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Form A24-3068-1

IBM Systems Reference Library

Miscellaneous Input/Output Instructions
IBM 1401 Data Processing System
IBM 1460 Data Processing System

This publication contains a description of the instructions used by the IBM 1401 or 1460 to operate these miscellaneous input/output units:

- IBM 1009 Data Transmission Unit
- IBM 1404 Printer
- IBM 1407 Console Inquiry Station
- IBM 1418 Optical Character Reader
- IBM 1428 Alphameric Optical Reader
- IBM 1412 Magnetic Character Reader
- IBM 1419 Magnetic Character Reader
- IBM 1448 Transmission Control Unit
- IBM 1026 Transmission Control Unit
- IBM 1231 Optical Mark Page Reader
- IBM 1285 Optical Reader
- IBM 1445 Printer
- IBM 7740 Communication Control System
- IBM 7770 Audio Response Unit, Model 1

Timing information is included for each unit attached to an IBM 1401 or 1460 Data Processing System.

Preface

This publication is a portion of the reference text for the IBM 1401 and 1460 Data Processing Systems. The full set of manuals provides a detailed explanation of all the instructions used by the system to manipulate data. Detailed explanations of the instructions used with the required and available input/output units attached to the system are also included. The reader should be familiar with the *IBM 1401 System Summary,* Form A24-1401, or the *IBM 1460 System Summary,* Form A24-1496, and the various publications on programming material, such as Symbolic Programming System (SPS) and Autocoder.

The complete manual is divided functionally into these sections:

System Operation Reference Manual (A24-3067)

- Section A Introduction
- Section B System Operations
- Section C IBM 1406 Operations
- Section D IBM 1447 Operations
- Section E IBM 1402 and 1403 Operations
- Section J Index of Instructions
- Section K Consolidated Index

Tape Input/Output Instructions (A24-3069)

- Section F Tape Input/Output Operations

Disk Input/Output Instructions (A24-3070)

- Section G Disk Input/Output Operations

Miscellaneous Input/Output Instructions (A24-3068)

- Section H Miscellaneous Input/Output Operations

Special Feature Instructions (A24-3071)

- Section I Special Feature Operations

The sections are independent and do not have to be used in the order in which they appear. A System Reference Library can be compiled using those sections applicable to the user's machine configuration.

This publication is intended for programmers and systems personnel who have a general knowledge of the IBM 1401 or 1460 Data Processing Systems and who require a reference text for detailed information.

Other publications referenced here are, in most cases, prerequisites for a complete understanding of the material presented in this publication.

Major Revision, November 1964

This publication, Form A24-3068-1, is a major revision of A24-3068-0, however it does not obsolete the previous publication, nor Technical Newsletter N24-0195 which it includes. The added material covers the new input/output units:

- IBM 1026 Transmission Control Unit
- IBM 1231 Optical Mark Page Reader
- IBM 1285 Optical Reader
- IBM 1445 Printer
- IBM 7740 Communication Control System
- IBM 7770 Audio Response Unit, Model 1

Refer to the *IBM 1401 and 1460 Bibliography,* A24-1495, for other publications.

Copies of this and other IBM publications can be obtained through IBM Branch Offices.

Address comments concerning the content of this publication to IBM Product Publications, Endicott, New York 13764.

Contents

IBM 1009 Data Transmission Unit

The IBM 1009 (Figure H-1) permits high-speed 2-way communication between two IBM 1401 or 1460 Data Processing Systems:

- A 1401 and a 1460 Data Processing System
- A 1401 or 1460 and an IBM 7701 Magnetic Tape Transmission Terminal
- A 1401 or 1460 and an IBM 7702 Magnetic Tape Transmission Terminal
- A 1401 or 1460 and an IBM 1013 Card Transmission Terminal

With this unit, a 1401 or 1460 system can transmit at speeds up to 300 characters per second over toll or leased communications-company lines. This information can be sent short distances between local plants, or long distances across country — all under stored-program control.

IBM 1401 or 1460 Programming Logic

When a terminal is made up of a 1009 and a 1401 or 1460 system, transmitting and receiving follow set patterns. Block diagrams of the logic are provided as programming aids.

Transmit Subroutine

Before the transmitting 1401 or 1460 program moves the first message from the cards or tape and assembles it in the read-out area, it first tests to see that the receiving 1009 is ready to accept data. This is done by testing indicators 3 and/or 4 (Figure H-2). Indicator 4 is tested in case the last message of the previous transmission was received in error. Then, a U %D1 E instruction starts the transmission of the message. One character is transmitted at a time to the receiving 1401 or 1460, through the two IBM 1009 Data Transmission Units connected to the 1401 or 1460 systems. Before the transmitting 1009 sends a character, it checks for a group-mark with a word-mark that signals the end-of-message. If there are more characters in the message, the 1401 or 1460 program increases the B-address of the move or load instruction that stores the character in the 1009, and repeats the transmitting process. When the transmitting 1401 or 1460 encounters an end-of-message signal, it must wait for 250 ms while the receiving 1401 or 1460 sends back a good-transmission or transmission-error signal. The transmitting 1401 or 1460 can use these 250 ms for any processing that does not call upon the 1009.

The next part of the subroutine includes two tests for the status of the message. See *Branch if Indicator On* instruction for an explanation of this test loop.

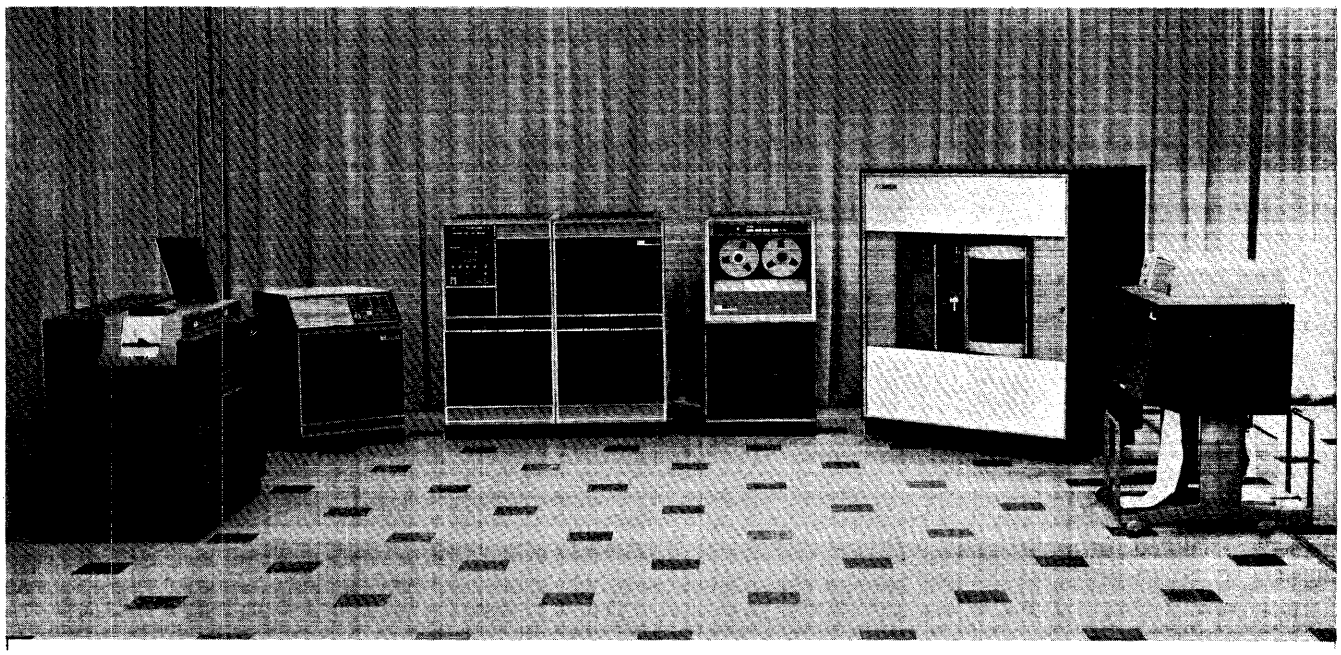
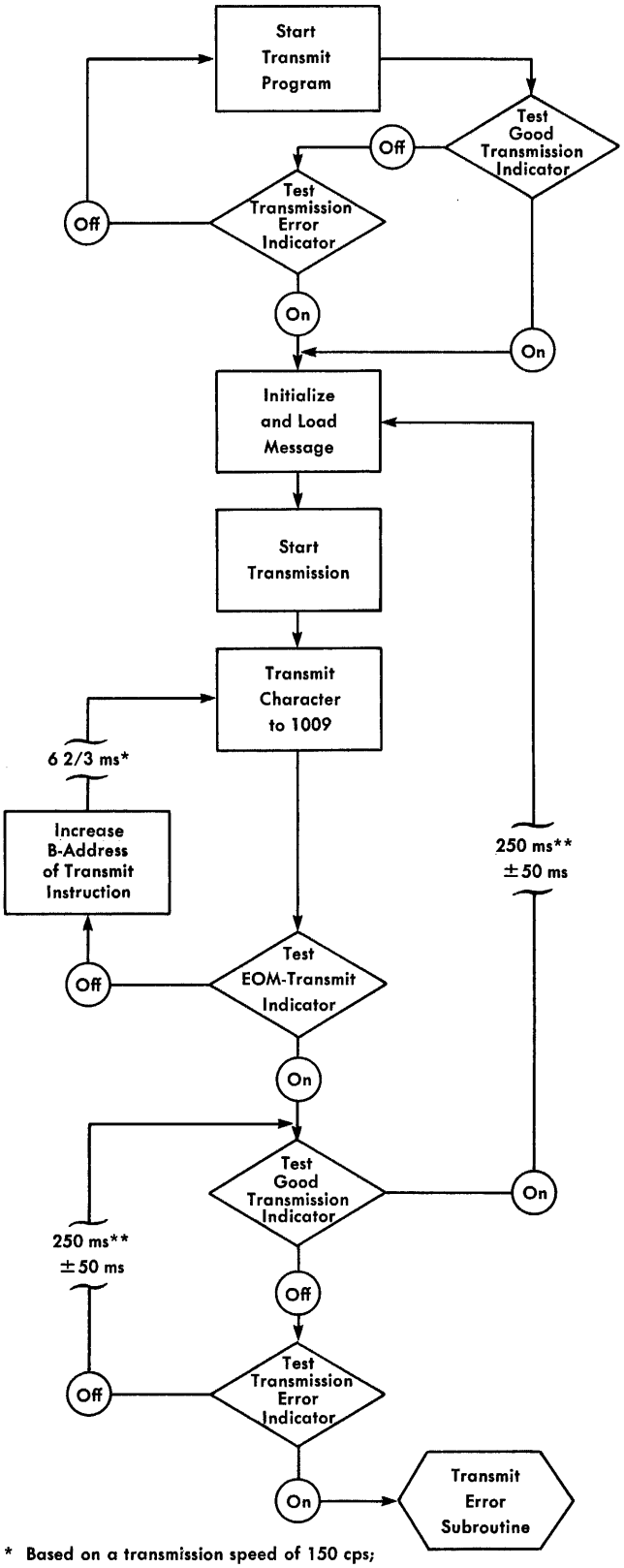


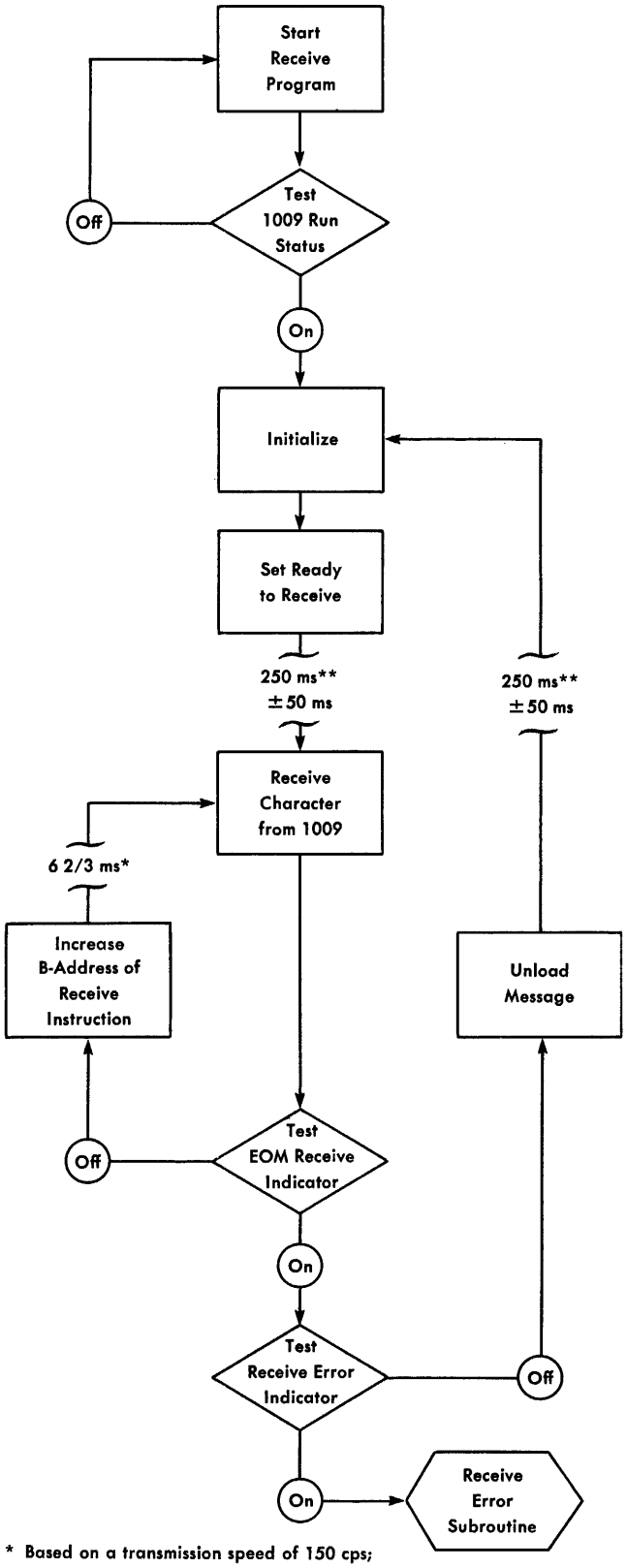
Figure H-1. The IBM 1401 or 1460 with 1009 Terminal



* Based on a transmission speed of 150 cps; 13⅓ ms if 75 cps; 4 ms if 250 cps.

**Turn-around time using half-duplex facilities. A full-duplex line requires no turn-around time.

Figure H-2. Block Diagram – Transmit Subroutine (1401)



* Based on a transmission speed of 150 cps; 13⅓ ms if 75 cps; 4 ms if 250 cps.

**Turn-around time using half-duplex facilities. A full-duplex line requires no turn-around time.

Figure H-3. Block Diagram – Receive Subroutine

When a good-message condition is recognized, the program branches to initialize and load a new message.

Receive Subroutine

The receiving 1401 or 1460 program first tests to see that the 1009 is in a RUN condition (Figure H-3). Then it prepares the read-in area, and sets up conditions for ready-to-receive. This includes acknowledging the previous message, if any. Depending on the type of communications-company data set used, anywhere from 200 to 300 ms elapse before the first character is received. This allows for turn-around-time when half-duplex facilities are used. If the communications-company transmission facilities are full-duplex (4-wire), there is virtually no turn-around-time. After it receives each character, the 1009 checks for an end-of-message (EOM) signal. The receiving 1401 tests the indicator, and, if the indicator is off, increases the B-address by one, and returns to receive another character. If it recognizes an EOM signal (the indicator is on), the program branches to test the receive error indicator. If there is an error, the program branches to an error subroutine. If there is no error, the message is unloaded, and the program returns to the initializing step.

IBM 1009 Instructions

Several 1401/1460 instructions are expanded to provide program control for operations that involve the IBM 1009 Data Transmission Unit.

Start Transmission

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*d-character*
CU	U	%D1	E

Function. This instruction initiates a start of message signal if the 1009 is in a SEND-RUN condition (transmit-receive switch is set to TRANSMIT). If the 1009 is in a RECEIVE-RUN condition (transmit-receive switch set to RECEIVE) the instruction causes an alarm to sound, signaling that operator intervention is necessary.

The A-address specifies the 1009 and the d-character specifies the start transmission operation.

Word Marks. Word marks are not affected.

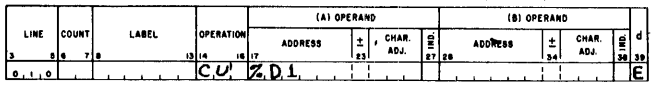
Timing. $T = N\ (L_I + 1)$ ms.

$N = .0115\ (1401),\ .006\ (1460)$

Address Registers After Operation.

I-Add. Reg.	*A-Add Reg.*	*B-Add. Reg.*
NSI	%41	d41

Example. Signal the 1009 to initiate a start-of-message signal (Figure H-4).



Assembled Instruction: U %D1 E

Figure H-4. Start Transmission

Set Ready to Receive

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*d-character*
CU	U	%D1	D

Function. The receiving 1009 signals the transmitting station that it is ready to receive and indicates the status of the previous message (see *Branch if Indicator On* instruction).

Word Marks. Word marks are not affected.

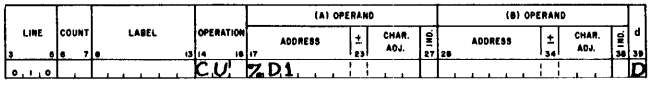
Timing. $T = N\ (L_I + 1)$ ms.

Note. The transmit-receive switch on the receiving 1009 should be set to RECEIVE. If it is set to TRANSMIT, the alarm is sounded to signal the operator.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	%41	d41

Example. Signal the transmitting station and indicate the condition of the message received (Figure H-5).



Assembled Instruction: U %D1 D

Figure H-5. Set Ready to Receive

Move Character to the Transmitting 1009

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
MCW	M	%D1	xxx	W

Function. The transmitting 1401 or 1460 sends the single character at the B-address to 1009. The d-character, W, specifies a transmit operation.

Word Marks. Word marks are not affected.

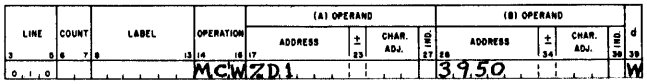
Timing. $T = N\ (L_I + 2)$ ms.

Note. If a group-mark with a word-mark is sensed in 1401 or 1460 storage, an end-of-message transmit condition is recognized.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	%41	B + 1

Example. Move the character at location 3950 to the 1009 (Figure H-6).



Assembled Instruction: M %D1 150 W

Figure H-6. Move Character to the Transmitting 1009

Move Character from the Receiving 1009

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
MCW	M	%D1	xxx	R

Function. This instruction transfers the single character in the receiving 1009 to the receiving 1401 or 1460 core-storage location specified by the B-address. The d-character specifies a receive operation.

Word Marks. Word marks are not affected.

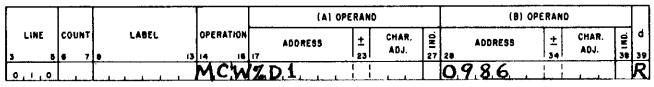
Timing. $T = N\ (L_I + 2)$ ms.

Note. When the 1009 recognizes an end-of-message condition, the receiving 1401 or 1460 gets an end-of-message receive signal and inserts a group mark in the core-storage location specified by the next M %D1 xxx R instruction.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	%41	B + 1

Example. Read a character from the 1009 and place it in core-storage position 0986 (Figure H-7).



Assembled Instruction: M %D1 986 R

Figure H-7. Move Character from Receiving 1009

Load Character to the Transmitting 1009

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
LCA	L	%D1	xxx	W

Function. The transmitting 1401 sends the character at the B-address to the 1009. The d-character, W, specifies a transmit operation.

Word Marks. If a word mark is associated with the character, the 1401 or 1460 converts the word mark to a word-separator character (A841). In two separate transmission cycles, the 1401 or 1460 sends the word separator, then the character to the 1009. The re-cycle for the character associated with the word separator is automatic.

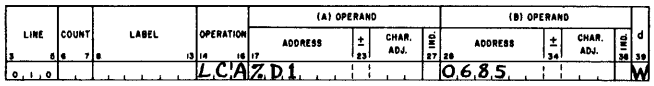
Timing. $T = N\ (L_I + 2)$ ms.

Note: A group mark in core storage signals an end-of-message transmit condition.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	%41	B + 1

Example. Send the character and word mark at location 0685 to the 1009 (Figure H-8).



Assembled Instruction: L %D1 685 W

Figure H-8. Load Character to the Transmitting 1009

Load Character from the Receiving 1009

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
LCA	L	%D1	xxx	R

Function. This instruction transfers the single character in the 1009 to the receiving 1401 or 1460 storage location specified by the B-address. The d-character, R, signals a receive operation.

Word Marks. If a word mark is associated with the character, it is transmitted and inserted in core storage with the character. Two transmission cycles are required to transfer the character and the word mark. The re-cycle for the word-marked character is automatic. The 1401 or 1460 converts the word-separator character to a word mark.

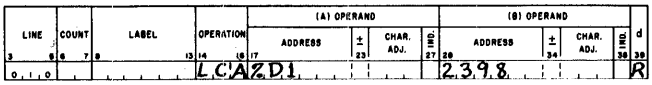
Timing. $T = N (L_I + 2)$ ms.

Note. When the 1009 recognizes an end-of-message condition, the receiving 1401 or 1460 interprets an end-of-message receive signal and inserts a group mark in the core-storage location specified by the next L %D1 xxx R instruction.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	%41	B + 1

Example. Read a character with word mark from the 1009 and place it in core-storage position 2398 (Figure H-9).



Assembled Instruction: L %D1 L98 R

Figure H-9. Load Character from the Receiving 1009

Branch if Indicator On

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
B	B	xxx	x

Function. This instruction tests the indicator specified by the d-character. If the indicator is on, the program branches to the I-address for the next instruction. If it is off, the program continues with the next instruction in sequence.

d-character	*Indicator*
1	1009 RUN
2	END-OF-MESSAGE TRANSMIT
3	GOOD TRANSMISSION
4	TRANSMISSION ERROR
5	END-OF-MESSAGE RECEIVE
6	RECEIVE ERROR

Indicators. 1009 RUN (B xxx 1) turns on when the 1009 is in RUN condition. If the 1009 is not in a RUN condition, the program should stop, or loop until the RUN condition is established.

END-OF-MESSAGE TRANSMIT (B xxx 2) turns on in the transmitting 1401 or 1460 when the 1401 or 1460 senses a group-mark with a word-mark at the B-address during the execution of an L %D1 xxx W, or M %D1 xxx W instruction. The indicator is turned off by the next U %D1 E instruction. The 1009 will be busy during the next 250 milliseconds.

GOOD TRANSMISSION (B xxx 3) turns on if the signal sent to the transmitting station by the U %D1 D instruction specified that a good transmission occurred. The transmitting 1401 or 1460 should test this indicator and branch to the routine for the next message if it is on. If the indicator is not on, the program should advance to test the transmission-error indicator.

TRANSMISSION ERROR (B xxx 4) turns on if the signal sent to the transmitting station by the U %D1 D instruction specified that a transmission error occurred. The transmitting 1401 or 1460 should test this indicator and branch to an error subroutine if an error occurred. If there was no indication of error, the program should loop to retest the good transmission indicator. The logic behind this technique can be explained by the fact that it is possible that a good-transmission condition exists, but that the signal has not been received by the transmitting 1401 or 1460 before the first good-transmission test is given. This loop will be repeated until one of the indicators is turned on.

END-OF-MESSAGE RECEIVE (B xxx 5) turns on when the end-of-message signal is recognized by the receiving 1009.

RECEIVE ERROR (B xxx 6) turns on if an error was detected during the transmission from the transmitting 1009 to the receiving 1401 or 1460. The receiving 1401 or 1460 tests the indicator and branches to an error routine if it is on.

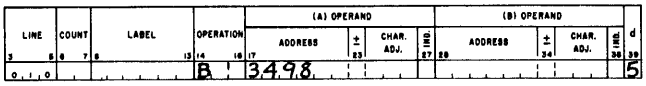
Word Marks. Word marks are not affected.

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

Address Registers After Operation.

	I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
	With Indexing		
Branch	BI	BI	NSI
No Branch	NSI	BI	d*bb*
	Without Indexing		
Branch	BI	BI	cleared to blanks
No Branch	NSI	BI	d*bb*

Example. Branch to location 3498 if the end-of-message receive indicator is on (Figure H-10).



Assembled Instruction: B D98 5

Figure H-10. Branch if End-of-Message Receive Indicator On

Suppress 3-Second Alarm

Instruction Format.

Mnemonic	*Op Code*	*d-character*
SS	K	A

Function. This instruction prevents the 3-second alarm from sounding during a delay (such as tape rewind). Normal alarm functions will be restored when any subsequent instruction addresses the 1009. This instruction can be given when a delay in processing can be foreseen.

Word Marks. Word marks are not affected.

Timing. $T = N\ (L_I + 1)$ ms.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	dpp	dpp

The chart (Figure H-11) shows a comparison of effective transmission rates of characters per second for the IBM 1401-1460/1009 Data Transmission Unit.

Type	Record Size (Characters)	Message Size (Characters)	Half Duplex 150 cps	Half Duplex 250 cps	Full Duplex 150 cps	Full Duplex 250 cps
Card to Card		80	74	95	91	121
		160	88	115	94	123
		240	93	123	94	124
		320	94	125	94	125
		400	94	125	94	125
		480	94	125	94	125
		560	94	125	94	125
		640	94	125	94	125
Card to Tape 729 II (200 cpi)		80	74	95	120	191
		160	100	137	125	196
		240	103	162	127	199
		320	118	172	128	199
		400	121	178	128	200
		480	122	181	129	200
		560	124	184	129	201
		640	125	186	129	201
Tape to Tape 729 II (200 cpi)	120	120	90	119	140	229
	120	240	112	162	143	235
	120	360	122	183	144	237
	120	480	128	196	145	237
	120	600	132	205	145	238
	120	720	135	211	145	238
	120	840	137	216	145	239
	120	960	138	220	146	239
	100	100	83	108	138	226
	100	200	107	151	142	233
	100	300	118	174	143	235
	100	400	125	188	144	236
	100	500	129	198	145	237
	100	600	132	205	145	237
	100	700	134	210	145	238
	100	800	136	215	145	238
	80	80	74	95	135	221
	80	160	99	138	140	229
	80	240	112	162	142	232
	80	320	119	177	143	234
	80	400	125	188	143	234
	80	480	128	196	144	235
	80	560	132	203	144	235
	80	640	134	207	144	236

Character transmission rates do not allow for line propagation or retransmissions due to line errors. Half-duplex rates are based upon turn around time of 250 milliseconds. Calculations have included time for blocking tape records at the transmit end and deblocking at the receive end. Tape writing at receiving terminal overlaps input at transmitting terminal on full duplex. On half-duplex facilities, tape writing and input are both overlapped by line turn around time.

Figure H-11. IBM 1401-1009 Comparison of Effective Transmission Rates (Characters per Second)

IBM 1404 Printer

The IBM 1404 Printer, Model 2 (Figure H-12), is another output medium for the IBM 1401 Data Processing System, and it can be used on all 1401 systems except A and D. It is a combination printer, capable of processing either cut-card forms or continuous forms. The 1404 retains all the basic features of the IBM 1403 Printer -- tape-controlled carriage, printing unit and continuous forms carriage and incorporates the card feeding mechanism--under the control of the 1401 stored program and the tape-controlled carriage.

Data Flow

A printing operation requires moving and arranging of data into the core-storage print area (locations 201 through 332) before a printing operation is executed.

When a WRITE LINE instruction is given, the data to be printed is read out of core storage to the B-register character by character. As each character is read into the B-register from a particular core-storage position, it is compared in the print-compare area to the characters on the chain in the corresponding print position. When the comparison is equal, the hammer is fired, printing that character.

The IBM 1404 Printer operates at a maximum rate of 600 lines per minute when printing on continuous forms or it can print on card documents at a rate of 800 cards per minute.

The print-cycle timing is 100 ms, which permits 16 ms of processing time, and the 1401 is interlocked for 84 ms print-interlock time. If additional form-movement time is required, this time must be added to the basic 100-ms cycle to determine the printing speed.

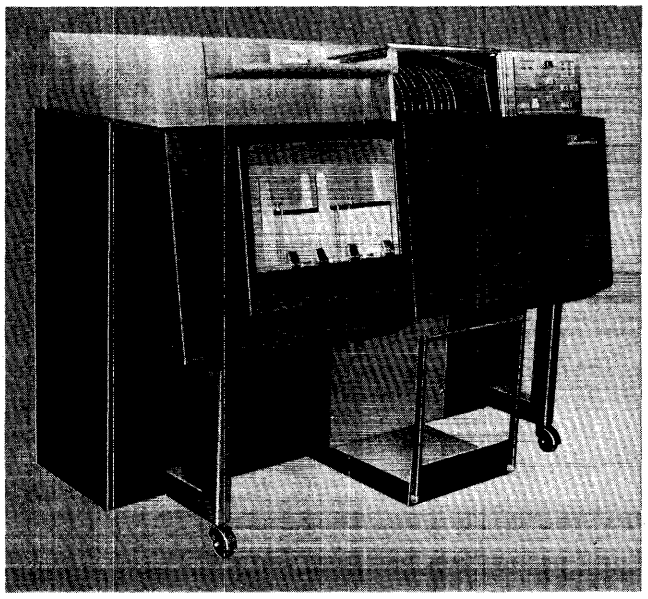


Figure H-12. IBM 1404 Printer, Model 2

IBM 1404 Instructions

The following instructions control IBM 1404 Printer operations. The instructions that relate to reading cards from the 1404 use the d-character, 0 (zero), thus modifying certain existing 1401 instructions. Other instructions in the following set apply without modification.

Read Card from 1404 Printer

Instruction Format.

Mnemonic	*Op Code*	*d-character*
R	1	0

Function. This instruction causes a card to be read, and as many as 30 columns of information to be transferred into core-storage positions 334 to 363. The d-character specifies that this is a read instruction for the 1404. There is no valid READ AND BRANCH instruction for the 1404.

Word Marks. Word marks are undisturbed.

Timing. $T = .0115\ (L_I + 1) + I/O$ ms.

A 1404 card read cycle (I/O time) requires a total of 150 ms. The cycle is divided into three major operations. (See section on *Timing.*)

Note 1. When the 1404 is being used as the only card input medium, a storage-scan operation should be performed or the 1404 card read-in area should be given a clear operation prior to the first 1404 card read.

Note 2. The read instruction must always follow the instruction F 1 or the instructions F A and 2.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	Ap	364

Example. Read as many as 30 columns (specified by the 1404 control panel), and transfer the data to IBM 1401 core-storage positions 334-363 (Figure H-13).

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	WM	(B) OPERAND ADDRESS	±	CHAR. ADJ.	WM	d
3 5	6 7	8 13	14 16	17 23			27	28 34			38	39
			R									0

Assembled Instruction: 1 0

Figure H-13. Read Card from 1404 Printer

Write Line

Instruction Format.

Mnemonc	*Op Code*
W	2

Function. This instruction causes the data in the print area to be transferred to the printer. The program continues after printing is complete. The printer takes an automatic space after printing a line, except when a SPACE AFTER PRINT or a SKIP AFTER PRINT control-carriage instruction is used.

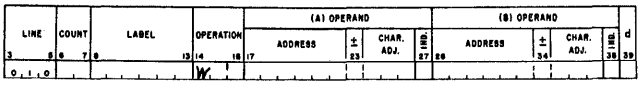
Word Marks. Word marks are not affected.

Timing. $T = .0115\ (L_I + 1) + I/O$ ms.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	Ap	332

Example. Print the data in the print area (Figure H-14).



Assembled Instruction: 2

Figure H-14. Write Line

Write and Read on 1404 Printer

Instruction Format.

Mnemonic	*Op Code*	*d-character*
WR	3	0

Function. This instruction combines the functions of READ CARD FROM 1404 PRINTER (1 0) and WRITE LINE (2). The print operation takes priority, and the print cycle is completed before the card reading operation takes place.

Without the special feature, print storage, this instruction must follow an F A instruction. In this instance, no processing time is available between print and read.

With the print-storage feature, this instruction can follow either an F 1 or an F A instruction. If it follows F 1, it must be given no more than 29.2 ms later.

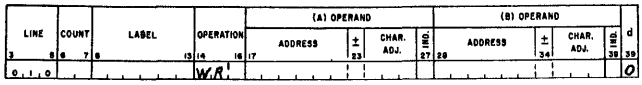
Word Marks. Word marks are undisturbed.

Timing. $T = .0115\ (L_I + 1) + I/O$ ms.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	Ap	081

Example. Write a line, and read as many as 30 columns (specified by the 1404 control panel) and transfer the data to IBM 1401 core-storage positions 334-363 (Figure H-15).



Assembled Instruction: 3 0

Figure H-15. Write and Read on 1404

Control Carriage

Instruction Format.

Mnemonic	*Op Code*	*d-character*
CC	F	x

Function. This instruction causes the carriage to move as specified by the d-character. The instructions F 1 and F A cause normal carriage skips to channel 1. If the 1404 card feed switch is ON:

1. F 1 causes the immediate eject to the stacker of the card at the print station, a new card to be positioned at the first printing line (channel 1) in the print station, and a new card to be fed from the hopper.
2. F A causes the card at the print station to eject immediately after the next print cycle, a new card to be positioned at the first printing line (channel 1) in the print station and a new card to be fed from the hopper.

All other F (d) instructions cause normal carriage control operations.

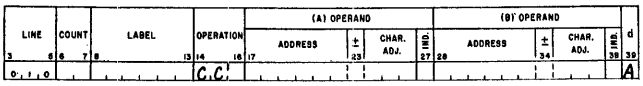
Word Marks. Word marks are not affected.

Timing. $T = .0115\ (L_I + 1)$ ms plus the remaining form-movement time, if the carriage is moving when this instruction is given. The form-movement time is determined by the number of spaces the form moves. Allow 20 ms for the first space, plus 4.4 ms for each additional space skipped or spaced at low speed and 2.0 ms for each additional space skipped at high speed.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	dpp	dpp

Example. Eject the card at the print station after the next print cycle (Figure H-16).



Assembled Instruction: F A

Figure H-16. Control Carriage

Branch if Indicator On

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
B	B	xxx	0

Function. As in any 1401 BRANCH IF INDICATOR ON instruction, the d-character specifies the indicator tested. If the special feature, read-compare, is installed, the d-character, 0 (zero), permits testing for a validity error after a 1404 card reading operation. If it is used, this instruction must be given *after* a 1 0 or 3 0 instruction, and before the next F 1 or F A instruction.

Word Marks. Word marks are not affected.

Timing. $T = .0115\ (L_I + 1)$ ms.

Address Registers After Operation.

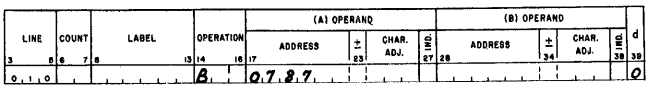
With Indexing

	I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
Branch	BI	BI	NSI
No Branch	NSI	BI	dbi

Without Indexing

Branch	BI	BI	Cleared
No Branch	NSI	BI	dbi

Example. Test to see if there was an invalid card code read by the read-compare brushes during the last read operation in the 1404. If there was an error, branch to location 0787 (Figure H-17).



Assembled Instruction: B 787 0

Figure H-17. Branch if Invalid Card Code Indicator On

Compare

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*
C	C	xxx	363

Function. The data in the A-field is compared to an equal number of characters in the B-field. The bit configuration of each character in the two fields is compared. If there is an unequal comparison, an indicator turns on. This indicator can then be tested by a BRANCH IF INDICATOR ON instruction.

If the read-compare feature is installed in the IBM 1404 Printer, any of the 30 (334-363) core-storage locations, assigned as a read-in area from the 1404, can be compared with any other field.

Word Marks. The first word mark encountered stops the operation. If the A-field is longer than the B-field, the extra positions in the A-field are not compared. If the B-field is longer than the A-field, an unequal compare results.

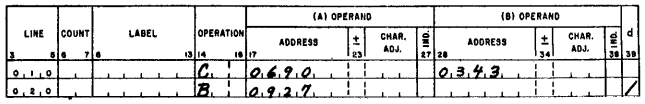
Timing. $T = .0115\ (L_I + 1 + L_A + L_B)$ ms.

Note. Both fields must have exactly the same bit configuration to be equal.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	$A\text{-}L_W$	$B\text{-}L_W$

Example. Compare the 10-digit serial number of one card with that of the preceding card (moved to locations 681-690). Then test the unequal-compare indicator. If the serial numbers are equal, continue the program in sequence. If they are unequal, branch to location 0927 for the next instruction (Figure H-18).



Assembled Instruction: C 690 343
B 927 /

Figure H-18. Compare

IBM 1407 Console Inquiry Station

The IBM 1407 Console Inquiry Station (Figure H-19) provides a manually controlled means of communication between the operator and the IBM 1401 Data Processing System.

Data Flow

The 1407 can control both reading from, and writing into, storage by using an instruction format keyed into the system to direct the particular operation desired.

This permits the operator to examine or alter the status of data or instructions stored in the system. A request can be made to the system for the specific data to be typed out for verification. This also serves as a record of the changes made to the storage information.

