



*Personal Computer
Hardware Reference
Library*

IBM Personal Computer Color Printer

6361478



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Description

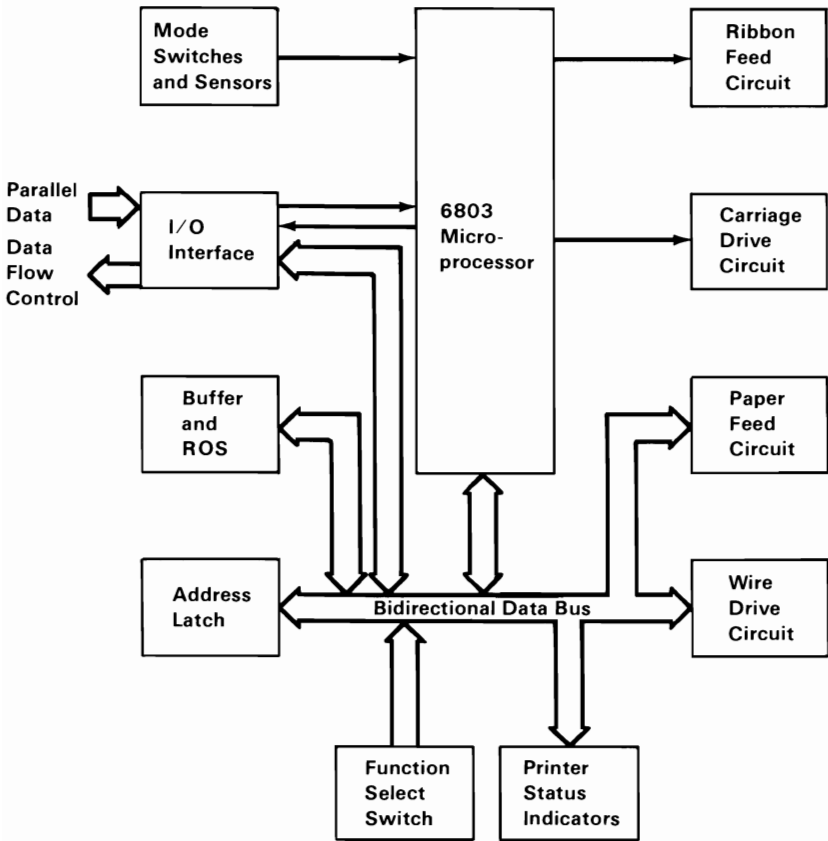
The IBM Personal Computer Color Printer is a tabletop, wire matrix, color printer. It attaches to the system unit's Printer Adapter or combination Monochrome Display and Printer Adapter through a standard printer cable, which has a 25-pin connector on the system unit end and a 36-pin connector on the printer end.

When the Color Printer is ready to accept data, the system unit sends the data and control codes through the printer cable to the printer's input/output (I/O) board. The I/O board directs the data and control codes to a buffer. The 6803 Microprocessor on the printer's controller circuit board monitors the buffer constantly and decides when and how to print the information based on the control codes.

The 6803 Microprocessor takes a character from the buffer and compares the character against a table to determine what dots to print. If the character is a control character, the microprocessor compares the character against a control-character table so that it knows what action to take.

When the 6803 Microprocessor reads a line-ending character, it determines whether it would be faster to move to the right margin and print backwards or to the left margin to begin printing. This ability, called *logic seeking*, allows faster printer output.

The following block diagram shows the operation of the IBM Personal Computer Color Printer.



Color Printer Block Diagram

Major Subsystems

The three major electromechanical subsystems of the printer are the I/O subsystem, controller subsystem, and print subsystem. Each subsystem is controlled by the 6803 Microprocessor mounted on the controller circuit board. The power-supply regulator circuits are an integrated portion of the controller card.

The I/O Subsystem

The I/O circuit board contains the circuits needed to direct the parallel data from the computer and interface cable to the printer's controller circuit board for processing. The I/O board also contains the circuits for directing operational status signals between the printer and the system unit.

Controller Subsystem

The controller subsystem consists of a 6803 Microprocessor and its peripheral interface and memory devices, which are mounted on the controller circuit board. The controller line buffer accepts data from the computer through the printer's I/O board. The controller decodes the data, then sends the data to the print subsystem for printing.

The controller also controls operation of the paper and ribbon feed. These circuits are activated by programming or by a function-select switch. Power regulation and distribution within the printer are also controlled by the controller board.

The power regulator circuit, which is part of the controller circuit board, receives 5, 10, and 40 volts ac from the power supply transformer. It rectifies and distributes the different voltages to the various circuits and motors in the printer.

Print Subsystem

The print subsystem prints the data received from the controller. The subsystem consists of the following:

- Print head and carriage assembly
- Carriage drive motor and belt
- Left-margin sensor
- Paper feed assembly
- Ribbon drive assembly

The print head contains nine print wires. The print wires are staggered in two vertical columns with five wires in one column and four wires in the other. This arrangement is designed to allow overlapping of print dots. Selectively driving the wires against the ribbon and paper as the print head is moved across the platen, results in the printing of high-quality characters.

The print head is mounted on a carriage which is driven bidirectionally by the carriage drive stepper motor and drive belt. The left-margin sensor is used to signal the controller that the print head is at the home position.

The paper feed assembly is made up of a tractor assembly, paper stepper motor, and a paper-out sensor. It feeds the forms into position and holds the paper stationary while printing.

Continuous forms are fed by pin belts in the tractor assembly, and single sheets of paper are fed by pressure rolls in the paper path. The pin belts and pressure rolls are driven by a drive shaft, drive belt, and the paper stepper motor.

The ribbon feed assembly drives the ribbon between the paper and the print head at a constant speed. It consists of a ribbon cartridge, ribbon drive motor, and a ribbon feed path made up of two rollers, two fixed posts, and a print-head ribbon guide. The ribbon cartridge contains a continuous loop of pre-inked 19-mm (3/4-in.) wide ribbon. The ribbon is pulled from the cartridge, around two guide posts, through the print-head ribbon guide, around two more ribbon posts, and “stuffed” back into the cartridge by two “stuffing” wheels.

In order to print different colors, the ribbon is shifted up and down by the color control mechanism, which is made up of a motor and cam assembly. The cam pivots the complete ribbon feed assembly to four different levels that match the four color bands on the ribbon.

6803 Microprocessor

The 6803 Microprocessor and its peripheral devices, which are mounted on the controller circuit board, direct all operations of the printer. This 8-bit single-chip microprocessor unit (MPU) functions as a monolithic MPU requiring one +5-Vdc power supply and is TTL-compatible. On-chip resources include parallel I/O and a three function programmable timer. Some of the other features include:

- Enhanced 6800 MPU instruction set
- 8 x 8 multiply instruction
- Upward-source and object-code compatibility with the 6800 MPU
- Expanded operation to 64K-byte address space
- 29 parallel I/O and 2-handshake control lines
- Internal clock generator with divide-by-4 output

The program-controlled operating mode determines the configuration of 18 of the 40 MPU pins available, location (internal or external) of interrupt vectors, and type of external bus. The configuration of the remaining 22 pins is not dependent on the operating mode.

Twenty nine pins are organized as three 8-bit ports and one 5-bit port. Each port consists of at least a data register and a write-only data-direction register. The data-direction register is used to define whether corresponding bits in the data register are configured as an input (clear) or output (set).

When the port is used as a "data port" or "I/O port," it is controlled by the port data direction register and the programmer has direct access to the port pins using the port Data Register. Port pins are labeled as P_{ij}, where "i" identifies one of four ports and "j" indicates the particular bit. The operating mode determines the configuration of Port 3, Port 4, SC1, SC2, and the physical location of the interrupt vectors.

The mode used by the 6803 MPU is called the Expanded Multiplexed mode. Expanded Multiplexed mode refers to the type of bus it supports. In this mode, Port 3 functions as a time-multiplexed address/data bus with address valid on the negative edge of Address Strobe (AS), and data valid while "E" (which is a timing signal), is high. Port 4 provides address lines A8 to A15.



Programming Considerations

Printer Control Codes

The following pages list, in alphabetic order, the printer control codes with a description of each. Some knowledge of BASIC programming is necessary to insert printer control codes in your program. An example of each code in BASIC is at the end of each description. The “Format” information is given where more information is needed for programming considerations.

Note: All combinations of printing qualities, character spacings, and types are valid. For example, you can print in emphasized print, double-width, and underline all at the same time.

The printer can accept parameters for the ESC commands in either of two formats:

- Binary
- ASCII Character

Although the default format is binary (as used in all examples in the “Printer Control Codes” section), the command, ESC @;n;, can be used to select either format.

This command affects only certain numeric parameters which follow ESC control codes. Parameters not affected by this command are those which select On or Off (1 or 0) because the Color Printer operates on only the least significant bit of n in these commands. Therefore, any odd-numbered ASCII decimal value gives the same result as n=1 and any even-numbered ASCII decimal value gives the same result as n=0.

Parameters affected by this command are given in the following three examples:

1. A parameter defining numeric values.

In ASCII format these parameters must be stated as decimal characters, with each numeric field terminated with a non-numeric character (semicolon recommended). For example, to select the near letter quality type font, (ESC I3) the command is: `LPRINT CHR$(27); CHR$(73);"3;"`;

In binary format the command is: `LPRINT CHR$(27); CHR$(73); CHR$(3)`;

2. A parameter defining lists of values ending in NUL.

In ASCII format these parameters must be stated as decimal numeric characters, with each numeric field terminated with a non-numeric character (semicolon recommended) , with the final NUL being a second semicolon. For example, to set tabs at columns 10 and 40, (ESC D) the command is: `LPRINT CHR$(27); CHR$(68);"10;40;;"`;

In binary format the command is: `LPRINT CHR$(27); CHR$(68);CHR$(10);CHR$(40);CHR$(0)`;

3. A two byte parameter (n1;n2;) defining the amount of data to be printed after the command.

In ASCII format this parameter must be sent as a single decimal numeric value (0 to XXXX) terminated with a non-numeric character (semicolon recommended). For example, to print twenty eight bytes in bit-image graphics, (ESC K) the command is: `LPRINT CHR$(27); CHR$(75);"28;":FOR X = 1 TO 28: LPRINT CHR$(255);: NEXT X`

In binary format the command is: `LPRINT CHR$(27); CHR$(75);CHR$(28);CHR$(0);: FOR X = 1 TO 28: LPRINT CHR$(255);: NEXT X`

Printer Code	Printer Function
BEL	<p>Audible Alarm Sounds the printer buzzer for 1 second or less. The buzzer may be turned off with DIP Switch 8. Example: LPRINT CHR\$(7);</p>
BS	<p>Backspace Moves the print head one character width to the left. The character width is determined by the selected character spacing. Example: LPRINT CHR\$(8);</p>
CAN	<p>Clear Data Clears the printer memory of all data waiting to be printed following the last received line ending code. If the initialize function is set On by ESC ? (Set Initialize Signal Function), all control codes, except SO (Double-Width printing), remain in effect. If the initialize function is set Off by ESC ?, all control codes are cleared and the printer is set to the values set by the DIP switches. (See "ESC ?" for more details about the initialize function.) Example: LPRINT CHR\$(24);</p>
CR	<p>Carriage Return Causes the printer to print the data that follows CR beginning at the left margin. No line-feed operation takes place unless DIP Switch 4 is On or ESC 5 (automatic line-feed) has been sent.</p> <p>Note: IBM Personal Computer BASIC (and many other programs) automatically sends LF (line feed) with CR. If you do not want LF sent after CR, use ASCII decimal value 141 from Character Set 1 instead of ASCII decimal value 13.</p> <p>Example: LPRINT CHR\$(13);</p>
DC1	<p>Select Printer Sets the printer to accept data from the system unit. Example: LPRINT CHR\$(17);</p>
DC2	<p>10 Characters per Inch Print Selects character spacing of 10 characters per inch. Example: LPRINT CHR\$(18);</p>

