

**Programmer's  
Reference Manual**

**DatagraphiX 4440  
Micromation  
Printer**

**4440**

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Micromation  
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# A

.....(Removable Sheet)

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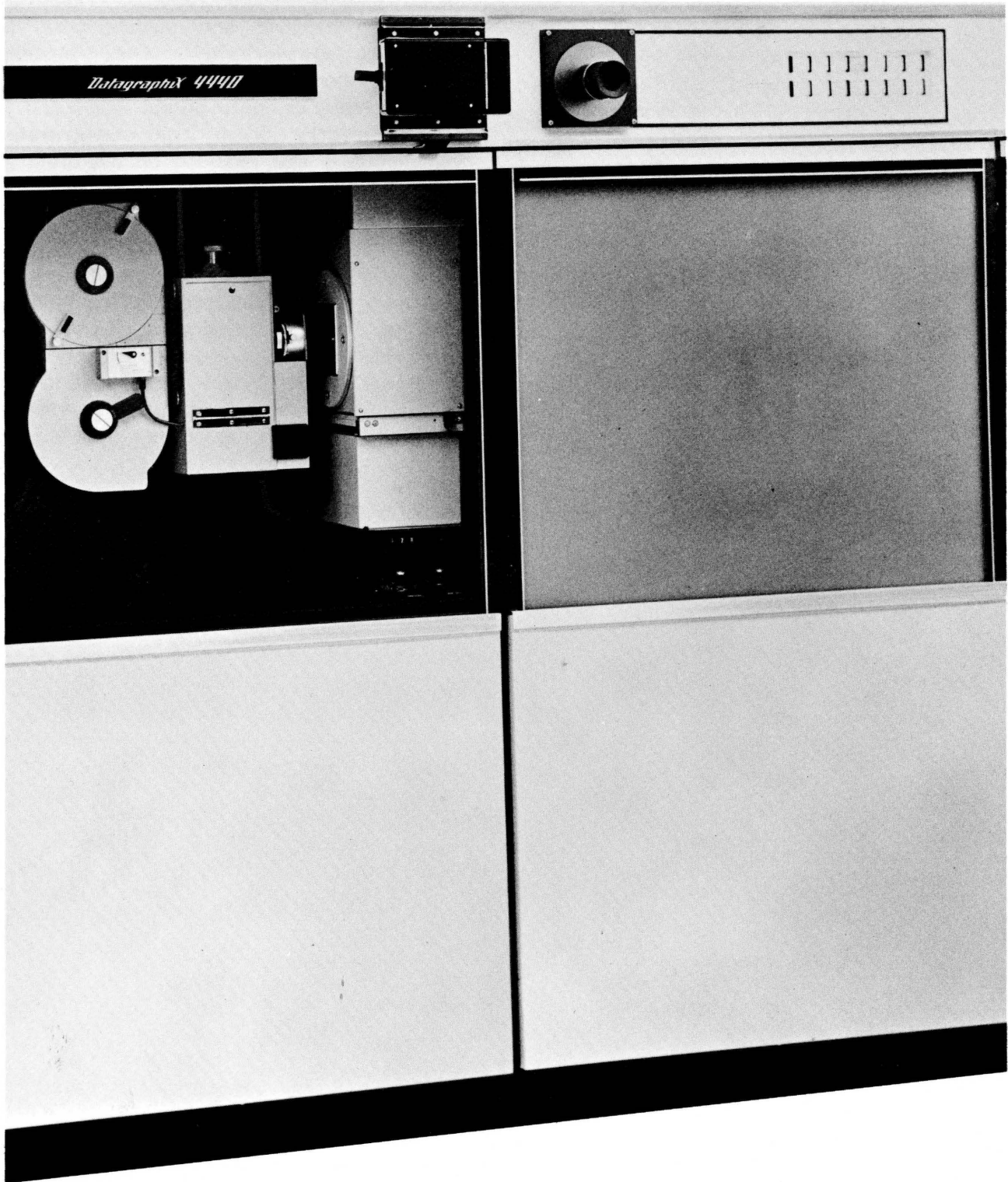
**Description of DatagraphiX 4440 (1-1)**

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The DatagraphiX 4440 Micromation Printer (see Figure 1), designed and manufactured by Stromberg DatagraphiX, Inc., provides high-quality permanent photographic recordings of alphanumeric computer output. The output is taken directly from computer-generated magnetic tapes and recorded on microfilm at computer speeds.

Optional features for the DatagraphiX 4440 include the following: Line Printer Simulator, Automatic Frame Backspace for refilming a frame containing a parity error, Record Edit, File Identification, a 90,000-character-per-second Tape Control Interface, and the Universal Camera; with DatagraphiX tape drives, a 120,000-character-per-second Interface is available.

Figure 1. DatagraphiX 4440 Micromation Printer



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**Character Generation (2-1)**

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Digital data is read through a logic-and-conversion unit in the DatagraphiX 4440 Micromation Printer. Commands to the printer are directed to the appropriate component, and data which is to be printed is converted into an analog signal. This signal is directed to a CHARACTRON® Shaped Beam Tube of the aperture selection type. This cathode-ray tube contains an electron gun, a character matrix, selection plates, deflection circuitry, and a phosphor coating on the inside of the tube face.

The CHARACTRON® tube's gun emits an electron stream which floods the character matrix. The matrix is a thin foil disc through which all the alphanumeric and special characters in the character set have been etched. (See Figure 2.) When the electron stream passes through the matrix openings, all of these characters are extruded as a bundle of shaped electron beams. This bundle is deflected by the selection plates so that only the specific character required by the digital input passes through an aperture en route to the tube face. This character is magnified, accelerated, and deflected to the proper line-and-character position on the tube face, where it is viewed by the camera.

Character generation occurs at speeds up to 120,000 characters per second, depending upon the tape transport used. An effective throughput speed of 21,500 lines per minute at 120,000 characters per second generates 5 or more frames (pages) per second. Up to 76 lines of 132 characters each may be printed on each frame. (Exception: See Dump Mode, section 5.) A Polaroid Monitor Camera, and Horizontal/Vertical Tabbing are standard equipment.

NOTE: Only those characters (Figure 2.) within the outline can be printed in the standard DatagraphiX 4440. Characters outside the outline are available only by special factory modification and require sacrificing a character within the outline.



# 2

Figure 2. DatagraphiX 4440 Character Matrix

÷	↑	○	^	.	]	[	!				
R	*	□	Q	\$	&	%	J	Z	?	'	‡
-	a	K	F	M	H	R	S	G	U	#	→
-	=	C	L	T	E	I	A	P	O	Y	;
,	V	1	0	N	W	D	B	6	9	X	:
□	/	+	8	3	2	5	7	4	¢	\	
‡	≠	‡	"	>	)	(	<	□			

## Tape Format (2-2)

The DatagraphiX 4440 Micromation Printer accepts Stromberg DatagraphiX or standard IBM (Industry Compatible) 7- or 9-channel ½-inch magnetic tape recorded in BDC, EBCDIC, or BCDIC. Characters are printed immediately upon being read and checked for errors.

