

# THE COMPLETE GRAPHICS SYSTEM

**for the Apple II**  
by Mark Pelczarski

CO-OP   
software

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# The Complete Graphics System

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This software has been thoroughly tested prior to release. If you should have any problem with it, try to duplicate the situation leading to the problem. If it recurs, let us know the exact circumstances and we will act to correct the situation. Those who return their registration cards will be notified of updates, if any.

# I. INTRODUCTION

## Overview

The Complete Graphics System is a user-orientated set of graphics programs for the Apple II microcomputer. It offers almost every feature possible to aid in creation of multi-color graphic and text displays with your computer. With it you can, for example, design a house in three dimensions by drawing each of its faces on the screen. Then with the 3-D module you can assemble the pieces and present several different views of the house, in true three-dimensional perspective. Saving these views, you can use the Drawing Module to fill in the walls with your choice of over 100 colors and add any finishing touches to each picture. You can even add text descriptions to the pictures, anywhere on the screen. If you want, you can shrink your pictures so that four different views are shown at once.

That's not all; most of the utilities in the graphics system can be adapted to your own programs. Instructions are included here for using pictures and shape tables, and how you can use the 100-color fill routine and text routine with your own programs. Instructions are also included for duplicating the 3-D file format from your own programs.

Do not expect to sit down and master all of the capabilities of this system at once. Even though it is very user-orientated, there is a lot that it can do. There are actually six programs and several machine language subroutines in the system (although you won't really notice; once you boot the disk movement back and forth among the programs is handled totally by the system). You will most likely be discovering new tricks and ideas for a long time. We hope you enjoy it, and let us know if you have any comments or suggestions.

## Data Disks and Backup Copies

Most of the information on the system master can be copied with a standard copy program. You will, however, have to boot with the original disk in order to load all the information necessary for the system. Although all data files (pictures, shape tables, text fonts, 3-D files) can be saved on any Apple formatted disk (of the matching DOS: 3.2 or 3.3), we suggest the following for the easiest use of the system, and for minimal wear on the system master:

- 1) Make back-up copies of the system master with any standard copy program.
- 2) When you use the graphics system, boot with the system master. When the menu page is displayed, put the master away and insert one of your back-up copies. Use this as your data disk so that you won't have to swap disks as you go from one graphics module to another. Your system master gets less wear this way, and you don't have to concern yourself with constantly swapping disks.
- 3) If you want one of your files (picture, shape table, etc.) transferred to a non-system disk, this is easily accomplished by loading the file, inserting the non-system disk, and saving from the appropriate module.

If anything goes wrong with your system master, return it, with \$5.00 to cover a new disk and handling, and we'll promptly send a replacement. Be sure to return your registration card so we can notify you of updates and other graphics system compatible products. We are looking for user-generated text fonts, shape tables, and sets of 3-D files that we can make available to owners of the graphics system at a low cost. Write or call Co-op Software for information.

# II. GETTING STARTED

First, be sure your paddles are plugged into your computer. Half of the modules allow or require use of the paddles. After you've booted the system master (and put in your back-up, if you've made one), you will be shown the main options page, hereafter called the "menu". On it are displayed the names of the six main modules: (D) Drawing, (T) Text, (3) 3-D Graphics, (S) Shape Tables, (P) Panel Drawing for 3-D files, and (K) Shrink utility. Below those are two other options: (C) Color Bars, and (I) Issue a Disk Command.

When you first boot it is a good idea to select the Color Bars option by typing 'C'. This displays and labels the six primary high-resolution colors: green, violet, white, black, orange, and blue. Adjust your set so that you are getting the proper colors and an intensity that does not distort the edges. Some of the original Apples only have four colors (lacking orange and blue). Some televisions may change the orange and blue. After making any adjustments, pressing any key returns you to the menu.

The "I" command is the one you'll use if you want to CATALOG a disk, or DELETE a file. If at any point you forget a file name or run out of room on a disk, you can return to the menu and issue any disk command.

In the graphics system, anytime you are asked a question that has a yes or no answer, press the letter 'Y' or 'N'. If ever an error message appears, or if the computer seems to be waiting, you can usually press any key to go on. A list of error messages and probable causes appears in Appendix C.

The easiest way to get started is with the Drawing module, so we suggest that you type 'D' and go on to the next chapter.

## III. THE DRAWING MODULE

The first choices you see from the Drawing module are on its "options page": (L) Load a picture, (S) Save a picture, (C) Clear the screen, (T) Load a Shape Table, (D) Draw, and (M) Return to menu. If the color bars are on the screen, select 'C' to clear it, type 'Y' to verify that you want what's on the screen to be deleted, and type '0' for color number 0, which is black. Once the screen is clear, select 'D' to start drawing.

### DRAWING

At the bottom of the screen you should see a bunch of text, as shown in figure 1, and somewhere on the screen there should be two flashing circles, which are your cursors. The text at the bottom tells you the mode you are in, the location of the movable cursor, the color you are using, and your options. The top row of letters are the commands you can use. Every module has a similar format, displaying the single letter commands available to you at any given time. You should see that you are in Line Mode, your color is 7, the background color is 0, and what the X,Y coordinates of your movable cursor are.

Turn the paddles: One of the cursors will move and the X,Y coordinates at the bottom will change. Paddle 1 moves the cursor from left to right; paddle 0 moves it up and down. Move the cursor all the way to the left. Now move it slowly to the right. Toward the right side of the screen you should see it jump to the edge. Now if you move it all the way to the left, it should do the same thing near the left edge. This is because the paddle returns a number from 0 to 255, and the screen width is 0 to 279. An offset is added on so that you can address any point across the screen. Once you have gone to the edge of the screen, the cursor will move smoothly until you go near the opposite edge. This is okay, because in detail work seldom do you jump clear across the screen. Note that if you don't find this happening, or if either of the X or Y coordinates won't move in the full range (0-279 for X, 0-191 for Y), the variable resistor in your paddle may be dirty. Get some spray contact cleaner, open the back of the paddle by removing the screw, and spray the cleaner into the small hole in the back of the resistor, turning the knob back and forth for a while. This usually takes care of it.

### Lines

Onward... Now press the button on paddle 1. The stationary cursor will move to the position of the movable cursor. Move the movable cursor with the paddles, then press the button on paddle 0. Presto! A white line connects the cursors, and the stationary cursor joins the movable one. Try it a few times. This is Line mode. Call the stationary cursor the starting point, and the movable cursor the endpoint, and each time you draw a line, the endpoint becomes the new starting point. If you hold down button 0 while you move the cursor, you can even approximate a rounded edge.

### Fill (Manual)

Looking at the commands on the top line, "L" stands for line mode. Anytime you press the letter 'L' you get back to the mode you started with. 'F' stands for Fill mode. This is a manual fill, using the six primary colors. It's similar to line mode, except the starting point doesn't change. Therefore, if you hold down button 0, you can sweep out an area and all the lines drawn to the same point will fill the enclosed space.

