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IBM 1622 Card Read-Punch

This manual describes the operation of the 1622 Card Read-Punch, Models 1 and 2, as they are used in the 1620 Data Processing System, Models 1 and 2, and in the 1710 Control System.

This manual has been extracted from and supersedes the publication *IBM 1620 Input/Output Units* (Form A26-5707). Input/Output instructions for the 1622 are described in either *1620 Central Processing Unit, Model 1* (A26-5706) or *1620 Central Processing Unit, Model 2* (A26-5781). The Paper Tape Unit is described in the publication *1621 Paper Tape Unit* (A26-5836).

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Contents

IBM 1620 Data Processing System

The IBM 1622 Card Read-Punch (Figure 1) provides punched card input and output for the system. The reader and punch feeds are separate and functionally independent, with individual switches, lights, checking circuits, buffer storage, and instruction codes.

The Model 1 reads and punches at a rate of 250 and 125 cards per minute; the Model 2 reads and punches at a rate of 500 and 250 cards per minute. The programming and operating features of both models are identical.

Reading, punching, and processing can occur simultaneously because of individual buffer storage. Buffer storage data is transferred in 3.4 ms in the 1620 Model 1 System and in 1.7 ms in the 1620 Model 2 System (Figure 2).

Figure 1. IBM 1622 Card Read-Punch

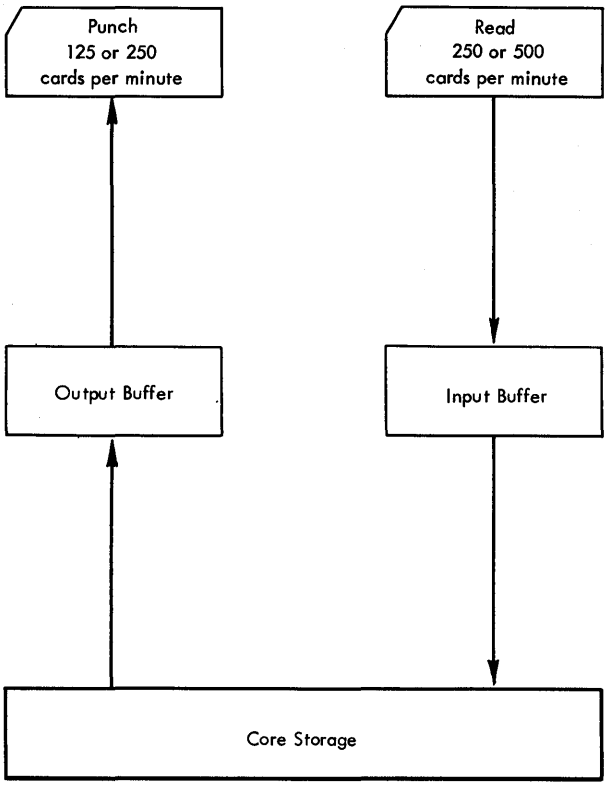

Figure 2. 1622 Buffer Storage

The IBM Card

The IBM card measures 7-3/8 inches by 3-1/4 inches and is .007 inches in thickness. The card stock is of controlled quality, manufactured according to rigorous specifications in order to provide strength and long life. This is necessary to ensure the accuracy of results, the proper operation of IBM data processing machines, and the continued usability of information long after it is recorded.

The card is divided into eighty vertical areas called "columns" or "card columns." They are numbered 1 to 80 from the left side of the card to the right. Each

column is then divided horizontally into 12 punching positions. Thus the IBM card has 960 punching positions in all. The punching positions are designated, from top to botton of the card, 12, 11 or X, 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9. The punching positions for digits 0 to 9 correspond to the numbers printed on the card. The top of the card is known as the "12 edge" and the bottom as the "9 edge." These designations are made because cards are fed through machines either "9 edge first" or "12 edge first." "Face up" means the printed side is facing up; "face down," the reverse.

Each column of the card is able to accommodate a digit, a letter, or a special character. Thus the card may contain up to 80 individual places of information. Digits are recorded by holes punched in the digit punching area of the card from 0 to 9. For example, the card in Figure 3 shows a 1 punched in column 63, a 9 in column 72, and a 4 in column 77.

The top three punching positions of the card (12, 11 or X, and 0) are known as the zone punching area of the card. (It should be noted that the 0 punch may be either a zone punch or a digit punch.) In order to accommodate any of the 26 letters in one column, a combination of a zone punch and a digit punch is used. The various combinations of punches which represent the alphabet are based upon a logical structure or code.

The first nine letters of the alphabet, A to I, are coded by the combination of a 12 punch and digit punches 1 to 9. Letters J through R are coded by an 11 or X punch and digit punches 1 through 9. S through Z, the last eight letters, are the combination of the 0 zone punch and digit punches 2 through 9. Figure 4 illustrates alphabetic coding. The conversion of letters to and from this coding structure is done automatically by the various machines used to record or process data and it is rarely necessary to refer to data in its coded form. The 11 special characters, which are considered alphameric data, are recorded by one, two, or three punches.

Figures 3 and 4 illustrate the two most common types of corner cuts — upper left and upper right. The corner cut is used to identify visually a card type or to ensure that all the cards in a group are facing the same direction and are right side up. Card types may also be distinguished by the use of colored cards or by a colored stripe on cards of a similar nature.

