

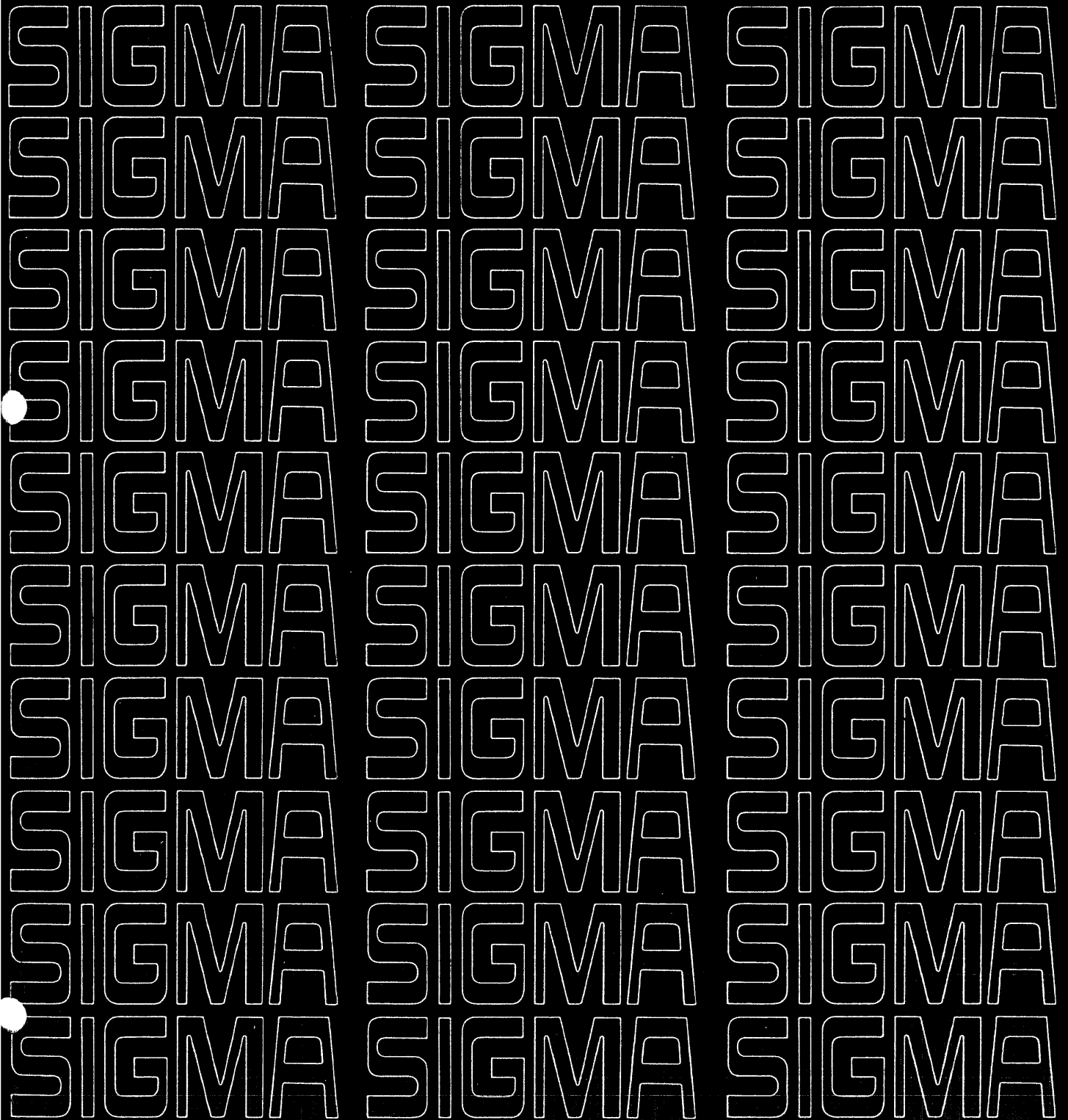


Xerox Data Systems

XDS SIGMA KEYBOARD/PRINTERS (ASR, KSR)

MODELS 7012/7014/7020/7021/8091/8092

Reference Manual



KSR ORDER CODES

<u>Hexadecimal Code</u>	<u>Function</u>
05	Output
06	Read keyboard continuously until EOM character typed or "count done" signal
86 [†]	Read keyboard until control character [codes 05 (HT), 08(EOM), and 15(NL)] typed or "count done" signal

ASR ORDER CODES

<u>Hexadecimal Code</u>	<u>Function</u>
00 ^{††}	Stop
01	Punch
02	Read ignoring initial leader frames
05	Type
06	Read keyboard continuously until EOM character typed or "count done" signal
82	Read immediate
86 ^{††}	Read keyboard until control character [codes 05(HT), 08(EOM), and 15(NL)] typed or "count done" signal

[†]Not applicable to Model 8091

^{††}Not applicable to Model 8092

KEYBOARD/PRINTERS (ASR,KSR)

MODELS 7012/7014/7020/7021/8091/8092

REFERENCE MANUAL

for

XDS SIGMA COMPUTERS

90 16 72A

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XDS

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NOTICE

This publication (90 16 72A) combines two previous manuals, the Sigma Keyboard/Printers Reference Manual (90 09 74) and the Sigma Keyboard/Printers with Paper Tape Reader/Punch Reference Manual (90 11 96), into one manual. The KSR and ASR devices now have a common controller. This controller is compatible with the controllers previously used with these same model numbers.

RELATED PUBLICATIONS

<u>Title</u>	<u>Publication No.</u>
XDS Sigma 7 Computer Reference Manual	90 09 50
XDS Sigma 5 Computer Reference Manual	90 09 59
XDS Sigma 3 Computer Reference Manual	90 15 92
XDS Sigma 2 Computer Reference Manual	90 09 64
XDS Sigma 5/7 Symbol and Meta-Symbol Reference Manual	90 09 52
XDS Sigma 2/3 Symbol Reference Manual	90 10 51
XDS Sigma 2/3 Extended Symbol Reference Manual	90 10 52

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

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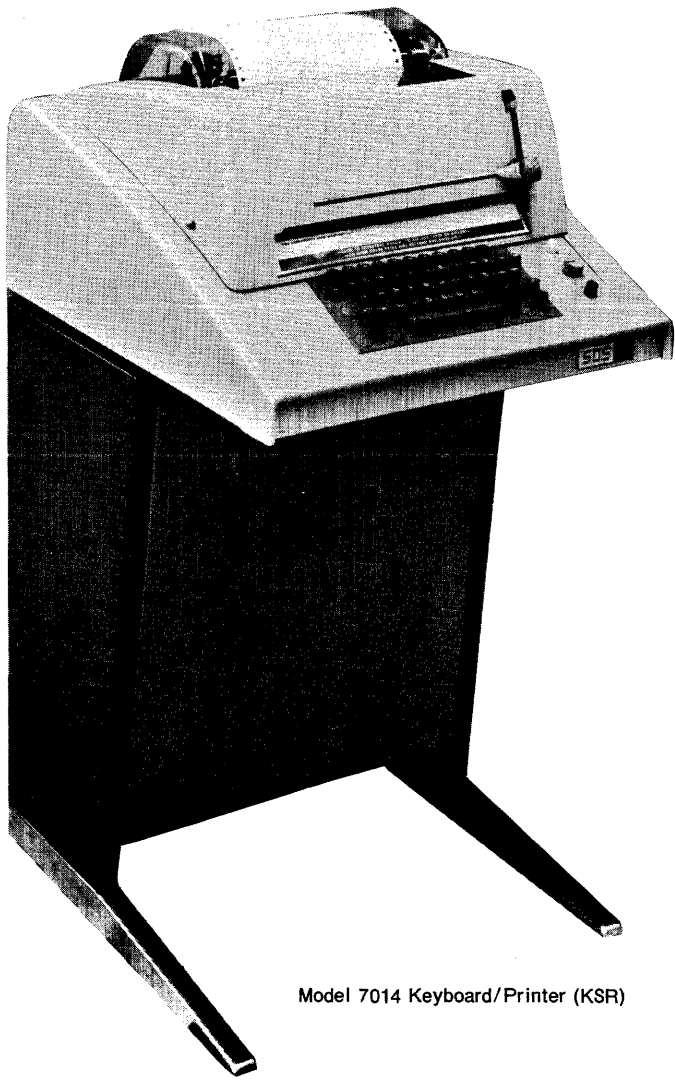
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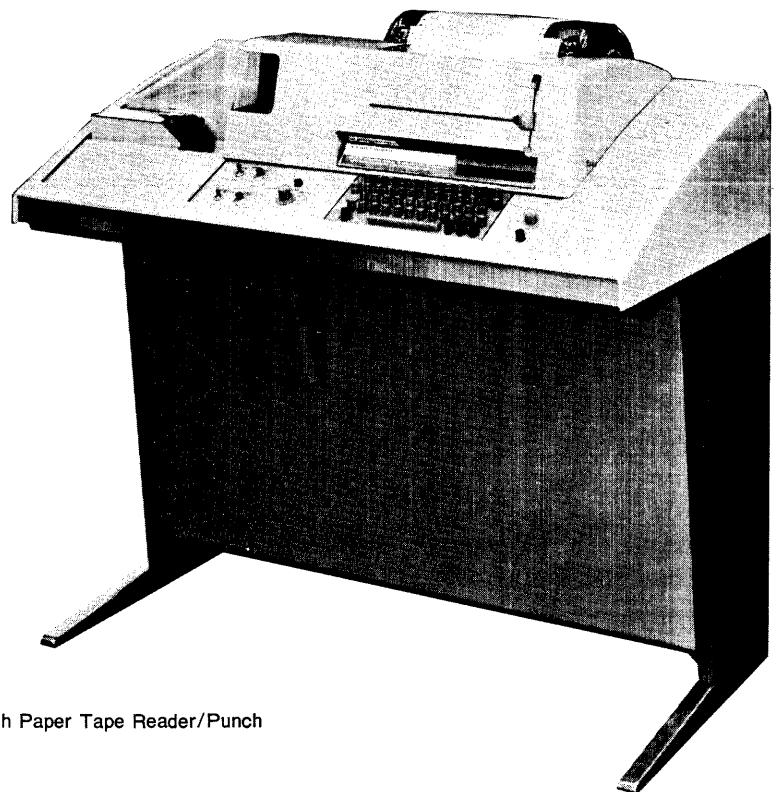
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Model 7014 Keyboard/Printer (KSR)



Model 7020 Keyboard/Printer (ASR) with Paper Tape Reader/Punch

1. GENERAL DESCRIPTION

INTRODUCTION

XDS keyboard/printers provide communication with Sigma computers through the input/output controlling system. A complete subsystem consists of a mechanism and a controller, which connects to an 8-bit I/O channel on a Sigma computer system. Each controller can control one keyboard/printer.

This device provides operation control, error and status message reporting, and other communication between the computer and the user. The keyboard permits direct manual input to the computer; the printer automatically prints computer output in hard-copy form; and the paper tape reader and punch on the ASR device provide inexpensive input/output, in 5-, 6-, or 7-level tape format (and 8-level for output) for the computer. The latter combination also adds the following offline capabilities:

1. Preparation of hard copy (keyboard to printer)[†]
2. Generation of punched tape (keyboard to punch)[†]
3. Listing of punched tape (reader to printer)^{††}
4. Duplication of punched tape (reader to punch)^{††}

The Sigma models (see Table 1 for the characteristics) described in this manual are:

Model	Computer Used With	Description
7012 ^{†††}	Sigma 2/3/5/7	KSR keyboard/printer with controller
7014	Sigma 2/3/5/7	Spare KSR mechanism
7020	Sigma 2/3/5/7	ASR keyboard/printer with paper tape reader, punch, and controller
7021	Sigma 2/3/5/7	Spare ASR mechanism
8091	Sigma 2	KSR keyboard/printer with controller
8092	Sigma 2	ASR keyboard/printer with paper tape reader, punch, and controller

To use this manual effectively, the reader should be familiar with the Sigma Computer Reference Manual applicable to his installation, particularly the sections on I/O instructions and operations.

