DELTA DRAWING™

Learning Program

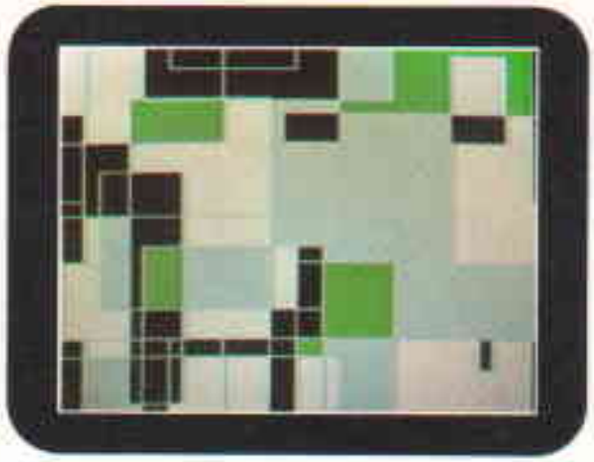
SOME COLOR DRAWINGS

The number in parentheses refers to the page in the GUIDE where the drawing commands for this picture appear.

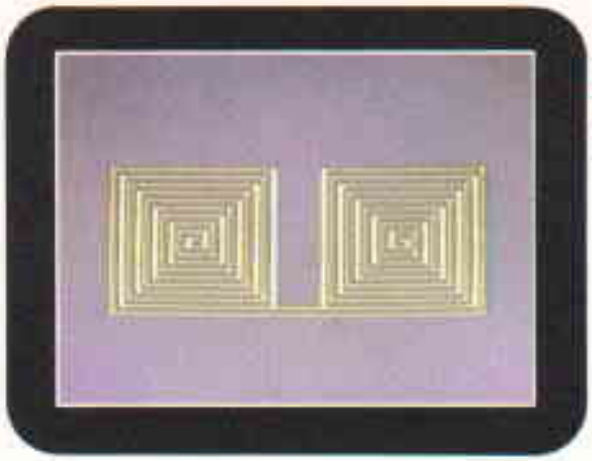
Coloring Lines and Shapes (22)

Changing Colors (24)

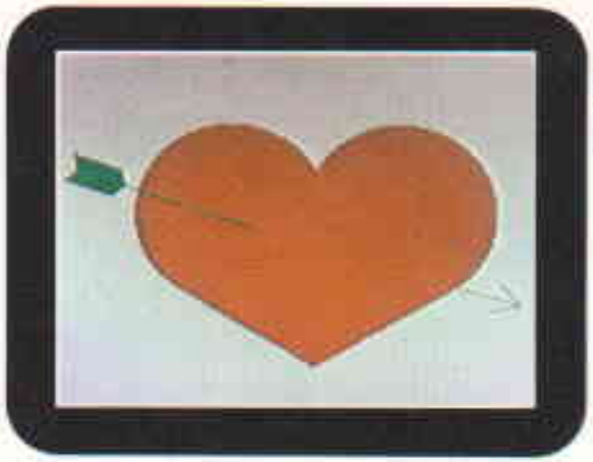
Background Color (26)



Random Drawing (34)



Squirals (36)



Heart (38)

DELTA DRAWING
USER'S GUIDE

for
Atari® and
Commodore 64™ Computers

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NTRODUCTION

Welcome to the world of DELTA DRAWING. Drawing with a computer is fun, and DELTA DRAWING makes it easy—even if you have never used a computer before. While you are having fun drawing, you'll also learn some things about computer graphics and computer programming.

DELTA DRAWING is a program that invites you to use your creativity. You can try any drawing idea. If you don't like the result, you can erase it and try again. In fact, conducting your own drawing experiments is probably the best way to become familiar with all of the features of the program. And you can't press any keys that will harm the program or your computer.

USING THIS GUIDE

DELTA DRAWING puts you in control of the computer; and this guide will help you get started using the program.

The DELTA DRAWING USER'S GUIDE is written for users with either ATARI or COMMODORE 64 computers. Some DELTA DRAWING commands are executed by pressing different keys on the different computers. This guide will represent command keys for ATARI computers as CTRL, and command keys for COMMODORE computers as CTRL. Where command keys are the same for both computer brands they will be shown as CTRL.

PART I, DRAWING, contains a three-level introduction to the operation of the program. Chapter 1, FUNDAMENTALS, will introduce you to all of the commands you'll need to draw with your computer, and it will get you started drawing quickly. Chapter 2, ADVANCED TECHNIQUES, will introduce you to some specialized commands that will

enable you to draw more complex pictures. Chapter 3, IDEAS, will provide you with some examples of the kinds of pictures you can create with DELTA-DRAWING.

PART II, FILING AND PRINTING, contains information on how to use a tape filing system to save your drawing programs and how to print the text of your programs.

PART III, REFERENCE, is a reference manual. It contains a listing of all the DELTA DRAWING commands with the name, key(s), text abbreviation and functional definition for each one.

The DELTA DRAWING USER'S GUIDE concludes with a glossary/index.

LOADING DELTA DRAWING

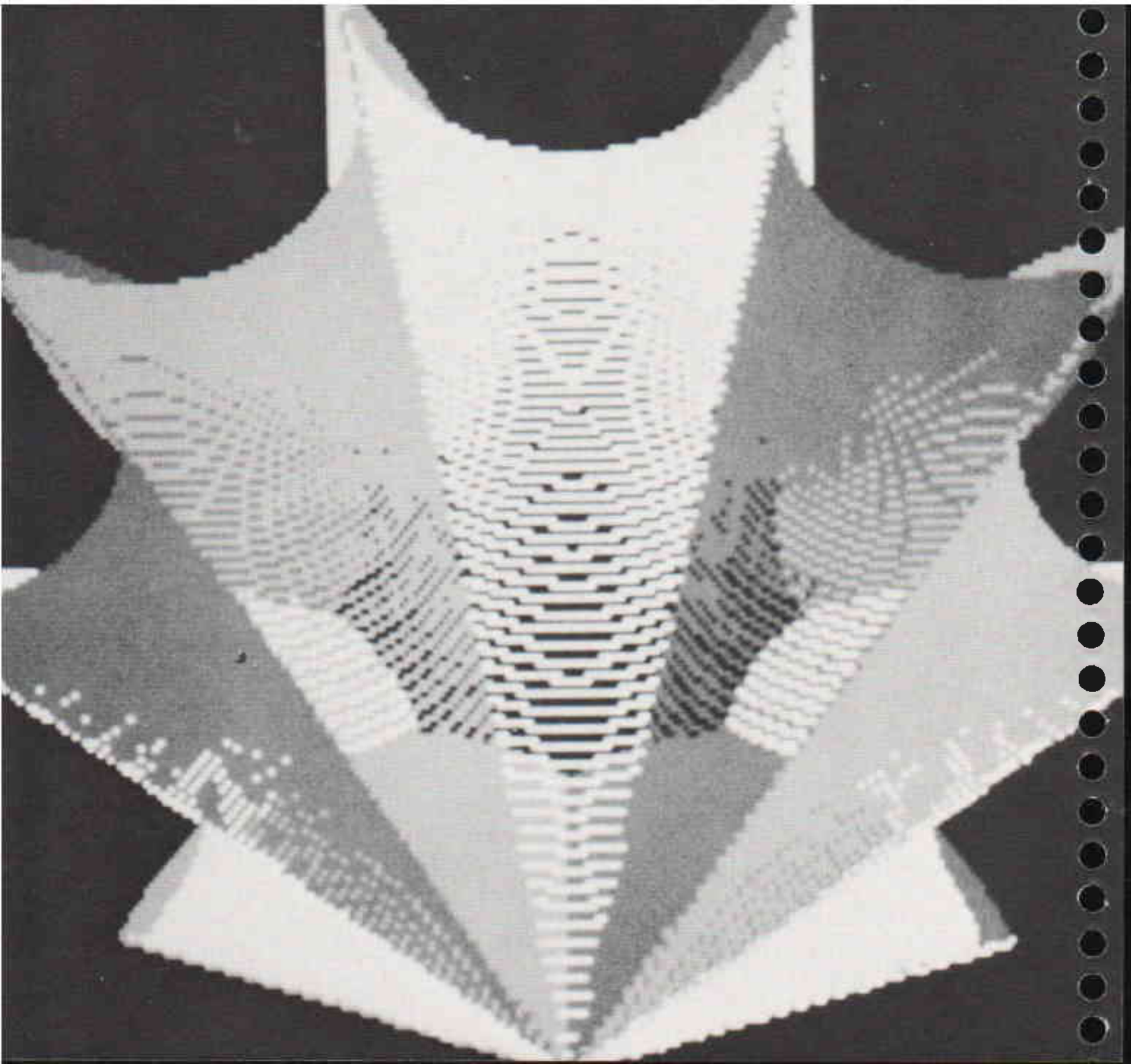
DELTA DRAWING is designed for use with ATARI and COMMODORE 64 computers that have a minimum of 16K random access memory.

To load the program into your computer, make sure your television set or monitor is properly connected and turned on. Insert the DELTA DRAWING cartridge into your computer's cartridge slot and turn on the computer's power (on the ATARI 800, insert the cartridge in the LEFT CARTRIDGE slot). On ATARI computers, close the cartridge door after you have inserted the cartridge.

The DELTA DRAWING program is loaded into your computer when the title and publication data are displayed on the monitor. After about ten seconds (or after you press any key), the publication data disappear and the DELTA pointer shows up in the center of the screen. The program is now ready to accept your commands. You can begin drawing.

QUICK REFERENCE CARD

There is a separate QUICK REFERENCE CARD in the DELTA DRAWING package. This card contains a summary of all the commands in DELTA DRAWING.



1. FUNDAMENTALS

Getting Started
Basic Drawing
Creating Drawing Programs
Text And Graphics Displays
Command Repetition
Smaller Steps And Turns
Erasing Program Elements
Editing In Text
Coloring Lines And Shapes
Changing Colors
Background Color

GETTING STARTED

After you have loaded the DELTA DRAWING program into your computer, the DELTA pointer will appear in the center of the screen.

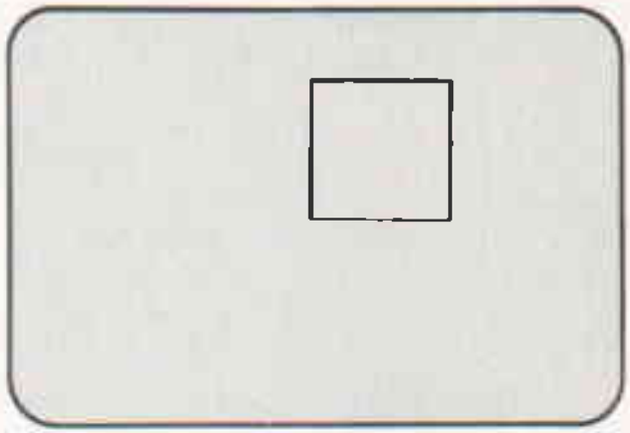
The DELTA pointer is your drawing instrument. You control it with commands. You give the computer commands by pressing keys on the keyboard. A command tells the computer to perform a specific operation, such as, "Turn the DELTA pointer left".

The DELTA pointer is like an arrow—it points in the direction it will move. The front end also changes its size, shape and color in response to certain commands. The blinking dot at the back end marks the exact position from which the DELTA pointer will move, turn or draw. The blinking dot disappears while the DELTA pointer is executing a command. When the dot reappears, the DELTA pointer is ready to accept another command.

The DELTA pointer turns to (its) right and to (its) left. Therefore, a right turn will turn it clockwise and a left turn will turn it counterclockwise.

A line is drawn around the screen. You can draw with the DELTA pointer only on the area of the screen within this boundary line. If the DELTA pointer touches this line, it will jump to a position just inside the boundary on the opposite side of the screen. You can return the DELTA pointer to its previous in-bounds position with the Erase command.

You make the DELTA pointer draw a line with the **Draw** command; press [D]. You make it turn to its right with the **Right Turn** command; press [R], and you make it turn to its left with the **Left Turn**; press [L]. With just a very few commands you can use the DELTA pointer to draw very complex figures.



DRAWING A SQUARE

Press **8** [D]
Press **3** [R]
Press **8** [D]
Press **3** [R]
Press **8** [D]
Press **3** [R]
Press **9** [D]
OOPS!

Press [E]

To erase the picture, press [E] a few times, then hold it down.

The above list of commands draws a square. **8** [D] means press the D key eight times; **3** [R] means press the R key three times. Try it!

A list of commands can be written in lines which you read from left to right and down the page, just as you are reading the words in this paragraph. The following two lines contain a list of commands that will produce the above square:

8 [D] . . . . **3** [R] . . . . **8** [D] . . . . **3** [R] . . . . **8** [D]
3 [R] . . . . **8** [D]

We will write command lists in this way for the remainder of this chapter on fundamentals. In other chapters of this guide we will write lists of commands as they are written on the text display; but that comes later.

BASIC DRAWING

Drawing Commands	Key(s)	Use to
Draw	D	Draw a line 8 units long*
Move	M	Move 8 units (no line)
Right Turn	R	Turn right 30°
Left Turn	L	Turn left 30°
U-Turn	U	Turn around 180°

Editing Commands	Key(s)	Use to
Erase	E	Erase the last command
Erase Picture	CTRL E	Erase the graphics display

In the first drawing exercise we introduce you to the five basic drawing commands and two basic editing commands in DELTA DRAWING.

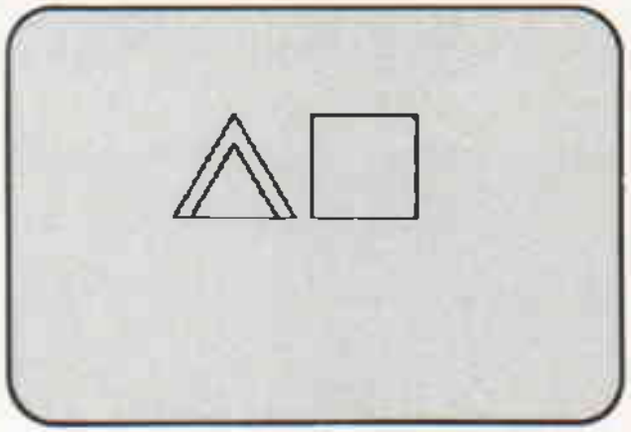
The DELTA pointer has two major characteristics, position and heading. Make the DELTA pointer go forward to change its position; turn it to change its heading. You can turn it around by pressing U.

