TP-09
A27-3013-0

IBM Systems Reference Library

System Components
IBM 2770 Data Communication System

This System Components manual describes the principles of operation of the component units of the IBM 2770 Data Communication System. The data link control characters, code structures, and timeouts associated with the Binary Synchronous method of transmission used by the 2770 are described. Also described are the operating characteristics of the various input/output devices and the specifications of the input/output media. Special features and specify features for all system units are included.

This manual comprises descriptions of individual units within the 2770 Data Communication System. For introductory information about the total 2770 system, refer to the *IBM 2770 System Summary,* Form A27-3014.

Preface

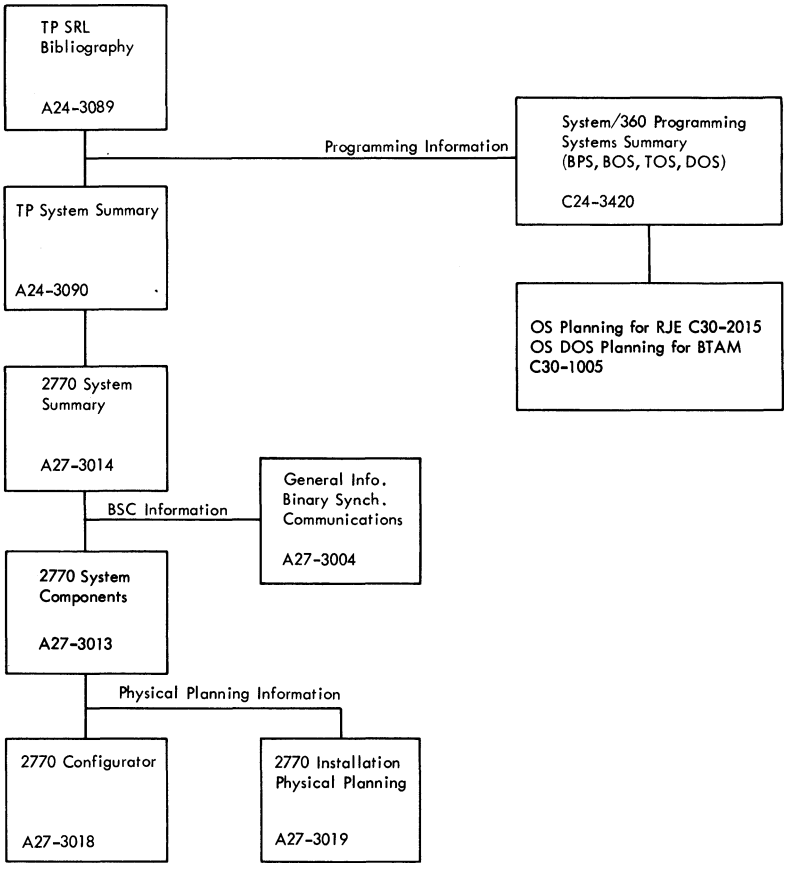
This manual presents detailed information about the units introduced in SRL, *IBM 2770 System Summary,* Form A27-3014, and assumes that the reader is familiar with the content of that summary. Those readers unfamiliar with the Binary Synchronous method of communications should also review SRL, *General Information—Binary Synchronous Communications,* Form A27-3004. Other manuals related to the 2770 system are shown in the availability guide below.

This manual is uniquely structured to permit easy customizing by the user. Each major section covers a class of device available for the 2770 (e.g., Control, Card, Paper Tape, etc.), and presents information on the functions, operating characteristics, features, controls, and error recovery procedures for the device(s) presented. Information common to all devices, such as data coding and format, and system error recovery procedures is included in the Control section of the manual.

Easy access to each section of the manual is provided by the index tags along the right edge of the master contents page. Each section contains its own contents (with its index tag), appendix, and index, so that it is essentially an independent entity within the manual. For additional convenience and flexibility, each machine unit description (e.g., 2772, 1017, 1018, 2502, etc.) has its own page-number and illustration-number series. Removal of non-applicable major sections or unit descriptions tailors the manual to match the configuration of the specific 2770 system. Thus, the user can design his copy to conform with his particular IBM 2770 System configuration.

2770 SRL Publications Availability Guide

Use this guide to determine what available publications will best fulfill your individual requirements.



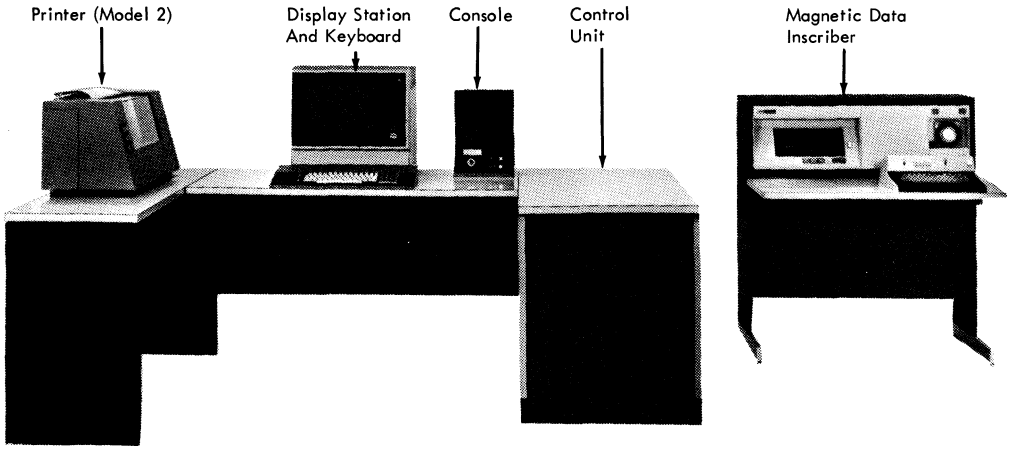
First Edition (August 1969)

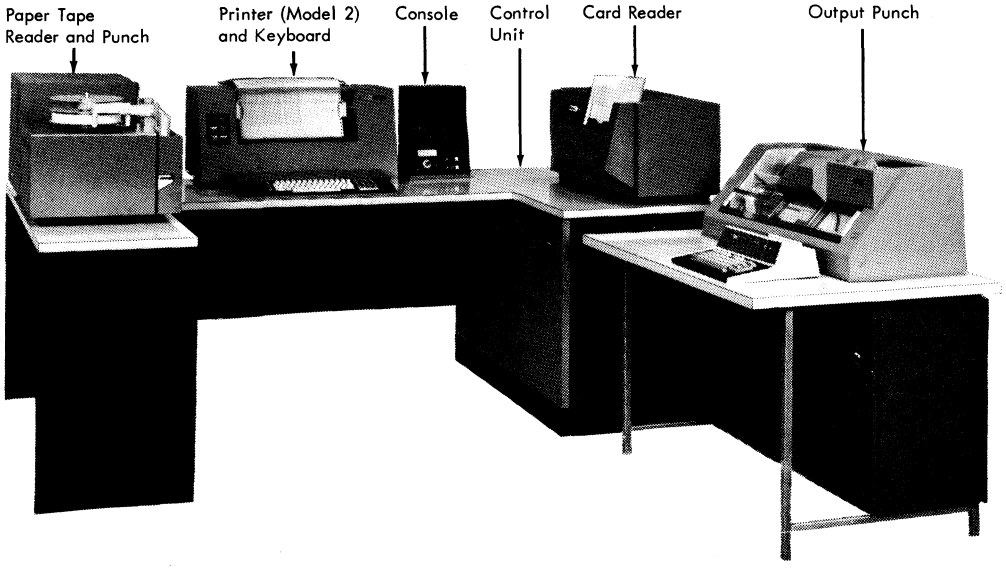
Changes are periodically made to the specifications herein; any such changes will be reported in subsequent revisions or Technical Newsletters.

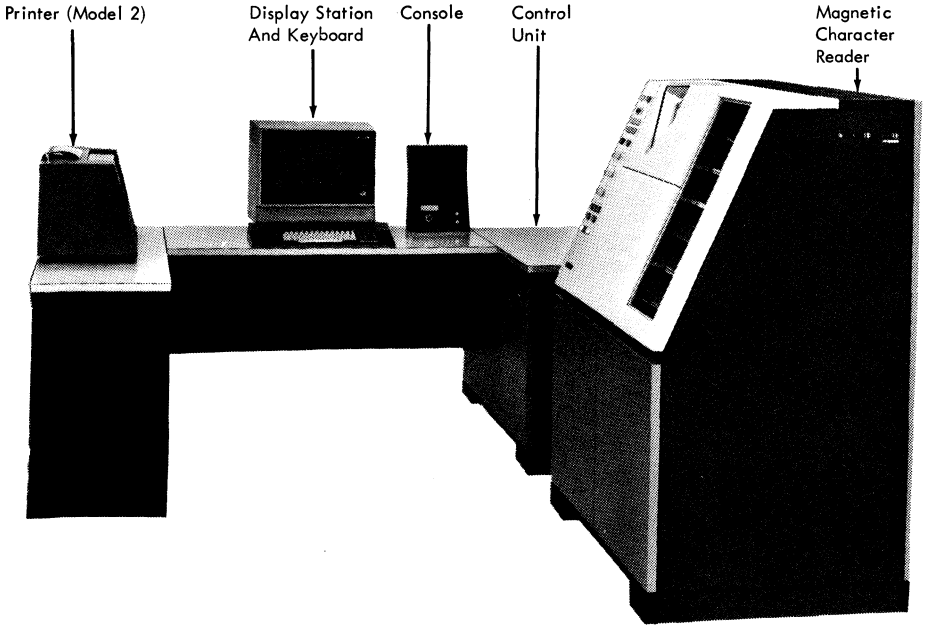
This manual has been prepared by the IBM Systems Development Division, Product Publications, Dept. 860, P. O. Box 12275, Research Triangle Park, North Carolina 27709. A form for readers' comments has been provided at the back of this manual. If the form has been removed, comments may be sent to the above address.

Master Contents

System Components: IBM 2770 Data Communication System







IBM 2770 Data Communication System: Three Typical Configurations

Introduction

The IBM 2772 Multi-Purpose Control Unit is the control unit of the IBM 2770 Data Communication System. The 2772 operates with a variety of media, and it uses the binary synchronous communications (BSC) procedures over leased, privately owned, or switched networks--in EBCDIC or USA-SCII code. Communication can be with another 2770 Data Communication System, with a System/360* Model 25-85 processor through a properly featured IBM 2701 or IBM 2703, or with a properly featured System/360 Model 25. The 2772, with features, may be multidropped on the same line facility with properly featured IBM 2770, 2780, 1130, and System/360 Model 20 tributary stations. When dial facilities are used, the same BSC feature installed on a 2701, 2703, or System/360 Model 25 (with ICA) can serve 2772, 2780, 1130, and System/360 Model 20 terminal stations.

The 2772 Control Unit and the associated table-top mounting area for input/output devices form an L-shaped or U-shaped layout (Frontispiece) that provides easy access to the system units from the operator's station. The console on the Control Unit reading board accommodates system controls and is centrally located immediately to the right rear of the keyboard position. The device location directly behind the keyboard position accommodates a visual display or printer.

The 2772 Multi-Purpose Control Unit affords two principal modes of operation: line mode or home mode. In line mode, the 2772 transmits data from, or receives data for, a selected input or output device. Device selection in line mode may be done by preplanned job setup, by processor programming, or by the operator. In home mode, the 2772 transmits data from an attached input device to an attached output device. Device selection in home mode may be done by preplanned job setup or by the operator.

The 2772 uses a monolithic-circuit storage unit. This storage unit is segmented into two block buffers for temporary data storage. These buffers alternate in use, sharing interfaces to the input or output devices and the communications line (see Figure 2772-1). In operational sequence, the 2772 accepts data character-by-character at the input interface and stores the data in a buffer. It retrieves data from a buffer, and sends the data character-by-character to the output interface. While one buffer is accepting input data, the other may be sending output data. Each buffer alternates its operation after completing input or output (Figure 2772-2).

*System/360 Model 25-85, as used in this manual, excludes Model 44 and also Model 67 except in Model 65 mode.

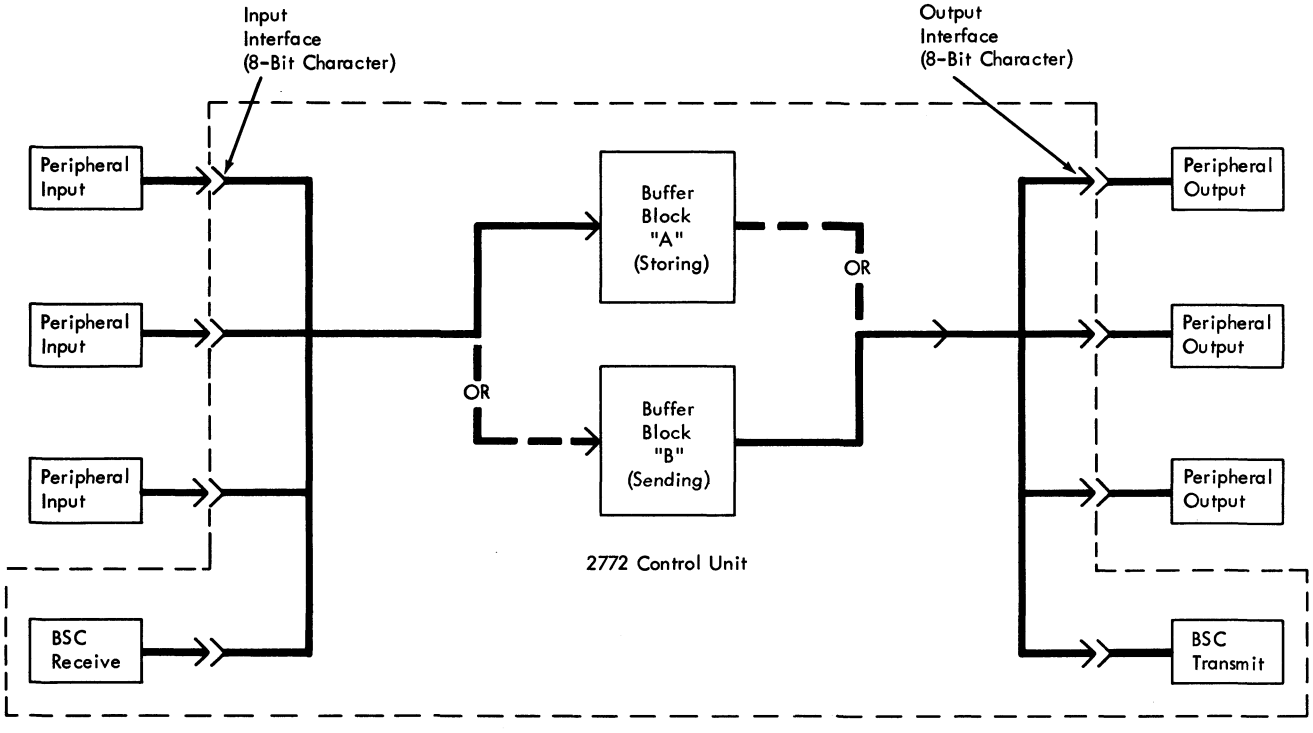
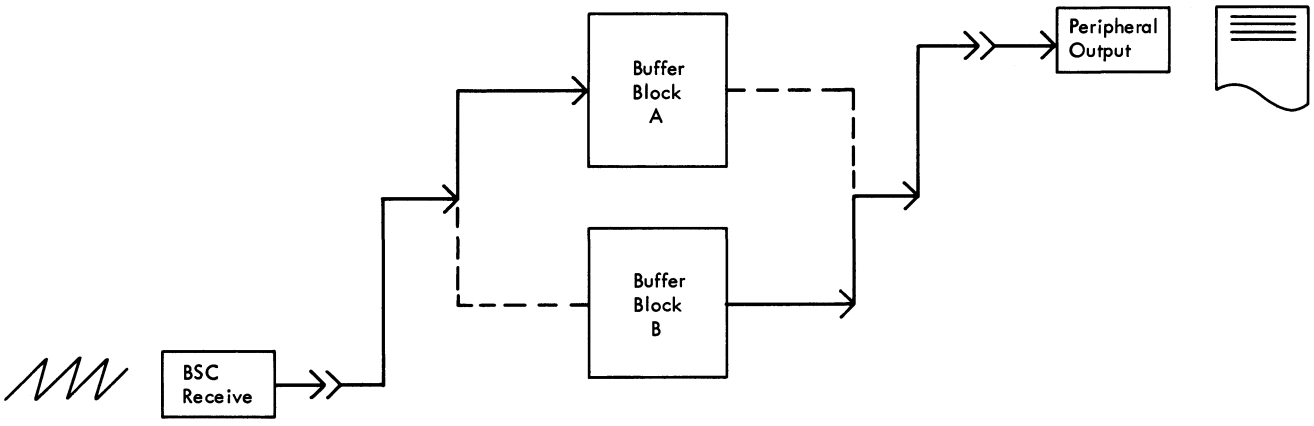
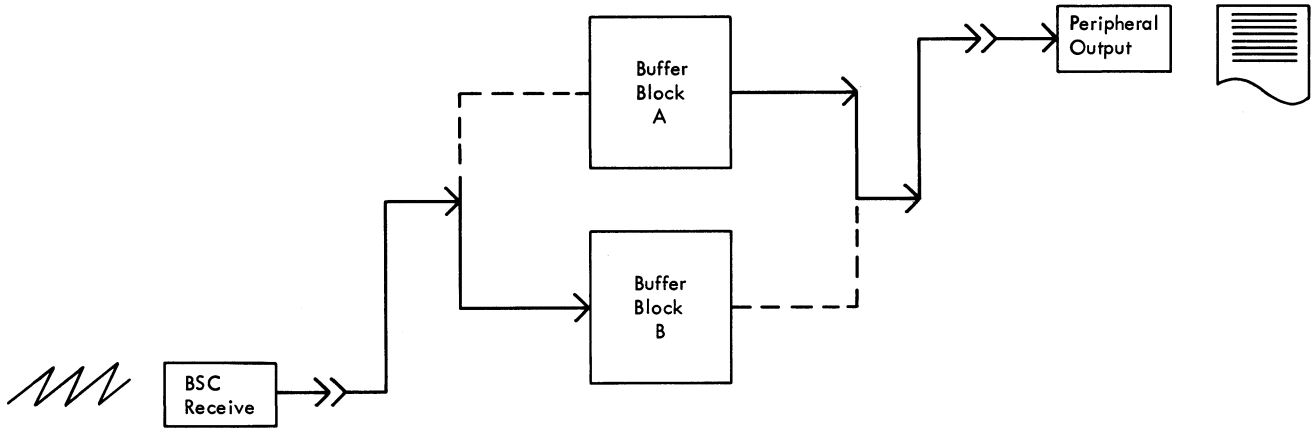


Figure 2772-1. Schematic of 2772 in a 2770 System



Buffer Block A Fills, B Empties



Buffer Block B Fills, A Empties

Figure 2772-2. Buffer Block Alteration

The advantages of this buffering scheme are:

a. It allows consistent line rate with variable I/O (input/output) rate.
b. It allows overlap of input and output operations.
c. It permits checking of data before output or transmission.

Data character movements, internal operations, and BSC are checked at many points within the 2772 (Figure 2772-3) and input/output devices attached to it. Diagnostic modes allow on-line and off-line testing. The Control Unit gives both visual and audible alarm when an error is detected.

Table 2772-1 presents the basic characteristics, specify features, and special features of the 2772 Multi-Purpose Control Unit.

KEYBOARD

The keyboard is the manual data input to the 2772. It can be used for inquiry or data-entry applications, or for heading information. The control keys provide for formatting of data. The keyboard also provides control functions for the Printer and/or Display Station.

The keyboard features a conventional typewriter-like arrangement of graphics keys and printer-function keys, and has convenient side locations for other control keys. Graphics and printer-function keys are interlocked to prevent depression of two keys simultaneously. The keyboard is locked when its use is inappropriate.

The keyboard can be specified in four layouts:

1. EBCDIC encoding for printer.
2. USASCII encoding for printer.
3. EBCDIC encoding for printer and display.
4. USASCII encoding for printer and display.

The design of the keyboard utilizes a simple, dependable, sealed-contact closure mechanism, resulting in a light, easy touch. Typamatic operation allows repetitive use of certain keys simply by pressing the key farther down.

Further information about the keyboard may be found under "Operating Characteristics--Direct Data."

Functions

The characteristic functions of the IBM 2772 Multi-Purpose Control Unit contribute to the versatility and broad applicability of the IBM 2770 Data Communication System. Descriptions of several of these functions, and the terminology used to describe them, are contained in the following paragraphs.

TERMINOLOGY

The following terminology is used to describe 2772 characteristics and functions throughout the remainder of this section.

- *Record.* The data in a single card, in a single MICR encoded document, in a single line of print, in a single display line, or defined by NL or IRS/RS characters.
- *Block.* A segment of data that is transmitted as a unit (block) and that causes a line turnaround to verify the accuracy of the transmission. A block is framed by appropriate transmission control characters, and is related to a record or records only when composed of card-formatted data.
- *Message.* A group of one or more blocks that represent an entity of data. A message is framed by appropriate transmission control characters, and is called a job.
- *Batch Operation.* A lengthy quantity of data that will be transmitted in a contiguous manner.

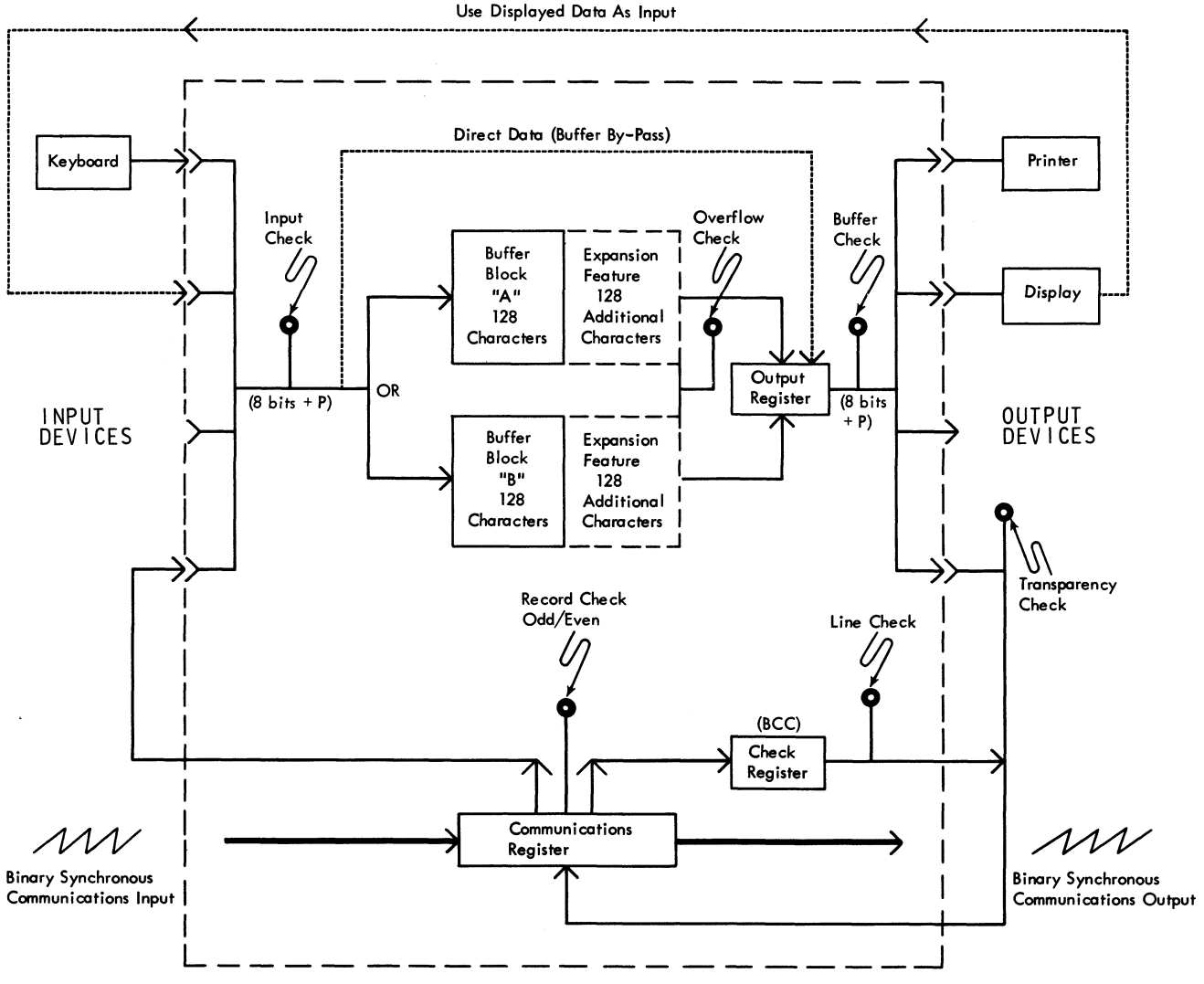


Figure 2772-3. 2772 Data Flow and Check Points

Table 2772-1. Summary of 2772 Characteristics, Specify Features, and Special Features

Buffers A and B

Basic -	128 characters each
Special Features -	Buffer Expansion (256 characters each) Keyboard Correction Transmit-Receive Monitor Print

I/O Media Attachments

Basic -	Keyboard
Special Features -	2213 Printer
	Two other media: 2265-2 Display Station, One or Two 50 Magnetic Data Inscribers, 1017 Paper Tape Reader and/or 1018 Paper Tape Punch, 2502 Card Reader and/or 545 Output Punch, or 1255 Magnetic Character Reader.

Line Communications

Basic -	Data set clocking (up to 2400 bits per second) Line mode Home mode Three response re-tries Processor Interrupt
Specify -	Data set interface (see IBM 2770 Data Communications System, Installation Manual--Physical Planning, form A27-3019) Fifteen response re-tries (EBCDIC) Point-to-Point (leased or privately-owned line) or switched network operation EBCDIC or USASCII code 2772-to-2772 or 2772-to-S/360 processor (CPU) operation Immediate WACK response
Special Features -	Multipoint Data Link Control Automatic Answering (switched network) EBCDIC Transparency Synchronous Clock (at 1200 bits per second) Conversational mode

Note: Special features unique to an I/O device are described in the applicable device section of this manual.

- *Line Mode.* An operating status that provides for transmitting or receiving communications line data.
- *Home Mode.* An operating status that provides for moving data from an attached input device to an attached output device.
- *Data Link Control.* Used here to refer specifically to binary synchronous communications terms, rules, and procedures. See "Operating Procedures–Binary Synchronous Communications (BSC)."
- *Hexadecimal or Hex.* A base-16 number system using digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, and F. Two hex digits define a S/360 byte. All-ones is denoted thus: Hex 'FF'.

COMMUNICATIONS FACILITIES

The communications facilities used by the IBM 2772 Control Unit must have appropriate modulation/demodulation capability. The communications facilities can be either leased common-carrier private line services (channels), common-carrier switched telephone networks, or equivalent privately owned facilities. When transmission speed is a primary consideration on private-line facilities, it may be advantageous to use a four-wire (full-duplex) channel because it can reduce significantly the time required to reverse the direction of transmission for control purposes. Although use of a four-wire (full-duplex) communications line can minimize turnaround delay, the 2772 cannot receive and transmit data simultaneously. It can perform half-duplex data transmission only. (Whether or not full-duplex charges apply depends on the local common carrier.)

Transmission speed depends on the type of communications facilities used, and must be specified when the IBM 2772 is ordered (Table 2772-2). The type of data set, and whether the terminal is to be used on two-wire or four-wire communications facilities, must also be specified when the 2772 is ordered (Table 2772-2).

CODE STRUCTURES

The IBM 2772 Multi-Purpose Control Unit can operate with either of two code structures. The choice will depend on the application. However, for system compatibility, the same code must be chosen for all terminals on a particular communications line. The two available codes are: EBCDIC (Extended Binary-Coded-Decimal Interchange Code) and USASCII (United States of America Standard Code for Information Interchange). A chart of each code, including card codes, is shown in the Appendix to this section. Not all the data-link control or format control characters available are used by the IBM 2772.

The eight-bit EBCDIC code provides 256 different characters. These 256 characters comprise the internal code structure of the IBM System/360, and the transmission of System/360 decks is possible when this code is used. The data-link and format control characters cannot be used as data unless the EBCDIC Transparency special feature is installed (see "Special Features"). The EBCDIC data-character bits (01234567) are transmitted low-order first (76543210) onto the line.

The USASCII code consists of seven data bits plus a check bit, which by its presence or absence provides each character with odd parity. The data-link control characters cannot be used as data characters. The order of USASCII-character bits (P7654321) over the transmission line is low-order to high-order--that is, 1, 2, 3, 4, 5, 6, 7, and check bit (P).

NOTE: A 2772 terminal equipped for the USASCII code will not operate with an IBM 2701 Data Adapter Unit or IBM 2703 Transmission Control equipped with the USASCII Transparency feature. It will not operate multidropped with stations that operate in USASCII transparency. The USASCII-equipped 2772 cannot encode or decode the EBCDIC code, or the USASCII code in transparent mode.

REDUNDANCY CHECKING

A redundancy check is performed on all communications line data. A check character is accumulated for each block of data at both the transmitting and receiving terminal. The check-character accumulation is initiated by, but does not include, the STX (start-of-text) framing character. All significant characters following the STX, to and including the end-of-block character, are part of the accumulation. The receiving terminal compares the received check character that follows the end-of-block character with the one it has accumulated. If the redundancy accumulations are different, an error has occurred.

Table 2772-2. Specify Communications Facilities

	1200 bps [1]	2000 bps	2400 bps	Two-wire (half-duplex)	Four-wire (full-duplex)
Private-Line Telephone Facilities (Leased or Privately Owned)	Note [2]	Note [2]	Note [2]	Yes	Yes
Switched Telephone Facilities (Leased or Privately Owned)	Note [2]	Note [2]	-----	Yes	No

[1] The IBM 2772 can operate at the speed of 1200 bps provided the Synchronous Clock special feature is installed (see "Special Features").

[2] Refer to IBM Tele-processing Systems Summary, form A24-3090-3 (or later) and any existing Technical Newsletters for specific common carrier equipment and services that may be used.

The method of accumulating the check character varies depending on the code being used:

EBCDIC--A 16-bit cyclic accumulation using the polynomial x16 + x15 + x2 + 1. This check character is sent as two eight-bit bytes and is referred to as the BCC (block check character).

USASCII--Odd-parity VRC (vertical redundancy check) on each character, and an eight-bit cyclic accumulation for the block using the polynomial x8 + 1 (LRC). The LRC (longitudinal redundancy check) character is sent as one eight-bit character. A VRC check is performed on the LRC character.

The redundancy-check character is accumulated serially by bit. A pad character follows the block-check character(s) to cause complete transmission of the last byte or character. For correct transmission of a record, the redundancy accumulation must be all zero bits after receiving the block-check character(s).

Therefore, the end-of-block-checking sequences are as follows:

EBCDIC	E B B p T C C a B C C d	E B B p T C C a X C C d
USASCII	E L p T R a B C d	E L p T R a X C d

In either code, transmission formats (data-link controls) are rigidly screened so that communication is orderly and accurate. Improper transmissions are ignored or rejected to avoid accepting faulty messages. Received or transmitted data blocks are counted odd-even-odd-even-odd-etc. by both transmitter and receiver, and their counts must agree at each block-check point (Figure 2772-4).

OPTIONAL MEDIA

The arrangements of alternating the buffer in servicing input and output to gain throughput efficiency, of the I/O selection capabilities, and of the independence of device speeds through buffering allow flexibility in configuring the terminal system to meet a user's individual requirements. Thus, the 2772 is designed to operate with keyed data, magnetic tape, paper tape, punched card, visual display, printed copy and MICR document media.

BUFFERING

The buffered-data concept of data transfer not only facilitates operation with various media at various rates, but provides a temporary area for data storage. If data communication over common-carrier lines is unsuccessful, the 2772 retransmits the data in the buffer.

Input to the buffer from the line is held until validated before output begins. This prevents erroneous output and avoids sorting good from bad output. Buffering makes possible the correction of keyed data held in the buffer before output to media or line occurs. (Keyboard Correction is a special feature for the 2772, but the correction function is basic with the 2265 Display Station Attachment.)

AUDIBLE ALARM

The audible alarm alerts the operator that the 2770 system requires attention. The alarm sounds for eight seconds with one of two intensities (wired by the Customer Engineer). One or more of the lights on the system console will light or flash to indicate the cause of the alarm, as follows:

At a transmitting 2772 terminal:

1. Failure to secure the communications line when attempting to transmit.
2. Aborting transmission after failing to get the correct response to a redundancy check.
3. Aborting a transmission because of an I/O or buffer error.
4. An EOT character is received in response to a redundancy check indicating that the receiving station is aborting transmission.
5. A disconnect occurs and the Automatic Answering feature is installed.
6. A data-link control character is detected in the data stream by the communication adapter, and the control unit is not in transparent mode.
7. A bid or selection sequence is received while the operator is keying data into the buffer. If the Check Reset Key is depressed to turn off the Terminal Addressed light, the alarm will sound again if another bid or selection sequence is received.
8. Aborting a transmission as a result of a request from an input device.

At a receiving 2772 Terminal:

1. Aborting a transmission because of an I/O or buffer error.
2. Receiving the BEL character.
3. An attempt has been made to select an output device that is not assigned, and ready to receive or a required component select character is missing from the data.

4. Aborting a transmission as the result of a request from an output device.
5. A buffer overrun condition has occurred.
6. A disconnect occurs and the Automatic Answering feature is installed.
7. The line is aborted because a block of data failed to satisfy a redundancy check (World Trade public switched network only).

At a 2772 in home mode:

A bid or selection sequence for that station is received on the communications line.

Refer to "Error Recovery Procedures" for the specific indications of alarm conditions, how to clear them, and how to proceed with the interrupted data communications.

MEDIA FORMATS INDEPENDENT OF TRANSMISSION FORMAT

The format of the data input or output medium--printed, displayed, or taped (magnetic or paper)--has customarily affected the blocking of transmission data, and vice versa. Through the use of output format controls that appear as format effector characters in text, units of the 2770 system are largely freed of this limitation. For example, the printer and display perform a new-line function in response to a function code (NL or IRS/RS) in text, independent of the buffer block. Thus, portions of a transmission block may print or be displayed on two or more lines, and a line may extend from one buffer into the other (Figure 2772-5). This results in maximized utilization of buffer capacity. The only requirement for matching medium format with transmission format exists when the output medium is punched-card.

Operating Characteristics

The IBM 2772 Multi-Purpose Control Unit handles data movements in an IBM 2770 Data Communication System. Through internal, automatic controls, and through manual controls on the system console or on the keyboard, the 2772 regulates the operation of the I/O devices, the alternating block buffers, and binary synchronous communications (BSC). The Control Unit also provides a direct-data function that sends keyed data character-by-character, generally to the Printer or Display Station.

The Control Unit also checks internal data movements and operations, and provides facilities for off-line testing of BSC. (On-line testing of BSC is a processor-programmed exercise resembling normal communication.)

BINARY SYNCHRONOUS COMMUNICATIONS (BSC)

Binary Synchronous Communications is a system of data-link control that uses standard terminology (Table 2772-3), control vocabulary and timing system (Tables 2772-4, 5, and 6), and sequence of operation under a given set of conditions (Figure 2772-4). These disciplines permit the same BSC adapter on the 2701 or 2703, or the same System/360 Model 25 Integrated Communications Attachment feature, to operate with the 2772, 2780, 1130, and System/360 Model 20. For intermixing these BSC devices, there must be conformity of data set, bit rate, machine features, and transmission code. The basic 2772 Control Unit is capable of ordinary point-to-point operation with another 2772 terminal or with a processor (S/360 Models 25-85). Wiring (by the factory or Customer Engineer) for 2772 operation with a System/360 processor (Models 25-85) enables counting of retransmissions exclusively by the processor (Tables 2772-4 and 5, and Figure 2772-4).

Special features are offered that expand the scope of BSC as used by the 2772 Multi-Purpose Control Unit (see "Special Features").

Further general information on data links and BSC may be found in the IBM Systems Reference Library publication, *General Information–Binary Synchronous Communications,* Form A27-3004.

NOTE: The bell signal (BEL character, Tables 2772-4 and 5) is an operator-to-operator signal. It can be used only with 2772-to-2772 connections when both terminals are on-line and idle.

PROCESSOR INTERRUPT

This feature provides for automatic interruption of a transmitting 2772 for priority transmission from a processor. The 2772 in turn interrupts the input device and completes transmission of buffer data to clear the buffer.

The 2772 recognizes the RVI character (see Table 2772-4) as an affirmative acknowledgment and as a signal to end transmission (Figure 2772-13). The Control Unit stops the input device at the end of the block and transmits the input data already in the buffer. The 2772 sends EOT following acknowledgment of the last input block and the processor bids for the line. A 2772 output device must be assigned and ready.

The incomplete message transmission is resumed by the 2772 after processor interruption if the 2772 Start key is pressed.

INPUT/OUTPUT DEVICE CONTROL

The maximum configuration of an IBM 2770 Data Communication System with 2772 Multi-Purpose Control Unit includes a keyboard, a Printer, and two I/O media. The Control Unit has facilities for device selection, for passing data and control to and from I/O devices during on-line (line mode) operation, for directly recording keyed data, and for passing data and control to and from I/O devices during off-line (home mode) operation.

A. Normal Message Transmission

		ODD		EVEN		ODD		EVEN	
Transmitting Station sends:	E	S	E	S	E	S	E	S	E	E
	N	T (TEXT)	T	T (TEXT)	T	T (TEXT)	T	T (TEXT)	T	O
	Q	X	B	X	B	X	B	X	X	T
Receiving Station sends:		A		A		A		A		A
		C 0		C 1		C 0		C 1		C 0

B. Contention for Master Status

				ODD				ODD	
Primary Station sends:	E	(1-sec. bid	E	S	E	E	A		A
	N	timeout)	N	T (TEXT)	T	O	C 0		C 1
	Q		Q	X	X	T	K		K
Secondary Station sends:	E	(3-sec. bid	A	A	E	S	E	E	
	N	timeout not	C 0	C 1	N	T (TEXT)	T	O	
	Q	completed)	K	K	Q	X	X	T	

Note: Initially calling station is conventionally the master station on switched networks; however, because of switched-network discipline, contention should not occur.

C. Unanswered Line Bid

Transmitting Station sends:	E	(1-sec. or 3-sec.	E	(1-sec. or 3-sec.	E	(1-sec. or 3-sec.	E	
	N	bid timeout)	N	bid timeout)	N	bid timeout)	O	
	Q		Q		Q		T	

Note 1: Primary stations wait one second; secondary stations wait three seconds. Specify 3 tries or 15 tries (EBCDIC).

Note 2: A 2772 that operates over switched network usually with a processor is a primary station.

D. Terminal-to-Terminal Retransmission Accepted

		ODD		ODD		EVEN		
Transmitting Station sends:	E	S	E	S	E	S	E	E
	N	T (TEXT-A)	T	T (TEXT-A)	T	T (TEXT-B)	T	O
	Q	X	B	X	B	X	X	T
Receiving Station sends:		A		N		A		A
		C 0		A		C 1		C 0
		K		K		K		K

E. Terminal-to-Terminal Retransmission Rejected

		ODD		ODD		ODD		ODD		
Transmitting Station sends:	E	S	E	S	E	S	E	S	E	E
	N	T (TEXT-A)	T	T (TEXT-A)	T	T (TEXT-A)	T	T (TEXT-A)	T	O
	Q	X	B	X	B	X	B	X	B	T
Receiving Station sends:		A		N		N		N		N
		C 0		A		A		A		A
		K		K		K		K		K

F. Terminal-to-Processor Retransmission Rejected

		ODD		ODD			ODD	
Terminal Station sends:	E	S	E	S	E	(Repeat "N" times,	S	E
	N	T (TEXT-A)	T	T (TEXT-A)	T	counted by processor	T (TEXT-A)	T
	Q	X	B	X	B	program.)	X	B
Processor Station sends:		A		N		N		E
		C 0		A		A		O
		K		K		K		T

G. Processor-to-Terminal Retransmission Rejected

		ODD		ODD			ODD		
Processor Station sends:	E	S	E	S	E	(Repeat "N" times,	S	E	E
	N	T (TEXT-A)	T	T (TEXT-A)	T	counted by	T (TEXT-A)	T	O
	Q	X	B	X	B	processor program.)	X	B	T
Terminal Station sends:		A		N		N		N	
		C 0		A		A		A	
		K		K		K		K	

H. Receive-Initiated Transmission Delay

		ODD		EVEN		ODD					EVEN	
Transmitting Station sends:	E	S	E	S	E	S	E	E	E	E	S	E
	N	T (TEXT)	T	T (TEXT)	T	T (TEXT)	T	N	N		T (TEXT)	T
	Q	X	B	X	B	X	B	Q	Q		X	B etc.
Receiving Station sends:		A		A		A		(2-sec.	W	(2-sec.	W	A
		C 0		C 1		C 0		interval)	A	interval)	A	C 1
		K		K		K			C		C	K
									K		K	

Note: Allows receiver to clear buffer block. ENQ may be an immediate response to WACK. WACK-ENQ sequences are not counted by 2772.

Note 1: Line bid acknowledgements are always even, the first text block is always odd.
Note 2: Refer to table 2772-5 for actual line-turnaround character sequences.

Figure 2772-4. Data Transmission and Transmission Control Sequences (Part 1 of 2)

I. Transmitter-Initiated Transmission Delay

Transmitting Station sends:	E		S		E		S		E			T		T		T		S		E		E	
	N		T	(TEXT)	T		T	(TEXT)	T		(2-sec.	T	(2-sec.	T	(2-sec.	T		T	(TEXT)	T		O	
	Q		X		B		X		B		interval)	D	interval)	D	interval)	D		X		X		T	
Receiving Station sends:		A				A				A			N		N		N				A				
		C 0				C 1				C 0			A		A		A				C 1				
		K				K				K			K		K		K				K				

Note: Allows transmitter to fill buffer block. TTD-NAK sequences are not counted by 2772.
If the transmitter is unable to continue it sends EOT instead of TTD and transmission ends incomplete.

J. STX Format Error, Data Ignored by Slave Station

			ODD			EVEN									EVEN			ODD							
Transmitting Station sends:	E		S		E		E				E		S		E	S		E		E	
	N		T	(TEXT-A)	T		(TEXT-B)	T	(3-sec. response		N		T	(TEXT-B)	T	T	(TEXT-C)	T		O	
	Q		X		B			B	timeout)		Q		X		B	X		X		T	
Receiving Station sends:		A				A						A				A			A						
		C 0				C 1			(No Response)			C 1				C 0			C 1						
		K				K						K				K			K						

Note: Receiver did not synchronize nor did it receive TEXT-B the first time.
The Transmitter retransmits.

K. Response Not Matched to ODD-Even Block Count

		ODD			EVEN															
Transmitting Station sends:	E		S		E	S		E		E		E		E		E				
	N		T	(TEXT-A)	T	T	(TEXT-B)	T		N		N		N		O				
	Q		X		B	X		B		Q		Q		Q		T				
Receiving Station sends:		A				A			A		A		A		A					
		C 0				C 1			C 1		C 1		C 1		C 1					
		K				K			K		K		K		K					

Note: Specify three tries or fifteen tries (EBCDIC)

L. Data Link Aborted on No-Response from Receiver

			ODD																	
Transmitting Station sends:	E		S		E		E			N		N		N		E				
	N		T	(TEXT)	T	(3-sec. response		N	(3-sec. ENQ		N	(3-sec. ENQ		N	(3-sec. ENQ		O				
	Q		X		B	timeout)		Q	timeout)		Q	timeout)		Q	timeout)		T				
Receiving Station sends:		A																		
		C 0				(No Response)			(No Response)			(No Response)			(No Response)					
		K																		

Note 1: Specify three tries or fifteen tries (EBCDIC).
Note 2: The 3-sec. timeout also limits time between turnarounds and length of uninterrupted transmission. In these cases, synchronism is dropped and the transmission is ignored by the receiver.

M. Data Link Stalemated on No-Continuation by Transmitter

Transmitting Station sends:	E		S		E		
	N		T	(TEXT)	T		
	Q		X		B		(No continuation)
Receiving Station sends:		A				A	
		C 0				C 1	(Indefinite wait for continuation. If installed,
		K				K	Auto answer feature disconnects after 20 sec.)

N. Transmitter Buffer Check

		ODD						
2272 Transmitting Station	E		S		E		E	
sends:	N		T	(TEXT)	N		O	
2772 Receiving Station	Q		X		Q		T	
sends:		A				N		
		C 0				A		
		K				K		

O. Receiver Buffer Check or Device Error

		ODD			EVEN			
E		S		E		S		E
N		T	(TEXT)	T		T	(TEXT)	T
Q		X		B		X		B
	A				A			E
	C 0				C 1			O
	K				K			T

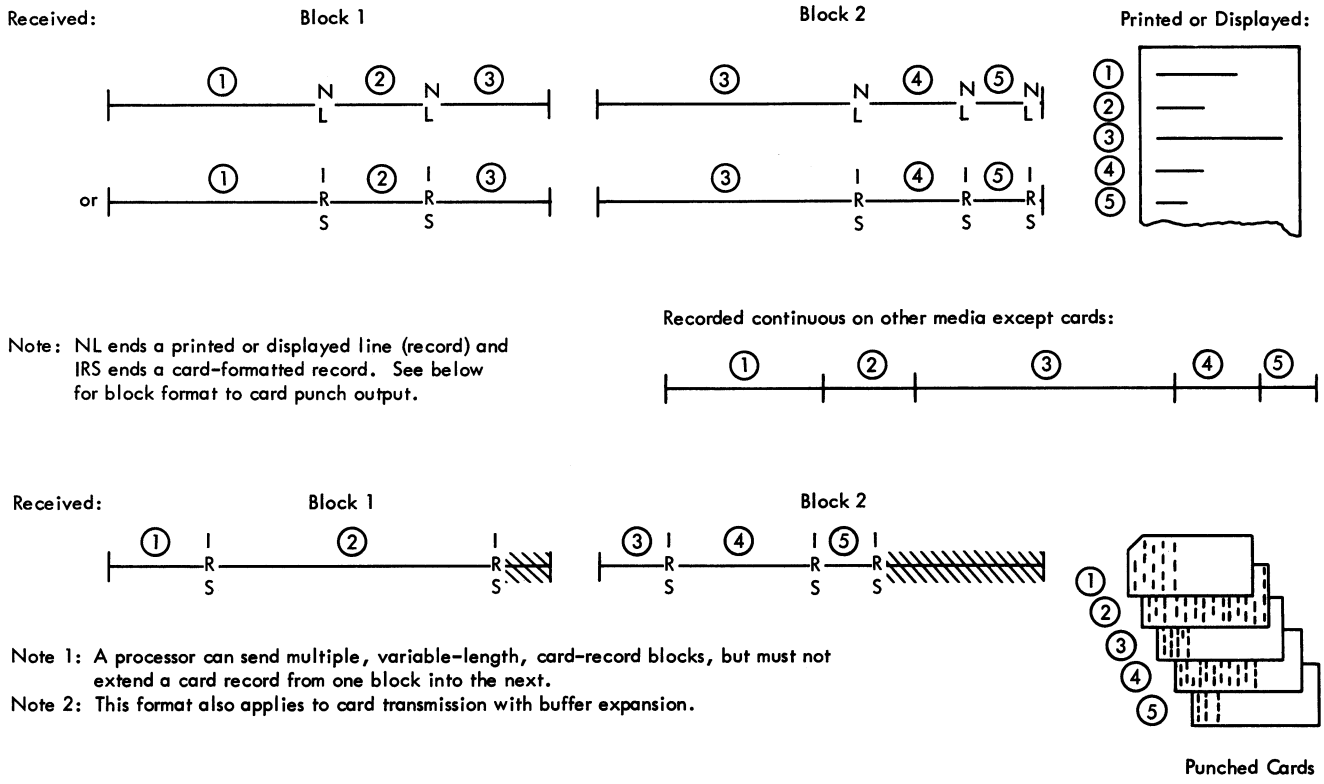
P. Transmitter Device Error or Input Check

		ODD							
2772 Transmitting Station	E		S		E		T		E
sends:	N		T	(TEXT)	T		T		O
	Q		X		B		D		T
2772 Receiving Station		A				A			N
sends:		C 0				C 1			A
		K				K			K

Q. Buffer Overflow at Receiver

		ODD						
E		S		E				
N		T	(TEXT-A)	T				
Q		X		B				
	A				E			
	C 0				O			
	K				T			

Figure 2772-4. Data Transmission and Transmission Control Sequences (Part 2 of 2)



Note: NL ends a printed or displayed line (record) and IRS ends a card-formatted record. See below for block format to card punch output.

Note 1: A processor can send multiple, variable-length, card-record blocks, but must not extend a card record from one block into the next.

Note 2: This format also applies to card transmission with buffer expansion.

Figure 2772-5. Media Records Independent of Transmission Blocks

Table 2772-3. Standard Communications Terminology

Point-to-Point Network - A data connection between only two stations (can be switched or leased connection).

Switched Network - A system capable of completing a dialed, point-to-point connection between any two stations of the network.

Control State - A data link status during which message transmission is arranged for.

Message-Transfer State - The data link status during which a message or batch message segment is transmitted. Starts with first STX and ends with EOT.

Line Bid - A request by a station to initiate transmission.

Timeout - A measured waiting period.

Contention - A situation characterized by simultaneous line bids on the same line.

Primary Station - A station arranged to bid successfully in contention (by shorter bid repetition timeout).

Secondary Station - A station arranged to capitulate in contention (by normal bid repetition timeout).

Master Station - The station transmitting a message.

Slave Station - The station receiving and acknowledging the message.

Transmission (Text) Block - Data or text framed by STX or SOH and ETB or ETX.

Redundancy Check - The matching at the receiver of a numerical value, computed from the binary content of a received block, against a numerical value computed from the same block by the transmitter and sent to the receiver. The receiver returns an affirmative acknowledgment if the values match, a negative acknowledgment if they do not. These check values are redundant to the message, hence the term redundancy check.

Turnaround - Reversal in the direction of transmission between two stations.

Pad Character - A time-fill character that buffers turnaround.

Table 2772-4. Control Vocabulary

Note: These characters are for communications control only. They are added to input data and deleted from output data. BEL is an operator signal and not a data link control.

Vocabulary Character	Character Name	Character Meaning		Character Structure (see Appendix)	
		Control State	Message-Transfer State	EBCDIC	USASCII
*ENQ	Enquiry	Can you accept transmission (point-to-point)? Respond to your address (multipoint).	Between blocks: Please respond or repeat last response. Terminating a block: Discard this block and respond with NAK acknowledgment.	ENQ	ENQ
*ACK 0	Even affirmative acknowledgment	I can accept transmission.	Even block received and validated.	DLE Hex '70'	DLE 0
*ACK 1	Odd affirmative acknowledgment	None	Odd block received and validated.	DLE /	DLE 1
STX	Start of Text	Change to message-transfer state and start computing check value. (2772 treats SOH as STX, normally sends only STX.)	Clear check circuits and start computing new check value. (2772 treats SOH as STX, normally sends only STX.)	STX	STX
*NAK	Negative acknowledgment	I cannot accept transmission.	Block not validated, can accept retransmission.	NAK	NAK
*TTD	Temporary Text Delay	Transmission will begin presently. Respond NAK and wait.	Transmission will continue presently. Respond NAK and wait.	STX ENQ	STX ENQ
*WACK	Wait Before Transmit	Enquire again later and delay transmission until an affirmative acknowledgment is received.	Enquire again later and delay further transmission until an affirmative acknowledgment is received. Block received and validated	DLE,	DLE;
*ETB	End of Text Block	None	Check value follows, then turnaround and response. Another text block to follow.	ETB	ETB
*ETX	End of Text	None	Check value follows, then turnaround and response. This completes the text of a 2772 job but does not release the data link.	ETX	ETX
*RVI	Reverse Interrupt	None	Affirmative acknowledgment and signal that processor slave station wants master 2772 to relinquish the line.	DLE @	DLE <
EOT	End of Transmission	Drop synchronism and return to control state.	Drop synchronism and return to control state. Not valid in text.	EOT	EOT
BEL	Bell	Turn on receiving 2772's Bell light and audible alarm to request switch-to-talk for verbal conversation. Only used 2772-to-2772.	None	BEL	BEL
PAD	Leading Pad	Establish bit synchronism.	Establish bit synchronism.	Hex 'AA'	Alternating Bits (01010101)
	Trailing Pad	Turnaround time.	Turnaround time.	All ones (Hex 'FF')	All ones
SYN	Synchronous Idle	Establish or assure character synchronism, or time-fill. Discard character.	Establish or assure character synchronism, or time-fill. Discard character.	SYN	SYN

*Line turnaround.

Table 2772-5. Initiating and Terminating Synchronization (Part 1 of 2)

ENQ	P S S E P A Y Y N A D N N Q D	Response solicitation. (May be a line bid.)
OR	(TEXT) E P N A Q D	Premature ending when transmitter cannot complete block. Correct acknowledgment is NAK.
ACK0 or 1	P S S D (See) P A Y Y L (Table) A D N N E (2772-4) D	Affirmative acknowledgment to even or odd block, or to a line bid (ACK 0 only).
STX	P S S S A Y Y T (TEXT) D N N X	Text block beginning. Check circuits clear and computation of a new check value at both transmitter and receiver begins. Serves additionally as an affirmative acknowledgment when it starts a conversational response.
NAK	P S S N P A Y Y A A D N N K D	Acknowledgment made by receiver when preceding transmission is not accepted, or when line bid is refused.
TTD	P S S S E P A Y Y T N A D N N X Q D	Transmitter-initiated transmission delay. This sequence replaces STX and text when the transmitter needs time to make itself ready to transmit. Receiver responds NAK and waits for transmission to begin. If still not ready, transmitter repeats TTD after two seconds.
WACK	P S S D (See) P A Y Y L (Table) A D N N E (2772-4) D	Receiver-initiated transmission delay. This sequence replaces an ACK response when the receiver needs time to make itself ready to receive. Transmitter enquires again immediately and receiver repeats WACK after two seconds if still not ready to receive.
ETB	(TEXT) E B B P T C C A (EBCDIC) B C C D	ETB signals that the transmitter's computed check value, block check character (BCC or LRC) follows, after which a turnaround and response is expected. (BCC is two characters in EBCDIC; LRC is one character in USASCII.) More text is coming.
OR	(TEXT) E L P T R A (USASCII) B C D	

ETX	(TEXT) E B B P T C C A X C C D (EBCDIC) OR (TEXT) E L P T R A X C D (USASCII)	ETX signals that the transmitter's computed check value, block check character (BCC), follows, after which a turnaround and response is expected. (BCC is two characters in EBCDIC, LRC is one character in USASCII.) This completes a job.
RVI	S S S D P Y Y Y L (See Table 2772-4) A N N N E D	Processor-slave-initiated reversal of status (master/slave) in an established data link. Serves as an affirmative acknowledgment; processor receives one more block and acknowledges normally, the 2772 sends EOT and processor bids for line. An incomplete message is not resumed by the 2772 without operator intervention.
EOT	S S S E P Y Y Y O A N N N T D	Data link termination. All stations that receive this sequence drop synchronism and return to the control state, waiting for a new data link to be established by a line bid and response.
BEL	S S S B P Y Y Y E A N N N L D	Used only on 2772-to-2772 in control state, the Bell key of the initiating 2772 lights the Bell light and sounds the audible alarm at the receiving 2772. The receiving operator responds with the same action and thus the operators agree to switch to talk for verbal conversation.

Note 1: Synchronism is dropped at each line turnaround. The PAD SYN SYN sequence after turnaround re-establishes synchronism.

Note 2: The trailing PAD character (recommended to be all ones, hexadecimal FF) may not be received in its entirety during line turnaround and may overlap in time with the first portion of the leading PAD character. Thus, the first portion of the leading PAD may also not be received.

Note 3: TTD and WACK are not used if operater intervention is required; EOT applies instead (except between tapes when the IBM 50 is the input device).

Note 4: PAD, SYN, BCC, and LRC characters used in line turnaround sequences are elsewhere in this manual assumed and are not shown.

Table 2772-6. Timeouts

Line bid -	A station sending ENQ as a bid for the line waits three seconds for an acknowledgment before repeating ENQ. Special wiring that converts a 2772 station of a terminal-to-terminal connection to a primary station shortens this timeout to one second. A 2772 operating on a switched network is converted to a primary station if it normally communicates with a processor.
Response -	A master station waits three seconds for response to ENQ, ETB, or ETX. The normal three automatic retry requests (ENQ) for response can be extended to fifteen by plant or Customer Engineer wiring.
Transmission -	A receiving station waits three seconds for STX after achieving synchronization. It accepts three seconds of transmission after STX. The acceptance period can be lengthened by interspersing pairs of SYN characters at less-than-three-second intervals.
Wait -	The wait sequences, WACK and TTD, are timed by a two-second timeout at the initiating station. This interval avoids the three-second transmission or response timeout at the remote station.
Sync Timeout -	Only SYN characters have been received for three seconds.

Job Configuration and Device Control

Once physically configured, the 2770 system includes a maximum of: binary synchronous communications (BSC) capability, keyboard, Printer, an input device and an output device in one of the available media (display, paper tape, magnetic tape, punched cards or MICR documents), and an input device and an output device in another of the available media. (The Display Station is both an input and output device; the 50 Magnetic Data Inscriber is an input device only--two 50 units may be attached in tandem as one input.)

A job setup assigns input device(s) and output device(s). The Job Select rotary switch has five prewired job setups and one variable job setup (see "Indicators, Controls, and Procedures"). Table 2772-7 shows the decisions that are made for each setup, whether prewired or variable.

The Control Unit operates with the input and output devices by way of the input and output interfaces. At the input interface, the Control Unit requests a character from the selected input device (Figure 2772-6). The device signals the Control Unit when it has a character present (Figure 2772-6). At the output interface, the selected output device requests a character from the Control Unit and the Control Unit signals when it has a character present (Figure 2772-7). These demand-response character transfers allow I/O operation at varying rates.

All the I/O devices that operate with the IBM 2772 are character-by-character (serial-by-character) devices. *Incremental* devices can stop between characters; *synchronous* devices can stop only between records. The direct-data output device must be incremental, and is normally the Printer or Display Station (Table 2772-7). Other devices can be used as direct-data output, without benefit of available correction capabilities (see "Direct Data" for keyboard operation with direct-data output).

Data Buffer

The data buffer comprises buffer A and buffer B, each basically 128 characters (see "Special Features" for Buffer Expansion). Each buffer can accept input or send output (Figures 2772-2 and 3). Most buffer considerations apply to the input.

An input buffer becomes a complete block upon:

a. End-of-block from communication line,
b. End-of-file,
c. 128 characters stored,
d. Recognition of a predetermined number of records (documents) per buffer (1255 only),
e. Recognition of IRS character from incremental device other than the IBM 50, or
f. End-of-card from card reader.

When a block is complete, input switches to the other buffer; input waits if output is being sent from the other buffer. (Refer to "Appendix—Data Format Specifications" for more detailed information.)

A text block received from the line into a buffer must be checked and valid before the Control Unit considers input to that buffer block complete. Retransmissions store in the same buffer, obliterating the earlier transmission of that block. Output occurs only if the block is valid.

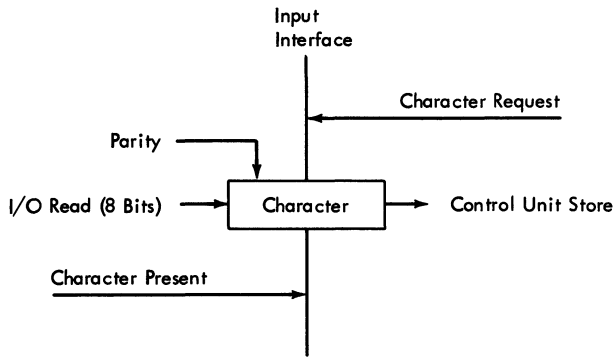
Keyboard input goes directly to a buffer when done in conjunction with direct-data output to the Printer (providing another output device is assigned in home mode, or the 2772 is in line mode. Keyboard input in conjunction with direct-data output to the Display Station is stored by the display attachment (2265 Attachment), and goes to a buffer only when the Enter key is pressed. Automatic 2772 operations are initiated by the Enter key (on the keyboard) or Start key (on the Control Unit console), and send stored data to an output function (see "Direct Data").