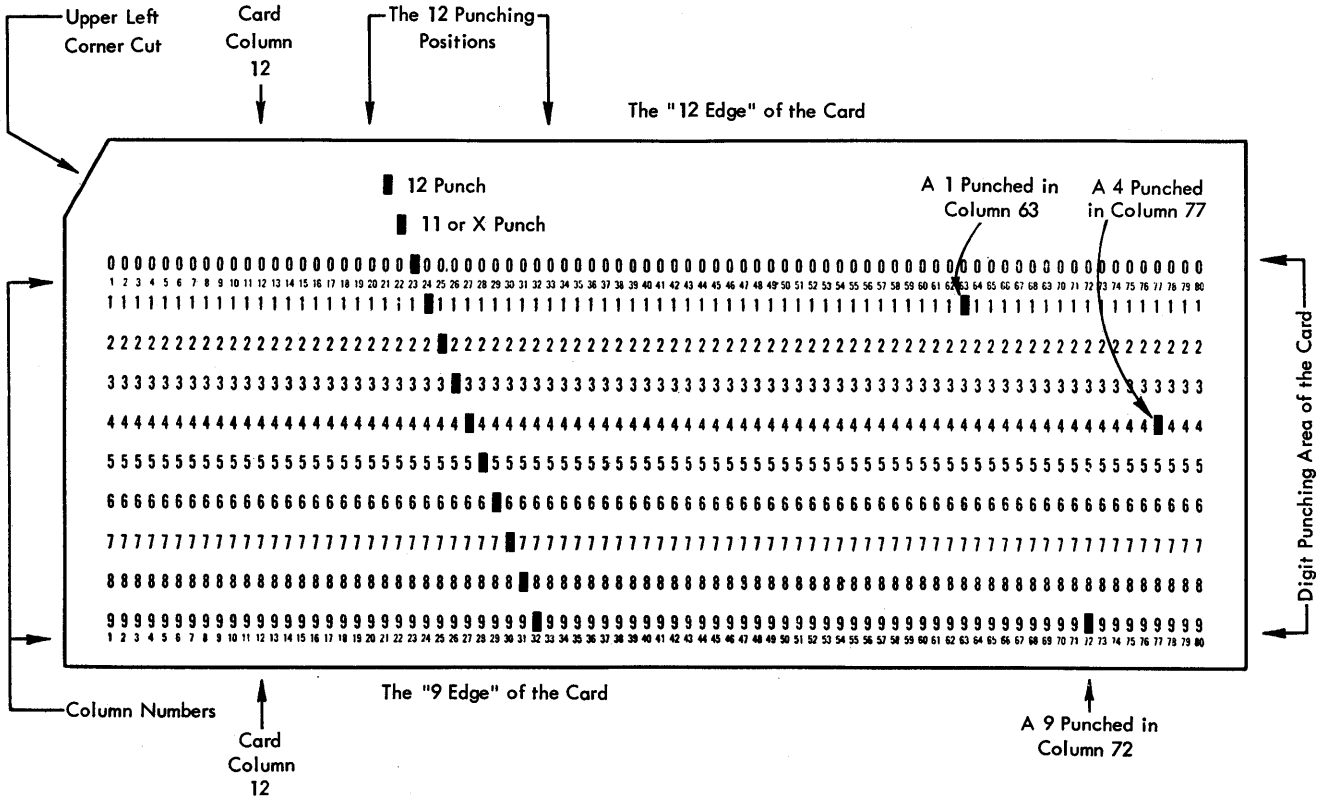

Figure 3. IBM Card

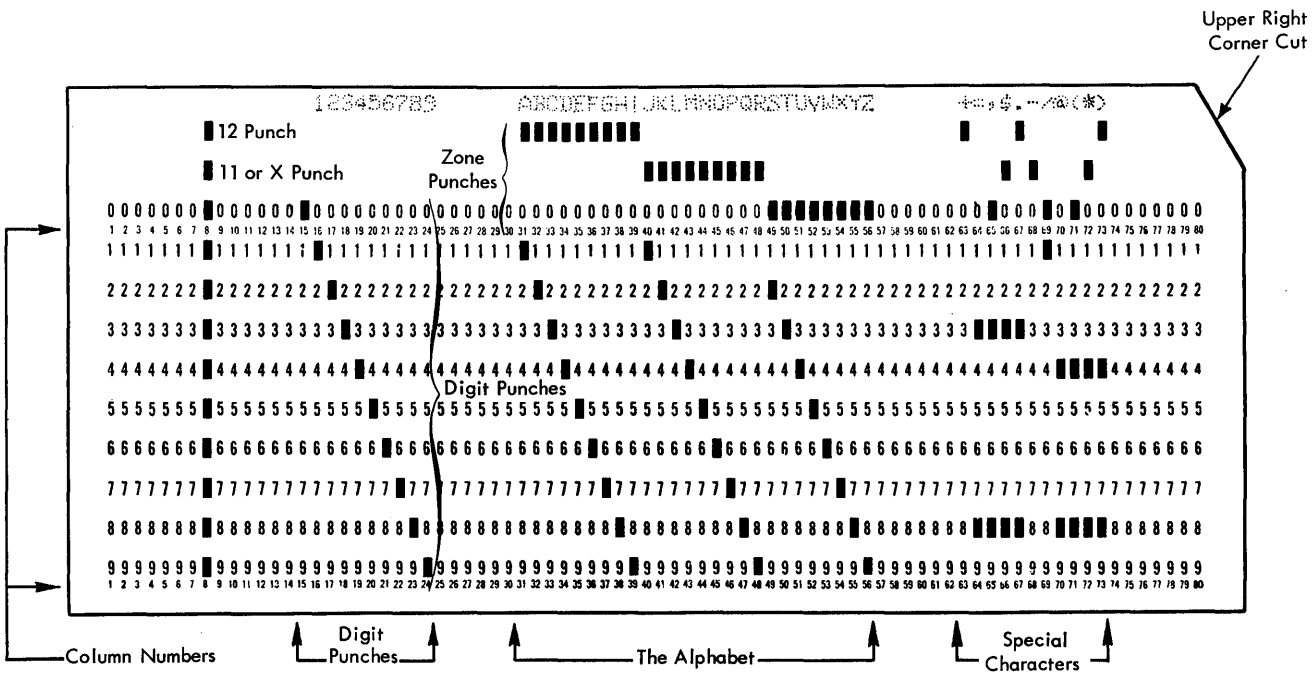

Figure 4. Card Character Coding

Field Definition

The fields in a card normally consist of 1 to 80 columns of data, depending on the length of the particular type of information. However, a field in 1620 core storage must consist of at least 2 digits or positions.

NUMERICAL DATA FIELD DEFINITION

The high-order column of a field is punched with an 11 punch as well as the digit punch. Thus, the field defining column of a numeric field contains an alphameric character (J through R) which becomes a digit with a flag bit when read into core storage by a Read Numerically instruction. (See CHARACTER CODING, APPENDIX A.)

ALPHAMERIC RECORD DEFINITION

The record-defining record mark character must be stored in core storage before or after a Read Alphamerically instruction is used to read alphameric data into core storage.

As shown in Figure 5, cards are fed from the read hopper on the right and the punch hopper on the left. Each hopper has a capacity of 1,200 cards. Both feeds have misfeeding and jam detection, and a select and a nonselect stacker. The 1,000-card-capacity stackers are of the radial type: the cards are stacked on end to permit their removal while the 1622 is running.

If either the read or punch feed is not used for approximately one minute, the drive motor for that feed is turned off to reduce noise and wear. However, the 1622 is still in ready status and responsive to a read or write command.

Card Reading

Cards are fed 9-edge first, face down, past two reading stations: check and read. Input buffer storage is initially loaded with 80 columns of card data during the Start key or Load key run-in operation. Thereafter, each card feed cycle is under program control. Data flow during card reader operation, shown in Figure 6, is as follows:

1. A read command causes a data transfer from input buffer storage to core storage. The transferred data is parity-checked in the 1620; if parity is correct, a card feed cycle follows immediately to reload buffer storage.

