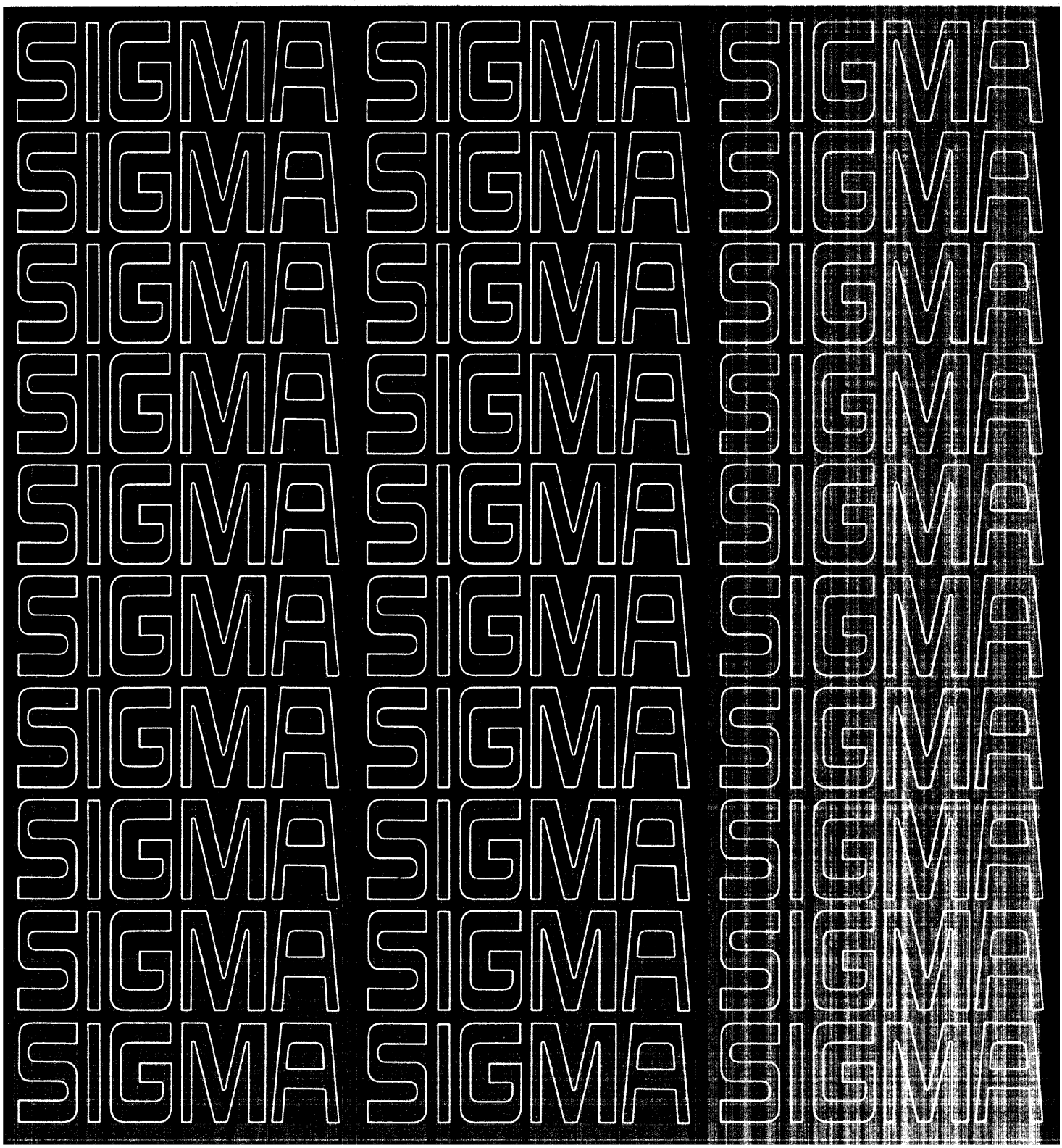
SDS SIGMA CARD READERS
MODELS 7120 / 7122 / 7140

Reference Manual

SCIENTIFIC DATA SYSTEMS



CARD READER ORDER CODES

Code (Hexadecimal)	Function	Stacking Action[†] Model 7120	Model 7140
02	Read Binary	Normal stacker	Normal stacker
06	Read Automatic	Normal stacker	Normal stacker
12	Read Binary	Alternate stacker 1	Alternate stacker
16	Read Automatic	Alternate stacker 1	Alternate stacker
32	Read Binary	Alternate stacker 2	Normal stacker
36	Read Automatic	Alternate stacker 2	Normal stacker
0A	Read Binary	If no data overrun occurs, stack card in normal stacker; if data overrun occurs, stack card in alternate stacker 2.	If no data overrun occurs, stack card in normal stacker; if data overrun occurs, stack card in alternate stacker.
0E	Read Automatic	If neither data overrun nor validity error occurs, stack card in normal stacker; if data overrun or validity error occurs, stack card in alternate stacker 2.	If neither data overrun nor validity error occurs, stack card in normal stacker; if data overrun or validity error occurs, stack card in alternate stacker.
1A	Read Binary	If no data overrun occurs, stack card in alternate stacker 1; if data overrun occurs, stack card in alternate stacker 2.	If no data overrun occurs, stack card in normal stacker; if data overrun occurs, stack card in alternate stacker.
1E	Read Automatic	If neither data overrun nor validity error occurs, stack card in alternate stacker 1; if data overrun or validity error occurs, stack card in alternate stacker 2.	If neither data overrun nor validity error occurs, stack card in normal stacker; if data overrun or validity error occurs, stack card in alternate stacker.
3A	Read Binary	Alternate stacker 2	Normal stacker
3E	Read Automatic	Alternate stacker 2	Normal stacker

[†]Model 7122 accepts all the above order codes but offers no alternative stacking since it has one stacker.

Price: $1.00

CARD READERS

MODELS 7120/7122/7140

REFERENCE MANUAL

for

SDS SIGMA COMPUTERS

90 09 70C

March 1968

SDS

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

©1966, 1967, 1968, Scientific Data Systems, Inc.

Printed in U.S.A.

REVISION

This publication, 90 09 70C, is a revision of the SDS Sigma Card Reader Reference Manual, 90 09 70B (dated February 1967). Information on two new card readers, Model 7122 (400 cpm) and Model 7140 (1500 cpm), is included in this revised edition.

A change in text from that in the previous manual is indicated by a vertical line in the margin of the affected page.

RELATED PUBLICATIONS

Title	Publication No.
SDS Sigma 7 Computer Reference Manual	90 09 50
SDS Sigma 5 Computer Reference Manual	90 09 59
SDS Sigma 2 Computer Reference Manual	90 09 64
SDS Sigma 5/7 Symbol and Meta-Symbol Reference Manual	90 09 52
SDS Sigma 2 Symbol Reference Manual	90 10 51

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

CONTENTS

1. GENERAL DESCRIPTION 1

Introduction 1

2. FUNCTIONAL DESCRIPTION 2

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

3. PROGRAM INTERFACE 5

Read Orders 5
Read Card Binary 5
Read Card Automatic 6
Key Events 6
Start Input/Output 6
Unusual End Conditions 6
Channel End Conditions 6
Error Conditions 7
Incorrect Length 7
Invalid EBCDIC Punches 7
Data Overrun 7
Not Operational Conditions 7
Card Reader Status Response 7
I/O Instruction Status Bits 7
Device Status Byte 7
Status Response for SIO, TIO, and HIO 7
Status Response for TDV and AIO 9
Operational Status Byte 9
Incorrect Length 9
Transmission Data Error 9
Channel End 9
Unusual End 9
Programming Considerations 9
Sequence of Activity 9
Timing Information 9

4. OPERATIONS 14

Introduction 14
Operator Controls (Model 7120) 14
OPER'L/POWER 14
START 14
FAULT/RESET 14
STOP 14
Operator Controls (Models 7122/7140) 14
POWER 14
START 14

4. OPERATIONS (cont.)

STOP 15
FEED/READ 15
RESET 15
HOPPER/STACKER 15
Card File Loading Procedure (Model 7120) 15
Card File Unloading Procedure (Model 7120) 16
Card File Loading Procedure (Model 7122) 16
Reader Halted 16
Reader Running 16
Card File Unloading Procedure (Model 7122) 17
Reader Halted 17
Reader Running 17
Card File Loading Procedure (Model 7140) 17
Reader Halted 17
Reader Running 17
Card File Unloading Procedure (Model 7140) 17
Reader Halted 17
Reader Running 17

APPENDIXES

A. SDS EBCDIC CARD CODES 18

B. PROGRAMMING EXAMPLES 20

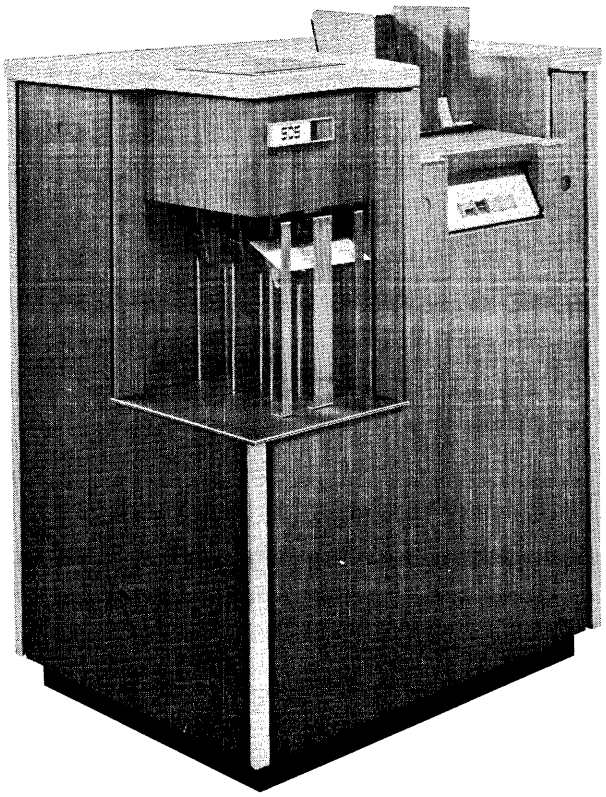
Sigma 5/7 Programming Example 20
Sigma 2 Programming Example 21

ILLUSTRATIONS

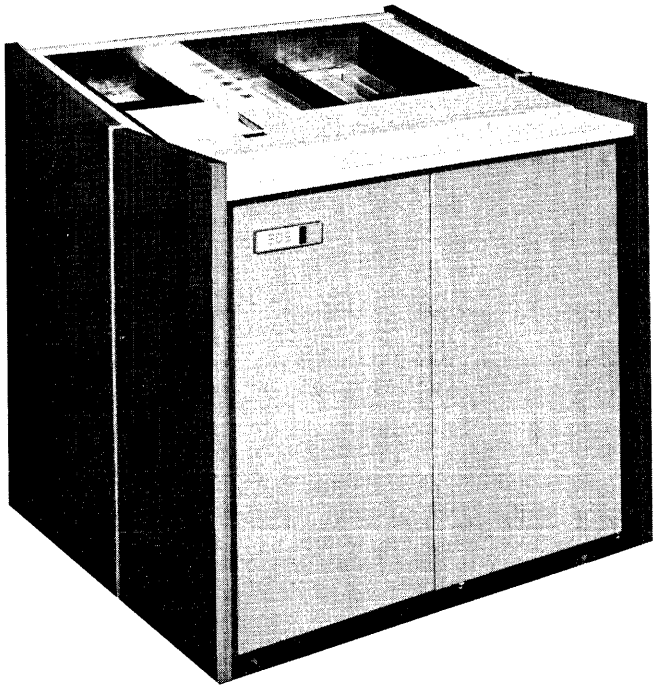
1. EBCDIC Read Operation 2
2. Binary Read Operation 2
3. Controlling System/Card Reader Actions 10
4. Card Reader Event Times (Model 7120) 11
5. Card Reader Event Times (Model 7122) 12
6. Card Reader Event Times (Model 7140) 13
7. Model 7120 Card Reader Control Panel 14
8. Model 7122 Card Reader Control Panel 14
9. Model 7140 Card Reader Control Panel 15
10. Model 7120 Input Hopper 16
11. Model 7120 Multiple Output Stackers 16
12. Model 7122 Input Hopper and Output Stacker 16
13. Model 7140 Input Hopper and Output Stackers 17

TABLES

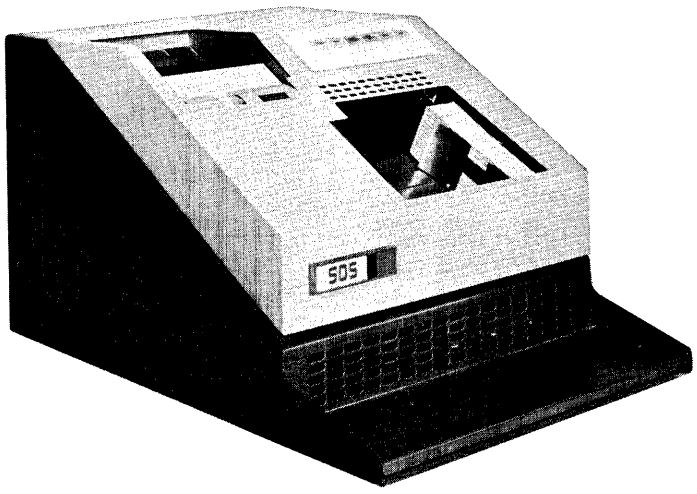
1. Specifications 1
2. Card Reader State Transitions 4
3. Binary Mode Stacking Action 5
4. Automatic Mode Stacking Action 6
5. Card Reader I/O Instruction Execution Response 8



Model 7120 Card Reader



Model 7140 Card Reader



Model 7122 Card Reader

1. GENERAL DESCRIPTION

INTRODUCTION

SDS Models 7120/7122/7140 Card Readers are capable of reading standard 80-column tabulating cards conforming to the Electronic Industries Association (EIA) punched card standard RS-292.

