SDS SIGMA CARD PUNCH
MODEL 7160

Reference Manual

SCIENTIFIC DATA SYSTEMS

CARD PUNCH ORDER CODES

Code (Hexadecimal)	Function
00	Stop
01	Punch Binary (stack previous card in normal stacker)
05	Punch EBCDIC (stack previous card in normal stacker)
09	Punch Binary (if no error, stack previous card in normal stacker; if error occurs, stack previous card in alternate stacker)
0D	Punch EBCDIC (if no error, stack previous card in normal stacker; if error occurs, stack previous card in alternate stacker)
11	Punch Binary (stack previous card in alternate stacker)
15	Punch EBCDIC (stack previous card in alternate stacker)
19	Punch Binary (stack previous card in alternate stacker)
1D	Punch EBCDIC (stack previous card in alternate stacker)
80	Stop and Interrupt

Price: $ .50

CARD PUNCH

MODEL 7160

REFERENCE MANUAL

for

SDS SIGMA COMPUTERS

90 09 71A

November 1966

SDS

SCIENTIFIC DATA SYSTEMS/1649 Seventeenth Street/Santa Monica, California

Printed in U.S.A.

All specifications subject to change without notice.

CONTENTS

1 GENERAL DESCRIPTION 1

SDS Model 7160 Card Punch 1
Characteristics 1

2 FUNCTIONAL DESCRIPTION 1

Data Representation 1
EBCDIC Data Format 1
Binary Data Format 2
Card Punch States 2
Operational States 2
Conditions 2
Modes 2
Transitions Between States 3
Data Transfer 3

3 PROGRAM INTERFACE 4

Punch Orders 4
Punch Card EBCDIC 4
Punch Card Binary 4
Stop 4
Key Events 4
Start Input/Output 4
Unusual End Conditions 4
Channel End Condition 5
Fault Conditions 5
Error Conditions 5
Data Overrun 5
Parity Error 5
Read Check 5
Card Punch Status Response 5
Device Status Byte 5
Status Response for SIO, TIO, and HIO 5
Status Response for TDV and AIO 6

3 PROGRAM INTERFACE (cont.)

Operational Status Indicators 6
Transmission Data Error 6
Channel End 6
Unusual End 6
Chaining Modifier 6
Programming Considerations 6
Timing Information 6
Sequence of Activity 6

4 OPERATIONS 8

Operator Controls 8
Indicator Panel 9
Card File Loading Procedure 9
Card File Unloading Procedure 9

APPENDIXES

A SDS EBCDIC CARD CODES 10

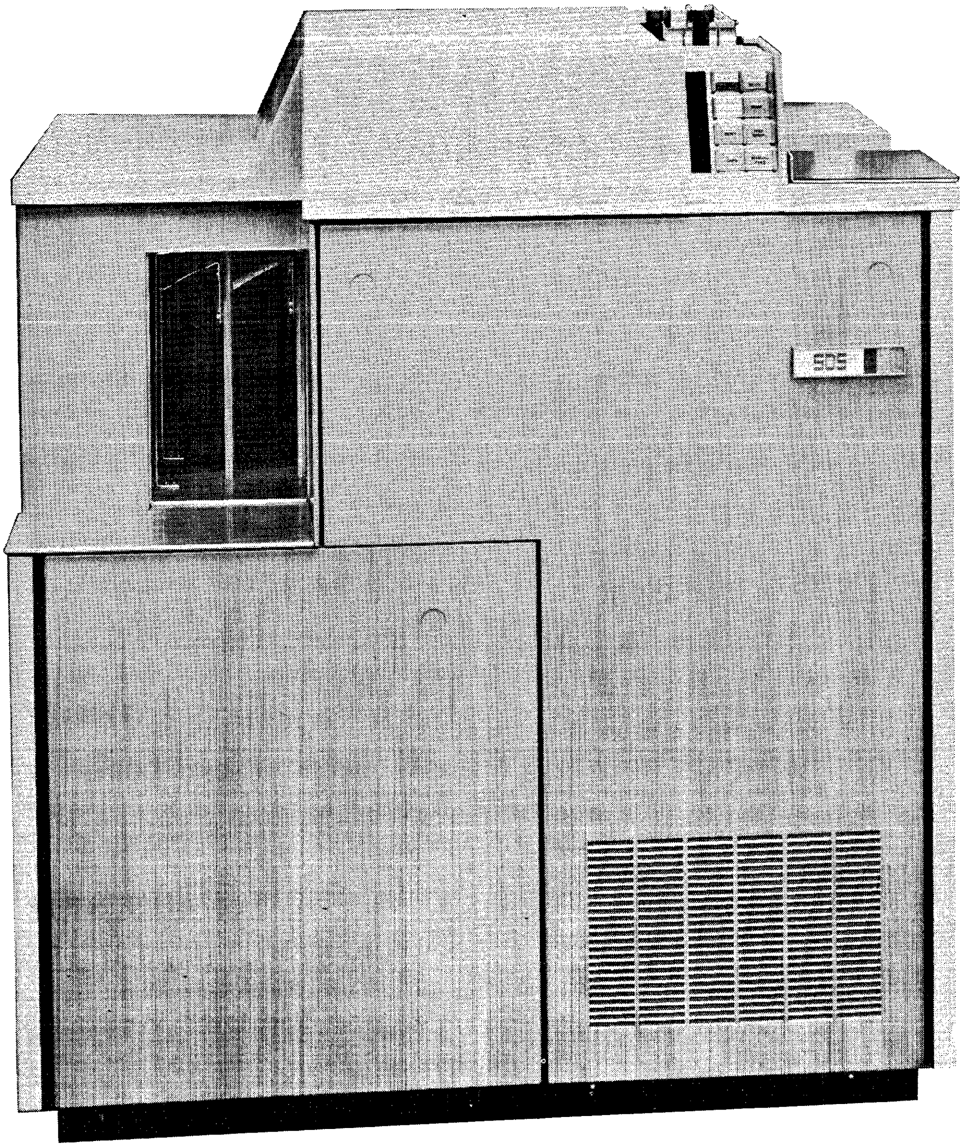
B SIGMA 7 CARD PUNCH PROGRAM 12

ILLUSTRATIONS

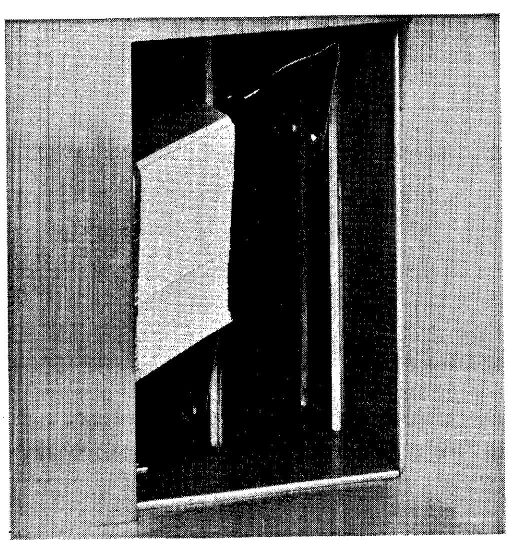
1 EBCDIC Punch Operation 1
2 Binary Punch Operation 2
3 Card Punch Event Times 6
4 Controlling System/Card Punch Actions 7

