TECHNICAL BULLETIN

UNIVAC 490

Card Subsystem

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1. INTRODUCTION

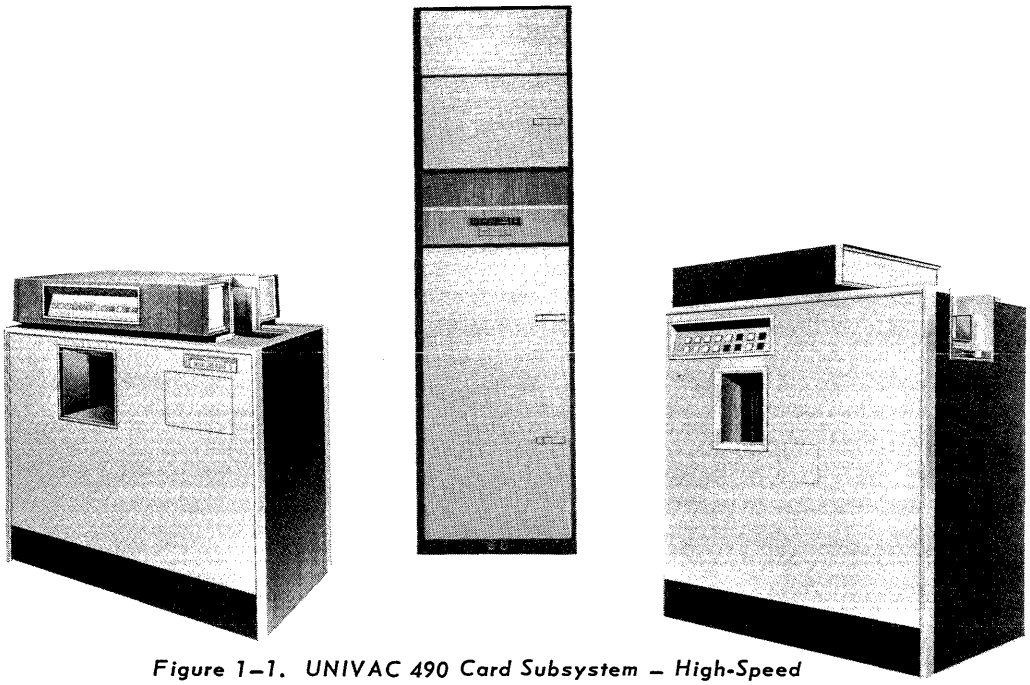


Figure 1–1. UNIVAC 490 Card Subsystem – High-Speed Reader, Channel Synchronizer-Control Unit and Punch Verifier

The High-Speed Reader and Punch-Verifier are integral parts of the UNIVAC 490 Real-Time System. They work together with the Real-Time Computer, the High-Speed Printer, data storage units and communications equipment to form a completely on-line real-time data-processing system.

Operating as an input device, the High-Speed Reader can read and check 80–column prepunched cards at speeds up to 600 cards per minute.

Operating as an output device, the Punch-Verifier can punch and check 80–column cards at speeds up to 150 cards per minute.

The Punch-Verifier can be specially equipped to provide card-reading capabilities as well as the standard card-punching capabilities. Operating in this mode, it reads and checks, punches and checks or combines reading, punching and checking at speeds up to 150 cards per minute.

Outstanding features of the card system include:

- Three modes of program controlled translation – card code, row binary and column binary.
- Stacker select.
- Ability to read and punch the same card.
- Bit-by-bit verification of all data read and punched.
- Flexibility in choice of hardware.
- Arbitrary selection of card code and computer code.

2. FUNCTIONAL DESCRIPTION

The versatile High-Speed Reader consists of an input-magazine, a first read station, a read-verify station and three output card stackers. The Punch-Verifier consists of an input magazine, a first read station, a read-verify station, a punching station, a waiting station and a punch-verify station (Figure 2–1). The first read and read-verify stations are used only in the read-check punch-check modes of operation.

MODES OF OPERATION

Two modes of operation are possible with the 80–Column Card Subsystem. These modes are not interchangeable so that the desired mode of operation must be specified before delivery of the Subsystem.

The first mode uses a High-Speed Reader and a Punch-Verifier. The Reader can sense (read) and check 80–column cards at the continuous rate of 600 cards per minute. The Punch-Verifier can punch and check (Post-Punch Sense) 80–column cards at the continuous rate of 150 cards per minute. It is possible to have concurrent operation of the High-Speed Reader and Punch-Verifier so that cards are read and punched at the rate of 750 cards per minute. This concurrent operation is achieved by programming and requires a 4 to 1 interlace of read instructions to punch instructions.

The second mode uses the 80–column Punch-Verifier as a read-check punch-check unit to read and punch 150 cards per minute. The first read station is used for reading data from the cards. Additional data can be punched on the card to complete a read-check punch-check operation.

DEGREES OF OPERATION

The four types of operations available to the Card Subsystem are:

- Punch Operation (output from Computer)
- Read Operation (input to Computer)
- Concurrent Operation (input-output, to-from Computer)
- Read-Check Punch-Check Operation (input-output, to-from Computer)

Punch-Verifier Operation

The Punch-Verifier has two sensing stations located just ahead of the punch station. Card 1 is positioned in the first sensing station. Card 1 is then transferred to the second sensing station and card 2 is set in the first sensing station. Card 1 is transferred to the punch station, card 2 is in the second sensing station and card 3 is in