Printer Code	Printer Function
DC3	<p>Deselect Printer Sets the Color Printer so it will not accept data from the system unit. A printer must be initialized by the system or control panel buttons or selected using DC1 (Select Printer) to accept data. Example: LPRINT CHR\$(19);</p>
DC4	<p>Cancel Double-Width Printing by Line Ends double-width printing by line which was started by SO. Example: LPRINT CHR\$(20);</p>
ESC	<p>Command Prefix Sets the printer to accept the next data sent as a printer command. (See the following list.) Example: LPRINT CHR\$(27);</p>
ESC A	<p>Store Text Line Spacing Format: ESC A;n; ESC A stores a line-feed value of n/72 inch. ESC 2 (Start Text Line Spacing) must then be sent before the line spacing will change. For example, to store a line-feed value of 24/72 inch, the code is ESC A 24. However, until ESC 2 is sent, any text following the ESC A 24 will space at the previously set line-feed increment. The text following the ESC 2 will be printed with a new line-feed increment of 24/72 inch. Any increment between 1/72 and 85/72 may be used. Example: LPRINT CHR\$(27);CHR\$(65);CHR\$(n);</p>
ESC a	<p>Select Automatic Ribbon-Band Shift Causes the ribbon to shift one color band at the end of each page. This command is used with an all-black ribbon to extend the ribbon life. Example: LPRINT CHR\$(27);CHR\$(97);</p>
ESC B	<p>Set Vertical Tabs Format: ESC B;n₁;n₂;...n₆₄;NUL; Sets the vertical tab-stop positions. The power-on default is without vertical tab stops set. n₁ through n₆₄ represent tab-stop positions by line number. The topmost line of the page is line 0. Tab-stop positions must be received in ascending numeric order and cannot exceed the set page length. Up to 64 positions are recognized by the Color Printer. The positions do not take effect until NUL is received.</p>

Printer Code	Printer Function
ESC B. Cont.	<p>Once vertical tab stops are set, they remain in effect until new ones are specified or all tab stops are set to the power-on defaults by ESC R (Set All Tabs to Power-On Defaults). If no vertical tab stops are set, the Vertical Tab (VT) command behaves as a Line Feed (LF) command. ESC B followed only by NUL cancels all vertical tab stops. The form length must be set by the ESC C command (Set Page Length in Lines) prior to setting vertical tab stops.</p> <p>Example: LPRINT CHR\$(27);CHR\$(66);CHR\$(n₁); CHR\$(n₂);...CHR\$(n₆₄);CHR\$(0);</p>
ESC b	<p>Select Band 4 Selects ribbon band 4 (black). The printer will continue to print with band 4 until a command to change the ribbon band is received.</p> <p>Example: LPRINT CHR\$(27);CHR\$(98);</p>
ESC C	<p>Set Page Length in Lines Format: ESC C;n; Sets the page length in lines. The number of lines n is converted to inches using the current line spacing. ESC C must be followed by a value, n, that specifies the desired length of page in lines. Maximum page length for this printer is 127 lines. This command also sets the current position of the paper as the top-of-form.</p> <p>Note: Automatic perforation-skip (ESC N) and vertical tabs (ESC B) may need to be reset after changing the page length.</p> <p>Example: LPRINT CHR\$(27);CHR\$(67);CHR\$(n);</p>
ESC C 0	<p>Set Page Length in Inches Format: ESC C;0;n; Sets the page length in inches. This command requires a value of n between 1 and 22. The power-on default is set with DIP Switch 6. This command also sets the current position of the paper as the top-of-form.</p> <p>Note: Automatic perforation-skip (ESC N) and vertical tabs (ESC B) may need to be reset after changing the page length.</p> <p>Example: LPRINT CHR\$(27);CHR\$(67);CHR\$(0); CHR\$(n);</p>

Printer Code	Printer Function
ESC c	<p>Select Band 3 Selects ribbon band 3. The actual color printed will depend on the ribbon being used. The printer will continue to print with band 3 until a command to change the ribbon band is received. Example: LPRINT CHR\$(27);CHR\$(99);</p>
ESC D	<p>Set Horizontal Tabs Format: ESC D;n₁;n₂;...n₂₈;NUL; Sets the horizontal tab-stop positions represented by n₁ through n₂₈. The power-on default is a tab stop set at column 8 and every eighth column thereafter. The printer recognizes up to 28 horizontal tab stops. They must be in ascending numeric order and followed by NUL. Tab stops can be set between 1 and the maximum column count for the character spacing in effect. ESC D immediately followed by NUL will clear all horizontal tabs. ESC R (Set All Tabs to Power-On Defaults) may be used to set horizontal tabs to the power-on default.</p> <p>Note: Setting a tab at column 0 clears all tabs and the following tabs will be considered data.</p> <p>Example: LPRINT CHR\$(27);CHR\$(68);CHR\$(n₁); CHR\$(n₂);...CHR\$(n₂₈);CHR\$(0);</p>
ESC d	<p>Variable Forward Space Format: ESC d;n₁;n₂; Places the next printed character n₁;n₂/120 inch to the right of the last dot of the current character. The position may be beyond the right margin setting. If the position is beyond the physical end of the line, the next character will be printed at the left end of the printer.</p> <p>n₁ and n₂ are binary numbers that specify the number of 1/120-inch increments the next printed character is to be placed to the right. n₁ represents values from 0 to 255, and n₂ represents values from 0 to 255 times 256. Example: LPRINT CHR\$(27);CHR\$(100);CHR\$(n₁);CHR\$(n₂);</p>
ESC E	<p>Emphasized Printing Changes the printer to emphasized printing. Characters are double struck with the smallest possible horizontal offset between strikes. Example: LPRINT CHR\$(27);CHR\$(69);</p>

Printer Code	Printer Function
ESC e	<p>Variable Backspace Format: ESC e;n₁;n₂; Places the next printed character n₁;n₂/120 inch to the left of the last dot of the current character. The position may be beyond the left margin setting. If the specified position is beyond the physical left end of the printer, the next character will be printed at the left end of the printer. n₁ and n₂ are binary numbers that specify the number of 1/120-inch increments the next printed character is to be placed to the left. n₁ represents values from 0 to 255, and n₂ represents values from 0 to 255 times 256. Example: LPRINT CHR\$(27);CHR\$(101);CHR\$(n₁);CHR\$(n₂);</p>
ESC F	<p>Cancel Emphasized Printing Ends emphasized printing started by ESC E. Example: LPRINT CHR\$(27);CHR\$(70);</p>
ESC G	<p>Double-Strike Printing Sets the printer to double-strike printing. Characters are struck twice with no horizontal offset between strikes. Example: LPRINT CHR\$(27);CHR\$(71);</p>
ESC H	<p>Cancel Double-Strike Printing Ends double-strike printing started by ESC G. Example: LPRINT CHR\$(27);CHR\$(72);</p>
ESC I	<p>Change Printing Quality Format ESC I;n; Selects the printing quality. When n is 1, data processing quality is selected; when n is 2, text quality is selected; when n is 3, letter quality is selected. Each printing quality selection produces a different spacing of the dots that make up a character. Each character box is: with data-processing quality selected, 8 by 9 dots; with text quality selected, 24 by 9 dots; and with near-letter quality selected, 36 by 18 dots. Example: LPRINT CHR\$(27);CHR\$(73);CHR\$(n);</p>
ESC J	<p>Variable Line Space Format: ESC J;n; Advances the paper in increments of n/144 inch. The value of n must be between 1 and 255. Line spacing of 14/144 is recommended for bit-image graphics using eight bits. ESC J is canceled after the line space takes place. The value of n is not stored. Example: LPRINT CHR\$(27);CHR\$(74);CHR\$(n);</p>

Printer Code	Printer Function
ESC K	<p>1108 Bit-Image Graphics Format: ESC K;n₁;n₂;v₁;v₂;...;v₁₁₀₈; Sets dot spacing to 84 by 84 dots per inch in 1:1 aspect ratio, to 70 by 84 dots per inch in 5:6 aspect ratio (see "ESC n (Set Aspect Ratio)"). All bit-image graphics is printed from left to right. If the graphics data exceeds the space remaining on the line, the data to be printed beyond the end of the line is printed at the left margin on the next line.</p> <p>n₁ and n₂ are binary numbers that specify the number of bit-image data bytes to be transferred. n₁ represents values from 0 to 255, and n₂ represents values from 0 to 4 times 256. The total number of bit-image data bytes is equal to n₁ + n₂ x 256 and cannot exceed 1108 (the total number of dot positions in a 13.2 inch line).</p> <p>Bit-image graphics is printed using eight of the nine print-head wires (the bottom wire is not used). v₁ through v₁₁₀₈ are bit-image data bytes, each of which represents a set of 8 dots in a vertical line. The horizontal position of these 8 dots is determined by the position of the bit-image data byte within the v₁ through v₁₁₀₈ series. v₁ is printed at the starting position followed in order from left to right by v₂ through v₁₁₀₈. Each bit of a bit-image data byte represents a vertical dot position at the horizontal position represented by that bit-image data byte. The lowest value, or least significant bit (Bit 0), represents the bottom dot position, and the highest value, or most significant bit (Bit 7), represents the top dot position.</p>