The DatagraphiX 4440 prints a maximum of 132 characters per line and up to 64 or 76 lines per page, the choice of maximum lines being selectable. Characters are read and printed at tape speed. Tape record blocks having up to 16,384 characters between gaps are permissible. The maximum number of printable characters in a tape record for standard mode printing is 8,448 or 10,032, depending upon the maximum line count selected. (132 characters per line and 64 lines per page = 8,448 characters; 132 characters per line and 76 lines per page = 10,032 characters.) Larger blocks provide faster throughput on the DatagraphiX 4440. Variable-length records and/or blocks are accepted by the DatagraphiX 4440 without delimiters other than record marks. Each frame of data must be followed by an interrecord gap. This IRG allows time for the DatagraphiX 4440 to advance the film.

There is no mechanical buffer within the DatagraphiX 4440. The printer operates in an asynchronous mode, i.e., characters are printed immediately upon being read from tape and checked for errors. Each record mark encountered changes the logic from the print mode to the control mode to sense and react to the next control character. Thus, there is no restriction regarding fixed-length records or even regarding a fixed minimum number of print positions within a record.

## Error Checks (2-3)

Records which cause printing to go beyond the last (132nd) character position of a line trigger an overflow condition and the line is truncated. The DatagraphiX 4440 halts in the next interrecord gap and the "Line Overflow" indicator is lit. The operator may then depress the START button which will cause the equipment to refilm the frame until the point of error is reached. If the error does not exist at this point printing continues; if the error does occur the above procedure will be repeated.

If the machine being operated has the frame backspace feature, the operator has the alternative of depressing the PROCEED and START buttons; this causes the machine to reprint the entire frame and print a light VOID over the data.

A similar alarm condition occurs when records cause printing to be beyond the 64th or 76th line position. Additional print line records are ignored and the unit halts in the next IRG with the page overflow indicator lit. The operator then has a choice similar to that described above. Depressing the RESET and START button will cause the equipment to reread the frame in an attempt to correct the error. If the overflow condition is still present the DatagraphiX 4440 will repeat the alarm procedure.

If the machine being operated has the frame backspace feature, the operator may instead depress the PROCEED and START button. The machine will then refilem the entire page, wrap around to the top of the page, overprint the excess data, and place a light VOID on the data.

The DatagraphiX 4440 has built-in logic to perform parity checks. The vertical parity checking circuitry (VRC) checks the parity of each character. If a particular character does not pass the parity check the tape reread cycle is entered. This feature allows rereading of each character in error, seven times. If the character is in error after seven tries, a parity error symbol "█" is printed in the position intended for the character in error. If more than one error occurs within one frame, the parity symbol is substituted for the erroneous character without any reread attempts. VOID is overprinted on the frame containing a parity error.

The DatagraphiX 4440 also contains longitudinal redundancy checking capabilities to check for the correct horizontal bit count for each tape track in every tape block. If an error is found, the DatagraphiX 4440 voids the frame and halts, indicating multiple self-cancelling parity errors.

The Cyclic Redundancy Check Correction (CRCC) for 9-track tapes automatically corrects most single and multiple errors in a single channel. It is not applicable to 7-channel tapes.

The write check feature permits verification of the accuracy of the deflection circuitry of the CHARACTRON® tube as an internal quality control check. The check is made before printing each page. Failures cause a halt and an alarm condition.

The DatagraphiX 4440 has a counter on the control panel to indicate the number of frames printed.

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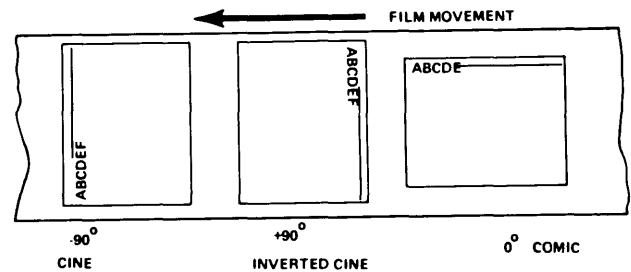
## 2-4 Frame Orientation

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The frame (page) on film may be recorded in one of three conventional orientations by rotating the CHARACTRON® tube manually as

established by a positive indexing pin. The image orientations thus achieved are (1) comic, (2) cine, and (3) inverted cine as shown in Figure 3.

**Figure 3. Frame Orientation**




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## 16mm Camera (2-5)

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The DatagraphiX standard camera contains five light sources for recording:

1. A void mark on error frames.
2. A Sequential Retrieval Mark (SRM) in the margin of the film.
3. File identification marks.
4. Retrieval coding marks recorded between film frames.
5. Image count marks in the margin of the film.

The 16mm Camera is capable of producing film without coding, or film compatible with image count, code line indexing, or Miracode Retrieval Systems. Coding for DatagraphiX Microfilm Systems is obtained via the Sequential Retrieval Mark (SRM). The SRM provides the image for random retrieval in the DatagraphiX 1700 and for correct page alignment in the DatagraphiX 3400.

The user has the choice of either Miracode or Codeline with the standard camera. A separate light box is required for each; both light boxes cannot be used simultaneously in a single camera. The Miracode light box provides for 14 coding bars per column on film; the Codeline light box provides for either 21 or 26 bars. The number of columns to be coded is under programmer control.

# 2

The control switch on the operator's control panel can be set at one of five positions:

0. No coding.
1. Image count.
2. Codeline.
3. Miracode.
4. Sequential Retrieval Mark (SRM).

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## Print Modes (2-6)

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The DatagraphiX 4440 may be set in one of three print modes, selectable by a Print/Mode switch on the maintenance panel. Positions for selection are:

1. Standard Mode.
2. Line Print Simulator Mode.
3. Dump Mode.

Sections 3, 4, and 5 explain each of these modes.

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**Programming Format (3-1)**

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For maximum throughput speed and to fully utilize the DatagraphiX 4440 options, the programmer should format the tape records in accordance with the considerations given in this section.

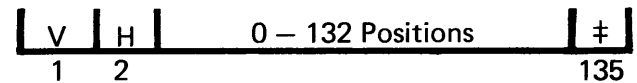
All tape records in the standard mode fall into one of two categories: (1) print records or (2) action records.

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**Print Records (3-2)**

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A complete maximum length print record consists of 135 characters as shown below. Of these, 132 are printable and 3 are control characters.



V = Vertical Control Character or Vertical Tabbing Digit

H = Horizontal Tabbing Control Digit (see paragraph 3-5)

‡ = Record Mark

*Print* records consist of one line or part of one line of printable information. The *first character* of the *print* record is a vertical print control character and determines the vertical starting position.

The DatagraphiX 4440 electron beam is not automatically advanced to the next line upon completing a logical record or print line. The record mark (‡) at the end of each record signals the end of the current line, obtains line reset (carriage return), and activates the print control or action code for the next record. Thus, the first character of a *print* record could contain a command to suppress spacing, or it could instruct the unit to space 1, 2, or 3 lines. It could also direct the beam to a preset line number on the page by using the tabbing feature (see paragraph 3-4).

# 3

A blank (space) vertical control character generates a single line space. A zero in this position skips a line, giving the effect of double spacing. For triple spacing, a minus is used. Line spacing may be suppressed by using a plus in this position; this is useful for the first *print* record of each page or for printing multiple records on a line.

### Vertical Control Characters

<i>Symbol</i>	<i>Effect</i>
Plus + .....	0 line space
Blank .....	1 line space
Zero 0 .....	2 line space
Minus - .....	3 line space

All print control codes are executed before printing the associated record, i.e., the logic spaces, then prints the record. Printing begins with the third character after a record mark and continues until a record mark or an overflow condition is sensed.