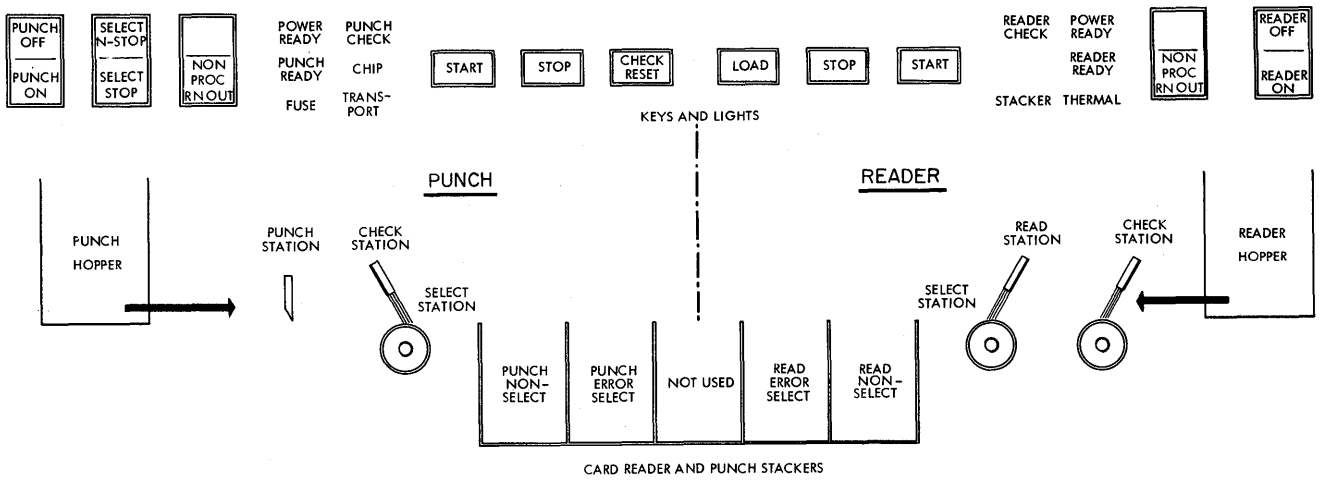

Figure 5. 1622 Keys, Lights, and Card Feed

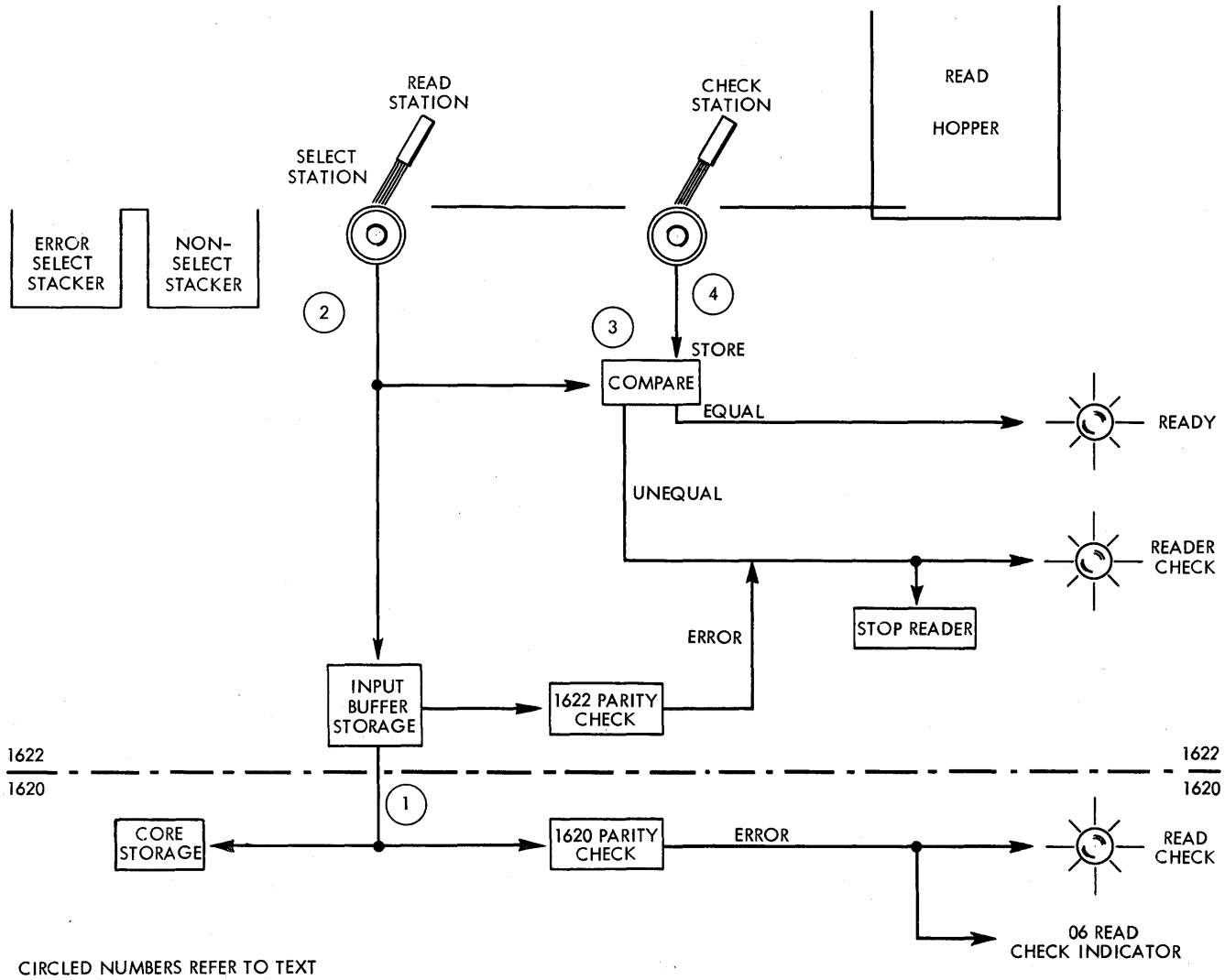

Figure 6. Read Operation Data Flow

If a parity error occurs during data transfer to the 1620, the 1620 console Read Check light and 06 indicator are turned on. The 06 indicator may be used to branch to an error-handling subroutine.

2. Following a correct transfer of data, a card is fed and new data is read into buffer storage.
3. The new data is compared at the read station against stored data previously read at the check station.

   An unequal comparison between check and read stations, or a 1622 parity error stops the reader, turns on the 1622 Reader Check light, and terminates ready status. No data transfer to the 1620 is permitted. The Reader Check light therefore cannot be on simultaneously with the 1620 Read Check light.
4. At the same time that new data is read at the read station (Step 2), data on the card following is read at the check station and stored for comparison on the next card feed cycle.

Card Punching

Cards are fed 12-edge first, face down, past the punch and check stations. Data flow during the card punch operation shown in Figure 7, is as follows:

1. A write command causes a data transfer from core storage to output buffer storage. The transferred data is parity-checked in the 1620; if parity is correct, a card feed cycle follows immediately to punch the data into the card from buffer storage. The data is also parity-checked in the 1622 as it is punched into the card.

   If a parity error occurs during data transfer, the 1620 console Write Check light and 07 indicator are turned on. The 07 indicator may be used to branch to an error-handling subroutine.
2. Following a correct transfer, the data is stored for comparing (Step 3), punched into the card, and parity-checked.

   If a 1622 parity error occurs, a cycle delay is initiated and the punch is stopped one card feed cycle after punching the incorrect data (Select Stop switch set to STOP). The 1622 Punch Check light is turned on and ready status is terminated.
3. The card punched in Step 2 is read at the check station one cycle later and compared with the data stored in Step 2. An unequal comparison has the same effect as a 1622 parity error: the punch is stopped after the card cycle on which the unequal comparison occurred (nocycle delay), the Punch Check light is turned on, and ready status is terminated.