TABLE

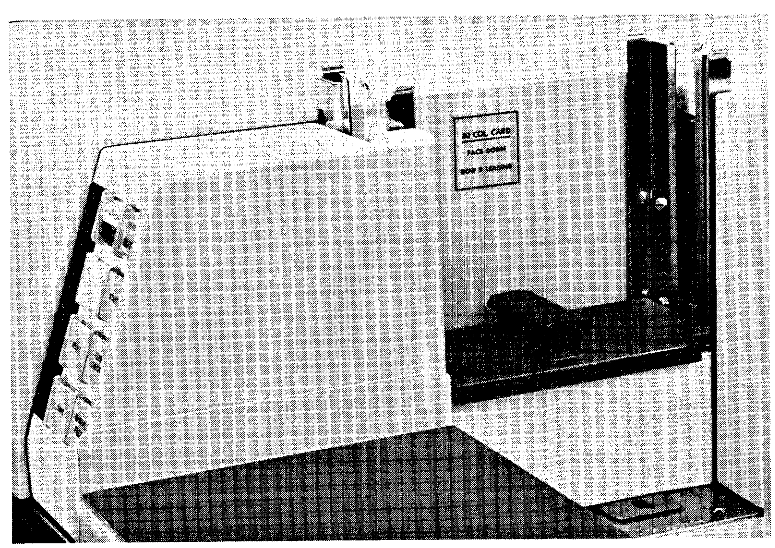
1 Card Punch State Transitions 3



Model 7160 Card Punch



Multiple Output Stackers



Input Hopper

1. GENERAL DESCRIPTION

SDS MODEL 7160 CARD PUNCH

The SDS Model 7160 card punch system is capable of punching standard 80-column tabulating cards conforming to the Electronics Industries Association (EIA) punched card standard RS-292.

Cards are punched row by row in either of two punch modes: binary (absolute) or Extended Binary Coded Interchange Code (EBCDIC). Automatic translation occurs for the EBCDIC punch mode, expanding an 8-bit EBCDIC character to its equivalent 12-bit column punch configuration. Automatic read-after-punch validates the previously punched card image.

Multiple output stackers provide for preselection of stacker by the controlling system.

Transport check and read check facilities provide for detection of fault conditions by the controlling system. Empty input hopper, full output stacker, and chip box full conditions are also signaled to the controlling system.

CHARACTERISTICS

Item	Specification
Punch speed	300 cards/minute
Hopper capacity	1000 cards
Stacker capacity	1000 cards each
Number of stackers	2
Dimensions	height = 48.5 in. width = 42.5 in. depth = 25.0 in.
Weight (approximate)	550 lb
Recommended access area	3 ft on all sides
Power requirement	208 vac ± 5% (phase-to-phase of 3-phase service), 60 ± 0.5 Hz
Operating temperature	$50^{\circ}F$ to $90^{\circ}F$
Operating humidity	20% to 80%

2. FUNCTIONAL DESCRIPTION

DATA REPRESENTATION

A single 80-column card can be used to record data in either of two formats: EBCDIC or binary.

EBCDIC DATA FORMAT

In the EBCDIC data format, a card image consists of 80 consecutive bytes (8 bits per byte) of data. Each byte of the EBCDIC card image is an 8-bit code in the range $0\text{-}255_{10}$ ($00_{16}\text{-}FF_{16}$), each of which corresponds to a punch configuration for a single column (see Appendix A). This card image, when transmitted to the card punch, is recorded on the card (row by row) as 80 columns of punch configurations, with the punch configuration in column 1 corresponding to the first transmitted byte of the card image and the punch configuration in column 80 corresponding to the 80th byte of the card image.

Figure 1 illustrates how the first two bytes of an EBCDIC card image are presented to the card punch by the controlling system. Note that EBCDIC code 40_{16} produces a blank (no punch) card column.

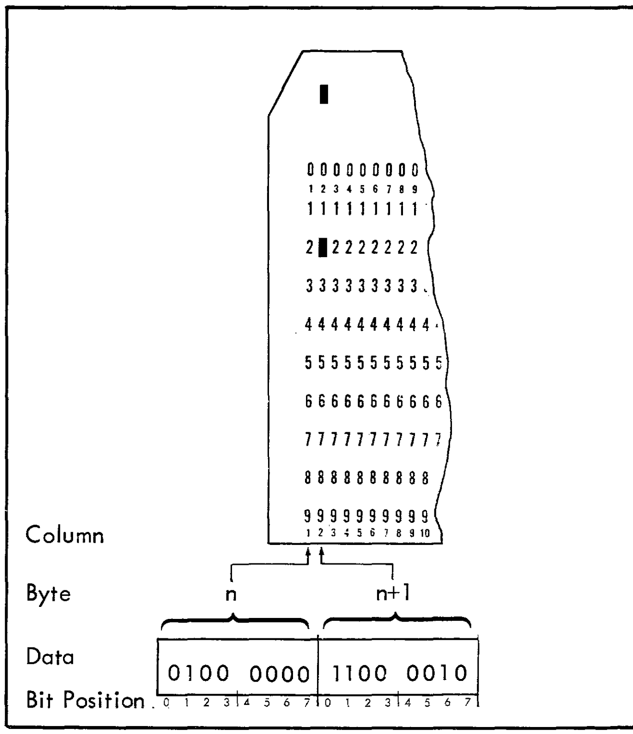


Figure 1. EBCDIC Punch Operation

BINARY DATA FORMAT

In the binary data format, a card image consists of 120 consecutive bytes of data. The binary card image, when received by the card punch, is reassembled as 80 12-bit codes and each 12-bit code is punched in the corresponding card column (row by row).

Figure 2 illustrates how the first three bytes of a binary card image are punched on the card. Note that the first byte of the binary card image is punched in column 1, rows 12-5, with a 1 in the byte corresponding to a punch in the appropriate row. The second byte of the card image is separated so that bits 0-3 of the byte correspond to punches in rows 6-9 of column 1 and bits 4-7 of the byte correspond to rows 12-1 of column 2. The third byte of the card image is punched in rows 2-9 of column 2. Thus, for each set of three bytes in the card image, one pair of card columns is punched with holes to correspond with ones in the binary card image.

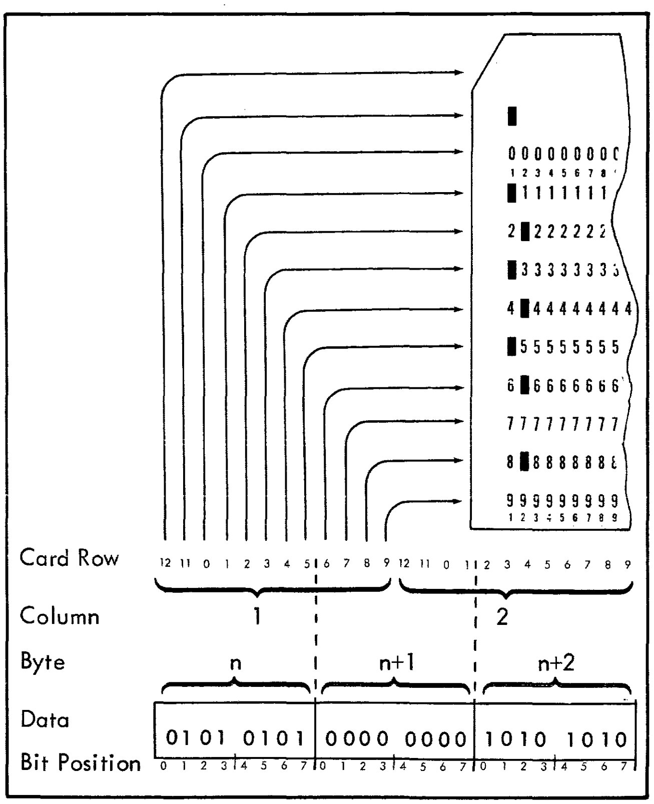


Figure 2. Binary Punch Operation

CARD PUNCH STATES

The initial state of the card punch depends on its power status. The complete absence of power to the card punch subsystem (that is, the absence of its prime ac power or system dc power) effectively removes the card punch from the controlling system. All attempts to access the card punch result in a response of "no input/output address recognition" to the I/O instruction. Furthermore, unpredictable status indications are supplied if status is requested by the I/O instruction. In the absence of ac power, the presence of system dc power will enable address recognition, but the card punch assumes a "not operational" condition. Likewise, failure of power supplies internal to the card punch causes the card punch to assume a "not operational" condition.