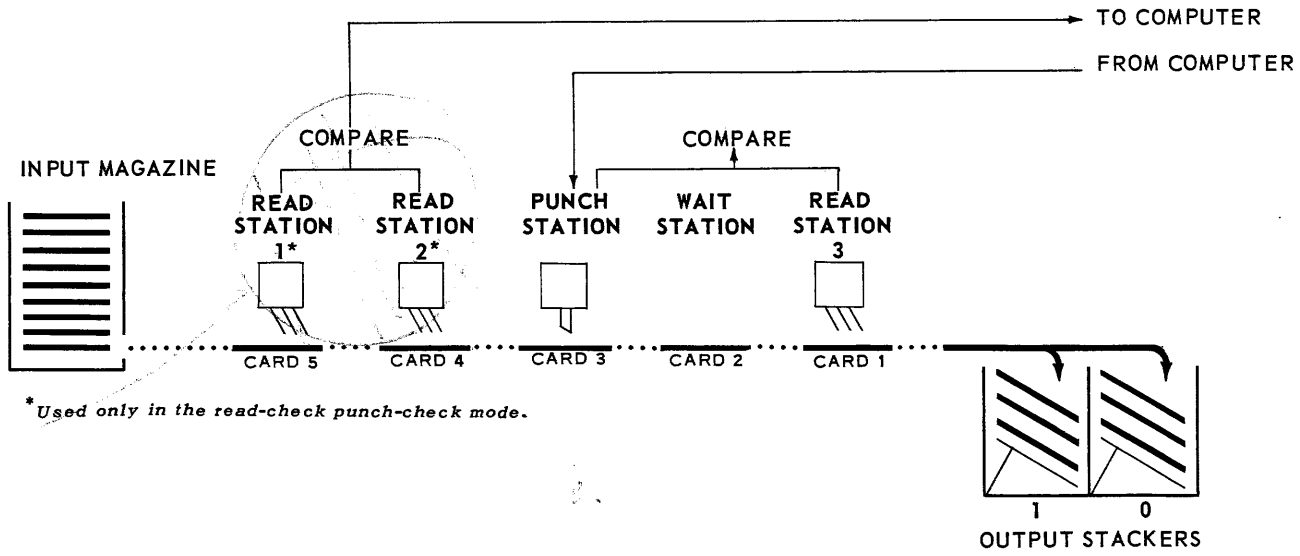


Figure 2–1. Punch-Verifier Transport System

the first sensing station. After card 1 is punched, it is transferred to a wait station, card 2 is at the punch station, card 3 is at the second sensing station and card 4 is at the first sensing station. The cards are all advanced one position: now card 1 is verified at the third sensing station, card 2 is at the wait station, card 3 is at the punch station, card 4 is at the second sensing station and card 5 is at the first sensing station. Verification of the first card is not complete until the third card has been punched.

Two types of verification operation may be selected via a switch. If the switch is in its normal position, the card in error will be placed in the error stacker and operation of the Punch-Verifier unit will stop until the operator performs the necessary recovery steps.

If an error occurs, throwing the switch to it's other position initiates an auto-recovery process. The error is stored in an auto-recovery register. The error card and the following two cards are placed in the error stacker. All three cards of data are repunched from the Channel Synchronizer-Control Unit memory and again verified. If the error is not detected during the second pass, the program continues. If the error does occur, the Punch-Verifier will stop and the operator must take the necessary steps to resume operation.

If the unit runs out of cards, an Interlock fault is generated and the operation is continued when more cards are placed in the input magazine and the *RESUME* Switch is depressed.

Read Operation

Cards are automatically read by the Reader and the data stored in the Channel Synchronizer-Control Unit memory is sent, upon request, to the Computer. Cards are inserted 12 edge first, face down.

Upon receipt of the proper input functions, cards are moved from the input magazine into the card channel. As it leaves the magazine card 1 passes through the first read station where it is sensed and stored in memory in card image format. When the complete card has been stored, a translate mode is automatically requested. In this mode the card image characters are retained in the proper memory location while their computer code translation is stored in what might be called an input memory block.

As card 1 moves into the second station, card 2 moves into the first station. At this time, two operations occur simultaneously. Card 2 is sensed and stored in memory while card 1 is verified on a bit-by-bit basis. At the completion of the sense and check operation, card 1 becomes available to the Computer and card 2 is automatically translated. All verified cards will go into either the normal stacker or one of the program selected stackers. Error cards will automatically be placed in the error stacker.

Concurrent Operation

This Card Subsystem is designed to read and punch 80–column cards at the continuous rate of 750 cards per minute. During its operation, cards are read and punched simultaneously. The

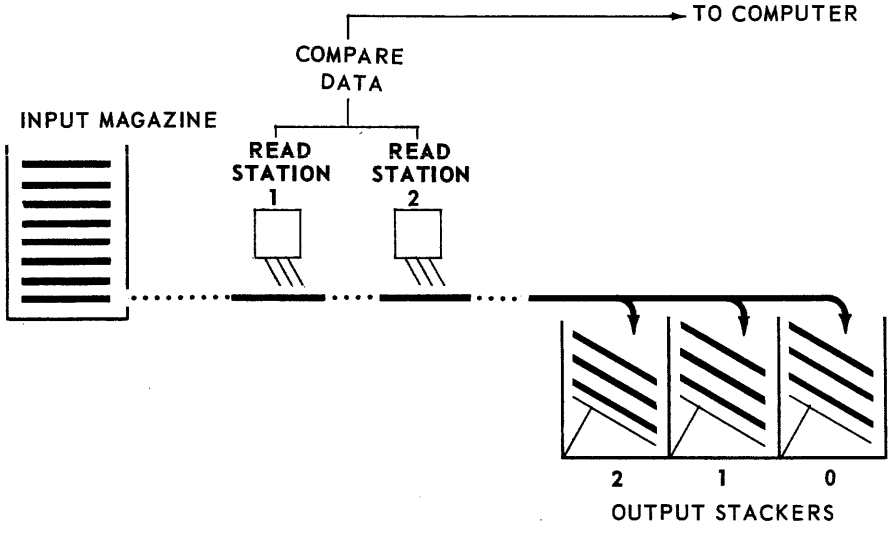


Figure 2–2. High-Speed Reader Transport System

Channel Synchronizer-Control Unit can handle the reading of four cards and the punching of one card. However, data is not sent to, and received from, the Computer simultaneously.

While data is being read from a card and stored in the Channel Synchronizer-Control Unit memory, the Computer is sending data to the Channel Synchronizer-Control Unit memory for punching.

While data is punched into a card, the High-Speed Reader is reading and storing data in the Channel Synchronizer-Control Unit memory and transferring stored data from the memory to the Computer.

To achieve maximum concurrent operation a 4 to 1 interlace must be maintained through programming (reading of four cards to the punching of one card).

A memory priority register contained in the Channel Synchronizer-Control Unit is used to direct reading or punching, or to determine if reading or punching is occurring. Data is read at the rate of 600 cards per minute and punched at the rate of 150 cards per minute. The normal procedures for reading and punching are still adhered to.