[†]In off-line operation, operations 1 and 2 can occur simultaneously.

^{††}In off-line operation, operations 3 and 4 can occur simultaneously.

^{†††}Earlier Model 7010 was functionally the same as new Model 7012.

Table 1. Characteristics

Operating Characteristics		
<u>Printer</u>		
Speed	10 characters/sec	
Horizontal spacing	12 characters/in.	
Vertical spacing	6 lines/in.	
Paper	Fan-folded, continuous form with pin-feed edge, 8-1/2 in. wide	
Feed	Pin-feed platen, adjustable for single- or double-line feed	
Typing line	86 characters	
Legible copies	Original and 3 carbon copies	
<u>Reader/punch (ASR)</u>		
Input/output speed [†]	10 characters/sec	
Tape	Paper or Mylar	
Tape width	1 in.	
Tape thickness	0.0025 to 0.008 in.	
Levels	8 data channels, 1 sprocket channel per EIA standard RS-227	
Supply reel	1000 ft	
Physical Dimensions		
	<u>ASR</u>	<u>KSR</u>
Height	38.5 in.	38.5 in.
Width	40 in.	20 in.
Depth	24 in.	24 in.
Weight (approximate)	250 lbs	132 lbs
Environmental Characteristics		
Power requirements	115 vac ± 10%, 60 ± 0.5 Hz, single phase, 10 amp (ASR) and 6 amp (KSR)	
Operating temperature	40° to 95° F	
Operating humidity	5% to 95%	
[†] Reads 20 characters/second under computer control; reads 10 characters/second off-line.		

2. FUNCTIONAL DESCRIPTION

KEYBOARD/PRINTER DATA REPRESENTATION

A 62-character subset of the Extended Binary-Coded Decimal Interchange Code (EBCDIC) has been defined for the keyboard/printer. No more than 62 printing graphics are used; any other codes are nonprinting characters used only for control. The 62 graphics plus control characters and their codes are listed in Table 2. The control characters are:

- ✓ TAB (HT) horizontal tabulation
- ✗ NEW LINE (NL) corresponds to typewriter return key
- (= BS) EOM end of message
- ✓ RUB OUT delete code for paper tape (ASR)

Characters entered on the keyboard are transmitted to the computer as 8-bit bytes, one byte at a time. Computer output information is transmitted in 8-bit bytes to the printer, which prints one character for each byte received.

Parity is neither generated nor checked by the device or controller.

TAPE DATA REPRESENTATION

Each frame of information on the tape represents an 8-bit byte image (see Figure 1). When a tape is read in the Ignore LeaderFrames read mode (see Chapter 3), leading null bytes (00₁₆) are ignored, and the transmission of data begins with the first non-null byte. When a tape is read in the Immediate read mode, leader frames are not ignored but are transmitted as zero bytes.

DEVICE STATES

The device can be in either the "not operational" or "operational" state. Its initial state depends on its power status. Complete absence of power (that is, absence of primary ac power or system dc power) effectively removes the unit from the controlling system. Any attempt to access the unit results in a response of "no input/output address recognition" (i.e., non-existent device controller or off-line switch in controller) to the I/O instruction. Also, no status indications are supplied if a status response is requested by the instruction. In the absence of ac power, the presence of system dc power enables address recognition, but the unit assumes a "not operational" state. Likewise, failure of internal power supplies causes the unit to assume a "not operational" state.

Table 2. Keyboard/Printer Codes

Character	8-bit Code	Hex. Code	Character	8-bit Code	Hex. Code	Character	8-bit Code	Hex. Code
<u>Control Characters</u>			E	1100 0101	C5	<	0100 1100	4C
HT (TAB)	0000 0101	05	F	1100 0110	C6	(0100 1101	4D
NL (NEW LINE)	0001 0101	15	G	1100 0111	C7	+	0100 1110	4E
EOM	0000 1000	08	H	1100 1000	C8		0100 1111	4F
RUB OUT (ASR device)	1111 1111	FF	I	1100 1001	C9	&	0101 0000	50
<u>Printing Characters</u>			J	1101 0001	D1	!	0101 1010	5A
Blank	0100 0000	40	K	1101 0010	D2	\$	0101 1011	5B
0	1111 0000	F0	L	1101 0011	D3	*	0101 1100	5C
1	1111 0001	F1	M	1101 0100	D4)	0101 1101	5D
2	1111 0010	F2	N	1101 0101	D5	;	0101 1110	5E
3	1111 0011	F3	O	1101 0110	D6	7	0101 1111	5F
4	1111 0100	F4	P	1101 0111	D7	-	0110 0000	60
5	1111 0101	F5	Q	1101 1000	D8	/	0110 0001	61
6	1111 0110	F6	R	1101 1001	D9	,	0110 1011	6B
7	1111 0111	F7	S	1110 0010	E2	%	0110 1100	6C
8	1111 1000	F8	T	1110 0011	E3	-	0110 1101	6D
9	1111 1001	F9	U	1110 0100	E4	>	0110 1110	6E
A	1100 0001	C1	V	1110 0101	E5	?	0110 1111	6F
B	1100 0010	C2	W	1110 0110	E6	:	0111 1010	7A
C	1100 0011	C3	X	1110 0111	E7	#	0111 1011	7B
D	1100 0100	C4	Y	1110 1000	E8	@	0111 1100	7C
			Z	1110 1001	E9	'	0111 1101	7D
			/	0100 1010	4A	=	0111 1110	7E
			.	0100 1011	4B	"	0111 1111	7F

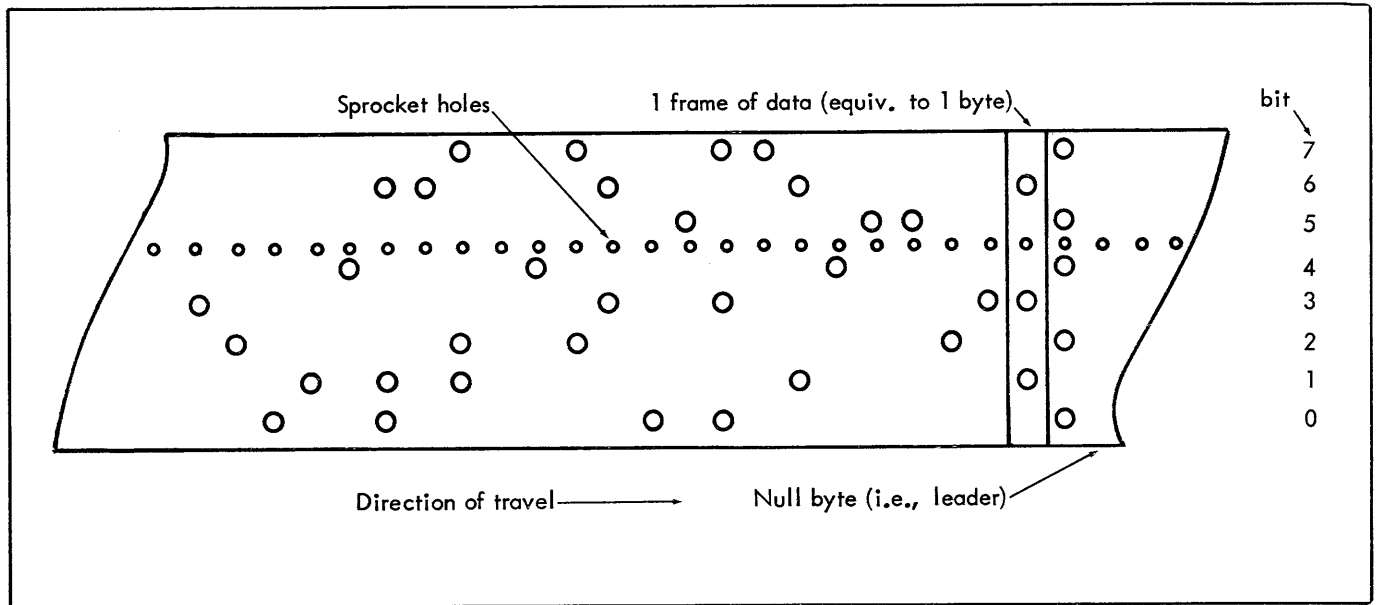


Figure 1. Tape Data Format

When the mode selector switch on the ASR unit is in any of the off-line positions (PRINT/PUNCH, PRINT, or PUNCH), the unit appears "not operational" to the controlling system.

OPERATIONAL STATES

The presence of ac and dc power, with no fault conditions, enables the unit to assume one of two possible device conditions ("ready" or "busy") and, for the ASR device, one of two possible operating modes ("manual" or "automatic"). The KSR device is always in the "automatic" mode.

The current operational status of the unit may be determined by examining the status response to one of the I/O instructions, START INPUT/OUTPUT (SIO), TEST INPUT/OUTPUT (TIO), and HALT INPUT/OUTPUT (HIO). Another I/O instruction, TEST DEVICE (TDV), provides additional specific status indications.

CONDITIONS

Ready. In the "ready" condition, the unit can accept an SIO instruction provided that no interrupt is pending. To be in this condition, the unit must be "operational" and must not be executing an order or chain of orders.

Busy. In the "busy" condition, the unit has accepted an SIO instruction. A new SIO will not be accepted until the current order list is completed and no interrupt is pending.

MODES

Manual. The ASR unit assumes the "manual" mode when any condition occurs that requires operator intervention before it can function normally. The "manual" mode may

be forced by placing the RUN/STOP switch on the ASR control panel in the STOP position or not having tape inserted in the reader. The unit can accept an SIO instruction from the controlling system in this mode, but will not act on it until the "automatic" mode is entered.

Automatic. The ASR unit is placed in the "automatic" mode (under control of the device controller) when the rotary selection switch on the control panel is in the ON LINE position, the RUN/STOP switch is in the RUN position, and tape is installed in the reader.

The KSR device is always in the "automatic" mode.

TRANSITION BETWEEN STATES

The allowable device state transitions and the conditions causing it to change from one state to another are summarized in Tables 3 and 4.

DATA TRANSFER

Data transfer operations are initiated by executing a START INPUT/OUTPUT (SIO) instruction, which is accepted only if:

1. The unit is "operational".
2. I/O address recognition exists.
3. The unit is in the "ready" condition.
4. No interrupt is pending.

After an SIO is accepted, the controller requests an order from the controlling system. If the order byte is valid, output data is requested from the controlling system or input

data is provided (for example, keys are pressed on the keyboard). After a valid read/punch order is accepted, the tape image for one frame is transmitted to (read) or accepted from (punch) the controlling system. The tape is then automatically moved ahead by one frame.

Data transfer operations terminate when a "channel end" or "unusual end" condition is reported. "Channel end" is reported when the device controller receives a "count done" signal (i.e., the last character called for by the I/O

command doubleword for this operation) from the controlling system. An input operation may be terminated before the "count done" signal is received when a control character is input[†]. An output operation may be terminated before this signal is received if the BREAK switch is pressed[†]; in this case, an "unusual end" condition is reported to the controlling system.

[†]Not operable on Model 8091 or 8092.

