COLOR SCHEMATIC DESIGNER VERSION 2.0

BY **PRAKASH MISHRA**

DIST BY MICROCOM SOFTWARE

Color Schematic Designer v2.0

Welcome to CSD version 2.0!

Color Schematic Designer is a powerful software package designed for use by the electronics hobbyist interested in drafting schematic diagrams in a precise interactive environment, including the capability to create high-quality reproductions of schematic diagrams on inexpensive printers.

Besides the common features of line drawing, symbol libraries, text display, etc. found in other similar programs, Color Schematic Designer, designed for the 128K Color Computer with disk drive and RS-DOS, gives you a substantially larger workspace, different color coded layers of circuitry, a range of different text fonts, multiple error undo features, and superior, publication quality output.

Unlike other Color Computer graphics design and circuit design programs, which store actual graphics screens of the circuitry in memory, Color Schematic Designer is an "object-oriented" program. The circuit is stored as a set of objects and instruct icons on how the circuit is put together. This means the physical size of the circuit is nearly unlimited - any design consisting of up to nearly one-thousand symbols, lines, etc., can be kept in memory.

Color Schematic Designer represents the cutting edge of CoCo software with its graphical interface, pull-down menus, and user-friendly design. Version 2.0 adds true publication quality output as well as faster execution and other new features. Thank you for purchasing Color Schematic Designer v2.0 - you will find it a step above and beyond any other similar program for the Color Computer series.

A Note about CSD and Backups

It is always important to have backups of important files and programs, in case of accidental physical damage to the disk, such as spilled coffee, or a collision with a dog's jaws. However, in certain cases backups are even more important.

Color Schematic Designer is a disk intensive program. Because it is too large to fit into memory at once, parts of the program and your data are constantly being swapped in and out of memory and the disk drive. For this reason, the disks you keep Color Schematic Designer on will wear out after a period of time, not because of physical neglect, but just because the program uses the disk drive so much.

For your own protection make backups of your datafiles and main program disk often, and keep them in a safe place.

Table of Contents

Getting Started

After turning on your computer system, make a DISKCOPY of your Color Schematic Designer disk onto a blank disk and set aside your original. Use the new disk as your work disk, always keeping the original in a safe place.

After you have made this backup copy, place it into your disk drive (or drive 0 in a multi-drive system) and type

RUN "BOOT"

After you press ENTER the program will load and begin its startup functions. In five or ten seconds you will see a small blinking cursor in the center of the screen. The program is now ready for use.

General Use

The cursor is used to indicate where to draw lines or put symbols or text. Press your arrow keys a few times and note its movement, along with the changing coordinates (labelled X and Y) on the menu bar at the top of the screen. Try holding the keys down for various lengths of time, or pressing two of them simultaneously. More details on cursor movement, including the use of a joystick or mouse, are given in the Mode section of the manual, but for now familiarize yourself with the arrow keys.

Across the top of the screen is a colored area called the menu bar. Each of the words across the top two lines denote a command or class of commands. Attached to most of these words is another list of commands, collectively called a menu. These can be displayed by pressing the first letter of the word on the menu bar. For instance, press [F] to "pull down" the File menu. You will now see a list of commands classified under File: Open, Close, Save, Directory, et cetera. To access any of these File commands, simply press its first letter. Try pressing [D], for Directory. The File menu will disappear, and a box will appear on the screen. These boxes are often called dialog boxes, because the computer can ask you questions by using them. In the Directory dialog box you will see a list of all the schematic files on the disk currently in the disk drive. This may take a few seconds. Note that only schematic files are displayed in the directory. At this point you will see a number of test and sample circuits included with the program.

Press any key to remove the dialog box from the screen. Suppose now you want to load a circuit diagram from the disk, perhaps the one called RECEIVER. Type the following one letter commands:

File Open

Do not press ENTER. You will see a dialog box asking for a filename. Type

RECEIVER

Feel free to backspace with the left arrow key if you make a mistake. Notice that because the filename is exactly eight characters long, you do not have to press ENTER. If it were shorter, you would have to press ENTER.

The circuit will load from disk and momentarily it will be drawn on the screen. Notice how this process takes place - it is very similar to the method employed in the IBM PC world by such programs as AutoCAD and VersaCAD. Once complete, the cursor will reappear, signifying readiness for another command.

This generally introduces you to the way Color Schematic Designer works. All the commands and features are described in detail in the next section of the manual. Please read the entire next section of the manual before attempting to use the program . You may, however, skip the asterisked (*) entries, as they deal with more advanced and complicated features which will be considered later in the manual.

Command Overviews

The following sections detail the various menus and commands of Color Schematic Designer. Entries marked with an asterisk (*) denote more advanced functions which will be covered in greater detail later in the manual.

The File menu

The File menu contains those commands used to save and load schematic files, get a disk directory, create printer output, erase memory, and to quit.

Open: Loads a diagram from the disk. Type in the name of the file to load. Note that if the filename is eight characters long, you do not have to press the ENTER key. Erases any previously loaded data in memory.

Close: Saves the schematic file currently in memory to disk and allows you to exit the program if you want to. If the file you are working on already has a name, it will be saved with that name. If not, the file will be given the name CURRFILE and will be loaded automatically the next time you run the program. This autoload feature is covered in more detail in a later section.

Save: Use this command when you want to rename a file or name a file for the first time. Simply give it a name eight or fewer characters in length, and press ENTER if necessary. The file will be saved to disk.

Quit: Use this command when you are finished working on your diagram for the time being, have already saved it, and would like to exit the program.

Directory: Gives you a listing of the schematic files in your disk drive. Press any key when you have finished looking.

*Top Layer: Takes a schematic file and loads it directly into the top layer of the workspace. On the screen it will appear all one color to distinguish it from other layers and the "global" layer. Note that any layer information in the file to be loaded is ignored, and the entire file is merged with the current top layer. Refer to the Advanced Features section for more information on layering.

*Mid Layer: Similar to the Top Layer command, this will merge a file into the middle layer of the workspace.

*Low Layer: Similar to the Top Layer and Mid Layer commands, this merges a file into the low layer of the workspace.

Print: Allows you to print out all or a part of the circuit in various different resolutions and sizes on a number of printers. Baud rate, etc. is selectable. Please see the Printout section for more details.

Erase All: This command will clear the workspace to allow you to start a new circuit. Note: this will not ask you for confirmation before erasing memory. Once erased, you cannot retrieve you circuit unless you had saved it prior to issuing the command. Be careful with this command!