Table 2772-7. Job Setup Controls on the Job Select Switch

FUNCTION	AVAILABLE	DECISION
Input Device Assignment	Keyboard, #2, #3	Any or all (2265-2 cannot be assigned as only an input. Tandem 50 Magnetic Data Inscribers are not individually assignable or selectable.)
Output Device Assignment	Printer, #2, #3	Any or all (50 Magnetic Data Inscriber, or 1255 Magnetic character Reader, cannot be assigned as an output.)
Monitor Print Receive	Special Feature	Yes or no } Printer must be assigned as output device. If component selection is not required, Printer should also be assigned as direct data device.
Monitor Print Transmit	Special Feature	Yes or no }
Direct Data Device Assignment	Printer, Output #2, #3	Select one -- normally printer or display. If Display is assigned as both input and output device it must be the direct data device. If Display is output only it cannot be direct data device. Direct data device cannot be a synchronous device, such as the 545.
Inquiry Mode	With Multi-Point Data Link Control Special Feature	Relinquish the line after every two buffer blocks (Inquiry Mode) or operate block-by-block for the contiguous transmission of the entire job (non-Inquiry Mode).
Answer	Auto or Manual (with Auto Answer Special Feature)	Make, answer, and disconnect calls manually, or answer and disconnect calls automatically. Manual calling, or extended (over 20 sec.) on-line keyboard input requires "Manual".
Terminal Mode	Line mode, home mode	Line or home, if home both an input and an output must be assigned.
Component Selection Required	Not required with Multi-Point Data Link Control Special Feature, but can be required with Conversational Mode response.	* Require remote selection of local output device or allow automatic selection of highest priority output that is ready.

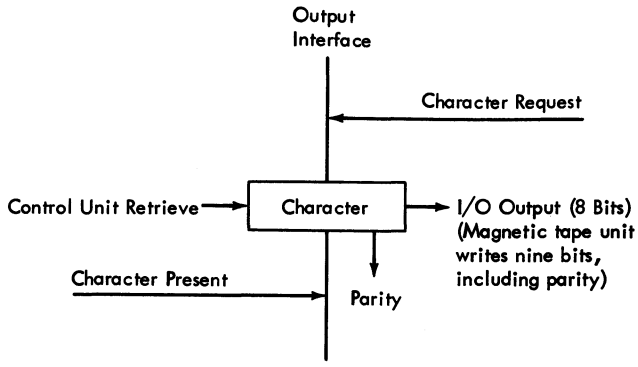
* When the job setup assigns multiple output devices, this decision determines which of two ways the actual output device is chosen. With automatic selection, the highest-priority output device that is ready to operate accepts the output. The priority order is Printer, #2, and lowest #3. Direct data device (only one can be assigned) becomes the lowest priority device. Remote component selection, if used, has to be a DC-character at the beginning of (and preferably by itself in) the first block of received text. Output component selection can be made only once for each message. If the remotely selected device is not ready to operate, or if a required remote component selection is not received, the 2772 sends EOT as its next response and the data link is aborted. The format for the remote selection block of text and the DC-characters available for the selection are as follows:

S	D	E			S	D	E			S	D	E			
T	C	T	selects Printer,		T	C	T	selects Output #2,		T	C	T	selects Output #3.		
X	1	B			X	2	B			X	3	B			



Note: Timing determines which interface signal is the demand and which is the response.

Figure 2772-6. Demand-Response Input Character Transfer



Note: Timing determines which interface signal is the demand and which is the response.

Figure 2772-7. Demand-Response Output Character Transfer

Output sent from a buffer to the line must be affirmatively acknowledged by the receiving station before the Control Unit considers that buffer to be empty. The same stored information is retransmitted if the response is negative. If all responses are negative, transmission ends with the *job incomplete and one or two buffer block(s) read in but not transmitted.*

Buffer input and buffer output are checked for proper parity, before the character is stored and after it is retrieved (see "Error Recovery Procedures").

Direct Data

It is the direct-data function that most clearly involves the keyboard with the IBM 2772 Multi-Purpose Control Unit. The keyboard's main purpose is to permit message data to be manually keyed into the data buffer. The direct-data function, enabled by assigning an output device on the job setup as a direct data output (see Table 2772-7), provides for a visual record of keyed characters. On the basic system keyboard entry begins with the pressing of the Keyboard Request key. If the keyboard is selected and the Control Unit is ready, the Proceed light comes on and the keyboard unlocks.

Correction of displayed direct data is done by erasing and rekeying any individual character on the screen. Refer to the IBM 2265 Display Station section of this manual for a description of correction procedures and the keyboard keys that accomplish correction. Correction of printed direct data is done on the basic machine by resetting and rekeying. For a description of the Keyboard Correction feature and its operation with the Printer, see "Special Features".

The Control Unit uses a buffer by-pass to provide character-by-character direct-data output. If the 2213 Printer is the assigned direct-data output device, or if the direct-data output is not also assigned as an input, each character enters a buffer as it goes to the device. Printer function codes are stored as the Printer performs the function. Therefore, should the assembled message be transmitted to a remote Printer, its actions will duplicate those of the direct-data Printer. If the Display Station is assigned as an input and as the direct-data output, function codes and displayable codes are stored by the display attachment and pass to the buffer at high speed after the Enter key (located on the keyboard) is pressed.

Table 2772-8 lists the controls and the encoded characters initiated at the keyboard. System controls not pertaining to the direct-data output devices or to manual origination of a message are on the 2772 console and are explained under "Indicators, Controls, and Procedures."

The keyboard locks and keyboard entry ends when the Enter key (on the keyboard) is pressed. The Control Unit bids for the line to transmit the message. The Start key (on the 2772 console) also ends keyboard input, and starts another assigned input device after the keyed data is sent. (The Start key is not used when the Display Station is assigned to both direct-data output and input.) Output operation proceeds automatically, according to the job setup. With a home-mode job setup, the Enter key or Start key initiates an output operation instead of a line bid (see "Home Mode").

Table 2772-8. Keyboard–Control and Graphics Keys

Graphics Keys (as illustrated in Figures 2772-8,9,10, and 11) - Encode EBCDIC or USASCII characters as shown in the code tables in the Appendix of this section. The shift key and associated shift lock determine whether the upper or lower case is encoded. (Printer and display convert lower case graphics to upper case.)

Display Control Keys - See 2265-2 Display Station section.

Standard Typewriter-like Functions - Encode EBCDIC or USASCII characters as shown in the Appendix of this section, as follows:

SP - space
NL(EBCDIC), LF(USASCII) - Return to left margin and line space
LF(EBCDIC) - Line space only
BS - backspace
HT - horizontal tab
RLF(EBCDIC) - Reverse line feed

Special Functions - Encode EBCDIC or USASCII characters as shown in the code tables in the Appendix of this section, as follows:

*FF - forms feed (printer skips to 1)
*VT - vertical tab (printer skips to 2)
EM - end of media
IRS(EBCDIC), RS(USASCII) - end of card, record separator
SOH - start of heading (treated as STX)
STX - start of text
SMM(EBCDIC) - start of manual message, see 2265-2 Display section
SMM(USASCII) - encode DC 4.
DC 1, DC 2, DC 3 - Device Control (component selection character)

Special Functions - Keyboard commands to the control unit, as follows:

Keyboard Request - Unlock the keyboard and allow keyboard entry. Honored by the proceed light if the keyboard is assigned on the job setup and the control unit is ready.
Enter - Lock the keyboard and transmit the keyed message. Honored by a line bid and transmission or by a home mode output operation when the control unit is ready.
* New Line Correct - see "Special Features".
* Backspace Correct - see "Special Features".

*Special feature. Refer to the appropriate device section of this manual.

Note 1: Typamatic operation on the keyboard causes repetitive functioning with emphasized pressure on the following keys:

EBCDIC	USASCII
New Line	New Line
↓ (Index)	Space
Space	Backspace
Backspace	Underscore/Dash
Underscore/Dash	↓ (Index)
↑ (Reverse Index)	↑ (Reverse Index)
→ (Advance: display only)	→ (Advance: display only)
← (Backspace: display only)	← (Backspace: display only)

Note 2: The keyboard accepts two special commands from the control unit:
Restore - Unlocks interlocked keys so that the operator can continue.
Keyboard Lock - Prevents keyboard operation at times when it is not appropriate to the job setup. The keyboard locks at the end of the first buffer block if keying input in home mode, at the of the second buffer block if keying in line mode. (When keying to display, entire display is available and keyboard does not lock.)

Note 3: Once Selected and requested in home mode, the keyboard remains selected until the Terminal Reset key or Start key is pressed. The keyboard can be used only when the Proceed light is on.

Home Mode

A home-mode operation differs from a line-mode operation only in that the communications line is not used and the 2772 transmits from one of its attached devices to another. Home mode is selected on the job setup, or is forced during line mode by a keyboard-to-display, keyboard-to-buffer, or display-to-printer operation performed as part of the job setup. Forced-home-mode terminates when the data transfer is complete; the 2772 returns to line mode to transmit the entered data. Selected-home-mode is terminated by switching to another job setup (see "Indicators, Controls, and Procedures").

Home mode (selected or forced) does not cause the 2772 to ignore the communications line. If a line bid is received, a NAK or EOT answer is sent, the Terminal Addressed light comes on, and the audible alarm sounds. (The alarm sounds only once, unless the light is reset and another bid is received.) At a convenient point in a selected home-mode operation, the operator can switch to the appropriate line-mode job setup in order to honor the bid when it is repeated.

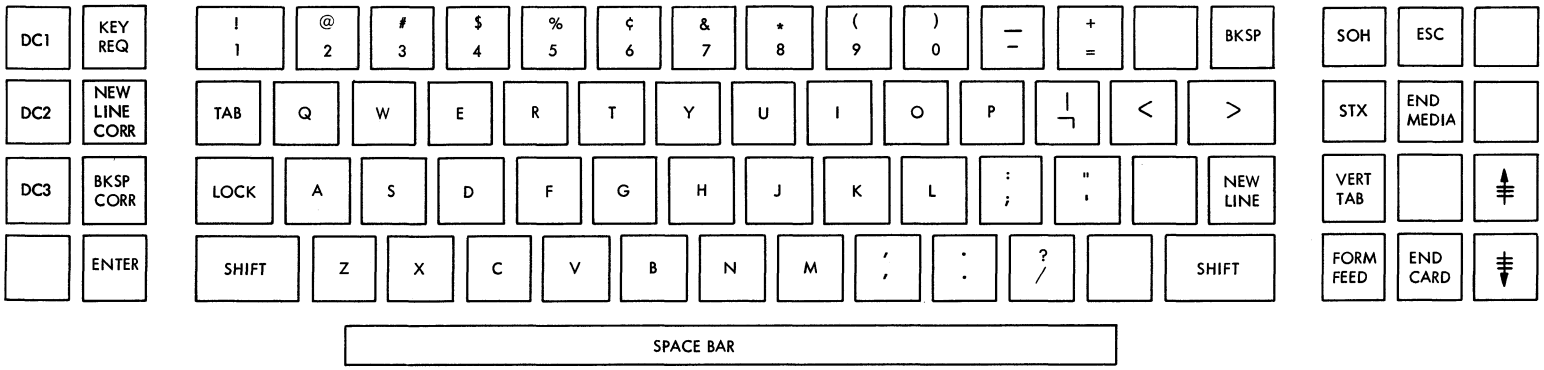


Figure 2772-8. EBCDIC Keyboard for Printer

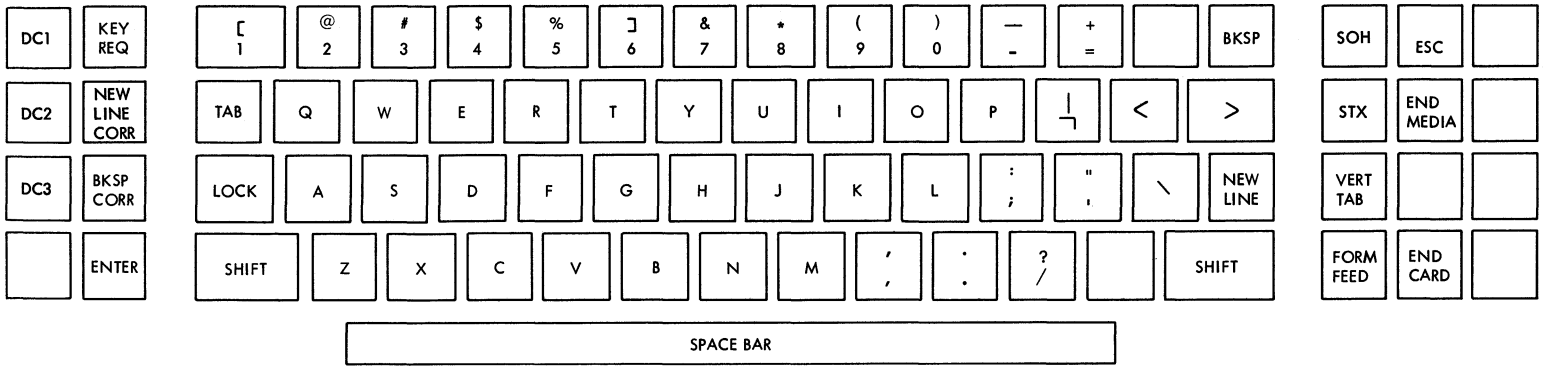


Figure 2772-9. USASCII Keyboard for Printer

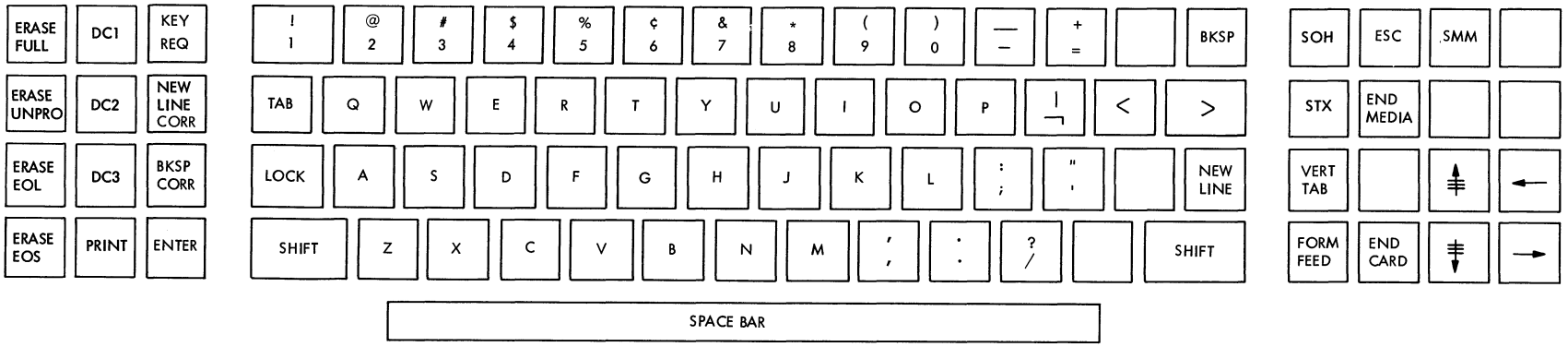


Figure 2772-10. EBCDIC Keyboard for Printer and Display

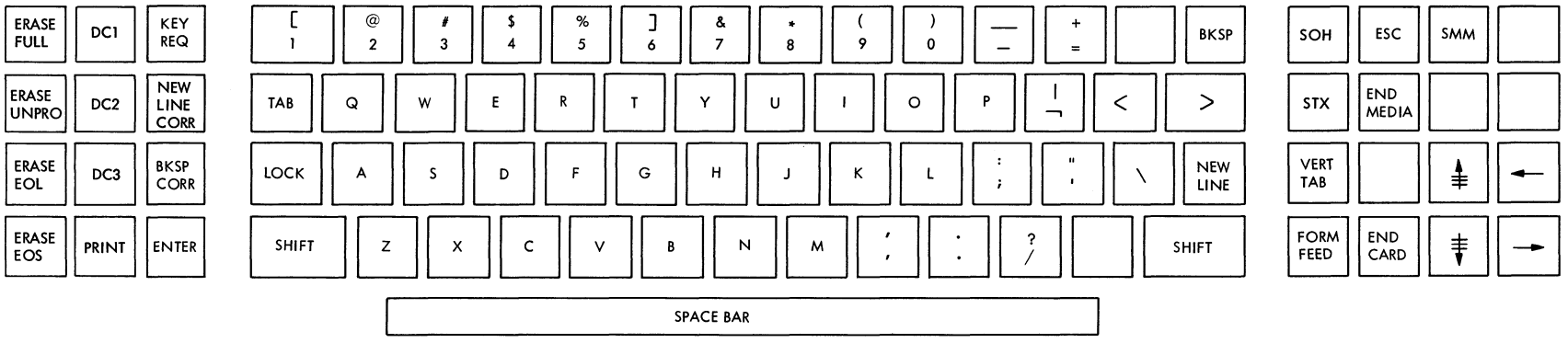


Figure 2772-11. USASCII Keyboard for Printer and Display

TERMINAL TEST

Two methods of testing BSC are provided: off-line self-testing, and on-line testing (which resembles normal communication). Each uses a unique job setup. (Efficient off-line testing requires card or paper tape input, and printer output.)

Off-Line Self-Test

This test checks the ability of the 2772 to encode and decode data-link control characters, to perform checking operations and timeouts, and to send and receive data. Sections of the test are read in and performed successively, a new section being read in when the preceding one is completed. Should there be an error, the test stops with the Test Check light on. Pressing Check Reset turns off Test Check and pressing the Start key causes the uncompleted portion of that section of the test to print out. The last two characters printed are the number of the test section that failed to complete. Testing is resumed by pressing the Terminal Reset key, then the Start key again. The stop location or locations are indicative of the cause.

On-Line Test

This test is an exercise of BSC controlled by processor program. The 2772 does not encode SOH or STX characters when the on-line-test job setup is in effect, so these are included in the peripheral input to the 2772. This input is provided on cards, paper tape, or is keyed at the keyboard.

Special Features

The following special features enhance the 2772 by increasing its capacity and capability, and by broadening the applicability of the 2770 system:

- I/O Device Attachments
- Multipoint Data Link Control
- Buffer Expansion (increased capacity and functions)
- EBCDIC Transparency
- Automatic Answering (switched network)
- Identification
- Conversational Mode
- Transmit-Receive Monitor Print
- Keyboard Correction (Printer)
- Display Format Control (see the 2265 Display Station section of this manual)
- Synchronous Clock (1200 bits per sec)
- World Trade Features

NOTE: For description of special features unique to an I/O device, see the appropriate device section of this manual.

I/O DEVICE ATTACHMENTS

Functionally unique to the I/O device and responsible for its manner of operation on the 2770 system, the attachment features (except the IBM 1255 attachment) are actually housed in the 2772 Control Unit. Some device special features affect not only the device and the device-attachment circuits but also the Control Unit circuits. All features unique to an I/O device are described in the appropriate device section of this manual.

MULTIPOINT DATA LINK CONTROL

The Multipoint Data Link Control feature on the 2772 equips it to operate on a communications line with multiple stations. The feature provides for time-sharing of the line by interleaving transmission from other stations with transmission from the 2772.

This feature equips the 2772 to operate multidropped on the same leased, private-line communications channel with other properly featured 2772, 1130, System/360 Model 20, and 2780 stations, and a properly featured System/360 processor. The processor is the *control station* of the multipoint, centralized network. All other stations are *tributary stations.* The control station is the focal point of the network and maintains an orderly flow of network traffic by initiating all data transfers. The control station is either the transmitter or the receiver of every communication.

The control station precedes each network activity with EOT (see Tables 2772-4 and 5) to ensure that all stations are in the control state and monitoring the line. Then it transmits one of two addressed line-bid sequences (Figure 2772-12) to alert a particular station.

A *selection* sequence alerts a tributary station that is to receive; a *polling* sequence requests a tributary station to transmit. The station address in the line-bid sequence is an alphabetic character preceding the line-bid ENQ, encoded in uppercase for a poll or lowercase for a selection. Each tributary station has its own alphabetic-character address, assigned and wired by the Customer Engineer. The Multipoint Data Link Control feature adds to the 2772 the ability to respond to its own polling or selection address. A component-selection appears as a single character between the station-address character and the line-bid ENQ (Figure 2772-12); both outputs and inputs thus become remotely selectable, but they must also be assigned on the Job Select switch (see "Indicators, Controls, and Procedures–Job Select switch").

An additional function of the Multipoint Data Link Control feature is the 'inquiry mode'. When inquiry mode is in effect (see Table 2772-7) at the 2772, and after the 2772 accepts a poll from the control station, both buffers fill from the selected (by the polling address) input device. These two blocks are transmitted as an incomplete message and the line is relinquished. Two more blocks are auto-

matically read off-line from the input device and are sent when the next poll is received; the last block of the job ends with ETX, and the job is complete.

Throughput at a 2772 transmitting in inquiry mode is depreciated; however, inquiry mode allows interleaving of inquiry messages from other stations that require fast response. Thus, the processor can continue receiving a batch message from the 2772 without appreciably degrading inquiry operations.

BUFFER EXPANSION

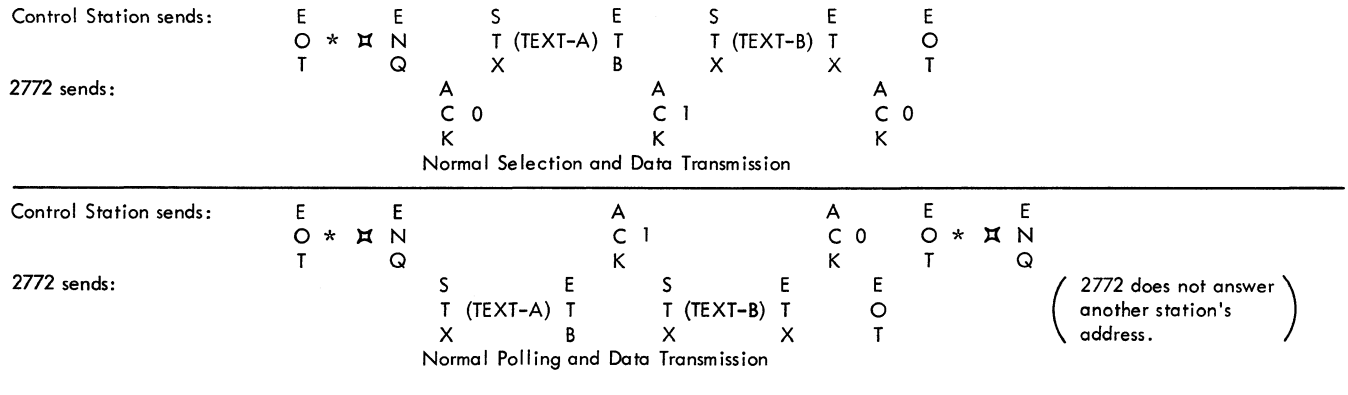
The Buffer Expansion feature not only increases the capacity of each buffer block from 128 to 256 characters, but also adds the internal capability of storing variable-length, multiple-card records from Card Reader input. Without this feature, an end-of-card signal from the Card Reader ends a buffer block and causes buffer alternation. With the feature, the end-of-card signal backspaces the buffer to the position following the last non-blank input character. Thus, the IRS character stores at the end of the actual data from that card. If enough buffer space remains to accept another 80-column card, the block is not full and buffer alternation does not take place.

The Buffer Expansion feature (prerequisite when the 1255 Magnetic Character Reader is used) also allows a predetermined number of MICR encoded documents to enter the buffer before alternation of buffer blocks. An IRS/RS character is stored after each correctly read document. Thus, multiple, variable-length cards, or a predetermined number of MICR documents can be read into a single buffer. Much of the communications-line time that would be spent in turnarounds and acknowledgments of individual card records is saved.

NOTE: For 2772-to-2772 operation, both terminals must have the same size buffer.

EBCDIC TRANSPARENCY

With this feature, any binary configuration, such as non-EBCDIC coding, can be transmitted as transparent data. The feature also equips the 2772 to receive any eight-bit configuration as data at any time. Therefore, all 256 eight-bit combinations can be transmitted or received as data. The Transparency switch, which controls the transmission of transparent data, also allows all 256 combinations to be transferred from input media as data. Data received in transparent format can always be transferred to output media.



Note 1: Inquiry mode operation is two blocks at a time; all blocks end with ETB except the last block of the message. Non-inquiry operation may involve many more alternating odd-even message blocks.

Note 2: The 2772 accepts only EOT, STX, or its own station address following synchronization in the control state. EOT preceding polling or selection drops synchronization throughout the network, but no pad characters are used because there is no turnaround. Two SYN's precede the station address after the EOT.

* Station alphabetic address, lower case for selection or upper case for polling.

¤ Numerical unit selection as follows:

Input Selection	Output Selection
0 - any input that is ready	DC 1 - Printer
5 - keyboard	DC 2 - Output #2
6 - input #2	DC 3 - Output #3
7 - input #3	

Note: Any bid is rejected if a remotely-selected unit is not also locally assigned and ready. A not-ready tributary station rejects a selection by sending NAK, a poll by sending EOT.

Figure 2272-12. Added Multipoint Data Link Control Sequences

In transparent line-mode operation, the binary-bit configurations of data link and format control characters (Table 2772-4) can be transmitted and received as data. Interference is prevented by inserting a DLE ahead of an initial STX or any data-link control character sent in message-transfer state, *if it is truly a control character.* Otherwise (with no preceding DLE as identification), any bit configurations that are equivalent to those of control characters are sent as text data. The exception is the DLE character itself, which is identified as data by a preceding DLE. Thus, transparency causes the transmitter to add, and the receiver to delete, DLE's to identify a follower character that must be specifically treated. All others are always treated as data, and only true data enters the buffer.

The Printer does not recognize NL or IRS/RS, or ESC in transparency. One line is printed from each buffer, basic or expanded, and the alternation of the output buffer signals the Printer to do a new-line function (left-margin return, line space). The Display Station does a new-line function at the end of each displayed line. (Either the Printer or Display Station automatically overflows to a new line if the capacity of a line is exceeded before the end of the block.) Transmission-block format is output format in transparency. Multiple records received in a single block can be properly formatted only if record length coincides with output unit-record capacity: 80 columns for card output, right margin for printed output, or line length for displayed output.

NOTE 1: Remote output-component selection in text is not possible in transparent line mode and only one output device should be assigned at a receiving point-to-point 2772. The remote processor must transmit a non-transparent data block containing the component selection character to execute output-component selection at a receiving 2772.

NOTE 2: With the EBCDIC Transparency feature installed, the 2772 is always able to receive blocks of transparent text data. It transmits text blocks in transparent format only if the Transparency switch is on. The 2772 must have the EBCDIC Transparency feature installed if transparent data is to be transmitted over the line to which it is attached.

AUTOMATIC ANSWERING

This feature prevents maintaining an unused connection in switched-network operation. It enables the 2772, under control of the job setup (see Table 2772-7), to automatically answer an incoming call on a switched network, to recognize and carry out a Disconnect command from a remote station, and to disconnect of its own accord when the connection is not fruitful.

A 20-second timeout precedes automatic disconnection. Any legitimate and useful activity on the line within the 20 seconds restarts the timing period. The disconnect operation is not timed and takes place at once if the data set becomes not ready to operate or if the remote station sends DLE EOT. A processor station uses this Disconnect sequence, and will either substitute:

D	E		E
L	O	for the	O
E	T		T

it would have sent (Figure 2772-4), or respond

D	E		E
L	O	to a 2772's	O
E	T		T

The connection is not broken by EOT and message traffic via the dialed connection can continue until DLE EOT is sent. Then both stations disconnect, or "hang up the phone."

NOTE: The "Answer-Auto/Manual" decision on the job setup (Table 2772-7) can be made "Manual" to inhibit the 20-second timeout in inquiry applications so that the connection is not broken if the 2772 operator takes more than 20 seconds to key the inquiry message. ("Manual" also allows the 2772 operator to initiate switched network calls. Manually initiated calls must be manually disconnected.)

IDENTIFICATION

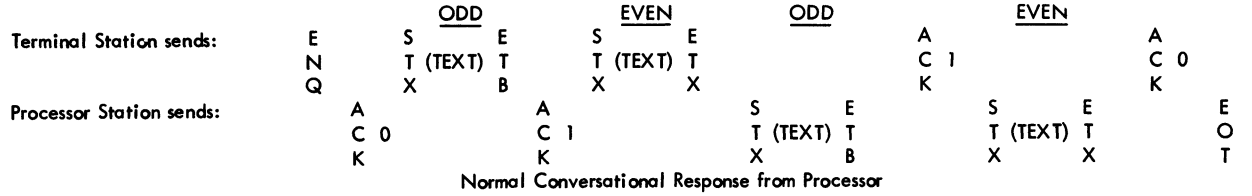
This feature is available when the 2772 is to operate on switched networks. The feature causes the 2772 to transmit and to accept identification characters when connection has been established on the switched network. The identification character transmitted by the 2772 is specified by the user and jumpered by the Customer Engineer. The character specified can be any USASCII character Hex 60 through Hex 7F (Table CU-4), or any EBCDIC character Hex C0 through Hex FF (Table CU-5).

Identification characters are transmitted and received during initial line bid and response sequences after connection has been established on the switched line. If the 2772 transmits first, after connection, it transmits its identification character, twice (as two contiguous characters), between the initial SYN characters and the line bid ENQ. The 2772 will then accept any number of identification characters from the remote end as long as the ENQ, DLE 0, or NAK response is received before the three second time-out (initiated by establishing character phase) elapses. No checking is performed on the received identification characters.

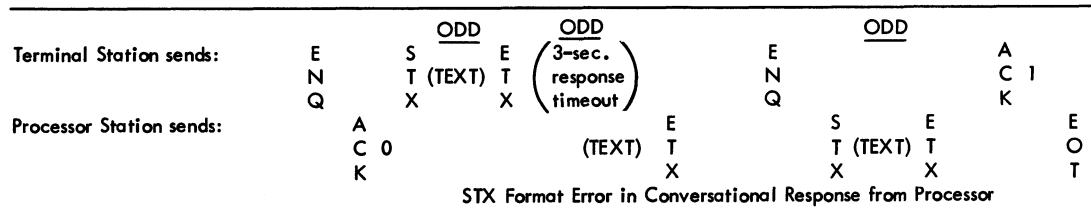
If the remote station is first to transmit, after connection, the 2772 accepts identification characters between the SYN characters and the ENQ character. The 2772 then responds by transmitting its identification character, twice, between the SYN characters and the DLE 0, or NAK response.

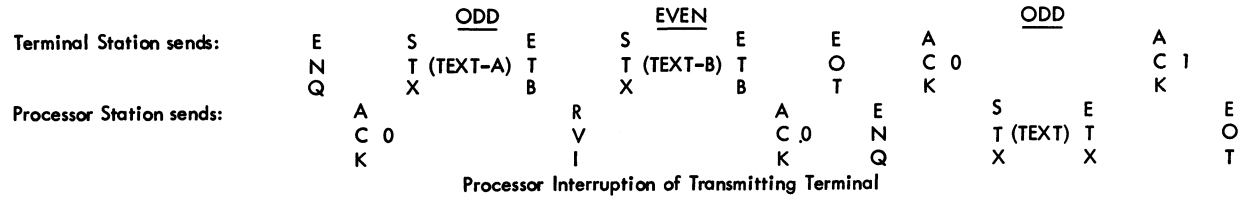
CONVERSATIONAL MODE

This feature allows the 2772 to accept message text from a processor as an affirmative acknowledgment to the last block of a transmitted message (Figure 2772-13). Text is accepted in this manner by the 2772 when ETX is transmitted at the end of message text. The response format must begin with



Note 1: Only one such reversal of master/slave status occurs during one transmission.
Note 2: Output unit selection may be required in the conversational response (see Table 2772-7).





Note: The operator must re-start the 2772 to resume the incomplete message.

Figure 2772-13. Processor-Initiated Transmission Reversal

STX, and an output device must be assigned and ready at the 2772. Output-device selection may be required.

The Conversational Mode feature improves the response time and line efficiency for inquiry-type applications by eliminating two turnarounds and the associated acknowledgments and selection characters.

TRANSMIT-RECEIVE MONITOR PRINT

This feature provides a printed message audit. A 2772 having this feature installed and enabled by the job setup (see Table 2772-7) prints every message that is transmitted, every message received, or both transmitted *and* received messages. The Printer will monitor 2772 data transfers in line or home mode.

Transmit Monitor Print causes printing after each block of text data has been transmitted and validated. Receive Monitor Print causes printing after each block has been received, validated, and successfully transferred to the selected output device. Since printing occurs only after data has been checked, overall throughput is reduced by a maximum of printing time. If the output device is the Printer, monitor printing does not take place. If the monitor Printer is not ready to operate when assigned on a job setup, the job is rejected, no message transfer takes place, and the Printer select light flashes.

KEYBOARD CORRECTION

The Keyboard Correction feature facilitates the correction of printed direct data. This feature allows rekeying from the point of an individual character or an individual line (record) stored in the buffer. Correction capability is intrinsic to the Display Station; refer to the Display section of this manual.)

In operation, the added keyboard keys, Backspace Correct and New Line Correct, backspace the buffers one character or one line, respectively. The Printer backspaces along with the buffer for Backspace Correct, but does a new-line function for New Line Correct. New Line Correct moves buffer input back to the beginning of the present line. The Data In Buffer indicator light turns off if backspacing continues to the beginning.

NOTE 1: Pressing New Line Correct (once) followed by Backspace Correct (twice) allows correction of the last character in the preceding line. Continued backspacing accesses other character locations in that line. All data following the correction must be rekeyed.

NOTE 2: The correction keys are effective (before the Enter or Start key is pressed) whenever the job setup provides for manual entry from the keyboard, even if the keyboard has locked due to full buffer. Backspacing unlocks the keyboard and allows rekeying.

NOTE 3: Only the last record of card-formatted data (which is delineated by IRS/RS) can be corrected.

SYNCHRONOUS CLOCK

This 2772 feature provides an internal synchronous clock so that the terminal can operate with data sets that have no clocking signals. With this feature installed, the terminal can operate with a data set over switched or leased private-line, telephone-grade facilities at a data rate of 1200 bits per second. All stations on the same line with the 2772 must have a synchronous clock operating at the same bit rate.

When operating with the Synchronous Clock, the sync pattern at the beginning of each transmission is expanded from a leading pad character and two SYN characters to three leading pad characters and two SYN characters.

NOTE: See Table 2772-2 for reference to specific data-set and common-carrier service information.

WORLD TRADE FEATURES

To provide for use of the 2772 Multi-Purpose Control Unit outside the areas served by the domestic IBM Corporation, the following additional special features are provided. For specific information about these features, contact the IBM World Trade sales representative.

- Power system for 50 and 60-cycles-per-second input power at several voltages.
- Interface to certain World Trade data sets.
- Key and indicator nomenclature and keyboard arrangement in American English, United Kingdom English, French, German, Italian, or Japanese.
- Internal Synchronous Clock feature at 600, 1200, 2000, or 2400 bits per second. (See 'Synchronous Clock.')
- SYN insertion. (2772 sends two consecutive SYN's in text once a second when operating at 600 bits per second.)
- Feature for operation on World Trade Public Switched Network.

Indicators, Controls, and Procedures

Indicators on the 2772 console show operating status; switches and keys control system operation (Figure 2772-14). A brief description of indicators, switches, and keys, and a resume of normal operating procedures follow.

KEYS

Start Key

This key initiates an input operation in line or home mode. It also restarts an incomplete job (see "Error Recovery Procedures"). The Start key is not required for initiating an output operation in line mode.

Bell Key

This key is effective only on a 2772-to-2772 connection when both 2772's are on-line in the control (non-message-transfer) state. It causes a BEL character to be transmitted, which lights the Bell light and sounds the audible alarm at the remote 2772.

Lamp Test Key

This key illuminates all the indicator lights of the 2772 and locally attached input/output devices (except the 545 Output Punch and 50 Magnetic Data Inscriber) to ensure that they are operative.

Terminal Reset Key

This key initializes the 2772, clearing all operating controls and leaving the 2772 in a receive status.

Check Reset Key

This key turns off the following indicators (see "Indicators") and enables the 2772 to proceed (see "Error Recovery Procedures").

- Bell
- Terminal Addressed
- Overrun
- Record Check
- Bid Retry
- Sync Timeout
- Test Check
- Certain I/O device indicators

Other System-Control Keys

The following control keys located on the keyboard are included here to complete the list of system controls (see Table 2772-8).

Keyboard Request. Initiates manual data entry from the keyboard. The keyboard unlocks and the Proceed light comes on if the keyboard is assigned and the Control Unit is ready.

Enter. Terminates data entry from the Keyboard and initiates execution of the job setup. If another input device (except the Display Station) is also assigned and ready, the Start key can be used instead of the Enter key. Keyed input is then sent and automatically followed by input from the other device.

Print. Initiates a data transfer from the display-attachment storage to the Printer.

Backspace Correct. See "Special Features."

New Line Correct. See "Special Features."

INDICATORS

A lighted indicator signifies the 2772, line, or check status described in the following paragraphs. A status indication

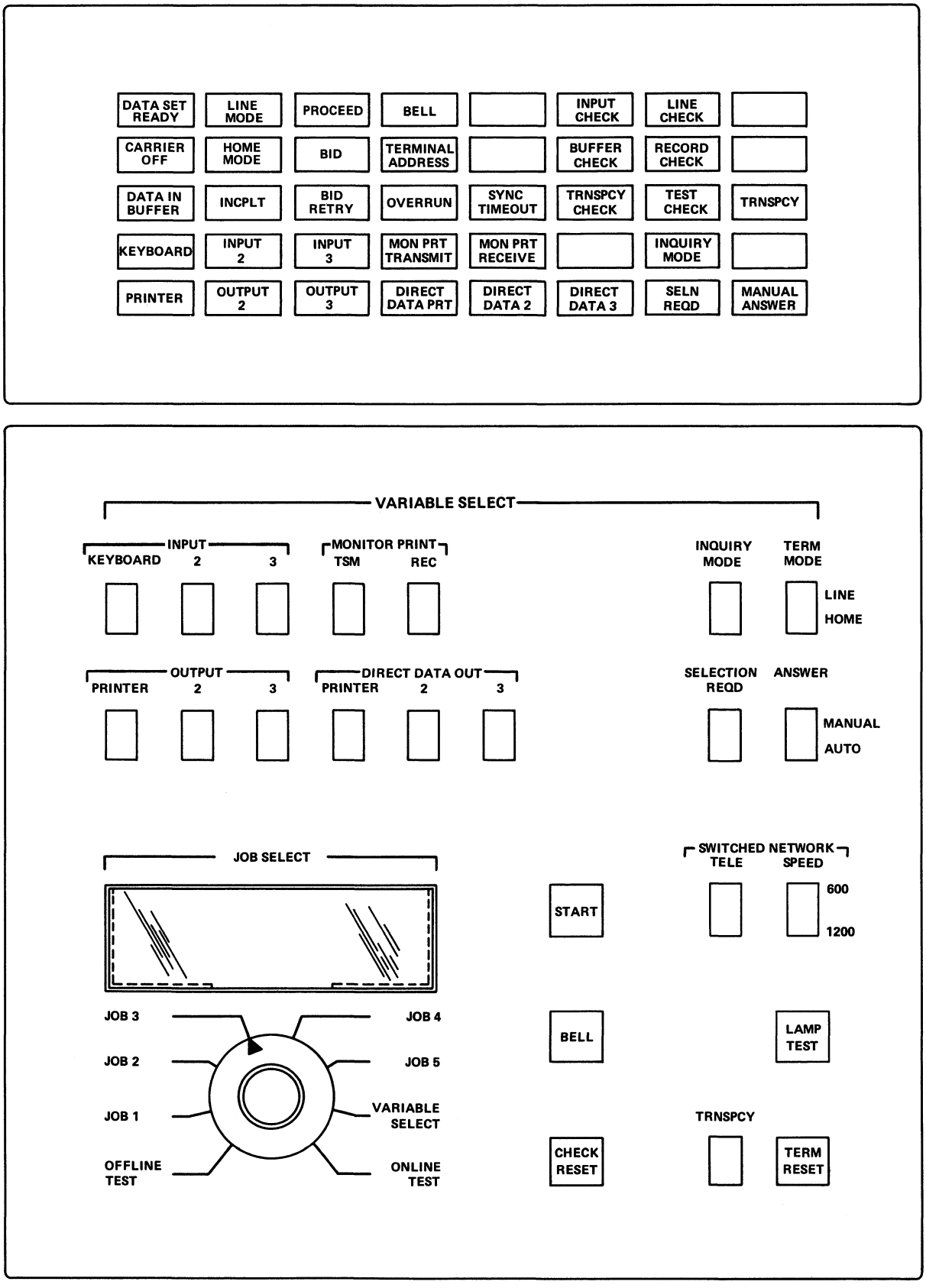


Figure 2772-14. IBM 2772 Console

that interrupts communications or requires operator attention is accompanied by the sounding of the audible alarm; each of these is marked in the following with an asterisk (*).

2772 Status Indicators

**Keyboard, Input 2, Input 3*

Input device assigned on the job setup. These indicators flash if the corresponding device is assigned but not ready to operate. (Alarm sounds if not-ready device is selected by remote station.)

Line Mode

Line mode is selected on the job setup. See Table 2772-7.

Home Mode

Home mode is selected on the job setup, or forced during line mode operation. See "Operating Characteristics—Home Mode."

**Printer, Output 2, Output 3*

Output device assigned on the job setup. These indicators flash if the corresponding device is assigned but not ready to operate. (Alarm sounds if not-ready device is selected by remote station.)

Proceed

Keyboard is unlocked and manual data can be keyed.

Data in Buffer

Buffer contains data that has not yet been transferred out. Successful transfer of data turns off the indicator, as does the Terminal Reset key.

Transparency

Transparency switch is on indicating that, if in home mode, data is being handled in transparent mode, or that, if in line mode, data is being transmitted in transparent mode.

Direct Data Printer, Direct Data 2, Direct Data 3

Output direct data device is assigned by the Job Select switch.

Monitor Print Transmit

Printer has been assigned by Job Select switch to monitor data transmitted to the communications line, or data transferred in home mode.

Monitor Print Receive

Printer has been assigned by Job Select switch to monitor data received from the communications line, or data transferred in home mode.

Line Status Indicators

**Data Set Ready*

With a leased line, this indicator is on when the data set has power. In switched-network operation, this indicator is on when the data set has power and has completed a switched-network connection. (Alarm sounds if light goes out during operation with a dialed connection and the Automatic Answering special feature active).

Carrier Off

Carrier not being received from remote station.

Bid

Start key or Enter key has been used to initiate a line-transmit request. This indicator turns off when the remote station agrees or declines to accept the message, or when the Terminal Reset key is pressed. An outstanding bid is canceled by Terminal Reset.

**Bid Retry*

Turns on when the remote station declines to accept a message from the 2772. The Check Reset key turns this indicator off and the line bid is automatically re-initiated.

**Bell*

The operator of the remote 2772 requests voice conversation on the data line. Check Reset turns off the Bell indicator.

**Terminal Addressed*

The 2772 has rejected a line bid because it is not ready to operate on-line. The buffer may have data, the 2772 may be in home mode or may have an outstanding line bid, or an input/output device may be selected and not ready. The Check Reset key or an accepted line bid turns this indicator off.

**Incomplete*

Transmission has been prematurely terminated by EOT sent by the remote station. The alarm sounds at only a 2772 master station which has not been able to conclude its message. The master station is responsible for recovery. This indicator is turned off by the Start key or when more data is received in receive mode.

Sync Timeout

Only SYN characters have been received for three seconds. This indicator turns off if the Check Reset key is pressed.

Selection Required

Data cannot be accepted from the communications line unless preceded by a component selection character.

Inquiry Mode

The 2770 is operating in inquiry mode.

Manual Answer

Incoming calls must be answered manually.

Check Indicators

**Overrun*

Buffer capacity has been exceeded at a receiving 2772. Check Reset turns off Overrun.

**Input Check*

A character with even parity has been sent to the Control Unit by an input device. The Terminal Reset key turns this indicator off.

**Buffer Check*

A character with even parity has been read from the buffer. The Terminal Reset key turns this indicator off.

**Line Check*

Indicates lack of the proper response (Figure 2772-4) to a block check at a transmitting 2772, or block-check redundancy error at a receiving 2772. This indicator remains on, the data link is aborted, and the alarm sounds if all retries are unsuccessful. This indicator turns off following error-free transmission, or when the 2772 Check Reset key is pressed.

**Record Check*

This indicator notifies the operator of a transmitting 2772 that the receiving station has sent the wrong alternating ACK response to a data block (Figure 2772-4). The correct response following enquiry turns off the Record Check indicator. The Check Reset key also turns off Record Check.

**Transparency Check*

A transmitting 2772 has detected a data-link control character in non-transparent data to be transmitted. Such characters include: SYN, EOT, DLE, NAK, ENQ, ETB, ETX, and IUS (US). The Terminal Reset key turns this indicator off.

Test Check

The off-line test of BSC has stopped prematurely. The Check Reset key turns off Test Check and the Start key causes the unexecuted remainder of the test section to print. The last two characters printed are the number of the test section that failed to complete.

SWITCHES

Power On / Off Switch

This switch, located on the 2772 Control Unit, controls input power to the 2770 system. The 50 Magnetic Data Inscriber and the 1255 Magnetic Character Reader do not use the 2772 as a power source.

Transparency Switch

This switch, on the 2772 console, places the 2772 in transparent mode. With this switch ON, all transmission are in transparent format. (See "Special Features.") Also with the Transparency switch ON, home mode data transfers are transparent. With the EBCDIC Transparency feature, the 2772 can receive data in transparent format regardless of the Transparency switch setting.

Job Select Switch

This is an eight-position rotary switch on the 2772 console used for job setup control. The five prewired (at the plant or by a Customer Engineer) positions allow selection among five preplanned job setups. A sixth (variable-select mode) position provides the facility to vary the setup. The decisions listed in Table 2772-7 can then be made by operating the Variable Select switches. The seventh and eighth positions are reserved for on-line and off-line testing of the 2770 system. Job setup for on-line and off-line testing is also controlled by the Variable Select switches.

Tele Switch

This switch is present on all World Trade machines, and is operational when attached to common carrier switched networks via data sets not having a Tel key. The switch controls the Data Terminal Ready signal to the data set. When the switch is OFF, the data terminal ready is signaled to the data set and calls can be answered. The switch must be turned ON to disconnect the call.

Speed Switch

This switch is present on all World Trade machines. The switch is operational when these machines are attached to switched networks outside the USA. The switch controls transmission rate. When the switch is in the 600 position transmission is at 600 bits per second. When the switch is in the 1200 position transmission is at 1200 bits per second.

PROCEDURES

General Operating Sequence

The *general operating sequence* for the 2772 is:

1. Select the desired job setup by rotating the Job Select switch.

2. Press the Terminal Reset key to turn off the Proceed light if it is on, or to clear an incomplete or error situation.
3. Make the assigned input and/or output devices ready for operation (refer to the individual device sections of this manual), including the Printer if Monitor Print is assigned.
4. Press the Start key (if input operation). The job proceeds automatically.

Keyboard Input Sequence

A *keyboard input operation* modifies the general sequence as follows (steps 1 and 2 are the same):

1. Select the desired job setup by rotating the Job Select switch.
2. Press the Terminal Reset key to turn off the Proceed light if it is on, or to clear an incomplete or error situation.
3. Make all assigned input and output devices ready to operate.
4. Hold the Keyboard Request key down and wait for the Proceed indicator to come on.
5. Key the desired input data. When in home mode, the Keyboard locks when one buffer is full (one block). When in line mode, both buffers are available for keyed data (two blocks). If the Display Station is the direct-data device, its entire data capacity is available.
6. Press the Enter key (on the keyboard). If another input device is assigned and additional input is required from it, press the Start key (on the console) instead of the Enter key.
7. When the one or two blocks of data have been transferred, the keyboard can be requested again (step 4) and more input data can be keyed when the Proceed indicator comes on. (The Proceed indicator comes on again automatically in home mode.)
8. In home mode, Terminal Reset must be pressed to deselect the Keyboard.

Miscellaneous Procedures

Readying an I/O device for an initial start or for a restart is described in each device section of this manual. Refer to "Special Features" for keyboard-correction procedures. Refer to "Error Recovery Procedures" for restart procedures.

Error Recovery Procedures

The kind of error found, together with the time and manner of its indication, affect the sequence of actions needed to initiate an effective restart. Table 2772-9 shows detectable errors, the indication of each error, and the method of resetting the error condition in preparation for restart. Table 2772-10 shows the line actions that result from detection of an error condition. Tables 2772-11 and 12 show overall 2770 recovery procedures. Refer to the individual device section of this manual for the methods of readying that device for a restart.

When operating in line mode, error recovery may involve both the transmitting and receiving stations. Restart procedures must insure that no data is lost or duplicated in the output. Most errors can be recovered from the point of error; however, some situations require restart at a predefined check point, or at the beginning of the job. In these situations, communication is required between stations, to establish the restart point. Operation following an error, caused by improper formatting of data, can be resumed only by alerting the transmitting station that message format must be corrected. Thus, system design should include, as a minimum, definition of the following error restart messages:

Check point restart
Job restart
Format error

If communication is point-to-point between 2770 terminals, these messages would usually be communicated by direct operator-to-operator conversation. If communication is between 2770 and central processor, the processor program should include error message handling routines and format definitions. These program defined error messages can be transmitted from the 2770 by the following procedure:

1. Place Job Select switch in ON-LINE TEST position.
2. Press Terminal Reset key.
3. Enter message from keyboard, and press Enter key.

NOTE: If a card reader is present on the system, each error message can be prepunched in cards and entered from the card reader, instead of from the keyboard.

Tables 2772-11 and 2772-12 indicate when error messages are required.

Error recovery in home mode is essentially the same as recovery in line mode. The exception, of course, is that the communications line does not have to be dealt with in home mode. Therefore, the determination of input and output restart points is by the same operator, and the data link does not have to be re-established.

Table 2772-9. Detectable Errors

Error	Indicator	Audible Alarm	Indicator Reset
Outgoing line bid rejected or unanswered	Bid Retry	✓	Check Reset
Continuous SYN's on line	Sync Timeout		Check Reset
Incoming line bid rejected	Terminal Addressed	✓	Check Reset
Proper acknowledgment not received	Line Check	✓	Start key
Incorrect odd/even acknowledgment	Record Check	✓	Check Reset
Premature end by remote station	Incomplete	Master Station	Start key
Selected output device not ready	Blinking select light	✓	Ready the device, Check Reset
Selected input device not ready	Blinking select light	✓	Ready the device, Check Reset
Incorrect buffer parity	Buffer Check	✓	Terminal Reset
Incorrect input parity	Input Check	✓	Terminal Reset
Received input exceeds buffer capacity	Overrun	✓	Check Reset
Automatic disconnect by auto answer feature	Data Set Ready (not on)	✓	Remedy data set condition
Data link control character in nontransparent transmit data stream	Transparency Check	✓	Terminal Reset

NOTE: When restart involves going back to a restart point, use Terminal Reset to clear the error condition. See Tables 2772-11 and 12.

Table 2772-10. On-Line Action in Error Situation

Error Situation	Line Action
2772 Receiving:	
Selected output device is not assigned or not ready when selected in text, or becomes not ready while operating.	Send EOT
Output device selection required but not received.	Send EOT
Buffer parity error at 2772.	Send EOT
Output device detects error or attention condition.	Send EOT
ENQ received in text.	Send NAK
Received data block exceeds buffer capacity (Overrun).	Send EOT
Locally - computed redundancy check disagress with received redundancy check (BCC) at end of block.	Send NAK
2772 Transmitting:	
Buffer parity error at 2772. Data link control character found in non-transparent data.	Send ENQ in text } receive NAK, send EOT Send ENQ in text }
The selected input device becomes not ready, detects an error, or delivers an even-parity character at the input interface.	Send TN/XQ, receive NAK, send EOT

Transmitting Terminal Station			Receiving Terminal Station		Receiving Processor Station Recovery
Indicator	Operator Recovery	Line Action	Indicator	Operator Recovery	
Buffer Check	Card, paper tape, magnetic tape, MICR documents: Send job restart or check point restart message. Reload data from predefined restart point or beginning of job. Depress Terminal Reset, then Start. Keyboard: Depress Terminal Reset, depress Keyboard Request, rekey data, depress Enter. Display: Depress Terminal Reset, depress Keyboard Request, position cursor where SMM is to be entered, enter SMM, reposition cursor to EOM position, depress Enter.	ENQ encoded in place of bad character, receiver responds NAK, transmitter closes with EOT.	Incomplete	Discard media back to predefined restart point or discard media and restart job, depending on prior restart agreement.	Discard data back to predefine restart point or restart job, depending on prior restart agreement. If multi-point line, resume polling.
Input Check	Same as Buffer Check. With display check for Check symbols and replace with valid data before restarting.	If a completed buffer load is in buffer, STX ENQ is sent after good block response is received, receiver responds NAK, transmitter closes with EOT.	Incomplete	Same as Buffer Check.	Same as Buffer Check.
Line Check	Depress Start to reset error condition and reinitiate line bid. If on dial line and condition continues to reoccur, hang up and redial connection.	If retransmission is not successful after allotted retries, an EOT is sent to abort the line.	Incomplete Line Check	No action required.	No action required. Would occur because terminal could not understand responses after allotted ENQ tries. If multipoint line, resume polling.
Line Check Incomplete	Same as Line Check.	If retransmission is not successful after allotted retries, an EOT is sent by the processor to abort the line.		Not Applicable.	No action required. If multipoint line, resume polling.
Record Check	Depress Check Reset to reset error condition and reinitiate line bid.	If response does not agree after allotted ENQ retires, EOT is sent to abort the line.	Incomplete	No action required.	No action required. If multipoint line, resume polling.
Transparency Check	Depress Terminal Reset to clear error condition. Send job restart message. Resend job with Transparency Switch on. Terminal could recover; however, data already sent could have different meaning in transparent mode.	ENQ is encoded in place of character causing check condition. After the receiver responds with NAK, the transmitter aborts with EOT.	Incomplete	Discard media and restart job.	Discard data and restart job. If multipoint line, resume polling.

Table 2772-11. Terminal Operator Recovery Procedures—2772 Transmitting (Part 1 of 2)

Table 2772-11. Terminal Operator Recovery Procedures–2772 Transmitting (Part 2 of 2)

Transmitting Terminal Station		Line Action	Receiving Terminal Station		Receiving Processor Station Recovery
Indicator	Operator Recovery		Indicator	Operator Recovery	
Sync Timeout	Depress Check Reset to reset the indicator. If the indicator continues to come on, contact the receiving terminal operator or the console operator to investigate the source of the problem at the receiving terminal or the processor.	The receiving station is holding a continuous stream of SYN characters on the line.	No indication	After being contacted by the transmitting operator, move Job Select switch to Off-line Test position and depress Terminal Reset to reset bi-sync. Determine restart point where transmission can resume.	Correct the faulty condition at the processor and determine the restart point. If on a multipoint line, resume polling.
Keyboard, Input Device 2, Input Device 3, - any of these lights blinking	Examine the device associated with the blinking light on the console to determine the problem with the device. Correct the problem following procedures defined in the device sections of this manual. Send job restart or check point restart message if requred. Depress Check Reset if required to clear out any check conditions. Depress Start to initiate a line bid. Control Unit is able to restart where device left off without losing data.	If the input device is Synchronous, all good records in the buffer are transmitted; if the input device is incremental all good data in the buffer is transmitted. After good data (or records) are transmitted and acknowledged, STX ENQ is sent, receiver responds NAK, Transmitter closes EOT.	Incomplete	No action required, unless error message is received.	No action on data required, unless error message is received. If multipoint line, resume polling.

Receiving Terminal Station		Line Action	Transmitting Terminal Station		Transmitting Processor Station Recovery
Indicator	Operator Recovery		Indicator	Operator Recovery	
Buffer Check	Depress Terminal Reset to clear out error condition. Contact transmitting station to inform operator to restart job or restart at predefined restart point. Discard media back to restart of job or predefined restart point.	EOT is sent as response to next block checking sequence calling for a response.	Incomplete	After receiving instructions from the receiving operator, resend job or resend starting at a defined restart point. Depress Terminal Reset to terminate the operation. Depress Start to initiate a line bid.	After receiving instructions from the receiving operator, resend job or resend starting at a predefined restart point.
Overrun	Contact transmitting operator to determine the problem.	EOT is sent as response to block of data causing the overrun.	Line Check	Resend block by depressing Check Reset. If contacted by receiving operator because condition persists, transmission cannot continue because of a hardware failure or mismatch of buffer sizes.	Resend block of data unless contacted by receiving operator. If block of data cannot be sent because it is too long, block length must be corrected for transmission to continue.
Sync Timeout	Depress Check Reset to reset the indicator. If the indicator continues to come on, contact the transmitting terminal operator or the console operator to investigate the source of the problem at the transmitting terminal or the processor.	The transmitting terminal is holding a continuous stream of SYN characters on the line.	No indication	After being contacted by the receiving operator, move Job Switch to Off-line Test position and depress Terminal Reset to reset bi-sync. Determine restart point where transmission can resume and inform receiving operator.	Correct the faulty condition at the processor and determine the restart point. Inform the receiving operator.
Terminal Addressed	Component Selection has been unsuccessful. Make certain all assigned output devices are ready, and that Job Select switch is at correct setting. After correcting these conditions, press Terminal Reset to resume operation. If Selection Required Light is on and conditions above are correct, inform remote station that component Select Character is missing (format error).	EOT is sent as response to first block of data received.	Incomplete	Attempt retransmission. If informed by remote Station that component Select Character is missing, restart job with component Select Character as first data character.	Attempt retransmission. If informed by remote Station that component Select Character is missing, restart job with component Select Character as first data character.
Printer Output Device 2 Output Device 3 – any of these lights blinking	Examine the device associated with the blinking light on the console to determine the problem with the device. Correct the problem following the defined procedures in the device sections of this manual. Depress Check Reset to clear out any check conditions. Depress Start to prepare the terminal to receive and unload any data stored in the buffer. Control unit is able to restart where device left off without losing any data. If no error or attention condition exists at the device, it may not have been ready or assigned by the Job Select switch when a component select sequence was received in text.	EOT is sent as response to next block checking sequence calling for a response.	Incomplete	Unless contacted by the receiving operator, depress Start Key to reinitiate line bid and start up transmission.	Unless contacted by the receiving operator, restart transmission by retransmitting the block which received EOT as a response. If contacted by operator, restart point is determined. A minimum of the last two blocks must be retransmitted.

A. Field-Changeable Specify Features (IBM 2772)

Device Assignment

Both an Input # and an Output # must be assigned for a 2265 Display Station. The keyboard and the printer have fixed input assignments. Other devices may be assigned at will. (If two 50 Magnetic Data Inscribers are attached, both are assigned the same input #.)

Primary Station

Provides primary station with one-second instead of three-second ENQ timeout (see Table 2772-6). On a 2772-to-2772 leased network, one 2772 is wired as the primary station. When a 2772 will communicate mainly with a processor, the 2772 should be wired as the primary. Whenever multiple 2772 switched-network stations communicate mainly with a processor, all of them should be wired as primary stations.

Address Assignment (with Multipoint Data Link Control Special Feature)

Any alphabetic character may be assigned as the station-address code. The same address character serves for polling (in uppercase) and for selection (in lowercase).

Alarm Intensity

High or low.