For numeric and alphameric input/output instructions, data is transferred between 1620 core storage and 1622 buffer storage in blocks of 80 or 160 digits, without consideration of record marks. A full 80 columns of card data are always transferred. Buffer storage to core storage and core storage to buffer storage transfers require the same amount of time regardless of whether numeric or alphameric transfers are involved. When the highest-numbered core storage address of a 20,000-digit module falls within the transfer, core storage locations in the next highest 20,000 module are used or a "loop-back" to location 00000 occurs.

Card Coding

Record marks and blank columns are processed in the following manner:

Record Marks (+). Card columns punched 0-2-8 are read into core storage as record marks, with either a Read Numerically or a Read Alphamerically instruction. Record marks are handled as data on both input and output, and do not end the transfer of data.

A negative record mark ($\overline{+}$), coded X-8-2, is placed in core storage as F-8-2, and punched X-8-2, in an output card.

Group Mark ($\pm$). The group mark, coded C-8-4-2-1 in core storage, is used in disk storage operations to verify the correct length of records written on or read from disk storage. The group mark is recorded in *disk storage* as 0-8-4-2-1. The negative group mark ($\overline{\pm}$) is recorded as C-X-0-8-4-2-1 in disk storage, as F-8-4-2-1 in core storage, and as 12-7-8 in card input/output.

Blank Card Columns. Because blank columns are read numerically into core storage as zeros, they cannot be punched in the card as blanks with a Write Numerically instruction. Therefore, cards specially punched 8-4 in all columns must be read into core storage to be used when blank columns are required in output cards. The 8-4 punches are stored as C, 8, and 4 bits, and are decoded as numeric blanks when transferred to output buffer storage.

By programming, the C, 8, and 4 bits (format blanks) are read into, or transmitted to, the output area of core storage. The output data is then transmitted into this 80-column record of blanks, leaving only the blanks required. The write instruction follows.

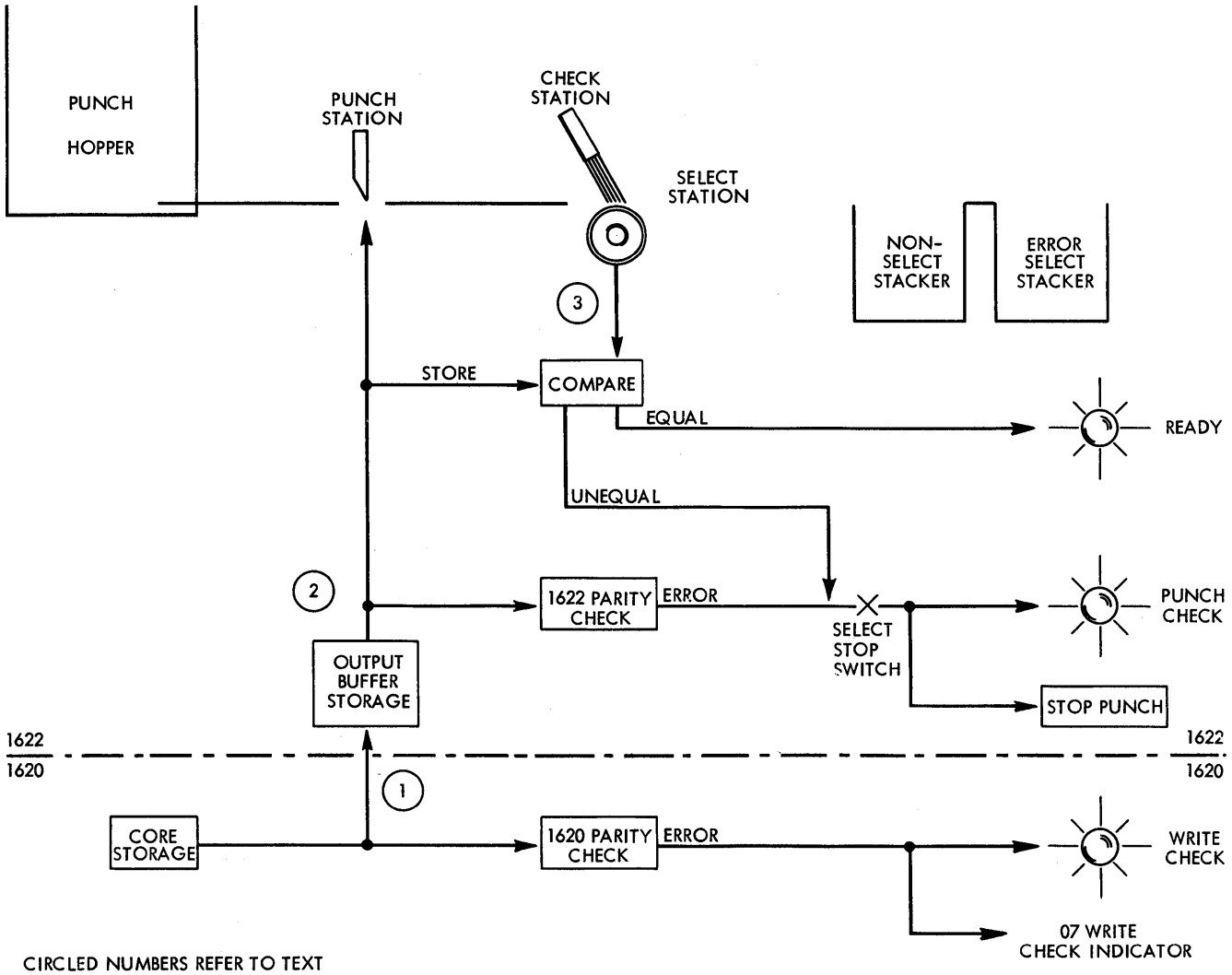

Figure 7. Punch Operation Data Flow

Double Punch Detection

Double punches are detected only if there is a duplication of Binary-Coded Decimal (BCD) bits. For example, a nine (8, 1) punch and an eight (8) punch in the same column are detected as a reader check because of 8-bit duplication. However, a six (4, 2) punch and a one (1) punch in the same column are read without error as a seven (4, 2, 1) because there is no bit duplication.