IBM 1407 Instructions

Read from Console Printer

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
MU	M	%T0	xxx	R

Function. This instruction causes the enter key-light to come ON, the keyboard to unlock, and the data (to be typed on the 1407) to enter 1401 core storage. The A-address specifies an inquiry station operation. The B-address is the high-order position in 1401 core storage wherein the data is to be stored. The d-character specifies a read-in operation. The inquiry request indicator must be ON to process this instruction.

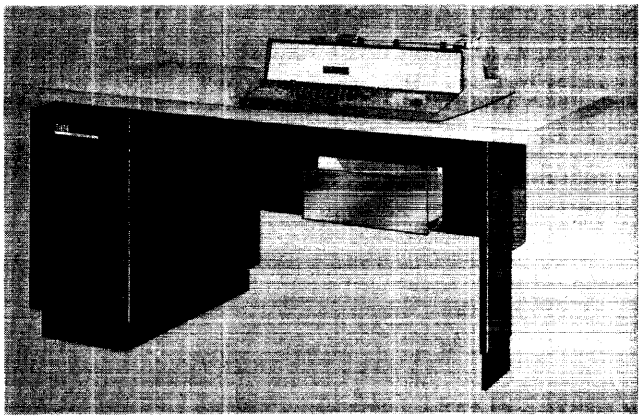


Figure H-19. IBM 1407 Console Inquiry Station

Word Marks. A group-mark with a word-mark must be inserted in 1401 core storage to the right of the last character sent to the 1401 from the 1407. Another method of terminating a read-in operation is pressing the clear key.

Timing. $T = .0115\ (L_I + 1)$ ms + typing time.

Note. The lower case *b* (special character) or space bar causes a space to be taken and a blank to enter core storage. If the b-key is pressed, a lower case *b* is printed. The method of entering data is discussed in the manual on 1407 *Console Inquiry Station*, Form A24-3084.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	%30	$B + L_B$

Example. Transfer the data typed on the IBM 1407 to the area in 1401 core storage labeled INQIN (0785), Figure H-20.

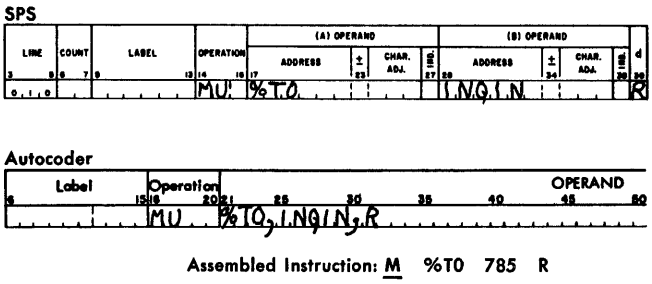


Figure H-20. Read from Console Printer

Read from Console Printer with Word Marks

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
LU	L	%T0	xxx	R

Function. This instruction causes the enter key light to come ON, the keyboard to unlock, and the data with word mark (to be typed on the 1407) to enter 1401 core storage. The A-address specifies an inquiry station operation. The B-address is the high-order position, in 1401 core storage, in which the data is to be stored. The d-character specifies a read-in operation. Word marks are entered by first pressing the word-mark key, and then pressing the associated character key. Characters with a word mark print in red. The inquiry request indicator must be ON to process this instruction.

Word Marks. A group-mark with a word-mark must be inserted in 1401 core storage to the right of the last character sent to the 1401 from the 1407. Another method of terminating a storage read-in operation is to press the clear key.

Timing. T = .0115 (L_I + 1) ms + typing time.

Note. The lower case *b* (special character) or space bar causes a space to be taken and a blank to enter core storage. If the b-key is pressed, a lower case *b* is printed. The method of entering data is discussed in the manual on 1407 *Console Inquiry Station*, Form A24-3084.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	%30	GMWM + 1

Example. Transfer the data with word marks (typed on the 1407) to the area in 1401 core storage labeled INQIN (0785), Figure H-21.

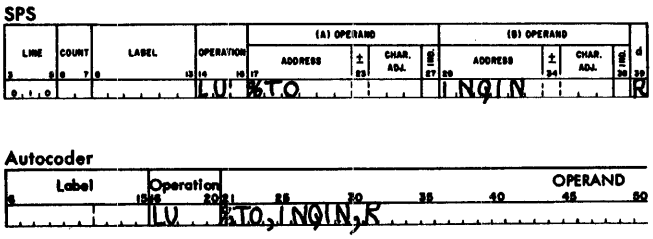


Figure H-21. Read from Console Printer with Word Marks

Write on Console Printer

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
MU	M	%T0	xxx	W

Function. This instruction causes data from 1401 storage to be typed by the inquiry station. While the data is being typed, the typeout light is ON. The B-address is the high-order position in 1401 core storage of the data to be transferred to the console printer. The d-character specifies a write operation.

Word Marks. A group-mark with a word-mark in 1401 core storage stops the transfer of data to the 1407 and causes a carriage return. Pressing the clear key also stops the transfer of data from the 1401.

Timing. T = .0115 (L_I + 1) ms + typing time.

Note. Characters that have incorrect parity (even-bit) are typed as a ✳ if the process-check stop switch is OFF. If the switch is ON, typing stops before typing the incorrect character.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	%30	GMWM + 1

Example. Type the data, beginning in the area labeled INQOUT (0785) and ending with a group-mark, with a word-mark (Figure H-22).

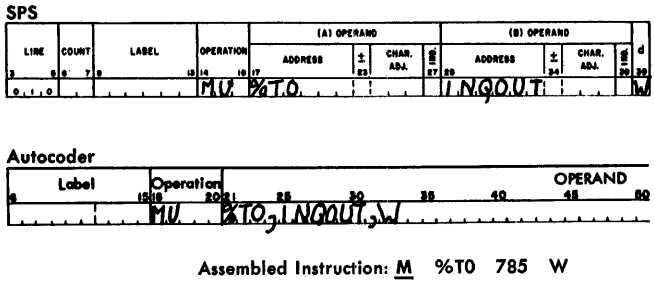


Figure H-22. Write On Console Printer

Write on Console Printer with Word Marks

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
LU	L	%T0	xxx	W

Function. This instruction causes data from 1401 storage to be typed by the inquiry station. While the data is being typed, the typeout light is ON. The A-address specifies an inquiry station operation. The B-address is the high-order position in 1401 core storage of the data to be transferred to the typewriter. The d-character specifies a write operation.

Word Marks. A group-mark with a word-mark stops the transfer of data to the 1407 and causes a carriage return. Pressing the clear key also stops the transfer of data from the 1401.

Timing. T = .0115 (L_I + 1) ms + typing time.

Note. Characters that have a word mark in association with them are typed in red. All other characters are typed in black. A space is printed as a lower case *b*. Characters with incorrect parity (even-bit) are typed as a ✳ if the process-check stop switch is OFF. If the switch is ON, typing stops before typing the incorrect character.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	%30	GMWM + 1

Example. Type the data with word marks located in the area labeled INQOUT (0785) and ending with a group-mark with a word-mark (Figure H-23).

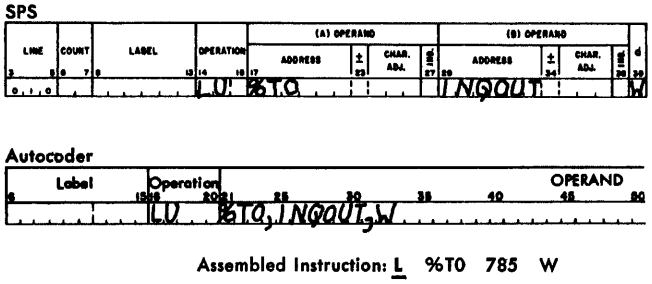


Figure H-23. Write On Console Printer with Word Marks

Line Space

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
LU or MU	L or M	%T0	xxx	W

Function. This instruction causes the console printer to space one line. The B-address is the storage location of a group-mark with a word-mark.

Word Marks. A group-mark with a word-mark must be at the B-address.

Timing. T = .0115 (L_I + 1) ms + space time.

Note. Multiple line spacing is controlled by this instruction and by the setting of the line-space lever.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	%30	B + 1

Example. Space a single line on the console printer. The storage position labeled GMWM (0895)) contains a group-mark with a word-mark (Figure H-24).

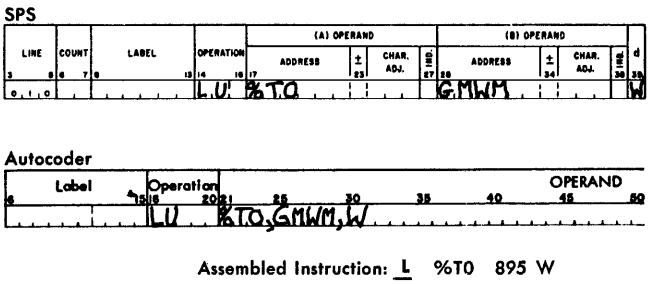


Figure H-24. Line Space

d–CHARACTER	INDICATOR
*	Inquiry Clear
Q	Inquiry Request

Figure H-25. IBM 1407 Branch Instruction d-Character

Branch if Indicator On

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
SPS B	B	xxx	x
A BIN			

Function. The d-character specifies the indicator tested. If the indicator is ON, the next instruction is taken from the I-address. If the indicator is OFF, the next sequential instruction is taken. Figure H-25 shows symbols that are valid d-characters and the indicators they test.

Indicators. Inquiry Clear – This indicator turns ON when the clear key-light is pressed, if the 1401 is in the RUN mode. It turns OFF when the 1401 program processes a console inquiry instruction or the start reset key on the 1401 console is pressed. It must be tested before processing the next inquiry.

Inquiry Request – This indicator turns ON when the request enter key-light is pressed to signal the 1401 that an inquiry is to be processed, and the 1401 is in the RUN mode. It is turned OFF after the 1401 processes a console inquiry instruction. Pressing the start reset key on the 1401 console or the clear key on the 1407 also turns this indicator off.

Word Marks. Word marks are not affected.

Timing.

Without Indexing:

T = .0115 (L_I + 1) ms.

With Indexing:

T = .0115 (L_I + 2) ms.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	BI	d*bb*

Example. Branch to the inquiry routine labeled INQRUT (0950) if the inquiry request indicator is ON (Figure H-26).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	(B) OPERAND ADDRESS	±	CHAR. ADJ.	d
			B	INQRUT						Q

Autocoder

Label	Operation	OPERAND
	BIN	INQRUT,Q

Assembled Instruction: B 950 Q

Figure H-26. Branch if Inquiry Request Indicator On

IBM 1418 Optical Character Reader

Numeric data on printed card or paper documents can be read optically into 1401 or 1460 core storage with the IBM 1418 Optical Character Reader, Model 1, with three stackers, can select the documents according to class, or general category; Model 2 (Figure H-27), with 13 stackers, in addition to sorting by class, can sort each document numerically. Model 3, which is similar in appearance and operation to the Model 1, has a broader range of document-handling capabilities. The Model 3 is particularly adaptable to cash-accounting applications where a small stub is customarily returned with a payment.

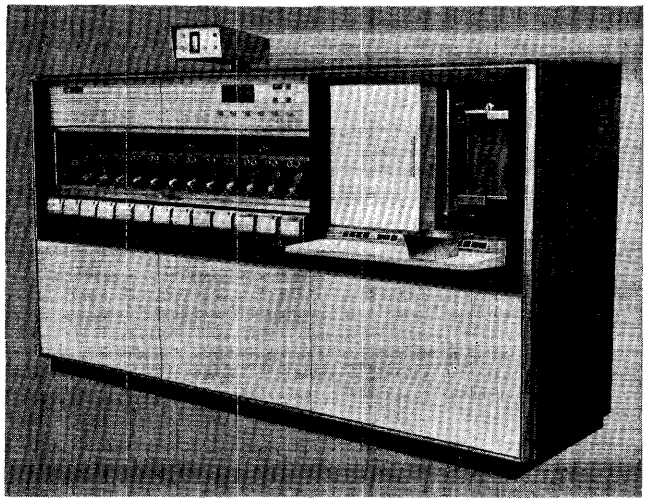


Figure H-27. IBM 1418 Optical Character Reader, Model 2

IBM 1418 Instructions

Eleven instructions are available for on-line control of the IBM 1418. The operation codes for programming the 1418 are:

Control Unit

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*d-character*
CU	U	%S2	d

Function. This instruction controls 1418 document feeding according to the d-character.

d-Character	*Operation*
E	ENGAGE: Selects the 1418 and instructs it to start feeding documents continuously. Feeding continues until a DISENGAGE instruction is executed, or until either a system or a 1418 stop automatically disengages the 1418.
D	DISENGAGE: Instructs the 1418 to stop feeding documents. Documents already beyond the ready station are read and processed after the 1418 is disengaged.

Word Marks. Word marks are not affected.

Timing. $T = N\ (L_I + 1)$ ms + I/O
$N = .0115$ (1401); .006 (1460)

Example. Engage the 1418 and start feeding documents (Figure H-28).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	(B) OPERAND ADDRESS	±	CHAR. ADJ.	d
			CU	%S2						E

Autocoder

Label	Operation	OPERAND
	CU	%S2,E

Assembled Instruction: U %S2 E

Figure H-28. Control Unit (Engage)

Read in Move Mode

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
MU	M	%S2	xxx	R

Function. This instruction moves the character read by the 1418 from the character register to the core-

storage position specified by the B-address. A read instruction must be given for each character transferred to the 1401 or 1460.

Word Marks. Word marks are not affected.

Timing. T = N (L_I + 1) ms + message length + document movement* + 1.

*Refer to Figure H-41.

Example. Read a character into a location called INPUTA (0950) from the 1418 (Figure H-29).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	IND.	(B) OPERAND ADDRESS	±	CHAR. ADJ.	IND.	d
0,1,0			M.U.	%,O,S,2,				I,N,P,U,T,A				R

Autocoder

Label	Operation	OPERAND
	M.U.	%S2,,I,N,P,U,T,A,,R

Assembled Instruction: M %S2 950 R

Figure H-29. Read in Move Mode

Select Stacker

Instruction Format.

Mnemonic	*Op Code*	*d-character*
SS	K	d

Function. This instruction, with a d-modifier A through L, selects the pocket to which a document is to be directed. The modifiers, A through L, correspond respectively to pockets A, B, and 0-9. If no SELECT-STACKER instruction is given within 10 ms after the document passes document-end 4, the document goes to the reject pocket. A second SELECT-STACKER instruction must not be given before a 15-ms lapse after the previous document has passed the document-end 4 sensing station.

Word Marks. Word marks are not affected.

Timing. T = N (L_I + 1) ms.

Example. Select into stacker 7 the document which has just been read (Figure H-30).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	IND.	(B) OPERAND ADDRESS	±	CHAR. ADJ.	IND.	d
0,1,0			S,S,									J

Autocoder

Label	Operation	OPERAND
	S,S,	J

Assembled Instruction: K J

Figure H-30. Select Document into Stacker 7

Read Station Select (Special Feature)

Instruction Format.

Mnemonic	*Op Code*	*d-character*
SS	K	d

Function. This instruction, with the d-modifier N, selects the second reading station (standard) as the source of information. A d-modifier of M selects the first reading station (special feature either video or mark read).

Word Marks. Word marks are not affected.

Timing. T = N (L_I + 1) ms.

Example. Select the first reading station to read in data (Figure H-31).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	IND.	(B) OPERAND ADDRESS	±	CHAR. ADJ.	IND.	d
0,1,0			S,S,									M

Autocoder

Label	Operation	OPERAND
	S,S,	M

Assembled Instruction: K M

Figure H-31. Read Station Select

Branch if Indicator On

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
BIN	B	xxx	d

Function. This instruction tests for the 1418 operational conditions specified by the d-character. If the

indicator is ON, the next instruction is taken from the I-address; if OFF, the 1401 or 1460 goes to the next sequential instruction.

d-Character	*Branch and Function*

1 BRANCH ON LATE READ

Branch if the late-read indicator is ON. The test for branch-1 resets this indicator.

The 1418 is scanning as long as a document is under the selected read station. Unless all information scanned is transferred to the system, the late-read indicator turns ON. The stored program must include turning OFF this indicator prior to reading a significant field on a document. Testing this indicator at the end of a significant field determines whether or not all the information was transferred to core storage.

2 BRANCH ON READY TO ENGAGE

Branch if the 1418 is ready to engage. This indicator remains ON when the 1418 is:
a. disengaged with a document at the ready station,
b. ready to operate (all interlocks normal, drive motors up to speed), and
c. not in register-run, test, or off-line mode.

Branching on ready-to-engage must precede each ENGAGE instruction. Not branching to an ENGAGE instruction allows the stored program to continue processing when the 1418 operating conditions are not satisfied.

Single-document feeding is accomplished by consecutive ENGAGE-DISENGAGE instructions following a branch on the ready-to-engage test.

3 BRANCH ON DOCUMENT UNDER SELECTED READ STATION

The leading edge of the document at the selected reading station turns ON this indicator provided that the document has not caused a hopper check. The trailing edge turns it OFF. A prior STATION-SELECT instruction (KM or KN) specifies the particular reading station.

Many 1401 or 1460/1418 subroutines require a document either *under* or *not under* a selected read station during their execution. Branch 3 is used to delay the program by a loop until the document is in proper position. Meeting the branch-3 conditions allows the stored program to enter these subroutines. For example, branching on branch 3 precedes the character-on-line test. This assures that a document is present while the program is looking for a character to be read at the selected read station.

If a document is to be read only partially, a program delay may be necessary to prevent reading the trailing edge of that document. A branch 3 can be programmed to loop until that particular document has left the reading station.

The ready-to-read (branch 8) test should precede testing each branch-3 instruction. This allows the system to continue processing if the 1418 is no longer ready to read.

5 BRANCH ON DOCUMENT END

Branch if the trailing edge of the document has passed the point specified by the document-end switch. The leading edge of the next document resets the indicator. This test is used to delay the stored program until a document has passed the specified point.

The ready-to-read (branch 8) test should precede testing each branch-5 instruction. This allows the system to continue processing if the 1418 is no longer ready to read.

6 BRANCH ON CHARACTER ON LINE

Branch if a character is available to the system. This indicator is ON whenever the 1418 places a character in the on-line register. A character must be in the on-line register before a read instruction (M %S2 xxx R) is given. A character is never placed in the on-line register from a scanned document that caused a hopper check.

The ready-to-read (branch 8) test should precede testing each branch-6 instruction. This allows the system to continue processing if the 1418 is no longer ready to read.

7 BRANCH ON EMPTY HOPPER AND TRANSPORT (END OF FILE)

This indicator turns ON when the hopper becomes empty and the trailing edge of the last document passes a point one-half inch (10 ms) beyond the document-end 4 sensing station.

This instruction should be given only following a ready-to-read (branch 8) failure-to-branch to indicate the 1418 is out of documents. Failure of the branch-7 to branch at this time indicates a condition requiring operator intervention, for example: jam, full pocket, open interlock, etc. The branch-7 indicator, in conjunction with a sense switch on the system console, can signal an end-of-job condition, and release the stored program from 1418 input.

8 BRANCH ON READY TO READ

Branch if the 1418 is ready to read. This indicator turns ON as the first document leaves the ready station. The indicator remains ON until the last document passes a point one-half inch (10 ms) beyond the document-end 4 sensing station, or until the 1418 stops for an empty hopper, a feed jam, or a full pocket.

The branch-8 instruction is used in conjunction with other instructions to indicate that the 1418 is ready to read documents.

Word Marks. Word marks are not affected.

Timing.

No Branch:
$T = N(L_I + 1)$ ms.

Branch (without indexing):
$T = N(L_I + 1)$ ms.

Branch (with indexing):
$T = N(L_I + 2)$ ms.

Example. If a late read condition occurs, branch to a routine called LATRD (0841) (Figure H-32).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	(A) OPERAND ±	(A) OPERAND CHAR. ADJ.	(A) OPERAND IND	(B) OPERAND ADDRESS	(B) OPERAND ±	(B) OPERAND CHAR. ADJ.	(B) OPERAND IND	d
			B	L.A.T.R.D.								1

Autocoder

Label	Operation	OPERAND
	B	L.A.T.R.D.,1.

Assembled Instruction: B 841 1

Figure H-32. Branch if Late Read Condition Indicator On

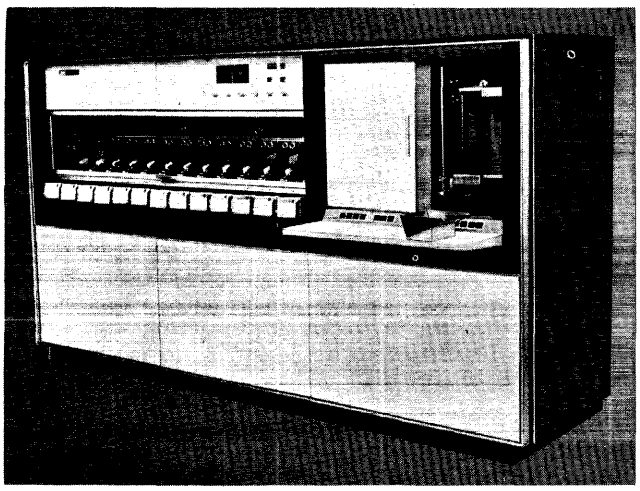


Figure H-33. IBM 1428 Alphameric Optical Reader, Model 2

IBM 1428 Alphameric Optical Reader

The IBM 1428 (Figure H-33) can be connected, through a serial input/output adapter, to an IBM 1401 or 1460 system. When connected to a 1401 or 1460, the 1428 supplies high-speed alphameric input to the data processing system from printed documents of various sizes. Thus the 1428 provides for direct entry into the 1401 or 1460 system of data from such documents as insurance premium notices, charge sales invoices, operations and route slips, payroll and dividend checks, and mail orders.

The IBM 1428, Model 1, is equipped with three sorter pockets. The Model 2 is equipped with thirteen pockets. The Model 3, which is similar to the Model 1 in appearance and operation, can handle documents of a broader size range. It is particularly adaptable to handling small stub-size documents such as those returned with a payment in many cash-accounting applications. The IBM 1428, Model 2, can also be used off-line as an optical sorter.

IBM 1428 Instructions

Twelve instructions are available for on-line control of the IBM 1428. The 1401 or 1460 operation codes for programming the 1428 are:

Control Unit

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*d-character*
CU	U	%S2	d

Function. This instruction controls IBM 1428 document feeding according to the d-character.

d-Character	*Operation*
E	ENGAGE: Selects the 1428 and instructs it to start feeding documents continuously. Feeding continues until a disengage instruction is executed, or until a 1401/1460 with 1428 stop automatically disengages the 1428.
D	DISENGAGE: Instructs the 1428 to stop feeding documents. Documents already beyond the ready station are read and processed.

Word Marks. Word marks are not affected.

Timing. $T = N\,(L_I + 1)$ ms + I/O.

Example. Engages the 1428 and starts feeding of documents (Figure H-34).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	(A) OPERAND ±	(A) OPERAND CHAR. ADJ.	(A) OPERAND IND	(B) OPERAND ADDRESS	(B) OPERAND ±	(B) OPERAND CHAR. ADJ.	(B) OPERAND IND	d
			C.U.	%S.2.								E

Autocoder

Label	Operation	OPERAND
	C.U.	%S.2.,E.

Assembled Instruction: U %S2 E

Figure H-34. Control Unit (Engage)

Reading Mode Determination

Instruction Format.

Mnemonic	*Op Code*	*d-character*
SS	K	d

Function. This instruction with a d-modifier C, E, or F, permits the 1428 to read only those characters

included in the corresponding alphabetic, numeric, or alphameric character set.

C – A through Z | - $ / * , . defines the alphabetic set.
E – 0-9 | - $ / * , . defines the numeric set.
F – All characters recognized by the 1428 define the alphameric set.

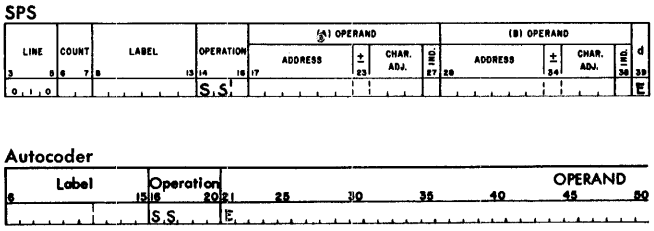
Pressing the 1428 reset key in an on-line operation automatically places the system in the alphameric reading mode.

A programmed reading-mode change must be given within .8 ms after a character has been placed in the 1428 on-line character register. Failure to consider this timing results in missing the next character following the programmed reading-mode change.

Word Marks. Word marks are not affected.

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

Example. Read only the numeric set defined by the d-character E (Figure H-35).



Assembled Instruction: K E

Figure H-35. Reading Mode Determination

Read in Move Mode

Instruction Format.

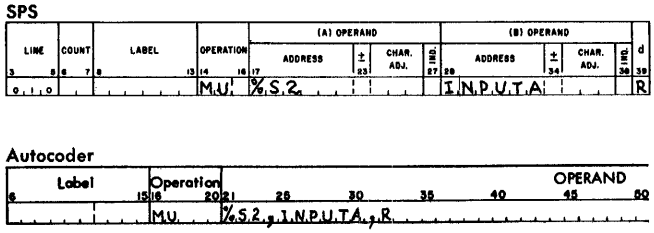
Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
MU	M	%S2	xxx	R

Function. This instruction moves the character read by the 1428 from the character register to the core storage specified by the B-address. A read instruction must be given for each character transferred to the 1401 or 1460.

Word Marks. Word marks are not affected.

Timing. $T = N(L_I + 1)$ ms + message length + document movement* + 1.
*Refer to Figure H-41.

Example. Read a character into location called INPUTA (0880) from the 1428 (Figure H-36).



Assembled Instruction: M %S2 880 R

Figure H-36. Read in Move Mode

Select Stacker

Instruction Format.

Mnemonic	*Op Code*	*d-character*
SS	K	d

Function. The stacker selection is accomplished in the 1428 by either one instruction with a d-modifier or the combination of three consecutive instructions with their appropriate d-modifiers. A SELECT STACKER instruction must be given within 10 ms after the document passes document-end 4.

A SELECT STACKER instruction must be issued by the program for some pocket, including the reject pocket, for every document that was scanned and had any of its characters read into core storage. If a SELECT STACKER instruction is not issued, a sort check occurs and the system stops.

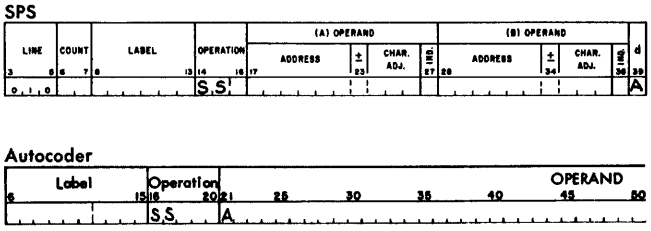
Failure to give a SELECT STACKER instruction for a document that is scanned, but that has none of its characters read to the process unit from the on-line register, results in the document being rejected without a selection error and without stopping the system. The SELECT STACKER instructions with their d-modifiers are as follows:

1401/1460 Instruction Configuration	*1428 Pocket Selected*
KBKHKG	0
KA	1
KB	2
KAKBKG	3
KD	4
KAKDKG	5
KBKDKG	6
KAKBKD	7
KH	8
KAKHKG	9
KAKDKH	A
KBKDKH	B
KG	R

Word Marks. Word marks are not affected.

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

Example. Select into stacker pocket 1 the document that was scanned and had its characters read to core storage (Figure H-37).



Assembled Instruction: K A

Figure H-37. Select Document into Stacker 1

Read Station Select (Special Feature)

Instruction Format.

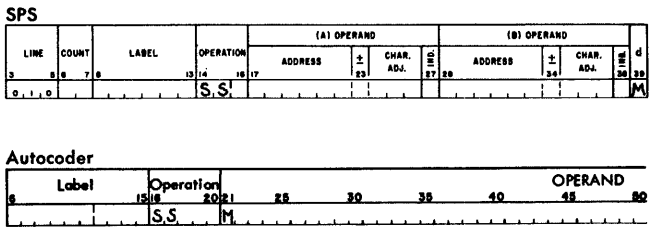
Mnemonic	*Op Code*	*d-character*
SS	K	d

Function. This instruction, with the d-modifier N, selects the second reading station (standard) as the source of information. A d-modifier of M selects the first reading station (special feature: either video or mark read).

Word Marks. Word marks are not affected.

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

Example. Select the first reading station to read in data (Figure H-38).



Assembled Instruction: K M

Figure H-38. Read Station Select

Branch if Indicator On

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
B	B	xxx	d

Function. This instruction tests for the 1428 operational conditions specified by the d-character. If the indicator is ON, the next instruction is taken from the I-address. If the indicator is OFF, the stored program goes to the next sequential instruction.

d-Character	*Branch and Function*
1	BRANCH ON LATE READ OR LATE READING MODE CHANGE Branch, if the late-read or late-reading mode change indicator is ON. The test for branch 1 resets this indicator. The 1428 scans as long as a document is under the selected read station. Unless all information scanned is transferred to the system, the late-read indicator turns ON. The stored program must include turning OFF this indicator prior to reading a significant field on a document. Testing this indicator at the end of a significant field determines whether or not all the information was transferred to core storage. Failure to change reading modes within the specified .8 ms after the branch-6 indicator turns ON also turns this indicator ON.
2	BRANCH ON READY TO ENGAGE Branch if the 1428 is ready to engage. This indicator remains ON when the 1428 is: a. disengaged with a document at the ready station, b. ready to operate (all interlocks normal, drive motors up to speed), and c. *not* in register-run, test, or off-line mode. Branching on READY TO ENGAGE must precede each engage instruction. Not branching to an engage instruction allows the program to continue processing when the 1428 operating conditions are not satisfied. Single-document feeding is accomplished by consecutive engage-disengage instructions following a branch on the ready-to-engage test.
3	BRANCH ON DOCUMENT UNDER SELECTED READ STATION The leading edge of the document at the selected reading station turns ON this indicator, provided that the document has not caused a hopper check to occur. The trailing edge turns it OFF. A prior station-select instruction (KM or KN) specifies the particular reading station. Many 1401/1460 with 1428 subroutines require a document either *under* or *not under* a selected read station during their execution. Branch 3 is used to delay the program by a loop until the document is in the proper position. Meeting the branch-3 conditions allows the program to enter these

subroutines. For example, branching on branch-3 precedes the character-on-line test. This assures that a document is present while the program is looking for a character to be read at the selected read station.

If a document is to be read only partially, a program delay may be necessary to prevent reading the trailing end of that document. A branch 3 can be programmed to loop until that particular document has left the reading station.

The ready-to-read (branch-8) test should precede testing each branch-3 instruction. This allows the 1401 or 1460 to continue processing if the 1428 is no longer ready to read.

5 BRANCH ON DOCUMENT END

Branch, if the trailing edge of the document has passed the point specified by the document-end switch. The leading edge of the next document resets the indicator. This test is used to delay the stored program until a document has passed the specified point.

The ready-to-read (branch-8) test should precede testing each branch-5 instruction. This allows the 1401 or 1460 to continue processing if the 1428 is no longer ready to read.

6 BRANCH ON CHARACTER ON LINE

Branch, if a character is available to the 1401 or 1460. This indicator is ON whenever the 1428 places a character in the on-line register. A character must be in the on-line register before a read instruction (M %S2 xxx R) is given.

A character is never placed in the on-line register from a scanned document that caused a hopper-check to occur.

The ready-to-read (branch-8) test should precede testing each branch-6 instruction. This allows the 1401 or 1460 to continue processing if the 1428 is no longer ready to read.

7 BRANCH ON EMPTY HOPPER AND TRANSPORT (END OF FILE)

This indicator turns ON when the hopper becomes empty and the trailing edge of the last document passes a point one-half inch (10 ms) *beyond* the document-end 4 sensing station.

This instruction should be given only following a ready-to-read (branch-8) failure, to branch to indicate the 1428 is out of documents.

The branch-7 indicator, in conjunction with a sense switch on the console, can signal the end-of-job condition and release the program from 1428 input.

8 BRANCH ON READY TO READ

Branch, if the 1428 is ready to read. This indicator turns ON as the first document leaves the ready station. The indicator remains ON until the last document passes a point one-half inch (10 ms) beyond the document-end 4 sensing station, or until the 1428 stops for an empty hopper, a feed jam, or a full pocket.

The branch-8 instruction is used in conjunction with other instructions to indicate that the 1428 is ready to read documents.

Word Marks. Word marks are not affected.

Timing.

No Branch:

$T = N(L_I + 1)$ ms.

Branch (without indexing)

$T = N(L_I + 1)$ ms.

Branch (with indexing)

$T = N(L_I + 2)$ ms.

Example. If a late read condition occurs, branch to a routine called LATRD (0841) (Figure H-39).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	IND.	(B) OPERAND ADDRESS	±	CHAR. ADJ.	IND.	d
3 5	6 7	8 13	14 16	17 23			27	28 34			36	39
0 1 0			B	L A T R D								1

Autocoder

Label	Operation	OPERAND
6 15	16 20	21 25 30 35 40 45 50
	B I N	L A T R D , 1

Assembled Instruction: B 841 1

Figure H-39. Branch if Late Read Condition Indicator On

IBM 1401 or 1460 with 1418 or 1428 General Block Diagram

The general block diagram (Figure H-40) illustrates the 1401 or 1460 with 1418 or 1428 operation codes used in a sample program. Other programs can be equally valid. However, several machine functions make using some of the routines shown advisable. Except for a few variations, the block diagram and program description for both the 1418 and 1428 are identical. The variations are discussed individually for each machine.

1. The main loop for the IBM 1418 or 1428 begins at a ready-to-engage test. When this test has been conditioned to branch to ENGAGE, the optical reader starts feeding documents.

2. (1418) Select the reading station that is to be the source of information. Unless multiple-line documents are to be read, the station selected for a particular run remains selected until power is turned OFF to the system.

2. (1428) Select the reading status of the system to read the character-set to be scanned. The reading status of the machine can be changed at any time during a document cycle, provided that the previously mentioned timing considerations are respected. Failure to comply may result in setting the late-read or late-reading mode change indicator and in missing the first character following a programmed reading mode change. Select the reading station that is to be the source of information. Unless multiple-line documents are to be read, the station selected for a particular run remains selected until power is turned OFF to the system.

3. Test for DOCUMENT UNDER SELECTED READ STATION. The program goes into a subroutine with a READY TO READ while waiting for the leading edge of the document to reach the selected reading station.

4. Reset late-read indicator (branch 1). Testing this indicator resets the indicator if it is ON. The indicator can then be tested (item 8) at the end of the field or document to be certain that all data scanned was transferred to core storage.

5. Test ready-to-read indicator. This test should always be part of any subroutine loop containing a test for DOCUMENT UNDER SELECTED READ STATION, CHARACTER ON LINE, or DOCUMENT END. This prevents holding up the processing unit when the optical reader is not ready to read. The program can exit from the subroutine, if, for example, a jam condition occurs. A ready-to-read test failure should always branch to the hopper-and-transport-empty test to distinguish between (1) an empty hopper and (2) a jam, a full pocket, or an open interlock.

6. Test for character-on-line. The program loops waiting for a character to be placed in the on-line register. A document leaving the selected reading station while the program is in the character-on-line loop indicates: an end-of-data for the document was not reached, and the data read to the processing unit was either incomplete or in error. This subroutine rejects such documents and provides an exit from the loop to prevent reading the following document as part of the error document because the end-of-data indicator was not detected. The program proceeds to the next document.

7. Read from optical reader to the core storage. This instruction initiates entry into the basic 1401 or 1460 subroutine that transfers and processes each character in core storage.

   Move each character to the same arbitrary location before it is moved to the collect area. This places the character in a known fixed location where it can be identified easily by a series of test-character and branch instructions. This avoids having to address-modify the B-address of each instruction referring to the character location.

   Depending on the format of the scanned document, an invalid character:

   a. is ignored if the data read is not significant, or
   b. signals the program to reject the document if the data read is significant.

   NOTE: If field correction is used, the document is not rejected unless more than one failure is encountered per check-digit field.

   This same basic subroutine should also include an end-of-data test. Characters in a fixed-length field, or field marks, can be counted. Where document format is suitable, the document-end test can indicate end-of-data.

   NOTE: The read instruction (M %S2 xxx R) in item 7 must be executed by the time the optical reader places another character on-line or a late-read occurs.

8. (1418) Test for late-read indicator. Branching on this test indicates at least one character was not transferred to the processing unit. The error routine bypasses the stacker selection (item 9) and causes the document to be rejected.

