BASIC 8

WITH BASIC PAINT

PATECH Software, Inc.

Basic 8.0

The Enhanced Graphics System For The C128

Developed by

LR Wallace, DP Darus
WALRUSOFT

March 19, 1987

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Dear Valued Customer,

Thank you for purchasing *Basic 8* with *Basic Paint*. *Basic Paint* was created using *Basic 8* and has been included with the package as an added bonus to show what can be accomplished with *Basic 8*. Also included is an Icon based, Desk-top utility which enables you to access your *Basic 8* programs quickly and conveniently.

We think you will find *Basic 8* to be one of the most sophisticated and powerful software packages available for the C-128. It breaks new ground in unleashing hidden graphic capabilities rivaling those of 16-Bit Computers! Your purchase enables us to continue to offer software of the highest quality to users of the Commodore 64 and 128.

<u>Patech Software is Founded on Three Basic Principles</u>:

1. To offer the best quality software at a fair price. (One which accurately reflects its true *value* to the user.)

2. To offer realistic and usable support to each Registered user *after* purchase, to ensure that he gets full value from the software.

3. To Present the software in its original state, *without copy-protection of any kind!* This enables you to make back-ups for your convenience and the protection of your investment (as well as your equipment!).

   You put your trust in Patech when you purchased *Basic 8*. In turn, we are putting our trust in *you* to help ensure that we are fairly compensated for our software. Only through this mutual trust can we continue to serve your software needs. Please don't force us to add copy protection to our software. That would only hurt *both* of us!

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To keep fully informed of future products and updates; and to become a Registered User, please mail the enclosed Registration Card. Whenever you contact us for support, please reference the Serial Number printed on the card. (Make a record of the number *before* you mail the card!)

I hope you find that *Basic 8* fulfills your expectations. Thanks again for your support.

Sincerely,

Paresh Patel

Paresh Patel, President
Patech Software, Inc.
P.O. Box 5208
Somerset, NJ 08873.

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Required Equipment

Commodore C128 (or C128D) Computer in C128 80 column Mode only

At Least 1 disk drive (1541, 1571, 1581 and compatibles)

RGB Monitor

Supported Hardware Options

External RAM Expansion
  Model 1700 128K RAM cartridge, or
  Model 1750 512K RAM cartridge

Internal 64K RAM Expansion for the 8563 Video Display Chip
  (New C128D model comes with the 64K already built in.)

Model 1351 Proportional Mouse

Standard Joystick

Dot Matrix Printer (See Chapter 11 for specific printers)

MAKING BACKUPS OF YOUR BASIC 8.0 DISK

Even though it is **copyrighted**, your **BASIC 8.0** disk is **not copyprotected.** In fact, it comes with a built in backup facility. The original disk you buy is **not** meant to be used for work. The first time you boot the disk, have three formatted blank disks ready. Put the **original BASIC 8.0** disk into the drive and either turn on the computer or press the reset button (if the computer is already on). You will be prompted with a menu which has three choices. These menu options allow you to make a **BASIC 8.0 Work Disk**, a **BASIC PAINT Work Disk** or a **BASIC 8.0 RunTime Disk**. You should make one of each, then put the original **BASIC 8.0 System Disk** away, where it will be safe. Use it at another time to make additional work disks or runtime disks. Of course, you can also use your favorite disk copy program to back up your work disks and runtime disks.

The **BASIC 8.0 Work Disk** is for writing and editing your **BASIC 8.0** programs. You **may not** give this disk away! Make a backup of this disk, and work from your backup work disk. This disk contains the complete **BASIC 8.0** editor system, and is the disk you will use for creating your own **BASIC 8.0** programs. To use this disk, just put it in the drive and boot the computer. The **BASIC 8.0** system will load and become initialized. You may then write programs, run them and save them as you normally would. The difference lies in the many new **BASIC 8.0** commands available.

The **BASIC PAINT Work Disk** contains the included 80 column color paint program, as well as menus, fonts and requestors. It is a **RunTime Program**, meaning it contains only **the** runtime library, not the editor. You cannot edit or list the program, and you cannot sell or give it away. The **BASIC PAINT** disk is also an autoboot disk. Just plug in a 1351 mouse into port one or a joystick into port two and boot the disk. You will be presented with a series of menus and requestors that allow you to configure the program to your system.

The **BASIC 8.0 RunTime Disk** is the only legal way to sell or give away programs you have written with **BASIC 8.0**. It contains the **RunTime Library**, which is a program that allows **BASIC 8.0** programs to run, but not edited or listed. This disk also contains the **WORKBENCH** program, which is simply a **BASIC 8.0** program that allows you to use a mouse to load and run **BASIC 8.0** programs. This disk too is a autoboot disk. It will load and activate the **RunTime Library**, and then it loads and runs the WIOS WORKBENCH. You can put your own programs and their required files on this disk, where they can be loaded by pointing the mouse and selecting them with the mouse buttons. Or you can alter the booting sequence of the **RunTime Disk** in order to directly load and run your program. See Chapter Seven for details.

OUR PHILOSOPHY ON SOFTWARE COPY PROTECTION

We made a very deliberate decision to not put any type of copy protection on the disk, so you could easily make working disks. At this time, nearly all new Commodore software is protected. So why not **BASIC 8.0**? We believe that C128 users deserve to be trusted. We believe in giving you value for your money. So on this disk is not only the first truely unique C128 software package (**BASIC 8.0**), there is a **FREE** run time system that can be used by **registered owners** to produce program disks that will run your BASIC **8.0** programs without using the BASIC **8.0** editor disk. *These run time systems can be given away or sold without you paying us royalties!* So if you write an exceptional program you want to share, you can do so **legally** without infringing on our copyright. (These run time programs can only be ran, not edited or altered by the user.)

If that isn't enough, there is also a bonus program written in **BASIC 8.0** called **BASIC PAINT**. This is a very powerful graphic paint package, actually more powerful than most commercial systems available for sale. This program is also copyrighted, so you may not give it away or sell it. Use **BASIC PAINT** just as a paint system, or use it to create pictures, brushes and patterns for use in your **BASIC 8.0** programs.

Besides informing you that making copies of **BASIC 8.0** and **BASIC PAINT** and giving them away (or selling them) is illegal and makes you subject to criminal penalties, please consider this. We spent two years developing this system for the C128, at a time when most software developers were ignoring your software needs. We have given you one of the most powerful graphic languages ever produced on eight bit machines, a free run time system for the programs you develop, as well as a powerful paint package. We have trusted you by allowing you to make copies of the disk for your own use. If we find that all this is not respected and piracy occurs anyway, other software being developed by us may well never show up, or may be protected if it does.

But if you show the proper restraint and do not give out illegal copies, rest assured we will follow with more powerful, unique and **unprotected** software for your C128. And who knows, other companies may follow our lead!

FOREWORD

The Commodore 128 personal computer was released in mid 1985 as the logical upgrade path to the popular C64 computer. In order to address the wants and needs of the potential C128 computer buyers, Commodore asked for suggestions about what the users would like in this new computer system. The major suggestions were implemented. These were C64 compatibility, a faster high capacity disk drive, more standard memory and ram expansion capability, a higher level BASIC language, and a professional 80 column color display. All these improvements over the C64 allowed Commodore to create what is perhaps the most powerful 8 bit microcomputer yet released to the public, and they explain why in a little more than a year over one million C128's have been sold.

One problem associated with the C128 has been the limited amount of software developed for its native C128 mode. This is mainly because of the C64 compatibility as software developers wanted to play it safe and only released software that would run in C64 mode. This lack of real C128 mode software has led to a good deal of anger and disappointment in the C128 buying public, yet they have stayed with their chosen computer system. And of the one hundred or so native C128 packages available after a year, most have been productivity packages like word processors, spreadsheets and databases. Interestingly enough the ones that have been successful have all catered to the C128's 80 column display capabilities.

While the built in Basic 7.0 has a very large base of commands that take advantage of the C128's 40 column graphics capability, almost nothing is available to the BASIC programmer to access the C128's 80 column graphics possibilities, which are quite extensive and actually more powerful than the supported 40 column graphics. In fact Commodore originally stated that there would be no high resolution RGB graphics (except text) as the 8563 chip was not designed to support them and any that could be added via software would be too slow to be usable. The authors of **Basic 8.0** demonstrated that high speed monochrome graphics were not only possible, but quite practical in an early copyrighted language extension called **Ultra Hires**. This small graphics language generated such an avalanche of world-wide interest that we decided to see just how extensive the graphics of the 8563 were. Our criteria was to produce the most powerful and productive graphics system ever developed for a 8 bit computer. With **Basic 8.0** we more than succeeded.

David P. Darus
Louis R. Wallace

CHAPTER ONE
INTRODUCTION TO THE BASIC 8.0 PROGRAMMING LANGUAGE

Basic 8.0 is a new and exciting programming environment for the C128 computer owner. It allows you to use an entirely new aspect of graphics on the C128, graphics that actually exceed the high resolution and power that the C128 and C64 user have come to expect. Yet it does so while being compatible with the existing advanced non-graphic commands of Basic 7.0 that are built into the computer.

Why is **Basic 8.0** so powerful? Well, first of all it offers an extremely high resolution graphics display of 640 X 200 pixels on the screen at the same time (twice the resolution of 40 column mode). This screen memory is completely separate from the normal system ram contained in the computer, and unlike the 40 column graphic screen it does not use any of the users valuable programming ram. Secondly, the normal bitmap graphics used on microcomputers are a two dimensional system. With **Basic 8.0** however, its drawing commands work in a <u>three dimensional</u> **<u>environment</u>**, and the BASIC programmer has a great deal of control over perspective, rotation, viewing angles, the origin and depth of view. Futhermore, it gives the programmer commands to generate three dimensional solid surfaces, a power usually only available on much more expensive computers. Third, **Basic 8.0** offers the RGB graphics user five different types of graphic displays, four of which can use all 16 colors on the screen at the same time. It is also possible to have several screens in memory simultaneously, each with a different color resolution and/or screen size. Fourth, **Basic 8.0** has many other special and unique features. For example you can make Virtual screens that are much larger than the normal 640 X 200 displayable screen. By using the **SCRDEF** command you can create custom screens that are up to 2040 pixels wide or over 800 pixels tall. Conversely, by using the **MODE** command you can easily switch between any of the 32 predefined graphic screens. There are also commands to **SCROLL** a screen, save and load screens and brushes, define a **LOGO**, **PAINT** with exotic color **PATTERNS** of your own design, create **WINDOWS**, make printed copies of your images on many different printers (and in many different sizes as well as in **color**) and much more.

Another important feature of **Basic 8.0** is it's total support of the C128 and its hardware expansion capabilities. Obviously the 80 column RGB display is used. And of course the **Basic 8.0** user can make use of the 1541,1571 and 1581 disk drives. Support for a number of different dot matrix printers allow programs to create hardcopy of the graphic screens. **Basic 8.0** also is one of the first commercial software packages to support the 1700 and 1750 ram expansion modules. You will find that the new 1351 proportional mouse has found a home here in **Basic** 8.0 programs, and you can still use a joystick too. You will even find that the extra 64K video ram expansion for the 8563 chip being installed in tens of thousands of C128's by their owners (and already present in the new C128D) is completely supported. **Basic 8.0** can use in one way or another the whole 704 K ram that can be installed in the C128, as well as virtually every periphial device. In fact everytime you upgrade your C128 computer, you will find **Basic 8.0** waiting with even more capabilities for you to use!

Chapter One

The following chapters will help you learn about **Basic 8.0** and its commands and techniques. They are divided into several sections: screens and modes, 3d graphics, solid shapes, memory management, data structures, the mouse/joystick/pointer system, printers and more. Following these chapters you will find a **Basic 8.0 ENCYLOPEDIA**, which is an organized directory of the commands and their syntax. Here every command is listed and each parameter explained. Then comes the **Basic 8.0 MEMORY MAP**, which simply shows the areas of the computer that are used by the ROMS, RAM and **Basic 8.0** itself. Finally the appendix contains information on the data compression algorithms used, the file format for the graphics, 3d data file structures and more!

The hardware in the C128 that lets **Basic 8.0** generate all these special graphics is the **8563 Video Display Chip**. This is a very powerful RGB display processor that is a new addition to the Commodore computer family. It is controlled through 37 registers that are completely separate from the normal C128 operating system. If is only possible to address the 8563 registers and its video display ram through two locations in the C128. These are $D600 (**Address Register**) and $D601 (**Data Register**). Programming the 8563 can be quite complex, and explains why graphics were thought to be infeasable, though obviously not impossible. On a standard C128 the 8563 video chip has 16k of dedicated display ram you can use, but it is quite possible to expand that ram to 64k, opening a whole new world of C128 and **Basic 8.0** graphics.

Basic 8.0 allows you to access these new capabilities as well as creating many additional features in your own programs. It does this while still supporting the built in Basic 7 commands (except of course the 40 column graphics commands).

How does **Basic 8.0** work? Well, the language is what is known as a **wedge**. A wedge is a machine language program that is *wedged* into the computers BASIC interpreter where the new commands can be executed (and evaluated) along with the old. One of the problems associated with these types of languages is the fact they slow down the normal basic interpreter simply by adding more commands. **Basic 8.0** does **not** work this way because we did not want to slow down your programs. Instead we choose a method called a **syntax error wedge**. This technique prefixes the new commands with a character that is not used by BASIC in any of its' normal commands. So when this character is encountered in a statement, the operating system jumps to the routine that handles syntax errors. We have taken over that function, and check for one of our commands when an error occurs. If it is a real syntax error the program passes it on to the operating system for evaluation. If however we find it to be a **Basic 8.0** command it jumps to our new interpreter. Only then is the new command interpreted. This technique saves a great deal, of time in processing the program, especially when (like in **Basic 8.0**) the added language consists of a large number of new commands. This time savings means your programs run as fast as is possible.

The special character used to prefix all **Basic 8.0** commands is the @ character. It is easy to see in your programs, and does not require pressing the shift key on the C128 keyboard to use. And, finally it should make it far easier for a compiler to be developed for the **Basic 8.0** language, should a developer wish to do so.

Chapter One

Basic 8.0 COMMAND SUMMARY

@ANGLE
@ARC
@BOX
@BRUSHPATRN
@BUFFER
@CBRUSH
@CHAR
@CIRCLE
@CLEAR
@COLOR
@COPY
@CYLNDR
@DIR$
@DISPLAY
@DOT
@DRWMODA
@DRWMODB
@FETCH
@FLASH
@FONT
@GROW
@HCOPY
@LINE
@LOGO
@LSTRUCT
@MODE
@MOUSE
@ORIGIN
@PAINT
@PATTERN
@PIXEL
@PTR
@SCALE
@SCLIP
@SCRDEF
@SCREEN
@SCROLL
@SDAT
@SEND
@SPHERE
@SPOOL
@SSTRUCT
@STASH
@STORE
@STRUCT
@STYLE
@TEXT
@TOROID
@VIEW
@WALRUS
@WINDOWCLOSE
@WINDOWOPEN
@ZOOM

STARTING BASIC 8.0

To start **BASIC 8.0** turn on your disk drive and RGB monitor. If you are using a dual monitor (like the 1902) make sure it is in RGB mode. Press the 40/80 column key on the C128 down. Put the **BASIC 8.0 Work Disk** in the drive, and turn on the computer. The system will autoboot (load and run itself). When it is finished loading, you can then run one of the supplied utility programs or write your own.

CHAPTER TWO
SCREENS AND MODES

There are five different screen formats supported by **BASIC 8**. The key difference between them lies not in the screen pixel resolution, but rather in the color resolution or color cell size. In monochrome graphics mode there is no color information stored for a color cell, so there is only two colors, foreground and background, available to the screen. Therefore a 640 X 200 monochrome screen requires 16000 bytes of ram for the bitmap, and no ram for color information. To use many colors at once you must have somewhere in memory to store the color information, or attributes. On the C128 a single attribute byte controls the color information for a **color cell**. Each attribute is responsible for storing the color information for a specific area of the screen known as the color cell. A color cell is always 8 bits (pixels) wide, and can be either 2, 4, 8 or 16 scanlines (pixels) tall. Each color cell can have any 2 colors, a foreground color and a background color, from a palette of 16 colors. The larger the color cell, the smaller the amount of ram required for color attributes. The smaller the color cell the more ram required for color attributes. So when using the multicolor modes some ram in addition to the bitmap ram is required to store the color information, with the exact amount depending on the color cell and screen size.

The five possible display modes are defined as such:

Mode	**Type**	**Color Resolution**
0	Monochrome	No color cell
1	Color Mode 1	8 X 2 pixel color cell
2	Color Mode 2	8 X 4 pixel color cell
3	Color Mode 3	8 X 8 pixel color cell
4	Color Mode 4	8 X 16 pixel color cell

For some point of reference look at display mode 3. It uses an 8 X 8 pixel color cell, which means that each of the 8 X 8 cells on the screen in this display mode can have their own unique pair of colors, one for the foreground and the other for the background. This is the same color resolution as the C64 or C128 composite high resolution screens color capacity, yet the bitmap has twice the horizontal screen resolution of the composite mode. Each color cell requires 1 byte of attribute memory in addition to the bitmap ram requirements. Using a 640 X 200 display with an 8 X 8 color cell requires 16000 bytes for the bitmap and 2000 bytes for the color attributes totaling 18000 bytes of ram. This is obviously more than the 16K built in for the 8563 to use and since none of the C128's system ram can be directly accessed for 80 column graphic purposes it is not possible to display a full 640 X 200 color screen in any of the color modes with only the standard 16K. That's why we strongly recommend you have the full 64K video ram installed in your C128 (see appendix). The ram requirements for a 640 X 200 screen in each display mode are :

DISPLAY MODE	**DESCRIPTION**	**COLOR CELL SIZE**	**RAM REQUIRED**
0	Monochrome	0	16000
1	Color Mode 1	8 X 2	24000
2	Color Mode 2	8 X 4	20000
3	Color Mode 3	8 X 8	18000
4	Color Mode 4	8 X 16	17000

As you can see it is not possible to have these full screen colors without the extra ram. If you have installed the full 64K of ram (or have a C128D) you can use any display mode as well as virtual screens larger than 640 x 200. However in a standard C128 there is only 16K, so to get around this limitation and still provide color, you must define screens that are less than

200 pixels high, which frees some ram to be used for color information. You can define your own screens using the **@SCRDEF** (**SCR**een **DEF**inition) command, or simply use the **@MODE,0** command to define 8 separate screens designed for the 16K C128. These screens already make allowances for the limited memory, and create screen displays of various heights and resolutions. They are as follows:

SCREEN 0	**640 X 200 Monochrome**	
SCREEN 1	**640 X 192 Color 8 X 16**	
SCREEN 2	**640 X 176 Color 8 X 8**	
SCREEN 3	**640 X 152 Color 8 X 4**	
SCREEN 4	**640 X 104 Color 8 X 2**	
SCREEN 5	**640 X 176 Color 8 X 8**	**Interlaced**
SCREEN 6	**640 X 152 Color 8 X 4**	**Interlaced**
SCREEN 7	**640 X 104 Color 8 X 2**	**Interlaced**

After using the **@MODE,0** command you can work on any of the above screens by just using the **@SCREEN,n** command, where **n** is 0-7. We have found the **@SCREEN,2** (640 X 176 Color, 8 X 8 color cell) the most generally useful color display in the standard, unexpanded C128. If your needs are such that a smaller display (640 X 152 or 640 X 104) is useful, by all means use those screens. The extra color capability is exceptional, and it allows for strikingly beautiful color displays. If you need a larger color display in a 16K system, use **@SCREEN,1** for a 640 X 192 color display using a 8 X 16 color cell. You can use only one of the **@MODE,0** screens at any one time, but you can switch very easily between the different screen types. You can also maintain the different screens in memory as brushes, or **@STORE** them to disk until needed. Depending on the size of your program, you can **@STASH** several screens in the C128's ram banks 0 and 1. However, if you have the **1700** or **1750 Ram Expansion** cartridges you can have dozens of screens, fonts, brushes, logos and patterns in memory at one time.

If you have the 64K video ram expansion installed in your C128 (see Appendix) or own a C128D your screen possibilities are enhanced virtually 1000%! You can now use all four **@MODE** commands. **@MODE,1-3** offers twenty four spectacular screen combinations. Besides 640 X 200 monochrome screens there is every possible 640 X 200 color screen (8 X 16, 8 X 8, 8 X 4 and 8 X 2). There is a large variety of VIRTUAL SCREENS (screens larger than what can be displayed on the monitor at once), including monochrome displays such as 1280 X 409, 640 X 819, 2040 X 252 and 800 X 655 pixels. There are many virtual color screens as well, up to 640 X 728 pixels. **@MODE,1** and **@MODE,2** both contain combinations that allow two to four screens in memory at once, regardless of the screen size or type. Of course, you can use the **@SCRDEF** command to custom design screens of any size using any of the five color types. When used it overides the definition given that screen number by **@MODE,n**. Take a look at the various screens in each mode, because it is likely most of the screens you want will be there; if not, then make some of your own design. You can find a detailed list of the screens in each mode in the chapter BASIC 8 COMMAND ENCYCLOPEDIA under **@MODE**; the complete syntax of **@SCRDEF** is also listed there.

You activate your chosen graphic screen with the command **@SCREEN,draw screen, view screen.** The **draw screen** and **view screen** signifies which of the possible (at one time) 8 screen definitions to use as your current drawing screen and viewing screen. They do not have to be the same, so you can be looking at one screen while drawing on another (in 64K video ram systems). This is ideal for many applications, and can be used for **double buffered displays**, a technique often used for animation. And screens can be saved or loaded with the **@STORE** and **@DISPLAY** commands.

At times you will need the use of the normal text screen, and you can return to it quite easily with **@TEXT**. This initializes the C128 80 column text display, using the standard character fonts. If you want to install custom fonts in text mode, using the **@FONT** command will allow you to load any two fonts into memory for use with the 80 column text display.

Another powerful command is **@WINDOWOPEN**. This command allows you to define special subwindow areas of the screen. The upper left corner of the window becomes the screen location **0,0**. Both the windows size and location is user defined, and once defined all subsequent drawing commands default to it. It stays the default output until another **@WINDOWOPEN** or @SCREEN command is issued or you give the command **@WINDOWCLOSE**. Once opened, the window can be cleared, filled with color, drawn into, etc. If clipping is on, objects drawn outside the window are clipped.

Most, but not all, of the graphic commands work on the current window. Those that do not (like **@STASH**, **@FETCH**, **@COPY** etc) are not drawing commands. In the **BASIC 8.0 COMMAND ENCLYCLOPEDIA** each command is defined and if it does not respond to the **@WINDOWOPEN** command, it will be clearly labeled as such.

Here is a simple example program that will define a @MODE,0 640 X 176 color screen, clear the display and set up some default drawing colors.

```
10 @WALRUS,0:REM define the 16K ram mode
20 @MODE,0:REM Select the 8 screens available to 16K users
30 @COLOR,0,8,0:REM black background, red drawing color, black border
40 @SCREEN,2,2:REM use the 640 x 176 color display 8x8 cells
50 @CLEAR,0:REM clear the display
60 SLEEP 5:REM wait 5 seconds
```

```
70 @TEXT:REM return to text mode
```

A final note. The different color screens are not compatible. You cannot display an 8 x 8 screen in an 8 x 2 mode. The same is true for brushes. They can only use the color mode from which they were created. Monochrome screens and brushes can be loaded into any screen, although they will not contain any color information. Color screens and brushes of any color cell resolution can be displayed in a monochrome screen, with the color information ignored by the monochrome display. By going through a monochrome intermediary, you can transfer the bitmap of screens and brushes from different color modes.

CHAPTER THREE
GRAPHICS

BASIC 8.0 has all the graphics shapes you would expect from a graphics oriented language. It has **@DOT**, **@LINE**, **@BOX**, **@ARC**, **@CIRCLE**, **@PAINT** and more. These are normally rather standard commands, but this is **BASIC 8.0**, not some simple graphics system. Each of these commands offers far more than found in any other language. For example, each of them works in 3 dimensions. Thats right, 3D! Each point is defined as an element of a **X,Y,Z** coordinate system. This is far more advanced than the simpler 2D system used on other graphic systems. It allows you to define and draw complex 3D objects without complex (and slow) mathamatical calculations. It doesn't stop there either. **BASIC 8.0** has some powerful pattern capabilities that allows you to define patterns **n** bytes wide by **m** pixels deep and in color. This is especially useful with the **@PAINT** command, but also the drawing commands (and the character command) can be told to draw in the current pattern. That means your lines, circles, boxes, dots, arcs and letters can all be patterned (like the AMIGA). There's more! Each of the drawing commands (except **@DOT**) can be given a **height** parameter that allows you to **multidraw** it. You can define both the **direction** and the **step value** used by the height parameter with the **@GROW** command. The syntax is **@GROW,x step,y step,z step**; these step parameters can be positive or negative values. Therefore it is possible to grow in several dimensions and directions, **all at the same time!** If the step value is 1 or -1, the line is drawn as a solid. If it is 0 there is no growth in that direction. If greater or less than 1 or -1 then each layer of the graphic is stepped by that number of lines. What can you do with this? Well, for one thing it allows lines of different **weights**. For another, when used with the **@CIRCLE** command it allows you to draw cylinders. Used with the **@ARC** or **@BOX** commands it allows you to draw 3D bars of various shapes, or use a subtended arc and make 3D pie wedges for graphs or charts.

@BOX allows shearing which means to **pull** the base left or right from its position, while holding the top still. These parameters allow you to specify a shear direction (X or Y) and a shear value (how far to shear it). This allows you to make complex 3D bars very easily.

@ARC offers a few special features too. While it can be used for circles or ellipses, it can also be used for generating segments of a curve by specifing the start and ending angles of the arc. You can set the **increment** of the arc (angle between the lines used to draw the arc) to create other geometric shapes. The smaller the increment, the smoother the line. The larger the increment, the more noticable the lines. If you define an increment of 45 degrees, the arc becomes a octagon (8 sides). Use 60 degrees and it's a hexagon (6 sides), 90 degrees and you have a diamond, and 120 degrees for a triangle.

When using pixel oriented graphics, a problem arises. The pixel is not symetrical, rather it is bigger in the Y direction than the X. This means if you draw a 100 pixel horizontal line and a 100 pixel vertical line, the vertical line will be physically longer. To compensate for this **BASIC 8.0** has the command **@SCALE**. There are three scale modes available. The first, **@SCALE,0** is the normal mode. Here the Y pixel is longer then the X, so a 640 X 200 pixel screen is just that. **@SCALE,1** tells the graphic primitives to use a different pixel scale. The

640 X 200 physical pixel screen becomes a 640 X 512 **logical screen.** There are no more real pixels displayed but they are addressed differently. This new graphic scale means that in the example above, both 100 pixel lines are the same physical length. **@SCALE,2** doubles the logical scale of **@SCALE,1**. The screen now becomes 1280 X 1024 logical pixels. Again here we have no additional pixels, only a better logical addressing where all the addressible points are the same size. It is very important not to confuse these logical screens with **virtual** screens. **Virtual** screens really are physically larger in terms of real pixels. If you are working in a large virtual screen and change the scale the virtual screen is adjusted accordingly. To determine the new pixel ranges, use these formulas:

```
     @SCALE,1
             NewX = OldMaxX, NewY = OldMaxY/.39
     @SCALE,2
             NewX = OldMaxX*2, NewY = (OldMaxY/.39)*2
```

OldMaxX and **OldMaxY** are the largest X and Y values in the current screen.

A word about using **@SCALE** is in order. While it does compensate for the C128's non-symetrical pixel, it has the drawback of slowing the rate of drawing. Thats because the scaled points must be converted to the physical screen pixels. So don't use **@SCALE** 1 or 2 in situations where speed is important.

