TECHNICAL SPECIFICATION

B-L 120 MICROFILM PRINTER/PLOTTER

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Section 1

INTRODUCTION

1-1. GENERAL.

1-2. This specification outlines the Benson-Lehner B-L 120 Microfilm Printer/Plotter and defines its functional characteristics and performance. The B-L 120 is a high-speed, electronic printer/plotter designed to transcribe digital data recorded on magnetic tape to alphanumeric data recorded on microfilm or paper.

1-3. APPEARANCE AND SIZE.

1-4. The general appearance of the B-L 120 is shown in Figures 1 and 2. The B-L 120 measures 61-inches high, 69-inches wide, and 39-inches deep. The microfilm camera and hard copy camera (an optional feature of the B-L 120) are housed in the left-end of the cabinet. Both cameras may be pulled forward to provide convenient access to load and unload film and paper. The cabinet exterior is finished with Benson-Lehner standard light blue, gray, and white baked enamel. Decorative trim is satin finished aluminum.

1-5. WEIGHT.

1-6. Approximate weights of the B-L 120 Microfilm Printer/Plotter and each of the options are as follows:

a.	B-L 120	1700 pounds
b.	Forms Projector	100 pounds
c.	Hard Copy Camera	125 pounds

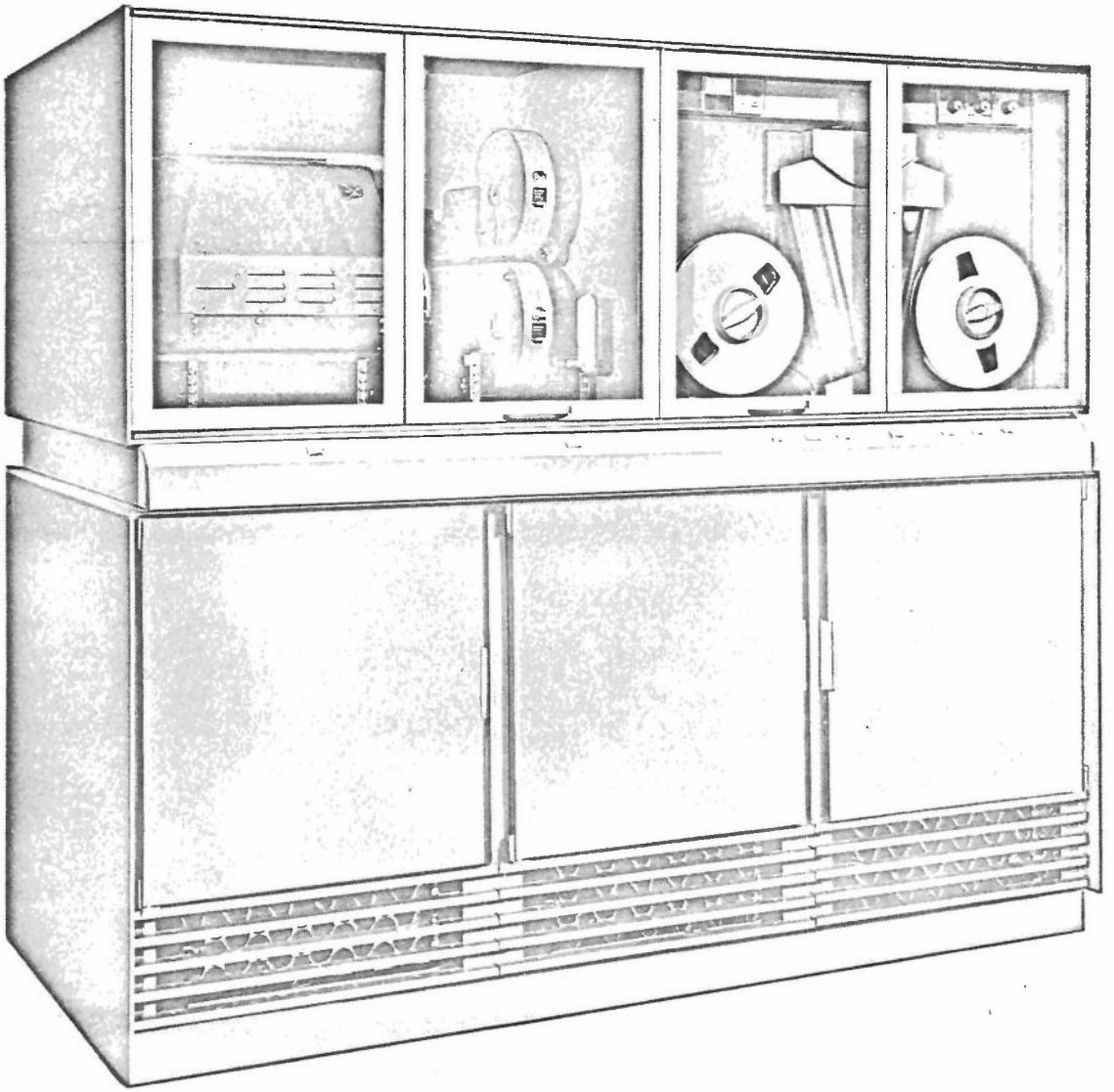


Figure 1. Benson-Lehner B-L 120 Microfilm Printer/Plotter

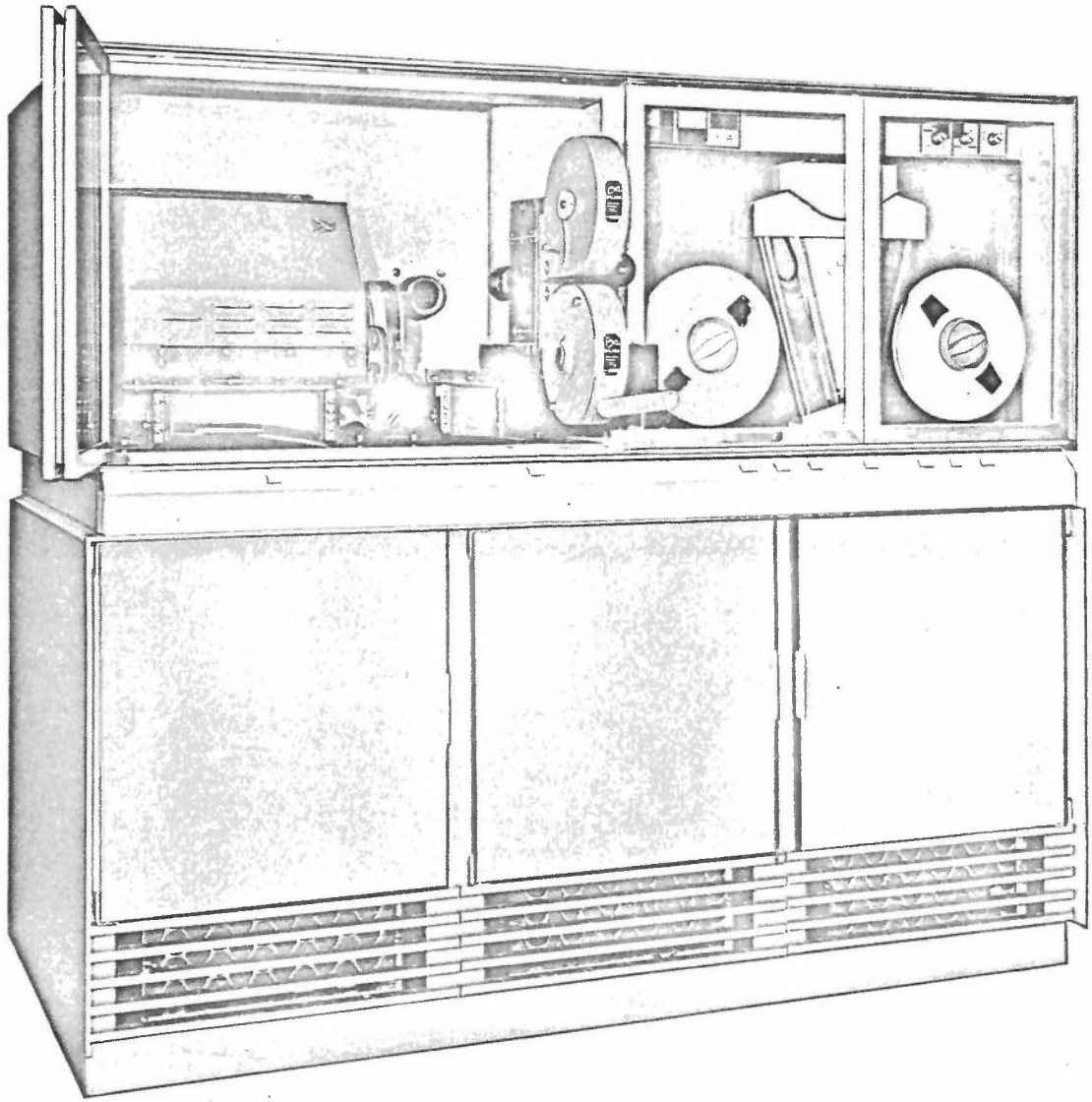


Figure 2. B-L 120, Microfilm Camera Pulled Forward for Loading

1-7. OPERATING ENVIRONMENT.

1-8. The B-L 120 is designed to provide reliable, trouble-free service when operating in an ambient room temperature of 60°F to 85°F with relative humidity between 10% and 80%. The printer/plotter does not require ducted cooling air, compressed air, nor provision for chemical drainage. Except for electrical power, the B-L 120 is an integrally self-contained system.

1-9. ELECTRICAL POWER.

1-10. The B-L 120 and options normally require three-phase, 60-cycle, WYE connected, four-wire, 208/120 volts ±5 percent power service. (60-cycle, single-phase power can optionally be accommodated.) The neutral wire will not be grounded. A fifth wire is also required for machine grounding. Approximate power consumption of the basic unit and options is as follows:

a.	Basic Printer	4000 watts
b.	Forms Projector	400 watts
c.	Hard Copy Camera	1500 watts

1-11. DATA INPUT.

