free-form drawing" program we discussed earlier. We've added the program lines you'll need to save and load the machine-language file.

```
10   C0SCREENPAGES=4
20   C1STARTPAGES=1
30   C2PAGELENGTH=1.5*1024
40   C3STARTSCREEN=(C1PAGESTART-1)
     *C2PAGELENGTH+&H600
50   C4ENDSCREEN=C0SCREENPAGES*
     C2PAGELENGTH+C3SCREENSTART
60   PMODE 4,1
70   PCLS
80   SCREEN 1,1
90   GOSUB 170
```

```
100 IF S<>3 AND S<>2 THEN 90
110 PSET(X,Y,1)
120 X1=X:Y1=Y
130 GOSUB 170
140 LINE(X1,Y1)-(X,Y),PSET
150 IF PEEK(65378)=3 THEN 120
160 GOTO 90
170 X=PEEK(65376):Y=PEEK(65377):S=PEEK
    (65378)
180 IF S<>15 THEN 230
190 SCREEN 0,0:CLS
200 INPUT"STORAGE FILENAME"
    ;V1SCREENFILE$
210 CSAVEM V1SCREENFILE$,
    C3STARTSCREEN,C4ENDSCREEN,0
220 SCREEN 1,1
230 IF S<>11 THEN 280
240 SCREEN 0,0:CLS
250 INPUT "LOAD FILENAME";
    V1SCREENFILE$
260 SCREEN 1,1
270 CLOADM V1SCREENFILE$
280 RETURN
```

Tele-Prompter

Included in this program are two prompts:

- A saving prompt for the name of the file to be saved ("STORAGE FILENAME?").
- A loading prompt for the name of the file to be loaded ("LOAD FILENAME?"). After each prompt, you'll have to type the filename and press (ENTER).

RUN the program and draw. To save your display on cassette:

1. Draw until you are ready to save.

2. Press the RECORD and PLAY buttons on your Cassette Recorder.

3. Press the Pen in the upper-left or upper-right corner of the margin. The display shifts to the Text Screen and prompts you for a filename.

4. Enter the name you want to call your file (the filename must conform to standard Color Computer syntax) and press (ENTER). The file begins saving when the cassette starts moving.

5. After the file is saved, the Graphics Screen returns, as well as the display.

Be sure to mark all your cassettes clearly with filenames so you won't have trouble locating them later.

CLOADM 'Em Up and Head 'Em Out!

(BREAK) the program (it's easier to see the program load on a clear Screen) and re-run it. To load the same display from cassette:

1. Rewind the cassette to the beginning or to the position where you began saving the file.

2. Press the PLAY button.

3. Move the Pen to the center of the top margin. The Screen shifts to Text Screen and you'll get the prompt for the filename. Type the filename and press (ENTER).

4. As soon as you press (ENTER), the Screen shifts to Graphics Screen, the file is loaded, and the Graphics Screen fills with the display, starting from the top of the Screen and proceeding to the bottom. The display is fully loaded when the cassette stops turning.

If you wish, you can press (ENTER) for the filename and the first file on the cassette will be loaded.

There's More To This Than Meets the Eye

Let's take a closer look at this program:

PMODE #	Pages Used
4	4
3	4
2	2
1	2
0	1

Line 10, C0SCREENPAGES = 4, sets the number of Screen Pages (4) needed for PMODE 4. This is the only variable in the program. You can change the number of pages for other PMODEs (you don't have to though; if you leave it at 4, you'll just save memory). As resolution gets lower, so do the number of memory pages needed for that resolution. For example, for PMODE 3, you still need four pages; for PMODE 2 and 1, you need two pages; and for PMODE 0, you need one page.

- Line 20, C1STARTPAGE = 1, sets the starting page.
- Line 30, C2PAGELENGTH = 1.5*1024, sets the length of each page (a constant).
- Line 40, C3STARTSCREEN = (C1PAGESTART-1) *C2PAGELENGTH + &H600, tells the Color Computer where to start saving the graphic display in memory.
- Line 50, C4ENDSCREEN = C0SCREENPAGES *C2PAGELENGTH + C3SCREENSTART, tells the Computer where to stop saving the display in memory.
- Line 180, IF S<>15 THEN 230, sets the upper-left and upper-right corners of the margin (S = 15) for CSAVEM.
- Line 190, SCREEN 0,0:CLS, sets Screen from Graphics to Text.
- Line 200, INPUT "STORAGE FILENAME";V1SCREENFILE$, prompts for the name of the file that you want saved.
- Line 210, CSAVEM V1SCREENFILE$,C3STARTSCREEN,

C4ENDSCREEN,0, sets the parameters for saving.
- Line 220, SCREEN 1,1, sets Screen back to Graphics and Color Set 1.
- Line 230, IF S<>11 THEN 280, sets the center of the top margin (S = 11) for CLOADM.
- Line 240, SCREEN 0,0:CLS, sets Screen from Graphics to Text.
- Line 250, INPUT"LOAD FILENAME";V1SCREENFILE$" prompts for the name of the file that you want loaded.
- Line 260, SCREEN 1,1, sets Screen back to Graphics and Color Set 1.
- Line 270, CLOADM V1SCREENFILE$, loads the file into memory.