NOTE: For correct hexadecimal or octal input for these control characters, see tables 3, 4, and 5 in section 7.

If a 7-channel tape is converted or translated to 9-channel tape via software or hardware, the "+" control character may become a "&". By using the DatagraphiX 9 track BCDIC interface the "&" will result in 0 line space, otherwise the + is 0 line space in all cases.

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### 3-3 Print Illegal

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When activated, the Print Illegal switch causes the DatagraphiX 4440 to print those records which contain a control character that is not in the character set of the print mode being used. If this switch is not on, those records which contain an illegal control character are ignored.

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### 3-4 Vertical Tabbing

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The DatagraphiX 4440 has the mechanical printer's capability of skipping to a predetermined line, plus the ability to "backspace" lines *up* the page. Since the entire frame is stationary until an action command in

an *action* record is received to advance the film, the electron beam may be directed to any point on the frame at any time and in any sequence of movements.

Vertical tab control characters are the numeric digits, in the first position of a *print* record, which control the skip movements. Their use is analogous to that of a special carriage-control tape in a mechanical printer. The numeric digit is equated with a specific line number through an external tab patch panel (see Figure 4). Diode pins, inserted in a vertical column under one of the numbers shown across the horizontal axis, are additive. Line numbers are normally 1 through 64 or 1 through 76, with the first line being line one.

When tabbing, however, the first printable line is zero and the last is 63 (or 75). Therefore, the sum of the line numbers activated by diode pins will always be *one less* than the actual line count. For example, assume that diode pins have been inserted in rows 2, 4, and 16 of the vertical column under "5". An input *print* record which has a "5" in position one will be printed on line 23. The patch panel count of 22 is equivalent to line 23.

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### 3-5 Horizontal Tabbing

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In addition to the vertical tabbing capability it is also possible to "tab" lines horizontally on the DatagraphiX 4440. The second position of each *print* record is allocated for horizontal tabbing. If no tabbing is desired for a particular record, the vertical control position should be left blank. This capability can be compared to tab setting of a typewriter. When tabbing horizontally, the first print position is zero and the last possible print position is 131. The sum of the print positions activated by diode pins will always be one less than the actual position count. If diode pins have been inserted in rows 8, 4, and 16 of the horizontal column under "2," all input records which have a "2" in the record position will write the first character in print position 29. When tabbing more than 60 positions horizontally, the first character programmed

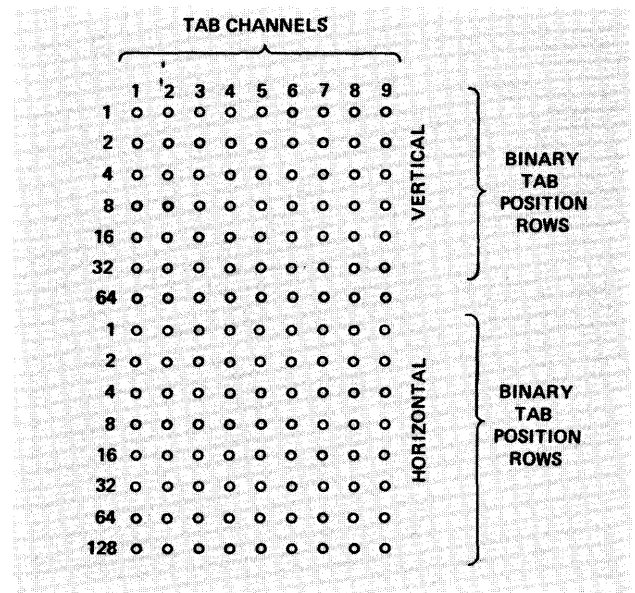
should be a blank to allow sufficient time for the beam to settle to prevent the blurring of the first print character.

For example, assume the requirement is to print a columnar report of part numbers and descriptive information. There is room on the page for three separate columns, and the part number sequence is to be vertical; i.e., part numbers 1 through 50 in the left-hand column, 51 through 100 in the center column, and 101 through 150 in the right-hand column.

If the data on the input tape is in ascending part-number sequence, it would be necessary, using an impact printer, to store the data for an entire page and write it out a line at a time. However, since the DatagraphiX 4440 prints a full page before moving the film, the added computer storage requirement is avoided. The user may print column one from top to bottom, return the electron beam to the top of the frame for column two and print, and repeat for the third column. If the first entry in each column is to be the same line, that line may be referenced by calling for the same numeric channel in the vertical control-character position of the first *print* record of each column. When moving from the bottom of one column to the top line of the next, the programmer simply uses the numeric which represents the first line, and changes his horizontal tab reference character.

Each record to be printed in each column must reference the horizontal tab character established for that column. Every *print* record would be less than 135 characters in length; the length would be the sum of the three control characters (including record mark) plus the characters to be printed in a particular portion of the line. The relationship between numeric control characters used in *print* records and specific lines (vertical tabs) and print positions (horizontal tabs) is established through use of the diode patch panel (see Figure 4). When a page has been filled, the programmer writes an *advance* record (see *action* records A and F) and reinitializes the vertical and horizontal numerics for the next page.

Figure 4. Diode Patch Panel



### 3-6 Additional Tabbing Comments

These features not only allow "scatterprinting," but also insure more efficient use of the recorder. All blank padding preceding the first printable character on a print line is eliminated. Each *print* record can be of minimum length, saving computer channel time, when writing tape, as well as conversion time.

A tab channel, once set, can only refer to one line position in the vertical direction and one character position within a print line for a certain run. This is unlike the impact printer carriage-control tape, where the same channel can refer to various line numbers on the same page, e.g., channel 2 can reference lines 5, 15, and 35.

In the diode pin arrangement for the DatagraphiX 4440, a different channel number must be used for each skip. Since the patch board is coded with binary numbers, it is impossible to set a channel to refer to anything but a unique position on the page in either the vertical or the horizontal direction. (This does not apply to the "true tab" feature of LPS, which is discussed in a following section.)

# 3

NOTE: If tabbing causes a skip greater than half of the frame (60 horizontal positions or 32 vertical lines), use a blank character in the first print character to allow the deflection yoke to settle; otherwise, the first character may be somewhat smeared.

### Tabbing Example

	H <sub>1</sub>			H <sub>2</sub>		
Vertical channel 2	PART NO.	QTY	UNIT PRICE	PART NO.	QTY	UNIT PRICE
Vertical channel 3	001	5	1.05	038	2	1.00
	002	3	1.75	039	7	0.50
	003	2	2.50	040	-	0.75
	004	1	5.20	041	2	1.25
	'	'	'	'	'	'
	'	'	'	'	'	'
	037	2	1.25	074	1	2.05

Tape Records used to create the above page:

2	1	PARTbbbQTYbbbUNITbbb
	1	PARTbbbQTYbbbUNITbb‡
	1	NO.bbbbbbbbbbPRICEbbb
	1	NO.bbbbbbbbbbPRICEb‡
3	1	001bbbbbb 5bbbb 1.05 ‡
	1	002bbbbbb 3bbbb 1.75 ‡
	1	003bbbbbb 2bbbb 2.50 ‡
	1	004bbbbbb 1bbbb 5.20 ‡
	'	'
	'	'
	1	037bbbbbb 2bbbb 1.25 ‡
3	2	038bbbbbb 2bbbb 1.00 ‡
	2	039bbbbbb 7bbbb 0.50 ‡
	2	040bbbbbb - bbbb 0.75 ‡
	2	041bbbbbb 2bbbb 1.25 ‡
	'	'
	'	'
	074bbbbbb 1bbbb 2.05 ‡	