### Color

'C' lets you change colors., Unless you are in Auto Fill mode, you are given the choices 0-7. 0 and 4 are black, 1 is green, 2 is violet, 3 and 7 are white, 5 is orange, and 6 is blue. At some point in using the Apple, you probably noticed that some colors tend to "bleed" over onto others when placed side by side. This is because of the way the colors and points on the screen are stored. Any single row of points on the screen is divided into sets of seven dots. In any of these little sets, you can have colors 0-3 or 4-7, but not any mixture between the two groups. Green (1) does terrible things next to orange (5) or blue (6), orange does nasty things to green and violet (2), and so on. The reason for this side remark, however, is that the two whites and blacks can act differently on your drawing. Black (0) and white (3) affect blue and orange; black (4) and white (7) do not. The opposite conditions are true with green and violet.

Another color restriction with the Apple is that colors other than black and white may only appear in even or odd columns, hence those colors have only half the resolution. Vertical lines in the wrong column will not show if they're in the wrong color. Corrections are made for this in all but the 3-D module, and that's why vertical lines may occasionally be plotted slightly off-center from the cursors.

### Auto Fill

Draw enough lines on the screen so that there are several black areas enclosed by lines (preferably white). Type 'A'; you are now in Auto Fill mode, and should have only one cursor. At the bottom it should say that you are using color 0, which is white in this mode (see Appendix B for colors). Position the cursor in one of the enclosed areas and push button 0. Much of the area should fill with white. You can fill most areas in 1-3 steps. The computer looks until it finds the border directly above the cursor, then starts filling across until it finds the boundary directly below the cursor. After a few tries you should be able to determine the quickest way to fill different shapes.

```
L F A P C B S ESC O
LINE MODE
COLOR : 7 BACKGROUND : 0
X:154 Y:113
```

Figure 1 - Drawing Command Page

## More Colors

Type 'C' while you're in Auto Fill mode. You should now be given a choice of colors 0 to 107. Type a number and press RETURN. That is now your fill color. The fill colors have been organized to minimize the "bleed" with the Apple; most can be used side by side with no problem.

## Palette

Instead of guessing when using the auto fill colors (108 are too many to remember), a palette option (P) has been included, where you can test colors before using them on your drawing. The palette is drawn on graphics page 2, so it does not affect your display, and you can switch back and forth anytime. To display a color, type the number and press RETURN. To clear the palette, type 'C'. To return to the drawing page, press the space bar. When you return to the palette, the previous colors will still be there. The palette clears automatically when it is full.

## Paintbrushes

Another of the drawing options is using a set of "brushes" that are built into the program. Command 'B' lets you select a brush number, 1 through 9. The brushes range from a single point, to small straight lines, to large brushes and "airbrushes". Once in Paint mode, you may use any of the primary colors. A brush may be either in the "up" position (not plotting), or the "Down" position (plotting). The paddles control movement of the brush, button 0 sets the brush down, and button 1 lifts it up. A footnote here is that the brushes are actually a shape table by the name "BRUSHES", and you can re-define how they look with the shape module.

## Using Shapes

Another of the Apple's capabilities is that of handling shape tables. A shape is a defined figure that can be rotated, scaled, and plotted anywhere on the screen. You can design your own shapes with the shape module, then use these shapes in the drawing module. To use one of these shapes, you must first load the table with the 'T' command on the options page. Then from the drawing page, type 'S' for shape, and then the number of the shape that you want to use from the table. Your cursor will become that shape. The paddles move the shape, and button 0 plots the shape in any of the primary colors.

When using shapes, button 1 puts you into a mode called Rotate and Scale. After pressing the button, the paddles control the rotation (paddle 0) and scale (paddle 1) of the current shape. When you've adjusted them the way you want your shape, any keypress will return you to normal shape mode.

## Full Screen Graphics

Although there is text at the bottom of the screen, under that text is room for 32 more lines of graphics. To see what's under there, press the ESC key. You may do anything with that section that you can do with the rest of the screen. To see the text area again, press any key. The graphics remain whether they are displayed or not. This ESC option is used the same way in almost every module.

## Other Options

To return to the options page from the drawing page, type 'O'. The other options are:

L : This loads a picture that was previously saved from the drawing module or any of the other modules.

S: This saves the drawing that is currently displayed. ".PIC" is automatically appended to the name you give the picture, although you don't use it when asked for a picture name in any of the modules. The suffix allows you to identify the types of files when you CATALOG a disk.

C: this clears the screen to a primary background color (0-7). You should use one of the blacks (0 or 4) if you want to use the auto fill option.

T: Load a previously defined shape table (created with the shape module) for use in the shape mode.

M: Returns to the master menu.

## IV. The Text Module

After you've used the drawing module you can save your picture, or you can return to the master menu and select the Text option. The Text module allows you to type on your pictures, using either a normal size character set, or a larger set with characters twice as tall and wide. The large characters may be used in any of the 108 auto-fill colors, although a few of the colors will not give enough resolution to produce good results. Text may be placed anywhere on the screen by using the paddles for positioning the cursor. The text itself may be plotted so that it reverses the background color, is placed over the background color (non-destructive), or is placed over a black background at the cursor position (destroying the background color). A small and large font are loaded automatically when you run the text module, but you can also create your own characters or character sets.

The options page on the text module allows you to: (L) load a picture, (S) save a picture, (T) type on the hi-res screen, (G) get a font (if you've created one of your own), (F) save a font in memory (if you've made any changes to the existing fonts), (E) edit one of the fonts in memory, or (M) return to the master menu. Any picture that was on the hi-res screen when you called the text module will remain intact, but if you want to type on another picture that you had saved, you will have to load it back in. When you edit or save a font, you'll have to specify whether you want the current large or small font. You may edit the default character sets and save them under your own names, if you wish. When you load a font, you give the name of the font you want loaded. It will automatically be loaded as a large or small font, whichever it is.

### Typing Commands

To type on the hi-res screen, press 'T' on the options page. The bottom of the screen will display the current mode, color, coordinates, and available commands, as shown in figure 2. You should find that you are using the small font, in destructive mode, with color zero (white - the small font will not allow you to use other colors). If you move the paddles, your cursor will move around the screen in the same manner as in the drawing module.

### Mode

The commands 'R', 'D', and 'N' let you change the mode to reverse, destructive, or non-destructive, respectively. Destructive is the only mode that creates its own background, therefore it is the most reliable and can be used with most colors. The other modes depend on the background color and the text color; generally you'll get better results with colors close to the primary Apple colors.

```
C S L R D N P ESC O POSITION
SIZE : SMALL COLOR : 0
DESTRUCTIVE
X:154 Y:110
```

Figure 2 - Typing Command Page

### Size

The 'L' and 'S' commands let you switch between large and small fonts. Cursor position for each gives the X,Y location of the upper left corner.

### Color

The command 'C' allows you to change colors with the large font. You may choose any of the blended colors from 0 to 107. The 'P' command lets you use the palette in exactly the same way it works with the drawing module.

### Other Commands

The ESC key again allows you to view full screen graphics. Any command issued returns you to normal mode. The 'O' command returns you to the options page.

### Typing

To start typing, position the cursor with the paddles and press the button on paddle 1. The upper right corner of the instructions area will now say 'TYPE', instead of 'POSITION'. Any keys you now press will be interpreted as characters, rather than commands, and be placed on the screen. A letter key by itself gives lower case; a letter key preceded by ESC gives the upper case character. Also, any number preceded by ESC gives an extra character as shown in Appendix A (which gives all the ASCII codes, characters, and which key combinations display them). Use ESC twice to get the ESC character. If you have a shift-key modification on your Apple, you can use it while typing instead of ESC to get capitals.