Printer Code	Printer Function																																				
ESC K Cont.	<p>In the following table the left-hand column of (•)s represents dot positions within a vertical line. The right-hand column shows the corresponding bit number within a bit-image data byte. (The bits are numbered 7 through 0, from left to right.)</p> <table data-bbox="359 269 745 496" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Dot Position</th> <th style="text-align: center;">•</th> <th style="text-align: center;">–</th> <th style="text-align: center;">Bit Number</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Top</td> <td style="text-align: center;">•</td> <td style="text-align: center;">–</td> <td style="text-align: center;">7</td> </tr> <tr> <td></td> <td style="text-align: center;">•</td> <td style="text-align: center;">–</td> <td style="text-align: center;">6</td> </tr> <tr> <td></td> <td style="text-align: center;">•</td> <td style="text-align: center;">–</td> <td style="text-align: center;">5</td> </tr> <tr> <td></td> <td style="text-align: center;">•</td> <td style="text-align: center;">–</td> <td style="text-align: center;">4</td> </tr> <tr> <td></td> <td style="text-align: center;">•</td> <td style="text-align: center;">–</td> <td style="text-align: center;">3</td> </tr> <tr> <td></td> <td style="text-align: center;">•</td> <td style="text-align: center;">–</td> <td style="text-align: center;">2</td> </tr> <tr> <td></td> <td style="text-align: center;">•</td> <td style="text-align: center;">–</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;">Bottom</td> <td style="text-align: center;">•</td> <td style="text-align: center;">–</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> <p>For example: if v_1 is binary 10000000 (decimal 128), only the top dot prints in that horizontal position; if v_1 is binary 00000001 (decimal 01), only the bottom dot prints; and if v_1 is binary 11111111 (decimal 255), all eight dots print.</p> <p>Example: LPRINT CHR\$(27);CHR\$(75);CHR\$(n₁); CHR\$(n₂);CHR\$(v₁);CHR\$(v₂); ... CHR\$(v₁₁₀₈);</p>	Dot Position	•	–	Bit Number	Top	•	–	7		•	–	6		•	–	5		•	–	4		•	–	3		•	–	2		•	–	1	Bottom	•	–	0
Dot Position	•	–	Bit Number																																		
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	•	–	4																																		
	•	–	3																																		
	•	–	2																																		
	•	–	1																																		
Bottom	•	–	0																																		
ESC L	<p>2216 Bit-Image Graphics (half-speed) Format: ESC L;n₁;n₂;v₁;v₂;...v₂₂₁₆; Sets dot spacing to 168 by 84 dots per inch in 1:1 aspect ratio, to 140 by 84 dots per inch in 5:6 aspect ratio (see "ESC n (Set Aspect Ratio)"). 2216 bit-image graphics (half-speed) prints at one-half the speed of 2216 bit-image graphics (ESC Y) for improved print quality and the ability to print consecutive dot positions. n₁, n₂, v₁, and v₂ through v₂₂₁₆ represent the same values as in 1108 bit-image graphics (ESC K). Refer to the description of ESC K for a complete description of these values. The total number of bit-image data bytes cannot exceed 2216 (the total number of dot positions in a 13.2-inch line).</p> <p>Example: LPRINT CHR\$(27);CHR\$(76);CHR\$(n₁); CHR\$(n₂);CHR\$(v₁);CHR\$(v₂); ... CHR\$(v₂₂₁₆);</p>																																				
ESC M	<p>Automatic Line Justification Format: ESC M;n; Justifies the right margin. Automatic justification is started when n is 1, and stopped when n is 0. The printer adjusts the spaces between words in the text so that the last character of the words at the end of the lines all print in the last position of the line. Thus both the left and right margins appear as straight lines. This gives a block appearance to the printed text. Automatic line justification can be used with any of the character spacings.</p>																																				

Printer Code	Printer Function
ESC M Cont.	<p>Notes:</p> <ol style="list-style-type: none"> 1. Lines are not right justified if the text is less than 75% of the specified line length. If a line fails the greater than 75% rule, the remaining portion of the text is tested. 2. If the justification results in a word wrap condition, the remaining text is treated as separate lines and follows the above rule. 3. Control codes in the datastream cause the text before the control code to be printed based on the justification rules. The remainder of the text is justified between the current print position and the right margin. 4. If the last line of a paragraph, or any line of data, is not to be justified, use the control code sequence, backspace (BS) and carriage return (CR). 5. The Color Printer operates only on the least significant bit of n. Therefore, any odd-numbered ASCII decimal value gives the same result as n=1, and any even-numbered ASCII decimal value gives the same result as n=0. <p>Example: LPRINT CHR\$(27);CHR\$(77);CHR\$(n);</p>
ESC m	<p>Select Band 2 Selects ribbon band 2. The actual color printed depends on the ribbon being used. The printer will continue to print with band 2 until a command to change the ribbon band is received by the printer.</p> <p>Example: LPRINT CHR\$(27);CHR\$(109);</p>
ESC N	<p>Set Automatic Perforation-Skip Format: ESC N;n; Specifies the number of lines to be skipped at the end of each page. This causes the printer to automatically skip over the perforation between pages of continuous forms. The number of lines n, is converted to inches using the line-spacing in effect. The value of n must be between 1 and 127. ESC N must be reset anytime the page length is changed by ESC C (Set Page Length in Lines) or by ESC C 0 (Set Page Length in Inches).</p> <p>Example: LPRINT CHR\$(27);CHR\$(78);CHR\$(n);</p>

Printer Code	Printer Function
ESC n	<p>Set Aspect Ratio Format: ESC n;x; Sets the printer to a 5:6 or 1:1 aspect ratio. When x is 1, the aspect ratio is set to 1:1; when x is 0, the aspect ratio is set to 5:6. With the 5:6 aspect ratio selected, graphics are printed to match the shape that appears on the display. The 1:1 aspect ratio is recommended for bit-image graphics to improve quality and simplify bit-position calculations. The power-on default is the 5:6 aspect ratio.</p> <p>Note: The Color Printer operates only on the least significant bit of n. Therefore, any odd-numbered ASCII decimal value gives the same result as n=1, and any even-numbered ASCII decimal value gives the same result as n=0.</p> <p>Example: LPRINT CHR\$(27);CHR\$(110);CHR\$(x);</p>
ESC O	<p>Cancel Automatic Perforation-Skip Cancels the automatic perforation-skip function. Example: LPRINT CHR\$(27);CHR\$(79);</p>
ESC P	<p>Proportional Spacing Format: ESC P;n; Starts proportional spacing when n is 1. Stops proportional spacing when n is 0. Proportional spacing gives each different character a different amount of space on the line. That is, narrow characters, such as i, are given a small amount of space on the line relative to a broader character, such as M. This is similar to the way people write characters and gives a more balanced look to the text. Many books are printed in proportional spacing, as is this one.</p> <p>The distance of a forward space is 10 units; the distance of a backspace is determined by the last printed character or space, if the printing of the character or the space was the last carriage movement.</p> <p>Normal processing of all control codes continues during proportional spacing.</p> <p>Note: The Color Printer operates only on the least significant bit of n. Therefore, any odd-numbered ASCII decimal value gives the same result as n=1, and any even-numbered ASCII decimal value gives the same result as n=0.</p> <p>Example: LPRINT CHR\$(27);CHR\$(80);CHR\$(n);</p>

Printer Code	Printer Function
ESC Q 2	<p>Deselect Specific Printer Format: ESC Q;2; Sets only the Color Printer so it will not accept data from the system unit. The printer must be initialized by the system or selected using DC1 (Select Printer) to accept data. Example: LPRINT CHR\$(27);CHR\$(81);CHR\$(2);</p>
ESC R	<p>Set All Tabs to Power-On Defaults Sets all tabs, horizontal and vertical, to the power-on defaults. Example: LPRINT CHR\$(27);CHR\$(82);</p>
ESC S	<p>Subscript or Superscript Printing Format: ESC S;n; ESC S followed by 1 changes the printer to subscript printing. ESC S followed by 0 changes the printer to superscript printing. ESC S is canceled by ESC T.</p> <p>Notes:</p> <ol style="list-style-type: none"> 1. If line feed (LF) codes are issued while in subscript or superscript printing, the line feed does not change the subscript or superscript setting. For example, if in superscript printing, the line feed causes the paper to advance to the superscript position of the next line. 2. The Color Printer operates only on the least significant bit of n. Therefore, any odd-numbered ASCII decimal value gives the same result as n=1, and any even-numbered ASCII decimal value gives the same result as n=0. <p>Example: LPRINT CHR\$(27);CHR\$(83);CHR\$(n);</p>
ESC SI	<p>Compressed Printing Alternate command for SI. Example: LPRINT CHR\$(27);CHR\$(15);</p>
ESC SO	<p>Double-Width Printing by Line Alternate command for SO. Example: LPRINT CHR\$(27);CHR\$(14);</p>

Printer Code	Printer Function
ESC T	<p>Cancel Subscript or Superscript Ends subscript or superscript printing started by ESC S.</p> <p>Note: If ESC T is issued when not printing in subscript or superscript, it is acknowledged and ignored.</p> <p>Example: LPRINT CHR\$(27);CHR\$(84);</p>
ESC U	<p>Unidirectional Printing Format: ESC U;n; When n is 1, sets the printer to print from left to right only. ESC U 0 returns the printer to normal two-direction printing. Unidirectional printing ensures a more accurate printing start position for better print quality.</p> <p>Note: The Color Printer operates only on the least significant bit of n. Therefore, any odd-numbered ASCII decimal value gives the same result as n=1, and any even-numbered ASCII decimal value gives the same result as n=0.</p> <p>Example: LPRINT CHR\$(27);CHR\$(85);CHR\$(n);</p>
ESC W	<p>Continuous Double-Width Printing Format: ESC W;n; ESC W 1 changes the printer to double-width printing. ESC W 0 ends the double-width printing started by ESC W 1. ESC W 1 is not canceled by a line ending code and must be canceled by ESC W 0.</p> <p>Note: The Color Printer operates only on the least significant bit of n. Therefore, any odd-numbered ASCII decimal value gives the same result as n=1, and any even-numbered ASCII decimal value gives the same result as n=0.</p> <p>Example: LPRINT CHR\$(27);CHR\$(87);CHR\$(n);</p>

Printer Code	Printer Function
ESC X	<p>Set Left and Right Margins Format: ESC X;n₁;n₂; The numbers, n₁ and n₂, are selected in relation to the left side of the printer, with n₁ representing the left margin and n₂ the right margin. The value of n₁ or n₂ is the column of the page you wish to set as the left or right margin.</p> <p>n₂ must be greater than n₁ by 1.27 cm (1/2 inch) or more, and cannot be greater than 13.2 times the character-spacing (in characters per inch) in effect. If n₂ is greater than this limit, the right margin will be set at the maximum allowable length. Data is printed beginning in column n₁. Column n₂ is considered the last printable position of the line. If a word to be printed exceeds the right margin, a carriage-return and line-feed are inserted before the word, and the word is printed on the next line. The margins are converted to inches based on the current character-spacing setting. The power-on default is set with DIP Switch 5.</p> <p>Note: Both n₁ and n₂ must be included in the command or the results will be unpredictable.</p> <p>Example: LPRINT CHR\$(27);CHR\$(88);CHR\$(n₁);CHR\$(n₂);</p>
ESC Y	<p>2216 Bit-Image Graphics Format: ESC Y;n₁;n₂;v₁;v₂;...v₂₂₁₆; Sets dot spacing to 168 by 84 dots per inch in 1:1 aspect ratio, to 140 by 84 dots per inch in 5:6 aspect ratio (see "ESC n (Set Aspect Ratio)") and prints at normal printing speed. ESC Y graphics cannot print dots in consecutive horizontal dot positions. If consecutive dot positions are specified, the printer will not print the second dot.</p> <p>n₁, n₂, v₁, and v₂, through v₂₂₁₆ represent the same values as in 1108 Bit-Image Graphics (ESC K). Refer to the description of ESC K for a complete description of these values. The number of bit-image databytes cannot exceed 2216 (the total number of dot positions in a 13.2-inch line).</p> <p>Example: LPRINT CHR\$(27);CHR\$(89);CHR\$(n₁);CHR\$(n₂); CHR\$(v₁);CHR\$(v₂); ...CHR\$(v₂₂₁₆);</p>
ESC y	<p>Select Band 1 Selects ribbon band 1. The actual color printed depends on the ribbon being used. The printer will continue to print with band 1 until a command to change the ribbon band is received by the printer.</p> <p>Example: LPRINT CHR\$(27);CHR\$(121);</p>