The Mode menu

The Mode menu allows you to specify what type of display you have and whether you have a joystick or mouse. It also includes advanced layer-mode related commands.

RGB: Tells the program you have an RGB monitor, and you want the standard color set.

NSTC: Indicates that you have a color TV or a color composite monitor. Refer to the Changing Defaults section of the manual to set the program to automatically select this mode when it is run. Note that the resolution of a composite screen is limited and menus may not be very legible - RGB or monochrome monitors are recommended.

B&W: Similar to the preceding two commands, this specifies that you have a monochrome television or monitor. Refer also to Changing Defaults later in the manual.

Inv RGB: The same as RGB, but a different color set, for those who prefer a dark background.

Joystick: Turns on the joystick as a positioning device. The joystick or mouse plugged into the right-hand receptacle on your computer will be used. The joystick can be used to move the cursor in place of the arrow keys. The button on the joystick may be used in the same capacity as the ENTER key on the keyboard. If you have a two-button joystick, the second button can be used to set a junction at the current cursor location, indicating that two wires are connected there. It has the same function as the [.] key on the keyboard. The joystick may not be used to make command selections from the pull down menus. Note that the keyboard cursor controls still function when the joystick is on, and may be used for fine adjustments which are difficult with the joystick. Also, note that there are two cursor speeds when the joystick is being used - when moderately extended in one direction, the cursor will move slowly; when the joystick is fully extended, the cursor moves much more quickly. If you are using a mouse instead of a joystick, keep in mind that the program will deal with it in the same way it deals with a joystick - eight different directions of movement, and two different speeds.

Keyboard: Turns off joystick control. The keyboard can control the cursor in a number of different ways. If you press any of the four arrow keys, the cursor will move one step in the direction you choose. If you hold the key down it will repeat, and the cursor will keep moving in that direction, at first slowly, and then much faster. If you press two arrow keys simultaneously, for instance right and up arrows, the cursor will move diagnally in the corresponding direction. SHIFT plus an arrow key causes the cursor to jump to that edge of the screen in one step, and the CLEAR key causes the cursor to go to the center of the screen.

*Top Layer: Causes the program to display only the circuitry contained in the top layer of the workspace. Any items drawn while in Top Layer mode automatically are put into the top layer. See Advanced Features for more information on layering.

*Mid Layer: Similar in operation and result to the last command, this

allows you to work with the middle layer.

*Low Layer: The obvious complement to the two preceding commands, it allows you to work with the lowest layer of the workspace.

*All Layer: Use this command to return to the normal mode of operation, after you have used one of the other layering commands. Gets you back to the standard display mode, showing all three layers as well as the "global" layer.

*Symb Size: This command allows you to switch the size of the internal symbol table back to the 16 pixel by 16 pixel size which previous versions of CSD used. (From Version 2.0 the standard symbol size is 32 by 32 pixels). The command can also be used to return to the standard 32 x 32 pixel size when desired. For more information refer to Using the Other (CSD 1.x) Symbols.

The Zone menu

The Zone menu contains some very important commands. The Color Schematic Designer workspace is far larger than in any comparable Color Computer program, and is represented in the Zone menu by the vertical rectangle near the bottom. This area contains 640 x 1000 pixels, far more than the screen (640 x 192) can display at once. To solve this problem, the screen can be moved up and down in the workspace. The screen area, symbolized in the Zone menu by the small horizontal rectangle at the top of the larger vertical workspace rectangle, can be moved up and down to different areas of the workspace.

Please note that if you have just begun using Color Schematic Designer, you can ignore much of this information for the time being by keeping your diagrams small enough to fit in one screen. Once you start making more complex diagrams you can experiment with these features.

Up: Moves the screen area up in the workspace. When it is positioned where you want, use Redraw to jump to that area.

Down: Moves the screen area down in the workspace. Use Redraw when it is properly positioned to complete the command.

Jump: Allows you to jump directly to a specific vertical coordinate in the workspace. The workspace of 640 x 1000 pixels is divided into 160 x 250 blocks, which are the size of the cursor. Therefore, you may enter a vertical coordinate between 0 and about 210 to jump directly to an area of the workspace. The vertical coordinate given becomes the top of the display.

1-7: The most convenient way to get to different areas of the workspace is to use the numerical keys [1], [2], [3], [4], [5], [6], and [7]. This commands treats the workspace as seven regions, any of which you can jump to instantly by pressing the corresponding digit. The initial region when the program starts out is region 1.

Redraw: use this command after Up or Down to actually move the screen display to that area of the workspace. This command can also be used to clean up the screen if there is any clutter on it, or to remove anything else which you are not sure should be there.

The Mode menu

The Mode menu allows you to specify what type of display you have and whether you have a joystick or mouse. It also includes advanced layer-mode related commands.

RGB: Tells the program you have an RGB monitor, and you want the standard color set.

NSTC: Indicates that you have a color TV or a color composite monitor. Refer to the Changing Defaults section of the manual to set the program to automatically select this mode when it is run. Note that the resolution of a composite screen is limited and menus may not be very legible - RGB or monochrome monitors are recommended.

B&W: Similar to the preceding two commands, this specifies that you have a monochrome television or monitor. Refer also to Changing Defaults later in the manual.

Inv RGB: The same as RGB, but a different color set, for those who prefer a dark background.

Joystick: Turns on the joystick as a positioning device. The joystick or mouse plugged into the right-hand receptacle on your computer will be used. The joystick can be used to move the cursor in place of the arrow keys. The button on the joystick may be used in the same capacity as the ENTER key on the keyboard. If you have a two-button joystick, the second button can be used to set a junction at the current cursor location, indicating that two wires are connected there. It has the same function as the [.] key on the keyboard. The joystick may not be used to make command selections from the pull down menus. Note that the keyboard cursor controls still function when the joystick is on, and may be used for fine adjustments which are difficult with the joystick. Also, note that there are two cursor speeds when the joystick is being used - when moderately extended in one direction, the cursor will move slowly; when the joystick is fully extended, the cursor moves much more quickly. If you are using a mouse instead of a joystick, keep in mind that the program will deal with it in the same way it deals with a joystick - eight different directions of movement, and two different speeds.

Keyboard: Turns off joystick control. The keyboard can control the cursor in a number of different ways. If you press any of the four arrow keys, the cursor will move one step in the direction you choose. If you hold the key down it will repeat, and the cursor will keep moving in that direction, at first slowly, and then much faster. If you press two arrow keys simultaneously, for instance right and up arrows, the cursor will move diagnally in the corresponding direction. SHIFT plus an arrow key causes the cursor to jump to that edge of the screen in one step, and the CLEAR key causes the cursor to go to the center of the screen.