When you reach the end of a line, the cursor will advance to the beginning of the next line. When you reach the end of the page, the display will NOT scroll, and the cursor will stop there. The back arrow (<-) allows you to backspace, and will go up to the previous line if necessary. Neither the forward arrow (->) or the RETURN key will affect the cursor as expected; both plot the character equivalent of their ASCII codes (CTRL-U and CTRL-M, respectively). For pure cursor moves, use ESC-> for right, ESC-RETURN for up, and ESC-/ for down. (The RETURN and '/' keys are located above and below the arrows, hence the associated directions.)

To return to position mode, press the button on paddle 1 once again. This allows you to reset the cursor with the paddles and issue commands. If you want to issue a command, but do not want to lose the cursor position while typing, press the button on paddle 0. This allows you to insert a single command while still in type mode.

### Editing a Font

From the options page, typing 'E' allows you to view an entire character set and make any changes, if desired. You must first save any picture you have displayed that you wish to keep, because the display area is used by the editor. You will be asked whether to operate on the current large or small font, after which the chosen set will be displayed on the screen. At the bottom of the screen are the choices C, E, and O; 'C' to create a new character from scratch, 'E' to edit an existing character, and 'O' to return to the options page.

## Creating a Character

When you choose to create a new character, you will be asked which key-stroke(s) the new character should be associated with (plural when you use ESC). A matrix of dots, 7 x 8 for the small font, 14 x 16 for the large font, will be displayed in the upper left corner (see figure 3). Each dot represents a point in that character that can be turned on or off. Each point you set will be circled.

To move around and set points within the character, use the I, J, K, M, Z, and X keys. The I, J, K, and M keys move the cursor (a flashing dot) up, left, right, and down, respectively, the same way those keys are laid out on the keyboard. Each direction wraps around. If you move up past the top, for example, the cursor re-appears at the bottom. To turn the plotting on, press the 'Z' key; to turn it off, press the 'X' key. As you are creating the character it should appear as an enlarged version of your final product.

## Testing the Character

To see what your character looks like before you enter it into the character table, press the 'T' key to test it. Your character will appear in hi-res at the lower left corner of the screen. You may still make alterations at this point if the character is not to your liking, although, as you will notice, the roles of the 'on' and 'off' cursors will have been reversed.

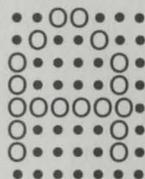


Figure 3 - Creating a Character

## Saving the Character

To save your character in the table, press the 'S' key. (The 'test' step may be omitted.) The new character will appear twice in the table, once in the upper left corner, and once in its proper position. The upper left corner always holds the most recently edited character. If you do not wish to use your new character in the table, type 'F' to forget the character.

## Editing a Character

Editing an existing character uses the same procedure as creating a new character, except that the dots in the upper left corner will be circled to show the make-up of the original.

When you are done making changes to the character set, press 'O' to return to the options page. When you save a character set from the options page, ".FNT" is added to the name you give it, identifying it as a text font.

## V. 3-D Graphics Module

Be sure to save the picture that you have displayed (if any) before you use the 3-D module; it uses the same display area. To enter the 3-D module, type '3' from the menu page.

### What is a 3-D Figure?

A 3-D figure, to the computer, is a set of numbered points, given in X,Y,Z coordinates, and a list of pairs of point numbers to connect with lines. When viewed, a figure appears as a set of interconnected lines in space. As an example, a cube would be stored as 8 points (numbered 0-7) with the coordinates of the 8 vertices of the cube. The definition of the cube would also include 12 lines (numbered 0-11). The information necessary for each line would be the starting point number, ending point number, and color. The color may be any of the primary Apple colors, although black is impractical. White gives the best results, as it has twice the resolution of the other colors. Figure 4 has a list of points and lines necessary to define a cube. The key feature of this 3-D module is that you don't have to use coordinates to create a figure if you use the Panel Utility described in the next chapter for building your figures.

If you are going to use X,Y,Z coordinates, the X, Y, and Z axes are orientated such that X goes from left to right across the screen, Y goes from bottom (negative) to top (positive) on the screen, and Z goes from where you sit toward the back of the monitor (negative to positive).

A figure may also be a group of other figures. Several figures may be loaded into memory at a time, composing one larger figure. This larger figure can now also be saved. When it is loaded back, all of the original, smaller figures may still be referred to by name and manipulated individually.

There is room in memory for up to 50 figure names (0-49), 512 points (0-511), and 512 lines (0-511).

Points				Lines	
#	X	Y	Z	From	To
0	0	0	0	0	1
1	5	0	0	1	2
2	5	5	0	2	3
3	0	5	0	3	0
4	0	0	5	4	5
5	5	0	5	5	6
6	5	5	5	6	7
7	0	5	5	7	4
				0	4
				1	5
				2	6
				3	7

Figure 4 - Coordinates and Lines for Creating a Cube

## Using the 3-D Module

The options page for the module gives you nine choices, most of which we'll get back to later. The system master disk has two 3-D figures already stored on it: 'CUBE' and 'M'. (3-D figures have the suffix ".TD" appended to their names as identifiers.) Type 'L' to load one of the figures. Type 'M' when it asks for a name, then press RETURN. It will ask if you want to give it a new name. Press RETURN to keep the name 'M'. The new name option helps you distinguish between figures in case you load more than one copy of a single figure from disk; say two M's and a 'cube'. You could rename the M's 'M1' and 'M2'. There are other options for dealing with figures with the same name that we'll deal with later.

## Viewing a Figure

After the figure is loaded from disk, choose option 'V' to view the figure. A 3-dimensional block letter 'M' will appear on the screen, and at the bottom will appear the information in figure 5. The current function will be 'rotate', the direction will be 'U/D' (up/down), and the constant will be zero. The figure name will be 'ALL'. A list of one-letter commands will appear at the bottom of the screen.

## Manipulations

To manipulate the figure, there are four functions: rotate (R), move (M), scale (S), and distort (D). The direction and constant determine exactly how these manipulations will affect the object. The arrow keys (<-,>) execute the operation displayed under function, direction, and constant. To change direction, press the space bar; your choices will be displayed on the bottom line. In the case of a two-letter choice (such as U/D), either letter is acceptable. To change the constant, simply type the number you desire (any combination of the digits 0-9, a minus sign, and a decimal point). After typing the new constant, press RETURN.

## Rotations

When rotating, the constant is the number of degrees each rotation will be. The directions for rotating are as follows:

U/D - up/down  
L/R - left/right  
C/C - clockwise/counterclockwise

In each case, the directions refer to the direction of movement of the part of the object closest to you. (This is necessary to know, because if the front is rotating upward, the back is moving downward.) On rotating, the left arrow causes rotations of down, left, or counterclockwise, depending on the direction setting. The right arrow causes a rotation of up, right, or clockwise. If you want a repeated movement with the same constant and direction, you may use the REPT key by holding it down simultaneously with one of the arrows.

```
FUNCTION  DIRECTION  CONSTANT
ROTATE    U/D        0
*FIGURE : ALL
R M S D P A E C O V SP ESC <- ->
```

Figure 5 - 3-D View Command Page

## Moving a Figure

Moving a figure simply shifts an object, and the constant is the number of units the object will move. Directions for movement are:

U/D - up/down  
L/R - left/right  
F/B - forward/back

The right arrow moves the object up, right, and forward (towards you). The left arrow moves the object down, left, or back.