☑ *Chapter 11 Checkpoint*

1. (True/False) The command CSAVEM loads a machine-language file into the Color Computer's memory.

2. When saving a graphic display, the number of Screen Pages depends on:
   a. how long the program is.
   b. Color Set.
   c. PMODE (resolution).
   d. PCLS.
   e. page length.

3. (True/False) When you want to load a file, rewind the cassette to the position where you began saving the file.

12/ Troubleshooting and Maintenance

The X-Pad does not require periodic maintenance but you should keep the Writing Surface clean, dry, and free of conductive materials including heavy pencil lead.

It is especially important to keep conductive materials away from the Writing Surface because these materials interfere when you are drawing.

Tender Loving Care

As a sensitive instrument, the X-Pad should be handled and stored carefully.

When you move the X-Pad:

- Carefully remove the Pak from the Color Computer after you turn the power OFF.
- Lift the X-Pad, making sure you are also holding the Pen and Cable to keep them from dangling. Note: To

avoid slippage, be sure the X-Pad is dry before you pick it up.

A Clean X-Pad is a Happy Pad

If you store your X-Pad on a desk, periodically clean the Writing Surface with a dry, lint-free cloth to remove dust and other particles. Lay a plastic cover or towel over the Pad to keep dust and other particles away from X-Pad when it is not in use.

Take It Easy On X-Pad (It Can't Take the Pressure)

To use X-Pad, you must put some pressure on the Pen tip,

but be sure the pressure is moderate.

On the Writing Surface, never:

- Press the Pen down heavily.
- Repetitively hit or "hammer" with the Pen.

Shooting Down the Trouble

If you have problems operating your X-Pad or Color Computer, refer to the following checklist for a solution. If, after checking the list, you haven't solved the problem, take your X-Pad and Color Computer to your Radio Shack store for service.

Symptom	Cure
Program or data does not operate.	1. Check program. Make sure X-Pad's addresses have been entered correctly.
	2. Check the cartridge connection. Be sure it is snugly in place in the slot on the right side of the Computer.
	3. Check to see how your Color Computer operates without the X-Pad connected. (This can narrow the problem down to either the Color Computer or the X-Pad.)

Symptom	Cure
Data does not correspond to the correct physical Pen location.	1. Make sure the surface of the paper is clean and dry.
	2. Be sure the material used on the surface is not conductive. (Standard-sized paper is preferable.)
	3. Pencil or felt-tip pen should not be used.
Pen down does not operate.	1. Be sure you are pressing the Pen against the paper with enough pressure. (The Pen must be pressed with enough force to activate the 'Switch' inside the Pen.)
	2. Tap your thumb near the Pen's grip rings to free the Switch.
	3. Loosen Pen's tip and retighten.
	4. Clean the Pen's tip with a rubber eraser.

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Appendix A/ Specifications

Data Format:	Three 8-bit words (X, Y, and status)
Data Speed:	Converts 106 (X-Y) coordinates per second
Pen:	X-Pad Pen Cartridge (Standard Fisher Space Pen Pressurized Refill No. PR4 medium black cartridge.)
Writing Surface:	8-1/2″ x 11″
Display Surface:	7″ x 9″
Paper Size:	8-1/2″ x 11″
Menu Area:	8″ x 10-1/2″
Dimensions:	.75″(H) x 13″(W) x 10.75″(L) (19 x 330 x 273 mm)
Resolution:	256 (X-axis) x 192 (Y-axis)
Ambient Temperature:	Operation: 41 to 104 F (5 to 40 C) Storage: 14 to 122 F (-10 to 50 C)
Humidity:	Operation: 40 to 80% Storage: 20 to 90% (non-condensing)
Power:	Supplied by Color Computer.
Weight:	2 lb. 10 oz. (1.193 kg)

Appendix B/ Pen Status Summary

	X-Pad Pen Status
Signal Sent to Computer	Meaning
0	Pen not down, out of range of Pad (Pen out of proximity)
1	Pen down, off Pad
2	Pen near Surface (within 1″) (Pen proximity only)
3	Pen down on Display Area or on bottom margin (Pen down and proximity)
4	Pen not within 1″ of X-margin (left or right margin)
5	X-margin and Pen down
6	Pen touching paper on X-margin (left or right margin) but Pen not down (X-margin and proximity)
7	Pen down on X-margin (left or right margin) (X-margin, Pen down, and proximity)
8	Pen not within 1″ of the Y-margin (top margin)
9	Y-margin and Pen down
10	Pen within 1″ of Y-margin (top margin) (Y-margin and proximity)
11	Pen down on Y-margin (top margin) (Y-margin, Pen down, and proximity)
12	X- and Y-margin
13	X- and Y-margin and Pen down
14	Pen touching paper in upper-right or upper-left X-Y corner but Pen not down (X- and Y-margin and proximity)
15	Pen down in upper-right or upper-left X-Y corner (X- and Y-margin, Pen down, and proximity)