BCD Coded Data

It is possible to read data recorded on IBM cards in BCD form directly into the 1620 Data Processing System or 1710 Control System from the 1622 without first transforming the data to decimal codes.

The BCD codes shown in Table 1, are translated without read checks or parity checks. However, if the 12 punch is used for positive indication, then the 8, 2, 12 combination results in a flagged record mark ($\overline{+}$). All other BCD card punches result in core storage values independent of a 12 punch, i.e., 4, 1, 12 gives 5.

When a card is read by the 1622, the data is stored in the buffer in BCD notation. For example, if a 1 and 8 are punched in the same column of the card, they are stored in the buffer as a 1 and 8, which is the BCD coding for a 9. (Note that a 9 punch also produces a 1 and 8 code in the buffer.) Zone punches in the card are also converted to the appropriate BCD coding. Thus an X, 1, 4 punched in a column is stored as an "N" in BCD. Binary-Coded Decimal buffer codes are shown in Table 2.

Table 1. Valid Codes With Read Numerically

Positive Numbers		Negative Numbers	
Card Punches	Core Storage Value	Card Punches	Core Storage Value
1	1	1, 11 (or X punch)	$\bar{1}$
2	2	2, 11	$\bar{2}$
2, 1	3	1, 2, 11	$\bar{3}$
4	4	4, 11	$\bar{4}$
4, 1	5	4, 1, 11	$\bar{5}$
4, 2	6	4, 2, 11	$\bar{6}$
4, 2, 1	7	4, 2, 1, 11	$\bar{7}$
8	8	8, 11	$\bar{8}$
8, 1	9	8, 1, 11	$\bar{9}$
8, 2	≠ (RM)	8, 2, 11	≠ (RM)

The data transferred to core storage is under control of the Read instruction. A Read Numerically instruction reads the X, 1, 4 into core storage as a flagged five ($\bar{5}$). A Read Alphamerically instruction reads the X, 1, 4 into core storage as a fifty-five (55).

Table 2. Character Coding Chart (Read Buffer)

Character	Card	Read Buffer
Blank	Blank	C
.	12,3,8	XO821
)	12,4,8	CXO84
-	11	X
$	11,3,8	CX821
*	11,4,8	X84
,	0,3,8	CO821
(	0,4,8	O84
+	12	XOC
=	3,8	821
@	4,8	C84
A-I	12,(1-9)	XO,(1-9)
J-R	11,(1-9)	X,(1-9)
/	0,1	CO1
S-Z	0,(2-9)	O,(2-9)
0-9(+)	(0-9)	(0-9)
$\bar{1}$-$\bar{9}$(-)	11,(1-9)	X(1-9)
$\bar{0}$(-0)	11,0	CX841
0(+0)	12,0	O
‡	0,2,8	O28
≠	11,2,8	X28
Num. Blank	4,8	C,8,4
≢	0,7,8	O8421
≢	12,7,8	CXO8421

Operator Keys and Lights

The card reader and card punch have separate keys and lights (Figures 5 and 6).

Card Reader

Reader On/Off Switch. The Reader On/Off switch is used to supply power to the reader and to turn on the Power Ready light. The 1620 Power On/Off switch must be on to make the 1622 Reader On/Off switch active.

Load Key. The Load key causes data from the first card to be checked, read into buffer storage, and automatically transferred in numeric mode to core storage positions 00000-00079. Upon completion of this data transfer, another card feed cycle occurs which loads buffer storage with data from the second card. The 1620 then simulates release and *program start* at 00000. The instructions from the first card, now in 00000-00079, can be used to continue loading the program or to begin processing. The 1620 must be *reset* and in manual mode to make the Load key operate correctly.

Start Key. The Start key is used: (1) to run in cards, which are then placed under program control (data from the first card is checked and loaded in input buffer storage); (2) to set up a runout condition, which permits programmed reading of the cards remaining in the feed when the hopper has become empty; and (3) to restore ready status after the reader has been stopped by either the Stop key, an empty hopper, an error, a misfeed, or a transport jam.

Stop Key. The Stop key is used to stop the read feed at the end of the card cycle in progress and/or to remove the reader from ready status. Data that is entered into buffer storage during the read cycle in progress is transferred to core storage. The computer continues processing until the next read card command causes a reader-no-feed stop.

Nonprocess Runout Key. The Nonprocess Runout key is used to run cards out of the read feed after a reader check error, or after the Stop key has been used to stop the reader. The cards are run out into the read select stacker without a buffer storage to core storage transfer. The Reader Check light and check circuits are turned off. Cards must be removed from the hopper to make the Nonprocess Runout key active.

Reader Ready Light. The Reader Ready light is turned on to indicate that the first card has been loaded into buffer storage with the Start key, without a reader check error. It remains on until the following occurs: depression of the Stop key, a reader check error, a transport jam, a misfeed, or an empty hopper.

