

PRO-DRAW

Advanced Hi-Res Drawing Program

USER'S REFERENCE MANUAL V1.0

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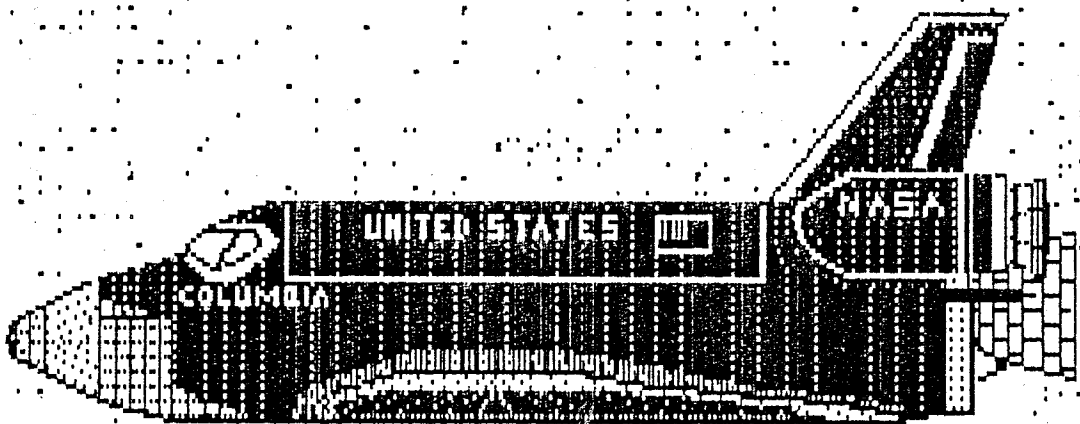


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PRO-DRAW

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Developed by Ted Carter

1) INTRODUCTION

PRO-DRAW is a powerful graphics editing package which allows drawings or designs to be easily created. The program contains 15,000 assembly language instructions for maximum speed and flexibility. By moving the cursor with the arrow keys and entering one letter commands, you can set, clear or complement points, lines, circles, ellipses, arcs, or boxes. A 10X zoom is available for detailed work. Any of 80 different paintbrush patterns can be selected. Sections of the screen can also be filled in with any of 256 patterns. Cursor size and speed may be changed at any time. The screen can be shifted in any direction, reversed, or complemented. Rectangular sections of any size can be saved to create custom symbol sets and figures for later recall using any of five logical functions. These saved blocks can also be stored on disk, enlarged, shrunk, or rotated. Text labels can be placed anywhere on the screen and made any size using the block functions. The Joy-Mouse Interface (\$119.95) allows easier positioning and drawing using a mouse or touch-pad. These features are normally found in computer aided design systems costing ten times as much.

PRO-DRAW is obviously a must for generating computer art and engineering drawings, but is also a necessity for anyone, no matter what his application. Businessmen, scientist, and mathematicians will use PRO-DRAW to load previously generated graphs and add text labels and refinements. With PRO-DRAW you can load a picture, edit it so that it is centered, labeled and otherwise refined, save the picture back on disk and print it out. It is also possible to draw schematics or other drawings which contain a number of repeated parts by saving each symbol or block and then placing it anywhere on the screen as often as needed using the Put command. And since the cursor position is constantly displayed and you may Jump to a particular position, it is easy to create drawings with exact scaled dimensions. All of this is done with single letter commands without ever leaving the PRO-DRAW program.

2) LOADING & EXECUTING PRO-DRAW

PRO-DRAW and a number of sample hi-res pictures are supplied on a TRSDOS data disk. If you own a model 4 then the supplied disk is a floppy disk containing the model 3 version on one side and the model 4 version on the reverse. (If you have a single drive system, you should request a copy of PRO-DRAW with an auto-copy program which copies the PRO-DRAW program to a system disk after placing the PRO-DRAW disk in drive 0 and pressing reset). In any case, the PRO-DRAW program can be loaded and executed with little effort. Once the PRO-DRAW program is loaded, the sample hi-res pictures designated with an /HR extension can be loaded using the PRO-DRAW Load command. The sample block file designated with an /BLK extension can be loaded with the Input block file command. It is a good idea to use the TRSDOS BACKUP command to make a backup of your PRO-DRAW disk before proceeding.