Appendix C/ Chapter Checkpoint Answers

Chapter 1

1. c
2. b

Chapter 2

1. True
2. d
3. b

Chapter 3

1. Display Area and Menu Area
2. c
3. a
4. False
5. b

Chapter 4

1. False
2. True
3. False

Chapter 5

1. False
2. True
3. False
4. True

Chapter 6

1. True
2. False
3. True

Chapter 7

1. True
2. False
3. True

Chapter 8

1. True
2. True
3. False

Chapter 9

1. True
2. True
3. True
4. False
5. True
6. True

Chapter 10

1. True
2. False
3. True
4. c

Chapter 11

1. False
2. c
3. True

Appendix D/ X-Pad Data Interpretation

The X-Pad is one of the easiest peripherals to use. It simply outputs the X- and Y-coordinate positions and Pen Status information consisting of proximity, Pen down, and margin conditions.

The data is represented by numbers that vary from a value of 0 at the upper-left corner of the surface (the Origin) to their maximum values as the Pen is moved to the lower-right corner.

Each data output corresponds directly with a position on the Screen. Position numbers created by the X-Pad are the same as those that are manually keyed into the Computer to select a desired display location.

The Pen Status information provides additional capabilities in the use of the X-Pad. Pen proximity provides a means of disabling data when the Pen is out of range of the Writing Surface. X- and Y-margins tell when the Pen is beyond the 7" x 9" Display Area and defines left, top, and right margin areas that can be used for Menu or other purposes. A lower margin is not defined. However, a lower margin can be easily created in software. It should be noted that a Menu can be created in the Display Area, as well as in the Margin Area.

See Table 2 earlier in this manual for a description of Pen Status.

The Computer reads the X-Pad data and status information from three memory addresses — X = PEEK(65376), Y = PEEK(65377), S = PEEK(65378).

The X-Pad is fully buffered to allow the Computer to simply input or read the data and status information in a random or asynchronous fashion. When the X- data is read by the Computer, the Y-data and status word updates are inhibited to maintain a grouping of the coordinate data pair and status. This is to insure that the data and status are all read at a single time — so they represent the Pen at a single location while the Pen is moving. The status word can be read at any time, for example, while waiting for a Pen-down condition. X- data, Y-data, and status can then be read in order.

Data Format			
	1st Word	2nd Word	3rd Word	Description
Output	X-data	Y-data	Status	
Address	65376	65377	65378	The Interface is fully buffered to allow the Computer to read the data and status information.
Bits				When the X-data
D0	0 (LSB)	0 (LSB)	Pen Down	word is read by the
D1	1	1	Proximity	Computer, the Y-data
D2	2	2	X-margin	and status word
D3	3	3	Y-margin	updates are
D4	4	4	Logic 0	inhibited to maintain a grouping.
D5	5	5	Logic 0	
D6	6	6	Logic 0	The status word can
D7	7	7	Logic 0	be read at any time.

Appendix E/ Template/Menu Demonstration Program

The X-Pad Menu Demonstration Program will illustrate some more of the possibilities of your X-pad and must be used with the X-Pad Menu Template. The following program and the Template will allow you to:

- Use the graphics capabilites of your Color Computer without touching the keyboard.
- Simulate PRINT @ with the TEXT Command for labeling charts.
- Copy graphics from one screen location to another.
- Draw freehand in High Resolution Graphics and more!