@PATTERN allows you to specify one of the 192 structures as the current pattern. You can fill an enclosed area with the **@PAINT** command. **@PAINT** uses the currently defined pattern, if pattern mode has been selected in @DRWMODA, otherwise **@PAINT** uses the current color for a solid paint. @PATTERN allows you to create incredibly detailed patterned fills, and of course the pattern can be in color. Anything you can define as a brush can be used as a pattern. Just **@STASH** the screen area you want in memory as a brush, then use **@BRUSHPATRN** to make that brush into a pattern. For information on defining a pattern structure see the chapter on structures or the BASIC 8.0 ENCYCLOPEDIA.

You can also find out information on any specified pixel with the command **@PIXEL**. It allows you to tell if a given pixel is on, and what the colors are within its color cell.

When using the multicolor modes, it is easy to set the drawing, background and border color with the **@COLOR** command. It allows each to be any of 16 colors. Normally there is no different border color in the C128 RGB mode, but while in color mode **BASIC 8.0** was able to get around that limitation. You can also use the **@CLEAR** command to fill the current screen or window with the colors of your choice, or even to fill it with one of 255 different simple patterned shades based upon the numbers 0-255.

Another graphic command is **@CHAR**. **@CHAR** allows you to write on the graphics screen using any character font you want. You can use the two built in fonts, or you can load a new font into a structure and use it. The characters can be enlarged up to 16 times in both the x and y directions. You can position the character string anywhere on the active drawing screen. If you are using the color modes you can specify the foreground and/or the background color of the character by inserting control codes in the string. You can also give the **direction** to print the character string. The direction can be left, right, up, down or combinations of them, like up and to the right. And there are many special character control codes in addition to colors available. For example, you can underline, rotate, flip, mirror, reverse, pattern, complement, inverse and blank under the character string, just by including the proper control code. For details of the **@CHAR** command see the **BASIC 8.0 ENCYCLOPEDIA** (**CHAPTER 10**).

There are other commands used with the graphic commands that modify the way they are used. The commands are **@DRWMODA** and **@DRWMODB**. Each allows you to turn on and off different drawing modes. For example, you can use **@DRWMODA** to draw, erase or use the XOR (complement) mode when drawing pixels. You can turn on and off patterned drawing. You can merge a pattern with the screen, and set the clipping flag. (Clipping chops off the drawing commands when they leave the edges of the current screen or window.) You can also change from perspective to parallel 3D drawing modes with the **@DRWMODB** command as well as setting the **Unplotlast** and **Unplotvertex** flags, so that when drawing multiheight objects they have a more obvious 3D appearance. All the parameters of **@DRWMODA** and **@DRWMODB** are explained in the BASIC 8.0 COMMAND ENCYCLOPEDIA.

```
10 @WALRUS,0:REM 16K video ram system
20 @MODE,0:REM use 16K screens
30 @SCREEN,2,2:REM use 640 x 176 screen
40 @DRWMODA,1,0,0,0,0,0,0:REM define drawmoda using JAM1 color
50 @DRWMODB,0,0,0
60 @COLOR,0,8,0:@CLEAR,0:REM set colors, clear screen
70 FOR I=1 TO 100:REM Define random lines and colors
80 X1=INT(RND(1)*640)
90 Y1=INT(RND(1)*176)
100 Z1=INT(RND(1)*100)
110 X2=INT(RND(1)*640)
120 Y2=INT(RND(1)*176)
130 Z2=INT(RND(1)*100)
140 C=INT(RND(1)*15)+1
150 @COLOR,0,C,0
160 @LINE,X1,Y1,Z1,X2,Y2,Z2,1
170 NEXT I
180 SLEEP 5:REM wait 5 seconds
190 @CLEAR:@TEXT:REM return to text mode
```

CHAPTER FOUR
THREE DIMENSIONAL GRAPHICS
Commands and Theory

Many of **BASIC 8.0's** graphic commands work in three dimensions, or 3 space. In order to increase the graphics power available, there are a number of special commands that effect how the graphics are drawn. But before discussing them, a short explaination of 3 dimensional graphics and its terms is necessary.

Three dimensional graphics means there are three coordinate axis used to define a point. In normal microcomputer graphics only 2 dimensions are used. They are labeled X and Y, where the X axis is horizontal to the screen and Y is vertical (up and down). In three space, a new axis is defined, Z. This Z axis is directed into and out of the screen. (See Figure 4.1)

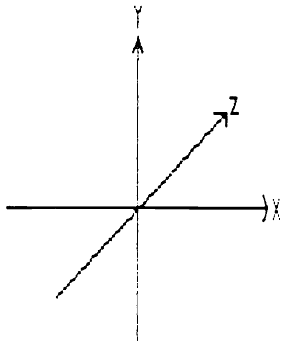


Figure 4.1 3D Coordinate Axis

There are two viewing methods commonly used in 3D graphics. One is **parallel**, where the Z coordinate is simply used to offset the point when converted to the 2D space of the screen. The other is **perspective** viewing, which uses a point in 3 space as its **vanishing point**. Perspective makes objects drawn near to the viewer (Z values decrease) appear bigger, and objects drawn away from the observer toward the vanishing point (Z values increase) appear smaller. You can select perspective or parallel mode by using the **@DRWMODB** command. The vanishing point has no effect when using parallel mode.

When drawing in perspective mode, objects that approach the vanishing point appear to be smaller. If they reach the vanishing point they become a single point, and if they exceed it they become larger (to our eyes). By being able to define the vanishing point (with the **@ORIGIN** command) you can control the degree of three dimensional perspective your images will assume.

Another aspect of 3 space that effects the way we perceive a 3D object is its **origin**. The origin is essientially the center of the universe to your object, line or point. When you rotate, you are rotating around the origin. The default center of rotation is the 3D point **0,0,0**. Sometimes you don't want an object to rotate around this point, because, depending on your position in space relative to this default origin, you can end up with your object completely off the screen. If you wanted to rotate an object around its own center and stay in the same screen location you would have a problem. **BASIC 8.0** removes this difficulty by allowing you to define any spot in 3 space as the center of rotation. To control where the origin is as well as the vanishing point, use the **@ORIGIN** command. For example, if your object was a cube, by setting the center of origin to the center of the cube your object would rotate around its own center, and stay in the same spot while doing so.

In **BASIC 8.0** you can make a 3D object or point appear different with parallel drawing mode set by using the **@VIEW** command. **@VIEW** sets the position of your eye around the Y axis. It has the effect of a simple rotation of your eye (not your data) around the Y axis, so when you draw you see your object at a different point of view.

In order to have complete rotation control, BASIC 8.0 uses the **@ANGLE** command. It allows you to set global rotation values that are used by all the drawing commands (except @[illegible]P), as well as the rotation sequence.

There are three different axis in 3 space, the X, Y and Z axis. You can rotate your objects in any of these three directions, both in the positive and negative directions. You can rotate in more than one axis at once, which results in a multiple transformation of the object. When rotating in several directions at once, the end results differs based on what sequence you rotate (XYZ, XZY, YXZ, YZX, ZXY or ZYX). An object rotated in the sequence XYZ will appear different from one rotated in XZY, even if the angles of rotation are the same. All of these parameters are definable with the @ANGLE command. When you draw with the graphic commands they respond to the currently defined **@ANGLE** setting. The default is @ANGLE,0,0,0,0 (no rotation). Once set to another value, all the drawing commands output their functions accordingly. For example, if you are drawing an arc, and the **@ANGLE** is defined to be a 45 degree rotation around the Y axis (**@ANGLE**,0,45,0,0), the resulting arc will appear to be rotated 45 degrees in the Y axis. The commands **@DOT**, **@LINE**, **@BOX**, @ARC, and @CIRCLE all will respond to the given **@ANGLE**. Most importantly, you can change the rotation angle as many times as your program requires. However, remember that complex rotations will decrease the speed of your graphics (although only a tiny fraction of what they would be if mathematically rotated in basic).

Here is an example of a **BASIC 8.0** program that draws a rotated line using the **@ANGLE** command to rotate it around the Z axis. Notice that the line definition is never changed, only the **@ANGLE** values change.

```
 10 @WALRUS,0:REM 16 K VIDEO MODE
 20 @MODE,0:REM USE FIRST 8 SCREEN DEFINITIONS
 30 @SCREEN,0,0:REM MONOCHROME SCREEN 640 X 200
 40 @SCALE,0:REM USE NORMAL SCALE
 50 @DRWMODA,1,0,0,0,0,0,0:@DRWMODB,0,0,0:REM STANDARD MODES
 60 @ANGLE,0,0,0,0:REM DEFAULT NO ROTATION
 70 @ORIGIN,320,100,0,320,100,200:REM ORIGIN IN SCREEN CENTER
 80 @CLEAR,0:@COLOR,0,8,0:REM CLEAR SCREEN, SET COLOR TO RED
 90 FOR AN=0 TO 360 STEP 20 :REM CHANGE ANGLE BY 20 DEGREES
100 @ANGLE,0,0,AN,0:REM ROTATE LINE AN DEGREES AROUND Z
110 @LINE,200,100,0,440,100,0,1:REM DRAW LINE
120 NEXT AN
130 GETKEY A$:REM WAIT FOR A KEY PRESS
140 REM CLEAR ALTERED ROTATION VALUES
150 @ANGLE,0,0,0,0
160 REM RETURN TO TEXT MODE
170 @TEXT
```

In addition to these 3D drawing commands, there are several designed to be used to generate **SOLID 3D OBJECTS**. These are based upon techniques developed for the C64 computer by **Mr. Richard Rylander** and first published in the May 1985 Dr. Dobb's Journal. Because of the 3D nature of our work, Mr. Rylander allowed us to convert his solids algorithms to the C128 for use in **BASIC 8.0**. We wish to thank him for his great work and generosity.

The Rylander Solid commands allow you to generate textured (halftone or random) solid images such as **SPHERES, TORIDS, CYLINDERS** and **SPOOLS**. You have a great deal of control over clipping the objects, shading and texture. It cannot be emphasized enough the incredible graphics possibilities of the solid generation commands.

The solid commands differ from the regular 3D graphic commands in that they are defined using the normal 2D X,Y system. You can not use a Z coordinate value when defining their positions.

Perhaps the most interesting of the Rylander shapes is the sphere. It allows you to generate a solid spherical object, which can be used in many drawings or illustrations for quite a dramatic effect. The command is **@SPHERE,X,Y,RADIUS**. It will place the sphere at the given coordinate X,Y (remember these commands have no Z axis control). You can change the clipping, shading and lighting with the **@STYLE** and **@SCLIP** commands.

You can create a **toroidal** shape (somewhat donut shaped) with the command **@TOROID**. This allows you to define both the inside radius and the outside radius, as well as the view (horizontal, vertical or top) so the shape can be quite different looking with the same command.

Another of the Rylander shapes is **SPOOL**. A spool surface can be thought of as the inside of the toroid surface. Created with the **@SPOOL** command, it allows you to specify the inner and outer radius, and two viewpoints, horizontal and vertical.

The final Rylander solid shape is the CYLINDER shape. This will create a horizontal or vertical cylinder, with you defining its radius, halflength and view.

To make these even more useful, there are two command that can be used to define the characteristics of the solids in much the same way as **@DRWMODA** and **@DRWMODB** define the drawing commands.

@STYLE sets up the shading (textured or halftoned), scaling (symetrical or elongated) and lighting (normal or backlite). **@SCLIP** allows you to only draw part of the solid, and clip the rest. This makes it easier to combine the shapes into more complex solids.

While the solids commands do not respond to the 3D commands (**@ANGLE, @VIEW** etc) they do respond to the **@COLOR, @WINDOWOPEN/@WINDOWCLOSE** and bitmap screen (**@COPY, @STASH/@FETCH**) commands.

Here is a simple example that creates a green textured sphere.

```
10 @MODE,0
20 @SCREEN,2
30 @COLOR,0,5,0:@CLEAR,0
40 @DRWMODA,1,0,0,0,0,0,0:@DRWMODB,0,0,0
50 @STYLE,0,1,1
60 @SPHERE,320,200,50
70 GETKEY A$
80 @TEXT
```

An important point should be made about the 3D drawing and 3D solid commands. Your program, when it finishes up and exits, should set the **ANGLE, VIEW, DRWMOD's, ORIGIN** etc back to the default values. Otherwise the next program will begin in these modes. Always finish with **@ANGLE,0,0,0,0** and **@DRWMODA,0,0,0,0,0,0,0**. (See Appendix D)

CHAPTER FIVE
MEMORY MANAGEMENT
BUFFERS, STRUCTURES AND OTHER DELIGHTS

BASIC 8.0 is able to utilize up to 10 different 64K banks of ram for storage. Two of these are ram banks 0 and 1, which are the two standard ram banks used by the C128 itself. The other 8 are made available when you install external ram via the 1700 or 1750 ram expansion cartridges. If you have added the 1700 ram expansion cartridge, which has 128K of ram, you have then added two addition banks, bringing the total available 64K banks to 4. If you have added the 1750 ram expansion cartridge it adds 512K additional ram, giving you 8 additional banks of 64K for a total of 10 banks.

BASIC 8.0 allows you to access that ram by the use of a data structure system. Each of the 10 banks is refered to as a **BUFFER**. The **BUFFER** numbers are 0-9, where 0 and 1 are the standard C128 banks 0 and 1, and **BUFFERS** 2-9 are the external banks added with the ram expansion. You can also define where in the ram bank a **BUFFER** will begin and it's size in order to effectively use the system ram banks 0 and 1. Obviously you cannot just use all the ram in banks 0 and 1, as that would leave no room for programs and variables; yet very few programs use every byte in those banks. That leaves some for use as **BUFFERS**; but it is far better to have the external ram for structures, and leave internal ram for programs. For example, let's define a **BUFFER** in ram bank 1. Since this bank is also used for basic program variables you should adjust the variable start or end pointers so that your buffer doesn't corrupt your variables or visa versa.

```
POKE 47,0:POKE 48,68:CLR
@BUFFER,1,1024,16384
```

This example uses ram bank 1 as the **BUFFER**, with it starting at decimal 1024 and is 16384 bytes long. It moves the start of variables in bank 1 up 16K to make room for the data buffer. Thats enough for several fonts, or even a full screen monochrome picture. If you have the external ram expansion installed, you could use several of its ram banks instead. For example;

```
@BUFFER,2,0,65535  :rem use external ram bank 0, use all 64k
@BUFFER,3,0,65535  :rem use external ram bank 1, use all 64k
@BUFFER,4,0,65535  :rem use external ram bank 2, use all 64k
@BUFFER,5,0,65535  :rem use external ram bank 3, use all 64k
```

This gives you a total of 256k of ram to use as **BASIC 8.0 STRUCTURE** storage. You can use all 10 banks if you wish, or any combination. With the external ram installed and used for storage, you can use banks 0 and 1 just for your program and its variables, allowing for very large and graphically complex programs.

STRUCTURES

Once you have declared your **BUFFERS**, you can define structures to use that memory. There are 4 types of structures you can define. There is the **PATTERN** structure, used to define a bitmap pattern (of any size) and its' color (if any). There is the **LOGO** type, which is used to generate one or more character strings. For example, you could define a structure that would print to a specific place on the screen, with a particular font, and any defined size. You can define many character fonts with the **FONT** structure, allowing you to have an **unlimited** number of different character fonts all at once. Finally there is the **BRUSH** type of structure, which is a rectangular area of bitmap (including color if it is present). Brushes allow you to pick up any area of the screen and save them to memory or disk, flip them, mirror or reverse them, then put them back on the screen where ever you want. If you are using color the color is saved and manipulated as well. You can even compress them to their smallest possible size for compact storage. Even more impressive is that a brush can be copied to another **STRUCTURE** as a pattern type. This allows **ANYTHING** you can place on the screen to be used as a pattern!

The data structure is defined using the commands @STRUCT, **@SDAT**, and **@SEND**. These commands work together to create different types of usable structures. The command @STRUCT includes the structure number (0-191) used to identify which structure when using later commands. Then the structure type (1-4), followed by a **BUFFER number**, and an address in the buffer. Once you have defined the type, use the command @SDAT (Structure **DAT**a) to send whatever data is appropriate. You can use Basic 7.0 commands within the @STRUCT:@SDAT:@SEND block, for example FOR NEXT, DO WHILE LOOP etc., to generate data. You can use the **@SDAT** and @SEND commands to find the next available address in the buffer, as they return that information value when used. For example, if you are using the **@SDAT** command to send pattern data, the next available address in the BUFFER is found by using @SDAT like this;

```
@BUFFER,2,0,65535  :rem external ram, 64k buffer
@STRUCT,2,1,2,0:rem struct 2,type pattern,buffer 2,address 0
AD = @SDAT,pattern data, pattern data, pattern data
rem   AD = next address available
@SEND :rem finished defining pattern structure
```

A) Loading and Saving STRUCTURES

STRUCTURES come in four types, pattern, **logo**, **character** and

brush. You use the commands **@LSTRUCT** and **@SSTRUCT** to load and save all four types of **STRUCTURES**. When you want to load you define a **BUFFER** that can be used to store the data, then use **@LSTRUCT** to load it into memory. If you have a **STRUCTURE** in memory you want to save, then **@SSTRUCT** can be used to store it to disk. Here is a small example that loads the supplied 160 column character font into a **STRUCTURE** to be used with the **@CHAR** command.

```
@BUFFER,9,0,65535 : REM use external ram bank 9, all 64 k
@LSTRUCT,0,8,9,0,"FNT.160 COL":REM STRUCT0, DRIVE 8,BUFFER 9,
                                 Address 0,filename
AD=@SEND :REM AD now has the next address in BUFFER 9
```

This short program segment has now added a 160 column character font to external ram memory as **structure 0**, where you can use it with the **@CHAR** command. If we wanted to add another font as well, the program would continue this way.

```
@LSTRUCT,1,8,9,AD,"FNT.COMPUTER":REM STRUCT#1,DRIVE8,BUFFER
                                 9,Address AD,filename
AD=@SEND :REM AD now has the next address in BUFFER 9
```

We could now begin using the different fonts with the **@CHAR** command, indicating which one we wanted with it's **STRUCTURE number**. However, perhaps we want to load some **BRUSH** types also. We still use **@LSTRUCT** to load.

```
@LSTRUCT,2,8,9,AD,filename :REM STRUCT#2,DRIVE8,BUFFER 9,
                           Address AD,filename
AD=@SEND :REM AD now has next available address in BUFFER 9
```

We now have easily loaded two fonts and a **BRUSH** in as user recallable **STRUCTURES**. We could have loaded **LOGO** or **PATTERN** types just as easily. The **@LSTRUCT** command allows you total control, for example, you might have created on the screen an object that you want to save as a **BRUSH**. Continuing our program above (still using **BUFFER 9**) we will **@STASH** it to a **STRUCTURE**, then save it to disk.

```
OA=AD :REM Save starting address of this Structure
AD=@STASH,3,9,AD,0,0,100,100,1 :REM STASH area of screen
                                    0,0 to 100,100 to
                                    STRUCTURE 3  in BUFFER 9
                                    in compressed format. AD
                                    now contains the next
                                    address in BUFFER 9.
@SSTRUCT,3,8,filename :REM SAVE STRUCTURE
@SEND :REM Save the file
```

We have now saved the **BRUSH** as a disk file, but it is also still available in memory to be used. We could **@FETCH** it to the screen, use **@CBRUSH** (Change**BRUSH**) to flip, reverse or mirror it, or even use **@BRUSHPATRN** (**BRUSH** to **PATTERN**) to make a pattern out of it. Of course, since it is stored on the disk we can always reload it at another time.

B) PATTERN STRUCTURES

BASIC 8.0 has a very extensive pattern capability. You can define a pattern from 1 to 255 bytes wide, and up to 255 pixels deep. If you wish, it can also contain foreground and background information for each color cell in the pattern. Once defined, the pattern can be loaded to and from disk, and used to fill an enclosed area with the **@PAINT** command. It can also be used in the graphic drawing commands as **draw pattern** by setting the appropriate parameter in **@DRWMODA**. The syntax of the **PATTERN STRUCTURE** is :

```
@STRUCT,4,1,9,AD:REM STRUCT#4,pattern,BUFFER 9,Address AD
@SDAT,2,8,1,1 :REM 2 bytes X 8 pixels bitmap, 1 X 1 color
@SDAT,255,255,128,0,128,0,128,0,255,255,0,128,0,128,0,128
   :REM That is the bitmap data for a brickwall
@SDAT,206 :REM color  (brown on lite grey), AD=next address
AD=@SEND
```

STRUCTURE 4 is now defined as a **PATTERN** type. You can use it by specifing **STRUCTURE 4** when you use the **PATTERN** command. You can make small simple patterns, or very complex ones. The easiest way to make a pattern is to convert a **BRUSH** to a **PATTERN**

with the command **@BRUSHPATRN**.

C) **LOGO STRUCTURES**

LOGO STRUCTURES are a special form of the @CHAR command. They allow you to print a number of different character strings out by a single command. So certain often used strings can be save and loaded directly from the disk. A good example of a **LOGO STRUCTURE** is a menu of options. It could be stored as a **BRUSH**, but a **LOGO** requires much less memory because it is text data, not bitmap data. Here is an example of a **LOGO STRUCTURE**.

```
OA=AD:REM SAVE AD FOR NEXT EXAMPLE
LA=XXXXX :REM LA (LOGO Address in BUFFER 1)
@STRUCT,5,2,1,LA :REM STRUCT#5, LOGO, BUFFER 9, Address LA
@SDAT,1,CHARSET STRUCT#,14,16,0,2,2,2,13,"MENU OPTION 1"
@SDAT,1,CHARSET STRUCT#,14,32,0,2,2,2,13,"MENU OPTION 2"
@SDAT,1,CHARSET STRUCT#,14,48,0,2,2,2,13,"MENU OPTION 3"
@SDAT,1,CHARSET STRUCT#,14,64,0,2,2,2,13,"MENU OPTION 4"
@SDAT,0 :REM Finished the LOGO
AD=@SEND :REM complete this STRUCTURE, AD is next address
@SSTRUCT,5,8,"LOGO.MENU":REM Save LOGO STRUCTURE
@SEND :REM save LOGO to disk
LA=AD:REM SAVE NEXT ADDRESS IN BUFFER 1
AD=OA:REM RESTORE AD FOR NEXT EXAMPLE
```

When defining **LOGO STRUCTURES**, the first parameter of the **@SDAT** command should be either 0 or 1. A 0 indicates you are finished, while a 1 means continue, I have more data to give. And, because the character string data in LOGO's are accessed by the CHAR command (in much the same way as a string variable) ALL LOGO structures must be stored in BUFFER 1 (system bank 1). Remember, LOGO structures in BUFFER 1 only!

D) **CHARACTER FONT STRUCTURES**

BASIC 8.0 has the capability of using virtually unlimited fonts. These fonts can be defined with any standard character editor used for the C64 or C128. They must be converted to the proper **BASIC 8.0** format for a **CHARACTER STRUCTURE** with the utility program **Font Converter** supplied on your **BASIC 8.0** disk.

All this program does is add a small header file to the beginning of the font so **BASIC 8.0** can tell what kind of **STRUCTURE** it is. (For information on file formats see the Appendix.) **CHARACTER STRUCTURES** must be loaded into memory with the @LSTRUCT/@SEND command. After that they are available whenever you need them. Continuing our program examples above:

```
@LSTRUCT,6,8,9,AD,"FNT.TECH":REM STRUCT#,DRIVE#,BUFFER9,AD,name
AD=@SEND :REM Get the font, AD=next Address in BUFFER 9
```

E) BRUSH STRUCTURES

Perhaps the most useful type of STRUCTURE is the BRUSH **STRUCTURE**. This type allows you to @STASH and @FETCH a piece of the screen, any size, back and forth from memory. Of course you can also save it to disk, where it can be recalled as a BRUSH with the @LSTRUCT, or even displayed directly with the @DISPLAY command. BRUSHES can also be manipulated with the @CBRUSH (ChangeBRUSH) command. This can make flipped, reversed or mirrored images of your brush. Or use the @BRUSHPATRN command to make a copy of a BRUSH as a **PATTERN STRUCTURE**.

```
@STASH,7,9,AD,0,0,100,100,0 :REM STASH screen 0,0-100,100 as
                             brush structure #7. Do not
                             compress the data.
                             AD=next BUFFER 9 address
@CBRUSH,7,0,0,1 :REM FLIP BRUSH IN MEMORY
@SSTRUCT,7,8,"BRUSH.TWO" :REM Prepare to save BRUSH
@SEND :REM Save To Disk as BRUSH.TWO
AD=@BRUSHPATRN,7,8,9,AD :REM Make Pattern Structure #8
@FETCH,7,0,100,0 :REM FETCH FLIPPED BRUSH TO SCREEN
```

A BRUSH can be loaded to a STRUCTURE and saved from a **STRUCTURE**. It can be returned to the screen with the @FETCH command, or loaded directly to the screen from disk with **@DISPLAY**. When loaded with the @DISPLAY command, the brush is returned to exactly where it was stored from, or you can specify the X and Y to load it to. Other areas of the screen are not affected.

CHAPTER SIX
ADDITIONAL BASIC 8.0 COMMANDS

BASIC 8.0 offers a number of other interesting advanced commands. For example, if you have the extra 64K video ram installed for the 8563 video chip (the new C128D comes with it standard, older C128's do not) you can make use of the **@SCROLL** command. **@SCROLL** allows you to move in one of eight directions at any of 255 speeds and up to 255 units. The directions are up, up/right, right, down/right, down, down/left, left and up/left. The speed is from 0-254, where 0 is the fastest. Each unit of speed adds a 0.0255 second delay between increments. The X scroll unit is on the byte level, while the Y scroll unit is in pixels. Or, by beginning your parameter list for **SCROLL** with 255, you can move directly to a specified scanline. Use **@SCROLL** with **virtual screens** (screens wider than 640 or higher than 200) to move around.

One very important aspect of any graphics system (language or application) is in getting what is on your screen to a printer. In order to make it easy, we have created installable printer drivers that allow you to create a hardcopy of the screen. The programmable command to do so is called **HCOPY,** and just as **BASIC 8.0** is very flexible, so is it's hardcopy capabilities.

There are 11 different printers that are directly supported by **BASIC 8.0.** The default (built in) is EPSON, but if your printer is different merely load in one of the other drivers. (See chapter on printers for instructions on installing a printer driver.) Since the screen size you can use with **BASIC 8.0** can differ, and also since many printers have different dot densities and different horizontal resolutions, HCOPY was designed to allow you to print in a variety of different ways. The syntax of **HCOPY** is:

@HCOPY,Secondary Address,Height (1-4),Density (1-7),Rotation Flag

The secondary address for printer bitmap mode differs from printer to printer. (See chapter on **BASIC 8.0** printer drivers for secondary address of your printer.) The height flag is how large to make your printout, with 1 the smallest and 4 very tall. The density parameter allows you to change the dot density of your printer, if possible. (Not all printers have more than one density, but some like the EPSON and PANASONIC have seven different settings. By setting to a larger density, you can print an image smaller than it would have been in a lower density.) Finally, the rotation flag allows you to rotate the printed image 90 degrees. With some printers, like the Commodore MPS 801 or Seikosha 1000, the image is always rotated because these printers cannot even print 640 dots per line (the smallest horizontal screen resolution).

To make it possible for even more printers to be supported, Chapter Eleven lists the assembly language source code for every printer driver. Experienced programmers can use these as a base to develop even more printer drivers.

