IBM / Technical Newsletter

Replacement pages for <u>Miscellaneous Input/Output Instructions, IBM 1440 Data Processing System</u>, Form A24-3117-0.

To bring your publication up to date, please replace the following pages with the corresponding pages attached to this Newsletter. Changes are identified by a vertical line at the left of the affected text and a dot (●) at the left of an affected figure.

   <u>Pages</u>

   21 and 22
   23 and 24
   31 and 32
   33 and 34
   35 and 36

File this Newsletter at the back of the manual. It will provide a reference to changes, a method of determining that all amendments have been received, and a check for determining if the bulletin contains the proper pages.

The last page of the Technical Newsletter is a Reader's Survey included for your comments regarding this manual (A24-3117-0).   We solicit your participation in this survey so that we can attain our goal of providing you with publications of the highest quality. If you wish to complete the survey later, it may be inserted in the manual following page 44.   When mailed in the United States, no postage is required.

IBM 1442 Card Read-Punch

This section describes the instructions the IBM 1440 Data Processing System uses to control the: IBM 1442 Card Read-Punch, and the IBM 1442, Model 4, Card Reader. The IBM 1442, Model 4, Card Reader operates under the control of the same read and stacker instructions as the IBM 1442 Card Read-Punch.

The data flow for the IBM 1442, Model 4, Card Reader is the same as the read operation on the IBM 1442 Card Read-Punch.

Data Flow

The card path and data flow for the IBM 1442 Card Read-Punch (Figure 31) is shown in Figure 32. The cards are placed in the 1,200-card capacity hopper face down, 9-edge first. The first card cycle moves the card from the hopper to the read station where it is registered at column zero. During the second card feed cycle, the card is fed to the reading station by a READ CARD instruction. This operation causes each card column to be read twice as the card moves by the reading station column-by-column.

During read cycle 1, the punched-card code for a column is translated to BCD code and stored in core-storage positions specified by the B-address of the READ CARD instruction. On read cycle 2, the punched-card code for the same column is read a second time. The resultant BCD-coded character from the second reading is compared to the BCD-coded character read
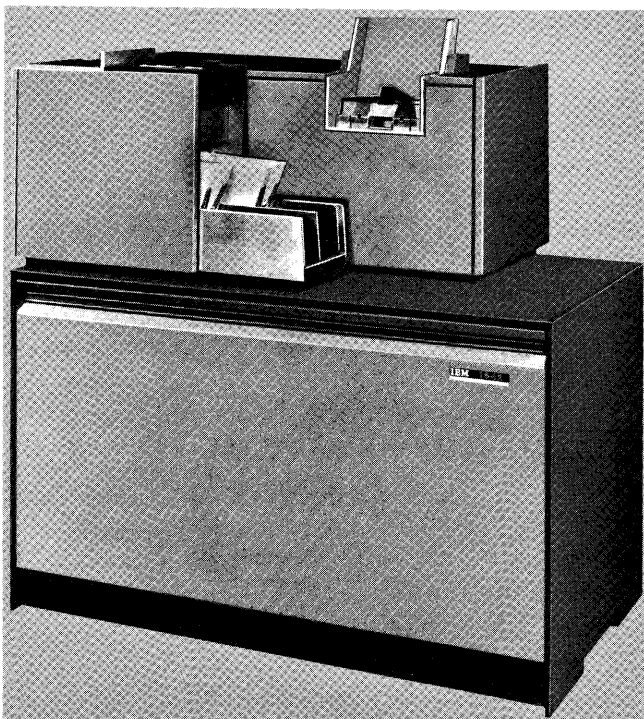

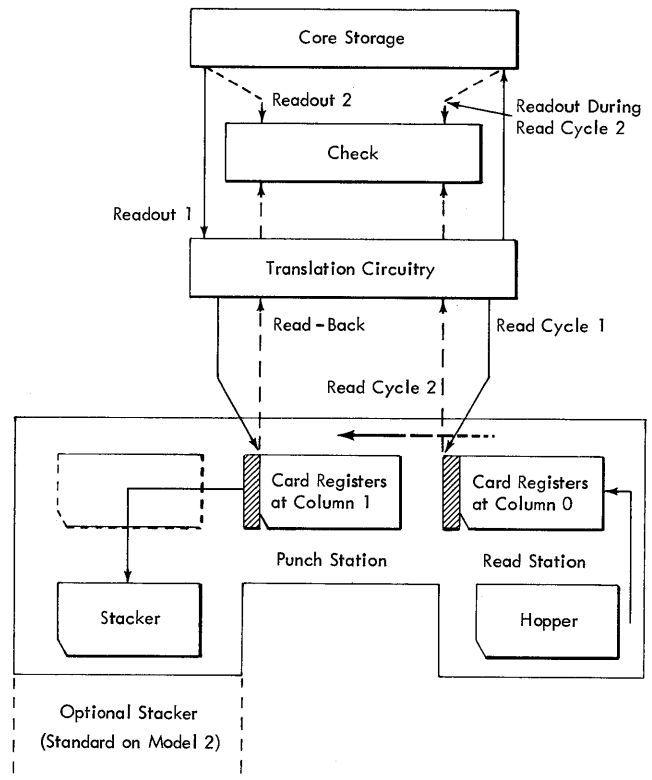Figure 31.   IBM 1442 Card Read-Punch

Figure 32.   IBM 1442 Card Read-Punch Data Flow

into storage from the first read cycle. If no error is detected, the process continues for each column until a group-mark with a word-mark is detected at the end of the B-field.