↑ Horizontal Control Codes  
↑ Vertical Control Codes

Table 1. Tab Control Codes

Symbol Code	Effect
1	Execute tab channel 1
2	Execute tab channel 2
3	Execute tab channel 3
4	Execute tab channel 4
5	Execute tab channel 5
6	Execute tab channel 6
7	Execute tab channel 7
8	Execute tab channel 8
9	Execute tab channel 9

### Action Records (3-7)

The only moving elements in the printer are the film and the film-transport devices located within the camera. This movement dictates a unique programming consideration. Instead of printing one line at a time, the DatagraphiX 4440 prints an entire page at a time. There is no "line feed" travel of film. When a frame, or a page, has been recorded, the film is advanced one full frame. *Action* records which cause film movement must be followed immediately by an interrecord gap (IRG).

An IRG is defined as a 0.75" tape gap on 7-channel tape; and a 0.6" tape gap on 9-channel tape. The time necessary to advance film from frame to frame is acquired during tape drive stop-start time. When the IRG following the *action* record is detected, the tape drive is commanded to halt and the camera signals the tape controller when it has completed its cycle, and the tape controller resumes reading tape.

A description of each operation code acceptable by the printer follows. In every case the action code occupies the first position of a logical record. Each record *must* be terminated by a record mark.

An *action* record can vary in size from the minimum record permitted by the I/O supervisor of the computer writing the tape, to an *unlimited maximum*, since anything between the action code and the terminating record mark is ignored. Specific *action* records require some additional information following the *action* code.

<i>Action Code</i>	<i>Effect</i>
A	Execute frame advance.
F	Execute form flash and frame advance.
✓	End of file. Causes the machine to stop, pending operator action. Illuminates End-of-File light.
Y	Halt at next IRG after Frame Advance.
Z	No-Op. Causes record to be disregarded.
E	Compare Edit Codes.
I	Expose File Identification.

Each of the above *action* codes must be the first character of a record. With the exception of the No-Op, Edit, and Halt, each *action* record must be followed by an IRG.

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### 3-8 Frame Advance (Action Code A)

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When *action* code A is used, the film advances one frame. No other action takes place as a result of this code. Since characters are printed at tape speed and the physical movement to advance the film to the next frame takes 100 msec, the tape unit must be halted, thereby requiring a following IRG. The frame advance instruction automatically resets line spacing to the top line of the new page (frame).

This record could consist of only two characters: "A+" or the minimum record accepted by the computer operating system. Any other print characters within this record are ignored and *not printed*.

If host computer software requires fixed-length blocks and a page is completed before a block is filled, the *advance* record can take up the remainder of the block, or, if fixed-length records are used, the *advance* record can be preceded or followed by padding records. There cannot be any *print* records following within the same block.

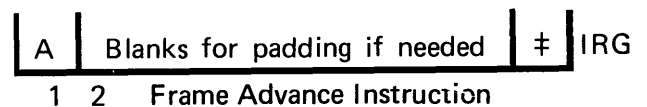
#### *Maximum Record*

Position 1 ..... A  
 Any number of ..... Blanks\*  
 Last Position ..... Record Mark  
 Next Position . . . . . IRG

#### *Minimum Record*

Position 1 ..... A  
 Position 2 ..... Record Mark  
 Next Position ..... IRG

\*In DatagraphiX 4440 units having Universal Cameras, the occurrence of a "W" within the possible Blank positions will cause a new microfiche to be started.




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### 3-9 Forms Flash and Frame Advance

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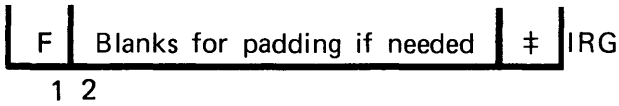
All Stromberg DatagraphiX printers have the capability of superimposing images of preprinted forms over the variable data recorded on film. A glass slide, onto which a form's image is photoetched, is inserted into the machine. When the *action* code of "F" is read, a strobe light optically projects the image onto the film and then advances the frame.



# 3

The form flash can also be achieved under operator control. The operator can set a switch to force a form flash on every frame of a particular run.

Like the advance code "A", the record could consist of as few as 2 characters, "F‡" or as many characters as needed (below) and must be followed by an IRG. The form flash instruction automatically resets line spacing to the top of the new page (frame).



Forms Flash and Frame Advance Instruction

### 3-10 End of File (Action Code ✓)

Whenever a ✓ (tape mark) follows an interrecord gap, the DatagraphiX 4440 stops the tape unit in the next interrecord gap and the end-of-file lamp will be lit. This may be used to indicate the end point of a microfilm reel or the end point of the magnetic tape reel. If this code is sensed in the middle of a block of *print* records, the DatagraphiX 4440 will ignore the end-of-file mark and continue to print.

For multireel print-tape files, it is not necessary for the programmer to end each magnetic tape reel with the last line of a page. If the operator presses the START button, the new reel can be continued within the same frame. However, if the operator presses the RESET button, the deflection (line spacing) will be sent to the first printable line. When printing is resumed, overprinting will occur.

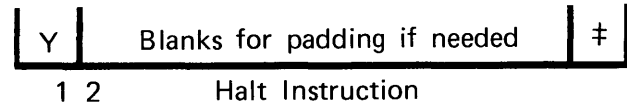


NOTE: The DatagraphiX 4440 may be attached to two tape units of the same type. The tape control unit designates one of these as unit "one" and the other as unit "two". The operator may select either tape unit by a two-position

switch on the operator's control panel. Reading and printing from the selected tape unit is unaffected by local operations of the other unit, such as rewinding or loading tape.

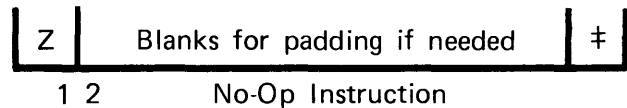
### 3-11 Halt (Action Code Y)

When *action* code "Y" appears as the first character in a record, the DatagraphiX 4440 will halt in the next IRG immediately following a frame advance. This is a programmed halt for operator intervention as specified in the job instructions or run book. This *action* code can be used, for example, to provide a break for operator convenience between stacked print jobs on a particular tape. This record does not require an IRG to follow immediately after the record mark.



### 3-12 No-Op (Action Code Z)

When using some programming languages, it is necessary to block records in a fixed format not easily controllable by the programmer. Since A and F *action* codes require an IRG following the record, it may be necessary to pad a portion of the block with No-Op records. When the first character of a record is a "Z" no printing action will be taken by the DatagraphiX 4440. If variable-length records are permitted within a fixed block size, a No-Op record of any length is acceptable if terminated by a record mark.



### 3-13 Edit (Action Code E)

The *edit* record makes it practical for the programmer to generate several reports in one pass of a master file and to merge the different reports onto a single print tape.