OPERATIONAL STATES

The card punch assumes one of four operational states if all of the following conditions are satisfied.

1. ac and dc power are present
2. no dc fault exists
3. no transport mechanism fault exists
4. all interlocks are closed
5. no manual card feed is in process

A dc fault exists if the required dc voltages were not present in the card punch during the previous punch cycle. A transport mechanism fault exists if there is a card jam in any part of the card transport area.

The exact condition and mode status of the card punch at any given time is returned to the CPU in response to such I/O instructions as SIO, HIO, and TIO, Other I/O instructions, such as AIO and TDV, provide more specific indications of the card punch status. A brief explanation of the possible conditions ("ready" and "busy") and modes ("manual" and "automatic") of the card punch follows.

Conditions

Ready. In the "ready" condition the card punch is capable of accepting an SIO instruction, providing no interrupt is pending. In order to be in the "ready" condition, the card punch must be operational (that is, all conditions defined under "Operational States" must be satisfied), and the execution of an order to punch a card is not pending.

Busy. In this condition the card punch has accepted an SIO instruction. The unit will not accept a new order until the current order is completed and no device interrupt is pending.

Modes

Manual. The card punch assumes the "manual" mode when any condition arises requiring operator intervention before the punch can function normally (e.g., stacker full, hopper empty, etc.). The "manual" mode is forced by the operator pressing the STOP switch on the card punch control panel or by an I/O reset signal from the controlling system. The punch can accept an SIO instruction in this mode, but will not act on it in any way until it enters the "automatic" mode.

Automatic. When all necessary conditions for successful card punch operation are present, the punch is placed in the "automatic" mode by the operator pressing the START switch on the card punch control panel.

TRANSITION BETWEEN STATES

The allowable card punch state transitions and the conditions causing the punch to change from one operational state to another are summarized in Table 1.

DATA TRANSFER

A card punch operation is initiated by the controlling system with a START INPUT/OUTPUT (SIO) instruction that transmits a punch order to the card punch if the following conditions are satisfied:

1. input/output address recognition exists
2. the card punch is in the "ready" condition
3. no interrupt is pending

If the card punch is in the "automatic" mode, it then requests an order from the controlling system. After receiving a valid punch order, the card punch commences to accept the card image (for one row) from the controlling system. The card punch continues to accept the card image until any of the following conditions occurs:

1. row punch time is detected
2. the card punch receives a "count done" or "halt" signal from the controlling system
3. a fault condition is encountered

When row 9 punch time is detected, the card punch punches the appropriate configuration of row 9 for the entire 80 columns of the card and then provides the controlling system with an indiciation that row 9 has been punched. The controlling system then must transmit the punch order and card image 11 more times (for a total of 12) to complete the punching of a single 80-column card image.

If the card punch operation was not terminated by a fault condition, the card just punched is directed to the read verification station. The card previously at that station is simultaneously directed to the normal stacker unless:

1. a punch error was detected in the previous card and the punch order (for row 12 of the card just punched) specified error stacking, in which case the previous card is directed to the alternate stacker; or
2. the punch order (for row 12 of the card just punched) specified the alternate stacker unconditionally for the previous card.

Table 1. Card Punch State Transitions

Present State \ Next State	Not Operational	Ready Manual	Busy Manual	Ready Automatic	Busy Automatic
Not Operational	—	Fault condition cleared	Not possible	Not possible	Not possible
Ready Manual	Fault condition encountered or RESET switch operated	—	SIO accepted	START switch operated with hopper not empty and stacker not full	Not possible
Busy Manual	Fault condition encountered or RESET switch operated	I/O reset or HIO received from controlling system	—	Not possible	START switch operated with hopper not empty and stacker not full
Ready Automatic	Fault condition encountered or RESET switch operated	STOP switch operated	Not possible	—	SIO accepted
Busy Automatic	Fault condition encountered or RESET switch operated	STOP and then RESET switches operated, or execution completed and manual operation required	STOP switch operated and card cycle completed, or execution pending but manual operation required	Execution completed, HIO received, invalid order received, or stop order received	—

3. PROGRAM INTERFACE

PUNCH ORDERS

The 8-bit punch order specifies the punch mode (binary or EBCDIC) and the stacker in which the previously punched card will be stacked upon completion of the punch operation. The specified punch mode applies to the entire card image – columns 1 through 80. Punch modes may not be changed after punching the first row of a given card.

If the initial punch order is a valid order, the card punch requests the card image from the controlling system and then punches the proper hole pattern for row 9 of the card at the prepunch station. The next ten punch orders each cause the card punch to request the card image and punch the proper hole pattern for the next 10 rows (8 through 11). The twelfth punch order causes the card punch to request the card image and specifies to which stacker the previously punched card (at the read station) is to be directed. After row 12 is punched, the previously punched card is verified and directed to one of the stackers, the card just punched is directed to the preread station, and a blank card is fed from the input hopper to the prepunch station, in preparation for the next punch order.

The following illustration indicates the required and optional bit configurations of the basic punch order. (Bits 0, 1, 2, 6, and 7 must be coded as shown; bits 3-5 are optional modifier bits.)

```
0 1 2 3 4 5 6 7
0 0 0 M M M 0 1
            └─ Punch
          Bit 5: 0 Binary
                 1 EBCDIC
          Bit 4: 0 Stack card in stacker specified
                     by bit 3
                 1 Stack card in stacker specified
                     by bit 3; on error, stack card
                     in alternate stacker
          Bit 3: 0 Stack card in normal stacker
                 1 Stack card in alternate stacker
```

PUNCH CARD EBCDIC

The following table lists the four valid orders (hexadecimal code) to feed and punch a card in the EBCDIC mode, with the previously punched card being directed to one of the multiple stackers.

Order	Action
X'05'	Stack card in normal stacker
X'0D'	If no error, stack card in normal stacker – on error, stack card in alternate stacker
X'15'	Stack card in alternate stacker
X'1D'	Stack card in alternate stacker

PUNCH CARD BINARY

The following table lists the four valid orders (hexadecimal code) to feed and punch a card in binary mode, with the previously punched card being directed to one of the multiple stackers.

Order	Action
X'01'	Stack card in normal stacker
X'09'	If no error, stack card in normal stacker – on error, stack card in alternate stacker
X'11'	Stack card in alternate stacker
X'19'	Stack card in alternate stacker

STOP

If the card punch receives the order code X'00', it returns to the "ready" condition but does not signal "unusual end" to the controlling system. If the card punch receives the order code X'80', it signals "device interrupt pending" to the controlling system and then returns to the "ready" condition.

KEY EVENTS

The key events that occur during a card punch operation are described in the following paragraphs. No chronological order should be assumed from the order of presentation. Timing information is discussed under "Programming Considerations".

START INPUT/OUTPUT

A card punch operation is initiated with the execution of a START INPUT/OUTPUT instruction by the controlling system. If I/O address recognition exists and the punch is in the "ready" condition with no interrupt pending, the controlling system sets its "I/O address recognition" and "successful start" indications; meanwhile, the card punch advances from the "ready" to the "busy" condition, requests an order from the controlling system (if in the "automatic" mode), and then waits for the order to arrive. Note that "successful start" does not mean that the card punch has started to feed and punch a card. "Successful start" signifies only that a device has acknowledged the I/O address and the device is in the "ready" condition with no interrupt pending.

UNUSUAL END CONDITIONS

The detection of any of the following conditions after an order is received causes the card punch to return an "unusual end" indication to the controlling system.