   NOTE: A late-read indication can occur if the optical reader scans characters or marks *after* the system completes

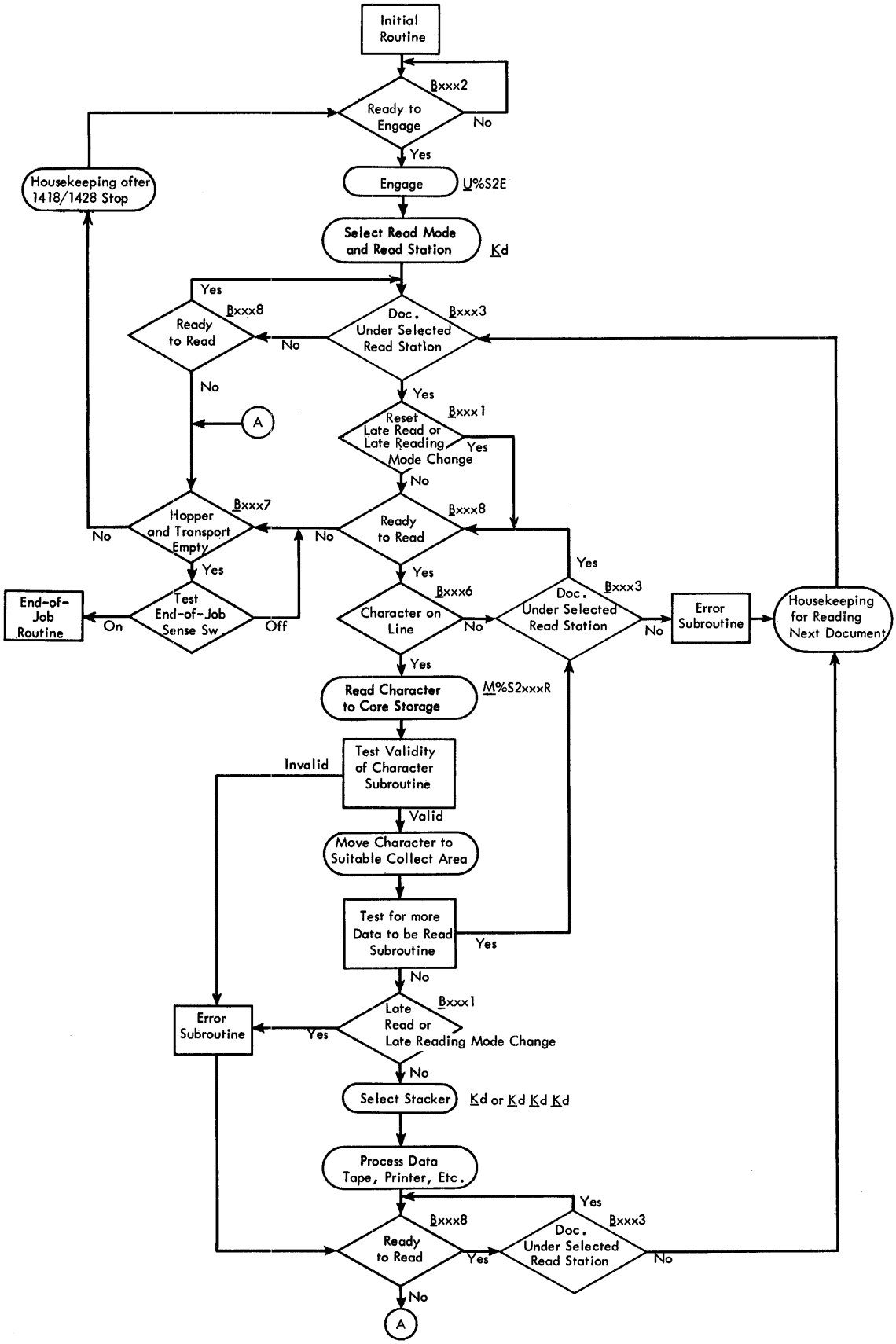


Figure H-40. IBM 1401 or 1460 with 1418 or 1428 General Block Diagram

the regular subroutine for transferring characters to storage. If this happens, failure to execute the late-read reset (see item 4) causes the program to enter the error subroutine.

8. (1428) Test for late-read or late-reading mode change indicator. In addition to performing the same function as in the 1418, the branch-1 indicator can be turned ON because of improperly programmed reading-mode change.
9. Select stacker. If the late-read and other tests such as the check-digit confirm the data as valid, the stored program directs the document to the selected pocket. The optical reader stores the select stacker information until the document reaches the selector station.
10. Process data. The processing unit is now released until the field to be read on the next document is under the selected reading station. The information scanned can be written on tape, printed, or both. If time permits, an *independent* tape-to-printer operation can be performed.
11. Test for DOCUMENT UNDER SELECTED READ STATION. This test, together with the ready-to-read test, delays the program to assure that the document read has left the reading station. This prevents premature re-entry to the character-on-line subroutine for the same document.
12. The program now performs the necessary housekeeping (resetting addresses, clearing storage and output areas, resetting indexes and counters, etc.) and returns to read or to wait for the next document.
13. After the last document, the ready-to-read test does not branch, and the hopper-and-transport-empty test shows that the hopper needs more documents or than an end-of-job condition exists.

Programming Considerations

In planning the stored program, the programmer should consider the factors that contribute to efficient operation of the 1401 or 1460 with 1418 or 1428 system.

Timing

To operate at the speed of the IBM 1401 or 1460 Data Processing System, IBM 1418 or 1428 timing considerations are important. Document speed and spacing, document length (horizontal dimension), character spacing, and field location on the document affect programming.

Computer processing time is available during a portion of the document scanning cycle. This happens when the selected read station is between fields being scanned on the same document, and also between the last field of one document and the first field of the following document. A limited amount of computer process time is also available between characters read in the same field. Although most of this time is consumed in processing the character that is read, any remaining time can be used in other operations, for example, accumulating a check digit. The elapsed time of a document scanning cycle, in milliseconds, can be calculated as follows:

- *Continuous Feeding*
  Document length (in inches), plus .5 inch (minimum space between documents), multiplied by 20 ms per inch (document speed).
- *Noncontinuous Feeding (Single-document feeding)*
  Document length (in inches), plus programmed arbitrary spacing between documents (in inches), multiplied by 20 ms per inch (document speed).

When significant fields of data are scanned, a 1418 or 1428 read instruction must be given for each scanned character since it is stored only temporarily in the 1418 or 1428 on-line register. The character is lost unless it is transmitted to core storage within the allotted period of time. (See *Character-Recognition Rate.*) The uninterrupted duration of available process time is then limited by the character-recognition rate of the scanner and the rules governing a SELECT STACKER instruction.

Document Speed

The time required for a document to pass under a reading station depends on document length. Document speed is approximately 1 inch in 20 ms. Use these factors for calculating document position and time lapse. The document design and PDS (photo document sensor) timing chart (Figure H-41) shows the timing and check points along the document path.

A fullsize drawing of Figure H-41 is available in quantities of 25 in a pad (Form X24-3039) as an aid in determining document position and lapse of time as the document follows the transport path past the sensing station(s). Refer to the *Document Design and PDS Timing Chart* section of the Systems Reference Library publication, IBM *1418 Optical Character Reader and* IBM *1428 Alphameric Optical Reader,* Form A24-1473, for detailed information on the use of this chart.

Character-Recognition Rate

The rate of character recognition depends on character spacing. For various character spacings, the maximum available process time before the next character is recognized is:

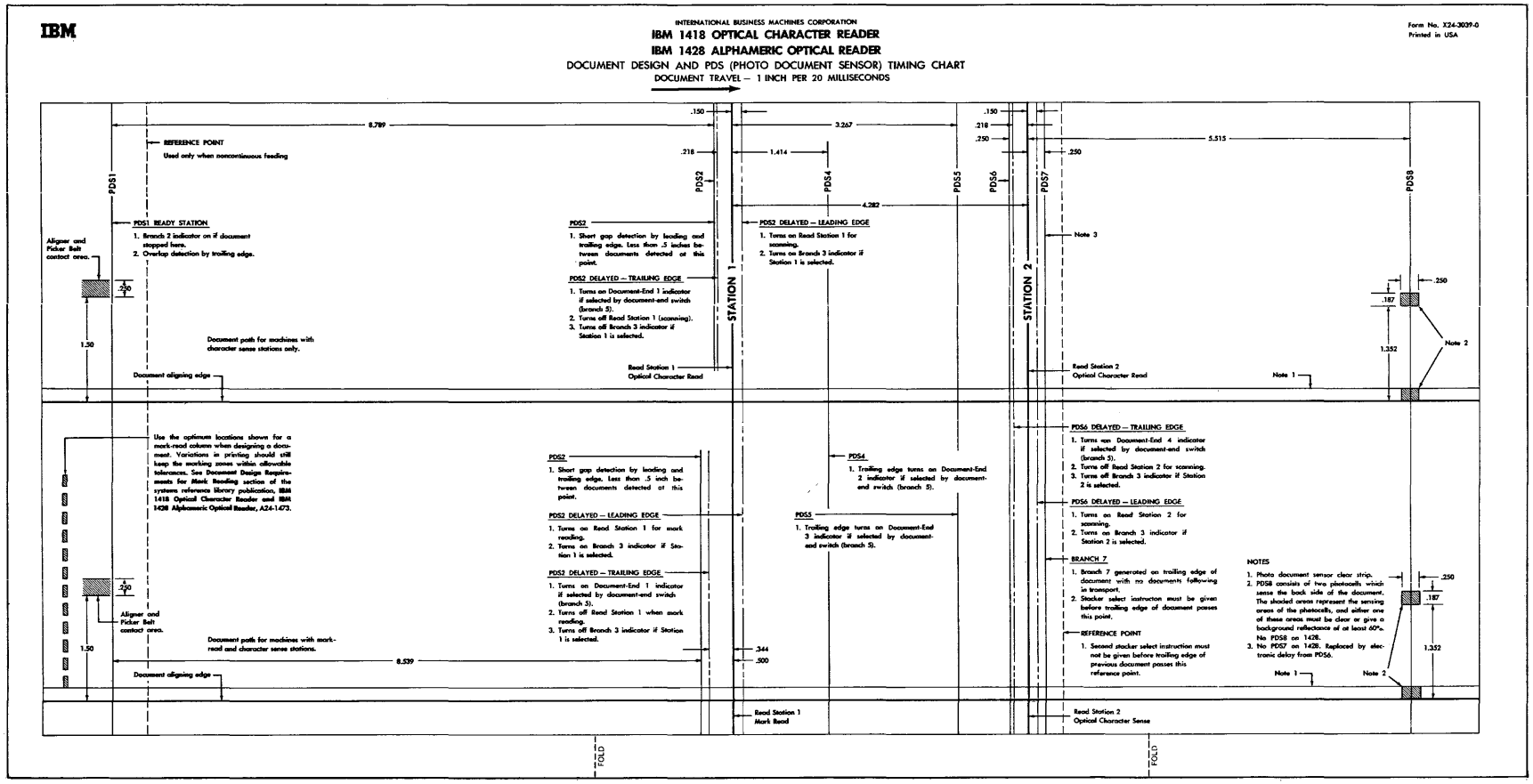


Figure H-41. IBM 1418 or 1428 Document and PDS Timing Chart

Characters per Inch	*Milliseconds*
10	1.5
9	1.7
8	1.9
7	2.3
6	2.7
5	3.3
Mark Reading (minimum spacing – .140 inch)	2.6

Late Read

A read instruction must be executed for each character the 1418 or 1428 places in the on-line register. This instruction must be given before the next character is recognized by the reader.

The 1418 or 1428 tests the register before placing another character on-line. If the previous character has not been transferred to core storage, the new character replaces the character in the register, and the late-read indicator turns ON. The previous character is lost. A BRANCH ON LATE READ (Bxxx1) instruction resets this indicator.

NOTE: The 1428 also branches if the late-reading mode change indicator is ON. Refer to *Branch if Indicator On (1-code)* under IBM *1428 Instructions.*

Multiple-Line Reading

When switching from one reading station to another (special feature), a minimum of 4 ms must be allowed for activating the reading circuits.

Stacker Selection

A SELECT-STACKER instruction *must* be given within 10 milliseconds after the document passes document-end 4 sensing station. The SELECT-STACKER instruction can be given any time before this point is reached. However, the next SELECT-STACKER instruction *must not* be given before the previously selected document passes this point by 15 ms or $\frac{3}{4}$ inch. If a SELECT-STACKER instruction is not given within 10 ms after the document passes document-end 4 sensing station, the 1418 automatically rejects the document, and the operation continues.

When using a 1428, if a SELECT-STACKER instruction is not given within 10 ms, the machine stops and the sort light turns on. However, if no characters on the document are programmed to read into the system, the document is automatically rejected, and the operation continues without signaling a sort-check error. When a document-end switch setting is used to indicate end-of-reading, the maximum time available for a SELECT-STACKER is:

Document-End 1	94 ms
Document-End 2	62 ms
Document-End 3	25 ms
Document-End 4	10 ms

The 1418 or 1428 stores the program-executed SELECT-STACKER request until the designated document reaches the selector station. Document reading can occur while a stacker selection is being executed for a previous document.

Sort Check (1428 only)

The sort-check feature checks the operation of the PDS (photo document sensor) cells and associated circuitry as the document passes through the transport of the scanner. If a photo document sensor failure is detected, the 1428 stops and the sort light (located on the display panel) is turned ON. One of the pocket-check lights located on the display panel is also turned ON. The operating pocket-check light indicates the pocket where the last properly read document was selected. All succeeding documents in flight are also routed to this pocket. Because the number of documents in transport at the time the sort check occurs can vary, it is necessary to remove the top 3 to 5 documents (depending on document length) from the indicated pocket and find the last document that read correctly. All documents behind the correct one must be rerun because they have not been read.

Spacing

Spacing between documents cannot be less than $\frac{1}{2}$ inch. However, for continuous feeding, this spacing averages $1\frac{1}{4}$ inches, depending on the document condition (humidity, temperature, type of stock, and surface conditions). Programmers should allow for no more than 10 ms ($\frac{1}{2}$ inch) processing time between documents. Additional processing time can be obtained by using the time available during a document cycle when reading from the document at the selected read station is either unnecessary, or the scanned data is to be ignored. Additional processing time is also available during the document cycle when document borders, insignificant data, or spaces between fields are passing the selected read station.

An arbitrary amount of time always can be obtained by single-feeding documents under control of the stored program. Document output for single-document feeding is determined by dividing the transport speed (inches per minute) by the sum of the document length (in inches) plus the arbitrary space between documents (in inches). The arbitrary space between documents is controlled by the programmer when feeding single documents. Document output for single-document feeding is always less than the document output for continuous feeding.

Hopper Checks

Invalid Spacing

Spacing of less than $\frac{1}{2}$ inch between documents is detected at read-station 1. If the leading edge of a document (B) reaches document-end 1 sensing station before the previous document (A) leaves read-station 1, document B cannot be read. Document B is automatically rejected and the hopper-check light turns ON without stopping the 1418 or 1428. Branch-3 and branch-6 indicators are prevented from turning ON until the leading edge of the next properly spaced document is detected. However, the trailing edge of document B still activates branch-5 according to the document-end switch setting.

Overlapping

The 1418 or 1428 senses document overlapping when the combined length of two or more consecutive documents exceeds $9\frac{1}{4}$ inches. Overlapped documents are automatically rejected without being read and the hopper-check light turns ON without stopping the 1418 or 1428. Branch-3 and branch-6 indicators are prevented from turning ON until the leading edge of the next properly spaced document is detected. The trailing edge of the last document in the overlapped group activates the branch-5 indicator according to the document-end switch setting.

Because branch-3 and branch-6 indicators are never turned ON for documents causing a hopper check, no erroneous data can ever enter the processing system while these unread, automatically rejected, documents are being scanned.

Programming for Hopper-Check Detection

A programmed combination of branch-3 and branch-5 can be used to establish when hopper checks occur, provided that the setting of the document-end switch is appropriate. To detect a hopper check at read-station 1, the document-end switch must be set at 1. To detect a hopper check at read-station 2, the document-end switch must be set at 4. If, at any time during the document cycle, branch-5 indicator is turned OFF by the leading edge of a document, and branch-3 indicator has *not* been turned ON within 15 ms *after* branch-5 is turned OFF, a hopper check has occurred.

Line Switching

When the IBM 1418 or 1428 is equipped with an additional reading station (special feature), specific distances must be allowed between the last character to be read at one station and the first character at the other station. For switching from station 1 to station 2, the distance cannot be more than 4.05 inches. For switching from station 2 to station 1, the distance cannot be less than 4.45 inches. (See *Switching Stations* in the Systems Reference Library publication, IBM *1418 Optical Character Reader and* IBM *1428 Alphameric Optical Reader,* Form A24-1473.

IBM 1412 Magnetic Character Reader, Model 1

The IBM 1412 Magnetic Character Reader (Figure H-42) can be used as a separate unit to sort documents (off-line), or it can be attached to an IBM 1401 or 1460 Data Processing System with sorting controlled either by the 1412 or by the stored program (on-line). This flexibility permits the most efficient use of both the data processing system and the 1412.

Data Flow

The IBM 1412 reads documents into the processing unit for processing when the reader is instructed by the stored program to feed a document. Control over the selection of data for transmission to the processing unit remains with the 1412 read-field keys.

Sorting functions are identical in the reader on-line mode and reader off-line mode because sorting, in both instances, remains under the control of the 1412.

The stored program must instruct the 1412 to read each document. After the data is read into the processor, the stored program can determine the pocket to which each document is directed by examining the sort-column digit. In the case of error documents, the read-check indicator and the appropriate field-error indicators can be interrogated to determine the type of error.

IBM 1412 Instructions

One IBM 1412 can be connected with the IBM 1401 or 1460 Data Processing System to read magnetic-ink characters. Instructions that control 1412 operations are presented in this section.

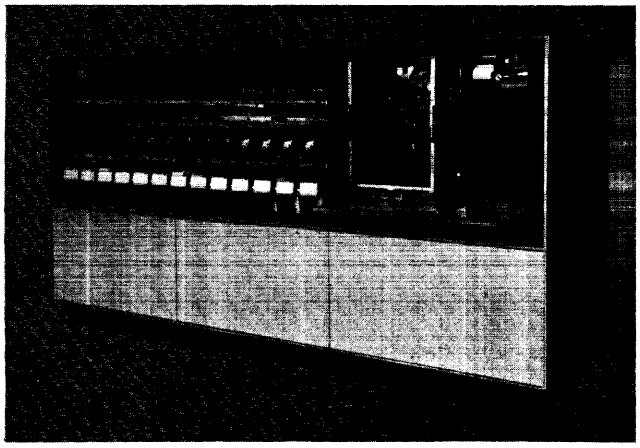


Figure H-42. IBM 1412 Magnetic Character Reader

Engage Magnetic Character Reader

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*d-character*
CU	U	%S1	E

Function. This instruction selects the 1412 and starts document feeding.

This instruction must precede LOAD FROM MAGNETIC CHARACTER READER and MOVE FROM MAGNETIC CHARACTER READER instructions. Once selected, the 1412 begins feeding documents. Document feeding continues until the 1412 is instructed to stop feeding documents, or until a system stop occurs.

Word Marks. Word marks are not affected.

Timing. $T = N\,(L_I + 1)$ ms + I/O.

Refer to the timing chart (Figure H-60).

Example. Engage the 1412 and start feeding documents (Figure H-43).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	WM	(B) OPERAND ADDRESS	±	CHAR. ADJ.	WM	d
3 8	6 7	8 13	14 16	17	23		27	28	34		36	39
0 1 0			C U	%S1								E

Autocoder

Label	Operation	OPERAND
6 15	16 20 21	25 30 35 40 45 50
	C U	%S1,E

Assembled Instruction: U %S1 E

Figure H-43. Engage Magnetic Character Reader

Disengage Magnetic Character Reader

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*d-character*
CU	U	%S1	D

Function. This instruction disengages the 1412 and signals it to stop feeding documents.

Word Marks. Word marks are not affected.

Timing. $T = N\,(L_I + 1)$ ms + I/O.

Refer to timing chart (Figure H-60).

Example. Disengage the 1412 and stop feeding (Figure H-44).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	(B) OPERAND ADDRESS	±	CHAR. ADJ.	d
0,1,0			C,U'	%S,1,						D

Autocoder

Label	Operation	OPERAND
	C,U'	%S,1,,D,

Assembled Instruction: U %S1 D

Figure H-44. Disengage Magnetic Character Reader

Load from Magnetic Character Reader

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
LU	L	%S1	BBB	R

Function. This operation causes a serial transfer of characters from the 1412 to the processing unit. The 1412 must have previously been signaled to begin feeding documents before this instruction can be executed. The data processing system cannot perform any other operation during the execution of this instruction.

The first character (including A. B. A. special symbols) transferred from the reader to the processing unit is placed in the storage location specified by the B-address. Subsequent characters transmitted from the same document enter successively lower storage locations.

When the load instruction is used, a word mark is automatically placed in each storage position containing an A. B. A. special symbol.

NOTE: The read operation is completed when the processing unit receives an end-of-data signal.

The earliest occurrence of the following conditions generates an end-of-data signal:

1. The high-order field-definition symbol for the last field selected for reading passes the read head (photocell 3).

2. The leading edge of the document reaches photocell 3A during processing unit on-line operations. When this condition generates an end-of-data signal, 7.5 ms are available for stacker selection.

3. The trailing edge of the document reaches photocell 3.

4. The processing unit encounters a group-mark with a word-mark in read-in storage.

A read instruction is required for each document. If the leading edge of the document reaches photocell 3 without a read instruction for that document, the late-read indicator turns ON. The indicator turns OFF when the leading edge of the next document reaches photocell 2 (read-ready time for the next document). When the stored program is controlling document distribution, the document must be directed to a pocket with a SELECT STACKER instruction (Kd). When the 1412 controls distribution, the late-read document automatically enters the reject pocket.

Word Marks. The word marks are read into storage as a result of sensing A. B. A. special symbols. Therefore each position in storage containing A. B. A. symbols also contains a word mark.

Timing. $T = N(L_I + 1)$ ms + message length + document movement* + 1.

*Refer to Figure H-60.

Example. Transfer characters serially from the 1412 to area labeled INPUTA (0705) (Figure H-45).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	(B) OPERAND ADDRESS	±	CHAR. ADJ.	d
0,1,0			L,U'	%S,1,			I,N,P,U,T,A,			R

Autocoder

Label	Operation	OPERAND
	L,U'	%S,1,,I,N,P,U,T,A,,R

Assembled Instruction: L %S1 705 R

Figure H-45. Load from Magnetic Character Reader

Move from Magnetic Character Reader

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
MU	M	%S1	BBB	R

Function. This operation is the same as the LOAD FROM MAGNETIC CHARACTER READER operation, with two exceptions:

1. No word marks are placed in storage in those positions containing special symbols.

2. This operation does not clear word marks from storage.

NOTE: If a word mark exists in storage where a group mark is placed by an end-of-data signal, the storage position thereafter contains a group-mark with a word-mark.

Word Marks. Word marks are not affected.

Timing. T = N (L_I + 1) ms + message length + document movement* + 1.

*Refer to Figure H-60.

Example. Transfer characters serially from the 1412 to area labeled INPUTA (0705) (Figure H-46).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	(B) OPERAND ADDRESS	±	CHAR. ADJ.	d
			MU	%S1,			INPUTA			R

Autocoder

Label	Operation	OPERAND
	MU	%S1,INPUTA,R

Assembled Instruction: M %S1 705 R

Figure H-46. Move from Magnetic Character Reader

Select Stacker — Magnetic Character Reader

Instruction Format.

Mnemonic	*Op Code*	*d-character*
SS	K	x (See Figure H-47)

Function. This instruction directs the document that was just read by the reader to the reader pocket specified by the d-character.

The reader must be operating in the processing unit on-line mode to execute this instruction. If this instruction is given when the reader is operating in the reader on-line mode, the 1412 feeding stops and the processing unit light turns on.

The d-character (A-M) representing one of the 13 reader pockets is sent to the 1412 and activates the chute blade that directs the document to the selected pocket.

The SELECT STACKER instruction must be given before the document reaches photocell 4. Processing time available to determine pocket selection depends on the position of the leading edge of the document when all required reading has been completed. For example, a minimum of 13 ms is available for pocket selection if the transit-routing field is the last read field selected.

d-character	Reader Pocket
A	A
B	B
C through L	0 through 9
M	Reject

Figure H-47. Select Stacker d-Character

If the trailing A. B. A. field-definition symbol is missing from the last read field selected, an end-of-data signal is provided by either photocell 3 or 3A to guarantee at least 7.5 ms for a SELECT STACKER decision.

Photocell 3A is located in the transport mechanism in such a position that the end-of-data signal occurs after all possible inscribing positions on the document have passed under the read head. If a SELECT STACKER instruction is not given in time, the 1412 stops feeding documents (sort-compare) and directs all documents that have left the separator station to the reject pocket.

Word Marks. Word marks are not affected.

Timing. T = N (L_I + 1) ms.

Example. Select the document that was just read into pocket number 1 (Figure H-48).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	(B) OPERAND ADDRESS	±	CHAR. ADJ.	d
			S,S'							D

Autocoder

Label	Operation	OPERAND
	S,S'	D

Assembled Instruction: K D

Figure H-48. Select Document into Stacker 1

Branch if Magnetic Character Reader Late-Read Indicator On

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
B	B	xxx	1

Function. This operation tests the 1412 to determine whether or not it has detected a late-read condition (document reaching photocell 3 without a READ in-

struction for that document). This indicator turns off when the next document creates a read-ready condition.

Word Marks. Word marks are not affected.

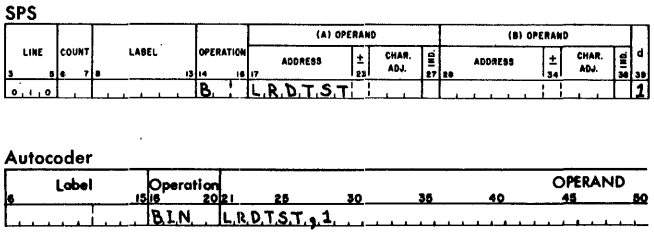
Timing.

No Branch:
$T = N(L_I + 1)$ ms.

Branch (without indexing):
$T = N(L_I + 1)$ ms.

Branch (with indexing):
$T = N(L_I + 2)$ ms.

Example. Test the late-read indicator. If the indicator is ON, branch to LRDTST (0623) (Figure H-49).



Assembled Instruction: B 623 1

Figure H-49. Branch if Magnetic Character Reader Late Read Indicator On

Branch if Magnetic Character Reader Read-Not-Ready Indicator On

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
B	B	xxx	2

Function. This instruction tests the read-not-ready indicator and branches to the instruction specified by the I-address when the indicator is ON. The leading edge of a document passing photocell 2 turns off the indicator when the trailing edge of the previous document has passed under photocell 3. This occurs for the 15 ms prior to the reading of the document. This indicator turns on when the leading edge of the document passes photocell 3. A read instruction should be given only when the read-not-ready indicator is OFF.

Word Marks. Word marks are not affected.

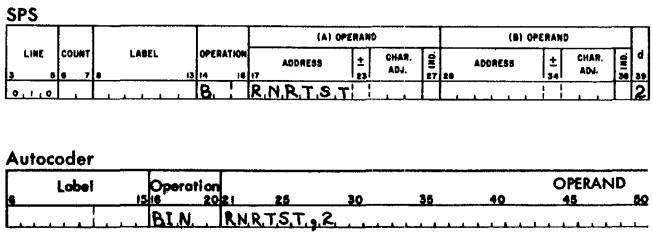
Timing.

No Branch:
$T = N(L_I + 1)$ ms.

Branch (without indexing):
$T = N(L_I + 1)$ ms.

Branch (with indexing):
$T = N(L_I + 2)$ ms.

Example. Test the read-not-ready indicator. If the indicator is ON, branch to RNRTST (0735) (Figure H-50).



Assembled Instruction: B 735 2

Figure H-50. Branch if Magnetic Character Reader Read-Not-Ready Indicator On

Branch if Magnetic Character Reader Read-Check Indicator On

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
B	B	xxx	3

Function. This operation tests the read-check indicator and branches to the instruction specified by the I-address when the indicator is ON. The indicator turns ON during a read operation if any of the selected fields have:

1. an unreadable digit or symbol
2. a wrong sequence of symbols
3. missing digits or symbols
4. a missing field
5. an account number self-check-digit verification error.

This indicator turns OFF when the leading edge of the next document passes photocell 3.

Word Marks. Word marks are not affected.

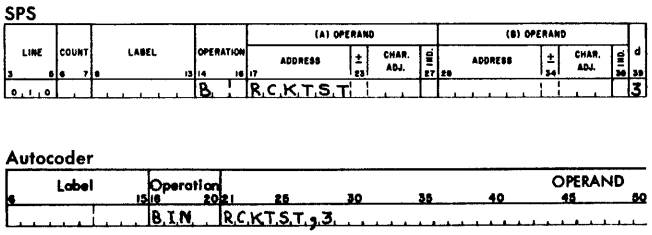
Timing.

No Branch:
$T = N(L_I + 1)$ ms.

Branch (without indexing):
$T = N(L_I + 1)$ ms.

Branch (with indexing):
$T = N(L_I + 2)$ ms.

Example. Test the read-check indicator. If the indicator is ON, branch to RCKTST (0432) (Figure H-51).



Assembled Instruction: B 432 3

Figure H-51. Branch if Magnetic Character Reader Read-Check Indicator On

Branch if Magnetic Character Reader Amount-Field Indicator On

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
B	B	xxx	4

Function. This operation tests the amount-field indicator and branches to the instruction specified by the I-address when the indicator is ON. The indicator turns ON during a 1412 read operation if:

1. Any of the characters in the amount field (including the amount special symbols) are unreadable.
2. Special symbols are missing or out of sequence.
3. The field is missing.
4. The field length is invalid.
5. The late-read indicator is ON. The amount-field indicator turns OFF when the leading edge of the next document passes photocell 3.

Word Marks. Word marks are not affected.

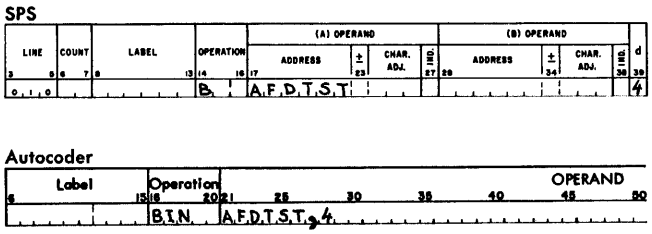
Timing.

No Branch:
$T = N(L_I + 1)$ ms.

Branch (without indexing):
$T = N(L_I + 1)$ ms.

Branch (with indexing):
$T = N(L_I + 2)$ ms.

Example. Test the amount-field indicator. If the indicator is ON, branch to AFDTST (0688) (Figure H-52).



Assembled Instruction: B 688 4

Figure H-52. Branch if Magnetic Character Reader Amount-Field Indicator On

Branch if Magnetic Character Reader Process-Control Field Indicator On

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
B	B	xxx	5

Function. This operation tests the process-control field indicator and branches to the instruction specified by the I-address when the indicator is ON. The indicator turns ON during a 1412 read operation if:

1. Any of the characters in the process-control field (including the special symbols) are unreadable.
2. The field is missing.
3. Special symbols are out of sequence or are missing.
4. The field length is invalid.
5. The late-read indicator is ON. The process-control field indicator turns OFF when the leading edge of the next document passes photocell 3.

Word Marks. Word marks are not affected.

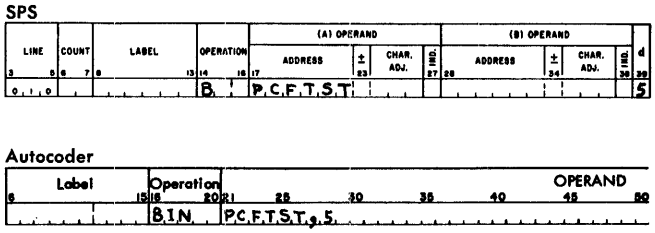
Timing.

No Branch:
$T = N(L_I + 1)$ ms.

Branch (without indexing):
$T = N(L_I + 1)$ ms.

Branch (with indexing):
$T = N(L_I + 2)$ ms.

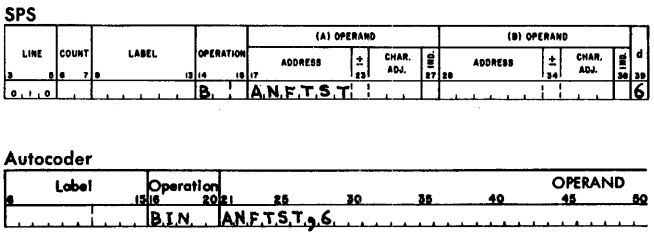
Example. Test the process-control field indicator. If the indicator is ON, branch to PCFTST (0892) (Figure H-53).



Assembled Instruction: B 892 5

Figure H-53. Branch if Magnetic Character Reader Process-Control Field Indicator On

Example. Test the account-number field indicator. If the indicator is ON, branch to ANFTST (0392) (Figure H-54).



Assembled Instruction: B 392 6

Figure H-54. Branch if Magnetic Character Reader Account-Number Field Indicator On

Branch if Magnetic Character Reader Account-Number Field Indicator On

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
B	B	xxx	6

Function. This operation tests the account-number field indicator and branches to the instruction specified by the I-address when the indicator is ON. The indicator turns ON during a 1412 read operation if:
1. Any of the characters in the account-field (including the special symbols) are unreadable.
2. The field is missing.
3. Special symbols are missing or out of proper sequence.
4. The field length is invalid.
5. The late-read indicator is ON. If the 1412 is equipped with the self-checking number special feature, self-checking digit errors also turn ON the account-number field indicator. The account-number field indicator turns OFF when the leading edge of the next document passes the photocell 3.

Word Marks. Word marks are not affected.

Timing.

No Branch:
$T = N(L_I + 1)$ ms.

Branch (without indexing):
$T = N(L_I + 1)$ ms.

Branch (with indexing):
$T = N(L_I + 2)$ ms.

Branch if Magnetic Character Reader Transit-Routing Field Indicator On

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
B	B	xxx	7

Function. This operation tests the transit-routing field indicator and branches to the instruction specified by the I-address when the indicator is ON. The indicator turns on during a 1412 operation if:
1. Any of the characters in the transit-routing field (including the special symbols) are unreadable.
2. The field is missing.
3. Special symbols (except the dash) are missing or out of sequence.
4. The field length is invalid.
5. The late-read indicator is ON. The transit-routing field indicator turns off when the leading edge of the next document passes photocell 3.

Word Marks. Word marks are not affected.

Timing.

No Branch:
$T = N(L_I + 1)$ ms.

Branch (without indexing):
$T = N(L_I + 1)$ ms.

Branch (with indexing):
$T = N(L_I + 2)$ ms.

Example. Test the transit-routing field indicator. If the indicator is ON, branch to TRFTST (0543) (Figure H-55).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	(A) OPERAND ±	(A) OPERAND CHAR. ADJ.	(A) OPERAND IND.	(B) OPERAND ADDRESS	(B) OPERAND ±	(B) OPERAND CHAR. ADJ.	(B) OPERAND IND.	d
0			B	TRFTST								7

Autocoder

Label	Operation	OPERAND
	BTN	TRFTST,7

Assembled Instruction: B 543 7

Figure H-55. Branch if Magnetic Character Reader Transit-Routing Field Indicator On

Branch if Magnetic Character Reader Document-Spacing Check Indicator On

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
B	B	xxx	8

Function. This instruction tests the document-spacing check indicator and branches to the instruction specified by the I-address when the indicator is ON. The testing must be made only after the trailing edge of the document passes photocell 3. This is nearly equivalent to read-ready time.

The document-spacing check indicator turns on when there is less than a minimum space between documents, or when a document is longer than a specified maximum.

This indicator turns off when the leading edge of the next document passes photocell 3.

Word Marks. Word marks are not affected.

Timing.

No Branch:
$T = N(L_I + 1)$ ms.

Branch (without indexing):
$T = N(L_I + 1)$ ms.

Branch (with indexing):
$T = N(L_I + 2)$ ms.

Example. Test the check indicator, and branch to location labeled DSCTST (0650) (Figure H-56).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	(A) OPERAND ±	(A) OPERAND CHAR. ADJ.	(A) OPERAND IND.	(B) OPERAND ADDRESS	(B) OPERAND ±	(B) OPERAND CHAR. ADJ.	(B) OPERAND IND.	d
0			B	DSCTST								8

Autocoder

Label	Operation	OPERAND
	BTN	DSCTST,8

Assembled Instruction: B 650 8

Figure H-56. Branch if Magnetic Character Reader Document-Spacing Check Indicator On

IBM 1412 Programming Considerations

The conditions described in this section are items that will assist the programmer in developing the programs.

Document Spacing Error

The document-spacing indicator turns ON if:
1. The space between documents at the read station is less than 3 inches.
2. The distance between leading edges of adjacent documents at photocells 3 and 4 is less than 9 inches.
3. The document is more than 9 inches long.

If the indicator is ON at read-ready time, the document just read is directed to the reject pocket, regardless of SELECT-STACKER instructions.

Engage Line

After the engage line is turned on by an ENGAGE 1412 instruction, it is turned OFF only:
1. by a DISENGAGE 1412 instruction.
2. by pressing START/RESET on the 1401.
3. if the 1401 check-reset light is ON.

These machine errors require a restart procedure. This restart procedure must always include an ENGAGE 1412 instruction.

Serial Number (Auxiliary On-Us) Field

These facts should be considered when processing data from the serial number field:
1. When operating in the processing unit on-line mode, inscribing in the serial number field must *not* extend beyond 7¼ inches from the leading edge if the serial number is to be read.
2. The reader on-line mode allows reading beyond the first 7¼ inches of a document.
3. There is no field-length count on the serial number field.

Word Marks

A word mark accompanies each special symbol read into the processing unit when the LOAD instruction is used. All special symbols (except the dash symbol) associated with active read fields read into the system.

Group Marks

A group mark only enters storage in the processing unit at the end of each READ FROM 1412 operation.

Clearing Storage After Read Error

The read-in area should be cleared before each READ FROM 1412 operation. This is to ensure that only data from the document currently being read is in storage at the end of any read operation.