MOUSE, JOYSTICK and POINTERS

BASIC 8.0 also offers mouse and joystick control, along with a very precise graphic pointer function. You choose between the mouse (the 1351 proportional mouse, **NOT** the 1350 joystick mouse) and a joystick with **@MOUSE,1,DEVICE,X,Y[,Joystick speed]**. This activates the IRQ controller reading routine. As long as it remains on it will then constantly update (internally) the position of the mouse or joystick. You can then find the current

X and Y value with the **@MOUSE** function. It will return the X or Y value, where it can be used to position the arrow with the **@PTR,1,X,Y,PTR DEF#** command. For example;

```
@MOUSE,1,0,320,100     starts the mouse reader using the mouse
                       and positions it at 320,100
@MOUSE,1,1,320,100,2   starts the mouse reader using the joystick
                       and positions it at 320,100 moving 2 pixels
@MOUSE,0               turns off the IRQ mouse reader
MX=@MOUSE,2,0          returns the current mouse x position to MX
MY=@MOUSE,2,1          returns the current mouse y position to MY
```

The pointer function has three basic forms. One turns off the pointer while the other two are used for positioning.

```
@PTR,0     Turn off the pointer and restore the old image.
@PTR,1,MX,MY,PTR DEF (0-15)  Turn on at MX,MY using the
           pointer defintion given and 'floats" over bitmap.
@PTR,2,MX,MY,PTR DEF (0-15)  Turn on at MX,MY using the
           pointer definition given and draws on the bitmap
```

Programming the mouse/pointer system is quite easy. First you turn on the proper mode (mouse or joystick) at the location you want to start. Then just use the **@MOUSE,2** command to find the X and Y positions, and set the pointer position to those locations. Here is a small example program that will initialize the mouse, and move the pointer as you move the mouse.

```
10 TRAP 140:REM PRESS RUN/STOP KEY TO EXIT PROGRAM
20 @WALRUS,0:REM 16K MODE
30 @MODE,0:REM USE MODE 0 SCREENS
40 @SCREEN,0:REM USE SCREEN 0, MONOCHROME
50 @COLOR,0,4,0:REM SET COLOR
60 @CLEAR,0:REM CLEAR SCREEN
70 @DRWMODA,1,0,0,0,0,0,0;@DRWMODB,0,0,0:REM JAM 1 MODE
80 MX=320:MY=100:REM INITIAL X,Y
85 OX=MX:OY=MY:REM SAVE VALUES
90 @MOUSE,1,0,MX,MY:REM USE 1351 MOUSE
100 @PTR,1,MX,MY,0:REM USE ARROW POINTER (0) AT MX,MY
110 MX=@MOUSE,2,0:MY=@MOUSE,2,1:REM FIND NEW MX,MY
115 IF MX=OX AND MY=OY THEN GOTO 110:REM ANY MOVEMENT?
120 @PTR,1,MX,MY,0:REM REPOSITION POINTER AT NEW MX,MY
125 OX=MX:OY=MY:REM UPDATE OLD VALUES
130 GOTO 110:REM CONTINUE TO CHECK FOR MOVEMENT
140 @PTR,0:@MOUSE,0:REM TURN OFF POINTER AND MOUSE READER
150 @TEXT:REM RETURN TO TEXT MODE
```

Another useful command is **@FLASH**. This command allows you to reverse a rectangular area of the screen, from 1 to 255 times. It is very useful for bringing something to a users attention. If you are in monochrome mode, it reverses the bitmap. If you are in color mode only the color information is reversed (which is very fast compared to the bitmap flash).

Another **BASIC 8.0** command that is both exotic as well as useful is the command **@ZOOM**. This command allows you to fetch an uncompressed brush from memory as an enlarged version of the brush. And it can do so in a number of different sizes.

Since **BASIC 8.0** is a bitmap graphics language, it offers very little for use in 80 column text mode. However, there are two text commands. The first is **@TEXT**, which returns your program to text mode from graphics mode. It also re-initializes some of the various parameters back to their default values. For example, **@ANGLE** is set to 0,0,0,0 and **@SCALE** is set to 0.

The other text mode command is **@FONT**. This command allows you to set the two character sets available in text mode to any font you wish. Just load in the font as a structure and specify in the **@FONT** command which structure to use as a font. It is downloaded to the 8563 chip, where it becomes available in text mode. Once a **@TEXT** command has been issued, the standard character fonts are restored, so it will be necessary to re-issue the **@FONT** command.

Chapter Seven
Making A Distributable Disk
The Run-Time Module

The ability to give away (or sell) programs written with **BASIC 8.0** centers around the **RunTime Library** supplied with your **BASIC 8.0** system. When you first booted your original disk, you were offered the option of making a **Basic 8.0 Run Time Disk**. If you have not yet done so, you should get a blank disk and create one. If you have already done so, make a backup of the **Run Time Disk**. It is this disk that you are allowed to distribute.

The **Run Time Disk** is a autoboot disk, meaning it will load and run when you boot the computer (if the disk is.in the drive). The normal startup sequence will install the **BASIC 8.0 Run Time System**, then load and run the **WIOS WORKBENCH** (see Chapter Nine). To use your program under the **WORKBENCH**, save your program on the **Run Time Disk** with a filename that starts with the letters **B8.** and is followed with a filename less than 12 characters. For example, if your program is called **'CHARTMAKER'** you would save it with the name

B8.CHARTMAKER

on the **WORKBENCH** disk. When the **WIOS WORKBENCH** is automatically ran on bootup, it will be able to find the **CHARTMAKER** program.

However, you may want to have your program be loaded directly, bypassing the **WIOS WORKBENCH**. In that case, you will need to change one of the programs on the **Run Time Disk**.

To do this, insert a your working copy of the **Run Time Disk**. Save your program to this disk. Then load the program called:

STARTUP

and type **LIST** and press return. You will see the single line:

```
10 RUN "WORKBENCH"
```

To change the bootup sequence in order to autoboot your

BASIC 8.0 program, type the following line

```
10 RUN "filename"   {RETURN}
```

(the **{RETURN}** means press the **RETURN KEY**). The filename should be the name of your program.

To make sure the new line has been entered correctly, type **LIST** and then **RETURN**. You should see

```
10 RUN "filename"
```

as the only line in the program. If it is wrong, retype the line as instructed above and check it again. If it is okay, then type:

```
SCRATCH "STARTUP" {RETURN}       The C128 will ask:
ARE YOU SURE? Y {RETURN}         You reply Y and press return
```

You have now erased the startup file. At this point you need to save the newly modified (with your filename in place of **WORKBENCH**) program as **STARTUP**. To do so type:

```
DSAVE "STARTUP"  {RETURN}
```

You have now created a **BASIC 8.0 Run Time Disk** that will automatically load and run your program. As a registered owner of **BASIC 8.0**, you may give away this **Run Time Disk**, or sell it if you wish. <u>Remember, this is the only way you may give away programs using the BASIC 8.0 language!</u>

Chapter Eight
BASIC PAINT
The 80 Column Color Paint Program

Along with all the added programming capabilities of **BASIC 8.0**, you also get a complete graphics application. This program, written completely in **BASIC 8.0**, is called **BASIC PAINT** ((c) 1987 WALRUSOFT). **BASIC PAINT** has several very important uses. First and foremost, it is meant to be a stand alone graphics paint program, complete in every detail. You can use it simply to draw or paint pictures for your amusement or as a means of artistic expression. Secondly, it is meant to be an accessory to the **BASIC 8.0** programmer. You can use it to create pictures, brushes, icons or patterns that can be used later in your own **BASIC 8.0** programs. And finally, **BASIC PAINT** is meant to be an example of what you can do with the programming power offered by **BASIC 8.0**.

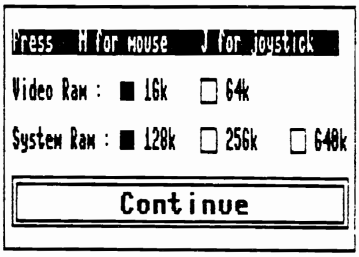
As mentioned, **BASIC PAINT** offers all the standard computer paint package graphic functions (freehand draw, line, box, circle and polygon) found in most commercial programs. You can add text, fill areas (with solids and patterns) and print your pictures. But **BASIC PAINT** goes further than that. You can add 3D solids to your pictures, cut and paste to and from a clipboard, zoom in for precise editing, and even lock your image for later recall (lock acts like an oops function). You control the program with a pointer using either a mouse or joystick, you can change your pointer to eight different shapes, and can set the drawing modes in many combinations of draw, erase, complement and pattern. You can also draw using thick lines or very thin lines, with the exact size being up to you.

BASIC PAINT works in all five graphic modes supported by

BASIC 8.0. You have your choice of monochrome and the four color resolutions (8 x 16, 8 x 8, 8 x 4 and 8 x 2). And just like **BASIC 8.0**, **BASIC PAINT** supports the 1700 and 1750 external ram expansion modules. Even more exciting, if your C128 has the full 64K of video ram you can use **BASIC PAINT** to draw on several size virtual vertical screens.

BASIC PAINT is designed to be simple to use, even intuitive in nature. It is essientially a mouse driven program, controlled by the mouse, the left and right mouse buttons and graphic icons. (Icons are pictures that represent a particular function.) By pointing to a icon and pressing the left mouse button (or the joystick button) you select that icon's function. At times you will want to indicate that you are finished doing something, or perhaps you will want to change your mind and return to the previous option. This is accomplished by clicking the right mouse button (or the ESCAPE key if you are using a joystick). This left button (for selection) and right button (for ESCAPE) system becomes very natural after a while. In fact, if you are using a mouse, the only keyboard input is when you are saving an image or if you want to shear a box. (If you are using a joystick the keyboard ESCAPE key is used instead of the mouse right button.)

To use **BASIC PAINT**, simply insert the **BASIC PAINT Work Disk** in your C128 and boot it, either by turning on the computer or (if it is already on) by pressing the reset button. The program will autoboot, and you will quickly be presented with a special type of menu called a **requestor** (see Figure 1). This requestor menu is requesting information on how your computer is equipped, so **BASIC PAINT** will work best with your system. (You should always keep your working copy of the **BASIC PAINT** disk in drive 8 when using it as it will often need to load requestors and menus from the disk.)



Press M for mouse J for joystick

Video Ram : ■ 16k ☐ 64k

System Ram : ■ 128k ☐ 256k ☐ 640k

Continue

Figure 1

The first thing to do is indicate what type of controller you are using (see figure 1). If you have the 1351 mouse (inserted in port 1 only), press M. If you are using a joystick (inserted in port 2 only), press J. Once you have done so, you will notice an arrow pointer appear on the screen. You can now use your chosen control device to move this pointer, and the select button (left mouse button or the joystick button) to indicate your choices to the computer.

Next tell the computer how much ram your 80 column video chip has installed. If your computer is a standard C128 and has not been modified, you have 16K. That is the default selection. If your C128 has had the 64K video ram installed (the C128D comes with the extra ram), point to the 64K box and click the select button (left mouse button). Notice how the box becomes black. This indicates you have now selected 64K of video ram. **(WARNING!** If you do NOT have 64K, it does no good at all to make this choice and choosing it will cause the program to work incorrectly.)

Next, choose the amount of system ram your C128 has installed. If your computer does not have any extra ram you have 128K, the default. If you have the 1700 expansion cartridge you have a total of 256K, and if you have the 1750 cartridge you have a total of 640K. Point to the appropriate box and click the select button.

If you have made a mistake and selected the wrong options, you can change them quite easily by simply pointing to the correct box and clicking the select button. Once you have the proper settings, point to the **CONTINUE** box and click the select button, and these values will be used by **BASIC PAINT** during this session.

Once you have selected the **CONTINUE** box, **BASIC PAINT** will display a new requestor menu. Depending on your previous choices, you will be offered a selection of graphic screen type to choose from.

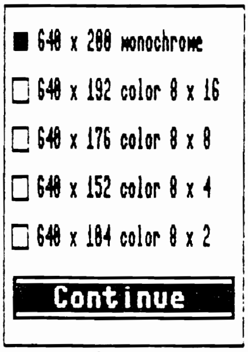


Figure 2

If your system has 16K of video ram, the second requestor menu (Figure 2) allows you to choose one of five different screens. These are the same screens allowed in **MODE 0** of **BASIC 8.0**. They differ on the size of the color cell and the total size of the screen. (See Chapter Two for more information on screens.) Choose the screen you wish to work with by pointing to the proper box and clicking the select button, then click on the **CONTINUE** box. You will then proceed to the main drawing screen.

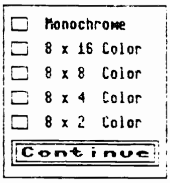
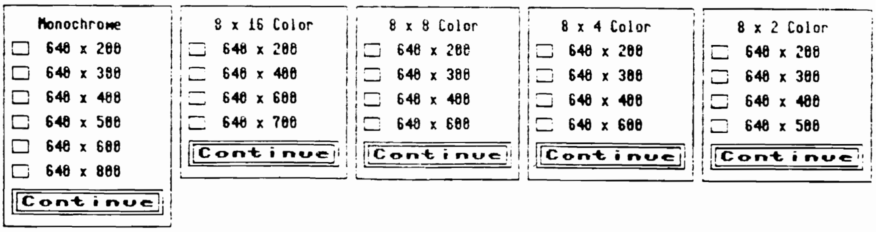


Figure 3

If your system has the full 64K of video ram, you are also presented with a requestor menu (Figure 3) asking for the screen type, however no screen sizes are listed. Choose the screen type you want, you will then be presented with a third requestor menu that asks for the actual size of the screen you want. These third menus (see Figure 4-8) offer screens greater than 200 pixels high, although only a viewport of 640 x 200 pixels is visible at one time. When you are drawing the screen will automatically scroll up and down to keep up with the mouse.



FIGURES 4-8

Figure 4-8

At this point the screen will display the WALRUS logo screen and indicate the amount of video ram you have choosen. It then clears and the **BASIC PAINT** drawing screen is created.

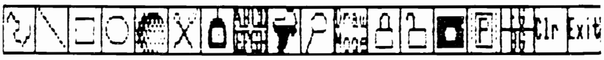


Figure 9

This screen consists of the drawing area and a strip of icons (pictures) at the top of the screen (Figure 9). Each icon represents one or more graphic functions, and they can be selected by pointing with the arrow and clicking the select button. When additional choices are required, submenus will appear. You can make the additional selections, or use the right button to ESCAPE back one step. Once you have made your selection, the icon strip disappears and the screen is made available for your drawing activity. When you are finished with that function, click the right button of the mouse to escape back to the menu(s) (or use the ESCAPE key if you are using the joystick). Here is a description of each function.

FREEHAND DRAW

To draw in a freehand mode, move the pointer to the first icon in the icon strip. The wiggly line represents drawing. With the pointer on the icon, click the select (left mouse) button. The icon strip will disappear, leaving the entire screen available for drawing. To draw hold down the left mouse button and move the mouse. A line will follow the pointer's tip. When you wish to stop drawing, let off the button. You can then move to another location and start drawing again, or click the right mouse button (or ESCAPE key if using a joystick) to restore the icon strip. You will notice that the lines you have drawn are black on the grey screen. These are the default colors. You can change them with the color icon (be sure and set the JAM options in the drawmode icon properly).

LINE

The second icon represents the line function. To draw lines, point to this icon and click the select button on your controller. As before, the icon strip disappears. Point to where you want the line to start and click the select button. The pointer will disappear, leaving you with a flashing line. As you move the mouse this line will follow you, a process called rubber-banding. Move the tip of the line to where you want it to end, and click the select button. The line will quit rubber-banding, but will continue to flash. At this point you can click the select button to accept this line, causing it to be drawn in the current color and mode, or if you decide it is not what you want you can click the right mouse button and it will disappear. You can then either draw another line, or click the right button and escape back to the icon strip. You can also use the right button to escape while actually rubber-banding the line. You will notice that when you escape while rubber-banding the pointer returns to the exact spot where you started the line. And when you have actually drawn a line, it starts exactly where the line ends.

BOX

Box allows you to draw rectangles and works very much like the line function. Point to the box icon and click the select button. The icon strip disappears, and you are free to move the pointer to any spot on the screen. When you have the pointer where you want one of the corners of the rectangle to be, click the select button. Just as with line the pointer goes away, only this time you have a box that rubber-bands, not a line. If the starting location was not correct, click the right button to escape and start the box again, otherwise move it's corner to create the size and position you want. When it is just as you want it, click the select button and again you have a flashing box that is waiting for the select button to accept and be drawn or the escape button to cause it to be erased. However, box has a couple of extra features at this point. You can press the X or Y key, and this will allow you to **shear** the flashing box in the indicated direction. (Shearing means to move one side while holding the opposite side still.) This allows you to create more complex shapes. Once you have begun shearing you have the same options as in normal box mode, that is to select or escape. Once selected you can still escape and start over as before. When you have finished drawing your boxes you can use the right button to escape back to the icon strip.

POLYGONS

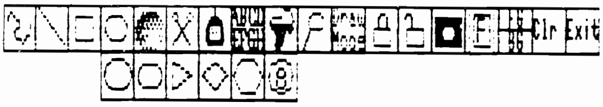


Figure 10

The circle icon represents the polygon menu. Select this icon and a new submenu (Figure 10) appears. This submenu has six icons, circle, ellipse, triangle, diamond, hexagon and octagon. You can select one of these by pointing and clicking at the desired object, or use the right button to escape back to the icon strip.

If you chose circle, the icons disappear and you are free to move anywhere in the screen. Place the pointer on the spot where the center of the circle is to be and click the left button. The pointer is replaced with a rubber-banding line. This line represents the radius of the circle, which is the distance from the center of the circle to its edge. When you have the radius the size you want, click the left button and the circle will be drawn over and over. If it is correctly sized and placed, click the left mouse button, otherwise use the right button to escape and start over. You can repeat this as often as you wish. When you are finished, use the right button to escape back to the polygon submenu, where you can select another shape or escape again back to the main icon strip.

The other five shapes (ellipse, triangle, diamond, hexagon and octagon) work somewhat differently. When they are selected, you again point to where the center is to be and click the left button. Only here, instead of a single line you get two lines. These represent the two different radius required for these types of shapes, the X radius and the Y radius. As you move the mouse (or joystick) you will notice they each change in length. With a little practice you can quickly become quite skilled at using this technique for these complex polygons. And as always, use the left button to select and the right button to escape back to the polygon submenu and main icon strip.

SOLIDS

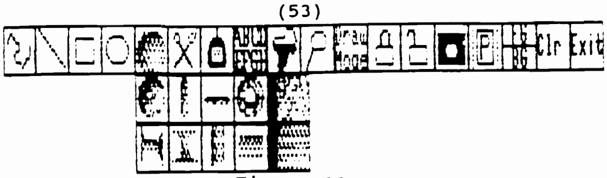


Figure 11

The solids icon also represents a more complex submenu. When the solid icon is selected, a submenu (Figure 11) is presented that offers eight different shapes and two drawing styles. The shapes are sphere, horizontal, vertical and topview toroids, horizontal and vertical spools and horizontal and vertical cylinders. The two style options on the right side of the menu represent the type of texture (random or halftone). You can change the texture freely from the menu by pointing and clicking with the left selection button.

Sphere is controlled just like circle. Point to where the center is to be and click the left button. The pointer is replaced with a single line, (the radius). Move the line to make the proper radius, then click the left button. A beautiful solid sphere will be quickly drawn. Once it is finished, you can create another or click the right button to escape back to the solids submenu.

The other solids use the two line radius method. In the case of the horizontal and vertical spools, cylinders and toroids, they are fairly straight forward and easy. The topview toroid also uses two lines, but in this case they represent the inside radius and the outside radius. It is possible to select it such that the outside radius is smaller than the inside, an obvious impossibility. In that case the pointer appears as a question mark for a couple of seconds, meaning essientially "Say What?". Practice using the solids for a while and their use will become quite clear and easy.

Use the right button to escape to the submenu, where you can select a different shape or escape again to the main icon strip.

CUT

The icon shaped like a pair of sissors is used to **cut** a rectangular area of the screen to the clipboard area, where it can be copied (pasted) to another location, or saved to disk as a brush (from the disk menu), or even used as a pattern for the fill function. CUT **does not** erase the area you have selected.

To cut an area, select the cut icon and position the pointer at one corner of the desired rectangle and click the left button. The pointer is replaced with a rubber-banded box, which you then use to enclose the area you want to put in the clipboard. Again use the left button to select, and the box will be adjusted to the boundaries required by the graphic mode you are in (color modes always round up and down to the edges of the color cell, and the rectangle must always begin and end on an even byte boundary. For more information on this see GRID mode in the drawmodes section.) At this point you can accept by clicking with the left button, or reject and escape with the right button. Once you have selected, you can then escape back to the icon strip, or replave the current contents of the clipboard with a new object. You can only have one item in the clipboard at a time.

PASTE

The paste jar icon is used to paste (copy) the contents of the clipboard back on the screen. To use point to the paste jar icon and click the left button. Then point to the position where you want the upper left corner of the clipboards object to be and click the left button to paste it on the screen. You can repeat this as often as you wish, making many copies of a single object. When you are finished, click the right button to escape back to the icon strip.

When pasting while in the color modes, keep in mind that the color memory of the object has been stored in the clipboard as well as the bitmap. So if your pasted object overlaps upon an area with a different set of colors than that found in the clipboard, the old screen colors in that area will be replaced with those of the stashed object.

TEXT

Choosing the text icon loads another submenu. This one offers a number of different fonts, as well as allowing you to set the height and width of the font you are using. To select a font, point to the one you want and click the select button. It will be loaded into the memory of the computer where it can be used. To change the height, point to the letters **Ht** and click once. Then click on the up or down arrows to change the height. To change the width, point to the letters **Wd** and click once. Again, the arrows are used to increase or decrease the width of the character.

If you have selected the special 160 column font, set your width to 0. (This is the only time the width should be less than 1.)

When you are ready to type your characters, point to the word DRAW and click once. The menus disappear, and you can position your letters with the mouse pointer or with the keyboard cursor keys. Wherever the pointer rests is the top of the character cell. You may type whatever you wish. Pressing RETURN moves the cursor down one line and flush left on the screen (if there is enough room to do so). To exit this mode press the escape button. Remember, the text responds to the draw modes DRAW and COMPLEMENT in the DRAWMODE submenu.

FILL

The FILL icon is used to paint an enclosed area with either a solid color or the current pattern, depending on the drawmode in use at the time of the fill action. To fill just point at the icon and click with the select button. The icon strip disappears and the pointer can be moved to any spot on the screen. Point to a spot within the area to fill and click the select button. (Remember to only fill a completely enclosed area, as it will **leak out** and fill the whole screen!) The area will then be filled. When it is finished you can repeat it again, or escape back to the main icons.

ZOOM

The ZOOM icon (it looks like a magnifying glass) allows you to zoom into a small area for editing. Point to it and click on the select button. The icon strip is removed and you can then move to the general area you wish to edit. Once there click the select button and a box will appear. You can then move the box to enclose the exact area you wish. Click the select button again, and a ZOOM window will appear, and it will fill with the magnified image of the smaller box's contents.

Once it is filled you can move the mouse to the points you wish to edit and change them by clicking with the select button. If the pixel is already on it is turned off, if off it is turned on. The dot will be in the current color and drawmode. To change these there are icons to change color and drawmode outside the ZOOM window. Once you are finished editing, use the escape button to close the ZOOM window. You can then ZOOM into another area, or escape back to the main icon strip. **NOTE: ZOOM does not work in 8 x 16 mode!**

DRAWMODE

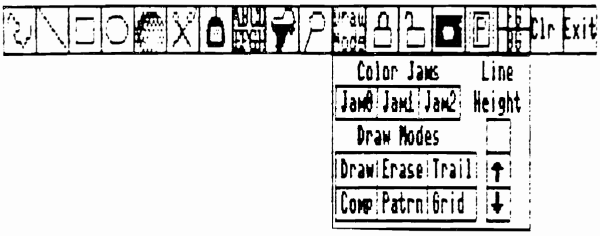


Figure 12

The **DRAWMODE** icon represents a second submenu (Figure 12). Once selected this menu appears and you can select the functions you want. One set of functions is called the **COLOR JAMS**. These set the various **JAM** modes. Jam0 uses the color information found on the screen, and it ignores your choice of colors in the icon strip. Jam1 uses your foreground color choice, but ignores your background color. Instead it uses the background colors it finds in the area you are drawing in. JAM2 uses both of your current color choices, foreground and background.

The other set of modes concern the type of bitmap drawmode you wish. These are **DRAW, ERASE, COMPlement,Pattern,Trail** and **GRID.**

Draw is the normal drawing mode. This simply means you want to draw in normal mode using a solid line.

Complement mode produces a reverse image. The points that are already off are turned on, those on are turned off. (You will notice that the pointer also responds to this mode.)

Erase sets the mode to turn off all points that you draw on. Use this mode to remove (unpaint) an area. If you want you can change the pointer from the arrow to another defintion (from the main icon strip) in order to make a larger eraser.

Pattern mode turns on and off the pattern drawmode. When off all drawing and filling is done in solid mode. When on the current pattern is used when drawing.

Trail mode is used when in freehand drawing. Instead of drawing it leaves a trail of the current pointer definition. Trail always uses the JAM0 mode, regardless of the settings in the JAM options.

Grid sets the drawing mode to a grid. The grid is always 8 pixels wide, and is as tall as the color cell size. This is very useful when cutting and pasting, as it allows you more precision when performing these functions.

One addition feature is found in the DRAWMODE menu. This is the line height. You can change the line thickness by pointing to the up or down arrows, changing the line size found in the box.

LOCK

Lock allows you to store a copy of the screen in memory (if you have the available memory free in the form of the 1700 or 1750 ram cartridges) in case you wish to restore it later after making some change you don't like. Once a screen is locked, you can restore it by choosing the CLEAR SCREEN option.

UNLOCK

Unlock turns off LOCK mode, allowing you to completely clear the screen.

DISK

The DISK icon loads a submenu that makes available many disk functions, as well as the ability to convert brushes in the clipboard into patterns.

LOAD PICTURE	Loads a directory of available brushes to be loaded as pictures. Just point and select, or return to the **MAIN MENU**.
SAVE PICTURE	A input box opens where you type in a filename to save the current picture to the currently selected drive. The name should start with '**PICT.**'.
LOAD BRUSH	Load a directory of brushes that can be loaded into the clipboard as brushes, or you can return to the **MAIN MENU**.
SAVE BRUSH	A input box opens where you type in a filename to save the current clipboard to the currently selected drive. The name should start with '**BRUS.**'.
LOAD PATTERN	Load a directory of patterns that can be loaded into the pattern clipboard, or you can return to the **MAIN MENU**.
SAVE PATTERN	A input box opens where you type in a filename to save the current pattern clipboard to the current drive. The file should begin with '**PATR.**'.
BRUSHTOPATTERN	This copies the contents of the brush (CUT & PASTE) clipboard to the pattern clipboard, where it can be used as a pattern (if pattern is set in DRAWMODES) or it can be saved as a pattern using SAVE PATTERN.
DIRECTORY	Loads a directory of all files on the current disk.
CHANGE DEVICE	Change your disk drive from drives 8-12. **CAUTION:** BASIC PAINT requires the disk with it's files and requestors to always be in device 8. By changing the device, you only change the input/output of user created files (brushes, pictures and patterns). When a menu requestor is needed it will still be loaded from device 8.
CHANGE DRIVE	Switches between drive 0 and 1 for users of dual drives. BASIC PAINT menu requestors will always be loaded from drive 0.

PRINT

The PRINT icon displays a submenu that requests several types of information. It asks for the HEIGHT of the printout, which can be up to 4. It allows you to set the DENSITY of the printout from 1-7. You can set the hardcopy to be rotated or unrotated, and you can set the secondary address to whatever your printer (and interface) requires for graphics screen dumps. And it allows you to switch between the various printer drivers. (If you change the printer type the appropriate driver will be loaded from disk and installed.) When you have the settings you want press the ESCAPE button and you will be presented with a small requestor that simply says PRINT. If you still want to print, point at it and click the select button. (Make sure you have your printer hooked up and turned on.) If you wish to change your mind click the ESCAPE button and you will abort the printing process. The next time you return to the PRINT submenu it will remember your last settings.