After the read operation is completed, the card is registered in column 1 at the punch station.

During the third card-feed cycle, which is started by a PUNCH AND FEED instruction, the BCD-coded characters to be punched are read from core storage, translated to punched-card code, and punched column-by-column into the card at the punch station.

A second core-storage readout cycle occurs that compares the BCD characters in storage to the BCD translation of the punched-card code punched in the card. If no error is detected, this operation continues for the length of the B-field in storage identified by a group-mark with a word-mark.

When the card leaves the punch station, it is carried to the stacker by a continuously-moving mechanism.

Card Read-Punch Instruction Format

All card read-punch operations are initiated by a card read-punch instruction. This instruction can initiate different card read-punch operations by using specific characters in certain locations of the actual instruction (Figure 33).
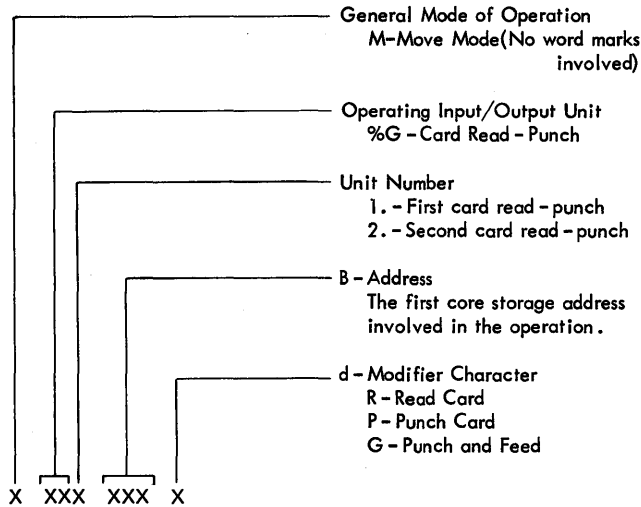
General Mode of Operation
M–Move Mode(No word marks involved)

Operating Input/Output Unit
%G – Card Read – Punch

Unit Number
1. – First card read – punch
2. – Second card read – punch

B – Address
The first core storage address involved in the operation.

d – Modifier Character
R – Read Card
P – Punch Card
G – Punch and Feed

X   XXX   XXX   X

Figure 33.   IBM 1442 Card Read-Punch Instruction Format

The various parts of the card read-punch instruction and their uses are:

General Mode of Operation

This part of the instruction identifies the operation as a move operation. Word marks will not be moved from the specified core-storage area during punching or reading operations.

Unit Number

This part of the instruction specifies which one of the operating units will be active when there is more than one card read-punch attached to the system.

B-Address

This part of the instruction specifies the first core-storage position that will be involved in the operation.

d-Modifier Character

This part of the instruction specifies the type of operation that will be performed in the card read-punch.

IBM 1442 Card Read-Punch Instructions

Read Card

Instruction Format.

Mnemonic	Op Code	A-address	B-address	d-character
R	M	%Gn	xxx	R

Function. This instruction is used to transfer data read at the card read-punch read station into a specified core-storage area.

The data punched in card column 1 is translated and stored in the core-storage position specified by the B-address. The rest of the data punched in the card is transferred, column-by-column, into the adjacent core-storage positions until a group-mark with a word-mark in core storage is sensed. The number of characters read from the card depends on the B-field length that is established in core storage. The B-field length can be from 1 to 80 positions, plus one position for the group-mark with a word-mark. (The system will *hang-up* in a read operation with the reader-ready light OFF, if the group-mark with a word-mark is missing.

An end-around check condition occurs when the data record length is longer than the number of core-storage positions from the B-address to the highest-numbered position in core storage. In a system of 4,000 storage positions, for example, if the input data is 75 characters long, and the B-address is 3980, the first 20 input data characters are read into positions 3980 through 3999, and the remaining 55 characters are read into positions 000 through 054. The storage light on the 1447 console is turned ON to indicate this check condition.

As the card at the read station is read, any card at the punch station is also being moved at the same speed, and is ejected into the number 1 stacker at the end of the read operation.

Word Marks. Word marks are not affected. A group-mark with a word-mark is needed to end the operation.

Timing.

$$\text{Model 1: } T = .0111\,(L_I + 1) + 10 + [15 + 1\,(L_B + 1)] \text{ ms.}$$
$$\text{Model 2: } T = .0111\,(L_I + 1) + [15 + (L_B + 1)] \text{ ms.}$$

Address Registers After Operation.

I-Add. Reg.	A-Add. Reg.	B-Add. Reg.
NSI	BBB	$B + L_B + 1$

Example. Transfer the data read from card read-punch 1 to the area in core storage labeled RDLIN (0303), Figure 34.