Cards are read serially, column by column, in either of two read modes: binary (absolute) or automatic (EBCDIC). Automatic read mode switching, from EBCDIC to binary, facilitates reading of intermixed EBCDIC- and binary-punched cards.

The photoelectric read station reads each 12-bit column of an 80-column card. The data thus sensed are presented to the controlling system as a series of 8-bit bytes.

Transport check and read check facilities provide for detection of "not operational" conditions by the controlling system. Empty input hopper and full output stacker conditions are also signaled to the controlling system.

Table 1. Specifications

Operating Characteristics			
	Model 7120	Model 7122	Model 7140
Reading speed	400 cards/minute	400 cards/minute	1500 cards/minute
Hopper capacity	1200 cards	1200 cards	2500 cards
Stacker capacity	1000 cards/stacker	1000 cards	2000 cards/stacker
Number of stackers	3	1	2
Physical Dimensions			
Height	42 in.	17 in.	40 in.
Width	32 in.	21 in.	37.5 in.
Depth	25 in.	31.5 in.	33 in.
Weight (approximately)	450 lb	200 lb	350 lb
Recommended access area	3 ft on all sides	3 ft on all sides	3 ft on all sides
Environmental Characteristics			
Power Requirements	120 vac ± 10%, 60 Hz† ± 3 Hz, 2 amps	120 vac ± 10%, 60 Hz† ± 3 Hz, 8 amps	120 vac ± 10%, 60 Hz† ± 3 Hz, 16 amps
Operating temperature	50°F to 90°F	50°F to 95°F	50°F to 95°F
Operating humidity	20% to 80%	20% to 80%	20% to 80%

†50 Hz option available

2. FUNCTIONAL DESCRIPTION

DATA REPRESENTATION

A single 80-column card can contain data in either of two formats: EBCDIC or binary.

EBCDIC CARD FORMAT

In the EBCDIC card format there are 256 valid punch configurations for a single card column (see Appendix A), each of which is translated into an 8-bit code in the range $0\text{-}255_{10}$ (00_{16}-FF_{16}). Thus, the EBCDIC card image (i.e., the 80 columns of punch configurations) consists of a translated string of 8-bit bytes, with the first byte of the string corresponding to the configuration punched in column 1 and the last byte of the translated string corresponding to column 80. The card image is always presented to the controlling system in column order.

Figure 1 illustrates how the first two columns of an EBCDIC card image are presented to the controlling system. Note that column 2 contains an invalid EBCDIC punch configuration, which is translated as 8 zeros and which causes a transmission data error condition (see "Error Conditions" in Chapter 3). If column 1 of a card contains punches in rows 1 and 2, the entire card is interpreted as a binary card image rather than an EBCDIC image (see "Read Orders" in Chapter 3).

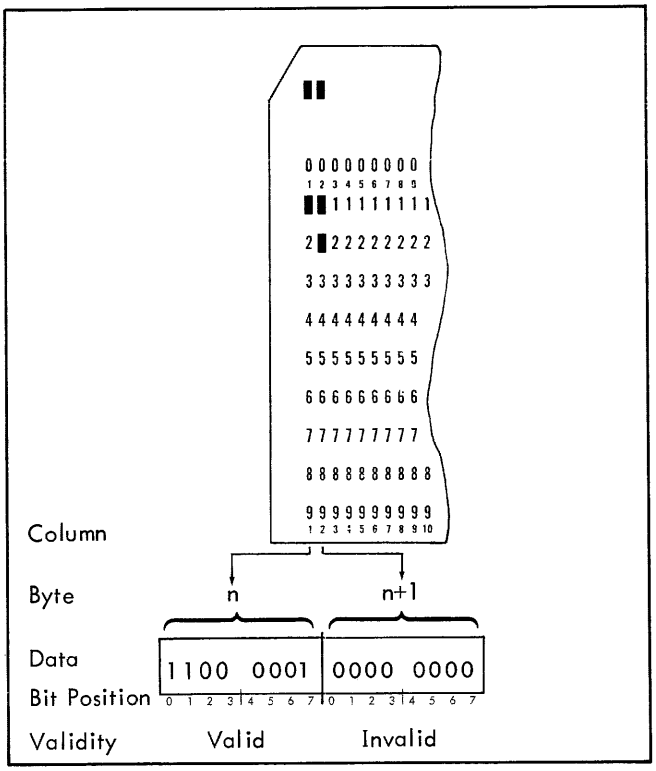


Figure 1. EBCDIC Read Operation

BINARY CARD FORMAT

In the binary card format there are 4096 possible punch configurations for a single card column, and all configurations are valid. In this format each card column corresponds to a 12-bit code in the range 0-4095 (000_{16}-FFF_{16}), with each row punch corresponding to a 1 in the 12-bit code. Thus, the binary card image consists of a string of 80 12-bit codes, with the first code corresponding to the actual punch configuration in column 1 and the last code corresponding to the actual punch configuration in column 80. Because Sigma I/O systems use an 8-bit byte as the basic data grouping, the 80 12-bit codes are presented to the controlling system as 120 8-bit bytes.

Figure 2 illustrates how the first two columns of a binary card image are presented to the controlling system. Note that for odd-numbered columns, the data in rows 12 through 5 comprise one byte and that the data in rows 6 through 9 are combined with the data in rows 12 through 1 of the next even-numbered column to form a second byte. A third byte is formed from the data in rows 2 through 9 of the even-numbered column. Thus, for each odd- even-numbered pair of binary card columns, the controlling system receives a sequence of three 8-bit bytes.

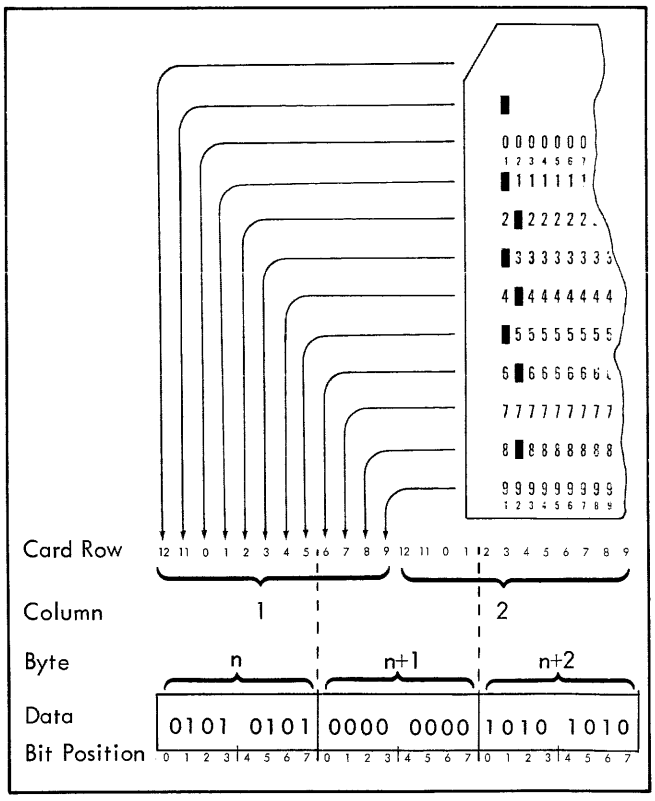


Figure 2. Binary Read Operation

The binary card image is always presented to the controlling system in column order and in the byte sequence described above.

CARD READER STATES

The initial state of the card reader depends on its power status. The complete absence of power to the card reader subsystem (that is, the absence of its prime ac power and system dc power) effectively removes the card reader from the controlling system. All attempts to access the card reader result in a response of "no input/output address recognition" to the I/O instructions. Furthermore, unpredictable status conditions are supplied if status response 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 reader assumes a "not operational" state. Likewise, failure of power supplies internal to the card reader causes the card reader to assume a "not operational" state.

OPERATIONAL STATES

The presence of ac and dc power, with no read station fault or transport mechanism fault, enables the card reader to assume either of two device conditions ("ready" or "busy") and either of two modes ("manual" or "automatic"). A read station fault exists if one or more of the photoelectric channels for sensing punches in the card rows have failed to pass the read station test in the previous card read operation. A transport mechanism fault exists if a card jam exists in any portion of the card transport area.

The exact condition and mode status of the card reader at any given time is returned to the controlling system 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 reader's status (see "Status Response" in Chapter 3). A brief explanation of the possible conditions and modes of the card reader follows.

CONDITIONS

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

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

MODES

Manual. The card reader assumes the "manual" mode when any condition arises requiring operator intervention before the reader can function normally (e.g., stacker full, hopper empty, etc.). The "manual" mode is forced by the operator pressing the STOP switch or RESET switch on the card reader control panel. The reader 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 reader operation are present, the reader is placed in the "automatic" mode by the operator pressing the START switch on the card reader control panel (thus illuminating the switch).

TRANSITION BETWEEN STATES

The allowable card reader state transitions and the conditions causing the reader to change from one state to another are summarized in Table 2.

DATA TRANSFER

A card read operation is initiated by the controlling system with a START INPUT/OUTPUT (SIO) instruction if all the following conditions are satisfied:

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

If the card reader is in the "automatic" mode, it then requests an order from the controlling system. After accepting a read order, the card reader advances a card from the input hopper to the read station, and commences to read the card, column by column, beginning with column 1. If reading is performed in the EBCDIC mode, one 8-bit byte is transmitted to the controlling system for each column read, and a code validity check is performed on each byte. In the binary read mode three 8-bit bytes are transmitted to the controlling system for each odd-even-numbered pair of columns (no validity check is performed in this mode). Reading continues until one of the following conditions occurs:

1. the end of the card is detected
2. the card reader receives a "count done" or "halt" signal from the controlling system
3. a fault condition is encountered

If the card read operation was not terminated by a card jam, the card is then routed to the stacker station, where it is sensed and directed to the normal stacker unless:

1. The Read Automatic order specified error stacking and the validity check (for EBCDIC mode only) indicated that the card contained an invalid EBCDIC punch configuration, in which case the card is directed to alternate stacker 2 (Model 7120) or to the alternate stacker (Model 7140).
2. The read order specified error stacking and a data overrun has occurred, in which case the card is directed to alternate stacker 2 (Model 7120) or the alternate stacker (Model 7140) and the controlling system is notified of the error with the Data Overrun and Unusual End indicators.

3. The read order selected an alternate stacker unconditionally for this card, in which case the card is directed to the selected stacker.[t]

The photoelectric circuitry is automatically checked at the beginning of each card read cycle. If this check indicates a malfunction, the card reader switches to the "not operational" state, lights the FAULT (Model 7120) or READ (Models 7122/7140) indicator, and signals "unusual end" to the controlling system.

If no fault or other condition caused the card reader to switch to the "not operational" state or the "manual" mode, the card reader either returns to the "ready" condition or (if command chaining has been specified by the controlling system) requests a new read order to read the next card. Note that each read card cycle requires a read order.

[t]For Model 7120, alternate stacker 1 or 2; for Model 7140, alternate stacker or normal stacker.