1-12. The B-L 120 receives its input from magnetic tapes which are read on the tape transport located at the right of the unit. The standard B-L 120 accepts tapes recorded at 556 and/or 800 bits-per-inch on IBM 729 tape transports or equivalents. Other densities and characteristics can be optionally provided. Tape characters are to be coded in IBM format,

with parity in the C channel. Parity may be either even or odd; the appropriate check is made automatically within the B-L 120. See Section 3 for further discussion.

1-13. DESIGN AND CONSTRUCTION.

1-14. The design of the B-L 120 has accentuated reliability, convenient usage, and ease of servicing. All electronic circuits are modular, with convenient access to signal points. Silicon transistors and diodes are used exclusively in the logic circuits. Analog circuits utilize silicon components, except where the requirements of the devices preclude the use of germanium devices. An internal test programmer is provided to automatically display testing patterns for alignment and maintenance.

Section 2

DESCRIPTION

2-1. B-L 120 MICROFILM PRINTER/PLOTTER.

2-2. As shown in Figure 3, the B-L 120 consists of eight basic components with optional components available. These components are as follows:

a. Magnetic Tape Unit	Reads the recorded digital data input from magnetic tapes.
b. Logic and Control Circuits	Processes the incoming data and routes the proper information to the appropriate recorder circuits.
c. Deflection Circuits	Locates the plotted or printed alphanumeric data at the appropriate location.
d. Character Generation Circuits	Generates the required signals to synthesize shapes.
e. Vector Generator	Generates line segments from point to point as a plotting adjunct.
f. Axis Generator	Generates continuous lines from point to end of plotting format.
g. Cathode Ray Tube	The display surface upon which the printed or plotted information is presented.
h. Microfilm Camera	Records the alphanumeric data displayed on the CRT.
i. Hard Copy Camera (Optional)	Records the alphanumeric data displayed on the CRT.
j. Forms Projector (Optional)	Superimposes photographic images on the display surface for special applications.
k. Custom Features	Unique capabilities are possible for special applications.

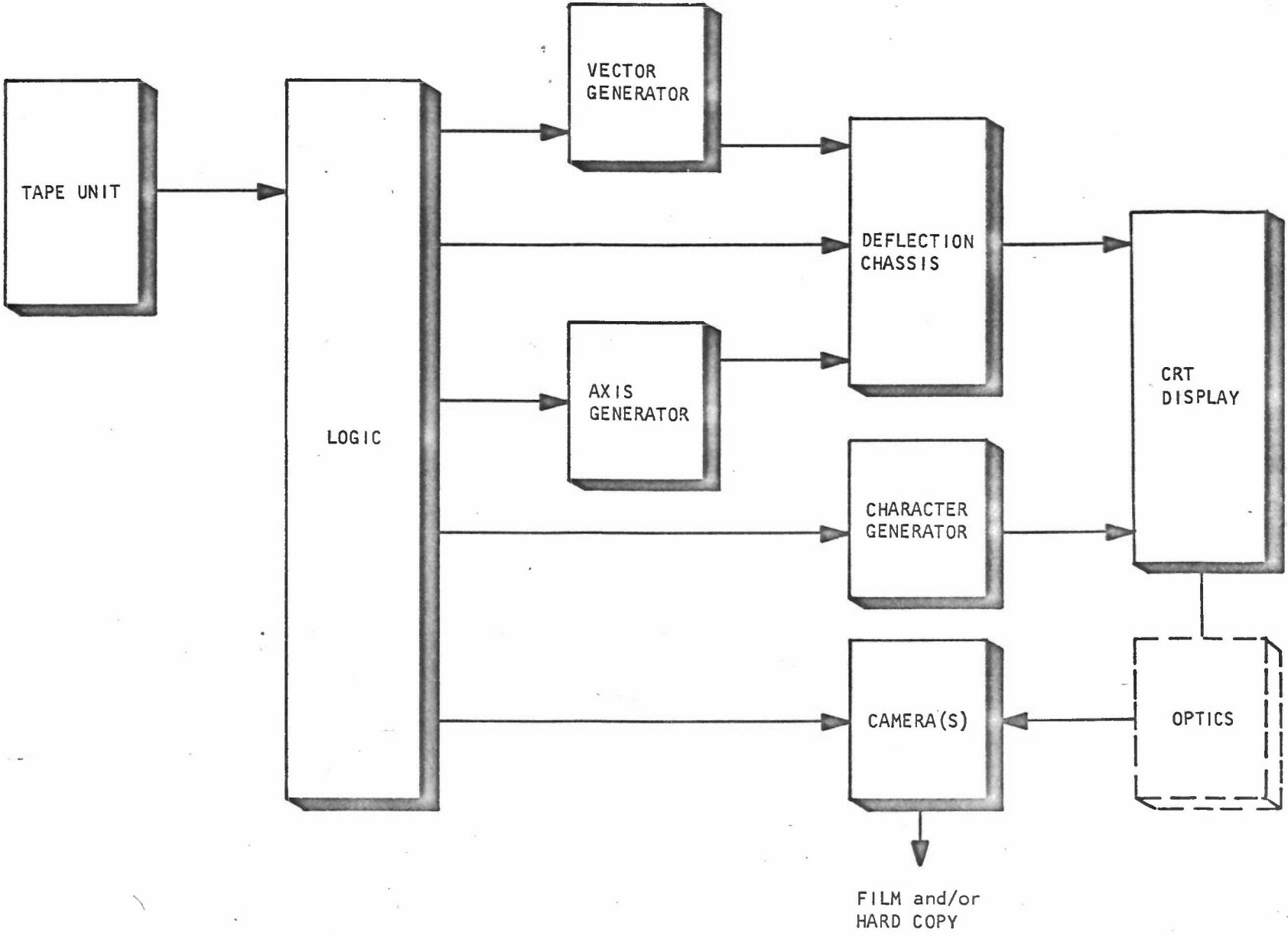


Figure 3. B-L 120 Functional Block Diagram

2-3. MAGNETIC TAPE UNIT.