Printer Code	Printer Function
ESC Z	<p>4432 Bit-Image Graphics Format: ESC Z;n₁;n₂;v₁;v₂;...v₄₄₃₂; Sets dot spacing to 336 by 84 dots per inch in 1:1 aspect ratio, to 280 by 84 dots per inch in 5:6 aspect ratio (see "ESC n (Set Aspect Ratio)"). 4432 bit-image graphics prints at one-half the speed of 1108 bit-image graphics (ESC K) for improved print quality. ESC Z graphics can print only every third consecutive horizontal dot position. If consecutive dot positions are specified, the printer will ignore the second and third dots.</p> <p>n₂, v₁, v₂, and v₄₄₃₂ represent the same values as in 1108 bit-image graphics (ESC K). Refer to the description of ESC K for a complete description of these values. The number of bit-image databytes cannot exceed 4432 (the total number of dot positions in a 13.2-inch line). Example: LPRINT CHR\$(27);CHR\$(90);CHR\$(n₁);CHR\$(n₂); CHR\$(v₁);CHR\$(v₂); ...CHR\$(v₄₄₃₂);</p>
ESC 0	<p>1/8 Inch Line Spacing Sets line spacing to 8 lines per inch. Example: LPRINT CHR\$(27);CHR\$(48);</p>
ESC 1	<p>6/72 Inch Line Spacing Sets line spacing to 6/72 inch. Example: LPRINT CHR\$(27);CHR\$(49);</p>
ESC 2	<p>Start Text Line Spacing ESC 2 is an execution command for ESC A (Set Text Line Spacing). If no ESC A command has been given, line spacing returns to 6 lines per inch. Example: LPRINT CHR\$(27);CHR\$(50);</p>
ESC 3	<p>Graphics Line Spacing Format: ESC 3;n; Sets line spacing to n/144 inch. Line spacing of 14/144 is recommended for bit-image graphics using eight bits. The value of n must be between 1 and 255. Example: LPRINT CHR\$(27);CHR\$(51);CHR\$(n);</p>
ESC 4	<p>Set Top of Page Sets the current vertical position as the top-of-page. Example: LPRINT CHR\$(27);CHR\$(52);</p>

Printer Code	Printer Function
ESC 5	<p>Automatic Line Feed Format: ESC 5;n; When n is 1, automatic line feeding starts; the printer will line-feed each time a code that indicates the end of a line, such as CR, is received. When n is 0, automatic line feeding stops.</p> <p>Note: The Color Printer operates only on the least significant bit of n. Therefore, any odd-numbered ASCII decimal value gives the same result as n=1, and any even-numbered ASCII decimal value gives the same result as n=0.</p> <p>Example: LPRINT CHR\$(27);CHR\$(53);CHR\$(n);</p>
ESC 6	<p>Select Character Set 2 Selects character set 2. (See "Character Set 2.") Character Set 2 contains most characters and symbols used in non-English languages. The power-on default for Character Set is set with DIP Switch 1.</p> <p>Note: Some programs use the control codes in Character Set 1 that have ASCII decimal values above 128. These control codes are not in Character Set 2. The use of Character Set 2, therefore, may not give the desired results with some programs.</p> <p>Example: LPRINT CHR\$(27);CHR\$(54);</p>
ESC 7	<p>Select Character Set 1 Selects character set 1. (See "Character Set 1".) Character Set 1 contains characters and symbols commonly used in the English language, along with some common, non-English, characters and symbols. The power-on default for Character Set is set with DIP Switch 1.</p> <p>Example: LPRINT CHR\$(27);CHR\$(55);</p>
ESC -	<p>Continuous Underline Format: ESC -;n; When n is 1-all of the following data is underlined. ESC - followed by 0 cancels underlining.</p> <p>Note: The Color Printer operates only on the least significant bit of n. Therefore, any odd-numbered ASCII decimal value gives the same result as n=1, and any even-numbered ASCII decimal value gives the same result as n=0.</p> <p>Example: LPRINT CHR\$(27);CHR\$(45);CHR\$(n);</p>

Printer Code	Printer Function
ESC :	<p>12 Characters per Inch Printing Sets character spacing to 12 characters per inch. Example: LPRINT CHR\$(27);CHR\$(58);</p>
ESC <	<p>Move Carriage to Home Position Returns the print head to the left side of the printer to print the line following the command. No line feed occurs. Example: LPRINT CHR\$(27);CHR\$(60);</p>
ESC ?	<p>Set Initialize Signal Function Format: ESC ?;n; Defines what the printer does when an initialize signal is received. The initialize signal is a hardware signal sent to the printer by the system unit when called for by the program being used. This signal is commonly called for when a program is first loaded. When n is 1, the initialize function is set On; when n is 0, the initialize function is set Off.</p> <p>When the initialize function is On, the initialize signal causes the printer to clear all data from the printer memory and set all printer functions to the power-on defaults. Some of the data may not have been printed and will be lost.</p> <p>When the initialize function is Off, the initialize signal causes the printer to insert CAN (Clear Data) into the data in the printer memory. The CAN, when processed by the printer, clears the printer memory of all data waiting to be printed following the last received line-ending code. All control codes are cleared and the printer is set to the values set by the DIP switches. This allows a printing job to be completed before the printer is reset for the next application. The power-on default is the initialize function set Off.</p> <p>Note: The Color Printer operates only on the least significant bit of n. Therefore, any odd-numbered ASCII decimal value gives the same result as n=1, and any even-numbered ASCII decimal value gives the same result as n=0.</p> <p>Example: LPRINT CHR\$(27);CHR\$(63);CHR\$(n);</p>

Printer Code	Printer Function
ESC @	<p>Select Control-Value Data Type Format: ESC @;n; Allows the printer to accept certain parameters for the ESC commands in either of two forms: binary or ASCII character. When “n” is 1 (odd) ASCII is selected. When “n” is 0 (even) Binary is selected.</p> <p>Note: See “Programming Considerations at the Beginning of this section for a detailed explanation of this command.</p> <p>Example: LPRINT CHR\$(27);CHR\$(64);CHR\$(n);</p>
ESC \	<p>Print All Characters Format: ESC \;n₁;n₂; Allows the printing of all characters. This includes characters that are normally recognized by the printer as control codes. This code (ESC \) allows the printer to print the special symbols assigned to these ASCII values. If no character is assigned to a decimal value received by the printer, a space character is printed. No control code functions are performed when this command is in effect. n₁ and n₂ are binary numbers that specify the number of characters to be printed. n₁ represents values from 0 to 255, and n₂ represents values from 0 to 255 times 256.</p> <p>Example: LPRINT CHR\$(27);CHR\$(92); CHR\$(n₁);CHR\$(n₂);</p>
ESC]	<p>Reverse Line Feed Causes the printer to move the paper down one line space as defined by DIP Switch 2 or by printer control codes, ESC A and ESC 2, ESC 0, ESC 1, or ESC 3.</p> <p>Example: LPRINT CHR\$(27);CHR\$(93);</p>
ESC ^	<p>Print Any Character Allows the printer to print any character each time the command is received. This includes characters normally recognized by the printer as control codes. This code (ESC ^) allows the printer to print the special symbols assigned to these ASCII values. If no character is assigned to a decimal value received by the printer, a space character is printed.</p> <p>Example: LPRINT CHR\$(27);CHR\$(94);</p>

Printer Code	Printer Function
FF	<p>Form Feed Advances the paper to the next top-of-form position. The top-of-form position is set by the position of the paper when power is switched On, or by ESC 4, ESC C, or the control-panel buttons. The next top-of-form is determined by the form length defined by DIP Switch 6, ESC C, or ESC C 0. Example: LPRINT CHR\$(12);</p>
HT	<p>Horizontal Tab Moves the print head to the next horizontal tab stop. If the next horizontal tab stop is beyond the right margin, the character following HT is printed at the left margin. Tab stops are set with ESC D. A tab stop every 8 columns is the power-on default. Example: LPRINT CHR\$(9);</p>
LF	<p>Line Feed Advances the paper one linespace, as defined by DIP Switch 2 or by printer control codes; ESC A and ESC 2, ESC 0, ESC 1, or ESC 3. Example: LPRINT CHR\$(10);</p>
NUL	<p>Command End Used with control commands as a command list terminator. NUL is also used with other printer control codes to select options. Example: LPRINT CHR\$(0);</p>
SI	<p>Compressed Printing Causes the printer to begin compressed printing. Character spacing in compressed printing is 17.1 characters per inch. Example: LPRINT CHR\$(15);</p>
SO	<p>Double-Width Printing by Line Causes the printer to start double-width printing. Double-width printing prints the characters twice as wide as the current character spacing. This results in half as many characters per inch. A Carriage Return, Line Feed or DC4 (End Double-Width Printing by Line) cancels the SO command. Example: LPRINT CHR\$(14);</p>

Printer Code	Printer Function
VT	<p>Vertical Tab</p> <p>Advances the paper to the next vertical tab-stop position. If the next vertical tabstop is beyond the bottom of the page, the paper is placed at the first line of the next page. If no vertical tab stops are set, the VT command is treated as a line-feed (LF) command.</p> <p>Example:</p> <pre>LPRINT CHR\$(11);</pre>

Printer Control Code Quick Reference

This is an alphabetic listing of the descriptions of the printer control codes. You will find it helpful in locating the code you need to perform a certain job, or to determine the ASCII decimal value quickly, once you are familiar with the control codes.

Note: ASCII values greater than 27 must be preceded by the ESC code (ASCII value 27).

Description	Code	ASCII Value
10 characters-per-inch print	DC2	18
12 characters-per-inch print	ESC :	58
17.1 characters-per-inch print	SI	15
Alarm	BEL	7
All-characters print	ESC \	92
Aspect ratio set	ESC n	110
Audible alarm	BEL	7
Auto justification On/Off	ESC M	77
Auto line feed On/Off	ESC 5	53
Auto perforation skip Off	ESC O	79
Auto perforation skip On	ESC N	78
Auto ribbon-band shift	ESC a	97
Auto ribbon shift	ESC a	97
Backspace	BS	8
Backspace n increments	ESC e	101
Backspace variable	ESC e	101
Band 1	ESC y	121
Band 2	ESC m	109
Band 3	ESC c	99
Band 4	ESC b	98
Bell	BEL	7
Black ribbon band	ESC b	98
Buzzer	BEL	7

Description	Code	ASCII Value
Cancel	CAN	24
Cancel auto line feed	ESC 5	53
Cancel data	CAN	24
Cancel double-strike printing	ESC H	72
Cancel double-width by line	DC4	20
Cancel double-width printing (lines)	ESC W	87
Cancel emphasized printing	ESC F	70
Cancel perforation skip	ESC O	79
Cancel proportional spacing	ESC P	80
Cancel subscript	ESC T	84
Cancel superscript	ESC T	84
Carriage return	CR	13
Change color (see ribbon band desired)		
Change printing quality	ESC I	73
Character quality set	ESC I	73
Character set 1 select	ESC 7	55
Character set 2 select	ESC 6	54
Character spacing, 12 per inch	ESC :	58
Character spacing, 10 per inch	DC2	18
Character spacing, 17.1 per inch	SI	15
Character under decimal 32, print	ESC ^	94
Characters under decimal 32, print	ESC \	92
Clear data	CAN	24
Clear horizontal tabs	ESC R	82
Clear tabs	ESC R	82
Clear vertical tabs	ESC R	82
Color band 1	ESC y	121
Color band 2	ESC m	109
Color band 3	ESC c	99
Color band 4	ESC b	98