Table 2. Card Reader State Transitions

Present State \ Next State	Ready Manual	Busy Manual	Ready Automatic	Busy Automatic
Not Operational	Operational	Not possible	Not possible	Not possible
Ready Manual	—	SIO accepted	START switch operated with no operator intervention required	Not possible
Busy Manual	• HIO received • RESET switch operated • I/O reset • Invalid order	—	Not possible	START switch operated with no operator intervention required
Ready Automatic	STOP or RESET switch operated	Not possible	—	SIO accepted
Busy Automatic	• STOP switch operated • RESET switch operated • Execution completed and no order pending and operator intervention required	STOP switch operated and card cycle completed but order pending, or operator intervention required	• Operation completed and no operator intervention required • HIO received • I/O reset • Invalid order	—

3. PROGRAM INTERFACE

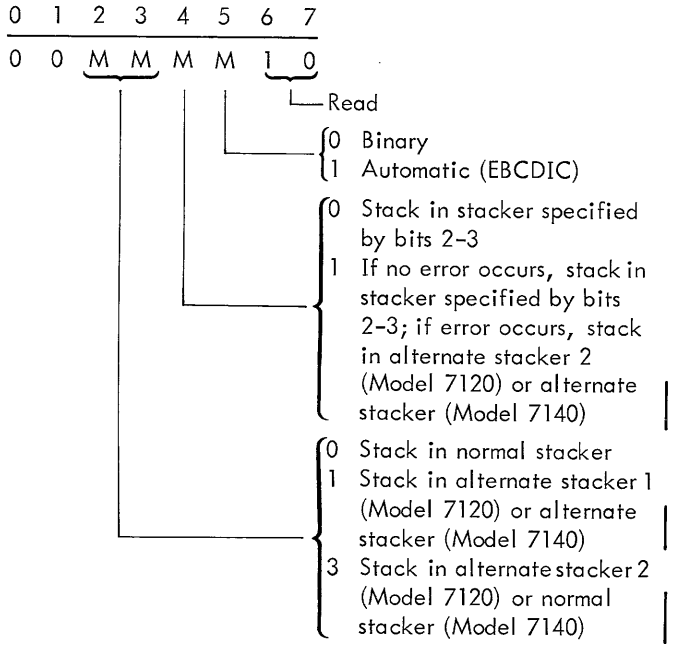
READ ORDERS

The 8-bit read order specifies the read mode (binary or automatic) and the stacker in which the card will be stacked upon completion of the read operation. The specified read mode applies to the entire card image—columns 1 through 80. Read modes may not be changed after the first column of a given card has been read. A change to binary read mode occurs automatically if the automatic read mode is specified and column 1 contains punches in rows 1 and 2.

Each valid order received by the card reader causes one card to be fed. Order modifiers may be included in the basic read order to specify binary or automatic read mode, stack on error condition and/or selection of multiple stackers.

Stacker select options apply to the current card being read. The card will be directed to the specified stacker unless an invalid EBCDIC punch configuration is encountered (or a data overrun occurs) and the optional stack on error modifier bit of the read order is set to 1, in which case the card will be stacked in alternate stacker 2 (Model 7120) or in the alternate stacker (Model 7140).

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



READ CARD BINARY

The orders (hexadecimal code) listed in Table 3 cause the card reader to feed and read a card in the binary mode, with the card being directed to one of the multiple stackers.

In the binary read mode, 120 bytes are present on a card. Incorrect length will be signaled to the controlling system if either fewer or more than 120 bytes are requested for a binary read card operation.

Table 3. Binary Mode Stacking Action

Order	Stacking Action[†]	
	Model 7120	Model 7140
X'02'	Stack card in normal stacker.	Stack card in normal stacker.
X'12'	Stack card in alternate stacker 1.	Stack card in alternate stacker.
X'32'	Stack card in alternate stacker 2.	Stack card in normal stacker.
X'0A'	If no data overrun occurs, stack card in normal stacker; if data overrun occurs, stack card in alternate stacker 2.	If no data overrun occurs, stack card in normal stacker; if data overrun occurs, stack card in alternate stacker.
X'1A'	If no data overrun occurs, stack card in alternate stacker 1; if data overrun occurs, stack cards in alternate stacker 2.	If no data overrun occurs, stack card in normal stacker; if data overrun occurs, stack card in alternate stacker.
X'3A'	Stack card in alternate stacker 2.	Stack card in normal stacker.

[†]Model 7122 accepts all the above order codes but offers no alternative stacking since it has only one stacker.

Table 4. Automatic Mode Stacking Action

Order	Stacking Action[t]	
	Model 7120	Model 7140
X'06'	Stack card in normal stacker.	Stack card in normal stacker.
X'16'	Stack card in alternate stacker 1.	Stack card in alternate stacker.
X'36'	Stack card in alternate stacker 2.	Stack card in normal stacker.
X'0E'	If no validity error or data overrun occurs, stack card in normal stacker; if validity error or data overrun occurs, stack card in alternate stacker 2.	If no validity error or data overrun occurs, stack card in normal stacker; if validity error or data overrun occurs, stack card in alternate stacker.
X'1E'	If no validity error or data overrun occurs, stack card in alternate stacker 1; if validity error or data overrun occurs, stack card in alternate stacker 2.	If no validity error or data overrun occurs, stack card in normal stacker; if validity error or data overrun occurs, stack card in alternate stacker.
X'3E'	Stack card in alternate stacker 2.	Stack card in normal stacker.

[t]Model 7122 accepts all the above order codes but offers no alternative stacking since it has one stacker.

READ CARD AUTOMATIC

The orders (hexadecimal code) listed in Table 4 cause the card reader to feed and read a card in the automatic mode, with the card being directed to one of the multiple stackers.

To facilitate reading of intermixed EBCDIC and binary card decks, card column 1 is sensed for the presence of punches in rows 1 and 2; if both are present, the read operation is automatically forced to the binary read mode and all data, including column 1, is transmitted as described previously under "Binary Card Format".

In the EBCDIC card format, 80 bytes are present on a card. Incorrect length will be signaled if either fewer or more than 80 bytes are requested for an EBCDIC card. However, if the binary read mode is invoked automatically, incorrect length will be signaled if either fewer or more than 120 bytes are requested.

KEY EVENTS

The key events that occur during a card read 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 read operation is initiated with the execution of a START INPUT/OUTPUT instruction by the controlling system. If I/O address recognition exists and the reader is in the "ready" condition with no interrupt pending, the controlling system sets its "I/O address recognition" and "SIO accepted" indicators. The card reader advances from the "ready" to the "busy" condition and, if the reader is in the "automatic" mode, it requests an order byte from the controlling system. Note that "SIO accepted" does not mean that the card reader has started to feed and read a card. "SIO accepted" signifies only that a device has accepted the SIO instruction and the device was in the "ready" condition with no interrupt pending.

UNUSUAL END CONDITIONS

The detection of any of the following during the "busy" condition causes the card reader to return an "unusual end" indication to the controlling system at the time the condition occurs:

1. invalid order code
2. read station malfunction
3. transport mechanism malfunction
4. absence (or failure) of ac and/or dc power in reader
5. operator pressing the RESET switch
6. the occurrence of a data overrun

CHANNEL END CONDITIONS

After receiving an order from the controlling system, the card reader signals "channel end" to the controlling system when the end of the card is encountered or an "unusual end" condition occurs, whichever occurs first.

ERROR CONDITIONS

The card reader is capable of detecting and reporting three error conditions to the controlling system: incorrect length, invalid EBCDIC punches, and data overrun.

INCORRECT LENGTH

Incorrect length is caused by the card reader encountering end of card prior to the "count done" signal from the controlling system or by the occurrence of the "count done" signal prior to reading column 80 of the card. Thus, exactly 120 bytes must be requested for the binary read mode and exactly 80 bytes must be requested for the EBCDIC read mode; otherwise, an incorrect length condition will be signaled to the controlling system. However, the card is always directed to the stacker specified by bits 2 and 3 of the read order.

INVALID EBCDIC PUNCHES

When the card reader has received a Read Automatic order and column 1 of the card does not have punches in rows 1 and 2, any punch configuration (including column 1) that cannot be converted into 8-bit EBCDIC (i.e., more than one punch in rows 1-7) is considered invalid. Detecting an invalid EBCDIC punch configuration causes the card reader to generate 8 zeros as the data for the invalid column and to request the controlling system to check parity, in which case the controlling system sets its Transmission Data Error indicator to 1. (Sigma 2 indicates validity errors by setting the parity error (E) flag in the odd channel register, not the transmission data error (TE) flag in the even channel register.) If the Read Automatic order specified error stacking, an invalid EBCDIC punch configuration causes the card to be directed to alternate stacker 2 (Model 7120) or the alternate stacker (Model 7140).

DATA OVERRUN

A data overrun (rate error) is defined as failure of the controlling system to service the card reader at the required data transfer rate. If the read order specified error stacking, a data overrun causes the card to be directed to alternate stacker 2 (Model 7120) or the alternate stacker (Model 7140).

NOT OPERATIONAL CONDITIONS

A "not operational" condition, generally, is any condition that causes a peripheral device to switch to the "not operational" state. For the card reader, any of the following fault conditions (singly or in combination) may occur during a card read cycle:

1. read station malfunction
2. transport mechanism malfunction (i.e., card jam)
3. absence (or failure) of ac and/or dc power in the reader

CARD READER STATUS RESPONSE

The card reader system is capable of returning various status flags in response to computer-executed I/O instructions. Detailed explanations of the input/output instruction to request status of the card reader 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 reader.

I/O INSTRUCTION STATUS BITS

The execution of an I/O instruction by the controlling system provides 2 bits of immediate information pertaining to the general status of the addressed I/O device and its controller. This information is retained by the controlling system in a form that allows for conditional branching based on the response to the I/O instruction. Table 5 lists the I/O instructions, the possible status bit settings provided by each I/O instruction, and the significance of each setting.

DEVICE STATUS BYTE

The following eight bits of information in the Device Status Byte are made available to the computer 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, and interrupt call is pending (issued but not yet acknowledged by an AIO instruction). The card reader will continue to transmit data (if specified) until the end of the card is encountered, but it will not accept an SIO until the interrupt is cleared. Command chaining, if specified, will initiate a new read card cycle even though an interrupt may be pending. The interrupt may be cleared by executing an AIO or HIO instruction or by manual intervention (I/O reset signal from the controlling system control panel).

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

Flags	Condition
00	Card Reader Ready—the card reader is capable of accepting an SIO instruction if no interrupt is pending.
01	Card Reader Not Operational—manual intervention is required to clear the "not operational" condition.
10	Device Unavailable—this condition is not applicable to the card reader system.
11	Card Reader Busy—the card reader has accepted an SIO instruction or is currently executing a previous order.

Table 5. Card Reader I/O Instruction Execution Response

Instruction	Code				IOP Type			Address/ Interrupt Recognition	Operation Accepted	Status Returned To CPU Registers	Significance
	CC-1 (Σ5/7)	Overflow (Σ2)	CC-2 (Σ5/7)	Carry (Σ2)	Multiplexor	Integral	Selector				
SIO	0		0		Yes	Yes	Yes	Yes	Yes	Yes	Device was "ready", now "busy".
	0		1		Yes	Yes	Yes	Yes	No	Yes	Device was "not ready".
	1		0		No	No	Yes	Yes	No	No	Selector IOP was "busy".
	1		1		Yes	Yes	Yes	No	No	No	I/O address not recognized.
HIO	0		0		Yes	Yes	Yes	Yes	Yes	Yes	Device (and selector IOP) was "not busy".
	0		1		Yes	Yes	Yes	Yes	Yes	Yes	Device (and/or selector IOP) was "busy".
	1		0		No	No	No	No	No	No	Invalid code.
	1		1		Yes	Yes	Yes	No	No	No	I/O address not recognized.
TIO	0		0		Yes	Yes	Yes	Yes	Yes	Yes	Device is "ready".
	0		1		Yes	Yes	Yes	Yes	Yes	Yes	Device is "not ready".
	1		0		No	No	Yes	Yes	No	No	Selector IOP is "busy".
	1		1		Yes	Yes	Yes	No	No	No	I/O address not recognized.
TDV	0		0		Yes	Yes	Yes	Yes	Yes	Yes	Normal response.
	0		1		No	No	No	No	No	No	Invalid code.
	1		0		No	No	Yes	Yes	No	No	Selector IOP is "busy".
	1		1		Yes	Yes	Yes	No	No	No	I/O address not recognized.
AIO	0		0		Yes	Yes	Yes	Yes	Yes	Yes	Normal interrupt recognition.
	0		1		Yes	Yes	Yes	Yes	Yes	Yes	Abnormal interrupt recognition.
	1		0		No	No	No	No	No	No	Invalid code.
	1		1		Yes	Yes	Yes	No	No	No	No interrupt recognition.