*Top Layer: Causes the program to display only the circuitry contained in the top layer of the workspace. Any items drawn while in Top Layer mode automatically are put into the top layer. See Advanced Features for more information on layering.

*Mid Layer: Similar in operation and result to the last command, this

allows you to work with the middle layer.

*Low Layer: The obvious complement to the two preceding commands, it allows you to work with the lowest layer of the workspace.

*All Layer: Use this command to return to the normal mode of operation, after you have used one of the other layering commands. Gets you back to the standard display mode, showing all three layers as well as the "global" layer.

*Symb Size: This command allows you to switch the size of the internal symbol table back to the 16 pixel by 16 pixel size which previous versions of CSD used. (From Version 2.0 the standard symbol size is 32 by 32 pixels). The command can also be used to return to the standard 32 x 32 pixel size when desired. For more information refer to Using the Other (CSD 1.x) Symbols.

The Zone menu

The Zone menu contains some very important commands. The Color Schematic Designer workspace is far larger than in any comparable Color Computer program, and is represented in the Zone menu by the vertical rectangle near the bottom. This area contains 640 x 1000 pixels, far more than the screen (640 x 192) can display at once. To solve this problem, the screen can be moved up and down in the workspace. The screen area, symbolized in the Zone menu by the small horizontal rectangle at the top of the larger vertical workspace rectangle, can be moved up and down to different areas of the workspace.

Please note that if you have just begun using Color Schematic Designer, you can ignore much of this information for the time being by keeping your diagrams small enough to fit in one screen. Once you start making more complex diagrams you can experiment with these features.

Up: Moves the screen area up in the workspace. When it is positioned where you want, use Redraw to jump to that area.

Down: Moves the screen area down in the workspace. Use Redraw when it is properly positioned to complete the command.

Jump: Allows you to jump directly to a specific vertical coordinate in the workspace. The workspace of 640 x 1000 pixels is divided into 160 x 250 blocks, which are the size of the cursor. Therefore, you may enter a vertical coordinate between 0 and about 210 to jump directly to an area of the workspace. The vertical coordinate given becomes the top of the display.

1-7: The most convenient way to get to different areas of the workspace is to use the numerical keys [1], [2], [3], [4], [5], [6], and [7]. This commands treats the workspace as seven regions, any of which you can jump to instantly by pressing the corresponding digit. The initial region when the program starts out is region 1.

Redraw: use this command after Up or Down to actually move the screen display to that area of the workspace. This command can also be used to clean up the screen if there is any clutter on it, or to remove anything else which you are not sure should be there.

The Text menu

Color Schematic Designer has a variety of text styles (or fonts) available, most of which include special characters such as the ohm and kilo-ohm symbols. Any three of these can be used at once in your diagram, and you can choose from these three when you use the Text menu. To change any or all of the available three fonts, please refer to the Font Customization section of the manual.

To use one of the three available fonts, simply press the letter of the one in the menu which you want to use ([A], [B], or [C]). Once you have selected one, use the arrow keys or the joystick to position the cursor wherever you want text. You can type some text, and then move the cursor to a new location and type more without reselecting the Text menu. However, once you are done with all of your text, you must press the ENTER key to signal you have finished. Special symbols, if available, can be used by pressing and holding down the ALT key while typing one of the following characters:

[O]: Ohm, [K]: Kilo-ohm, [M]: Mega-ohm
[C]: cc, [D]: dd, [S]: ss

Some of these may not be available, or may be replaced by some other character. IMPORTANT: if you make a mistake while typing, do not use the left arrow to backspace. The program will think you are just moving the cursor to a new location to type another line of text. Instead, hold down ALT while you press the left arrow. This will work as a backspace feature. Optionally you can leave the text mode by pressing ENTER, and use the Undo Last command to remove the entire line of text, and then retype it.

Experiment with the text feature awhile to get the hang of it - it is always better to be familiar with it before you have some complex diagram waiting to be labelled.

The Line menu

One of the most often used options, the Line menu lets you draw different types of lines or boxes between two or more points.

Normal: Use this to draw a solid line between any two points in the workspace - this is the most commonly used drawing command. After selecting Line Normal, move the cursor to wherever you want one end of the line. If you are connecting the line to another line or a symbol, place the cursor right over the point of connection - the line will attach automatically at exactly the rightspot. Press ENTER or use button #1 on your joystick to "anchor" this end of the line once you have positioned it properly. Make sure the cursor is not moving when you do this. Now move the cursor to wherever you want the line to end and press ENTER or your joystick button again. Use the X/Y coordinate display in the menu bar if necessary to align it properly when you use a joystick. Once you have selected the end point, the line will be drawn. If the line is not quite right, use the Undo Last command to erase it, and draw a new line. You can keep drawing lines until you choose some other function from the menu.

Dotted: This is used to draw a dotted line between points, to indicate

that two switches are joined, for instance. Its operation is exactly like the Line Normal command, except you will notice it takes longer to draw the line. Note: if possible, on large diagrams use Line Dotted sparingly, becauses it makes screen updates more sluggish.

Box: Use Line Box whenever you need to make a rectangle on the screen; examples include large and small integrated circuits, flip flops, and borders around parts lists, etc. Simply anchor one corner of the box using the same method as Line Normal, move the cursor to the place you want the diagonally opposite corner of the box, and press the button again. Note: if you want a dotted box instead of one with solid lines, you have to draw four dotted lines instead.

The Undo menu

Another very powerful feature, Color Schematic Designer's Undo commands allow you to literally erase your mistakes. Like other programs' undo features, you can remove the last thing you drew. However, in CSD you can also undo the last five things you drew, or even the last ninety-five things! An area erase feature is also available to revise things you can not use Undo Last or Undo Many for.

Last: Erases from memory the last thing you did, be it draw a line, draw a symbol, type some text, or any other workspace altering command. Note that once you undo something you can not get it back again without drawing it over. (Note to users of earlier versions: this command is now monumentally faster than before - try it out!)

Many: Allows you to erase a larger number of prior commands, to make revisions, etc. Simply type in the number of objects you would like to remove, and that many of your most recent drawing commands will be rescinded.

Eraser: This command allows you to alter an area of the workspace which you worked on earlier, whereas the previous two commands would erase more recent activity. It works just like the Line Box function, but instead of drawing a rectangle, it erases everything enclosed in its corners. Note that if you Undo Eraser the wrong area, you can Undo Last to get that area back.

