TRRS-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.

Warning: This equipment has been certified to comply with the limits for a Class B computing device, pursuant to Subpart J of Part 15 of FCC Rules. Only peripherals (computer input/output devices, terminals, printers, etc.) that are certified to comply with the Class B limits may be attached to this computer. Operation with non-certified peripherals is likely to result in interference to radio and TV reception.

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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.
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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!

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.
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:
   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.

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.)

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).
### Color Computer/X-Pad Memory Locations

<table>
<thead>
<tr>
<th>Address</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>65376</td>
<td>Reads the current X-Axis Coordinate on the horizontal axis.</td>
</tr>
<tr>
<td>65377</td>
<td>Reads the current Y-Axis Coordinate on the vertical axis.</td>
</tr>
<tr>
<td>65378</td>
<td>Reads the current Pen Status.</td>
</tr>
</tbody>
</table>

**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](image)

**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:

```plaintext
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(6537B)=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(6537B)=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.
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.
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 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

---

**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,
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:

   ```plaintext
   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 ($S = \text{PEEK}(65378)$) 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:

```plaintext
100 IF S<>3 THEN 90
220 IF S=15 THEN RETURN
```}

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

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.
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).

---

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.
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.
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=PPINT (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 or 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:

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

60 PSET(X,Y,1)
70 X1=X;Y1=Y
80 GOSUB 120
90 IF $<>3 THEN GOTO 40
100 LINE(X1,Y1)-(X,Y),PSET
110 GOTO 70
120 X=PEEK(65376);Y=PEEK(65377)
   $=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\textsuperscript{4}). 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 60
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.
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(A2/37384)  
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 \(\pi r^2 = 3.14159265 \times (1) = 3.14\) (rounded to three significant digits).

\(\square\) 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

<table>
<thead>
<tr>
<th>Line</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>PMODE 4,1</td>
</tr>
<tr>
<td>20</td>
<td>PCLS</td>
</tr>
<tr>
<td>30</td>
<td>SCREEN 1,1</td>
</tr>
<tr>
<td>40</td>
<td>GOSUB 150</td>
</tr>
<tr>
<td>50</td>
<td>IF S&lt;&gt;3 THEN 40</td>
</tr>
<tr>
<td>60</td>
<td>PSET(X,Y,1)</td>
</tr>
<tr>
<td>70</td>
<td>IF PEEK(65378)=3 THEN GOTO 70</td>
</tr>
<tr>
<td>80</td>
<td>X1=X;Y1=Y</td>
</tr>
<tr>
<td>90</td>
<td>GOSUB 150</td>
</tr>
<tr>
<td>100</td>
<td>IF S&lt;&gt;3 THEN GOTO 90</td>
</tr>
<tr>
<td>110</td>
<td>L=ABS(X1-X)+1:C=ABS(Y1-Y)+1:R =SQR((L<em>L)+(C</em>C))</td>
</tr>
<tr>
<td>115</td>
<td>REM COMPUTES CIRCLE'S SIZE</td>
</tr>
<tr>
<td>120</td>
<td>CIRCLE (X1,Y1),R</td>
</tr>
<tr>
<td>130</td>
<td>IF PEEK(65378)=3 THEN 130</td>
</tr>
<tr>
<td>140</td>
<td>GOTO 40</td>
</tr>
<tr>
<td>150</td>
<td>X=PEEK(65376);Y=PEEK(65377)</td>
</tr>
<tr>
<td></td>
<td>:S=PEEK(65378):RETURN</td>
</tr>
</tbody>
</table>
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.
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:

<table>
<thead>
<tr>
<th>Color Set</th>
<th>Colors Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>green/yellow/blue/red (green is the background color and you can set the three margins to the other three colors)</td>
</tr>
<tr>
<td>1</td>
<td>buff/cyan/magenta/orange (buff is the background color)</td>
</tr>
</tbody>
</table>

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

- left = 3 (blue)
- right = 2 (yellow)
- top = 4 (red)
- bottom = clears the Screen
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):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,0:GOTO 240
300 A=POINT(X,Y)
310 IF A<>5 THEN 360
320 PSET(X,Y,B)
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.
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:

```
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
```

Figure 7. Telephone Keyboard
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:

```
1 2 3  Row 1 = 123
4 5 6  Row 2 = 456
7 8 9  Row 3 = 789
* 0   #  Row 4 = "0#"
```

### Telephone Keypad menu

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>*</td>
<td>0</td>
<td># (clears Screen)</td>
</tr>
</tbody>
</table>