CPU Operation

Processor counts retransmissions in both directions.

Extended Retry Transmission

Provides for fifteen instead of three automatic 'retry' requests for response. See Table 2772-6.

WACK Response

Initial WACK (wait before transmit--positive acknowledge) to be transmitted immediately.

Fixed Job Setups (Job Select Switch)

For each of the five fixed job setups, the following decisions and assignments must be made (see Table 2772-7):

a. Input device(s) #
b. Output device(s) #
c. Receive Monitor Print or not
d. Transmit Monitor Print or not
e. Direct-data device #
f. Inquiry mode or normal line mode with Multipoint Data Link Control special feature
g. Call, answer, and disconnect manually, or answer and disconnect automatically.
h. Line or home mode
i. Component selection required or not

B. Data-Format Specifications (IBM 2772)

In media, data format has two main divisions: messages and records. As transmitted, data format also has two divisions: messages and blocks. Thus, records are medium-oriented and blocks are transmission-oriented (Figure 2772-5). In the 2772, end-of-file and end-of-message are equivalent; an end-of-file condition from media ends message text and causes the Control Unit to transmit ETX at the end of the last text block. Each input device provides an end-of-file signal at the end of a job. (See appropriate device section of this manual.) Interactions of record and block are described in the following paragraphs.

Except for card operations, record separators (NL or IRS/RS) are recorded in input media and transferred as data characters to output media, where action is taken if required. Blocks and records are usually independent if non-transparent. Table CU-1 summarizes output record formatting and the controls that affect it. Table CU-2 summarizes the effect of input record format on the buffer.

The 1255 Magnetic Character Reader inserts a record separator (IRS/RS) in the buffer after each correctly read document. When a predetermined number of documents have been read, the 1255 provides an End-Of-Card signal to the Control Unit. This signal causes the buffers to alternate and transmission of data to begin.

The Card Reader provides an End of Card command at the conclusion of each card read. This command stores a record separator (IRS or RS) in the buffer. If an end-of-card character (IRS/RS) is punched in the midst of data, it is read as a data character and stored in the buffer. One buffer never contains a partial record obtained from a card reader or for sending to a card punch. A card punch starts a new card for each IRS/RS; therefore an input card having IRS/RS punched within it results in two output cards. Each card record is a block except when: (1) received from a processor; (2) Buffer Expansion feature is operating non-transparent.

Only data to or from card I/O devices, or from MICR encoded documents affects transmission-block formatting. This characteristic results from the synchronous nature (unable to stop in mid-record) of the card devices. The Buffer Expansion feature (see "Special Features") enhances card I/O efficiency in that it allows multiple card records to be grouped in a transmission block.

In transparent transmitting operation, only one card (regardless of its length and regardless of expanded buffer) is read into a buffer block. Output of data received in transparent operation has a format determined by the limitations of the output device and/or by the data grouping in the block (see Table CU-3).

NOTE: Multiple card records of transparent data per expanded-buffer block can be received from a processor. Each record must exactly coincide with card capacity.

C. Code Sets

Tables CU-4 and CU-5 are charts of the binary configurations of the USASCII and EBCDIC code sets. All assigned graphics and card codes are shown.

Table CU-1. Non-Transparent Output Format Control

Format Control Characters: NL - Left margin return and line feed. LF - Line feed only. RLF - Reverse line feed. IRS/RS - Record separator (card). HT - Horizontal tabulate. BS - Backspace. VT - Vertical tabulate (2213 skips to 2). FF - Forms feed (2213 skips to 1). ESC - Prefix character of two-or three-character control sequence. EM - End of media.

Output Device:	Output Device Recognizes and Executes:												
	NL	LF	RLF	RS, IRS	HT	BS	VT	FF	ESC-Command	EM	End-of-file Command	End of Buffer block	End of Line/ Card/Tape
**2213 Model 1	✓	✓		NL	✓	✓							NL
**2213 Model 2	✓	✓		NL	✓	✓	✓	✓	✓				NL
545 - 3 or 4				Release							Extra release	Release, punch 81 indication	Release
1018													Becomes not-ready
2265-2	✓	✓	✓	NL	Feature	✓			✓				NL (at end of screen, return to start of screen.)

* Characters sent to the 2265-2 that cannot be displayed or executed as a control are converted to NUL's (appear as space on screen). Other media that can later serve as input write or otherwise save format and graphics characters.

**Printer prints the graphic equivalent to the low-order six bits of an output interface character, except for executable controls.

Table CU-2 End-of-Buffer-Block Conditions

Condition	Non-Transparent		Transparent	
	Basic	Expanded	Basic	Expanded
End-of-card signal from magnetic character reader		✓		✓
End-of-data (EM) character from 50 Magnetic Data Inscriber	✓	✓		
End-of-file signal from input device	✓	✓	✓	✓
End-of-card signal from chard reader	✓		✓	✓
IRS/RS from any device except card reader, magnetic character reader, or Type 50 in line mode.	✓			
End-of-card signal from card reader and not enough room for another 80-col. card		✓		
IRS/RS from any device except card reader, magnetic character reader, or Type 50 in line mode, and not enough room for another 80 characters.		✓		
Start key operated when Proceed indicator is on and data has been keyed.	✓	✓	✓	✓
ETB or ETX received or sent and validated	✓	✓	✓	✓
All character positions filled	✓	✓	(Tape only)	(Tape only)

NOTE: These conditions cause the buffers to alternate; input block becomes output block, output block becomes input block. Input from line or output to line must be validated; input from device or output to device must be complete and valid.

Table CU-3 Transparent Output Format Control

Output Device:	Performs NL or Eject Function:	Performs End-of-File Function:
2213	At right margin or at end of buffer block.	(none)
545 - 3 or 4	At end of card or at end of buffer block.	Extra release on end-of-file command.
1018	(none)	(none)
2265-2	Only at end of line.	(none)

Table CU-4. USASCII Code Set in Hexadecimal Order

CHAR.	CARD CODE	USASCII CODE								HEX
NUL	12-0-9-8-1									00
SOH	12-9-1	1								01
STX	12-9-2		2							02
ETX	12-9-3	1	2						P	03
EOT	9-7			3						04
ENQ	0-9-8-5	1		3					P	05
ACK	0-9-8-6		2	3					P	06
BEL	0-9-8-7	1	2	3						07
BS	11-9-6				4					08
HT	12-9-5	1			4				P	09
LF	0-9-5		2		4				P	0A
VT	12-9-8-3	1	2		4					0B
FF	12-9-8-4			3	4				P	0C
CR	12-9-8-5	1		3	4					0D
SO	12-9-8-6		2	3	4					0E
SI	12-9-8-7	1	2	3	4				P	0F
DLE	12-11-9-8-1					5				10
DC1	11-9-1	1				5			P	11
DC2	11-9-2		2			5			P	12
DC3	11-9-3	1	2			5				13
DC4	4-8-9			3		5			P	14
NAK	9-8-5	1		3		5				15
SYN	9-2		2	3		5				16
ETB	0-9-6	1	2	3		5			P	17
CAN	11-9-8				4	5			P	18
EM	11-9-8-1	1			4	5				19
SUB	9-8-7		2		4	5				1A
ESC	0-9-7	1	2		4	5			P	1B
FS	11-9-8-4			3	4	5				1C
GS	11-9-8-5	1		3	4	5			P	1D
RS	11-9-8-6		2	3	4	5			P	1E
US	11-9-8-7	1	2	3	4	5				1F
SPACE	NO PUNCHES						6			20
!	12-8-7	1					6		P	21
"	8-7		2				6		P	22
#	8-3	1	2				6			23
$	11-8-3			3			6		P	24
%	0-8-4	1		3			6			25
&	12		2	3			6			26
'	8-5	1	2	3			6		P	27
(	12-8-5				4		6		P	28
)	11-8-5	1			4		6			29
*	11-8-4		2		4		6			2A
+	12-8-6	1	2		4		6		P	2B
,	0-8-3			3	4		6			2C
-	11	1		3	4		6		P	2D
.	12-8-3		2	3	4		6		P	2E
/	0-1	1	2	3	4		6			2F
0	0					5	6		P	30
1	1	1				5	6			31
2	2		2			5	6			32
3	3	1	2			5	6		P	33
4	4			3		5	6			34
5	5	1		3		5	6		P	35
6	6		2	3		5	6		P	36
7	7	1	2	3		5	6			37
8	8				4	5	6			38
9	9	1			4	5	6		P	39
:	8-2		2		4	5	6		P	3A
;	11-8-6	1	2		4	5	6			3B
<	12-8-4			3	4	5	6		P	3C
=	8-6	1		3	4	5	6			3D
>	0-8-6		2	3	4	5	6			3E
?	0-8-7	1	2	3	4	5	6		P	3F

CHAR.	CARD CODE	USASCII CODE								HEX
@	8-4							7		40
A	12-1	1						7	P	41
B	12-2		2					7	P	42
C	12-3	1	2					7		43
D	12-4			3				7	P	44
E	12-5	1		3				7		45
F	12-6		2	3				7		46
G	12-7	1	2	3				7	P	47
H	12-8				4			7	P	48
I	12-9	1			4			7		49
J	11-1		2		4			7		4A
K	11-2	1	2		4			7	P	4B
L	11-3			3	4			7		4C
M	11-4	1		3	4			7	P	4D
N	11-5		2	3	4			7	P	4E
O	11-6	1	2	3	4			7		4F
P	11-7					5		7	P	50
Q	11-8	1				5		7		51
R	11-9		2			5		7		52
S	0-2	1	2			5		7	P	53
T	0-3			3		5		7		54
U	0-4	1		3		5		7	P	55
V	0-5		2	3		5		7	P	56
W	0-6	1	2	3		5		7		57
X	0-7				4	5		7		58
Y	0-8	1			4	5		7	P	59
Z	0-9		2		4	5		7	P	5A
[	12-8-2	1	2		4	5		7		5B
\	0-8-2			3	4	5		7	P	5C
]	11-8-2	1		3	4	5		7		5D
↑	11-8-7		2	3	4	5		7		5E
←	0-8-5	1	2	3	4	5		7	P	5F
`	8-1						6	7	P	60
a	12-0-1	1					6	7		61
b	12-0-2		2				6	7		62
c	12-0-3	1	2				6	7	P	63
d	12-0-4			3			6	7		64
e	12-0-5	1		3			6	7	P	65
f	12-0-6		2	3			6	7	P	66
g	12-0-7	1	2	3			6	7		67
h	12-0-8				4		6	7		68
i	12-0-9	1			4		6	7	P	69
j	12-11-1		2		4		6	7	P	6A
k	12-11-2	1	2		4		6	7		6B
l	12-11-3			3	4		6	7	P	6C
m	12-11-4	1		3	4		6	7		6D
n	12-11-5		2	3	4		6	7		6E
o	12-11-6	1	2	3	4		6	7	P	6F
p	12-11-7					5	6	7		70
q	12-11-8	1				5	6	7	P	71
r	12-11-9		2			5	6	7	P	72
s	11-0-2	1	2			5	6	7		73
t	11-0-3			3		5	6	7	P	74
u	11-0-4	1		3		5	6	7		75
v	11-0-5		2	3		5	6	7		76
w	11-0-6	1	2	3		5	6	7	P	77
x	11-0-7				4	5	6	7	P	78
y	11-0-8	1			4	5	6	7		79
z	11-0-9		2		4	5	6	7		7A
{	12-0	1	2		4	5	6	7	P	7B
|	12-11			3	4	5	6	7		7C
}	11-0	1		3	4	5	6	7	P	7D
~	11-0-1		2	3	4	5	6	7	P	7E
DEL	12-9-7	1	2	3	4	5	6	7		7F

Table CU-5. EBCDIC Code Set in Hexadecimal Order (Part 1 of 2)

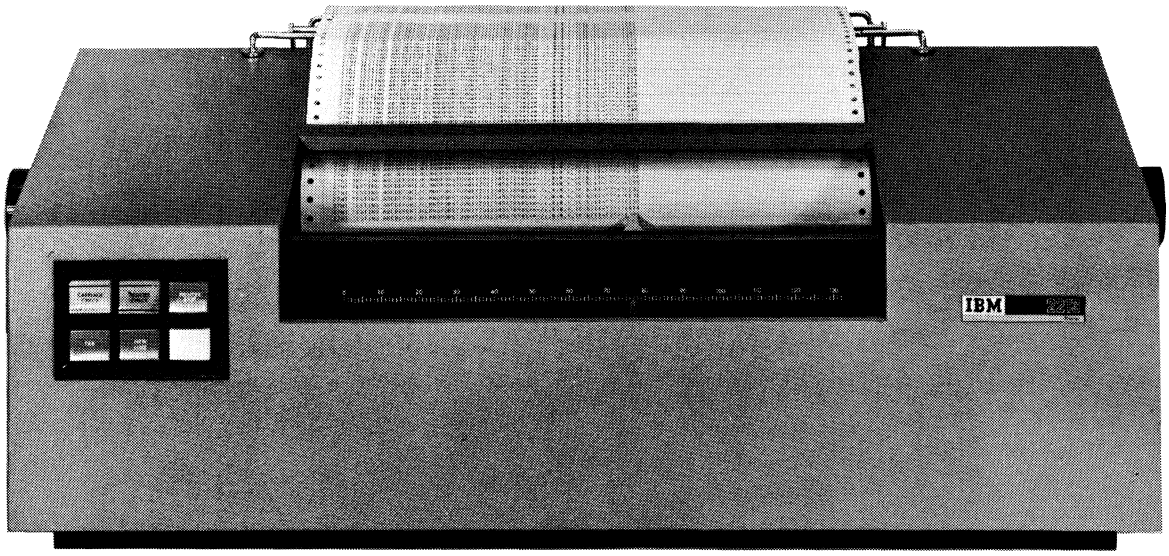
CHAR.	CARD CODE	EBCDIC CODE							HEX
NUL	12-0-1-8-9								00
SOH	12-1-9						7		01
STX	12-2-9					6			02
ETX	12-3-9					6	7		03
PF	12-4-9				5				04
HT	12-5-9				5		7		05
LC	12-6-9				5	6			06
DEL	12-7-9				5	6	7		07
	12-8-9			4					08
RLF	12-1-8-9			4			7		09
SMM	12-2-8-9			4		6			0A
VT	12-3-8-9			4		6	7		0B
FF	12-4-8-9			4	5				0C
CR	12-5-8-9			4	5		7		0D
SO	12-6-8-9			4	5	6			0E
SI	12-7-8-9			4	5	6	7		0F
DLE	12-11-1-8-9		3						10
DC1	11-1-9		3				7		11
DC2	11-2-9		3			6			12
DC3(TM)	11-3-9		3			6	7		13
RES	11-4-9		3		5				14
NL	11-5-9		3		5		7		15
BS	11-6-9		3		5	6			16
IL	11-7-9		3		5	6	7		17
CAN	11-8-9		3	4					18
EM	11-1-8-9		3	4			7		19
CC	11-2-8-9		3	4		6			1A
CU1	11-3-8-9		3	4		6	7		1B
IFS	11-4-8-9		3	4	5				1C
IGS	11-5-8-9		3	4	5		7		1D
IRS	11-6-8-9		3	4	5	6			1E
IUS	11-7-8-9		3	4	5	6	7		1F
DS	11-0-1-8-9	2							20
SOS	0-1-9	2					7		21
FS	0-2-9	2				6			22
	0-3-9	2				6	7		23
BYP	0-4-9	2			5				24
LF	0-5-9	2			5		7		25
ETB(EOB)	0-6-9	2			5	6			26
ESC(PRE)	0-7-9	2			5	6	7		27
	0-8-9	2		4					28
	0-1-8-9	2		4			7		29
SM	0-2-8-9	2		4		6			2A
CU2	0-3-8-9	2		4		6	7		2B
	0-4-8-9	2		4	5				2C
ENQ	0-5-8-9	2		4	5		7		2D
ACK	0-6-8-9	2		4	5	6			2E
BEL	0-7-8-9	2		4	5	6	7		2F
	12-11-0-1-8-9	2	3						30
	1-9	2	3				7		31
SYN	2-9	2	3			6			32
	3-9	2	3			6	7		33
PN	4-9	2	3		5				34
RS	5-9	2	3		5		7		35
UC	6-9	2	3		5	6			36
EOT	7-9	2	3		5	6	7		37
	8-9	2	3	4					38
	1-8-9	2	3	4			7		39
	2-8-9	2	3	4		6			3A
CU3	3-8-9	2	3	4		6	7		3B
DC4	4-8-9	2	3	4	5				3C
NAK	5-8-9	2	3	4	5		7		3D
	6-8-9	2	3	4	5	6			3E
SUB	7-8-9	2	3	4	5	6	7		3F

CHAR.	CARD CODE	EBCDIC CODE							HEX
SPACE	NO PUNCHING	1							40
	12-0-1-9	1						7	41
	12-0-2-9	1					6		42
	12-0-3-9	1					6	7	43
	12-0-4-9	1				5			44
	12-0-5-9	1				5		7	45
	12-0-6-9	1				5	6		46
	12-0-7-9	1				5	6	7	47
	12-0-8-9	1			4				48
	12-1-8	1			4			7	49
¢	12-2-8	1			4		6		4A
.	12-3-8	1			4		6	7	4B
<	12-4-8	1			4	5			4C
(	12-5-8	1			4	5		7	4D
+	12-6-8	1			4	5	6		4E
|	12-7-8	1			4	5	6	7	4F
&	12	1		3					50
	12-11-1-9	1		3				7	51
	12-11-2-9	1		3			6		52
	12-11-3-9	1		3			6	7	53
	12-11-4-9	1		3		5			54
	12-11-5-9	1		3		5		7	55
	12-11-6-9	1		3		5	6		56
	12-11-7-9	1		3		5	6	7	57
	12-11-8-9	1		3	4				58
	11-1-8	1		3	4			7	59
!	11-2-8	1		3	4		6		5A
$	11-3-8	1		3	4		6	7	5B
*	11-4-8	1		3	4	5			5C
)	11-5-8	1		3	4	5		7	5D
;	11-6-8	1		3	4	5	6		5E
¬	11-7-8	1		3	4	5	6	7	5F
-	11	1	2						60
/	0-1	1	2					7	61
	11-0-2-9	1	2				6		62
	11-0-3-9	1	2				6	7	63
	11-0-4-9	1	2			5			64
	11-0-5-9	1	2			5		7	65
	11-0-6-9	1	2			5	6		66
	11-0-7-9	1	2			5	6	7	67
	11-0-8-9	1	2		4				68
	0-1-8	1	2		4			7	69
	12-11	1	2		4		6		6A
,	0-3-8	1	2		4		6	7	6B
%	0-4-8	1	2		4	5			6C
—	0-5-8	1	2		4	5		7	6D
>	0-6-8	1	2		4	5	6		6E
?	0-7-8	1	2		4	5	6	7	6F
	12-11-0	1	2	3					70
F1	12-11-0-1-9	1	2	3				7	71
F2	12-11-0-2-9	1	2	3			6		72
F3	12-11-0-3-9	1	2	3			6	7	73
F4	12-11-0-4-9	1	2	3		5			74
F5	12-11-0-5-9	1	2	3		5		7	75
F6	12-11-0-6-9	1	2	3		5	6		76
F7	12-11-0-7-9	1	2	3		5	6	7	77
F8	12-11-0-8-9	1	2	3	4				78
	1-8	1	2	3	4			7	79
:	2-8	1	2	3	4		6		7A
#	3-8	1	2	3	4		6	7	7B
@	4-8	1	2	3	4	5			7C
'	5-8	1	2	3	4	5		7	7D
=	6-8	1	2	3	4	5	6		7E
"	7-8	1	2	3	4	5	6	7	7F

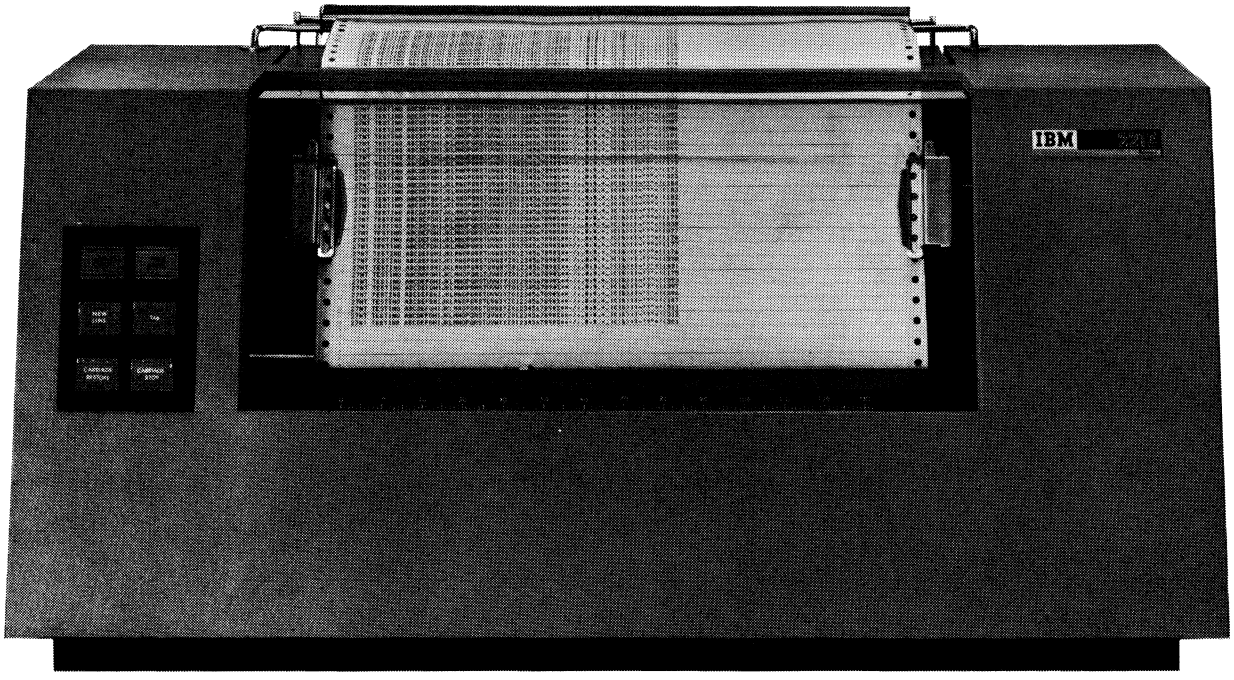
Table CU-5. EBCDIC Code Set in Hexadecimal Order (Part 2 of 2)

CHAR.	CARD CODE	EBCDIC CODE								HEX
	12-0-1-8	0								80
a	12-0-1	0							7	81
b	12-0-2	0						6		82
c	12-0-3	0						6	7	83
d	12-0-4	0					5			84
e	12-0-5	0					5		7	85
f	12-0-6	0					5	6		86
g	12-0-7	0					5	6	7	87
h	12-0-8	0				4				88
i	12-0-9	0				4			7	89
	12-0-2-8	0				4		6		8A
	12-0-3-8	0				4		6	7	8B
	12-0-4-8	0				4	5			8C
	12-0-5-8	0				4	5		7	8D
	12-0-6-8	0				4	5	6		8E
	12-0-7-8	0				4	5	6	7	8F
	12-11-1-8	0			3					90
j	12-11-1	0			3				7	91
k	12-11-2	0			3			6		92
l	12-11-3	0			3			6	7	93
m	12-11-4	0			3		5			94
n	12-11-5	0			3		5		7	95
o	12-11-6	0			3		5	6		96
p	12-11-7	0			3		5	6	7	97
q	12-11-8	0			3	4				98
r	12-11-9	0			3	4			7	99
	12-11-2-8	0			3	4		6		9A
	12-11-3-8	0			3	4		6	7	9B
	12-11-4-8	0			3	4	5			9C
	12-11-5-8	0			3	4	5		7	9D
	12-11-6-8	0			3	4	5	6		9E
	12-11-7-8	0			3	4	5	6	7	9F
	11-0-1-8	0	2							A0
	11-0-1	0	2						7	A1
s	11-0-2	0	2					6		A2
t	11-0-3	0	2					6	7	A3
u	11-0-4	0	2				5			A4
v	11-0-5	0	2				5		7	A5
w	11-0-6	0	2				5	6		A6
x	11-0-7	0	2				5	6	7	A7
y	11-0-8	0	2			4				A8
z	11-0-9	0	2			4			7	A9
	11-0-2-8	0	2			4		6		AA
	11-0-3-8	0	2			4		6	7	AB
	11-0-4-8	0	2			4	5			AC
	11-0-5-8	0	2			4	5		7	AD
	11-0-6-8	0	2			4	5	6		AE
	11-0-7-8	0	2			4	5	6	7	AF
	12-11-0-1-8	0	2	3						B0
	12-11-0-1	0	2	3					7	B1
	12-11-0-2	0	2	3				6		B2
	12-11-0-3	0	2	3				6	7	B3
	12-11-0-4	0	2	3			5			B4
	12-11-0-5	0	2	3			5		7	B5
	12-11-0-6	0	2	3			5	6		B6
	12-11-0-7	0	2	3			5	6	7	B7
	12-11-0-8	0	2	3	4					B8
	12-11-0-9	0	2	3	4				7	B9
	12-11-0-2-8	0	2	3	4			6		BA
	12-11-0-3-8	0	2	3	4			6	7	BB
	12-11-0-4-8	0	2	3	4	5				BC
	12-11-0-5-8	0	2	3	4	5			7	BD
	12-11-0-6-8	0	2	3	4	5	6			BE
	12-11-0-7-8	0	2	3	4	5	6		7	BF

CHAR.	CARD CODE	EBCDIC CODE								HEX
{	12-0	0	1							C0
A	12-1	0	1						7	C1
B	12-2	0	1					6		C2
C	12-3	0	1					6	7	C3
D	12-4	0	1				5			C4
E	12-5	0	1				5		7	C5
F	12-6	0	1				5	6		C6
G	12-7	0	1				5	6	7	C7
H	12-8	0	1			4				C8
I	12-9	0	1			4			7	C9
	12-0-2-8-9	0	1			4		6		CA
	12-0-3-8-9	0	1			4		6	7	CB
ſ	12-0-4-8-9	0	1			4	5			CC
	12-0-5-8-9	0	1			4	5		7	CD
Ч	12-0-6-8-9	0	1			4	5	6		CE
	12-0-7-8-9	0	1			4	5	6	7	CF
}	11-0	0	1		3					D0
J	11-1	0	1		3				7	D1
K	11-2	0	1		3			6		D2
L	11-3	0	1		3			6	7	D3
M	11-4	0	1		3		5			D4
N	11-5	0	1		3		5		7	D5
O	11-6	0	1		3		5	6		D6
P	11-7	0	1		3		5	6	7	D7
Q	11-8	0	1		3	4				D8
R	11-9	0	1		3	4			7	D9
	12-11-2-8-9	0	1		3	4		6		DA
	12-11-3-8-9	0	1		3	4		6	7	DB
	12-11-4-8-9	0	1		3	4	5			DC
	12-11-5-8-9	0	1		3	4	5		7	DD
	12-11-6-8-9	0	1		3	4	5	6		DE
	12-11-7-8-9	0	1		3	4	5	6	7	DF
\	0-2-8	0	1	2						E0
	11-0-1-9	0	1	2					7	E1
S	0-2	0	1	2				6		E2
T	0-3	0	1	2				6	7	E3
U	0-4	0	1	2			5			E4
V	0-5	0	1	2			5		7	E5
W	0-6	0	1	2			5	6		E6
X	0-7	0	1	2			5	6	7	E7
Y	0-8	0	1	2		4				E8
Z	0-9	0	1	2		4			7	E9
	11-0-2-8-9	0	1	2		4		6		EA
	11-0-3-8-9	0	1	2		4		6	7	EB
ᵸ	11-0-4-8-9	0	1	2		4	5			EC
	11-0-5-8-9	0	1	2		4	5		7	ED
	11-0-6-8-9	0	1	2		4	5	6		EE
	11-0-7-8-9	0	1	2		4	5	6	7	EF
0	0	0	1	2	3					F0
1	1	0	1	2	3				7	F1
2	2	0	1	2	3			6		F2
3	3	0	1	2	3			6	7	F3
4	4	0	1	2	3		5			F4
5	5	0	1	2	3		5		7	F5
6	6	0	1	2	3		5	6		F6
7	7	0	1	2	3		5	6	7	F7
8	8	0	1	2	3	4				F8
9	9	0	1	2	3	4			7	F9
	12-11-0-2-8-9	0	1	2	3	4		6		FA
	12-11-0-3-8-9	0	1	2	3	4		6	7	FB
	12-11-0-4-8-9	0	1	2	3	4	5			FC
	12-11-0-5-8-9	0	1	2	3	4	5		7	FD
	12-11-0-6-8-9	0	1	2	3	4	5	6		FE
	12-11-0-7-8-9	0	1	2	3	4	5	6	7	FF



Model 1



Model 2

IBM 2213 Printer

Introduction

The IBM 2213 Printer (Frontispiece) used with the IBM 2770 Data Communication System is a serial-matrix type printer. The 2213 prints up to 66 characters per second, 10 characters per inch, and up to 132 characters per line.

The print head consists of a column of seven print wires mounted on a carrier. Printing is accomplished through selective pushing of the print wires forward so that an inked ribbon contacts the paper to construct the characters out of dots as the print head moves from left to right across the character space and the print line. The wires can be activated independently up to five times for any one character.

The 2213 Printer contains the mechanical and electromechanical components. Control logic, the character-pattern generator, and the interface to the IBM 2772 Multi-Purpose Control Unit are contained in the 2213 Attachment feature (i.e., the printer attachment, or print adapter) physically located in the 2772.

The 2213 is available in two models. The Model 1 has a friction-feed platen similar to that used on a typewriter; vertical linespacing of either six or eight lines-per-inch can be specified when the printer is ordered. Manual selection of single or double linespacing is a standard feature. Special features available for the Model 1 are:

Pin Feed Platen
Roll Paper Feed
Forms Stand Stacker

The Model 2 provides Vertical Forms Control (VFC) consisting of a 12-track tape-controlled tractor carriage. This feature provides complete flexibility of vertical forms movement under control of instructions received from the 2772 Control Unit. Vertical form-skip rate is 12 inches per second when printing 6 lines per inch, or 9 inches per second when printing 8 lines per inch.

Except where model number is indicated, the following descriptions apply to either model.

Functions

In addition to printing, the 2213 Printer performs the following five functions usually associated with electric typewriters:

a. Space
b. Backspace
c. Tabulate (Tab)
d. Line Feed
e. New Line

The 2213 Printer depends on the printer attachment in the 2772 Control Unit to initiate each function; however, two of these functions--"tab" and "new line"--may also be initiated from keys on the operator's panel on the Printer. All five functions can be initiated from the keyboard as well as from the data stored in the 2772 Control Unit buffer.

During execution of the listed functions, no printing can take place.

SPACE

This function moves the print head one character space (0.100 inch) to the right without printing.

When printing from the keyboard, spacing takes place on a character-by-character basis--that is, the print head stops after each character space and awaits the next operation.

When printing from the 2772 Control Unit buffer, the space is produced by suppressing print-magnet pulses for the duration of the desired character spaces while the print head moves, without stopping, across the print line.

BACKSPACE

This function moves the print head back (to the left) one character space, without printing.

TABULATE (TAB)

This function moves (tabs) the print head continuously from left to right along the print line (without printing) until either a tab stop or a margin stop is encountered. Printing can then continue in the next character space.

If the right hand margin stop is encountered while tabbing, the tab operation ends; if the tab was initiated by the 2213 Tab key, a new line function is performed; if the tab was initiated from the keyboard, or by receiving a tab character from the Control Unit buffer, the print carrier stops at the right margin and awaits the next operation.

Printing pulses to the print head are suspended from the start of a tab operation until the tab stop or margin stop is sensed.

The tab stops are set and cleared manually by the operator (see "Operating Characteristics--Tab Stops"). There is no restriction on the minimum number of print positions which can be tabbed.

LINE FEED

This function cannot be performed on printers using USA-SCII code.

Model 1. A line feed instruction from the 2772 Control Unit causes the carriage to immediately move the form a single or double space vertically, depending on the setting of the Line Feed Select Lever.

Model 2. A line feed instruction from the 2772 Control Unit causes the carriage to immediately move the form one space vertically. In addition to line feeding, the Control Unit can initiate single, double, or triple line spaces and vertical skipping of the form to predefined points (see "Model 2 Vertical Forms Control").

NEW LINE

Model 1. This operation combines the functions of "carrier return" and "line feed." The carrier returns to the left margin stop accompanied by a simultaneous line feed of one or two spaces, depending on the setting of the Line Feed Select lever. The carrier returns at approximately 16 inches per second. The new-line function is initiated by pressing the New Line key on the Printer control panel (printer not selected); by sensing the NL or IRS code (EBCDIC), or the LF or RS code (USASCII); by pressing the New Line Key on the keyboard; or by detecting the right hand margin stop.

Model 2. This operation combines the functions of "carrier return" and "line feed." The carrier returns to the left margin stop at approximately 16 inches per second accompanied by a simultaneous line feed. The number of spaces taken during the line feed depend upon how the New Line operation was initiated. Pressing the New Line key on the 2213 (printer not selected), or detecting the right hand margin stop causes a single line space. Reception of a NL or IRS character (EBCDIC) or a LF or RS character (USASCII) from the Control Unit, or pressing the New Line key on the keyboard (printer selected) causes a pending line space instruction to be executed. If the carrier is at the left hand margin, only line spacing is per formed.

Operating Characteristics

PRINTING METHOD

Printing is accomplished by selectively firing seven print hammers attached to print wires. As the print head moves from left to right across the print line, these wires construct the graphic characters out of dots. The seven print wires are arranged in a column in the print head, and the dots are formed as the end of each wire presses the inked ribbon against the paper. The hammers can fire independently up to five times for any one character.

For characters containing diagonal or curved elements, the hammers can optionally fire at four alternate (halfway) points to obtain better character definition and improved legibility. This produces the restricted 9 by 7 dot matrix illustrated for the letter "A" in Figure 2213-1. The print hammers are operated under control of a read-only storage in the printer attachment. A print hammer, however, cannot fire more than five times per character, due to the time required to restore the hammer. This limitation precludes the possibility of firing a hammer at any two successive numbered points in Figure 2213-1.

PRINT CARRIER

A small carrier platform supports the print head, print hammers and wires, and the print magnets. During automatic operation, the carrier travels along the print line from left to right at a constant rate of approximately 6.6 inches per second and returns at about 16.0 inches per second.

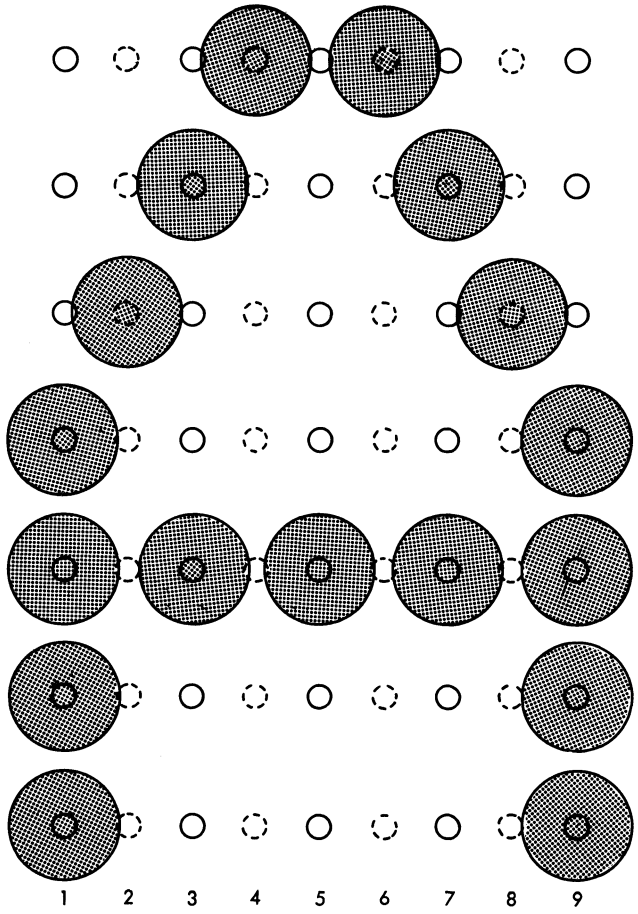


Figure 2213-1. Character Matrix

When printing from the 2772 Control Unit buffer this motion is continuous, and the carrier stops only momentarily to change direction at each end of the print line.

When printing from the keyboard, the operation is character-by-character, and the carrier drive mechanism stops after printing each character. The rate depends on the operator.

PRINT-POSITION POINTER

Attached to the carrier is an indicating pointer that moves across the print line. This pointer indicates on the print-position indicator scale the location of the next character to be printed.

PRINT MECHANISM

The print mechanism (Figure 2213-2) consists of the print head, print hammers with attached print wires, and print magnets. All of these are mounted on the print carrier and travel with it.

The seven print hammers and their attached print wires are arranged radially about the print head in a horizontal plane. The free ends of the print wires, however, pass through the print head in a vertical plane. The print head acts as a guide to keep the print wires in line, spaced at precise vertical intervals.

When the printing impulses are received, the print magnets are energized to drive the print wires against the ribbon, paper, and platen to form the characters out of dots. When the print magnets are de-energized, the print wires are withdrawn behind the surface of the print head.

PRINT-POSITION INDICATOR SCALE

A scale, graduated in print positions, serves the dual purpose of indicating the location of both the print head and the margin stops. This scale is prominently located on the front of the machine. It indicates the print-line location in which the next character can print.

PRINT VISIBILITY

Except for about four print positions blocked by the print head, the entire print line is visible to the operator.

CHARACTER SIZE

Nominal character height is 0.102 inch; width is 0.070 inch.

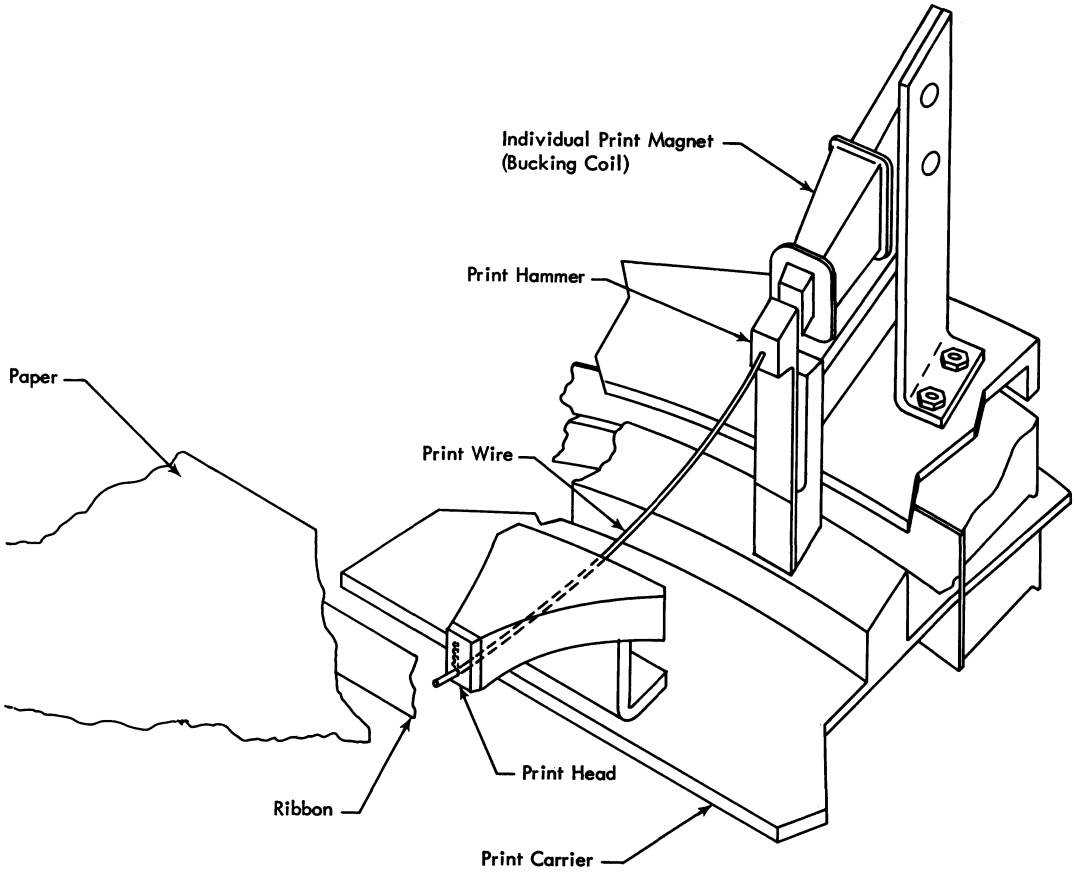


Figure 2213-2. Print Mechanism

CHARACTER SPACING--VERTICAL

Model 1. Six-lines-per-inch vertical line-spacing is standard; eight-lines-per-inch is available as a Specify feature at time of order.

Model 2. Vertical linespacing of either six or eight-lines-per-inch can be manually selected.

CHARACTER SPACING--HORIZONTAL

Characters are nominally spaced 0.100 inch, center to center (10 characters per inch). This includes a full character width plus the space between characters.

MARGINS

Left and right margins are determined by the setting of the respective margin stops to the print-position indicator scale. The margin stops are movable, and are set manually by the operator. The minimum distance between stops is 2.5 inches (25 spaces at 10 per inch).

CAUTION
Margins must be adjusted according to the length of the platen used. They should be set so as to prevent the print head from going beyond the ends of the platen and from printing on the pins.

Left Margin Stop

This stop signals the printer attachment when the print carrier has arrived at the left-margin limit (the position in which the first character in the line will print).

Right Margin Stop

This stop is provided as a safety device to prevent overtravel of the print carrier; right hand margins are normally established by control characters within the text; thus, the stop is not encountered. If the required control character is not received before the margin stop is encountered, the carrier stops and awaits the next character. Print carrier and forms movement is then dependent on what character is received, as follows:

1. If the next character is a New Line code or a Record Separator code, the carrier returns to the left, and the forms move one or two spaces (Model 1), or under control of the Vertical Forms Control (Model 2).
2. If the next character is a printable code, the carrier returns to the left, the forms move one or two spaces (Model 1) or a single space (Model 2), and the character is printed. On the Model 2, a pending Escape sequence will be executed when the next New Line or Record Separator is received.
3. If the next character is a Backspace or Line Feed the function is performed. Likewise, on the Model 2, a Forms Feed or Vertical Tab function is performed.
4. If the next character is a Horizontal Tab, the carrier returns to the left and the tab is performed.

TAB STOPS

Tab stops are mechanical, and are set and cleared manually by the operator. Each tab stop can be set or cleared individually, regardless of the location of the print carrier. Tab locations are indicated on a special scale (just above the tab stops) that provides the operator with a visual means for checking the setup before running a job.

Tab-Stop Indicator Scale

This scale, graduated in print positions, is located above the tab stops and enables the operator to correctly locate them.

CHARACTER SETS

The basic 2213 Printer character set is EBCDIC; however, USASCII is available as a Specify feature at time of order. The Printer relies on a decode matrix in the printer attachment to control the sequence of hammer-firing signals for printing the desired characters.

Any character that falls within the modified 9 x 7 matrix described under "Printing Method" can be printed. There is, however, a limitation in the use of the Underscore. When used in conjunction with other characters, the Underscore will overwrite the lowest matrix dot forming the character.

The character set consists of:

10 numeric digits--0 through 9
26 uppercase letters--A through Z
26 (EBCDIC) or 27 (USASCII) special characters

The special characters are shown in Figure 2213-3.

EBCDIC	USASCII	EBCDIC	USASCII
¯	¯	'	'
"	"	+	+
:	:	;	;
.	.	=	=
$	$	¢	[
,	,	!	]
#	#	?	?
<	<	&	&
*	*	-	-
%	%	/	/
@	@	¦	¦
(	(	>	>
)	)	¬	\
			¬

Figure 2213-3. Special Characters

RIBBON

The 2213 Printer uses a special single-color fabric ribbon with a cartridge drive similar to the type used on a Selectric® typewriter. A standard Selectric cartridge ribbon cannot be used without potential damage to the print unit.

APPLICATION RESTRICTIONS

The 2213 Printer is not recommended for preparation of documents that are to be optically scanned. Before using the Printer for specialty applications (such as spirit, photo-offset, multilith, diazo, heat-transfer, or similar processes), it is recommended that these applications be tested beforehand to assure satisfactory results.

FORMS SPECIFICATIONS

The stacking characteristics of forms depend to a great extent on environmental conditions. Good stacking conditions are obtained within the following ranges:

Temperature: 50 degrees F to 110 degrees F
Relative Humidity: 26% to 62%

Occasional operator intervention to adjust stacking may be required. When temperature or relative humidity or both fall outside these ranges, forms stacking may be adversely affected, requiring additional operator attention.

Width of forms used on the Model 1 Printer are restricted by platen type as follows:

a. Friction Feed Platen (Standard)--15 inches maximum form width. Friction feeding is restricted to single part roll paper.
b. Pin Feed Platen (Special Feature)--Form width must match the particular pin-feed platen used. Following is a list of platens available to cover a wide range of form widths. All platens are available for either six lines per inch or eight lines per inch spacing.

Overall Form Width (inches)	*Hole-to-Hole Width (inches)*	*Writing Line (inches)*
5-3/4	5-1/4	4-5/8
6-1/2	6	5-3/8
8	7-1/2	6-7/8
8-1/2	8	7-3/8
9-1/2	9	8-3/8
9-7/8	9-3/8	8-3/4
10-3/8	9-7/8	9-1/4
10-1/2	10	9-3/8
10-5/8	10-1/8	9-1/2
11-3/4	11-1/4	10-5/8
12	11-1/2	10-7/8
13	12-1/2	11-7/8
13-5/8	13-1/8	12-1/2
14-3/8	13-7/8	13-1/4

The hole-to-hole width of the form must match the pin-to-pin width of the platen used. With pin-feed platens, up to six-part forms having a maximum thickness of 0.018 inch can be printed.

c. Continuous forms should be fastened on both sides for best feeding on a pin-feed platen.

Forms used on the Model 2 Printer can have a maximum width of 14-3/8 inches. A maximum forms thickness of 0.025 inch is permitted. Forms must be a minimum of 3 inches in length; maximum length allowed depends on lines per inch being printed, as follows:

6 lines per inch: maximum length 14 inches
8 lines per inch: maximum length 11 inches

Stapled forms should not be used on either Model because of potential damage to the print head.

Forms should be fastened by gluing, crimping, or stitching. For multipart forms, best results are obtained with forms that are positively fastened in both margins. Consult your forms representative for recommendations.

Forms in which the top sheet is less than the width of the rest of the form cannot be used.

FORMS LAYOUT

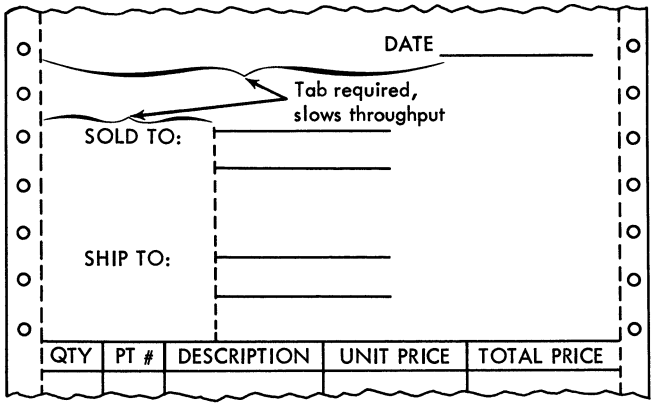
Serious consideration should be given to the forms layout to obtain maximum printer throughput.

Tab or space operations require the same amount of time as printing a character--15ms per character space. Therefore, eliminating excessive spaces or tabs can improve the effective throughput of the printer.

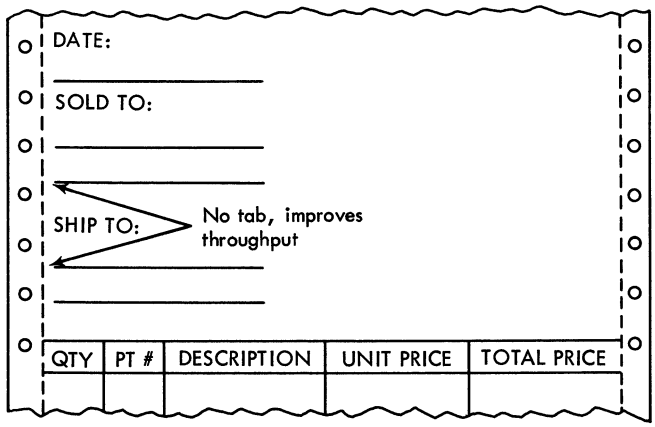
In general, printing should start as near the left margin as possible, to maximize throughput. An example of good and bad forms design is shown in Figure 2213-4.

MODEL 2 VERTICAL FORMS CONTROL (VFC)

The Model 2 VFC provides automatic forms feeding and skipping; manual line-density selection of six or eight lines per inch; and single, double, or triple spacing at either density.



POOR FORMS LAYOUT



GOOD FORMS LAYOUT

Figure 2213-4. Example of Poor and Good Forms Design

VFC Carriage

The carriage is equipped with a control tape having 12 tracks (levels) of control, and a pair of forms tractors. The VFC carriage also has additional control circuits as well as the added controls described under "Operator's Panel" and under "Machine Interlocks--Carriage-Tape Interlock Switch."

Control Tape

To enable the print adapter (i.e., the 2213 Attachment in the 2772 Multi-Purpose Control Unit) to keep track of the position of the form with respect to the print line, the VFC carriage employs a paper or plastic control tape. The tape moves in synchronism with the paper forms, and has 12 control tracks in which holes can be punched. These holes correspond to the locations on the form at which printing, spacing, skipping, or stopping is to take place. A sense head, having a separate starwheel and contact for each track, is used to sense the holes punched in the control tape and signal the printer attachment (print adapter) to initiate the action indicated.

The tape is about 1-5/8 inches wide and 25 inches long as received by the customer. However, when prepared for use on the VFC carriage, the tape cannot exceed 14 inches. The tape is moved by a drive sprocket having pins that engage a row of holes between tracks 6 and 7.

In practice, the tape is cut to correspond to the length of the form, punched according to the desired vertical print format, and glued at the indicated line to form an endless loop. One tape punch is supplied per installation at no charge for new-name accounts. For short forms, the format punching may be repeated to get two or more complete page formats on a single tape; this is desirable to increase tape life by distributing wear. However, the total tape length cannot exceed 14 inches.

The tape is then placed on the drive sprocket and the sense head is latched down (closed). If the tape sense head is not latched down, the Printer will not operate.

The holes in the tape are sensed by their corresponding starwheel contacts in the sense head, and signals are sent to the printer attachment when predetermined locations on the form have reached the print line.

The short lines running across the width of the tape correspond to the print lines on the form, regardless of whether printing is set for six or eight lines to the inch (see Figure 2213-7).

Tape Tracks

Holes punched in the tape tracks control the carriage and forms movement. Three of the tracks (1, 2, and 12) have pre-assigned functions. Track assignments are as follows:

Track 1. Track 1 is always punched for the first printing line of a form. This is the starting or "home" position. Every time the Carriage Restore key is operated, the tape advances until a hole in this track is sensed. The forms advance simultaneously with the tape to align the first print-line position for printing, if the Line Space (6-8) Selection control is not in the neutral position.

Track 2. Track 2 is used as a normal skip track when the Printer is controlled by the ESC B control sequence. A Skip to Track 2 command also occurs when the Vertical Tab (VT) code is sensed by the 2772 Control Unit.

Tracks 3 through 11. Tracks 3 through 11 have no predetermined assignments. They can be used in any order to assure that a certain print-line location on the form is in position to be printed.

Track 12. Track 12 is generally used to indicate the last body print-line on the form. A hole sensed in this track causes the Printer to perform a carriage-restore operation (skip to track 1). This operation is performed unless there is an outstanding skip sequence overriding the overflow action, such as a skip to a predetermined page-total line.

Use of the track-12 overflow function is not recommended for formatted forms having headings or page identification. There is no feedback to the CPU to initiate page identification when track 12 is sensed. Therefore the CPU cannot, except by counting lines, know when to send the heading information. For this reason, form skipping should be under control of the CPU, which should send an ESC A on the last body line to cause a skip to track 1. Overflow can best be used for straight listing operations.

A skip to track 12 can also be performed by an Escape ESC L.

Programming Considerations

After the vertical line spacing is manually set for six or eight lines per inch, individual two-character instruction sequences control the VFC carriage spacing and skipping operations.

The two-character code for each operation is shown in Figure 2213-5. The Escape (ESC) sequence can occur anywhere within a print line, but must precede the new line (NL/LF) or interrecord separator (IRS/RS) character; instructions are executed after printing when either the New Line or Interrecord Separator character is received. If no specific spacing instruction is received, the carriage will automatically single space after receiving the NL or IRS/RS character. If more than one line-space instruction is received before the New Line or Interrecord Separator is received, only the last instruction is performed. The VFC escape sequence is shown in Figure 2213-6.

USASCII Code Sequence	EBCDIC Code Sequence	Carriage Operation After Printing
ESC Q	ESC/	Single Space
ESC R	ESC S	Double Space
ESC S	ESC T	Triple Space
ESC A	ESC A	Skip to Track 1 *
ESC B	ESC B	Skip to Track 2 **
ESC C	ESC C	Skip to Track 3
ESC D	ESC D	Skip to Track 4
ESC E	ESC E	Skip to Track 5
ESC F	ESC F	Skip to Track 6
ESC G	ESC G	Skip to Track 7
ESC H	ESC H	Skip to Track 8
ESC I	ESC I	Skip to Track 9
ESC J	ESC J	Skip to Track 10
ESC K	ESC K	Skip to Track 11
ESC L	ESC L	Skip to Track 12
ESC M	ESC M	Space Surpress

* A skip to Track 1 will be executed immediately by receiving a Form Feed (FF) Code from the keyboard or from the 2772 Control Unit buffer.

** A skip to Track 2 will be executed immediately by receiving a Vertical Tab (VT) Code from the keyboard or from the 2772 Control Unit buffer

Figure 2213-5. Two-Character VFC Sequence Code

ESC Sequence From Figure 2213-5

S	E				NL	E				NL	E
T	S	*	DATA		OR	S	*	DATA		OR	T
X	C				IRS	C				IRS	B

Figure 2213-6. Two-Character VFC ESC Sequence

Typical Application

Figure 2213-7 shows a tape punched for a typical invoice application. This is only one of many applications. Actual usage depends on the program used to control the Printer and carriage.

References for Figure 2213-7

The parenthetical reference letters A, B, C, and D in Figure 2213-7 point out how the various tape-track punches are used, as follows:

Reference (A)--Track 1. This punch represents the first print line on the form. On an overflow operation, the Printer will stop the form on this line. This line is normally used for identification printing.

Reference (B)--Tracks 3 through 11. Holes in any of these tracks terminate skipping when they are sensed. In the figure, tracks 3 through 6 are used for different types of heading stops.

Reference (C)--Track 2. This represents the first body line of the form.

Reference (D)--Track 7. This is one of the normal skip-stop tracks used; in this case it is used to stop the form for printing on a predetermined total-line position. Any one of tracks 3 through 11 could be used for this.

Special Features

MODEL 1

Pin-Feed Platen

The pin-feed platen discussed in this manual is available in various widths as a special feature on a purchase-only basis. However, when the pin-feed platen is ordered instead of the friction-feed platen on original factory orders, the customer is required to pay only a one-time charge equal to the difference in purchase price between the standard friction-feed platen and the particular pin-feed platen ordered.

CAUTION

Six-lines-per-inch and eight-lines-per-inch platens cannot be interchanged. All platens for a particular 2213 must have the same line spacing as that specified by the customer at the time of original order.

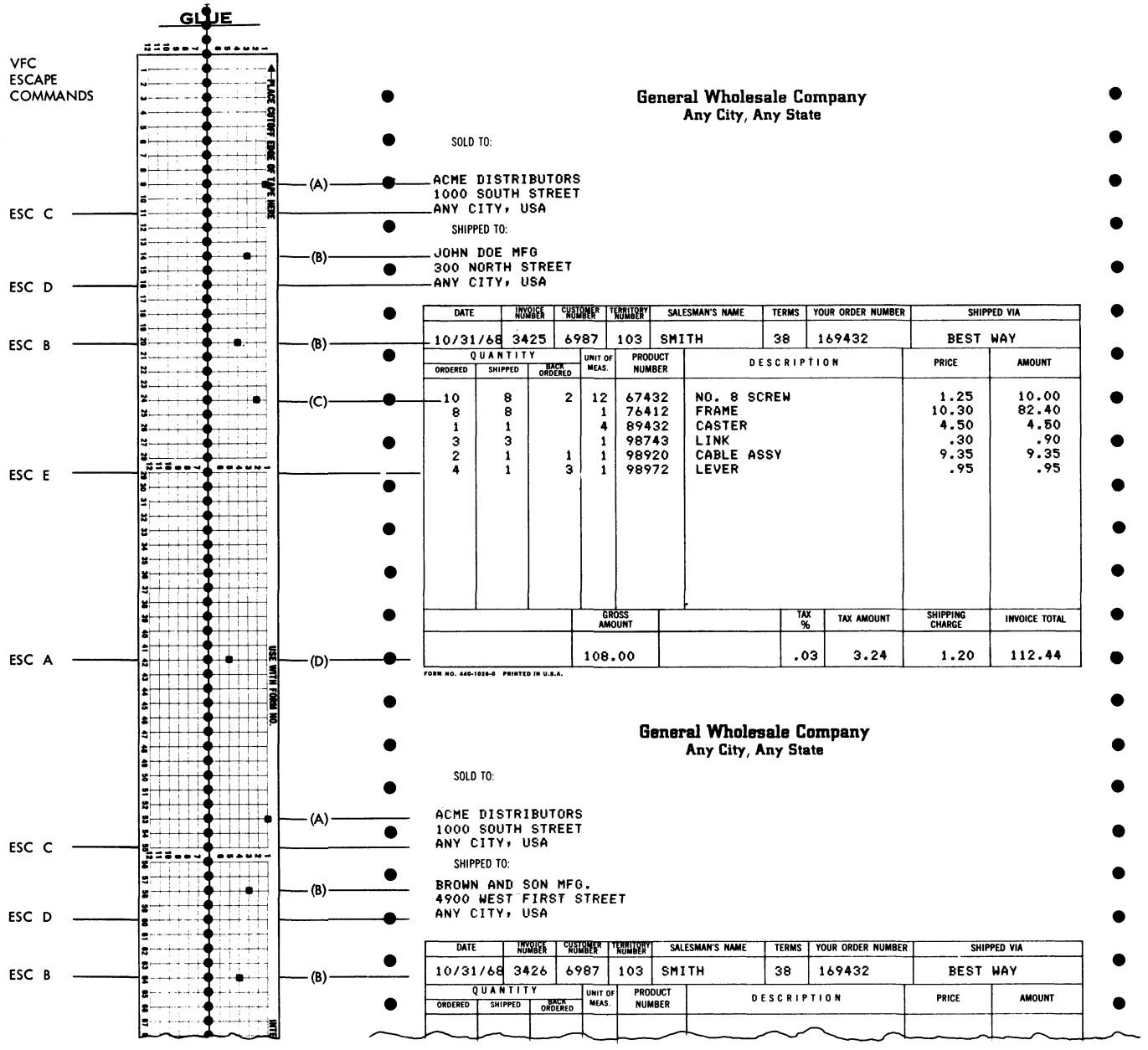


Figure 2213-7. Tape-Form Correlation for a Typical Application

Roll Paper Feed

As a special feature, a 2213 Printer with friction-feed platen or pin-feed platen can be equipped to handle single-ply paper in rolls. Only marginally punched paper can be used with the pin-feed platen, but either punched or unpunched paper can be used with the friction-feed platen. A paper guide and a tear bar are provided.