DISK OWNERS with a MODEL 3 or a MODEL 4 in the 3 mode should place the PRO-DRAW disk in drive 1 with the yellow label saying 'for TRSDOS 1.3, etc.' facing upward, a TRSDOS 1.3 System disk in drive 0, and type 'DO DRAW' followed by pressing <ENTER>.

The files on the PRO-DRAW diskette can be transferred to the Model III versions of DOSPLUS, NEWDOS80, and LDOS using the corresponding DOSes convert command. For LDOS, the command is 'CONV :1 :0' and for DOSPLUS it is 'CONVERT :1 :0 (Q)' To run the program under LDOS or DOSPLUS type 'DO DRAW'; for NEWDOS80 type 'DO NDRAW'.

DISK OWNERS with a MODEL 4 in the 4 mode should place your TRSDOS 6.1.2, 6.2.x, or 6.3.x disk in drive 0 and the PRO-DRAW disk in drive 1 with the yellow label saying 'for TRSDOS 6.1.2, 6.2, 6.3' facing upward. You can then type 'DO DRAW' if you own our Grafyx Solution board or 'DO DRAWR' if you have the Radio Shack graphics board.

3) COMMANDS

The following is a condensed list of the commands available with the PRO-DRAW program. Some general operating principles are described and then each command is explained in detail.

<Arrow keys> - Move cursor	<Space> - Complement point
<SHIFT> + <Arrow> - Move screen	<CLEAR> - New picture
<BREAK> - Exit program	<ENTER> - Exit subcommand
0 - Clear point mode	1 - Set point mode
2 - Complement point mode*	3 - Skip mode
Ⓐ - Adjust cursor size	* B - Draw a Box
C - Draw a Circle *	D - Dump screen to printer
E - Set line Endpoint	F - Fill in shape
G - Get block from screen	Ⓘ - Input block file
J - Jump to position	Ⓚ - Kill block
L - Load Hi-res screen	M - Display Menu
N - Negate screen	Ⓞ - Output block file
P - Put block onto screen	R - Reverse image L/R
S - Save Hi-res screen	T - Text entry mode
Ⓤ - Undo/erase box	V - Velocity of cursor
W - Paint brush Width	X - Random X coordinate
Y - Random Y coordinate	Ⓩ - Zoom in

After executing the PRO-DRAW program you will see a menu containing the above command list. After looking at the menu you should press the <ENTER> key. You will then be given the option of beginning with a clear screen or one which contains the last hi-res screen programmed. After answering this question you will be placed in the Edit mode. You will then see a flashing bar with a dot in the middle of it at the very center of the screen. This is the cursor and most commands use it as the reference point for their operations. When using a Micro-Labs graphics board in the model 4 mode you will also notice the word Skip and two numbers appear in the lower right corner of the screen. The text refers to the mode that you are in and the numbers are the X,Y cursor coordinates.

There are five basic drawing modes. The first four modes, numbered 0 to 3

determine what happens when you move the cursor with the arrow keys and when you draw a line, circle, or box. If you are in mode 1, for example, solid (lit) points will be drawn. Mode 3 is the skip mode which allows you to move around without disturbing the picture. The fifth mode is the Text Entry mode and lets you type text on the screen.

The most important thing to remember when using the PRO-DRAW program is that any time you are unsure what to do, press the <ENTER> key and any command in progress will be halted and you will be returned to the Edit mode. In some instances; screen Dump, Load, Save, Circle command, and Fill command you may have to hold the <ENTER> key down for a number of seconds before the program gets to a point at which it can gracefully quit.

With some commands, such as the Save or Get command, there is nothing being changed on the screen during command execution. In order to determine when it has been completed and you may continue editing, you can look for the cursor to return.

The Box, Circle, line Endpoint, Get, and Undo commands all require that two points be specified. With all of these commands you press the proper command letter once to define the reference endpoint. Once this is done, when you move the cursor you will see that a flashing line is displayed connecting the defined endpoint and the current cursor position. If you decide to abort the command at this point you may press <ENTER>. Otherwise, when you have the cursor in the proper position, you can press the command letter again and it will be implemented. Note that the first time one of these keys is pressed, an endpoint flag is set but no distinction is made as to which key it was. Therefore, you could always press 'E' to define the first endpoint since it is the second key press that determines which command is executed.