## Scaling a Figure

Scaling a figure changes its actual size. The constant is the number to multiply the size by. Direction is unnecessary, as the object expands (or diminishes) in all directions. The right arrow multiplies the size by the constant. The left arrow divides the size by the constant. For example, using a constant of 2, the right arrow would double the dimensions, and the left arrow would halve the dimensions.

## Distorting A Figure

Distorting is actually scaling on one dimension. Direction does matter here, and may be as follows:

H - height  
W - width  
D - depth

The arrow keys work the same as with scaling. Distorting has the effect of stretching or compressing the object in the specified direction. By distorting a cube you can create a rectangular box of any size, for example.

## Editing while Viewing

You may move individual points of a figure around while you are looking at an object, changing the object's actual shape. To do so, use the 'E' command while the object is on the screen. A flashing cursor will appear over one of the points. Press the space bar until the cursor is on the point you want to move, then press RETURN. You may now move that point just as you would move the entire figure, using the directions, a constant, and the arrow keys.

## Changing the Center

When an object is rotated or scaled, it is necessary to use a center. Rotations turn the object around the center point. Scaling operations expand the object out from the center, so that the center point is the only one that remains stationary. When you choose to view a figure, the center is computed to be the average of the high and low X values, the high and low Y values, and the high and low Z values. You may want a particular point to remain stationary in a rotate/scale operation. This may be accomplished with the 'C' command, making that point the center. The point is selected in the same manner as with the edit function above. The normal center is re-computed after use of the 'P', 'A', or 'O' commands.

## Full Screen Graphics

As with the other modules, the ESC key allows you to switch to viewing the entire screen of graphics. Any subsequent command restores the text at the bottom.

## Viewing More than One Figure

After you've tried all the options that allow you to manipulate a figure, you're ready to try using two figures in memory. Go back to the options page using the 'O' command, and using the 'L' option as before, load the CUBE from the master disk. Then go back and view what you have with the 'V' option. You should see both the 'M' and a cube.

Try a couple of commands manipulating the figures. Both the 'M' and the cube should be affected. Now use the 'P' command, which allows you to manipulate part of what's in memory. You will be asked "WHICH FIGURE :". At this point type the name of either figure and press RETURN. Any manipulations will now affect only the figure you specified. To go back to manipulating everything, use the 'A' command, for "all".

When you were asked "WHICH FIGURE :", you also could have pressed RETURN first, and the name of the first figure in memory would have been displayed, and the matching figure on the screen would have flashed. By using the arrow keys at that point, you can step forward or backward through the list of figure names until the one you want is displayed, upon which you press RETURN to select it.

## Scaling the View, but not the Objects

The last view command is 'V', which is similar to scale, except the actual size of the figures is not changed. With all the other commands, the actual stored coordinates are changed, thus, with scaling, the object is changed. The 'V' command scales your view, and is more like using a pair of binoculars or a telescope. What you see changes size, but the object doesn't.

This command is also helpful when you want more or less "perspective" in your view of an object. The closer an object is to you, the more pronounced the perspective on the object will be. This is similar to holding something directly in front of your eye, as opposed to seeing it at a distance. To get less "perspective" move the object father away, and magnify it with the 'V' command. To get more "perspective", move it closer and reduce it with the 'V' command.

## Saving Figures and Images

From the options page, there are several other commands affecting the figures stored in memory. The 'S' option saves all of the figures currently in memory. You must enter a name under which it will be saved. When the figures in memory are stored on disk, the names of all the figures are also stored as part of the one large figure being saved. When you load this large figure later, you will still be able to manipulate each of the smaller figures of which it was originally made.

You may also save exactly what is displayed on the screen as a two-dimensional picture using the 'I' option. This type of picture can later be loaded with the drawing module, text module, and others.

## Deleting Figure Names

Occasionally you will load several figures from disk, assemble them in some manner, and then wish to address the newly created figure with only one name, forgetting the names of all its parts. The 'D' option allows you to delete a figure name from memory, but keeps all the points and lines intact as part of a larger figure. If you are working with large figures that are combinations of several smaller figures, you may want to "house-clean" this way occasionally. When you are asked for a figure name, you may respond in either of the ways explained under the 'P' (manipulate part) command above.

## Clearing Memory

If you wish to start over and delete all of the figures from memory, use the 'C' option. You will be asked to verify that you really want to delete everything, then returned to the options page.

## Editing a Figure

The 'E' option lets you go in and change the actual coordinates of a point, change endpoints of lines, add points and lines, delete points and lines, and change colors. When you choose 'E', you will again be asked "WHICH FIGURE :", to which you can give the same types of responses as before. After you select a figure, the coordinates of the first 21 points of that figure will be displayed. At the top of the page you will see the available commands:

```
"L P D O SP <- ->"
```

The X coordinate of the first point will be shown in inverse. This is your cursor. At the lower left corner you'll see a '!' or '-'. This denotes the direction of movement for your cursor (up/down or left/right).

To move the cursor, use the arrow keys. To change the direction that the cursor moves, press the space bar; the sign in the lower left will change.

If you want to change a coordinate, type the number you want at the cursor position, followed by RETURN. That number will now be entered.

If you want to delete a point from the figure, position the cursor over any of the coordinates of that point and press 'D'. After you verify that you want that point deleted, all the subsequent points will be pushed up one and the lines will be adjusted.

To add a new point to a figure, move the cursor past the last point, and a new point with coordinates 0,0,0 will be added. Change the coordinates to whatever you wish.

The 'L' and 'P' commands let you switch between editing lines and points. The edit commands for lines are the same as those for points. Instead of coordinates, for lines you will be shown the color (0-7), the starting point number, and the ending point number.

'O' returns you to the options page.

## Adding a Figure

Using 'A' from the options page allows you to add a figure by entering its coordinates and line endpoints. You will first have to give the figure a name, and from then it will be the same as using edit mode.

There is another way to add figures that is much easier and doesn't require use of coordinates: the panel utility described in the next chapter. With it you can draw the flat surfaces of an object, then use the 3-D module to assemble the pieces into a 3-D figure. Adding by coordinates is more precise, however, and will usually take fewer points and lines, so if you want to use this method there are advantages.

## Returning to the Master Menu

As usual, the 'M' command from the options page will return you to the master menu. Anything that you haven't saved while using this module, except for the image currently on the hi-res screen, will be lost.

# VI. The Panel Utility

The panel utility is a short module with the single purpose of allowing one to draw 2-dimensional surfaces that can be used with the 3-D module. The panel utility is run by selecting 'P' from the menu page. The three options given by this module are to create a panel (C), save a panel (S), and return to the menu (M).