1. invalid order code (i.e., neither a valid punch order nor a stop order)
2. transport mechanism malfunction while punching

3. failure of ac and/or dc power while punching
4. parity error during transfer of data between the controlling system and the card punch
5. read check or feed check
6. operator pressing the RESET switch while a punch operation is in process
7. data overrun detected while punching
8. operator opening one or more of the electrical interlocks while a punch operation is in process

CHANNEL END CONDITION

After receiving a valid order from the controlling system, the card punch signals "channel end" to the controlling system at the end of row punch time if one or more data bytes have been received for punching a row.

FAULT CONDITIONS

A fault condition, generally, is any condition that causes a peripheral device to report a "not operational" condition in response to an SIO, HIO, or TIO instruction. For the card punch, any of the following conditions cause the card punch to become "not operational".

1. transport mechanism malfunction
2. default
3. electrical interlock open
4. TEST switch in TEST position

An error condition, generally, is any condition that results in invalid data being recorded on the output medium, but does not cause the device to become "not operational"; thus, program recovery is possible.

ERROR CONDITIONS

The card punch is capable of detecting and reporting the following error conditions to the controlling system.

Data Overrun. For the card punch, a data overrun condition occurs when it has not received sufficient data for punching a row when the row punch time has arrived.

Parity Error. For the card punch, a parity error condition is the result of a parity error in data received from the controlling system.

Read Check. A read check occurs if the number of holes in a card does not match the number of ones generated for that card by the punch controller.

CARD PUNCH STATUS RESPONSE

The card punch is capable of returning various status flags in response to CPU-executed I/O instructions. Detailed explanations of the input/output instructions to request status of the card punch are contained in the reference manuals for the SIGMA computers.

The following paragraphs explain the significance of each status flag returned to the controlling system by the card punch.

DEVICE STATUS BYTE

The following eight bits of information are made available to the controlling system in the Device Status Byte in response to the execution of an I/O instruction.

Status Response for SIO, TIO, and HIO

Bit 0: Device Interrupt Pending. If this bit is a 1, an interrupt call is pending (issued but not yet acknowledged by an AIO instruction). The card punch will continue to request data (if specified) to be punched until the entire card is punched, but it will not accept a new punch order until the interrupt is cleared. The interrupt may be cleared by execution of an AIO or HIO instruction or by manual intervention (by performing an I/O reset operation from the computer control panel).

Bits 1-2: Card Punch Condition. A combination of these two flags reflects the current card punch condition.

Flags	Condition
00	Card Punch Ready – the card punch is capable of accepting an SIO instruction if no interrupt is pending.
01	Card Punch Not Operational – a fault condition exists or the TEST switch is in the TEST position; thus, the card punch will not accept an SIO instruction. Manual intervention is required to clear the "not operational" condition.
10	Device Unavailable – this condition is not applicable to the card punch system.
11	Card Punch Busy – the card punch is currently engaged in the execution of a previous order.

Bit 3: Mode. If this bit is a 0, the card punch is in the "manual" mode; thus, manual intervention is required. If this bit is 1, the card punch is in the "automatic" mode; thus, no manual intervention is required in order to feed and punch a card.

Bit 4: Device Unusual End. If this bit is a 1, execution of the previous punch order was terminated due to an abnormal condition, as listed under "Unusual End Conditions".

Bits 5-6: Not Applicable. These condition states are not applicable to the card punch system; thus bits 5-6 are always reset to zeros.

Bit 7: Unassigned. This status bit is currently unassigned and is always reset to zero.

Status Response for TDV and AIO

Bit 0: Data Overrun. If this bit is a 1, a data overrun occurred since the previous punch order was received.

Bit 1: Unassigned. This bit is currently unassigned and is always reset to zero.

Bit 2: Read Check. If this bit is a 1, the number of holes in the previously punched card does not agree with the number of ones generated for that card by the punch controller.

Bit 3: Parity Error. If this bit is a 1, the card punch controller has detected a parity error in data transmitted from the controlling system.

Bit 4: Unusual End. If this bit is a 1, execution of the previous punch order was terminated due to an abnormal condition, as listed under "Unusual End Conditions".

Bit 5: TEST Switch. If this bit is a 1, the card punch TEST switch is in the TEST position (the card punch is "not operational").

Bits 6-7: Unassigned. These two bits are currently unassigned and are always reset to zeros.

OPERATIONAL STATUS INDICATORS

The following indicators are made available to the controlling system in the Operational Status Byte.

Transmission Data Error. If this flag is a 1, a parity error, read check, or data overrun was encountered since the previous punch order was received.

Channel End. If this flag is a 1, the card punch has received a valid punch order, one or more data bytes have been transmitted to the punch, and the end of row punch time has been encountered.

Unusual End. If this flag is a 1, the card punch has terminated execution of the previous punch order for any of the reasons listed under "Unusual End Conditions".

Chaining Modifier. If this flag is a 1, the card punch has received data for punching the last row (12) of the card image.

PROGRAMMING CONSIDERATIONS

TIMING INFORMATION

Figure 3 illustrates the time-dependent events that occur during a punch card operation.

SEQUENCE OF ACTIVITY

Figure 4 illustrates the sequential relationship of the key events that occur during a card punch operation.