Autocoder

Label	Operation	OPERAND
	R	1,,RDLIN

Assembled Instruction: M %G1 303 R

● Figure 34.   Read Card

Punch and Stop

Instruction Format.

Mnemonic	Op Code	A-address	B-address	d-character
PS	M	%Gn	xxx	P

Function. This instruction is used to transfer data from core storage to the card read-punch where it is punched in a card.

The data in the core-storage position specified by the B-address is transferred and punched in the card column registered beneath the punching mechanism. The rest of the data located in the adjacent core-storage positions is transferred, column-by-column, and punched in the adjacent card columns until a group-mark with a word-mark in core storage is sensed. The number of characters punched in the card depends on the B-field length that is established in core storage. The B-field length can be from 1 to 80 positions, plus one position for the group-mark with a word-mark. (Characters in excess of 80 will all punch in column 81 and be lost.) When the punching operation ends, the card movement also ends. No other card movement takes place during a punch and stop operation.

Word Marks. Word marks are not affected. A group-mark with a word-mark is needed to end the operation.

Timing.

Model 1: $T = .0111 (L_I + 1) + 6.25 + 12.5 (L_B)$ ms.

Model 2: $T = .0111 (L_I + 1) + 3.13 + 6.25 (L_B)$ ms.

Note. When a punch and stop operation follows either a read card or a punch and feed operation, the card at the punch station is registered in column 1, and punching begins in column 1. When a punch and stop operation follows another punch and stop operation, the card at the punch station is the card that was punched during a previous operation, and punching begins in the column adjacent to the last column previously punched.

Address Registers After Operation.

I-Add. Reg.	A-Add. Reg.	B-Add. Reg.
NSI	BBB	$B + L_B + 1$

Example. Punch the data on card read-punch 1, beginning in the area labeled PCHOUT (0303) and ending with a group-mark with a word-mark (Figure 35).

Autocoder

Label	Operation					OPERAND	
	PS	1,PCHOUT					

Assembled Instruction: M %G] 303 P

● Figure 35. Punch and Stop

Punch and Feed

Instruction Format.

Mnemonic	Op Code	A-Address	B-address	d-character
P	M	%Gn	xxx	G

Function. This instruction is used to transfer data from core storage to the card read-punch where it is punched in a card. When the punching operation ends, the card is ejected from the punch station and selected into a stacker.

The data stored in the core-storage position specified by the B-address is transferred and punched in the card column registered beneath the punching mechanism. The rest of the data located in the adjacent core-storage positions is transferred, column-by-column, and punched in the adjacent card columns until a group-mark with a word-mark in core storage is sensed. The number of characters punched in the card depends on the B-field length that is established in core storage. The B-field length can be from 1 to 80 positions, plus one position for the group-mark with a word-mark. (Characters in excess of 80 will all punch in column 81 and be lost.) When the punching operation ends, the card is ejected from the punch station and selected into a stacker.

The card located at the read station advances during this operation also, but the data in the card *is not* transferred into core storage. A card from the hopper is also advanced and registered at the read station during the punch and feed operation.

Word Marks. Word marks are not affected. A group-mark with a word-mark is needed to end the operation.

Timing.

Model 1: $T = .0111 (L_I + 1) + 6.25 + 12.5 (L_B) + 210^*$ ms.

Model 2: $T = .0111 (L_I + 1) + 3.13 + 6.25 (L_B) + 160$ ms.

*When a punch and feed instruction is initiated, a period of 210 ms will elapse before another card read-punch operation can be executed.

Note. When a punch and feed operation follows either a read card or a punch and feed operation, the card at the punch station is registered in column 1, and punching begins in column 1. When a punch and feed operation follows a punch and stop operation, the card at the punch station is the card that was punched during a previous operation, and punching begins in the column adjacent to the last column previously punched. The card is punched and stacked.

Address Registers After Operation.

I-Add. Reg.	A-Add. Reg.	B-Add. Reg.
NSI	BBB	$B + L_B + 1$

Example. Punch the data on card read-punch 1, be-
ginning in the area labeled PCHOUT (0303) and
ending with a group-mark with a word-mark, and
then eject the card (Figure 36).

Autocoder

Label	Operation						OPERAND	
	P	1,PCHOUT						

Assembled Instruction: <u>M</u> %G1 303 G

● Figure 36. Punch and Feed

Select Stacker

This feature provides a second stacker (special fea-
ture) for the IBM 1442, Model 1, so that cards can be
selected under program control for special applications.
The IBM 1442, Models 2 and 4, have two stackers as
standard equipment.

Instruction Format.

Mnemonic	Op Code	d-character
SS	<u>K</u>	2 or 0*

Function. This instruction causes the card at the punch
station to fall into stacker 2. Unless stacker 2 has
been selected before the operation that ejects the
card (read or punch feed), the ejected card is di-
rected to stacker 1.

*Note: The d-character for the first card read-punch or card
reader installed on the system is designated by 2, and the
second card read-punch or card reader installed on the sys-
tem is designated by 0.

Word Marks. Word marks are not affected.

Timing. $T = .0111 (L_I + 1)$ ms.