Data in Storage

A field cannot be read if the proper leading special symbol of that field is not recognized. The field is terminated by recognition of the proper trailing special symbol or any other field definition special symbol. (Dashes are not interpreted as field definition special symbols.) The following examples are used to illustrate the preceding statements. Note that a field is not valid unless it has the proper leading symbol and the proper trailing symbol. For the examples, a document containing all fields except the serial number field has been chosen. All inscribed fields on the document have been selected.

Data Stored Without Read Errors

Figure H-57 illustrates data correctly inscribed. Figure H-58 illustrates its appearance in storage.

Data Stored with Read Error Conditions

1. If the low-order amount field symbol (1 S S 1) is not identified, nothing enters storage until a special symbol is identified. The dollar amount field never enters storage. The amount and process control fields are in error. All fields except the amount field enter storage (Figure H-59). Note that the dash does not enter storage.
2. If the second amount symbol (2 S S 1) is not identified, the dollar amount field and process control field are in error. They appear in storage with the second amount-symbol represented as an asterisk. All other fields are in storage.

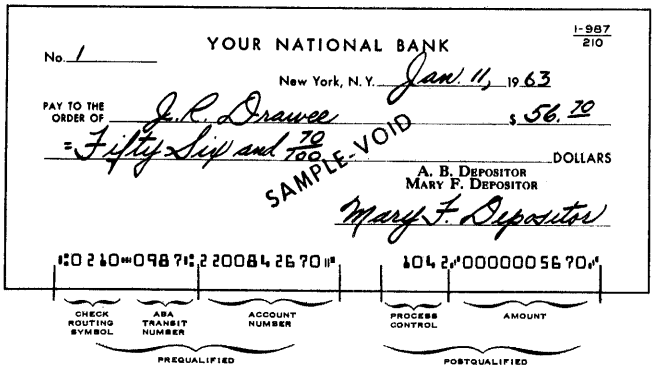


Figure H-57. Inscribed 6-Inch Check

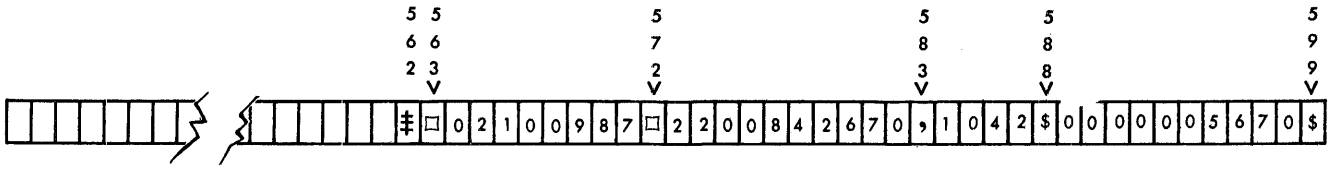


Figure H-58. Data Read into Storage Correctly

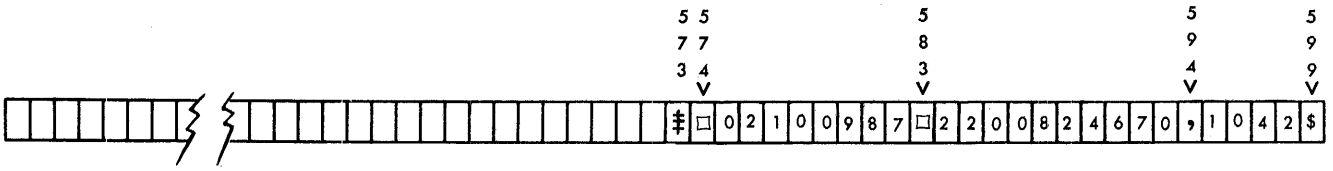


Figure H-59. Data Read into Storage, First Amount Symbol not Identified

3. If the first on-us symbol (1 S S 2) is not identified, the process control and account number fields are in error. They appear in storage with the first on-us symbol represented as an asterisk. All other fields are in storage.
4. If the first transit symbol (1 S S 3) is not identified, the account number and transit fields are in error. They appear in storage with the first transit symbol represented as an asterisk. All other fields are in storage.
5. If the second transit symbol (2 S S 3) is not identified, the transit field is in error. The second transit symbol appears an as asterisk. All other fields are in storage. When operating in the processing unit on-line mode, the end of data occurs, for documents less than 7¼ inches long, when the trailing edge of the document passes photocell 3, and for documents 7¼ inches or longer, when the leading edge of the document passes photocell 3A. When operating in the reader on-line mode, the end of data occurs when the trailing edge of the document passes photocell 3.
6. If a dash in the transit field is not identified, the transit field is in error. An asterisk appears as an extra character position in storage.
7. A missing dash (S S 4), a missing blank space, extra dashes, or extra blank spaces cause no read-in errors. Blank spaces and missing dashes are not transmitted to storage.
8. A missing character in any field causes that field to be in error. It forces all data that is to the left of the missing character on the check to shift one position up in storage.
9. An unreadable character (including the dash symbol) causes that field to be in error and an asterisk to be inserted in that position.
10. A missing field symbol is the same as an unreadable symbol except that an asterisk is not placed in storage.
11. If the transit routing field is not selected and the first transit symbol (1 S S 3) is not identified, the 1412 continues to load the transit field and stops after sensing the second transit symbol. The first transit symbol enters storage as an asterisk. The account number field is in error. The account number field and the transit field enter storage. For this example, assume that the account number field has been selected.
12. If the amount and transit fields are selected and the second amount symbol is not sensed, the 1412 continues to read data into storage until it senses a field-definition special symbol or an end-of-data condition.
13. If the amount and transit fields are selected and the first transit symbol is not sensed, only the amount field and the second transit symbol enter storage. The 1412 considers the second transit symbol to be the first transit symbol (1 S S 3) and continues to read data until it senses an end-of-data condition. If the serial number is on the check, sensing an *on-us* symbol causes an end-of-data signal.
14. A second on-us symbol (S S S 2) before the first transit symbol (1 S S 3) is acceptable. The S S S 2 acts as a closing symbol for the account number field and takes an extra position in storage. If the S S S 2 is unreadable, the account number field is in error and an asterisk enters storage, even though the first transit symbol is readable.
15. If the SSS 2 is missing but the first SS 3 is present and readable, the account number field enters storage as a valid field.
16. Any special symbol conflict causes all field error latches to turn on.

Stop Conditions

The stored program must be written to handle stops initiated in the data processing system.

Whenever possible, system stops should be initiated by pressing the 1412 stop-restore key. When this is done, source documents stop feeding in the 1412. All data read is properly entered into the system and correctly processed. The system can then be stopped with a minimum of problems, and the program will have stopped in a read-not-ready condition. All additional processing will have been accomplished.

Whenever any other stop key in the system is pressed, the stored program executes the instruction being handled. Then, the processing unit stops operating.

All documents in the 1412 whose leading edges are past photocell 1 when the processing unit stops continue to feed through the reader. Those whose leading edges are past photocell 4 have been read into the system, and have been correctly distributed. Those whose leading edges have not reached photocell 4, but whose active read-fields have passed the read head when the system stops, have entered data into the system correctly, but have not been properly distributed. Those that have started under the read head but whose active data fields have not completely passed under the read head, have entered part of their data into the system, and have not been assigned distribution. Those whose leading edges have not yet reached photocell 3 have been neither read nor assigned distribution.

A system error stop acts upon the 1412 in the same manner.

The stored program, therefore, must be written to print out (or otherwise indicate to the operator) the last data entered into storage. With this information the operator can determine the last document read and verify the accuracy of document distribution. This print-out indication is also needed in case of 1412 jams and 1412 emergency stops.

IBM 1412 Timings

Determining the 1412 Feeding Rate

The facts needed to develop a formula for the 1412 feeding rate are:

1. Documents move through the 1412 at a rate of 5 ms per inch.
2. The average space between documents approximates the average length of the documents.
3. One millisecond is equal to 1/1000 of one second.

To find the average 1412 document cycle time:

1. Determine the average length of the documents.
2. Multiply this figure by two. (This accounts for the space between documents.)
3. Multiply this result by 5 (ms per inch). This product is the average number of milliseconds required for each document.

Example: If the average document length is 8 inches, then 8 in/doc. $\times 2 \times 5$ ms/in. $= 80$ ms per document. Because 2 and 5 are constants, they can be combined to arrive at the formula: $A \times 10 =$ ms/document, where A is the average length of the document.

However, a figure in documents-per-minute will be more practical. To determine the number of milliseconds per minute, multiply 1000 (ms per sec.) $\times 60$ (seconds per minute). $1{,}000 \times 60 = 60{,}000$ milliseconds in a minute.

To determine the number of documents per minute, divide the number of milliseconds per minute by the document cycle time (in milliseconds). Therefore, the formula is:
$60{,}000 \div (A \times 10)$, or
$6{,}000 \div A$

Example: Using the example of 8 inches for an average document:
$6{,}000 \div 8 = 750$ documents per minute.

Feed Call

Figure H-60 illustrates, schematically, the path of a document through the 1412. The positions of five photoelectric cells, which detect the presence or absence of a document, are shown.

Pressing the 1412 start key feeds documents to photocell 1. To move documents past photocell 1 when operating on-line, the stored program must initiate a *1412 feed call* by supplying an ENGAGE *1412* instruction. During normal operations, the feed call is available when documents reach photocell 1. This allows a continuous flow of documents from the separator station. However, if a feed call is not available when the leading edge of a document is sensed at photocell 1, the document stops. If a feed call is interrupted at any time after its leading edge is sensed at photocell 1, that document feeds on to a pocket.

Conditions that Interrupt the Feed Call. Conditions that interrupt a feed call and stop document feeding with a document under photocell 1 are:

1. A DISENGAGE 1412 instruction has been issued.
2. A pocket in the 1412 is full.
3. The unload-pocket/restart key has been pressed.
4. No read-field key was pressed for a processing unit-on-line operation.
5. The electronic accumulator — sequence checking feature is executing a print cycle.
6. The machine is single-cycling in the customer-engineering single-feed mode.

All these conditions except the disengage instruction cause the stored program to enter a programmed read-not-ready loop (no document sensed by photocell 2).

Time Between Documents

The minimum time between documents is 15 ms.

Documents in Flight

A disengage 1412 instruction interrupts the feed call. Any documents whose leading edges have passed photocell 1 must be processed by the processing unit program.

Photocell 3 is located near the read head. The distance between photocell 1 and photocell 3 is $10^{13}/_{16}$ inches. Normally, the spacing between documents is approximately equal to the length of the trailing document. The minimum spacing is 3 inches. Considering the minimum length check (6 inches) and the minimum spacing requirements, a program would, under valid conditions, need to handle the processing of two documents after a disengage instruction. However, if

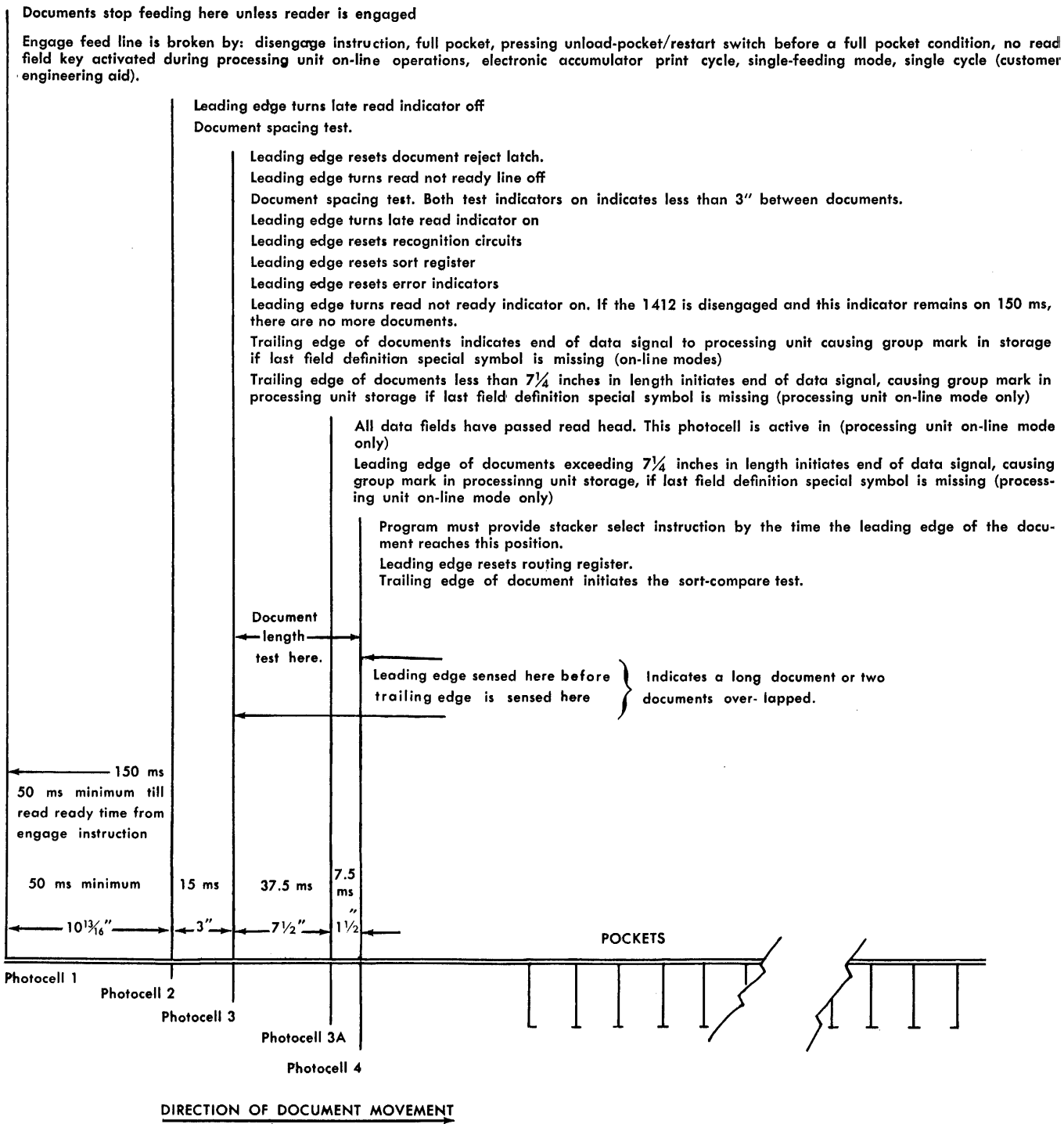


Figure H-60. Timing Chart

less than the minimum spacing is present, or a document is short, it is possible to have as many as three documents whose leading edges have passed photocell 1, but have not yet reached the read head. Because every one of these documents must be read and distributed (if only to determine invalid spacing), the program should be written to handle three documents after every disengage instruction.

When a read-not-ready condition exists for 115 ms after a disengage 1412 instruction has been executed, the stored program can proceed as if there are no more documents to be processed.

Select Stacker Timings

Processing time for stacker selection begins with the end-of-data signal. The SELECT STACKER instruction must be available to the 1412 when the document reaches photocell 4. The time available for selection can be determined by measuring the distance between the leading edge of the document and photocell 4 when the stored program receives an end-of-data signal.

A formula for select-stacker time is: $(9 - R) \times 5$.

9 = inches between read head and photocell 4.
R = distance between the leading edge of the document and the read head when the end-of-data signal is generated.
5 = number of milliseconds per inch of document travel.

When no read-error occurs, these timings apply:

1. *Amount field only is selected.* The available time is 35 ms for stacker selection and 35 ms for processing.
2. *Process control field is last field selected.* Timing depends upon the maximum number of digits to be read. Use the formula to determine select-stacker and processing time.
3. *Account number field is last field selected.* Read fields can use $4^{15}/_{16}$ inches of document space. Available time is 20 ms for stacker selection and 20 ms for processing.
4. *Transit routing field is the last field selected.* The transit/routing field can extend as far as $6^{3}/_{16}$ inches from the leading edge. This condition allows 13 ms for stacker selection and 15 ms for processing.
5. *Serial number field is selected.* If the serial number field is selected, only 7½ ms are available for stacker selection. Because this field may not be inscribed on some documents, the end-of-data signal must be generated by the leading edge of the document passing photocell 3A. Processing time is 15 ms.

NOTE: More than 7½ ms may be available for stacker selection when:
1. the document is completely read before the leading edge of the document reaches photocell 3A.
2. the document is less than 7½ inches long.
3. a group-mark with a word-mark is reached in storage.

Because it is impossible to estimate the actual time available in such cases, 7½ ms should be used as the minimum time available for processing and program-sorting the error document.

IBM 1419 Magnetic Character Reader

When attached to an IBM 1401 or 1460 Data Processing System, the IBM 1419 Magnetic Character Reader (Figure H-61) permits fast and direct entry of banking transactions into core storage. Data, in the form of magnetically inscribed characters, is read from documents and transferred into core storage for processing. During this time, the documents are selected into stackers specified by the stored program.

IBM 1419 Instructions

The instructions presented in this section are those used by the IBM 1401 or 1460 Data Processing Systems and those data processing systems wherein the instructions are compatible with the 1401 or 1460. Any other data processing system to which the 1419 is attached must provide the 1419 with similar instructions. Actual instructions for these systems can be found in reference material for the specified data processing system.

Unless the mnemonic is identified as either a *Symbolic Programming System (SPS)* mnemonic or an *Autocoder (A)* mnemonic, the one shown applies to both.

One 1419 can be connected with the IBM 1401 or 1460 Data Processing Systems to read magnetic-ink characters. Instructions that control 1419 activity are presented in this section.

Unit Control

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*d-character*
CU	U	%S1	x

Function. This instruction controls the operation of the IBM 1419. Its function depends on the character in the d-character position of the instruction.

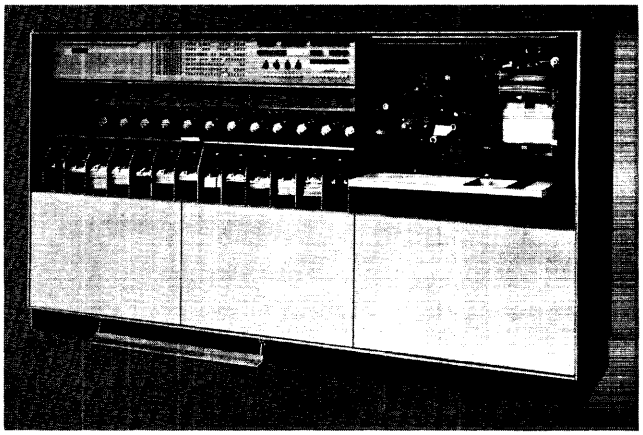


Figure H-61. IBM 1419 Magnetic Character Reader

d-Character	*Operation*
E	ENGAGE: Selects the magnetic character reader and instructs it to start feeding documents continuously. This document-feeding capability continues until the 1419 is instructed to stop feeding documents (DISENGAGE) or until a system-stop occurs.
D	DISENGAGE: Instructs the 1419 to stop feeding documents.

Word Marks. Word marks are not affected.

Timing. $T = N(L_I + 1)$ ms + I/O.

Note. When operating in the overlap mode, an interlock occurs whenever an ENGAGE 1419 or a DISENGAGE 1419 instruction is issued while the channel is busy. Therefore, always test to determine that the I/O channel is not busy before issuing one of these instructions during overlap-mode operations.

Example. Engage the 1419 and start feeding of documents (Figure H-62).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	WM	(B) OPERAND ADDRESS	±	CHAR. ADJ.	WM	d
3 8	9 6 7 8		12 13 14 16	17	23		27	28	34		36	39
0 , 1 , 0			C,U,	%,S,1,								E

Autocoder

Label	Operation	OPERAND
1 6	15 16 20	21 25 30 35 40 45 50
	C,U,	%,S,1,,E,

Assembled Instruction: U %S1 E

Figure H-62. Unit Control (Engage)

Read Instructions

There are four different instructions that can be used to read information from the 1419 into processing-unit storage. One of these must be issued for each document before that document reaches PDS 4 at the read head. Otherwise, a read-instruction late error (commonly called a late-read error) occurs.

A read instruction always causes the I/O channel to become busy as soon as the instruction is issued. Any document under the read head when the read instruction is issued (the late-read document) is not read. The read instruction intended for the late-read document does not end when PDS 4 senses the trailing edge of the late-read document, but remains effective for the next document to reach the read head, unless an end-of-data is generated by a system-restart procedure or by programming.

A late-read instruction, therefore, causes the channel to be busy from the time the instruction is issued until the next end-of-data occurs. The end-of-data is usually

generated by the following document. Thus, after a read instruction is issued, a condition of a document under the head, followed by no document under the read head and a simultaneous channel-busy indication, indicates that the last read instruction was issued too late.

When the system is operating in the overlap mode, an interlock occurs whenever a read instruction is issued while the channel is busy. Therefore, always test to determine that the I/O channel is not busy before issuing a read in overlap instruction.

Late-read documents are always sent to the reject pocket by the 1419, regardless of stored-program stacker selection. Late-read pocket selection never forces a sort-compare condition, however.

The read instruction is completed when the processing unit receives an end-of-data signal. An end-of-data signal occurs when the trailing edge of the document being read passes PDS 4, when the processing unit encounters a word-mark with a group-mark in the read-in storage area, or (when operating in the process-overlap mode) when the program issues a K□ instruction, whichever occurs the earliest.

Read from 1419 in Load Mode

Instruction Format.

Mnemonic		*Op Code*	*A-address*	*B-address*	*d-character*
SPS	LCA	L	%S1	xxx	R
A	LU				

Function. This operation causes a serial transfer of characters from the 1419 to the processing unit. The data processing system cannot perform any other operation during the execution of this instruction.

The first character (including the A.B.A. special symbols) transferred from the reader to the processing unit enters the storage location specified by the B-address. Subsequent characters transmitted from the same document enter successively lower storage locations.

Word Marks. When the load instruction is used, a word mark automatically enters each storage position containing any A.B.A. special symbol, except the dash (SS4). The dash is transmitted as a B-bit when it is read from a variable-length field. Also, word marks in the storage area specified by the B-address are destroyed by the loading.

Timing. $T = N(L_I + 1)$ ms + message length + document movement* + 1.

*Refer to Figure H-81.

Example. Transfers data from the reader to core-storage area labeled READIN (0785) (Figure H-63).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	IND.	(B) OPERAND ADDRESS	±	CHAR. ADJ.	IND.	d
3 6	6 7	8 13	14 16	17 23			27	28 34			38	39
0 1 0			L C A	%S 1				R E A D I N				R

Autocoder

Label	Operation	OPERAND
6 15	16 20	21 25 30 35 40 45 50
	L U	%S 1 , R E A D I N , R

Assembled Instruction: L %S1 785 R

Figure H-63. Read from 1419 in Load Mode

Read from 1419 in Load Mode (Overlapped)

Instruction Format.

Mnemonic		*Op Code*	*A-address*	*B-address*	*d-character*
SPS	LCA	L	@S1	xxx	R
A	LU				

Function. This instruction can be used only when the 1401 or 1460 is equipped with the processing-overlap feature. Normally, without this feature, the processing unit is not released for operation until an end-of-data signal is received from the 1419, thereby signifying completion of reading.

This instructioin is similar to the preceding one in that it prepares the processing system to accept information from the document being read, but it also permits the system to continue operating without waiting for all the data to be read from a document.

When a 1401 or 1460 overlapped-tape read or read-from-1419 instruction is issued, the internal circuitry of the 1401 or 1460 processing-overlap feature forces the d-character (R) of the instruction into the first position of the specified read-in area. The R remains in this position until the tape or 1419 transmits a character to replace it, or an end-of-transmission signal causes the R to be replaced by a group mark. If this first position is used to check for a blank field before the first character arrives from the tape or 1419, the R (stored d-character) gives a false indication of the contents of the read-in area.

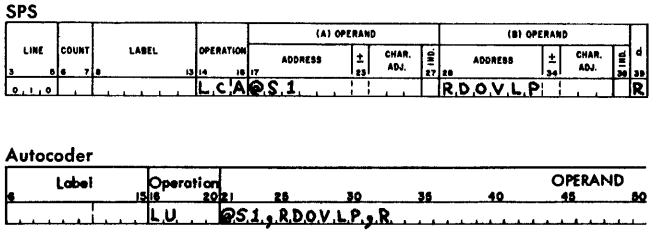
To ensure proper system operation under these conditions, check some position of the field other than the first position to determine whether or not the field is blank.

Word Marks. Word marks are cleared in storage except when a word-mark with a group-mark is sensed, which stops the operation.

Timing. T = N (L_I + 1) ms + message length + document movement* + 1.

*Refer to Figure H-81.

Example. Transfers data from the reader to core-storage area labeled RDOVLP (0745) (Figure H-64).



Assembled Instruction: L @S1 745 R

Figure H-64. Read from 1419 in Load Mode (Overlapped)

Read from 1419 in Move Mode

Instruction Format.

Mnemonic		*Op Code*	*A-address*	*B-address*	*d-character*
SPS	MCW	M	%S1	xxx	R
A	MU				

Function. This instruction is the same as the READ IN LOAD MODE instruction (without processing overlap feature) with two exceptions:

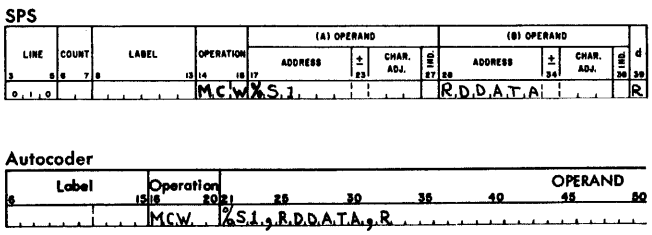
1. No word marks are placed in those storage positions containing special symbols.
2. This operation does not clear word marks from storage.

Word Marks. Word marks are not affected, except as stated under the function description.

Timing. T = N (L_I + 1) ms + message length + document movement* + 1.

*Refer to Figure H-81.

Example. Transfers data from the reader to core-storage area labeled RDDATA (0675) (Figure H-65).



Assembled Instruction: M %S1 675 R

Figure H-65. Read from 1419 in Move Mode

Read from 1419 in Move Mode (Overlapped)

Instruction Format.

Mnemonic		*Op Code*	*A-address*	*B-address*	*d-character*
SPS	MCW	M	@S1	xxx	R
A	MU				

Function. This instruction can be used only when the 1401 or 1460 is equipped with the processing-overlap feature. It performs the same function as READ FROM 1419 IN MOVE MODE, except that it releases the processing unit for operation even though the data has not been completed.

When a 1401 or 1460 overlapped tape-read or read-from-1419 instruction is issued, the internal circuitry of the 1401 or 1460 processing-overlap feature forces the d-character (R) of the instruction into the first position of the specified read-in area. The R remains in this position until the tape or 1419 transmits a character to replace it, or an end-of-transmission signal causes the R to be replaced by a group mark. If this first position is used to check for a blank field before the first character arrives from the tape or 1419, the R (store d-character) gives a false indication of the contents of the read-in area.

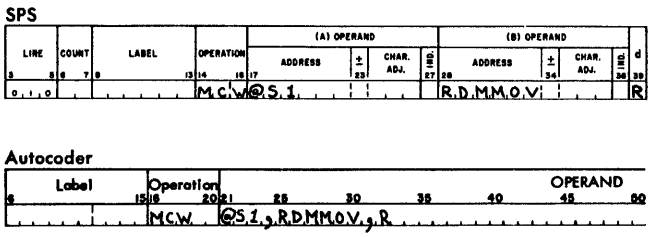
To ensure proper system operation under these conditions, check some position of the field other than the first position to determine whether or not the field is blank.

Word Marks. Word marks are not affected.

Timing. T = N (L_I + 1) ms + message length + document movement* + 1.

*Refer to Figure H-81.

Example. Transfers data from the reader to core-storage area labeled RDMMOV (0575) (Figure H-66).



Assembled Instruction: M @S1 575 R

Figure H-66. Read from 1419 in Move Mode (Overlapped)

Branch if 1419 Indicator On

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
SPS B	B	xxx	x
A BIN			

Function. This instruction tests for certain conditions and branches to the I-address if the condition tested is met. Otherwise, the program continues sequentially.

When the 1401 or 1460 is equipped with the processing-overlap feature, any test for a valid field can be executed immediately after reading of the field to be tested has been completed.

If the processing-overlap feature is not being used, branch instructions cannot be executed until after the trailing edge of the document has passed PDS 4.

The conditions tested are determined by the d-character as follows:

d-Character	*Branch on*
1	Document to be read
2	Document under read head (PDS 4)
3	Valid amount field
4	Valid process-control field
5	Valid account-number field
6	Valid transit-number field
7	Valid serial-number field
8	Auto-Select

Word Marks. Word marks are not affected.

*Timing.**

No Branch:
$T = N (L_I + 1)$ ms.

Branch (without indexing):
$T = N (L_I + 1)$ ms.

Branch (with indexing):
$T = N (L_I + 2)$ ms.

*This timing applies to all the d-characters.

Example. Tests a document sensed by PDS 2, PDS 2X, PDS 3, or PDS 4. If indicator is ON, branch to DRDTST (0827), Figure H-67.

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	IND.	(B) OPERAND ADDRESS	±	CHAR. ADJ.	IND.	d
			B	D,R,D,T,S,T								1

Autocoder

Label	Operation	OPERAND
	B,I,N,	D,R,D,T,S,T,,1,

Assembled Instruction: B 827 1

Figure H-67. Branch if Indicator On, Document to be Read

Example. Test for document when PDS 4 senses the leading edge of a document. If indicator is ON, branch to DOCPDS (0835), Figure H-68.

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	IND.	(B) OPERAND ADDRESS	±	CHAR. ADJ.	IND.	d
			B	D,O,C,P,D,S								2

Autocoder

Label	Operation	OPERAND
	B,I,N,	D,O,C,P,D,S,,2,

Assembled Instruction: B 835 2

Figure H-68. Branch if Indicator On, Document under Read Head

Example. Test the complete correct reading of the amount-field. If indicator is ON, branch to VALAMT (0843), Figure H-69.

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	IND.	(B) OPERAND ADDRESS	±	CHAR. ADJ.	IND.	d
			B	V,A,L,A,M,T								3

Autocoder

Label	Operation	OPERAND
	B,I,N,	V,A,L,A,M,T,,3,

Assembled Instruction: B 843 3

Figure H-69. Branch if Indicator On, Valid-Amount Field

Example. Test the complete correct reading of the process-control field. If indicator is ON, branch to TSTPCF (0851), Figure H-70.

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	IND.	(B) OPERAND ADDRESS	±	CHAR. ADJ.	IND.	d
			B	T,S,T,P,C,F								4

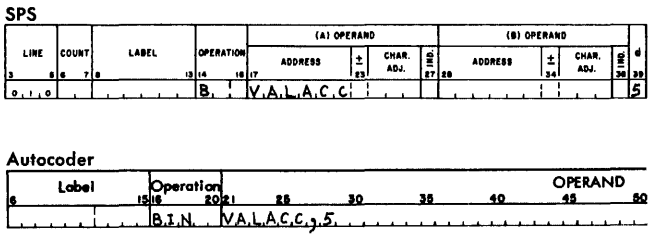
Autocoder

Label	Operation	OPERAND
	B,I,N,	T,S,T,P,C,F,,4,

Assembled Instruction: B 851 4

Figure H-70. Branch if Indicator On, Valid Process-Control Field

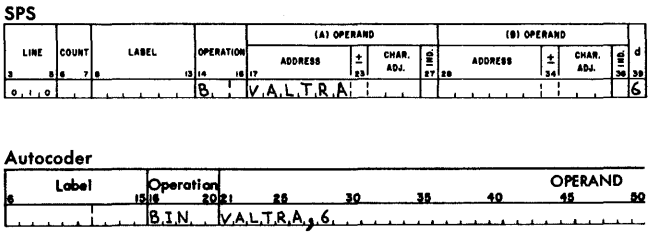
Example. Test the correct reading of account-number field. If indicator is ON, branch to VALACC (0859), Figure H-71.



Assembled Instruction: B 859 5

Figure H-71. Branch if Indicator On, Valid Account-Number Field

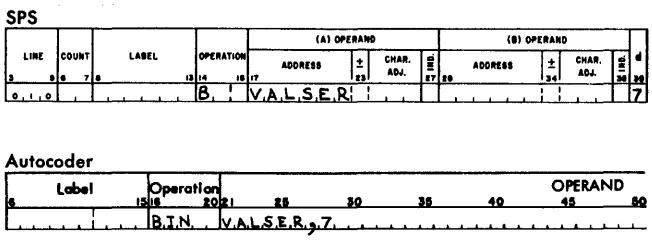
Example. Test the correct reading of transit-number field. If indicator is ON, branch to VALTRA (0867), Figure H-72.



Assembled Instruction: B 867 6

Figure H-72. Branch if Indicator On, Valid Transit-Number Field

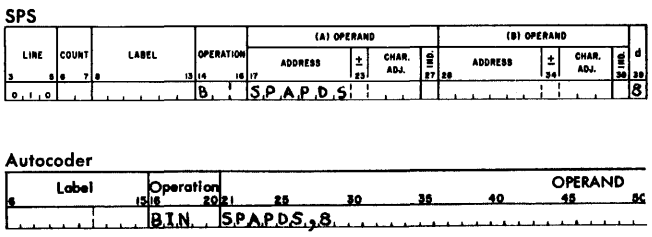
Example. Test the correct reading of serial-number field. If indicator is ON, branch to VALSER (0875), Figure H-73.



Assembled Instruction: B 875 7

Figure H-73. Branch if Indicator On, Valid Serial-Number Field

Example. Test for the trailing edge of a document to pass PDS 4 if the leading edge of the succeeding document has passed PDS 3. If indicator is ON, branch to SPAPDS (0883), Figure H-74.



Assembled Instruction: B 883 8

Figure H-74. Branch if Indicator On, Auto-Select

Functions of the Indicators

Document to Be Read

This indicator turns ON whenever a document is sensed by PDS 1 while the separator is running. It also turns ON if a document is sensed by PDS 2, PDS 2X, PDS 3, or PDS 4. If the separator is OFF, only a document sensed by PDS 2, PDS 2X, PDS 3, or PDS 4 turns the document-to-be-read indicator ON.

The indicator turns OFF when PDS 4 senses the trailing edge of a document and there are no more documents to be read, as indicated by the test just shown.

A misfeed can cause the document-to-be-read indicator to remain ON if the misfeed occurs between PDS 1 and PDS 4. In this case, the indicator turns OFF when the documents involved are removed from the transport.

The document-to-be-read indicator should be used at two points in the program. Testing the indicator after an ENGAGE 1419 instruction, but prior to a read instruction, prevents the 1401 or 1460 from *hanging-up* on a read instruction, awaiting an end-of-data signal. Therefore, for the first document after an ENGAGE 1419 instruction, a document-to-be-read condition must exist before the read instruction is issued.

Unless the stored program is single-feeding documents through the 1419, the following are recommended with respect to the number of documents after a disengage:

1. Provide a storage hold area for a minimum of four documents. If storage area permits, provide for five or six.
2. Program to halt if you get more than hold area provides for.

3. If a halt occurs, the operator should clean the PDS's (particularly PDS 1), reverse the restraint belt, and restart.

The stored program must be written to test for a document-to-be-read condition, branching to another routine only when the document-to-be-read indicator is OFF. Otherwise, not all documents will be read.

Document Under the Read Head

The document-under-the-read-head indicator turns ON when PDS 4 senses the leading edge of a document. The indicator turns OFF when PDS 4 senses the trailing edge of the same document. (Any dirt or foreign particles obstructing the light beam used to operate PDS 4 can provide a false indication of a document under the read head. Therefore, keep the photocells clean and clear of scraps of paper at all times.)

Valid Amount Field

The valid-amount-field indicator turns ON when the amount field has been completely read, and read without errors. The indicator turns OFF when the leading edge of the next document is sensed at the read head. The indicator does *not* turn ON if:

- any of the characters in the amount field (including the amount-field special symbols) are unreadable
- amount-field symbols are missing or out of sequence
- the field is missing
- the field length is invalid
- a group-mark with a word-mark is encountered in read-in storage before the trailing symbol of the amount field is transmitted
- the 1419 control unit detects an improper transmission (clock-control error)
- the electronic-accumulator and sequence-checking feature starts a print cycle before the amount field has been completely transmitted
- the field is not selected for transmission to the processing unit (amount read-out key not pressed).

Valid Process-Control Field

This indicator turns ON when the process-control field has been completely read without errors. It turns OFF when the leading edge of the next document is sensed at the read head. The indicator does *not* turn ON if:

- any of the characters in the process-control field (including the special symbol) are unreadable
- the reader is equipped to process a fixed-length process-control field, and the field is missing
- special symbols (except the dash) are out of sequence or missing
- the field length is invalid (fixed field lengths only)
- a group-mark with a word-mark is encountered in read-in storage before the trailing symbol of the amount field is transmitted
- the 1419 control unit detects an improper transmission (clock-control error)
- the electronic-accumulator and sequence-checking feature starts a print cycle before the process-control field has been completely transmitted
- the field is not selected for transmission to the processing unit (process-control read-out key not pressed).