Using the basic editing commands, you can erase previous commands one at a time or erase the entire graphics display and start over.

The control key CTRL is an auxiliary command key. When you use the **Erase Picture** command, press CTRL first and hold it down; then press E.

Try the drawing on the next page. It will give you an opportunity to use the five basic drawing commands.

*One unit is approximately equal to one picture element, or pixel, which is the smallest mark, or dot, that can be made on the graphics display.



DRAWING A SQUARE AND TRIANGLES

First draw the square:

6 [D] . . . . **3** [R] . . . . **6** [D]
3 [R] . . . . **6** [D] . . . . **3** [R]
6 [D]

Then move:

[M]

Next draw the first triangle:

2 [R] . . . . **7** [D] . . . . **4** [L] . . . . **7** [D] . . . . **4** [L]
7 [D]

Then turn around and move:

[U] . . . . [M]

Now draw the second triangle:

2 [R] . . . . **5** [D] . . . . **4** [L] . . . . **5** [D]

To erase your drawing:

Press [CTRL] [E]; hold down [CTRL], then press [E].

CREATING DRAWING PROGRAMS

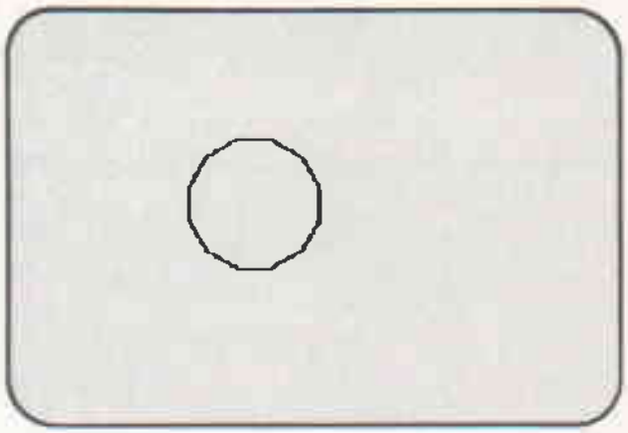
Program Commands	Key(s)	Use to
Save	S	Save a sequence of commands as a drawing program.
First–Ninth Program	X 1 – X 9	Execute the first through the ninth program.
Editing Commands	**Key(s)**	**Use to**
Erase Programs	SHIFT Q	Erase all text and graphics and return to the start of DELTA DRAWING.

When you draw a picture with the DELTA pointer, you also create a drawing program. The program consists of the sequence of commands you use to produce your picture.

For example, if you press D, then press R, and do this two-step sequence twelve times in a row, you will produce a circle on the screen. You can save this sequence of commands as a drawing program by using the **Save** command; press S.

When you press S the graphics display is erased, the computer identifies the previous sequence of commands as a program, numbers it, and stores the program's contents in memory. Now, whenever you want the computer to redraw your circle on the screen, you can call the circle program from memory by executing the program command that refers to it.

In addition to Save, there are nine program commands in DELTA DRAWING.



You execute these **program commands** by pressing [X], then the number key (1-9) which corresponds to the number of the program you want to redraw.* You can save up to nine drawing programs and you can use them to create a tenth picture—but you can't save the tenth drawing as a program.

If your circle was the second picture you saved, you would press [X], then [2] to call the program and make the computer redraw it on the screen. Use the **Erase Programs** command, [SHIFT] [Q], only when you want to erase **all** of your drawing programs and start over.

CREATING A DRAWING PROGRAM

First create a circle-segment program:

2 [D] . . . . [L] . . . . [S]

Then use the segment to create a circle program:

12 [X] [1] . . . . [S]

Now call the circle program:

[X] [2]

Do not erase the circle:

Please turn to the next page.

*Press the [X] key once and release it. Do not press x and hold it down while you press the number key.

TEXT AND GRAPHICS DISPLAYS

Display Commands	Key(s)	Use to
Text	T	View the text display.
Graphics	G	View the graphics display.

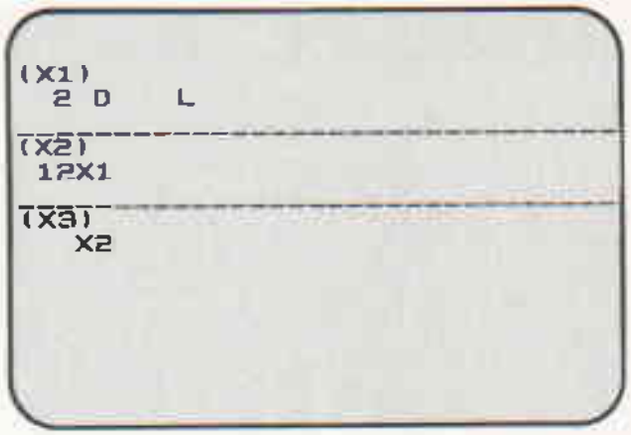
DELTA DRAWING uses the screen in three ways—for graphics and text displays and for the tape filing system menu. When you are in the **graphics mode,** your current drawing is displayed on the screen. When you are in the **text mode,** the screen displays the lists of commands in your drawing programs.

To view the text display, press T. To view the graphics display, press G.

Most of the commands you will use to create your drawings affect both the graphics display and the text display. Some commands, however, are not recorded on the text display. These unrecorded commands are not included as contents of drawing programs. All of the recorded and unrecorded commands in the program are shown in the DELTA DRAWING Command Summary, pages 81 - 82.

The text display is easy to read. The symbols (X1-X9) indicate the beginning of each drawing program. A line under the list of commands ends that program. The drawing program that has no line under its command list is considered "open." A drawing program is "closed" when a line is drawn under its command list. You close a program and it is assigned a number when you press S.

The cursor is the small blinking line on the text display. It appears to the immediate right of the spot where you insert or delete commands. The cursor always adds or erases commands to its left, and its left is the same as your left when you are facing the screen.



So far, you have numbered and closed two drawing programs, the circle-segment program and the circle program. The text display abbreviates the names of the commands. The abbreviation for each command is listed in Commands, Chapter 6.

READING THE TEXT DISPLAY

Press [T] to view the text display.

Read the first program, (X1), the circle-segment, as:
Two Draws, One Left Turn

Read the second program, (X2), the circle, as:
Twelve First programs

The third program is "open." Read it as:
One Second Program

Do not erase your programs.

Please turn to the next page.

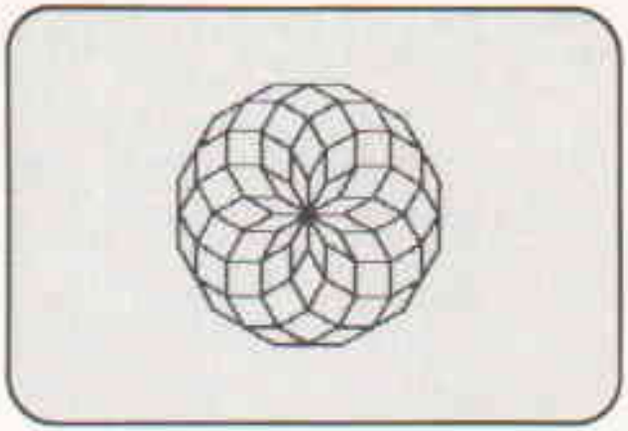
COMMAND REPETITION

System Commands	Key(s)	Use to
Escape	ESC Q	Delete incorrect numerical input and stop the repetition of a command.

Display Commands	Key(s)	Use to
High-Speed Drawing	H	Make the DELTA pointer draw programs at high speed/return to standard-speed drawing.

There are three basic ways to repeat a command in DELTA DRAWING. First, you can press the same command key several times in a row. For example, the Right Turn command makes the DELTA pointer turn 30° to its right; to make it turn 90° to its right, you can press R three times. Second, you can press a command key and hold it down. The command is executed repeatedly until you take your finger off the key. Third, you can specify the number of times a command is to be repeated by pressing a number key at the top of the keyboard before pressing a command key. For example, if you want the DELTA pointer to turn right 90,° you can press 3 then R. You can specify the number of repeats from 1-100, using the number keys. To execute a command such as 150 Moves, press 1 0 0 M, then press 5 0 M.

When you repeat a program command, the entire sequence of commands that makes up the program is repeated, starting from the DELTA pointer's current position and heading. You will discover that you can create some delightful pictures and designs by repeating simple drawing programs over and over again. You also can draw these programs very quickly by using the



High-Speed Drawing command. You do this by pressing [H].* Press [H] again to return to standard speed drawing. You can use the **Escape** command before pressing a command key to cancel any number keys you may have pressed by mistake. And you can use Escape to stop the repetition of a command.

*Pressing [H] also "hides" the DELTA pointer so that only the blinking dot is visible.

REPEATING A DRAWING PROGRAM

Let's get back to the graphics display:

Press [G]

To create the design on this page, add a left turn to the circle and close the third program:

[L] . . . . [S]

Now repeat the third program a dozen times; and save that as the fourth program:

[1] [2] [X] [3] . . . . [S]

Select high-speed drawing:

[H]

Call the circle-design program:

[X] [4]

To erase all of your drawing programs:

Press [SHIFT] [Q]; hold down [SHIFT], then press [Q].

SMALLER STEPS AND TURNS

Drawing Commands	Key(s)	Use to
Half Draw	SHIFT D	Draw a line 4 units long.*
Half Move	SHIFT M	Move 4 units (no line).
Half Right Turn	SHIFT R	Turn Right 15.°
Half Left Turn	SHIFT L	Turn Left 15.°

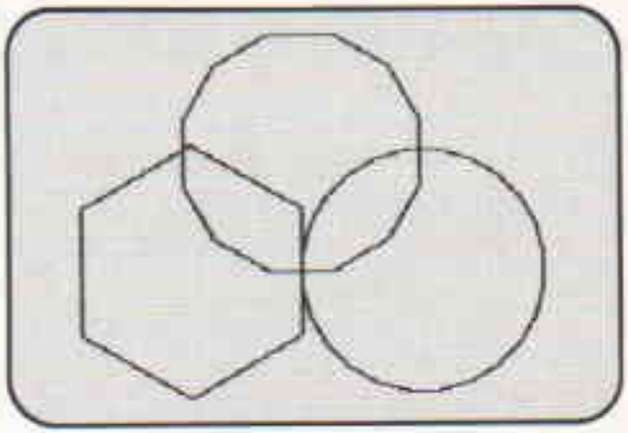
You can make the DELTA pointer take smaller steps and turns to draw smoother curves and produce more detailed shapes.

The drawing commands that we introduce here require the use of SHIFT and CTRL, which are auxiliary command keys. When you use one of these keys, hold it down, then press the other command key.

The four drawing commands above give you half the step size and half the turn angle of the standard drawing commands. You can use the unit drawing commands below to do very detailed drawings. The step size is one unit, or one pixel, and the turn angles are one degree.

Drawing Commands	Key(s)	Use to
Unit Draw	CTRL D	Draw a line 1 unit long.*
Unit Move	CTRL M	Move 1 unit (no line).
Unit Right Turn	CTRL R	Turn Right 1.°
Unit Left Turn	CTRL L	Turn Left 1.°

Unit commands have such a small effect that you can barely see the DELTA pointer take a step or make a turn. You may have to press a unit command



several times before you see a line lengthen or see the DELTA pointer change its heading. You can use the number keys in combination with unit commands to select the exact number of pixels in a line segment or the exact number of degrees in a turn.

DRAWING SMOOTHER CURVES

First, make the polygon segment programs:

```
[4] [D] . . . . [2] [L] . . . [4] [D] . . . . [S]
[2] [D] . . . .     [R] . . . [2] [D] . . . . [S]
    [D] . . [SHIFT] [R]       [D]           [S]
```

Next, put it all together and compose the picture:

```
    [U] . . . [3] [M] . . . . [U] . . . [6] [X] [1] . [2] [4] [X] [3]
[3] [L] . . [1] [2] [X] [2]
```

Do not erase the picture.

Please turn to the next page.

*One unit is approximately equal to one picture element, or pixel, which is the smallest mark, or dot, that can be made on the graphics display.

ERASING PROGRAM ELEMENTS

Editing Commands	Key(s)	Use to
Erase Element	DELETE BACK S ←	Erase the last program element.

You can experiment as much as you like with DELTA DRAWING. If you want to see how something will look, try it. If you don't like the result, change it. You can keep changing it until you get the line, figure, design, or effect you want.

You have already learned three editing commands: Erase, [E], Erase Picture, [CTRL] [E], and Erase Programs, [SHIFT] [Q].* These commands, along with Erase Element, are the four editing commands that operate on both the text display and the graphics display. The other editing commands operate only on the text display.

A program element is a single or repeated instance of the same command. On the text display, program elements are listed in sequence from left to right. Rows of program elements are called program lines. Up to five program elements may be listed on a program line. The **Erase Element** command erases program elements one at a time, starting with the element to the immediate left of the cursor.

If you draw too long a line, make too sharp a turn or call the wrong drawing program, you can erase what you have done with these four editing commands. You can erase one command at a time, one element at a time, or one program at a time. Or you can erase all programs, quit the session, and start over.

*When you press [SHIFT] [Q] while viewing the text display, your drawing programs are erased and the screen returns to the graphics display.

Erasing Program Elements

Let's do the erasing on the Text display:

[T]

To erase the open program one program element at a time:

Press [DELETE BACK S] eight (8) times or [←] eight (8) times.

To erase all your drawing programs:

Press [SHIFT] [Q]

NOTE: On the text display [SHIFT] is represented by %.

```
(X1)
  4 D    2 L    4 D
(X2)
  2 D      R    2 D
(X3)
    D     %R      D
(X4)
    U    3 M      U    6X1    3 L
 12X2    3 R   24X3_
```

```
(X1)
  4 D    2 L    4 D
(X2)
  2 D      R    2 D
(X3)
    D     %R      D
(X4)
```

EDITING IN TEXT

Editing Commands	Key(s)	Use to
Move Up	CTRL ↑ SHIFT ⇧	Move the cursor up one program line.*
Move Down	CTRL ↓ ⇩	Move the cursor down one program line.**
Move Left	CTRL ← SHIFT ⇦	Move the cursor one program element to the left.
Move Right	CTRL → ⇨	Move the cursor one program element to the right.