The entire program requires a 32K Color Computer, but we'll show you how to run it on a 16K Computer.

```
20 REM XPAD DEMONSTRATION
30 REM
40 REM
41 REM TOP MENU FUNCTIONS:
42 REM    BOX 1 COPY CONTENTS OF BOX TO NEW LOCATION
43 REM    BOX 2 ENTER TEXT FROM KEYBOARD AT GIVEN LOCATION
44 REM    BOX 3 DRAW CONTINUOUSLY WHILE PEN IS DOWN
45 REM    BOX 4 PAINT COLOR SELECTED FROM LOWER MENU
46 REM    BOX 5 ERASE A LINE
47 REM    BOX 6 DRAW A STRAIGHT LINE BETWEEN TWO POINTS
48 REM    BOX 7 DRAW A CIRCLE AROUND A CENTER POINT WITH
DEFINED RADIUS
49 REM    BOX 8 DRAW A BOX AT DIAGONAL CORNER POINTS
50 REM    BOX 9 CLEAR THE SCREEN
51 REM
52 REM BOTTOM MENU COLORS:
53 REM    BOX 1 BLACK
54 REM    BOX 2 GREEN
55 REM    BOX 3 YELLOW
56 REM    BOX 4 BLUE
57 REM    BOX 5 RED
58 REM    BOX 6 BUFF
59 REM    BOX 7 CYAN
60 REM    BOX 8 MAGENTA
61 REM    BOX 9 ORANGE
62 REM
70 REM ***********************
80 REM SOME HANDY VARIABLES:
90 REM X=HORIZONTAL PEN POSIT
```

```
100 REM Y=VERTICAL PEN POSIT
110 REM S=PEN STATUS
120 REM MU=CURRENT MENU FUNCTION
130 REM C=CURRENT PAINT COLOR
140 REM B=CURRENT BORDER COLOR
150 REM TP=TEXT POSIT SELECTED
152 REM CS=COLOR SET
160 REM ***********************
161 REM
162 REM THIS PROGRAM WILL RUN IN A 16K MACHINE
163 REM IF THE FOLLOWING LINES ARE DELETED:
164 REM 200-210,610-690,1080,1160
165 REM THIS DISABLES THE "COPY" FUNCTION
170 REM
180 REM INITIALIZE PROGRAM
210 DIM V(30,30)
220 DIM AZ$(25)
230 FOR LE = 0 TO 25
240 READ AZ$(LE)
250 NEXT LE
260 CS=1
270 PCLS:PMODE 3,1:SCREEN 1,CS
280 MU=0
290 REM
300 REM ***********************
310 REM TOP OF MAIN LOOP
320 REM DECODE PEN STATUS AND
330 REM DISPATCH ACCORDINGLY
332 REM IF TEXT IS BEING ENTERED
334 REM DECODE AND DRAW THE LETTER
340 REM ***********************
350 GOSUB 2870
360 IF S>15 THEN 350
370 S=S+1: REM "ON S" MUST START WITH 1
380 ON S GOSUB
2900,2900,530,780,2900,2900,2900,3630,2900,2900,2900,890,2900
,2900,2900,2900
390 IF MU<>2 THEN 350
400 IF TP=0 THEN 350
410 A$=INKEY$
420 IF A$="" THEN 350
430 IF "A">A$ OR "Z"<A$ THEN 350440 DRAW AZ$(ASC(A$)-65)
450 DRAW "BR5BU7"
460 GOTO 350
470 REM
480 REM ***********************
490 REM PEN STATUS 2:
500 REM "PEN NOT DEPRESSED"
510 REM DISPLAY CURSOR
```

49

```
512 REM IF DOING A "COPY" DISPLAY
514 REM THE FLOATING BOX
520 REM ***********************
530 IF MU=1 THEN 600
540 A=PPOINT(X,Y)
550 FOR W = 0 TO 8
560 PSET (X,Y,W)
570 NEXT W
580 PSET (X,Y,A)
590 RETURN
592 REM DISPLAY FLOATING BOX FOR "COPY"
600 IF X<15 THEN X=15
602 IF Y<15 THEN Y=15
604 IF X>240 THEN X=240
606 IF Y>176 THEN Y=176
610 PMODE 3,5
620 SCREEN 1,CS
630 PCOPY 1 TO 5
640 PCOPY 2 TO 6
650 PCOPY 3 TO 7
660 PCOPY 4 TO 8
670 LINE (X-15,Y-15)-(X+15,Y+15),PSET,B
680 PMODE 3,1
690 SCREEN 1,CS
700 RETURN
710 REM
720 REM ***********************
730 REM PEN STATUS 3:
740 REM "PEN DEPRESSED ON THE DISPLAY AREA"
750 REM DISPATCH TO THE FUNCTION760 REM SELECTED ON THE MENU
770 REM ***********************
780 ON MU GOSUB 1030,1520,1700,1850,2070,2190,2400,2620,2800
790 RETURN
800 REM
810 REM ***********************
820 REM PEN STATUS 11:
830 REM "PEN DEPRESSED ON THE TOP MENU"
840 REM WAIT UNTIL IT IS LIFTED
850 REM CALCULATE WHICH BOX
860 REM DISPATCH TO ANY THAT
870 REM NEED IMMEDIATE ACTION
880 REM ***********************
890 GOSUB 2890
900 IF S=11 THEN 890
910 MU=INT(X/28.334)+1
920 PLAY STR$(MU)
940 ON MU GOSUB 1010,1502,2900,1810,2900,2160,2370,2590,2800
950 RETURN
960 REM
970 REM ***********************
980 REM TOP MENU BOX 1:
990 REM "COPY CONTENTS OF THE BOX"
1000 REM ***********************
1010 SW=0
1020 RETURN
1030 ON SW GOTO 1120
1040 GOSUB 2890
1050 IF S=3 THEN 1040
1060 IF X<15 THEN X=15
1070 IF Y<15 THEN Y=15
1072 IF X>240 THEN X=240

1074 IF Y>176 THEN Y=176
1080 GET (X-15,Y-15)-(X+15,Y+15),V,G
1090 SW=1
1100 RETURN
1110 REM ENTRY POINT FOR "PUT" END OF THE MOVE
1120 GOSUB 2890
1130 IF S=3 THEN 1120
1140 IF X<15 THEN X=15
1150 IF Y<15 THEN Y=15
1152 IF X>240 THEN X=240
1154 IF Y>176 THEN Y=176
1160 PUT (X-15,Y-15)-(X+15,Y+15),V,PSET
1170 SW=0
1180 MU=0
1190 RETURN
1200 REM
1210 REM ***********************
1220 REM TOP MENU BOX 2:
1230 REM "TEXT"
1240 REM ***********************
1250 DATA BD1D6U4NR5U2E1R3F1D6
1260 DATA ND7R4F1D1G1NL4F1D2G1NL4BR1
1270 DATA BD1D5F1R3E1U1BU3U1H1L3G1BD6BR5
1280 DATA D7R4E1U5H1L4BD7BR5
1290 DATA NR5D3NR4D4R5
1300 DATA NR5D3NR4D4BR5
1310 DATA BD1D5F1R3E1U2NL2BU2U1H1L3G1BD6BR5
1320 DATA D7U4R5NU3D4
1330 DATA R4L2D7L2R4BR1
1340 DATA BD5D1F1R3E1U6BD7
1350 DATA D7U4R3E2NU1G2F2D2
1360 DATA D7R5
1370 DATA ND7F2BD1E3D7BR2
1380 DATA D1ND6E1R3F1D6
1390 DATA BD1D5F1R3E1U5H1L3G1BD6BR5
1400 DATA ND7R4F1D2G1L4BD3BR5
1410 DATA BD1D5F1R3E1U5H1L3G1D4BR3F2
1420 DATA ND7R4F1D1G1NL4F1D3
1430 DATA BD1D1F1R3F1D2G1L3H1BU5E1R3F1BD6
1440 DATA R4L2D7BR3
1450 DATA D6F1R3E1U6BD7
1460 DATA D5F2E2U5BD7BR1
1470 DATA D7E3F3U7BD7BR1
1480 DATA D1F5D1BL5U1E5U1BD7
1490 DATA D2F2ND3E2U2BD7BR1
1500 DATA R5D1G5D1R5
1502 TP=0: 'TEXT POSIT NOT SELECTED
1504 RETURN
1510 REM ENTRY FOR TEXT POSITION
1520 GOSUB 2890
1530 IF S=3 THEN 1520
1540 DRAW "S4"
1550 DRAW "BM0,0"
1560 IF X>0 THEN
1570 FOR I = 1 TO X
1580 DRAW "BR1"
1590 NEXT I
1600 IF Y>0 THEN
1610 FOR I = 1 TO Y
1620 DRAW "BD1"
1630 NEXT I
```