2-4. The magnetic tape unit used in the B-L 120 is designed to read tapes recorded on IBM 729 tape transports* or equivalent units at 556 and/or 800 bits-per-inch. The tape is transported 36-inches per second for 556 bpi, and at 25-inches per second for 800 bpi, providing a 20,000 character-per-second reading rate at both 556 and 800 bpi recording densities. One-half inch tapes are used. Acceleration or deceleration of the tape is achieved by a solenoid-actuated pinch-roller which clutches the tape to one of two counter-rotating capstans. Tape storage loops are maintained within vacuum chambers by a reel servo using vacuum-switches as loop length sensors to control the reel motors. All tape motion, including high-speed rewind is controlled by the B-L 120. Rewind of a 2400 foot reel requires approximately 2-1/2 minutes.

2-5. LOGIC AND CONTROL CIRCUITS.

2-6. The logic and control section of the B-L 120 accepts seven-bit* tape characters, interprets commands, steers and sequences data to other circuits, provides format control, checks parity, and communicates with the tape unit. The logic and control section uses all silicon components and operates on a synchronous clock timing system.

2-7. DEFLECTION CIRCUITS.

2-8. The deflection circuits of the B-L 120 receive digital signals from

* Provision for the acceptance of nine-bit characters is included in the system for adaptation to nine-bit tapes.

the appropriate registers in the logic and control section and converts these signals to analog voltages. The analog voltages obtained are converted to currents which are then used to drive the deflection yoke on the neck of the cathode ray tube. The precision deflection yoke causes the electron beam to be positioned in accordance with the demands of the logic and control section. Salient characteristics of these circuits are the stability and accuracy obtained while maintaining excellent transient response.

2-9. CHARACTER GENERATION CIRCUITS.

2-10. The character generation circuits receive digital signals from the logic and control circuits and, using monoscope "character generation," furnish the appropriate analog voltages to the deflection circuits and display CRT.

2-11. The monoscope (a separate and special CRT) contains 64 different character shapes which have been etched into a metal plate, providing a stencil-like barrier to the electron beam (see Figures 4 and 5). The electron beam within the monoscope is positioned at the selected character location on the etched stencil and then scans the area on the stencil allotted for the selected character. The scanning beam follows a sinusoidal pattern in the vertical axis and a linear ramp in the horizontal axis. The monoscope scan voltages are applied electronically, via the deflection circuits, to the display CRT, causing the electron beam in the CRT to follow the same scan pattern as the monoscope.

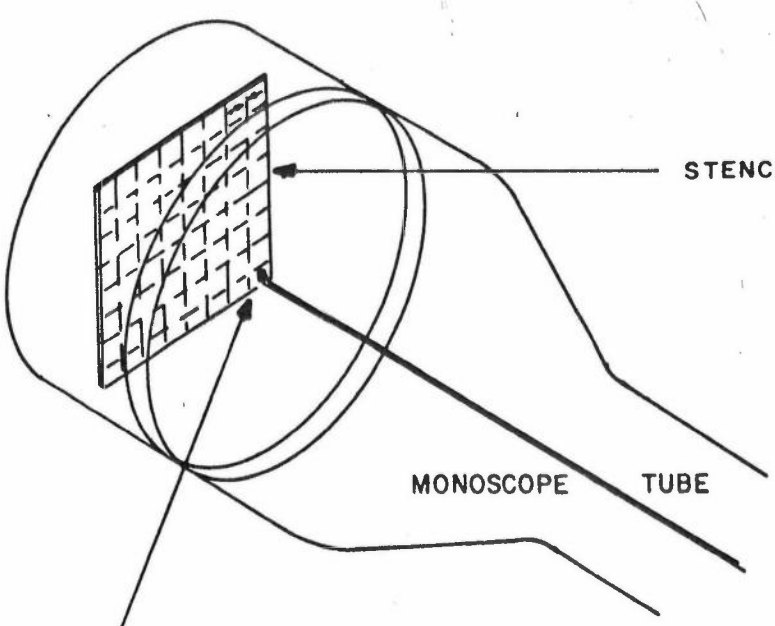
2-12. During the scanning process, when the electron beam passes through the etched portion of the stencil in the monoscope, a signal is developed which is used to unblank the display CRT. The resulting image, appearing as light on the display phosphor in the CRT, is a reproduction of the character shape etched through the stencil. (In Figure 4, the scan voltage is positioned at etched-character "B" on the stencil, and the scan voltage is electrically applied to the CRT, resulting in the character "B" image.) Almost any character shape may be etched in the stencil, providing virtually an unlimited number of fonts and symbols for special applications. The annoying "grain" of dot generators and limited font capability of stroke generators is precluded by the B-L 120 character generation scheme. Resolutions of approximately fifteen lines per character width are achieved by using the Benson-Lehner character generator.

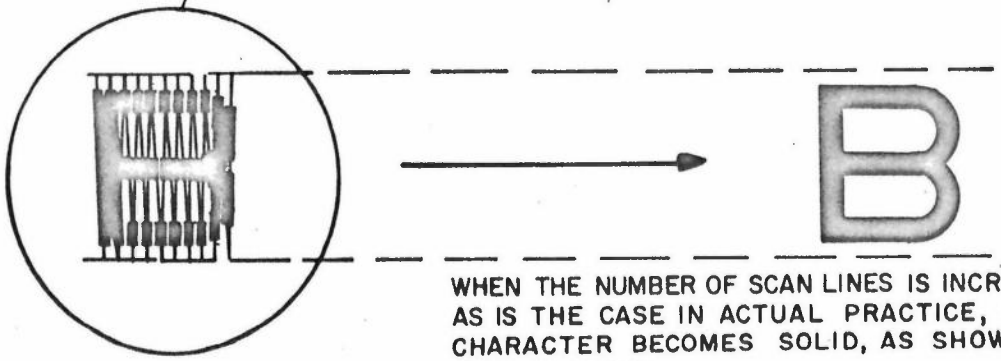
2-13. VECTOR GENERATOR.

2-14. The vector generator circuits enable the B-L 120 to draw line segments from origins to end points having both X and Y components. This generator receives digital signals from the logic commands and furnishes analog voltages to the deflection circuits.

2-15. AXIS GENERATOR.

2-16. The axis generator circuits also receive digital signals from the logic, but furnish analog voltages to the deflection circuits that enable straight lines to be drawn in either axis from a specified origin to the top or sides of the plotting format.





WHEN THE NUMBER OF SCAN LINES IS INCREASED, AS IS THE CASE IN ACTUAL PRACTICE, THE CHARACTER BECOMES SOLID, AS SHOWN, AT THE RIGHT.