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

Bit 4: Device Unusual End. This bit is set to 1 if execution of the previous read order was terminated due to an abnormal condition, as listed under "Unusual End Conditions". (Sigma 2 does not signal "unusual end" when an invalid EBCDIC punch configuration is detected.)

Bits 5-6: Device Controller Condition. These bits have the same configuration as bits 1-2.

Bit 7: Unassigned. This status bit is currently unassigned and is always reset to 0.

STATUS RESPONSE FOR TDV AND AIO

Bit 0: Data Overrun. If this bit is a 1, a data overrun has occurred since the previous read order was received by the card reader.

Bits 1-7: Unassigned. These seven bits are currently unassigned and are always reset to zeros.

OPERATIONAL STATUS BYTE

In addition to the information contained in the Device Status Byte, the following indicators are made available to the controlling system in the Operational Status Byte.

INCORRECT LENGTH

If this flag is a 1, an incorrect length condition has occurred since the previous read order was received by the card reader.

TRANSMISSION DATA ERROR

If this flag is a 1, an invalid EBCDIC punch configuration was encountered during an automatic read operation (and/or a data overrun has occurred) since the previous read order was received by the card reader. (Sigma 2 indicates an invalid EBCDIC punch configuration by setting the parity error (E) flag in the odd channel register, not the transmission data error (TE) flag in the even channel register.)

CHANNEL END

If this flag is a 1, the card reader has terminated its operation for any of the reasons listed under "Channel End Conditions".

UNUSUAL END

If this flag is a 1, the card reader has terminated its operation for any of the reasons listed under "Unusual End Conditions". (Sigma 2 does not signal "unusual end" when an invalid EBCDIC punch configuration is detected.)

PROGRAMMING CONSIDERATIONS

SEQUENCE OF ACTIVITY

Figure 3 illustrates the sequential relationship of the key events that occur during a read card operation.

TIMING INFORMATION

Figures 4, 5, and 6 illustrate the time-dependent events occurring during a read operation for the respective models.

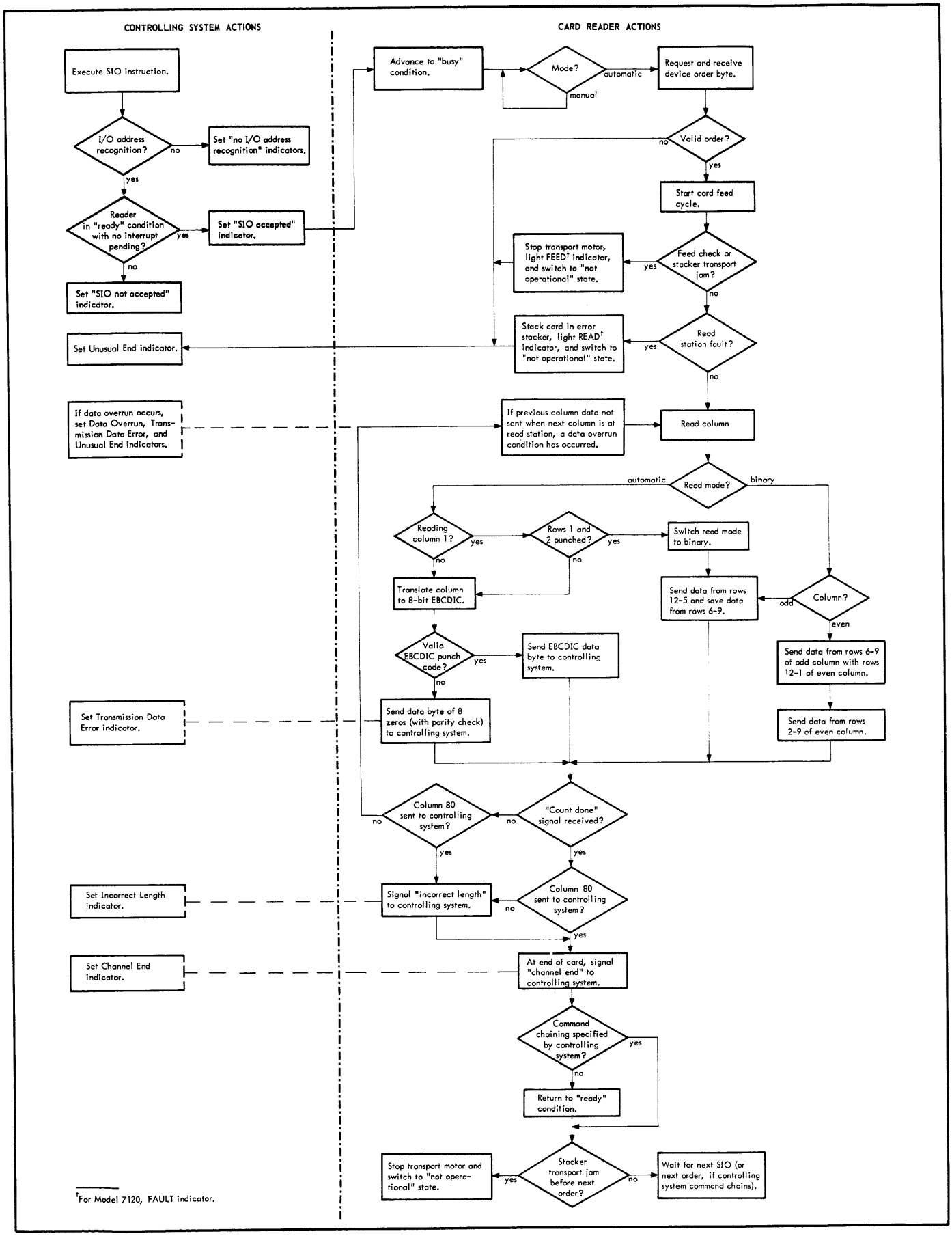
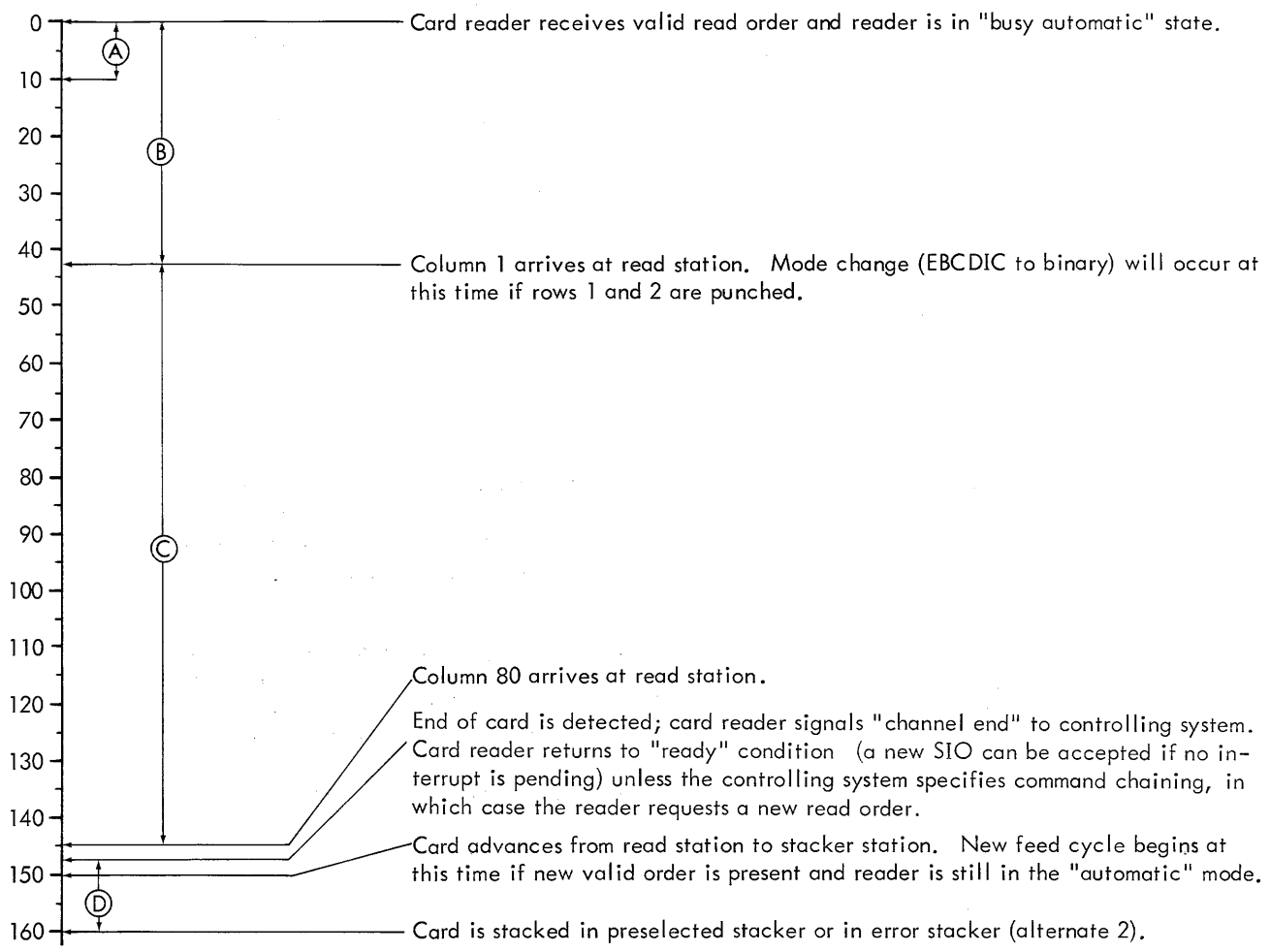


Figure 3. Controlling System/Card Reader Actions

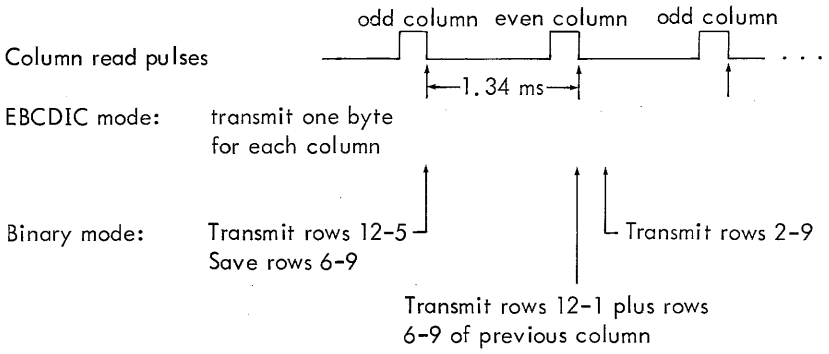


Notes

Ⓐ If the feed cycle begins while the previous card is being stacked, a stacker transport jam occurring in this time interval causes the reader to stop the transport motor, switch to "not operational", light the FAULT indicator, and signal "unusual end" to the controlling system.

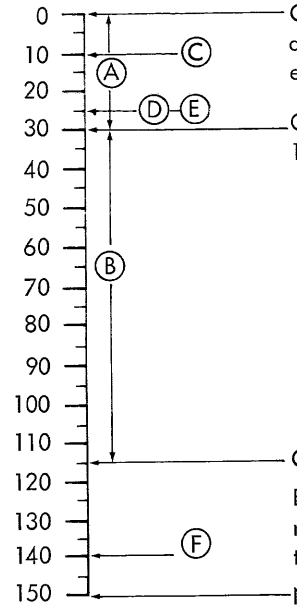
Ⓑ Feed cycle (approximately 43 milliseconds).

Ⓒ The data bytes are transmitted, with respect to the column read time (approximately 1.34 milliseconds), as follows:



Ⓓ If stacker jam occurs after new feed cycle begins, action during this interval is identical to note A. If stacker jam occurs before new feed cycle begins, reader turns off transport motor, switches to "not operational" state, and lights FAULT indicator ("unusual end" is not signaled in this case).