The Box, Circle, and line Endpoint commands will be drawn using the current paint brush Width and will reflect the current mode. If you are in skip mode 3 then the points are drawn as if you were in mode 1 on the assumption that you wish to set points.

Each command will now be described in detail. Just remember that if you ever forget what key does what, just press 'M' and the command Menu will be displayed.

<Arrow keys> - Move cursor

The four arrow keys move the cursor in the direction shown on the key. Two arrow keys may be pressed simultaneously in order to move diagonally except when in the 10X zoom mode. When the cursor goes off the edge of the screen it wraps around and appears on the opposite side. Under certain conditions the cursor will seem to disappear when moving in the skip mode and you may need to stop for a second or observe the cursor coordinate display to find out where you are on the screen.

<Space bar> - Complement point

By pressing the space bar you can complement the point under the cursor. This command is used when you are only setting a few points or doing detailed work. It saves you from having to change into and out of the set mode just to change one point.

<SHIFT> + <Arrow> - Move screen

By simultaneously holding down the shift key and pressing one of the four arrow keys you may shift the entire screen in any direction. The screen is moved one dot at a time when shifting up or down and two dots when going left or right. Dots being shifted off the screen wrap around to the opposite side.

<CLEAR> - New picture

Pressing the <CLEAR> key will erase the entire graphics screen so that you can begin with a new picture. You will be asked for confirmation before the screen is actually erased. Clearing the screen has no affect on any blocks saved with the Get command.

<BREAK> - Exit program

When you wish to leave the PRO-DRAW program and return to TRSDOS, press the <BREAK> key. You will be asked for confirmation to make sure that you really want to quit.

<ENTER> - Exit subcommand

This key can be pressed at any time in order to exit any of the other commands. It may be pressed in response to any prompt or to halt the execution of

the Get, Put, Fill, screen Save, screen Dump, and Text entry commands. In some cases it may be necessary to hold the key down for several seconds before it can be recognized.

0 - Clear point mode

Pressing the number '0' key will place the program in the Clear point mode. In this mode, any points which the cursor passes over will be erased.

1 - Set point mode

Pressing '1' results in any points which the cursor passes over being set.

2 - Complement point mode

In this mode any point which the cursor passes over will be complemented; if it was clear before it will be set and vice/versa.

3 - Skip mode

This is the default mode which allows the cursor to be moved anywhere on the screen without affecting any of the points it passes over.

A - Adjust cursor shape

This command lets you change the cursor symbol to any of the following shapes: 0)point (this is the normal default shape), 1)backslash, 2)large backslash, 3)forward slash, 4)large forward slash, 5)spray pattern (good for adding texture or shading), 6)square, 7)circle, 8)diamond, 9)inverted V. The cursor shape drawn will be different depending on which of the 4 Width settings you use and whether you are in the set point or complement point mode for a total of $10 \times 4 \times 2 = 80$ different combinations. Many interesting effects can be obtained with the different cursors, especially when moving the cursor diagonally or when using the Joy-Mouse to draw freehand. The larger cursors can also be used to erase parts of your drawing much faster than with the normal cursor.

B - Draw a Box

This command requires that two corner points be defined. This is done by pressing 'B' at one of the desired box corners and then moving the cursor to the opposite diagonal corner of the desired rectangle and pressing 'B' again.

C - Draw a Circle

This command requires that you first press 'C' to set the center of the circle. You should then move the cursor in any direction so that it is positioned at the desired radial distance from the center of the circle. Pressing 'C' a second time results in a prompt for an optional begin, end, and aspect ratio. If you want a normal, round circle press <ENTER> and it will be drawn. To draw an ellipse, enter a comma followed by an aspect ratio between .0001 and 1000 with .5 resulting in a circle. To draw an arc, enter the start and end points separated by a comma. These values should be in radians and range from 0 to 6.28319. You may also draw a section of an ellipse by entering the start, end, and aspect values separated by commas. If you decide that you want to abort the circle function at this point you can press the <BREAK> key.