Reader Check Light. The Reader Check light is turned on by an unequal comparison between the read and check stations and by incorrect parity detected in buffer storage during card read. When there is an unequal comparison, the reader is stopped, ready status is terminated, and the buffer storage data just read cannot be transferred to core storage on the next read command.

1620 Console, Read Check Light. The 1620 Read Check indicator (06) and console Read Check light are turned on by a 1620 parity error during a buffer storage to core storage transfer.

1620 Console, Reader-No-Feed Light. The console Reader-No-Feed light is turned on each time the reader is selected by a read command. The light remains on, if for any reason the reader is not in ready status and the read command therefore cannot be executed. It appears to be on almost continuously when the time between read calls is less than 240 ms in the 1622-1 (or 120 ms in the 1622-2) indicating that processing time is available.

NOTE: ON the 1620 Model 2 this light is called the Read Interlock light.

Card Punch

Punch On/Off Switch. The Punch On/Off switch is used to supply power to the punch and to turn on the Power Ready light. The 1620 Power On/Off switch must be on to make the 1622 Punch On/Off switch active.

Start Key. The Start key is used to feed cards to the punch station initially or after an error or nonprocess runout, and to re-establish ready status after an empty hopper, a misfeed, a transport jam, or depression of the Stop key.

Stop Key. The Stop key is used to stop the punch feed at the end of the card cycle in progress and/or to remove the punch from ready status.

Check Reset. The Check Reset key is used to reset error circuits and to turn off the Punch Check light. A Start key or Nonprocess Runout key depression follows, as described under ERROR RESTART PROCEDURES.

Select N-Stop — Select Stop Switch. This switch is used to control the stopping of the punch when error cards are selected into the punch error select stacker. With the switch set to STOP, the punch feed stops with the error card in the select stacker.

Nonprocess Runout Key. Following a punch check error, press the Nonprocess Runout key to reset the error circuits which cause the punched card that is between the punch station and the punch check station, (if it is in error), to follow the error card into the select stacker. If this card is in error, the Punch Check light is turned on again. The next two (blank) cards go into the nonselect pocket. These cards should be removed before processing is continued.

This key is also used to run out and check the last punched card of a job. Cards must be removed from the hopper to make the Nonprocess Runout key operate.

Punch Ready Light. The Punch Ready light is used to indicate that the 1622 has a card in punch position and will respond to a write command from the 1620. The Ready light is turned off by a punch check error, an empty hopper, a full chip box, a Stop key depression, a transport jam, or a misfeed.

Punch Check Light. The Punch Check light is turned on when there is an unequal comparison between the data punched and the data read (one card feed cycle later, at the check station), or when a 1622 parity error occurs during punching (Select Stop switch set to STOP). The machine stops, and ready status is terminated.

Chip Light. The Chip light is turned on to indicate that the chip box should be emptied.

1620 Console, Write Check Light. The 1620 Write Check indicator (07) and console light are turned on by a parity error during a core storage to buffer storage transfer. The 07 indicator may be used. by programming, to transfer data several times, and to halt if a correct transfer cannot be obtained.

1620 Console, Punch/Disk Interlock Light. This console light is turned on each time the punch is selected by a write command. The light remains on until the punch unit is ready and executes the command. Normally, no light is seen if commands are farther apart than 480 ms in the 1622-1, or 240 ms in the 1622-2. The write command cannot be executed until the punch is in ready status.

NOTE: On the 1620 Model 2 this light is called the Write Interlock light.

Card Reader/Punch Lights

The stacker, transport, fuse, and thermal lights are common to both the read and punch feeds and are used as follows:

Stacker Light. The Stacker light is turned on when a stacker is full. Both feeds are stopped temporarily and removed from ready status. The Ready light remains on. Operation resumes automatically after the stacker is emptied.

Transport Light. The Transport light is turned on when a card jam has occurred in either the read or punch feed or above any stacker. When this occurs, both feeds are stopped and removed from ready status. Both Start keys must be pressed to resume operation after the condition is corrected.

Fuse Light. The Fuse light turns on to indicate a blown fuse.

Thermal Light. The Thermal light is turned off if the internal temperature of the 1622 becomes excessive. After several minutes delay, the 1620 console Reset key may be pressed to turn off the Thermal light. If depression of the Reset key turns off the Thermal light, the 1620 Power switch must be turned off and then on again. Operation may be resumed after the Power Ready light has been turned on.

Error Restart Procedures

Reader Check Error

Cause. Unequal comparison between the read and check stations, or a buffer storage parity error. The reader stops with the error card in the select stacker (last card).

Indicators. 1622 Reader Check light ON.
1622 Ready light OFF.

Restart procedure:

1. Remove cards from the read hopper.
2. Press the Nonprocess Runout key.
3. Remove the last three cards from the select stacker.
4. Place these three cards in front of the cards removed from the hopper and replace the deck in the hopper.
5. Press the Start key. The card that caused the error is read into buffer storage again and if an equal comparison is obtained, the interlocked read instruction is executed and processing continues.

1620 Read Check Error

Cause. Parity error in the 1620 during data transfer from 1622 buffer storage to 1620 core storage. The reader stops with an error card (card associated with the error) in the nonselect stacker (last card). Under program control a reread can be initiated as often as desired by the programmer.

Indicators. 1620 Read Check light ON.
1622 Reader Ready light ON.
06 Read Check indicator ON.