Description	Code	ASCII Value
Command designator	ESC	27
Command end	NUL	0
Command prefix	ESC	27
Command start	ESC	27
Command terminator	NUL	0
Compressed On	SI	15
Compressed print	SI	15
Condensed print	SI	15
Control-data value-type set	ESC @	64
Data clear	CAN	24
Data-processing quality set	ESC I	73
Data-value type set	ESC @	64
Deselect printer	DC3	19
Deselect specific printer	ESC Q	81
Double-strike printing	ESC G	71
Double-strike printing Off	ESC H	72
Double-width-by-line Off	DC4	20
Double-width-by-line On	SO	14
Double-width On/Off (lines)	ESC W	87
Eject form	FF	12
Eject paper	FF	12
Emphasized printing	ESC E	69
Emphasized printing Off	ESC F	70
Escape	ESC	27
Feed line	LF	10
Form feed	FF	12
Form, set top of	ESC 4	52
Forward space variable	ESC d	100
Graphics, 1108 bit-image	ESC K	75
Graphics, 2216 bit-image, 1/2 speed	ESC L	76
Graphics, 2216 bit-image, full speed	ESC Y	89

Description	Code	ASCII Value
Graphics, 4432 bit-image, 1/2 speed	ESC Z	90
Graphics, line-feed set	ESC 3	51
Head, home	ESC <	60
Home head	ESC <	60
Horizontal tab	HT	9
Horizontal tab stops set	ESC D	68
Incremental backspace	ESC e	101
Initialize function set	ESC ?	63
Justification On/Off	ESC M	77
Length-of-page set in lines	ESC C	67
Length-of-page set in inches	ESC C 0	67 0
Line-feed	LF	10
Line-feed, auto On/Off	ESC 5	53
Line-feed, reverse	ESC]	93
Line-feed, set 1/8 inch	ESC 0	48
Line-feed, set 6/72 inch	ESC 1	49
Line-feed, set graphics	ESC 3	51
Line-feed, store text	ESC A	65
Line-feed, start text	ESC 2	50
Line-feed, variable	ESC J	74
Margins set	ESC X	88
Near-letter quality, set	ESC I	73
Null	NUL	0
Page eject	FF	12
Page length, set in inches	ESC C 0	67 0
Page length, set in lines	ESC C	67
Paper eject	FF	12
Perforation skip Off	ESC O	79
Perforation skip set	ESC N	78
Print all characters	ESC \	92
Print character under decimal 32	ESC ^	94

Description	Code	ASCII Value
Print double-width one line	SO	14
Print double-width multiple lines	ESC W	87
Print emphasized	ESC E	69
Print emphasized Off	ESC F	70
Print quality set	ESC I	73
Print 10 characters per inch	DC2	18
Print 12 characters per inch	ESC :	58
Print unidirectional On/Off	ESC U	85
Printer deselect	DC3	19
Printer deselect specific	ESC Q	81
Printer select	DC1	17
Proportional spacing On/Off	ESC P	80
Quality set	ESC I	73
Return carriage	CR	13
Reverse line feed	ESC]	93
Ribbon band 1	ESC y	121
Ribbon band 2	ESC m	109
Ribbon band 3	ESC c	99
Ribbon band 4	ESC b	98
Ribbon band auto shift	ESC a	97
Select character set 1	ESC 7	55
Select character set 2	ESC 6	54
Select color (see ribbon band desired)		
Select printer	DC1	17
Set 1 (character set 1)	ESC 7	55
Set 1/8-inch line feed	ESC 0	48
Set 2 (character set 2)	ESC 6	54
Set 6/72-inch line feed	ESC 1	49
Set aspect ratio	ESC n	110
Set data-processing quality	ESC I	73

Description	Code	ASCII Value
Set data-value type	ESC @	64
Set graphics line feed	ESC 3	51
Set horizontal tab stops	ESC D	68
Set initialize function	ESC ?	63
Set left margin	ESC X	88
Set margins	ESC X	88
Set near-letter quality	ESC I	73
Set page length in lines	ESC C	67
Set page length in inches	ESC C 0	67 0
Set perforation skip	ESC N	78
Set right margin	ESC X	88
Set text quality	ESC I	73
Set top-of-form	ESC 4	52
Set vertical tabs	ESC B	66
Space forward variable	ESC d	100
Specific printer deselect	ESC Q	81
Start 6/72 inch line feed	ESC 1	49
Start auto line feed	ESC 5	53
Start double-strike print	ESC G	71
Start double-width print by line	SO	14
Start double-width print (lines)	ESC W	87
Start emphasized print	ESC E	69
Start graphics line feed	ESC 3	51
Start perforation skip	ESC N	78
Start proportional spacing	ESC P	80
Start subscript	ESC S	83
Start superscript	ESC S	83
Start text line feed	ESC 2	50
Start underline	ESC -	45
Stop auto line feed	ESC 5	53
Stop double-strike print	ESC H	72

Description	Code	ASCII Value
Stop double-width by line	DC4	20
Stop double-width print (lines)	ESC W	87
Stop emphasized print	ESC F	70
Stop perforation skip	ESC O	79
Stop proportional spacing	ESC P	80
Stop subscript	ESC T	84
Stop superscript	ESC T	84
Stop underline	ESC -	45
Stops, horizontal tabs, set	ESC D	68
Stops, vertical tabs, set	ESC B	66
Store text line feed	ESC A	65
Subscript Off	ESC T	84
Subscript On	ESC S	83
Superscript Off	ESC T	84
Superscript On	ESC S	83
Tab horizontal	HT	9
Tab stops, horizontal, set	ESC D	68
Tab stops, vertical, set	ESC B	66
Tab vertical	VT	11
Tabs clear	ESC R	82
Tabs horizontal set	ESC D	68
Tabs vertical set	ESC B	66
Text line-feed store	ESC A	65
Text line-feed start	ESC 2	50
Text quality set	ESC I	73
Top-of-form set	ESC 4	52
Underline On/Off	ESC -	45
Unidirectional printing On/Off	ESC U	85
Variable backspace	ESC e	101
Variable forward space	ESC d	100
Variable line feed	ESC J	74
Vertical tabs set	ESC B	66
Vertical tab	VT	11

Printing in Color

The IBM Personal Computer Color Printer is capable of printing in 8 colors when the process color ribbon is used. The 4 colors of the ribbon are selected by: ESC b (Select Band 4) for black, ESC c (Select Band 3) for cyan, ESC m (Select Band 2) for magenta, and ESC y (Select Band 1) for yellow. You can print four additional colors, orange, green, violet, and brown, by printing the data twice. Print the data in one color and then print over the data in a second color according to the table below. When printing data twice to mix colors, always print the lighter color first to avoid contaminating the ribbon.

Color Desired	Ribbon Bands to Mix
Orange	Bands 1 (ESC y) and 2 (ESC m)
Green	Bands 1 (ESC y) and 3 (ESC c)
Violet	Bands 2 (ESC m) and 3 (ESC c)
Brown	Bands 2 (ESC m) and 4 (ESC b)

To mix colors, data must be sent to the printer in the following order: printer control code to select the first color, data to be printed, carriage return with no line feed, printer control code to select the second color, repeat the data to be printed. For example, to print "IBM Personal Computer" in green, you must; select band 1 (yellow) with ESC y, print "IBM Personal Computer", return the carriage with no line feed with ASCII decimal value 141 from "Character Set 1," select band 3 (cyan) with ESC c, and print "IBM Personal Computer." To do this, type the following:

```
LPRINT CHR$(27);CHR$(121);"IBM Personal  
Computer";CHR$(141);CHR$(27);CHR$(99);"IBM Personal  
Computer"
```

Note: The above example is for use with "Character Set 1."

Color Printer Character Set 1

0	1	2	3	4	5	6	7	8	9
NUL	☺	☹	♥	◇	♣	♠	BEL	BS	HT
10	11	12	13	14	15	16	17	18	19
LF	VT	FF	CR	SO	SI	▶	DC1	DC2	DC3
20	21	22	23	24	25	26	27	28	29
DC4	§	■	↕	CAN	↓		ESC	└	↔
30	31	32	33	34	35	36	37	38	39
▲	▼	SP	!	”	#	\$	%	&	'
40	41	42	43	44	45	46	47	48	49
(	)	*	+	,	—	.	/	0	1
50	51	52	53	54	55	56	57	58	59
2	3	4	5	6	7	8	9	:	;
60	61	62	63	64	65	66	67	68	69
<	=	>	?	@	A	B	C	D	E
70	71	72	73	74	75	76	77	78	79
F	G	H	I	J	K	L	M	N	O
80	81	82	83	84	85	86	87	88	89
P	Q	R	S	T	U	V	W	X	Y
90	91	92	93	94	95	96	97	98	99
Z	[	\	\]	^	_	`	a	b	c
100	101	102	103	104	105	106	107	108	109
d	e	f	g	h	i	j	k	l	m
110	111	112	113	114	115	116	117	118	119
n	o	p	q	r	s	t	u	v	w
120	121	122	123	124	125	126	127	128	129
x	y	z	{	|	}	~		NUL	ü

Color Printer Character Set 1 (Continued)

130	131	132	133	134	135	136	137	138	139
é	â	ä	à	å	BEL	BS	HT	LF	VT
140	141	142	143	144	145	146	147	148	149
FF	CR	SO	SI	É	DC1	DC2	DC3	DC4	ò
150	151	152	153	154	155	156	157	158	159
û	ù	CAN	Ö		ESC	£	¥	₪	ƒ
160	161	162	163	164	165	166	167	168	169
á	í	ó	ú	ñ	Ñ	ā	ō	ı	┐
170	171	172	173	174	175	176	177	178	179
┌	½	¼	ı	◀	▶	▒	▓	▔	▕
180	181	182	183	184	185	186	187	188	189
▖	▗	▘	▙	▚	▛	▜	▝	▞	▟
190	191	192	193	194	195	196	197	198	199
■	□	▢	▣	▤	▥	▦	▧	▨	▩
200	201	202	203	204	205	206	207	208	209
▪	▫	▬	▭	▮	▯	▰	▱	▲	△
210	211	212	213	214	215	216	217	218	219
▴	▵	▶	▷	▸	▹	►	▻	▼	▽
220	221	222	223	224	225	226	227	228	229
▾	▿	▾	▿	α	β	Γ	Π	Σ	σ
230	231	232	233	234	235	236	237	238	239
μ	τ	ϕ	θ	Ω	δ	∞	∅	ε	∩
240	241	242	243	244	245	246	247	248	249
≡	±	≥	≤	∫	J	÷	≈	◦	●
250	251	252	253	254	255				
•	√	ⁿ	²	■	SP				