D - Dump screen to printer

This command allows you to obtain a hardcopy printout of the graphics screen on any of the following printers: Radio Shack LPVII, LPVIII, DMP-series; Epson or Star Micronics printers; IDS 445G, 460G, 560G; Centronics 739; Okidata Microline 82A, 83A with Okigraph, 84, 92, 93; Anadex 9500, 9501; NEC PC-8023, and the C. Itoh Prowriter I (8510A). This command may be aborted at any time by holding the <ENTER> key down until the printer finishes printing the current line.

E - Set line Endpoint

This command draws a line. Press 'E' once to define one end of the line; move the cursor to the other end; and press 'E' to draw the line.

F - Fill in shape

This command will fill in an area with any of 256 binary bit patterns. The cursor should be placed within the shape to be colored in. After pressing F you are then prompted for a color value from 0-255.

The area to be filled in must be bounded on all sides by solid lines or the edge of the screen. The most common mistake made when using this command is trying to fill an area when you are in mode 1 or when the cursor is positioned over a set point. This is because the fill routine begins at the cursor and it quits as soon as it sees a set point. So for example you couldn't draw a circle and then fill

it in without moving the cursor off the solid edge of the circle.

G – Get block from screen

This command lets you save a section of the screen into a separate area of memory for later recall by the Put command. This area of memory has room for 15000 bytes of data except on 128K computers in which case 32000 are available. The section of the screen to be saved is defined by specifying two opposite diagonal corners of the rectangular area to be saved. After pressing 'G' once at each corner you will be prompted for the name of the block. Enter any descriptive name up to seven characters long and the block will be saved in memory. Up to the entire screen can be saved in one block if there is enough free memory. The Kill block command can be used to erase unwanted blocks and free up memory for new blocks. When saving very large areas there may be a delay of several seconds during which the screen will say 'Working...'

The blocks saved could be any kind of special symbol or shape such as a game figure, electronics part, picture, or design.

I – Input a block file

This command loads a block file containing blocks/shapes/symbols created with the Get block command and saved on disk with the PRO-DRAW Output block file command. Any blocks currently in memory will be lost. Do not include an extension on the end of the file name since /BLK is automatically added. Disk owners may obtain a display of a disk directory by entering a drive number from 0 to 3. Note that the disk directory function call only works under TRSDOS and you should not attempt to use it with any other DOSes. Once in memory, blocks are placed on the screen with the Put block command. A sample block file containing some common electronic symbols is saved under the name SYMBOLS.

J – Jump to position or measure distance

This command moves the cursor to any position on the screen or to any position relative to the current position. The allowed range of values is 0-639 for X, and 0-479 for Y with the point 0,0 located in the upper, left corner of the screen. Note that the Y axis resolution values have been doubled so that the numbers are now proportional and specifying a value of 10 pixels in the X direction now is the same distance as 10 pixels in the Y direction.

If you wish to move to an absolute cursor position simply enter the X and Y coordinates separated by a comma. If you want to move a given distance from the current cursor position you can specify a relative movement value by typing the letter 'r' followed by a comma followed by the X, Y distances to move. Note that since movement is relative, X and Y may be either positive or negative. If you do not wish to change the cursor position, just press <ENTER> without making an entry.

The distance between any two points can be measured by pressing 'E' to set the endpoint of the first point, moving the cursor to the second point, then pressing 'J' at which point the distance between the points is displayed in the lower, left corner, and then pressing the <ENTER> key to return to the drawing screen.

If you are using the program with the Radio Shack board or in the model III mode you can quickly determine your current X, Y cursor position by selecting this command at which point the drawing mode and cursor position will be shown in the lower, right corner, and then pressing <ENTER> to return to the drawing screen.

K - Kill a block

This command deletes a block created with the Get block command. All of the blocks currently saved in memory are displayed and you are prompted for the one to erase. To abort this command simply press <ENTER>.

L - Load Hi-res screen

This command loads a hi-resolution picture previously saved with DRAW, PRO-DRAW, SAVLOAD, or GBASIC. Do not include an extension on the end of the file name since /HR is automatically added. If you wish to load a file without an extension you can enter the name with a single '/' character at the end. Disk owners may obtain a display of a disk directory by entering a drive number from 0 to 3. Note that the disk directory function call only works under TRSDOS and you should not attempt to use it with any other DOSes.