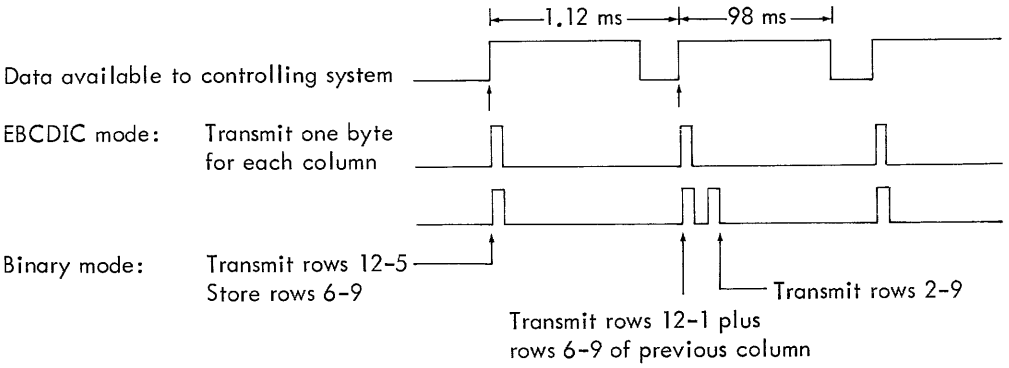
Figure 4. Card Reader Event Times (Model 7120)



Notes:

Ⓐ Feed cycle is approximately 27 ms if card feeds on first attempt, approximately 87 ms if card feeds on second attempt, and approximately 147 ms if card feeds on third attempt. If a card has not been fed after three attempts, the transport motor will halt, the reader will switch to "not operational", the FEED indicator will light, and an "unusual end" will be signaled to the controlling system.

Ⓑ The data bytes are transmitted, with respect to the column read time (approximately 1.12 ms), as shown below.



† indicates data overrun will occur at this time if data is not accepted by controlling system.

Ⓒ Throat jam detection occurs 125 ms later if card jams in throat area, causing transport motor to halt, FEED indicator to light, reader to switch to "not operational", and an "unusual end" to be signaled to controlling system.

Ⓓ Read and timing jam detection occurs 125 ms later if card jams in read and timing area. Results in same action as Ⓒ above.

Ⓔ Dark check occurs at this time. If dark check fails, the READ indicator will light, the reader will switch to "not operational", and an "unusual end" will be signaled to the controlling system.

Ⓕ Stacker jam detection occurs 125 ms later if card jams in stacker area. Results in same action as Ⓒ above.

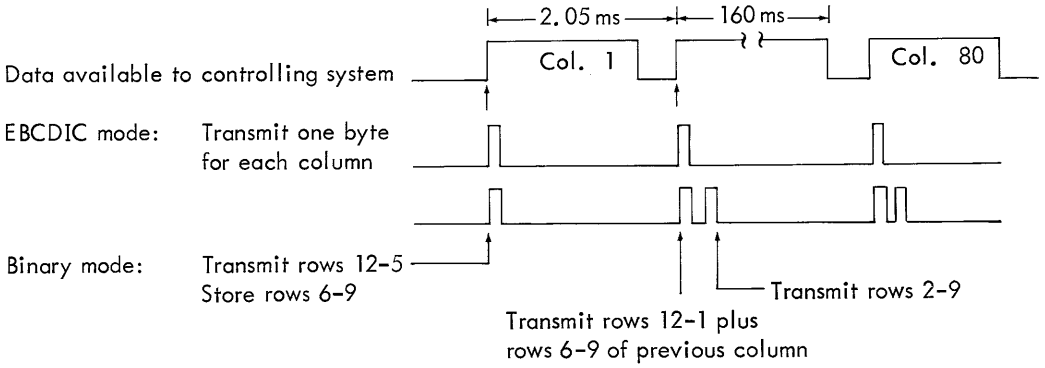
Figure 5. Card Reader Event Times (Model 7122)

Time (in milliseconds)	Event
0	Card reader receives valid read order and reader is in "busy automatic" state. Light check occurs at this time. If light check fails, the read indicator will light, the reader will switch to "not operational" and an "unusual end" will be signaled to the controlling system.
16 (A) (C)	
47 (D) (E)	
50	Column 1 arrives at read station. Mode change (EBCDIC to binary) will occur at this time if rows 1 and 2 are punched.
60	
70	
80	
90 (B)	
100	
110	
⋮	
210	Column 80 arrives at read station.
220	End of card is detected; card reader signals "channel end" to controlling system. Card reader returns to "ready" condition (a new SIO can be accepted if no interrupt is pending) unless the controlling system specifies command chaining, in which case the reader requests a new read order.
230	
240	
250 (F)	New feed cycle enabled at this time if new valid order present and reader still in "automatic" mode.

Notes:

(A) Feed cycle is usually approximately 47 ms but can be as long as 200 ms (in case of slippage or slight jam). If a card has not been fed after 200 msec, the transport motor will halt, the reader will switch to "not operational", the FEED indicator will light, and an "unusual end" will be signaled to the controlling system.

(B) The data bytes are transmitted, with respect to the column read time (approximately 2.05 ms), as shown below.



† indicates data overrun will occur at this time if data is not accepted by controlling system.

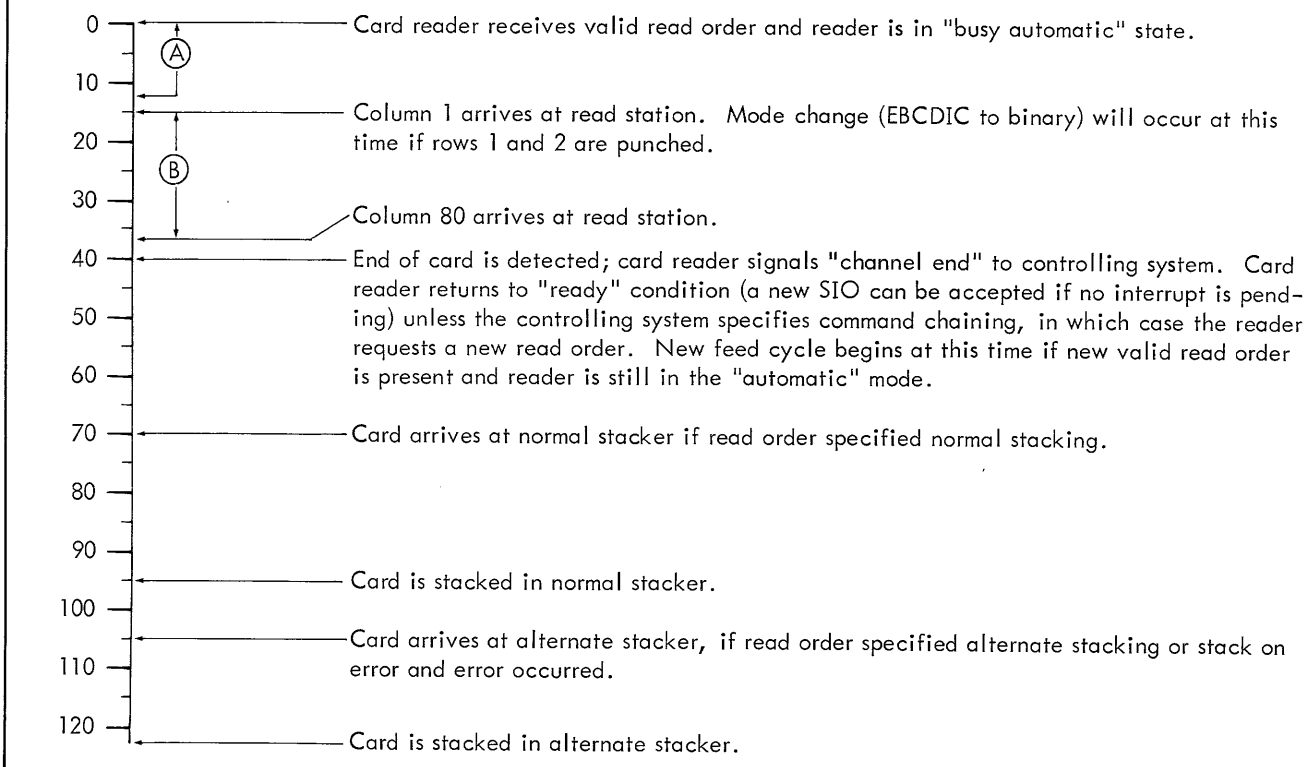
(C) Throat jam detection occurs 215 ms later if card jams in throat area, causing transport motor to halt, FEED indicator to light, reader to switch to "not operational", and an "unusual end" to be signaled to controlling system.

(D) Read and timing jam detection occurs 225 ms later if card jams in read and timing area. Results in same action as (C) above.

(E) Dark check occurs at this time. If dark check fails, the READ indicator will light, the reader will switch to "not operational", and an "unusual end" will be signaled to the controlling system.

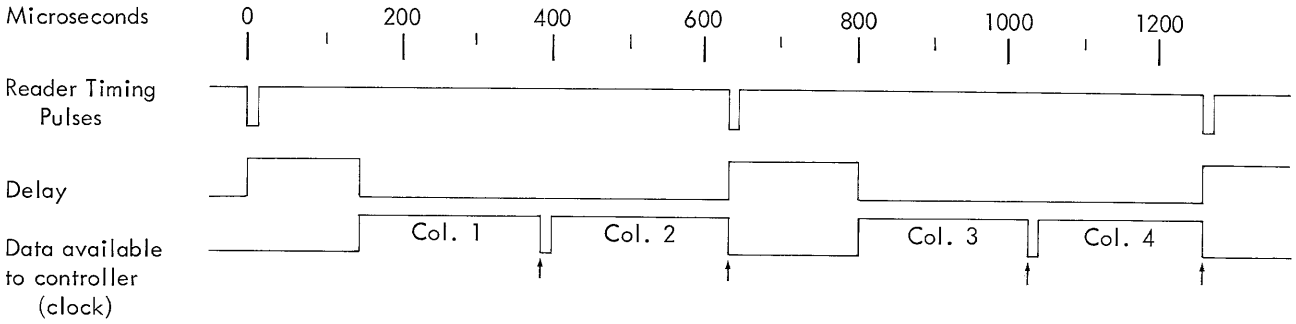
(F) Stacker jam detection occurs 215 ms later if card jams in stacker area. Results in same action as (C) above.

Figure 5-1. Card Reader Event Times (Model 7121)



Notes: (A) Card feed cycle is approximately 13 milliseconds if card is picked on first attempt (normal operation), approximately 45 milliseconds if picked on second attempt, and approximately 77 milliseconds if picked on third attempt. If a card does not reach the read station within 96 milliseconds from initiation of feed cycle, the reader will switch to "not operational", the FEED indicator will light, and the reader drive motors will turn off. "Unusual end" will be reported to the controlling system. Any other card transport error (jam) will result in the same sequence of events.

(B) The data bytes are transmitted with respect to the reader timing pulses, approximately as follows:



Successive reader timing pulses occur every 644 ± 50 microseconds. The delay pulse width is approximately 150 microseconds. Column clocks occur in pairs as illustrated. Clock width is 250 ± 50 microseconds. ↑ indicates controlling system must accept the data before the end of the pulse or data overrun will occur. Odd to even clock delay is 10 microseconds. In the EBCDIC mode, one byte is transferred for each column. In the binary mode, one byte is transferred for odd columns and two bytes are transferred for even columns.

Figure 6. Card Reader Event Times (Model 7140)

4. OPERATIONS

INTRODUCTION

The operator controls, loading procedure, and unloading procedure for Models 7120, 7122, and 7140 are described in this section.

OPERATOR CONTROLS (MODEL 7120)

The Model 7120 control panel consists of four switch-indicators mounted on the front panel (see Figure 7).

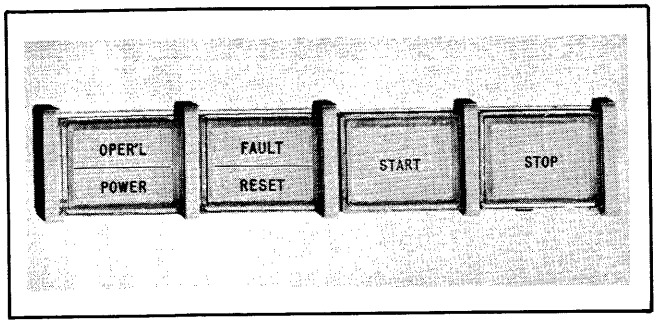


Figure 7. Model 7120 Card Reader Control Panel

OPER'L/POWER

This push-on/push-off, split field, switch-indicator controls ac power to the card reader. Nonillumination of the OPER'L/POWER switch-indicator indicates ac power is not applied. When the switch is momentarily pressed, ac power is applied and POWER is illuminated (green).

OPER'L is illuminated (white) if ac and system dc power are on and the read station and transport mechanism are operative.

START

Operation of this momentary switch-indicator places the card reader in the "automatic" mode and illuminates the START indicator (white) if the unit is operational, the input hopper is not empty, and none of the multiple stackers is full. In addition, if a card is not present on the card read platform, operation of the START switch feeds one card from the input hopper onto the card read platform. The indicator is extinguished and the unit enters the "manual" mode if any of the following conditions occurs:

1. The STOP switch is operated.
2. One or more of the output stackers are full.
3. The input hopper is empty.
4. The unit becomes not operational.