See Chapter 11 on printers for information on your specific printer.

COLOR

Colors are set by the FG/BG color box. To change these colors, point at the top of the box (for ForeGround) or the bottom (for BackGround) and click the select button. If you are using monochrome, the entire display will change as a result. If you are in color mode, only the contents of the color box will reflect the new colors. However, if you draw (while in JAM1 or JAM2 DRAWMODES) you will use these selected colors.

CLR

The CLR icon is used to clear the display. If in color mode it clears the image using the current colors for foreground and background. However, if the screen has been LOCKed, clicking on clear will simply restore it to the LOCKed image.

EXIT

The EXIT icon will open a small window in the upper left side of the screen. You may exit the program completely start it again (perhaps to draw in a different mode). Or, if you change your mind you can click the ESCAPE button and return to drawing.

****

Finally, if you are at the main icon strip there are a couple of additional features you can access from the keyboard.

1) If you are using a joystick, you can change your drawing speed by pressing the +/- keys. (The faster you draw with the joystick, the coarser the resolution.)

2) You can change the pointer to one of eight definitions by pressing the ALT key and one of the keys 0-7 (at the same time). There are several interesting shapes, some of which you may prefer to the arrow.

If your pointer seems to disappear when it is inside a solid color area, remember it is NOT a sprite. It shares the same color memory as the image it rests upon. To make it always visible, set the draw mode to COMP. However, when drawing the complement mode draws on areas where the bitmap is empty, and reverses where it is already on. COMPLEMENT mode is not always the best choice when drawing, but it does offer some interesting effects.

If you have questions about BASIC PAINT's screens and modes, see Chapter 2 for further information.

Chapter Nine
WIOS WORKBENCH
And Other Supplied Utilities

WIOS WORKBENCH

The **WIOS** (**W**alrusoft Icon Operating System) **WORKBENCH** is really nothing more than a **BASIC 8.0** program. It uses a few of the new commands, along with some standard BASIC 7 commands, to emulate the increasingly popular graphics user interface. It will load and run any program written in **BASIC 8.0** that starts with the letters **B8.** and are followed by a filename that does not exceed 12 characters.

The WIOS WORKBENCH supports up to 4 disk drives, including the 1541, 1571 and 1581 drives. When it is first run it checks to see how many disk drives are present, then puts up on the screen a simple requestor that asks if you are using a mouse (port 1) or a joystick (port 2). Press the appropriate key (M or J) and you will then see one or more disk icons labeled DRIVE N (N is 8-11). The arrow pointer is also active. By moving the control device (mouse or joystick) the pointer will move. To see the contents of a drive, move the pointer to the drive you want and press the left mouse button (or the joystick firebutton). (Make sure there is a disk in the drive!)

Once you have pressed the button, a window will open and some brief disk activity will occur. If any files are found (that start with **B8.XXXXX**) the name of the file and a small icon that looks like a flowchart is shown in the window. A total of tem files can be seen in the window at one time. If there is more than 10 files, you can see them by putting the arrow pointer on the little **scroll arrows** (at the bottom of the window) and clicking the left mouse button (or joystick firebutton). If there are any more files, the screen will shift and the new files will be displayed. To move back the other direction, click on the other **scroll arrow**. If you see the program you want, just point to it and click the button and it will load and run.

If the file you want is not there, point to the **close gadget** in the upper left corner of the window (**NOT THE SCREEN!**) and click the button. This will instantly close the window. You can then point to another disk icon, or remove the disk from the drive and insert another and repeat the process.

If you want to exit the **WIOS WORKBENCH**, use the **close gadget** in the upper left corner of the screen. Clicking on this gadget will close the screen and return to text mode. If you want to run it again, insert the disk with the **WORKBENCH** and type:

RUN "WORKBENCH"

The **WORKBENCH** program, like many of the supplied programs written in **BASIC 8.0**, is meant to be both useful and instructive. It is a real (although somewhat limited) graphic interface. It allows a user to load **BASIC 8.0** applications quickly and easily, even if they don't even know how to find a directory by the normal methods. For that reason, it is the standard startup program on your **BASIC 8.0 RUNTIME DISK** (It is also on the **BASIC 8.0 WORK DISK**). All you (the **BASIC 8.0** programmer) have to do to share your programs is to DSAVE them to the runtime disk with the name **B8.XXXXX** and the **WORKBENCH** will allow users to simply boot, point, click and go!

However, like all the supplied **BASIC 8.0** programs, the **WORKBENCH** is meant to be instructive. It demonstrates many aspects of programming in **BASIC 8.0**, and is a good place to look for examples of using the language.

Chapter Nine

BASIC 8.0 Utilities
PICT CONVERTER/FONT CONVERTER/LOGO MAKER

This is a set of utility programs that are used for various special functions.

The **PICT CONVERTER** allows you to convert pictures made with **ULTRA HIRES** (a early graphics language for the 80 column C128) to **BASIC 8.0** format.

The **FONT CONVERTOR** will convert a standard 40 column font created with any C64/C128 font editor to the **BASIC 8.0** structure format. The font **must** be a simple binary file. Once converted, it can be loaded with the **@LSTRUCT** command in **BASIC 8.0** programs.

The **LOGO MAKER** utility allows you to make **LOGO structures** that can be loaded directly with the **@LSTRUCT** command. Just follow the prompts and it will do all the work of creating your **LOGO**.

<u>@ANGLE</u> Angle will perform a rotation of how your object (line, box, circle, dot and arc) is viewed around the X,Y,Z axis. Your data remains unchanged, but the result is one of a 3D transformation around the given axis in the given rotation sequence. This rotation occurs when you render graphics.

SYNTAX:

@ANGLE,X angle, Y angle, Z angle, Rotation Sequence

X angle	-	-360 to 360	X angle of rotation
Y angle	-	-360 to 360	Y angle of rotation
Z angle	-	-360 to 360	Z angle of rotation
Rotation Sequence	-	0-5	Order in which rotation about the various axis is performed. Different sequences give different results. If rotation sequence is greater than 5 than rotation sequence defaults to 0.

Sequence #	**Rotation Sequence**
0	XYZ
1	XZY
2	YXZ
3	YZX
4	ZXY
5	ZYX

<u>@ARC</u>   Used to draw ellipse, arcs, polygons, pie wedges, subtended arcs

SYNTAX:

```
  @ARC,Center X,Center Y,Center Z,X radius,Y radius,Starting angle,
       Ending angle,Increment,Thickness,Subtend Flag

     Center X -  0-65535         X center of arc
     Center Y -  0-65535         Y center of arc
     Center Z - -32768 to 32767  Z center of arc

     X radius 0-65535  radius of arc in horizontal direction
     Y radius 0-65535  radius of arc in vertical direction

     Starting angle -360 to 360  angle at which to start arc
     Ending angle   -360 to 360  angle at which to end arc

     Increment        1-180 smoothness of the arc (angle between lines)
                      1-8   very smooth
                      30    12 sides
                      45    8 sides
                      60    6 sides
                      90    4 sides
                     120    3 sides

     Thickness - 0-65535 Number of times the @ARC is drawn stepping
                       by the value defined by the @GROW command.

     Subtend Flag - 0-1    0 = do not subtend arc
                       non 0 = draw lines from starting and ending angle
                               to center of arc.
```

ARC is rotated, scaled and clipped (if necessary) before being drawn.

@BOX Draw a box or rectangle

SYNTAX:

@BOX,X1,Y1,Z1,X2,Y2,Z2,Shear direction,Shear value,Thickness

```
X1  -  0-65535         Corner 1 X coordinate of box.
Y1  -  0-65535         Corner 1 Y coordinate of box.
Z1  - -32768 to 32767 Corner 1 Z coordinate of box.

X2  -  0-65535         Opposite diagonal corner X coordinate of box.
Y2  -  0-65535         Opposite diagonal corner Y coordinate of box.
Z2  - -32768 to 32767 Opposite diagonal corner Z coordinate of box.

Shear direction 0-2  0=no shear
                     1=X shear  (move corners 3&4 right or left)
                     2=Y shear  (move corners 2&3 up or down)
                     3=X & Y shear
                     4 or greater produces a value of 0-3, depending
                       on  the valueAND3.

Shear value -32768 to 32767  number of pixels to move the affected
                             corners depending on direction of shear.

Thickness - 0-65535 Number of times the box is drawn stepping
                    by the value defined by the @GROW command.
```

BOX is rotated, scaled and clipped (if necessary) before being drawn.

@BRUSHPATRN **Convert a brush to a pattern. Allows any piece of a screen to be used as a pattern for the paint command.**

SYNTAX:

```
    @BRUSHPATRN,Brush Structure #, Pattern Structure #, Buffer #, Address

               Brush Structure #    - Brush # to convert to pattern
               Pattern Structure #  - Destination pattern structure 0-191
               Buffer #             - Buffer to store the structure
               Address              - Address in Buffer for pattern
```

@BRUSHPATRN works on any uncompressed brush that is no more than 255 bytes (2040 pixels) wide and 255 scan lines (pixels) deep. If the brush is color, the pattern is color.

```
   A=@BRUSHPATRN,0,1,2,1024
   IF A=-1 then wrong structure type or brush is compressed.
   ELSE A=next address in the destination pattern buffer.
```

@BUFFER Defines an area in each bank to be used as data storage of **Structures**.

SYNTAX:

@BUFFER, Buffer #, Beginning Address, Size

Buffer #	-	0-9	Indicates which of the 10 banks to use
		0	System Ram Bank 0
		1	System Ram Bank 1
		2-9	Expansion Ram Banks 0-7

*** Buffer numbers greater than 9 default to 9. ***

Beginning Address - 0-65535 Indicates where BUFFER will begin in designated bank.

Size - 0-65535 Indicates the amount of continuous ram to be used as a BUFFER.

NOTE: @BUFFER **doesn't check if size is greater than the amount left after the beginning address is defined.**

For example:
```
@BUFFER,1,32000,65535 Buffer starts at 32000 for 65335 bytes
This will give unpredictable (and probably unpleasant) results
```

<u>@CBRUSH</u> **Change a non-compressed BRUSH in memory**

SYNTAX:

@CBRUSH,STRUCTURE #,REVERSE, REFLECT, FLIP

Structure #	0-191		Number of STRUCTURE with BRUSH data
REVERSE	0-1	0	No Reverse
		1	Reverse
REFLECT	0-1	0	No Reflect
		1	Reflect
FLIP	0-1	0	No Flip
		1	Flip

Once a BRUSH is modified with **@CBRUSH**, you can **@FETCH** it to the screen in its new form. You can combine the commands to do several actions at once.

If structure is wrong type or compressed, -1 is returned.

ex., e=@cbrush,structure#,reverse,reflect,flip

@CHAR Outputs a text string to the 8563 bitmap screen.

SYNTAX:

@CHAR,Structure#,Column,Row,Height,Width,Direction,"Character String"

Structure#	-	0-191	indicate a ram resident font in a user defined structure.
		254	indicates uppercase/lowercase ROM font.
		255	indicates uppercase/graphics ROM font.
Column	-	0-255	Horizontal column number
Row	-	0-819	Vertical scan line (pixel)
Height	-	1-16	height of character
Width	-	0-16	Width of character 0 indicates 160 col char set Values greater than 16 default to 16.
Direction	-	0-7	Indicates direction to print
		0	Print up
		1	Print up & right
		2	Print right
		3	Print down & right
		4	Print down
		5	Print left & down
		6	Print left
		7	Print left & up
		Greater then 7 becomes 0-7	
String	-		Text string to print. String can contain special control codes embeded within the character string to be printed. These control codes are created by pressing the CTRL key and the indicated letter.

<u>CONTROL CODES</u>

CTRL-B	Blank cell under character
CTRL-I	Inverse cell (AND) with character
CTRL-O	Overwrite cell (OR) with character
CTRL-X	Complement cell (XOR) with character
CTRL-F	Flip character upside down (Toggle)
CTRL-P	Pattern character (Toggle)
CTRL-U	Underline character (Toggle0
CTRL-Y+	Rotates character left 90 degrees
CTRL-Y-	Rotates character right 90 degrees
CTRL-Y	Resets character upright
CTRL-Z	Mirror Image character (toggle)
CTRL-RVS ON	Reverse on
CTRL-RVS OFF	Reverse off

COLOR CTRL CODES

CTRL-C By itself turns Jam 0 color control on

CTRL-C**Foreground Color** Sets character color (Jam 1)

CTRL-C**ForeGroundBackground Color** This is Jam 2 mode.

Foreground or Background color is set by pressing

the CTRL Key or CBM Key and the approriate color key.

CTRL-Cursor	Up,down,left,right These work on a 8 X 8 cell only
SHIFTED CLR	Clears screen with last FC/BG colors.
HOME	Places cursor at 0,0 position in window.

FULL CHARACTER WRAP IS SUPPORTED IN OUTPUT WINDOW IN ALL DIRECTIONS.

__@CIRCLE__ **Draws a fast circle.**

SYNTAX:

@CIRCLE,Center X,Center Y,Center Z,Radius,Thickness

```
Center X -  0-65535         X center of circle
Center Y -  0-65535         Y center of circle
Center Z - -32768 to 32767  Z center of circle

Radius 0-65535  radius of circle

Thickness - 0-65535 Number of times the circle is drawn stepping
                    by the value defined by the @GROW command.
```

CIRCLE is rotated, scaled and clipped (if necessary) before being drawn.

The **@CIRCLE** command produces a symetrical circle, but in SCALE 0 it will appear to be an ellipse (due to the unsymetrical y direction). Setting SCALE to 1 or 2 will allow you to make a proper circle. Or use **@ARC** with the x radius and y radius adjusted accordingly.

@CLEAR **Clear the bitmap screen**

SYNTAX:

@CLEAR,Bitmap Fill Value[,Background Color,Foreground Color]

Bitmap Fill Value -	0-255	Fills bitmap area with given value
	0	clear window
	1	Only the windows color information is affected, bitmap image is untouched.
	255	solid window
	2-254	various vertical striped windows result

Color parameters are optional. If omitted current colors are used.

Background Color -	0-15	Sets Background color
Foreground Color -	0-15	Sets Foreground color

If a window was opened with the border flag set, every time the window is cleared the border is drawn in the current drawmode on the inside boundaries of the window. This will continue to occur until the window is closed.

<u>@COLOR</u>   Defines colors for foreground, background and border

SYNTAX:

@COLOR,background color, foreground color,outline (border) color

Background color	:	0-15 See color table
Foreground color	:	0-15 See color table
Outline Color	:	0-15 See color table

NOTES: Outline color achieved only in multicolor modes.

<u>COLOR TABLE</u>

0	Black
1	Dark Grey
2	Blue
3	Lite Blue
4	Green
5	Lite Green
6	Cyan
7	Lite Cyan
8	Red
9	Lite Red
10	Purple
11	Lite Purple
12	Brown
13	Yellow
14	Lite Grey
15	White

If using monochrome mode the effect of the **@COLOR** command will be to change the display colors immediatly. In color modes the border will change at once, but only subsequent graphic commands will use the new colors.

@COPY — **@COPY** moves a rectangular area of screen to any other defined screen area. It uses the 8563 block write capabilities, and is very fast. It works on the column (8 pixel) level horizontally and scan lines (pixels) vertically when in monochrome. When in color the y values are adjusted to the color cell size.

SYNTAX:

@COPY,Source Screen,Start X, Start Y,DX,DY,Destination Screen,EX,EY

Source Screen	: 0-7 as defined by **@MODE** or **@SCRDEF**
Start X	: 0-2047 Defined as pixels, but **rounded down** to nearest column.
Start Y	: 0-819 Defined as scan lines (pixels) but **rounded down** to color cell.
DX	: Distance in pixels, **rounded up** to columns
DY	: Distance in scan lines (pixels) **rounded up** to next color cell.
Destination Screen	: 0-7 as defined by **@MODE** or **@SCRDEF**
EX	: Ending X at destination screen, **rounded down** to nearest column
EY	: Ending Y at destination screen, in scan lines (pixels)

****** NOTE ****** **@COPY WILL NOT WORK RELIABLY WHEN VIEWING A VIRTUAL HORIZONTAL SCREEN GREATER THAN 640 PIXELS. YOU MAY USE @COPY ON A VERTICAL VIRTUAL SCREEN, BUT @COPY WILL ONLY WORK ON VIRTUAL HORIZONTAL SCREENS IF YOU ARE VIEWING A NON-VIRTUAL HORIZONTAL SCREEN. FOR EXAMPLE, IF YOU HAVE TWO SCREENS, ONE THAT IS A HORIZONTAL VIRTUAL OF 1280 X 200 AND ANOTHER THAT IS 640 X 400 VERTICAL VIRTUAL. YOU CAN @COPY ON THE 1280 X 200 IF YOU ARE VIEWING THE 640 X 400. ATTEMPTS TO @COPY ON THE 1280 X 200 WHILE VIEWING IT WILL CAUSE THE COPIED BITMAP TO BE DISTORTED. THIS IS DUE TO A BUG IN THE 8563 ADDRESS INCREMENT PER ROW REGISTER.**

IF START X,Y PLUS DX,DY IS OUT OF BOUNDS THEN SOURCE RECTANGLE COPIED IS CLIPPED. IF END X,Y PLUS DX,DY IS OUT OF BOUNDS THEN DESTINATION RECTANGLE IS CLIPPED, AND X,Y,DX,DY,EX,EY ARE SCALED IF NECESSARY.

@CYLNDR Draw solid cylinder

SYNTAX:

```
      @CYLNDR,X,Y,Radius,Halflen,View

             X   -   0-XMax
             Y   -   0-YMax
         Radius  -   1-255
         Halflen -   1-128
         View    -   0/1  type of cylinder
                     0 horizontal
                     1 vertical
```

@DIR$ Read a directory entry
Requires considerable setup from basic

SYNTAX:

```
L=@DIR$
```

@DIR$ returns a string to the first variable in your program. The variable must be a string type. @DIR$ returns a value equal to the length of the string found. You must use the LEFT$(VAR$,L) to remove any trailing null values. Here is an example routine that will search the directory for all BRUS. files.

VARIABLE DESCRIPTIONS

dn=device#
sd=drive side (0 or 1)
dp$=directory pattern to seek
de=directory index variable = ends up as last index in de$()
de$=directory entry variable...This must be first variable in your program.

```
 10   de$="                ":rem de$=16 spaces
 20   dim de$(244):rem maximum number of possible files
 30   dp$="brus.":rem look for brush files
 40   dn=8:sd=0:rem drive 8, side 0
 50   de=0:rem number of directory entries
 60   open 3,dn,0,"$"+mid$(str$(sd),2)+":"+dp$+"*":rem open file
 70   l=@DIR$:rem l is the length of the string now in de$
 80   if st<>0 then 110
 90   de$(de)=left$(de$,l)
100   de=de+1:goto 70
110   close 3
120   rem print out all found entries
130   for i=0 to de:print de$(i):next i
```

The pattern used in the open command is a wildcard used to search for specific files. To get all the files on a directory, just use the **$** as the search string. The variable **sd** is used in case of a dual drive. And the array used to store the filenames, **DE$(244)** is dimensioned to the number 244 in order to work with the 1581 disk drive, which can store a larger number of file entries than the 1541 or 1571 disk drives (144 each).

<u>@DISPLAY</u> Recalls a **@STORE**d screen or brush to the designated screen at the location from which it was stored or a specified location.

SYNTAX:

@DISPLAY,SCREEN#,DEVICE #,DRAWMODE,"FILENAME"[,X,Y]

```
SCREEN#   -  The number of the screen the file is to be
             loaded to.  It does not have to be the screen
             you are currently viewing.
DEVICE # -  The drive number you are using, ex. 8
DRAWMODE -  0-3
                0  Erase under (replace)
                1  Merge with (OR)
                2  Common (AND)
                3  Complement  (XOR)
FILENAME -  The name of the screen or brush to load. It will
             be loaded to the area of the screen it was saved
             from (ie., the same X,Y coordinates).
X,Y       -  Optional screen locations to display brush to.
```

NOTE: If you use the optional X,Y parameters for displaying a brush to a position other than the default values, there is one thing to watch for. If Y is greater than the original Y it was saved from, (0 in the case of a picture, the Y hotspot in the case of a brush), then THERE IS NO CLIPPING PERFORMED IN THE Y DIRECTION!. So be sure your brush or picture will fit in the area and not overrun the bottom of the current screen display. If it does, unusual (and probably visually unpleasant) screen effects occur. This will happen only with @DISPLAY.

@DOT Plots a single pixel in 3 space

SYNTAX:

@DOT,X,Y,Z

X	-	0-65535	X coordinate of point. Highest visible X is equal to Xmax of virtual screen, or Window width.
Y	-	0-65535	Y coordinate of point. Highest visible Y is equal to Ymax of virtual screen, or Window depth.
Z	-	-32768 to 32767	Z coordinate of point. Z value of 0 is the plane of the screen. Positive values are directed into the screen, while negative vales are directed towards the viewer.

DOT is rotated, scaled and clipped (if necessary) before being drawn.

<u>@DRWMOD</u>   Two Commands to define global drawing modes to be used with graphic commands.

SYNTAX:

@DRWMODA,Jam,InverseVideo,Complement,Undraw,Pattern,Merge,Clip
@DRWMODB,Zview,Unplotlast,Unplotvertex

```
Jam  : 0-2  Updates color memory when drawing on a color screen.
       0  Uses foreground/background colors found in cell.(Fastest)
       1  Uses background color in cell and foreground color set
          by @COLOR command.
       2  Uses foreground/background colors set by @COLOR command.

InverseVideo    :  0-1  Reverses colors set by Jam option.
                   0  off
                   1  on

Complement      :  0-1  Turns on XOR mode.  Pixels on are turned off,
                        pixels off are turned on.
                   0  off
                   1  on

Undraw          :  0-1  Turns on erase mode.  Actually unplots all
                        pixels.
                   0  off
                   1  on

Pattern         :  0-1  Uses previously defined pattern when drawing.
                   0  off
                   1  on

Merge           :  0-1  Merge pattern with screen using OR mode,
                        pixels on are unaffected.
                   0  off
                   1  on

Clip            :  0-1  Turns on and off global screen/window clipping.
                   0  qn
                   1  off
```

*****NOTE*** The default is 0, CLIPPING ON. Turn it off for an increase in drawing speed.**

```
     ***** DRWMODB values may be used in any combination *****
Zview          : 0-1  Turns on either parallel or perspective 3D
                  0    Perspective on (objects drawn toward vanishing
                       point appear smaller as they approach it).
                  1    Parallel on.  Retains object shape and size but
                       it is offset based upon Z coordinate.

Unplotlast     : 0-1  Unplots last iteration of a multi-height
                      drawing of a graphic primitive (i.e., lines,
                      circles, boxes etc).  Used to make 3D bars
                      from boxes.
                 0  off
                 1  on

Unplotvertex : 0-1  Unplots vertexs of graphic primitives (i.e.,
                    circles, arcs, boxes etc)  Also used to
                    give 3D appearances of bars, tubes etc.
```

@FETCH To recall a **@STASH**ed area to the display screen.

SYNTAX:

@FETCH,STRUCTURE#,X,Y,DRAW MODE

```
STRUCTURE#    - 0-191 The structure # used when @STASHing
X             -  The screen X location to recall the
                 BRUSH to.  X is rounded down to the
                 start of the current byte.
Y             -  The screen Y location to recall the
                 BRUSH to.  Y is rounded up to the top
                 of the current color cell.
Draw Mode     -  0-3
                 0  Erase under (replace)
                 1  Merge with (OR)
                 2  Common (AND)
                 3  Complement  (XOR)
```

@FLASH Reverse a rectangular area of the screen 1-255 times

SYNTAX:

```
@FLASH,X,Y,DX,DY,Number Of times to flash[,FAST]

      X - Screen X  0-639
      Y - Screen Y  0-Ymax
     DX - Number of pixels wide (X+DX)<640
     DY - Number of pixels down (If using color, rounded up
          to color cell)
     Number - Number of times to reverse the rectangle
              1-255
     FAST   0-1  OPTIONAL PARAMETER (DEFAULT IS 1)
            0  No fast FLASH, use bitmap regardless of graphic
               mode.
            1  Use fast FLASH, means reverse color cells only
               when in color graphic mode.
```

****** WARNING ****** @FLASH, like @COPY will not work on a horizontal virtual screen. The screen must be 640 pixels wide, no wider. Y depth is irrelevent.

@FONT Loads a custom font to 8563 chip ram for use on the text screen. Two complete fonts can be resident at one time (512 total chars).

SYNTAX:

@FONT,Charset #,Structure #

Charset #	-	0-1	Indicates which character set to replace (Character set consist of 256 characters) Value greater than 1 defaults to 1
Structure #	-	0-191	Indicates the data structure that contains the ram resident character font data.
		254	Uppercase/Lowercase ROM font in bank 14
		255	Uppercase/Graphics ROM font in bank 14

@GROW Step value for the X, Y and Z axis when using the multidrawing (thickness) parameter of the graphic drawing commands. Minus value indicates negative direction.

SYNTAX:

@GROW,X step, Y step, Z step

X step	-	-32768 to 32767	Step value in X direction (i.e., left and right). A value of 1 indicates a solid line, n>1 steps lines by n.
Y step	-	same as X step except up and down	
Z step	-	same as X step except towards or away from viewer.	

<u>@HCOPY</u> Print a hardcopy of the current screen on a dot matrix printer.

SYNTAX:

```
       @HCOPY,Sec Address,height,density,rotation

            Sec Address  See chapter on printer drivers for specifics
            Height  1-4  Height of printed output
            Density 1-7  Allows for variable densities, if printer
                          supports different densities.  See chapter
                          on printer drivers for specific capabilities
                          of supported printers.
            Rotation 0-1  0 means no rotation
                          1 means rotate 90 degrees.  Some printers
                            (like MPS 801) are ALWAYS rotated.
```

@LINE Draw a line in 3 space

SYNTAX:

@LINE,X1,Y1,Z1,X2,Y2,Z2,Thickness

```
X1   -   0-65535   Starting X coordinate of line.
Y1   -   0-65535   Starting Y coordinate of line.
Z1   -  -32768 - 32767 Starting Z coordinate of line.

X2   -   0-65535   Ending X coordinate of line.
Y2   -   0-65535   Ending Y coordinate of line.
Z2   -  -32768 - 32767 Ending Z coordinate of line.

Thickness - 0-65535 Number of times the line is drawn stepping
                    by the value defined by the @GROW command.
```

LINE is rotated, scaled and clipped (if necessary) before being drawn.

__@LOGO__ Draws a logo using the **@CHAR** command. LOGO screen position is defined within the LOGO itself.

SYNTAX:

@LOGO,Structure number

Structure number 0-191 selects which structure to use as @LOGO data. If Structure is of wrong type it returns a value of -1

```
example     A=@LOGO,STRUCTURE Number
            IF A=-1 THEN ERROR IN STRUCTURE TYPE
```

__NOTE__ **Because LOGO uses the CHAR command, (which get string data from the variable bank 1) all LOGO structures MUST be in BUFFER 1 (System Bank 1). Use the @BUFFER command to define a buffer in bank 1.**

@LSTRUCT Loads a structure into memory

SYNTAX:

```
@LSTRUCT,STRUCT #, DEVICE #,BUFFER #,BUFFER ADDRESS,FILENAME

        STRUCT # - 0-191
        DEVICE # - 8-11
        BUFFER # - 0-9
        BUFFER ADDRESS - 0-65500
        FILENAME - name of structure on disk you want to load
```

***** @LSTRUCT MUST BE FOLLOWED BY @SEND *****

@MODE Specify's which of the four group of predefined screens (graphic modes) to be used as display areas. For unexpanded 8563 chip ram (16K) only **MODE 0** (default) is available.