The output tape is then printed on the DatagraphiX 4440 one time for each report, selecting only the pertinent data for printing. The DatagraphiX 4440 can select one or more combinations of coded records from more than 10,000 possible combinations. The *edit* record of four decimal digits is compared with the setting of the four 11-position Record Edit switches on the operator's maintenance panel. Each of these switches may be set at 0 through 9, or at the "Superdigit" (10 or 11 position). The tape record may have the numerics 0 through 9, or the superdigit "X". If the comparison is favorable, all data are accepted for normal printing until the next *edit* record is detected. The Superdigit switch position means "it is the same as any other digit." If a superdigit appears in the *edit* record or on the panel switch, that digit will give a "yes" comparison. All four digits must compare to turn on the printing function and allow the following records to print.

If two or more of the merged reports contain some of the same information, such as names and account numbers, these items need only be written once on the print tape. The superdigit function will cause these items to be accepted for printing for more than one edit switch setting.

The *edit* record itself contains no printable data; rather, it precedes the *print* records. Thus, if a tape consists of various sections of data that have to be converted at different times with various selection parameters, each group or section must be preceded with an *edit* record. An example is shown below.

Switch Setting	Edit Record	Result
1 0 0 0	1000	Print
1 10 10 10	2XXX	No Print
1 10 10 10	1987	Print
10 9 8 7	1987	Print
10 10 10 10	1987	Print
1 2 3 4	X 2 3 4	Print
1 2 3 4	1 2 3 3	No Print

To force every record to be printed, all switches should be set to 10 or 11.

The *edit* record could be a minimum of 6 characters:

Position 1: "E" for *action* code.

Positions 2-5: The four edit digits desired (0 through 9, or X).

Position 6: Record mark.

Padding could be included, as necessary, to expand the record to software requirements.

The absence of *edit* records on tape will cause all records to be printed.

E	NNNN	Blanks for padding if needed	‡
1	2	5	6

Edit Record Instruction

### 3-14 File Identification (Action Code I)

File Identification is a method of flashing large, 3/8" numbers on the film, so that discrete strings of pages may be identified by observing characters which are recognizable without special viewing equipment. An example of its use would be regional distribution of a report; at each control break separating regions, the programmer may flash a series of numeric digits which identify the block of data being terminated, and then another leading identifier for the forthcoming block of pages. Characters which may be flashed are the numbers zero through nine and the period ".". Each I-command causes one digit to be exposed on film. Any character other than the range listed above will cause a blank space to be created. Again, each I-command must be followed by an IRG. There is no limit to the number of file identification characters which may be printed. After the final file ID character, however, there must be six frame advance commands (each followed by an IRG). This is necessary because the point at which these characters are exposed on film is physically located "up-stream" of the normal camera recording station.

I	n	Blanks for padding if needed	‡	IRG
---	---	------------------------------	---	-----

File Identification Instruction  
n = digit to be printed

NOTE: This special feature is only available for use with the 16mm camera.

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### Simulation Version (4-1)

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The DatagraphiX 4440 Line Printer Simulator (LPS) feature allows the microfilm recorder to accept directly, without reformatting, many of the magnetic tapes prepared for computer line printers.

The LPS option is wired to simulate the logic and data manipulation of the computer buffer, the print control program, and some of the special characteristics of the mechanical line printer.

Three modes of operation are provided when the LPS option is installed in the data recorder: (1) standard DatagraphiX 4440 print mode, (2) three line-printer-simulator modes, and (3) dump mode.

The standard print mode allows maximum throughput speed and use of the unique features of the data recorder. The operator selects the simulator mode by selecting the desired LPS logic. Selection between the standard print mode, LPS, and the dump mode is made by switch control.

---

### Tape Format (4-2)

---

Tapes prepared for printing on computer satellite line printers can be read and printed. The tapes must be prepared in print-line image and page image with each line separated by a record mark.

There are three versions of LPS; they differ only in their recognition of different sets of control characters and in the resulting line and page spacing. These coding and spacing conventions conform to IBM types B, C, and D (refer to IBM form C-24-5026).

The maximum accepted tape record has 16,384 characters. The recommended size is from 20 to 32 logical records (lines) per block. These smaller block sizes allow faster throughput in this mode.

# 4

Logical records of variable length which end with a record mark are accepted. Each record must start with a vertical print control symbol and end with a record mark. From 0 to 132 printable characters may follow the print control symbol. Characters in excess of 132 are ignored and the logic continues to read the print tape until a record mark is recognized.

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## Operating Characteristics (4-3)

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The most significant difference between formatting for the LPS mode and formatting for the standard mode is that the LPS logic provides for the generation of multiple output frames from a single input tape block. In LPS mode, the DatagraphiX 4440 counts the number of characters which have been read since the previous IRG. When a control character is encountered which calls for overflow, the contents of this counter are stored, and the printer enters a reread cycle. During this time printing is inhibited while the film is advanced. The magnetic tape is stopped in the IRG preceding the present block until the frame advance has been completed. Then, with printing still inhibited, it rereads the tape, counting characters until the character which caused the frame advance is reached. Character positioning is established, and printing resumes until (1) another *carriage eject* character is encountered, or (2) the page is completely filled (with *auto advance* activated).

Throughput speed of the DatagraphiX 4440 may be reduced approximately 20% to 30% by the LPS, as the unit must read to the next interrecord gap on the tape when it has sensed a command to advance to the next frame. After executing the advance, the tape must be backspaced, and positioned correctly to the location where the advance command was sensed so that printing can continue. If the page-skip command is always the last record of a tape block, and it is a command that causes advance of the frame after printing that particular record, there will be no loss of time.

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## True Tab (4-4)

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LPS for the DatagraphiX 4440 allows the use of up to 12 vertical channels. This is achieved by the "true-tab" feature, which can be compared to the carriage control tape of the mechanical printer. Instead of the standard board used only when running in the standard DatagraphiX 4440 print mode, a different plug board is employed. This patch panel numbers 1-12 on the X-axis and 1-76 on the Y-axis.

Any number of print lines may be addressed in each vertical channel by inserting a diode pin into the appropriate print line number.

To recognize which vertical line number is addressed when more than one line is referenced by the same tab channel number, special logic is provided within the LPS feature. Whenever a skip command is recognized, this counter is examined and a comparison is made with the setting of the various pins for that channel. The skip will be executed to the line number which is next in sequence to the current line position and the skip will always be down the page.

The true-tab feature enables the DatagraphiX 4440 to interpret correctly the requirement for multiple print lines from a single carriage control character. For example, carriage control character "2" may be made to print on lines 10, 20, and 30, as printing progresses down the page, by inserting diode pins in holes 10, 20, and 30 under the number "2" (See Table 2).

---

## Print Illegal (4-5)

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When the Print Illegal switch is on, all illegal records are printed. In LPS modes B and C, the record is printed and a one-line space occurs. In mode D, the printer spaces one line and prints the record.