M - Display Menu

This command shows the list of all of the possible commands and then returns to the Edit mode after the <ENTER> key is pressed.

N – Negate screen

This command complements every point on the screen.

O – Output a block file

This command creates a block file on disk containing blocks/shapes created with the Get block command. Do not include an extension on the end of the file name since /BLK is automatically added. Disk owners may obtain a display of a disk directory by entering a drive number from 0 to 3. Note that the disk directory function call only works under TRSDOS and you should not attempt to use it with any other DOSes.

P – Put block onto screen

This command allows you to place a block previously saved with the Get command anywhere on the screen. The block is placed such that the upper left corner of the block begins at the current cursor position. A list of all previously saved blocks is displayed and you are prompted for the block to put on the screen. After entering a valid block name you are prompted for the function. You may 0)choose to complement every point within the defined rectangular block regardless of what was stored in the block, 1)copy the contents of the block onto the screen overwriting whatever was previously there, 2)perform a logical AND of the block and screen contents so that points appear only where the screen and block both had points lit, 3)perform a logical OR so that the block is placed in addition to, or 'on top of' the current screen contents, or 4)perform a logical XOR between the block and screen.

You are next asked to enter an X, Y scaling factor. If you want the block reproduced the same as when you saved it or you want to rotate the block, simply press the <ENTER> key. If you would like to enlarge or shrink the block, enter two values from .1 to 10 separated by a comma. A value of one for X or Y would leave that dimension unchanged and values less than one would shrink the image. Note that the block can be stretched vertically or horizontally since the two scaling factors do not have to be the same. Since this function can take awhile, especially if you are enlarging a block, *always use the logical OR function if possible.*

If you pressed <ENTER> for the scaling factor question, you will be asked for the number of degrees (0-360) to rotate the block. Press <ENTER> once more if you want the block reproduced the same as when you saved it. Note that the

point that the entire block is rotated around is the cursor position which is also equal to the upper, left corner of the block. Since this function can take awhile, especially if the block is very large, *always use the logical OR function if possible*. Note that because of the length of time required, the program doesn't allow you to scale and rotate the block at the same time. If you wish to do this simply perform the scaling operation, Get the scaled block from the screen and give it a different name, and then place it on the screen with the desired rotation value.

Note that since the density of pixels in the X direction is twice that in the Y direction, the program compensates for this fact in order to keep the block proportional. However, when a block is rotated 90 degrees, this results in gaps between pixels on the X axis since each Y pixel now fills the space of two X pixels. However, since the effect is consistent, rotations of 90, 180, and 270 degrees give good images. Other angles will result in blocks not looking as good because the distortion is not periodic and you may need to clean the image up using the Zoom command and adding or subtracting pixels to smooth out and fill in the lines. If you want a more solid image and want the gaps filled in you can also move the cursor one pixel horizontally and Put the block down again with the OR function.

If you want the mirror image of a block, press 'R' to reverse the screen, Put the block in the desired position, then press 'R' again and the screen will be normal but you will have the mirror image of the block.

A block that has been put on the screen can be erased as long as the cursor is in the same position it was when the block was placed there. This is done by putting the block back on top of itself using the XOR function. Similarly, if you are not sure if the block will be placed where you want it, place it with XOR and then remove it with XOR if it is in the wrong place and the screen will be as before.

R - Reverse image L/R

This performs a left-right mirror image reversal of the entire screen.

S - Save Hi-res screen

This command allows you to save the contents of the hi-resolution memory to disk in the standard SAVLOAD/GBASIC format. Do not include an extension on the end of the file name since /HR is automatically added. If you wish to save it without an extension you can enter the name with a single '/' character at the end. Disk owners may obtain a display of a disk directory by entering a drive number

from 0 to 3. Note that the disk directory function call only works with TRSDOS and you should not attempt to use it with any other DOSes. When saving a file, the cursor will return when the save operation is complete.