Color Printer Character Set 2

0	1	2	3	4	5	6	7	8	9
NUL	☺	☹	♥	♦	♣	♠	BEL	BS	HT
10	11	12	13	14	15	16	17	18	19
LF	VT	FF	CR	SO	SI	▶	DC1	DC2	DC3
20	21	22	23	24	25	26	27	28	29
DC4	§	■	↕	CAN	↓		ESC	└	↔
30	31	32	33	34	35	36	37	38	39
▲	▼	SP	!	”	#	\$	%	&	'
40	41	42	43	44	45	46	47	48	49
(	)	*	+	,	—	.	/	0	1
50	51	52	53	54	55	56	57	58	59
2	3	4	5	6	7	8	9	:	;
60	61	62	63	64	65	66	67	68	69
<	=	>	?	@	A	B	C	D	E
70	71	72	73	74	75	76	77	78	79
F	G	H	I	J	K	L	M	N	O
80	81	82	83	84	85	86	87	88	89
P	Q	R	S	T	U	V	W	X	Y
90	91	92	93	94	95	96	97	98	99
Z	[	\	\]	^	_	`	a	b	c
100	101	102	103	104	105	106	107	108	109
d	e	f	g	h	i	j	k	l	m
110	111	112	113	114	115	116	117	118	119
n	o	p	q	r	s	t	u	v	w
120	121	122	123	124	125	126	127	128	129
x	y	z	{	|	}	~		Ç	ü

Color Printer Character Set 2 (Continued)

130	131	132	133	134	135	136	137	138	139
é	â	ä	à	å	ç	ê	ë	è	ï
140	141	142	143	144	145	146	147	148	149
î	ì	Ä	Å	É	æ	Æ	ô	ö	ò
150	151	152	153	154	155	156	157	158	159
û	ù	ÿ	Ö	Ü	ç	£	¥	₤	ƒ
160	161	162	163	164	165	166	167	168	169
á	í	ó	ú	ñ	Ñ	á	ó	¿	┐
170	171	172	173	174	175	176	177	178	179
┐	½	¼	ı	<<	>>	■	■	■	■
180	181	182	183	184	185	186	187	188	189
■	■	■	■	■	■	■	■	■	■
190	191	192	193	194	195	196	197	198	199
■	■	■	■	■	■	■	■	■	■
200	201	202	203	204	205	206	207	208	209
■	■	■	■	■	■	■	■	■	■
210	211	212	213	214	215	216	217	218	219
■	■	■	■	■	■	■	■	■	■
220	221	222	223	224	225	226	227	228	229
■	■	■	■	α	β	Γ	Π	Σ	σ
230	231	232	233	234	235	236	237	238	239
μ	τ	ϕ	θ	Ω	δ	∞	∅	ε	∩
240	241	242	243	244	245	246	247	248	249
≡	±	≥	≤	↑	↓	÷	≈	◦	■
250	251	252	253	254	255				
-	√	n	2	■	SP				

All Printable Characters

0	1	2	3	4	5	6	7	8	9
NUL	☺	☹	♥	♦	♣	♠	•	◼	◯
10	11	12	13	14	15	16	17	18	19
◼	♂	♀	♪	♫	☀	▶	◀	↕	!!
20	21	22	23	24	25	26	27	28	29
¶	§	▬	↕	↑	↓	→	←	└	↔
30	31	32	33	34	35	36	37	38	39
▲	▼	SP	!	”	#	\$	%	&	'
40	41	42	43	44	45	46	47	48	49
(	)	*	+	,	—	.	/	0	1
50	51	52	53	54	55	56	57	58	59
2	3	4	5	6	7	8	9	:	;
60	61	62	63	64	65	66	67	68	69
<	=	>	?	@	A	B	C	D	E
70	71	72	73	74	75	76	77	78	79
F	G	H	I	J	K	L	M	N	O
80	81	82	83	84	85	86	87	88	89
P	Q	R	S	T	U	V	W	X	Y
90	91	92	93	94	95	96	97	98	99
Z	[	\	\]	^	_	`	a	b	c
100	101	102	103	104	105	106	107	108	109
d	e	f	g	h	i	j	k	l	m
110	111	112	113	114	115	116	117	118	119
n	o	p	q	r	s	t	u	v	w
120	121	122	123	124	125	126	127	128	129
x	y	z	{	|	}	~		Ç	ü

All Printable Characters (Continued)

130	131	132	133	134	135	136	137	138	139
é	â	ä	à	å	ç	ê	ë	è	ï
140	141	142	143	144	145	146	147	148	149
î	ì	Ä	Å	É	æ	Æ	ô	ö	ò
150	151	152	153	154	155	156	157	158	159
û	ù	ÿ	Ö	Ü	ç	£	¥	₪	ƒ
160	161	162	163	164	165	166	167	168	169
á	í	ó	ú	ñ	Ñ	à	ó	¿	Γ
170	171	172	173	174	175	176	177	178	179
⌋	½	¼	ı	<<	>>	■	■	■	■
180	181	182	183	184	185	186	187	188	189
■	■	■	■	■	■	■	■	■	■
190	191	192	193	194	195	196	197	198	199
■	■	■	■	■	■	■	■	■	■
200	201	202	203	204	205	206	207	208	209
■	■	■	■	■	■	■	■	■	■
210	211	212	213	214	215	216	217	218	219
■	■	■	■	■	■	■	■	■	■
220	221	222	223	224	225	226	227	228	229
■	■	■	■	α	β	Γ	Π	Σ	σ
230	231	232	233	234	235	236	237	238	239
μ	τ	ϕ	θ	Ω	δ	∞	∅	ε	∩
240	241	242	243	244	245	246	247	248	249
≡	±	≥	≤	↑	↓	÷	≈	◦	●
250	251	252	253	254	255				
•	√	n	2	■	SP				

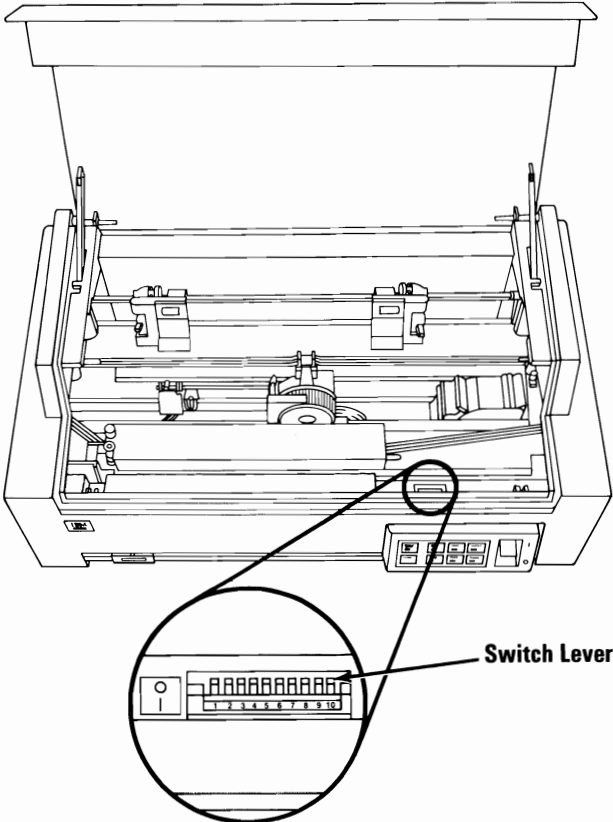
DIP-Switch Settings

Many of the printer functions can be manually set with a 10-position dual in-line package (DIP) switch. Although these same functions are programmable, the printer defaults to the values set by the DIP switch.

The DIP switches must be set prior to switching the printer's power to On. The printer logic reads the DIP-switch settings only at power-on or printer initialization.

Note: Some programs use the control codes in Character Set 1 that have ASCII decimal values above 128. These control codes are not in Character Set 2. The use of Character Set 2, therefore, may not give the desired results with some programs.

The charts on the following page describe the functions available through the DIP-switch settings.



Location of Printer DIP Switch

Switch	Setting	Function
1	On	Selects Character Set 2 (see "Character Set 2")(see "Note" below)
1	Off	Selects Character Set 1 (see "Character Set 1")
2	On	Sets line spacing to 8 lines per inch
2	Off	Sets line spacing to 6 lines per inch
3	On	Sets automatic 1-inch perforation skip
3	Off	No automatic perforation skip
4	On	Sets automatic line feed on carriage return
4	Off	No automatic line feed on carriage return
5	On	Sets printer to a 13.2-inch print line
5	Off	Sets printer to an 8-inch print line.
6	On	Selects 12-inch page length
6	Off	Selects 11-inch page length
7	On	Sets automatic ribbon-band shift (use with all-black ribbon)
7	Off	No automatic ribbon-band shift (use with color)
8	On	Does not allow audible alarm to sound
8	Off	Allows audible alarm to sound

DIP-Switch Settings — 1 Through 8

Switch 9	Switch 10	Quality and Spacing Set
Off	Off	Data processing quality, 12 characters per inch, (see "Note" below)
Off	On	Data processing quality, 10 characters per inch
On	Off	Text quality, 10 characters per inch
On	On	Near letter quality, 10 characters per inch

DIP-Switch Settings — 9 and 10

Switches 9 and 10 select the printing quality and character spacing. See "ESC I" in "Printer Control Codes" for a description of the printing qualities.

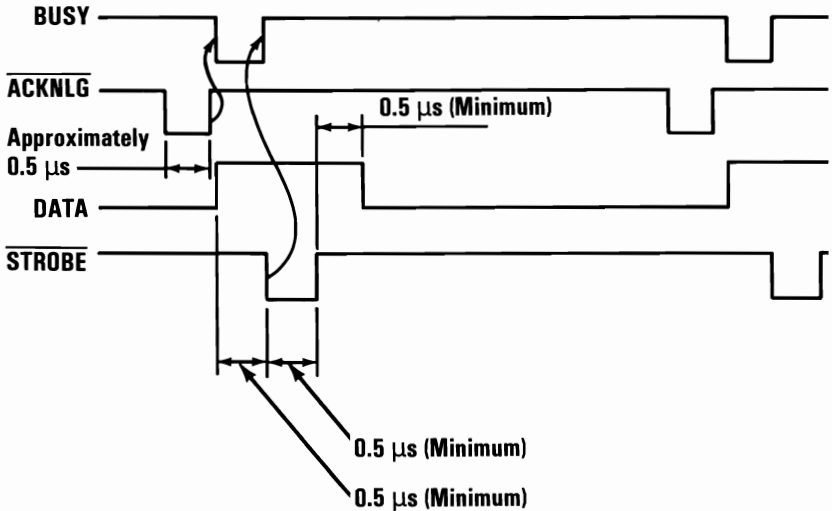
Note: When switches 9 and 10 are Off, the printer prints with a 1-inch page length with no perforation skip. Switches 3 and 6 are overridden. This is the self-test setup.

Interface

Specifications:

- Data transfer rate: 1000 CPS (max.)
- Synchronization: By externally supplied STROBE pulses.
- Handshaking: -ACKNLG or +BUSY signals.
- Logic level: Input data and all interface control signals are TTL-compatible.
- Connector type: 57-30360 (AMPHENOL), or equivalent, 36-pin connector on printer end of cable.