The Junction:[.] command

Junction:[.] is not a menu, but rather a command used so often that it needs an entry of its own. Junction:[.] is used to indicate that two intersecting wires are electrically connected. The absence of a junction marker at the intersection of two wires usually means they are not connected electrically. At any time except when you are in Text mode, you can place a connection or junction marker at the current cursor position by pressing [.] or button #2 on your joystick device. If you are drawing lines, you can use this command whenever you want without having to reselect the Line Normal command each time you use it. (Note: some people prefer not to mark junctions, but mark non-intersections instead with a little half-loop. This is a somewhat outdated practice and results in the waste of precious worksheet memory as well as slower screen updates. Junction markers are far superior, more standard, and more efficient as well).

The Rotate command

Rotate allows you to rotate symbols in the internal symbol table by ninety degree increments. The current state of rotation is indicated by the arrowhead with appears immediately to the right of the Rotate: indicator on the menu bar when the command is used. When the arrowhead is pointing
up, the symbol is in standard orientation. Refer to the following command description for details
on its use.

The Symbol subscreen

This pull-down screen allows you to browse through, view, and select from the various schematic symbols supplied with the program. After pulling down this screen, the cursor temporarily stops, and the following keys become activated:

[<-]: Move backward one step in the symbol table.
[->]: Move forward one step in the symbol table.
ENTER: Select the symbol currently displayed for use in your design.

Any other key causes the command to be cancelled. The current symbol is displayed in the symbol window within the pull-down screen. Also displayed is a number associated with that symbol. Later on, once you become familiar with the symbol table, you can select a symbol by typing in its number in a two-digit format (if you want symbol 6, type 06). The number you type will become the current symbol. Then you can press ENTER to select it. You can also use this feature to jump around the symbol table while you are browsing.

Once you have found the symbol you want and have pressed ENTER, the symbol screen will disappear and the symbol you chose will appear at the cursor position. You can now move the symbol using the standard cursor movement commands, pressing ENTER or button #1 whenever you want to place it at its current location (make sure the cursor/symbol is stationary when you press ENTER). Also, once selected, a symbol can be rotated in ninety degree increments by using the Rotate command. You will visibly see the the symbol rotate when you do this.

Users of the CSD 1.x versions will notice that this screen system is much different, and the symbols themselves are larger and better looking. Although this new symbol set is not compatible with the circuits you made using CSD 1.x versions, provisions do exist for you to use CSD 2.0 with the older lower resolution symbol sets to maintain compatibility, and in some cases (very large, complex circuits with many discrete components) using the smaller symbols may even now be beneficial. For those users who need compatibility with CSD 1.x, or for those advanced CSD 2.0 users who want to experiment, refer to the section called Using the Other (CSD 1.x) Symbols.

Printer Output

Color Schematic Designer 2.0 has been extensively reworked in the area of printer output. Printing capabilities include fifteen different types of output, each in two different sizes, eleven more than previous versions of the program. All of these modes are for standard 9 pin printers, including EPSON, EPSON compatibles, IBM Graphics

printers, and the Tandy DMP series. Your printer may or may not be able to use all of these modes -details are given in the following section. In the description of the printout modes, three different things are specified for comparison purposes: Resolution: a number from 1 to 10, giving an indication of the output quality; Aspect ratio: a number from 0.5 to 2.0 which indicates how round circles which are output will be (a figure of 1.0 corresponds to perfectly round circles, though in practice anything from 0.8 to 1.2 will appear almost perfect); and Speed: a number from 1 to 10, where 1 takes the most time to print out and 10 takes the least time.

Note: If at first you do not want to go through all of these modes to determine what you like the best, simply use the Normal mode corresponding to your printer. When later you decide you want more control over your printouts, you can go through this information.

Tandy DMP series
If your Tandy DMP compatible printer is IBM Graphics compatible, please refer to the IBM Graphics section and use your printer in IBM mode for the best results. If you have an older model which is not compatible, you can still obtain printouts of medium resolution using the following modes:

Mode	Carriage	Quality	Aspect	Speed
Normal	std	6	1.4:1	7
Wide	wide	5	1.0:1	6
Rotated Narrow	std	5	1.2:1	5
Rotated Wide	std	5	2.3:1	4

Normal: This is the mode to use on a standard width DMP printer.
Wide: Use this as an alternate to Normal on wide carriage DMP printers.
Rotated Narrow: Rotated Narrow is really only present to preserve compatibility with older versions of CSD. In general the output from the Rotated Modes is useful because is gives you larger output, although the reolution is lower. Rotated Wide: Similar to Rotated Narrow. Will work on a standard carriage printer.

IBM Graphics compatible printers
A variety of printing modes are available for IBM Graphics compatible printers. This includes all printers which are termed "EPSON compatible." Please note that depending on the degree of compatibility of your printer, the HiRes output modes (most newer Tandy DMP printers are HiRes compatible) may not all be available - try them out to see. Also, if your printer is sufficiently compatible, you may be able to use some of the EPSON FX/LX modes in the following section as well.

Mode	Carriage	Quality	Aspect	Speed
Normal	std	6	1.7:1	7
Normal HiRes	std	9	1.7:1	2
Wide	wide	5	0.8:1	6
Wide HiRes	wide	7	0.8:1	2
Fast	std	4	1.7:1	9

Normal: Standard output mode for standard carriage printers.
Normal HiRes: High quality output mode for standard carriage printers.
Wide: Alternate output mode for wide carriage printers.
Wide HiRes: Better quality wide output.
Fast: This mode is great for getting legible draft copy very fast.

EPSON FX/LX compatible printers
This series of printers has a wider variety of available graphics modes. All of the newer EPSON models fall into this category, though some earlier ones, like the EPSON MX, do not. Certain compatibles also will be able to use these modes: you must try them out on your own printer to be sure. (Technically, if your printer supports the ESC "?n" CHR$(m) control code, these modes should work) These printers can also use all of the IBM Graphics modes, including Fast, as well.

Mode	Carriage	Quality	Aspect	Speed
Normal	std	6	1.1:1	6
Normal HiRes	std	9	1.1:1	2
90 DPI	std	7	1.2:1	6
90 DPI HiRes	std	10	1.2:1	2
72 DPI	wide	6	1.0:1	6
72 DPI HiRes	wide	8.5	1.0:1	2

Normal: Standard carriage. Same as output from older versions of CSD.
Normal HiRes: Standard carriage.
90 DPI: Slightly more compact output than Normal mode.
90 DPI HiRes: Standard carriage.
72 DPI: Wide carriage (10.5 in. minimum). Gives perfectly round circles.
72 DPI HiRes: Wide carriage, round circles.