Table 3. KSR Device State Transitions

Next State Present State	Not Operational	Ready Automatic	Busy Automatic
Not Operational	—	Power is turned on	Not possible
Ready Automatic	Power is turned off	—	SIO accepted
Busy Automatic	Power is turned off	<ul style="list-style-type: none"> • Operation completed • HIO received • I/O reset received • Invalid order received 	—

Table 4. ASR Device State Transitions

Next State Present State	Ready Manual	Busy Manual	Ready Automatic	Busy Automatic
Not operational (power off or rotary switch set to one of the off-line positions)	Operational	Not possible	Operational	Not possible
Ready Manual	—	SIO accepted	Reader switch in RUN and tape in reader	Not possible
Busy Manual	<ul style="list-style-type: none"> • HIO received • I/O reset received • Invalid order received 	—	Not possible	Reader switch in RUN and tape in reader
Ready Automatic	Reader switch in STOP or no tape in reader	Not possible	—	SIO accepted
Busy Automatic	Not possible	Reader switch in STOP or no tape in reader	<ul style="list-style-type: none"> • Operation completed and no operator intervention required • HIO received • I/O reset received • Invalid order received 	—

3. PROGRAM INTERFACE

DEVICE ORDERS

The following orders are recognized by the device controller.

KSR/ASR KEYBOARD/PRINTER ORDERS

<u>Order</u>	<u>Action</u>
X'05'	Type.
X'06'	Read keyboard continuously until EOM character is typed or "count done" signal from controller.
X'86' [†]	Read keyboard until a control character is typed, where the control characters are the codes 05(HT), 08(EOM), and 15(NL), or until "count done" signal.

OUTPUT ORDERS

When an output order is read, the controller requests characters from the I/O controlling system and presents them to the printer to be typed at a maximum rate of 10 characters per second (86 characters per line). A program should output no more than 86 printable characters between NL codes, since any excess will be superimposed on the last character printed. The BREAK switch permits halting output operations.[†] (See "Operator Controls", Chapter 4.)

INPUT ORDERS

The KEYBOARD or INPUT lamp located directly above the power switch indicates to the operator that the computer can accept input information. Each time a key is pressed, an 8-bit EBCDIC character is generated and transmitted to the controlling system. A blank character is generated by pressing the space bar. When the order X'86' is active and the control characters, HT[†], NL[†], or EOM, are encountered, a "channel end" occurs, terminating input. All characters, including control characters, are read into memory.

ASR READ ORDERS

<u>Order</u>	<u>Action</u>
X'00'	Stop
X'02'	Read, ignoring initial leader frames
X'82'	Read, immediate

When a Read order is received, the reader starts the tape moving forward, using the sprocket hole as a clocking signal; each 8-bit frame is transmitted to the computer. Blank

[†]Not operable on Model 8091 or 8092.

frames preceding the first nonblank frame can be read or ignored by selecting the appropriate order. The reader passes tape and transmits bytes, reading all combinations of eight punches, including blanks, until the computer terminates the reading operation. At this time the reader stops tape motion. Records of any length can be read. The reader can terminate, then resume reading within one record, without losing a character.

ASR PUNCH ORDERS

<u>Order</u>	<u>Action</u>
X'00'	Stop
X'01'	Punch

Receipt of a Punch order initiates operation of the punch. The 8-level tape is perforated with the various combinations of allowable punches. The punch receives its information in bytes. It punches one frame for each byte received, then advances the tape forward one frame. Punching continues until terminated by the computer.

KEY EVENTS

The key events that occur during an input/output operation are described in the following paragraphs. No chronological order should be assumed from the order of presentation.

START INPUT/OUTPUT

A data transfer operation is initiated with the execution of a START INPUT/OUTPUT (SIO) instruction by the controlling system. If I/O address recognition exists and the device is in the "ready" condition with no interrupt pending, the controlling system sets its "I/O address recognition" and "SIO accepted" indicators. The device advances from the "ready" to the "busy" condition and requests an order byte from the controlling system. Note that "SIO accepted" does not mean that the device has initiated an input/output operation, but only that it has accepted the SIO instruction and it was 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 device to return an "unusual end" indication to the controlling system:

1. Input/Output Processor (IOP) Halt (not applicable to Sigma 2).
2. BREAK switch[†] on keyboard/printer was pressed during output.
3. Occurrence of "not operational" condition during I/O operation.
4. Device (ASR) is placed in off-line mode while controller is "busy".

CHANNEL END CONDITIONS

A "channel end" condition is reported when any one of the following occurs:

1. An EOM character is typed during an order code 06 input operation.
2. An HT[†], NL[†], or EOM character is typed during an order code 86 input operation.
3. An input or output operation is terminated for one of the following reasons:
 - a. The device receives a "count done" or halt signal from the controlling system.
 - b. An "unusual end" is detected.

FAULT CONDITIONS

A "fault" condition is any condition that causes a device to report a "not operational" condition in response to an SIO, HIO, or TIO instruction. A power failure will cause the device to become "not operational".

STATUS RESPONSE

The device can return various status information in response to computer-executed I/O instructions. Detailed explanations of the input/output instructions that request the status of the device are contained in the applicable Sigma Computer Reference Manual.

[†]Not operable on Model 8091 or 8092.

I/O INSTRUCTION STATUS BITS

The execution of an I/O instruction by the controlling system provides two 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 possible status bit settings provided by each I/O instruction and the significance of each setting.

DEVICE STATUS BYTE

Eight bits of information in the Device Status Byte are made available to the controlling system in response to the execution of an input/output instruction, as shown in Tables 6, 7, and 8.

OPERATIONAL STATUS BYTE

In addition to the information contained in the Device Status Byte, the Operational Status Byte generated at the end of each I/O operation also provides indicators to the controlling system (see Table 9).

PROGRAMMING CONSIDERATIONS

Figure 2 (KSR) and Figure 3 (ASR) illustrate the sequential relationship of the key events that occur during an input/output operation.

Table 5. Keyboard/Printer I/O Instruction Status Bits

Instruction	Status Bits [†]		Significance
	CC1 or O	CC2 or C	
SIO	0	0	I/O address recognized and SIO accepted (i.e., keyboard/printer has advanced to "busy" condition).
	0	1	I/O address recognized but SIO not accepted (i.e., keyboard/printer was already "busy" or interrupt is pending).
	1	0	Invalid code.
	1	1	I/O address not recognized.
HIO	0	0	I/O address recognized and the keyboard/printer was not "busy" when the halt occurred.
	0	1	I/O address recognized but the keyboard/printer was "busy" when the halt occurred. A "channel end" condition is also reported to the controlling system in this case.
	1	0	Invalid code.
	1	1	I/O address not recognized.

[†]The symbols "CC1" and "CC2" refer to condition code bits in Sigma 5/7 computers. The symbols "O" and "C" refer, respectively, to Overflow and Carry indicators in Sigma 2/3 computers.

Table 5. Keyboard/Printer I/O Instruction Status Bits (cont.)

Instruction	Status Bits [†]		Significance
	CC1 or O	CC2 or C	
TIO	0	0	I/O address recognized and SIO can currently be accepted (i.e., keyboard/printer is in "ready" condition with no interrupt pending).
	0	1	I/O address recognized but SIO can not currently be accepted.
	1	0	Invalid code.
	1	1	I/O address not recognized.
TDV	0	0	I/O address recognized.
	0	1	Invalid code.
	1	0	Invalid code.
	1	1	I/O address not recognized.
AIO	0	0	Normal interrupt (i.e., "channel end" or "zero byte count") condition present.
	0	1	Unusual interrupt (i.e., "unusual end") condition present.
	1	0	Invalid code.
	1	1	No interrupt condition present.

[†]The symbols "CC1" and "CC2" refer to condition code bits in Sigma 5/7 computers. The symbols "O" and "C" refer, respectively, to Overflow and Carry indicators in Sigma 2/3 computers.

Table 6. Device Status Response for SIO, TIO, and HIO

Bit Position	Function	State	Meaning
0	Interrupt Pending	1	Interrupt is pending (that is, issued but not yet acknowledged by an AIO instruction). A new order will not be accepted until the interrupt is cleared by an AIO or HIO instruction, or manually (I/O reset from computer control panel).
1,2	Device Condition		A combination of these two bits indicates the current device condition.
		00	Device Ready.
		01	Device Not Operational – Manual intervention required to clear "not operational" condition.
		10	Device Unavailable – Not applicable.
		11	Device Busy.

Table 6. Device Status Response for SIO, TIO, and HIO (cont.)

Bit Position	Function	State	Meaning
3	KSR Mode ASR Mode – Automatic or Manual	0	The KSR keyboard/printer is always in the "automatic" mode. Reader or punch in "manual" mode; reader is in STOP position or there is no tape in it (manual intervention required).
		1	Reader and punch are in "automatic" mode.
4	Unusual End	1	Execution of previous order terminated due to abnormal condition, as listed under "Unusual End Conditions".
5,6	Controller Condition		Same configurations as bits 1, 2.
7	Unassigned	0	Currently unassigned and always zero.

Table 7. Device Status Response for TDV

Bit Position	Function	State	Meaning
0-2	Unassigned	0	Currently unassigned and are always zero.
3	Reader-Manual Mode (ASR)	1	Reader is in the "manual" mode.
4	Off-line (ASR)	1	Device is being used off-line.
5-7	Unassigned	0	Currently unassigned and are always zero.

Table 8. Device Status Response for AIO

Bit Position	Function	State	Meaning
0-7	Unassigned	0	Currently unassigned and always zero.

Table 9. Operational Status Byte[†]

Bit Position	Function	State	Meaning
0-2	Unassigned	0	Currently unassigned and always zero.
3	Channel End	1	I/O operations have been terminated for any reason listed under "Channel End Conditions".
4	Unusual End	1	Execution of previous order terminated due to abnormal condition listed under "Unusual End Conditions".
5-7	Unassigned	0	Currently unassigned and always zero.

[†]For Sigma 2/3 computers; for Sigma 5/7 computers, see the "Operational Status Byte" in the applicable computer reference manual.