Data Transfer Sequence:



Parallel Interface Timing Diagram



Specifications

Size	
Height	24.4 cm (10 in.)
Width	57.8 cm (22.75 in.)
Depth	35.43 cm (14 in.)
Weight	
	18.4 kg (40 lb)
Power Cable	
Length	1.98 m (6.5 ft)
Size	28 AWG
Signal Cable	
Length	1.89 m (6 ft)
Size	3 by 18 AWG

Physical Specifications

Voltage (Vac)			Frequency (Hz)	Current (Amps)	Power (Watts)
Nominal	Minimum	Maximum	± 3 Hz	Maximum	Maximum
100	90	118	50/60	1.5	135
120	102	139	60	1.5	135
200	180	236	50/60	1.0	135
220	190	264	50/60	1.0	135

Electrical Specifications

Print Method	Wire matrix	
Print Speed		
Data Processing Quality	200 cps	
Text Quality	110 to 150 cps	
Near Letter Quality	30 to 40 cps	
Print Direction	Bidirectional with logic seeking	
Number of Pins in Head	9 (4- and 5-column arrangement)	
Size of Pins in Head	.356-mm (0.014-in.) wire diameters	
Line Spacing	4.23 mm (1/6 in.) or programmable	
Printing Characteristics		
Matrices	Data processing: 9 x 9 Text: 24 x 9 Near-letter: 36 x 18 Block graphic: 24 x 14	
Character Sets	See "Color Printer Character Sets" 1 and 2.	
Printing Sizes		
	Characters per inch	Maximum characters per line
Normal	10	132
Double Width	5	66
Compressed	17.1	225.7
Double Width-Compressed	13.3	175.5
Proportional	12 (average)	158.4 (average)
Subscript	10	132
Superscript	10	132
Media Handling		
Paper Feed	Forms tractor feed and friction feed	
Speed	127 mm (5.0 in.) per second	
Paper Width Range		
Forms tractor feed	76.2 to 406.4 mm (3 to 16 in.)	
Friction feed	177.8 to 304.8 mm (7 to 12 in.) (216 to 432 mm (8.5 to 17 in.) adjustable length)	
Paper Weight		
Continuous forms	Single part: 15 to 20 lb bond Multipart: 12 to 15 lb, 6 to 8 lb carbon	
Single sheet	15 to 20 lb bond	

Printer Specifications (Part 1 of 2)

Media Handling (continued)**Copies**

Continuous forms	1 to 4 parts
Single sheet	1 part only

Paper Path

Continuous forms	Front, bottom, and rear
Single sheet	Front

Interfaces

Standard parallel 8-bit
Data and Control lines

Inked Ribbon

Type Cartridge (all ribbons)

Color

Process Ribbon	COLOR	BAND
	Yellow	1
	Magenta	2
	Cyan	3
	Black	4

Primary Ribbon

COLOR	BAND
Red	1
Green	2
Blue	3
Black	4

Environmental Conditions

Operating Temperature	10 to 40°C (50 to 104°F)
Operating Humidity	10 to 80% non-condensing

Heat Output

140 BTU/hr (maximum)

Memory Allocation

Internal	2K bytes
Data	6K bytes
Reserved	8K bytes
Total	16K bytes

Printer Specifications (Part 2 of 2)

Connector Pin Assignments

Printer connector-pin assignments and descriptions of signals are provided in the following chart.

Connector Pin Assignment		
Signal Pin No.	Signal	Description
1	-STROBE	-STROBE pulse to read data in. Pulse width must be more than 0.5 μ s at receiving terminal. The signal level is normally high (logical 1); data is read at the low (logical 0) level.
2	DATA 1	These signals represent information of the 1st to 8th bits of parallel data respectively.
3	DATA 2	
4	DATA 3	
5	DATA 4	
6	DATA 5	
7	DATA 6	
8	DATA 7	
9	DATA 8	
10	-ACKNLG	Approx. 0.5 μ s pulse. A low signal indicates that the printer is ready to accept other data.
11	+ BUSY	A high signal indicates that the printer cannot receive data. The signal becomes high in the following cases: 1. During data entry 2. During printing operation 3. In offline state 4. During printer error status
12	+ PE	A high signal indicates that the printer is out of paper.
13	+ SLCT (ENABLE)	A high signal indicates that the remote control select feature has not deselected the printer. The signal level goes high upon going ready or receiving a DC 1 (SELECT). If currently ready but deselected, it goes low upon receiving a DC 3 (DESELECT).
14	-AUTO FEED	Not used
15		Not used
16	0v	Logic GND level.

Connector Pin Assignment (Part 1 of 2)

Connector Pin Assignment		
Signal Pin No.	Signal	Description
17	CHASSIS GND	Printer chassis ground (GND). In the printer, the chassis GND and the logic GND are isolated from each other.
18		Not used
19-30	GND	TWISTED-PAIR RETURN logic GND level.
31	-INIT	When the level of this signal becomes low, the printer controller is reset to its initial state, and the print buffer is cleared. This signal is normally at high level, and its pulse width must be more than 50 μ s at the receiving terminal.
32	-ERROR	The level of this signal becomes low when the printer is in: 1. Paper Out state 2. Offline state 3. Error state
33	GND	TWISTED-PAIR return logic GND level.
34		Not used
35		Not used
36		Not used

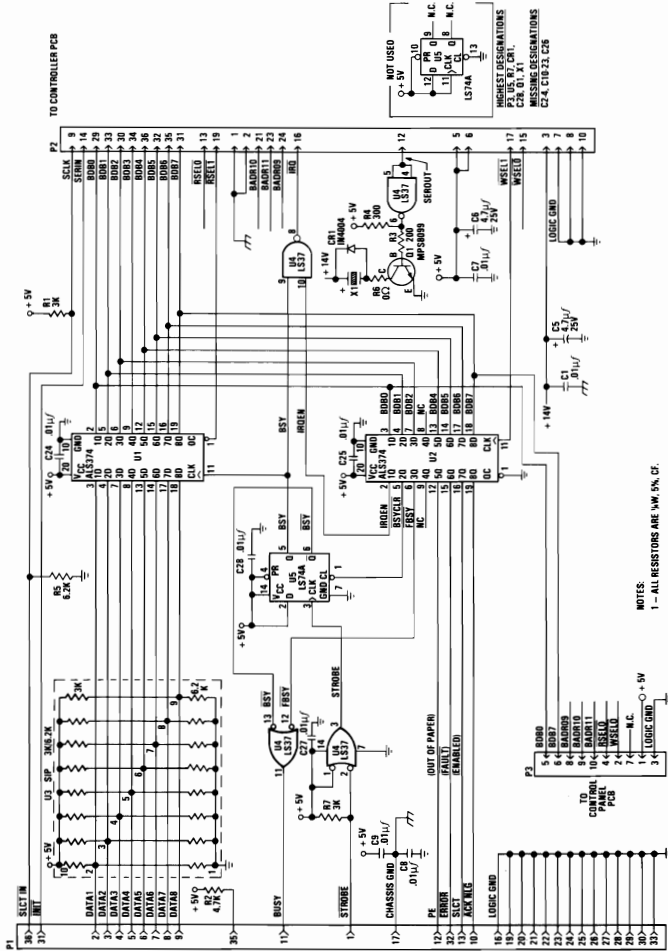
Connector Pin Assignment (Part 2 of 2)

Notes:

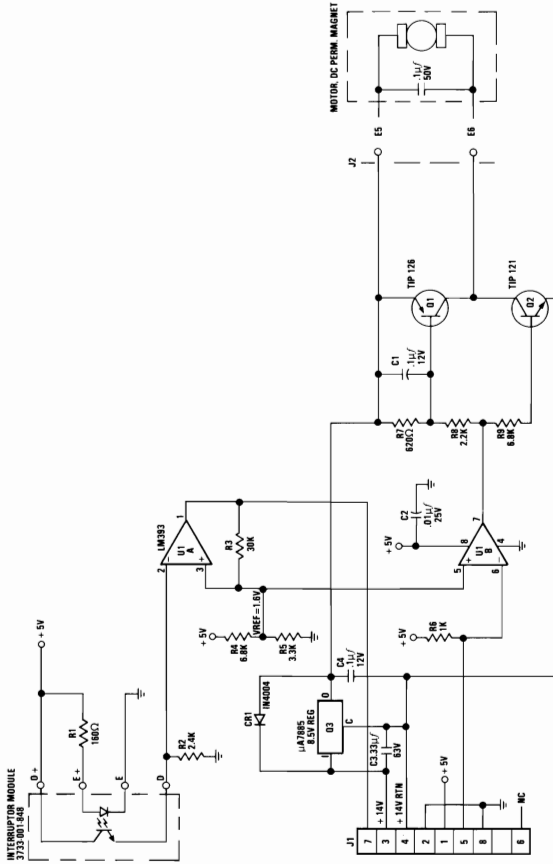
1. All interface conditions are based on TTL-level signals. The rise and fall time of each signal must be less than 0.2 microseconds.
2. Data must not be transmitted until the –ACKNLG signal and +BUSY signal go low.



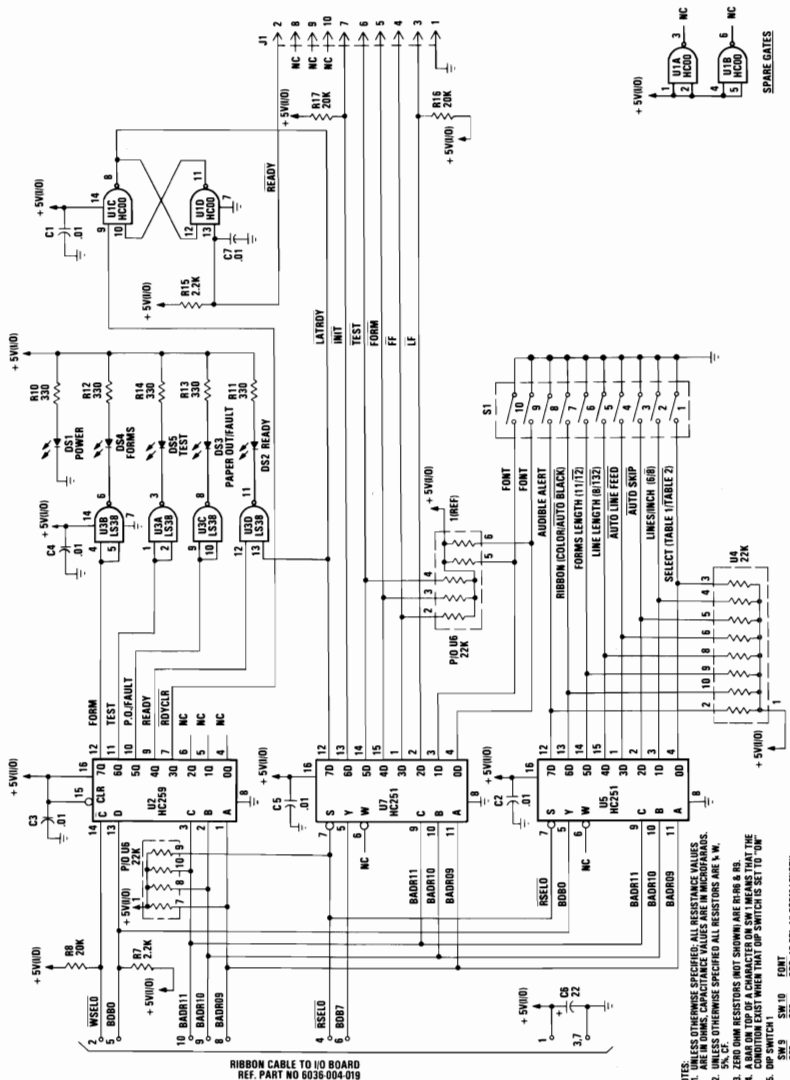
Logic Diagrams



Color Printer — I/O Board (Sheet 1 of 1)