FAULT/RESET

The FAULT indicator of this split field, switch-indicator is illuminated (red) only when a read station fault or transport mechanism fault is encountered. Transport motor power is removed when any transport mechanism fault occurs, such as failure to feed a card from the input hopper to the card read platform or a card jam in the transport mechanism. Illumination of the FAULT indicator normally indicates that the assistance of maintenance personnel is required to restore the card reader to an operational condition.

When the card reader is in the process of reading a card, pressing the RESET switch causes an "unusual end" condition to be signaled to the controlling system and places the card reader in the "manual" mode at the completion of the current card read operation.

STOP

Operation of this momentary switch-indicator changes the card reader from the "automatic" mode to the "manual" mode. The STOP indicator is illuminated (white) only while the unit is in the "manual" mode, with the current card read operation (if in process) being completed.

OPERATOR CONTROLS (MODEL 7122/7140)

The control panels for Models 7122 and 7140 Card Readers consist of four switches and eight indicators (see Figures 8 and 9).

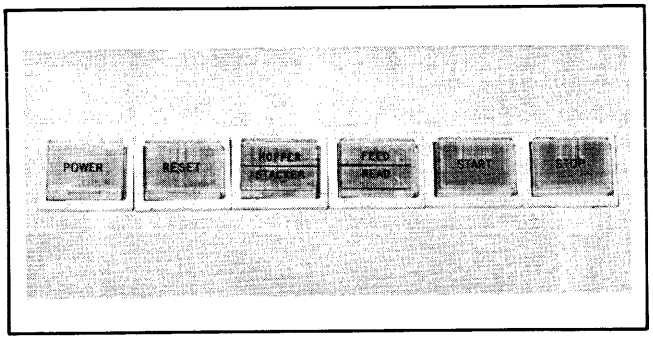


Figure 8. Model 7122 Card Reader Control Panel

POWER

This control is a push-on-/push-off switch-indicator that controls ac power to the card reader. When the switch is pressed, ac power is applied and POWER is illuminated. Nonillumination of the switch indicates that ac power is not applied.

START

Operation of this momentary switch-indicator places the card reader in the "automatic" mode if the unit is operational, the input hopper is not empty, and no output stacker is full.

When the reader is in the "automatic" mode, the START indicator is illuminated and the STOP indicator is extinguished.

STOP

Operation of this momentary switch-indicator changes the card reader from the "automatic" to the "manual" mode. The STOP indicator is illuminated, and the START indicator is extinguished, only while the unit is in the "manual" mode, with the current, in-process card read operation being completed. The reader enters the "manual" mode if any of the following conditions occurs:

1. The STOP switch is operated.
2. The input hopper is empty.
3. An output stacker is full.
4. The RESET switch is operated.
5. The unit becomes not operational.

FEED/READ

If either section of this split field indicator is illuminated, the unit is in the "not operational" condition. The FEED section is illuminated when a transport feed error is detected. Feed errors are defined as follows:

1. Failure to pick and deliver a card to the read station.
2. Failure of card to exit throat area.
3. Failure of card to exit read station.
4. Failure of card to reach stacker area.
5. Card jam in stacker area.
6. Erroneous picking of card (picked without command).

Note: Reader motor power is off whenever the FEED indicator is illuminated.

After the fault condition has been corrected, operation of the RESET control clears the FEED indicator.

The READ section is illuminated when a photoelectric system error is detected. A "light-dark" check on the read station is performed at the start of each card cycle. Failure of this check causes the READ indicator to light. Operation of the RESET control clears the READ indicator.

RESET

Operation of this momentary switch clears the FEED/READ error indicators and places the unit in the "manual" mode at the completion of the current card read operation. Operation of this switch while a reader photo-element is covered will put the reader in the "manual" mode but will not clear read and feed errors. The reset signal is also supplied to the controller for input/output system requirements.

HOPPER/STACKER

The HOPPER section of this split field indicator is illuminated when the input hopper is empty. The STACKER section is illuminated if an output stacker is full. The card reader will be in the "manual" mode if either section of the indicator is illuminated.

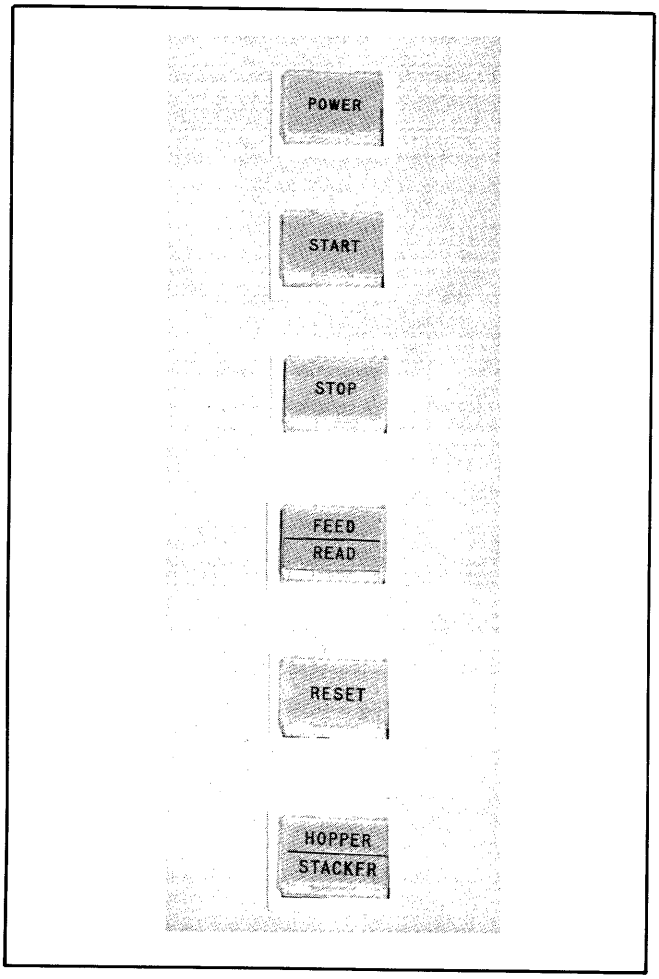


Figure 9. Model 7140 Card Reader Control Panel

CARD FILE LOADING PROCEDURE (MODEL 7120)

1. Ensure power is applied by visually checking the OPER'L/POWER switch on the operator control panel. Illumination of the POWER switch and audible mechanical operation indicate ac and dc power are applied and the read station and transport mechanism are operative.

2. Remove the card weight (and cards, if present) from the input hopper (see Figure 10). Press the RESET switch to feed the card (if present) from the card read platform into alternate stacker 2 (see Figure 11).

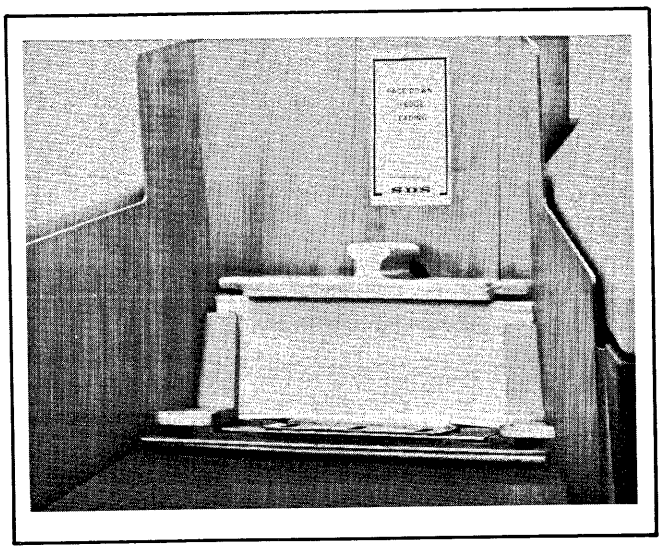


Figure 10. Model 7120 Input Hopper

3. Place the card file to be read in the input hopper (face down, row 9 away from the operator) with the card weight on top of the card file.

4. Press the START switch to feed the first card of the file from the input hopper to the card read platform. Illumination of the START switch indicates that the card reader is ready for automatic reading of the card file by the controlling system.

CARD FILE UNLOADING PROCEDURE (MODEL 7120)

1. Press the STOP switch to place the card reader in the "ready manual" state. Remove the card weight and the remainder of the card file from the input hopper.

2. Press the RESET switch to feed the card on the card read platform into alternate stacker 2. To maintain the correct sequence of the card file, this card should be placed in front of the bottom card taken from the input hopper.

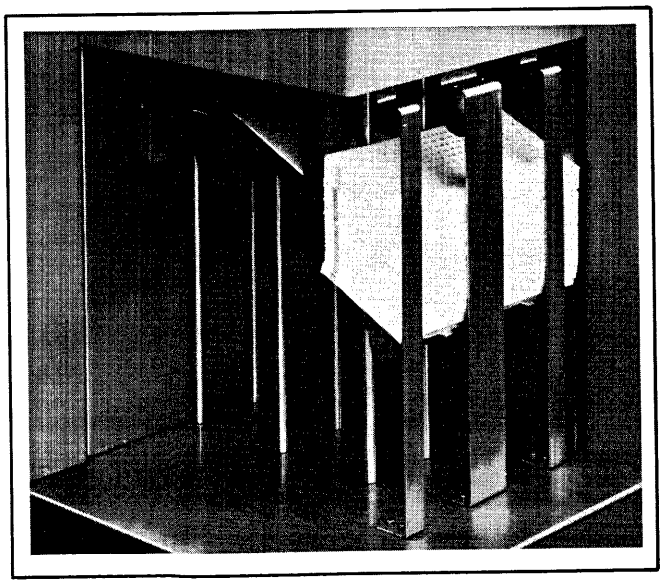


Figure 11. Model 7120 Multiple Output Stackers

CARD FILE LOADING PROCEDURE (MODEL 7122)

READER HALTED

1. Remove the card weight (and any card present) from input hopper (see Figure 12). Cards may remain in the output stacker provided it is not full (indicated by illumination of the STACKER light). Press the RESET switch to initialize the reader and clear fault conditions. The transport motor may start depending upon the position of the POWER switch.

2. Ensure power is applied by visually checking the POWER indicator on the operator control panel. Illumination of the POWER indicator and audible mechanical operation indicate ac and dc power are applied and the read station and transport mechanism are operative.

3. Place the card file to be read in the input hopper (printed side down and column one to the right). Place the card weight on top of the cards with the circular hole in the weight to the left and down.

4. Press the START switch. Illumination of the START indicator indicates that the card reader is ready for automatic reading of the card file by the controlling system.

READER RUNNING

1. With a minimum 2-inch stack of cards remaining in the input hopper, remove the card weight.

2. Load additional cards and replace the card weight.

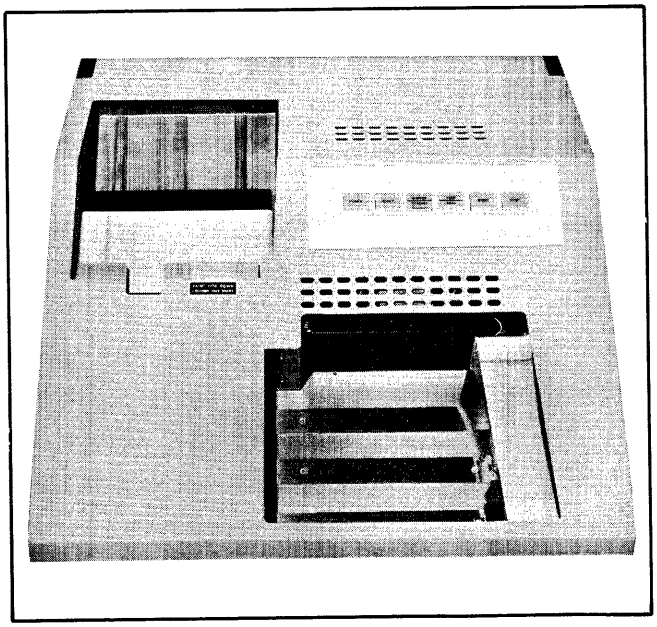


Figure 12. Model 7122 Input Hopper and Output Stacker

CARD FILE UNLOADING PROCEDURE (MODEL 7122)

READER HALTED

1. If the reader has stopped due to a "stacker full" condition (STACKER light is illuminated), remove the cards from the stacker and press the START switch to continue.