Maximum acceptable roll-paper dimensions are:

Width--15 inches
Outside diameter--4.0 inches
Inside diameter of center hole--0.375 inch minimum

MODEL 2

No Special Features are available presently for the Model 2.

Keys, Lights, and Switches

Operator controls and indicators for the IBM 2213 Printer are reduced to a minimum. Some are located on the operator's panel; other manual controls are located on the carriage. These controls and indicators, along with the various machine interlocks, are described in the following.

OPERATOR'S PANEL

Except for the Stop Key, all keys on the operator's panel are inoperative when the printer is selected.

New Line Key

This key signals the printer attachment to initiate a new-line operation. (Refer to "Functions--New Line" for a description of this function.)

Tab Key

This key signals the printer attachment to initiate a tab operation. (Refer to "Functions--Tabulate (Tab)" for a description of this function.)

Stop Key

Removes the Printer from ready status, and on the Model 2 signals the printer attachment to stop the carriage immediately to prevent further forms movement.

Carriage Restore Key (Model 2)

This key advances the carriage control tape from any position to "home" position (track 1). This key is operational when the printer covers are open.

Carriage Check Light

This light indicates that a forms-runout condition has occurred. On the Model 2 this light also indicates that the carriage tape-sensing head is not latched closed, and/or the Line Space (6-8) Selection control is in the neutral position, and/or the forms-tractor doors are open, and/or the Stop switch has been pressed.

Print Check Light

This light turns on when there is a parity error in the printer attachment's read-only storage.

MANUAL CONTROLS

In addition to the tab and margin stops described elsewhere in this manual, the Printer has the following manual controls for forms adjustment:

Paper Drag Lever (Model 2)

This lever, at the right side of the VFC carriage, controls the amount of drag on the paper forms.

Paper Advance Knob

This knob, on the left side of the carriage, provides manual control of both coarse and fine vertical-forms positioning.

Horizontal Forms Alignment Knob (Model 2)

This knob provides a vernier horizontal adjustment of the forms position.

Line Space (6-8) Selection Control (Model 2)

This control allows the operator to select either six or eight lines to the inch. When the control is in its neutral position the forms tractor is disengaged and can be manually operated.

Forms Thickness Control

This control provides adjustment of the clearance between the platen and the face of the print head. This clearance must be adjusted according to the thickness of the forms being used. A graduated scale provides the operator with ready reference points.

Line Feed Select Lever (Model 1)

This lever allows the operator to manually select single or double spacing. Effectively this produces six or eight lines to the inch when set to single-space, and three or four lines to the inch when set to double-space, depending on spacing specified by the customer at time of factory order.

MACHINE INTERLOCKS

Electrical interlocks are provided on the 2213 Printer to prevent its operation under certain conditions. These interlocks and conditions follow.

End of Forms Switch

This switch is located in the paper path, and it signals that forms runout is imminent when the end of the forms reaches within three inches of the print line. The Carriage Check light on the Printer operator's panel turns on, and, after the line is printed, further Printer operation is prevented until the forms have been replenished. The Model 2 Printer will continue to operate until the track-1 hole in the carriage tape is sensed.

Carriage-Tape Interlock Switch (Model 2)

This switch signals the status of the tape-sensing head. If the head is not latched closed, Printer operation is prevented.

Forms Jam Switch (Model 2)

This switch detects a jam condition at the forms tractors and prevents further printing operation until the jam is cleared.

Cover Interlock Switch

This switch removes the Printer from the "ready" condition when the Printer cover is raised.

Line-Space Switch Interlock (Model 2)

This interlock prevents the Printer from running when the Line Space (6-8) Selection control is in the neutral position.

Error Recovery

PARITY ERROR

The printer attachment (i.e., 2213 Attachment feature in the 2772 Multi-Purpose Control Unit) provides a parity check on the character-pattern generator. When a parity error is detected during printing of a character, the character will finish printing, the Output Device error light on the 2772 console will turn on, and ready status will be dropped. This will cause the Output Device light on the 2772 operator's console to blink and the Print Check light on the Printer to turn on. The operator may try to recover by pressing the Check Reset key and the Start key on the 2772 console. This will re-initiate data transfer from the Control Unit to the Printer. If a parity error persists, CE intervention is required. The CE will accomplish error detection and repair verification by inspecting the printout.

FORM ERROR

This condition is indicated by the blinking Output Device light on the 2772 console and by the Carriage Check light on the Printer being lit. The operator may recover from this condition by seeing that forms are loaded properly, that the carriage tape-sensing head is latched (Model 2), and/or that the Line Space (6-8) Selection control is not in the neutral position. Data transfer may be re-initiated by pressing the Check Reset, then the Start key on the 2772 console.

IBM 2265 Display Station

Introduction

The 2265 Display Station Model 2 is used with the keyboard and display adapter (2265 Attachment feature) to provide an input/output medium for the 2770 Data Communication System. The display is an incremental device capable of operating at speeds up to 300 characters per second.

The Display Station employs a 14-inch (diagonal measurement) cathode-ray tube (CRT) and associated circuits to permit displaying up to 960 characters on the screen.

Character format is specified at the time of ordering, and can consist of either 12 lines of 80 characters each or 15 lines of 64 characters each. Character size depends on which format is chosen.

Clear images are formed by a character generator capable of producing up to 40 strokes per character. Images on the screen are regenerated at a rate sufficient to prevent flicker. Brightness is adjustable by the operator to provide comfortable viewing under a wide range of ambient light conditions.

The display adapter contains a buffer, timing and control logic, and the circuits needed to interface the 2265 to the 2772 Multi-Purpose Control Unit, in which the adapter is physically packaged.

As each character is entered at the keyboard, it is stored in the display buffer and appears on the screen at a location indicated by a position indicator called a "cursor." The cursor then steps to indicate where the next character will be displayed.

The operator can move the cursor to any character position within the display area of the screen by pressing the proper function keys on the keyboard; and is thereby afforded considerable flexibility in message formatting. The operator can correct or change a character simply by positioning the cursor under the unwanted character and then pressing the desired character key; the new character will replace the unwanted character on the screen. When data entry from the keyboard is complete, the operator can either transmit the message to a remote location or print it on the local printer if one is present in the 2770 system configuration.

When the 2265 Model 2 is operating as an output device, messages received over communications facilities are placed in the display buffer, and displayed on the screen. Also, "hard" copy of the output message can be obtained if a printer is present in the system.

Functions

The IBM 2265 Model 2 operates under control of the Job Select switch, located on the 2772 console, which will assign it as either an input/output device or an output device only. Operation can be in either line mode or home mode.

The Display Station is in line mode whenever data is moving between the display buffer and the communications facilities via the 2772 Control Unit. During line-mode operations, home-mode operations are inhibited. The Display Station is in home mode while data is being entered into the display buffer via the keyboard, or while data in the display buffer is being printed. During home-mode operations, the 2770 Data Communication System is inhibited from performing line-mode operations.

The Display Station will perform the following functions:

a. Keyboard-to-Display (Data Entry)
b. Display-to-Line (Transmit)
c. Display-to-Printer (Print)
d. Display-to-Output Device
e. Input Device-to-Display
f. Line-to-Display (Receive)

KEYBOARD-TO-DISPLAY (DATA ENTRY)

This is a home-mode operation in which the Control Unit inhibits all output devices while data is being keyed into the display buffer.

Characters stored in the display buffer are also displayed on the CRT screen.

To enter data from the keyboard, the operator must first press the Keyboard Request key. This action forces the Control Unit to home mode, inhibits all output devices, and selects the keyboard as the input device and the Display Station as the direct-data device. The Keyboard Request key will have no effect if it is pressed while the Control Unit is executing an input/output operation.

After the keyboard is selected, the operator moves the cursor, by use of the proper function keys, to the display position in which it is desired to start the message.

The Start of Manual Message (SMM) key is then pressed. This action enters the start (SMM) symbol into the display buffer and causes it to appear on the display screen in the

position previously occupied by the cursor. The cursor advances to the next position.

Following entry of the SMM symbol, data can be entered, and appears on the display screen as the character keys are operated. The cursor automatically advances as each character is entered. Cursor control keys allow the operator to correct, or otherwise alter, the displayed data until the message is completely satisfactory.

After message entry, the cursor is positioned to the space following the last message character, in preparation for entry of an end-of-message (EOM) character. The EOM is entered by pressing either the Print key or the Enter key. These keys initiate one of the "Display-to-" functions discussed in the following paragraphs. Figure 2265-1 shows the data flow during keyboard entry in home mode.

NOTE: If any character except an EOM is keyed into the last display position (position 960) or if this position is tabbed or spaced over, the cursor wraps around to position one of the display, the keyboard locks, and all display positions are underlined. This prevents accidental loss of data due to overfill of the display. Pressing the Terminal Reset and the Keyboard Request keys unlocks the keyboard; the cursor can then be moved to a convenient position for entry of the EOM to end the message.

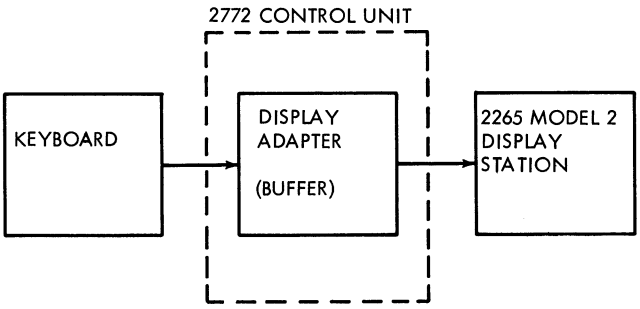


Figure 2265-1. Keyboard Entry in Home Mode

DISPLAY-TO-LINE (TRANSMIT)

This is a line-mode operation in which data stored in the display buffer is transferred to the communications line via the 2772 Control Unit. The data transfer is accomplished by pressing the Enter key on the keyboard. This action causes the End of Message (EOM) symbol to be displayed in the character position occupied by the cursor, and allows the Control Unit to select the display adapter as the input device. The Control Unit also attempts to secure the communications line. The display buffer is then searched for the SMM symbol, and the Display Station remains in transmit-wait mode until the Control Unit secures the line or until the Display Station is polled by a remote CPU. All data following the SMM symbol up to, but not including, the EOM symbol is then transmitted via the Control Unit to the remote CPU. If no SMM symbol is present, all data from the first display position to the EOM symbol is transmitted. The EOM is not transmitted.

An exception to these operations occurs when a New Line (NL) symbol is encountered in the message. In this case all remaining data (except other NL symbols) on the line containing the NL symbol is excluded from the transmitted message. The NL symbol and its use is described under "Operating Characteristics--Control Symbols" and "Special Features." Figure 2265-2 shows the data flow during a transmit operation.

DISPLAY-TO-PRINTER (PRINT)

This is a home-mode operation that provides a printout of the data on the display screen. This operation is performed after data has been entered from the keyboard (as described under "Keyboard-to-Display") or after data has been received from a remote CPU. To provide the printout, the operator presses the Print key on the keyboard. This action forces the Control Unit to home mode, inhibits the direct-data device, and then allows the Control Unit to select the Display Station as the input and the Printer as the output device. The EOM symbol will be displayed in the cursor position, and all data from the SMM symbol up to but not including the EOM symbol will be transferred to the Printer and printed. If no SMM symbol is present, all data from the first displayable position on the screen up to the EOM symbol will be printed. An exception to the above occurs when a NL symbol is encountered. As described under "Display-to-Line," all data on a line to the right of the NL symbol will not be printed. All NL symbols on each display line will be transferred to the Printer to cause a carriage return--line feed operation.

When the data displayed on the screen is the result of a transmission from a CPU and only a partial printout is required, the operator can select the point in the data where printing will start by inserting a SMM symbol from the keyboard (as described under "Keyboard-to-Display"). Data flow for the print operation is shown in Figure 2265-3.

DISPLAY-TO-OUTPUT DEVICE

This is a home-mode operation in which data stored in the display buffer and displayed on the Display Station screen is used as input to any of the output devices on the 2770 system. The Display Station must be assigned as the input/output device, and the desired output device must also be assigned by wiring a position of the Job Select switch on the 2772 console. The display-to-output device operation is shown in Figure 2265-4.

INPUT DEVICE-TO-DISPLAY

This is a home-mode operation in which the Display Station is used as an output device to display data from any of the

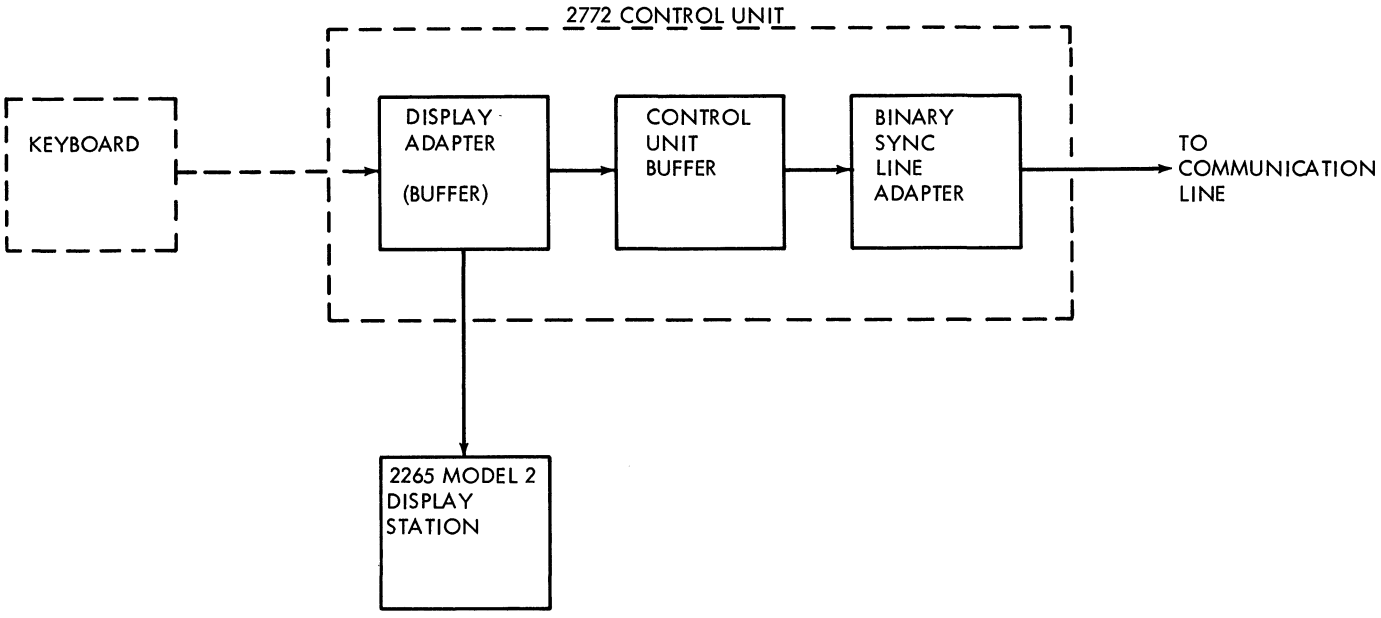


Figure 2265-2. Transmit Operation in Line Mode

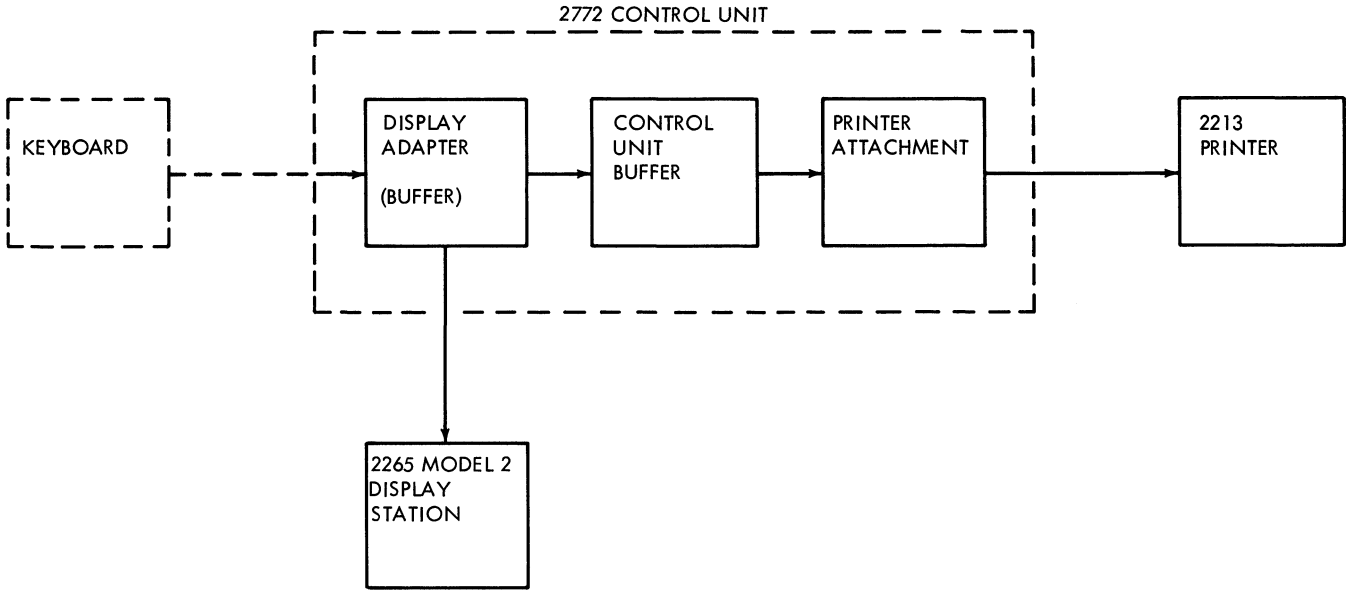
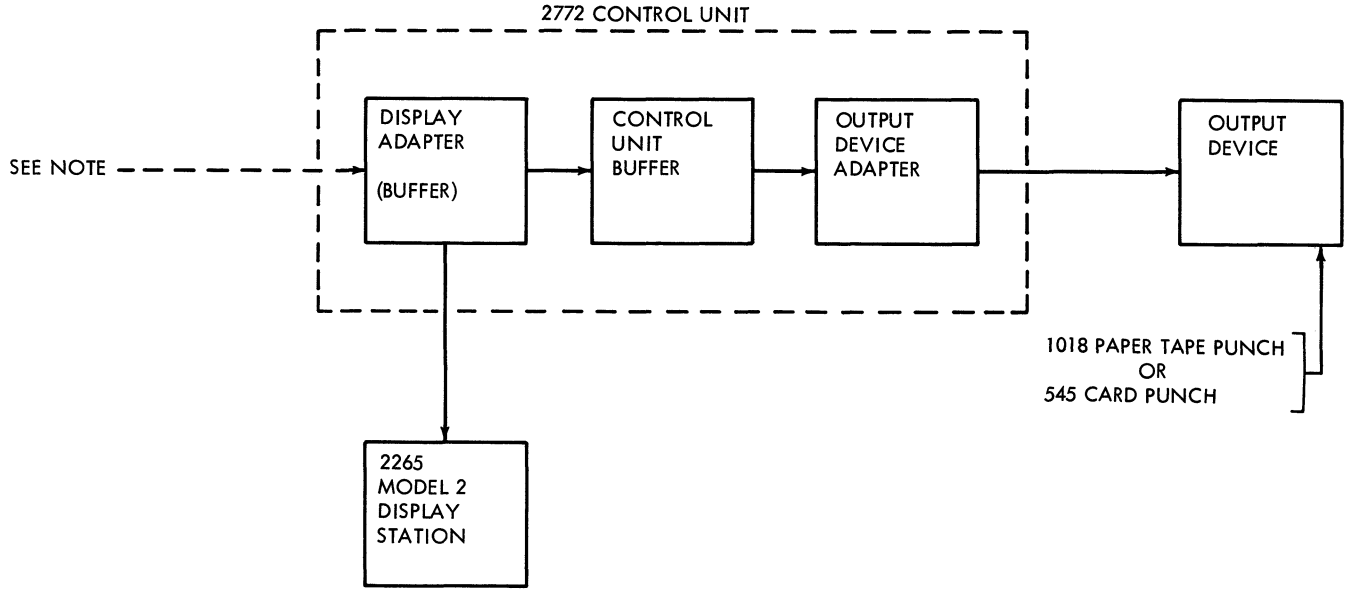


Figure 2265-3. Print Operation in Home Mode



NOTE:
DATA IS IN THE DISPLAY BUFFER AS A RESULT OF A PREVIOUS OPERATION SUCH AS KEYBOARD ENTRY ETC.

Figure 2265-4. Display-to-Output Operation Home Mode

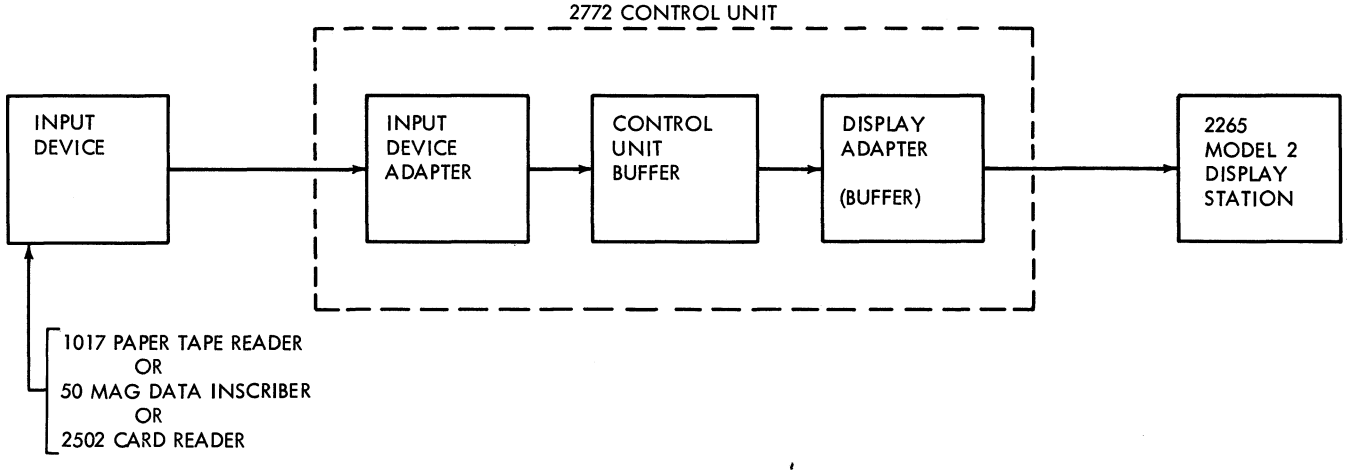


Figure 2265-5. Input-to-Display Operation Home Mode

input devices on the 2770 system. The desired device must be assigned as an input, and the Display Station must be assigned as the output device by wiring a position of the 2772 console's Job Select switch. The input device-to-display operation is shown in Figure 2265-5.

LINE-TO-DISPLAY (RECEIVE)

This is a line-mode operation in which data that the 2265 Model 2 receives over the communications facilities is displayed on the screen following a successful Display Station addressing operation. Data is transferred from the communications line to the display buffer via the 2772 Control Unit. The data is displayed starting at the location of the cursor or at the first character position of a specifically addressed line within the display area of the screen. If the number of characters received exceeds the display capacity, the display 'wraps around', and beginning at display position one, overwrites previously displayed data.

A remote CPU can erase the display screen, before sending a message, by first selecting the Display Station and then sending an Erase/Write control sequence. This assures that

the desired message appears alone on the screen, starting either in the first character position of the first display line or at a specifically addressed line.

The 2265 Display Station Model 2 will not respond to a control sequence from a CPU if it is in either data-entry or print mode.

A 2265 Model 2 that is in transmit-wait mode (as a result of the Enter key having been pressed) will respond to polling but not to selection. Data flow for the receive operation is shown in Figure 2265-6.

Operating Characteristics

CHARACTER GENERATION

A character image is formed on the 2265 Model 2 display screen by first positioning the electron beam to a character position on the screen. The beam is then moved in a predefined series of short strokes and, at the proper times, the beam is intensified (unblanked) so that the character is drawn on the screen. A maximum of 40 strokes are available for use in forming a character. The combination of very short strokes and their integration due to the inductance of the deflection coils provides a smooth character structure. The X,Y deflection data and the intensity data required to form a character are obtained from a read-only storage located in the Display Station. The read-only storage unit contains 64 addressable character "words"; and each word contains 40 five-bit character-stroke bytes. Some characters are formed using less than 40 strokes; therefore the unused stroke bytes contain no intensity information.

Beam positioning and character-stroke movement is accomplished through the use of two deflection yokes surrounding the neck of the CRT. One yoke positions the beam to the proper one of the 960 character positions in the viewing area of the display screen. When the beam is in position, the second deflection yoke moves the beam in short strokes as determined by the stroke bytes from read-only storage.

CHARACTER FORMAT AND SIZE

Two character formats are available for the 2265 Display Station Model 2, and a choice must be specified at the time of ordering.

The available formats are:

a. Twelve lines of 80 characters each, which covers a nominal area of 10.3 inches wide by 3.0 inches high on the display screen. The image size (character size) is 0.104 inch wide by 0.150 inch high.
b. Fifteen lines of 64 characters each, which covers a nominal area of 10.3 inches wide by 4.6 inches high on the display screen. The image size for this format is about 20% larger, producing an image 0.128 inch wide by 0.180 inch high.

Figure 2265-7 shows the relationship between image sizes.

DISPLAY BUFFER

On any CRT-display-system screen, information must be regenerated periodically; otherwise the image will fade. Therefore, the data used to generate an image must be stored so that it is available as needed.

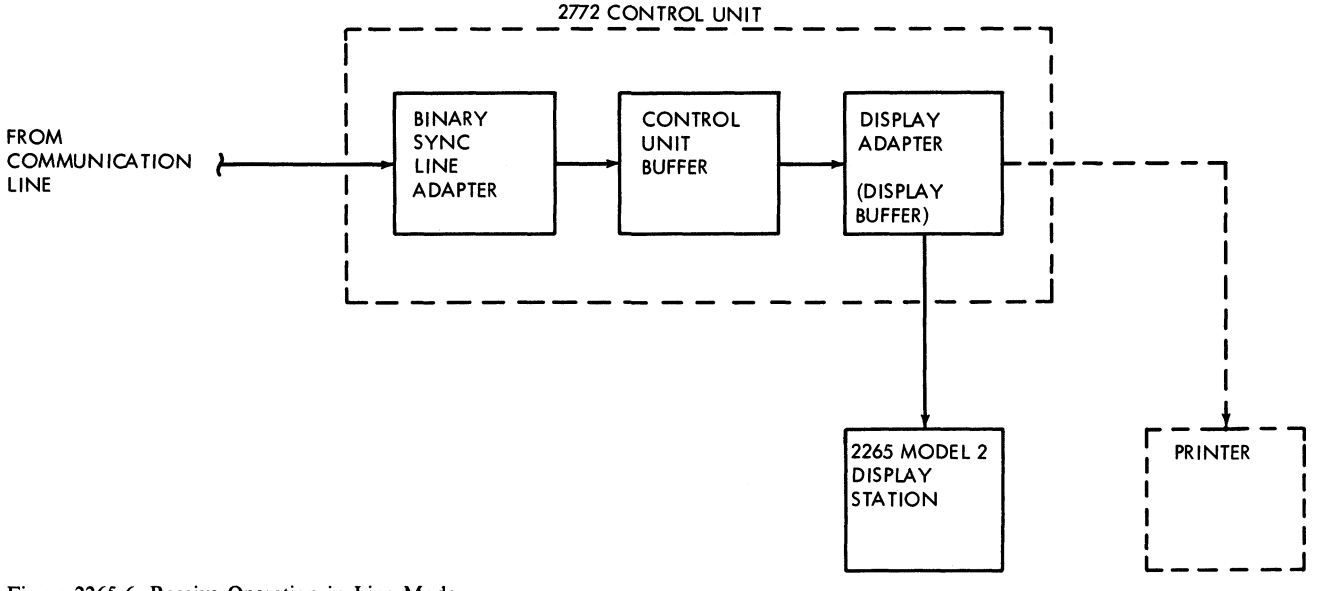


Figure 2265-6. Receive Operation in Line Mode

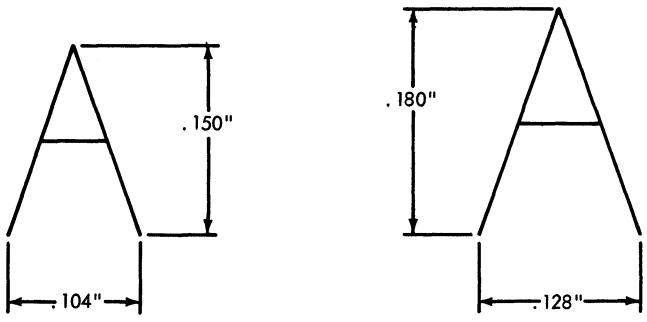


Figure 2265-7. Image Size Comparison

Regeneration in the 2265 Display Station Model 2 is accomplished by storing the displayed data in a delay-line buffer having a capacity of 960 characters. Characters are placed in the delay line serially by bit; and, as the bits emerge from the output end of the delay line, they are collected in a register until a character is assembled. The character is decoded and used to refresh the image on the screen. The character is again serialized and returned to the delay line. This process is continued so that all images on the screen are regenerated often enough to maintain their intensity and prevent flicker. Parity checking is performed on data in the delay-line buffer.

CHARACTER CODE

The EBCDIC character set is standard on the 2265 Model 2. (The USASCII character set is also available, and may be substituted at the time of ordering.) Only the low-order six bits are used, thus providing 64 displayable characters and symbols. The complete EBCDIC character set, including special control symbols, is shown in Figure 2265-8.

CONTROL SYMBOLS

The operator requires a visual indication on the display screen when certain control functions are performed. These visual indicators are in the form of unique symbols whose appearance and function are as follows.

New Line (NL) Symbol (◢)

The NL symbol can be inserted either from the keyboard by pressing the New Line key, or by program from a CPU. This symbol provides the ability to transfer only a portion or portions of data displayed on the screen. When the NL symbol is present, it inhibits transfer of all data (except other NL symbols) displayed between the symbol and the end of the line on which it appears. During a read operation, data transfer will occur until the NL symbol is detected. The remaining data on the line will not be transferred and the cursor will move to the first position on the next line. There can be a NL symbol on every line on the screen if desired.

CHARACTER	CHARACTER	CHARACTER	CHARACTER
SP	J	T	4
A	K	U	5
B	L	V	6
C	M	W	7
D	N	X	8
E	O	Y	9
F	P	Z	:
G	Q	*3 NL ◢	#
H	R	'	@
I	*2 EOM ▬	%	'
*1 SMM ▶	$		=
.	*	>	*4 CHECK ◣
<	)	?	
(	;	0	
+	-	1	
|	/	2	
&	S	3	

*1 Start of Message
*2 End of Message
*3 New Line
*4 Check

Figure 2265-8. 2265 Model 2 EBCDIC Character Set

Start Manual Message (SMM) Symbol (▸)

This symbol can be inserted either from the keyboard by depressing the SMM key, or by program from a CPU. The start (SMM) symbol is used to indicate the beginning of data that is to be transferred during a read operation. When transfer is to occur, the display buffer is scanned for the presence of the SMM symbol. From its point of detection, all remaining data is transferred, except data to the right of a NL symbol and certain protected data to be discussed later. If no SMM symbol is detected when the display buffer is scanned, data transfer will start at the first character displayed.

End-of-Message (EOM) Symbol (▪)

The EOM symbol is automatically inserted after the last data character on the screen when the Enter key or the Print key on the keyboard is pressed. The EOM is used to indicate the end of the data that is to be transferred from the display buffer during a read operation. During a print operation, the EOM symbol will not print.

Check Symbol (~)

This symbol appears on the display screen when a parity error is detected in the display buffer. If a check character is present in the display buffer during a read operation, the 'input device error' line becomes active; however the Check symbol will not be transferred to the Control Unit.

Cursor

The cursor symbol is not entered into the Display Station by any action of the operator, and does not appear in the EBCDIC code chart of Figure 2265-8. It is mentioned here, however, because it is a visible symbol used by the operator to position the starting point of data display and to indicate a particular character that is to be corrected. The cursor is a bar symbol (▬) similar to an EOM symbol, except that it appears in the space immediately below a character location; therefore it can be moved by the operator to any character position within a message without affecting the appearance of the character. Because of this property, the cursor is called nondestructive.

LINE MODE CONTROL SEQUENCES

A display-oriented 2770 Data Communication System will operate either in a multipoint processor-controlled configuration, or in a point-to-point contention configuration. The following control sequences are used with the 2265 Display Station Model 2: Erase/Write, Write, Write Line Address, and Read.

Erase/Write

The Erase/Write addressing and control sequence is shown in Figure 2265-9. This is essentially an Erase sequence combined with a Write sequence. After the CPU selects the Display Station as an output device, the entire screen is erased and the cursor moves to the first displayable position in the upper left corner of the display area of the screen; then the new message is written on the screen.

Write

Figure 2265-10 shows the Write selection sequence. After the Display Station is selected as an output device, this operation causes data from a CPU to be displayed on the screen starting from the location indicated by the cursor.

					Erase/Write Sequence					
CPU Sequences and Responses	Terminal Address	Device Address	E N Q		S T X	E S C	U	Text		
2772 Control Unit Sequences and Responses				D L E	Ø					*See Note

* Note: Display screen is erased and new message is displayed, starting at first character position of first line.

Figure 2265-9. Erase/Write Sequence

CPU Sequences and Responses	Terminal Address	Device Address	E N Q		S T X	Text
2772 Control Unit Sequences and Responses			D L E	Ø		*See Note

*Note: Message will be displayed, starting at location indicated by cursor.

Figure 2265-10. Write Sequence

Write Line Address

The 12 or 15 possible display-line addresses are shown in Figure 2265-11; Figure 2265-12 shows the Write Line Address sequence. This sequence combines a write operation with line-selection capability, thus enabling the selection of a particular line on the display screen as the beginning line of a message.

Read

The Read sequence is shown in Figure 2265-13. The Read sequence, through a polling operation, tests the 2772 Control Unit for the presence of a transmit-wait condition. When this condition is found, the Read causes all data displayed between the SMM symbol and the EOM symbol to be transmitted, except data between a NL symbol and the end of the line on which the NL symbol appears. The transmit-wait condition occurs in the 2772 Control Unit when an operator presses the Enter key after a message is keyed into the display buffer.

Display Line	Line Address Code	
	15 Lines	12 Lines
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9
10	A	A
11	B	B
12	C	C
13	D	
14	E	
15	F	

Figure 2265-11. Line Address Code

Special Features

FIELD-CONTROL OPERATION

This special feature permits operator or program entry of three field modifiers that can be entered individually in any given character location in the display buffer.

Protected Data

Two of the three field modifiers provided by the Field-Control Operation special feature serve to identify the beginning and end of a field of data that is to be protected. They are:

a. Protected-Data-Field Modifier (ESC Z): The presence of this modifier in the display buffer identifies the start of a field of protected data and prevents manual erase or over-write of the data.
b. End-Field Modifier (ESC 9): The presence of this modifier in the display buffer identifies the end of a protected-data field and automatically terminates the field-control operation.

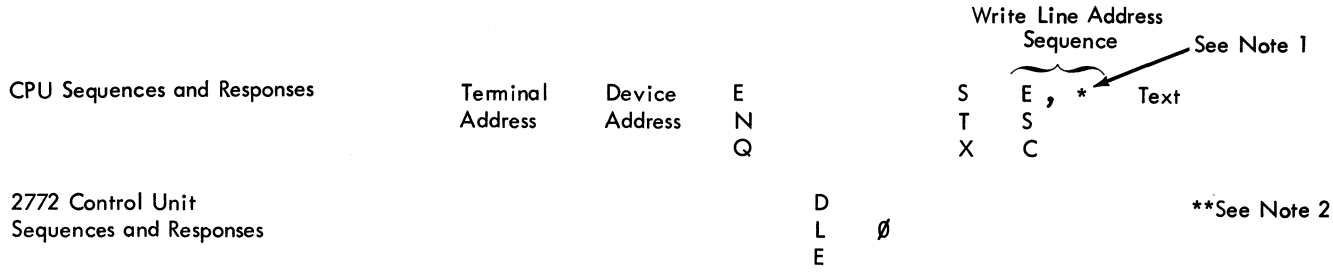
These field-control modifiers are entered into the system via escape (ESC) sequences. The characters Z and 9 are stored in the display buffer and they are reproduced on the display screen as:

Protected Data Field Modifier -- (
End-Field Modifier --)

When the (and) symbols are not preceded by ESC, they may be used as normal data. During a read or write operation, if the display cursor encounters a Protected-Data-Field Modifier it moves over the field until it reaches the End-Field Modifier. The cursor then locates in the next display position beyond the End-Field Modifier and normal read or write operation continues.

Tab Set

The presence of the Tab Set Character Field Modifier in the display buffer identifies the position as a Tab Set character



*Note 1. See Figure 11 for line address details

**Note 2. Message is displayed starting at line indicated by line address.

Figure 2265-12. Write Line Address Sequence

location. When a Horizontal Tab (HT) is received from a remote CPU or from the keyboard, the HT character is stored in the first unprotected character space, and then the cursor automatically advances to one character space beyond the next Tab Set character. The Tab Set Character Field Modifiers are entered into the system via a format message. The first data in this message should be ESC HT, to set up a tab-set sequence. Each HT following this represents a Tab Set character. A vertical bar is displayed in each line from and including the line containing the cursor to the bottom of the screen for each Tab Set character. This character cannot be written within a protected field. Caution must be exercised to see that the cursor is not positioned in a protected field when a Tab Set character is to be written. The tab-set sequence is not terminated until the New Line (NL) character is entered. Once this format message has been stored, messages may be transmitted without spaces, as they need contain only the Horizontal Tab (HT) character to provide formatting. The HT character is stored and will be read back to provide Printer formatting and/or better communications line efficiency. See Figure 2265-14 for an example of this operation. If a Horizontal Tab (HT) is given and there are no Tab Field Modifiers, the cursor will be positioned at the begining of the next line.

Controls and Indicators

FUNCTION KEYS

The following function keys on the keyboard (see Figure 2265-15) are provided for operation of the Display Station.

Erase Full

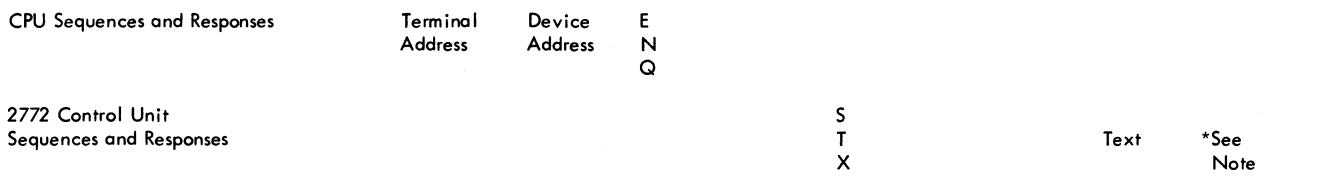
Pressing this key causes all data (protected and unprotected) on the screen to be erased and the cursor to be positioned in the upper left corner.

Erase to End of Line (Erase EOL)

Pressing this key causes all unprotected data to be erased from the cursor position to the end of the line on which the cursor is positioned.

Erase to End of Screen (Erase EOS)

Pressing this key causes all unprotected data to be erased from the cursor position to the end of the screen.



*Note: All data between SMM and EOM symbols is transferred to CPU except data between a NL symbol and the end of the line containing the symbol.

Figure 2265-13. Read Sequence (Multipoint Operation)

1. Format message sent to display

```
S    E    H          H                H          H         H       HNE
T    S    T  SSSSSS  T  S...43.....SS  T SSSSSS  T SSSSSS T SSSS  T LT
X    C                                                             B
```

2. Transmitted message to the display

```
S
T              SS123  H   Nut - 1/2" - STD  H S1,010  H H SS.01  H S10.01N
X                     T                    T         T T        T        L
```

3. Displayed

```
SS123S/Nut - 1/2" - STD SSS...31...SS/S1,010S/SSSSSS/SS.01S/S10.10 ◢
```

4. Stored in display adapter storage buffer

```
SS123 H/Nut - 1/2" - STD  H  SS ... 30 ...SS/S1,010H/HSSSSS/SS.01H/S10.10
      T                   T                          T T            T
```

5. Read back during print or enter operation

```
SS123H  Nut - 1/2" - STD  H  S1,010HHSS.01HS10.10N
     T                    T        TT             L
```

S = Space

Figure 2265-14. Tab-Set Operation

Erase Unprotected (Erase Unpro)

Pressing this key causes all unprotected data on the screen to be erased.

Advance (→)

Pressing this key causes the cursor to move forward one character position without erasing the character position to which it moves. The Advance key is "cursormatic" at 7.5 cycles per second, which means that it will advance the cursor 7.5 character positions a second as long as it is held down. When the cursor is in the last character position on the last display line and the Advance key is operated, the cursor will wrap around to the first character position of the first line.

Print

Pressing this key inserts the EOM (▬) symbol in the cursor position and causes printing of all data between the first display position of the first line or the SMM symbol and the EOM symbol.

Start of Manual Message (SMM)

Pressing this key causes the SMM (▶) symbol to be displayed in the character position occupied by the cursor.

Backspace (←)

This key causes the cursor to move backward one character position without erasing the character position to which it moves. Similar to the Advance key, this key is cursormatic at 7.5 cycles per second. When the cursor is backspaced from the first character position on the first display line, it will wrap around to appear in the last character position of the last line.

MODIFIED KEYS

In addition to the function keys provided specifically for use with the Display Station, the following standard keys on the keyboard will have modified functions when used with this display.

Line Index (↕)

Pressing this key causes the cursor to move down one line on the display screen. The relative (horizontal) position of the cursor on the line will not change. This key is also cursormatic at 7.5 cycles per second. When the cursor is on the last display line, operation of the Line Index key will cause the cursor to move to the first line.

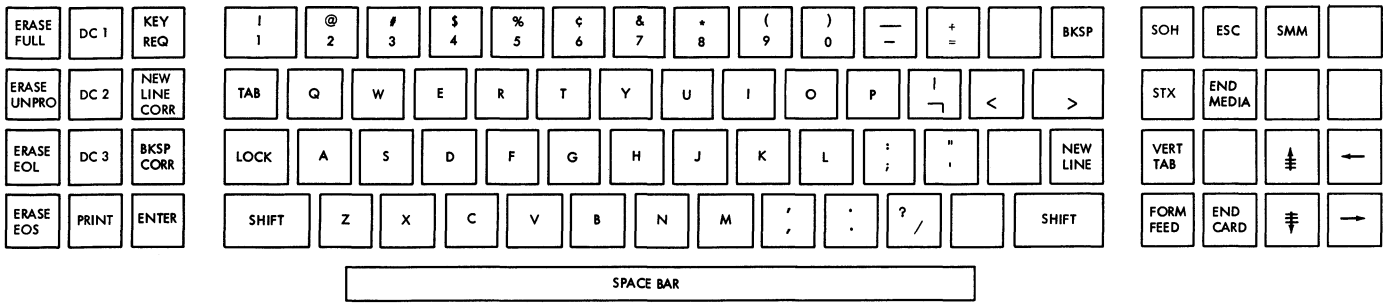


Figure 2265-15. Function Keys (EBCDIC Keyboard)

Reverse Line Index (⇞)

Operating this key causes the cursor to move up one line on the screen. The relative position of the cursor on the line will not change. This key is also cursormatic at 7.5 cycles per second. If the Reverse Line Index key is pressed when the cursor is on the first display line, the cursor will move to the last line.

Space/Erase

Pressing the Space bar on the keyboard causes the cursor to advance one character position, and erases any character present in the position advanced from, so that a space is left in that position. This key is also cursormatic at 7.5 cycles per second. Pressing the Space bar when the cursor is in the last position of the last line will cause wrap-around to the first position of the first line.

Tab

Pressing this key causes the cursor to advance to the first character position to the right of the next tab set symbol or end field modifier, provided the Field-Control Operation--Tab Set special feature is installed (see "Special Features"). If the cursor reaches the last character position on the screen and no Tab Set symbol has been found, it will wrap around to the first position.

New Line

Pressing this key enters a new line (NL) symbol in the cursor position and causes the cursor to move to the first character position on the next lower display line. The New Line key is cursormatic at 7.5 cycles per second. When a NL symbol is inserted in the last display line, the cursor moves to the next character position of the line.

Enter

Pressing this key causes the EOM symbol to be placed in the cursor position. All displayed data from the first character-display position or the SMM symbol to the EOM symbol is transferred to the 2772 Control Unit buffer for transmission over the communications facilities.

Keyboard Request

Pressing this key causes the display adapter to take control of the system and select the Keyboard as the input device.

SWITCHES

Power-On Switch/Indicator

This switch is located to the right of the screen on the Display Station. When actuated, the switch turns on the Display Station, provided the 2772 Control Unit's Power On-Off switch is in the ON position. The Display Station's Power On switch is illuminated when power is on.

Power-Off Switch

This switch is located immediately below the Power-On switch and, when actuated, turns off the Display Station power.

CONTROLS

Brightness

This control knob located immediately above the Power On switch allows the operator to adjust the brightness of the displayed images to a comfortable viewing level for a wide range of room illumination.

WORLD TRADE REQUIREMENTS

Nomenclature translations will be provided on an as-specified basis in French and German.

Error Recovery

OPERATOR ERROR

The method of correcting typograghical errors and mistakes made as data is entered into the display buffer via the keyboard depends on many factors--e.g., the position of the error, the type of operation, etc. Keyboard keys that are particularly useful in the correction of typing errors are: Backspace, Space/Erase, Advance, Line Index, Reverse Line Index, and the various erase keys.

The "cursor movement" keys permit the operator to move the cursor forward or back and up or down to the display position in error, and to effect the correction with the Space/Erase key. For larger errors, the entire unprotected display may be erased and the message re-entered.

The operator may try to correct a Check symbol before pressing the Enter or Print key. The Check symbol appears twice on the display screen (due to the display-buffer readout method employed) and will actually be located in the display position that had the parity error. Once the operator has visually located the faulty character, the Check symbol may be overwritten.

NOTE: Two check characters must be corrected, except when the check occurred in the 8th line of a 15 line display; in which case, only one check character is displayed.

NOTE: It is not necessary to correct a Check symbol in a protected field, since that data is not transferred to the Control Unit.

SYSTEM ERROR--INPUT DEVICE

After the entire message is displayed on the screen and is visually verified, the message enters the Control Unit via the depression of the Enter key. The keyboard will be locked during this operation. The first SMM symbol (if displayed) is deleted from the screen when data transfer from the display-storage buffer commences. The three interface-buffer registers will be filled from the display-storage buffer and the cursor will be positioned under the fourth character position until the Control Unit is ready to accept the data.

Upon successful completion of the transfer of data, the cursor will be positioned under the EOM symbol. When the Control Unit has finished acting on the data, the Data In Buffer light on the operator console will be off. The operator may then initiate another message by pressing the Keyboard Request key and entering the next message.

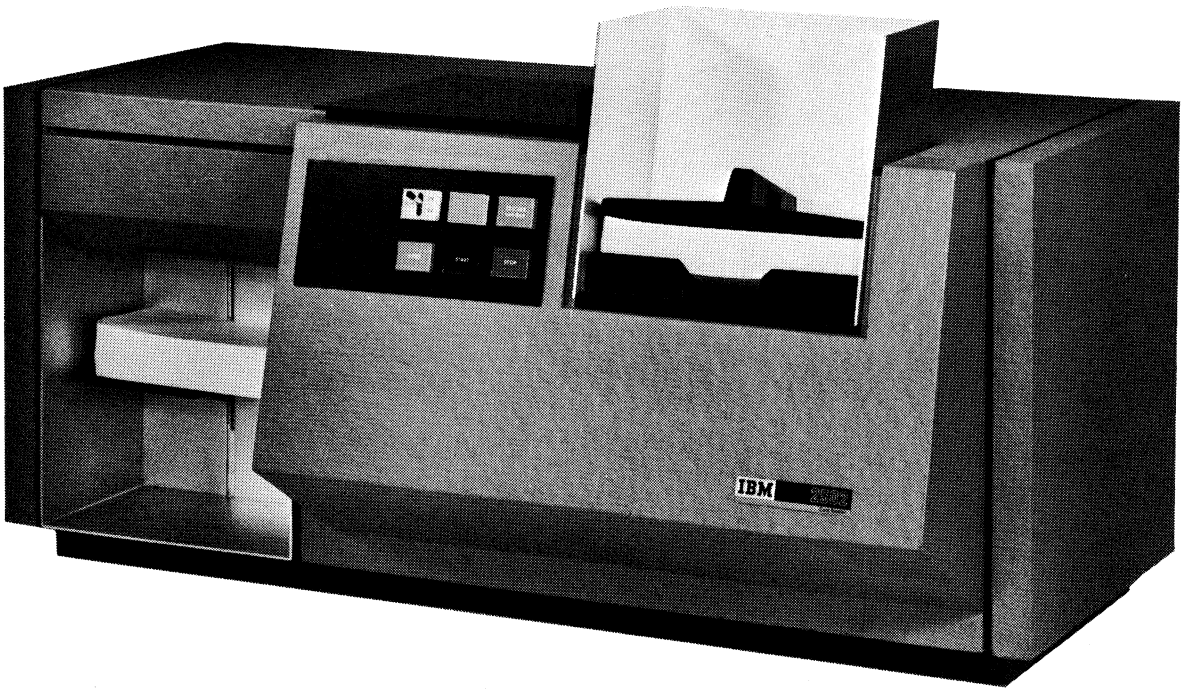
Figure 2265-16 summarizes the types of errors and the required recovery procedures.

SYSTEM ERROR--OUTPUT DEVICE

If a parity error occurs in the interface buffers as data is being transferred from the Control Unit to the display adapter, the Output Device light will blink and, if the 2772 is in line mode, the audible alarm will sound. The operator may recover either by pressing the Terminal Reset key and Keyboard Request key and rekeying the message or by pressing the Check Reset key and Start key, depending on whether the keyboard or another device is the input.

	Indication	Error	Recovery Procedure
1.	Check symbol on Disyplay Screen and Input Device Light on the operator console blinking.	Storage buffer parity error.	a) Check Reset Key b) Terminal Reset Key c) Keyboard Request Key d) Position the cursor and correct characters. e) The SMM symbol (if previously displayed) should be replaced at the beginning of the data to be transmitted. f) The cursor should be positioned at the end of the message to be transmitted and Enter Key pressed.
2.	Input Device Light on operator console blinking.	Power on the Display Station is dropped due to undervoltage condition	a) Turn power on in the Display Station b) Repeat above procedure.
3.	Input Check Light on the operator console is lit.	Parity error on the interface	a) Repeat above Procedure.

Figure 2265-16. Error Recovery Procedure



IBM 2502 Card Reader

Introduction

The IBM 2502 Card Reader is used with the IBM 2770 System as a synchronous input device. The 2502 is available in either of two models. The Model A1 reads punched cards at a rate of about 150 cards per minute; the Model A2 reads at a rate of about 300 cards per minute. The following description applies to both models.

Flexibility of input is an outstanding feature of the 2502; in addition to reading the standard 80-column punched card, the 2502 can be equipped to read:

- 51-column cards
- 66-column cards

For card specifications, see the Appendix in this section.

The 2502 can be specified at the time of ordering for attachment either to a 2770 system using EBCDIC, or to a 2770 system using USASCII. For card codes and graphics, see the code charts in the Appendix of the Control Unit section of this manual.

Functions

The basic 2502 reads standard 80-column punched cards; heavy duty, edge-coated, and Port-a-Punch® cards are acceptable. Data read from the cards is translated into the appropriate code (EBCDIC or USASCII), and transferred directly to the 2772 Control Unit. Each column read is checked for invalid punch combinations (multiple punches in rows 1-7).

The 2502 can be equipped with either the 51-Column Interchangeable Feed special feature or the 66-Column Interchangeable Feed special feature, but not both. The 2502 can then process 51-column or 66-column cards as well as standard 80-column cards; however, standard and short cards cannot be intermixed.

Operating Characteristics

CARD PATH

Figure 2502-1 shows the 2502 card path. Cards move from the hopper, through the cornering station and read station, and into the stacker, face down, during two distinct machine cycles.

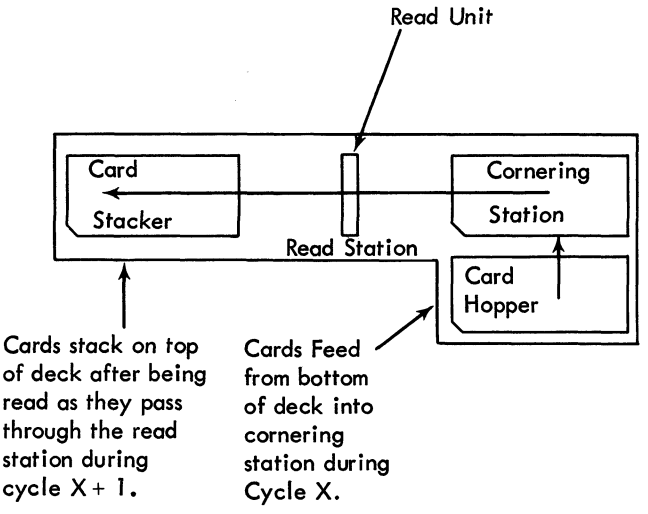


Figure 2502-1. Card Path

HOPPER

The hopper holds about 700 cards. Cards are fed from the hopper by a friction-feed device; if a card fails to feed, a second feed cycle is automatically taken. If the End of File switch is off, an empty hopper causes the Card Reader to stop, and its Attention light to turn on. Cards can be added to the hopper while the 2502 is running; however, if the hopper is less than one-fourth full, card feeding should be stopped before cards are added. Feeding can be stopped for up to 30 seconds by pressing the Stacker Unload key; if the Start key is pressed, feeding resumes immediately; otherwise feeding resumes automatically at the end of the 30 second delay.

CORNERING STATION

Each card moves from the hopper to the cornering station during the first machine cycle for that card. At the cornering station, each card is aligned correctly for reading, and is held until the next machine cycle.

READ STATION

The card passes from the cornering station through the read station (Figure 2502-2), column-1 end first, during the second machine cycle acting upon that card. This cycle is initiated by a command from the Control Unit. Once it is started, card movement continues until the card enters the stacker; 80 characters are sent to the control unit.

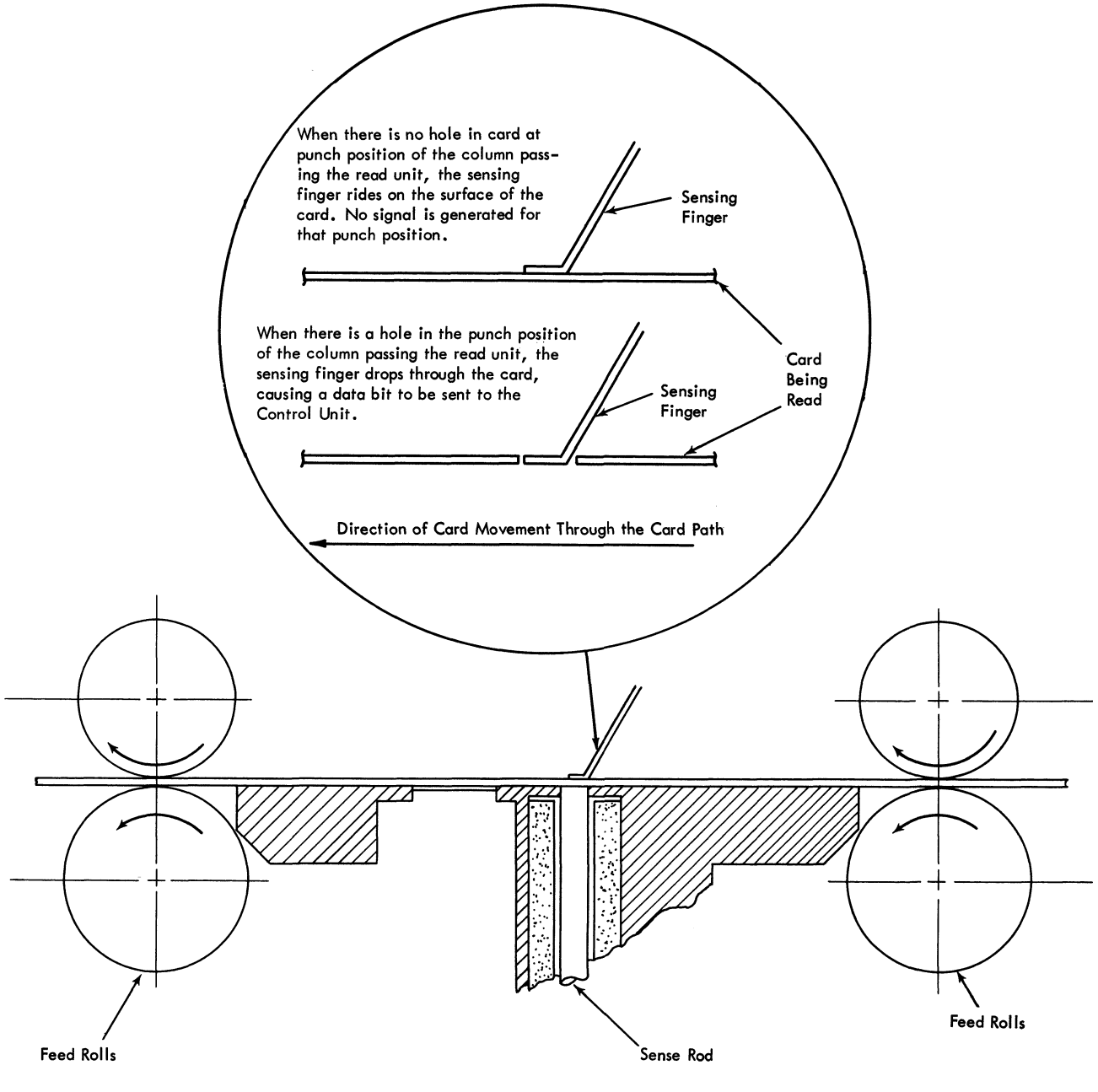


Figure 2502-2. Read Station

The 12-position read unit samples each column of the card as the card passes through the read station. A finger at each punch position rides along the matching row of the card. A hole in the card allows the finger to drop through the card, producing a data-bit signal for that punch position.

NOTE: Small plastic patches to cover unwanted punched holes are commercially available. IBM does not recommend their use; the patches can cause misfeeds and read errors.

STACKER

Cards enter the stacker automatically after they have been read, stacking face down in their original sequence. The stacker holds about 600 cards.

Special Features

51-COLUMN INTERCHANGEABLE FEED FEATURE

This special feature allows the 2502 Card Reader to feed 51-column cards. The operator can easily change the 2502 from 80-column card processing to 51-column card processing, and vice versa. Installation of the feature does not affect normal 2502 operations and does not change the throughput rate.

The 51-Column Interchangeable Feed feature can be installed in the field. A 2502 cannot have both this feature and the 66-Column Interchangeable Feed feature.

66-COLUMN INTERCHANGEABLE FEED FEATURE

This special feature allows the reader to feed 66-column cards. Otherwise, this feature is identical to the 51-column feature.

The 66-Column Interchangeable Feed feature can be installed in the field. A 2502 cannot have both this feature and the 51-Column Interchangeable Feed feature.

Keys, Lights, Switches, and Operating Procedures

OPERATOR CONTROLS AND INDICATORS

The operator's panel (Figure 2502-3) contains keys, lights, and switches used by the operator.

Read Check Indicator

This light indicates one of the following:

a. Card not properly aligned during reading, or a card having out-of-registration punching.
b. A late end-of-card detection.
c. A card-sensor failure.
d. A card failed to pass through the read station.

To turn the Read Check indicator off, empty the hopper, then press the NPRO key.