A panel is a single 2-dimensional figure which is stored on disk with 3-dimensional coordinates. The Z coordinate, or the depth, is assigned a value of zero. To create a panel, press 'C', and you will be asked whether you want the screen cleared. With the first panel you create, the screen will be clear anyway, so it doesn't matter. With subsequent panels you may want to use earlier panels for reference, for matching sides and sizes so that when they are assembled the parts will fit.

The next question asked will allow you to set the scale of the screen. You will first be asked if you want to change the scale. If you answer 'Y', then two points will be displayed, and you'll be asked to assign a number to the distance between them. The actual screen distance between them is 20 points, and the default distance assigned is 5 units (making the distance from one point to the next 1/4 unit). Unless you want to design a panel that is supposed to be much larger or much smaller than other figures you've designed, press RETURN to select the default. Otherwise, type the number you want, then press RETURN.

After you select the scale, the text at the bottom will list your panel drawing commands (see figure 6). Also listed will be the X and Y coordinates of the two cursors on the screen, the distance between them according to your scale, the current color, and the point number, if any, of each of the cursor locations. If a cursor is not on a previously used point, '-' will be displayed for the point number.

One of the two cursors will be flashing, and its point number will be shown in inverse at the bottom. This is the cursor that you can currently move. To move the other cursor press the space bar, which allows you to switch back and forth between the two. The I, J, K, and M keys allow you to move the cursor up, left, right, and down, respectively, in the same manner in which those keys are laid out on the keyboard. Any of those keys can be used with the REPT key to speed movement. To update the coordinates and distance, press 'D'.

When you have the cursors in position and you want to connect them with a line, press 'L'. A line will be drawn, and each endpoint will be assigned a number.

```
L P D C I J K M SP ESC F
POINT -                POINT -
X:2.25 Y:- 3.75       X:2.27 Y:- 3.75
DISTANCE : 5          COLOR : 7
```

Figure 6 - Create Panel Command Page

Lines will be entered and drawn with the color number that is displayed. To change colors, type 'C' and enter a number 1 through 7, excluding 4 (0 and 4 are black).

If you want to move a cursor back to a previous point, type 'P'. The flashing cursor will move to the first point. Press the space bar until it moves to the point you want, then press RETURN.

To view the full screen of graphics, press ESC. The next keystroke will return the text.

When done drawing a panel, press 'F', for finished. You will be returned to the options page, where you can give the panel a figure name and save it, then draw another panel or return to the master menu.

When assembling panels in the 3-D module, it is strongly recommended that you only use 90 degrees for rotations of your entire figure. Combinations of other angles of rotation are not as easy to reverse, and it is not difficult to lose your reference position. Using 90 degree rotations you can make sure your pieces are fitted properly, viewing it from any of six possible directions (front, back, top, bottom, left, and right), yet still easily return to any of those six views. Individual panels, of course, may be rotated however you want for positioning.

## VIII. The Shape Module

The shape module lets you create Apple "shape tables". The Apple computer has the capability of storing graphic objects called shapes, several of which make up a shape table. Applesoft BASIC has special commands that allow you to scale and rotate these shapes, and draw them anywhere on the screen in any of the primary Apple colors. See chapter 9 of the Applesoft manual for details about these programming commands.

This module allows you to create shapes by drawing them on the screen. These shapes are automatically coded by the program and stored in a table. You may save the table for use in the drawing module, or in your own programs. The "brushes" in the drawing module are an example of a shape table with nine shapes. You may re-define what the brushes look like by using the shape module. Of course you always will have a copy of the original brushes on your system master disk.

### Using the Shape Module

By selecting 'S' from the master menu, you enter the shape module. Be sure you've saved any picture that you had displayed, as this module will use the display area.

When you first enter the module, you will want to start a new shape table (N), or load an existing shape table (L). Starting a new table destroys any shapes currently in memory, but upon first entering the module there are none in memory about which to worry. If you are starting a new table, you'll want to continue by adding a shape (A).

### Designing a Shape

There are two ways to design a shape: with paddles and with keystrokes. With the paddles you draw the shape in lo-res graphics, and it's converted to a hi-res shape. Using the paddles is easier, but the shape will usually take a little more storage. Shapes created in this manner also do not work very well if you plan to use scaling with them. With keystrokes you can create the shape with more precision. You view it in hi-res as you are creating it. It is usually slower than with the paddles, and it may take a few tries to get exactly the look you want.

### Using Paddles

To use the paddles, you must first give a width and height for your shape. Each will be a number of points, and must be an even number in the range 2 through 38. (Your shape will take approximately  $W \cdot H/2$  bytes.) A rectangle with the specified dimensions will be displayed, with a flashing cursor controlled by the paddles. The button on paddle 0 will turn the plotting on, and the button on paddle 1 will turn it off. When you've drawn the shape as you want it, type 'F' for finished. The shape will now be compiled and shown in hi-res. If you are satisfied, type 'S' to save it in the table. If you want to go back and edit the lo-res drawing, type 'E' to edit.

While the shape is displayed in hi-res, you may control the rotation and scale with the paddles. Paddle 1 controls the rotation and paddle 0 controls the scale. Set both all the way to the left for the normal view of the shape.

## Using Keystrokes

To use keystrokes in creating a shape, the I, J, K, and M keys once again control the direction of movement. If you want to turn the plotting off, use the 'X' key. To turn it back, press 'Z'. The paddles control the rotation and scale of the shape as it is shown. When done, type 'F' for finished.

## Storage

Room is set aside for 12115 bytes in a shape table. In general a byte will contain information for 2 points of a shape, so you have room for shapes totaling approximately 24000 points, or for example, more than 180 shapes of dimension 16 by 16.

## Other Options

Once you have a table of at least one shape in memory you may use a few other options. 'V' lets you view one of the shapes in memory. While viewing, the paddles control rotation and scaling. Any keypress returns you to the options.

You may also delete unwanted shapes with the 'D' option, and replace an existing shape with a new one using the 'R' option. The table will be compressed to maximize use of storage.

When you are satisfied with the table in memory, you may save it to disk with the 'S' option. Shape tables have the suffix ".SHP" appended to their names as identifiers.

'M' returns you to the master menu.

# VIII. The Shrink Utility

Any picture may be reduced in size with the shrink utility. This utility takes a picture the size of the screen and reduces it to one-fourth of a screen. The reduction may be placed in any of the four quadrants. The intensity of the reduction can also be controlled, from 1 to 4, with 4 having the most points set.

Colors will not reproduce in reductions. You may get some color with certain intensities, but generally the reduction will be in black and white.

Further reductions can be made by reducing a reduction. You lose detail each time, but in this way you can get reductions of 1/16th, 1/64th, 1/256th (?), etc.

## Using the Shrink Utility

Type 'K' from the master menu to enter the shrink module ('S' was already taken...). Any picture you had displayed remains when you enter the module. If you want to load a different picture, use the 'L' option.

Normally a picture is stored on graphics page 1. Reductions take the picture on page 1 and put the result on graphics page 2. The space bar switches the screen you are viewing from page 1 to page 2 and back. The ESC key lets you see full screen graphics or the text options, which are at the bottom of graphics page 1.