Valid Account-Number Field

This indicator turns ON when the account-number field is read correctly. It turns OFF when the leading edge of the next document is sensed at the read head. The indicator does *not* turn ON if:

- any of the characters in the account-number field (including the special symbol) are unreadable
- special symbols (except the dash) are missing or out of sequence
- the field is missing
- the field length is invalid (fixed-lengths only)
- the self-checking account-number device (special feature) indicates the account number is in error
- the 1419 control unit detects an improper transmission (clock-control error)
- the electronic-accumulator and sequence-checking feature starts a print cycle before the account-number field has been completely transmitted
- the field is not selected for transmission to the processing unit (acount-number read-out key not pressed).

Valid Transit-Number Field

This indicator turns ON when the transit-number field is read correctly. It turns OFF when the leading edge of the next document is sensed at the read head. The indicator does *not* turn ON if:

- any of the characters in the transit-number field (including the special symbols) are unreadable
- special symbols (except the dash) are missing or out of sequence
- the field is missing
- the field length is invalid
- the self-checking account-number device (special feature) indicates the account number is in error
- the 1419 control unit detects an improper transmission (clock-control error)
- the electronic-accumulator and sequence-checking feature starts a print cycle before the transit-number field has been completely transmitted
- the field is not selected for transmission to the processing unit (transit read-out key not pressed).

Valid Serial-Number Field

This indictor turns ON when the serial-number field is read correctly. It turns OFF when the leading edge of the next document is sensed at the read head. The indicator does *not* turn ON if:

- any of the characters in the serial-number field (including the A.B.A. special symbols) are unreadable
- special symbols (except the dash) are missing or out of sequence
- the field is missing
- the 1419 control unit detects an improper transmission (clock-control error)
- the electronic-accumulator and sequence-checking feature starts a print cycle before the serial-number field has been completely transmitted
- the field is not selected for transmission to the processing unit (serial-number read-out key not pressed).

Auto-Select

The auto-select indicator turns on when a document that is automatically selected into the reject pocket (late-read and document-spacing errors) leaves the read head. The indicator turns off when the next document reaches the read head. A 51-column card does not turn the indicator on unless a spacing error or late read is involved.

The following conditions apply when the auto-select indicator is on:

1. An end-of-transmission signal is sent to the processing unit when the trailing edge of a late-read document passes PDS 4.
2. No data is transmitted from the trailing document of a spacing-error pair, but an end-of-transmission signal is sent to the processing unit when the trailing edge of this document passes PDS 4.
3. All valid-field indicators will be off.

NOTE: The auto-select indicator should be tested as soon as possible after the document leaves the read head (when the document-under-the-read-head indicator turns off) to determine whether it was auto-selected.

Miscellaneous Instructions

Select Stacker

Instruction Format.

Mnemonic	*Op Code*	*d-character*
SS	K	x

Function. This instruction directs the document that was just read by the reader into the pocket specified by the d-character. The modifiers A through L correspond respectively to pockets A, B, and 0-9. If an M is used in the d-character position, the reject pocket is selected (Figure H-75).

d-character	Reader Pocket
A	A
B	B
C through L	0 through 9
M	Reject

Figure H-75. IBM 1401 Select Stacker d-Character

NOTE: The reader should be operating in the program-sort mode to execute this instruction. If this instruction is given when the reader is operating in the 1419 sort mode, a sort-compare stop will result if the programmed selection does not agree with the 1419 pocket selection.

The SELECT STACKER instruction must be given after the trailing edge of the document has passed PDS 4 but before the leading edge of the document reaches PDS 6.

If a SELECT STACKER instruction is issued either too soon or too late, the 1419 stops feeding documents (sort-compare stop) and directs all documents that have left the separator station into the reject pocket. A sort-compare also results if more than one stacker selection is issued for one document, and different pockets have been selected.

Processing time available to determine stacker selection depends on the position of the leading edge of the document being read when all required reading has been completed. When operating in the overlap mode, processing can start as soon as the required data is available for stacker selection. When operating in a non-overlap mode, select stacker processing cannot begin until an end-of-data signal occurs, terminating the read instruction.

An end-of-data signal always occurs when the trailing edge of the document passes PDS 4, unless one has occurred earlier. This guarantees at least 9.5 ms for select stacker decision if the document does not exceed A.B.A. specifications. If an end-of-data occurs before the document passes PDS 4 (group-mark with a word-mark encountered in storage, or a K instruction has been issued by the stored program), more processing time is available, depending on the position of the leading edge of the document when the end-of-data occurs.

Word Marks. Word marks are not affected.

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

Example. Selects the documents just read into pocket 1, Figure H-76.

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	IND	(B) OPERAND ADDRESS	±	CHAR. ADJ.	IND	d
3 0	6 7	8 13	14 16	17 23			27	28 34			36	38
0 1 0			S S									D

Autocoder

Label	Operation	OPERAND
6 15	16 20	21 25 30 35 40 45 50
	S S	D

Assembled Instruction: K D

Figure H-76. Select Stacker, Pocket 1

Select Stacker and Branch

Instruction Format.

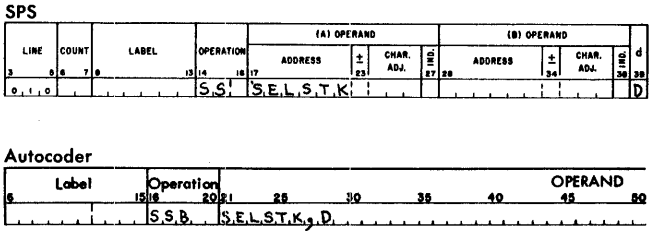
Mnemonic	*Op Code*	*I-address*	*d-character*
SPS SS	K	xxx	x
A SSB			

Function. The function of this instruction is the same as the function of the SELECT STACKER instruction except that the stored program branches to the instruction located at the address specified by the I-address.

Word Marks. Word marks are not affected.

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

Example. Select the document just read into pocket 1 and branch to SELSTK (0988) Figure H-77.



Assembled Instruction: K 988 D

Figure H-77. Select Stacker and Branch

Branch if I/O Channel-Busy Indicator On

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
SPS B	B	xxx	J
A BIN	—		

Function. The d-character specifies the indicator tested. If the indicator is ON, the next instruction is taken from the I-address. If the indicator is OFF, the next sequential instruction is taken.

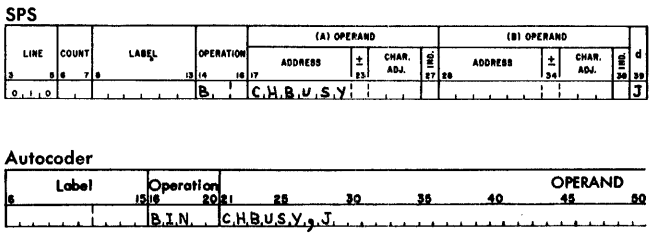
Input/Output Channel-Busy Indicator. This indicator turns ON when the system is performing an overlapped magnetic tape or 1419 operation. The indicator automatically turns OFF when the overlapped operation is completed.

NOTE: Without the advanced-programming special feature, the B-address register is reset when the next sequential instruction is taken. If the system has the advanced-programming special feature, the B-address register is reset and the contents of the O-address register are transferred to the B-address register before the next sequential instruction is taken.

Word Marks. Word marks are not affected.

Timing. $T = N (L_I + 1)$ ms.
$T = N (L_I + 2)$ ms for I/O busy indicator if it is not ON.

Example. Test channel-busy indicator, and branch to I-address beginning at location labeled CHBUSY (0981), Figure H-78.



Assembled Instruction: B 981 J

Figure H-78. Branch if I/O Channel-Busy Indicator On

Reset Overlap

Instruction Format.

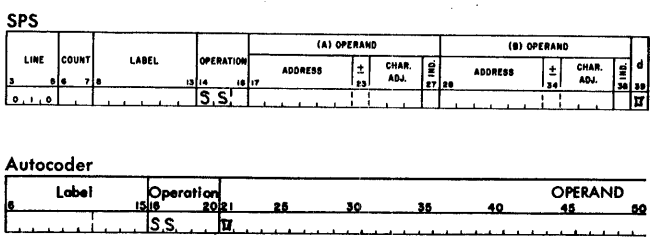
Mnemonic	*Op Code*	*d-character*
SS	K	□

Function. This instruction is operative only when the serial input/output adapter special feature is installed. If the system is performing an overlapped 1419 instruction when the RESET OVERLAP instruction is given, the 1419 is disconnected from the system as though an end-of-data had occurred. Therefore, the 1419 field valid indicators can be tested immediately. If the system is performing an overlapped tape instruction when the RESET-OVERLAP instruction is given, the tape is disconnected from the system and the tape transmission error indicator (d-character, L) is turned ON. If 1419 overlap operation is in effect, the instruction generates an end-of-data signal and releases the read operation.

Word Marks. Word marks are not affected.

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

Example. Reset overlap mode and return the system to normal operation, Figure H-79.



Assembled Instruction: K □

Figure H-79. Reset Overlap

Reset Overlap and Branch

Instruction Format.

Mnemonic		*Op Code*	*I-address*	*d-character*
SPS	SS	K	xxx	□
A	SSB			

Function. This instruction is the same as RESET OVERLAP except that the next instruction is taken from the I-address.

Word Marks. Word marks are not affected.

Timing. $T = N\ (L_I + 1)$ ms.

Example. Reset overlap mode and branch to the I-address location labeled REOVLP (0666) (Figure H-80).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	(A) OPERAND ±	(A) OPERAND CHAR. ADJ.	(A) OPERAND IND.	(B) OPERAND ADDRESS	(B) OPERAND ±	(B) OPERAND CHAR. ADJ.	(B) OPERAND IND.	d
3 8	6 7	8 13	14 16	17	23		27	28	34		38	39
0 1 0			K	R E O V L P								□

Autocoder

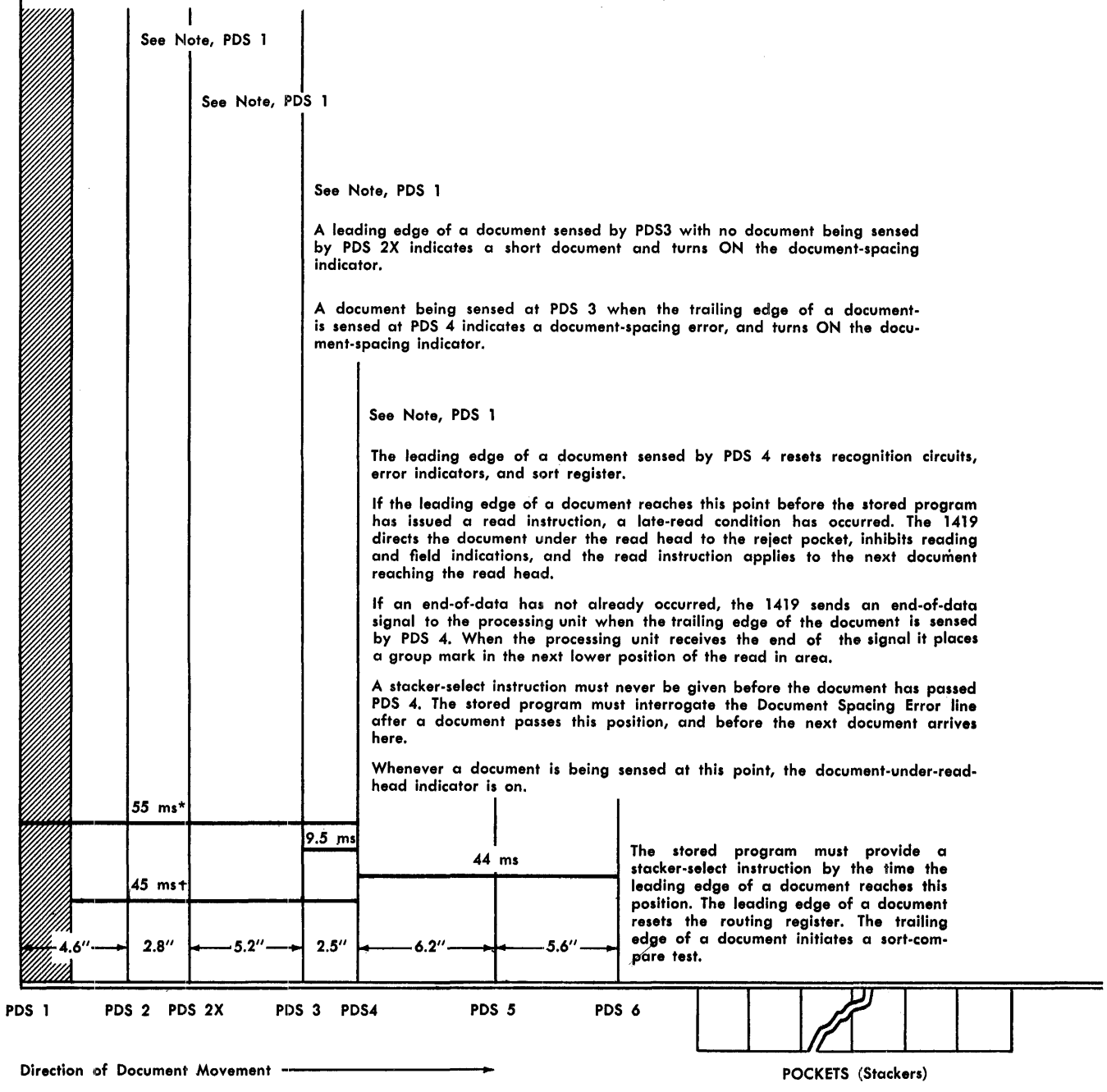
Label	Operation	OPERAND
6 15	16 20	21 25 30 35 40 45 50
	K	R E O V L P , □

Assembled Instruction: K 666 □

Figure H-80. Reset Overlap and Branch

If the 1419 has been conditioned to stop feeding documents because of a normal stop or disengage instruction, the separator stops operating when the next trailing edge of a document is sensed by PDS 1. Documents stop their forward movement in the transport mechanism with their leading edges somewhere in the shaded area.

NOTE: A document sensed under PDS 1 while the separator is running turns ON the document-to-be-read indicator. When the separator is OFF, a document-to-be-read indication is given only if a document is under PDS 2, PDS 2X, PDS 3, or PDS 4.



* Processing time available after the initial engage instruction.

† Processing time available after an engage instruction that follows a previous disengage instruction.

Figure H-81. Timing Chart

IBM 1448 Transmission Control Unit

Data processing, without fast accurate communication, is limited by the numerous delays between the source of data and the processor. A data processing system serving as a central control for many remote locations requires the best techniques of data communication. The ideal method is a combination of communication and processing operations in an effective single system.

IBM Tele-processing systems are serving business and industry by combining computer operations and data transmission facilities into integrated data processing systems. Here are the speed, convenience, and efficiency of centralized data processing for the business, large or small, that is physically decentralized. Here is the control center for the financial institution that requires, at a central point, variable or fixed information from many locations.

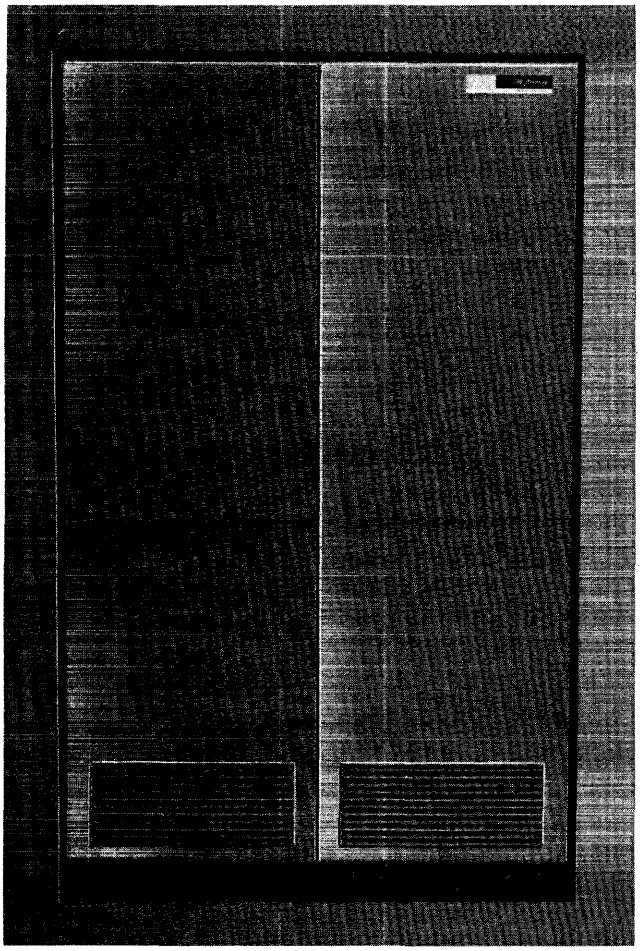


Figure H-82. IBM 1448 Transmission Control Unit

Transmission Control

Each line added to a communication network increases the possibility of delay and error. Speed and dependability of a communication system depend on the control equipment, which blends the array of transmission lines into an efficient network. Transmission control is the nucleus of any communication system made up of many lines, each with a number of terminals, leading to a central point.

The three basic purposes for transmission control in an integrated data processing system are:

1. to establish a connection between the central processor and the terminals on the communication circuit.
2. to prevent indeterminate situations on the line, such as distorted transmission or garbled or lost signals.
3. to allow for the requirements of the data processing equipment.

The IBM 1448 Transmission Control Unit (Figure H-82) is an economical means of entering numeric, alphabetic, and special-character data directly into an IBM data processing system from as many as 40 half-duplex multipoint communication lines (Figure H-83). Information can be transmitted on half-duplex lines in either direction, but only one direction at a time. This IBM Tele-processing system component directs and regulates the flow of data and provides compatibility among terminals and processing and exchange devices.

The 1448 with its associated processor handles such applications as inquiry and file updating. The 1448 and processor combination controls transmission of information, and processes this information in-line.

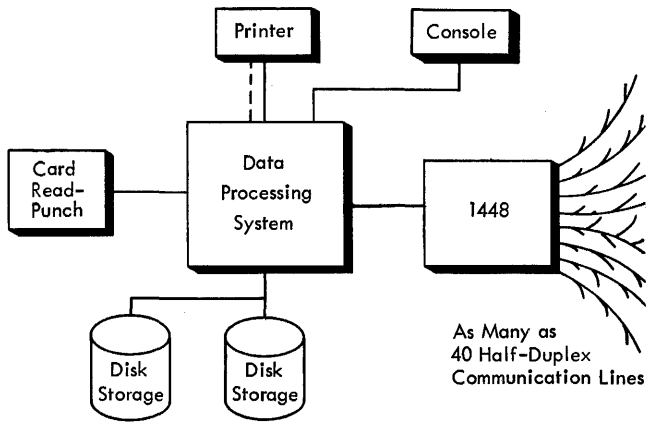


Figure H-83. The Processor Controls as Many as 40 Half-Duplex Channels

The 1448 and the data processing system provide on-line peripheral service to other IBM data processing systems (Figure H-84). In this role, the 1448 processor combination functions as a stored-program transmission control system that controls and monitors the lines and assembles messages.

Transmission data is transferred from communication lines to processor core storage. The processor stores the message data on disks, and transfers the data to another processor on a scheduled or demand basis. The disks can also be transferred manually to other systems having IBM 1311 Disk Storage Drives. With the direct-data-channel feature, data is transferred directly to and from another IBM data processing system having direct-data-channel capabilities.

This expanded system covers a list of other operations, such as: format checking of incoming messages, editing and scheduling outgoing messages from the data of the second processor, message accounting, and message switching. The second processor takes over a share of the total required systems function, and uses the first processor with its disk-storage capabilities as a backup.

Effectiveness and efficiency of large systems increase substantially with the IBM 1401 Data Processing System as a peripheral data converter (card-to-tape, tape-to-tape, and tape-to-printer). A 1448/1460 system (for transmission, data conversion, and editing) magnifies even more the economy and efficiency of the system.

With the 1448, a decentralized system becomes, in effect, centralized. The program of the processing unit control unit is an instrument of that control.

Operation

The exchange of information between the 1448 and the processor is initiated by a scan operation code associated with a priority interrupt. An interrupt is a temporary interruption of the processor's main routine by an external signal, in this case, from the 1448. The main routine continues in sequence after the interrupt routine, including the scan operation if completed.

The scan operation itself causes the automatic transfer of characters from the 1448 to the message-assembly areas in the processor.

The stored program assigns the message-assembly and distribution areas, which are variable in both length and location.

IBM 1448 Instructions

The instructions described in this section are used with the IBM 1460 Data Processing System to provide for the exchange of information between the IBM 1448 and the processor.

Scan

Instruction Format.

Op Code	*I-address*
O	xxx

Function. The SCAN instruction, in actual machine language, is made up of an alphabetic O as the operation code, and a 3-character address representing the high-order position of the scan control field.

The SCAN instruction is restricted to basic single-address format and must be followed by a word mark in the next location. An attempt to force a 2-address format causes an improper address in the B-address register at the beginning of instruction execution time, and the instruction affects storage locations other than the intended control field.

Word Marks. Word marks are not affected.

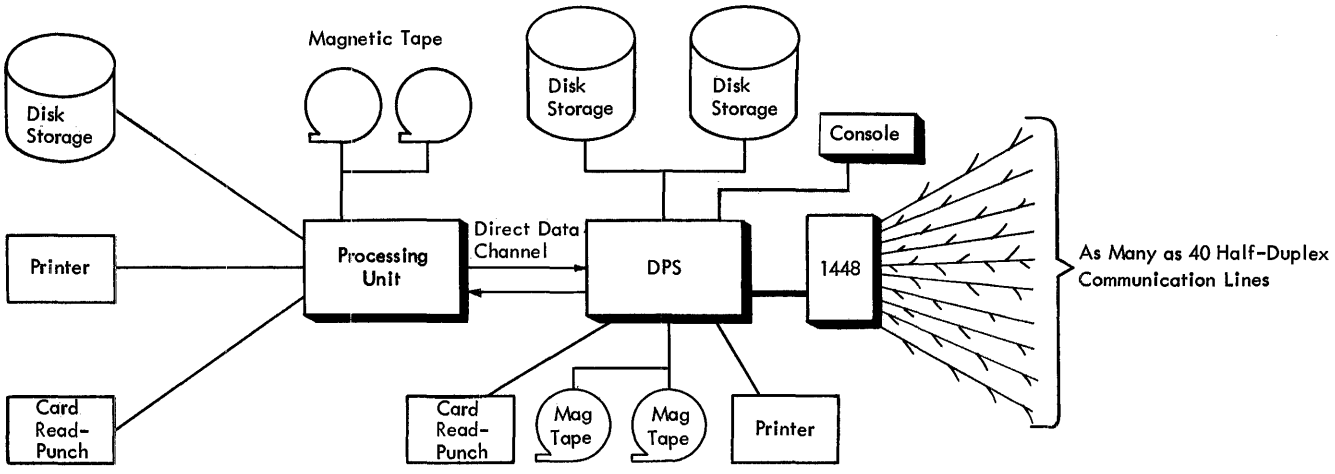


Figure H-84. IBM 1448 and Processor Serving a Central Data Processing System

Timing. T = I + 2 +2N + 5M + 6P + 7R) 11.1 microseconds.

I = The number of characters in instruction (4).

N = The number of idle lines or receiving lines with empty line buffers, and/or the number of transmitting lines with one or more characters in the line buffers at the beginning of the scan operation, and/or the number of polling lines that do not need a new polling address.

M = The number of receiving lines with one character in the line buffers at the beginning of the scan operation.

P = The number of receiving lines with two characters in the line buffers, and/or the number of transmitting lines with empty line buffers at the start of the scan operation.

R = The number of lines in RECEIVE-CONTROL status that are transferring 2-character polling addresses from the processor to the 1448.

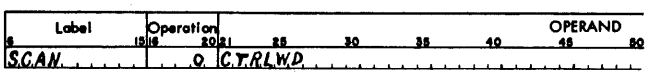
Minimum execution time:
T = (I + 2 + 2L) 11.1 microseconds.
L = The number of lines.

Maximum execution time:
T = (I + 2 + 7L) 11.1 microseconds.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	Storage address of the last data cycle. If no data cycles are taken, it is the address of the beginning of the control field.	End of control field + 3.

Example. Scan IBM 1448 lines for input or output traffic. The beginning address of the control field is labeled CTRLWD (0300), Figure H-85.



Assembled Instruction: O 300

Figure H-85. Scan

Interrupt Instructions

Any of these conditions in the 1448 makes the 1448 request an interrupt of the processor's main program:
1. Any buffer-full condition on the receiving lines.
2. Any buffer-empty condition on the transmitting lines.
3. Any status condition with an EOB (end-of-block) bit.
4. The 1448 requests the next polling address.

The interrupt routine contains the necessary preparatory operations and the scan operation. The actual interruption of the main program takes place when an instruction is being read, but before the execution of that instruction. Only unchained operations can be interrupted. Figure H-86 is a list of interruptible operations.

The interrupt causes a program skip to address 182 in the processor, where the first instruction of the interrupt routine is located.

An interlock prevents interrupting while the system is in the interrupt routine. The ENABLE INTERRUPT AND BRANCH instruction resets the interlock at the end of the interrupt subroutine. The interrupt routine must include:
1. Store B-address register contents. The address in the B-address register must be decreased by four to establish the position of the interrupted main-program instruction. This new address is placed in the ENABLE INTERRUPT AND BRANCH instruction.
2. Saving program conditions (arithmetic overflow, high-low-equal compare and index locations), if they might be lost during the interrupt subroutine. After the interrupt subroutine, the program must restore these conditions.

Enable Interrupt

Instruction Format.

Op Code	*d-character*
K	>

Function. The ENABLE INTERRUPT instruction is made up of K for the operation code and a bit configuration of 8-4-2 for the d-character. The interrupt subroutine is reset, and the program continues with the next sequential instruction.

Word Marks. Word marks are not affected.

Timing. The interrupt precedes a possible 1448 buffer overflow by at least the number of milliseconds in time *A* of Figure H-87. It follows a scan operation no sooner than time *B* of Figure H-87. The minimum time between a scan operation and a possible 1448 buffer overflow is time *C* of Figure H-87.

Description	Interruptable Ops Op Code	Length	Non-Interruptable Ops Op Code	Length	
Zero and Add	?	7	?	4	1
Zero and Subtract	I	7	I	4	1
Add	A	7	A	4	1
Subtract	S	7	S	4	1
Multiply	@	7	@	4	1
Divide	%	7	%	4	1
Edit	E	7	E	4	1
Move Zero Suppress	Z	7	Z	4	1
Compare	C	7	C	4	1
Clear	/	7	/	4	1
Set Word Mark	'	7	'	4	1
Clear Word Mark	¤	7	¤	4	1
Test Zone or Word Mark	V	8, 5	V	4	1
Move Digit	D	7	D	4	1
Move Zone	Y	7	Y	4	1
Branch	B	5	B	4	
Move Excluding I/O	M	7	M	4	1
Load Excluding I/O	L	7	L	4	1
No Op	N	5	N	4	1
Store A-Register			Q	4	1
Store B-Register			H	4	1
Forms Control	F	5	F		2
Scan Operation			O	4	1

Figure H-86. Interruptible Operation

Character Rate of Terminal	Characters Per Second	
	14.8	60
Time A	67.5 ms	41 ms
Time B	59 ms	59 ms
Time C	132.5 ms	100.2 ms
Time D	128.5 ms	96.2 ms

Figure H-87. Interrupt Timing

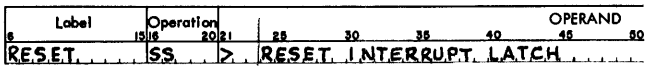
The maximum time for noninterruptible operations in the main program immediately following a scan operation is 132.5 ms (14.8 cps) minus the time taken by the interrupt routine. Assuming that the time from interrupt to the execution of the scan operation is 4.0 ms, the maximum length of a noninterruptible operation in the main program is about 128.5 ms (time *D* for 14.8 cps).

With a mixed system (more than one type of terminal) the shorter time applies.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	d*bb*	d*bb*

Example. Reset the interrupt latch after an input-output request from a 1448 line (Figure H-88).



Assembled Instruction: K >

Figure H-88. Enable Interrupt

Disable Interrupt

Instruction Format.

Op Code	*d-character*
K	<

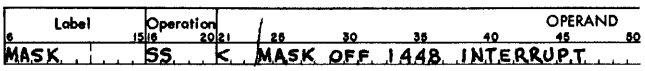
Function. The DISABLE INTERRUPT instruction consists of K for the operation code and a bit configuration of B-A-8-4-2 for the d-character. This instruction, by setting the interrupt interlock, prevents the processor from honoring any interrupt requests. The interrupt interlock is reset by the ENABLE INTERRUPT instruction.

Word Marks. Word marks are not affected.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	d*bb*	d*bb*

Example. Prevent a 1448 interrupt while performing a disk operation (Figure H-89).



Assembled Instruction: K <

Figure H-89. Disable Interrupt

Enable Interrupt and Branch

Instruction Format.

Op Code	*I-address*	*d-character*
K	xxx	>

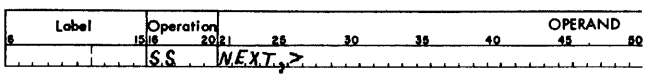
Function. The ENABLE INTERRUPT AND BRANCH instruction, which is used to re-enter the main program, is made up of K as the operation code, a 3-character I-address representing the contents of the B-address register minus four at the time of interrupt, and the d-character with bit configuration 8-4-2. The interrupt routine interlock resets, and the program branches to the instruction address.

Word Marks. Word marks are not affected.

Address Registers After Operation.

	I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
Branch	BI	BI	NSI
No Branch	NSI	BI	d*bb*

Example. Reset interrupt latch and return to non-multiplexing routine by branching to NEXT (0800), (Figure H-90).



Assembled Instruction: K 800 >

Figure H-90. Enable Interrupt and Branch

Disable Interrupt and Branch

Instruction Format.

Op Code	*I-address*	*d-character*
K	xxx	<

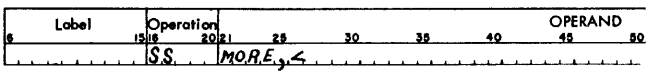
Function. The DISABLE INTERRUPT AND BRANCH instruction is made up of K as the operation code, a 3-character I-address representing the next instruction, and a bit configuration of B-A-8-4-2 as the d-character. This instruction is the same as DISABLE INTERRUPT except that the next address is specified by the branch address.

Word Marks. Word marks are not affected.

Address Registers After Operation.

	I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
Branch	BI	BI	NSI
No Branch	NSI	BI	d*bb*

Example. Prevent 1448 interrupt and branch to disk-file routine labeled MORE (0900), Figure H-91.



Assembled Instruction: K 900 <

Figure H-91. Disable Interrupt and Branch

Branch if End of Block

Instruction Format.

Op Code	*I-address*	*d-character*
B	xxx	>

Function. The BRANCH ON END OF BLOCK instruction is made up of B as the operation code, an I-address, and the d-character > with bit configuration 8-4-2.

When a processor status character contains an end-of-block bit, the end-of-block indicator turns ON. If it is ON, when the BRANCH ON END OF BLOCK instruction is executed, the next instruction is taken from that branch address. If the indicator is OFF, the program continues to the next seqnential instruction.

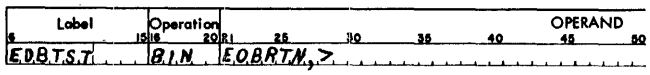
The indicator is reset at the start of each scan operation.

Word Marks. Word marks are not affected.

Address Registers After Operation.

	I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
Branch	BI	BI	NSI
No Branch	NSI	BI	d*bb*

Example. If end-of-block indicator is on, branch to routine beginning at EOBRTN (1313), Figure H-92.



Assembled Instruction: B T13 >

Figure H-92. Branch on End of Block

Branch if Early Warning

Instruction Format.

Op Code	*I-address*	*d-character*
B	xxx	<

Function. The BRANCH ON EARLY WARNING instruction is made up of B as the operation code, an I-address, and the d-character < with a bit configuration of B-A-8-4-2.

When the early-warning indicator is ON, this instruction turns it off and causes a branch to the I-address (address of the chaining subroutine). There the program may first locate lines that require more assembly area, then provide new assembly blocks and add a link address to the previous blocks. When this type of storage allocation is used, the program issues this branch instruction after every scan operation.

The low-order positions of the storage block should contain at least the number of consecutive group marks that equals the maximum number of characters that can be transferred during a single scan operation for that line. The last group mark of the series can be followed by three positions for the link address provided by the chaining subroutine.

All group marks turn on the early-warning indicator. The first group mark provides the initial warning. Subsequent group marks are also used in one or more of these ways:

1. Locating the assembly block requiring chaining (by testing for absence of group marks).

2. Timing the buffers to allow for the actual delay in locating and chaining to the block in an early-warning condition.

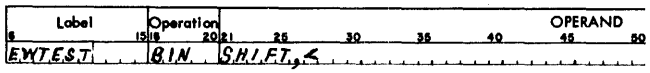
3. Determining the penetration of data into the early-warning area (group-mark area).

Word Marks. Word marks are not affected.

Address Registers After Operation.

	I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
Branch	BI	BI	NSI
No Branch	NSI	BI	d*bb*

Example. If the early-warning indicator is on, branch to area that contains the chaining subroutine for storage allotment for additional input message areas. The early-warning area is labeled SHIFT (0700), Figure H-93.



Assembled Instruction: B 700 <

Figure H-93. Branch on Early Warning

Direct-Data-Channel Interrupt

Direct-data-channel interrupt is standard with the transmission control unit (1448) attachment. It is not available on the direct-data channel without the attachment.

With the direct-data-channel interrupt, an interrupt request in computer A (1440 with 1448) is made when computer B (host computer) indicates that it is requesting to read from computer A, or indicates that it is requesting to move data to computer B.

The main program is interrupted when an instruction is being read, but before the actual execution of that instruction. Only unchained instructions can be interrupted.

An interrupt request by the direct-data channel causes the 1440 to start checking the instruction readouts for an interruptible point. This is accomplished by interrogating the fifth instruction (actually I_4) readout cycle for no B-register word mark.

The actual interrupt causes a program skip to address 182 where the first instruction of the interrupt routine should start.

The direct-data-channel interrupt request is reset when it actually causes the interrupt. If the 1448 interrupt request causes an interrupt first, the direct-data-channel interrupt is not reset, and a subsequent interrupt occurs.

Line Control

Time on the communication line is divided into two modes, line-control mode and text mode. The coded characters have a different meaning in each.

Line-Control Mode

In the line-control mode, the characters are interpreted as line-control signals, polling signals, and addressing signals. In this mode, signals control the transmission line, and are not read by the data processing components. Figure H-94 is a list of line-control characters.

When a terminal receives an EOT (end-of-transaction) signal from the 1448 the terminal goes to, or remains in, the line-control mode. If the terminal is in selected status, it goes to a nonselected status.

Text Mode

In the text mode, the characters are interpreted the same as those that make up messages in the interchange between the 1448 and the terminal components. They consist of graphic characters, interstation-control characters (such as upper-case and line feed) and checking characters.

For additional information refer to SRL publication, IBM *1448 Transmission Control Unit,* Form A24-3010.

Description	Symbol	Bit Configuration	Processor Character
End of Transaction (EOT)	Ⓒ	C-8-4-2-1	¬ (tape mark)
End of Address (EOA)	Ⓓ	8-2-1	# (pound sign)
Negative Response (Control)	Ⓝ	B	- (hyphen)
Positive Response (Control)	Ⓨ	B-A-8-2-1	. (period)
Negative Response (Text)	ⓝ	B	- (hyphen)
Positive Response (Text)	ⓨ	B-A-8-2-1	. (period)
Positive Response (Inquiry)	ⓓ	8-2-1	# (pound sign)
End of Block (EOB)	Ⓑ	A-8-2	‡ (record mark)

Figure H-94. Line-Control Character

IBM 1026 Transmission Control Unit

The IBM 1026 Transmission Control Unit (Figure H-95) is an economical means of entering numeric, alphabetic, and special-character data directly into the IBM 1401 or 1460 Data Processing System from a half-duplex multipoint communication line (Figure H-96). As many as four 1026 units can be attached to a data processing system. Information can be transmitted on a half-duplex line in either direction, but in only one direction at a time. This IBM Tele-processing system component directs and regulates the flow of data and provides compatibility among terminals and processing and exchange devices.

The IBM 1026 Transmission Control Unit operates with most of the controls that the IBM 1448 uses, except it can handle only one line. The four instructions used are four of the instructions that are used with the IBM 1448 Transmission Control Unit:

ENABLE INTERRUPT

ENABLE INTERRUPT AND BRANCH

DISABLE INTERRUPT

DISABLE INTERRUPT AND BRANCH

For additional information refer to the SRL publication, IBM *1026 Transmission Control Unit,* Form A24-3244.