Read-Check Punch-Check Operation

This operation utilizes a modified Punch-Verifier only. The High-Speed Reader is not used in a system operating in the read-check punch-check mode.

The steps that a card must follow in the read-check, punch-check operation are as follows:

- Card 1 is sent to the first punch-sensing station where the card is sensed.
- Card 1 is then transferred to the second punch-sensing station where the card is verified on a bit-by-bit basis.
- The card is then transferred to the punch station where additional data may be punched into the card.
- Card 1 is then transferred to the waiting station and then to the third punch-sensing station where it is verified on a bit-by-bit basis.
- When card 1 leaves the first station, card 2 enters this station and the same process is carried on for card 2 as for card 1; that is, when card 1 is at the second station, card 2 is at the first station, and when card 1 is at punch station, card 2 is at the second station and card 3 is at the first station, and so on.
- All cards which do not pass verification will go to the error stacker, while all the verified cards go into the normal or a selected output stacker.

CARD READER TIMING (INPUT)

The High-Speed Reader, under normal operating conditions, can read a card in 100 milliseconds. To initiate a read operation, the High-Speed Reader must be active and the Computer must send an External Function *(EF)* signifying an input operation to the Reader. The *EF* will automatically start the cards through the Reader.

The sensing and storing of the data requires 82.4 milliseconds. The remaining 17.6 milliseconds is used as *dead* time to insure that the card is completely sensed and its contents transferred to the Channel Synchronizer-Control Unit memory.

A Stacker Select instruction must be sent to the High-Speed Reader within 100 milliseconds after information from the card to be selected has been completely transferred to the Computer.

The operation is stopped if the contents of three cards have been stored in the Channel Synchronizer-Control Unit memory and none has been transferred to the Computer. When a card's contents are transferred to memory the operation will continue automatically.

CARD PUNCH TIMING (OUTPUT)

The Punch-Verifier Unit, under normal operating conditions, can punch a card in 400 milliseconds. To initiate a punch operation the Punch-Verifier must be activated and the Computer must send an External Function *(EF)* signifying an output operation, to the Punch. When depressed, the *Run* Switch automatically sends three cards into the Punch-Verifier so that when the *EF* is detected, there is a card at the punch station ready to be punched.

The first 265.9 milliseconds are used to translate from computer code to card code, and to transfer and set up the data that will be punched into the card. The remaining 134.1 milliseconds are used to punch the data into the card.

During the first 265.9 milliseconds, the punch must receive a new *EF* (signifying output) in order to get the next card to be punched, translated and transferred. If an *EF* is not detected during this time, the operation is stopped after the present card has been transferred.

The next card is delayed until the *EF* is detected and the translation and transfer of computer code to card code is accomplished for this card. The operation is started again and cards are punched automatically.

CONCURRENT OPERATION TIMING

Under normal operating conditions, a card can be read in 100 milliseconds upon receipt of an *EF* (signifying input) or a card can be punched in 400 milliseconds upon receipt of an *EF* (signifying output). Thus it is possible to read four cards while one card is punched.

The allotted times for card transfer, translation, storage and setup for reading or punching are the same as the times mentioned above.

If the contents of three cards are stored in the Channel Synchronizer-Control Unit memory, reading stops but punching continues. If the *EF* (signifying output) is not detected in time, the punch operation will stop, but the read operation will continue.

If either unit is given a function with interrupt, the other unit cannot receive an External Function signal until the unit that received the function with interrupt has completed its data transfer and sent an interrupt to the Computer.

READ-PUNCH TIMING

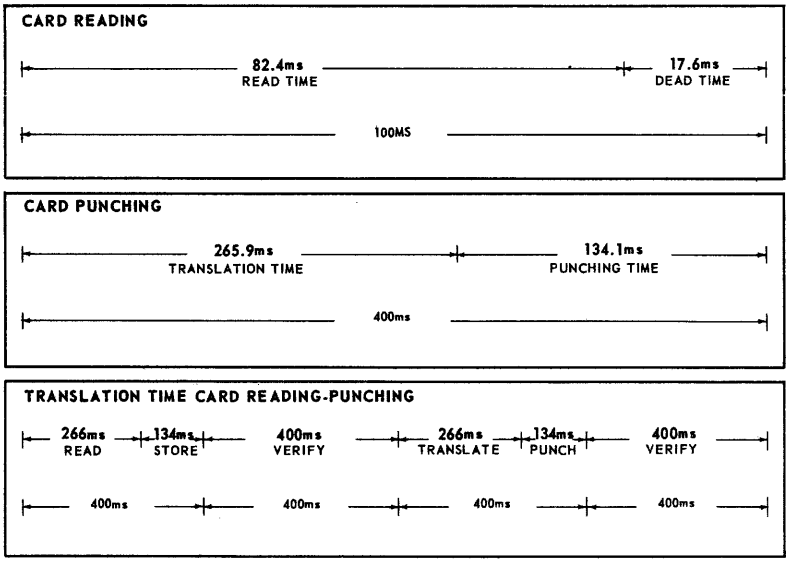
The Punch-Verifier is first activated by an *EF* (signifying input) and under normal operating conditions the first card is read in 266 milliseconds. The remaining 134 milliseconds are used to store the data in the Channel Synchronizer-Control Unit memory.

The next 400 milliseconds are used to verify the data read. Verification is done on a bit-by-bit basis. Data to be punched on the card and the actual punching of this data takes place in the next 400 milliseconds.

The next 400 milliseconds are used to verify the data punched into the cards. Verification is done on a bit-by-bit comparison basis.

If during a read operation or a punch operation, an error is detected the operation in progress is stopped. Normal operation will continue when the error is corrected. An *EF* (signifying input) is required if the error is detected during a read operation; an *EF* (signifying output) is required if the error is detected on a punch operation in order to resume operation.

TIMING CHARTS



3. 80-COLUMN PUNCHED CARDS

Alphabetic and numeric information is punched in 80-column cards in the form of holes. Each card contains 960 possible punching positions, 80 columns with 12 punching positions in each column.