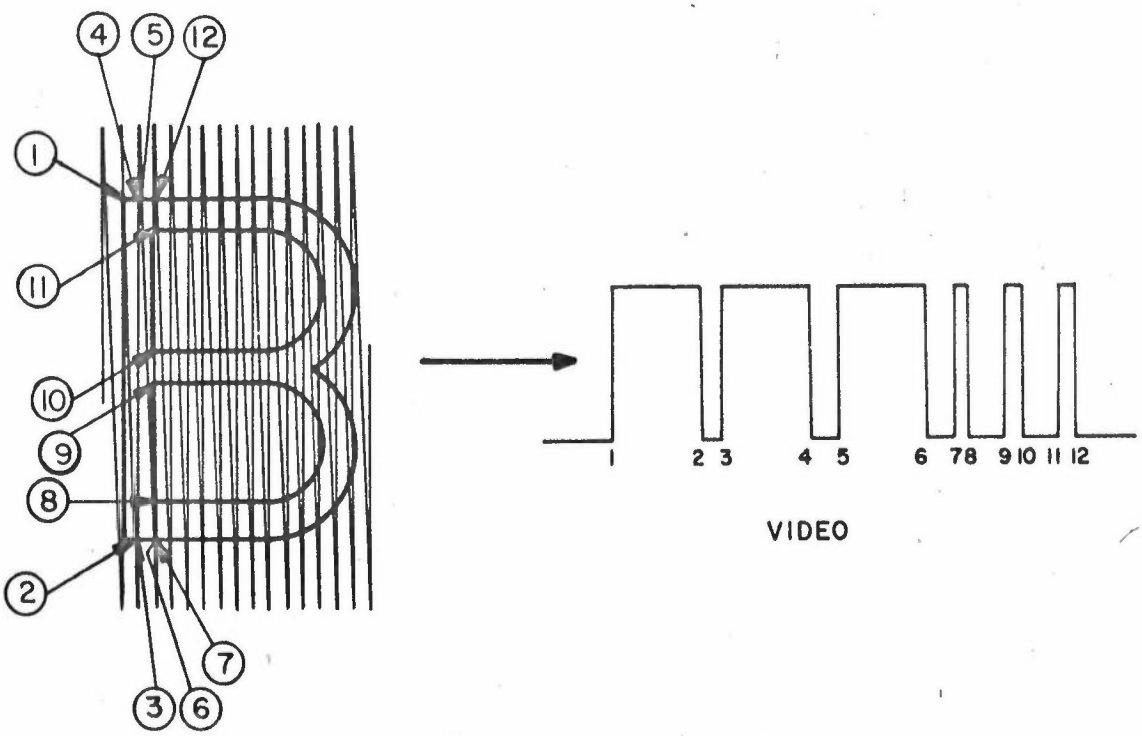


Figure 4. Character Generation

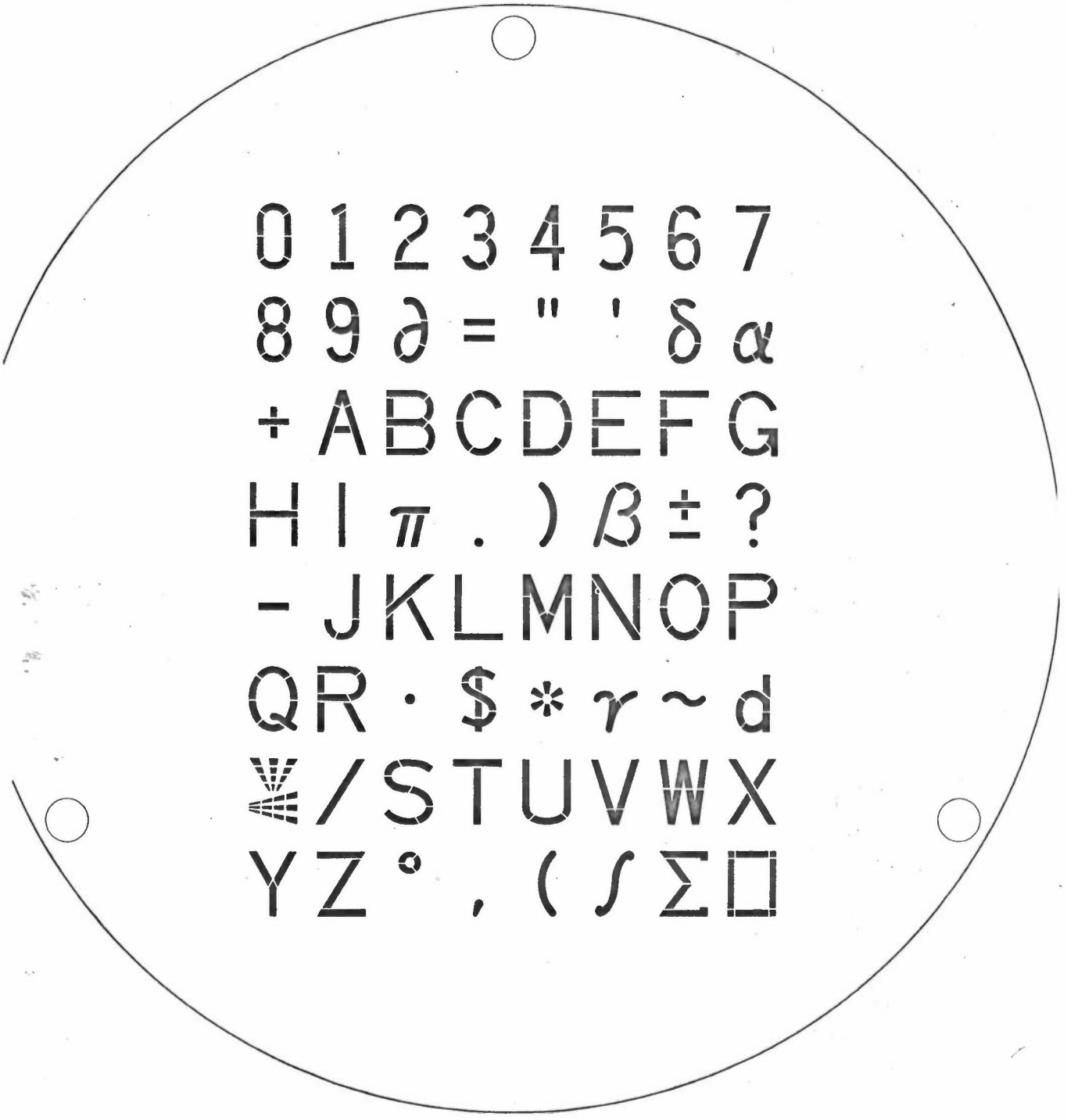


Figure 5. Etched Stencil Character Shapes

2-17. CATHODE RAY TUBE.

2-18. The five-inch cathode ray tube used by the B-L 120 features high resolution and low geometric distortion. This tube is magnetically deflected, contributing to the small spot size achieved, and is extensively shielded to eliminate spurious jitter and distortion. The spot size is less than two mils when measured by a shrinking raster at typical brightness on the phosphor. This tube is commercially available and may be readily replaced at nominal cost.

2-19. MICROFILM CAMERA.

2-20. The B-L 120 utilizes a pulse operated, magazine fed, 35mm camera incorporating many special features to facilitate loading, unloading, and interlock protection.

2-21. HARD COPY CAMERA (OPTIONAL).

2-22. The hard copy camera, optionally provided with the B-L 120, produces output copy directly on nine-inch width paper. Hard copy exposure is performed at the same speeds as microfilm recording. The hard copy camera performs four distinct functions.

a. Stores and feeds recording paper.

b. Exposes CRT light image to paper.

c. Develops the exposed image.

d. Drys the developed copy.