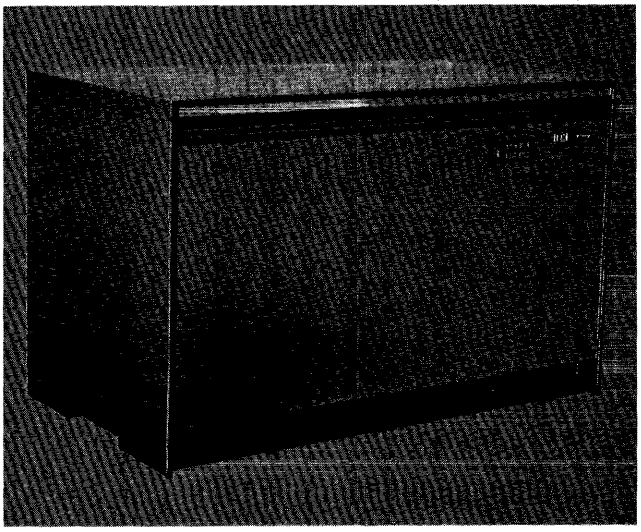


Figure H-95. IBM 1026 Transmission Control Unit

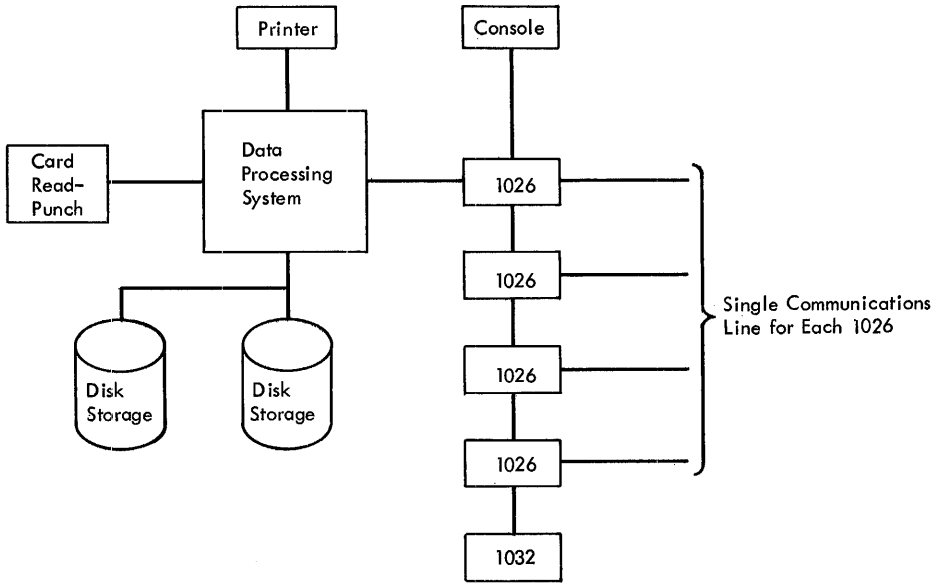


Figure H-96. IBM 1026 Transmission Control Unit

IBM 1231 Optical Mark Page Reader

The IBM 1231 Optical Mark Page Reader (Figure H-97) provides a means of reading marked data from 8½" x 11" data sheets directly into the 1401 or 1460 systems. The documents can be read at varying rates of speed, depending on the mode switch setting. When set to CONTINUOUS, feeding is at a constant speed of 2,000 documents per hour. When set to DEMAND, feeding is controlled by the computer program with speeds varying up to 1,600 documents per hour. The feeding mode selected depends on the computer program-control method used.

IBM 1231 Instructions

The instructions described are for the control of the 1231 through the stored program in the system.

Branch if Auto Select

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
SPS B	B	xxx	1
A BIN	B		

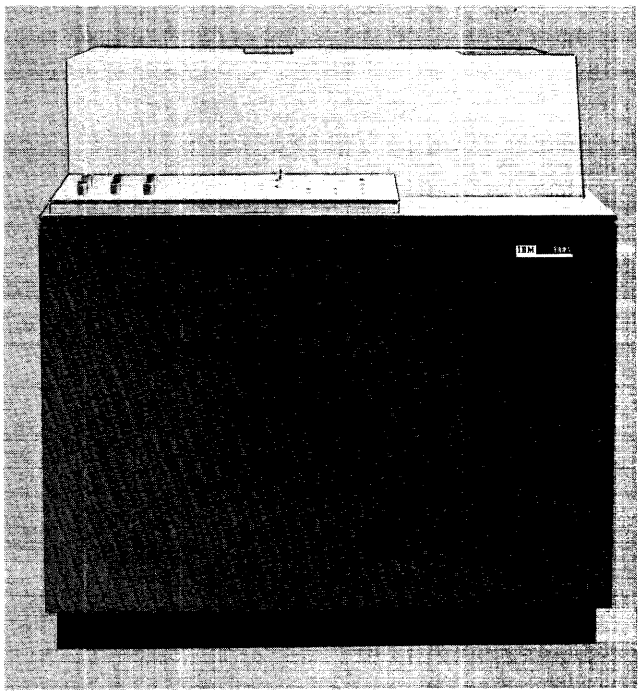


Figure H-97. IBM 1231 Optical Mark Page Reader

Function. This operation indicates that the document does not meet all the 1231 read conditions and that the 1231 has directed the document into the select stacker. When a document feeds through the read area, one of two conditions is sensed, either auto select or a full buffer. If an auto seelct is sensed, it means the document did not satisfy the 1231 field-checking switch settings. The 1231 can select a document itself if the internal editing conditions are not satisfied. If an auto select occurs, the machine clears the buffer and causes the next document to feed.

Branch if Full Buffer

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
SPS B	B	xxx	2
A BIN	B		

Function. This operation indicates that the document has passed all the IBM 1231 internal program conditions and has been completely read. The buffer is full.

This indicator should always be program tested first when entering the 1231 read subroutine from the main computer program.

Branch if 1231 Ready to Read

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
SPS B	B	xxx	3
A BIN	B		

Function. The branch condition indicates that all normal operating conditions have been satisfied and the start key has been pressed. This branch remains on until the buffer is empty or some interruption in the 1231 occurs, such as a manual stop, full stacker, empty hopper, jam, or misfeed.

Branch if Empty Hopper

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
SPS B	B	xxx	4
A BIN	B		

Function. This branch condition distinguishes an empty hopper from other IBM 1231 conditions. It

is normally used in conjunction with the end-of-job routine. It is off, except when the hopper is out of documents. The 1231 ready-to-read condition will be off when the empty-hopper condition is on.

Branch if Read Error and Overrun Detection

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
SPS B	B	xxx	5
A BIN	B		

Function. This indicates the data read from the 1231 has not been completely transferred to the computer. This condition is caused by a parity error detected by the 1231 or by a delay in the processor start-timing relationship. With this condition, the 1231 stops and operator intervention is required. The indicator is turned off by pressing the RESET or LOAD keys on the 1231.

The document in error is the top document in the normal stacker.

Word Marks. Word marks are not affected.

Branch if Timing Mark Check

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
SPS B	B	xxx	6
A BIN	B		

Function. This branch instruction indicates that the timing-mark track was found in error, either by the presence of extra timing marks or missing timing marks. If the control timing-mark switch is set to YES, a timing-mark check indication is sent to the computer 75 ms after a buffer-full indicator comes on. If the control timing-mark switch is set to NO, the timing-mark check is sent to the computer immediately following a buffer-full indicator signal. This timing-mark indicator is turned OFF when the reset key is pressed to resume normal operations.

Word Marks. Word marks are not affected.

Timing. The following timing formulas apply to all 1231 branch instructions.

$T = N (L_I + 1)$ ms (without indexing).

$T = N (L_I + 2)$ ms (with indexing).

Move

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
MU	M	%S3	xxx	R

Function. This instruction causes data to be read from the 1231 storage into core-storage positions designated by the B-address in the instruction.

Word Marks. A word-mark with a group-mark must be one position to the right of the last position reserved in core storage for the data.

Timing. $T = N (L_I +$ access time $= 1$ delay-line cycle) ms.

1 delay-line cycle = 3.582 ms.

Access time = 0 to 3.582 ms or average time of 1.791 ms.

Select Stacker

Instruction Format.

Mnemonic	*Op Code*	*d-character*
SS	K	A

Function. This instruction causes a stacker select when the document has been read correctly but fails the internal computer program test. A SELECT STACKER instruction must be given within 50 ms after a buffer-full signal is initiated.

Word Marks. Word marks are not affected.

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

IBM 1231 Program Control

Continuous Feed Mode

In the continuous-feed mode, the computer program must be designed to repetitively test BUFFER FULL and READY TO READ at a frequency not to exceed 1,800 ms when the 1231 is placed in operation, on-line. The explanation of the parts of the block diagram (Figure H-98) follow:

1. *Start.* Document feeding will be initiated by pressing the 1231 start key if the processing unit is in program-run status. If the 1231 start key is pressed when the computer program is in a halt condition, document feeding is inhibited. After the first document is fed, feeding is continuous until an interruption occurs in either the 1231 or the processing unit.

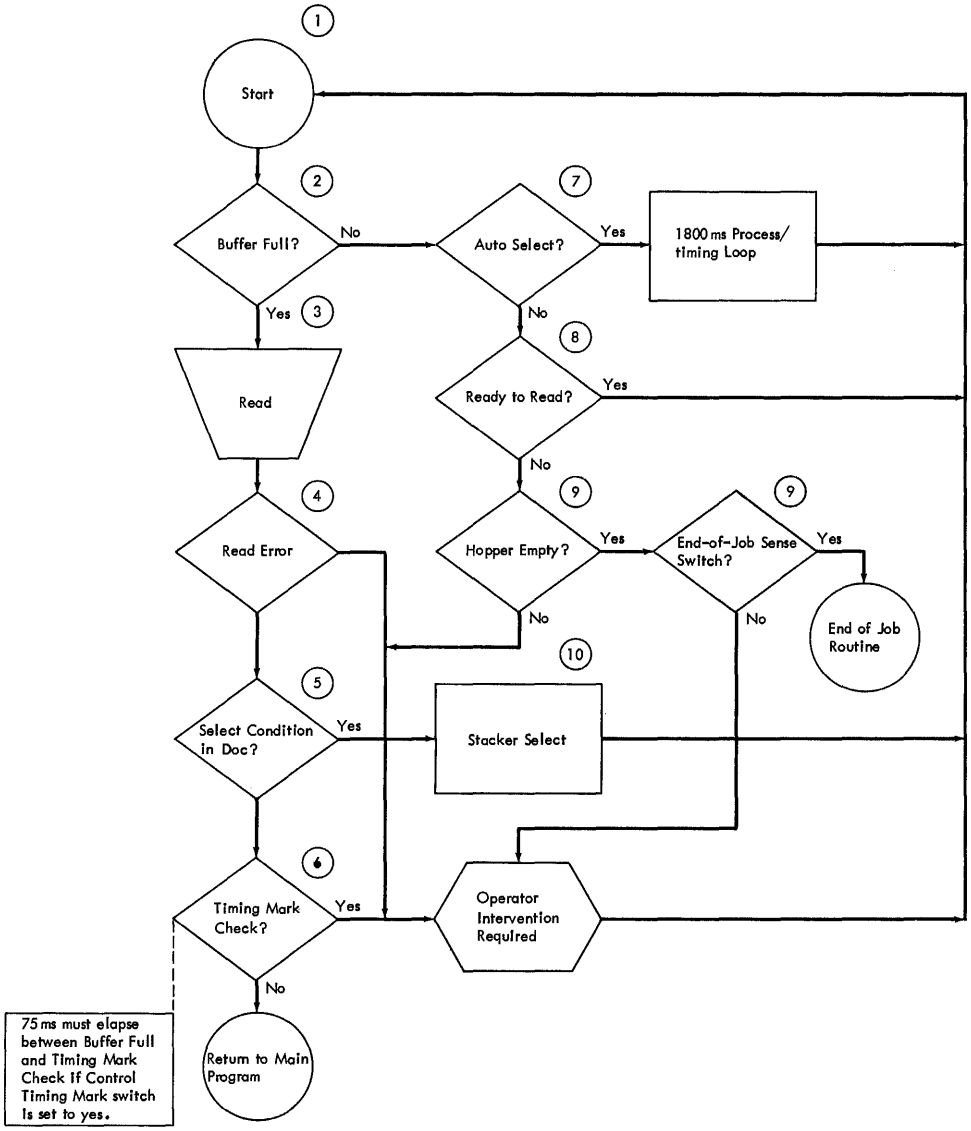


Figure H-98. IBM 1231 Continuous Feed Routine

2. *Buffer Full.* This branch is turned on immediately following the reading of a complete data sheet. BUFFER FULL is tested repetitively as a part of a loop. The signal of a BUFFER FULL is used as the program reference point for each succeeding document cycle.

3. *Read.* This instruction is used to transfer data from 1231 storage to the processing unit. The READ instruction must be executed within 150 ms following BUFFER FULL. If the 1231 storage is still full when the next sheet is detected at the read head, the process-check light is turned on and the 1231 stops. The maximum time required to transfer the contents of the 1231 output storage to the processing unit is 7.2 ms.

4. *Read Error.* This branch comes on to indicate that a 1231 read-out error occurred during the transfer of data to the processing unit. When a read-out error occurs, READY-TO-READ will be turned off and the process-check light turned on. The top data sheet in the normal stacker must be reprocessed because the contents of buffer storage is destroyed during read-out. At this point, operator intervention is required. The computer can, however, branch to other subroutines until the 1231 is again placed in ready-to-read status.

5. *Select Condition in Document.* This programmed check of data can be used to test any desired condition for which the document should be selected. The decision to select the document must be given within 50 ms after a buffer-full indication.

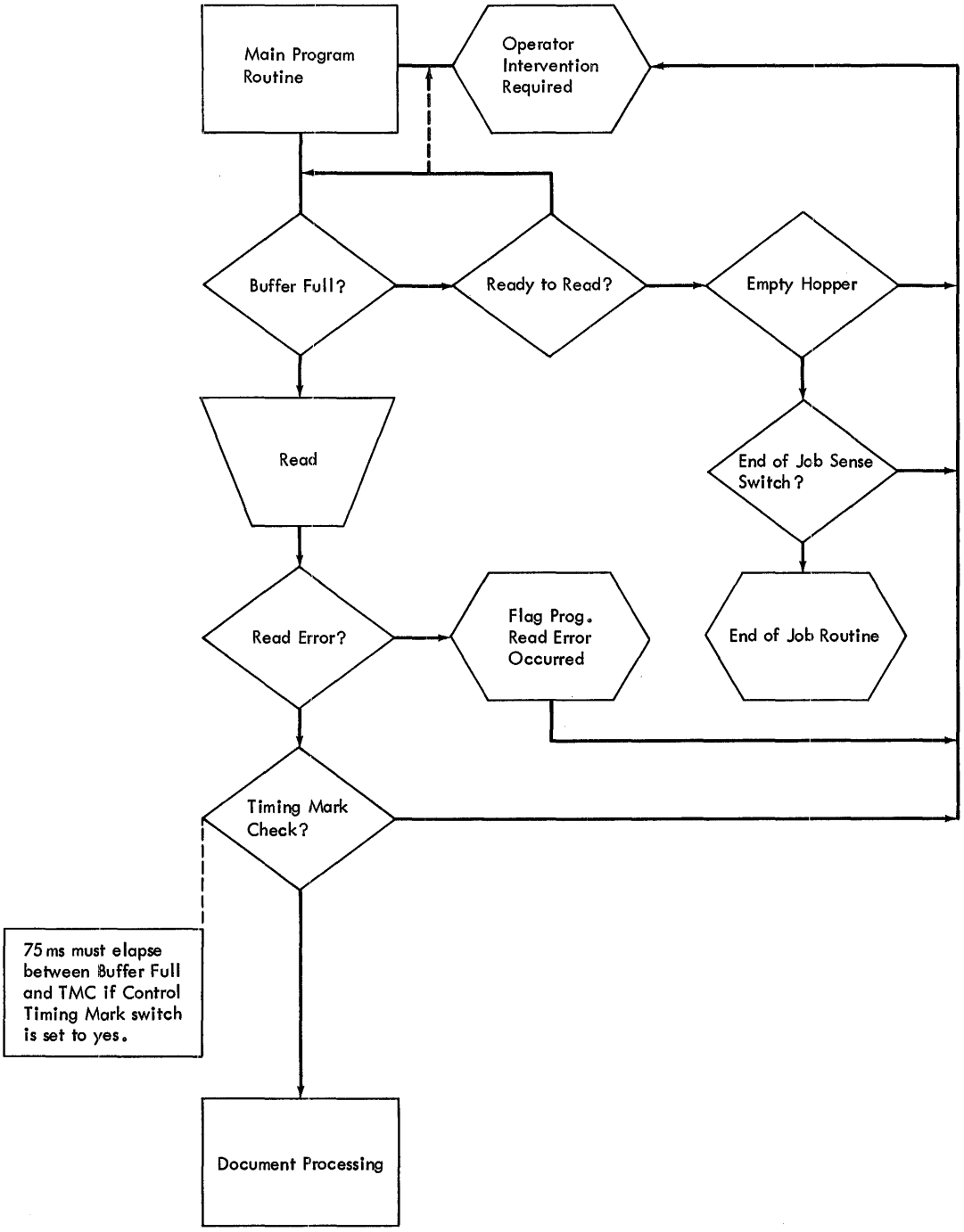


Figure H-99. IBM 1231 On-Demand Feed Routine

6. *Timing-Mark Check.* This branch comes ON to indicate that the timing-mark count did not agree with the setting of the timing-mark-check switch. At least 75 ms must elapse between the signal of a BUFFER FULL and the TIMING MARK CHECK if the CONTROL TIMING MARKS switch is set to YES. A minimum of 75 ms can be utilized by the program in a process/timing loop. Any processing of data from the document just read before the timing-mark check is made may require the backing out of data from various storage locations if the timing-mark check comes up. The signal of TIMING MARK CHECK indicates that the information read from the document is invalid.

7. *Auto Select.* When this branch comes on, it is an indication that the document just read was sent to the select stacker. When this condition arises, it will be at least 1,800 ms before the next READ instruction needs to be given. This branch, therefore, can be used as an exit to other processing routines.

8. *Ready-to-Read.* This branch being on indicates that the 1231 is in an operating status, that all normal operating conditions are satisfied, and that the start key has been pressed. READY-TO-READ NO indicates that an interruption has occurred in the 1231 and provides an exit from the subroutine.

9. *Empty Hopper.* This branch indicates that no more documents remain in the feed. The operator should turn on the END-OF-JOB sense switch when the last batch of documents is placed in the hopper.

10. *Select Stacker.* Certain data sheets may be selected at the programmer's option. The SELECT STACKER instruction must be executed within 50 ms after the signal of a BUFFER FULL.

On-Demand Feed

No special timing considerations are necessary when entering the subroutine in the on-demand mode. (Figure H-99). When the 1231 start key is pressed, the first document is fed past the read station and the data is stored in the 1231. The next document will not feed until the contents of the output storage is transferred to the computer.

Buffer Full. BUFFER FULL ON indicates that a document has been read and stored in the 1231. A successful test of this branch is normally followed by a read instruction. BUFFER FULL should precede a test for READY TO READ in the on-demand mode, because it is possible that READY TO READ will be turned off after a document has been read owing to a full stacker. This sequence of branch tests ensures that the last document stored in the 1231 just prior to a stop will be transferred to the computer.

Ready to Read. This branch comes on to indicate that the 1231 is in an operating status; all normal operating conditions are satisfied and the start key has been pressed. READY TO READ NO indicates that an interruption has occurred in the 1231 and provides an exit from the subroutine when the 1231 stops.

Read. This instruction causes a transfer of data from the 1231 storage to the computer read-in area. A read instruction may be executed at any time following a BUFFER FULL. Execution of the READ instruction in the on-demand mode also initiates the next document feed cycle unless there is a stop condition in the 1231.

Read Error. This branch comes on to indicate that a 1231 read-out error occurred during the transfer of data from the 1231 to the computer. Because an incomplete record has been sent to the computer, the subroutine should include a provision to clear the computer read-in area. The top document in the normal stacker must be reprocessed. Operator intervention is required for this condition, however; the computer can branch to other subroutines until the 1231 is again placed in a ready-to-read status.

Empty Hopper. This branch provides a conventient means for detecting an empty hopper.

Timing-Mark Check. This branch comes ON to indicate that the timing-mark track on the data sheet just read was found to be contaminated, either by extra or missing timing marks. At least 75 ms must elapse between the signal of a BUFFER FULL and the TIMING MARK CHECK, when the CONTROL TIMING MARKS switch is set to YES. If the documents being run do not contain control timing marks (as used by the IBM 1230 Optical Mark Scoring Reader) the CONTROL TIMING MARKS switch can be set to NO and the timing-mark check can be made immediately after the signal of a BUFFER FULL. This branch is turned off when RESET is pressed to resume normal operation.

IBM 1285 Optical Reader

The IBM 1285 Optical Reader Model 1 (Figure H-100) serves as an input device for IBM 1401 and 1460 Data Processing Systems. The 1285 reads printed paper tapes such as those produced on cash registers and adding machines. Using advanced optical-recognition techniques to read directly from the source document of many business transactions, the 1285 eliminates the time, expense, and errors inherent in a system that requires information to be manually punched into cards before being entered into the system.

IBM 1285 Instructions

The IBM 1285 Optical Reader, Model 1, can be operated in overlap or nonoverlap mode. The following descriptions of the instructions for the 1285 deal only with the nonoverlap mode. Additional considerations that arise in the overlap mode are discussed separately in *Overlap Operations.*

Read in Move Mode

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
MU	M	%V1	xxx	R

Function. This instruction reads either one character or one line into core storage from the 1285. When header information is entered from the keyboard, characters are transmitted in single-character mode, one character for each read instruction. The character is entered in the core-storage location specified by the B-address and the operation is terminated. Assuming the operator keys in information from left to right, the B-address of this instruction should be modified by +1 for each subsequent read operation.

When data is read from the journal tape, characters are transmitted in line mode, one line of information for each read instruction. The line is read from right to left, with the first character being read into the core-storage location specified by the B-ad-

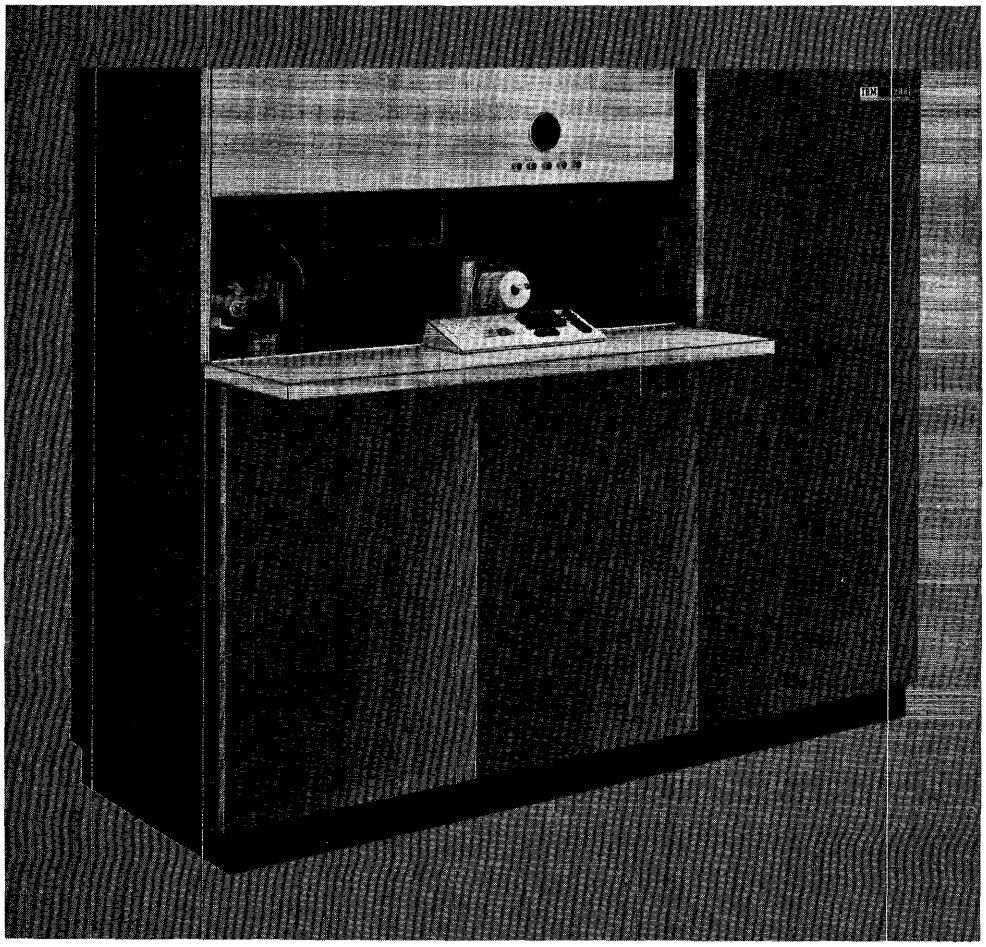


Figure H-100. IBM 1285 Optical Reader

dress. The contents of the B-address register are automatically modified by −1 before transferring each subsequent character.

A read operation is normally terminated when the reader senses the left margin of the tape. When this occurs, a group mark is automatically inserted in the core-storage position to the left of the last character read, and the end-of-line indicator is turned on. If a group mark with word mark is detected before reading the last character on the line, the read operation is terminated and the end-of-line indicator is not turned on.

Go to Next Line

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
SPS SS *A* SSB	K	xxx	G

Function. This instruction causes the reader to advance to the next line. The normal procedure is to test for end-of-line after a read instruction and, if on (indicating a valid read), to issue this instruction to cause the reader to begin scanning for the next line. If not given after a read operation is terminated, the next read instruction will reread the line.

The next instruction executed is that specified by the I-address, if supplied, or the next instruction in sequence, if no I-address is specified.

Mark a Line

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
SPS SS *A* SSB	K	xxx	M

Function. This instruction causes the line that the reader is on to be marked by the reject line marker. The line is transported to the top of the scan window and marked *after* the next go-to-next-line instruction. The mark-a-line instruction can be given at any time after the ready-to-read-a-line indicator is turned on and before the go-to-next-line instruction.

Branch if Indicator On

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
B	B	xxx	d

Function. This instruction tests for the IBM 1285 operational conditions specified by the d-character. If the indicator is on, the next instruction is taken from the I-address. If off, the program goes to the next sequential instruction.

d-character	*Indicator and Condition*
1	BRANCH IF ERROR If a process-check condition occurs in the processing unit or if a skew check occurs in the reader, this indicator is turned on, and remains on until tested.
2	BRANCH IF END OF LINE This indicator is turned on when the last character of a line is transferred to the processing unit. If this indicator is not on when a read operation is completed, the program should assume that an error condition exists. (See possible exception under *Overlap Operation.*) This indicator is turned off by the go-to-the-next-line instruction.
3	BRANCH IF READER TRANSPORTING This indicator is turned on when the transport mechanism is started to bring a new segment of tape over the scan window. It is turned off when the transport mechanism is stopped. Note that a minimum of 1 millisecond elapses between execution of the GO-TO-NEXT-LINE instruction and the beginning of the transport operation. Also, this indicator is turned off as soon as the transport stops, leaving about 6 milliseconds until the ready-to-read-a-line indicator is turned on.
4	BRANCH IF MARKED LINE This indicator is turned on if the last line read was or will be marked by the reject line marker. If the MARK-A-LINE instruction was given, or if the line contains a reject symbol (@), it will be automatically transported to the reject line marker after the next GO-TO-NEXT-LINE instruction is given.
5	BRANCH IF HEADER INFORMATION This indicator is turned on (before reading the first line from the tape) if a character of header information was entered from the keyboard. It is reset for each character read by the program. As long as this indicator is on, the reader will not respond to the start key to begin processing the journal tape. When no more header information is to be entered, the start key is pressed, and the ready-to-read-a-line indicator is turned on.
6	BRANCH IF READY TO READ A LINE This indicator is turned on when the reader has found a line and is ready to read it. The indicator is turned off by the next read instruction. NOTE: When a line is found, the scanner enters the normalizing mode and continues from character to character in the line until a read instruction is given. At that time, the flying spot sweeps back to the low-order character.

To keep read time to a minimum, a read instruction should be given within 1.5 ms after this indicator is turned on. Otherwise, up to 3 ms may be lost in returning to the low-order position.

7 BRANCH IF READER READY
This indicator is turned on when a tape is loaded and the first line is found by the scanner. The indicator remains on until the operator runs the end of the tape through the transport by pressing the end-of-file key, or until an error occurs that requires operator intervention.

8 BRANCH IF END OF FILE
This indicator is turned on when the trailing end of the roll is run through the transport by pressing the end-of-file key. The indicator is reset when another roll is loaded.

Overlap Operations

The 1285 can be operated in overlap mode if the attached processing unit has the process-overlap feature. In this mode, processing is interrupted only long enough to transfer a single character into core storage, and then is released until the next character in the line has been recognized by the reader and is ready to be transmitted. The programming aspects of overlapped operations in this section are given as exceptions to the previous discussion of the instruction set.

Read in Overlap Mode

To read in overlap mode, code the A-address field with @VI (instead of the %VI used for a nonoverlapped read). Processing is interrupted to transfer each character, and then released until the next character is ready to be transferred.

Go to Next Line

This instruction can be used to terminate an overlapped read operation. In this case, the error indicator is turned on and the reader advances to the next line.

Branch if Error

This indicator is turned on if an overlapped read operation is terminated by a GO-TO-NEXT-LINE instruction.

NOTE: This type of operation may be deliberate and not actually an error condition. For example, a program might be processing only those lines with a particular code in the low-order position. Processing is released after the first character is read, allowing the program to test to see if the read is to be continued. If not, the program can go to the next line, ignoring the error indicator.

Timing Considerations

The rated speed of the IBM 1285 Optical Reader is 2,190 lines per minute. This assumes a 10-character line, vertically spaced at 4 lines per inch. To derive speeds for individual application requirements, use the following formula:

Throughput

$$(\text{lines per minute}) = 1{,}000 \left(\frac{600}{13N + \frac{518}{L} + 14} \right)$$

Where:

N = characters per line
L = lines per inch

IBM 1445 Printer for the 1401 System

The IBM 1445 Printer (Figure H-101) provides a means of inscribing in magnetic ink A.B.A. (E-13B) type font as well as conventional characters for another medium of printed output from the 1401 system (equipped with a serial input/output adapter).

IBM 1445 Printer Instructions for 1401

Write Line

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
MU	M	%Y2	xxx	W

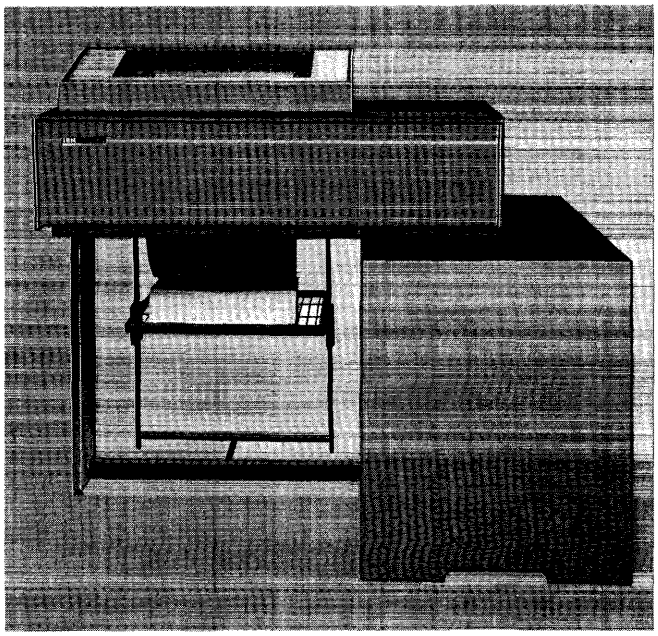


Figure H-101. IBM 1445 Printer

Function. This instruction is used to transfer data from core storage to the 1445 printer, where it will be printed.

The B-address (xxx) contains the first character to be printed. Because the printer cannot recognize or fill a short line, the print field must contain 170 parity valid characters. The first 113 characters are all that are printed. The remaining buffer positions are filled with valid characters or blanks.

An end-of-transmission signal, which is an internal signal that is developed when the print field is filled with 170 parity valid characters, stops the data transfer and initiates an I/O disconnect to the processor. This permits the processor to continue while the printer writes the line of data from the print buffer.

Word Marks. Word marks are not affected.

Timing. $T = .0115\ (L_I + 1) + 2.5$ ms.

Control Carriage

Instruction Format.

Mnemonic	*Op Code*	*d-character*
SS	K	A

Function. This instruction is used for carriage control through the program to move the form for the desired spacing.

This conditions the printer to enter the next character on the data lines into the carriage register. The B-address of the next print instruction must contain the specific modifier character for the forms operation desired.

This instruction ends after the single character is read (I-cycle) and continues on the next instruction.

Word Marks. Word marks are not affected.

Timing. $T = .0115\ (L_I + 1)$ ms + remaining form-movement time, if the carriage is already in motion when this instruction is given. The total movement time depends on the specific carriage operation being performed.

Space Suppress

Instruction Format.

Mnemonic	*Op Code*	*d-character*
SS	K	B

Function. This instruction suppresses the single space after a print operation.

A SPACE SUPPRESS instruction must be preceded by tests for print check and printer busy, and followed by a WRITE LINE instruction. When these tests are made before a SPACE SUPPRESS instruction, it is not necessary to repeat the test before the print instruction because the tests are still valid.

Word Marks. Word marks are not affected.

Timing. $T = .0115\ (L_I + 1)$ ms.

Branch if Printer Status

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
BIN	B	xxx	d (see chart)

d-character	*Description*
1.	Printer Error
5.	Printer Busy
6.	Carriage Busy
7.	Carriage Channel 9
8.	Carriage Channel 12

Function. This instruction and its associated d-characters are used to check the printer status. When a tested condition is present, the program branches to the I-address. If the condition is not present, the program goes to the next sequential instruction.

Word Marks. Word marks are not affected.

Timing. $T = .0115\ (L_I + 1)$ ms.

IBM 1445 Printer for the 1460 System

The IBM 1445 Printer provides a means of inscribing in magnetic ink A.B.A. (E-13B) type font as well as conventional characters for another medium of printed output from a 1460 system.

IBM 1445 Printer Instructions for 1460

Write Line

Instruction Format.

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

Function. This instruction is used to transfer data from core storage to the 1445 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 number of characters printed depends on the B-field length established in core storage. The B-field length is 113 positions plus one 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. $T = .006\ (L_I + 1) + 361$ ms.

Write Line and Suppress Space

Instruction Format.

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

Function. This instruction is used to transfer data from core storage to the 1445, 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 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 length is 113 positions plus one 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. $T = .006\ (L_I + 1) + 361$ ms.

Control Carriage

Instruction Format.

Mnemonic	*Op Code*	*d-character*
CC	F	X (see Figure H-102)

Function. This instruction causes the carriage to move as specified by the d-character (Figure H-102). 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, and immediate-space operation, as specified by the digit portion of the character, occurs.

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 H-102. Control Carriage d-Characters

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.

Word Marks. Word marks are not affected.

Timing. T = .006 (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.

Multiple Printer Output for the 1460 System Using the 1445 Printer

Printer Selection

All the printers share the same output area, core-storage positions 201-332. A PRINTER PRESELECT instruction specifies which printer is to accept and print the data from core-storage positions 201-332. This instruction is a 2-character instruction and consists of an operation code and a d-modifier character. The operation code is the letter U with an associated word mark. The d-character is a (/) diagonal, which specifies the IBM 1445 Printer. This instruction is executed prior to executing any instruction involving a printer. The instruction activates the 1445 printer and deactivates the previously selected printer. The specified printer remains selected until the program selects another printer.

After the printer is selected, the program control is uniform to the normal 1445 printer operation with the 1460 system.

E-13B Character	Card Code	BCD Code	Equivalent Character	Name
5	5-8	84 1	:	Colon
1	0-5-8	C A84 1	V	Word Separator
1:	12-5-8	BA84 1	[	Left Bracket
.1	11-5-8	CB 84 1	]	Right Bracket
9	0-2-8	A8 2	‡	Record Mark
7	12-0	CBA8 2	?	(Plus Zero)
8	11-0	B 8 2	!	(Minus Zero)
3	3-8	8 21	# or =	Number Sign or Equal To
4	4-8	C 84	@ or '	At Sign or Apostrophe
0	0-4-8	A84	% or (	Percent or Left Parenthesis
11	12-4-8	CBA84	◻ or)	Lozenge or Right Parenthesis
6	7-8	C 8421	√	Tape Mark
2	0-7-8	A8421	⊞	Tape Segment Mark
11	12	CBA	& or +	Ampersand or Plus

Figure H-103. E 13B Characters and Codes

IBM 7740 Communication Control System

The IBM 7740 Communication Control System can be attached to an IBM 1401 or 1460 Data Processing System through the system's serial input/output adapter.

The stored program in the system has complete control over the data transmission to and from the 7740 system. To facilitate this control, three types of instructions are used:

1. SIGNAL CONTROL instructions.
2. BRANCH IF INDICATOR ON instructions.
3. MOVE and LOAD instructions.

IBM 7740 Instructions

Signal Control

Instruction Format.

Mnemonic	*Op Code*	*d-character*
SS	K	Refer to Figure H-104

Function. The SIGNAL CONTROL instructions are used by the processing system to:

1. Inform the 7740 system that it wants to perform a particular operation, or
2. Send a reply to the 7740 system after recognizing a specific condition.

Refer to Figure H-104 for the d-characters and the associated signals sent to the 7740 system.

Instruction *	Signal Sent to 7740 System
K B or K (III) B	Attention Response — given when the system recognizes an "Attention" signal sent from the 7740.
K C or K (III) C	Read Request — given when the system wants to read (receive) data from the 7740.
K D or K (III) D	Write Request — given when the system wants to write (send) data to the 7740.
K E or K (III) E	End Response — given when the system recognizes an "End" or "Unusual-End" condition signal sent from the 7740.
K F or K (III) F	Control Request — given when the system wants to send control data to the 7740.
K G or K (III) G	Sense Request — given when the system wants to receive status data from the 7740. This is normally done after the system receives an "Unusual-End" condition signal from the 7740.