NUMERIC REPRESENTATION

The punching positions in each column are numbered from top to bottom 12, 11, 0, and 1 through 9. Numeric digits are represented by a single punch in the proper digit position. The 11 and 12 positions are not used for numeric punching.

ALPHABETIC REPRESENTATION

Alphabetic characters are represented by a combination of two punches a zone punch and a numeric punch. The letters *A* through *I* are represented by a combination of a 12 zone punch plus the digit punch 1 through 9. *A* is a combination 12 and 1, *B* is a combination 12 and 2, and so on.

The letters *J* through *R* are represented by a combination of an 11 zone punch plus the digit punch 1 through 9. *J* is a combination of 11 and 1, *K* is a combination of 11 and 2 and so on.

The letters *S* through *Z* are represented by a combination of a 0 zone punch plus the digit punch 2 through 9. *S* is a combination of 0 and 2, *T* is a combination of 0 and 3 and so on.

SPECIAL CHARACTER REPRESENTATION

Special characters are represented by various combination of single and multiple punches. Most special characters are composed of three punches, one of which is an 8.

INPUT TRANSLATION

During the input-translation the 12-bit card code is translated into a 6-bit machine code. The 12-bit code is first translated into an 8-bit binary code, which in turn locates an address in the Channel Synchronizer-Control Unit memory. From this address the 6-bit code is obtained and sent to the Computer. Any 6-bit code may be inserted in the memory through the Channel Synchronizer-Control Unit maintenance panel.

The translation of the 12-bit card code to the 8-bit binary code is accomplished by using four of the twelve rows on the card as zone bits, and the other eight rows as numerics. The zone bit plus a numeric will give a letter of the alphabet, a number or a symbol.

Rows 12, 11, 0, and 8 are used as the zone bits and rows 1, 2, 3, 4, 5, 6, 7, and 9 are used as the numerics.

The 8-bit binary code has the following format:

ZONE BITS				NUMERICS			
12	11	0	8	8	4	2	1

The alphabetic character G consists of a 12 zone punch and a numeric 7. The binary representation would be:

1	0	0	0	0	1	1	1

The address for this character in the Channel Synchronizer-Control Unit memory would therefore be at location 10000111 or 135. The 6-bit code for the letter G would be found in this location.

Output Translation

During the output translation the 6-bit machine code is translated into the 12-bit card code. The output translation is essentially the reverse of the input translation. The 6-bit code is translated to to 8-bit binary code and from this into the 12-bit card code. Any 12-bit card code may be inserted in the Channel Synchronizer-Control Unit memory through the maintenance panel.

Binary Transfer

The Channel Synchronizer-Control Unit can transmit full 80-column card images by row from the Punch-Verifier to the Computer, and can transmit full 80-column card images by row from the Computer to the Punch-Verifier. The image read from each row, or sent to be punched in each row, consists of two full computer words plus a third word containing 20 bits of data in the most

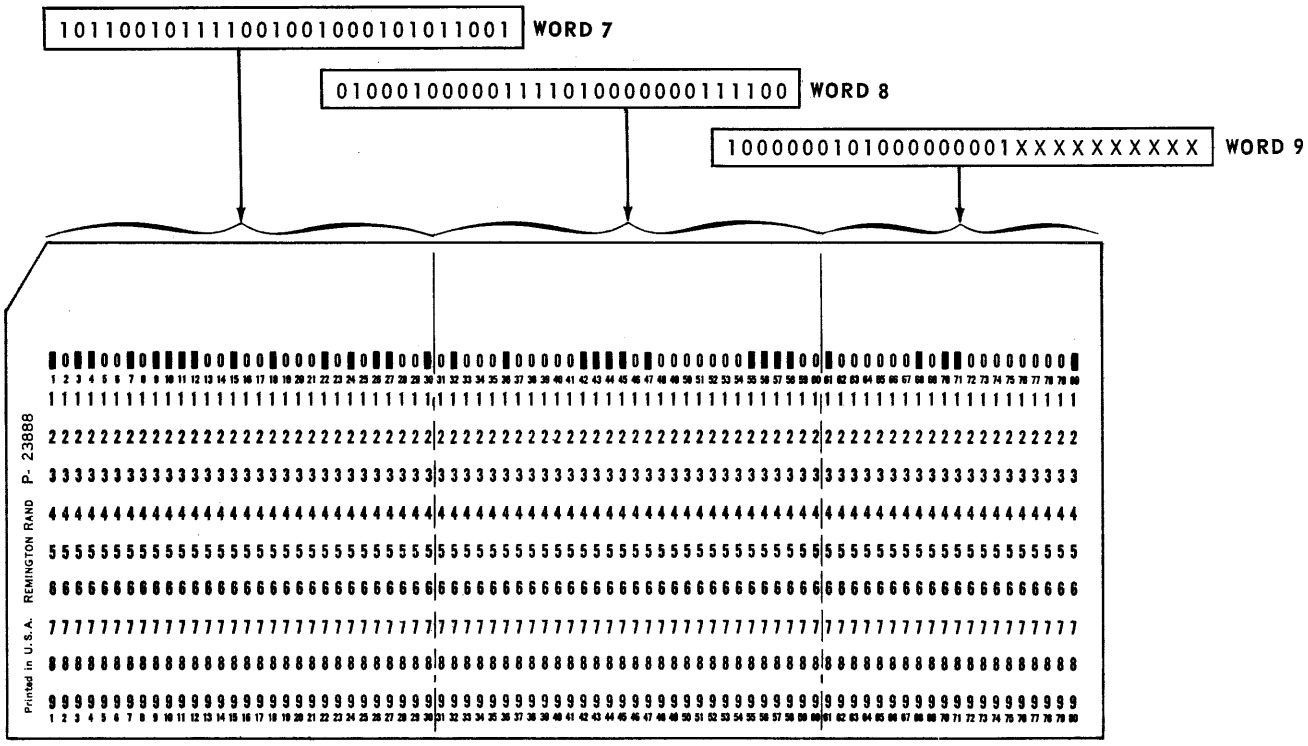


Figure 3–1. Relationship of Computer Words to Card Punches (by Row)

significant bit positions padded out with 0's in the 10 least significant bit positions (Figure 3-1).