To shrink the picture on page 1, type 'S'. You will be asked to select the quadrant (1-4; a diagram in the corner of the screen shows their locations) and the intensity (1-4). The display will be switched to page 2 to show the result. You may go back and load another picture, or use the same picture, and shrink it onto another quadrant. You may also shrink a picture onto the same quadrant as another if you don't wish to save the first result.

When you're ready to save the reduced picture(s) on page 2, type 'T'. This transfers the contents of page 2 to page 1, then saves it to disk.

Once again, 'M' returns you to the master menu.

## IX. Programmers' Notes

This section will show you how to use graphics that you create and some of the graphics subroutines in your programs. This section is not essential for using the system by itself.

### Using Pictures

It's fairly easy to load and display a picture in another program. First, be sure to store the picture on the same disk as your program. You can do this by loading it with the drawing module, inserting your disk, then saving the picture.

In your program, insert the following commands to display the picture (line numbers can be changed):

```
10 HGR : D$ = CHR$(4)
20 PRINT D$; "BLOAD name.PIC"
```

where "name" is the name you gave your picture. To display the full screen of graphics, insert the command:

```
15 POKE -16302,0
```

To get back to normal text mode, use the TEXT command in your program.

If you have a program with large arrays, you may have to use the command:

```
5 LOMEM: 16384
```

which will protect the graphics screen from variable storage.

### Using Shape Tables

First put the shape table onto your program disk by loading it with the shape module, inserting your disk, then saving the table. To use a shape table in your program, you must include the following commands (line numbers can be changed):

```
10 D$ = CHR$(4)
20 PRINT D$; "BLOAD name.SHP"
30 POKE 232,0 : POKE 233,64
```

"name" is the name of your shape table. You must then use HGR when you are ready to display a shape from the table. Explanation of use of the following shape commands is in the Applesoft manual:

ROT, SCALE, HCOLOR, DRAW, XDRAW

The shape table resides starting at location 16384, and ends no further than location 28499.

Don't overlook use of the text routine as an alternative to shape tables for animation purposes. You can define sets of graphics characters and use them in a manner similar to the way you use shapes.

## Using the 100-color Fill Routine

The fill routine resides at locations 24576 to 25508 (\$6000-\$63A3). To put it on your disk, use the following sequence:

- 1) Insert the graphics system disk
- 2) Type 'BLOAD FILL' and press RETURN
- 3) Insert your program disk
- 4) Type 'BSAVE FILL,A\$6000,L\$3A4' and press RETURN

(do not use the quotes (') in what you actually type)

To use the routine in your program, first load it with the following commands:

```
10 D$ = CHR$(4)
20 PRINT D$; "BLOAD FILL"
```

The fill routine works on either page 1 or page 2, so you can use either command HGR or HGR2 to display graphics. The fill routine fills a black area bounded by lines or the edge of the screen. You may create the boundaries with the H PLOT command, preferably using either white as the color, or you may plot a shape from a shape table that encloses an area. To fill an area, you need an X,Y coordinate within that area, plus the color number with which to fill. The following example uses a subroutine to do the actual POKES and CALL the routine. The line numbers may be changed.

```
100 X = x : Y = y : C = z : GOSUB 1000
1000 POKE 24576,C
1010 POKE 24577,(X>255)
1020 POKE 24578,X - (X>255)*256
1030 POKE 24579,Y
1040 CALL 25145
1050 RETURN
```

x is the x coordinate from 0 to 279

y is the y coordinate from 0 to 191

z is the color from 0 to 107

### Using the Text Routine

The text routine occupies locations 29952 to 31072 (\$7500 to \$7960).

To put it on your disk, use these steps:

- 1) Insert the graphics system disk
- 2) Type 'BLOAD TEXT' and press RETURN
- 3) Insert your program disk
- 4) Type 'BSAVE TEXT,A\$7500,L\$961' and press RETURN

(Again, don't type the quotes.)

You must also put the font, or fonts, that you will be using on your disk. To move the default small font, do the following:

- 1) Insert the system disk
- 2) Type 'BLOAD SMALL.FNT' and press RETURN
- 3) Insert your program disk
- 4) Type 'BSAVE SMALL.FNT,A\$7A00,L\$400' and press RETURN

If you want to use a small font that you designed, replace 'SMALL' with your font name.

To move the default large font, use the following steps:

- 1) Insert system disk
- 2) Type 'BLOAD LARGE.FNT' and press RETURN
- 3) Insert your disk
- 4) Type 'BSAVE LARGE.FNT,A\$7E00,L\$1000' and press RETURN

To use a large font that you designed, substitute the name of your font for 'LARGE'.

To load the text routine and fonts into your program, use the commands:

```
10 D$ = CHR$(4)
20 PRINT D$; "BLOAD TEXT"
30 PRINT D$; "BLOAD SMALL.FNT"
40 PRINT D$; "BLOAD LARGE.FNT"
```

Either line 30 or 40 may be omitted if you're using only one of the fonts.

The text routine also works on either hi-res page, so use either HGR or HGR2. The following POKES only have to be done once in your program, or whenever you want to change one of the options:

POKE 29952,c  
c is a color, 0-107, used with the large font. If you are using the small font, this POKE is unnecessary, since it can only use white.

```
POKE 29953,(x>255)
POKE 29954,x - (x>255)*256
POKE 29955,y
```

x (0-273) and y (0-185) are the starting locations of the text to be printed. The coordinate will be the upper-left corner of the first character. It is not necessary to set X and Y for each character; they are incremented by the machine language routine.

```
POKE 29956,s
s = 1 for a large font
s = 0 for a small font
```

```
POKE 29958,m
m = 255 for destructive mode
m = 0 for reverse mode
m = 1 for non-destructive mode
```

After the appropriate POKES have been made by the program, the following will print a character on the current hi-res screen:

```
POKE 29957,a : CALL 30445
where 'a' is the ASCII value of the character to print. (You can use ASC("") in place of 'a', and put the character you want in the quotes.) An easier method for printing characters is to use the following subroutine in your program:
```

```
1000 E = 1 : FOR I = 1 TO LEN(A$)
1010 A = ASC(MID$(A$,I,1))
1020 IF A = 27 THEN E = 0:GOTO 1070
1030 IF E AND A > 63 AND A < 91 THEN A = A + 32
1040 IF E THEN 1060
1050 IF A > 47 AND A < 58 THEN A = 43 + (A > 52) * 27 + A
1060 POKE 29957,A : CALL 30445 : E = 1
1070 NEXT : RETURN
```

You can print a string of characters now with a statement like the following:

```
150 A$ = "PRINT THIS STRING" : GOSUB 1000
```

The color, modes, and location switches must be set prior to the first subroutine call. You may wish to incorporate some of them into the subroutine.

The subroutine will change any values in variables A, E, and I, if you use them elsewhere in your program. The ESC character can be imbedded in the string to produce capitals and special characters. If you want to use something more visible than ESC for showing upper case, you may substitute any character by changing '27' in line 1020 of the subroutine to the ASCII value of the character you want. To use 'A' (Shift-N) to precede capitals in your program, for example, substitute '94' for '27'. See the ASCII table in Appendix A for reference.