* K (III) X form of instruction results in a branch to the specified I-address

Figure H-104. Signal Control Instruction Summary

Word Marks. Word marks are not affected.

Timing. $T = N^* (L_I + 1)$ ms.
*N = .0115 for 1401, .006 for 1460

Address Registers After Operation.

	I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
KX	NSI	d*bb*	d*bb*
K(III)X	NSI	BI	d*bb*

Example. The system signals the 7740 that it wants to receive data from the 7740 (Figure H-105).

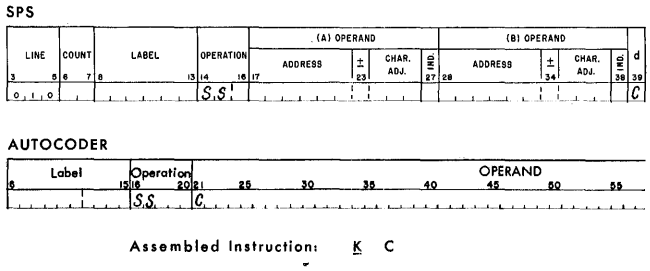


Figure H-105. Read Request

Branch if Indicator On

Instruction Format.

	Mnemonic	*Op Code*	*I-address*	*d-character*
SPS	B	B	xxx	see Figure H-106
A	BIN*			

* An I-address can be specified for these instructions, and it results in a branch to the specified I-address. The Autocoder mnemonic for this form of the instruction is SSB.

Function. This instruction and its associated d-characters are used by the system to check for various conditions on the 7740 system. When a tested condition is present, the program branches to the previously written subroutine. The BRANCH IF INDICATOR ON instruction d-characters and the tests they perform, are shown in Figure H-106.

Word Marks. Word marks are not affected.

Timing.

No Branch:

$T = N (L_I + 1)$ ms.

d-character	Test Performed
1	Causes a branch to the specified I-address when a data transmission is ended and a condition is present of which the system must be aware. The condition remains ON until it is set OFF by executing a K E instruction.
2	Causes a branch to the specified I-address when a data transmission is successfully completed. The "Successful Completion" condition remains ON until it is set OFF by executing a K E instruction.
3	Causes a branch to the specified I-address when the 7740 system has received a Read, Write, Control, or Sense request from the system. The "Receive Request" condition remains ON until it is set OFF by executing a K E instruction.
4.	Causes a branch to the specified I-address when the 7740 system wants the system to "service" it (attention signal). The attention signal remains ON until it is set OFF by executing a K B instruction.

Figure H-106. Branch if Indicator On d-Character Summary

Branch (without indexing):
$T = N\ (L_I + 1)$ ms.
Branch (with indexing):
$T = N\ (L_I + 2)$ ms.

Note. The Autocoder mnemonic must also have the d-character in the operand.

Address Registers After Operation.

	I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
No Branch	NSI	BI	d*bb*
Branch (without indexing)	NSI	BI	d*bb*
Branch (with indexing)	NSI	BI	NSI

Example. Tests for the attention signal. If the signal is present, branch to core-storage location 0385 (area labeled MSGST), Figure H-107.

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	IND	(B) OPERAND ADDRESS	±	CHAR. ADJ.	IND	d
3 5	6 7 8	13	14 16	17	23		27	28	34		38	39
0 1 0			B	M,S,G,S,T								4

AUTOCODER

Label	Operation	OPERAND
6 15	16 20	21 25 30 35 40 45 50 55
	B,I,N	M,S,G,S,T,,4

Assembled Instruction: B 385 4

Figure H-107. Branch if Attention Signal Indicator On

Instruction Name	Read Data	Read Data with Word Marks	Write Data with Word Marks	Write Data
Instruction Format	M (%A1) (BBB) R	L (%A1) (BBB) R	L (%A1) (BBB) W	M (%A1) (BBB) W
Function	Data without word marks received from 7740 system	Data with word marks received from 7740 system	Data with word marks sent to 7740 system	Data without word marks sent to 7740 system
Transmission Ended by	GM-WM sensed in system core storage or an "End" or "Unusual End" signal from the 7740 system			
Word Marks	Word marks are not transmitted	Word marks are transmitted		Word marks are not transmitted
Timing	$T = N\ (L_I + 1)$ ms + transmission and start time			
Address Registers After Operation	I-Add. Reg. NSI	A-Add. Reg. %11	B-Add. Reg. B + message length + 1	

Figure H-108. Read and Write Instruction Summary

Read and Write

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
MU or LU	M or L	%A1	xxx	R or W

Function. The READ AND WRITE instruction — M or L (%A1) (BBB) R or W, initiates the data transmission operation between the system and the 7740 system in the specified mode.

The parts of the instruction and their uses are:

M or L — The M or L operation code specifies whether the data transmission will be performed in the move mode or load mode. If the move mode (M Op code) is specified, up to 7 bits per character (CBA8421) are involved in the data transmission. If the load mode (L Op code) is specified, up to 8 bits per character (WM CBA 8421) are involved in the data transmission.

%A1 — The A-address (%A1) specifies that data transmission between the system and the 7740 system will take place when the instruction is executed.

BBB — The B-address specifies the high-order position of the core-storage area involved in the data transmission.

R or W — A d-character R specifies a read operation. This d-character is used when the 7740 will send data. A d-character W specifies the write operation. This d-character is used when the 7740 will receive data.

Refer to Figure H-108 for a summary of the READ and WRITE instructions.

Example. Read data from 7740, without word marks, and place in core storage, beginning at location 0853 (area is labeled INPDAT), Figure H-109.

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	WM	(B) OPERAND ADDRESS	±	CHAR. ADJ.	WM	d
3 5	6 7	8 13	14 16	17	23		27	28	34		38	39
0 1 0			MU	%A1				INPDAT				R

AUTOCODER

Label	Operation	OPERAND
6 15	16 20	21 25 30 35 40 45 50 55
	MU	INPDAT,,R

Assembled Instruction: M %A1 853 R

Figure H-109. Read Data

IBM 7770 Audio Response Unit Model 1

The IBM 7770 Audio Response Unit (Figure H-110) can be attached to the IBM 1401 or 1460 Data Processing System through the IBM 1311 disk-control channel. It provides audio response to inquiries made from telephone-type terminal devices, IBM 1001 Data Transmission Terminals, or other similar terminals. The composed audio response comes from a vocabulary pre-recorded on a magnetic drum in the 7770. Connection between the inquiry terminals and the 7770 is made through appropriate common-carrier-provided facilities.

In operation, a calling party enters an inquiry consisting of a series of digits from an inquiry terminal. The 7770 buffers the inquiry and, when complete, sends the whole inquiry to the processing unit under program control. The processing unit processes the inquiry and composes a coded-response message. This message is sent back to the 7770, which interprets the response message, selects the proper words from the pre-recorded vocabulary, and transmits these words as an audio response back to the inquirer.

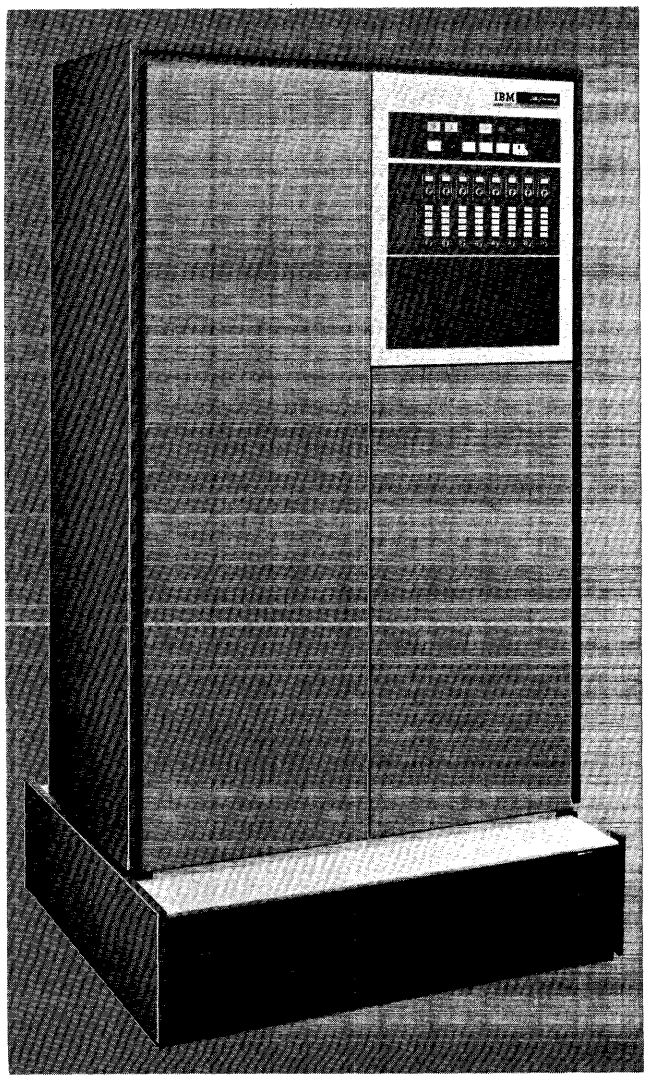


Figure H-110. IBM 7770 Audio Response Unit, Model 1

IBM 7770 Instructions

The instructions for the operation and control of the 7770 are the same instructions that apply to the IBM 1311 Disk Storage Drive, Model 2.

Seek Disk

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
SPS MU or LU	M or L	%F0	xxx	R
A SD				

Function. The A-address specifies that a seek operation is to be performed to get the record about which the inquiry is being made. The B-address specifies the high-order position in core storage of at least the first six functions of the disk-control field. Only the alternate-code position and the first five positions of the core sector address are used during a seek-disk operation.

Word Marks. Word marks are not affected.

Timing. $T = N (L_I + 7)$ ms.

Read Disk Sector

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
SPS MU or LU	M or L	%F1	xxx	R
A RD				

Function. This instruction causes data to be read from the 7770 into core storage. The digit 1 in the A-address (%F1) specifies that a sector operation is to be performed. The number of sectors to be read is specified by the sector-count field which must be 1. The reading of the 7770 data is stopped by a group-mark with a word-mark in core storage.

The B-address specifies the high-order position in core storage of the disk-control field, and the area in storage reserved for the data read from the 7770. The disk-control field of the 7770 is 8000000001.

The R in the d-character position signifies a read operation.

Word Marks. A group-mark with a word-mark must be one position to the right of the last position reserved in core storage for the message. If a group-mark with a word-mark is detected before reading of the message is completed, the wrong-length record indicator turns on and reading stops.

Timing. See IBM *1311 Disk Storage Drive Timing* — Section G.

Note. Instructions must be L (LOAD) if the 7770 has the extended-vocabulary feature. If this feature is not installed, the instructions must be M (MOVE).

Write Disk Sector

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
SPS MU orLU	M or L	%F1	xxx	W
A WD				

Function. This instruction causes record data in core storage to be transferred to the 7770 for interpreting and transmitting to the inquirer. For details of the write instruction see 1311 instructions in Section G.

Word Marks. A group-mark with a word-mark must be one position to the right of the last character of the message in core storage. The writing of data stops when the end of message is reached in the 7770 and a group-mark with a word-mark is sensed in core storage. If the group-mark with a word-mark is sensed before the end of a record, the remainder of the disk record is filled with valid blanks (C-bits), and any-disk condition and wrong-length record indicators are turned on.

Timing. See IBM *1311 Disk Storage Drive Timing* — Section G.

IBM 7770 Model 1 Programming

The function of the IBM 7770 Audio Response Unit is to provide a spoken reply message to a digital inquiry entered by an inquiring party. To provide this reply, the 7770 outputs pre-recorded words in a specific sequence to form a message. Because the 7770 is merely an input, storage, and output device, it is incumbent upon the processor to tell the 7770 the sequence of the words of the message. This is accomplished by a user-written program.

When the user writes his program, it should consist of the following phases:

1. Inquiry input
   a. Bring the inquiry into core.
   b. Determine if it is a test message.
   c. Determine if it is of proper length.

2. Evaluation of input
   a. Determine information required.
   b. Check security code, if present.
3. Information retrieval
   a. Seek information on account from files.
   b. Get output message format, if required.
4. Message assembly and output
   a. Extract information from account file and place in proper order in the output area.
   b. Write the output area to the 7770.

IOCS for 1311 disk storage will provide the necessary *get* and *put* instruction macros for retrieval and placement of 7770 input and output information, respectively. To provide for IOCS, it is necessary to properly define the IOCS requirements. This is covered under *IOCS Usage* in *Input/Output Control System (on Disk) for* IBM *1401/1460: Specifications,* Form C24-1489.

Figure H-111 shows the program necessary to service the 7770 in a disk-storage environment. The unconditional branch to the polling subroutine should be performed about every 3 to 5 seconds of mainline program time (a maximum of 10 seconds is permitted). This time depends on the type of mainline program being run. The wide latitude of time between polling operations is provided because polling and servicing routines should require all waiting inquiries to be serviced before returning to the mainline program. Because the polling and servicing subroutines together probably will not exceed 300 milliseconds (including one disk seek to get the record about which inquiry is being made), the delays in processing unit service will not cause excessive wait-time for the calling party. The branch on tape mark is particularly important. When the 7770 does not have an inquiry to be processed, the read will return a first character tape mark. This must be interpreted by the user's program as no-service-required and a return to the mainline program may take place at this point.

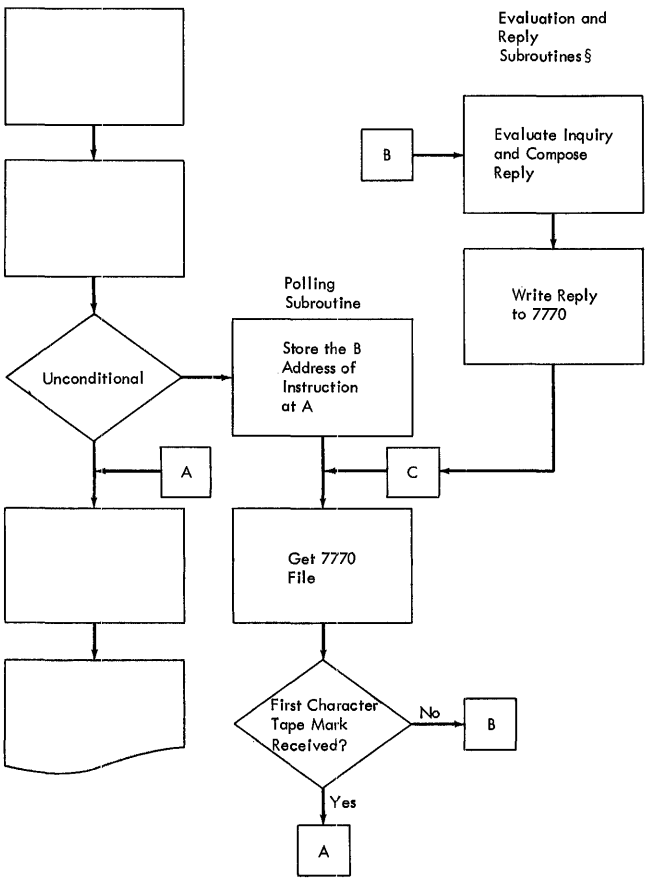


Figure H-111. Inquiry Processing Subroutine

Generally, the same instructions and program precautions (i.e., error routines) used with disk storage apply to the 7770. The following is a more detailed explanation of the program phases described earlier.

Inquiry Input

The inquiry is brought into core storage by the use of a read file instruction sequence. In the event of transmission errors, a reread is possible in exactly the same way as a file reread. Should the reread not correct the error condition, a standard message should be sent by the user to the 7770 indicating the necessity of a *redial* by the calling party. Except in the case of the transfer of a first character tape mark to core storage, it is mandatory for the user to return a reply to the 7770. The 7770 must always receive a *write* after a *read,* if a tape mark is not received.

Because of the unique character of the 7770, it is possible to test on one input line while the others are performing their normal functions. For this reason, a testing routine should be built into the user's normal servicing program. This is simplified because the test message entered from the CE panel is one character followed by a group mark (≢); no other input messages have this characteristic. Also, no actual processing of this test message must be done. It is read into core storage, recognized by the program and returned unmodified to the 7770. Because the inquiry is already in core storage (through the polling routine), a routine similar to the one shown in Figure H-112 might be used.

If an inquiry is not of the correct length, it causes an error condition. The error condition may be tested at the discretion of the user. In applications requiring inquiries of various lengths (i.e., in banks, mortgage accounts might be six digits and savings accounts seven digits), additional verification techniques may be required. However, if all inquiries are to be of one specific length, record length might be considered ade-

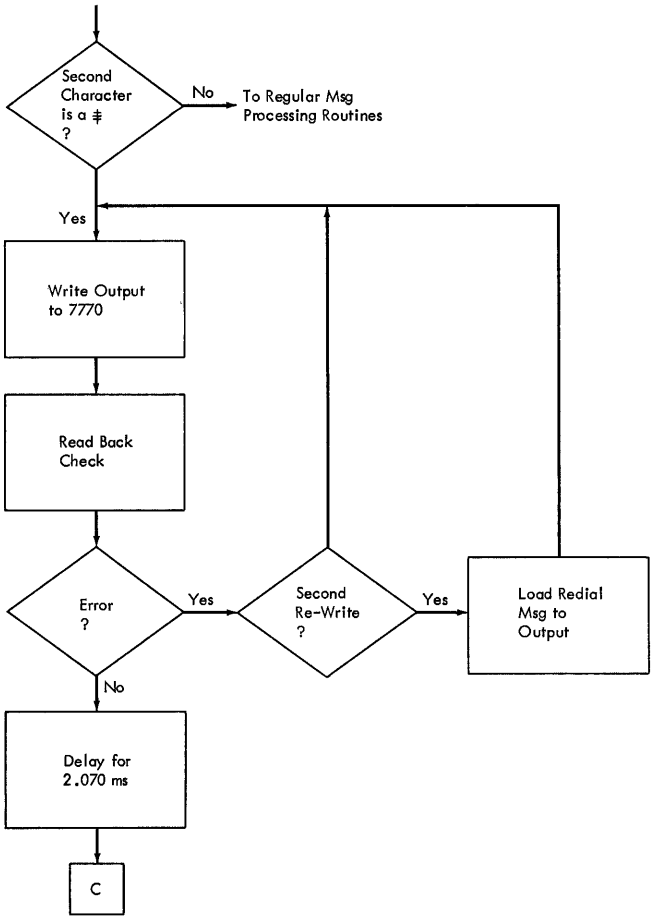


Figure H-112. Testing Subroutine

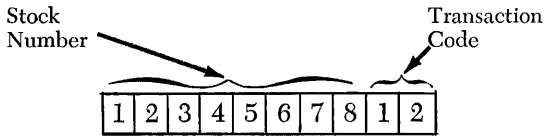
quate. Other record verifying techniques may be used at the option of the user. In the event of an invalid inquiry, an error message (such as *redial*) must be sent by the user's program to the 7770 to release it for further line servicing. After a read back check with no errors, the program must delay for about 2.8 milliseconds before proceeding to the next *read*. This delay is required because of 7770 timing. A routine patterned after the following might be used:

```
DELAY    A      *−6, *+17
         C      *+10, @7@
         BE     *+7
         B      *−22
         DCW    0
         DCW    0
         LCA    *−7, *−8
         B      ITEMC (See Figure H-111)
```

This routine allows approximately 2.8 milliseconds and requires 37 positions of core storage.

Evaluation of the Input

The information required by the inquiry from disk storage must be indicated by the inquiry if many different types of spoken replies are to be given; for example, a retailer may desire to know the amount of a certain stock number on hand. To get the information desired, and only that information, can be easily accomplished by assigning *transaction codes* as part of the inquiry. A format for an inquiry might be:



The length of the stock number and transaction code is variable at the discretion of the user. The user's program must interpret the meaning of both the stock number and transaction code. The evaluation of the inquiry might also involve the length of the inquiry as discussed in the *Inquiry Input* section. In some applications, the user may desire to have the transaction code located elsewhere in the inquiry. Because this program is interruptible, the placement is not limited.

On occasion, some stored information must be inaccessible except to certain persons. In order to perform this fuction, several methods may be used and five of these are described in detail in SRL publication, IBM *7770 Audio Response Unit Model 1*, Form A22-6800. Some security codes may appear as part of the data from which the response message will be composed while others may be part of the inquiry itself in much the same manner as the transaction code.

If a blank is received in the first character of an inquiry read from the 7770, the user's program should interpret this as a transmission error and return a redial.

Information Retrieval

Once the actual inquiry has been evaluated, a response message must be composed. To do this, the general source of information, described by the inquiry, is brought into core storage. The general source of information in a disk system would probably be one or more sections from disk.

To simplify message assembly, some systems may utilize a message format method. With the inquiry transaction code evaluated, it would be known that a certain form of reply is required. This form might well be prepared in advance and stored either in core storage or on disk to be moved to some output area and there to be added to with information extracted from the data brought into core storage.

Message Assembly and Output

A number of methods may be employed for the composition of response messages. An understanding of vocabulary organization as described in SRL publication, IBM *7770 Audio Concepts and Vocabulary,* Form A22-6805, is necessary. Because the response message composed by the processing unit is not an audio message, but rather a sequence of addresses sent to the 7770 indicating where a particular word may be located on the analog drum, it is possible to use raw-data for message composition.

For example, the disk file record of an insurance policy right include such information as a repeat of the policy number, the name of the insured, and the current loan value of the policy. Recalling that the method of addressing audio words used by the 7770 is the straight binary decode of a BCD character, the recommended vocabulary organization places the spoken word "one" on track number 1, and the BCD equivalent is 1. The spoken word "A" would be found on track 49, the BCD "A" being BA 1 (which is the binary representation of 49) and so on through the alphabet and numbers from one to zero. The special characters might be used to address words of unique meaning. The actual assembly of the message may use the format system described in the *Information Retrieval* section, but placement of specific words within the format must be done on an individual message basis. Using the example of the insurance policy, note the following disk record:

Policy Number	Insured's Name	Loan Value
9 3 7 6 4 3	JOHN J DOE	516

It is desired to say:

Account Number: 937643
Insured: J-O-H-N J D-O-E
Loan Value: 516 Dollars.

The unique words might be represented by:

@	=	Account
#	=	Number
!	=	Insured
*	=	Loan
‡	=	Value
$	=	Dollars

A BCD blank is interpreted by the 7770 as *silence required.* Thus the message format might be (bl is used to represent a BCD blank):

@ # bl bl bl bl bl bl bl ! bl bl bl bl bl
bl bl bl bl bl bl bl * ‡ bl bl bl bl $ ‡

The group mark must be the last character of any message so it serves as an end-of-message character.

The fully assembled message would resemble the following in core storage or in 7770 storage:

937643bl!JOHNbl!JblDOEblbl*‡bl516$ ‡

It is also possible to place data in the disk record according to the response expected, thus making the format a part of the stored data rather than putting the stored data into a message format at the time it is called. The maximum length of response is 38 words.

The response message may be assembled for output in the same buffer area reserved for input because only one message is handled at a time. The maximum length of inquiry is 40 characters and the maximum length of the response is 38 characters plus one group mark. The response message is sent to the 7770 through a *write disk* to disk-control field (DCF) 8000000001. It is necessary that a read-back check be issued after a *write.* The transmission error indicator must be tested immediately and, in the event of an error, a user-written error routine must issue a *rewrite* within 2.2 milliseconds of the read back check.

If longer delay before rewrite is desired, a seek should be given within 2.2 milliseconds.

NOTE 1. It is possible for a calling party to dial or otherwise unintentionally put in an incorrect inquiry code; the user should program-protect the caller from getting information that is incorrect. Because it is usually not possible to determine if a number has been incorrectly dialed until a response is made to that number, it is advisable to provide some means of checking the input number. One of the easiest methods of doing this is to program the IBM 7770 to repeat back to the calling party the number as received by the IBM 7770. If the number repeated back is not what the caller expects, the caller should place the inquiry again. Other checking methods may be used, but the repeat back is one of the simplest.

One character, the group mark, is recognized by the 7770 as having special meaning. This is the end-of-message character and must appear as the last character of any message. A message may contain a maximum of 38 address characters plus one group mark. A group-mark with a word-mark must not appear at any point in the message because its presence indicates an end of transmission to the 7770.

NOTE 2. If the extended-vocabulary feature is installed on the 7770, the maximum inquiry length decreases to 36 characters and the response length to 35 characters plus group mark.

IBM **Technical Newsletter**

File No. 1401/1460-01

Re: Form No. A24-3068-1

This Newsletter No. N24-0363

Date: February 14, 1966

Previous Newsletter Nos. None

Replacement pages for Miscellaneous Input/Output Instructions, IBM 1401 Data Processing System, IBM 1460 Data Processing System, Form A24-3068-1.

To bring your publication up to date, replace the following pages with the pages attached to this newsletter.

Pages	To be replaced with
H-61, H-62, H-63 and H-64	H-61, H-62, H-63, H-63.1, H-63.2, H-63.3, H-63.4 and H-64

Changed figures are designated by a bullet (●) to the left of the figure title. Changes to text are indicated by a vertical line (|) next to the affected text. Insert this page to indicate that your publication now includes the modified pages issued with this technical newsletter.

IBM Corp., Product Publications Dept., Endicott, N. Y. 13764

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IBM 1285 Optical Reader

The IBM 1285 Optical Reader Model 1 (Figure H-100) serves as an input device for IBM 1401 and 1460 Data Processing Systems. The 1285 reads printed paper tapes, such as those produced on cash registers and adding machines. Using advanced optical-recognition techniques to read directly from the source document of many business transactions, the 1285 eliminates the time, expense, and errors inherent in a system that requires information to be manually punched into cards before being entered into the system.

Refer to *IBM 1285 Optical Reader, Component Description,* Form A24-3256, for additional information concerning operation of the 1285.

IBM 1285 Instructions

The IBM 1285 Optical Reader, Model 1, can be operated in overlap or nonoverlap mode. The following descriptions of the instructions for the 1285 deal only with the nonoverlap mode. Additional considerations that arise in the overlap mode are discussed separately in *Overlap Operations.*

Instructions applying to the 1285 cannot be successfully chained.

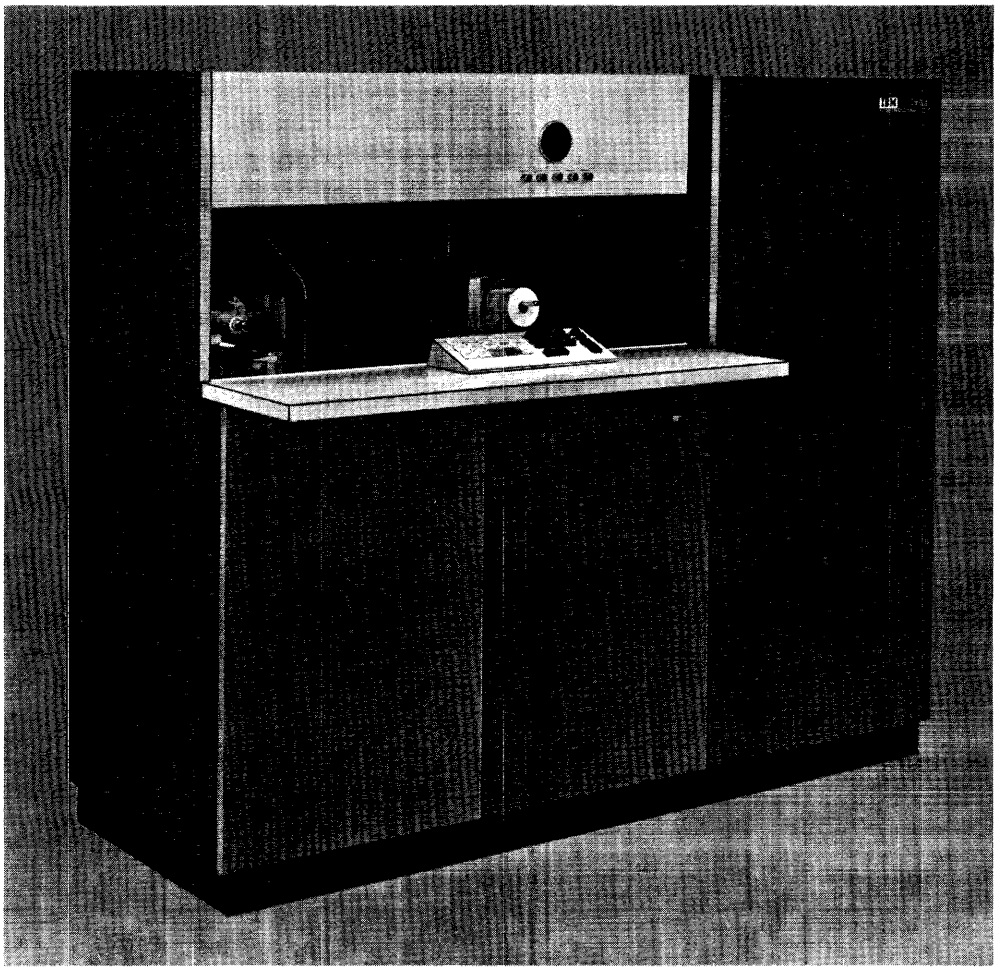


Figure H-100. IBM 1285 Optical Reader

Read in Move Mode

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
MU	M	%V1	xxx	R

Function. This instruction reads either one character or one line into core storage from the 1285. When header or full-line correction information is entered from the keyboard, characters are transmitted in single-character mode, one character for each read instruction. The character is entered in the core-storage location specified by the B-address and the operation is terminated. Assuming the operator keys in information from left to right, the B-address of this instruction should be modified by +1 for each subsequent read operation.

When data is read from the journal tape, characters are transmitted in line mode, one line of information for each read instruction. The line is read from right to left, with the first character being read into the core-storage location specified by the B-address. The contents of the B-address register are automatically modified by −1 before transferring each subsequent character.

A character entered from the keyboard for single-character on-line correction is handled in the same manner as one read from the tape in this line-reading mode.

A read operation is normally terminated when the reader senses the left margin of the tape. When this occurs, a group mark is automatically inserted in the core-storage position to the left of the last character read, and the end-of-line indicator is turned on. If a group mark with word mark is detected in core storage before reading the last character of the line, the read operation is terminated and the end-of-line branch indicator is not turned on.

A read operation is also terminated if the branch on error indicator is set on.

Word Marks. Word marks are not affected. A group mark with a word mark will terminate the read operation.

Timing. See *IBM 1285 Timing Considerations* section.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	%51	B_p – length of line.
or		
NSI	%51	GMWM – 1

Example: Read the 1285 keyboard and place the character in the core-storage location labeled KB1285 (0881). The enter key must be pressed after each character key is pressed (Figure H-100.1).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	IND	(B) OPERAND ADDRESS	±	CHAR. ADJ.	IND	d
0	0	RDKB85	MU	%V1				KB1285				R

Autocoder

Label	Operation	OPERAND
RDKB85	MU	%V1,KB1285,R

Assembled Instruction: M %V1 881 R

● Figure H-100.1. Read IBM 1285 in Move Mode

Read in Load Mode

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
LU	L	%V1	BBB	R

Function. This instruction functions in the same manner as the read-in-move-mode instruction except that, in line reading, word marks accompany characters sent from the keyboard in on-line reject correction. This allows the CPU to distinguish between characters read from tape and characters entered from the keyboard.

Go to Next Line

Instruction Format.

	Mnemonic	*Op Code*	*I-address*	*d-character*
SPS	SS	K	xxx	G
A	SS	K		G
A	SSB	K	xxx	G

Function. This instruction causes the reader to advance to the next line. The normal procedure is to test the end-of-line branch indicator after a read instruction and, if on (indicating a valid read), to issue this instruction to cause the reader to begin scanning for the next line. If not given after a read operation is terminated, the next read instruction will reread the line.

The next instruction executed is that specified by the I-address, if supplied, or the next instruction in sequence, if no I-address is specified.

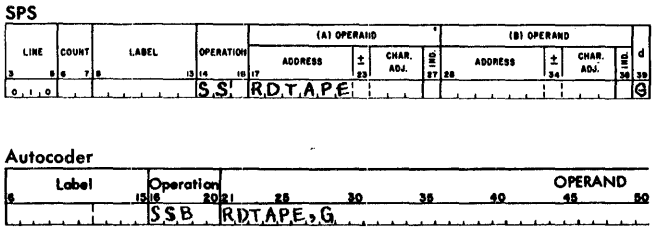
Word Marks. Word marks are not affected.

Timing.
Go to next line: $T = N (L_1 + 1)$ ms.
Go to next line and branch (without indexing):
$T = N (L_1 + 1)$ ms.
Go to next line and branch (with indexing):
$T = N (L_1 + 2)$ ms.

Address Registers After Operation.

	I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
Go to next line:	NSI	Gbb	Gbb
Go to next line and branch (without indexing):	NSI	BI	blank
Go to next line and branch (with indexing):	NSI	BI	NSI

Example. Cause the 1285 to advance to the next journal-tape line, and branch unconditionally to a subroutine labeled RDTAPE (1286) specified by the I-address (Figure H-100.2).



Assembled Instruction: K S86 G

● Figure H-100.2. Go to Next Line and Branch

Set Correction Mode

Instruction Format.

	Mnemonic	*Op Code*	*I-address*	*d-character*
SPS	SS	K	xxx	C
A	SS	K		C
A	SSB	K	xxx	C

Function. This instruction causes the 1285 to go into a line display and sets up controls for character-by-character reading from keyboard entry. If the first line of the tape has not yet been read, the enter light turns on, indicating to the operator that he should enter header data. If at least one line of the tape has been read, the reject light turns on, indicating to the operator that he should do a full-line correction.

The next instruction executed is either specified by the I-address or the next sequential instruction (if no I-address is specified).

Word Marks. Word Marks are not affected.

Timing.

Set correction mode: $T = N (L_1 + 1)$ ms.

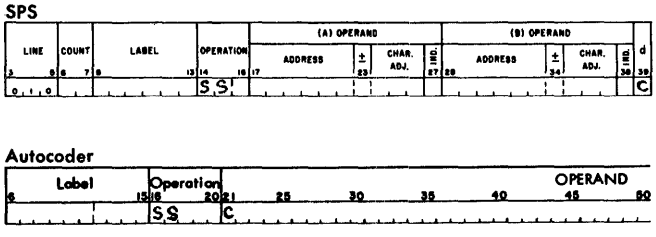
Set correction mode and branch (without indexing): $T = N (L_1 + 1)$ ms.

Set correction mode and branch (with indexing): $T = N (L_1 + 2)$ ms.

Address Registers After Operation.

	I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
Set correction mode:	NSI	Cbb	Cbb
Set correction mode and branch (without indexing):	NSI	BI	blank
Set correction mode and branch (with indexing):	NSI	BI	NSI

Example. Cause the 1285 to go into line display and set up controls for character-by-character entry from keyboard (Figure H-100.3).



Assembled Instruction: K C

● Figure H-100.3. Set Correction Mode

Mark a Line

Instruction Format.

	Mnemonic	*Op Code*	*I-address*	*d-character*
SPS	SS	K	xxx	M
A	SS	K		M
A	SSB	K	xxx	M

Function. This instruction causes the line that the reader is on to be marked by the reject line marker. The line is transported to the top of the scan window and marked after the next GO TO NEXT LINE instruction. The MARK A LINE instruction can be given at any time after the ready-to-read-a-line indicator is turned on and before the GO TO NEXT LINE instruction.

Note: If the line is re-read (a GO TO NEXT LINE instruction is not given), the effect of this instruction is cancelled.

The next instruction executed is that specified by the I-address, or the next sequential instruction (NSI) if no I-address is specified.

Word Marks. Word Marks are not affected.

Timing.

Mark a line: $T = N (L_1 + 1)$ ms.

Mark a line and branch without indexing: $T = N (L_1 + 1)$ ms.

Mark a line and branch with indexing: $T = N (L_1 + 2)$ ms.

Address Registers After Operation.

	I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
Mark a line:	NSI	Mbb	Mbb
Mark a line and branch (without indexing):	NSI	BI	blank
Mark a line and branch (with indexing):	NSI	BI	NSI

Example. Cause the reader to mark the line it is now reading, after the next GO TO NEXT LINE instruction (Figure H-100.4).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	IND	(B) OPERAND ADDRESS	±	CHAR. ADJ.	IND	d
3 5	6 7	8 13	14 16	17 23			27	28 34			38	39
			S S									M

Autocoder

Label	Operation	OPERAND
5 15	18 20	21 25 30 35 40 45 80
	S S	M

Assembled Instruction: K M

● Figure H-100.4. Mark a Line

Branch if Indicator On

Instruction Format.

	Mnemonic	*Op Code*	*I-Address*	*d-character*
SPS	B	B	xxx	d
A	BIN	B	xxx	d

Function. This instruction tests for the IBM 1285 operational conditions specified by the d-character. If the indicator is on, the next instruction is taken from the I-address. If off, the program goes to the next sequential instruction.

d-character	*Indicator*
1	ERROR
2	END-OF-LINE
3	READER-TRANSPORTING
4	MARKED-LINE
5	HEADER-INFORMATION
6	READY-TO-READ-A-LINE
7	READER-READY
8	END-OF-FILE

Indicators

Branch if Error. This indicator (d-character 1) is turned on if any of the following conditions exist. This indicator remains on until tested.