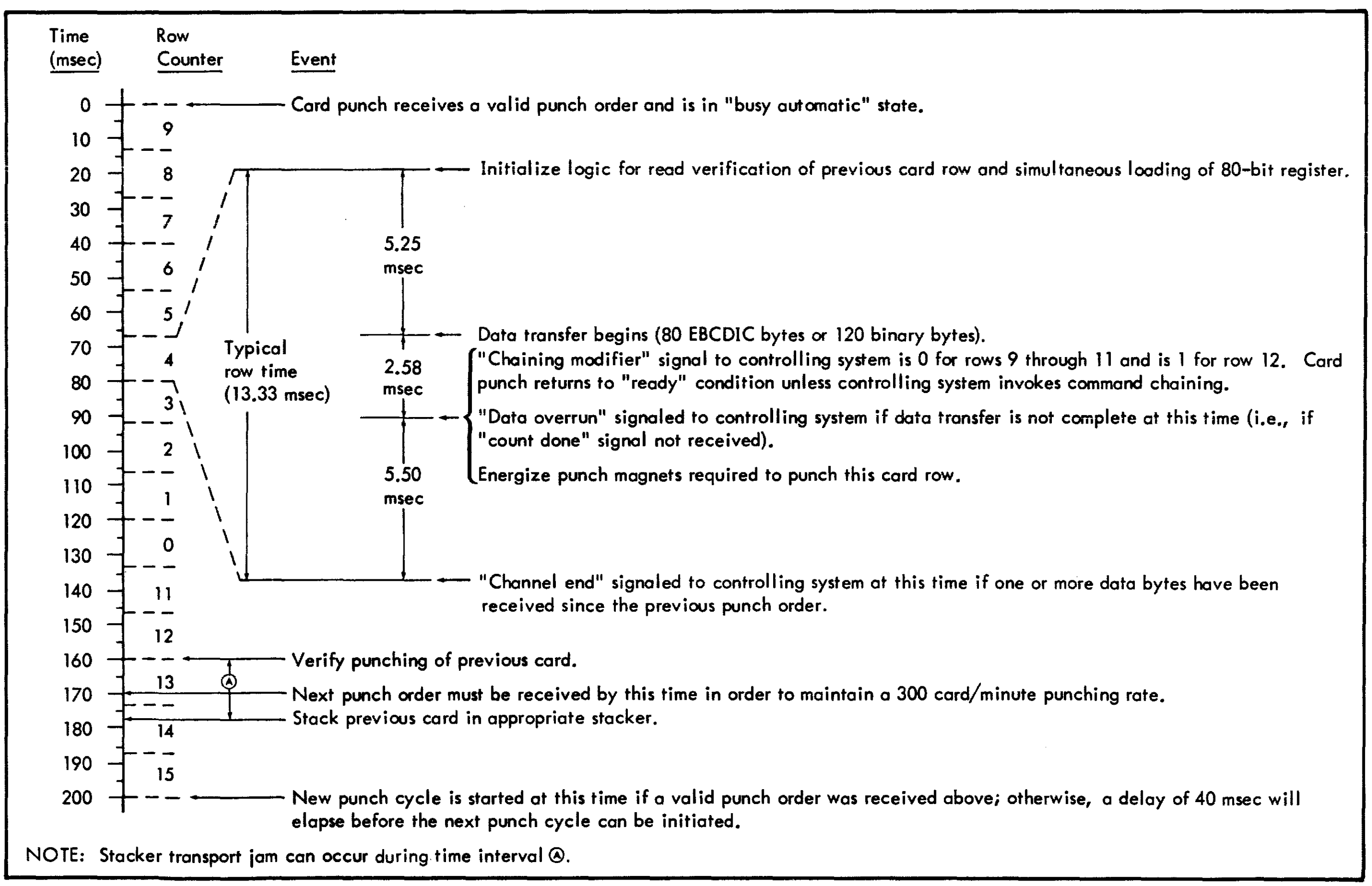


Figure 3. Card Punch Event Times

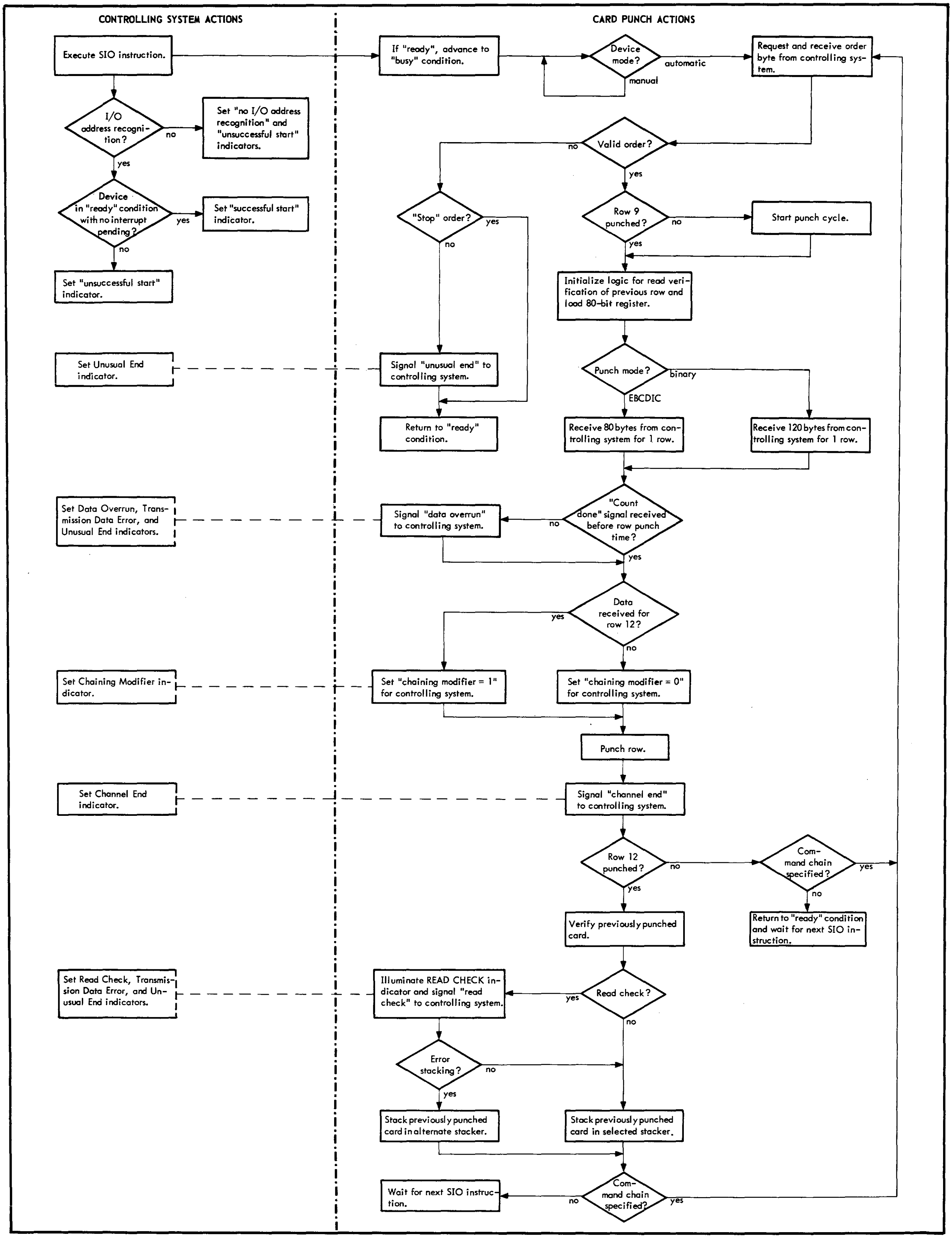
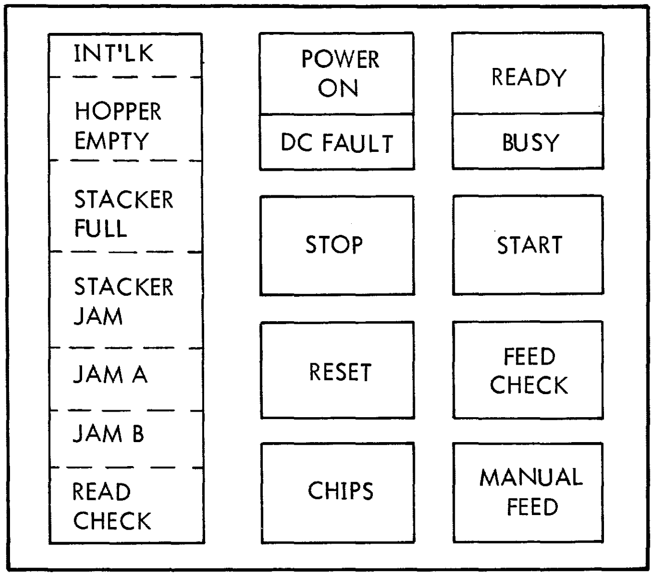


Figure 4. Controlling System/Card Punch Actions

4. OPERATIONS

OPERATOR CONTROLS

The card punch control panel consists of switch-indicators mounted on the front panel according to the following layout.



POWER ON/DC FAULT

This is a push-on/push-off switch-indicator that controls the ac power to the card punch mechanism. Nonillumination of POWER ON signifies that ac power is not applied to the card punch mechanism. In this state, DC FAULT is illuminated (red) denoting absence of dc power to the card punch system. When the switch is momentarily depressed, ac power is applied or removed from the system.

POWER ON is illuminated (white) and DC FAULT is non-illuminated if ac and dc power are both applied to the card punch system.

READY/BUSY

This is a dual indicator, with READY being illuminated (green) and BUSY nonilluminated only if the card punch system is capable of accepting an order to feed and punch a card upon demand from the controlling system. Conversely, BUSY will be illuminated (amber) and READY non-illuminated, to signify that the card punch system is currently engaged in executing an order to feed and punch a card and thus is incapable of accepting another order until the current order is completed and no device interrupt is pending. If neither READY nor BUSY is illuminated, the card punch is in the "not operational" condition.

STOP

This is a switch-indicator to control and indicate the manual state of the card punch system. Pressing STOP places the card punch in the "manual" mode, illuminating the STOP indicator (white).