**Table 2. 4440 Line Printer Simulator Spacing Control Characters.**

<i>LPS Mode</i>	<i>Valid Symbols</i>	<i>Effect</i>
B*	J	Space 1 line and print
	K	Space 2 lines and print
	L	Space 3 lines and print
	/(slash)	Print and space 1 line
	S	Print and space 2 lines
	T	Print and space 3 lines
	1(one)	Skip to Channel 1 and print
	2 thru 0	Skip to Channel 2 thru 10 and print
	#	Skip to Channel 11 and print
	@	Skip to Channel 12 and print
	A thru I	Print and skip to Channel 1 thru 9
	?	Print and skip to Channel 10
	.(period)	Print and skip to Channel 11
	□	Print and skip to Channel 12
✓	End of File	

C	Plus	Suppress space and print
	Blank	Space 1 line and print and space
	Zero	Space 2 lines and print and space
	Minus	Space 3 lines and print and space
	1(one) or J	Skip to Channel 1 and print
D	2 thru 9	Skip to Channel 2 thru 9 and print
	K thru R	Skip to Channel 2 thru 9 and print
	✓	End of file
	Plus	Suppress space and print
	Blank	Space 1 line and print
D	Zero	Space 2 lines and print
	Minus	Space 3 lines and print
	1(one)	Skip to Channel 1 and print
	2 thru 9	Skip to Channel 2 thru 9 and print
	A	Skip to Channel 10 and print
	B	Skip to Channel 11 and print
	C	Skip to Channel 12 and print
✓	End of File	

\*LPS mode B is available in two versions, Standard, as shown, or Modified to suppress the automatic space-before-print.

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**Dump Mode (5-1)**

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The Dump Mode is designed to dump any tape on film. Each line is filled with up to 136 characters, and each physical record begins printing on a new line, starting at the left margin.

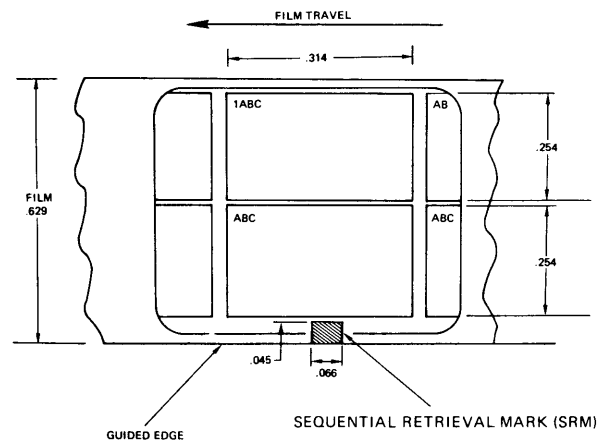
Depending on operator switch selection, each frame will be filled with either 64 or 76 lines. After filling a page the logic directs printing to begin on a new frame.

Any tape that is DatagraphiX or IBM compatible and is coded in BCD, BCDIC or EBCDIC is acceptable.

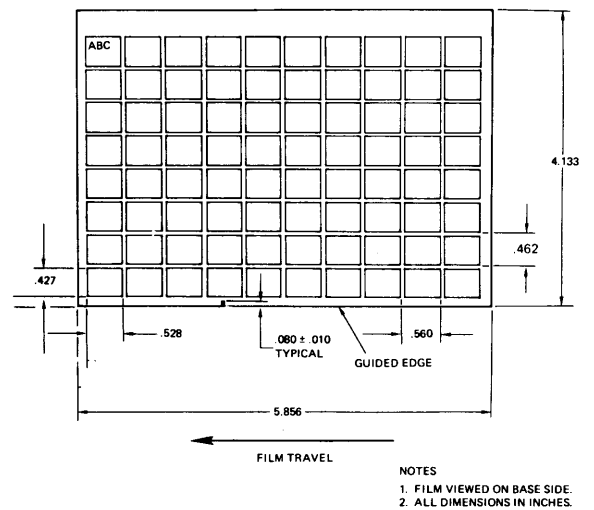
## Film Format Variations (6-1)

The Universal Camera, in its standard form, records images on roll film at a 25X or 42X reduction ratio. It is able to record on 16mm and 105mm film. (See Figures 5, 6, and 7.) Magnetic tape formatted for roll film on the DatagraphiX 4440 can generate microfiche from the Universal Camera without reformatting.

**Figure 5. 42X 2up 16mm Format**



**Figure 6. 25X 105mm Format**



The output obtained can be in several formats: from "one-up" 16mm film to 105mm

# 6

microfiche. Columns of two or more frames across any width of film are accomplished by lens movement across the film. The rows of frames are spaced by the film movement through the camera.

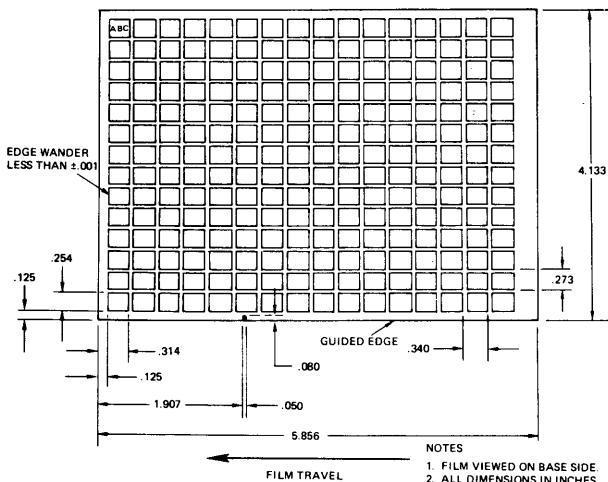
## Camera Controls (6-2)

Eight operator's controls define parameters for the Universal Camera. The camera produces a wide variety of film formats and microfiche sizes. Once a format has been decided upon for a particular application, control settings recorded on a job sheet or in a run book will permit fast operator setup for the desired microfiche format.

**1. Sequence Mode Control** – This control regulates the path in which the lens mechanism moves, according to the following settings.  
**Single** – Used for conventional "one-up" recording on 16mm film.

**Zig-Zag** – When the sequence mode control is placed in this position, the lens travels up one column (across the film) and down the next column. When the top of the first column is reached (as defined by the Frames per Column control), the film is advanced one column and the lens starts back across the film in the opposite direction. The last frame recorded in column two will then be opposite the first frame in column one. (See Figure 8.)

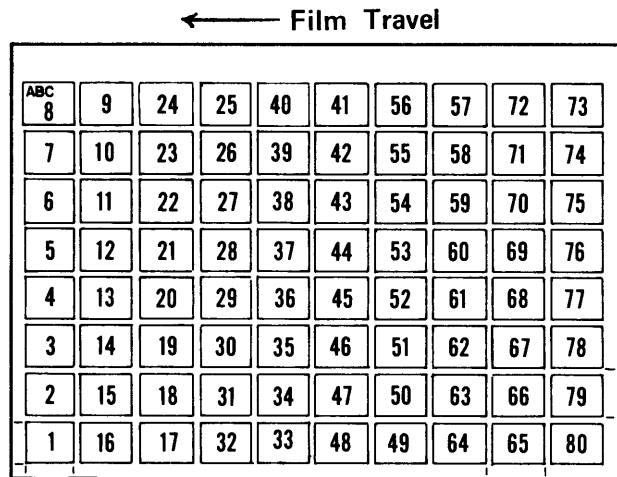
Figure 7. 42X 105mm Format



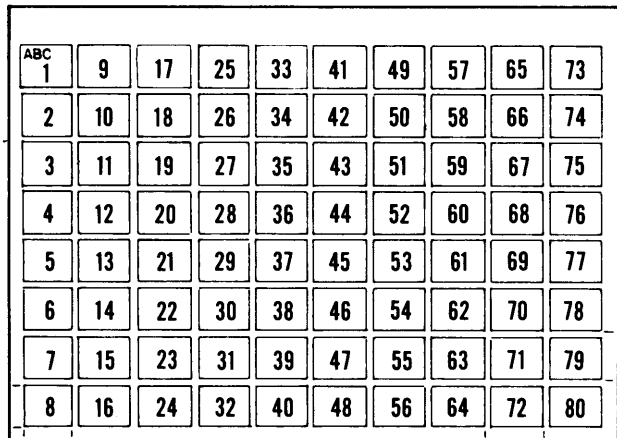
**Slew-Left** – Causes the lens to move up one column, then return to the bottom and record up the next column. (See Figure 8.)