50

```
1640 TP=1: 'TEXT POSIT SELECTED
1650 RETURN
1660 REM **********************
1670 REM TOP MENU BOX 3:
1680 REM "DRAW"
1690 REM **********************
1700 PSET(X,Y,1)
1710 X1=X:Y1=Y
1720 GOSUB 2870
1730 IF S<>3 THEN RETURN
1740 LINE(X1,Y1)-(X,Y),PSET
1750 GOTO 1710
1760 REM
1770 REM **********************
1780 REM TOP MENU BOX 4:
1790 REM "PAINT"
1800 REM **********************
1810 B=8: C=8
1820 SW=0
1830 RETURN
1840 REM ENTRY TO SELECT COLOR
1850 ON SW GOTO 1970
1860 GOSUB 2890
1870 IF S=3 THEN 1860
1880 IF Y<192 THEN RETURN
1890 C=INT(X/28.334)
1900 CS=0
1910 IF C>4 THEN CS=1
1920 SCREEN 1,CS
1930 PLAY STR$(C+1)
1940 SW=1
1950 RETURN
1960 REM ENTRY TO SELECT AREA TO PAINT
1970 GOSUB 2890
1980 IF S=3 THEN 1970
1990 IF Y>191 THEN RETURN
2000 PAINT (X,Y),C,B
2010 RETURN
2020 REM
2030 REM **********************
2040 REM TOP MENU BOX 5:
2050 REM "ERASE"
2060 REM **********************
2070 PSET (X,Y,1)
2072 X1=X:Y1=Y
2074 GOSUB 2870
2076 IF S<>3 THEN RETURN
2078 LINE (X1,Y1)-(X,Y),PRESET
2080 GOTO 2072
2090 PSET(X,Y)
2110 REM
2120 REM **********************
2130 REM TOP MENU BOX 6:
2140 REM "LINE"
2150 REM **********************
2160 SW=0
2170 RETURN
2180 REM ENTRY FOR FIRST END POINT
2190 ON SW GOTO 2270

2200 GOSUB 2890
2210 IF S=3 THEN 2200
2220 PSET (X,Y)
2230 X1=X:Y1=Y
2240 SW=1
2250 RETURN
2260 REM ENTRY FOR SECOND END POINT
2270 GOSUB 2890
2280 IF S=3 THEN 2270
2290 LINE (X1,Y1)-(X,Y),PSET
2300 SW=0
2310 RETURN
2320 REM
2330 REM **********************
2340 REM TOP MENU BOX 7:
2350 REM "CIRCLE"
2360 REM **********************
2370 SW=0
2380 RETURN
2390 REM ENTRY FOR CENTER POINT
2400 ON SW GOTO 2480
2410 GOSUB 2890
2420 IF S=3 THEN 2410
2430 PSET (X,Y)
2440 X1=X:Y1=Y
2450 SW=1
2460 RETURN
2470 REM ENTRY FOR RADIUS
2480 L=ABS(X1-X):C=ABS(Y1-Y)
2490 D=SQR((L*L)+(C*C))
2500 CIRCLE (X1,Y1),D
2510 PRESET (X1,Y1)
2520 SW=0
2530 RETURN
2540 REM
2550 REM **********************
2560 REM TOP MENU BOX 8:
2570 REM "BOX"
2580 REM **********************
2590 SW=0
2600 RETURN
2610 REM ENTRY FOR FIRST CORNER POINT
2620 ON SW GOTO 2700
2630 GOSUB 2890
2640 IF S=3 THEN 2630
2650 PSET (X,Y)
2660 X1=X:Y1=Y
2670 SW=1
2680 RETURN
2690 REM ENTRY FOR DIAGANOL CORNER POINT
2700 GOSUB 2890
2710 IF S=3 THEN 2700
2720 LINE (X1,Y1)-(X,Y),PSET,B
2730 SW=0
2740 RETURN
2750 REM
2760 REM **********************
2770 REM TOP MENU BOX 9:
2780 REM "CLEAR DISPLAY AREA"
2790 REM **********************
```

```
2800 PCLS
2810 RETURN
2820 REM
2830 REM **********************
2840 REM ROUTINE TO READ STATUS
2850 REM AND POSITION OF PEN
2860 REM **********************
2870 X=PEEK(65376)
2880 Y=PEEK(65377)
2890 S=PEEK(65378)
2900 RETURN
```