Ready to Print
Once you have decided on a printout style, we are ready to proceed. Load the sample file RECEIVER from the CSD disk. Make sure your printer is connected to the computer and has paper in it, and then type File Print. It will take a minute or so for the program to get the file ready for printing. You will now see on the screen the following options:

IBM Graphics - STAR NX-1000
Epson FX/LX
Tandy DMP
Repeat Last
Set Baud Rate

BREAK to Quit

Since this is your first time through the print menu, select Set Baud Rate. You will be given a choice of rates from 600 to 9600 baud. Always choose the highest baud rate your printer can handle. Printing graphics is a tedious task at best - the speed of output should be limited by the speed of your printer, not the speed of your serial port. Once you have set the baud rate (by pressing the first digit of its value), the program will always automatically remember it, until you change it by repeating this process. Now choose the printer type that best applies to you (remember that newer Tandy DMP printers work best in IBM Graphics mode, once their DIP switches are set properly). You will now see a list of the types of printouts which your printer should be able to do. For now choose the entry labelled Normal. The program will now save your printer type and printout style to disk, so that if you want you can use Repeat Last next time and skip these two steps.

Once this is done a box will appear asking you if you want a Screen print or a Full print. Screen print will print out whatever is on the screen at the moment - it is a faster method of printing and should always be used when possible. Full print is for larger designs and takes more time to execute. For now choose Screen print. Assuming your printer type is right and you have it connected properly with the proper baud rate, your printer should begin printing. Graphics printing is always a tedious process, more or less so depending on the speed of your printer and the baud rate, and it will take a few minutes to print out the result.

Once the program is done, the first menu listing printer types will be shown. At this point you can try printing out in another style, or you can press BREAK to quit and return to CSD. When you use the Full print command, there will be delays while the program is "thinking" about the various details of the printout. Sizing is automatic -however long your diagram is, the Full print command will print it out properly. Also, although the program will not print an image 1000 pixels long if your schematic is only 350 pixels, the printer may go through a few blank lines before it realizes there is nothing left to print. Incidentally, if you really hate to wait out those final few blank lines, you can safely RESET your computer and rerun CSD without causing any harm; in fact, CSD will even automatically reload the file you were working on.

Changing Defaults

There are options in CSD which you can set so that CSD automatically will remember your preferences for these attributes. These include changing the default monitor type and colors, changing the startup state of the joystick device, and setting the Baud rate of your printer.

Monitor Type: you can set CSD to automatically start up in Monochrome or Composite Color (TV) mode, or the alternate RGB colors by doing the following :

1. Insert a CSD disk into your drive
2. LOAD "BOOT" <ENTER>
3. EDIT 80 <ENTER>
4. Replace the RGB after the DATA statement with MONO (for Monochrome, B&W TV), NSTC (for color TV/ non-RGB monitors), or INV (for the alternate RGB color set)
5. SAVE "BOOT" <ENTER>

The next time you run CSD with this disk, your new colors will be used. (Note for advanced users: if you are really into customizing your software, you can physically change the PALETTE values in line 55 to your own custom color set; in fact, you can redefine all four options!)

Joystick State: Initially, CSD is configured for Keyboard- only cursor operation. This is so people without a joystick device plugged into their computer will have a cursor that behaves sanely, and even if you do have a joystick, you still should start out by learning the keyboard commands. However, changing the power up state of CSD to Joystick On is a simple matter of following these steps carefully:

1. Insert a CSD disk into your drive

2. LOAD "COSCHDES.SYS"
   This is a large (and important!) file - it may take a few seconds ...
3. EDIT 60000
4. Replace the KEY after the DATA statement with JOY
5. SAVE "COSCHDES.SYS"

The next time you run CSD with this disk, your joystick device will automatically be activated.

Baud Rate: Details of this are already given in the printout section. However, in a nutshell, you must:

1. RUN "BOOT"
2. Type [F] (for File)
3. Type [O] (for Open - something must be in memory for this to work)
4. Type the name of any schematic file on your disk (for example, TOPMOST is a short file supplied with CSD) and press ENTER
5. Type [F] again, then [P] for Print
6. Wait till the menu appears, and type [S], for Set Baud
7. Choose your baud rate from the choices listed
8. Press BREAK to return to CSD

There are other default settings which can be modified, for instance, Font types or Symbol set, but these are more involved procedures and are given whole sections later in the manual.

Getting Down To Business

Color Schematic Designer is a powerful program -in the remainder of the manual there are various topics which you can move through in any order you like, whenever you feel you have the need to know more about that topic. Do not worry about knowing this all when you start using CSD 2.0; it is not necessarily vital information. It is, however, important if you want to get the full power of CSD.

Using Layers

Layering is a powerful function of Color Schematic Designer. With layering you can create three circuits each as big as the physical workspace, keep them in memory simultaneously, and still view and work with them individually. You can also use the layering functions to create parts of a circuit independently in separate files, and then merge them together at printout time.

Normally, any circuitry on the screen is coded in three colors; one for lines, one for symbols, and one for text. Those colors are also used to indicate layers, however, as you will see. First erase the workspace (File Erase all) and load the file TOPMOST into the top layer of the workspace using the File Top layer command. You will notice that the entire circuit will be one color, instead of three colors as it normally would be. Now display just the lower layer of the workspace by typing Mode Low layer. The screen will now be blank, because the low layer is empty. Load the file LOWEST into the lower layer by using the File Low layer command. It will be displayed in three colors, because you are currently in low layer mode. Now type Mode All layer to return to the normal display mode. You will now see both layers. Next, type Mode Mid layer to see the middle one - it should be empty still. Load the file MIDDLE into the middle layer, and type Mode All layer to see the final effect. Note that layers can only be loaded, not saved, independently. Also, the only way to print out a layer independent of the other layers loaded into memory is to use the Print Screen command - Print Full only can be used to print all layers sim ultaneously.

Layers are useful as tools for many purposes. One example is in modular design technique. If you have a generic bus interface which you use often in your circuitry, but which you may alter at a later date, simply make a note of the physical coordinates of the connection points to it. Then when you design your peripheral circuitry, draw the connections going to those coordinates (or store a connection bus in another layer and use it in both drawings). When you want to make hardcopy or see the whole design, simply merge your interface design into a layer of your peripheral design. In this way, if you later redesign your interface, as long as you maintain the same connection points, you can still use your old drawings without any modifications.