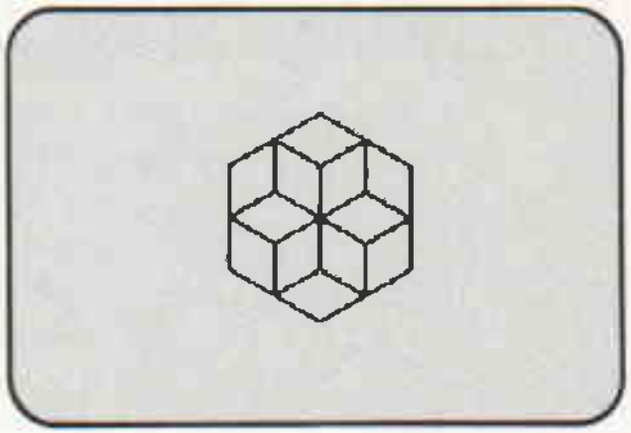
When you have a lot of program editing to do, you will find it easiest to do it in the text mode. With the full-screen editor, you can edit any part of a drawing program at any time.

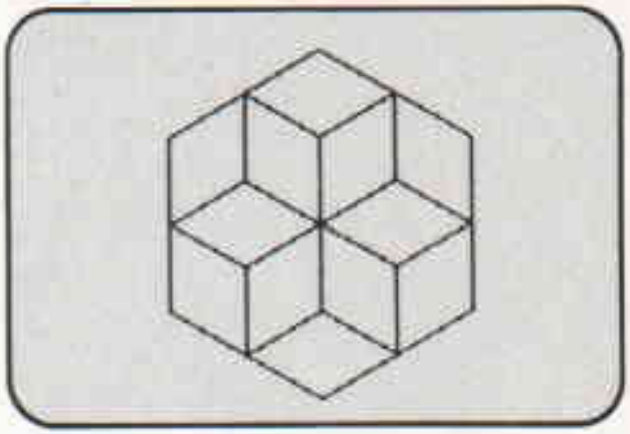
When you enter the text mode, notice the blinking line in the open program. This is the cursor. To edit, move the cursor to the program you want to change and then to the place in that program where you want to make the change. You place the cursor to the right of the program element you want to edit. You can then erase or add commands to the left of the cursor.***

* If there are fewer than five program elements between the cursor and the beginning of a program, Move Up will move the cursor to the beginning of that program.

** If there are fewer than five program elements between the cursor and the end of a progam. Move Down will move the cursor down to the end of that program.

*** When you edit or add commands in the text mode, the open program will be redrawn when you return to the graphics mode.





The above four editing commands operate only on the text display. These editing command keys are the four arrow keys on your keyboard. Press the key with an arrow heading in the direction you want to move the cursor.

EDITING A DRAWING PROGRAM

First, draw a set of cubes:

[3] [D] . . . [2] [R] . . . [S]
[6] [X] [1] . . . [2] [L] . . . [S]
[6] [X] [2]

Edit to make the cubes bigger:

Press [T]
Press [CTRL] [↑] four times or [SHIFT] [⇧] four times
Press [CTRL] [←] or [SHIFT] [⇦] once
Press [2] [D]

Now return to graphics to see the revised drawing:

Press [G]

To erase all of your drawing programs:

Press [SHIFT] [Q].

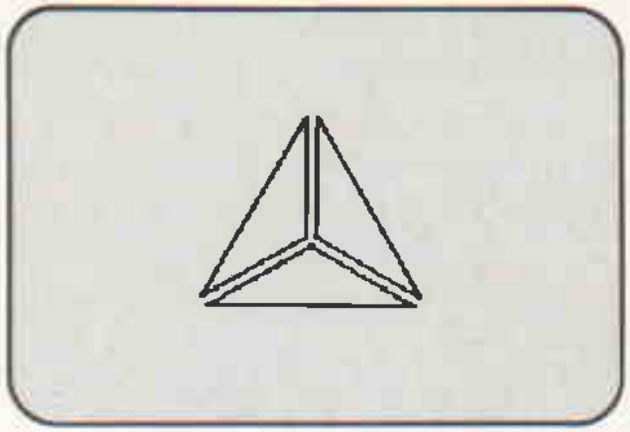
COLORING LINES AND SHAPES

Coloring Commands	Key(s)	Use to
Change Foreground Color	C	Select the next color in a cycle of three foreground colors.
Fill With Color	CTRL F	Fill an enclosed shape with the current foreground color.

With DELTA DRAWING, you can draw in color. You can draw lines in color, fill closed shapes with color, and change the background color of your drawing. You can use as many as four different colors in the same drawing—three foreground colors and a background color.

Change Foreground Color, C, is the basic color command. You use this command to draw with different colored lines. There are three basic foreground colors: white, green and blue. The DELTA pointer changes color each time you press C: from white to green, from green to blue and from blue back to white. You can create a drawing with any one of the three basic foreground colors, or use a combination of them.

You can also fill closed shapes with the foreground colors. To fill a closed area of the screen with color, move the DELTA pointer's blinking dot to a position inside the area. Press C to select a foreground color, and execute the **Fill With Color** command; press CTRL F. When filling a shape with color, make sure the shape is completely closed. Otherwise, color will "leak out" and continue to fill the screen until it reaches either a line drawn by the DELTA pointer or the boundary line around the screen. Use any of the Move commands to place the blinking dot completely inside the shape. If the dot is touching a line, Fill With



Color will not operate. (To erase a Fill With Color command, see the Redraw command, page 30.)

Change Foreground Color and Fill With Color are recorded commands; they are included in drawing programs. When you call a program that includes the Change Foreground Color command, the computer will change the DELTA pointer to the next color in the three-color cycle as it executes this command. When you use Fill With Color, wait for the color fill to stop before you execute another command.

COLORING LINES AND SHAPES

First, create a triangle program:

[7] [D] . . . [5] [R] . . . [1] [2] [D] . . [5] [R] . . . [7] [D] . .
. . [L] . . . [SHIFT] [M] . . [L] . . . . . [S]

Then, draw the triangles in color:

[X] [1] . . . [C] . . . . . [X] [1] . . . [C] . . . . . [X] [1]
[S]

To fill the triangles with color:

[X] [2] . . . [U] . . . . . [M] . . . . . [CTRL] [F] . . [3] [L]
[3] [M] . . . [C] . . . . . [CTRL] [F] . . [U] . . . . . [6] [M] . .
. . [C] . . . [CTRL] [F] . . [S]

Do not erase the programs.

Please turn to the next page.

See the inside front cover for the colored version of this drawing.

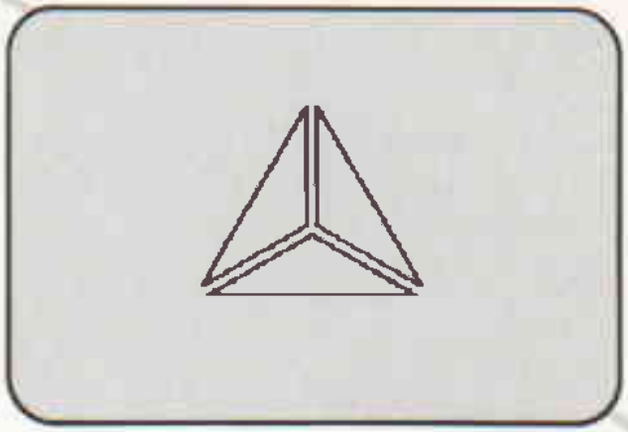
CHANGING COLORS

Coloring Commands	Key(s)	Use to
Change Hue	CTRL C	Select the next hue in a cycle of eight hues.
Change Brightness	B	Select the next brightness in a cycle of eight levels of brightness

DELTA DRAWING includes a color spectrum of eight different colors, or hues.* You can change any color on the screen to any other color in the spectrum with the **Change Hue** command; press CTRL C. When you start DELTA DRAWING, the foreground colors are set at white, green and blue and the background color is black. You can change these colors at any time. However, Change Hue is not a recorded command, so the color change you make will not be included in your drawing programs.

To change a foreground color, place the DELTA pointer's blinking dot on the colored line or filled shape that you want to change and press CTRL C. When you press CTRL C, the color touching the blinking dot changes to the next hue in the cycle of eight hues. All other lines and shapes on the screen with this foreground color will also change hue. Any new lines you draw or shapes you fill now will be in the new hue. To see all of the hues, press CTRL C eight times.

With ATARI computers there are eight different levels of brightness which range from very dark to very light. To change the brightness of a color, place the DELTA pointer's blinking dot on the color you want to change and use the **Change Brightness** command; press B. When you press B, the brightness of the color touching the blinking dot changes to the next level of brightness in a



cycle of eight levels. Any new lines you draw in that foreground color will have the new level of brightness. To see all of the steps in the brightness scale, press [B] eight times. Change Brightness is also an unrecorded command.

When you press [SHIFT] [Q], the colors on the graphics display are reset to the initial foreground colors, white, green and blue, and the background color is reset to black.

CHANGING COLORS

First call the triangle design:

[X] [3]

To see all of the hues:

Press [CTRL] [C] eight times.

For ATARI computer users only:
To see one of the hues at all of the different levels of brightness:

Press [B] eight times.

You also can press [CTRL] [C] eight times at each level of brightness and see all sixty-four color selections.

To erase your drawing programs:

Press [SHIFT] [Q].

See the inside front cover for the colored version of this drawing.

*The ATARI color spectrum begins with a bright intensity of grey that looks like white. It includes eight colors in the following order: grey, red, orange, yellow, yellow/green, green, blue and violet. The COMMODORE color spectrum begins with black and includes the following other seven colors: white, red, cyan, purple, green, blue and yellow.

BACKGROUND COLOR

Coloring Commands	Key(s)	Use to
Background Drawing Color	SHIFT C	Select background color for drawing/ return to foreground drawing colors.

You can add a fourth color to your drawings by **changing the color of the background.** The background of a drawing is any portion of the graphics display that has not been drawn on or filled with a foreground color.* You can use any one of the eight available colors as a background color.

To change the background color, place the DELTA pointer's blinking dot on any area of the background and use the Change Hue command; press CTRL C. When you press CTRL C, all background areas of the screen change to the next hue in the cycle of eight hues.

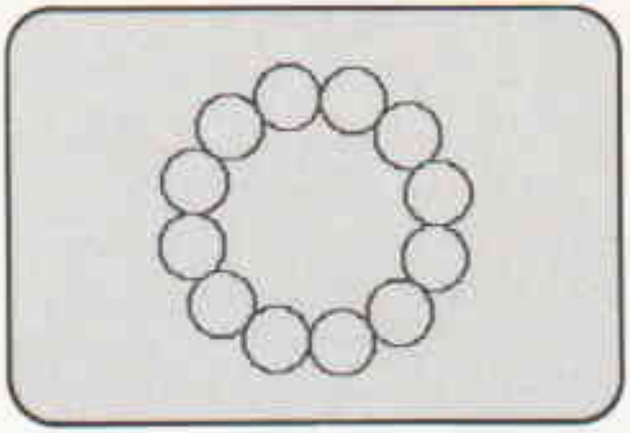
ATARI computer users can change the level of brightness of the background color. Place the DELTA pointer's blinking dot on any area of the background and use the Change Brightness command; press B. When you press B, the brightness of the background color changes to the next level of brightness in the cycle of eight levels.

Changing the background color does not affect the Fill With Color command; you can fill a closed shape with a foreground color over any background color.

You also can use the background color to draw lines.** If you press SHIFT C, you change the line drawing color of the DELTA pointer to the current back-

*The current background color also appears outside the boundary line drawn around the screen on Atari computers.

**You cannot, however, fill a shape with the background drawing color.



ground color. Then, you can use the background color to draw over colored shapes or erase lines in a drawing. To return the DELTA pointer to the previous foreground colors, press [SHIFT] [C] again.

BACKGROUND COLOR

First, create a curve program:

[D] . . . . . [R] . . . . . [S]

Next, draw and color one spoke of the design:

[3] [L] . . . [5] [D] . . . [SHIFT] [D] . . [R] . . . . [1] [1] [X] [1]
[3] [R] . . . [M] . . . . . [C] . . . . [CTRL] [F] . . [U] . .
. . [M] . . . [3] [L] . . . [4] [M] . . . [SHIFT] [M] . . [2] [L] . .
. . [D] . . . [S]

To draw the design:

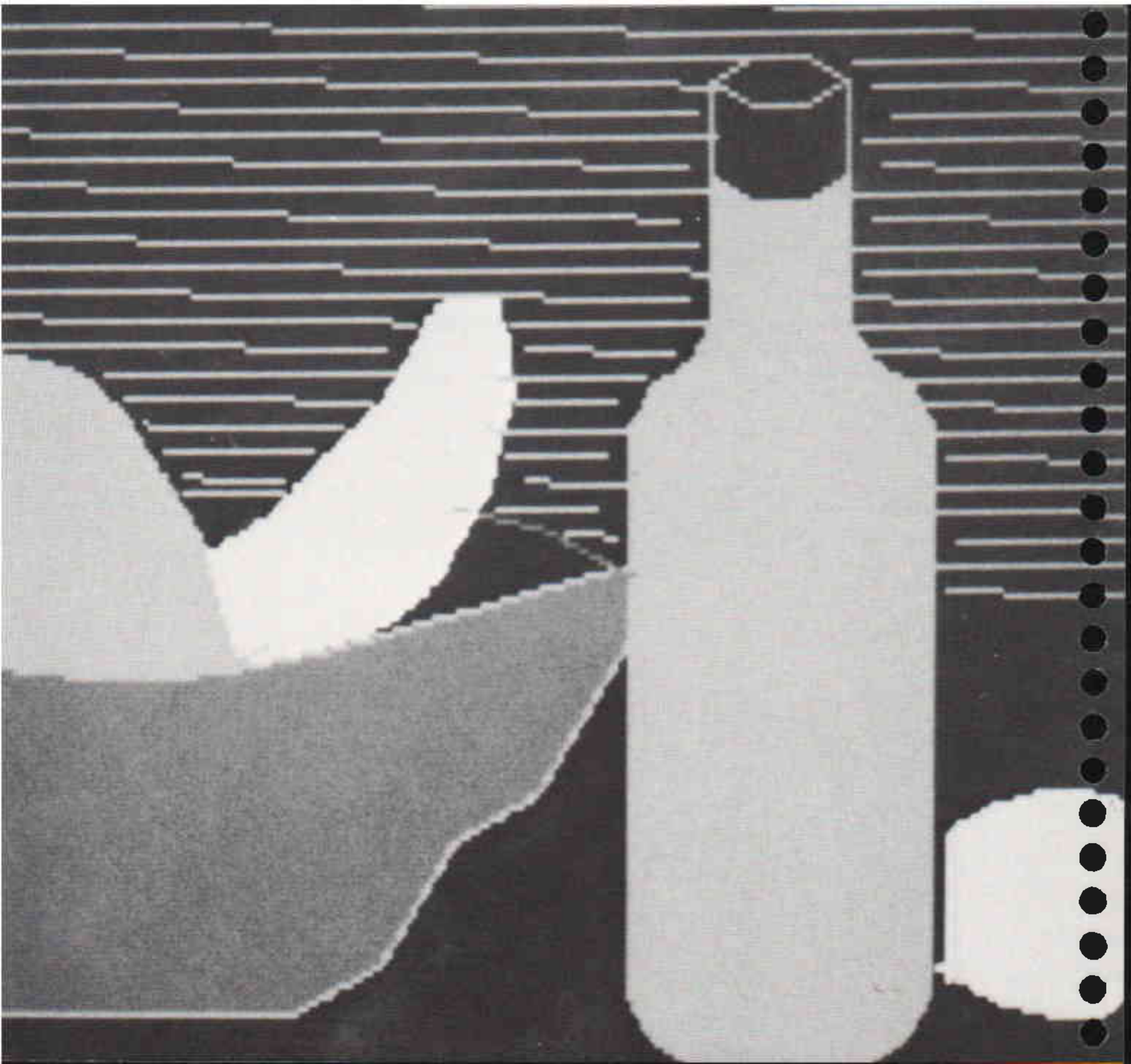
[3] [L] . . . [2] [M] . . . [3] [R] . . . [1] [2] [X] [2]

Erase the spokes with the background drawing color:

[SHIFT] [C] · · [1] [2] [X] [2]

Press [CTRL] [C] to change the background color.