Address Registers After Operation.

I-Add. Reg.	A-Add. Reg.	B-Add. Reg.
NSI	2bb	2bb

Example. Enters selected card into pocket 2 (Figure
37).

Autocoder

Label	Operation						OPERAND	
	SS	2						

Assembled Instruction: <u>K</u> 2

Figure 37. Select Stacker

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Card Read-Punch Timing

Model 1 Card Reading

Card reading on the IBM 1442, Model 1, can be done
at either 285 or 300 cards per minute (CPM).

285 Cards per Minute

The 285-CPM cycle occurs when the next CARD READ
instruction is given during the last 20 ms of a card-read
cycle (Figure 38). The clutch is allowed to latch up
and the 10-ms clutch-pickup time must take place at
the beginning of the next card-read cycle.

The time the system is interlocked during a read
operation, when the clutch latches up after each opera-
tion, is shown in Figures 38 and 39. This timing for-
mula can be consolidated as shown in Figure 39. By
using the consolidated formula, the total time avail-
able for other processing during one card-read cycle
can be found by subtracting the consolidated formula
from 210. The bottom portion of Figure 39 shows the
approximate processing times available by the number
of card columns being read.

300 Cards per Minute

The 300-CPM cycle occurs when the next CARD READ
instruction is given before the last 20 ms of a card-read
cycle (Figure 40). The clutch remains engaged, and
does not latch up. The clutch-pickup time of 10 ms is
not needed, and the card-cycle time is reduced to 200
ms, which is equivalent to 300 CPM.

The time the system is interlocked during a card-
read operation, when the clutch does not latch up after
each operation, is shown in Figures 40 and 41. This
timing formula can be consolidated as shown in Figure
41. By using the consolidated formula, the total time
available for other processing during one card-read
cycle can be found by subtracting the consolidated
formula from 200. The bottom portion of Figure 41
shows the approximate processing time available by
the number of card columns being read.

Less than 285 Cards per Minute

If the card-reading time and the necessary processing
time between card-read cycles exceeds 210 ms, there is
a corresponding drop in the number of cards read per
minute. The formula to compute the number of cards
read per minute is shown in Figure 42. The table in
Figure 42 shows the approximate number of cards read
per minute when the elapsed time between a given
card column in a card-read operation is at least, or
more than, 210 ms later than the same card column in
the preceding card-read operation.

The punch operation takes only 503 ms. Because the first 40 columns are being punched, the B-field in core storage must be only 40 positions in length. This brings the total time for the entire operation to 713 ms.

As can be seen from these examples, the important consideration is not how many columns are punched, but where the punched columns are in the card. Punching 5 columns in the first 5 columns of the card instead of columns 26-30, for example, results in a faster CPM rate (Figure 57). A CPM rate of 215 results on an IBM 1442, Model 2, when the first 5 columns are punched; a CPM of 102 when columns 26-30 are punched.

IBM 1444 Card Punch

The IBM 1444 Card Punch (Figure 58) provides a high-speed card output to the IBM 1440 Data Processing System. This section describes the instructions used with the 1440 system to control the card punch.

IBM 1444 Card Punch Instructions

Punch Card

Instruction Format.

Mnemonic	Op Code	A-address	B-address	d-character
P	M	%G3	X01	G

Function. This instruction is used to transfer data from core storage into the card punch where it is punched in a card. The data transfer from core storage to the punch ends when a group-mark with a word-mark is sensed.

Word Marks. Word marks associated with the data being transferred are neither considered nor affected. The data transfer ends when the group-mark with a word-mark located in core-storage position B01 + L_B (length of B-field) is sensed.

Timing. T = .0111 (L_I + 1) + I/O ms. I/O equals 240 ms plus punch-access time of 0-60 ms. The processing-unit interlock is released after 217.5 ms of the 240-ms punch cycle.

Address Register After Operation.

I-Add. Reg.	A-Add. Reg.	B-Add. Reg.
NSI	BBB	.B + L_B + 1

Example. Punch the data on card punch, beginning in the area labeled PCHOUT (401) and ending with a group-mark with a word-mark (Figure 59).
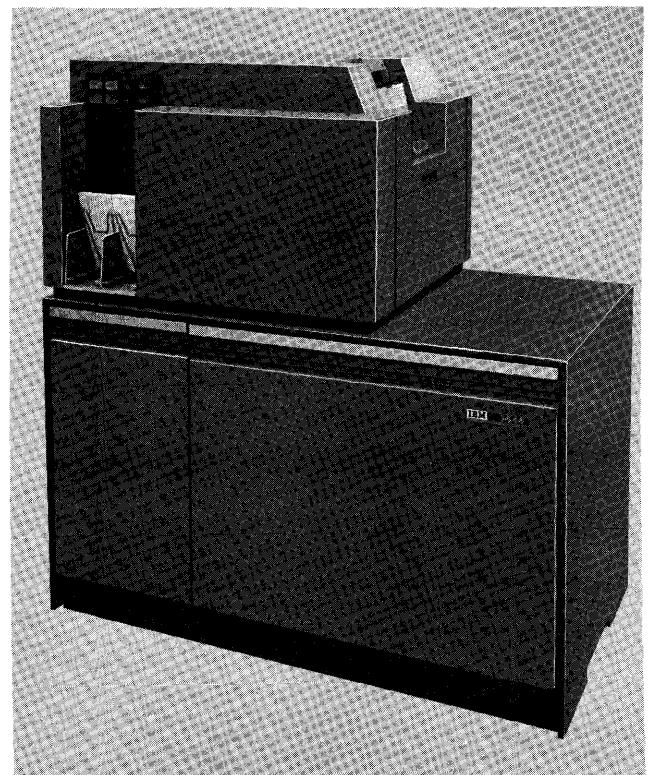
Figure 58. IBM 1444 Card Punch