2. If the reader has stopped due to a "hopper empty" condition (HOPPER light is illuminated), remove the cards from the stacker, reload the hopper, and press the START switch to continue.

3. The reader may be stopped at any time by pressing the STOP switch. The hopper and/or stacker may then be unloaded.

READER RUNNING

Cards may be removed from the stacker without halting the reader provided that:

1. The stacker is no more than three-fourths full. This ensures that the STACKER switch is not accidentally activated while removing cards.

2. A minimum 2-inch stack of cards remains in the stacker. This ensures proper stacking action.

CARD FILE LOADING PROCEDURE (MODEL 7140)

READER HALTED

1. Remove the card weight (and any card present) from the input hopper (see Figure 13). Cards may remain in the output stacker provided it is not full (indicated by illumination of the STACKER light). Press the RESET switch to initialize the reader and clear fault conditions. The transport motor may start depending upon the position of the POWER switch.

2. Ensure power is applied by visually checking the POWER indicator on the operator control panel. Illumination of the POWER indicator and audible mechanical operation indicate ac and dc power are applied and the read station and transport mechanism are operative.

3. Place the card file to be read in the input hopper (printed side down and column one to the right). Place the card weight on top of the cards.

4. Press the START switch on the control panel. Illumination of the START indicator indicates that the card reader is ready for automatic reading of the card file by the controlling system.

READER RUNNING

With a minimum 5-inch stack of cards remaining in the input hopper, remove the card weight, load additional cards, and replace the card weight.

CARD FILE UNLOADING PROCEDURE (MODEL 7140)

READER HALTED

1. If the reader has stopped due to a "stacker full" condition (STACKER light is illuminated), remove the cards from the stacker and press the START switch to continue.

2. If the reader has stopped due to a "hopper empty" condition (HOPPER light is illuminated), reload the hopper and press the START switch to continue.

3. The reader may be stopped at any time by pressing the STOP switch. The hopper and/or stacker may then be unloaded.

READER RUNNING

Cards may be removed from the stacker without halting the reader provided that a minimum 2-inch stack of cards remains in the stacker. This ensures proper stacking action.

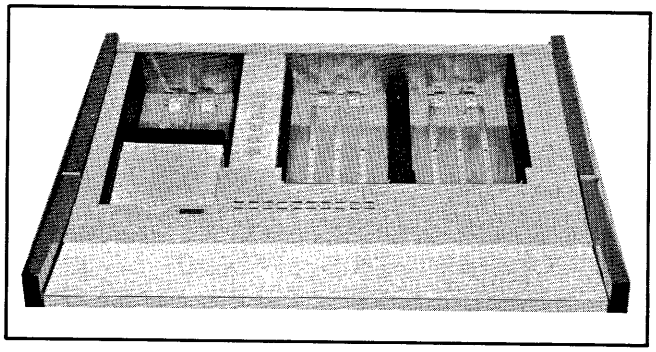


Figure 13. Model 7140 Input Hopper and Output Stackers

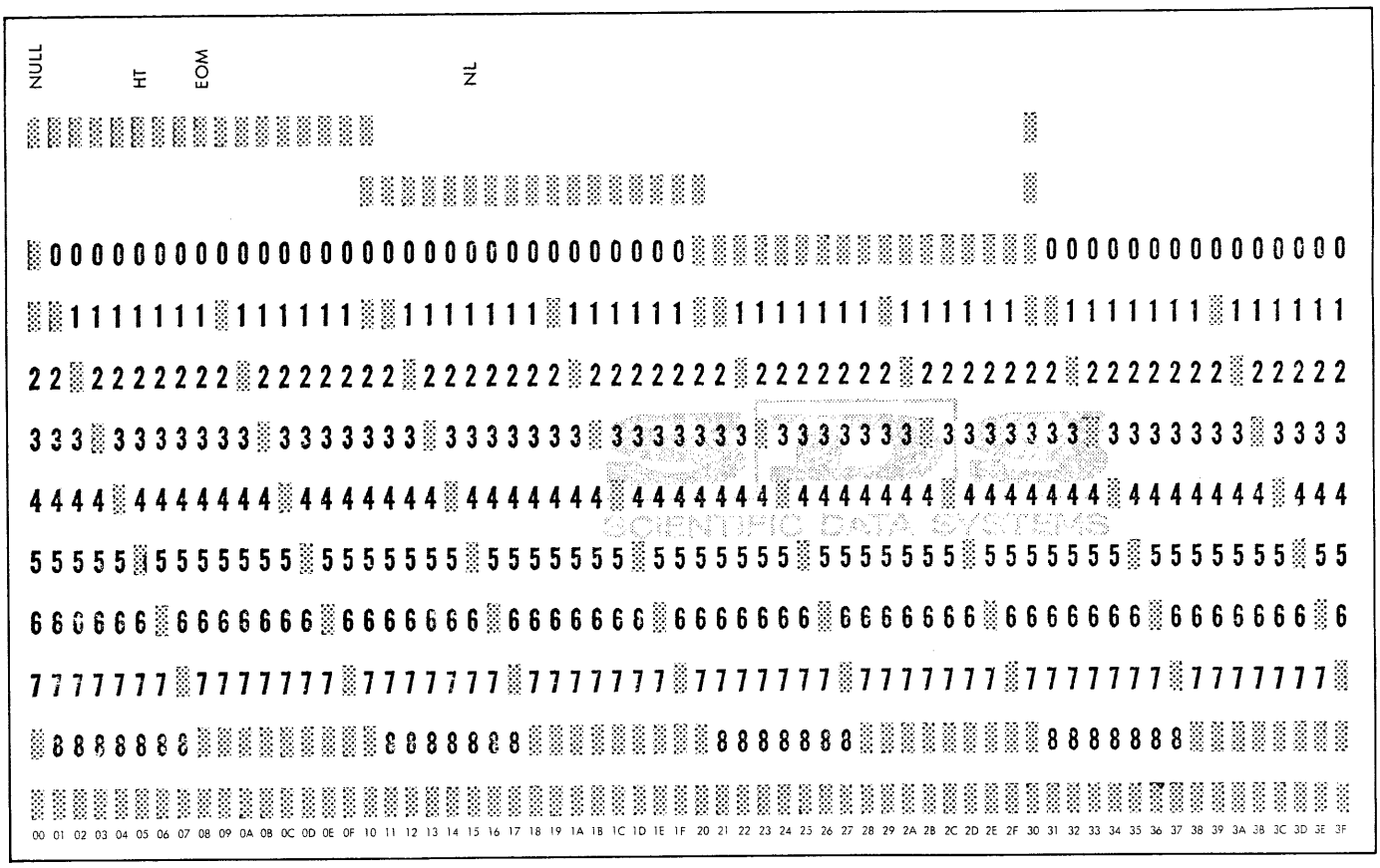
Notes: 1. For optimum reader performance for all models the following procedures should be observed:

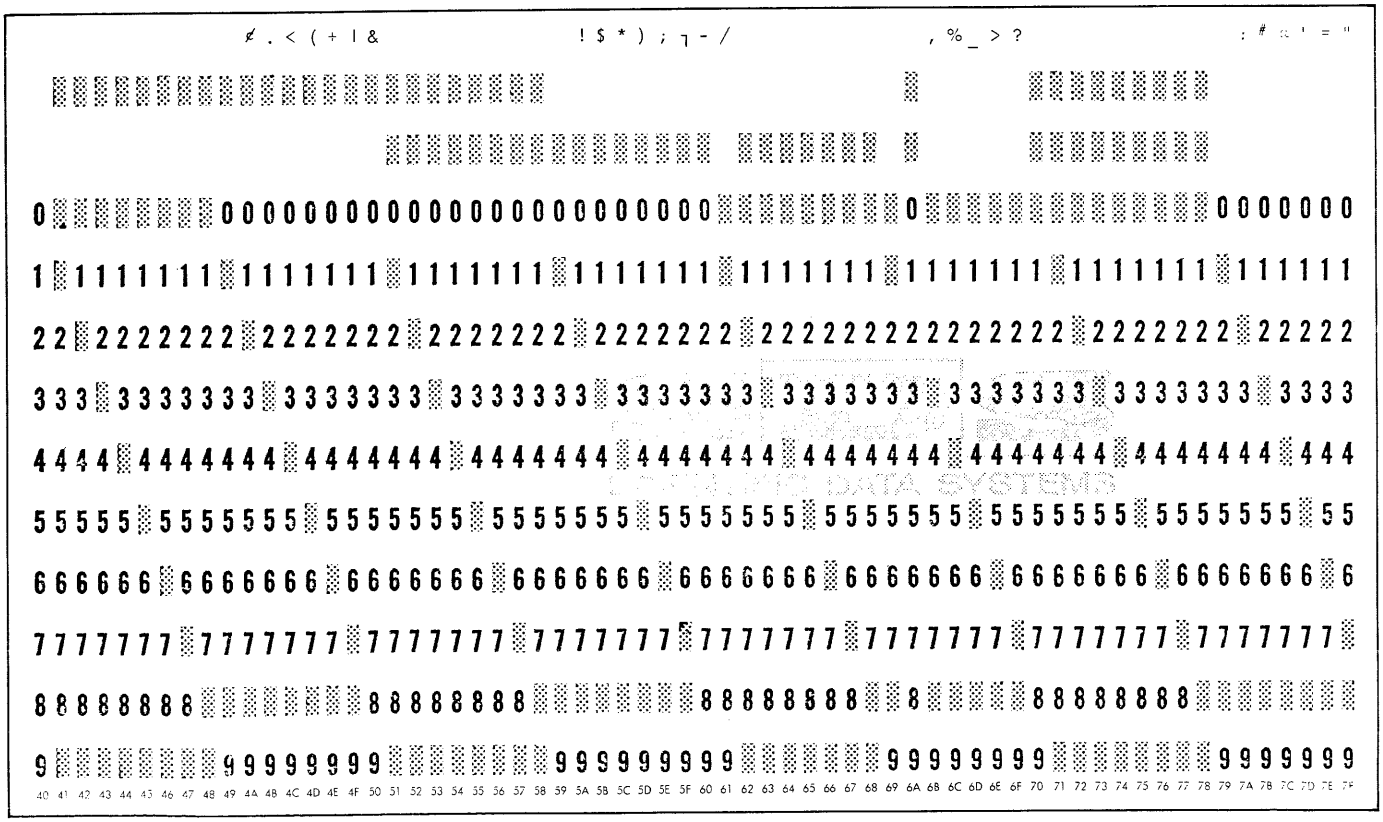
   a. A card deck should be riffled and tamped to square up the deck before loading it into the reader input hopper.

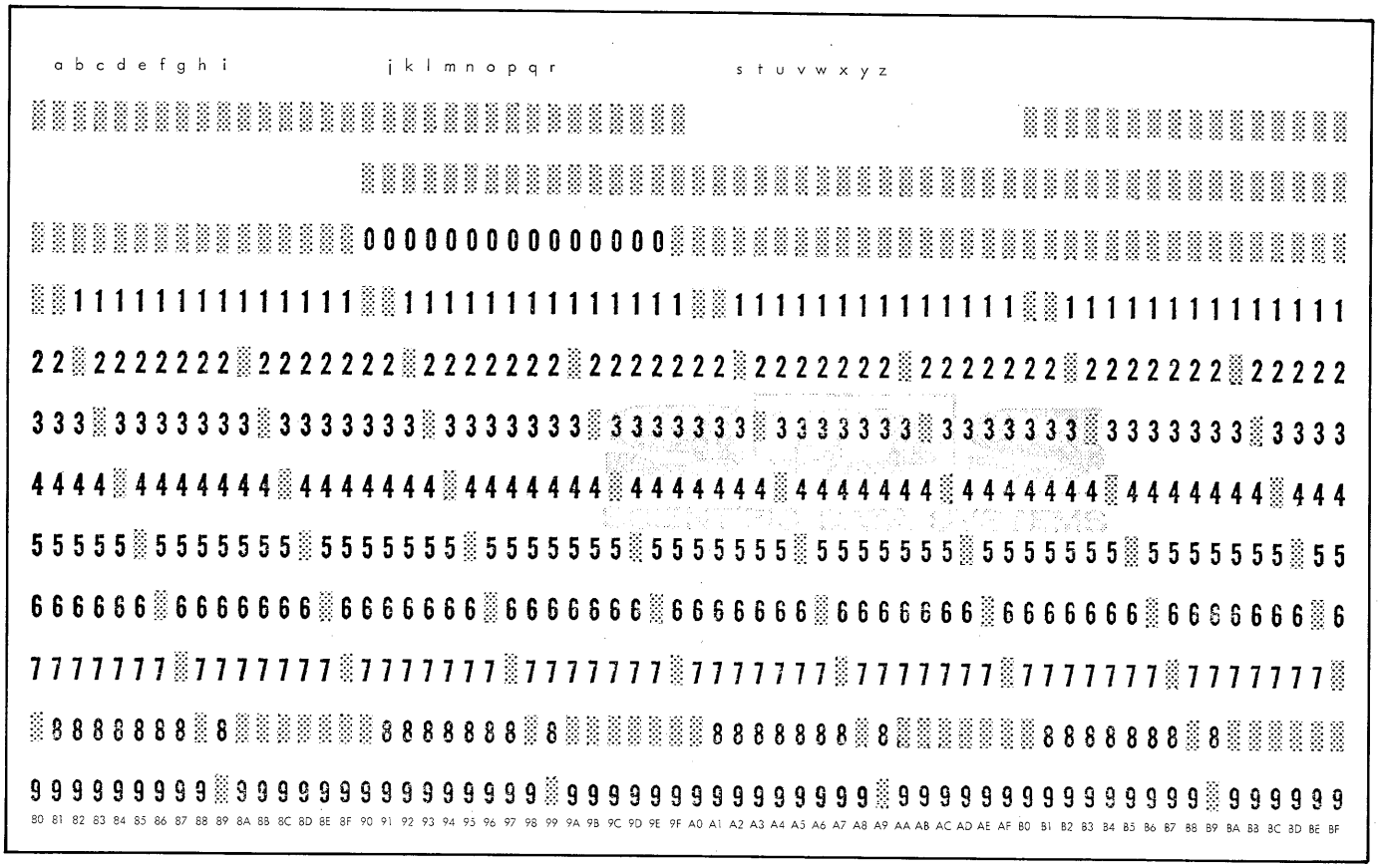
   b. Card weights should be kept in place except when actually loading or unloading cards.