**Slew-Right** – Causes frames to be recorded down the columns in the opposite fashion of Slew-Left. (See Figure 8.)

Figure 8. Sequence Mode



ZIG - ZAG



SLEW RIGHT

**2. Frames Per Row** – This control defines the length, in frames, of an individual microfiche. Microfiche may be cut from the continuous roll to individual size by an automatic cutter which senses a special mark, recorded by the Universal Camera, in the margin of the film. This control defines the overall length of each microfiche. All



microfiche within a single application should be the same size as one which has been filled to capacity. The switch has settings for 1 to 32 frames.

3. *Frames Per Column* – This control regulates the number of lens advances made as images are printed across the width of the film before the film advances one column and the lens is repositioned. Permissible values are from 1 to 31 frames.

4. *Film Steps Per Frame* – Specifies the distance between frames in the rows; the distance is measured between the optical centers of the frames and is given in increments of .020". Values may range from 1 to 63.

5. *Lens Steps Per Frame* – Specifies the distance between frames in the columns. The lens moves 0.0098 inch per step. There may be from 1 to 63 step-by-step increments.

6. *Lens Offset* – Defines the location of the first film image in a column relative to the edge of the film. The distance specified by this control will be the distance from the optical center of the image to the reference edge of the film. A thumb wheel gives increments from 1 to 511 increments of 0.01177 inch.

7. *Steps Between Fiche* – This control defines the longitudinal distance between the optical centers of the last column on one microfiche and the first column of the next microfiche. The distance is measured in increments of .020". From 1 to 63 increments are provided.

8. *Mark* – Selects either Sequential Retrieval Mark for 16mm or the cut mark required by an automatic microfiche cutter. The SRM is the only retrieval coding system available with the Universal Camera.

The DatagraphiX 4440 has a frame counter that counts individual pages and a second counter that counts the number of microfiche produced.

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### Programming Considerations (6-3)

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The record formatting described in section 3 remains unchanged for the Universal Camera. Additional action commands are listed below. These allow the programmer to take advantage of the unique features of the Universal Camera.

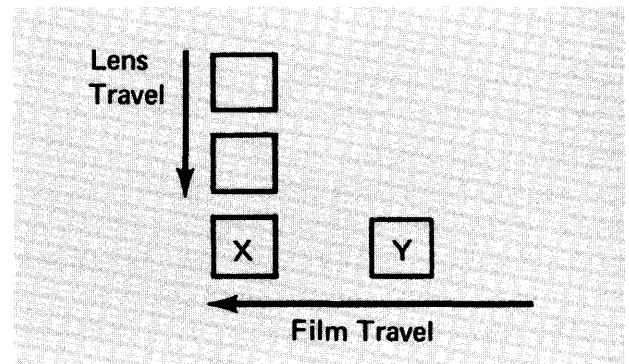
---

#### 6-4 AX or FX – Column Advance

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If the second control character is an X (e.g., "AX – PAD –," or "FX – PAD –") a film advance is caused, while the *lens movement is inhibited*. This instruction will normally be used when automatically titling microfiche and the title extends above the unused columns of a partially filled microfiche. *The programmer must know the relative frame position on the microfiche so he can direct the lens back to the title row by employing dummy frame-advance records*. The column-advance command will also cause an exit from the titling mode. AX and FX records must be followed by an IRG.

Example: If an AX command is given in the frame denoted "X", the beam will be positioned at the first print position of frame "Y".




---

#### 6-5 AW or FW – Fiche Advance

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To generate microfiche of uniform size regardless of the number of frames or pages on each, an AW or FW command following the final *print* record on the last page of an unfilled microfiche will cause the following:

# 6

1. Film will be advanced to the starting point of the next microfiche as defined by Frames/Row, Film Steps/Frame, and Steps Between Fiche.
2. Lens will be reset to the starting point as defined by Sequence Mode and Lens Offset.
3. Microfiche cut mark will be recorded on film.
4. Microfiche counter will be incremented.
5. Form will be flashed for last page of previous microfiche if specified by FW.
6. Exit from titling mode.

The AW or FW record must be followed by an IRG.

NOTE: The AW or FW record should follow the final *print* record on the last page of a *filled* microfiche to assure correct film position for the next fiche. This procedure will prevent the entire job being ruined if a particular fiche is not properly formatted.

---

## 6-6 X – Enter Titling Mode

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The Universal Camera enters the microfiche titling mode only if the action code X is in the first position of an *action* record. This is a dummy record, normally the first on a page, and need only be as long as required by the computer output software. Subsequent *print* records will be constructed in the format described previously; however, the X record serves as a trigger which instructs the DatagraphiX 4440 to convert all X characters in subsequent print records into the parity error symbol "■". These special symbols will be used to block the line-image-generated title characters, which are visible without the aid of special viewing equipment.

```

XXXXXXXXXX  XXXXXXXXXXXX
X           X           X
X           X           X
X           X           X
XXXXXXXXXX  X           X
X           X           X
X           X           X
X           X           X
X           X           X
X           X           X
X           X           X
XXXXXXXXXX  XXXXXXXXXXXX

```

Any character other than X in title records will print normally, but a title frame record will ordinarily contain only X – characters and blanks. A Frame Advance, Column Advance, or Fiche Advance command will cause an exit from the titling mode thereby requiring an X record to be the first record of a page whenever the titling capability is desired. An X record does not require a following IRG since no mechanical function will be performed.

---

## 6-7 Special 16mm Film Format

---

The Universal Camera, in its basic form, will record images in the "comic" mode at 42X reduction ratio in a special format on 16mm film (see Figure 5). The sequence in which frames are recorded is determined by the Sequence Mode switch. If magnetic tapes have been created which are compatible with the 16mm camera logic, no programming is necessary to produce 2 up 16mm film. In this special format, the Frames Per Column switch will be set at "01".

This format may be likened to a microfiche of infinite length, with two frames per column. The frames may be arranged in either zig-zag, slew-left, or slew-right. The Steps Between Fiche control will be set equal to the Film Steps Per Frame control. The frames of data are highly compacted when recorded in this fashion. The Stromberg DatagraphiX 1700 Micromation Inquiry Station displays either of the two frames at full screen size under operator control.

**Code Tables (7-1)**

Access to the printable characters shown in Tables 3 through 5 is obtained through one of three basic "code plugs." The code plug converts tape input codes into weighted analog voltages which are used to select given characters on the CHARACTRON® tube. A maximum of 64 characters may be addressed through the BCD or BCDIC code plug. Up to 68 characters may be addressed via the EBCDIC code plug. The "BUS/SCI" designation indicates the compatibility of the DatagraphiX 4440 character set with a standard or scientific print chain on an impact printer. Code plugs are interchangeable by the DatagraphiX 4440 operator.

To obtain the Octal Code Equivalent of BCD or BCDIC coded characters, convert the binary configuration of the tape format given in Tables 2 or 3.