Autocoder

Label	Operation						OPERAND	
	P	3,PCHOUT						

Assembled Instruction: M %G 3 401 G

● Figure 59. Punch Card

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Select Card in Stacker 2

Instruction Format.

Mnemonic	Op Code	d-character
SS	K	#

Function. This instruction causes the card that was just punched to be selected into stacker 2 after the next punch operation takes place. (The card just punched must be checked at the punch read station before it can be stacked.) If a punch-check condition occurs during the next punch operation, the card is automatically directed to stacker 1.

NOTE: This instruction must be issued prior to the PUNCH AND GO or READ CARD instruction that moves the card on through the feed.
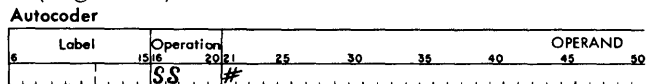
Word Marks. Word marks are netiher considered nor affected.

Timing. $T = .0111 (L_I + 1)$ ms.

Address Registers After Operation.

I-Add. Reg.	A-Add. Reg.	B-Add. Reg.
NSI	dbb	dbb

Example. Place the card, just punched, in stacker 2 (Figure 60).

Autocoder

Label	Operation						OPERAND	
6	15 16	20 21	25	30	35	40	45	50
	SS	#						

Assembled Instruction: K #

Figure 60. Select Card in Stacker 2

IBM 1444 Card Punch Timing

The card punch operates at a rated speed of 250 cycles per minute (240 ms per cycle). Actual card punching, at an optimum rate of 250 cards per minute, is controlled by punch instructions in the program.

There are four points in the cycle (occurring at 60-millisecond intervals) when the punch feeding mechanism can receive an impulse to start the punch cycle.

The punch cycle is divided into three separate functions (Figure 61).

1. Punch-start time is 37 ms. After the feed mechanism has been impulsed, the time required for the card to feed and be positioned for punching is called *punch-start time.* The IBM processing unit is interlocked during punch-start time.

2. Card punching time is 181 ms. Actual card punching takes place during this part of the cycle. The processing unit is always interlocked during *card-punching time.*

3. Processing time is 22 ms. This is the remainder of the punch cycle allotted for *processing* in the system.

The next PUNCH CARD instruction must be given during this 22-ms period, or the punch operation will end, and at least 60 ms will elapse before the punch can start again.

Figure 62 shows card-punching speeds and the processing time available with each.

Cards Punched Per Minute	Length of Cycle (ms)	Processing Time (ms)
250	240	22
200	300	82
166	360	142
143	420	202
125	480	262

Figure 62. Card Punching Speeds

CARD PUNCHING

250 CARDS PER MINUTE (Assume that the punch card instruction was given during the previous cycle)

240 ms

37 ms
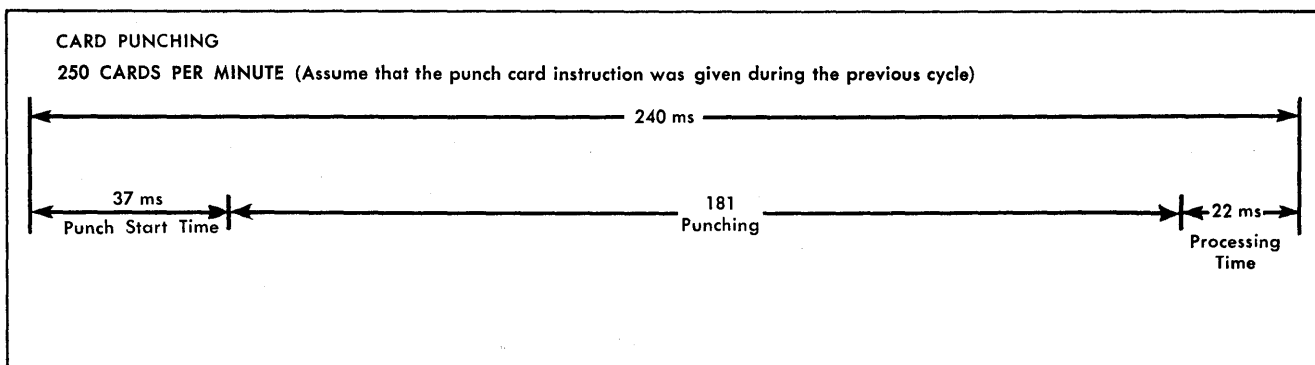Punch Start Time

181
Punching

22 ms
Processing Time

Figure 61. Punch Cycle

IBM 1443 Printer

The IBM 1443 Printer (Figure 63) is another output medium for the 1440 system. The number of lines that can be printed per minute depends on the 1443 model and the character set being used. Refer to IBM *1443 Printer* (Form A24-3120) for details.