T - Text entry mode

This mode allows you to add standard upper or lower case characters to your hi-resolution screen beginning at the current cursor position. To toggle the upper/lower case keyboard lock press <SHIFT> 0. The text characters are actually placed into the hi-resolution screen instead of the normal screen memory. Since characters are always placed onto the screen in the complement mode, the text will show up regardless of whether the background is lit or dark. However, you must be careful not to write over non-solid backgrounds since garbled characters will result. The arrow keys are used to move one character in any direction. In order to erase a character you must back up and press the same key that you pressed to display the character. If you make an error you may have to go back to the Edit mode and erase the area and then go back into the Text entry mode. Pressing <ENTER> at any time exits the text entry mode. You may need to exit and re-enter the Text entry mode if you lose track of where the cursor is positioned since no cursor is displayed during text entry. The characters are made up of an 8 x 10 matrix and can be positioned beginning at any point on the screen.

It is possible to create text of any size and proportion and even at any angle. To do this place the text on the screen in the normal manner in an area away from the main part of the drawing. Then go to the lower right corner, press 'G' then go to the upper, left corner of the text and press 'G' again and give it a name such as TEXT. Then, without moving the cursor, press 'P' to put the text back, enter the name you just defined, select XOR function 4, then press <ENTER> on the next two questions. This will erase the text from the screen and you can now place it in the desired position with the Put block function and specify a magnification factor for X and Y and an optional amount to rotate the text. Refer to the Put block command for further details.

U - Undo/erase rectangle

This command requires that you define the two corner points of the rectangle that you want erased. This is done by pressing 'U' at one of the desired box corners and then moving the cursor to the opposite diagonal corner of the rectangle

to erase and pressing 'U' again.

V - Velocity of cursor

You may change the speed at which the cursor moves. Speeds may vary from 0 to 9 with the velocity initially being set at the fastest value of 0. The slower speeds are used when you are trying to move the cursor a single point at a time for detailed drawings or positioning.

W - Paint brush Width

The size of the points drawn may be changed to one of four values. A width of 1 gives the highest resolution of 640 x 240 (512 x 192 on Model III Grafyx Solution) and sets one pixel at a time; 2 sets two side by side pixels for a resolution of 320 x 240; 3 sets four pixels in a row for 160 x 240; and 4 sets a block of eight pixels for 160 x 120 resolution. As an added feature you may obtain dotted lines when moving the cursor in complement mode 2 and setting the brush width to 3 or 4. This option can be used with the Adjust cursor shape command to create a number of different interesting effects.

X - Random X coordinate

When creating artistic type pictures it often helps to have some random aspect involved in determining how things are drawn. We have therefore included this command which will re-position the cursor to a new random X coordinate while maintaining the same Y coordinate.

Y - Random Y coordinate

This command moves the cursor to a random Y coordinate while maintaining the same X coordinate.

Z - Zoom in

This is a very powerful command because it instantly enlarges by a factor of ten the area of the screen centered around the cursor. To return to the normal Edit mode simply press the <ENTER> key. On the enlarged screen it is much easier to modify individual pixels or to move the cursor to just the right position before executing one of the other commands. Note that the only editing keys/commands available in this mode are 0, 1, 2, 3, the arrow keys, and the spacebar.

4) INCLUDED PICTURES

There are a number of pictures included on the disk which were drawn using the PRO-DRAW program and which are signified by their /HR extension. A brief explanation of some techniques used to create drawings follows:

ART4 was created by first using the random X and Y coordinate functions and drawing a short vertical or horizontal line wherever the cursor landed. The cursor was then set at random positions and everything on the upper half of the screen filled in with a shaded pattern and everything on the bottom with a solid shade. To some people the drawing looks like a city and its reflection in a lake.

DRAGON was created by a talented customer simply by using the arrow keys to set individual points.

FLOWER was created by first tracing a drawing of one butterfly and flower using the Joy-Mouse interface and the Koala pad. The reverse screen command and block copy was used to then create the second flower and other butterflies.

LOGIC was created using the blocks stored in the supplied SYMBOLS file and then the parts were simply connected with lines.

RECO and **TRON** were created by a customer who based his designs on machines contained in the movie TRON.

SHUTTLE2 was created by a talented customer who just used the set point, circle, and line commands to draw a very good image of the space shuttle.