2-23. During operation of the hard copy camera, paper is positioned at

the exposure station while information is presented on the CRT display. The paper is then advanced and passes by a narrow slit which applies developer on the emulsion side of the paper. Only enough liquid is applied to wet the emulsion layer, and the paper then passes over a heated platten which completely dries the emulsion at a rate of one foot per second and leaves the paper dry and undistorted. Platten temperature is moderate and continuous contact with stationary paper does not cause damage. The small amount of developer which is evaporated yields only one ounce of water vapor for every forty feet of paper. Developed hard copy can be produced within four seconds after exposure and may be fed out of the front of the unit, permitting convenient examination of the output. A "tear bar" enables easy removal of the copy; or alternately, the developed copy is accumulated on a takeup spool. When the hard copy camera is not in use, it can be serviced without interrupting microfilm recording operation of the B-L 120. Selection of the hard copy camera as the output recording device may be effected by program control or by the manual operation of a switch.

2-24. FORMS PROJECTOR (OPTIONAL).

2-25. The forms projector permits a prepared optical slide to be superimposed over the computer generated data on the recording medium. Forms, maps, company letterheads, or any other format may be superimposed on the frame. The optical slide is a prepared photographic negative plate and may be interchanged in minutes.

2-26. CUSTOM FEATURES.

2-27. In addition to the standard options which have been described, features can be added or changed on a custom basis. Special characters and codes, special cameras, additional film magazines, serial on-line connection, etc., may be necessary in some cases and can be obtained on special order. Changes to accommodate certain tape transports and data formats may also be accommodated. New circuit functions to extend the usage of the B-L 120 into entirely new applications are often possible.

Section 3

FUNCTIONAL CHARACTERISTICS

3-1. GENERAL.

3-2. The B-L 120 produces high quality microfilm recordings of plotted graphs, tabular data listings, and other data under tape control. There are normally three modes of operation available for operator selection. The NORMAL position of the switch enables the complete functional operation of the unit, as described in the following paragraphs. The LIST BINARY and LIST DECIMAL switch positions inhibit the NORMAL operation of the unit, and cause the input magnetic tape data to be listed, with an automatic page advance at each record gap. Binary or decimal character coding is selected in accordance with the operator's selection. A fourth selection, SPECIAL, is provided which may be used for custom features if required.

3-3. PLOTTING.

3-4. When the tape instructs a plotting operation, characters are positioned in accordance with programmed X and Y position addresses of ten-bits each, contained as a part of the plotting instruction. Thus, a given character or dot may be positioned at any one of the more than one million possible locations on a 1024 by 1024 plotting matrix.

3-5. PRINTING.

3-6. When the tape instructs a printing operation, characters are

automatically positioned on the page and it is only necessary for the tape to specify character selection. Characters are printed 128 to the line and 64 lines to the page, starting at the upper left corner (or at other tape instructed address), and progressing left-to-right and top-to-bottom in typewriter fashion. This format may be varied by programming spaces, line reset, and/or other commands.

3-7. FORMATTING.

3-8. Format variations can be optionally included. Tab set, single or double spacing, IBM 1401/1403 compatibility and other computer printer formats can also be furnished.

3-9. TAPE CHARACTER CODING.

3-10. The B-L 120 is designed to read binary coded data. The magnetically recorded data must be coded as shown in Table 1. Alphanumeric character coding, as well as character shape (see Figure 5), is determined by the etched stencil in the monoscope used for character generation. These codes and/or shapes may be easily changed by the use of stencils differing from the standard stencil.

3-11. RECORD LENGTH.

3-12. Tape record length is variable but the number of tape characters in the record must be a multiple of six. In order to specify a cartesian address at which a point is to be plotted, one word (36 bits or 6 tape characters) is required; when printing, it is necessary to call out the

TAPE CODE OCTAL	CHARACTER	COMMAND
00	0	PLT**
01	1	PHN**
02	2	PHL**
03	3	PLN**
04	4	PLL**
05	5	
06	6	
07	7	IGN
10	8	
11	9	
12	∂	NOP - XIT*
13	=	
14	"	
15	'	
16	δ	LFT*
17	α	Tape Mark
20	+	PSN
21	A	PSL
22	B	PCN
23	C	PCL
24	D	
25	E	
26	F	
27	G	
30	H	AXX
31	I	
32	π	AXY
33	.	
34	)	
35	β	
36	±	ST2*
37	?	
40	-	

TAPE CODE OCTAL	CHARACTER	COMMAND
41	J	SC1
42	K	SC2
43	L	SBC
44	M	
45	N	
46	O	AFM
47	P	
50	Q	PFM
51	R	
52	$	LNR*
53	•	
54	$	
55	γ	NFT*
56	~	CLR CLR*
57	d	
60	blank	VCR
61	/	VCR
62	S	VCR
63	T	VCR
64	U	VCR
65	V	VCR
66	W	VCR
67	X	VCR
70	Y	VCR
71	Z	VCR
72	o	VCR
73	,	VCR
74	(	VCR
75	∫	VCR - ST1*
76	Σ	VCR
77	□	VCR

*These commands recognized only when PRINTING

**See Section 3-14b. for orientation & set modifications of these operations.

Table 1. Character Coding

characters to be printed with up to six characters per word; and when advancing film, a record gap is required to allow time for the advance. Because of the several operations which may be performed, record length and organization of tape characters within the record must meet requirements which depend on the tape controlled operation itself. These requirements are specified in the following paragraphs. The tape character, tape mark, will cause the B-L 120 to stop the tape unit and signal that the tape mark has been read. The tape mark must be written as the first character after a gap.

3-13. PLOTTING.

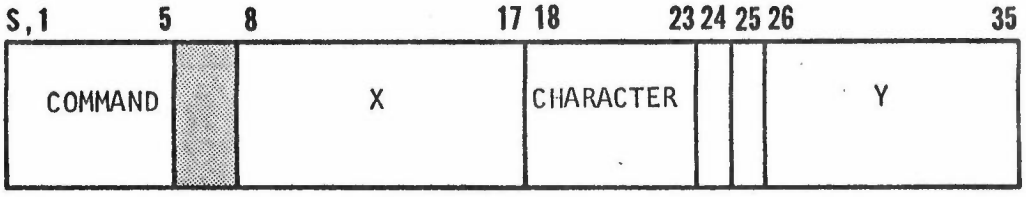
3-14. There are 1024 X by 1024 Y locations at which points can be plotted. X=0, Y=0 is the upper left corner of the recording area and X=1023, Y=1023 is the lower right corner of the recording area. There are five PLOT commands which may be given. Each of these commands may be further modified by specifying the sideways orientation of the plotted character. The five PLOT commands are:

PLOT (PLT)
PLOT, HEAVY, NORMAL (PHN)
PLOT, HEAVY, LARGE (PHL)
PLOT, LIGHT, NORMAL (PLN)
PLOT, LIGHT, LARGE (PLL)

a. Plotting is accomplished in heavy or light recording intensity and in normal or large size characters depending on the selection of the command. The PLOT command, with intensity and size not specified, is used to specify plotting with the intensity and size previously placed in operation. Intensity and size are stored, and will be used for

further operations unless negated by a different specification of these variables.

b. One word (6 tape characters) is required to specify a plotting operation. The bits S and 1 through 5 contain one of the five plotting commands. Bits 8 through 17 specify the X coordinate location. Bits 18 through 23 specify any one of the 64 alphanumeric characters to be plotted. Bit 24 is used to specify character selection from the second of two character sets if optionally provided. This selection is also stored for future operations. Bit 25 is used to specify "sideways" orientation of the plotted character, and is applicable for only the single PLOT operation containing the orientation bit.