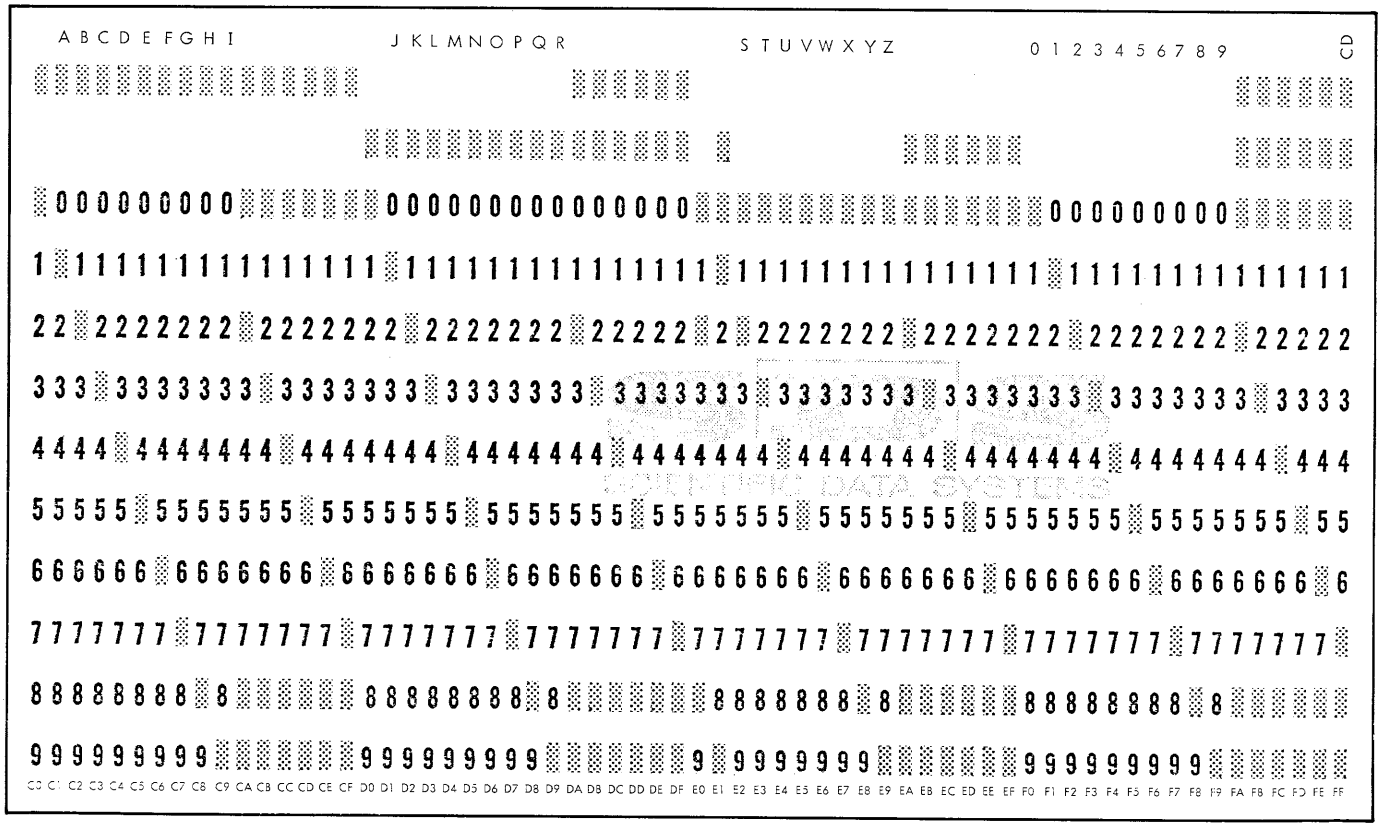
2. All card reader models have interlocks. If the transport access cover is raised, reader drive motor power is removed and the unit becomes "not operational".

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
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
CD
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. PROGRAMMING EXAMPLES

SIGMA 5/7 PROGRAMMING EXAMPLE

The following partial program for a Sigma 5/7 computer is intended to illustrate the use of the I/O instructions and the card reader responses to these instructions. The program is coded as a nonrecursive routine that reads one EBCDIC-punched card and one binary-punched card. 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 reader is in the "ready automatic" state when the SIO instruction is executed.

Label	Command	Argument	Comments
RDCARD	LI, 0	DA(IOCD)	Load general register 0 with the doubleword address of the I/O control doubleword for the read card operation.
STARTIO	SIO, 10	3	This instruction starts the card reader (device 3 on IOP 0).
TESTIO	TIO, 10	3	This instruction obtains the I/O system and card reader status response.
	CW, 11	BZTEST	This instruction compares the status response in register 11 with a "busy" test constant.
	BCS, 4	TESTIO	This instruction causes a branch back to the TIO instruction if the card reader is still "busy".
	CW, 11	ERRCHK	This instruction compares the status response in register 11 against an error check constant.
	BCS, 4	ERROR	This instruction causes a branch to a routine that determines the cause of the error(s).
	BCR, 0	DONE	This instruction causes an unconditional branch to another part of the program, where the card images are processed.
BZTEST	DATA	X'40000000'	This assembler directive defines the "busy" test constant.
ERRCHK	DATA	X'28FE0000'	This assembler directive defines the error check constant.
	BOUND	8	This assembler directive establishes a doubleword boundary for data to follow.
IOCD	GEN 8, 24 GEN 8, 24	X'0E', BA(EBCDIC) X'24', 80	These two assembler directives define the first I/O command doubleword for the card reader operation. The command specifies EBCDIC read, normal stacker, stack on error in alternate 2, store card image in area EBCDIC, command chain, halt on transmission error, and a byte count of 80.
	GEN 8, 24 GEN 8, 24	X'0A', BA(BINARY) X'04', 120	These two assembler directives define the second I/O command doubleword for the card read operation. The command doubleword specifies binary read, normal stacker, stack on error in alternate stacker 2, store card image in area BINARY, halt on transmission error, and a byte count of 120.
EBCDIC	RES	20	This assembler directive reserves 20 word locations (80 bytes) for the EBCDIC card image.
BINARY	RES	30	This assembler directive reserves 30 words (120 bytes) for the binary card image.

SIGMA 2 PROGRAMMING EXAMPLE

The following coding sequence illustrates a card reader routine for use with an SDS Sigma 2 Computer. The routine performs a read operation and returns to the main program. The calling sequence is:

```
        LDX     BUFFER      X = Address of input buffer
        LDA     ORDER       A = Card reader order code
        RCPYI   P, L
        B       READ
        RETURN LOCATION
```

Label	Command	Argument	Comments
P	EQU	1	Define P register.
L	EQU	2	Define L register.
X	EQU	4	Define X register.
A	EQU	7	Define A register.
READ	STA	ORDERLOC	Store order code.
	RCPY	X, A	
	STA	IOCD1	Store buffer address.
	LDA WD	=ORDERLOC X'E'	Load address of order into even-numbered channel register.
	LDA	=X'4001'	Odd-numbered channel register.
	WD	X'F'	Set to data chain with byte count = 1.
	LDA	=3	Device number of card reader.
	SIO		Start input.
	TIO		Test input.
	BNC	S+2	Branch if input complete.
	B	S-2	Branch if input not complete.
	RD	X'F'	Check for validity error.
	BAN	ERROR	Branch if validity error.
	RD AND	X'E' =X'8800'	Check for transmission error or unusual end.
	BAZ	RETURN	Branch if no error or unusual end.
ERROR	RCPY	*0, A	Set A register to -1 (error code).
RETURN	RCPY	L, P	Return to main program.
ORDERLOC	RES	1	Set to A register value on entry.
IOCD1	RES	1	Set to X register value on entry.
IOCD2	DATA	120	Byte count (no data chaining).
	LPOOL		Allocate literals.

XDS Publication Revision Sheet

CORRECTIONS TO XDS SIGMA CARD READERS REFERENCE MANUAL, NOVEMBER, 1969

PUBLICATION NO. 90 09 70C, MARCH, 1968

The line of card readers has been expanded by the addition of Model 7121. It is similar to Model 7122 except that its reading speed is 200 cards per minute.

To update the reference manual, add Model 7121 wherever Model 7122 appears. Attached additional page 12-1 (Figure 5-1) should be inserted following page 12. Also, make the following changes:

FRONT COVER:

Change Model number designation

from 7120/7122/7140

to 7120/7121/7122/7140

TITLE PAGE

Change Model number designation

from 7120/7122/7140

to 7120/7121/7122/7140

Page ii

Add to the list of "Related Publications" the following manuals:

Sigma 3 Computer Reference Manual	90 65 92
Sigma 2/3 Extended Symbol Reference Manual	90 10 52

Page 1, Table 1

Change Reading Speed row (7122 column)

from 400 cards/minute

to 200 cards/minute (Model 7121)
400 cards/minute (Model 7122)

Page 5, Table 3

Under Model 7140, opposite the order X'1A', change the stacking action

from If no data overrun occurs, stack card in normal stacker; if data overrun occurs, stack card in alternate stacker.

to Stack card in alternate stacker.

Under Model 7140, opposite the order X'3A', change the stacking action

from Stack card in normal stacker.

to If no data overrun occurs, stack card in normal stacker; if data overrun occurs, stack card in alternate stacker.

Page 6, Table 4

Under Model 7140, opposite the order X'1E', change the stacking action

from If no validity error or data overrun occurs, stack card in normal stacker; if validity error or data overrun occurs, stack card in alternate stacker.

to Stack card in alternate stacker.

Under Model 7140, opposite the order X'3E', change the stacking action

from Stack card in normal stacker.

to If no validity error or data overrun occurs, stack card in normal stacker; if validity error or data overrun occurs, stack card in alternate stacker.

Page 6, Col. 2

Add to the list of "Unusual End Conditions":

7. IOP Halt (Not applicable to Sigma 2).

Page 7, Col. 2

Under "Status Response for SIO, TIO, and HIO", change heading of first line

from Bit 0: Device Interrupt Pending.

to Bit 0: Interrupt Pending.

Page 21

Change top heading

from SIGMA 2 PROGRAMMING EXAMPLE

to SIGMA 2/3 PROGRAMMING EXAMPLE

Change end of first sentence

from . . . with an SDS Sigma 2 Computer.

to . . . with an XDS Sigma 2/3 Computer.

INSIDE FRONT COVER

Under Model 7140, make same changes to stacking action for orders X'1A', X'3A', X'1E', X'3E' that were specified above for Page 5, Table 3, and Page 6, Table 4.

SDS SCIENTIFIC DATA SYSTEMS • 1649 Seventeenth Street • Santa Monica, California 90404