START

This is a switch-indicator to control and indicate the "automatic" mode of the card punch system. Pressing START places the card punch in the "automatic" mode and illuminates the START indicator (white). The card punch system will go automatic only if the following conditions are all satisfied.

1. ac and dc power are applied
2. all interlocks are closed
3. no transport fault exists
4. the chip box is not full
5. input hopper is not empty
6. no stacker is full

In addition, if the card punch is not primed (that is, cards are not present at all required card stations, pressing START causes the punch to feed the necessary blank cards and switch to the "manual" mode (STOP illuminated). The START switch must be pressed a second time to advance the card punch to the "automatic" mode.

RESET

This is a momentary switch that is used to reset the stacker control and card control logic. If a punch cycle is in progress when this switch is activated, the punch cycle is terminated and an "unusual end" signal is transmitted to the controlling system. Activation of this switch also forces the card punch to the "manual" mode and inhibits read verification of the next card arriving at the read station.

FEED CHECK

This indicator, when illuminated (white), signifies that the card punch system failed to move a card from the input hopper to the prepunch station. Action by maintenance personnel may be required, since the punch is in the "not operational" condition when this indicator is illuminated.

CHIPS

This indicator, when illuminated (white), signifies that the chip box is almost full. The card punch will automatically switch to the "manual" mode when the chip box becomes full. To correct this condition, empty the chip box, and then press START.

MANUAL FEED

When the card punch is in the "manual" mode (STOP illuminated), pressing this momentary switch causes the card punch to feed cards continuously through the card punch system into the alternate (right) stacker as long as the switch is pressed. (No read verification is performed.)

INDICATOR PANEL

The following indicators are located to the left of and adjacent to the control panel switch-indicators and are visible only when illuminated.

INT'LK

One or more of the mechanical interlocks in the card punch system are open, such as side panel off, etc. Action by maintenance personnel may be required, since the punch is in the "not operational" condition.

HOPPER EMPTY

The input card hopper is empty, placing the punch in the "manual" mode. This situation is corrected by placing more cards in the input hopper and then pressing START.

STACKER FULL

One or more of the multiple output stackers is full, placing the punch in the "manual" mode. This situation is corrected by removing cards from the full stacker and then pressing START.

STACKER JAM

A card jam exists at the stacker station ahead of the multiple stackers. Action by maintenance personnel may be required, since the punch is in the "not operational" condition.

JAM A

A card jam exists at the prepunch station. Action by maintenance personnel may be required, since the punch is in the "not operational" condition.

JAM B

A card jam exists at the preread station. Action by maintenance personnel may be required, since the punch is in the "not operational" condition.

READ CHECK

A read check (read verification error) exists for the card passing through the read station. This condition does not cause the card punch system to go "not operational"; however, it does require a program recovery procedure.

CARD FILE LOADING PROCEDURE

1. Ensure power is applied by visually checking the POWER ON/DC FAULT switch on the operator control panel. Illumination of the POWER ON switch (white) and nonillumination of the DC FAULT switch signifies that both ac and dc power are applied.

2. Remove the card weight from the input hopper, place blank cards in the input hopper (face down, row 9 toward the back of the hopper), and place the card weight on top of the blank cards.

3. Depress the START switch to prime the card punch; that is, feed blank cards into the appropriate stations. The START switch will remain illuminated if the card punch has been previously primed; otherwise, a second activation of the START switch is required. Illumination of the START switch indicates the card punch is in the "automatic" mode.

CARD FILE UNLOADING PROCEDURE

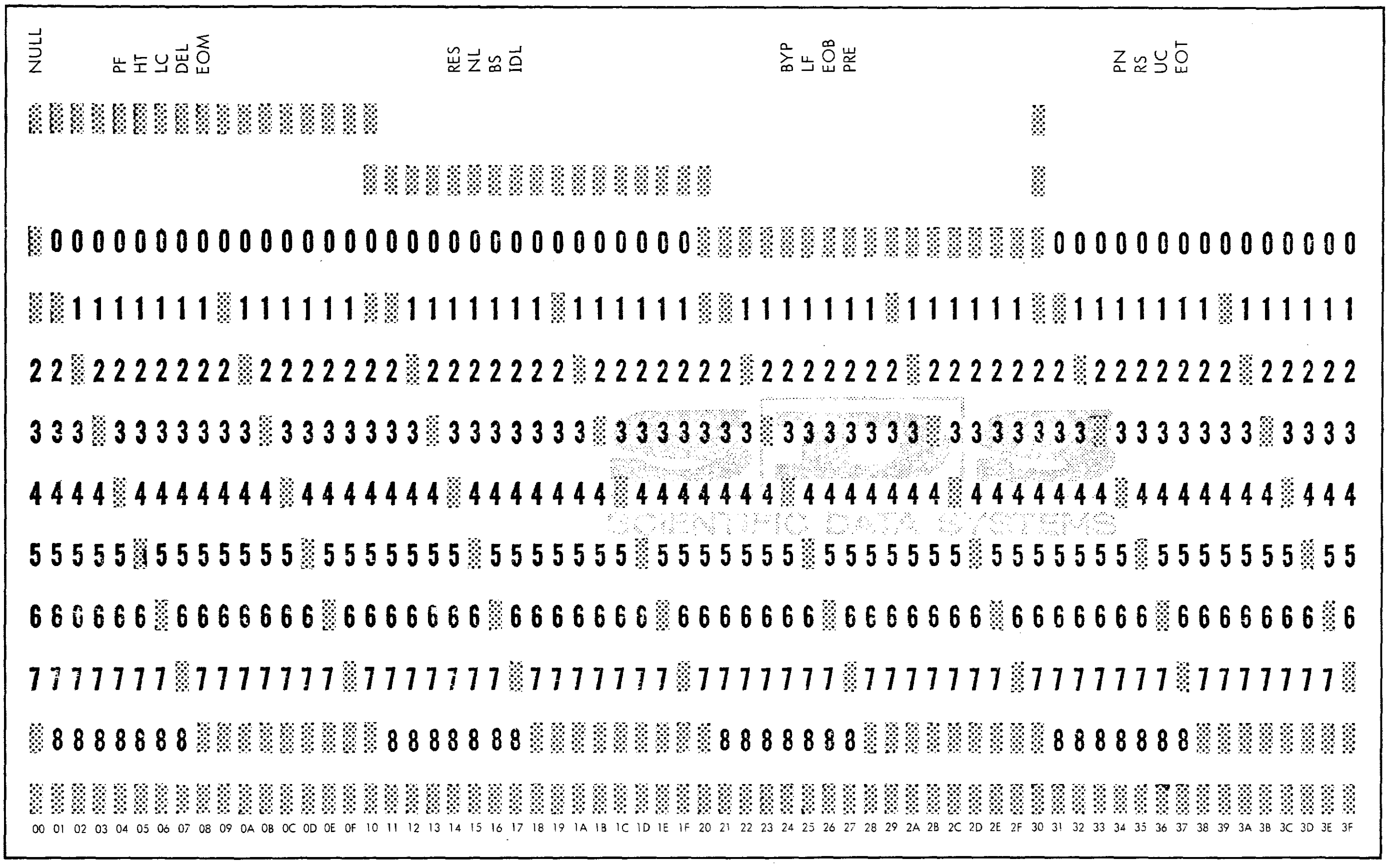
Step 1 of the following procedure is required only if the controlling system does not feed a blank card at the completion of punching the card file (to verify and place the last card in the preselected stacker).