On tape this appears as follows:

	C	B	A	8	4	2	1
Tape Character 1	COMMAND (Table 1)						
Tape Character 2				X^9	X^8	X^7	X^6
Tape Character 3	X^5		X^4	X^3	X^2	X^1	X^0
Tape Character 4	CHARACTER (Table 1)						
Tape Character 5				Y^9	Y^8	Y^7	Y^6
Tape Character 6	Y^5		Y^4	Y^3	Y^2	Y^1	Y^0

Each and every point to be plotted must be specified in this form.

3-15. NO OPERATION (NOP).

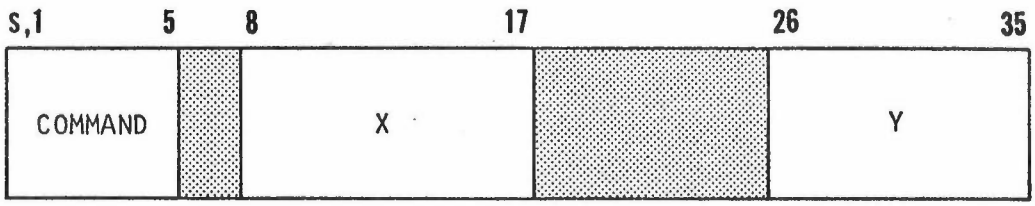
3-16. When the B-L 120 is not in the PRINT mode of operation, the NOP command is utilized as a "buffer" control. No operation is performed under this command and it is used as an adjunct to programming. (In the PRINT mode, this command is interpreted as an XIT from printing. See Paragraph 3-42c.)

3-17. IGNORE (IGN).

3-18. When the B-L 120 is not in the PRINT mode, the IGN command causes the B-L 120 to ignore all remaining data in the record. The first record gap sensed after the receipt of the IGN command will enable normal operation.

3-19. AXIS X, AXIS Y (AXX), (AXY)

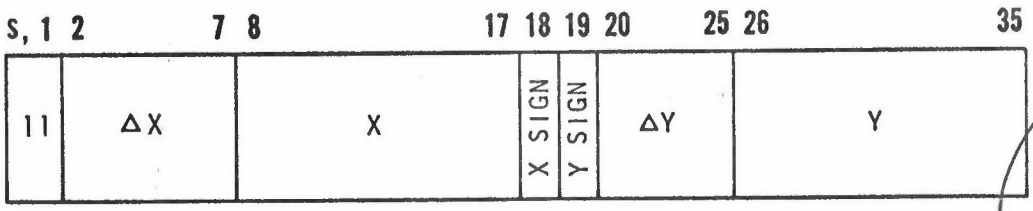
3-20. These instructions cause a horizontal or vertical line to be drawn, originating at the specified location and ending at the right or top of the plotting area. The organization of these instructions is as follows:



3-21. DRAW VECTORS (VCR).

3-22. This instruction is used to cause line segments to be generated and recorded. A vector may be instructed to originate at any point in

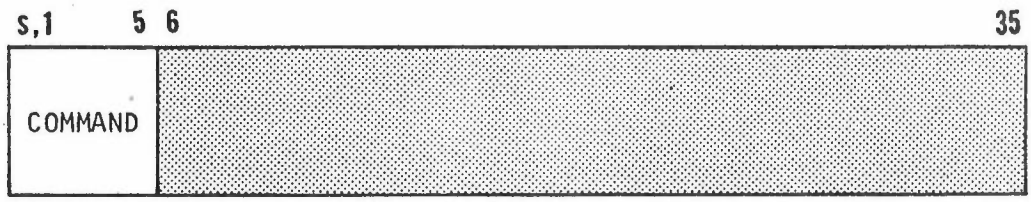
the plotting area. The vector is formed having signed ΔX and ΔY components as specified by the tape recorded instruction. The ΔX and ΔY components may have lengths up to 64 adjacent plotting positions. The organization of this instruction is as follows:



The ΔX and ΔY sign bits are positive if 1 or negative if 0. A positive sign causes drawing upward or rightward for the ΔY and ΔX components respectively.

3-23. CONTROL FUNCTIONS.

3-24. Camera film advance and camera selection (when using optional hard copy) are under control of the tape input data. The organization of these instructions is as follows:

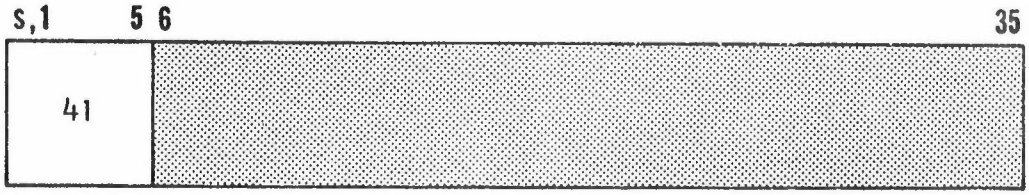


If only the microfilm camera is used, the camera selection control is not needed; and if the camera select commands exist on a tape, they are ignored. The time required to execute these control instructions requires that a record gap follow these commands. When the commands are recognized by the B-L 120, recording will cease and these operations will be performed when the next record gap is encountered. Magnetic tape characters

interspersed between the command and the gap will be ignored.

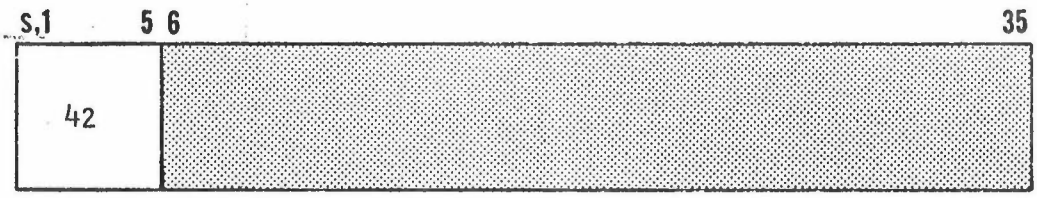
3-25. SELECT CAMERA 1 (SC1).

3-26. This instruction selects the microfilm camera to be used as the output device. If the hard copy camera has been previously selected, this command will cause it to be NOT selected.



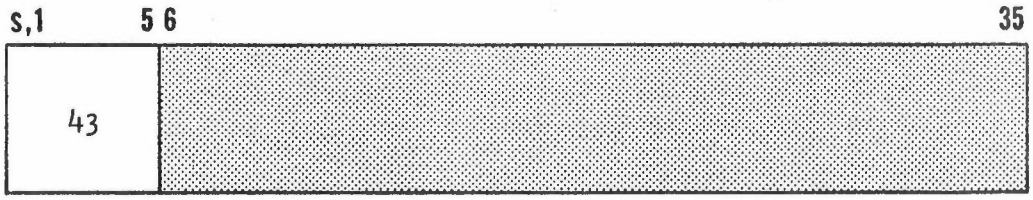
3-27. SELECT CAMERA 2 (SC2).

3-28. This instruction selects the hard copy camera to be used as the output device. If the microfilm camera has been previously selected, this command will cause it to be NOT selected.