The Channel Synchronizer-Control Unit can transmit full 80-column card images by column from the High-Speed Reader to the Computer, and can transmit full 80-column card images by column from the Computer to the Punch-Verifier. The image read from each card, or sent to be punched in each card, consists of 32 full words of data (Figure 3-2).

When the Channel Synchronizer-Control Unit is conditioned for either of the two types of binary output it is possible for the Computer to send it output data which calls for punching up to 960 holes in a single card. However, an attempt to punch more than 240 holes per card causes the Punch-Verifier or Read-Check-Punch-Check to interlock. The Computer is advised of this condition by means of a Status Word and an External Interrupt signal.

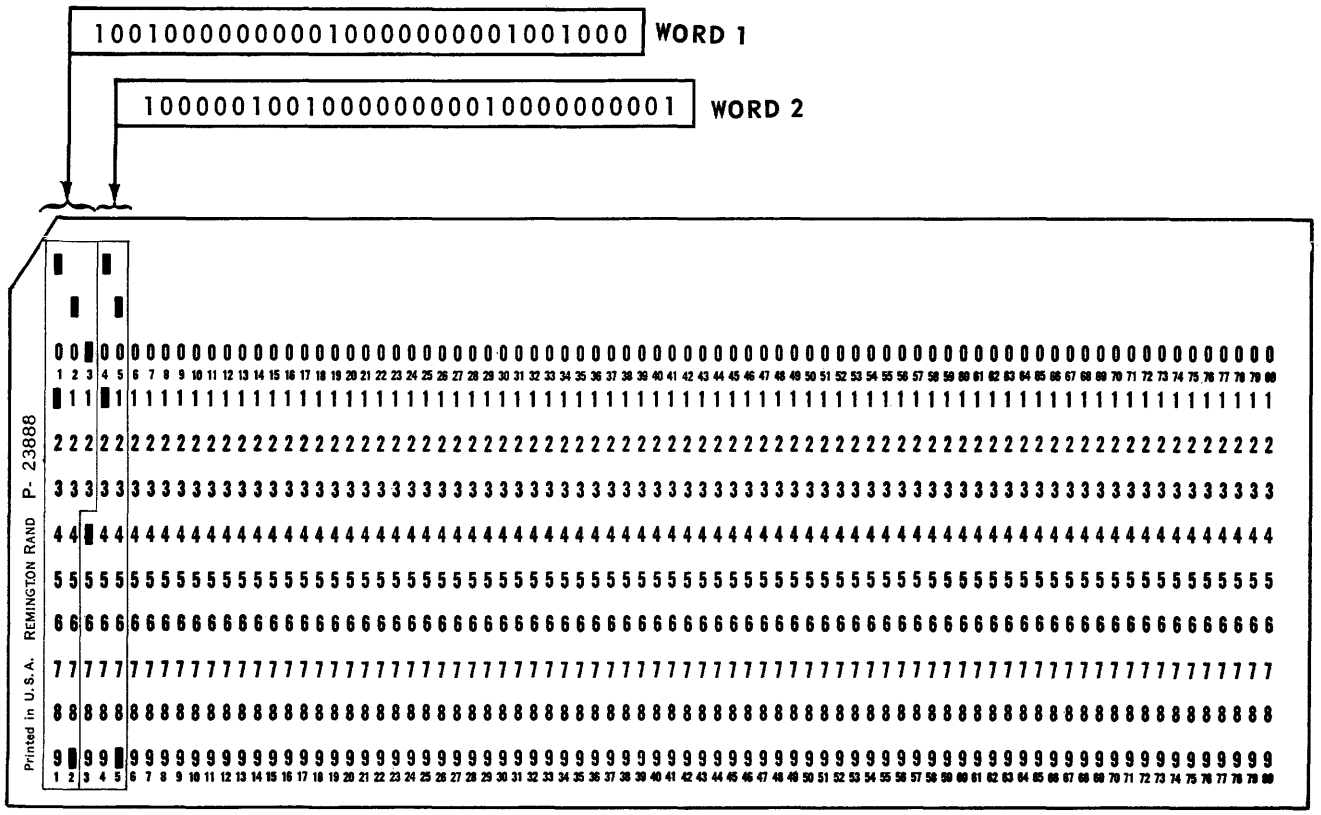


Figure 3–2. Relationship of Computer Words to Card Punches (by Column)

4. CONTROL PANELS

HIGH-SPEED READER

The High-Speed Reader Control Panel (Figure 4–1) contains the controls and indicators necessary to control this 80–Column Unit manually and to indicate abnormal conditions within it. The function of each control and indicator is shown below:

Switches

VACUUM MOTOR*

Lights when depressed, applies power to the vacuum motor.

FEED MOTOR*

Lights when depressed, applies power to the feed motor.

STOP**

Used to stop feeding cards.

RUN**

Used to start feeding cards.

RESUME**

Used to resume feeding cards after an error stop.

POWER ON-OFF*

Lights when depressed, used to apply power to the unit.

RESET CARD JAM**

Indicates card jam, allows card jam to be removed without machine restarting until reset switch is pressed.

Indicators

MISFEED

Indicates a card did not feed.

OUTPUT STACKER FULL

Indicates one of the three output stackers is full.

OFF NORMAL

Indicates an off normal condition in the High-Speed Reader.

AIR FLOW

Indicates blower motor not running.

** Latch Type Switch*

*** Momentary Type Switch*

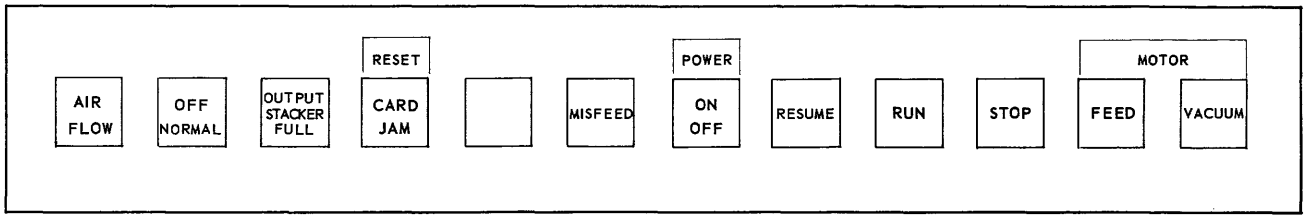


Figure 4–1. High-Speed Reader Control Panel

PUNCH-VERIFIER

The 80–Column Punch-Verifier Control Panel (Figure 4–2) contains the controls and indicators necessary to control the Punch-Verifier manually and to indicate abnormal conditions within the Punch-Verifier. The function of each control and indicator is shown below:

Switches

POWER ON/OFF*

Lights when depressed, used to apply power to the unit.