Appendix F has a Subprogram you can add to your Menu Demonstration Program that let's you define your own menu.

Your X-Pad comes supplied with a cassette which includes the Template/Menu Demonstration Program listed above. Follow the steps below to use the Template/ Menu Demonstration Program.

1. Put a piece of drawing paper into the X-Pad, then put the Template over the paper with the row of Commands at the top and the row of Colors at the bottom. Tape the corners to hold it securely in place.

2. Type NEW (ENTER).

3. When the OK prompt is displayed, type PCLEAR 8 (ENTER).

4. CLOAD the program from tape.

5. If your Color Computer has only 16K of RAM (Random Access Memory), after loading the program, delete the following lines:

   200-210
   610-690
   1080
   1160

   The program will operate the same, except that the COPY routine will not be included.

6. Type PCLS (ENTER).

7. RUN the program.

8. Turn up the volume on your television receiver so you can hear the tones played when you press your Pen into the Command Boxes.

   If graphic characters appear on the screen when you first run the program, press the pen into the CLEAR box on the Template and continue.
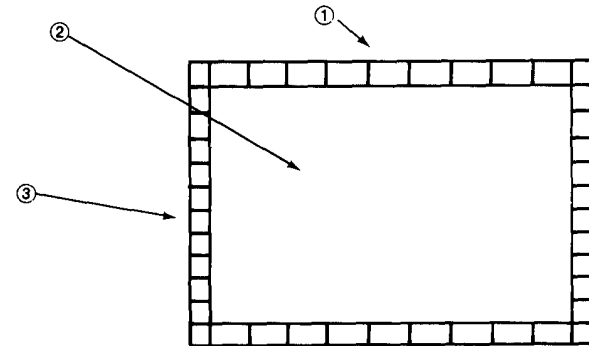
Template

① The Command Margins. Press your Pen Point in this area to tell the Menu Demonstration Program what you want to do next.

② The Display Area. This is the area that will be displayed on the Screen.

③ User Definable Commands. Use these boxes to write your own program later.

Once the program is running, try all the items below to become familiar with all the features of the program.

The Cursor

Hold the Pen so that it is within 2″ of the Display area (but not touching) and notice that a very small flashing Cursor appears on the Screen, showing you "where you are" on the screen. You do not need to touch the Template at all. If you move the Pen Point too far away from the

surface of the Template the Cursor will disappear. It will reappear when you bring the point back to within 2″ of the Template. The Cursor will also disappear if you press the pen point against the Template.

Operating the Demonstration Program is easy. You tell the program what you want to do — by touching one of the commands across the top of the Template, then where you want to do it by touching the Pen Point one or more times on the Display Area.

The boxes along the top of the page are commands. They represent the things you can do with the Demonstration Program. Try each one out as we explain it.

COPY

Copy to another Screen Location

Press your Pen Point into this box and a rectangle will appear on the Screen at the Cursor position. You can move the rectangle around the Screen by moving the Pen. If you move further than a 2″ or so up from the surface, the rectangle will disappear. It will reappear when you move the Pen closer to the Surface. When you press the point down, whatever is in the rectangle at that moment will be stored in the Color Computer's memory.

COPY uses the Extended BASIC commands GET and PUT to move graphics from place to place on the Screen.

When you relocate the rectangle to another place on the Screen, a copy of the original contents of the rectangle will appear at the new location. The COPY routine must be deleted if the program is to run on a 16K Color Computer.

TEXT

Write on the Screen

Press your Pen Point into the TEXT box, then select a point on the Display Area and press the Pen down again.

Now any keys you type on the Keyboard will appear on the Screen starting at the point you selected. You may type text until you reach the right edge of the Screen. After that, all the characters you type will stack up on top of each other in the last box.