The Autoload Feature

Often when you are working on a project you will not want to keep on typing its filename when you save and load - would it not be wonderful if the program would automatically load your schematic when you type RUN "BOOT", and save it automatically whe n you were finished? CSD has

this time-saving capability. Basically, when you RUN "BOOT", CSD checks the disk for a file named CURRFILE. If such a file exists, it is automatically loaded into the workspace.

To try out this feature, do the following. File Erase all, and draw a simple diagram (a few lines will do) or load one you have previously drawn. Now use File Save to save it and give it the name CURRFILE. Now type File Quit Yes. Remove the CSD disk from the drive, and turn your computer off for a few seconds. Then reinsert CSD and type RUN "BOOT". After a few seconds of disk drive activity, you will see that your diagram will load itself.

After the first time you save your file as CURRFILE, use File Close instead of File Save -File Close remembers your filename automatically. Once your project is done and you want to disable the autoload, simply save it with a name other than CURRFILE.

Using the Other (CSD 1.x) Symbols

Older versions of CSD had a symbol set where all of the components had to fit within a 16 by 16 pixel "window" for CSD to handle them properly. The benefit of this relatively small size was that quite a bit of circuitry could fit on the screen at once, and printout times were shorter if less display space was taken up. This methodology had a couple of drawbacks, however - first of all, resolution of symbols squeezed into a 16x16 area (especially circles!) was often not very high, and more importantly, the resulting printouts had very small devices, lowering readability.

The new version of CSD has changed this - symbol resolution has increased four times by the use of a 32 by 32 standard symbol size, plus printout resolution has been increased four times as well, with a result that very high resolution, very readable hardcopy can be generated. There is something lost in this gain, however - the symbol set, both in size and contents, is totally different from the old system. Even worse, it is totally incompatible with circuitry developed by the old versions of the program. But there is a light at the end of this tunnel ...

CSD 2.0 gives you the ability to create and use multiple symbol sets of both 32x32 and 16x16 pixel size. The only restriction on your sets is that you can only use one symbol set in any given schematic diagram. CSD includes two complete sets - the 32x32 standard symbol set, and a 16x16 set fully compatible with older CSD schematics.

In a later section details will be given on how to create your own symbol sets. In this section you will learn how to activate the alternate supplied symbol set and tell CSD that you are using a 16x16 set.

Insert your CSD disk into your drive and type :

RUN "SYMMAN" (stands for Symbol Manager)

SYMMAN will ask you for a three letter activation code. Type SML and

press ENTER. This is the code for the 16x16 symbol set compatible with CSD 1.x versions and files. Next you must start up CSD by typing :

```
RUN "BOOT"
```

Now type Mode Symbsize. The disk drive will spin as CSD saves your new configuration, and in the indicator slot in the menu bar you will see the word Small. At this point you can load old schematic files and use them as you would before. Note that to maintain compatibility with the old tri-menu (symbol/part/device) system, there are gaps in the symbol table when you use the Symbol Subscreen browse features. This is normal, and does not affect operation.

When you later want to return to the standard 32x32 symbol set, do the following :

1. RUN "SYMMAN"
2. Use code LRG
3. RUN "BOOT"
4. Type [M] [S] again - this time the word Large will appear
5. You are now back to normal

Symbol Modification

In the previous section some details are given about the symbol system in CSD 2.0. Here you will be given the information you need to modify the existing symbol sets and add your own symbols or even your own entire symbol sets in 32x32 or 16x16 sizes. (Note: the 16x16 set supplied with CSD is designed for compatibility with prior versions only. No direct provision for modification of this set is made, although a new 16x16 set can be added which includes the features of the old one, giving you essentially the same result)

The CSD symbol system is based on a descriptive language very similar to that used in the BASIC DRAW and HDRAW commands. Those of you familiar with these commands will fit right in perfectly from the start. If you are unfamiliar with these BASIC commands, it may be helpful to refer to your BASIC manual and get acquainted with them -not necessary, but helpful.

CSD SDL (Symbol Description Language)

U: draw a point at the current location, then move the cursor up one pixel. Also, U2 is equivalent to two U commands, U3 equals three U commands, etc. This method of repetition is used consistently in all the following commands.
D: set current location, then move down one.
L: set current location, then move left one.
R: set current location, then move right one.
E: set current location, then move diagonally NE.
F: set current location, then move diagonally SE.
G: set current location, then move diagonally SW
H: set current location, then move diagonally NW

If you prefix any of the preceding commands with a B, it will move the cursor without setting the current location. If you prefix any of the preceding commands with an N, it will set the current location, move the cursor, set the new location, and then return the cursor back to where it was before the N command.

Also, if you prefix the entire command list with a C, CSD will draw a circle around your device.

For example, NR8 NL8 NU8 D8 corresponds to a plus sign with four arms, each eight pixels long, centered at the cursor. C BR4 NU8 ND8 BL8 NU8 D8 corresponds to two vertical parallel lines eight pixels apart, each 16 pixels in length, surrounded by a circle, and centered at the cursor. Note that when you use these definitions in the program, you must remove the spaces for proper execution. The first example becomes NR8NL8NU8D8, the second CBR4NU8ND8BL8NU8D8. Although this is harder for you to read, it is easier for the computer.

CSD works with connections on a 4x4 pixel center. This means that if you want CSD to be able to connect wires precisely to any part of your device, that part must be located on a 4x4 center. As a rule, if you always use multiples of four in you definitions, as in the two preceding ones (only fours and eights are used), you will never run into a problem with CSD not being able to figure out where to connect wires to your device. If you want more flexibility, look through some of the definitions of existing CSD symbols using the methods about to be detailed to determine how to circumvent this requirement. (Basically, only terminals on your device need be located on 4x4 centers) This is true for both 16x16 and 32x32 pixel sets.

Type LOAD "SYMGEN" and list the program. You will see the definitions of all the 32x32 symbols in the standard symbol set. In each line there is a symbol definition, and then a description of that symbol. To add your own symbols to this list, start at the first available line before the program code (probably line 520 is the last used line, so in this case we use line 530) and type :

```
530 DATA xxxxxxxxxxxxxxxxxxxxxxx, 'symbol name
```

Where xxxxxxxxxxxxxxxxxxx is replaced by the SDL description of your device, and symbol name is replaced by the name of your symbol. You can go on adding symbols in this manner, up to a maximum total number, including previously defined symbols, of 63. Do not exceed 63 symbols total. Memory errors and loss of your data could result.