MOTOR PRESS ON/OFF*

Lights when depressed, used to activate drive motor.

MOTOR AND BRAKE OFF*

Lights when depressed, use to remove power from motor and brake.

RUN**

Used to start feeding cards.

STOP**

Used to stop feeding cards.

RESUME**

Used to resume feeding cards after an error stop.

** Latch Type Switch*

*** Momentary Type Switch*

RESET OVER PUNCH**

Indicates when overpunch condition is present, used to reset over punch circuitry.

Indicators

CHIP BOX

Indicates when chip box is full.

MISFEED

Indicates a card did not feed

PUNCH OPEN

Indicates die and stripper section is open.

AIR FLOW

Indicates blower motor not running.

INPUT MAGAZINE EMPTY

Indicates when the input magazine is empty.

CARD JAM

Indicates when a card jam occurs.

OUTPUT STACKER FULL

Indicates either or both of the output stackers are full.

OFF NORMAL

Indicates when an off normal condition exists within the card punch.

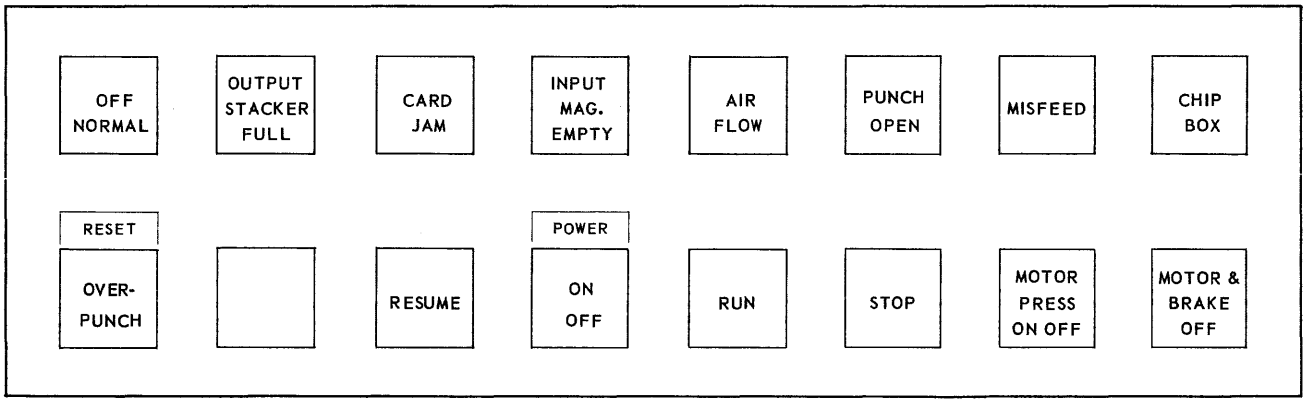


Figure 4–2. Punch Verifier Control Panel

5. CHANNEL SYNCHRONIZER-CONTROL UNIT FUNCTIONAL DESCRIPTION

The Channel Synchronizer-Control Unit directs the punching of data in a card, and verifies the data punched. It also controls and verifies the reading of data from a card.

Translation from computer code to card code or binary code is performed by the Channel Synchronizer-Control Unit as well as translation from card code or binary code to 6–bit machine code.

A core memory device in the Channel Synchronizer-Control Unit is used for storing machine codes and card codes as well as for storing the card information prior to punching or transmitting to the Computer.

CONTROL PANEL

A control panel (Figure 5–1) on the Channel Synchronzer-Control Unit contains the controls and indicators necessary to control the unit manually and indicate abnormal conditions within it. The description of each control and indicator is shown below:

CONTROL INTERLOCK

Indicator switch which indicates that neither the Reader nor the Punch can be operated.

PARITY FAULT*

Indicates when a parity error has been detected.

READ INTERLOCK

Indicator switch which indicates that a Read Interlock Fault has occurred in the High-Speed Reader. However, the Computer can operate with the Punch-Verifier Unit.

PUNCH INTERLOCK

Indicator switch which indicates that a Punch Interlock Fault has occurred in the Punch-Verifier and the Computer cannot operate with the Punch. However, the Computer can operate with the High-Speed Reader.

READ CHECK

Indicator switch which indicates that a Read Verification error has been detected and must be corrected before operation can continue. The Punch-Verifier Unit is not affected.

PUNCH CHECK

Indicator switch which indicates that a Punch-Verification error has been detected and must be corrected before operation can continue. The High-Speed Reader is not affected.

POWER ON/OFF

Indicator switch used to turn power OFF only. When the indicator is red, power is OFF and when the indicator is green, power is ON.

TEST*

Indicator which indicates that the Subsystem is in an OFF LINE mode and therefore it cannot communicate with the Computer.

Denotes indicators; all other are indicator switches.

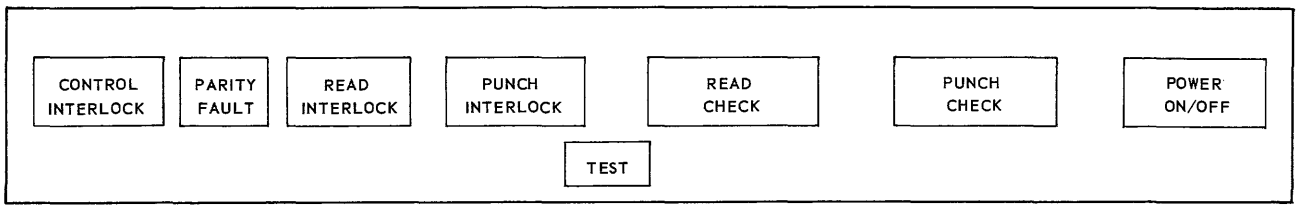


Figure 5–1. Card Subsystem Channel Synchronizer – Control Unit Control Panel

6. PROGRAMMING FEATURES

Any part of the Computer's internal core storage can be used as an input-output data buffer storage area, with the exception of the few special core storage locations that are reserved for the Incremental Clock and the Interrupt Words. Information is transferred between the Computer and the Card Subsystem in "blocks" of data. A block is made up of 16, 32 or 36 computer words depending on the type of translation. Words in a block must occupy consecutive core memory addresses, starting with a program determined first word address and ending with a program determined last word address.