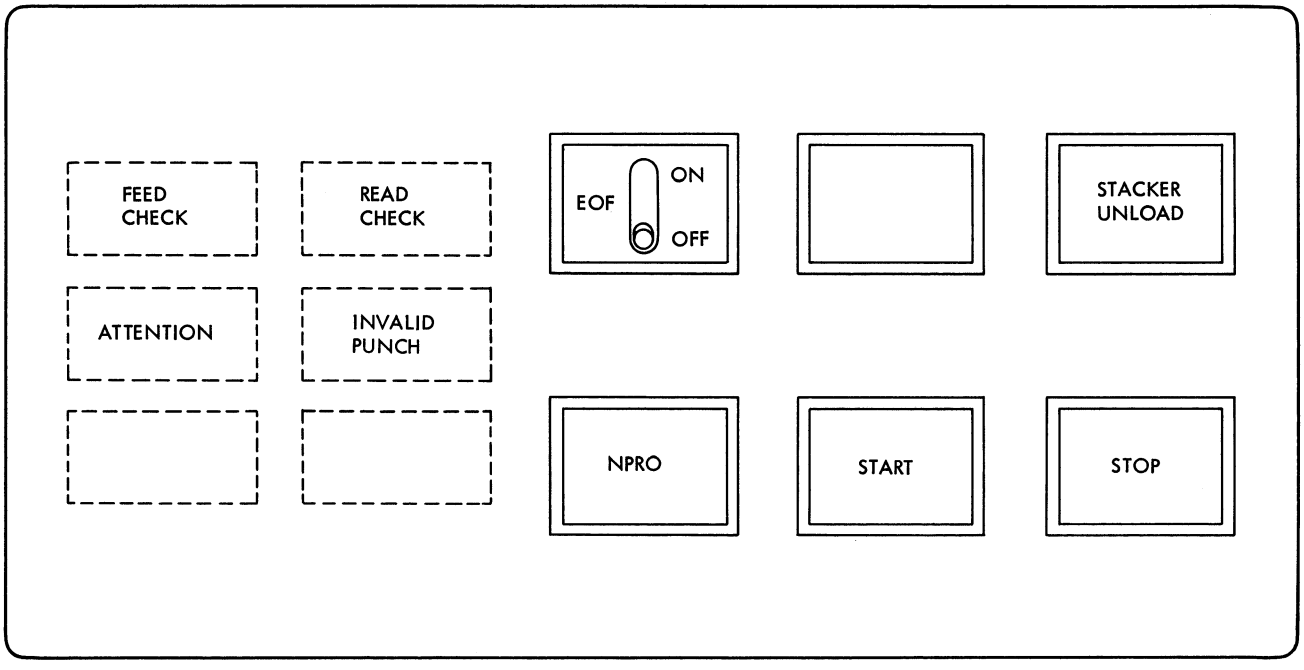


Figure 2502-3. Operator's Panel

Feed Check Indicator

This light indicates one of the following:

a. A card failed to feed from the hopper after two feeding attempts.
b. A card jam at the cornering station.
c. Initial power-on condition.

To turn the Feed Check indicator off, empty the hopper, then press the NPRO key.

Attention Indicator

This light indicates one of the following:

a. A full stacker.
b. A stacker jam.
c. An empty hopper while the 2502 is in a ready condition (ready status, no end-of-file).
d. 2502 cover is open.
e. Post read station cover open.

To turn the Attention light off, correct the condition causing the light.

Invalid Punch Indicator

This light indicates that an invalid code has been read. To turn the light off, empty the hopper, then press the NPRO key.

Start Key

Pressing the Start key feeds a card from the hopper to the cornering station and establishes a ready condition, unless an error condition or an attention condition exists or the hopper is empty.

Stop Key

Pressing the Stop key stops the reader after the card being read has been read completely and the card has been fed into the stacker. An input-device error is signaled to the Control Unit, and the associated input-device light blinks.

NPRO (Nonprocess Runout) Key

Pressing this key causes the card at the cornering station to be ejected into the stacker without being read. This key is ineffective if cards are in the hopper, or if the 2502 is in a 'ready' condition.

Stacker Unload Key

Pressing this key while the 2502 is in a ready status causes the 2502 to stop reading cards for 30 seconds, to allow time for unloading the stacker. Pressing the Start key during this 30-second interval causes card reading to resume. If the Start key is not pressed within 30 seconds, the 2502 automatically starts feeding cards again. This key can also be used to temporarily halt feeding, when cards are to be added to the hopper.

EOF (End-of-File) Switch

This toggle switch must be set to the OFF position while any cards in the file being read are yet to be loaded into the hopper. When placing the last cards of the file in the hopper, set the EOF switch to the ON position. When the last card in the hopper has been read without error, the 2502 signals an 'end-of-file' to the Control Unit.

OPERATING PROCEDURES

Ready State

The 2502 Card Reader cannot read data unless it is in the 'ready' state. To establish the ready state:

1. Turn on the Power switch (on the Control Unit).
2. Press the NPRO key to reset the circuits.
3. Load the hopper, being certain that the card weight is placed on the cards in the hopper.
4. Press the Start key to feed a card into the cornering station.

The following actions or conditions will interrupt the ready state:

a. Depression of the Stop key.*
b. An attention condition.**
c. A read check condition.***
d. A feed check condition.***
e. The 2772 Control Unit's Power switch being turned off.***

---

*To restart: press the Start key.

**To restart: correct the condition causing the stop; then press the Start key.

***To restart: (1) correct the condition causing the stop (see Figure 2502-4); (2) if operating in line mode, establish restart procedure with the other terminal operator; (3) remove cards from the hopper; (4) press the NPRO key to reset the error circuits; (5) place the unprocessed cards on bottom of the deck removed from the hopper; (6) place the deck of cards back into the hopper; and (7) then press the Start key.

Short-Card Setup

To set up the 2502 to process either 51-column or 66-column cards, follow this procedure:

1. Insert the spacer(s) in the hopper (one on each side for 51-column cards, one on the left side only for 66-column cards).
2. Move stacker-stop assembly to the short-document position and latch it there.
3. Adjust stacker spring tension by setting stacker-spring lever at its short-document setting.
4. Load the hopper with short cards, placing the short hopper weight on top of the cards.

To set up for 80-column card processing after running short cards, reverse the short-card setup procedure.

Error Recovery Procedures

Figure 2502-4 is a chart showing error indications and restart procedures.

INDICATION	PROBABLE CAUSE	RESTART PROCEDURE
Read Check Light Feed Stoppage	Punching off registration Card arrived at read station too late Misfeed or card jam in read station Read unit failure	Open cover and check for card jam in read station area. A. If there is a card jam, clear the damaged cards from the transport. Close the transport card guides and the machine covers. Remove all cards from the hopper and press NPRO on the 2502 to reset the error indicators. Replace or repair the damaged card (last read) from the transport, and place it with cards obtained by pressing NPRO in proper order with cards removed from hopper. Replace cards in hopper and restart. B. If no jam exists, check the top card in the stacker for (1) off-registration punching, (2) card torn between holes, (3) other card damage. If any of these conditions exists: 1. Remove cards from hopper. 2. Press NPRO. Remove card that runs into stacker. 3. Correct error card and place it, along with NPRO card, on bottom of stack of cards removed from hopper. 4. Place cards in hopper. C. If neither A nor B apply: 1. Remove cards from hopper. 2. Press NPRO. Remove card that runs into stacker from stacker. Place it, along with top card from stacker, on bottom of cards removed from hopper. 3. Reload the hopper. 4. Press START.
Feed Check Light Feed Stoppage	Hopper Misfeed Jam in hopper or cornering station Power up cycle	A feed check will always occur during power up operations. This can be cleared by pressing the NPRO key while the hopper is empty. For other feed check conditions: 1. Remove cards from hopper. 2. Check bottom cards for damage, then check the throat knife area and hopper throat for foreign material. • Remove any foreign material found, and repair any damaged cards or replace them. • Press NPRO. • Place cards in correct sequence, and reload them into hopper. 3. If there was no obstruction at throat area and there were no damaged cards; open covers and check for a jam in the hopper or cornering station. For a jam, follow the procedure in item A for a read check restart procedure. If no jam exists, check for the presence of a card in the cornering area. (Press the NPRO key with the hopper empty.) If there was a card in the cornering station, place it in the hopper along with the rest of the cards from the hopper, in proper sequence. Restart the 2502. If a feed check without a jam occurs again, replace the bottom card in the hopper, check for a card in the cornering station, clear the station, place cards in the hopper in proper order, and restart.
Attention Light Feed Stoppage	Full Stacker Open Cover Empty Hopper Jam in Stacker Post Read Station Cover Open	If a stacker jam caused the attention light, the cards have been read and need not be run again. To restart after an attention stop, correct the condition causing the stop and press the start key on the 2502.
Invalid Punch Light Feed Stoppage	Invalid Code in card	Top card in stacker contains error (more than one punch in rows 1 - 7). 1. Remove cards from hopper. 2. Press NPRO key - one card enters stacker. 3. Correct error card and place it with the NPRO card on the bottom of cards removed from hopper. 4. Place cards in hopper. 5. Press start.

Figure 2502-4. Error Recovery Procedures

IBM 545 Output Punch

Introduction

The IBM 545 Output Punch Models 3 and 4 (Frontispiece) are free-standing, dual-purpose card punches that attach by cable to the IBM 2772 Multi-Purpose Control Unit of the IBM 2770 Data Communication System. The 545 Attachment feature (2772 special feature) and Punch 81 Indication feature (545 special feature) are prerequisites when using the 545 to provide punched-card output for the 2770 system. The 545 Models 3 and 4 can punch all characters in either the EBCDIC or USASCII code set. The 545 Model 4 can also print the characters defined under "Operating Characteristics-Printing."

The IBM 545 Output Punch has the popular features of other IBM card punches plus the unlimited use of two levels of program-card control (standard feature) when operating in "keypunch" mode. The 545 is similar in appearance and function to the IBM 29 Card Punch, and consists of the following units:

- Hopper
- Card Feed
- Punch Unit
- Read Unit
- Stacker
- Program Unit
- Keyboard
- Print Unit (Model 4 only)

When operating in "autopunch" mode, the IBM 545 provides punched-card output for the system. When operating in "keypunch" mode, the IBM 545 functions and operates as an independent keypunch. The punching and duplicating speed is 20 CPS (columns per second) for the Model 3, and 18 CPS for the Model 4. The skipping and release speed is 80 CPS for both models.

In autopunch mode, IBM 545 operation is controlled by the 2770 system. In keypunch mode, the IBM 545 is controlled by the operator through the use of the keyboard, and also by the punching in the program card. (The program card need not be punched if skipping or duplicating is not required.) The setting of one switch determines the mode of operation, and the cable connecting the 545 to the 2770 system need not be disconnected when operating in keypunch mode. During operation in auto-punch mode, all data to be punched must pass through the Control Unit of the 2770 system, regardless of whether the 2770 system is operating in line mode or in home mode. When in autopunch mode, the IBM 545 operates with the 2770 as a synchronous output device. The 545 cannot be selected as a direct data device.

The following characteristics of the IBM 545 Output Punch provide for ease of operation and maximum output efficiency:

- Standard keyboard (similar to IBM 29 keyboard) requires a minimum of additional operator training.
- Two levels of program-card control (keypunch mode only) reduce the punching and insertion of program cards to a minimum.
- Changing from keypunch to autopunch mode of operation requires only a change of program card and the operation of one switch, as outlined in Initial Preparation of 545 Prior to Punching (Autopunch Mode), under Operator Procedures.
- The mutilated-card-feed feature (a standard feature) enables partially mutilated cards to be reproduced.
- A sound-deadening acoustical hood is available to reduce the punching noise level to a minimum.
- Characters coded in either EBCDIC (Extended Binary-Coded-Decimal Interchange Code) or USASCII (United States of America Standard Code for Information Interchange) can be punched. The EBCDIC code is standard; if the USASCII code is desired instead, it must be specified when ordering. The code selected must be in agreement with the code used by the system.

Functions

CARD PUNCHING

Data to be punched can be received from the 2772 Multi-Purpose Control Unit, from the 545 Keyboard, or from the previous card if duplicating. Up to 80 columns of the card can be punched.

Each card column has 12 punching positions: one each for the digits 1 to 9, and one each for the zones 12, 11, and 0; the 0-zone position is also used for punching the digit 0. The 11-zone punch is some-times referred to as an X punch (not to be confused with the letter X). A digit is recorded by punching a single hole in the corresponding digit (or 0-zone) position of the desired column.

An uppercase letter is a combination of one zone punch and one digit punch in the desired column. For example, "A" has 12-zone and digit-1 punches; "N" has 11-zone (X) and digit-5 punches; and "Z" has 0-zone and digit-9 punches.

A lowercase letter is a combination of two zone punches and one digit punch in the desired column. For example, "a" has 12-zone and 0-zone, and digit-1 punches; "n" has 12-zone and 11-zone, and digit-5 punches; and "z" has 11-zone and 0-zone, and digit-9 punches.

A special character can consist of from one through six holes punched in the desired card column. Punching of multiple holes in one column for a letter or special character is automatic (that is, does not require repetitive punching of single holes) when the corresponding key on the 545 keyboard is pressed or when the code for the character is received from the system control unit. All characters in either the EBCDIC or USASCII code set can be punched. (See code charts in the Appendix of the Control Unit section of this manual for all card codes.)

DUPLICATION

When operating in keypunch mode, the IBM 545 Output Punch duplicates common information from any card into the following card in a gang-punch type of operation. The duplication can be automatic, under program-card control; or manual, controlled from the keyboard. This method of duplicating reduces manual keying of repetitive data and consequently increases production.

All the characters in the EBCDIC or USASCII code set can be duplicated. The duplicating feature greatly facilitates error correction during punching. When an error is made, the operator need not repunch the whole card manually. Instead, without any card handling, the operator duplicates into the next card all correctly punched fields and rekeys only the field in error.

SKIPPING

Card columns or fields that are not to be punched or duplicated may be skipped when operating in keypunch mode. Skipping can be performed automatically (under program-card control) or manually (controlled from the keyboard).

Card release is controlled from the system when operating in autopunch mode, and from the keyboard when operating in keypunch mode. Programmed auto-duplicate fields are duplicated during card release. Skipping and card release proceed at a rate of 80 columns per second (CPS).

PRINTING

The IBM 545 Output Punch Model 4 can print as well as punch all the graphics defined as being printable in Figure 545-1. Printing is suppressed on characters which are not defined in Figure 545-1.

EBCDIC CODE		USASCII CODE
(Arrangement A) 48-Character Keyboard	(Arrangement EL) 64-Character Keyboard	(USASCII Code Character Arrangement) 64-Character Keyboard
&	&	&
-	-	-
/	/	/
.	.	.
$	$	$
,	,	,
#	#	#
<	<	<
*	*	*
%	%	%
@	@	@
	¢	]
	!	[
	:	:
	(	(
	)	)
	¬	¬
	+	+
	;	;
	>	>
	=	=
	|	|
	¬	¬
	?	?
	"	\

NOTE: The 545 Model 4 prints the 26 alphabetic and 10 numeric character regardless of the type keyboard or code used. See the EBCDIC and USASCII code charts in the Appendix of the Control Unit section for the card codes associated with the printable graphics.

Figure 545-1. Printable Special Characters--By Code and Keyboard

When the Print switch on the 545 keyboard is on, each character prints at the top edge of the card, above the punches in the column, thus providing for full interpretation of the card. When the Print switch is off, printing is suppressed.

When the 545 is printing, a second switch, the LZ Print (left-zero print) switch, controls whether the 545 will print (LZ Print on) or suppress (LZ Print off) left zeros. (Left zeros are those zeros that are to the left of the first significant digit in any defined numeric field.)

PROGRAM-CARD CONTROL

One of the most important features, when operating in keypunch mode, is the simple means of setting up the 545 for automatic control of duplicating and skipping operations. Each setup or program is made by punching a card and

mounting it on a program drum, which is inserted in the machine (see Figure 545-7).

On the 545 Output Punch, with unlimited use of two program levels, each program card can contain two totally different, complete 80-column programs. Either program can be selected for card-to-card use by setting the Prog Sel (program selection) toggle switch to ONE or TWO. If it is desired to use both program levels to control punching on a single card, alternations from program to program can be made by pressing the program-selection keys (Prog One and Prog Two) on the keyboard. Programs can be alternated at will, during the punching of a single card, by use of these keys.

Operating Characteristics

DATA FLOW

The IBM 545 Output Punch can punch output data that originates at four different sources.

Three of these sources can be active, on an individual basis, when the 545 is operating in autopunch mode (Auto Pch/Key Pch switch on 545 keyboard set to AUTO PCH position). The source of data depends on the job setup of the 2770 system. If the 2770 terminal system is in home mode, the source of data would be one of the input units within the same 2770 system, such as Card Reader, Paper Tape Reader, etc. (Figure 545-2). If, however, the 2770 is operating in line mode, the source of data would be either: (1) one of the input units of another, transmitting 2770 terminal system (2770-to-2770 operation); or (2) output from an IBM System/360 (2770 and S/360 operation, Figure 545-3).

When the 545 is operating in keypunch mode, the source of data is from the 545 punch itself--that is, from its keyboard, or its read station if duplicating (Figure 545-4).

CARD HOPPER

The card hopper, which holds approximately 500 cards, is on the upper right of the machine (Figure 545-5). The cards are placed face-forward in the hopper, in front of the sliding pressure plate, with the 9-edge down, and are fed front card first. The sliding pressure plate assures uniform feeding.

To feed a card down from the hopper to the card bed, press the Feed key. If the Auto Feed switch is on, only the first two cards to be punched must be fed by pressing the Feed key, and all other cards in the hopper will be fed automatically.

PUNCH STATION

Punching is performed at the first of the two stations in the card bed through which the cards pass from right to left (Figure 545-5). To start a punching operation (keypunch mode), press the Feed key twice; this feeds two cards into the card bed at the right of the punch station.

NOTE: To make the 545 ready to start a punching operation (autopunch mode), press the Feed key twice and then the Release key. See Initial Preparation of 545 Prior to Punching (Autopunch Mode) under Operator Procedures.

As the second card is fed in, the first card is automatically registered for punching. The registering operation moves the card in position to punch column 1. While the first card is being punched, the second card remains at the right of the punch station, in the preregister position. The first card is

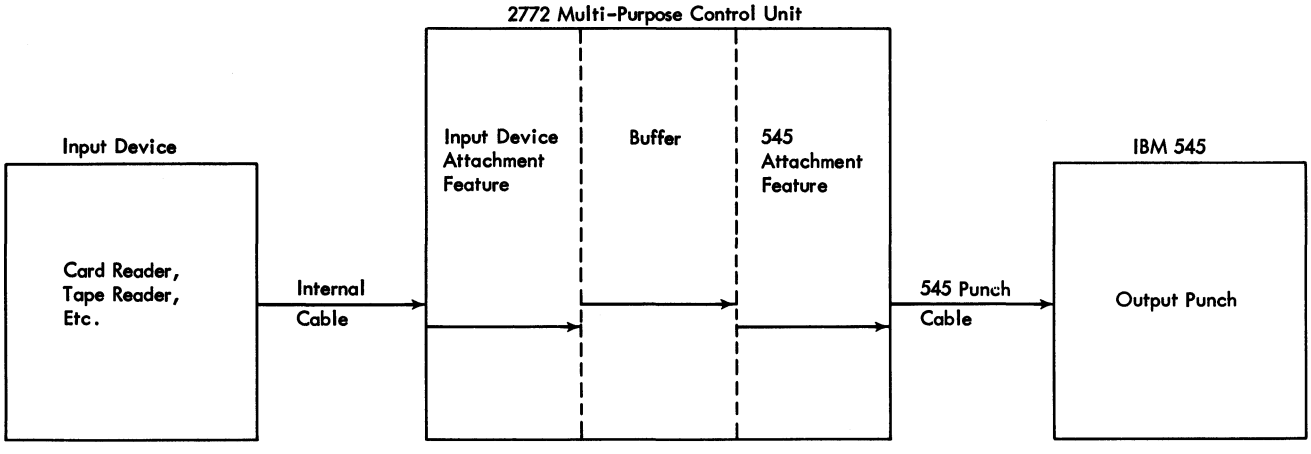


Figure 545-2. Data Flow--Home Mode and Autopunch Mode

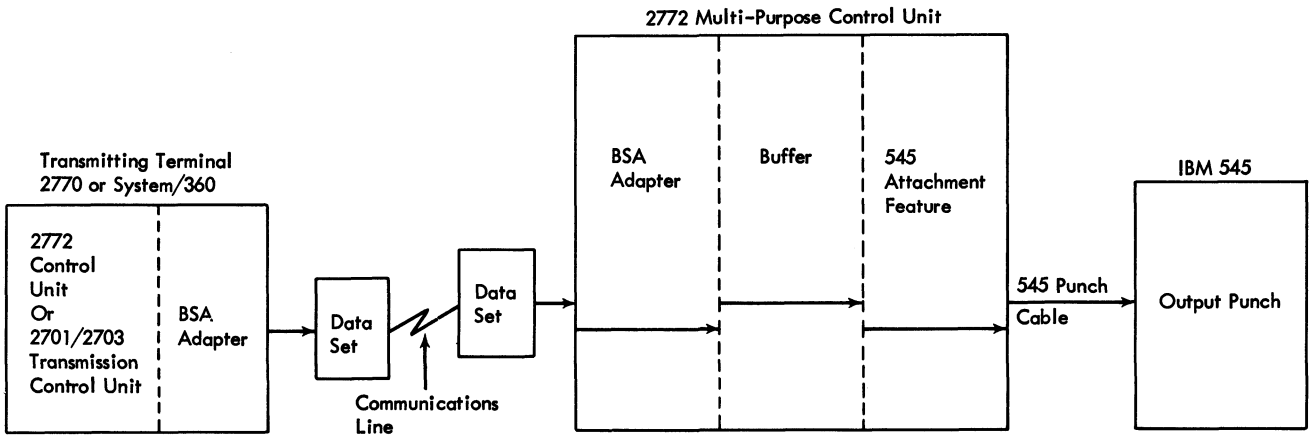


Figure 545-3. Data Flow--Line Mode and Autopunch Mode

transported to the read station as it is punched or released through column 80. When the third card is fed to the preregister position, the first and second cards are registered in the read and punch stations respectively (Figure 545-5).

A single card may be placed in the card bed by hand (instead of feeding it down from the hopper). To register it in punching position, press the Reg (register) key.

The whole card is visible before it is registered at the punching position, and at least 71 columns are visible after punching has started. For example, when column 15 is to be punched (Figure 545-6), columns 1 to 12 and columns 22 to 80 are visible.

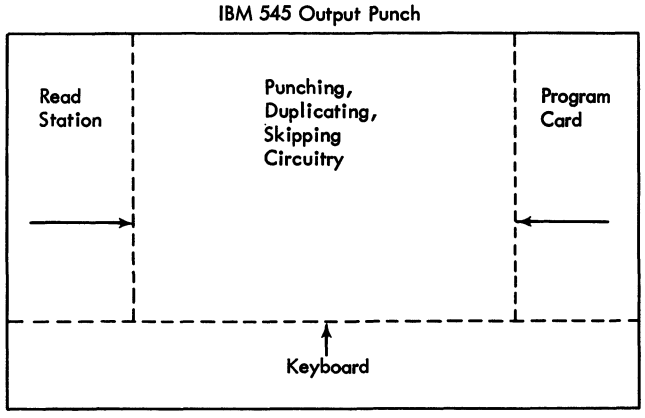


Figure 545-4. Data Flow--Keypunch Mode

In order to maximize data throughput when operating in autopunch mode, the 545 Attachment to the 2772 Multi-Purpose Control Unit causes data to be punched on a per-card basis. That is, the punching in each card represents the data in one record. The 545 starts punching when signaled to do so by the 2772 Control Unit. This occurs when the 545 is selected, by the setting of the Job Select switch on the 2772, to punch data that has been received correctly in one of the two 128-position buffers in the Control Unit. Data is punched in the card, column-by-column, until all 80 columns have been punched. Punching of less than 80 columns in a card is determined by:

a. Recognition of an IRS/RS character in the data stream (unless it is immediately preceded by a card eject caused by 80 columns being punched); or
b. The 2772 Multi-Purpose Control Unit recognition of an ETB or ETX signal (unless immediately preceded by a card eject caused by recognition of an IRS/RS character or by 80 columns being punched in the card).

If the card being punched represents the last record in the buffer, an 11 hole is punched in column 81 of the card (see "Punch 81 Indication" under "Special Features" in this section of the manual). The IRS/RS, ETB, ETX character in the data stream causes the 2772 Control Unit to signal the 545 to stop punching, release the card, and feed another card. These characters are not punched in the card. The card is released at high speed (80 CPS) because of the 12's punched in the program card (see "Program Unit").

Transparency Feature

EBCDIC Transparency is a special feature available for the Control Unit only (see "EBCDIC Transparency" under "Special Features" in the 2772 Multi-Purpose Control Unit section of this manual). However, if this feature is installed in the 2772, it affects the 545 Output Punch in the following manner.

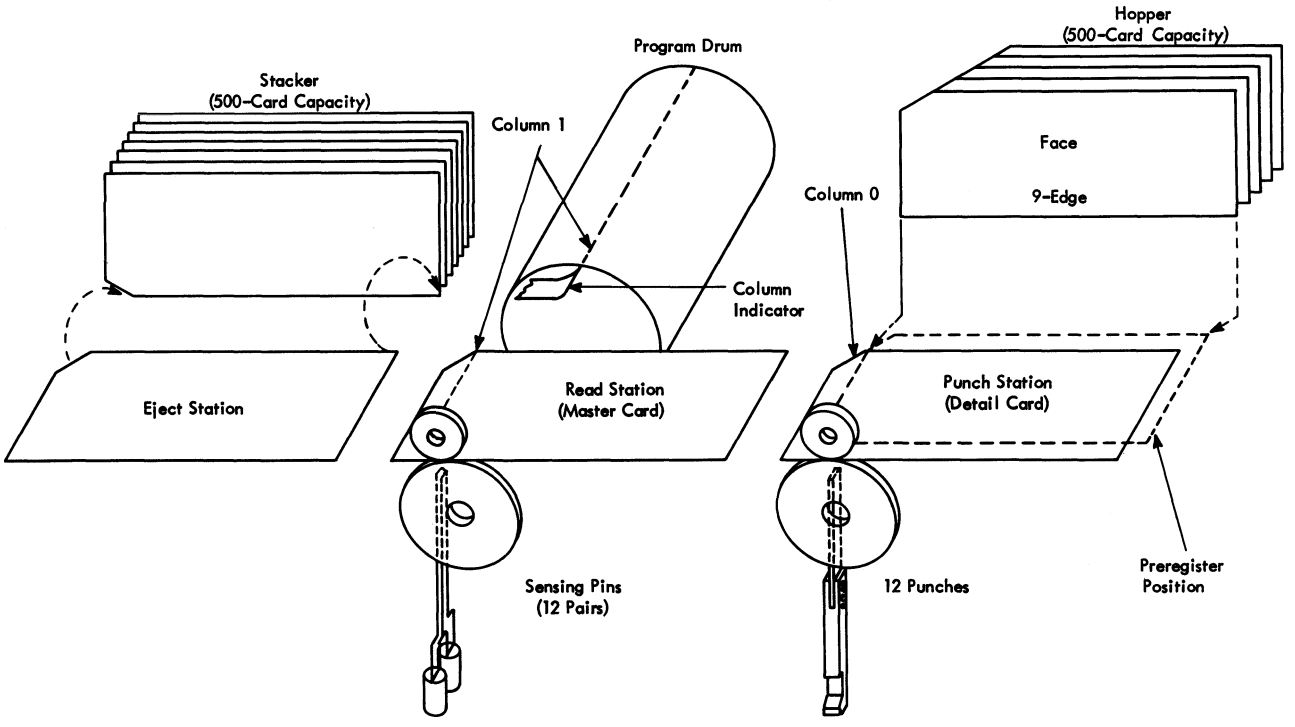


Figure 545-5. Card Path

IRS/RS characters are not recognized when operating in transparent mode; therefore, punching from a buffer block continues until (1) the end of the received record, or (2) the end of the buffer block is reached. If the received record contains more than 80 characters, the data is punched into two or more cards; each card, except the last, contains 80 columns of data, the last card contains the number of characters by which the received record's length exceeds a multiple of 80 characters.

The last card punched from a buffer block contains an 11 (X) punch in column 81. This column 81 punch is useful in identifying a restart point if a system restart is required (see "Punch 81 Indication" under "Special Features").

READ STATION

The read station, where the cards are read for duplicating (keypunch mode only), is slightly greater than one card length to the left of the punch station (see Figure 545-5). Consequently, each card that has been punched passes through the read station as the next card is being punched. The two cards move in synchronism, column-by-column, and information fields to be duplicated are transferred from the first card to the second card.

This principle of duplication is the same as gang-punching. Reading from one card to another can be controlled, field-by-field, so that only the desired information is duplicated from one card to the next. Thus card handling is eliminated when information punched in one card is to be duplicated in the following card. Card handling is necessary only when an operation requires duplication from prepunched master cards. In this case, the prepunched master card is inserted manually at the right of the read station before the next card to be punched (the "detail" card) is registered at the punch station. Pressing the Reg (register) key will then register both the master card and the detail card at their respective stations.

The whole card is visible before it is registered at the read station, and at least 68 columns are visible after reading has started. For example, when column 15 is being read, columns 1-8 above the 7-row and columns 21-80 are visible.

CARD STACKER

The card stacker, which will hold about 500 cards, is on the upper left side of the machine on a level with the hopper (see Figure 545-5). During the feed cycle after completing its pass through the read station, the card is fed into the stacker. Cards are stacked at an angle, 12-edge to the rear, face up in their original sequence, and are held in position by a card weight.

A full-stacker condition (approximately 550 cards) operates a switch that interlocks the card feed. In keypunch-mode operation, feeding and punching may be resumed as soon as

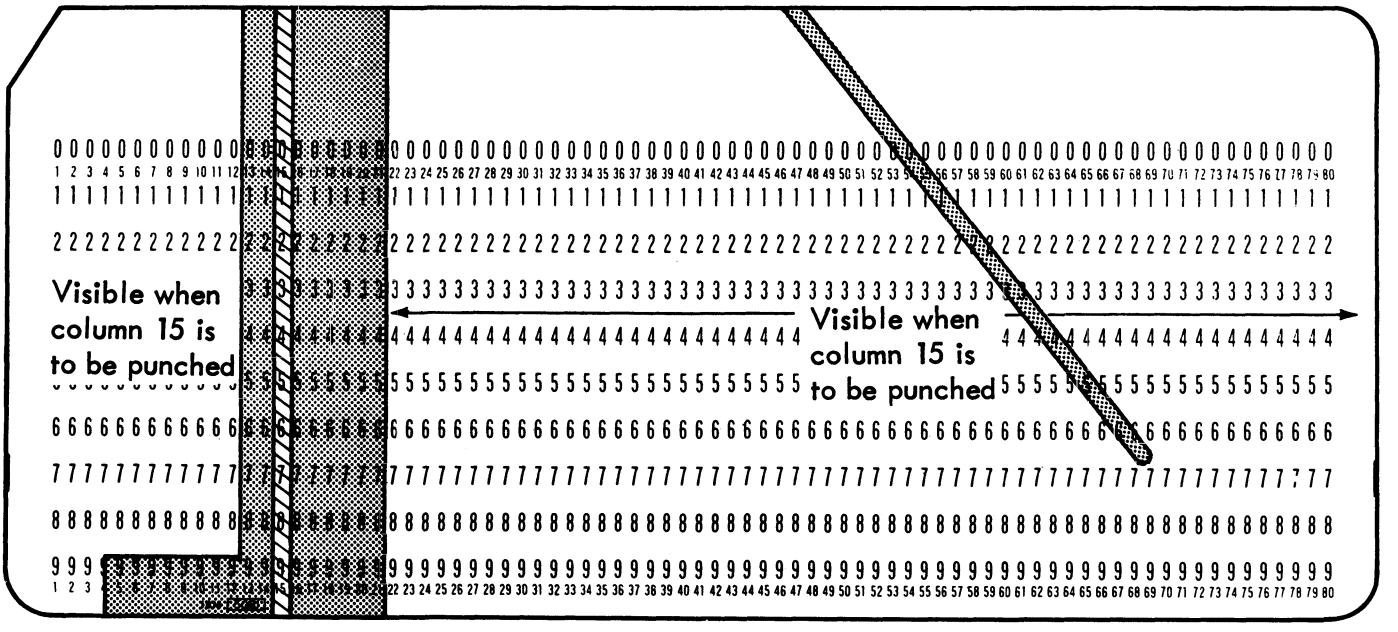


Figure 545-6. Card Visibility at the Punch Station

the cards are removed from the stacker. During autopunch-mode operation, a full-stacker condition also turns on the Check light on the 545 keyboard, and feeding of the next card is inhibited. (See "Error Recovery Procedures" for restart procedure in autopunch mode.)

A scale is provided in the stacker to aid in estimating the total number of cards processed before they are removed from the stacker.

PROGRAM UNIT

In keypunch-mode operation, the program unit on the 545 controls automatic skipping, automatic duplicating, and shifting from numeric to alphabetic punching. In autopunch-mode operation, the program unit is used only to allow the release of the card at high speed (if less than 80 columns are punched). The unit is accessible to the operator from the front of the machine. By lifting the middle portion of the top cover, the operator can remove the program drum and install the program card.

Several operations may be performed under control of the program unit; each is designated by a specific code punched in the program card. The program card is punched, column by column, with the appropriate program-card codes to designate the operations desired in the corresponding columns or fields of the cards being punched. The program card is then mounted on the program drum, which is placed on the program unit (Figure 545-7). The program drum revolves in synchronism with the movement of the cards past the punch and read stations so that the codes punched in the program card control the operations, column-by-column.

The program unit is equipped with two program levels (that is, two programs are punched on one program card), which give added flexibility to a program operation. Automatic skipping, duplicating, field definition, and alphabetic shift can be performed through both levels of program control.

The coding of the program card is as follows:

Level 1	*Function*	*Level 2*
12	Field Definition	4
11	Start Auto-Skip	5
0	Start Auto-Dup	6
1	Alphabetic Shift	7

The program-control lever (see Figure 545-7), located below the program unit, controls operation of the program unit. Turning the control lever on (to the left) lowers the sensing mechanism. The sensing mechanism consists of 12 starwheels, which, when the mechanism is lowered, ride along the surface of the program card to sense the program-control punches in the card. When a punched hole is sensed by a starwheel, a signal is sent to the controlling circuits of the machine. This signal initiates the particular function designated by the code punch detected in the program card.

Turning the control lever off (to the right) raises the sensing mechanism. This lifts the starwheels off the program

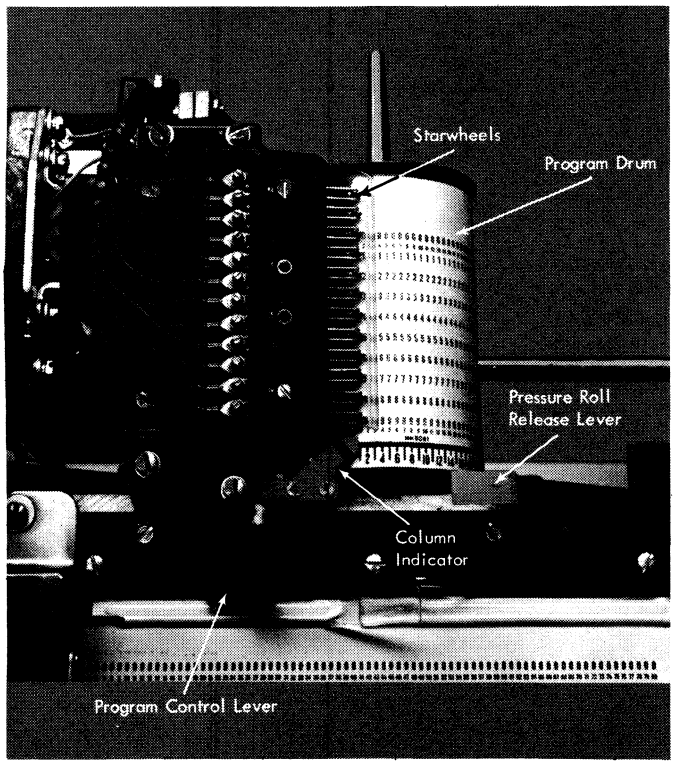


Figure 545-7. Program Unit

card and the program-control punches will not be sensed. The control lever must be turned to the off position to remove the program drum, and always left in that position when a drum is not in the machine.

PRINTING

The characters that a 545 Model 4 will print are determined by the keyboard used (48- or 64-character) and the code used (EBCDIC or USASCII). Machines with a 64-character keyboard print 64 characters; machines with a 48-character keyboard print only 48 characters. Twenty-six uppercase alphabetic and ten numeric characters will print regardless of the code or keyboard used. The special characters that will print, by keyboard type and also by code, are shown in Figure 545-1.

The 545 Model 4 print-protection circuit is designed so that any *valid* EBCDIC or USASCII card code outside of the 48- or 64-character print capability will be correctly punched, but printing of the character is suppressed. The printable characters remain the same in the autopunch and the keypunch modes of operation.

Special Features

PUNCH 81 INDICATION

The Punch 81 Indication special feature is a prerequisite when using the 545 to punch output data from the 2770 system. This feature prevents the loss or duplication of data when performing a system-restart procedure. With this feature installed, an 11 hole is punched in column 81 of the card that represents the last record in the buffer.

EBCDIC TRANSPARENCY (2772 FEATURE)

EBCDIC Transparency is a special feature to be installed on the 2772 Multi-Purpose Control Unit only. However, with this feature installed on the Control Unit, the operation of the 545 will be affected. (See "EBCDIC Transparency" under "Special Features" in the 2772 Multi-Purpose Control Unit section of this manual; also see "Punch Station" under "Operating Characteristics" in this section of the manual.)

Keys, Lights, Switches, and Procedures

KEYS

The keys located on the keyboard of the 545 Output Punch, except for the Feed and Release keys, are used during keypunch-mode operation only and should not be operated while in autopunch-mode.

48-Character Keyboard Arrangement

One 48-character keyboard arrangement, which is designated as arrangement A, is available for the 545, and is used only with the EBCDIC code. In addition to the 26 letters and the numerals 0-9, special characters in various combinations can be punched by pressing a single key. The special characters available in arrangement A are shown in Figure 545-1.

64-Character Keyboard Arrangements

Two 64-character keyboard arrangements are available for the 545. One, which is designated as arrangement EL (Figure 545-8), uses the EBCDIC code and graphics, and is compatible with System/360 code; the other (designated only as the USASCII character arrangement) uses the USASCII code. In addition to the 26 letters and the numerals 0-9, the special

Figure 545-8. Sixty-Four Character Keyboard and Controls (EL Arrangement)

characters shown in Figure 545-1 for EBCDIC or USASCII code can be printed on the Model 4. In Figure 545-9, each key is numbered for indentification purposes, and these numbers are used in the following discussions of punching keys and functional keys.

Punching Keys

Keys 1-29, 33, and 40-43--except for key 7 (A) and key 13 (Z)--are dual-character keys that may be pressed when the keyboard is in either numeric or alphabetic shift. (Keys 7-13 should be pressed only when the keyboard is in alphabetic shift; in numeric shift they cause the keyboard to lock up.) The resulting punched-hole combinations represent numerals, letters, and special characters.

Note that in numeric shift, key 5 punches a combination of the zero, two, and eight holes in the card. An EBCDIC code graphic has not been assigned to this combination; hence the punched-hole code punched by the key is shown in the keytop instead. When using the USASCII code, the reverse slash (\) is the graphic assigned to the zero, two, and eight code.

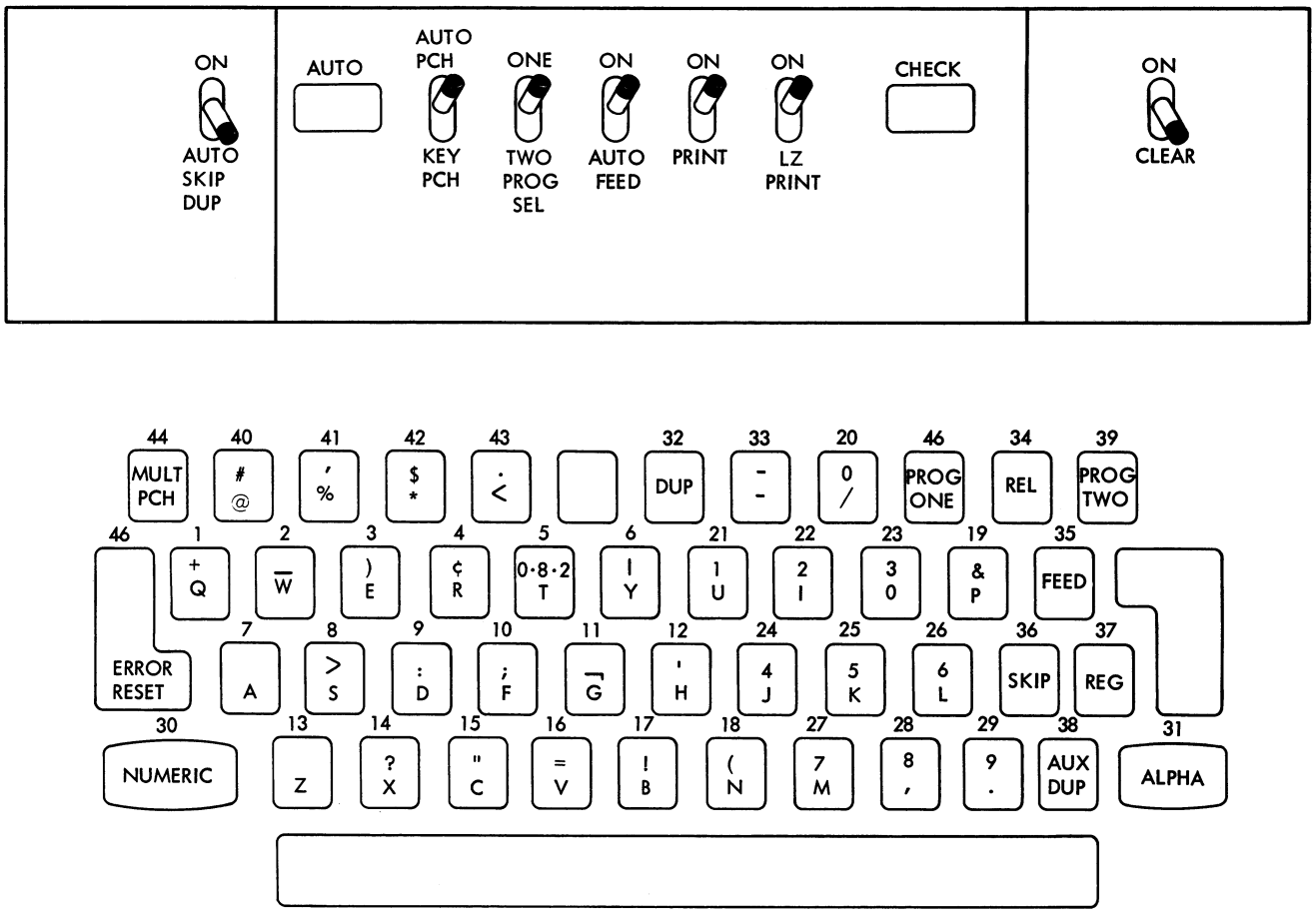
Space Bar

The space bar can be pressed at any time in a manual field to cause spacing over one column of the card.

Functional Keys

The remaining keys, numbers 30-32, 34-39, and 44-46, control the various functions of the 545 Output Punch, as follows.

30. Numeric (Numeric Shift). Pressing this key shifts the combination keyboard into numeric shift or mode as long as it is held down. It is normally used to punch numbers in an otherwise alphabetic field.



NOTE: When USASCII Code is used the following three keys are changed:
key 4,] /R; key 5, \/T; key 17, [/B.

Figure 545-9. Keys with Identification Numbers and Controls (EL Arrangement)

31. Alpha (Alphabetic Shift). This key shifts the combination keyboard into alphabetic shift or mode as long as it is held down. It is normally used to punch letters in an otherwise numeric field. When duplication is being performed in numeric shift, pressing this key permits automatic spacing over blank columns.

32. Dup (Duplicate). When a manual field contains identical information for two or more cards, this field can be duplicated at 20 (Model 3) or 18 (Model 4) columns per second on the cards that follow. With the machine under program control, pressing the Dup key once initiates the operation. Duplication continues until the end of field definition.

Without program control, duplication occurs at the rate of 10 (Model 3) or 9 (Model 4) columns per second and occurs only as long as the Dup key is held down. This allows the operator precise column control in a card correction or make-over application.

Encountering a space during duplication of numeric fields locks the keyboard. The Error Reset key unlocks the keyboard and permits keying of the space, substitute data, or release. The Alpha shift key can also be used to get over the space without pressing the Error Reset key.

34. Rel (Release). This key is used to advance the card in the read or punch station through column 80. If the machine is under program control and the release operation encounters an auto-dup field, the auto-dup information is punched before the release operation can continue. Thus, when a card is released because of a keying error (Rel key inadvertently pressed), the common information is not lost.

Multiple release and register cycles are not required to clear the card transport area of cards. Use the Clear switch for this operation.

35. Feed (Card Feed). The Feed key, if held down, moves two cards from the hopper into the punch station and preregister station. It is inoperative when a card is already registered at the punch station.

36. Skip. A skip can be initiated manually by pressing the Skip key. Skipping occurs at 80 columns per second and continues to the end of field definition under program control; in the absence of field definition, each key operation results in a single space.

37. Reg (Card Register). When a single card is fed from the hopper, or when a card is manually inserted at either the punch or read station, operating the Reg key locates the card in the proper position for reading or punching column 1. This key does not cause an additional card to be fed from the hopper.

38. Aux Dup (Auxiliary Duplicate). This is a 545 Output Punch special feature that is not operative when the 545 is attached to the 2772 Multi-Purpose Control Unit.

39. Prog Two (Program Two). With the 545 under program control, card format may be changed by pressing the Prog Two key to place the operation under the control of program-level two. The shift between program-levels one and two can be made any number of times during the punching of a card.

If the Auto Feed switch is off and Prog Two (or Prog One) is pressed at the end of a completed card, a feed cycle is initiated and the next card registered at the punch station will be controlled by program-level two (or one), regardless of the setting of the Prog Sel (program selection) switch.

In a one-program application, if the second level is not punched in the program card, pressing the Prog Two key suspends programming. This makes it unnecessary to lift the starwheels for program suspension.

44. Mult Pch (Multiple Punch). Pressing and holding this key places the keyboard in numeric shift and suppresses spacing, allowing any desired individual code (any combination of holes) to be keyed and punched in a column.

45. Prog One (Program One). Pressing this key causes the machine program control to transfer immediately to program-level one, assuming it had been in program-level two. (This key's function is similar to that of Prog Two. See key 39.)

46. Error Reset. Pressing this key unlocks an interlocked keyboard. (The Backspace key does not have to be used for this purpose.)

Backspace Key

Operating the Backspace key, located on the punch between the punch and read stations, causes the card to backspace, column-by-column, until the key is released. A punch interrupt will occur if this key is operated while in autopunch mode.

Column Indicator

The column indicator, at the base of the program drum holder (see Figure 545-7), indicates the next column to be punched. Use this indicator as a guide for spacing or backspacing to a particular column.

Pressure-Roll Release Lever

The pressure-roll release lever is next to the column indicator (see Figure 545-7). This lever is accessible by raising the center cover over the program unit. Pressing this lever permits manual removal of a card from the punching or reading station. Normally, a card can be removed in one piece if it is pulled out with care. If torn pieces are caught at either station, push them out with another card or a smooth-edge metal blade while holding down the pressure-roll release lever. Do not use saw-edge metal blades.

Chip Box and Fuses

The chip box is under the desk top below the keyboard. When the chip box is removed, the fuses for the machine are accessible. The chip box should be emptied daily.

INDICATOR LIGHTS

The following indicator lights are located directly above the keyboard (see Figures 545-8 and 9).

Auto Light

This white indicator light, when on, indicates power is being supplied to the 545 and that the Autopunch/Keypunch switch is set to the AUTO PCH (autopunch) position. This light is always off during keypunch-mode operation.

Check Light

This red indicator light is operative in autopunch mode only, and turns on when any of the following conditions are sensed:

a. Full stacker;
b. Card jam, or card levers not closed at the punch, read, and stacker stations;

c. Program control lever in OFF position (starwheels raised off program card);
d. Hopper empty or cards fail to feed.

The Check light also lights momentarily when a card is fed during autopunch-mode operation. The Check light is always off during keypunch-mode operation.

SWITCHES

The following switches (except the Main Line switch) are located directly above the keyboard (see Figure 545-8 and 9).

Main Line Switch

The 545 Main Line switch (located on the front right side of the cabinet beneath the keyboard) supplies power to the 545 Output Punch only (provided 2770 system power is turned on). This switch must be on to operate in either mode (autopunch or keypunch).

Auto Pch/Key Pch Switch

The setting of this switch selects the mode of operation of the 545 Output Punch. When set to the AUTO PCH (autopunch) position, it permits the use of the 545 as an output punch under the control of the 2770 system. When set to the KEY PCH (keypunch) position, it permits the 545 to be used as a normal keypunch. This switch must be set to the AUTO PCH position when the 545 is operating with the system.

Auto Feed Switch

The Auto Feed switch is used only during keypunch-mode operation. In the ON position, the switch causes an automatic card-feed cycle to occur following the punching or skipping of column 80 in the card. During autopunch-mode operation, the Auto Feed switch is bypassed and the 545 will always perform a card feed automatically regardless of the position of this switch.

Auto Skip-Dup Switch

When the Auto Skip-Dup (automatic skip-automatic duplicate) switch is on, the appropriate punches (11 or 0) in the program card initiate the skipping and duplicating functions automatically. The setting of this switch has no effect during autopunch-mode operation.

Prog Sel Switch

The Prog Sel (program select) switch has two positions, ONE and TWO, and selects the beginning program level for each card--that is, either program-level one or program-level two is the program in effect in column 1 of each card. During autopunch-mode operation, the setting of this switch has no effect if the program card is punched properly.

Print Switch (Model 4 Only)

When ON, this switch activates the printing mechanism. When off, all printing is suppressed.

LZ (Left Zero) Print Switch (Model 4 Only)

The setting of this switch has no effect unless the Print switch is ON. When LZ Print is ON, zeros are printed to the left of the first significant digit in a defined numeric field. When OFF, left-zeros are not printed. During autopunch-mode operation, the LZ Print switch must be ON whenever the Print switch is ON.

Clear Switch

The Clear Switch (a spring-loaded, self-restoring switch) is used to clear all cards from the feed bed, without feeding additional cards from the hopper. One or two operations of this switch initiate the multiple cycles necessary to complete the operation. This switch should not be operated in autopunch mode.

OPERATOR PROCEDURES

Initial Preparation of 545 Prior to Punching (Autopunch Mode)

The following procedure is used to make the 545 ready for use in autopunch mode.

1. Turn 545 Main Line switch ON.
2. Place blank cards in hopper.
3. Set Auto Pch/Key Pch switch to KEY PCH position.
4. Punch 12's and 4's (upper case 'D') in columns 2 through 80 of a program card and insert card and drum (see "Program Drum").
5. Lower starwheels on program card.

The setting of the Prog Sel switch has no effect if the program card is punched properly.

The setting of the Auto-Dup switch has no effect when operating in autopunch mode.

The Output Device light on the 2772 console will blink if the 545 punch is selected by the setting of the 2772's Job Select switch.

6. Feed three cards by pressing the Feed key twice and then the Release key once. This places one card at the read station, one card at the punch station, and one card in the preregister position.

7. Set Auto Pch/Key Pch switch to the AUTO PCH position. This causes the Auto light on the keyboard to turn on, and, if the Job Select switch on the 2772 is set to use the 545 punch, causes the Output Device light on the 2772 to remain on constantly (not blinking).

The 545 punch is now ready to punch and feed cards under the control of the Control Unit of the 2770 system.

NOTE: No attempt should be made to operate any keys, switches, or levers while the 545 is operating in autopunch mode.

Job-End Procedure (Autopunch Mode)

The first card in the stacker is not part of the punched data, since it was at the read (master) station when the job was started (initial run-in of cards). For each job, therefore, the first card in the stacker must be discarded.

At the completion of the punching operation, the last card punched with data will be in the stacker and blank cards will be at all other stations.

Program Card Punching (Keypunch Mode)

NOTE: Field-definition punching is used with autopunch-mode as well as keypunch-mode operation; all other program-card punching applies only to keypunch-mode operation.

A program card, which is a basic part of the program unit, is prepared for each punching application and can be used repeatedly. Proper punching in the program card controls the automatic operations for the corresponding columns of the cards being punched. Each row in the program card governs a specific function. (See "Program Card Preparation.")

Figure 545-10 shows a typical program card using program one. For program two, the identical hole pattern would appear in card rows 4-9. For example, all the 12-punches would be 4-punches, all the 1-punches would be 7-punches, etc.

Figure 545-11 shows the program codes.

Field Definition (12,4)

The 12-punch is the field-definition punch for program one; the 4-punch is the field-definition punch for program two. A field-definition punch for the program level being used must appear in every column except the first (left-hand position) of every field to be automatically skipped, duplicated, or manually punched. Column one of the program card should never contain a field definition punch.

For autopunch-mode operation, 12's and 4's are punched in columns 2 through 80 of the program card, to allow a card release to occur at high speed.

The field-definition punch causes any skip or duplication operation started within a defined field to continue to the end of that field. Several consecutive fields to be automatically skipped or duplicated can be programmed as a single field. A single-column field should not be programmed with a field-definition punch.

Field-definition punches in the program card for manually punched fields permit occasional skipping or duplicating of such fields. Pressing the Skip or Dup keyboard-control key starts this skipping or duplicating.

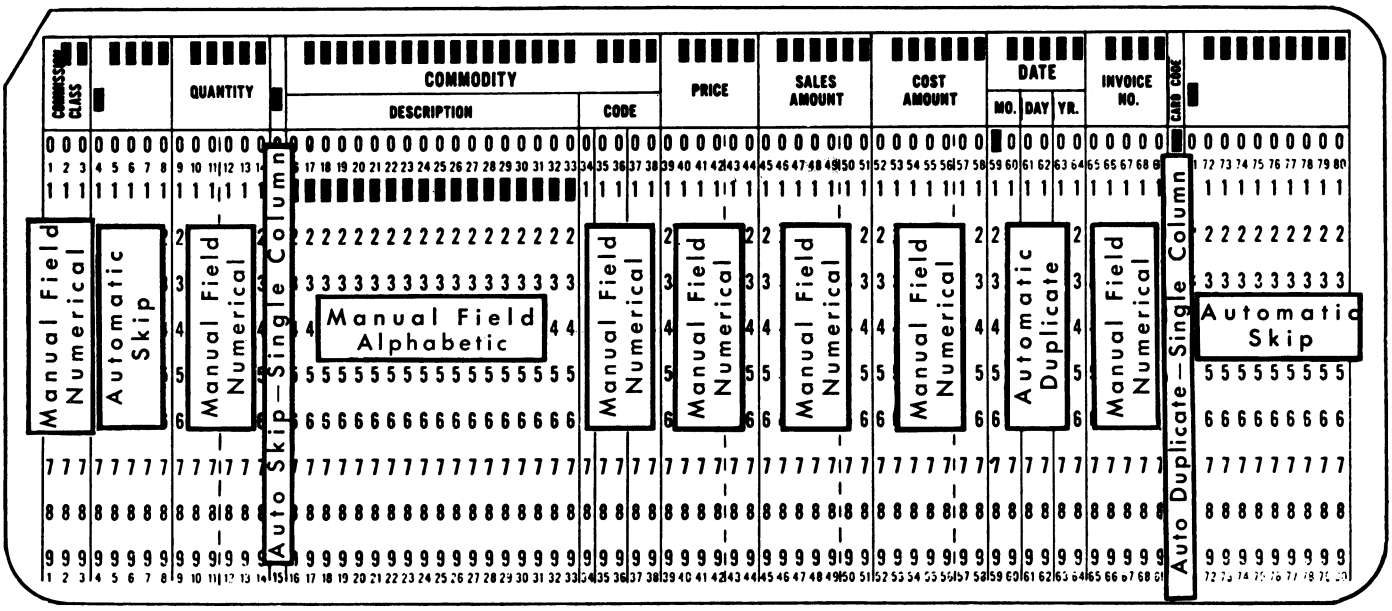


Figure 545-10. Program Card--Program-Level One (Keypunch Mode Only)

Program One	Function	Where Punched	Program Two
12	Field Definition	Each column of field, except first	4
11	Start Auto-Skip	First column of field only	5
0	Start Auto-Dup	First column of field only	6
1	Alphabetic Shift (Keypunch Mode Only)	Every column of alpha field	7

Figure 545-11. Program Codes (Keypunch Mode Only, except Field Definition)

Automatic Skip (11,5)

The start-automatic-skip code for program one is the 11-punch; the start-automatic-skip code for program two is the 5-punch. In either program level, the start-automatic-skip code punched in the first column of the field to be skipped starts an automatic skip, which continues to the end of the field defined by the field-definition punches.

This operation is also under control of the Auto Skip/Dup switch on the keyboard. If this switch is off, the program-card codes for start-automatic-skip are not effective.

Automatic Duplication (0,6)

The start-automatic-duplication code for program one is the 0-punch; the start-automatic-duplication code for program two is the 6-punch. In either program level, the start-automatic-duplication code in the first column of the field to be duplicated starts automatic duplication, which continues to the end of the field defined by the field-definition punches.

This operation is also under control of the Auto Skip/Dup switch on the keyboard. If the switch is off, the program-card codes for start-automatic-duplication are not effective.

Alphabetic Shift (1,7)

The alphabetic-shift code for program one is the 1-punch; the alphabetic-shift code for program two is the 7-punch. Lowering the program sensing mechanism to place the 545 under program control sets the keyboard in the numeric shift or mode. Therefore, to punch any alphabetic characters (or special characters that are part of the alphabetic shift), the keyboard function must be shifted to the alphabetic mode. The shifting is accomplished by an alphabetic-shift code punched in the program card. Each column of the card to be punched alphabetic requires an alphabetic-shift code in the corresponding program-card column. Field definition does not extend alphabetic shift.

Program Drum

The program drum (Figure 545-12) is the part of the program unit that holds the program card. The program drum can be removed by the operator so that the program card can be inserted to set up the program operation for a specific application.

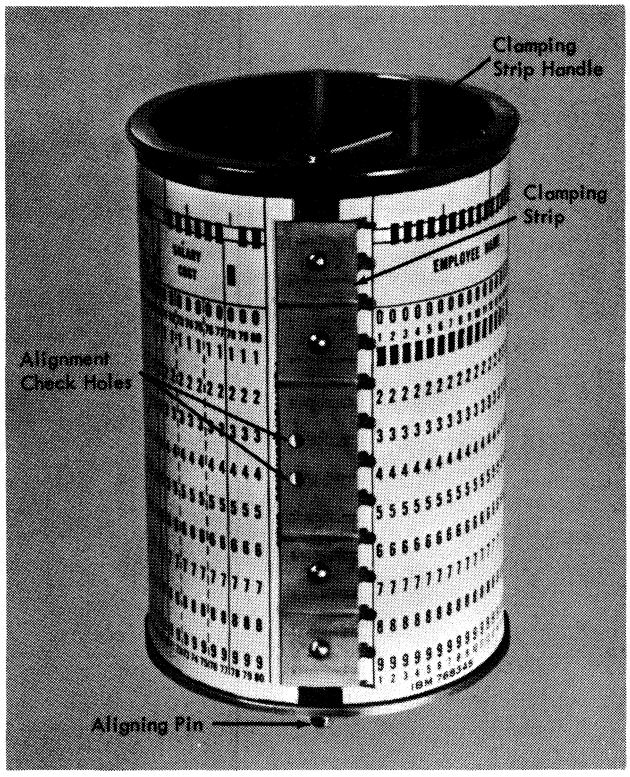


Figure 545-12. Program Drum

Drum Removal

1. Raise the sensing mechanism by turning the program control lever to the right or off position (see Figure 545-7).
2. Remove the program drum by gently pulling it up and toward the rear, in a parallel direction to the sensing mechanism, off the mounting shaft. The program card can then be removed from the drum.