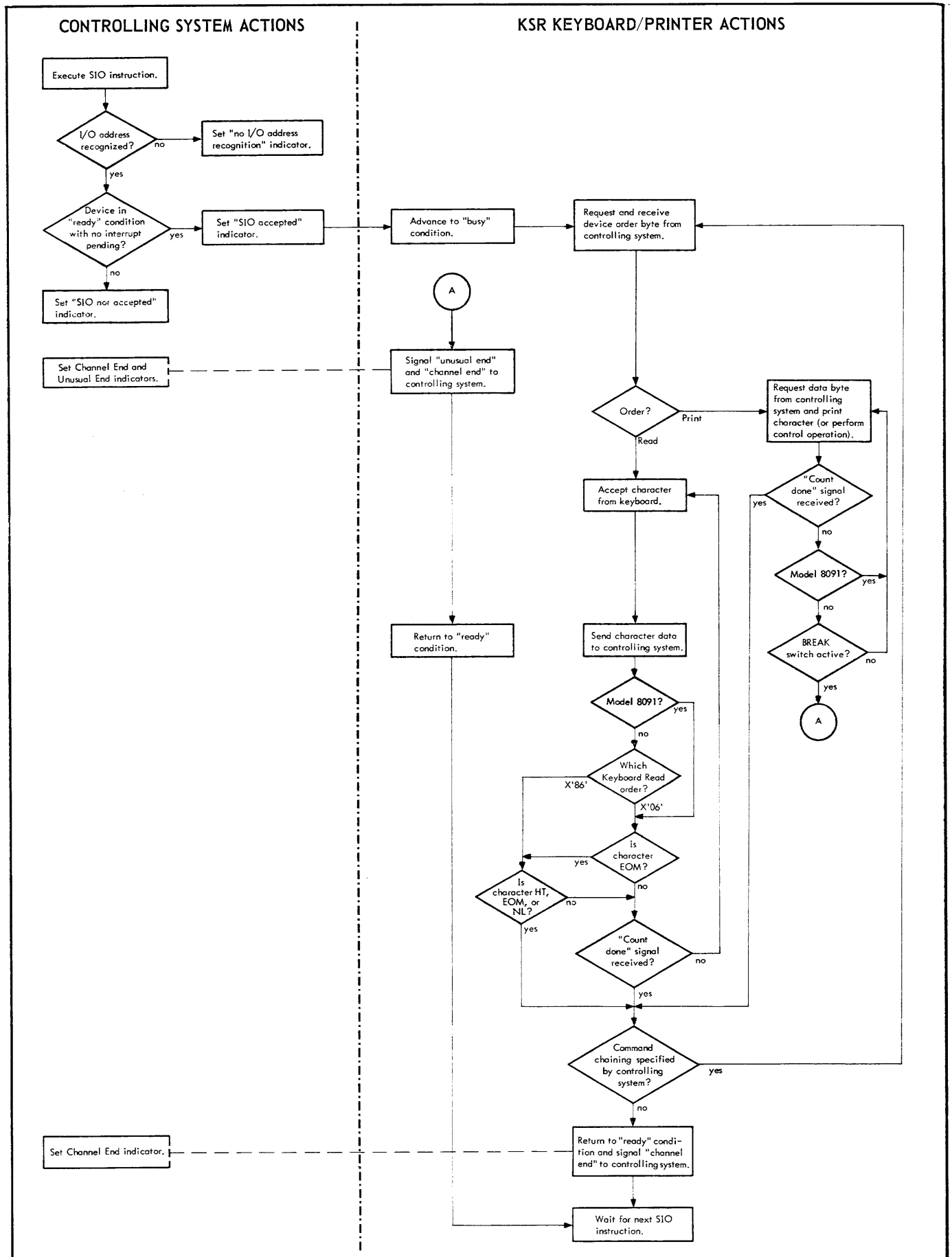


Figure 2. Controlling System – KSR Keyboard/Printer Actions

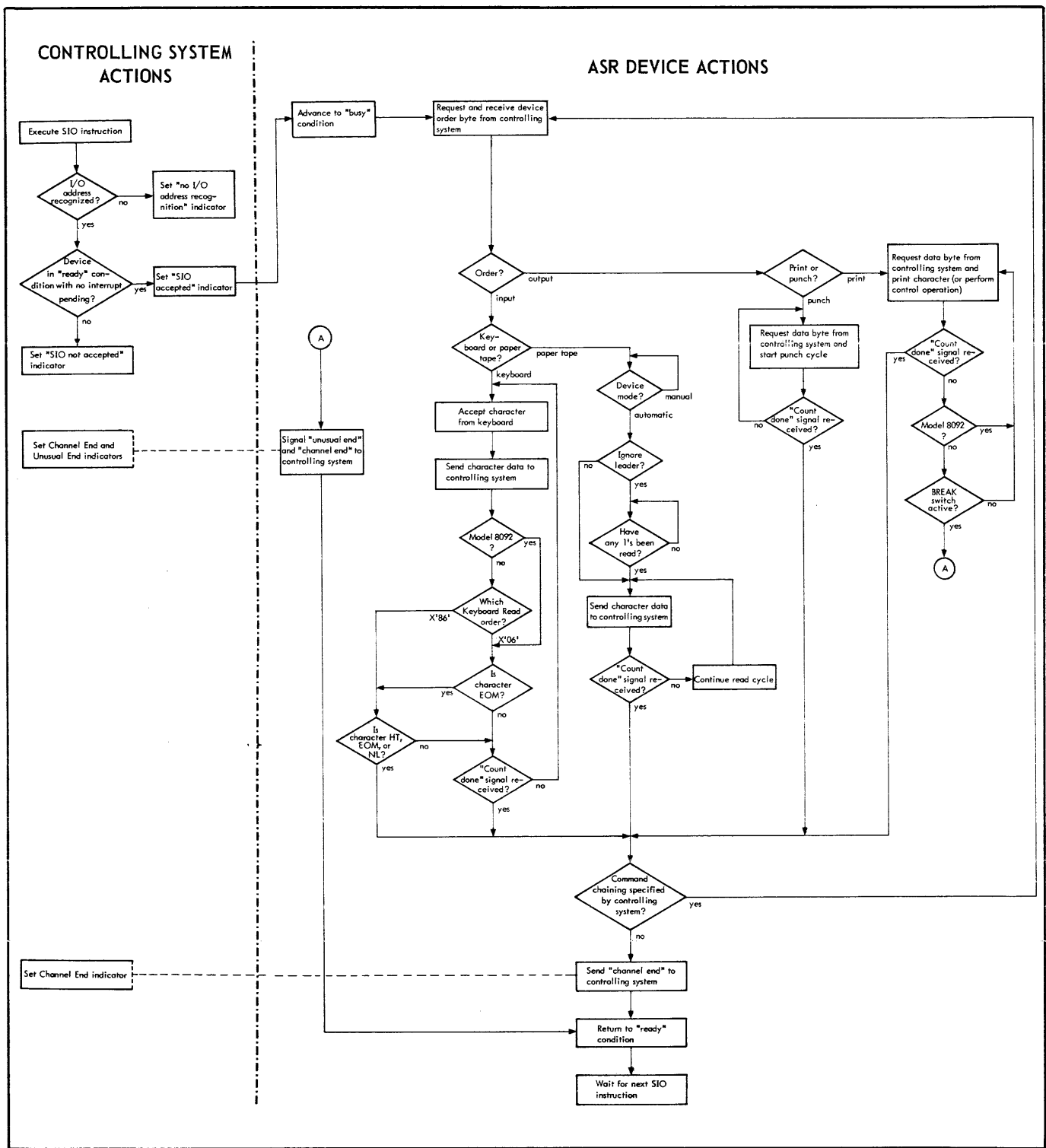


Figure 3. Controlling System/ASR Device Actions

4. OPERATIONS

KEYBOARD/PRINTER OPERATOR CONTROLS

The keyboard/printer control panels (see Figures 4 and 5) contain a standard typewriter upper-case keyboard and the following controls: power switch, KEYBOARD or INPUT lamp, BREAK switch, EOM (end-of-message) key, NEW LINE key, SHIFT keys, REPT (repeat) key, LOC LF (local line feed) key, LOC CR (local carriage return) key, and TAB (horizontal tabulator) key. The RUB OUT key and LOC BSP (local backspace) key are only on the ASR device.

POWER SWITCH

When this switch is ON, ac power is applied.

KEYBOARD OR INPUT LAMP

When on, this lamp indicates that the controlling system will accept information from the device.

END OF LINE LAMP

When this lamp is on, it indicates that the type box is within 5 characters of the end of the line.

BREAK SWITCH[†]

When this switch is pressed, output operations are halted. If an output operation was in progress, an "unusual end" condition results.

EOM (END-OF-MESSAGE) KEY

When this key is pressed, any message being input to the controlling system is terminated.

[†]Not operable on Model 8091 or 8092.

TAB KEY

When this key is pressed, horizontal tabulation occurs.

NEW LINE KEY

When this key is pressed, the type box is returned to the left margin and the paper is vertically advanced one or two spaces, or preset by the single/double line feed lever.

SHIFT KEY

This key causes the special character on the upper half of any key to be typed. (Upper-case letters are typed when this key is not used.)

REPT (REPEAT) KEY

Pressing this key plus any character key causes repetition of that character until the repeat key is released.

LOC LF (LOCAL LINE FEED) KEY

When this key is pressed, paper is advanced vertically at a rapid rate.

LOC CR (LOCAL CARRIAGE RETURN) KEY

When this key is pressed, the type box is returned to the left margin but the paper is not advanced.

Note that use of the REPT, LOC LF, and LOC CR keys do not result in codes being generated or in any action by the controlling system, but only the performance of their functions. The TAB, NEW LINE, and EOM keys transmit EBCDIC code combinations to the computer.