SYNTAX:
@MODE,mode#[,Interlace Flag]

Mode#	-	0-3	Which of the 4 screen sets to use
Interlace Flag	-	0/1	Interlace option [Optional parameter]
		0	No Interlace Sync
		1	Use Interlace Sync (Not all monitors can display interlace sync.)

MODE# : 0-3

0 For use with 16K or 64K chip ram **Mixed Types**

***** NOTE ***** **Only 1 screen is available at a time in Mode 0**

```
@SCREEN,0 - 640 X 200 Monochrome screen
@SCREEN,1 - 640 X 192 Color 8 X 16 cell
@SCREEN,2 - 640 X 176 Color 8 X 8  cell
@SCREEN,3 - 640 X 152 Color 8 X 4  cell
@SCREEN,4 - 640 X 104 Color 8 X 2  cell
@SCREEN,5 - 640 X 176 Color 8 X 8  cell  interlaced
@SCREEN,6 - 640 X 152 Color 8 X 4  cell  interlaced
@SCREEN,7 - 640 X 104 Color 8 X 2  cell  interlaced
```

1 For use with 64K chip ram only - **Mixed Types**

***** NOTE ***** **SCREENS 0, 1, and 2 can be used at the same time, or SCREENS 0, 1, and 3 can be used at the same time, or SCREENS 4, 5, and 6 can be used at the same time, or SCREEN 7.**

```
@SCREEN,0 - 640 X 200 Monochrome
@SCREEN,1 - 640 X 200 Color 8 X 8 cell
@SCREEN,2 - 640 X 200 Color 8 X 2 cell
@SCREEN,3 - 640 X 300 Monochrome Virtual
@SCREEN,4 - 640 X 200 Color 8 X 8 cell
@SCREEN,5 - 640 X 200 Color 8 X 8 cell
@SCREEN,6 - 640 X 200 Color 8 X 8 cell
@SCREEN,7 - 640 X 728 Color 8 X 8 cell Virtual
```

2 For use with 64K chip ram only

***** NOTE ***** **SCREENS 0, 1, 2 and 3 can be used at the same time, or SCREENS 3, 4 and 5, or SCREENS 4, 6 and 7, or**

```
@SCREEN,0 - 640 X 200 Monochrome
@SCREEN,1 - 640 X 200 Monochrome
```

```
@SCREEN,2 - 640 X 200 Monochrome
@SCREEN,3 - 640 X 200 Monochrome
@SCREEN,4 - 640 X 200 Color 8 X 2 cell
@SCREEN,5 - 640 X 200 Color 8 X 2 cell
@SCREEN,6 - 640 X 200 Color 8 X 4 cell
@SCREEN,7 - 640 X 200 Color 8 X 4 cell
```

3 For use with 64K chip ram

***** NOTE ***** **ONLY ONE SCREEN CAN BE USED AT ONCE!**

```
@SCREEN,0 - 1280 X 409  Monochrome Virtual
@SCREEN,1 - 640 X 819   Monochrome Virtual
@SCREEN,2 - 2040 X 252  Monochrome Virtual
@SCREEN,3 - 800 X 655   Monochrome Virtual
@SCREEN,4 - 640 X 546   Color 8 X 2 cell Virtual
@SCREEN,5 - 640 X 655   Color 8 X 4 cell Virtual
@SCREEN,6 - 640 X 728   Color 8 X 8 cell Virtual
@SCREEN,7 - 640 X 768   Color 8 X 16 cell Virtual
```

***** NOTE ***** **Interlaced mode screens merely change the display to Interlaced Sync Mode. These SCREENS are duplicates of a non-interlaced display. For more information on Interlace Sync mode see the appendix.**

@MOUSE **Commands to turn on and off the interrupt Mouse and Joystick, and return the current X and Y position.**

SYNTAX:

```
      @MOUSE,1,DEVICE,X,Y[,Joystick Increment]

            1       -  Activate IRQ reader

            DEVICE    -  0/1
                         0 mouse   (Port 1)
                         1 joystick (Port 2)

            X       -    0-2047 horizontally, depending on Screen X Max

            Y       -    0-819  Vertically, depending on Screen Y Max

            Joystick Increment  -  Required ONLY FOR JOYSTICK - NOT MOUSE!
                                   1-255 Controls number of pixels the
                                   arrow moves when using the joystick.
                                   If increment=0 then no movement is
                                   possible.
```

@MOUSE,0 **Turn OFF interrupt reader**

@MOUSE,2,0 **Returns X coordinate of mouse (or joystick)**

```
X=@MOUSE,2,0
```

@MOUSE,2,1 **Returns Y coordinate of mouse (or joystick)**

```
Y=@MOUSE,2
```

READING THE MOUSE BUTTONS (PORT 1)

To read the LEFT MOUSE button on the 1351 mouse:

```
10 IF JOY(1)>127 THEN PRINT "LEFT MOUSE BUTTON IS PUSHED'
```

To read the RIGHT MOUSE button on the 1351 mouse:

```
10 IF JOY(1)=1 THEN PRINT "RIGHT MOUSE BUTTON IS PUSHED"
```

READING THE JOYSTICK BUTTON (PORT 2)

To read the JOYSTICK FIREBUTTON:

```
10 IF JOY(2)>127 THEN PRINT "JOYSTICK FIRE BUTTON PRESSED!"
```

@ORIGIN Establishes center of rotation and vanishing point (used for perspective draw mode). Vanishing point determines where an object will appear as a single point if drawn in perspective drawmode. Allows varied depths in Z axis.

SYNTAX:

@ORIGIN,Center X, Center Y, Center Z,Vanish X, Vanish Y, Vanish Z

Center X	-	0-65535	(Value can be larger than Virtual X)
Center Y	-	0-65535	(Value can be larger than Virtual Y)
Center Z	-	-32768 to 32767	
Vanish X	-	0-65535	
Vanish Y	-	0-65535	
Vanish Z	-	-32768 to 32767	

NOTE: All X,Y coordinates are scaled to current scale factor.

<u>@PAINT</u>   Paint an area with pattern or solid.

SYNTAX:

@PAINT,X,Y,Bank#,Address,Size

```
      X = 0-XMax  x coordinate to start paint from.
      Y = 0-YMax  y coordinate to start paint from.
  Bank# = 0-1      C128 system ram bank for PAINT stack area.  The more
                   complex the area to be filled, the larger the stack
                   area you need. If the stack fills up the paint action
                   stops, but the program continues from the next
                   statement. Make sure you don't use memory where your
                   program resides.
Address = 0-65535  Starting address in designated bank for stack area
   Size = 0-65535  Size of stack area in bytes
```

To determine if an error condition occurs, use;

ER=@PAINT,X,Y,BANK#,BANK ADDRESS,STACK SIZE
IF ER=0 then no error occurs
IF ER=-1 then an error occured, PAINT aborted.

NOTES:

1. **@PAINT works on SCALED coordinates.**
2. **For many programs we suggest you use 1K of ram in Bank 0 starting at 57343.**

ex;   @PAINT,X,Y,0,57343,1024 :REM Use 1K stack at 57343

@PATTERN

SYNTAX:

@PATTERN,Structure number

Structure number	-	0-191 Indicates which of the possible 192 **STRUCTURES** to use as pattern data. If indicated **STRUCTURE** is not of a pattern type then error status is -1.

example **A=@PATTERN,STRUCTURE number**
If A=(-1) then Stucture was wrong type.
If A <>(-1) then Pattern was successfully defined.

__**@PIXEL**__ Function to tell if a pixel is on/off or the color of that cell.

SYNTAX:

@PIXEL,X,Y,Mode

```
X - 0-65535  x coordinate of point to get value of.
Y - 0-65535  y coordinate of point to get value of.
Mode - 0-1   0 = Bitmap pixel status  returns
                 0=off  1=on  -1=out of bounds

             1 = Color attribute status  returns value
                 with foreground/background color combined

                 foreground color = value and 15
                 background color = (value and 240)/16
```

PIXEL is rotated, scaled and clipped (if necessary) before being drawn.

```
A=@PIXEL,320,100,0
IF A=0 THEN PIXEL NOT ON ELSE PIXEL IS ON

A=@PIXEL,320,100,1
FC=A AND 15:REM Foreground color = FC
BC=INT((A AND 240)/16)
```

@PTR Plots a sprite-like pointer at position X and Y

SYNTAX:

@PTR,0 Turns off the pointer

@PTR,1,X,Y,DEF#[,hgt] Turns on the pointer and positions it at X,Y The mode of 1 indicates the pointer 'floats' over the bitmap images.

X	-	X coordinate of arrow
Y	-	Y coordinate of arrow
DEF#	-	0-15 Sixteen pointer definition shapes
HGT	-	1-16 Height of pointer, system defaults to eight but you can change it to be larger. By setting it to 16 you can use two definitions as one. This allows pointer defintions of 16 x 16 pixels. In this case the pointers are paired, with n and n+1 acting as a single pointer.

POINTER will automatically restore what was underneath it when moved or turned off when using mode 1.

@PTR,2,X,Y,DEF# Turns on the arrow pointer and positions it at X,Y The mode of 2 indicates the pointer leaves a trail on the bitmap of the pointer image.

X	-	see above
Y	-	see above
DEF#	-	see above
HGT	-	see above

POINTER will not restore what was underneath it when moved using mode 2.

See Appendix C for information on defining your own pointers.

NOTE: POINTER RESPONDS TO DRAW MODES UNDRAW AND COMPLEMENT.

RYLANDER SOLIDS

These are a special subset of **BASIC 8.0** commands. They were developed by **Richard Rylander** for the Commodore 64, and he allowed us to adapt them to the **BASIC 8.0** graphics system. However, they are not an integral part of the language, and do not respond to all the possible 3D parameters. We consider them important enough to have included them, and have made a number of changes to allow them to work on the C128 **BASIC 8.0** hires display screen. You will find they offer a very powerful graphics capability, and we wish to thank Mr. Rylander for his gracious permission for their use.

For more information on the Rylander Solids, see the commands **@SPHERE**, **@TOROID**, **@SPOOL**, **@CYLNDR**, **@SCLIP** and **@STYLE**.

@SCALE Changes bitmap plotting area to logical equidistant units. This results in X and Y coordinate ranges being equally proportioned.

SYNTAX:

@SCALE,scale number

```
Scale number  -  0-2 Sets scale units.
                 0   No scale, screen remains pixel oriented.
                 1   Sets Y pixel values to .39 of a real pixel.
                     For example, a 640 X 200 physical screen
                     becomes a 640 X 512 logical screen.
                 2   Doubles logical screen size.  Same logical
                     screen (640 X 512) at SCALE 1 becomes
                     1280 X 1024 logical points at SCALE 2.
```

* NOTE! **Logical screens are not the same as Virtual screens. Larger Virtual screens result in larger logical screens. Scale values greater than 2 default to 0.**

<u>@SCLIP</u> **Solids Clip, sets the clipping boundaries for the Rylander Solids**

SYNTAX:

```
      @SCLIP,left,right,up,down

            left  0-255  based upon center of solid object
            right 0-255  based upon center of solid object
            up    0-255  based upon center of solid object
            down  0-255  based upon center of solid object
```

__@SCRDEF__ Defines an area of memory in the 8563 chip ram to be used as a custom screen for display. This overrides the **@MODE** command for the specified screen #.

SYNTAX:

@SCRDEF,screen#,display type,color size,size x,size y, bitmap beg. addr,color beg. addr

screen# : 0-7 indicates which screen definition to be used by the **@SCREEN** command. Values greater than 7 are converted to 0-7 (eg., 8=0, 9=1, 10=2 etc.). This is always the case.

display type : 0 = normal RGB
non 0 = Interlace Sync - area between scan lines filled to yield a sharper image.
(some monitors will not display this mode properly)

color size : 0-4 Indicates the color resolution to be used.

0	Use monochrome mode	
1	Use 8 X 2 color cell	: requires 8000 bytes
2	Use 8 X 4 color cell	: requires 4000 bytes
3	Use 8 X 8 color cell	: requires 2000 bytes
4	Use 8 X 16 color cell	: requires 1000 bytes

Number of bytes is in addition to 16000 required for screen bitmap of 640 X 200 pixels. Larger virtual screens require more ram. Color sizes greater than 4 default to type 4. To determine the amount of ram needed for a bitmap, use the formula ;

Bitmap Ram = ((maximum x)/8)*(maximum y)
Color Ram = 80*(maximum y)/sizecode

Screen Type	**Sizecode**
mono	**no color ram**
color 8 X 16	**16**
color 8 X 8	**8**
color 8 X 4	**4**
color 8 X 2	**2**

Total ram for a color screen=Bitmap ram + color ram

SizeX : 640 to 2040 in increments of 8 pixels
Indicates horizontal size of virtual screen area. Only 640 pixels can be seen on one line at time. Values greater than 640 only possible if 64K 8563 chip ram installed. Virtual screens greater than 640 pixels work in **monochrome** mode only.

SizeY : 200 X 819 in increments of scan lines (1 pixel)
Indicates vertical size of virtual screen area. Only 200 lines can be seen at one time. Values greater than 200 only possible if 64K 8563 chip ram is installed. Virtual screens greater than 200 are allowed in both color and monochrome modes.

Bitmap Address : 0 if only 16K 8563 chip ram installed.
0-65535 if 64K 8563 chip ram installed.
49535 last available address for a contiguous 16K bitmap. (65535 - 16000 = 49535)

Color Address : 0-16383 if only 16K 8563 chip ram installed.
0 - 63535 if 64K 8563 chip ram installed.

@SCREEN select which screens to use when drawing and/or viewing.

SYNTAX:

@SCREEN,draw screen #[,view screen #]

```
draw screen #:  0-7 Indicates which is active drawing screen.
view screen #:  0-7 Indicates which screen is displayed.
```

If both parameters are the same or view screen # is omitted then the view screen becomes the active drawing screen. If they differ this allows you to draw on one screen while viewing another. This can be used for **DOUBLE BUFFERING**, which is a common animation technique.

@SCROLL Scroll bitmap area

SYNTAX 1:

@SCROLL,Direction,Number of Units,Speed

```
    Direction - 0-7     0 = up
                        1 = up & right
                        2 = right
                        3 = down & right
                        4 = down
                        5 = down & left
                        6 = left
                        7 = up & left
                        Greater then 7 becomes 0-7

       Number of Units - 0-255  number of columns and/or color cells to
                                move in given direction.

       Speed               0-255  time delay between each scroll increment
                           0 = no delay
                           255 = .255 seconds

                 (delay = Speed * .001 seconds)
```

SYNTAX 2: Move the display immediately

@SCROLL,255,LByte of Color Cell,HByte of Color Cell

```
       255   -   Indicates you want Absolute Positioning
       LByte -   Lo byte of color cell (Color Row) to move to
       HByte -   Hi Byte of color cell (Color Row) to move to
```

This @SCROLL allows you to move directly to the start of any color cell or scanline (in monochrome).

For Example:

```
  (In monochrome)
    @SCROLL,255,25,0      Move to scanline 25

  (In 8x8 color)
   @SCROLL,255,2,0       Move to scanline 16 (color row 2)
```

<u>@SDAT</u> Structure DATa statements to read data into current structure buffer

SYNTAX:

```
    @SDAT,required parameters for the Structure Type
    @SDAT,optional data depending on Structure Type
```

*** Required parameters <u>MUST</u> be on a separate @SDAT command line than the optional data. If buffer fills before end of Structure data then status of -1 is returned to status variable. If variable is not -1 then variable contains the <u>next</u> available address in buffer. (16 bit address, 0-65535)

```
example     A=@SDAT,data...
            IF A=-1 then BUFFER ERROR, ELSE A=next available address
```

* <u>Required Parameters</u> *

Type 1 @SDAT,pattern width,pattern height,color width,color height
- Pattern width is in BYTES (8 pixels)
- Pattern height is in PIXELS
- Color width is in BYTES (8 pixels)
- Color height is based on size of current color cell height. For example, if color cell height is 4 pixels, then each color height of 1 is equal to 4 pixels.

Type 2 NO Required Parameters

Type 3 NO Required Parameters

Type 4 No Required Parameters

* <u>Optional Parameters</u> *

Type 1 @SDAT,Pattern bitmap data — pattern width X pattern height optional parameters needed.

For example, to define a brick wall pattern which is 2 bytes wide and 8 pixels deep you would use

```
@BUFFER,2,0,65535 : rem Buffer 2 is 64K buffer in ext. ram bank 0
@STRUCT,0,1,2,0 : rem Struct 0, type pattern, buffer 2, address 0
@SDAT,2,8,1,1  : rem 2 bytes X 8 pixels, 1 X 1 color
@SDAT,255,255,128,0,128,0,128,0,255,255,0,128,0,128,0,128
@SDAT,206  : rem brown on lite grey using JAM 2 color
@SEND
```

Type 2 @SDAT,Flag,Structure #,column,y(Lobyte),y (Hibyte),char height,char width,direction,length,"string of characters"

If Flag = 0 then structure is done, else if
not 0 then continue.
Other parameters described in @CHAR command.

Type 3 **No optional parameters as character set should be loaded from disk.**

Type 4 **No optional parameters as brushes should be loaded from disk.**

@SEND Terminates the current structure (Structure **END**).

SYNTAX:

@SEND

Special note: The **@STRUCT @SDAT @SEND** commands are to be used together. Once a **@STRUCT** command has been given **@SDAT** commands and then a **@SEND** command is expected. BASIC 7.0 commands only can be used in between these commands such as:

FOR..NEXT loop to pass data to the **@SDAT** command.

Use variable to find next byte in buffer with I/O

```
@LSTRUCT,0,8,2,0,"FNT.ROMAN":AD=@SEND
AD=next free byte in BUFFER.
```

USING BASIC 8.0 COMMANDS WITHIN THE @STRUCT @SDAT and @SEND COMMANDS WILL GIVE UNPREDICTABLE RESULTS.

@SPHERE **Plot a 3D solid sphere**

SYNTAX:

@SPHERE,X,Y,Radius

X	-	0-2047	Depending on Screen Max X
Y	-	0-819	Depending on Screen Max Y
Radius	-	1-255	

<u>@SPOOL</u> **Draws a solid spool structure**

SYNTAX:

@SPOOL,X,Y,Inner Radius,Outer Radius,View

```
X              -  0-Xmax   Center X of spool
Y              -  0-Ymax   Center Y of spool
Inner Radius   -  1-255 inner radius of spool
Outer Radius   -  1-255 outer radius of spool
View           -  0-1  Type of spool
                    0  Horizontal
                    1  Vertical
```

<u>@SSTRUCT</u> Saves a structure from memory to disk

SYNTAX:

```
    @SSTRUCT,STRUCT #,DEVICE #,FILENAME

             STRUCT # - 0-191
             DEVICE # - 8-11
             FILENAME - filename to store to disk
```

***** @SSTRUCT MUST BE FOLLOWED BY @SEND ******

@STASH Used to place a designated rectangle of screen display in a brush structure for later recall or storage to disk.

SYNTAX:

@STASH,STRUCTURE#,BUFFER#,BUFFER ADDRESS,X,Y,DX,DY,COMPRESSION

STRUCTURE #	- 0-191	The designated structure number used to recall the data with the **@FETCH** command.
BUFFER #	- 0-9	The ram bank to be used as a buffer. This parameter is just like the **@BUFFER** command.
Buffer Address	-	0-65535 The address within the buffer to begin storing the data.
X	-	0-Virtual X The beginning X coordinate of the rectangular area to store. X will be rounded down to an even byte boundary. For example, if X=26 then the actual X will be 24 (INT(26/8)=24)
Y	-	0-Virtual Y The beginning Y coordinate of the rectangular area to store. Y will be rounded down to the top of the current color cell.
DX	-	The length in pixels of the rectangle. The right side of the rectangle will be adjusted to the end of the byte it falls on.
DY	-	The height in pixels of the rectangle. The endpoint in Y will be adjusted to the end of the current color cell.
Compression	- 0/1	0 indicates no data compression, while 1 instructs the system to compress the data. The amount of compression depends upon the data itself.

To find the next address in the buffer use the syntax
AD=@STASH,STRUCURE#,BUFFER#,BUFFER ADDRESS,X,Y,DX,DY,COMPRESSION
AD=Next available address, or -1 indicating STASH failure.

The X,Y,DX,DY coordinates are scaled if necessary.

@STORE Saves an entire screen as a **BRUSH** to disk for later **@DISPLAY** as a screen or loading into a **STRUCTURE** as a **BRUSH** for use with **@FETCH.**

SYNTAX:

```
      @STORE,SCREEN#,DEVICE #,COMPRESSION FLAG,"FILENAME"

            SCREEN#      -  The number of the screen to store.  See @SCREEN
                            command for information on screen numbers.
            DEVICE #     - The drive number you are using,  ex. 8
            COMPRESSION - 0  No data compression
                          1  Compress data
                    ** NOTE ** See appendix for data compression algorithm
            FILENAME     - The name the screen display is to be stored
                          under on disk.  It must be within double
                          quotes (").
```

@STRUCT Defines data structure used in various **BASIC 8.0** commands and where in the indicated **BUFFER** it is at.

SYNTAX:

@STRUCT,Structure #,Type,Buffer #, Beginning address in buffer

```
        Structure #  -  0-191 Indicates which of 192 possible structures
                              you are defining.  Structure numbers
                              greater than 191 are converted to 0-191.


        Type  -  1-4  Indicates Structure data type
                   1  Pattern type
                   2  Logo type
                   3  Character Font type
                   4  Brush type


       Buffer #  -  0-9  Indicates which of ten buffer banks to use.
                         0-1 is internal ram banks 0 and 1
                         2-9 are external ram banks 0-7

       Buffer Address - 0-Buffer Size (Address to store data in buffer.)
```

<u>@STYLE</u> Define characteristics for Rylander Solids

SYNTAX:

@STYLE,SHADE,SCALE,LIGHTING

```
     Shade -  0/1     Sets shade style
                0     textured
                1     halftone
     Scale -  0/1
                0     Indicates no scaling, images are
                      elongated
                1     Images are symetrical
    Lighting - 0/1    Set lighting style
                   0  Normal
                   1  Backlite
```

<u>@TEXT</u>

SYNTAX:

@TEXT

Clears text screen, initializes **standard** fonts, enters text mode. It also **turns off** the window border flag. **@SCALE** is set to 0, all parameters of drawmodes A and B are set to 0, **@ANGLE** is set to 0,0,0,0 and current **@MODE** is removed from system, so **@MODE** must be re-issued or another **@SCRDEF** issued.

__@TOROID__ **Draw a solid toroid shape**

SYNTAX:

```
@TOROID,X,Y,Inside radius,Outside radius,View

        X    -    0-XMax
        Y    -    0-YMax
        Inside radius  - 1-255
        Outside radius - 1-255
        View           - 0/1/2
                         0 horizontal
                         1 vertical
                         2 top
```

@VIEW

SYNTAX:

@VIEW,Angle

Angle -	-360 to 360	Angle of view used when drawing in parallel draw mode (zview flag of **@DRWMODB** is equal to 1). Angle is the rotation of your eye around the Y axis. Angle is given in degrees. Angles between -360 and 360 yield all possible results. Greater values are redundant.

<u>**@WALRUS**</u> WALRUS logo,sets up the **BASIC 8.0** system for 16K or 64K video ram
@WALRUS must be executed at the beginning of a program.
Logo screen can be used as a title screen for BASIC 8.0 programs

SYNTAX:

@WALRUS,RAM TYPE

```
RAM TYPE  0-1
          0=16K 8563 video ram
          1=64K 8563 video ram
```

NOTE:
WALRUS command automatically goes to graphic mode and should be used before any other BASIC 8 command.
If used within a program more than once, the @MODE command will need to be issued again.

@WINDOWOPEN Windowopen allows you to define a subscreen within the main virtual screen area. The upper left corner of the window becomes the pixel coordinates 0,0. All graphic commands translate to this new origin. Any drawing that falls outside the window boundaries is clipped (not rendered). This new window remains active until a **@WINDOWCLOSE** command is encountered ,a new window is defined or a **@SCREEN** command is issued.

SYNTAX:

@WINDOWOPEN,X,Y,window width,window height,border flag

X : 0-2046 This is top lefthand corner of window. Value indicates a pixel number of the virtual screen. Values greater than 639 only possible with 64K 8563 chip ram installed. While X is given in pixels, it **rounds down** to the next lowest column value. (1 column = 8 pixels)

Y : 0-818 This is the top scan line (pixel) of the window. Values greater than 200 are only possible with 64K 8563 chip ram installed.

window width : 1-2040 This is the width of the window in pixels and **rounds up** to the nearest column number. Values greater than 640 only possible with 64K 8563 chip ram installed.

window height : 1-819 This is the height of the window in scan lines (1 pixel). Values greater than 200 are only possible with 64K 8563 chip ram installed.

border flag : 0-1 If set to one the window will have a border draw at the outer coordinates of the window when a **CLEAR** command is issued.

NOTE: If window is opened in a color screen, the beginning scan line number is rounded down to the closest color cell boundary. The window height is rounded up to the closest color cell boundary. This is done in order to prevent color bleed outside the window. **@WINDOWOPEN** does not save the contents of the area underneath the new window. Programmers who wish to preserve and restore this area should use the **@STASH** & **@FETCH** as appropriate.

@WINDOWCLOSE Closes last window created with **@WINDOWOPEN** command and redirects graphic output of screen to the current virtual screen boundaries.

SYNTAX:

@WINDOWCLOSE

NOTES: Turns border flag off, does not remove contents of window from screen viewing. You must have previously **@STASH**ed the screen area where the new window will appear and then restore the old screen area with a **@FETCH** command.

<u>**@ZOOM**</u> This command enlarges a STASHed structure from memory to the screen.

SYNTAX:

E=@ZOOM,STRUCTURE#,SIZE,DestX,DestY

STRUCTURE#	-	0-191	Number of an <u>uncompressed</u> brush structure
SIZE	-	1-15	Height of ZOOMed brush in color cells
DestX	-	0-MaxX	Destination X of enlarged brush structure
DestY	-	0-MaxY	Destination Y of enlarged brush structure

ZOOM does little in the way of error correcting. **YOU** must make sure the new enlarged brush will fit into the destination area. The enlargement is constant in the X direction (1 pixel->8 pixels) and is variable in the Y. For example, a SIZE of 2 for a brush in the 8x2 mode would make each pixel in the Y direction enlarge a total of 4 pixels (2 scanlines per cell * size 2 = 4 pixels). For a brush in the 8x8 mode, a SIZE of 4 would make each pixel equal to 32 pixels. (8 scanlines per cell * size 4 = 32 pixels

CHART OF COMMANDS
EFFECTS AND RETURN VALUES

COMMAND	ROTATION	XYZ2XY	SCALE	CLIP	WINDOW	V RETURN	MMU	BUFFERS/BANKS
ANGLE								
ARC	+	+	+	+	+			
BOX	+	+	+	+	+			
BRUSHPATRN						-1		
BUFFER								0-10
CBRUSH						-1		
CHAR				+	+	-1		0-10,14
CIRCLE	+	+	+	AL	+			
CLEAR					+			
COLOR								
COPY				+				
CYLNDR								
DIR$								
DISPLAY				+		-1		
DOT	+	+	+	AL	+			
DRWMODA								
DRWMODB								
FETCH			+	+		-1		0-10
FLASH			+	+	+			
FONT						-1		
GROW								
HCOPY								
LINE	+	+	+	+	+			
LOGO				+	+	-1		
LSTRUCT								0-10
MODE								
MOUSE								
ORIGIN								
PAINT			+	+	+	-1		0-1
PATTERN						-1		
PIXEL			+	+	+			
PTR								
SCALE								
SCLIP								
SCRDEF								
SCREEN								
SCROLL								
SDAT						-1/Adr		
SEND								
SPHERE								
SPOOL								
SSTRUCT								0-10
STASH				+		-1/Adr		0-10
STORE				+		-1		
STRUCT								0-10
STYLE								
TEXT								
TOROID								
VIEW								
WALRUS								
WINDOWCLOSE								
WINDOWOPEN								
ZOOM						-1		

CHAPTER ELEVEN
PRINTER SUPPORT

BASIC 8.0 has some of the most flexible printer drivers available to users of computer graphics. It supports most of the major printers used by Commodore 128 owners. Since the different printers have different capabilities and require different programming techniques to print bitmap graphics, different printer specific drivers are required. These are **installable** printer drivers, which means you (or a program written by you) can easily change the specific printer being used by loading a driver with the command **BLOAD "PRINTER NAME",B0,P26064**.