Printer Instruction Format

All printer operations are initiated by either one of two types of printer instructions. If the instruction is two characters long, an operation involving the printer carriage is specified. If the instruction is eight characters long, an operation involving a write operation is specified. The various parts of the printer instruction (Figure 64) are:

General Mode of Operation

This part of the instruction identifies the operation as either a write operation or a carriage operation. The write operation is performed in the move mode, and any word marks in the specified core-storage area are not moved during the operation.
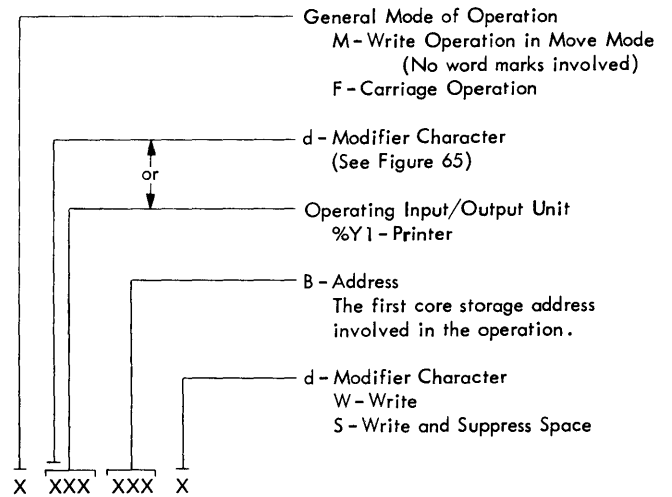
General Mode of Operation
M - Write Operation in Move Mode
(No word marks involved)
F - Carriage Operation

d - Modifier Character
(See Figure 65)

Operating Input/Output Unit
%Y1 - Printer

B - Address
The first core storage address
involved in the operation.

d - Modifier Character
W - Write
S - Write and Suppress Space

X   XXX   XXX   X

Figure 64. IBM 1443 Printer Instruction Format

d-Modifier Character

If the instruction is two characters long, the second character is the d-modifier character. This character specifies the type of carriage operation that will occur. Refer to Figure 65 for a list of the d-characters and the carriage operations they initiate.
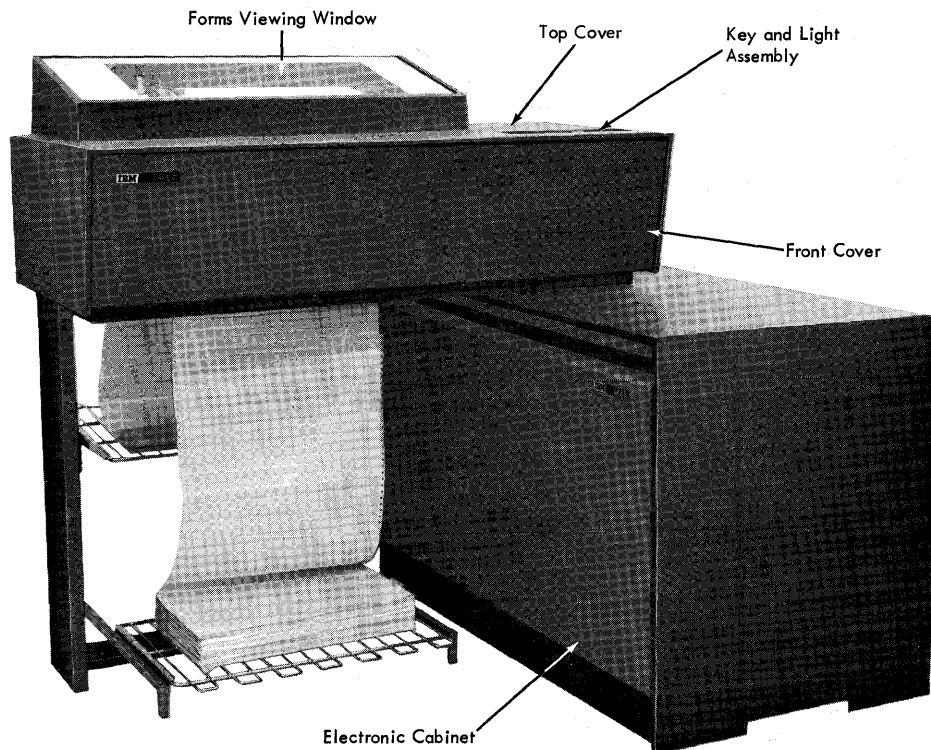
Figure 63. IBM 1443 Printer

d	Immediate skip to	d	Skip after print to
1	Channel 1	A	Channel 1
2	Channel 2	B	Channel 2
3	Channel 3	C	Channel 3
4	Channel 4	D	Channel 4
5	Channel 5	E	Channel 5
6	Channel 6	F	Channel 6
7	Channel 7	G	Channel 7
8	Channel 8	H	Channel 8
9	Channel 9	I	Channel 9
0	Channel 10	?	Channel 10
#	Channel 11	•	Channel 11
@	Channel 12	□	Channel 12

d	Immediate space	d	After print-space
J	1 space	/	1 space
K	2 spaces	S	2 spaces
L	3 spaces	T	3 spaces

Figure 65.   Control Carriage d-Characters

Operating Input/Output Unit

This part of the instruction specifies the printer as the active unit for this operation.