Card Removal

1. Turn the clamping-strip handle on the drum counter-clockwise to the center position, and remove the

column-1 end of the card from beneath the toothed clamping strip (see Figure 545-12).
2. Then turn the handle past the center position fully counterclockwise, and remove the column-80 end of the card from beneath the smooth edge of the strip.

Card Insertion

1. With the clamping-strip handle turned fully counterclockwise, insert the column-80 end of the card under the smooth edge of the clamping strip (see Figure 545-12). Two alignment check holes in the clamping strip make it possible to see that the card is flush with the metal edge under the strip. The card should be positioned so that the 9-edge of the card is against the lower rim of the drum.
2. Turn the handle to the center position. This tightens the smooth edge of the clamping strip and loosens the toothed edge.
3. Wrap the card tightly around the drum and insert the column-1 edge under the toothed edge of the clamping strip.
4. Turn the handle clockwise as far as it will go. This fastens the toothed edge of the clamping strip. The drum is ready to be inserted in the machine.

Drum Insertion

1. With the program sensing mechanism raised, place the drum on the mounting shaft of the program unit, positioned so that the aligning pin falls in the aligning hole in the column-indicator dial (see Figure 545-7).
2. Turn the program control lever to the left (the ON position) to lower the sensing mechanism to the program card. Press the Release key.

CAUTION
Never insert an empty program drum in the program unit, and never lower the sensing mechanism when the program drum is not in place.

Program Card Preparation

When a program card is to be prepared for a particular punching application, the card design should be carefully analyzed to code the program card for maximum punching efficiency. Proper use of the various features of the 545 punch reduces operator time and effort to a minimum. Greater programming flexibility is gained by using both program levels.

The following explanations include the codes for both program levels; in each instance, the program-one code is followed by the program-two code in parentheses. (Refer also to Figure 545-11.)

Programming

To prepare a program card, the following analysis must be made of the job cards to be punched:

1. Field-definition coding, which determines the length of each field. Punch a field-definition 12(4) punch in each column except the first (left-hand) of every field regardless of the type of operation to be performed in that field. The 12(4) punches are used in skipped or duplicated fields to continue the skip or duplication across the field, once the operation is started. Field-definition punches are also useful in fields programmed for manual punching, to make full use of the feature provided for the correction of errors made while punching. With all field lengths defined, each correct field can be duplicated by a single operation of the Dup key, and only the field containing the error must be rekeyed.
2. Automatic skipping for each field that is not to be punched at this time. If several successive fields are to be skipped on every card, program them as one large field. Punch an 11(5) in the first column, and 12(4) punches in all the other columns of the field to be skipped.
3. Automatic duplication of each field that is punched with the same data for a group of cards. If several successive fields are to be duplicated on every card, program them as one large field. Punch a 0(6) in the first column, and 12(4) punches in all the other columns of the field to be duplicated.
4. Alphabetic coding to shift the keyboard when letters or other alphabetic shift characters are to be keyed. If all or most of a field are to be punched, code the program card with 1(7) punches in each column of the field, and use the Numeric shift key for occasional numeric punching. In the duplication of alphabetic punching, the 1(7) punches permit duplication of blank columns.

Program Two used for Alternate Programming

When alternate programs are necessary to handle two types of cards in one punching job, the second type must be similarly analyzed so that the alternate program with the proper codes (4-9) can be punched. Consideration must be given to the time within the card cycle that the change to the alternate program is to be made. The change can be made either at the beginning of the card or at any time within the card cycle when it is desirable for the alternate coding to become effective. Once the alternate program is selected, by pressing the Prog Two selection key, the alternate program codes are read for the remainder of the card, or until the other program-selection key (Prog One) is pressed to return to the original program. Programs can be alternated at will in

this manner during punching of a card. However, when the following card is fed, the normal program coding, determined by the Prog Sel switch setting, becomes effective.

If the first field of a card is to be controlled by the alternate program, the Auto Feed switch should be turned off before the preceding card reaches column 80. This suppresses the feed cycle and allows the operator to select the alternate program by pressing the Prog Two key. Pressing the Prog Two key also causes a feed cycle, and the new card is registered in the punch station.

Multiple Functions

When alternate program functions are used in addition to the basic program functions, the program card may require several codes in a column (Figure 545-13). The multiple codes can be punched in each column by using the Mult Pch (Multiple Punch) key (see Mult Pch under Functional Keys). An alternate method is to punch a master deck of cards for the preparation of the program card. This deck consists of a maximum of 12 cards, one for each punching row: one card punched with all the required 12-codes, a second card with all the required 11-codes, a third card with all the required 0-codes, etc.

Using the program card shown in Figure 545-13 as an example of the program card to be created, the master deck card containing the 12 punches would be punched in columns 2-9, 11-27, 31, 33-35, 37, 39, 40, 42, 44-46, 48, 50-52, 54, 55, 57, 58, and 60-80. The card containing the 11 punches would be punched in column 59. The card containing the one punches would be punched in columns 10-27. Punch cards in a similar manner for the 4's, 5's, 6's, 7's, 8's, and 9's. After the cards of the master deck are punched, duplicate each card, one at a time, into a single card, which then becomes the program card. This method of preparing a program card facilitates the preparation of slightly changed or duplicate program cards on the 545.

Program Planning Card Form

A card form, usable as an aid in the preparation of program cards, is available on the reverse side of the installation supply form, *Card Punching or Verifying Instructions,* Form X24-6299.

Inserting Cards Manually

In certain instances it is desirable to insert cards manually, one at a time, as in the case of making over a damaged card or correcting an error found while verifying. Also, when an individual card accompanies each original document, manual insertion is necessary. A card can be manually inserted in the card bed to the right of either the punch station or the read station. No card need be inserted in the hopper.

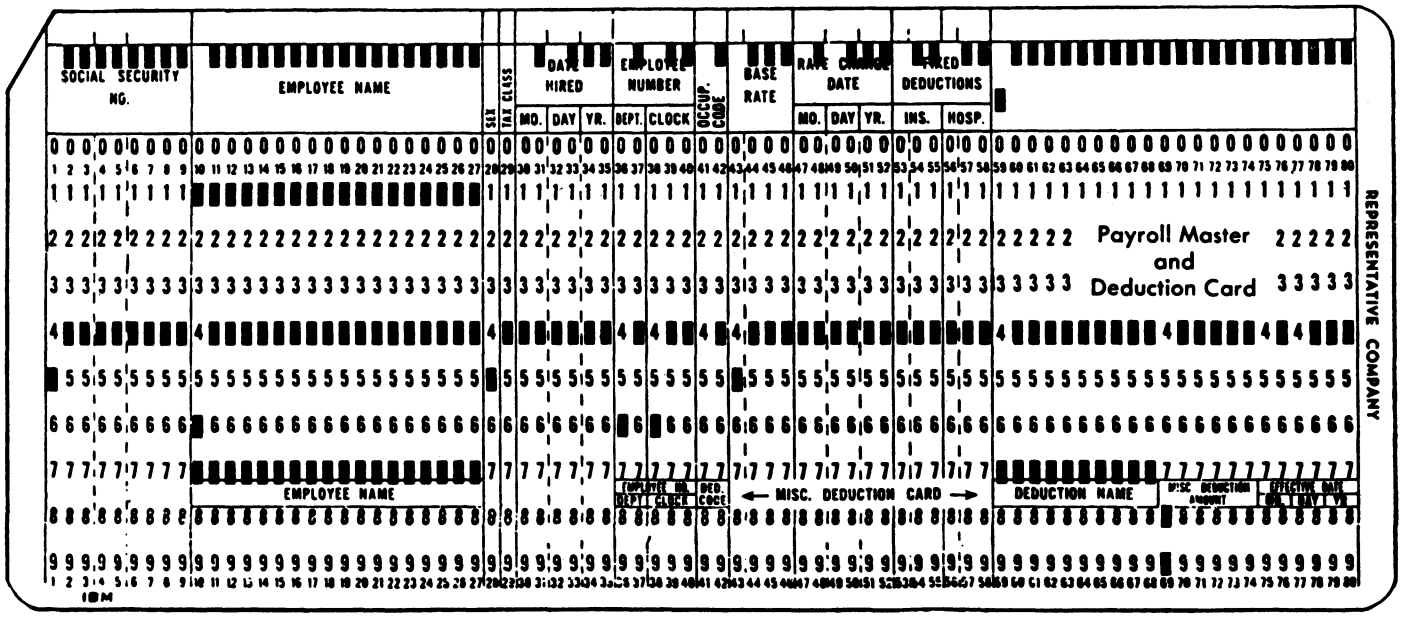


Figure 545-13. Program Card--Multiple Functions

CAUTION

Improper manual registration of a card at the read station may cause dropping of punches during an auto-duplication or key-duplication operation. Therefore, when manually inserting a card at the read station, do not push the card in all the way to the stop. Insert the card about one inch beyond the pressure roll so that, when the Reg key is operated, the card will be machine registered by the pressure roll.

In the example shown in Figure 545-14, cards prepunched with part code are to be punched and printed with part name, which is written on an accompanying ticket. Program control is on; and columns 1-25 are programmed as a manual alphabetic field, and columns 26-80 are skipped automatically.

Procedure for Inserting Cards Manually

1. Set the keyboard Auto Skip/Dup and Print switches ON, the Auto Feed switch off, the Prog Sel switch to the appropriate program level, and the Auto Pch/Key Pch switch to KEY PCH.
2. Place a card in the card bed at the right of the punch station, and press the Reg key.
3. Punch part name starting in column 1 (press the Numeric shift key when necessary). After punching the part name, the card automatically skips out through column 80.
4. Insert the next card in the card bed at the right of the punch station and press the Reg key. This registers the first card at the read station and the new card at the punch station. After the second card is punched, insert the third card in the punch station. The first card at the left of the read station moves into the stacker when the third card is registered.

Correcting Keypunching Errors

Errors in punching are often noticed and corrected by the operator at the time they are made. Usually this involves rekeying a large portion of the card. The 545 Output Punch reduces rekeying to a minimum, requires no concern about the precise column in which the error occurred, minimizes the possibility of making another error while correcting the first, and practically eliminates card handling.

Procedure for Correcting Keypunching Errors

As an example, to correct an error in the order-number field of the labor distribution card (Figure 545-15):

1. Press the Release key immediately upon detecting the error. This advances the card without punching the fields coded for manual punching, but allows duplication of the fields programmed for automatic duplication beyond the point of release. Therefore, columns 34 and 35 are duplicated into the error card as it is being released. This retains the common information for duplication into the following cards. The three

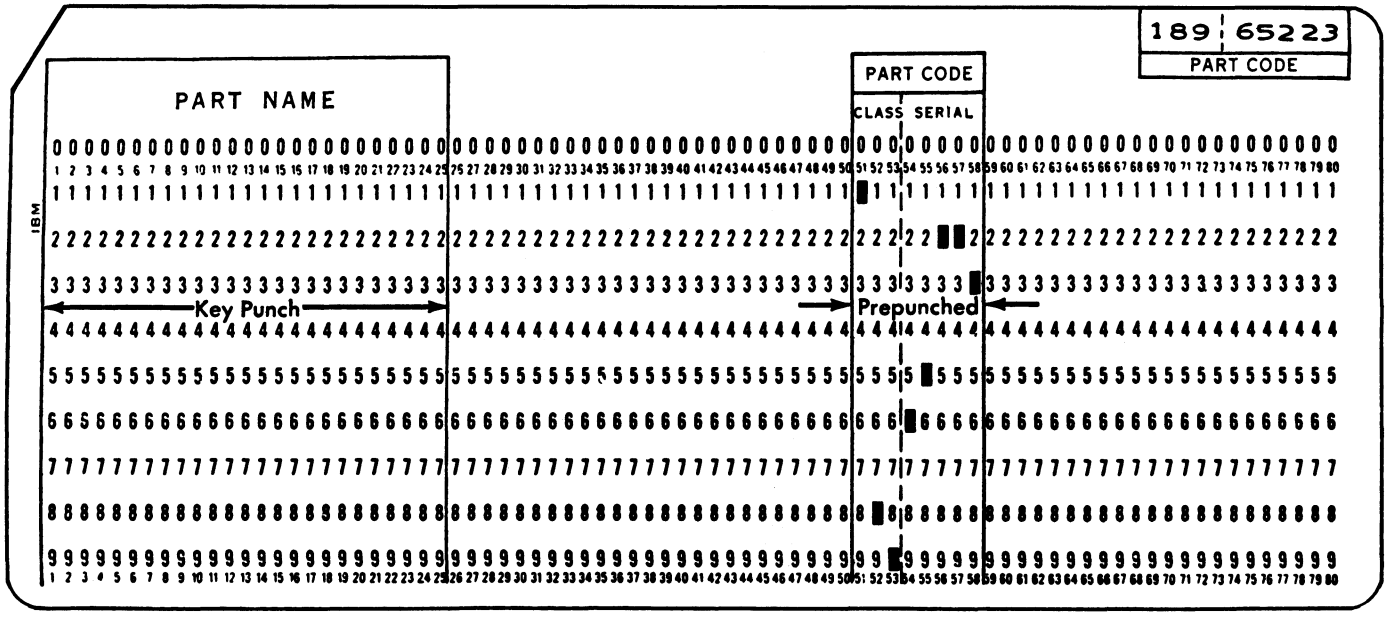


Figure 545-14. Inserting Cards Manually

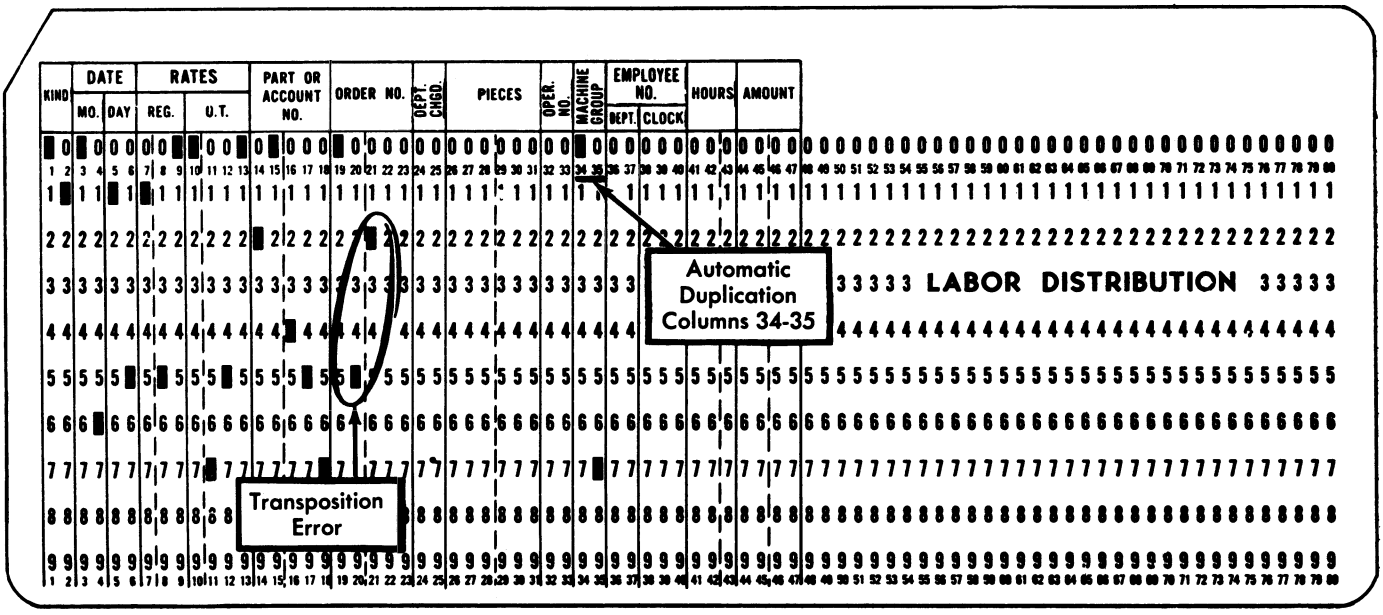


Figure 545-15. Error Correction

cards in the card bed advance to their proper stations and a new card is fed from the hopper.

2. Duplicate the "kind" field by pressing the Dup key once. (Columns 3-6 are programmed to duplicate automatically.)
3. Press the Dup key at the beginning of each field to manually duplicate the "regular rate", "overtime rate', and "part or account number" fields. Duplication stops at the end of the "part or account number" field.
4. Rekey the "order number" field, and manually punch the remaining fields programmed for manual punching ("machine group" is automatically duplicated). Then columns 48-80 are automatically skipped.
5. Remove the error card from the stacker.

NOTE: A different procedure must be used for correcting keypunching errors in partially prepunched cards. See "Correcting Partially Prepunched Cards" following.

Partially Prepunched Detail Cards

Partially prepunched detail cards may contain prepunched names or codes, or they may be serially numbered and punched. When an error is made in punching cards of this type and the correction is to be made immediately, automatic feeding from the hopper must be interrupted and a blank card must be inserted manually in the card bed. Because each card that feeds from the hopper contains some prepunched data, it is not possible to duplicate into the following card as outlined in "Correcting Keypunching Errors."

Correcting Partially Prepunched Cards

The commodity card in Figure 545-16 illustrates a partially prepunched card for which the punching is to be completed. The "commission class", "commodity description", "commodity code", and "price" fields are prepunched; the remainder of the card is to be punched. The "commodity code and description" fields are interpreted for pulling from a file. If an error is made in the keying of column 14 ("salesman" field):

1. Operate the Clear switch once. This advances the card in the read station, the error card in the punch station, and the card following in the preregister position until they are stacked in the stacker. The data in columns 70-75 is not duplicated as in a release-key release operation. Feeding does not take place, and the card bed is clear.
2. Remove the bottom card from the stacker and hold aside.
3. Again, remove the bottom card from the stacker; this is the error card.
4. Manually insert the error card to the right of the read station.
5. Manually insert a blank card to the right of the punch station.
6. Turn off the Auto Feed switch to prevent automatic feed cycles (which are undesirable while manually inserting cards).

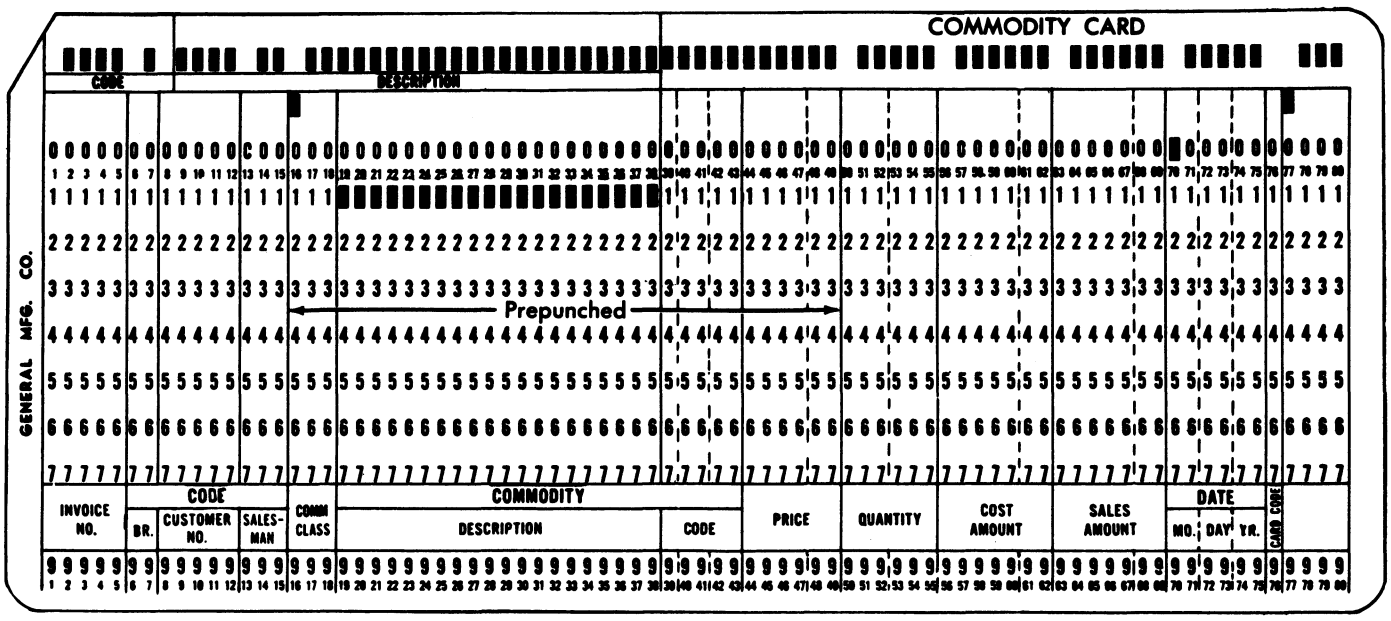


Figure 545-16. Error Correction--Partially Prepunched Cards

7. Turn off the Auto Skip/Dup switch to prevent automatic skipping during the correction of the error card. The prepunched fields are programmed for automatic skipping, but, when correcting an error, these fields must be manually duplicated into the blank card.
8. Press the Reg key to register the error card at the read station and the blank card at the punch station.
9. Press the Dup key at the beginning of each field to manually duplicate the "invoice number", "branch", and "customer number" fields, which were punched correctly.
10. Rekey the "salesman" field.
11. Press the Dup key in column 16 to manually duplicate the "commission class", "commodity description", "commodity code", and "price" fields. These fields are programmed as one field for automatic skipping in the regular punching operation. The "commodity description" field is coded with 1's in the program card to permit automatic spacing over blank columns during the correction of errors made in the punching operation.
12. Turn on the Auto Skip/Dup switch for preparation for automatic duplication of "date" field and automatic skipping of the last four columns.
13. Manually punch the remaining fields programmed for manual punching. The "date" field is duplicated automatically and columns 77-80 are skipped automatically.
14. Replace, in the right of the card bed (punch station), the card removed and held aside in step 2.
15. Turn on the Auto Feed Switch.
16. Press the Feed key to register the card replaced in step 14 at the punch station, and to feed the next card from the hopper to the preregister position. This operation will also result in moving the error card, again, to the stacker, where it will now be the bottom card. The repunched (corrected) card is also in its proper sequence in the card deck.
17. Remove the error card from the stacker for disposal, and continue the operation interrupted by the error.

Prepunched Master Cards

In some applications, duplicating certain fields from prepunched master cards is a useful operation. In such an operation, each master card must be inserted manually before duplicating the first card of the group. Master cards should be inserted in the card bed at the right of the read station.

Inserting Prepunched Master Cards

1. Turn off the Auto Feed switch before completing the punching of the last card of a group.
2. Manually slide the last card, after it is released from the punch station, to the left into the read station.
3. Press the Release key, while maintaining a slight leftward pressure on the card in the read station, to advance that card past the read station.

4. Place the prepunched master card in the read-station card bed. Do not push the card in all the way to the stop. Insert the card beneath and about one inch beyond the registering pressure roll so that the card can be machine-registered by the pressure roll during the next card feed cycle.
5. Press the Feed key to register the master card and the detail card that is at the right in the punch card bed, and to feed a new card from the hopper.
6. Turn on the Auto Feed switch. Normal punching of the first card of the new group can then proceed, with automatic feeding of the following detail cards.
7. Remove the master card, if it is not to be stacked with the detail cards, immediately after completion of the punching of the first detail card.

This type of operation normally precludes the possibility of automatic duplication of any common information (such as date) from one group of cards to the next, because the continuity of such duplication is interrupted by insertion of the prepunched master cards. Consequently, when common punching is required, the information must be manually punched in the first card of each new group.

Ribbon Replacement (Model 4 Only)

The ribbon on the IBM 545 Output Punch Model 4 is fed between two spools, through ribbon guides, and under the punch die (Figure 545-17). The old ribbon is removed and a new one is inserted as follows:

1. Turn off the Main Line switch.
2. Remove the ribbon-spool retaining clamp.
3. Cut or break the old ribbon.
4. Remove both spools from their spindles and pull out the two pieces of ribbon. Empty one of the spools.
5. Place the spool of the new ribbon on the right-hand spindle, positioning it so that the ribbon is fed from the top of the spool toward the front of the machine. Lift the right end of the ribbon-reversing arm, if it is not already up, and unroll 1-1/2 feet of ribbon; then push down the right end of the ribbon-reversing arm to hold the spool steady.
6. Feed the metal leading end of the ribbon between the punch die and the card bed, sliding it through the groove in the center of the card bed (between the 3-punch and 4-punch positions). The groove permits the extra thickness of the metal end and the reversing eyelet to pass between the punch die and the card bed. Be sure to keep the ribbon straight, with the top side up at all times.
7. Hook the metal leading end of the ribbon in the slot in the center of the empty spool and wind the ribbon onto the spool until the reversing eyelet is on the spool.

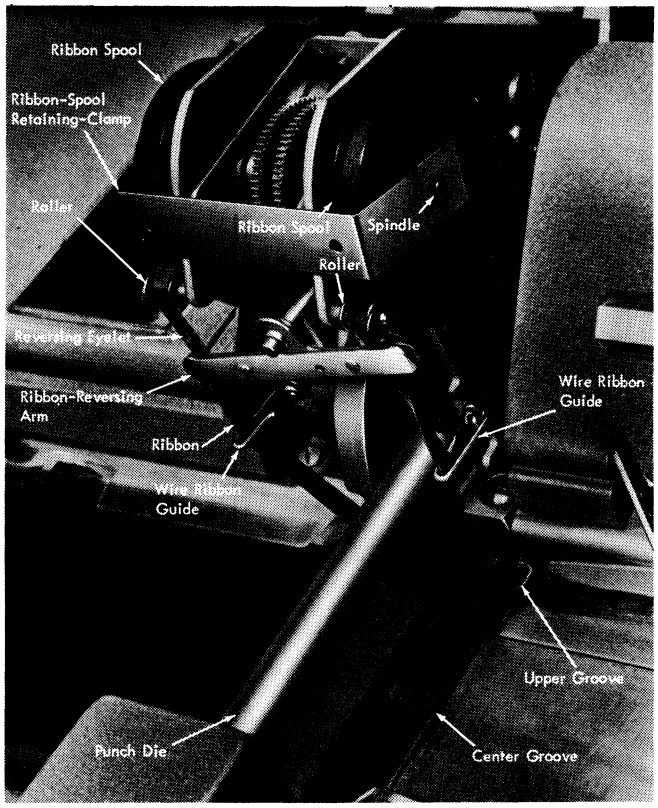


Figure 545-17. Ribbon Replacement

8. Place the spool on the left spindle, positioning it so that the ribbon is fed onto the spool over the top. Be sure that the ribbon is not twisted and that the top side of the ribbon is still up.
9. Hook the ribbon around the right and left wire ribbon guides, and slide it through the right and left ends of the reversing arm and over the rollers in front of the ribbon spools.
10. Slide the ribbon up under the punch die so that it is in the upper groove provided for it in card-printing position (above the 12-punch position), and take up the slack.
11. Replace the ribbon-spool retaining clamp.

ERROR RECOVERY PROCEDURES

Figure 545-18 gives the recovery procedures used when trouble is encountered during preparation of the 545 for autopunch operation.

If the 545 becomes interlocked during system operation because of operator intervention (raising star wheels, switching Auto Pch/Key Pch switch, etc.), the job must be restarted from the beginning, or from some recognizable intermediate point. If operating in line mode, this intermediate point must

INDICATION		ERROR CONDITION	RECOVERY PROCEDURE
545	2772		
Check Light	Output Device Light Blinking	Star Wheels Raised, Cards not properly Positioned at master, punch, and preregister stations, or 545 Start procedure not followed.	Perform start procedure outlined in 'Initial Preparation of 545 Prior to Punching' under 'Operator Procedures (Auto-punch Mode)'.
None	Output Device Light Blinking	545 Interlock because of: Main Line switch off, Auto Pch/Key Pch switch in KEY PCH Position 545 start procedure not followed.	Same as above.

Figure 545-18. Error Recovery Procedure (Initial Run-In of Cards)

be established by agreement with the remote station operator. When restarting from one of these interlock conditions use the procedures outlined in "Initial Preparation of 545 Prior to Punching" under "Operator Procedures (Autopunch Mode)".

Most other errors (full stacker, empty hopper, etc.) can be recovered at the point of error by: (1) carefully observing the condition of the 545 card feed path, and (2) comparing the conditions found with those listed under Error Condition in Figure 545-19, and (3) following the associated recovery procedure. The single exception to this is a punch station jam (card fails to complete its travel through the punch station) in which the leading edge of the jammed card has passed the midpoint of the master station bed-plate (this midpoint is identified by the slot used for manual insertion of master cards). Jams of this type cannot be recovered at the point of error without risk of lost data; therefore, the job must be restarted at the beginning or at some recognizable intermediate point. Punch station jams in which the leading edge of the jammed card has not reached this midpoint can be recovered at the point of error (see Figure 545-19).

Damaged cards containing good data can be repunched on the 545 with the Autopunch-Keypunch switch in KEY PCH position. To inhibit automatic skipping and duplicating under control of the program control unit, the Auto Skip Dup switch must be turned off. To permit use of all keys on the keyboard, the program control unit star wheels must be raised.

INDICATION		ERROR CONDITION	RECOVERY PROCEDURE
545	2772		
Check Light	Output Device Light Blinking Audible Alarm (Line - Mode only)	Card jam at the master station: card failed to complete its travel through the master station. Card jam at the punch station: card failed to complete its travel through the punch station and the leading edge of the jammed card has not passed the manual insertion notch in the master station. Stacker full: cards at the eject station, the master station (but not registered at the master station), at the preregister station, and the stacker is full.	1. Set Autopunch-Keypunch switch to KEY PUNCH position. 2. Remove cards from stacker. 3. Remove card (if any) from eject station, and add to the bottom of cards removed from stacker. 4. Remove card (if any) which is in, jammed in, or registered at the master station and add to those from the stacker; if a card at the master station can be easily moved from side to side it is not registered and should not be removed. Do not include any card which has fed under the card at the master station. 5. Starting from the bottom, search through the cards from the stacker (including any removed from the feed path) for the first card having a column 81 punch. All cards punched after this card will be repunched; therefore, discard all cards punched following the card containing the column 81 punch. 6. Clear the feed path of any punched cards remaining. 7. Cycle cards into the master, the punch, and the pre-register stations as required. 8. Set Autopunch-Keypunch switch to AUTO PCH. 9. Press Check Reset key (on 2772). 10. Press Start Key (on 2772); punching resumes. NOTE: The first card entering the stacker will be blank and should be removed.
		Stacker jam: card jammed in stacker. Stacker timing problem: card positions are normal but Check light is on. Failure to feed from hopper, or hopper empty: no card registered at punch station, or no cards at either the punch or the preregister stations.	1. Set Autopunch-Keypunch switch to KEY PUNCH position. 2. Remove cards from stacker, including any card jammed in the stacker. 3. Starting from the bottom, search through the cards from the stacker for the first card having a column 81 punch. All cards punched after this card will be repunched; therefore, discard all cards punched following the card containing the column 81 punch. 4. Clear the feed path of any punched cards remaining. 5. Cycle cards into the master, the punch, and the pre-register stations as required. 6. Set Autopunch-Keypunch switch to AUTO PCH. 7. Press Check Reset key (on 2772). 8. Press Start key (on 2772); punching resumes. NOTE: The first card entering the stacker will be blank and should be removed.

Figure 545-19. Error Recovery Procedure (545 Interlocked)

A. Input Card Specifications

The following corner cuts can be used: C1, C2, or C3.

The following scores are acceptable:

External: M-5, M-7, CF-4, and CF-11 on the high-numbered column end of the card; M-3, M-4, M-5, M-6, M-7, OM-2, OM-3, CF-4, and CF-11 on the column-1 end.

Other scores may be acceptable; if in doubt, contact your IBM Representative or the IBM Branch Office serving your locality.

Edge-coated and heavy duty cards can be used; however, some degradation in performance can be expected.

B. Output Card Specifications

Cards with lower corner cuts (except lower-left corner cut C3, 30-degree, 0.130-inch base measurement) cannot be used. For registration and spacing, the card is gripped along its lower edge by two serrated wheels. Lack of the two lower corners creates registration inaccuracies. Round corner cut cards are acceptable.

Cards containing an internal score (perforation) cannot be used unless the scored columns are skipped or spaced over. Data cannot be punched into scored columns of the card.

IBM 2502 Card Reader

IBM 545 Output Punch

Model 1

Model 2

IBM 1017 Paper Tape Reader

Introduction

The IBM 1017 Paper Tape Reader used with the IBM 2770 system is an incremental input device that reads paper or Mylar* tape at speeds up to 120 characters per second. The 1017 is available in two models: the Model 1--Reader (Frontispiece) for reading strip tape only, and the Model 2--Reader and Reeler for reading both strip tape and reeled tape. The 1017 can read any standard 8-track EBCDIC or USASCII coded tape (code dependent on the 2770 system's code capability). The tape must contain feed holes, and must be of the chad-type (all holes fully punched). The Model 2 can also wind reeled tape in either direction.

The 1017 can also read non-EBCDIC coded 5-, 6-, 7-, or 8-track tape in the transparent mode when the 2772 Control Unit's EBCDIC Transparency special feature is installed (see "Operating Characteristics--Transparency").

Functions

READING

Tape reading is done by eight sensing contacts, one for each tape track. A tape-feed sprocket wheel feeds tape past the read station from right to left, for reading. The 1017 reads characters parallel-by-bit and sends them without any form of translation to the 2772 Control Unit's buffer. The 2772 Control Unit controls tape speed on a character-by-character basis at a rate of up to 120 characters per second.

To detect the presence or absence of tape, the read head contains a tape-sensing contact on the right side of the read station.

TAPE REELING (1017 MODEL 2)

The 1017 Model 2 uses 8-1/2 inch reels with removable flanges that are adjustable to the width of the tape being used. IBM Logo's are printed on the reference flange; the reels must be installed with this reference flange facing the operator (away from the machine). An 8-1/2 inch reel accommodates up to 1000 feet of tape 11/16 inch, 7/8 inch, or 1 inch wide.

Two tape-tension arms apply proper tension to the tape, maintaining properly packed tape on the reels. The tape-tension arms also operate switches that control the reel drive motors, thus maintaining tape buffering during reeler operation. In addition, a taut or slack tape condition is detected by a limit switch associated with each arm. An incorrect tape-tension condition in non-transparent mode immediately stops the reader, and signals an input-device error to the 2772 Control Unit, causing the appropriate Input-Device indicator light on the 2772 console to blink. The Reader becomes not ready, and the 1017 Check light blinks.

PARITY CHECKING

The 1017 performs a parity check on each character as it is read if the Parity Check switch is set to ODD or EVEN parity. No parity check is performed if the Parity Check switch is set to NO parity. When the 1017 is reading EBCDIC coded tape, the switch must be set to NO parity. When reading USASCII coded tape, it must be set to EVEN parity.

When operating in the transparent mode using non-EBCDIC 5-, 6-, 7-, or 8-track tape, the action with different settings of the Parity Check switch is as follows:

ODD	Characters are checked for odd parity, and sent directly to the Control Unit.
EVEN	Characters are checked for even parity, and corrected to odd parity before they are sent to the Control Unit.
NO	No parity check is performed, but characters are corrected to odd parity before they are sent to the Control Unit.

If a parity error is detected during reading, the tape backspaces and the character is read again. If a parity error still exists, the adapter:

1. Turns off the 'ready' line.
2. Turns the 1017 check light on (steady).
3. Signals input device error to the Control Unit.
4. Causes the appropriate Input Device light to blink.

Operating Characteristics

DATA FORMAT

The hole pattern of the characters read by the 1017 corresponds to the bit configuration of the character sent to the Control Unit as shown in Figure 1017-1.

*Trademark of E. I. du Pont de Nemours & Co.

EBCDIC	7	6	5	Feed Hole	4	3	2	1	0	Bit Positions
USASCII	1	2	3		4	5	6	7	P	
8-Track	1	2	3		4	5	6	7	8	
7-Track	1	2	3		4	5	6	7	*	Tape Tracks
6-Track	1	2	3		4	5	6	*	*	
5-Track	1	2	3		4	5	*	*	*	

* Unused tracks are sent to the 2772 as "0" bits.

Figure 1017-1. Data Bit to Tape Track Relationship

Deleted Characters

The 1017 recognizes Delete-type characters and removes them from the data stream when operating in non-transparent mode. These characters, the USASCII Delete (DEL) and the EBCDIC Eight-Ones (EO), have all holes punched (8-channel tape).

Inter-Message Gaps

Any inter-record or inter-message gaps that are to be preserved and included in the data stream must be composed of the Idle or NULL (no bits) characters.

Control Characters

Three format control characters are used to control the formatting of data that is to be transmitted by the 2772; however, the 1017 itself recognizes and treats only one of these (the End-of-Media character) as a control character. The 1017 treats the Record Separator and New Line characters as data.

An End-of-Media character (EBCDIC or USASCII, 8-channel tape) must be punch as the last data character of a block of data in all non-transparent tapes in order to stop the Reader from reading beyond the desired data character. The EM character is decoded when the 1017 End-of-File switch is on, and is used to bring up the 'EOF' line to notify the Control Unit that the Reader has no more data to transmit at the present time. Several blocks of text, each terminated with an EM character, can be put on a single tape when it is desired to send these blocks to different terminals.

When operating in the non-transparent mode, if the tape contains no EM character or if the End-of-File switch is off, tape will be read until a no-tape-in-reader condition or an interlock condition occurs. At this time, the 'input device error' line to the Control Unit is raised, indicating a job abort.

TYPES OF TAPE

The 1017 can accommodate the following standard tape sizes:

5-track (11/16 inch)
6- and 7-track (7/8 inch)
8-track (1 inch)

These tapes are available in various forms, including yellow paper tape, opaque paper tape, aluminized Mylar tape, and foil-laminated polyester tapes (see "Appendix – Tape Specifications" in this section of the manual). All tape read by the 1017 must contain feed holes and be of the chad-type (information holes as well as feed holes fully punched). The minimum thickness of tape that can be read is 0.0025 inches.

At time of order the 1017 can be specified for reading standard (and Japanese), or advanced-feed-hole tapes.

TRANSPARENCY

The 1017 is capable of operating as a completely code-transparent device if the EBCDIC Transparency special feature (EBCDIC transmission code only) is installed in the 2772. When operating in this mode, the 1017 treats all characters--including the End-of-Media (EM), EBCDIC Eight-Ones (EO), and USASCII Delete (DEL)--as data. With the EOF switch on, tape is read until a no-tape-in-reader condition occurs (normal End-of-Message), or until a tape interlock (taut/slack tape) condition occurs on the Model 2. Since either a no-tape-in-reader or a tape-interlock condition (with EOF switch on) will give a normal 'end-of-message' signal, the operator must visually check the 1017 after each job to assure that a tape interlock did not occur in the middle of the job. If the EOF switch is off, tape will be read until a no-tape-in-reader condition, or a Tape Interlock condition occurs, at which time the 'input device error' line to the control unit is raised, indicating a job abort. The EOF switch must be on to properly complete tape reading.

Parity checking is performed the same as in the normal mode.

All non-EBCDIC coded tapes must be transmitted in the transparent mode, since some of the character codes may correspond to EBCDIC control characters, which would in turn cause a data-format error in the Control Unit.

Special Features

There are no special features for the 1017.

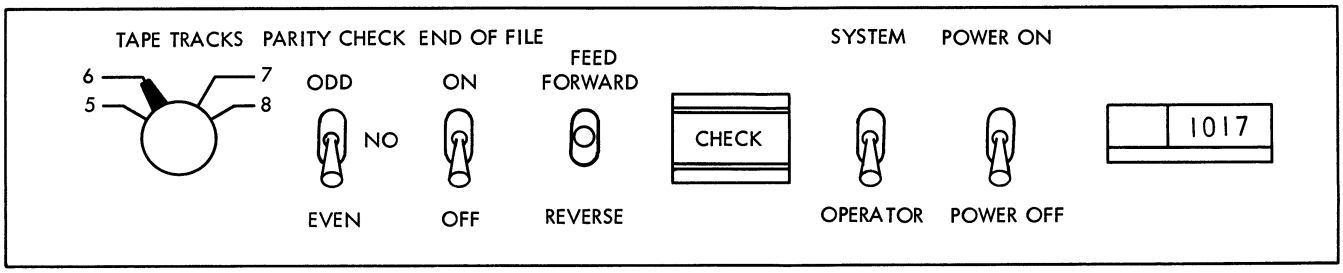


Figure 1017-2. IBM 1017 Operator Controls (Reader)

Lights, Switches, and Procedures

The 1017 Model 1 is equipped with controls that permit the operator to:

- Select the number of tape tracks to be read.
- Select the type of parity to be read.
- Allow recognition of the End-of-Media character.
- Control movement of tape in the operator mode.
- Start and stop Reader in the system mode.

The operator's panel (Figure 1017-2) also has a Check light and a Power switch. In addition to these controls, the Model 2 has a set of interlocked buttons for control of reeler operation (Figure 1017-3).

LIGHTS AND SWITCHES (MODELS 1 AND 2)

Mode Switch (System-Operator)

The Mode switch is a three-position toggle switch with two fixed and one momentary positions. When moved to the SYSTEM position (momentary), the Reader becomes ready if power is on and tape is properly loaded in the 1017. The 1017 Check light must be off at this time--and, if the Reader is assigned as the input device by the 2772 Job Select switch, the associated input-device light on the Control Unit console will turn on continuously, indicating that the 1017 is ready. When released, the Mode switch returns to the neutral position.

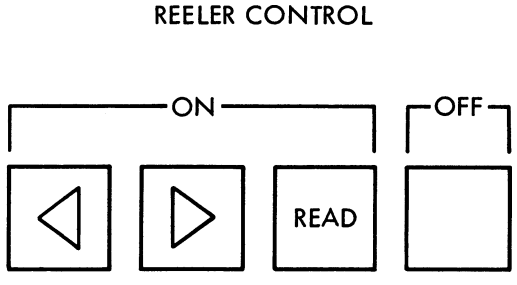


Figure 1017-3. IBM 1017 Operator Controls (Reeler)

When the switch is placed in the OPERATOR position (locking in this position), the 1017 becomes not-ready and, if the 1017 is selected by the 2772 Job Select switch, the Input-Device light will blink. The Check light will not blink when a tape interlock occurs in operator mode (see "Check Light").

Tape Tracks Selector Switch

This four-position rotary switch selects the number of tape tracks to be read (5, 6, 7, or 8) and indicates to the 2772 Control Unit how many tracks are being read.

Parity Check Switch

This three-position switch selects the type of parity check (odd, even, or no parity) to be performed on characters read from the 1017. See "Functions--Parity Checking" for operation of the parity-checking circuits with various tape codes and settings of the Parity Check switch.

End-of-File Switch

This two-position switch, when on, causes an End-of-Media (EM) character read from tape to be recognized as the last data character of a block of data. If the End-of-File switch is off, tape will be read until a no-tape-in-reader or tape-interlock condition occurs, at which time an 'input device error' (Input-Device light blinking) is indicated to the 2772, and the 1017 Check light turns on (blinking).

Feed Switch

This three-position switch is active only when the Mode switch is in the OPERATOR position and tape is loaded in the read head. When the Feed switch is held in the FORWARD or REVERSE position, the tape moves in the appropriate direction. On the Model 2, the Read button must be pressed to feed reeled tape, or the Off button pressed and tension arms properly positioned to feed strip tape (see "Reeler Controls").

Power On/Off Switch

This on/off switch controls ac power to the Reader.

Check Light

The 1017 Check light indicates--by being on either steady or blinking--different check conditions of the 1017, as described in the following:

On Steady. The 1017 Check light turns on steady to indicate that a parity error has been detected, or that the Power On/Off switch was switched off before the job in progress was completed. The light, when on steady, is turned off by pressing the Check Reset key on the Control Unit.

On Blinking. The 1017 Check light blinks to indicate to the operator that:

1. A no-tape-in-reader condition has occurred in non-transparent mode, or has occurred in transparent mode when the End-of-File switch is off. The light is turned off by reloading tape in the read head, or moving the Mode switch to OPERATOR.
2. A taut/slack tape condition (in the Model 2 only) has occurred in non-transparent mode, or has occurred in transparent mode when the End-of-File switch is off. The light turns off when the taut/slack tape condition is corrected, or the Mode switch is moved to OPERATOR.
3. The 1017 Power switch is off and power is on the 2772.

REELER CONTROLS (1017 MODEL 2 ONLY)

These four pushbuttons (Figure 1017-3) control operation of the tape reels for loading, rewinding, and on-line operation. They are mechanically interlocked so that pressing one button will restore the button previously pressed.

Forward (◂) and Reverse (▸) Wind

These buttons allow tape to be wound either on the left (take-up) reel or right (supply) reel. Tape is removed (unthreaded) from the read station for winding operations. The tape-feed sprocket is not activated while winding, and no tape movement will occur if tape is threaded for reading (see "Procedures").

When the winding operation is complete, pressing the Off button stops the reels.

Read

This button is pressed to prepare the reeler for operation, whether the Reader is in the system or operator mode. For reading reeled tape in the system mode, this button must be pressed before making the 1017 ready.

Off

This button deactivates the reeler mechanism for loading or unloading reels, or for threading tape. It also stops the reels after winding operations. When reading strip tape, the Off button must be pressed before making the 1017 ready.

PROCEDURES

This section describes the loading of both strip and reeled tape for reading, as well as the loading of reeled tape for rewinding. Tape leader and trailer should be provided on all tapes--approximately three inches for strip tape and six feet for reeled tape.

Loading Strip Tape (1017 Model 1 or 2)

Strip tape passes through the read station only; it is not associated with the reeler. To load strip tape, proceed as follows:

1. Check that the Reader is in the operator mode.

NOTE: For a 1017 Model 2, press the reeler-control Off button.

2. Turn read-head release knob counterclockwise. This releases the read head and upper tape guide for easy insertion of tape (Figure 1017-4).
3. Insert the tape in the read station:
   a. Face up;
   b. Reference edge toward the operator;
   c. With at least two inches of tape leader (no valid data) to the left of the read station; and
   d. With the feed holes (small holes near center of tape) properly engaged on the tape-feed sprocket wheel.
4. Latch the head down in reading position by pressing it downward against the tape (Figure 1017-5).
5. Check for correct positioning of the Tape Tracks Selector switch, the Parity Check switch, and the Power switch.
6. Check position of the tension arms. They must be in the extreme outside position (unlatched), or latched in the load position (Figure 1017-6).
7. Move the Mode switch momentarily to the SYSTEM position. Now the 1017 should be in the ready condition, the 1017 Check light should be off, and the appropriate input-device light on the 2772 Control Unit console should be on continuously.

CAUTION

If allowed to hang over the front edge of the table top, the tape tends to feed crooked and reading failures may result. Strip tape should be threaded along the forward edge of the table top parallel to the 1017 reading path.

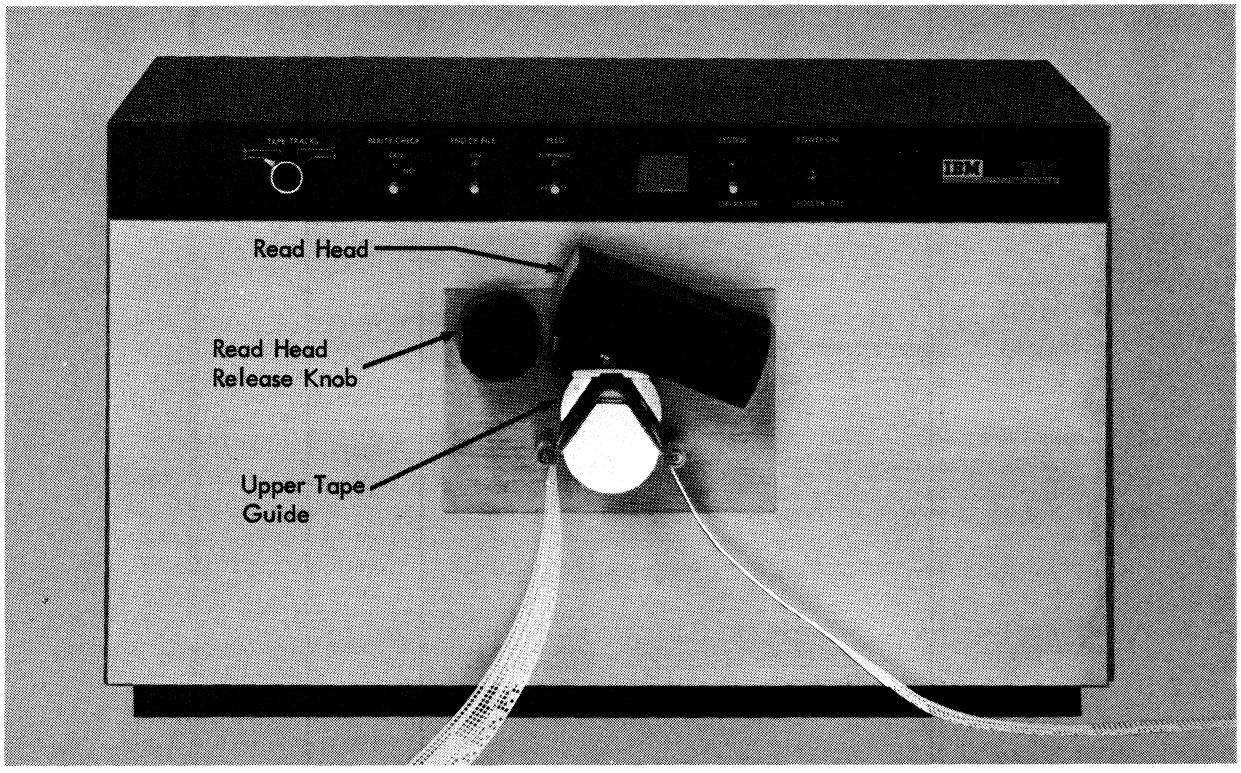


Figure 1017-4. Reader with Head Raised

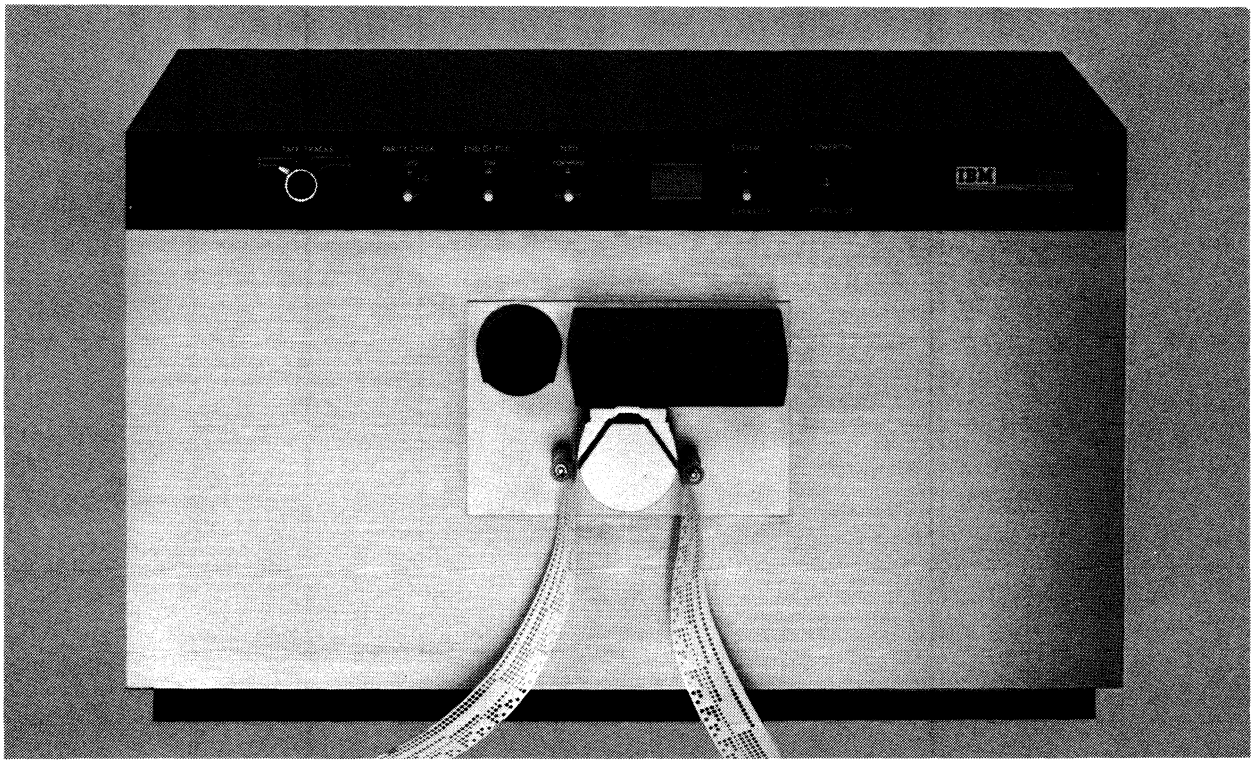


Figure 1017-5. Reading Strip Tape

Loading Reeled Tape for Reading (1017 Model 2 Only)

A unique procedure is available to permit rapid threading of tape through the tape-tension arms and fixed guides (see Figure 1017-6). To load reeled tape, proceed as follows:

1. Check that the Reader is in the operator mode, and the Power switch is ON.
2. Press the reeler-control Off button. This turns reeler power off for tape loading.
3. Turn the read-head release knob counterclockwise to release the read head and upper tape guide (see Figure 1017-4).
4. Latch the left and right tape-tension arms in the load position by moving them toward the read head.
5. Place the supply reel (containing the punched tape) on the right reel shaft and lock in place. Reel should be positioned so that the tape unwinds as the reel turns counterclockwise.
6. Place empty take-up reel on the left reel shaft and lock in place.
7. Remove about five feet of tape leader from the supply reel.
8. Thread the tape as shown in Figure 1017-6 so that tape is positioned:
   a. Between the right tape-tension-arm rollers and the fixed guide rollers;
   b. Under the fixed roller on the right side of the read head;
   c. Over the lower tape guide at the reading station;
   d. Under the fixed roller on left side of read head; and
   e. Between the left tape-tension-arm rollers and fixed guide.
9. Insert the tape on the take-up reel, and rotate the take-up reel manually in a clockwise direction until at least 12 inches of tape leader has been wound.
10. Check that the feed holes are accurately positioned on the tape-feed sprocket wheel.
11. Lower the read head against the tape and latch in reading position.
12. Rotate both the take-up and supply reels manually to take up slack in the tape.
13. Release the tape-tension arms by pressing the individual tension-arm-release buttons. As each arm is separately released, the associated reel should be manually turned to allow the tape to thread itself around the tension arms and guide rollers (Figure 1017-7). As each arm is released, take care to ensure that these spring-loaded arms do not snap the tape in returning to their normal position. This is why having no slack in the tape is essential at this time.
14. Press the reeler-control Read button. This conditions the reeler for a reading operation.

NOTE: Since these reeler buttons are interlocked, pressing the Read button cancels the previously actuated Off button (step 2).

15. Check both the Tape Tracks Selector switch and the Parity Check switch for correct positioning.
16. Move the Mode switch to the SYSTEM position momentarily. The Reader should now be in a ready condition, the 1017 Check light should be off, and the associated input-device light on the 2772 should be on steady.

Loading Reeled Tape for Rewinding (1017 Model 2 Only)

This procedure provides a method for rewinding the tape on the original supply reel. When rewinding is completed, the tape is in its original order (first data off the reel will be tape leader, followed by initial data). This procedure is essentially the same as for "Loading Reeled Tape For Reading," except for bypassing of the read head when threading the tape, and for the reeler controls used (Figure 1017-8).

To load reeled tape for rewinding, proceed as follows:

1. Check that the Reader is in the operator mode, and the Power switch is ON.
2. Press the reeler-control Off button. This turns the reeler power off for tape loading.
3. Latch the tape-tension arms in the load position by moving them toward the read head.
4. Place the reel of tape to be rewound on the left reel shaft and lock in place. Reel should be positioned so that tape unwinds as the reel turns counterclockwise.
5. Place an empty reel on the right reel shaft and lock in place.
6. Manually unwind about four feet of tape leader from the left reel.
7. Thread this tape as shown in Figure 1017-8 so that the tape is positioned:
   a. Between the left tape-tension-arm rollers and fixed guide rollers;
   b. Under the fixed rollers on left and right of read head;

NOTE: This tape is not threaded through the read head.

   c. Between the right tape-tension-arm rollers and fixed guide rollers.

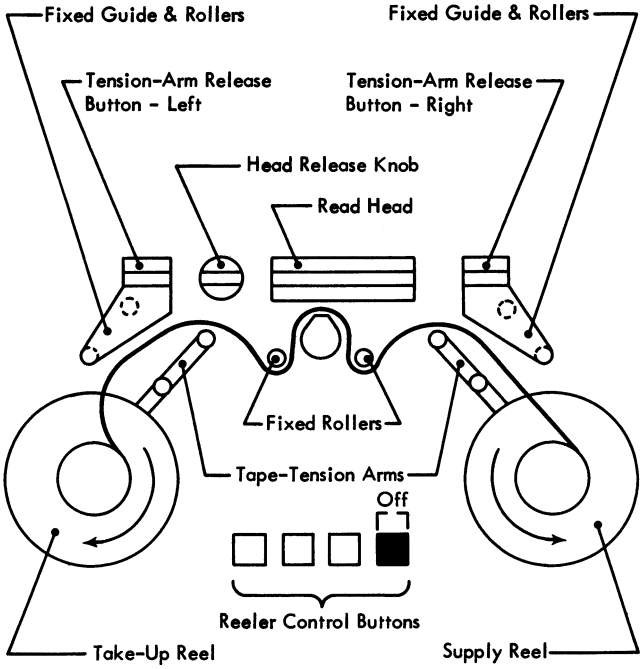


Figure 1017-6. Threading Reeled Tape

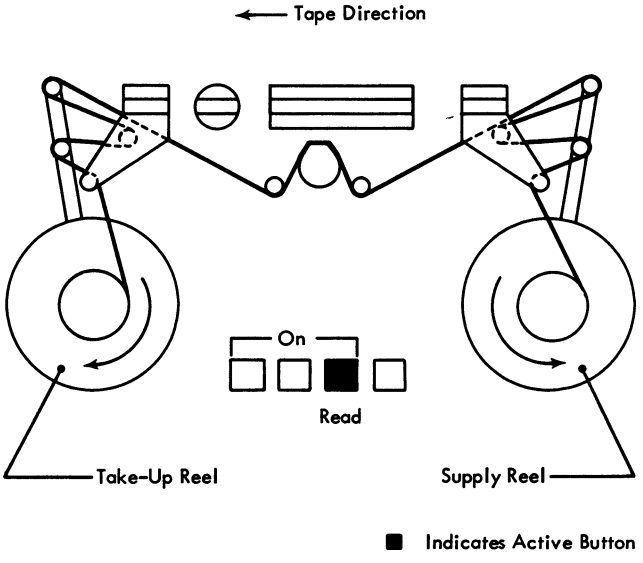


Figure 1017-7. Reading Reeled Tape

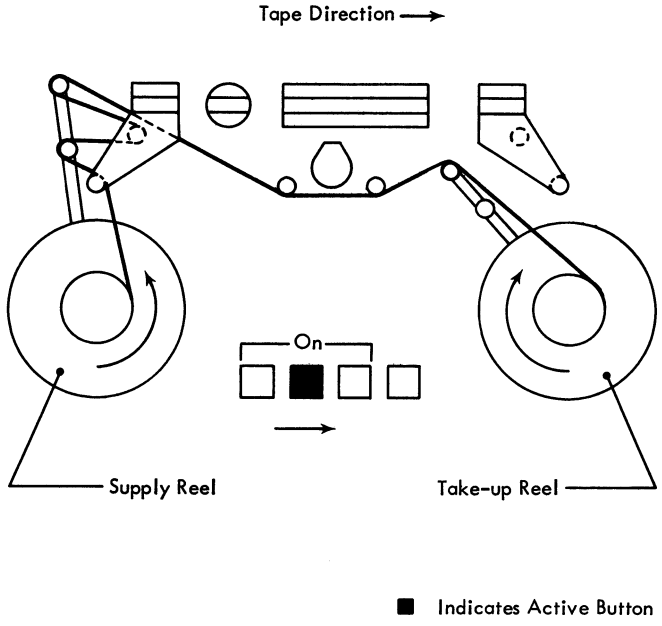


Figure 1017-8. Rewinding Reeled Tape

8. Insert tape on the right reel, and rotate the right reel manually in a clockwise direction until at least 12 inches of tape leader has been wound.
9. Rotate both the left and right reels manually to take up slack in the tape.
10. Release the left tension arm by pressing the individual tension-arm-release button. As the arm is released, tape is threaded around the tension-arm rollers and fixed guide rollers. Care must be taken to ensure that this spring-loaded arm does not snap the tape as it returns to normal position. This is why the lack of slack tape is essential at this time.
11. Press the reeler control button (▸) for rewind. This actuates the reels in the rewind direction as indicated by the arrowed button.
12. Press the reeler-control Off button to stop the operation.