You can also alter or replace pre-existing symbols by editing or replacing the line that they are on. Keep in mind that once you alter a symbol definition, every single schematic which uses that definition will automatically be altered as well.

Once you have finished, save the file as follows:

```
SAVE "SYMGEN01"
```

The next time you add new symbols, save it as SYMGEN02, etc., up to SYMGEN99. Now type RUN and press ENTER. Now type a three letter code which you would like to associate with the symbol set you just created. You may use digits, but no punctuation or spaces. If you use a code more than once, the most recent symbol set will be the one attached to the code. Once you press ENTER your new symbol file will be created.

To use your symbol file, and to choose between different symbol tables in general, you must use the program SYMMAN. Doing this is simple - just type RUN "SYMMAN", press ENTER, and then enter the three character

code corresponding to the symbol table you want to activate. Note that the standard 32x32 default symbol table is called LRG and the standard 16x16 compatibility symbol table is called SML - do not use these names, or the reserved name SYS, for your own tables, unless you want to risk losing compatibility with prior circuits. Finally, if the symbol table you just activated is not the same size (i.e. 16x16 or 32x32) as the last activated table, you must inform CSD that this is so by using the Mode Symbsize command.

Symbol tables are stored on disk under the name SYMBOLS.xxx, where xxx corresponds to the three letter activation code. For instance, the default activated symbol set is SYMBOLS.LRG.

Font Manipulation

CSD 2.0 is capable of using a huge variety of combinations of fonts, although there is a limit of three per schematic. In fact, you can even tailor the CSD screen and menus to your own preferences. Available fonts are Serif, Bold1, Small (the three default fonts), Sanserif, Bold2, Italic, and Digital. These may be used in any combination or permutation, as long as there are three specified fonts. In fact, you can even specify the same font three times if you want a very homogeneous screen display.

To use these features you must type RUN "FONTGEN", and answer its queries with the three fonts of your choosing. FONTGEN will then ask you for a three letter activation code, to which you can answer with any three letters or digits, with no punctuation or spaces. Also, you cannot use STD or SYS. Once you press ENTER the font set will be generated. Now whenever you want to use this font set, you can simply activate it.

To activate any font set, including the default font set, called STD, type RUN "FONTMAN". At this point you will be asked for the three letter code corresponding to the fontset you desire to activate. Reply with your three digits, using STD, if you want the original default set. Once done, the fontset will be activated, and you can type RUN "BOOT" and see your custom CSD facelift!

Future fonts will be available as demand requires. Custom fonts can be created by the author if desired - contact him through the address at the end of the manual. Finally, the author is working on a comprehensive and powerful font designing program for the CoCo 3 which will generate fonts compatible with CSD as well as any BASIC programs. This should be available through Microcom at some later date.

Workspace Details

The workspace is 640 x 1000 pixels, organized into 160 x 250 blocks of 16 pixels. Because of screen limitations, only about a seventh of that area can be displayed at a time. One block of 4 x 4 pixels is the smallest step the cursor can move at a time.

Because of the aspect ratio (shape) of the pixels, circular objects appear oblong on the screen. This is unavoidable because of the shape of the pixels in the Color Computer 3 640 x 192 mode. However, when you print out you can make your circles appear much closer to their namesake by selecting a printout mode with an aspect ratio near 1:1.

Refer to the printout section for details on this.

The workspace is also three layers deep, giving a total available physical area of 640 x 1000 x 3, or 1,920,000 pixels. In memory the circuitry is stored as a series of shapes and coordinates in three dimensions, X, Y, and Z (layer). However, you obviously cannot just keep filling up this gigantic area with symbols and not run out of memory. There is space for nearly 1000 objects, such as lines, symbols, boxes, and strings of text in memory. You will notice that the percentage of free space is displayed on the menu bar each time you create an object - keep track of this figure when you work on a large project, and be careful of dropping below 10% free.

Memory Conservation

On large projects response will slow down greatly and available memory may dwindle unexpectedly early if you are not aware of one important thing - text is very memory hungry. In practice all standard symbols, be they lines or boxes or transistors or junctions are coded and stored so that they occupy exactly 6 bytes of an approximately 8000 byte storage area. This storage area is independent of the %Free figure you get, which depends on other system constraints, but is big enough that it has excess capacity even when there is 0% Free space (if you have a 900 object diagram, which is about the largest you can have practically, 900 x 6, or 5400 bytes of this area will be occupied, leaving 2600 bytes extra - quite a large safety margin). However, every character of text you enter into your diagram uses up one byte of this area. As the unused space in this area dwindles, program response and redraw speed becomes steadily worse and worse, and if you have a lot of text (over a thousand characters) it is possible for you to run out of storage area and be unable to work with your program even if the %Free indicator says you have 6 or 7% to spare. Therefore, for the most effective designing do not mix large amounts of text with large schematics, and if you must, add the text after you have finished the object drawing, keeping in mind that the free space available is about 10% less than what is displayed.

File Storage

The workspace is stored on disk in two highly compressed files, one with a .SCE extension and one with a .SCT extension. The .SCE file contains all of the objects in the program, each stored in a compact 6 byte non-ASCII code (if you try to load this file into an editor you will get utter nonsense), while the .SCT file contains all of the text in your diagram, stored in standard ASCII (you can even edit it with an editor as long as it does not change the format of the file at all or add any new lines to it). One interesting thing about this storage medium is that it is very compact - an incredibly dense design with many hundreds of symbols spread over a 640 x 1000 pixel area in three layers and lots of text would take less than 10,000 bytes of disk space (about 4 grans). Compare this with 32,000 bytes (about 15 grans) to store one 640 x 192 hires screen using almost every other graphics oriented design program, or 160,000 bytes (about 70 grans -more than a 35 track SSDD disk can hold!) for a full 640 x 1000 pixel workspace. And loading data is also very fast because there is so much less to load from the disk.