5) ALTERNATE INPUT DEVICES

The Micro-Labs Joy-Mouse interface allows a TRS-80 Color Computer Mouse or Koala Touch Pad to be connected to the Model III/4/4D/4P. Therefore when you enter either of the two Mouse Modes described below you can directly position the cursor anywhere on the screen without any additional effort. However, the standard Joy-Mouse interface returns an X and Y position ranging from 0 to 255. This presents a slight problem in that there are more than 256 dots on the screen in the horizontal direction. To get around this problem and provide maximum accuracy, we allow two Mouse Modes. In one, the plotting screen resolution is cut in half for a 256 x 240 screen. In the second, the full screen can be addressed but only one section at a time. This is explained below.

To enter into the 256 x 240 Mouse Mode, press the '?' key. You will then be able to move the cursor almost anywhere on the screen but each point you draw will really be two smaller dots combined.

To enter into the hi-res 640 x 240 (512 x 192 on Model III Grafyx board) Mouse Mode, press the '/' key. The cursor will move to the current input device position. Now, instead of moving relative to its current position, the cursor will always follow the position of the input device. Moving the cursor in all directions, you will see that you are limited to only a portion of the screen. To move to the next section to the right, press the comma key. When you wish to move to a section to the left, press the period key. Note that when you move to a different section, you will automatically be placed in the skip mode.

The following pertains to both Mouse Modes. You may exit the Mouse Mode and return to using the arrow keys simply by pressing any one of the four arrow keys. When you enter a Mouse Mode, the drawing mode will be set to skip. In this state, you can set a single point on the screen by pressing the red mouse button or the left button on the touch pad. Also in this mode, the cursor will draw a line as long as the button is held down. Then by letting up on the button you can reposition the cursor without changing the drawing. You may also use the standard PRO-DRAW 0-Clear, 1-Set, and 2-Complement modes in which case the cursor will always do as the mode dictates and the button has no affect.

The Width of the cursor can be changed from 1 to 4 but should not be changed if in the Complement mode. Note that when you enter the 256 x 240 Mouse Mode, the width is set to 2. You can achieve an interesting dotted line by changing the width to 1. This can also be used to color in an area with a shaded pattern since only every other dot is set.

It is very easy to accurately and quickly lay down lines by moving the cursor to the first endpoint, pressing 'E' on the keyboard, and then moving to the second endpoint and pressing 'E' again. All of the keyboard commands can be used in the Mouse Mode except the Random X, Y and Jump keys which are not relevant.

Although a number of devices can be connected to the computer using the Joy-Mouse interface, each has its own unique advantages and disadvantages.

The TRS-80 Color Computer Joysticks are not recommended for serious use since the variable resistors used are not very precise and can give spurious readings. The joystick is also too coarse for fine drawing.

The Mouse is the most generally useful and recommended input device. It allows very fine control of the cursor positioning and drawing. It also requires only one hand to use and you don't have to take your eyes off the screen to use it. It also maintains the current cursor position even when you take your hand off it. Its' main limitation is that you can't trace a drawing already on paper.

The TRS-80 Koala Touch Pad allows very precise control of the cursor position using a pencil as a pointing device. Some users find this input method more natural. With this device images can be copied from paper to the screen.

The Touch Pad should always be used with the supplied drawing pencil. Also, if you lean your hand on or touch any portion of the pad surface it can produce unwanted points. There are several other things that you should be aware of when using the touch pad. First of all, whenever you are not touching the pad surface, it returns a coordinate value of approximately 128, 128 which puts the cursor in the center of the screen. This causes problems when you have the button pressed or are in the set point mode and are drawing on the screen. For the same reason, if you lift or even momentarily lighten the pencil pressure too much, the PRO-DRAW program will read and set a series of unwanted points going from

the previous cursor position to the center of the screen. To avoid this, do not use the set point mode and always make sure that the pencil is solidly pressed down on the pad before and after pressing the pad button.

To copy a drawing you need to first tape it in place over the Touch Pad so that it can't shift. Then place the pencil at some point on a line in the drawing and press 'E' on the keyboard. Then lift the pencil and place it on a point further along the line. Press the 'E' key twice to lay a line down and start a new line beginning where the old one ended. Since any curve can be broken down into a series of straight lines, by repeating the above procedure the tracing can be as accurate as you need it to be.