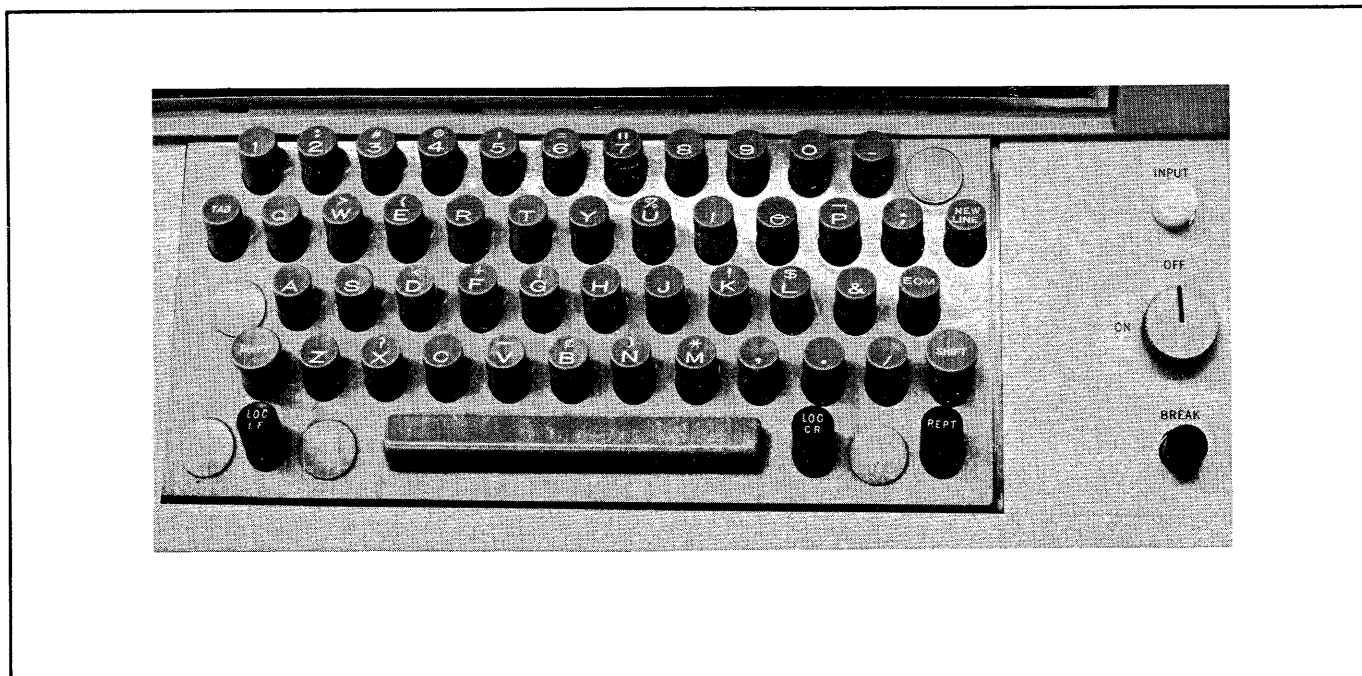


Figure 4. KSR Control Panel

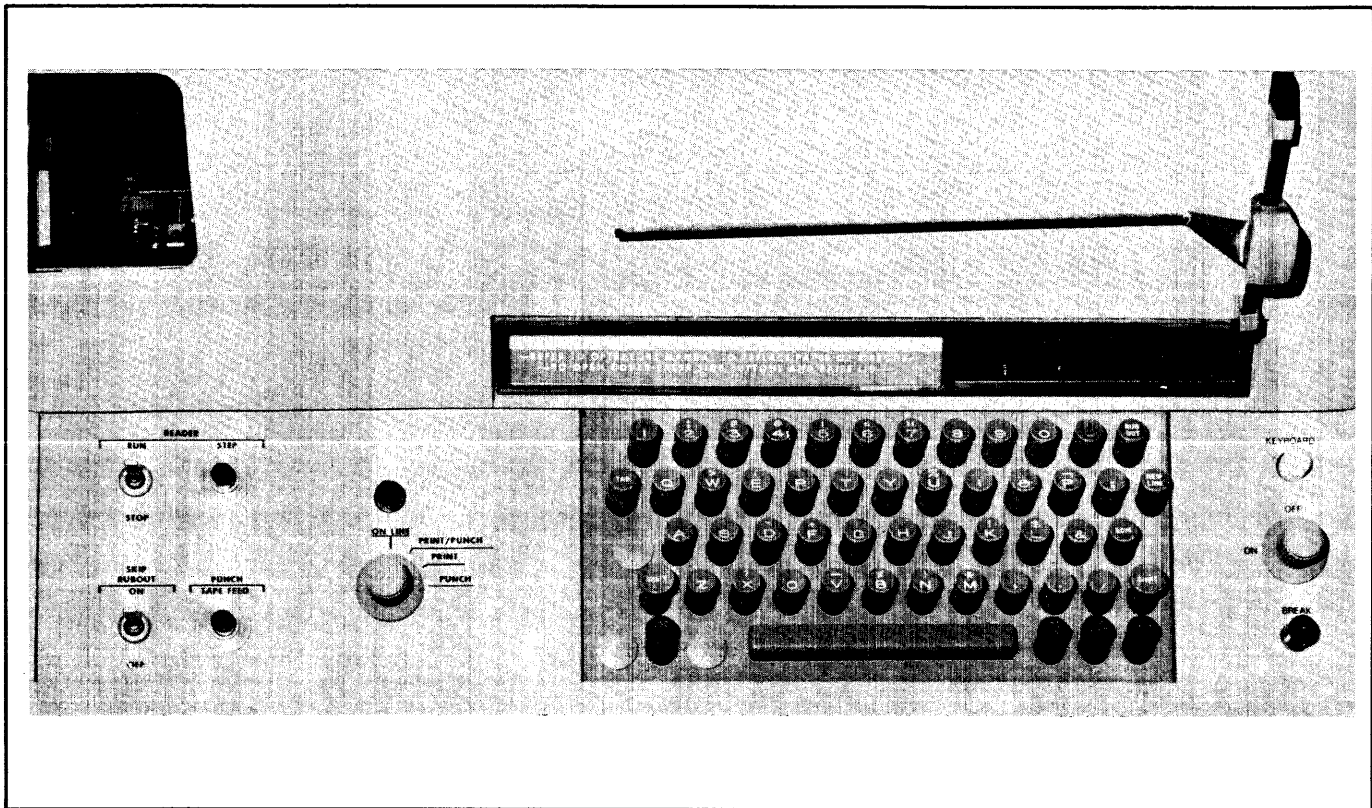


Figure 5. ASR Control Panel

LOC BSP (LOCAL BACKSPACE) KEY (tape operations)

Each time this key is pressed, the tape is backspaced one character.

RUB OUT KEY (tape operations)

Pressing this key causes a hole to be punched at every level on the tape (all 1's). It is used after a backspace operation (LOC BSP key) is performed to obliterate a mistake. (Also see "SKIP RUBOUT" in this section of the manual.)

READER/PUNCH OPERATOR CONTROLS (ASR)

The reader/punch controls are located to the left of the keyboard on the ASR device (see Figure 5). This device can operate as a free-standing unit for tape preparation and "hard copy" listing in addition to functionally replacing a Sigma keyboard/printer and high speed paper tape subsystem.

MODE SELECTOR SWITCH

The Mode Selector switch is a 4-position rotary switch that sets the device to either an on-line or off-line operating mode; there are three off-line positions.

ON LINE

When this switch is in the ON LINE position, the unit is under the control of the device controller.

PRINT/PUNCH

In this off-line mode, both the printer and punch respond to signal transmission from the reader or keyboard.

PRINT

In this off-line mode, the printer responds to signal transmission from the reader or keyboard.

PUNCH

In this off-line mode, the punch responds to signal transmission from the reader or keyboard.

If desired, "hard copy" (i. e. , keyboard to printer) and punched tape (i. e. , keyboard to punch) can be generated simultaneously. Also, duplicating punched tape (i. e. , reader to punch) and listing punched information (i. e. , reader to printer) can occur simultaneously.

ON LINE LAMP

When this lamp is lit, the unit is under the control of the device controller in the on-line operating mode.

READER RUN/STOP

When this 2-position switch is set to the RUN position, the reader reads tape continuously.

READER STEP

This momentary pushbutton switch causes the reader to read one character for each switch depression.

SKIP RUBOUT

When this 2-position switch is set to the ON position, the reader transmission of the character "rubbed out" is inhibited.

PUNCH TAPE FEED

This momentary pushbutton switch causes tape to advance through the punch and generate leader.

OPERATING PROCEDURES

The main operating procedures for the units are given in this section. The material on ribbon and paper loading includes specifications for reordering.

The following is one procedure that may be used to input and output data via the keyboard/printer and a Sigma computer. It is assumed that the program will execute the necessary instructions to start the input or output operation.

INPUT OPERATION

1. Turn the power switch to ON. When an order has been received to input from the keyboard, the KEYBOARD or INPUT lamp located directly above the power switch will light, indicating that the device is ready for typed input.
2. Press the LOC CR (Local Carriage Return) key to return the carriage to the leftmost typing position.
3. Press LOC LF (Local Line Feed) key to move the carriage up vertically. (The single or double vertical line spacing lever (see Figure 8 or 9) should be preset to determine spacing.)

Note: If the LOC LF key is held down, the paper will continue to advance vertically.

4. Type inputs into the computer. There are only upper-case keys in this device. The End-of-Line lamp will light when the typed line is within 5 characters from the right-hand margin.
5. Press the NEW LINE key to upspace and return carriage to the left.
6. Press the EOM (End-of-Message) key to terminate inputs.

OUTPUT OPERATION

1. Turn the power switch to ON. The device is now ready for data to be output from the computer.
2. Press the BREAK switch to halt output printing[†].

PAPER LOADING

An initial supply of paper is provided with the keyboard/printer. When new supplies of paper are required, refer to Table 10 for the specifications.

Table 10. Paper Specifications

Characteristics	Specifications
Form Width	8-1/2 in.
Form Length	Fan-fold, continuous
Punch	Standard edge punched (1/2 in. centers)
Number of copies	
1 part	15-lb white sulfite bond
2, 3, 4, and 5 part	12-lb white sulfite bond (with carbon paper between layers)

The paper is in a fan-fold ream, 8-1/2 inches wide, in a box at the rear of the typing unit. The procedure for loading paper is as follows:

1. Press and hold the two release buttons (see Figure 6 or 7) located on the lower front sides of the upper cover. Lift cover.
2. Bring the leading edge of the paper through the opening at the rear of the device.
3. Bring the paper over the paper-straightening shaft, and downward beneath the platen.
4. Press the PUSH lever (see Figure 8 or 9) to release the paper dispenser.
5. Push down on the platen handwheel and rotate it to the rear, causing paper to be passed beneath and around the platen. As the paper is turned around the platen, engage the feed sprockets with perforations along the edges of the paper. Push paper fingers forward and down.
6. Raise the PUSH lever to reengage the paper dispenser.
7. Lower cover.
8. Raise the plastic bubble by pressing against the thumb grips and applying an upward motion. Advance the paper by turning the platen handwheel to the rear until sufficient paper protrudes from the copy glass window when the bubble is lowered. The device is now ready for typing.

[†]Not operable on Model 8091 or 8092.