The letters displayed on the Screen are not the same letters normally displayed in program listings, program output etc. They are actually 'graphic" characters created using the Extended Color BASIC DRAW command.

TEXT uses the Color Computer command PRINT @ to position the text, and is very handy for printing labels for your displays.

DRAW

Draw Freehand

Press your Pen Point into this box to draw. When you draw a line on the Pad, the line will appear on the Screen just as though you were drawing with a Pen. This command uses the Color Computer DRAW command.

PAINT

Color in a Closed Area

To Paint a closed-in portion of the Screen:

1. Press the Pen down inside the PAINT box.

2. Press the Pen down inside one of the 9 COLOR boxes along the bottom of the Template.

3. Press the Pen down inside a closed shape on the Screen. The area you select will be painted the color you selected.

A "closed area" is one completely enclosed by lines. If the area you select isn't completely enclosed, paint will "leak out" and may paint the entire Screen! If this happens, just "stop up" the hole and paint the area again. Of course, you may paint the background also, or the whole Display Area. Refer to pages 48-51 of *Going Ahead With Extended Color BASIC*.

ERASE

Erase a Previously Drawn Line

Position the tip of the Pen over the line you wish to eliminate. Press down on the Pen and "erase" as if you were using an eraser on a pencil.

LINE

Draw a Line

Press your Pen point into this box, then specify two points on the Display area by pressing at each point with your Pen Point. A line connecting the points will appear.

BOX

Draw a Box

Press your Pen down inside this box, then locate two points on the Display Area the same way. The two points you select will be the corners of the box. Each rectangle will have sides parallel to the frame of the Display Area.

CIRCLE

Draw a Circle

Press the Pen Point into the box labeled CIRCLE, then specify two points in the Display area using the Pen Point. The first point sets the center of the circle and the second point sets the radius of the circle. If the circle is too large for the Screen, the edge of the Screen will be colored for that portion of the circle that is off the Screen.

CLEAR

Clear the Screen

Press the Pen Point into this box and everything you've drawn will be erased.

Hints and Tips

- Don't move the Pen too fast. The program requires some time to read the new data. If you go too fast, it may miss data.

- New data is not sent to the program until the point of the Pen comes up from the Template.

- Listen for the tone to sound before giving the next command or selecting the next point.

- When using the Template, be sure to press your Pen Point into the punched hole of the Menu Box to activate your selection.

Appendix F/ Defining Your Own Menu Commands

The Menu Demonstration Program uses the boxes along the top margin for commands and the boxes along the bottom margin for color selection. Rather than let the boxes along the right and left side go to waste, let's add a short subprogram using those boxes.

To control a Computer you must somehow input data into it. X-Pad inputs data through the position of the Pen. By positioning the Pen into one of the boxes along the right margin, we are going to put a number into a variable. The program can then use that number to decide what to do next.

The new routine puts the number of the box the Pen is in into a variable called BX. Then it branches to one of 5 subroutines based on the value of BX. Each subroutine draws a schematic symbol on the screen. You can use boxes 5-9 to branch to your own subroutines to draw other symbols.

Symbol	Represents	Program Line
⋀⋀	horizontal resistor	3010
⅀	vertical resistor	3150
⊣⊢	horizontal capacitor	3300
⊥	vertical capacitor	3410
⊕	transistor	3530

Putting a number into BX really involves locating the Pen Point, which is done in several steps:

- Is the Pen on the paper at one of the Side Margins? (Line 30)
- Is the Pen at the Right Margin? (Line 40)
- How far down the right side is the Pen? (Line 50)

There are 192 increments along the vertical (Y) axis, divided into 10 boxes, so every 19.2 increments down equals 1 box.

Look at line 50 and suppose Y is 102. 102/19.2 = 5.3125. The result is between 5 and 6 so we know we are in box 5. INT (Y/19.2) will give just the whole number part, which is the box number.

- Is the Pen up? (Line 60)

Line 60 says "Keep executing this line until the Pen comes up from the Template". This makes the program wait first for a Pen Down and then a Pen Up to procede. Without this line, the program would continue printing the box number as long as you hold the pen down. (Try it!)

Line 70 GOSUBs to the specified routine. This is the point you will want to add your own lines, using BX to GOSUB or GOTO to your own routines.

Finally Line 80 jumps back to the beginning to repeat the whole program until you stop it with (BREAK).