See the inside front cover for the colored version of this drawing.



2. ADVANCED TECHNIQUES

Getting Into The Program
Changing Size And Shape
Random Drawings
Using The Accumulator
Drawing Symmetrical Figures
Drawing in Kaleidoscope Mode
Action Drawings

GETTING INTO THE PROGRAM

Once you are familiar with the fundamentals, you will want to explore other capabilities of DELTA DRAWING. This chapter will introduce you to some specialized commands and the advanced drawing techniques that they make possible.

The drawing exercises in this chapter, and in the remainder of the guide, present a picture together with a complete history of the programs that were used to draw it. The text history is printed in the same notation that is used on the text display in the DELTA DRAWING program. On the text display [SHIFT] is represented by % and [CTRL] is represented by < . A line drawn under a list of commands means that a drawing program is closed. As you work through an exercise, you close a program by pressing [S] when you come to a line drawn under the program.

Many of the drawing exercises in this chapter and later in the guide construct a final picture from several drawing programs. When you press command keys, therefore, it might seem that not much is happening on the graphics display. Don't worry: When you get to the last program, you will see how the component programs contribute to the final picture.

TEXT HISTORY LIMIT

As you create your own drawings, you will discover that you can use hundreds of program elements in the same drawing without exhausting the program's memory. There is, however, a limit on the amount of text you can write with DELTA DRAWING.* If you do reach the text history limit, you can continue to draw on the graphics display, but the text display will stop recording the commands that you execute.

*DELTA DRAWING for ATARI Computers has a text history limit of 512 program elements. DELTA DRAWING for the COMMODORE 64 has a text history limit of over 5,000 program elements.

MODIFIER COMMANDS

Most of the commands in DELTA DRAWING are single-key or double-key commands. The modifier commands operate differently. To execute one of the modifier commands (Random, Input Accumulator, Reverse, or Mirror), press [?], [#], [@], or [:], release the key(s), then press the key or keys for the command (CMD) you want to modify.* The modifier commands do not appear on the text display until the complete command is executed.

REDRAW COMMAND

In two cases, when you erase lines and color, the graphics display will not reflect your edits accurately: when you erase lines that cross and when you erase a Fill With Color command. When you erase a line that crosses another line, a "hole" is usually left in the original line at the point where you erased. If you save a drawing program with such a hole, the hole will disappear when you call the program from memory. You can eliminate this hole while drawing by using the Redraw command; press [SHIFT] [G] When you press [SHIFT] [G], the graphics display is cleared and the open drawing program is rerun.

When you erase a Fill With Color command in graphics mode, the color remains on the graphics display, even though the command has been erased. To remove the color from the display, press [CTRL] [G] after you erase the Fill With Color command. The open program is then rerun without the Fill With Color command.

*Depending on which computer you use, one or more of the modifier commands may be the upper case of a key. You then hold the [SHIFT] key down while you press [?], [#], [@], or [:].

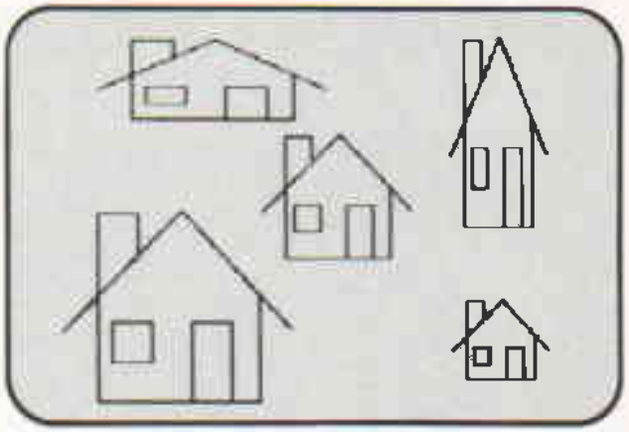
CHANGING SIZE AND SHAPE

Scaling Commands	Key(s)	Text Display	Use to
Enlarge	[*]	*	Enlarge subsequent drawing.
Reduce	[/]	/	Reduce subsequent drawing.
Squeeze in	[I]	I	Squeeze subsequent drawing to make it tall and thin.
Stretch Out	[O]	O	Stretch subsequent drawing to make it short and fat.

There are four scaling commands in DELTA DRAWING. You can use them to enlarge a drawing, to reduce it, to squeeze it in (making it tall and thin), or to stretch it out (making it short and fat). The front end of the DELTA pointer changes its size and shape to indicate the scaling commands you have used.

There are limits to how much you can change the size and shape of a drawing with scaling commands. You can **enlarge** or **reduce** a drawing 16 times. It takes 32 [*] or [/] commands to reach the limits. You can **squeeze in** a drawing until it is 16 times narrower and 16 times taller. Or you can **stretch it out** until it is 16 times wider and 16 times shorter. It takes 64 [I] or [O] commands to reach these limits. Once the limits are reached, additional scaling commands will not affect the drawing, although the text display will indicate keystrokes beyond the limits.

After a scaling command is used, the DELTA pointer remains in its enlarged, reduced, squeezed or stretched state until you press the same number of opposite scaling commands, or until you clear the screen with [S], [CTRL] [E] or [SHIFT] [Q]. Therefore, when you use scaling commands in a drawing program that is repeated several times, the DELTA pointer will be scaled up or down,



squeezed in or stretched out, once more each time the program is repeated.

HOUSES

To draw the standard size house:

(X1)	3%D	3 R	3%D	3 R	3%D
(X2)	U	4 D	3 L	6 D	3 L
	4 D	3 L	M	3 L	2 M
	%M	2X1	3 R	2 M	%M
	X1	3 R	3%D	3%M	3 R
	2 M	%M	3 R	4 M	3%D
	X1	3%R	4 M	U	6 D
	3 < D	3 R	2 < R	6 D	R
	13 < R				

To scale the house to different sizes and shapes:

(X3)	5*	X2	5 /
(X4)	5 /	X2	5*
(X5)	10 I	X2	10 O
(X6)	10 O	X2	10 I

To draw the five houses:

(X7)	3 L	2 M	3 R	2 M	X2
	5 M	3 R	20 M	3 R	X3
	3 L	13 M	3 L	X4	U
	13M	3 L	5 M	3 R	X5
	3 R	27 M	3 R	3 M	X6

RANDOM DRAWINGS

Repeating Commands	Key(s)	Text Display	Use to
Random	SHIFT ? CMD*	?_____	Repeat the next command a random number of times.

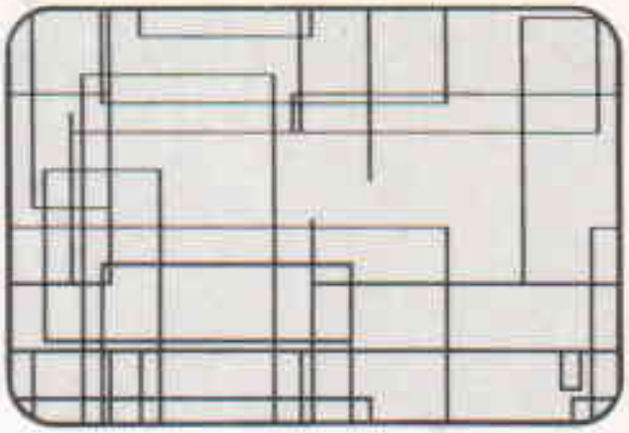
Random is a command that enables you to make drawings that are unique and unpredictable. When you press SHIFT ?, the next command you use will be repeated a random number of times. Using this command is like rolling dice to determine the number of degrees you want the DELTA pointer to turn or the length of the line you want it to draw.

When the computer uses a random number to repeat a command, it generates it from a limited range of numbers. The maximum number of times a command can be repeated when it is randomized is 25. When you randomize any of the Draw or Move commands, the command is repeated some number of times between 0 and 25.

Random Right or Left Turn commands are essentially the same. They turn the DELTA pointer to any of the 12 headings divisible by 30° between 0° and 360.° Half Turn commands are randomized left or right between 0° and 180° in 15° increments, while Unit Turn commands are randomized left or right between 0° and 15° in 1° increments.

You can use the Random command with any other command you would repeat with a number. For example, you can repeat a program command a random number of times. If the program contains any random commands,

*CMD is an abbreviation for "the command to be modified."



every repetition of the program will ordinarily produce a different drawing.

RANDOM DRAWING

Try this picture while viewing the text display.

Press [T]

To create a random drawing:

(X1) ? D 3 R

(X2) 50X1

To randomly color the drawing:

(X3) ? R 10 M

(X4) X 3 〈 F C

(X5) X2 75X4

Press [G].

See inside front cover for colored version of this drawing.

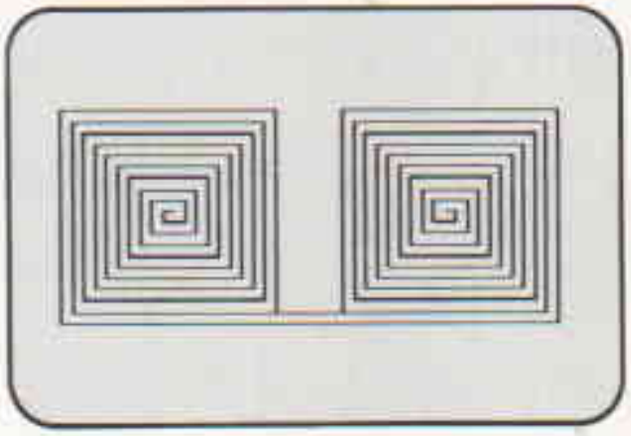
USING THE ACCUMULATOR

Repeating Commands	Key(s)	Text Display	Use to
Input Accumulator	SHIFT # CMD	#_____	Repeat the next command the number of times indicated by the current value of the accumulator.
Add to Accumulator	+	+	Add the number specified to the number in the accumulator.
Subtract from Accumulator	−	−	Subtract the number specified from the number in the accumulator.

DELTA DRAWING has an accumulator. You can think of the accumulator as a box, located somewhere in the computer's memory, where you can store a number. You can add to the value in the accumulator or subtract from it, and you can use its current numerical value to specify the number of times a command will be repeated.

When you start a new drawing program, the value in the accumulator is 0. You add a number to the accumulator with the **Add To Accumulator** command, [+]. If you wanted to add a value of two to the Accumulator, you would press [2], then [+]. Then you can repeat another command two times. You would do this by first executing the **Input Accumulator** command, [SHIFT] [#], and then executing the command you want to repeat two times.

For example, suppose you write a program consisting of the commands R. . . 2 + . . . # D and close the program by pressing [S]. The first time the program runs, the DELTA pointer makes a right turn and draws a line two steps in



length. The next repeat of the program, the DELTA pointer makes a right turn and draws a line four steps long. On the third repeat the DELTA pointer will draw a line six steps long. And so on. Each time the computer executes the Add To Accumulator command, the value of the accumulator increases by two and the Draw command is repeated two more times.

The **Subtract From Accumulator** command works in a way just the opposite of the Add To Accumulator; it subtracts from the value of the accumulator. The Subtract From Accumulator command has no effect unless there is a positive number in the accumulator.

SQUIRALS

Use the accumulator to make a square spiral out:

(X1)	# %D	3 R	+	# %D	3 R

Use the accumulator to make a square spiral in:

(X2)	# %D	3 R	–	# %D	3 R

To draw the two squirals:

(X3)	3 R	6 M	3 L	20X1	3 L
	3 D	3 R	%M	3 R	4 D
	3 R	%M	3 R	3 M	20X2

To color the picture:

(X4)	4 *	X 3	U	2 < M	C
	< F				

See inside front cover for colored version of this drawing.

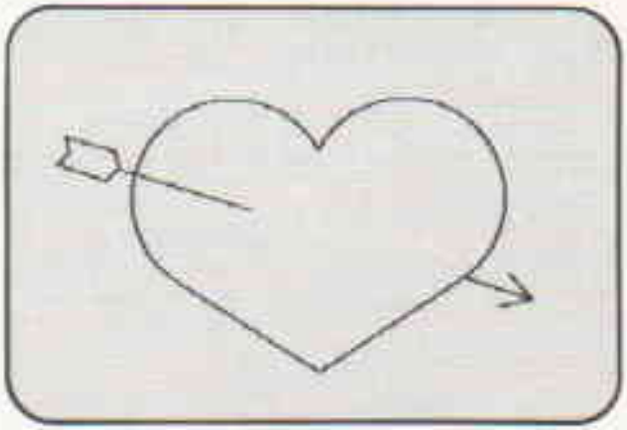
DRAWING SYMMETRICAL FIGURES

Repeating Commands	Key(s)	Text Display	Use to
Reverse	SHIFT @ CMD @ CMD	@_____	Execute the next command in reverse.
Mirror	SHIFT : CMD : CMD	:_____	Execute the mirror image of the next command.