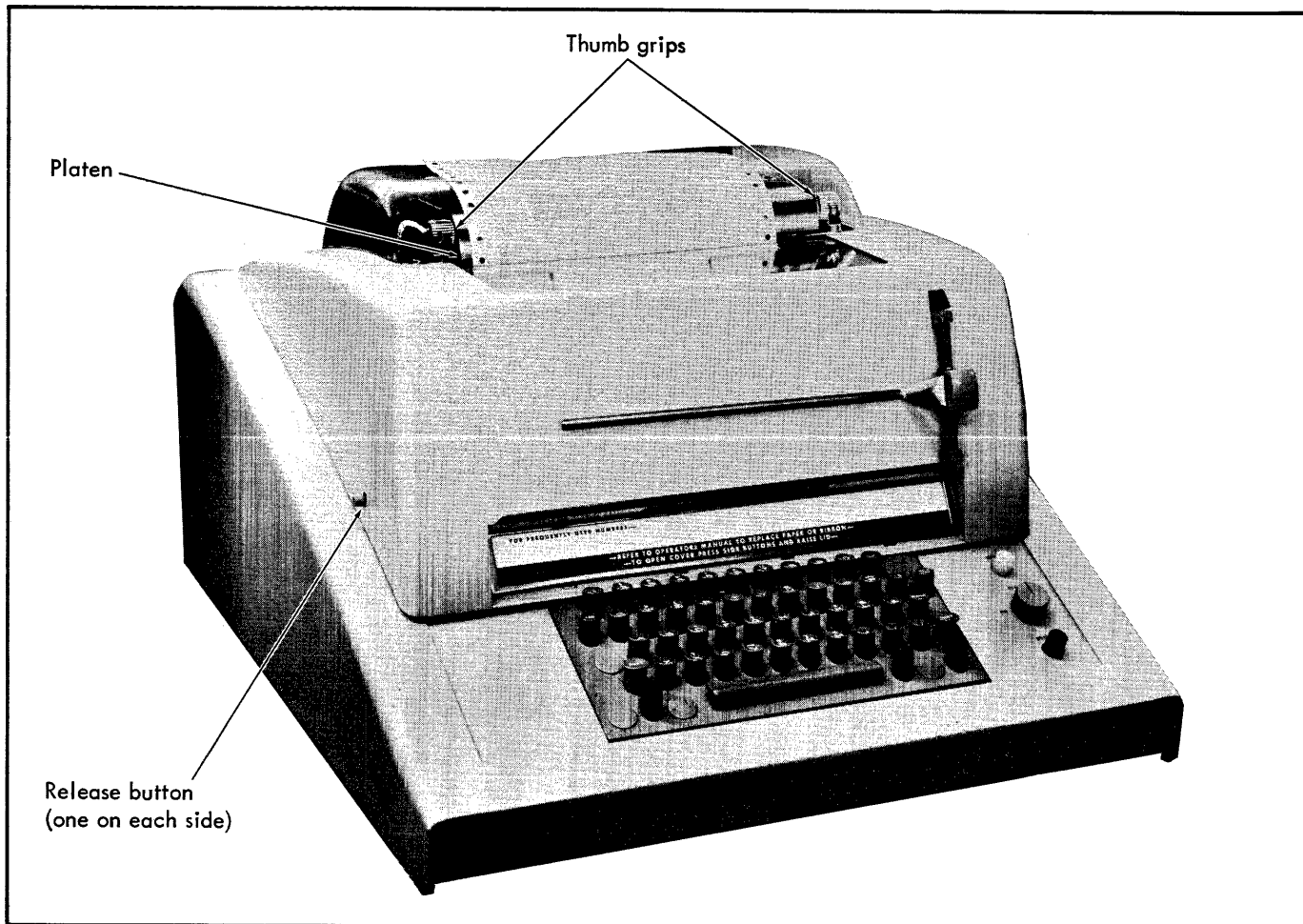


Figure 6. Top View of KSR Unit

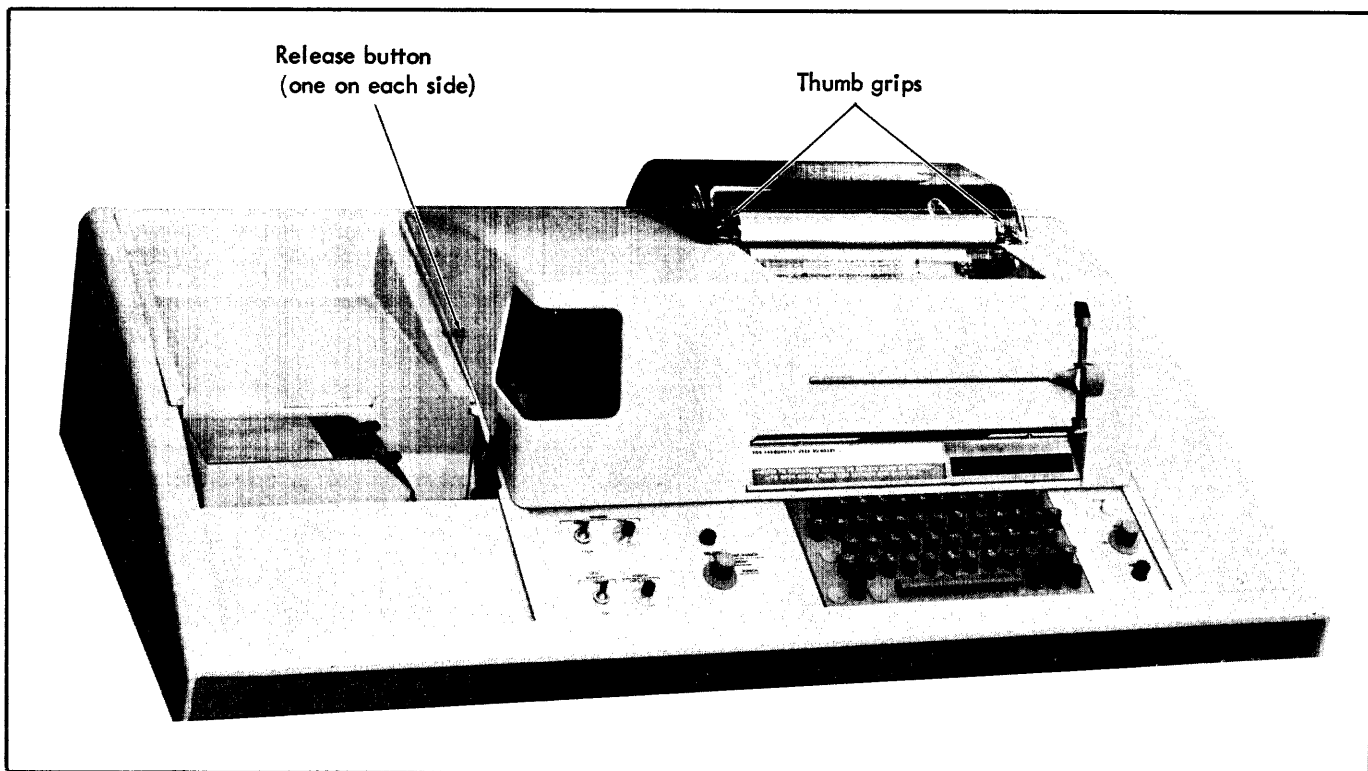


Figure 7. Top View of ASR Unit

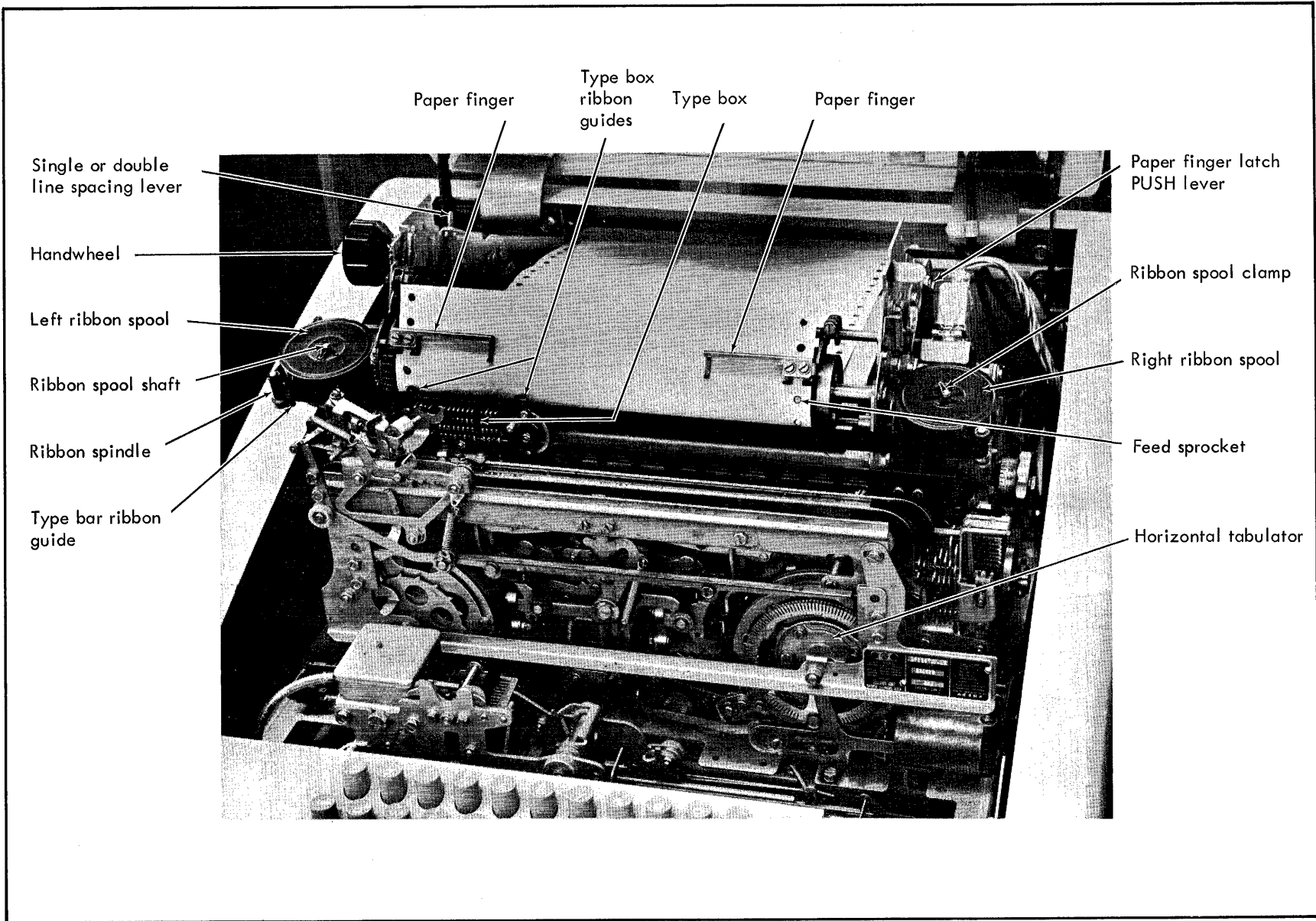


Figure 8. KSR Unit with Cover Removed

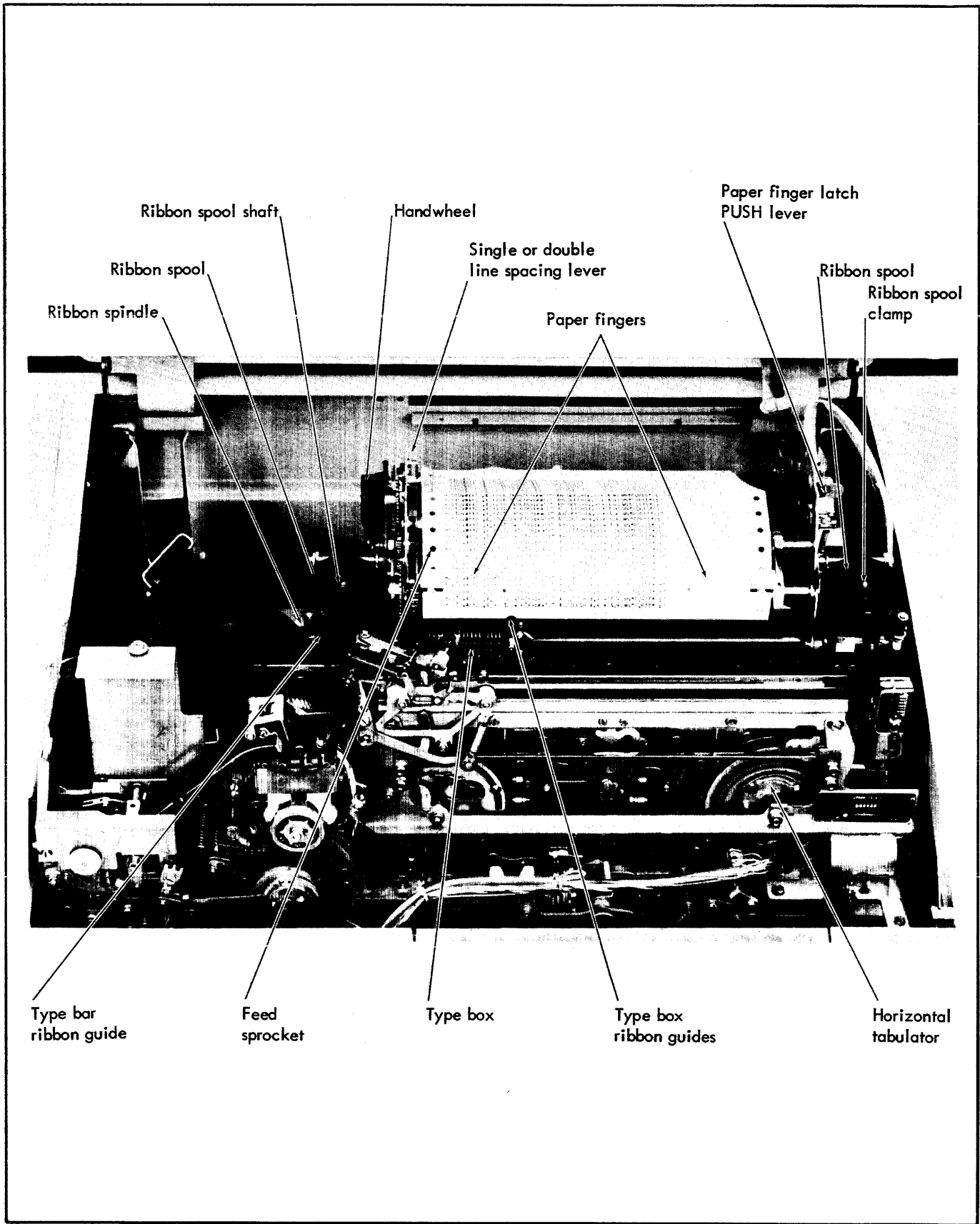


Figure 9. ASR Unit with Cover Removed

RIBBON LOADING

When the ribbon supplied with the keyboard/printer becomes unusable and must be replaced, refer to the specifications listed in Table 11.