You access the printer with the **BASIC 8.0** command called **@HCOPY**. This command is the same regardless of what printer you are using, so your programs will always be compatible. The parameters of **@HCOPY** control the secondary address of the printer you are using, the size of the printout, the printer density to use, and the orientation of the printout (rotated or unrotated).

Since not all printers are the same (some offer more dots per horizontal line, some have several densities, and others offer colors besides black) there may be limitations on what your printer can do. For example, the MPS 801 can print only 480 dots per horizontal line. So it cannot print out even the smallest unrotated **BASIC 8.0** image (which would be at least 640 pixels wide.) In order to use it, the image is automatically rotated 90 degrees, regardless of the value of the rotate parameter in the **@HCOPY** command. This also means you cannot have a height parameter greater than 2 (400 pixels) with a 200 scanline high screen. (A height of 3 would be 600, too large for the MPS 801.) And it offers only one density, so values greater than one are ignored. On the other extreme, the PANASONIC 1091 and EPSON FX both support seven dot densities. That means you could have a horizontal image upto 1920 dots wide (using density 7) before you had to rotate it. (The different density settings are not linear. This means a larger density value is not necessarily going to print a smaller picture. Instead it may instruct the printer to use more dots per inch, but still give the same size image as that of a smaller density setting. The best way of knowing what to expect from the various densities is to check with your printer manual, or simply print out a picture using different settings. We gave you the power to determine what the final printed output will look like.)

On the following pages is information concerning the eleven printers supported directly by **BASIC 8.0**. This information includes the assembly language source code, so other printer drivers could be written for **BASIC 8.0** by experienced programmers. For additional information on the **@HCOPY** command, see the **BASIC 8.0 COMMAND ENCYCLOPEDIA** in chapter 10.

EPSON FX-80
PANASONIC 1091
STAR NX-10

This printer driver is on your **BASIC 8.0** disk with the name **P.HC-EPSON**. This is the default driver built into the **BASIC 8.0** system, so it is not necessary to install it again unless another driver has been loaded.

The secondary address we used for the CARDCO G and G-WIZ interfaces is 5. Other printer interfaces may require a different secondary address.

This driver can use the full range of heights (1-4) in the height parameter of **@HCOPY**, as well as the full range of densities (1-7). For a 640 x 200 pixel screen a height of 2 with a density of 2 gives a very good proportional hardcopy of the screen. Or use a height of 1 with a density of 1 and your 640 x 200 image prints just about the size of a large business card. As mentioned, a density parameter of seven allows you to print a horizonatal unrotated image of 1920 pixels, larger than most applications will require.

You can also print your images rotated 90 degrees, which is very useful if the screen is more than 1920 pixels wide, or you want to use a lower density in order to get a larger image. Just set the rotation parameter to one and the picture will be rotated.

This is the source code (written with the Commodore C128 Assembler Development Package). If you have a near EPSON compatible printer that doesn't work quite right, it may be possible for you (if you are a machine language programmer) to convert it to a new driver for your printer.

This source code is supplied as a courtesy to all registered

ASIC 8.0 owners.

EPSON/PANASONIC/STAR NX-10 BASIC 8.0 PRINTER SOURCE CODE

```
 .PAGE
;NAME       HARD COPY
;CREATED    12/20/86
;UPDATED
;AUTHOR     DAVID DARUS
;ASSEMBLER HCD65
;COMPUTER   C-128
;REMARKS    BASIC 8   HARD COPY DRIVER FOR EPSON FX-NN,PANASONIC 1091,STAR NX
;                     X * 880   UNROTATED & ROTATED
*=$65D0

INCWRD   .MACRO ?IARG1
         INC ?IARG1
         BNE 255$
         INC ?IARG1+1
255$
 .ENDM

DECWRD   .MACRO ?DARG1
         LDA ?DARG1
         BNE 254$
         DEC ?DARG1+1
254$
         DEC ?DARG1
 .ENDM

MMU   = $FF00

CHROUT = $FFD2
CLRCHN = $FFCC
CLOSE  = $FFC3
SETLFS = $FFBA
OPEN   = $FFC0
CHKOUT = $FFC9

CLCADR     = $26A8
SWAPNYBL   = $25DB
GETPIXSTAT = $2652
GETCOLSTAT = $266E

CURCOLOR = $1318
SCRCSIZE = $131A
SCRSIZEY = $131C
SCRSIZEX = $1324
X0       = $136B
Y0       = $136D
MASK     = $137B
PARM1    = $13EF
PARM2    = $13F0
PARM3    = $13F1
PARM4    = $13F2
```

```
MLHCOPY
  LDA PARM4
  BEQ 99$
  JMP MLHCOPYR
99$
  LDA PARM1
  STA SECADR
  LDA PARM2
  STA HCHT
  LDX PARM3        ;1=SINGLE  2=DOUBLE 3-7 SEE EPSON FX-80 MANUAL
  DEX
  STX ESCDAT+6

  LDA SCRSIZEX
  STA ESCDAT+7
  LDA SCRSIZEX+1
  STA ESCDAT+8

  LDX HCHT
  DEX
  LDA CNVTHT,X
  STA HCHT
  LDA #8
2$
  DEX
  BMI 1$
  LSR A
  JMP 2$
1$
  STA STEP

  LDA MMU
  AND #$FE
  STA MMU
  JSR OPNCHN
  LDA #7
  STA BN
  LDA #0
  STA BV      ;BYTE VALUE TO CHROUT = 0
  STA YY1      ;Y0=0
  STA YY1+1
NXTY
  JSR PRTESC    ;DO FOR EACH ROW = 8*HEIGHT
  LDA #0
  STA X0
  STA X0+1
NXTX
  LDA YY1
  STA Y0
  LDA YY1+1
  STA Y0+1
  CLC
  LDA Y0
  ADC STEP
  STA ENDY0
  LDA Y0+1
  ADC #0
  STA ENDY0+1
```

```
NXTY0
   LDA #0
   STA HTCNTR
NXTHT
   JSR GETPIX    ;GET PIXEL VALUE AT X0,Y0  IF X0>SCRSIZEX AND <880 THEN CLC
   ROL BV        ;ROLL CARRY INTO BYTE VALUE   0 OR 1
   DEC BN        ;BIT#=BIT#-1
   BPL 1$
   LDA BV        ;IF BN<0 THEN PRINT BV:BN=7
   JSR CHROUT
   LDA #7
   STA BN
   LDA #0
   STA BV
1$
   INC HTCNTR
   LDA HTCNTR
   CMP HCHT
   BNE NXTHT
   INCWRD Y0
   LDA Y0
   CMP ENDY0
   BNE NXTY0
   LDA Y0+1
   CMP ENDY0+1
   BNE NXTY0
  .LOCAL
   INCWRD X0
   LDA X0
   CMP SCRSIZEX
   BNE NXTX         ;IF X0< SCRSIZEX THEN GOTO NXTY  DO NEXT SCANLINE
   LDA X0+1
   CMP SCRSIZEX+1
   BNE NXTX
   CLC
   LDA YY1
   ADC STEP
   STA YY1
   LDA YY1+1
   ADC #0
   STA YY1+1
   LDA YY1
   CMP SCRSIZEY
   LDA YY1+1
   SBC SCRSIZEY+1
   BCC NXTYJ
HCERR
   LDA #27        ;ESC
   JSR CHROUT
   LDA #'@        ;RESET CODE
   JSR CHROUT
   JSR CLRCHN
   LDA #4
   JMP CLOSE
NXTYJ
   JMP NXTY

OPNCHN
```

```
   LDA #0
   STA $B7
   LDX #4
   TXA
   LDY SECADR
   JSR SETLFS
   JSR OPEN
   LDX #4
   JMP CHKOUT

PRTESC
   LDX #0
1$
   LDA ESCDAT,X
   JSR CHROUT
   INX
   CPX #9
   BNE 1$
   RTS

GETPIX
   LDA Y0
   CMP SCRSIZEY
   LDA Y0+1
   SBC SCRSIZEY+1
   BCS 1$
   JSR CLCADR
   JSR GETPIXSTAT
   AND MASK
   BEQ 1$
   SEC
   RTS
1$
   CLC
   RTS

ESCDAT
  .BYT 13,10,27,'1',27,'*',0,<640,>640
CNVTHT
  .BYT 1,2,4,8    ;TRANSLATE HT OF 1,2,3,4 TO 1,2,4,8

SECADR
  .BYT 0
HCHT
  .BYT 0

BN
  .BYT 0
BV
  .BYT 0
HTCNTR
  .BYT 0
STEP
  .BYT 0
ENDY0
  .BYT 0,0
YY1
  .BYT 0,0
```

```
MLHCOPYR
  LDA PARM1
  STA SECADR
  LDA PARM2
  STA HCHT
  LDX PARM3         ;1=SINGLE  2=DOUBLE
  DEX
  STX ESCDAT+6

  LDA SCRSIZEY
  STA ESCDAT+7
  LDA SCRSIZEY+1
  STA ESCDAT+8
  LDX HCHT
  DEX
  LDA ESCDAT+7
4$
  DEX
  BMI 3$
  ASL A
  ROL ESCDAT+8
  JMP 4$
3$
  STA ESCDAT+7

  LDX HCHT
  DEX
  LDA CNVTHT,X
  STA HCHT
  LDA #8
  STA STEP

  LDA MMU
  AND #$FE
  STA MMU
  JSR OPNCHN
  LDA #7
  STA BN
  LDA #0
  STA BV      ;BYTE VALUE TO CHROUT = 0
  STA XX1      ;X1=0
  STA XX1+1
NXTX1R
  JSR PRTESC    ;DO FOR EACH ROW = 8*HEIGHT
  LDA SCRSIZEY
  STA Y0
  LDA SCRSIZEY+1
  STA Y0+1
  DECWRD Y0
NXTYR
  LDA #0
  STA HTCNTR
NXTHTR
  LDA XX1
  STA X0
  LDA XX1+1
```

```
   STA X0+1
   CLC
   LDA X0
   ADC STEP
   STA ENDX0
   LDA X0+1
   ADC #0
   STA ENDX0+1
NXTXR
   JSR GETPIX    ;GET PIXEL VALUE AT X0,Y0  IF X0>SCRSIZEX AND <880 THEN CLC
   ROL BV        ;ROLL CARRY INTO BYTE VALUE   0 OR 1
   DEC BN        ;BIT#=BIT#-1
   BPL 1$
   LDA BV        ;IF BN<0 THEN PRINT BV:BN=7
   JSR CHROUT
   LDA #7
   STA BN
   LDA #0
   STA BV
1$
   INCWRD X0
   LDA X0
   CMP ENDX0
   BNE NXTXR
   LDA X0+1
   CMP ENDX0+1
   BNE NXTXR
   INC HTCNTR
   LDA HTCNTR
   CMP HCHT
   BNE NXTHTR
  .LOCAL
   DECWRD Y0
   LDA Y0
   CMP #$FF
   BNE NXTYR         ;IF Y = 0 THEN GOTO NXTY  DO NEXT SCANLINE
   LDA Y0+1
   CMP #$FF
   BNE NXTYR
   CLC
   LDA XX1
   ADC STEP
   STA XX1
   LDA XX1+1
   ADC #0
   STA XX1+1
   LDA XX1
   CMP SCRSIZEX
   LDA XX1+1
   SBC SCRSIZEX+1
   BCC NXTXJR
HCERRR
   LDA #27        ;ESC
   JSR CHROUT
   LDA #'@        ;RESET CODE
   JSR CHROUT
   JSR CLRCHN
   LDA #4
  JMP CLOSE
NXTXJR
  JMP NXTX1R

ENDX0
 .BYT 0,0
XX1
 .BYT 0,0

 .END
```

OLIVETTI PR 2300

This printer driver is on your **BASIC 8.0** disk with the name **P.HC-OLIVETTI**. This is not the default driver built into the **BASIC 8.0** system, so it is necessary to install it with the command **BLOAD "P.HC-OLIVETTI",B0,P26064.**

The secondary address we used for the CARDCO G and G-WIZ interfaces is 5. Other printer interfaces may require a different secondary address.

This driver can use the full range of heights (1-4) in the height parameter of **@HCOPY**, but only 1 density is supported by the Olivetti. For a 640 x 200 pixel screen a height of 2 with a density of 1 gives a very good proportional hardcopy of the screen. Or use a height of 1 with a density of 1 and your 640 x 200 image prints just about the size of a large business envelope. The Olivetti PR2300 can print unrotated images upto 880 horizontal pixels wide.

You can also print your images rotated 90 degrees, which is very useful if the screen is more than 880 pixels wide. Just set the rotation parameter to one and the picture will be rotated.

This is the source code (written with the Commodore C128 Assembler Development Package). If you have a near OLIVETTI PR2300 compatible printer that doesn't work quite right, it may be possible for you (if you are a machine language programmer) to convert it to a new driver for your printer.

This source code is supplied as a courtesy to all registered **BASIC 8.0** owners.

```
 .PAGE
;NAME       HARD COPY
;CREATED    12/09/86
;UPDATED
;AUTHOR     DAVID DARUS
;ASSEMBLER HCD65
;COMPUTER   C-128
;REMARKS    BASIC 8  HARD COPY DRIVER FOR OLIVETTI PR 2300
;                    880 * Y UNROTATED    X * 880 ROTATED
*=$65D0

INCWRD  .MACRO ?IARG1
        INC ?IARG1
        BNE 255$
        INC ?IARG1+1
255$
 .ENDM

DECWRD  .MACRO ?DARG1
        LDA ?DARG1
        BNE 254$
        DEC ?DARG1+1
254$
        DEC ?DARG1
 .ENDM


MMU  = $FF00

CHROUT = $FFD2
CLRCHN = $FFCC
CLOSE  = $FFC3
SETLFS = $FFBA
OPEN   = $FFC0
CHKOUT = $FFC9

CLCADR     = $26A8
SWAPNYBL   = $25DB
GETPIXSTAT = $2652
GETCOLSTAT = $266E

CURCOLOR = $1318
SCRCSIZE = $131A
SCRSIZEY = $131C
SCRSIZEX = $1324
X0       = $136B
Y0       = $136D
MASK     = $137B
PARM1    = $13EF
PARM2    = $13F0
PARM3    = $13F1
PARM4    = $13F2

MLHCOPY
```

```
  LDA PARM4
  BEQ 99$
  JMP MLHCOPYR
99$
  LDA PARM1
  STA SECADR
  LDA PARM2
  STA HCHT

  LDX HCHT
  DEX
  LDA MULT8,X
  STA SSLN     ;SAVE SCANLINE#
  LDA HTABL,X
  STA ESCDAT+8
  LDA MMU
  AND #$FE
  STA MMU
  JSR OPNCHN
  LDA #7
  STA BN
  LDA #0
  STA SLN     ;SCANLINE#=0
  STA BV      ;BYTE VALUE TO CHROUT = 0
  STA Y0      ;Y0=0
  STA Y0+1
NXTY
  LDA #0
  STA HTMULT   ;HEIGHT COUNTER
4$
  LDA SLN
  BNE 3$
  JSR PRTESC    ;DO FOR EACH ROW = 8*HEIGHT
3$
  INC SLN      ;INCREMENT SCANLINE# IN ROW
  LDA SLN
  CMP SSLN     ;IF SLN=SSLN THEN END OF ROW REACHED
  BNE 6$       ;BR IF <>
  LDA #0       ;ELSE
  STA SLN      ;RESET SCANLINE# TO 0
6$
  LDA #0
  STA X0
  STA X0+1
2$
  JSR GETPIX    ;GET PIXEL VALUE AT X0,Y0  IF X0>SCRSIZEX AND <880 THEN CLC
  ROL BV        ;ROLL CARRY INTO BYTE VALUE   0 OR 1
  DEC BN        ;BIT#=BIT#-1
  BPL 1$
  LDA BV        ;IF BN<0 THEN PRINT BV:BN=7
  JSR CHROUT
  LDA #7
  STA BN
  LDA #0
  STA BV
1$
  INCWRD X0
  LDA X0
  CMP #<880
  BNE 2$        ;X0<880 THEN GOTO 2$
  LDA X0+1
  CMP #>880
  BNE 2$
  INC HTMULT   ;ELSE END OF LINE
  LDA HTMULT
  CMP HCHT
  BNE 4$       ;REPEAT SCANLINE HCHT TIME (HEIGHT)
 .LOCAL
  INCWRD Y0
  LDA Y0
  CMP SCRSIZEY
  BNE NXTY        ;IF Y0< SCRSIZEY THEN GOTO NXTY  DO NEXT SCANLINE
  LDA Y0+1
  CMP SCRSIZEY+1
  BNE NXTY
HCERR
  JSR CLRCHN
  LDA #4
  JMP CLOSE

OPNCHN
  LDX #4
  TXA
  LDY SECADR
  JSR SETLFS
  JSR OPEN
  LDX #4
  JMP CHKOUT

PRTESC
  LDX #0
1$
  LDA ESCDAT,X
  PHP
  AND #$7F
  JSR CHROUT
  INX
  PLP
  BPL 1$
  RTS

GETPIX
  LDA X0
  CMP SCRSIZEX
  LDA X0+1
  SBC SCRSIZEX+1
  BCS 1$
  JSR CLCADR
  JSR GETPIXSTAT
  AND MASK
  BEQ 1$
  SEC
  RTS
1$
  CLC
  RTS
```

```
ESCDAT
 .BYT 27,71,'1;110;2;2',27,90+$80

SECADR
 .BYT 0
MULT8
 .BYT 8,16,24,32
HTABL
 .BYT 49,50,51,52
BN
 .BYT 0
BV
 .BYT 0
HCHT
 .BYT 0
HTMULT
 .BYT 0
SLN
 .BYT 0
SSLN
 .BYT 0


MLHCOPYR
   LDA PARM1
   STA SECADR
   LDA PARM2
   STA HCHT

   LDA MMU
   AND #$FE
   STA MMU
   JSR OPNCHN
   LDX HCHT       ;1-4 GOES TO
   DEX            ;0-3 FOR INDEXING PURPOSES
   LDA HTABLR,X
   STA HCHT       ;1,2,4,8
   LDA #<880
   STA NUMSL
   LDA #>880
22$
   DEX
   BMI 11$
   LSR A
   ROR NUMSL
   JMP 22$
11$
   STA NUMSL+1
   LDA #7
   STA BN
   LDA #0
   STA SLN      ;SCANLINE#=0
   STA BV       ;BYTE VALUE TO CHROUT = 0
   STA X0       ;X0=0
   STA X0+1
NXTXR
   LDA SLN
   BNE 3$
   JSR PRTESCR    ;DO FOR EACH ROW = 8*HEIGHT
3$
   INC SLN       ;INCREMENT SCANLINE# IN ROW
   LDA SLN
   CMP #8        ;IF SLN=8 THEN END OF ROW REACHED
   BNE 6$        ;BR IF <>
   LDA #0        ;ELSE
   STA SLN       ;RESET SCANLINE# TO 0
6$
   LDA NUMSL
   STA Y0
   LDA NUMSL+1
   STA Y0+1
   DECWRD Y0
NXTYR
   LDA #0
   STA HTMULT
4$
   JSR GETPIXR    ;GET PIXEL VALUE AT X0,Y0  IF X0>SCRSIZEX AND <880 THEN CLC
   ROL BV        ;ROLL CARRY INTO BYTE VALUE   0 OR 1
   DEC BN        ;BIT#=BIT#-1
   BPL 1$
   LDA BV        ;IF BN<0 THEN PRINT BV:BN=7
   JSR CHROUT
   LDA #7
   STA BN
   LDA #0
   STA BV
1$
   INC HTMULT
   LDA HTMULT
   CMP HCHT
   BNE 4$
   DECWRD Y0
   LDA Y0
   CMP #$FF
   BNE NXTYR          ;Y0 <> 0 THEN GOTO NXTY
   LDA Y0+1
   CMP #$FF
   BNE NXTYR
  .LOCAL
   INCWRD X0
   LDA X0
   CMP SCRSIZEX
   BNE NXTXTR          ;IF X0< SCRSIZEX THEN GOTO NXTY  DO NEXT SCANLINE
   LDA X0+1
   CMP SCRSIZEX+1
   BNE NXTXTR

HCERRR
   JSR CLRCHN
   LDA #4
   JMP CLOSE

NXTXTR
   JMP NXTXR
```

```
PRTESCR
  LDX #0
1$
  LDA ESCDATR,X
  PHP
  AND #$7F
  JSR CHROUT
  INX
  PLP
  BPL 1$
  RTS

GETPIXR
  LDA Y0
  CMP SCRSIZEY
  LDA Y0+1
  SBC SCRSIZEY+1
  BCS 1$
  JSR CLCADR
  JSR GETPIXSTAT
  AND MASK
  BEQ 1$
  SEC
  RTS
1$
  CLC
  RTS

ESCDATR
 .BYT 27,71,'1;110;1;2',27,90+$80
HTABLR
 .BYT 1,2,4,8   ;TRANSLATE HT OF 1,2,3,4 TO 1,2,4,8
NUMSL
 .BYT 0,0

 .END
```

STAR NX-10C

This printer driver is on your **BASIC 8.0** disk with the name **P.HC-NX-10C**. This is not the default driver built into the **BASIC 8.0** system, so it is necessary to install it with the command **BLOAD "P.HC-NX-10C",B0,P26064.**

The secondary address to use is 8.

This driver can use the full range of heights (1-4) in the height parameter of **@HCOPY**, but only 2 densities are supported by the NX-10C. For a 640 x 200 pixel screen a height of 2 with a density of 2 gives a very good proportional hardcopy of the screen. Or use a height of 1 with a density of 1 and your 640 x 200 image prints just about the size of a small envelope. The NX-10C can print unrotated images upto 1280 horizontal pixels wide.

You can also print your images rotated 90 degrees, which is very useful if the screen is more than 1280 pixels wide. Just set the rotation parameter to one and the picture will be rotated.

This is the source code (written with the Commodore C128 Assembler Development Package). If you have a near NX-10C compatible printer that doesn't work quite right, it may be possible for you (if you are a machine language programmer) to convert it to a new driver for your printer.

This source code is supplied as a courtesy to all registered **BASIC 8.0** owners.

```
 .PAGE
;NAME       HARD COPY
;CREATED    12/20/86
;UPDATED
;AUTHOR     DAVID DARUS
;ASSEMBLER HCD65
;COMPUTER   C-128
;REMARKS    BASIC 8  HARD COPY DRIVER FOR STAR NX-10C
;                    X * 880   UNROTATED
*=$65D0

INCWRD  .MACRO ?IARG1
        INC ?IARG1
        BNE 255$
        INC ?IARG1+1
255$
 .ENDM

DECWRD  .MACRO ?DARG1
        LDA ?DARG1
        BNE 254$
        DEC ?DARG1+1
254$
        DEC ?DARG1
 .ENDM


MMU   = $FF00

CHROUT = $FFD2
CLRCHN = $FFCC
CLOSE  = $FFC3
SETLFS = $FFBA
OPEN   = $FFC0
CHKOUT = $FFC9

CLCADR     = $26A8
SWAPNYBL   = $25DB
GETPIXSTAT = $2652
GETCOLSTAT = $266E

CURCOLOR = $1318
SCRCSIZE = $131A
SCRSIZEY = $131C
SCRSIZEX = $1324
X0       = $136B
Y0       = $136D
MASK     = $137B
PARM1    = $13EF
PARM2    = $13F0
PARM3    = $13F1
PARM4    = $13F2

MLHCOPY
  LDA PARM4
  BEQ 99$
  JMP MLHCOPYR
99$
  LDA PARM1
  STA SECADR
  LDA PARM2
  STA HCHT
  LDX PARM3        ;1=SINGLE  2=DOUBLE
  DEX
  LDA DENSITY,X
  STA ESCDAT+6

  LDA SCRSIZEX
  STA ESCDAT+7
  LDA SCRSIZEX+1
  STA ESCDAT+8

  LDX HCHT
  DEX
  LDA CNVTHT,X
  STA HCHT
  LDA #8
2$
  DEX
  BMI 1$
  LSR A
  JMP 2$
1$
  STA STEP

  LDA MMU
  AND #$FE
  STA MMU
  JSR OPNCHN
  LDA #7
  STA BN
  LDA #0
  STA BV      ;BYTE VALUE TO CHROUT = 0
  STA Y1      ;Y0=0
  STA Y1+1
NXTY
  JSR PRTESC    ;DO FOR EACH ROW = 8*HEIGHT
  LDA #0
  STA X0
  STA X0+1
NXTX
  LDA Y1
  STA Y0
  LDA Y1+1
  STA Y0+1
  CLC
  LDA Y0
  ADC STEP
  STA ENDY0
  LDA Y0+1
  ADC #0
  STA ENDY0+1
NXTY0
  LDA #0
```

```
   STA HTCNTR
NXTHT
   JSR GETPIX     ;GET PIXEL VALUE AT X0,Y0  IF X0>SCRSIZEX AND <880 THEN CLC
   ROL BV         ;ROLL CARRY INTO BYTE VALUE   0 OR 1
   DEC BN         ;BIT#=BIT#-1
   BPL 1$
   LDA BV         ;IF BN<0 THEN PRINT BV:BN=7
   JSR CHROUT
   LDA #7
   STA BN
   LDA #0
   STA BV
1$
   INC HTCNTR
   LDA HTCNTR
   CMP HCHT
   BNE NXTHT
   INCWRD Y0
   LDA Y0
   CMP ENDY0
   BNE NXTY0
   LDA Y0+1
   CMP ENDY0+1
   BNE NXTY0
  .LOCAL
   INCWRD X0
   LDA X0
   CMP SCRSIZEX
   BNE NXTX           ;IF X0< SCRSIZEX THEN GOTO NXTY  DO NEXT SCANLINE
   LDA X0+1
   CMP SCRSIZEX+1
   BNE NXTX
   CLC
   LDA Y1
   ADC STEP
   STA Y1
   LDA Y1+1
   ADC #0
   STA Y1+1
   LDA Y1
   CMP SCRSIZEY
   LDA Y1+1
   SBC SCRSIZEY+1
   BCC NXTYJ
HCERR
   LDA #27     ;ESC
   JSR CHROUT
   LDA #'@     ;RESET CODE
   JSR CHROUT
   JSR CLRCHN
   LDA #4
   JMP CLOSE
NXTYJ
   JMP NXTY

OPNCHN
   LDA #0
   STA $B7
  LDX #4
  TXA
  LDY SECADR
  JSR SETLFS
  JSR OPEN
  LDX #4
  JMP CHKOUT

PRTESC
  LDX #0
1$
  LDA ESCDAT,X
  JSR CHROUT
  INX
  CPX #8
  BNE 1$
  RTS

GETPIX
  LDA Y0
  CMP SCRSIZEY
  LDA Y0+1
  SBC SCRSIZEY+1
  BCS 1$
  JSR CLCADR
  JSR GETPIXSTAT
  AND MASK
  BEQ 1$
  SEC
  RTS
1$
  CLC
  RTS

ESCDAT
 .BYT 13,27,'3',21,27,'K',<640,>640
CNVTHT
 .BYT 1,2,4,8    ;TRANSLATE HT OF 1,2,3,4 TO 1,2,4,8
DENSITY
 .BYT 'K','L'

SECADR
 .BYT 0
HCHT
 .BYT 0

BN
 .BYT 0
BV
 .BYT 0
HTCNTR
 .BYT 0
STEP
 .BYT 0
ENDY0
 .BYT 0,0
Y1
 .BYT 0,0
```

```
MLHCOPYR
  LDA PARM1
  STA SECADR
  LDA PARM2
  STA HCHT
  LDX PARM3        ;1=SINGLE  2=DOUBLE
  DEX
  LDA DENSITY,X
  STA ESCDAT+6

  LDA SCRSIZEY
  STA ESCDAT+7
  LDA SCRSIZEY+1
  STA ESCDAT+8
  LDX HCHT
  DEX
  LDA ESCDAT+7
4$
  DEX
  BMI 3$
  ASL A
  ROL ESCDAT+8
  JMP 4$
3$
  STA ESCDAT+7

  LDX HCHT
  DEX
  LDA CNVTHT,X
  STA HCHT
  LDA #8
  STA STEP

  LDA MMU
  AND #$FE
  STA MMU
  JSR OPNCHN
  LDA #7
  STA BN
  LDA #0
  STA BV      ;BYTE VALUE TO CHROUT = 0
  STA X1      ;X1=0
  STA X1+1
NXTX1R
  JSR PRTESC   ;DO FOR EACH ROW = 8*HEIGHT
  LDA SCRSIZEY
  STA Y0
  LDA SCRSIZEY+1
  STA Y0+1
  DECWRD Y0
NXTYR
  LDA #0
  STA HTCNTR
NXTHTR
  LDA X1
  STA X0
```

```
    LDA X1+1
    STA X0+1
    CLC
    LDA X0
    ADC STEP
    STA ENDX0
    LDA X0+1
    ADC #0
    STA ENDX0+1
 NXTXR
    JSR GETPIX     ;GET PIXEL VALUE AT X0,Y0  IF X0>SCRSIZEX AND <880 THEN CLC
    ROL BV         ;ROLL CARRY INTO BYTE VALUE   0 OR 1
    DEC BN         ;BIT#=BIT#-1
    BPL 1$
    LDA BV         ;IF BN<0 THEN PRINT BV:BN=7
    JSR CHROUT
    LDA #7
    STA BN
    LDA #0
    STA BV
 1$
    INCWRD X0
    LDA X0
    CMP ENDX0
    BNE NXTXR
    LDA X0+1
    CMP ENDX0+1
    BNE NXTXR
    INC HTCNTR
    LDA HTCNTR
    CMP HCHT
    BNE NXTHTR
   .LOCAL
    DECWRD Y0
    LDA Y0
    CMP #$FF
    BNE NXTYR          ;IF Y = 0 THEN GOTO NXTY  DO NEXT SCANLINE
    LDA Y0+1
    CMP #$FF
    BNE NXTYR
    CLC
    LDA X1
    ADC STEP
    STA X1
    LDA X1+1
    ADC #0
    STA X1+1
    LDA X1
    CMP SCRSIZEX
    LDA X1+1
    SBC SCRSIZEX+1
    BCC NXTXJR
 HCERRR
    LDA #27          ;ESC
    JSR CHROUT
    LDA #'@          ;RESET CODE
    JSR CHROUT
    JSR CLRCHN
   LDA #4
   JMP CLOSE
NXTXJR
   JMP NXTX1R

ENDX0
  .BYT 0,0
X1
  .BYT 0,0

  .END
```

MANNESMANN TALLY SPIRIT 80

This printer driver is on your **BASIC 8.0** disk with the name **P.HC-SPIRIT80**. This is not the default driver built into the **BASIC 8.0** system, so it is necessary to install it with the command **BLOAD "P.HC-SPIRIT80",B0,P26064.**

The secondary address to use is 5, if you are using the CARDCO G or G-WIZ interfaces. Other interfaces may require a different secondary address.