You can create symmetrical figures with DELTA DRAWING using the Reverse and Mirror commands. The **Reverse** command repeats a program, but does it in reverse order, starting with the last command and ending with the first. The **Mirror** command also repeats a program, but it switches all the right turns to left turns and all the left turns to right turns, producing a mirror image of the original drawing. To draw a symmetrical figure, draw half of the figure and save it as a drawing program. Then call the program, reverse it, and mirror it.

To use the Reverse command, press SHIFT @ or @, then press the program command key for the program you want to draw in reverse. To use the Mirror command, press SHIFT : or :, then press the program command key for the program that you want to mirror.

Reverse also can be used to execute the reverse of other commands. For example, if you execute Reverse, then a Draw command, the DELTA pointer will go backwards one step and draw a line.



HEART

First, create a curve program:

(X1) ⟨D ⟨R

Draw half the heart:

(X2)

5 M	R	100X1	100X1	7X1
12 D	2 ⟨D			

Use Reverse and Mirror commands to complete the heart:

(X3) X 2 @X2 :X2

Color and compose the picture:

(X4)

X3	3 L	M	⟨F	L
9 M	2 L	%L	5 M	C
10 D	3 M	2 R	D	4 R
3 D	2 R	D	2 R	D
2 R	3 D	4 R	D	2 R
M	⟨F	27 M	%D	5 D
5 L	2 D	U	2 M	4 R
2 D				

Change the arrow to yellow:

[6] [CTRL] [C] or [2] [CTRL] [C] [2] [B] ATARI ONLY

Change the heart to red:

R 5 M

[CTRL] [C] [6] [B] ATARI ONLY

See inside front cover for colored version of this drawing.

DRAWING IN KALEIDOSCOPE MODE

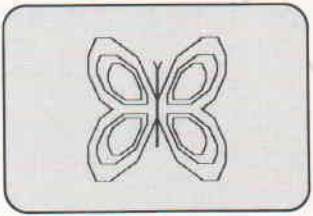
Drawing Commands	Key(s)	Text Display	Use to
Kaleidoscope	K	K	Select Kaleidoscope, the four-pointer drawing mode/ return to one-pointer drawing mode.

DELTA DRAWING includes a kaleidoscope mode of drawing. The **Kaleidoscope** command turns the DELTA pointer into four pointers which enable you to create pictures and designs with four-way symmetry.

To use Kaleidoscope, press K. After you press K, other drawing commands you enter will be executed by all four DELTA pointers.

In the kaleidoscope mode, two pairs of DELTA pointers appear on the screen, facing in opposite directions. When you execute a turn command, the pointers at the upper right and lower left turn in one direction, while the pointers at the upper left and lower right turn in the opposite direction. For example, if you press K and then press R, the pointers at the upper right and lower left will make a right turn, while the pointers at the upper left and lower right will make a left turn. All four pointers are always the same distance from the center of the screen.

To return to one DELTA pointer, press K again, or clear the screen with S, CTRL E or SHIFT Q.



BUTTERFLY

Draw the body and head using Kaleidoscope:

(X1)	K	4 D	R	K	D
	U	M	4 R	D	U
	M	R	3 M	5 L	K

Create curve programs for the wings:

(X2)	D	R
(X3)	2 D	R
(X4)	3 D	R

Draw the butterfly shape:

(X5)	X1	5 D	R	4 D	R
	2 D	2 R	2X3	X4	X3
	4 M	%M	3 R	%M	X2
	2X4	2 D	2 R	2X2	X3
	2X4	4 R	M	%M	2 L
	X2	2X3	D	2 R	3X2
	2X3				

Squeeze in and color the butterfly:

(X6)	2 I	X5	4 R	M	2 C
	⟨F	U	2 M	2 C	⟨F
	M	2 C	⟨F		

[3] [CTRL] [C]

See inside back cover for colored version of this drawing.

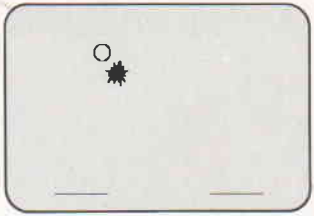
ACTION DRAWINGS

Editing Commands	Key(s)	Text Display	Use to
New Screen	CTRL N	<N	Clear the graphics display and return the DELTA pointer to its start position without erasing any commands in the open program.

Drawing Commands	Key(s)	Text Display	Use to
Pause	Z	Z	Pause for 1 second.
Half Pause	SHIFT Z	%Z	Pause for 1/2 second.
Unit Pause	CTRL Z	<Z	Pause for 1/10 second.

When you repeat a drawing program part of the fun is watching the way the computer redraws the picture on the screen. An action drawing is one in which the illusion of motion is created as the computer draws. The New Screen command and the Pause commands enable you to create a wide variety of action drawings.

You can use the **Pause** commands to control the time between the execution of two commands. For example, you can insert a five-second delay between two commands by pressing 5 Z. When a drawing program containing Pause commands is called, the computer delays the specified amount of time at each pause before executing the next command in the program. By varying the time



period between commands, you can establish the rhythm at which the computer redraws the picture.

New Screen, CTRL N, which is the only recorded editing command, clears the graphics display and returns the DELTA pointer to its start position without erasing any of the commands in the open program. This allows you to erase one drawing and immediately replace it with another drawing within the same program. You cannot accurately erase a New Screen command in the graphics mode. Erase it in the text mode.

BALLOON DARTS

First, in the text mode, create the dart program:

(X1)	U	%C	D	U	M
	%C	D	2 < Z		

The balloon programs:

(X2)	%D	R			
(X3)	12X2	3 R	M	C	<F
	2 C				
(X4)	12X2	3 R	M	2 C	<F
	C				

(Instructions continued on the next page)

ACTION DRAWINGS (Continued from page 42)

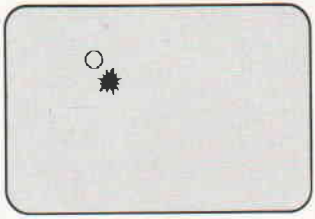
To burst a balloon:

(X5)	# < D	5 R	+
(X6)	29X5	29 -	

Draw the players' starting lines:

(X7)	U	7 M	3 L	7 M	C
	5 D	11 M	C	5 D	8 M
	3 L	C			

To play the game, one player positions his balloon and places the DELTA pointer on his opponent's starting line. The opponent then aims the DELTA pointer, estimates the distance and launches his dart. The object of the game is to hit the opponent's balloon with the blinking dot of the DELTA pointer. A hit scores a balloon burst.



Now press [G]
A sample play of the game:
First, change the white foreground color to red:
Press [D]
Press [CTRL] [C]
Press [6] [B] ATARI ONLY
Press [E]

(X8)	X7	2 R	16 M	3 L	6 M
	X3	R	13 M	3 R	14 M
	U	R	%R	10 < R	

Press [H]

33X1	(A Miss!)	2 Z	< N	

Press [H]

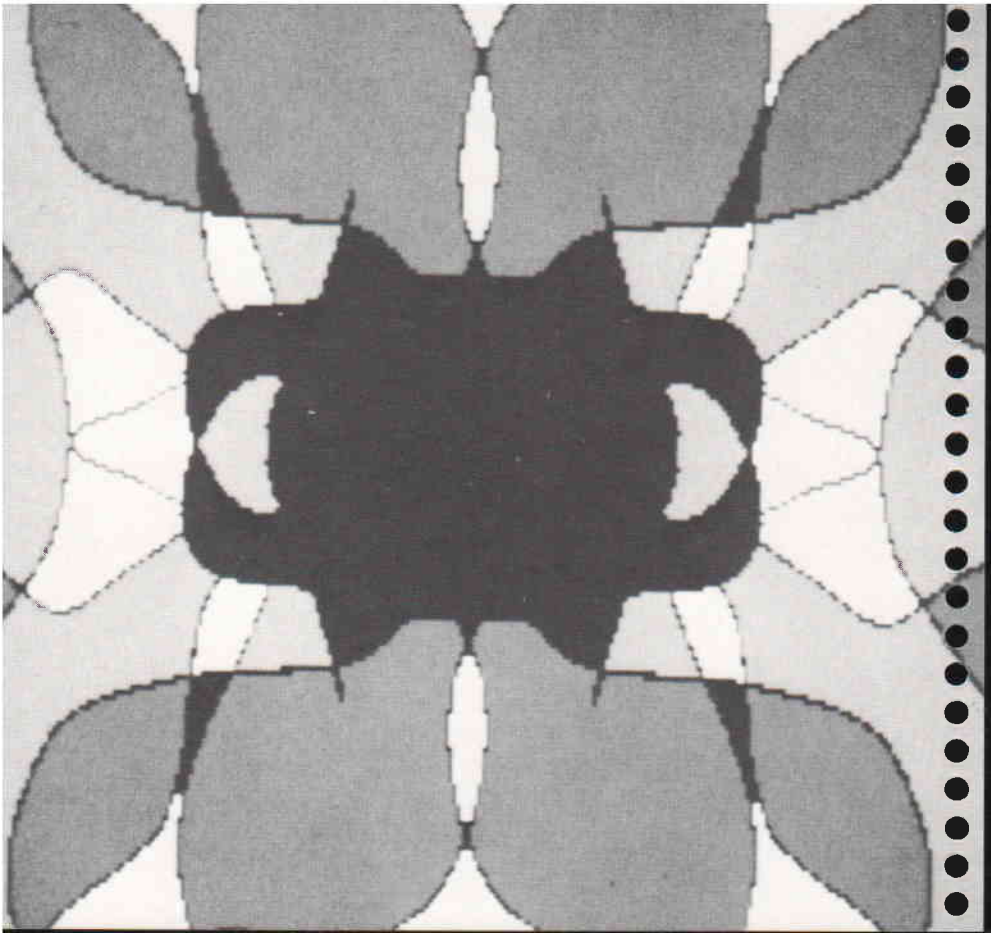
X7	2 L	17 M	X4	2 R
23 M	3 R	9 M	3 R	%R
7 < R				

Press [H]

25X1	(A Hit!)	X6	2 Z	< N

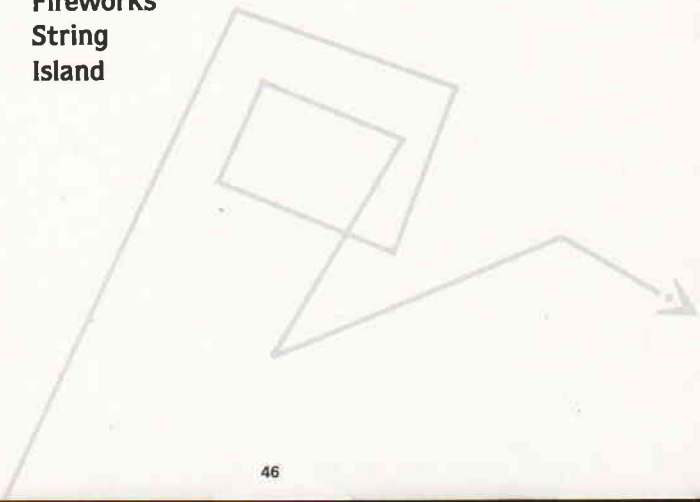
Press [H]

You can review the score at any time with the Redraw command, [SHIFT] [G].



3. IDEAS

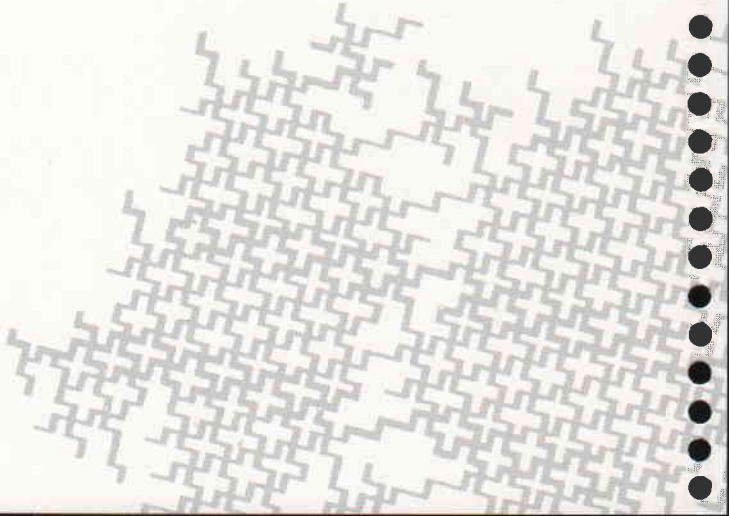
Creating Your Own Works
Design
Maze
Sailboat
Game
Fireworks
String
Island



CREATING YOUR OWN WORKS

This chapter of the guide illustrates a few of the different kinds of pictures you can create with DELTA DRAWING. Each picture is presented along with the programs that were used to produce it. You can recreate the picture by reproducing its text history on your computer. Or you may simply want to use some of the programs that are presented here as starting points for your own pictures.

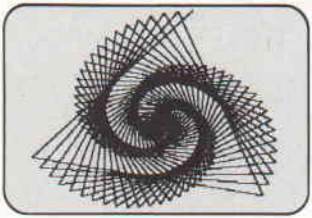
In either case, you will soon discover that there is not just one way to draw a picture with DELTA DRAWING. There are many different ways. As you continue to use the program, you will develop your own approach to solving visual problems and your own style of drawing. And you'll have even more fun using the program as you develop your computer-graphics skills.



Some of the pictures presented in the following exercises have long text histories. In some cases, you may find it easier to enter the list of commands in the text mode, so you can compare the commands on the page with those on your text display directly. If you do enter commands in the graphics mode and a picture doesn't come out right, view the text display and compare the commands on it to the commands printed on the page. If you find a mistake, you can correct it with the editing commands.

Most of the pictures presented in this chapter of the guide are composed of separate drawing programs which are combined to produce a final picture. This method of drawing illustrates how to use drawing programs to construct complex figures from simple parts, but it is not the only way to draw pictures with DELTA DRAWING. You can use as many commands as you like to produce an elaborate, detailed drawing with just one program. You can use the nine program commands to draw one picture or save nine different pictures in the same drawing session.