## Creating Files for the 3-D Display Routine

For the more ambitious, it is possible to have your own programs generate files for the 3-D module. 3-D files are Apple text files with very specific information about the 3-D figures. To talk about this information, we have to define some variables. The following will be dimensioned as arrays of 512 elements (0-511):

X - the x coordinate of each point  
Y - the y coordinate of each point  
Z - the z coordinate of each point  
P1% - starting point of each line  
P2% - endpoint of each line  
C% - color of each line (0-7)

This information requires the following dimension statement:

```
10 DIM X(511),Y(511),Z(511),P1%(511),P2%(511),C%(511)
```

We'll also use the variable NP for the number of the last point, and NL for the number of the last line. Note that if there are 8 points and 12 lines, NP = 7 and NL = 11 (the first point and line are numbered 0).

It will be up to your program and your ingenuity to assign values to the X, Y, and Z arrays. Each point 'I' will be a vertex of your figure, with coordinates X(I),Y(I),Z(I). You will also assign values to the P1%, P2%, and C% arrays. As an example, if line 'I' goes from point 0 to point 6, and its color is 5, P1%(I) = 0, P2%(I) = 6, and C%(I) = 5.

Once a program has assigned all the values necessary to create a figure, the only task is to save the information in the correct format. Use the following statements, substituting the name you want for 'name':

```
100 D$ = CHR$(4)
110 PRINT D$; "OPEN name.TD"
120 PRINT D$; "WRITE name.TD"
130 PRINT NP + 1:PRINT NL + 1:PRINT 1
140 FOR I = 0 TO NP
150 PRINT X(I): PRINT Y(I): PRINT Z(I)
160 NEXT
170 FOR I = 0 TO NL
180 PRINT P1%(I) + C%(I)*512: PRINT P2%(I)
190 NEXT
200PRINT D$; "CLOSE name.TD"
```

With the above information a good technical programmer should be able to use a program to create 3-dimensional models of, for instance, wiring and plumbing diagrams of buildings, any figures that can be generated mathematically, and any figures that involve repetitive patterns. These models, in turn, can be used fully with the 3-D module of the graphics system.

# APPENDIX A

## ASCII Codes

Following are the ASCII codes and characters generated by the default character sets (SMALL.FNT and LARGE.FNT). The third column tells you what to type to get each character. The CTRL key is used like a SHIFT key. The ESC key generates its own character and must precede the second character in it sequences.

Code	Char	Type	Code	Char	Type	Code	Char	Type
0		n/a	43	+	+	86	V	ESC-V
1	inv A	ctrl-A	44	,	,	87	W	ESC-W
2	inv B	ctrl-B	45	-	-	88	X	ESC-X
3		n/a	46	.	.	89	Y	ESC-Y
4	inv D	ctrl-D	47	/	/	90	Z	ESC-Z
5	inv E	ctrl-E	48	0	0	91	[	ESC-0
6	inv F	ctrl-F	49	1	1	92	\	ESC-1
7	inv G	ctrl-G	50	2	2	93	]	ESC-2
8	backspace	ctrl-H or <-	51	3	3	94	^	^ or ESC-3
9	inv I	ctrl-I	52	4	4	95	_	ESC-4
10	inv J	ctrl-J	53	5	5	96	@	@
11	inv K	ctrl-K	54	6	6	97	a	A
12	inv L	ctrl-L	55	7	7	98	b	B
13	inv M	ctrl-M or RETURN	56	8	8	99	c	C
14	inv N	ctrl-N	57	9	9	100	d	D
15	inv O	ctrl-O	58	:	:	101	e	E
16	inv P	ctrl-P	59	;	;	102	f	F
17	inv Q	ctrl-Q	60	<	<	103	g	G
18	inv R	ctrl-R	61	=	=	104	h	H
19	inv S	ctrl-S	62	>	>	105	i	I
20	inv T	ctrl-T	63	?	?	106	j	J
21	inv U	ctrl-U or ->	64	pi	ESC-@	107	k	K
22	inv V	ctrl-V	65	A	ESC-A	108	l	L
23	inv W	ctrl-W	66	B	ESC-B	109	m	M
24	inv X	ctrl-X	67	C	ESC-C	110	n	N
25	inv Y	ctrl-Y	68	D	ESC-D	111	o	O
26	inv Z	ctrl-Z	69	E	ESC-E	112	p	P
27	•	ESC-ESC	70	F	ESC-F	113	q	Q
28		n/a	71	G	ESC-G	114	r	R
29	inv C	ctrl-shift-M	72	H	ESC-H	115	s	S
30	inv H	ctrl-shift-N	73	I	ESC-I	116	t	T
31		n/a	74	J	ESC-J	117	u	U
32	space	space	75	K	ESC-K	118	v	V
33	!	!	76	L	ESC-L	119	w	W
34	"	"	77	M	ESC-M	120	x	X
35	#	#	78	N	ESC-N	121	y	Y
36	\$	\$	79	O	ESC-O	122	z	Z
37	%	%	80	P	ESC-P	123	{	ESC-5
38	&	&	81	Q	ESC-Q	124		ESC-6
39	'	'	82	R	ESC-R	125	}	ESC-7
40	(	(	83	S	ESC-S	126	~	ESC-8
41	)	)	84	T	ESC-T	127	■	ESC-9
42	*	*	85	U	ESC-U			

# Appendix B

## Colors

The primary Apple colors are:

0 - black	4 - black
1 - green	5 - orange
2 - violet	6 - blue
3 - white	7 - white

Colors mix well with other colors in the same column, but not necessarily so with those in the opposite column. Orange and blue may be different on some televisions.

The auto-fill colors are blends of one to four of the Apple primary colors. The resolution is at worst one-fourth that of using white or black, and one-half that of the other primary colors. Still, some of the colors may not be sharp enough to use for text or for filling very small areas.

The colors are grouped so that within each group they generally go from light to dark, and blend toward the surrounding groups. The primary colors are all specified individually below.

0	white
1-13	some tint, but generally closer to whites or black than base colors
14	black
15-22	from sand, to peach, to light oranges
23	orange
24-42	darker oranges, to yellows, to light shades of green
43	green
44-49	darker greens
50-63	blue-greens, to varying light blues
64	blue
65-71	darker blues
72-86	violet-blues, to light violets
87	violet
88-107	darker violets, to red violets, to orange violets

# Appendix C

## Error Messages

Below are possible error messages you may receive and their probable causes. Press any key after an error occurs to continue.

DISK ERROR - probable causes: disk full or write protected (possibly trying to save a file on the system master), no disk in drive, drive error.

NOT ON DISK - probable causes: wrong disk in drive (system master when you want to load one of your own files, or a non-system disk when loading a module or the "brushes"), mistyped or wrong name.

INVALID COLOR - number outside of range 0-7 or 0-107 was entered for a color.

INVALID NUMBER - shape number outside of available range was entered in drawing module.