B-Address

This part of the instruction specifies the first core-storage position that will be involved in the operation.

d-Modifier Character

This part of the instruction specifies the type of write operation that will be performed in the printer, when the d-character modifies a write operation code.

IBM 1443 Printer Instructions

Write Line

Instruction Format.

Mnemonic	Op Code	A-address	B-address	d-character
W	M	%Y1	B01	W

Function. This instruction is used to transfer data from core storage to the 1443 printer, where it will be printed.

The high-order position of data in the core-storage position specified by the B-address is transferred and printed in print-position 1. The rest of the data located in the adjacent core-storage positions is transferred, column-by-column, and printed in the adjacent print positions until a group-mark with a word-mark in core storage is sensed.

The B-address must always specify one of the zero one (01) positions in core storage. The number of characters printed depends on the B-field length established in core storage. The B-field length can be from 1 to either 120 or 144 positions (24 additional print positions are available as a special feature), plus one position for the group-mark with a word-mark. An automatic single space operation occurs after the actual printing ends unless a different carriage operation is programmed.

Word Marks. Word marks are not affected. A group-mark with a word-mark is required to end the operation.

Timing. T = .0111 [(L$_I$ + 1) + 384*] ms.
   *120 print positions

Note. An address-validity-check condition occurs if the B-address specifies the 01 position of the last 100-position block in core storage as well as any starting position other than 01 (unbuffered printer). The system interlocks with the printer light ON.

Address Registers After Operation.

I-Add. Reg.	A-Add. Reg.	B-Add. Reg.
NSI	%81	B + L$_B$ + 1

Example. Print the data beginning in the area labeled PRTOUT (0101) and ending with a group-mark with a word-mark (Figure 66).

Autocoder

Label	Operation						OPERAND
	W	PRTOUT					

Assembled Instruction: M %Y1 101 W

● Figure 66.   Write Line

Write Line and Suppress Space

Instruction Format.

Mnemonic	Op Code	A-address	B-address	d-character
WS	M	%Y1	B01	S

Function. This instruction is used to transfer data from core storage to the 1443 where it will be printed. The automatic single space, normally taken after printing, is suppressed.

Data in the core-storage position specified by the B-address is transferred and printed in print-position 1. The B-address must always specify one of the zero-one (01) positions in core storage when using

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an unbuffered printer. The rest of the data located in the adjacent core-storage positions is transferred, column by column, and printed in the adjacent print positions until a group-mark with a word-mark in core storage is sensed. The number of characters printed depends on the B-field established in core storage. The B-field lengths can be from 1 to either 120 or 144 positions (24 additional print positions are available as a special feature), plus one position for the group-mark with a word-mark.

Word Marks. Word marks are not affected. A group-mark with a word-mark is needed to end the operation.

Timing. $T = .0111 [(L_I + 1) + 384^*]$ ms.
*120 print positions

Note. An address-validity-check condition occurs if the B-address specifies the 01 position of the last 100-position block in core storage as well as any starting position other than 01 (unbuffered printer). The system interlocks with the printer light ON.

Address Registers After Operation.

I-Add. Reg.	A-Add. Reg.	B-Add. Reg.
NSI	%81	$B + L_B + 1$

Example. Print the data beginning in the area labeled PRTOUT (0101) and ending with a group-mark with a word-mark, and suppress the automatic single space (Figure 67).

Autocoder

Label	Operation		OPERAND
6	15 16 20	21 25 30 35 40	45 50
	WS	PRTOUT	

Assembled Instruction: M %Y1 101 S

● Figure 67. Write Line and Suppress Space

Control Carriage

Instruction Format.

Mnemonic	Op Code	d-character
CC	F	d

Function. This instruction causes the carriage to move as specified by the d-character. If the d-character is:

1. a digit, an immediate skip to the specified channel in the carriage tape occurs.

2. an alphabetic character containing a 12-zone, a skip to the specified channel in the carriage tape occurs after the next line is printed.

3. an alphabetic character containing an 11-zone, an immediate space operation, as specified by the digit portion of the character, occurs.

4. an alphabetic character containing a zero-zone, a space operation, as specified by the digit portion of the character, occurs after the next line is printed.

Refer to Figure 65 for a list of the d-characters and the carriage operations they specify. If the carriage is already in motion when another CONTROL CARRIAGE instruction is given, the stored program execution is suspended until the carriage operation being performed is completed. At that time, the carriage action specified by the instruction begins, and the program advances to the next instruction.

Word Marks. Word marks are not affected.