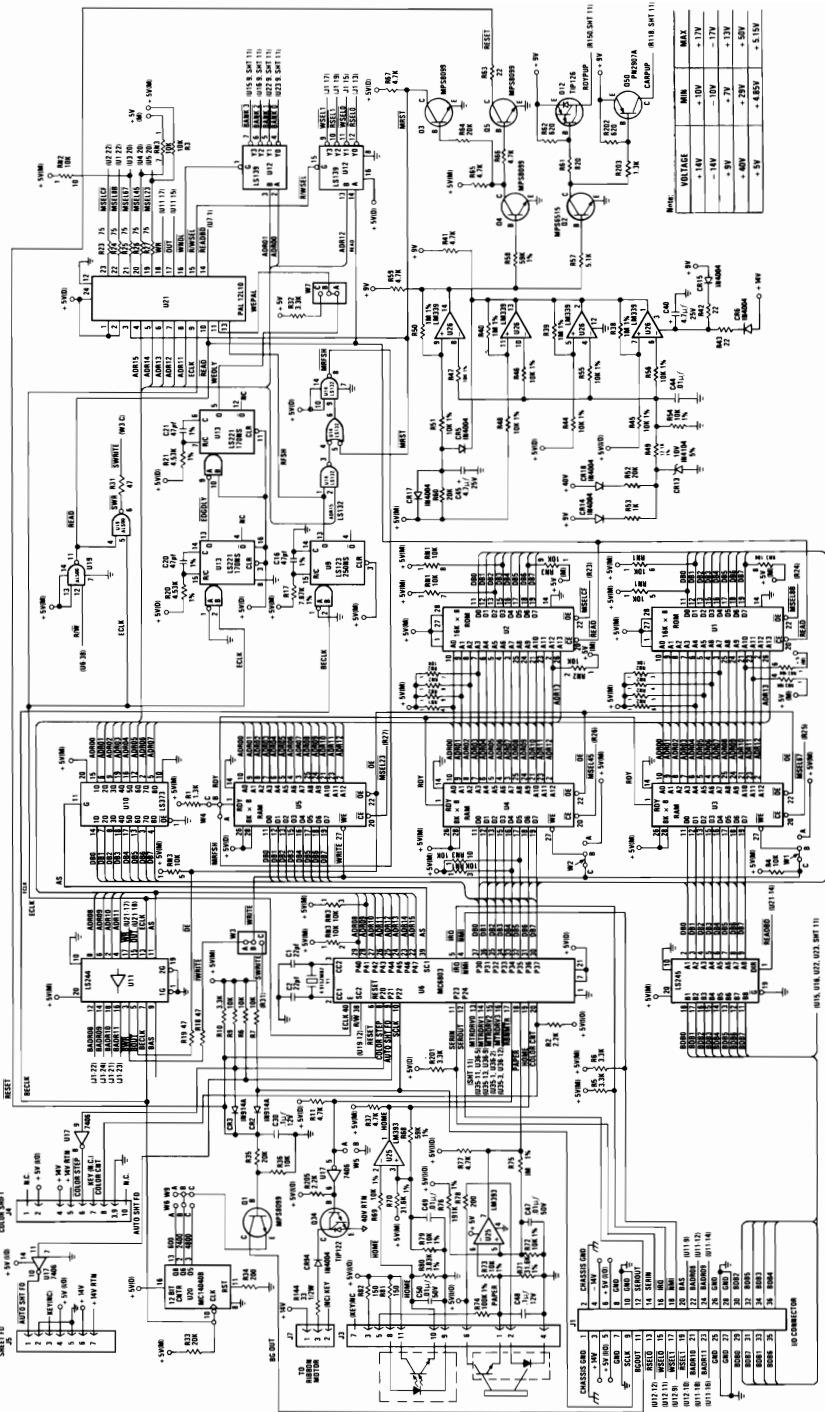


Color Printer — Color Shift (Sheet 1 of 1)

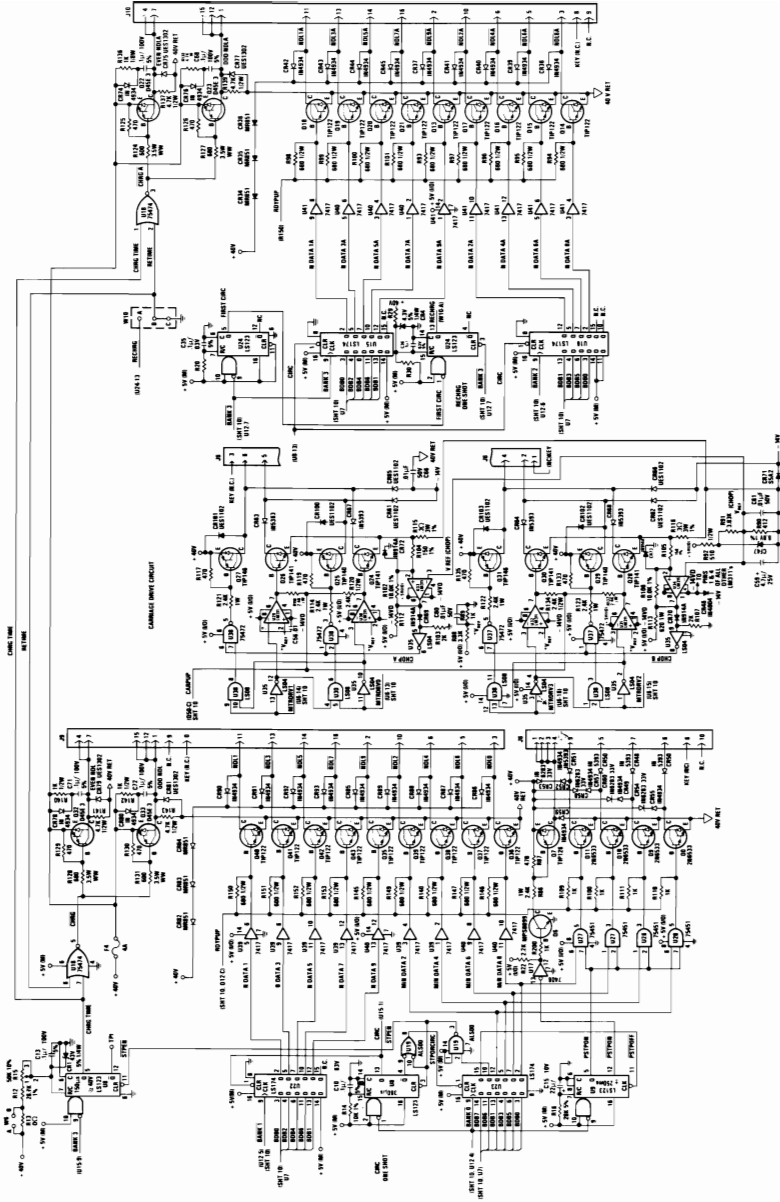


- NOTES:**
- UNLESS OTHERWISE SPECIFIED, ALL RESISTANCE VALUES ARE IN OHMS. CAPACITANCE VALUES ARE IN MICROFARADS.
 - SW, CLR, DS, AND S1 ARE 1/2" SQUARE SWITCHES.
 - ZERO OHM RESISTORS (NOT SHOWN) ARE BR18 & BR.
 - RESISTORS ARE 1% TOLERANCE UNLESS OTHERWISE SPECIFIED. THE CONDITION EXISTS WHEN THAT DIP SWITCH IS SET TO "ON".
 - DIP SWITCH 1:
 - SW 9 FORM LENGTH
 - SW 10 DP1, 10 CLR
 - SW 11 LETTER QUALITY, 10 CPI

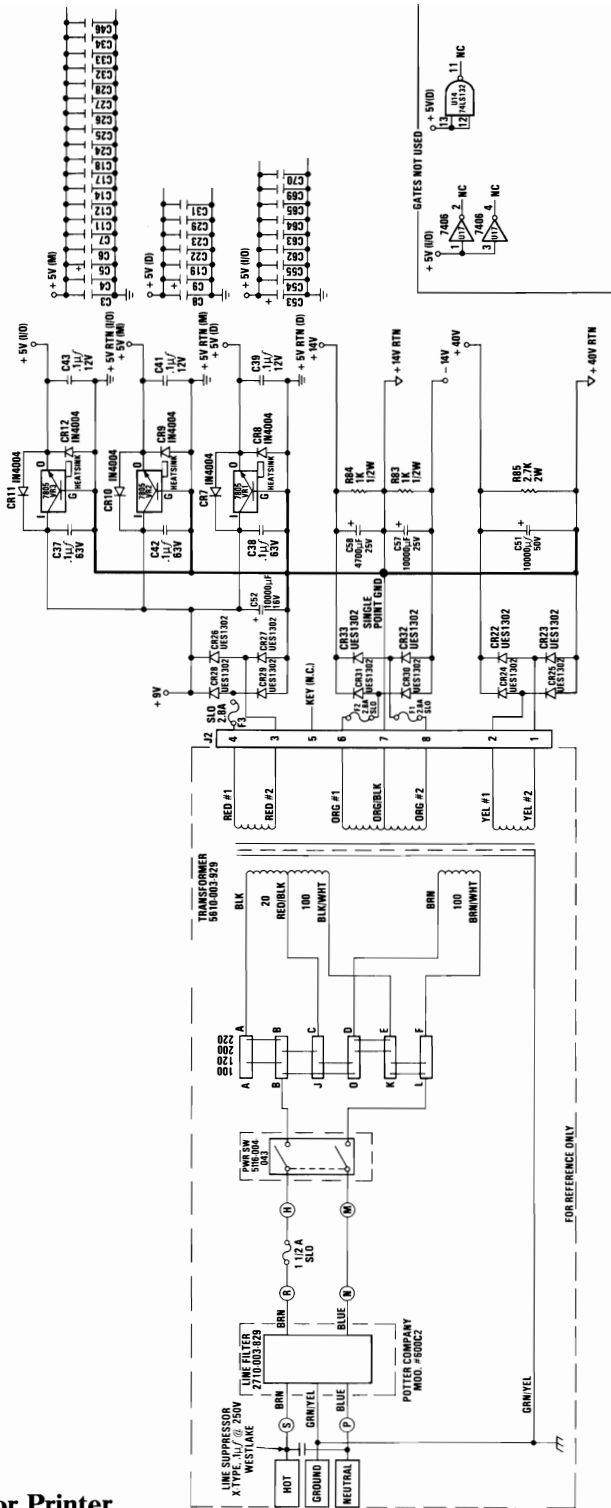
Color Printer — Control Panel (Sheet 1 of 1)



Color Printer — Controller Board (Sheet 1 of 3)



Color Printer — Controller Board (Sheet 2 of 3)



Color Printer — Controller Board (Sheet 3 of 3)

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