There is no end to the different kinds of pictures you can produce with the DELTA DRAWING program, and there is no limit to the fun you can have creating them.



DESIGN

First create the design program:

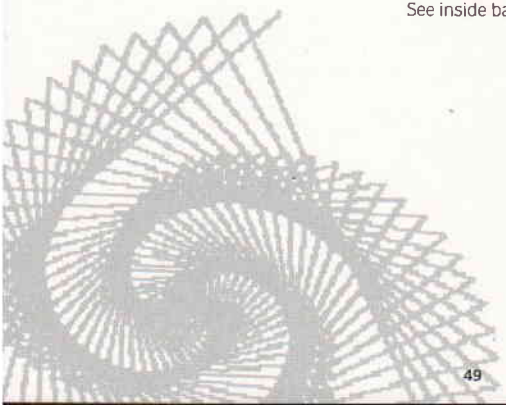
(X1) # 〈 D 4 R + C 〈 R

To draw the design:

Press [H].

(X2) / 3 R M 3 R 2 M
2 0 100X1 100X1 26X1

See inside back cover for colored version of this drawing.



MAZE

To make the curve programs:

(X1)	# 〈 D	12 〈 R	+		
(X2)	%C	X1	%C		

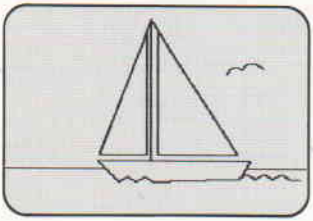
To draw the maze:

(X3)	2X1	3 R	14 D	U	14 M
	3 R	?X1	X2		

Press [H].

(X4)	32 /	45X1	2X2	19X3

You can press [SHIFT] [G] to produce a different maze.



SAILBOAT

The gull program:

(X1)	%D	R

The sail programs:

(X2)	14 D	4 R	%R	12 ⟨ R	%D
	2 C	15 D	%D	4 R	3 ⟨ R
	8 D	3 R	12 D	⟨ D	
(X3)	X2	@X2	3 /	6 I	:X2

The wave program:

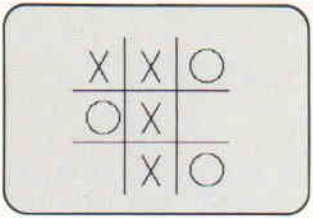
(X4)	D	2 R	D	2 L

To compose and color the picture:

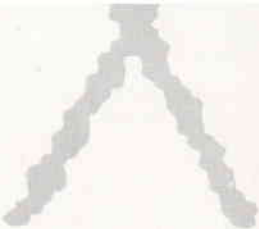
(X5)	U	4 M	3 R	C	5 D
	%D	4 L	%L	3 D	2 L
	%L	2 C	2X4	R	2〈L
	8 D	%D	L	2〈R	3X4
	R	D	U	6 M	4 R
	〈M	C	2 D	4 L	10 D
	3 R	X3	3 *	6 0	U
	4 M	3 L	8 M	2 L	4X1
	4 L	3X1	D	2 R	10 M
	3 R	16 M	16 D	U	30 M
	%M	6 D	U	7 M	C
	〈F	R	4 M	2 C	〈F
	8 M	〈F	4 L	9 M	2 C
	〈F	4 R	9 M		

Press 6 **CTRL** **C** or 3 **CTRL** **C**
Press 4 **B** ATARI ONLY

See inside back cover for colored version of this drawing.



GAME



To make the Tic-Tac-Toe board:

(X1)	U	6 D	U	6 M	12 D
	3 R	6 M	3 R	18 D	U
	6 M	3 L			
(X2)	U	3 M	3 R	3 M	3 R
	2X1	6 M	3 R	3 M	3 R
	M				

To make the X:

(X3)	3 L	M	4 R	4 D	4 L
	2 M	4 L	4 D	4 R	M
	3 R				

To make the O:

(X4)	2 L	D	R	D	R
	D	R	D	R	D
	R	D	R	D	R
	D	R	D	R	D
	R	D	R	D	3 R

To move left one square:

(X5) 3 L 6 M 3 R

To move right one square:

(X6) 3 R 6 M 3 L

To move up one square:

(X7) 6 M

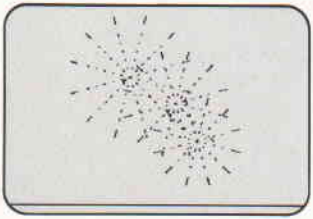
To move down one square:

(X8) U 6 M U

A play of the game:

(X9)

X2	X7	X5	X3	X8
X4	X6	X3	X6	X8
X4	2X7	X5	X3	X6
X4	2X8	X5	X3	



FIREWORKS

The 'explosion' generator program:

(X1)	#M	2<D	%C	D	%C
	D	U	2 M	<M	#M
	U	5 R			

The Fireworks Explosion:

(X2)	%R	12X1	+	%L

The rocket's blazing trail:

(X3)	U	%C	D	U	%C
	M	3<R	D	<Z	

The Fireworks Display:

(X4)	14 M	3 L	50 D	3 R	20X3
	6X2	6 -	C	2 R	6 M
	5X2	5 -	C	R	5 M
	4X2				

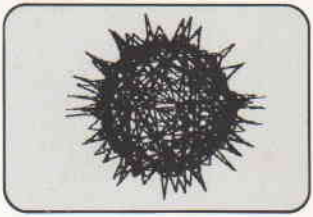
Enter these Drawing Programs on the text display.

Press [G] to see the show.

Press [SHIFT] [G] to see it again.

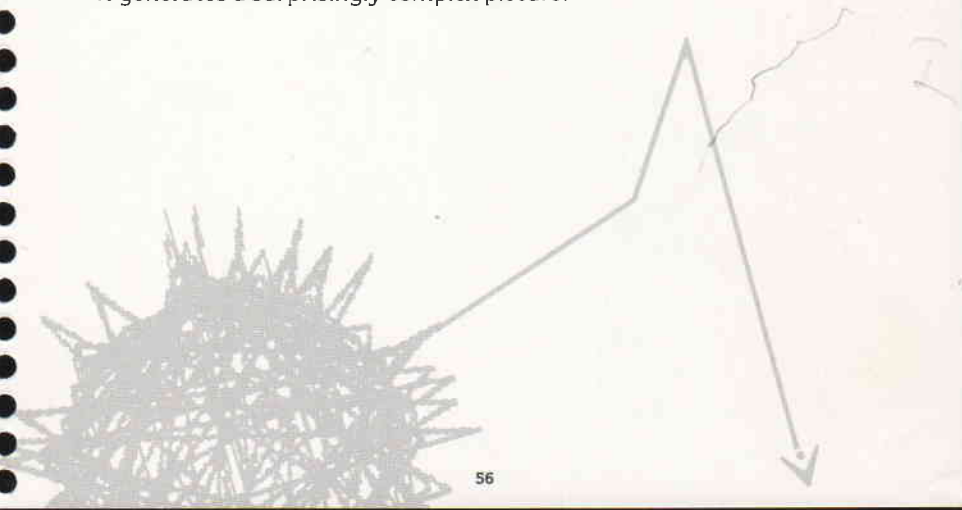
If you are using an Atari, try holding down [B] during 'the show'.

STRING



(X1)	# 〈 D	# 〈 R	+		
(X2)	3 L	7 M	3 R	100X1	80X1

Try this simple program.
It generates a surprisingly complex picture.



ISLAND

To draw the island and trunk of the tree:

(X1)	D	R			
(X2)	D	L			
(X3)	4 L	13 M	R	5 M	U
	C	21 D	3 < D	5 L	2 D
	L	X1	X2	2X1	X2
	2 L	X1	2 D	R	X2
	X1	L	X2	X1	L
	D	2 R	X2	D	L
	D	X1	D	3X2	4 L
	M	< F	R	M	%M
	3 L	X1	%L	2 D	%R
	2 D	< L	D	2 < L	D
	2 < L	4 D	5 L	2 < D	X2
	4 D	2 < R	D	2 < R	D
	2 < R	D	2 < R	D	< L
	2X2	4 L	M	< F	4 < L
	9 M	%M	3 R	5 < R	

To draw the top of the tree:

(X4)	X3	U	4X2	D	5 R

3X1	2D	R	D	5L
3X2	D	5R	3X1	2D
5L	2D	4R	3X1	D
3L	D	3X1	2D	R
D	5R	D	5X2	4L
D	<R	D	2R	X1
2D	R	D	5R	X2
2D	2L	X1	5L	2D
R	X2	5R	X1	2D
L	3D	4R	M	<F

To draw the water, sun and compose the picture:

(X5) 100D . .

(X6)

X4	4R	10M	2L	5M
<L	35D	10M	C	<F
C	X5	@X5	U	6M
3R	2M	R	%R	2D
%R	2D	%R	2D	%R
2D	%R	2D	%R	2D
%R	2D	%D	U	L
2M	<F	2R	11M	R
4M	3L	3X2	3R	3X2
6M	3R	%R	3*	3X2
3R	3X2			

Adjust the colors: 3 CTRL C or 6 CTRL C B ATARI ONLY

M 6 CTRL C or 3 CTRL C 4 B ATARI ONLY

See inside back cover for colored version of this drawing.

DELTA

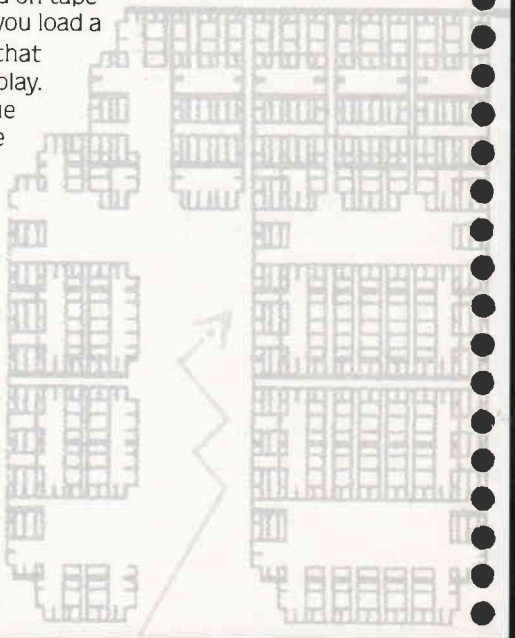
4. FILING DRAWING PROGRAMS

Using The Tape Filing System
Tape Filing System Menu
Saving A File
Loading A File

USING THE TAPE FILING SYSTEM

If you have a tape system that connects to your computer, you can save and view the drawings you create with DELTA DRAWING. You save drawings by saving the drawing programs that produced them.To save a drawing, you must save the entire text history, that is, all of the programs that have been recorded on the text display. When you save a text history on a tape, you create a file.

You can view a file that has been saved on tape by loading it into your computer. When you load a file from a tape, the drawing programs that were saved are recreated on the text display. You can use these programs and continue drawing as if you had just generated the text history from the keyboard.



TAPE FILING SYSTEM MENU

You save and load files by making selections from the tape filing system menu. To view the menu, use the tape filing system command: hold down [CTRL] and press [S]. When you press [CTRL] [S], the menu appears on the screen as follows:

Press:

[S] to SAVE a file
[L] to LOAD a file
[ESC] to exit*
[Q]

The saving and loading functions are selected from this menu and are described in the following sections.

* [Q] on the Commodore 64.

SAVING A FILE

When you save a file, you save all of the drawing programs that are currently recorded on the text display. The system saves the entire text history, up to and including ten drawing programs.*

1. Advance or rewind the tape until the counter registers the number where you want to save the file.
2. In graphics mode, hold down [CTRL] and press [S].
3. When the tape filing system menu appears, press [S] again.
4. Press Play and Record on the cassette player.
5. The message, IF RECORDER IS READY, PRESS ANY KEY, appears on the screen.** If you have not positioned the tape properly or depressed Play and Record, do so now.
6. Press any key on the computer keyboard. The message, SAVING . . . . appears on the screen. On Commodore 64 computers the screen then goes blank for the remainder of the saving operation. A second message, PRESS PLAY AND RECORD ON TAPE, appears on the Commodore 64 screen if the tape recorder is not ready.

When the file has been saved on the tape, the tape stops moving and the screen returns to graphics mode. It takes about 70 seconds to save a file on tape with Atari computers and about 20 seconds with the Commodore 64.

If you press [CTRL] [S] in text mode, nothing happens. If you press [CTRL] [S] in graphics mode, then decide not to save your drawing on the tape, you can press [ESC] (ATARI) or [Q] (COMMODORE 64). This returns you to graphics without saving the drawing.

It is a good practice to leave space (such as ten numbers) on the tape between the end of one file and the beginning of the next. If you save a new file over an existing file on the tape, the old file will be erased.

*A tenth program can be included in a file, but the program cannot be closed.

**Both computers "beep" at this point.

LOADING A FILE

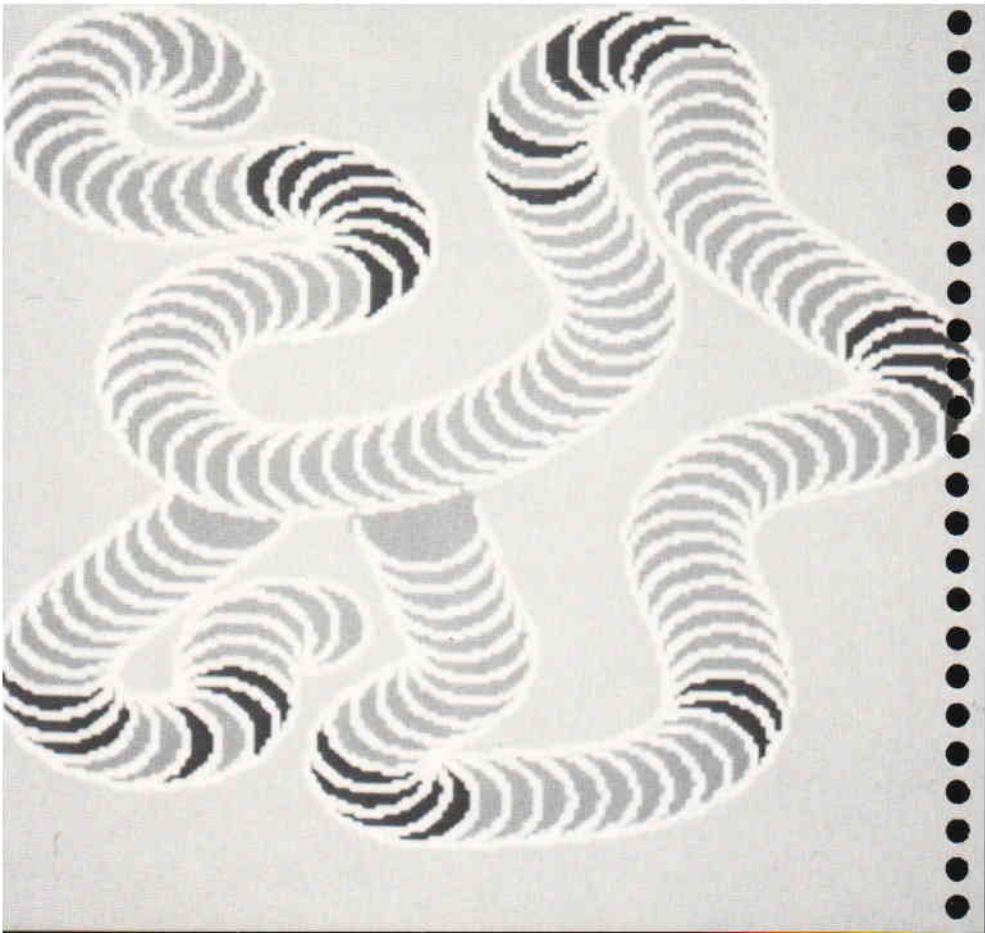
When you load a file from a tape, the text history in that file is reproduced on your text display and the drawing produced by the open program in that file is reproduced on your graphics display.* Loading a file from a tape does not erase that file from the tape.