System Files

The Color Schematic Designer 2.0 System Disk includes the following files:

BOOT.BAS	Loading program for CSD
SYMGEN.BAS	Symbol set generator
FONTGEN.BAS	Font set generator
SYMMAN.BAS	Symbol set manager
FONTMAN.BAS	Font set manager
COSCHDES.SYS	Main program code
ALLPRINT.SYS	Printer driver submenu overlay code
SCRNPEEK.SYS	Memory management routines
HIRES.SYS	Screen display/ font handler
SYMBOLS.SYS	Currently activated symbol set
SYMSTATE.SYS	Contains current symbol configuration
LASTPRNT.SYS	Contains current printer mode status
SCRNPRNT.LRS	Printout drivers for IBM/Epson
SCRNPRNT.HRS	Printout drivers for HiRes IBM/Epson
SCRNPRNT.DM1	Printout driver for standard DMP
SCRNPRNT.DM2	Printout driver for rotated DMP
SCRNPRNT.DM3	Printout driver for large, rotated DMP
FULLPRNT.EPS	Printout handler for IBM/Epson
FULLPRNT.DM1	Printout handler for DMP
FULLPRNT.DM2	Printout handler for rotated DMP
SYMBOLS.SML	16x16 standard symbol table
SYMBOLS.LRG	32x32 standard symbol table
FONTSET.STD	standard fontset
SERIF.,SANSERIF.,BOLD1.,BOLD2.,SMALL.,ITALIC.,DIGI TAL.	all .FNT font files
RECEIVER.SCE/SCT	receiver sample file
IDEAS.SCE/SCT	symbol combinations
TOPMOST.SCE/SCT	top layer demo file
MIDDLE.SCE/SCT	mid layer demo file
LOWEST.SCE/SCT	low layer demo file

Standard Symbol Set Contents

32x32 standard set:

01. antenna
02. tri- arrow
03. diagonal tr- arrow
04. terminal
05. diagonal terminal
06. arrow
07. diagonal arrow
08. angle piece/switch
09. dual small arrows
10. dual terminals
11. pushbutton
12. battery
13. earth ground
14. signal ground
15. capacitor
16. electrolytic capac.
17. crystal
18. diode
19. zener/schottky d.
20. PNP bipolar
21. reversed PNP
22. NPN bipolar
23. reversed NPN
24. unijunction -P
25. unijunction -N
26. empty circle
27. meter
28. lamp
29. resistor
30. inductor
31. inductor with core
32. microphone
33. speaker
34. sinewave/AC/fuse
35. AND gate
36. OR gate
37. exclusive OR gate
38. buffer
39. IC corner piece
40. IC tab piece
41. IC clock in
42. bus connection
43. DIP switch

16x16 standard set

01. resistor
02. potentiometer
03. capacitor
04. electrolytic capac.
05. switch
06. diode
07. zener diode
08. tunnel diode
09. triac
10. NO pushbutton
11. NC pushbutton
12. UJT
13. back diode
14. PNP bipolar
15. NPN bipolar
16. PNPN unit
22. signal ground
23. earth ground
24. antenna
25. large up arrow
26. small arrow
27. terminal
28. large terminal
29. diagonal arrow
30. small diag arrow
31. AC source
43. lamp
44. voltmeter
45. ammeter
46. ferrite
47. inductor
48. tapped inductor
49. speaker
50. microphone
51. cell
52. battery
53. NOT gate
54. buffer
55. OR gate
56. AND gate

Improvements in 2.0

Color Schematic Designer is very much improved from its last version, the 1.x series. Here is a partial list for those of you who are familiar with the old version.

Vastly improved selection of printout formats. Rather than having to install confusing drivers as in the last version, all these options are built into the main program's pull down menu system. No printer driver installation is necessary, and you can switch printers and printing modes as often as you like without exiting the program. The HiRes modes are excellent output quality - up to 52,000 dots per square inch. Compare that with the old Color Schematic Designer's maximum resolution of 9,000 dots per square inch, or a laser printer's 90,000 dots per square inch maximum resolution. The Fast mode gives you a quick way to get draft copy. Also, DMP printers can now print horizontally as well as vertically, solving many DMP users' problem with their printout format.

Better, higher resolution symbol support. Color Schematic Designer 2.0 supports two symbol sizes, the old small symbol size, and a new higher resolution symbol set. This large symbol set, coupled with the HiRes printing modes, results in near publication quality output. A new utility is included with the program to allow modification of existing symbols and addition of up to twenty-five new symbols. Also, the selection of symbols available and their output quality is better than before, and the Symbol selection menu is also easier to use.

Version 2.0 has a much more responsive cursor, which travels many times faster than the old cursor did. Also, joystick support is now better than before, with a proportional cursor speed system.

There is now a new Inverse RGB color set. This lets users who prefer a dark background tailor the program to their needs. Composite color and Monochrome are still supported. Now graphics mode changes are lightning fast - no lengthy redraw as before. And there is a more attractive menu layout and on screen font control. The new version is more legible and easier on the eyes, as well as nicer to look at. A new font handling utility allows you to decide which fonts you want in your menus and in your output - you're not locked into just three plain vanilla fonts anymore.

Better editing facilities. Previously, entering text into the design or answering a program prompt was a hassle if you made a mistake. Now these mistakes can be easily fixed. Also, the Undo Last command now works instantantly - users of the old version will be amazed at speed with which mistakes can be corrected. No more lengthy redraw time.

Additionally, the main program itself is more compact, and the system disk is less cluttered.

We Want Your Input

Please address any comments and criticisms, as well as any more involved questions or problems, in writing to the author:

Prakash Mishra
227 Church Street
Newington, CT 06111

Allow at least three to four weeks for a personal response. The author will only make phone replies with collect calls, if a phone reply is requested.

Note for DMP users:

The various Radio Shack/Tandy dot matrix printers sold over the years have had varied support of graphics output. Although the codes have remained relatively consistent, the actual dots/inch resolutions available have varied greatly from printer to printer.

Nearly all Radio Shack dot matrix printers will support the Rotated printout modes (options C and D), however, support of the Normal and Wide printing modes differs as detailed here :

LPVII, LPVIII, DMP-100: Rotated modes only

DMP-110: All modes will operate, but resolution is fixed at 960 dots/line (1.7:1 aspect ratio)

DMP-120: All modes, but Normal Mode gives a very dense 1600 dots/line output (3.0:1) while Wide mode gives 960 dots/line (1.7:1)

DMP-200: Normal mode: 1600 dpl (3.0:1), Wide mode: 1152 dpl (2.0:1)

DMP-400, DMP-420, DMP-500: Standard support of all modes supplied

DMP-2100: All modes give 1.0:1 output

CGP-220: All modes give 1.1:1 output

Printers not specified in this list, including most of the newer DMP series, are either IBM compatible, in which case the IBM modes will give the best results, or will probably support modes A and B. If not, modes C and D will be supported.