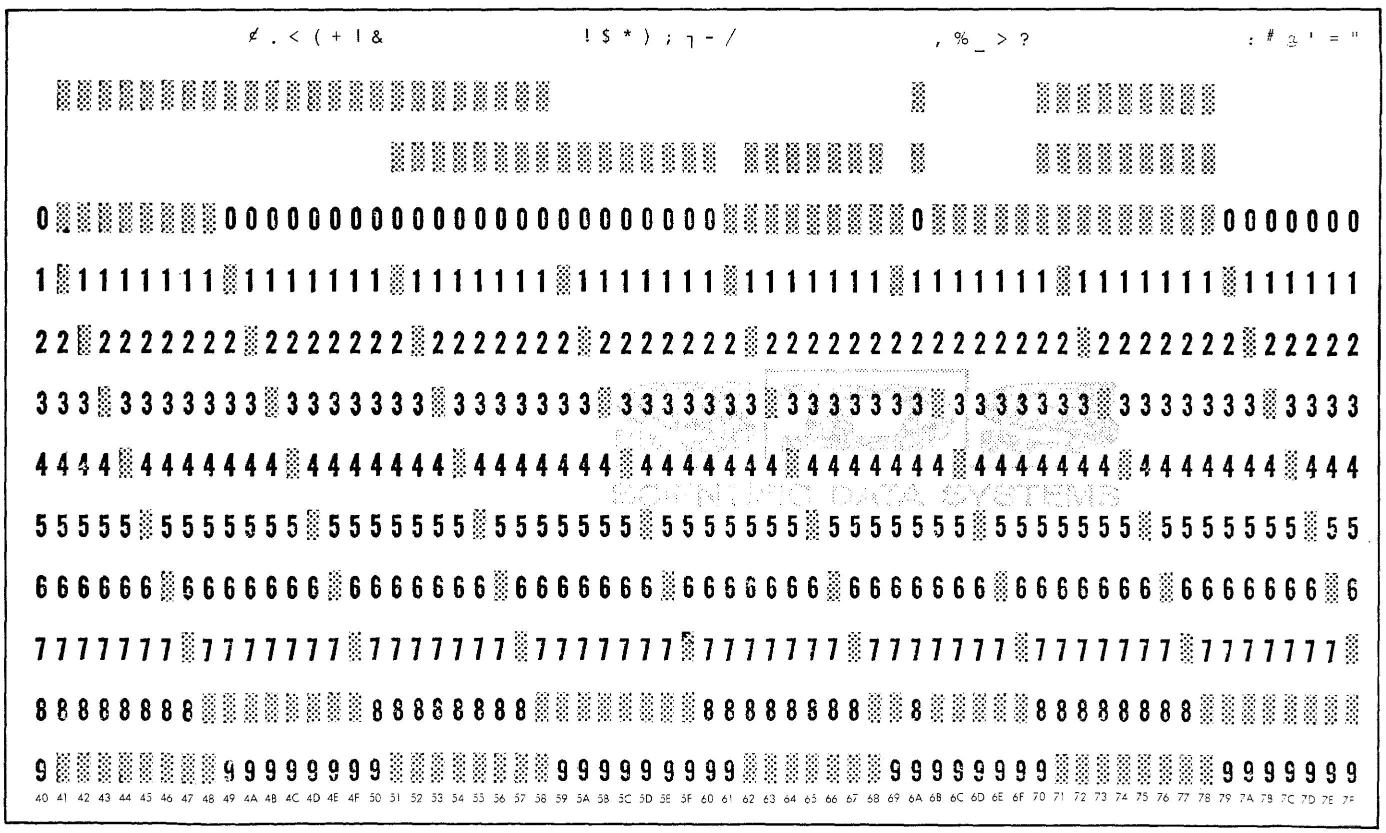
1. Press the STOP switch (to place the card punch in the "ready manual" state) and then press the MANUAL FEED switch (to feed the card at the preread station into the alternate stacker).

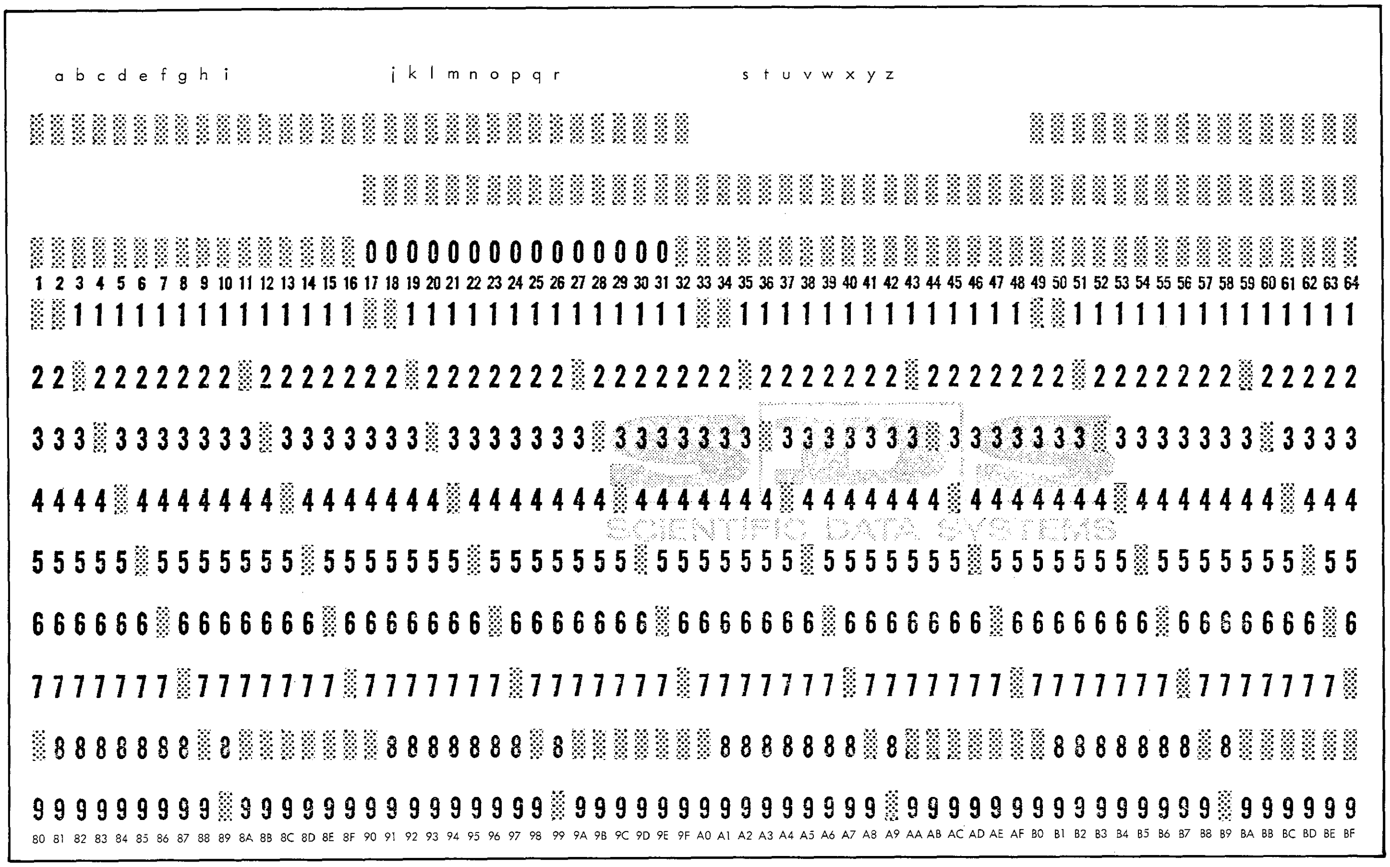
   Note: This unloading procedure does not verify the last card of the file (the card fed from the preread station to the alternate stacker).