BUFFER MODE

A buffer mode transfer, which occurs independently of main program control, is used to transfer data between core storage and the Card Subsystem. Before execution of a buffer mode transfer of data, the program must perform the following steps:

1. Activate the channel to be used for the information transfer.
2. Load the channel's index register with the data control word. (The lower and upper halves of the data control word contain the beginning and ending addresses of the section of core storage involved in the transfer.)
3. Send the proper Function Word or words to the card equipment.

Steps 1 and 2 above are accomplished with one of the Initiate Buffer instructions; 73, 74, 75, or 76, and step 3 is performed by the Enter External Function instruction, 13.

Data is then transferred between the Computer storage and the Card Subsystem without main program intervention. When a word is transferred to or from storage, 1 is added automatically to the lower half of the control word. The data transfer is terminated when:

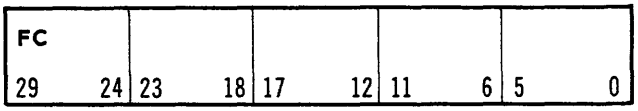
- The Computer senses that the upper and lower halves of the control word are equal.
- Sixteen, thirty-two, or thirty-six Computer words have been transferred.
- The terminate function is executed.

WORD ARRANGEMENT

The Card System accommodates three types of computer input-output words. They are the Function Word, Data Word, and Status Word.

Function Word

The Function Word designates the operation to be performed by the Card Subsystem. It is arranged in groups of characters as follows:



The six most significant bit positions (29 through 24) contain *FC* – the function code of the Function Word. The function code determines the actual operation to be executed by the Card Subsystem.

Data Word

The Data Word (input or output) is arranged in groups of 6-bit characters, with bit positions 29 through 24 containing the most significant character and bit positions 5 through 0 containing the least significant character.

MSC											
29	24	23	18	17	12	11	6	5	0		

Status Word

The Status Word contains the error information generated by the Channel Synchronizer-Control Unit; it is arranged in groups of 6-bit characters with the status code(s), represented by bit positions 29 through 24.

SC											
29	24	23	18	17	12	11	6	5	0		

The status code or error code is generated by the Channel Synchronizer-Control Unit. The upper 6 bits of the Status Word are commonly referred to as the interrupt code and any error information generated is contained in these upper 6 bits.

FUNCTION REPERTOIRE

Operation of the Channel Synchronizer-Control Unit depends on the type of Function Word handled. Table 1 is a list of the programmed function codes contained in the upper 6 bits of the Function Word.

ERRORS

The Channel Synchronizer-Control Unit is able to keep the Computer informed of certain normal and all abnormal conditions that exist within the Card Subsystem. An External Interrupt is sent to the Computer with a coded Status Word.

The following errors can occur during card operations:

- Read-Check or Punch-Check Verification.
- Illegal Character Code.
- Illegal or Inappropriate Function Code.
- Interlock Fault
- Stacker Select

Read Check or Punch Check Verification

The check verification error is sent to the Computer. The error is a Status Word accompanied with an External Interrupt and is sent on completion of the next output transfer.

Illegal Character Code

There are a total of 4096 possible punching combinations for each column of an 80-column card. Of these 4096 possibilities, 64 card codes are listed in Table 2. In the translating mode the remaining 4032 possibilities are always illegal combinations for input to the translator and are detected as such in cards read for input to the Computer.

The Channel Synchronizer-Control Unit provides the flexibility of permitting the customer to select up to 12 of the nonstandard card codes detected as illegal codes when information from a card is translated in preparation for input to the Computer.

A customer option for selecting up to all 12 of the nonstandard 6-bit configurations as illegal is provided. These are detected as illegal as they pass through the translator on the way from the Computer to be punched in the cards.

Illegal or Inappropriate Function Code

This error occurs when a Function Word received by the Channel Synchronizer-Control Unit has an illegal or undefined function code or an inappropriate function code. An inappropriate function code is a code which is defined but which cannot be performed because of the particular sequence of instructions which preceded it.

Interlock Fault

This error occurs because of the following conditions:

- Read-Check Unit is interlocked because of full output stacker, card jam, empty input-magazine, misfeed, drive motor off, abnormal switch setting.
- Punch-Verify Unit or Read-Check Punch-Check Unit is interlocked because of full output stacker, card jam, empty input-magazine misfeed, call for punching more than 240 holes per card.

TABLE 1. CARD SUBSYSTEM INSTRUCTIONS

FUNCTION CODE		DESCRIPTION
Octal	Binary	
02	000010	**Output (Type 1)** Punch a card with the data to follow; advance all cards one station and feed a card.
03	000011	**Output (Type 2)** Punch a card with the data to follow; select stacker 1 for the card, advance all cards one station and feed a card.
04	000100	**Translate (Type 1)** Translate the output data from machine code to card code for the next and all subsequent output transfers. Hollerith
05	000101	**Translate (Type 2)** Punch all subsequent output data card images by column. Binary
06	000110	**Translate (Type 3)** Punch all subsequent output data card images by row. Binary
12	001010	**Output (Type 3)** Punch a card with the data to follow; advance all cards one station and feed a card. When the operation is completed send an External Interrupt to the Computer.
13	001011	**Output (Type 4)** Punch a card with the data to follow; select stacker 1 for the card; advance all cards one station and feed a card. When the operation is completed send an External Interrupt to the Computer.
14	001100	**Translate (Type 4)** Translate output data from machine code to card code for the next and all subsequent output transfers. When the operation is completed send an External Interrupt to the Computer.
15	001101	**Translate (Type 5)** Punch all subsequent output data card images by column. When the operation is completed send an External Interrupt to the Computer.
16	001110	**Translate (Type 6)** Punch all subsequent output data card images by row. When the operation is completed send an External Interrupt to the Computer.
23	010011	**Terminate (Type 1)** Terminate the present operation.