Timing. $T = .0111 (L_I + 1)$ ms + remaining form-movement time, if carriage is already in motion when this instruction is given. The total form movement time depends on the specific carriage operation being performed. Refer to the IBM *1443 Printer Timing* section for more detail.

Address Registers After Operation.

I-Add. Reg.	A-Add. Reg.	B-Add. Reg.
NSI	dbb	dbb

Example. Skip to channel 1 after print operation (Figure 68).

Autocoder

Label	Operation		OPERAND
6	15 16 20	21 25 30 35 40	45 50
	CC	A	

Assembled Instruction: F A

Figure 68. Control Carriage

IBM 1443 Printer Timing

Model 1 Printing Speed

Model 1 of the IBM 1443 Printer operates at a maximum rated speed of 150 lines per minute when the 52-character typebar is installed.

The print cycle is 400 ms long (Figure 69). A total of 368 ms is needed during the 400-ms print cycle to transfer the data from core storage and print it. The form movement takes place during the last 32 ms of the print cycle. Up to two lines of form movement can take place during this time if the delayed forms op is programmed prior to the WRITE instruction. Additional lines (beyond 2) extend the print-cycle time by 10 ms per line. To establish the new line-per-minute rate, divide 60,000 by the print-cycle time (400 ms) to have a 150-ms time for one print line. For information on the additional form-movement timing, refer to the *Carriage Speed* section.
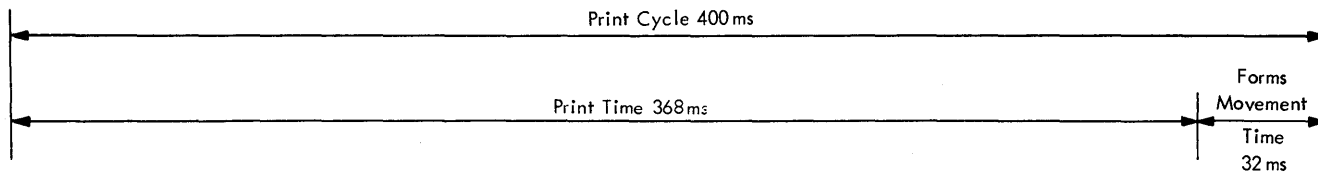
Figure 69. IBM 1443, Model 1, Print Cycle, 52-Character Typebar

No other processing can take place during the data-transfer and print time. The entire form-movement time is available to perform other systems operations.

Model 2 Printing Speed

Model 2 of the IBM 1443 Printer operates at a maximum rated speed of 240 lines per minute when the 52-character typebar is installed. The duration of the print cycle is 250 ms (Figure 70). A total of 218 ms is needed during the 250-ms print cycle to transfer the data from core storage and print it.

Up to two lines of form movement can take place during the normal print cycle. Additional lines extend the print-cycle time by 10 ms per line. For information on the additional form-movement timing, refer to the *Carriage Speed* section.

No other processing can take place during the data-transfer and print time. The entire form-movement time (32 ms) is available to perform other systems operations.

Carriage Speed

Normal Form-Movement Operation

Form movement is normally accomplished during the last 32 ms of a print cycle. It is possible to space two lines during the normal print cycle, if a DELAYED CONTROL CARRIAGE instruction is programmed before the WRITE instruction. Each additional line requires another 10 ms. This speed is equivalent to approximately 15 inches per second.

Immediate Form-Movement Operation

Figure 71 shows various timings that result when an immediate form-movement operation is specified by the CONTROL CARRIAGE instruction. If the carriage is already in motion when the instruction is given, the stored program execution is suspended until the carriage operation being performed is completed. At that time, the immediate form-movement operation, specified by the instruction, begins. The time required for spacing the first line is 60 ms, and each additional line requires another 10 ms.
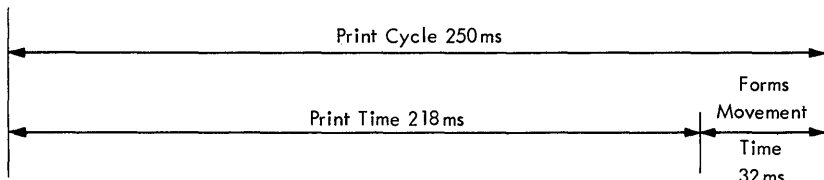

Figure 70. IBM 1443, Model 2, Print Cycle, 52-Character Typebar

MODEL 1		MODEL 2		Available Process Time (ms)	No. of Lines Spaced/ Skipped	Total No. of Lines Spaced/ Skipped
LPM	Cycle Length (ms)	LPM	Cycle Length (ms)			
133	450	200	300	74	1	2
130	460	196	310	84	2	3
127	470	188	320	94	3	4
125	480	182	330	104	4	5
122	490	176	340	114	5	6

Figure 71. Immediate Forms Space/Skip Operation Timings

Miscellaneous I/O Instructions: IBM 1440 Data Processing System (Form A24-3117-0)

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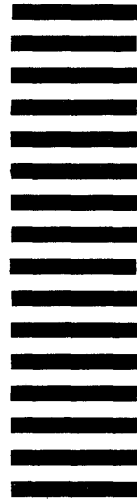Fold   Fold

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