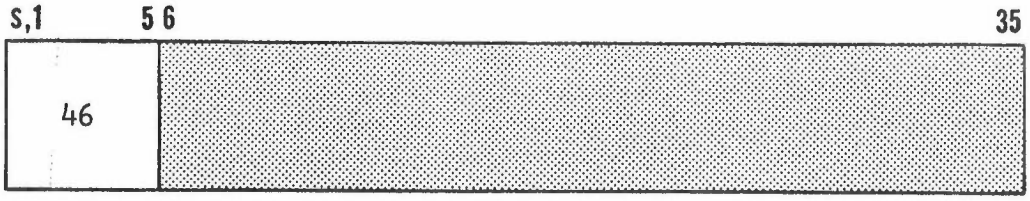
3-29. SELECT BOTH CAMERAS (SBC).

3-30. This instruction causes both cameras to be selected as output devices.



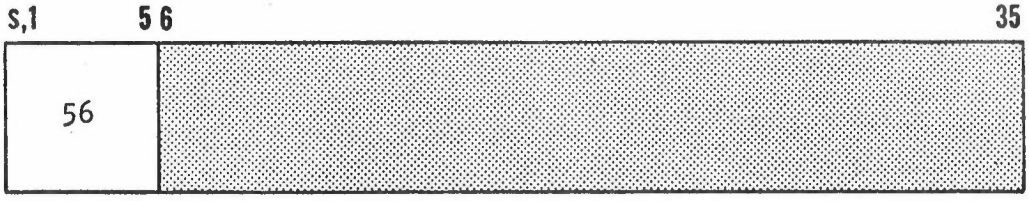
3-31. ADVANCE FILM (AFM).

3-32. This instruction advances the film in the microfilm camera one frame. If both cameras are fitted into the B-L 120, the selected camera (s) is (are) advanced one frame.



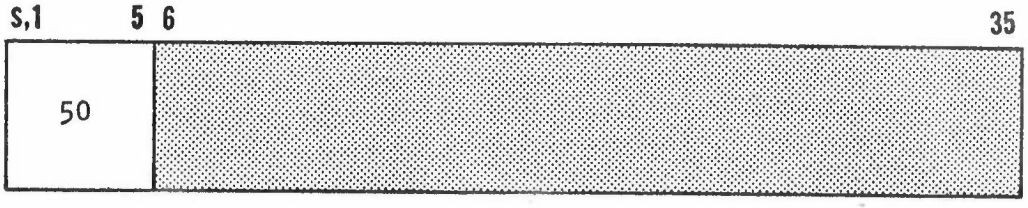
3-33. CLEAR (CLR).

3-34. This instruction performs the function of ADVANCE FILM and SELECT CAMERA 1. The B-L 120 is also placed in heavy recording density status, normal character size is selected, and the plotting position is set at X=0, Y=0.



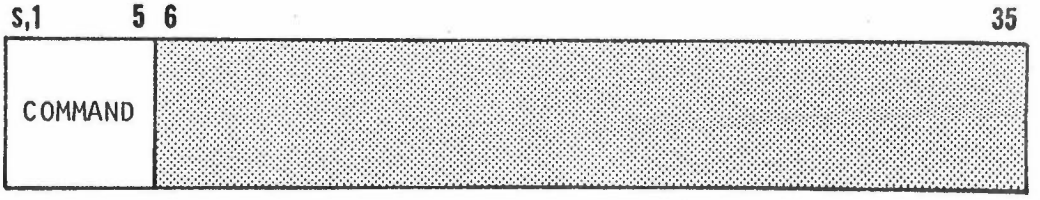
3-35. PROJECT FORM (PFM).

3-36. When the B-L 120 has been fitted with the Forms Projector, this command is used to cause the form to be superimposed on the recording medium.



3-37. PRINTING.

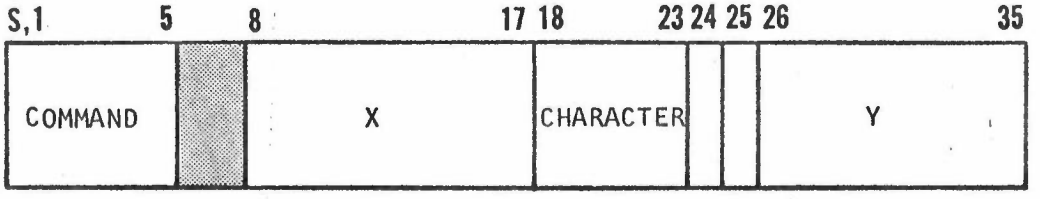
3-38. The PRINTING operation requires a single tape character per printed character once the PRINTING mode of operation is initiated. Alphanumeric characters are positioned automatically with spacing at every eighth plotting position horizontally and every sixteenth plotting position vertically, resulting in 128 characters per line and 64 lines per page. Recording density is selected by the previously stored conditions of a PLOT or CLEAR instruction. When the B-L 120 is in PRINTING status, five of the 64 characters are not printable, since these codes are reserved for command purposes. (See Table 1.)



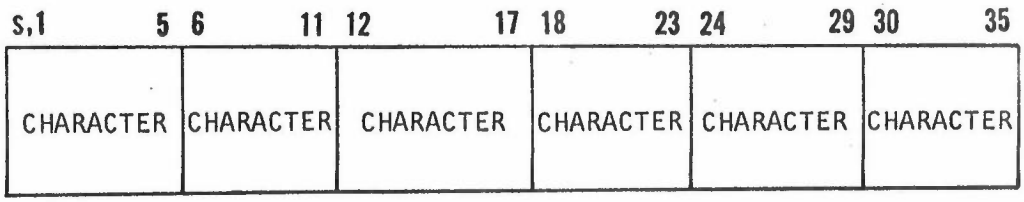
3-39. PRINT INSTRUCTION.

3-40. The instructions, PRINT SPECIFIED LARGE (PSL) or PRINT SPECIFIED NORMAL (PSN) are used to originate printing at any desired location. The instructions, PRINT CURRENT LARGE (PCL) or PRINT CURRENT NORMAL (PCN) are used to initiate printing at a previously determined position. These commands, in addition to selecting the PRINTING operation, select either large or normal size alphanumeric characters to be printed.

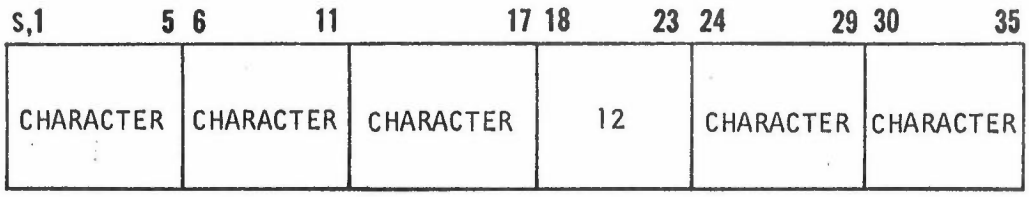
a. PSL and PSN. These instructions are organized as follows:



This organization is the same as the PLOT instruction, except the command itself. Note that bit 24 selects and stores the character set to be used for subsequent printing when provision for more than 64 characters has been made. This causes the alphanumeric character contained in the PSL or PSN instruction to be placed at the specified location. The characters following this instruction are printed as alphanumeric characters (except the PRINTING control commands described in Paragraph 3-40), and positioning is automatic, as defined in Paragraph 3-14. Any number of words containing six characters each may follow the instruction word.



The last character to be printed must be followed by an XIT. e.g.



When the end of the page has been reached, it is necessary to advance film to commence a new page. It is therefore important that an EXIT or CLEAR be written on tape prior to reaching the last printing position on the page or as the next character after the last position is printed.

b. PCL or PCN. This instruction requires the single command tape character only. The B-L 120 is thereby placed in the PRINTING status,

with printing commencing at the location entered by the previous instruction, is identical to the operation following the PSL instructions.