TABLE 1. CARD SUBSYSTEM INSTRUCTIONS (Cont.)

FUNCTION CODE		DESCRIPTION
Octal	Binary	
33	011011	**Terminate (Type 2)** Terminate the present operation, then send an External Interrupt to the Computer.
41	100001	**Input (Type 1)** Transfer the data from one card into the Computer, but do not feed any cards.
42	100010	**Input (Type 2)** Transfer the data from one card into the Computer and feed as many cards to the High-Speed Reader as the Channel Synchronizer-Control Unit memory can accept.
43	100011	**Trip (Type 1)** Feed one card to the High-Speed Reader, but do not transfer the data from this card to the Computer.
44	100100	**Translate (Type 7)** Translate the input data from card code to machine code for the next and all subsequent input transfers.
45	100101	**Translate (Type 8)** On the next and all subsequent input transfer instructions (Type 1, 2, 3, and 4) transfer input data card images by column to the Computer.
46	100110	**Translate (Type 9)** On the next and all subsequent input transfer instructions (Type 1, 2, 3, and 4) transfer input data card images by row to the Computer.
51	101001	**Input (Type 3)** Transfer the data from one card into the Computer, but do not feed any cards. When the operation is completed send an External Interrupt to the Computer.
52	101010	**Input (Type 4)** Transfer the data from one card into the Computer and feed as many cards to the Punch-Verifier as the Channel Synchronizer-Control Unit can accept. When the operation is completed send an External Interrupt to the Computer.
53	101011	**Trip (Type 2)** Feed one card to the Punch-Verifier but do not transfer the data from this card to the Computer. When the operation is completed send an External Interrupt to the Computer.

TABLE 1. CARD SUBSYSTEM INSTRUCTIONS (Cont.)

FUNCTION CODE		DESCRIPTION
Octal	Binary	
54	101100	**Translate (Type 10)** Translate the input data from card code to Computer code for the next and all subsequent input transfers. When the operation is completed send an External Interrupt to the Computer.
55	101101	**Translate (Type 11)** On the next and all subsequent input transfer instructions (Type 1, 2, 3, or 4) transfer input data card images by column to the Computer. When the operation is completed send an External Interrupt to the Computer.
56	101110	**Translate (Type 12)** On the next and all subsequent input transfer instructions (Type 1, 2, 3, or 4) transfer input data card images by row to the Computer. When the operation is completed send an External Interrupt to the Computer.
61	110001	**Select Stacker (Type 1)** Select stacker 1 for the card from which data was most recently read into the Computer.
62	110010	**Select Stacker (Type 2)** Select stacker 2 for the card from which data was most recently read into the Computer.
71	111001	**Select Stacker (Type 3)** Select stacker 1 for the card from which data was most recently read into the Computer, then send an External Interrupt to the Computer.
72	111010	**Select Stacker (Type 4)** Select stacker 2 for the card from which data was most recently read into the Computer, then send an External Interrupt to the Computer.

TABLE 2

80-COLUMN CARD CODE TO FIELD DATA CODE

80-COLUMN CARD CODE	SYMBOL	BIT CODE	OCTAL CODE	80-COLUMN CARD CODE	SYMBOL	BIT CODE	OCTAL CODE
0	0 (zero)	110000	60	0-6	W	011100	34
1	1	110001	61	0-7	X	011101	35
2	2	110010	62	0-8	Y	011110	36
3	3	110011	63	0-9	Z	011111	37
4	4	110100	64	blank	(space)	000101	05
5	5	110101	65	12	&	100110	46
6	6	110110	66	11	-	100001	41
7	7	110111	67	0-1	/	111100	74
8	8	111000	70	12-3-8	.	111101	75
9	9	111001	71	12-4-8	)	100000	40
12-1	A	000110	06	11-3-8	$	100111	47
12-2	B	000111	07	11-4-8	*	101000	50
12-3	C	001000	10	0-3-8	,	101110	56
12-4	D	001001	11	0-4-8	(	101001	51
12-5	E	001010	12	3-8	=	100100	44
12-6	F	001011	13	4-8	<	100011	43
12-7	G	001100	14	12-2-8	+	100010	42
12-8	H	001101	15	11-2-8	:	101011	53
12-9	I	001110	16	0-2-9	'	111010	72
11-1	J	001111	17	2-8	>	100101	45
11-2	K	010000	20	12-7-8	L.C.	000010	02*
11-3	L	010001	21	11-7-8	?	101100	54*
11-4	M	010010	22	0-7-8	□	111110	76*
11-5	N	010011	23	7-8	;	111011	73*
11-6	O	010100	24	12-6-8	U.C.	000001	01*
11-7	P	010101	25	11-6-8	"	101010	52*
11-8	Q	010110	26	0-6-8	⊕	101111	57*
11-9	R	010111	27	6-8	Idle	111111	77*
0-2	S	011000	30	12-0	L.F.	000011	03*
0-3	T	011001	31	11-0	C.R.	000100	04*
0-4	U	011010	32	0-5-8	!	101101	55*
0-5	V	011011	33	8-9	M.S.	000000	00*

* These are non-standard codes.

- Channel Synchronizer-Control Unit is interlocked because of unexpected bad parity in the buffer, or other errors indicating improper Channel Synchronizer-Control Unit operation.

All interlock interrupts, with the exception of parity error, are presented upon receipt of the error pertaining to the unit involved. Parity interlock is sent immediately upon detection,

Select Read Stacker Received Late

This error occurs if the Select Stacker instruction is received by the Channel Synchronizer-Control Unit more than 100 milliseconds after the card for which the instruction was required, has passed the check station of the read-check unit.

Normal Interrupt

Each instruction sent by the Computer to the Channel Synchronizer-Control Unit can contain an External Interrupt request. Therefore, when this request is present, the Channel Synchronizer-Control Unit sends an External Interrupt to the Computer upon completion of the operation specified. If the Channel Synchronizer-Control Unit receives a Terminate instruction, while it is performing an instruction which included an External Interrupt, the External Interrupt request is disregarded.

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