*Example:*

The BCD graphic "—" (Horizontal Bar) is realized from an Octal input of 56. This number is obtained by combining the octal numbers realized by the binary conversion of the octal values.

Octal Value	421	421
Tape Format Binary	101	110
Octal	5	6

To obtain the Hexadecimal Equivalent of EBCDIC characters, convert the binary configuration of the tape format given in Table 4.

*Example:*

The EBCDIC graphic "—" (Horizontal Bar) is realized from a hexadecimal input of 6D. This number is obtained by combining the hexadecimal numbers realized by the binary conversion of the assigned hexadecimal values.

Hexadecimal Value	8421	8421
Tape Format	0110	1101
Hexadecimal	6	D

# 7

**Table 3. DatagraphiX 4440 Character Code, IBM 729 7-Track, Standard BCD (7 Bits, Even Parity)**

BCD Code BA8421	Line Printer Char. Set BUS/SCI	4440 Char. Set BUS/SCI	BCD Code BA8421	Line Printer Char. Set BUS/SCI	4440 Char. Set BUS/SCI
000000	No Code		100000	-	- Minus
000001	1	1	100001	J	J
000010	2	2	100010	K	K
000011	3	3	100011	L	L
000100	4	4	100100	M	M
000101	5	5	100101	N	N
000110	6	6	100110	O	O
000111	7	7	100111	P	P
001000	8	8	101000	Q	Q
001001	9	9	101001	R	R
001010	0	0	101010	!	!
001011	# =	# =	101011	\$	\$
001100	@ ' :	@ ' :	101100	*	*
001101	:	:	101101	-	
001110			101110	-	-
001111	✓	"Tape Mark <sup>(1)</sup>	101111	Δ	Mode Chng. <sup>(3)</sup>
010000	h	Blank	110000	& +	& +
010001	/	/	110001	A	A
010010	S	S	110010	B	B
010011	T	T	110011	C	C
010100	U	U	110100	D	D
010101	V	V	110101	E	E
010110	W	W	110110	F	F
010111	X	X	110111	G	G
011000	Y	Y	111000	H	H
011001	Z	Z	111001	I	I
011010	‡	Record Mark <sup>(2)</sup>	111010	?	?
011011	,	,	111011	.	.
011100	% (	% (	111100	□ )	□ )
011101	∨	Word Mark <sup>(3)</sup>	111101		
011110			111110		
011111	#	Segment Mark <sup>(3)</sup>	111111	‡	Group Mark <sup>(3)</sup>
			No Code		■ <sup>(4)</sup>

1. DENOTES END-OF-FILE OR " DEPENDING ON POSITION IN RECORD.
2. DENOTES RECORD MARK. NOT PRINTED.
3. SPECIAL TAPE RECORD SYMBOLS. NO SYMBOL IN THE CHARACTER SET AND THE SYMBOL SHOULD NOT APPEAR IN TAPES.
4. CHARACTER VOID SYMBOL. CONTROLLED INTERNALLY.

Table 4. DatagraphiX 4440 Code, IBM 2400 7-Track, System 360 BCDIC (7 Bits, Even Parity)

IBM 360 BCDIC Code BA842I	Line Printer Char. Set BUS/SCI	4440 Char. Set BUS/SCI	IBM 360 BCDIC Code BA842I	Line Printer Char. Set BUS/SCI	4440 Char. Set BUS/SCI
000000	No Code		100000	--	- Minus
000001	1	1	100001	J	J
000010	2	2	100010	K	K
000011	3	3	100011	L	L
000100	4	4	100100	M	M
000101	5	5	100101	N	N
000110	6	6	100110	O	O
000111	7	7	100111	P	P
001000	8	8	101000	Q	Q
001001	9	9	101001	R	R
001010	0	0	101010	!	!
001011	# =	# =	101011	\$	\$
001100	@'	@'	101100	*	*
001101	:	:	101101	]	]
001110	>	>	101110	;	;
001111	√	"Tape Mark(1)	101111	Δ	Mode Change(3)
010000	␣	Blank	110000	& +	& +
010001	/	/	110001	A	A
010010	S	S	110010	B	B
010011	T	T	110011	C	C
010100	U	U	110100	D	D
010101	V	V	110101	E	E
010110	W	W	110110	F	F
010111	X	X	110111	G	G
011000	Y	Y	111000	H	H
011001	Z	Z	111001	I	I
011010	‡	Record Mark(2)	111010	?	?
011011	,	,	111011	.	.
011100	% (	% (	111100	▣ )	▣ )
011101	∨	Word Mark(3)	111101	[	[
011110	\	\	111110	<	<
011111	#	Segment Mark(3)	111111	‡	Group Mark(3)
			No Code		■(4)

1. DENOTES END-OF-FILE, NOT PRINTED OR " DEPENDING ON POSITION IN RECORD.
2. DENOTES RECORD MARK, NOT PRINTED.
3. SPECIAL TAPE RECORD SYMBOLS, NO SYMBOL IN THE CHARACTER SET AND THE SYMBOL SHOULD NOT APPEAR IN TAPES FORMATTED FOR THE DATAGRAPHIX 4440.
4. CHARACTER VOID SYMBOL, CONTROLLED INTERNALLY.

# 7

**Table 5. DatagraphiX 4440 Character Code, IBM 2400 9-Track, Standard EBCDIC (9 Bits, Odd)**

IBM 360 EBCDIC Code 01234567	Line Printer Char. Set BUS/SCI	4440 Char. Set BUS/SCI	IBM 360 EBCDIC Code 01234567	Line Printer Char. Set BUS/SCI	4440 Char. Set BUS/SCI
01000000	Space	Blank	01100000	-	- Minus
11000001	A	A	11100000	+	Rec. Mk (2)
11000010	B	B	01100001	/	/
11000011	C	C	11100010	S	S
11000100	D	D	11100011	T	T
11000101	E	E	11100100	U	U
11000110	F	F	11100101	V	V
11000111	G	G	11100110	W	W
11001000	H	H	11100111	X	X
11001001	I	I	11101000	Y	Y
01001010	ç ]	ç ]	11101001	Z	Z
01001011	.	.	01101010		
01001100	<	<	01101011	,	,
01001101	(	(	01101100	%	%
01001110	+	+	01101101	-	-
01001111	! !	! !	01101110	>	>
01010000	&	&	01101111	?	?
11010001	J	J	11110000	0	0
11010010	K	K	11110001	1	1
11010011	L	L	11110010	2	2
11010100	M	M	11110011	3	3
11010101	N	N	11110100	4	4
11010110	O	O	11110101	5	5
11010111	P	P	11110110	6	6
11011000	Q	Q	11110111	7	7
11011001	R	R	11111000	8	8
01011010	! [	! [	11111001	9	9
01011011	\$	\$	01111010	:	:
01011100	*	*	01111011	#	#
01011101	)	)	01111100	@	@
01011110	;	;	01111101	'	'
01011111	∟^	∟^	01111110	=	=
			01111111	"	"
			00010011	TM	Tape Mark (1)
			No Code		■ (3)

1. DENOTES END-OF-FILE, NOT PRINTED.
2. DENOTES RECORD MARK, NOT PRINTED.
3. CHARACTER VOID SYMBOL. CONTROLLED INTERNALLY.

# *Datagraphix*

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