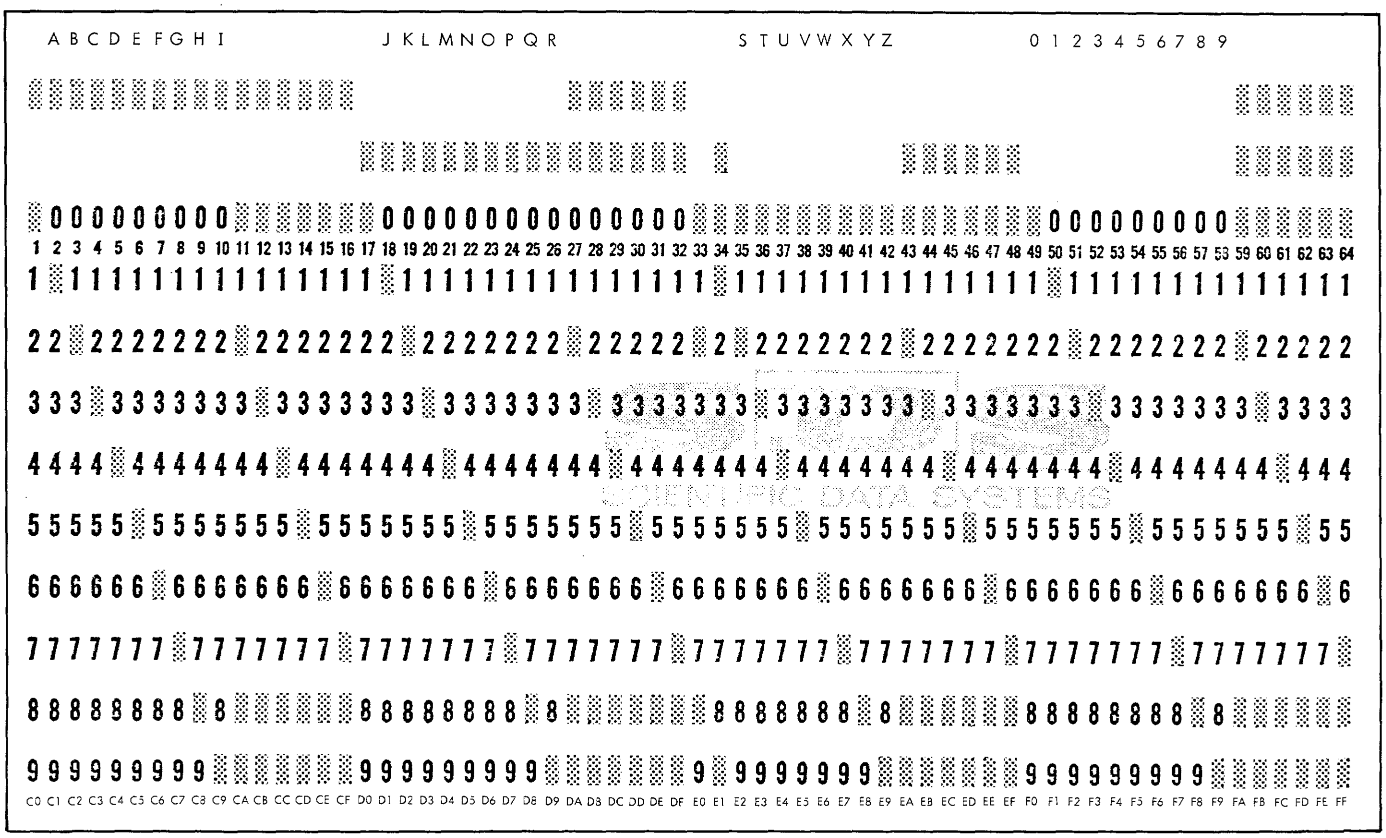
2. Remove the card file from the output stackers. The normal stacker is on the left: the alternate stacker is on the right.

APPENDIX A. SDS EBCDIC CARD CODES






a b c d e f g h i
j k l m n o p q r
s t u v w x y z
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64
SCIENTIFIC DATA SYSTEMS
80 81 82 83 84 85 86 87 88 89 8A 8B 8C 8D 8E 8F 90 91 92 93 94 95 96 97 98 99 9A 9B 9C 9D 9E 9F A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 AA AB AC AD AE AF B0 B1 B2 B3 B4 B5 B6 B7 B8 B9 BA BB BC BD BE BF


A B C D E F G H I
J K L M N O P Q R
S T U V W X Y Z
0 1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64
SCIENTIFIC DATA SYSTEMS
C0 C1 C2 C3 C4 C5 C6 C7 C8 C9 CA CB CC CD CE CF D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 DA DB DC DD DE DF E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 EA EB EC ED EE EF F0 F1 F2 F3 F4 F5 F6 F7 F8 F9 FA FB FC FD FE FF

APPENDIX B. SIGMA 7 CARD PUNCH PROGRAM

The following partial program is intended to illustrate the use of the I/O instructions and the card punch responses to these instructions. The program is coded as a nonrecursive routine that punches one card in the EBCDIC mode and punches one card in the binary mode. The program does not use the interrupt system, but does exit to another routine (not shown) that deals with specific error conditions. Also, the program uses command chaining and assumes that the card punch is in the "ready automatic" state when the SIO instruction is executed.

Label	Command	Argument	Comments
PNCARD	LI, 0	DA(IOCD1)	Load general register 0 with the doubleword address of the I/O control doubleword for the punch card operation.
STARTIO	SIO, 10	4	This instruction starts the card punch (device 4 on IOP 0).
TESTIO	TIO, 10	4	This instruction obtains the I/O system and card punch status response.
	LW, 10	BZTEST	This instruction loads register 10 with a "busy" test constant.
	CS, 10	BZTEST	This instruction compares the I/O status response in register 11 with the "busy" test constant.
	BCR, 3	TESTIO	This instruction causes a branch back to the TIO instruction if the card punch is still "busy".
	CW, 11	ERRCHK	This instruction compares the I/O status response in register 11 with an error check constant.
	BCS, 4	ERROR	This instruction causes a branch to a routine that determines the reason for the error condition.
	BCR, 0	DONE	This instruction causes a branch to another part of the program.
BZTEST	DATA	X'60000000'	This assembler directive defines the "busy" test constant.
ERRCHK	DATA	X'23FE0000'	This assembler directive defines the error check constant.
	BOUND	8	This assembler directive establishes a doubleword boundary.
IOCD1	GEN 8, 24 GEN 8, 24	X'0D', BA(EBCDIC) X'24', 80	These two assembler directives define the first I/O command doubleword for the card punch operation. The command doubleword specifies: EBCDIC punch, normal stacker, stack on error in the alternate stacker, punch card image from area EBCDIC, command chain, halt on transmission error, and a byte count of 80.
	GEN 8, 24 DATA	X'08', DA(IOCD1) 0	The second command doubleword specifies a Transfer in Channel (TIC) to the first command doubleword, causing the card image to be presented to the card punch 12 times. Upon completion of the twelfth transmission, the IOP automatically skips the TIC command doubleword.
IOCD3	GEN 8, 24 GEN 8, 24	X'09', BA(BINARY) X'24', 120	These two assembler directives define the third I/O command doubleword for the card punch operation. The command doubleword specifies: binary punch, normal stacker, stack on error in the alternate stacker, punch card image from area BINARY, command chain, halt on transmission error, and a byte count of 120.
	GEN 8, 24 DATA	X'08', DA(IOCD3) 0	The fourth command doubleword specifies a TIC to the third command doubleword, causing the card image to be presented to the card punch 12 times. Upon completion of the twelfth transmission, the IOP automatically skips the TIC.
	DATA DATA	0 0	These two assembler directives define a Stop command doubleword, causing the IOP to transmit a Stop order to the card punch as the final command of the command chain.
EBCDIC	RES	20	This assembler directive reserves 20 words (80 byte locations) for storage of the EBCDIC card image.
BINARY	RES	30	This assembler directive reserves 30 words (120 byte locations) for storage of the binary card image.