## Appendix D Reference Guide to Options

### From the master menu:

- D) Drawing module
- 3) 3-D module
- T) Text module
- S) Shape table module
- P) Draw a 2-dimensional panel for the 3-D module
- K) Shrink a picture
- C) Display color bars for monitor adjustment
- I) Issue a disk command

### Drawing module

- L - Load picture
- S - Save picture
- C - Clear background to color 0-7
- T - Load a shape table
- D - Draw
  - L : Line mode
    - button 1 sets point
    - button 0 draws line
  - F : Fill mode
    - same as line mode, except start point stays the same
  - A : Auto fill
    - button 0 fills enclosed black area with color 0-107. Paddles position cursor.
  - P : Palette
    - Displays palette for testing auto fill colors.
    - Type color number, RETURN, to display a color.
    - C - Clears palette
    - SPACE - returns to drawing page.
  - C : Select color
    - 0-7 or 0-107, depending on mode.
  - B : Brush mode
    - Select brush number, 1-9, button 1 lifts brush, button 0 sets it down. If a shape table was loaded the brushes are loaded back in, replacing the shape table.
  - S : Shape mode
    - Use a shape from a previously loaded shape table. Button 0 plots shape, button 1 allows the paddles to be used for rotation and scaling. Any key or button 1 returns from rotate and scale mode.
- ESC : Displays full screen graphics. Any key returns to mixed mode.
- O : Returns to options.
- M - Returns to master menu

### 3-D Module

- A - Add figure
  - enter name, then you are put in edit mode
- E - Edit a figure
  - Select name: type name, or press RETURN without typing a name. With the latter, existing names are displayed on by one, using the arrow keys ( < - > ), until you press RETURN to select the displayed name.
  - L : Display and edit lines.
    - Color, Point1, and Point2 are shown.
  - P : Display and edit points. X,Y,Z coordinates are shown.
  - D : Delete the line or point at the cursor position.
  - O : Return to options.
- SPACE: change direction of cursor movement. Symbol in lower left corner shows direction (1,-).
- <-,> : Arrow keys move cursor left/right, or down/up. Moving down past the last point or line adds a new point or line.
- 0-9,..- : Enter number at cursor position and press RETURN to replace current value.
- V - View figures in memory
  - R : Rotate
  - M : Move
  - S : Scale
  - D : Distort (Scale one dimension)
  - P : Operate on a single Part. You will be asked for a figure name. Same input technique for name as in edit mode.

- A : Operate on All figures in memory.
- E : Edit a point by moving it only. Flashing cursor lets you select point by sight. Press RETURN to select point, any other key to move to next point.
- C : Choose Center. Point is selected as in 'E' command.
  - 'P' and 'A' commands re-compute center. Center is used in rotation and scaling.
- ESC : Full screen graphics. Any other key returns to mixed.
- O : Return to options.
- V : Scale view on screen, but coordinates of figures remain unchanged.
- SPACE : Change direction. Following options depend on mode (Rotate, Scale, Move or Distort).
  - U/D - Up/Down
  - L/R - Left/Right

- C/C - Clockwise/Counterclockwise
- W - Width
- H - Height
- D - Depth

For the first four, either letter in option has the same effect.

- 0-9,..- : Number followed by RETURN selects constant to be used in Rotate, Move, Scale, and Distort modes.
- <-,> : Arrow keys effect an operation (rotate, scale, etc.) as per the displayed parameters.
  - > is right, up, forward, or larger; <- is left, down, back, or smaller, as per displayed.
- S - Save set of figures in memory
- L - Load a figure, you may give it a new name, in the case that more than one of that figure will be loaded for use in the current figure.
- I - Save 2-dimensional image as a picture that can be used by the other modules.
- D - Delete a figure name from memory.
- C - Clear all figures from memory.
- M - Return to master menu.

### Text Module

- L - Load picture
- S - Save picture
- T - Type

Paddles position cursor

Button 1 sets cursor for typing, and releases cursor for positioning.

Button 0 allows command insertion while actually typing.

Commands:

- C : Color (0-107), large font only
- S : Use small font
- L : Use large font
- R : Type reverses background
- D : Destructive, background is covered by a block the size of the character.
- N : Non-destructive, character is placed over background.
- P : Palette, same as in drawing module.
- ESC : Full screen switch in command mode, preceding a letter or number while typing gives a capital or an extra character. Twice while typing types ESC character.
- O : Returns to options.
- G - Get font (default large and small fonts are loaded automatically)
- F - Save font
- E - Edit font
  - Displays large or small font, allows you to replace or edit characters. You specify which keystroke (or keystrokes for ESC char.)
  - C : create a character
    - I - cursor up
    - J - cursor left
    - K - cursor right
    - M - cursor down
    - Z - plot on
    - X - plot off
    - F - forget change
    - T - test character before putting it in table
    - S - save character in table
- E : edit a character
  - same as create, except instead of starting blank, you start with the existing character.
- O : return to options
- M - return to master menu

## Shape module

N - clear memory for a new table

L - load an existing shape table

A - add a shape

K : keystrokes

I - cursor up

J - cursor left

K - cursor right

M - cursor down

Z - plot on

X - plot off

F - finished

paddles rotate and scale figure as it is shown

P : paddles

select width and height; paddles move cursor, button 0 turns plot on, button 1 turns plot off.

F - finished

figure is displayed in hi-res, and you have the following options:

S : save as is

E : go back to lo-res and edit

R - Replace a figure that's already in the table. Same method as add.

D - Delete a shape from the table.

V - View a shape. Paddles control rotation and scaling. Any key returns to options.

M - return to master menu

## Panel Module

S - Save panel on disk as a 3-D figure

C - Create panel

You may clear the screen, or leave it displaying any previous panels for reference. You may also change the scale by which the points, and distances, are interpreted.

L : Draw a line connecting the points at the cursor positions.

P : Move the flashing cursor to one of the previously used points.

Any key moves the cursor to the next point in sequence, RETURN Selects that point.

D : Display the coordinates of the cursor points, and the distance between them.

C : Color; select 1,2,3,5,6, or 7.

Lines will be drawn in the most recently selected color.

I : Move cursor up

J : Move cursor left

K : Move cursor right

M : Move cursor down

SPACE : Switch cursors, so the other point will move.

ESC : Full screen switch.

F : finished; return to options.

M : Return to menu

## Shrink Utility

L - Load a picture

T - Transfer and Save

Transfers small pictures to page 1 of graphics and saves them.

S - Shrink picture, puts small picture on graphics page 2. You select the quadrant (1-4), and intensity (1-4, 4 being the brightest).

ESC - Full screen graphics switch

SPACE — Switches display between page 1 and page 2 of graphics.

M - Return to menu

## Color Bars

Displays and labels the primary Apple colors for TV or monitor adjustment.

## Issue a Disk Command

Allows you to CATALOG and DELETE programs without leaving the graphics system.

The Complete Graphics System includes:

A Drawing module for drawing on the hi-res graphics screen. Draw lines or shapes, use a set of "paintbrushes", and fill areas with any of over 100 colors.

A Text module for putting text anywhere on the hi-res screen. Design your own large or small character sets. Text may be in any of the 100 fill colors.

A 3-D graphics module that lets you draw objects on the screen, then assemble them into 3-D figures. Complete viewing and editing functions allow you to easily manipulate objects in 3-D space.

A Shape Table module that lets you design shapes with keystrokes or paddles.

A Shrink utility that lets you display four pictures at once.

Instructions for using pictures, shape tables, hi-res text, and 100-color fill in your own programs.

Requires disk, 48K, and Applesoft firmware or the language system. Specify DOS 3.2 or 3.3.