Restart procedure:

1. Remove cards from the read hopper.
2. Press the Nonprocess Runout key.
3. Remove the last card from the nonselect stacker and the last two cards from the select stacker.
4. Place these three cards in front of the cards removed from the hopper. The error card from the nonselect stacker will be read in first.
5. Insert a branch to the address of the instruction that transfers the error card data from the input buffer storage to core storage.
6. Press the Start key.

Punch Check Error

Cause. Unequal comparison between the data punched and the data read (one card feed cycle later, at check station), or a 1622 parity error while punching data from buffer storage. If the Select Stop switch is set to STOP, the punch stops with the error card in the select stacker.

Indicators. 1622 Punch Check light ON.
1622 Punch Ready light OFF.

Restart procedure — to restart without (1) immediate manual correction of the error card or (2) reprocessing of the error card:

1. Press the Check Reset key.
2. Press the Start key. Processing continues from the point at which the program stopped.

For manual correction of the error card:

1. Remove the last (error) card from the punch (error) select stacker and correct the error card. Place the corrected card behind those in the punch nonselect stacker.
2. Press the Check Reset key.
3. Press the Start key. The interlocked write command for the second card following the error card can now be executed.

For reprocessing of the error card, *when one card is punched out for each card read:*

1. Remove cards from both hoppers.
2. Press both Nonprocess Runout keys.
3. Remove the last two cards from the punch error select stacker and the last two (blank) cards from the punch nonselect stacker. Also, remove the last two cards from the read nonselect stacker and the last two cards from the read select stacker.
4. Mark or destroy the two punched cards removed from the punch select stacker. Place four cards from the read stackers (nonselect in front of select) ahead of those removed from the read hopper. Place blank cards in the punch hoper.
5. Insert a branch to the address of the instruction that begins the reprocessing of the error card.
6. Press both Start keys.

1620 Write Check Error

Cause. 1620 parity error. The error has not been punched into a card.

Indicators. 1620 Write Check light ON.
07 Write Check indicator ON.

Restart procedure:

A typeout of the core storage positions that were transferred indicates whether the data in core storage is correct. If the data is incorrect in core storage, reread the card or cards from which this data originated.

Loading procedures and a utility load routine are included in the *IBM Data Processing Bulletin, Program Writing and Testing* (Form J26-5547).

Appendix A

Character Coding Chart

	Character	Input			Core Storage		Output		
		Typewriter	Tape	Card	Alpha	Num	Typewriter	Tape	Card
ALPHAMERIC MODE	(Blank)	(Space)	C	(Blank)	C	C	(Space)	C	(Blank)
	. (Period)	.	X0821	12,3,8	C	3	.	X0821	12,3,8
	)	)	X0C84	12,4,8	C	4	)	X0C84	12,4,8
	+	+	X0C	12	1	C	+	X0C	12
	$	$	XC821	11,3,8	1	3	$	XC821	11,3,8
	*	*	X84	11,8,4	1	4	*	X84	11,4,8
	- (Hyphen)	-	X	11	2	C	-	X	11
	/	/	0C1	0,1	2	1	/	0C1	0,1
	, (Comma)	,	0C821	0,3,8	2	3	,	0C821	0,3,8
	(	(	084	0,4,8	2	4	(	084	0,4,8
	=	=	821	3,8	3	3	=	821	3,8
	@	@	C84	4,8	3	4	@	C84	4,8
	A-I	A-I	X0, 1-9	12, 1-9	4	1-9	A-I	X0, 1-9	12, 1-9
	0 (—)	(None)	(None)	11,0	5	C	- (Hyphen)	X	11,0
	J-R	J-R	X, 1-9	11, 1-9	5	1-9	J-R	X, 1-9	11, 1-9
	1-9 (—)	J-R	X, 1-9	11, 1-9	5	1-9	J-R	X, 1-9	11, 1-9
	S-Z	S-Z	0, 2-9	0, 2-9	6	2-9	S-Z	0, 2-9	0, 2-9
	0 (+)	0	0	0 or 12,0	7	C	0	0	0
	1-9 (+)	1-9	1-9	1-9	7	1-9	1-9	1-9	1-9
	≠	≠	082	0,2,8	C	C82	(Stop)	EOL	0,2,8
NUMERICAL MODE	(Blank)	(Space)	C	(Blank)		C	0	0	0
	0 (+)	0	0	0		C	0	0	0
	0 (-)	$\bar{0}$	X, X0C	11,0		F	0	X	11,0
	1-9 (+)	1-9	1-9	1-9		1-9	1-9	1-9	1-9
	1-9 (-)	$\bar{1}$-$\bar{9}$	X, 1-9	11, 1-9		F, 1-9	1-9	X, 1-9	11, 1-9
	≠	≠	082	0,2,8		C82	(Stop, WN) ≠ (DN)	EOL(WN) 082 (DN)	0,2,8
	$\bar{\neq}$	$\bar{\neq}$	X82	11,8,2		F82	$\bar{\neq}$	X82	11,8,2
	≠ **	≠	08421	0,7,8		*C8421	≠	08421	0,7,8
	$\bar{\neq}$ **	$\bar{\neq}$	X8421	12,7,8		F8421	$\bar{\neq}$	X8421	12,7,8
	Num Blank †	@	C84	4,8		C84	@	C84	(Blank)

** Available with 1311 Disk Storage Drive
† For Card Format Use Only
* Recorded as 0, 8, 4, 2, 1 in Disk Storage

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