This is a listing of the Subprogram to use the boxes along the right side to draw schematic symbols. You must change Line 380 of the Main Program, to GOSUB to the new Subprogram when S = 7. This is done by changing the seventh number after the GOSUB from 2900 to 3630:

Note: An FC Error will occur if you select a User Definable Box which has not been assigned a value after previously selecting a Command Box.

```
3000 REM ************************
3010 REM ROUTINE TO DISPLAY
3020 REM HORIZONTAL RESISTOR
3030 REM ************************
3040 GOSUB 2870:IF S<>3 THEN GOSUB 540 : GOTO 3040
3050 SN=6:A=5
3060 LINE(X,Y)-(X+A,Y),PSET:X=X+A
3070 FOR I=1 TO 10
3080 X1=X:Y1=Y:X=X+4
3090 IF I MOD 2=0THEN SN=-SN
3100 Y=Y+SN
3110 LINE(X1,Y1)-(X,Y),PSET
3120 NEXT I
3130 LINE (X,Y)-(X+A,Y),PSET
3140 RETURN
3150 REM ************************
```

```
3160 REM ROUTINE TO DISPLAY
3170 REM A VERTICAL RESISTOR
3180 REM ************************
3190 GOSUB 2870:IF S<>3 THEN GOSUB 540 : GOTO 3190
3200 SN=6:A=5
3210 LINE(X,Y)-(X,Y+A),PSET:Y=Y+A
3220 FOR I=1TO10
3230 X1=X:Y1=Y:Y=Y+2
3240 IF I MOD 2 = 0 THEN SN=-SN
3250 X=X+SN
3260 LINE(X1,Y1)-(X,Y),PSET
3270 NEXT I
3280 LINE(X,Y)-(X,Y+A),PSET
3290 RETURN
3300 REM ************************
3310 REM ROUTINE TO DISPLAY
3320 REM A HORIZONTAL CAPACITOR
3330 REM ************************
3340 GOSUB 2870 : IF S<> 3 THEN GOSUB 540 : GOTO 3340
3350 A=5
3360 LINE(X-2*A,Y+A)-(X+2*A,Y+A),PSET
3370 LINE(X-2*A,Y+2*A)-(X+2*A,Y+2*A),PSET
3380 LINE(X,Y)-(X,Y+A),PSET
3390 LINE(X,Y+2*A)-(X,Y+3*A),PSET
3400 RETURN
3410 REM ************************
3420 REM ROUTINE TO DISPLAY
3430 REM A VERTICAL CAPACITOR
3440 REM ************************
3450 GOSUB 2870:IF S<>3 THEN GOSUB 540 : GOTO 3450
3460 A=5
3470 LINE(X+A,Y-A)-(X+A,Y+A),PSET
3480 LINE(X+2*A,Y-A)-(X+2*A,Y+A),PSET
3490 LINE(X,Y)-(X+A,Y),PSET
3500 LINE(X+2*A,Y)-(X+3*A,Y),PSET
3510 RETURN
3520 REM ************************
3530 REM ROUTINE TO DISPLAY
3540 REM A TRANSISTOR SYMBOL
3550 REM ************************
3560 GOSUB 2870:IF S<>3 THEN GOSUB 540: GOTO 3560
3570 A=10
3580 LINE(X,Y)-(X+2*A,Y),PSET
3590 LINE(X+2*A,Y-A)-(X+2*A,Y+A),PSET
3600 LINE(X+2*A,Y+A/3)-(X+4*A,Y+2*A),PSET
3610 LINE(X+2*A,Y-A/3)-(X+4*A,Y-2*A),PSET
3620 RETURN
3630 REM SIDE BOX IDENTIFICATION
3640 SW=0:MU=0
3650 BX=INT(Y/19.2)+1
3660 PLAY STR$(BX)
3670 IF PEEK(65378)=7 THEN 3670
3680 ON BX GOTO 3040,3190,3340,3450,3560,3620
3690 RETURN
```

The Sample Program uses X-data, Y-data, and Pen Status data for program control.

Pen Status is a number from 0 to 15. There are four switches that determine the value of S. Each switch can be OFF or ON. 0 means the switch is OFF.

For example, 0 means the Pen is not within 2″ of the Surface, the Pen is not within about 1″ of the Left or Right Margin or within approximately 1″ of the top margin, etc.

1 means the switch is ON, indicating that the Pen is within about 1″ of some margin, or within 2″ of the Surface etc.

Pen Status Table					
S	**Top Margin**	**L/R Margin**	**Proximity**	**Pen Switch**	
0	0	0	0	0	
1	0	0	0	1	
2	0	0	1	0	
3	0	0	1	1	
4	0	1	0	0	
5	0	1	0	1	
6	0	1	1	0	
7	0	1	1	1	
8	1	0	0	0	
9	1	0	0	1	
10	1	0	1	0	
11	1	0	1	1	
12	1	1	0	0	
13	1	1	0	1	
14	1	1	1	0	
15	1	1	1	1	

Top Margin

When the Pen is within about 1″ of the top margin, this switch is set (1).

L/R Margin

When the Pen is within about 1″ of either the right or left margin, this switch will be set (1).

Proximity

When the Pen is within 1″ of the Surface, this switch will be set (1).

Pen Switch

When the point of the Pen is pressed, this switch is set (1).

For Example, the Sample Program uses $S = 7$ to decide on a course of action. From the table, we can see that $S = 7$ means that the Pen is down, within 1″ of one of the two side margins. The Pen Switch is ON, the L/R Margin Switch is ON, and the Proximity Switch is ON.

The Pen is not within 1″ of the Top Margin so that switch is OFF.

For a second example, $S = 15$ would mean the Pen is down in one of the upper-left or right corner boxes.

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