1. Advance or rewind the tape so that the counter registers the number at the beginning of the file you want to load (you must load the entire file in order to view any drawing within it).
2. In graphics mode, hold down [CTRL] and press [S].
3. When the tape filing system menu appears, press [L].
4. Press **Play** on the cassette player.
5. The message, IF RECORDER IS READY, PRESS ANY KEY, appears on the screen. If you have not positioned the tape properly or depressed Play do so now.
6. Press any key on the computer keyboard. The message, Loading . . . , appears on the screen. On Commodore 64 computers the screen then goes blank for the remainder of the loading operation.

When the tape stops moving, the drawing (if there is one) produced by the open program is redrawn on the graphics display. To see the text, press [T]. The time it takes to load a file is the same as the time it took to save that file. If the file fails to load properly, repeat the procedure, making sure the tape counter registers a number before the beginning of the file.

If you press [CTRL] [S], then decide not to load a file, you can press [ESC] (ATARI) or [Q] (COMMODORE 64). This returns you to the graphics display without loading a file.

*Caution: Loading a file from a tape erases and replaces any programs that are recorded on the text display.



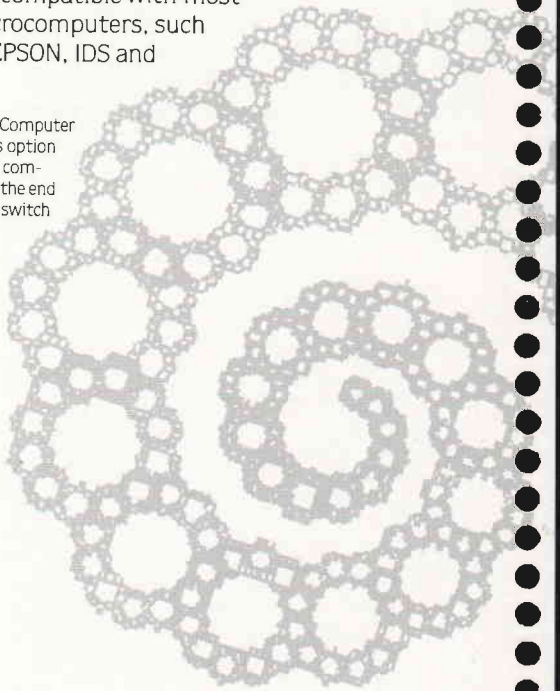
5. PRINTING DRAWING PROGRAMS

Printer Support
Printing Procedure

PRINTER SUPPORT

You can print the text history of your drawing programs if you have a printer compatible with the DELTA DRAWING program. DELTA DRAWING is compatible with most standard printers for microcomputers, such as ATARI, COMMODORE, EPSON, IDS and the OKIDATA 82A.*

*Because of the large number of printers available, Computer Access Corporation is unable to guarantee that this option works with all printers. DELTA DRAWING for Atari computers sends a carriage return, but not a line feed at the end of each line. Many printers have an option select switch which can be set to insert a line feed with each carriage return. Check your printer manual for this option.

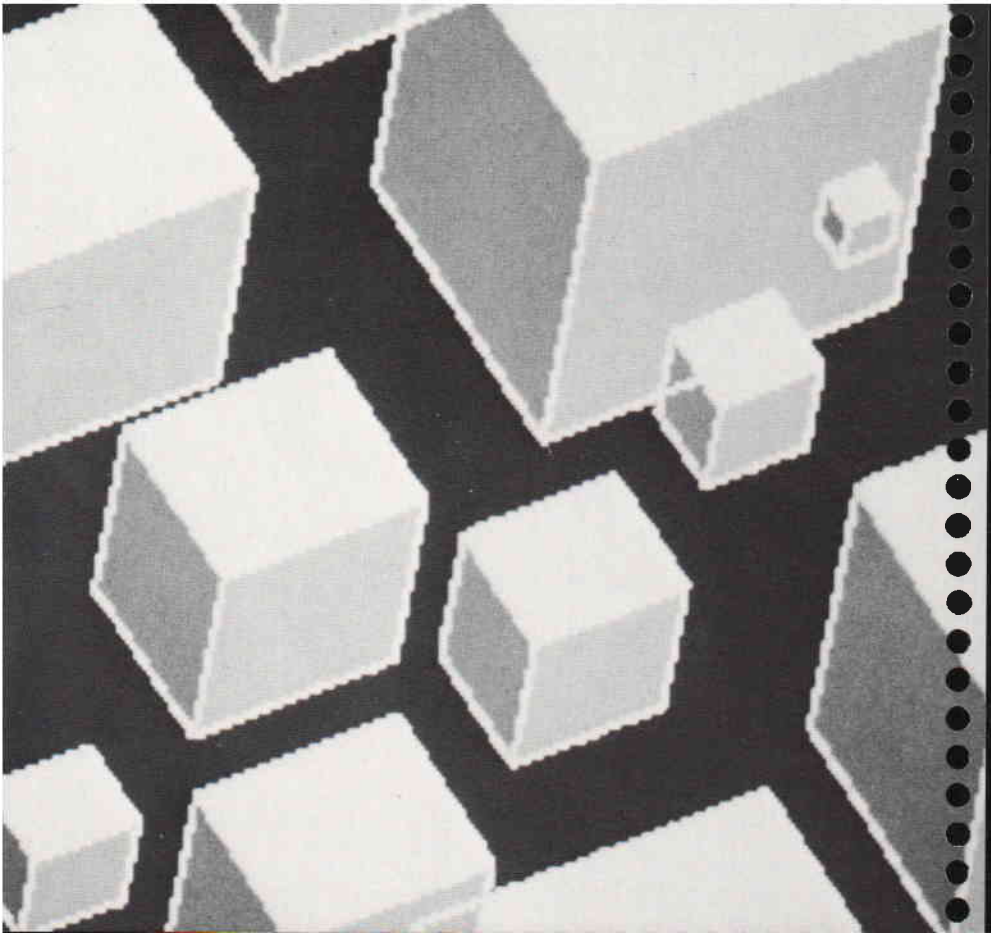


PRINTING PROCEDURE

To print the text history of a drawing:

1. Press [T] to view the text display.
2. Make sure the printer is on line and connected.
3. Hold down [CTRL] and press [P].

When you press [CTRL] [P], the cursor stops blinking and all of the programs that are currently recorded on the text display are printed. When the printing is completed, the cursor resumes blinking.



6. COMMANDS

Types of Commands
Drawing Commands
Editing Commands
Program Commands
Display Commands
Coloring Commands
Repeating Commands
Scaling Commands
System Commands
Command Summary

TYPES OF COMMANDS

This section of the User's Guide has been designed for reference. It contains a brief description of all the commands in the DELTA DRAWING program. The commands are organized into eight types. Each type includes a group of commands that have a similar function.

Most DELTA DRAWING commands are single-key commands. You press only one key to execute the command. But some commands require that you press two keys at the same time. **CTRL** and **SHIFT** are "auxiliary command" keys. When you use a command that requires one of these auxiliaries, press the auxiliary key first and hold it down; then press the other command key.

The DELTA DRAWING program contains both "recorded" and "unrecorded" commands. The commands that are recorded on the text display become elements of your drawing programs. The commands that are not recorded on the text display do not become elements of drawing programs.

Some commands in DELTA DRAWING must be used together with other commands. These are called "modifier commands," because they are used to modify the effects of other commands. All of the Repeating commands are modifier commands.

Some commands in DELTA DRAWING operate like a toggle switch, the kind of switch used to turn a light on and off. When you execute such a command, you change the state of the program; when you execute it again, you return the program to its previous state. These "toggle-switch" commands include: Background Drawing Color, Kaleidoscope and High-Speed Drawing.

Special abbreviations are used for the control and shift keys on the text display. The symbol < stands for the control key, **CTRL** and the symbol % stands for the shift key, **SHIFT**. These symbols are used in the text display column in the following tables of commands. The abbreviation, CMD, which also appears in the text display column, stands for "the command to be modified."

DRAWING COMMANDS

COMMAND	KEY(S)	TEXT DISPLAY	COMMAND FUNCTION
Draw	D	D	Draw a line 8 units long.*
Move	M	M	Move 8 units (no line).
Right Turn	R	R	Turn right 30.°
Left Turn	L	L	Turn left 30.°
U-Turn	U	U	Turn around 180.°
Pause	Z	Z	Pause 1 second.
Half Draw	SHIFT D	%D	Draw a line 4 units long.*
Half Move	SHIFT M	%M	Move 4 units (no line).
Half Right Turn	SHIFT R	%R	Turn right 15.°
Half Left Turn	SHIFT L	%L	Turn left 15.°
Half Pause	SHIFT Z	%Z	Pause ½ second.
Unit Draw	CTRL D	<D	Draw a line 1 unit long.*
Unit Move	CTRL M	<M	Move 1 unit (no line).
Unit Right Turn	CTRL R	<R	Turn right 1.°
Unit Left Turn	CTRL L	<L	Turn left 1.°
Unit Pause	CTRL Z	<Z	Pause 1/10 second.
Kaleidoscope	K	K	Select Kaleidoscope, the four-pointer drawing mode/ return to one/pointer drawing mode.

*One unit is approximately equal to one picture element, or pixel, which is the smallest mark, or dot, that can be made on the graphics display.

EDITING COMMANDS

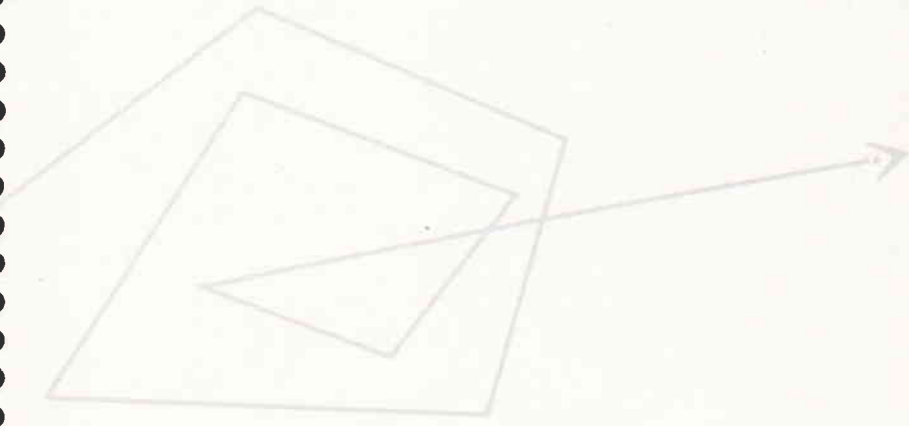
COMMAND	KEY(S)	TEXT DISPLAY	COMMAND FUNCTION
Erase	E	NONE	Erase the last recorded command
Erase Element	DELETE BACK S ←	NONE	Erase the last program element.
Erase Picture	CTRL E	NONE	Erase the graphics display and all commands in the open program.
Erase Programs	SHIFT Q	NONE	Erase the graphics and text displays and return to the start of DELTA DRAWING.
Move Up	CTRL ↑ SHIFT ⇧	NONE	Move the cursor up one program line.
Move Down	CTRL ↓ ⇩	NONE	Move the cursor down one program line.
Move Left	CTRL ← SHIFT ⇦	NONE	Move the cursor one program element to the left.
Move Right	CTRL → ⇨	NONE	Move the cursor one program element to the right.
New Screen	CTRL N	〈 N	Clear the graphics display and return the DELTA pointer to its start position without erasing any commands in the open program.

PROGRAM COMMANDS

COMMAND	KEY(S)	TEXT DISPLAY	COMMAND FUNCTION
Save	S	NONE	Save a sequence of commands as a drawing program.
First Program	X 1	X1	Call the first program.
Second Program	X 2	X2	Call the second program.
Third Program	X 3	X3	Call the third program.
Fourth Program	X 4	X4	Call the fourth program.
Fifth Program	X 5	X5	Call the fifth program.
Sixth Program	X 6	X6	Call the sixth program.
Seventh Program	X 7	X7	Call the seventh program.
Eighth Program	X 8	X8	Call the eighth program.
Ninth Program	X 9	X9	Call the ninth program.

DISPLAY COMMANDS

COMMAND	KEY(S)	TEXT DISPLAY	COMMAND FUNCTION
High-Speed Drawing	H	NONE	Make the DELTA pointer draw programs at high speed/return to standard-speed drawing.
Text	T	NONE	View the text display.
Graphics	G	NONE	View the graphics display.
Redraw	SHIFT G	NONE	Clear the graphics display and rerun the open program



COLORING COMMANDS

COMMAND	KEY(S)	TEXT DISPLAY	COMMAND FUNCTION
Change Foreground Color	C	C	Select the next color in a cycle of three foreground colors.
Fill With Color	CTRL F	< F	Fill a closed shape with the current foreground color.
Background Drawing Color	SHIFT C	%C	Draw in background color/ return to foreground drawing colors.
Change Hue	CTRL C	NONE	Change the color touching the DELTA pointer's blinking dot to the next hue in a cycle of eight hues.
Change Brightness*	B	NONE	Change the color touching the DELTA pointer's blinking dot to the next brightness in a cycle of eight levels of brightness.