This driver can use the full range of heights (1-4) in the height parameter of **@HCOPY**, but only 2 densities are supported by the SPIRIT 80. For a 640 x 200 pixel screen a height of 2 with a density of 2 gives a very good proportional hardcopy of the screen. Or use a height of 1 with a density of 1 and your 640 x 200 image prints just about the size of a small envelope. The SPIRIT 80 can print unrotated images upto 1280 horizontal pixels wide.

You can also print your images rotated 90 degrees, which is very useful if the screen is more than 1280 pixels wide. Just set the rotation parameter to one and the picture will be rotated.

This is the source code (written with the Commodore C128 Assembler Development Package). If you have a near SPIRIT 80 compatible printer that doesn't work quite right, it may be possible for you (if you are a machine language programmer) to convert it to a new driver for your printer.

This source code is supplied as a courtesy to all registered **BASIC 8.0** owners.

```
 .PAGE
;NAME       HARD COPY
;CREATED    12/20/86
;UPDATED
;AUTHOR     DAVID DARUS
;ASSEMBLER HCD65
;COMPUTER   C-128
;REMARKS    BASIC 8  HARD COPY DRIVER FOR SPIRIT80
;                    X * 880   UNROTATED
*=$65D0

INCWRD   .MACRO ?IARG1
         INC ?IARG1
         BNE 255$
         INC ?IARG1+1
255$
 .ENDM

DECWRD   .MACRO ?DARG1
         LDA ?DARG1
         BNE 254$
         DEC ?DARG1+1
254$
         DEC ?DARG1
 .ENDM


MMU   = $FF00

CHROUT = $FFD2
CLRCHN = $FFCC
CLOSE  = $FFC3
SETLFS = $FFBA
OPEN   = $FFC0
CHKOUT = $FFC9

CLCADR     = $26A8
SWAPNYBL   = $25DB
GETPIXSTAT = $2652
GETCOLSTAT = $266E

CURCOLOR = $1318
SCRCSIZE = $131A
SCRSIZEY = $131C
SCRSIZEX = $1324
X0       = $136B
Y0       = $136D
MASK     = $137B
PARM1    = $13EF
PARM2    = $13F0
PARM3    = $13F1
PARM4    = $13F2

MLHCOPY
  LDA PARM4
  BEQ 99$
  JMP MLHCOPYR
```

```
99$
  LDA PARM1
  STA SECADR
  LDA PARM2
  STA HCHT
  LDX PARM3        ;1=SINGLE  2=DOUBLE
  DEX
  LDA DENSITY,X
  STA ESCDAT+5

  LDA SCRSIZEX
  STA ESCDAT+6
  LDA SCRSIZEX+1
  STA ESCDAT+7

  LDX HCHT
  DEX
  LDA CNVTHT,X
  STA HCHT
  LDA #8
2$
  DEX
  BMI 1$
  LSR A
  JMP 2$
1$
  STA STEP

  LDA MMU
  AND #$FE
  STA MMU
  JSR OPNCHN
  LDA #7
  STA BN
  LDA #0
  STA BV      ;BYTE VALUE TO CHROUT = 0
  STA Y1      ;Y0=0
  STA Y1+1
NXTY
  JSR PRTESC    ;DO FOR EACH ROW = 8*HEIGHT
  LDA #0
  STA X0
  STA X0+1
NXTX
  LDA Y1
  STA Y0
  LDA Y1+1
  STA Y0+1
  CLC
  LDA Y0
  ADC STEP
  STA ENDY0
  LDA Y0+1
  ADC #0
  STA ENDY0+1
NXTY0
  LDA #0
  STA HTCNTR
```

```
NXTHT
   JSR GETPIX    ;GET PIXEL VALUE AT X0,Y0  IF X0>SCRSIZEX AND <880 THEN CLC
   ROL BV        ;ROLL CARRY INTO BYTE VALUE   0 OR 1
   DEC BN        ;BIT#=BIT#-1
   BPL 1$
   LDA BV        ;IF BN<0 THEN PRINT BV:BN=7
   JSR CHROUT
   LDA #7
   STA BN
   LDA #0
   STA BV
1$
   INC HTCNTR
   LDA HTCNTR
   CMP HCHT
   BNE NXTHT
   INCWRD Y0
   LDA Y0
   CMP ENDY0
   BNE NXTY0
   LDA Y0+1
   CMP ENDY0+1
   BNE NXTY0
  .LOCAL
   INCWRD X0
   LDA X0
   CMP SCRSIZEX
   BNE NXTX          ;IF X0< SCRSIZEX THEN GOTO NXTY  DO NEXT SCANLINE
   LDA X0+1
   CMP SCRSIZEX+1
   BNE NXTX
   CLC
   LDA Y1
   ADC STEP
   STA Y1
   LDA Y1+1
   ADC #0
   STA Y1+1
   LDA Y1
   CMP SCRSIZEY
   LDA Y1+1
   SBC SCRSIZEY+1
   BCC NXTYJ
HCERR
   JSR CLRCHN
   LDA #4
   JMP CLOSE
NXTYJ
   JMP NXTY

OPNCHN
   LDA #0
   STA $B7
   LDX #4
   TXA
   LDY SECADR
   JSR SETLFS
   JSR OPEN
  LDX #4
  JMP CHKOUT

PRTESC
  LDX #0
1$
  LDA ESCDAT,X
  JSR CHROUT
  INX
  CPX #8
  BNE 1$
  RTS

GETPIX
  LDA Y0
  CMP SCRSIZEY
  LDA Y0+1
  SBC SCRSIZEY+1
  BCS 1$
  JSR CLCADR
  JSR GETPIXSTAT
  AND MASK
  BEQ 1$
  SEC
  RTS
1$
  CLC
  RTS

ESCDAT
 .BYT 13,10,27,'1',27,'K',<640,>640
CNVTHT
 .BYT 1,2,4,8    ;TRANSLATE HT OF 1,2,3,4 TO 1,2,4,8
DENSITY
 .BYT 'K','L'

SECADR
 .BYT 0
HCHT
 .BYT 0

BN
 .BYT 0
BV
 .BYT 0
HTCNTR
 .BYT 0
STEP
 .BYT 0
ENDY0
 .BYT 0,0
Y1
 .BYT 0,0


MLHCOPYR
  LDA PARM1
  STA SECADR
  LDA PARM2
  STA HCHT
  LDX PARM3        ;1=SINGLE  2=DOUBLE
  DEX
  LDA DENSITY,X
  STA ESCDAT+5

  LDA SCRSIZEY
  STA ESCDAT+6
  LDA SCRSIZEY+1
  STA ESCDAT+7
  LDX HCHT
  DEX
  LDA ESCDAT+6
4$
  DEX
  BMI 3$
  ASL A
  ROL ESCDAT+7
  JMP 4$
3$
  STA ESCDAT+6

  LDX HCHT
  DEX
  LDA CNVTHT,X
  STA HCHT
  LDA #8
  STA STEP

  LDA MMU
  AND #$FE
  STA MMU
  JSR OPNCHN
  LDA #7
  STA BN
  LDA #0
  STA BV      ;BYTE VALUE TO CHROUT = 0
  STA X1      ;X1=0
  STA X1+1
NXTX1R
  JSR PRTESC    ;DO FOR EACH ROW = 8*HEIGHT
  LDA SCRSIZEY
  STA Y0
  LDA SCRSIZEY+1
  STA Y0+1
  DECWRD Y0
NXTYR
  LDA #0
  STA HTCNTR
NXTHTR
  LDA X1
  STA X0
  LDA X1+1
  STA X0+1
  CLC
  LDA X0
  ADC STEP
```

```
   STA ENDX0
   LDA X0+1
   ADC #0
   STA ENDX0+1
NXTXR
   JSR GETPIX     ;GET PIXEL VALUE AT X0,Y0  IF X0>SCRSIZEX AND <880 THEN CLC
   ROL BV         ;ROLL CARRY INTO BYTE VALUE   0 OR 1
   DEC BN         ;BIT#=BIT#-1
   BPL 1$
   LDA BV         ;IF BN<0 THEN PRINT BV:BN=7
   JSR CHROUT
   LDA #7
   STA BN
   LDA #0
   STA BV
1$
   INCWRD X0
   LDA X0
   CMP ENDX0
   BNE NXTXR
   LDA X0+1
   CMP ENDX0+1
   BNE NXTXR
   INC HTCNTR
   LDA HTCNTR
   CMP HCHT
   BNE NXTHTR
  .LOCAL
   DECWRD Y0
   LDA Y0
   CMP #$FF
   BNE NXTYR          ;IF Y = 0 THEN GOTO NXTY  DO NEXT SCANLINE
   LDA Y0+1
   CMP #$FF
   BNE NXTYR
   CLC
   LDA X1
   ADC STEP
   STA X1
   LDA X1+1
   ADC #0
   STA X1+1
   LDA X1
   CMP SCRSIZEX
   LDA X1+1
   SBC SCRSIZEX+1
   BCC NXTXJR
HCERRR
   JSR CLRCHN
   LDA #4
   JMP CLOSE
NXTXJR
   JMP NXTX1R

ENDX0
  .BYT 0,0
X1
  .BYT 0,0
```

.END

GEMINI II

This printer driver is on your **BASIC 8.0** disk with the name **P.HC-GEMINI2.** This is not the default driver built into the **BASIC 8.0** system, so it is necessary to install it with the command **BLOAD "P.HC-GEMINI2",B0,P26064.**

The secondary address to use is 8.

This driver can only use the range of heights (1-2) in the height parameter of **@HCOPY**, and only 2 densities are supported by the GEMINI II. For a 640 x 200 pixel screen a height of 2 with a density of 2 gives a very good proportional hardcopy of the screen, although the image is always rotated 90 degrees. Or use a height of 1 with a density of 1 and your 640 x 200 image prints just about the size of a small envelope. The GEMINI II can only print unrotated images upto 480 horizontal pixels wide, and since the smallest screen is at least 640 pixels wide the image is always rotated.

This is the source code (written with the Commodore C128 Assembler Development Package). If you have a near GEMINI II compatible printer that doesn't work quite right, it may be possible for you (if you are a machine language programmer) to convert it to a new driver for your printer.

This source code is supplied as a courtesy to all registered **BASIC 8.0** owners.

```
 .PAGE
;NAME       HARD COPY
;CREATED    12/20/86
;UPDATED
;AUTHOR     DAVID DARUS
;ASSEMBLER HCD65
;COMPUTER   C-128
;REMARKS    BASIC 8  HARD COPY  DRIVER FOR GEMINI II
;                    X * 480   ROTATED
*=$65D0

INCWRD  .MACRO ?IARG1
        INC ?IARG1
        BNE 255$
        INC ?IARG1+1
255$
 .ENDM

DECWRD  .MACRO ?DARG1
        LDA ?DARG1
        BNE 254$
        DEC ?DARG1+1
254$
        DEC ?DARG1
 .ENDM


MMU   = $FF00

CHROUT = $FFD2
CLRCHN = $FFCC
CLOSE  = $FFC3
SETLFS = $FFBA
OPEN   = $FFC0
CHKOUT = $FFC9

CLCADR     = $26A8
SWAPNYBL   = $25DB
GETPIXSTAT = $2652
GETCOLSTAT = $266E

CURCOLOR = $1318
SCRCSIZE = $131A
SCRSIZEY = $131C
SCRSIZEX = $1324
X0       = $136B
Y0       = $136D
MASK     = $137B
PARM1    = $13EF
PARM2    = $13F0
PARM3    = $13F1
PARM4    = $13F2

MLHCOPY
  LDA PARM1
  STA SECADR
  LDA PARM2
```

```
   STA HCHT
   LDX PARM3      ;1-2
   DEX            ;CONVERTED TO 0-1
   LDA DENSITY,X  ;DENSITY CODE 8 OR 9
   STA ESCDAT+1

   LDA #7
   STA STEP

   LDA MMU
   AND #$FE
   STA MMU
   JSR OPNCHN
   LDA #6
   STA BN
   LDA #0
   STA BV       ;BYTE VALUE TO CHROUT = 0
   STA X1       ;X1=0
   STA X1+1
NXTX1
   JSR PRTESC
   LDA SCRSIZEY
   STA Y0
   LDA SCRSIZEY+1
   STA Y0+1
   DECWRD Y0
NXTY
   LDA #0
   STA HTCNTR
NXTHT
   LDA X1
   STA X0
   LDA X1+1
   STA X0+1
   CLC
   LDA X0
   ADC STEP
   STA ENDX0
   LDA X0+1
   ADC #0
   STA ENDX0+1
NXTX
   JSR GETPIX    ;GET PIXEL VALUE AT X0,Y0  IF X0>SCRSIZEX AND <880 THEN CLC
   ROR BV        ;ROLL CARRY INTO BYTE VALUE   0 OR 1
   DEC BN        ;BIT#=BIT#-1
   BPL 1$
   SEC
   ROR BV
   LDA BV        ;IF BN<0 THEN PRINT BV:BN=7
   JSR CHROUT
   LDA #6
   STA BN
   LDA #0
   STA BV
1$
   INCWRD X0
   LDA X0
   CMP ENDX0
```

```
  BNE NXTX
  LDA X0+1
  CMP ENDX0+1
  BNE NXTX
  INC HTCNTR
  LDA HTCNTR
  CMP HCHT
  BNE NXTHT
 .LOCAL
  DECWRD Y0
  LDA Y0
  CMP #$FF
  BNE NXTY          ;IF Y = 0 THEN GOTO NXTY  DO NEXT SCANLINE
  LDA Y0+1
  CMP #$FF
  BNE NXTY
  CLC
  LDA X1
  ADC STEP
  STA X1
  LDA X1+1
  ADC #0
  STA X1+1
  LDA X1
  CMP SCRSIZEX
  LDA X1+1
  SBC SCRSIZEX+1
  BCC NXTXJ
HCERR
  LDA #13            ;CARRIAGE RETURN TO CLEAR OUT BUFFER
  JSR CHROUT
  LDA #15            ;SET TO NORMAL TEXT MODE
  JSR CHROUT
  JSR CLRCHN
  LDA #4
  JMP CLOSE
NXTXJ
  JMP NXTX1

OPNCHN
  LDA #0
  STA $B7
  LDX #4
  TXA
  LDY SECADR
  JSR SETLFS
  JSR OPEN
  LDX #4
  JMP CHKOUT

PRTESC
  LDX #0
1$
  LDA ESCDAT,X
  JSR CHROUT
  INX
  CPX #2
  BNE 1$
```

```
    RTS

GETPIX
    LDA X0
    CMP SCRSIZEX
    LDA X0+1
    SBC SCRSIZEX+1
    BCS 1$
    JSR CLCADR
    JSR GETPIXSTAT
    AND MASK
    BEQ 1$
    SEC
    RTS
1$
    CLC
    RTS

ESCDAT
  .BYT 13,8    ;CR,GRAPHIC MODE

SECADR
  .BYT 0

HCHT
  .BYT 0
HTCNTR
  .BYT 0

DENSITY
  .BYT 8,9

BN
  .BYT 0
BV
  .BYT 0
STEP
  .BYT 0
ENDX0
  .BYT 0,0
X1
  .BYT 0,0

  .END
```

MPS 801/SEIKOSHA 1000/GEMINI 10X

This printer driver is on your **BASIC 8.0** disk with the name **P.HC-MPS801**. This is not the default driver built into the **BASIC 8.0** system, so it is necessary to install it with the command **BLOAD "P.HC-MPS801",B0,P26064.**

The secondary address to use is 8 for the MPS 801, 8 for the GEMINI 10X and 0 for the SEIKOSHA.

This driver can only use the range of heights (1-2) in the height parameter of **@HCOPY**, and only 1 density is supported by these printers. For a 640 x 200 pixel screen a height of 2 with a density of 1 gives a very good proportional hardcopy of the screen, although the image is always rotated 90 degrees. Or use a height of 1 with a density of 1 and your 640 x 200 image prints just about the size of a small envelope. The MPS 801 and compatibles can only print unrotated images upto 480 horizontal pixels wide, which is why the image is always rotated.

This is the source code (written with the Commodore C128 Assembler Development Package). If you have a near MPS 801 compatible printer that doesn't work quite right, it may be possible for you (if you are a machine language programmer) to convert it to a new driver for your printer.

This source code is supplied as a courtesy to all registered **BASIC 8.0** owners.

```
 .PAGE
;NAME       HARD COPY
;CREATED    12/20/86
;UPDATED
;AUTHOR     DAVID DARUS
;ASSEMBLER  HCD65
;COMPUTER   C-128
;REMARKS    BASIC 8  HARD COPY DRIVER FOR MPS-801,SEIKOSHA,GEMINI 10X
;                    X * 480   ROTATED
*=$65D0

INCWRD  .MACRO ?IARG1
        INC ?IARG1
        BNE 255$
        INC ?IARG1+1
255$
 .ENDM

DECWRD  .MACRO ?DARG1
        LDA ?DARG1
        BNE 254$
        DEC ?DARG1+1
254$
        DEC ?DARG1
 .ENDM


MMU   = $FF00

CHROUT = $FFD2
CLRCHN = $FFCC
CLOSE  = $FFC3
SETLFS = $FFBA
OPEN   = $FFC0
CHKOUT = $FFC9

CLCADR     = $26A8
SWAPNYBL   = $25DB
GETPIXSTAT = $2652
GETCOLSTAT = $266E

CURCOLOR = $1318
SCRCSIZE = $131A
SCRSIZEY = $131C
SCRSIZEX = $1324
X0       = $136B
Y0       = $136D
MASK     = $137B
PARM1    = $13EF
PARM2    = $13F0
PARM3    = $13F1
PARM4    = $13F2

MLHCOPY
  LDA PARM1
  STA SECADR
  LDA PARM2
```

```
   STA HCHT

   LDA #7
   STA STEP

   LDA MMU
   AND #$FE
   STA MMU
   JSR OPNCHN
   LDA #6
   STA BN
   LDA #0
   STA BV      ;BYTE VALUE TO CHROUT = 0
   STA X1      ;X1=0
   STA X1+1
NXTX1
   JSR PRTESC
   LDA SCRSIZEY
   STA Y0
   LDA SCRSIZEY+1
   STA Y0+1
   DECWRD Y0
NXTY
   LDA #0
   STA HTCNTR
NXTHT
   LDA X1
   STA X0
   LDA X1+1
   STA X0+1
   CLC
   LDA X0
   ADC STEP
   STA ENDX0
   LDA X0+1
   ADC #0
   STA ENDX0+1
NXTX
   JSR GETPIX    ;GET PIXEL VALUE AT X0,Y0  IF X0>SCRSIZEX AND <880 THEN CLC
   ROR BV        ;ROLL CARRY INTO BYTE VALUE   0 OR 1
   DEC BN        ;BIT#=BIT#-1
   BPL 1$
   SEC
   ROR BV
   LDA BV        ;IF BN<0 THEN PRINT BV:BN=7
   JSR CHROUT
   LDA #6
   STA BN
   LDA #0
   STA BV
1$
   INCWRD X0
   LDA X0
   CMP ENDX0
   BNE NXTX
   LDA X0+1
   CMP ENDX0+1
   BNE NXTX
```

```
    INC HTCNTR
    LDA HTCNTR
    CMP HCHT
    BNE NXTHT
   .LOCAL
    DECWRD Y0
    LDA Y0
    CMP #$FF
    BNE NXTY           ;IF Y = 0 THEN GOTO NXTY  DO NEXT SCANLINE
    LDA Y0+1
    CMP #$FF
    BNE NXTY
    CLC
    LDA X1
    ADC STEP
    STA X1
    LDA X1+1
    ADC #0
    STA X1+1
    LDA X1
    CMP SCRSIZEX
    LDA X1+1
    SBC SCRSIZEX+1
    BCC NXTXJ
HCERR
    LDA #13
    JSR CHROUT
    LDA #15
    JSR CHROUT
    JSR CLRCHN
    LDA #4
    JMP CLOSE
NXTXJ
    JMP NXTX1

OPNCHN
    LDA #0
    STA $B7
    LDX #4
    TXA
    LDY SECADR
    JSR SETLFS
    JSR OPEN
    LDX #4
    JMP CHKOUT

PRTESC
    LDX #0
1$
    LDA ESCDAT,X
    JSR CHROUT
    INX
    CPX #2
    BNE 1$
    RTS

GETPIX
    LDA X0
   CMP SCRSIZEX
   LDA X0+1
   SBC SCRSIZEX+1
   BCS 1$
   JSR CLCADR
   JSR GETPIXSTAT
   AND MASK
   BEQ 1$
   SEC
   RTS
1$
   CLC
   RTS

ESCDAT
 .BYT 13,8    ;CR,GRAPHIC MODE

SECADR
 .BYT 0

HCHT
 .BYT 0
HTCNTR
 .BYT 0

BN
 .BYT 0
BV
 .BYT 0
STEP
 .BYT 0
ENDX0
 .BYT 0,0
X1
 .BYT 0,0

 .END
```

CANNON PJ-1080A

This printer driver is on your **BASIC 8.0** disk with the name **P.HC-CANNON**. This is not the default driver built into the **BASIC 8.0** system, so it is necessary to install it with the command **BLOAD "P.HC-CANNON",B0,P26064.**

The CANNON PJ1080A is a special printer because it is a color inkjet printer. It allows the **BASIC 8.0** user to generate a reasonable quality color hardcopy at a minimal cost. It supports only 8 colors, while the C128 80 column screen has 16 colors. However, the C128's 16 colors are really only 8 colors in two intensities, so the two shades will print out as one color. For example, red and light red both print as red.

The secondary address we used for the CARDCO G and G-WIZ interfaces is 5. Other printer interfaces may require a different secondary address.

This driver can use the full range of heights (1-4) in the height parameter of **@HCOPY**, but only 1 density is supported by the CANNON PJ1080A. For a 640 x 200 pixel screen a height of 2 with a density of 1 gives a very good proportional hardcopy of the screen. Or use a height of 1 with a density of 1 and your 640 x 200 image prints just about the size of a large business envelope. The CANNON PJ1080A can print images upto 640 horizontal pixels wide.

The CANNON PJ1080A driver does not support the rotation parameter. Images greater than 640 cannot be printed.

This is the source code (written with the Commodore C128 Assembler Development Package). If you have a near CANNON PJ1080A compatible printer that doesn't work quite right, it may be possible for you (if you are a machine language programmer) to convert it to a new driver for your printer.

This source code is supplied as a courtesy to all registered **BASIC 8.0** owners.