Table 11. Ribbon Characteristics

Characteristics	Specifications
Width	1/2 in.
Length	18 yards
Material	Nylon, "Buckeye bond"
Ink Color	Black Record #3

The ribbon-changing procedure is as follows:

1. Lift the ribbon spool clamps on top of both ribbon spools and lift the spools off the spool shafts.
2. Hook the end of the ribbon from the new spool to the inside of an empty spool. Wind the ribbon a few turns until the metal grommet on the ribbon is between the spool shaft and ribbon spindle.
3. Mount ribbon spools on spool shafts so that the ribbon flows from the outside of the left spool, around the outside of the left ribbon spindle, through the left type bar ribbon guide, through the ribbon guides at the rear of the type box, through the right type bar ribbon guide, around the outside of the right ribbon spindle, and back to the outside of the right ribbon spool.
4. Depress both ribbon spool clamps to secure the ribbon spools.

HORIZONTAL TABULATOR MECHANISM

The upper cover must be lifted to expose the horizontal tabulator mechanism located on the right front side of the machine (see Figure 8 or 9). Press and hold the two release buttons on the lower sides of the upper cover and lift the cover.

RIGHT MARGIN TABULATOR STOP SETTING

The procedure for setting the right margin tabulator stop is:

1. Position the printing carriage by moving it manually to the right margin.
2. Insert right margin tabulator stop with wide shelf in the slot immediately to the left of the tabulator pawl. The shelf should extend to the right so that the pawl rests on it.

TABULATOR STOPS SETTINGS

The procedure for setting the tabulator stops (see Figure 10) is:

1. Hook small spring hook in the hole in the tabulator stop and pull straight out from drum. Slide the stop on the spring while continuing to pull out from the drum. Position the drum to facilitate moving the stops.
2. Check that all stops are fully seated in the slots and not turned sideways.

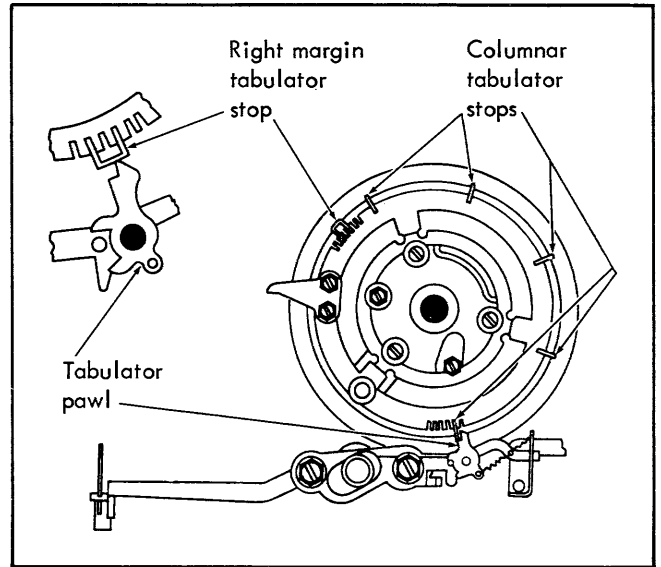


Figure 10. Horizontal Tabulator Mechanism

To set the mechanism for columnar information, the following procedure is suggested:

1. Place carriage in position to print first character in column. Insert stop in slot immediately to left of tabulator pawl.
2. Mark the desired slot position and rotate the drum to an accessible position. For slots near left margin, count number of space operations from the left margin and place the stop in the corresponding slot number, beginning with slot no. 1 just to the right of the roller.
3. When printing forms, check stop settings in relation to columns. Corresponding stops on all machines connected in a circuit must be the same number of spacing operations from the left margin.

READER LOADING (ASR)

The procedure for loading tape in the reader (see Figures 11 and 12) is:

1. Place the START-STOP lever on the reader in the RUN position.
2. Raise the tape lid by pressing the red tape lid button.
3. Insert tape between the adjustable tape guides and on the tape feed wheel so that the feed wheel protrudes through the sprocket holes. The tape should not be taut. A tight tape sensing device on the tape lid stops transmission if the tape becomes taut or tangled.

Note: An index line has been scored in the tape guides 0.600 inch (six characters) ahead of the sensing pins to aid in aligning tape start position.

4. Close the tape lid.
5. Place the RUN-STOP switch on the control panel in the RUN position. Place the Mode Selector switch in the ON LINE position.

The reader is now ready for on-line operation.

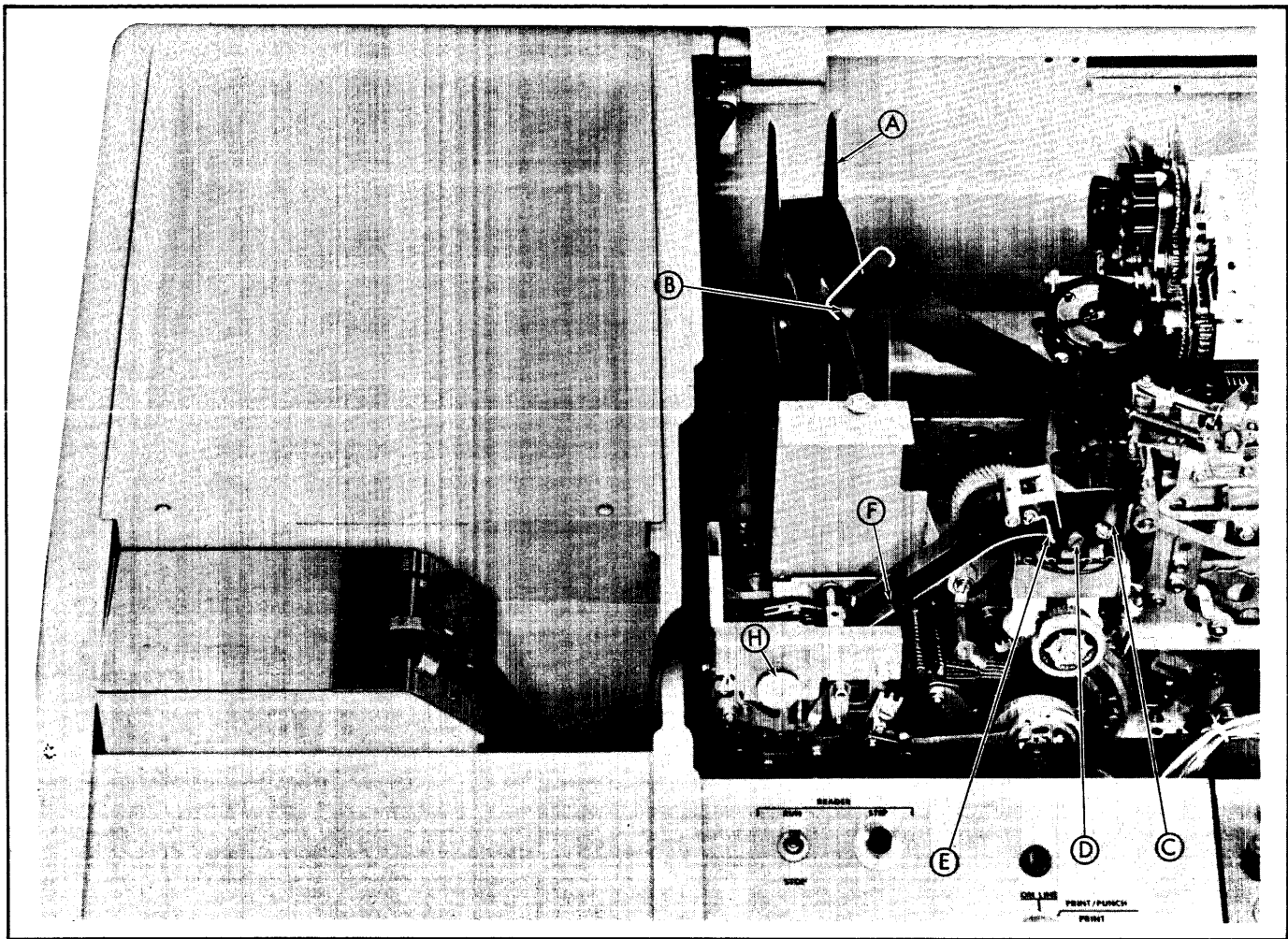


Figure 11. ASR Reader and Punch Mechanisms

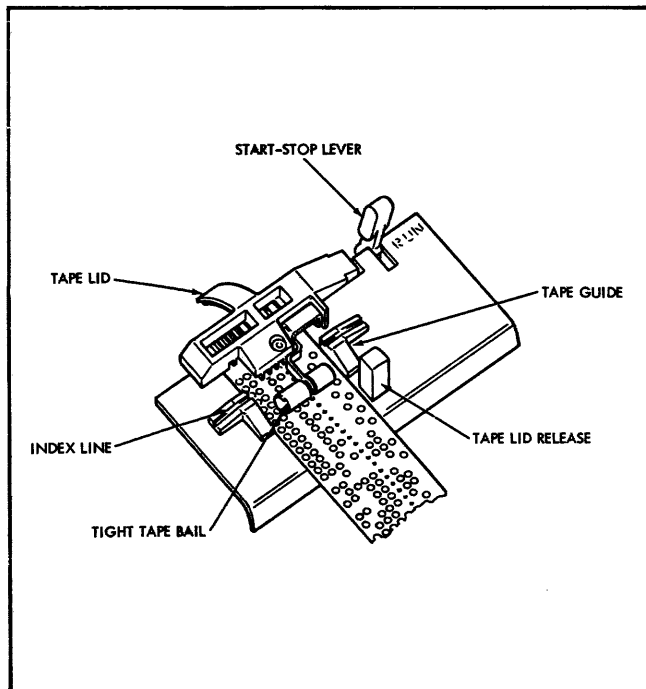


Figure 12. Reader Tape Guide Plate

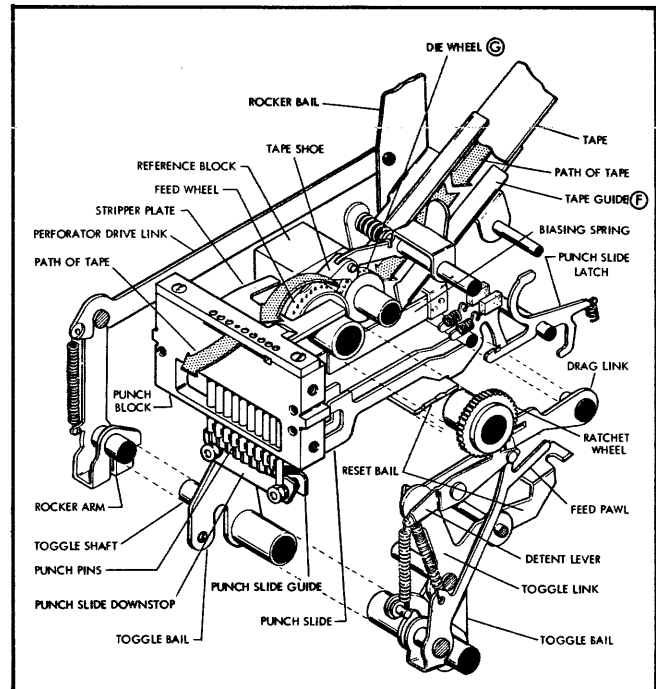


Figure 13. Punch Mechanism

PUNCH LOADING (ASR)

The procedure for loading the punch (see Figures 11 and 13) is:

1. Put a roll of blank tape on the tape reel and insert it in the tape container (A) with the tape unwinding from the top of the roll.
2. Pull the tape through the wire holder and over the first roller (B), around and under the second roller (C), over the stud (D), under the "anti-backup" latch (E), and insert into the tape guide (F).