3-41. PRINTING CONTROL.

3-42. There are several control codes which may be used to alter the page structure; LINE RESET, LARGE FONT, NORMAL FONT, EXIT, CLEAR. All other instructions are NOT recognized when printing.

a. LINE RESET (LNR). This instruction, a single tape character, will cause PRINTING to terminate at the current position in the line and to commence one line lower at X=0.

b. LARGE FONT (LFT); NORMAL FONT (NFT). These instructions, single tape characters, alter the character size to be used for subsequent characters. Printing position is not advanced one space when this character is received.

c. EXIT (XIT). This instruction, a single tape character, is used to terminate the PRINTING mode of operation.

d. CLEAR (CLR). See Paragraph 3-33.

e. SET 1 (ST1); SET 2 (ST2). This instruction is used to select alternate character sets when more than one set of characters has been provided.

Section 4

PERFORMANCE

4-1. POSITIONING ACCURACY.

4-2. The overall accuracy of the information on the output medium (microfilm or hard copy) of the B-L 120 is determined by the sum of three unrelated error sources. These are deflection, CRT, and optical errors. The composite error on the output medium (plotted information relative to the calculated position of that information) is less than ±0.5% of full scale. The position of a plotted point, referred to programmed axis lines within 10 positions of the point to be determined, is in error by less than 0.1% of full scale. The position of a plotted point relative to an adjacent plotted point is accurate to ±0.05% of full scale. Contiguous points plotted at increasing unit addresses are always to the right (or below in the vertical axis) of the proceeding plotted point. Absolute plotting position accuracy is also subject to variation with time. The drift variation is less than ±0.2% in a ten second interval; ±0.5% in ten minutes; and ±1.0% in twenty-four hours.

4-3. LINE DRAWING CHARACTERISTICS.

4-4. The axis line, origin, and terminus are accurate to within the 0.5% plotting performance specified in Paragraph 4-2. Axis line width is less than 1/512 of the full scale frame dimension. When referring vector origin and termination to the analogous plotted position, coincidence to within a single line width is attained: linearity of the vector, referred to best straight line, is to within 0.1% of full scale.

4-5. RESOLUTIONS.

4-6. The diameter of the plotting dot will not be more than 1/512 of the full scale plotting axis dimension.

4-7. PRINT REGISTRATION.

4-8. All characters will be positioned with a given line, and all lines are positioned on the page to the plotting performance accuracies specified in Paragraph 4-2. Additionally, when any line or column segment of up to sixteen character spaces is considered, the misalignment of randomly selected characters with respect to a normal straight line will not exceed ±5% of a character height (a character height is defined as 0.093-inch when enlargment is made to give ten characters per inch).

a. When determining adjacent character registration, the characters should be printed or plotted sequentially, with all character spaces occupied. The distance between the top of the highest character and the bottom of the lowest character in a horizontal line segment will not exceed the normal character height by more than 10%. Similarly, the distance between the right side of the rightmost character and the left side of the leftmost character in a vertical column segment will not exceed the normal character height by more than 10%. Both character sizes may be printed in an arbitrary sequence in a given line when performing this test.

4-9. CHARACTER SIZE.

4-10. Two character sizes are selectable by program control. NORMAL

character size is typically adjusted to correspond to a height of 0.093-inch when the recorded image is magnified to produce ten characters per inch and five lines per inch. LARGE character height is approximately 4/3 NORMAL character height. Character size is uniform over the entire frame to within ±5%. The size and aspect ratio of characters is adjustable as a calibration procedure to allow a latitude of character size adjustment.

4-11. CHARACTER QUALITY.

4-12. The characters obtained as output from the B-L 120 are clearly legible. They are designed for a minimum of ambiquity between similarly shaped characters. Character skew, tilt, and other distortions are neglible.

4-13. FORM PROJECTOR CHARACTERISTICS.

4-14. The projected form is aligned with the plotted or printed information frame to within ±0.25%. This accuracy applies to initial alignment. System drift as specified in Paragraph 4-2 will determine subsequent alignment.

4-15. MICROFILM CAMERA.

4-16. FILM ADVANCE SPEED.

4-17. The camera requires not more than 100 milliseconds per frame to advance film.

4-18. FILM MAGAZINES.

4-19. Supply and takeup magazines are independent, light-tight units

which may be attached and dismounted from the camera in daylight. Standard takeup and supply magazines are eight-inches in diameter and have a capacity of 400 feet of film. A meter indicates the amount of film remaining, and interlocks prevent operation when the film supply is exhausted. Provision is made for removing short lengths of exposed film without the necessity of rethreading the camera. A conveniently located pushbutton switch is provided for manual control of film advance. The B-L 120 Microfilm Printer/Plotter is delivered with two supply magazines and two takeup magazines.

4-20. FILM.

4-21. Perforated 35mm film is used in the B-L 120 camera. Film sensitivity should peak in the blue region (4,600 angstroms) to match the P11 phosphor used in the CRT. Some satisfactory film types include: Ansco Hyscan, Ilford RX, and Recordak SO 266.

4-22. IMAGE SIZE.

4-23. Recorded image sizes may be adjusted to within certain limits as a maintenance calibration to suit particular needs. The nominal image size is 17.5 millimeters $\pm$2.5 millimeters square.

4-24. HARD COPY CAMERA (OPTIONAL).

4-25. PAPER ADVANCE SPEED.

4-26. The time required to advance hard copy paper one nine-inch increment is 1.0 second. There is a four frame advance delay before the recorded

image is presented at the output of the camera. A conveniently located pushbutton switch is provided for manual control of the paper advance.

4-27. PAPER MAGAZINE.

4-28. A light-tight takeup magazine is furnished which enables the use of offline processing techniques. When this magazine is used it is necessary to manually turn off the heated platten and disable the developer applicator.

4-29. PAPER AND CHEMICALS.

4-30. Photographic paper and developing solution can be obtained commercially. The hard copy camera accepts four-hundred foot rolls of nine-inch paper. A meter is incorporated to indicate the remaining amounts of unexposed paper. The developer does not contain toxic chemicals, sprays, or vapors. The tank contains fourteen fluid ounces of developer which is adequate for a four-hundred foot roll of paper. The tank should be periodically cleaned with tap water.

4-31. IMAGE SIZE.

4-32. The recorded CRT image occupies a square frame of approximately seven inches on the paper. Frame advance is nominally nine-inches, leaving equal margins at the top and sides of pages.

4-33. PARITY CHECKING.

4-34. Each six-bit character read into the B-L 120 is checked for lateral

parity. If a lateral parity error occurs, the PARITY ERROR character is forced into the character selection register at this time and is printed in lieu of the character which should have printed. This occurrence also lights a PARITY ERROR light and stops the printer at the next record gap. The operator may decide whether to attempt to read that frame of data again or to go on to new data by depressing either the RESTART or the START pushbutton. When the RESTART pushbutton is depressed, the tape is returned to the beginning of the frame and a light is flashed in the optics area of the printer, partially obliterating the frame of film containing the parity error.

4-35. INTERLOCKS.

4-36. The function of the interlocks is to render the B-L 120 inoperative, interlocking the operation of the printer. These interlock checks are tabulated below:

a. Optics light seal (door to optics bay)

b. Microfilm camera door open

c. Microfilm camera selected and not in position

d. Microfilm camera film supply exhausted

e. Internal test generator on

f. Hard copy camera selected and not in position

g. Hard copy camera selected and paper supply exhausted