*For ATARI computers only.

REPEATING COMMANDS

COMMAND	KEY(S)	TEXT DISPLAY	COMMAND FUNCTION
Random	SHIFT ? CMD*	?_____	Repeat the next command a random number of times.
Input Accumulator	SHIFT # CMD	#_____	Repeat the next command the number of times indicated by the current value of the accumulator.
Add to Accumulator	+	+	Add the number specified to the number in the accumulator.
Subtract from Accumulator	−	−	Subtract the number specified from the number in the accumulator.
Reverse	SHIFT @ CMD @ CMD	@_____	Execute the next command in reverse.
Mirror	SHIFT : CMD : CMD	:_____	Execute the mirror image of the next command.

*CMD is an abbreviation of "the command to be modified."

SCALING COMMANDS

COMMAND	KEY(S)	TEXT DISPLAY	COMMAND FUNCTION
Enlarge	[*]	*	Enlarge subsequent drawing. 8 [•] doubles the size of a drawing.
Reduce	[/]	/	Reduce subsequent drawing. 8 [/] halves the size of a drawing.
Squeeze In	[I]	I	Squeeze subsequent drawing to make it tall and thin. 16 [I] makes drawing twice as tall and half as wide.
Stretch Out	[O]	O	Stretch subsequent drawing to make it short and fat. 16 [O] makes drawing half as tall and twice as wide.

SYSTEM COMMANDS

COMMAND	KEY(S)	TEXT DISPLAY	COMMAND FUNCTION
Tape Filing System	CTRL S	NONE	Save or load files to or from a file tape.
Print	CTRL P	NONE	Print the current text history.
Escape	ESC Q	NONE	Exit from tape filing and printing routines, delete incorrect numerical input and stop the repetition of a command.

DELTA DRAWING COMMAND SUMMARY

DRAWING

Recorded Commands

Draw	D
Move	M
Right Turn	R
Left Turn	L
U-Turn	U
Pause	Z
Half Draw	SHIFT D
Half Move	SHIFT M
Half Right Turn	SHIFT R
Half Left Turn	SHIFT L
Half Pause	SHIFT Z
Unit Draw	CTRL D
Unit Move	CTRL M
Unit Right Turn	CTRL R
Unit Left Turn	CTRL L
Unit Pause	CTRL Z
Kaleidoscope	K

EDITING

Recorded Commands

New Screen	CTRL N

Unrecorded Commands

Erase	E
Erase Element	DELETE BACK S ←
Erase Picture	CTRL E
Erase Programs	SHIFT Q
Move Up	CTRL ↑ SHIFT ⇧
Move Down	CTRL ↓ ⇩
Move Right	CTRL → ⇨
Move Left	CTRL ← SHIFT ⇦

PROGRAM

Recorded Commands

1st Program	X 1
2nd Program	X 2
3rd Program	X 3
4th Program	X 4
5th Program	X 5
6th Program	X 6
7th Program	X 7
8th Program	X 8
9th Program	X 9

Unrecorded Commands

Save	S

DISPLAY

Recorded Commands

Unrecorded Commands

High-Speed Drawing	H
Text	T
Graphics	G
Redraw	SHIFT G

COLORING

Recorded Commands

Change Foreground Color C

Fill with Color . . . . CTRL F

Background Drawing Color . . . . SHIFT C

Unrecorded Commands

Change Brightness . . . . B*

Change Hue . . . . . CTRL C

*ATARI Computers Only

REPEATING

Recorded Commands

Random . . . . . SHIFT ? (CMD)*

Input Accumulator . . . . . SHIFT # (CMD)

Add To Accumulator . . . +

Subtract From Accumulator . . . –

Reverse . . . . . SHIFT @ (CMD)
@ (CMD)

Mirror . . . . . SHIFT : (CMD)
: (CMD)

*CMD is the abbreviation of "the command to be modified."

SCALING

Recorded Commands

Enlarge . . . . . *

Reduce . . . . . /

Squeeze In. I

Stretch Out . . . . . O

SYSTEM

Recorded Commands

Unrecorded Commands

Tape Filing System . . CTRL S

Print . . . . . CTRL P

Escape. . . . . ESC
Q

This guide will represent command keys for ATARI computers as CTRL, and command keys for COMMODORE computers as CTRL. Where command keys are the same for both computer brands they will be shown as CTRL.

GLOSSARY/INDEX

This glossary/index defines terms that are used frequently in the DELTA DRAWING User's Guide. The numbers in parentheses refer to pages in the guide. The first number refers to the page on which the term is first used; subsequent numbers indicate pages that introduce additional applications of the term.

DELTA DRAWING commands are indexed but not defined here. In these cases, the first number refers to the page on which the command is first used; the second number refers to the page in chapter 6, COMMANDS, where the command is defined.

Add To Accumulator	**(35, 78)**
Auxiliary Command Key	**(7, 15)** CTRL and SHIFT are auxiliary command keys in DELTA DRAWING. Auxiliary command keys are used only in conjunction with other command keys. In these cases, the auxiliary command key is pressed first and held down while the other command key is pressed. CTRL E is an example.
Background	**(25)** The background of a drawing is any portion of the graphics display that has not been drawn on or filled with a foreground color.
Background Drawing Color	**(25, 77)**

Boundary	**(5, 21)** This term is used in two different ways in DELTA DRAWING. The screen boundary always appears on the graphics display as a line drawn around the edge of the screen. When the DELTA pointer touches this boundary line, it jumps to position just inside the boundary on the opposite side of the screen without changing its heading. A shape boundary is a drawn line that completely encloses an area of the screen.
Call	**(9, 75)** You call a drawing program from the computer's memory by pressing the program command keys previously assigned to that program. The keys (X1-X9) on the computer keyboard are the program command keys you use to call a program. When you call a program, the picture it produces is redrawn on the graphics display and the program command is included as an entry on the text display.
Change Brightness	**(23, 77)**
Change Foreground Color	**(21, 77)**
Change Hue	**(23, 77)**

Closed program **(11, 29)** A closed program is a drawing program that has been saved in the computer's memory by pressing [S]. When you execute the Save command you close the open program. A closed program can be called and included in another program by executing the program command that designates it. In DELTA DRAWING, up to nine drawing programs can be closed in a drawing session. A tenth program can be used to draw, but it cannot be closed.

CMD **(33)** An abbreviation for the phrase "a command to be modified." CMD stands for any DELTA DRAWING command that can be modified by one of the Repeating commands.

Command **(1, 5)** An instruction in a programming language that directs the computer to perform a specific set of operations.

Command Key **(1, 15)** Any key on the computer keyboard that is used to execute DELTA DRAWING commands. In DELTA DRAWING a command is executed immediately when the appropriate key(s) is pressed. Some command keys are used in conjunction with an auxiliary command key. In these cases, both the auxiliary and the command key must be pressed at the same time to execute the command.

Command List	**(6)** The commands included in a drawing program listed in their sequence of occurrence. A drawing program is described by its command list. A command list is arranged in program lines, each of which may contain up to five program elements.
Cursor	**(11, 19, 74)** The cursor appears on the text display as a blinking line. It is used for entering and editing commands on the text display. Commands are inserted or deleted to the immediate left of the cursor.
Delta Pointer	**(2, 5)** The pointer that appears on the graphics display when you start DELTA DRAWING. It is pointed at its front end, and it has a blinking dot at its back end. The DELTA pointer is your drawing instrument. It moves, turns and draws on the screen in response to the commands you give it. The DELTA pointer only appears on the graphics display. The cursor appears and moves on the text display.
Draw	**(5, 73)**
Drawing	In DELTA DRAWING the term "drawing" is used to refer to any visible marks or color changes produced on the graphics display as a result of executing DELTA DRAWING commands. The terms "drawing" and "picture" are used synonymously in this guide.

Drawing Program	**(9)** The sequence of commands used to produce a picture on the graphics display in DELTA DRAWING. A drawing program is described by a command list on the text display. The terms "drawing program" and "program" are used synonymously in this guide.
Edit	**(19, 74)** To change the contents of a drawing program. In DELTA DRAWING you can edit on either the text display or the graphics display. When you are in the graphics mode and erase or change a part of a picture, you also change the contents of the drawing program that is recorded on the text display.
Empty Program	A drawing program that does not contain any commands. In DELTA DRAWING, you start a new picture with an open program that is empty.
Enlarge	**(31, 80)**
Erase	**(5, 74)**
Erase Element	**(17, 74)**
Erase Picture	**(7, 74)**
Erase Programs	**(9, 74)**
Escape	**(13, 80)**

Execute A Command	**(1, 5)** A command is executed in DELTA DRAWING when you press the appropriate key or keys on the keyboard. When you execute, or use, a command, you instruct the computer to carry out the set of operations defined by that command.
Fill With Color	**(21, 77)**
First–Ninth Program	**(9, 75)**
Graphics	**(11, 76)**
Graphics Display	**(5)** DELTA DRAWING uses this screen in several ways—for text and graphics displays and for the tape filing system menu. The graphics display shows the picture produced by the open drawing program.
Half Draw	**(15, 73)**
Half Left Turn	**(15, 73)**
Half Move	**(15, 73)**
Half Pause	**(41, 73)**
Half Right Turn	**(15, 73)**
Heading	**(7)** The direction the DELTA pointer is pointing. The DELTA pointer is always pointing in some direction.

High-Speed Drawing	**(14, 76)**
Input Accumulator	**(35, 78)**
Kaleidoscope	**(39, 73)**
Left Turn	**(5, 73)**
Menu	**(11, 62)** A list from which to choose. In DELTA DRAWING, there is a menu that is part of the tape filing routine.
Mirror	**(37, 78)**
Mode	**(11)** DELTA DRAWING has three modes of operation: graphics, text and file/print. Press [G] to operate in the graphics mode, press [T] to operate in the text mode, and press [CTRL] [S] or [CTRL] [P] to operate in the file/print mode.
Modifier Command	**(30, 72)** A modifier command is a type of DELTA DRAWING command that modifies another command and, therefore, requires another command for its execution. The Random command is an example.
Move	**(7, 73)**
Move Down	**(19, 74)**

Move Left	**(19, 74)**
Move Right	**(19, 74)**
Move Up	**(19, 74)**
New Screen	**(41, 74)**
Open Program	**(11, 29)** An open program is a program that does not have a line under it on the text display—that is, a program that has not been closed by pressing [S]. In DELTA DRAWING the picture on the graphics display is produced by the open program and only one program is open at any time.
Pause	**(41, 73)**
Picture Element	**(7, 73)** A picture element (pixel) is the smallest mark or dot that can be shown on the graphics display. A picture element is one of the dots in the matrix of dots that make up the screen.
Position	**(5, 7)** The DELTA pointer's position is where it is located on the screen. The DELTA pointer is always located at some point on the screen.
Print	**(67, 80)**
Program	See Drawing Program.

Program Contents	**(9, 11)** The commands in a drawing program in the sequence in which they are recorded. Change a command, or the sequence of commands, and you change the contents of a drawing program.
Program Element	**(17, 29)** A program element is a unit of the text display that consists of an abbreviation of a command and the number of times it was executed successively. For example, 7D is a program element. A program line may consist of up to five program elements.
Program Line	**(17)** A program line is one or more commands grouped into program elements and arranged in a horizontal line on the text display. Program lines may contain up to five program elements. The elements in it are read from left to right. A drawing program consists of one or more program lines. A program line should not be confused with the solid line that appears under a closed program on the text display.
Random	**(33, 78)**
Recorded Command	**(11, 71)** A command that is recorded on the text display and included as an element in a drawing program.
Redraw	**(30, 76)**
Reduce	**(31, 80)**

Reverse	**(37, 78)**
Right Turn	**(5, 73)**
Save	**(9, 75)**
Single-Key Command	**(30, 71)** A command that is executed by pressing a single key on the computer keyboard.
Squeeze In	**(31, 80)**
Start Position	**(42)** The DELTA pointer is in the center of the screen, pointing up, and the open program is an empty program. You start the DELTA DRAWING program with the DELTA pointer in its start position, and it returns to this position whenever you press [S], [CTRL] [N], [CTRL] [E] or [SHIFT] [Q].
Step Size	**(15)** The step size of the DELTA pointer is the distance it travels when you use a draw or move command. The DELTA pointer moves and draws in one of three step sizes: standard-step, half-step, and unit-step.
Stretch Out	**(31, 80)**
Subtract From Accumulator	**(35, 78)**
Tape Filing System	**(61, 80)**

Text	**(11, 76)**
Text Display	**(6, 11)** DELTA DRAWING uses the screen in several ways—for text and graphics displays and for the tape filing system menu. The text display shows the recorded commands that are used to draw pictures on the graphics display.
Text History	**(29, 48)** All of the programs recorded on the DELTA DRAWING text display, from the first program up to and including the open program.
Unit Draw	**(15, 73)**
Unit Left Turn	**(15, 73)**
Unit Move	**(15, 73)**
Unit Pause	**(41, 73)**
Unit Right Turn	**(15, 73)**
Unrecorded Command	**(11, 71)** A DELTA DRAWING command that is not recorded on the text display. An unrecorded command is not included as an element of a drawing program.
U-Turn	**(7, 73)**

MORE COLOR DRAWINGS

Delta Drawing™
Learning Program
Proof of Purchase

Butterfly
(40)

Design
(49)

Sailboat
(51)

Island
(57)

The number in parentheses refers to the page in the GUIDE where the drawing commands for this picture appear.

Delta Drawing
Learning Program
Proof-of-Purchase

Computer Access Corporation, creators of the Delta Learning Series specializes in developing software that makes the computer easy to use for people of all ages.

DELTA DRAWING was authored by the principals of Computer Access Corporation.

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Computer Access Corporation owes a debt of gratitude to the many people whose help and time have made the DELTA DRAWING Learning Program series possible. They know who they are.

Thank You!

We must, however, give particular recognition to: Prof. Harold Abelson. His INSTANT program was the inspiration from which DELTA DRAWING evolved.

Computer Access Corporation solicits and welcomes suggestions and comments from users. PLEASE WRITE to us in care of:

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