Error Recovery Procedures

RECOVERY POINTS

Error recovery procedures for the 1017 permit restarting a job either at some intermediate restart point or at the beginning of the job. These restart points should be determined during the implementation planning of the 2770 Data Communication System.

The tape leader and trailer, and intermediate restart points, may consist of either NULL characters (which are "no bit" characters) or EBCDIC Eight-Ones or USASCII Delete characters (both of which are "all bit" characters).

The choice among these characters for tape leader and trailer and restart points should consider the following:

1. NULL characters are always transmitted by the 2770.
2. Delete and Eight-Ones (EO) characters are removed from the data stream and are *not* transmitted by the 2770 when it is operating in *nontransparent* mode.
3. EO characters *are* transmitted by the 2770 when it is operating in EBCDIC *transparent* mode.

With these considerations taken into acccount, intermediate restart points easily recognizable by the operator--such as sequences of NULL (no bits) or Delete (all bits) characters--should be chosen.

INPUT DEVICE ERROR, 1017 CHECK LIGHT OFF

Moving the Mode switch to OPERATOR while a job is in progress will signal an input-device error to the Control Unit, and the 1017 Check light will not turn on. The job can be restarted as follows, with no loss of data:

1. Move 1017 Mode switch momentarily to SYSTEM;
2. Press Start key on Control Unit.

NON-TRANSPARENT MODE CHECK CONDITIONS

The following 1017 check conditions may be detected, causing the 1017 Check light to turn on steady, or to blink (see "Check Light" under Lights and Switches):

1. 1017 Power On/Off switch placed in OFF position.
2. No Tape in Reader.
3. Tape Interlock.
4. Parity Check.

Any one of these check conditions causes the associated Input-Device light on the Control Unit to blink, and operator intervention is then necessary to resume operation. The procedures for recovering from the various conditions and resuming operation follow.

1017 Check Light Blinking

The job must be restarted at the beginning or at a previously determined restart point.

1017 Power Switch Off. Turn the 1017 Power switch on. If the Check light turns off:

1. Reposition tape to the beginning, or to some previously determined restart point.
2. Move 1017 Mode switch to SYSTEM momentarily.
3. Press Start key on Control Unit.

Tape-Interlock or No-Tape-in-Reader Condition. Correct the tape-interlock condition or no-tape-in-reader condition and the Check light will go out.

1. Examine the tape to determine if feed holes are torn and if a new tape must be punched.
2. Examine the tape to determine if it is properly terminated with an EM character and tape trailer. If incorrect, a new tape must be punched or a section of tape containing an EM character must be appended by splicing.
3. Ensure that the 1017 End-of-File switch is on.
4. Reposition tape to the beginning or to the previously determined restart point.
5. Move the 1017 Mode switch to SYSTEM momentarily.
6. Press Start key on the Control Unit.

1017 Check Light On Steady (Parity Error or Loss of Power)

The job must be restarted at the beginning or at some previously determined restart point.

1. Ensure that 1017 Power switch is on, and that Tape Tracks Selector and Parity Check switches are set correctly.
2. Determine if the character under the read head has proper parity, and repunch tape if necessary.
3. Reposition tape at the beginning or to the previously determined restart point.
4. Press the Check Reset key on the Control Unit.
5. Move the 1017 Mode switch to SYSTEM momentarily.
6. Press the Start key on the Control unit.

TRANSPARENT MODE CHECK CONDITIONS

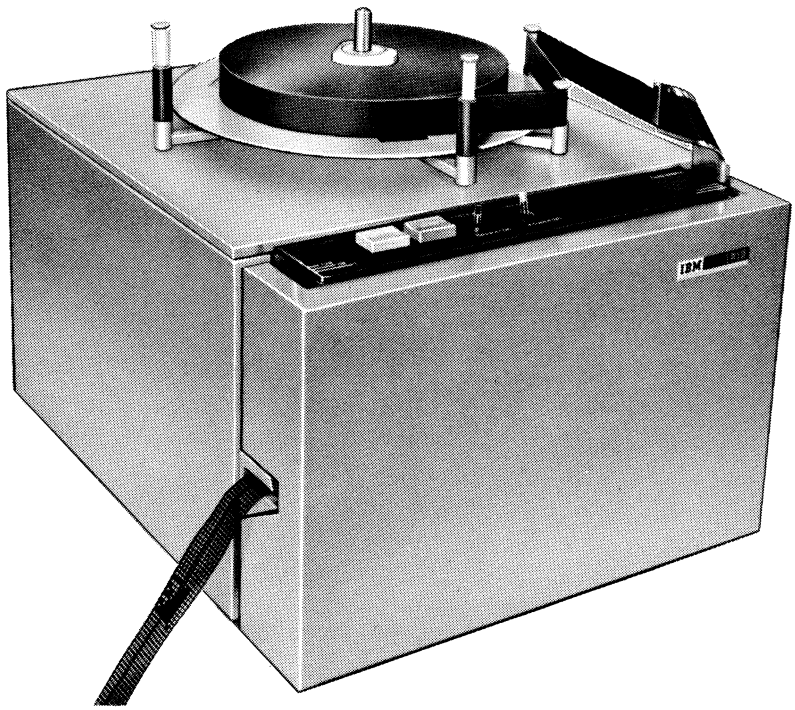
The following 1017 check conditions may be detected, causing the 1017 Check light to turn on steady, or to blink:

1. 1017 Power On/Off switch placed in OFF position.
2. No-tape-in-reader when EOF switch is off.
3. Tape interlock when EOF switch is off (Model 2 only).
4. Parity Check.

The parity-check error (Check light on steady) recovery procedure is the same as for non-transparent mode.

The tape-interlock or no-tape-in-reader error (Check light blinking) recovery procedure is the same as for non-transparent mode except that step 2 is eliminated (an EM character is not required to terminate data reading).

NOTE: Since a tape interlock condition in transparent mode, with EOF switch on, gives a normal end-of-job signal, the operator must visually check the 1017 Model 2 after each job to assure that a tape interlock did not occur in the middle of the job.



IBM 1018 Paper Tape Punch

Introduction

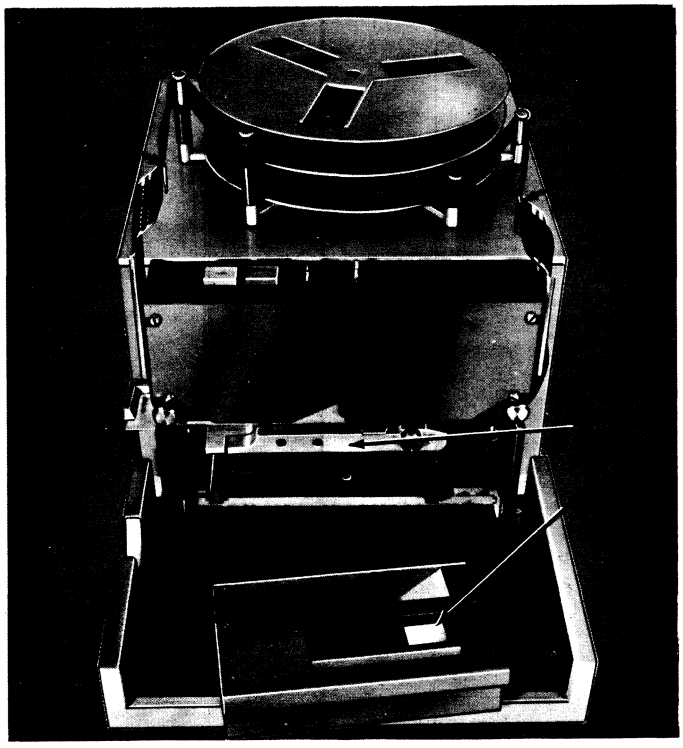
The IBM 1018 Paper Tape Punch (Frontispiece) used with the 2770 system is an incremental output device that punches paper or Mylar* tape at speeds up to 120 characters per second. The 1018 punches out information holes completely (chad-type tape), and also punches feed holes in the tape. The IBM 1018 will punch 11/16 inch (5-track), 7/8 inch (6- or 7-track), and 1 inch (8-track) paper or Mylar tape (see Appendix B in this section of the manual for types of tape). Manually adjustable tape guides enable the operator to select the width of tape punched.

In Figure 1018-1, which shows the functional parts of the 1018, the front cover is open for operator servicing (exposing the chad box and pressure guide to view).

The tape-supply mechanism accepts a 1000-foot roll of tape wound on a two-inch core. The tape may be fed onto a take-up reel (special feature, see Figure 1018-1), or torn off for strip-tape processing.

---

*Trademark of E. I. du Pont de Nemours & Co.



*Only With Tape Take-Up Special Feature

Figure 1018-1. Functional Parts of the 1018

Functions

PUNCHING

Under control of the 2772 Multi-Purpose Control Unit, the 1018 punches characters parallel-by-bit on an incremental basis into blank tape supplied from the supply mechanism. A feed hole is punched along with each character. By pressing the Feed key on the 1018 control panel, the operator may punch tape leader and trailer consisting of feed holes only; or, by pressing the Delete key, he may punch leader and trailer containing all-hole characters.

TAPE FEED

The tape-feed mechanism advances the tape with a sprocket. The teeth of the tape-feed sprocket fit into the tape feed holes punched at the punching station. A pressure guide (Figure 1018-1), which can be lowered for tape loading, contains adjustable guides that assure proper registration at the punching station. For adjustment of the tape guides, see "Procedures."

CHAD DISPOSAL

Chads are collected in a small, operator-removable box that holds the chad output of about 1000 feet of tape. The chad box (Figure 1018-1) must be removed for tape loading, as the pressure guide can be lowered only when the chad box is out. This reminds the operator to empty the chad box regularly. An interlock switch is mounted below the punch station to ensure that the chad box and pressure guide are positioned correctly.

PUNCH CHECKING

An echo check is performed on each character to ensure that the 1018 punched the character correctly. The echo pulses from the punch magnets are compared with the original character. If an error is detected, the 1018 stops, the 'ready' line is dropped, and the 1018 Check light is turned on (steady). The associated output-device light on the Control Unit will blink, indicating an error to the operator.

TAPE SUPPLY

The tape-supply mechanism accepts a roll of tape approximately 1000 feet long wound on a two-inch core. The tape is

fed from the supply mechanism to the punching station over a tape-tension arm, which causes an interlock indication in case of a broken tape or incorrect tape tension.

A low-tape-supply detector, located under the supply reel, gives a low-tape indication to the Control Unit when about 10 feet of tape remain on the supply reel. This low-tape indication will allow completion of the job in progress, but will not allow a new job to start. Therefore, to ensure that sufficient tape remains to complete punching a particular record if a low-tape condition occurs during a job, record length should not exceed about 900 characters.

Operating Characteristics

DATA FORMAT

All characters are punched exactly as they are received from the 2772 Control Unit buffer without any form of translation; the 1018 does not respond to any function codes, and thus it is a completely "code-transparent" output device.

OPTIONS

To accommodate a wide variety of applications, the following basic capabilities are available. The customer must specify which of these capabilities is desired when the 1018 is ordered.

Standard Punch

This capability enables the 1018 to punch 5-, 6-, 7-, or 8-track codes into tape of the corresponding width (see Appendix B of this section).

NOTE: The operator should make sure that all tape guides are properly adjusted with respect to tape width.

Japanese Punch

The Japanese Punch capability alters the 1018 for punching Japanese data format only, so that the 1018 punches 6-track codes in 7/8 inch tape only, with the centerline of the feed holes 0.439 inch from the reference edge (see Figure PT-5).

NOTE: The Standard Punch capability can be changed into the Japanese Punch capability or vice versa by a customer engineer. The CE will set all tape guides to the positions appropriate for this capability.

Advanced Feed Hole Punch

With this capability the 1018 is modified to punch 6-track codes in 7/8 inch tape only (see Figure PT-4). The feed holes are punched in the center of the tape 0.434 inch from the reference edge. The transverse centerlines of the feed holes are located 0.0122 inch ahead of the transverse centerlines of the respective data holes.

NOTE: The operator should make sure that all tape guides remain in the 7/8 inch position with this capability.

Special Features

2772 ATTACHMENT FEATURE

The 2772 Attachment feature must be installed on the 1018 for attachment to the 2772 Control Unit. This feature provides a Delete key and a Tape Tracks Selector switch (described under "Keys, Lights, Switches, and Procedures"), and punch checking (described under "Functions - Punch Checking").

TAPE TAKE-UP FEATURE

This feature (Figure 1018-1) provides a means of winding the tape on a reel as it leaves the punching station. The tape is wound on the reel counterclockwise (the reel turns clockwise), reference edge up, and face in. The outside diameter of the reel is 10-1/2 inches. The standard inside diameter of the reel is 2 inches.

NOTE: The 1018 accepts either a 10-1/2 inch or an 8-1/2 inch reel. If a 1018 with both the 2772 Attachment Special Feature and the Tape Take-Up Special Feature is ordered, the 8-1/2 inch reel is supplied. This allows tape punched on the 1018 to be read on a 1017. The 8-1/2 inch reel capacity when used on the 1018 is approximately 900 feet.

An adapter may be used to increase the inside diameter of 10-1/2 inch reels to 4-1/2 inches. This makes possible the use of the reeled output tape on center-roll-feed readers. When center-roll feed is not used, the tape wound on the take-up reel is generally rewound prior to reading. The take-up tension arm associated with the take-up reel causes an interlock condition in case of a broken tape or improper tape tension, but the interlock can be made inactive when punching strip tape by pulling the tension arm to the right (see Figure 1018-6).

Keys, Lights, Switches, and Procedures

KEYS, LIGHTS, AND SWITCHES

The following keys, lights, and switches are located on top of the 1018 for operator control (Figure 1018-2).

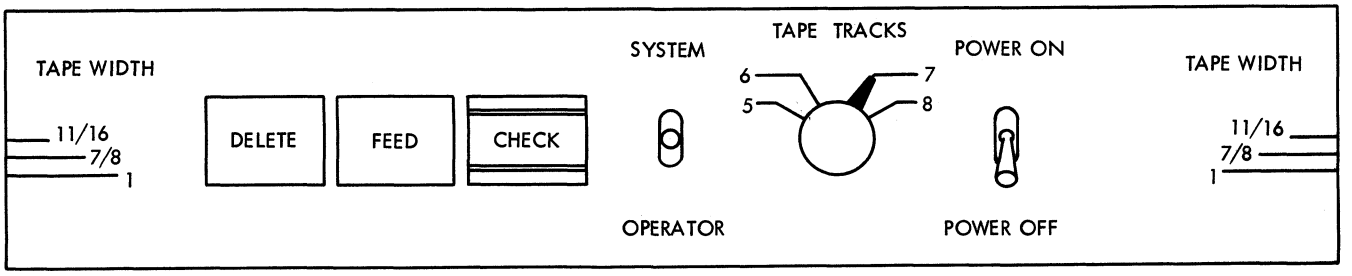


Figure 1018-2. IBM 1018 Operator Controls

Power On/Off Switch

This switch is used to turn 1018 ac power on and off. Power should be turned off only when the Punch is in the not-ready condition.

Mode Switch (System-Operator)

The Mode switch is a three-position toggle switch with one fixed and two momentary positions.

Moving the switch to the SYSTEM position (momentary) makes the 1018 ready if:

1. No interlock function is active;
2. 1018 power is on;
3. Power is on the 2772; and
4. No punch-check condition exists.

With the Punch in the ready condition, the 1018 Check light is off and the associated Output-Device light on the 2772 console is on continuously. The operator mode is used for operator servicing, such as tape loading or tape leader/trailer punching, or for FE servicing. Moving the switch to the OPERATOR position (momentary) makes the 1018 not-ready and the associated output-device light on the 2772 Control Unit will blink. If the 1018 Mode switch is moved to the OPERATOR position while the 1018 is selected by the 2772, an output-device error is indicated to the 2772. The 1018 becomes not-ready, and the associated Output-Device light on the 2772 will blink.

The switch will return to the neutral position upon release.

Feed Key

Pressing the Feed key causes the 1018 to feed tape continuously and punch feed holes. The Feed key is operative only in the operator mode.

Tape Tracks Selector Switch*

The Tape Tracks Selector switch is set to 5, 6, 7, or 8 tracks for punching 11/16 inch, 7/8 inch, or 1 inch wide tape. The position of the Tape Tracks Selector switch controls the number of tape tracks punched when the Delete key is pressed. This switch has no effect on data punched from the Control Unit.

Delete Key*

Pressing the Delete key causes the 1018 to feed tape continuously and punch EBCDIC Eight-Ones (all holes) or USASCII Delete (all holes) characters if the Tape Tracks Selector switch is in the 8 position. If the switch is in the 7, 6, or 5 position tape tracks 1 through 7, 1 through 6, or 1 through 5, respectively are punched when the Delete key is pressed. The Delete key is operative only in operator mode.

Check Light*

The Check light indicates three different conditions of the 1018 by blinking, being on steady, or lighting momentarily when the Mode switch is operated.

Blinking. The 1018 Check light is turned on (blinking), and the associated output-device light on the 2772 console is turned on (blinking), if either of the following tape-interlock conditions occur:

a. Broken tape, end of tape, or incorrect tape tension;
b. 1018 power off

The Check light, when blinking, is turned off when the tape-interlock condition is corrected.

---

*Only with 2772 Attachment special feature.

On Steady. The Check light is turned on steady (continuously) if a punch-check condition, or power loss, occurs. The Check light, when on continuously, is turned off by pressing the Check Reset key on the 2772 Control Unit.

Momentary. The Check light is turned on when the Mode switch is held in the SYSTEM position and either of the following punch-interlock conditions exist:

a. Low tape supply;
b. Chad box full, incorrectly positioned, or missing.

The Check light turns off when the Mode switch is allowed to return to its neutral position.

PROCEDURES

The operator must first determine how many tracks will be punched; then select the proper tape, adjust the tape guides accordingly, and properly position the Tape Tracks selector switch.

Number of Tracks	*Tape Width*
5	11/16 inch
6	7/8 inch
7	7/8 inch
8	1 inch

Angular Tape Guide Adjustment

The angular tape guides must be adjusted to the width of the tape being used. For this purpose, three lines are provided on the operator panel (Figure 1018-2), adjacent to the tape-guide handles. The longest line is marked 1 inch, the middle one 7/8 inch, and the shortest one 11/16 inch. Each angular tape guide is adjusted by moving the front edge of the handle to align with the appropriate position on the panel. The guide will seat in proper alignment at each position.

One angular tape guide, located in the upper right-hand corner on the front of the machine, is standard equipment. Another guide is supplied with the optional Tape Take-Up special feature; when installed, it is located in the upper left-hand corner.

Pressure Guide Adjustment

The pressure guide (Figure 1018-3) must be adjusted to the width of tape being used. To adjust the pressure guide, open the front cover, remove the chad box, and lower the pressure guide. The pressure-guide adjusting knob may then be turned to the appropriate position.

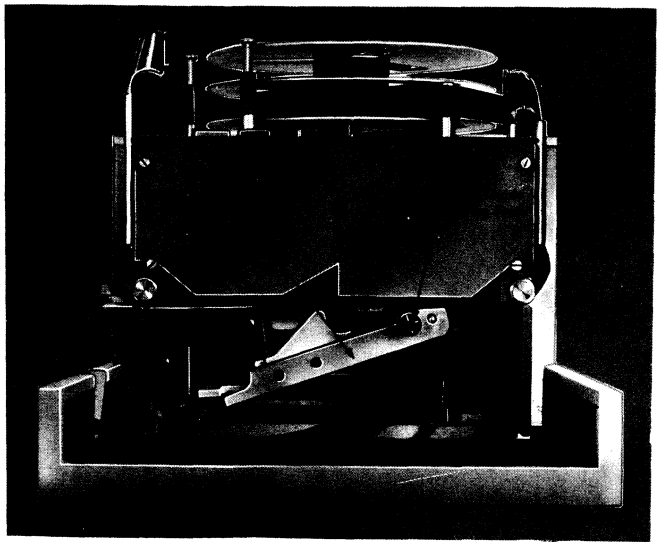


Figure 1018-3. Pressure Guide

Tape Loading

For punching reels or strips of tape, the unpunched tape is fed into the punch station from a roll of tape that is properly loaded onto the supply mechanism, as follows:

1. Remove the punched tape and take-up reel, if any, as described under "Punched Tape Removal."
2. Make sure the punch is in the operator mode; then turn 1018 power off.
3. Open front cover, remove and empty the chad box, and lower the pressure guide. (Chad box holds the chad of about 1000 feet of tape).
4. Remove remaining tape, if any, from the punch and feed area. To avoid tearing the tape, remove it from the front rather than pulling it out from the side of the mechanism.
5. Remove the old supply-roll core and any remaining tape.
6. Place a roll of unpunched tape on the supply reel so that the roll turns counterclockwise when the end of the tape is pulled.
7. Set right hand angular tape guide and the pressure guide according to the width of tape being used.
8. Loop the tape around the stationary roller arm, then around the supply tension arm (Figure 1018-4).
9. Insert the tape into the angular tape guide.
10. Taking about 1-1/2 feet of tape between both hands, with the leading edge held in the left hand, insert the tape horizontally into the feed track (Figure 1018-5).
11. Holding the tape's leading edge with the left hand, with the right hand push the pressure guide downward. The pressure guide should snap back into position under spring tension.
12. Replace empty chad box and close front cover.

13. Turn 1018 power on and press Feed key or Delete key to punch tape leader (three inches for strip tape, six feet for reeled tape).

NOTE: Some types of tape, Mylar for example, should be pulled gently in the transport direction, from right to left, until the tape feed holes reach the tape-feed sprocket.

14. Visually check the punched tape for correct feed-hole registration and proper tape transport.

NOTE: If the Tape Take-Up feature is on the 1018, the two-position roller arm of the take-up mechanism (Figure 1018-6) must be in the right-hand position (interlock inactive) for punching strip tape.

15. The punch is now ready for system operation.

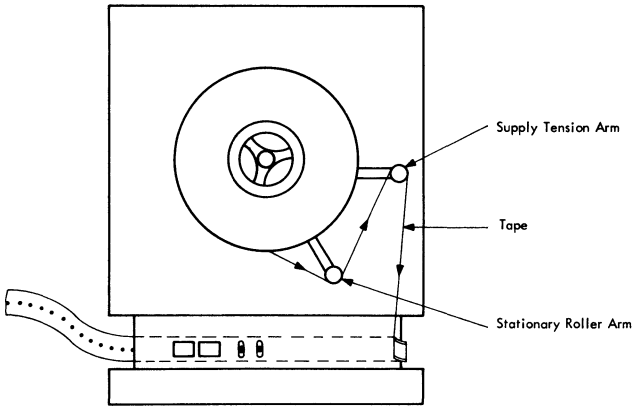


Figure 1018-4. Tape Loading (Supply Mechanism)

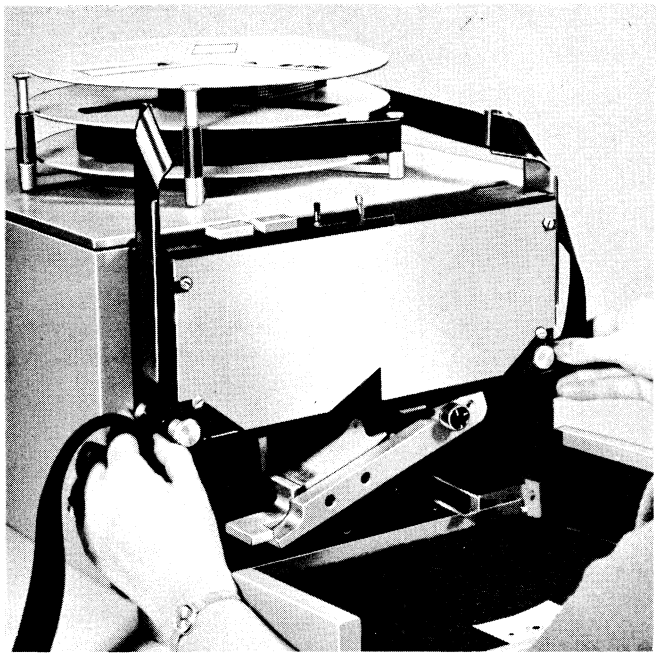


Figure 1018-5. Tape Loading (Punch Station)

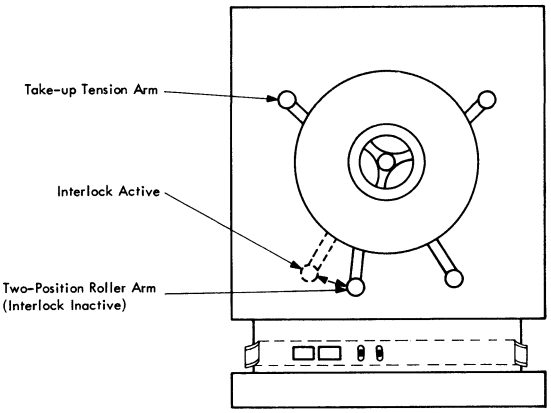


Figure 1018-6. Take-Up Mechanism

Threading the Take-Up Mechanism

When a roll of unpunched tape is loaded according to the preceding instructions, the take-up mechanism may be threaded as follows:

1. Turn 1018 power off (turn power off only in the operator mode).
2. Put empty take-up reel on take-up spindle.
3. Put two-position roller arm in the interlock-inactive position (Figure 1018-6).
4. If using 10-1/2 inch reel, set left hand angular tape guide according to the width of tape used. If using 8-1/2 inch reel, set guide on 1 inch regardless of tape width. Thread tape leader through guide.
5. Loop tape around the take-up tension arm (Figure 1018-7), then around the two-position roller arm.
6. Insert end of tape into the hub of the take-up reel, and manually turn the reel clockwise to remove the slack from the leader.
7. Turn the Power switch on and press the Feed key for a few seconds. This puts proper tension on the tension arm.
8. The punch is now ready for system operation.

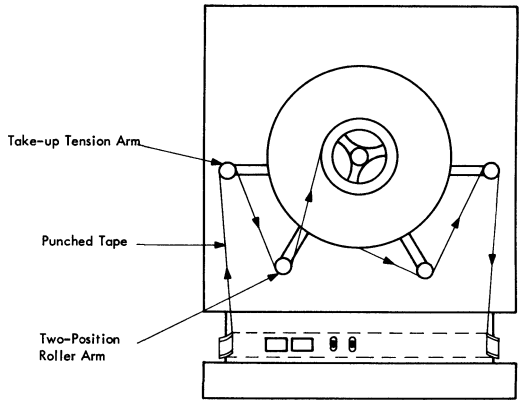


Figure 1018-7. Threading the Take-Up Mechanism

Punched Tape Removal

Punched-tape removal is described in the following for strips of punched tape and for reels of punched tape.

Strip Tape

1. Put the 1018 in the operator mode.
2. Produce a trailer by pressing the Feed key or Delete key until about three inches of feed holes have been punched after the last data character.
3. Tear or cut the tape at the left side of the machine, making sure that ample trailer is following the data punches.
4. Produce about three inches of new leader by pressing the Feed key or the Delete key.
5. Put the 1018 in the system mode for further strip punching.

Reeled Tape

1. Put the 1018 in the operator mode.
2. Produce a trailer by pressing the Feed key or Delete key until about six feet of trailer is punched after the last data character.
3. Turn 1018 power off.
4. Tear or cut the tape on the left side of the machine, making sure that ample trailer is following the data punches.
5. Remove the take-up reel.
6. If sufficient tape remains on the supply roll, turn power on and produce new leader (about six feet) by pressing the Feed key or Delete key. If not, proceed with "Tape Loading" procedure.
7. Rethread the take-up mechanism; or, should strip punching be desired, put the two-position arm in the right-hand position (interlock inactive); then put the 1018 on system.

Operator Maintenance

Normally, the operator should brush tape dust from the feed area and punch-die area daily. However, when punch usage is greater than normal, these areas should be cleaned more often to prevent dust from accumulating.

Error Recovery Procedures

RECOVERY POINTS

The 1018 error recovery procedures permit restarting a job at some intermediate restart point in a job, or at the beginning of the job. These restart points should be determined during the implementation planning of the 2770 Data Communication System. Tape leader and trailer can be punched consisting of either NULL (no bits) characters, EBCDIC Eight-Ones (all bits) characters, or USASCII Delete (all bits) characters, as determined by this planning. (See 1017 "Error Recovery Procedures--Recovery Points" for the considerations in choosing leader, trailer, and restart-point characters.)

CHECK CONDITIONS

Three types of errors or check conditions--Punch Check, Tape Interlock, and Punch Interlock--are detected, causing the 1018 Check light either to turn on steady, blink, or to turn on when the Mode switch is held in the SYSTEM position. Loss of 1018 power while punching causes either a Punch Check or a Tape Interlock.

Punch Check (Check light on steady). Echo pulses do not compare with original data character.

Tape Interlock (Check light blinks). Caused by one of the following:

a. 1018 Power switch off;
b. Taut/slack (or broken) tape on the supply side;
c. Taut/slack (or broken) tape on the take-up side.

Punch Interlock (Check light turns on when Mode switch is held in SYSTEM position). Caused by one of the following:

a. Low tape;
b. Chad box full, mispositioned, or missing.

RESTART PROCEDURES

Any of the above errors or check conditions causes the associated output-device light on the 2772 console to blink, and operator intervention is then required to resume operation.

Punch Check Restart

The job must be restarted at the beginning of a data block or job, or at some previously determined restart point. If the punch check occurred during a low-tape condition, the tape-supply reel must be reloaded before performing the following restart procedure.

1. Press the Check Reset key on 2772 Control Unit (1018 Check light turns off).
2. Move the 1018 Mode switch to the OPERATOR position momentarily.
3. Press the 1018 Feed key or Delete key to generate tape leader.
   a. If restarting at the beginning of a data block or job, discard the previously punched tape from the punch-check point back to the beginning of the data block or job.

b. If restarting at a previously determined restart point, discard the tape back only to the previously determined restart point; then splice the two sections of tape to form a complete data block or job.

4. Move 1018 Mode switch to the SYSTEM position momentarily (the associated output-device light on the 2772 will now be on continuously).
5. If operating in home mode, reposition source medium (paper tape or punched cards) to beginning of block or job, or to previously determined restart point, and make the input device ready.
6. If operating in 2770 line mode, re-establish communication with remote terminal.
7. Press 2772 Start key to re-initiate punch operation.

Tape Interlock Restart

The job must be restarted at the beginning of a data block or job, or at some previously determined restart point. If the tape interlock occurred during a low-tape condition, the supply reel must be reloaded before performing the following restart procedure.

1. Correct the tape-interlock condition (1018 Check light stops blinking).
2. Move the 1018 Mode switch to the OPERATOR position momentarily, and press Feed key or Delete key to generate tape leader.
   a. If restarting at the beginning of a data block or job, discard the previously punched tape from the tape-interlock point back to the beginning of the data block or job.
   b. If restarting at a predetermined restart point, discard the tape back only to the restart point and splice the tape to form a complete data block or job.
3. Move 1018 Mode switch momentarily to SYSTEM (the associated output-device light on the 2772 will now remain on continuously).
4. If in home mode, reposition the source medium (tape or punched cards) to beginning of data block or job, or to previously determined restart point, and make the input device ready.
5. If in 2770 line mode, re-establish communication with the remote terminal.
6. Press 2772 Start key to re-initiate punch operation.

Clearing Punch Interlock

Correct interlock condition and move Mode switch to SYSTEM position to start job.

A. Paper Tape Splicing

The ability of the 1017 Paper Tape Reader to read spliced tape successfully depends on the quality of the splice. The quality of the splice depends on: the type of splicing equipment, splicing material, and adhesive; and, in some cases, the skill of the operator.

The punch station of the 1018 will not pass a splice. Thus any necessary splicing of tape on the 1018 should be done on the output side of the punch station.

Paper tape splices are of two types: overlap splices, and butt-joint splices.

Overlap Splice

The overlap splice is made by overlapping matching paper-tape ends, by at least one punched column, and cementing the ends to hold them in place (Figure PT-1).

Some advantages of using the overlap splice are:

a. A variety of overlap-splicing equipment is available;
b. Many splicers are available at a reasonable cost;
c. Quality of splice does not usually depend on the skill of the operator.

Some disadvantages of using the overlap splice are:

a. The splice cannot be made in data areas of the tape without causing loss of data, parity conditions, and/or invalid characters;
b. Most adhesives require a relatively long time to dry;
c. Splice has short life.

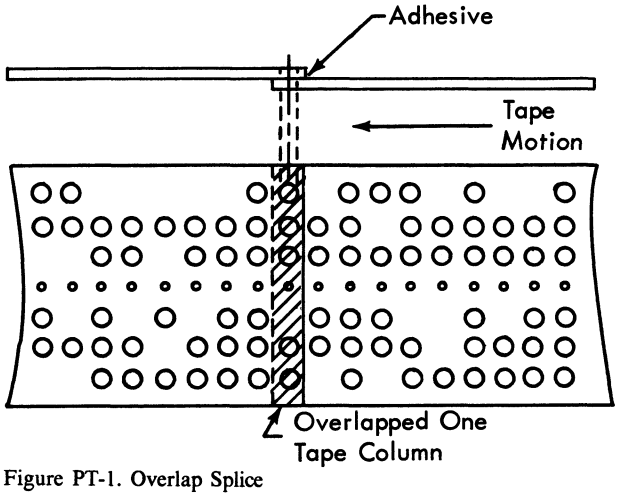


Figure PT-1. Overlap Splice

Butt-Joint Splice

The butt-joint splice (Figure PT-2) is made by butting two complementary tape ends together and holding them in position by a bonding agent and an overlay material. If the splice is in a data portion of the tape, the overlay material must be completely punched out (Delete characters) to allow proper reading of the tape. When overlays are placed on both sides of the tape, they must be offset by at least one character position from each other.

Some advantages of using the butt-joint splice are:

a. The splice can be made in data areas of the tape without causing loss of data;
b. The splice has relatively long life.

Some disadvantages of using the butt-joint splice are:

a. The choice of accurate tape-splicing equipment is limited;
b. The quality of the splice depends directly on the skill of the splicing-equipment operator.

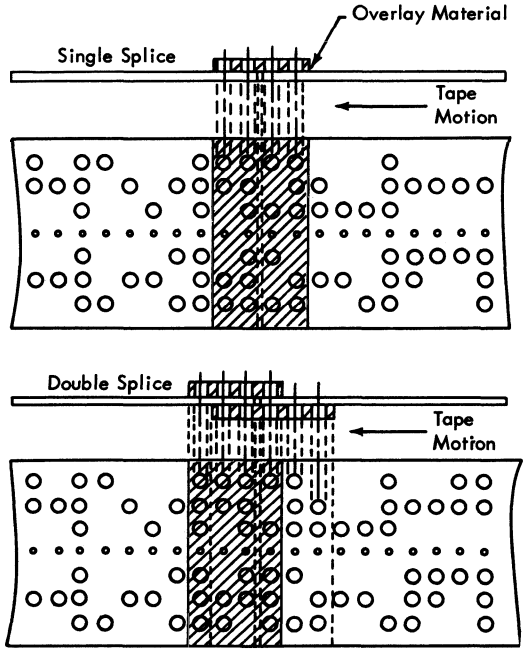


Figure PT-2. Butt-Joint Splice

Spliced-Tape Specifications

The dimensions of spliced tape used with the 1017 must conform to the allowable tolerances for unpunched tape except for thickness. The total thickness of the splice must not exceed 0.010 inch. In addition, the spliced tape must conform to the following;

a. The width of the splice must match the width of the tape;
b. The splice must be approximately as strong as unspliced IBM paper tape;
c. The splice must be flexible;
d. The splice must be clean and free of any substance that could create a hindrance in the tape-feed area;
e. The distance between the closest parts of two consecutive splices must be greater than 4-1/3 inches.

B. Tape Specifications

Nominal dimensions of the hole pattern as output from the 1018 and input to the 1017 are shown in Figures PT-3, 4, and 5.

The following IBM tapes and their equivalents can be used with both the 1017 and 1018:

190216 (5-track, yellow)
304469 (8-track, yellow)
426362 (8-track, black)
424864 and 424865 (8-track, Mylar tape)
425020 (8-track, laminated polyester tape).

Paper tape must meet USAS standard X3.2/601 specification for properties of unpunched paper perforator tapes, and should be punched in accordance with USAS X3.18-1967 and X3.19-1967.

Polyester or polyester reinforced perforator tape should have a minimum thickness of .0025 inches and a maximum thickness of .0037 inches.

C. Paper Tape Codes

Figure PT-6 shows the EBCDIC paper tape code, and Figure PT-7 shows the USASCII paper tape code.

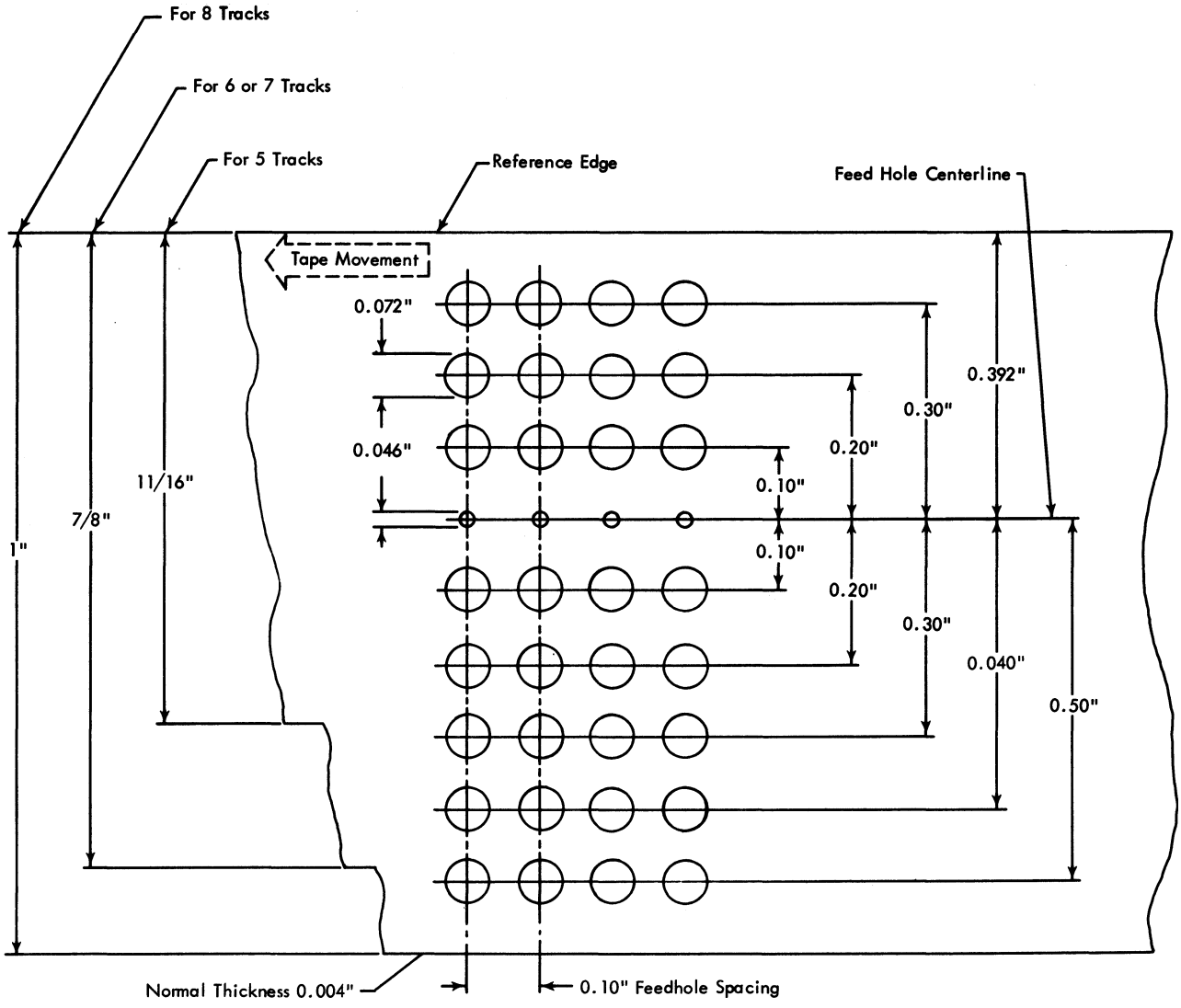


Figure PT-3. Tape Specifications

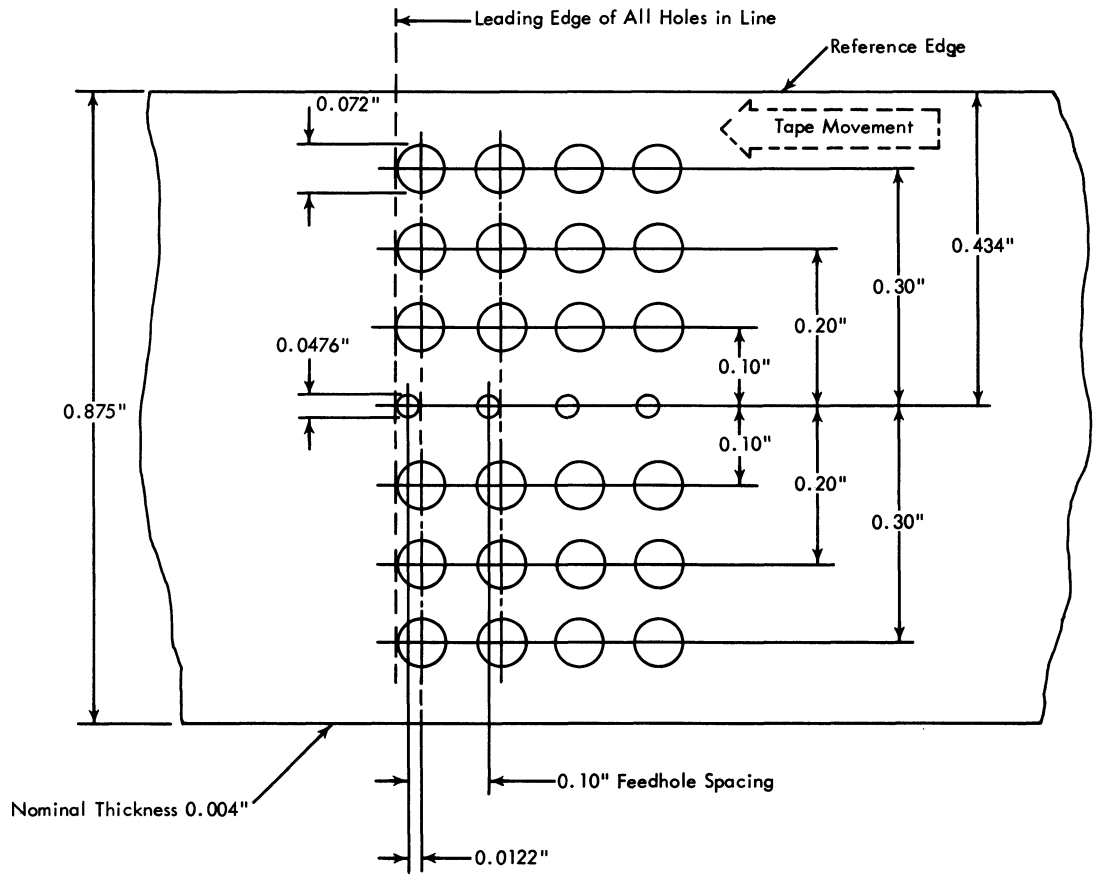


Figure PT-4. Tape Specifications, Advanced Feed Hole Tape

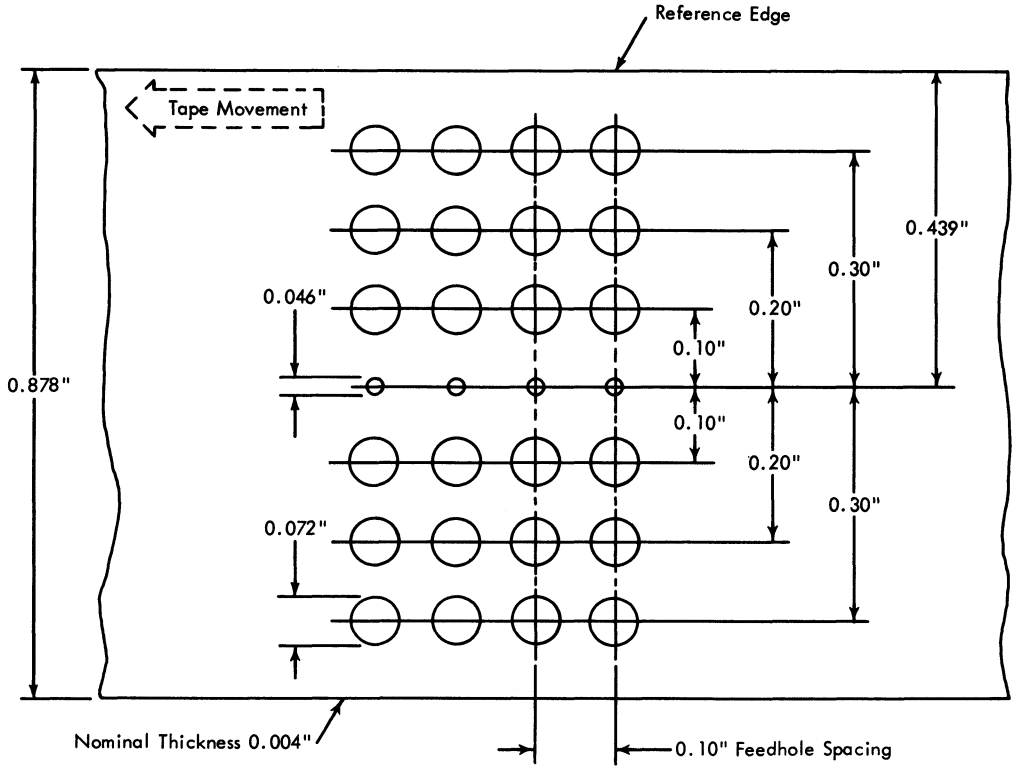


Figure PT-5. Tape Specifications, Japanese Tape

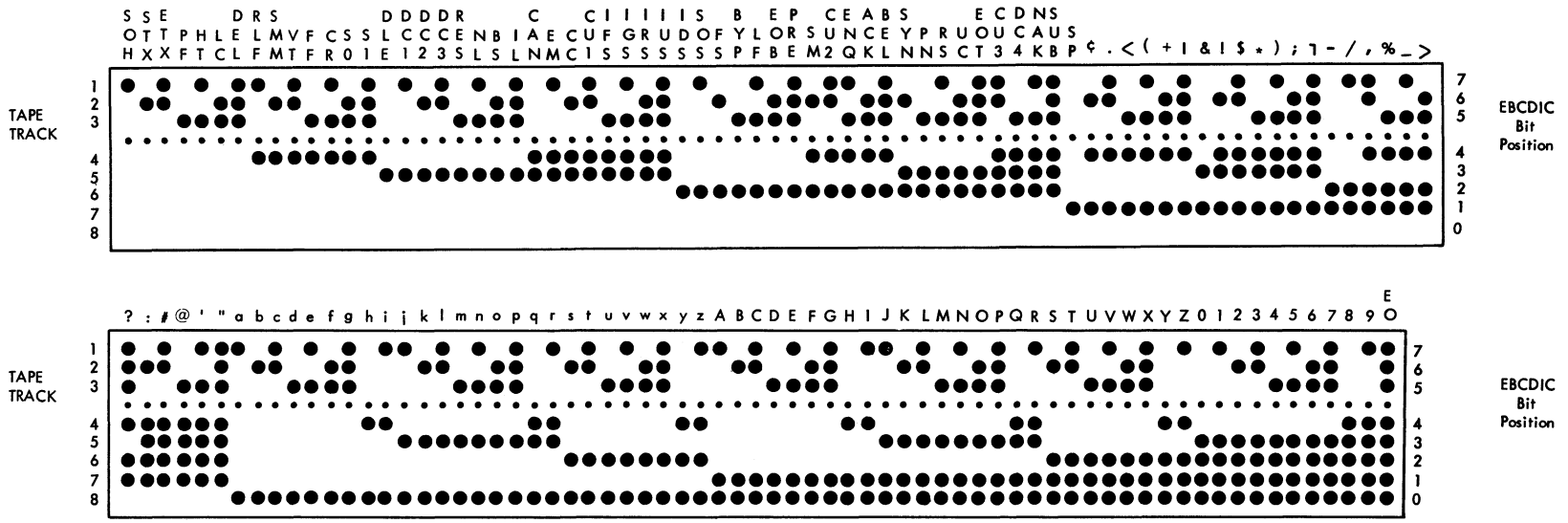


Figure PT-6. EBCDIC (Tape Code)

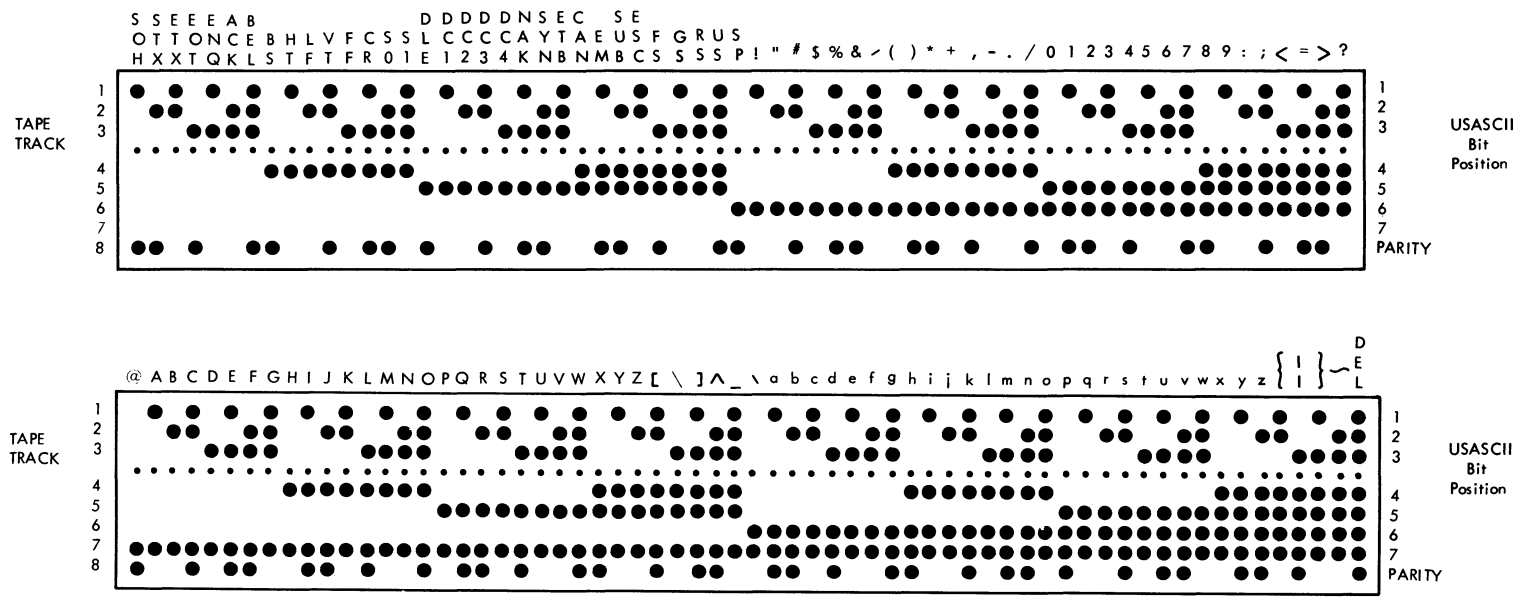


Figure PT-7. USASCII Tape Code

IBM 1017 Paper Tape Reader

IBM 1018 Paper Tape Punch

IBM 50 Magnetic Data Inscriber

Introduction

Operation of the IBM 50 Magnetic Data Inscriber when used as an input device on the IBM 2770 Data Communication System is described here. Details of the IBM 50 stand-alone operations are described in *IBM System/360 Component Description, IBM 50 Magnetic Data Inscriber,* Form A27-2725.

The IBM 50 Magnetic Data Inscriber (Frontispiece) is basically a stand-alone tape unit used to record keyboard entered data onto magnetic tape cartridges. Each cartridge (Figure 50-1) has a maximum capacity of 23,000 characters. The IBM 50 consists of a keyboard, program drum, operator console, and incremental tape transport.

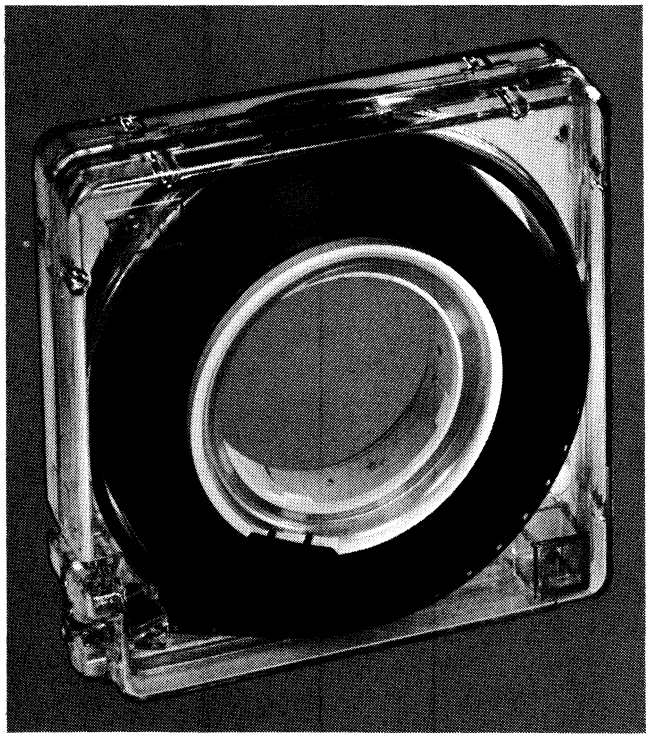


Figure 50-1. Tape Cartridge

Addition of the 2772 Attachment feature on the IBM 50, and the 50 Attachment feature (adapter) on the 2772 Control Unit, allows the tape unit to be used as an input device on the 2770 System. Data can then be read from tape cartridges and transferred through the 2772 to communications facilities (Figure 50-2). Data is read from cartridges at the rate of 117 characters per second (nominal).

When operating as input (terminal mode) on the 2770 System, IBM 50 keyboard entry is inhibited, and only tape reading can occur; however, when used alone, key entry, verify, and search can operate normally, and interlocking prevents interference with 2770 System operation.

Functions

As an input device on the 2770 system, the main function of the IBM 50 is to read data from tape and check it for correct parity. Other functions are automatic tape threading and tape rewinding.

Automatic Tape Threading

After a tape cartridge is loaded on the transport, pressing the "Search/Transmit" key on the tape Unit causes automatic threading of the tape until the first SOR character has been read.

The 2772 Control Unit is then signaled that the tape unit is in ready status.

Tape threading requires about five seconds.

Tape Rewind

Tape rewinds automatically into its cartridge when the "End of Data" (ED) character is read following the last character

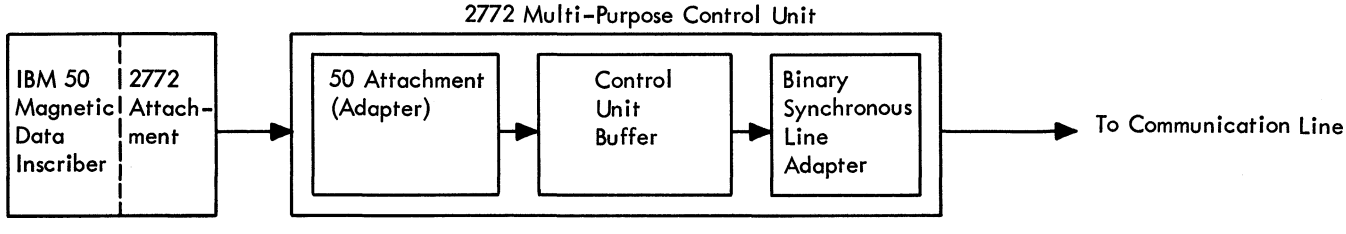


Figure 50-2. IBM 50 on 2770 Data Communication System

on the tape, when the Reset key on the tape unit is pressed, or when the physical end of tape is reached. At this point ready status is dropped.

NOTE: To be consistent with other sections of this manual, the ED character is hereafter referred to as the EM (End-of-Media) character; both have the same bit structure.

The time required to fully rewind tape into its cartridge is about 45 seconds.

Total interruption time for cartridge changing is approximately:

Rewind	45 sec
Operator Load	20 sec
Threading	5 sec
TOTAL	70 sec

Operating Characteristics

The IBM 50 Magnetic Data Inscriber with a 2772 attachment feature can operate in input (terminal) mode or stand-alone (manual) mode.

Mode selection is determined by the setting of the Terminal/Manual switch located on the IBM 50 console.

Terminal Mode

With the Terminal/Manual switch in the TERMINAL position, the tape unit is ready to read data into the 2770 Data Communication System when the following conditions have been met:

1. Tape unit power on.
2. Cartridge loaded on tape unit.
3. Search/Transmit key on the tape unit has been pressed.

When the Search/Transmit key is pressed, tape automatically threads to place the first character in position to be transferred to the 2772 Control Unit. The tape unit goes into ready status until an EM character is read from the tape.

After a read operation is initiated and the EM character is read into the 2772 Control Unit, a signal is returned to the tape unit, causing it to rewind tape into its cartridge. From this point the operation depends on the setting of the "End of File" switch on the tape unit.

If the "End of File" switch is in the ON position when the EM character is read, a normal job end is indicated to the 2772 control unit.

If the "End of File" switch is in the OFF position when the EM character is read, data transfer is interrupted until the tape is rewound and a new cartridge is loaded, and the Search/Transmit switch is pressed. The read operation will then continue. This procedure is followed until the last tape cartridge for the job is loaded on the transport. At this time, the "End of File" switch is placed in the ON position so that the 2772 Control Unit will be signaled to end the job when the next EM character is read.

Manual Mode

When the Terminal/Manual switch is in the MANUAL position, the 50 tape unit can perform its usual stand-alone operations of key entry, verify, and search.

Interlocking prevents manual operation of the tape unit from interferring with the 2770 System operation.

Code Set

When operating in manual mode the IBM 50 records data in EBCDIC code. Since there is no translator in the 2772 control unit adapter, data is read into the 2770 system only in EBCDIC code when the tape unit is operating in input (terminal) mode.

The "End of Data" (EM), and "Start of Record" (SOR) characters are the function codes recognized by the tape unit.