- A process check occurs in the processing unit during a read operation.
- A skew error occurs during a read operation.
- The scanner is unable to follow a line due to extraneous material on the tape during a read operation.
- A reject display exceeds the time limit.
- A line of header or a full line of correction data (cancel-enter sequence) from the reader.

Branch if End of Line. This indicator (d-character 2) is turned on after the last character of a line is transferred to the processing unit and the reader senses the left edge of the tape. If this indicator is not on when a read operation is completed, an error condition may exist, depending on the program and the tape format. This indicator is turned off by the GO TO NEXT LINE instruction, or by rereading the same line.

Branch if Reader Transporting. This indicator (d-character 3) is turned on when the transport mechanism is started to bring a new segment of tape over the scan window. It is turned off when the transport mechanism is stopped. Note that a minimum of 1 millisecond elapses between execution of the GO-TO-NEXT-LINE instruction and the beginning of the transport operation. Also, this indicator is turned off as soon as the transport stops, leaving about 6 milliseconds until the ready-to-read-a-line indicator is turned on.

This indicator may be used to determine if sufficient time is available to execute other instructions. This indicator is also on when displaying a line.

Branch if Marked Line. This indicator (d-character 4) is turned on if the last line read will be marked by the reject line marker. If the MARK A LINE instruction was given, or if the line contains a reject symbol (@), it will be automatically transported to the reject line marker after the next GO TO NEXT LINE instruction is given.

This indicator is reset by a GO TO NEXT LINE instruction, or by the rereading of the line (either line read or full-line correction).

Branch if Header Information. This indicator (d-character 5) is turned on when a character of header information or full-line correction is entered from the keyboard. It is reset for each character read by the program. As long as this indicator is on, the reader will not respond to the start key to begin processing the journal tape. When no more information is to be entered, the start key is pressed, and the ready-to-read-a-line indicator is turned on.

Branch if Reader Ready to Read a Line. This indicator (d-character 6) is turned on when the reader has found a line and is ready to read it. The indicator is turned off by a go-to-next-line instruction, or by loss of the reader-ready condition.

Note: When a line is found, the scanner enters the normalizing mode and continues from character to character in the line until a read instruction is given. At that time, the flying spot sweeps back to the low-order character.

To keep read time to a minimum, a read instruction should be given within 1.5 ms after this indicator is turned on. Otherwise, up to 3 ms may be lost in returning to the low-order position.

Branch if Reader Ready. This indicator (d-character 7) is turned on when a tape is loaded and the first line is found by the scanner. The indicator remains on until the operator runs the end of the tape through

the transport by pressing the end-of-file key, or until an error occurs that requires operator intervention.

Branch if End of File. This indicator (d-character 8) is turned on when the trailing end of the roll is run through the transport by pressing the end-of-file key. The indicator is reset when another roll is loaded.

Word Marks. Word marks are not affected.

Timing.

No branch or branch without indexing:

$T = N (L_1 + 1)$ ms.

Branch with indexing: $T = N (L_1 + 2)$ ms.

Address Registers After Operation.

	I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
No Branch:	NSI	BI	dbb
Banch (without indexing):	NSI	BI	blank
Branch (with indexing):	NSI	BI	NSI

Example. Branch to a subroutine labeled GO1285 (1644) if the reader-ready indicator is on (Figure H-100.5).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	(B) OPERAND ADDRESS	±	CHAR. ADJ.	d
010			B	G01285						7

Autocoder

Label	Operation	OPERAND
	BIN	G01285,7

Assembled Instruction: B W44 7

● Figure H-100.5. Branch if Reader-Ready Indicator On

IBM 1285 Timing Considerations

The reading speed of the IBM 1285 Optical Reader depends upon factors which vary with individual applications. The optimum reading speed when using the IBM 1428 character font is obtained by the following formula:

Throughput

$$\text{(lines per minute)} = \frac{60{,}000}{1.7W + 1.9S + \frac{47}{L} + 1.4C} \pm 5\%$$

Where:
- C = characters per line
- L = lines per inch
- W = tape width in inches
- S = distance from tape edge to first character in inches

With the NCR Optical Character Recognition Font, the optimum reading speed is found with the following formula, using the same symbols for the same variables:

$$\text{(lines per minute)} = \frac{60{,}000}{1.7W + 1.9S + \frac{47}{L} + 1.55C - 0.5} \pm 5\%$$

Note: Items that can lower the optimum calculated speed are: rescans, branch-1 errors, re-reads of wrong length lines, and line marking. Both equations pertain to calculations for constant line length and uniform line spacing only.

Using the IBM 1428 character font, two examples of throughput are given.

C = 10 characters per line
L = 4 lines per inch
W = 2 inches
S = 0.2 inch
} Throughput = 2030 lines per minute

C = 4 characters per line
L = 4 lines per inch
W = 1⅝ inches
S = 0.1 inch
} Throughput = 3035 lines per minute

IBM 1285 Programming Techniques

Figure H-100.6 shows how some of the IBM 1285 instructions might be used. Figure H-100.6 is only a guide: the application to be performed will dictate the actual use of the instructions.

Overlap Operations

The 1285 can be operated in overlap mode if the attached processing unit has the process-overlap feature. In this mode, processing is interrupted only long enough to transfer a single character into core storage, and then is released until the next character in the line has been recognized by the reader and is ready to be transmitted. The programming aspects of overlapped operations are given in this section as exceptions to the previous discussion of the instruction set.

Read in Overlap Mode

To read in overlap mode, code the A-address field with @VI (instead of the %VI used for a nonoverlapped read). Processing is interrupted to transfer each character, and then released until the next character is ready to be transferred.

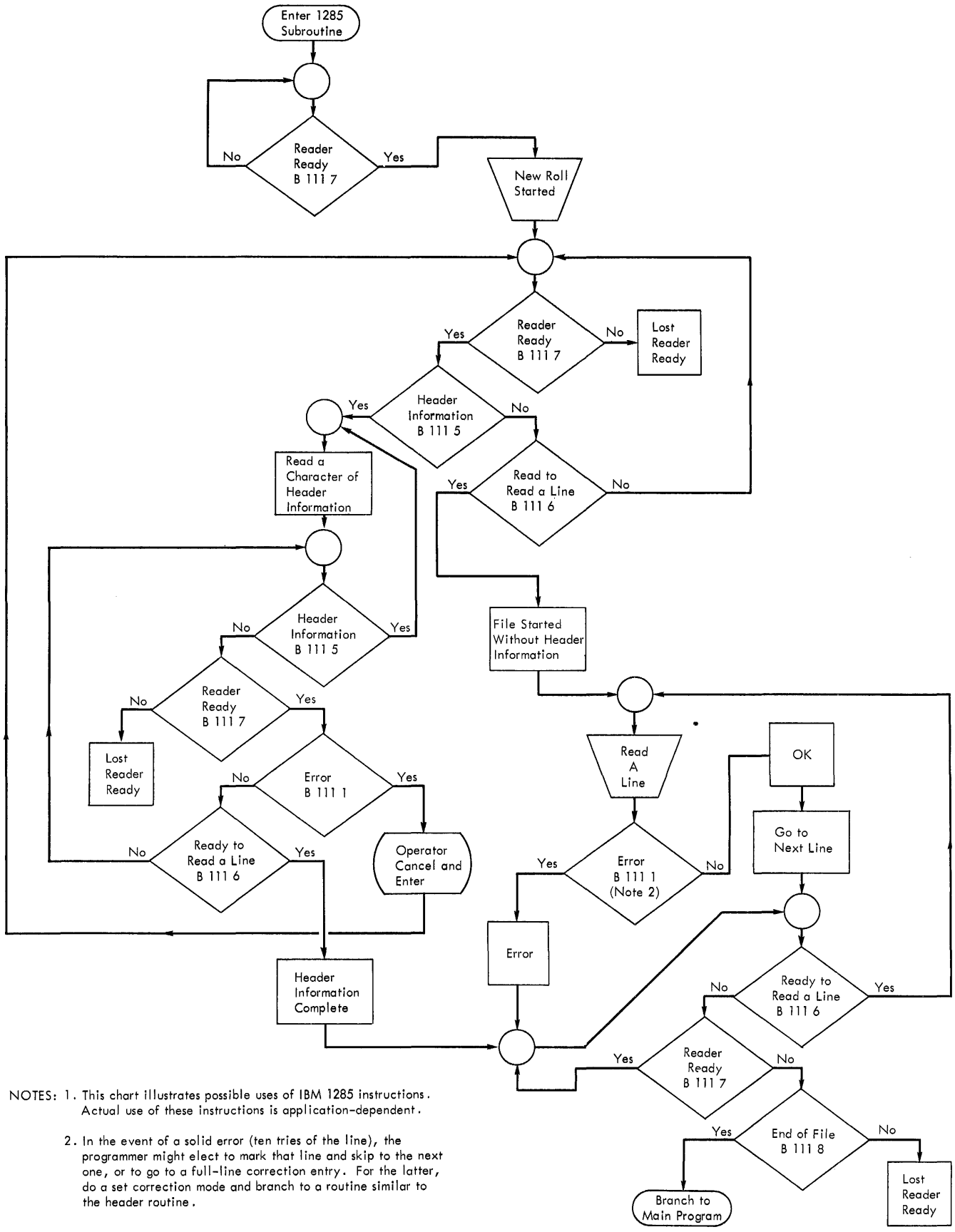
Go to Next Line

This instruction can be used to terminate an overlapped read operation. In this case, the error indicator is turned on and the reader advances to the next line.

Branch if Error

This indicator is turned on if an overlapped read operation is terminated by a GO TO NEXT LINE or set-correction-mode instruction.

Note: This type of operation may be deliberate and not actually an error condition. For example, a program might be processing only those lines with a particular code in the low-order position. Processing is released after the first character is read, allowing the program to test to see if the read is to be continued. If not, the program can go to the next line, ignoring the error indicator. (The error indicator should still be tested in order to reset it.)



NOTES: 1. This chart illustrates possible uses of IBM 1285 instructions. Actual use of these instructions is application-dependent.

2. In the event of a solid error (ten tries of the line), the programmer might elect to mark that line and skip to the next one, or to go to a full-line correction entry. For the latter, do a set correction mode and branch to a routine similar to the header routine.

● Figure H-100.6. IBM 1285 Programming Schematic

IBM 1445 Printer for the 1401 System

The IBM 1445 Printer (Figure H-101) provides a means of inscribing in magnetic ink A.B.A. (E-13B) type font as well as conventional characters for another medium of printed output from the 1401 system (equipped with a serial input/output adapter).

IBM 1445 Printer Instructions for 1401

Write Line

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
MU	M	%Y2	xxx	W

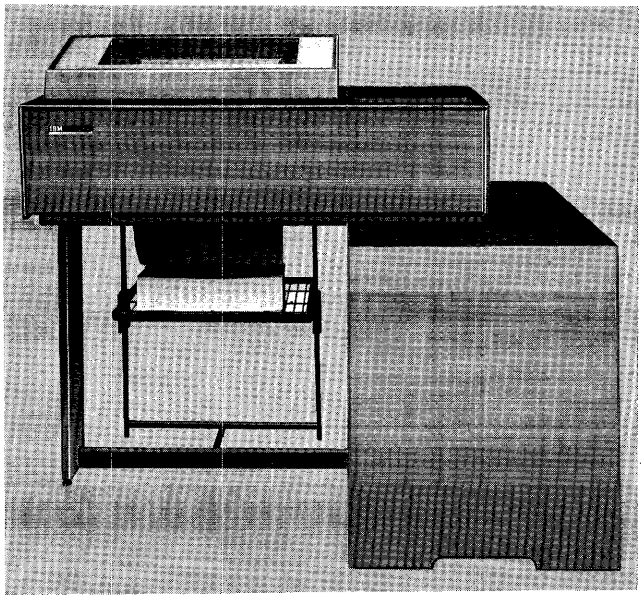


Figure H-101. IBM 1445 Printer

Function. This instruction is used to transfer data from core storage to the 1445 printer, where it will be printed.

The B-address (xxx) contains the first character to be printed. Because the printer cannot recognize or fill a short line, the print field must contain 170 parity valid characters. The first 113 characters are all that are printed. The remaining buffer positions are filled with valid characters or blanks.

An end-of-transmission signal, which is an internal signal that is developed when the print field is filled with 170 parity valid characters, stops the data transfer and initiates an I/O disconnect to the processor. This permits the processor to continue while the printer writes the line of data from the print buffer.

Word Marks. Word marks are not affected.

Timing. $T = .0115\ (L_I + 1) + 2.5$ ms.

Control Carriage

Instruction Format.

Mnemonic	*Op Code*	*d-character*
SS	K	A

Function. This instruction is used for carriage control through the program to move the form for the desired spacing.

This conditions the printer to enter the next character on the data lines into the carriage register. The B-address of the next print instruction must contain the specific modifier character for the forms operation desired.

This instruction ends after the single character is read (I-cycle) and continues on the next instruction.

Word Marks. Word marks are not affected.

Timing. $T = .0115\ (L_I + 1)$ ms + remaining form-movement time, if the carriage is already in motion when this instruction is given. The total movement time depends on the specific carriage operation being performed.

Space Suppress

Instruction Format.

Mnemonic	*Op Code*	*d-character*
SS	K	B

Function. This instruction suppresses the single space after a print operation.

A SPACE SUPPRESS instruction must be preceded by tests for print check and printer busy, and followed by a WRITE LINE instruction. When these tests are made before a SPACE SUPPRESS instruction, it is not necessary to repeat the test before the print instruction because the tests are still valid.

Word Marks. Word marks are not affected.

Timing. $T = .0115\ (L_I + 1)$ ms.

Branch if Printer Status

Instruction Format.

Mnemonic	*Op Code*	*I-address*	*d-character*
BIN	B	xxx	d (see chart)

d-character	*Description*
1.	Printer Error
5.	Printer Busy
6.	Carriage Busy
7.	Carriage Channel 9
8.	Carriage Channel 12

Function. This instruction and its associated d-characters are used to check the printer status. When a tested condition is present, the program branches to the I-address. If the condition is not present, the program goes to the next sequential instruction.

Word Marks. Word marks are not affected.

Timing. $T = .0115\ (L_I + 1)$ ms.

IBM **Technical Newsletter**

File No. 1401/1460-01

Re: Form No. A24-3068-2

This Newsletter No. N24-0393

Date: December 30, 1966

Previous Newsletter Nos. None

Replacement pages for Miscellaneous Input/Output Instructions, IBM 1401 Data Processing System, IBM 1460 Data Processing System, Form A24-3068-2.

To bring your publication up to date, replace the following pages with the pages attached to this newsletter.

Pages
H-61, H-62
H-63, H-63.1
H-63.2, H-63.3
H-63.4, H-63.5

Changed figures are designated by a bullet (●) to the left of the figure title. Changes to text are indicated by a vertical line (❙) next to the affected text. Insert this page to indicate that your publication now includes the modified pages issued with this technical newsletter.

IBM Corp., Product Publications Dept., Endicott, N. Y. 13760

PRINTED IN U.S.A.

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Refer to *IBM 1285 Optical Reader, Component Description,* Form A24-3256, for additional information concerning operation of the 1285.

IBM 1285 Instructions

The IBM 1285 Optical Reader, Model 1, can be operated in overlap or nonoverlap mode. The following descriptions of the instructions for the 1285 deal only with the nonoverlap mode. Additional considerations that arise in the overlap mode are discussed separately in *Overlap Operations.*

Figure H-100. IBM 1285 Optical Reader

Read in Move Mode

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
MU	M	%V1	xxx	R

Function. This instruction reads either one character or one line into core storage from the 1285. When header or full-line correction information is entered from the keyboard, characters are transmitted in single-character mode, one character for each read instruction. The character is entered in the core-storage location specified by the B-address and the operation is terminated. Assuming the operator keys in information from left to right, the B-address of this instruction should be modified by +1 for each subsequent read operation, by a subroutine. Such a subroutine is necessary because of the single-character transmission from the keyboard to core in these modes. The subroutine should be entered when the reader first becomes ready (branch on indicator 7). Wait loops for characters (indicator 5) should include repeated tests for Reader Ready (7), for Ready to Read a line (6, indicating the end of data input for the subroutine), and for Reader Error (1, indicating operator Cancel Enter). If Reader Error occurs in this subroutine, it is advisable to notify the operator through a printout or coded halt, and to re-initialize the subroutine. The subroutine should also be entered after giving a Set Correction Mode instruction to begin Full-Line Correction or to handle re-entry of Header or Full-Line Correction data for verification.

When data is read from the journal tape, characters are transmitted in line mode, one line of information for each read instruction. The line is read from right to left, with the first character being read into the core-storage location specified by the B-address. The contents of the B-address register are automatically modified by −1 before transferring each subsequent character.

A character entered from the keyboard for single-character on-line correction is handled in the same manner as one read from the tape in this line-reading mode.

A line read operation is normally terminated when the reader senses the left margin of the tape. When this occurs, a group mark is automatically inserted in the core-storage position to the left of the last character read, and the end-of-line indicator is turned on.

If a group mark with word mark is detected in core storage before reading the last character of the line, the read operation is terminated and the end-of-line branch indicator is not turned on.

A read operation is also terminated if the branch on error indicator is set on.

Word Marks. Word marks are not affected. A group mark with a word mark will terminate the read operation.

Timing. See *IBM 1285 Timing Considerations* section.

Address Registers After Operation.

I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
NSI	%51	B_p – length of line.
or		
NSI	%51	GMWM – 1

Example: Read the 1285 keyboard and place the character in the core-storage location labeled KB1285 (0881). The enter key must be pressed after each character key is pressed (Figure H-100.1).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	IND	(B) OPERAND ADDRESS	±	CHAR. ADJ.	IND	d
3 5	6 7	8 13	14 16	17 23			27	28 34			36	39
0 1 0		RDKB85	MU	%V1				KB1285				R

Autocoder

Label	Operation	OPERAND
5 15	16 20	21 25 30 35 40 45 50
RDKB85	MU	%V1,KB1285,R

Assembled Instruction: M %V1 881 R

Figure H-100.1. Read IBM 1285 in Move Mode

Read in Load Mode

Instruction Format.

Mnemonic	*Op Code*	*A-address*	*B-address*	*d-character*
LU	L	%V1	BBB	R

Function. This instruction functions in the same manner as the read-in-move-mode instruction except that, in line reading, word marks accompany characters sent from the keyboard in on-line reject correction. This allows the CPU to distinguish between characters read from tape and characters entered from the keyboard.

Go to Next Line

Instruction Format.

	Mnemonic	*Op Code*	*I-address*	*d-character*
SPS	SS	K	xxx	G
A	SS	K		G
A	SSB	K	xxx	G

Function. This instruction causes the reader to advance to the next line. The normal procedure is to test the end-of-line branch indicator after a read instruction and, if on (indicating a valid read), to issue this instruction to cause the reader to begin scanning for the next line. If not given after a read operation is terminated, the next read instruction will reread the line.

The next instruction executed is that specified by the I-address, if supplied, or the next instruction in sequence, if no I-address is specified.

To accomplish line skipping, the program should wait for the Ready-to-Read-a-Line indicator (6) before issuing the next Go To Next Line.

Word Marks. Word marks are not affected.

Timing.

Go to next line: $T = N (L_1 + 1)$ ms.

Go to next line and branch (without indexing): $T = N (L_1 + 1)$ ms.

Go to next line and branch (with indexing): $T = N (L_1 + 2)$ ms.

Address Registers After Operation.

	I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
Go to next line:	NSI	Cbb	Cbb
Go to next line and branch (without indexing):	NSI	BI	blank
Go to next line and branch (with indexing):	NSI	BI	NSI

Example. Cause the 1285 to advance to the next journal-tape line, and branch unconditionally to a subroutine labeled RDTAPE (1286) specified by the I-address (Figure H-100.2).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	IND	(B) OPERAND ADDRESS	±	CHAR. ADJ.	IND	d
3 5	6 7	8 13	14 16	17 23			27	28 34			36	38
0 1 0			S S B	R D T A P E								G

Autocoder

Label	Operation	OPERAND
5 15	16 20	21 25 30 35 40 45 50
	S S B	R D T A P E , G

Assembled Instruction: K S86 G

Figure H-100.2. Go to Next Line and Branch

Set Correction Mode

Instruction Format.

	Mnemonic	*Op Code*	*I-address*	*d-character*
SPS	SS	K	xxx	C
A	SS	K		C
A	SSB	K	xxx	C

Function. This instruction causes the 1285 to go into a line display and sets up controls for character-by-character reading from keyboard entry. If the first line of the tape has not yet been read, the enter light turns on, indicating to the operator that he should enter header data. If at least one line of the tape has been read, the reject light turns on, indicating to the operator that he should do a full-line correction.

The next instruction executed is either specified by the I-address or the next sequential instruction (if no I-address is specified).

Purposes:

1. To call for re-entry of Header or Full-Line data if verification is used.
2. To call for Full-Line Correction. This is recommended in the event of persistent (10 tries) Error indications after reading a line, or the presence of a reject symbol (@) entered in Single-Character Correction. The latter may be indicated by the presence of a reject symbol with a word mark in core storage after a Read in Load Mode, or the presence of the Reject Character in Line (4) indicator when a sense switch indicates the use of on-line reject correction.

Word Marks. Word Marks are not affected.

Timing.

Set correction mode: $T = N (L_1 + 1)$ ms.

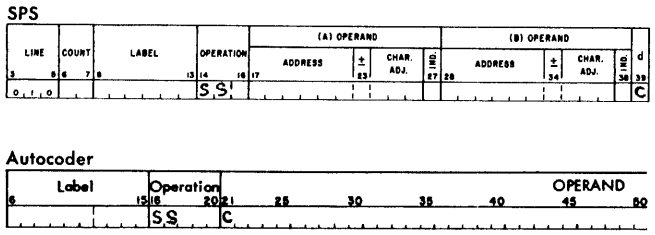
Set correction mode and branch (without indexing): $T = N (L_1 + 1)$ ms.

Set correction mode and branch (with indexing): $T = N (L_1 + 2)$ ms.

Address Registers After Operation.

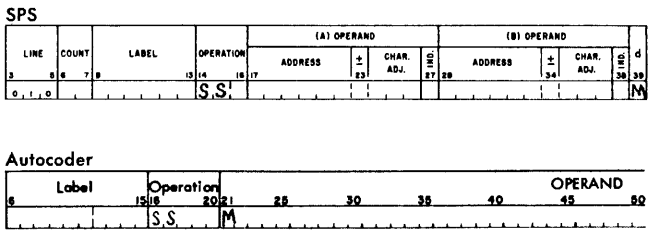
	I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
Set correction mode:	NSI	Cbb	Cbb
Set correction mode and branch (without indexing):	NSI	BI	blank
Set correction mode and branch (with indexing):	NSI	BI	NSI

Example. Cause the 1285 to go into line display and set up controls for character-by-character entry from keyboard (Figure H-100.3).



Assembled Instruction: K C

Figure H-100.3. Set Correction Mode



Assembled Instruction: K M

Figure H-100.4. Mark a Line

Mark a Line

Instruction Format.

	Mnemonic	*Op Code*	*I-address*	*d-character*
SPS	SS	K	xxx	M
A	SS	K		M
A	SSB	K	xxx	M

Function. This instruction causes the line that the reader is on to be marked by the reject line marker. The line is transported to the top of the scan window and marked after the next GO TO NEXT LINE instruction. The MARK A LINE instruction can be given at any time after the ready-to-read-a-line indicator is turned on and before the GO TO NEXT LINE instruction.

Note: If the line is re-read (a GO TO NEXT LINE instruction is not given), the effect of this instruction is cancelled.

The next instruction executed is that specified by the I-address, or the next sequential instruction (NSI) if no I-address is specified.

Word Marks. Word Marks are not affected.

Timing.

Mark a line: $T = N (L_1 + 1)$ ms.
Mark a line and branch without indexing:
$T = N (L_1 + 1)$ ms.
Mark a line and branch with indexing:
$T = N (L_1 + 2)$ ms.

Address Registers After Operation.

	I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
Mark a line:	NSI	Mbb	Mbb
Mark a line and branch (without indexing):	NSI	BI	blank
Mark a line and branch (with indexing):	NSI	BI	NSI

Example. Cause the reader to mark the line it is now reading, after the next GO TO NEXT LINE instruction (Figure H-100.4).

Force On-Line Correction

Instruction Format.

	Mnemonic	*Op Code*	*I-Address*	*d-character*
SPS	SS	K	xxx	F
A	SS	K		F
A	SSB	K	xxx	F

Function. This instruction causes the next line read by a Read Instruction to be read in On-Line Correction Mode, regardless of the setting of the off-line correction on the 1285 Operator Panel. It allows a program decision to change correction mode on re-reading of a line. The switch light should be on (in off-line correction mode) to make use of this instruction.

The next instruction executed is that specified by the I-address, if supplied, or the next instruction in sequence, if no I-address is specified.

Word Marks. Word Marks are not affected.

Timing:

Force On-Line Correction: $T = N (L_1 + 1)$ ms.
Force On-Line Corr. & Br. (without indexing:)
$T = N (L_1 + 1)$ ms.
Force On-Line Corr. & Br. (with indexing:)
$T = N (L_1 + 2)$ ms.

Address Registers After Operation.

	I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
Force On-Line Corr.	NSI	Fbb	Fbb
Force On-Line Corr. (without indexing):	NSI	BI	blank
Force On-Line Corr. (with indexing):	NSI	BI	NSI

Example. Causes the next line read by a Read Instruction to be read in On-Line-Correction Mode (Figure H-100.4.1).

SPS

LINE	COUNT	LABEL	OPERATION	(A) OPERAND ADDRESS	±	CHAR. ADJ.	IND	(B) OPERAND ADDRESS	±	CHAR. ADJ.	IND	d
3 5	6 7	8 13	14 16	17	23		27	28	34		38	39
0,1,0			S,S									F

Autocoder

Label	Operation	OPERAND
6 15	16 20	21 25 30 35 40 45 50
	S,S,	F

Assembled Instruction: K F

● Figure H-100.4.1 Force On-Line Correction

Branch if Indicator On

Instruction Format.

	Mnemonic	*Op Code*	*I-Address*	*d-character*
SPS	B	B	xxx	d
A	BIN	B	xxx	d

Function. This instruction tests for the IBM 1285 operational conditions specified by the d-character. If the indicator is on, the next instruction is taken from the I-address. If off, the program goes to the next sequential instruction.

d-character	*Indicator*
1	ERROR
2	END-OF-LINE
3	READER-TRANSPORTING
4	REJECT CHARACTER IN LINE
5	HEADER-INFORMATION
6	READY-TO-READ-A-LINE
7	READER-READY
8	END-OF-FILE

Indicators

Branch if Error. This indicator (d-character 1) is turned on if any of the following conditions exist. This indicator remains on until tested.

- A process check occurs in the processing unit during a read operation.
- A skew error occurs during a read operation.
- The scanner is unable to follow a line due to extraneous material on the tape during a read operation.
- A reject display exceeds the time limit.
- A line of header or a full line of correction data (cancel-enter sequence) from the reader.

A test for this indicator should be the first instruction following a READ. Wait loops for Header Information (5) should also include a test for Error (Cancel-Enter).

Branch if End of Line. This indicator (d-character 2) is turned on after the last character of a line is transferred to the processing unit and the reader senses the left edge of the tape. If this indicator is not on when a read operation is completed, an error condition may exist, depending on the program and the tape format. This indicator is turned off by the GO TO NEXT LINE instruction, or by rereading the same line.

Branch if Reader Transporting. This indicator (d-character 3) is turned on when the transport mechanism is started to bring a new segment of tape over the scan window. It is turned off when the transport mechanism is stopped. Note that a minimum of 1 millisecond elapses between execution of the GO-TO-NEXT-LINE instruction and the beginning of the transport operation. Also, this indicator is turned off as soon as the transport stops, leaving about 6 milliseconds until the ready-to-read-a-line indicator is turned on.

This indicator may be used to determine if sufficient time is available to execute other instructions. This indicator is also on when displaying a line.

Branch if Reject Character in Line. This indicator d-character 4) is turned on if the last line read (Line Reading only) contains at least one reject symbol (@). This indicator is turned off by Go-to-Next-Line or by Re-read instruction (either line read or full line correction).

Branch if Header Information. This indicator (d-character 5) is turned on when a character of header information or full-line correction is entered from the keyboard. It is reset for each character read by the program. As long as this indicator is on, the reader will not respond to the start key to begin processing the journal tape. When no more information is to be entered, the start key is pressed, and the ready-to-read-a-line indicator is turned on.

Branch if Reader Ready to Read a Line. This indicator (d-character 6) is turned on when the reader has found a line and is ready to read it. The indicator is turned off by a go-to-next-line instruction, or by loss of the reader-ready condition.

Note: Any wait loops testing this indicator should also include a test for Reader Ready (7).

Branch if Reader Ready. This indicator (d-character 7) is turned on when a tape is loaded and the first line is found by the scanner. The indicator remains on until the operator runs the end of the tape through the transport by pressing the end-of-file key, or until an error occurs that requires operator intervention. Any wait loops testing other indicators should include a test for Reader Ready. If Reader Ready is lost, the End-of-File indicator (8) should be tested.

Branch if End of File. This indicator (d-character 8) is turned on when the trailing end of the roll is run through the transport by pressing the end-of-file key. The indicator is reset when another roll is loaded. The test for this indicator should be executed immediately after the loss of the Reader Ready (7) indicator.

Word Marks. Word marks are not affected.

Timing.

No branch or branch without indexing:

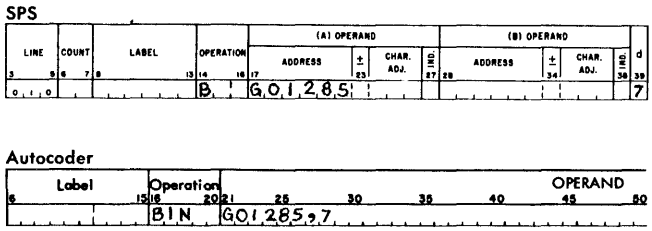
$T = N (L_1 + 1)$ ms.

Branch with indexing: $T = N (L_1 + 2)$ ms.

Address Registers After Operation.

	I-Add. Reg.	*A-Add. Reg.*	*B-Add. Reg.*
No Branch:	NSI	BI	dbb
Banch (without indexing):	NSI	BI	blank
Branch (with indexing):	NSI	BI	NSI

Example. Branch to a subroutine labeled GO1285 (1644) if the reader-ready indicator is on (Figure H-100.5).



Assembled Instruction: B W44 7

Figure H-100.5. Branch if Reader-Ready Indicator On

IBM 1285 Timing Considerations

The reading speed of the IBM 1285 Optical Reader depends upon factors which vary with individual applications. The optimum reading speed when using the IBM 1428 character font is obtained by the following formula:

Throughput

$$\text{(lines per minute)} = \frac{60{,}000}{1.7W + 1.9S + \frac{47}{L} + 1.4C} \pm 5\%$$

Where:
- C = characters per line
- L = lines per inch
- W = tape width in inches
- S = distance from tape edge to first character in inches

With the NCR Optical Character Recognition Font, the optimum reading speed is found with the following formula, using the same symbols for the same variables:

$$\text{(lines per minute)} = \frac{60{,}000}{1.7W + 1.9S + \frac{47}{L} + 1.55C - 0.5} \pm 5\%$$

Note: Items that can lower the optimum calculated speed are: rescans, branch-1 errors, re-reads of wrong length lines, and line marking. Both equations pertain to calculations for constant line length and uniform line spacing only.

Using the IBM 1428 character font, two examples of throughput are given.

C = 10 characters per line
L = 4 lines per inch
W = 2 inches
S = 0.2 inch
} Throughput = 2030 lines per minute

C = 4 characters per line
L = 4 lines per inch
W = 1⅝ inches
S = 0.1 inch
} Throughput = 3035 lines per minute

IBM 1285 Programming Techniques

Figure H-100.6 shows how some of the IBM 1285 instructions might be used. Figure H-100.6 is only a guide: the application to be performed will dictate the actual use of the instructions.

Overlap Operations

The 1285 can be operated in overlap mode if the attached processing unit has the process-overlap feature. In this mode, processing is interrupted only long enough to transfer a single character into core storage, and then is released until the next character in the line has been recognized by the reader and is ready to be transmitted. The programming aspects of overlapped operations are given in this section as exceptions to the previous discussion of the instruction set.

Read in Overlap Mode

To read in overlap mode, code the A-address field with @VI (instead of the %VI used for a nonoverlapped read). Processing is interrupted to transfer each character, and then released until the next character is ready to be transferred.

Go to Next Line

This instruction can be used to terminate an overlapped read operation. In this case, the error indicator is turned on and the reader advances to the next line.

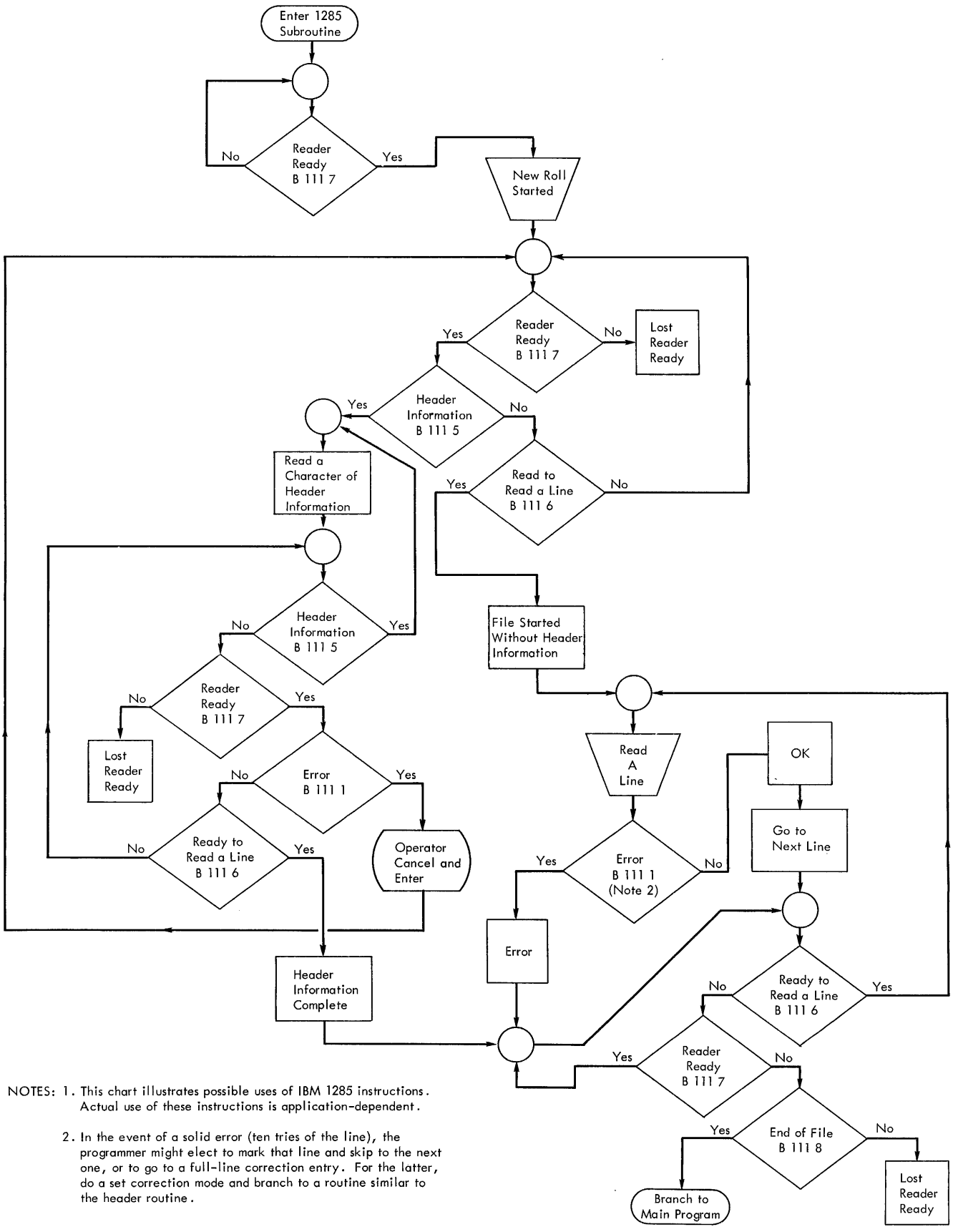
Set Correction Mode

This instruction can be used to terminate an overlapped read operation before it is complete if it is known that full-line correction will be necessary. The error indicator is turned on.

Branch if Error

This indicator is turned on if an overlapped read operation is terminated by a GO TO NEXT LINE or set-correction-mode instruction.

Note: This type of operation may be deliberate and not actually an error condition. For example, a program might be processing only those lines with a particular code in the low-order position. Processing is released after the first character is read, allowing the program to test to see if the read is to be continued. If not, the program can go to the next line, ignoring the error indicator. (The error indicator should still be tested in order to reset it.)



NOTES: 1. This chart illustrates possible uses of IBM 1285 instructions. Actual use of these instructions is application-dependent.

2. In the event of a solid error (ten tries of the line), the programmer might elect to mark that line and skip to the next one, or to go to a full-line correction entry. For the latter, do a set correction mode and branch to a routine similar to the header routine.

Figure H-100.6. IBM 1285 Programming Schematic

IBM 1401/1460 Data Processing System
Miscellaneous Input/Output Instructions (Form A24-3068-1)

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