---

### 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:
  \[ R=\text{INT}(Y/28)+1; C=\text{INT}(X/28)+1 \]
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 ":":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
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.
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+$H600
50 C4ENDSCREEN=C0SCREENPAGES*
   C2PAGELENGTH+C3SCREENSTART
60 PMODE 4,1
70 PCLS
80 SCREEN 1,1
90 GOSUB 170
```
100 IF S<>3 AND S<>2 THEN 90
110 PSET(X,Y,1)
120 X1=X:Y1=Y
130 GOSUB 170
140 LINE(X1,Y1)-(X,Y),PSET
150 IF PEEK(65378)=3 THEN 120
160 GOTO 90
170 X=PEEK(65376):Y=PEEK(65377):S=PEEK(65378)
180 IF S<>15 THEN 230
190 SCREEN 0:CLS
200 INPUT"STORAGE FILENAME";
   V1SCREENFILE$
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:

<table>
<thead>
<tr>
<th>PMODE #</th>
<th>Pages Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Cure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program or data does not operate.</td>
<td>1. Check program. Make sure X-Pad’s addresses have been entered correctly.</td>
</tr>
<tr>
<td></td>
<td>2. Check the cartridge connection. Be sure it is snugly in place in the slot on the right side of the Computer.</td>
</tr>
<tr>
<td></td>
<td>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.)</td>
</tr>
<tr>
<td>Data does not correspond to the correct physical Pen location.</td>
<td>1. Make sure the surface of the paper is clean and dry.</td>
</tr>
<tr>
<td></td>
<td>2. Be sure the material used on the surface is not conductive. (Standard-sized paper is preferable.)</td>
</tr>
<tr>
<td></td>
<td>3. Pencil or felt-tip pen should not be used.</td>
</tr>
<tr>
<td>Pen down does not operate.</td>
<td>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.)</td>
</tr>
<tr>
<td></td>
<td>2. Tap your thumb near the Pen’s grip rings to free the Switch.</td>
</tr>
<tr>
<td></td>
<td>3. Loosen Pen’s tip and retighten.</td>
</tr>
<tr>
<td></td>
<td>4. Clean the Pen’s tip with a rubber eraser.</td>
</tr>
</tbody>
</table>
# Appendix A/ Specifications

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

<table>
<thead>
<tr>
<th>Signal Sent to Computer</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Pen not down, out of range of Pad (Pen out of proximity)</td>
</tr>
<tr>
<td>1</td>
<td>Pen down, off Pad</td>
</tr>
<tr>
<td>2</td>
<td>Pen near Surface (within 1&quot;) (Pen proximity only)</td>
</tr>
<tr>
<td>3</td>
<td>Pen down on Display Area or on bottom margin (Pen down and proximity)</td>
</tr>
<tr>
<td>4</td>
<td>Pen not within 1&quot; of X-margin (left or right margin)</td>
</tr>
<tr>
<td>5</td>
<td>X-margin and Pen down</td>
</tr>
<tr>
<td>6</td>
<td>Pen touching paper on X-margin (left or right margin) but Pen not down (X-margin and proximity)</td>
</tr>
<tr>
<td>7</td>
<td>Pen down on X-margin (left or right margin) (X-margin, Pen down, and proximity)</td>
</tr>
<tr>
<td>8</td>
<td>Pen not within 1&quot; of the Y-margin (top margin)</td>
</tr>
<tr>
<td>9</td>
<td>Y-margin and Pen down</td>
</tr>
<tr>
<td>10</td>
<td>Pen within 1&quot; of Y-margin (top margin) (Y-margin and proximity)</td>
</tr>
<tr>
<td>11</td>
<td>Pen down on Y-margin (top margin) (Y-margin, Pen down, and proximity)</td>
</tr>
<tr>
<td>12</td>
<td>X- and Y-margin</td>
</tr>
<tr>
<td>13</td>
<td>X- and Y-margin and Pen down</td>
</tr>
<tr>
<td>14</td>
<td>Pen touching paper in upper-right or upper-left X-Y corner but Pen not down (X- and Y-margin and proximity)</td>
</tr>
<tr>
<td>15</td>
<td>Pen down in upper-right or upper-left X-Y corner (X- and Y-margin, Pen down, and proximity)</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Bits</th>
<th>1st Word</th>
<th>2nd Word</th>
<th>3rd Word</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>0 (LSB)</td>
<td>0 (LSB)</td>
<td>Pen Down</td>
<td>The Interface is fully buffered to allow the Computer to read the data and status information. When the X-data word is read by the Computer, the Y-data and status word updates are inhibited to maintain a grouping.</td>
</tr>
<tr>
<td>D1</td>
<td>1</td>
<td>1</td>
<td>Proximity</td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td>2</td>
<td>2</td>
<td>X-margin</td>
<td></td>
</tr>
<tr>
<td>D3</td>
<td>3</td>
<td>3</td>
<td>Y-margin</td>
<td></td>
</tr>
<tr>
<td>D4</td>
<td>4</td>
<td>4</td>
<td>Logic 0</td>
<td></td>
</tr>
<tr>
<td>D5</td>
<td>5</td>
<td>5</td>
<td>Logic 0</td>
<td>The status word can be read at any time.</td>
</tr>
<tr>
<td>D6</td>
<td>6</td>
<td>6</td>
<td>Logic 0</td>
<td></td>
</tr>
<tr>
<td>D7</td>
<td>7</td>
<td>7</td>
<td>Logic 0</td>
<td></td>
</tr>
</tbody>
</table>
Appendix E/ Template/Menu Demonstration Program

The X-Pad Menu Demonstration Program will illustrate some 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 capabilities 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.