CANNON PJ1080A BASIC 8.0 SOURCE CODE

```
 .PAGE
;NAME      HARD COPY
;CREATED   12/09/86
;UPDATED
;AUTHOR    DAVID DARUS
;ASSEMBLER HCD65
;COMPUTER  C-128
;REMARKS   BASIC 8  HARD COPY DRIVER FOR CANNON PJ-1080A
;                   640 * Y  UNROTATED  COLOR INK JET
*=$65D0

INCWRD  .MACRO ?IARG1
        INC ?IARG1
        BNE 255$
        INC ?IARG1+1
255$
 .ENDM

DECWRD  .MACRO ?DARG1
        LDA ?DARG1
        BNE 254$
        DEC ?DARG1+1
254$
        DEC ?DARG1
 .ENDM


MMU   = $FF00

CHROUT = $FFD2
CLRCHN = $FFCC
CLOSE  = $FFC3
SETLFS = $FFBA
OPEN   = $FFC0
CHKOUT = $FFC9

CLCADR     = $26A8
SWAPNYBL   = $25DB
GETPIXSTAT = $2652
GETCOLSTAT = $266E

CURCOLOR = $1318
SCRCSIZE = $131A
SCRSIZEY = $131C
SCRSIZEX = $1324
X0       = $136B
Y0       = $136D
MASK     = $137B
PARM1    = $13EF
PARM2    = $13F0
```

```
PARM3     = $13F1
PARM4     = $13F2

MLHCOPY
  LDA PARM1
  STA SECADR
  LDA PARM2
  STA ESCDAT+2    ;HEIGHT

  LDA MMU
  AND #$FE
  STA MMU
  JSR OPNCHN
  LDA #7
  STA BN
  LDA #0
  STA BV      ;BYTE VALUE TO CHROUT = 0
  STA Y0      ;Y0=0
  STA Y0+1
NXTY
  LDA #0
  STA RGBMODE
  JSR PRTESC    ;DO FOR EACH ROW = 8*HEIGHT
6$
  LDA #0
  STA X0
  STA X0+1
2$
  JSR GETPIX    ;GET PIXEL VALUE AT X0,Y0  IF X0>SCRSIZEX AND <880 THEN CLC
  ROL BV        ;ROLL CARRY INTO BYTE VALUE   0 OR 1
  DEC BN        ;BIT#=BIT#-1
  BPL 1$
  LDA BV        ;IF BN<0 THEN PRINT BV:BN=7
  JSR CHROUT
  LDA #7
  STA BN
  LDA #0
  STA BV
1$
  INCWRD X0
  LDA X0
  CMP #<640
  BNE 2$         ;X0<640 THEN GOTO 2$
  LDA X0+1
  CMP #>640
  BNE 2$
  INC RGBMODE
  LDA RGBMODE
  CMP #3
  BNE 6$        ;REPEAT SCANLINE TO GET 3 (RGB) COLOR ELEMENTS
 .LOCAL
  INCWRD Y0
  LDA Y0
  CMP SCRSIZEY
  BNE NXTY         ;IF Y0< SCRSIZEY THEN GOTO NXTY  DO NEXT SCANLINE
  LDA Y0+1
  CMP SCRSIZEY+1
  BNE NXTY
```

```
HCERR
  JSR CLRCHN
  LDA #4
  JMP CLOSE

OPNCHN
  LDA #0
  STA $B7
  LDX #4
  TXA
  LDY SECADR
  JSR SETLFS
  JSR OPEN
  LDX #4
  JMP CHKOUT

PRTESC
  LDX #0
1$
  LDA ESCDAT,X
  JSR CHROUT
  INX
  CPX #4
  BNE 1$
  RTS

GETPIX
  JSR CLCADR         ;X,Y TO ADDR
  LDA SCRCSIZE       ;COLOR SCREEN
  BEQ 1$             ;BR IF MONO
  JSR GETCOLSTAT     ;GET BC/FC
  JSR SWAPNYBL       ;SWAP TO FC/BC
  JMP 2$
1$
  LDA CURCOLOR       ;GET CURRENT FC/BC
2$
  STA HCOPYCOLR      ;SAVE COLOR NYBBLES
  JSR GETPIXSTAT     ;GET PIXEL ON/OFF STAT
  AND MASK
  BEQ 3$             ;BR IF OFF
  LDA HCOPYCOLR      ;USE FC BECAUSE PIXEL IS ON
  LSR A              ;PUT ON 0-15 SCALE TO BE USED AS AN INDEX
  LSR A
  LSR A
  LSR A
  JMP 4$
3$
  LDA HCOPYCOLR
  AND #%00001111     ;USE BG
4$
  TAX
  LDA RGBMODE        ;0=RED 1=GREEN 2=BLUE
  BEQ 5$
  CMP #1
  BEQ 6$
  LDA BLUETAB,X
  BEQ 10$
  BNE 11$
```

```
6$
  LDA GREENTAB,X
  BEQ 10$
  BNE 11$
5$
  LDA REDTAB,X
  BEQ 10$
11$
  SEC
  RTS
10$
  CLC
  RTS

REDTAB
 .BYT 0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,1

GREENTAB
 .BYT 0,0,0,0,1,1,1,1,0,0,0,0,1,1,1,1

BLUETAB
 .BYT 0,0,1,1,0,0,1,1,0,0,1,1,0,0,1,1


ESCDAT
 .BYT 27,114,0,80

SECADR
 .BYT 0
BN
 .BYT 0
BV
 .BYT 0
RGBMODE
 .BYT 0
HCOPYCOLR
 .BYT 0

 .END
```

PRINTER	DRIVER	SEC ADR*	SIZE	DENSITY	ORIENTATION	MAX X
EPSON FX-80	P.HC-EPSON	5	1-4	1-7	B	1920
PANASONIC	P.HC-EPSON	5	1-4	1-7	B	1920
STAR NX-10	P.HC-EPSON	5	1-4	1-7	B	1920
OLIVETTI	P.HC-OLIVETTI	5	1-4	1	B	880
STAR NX-10C	P.HC-NX-10C	8	1-4	1-2	B	1280
SPIRIT 80	P.HC-SPIRIT80	5	1-4	1-2	B	1280
GEMINI II	P.HC-GEMINI2	8	1-2	1-2	R	480
MPS 801	P.HC-MPS801	8	1-2	1	R	480
SEIKOSHA	P.HC-MPS801	0	1-2	1	R	480
GEMINI 10X	P.HC-MPS801	8	1-2	1	R	480
CANNON PJ	P.HC-CANNON	5	1-4	1	U	640

SYNTAX OF @HCOPY

@HCOPY,SEC ADR,SIZE,DENSITY,ROTATION

* Where a printer interface is required, these secondary addresses represent the values required with the CARDCO B, G+ and G-WIZ interface. Other interfaces may require different secondary address values.

PRINTER DRIVER PSEUDO-CODE

The following program code segments represent **pseudo-code**, which means it is not any specific computer language. Rather, it is meant to demonstrate programming techniques and logic. These pseudo-code segments describe the logic required for various printer drivers, and they are here to make it easier to understand the supplied assembly language source code.

There are several examples, some of which are appropriate for several printers.

```
OLIVETTI UNROTATED
FOR Y=0 TO SCRSIZEY
   FOR HTMULT=0 TO HGHT
      FOR X=0 TO SCRSIZEX
         GETPIXEL(X,Y)
         BUILDBYTE          ; RIGHT TO LEFT
         BIT#=BIT#+1
         IF BIT#=8 THEN PRINT BYTE:BIT#=0
      NEXT X
   NEXT HTMULT
NEXT Y

OLIVETTI ROTATED
FOR X=0 TO SCRSIZEX
   FOR Y=SCRSIZEY TO 0 STEP -1
      FOR HTMULT=0 TO HGCT
         GETPIXEL(X,Y)
         BUILDBYTE                ;RIGHT TO LEFT
         BIT#=BIT#+1
         IF BIT#=8 THEN PRINT BYTE:BIT#=0
      NEXT HTMULT
   NEXT Y
NEXT X


EPSON,PANASONIC,SPIRIT80,NX-10,NX-10C UNROTATED
INCRM=2^(HEIGHT-1)
FOR Y=0 TO SCRSIZEY STEP INCRM
   FOR X=0 TO SCRSIZEX
      FOR TEMPY=Y TO Y+INCRM
         FOR HT=0 TO HEIGHT
            GETPIXEL(X,Y)
            BUILDBYTE          ; RIGHT TO LEFT
            BIT#=BIT#+1
            IF BIT#=8 THEN PRINT BYTE:BIT#=0
         NEXT HT
      NEXT TEMPY
   NEXT X
NEXT Y
```

EPSON,PANASONIC,SPIRIT80,NX-10,NX-10C ROTATED

```
INCRM=2^(HEIGHT-1)
FOR X=0 TO SCRSIZEX STEP INCRM
   FOR Y=SCRSIZEY TO 0 STEP -1
      FOR HT=0 TO HEIGHT
         FOR TEMPX=X TO X+INCRM
            GETPIXEL(X,Y)
            BUILDBYTE              ; RIGHT TO LEFT
            BIT#=BIT#+1
            IF BIT#=8 THEN PRINT BYTE:BIT#=0
         NEXT TEMPX
      NEXT HT
   NEXT Y
NEXT X
```

GEMINI 2,MPS 801,SEIKOSHA 1000   ROTATED

```
BIT#=6
FOR X=0 TO SCRSIZEX
   FOR Y=SCRSIZE TO 0 STEP -1
      FOR HT=0 TO HEIGHT
         FOR TEMPX=X TO X+7
            GETPIXEL(X,Y)
            BIT#=BIT#-1
            BUILDBYTE             ; LEFT TO RIGHT
            IF BIT#=-1 THEN PRINT BYTE:BIT#=6
         NEXT TEMPX
      NEXT HT
   NEXT Y
NEXT X
```

CANNON PJ-1080A UNROTATED

```
FOR Y=0 TO SCRSIZEY
   FOR RGB=0 TO 2
      FOR X=0 TO 639
         GETPIXEL(X,Y)
         BIT#=BIT#+1
         BUILDBYTE        ; RIGHT TO LEFT
         IF BIT#=7 THEN PRINT BYTE:BIT#=0
      NEXT X
   NEXT RGB
NEXT Y
```

APPENDIX A
The 8563 Video Chip RAM Expansion

The 8563 Video Chip in the C128 has it's own ram bank that it uses for displaying graphics. In the standard C128 there is 16K of ram. This ram is in the form of two chips on the motherboard of the C128, inside the small metal box that contains the C128's two video chips (the 8563 and VIC II). These ram chips are either 4416 or 4164 rams. This means that each chip contains 8192 bytes of ram (for a total of 16384 bytes). As you have read in many places in this manual, you can use this 16K for some interesting graphic displays, but we constantly mention the option of having 64K of video ram installed (the new C128D comes from the factory with this extra ram). Having the full 64K of ram offers a great enhancement in your C128's graphics, as is obvious throughout the **BASIC 8.0** manual. What do you need to get this extra ram and how should you have it installed?

To get the full 64K, you need to have the 4416's (or 4164's) replaced with a different ram chip, the 4464. This 4464 contains 32 Kbytes of ram per chip, so by substituting two of these for the two 16 Kbyte ram chips increases your available 80 column graphic ram to 64K. These 4464 rams can be found in ads for computer chips in magazines like **BYTE**, **COMPUTER SHOPPER** and many other magazines. You can also find them (or have them ordered) by your local electronic parts store.

One problem in removing the old 4416 (or 4164) chips is the fact the chips are not socketed. They are soldered to the board, and the pins are crimped (bent) on the bottom. Removing them is a tedious job that requires a skilled technician, and **is not something you should attempt yourself**. It is very easy to damage the board and ruin your C128, not something you want to do. If you decide to upgrade to the 64K video ram, we strongly suggest you contact your local CBM service center and ask them to install the 4464 ram chips. If you are not skilled at this type of work, you can **count on** some serious harm coming to the computer. It is that easy to damage!

Also, have the service center install sockets before they put in the 4464 chips. This makes it easy to replace the chips in the future (if you ever need to).

If you would like more technical information on replacing your 8563 ram chips, there have been articles published in both the **Computer Shopper** and **Transactor** magazines that detail their installation.

A final warning. **Do not attempt to change these ram chips yourself! Your most likely result will be serious damage to the C128. Have the 4464 rams installed at a reputable Commodore Service Center.**

APPENDIX A

APPENDIX B
8563 VIDEO RAM MEMORY MAPS
MODE's 0-3

The **MODE** command configures the available bitmap ram for the 8563 into 8 different screens per mode. In **MODE 0** each screen represents the one screen available in the 16K ram area. In **MODE's 1-2** there are some combinations that allow multiple concurrent screens. **MODE 3**, while a 64K graphics ram mode, does not allow more than one screen to exist at the same time because each screen uses the entire 64K ram available.

The following memory maps show the memory usage of each screen and mode. 'You can create screens like these by using the SCRDEF command. For more information, see Chapter 10, the BASIC 8.0 COMMAND ENCYLOPEDIA for information on the **MODE** and **SCRDEF** commands.

MODE 0

Screen #	Type	Width	Height	Bitmap Address	Color Address
0	M	640	200	0-15999	0
1	C 8x16	640	192	0-15359	15360
2	C 8x8	640	176	0-14079	14080
3	C 8x4	640	152	0-12159	12160
4	C 8x2	640	104	0-8319	8320
5	C 8x8 Lace	640	176	0-14079	14080
6	C 8x4 Lace	640	152	0-12159	12160
7	C 8x2 Lace	640	104	0-8319	8320

MODE 1

Screen #	Type	Width	Height	Bitmap Address	Color Address
0	M	640	200	0-15999	0
1	C 8x8	640	200	16000-31999	32000
2	C 8x2	640	200	34000-49999	50000
3	M	640	300	34000-33999	34000
4	C 8x8	640	200	0-15999	16000
5	C 8x8	640	200	18000-33999	34000
6	C 8x8	640	200	36000-51999	52000
7	C 8x8	640	728	0-58239	58240

MODE 2

Screen #	Type	Width	Height	Bitmap Address	Color Address
0	M	640	200	0-15999	0
1	M	640	200	16000-31999	0
2	M	640	200	32000-47999	0
3	M	640	200	48000-63999	0
4	C 8x2	640	200	0-15999	16000
5	C 8x2	640	200	24000-39999	40000
6	C 8x4	640	200	24000-39999	40000
7	C 8x4	640	200	44000-59999	60000

MODE 3

Screen #	Type	Width	Height	Bitmap Address	Color Address
0	M	1280	409	0-65439	0
1	M	640	819	0-65519	0
2	M	2040	252	0-64259	0
3	M	800	655	0-65499	0
4	C 8x2	640	546	0-43679	43680
5	C 8x4	640	655	0-52399	52400
6	C 8x8	640	728	0-58239	58240
7	C 8x16	640	768	0-61439	61440

Appendix C
BASIC 8.0 MEMORY MAP

ZERO PAGE LOCATIONS USED:

```
$9E,9F
$AC-$B5
$FA,FB,FC,FD
```

BUFFER AREA USED: $0F00-$0FFF

SYSTEM CODE: $1300-$6FFF

FREE USER BYTES: $1464-$146B

PRINTER DRIVERS: $65D0-$68CF

SOLID ROUTINES: $68D0 - $6FFF

16 POINTER DEFINTIONS:16 bytes definable by user with pokes

```
 #0 - $0E00
 #1 - $0E10
 #2 - $0E20
 #3 - $0E30
 #4 - $0E40
 #5 - $0E50
 #6 - $0E60
 #7 - $0E70
 #8 - $0E80
 #9 - $0E90
#10 - $0EA0
#11 - $0EB0
#12 - $0EC0
#13 - $0ED0
#14 - $0EE0
#15 - $0EF0
```

Pointers consist of a 16 pixel by 8 pixel matrix. For example:

```
1111111100000000   255,0
1111100000000000   248,0
1100110000000000   204,0
1100011000000000   198,0
0000001100000000     3,0
0000000110000000   1,128
0000000011000000   0,192
0000000001100000    0,96
```

However, by using the optional last parameter in the @PTR command (see Chapter Ten) you can change the height used in the pointer. The number is definable from 1 to 16, with the default on powerup as 8. If you were to change the default by using the value 16, all subsequent uses of the **@PTR** command would use 16 scanlines to define the pointer, until a different height value is used.

If you wish, you can use the larger height values to create bigger, sprite-like objects. In the case of a height of 16, each of the new bigger pointers would consist of pairs of subsequent pointers. In this case, a pointer defintion of 0 would use pointer def's 0 and 1, a defintion of 2 would use pointer def's 2 and 3, etc.

If you create sets of pointer definitions you want to save and reuse, remember that the pointer definitions are stored in the same place as the 40 column sprite definitions. So you can save and load them with the Basic 7.0 commands BLOAD and BSAVE.

```
BLOAD "PTRS.B8",B0,P3584
BSAVE "PTRS.B8",B0,P3584 TO P3839
```

One final note. When programming with datafiles or devices, it is important that you are aware of the file numbers used by **BASIC 8.0**.

When performing a hardcopy with **@HCOPY**, **BASIC 8.0** uses file number 4. And when performing disk Input/Output it uses file number 2. You should not use these filenumbers in your programs when using these **BASIC 8.0** commands.

APPENDIX D
File Formats & Naming Conventions

BASIC 8.0 has four specific file types (**brushes, patterns, fonts** and **logo**). Each of these has a specific defined structure, in some ways like the Amiga PC's IFF system. This section documents these four formats, as well as suggesting a structure for 3D graphic data files. We also make suggestions on filenames to be used for each format, in order to make different applications written by different programmers recognize and use each others datafiles.

NAMING CONVENTIONS:

BRUSH - A BRUSH is really any piece of the bitmap screen. It can be as small as a single byte, or as large as the entire screen. We suggest the name **BRUSH** be used for sections smaller than a screen, in order to identify them as different in size from pictures.

Start each brush with the letters **BRUS**. For example;
BRUS.DISK
BRUS.CHART
BRUS.OBJECT8X2 (Indicates it is in 8x2 color format)

The structure of a **BRUSH** file is:

Load Address (2 bytes) Lo/Hi
FILE IDENTIFIER (4 bytes) BRUS
FILE TYPE (1 byte) 4
Column # (1 byte)
Scanline (2 bytes) Lo/Hi
Compression Flag (1 byte)
ColorSize (1 byte)
DX Columns (1 byte)
DY (2 bytes) Lo/Hi
BC (background color 1 byte)
FC (foreground color 1 byte)
OC (outline color 1 byte)
Brush data ...

PICTURE - A PICTURE is really a brush as large as the entire screen. We suggest the name **PICTURE** be used for brushes that are full screen, in order to identify them as different in size from brushes.

Start each picture with the letters **PICT**. For example;
PICT.SCENE
PICT.GRAPH
PICT.PLOT8X4 (Indicates it is in 8x4 color format)

The structure of a **PICTURE** file is exactly the same as a BRUSH.
PATTERNS

Start each pattern with the letters **PATR**. For example;

PATR.BRICKWALL
PATR.DIAGONAL8x8 (Indicates it is in 8x8 color format)

PATR.HAPPYFACE

The structure of a **PATR** datafile is:

LOAD ADDRESS (2 bytes) Lo/Hi
FILE IDENTIFIER (4 bytes) PATR
FILE TYPE (1 byte) 1
COLUMN DX (1 byte)
SCANLINE DY (1 byte)
COLOR DX (1 byte)
COLOR DY CELLS (1 byte)
Pattern data ...

FONTS

Start each font with the letters **FONT**. For example;
FONT.Roman
FONT.160Column
FONT.Technical

The structure of a **FONT** datafile is:

Load Address (2 bytes) Lo/Hi
FILE IDENTIFIER (4 bytes) FONT
FILE TYPE (1 byte) 3
FONT DEFINITION COLUMNS WIDE (1 byte)
FONT DEFINITION SCANLINES DEEP (1 byte)
FONT data ...

LOGO

Start each logo with the letters **LOGO**. For example;
LOGO.MENU1
LOGO.REQUESTOR
LOGO.TITLEPAGE

The structure of a **LOGO** datafile is:

LOAD ADDRESS (2 bytes) Lo/Hi
FILE IDENTIFIER (4 bytes) LOGO
FILE TYPE (1 byte) 2
FLAG (1 byte, 0 indicates end of data)
FONT STRUCT# (1 byte)
COLUMN (1 byte)
ROW LO (1 byte)
ROW HI (1 byte)
HEIGHT (1 byte)
WIDTH (1 byte)
DIRECTION (1 byte)
STRING LENGTH (1 byte)
STRING ... (string length)

3D DATAFILES

In addition to these system file formats, it is likely users will generate additional datafiles to store 3D line drawings. We suggest two formats which should cover most programmers needs, and if the filename convention is used will facilitate the use by others of user generated 3D objects.

Format one (3DF1.) concerns storing discrete lines as the six points used to define the line. The file consists of one word that identifies the total number of 3D lines (N) to follow. Then follow six*N points of data. This format is easy to read and write, but has the drawback of requiring a larger amount of file (and memory) space.

3DF1. An example of writing format 1

```
  0 read n
 10 dim x1(n),x2(n),y1(n),y2(n),z1(n),z2(n)
 20 rem read n 3D lines from data statements in program
 30 for i=1 to n
 40 read x1(i),y1(i),z1(i),x2(i),y2(i),z2(i)
 50 next i
 60 rem open seq disk file and write data as format 3DF1.
 70 open 8,8,8,"3DF1.object,s,w"
 80 print#8,"3DF1" : REM WRITE THE FILETYPE AS FIRST WORD
 90 print#8,str$(n)
100 for i=1 to n
110 x1$=str$(x1(i)):print#8,x1$
120 y1$=str$(y1(i)):print#8,y1$
130 z1$=str$(z1(i)):print#8,z1$
140 x2$=str$(x2(i)):print#8,x2$
150 y2$=str$(y2(i)):print#8,y2$
160 z2$=str$(z2(i)):print#8,z2$
170 next i
180 close8
190 rem this file defines n lines that can be drawn in
200 rem the BASIC 8.0 format LINE,X1,Y1,Z1,X2,Y2,Z2,1
```

Format 2 (3DF2.) is somewhat more complex, but can store more information in a smaller file. It consists of a system that stores information as groups of connected points. The file begins with a number (NG) that specifies the number of groups. Each group begins with a number (NP) that indicates the number of points in that group. These points are connected, with point 1 starting the object, point 2 as the endpoint of point 1, point 3 as the endpoint of point 2, and continuing with point NP as the endpoint of point NP-1.

Here is an example of reading a **3DF2** datafile.

```
10 open 8,8,8,"3DF2.datafile,s,r"
20 input#8,ft$:rem filetype 3df2
30 input#8,ng$:ng=val(ng$)
40 for i=1 to ng
50 input#8,np$:np=val(np$)
60 rem get first point in this group
70 input#8,x1$:x1=val(x1$)
80 input#8,y1$:y1=val(y1$)
90 input#8,z1$:z1=val(z1$)
100 for j=2 to np
110 input#8,x2$:x2=val(x2$)
120 input#8,y2$:y2=val(y2$)
130 input#8,z2$:z2=val(z2$)
140 rem draw line
150 @line,x1,y1,z1,x2,y2,z2,1
160 x1=x2:y1=y2:z1=z2
170 next j
180 next i
190 close8
200 end :REM OF FILEREADER
```

EXAMPLE OF 3DF1 FILE:

```
3DF1
4
0,0,0,10,10,10
100,50,-10,37,199,100
639,199,199,639,199,-199
0,100,0,0,100,100
```

EXAMPLE OF 3DF2 FILE:

```
3DF2
3
4
0,0,0
100,10,100
0,0,100
0,0,-100
3
25,25,-25
50,25,-25
50,50,-25
6
0,0,0
100,0,0
100,100,0
100,100,100
100,100,-100
100,100,200
```

A Standard Basic 8.0 Program

This is a simple program that introduces you to some of the basics of programming in BASIC 8.0. It demonstrates the proper way to start and end a BASIC 8.0 program, and the best way to handle error trapping in your C128 BASIC 8.0 programs.

```
  10 TRAP 1000:REM Get out if you have trouble
  20 @WALRUS,0:REM Set up for 16K mode
  30 @MODE,0:REM USe the 16K MODE Screens
  40 @SCREEN,2:REM 8x8 640x176 Color Screen
  50 @CLEAR,0,2,0
  60 @COLOR,2,4,0
  70 @DRWMODA,1,0,0,0,0,0,0
  80 @DRWMODB,0,0,0
  90 @ANGLE,0,0,0,0:@ORIGIN,320,100,100,320,100,200
 100 REM YOUR PROGRAM BEGINS HERE
     .
     .
     .
     .
     .
1000 @DRWMODA,1,0,0,0,0,0,0:REM RESTORE DRAWMODES TO DEFAULT
1010 @DRWMODB,0,0,0
1020 @ANGLE,0,0,0,0:REM SET DRAWING ANGLES TO 0
1030 @ORIGIN,320,100,100,320,100,200:REM RESET ORIGINS
1040 @TEXT:END
1050 END
```

This program demonstrates the proper way to begin and end a BASIC 8.0 program. It begins with the TRAP command. TRAP instructs the computer what to do if an error occurs, for example a syntax error or a press of the STOP key. In this case it goes to line 1000 and re-initializes the DRWMOD's, ANGLE and ORIGIN to the defaults, and returns the C128 to TEXT mode. This is a necessity in EVERY BASIC 8.0 program, as you will most likely have an error occur when you are in BITMAP mode. Without the TRAP command, you could get stuck and have to reset the C128 and re-boot BASIC 8.0 in order to regain command of the keyboard.

Appendix E
Data Compression

BASIC 8.0 offers as an option in it's storage of brushes and pictures the ability to compress the data into a smaller, more compact date structure. This data compression can be in memory as a structure or on disk as a file. This section offers some information for programmers who may need to be able to compress and uncompress data in the **BASIC 8.0** format.

Data compression is the process of compacting a set of data into a smaller set of data; yet still retaining the same meaning. This means that a set of data once uncompressed will be identical to the original data set. Besides requiring less disk space or ram to store the data, it also allows faster input/output then the original size data set.

The algorithm used to compress brushes in the **BASIC 8.0** system is a toggled run-length, meaning that if a value is repeated more than the break even point the value is compressed to a run count and run value. If a run is below the break even point then the values are retained as they are. The toggle aspect of the algorithm stems from the fact the data can toggle in and out of compressed format encoding within a single data file.

The details of the compression algorithm are:

Compressed format:

```
  byte 1 - bit 7 = 1
           bit 0-6 = count (4-127) of the number of times
                     to repeat the following byte value when
                     uncompressing data.
            4 is the break even point.  4 or more repeating
            values can be compressed.
  byte 2 - bitmap data value (0-255)
```

Uncompressed format:

```
  byte 1 - bit 7 = 0
           bit 0-6 = count n (1-127) number of uncompressed
                     unique data values to follow.
  byte 2-n uncompressed data values
```

```
   1 rem A sample uncompression program in Basic
   5 dim a$(11)
  10 open 2,8,2,"datafile,p,r"
  20 get#2,a$,b$:rem get load address
  30 for t=1 to 4:get#2,a$:next:rem BRUS header
  40 get#2,a$:rem file type
  50 for t=1 to 11:get#2,a$(t):next:rem get header info
  60 if a$(4)="1" then 120
  70 rem data not compressed
  80 get#2,a$:s=st
  90 a=asc(a$+chr$(0)):rem store A somewhere
 100 if s=0 then 80
 110 goto 200
 120 rem compressed data
 130 get#2,a$:s=st:a=asc(a$+chr$(0))
 140 if (a and 127) = 0 then 210
 150 get#2,a$:s=st:rem run value
 160 for t=1 to (a or 127):rem run count
 170 rem store asc(a$+chr$(0)) somewhere
 180 next
 190 if s=0 then 130
 200 close 2:end
 210 rem uncompressed toggle
 220 for t=1 to (a or 127)
 230 get#2,a$:s=st
 240 rem store asc(a$+chr$(0)) somewhere
 250 if s<>0 then t=(a or 127):goto 200
 260 next t
 270 goto 190
```

Appendix F
STANDARD STRUCTURE # USES

Suggested standard locations for data structures.

STRUCTURE#	USE
0	FONT.CURSIVE
1	FONT.COMPUTER
2	FONT.ROMAN
3	FONT.GOTHIC
4	FONT.FANCY
5	FONT.THIN
6	FONT.TECH
7	FONT.SCRIPT
8	FONT.CURSIVE
9	FONT.160 COLUMN
10-19	User supplied FONT's
20-29	LOGO.
30-39	PATR.
40-99	BRUS.

These are suggestions only, you may vary them as your programming requirements dictate.

The Players

WALRUSOFT Inc. -	Company started and owned by Louis R. Wallace and David P. Darus (with a little help from our friends)
David P. Darus -	President, Senior Programmer, Designer for Walrusoft Writer and Consultant Computer Science Graduate, University of Florida 1984 Fleet Analyst, Gainesville FL Regional Utilities
Louis R. Wallace -	Secretary/Treasurer, Programmer, Designer and Documentation Specialist, Writer, Editor Research Chemist and Computer Specialist, Veterans Administration Medical Center, Gainesville
Ken French -	A good friend who provided great insight and help in the design and implementation of the printer drivers.
Richard Rylander -	Original author of the 3D solids commands for C64

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