3. Push the tape down as far as it will go until it touches the die wheel (G).
4. Place the Power switch in the ON position and the Mode Selector switch in the PUNCH position.
5. As the PUNCH TAPE FEED button is pressed (with the left hand), push the tape down (with the right hand) until several inches of leader with sprocket holes are punched.

Note: There is a manual feed wheel (H) on the punch unit to move the tape, if needed.

APPENDIX

SIGMA 5/7 PROGRAMMING EXAMPLE

The following coding sequence illustrates addressing a keyboard/printer, accepting one byte of information from the device, and returning control to the main program to process this byte. The device is checked to determine if a typing operation is in progress. If so, the routine waits for it to be completed. The interrupt system is used to signal the completion operation; however, the instructions that set up and respond to the interrupts are not included in this example. This coding sequence makes no provision for data or command chaining.

This same coding sequence could be used as an output routine by changing the order field in the command doubleword to specify an output operation. The command doubleword requests interrupts at "channel end" and any "unusual end". (Note that a transmission error is defined as an "unusual end".)

<u>Label</u>	<u>Command</u>	<u>Argument</u>	<u>Comments</u>
KEYBOARD	TIO, 8	TYPERS	Test typewriter status
	BCR, 12	STARTIO	Exit to STARTIO if typewriter is ready
	LB, 9	9	Returned status is in register 9
	CI, 9	X'20'	Check for busy or not operational
	BCR, 4	NOTOP	Branch to error routine if not operational
	SLS, 8	1	Form command pair word address
	LB, 10	*8	Get order byte for ongoing operation
	CI, 10	X'05'	Check for "Type" order
	BCR, 3	KEYBOARD	If "Type" order, wait for operation to terminate
	HIO, 0	TYPERS	If other than "Type", halt operation
STARTIO	LI, 0	DA(COMDW01)	Load doubleword address of command pair
	SIO, 8	TYPERS	Start the typewriter
	BCS, 12	ERROR1	Branch to error routine if SIO is refused
	WAIT		Wait for interrupt
	B	MAINPROG	Branch to main program to process the character
COMDW01	BOUND	8	Establish doubleword boundary
	GEN, 8, 24	X'06', BA(BUFFER)	I/O command pair
	GEN, 8, 24	X'1C', 1	-Read keyboard -Interrupt on channel end -Halt on transmission error -Interrupt on unusual end
			Byte count = 1
TYPERS	EQU	X'101'	I/O address - IOP1, Device 1
BUFFER	RES	1	Reserve one word (4 bytes) for the character being input

The following coding sequence illustrates a paper tape reader program for use with an XDS Sigma 5/7 Computer. The program will perform a read operation and return to the main program. This program is written as a subroutine entered by a Branch and Link instruction using register 15 (i.e., BAL, 15 RDTAPE).

<u>Label</u>	<u>Command</u>	<u>Argument</u>	<u>Comments</u>
RDTAPE	LI, 0	DA(IOCDR)	Load general register 0 with the doubleword address of the I/O control doubleword for the read operation
STARTIOR	SIO, 10	5	Start the Reader for device 5 on IOP 0
	BCS, 8	NIOAR	Branch to no-I/O-address-recognition routine (not shown)
	BCS, 4	BUSY	Branch to the "busy" routine (not shown) if the reader is busy or an interrupt is pending
TESTIOR	TIO, 10	5	Test the Reader's status (general register 11 will contain status response)
	CW, 11	L(X'2000000')	Compare bit 1 for a "busy" condition
	BCS, 4	TESTIOR	Branch to TESTIOR if the Reader is "busy"
	CW, 11	L(X'2AFE0000')	Compare status for error
	BCS, 4	ERRORR	Branch to ERRORR routine (not shown) if a fault condition exists
	BCR, 0	*15	Return to the main program
	BOUND	8	
IOCDR	GEN, 8, 24	X'2', BA(TABLER)	These two directives define the I/O command doubleword: -Read ignoring leading null frames -Halt on transmission error -Byte count 100
	GEN, 8, 24	X'8', 100	
TABLER	RES	25	Reserve 25 words for storing message

The following coding sequence illustrates a paper tape punch program for use with an XDS Sigma 5/7 Computer. The program will perform a punch operation and return to the main program. This program is written as a subroutine entered by a Branch and Link instruction using register 15 (i.e., BAL, 15 PNTAPE).

<u>Label</u>	<u>Command</u>	<u>Argument</u>	<u>Comments</u>
PNTAPE	LI, 0	DA(IOCDP)	Load general register 0 with the doubleword address of the I/O control doubleword for the punch operation
STARTIOP	SIO, 10	5	Start the Punch for device 5 on IOP 0
	BSC, 8	NIOAR	Branch to the no-I/O-address-recognition routine (not shown)
	BCS, 4	BUSY	Branch to "busy" routine (not shown) if the Punch is busy or an interrupt is pending
TESTIOP	TIO, 10	5	Test the status of the Punch (general register 11 will contain the status response)
	CW, 11	L(X'2000000')	Compare bit 1 for a "busy" condition
	BCS, 4	TESTIOP	Branch to TESTIOP if the Punch is "busy"
	CW, 11	L(X'AFE0000')	Compare status for error
	BCS, 4	ERRORP	Branch to ERRORP routine (not shown) if a fault condition exists
	BCR, 0	*15	Return to the main program
	BOUND	8	
IOCDP	GEN, 8, 24 GEN, 8, 24	X'1', BA(TABLEP) X'8', 100	These two directives define the I/O command doubleword: -Punch -Halt on transmission error -Byte count 100
TABLEP	RES	25	Reserve 25 words for storing message

SIGMA 2/3 PROGRAMMING EXAMPLE

The following coding sequence for a Sigma 2/3 Computer illustrates addressing a keyboard/printer, accepting four bytes of information from the device, and reading the information into a buffer. All status information encountered is saved for user housekeeping. The routine will hang up on a WAIT instruction if the I/O interrupt process was not operational.

Alternatively, this coding sequence may be used as an output routine by changing the "ORDER" location to "5" and storing pertinent information in the buffer "BUFF". The locations CHECK 1-4, will contain additional coding depending upon the user's requirements.

The routine is called by the following instruction sequence:

<u>Label</u>	<u>Command</u>	<u>Argument</u>	<u>Comments</u>
	LDA	=X'200'	Arm and enable
	WD	*WD1	I/O interrupt
	LDA	=TYPEINT	Set up I/O interrupt
	STA	X'106'	Store in interrupt location
	RCPYI	P,L	Save return address in L
	B	TYPE	Branch to routine
WD1	DATA	X'1200'	I/O interrupt constant
<u>Read Keyboard Routine</u>			
TYPEINT	DATA	0,0	A doubleword reserved to store the program status doubleword when the interrupt is effected. It is followed by the coding of the routine itself.
	AIO		
	:	:	
	WD	X'D8'	Signals end of interrupt routine and effects exit sequence from it
	LDX	TYPEINT	Uses the routine's entry address, which is location of doubleword containing return address of the point in main program at which it was interrupted
TYPE	LDA	IOADD	IOADD contains the device address
	TIO		Test this device address
	STA	TIOSTAT	Save status response from TIO
	BNO	\$+2	Branch if device number was recognized
	B	CHECK 1	Branch if no device number was recognized
	BNC	\$+2	Branch if I/O operation can be accepted
	B	CHECK 2	Branch if I/O operation can not be currently accepted
	LDA	IOADD	Fetch the device address to extract device number
	AND	=X'1F'	
	RADD	A,A	Multiply by 2
	STA	CHANUM	Store channel number
	RCPY	A,X	
	LDA	ORDER	Fetch device order
	STA	*BUFFADD	Store order in buffer area
	LDA	BUFFADD	Fetch buffer address

<u>Label</u>	<u>Command</u>	<u>Argument</u>	<u>Comments</u>
	WD	8, 1	Load channel register
	LDA	=X'2000'	Load the interrupt flag bit
	ADD	BYTECT	Add the byte count
	ADD	=1	Add additional count for order byte
	WD	9, 1	Load second channel register
TYPE1	LDA	IOADD	Fetch the device address
	SIO		Execute I/O operation
	STA	SIOSTAT	Save status response from SIO
	RD	8, 1	Fetch operational status byte
	STA	OBSTAT	Save operational status byte which is set following the completion of the I/O operation
	BNO	\$+2	Branch if device number was recognized
	B	CHECK3	Branch if device number was not recognized
	BNC	\$+2	Branch if the SIO instruction was accepted
	B	CHECK4	Branch if the SIO instruction was not accepted
	WD	X'DO'	Wait for interrupt process completion
	RCPY	L, P	Return to user

Constants

IOADD	DATA	X'40'	Standard keyboard/printer device number
BYTECT	DATA	4	
ORDER	DATA	6	
BUFFADD	ADRL	BUFF	
BUFF	RES	2	
CHECK1	Device is considered to be not addressable. User may return from this point to location "TYPE", or alternatively execute other routines before returning.		
CHECK2			
CHECK3	I/O operation was not completed. User may return from this point to location "TYPE1", or alternatively execute other routines before returning.		
CHECK4			

The following coding sequence illustrates a paper tape program for use with an XDS Sigma 2/3 Computer. The program will perform a read or punch operation and return to the main program. It is written as a subroutine entered by a Register Copy and Increment instruction (RCPYI P,L) followed by a branch to either ENTERP (punch), ENTERI (read ignoring leader), or ENTERL (read including leader).

<u>Label</u>	<u>Command</u>	<u>Argument</u>	<u>Comments</u>
ERRCHK	DATA	X'1000'	
BZTEST	DATA	X'2000'	
PUNCH	DATA	X'01'	Order code
READI	DATA	X'02'	Order code
READL	DATA	X'82'	Order code
ORDER	RES	1	
IMAGE	RES	40	
IOCD1	ADRL	ORDER	
IOCD2	DATA	81	Byte count
P	EQU	1	Link to main program
L	EQU	2	Link to main program
T	EQU	3	
A	EQU	7	
ENTERP	LDA	PUNCH	Punch entry
	STA	ORDER	
	B	BEGIN	
ENTERI	LDA	READI	Read-ignoring-leader entry
	STA	ORDER	
	B	BEGIN	
ENTERL	LDA	READL	Read-including-leader entry
	STA	ORDER	
BEGIN	LDA	IOCD1	Load address of order
	WD	X'8'	
	LDA	IOCD2	Load byte count
	WD	X'9'	
	LDA	X'40'	Use standard keyboard/printer device

<u>Label</u>	<u>Command</u>	<u>Argument</u>	<u>Comments</u>
TEST1	TIO		Test device status
	BNC	\$+3	Branch if ready for SIO
	WD	X'DO'	Set wait FF to 1
		TEST1	Repeat test if device not ready
	SIO		Start I/O
TEST2	TIO		Test device status
	RCPY	A,T	
	LDA	BZTEST	
	RAND	*T,A	Reset busy indicator if busy
	BAZ	TEST2	Branch if busy
	RD	X'A'	Read operational status byte
	CP	ERRCHK	Error check
	BNC	ERROR	Branch on error
	RD	X'B'	Read error flag
	BAN	ERROR	Branch on error
	RCPY	L,P	Exit to main program
ERROR	B	ERR	Branch to error-recovery routine
	ADRL	ERR	