```vbnet
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 BROWN
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
```
512 REM IF DOING A "COPY" DISPLAY
514 REM THE FLOATING BOX
520 REM ****************************
530 IF MU=1 THEN 600
540 A=POINT(X,Y)
550 FOR W = β TO 8
560 PSET (X,Y,W)
570 NEXT W
580 PSET (X,Y,A)
590 RETURN
600 REM DISPLAY FLOATING BOX FOR "COPY"
602 IF X<15 THEN X=15
604 IF Y<15 THEN Y=15
606 IF X>24 THEN X=24
608 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)
930 ON MU GOSUB 1010,1502,2990,1810,2900,2160,2370,2590,2800
950 RETURN
960 REM
970 REM ****************************
980 REM TOP MENU BOX 1:
990 REM "COPY CONTENTS OF THE BOX"
1000 REM ****************************
1010 SW=β
1020 RETURN
1030 ON SW GOTO 1120
1040 GOSUB 2890
1050 IF S=3 THEN 1040
1060 IF X<15 THEN 1040
1070 IF Y<15 THEN Y=15
1072 IF X>24 THEN X=24
1640 REM "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/20.334)
1900 CS=g
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)
2080 X1=X:Y1=Y
2090 GOSUB 2870
2100 IF S>3 THEN RETURN
2110 LINE (X1,Y1)-(X,Y),PSET
2120 GOTO 2072
2130 PSET(X,Y)
2140 REM ********************
2150 REM TOP MENU BOX 6:
2160 REM "LINE"
2170 REM ********************
2180 SW=0
2190 RETURN
2200 REM ENTRY FOR FIRST END POINT
2210 ON SW GOTO 2270
2220 IF S=3 THEN 2270
2230 PSET (X,Y)
2240 X1=X:Y1=Y
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=0
2680 RETURN
2690 REM ENTRY FOR DIAGONAL 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 ********************
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 Diagram]

   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*. 

53
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.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Represents</th>
<th>Program Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>~</td>
<td>horizontal resistor</td>
<td>3010</td>
</tr>
<tr>
<td>‡</td>
<td>vertical resistor</td>
<td>3150</td>
</tr>
<tr>
<td>←</td>
<td>horizontal capacitor</td>
<td>3300</td>
</tr>
<tr>
<td>↑</td>
<td>vertical capacitor</td>
<td>3410</td>
</tr>
<tr>
<td>⊕</td>
<td>transistor</td>
<td>3530</td>
</tr>
</tbody>
</table>

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 proceed. 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.

```
390 REM ***************
391 REM ROUTINE TO DISPLAY
392 REM HORIZONTAL RESISTOR
393 REM ****************
394 GOSUB 287: IF S<>3 THEN GOSUB 54: GOTO 394
395 SN=6: A=5
396 LINE(X,Y)-(X+A,Y), PSET; X=X+A
397 FOR I=1 TO 10
398 X1=X: Y1=Y: X=X+4
399 IF I MOD 2# THEN SN=-SN
400 Y=Y+SN
401 LINE(X1,Y1)-(X,Y), PSET
402 NEXT I
403 LINE (X,Y)-(X+A,Y), PSET
404 RETURN
405 REM ***************
```
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 1/4 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.

<table>
<thead>
<tr>
<th>S</th>
<th>Top Margin</th>
<th>L/R Margin</th>
<th>Proximity</th>
<th>Pen Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**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.