Checking-Terminal Mode

All characters read from tape are checked for odd parity. When a parity error is detected, the tape unit reads the character up to three times in an attempt to obtain good parity. If a parity error remains after the third reading, the "Character Check Indicator" blinks 2 or 3 times at a one second rate and then remains on. Tape reading continues; however a substitute (SUB) character is transferred to the 2772 Control Unit in place of the character in error. The substitute character used is the EBCDIC SUB character (00111111).

When the character check indicator is on as the result of a parity check, it will also blink 2 or 3 times after any other unsuccessful attempt (3 reads) to read odd parity within data on the same cartridge.

An End of Data (EM) character must be read prior to the physical end of each tape; otherwise the "End of Tape" indicator in the tape unit will turn on and the tape will rewind. An input device error will also be indicated to the 2772 Control Unit.

Special Features

50 Attachment Feature, Second

This 2772 special feature allows the attachment of a second tape unit to the 2770 Data Communication System

(the 50 Attachment Feature–First is a prerequisite). When the second tape unit is attached via this feature, both units function as a single input device.

Either or both tape units can operate in terminal mode or in manual mode.

When both tape units are used as input to the 2772 Control Unit, the one designated as primary reads first.

When an EM character is read, and if the End of File Switch is off, the tape rewinds, and the secondary unit immediately begins reading tape. A new cartridge is then loaded on the primary tape unit, its Search/Transmit key is pressed, and it becomes ready to read as soon as the secondary unit finishes reading its tape. Tape reading continues on alternate units until all cartridges have been read. The "End of File" switch on both tape units is kept in the OFF position until the last cartridge for the job is loaded. Then, the End of File Switch on the tape unit reading the last tape is placed in the ON position so that the 2772 Control Unit will be signaled that the last tape for the job has been read.

If an EM character is read on a tape unit while the "End of File" switch is in the OFF position and the other tape unit is not in ready status, data transfer is interrupted until the non-ready condition is corrected, after which data transfer resumes.

Controls and Indicators

An IBM 50 attached to the 2770 Communications System has two additional switches. These switches are Terminal/Manual, and EOF. The key originally labeled Search is also changed to one labeled Search/Transmit. Figure 50-3 shows the location of these controls.

Power On Switch

This switch applies power to the IBM 50. The tape unit has its own line cord and does not depend on the power on status of the 2770 system.

Terminal/Manual Switch

This switch determines the operating mode of the tape unit. When in the TERMINAL position it allows data to be transferred to the 2772 Control Unit. When the switch is in the MANUAL position, the IBM 50 can perform all of its basic functions completely independent of the 2770 Data Communication System. This switch should always be in MANUAL position when the tape unit power is turned on or off.

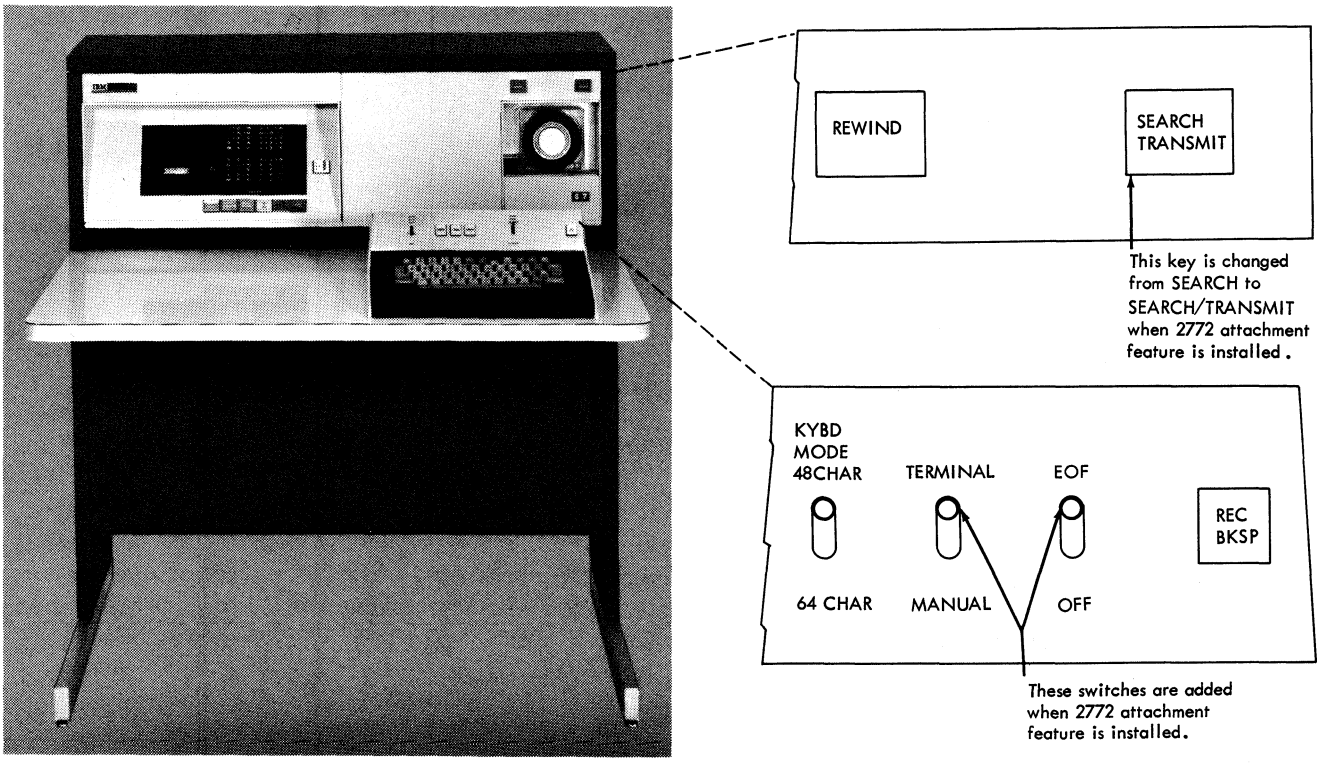


Figure 50-3. IBM 50 Operator Controls

End of File Switch

The setting of this switch determines the operation of the 2770 System when the "End of Data" (EM) character is read from tape. When in the ON position, the 2772 is signaled to perform an end-of-job routine upon detection of the EM character.

With the switch in the OFF position, the 2772 Control Unit is signaled to interrupt data transfer when the EM character is detected. Data transfer resumes after a new cartridge is loaded, and, upon detection of the first SOR character, the tape unit is put into ready status.

Search/Transmit Key

This key is pressed after a cartridge has been loaded. It causes tape to thread and activates Ready status upon detection of the first SOR character.

Reset Key

Pressing this key when reading deactivates ready status, signals input device error to the 2772 Control Unit, turns on the "End of Tape" indicator, and rewinds the tape. If the key is pressed when not reading, tape rewinds and ready status is deactivated.

Operate Indicator

This indicator turns on under the following conditions:

1. A cartridge loading is required.
2. The cartridge presently on the tape unit has had its data transferred successfully.

The indicator turns off when the tape unit is placed in ready status.

The indicator blinks from the time the Search/Transmit key is pressed until the first SOR character is read.

The indicator also blinks during rewind and remains blinking if the End of Tape indicator is on, indicating that the End of Tape error recovery procedure must be initiated.

End-of-Tape Indicator

This indicator turns on when the Reset key is pressed during a data transfer or when the physical end of tape is reached without detecting an EM character. The indicator is turned off when the Terminal Reset key on the 2772 Console is pressed.

Character Check Indicator

This indicator blinks 2 or 3 times at a one second rate, then stays on when a parity error is detected by the tape unit after it has attempted unsuccessfully to read the character for the third time. Tape reading continues until the cartridge is finished. The indicator is turned off when the Terminal Reset key on the 2772 control unit is pressed to abort the job, or when the Search/Transmit key is pressed after loading a new cartridge.

Unused Indicators and Keys

The First Character, X-Y Coordinate, Verify Error, Rewrite Character, and Cancel Record indicators are not functional when the tape unit is in terminal mode. None of the keyboard keys or switches are functional while the tape unit is in terminal mode except those described in this section.

Error Recovery Procedures

Character Check

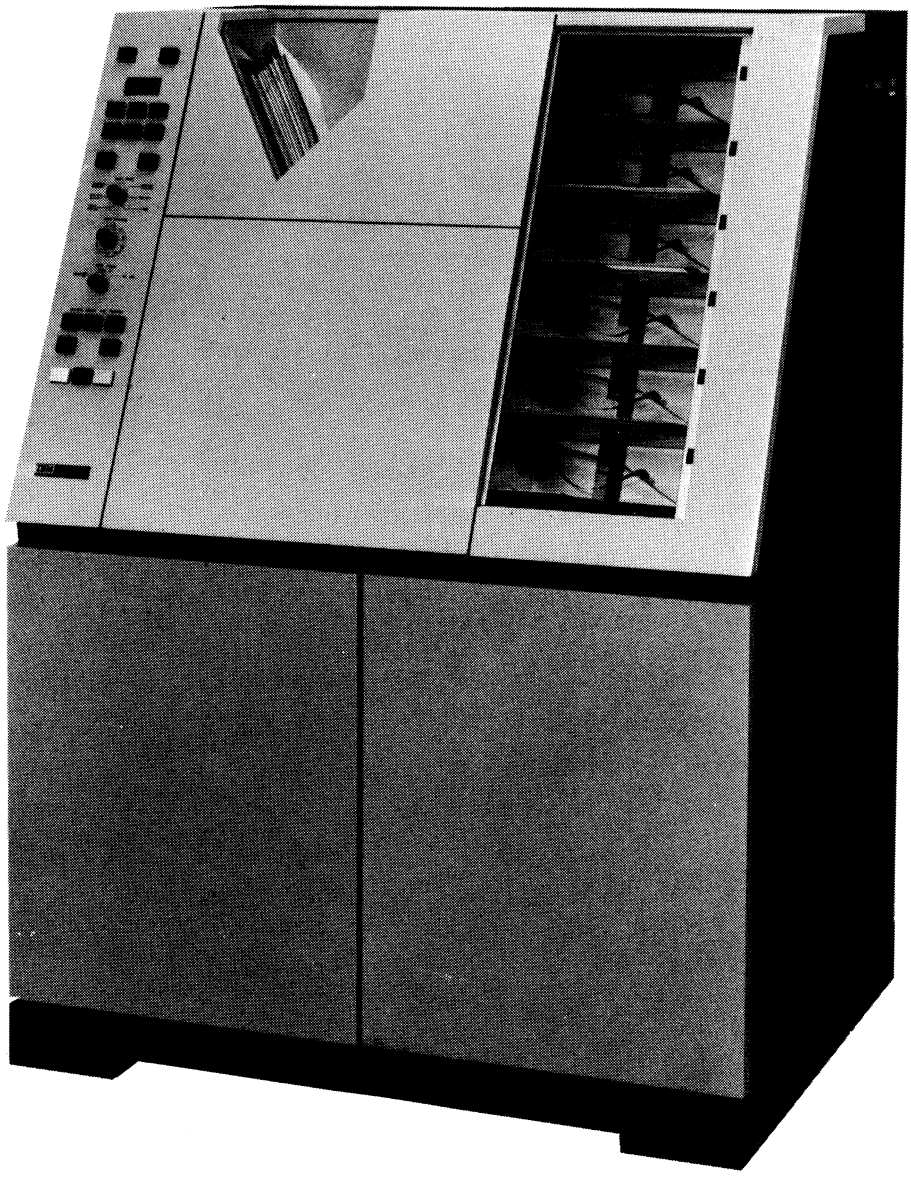
A character check results when a parity error is detected. The transfer of data from tape continues until all data on the tape is read; however, a substitute-character is transferred to the 2772 control unit in place of the one containing the parity error, and the Character Check indicator turns on.

The operator establishes a restart point in the data stream. The restart may be from the beginning of the job, from the beginning of the cartridge within the job, or the job may be continued by loading the next cartridge. The remote station should be notified of the action taken. The Character Check light is turned off when the 2772 Terminal Reset key is pressed, or when the Search/Transmit key is pressed to load the next cartridge.

End of Tape

The End-of-Tape indicator turns on when the physical end of tape is reached without reading an EM character, or when the tape unit Reset key is pressed.

Ready status is dropped, input device error is indicated to the Control Unit, and the tape rewinds; however the End-of-Tape indicator remains on. To restart from this condition, remove the cartridge and press the Terminal Reset key on the 2772 Control Unit console and follow normal initializing sequence. Establishing a restart position in the data stream is done by the operator. The restart may be at the beginning of the job or the beginning of a tape cartridge within the job.



IBM 1255 Magnetic Character Reader

Introduction

The IBM 1255 Magnetic Character Reader Model 1 (Frontispiece) is a free-standing input device that attaches by cable to the IBM 2772 Multi-Purpose Control Unit of the IBM 2770 Data Communication System. The IBM 1255 Magnetic Character Reader reads magnetic-ink-character coded data from intermixed card and paper documents of varying sizes and thicknesses. The reader sends the data, one character at a time, through its attachment feature (required special feature) to one of two buffers in the 2772 Multi-Purpose Control Unit. The 2772 must have the Buffer Expansion special feature, and must include a printer as an output device.

The 1255 reads and transfers data into the two buffers of the 2772 Control Unit, automatically stopping and alternating between buffers when a predetermined number of records-per-buffer have been read. The number of records (documents) stored in the buffer is determined by the number of characters per document that are to be read and transmitted. The records-per-buffer is set at 4, 6, 8, 10, or 12 as shown in the following table:

*Number of Characters per Document**	*Records (Documents) per Buffer*
20 Maximum	12
24 Maximum	10
30 Maximum	8
41 Maximum	6
53 Maximum	4

**NOTE:* Includes special symbols (other than the dash (-) symbol). If the Dash Transmission special feature is installed, the dash (-) symbol of the Transit-Routing field is counted.

The number of records-per-buffer must be specified at the time of ordering the 1255; however, the number is field changeable at customer request. Documents read by the 1255 can be listed by the system printer when the 2770 System is operating in home mode. The 1255 must be selected as the input device and the printer as the output device by the setting of the Job Select switch on the 2772 Operator's Console.

The IBM 1255 is used primarily in bank demand deposit applications. The reader performs on-line data capture from MICR (Magnetic Ink Character Recognition) encoded checks for updating of demand deposit accounts, and fine sorting of checks (usually by account number) when operating off-line.

NOTE: The terms on-line and off-line, when used in this section, refer to the status of the 1255 only; the 1255 is on-line when delivering data to the 2772 control unit, and off-line when operating as a stand alone unit. The 2772 Control Unit may be operating in line mode or in home mode when the 1255 is on-line.

The IBM 1255 Magnetic Character Reader consists of the following units:

- Hopper
- Aligner
- Main Transport
- Document Sensors
- Read and Recognition Station
- Stackers

Functions

DOCUMENT READING

Documents read by the IBM 1255 Magnetic Character Reader must be inscribed with the MICR E-13B type font (Figure 1255-1). The E-13B type font must agree with the recommendations of the American Bankers Association (A.B.A.) Technical Committee on the Mechanization of Check Handling. MICR-encoded documents in the E-13B font have predetermined fields of information inscribed (printed) near the bottom edge of the document. The IBM 1255 reads the inscribed fields starting from the right-hand end of the document; the 2772 Attachment feature reverses this order before transferring the data to the 2772 buffer.

Two versions of the IBM 1255 Magnetic Character Reader Model 1 are available, Domestic and World Trade. The Domestic version is capable (under switch control) of reading or sorting the following inscribed fields on the document:

- Amount—ten digits, fixed length. Must be bracketed by the Amount symbol (Figure 1255-1).
- Process Control—variable length (0-6 digits). Must be preceded by the second Amount symbol and followed by the On-Us symbol. Dashes or spaces are allowable anywhere in the field.
- Account Number—variable length (1-10 digits) or fixed length (5, 6, 7, 8, 9, or 10 digits). Must be preceded by the first On-Us symbol and followed by the On-Us or Transit symbol. Dashes or spaces are allowable anywhere in the field.

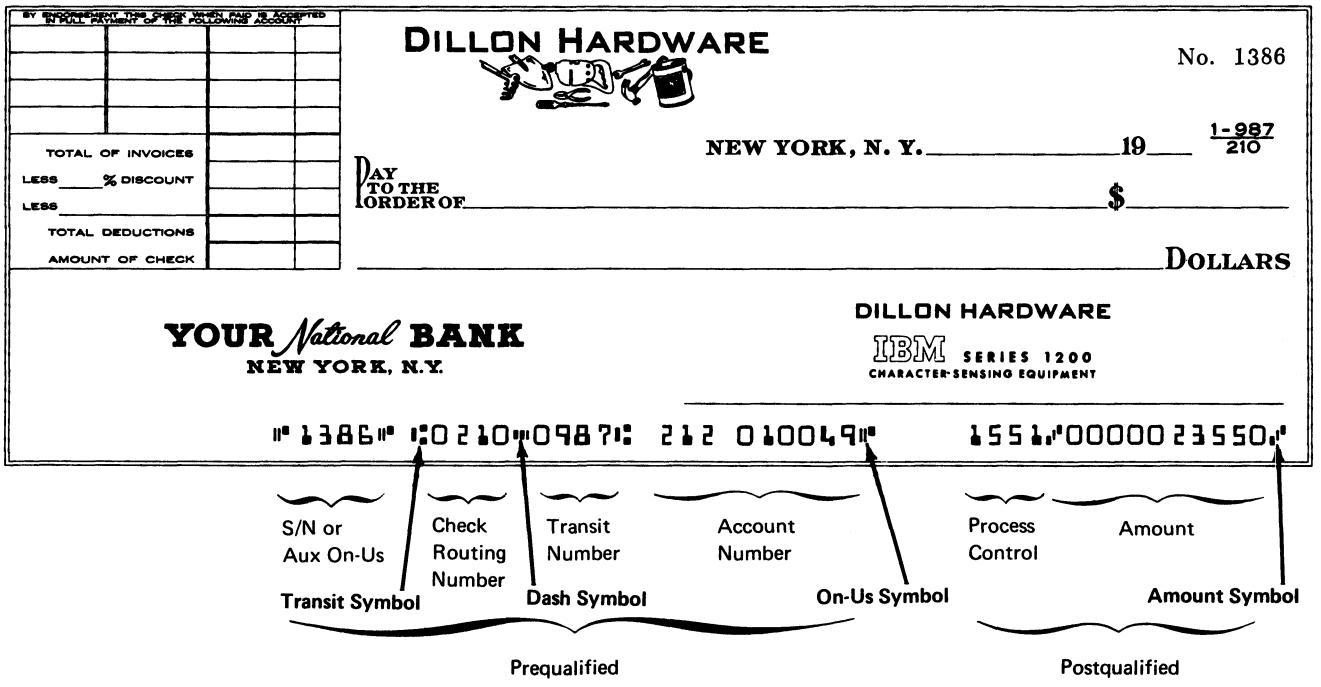


Figure 1255-1. Typical MICR Document

- Transit Routing–two four-digit numbers separated by a dash, or a three-digit number and a five-digit number separated by a dash. The field must be bracketed by the Transit symbols.
- Serial Number or Auxiliary On-Us–variable length (0-10 digits). Must be bracketed by the On-Us symbol. Dashes or spaces are allowable anywhere in the field.

The World Trade version of the IBM 1255 Magnetic Character Reader Model 1 is capable (under switch control) of reading or sorting the same inscribed fields as the Domestic version; however, in some cases the size of a field or the bracketing symbols are different. The differences are:

- Amount–ten *or* eleven digits, fixed length. Closed by the On-Us symbol.
- Serial Number or Auxiliary On-Us–the closing On-Us symbol for the Transit Routing field may also open this field.
- Transit Routing–fixed length of six or eight digits closed by the On-Us symbol.

The choice of field size (by machine version) is made by the customer to suit his individual requirements and is wired by an IBM Customer Engineer at the time of installation.

CHARACTER CODING

The IBM 1255 Magnetic Character Reader can operate in either of two code environments, EBCDIC or USASCII. However, the code used must be in agreement with the code used by the 2770 System. Figure 1255-2 illustrates the EBCDIC and USASCII code representation for each of the numerals and symbols that can be encoded on a document.

DOCUMENT SORTING

Document sorting is possible only when the IBM 1255 is operating off-line. When operating off-line, any of the inscribed fields on the document may be sorted, but only one

E-13B	Graphic	EBCDIC Structure	USASCII Structure	
0	0	1111 0000	011 0000	
1	1	1111 0001	011 0001	
2	2	1111 0010	011 0010	
3	3	1111 0011	011 0011	
4	4	1111 0100	011 0100	
5	5	1111 0101	011 0101	
6	6	1111 0110	011 0110	
7	7	1111 0111	011 0111	
8	8	1111 1000	011 1000	
9	9	1111 1001	011 1001	
⑆ Amount	$	0101 1011	010 0100	
⑈ (On–Us)	,	0110 1011	010 1100	
⑆ (Transit)	<	0100 1100	011 1100	
⑈ (Dash)	–	0110 0000	010 1101	
REC/SEP	None	0001 1110	001 1110	
HT (Hor Tab)	None	0000 0101	000 1001	Balance List Feature Only
Decimal	.	0100 1011	010 1110	Balance List Feature Only
Plus Sign	+	0100 1110	010 1011	Balance List Feature Only
Space	None	0100 0000	010 0000	Balance List Feature Only

Figure 1255-2. MICR Character Coding

field can be sorted at a time. Two passes of the documents through the machine (Phase 1 and Phase 2) are required for each digit position (column) of the field being sorted. All documents must be joggled by a commercially available mechanical document joggler prior to each pass through the machine.

Off-line sorting uses five sort-stackers and one reject stacker for a two-phase digital sort. Phase 1 sorts even digits, rejecting odd digits which are sorted in Phase-2. This conforms to the sort pattern of other six-pocket sorters and permits the start of Phase 2 without removing Phase 1 documents from the stackers. If the alternate Sort Pattern is specified at the time of ordering, digits 0-4 sort in Phase 1 and digits 5-9 sort in Phase 2 (see Figure 1255-4).

DOCUMENT THROUGHPUT RATE

Off-Line Operation

When operating off-line, the document throughput rate depends upon the length of the documents, weight of the document paper, temperature, and humidity. The average document throughput rate (documents per minute) can be calculated by dividing 3000 by the length of the documents in inches. For example, if document length is 6 inches, the average throughput rate is 500 documents per minute.

On-Line Operation

When operating on-line, the document throughput rate depends upon the length of the documents, the bit rate of the communications line used, and the number of documents per buffer (4, 6, 8, 10, or 12). Throughput formulas and examples, when operating with 1200, 2000 or 2400 bps (bits per second) communications lines, are shown in the SRL manual–*IBM 2770 System Summary*, Form A27-3014.

DOCUMENT COUNTER

A six-digit-position counter, located near the top of the 1255 operator's panel (see Figure 1255-5), counts each document as it passes the read station. The counter can be manually reset by the operator at any time except when documents are feeding.

Document Specifications

Random intermixed documents, within the specifications outlined in Figure 1255-3 can be fed, transported, and stacked by the IBM 1255 Magnetic Character Reader.

Length	5.750 in. (146,05 mm) to 8.875 in. (225,42 mm)
Width	2.5 in. (63,5 mm) to 4.25 in. (107,95 mm)
Thickness	.003 in. (0,076 mm) to .007 in. (0,178 mm) and carriers containing a document up to .013 in. (0,330 mm)
Weight	Short and long grain 20 to 44 lb. (75 to 165 grams per square meter). (Including card stock and American Express Travelers Checks)

Figure 1255-3. Document Specifications

Usage Meters

Two usage meters are located on the upper right-hand side panel of the 1255. The right-hand meter is used by IBM Customer Engineers only. Time is recorded on this meter whenever maintenance is performed on the 1255. The left-hand meter records customer usage time. The customer usage meter starts recording time (both on-line and off-line operation) when the first document leaves the hopper, and continues until one of the following conditions occur:

- Hopper becomes empty.
- Jam or open interlock condition exists.
- Data overrun stop.

Operating Characteristics

DOCUMENT HANDLING

The document transport path in the IBM 1255 Magnetic Character Reader consists of the following sections:

- Hopper, Separator, and Restraint section
- Aligner section
- Main Transport section
- Stacker section

Hopper, Separator, and Restraint Section

The hopper, separator, and restraint section consists of a fixed-guide hopper, a separator belt, a restraint belt, and associated drive mechanisms (Figure 1255-4).

Documents are placed in the hopper with the encoded MICR print line against the backguide and facing downward to the left. The maximum capacity of the hopper is a 5.5 inch (139.7 mm) thick stack of documents. The hopper can be filled to maximum capacity while documents are being fed without stopping the machine.

Document feeding from the hopper is under control of a separator belt and a restraint belt. The separator belt advances the bottom document in the hopper while the motion of the restraint belt (in the opposite direction) prohibits the feeding of any other document.

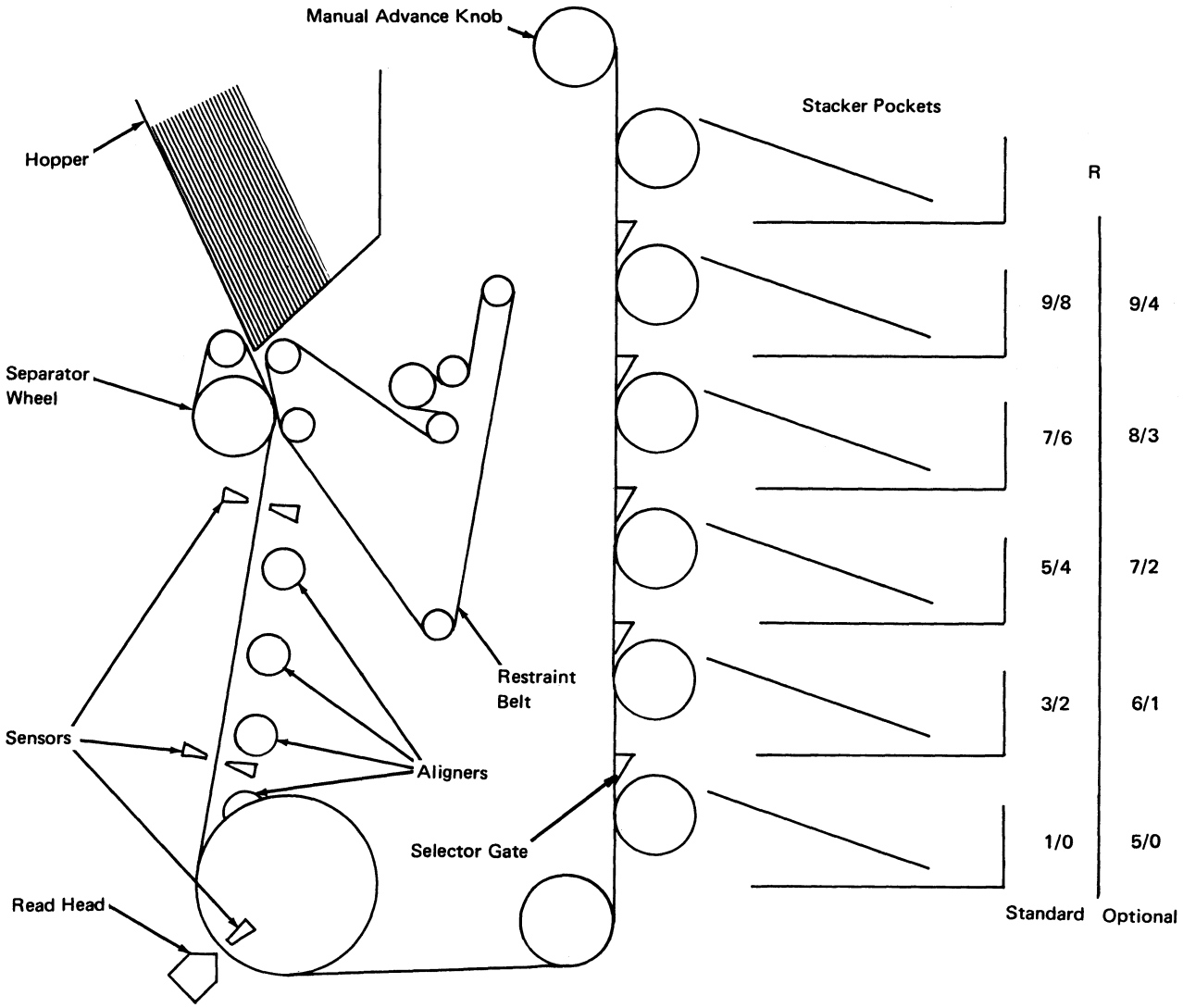


Figure 1255-4. Document Flow Path

Aligner Section

The aligner section positions the bottom edge of the documents against a fixed reference guide surface so that the encoded MICR characters are in the correct position to be read. This section also establishes a gap between documents.

Aligning is done by four sets of feed rolls inclined at an angle to the reference guide. Each set of rolls consists of a high-friction driving roll and a low-friction, spring-loaded pressure roll.

Main Transport Section

The main transport accelerates the documents to 150 inches per second (3810 millimeters per second), and carries them through the write and read area, and then into the vertical stacker transport. Here they can be directed into any one of six vertical stackers.

Stacker Section

Documents enter the vertical stacker transport after leaving the main transport section. In the vertical stacker transport area the documents are carried between the main transport belt and individual stacker rolls, one at each stacker, spaced four inches apart.

Documents are deflected by individual stacker selector gates into the five lowest stackers. A gate is rotated into the document path by energizing a solenoid attached to the corresponding gate. Since the sixth (top) stacker is located at the end of the transport, only a fixed guide is required to deflect a document into this stacker.

As a document enters one of the six stackers, it is forced by a pressure roll and accelerator roll into a concave shape. This increases document stiffness and allows the document to be fed over the stack of documents already in the stacker. Document feeding is stopped when a stacker fills to about 2.5 inches (63,5 mm).

DOCUMENT READ AND RECOGNITION

As a document leaves the aligner section of the transport mechanism and approaches the read station, it passes through a magnetic field generated by two permanent magnets. The magnets are located ahead of the read station on both sides of the document path. The magnetic field magnetizes the ink of the printed E-13B font characters as they move between the magnets.

As a character passes under the read head, the magnetized ink generates a signal that is characteristic of the printed character. A character is recognized through an electronic analysis of its characteristic signal. The recognition is used for:

- Synchronizing signals to the sort and run controls.
- Field recognition and validation.
- Error detection.
- Off-line column selection.
- Off-line stacker command generation.
- On-line data transmission.

DOCUMENT SENSORS

Three document sensing stations, located in the aligner, main transport, and document read sections, check for the proper movement of the document through the transport area (see Figure 1255-4).

Each document sensing station consists of a transmitter and a receiver placed on opposite sides of the document path. The transmitter emits sound waves which are detected by the receiver. A document passing between the transmitter and receiver prevents the sound waves from reaching the receiver. This condition indicates the presence of a document at the sensing station. The three document sensors are used as follows.

Document sensor 1 is used to stop document feeding when the predetermined number of documents (records) per buffer (4, 6, 8, 10, or 12) has been reached. This sensor also turns off the separator and transport drive mechanism when an empty-hopper condition occurs. Document sensor 2, in conjunction with document sensor 3, detects a document-spacing condition.

Document sensor 3 turns on the document read and recognition circuits, and also checks for short or overlength documents.

All three document sensors are also used to detect document jams.

CHECKING AND ERROR DETECTION

Character Recognition Checking

When a character in a selected field fails to be recognized, or is recognized as more than one character, the error circuitry prevents field validation. When operating on-line and an error is detected, the data from this document is not transferred to the 2772 buffer, and the document is directed to the reject stacker. When operating off-line, the document is rejected.

Field Length Checking

A column counter is used to check for the proper length of all selected fixed-length fields. The column counter is reset at the beginning of each field and is advanced only during the reading of a selected field. When operating on-line, a field-length error prevents the data for that document from being transferred to the 2772 buffer, and the document is rejected. When operating off-line, the document is rejected.

Validity Checking

On-Line Operation

All digits and the opening and closing symbols are checked for validity on all fields selected for transmission. Any invalid character or symbol prevents the data for that document from being transferred to the 2772 buffer and the document is rejected.

Off-Line Operation

Validity checking is performed on the column being sorted, all characters prior to the sort column, and both the opening and closing symbols of the selected sort field. In addition to the field being sorted, any other field and its bracketing symbols can be checked. A validity check error causes the document to be rejected.

Field Sequence Checking

Field sequence checking consists of a sequence check of all the special symbols required to properly identify selected fields. If a field is missing or the identifying symbol cannot be recognized, the circuitry allows field identification to continue after the next field is properly identified. If an error is detected while operating on-line, the document is rejected and all data for that document is prevented from being transferred to the 2772 buffer. When operating off-line, the document is rejected.

Document Length Checking

Document length is determined at the read station. A document longer or shorter than the allowable length (5.75 inches 146,1 mm minimum and 8.875 inches 225,4 mm maximum) is directed to the reject stacker when operating off-line. When operating on-line, the data for that document is prevented from being transferred to the 2772 buffer, and the document is rejected.

Document Spacing Checking

Two document-sensing stations (2 and 3) are used to detect the minimum allowable spacing between documents (7.5 inches, 191,0 mm). If the spacing is less than 7.5 inches, both documents are directed to the reject stacker (off-line or on-line operation). Also, when operating on-line, the data from the first of the two documents is prevented from being transferred to the 2772 buffer, and the second document is not read.

Record Length Checking

When the Function switch is in the on-line position, or either one of the checking positions (Mode A or B), and the machine is wired for more than four documents per buffer, a record length check is performed on the data read from each document. If more than the maximum number of characters specified are read from a document, a machine stop occurs, and the Data Overrun light turns on. This document and the following documents in flight (maximum of two) are directed to the reject stacker. This can occur if a document is inscribed incorrectly, or if an improper combination of Validy Check and Read Out switches are pressed.

Jam Detection

The three document-sensing stations and associated timing circuits are used to detect jams in the aligner, read, and intermediate transport areas of the document path through the machine. When a jam is detected in any of these areas, the separator drive is stopped immediately and the transport drive is stopped after a time interval which allows all documents in the transport to be stacked. A mechanical jam strip in the transport area, when activated by a jam, stops both the separator and transport drive immediately. A jam that occurs ahead of the first document sensing station is detected as an empty-hopper condition. If a document is not detected at the first document sensing station within a fixed period of time, the machine will stop. A jam indication is provided to the control unit when operating on-line.

Special Features

51-COLUMN CARD SORT

When installed, this special feature permits the reading and sorting of 51-column card documents that would otherwise be rejected by the 1255 Magnetic Character Reader. The 51-column documents can be fed separately or be intermixed with other size documents; however, to obtain optimum performance 51-column card documents should be separated from standard size ABA documents during first pass operations. Fifty-one column documents will feed about 525 documents per minute.

A change in separator speed, to allow 51-column sorting, reduces the average off-line throughput of 6 inch (152 mm) documents to approximately 425 documents per minute. To calculate the throughput rate, with the 51-column sort feature installed (documents per minute), divide 2550 by the length of the document in inches.

DASH TRANSMISSION

This special feature allows the dash (-) symbol, encoded in the Transit-Routing field (see Figure 1255-1), to be transferred to the buffer in the Control Unit for transmission. The feature is operative only if the Transit-Routing field is selected to be read (Transit-Routing Validity Check and Readout Key operated). With the dash symbol in storage the CPU program can distinguish between duplicate foreign and domestic transit numbers.

SELF-CHECKING NUMBER

The 1255 can be equipped with either of two self-checking number features, Modulus 10 or Modulus 11. The account number on each document can be verified during sorting or reading operations without affecting the throughput rate. The Self-Checking Number key on the operator's console turns the feature on or off. The digits in the account number field are acted upon mathematically to produce a check-digit that reflects the exact combination of digits in the account number. This check digit is then compared with the check-digit previously calculated and encoded on the document. This check digit can be located in any position of the account number and becomes a part of it. Once established, the check-digit position must be the same for all documents. With this feature installed, the account-number verification (maximum of 10 positions including dashes and self-check digit) occurs whenever the Self Checking Number key and the Validity Check and Readout Account Number keys on the console are operated.

Documents with incorrect account numbers are directed to the Reject stacker, except when the Function switch is set to either checking position (Mode A or B). If the Function switch is in a checking position, the error document is directed to the fourth stacker from the top and the machine stops. Documents following the error document are sorted properly.

Modulus 10 will check any weighting factor of 0 through 9. Modulus 11 will check any weighting factor including 0. The weighting factor of the check-digit is 1, regardless of its position. The weighting factor for each digit position in the account number and the position of the selfcheck-digit are determined by the customer and wired by an IBM Customer Engineer at the time of installation.

NOTE: The position of the self-check digit and the weighting factors used by the 1255 must be in agreement with the position and factors used by the device that initially encoded the account-number field on the documents.

BALANCE-LIST

This feature enables the terminal location (2770/1255) to pre-balance each batch of documents to a predetermined total prior to operating the 2770/1255 in line mode. By balancing batches of documents and determining the known rejects prior to transmission, total communication time can be reduced and delays at the central processor (System/360) can be avoided.

The Balance-List feature is under switch control and functions only when the 2770 System is operating in home mode. The 1255 is selected as the input unit and the system printer as the output unit, by the setting of the Job Select switch on the 2770 Console.

NOTE: Although this description assumes the printer is used as output, another output device could be assigned instead.

When the Function switch is set to the Checking Mode A position, an amount total is accumulated in the 1255 for all valid documents within a batch. When an End-of-Batch (batch total) document is detected, three totals are transferred in succession from the 1255 to the 2772 Control Unit buffer for printing. The first total transferred and printed is the batch total inscribed on the End-of-Batch document. The second total transferred and printed is the total of the Amount of each valid document read in the batch. The third total transferred and printed is the difference (if any) between the first and second totals. Documents feed continuously during this balance-only operation.

When the Function switch is set to the Checking Mode B position, the operation is the same as when the switch is set to the Checking Mode A position, except that each valid document is listed by the printer. This listing is partially edited in that horizontal tab codes are inserted before all special symbols or groups of special symbols encountered. Zero suppression and decimal insertion are also performed on each amount field. Spaces are transferred for each zero suppressed. The document fields to be read, transferred to the 2772 Control Unit, and printed are under control of the Validity-Check and Readout keys.

Only one control document (End-of-Batch) is required for the home mode balancing operation. This document must be recognized by the 1255. This is accomplished by inscribing the Account-Number field with a row of alike characters, for example ten fives (the 1255 is factory wired to recognize the digit five; if a different digit is to be used, it must be specified at time of order or at installation). The actual number of characters used will depend upon the length of the users Account-Number field. The End-of-Batch document recognition in the 1255 is similar to that employed to detect the End-of-File document, a required function when operating on-line (see On Line Operation in this (1255) section of the manual).

The three totals involved in the balance only or balance and list operation are printed in a single column with vertical alignment of the cents (right hand) position.

A Record Separator (RS/IRS) is automatically inserted between the batch total, the valid document total and the difference total. An additional RS/IRS code is provided at the end of the third print cycle to separate each group of totals by batch. The transfer of data from the 1255 to the control unit occurs between documents and therefore has no effect on the throughput rate. When performing a Balance-List operation, horizontal tab codes are inserted between the fields of the document that are selected to be read. Zero suppression and decimal insertion are provided for the amount field of each document, as well as for the three totals transferred, regardless of the operation.

A sign (+ or -) is printed adjacent to, and to the right of, the difference total. A + sign indicates a positive balance and a - sign indicates a negative balance. Zeros to the left of the first significant digit are suppressed and a decimal is inserted between the tens and hundreds position of all three totals. A balance condition is identified by printing a decimal, two zeros, and a + sign as the difference total.

When the 1255 is performing a balance-list operation, documents are fed in groups similar to the 1255 on-line operation. The number of documents per group is reduced to insure a sufficient number of storage positions in the 2772 buffer. This is necessary because of additional codes inserted in the data. The following table indicates the number of documents per group that can be handled by the buffer. The number of documents per group must be specified at the time of installation.

Characters Per Document	*Documents Per Group (Mode B)*
20 maximum	9
24 maximum	8
30 maximum	7
41 maximum	5
53 maximum	4

Dashes (--) in fields other than the Transmit-Routing field are not counted as characters. If the Dash Transmission special feature is installed and the Transit-Routing field is being read, the dash in that field must be counted as one character. If more than 4 documents per group are fed and the number of characters read from any document exceeds the maximum specified in the table, a Data Overrun error is generated. The document in error and documents in flight following the error document are rejected. Checking for a Data Overrun condition is performed during both modes of operation of the feature.

Error recovery procedures are required only in the case of jams which occur after the read station, or in case of a data overrun condition. In these cases the amount total counter in the 1255 should be reset and the entire batch rerun. Resetting the counter may be accomplished during error recovery or at the beginning of an operation by feeding an End-of-Batch document with a blank zero amount field.

Keys, Lights, and Switches

The following keys, lights, and switches are located on the operator panel of the 1255 (Figure 1255-5.)

KEYS

Power-On Key

Operating this back-lighted key causes power to be turned ON in the 1255. The key remains illuminated until the Power-Off key is operated.

Power-Off Key

This key, when operated, removes all secondary power from the 1255.

Start Key

Operating this key resets the electronic circuitry of the 1255 and causes the main motor to start. Documents will begin to feed if the machine is operating off-line. Document feeding, when operating on-line, commences only after the start key is operated *and* the control unit has signaled the 1255 that it is ready to receive data.

Stop Key

Pressing this key causes the separator belt drive mechanism to stop. However, the transport mechanism continues to run until all documents beyond the separator are stacked.

Validity-Check and Readout Keys

The Validity-Check and Readout Keys are mechanically latched when operated. A second operation of the key releases the latch and deactivates the key. These switches may be operated in any combination.

When operating off-line (with or without digital sorting), these keys cause the data in their respective fields to be validity checked. No transmission of data takes place and all correctly-read documents are directed to the second and third stacker from the top if not sorting, and to their respective

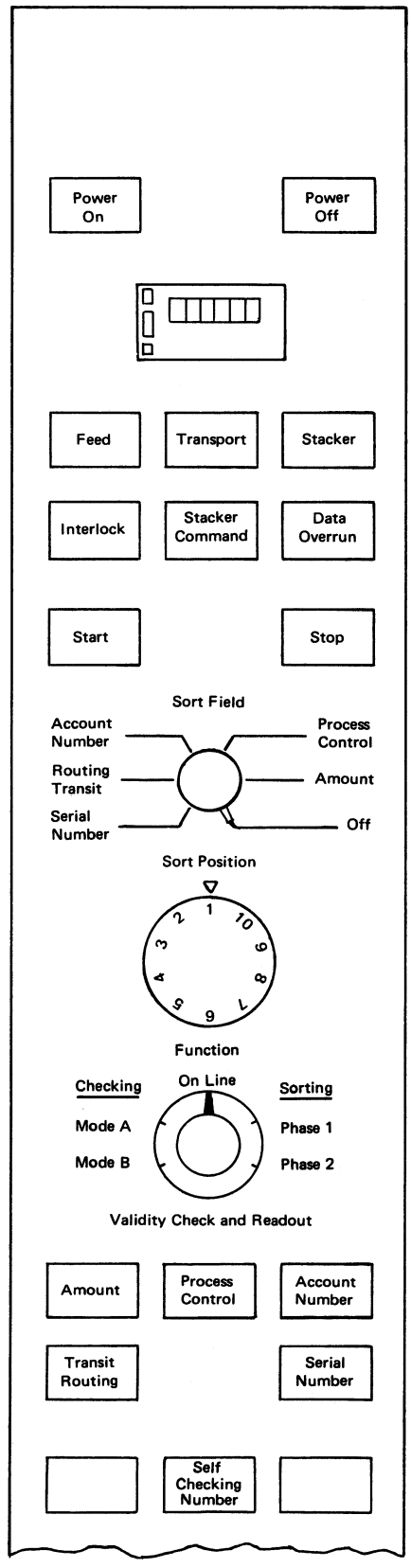


Figure 1255-5. Operator's Panel

stackers if sorting. Documents in error are directed to the Reject (top) stacker in either case (sorting or not sorting).

When operating on-line, these keys cause the data in their respective fields to be validity checked and transferred to the buffer in the Control Unit for transmission. All correctly-read documents are directed to the second and third stacker from the top. Documents in error are directed to the Reject (top) stacker.

Self-Checking Number Key (Special Feature)

This mechanically latched key, when operated, activates the account-number self-checking circuitry (see Self-Checking Number under Special Features).

INDICATOR LIGHTS

Feed Light

This indicator light turns ON when the separator and transport drive mechanism is stopped. This condition is usually caused by a jam in either the hopper-separator or aligner area of the document transport path. Pressing the 1255 Start key, after removing the jam or filling the hopper, resets the light when operating off-line. When operating on-line, the light remains on (after pressing the Start key) until the control unit indicates it is ready to receive data.

Transport Light

When ON, this light indicates a jam in the transport area or a jam in the stacker area. Removing the jam and pressing the 1255 Start key resets the indicator light.

Stacker Light

The Stacker light turns ON when one or more of the six stackers becomes full. Removing the documents from the full stacker(s), followed by the operation of the Start key, allows normal document feeding to continue.

Interlock Light

This indicator light turns ON and power is removed from the drive motor whenever the cover interlock or one of the moveable guides is open. Closing the cover guide and pressing the 1255 Start key turns the light off.

Stacker Command Light

This light, when ON, indicates that the 1255 has stopped because no stacker or more than one stacker has been selected for a document. The document receiving the erroneous stacker selection and all documents in flight following the error document (maximum of two) are directed to the reject stacker and the machine stops. Operating the 1255 Start key resets the indicator light.

When sorting documents off-line, this indicator is also used to signal the operator if the Sort Column switch is advanced and the Function switch is not returned to the Phase 1 position. The reader/sorter will not feed documents until the switches are set correctly.

Data Overrun Light

This indicator, when ON, indicates the 1255 has stopped because of its inability to complete transfer of data to the Control Unit, or because the number of data characters read from a document exceeds the maximum allowed by the group size (documents per buffer). Operator intervention followed by the operation of the 1255 Start key turns the indicator off and allows the machine to be restarted (see Operating Procedures, On-Line).

SWITCHES

Sort Field Switch

The setting of this rotary switch, active only in off-line mode, determines the field selected for fine sorting. This switch must be set to the OFF position when off-line validity-checking only (no sorting).

Sort Column Switch

The setting of this rotary switch, active only in off-line mode, determines the column of the field selected for fine sorting.

Function Switch

The setting of this five-position rotary switch determines the function performed by the 1255. The switch is subdivided into two checking positions, an on-line position, and two sorting positions.

When the switch is in the On-Line position, valid document data is transferred to the 2772 buffer. An alternate pocket mode of stacker selection is performed by the 1255. Documents, which have been successfully read and whose data has been transferred to the 2772, are directed to either the second or third stacker from the top; when one of these stackers becomes full, the other is automatically selected; if both stackers become full, 1255 operation stops. Documents not successfully read are directed to the top (reject) stacker.

The function of the checking positions varies depending upon whether or not the Balance-List special feature is installed on the 1255.

If the Balance-List feature is not installed, Mode A setting allows codeline verification to be performed by the 1255. Codeline verification consists of a validity check on all fields

read, a length check on fixed-length fields, and a record-length check. The fields read are selected by the Validity Check and Read Out keys on the operator panel. The maximum length of an acceptable record is determined by the number of documents fed (4--12) in the on-line mode of operation. Documents feed continuously.

The Mode B setting allows codeline verification and listing of document data on an output device connected to the 2772. Documents feed in groups.

When the Balance-List feature is installed, additional operations are performed by the checking portions of the Function switch. The Mode A setting allows the balance-only operation to be performed, and the Mode B setting activates the list and balance operation. These operations are described under Balance-List in the Special Features section (1255) of this manual.

The two switch settings, Sorting Phase 1 and Sorting Phase 2, are used when sorting off-line. Off-line sorting requires two passes of the documents through the machine for each column of the field being sorted. The two settings of the switch define the numerics to be sorted on a particular pass. When the switch is set to Sorting Phase 1, the even digits 0, 2, 4, 6, 8, or an alternate sort pattern, 0, 1, 2, 3, 4 are sorted into the first five stackers respectively. When the switch is set to Sorting Phase 2, the odd digits 1, 3, 5, 7, 9, or an alternate sort pattern, 5, 6, 7, 8, 9 are sorted into the first five stackers respectively. All other documents are directed to the Reject (top) stacker. This switch must always be set to the Sorting Phase 1 position after the Sort Position switch is advanced. When off-line validity checking only (no sorting) this switch can be set to either the Sorting Phase 1 or Sorting Phase 2 position but not the On-Line position. Either an odd/even sorting sequence, or a 0-4/5-9 sorting sequence (but not both) may be specified when the reader/sorter is ordered.

Operating Procedures

OFF-LINE SORTING (EVEN/ODD SORT SEQUENCE)

1. Press Power-On key.
2. Select field to be sorted (Sort Field switch).
3. Select low-order sort position (Sort Position switch).
4. Set Function switch to Sorting Phase 1 position.
5. Load documents and press Start key. Documents are placed in the hopper with the encoded MICR print line against the back guide and facing downward to the left.
6. Remove all documents from the Reject (top) stacker and reload them in the hopper at the end of the Phase 1 pass. Documents in the sort stackers need not be removed at this time.
7. Turn the Function switch to Sorting Phase 2 position and press the Start key.
8. Remove the documents from the stackers at the end of the Phase 2 pass. Retain the sort sequence of the documents. Set aside all reject documents.
9. Turn the Function switch to the Sorting Phase 1 position.
10. Select the next higher sort position (Sort Position switch).
11. Repeat steps 5 through 10 for each position of the field being sorted.

OFF-LINE SORTING (0-4/5-9 SORT SEQUENCE)

1. Press Power-On key.
2. Select field to be sorted (Sort Field switch).
3. Select low-order sort position (Sort Position switch).
4. Set Function switch to Sorting Phase 1 position.
5. Load documents and press Start key. Documents are placed in the hopper with the encoded MICR print line against the back guide and facing downward to the left.
6. Remove all documents from the Reject (top) stacker and reload them in the hopper at the end of the Phase 1 pass.
7. Unload all documents from the stackers and set them aside during the Phase 2 pass. Be sure to retain the sorted sequence of the documents (0 through 4).
8. Turn the Function switch to the Sorting Phase 2 position and press the Start key.
9. Set aside all rejected documents at the end of the Phase 2 pass.
10. Remove the documents from the stackers, retaining the sequence (5 through 9). These documents are placed behind the documents that were set aside after the first pass.
11. Turn the Function switch to the Sorting Phase 1 position.
12. Select the next higher sort position (Sort Position switch).
13. Repeat steps 5 through 10 for each position of the field being sorted.

OFF-LINE VALIDITY CHECKING (WITHOUT SORTING)

Validity checking of any or all fields without digital sorting may be done (using the top three stackers) with uninterrupted feeding.

1. Press Power-On key.
2. Press the desired Validity Check and Readout keys.
3. Turn the Sort Field switch to the OFF position.
4. The setting of the Sort Position switch has no effect during this operation.

5. Set the Function switch to either the Sorting Phase 1 or Sorting Phase 2 position, but not the On-Line position.
6. Load documents in the hopper and press the Start key. Documents are placed in the hopper with the encoded MICR print line against the back guide and facing downward to the left.

Documents without error will be directed to the second and third stacker from the top. When one stacker becomes full, the other (alternate) stacker will be selected. At this time, the full stacker may be unloaded. Continuous operation can be maintained by keeping the hopper loaded and unloading the full stacker after the alternate stacker has been selected. Documents with validity errors are directed to the Reject (top) stacker.

ON-LINE OPERATION

The 1255 must be placed in Ready mode before the feeding of documents can be initiated. Proceed as follows to place the 1255 in Ready mode:

1. Press Power-On key.
2. Reset Document Counter.
3. Press the appropriate Validity Check and Readout keys for the fields to be read and transferred to the control unit.
4. Set Function switch to the On-Line position.
5. Set Sort Position switch to any position, the setting has no effect when operating on-line.
6. Load documents in hopper. Documents are placed in the hopper with the encoded MICR print line against the back guide and facing downward to the left.
7. Press Start key.

Once the 1255 is in Ready mode, document feeding will start when the 1255 is signaled to do so by the 2772 Control Unit. The 1255 feeds documents in groups of 4 to 12 documents depending on the number of characters per document to be read and transmitted. The 80-column buffer test is not active when using the 1255; and if the EBCDIC Transparency special feature is installed on the 2772 Control Unit, the Transparency switch on the 2772 Operator's Console must be in the OFF position to allow document feeding.

A Record Separator (IRS in EBCDIC code, or RS in USASCII code) is transferred as data automatically at the end of each good document read into the buffer. An "Input End-of-Card" signal is generated automatically when the last document of a group (4, 6, 8, 10, or 12 documents) has passed the read station. The alternation of buffers occurs at this time. Data in the buffer just used are transmitted while the data in the next group of documents are entered in the alternate buffer. Rejected documents are counted as one of the group; therefore, the buffer may not always be full at time of transmission.

Documents are transmitted until the 1255 senses an End-of-File document. The End-of-File document is the last document in the run and has nines inscribed in the entire Account Number field. The combination of all nines being sensed in the End-of-File document and an empty hopper condition causes an EOF (End-of-File) signal to be transferred to the 2772. The EOF causes an ETX (End-of-Text) character to be transmitted to the System/360 signifying the end of transmission.

Batch Processing

Documents are usually processed in batches; the following discussion outlines one method of on-line batch processing.

The number of documents per batch depends on the overall size of the transmission run, and usually varies between 150 and 300 documents.

NOTE: Batches, as discussed here, have no relationship to, and do not affect the documents-per-buffer grouping discussed previously.

An End-of-Batch document, containing the batch total, is transmitted as the last document of each batch. The CPU program compares the total of the amounts of individual documents against the batch total document amount, and stores the results.

When a predetermined number of batches has been transmitted, the CPU program, by using the Processor Interrupt feature, directs the 2772 Control Unit to stop transmission (stop document feeding), and prepare to receive the batch totals from the CPU (as printed output). The number of batches transmitted between printouts can be controlled by inserting a uniquely coded document behind the desired number of batches. Detection of this unique document signals the CPU program to reverse transmission for printout of accumulated batch totals.

If the batch totals accumulated by the CPU and printed at the terminal agree with the totals inscribed on the batch total documents, processing can continue with the next series of documents. If the totals do not agree, operator intervention is required (see "Error Recovery Procedures"--"Batch Balancing").

ERROR-RECOVERY PROCEDURES

Documents that are rejected during an on-line operation are not indicated to the System/360 program since the data for these documents is not transferred to the 2772 buffer. Some of the conditions that cause the 1255 to stop are recoverable without an exchange of information with the CPU, while other conditions require an exchange of information. All 1255 stops cause the 2772 Control Unit to stop transmission; however, the recovery-procedure varies and depends upon the condition that caused the stop.

Procedures Requiring No Exchange of Information

The following table shows all the 1255 stop conditions that are recoverable without exchanging information with the System/360:

1255 Indicator	*Cause of Stop*
Feed	Jam prior to Read Head. Empty hopper. Operator stop.
Stacker	Both stackers full.
Interlock	Front cover or one of the removable guides in the document path is open.

Feed Indicator. If this indicator turns on because of a jam before the read head, remove the documents from the hopper and clear the machine of all documents in the transport. Place the documents removed from the transport in front of the documents removed from the hopper, and load the combined group back in the hopper. Press the Start key on the 1255, the Check Reset key on the 2772, and the Start key on the 2772, to resume operation.

If this indicator turns on because of an empty hopper, refill the hopper, press the Start key on the 1255, the Check Reset key on the 2772, and Start key on the 2772 to resume the operation.

If the indicator turns on due to an operator stop, the operator, once assured that the 1255 is capable of operating, should press the 1255 Start key, the 2772 Check Reset key, and the 2772 Start key to resume the operation.

Stacker Indicator. This indicator, when on, informs the operator that both good (alternating) stackers are full. After emptying both stackers, the operation can be resumed by pressing the 1255 Start key, the 2772 Check Reset key, and the 2772 Start key.

Interlock Indicator. This indicator, when on, informs the operator that the front cover or one of the removable guides in the document path is open. After correcting the condition that caused the indicator to turn on, press the 1255 Start key, the 2772 Check Reset key, and the 2772 Start key.

Procedures Requiring Exchange of Information

The following table shows the 1255 stop-conditions that require an exchange of information with the System/360:

1255 Indicator	*Cause of Stop*
Transport	Jam beyond the read head.
Data Overrun	Inability to transfer data between the 1255 and the 2772 Control Unit, or too many characters read from a document.

The Transport and Data Overrun indicators, when on, designate 1255 stop conditions that require sending a check point restart or a job restart message to the remote (receiving) station.

BATCH BALANCING

If batch totals accumulated at the CPU do not agree with the totals inscribed on batch total documents, the 1255 operator must take appropriate action to obtain agreement (see On-Line Operation-Batch Processing, for a description of batch totals). This action may be any of the following.

1. Enter reject documents into the system;
2. Re-run entire batch in error, and request that the batch in the CPU be cleared;
3. Request that the batch in CPU storage be retransmitted to the 2213 Printer at the terminal to assist in the reconciliation process;
4. Any combination of the above.

The batch balancing discussed in this section is a user function and is not supported by a Type I program.

CLEANING THE 1255

Paper dust accumulates as documents pass through the 1255. Miscellaneous failures can be prevented if the machine is cleaned regularly, however, be sure power is off and that all documents are removed before starting the cleaning operation. Use a vacuum cleaner with a narrow crevice-type attachment to pull dirt into the cleaner. Never blow dust from the machine; blowing creates a safety hazard and distributes dust to various areas of the machine where it can cause other failures.

To clean the document path, raise the front cover and unlatch both the aligner guide and the left side of the vertical stacker transport. Vacuum the feed, transport, and stacker sections thoroughly. Be watchful for and remove any paper clips, rubber bands, and staples.

Generally, the 1255 should be cleaned thoroughly twice each work week. However, this frequency should be increased if excessive dust build-up occurs.

Printed in U.S.A. A27-3013-0

International Business Machines Corporation
Data Processing Division
112 East Post Road, White Plains, N.Y. 10601
[USA Only]

IBM World Trade Corporation
821 United Nations Plaza, New York, New York 10017
[International]

READER'S COMMENT FORM

System Components
IBM 2770 Communication System

A27-3013-0

- How did you use this publication?

  As a reference source ☐
  As a classroom text ☐
  As a self-study text ☐

- Based on your own experience, rate this publication . . .

As a reference source:	Very Good	Good	Fair	Poor	Very Poor
As a text:	Very Good	Good	Fair	Poor	Very Poor

- What is your occupation?

- We would appreciate your other comments; please give specific page and line references where appropriate. If you wish a reply, be sure to include your name and address.

- Thank you for your cooperation. No postage necessary if mailed in the U. S. A.

Staple

A27-3013-0

YOUR COMMENTS, PLEASE . . .

This publication is one of a series that serves as a reference source for systems analysts, programmers, and operators of IBM systems. Your answers to the questions on the back of this form, together with your comments, help us produce better publications for your use. Each reply is carefully reviewed by the persons responsible for writing and publishing this material. All comments and suggestions become the property of IBM.

Please note: Requests for copies of publications and for assistance in using your IBM system should be directed to your IBM representative or to the IBM sales office serving your locality.

Fold Fold

FIRST CLASS
PERMIT NO. 155
RALEIGH, N. C.

BUSINESS REPLY MAIL
NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY . . .

IBM Corporation
P. O. Box 12275
Research Triangle Park
North Carolina 27709

Attention: Product Publications, Dept. 860

Fold Fold

Cut Along Line

Printed in U.S.A. A27-3013-0

IBM®

International Business Machines Corporation
Data Processing Division
112 East Post Road, White Plains, N.Y. 10601
[USA Only]

IBM World Trade Corporation
821 United Nations Plaza, New York, New York 10017
[International]

Additional Comments: