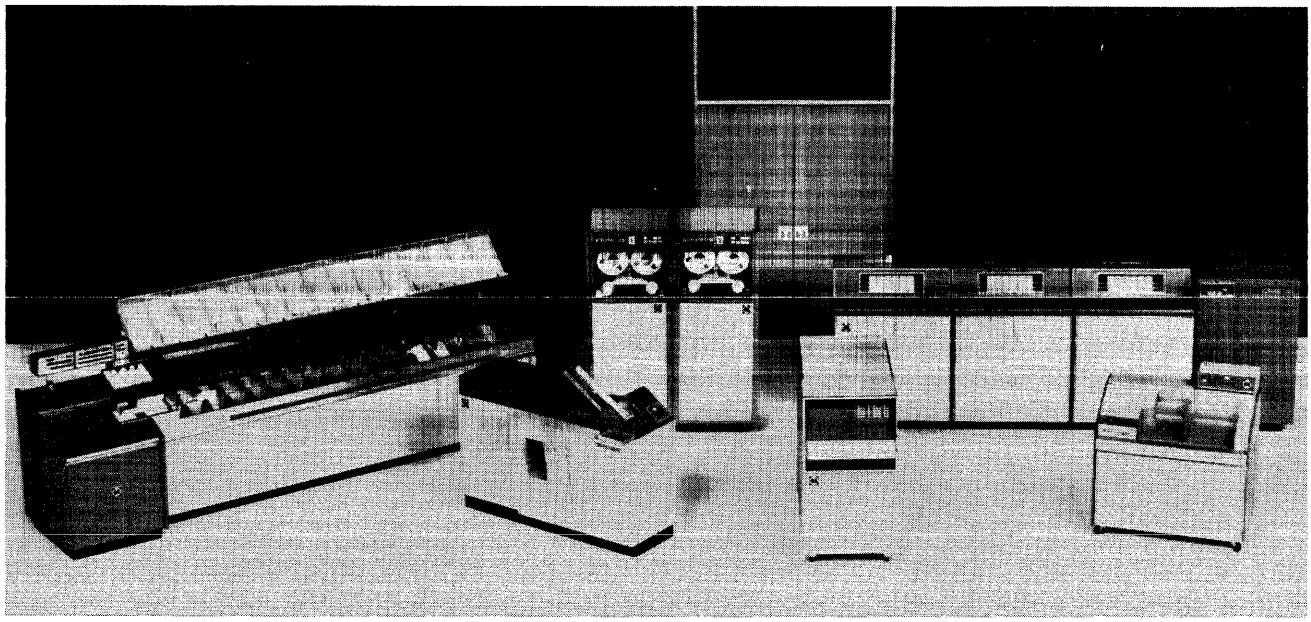
Burroughs

B 100 SERIES
B 200 SERIES
B 300 SERIES

Electronic Data Processing Systems

REFERENCE MANUAL



BURROUGHS B 300 SYSTEM

Burroughs

B 100/B 200/B 300 SERIES ELECTRONIC DATA PROCESSING SYSTEMS

REFERENCE MANUAL

BUSINESS MACHINES GROUP
SALES TECHNICAL SERVICES
SYSTEMS DOCUMENTATION

Burroughs Corporation
Detroit, Michigan 48232

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INTRODUCTION

This reference manual describes the Burroughs B 100/B 200/B 300 Series Electronic Data Processing Systems. These systems are compact, high-speed, solid-state computers that use common components in several problem-oriented equipment configurations. They are capable of handling a wide variety of data processing application media such as punch cards, paper tapes, magnetic tapes and MICR documents. Each system incorporates its own associated input and output units, thus providing a greater throughput capability.

It is intended that this publication provide the user with reference information concerning the characteristics and configurations of the various systems that comprise the B 100/B 200/B 300 Series as well as their functional capabilities, programing techniques, component description and usage, special features and operating functions.

The manual is divided into the following six sections and provides a complete reference guide for B 100/B 200/B 300 Series information.

SYSTEM DESIGN....Describes the various systems in the B 100/B 200/B 300 Series.

SYSTEM UNITS....Depicts the peripheral equipment that make up the various systems in the B 100/B 200/B 300 Series.

STORED PROGRAM INSTRUCTIONS....Describes the individual instructions which control all processing by the systems.

SOFTWARE SYSTEMS....A discussion of the use of the various software (Assemblers, Compilers, Generators, Operating Systems, Service Programs and Routines, and Translator Programs) used in the B 100/B 200/B 300 Series.

TIMING CONSIDERATIONS....Illustrates and describes the means to determine the processing time required for any particular application.

INPUT/OUTPUT MEDIA AND FORMS DESIGN....A description of the punch cards, paper documents, record cards and journals used with B 100/B 200/B 300 Series Systems.

SECTION 1

SYSTEM DESIGN

GENERAL

1-1. Data processing is the performance of a series of operations on specific data for the purpose of achieving desired results. To perform these operations, a data processing system requires five basic functions: input, control, storage, arithmetic, and output (figure 1-1).

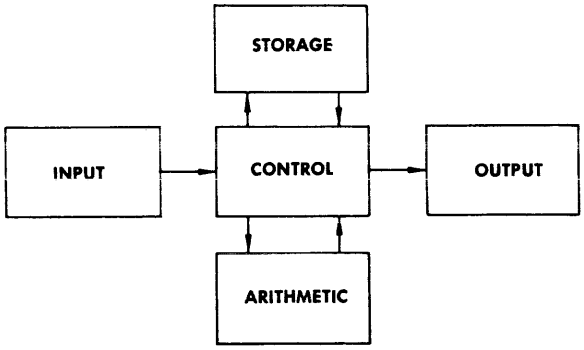


Figure 1-1. Functions of a Data Processing System

1-2. The input function transmits data to the system by means of several devices, depending on the desired input media.

1-3. The storage section retains the data received from the input device until it is required for operation by other sections of the system.

1-4. The arithmetic function handles the actual processing, or manipulation of data. This is the computing unit of the system that accomplishes all mathematical aspects of problem solving.

1-5. The output function transfers processed results from storage to the output device(s).

1-6. The control function directs the flow of data from input to storage, storage to arithmetic, arithmetic to storage, and from storage to output.

FUNCTIONAL DESCRIPTION

1-7. B 100/B 200/B 300 Series high-speed components are designed to function together as a total system. Through the use of special buffering techniques, each system is able to maintain rated speeds of all components despite differences in individual unit speeds. In this manner, work flows continuously through the system in the minimum amount of time. All system operations are directed by the program stored in the central processor. A powerful three-address logic permits the use of a minimum number of commands.

SYSTEM DESIGN

1-8. B 100/B 200/B 300 Series Systems use only three types of components: input units, central processors, and output units. A basic system consists of a central processor and a minimum of one input and one output unit. Systems can be expanded at the installation site by the addition of input/output units. (See table 1-1.)

B 100 SYSTEM DESIGN

1-9. The B 100 Series presently consists of three major models and/or reference

designations, the B 160, B 170, and B 180 Systems.

B 160 System

1-10. The B 160 (figure 1-2), is designed for punched card processing. It is capable of reading 475 cards-per-minute, punching 300 cards-per-minute, and printing 475 lines-per-minute. This system can combine in a single run collating, calculating, summarizing, summary punching, and printing operations which presently require multiple runs in conventional tabulating equipment. The components which make up a typical B 160 system are:

Central Processor (table 1-1)
Card Reader
Card Punch
Line Printer

B 170 System

1-11. This system (figure 1-3), is designed to handle as input media, MICR encoded documents, punched cards, and magnetic tape. As a financial institution system, it features the processing of MICR checks and deposits at speeds up to 1200 items-per-minute. As output media, the system prepares magnetic tape, punched cards, and is unique in that it automatically produces up to six complete detail and master listings which show the identity, amount, and distribution of every MICR item processed in proof, transit, and other operations. As a general-purpose system, it includes all punched cards and line printing capabilities of the B 160 System along with magnetic tape processing. The components that are used with the B 170 System are:

Central Processor (table 1-1)
Card Reader
Card Punch
Line Printer
Multiple Tape Lister
Magnetic Tape Units (1 to 4)
Sorter-Reader

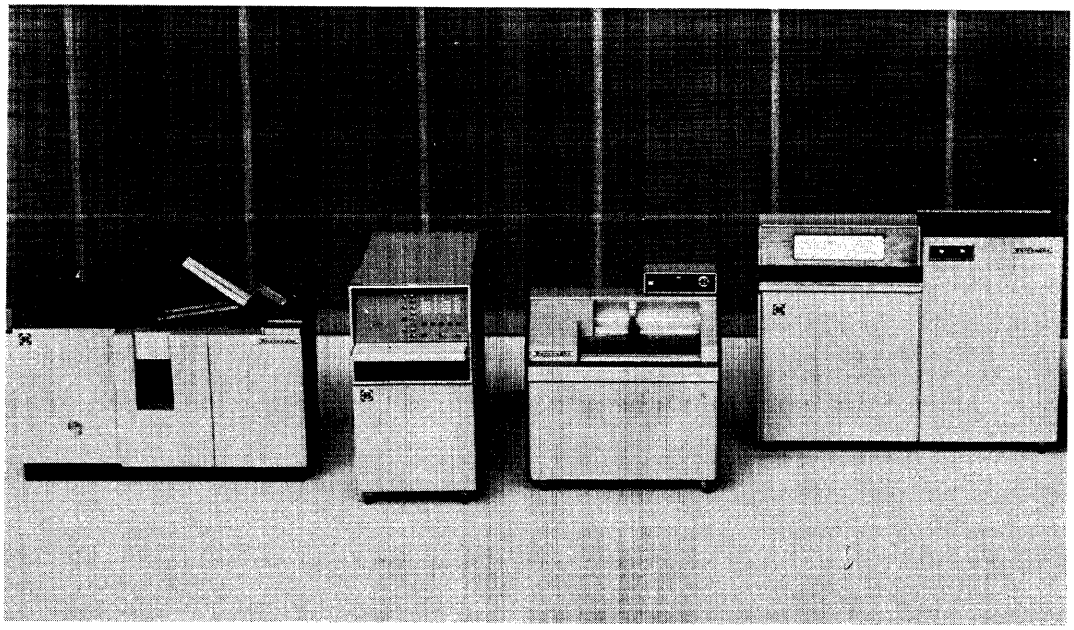


Figure 1-2. B 160 System

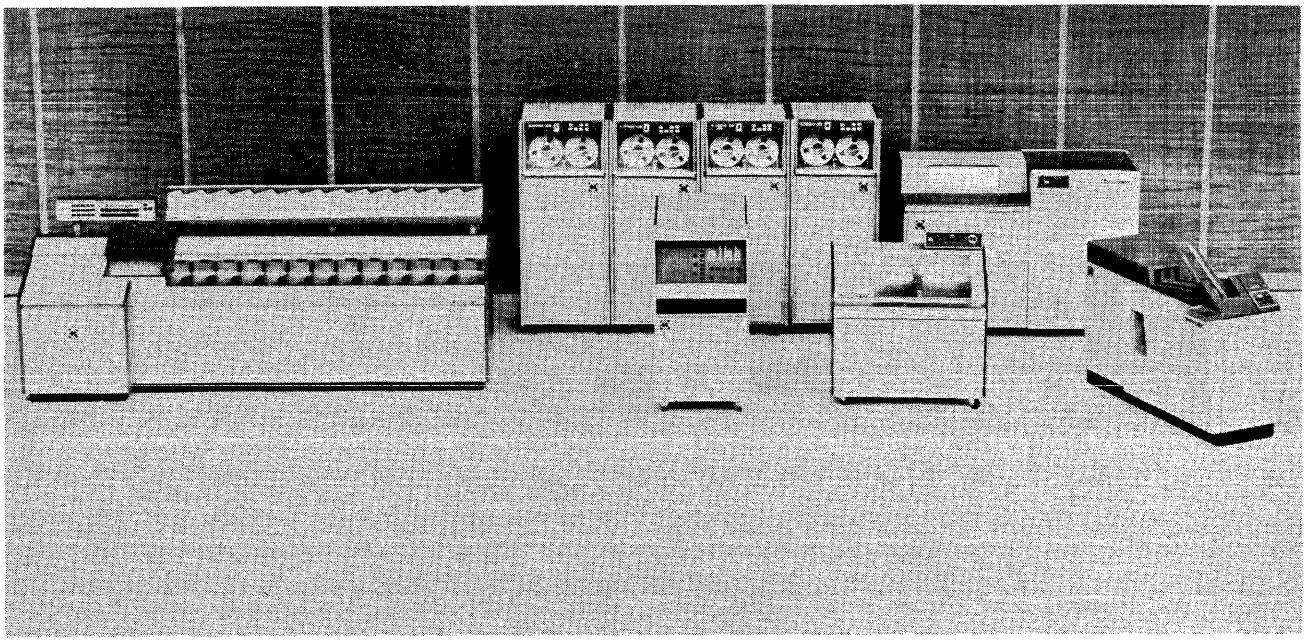


Figure 1-3. B 170 System

B 180 System

1-12. The B 180 (figure 1-4), unites the high-speed and storage capabilities of magnetic tape with the productivity and convenience of punched card processing. The B 180 can also be used as a low cost magnetic tape data processing system or as an off-line system performing peripheral operations for large-scale or medium-scale computers. The following input/output units are used in a B 180 System.

Central Processor (table 1-1)
Card Reader
Card Punch
Line Printer
Magnetic Tape Units (1 to 4)

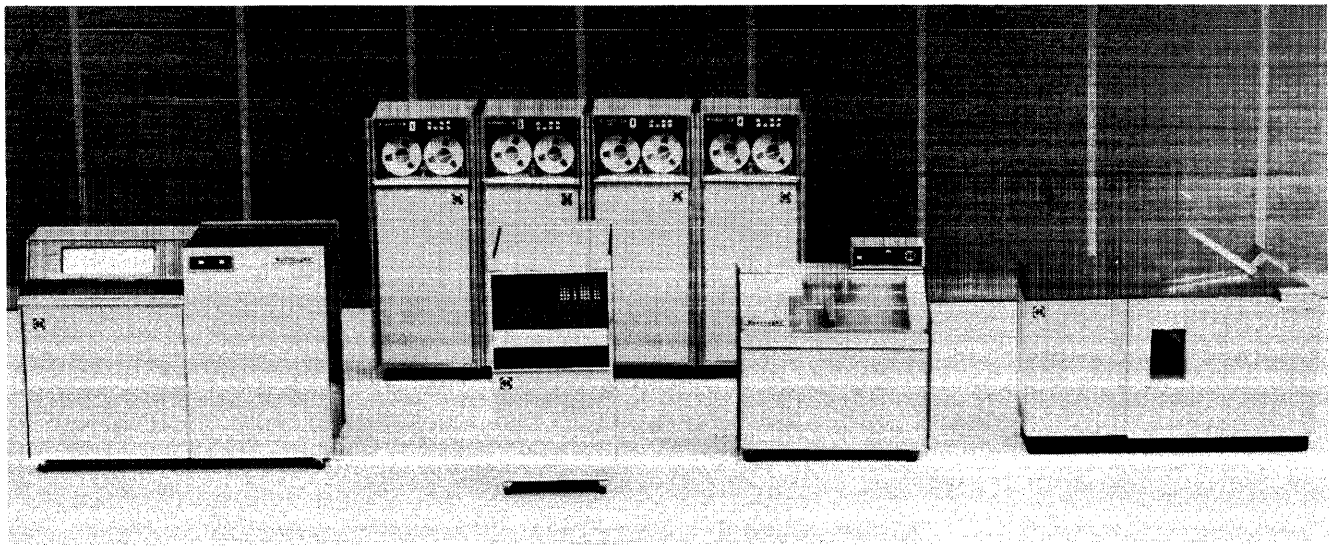


Figure 1-4. B 180 System

B 200 SYSTEM DESIGN

1-13. The B 200 Series presently consists of three major models and/or reference designations, they are: VRC, B 260, B 270, B 280 Series; the Improved Model B 260, B 270, B 280 Series, and the B 263, B 273, B 275 and B 283 Series. The primary differences between these systems are in the central processor capabilities.

NOTE

For information regarding the VRC system, consult the VRC Reference Manual.

B 260 System

1-14. The B 260 (figure 1-5) is a high-speed card processing system. It is capable of reading up to 1600 cards-per-minute, punching 300 cards-per-minute, and printing 700 lines-per-minute. This system can combine in a single run, collating, calculating, summarizing, summary punching, and printing operations which presently require multiple runs in conventional tabulating equipment. The components which make up a typical B 260 System are:

Central Processor (table 1-1)
Card Reader (1 or 2)
Card Punch
Line Printer
or
Multiple Tape Lister (1 or 2)

B 270 System

1-15. This system (figure 1-6) is designed to handle, as input media, MICR encoded documents, punched cards, and magnetic tape. As a financial institution system, it features the processing of MICR checks and deposits at speeds up to 1565 items-per-minute. As output media, the system prepares magnetic tape, punch cards, and is unique in that it automatically produces up to 12 complete detail and master listings. These show the identity, amount, and distribution of every MICR item processed in proof, transit, and other operations. As a general-purpose system, it includes all punched cards and line printing capabilities of the B 260 System along with magnetic tape processing. The system may also be used as an off-line satellite for large-scale computer systems. The components that are used with the B 270 System are:

Central Processor (table 1-1)
Card Reader (2 if sorter-reader not used)
Sorter-Reader
Card Punch
Magnetic Tape Storage Unit (1 to 6)
Line Printer
or
Multiple Tape Lister (1 to 2)

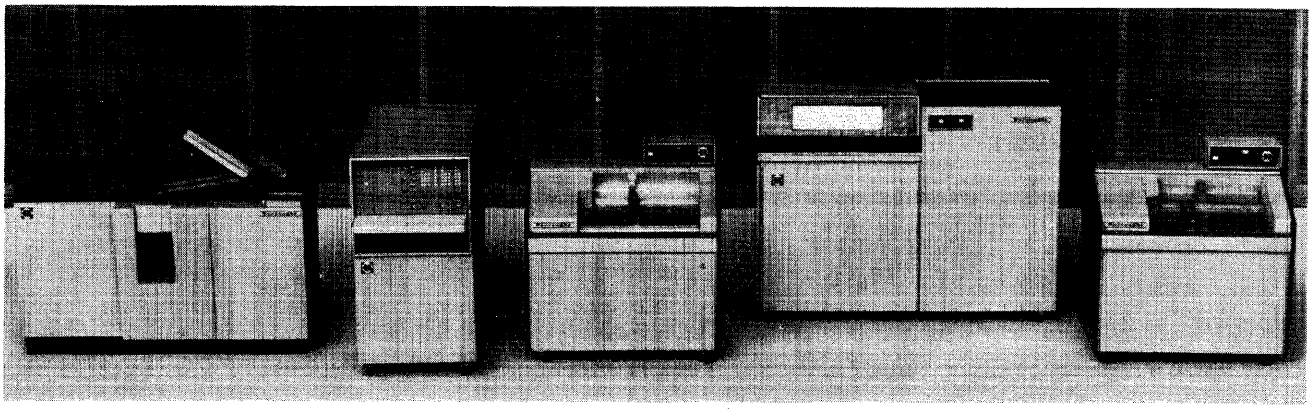


Figure 1-5. B 260 System

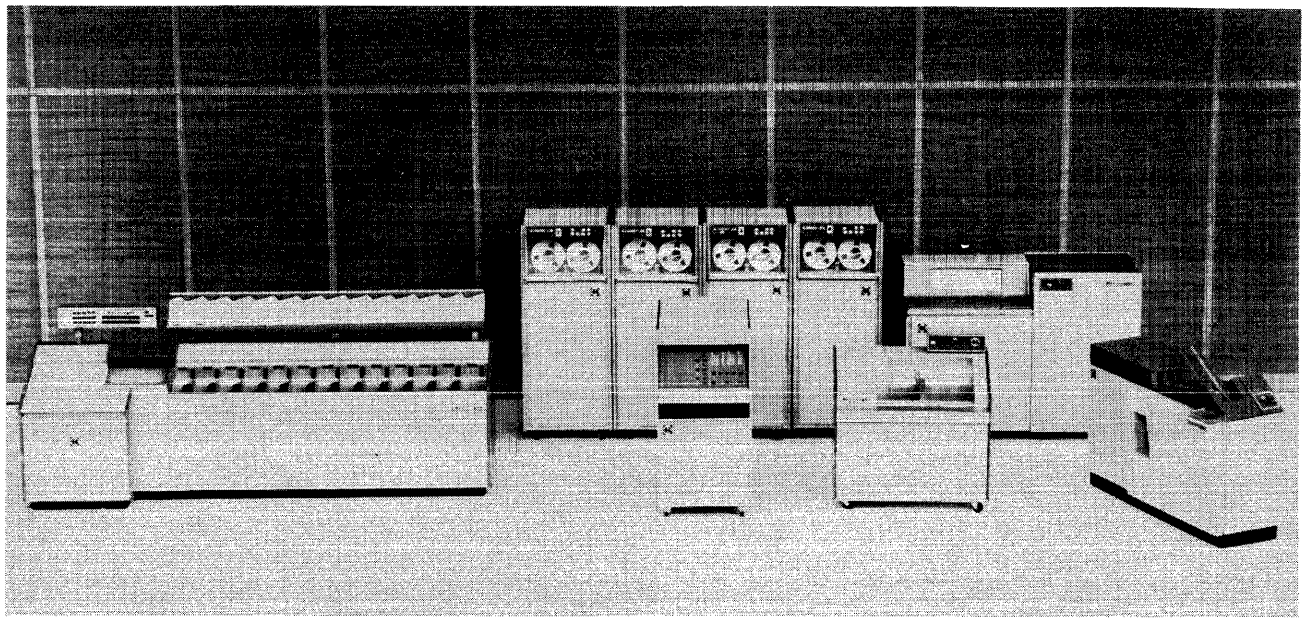


Figure 1-6. B 270 System

B 280 System

1-16. The B 280 (figure 1-7) unites the high-speed and storage capabilities of magnetic tape with the productivity and convenience of punched card processing. The B 280 can also be used as a low cost magnetic tape data processing system or as an off-line system performing peripheral operations for large-scale or medium-scale computers. The following input/output units are used in a B 280 System:

Central Processor (table 1-1)
Card Reader (1 or 2)
Card Punch
Magnetic Tape Unit (1 to 6)
Line Printer
or
Multiple Tape Lister (1 or 2)

Figure 1-7. B 280 System

IMPROVED B 200 SYSTEMS

Improved B 260 System

1-17. This system (figure 1-8) is also a high-speed punched card processing system. It is capable of reading a maximum of 1600 cards-per-minute, punching 300 cards-per-minute, and printing 1400 lines-per-minute. This system can also combine in a single run, collating, calculating, summarizing, summary punching, and printing operations. However, the design and application of this system is expanded to handle paper tape input and provide paper tape output through the addition and incorporation of the B 341 Paper Tape Punch and the B 141 Paper Tape Reader. Also, two line printers can be used simultaneously with this system when one of the printers contains a dual printer module. The components that are used with the Improved B 260 Systems are:

Central Processor (table 1-1)
Card Reader (1 or 2)
Paper Tape Reader (1 or 2)
Card Punch
Paper Tape Punch
Line Printer (1 or 2)
or
Multiple Tape Lister (1 or 2)

Improved B 270 System

1-18. This system (figure 1-9) features added throughput capability by handling paper tape input and paper tape output with the addition of the B 341 Paper Tape Punch and the B 141 Paper Tape Reader to the system. The Improved B 270 System may also be used as an off-line satellite for large scale computers. Two line printers can be used with this system when one of the printers contains a dual printer module. The components associated with the Improved B 270 are:

Central Processor (table 1-1)
Card Reader (2 if sorter-reader not used)
Paper Tape Reader (2 if sorter-reader not used)
Sorter-Reader
Card Punch
Paper Tape Punch
Magnetic Tape Unit (1 to 6)
Line Printer (1 or 2)
or
Multiple Tape Lister (1 or 2)

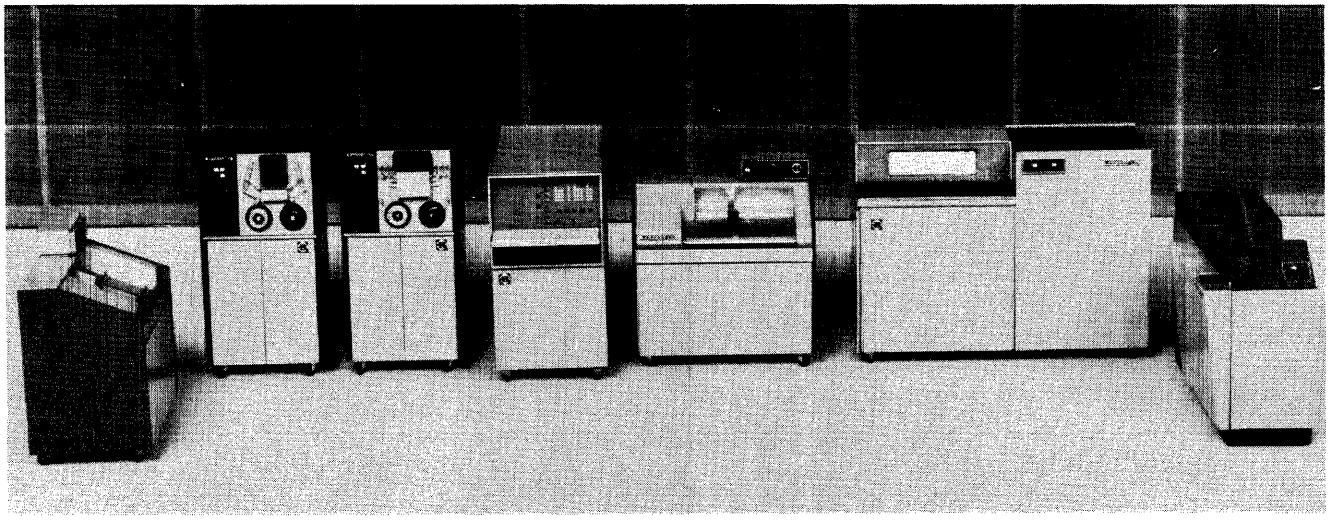


Figure 1-8. Improved B 260 System

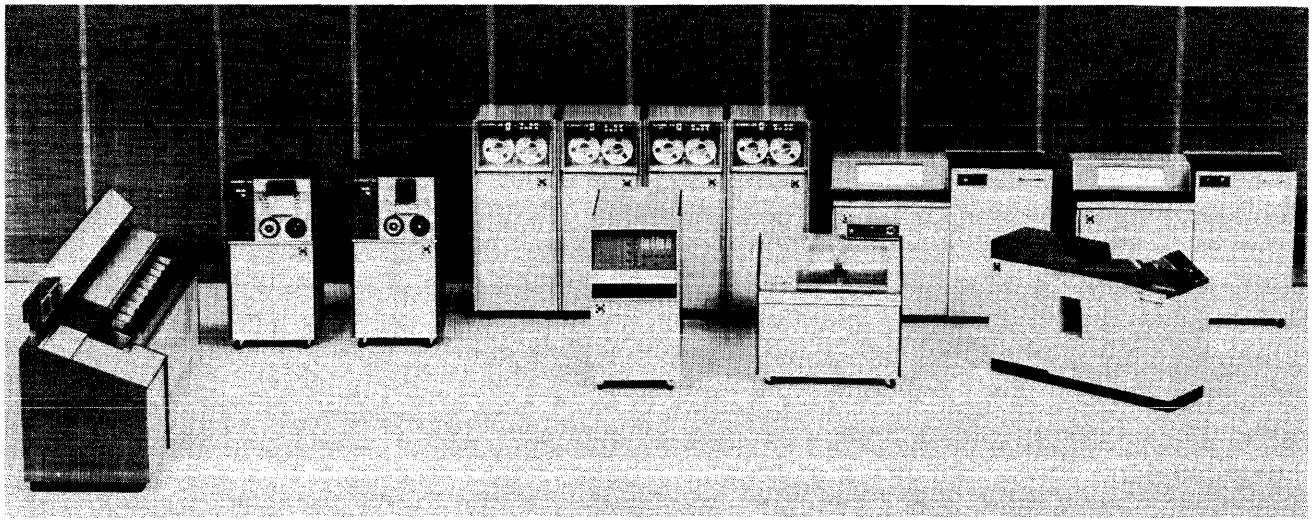


Figure 1-9. Improved B 270 System

Improved B 280 System

1-19. The Improved Model B 280 (figure 1-10) has the flexibility of handling the high-speed card processing applications of the Model 0 B 260 System with the added advantage of magnetic tape storage as well as providing paper tape input and paper tape output capability. However, it can also be used as a low-cost Electronic Data Processing system or as an off-line satellite for large-size computer systems. Two line printers may be used with this system if one of the printers contains a dual printer module. The following input/output units are associated with the Improved B 280 System:

Central Processor (table 1-1)
Card Reader (1 or 2)
Paper Tape Reader (1 or 2)
Card Punch
Paper Tape Punch
Magnetic Tape Unit (1 to 6)
Line Printer (1 or 2)
or
Multiple Tape Lister (1 or 2)

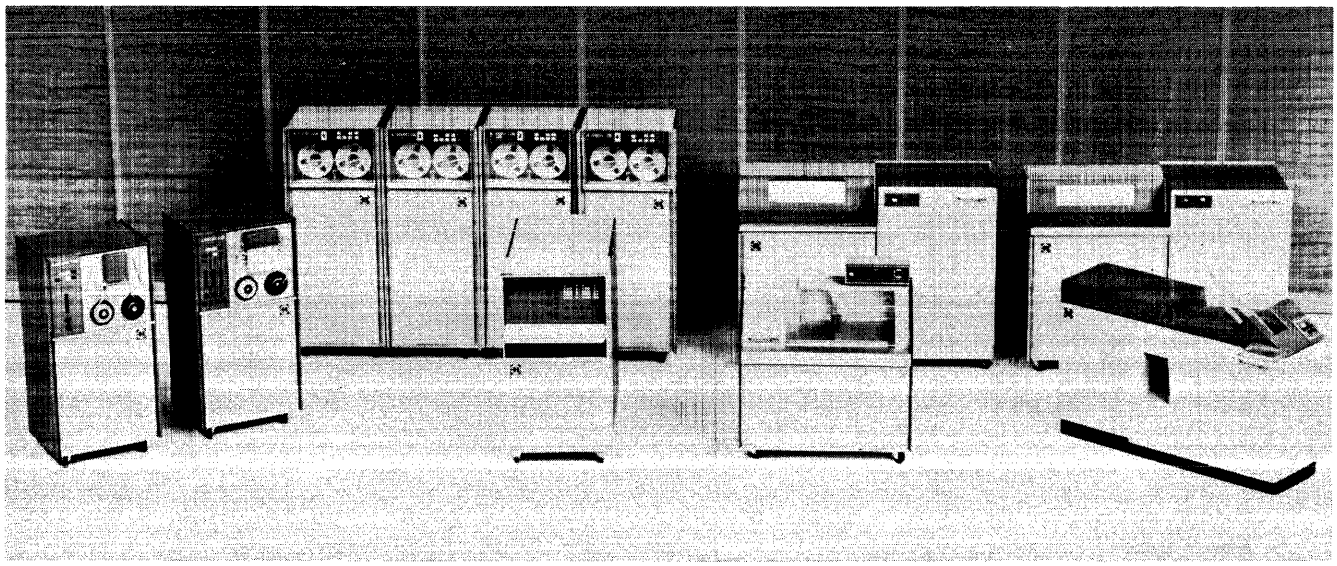


Figure 1-10. Improved B 280 System

B 263, B 273, B 275, B 283 SYSTEMS

B 263 System

1-20. This system (figure 1-11) includes all the high-speed card processing capabilities of the Model 0 B 260 Systems. However, the B 263 features an expanded memory option. This option provides the user with the choice of either of two memory modules: one memory module has a capacity of 4800 characters, the other memory module has a capacity of 9600 characters. Two line printers or two multiple tape listers can be used with the B 263 System when one of the printers contains a dual printer module. The input/output units associated with the B 263 System are:

Central Processor (table 1-1)
Card Reader (1 or 2)
Paper Tape Reader (1 or 2)
Card Punch
Paper Tape Punch
Line Printers (1 or 2)
or
Multiple Tape Listers (1 or 2)

B 273 System

1-21. This system (figure 1-12) features optional expanded memory (up to 9600 characters), on-line random access storage capability, and a data communication system. Together these features provide a wider range of user applications by featuring 480 million alphanumeric characters of stored information, and a means of handling an extremely broad range of inquiry traffic requirements. In addition, the system incorporates high-speed magnetic tape processing capabilities as well as maintaining those capabilities of the Improved B 270 System. Two line printers may also be used with this system if one of the printers contains a dual printer module. The input/output units associated with this system are:

Central Processor (table 1-1)
Card Reader (2 if sorter-reader is not used)
Paper Tape Reader (2 if sorter-reader is not used)
Sorter-Reader
Card Punch
Paper Tape Punch
Magnetic Tape Unit (1 to 6)
Supervisory Printer
Line Printer (1 or 2)
or
Multiple Tape Lister (1 or 2)
Disk File Control Unit (1)
Disk File Storage Unit (1 to 10)
Disk File Storage Module (1 to 40)
Data Communication Control Unit (1)
Teletype Terminal Unit (1 to 15)
Typewriter Terminal Unit (1 to 15)
Typewriter Station (1 to 120)
TWX Terminal Unit (1 to 15)

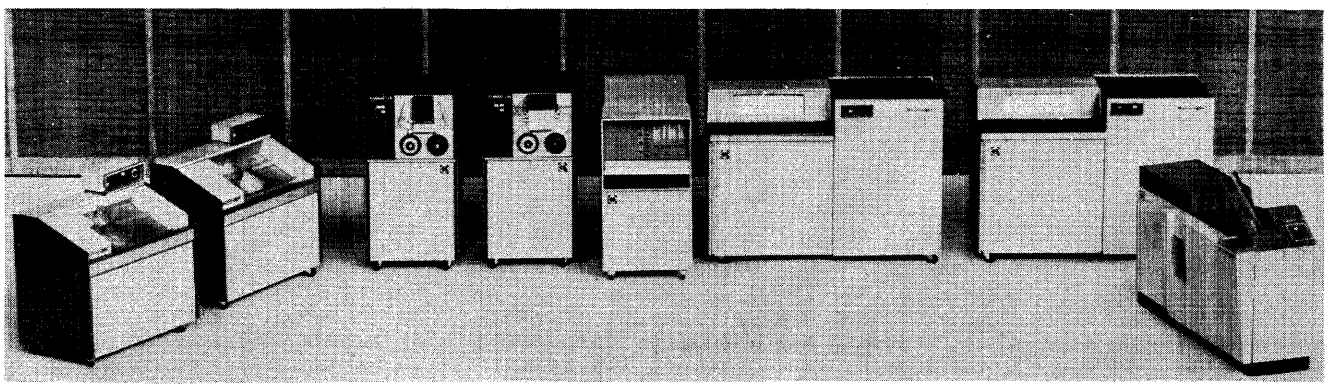


Figure 1-11. B 263 System

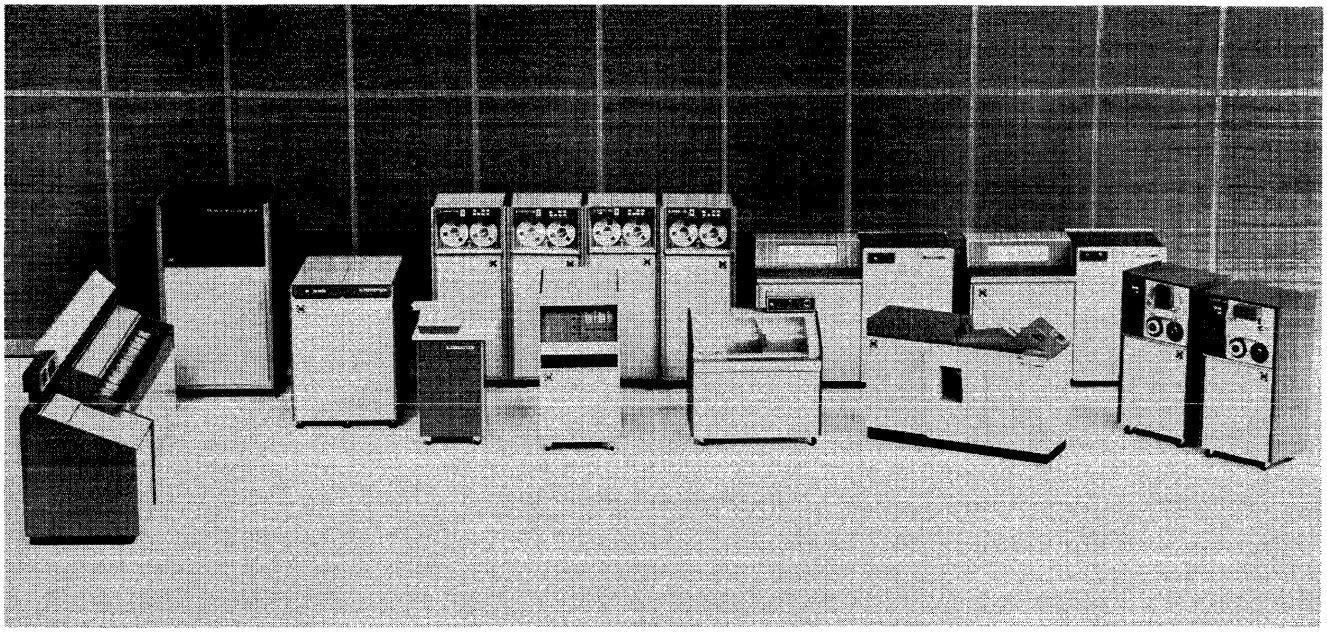


Figure 1-12. B 273 System

B 275 System

1-22. The B 275 System is designed to handle as input media, MICR encoded documents and punched cards. It does not feature the Magnetic Tape input capability. This system is available with either 4.8 K memory or 9.6 K memory. When a 9.2 K memory is utilized, the system features Paper Tape Input and Paper Tape Output. The input/output units associated with the B 275 are (Figure 1-13):

Central Processors (table 1-1)
Card Reader
Card Punch
Sorter-Reader

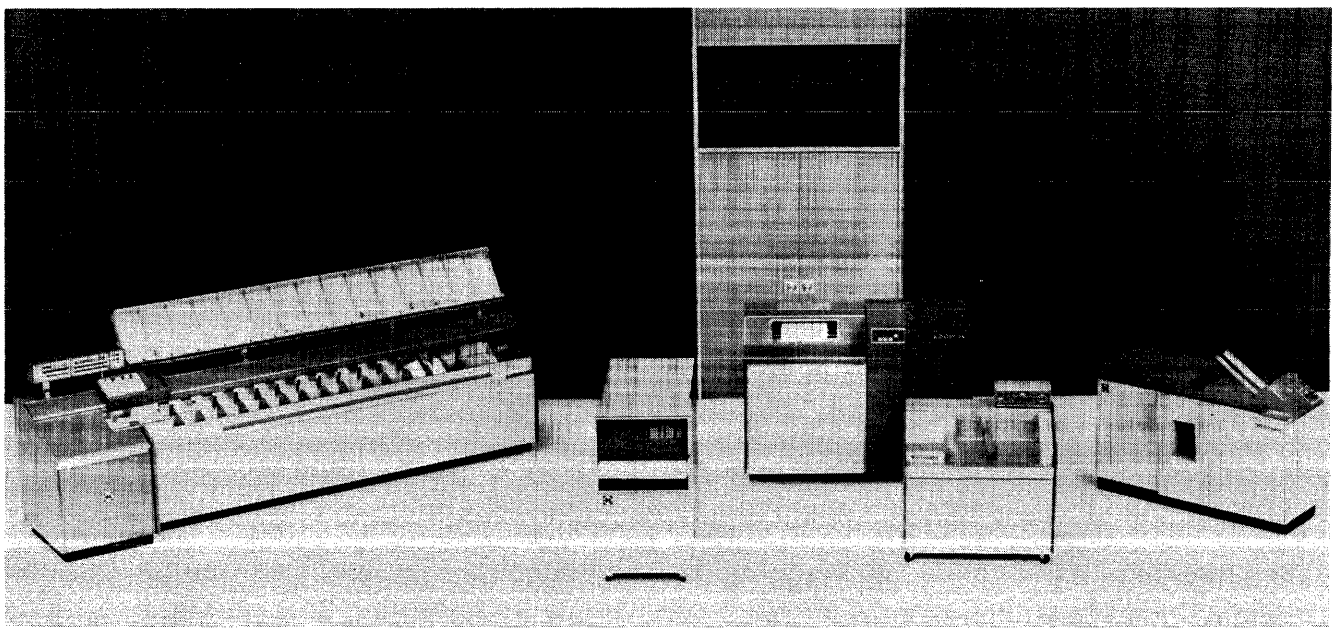


Figure 1-13. B 275 System

B 283 System

1-23. The B 283 (figure 1-14) is a powerfull high-speed punched card and magnetic tape system. It features the capability of on-line random access storage and data communication inquiry, paper tape input, and paper tape output, plus the availability of either of two memory modules: 4800 character capacity, and 9600 character capacity. Another feature of this system is that two line printers may be used simultaneously when one of the printers contains a dual printer module. The following input/output units are used with the B 283 System:

Central Processor (table 1-1)
Card Reader (1 or 2)
Paper Tape Reader (1 or 2)
Card Punch
Paper Tape Punch
Magnetic Tape Unit (1 to 6)
Supervisory Printer
Line Printer (1 or 2)
or
Multiple Tape Lister (1 or 2)
Disk File Control Unit (1)
Disk File Storage Unit (1 to 10)
Disk File Storage Module (1 to 40)
Data Communication Control Unit (1)
Teletype Terminal Unit (1 to 15)
Typewriter Terminal Unit (1 to 15)
Typewriter Station (1 to 120)
TWX Terminal Unit (1 to 15)

B 300 SYSTEM

1-24. The B 300 System is designed to function as a tailored system for individual data processing requirements. For example, the basic processor, which includes 4800 character positions of core storage and 132 print positions capability as standard, operates as a punched card system. However, through means of additional optional modular features, the system may be made to function as a magnetic tape system, a disk file and data communication system, or as an MICR bank data (or transit) system. The system is expandable to 19.2 K characters in three memory sizes (4.8 K, 9.6 K, or 19.2 K) at any time to meet the changing applicational needs as they occur. (See table 1-1 for complete system configuration and optional features.)

SYSTEM CONFIGURATIONS

1-25. The System Configurations Chart (table 1-1), specifies exactly what features, modules, and input/output units are standard, optional or not available for every model of the B 100/B 200/B 300 Systems.

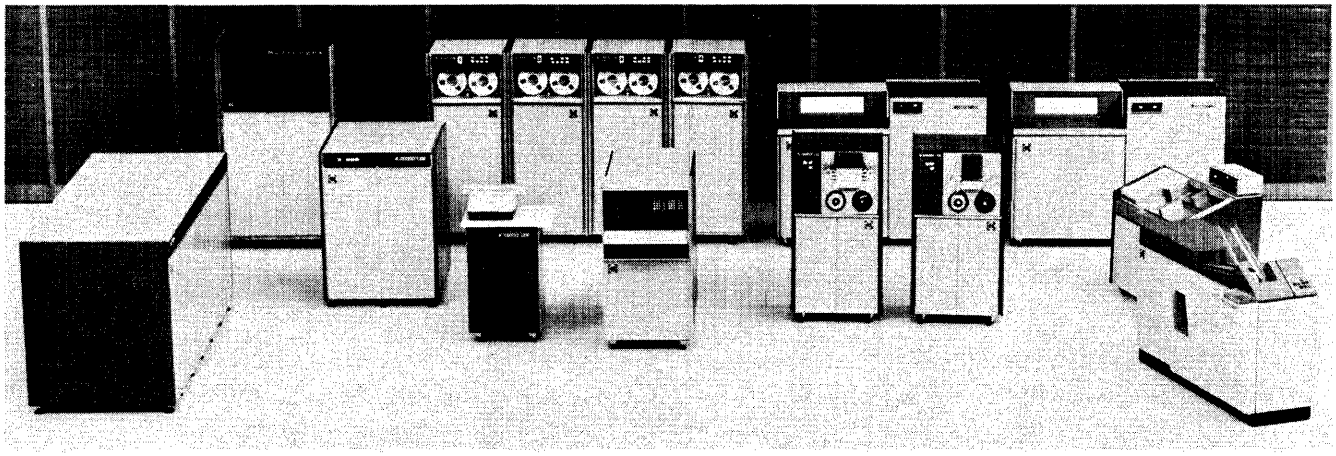


Figure 1-14. B 283 System

1-26. Certain approved Customer Engineering Requests (CER's) are indicated where appropriate in table 1-1. These features are to be ordered, where noted by the CER number listed. When referring to the table, several notations must be observed, namely:

STD - Standard. This feature is incorporated in the central processor specified, at no extra cost.

OPT - Optional. This feature is available as a factory or field installed option for the central processor specified.

A - Applicable. The input/output unit can be attached to the central processor specified.

A() - Applicable requiring central processor modules specified. The input/output unit can be attached to the central processor specified by adding the appropriate module or control as indicated by alpha key ().

NA - Not Applicable. The feature or input/output unit is not attachable to the central processor specified.

CER - Custom Engineering Request. The feature is field or factory installable.

TABLE 1-1

Burroughs B 100 B 200 B 300 System Configurator

LEGEND: STD - Standard. Feature included in processor specified.
OPT - Optional. Feature available as factory or field installed option for processor specified.
A - Applicable. I/O Unit can be attached to processor specified.
A ( ) - Applicable but requires processor modules specified by ( ).
NA - Not applicable.
CER - Custom Engineering Request. Field or Factory installable.

		COMPONENTS / PROCESSORS	B 300	B 263	B 273	B 275	B 283	B 260	B 270	B 280	B 160	B 170	B 180
		MEMORY MODULES											
	800/802	Additional 4800 Characters	OPT	OPT	OPT	OPT	OPT	NA	NA	NA	NA	NA	NA
	801/803	Additional 9600 Characters (1)	OPT	OPT	OPT	OPT	OPT	NA	NA	NA	NA	NA	NA
		I/O CONTROL MODULES											
(23) A	810	MICR Sorter	OPT	OPT	STD	STD	OPT	NA	STD	NA	NA	STD	NA
B	811	Paper Tape	OPT	OPT	OPT	OPT	OPT	NA	NA	NA	NA	NA	NA
	812	MICR Sorter/Paper Tape (2)	OPT	OPT	OPT	OPT	OPT	NA	NA	NA	NA	NA	NA
C	813	Supervisory Printer	OPT	OPT	OPT	OPT	OPT	NA	NA	NA	NA	NA	NA
D	814	Magnetic Tape	OPT	OPT	STD	OPT	STD	NA	STD	STD	NA	STD	STD
E	815	Disk File (3)	OPT	OPT	STD	OPT	STD	NA	NA	NA	NA	NA	NA
F	816	Data Communications (4)	OPT	OPT	STD	OPT	STD	NA	NA	NA	NA	NA	NA
		Card Reader	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD
		Card Punch	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD
		Printer/Lister	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD
	817	Auxiliary Output Control	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		PROCESSOR COMMAND MODULES											
	830	Transfer and Branch Command	OPT	CER 1305	CER 1305	CER 1305	CER 1305	NA	NA	NA	NA	NA	NA
	831	Transfer and Translate Command	OPT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	832	Interrogate Command	OPT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	833	Data Compress and Expand Command	OPT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	834	Binary Card Read/Punch Command	OPT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
G	835	B 300 Lister Command	OPT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
H	836	16-Pocket Sorter Control	OPT	NA	CER 1268	CER 1268	NA	NA	CER (5)	NA	NA	NA	NA
	837	Selective Stacking Control for B 304 Punch	OPT	CER 1123	CER 1123	CER 1123	CER 1123	NA	NA	NA	NA	NA	NA
		PROCESSOR FEATURE MODULES											
	850	Sense Switches (6)	OPT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	851	Card Read Early Release	OPT	CER 1126	CER 1126	CER 1126	CER 1126	NA	NA	NA	NA	NA	NA
K	852	66KC Control for B 422	OPT	OPT	OPT	OPT	OPT	NA	NA	NA	NA	NA	NA
L	853	72KC Control for B 425	OPT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	854	Printer-Lister Selector Switch (7)	OPT	OPT	OPT	OPT	OPT	NA	OPT	NA	NA	OPT	NA
	855	Card Reader Busy Branch	STD	STD	STD	STD	STD	OPT	OPT	OPT	NA	NA	NA
		Dual Card Reader Control	STD	STD	STD	STD	STD	STD	STD	STD	NA	NA	NA
M	856	132-Print Position Capability	STD	OPT	OPT	OPT	OPT	NA	NA	NA	NA	NA	NA
		B 100 I/O Adapters:											
N		Adapter to Use B 124 with B 160	NA	NA	NA	NA	NA	NA	NA	NA	OPT	NA	NA
P		Adapter to Use B 124 with B 170	NA	NA	NA	NA	NA	NA	NA	NA	NA	OPT	NA
Q		Adapter to Use B 124 with B 180	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	OPT
R		Adapter to Use B 321 with B 160	NA	NA	NA	NA	NA	NA	NA	NA	OPT	NA	NA
S		Adapter to Use B 321 with B 170	NA	NA	NA	NA	NA	NA	NA	NA	NA	OPT	NA
T		Adapter to Use B 321 with B 180	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	OPT
U		Adapter to Use B 102, B 103 & B 104 with B 170	NA	NA	NA	NA	NA	NA	NA	NA	NA	OPT	NA
V		Adapter to Use B 322 with B 170	NA	NA	NA	NA	NA	NA	NA	NA	NA	OPT	NA

FOOTNOTES:
(1) Additional 4800 Character Memory Module is a prerequisite for installing an additional 9600 character Memory Module.
(2) If both MICR Sorter-Reader and Paper Tape units are required, specify MICR Sorter/Paper Tape Module.
(3) Magnetic Tape Control Module is a prerequisite.
(4) Magnetic Tape and Disk File Control Modules are a prerequisite.
(5) CER 1334 for Model 0 and CER 1333 for Model 1 B 270's.
(6) Interrogate Command Module is a prerequisite.
(7) Whenever a printer and a lister are part of a system, this selector is required.

TABLE 1-1 (cont)

Burroughs B 100 B 200 B 300 System Configurator

LEGEND:
STD - Standard. Feature included in processor specified.
OPT - Optional. Feature available as factory or field installed option for processor specified.
A - Applicable. I/O Unit can be attached to processor specified.
A ( ) - Applicable but requires processor modules specified by ( ).
NA - Not applicable.
CER - Custom Engineering Request. Field or Factory installable.

COMPONENTS \ PROCESSORS	B 300	B 263	B 273	B 275	B 283	B 260	B 270	B 280	B 160	B 170	B 180
INPUT UNITS											
SORTER-READERS											
B 102 13-Pocket w/Standby (1565 DPM) (9)	A (A)	A (A)	A	A	A (A)	NA	A	NA	NA	A (U)	NA
B 103 13-Pocket w/ or w/o Endorser (1565 DPM)(22)	A (A)	A (A)	A	A	A (A)	NA	A	NA	NA	A (U)	NA
B 104 13-Pocket w/o Standby (1565 DPM)	A (A)	A (A)	A	A	A (A)	NA	A	NA	NA	A (U)	NA
B 106 13-Pocket w/Standby (1200 DPM) (9)	A (A)	A (A)	A	A	A (A)	NA	A	NA	NA	A	NA
B 107 13-Pocket w/Endorser (1200 DPM) (22)	A (A)	A (A)	A	A	A (A)	NA	A	NA	NA	A	NA
B 116 16-Pocket w/ or w/o Endorser (1565 DPM) (22)	A (A)(H)	A (A)(H)	A (H)	A (H)	A (A)(H)	NA	A (H)	NA	NA	NA	NA
CARD READERS											
B 122 200 CPM (10)	A	A	A	A	A	A	A	A	A	A	A
B 123 475 CPM	A	A	A	A	A	A	A	A	A	A	A
B 124 800 CPM	A	A	A	A	A	A	A	A	A (N)	A (P)	A (Q)
B 129 1400 CPM	A	A	A	A	A	NA	NA	NA	NA	NA	NA
PAPER TAPE READER											
B 141 500 - 1000 Characters/second	A (B)	A (B)	A (B)	A (B)	A (B)	NA	NA	NA	NA	NA	NA
OUTPUT UNITS											
CARD PUNCHES											
B 303 100 CPM	A	A	A	A	A	A	A	A	A	A	A
B 304 300 CPM	A	A	A	A	A	A	A	A	A	A	A
PAPER TAPE PUNCH											
B 341 100 Characters/second	A (B)	A (B)	A (B)	A (B)	A (B)	NA	NA	NA	NA	NA	NA
PRINTERS											
B 320 120 p.p. - 475 lpm	A	A	A	A	A	A	A	A	A	A	A
B 321 120 p.p. - 700 lpm	A	A	A	A	A	A	A	A	A (R)	A (S)	A (T)
B 325 132 p.p. - 700 lpm	A	A (M)	A (M)	A (M)	A (M)	NA	NA	NA	NA	NA	NA
B 328 120 p.p. - 1040 lpm max.	A	A	A	A	A	A	A	A	NA	NA	NA
B 329 132 p.p. - 1040 lpm max.	A	A (M)	A (M)	A (M)	A (M)	NA	NA	NA	NA	NA	NA
940 Dual Printer Control (11)	A	A	A	A	A	A	A	A	NA	NA	NA
MULTIPLE TAPE LISTERS											
B 322 1565 lpm Numeric	A (G)	A	A	A	A	A	A	A	NA	A (V)	NA
B 323 1565 lpm Alphanumeric	A (G)	A	A	A	A	A	A	A	NA	NA	NA
B 326 1250 lpm Numeric	A (G)	A	A	A	A	A	A	A	A	A	A
B 332 1565 lpm Master Alphanumeric	A (G)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B 333 1565 lpm Slave Alphanumeric (12)	A (G)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

FOOTNOTES:
(9) Some programing restrictions are imposed on demand feed operations.
(10) Optional Card Reader features are not applicable to the B 122.
(11) Dual printer control functions with any combination of printers.
(12) B 332 Master Lister is a prerequisite. One or two B 333 Slave Listers can be attached to a B 332.

TABLE 1-1 (cont)

Burroughs B 100 B 200 B 300 System Configurator

LEGEND: STD - Standard. Feature included in processor specified.
OPT - Optional. Feature available as factory or field installed option for processor specified.
A - Applicable. I/O Unit can be attached to processor specified.
A ( ) - Applicable but requires processor modules specified by ( ).
NA - Not applicable.
CER - Custom Engineering Request. Field or Factory installable.

COMPONENTS \ PROCESSORS	B 300	B 263	B 273	B 275	B 283	B 260	B 270	B 280	B 160	B 170	B 180
INPUT/OUTPUT UNITS											
MAGNETIC TAPE UNITS											
B 421 18 - 50 KC at 90 ips	A (D)	A (D)	A	A (D)	A	NA	A	A	NA	NA	NA
B 422 24 -66 KC at 120 ips	A (D)(K)	A (D)(K)	A (K)	A (D)(K)	A (K)	NA	NA	NA	NA	NA	NA
B 423 24 KC at 120 ips	A (D)	A (D)	A	A (D)	A	NA	A	A	NA	A	A
B 425 18 - 50 - 72 KC at 90 ips	A (D)(L)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TYPEWRITER											
B 495 Supervisory Printer	A (C)	A (C)	A (C)	A (C)	A (C)	NA	NA	NA	NA	NA	NA
DF & DC CONTROL UNITS											
B 450 Basic DF/DC Cabinet	A	A	A	A	A	NA	NA	NA	NA	NA	NA
B 452 Basic DF/DTTU Cabinet	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B 247 Disk File Control (13)	A (D) (E)	A (D) (E)	A (E)	A (E) (D)	A (E)	NA	NA	NA	NA	NA	NA
B 248 Data Communication Control (13)	A (D) (E) (F)	A (D) (E) (F)	A (E) (F)	A (D) (E) (F)	A (E) (F)	NA	NA	NA	NA	NA	NA
B 249 Data Transmission Control	A (D) (E)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B 451 Disk File Expanded Control (14) (24)	A	A	A	A	A	NA	NA	NA	NA	NA	NA
DISK FILE DEVICES											
B 471 Electronics Unit (15)	A	A	A	A	A	NA	NA	NA	NA	NA	NA
B 475 Storage Module (16)	A	A	A	A	A	NA	NA	NA	NA	NA	NA
B 478-1 Data Memory Bank	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B 478-2 Additional Data Memory Bank Storage	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DATA COMMUNICATION DEVICES											
B 481 Teletype Terminal (17) (18)	A	A	A	A	A	NA	NA	NA	NA	NA	NA
B 483 Typewriter Terminal (18)	A	A	A	A	A	NA	NA	NA	NA	NA	NA
B 493 Typewriter Inquiry Station (19)	A	A	A	A	A	NA	NA	NA	NA	NA	NA
B 484 Dial TWX Terminal (18) (20)	A	A	A	A	A	NA	NA	NA	NA	NA	NA
B 486 Central Terminal (18) (21)	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B 487 Data Trans. Terminal Unit & Line Adapters (25)	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

FOOTNOTES:
(13) Maximum combination of 2 units to a B 450.
(14) Maximum of two B 451 units to a B 450.
(15) Maximum of ten B 471 Electronics Units per B 247.
(16) Maximum of five B 475 Storage Modules per B 471.
(17) One buffer size available: 240 characters.
(18) Maximum of any 15 terminal units available on a B 248.
(19) Maximum of eight B 493's per B 483.
(20) B 484 serves a maximum of 399 Teletype units.
(21) B 486 serves a maximum of ninety-six B 606 Teller Consoles.
(22) Endorser feature applies optionally only to B 103 and B 116. Start/Stop Bar is standard on B 116 and is optional for B 103 only.
(23) Alphabetic key cross references processor modules that are required with Input/Output Devices.
(24) When system includes more than one processor, or more than five B 471's, a second B 451 is required.
(25) Maximum of four B 487 DTTU's and sixty-four Line Adapters. Requires B 452 Basic DF/DTTU Cabinet. Maximum two B 487 DTTU's per B 452.

CER'S CER'S referenced under PROCESSOR COMMAND MODULES and PROCESSOR FEATURE MODULES are to be ordered, where indicated, by CER number after obtaining approval from Home Office Product Support via your District Office.

SECTION 2
SYSTEM UNITS

GENERAL

2-1. System units are those units which are separate from the main computer (central processor) and which perform independently of the central processor, but are always under program control of the central processor. The system units are sometimes referred to as input/output equipment.

2-2. This section describes the central processors and the system units that are used with the B 100/B 200/B 300 Series. Included in this description are the operating characteristics, controls, and indicators.

CENTRAL PROCESSORS

2-3. The central processors contain the buffers, electronic circuitry, and internal logic necessary to control all input, output, formatting, checking, logical decisions and basic arithmetic functions (figure 2-1).

Magnetic Core Storage

2-4. Magnetic core storage is used in the central processor to store program instructions and data during processing runs. The use of magnetic core storage permits rapid access to the data stored in memory. The central processors contain either 4800, or 9600 or 19,200 positions of internal magnetic core storage, depending on the model of the particular central processor.

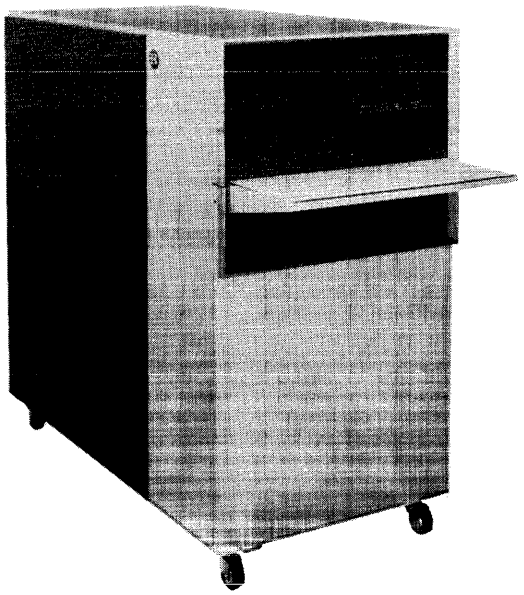


Figure 2-1. Central Processor

2-5. Each character position of memory consists of seven magnetic cores. Magnetic cores are "doughnut" shaped devices that have the inherent characteristics of becoming magnetized, and remaining so, when a current is passed through the center of the core (figure 2-2). The direction of magnetic lines of force about the core depends upon the direction of the current through the center of the core. If the current is passed through the core in the opposite direction, the direction of the magnetic lines of force will be reversed. The resultant magnetism is thereby designated as a bit (on or one) or no-bit (off or zero) condition. In either case the core is magnitized; the "on" and "off" designations are strictly arbitrary. Six of the cores in each character position are used to represent data; the seventh is used for internal parity checking.

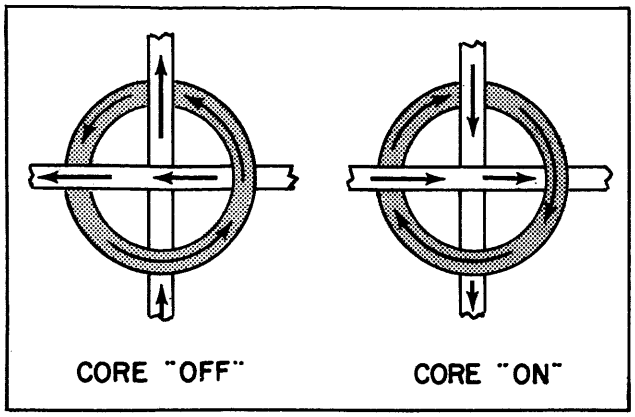


Figure 2-2. Magnetic Core Conditions

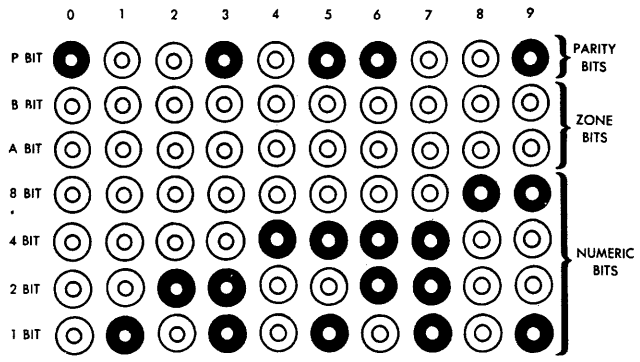


Figure 2-4. Magnetic Core Character Representation

2-6. Figure 2-3 illustrates one position of memory with the value of each core shown above. If a core is magnetized in the "ON" direction, the core will represent the value shown. Figure 2-4 depicts the coding of digits zero through nine in magnetic core storage. A shaded "doughnut" indicates that the core is "on". The four-level (8, 4, 2, 1) method of representation of numbers is known as Binary Coded Decimal (BCD). The other three levels of each character position (P, B, A) are used for parity checking, alphabetic and most special characters representation. Alphabetic and most special characters are represented by a combination of numeric and the A and/or B cores.

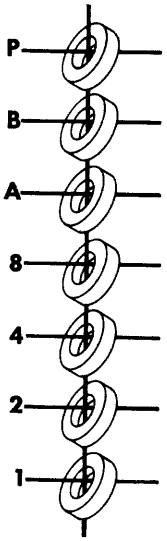


Figure 2-3. One Memory Position

2-7. When a character enters the central processor, its bit count is checked. If the bits are even, the parity core for that character location will be turned on. If the number of bits in the character is odd, the parity core will be turned off. Thereafter, as data is processed internally or transferred to an output unit, the number of "on" cores in each character is accumulated. Whenever an even core count results, the system will stop, indicating the type and location of the error.

2-8. In punched card code, the alphabetic characters are represented by a numeric (1 through 9) and zone (12, 11 and 0) punch. In the central processor memory, the alphabetic characters are represented by the same numeric character plus a zone punch value of A, B, or A and B. For example:

12 ZONE — A	11 ZONE — B	0 ZONE — AB
A—A, 1	J—B, 1	
B—A, 2	K—B, 2	S—A, B, 2
C—A, 3	L—B, 3	T—A, B, 3
D—A, 4	M—B, 4	U—A, B, 4
E—A, 5	N—B, 5	V—A, B, 5
F—A, 6	O—B, 6	W—A, B, 6
G—A, 7	P—B, 7	X—A, B, 7
H—A, 8	Q—B, 8	Y—A, B, 8
I—A, 9	R—B, 9	Z—A, B, 9

Buffering

2-9. The transfer of information between the central processor and selected input/output

units is aided by the use of buffers. These buffers serve as temporary storage areas for the data being transferred from the central processor to an input/output unit, and data being transferred from an input/output unit. Buffers are capable of accepting data at one transfer rate and transferring it later at a different rate of speed (measured in characters per second). At the same time, they permit the central processor to continue computing during the more time-consuming input/output operations.

2-10. An input buffer accepts data from an input unit at the speed of that unit, which is relatively slow. When the central processor calls for this input data, the buffer transfers it at a greatly increased rate of speed. An output buffer accepts data from the central processor at central processor speed and makes this data available to an output unit at the slower speed of the output unit.

2-11. By communicating with the buffers, the central processor is capable of transmitting and receiving information at high speeds. For example, the speed of the B 321 Line Printer is 700 lines per minute (120 characters per line) or a total of 1400 characters per second. The output buffer accepts print data at the rate of 92,300 characters per second and transfers the data to the printer at 1400 characters per second. Once the central processor has prepared a line of print, the information is transferred to printer buffer in approximately 1.3 milliseconds. The central processor is then free to continue processing additional data for future printings. During the following 84.4 ms. while the central processor continues to operate, the printer buffer transfers the information just received to the print section. By the time the line of print has been processed (printed), the central processor will normally have prepared additional information for printing. Thus, multiple operations can take place at the same time.

2-12. The timing sequence is reversed for input operations. For example, if a punched card is read, its contents are transferred to one of the central processor input buffers. During this data transfer, the central processor is free to continue its normal operations. When the central processor requires punched card input information, the contents of the previously filled input buffer are transferred to memory within 2 ms. As soon as the contents of the buffer have been transferred to the central processor memory, the card reader refills the buffer with additional information for future use by the central processor. During the period that the buffer is being refilled, the central processor is free to continue its normal processing operations.

B 100, MODEL 0 AND IMPROVED MODEL 0 CENTRAL PROCESSOR

2-13. The central processor used in B 100, Model 0 and Improved Model 0 Systems is a solid-state, digital computer with a magnetic core memory storage of 4800 alphanumeric and symbolic positions. Each position contains seven-bits; six are used for information representation and the seventh for parity checking. Every position in memory is individually addressable by a three-character address, thus permitting variable length data fields. The internally stored programs utilize an instruction format of 12-character fixed word length with a three-address command structure.

2-14. The magnetic core storage is composed of 40 sections; each section is composed of 10 fields and each field is composed of 12 characters. The hundred's position of the address represents the section, the ten's position represents the field, and the unit's position represents the character.

2-15. The memory map (figure 2-5) gives the address for every position of memory. The sections are addressed by the 10 numeric digits (0-9), 26 alphabetic characters, and four special characters (+ - blank 1).

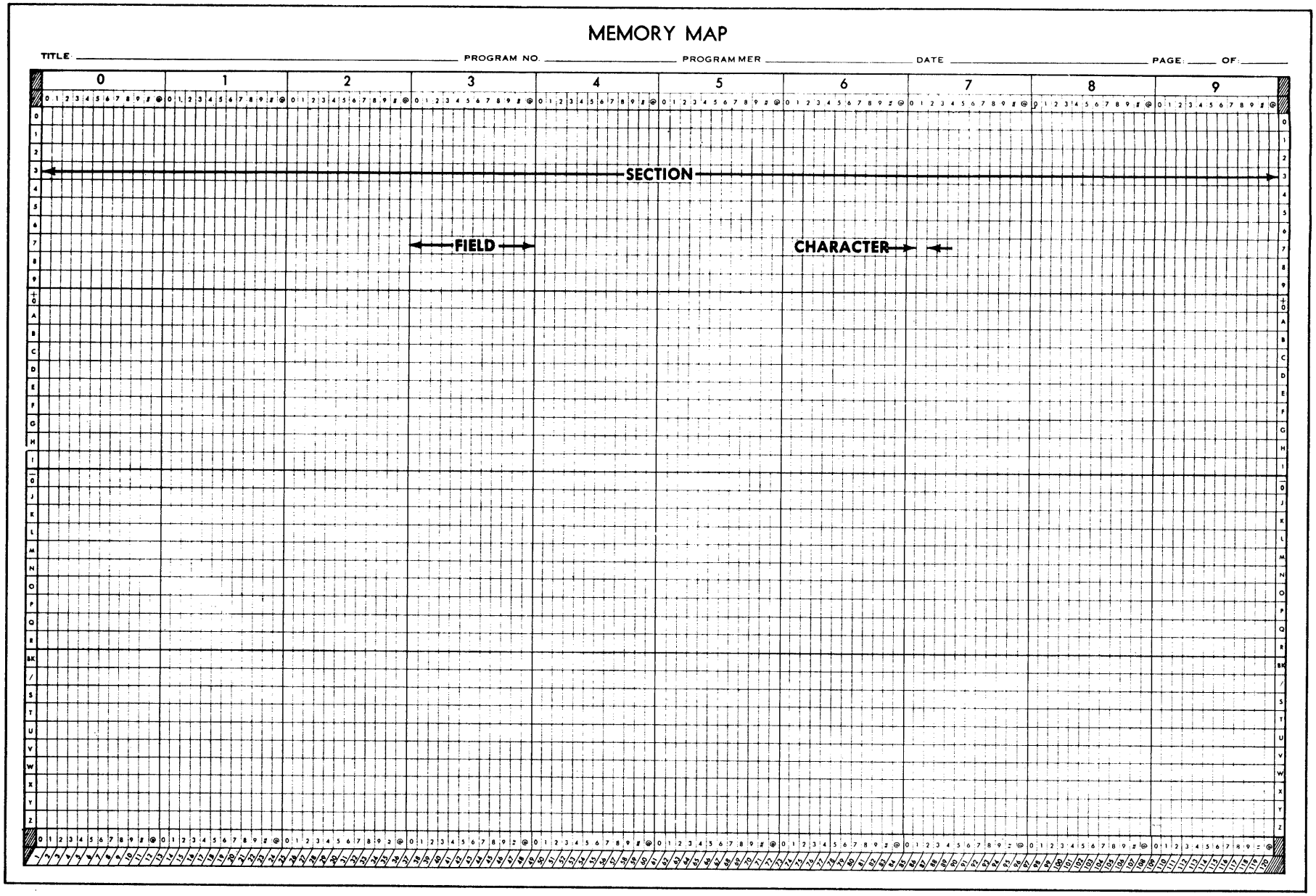


Figure 2-5. Memory Map

2-16. The fields within each section are addressed by the Arabic numerals 0-9 and the characters within each field are sequentially referenced by 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, # and @ (figure 2-6).

SECTION	FIELD	CHARACTER
0	0	0
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
+0		#
A		@
B		
C		
D		
E		
F		
G		
H		
I		
−0		
J		
K		
L		
M		
N		
O		
P		
Q		
R		
Blank		
/		
S		
T		
U		
V		
W		
X		
Y		
Z		

Figure 2-6. Character Address

B 263/B 273/B 275 AND B 283 CENTRAL PROCESSOR

2-17. The central processor used in these systems includes all of the features of the B 100, Model 0, and Improved Model 0 Central Processor, plus it incorporates the following new and improved features (see table 1-1):

a. Expanded Memory-Either of three memory modules are available for use with the B 263, B 273, and B 283 Systems. One memory module has a 4800 character capacity, the second memory module features a 9600 character capacity and a third features 19.2 K character capacity. The latter half of the 9600 character module is addressed with a B-bit in the tens position of the instruction address. The B-bits and associated indicators are added to the memory address register and instruction register. The load instruction reads data into memory from reader 1 unit until all data is read or memory is filled, either 4800, 9600, or 19.2 K characters. The expanded memory capability does not alter the buffering abilities of the central processor.

b. Disk File System - A B 450 Disk File/Data Communication Basic Control, B 247 Disk File Control Unit, a B 472 Disk File Storage Unit, and a B 475 Disk File Storage Module can be used on B 273 and B 283 Systems only, when a magnetic tape/disk module is installed in the central processor. Necessary commands are included in the central processor for programmatic control.

c. Data Communications System - A B 450 Disk File/Data Communication Basic Control, a B 248 Data Communications Control Unit, a B 481 Teletype Terminal Unit, a B 483 Typewriter Terminal Unit and a B 493 Typewriter Station may be used with a B 273 or B 283 Central Processor only, when a data communication module and a magnetic tape/disk file module is installed in the central processor. All the necessary commands have been added to the central processor for programmatic control (section 3).

d. Supervisory Printer - With accommodation for installation of a supervisory module on the central processor, a B 495 Supervisory Printer may be used with B 273 and B 283 Central Processors only. All appropriate commands have been added to the central processor for programmatic control (section 3).

e. High Speed Tape Compatibility - High Speed Magnetic Tape Units, Model B 422, may be used with B 273, B 283 Central Processors. These units have a tape speed of 120 inches per second and a packing density of both 200 (24 KC) and 555.5 (66 KC) frames per inch. B 421 (90 inches per second), B 422 (120 inches per second), and B 423 (120 inches per second) Magnetic Tape Units cannot be intermixed on a system. A 66 KC module must be installed in the central processor of B 273 and B 283 Systems in order to use the B 422 Magnetic Tape Units.

f. Bull Code Compatibility - A special version of the 800 CPM reader provides for bull code compatibility. This card reader will read only 80-column Hollerith cards punched with a modified Bull T-8 code. The line printer, incorporating a print drum with the Bull character set, provides compatibility for the printing of Bull codes. When the Bull Card Code Module is installed in a processor, Bull card codes can be punched on the standard punch (B 303 or B 304). The punch command permits punching BCL, Bull, and ICT card codes. See ICT Code Compatibility.

g. ICT Code Compatibility - A special version of the 800 CPM reader provides for both BCL and ICT code compatibility, but not on the same run. A manual switch can be set by the operator for either code. A line printer incorporating the ICT character set provides compatibility for the printing of ICT codes.

When the processor includes the ICT Card Code Module, ICT codes can be punched. However, only 80-column Hollerith cards with an expanded version of the ICT 5-3 zone (A-2) code can be read or punched. The Bull Card Code Module can be installed along with the ICT Card Code Module. This allows punching of BULL, ICT, and BCL codes. No change is required in the standard punch equipment.

NOTE

Bull code is the code used on punched card equipment manufactured by Bull Inc., of France. ICT is the code used by punched card equipment manufactured by International Computers and Tabulators, Ltd., of England. With the addition of either or both modules (BULL or ICT), the B 303 and B 304 Card Punch can be used with systems using these codes. Also, the B 124 Card Reader can be used for reading BULL or ICT codes when a BULL or ICT translator is installed in the card reader, at time of order.

h. Increased Clock Speed - The clock speed is increased from 100 KC to 166 KC, thus reducing the execution time of the following commands to 0.6 of the corresponding 100 KC Model 0 and Improved Model 0 times:

(1) No-Op.

(2) Add

(3) Subtract

(4) Multiply

(5) Divide

(6) Compare

(7) Branch

(8) Transfer

(9) Transfer Zone

(10) Mask

(11) Address Modification

(12) Halt

(13) Card Read

(14) Sorter-Read-Buffered Only

(15) Punch

(16) Paper Tape Write

(17) Paper Tape Read-Buffered Only

(18) Paper Tape Space

(19) Paper Tape Backspace

(20) Paper Tape Rewind

B 300 CENTRAL PROCESSOR

2-18. The B 300 Central Processor includes all of the features of the B 100 and B 200 Central Processor, plus it incorporates the following additional and improved features:

a. Expanded Memory - The magnetic core storage capacity is expandable to 19,200 characters in three memory sizes: 4800, 9600 and 19,200. The 19.2 K memory will permit larger processing jobs to be handled more efficiently by eliminating multi-pass runs. The need to overlay programs in memory will be reduced or in some cases, eliminated altogether.

b. Faster Sort Times - Sort times are speeded up approximately 20 to 30 percent, depending on whether magnetic tape or disk file processing is used with the 19.2 K memory capacity.

c. Input/Output Control Modules - Controls for magnetic tape, disk file, data communications, MICR Sorter-Reader paper tape and supervisory printer units are optional modules that may be added to the central processor at any time. (See table 1-1.)

d. Command Modules - In addition to the standard commands included in the B 200 Central Processor (section 3), the B 300 Central Processor features eight new optional commands. These commands enhance the flexibility and throughput power of the B 300, allowing new specialized applications to be handled with ease. The new commands are:

(1) Transfer and Branch Command - This command combines into a single transfer instruction, the frequently executed dual functions of moving data in memory and immediately changing sequence in instruction execution.

(2) Transfer and Translate Command - When input to or output from the B 300 is in a code structure other than BCL, this command translates by programmatic tables to whatever bit structure is required for processing.

(3) Interrogate Command - This command provides a programmatic means of detecting "busy" status on any input/output unit in order to direct control to a different area of processing. Special conditions can also be determined with this command by program testing sense switches or individual bits within a character.

(4) Data Compress and Expand Commands - With these commands, three numeric characters can be compressed to occupy the same number of bits normally required for two alpha characters. In this manner, the data storage capacity of both disk file and magnetic tape can be increased 50 percent for numeric fields. Transfer rates for compressed numeric information are also increased.

(5) Binary Card Read/Punch Commands - This command provides the means of processing data into and out of the central processor in punched card record "image" form, where each of the twelve positions of every card column is represented by a bit in memory.

(6) Lister Command - This command allows the selection of up to 18 listing tapes and provides the ability to print simultaneously on any three selectable tapes.

(7) 16-Pocket Sorter Control - The Control Sorter Command has been modified to allow the attachment of the 16-pocket B 116 Sorter-Reader to the B 300 Central Processor. The N variants of the control sorter command have been extended to select pockets for both 13- and 16-pocket sorters. Associated pocket lights can also be designated for all 16 pockets.

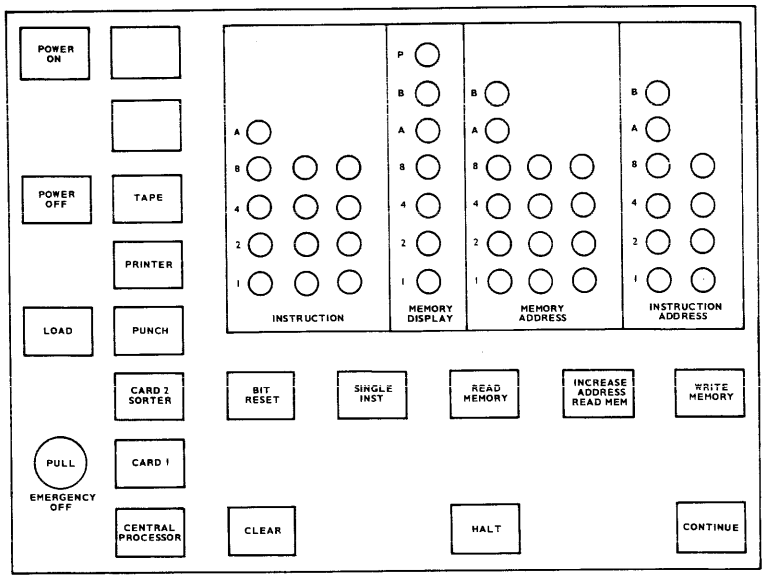
(8) Selective Stacking Control for B 304 Card Punch - The optional addition of a command variant to the Card Punch Command permits the programmer to select particular types of punched card output being produced in a program for stacking in a separate pocket for easy access and identification by the operator.

e. Sense Switches - External communication with a program is provided with a set of six operator controlled (on-off) sense switches located on the central processor control panel. These switches are set according to individual program specifications and are program tested by the Interrogate command. Multiple and unrelated variations may be built into a program with certain areas remaining ineffective until activated by the operator through setting or resetting any 64 combinations of these sense switches.

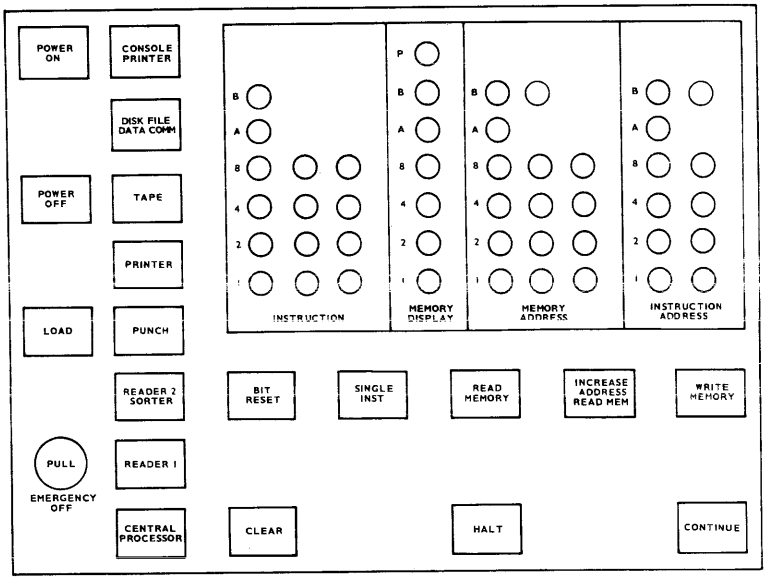
f. Card Read Early Release - This feature allows immediate release of the central processor following reading of the 80th card column. Any magnetic tape, data communication, disk file or card read command can be executed from 67 milliseconds earlier when using a B 124 Card Reader and 16 milliseconds earlier when a B 124 Card Reader is used, after the 80th card column has been read into the central processor input buffer.

Central Processor Console

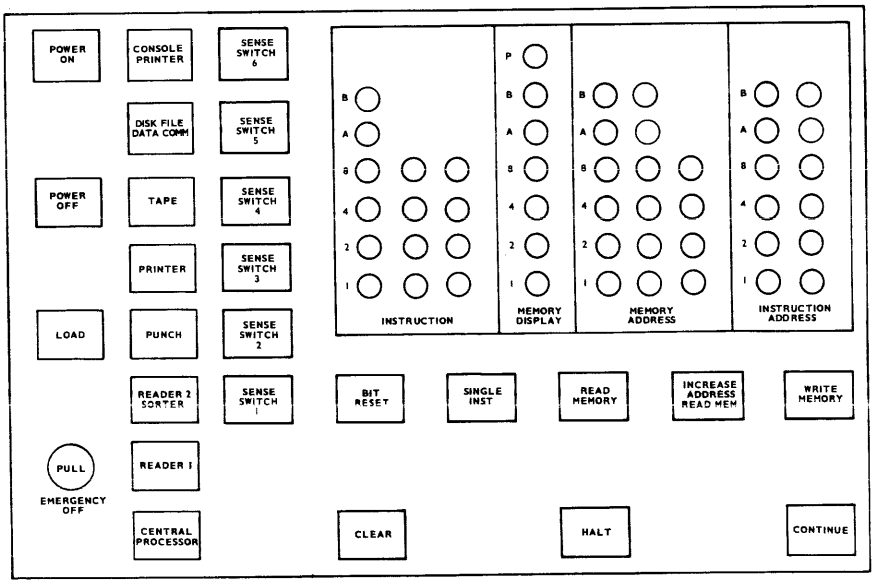
2-19. The B 100/B 200/B 300 Central Processors provide control panels (figure 2-7), which contain all the switches and indicators necessary for operation of the systems. The function of each switch and indicator is described in table 2-1.



B 100 and Model 0 Central Processor Control Panel



B 263/273/283 Central Processor Control Panel



B 300 Central Processor Control Panel

Figure 2-7. B 100/B 200/B 300 Central Processor, Control Panels

TABLE 2-1

B 100/200/300 Central Processor Control Panel
Switches and Indicators

SWITCH INDICATOR	FUNCTION
POWER ON	A self-indicating switch/indicator that turns system power on in correct sequence, and lights, indicating that power is on for the central processor. It also provides a turn-on signal, at the correct time, to all system units with the exception of the magnetic tape units and the sorter-reader.
POWER OFF	This switch turns systems power off including input/output equipment in correct sequence where required.
LOAD	This switch initiates the instruction to read data from the card reader into memory, starting with 000 and continuing until memory is filled or the hopper is empty. **NOTE** Load can be started at any pre-set address which is a multiple of 5-words and can be used with paper tape as well as cards. However, when used with paper tape, pressing the LOAD switch causes memory to be loaded, starting from the address displayed in the memory address register and continuing to end-of-memory, or to the first stop character encountered on the paper tape. After load, the CLEAR switch must be pressed.
EMERGENCY OFF	When pulled, turns off all power to all units in the system including the central processor (except the circuit breaker at entry to the unit and convenience outlets). When this switch is pulled, only a field engineer can restore the power.
CONSOLE PRINTER DISK FILE DATA COMM TAPE PRINTER PUNCH READER 2 SORTER READER 1	These indicators are the system-unit lights and are lit when the command in the INSTRUCTION register refers to the unit named on the light. If the system stops, the light which remains lit indicates the unit which is unable to complete its function. **NOTE** Indicators READER 1 and 2 are labeled CARD 1 and CARD 2 on B 100 and Model 0 Central Processors.

TABLE 2-1 (cont)

B 100/200/300 Central Processor Control Panel
Switches and Indicators

SWITCH/INDICATOR	FUNCTION
SENSE SWITCH 1 **SENSE SWITCH 2** **SENSE SWITCH 3** **SENSE SWITCH 4** **SENSE SWITCH 5** **SENSE SWITCH 6**	These switches provide external communication with the program being processed. They are set according to individual program specifications and are program tested by the Interrogate command. Multiple and unrelated variations may be built into a program while maintaining ineffective areas until activated through setting or resetting of any 64 combinations of these switches. These switches are optional on B 300 Central Processors and are not applicable to all other Central Processors.
CENTRAL PROCESSOR	Illuminates, indicating that a parity error is sensed when information leaves memory, i.e., during command execution or buffer access. **NOTE** Sensing a parity error causes the central processor to stop. To re-establish automatic operation, operator must manually correct the error in memory and cause the command to be re-executed.
INSTRUCTION	Three columns of lights which display the operation code and M and N variants of the instruction to be executed. **NOTE** B 263/273/283 and B 300 Central Processors include a B-bit to display new OP codes.
MEMORY DISPLAY	An array of seven lights which displays one character-at-a-time; either one called from storage for display or change, or a character manually inserted in the register for transfer to storage.

TABLE 2-1 (cont)

B 100/200/300 Central Processor Control Panel
Switches and Indicators

SWITCH/INDICATOR	FUNCTION
MEMORY ADDRESS	Three columns of lights which display a storage address. The address displayed in either that of the location of a character from storage to be transferred to the Memory Display or that of a location in which a character from the Memory Display is to be stored.
INSTRUCTION ADDRESS	Two columns of lights which display the address of the next instruction to be executed. Since the third character of a machine language instruction address is always zero, only the first two digits are displayed. **NOTE** A B-bit indicator in the tens position of the Instruction and Memory address is included on B 263/273/283 and B 300 Central Processors.
BIT RESET	This switch when held down, and at the same time momentarily pressing any bit light on the display panel, turns off the light and its associated flip-flops.
SINGLE INST	Used to execute programs one instruction at a time under manual control.
READ MEMORY	Reads and displays the one character in the memory display as signified by the memory-address register.
INCREASE ADDRESS READ MEM	When pressed, the memory-address register advances by one and displays the character in that address in the memory display.
WRITE MEMORY	Writes into memory, in the address displayed by the memory address register, the character shown in the memory display.
CLEAR	This switch clears all flip-flops and their corresponding lights in central processor. **NOTE** This switch does not clear the central processor input and output buffers.

TABLE 2-1 (cont)

B 100/200/300 Central Processor, Control Panel
Switches and Indicators

SWITCH/INDICATOR	FUNCTION
HALT	A self-indicating switch/indicator that halts the system at the completion of all operations in progress. However, execution of instructions for all system units in process is completed before the system stops.
CONTINUE	A self-indicating switch that initiates automatic operation after all error conditions have been reset in the central processor. This switch is also used as a START switch for continuing operation.

SORTER-READER

2-20. The Sorter Reader (figure 2-8), is capable of reading and sorting documents encoded with magnetic ink at speeds up to 1565 items-per-minute. Information encoded on the documents is converted to Burroughs Common Language (BCL) representation and transferred to core storage in the central processor. When used with a magnetic tape system, information can be transferred to the central processor for editing and then to magnetic tape. When under program control, the sorter-reader can operate in two modes: demand and flow. In demand mode, documents are fed one at a time, as required by the program, at a maximum rate of 400 items-per-minute. In flow mode, documents are read and sorted at the free flow rate of the sorter-reader which is up to 1565 items-per-minute, depending upon document size (section 6).

2-21. Presently, six models are available for use with the B 100/200/300 Systems. They are: B 102/103/104/106/107 and B 116 Sorter-Reader (see table 1-1).

2-22. The sorter-reader is comprised of five distinct areas illustrated in figure 2-8 and identified by the letters a through e:

a. Document feeding area.

b. Transport and read area.

c. Transport and pocket area.

d. Temporary storage area and mobile carrier.

e. Control panel.

Document Feeding Area

2-23. This area encompasses the document hopper, the feeder belt, the hold belt, and the acceleration drum.

2-24. The document hopper (figure 2-9) is 15 inches long, 9-1/2 inches wide, and can hold approximately 3000 documents. Documents are placed in the hopper with the front of the document facing to the left.

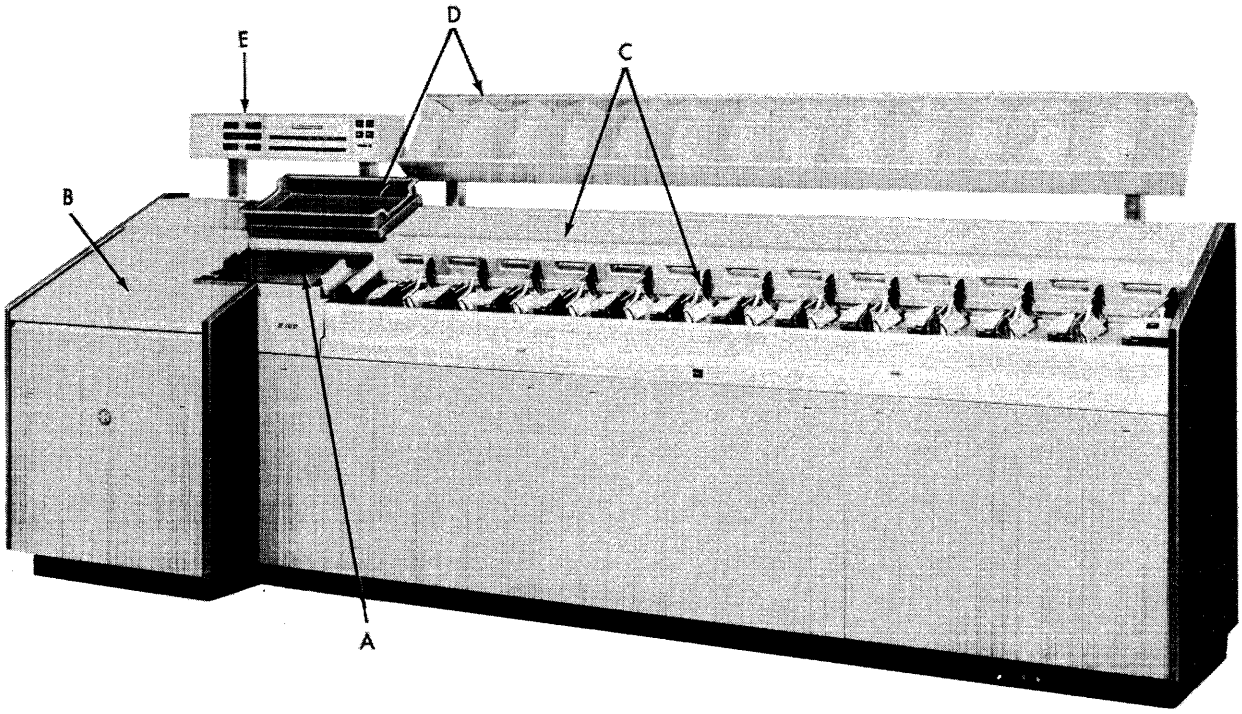


Figure 2-8. B 116 Sorter-Reader

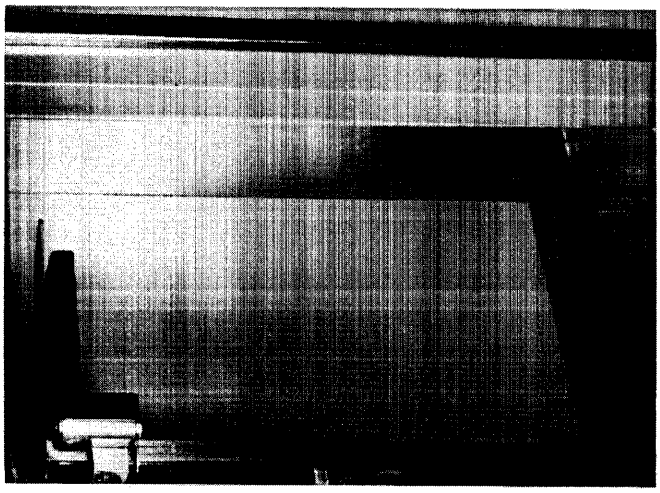


Figure 2-9. Document Hopper

2-25. A follow block provides the necessary pressure to move the documents into the feeder belt. It moves smoothly along a guide rail which extends the length of the hopper and can easily be tilted out of the hopper when desired. To load documents while sorting takes place, the new documents are placed in back of the follow block and the follow block is then raised from its position between the two groups of documents and repositioned directly behind the last document in the hopper.

2-26. The hold back belt, in combination with the feeder belt, restricts feeding to one document at a time. The function of the hold back belt is to separate the documents, thus permitting only one document at a time to be transported to the read station. Figure 2-10 illustrates the two belts in relation to their position in the document feeding mechanism.

2-27. Documents are selected from the hopper by the feeder belt at the rate of 150

inches-per-second and accelerated to 400 inches-per-second by the acceleration drum. Proper spacing between documents is important to insure reading and sorting of each document. Improper spacing between documents is detected by strategically located beams of light which cause such documents to be sorted into a reject pocket. Document feeding is stopped for 300 milliseconds to permit the reject and then automatically continues. Such rejects also occur when a document fails to meet minimum or maximum size specifications.

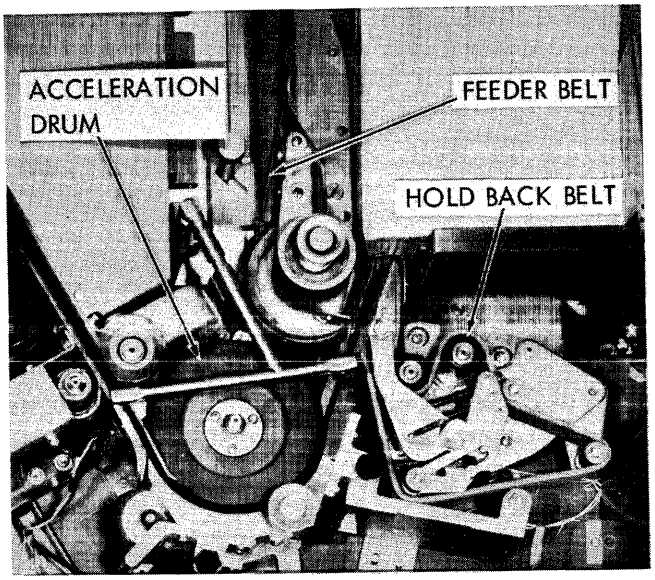


Figure 2-10. Document Feeding Area

2-28 The document feeding area also includes a device called the batch ticket detector. This is an optical sensing device located between the hopper and the acceleration drum to provide the means of stopping the feeding of documents upon the detection of a black band on the front of the batch ticket. By stopping the flow of items, all items in the preceding batch can be completely processed before continuing with the next batch.

Transport and Read Area

2-29. This area is made-up of four functional control points which are located between the document feeding area and the pocket area. The four functional points illustrated in figure 2-11 are as follows:

The aligning mechanism.

The read station.

The standby station.

The chute blade selector.

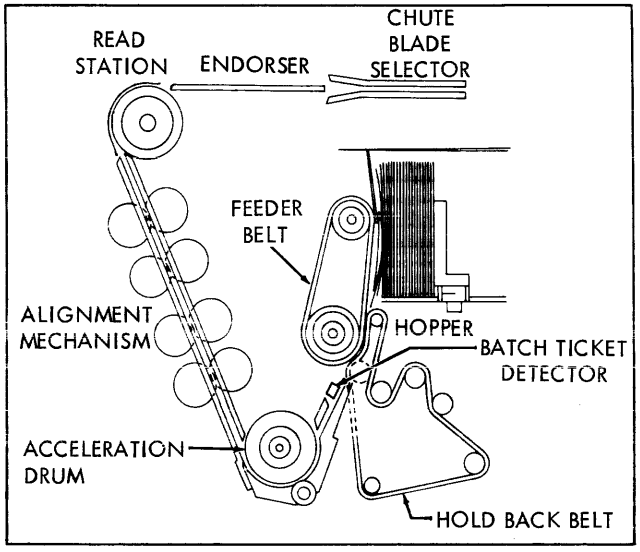


Figure 2-11. Transport and Read Area

2-30. After the documents pass the acceleration drum, they enter the alignment mechanism which positions the documents by the application of a firm, but gentle, downward pressure by a series of eight alignment rollers, four of which are located on each side of the document transport belt. By the time the document reaches the end of the alignment mechanism, its lower edge is in the correct position for entry into the read station.

2-31. To assure that the characters to be read have been properly magnetized before the document passes the read head, it is passed over a permanent magnet. This permanent magnet is mounted in the stationary hub of the read drum assembly. A non-magnetic metallic strap is used to guide the document through the read station and to maintain a constant pressure between the magnetized characters and the read head. After passing the permanent magnet, the characters on the document are read by the read head and the resultant impulses are routed to the central processor memory.

2-32. The third control point, the stand-by station, is used in the B 102 and B 106 Sorter-Reader. Items which have passed the read station are held in the stand-by station until a pocket select command is received from the central processor. This type of operation occurs in demand mode and the maximum rate of document processing is 400 items-per-minute. In the B 103/116 Sorter-Readers, the stand-by station is replaced with an endorser unit. This high-speed endorser provides the ability to endorse all items as they pass through the sorter-reader. The endorsement is printed on the backs of all documents as they move from the read station to the chute blades. The use of the endorser prevents the use of the demand mode.

2-33. The fourth control point is made-up of the chute blade selector and magnetic assemblies which are used to control the path of the documents to the pockets and are under control of the central processor. There are 12 moveable chute blades. In actuality, the chute blades are in two sections and so positioned that they cover the lower and upper portions of the document as it is routed to its pocket. The blades extend the entire length of the transport mechanism ending at the entrance to the document pocket. This assures that once an item enters the chute blades, it will only be routed to the selected pocket.

Transport and Pocket Area

2-34. The transport area is located above and behind the pocket area and carries documents from the chute blades to the pocket determined by the chute blade opening. Once the proper chute selection is made, the document cannot be delivered to any other pocket. Figure 2-12 shows the sorter-reader with the cover raised and a document in the transport area.

2-35. The sorter-reader has 13 pockets positioned left to right from the document hopper and designated in the following order: Reject, 0 through 9, X, and Y. Each pocket is 4 inches wide and has the capacity for approximately 800 documents. Items are sorted to any of the 13 pockets based upon the program instructions in core storage. All checking functions are also under control of the central processor.

NOTE

The B 116 Sorter-Reader incorporates 16 distribution pockets. The sixteenth pocket (Y-pocket) has a 2000 item capacity as compared with 800 items for the other pockets. When operating in the off-line Sort Mode, the additional three pockets serve as overflow capacity for the X-pocket.

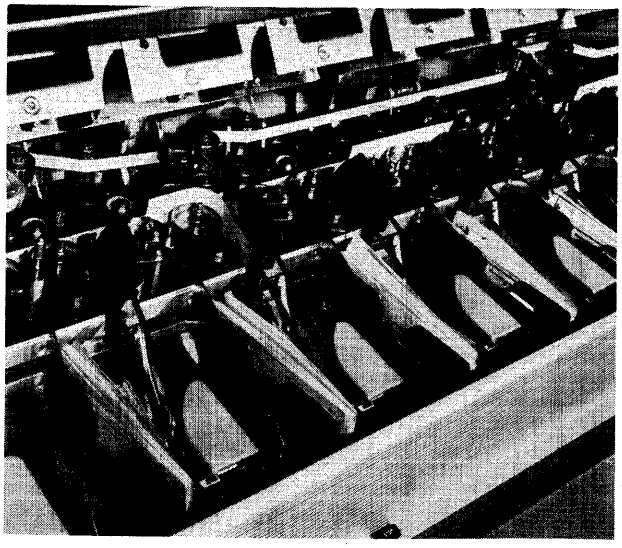


Figure 2-12. Transport and Pocket Area

2-36. There are two plastic worm gears in the bottom of each pocket which guide the lower edges of the document toward a sliding pocket wall (figure 2-13). These worm gears are friction driven so that light finger pressure will immediately stop their operation, thus protecting the operator.

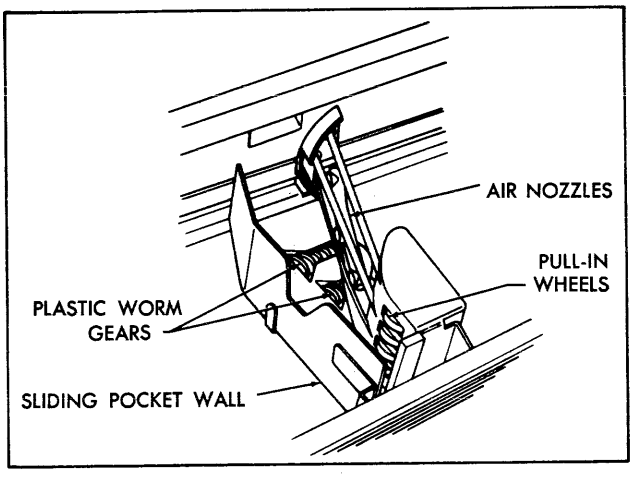


Figure 2-13. Pocket Mechanism

2-37. As the documents enter the pocket, their leading edges are "caught" by the pull-in wheels. These wheels serve two purposes --they pull the items to the front of the pocket and keep the items from rebounding after hitting the front of the pocket.

2-38. While the bottom edge of the document is being guided by the plastic worm gears, a continuous jet of air from three air nozzles is directed against the top rear of the documents from the instant they enter the pocket. This helps position the documents and produces a more orderly pack of stacked items.

2-39. The right side of the pocket is engineered to guide the documents along smooth guide rails into their proper position in the pocket. The sliding pocket wall permits the pocket size to vary according to the number of items in the pocket. As documents enter the pocket, the sliding pocket wall moves to the left. When the pocket is filled to 3/4 of its capacity (approximately 600 items), a pocket warning light, located immediately above the pocket, is turned on automatically. When the capacity of the pocket is reached, the document feeder automatically stops and a Full Pocket Indicator on the control panel illuminates.

2-40. Each pocket can be unloaded while the sorter-reader continues its normal sorting pattern by the use of a Divider Block which is similar in construction to the Follow Block in the Document Feeder. By inserting the Divider Block into the pack of documents in the pocket, the items to the left of the Divider Block can be easily removed while documents are entering the pocket during this operation. When the items have been removed, the sliding pocket wall, which provides the expansion pressure required to hold the items in place, returns to its normal position and the Divider Block can be returned to the left side of the pocket.

2-41. Figure 2-14 shows the Divider Block in its normal position to the left of the sliding pocket wall while figure 2-15 shows the Divider Block inserted in the pack of documents in the pocket prior to document removal.

Temporary Storage Area and Mobile Carrier

2-42. The Temporary Storage Area and Mobile Carrier assist in the removal and storage of sorted documents efficiently while sorting operations continue.

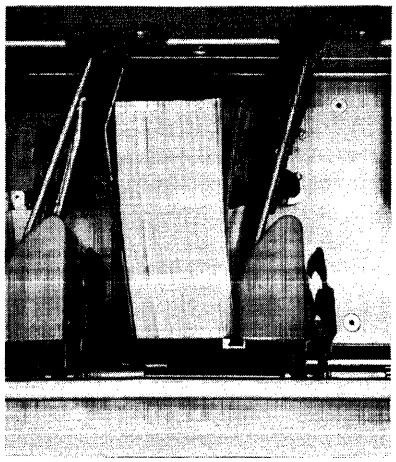


Figure 2-14. Divider Block—Normal

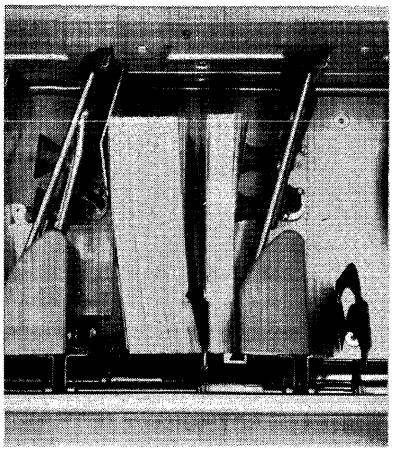


Figure 2-15. Divider Block—Inserted

2-43. Documents removed from the pockets during sorting can be placed in the corresponding compartments of the Temporary Storage Area located above the transport area. Up to 4000 documents can be loaded in the removable item tray, which moves in either direction with the mobile carrier. Figure 2-16 illustrates the two features.

Figure 2-16. Temporary Storage Area and Mobile Carrier

2-44. The sorter-readers can also be used independently of the system. When used off-line, sorting is controlled by a patchboard housed in the rear of the control panel. A detailed explanation of the use of the sorter-reader off-line is available in the Sorter-Reader Operator's Manual, 1018678.

Sorter-Reader Control Panels

2-45. The sorter-reader control panels contain a number of switches, indicators and selection keys that provide a communication link between the operator and the sorter-reader. There are four major elements of the control panel:

a. Operating switches.

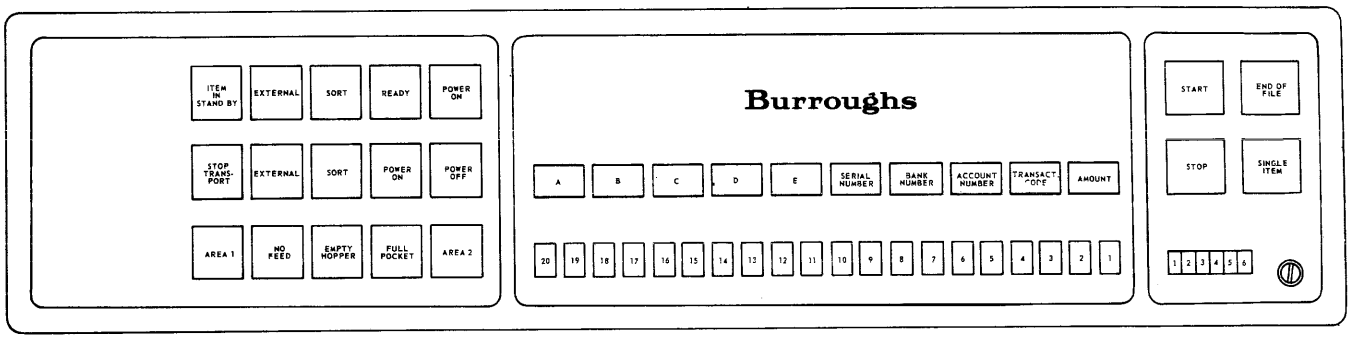
b. Communication indicators.

c. Field selection keys.

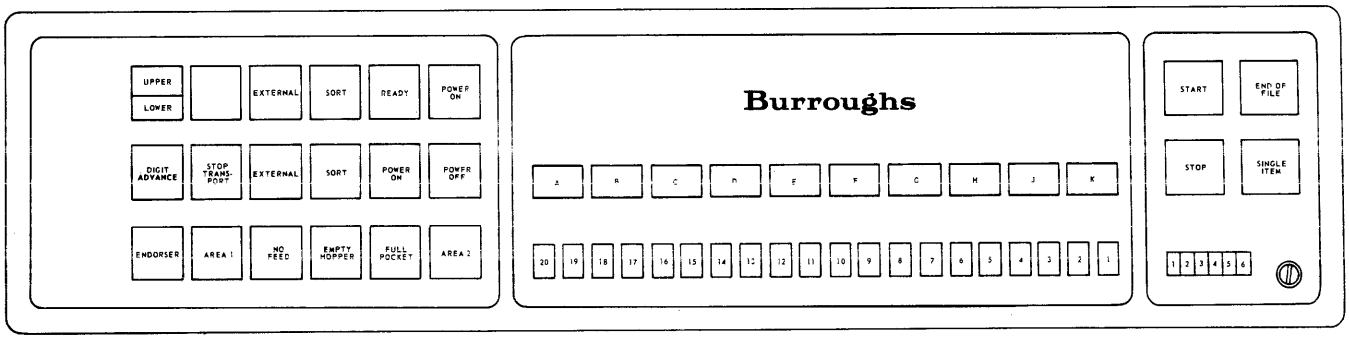
d. Digit selection keys.

Figure 2-17 illustrates the control panels of the B 102, B 103, and B 116 Sorter-Readers. The B 103/B 116 control panels contain more switches and indicators than the B 102 due to their endorser operation. The function of these switches and indicators is provided in tables 2-2 and 2-3.

B 102



B 103



B 116

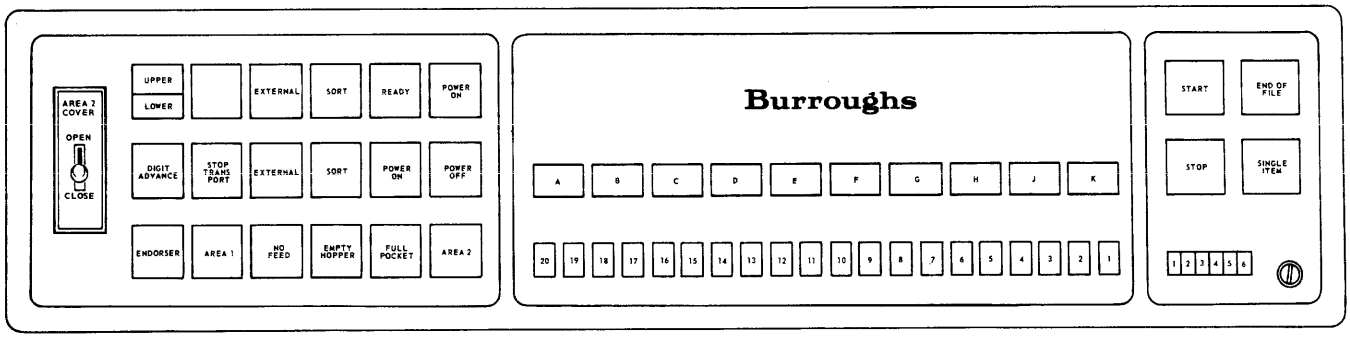


Figure 2-17. B 102/B 103 and B 116 Control Panels

TABLE 2-2

Sorter-Reader Control Panel
Operating Switches

SWITCH	FUNCTION
(Left Side of Control Panel)	
DIGIT ADVANCE	This switch (B 103 only) is used off-line to advance the three-digit batch number in the endorser unit by one (1). It is inactive if the document feeder is running. It has no function during on-line operation since the batch number is advanced by the external unit under program control.
STOP TRANSPORT	This switch (B 103 only) is used to stop the transport system. The NO FEED indicator will turn on. To return the sorter-reader to the "Ready" state, it is necessary to use the SINGLE ITEM switch.
EXTERNAL	When power is turned on, the sorter-reader is automatically put in sort mode. This switch is used to transfer control to the central processor when the sorter-reader is used for input purposes. This switch can be used before the sorter-reader is in a "Ready" state.
SORT	This switch has no function when the sorter-reader is used on-line.
POWER ON	This switch applies power to the sorter-reader. The POWER ON indicator will light.
POWER OFF	This switch removes power from the equipment. An auxiliary POWER OFF switch is located immediately to the right of the Y-pocket (figure 2-18). It serves the same function as the one on the control panel.

TABLE 2-2 (cont)

Sorter-Reader Control Panel
Operating Switches

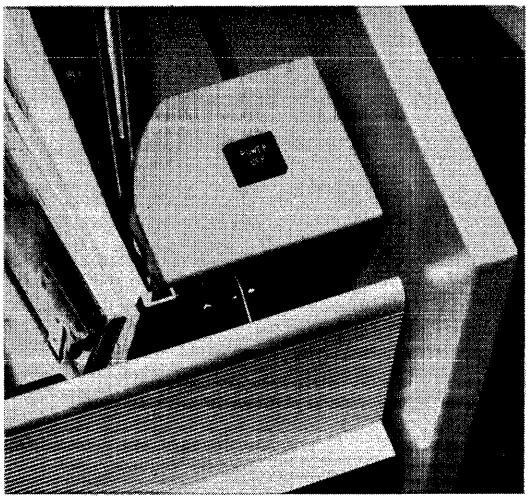
SWITCH	FUNCTION
	
	Figure 2-18. Auxiliary POWER OFF Switch
(Right side of Control Panel)	
START	This switch sends a signal to the central processor. Document feeding starts on command from the central processor. Specifically, if the program has stopped because of an empty hopper, the program will restart automatically upon loading the hopper and using the START switch. In other instances, it is used simply to turn off the EMPTY HOPPER indicator.
END OF FILE	This switch is used whenever an end-of-file branch is called for by the program. The EMPTY HOPPER indicator will light to signal this requirement.

TABLE 2-2 (cont)

Sorter-Reader Control Panel
Operating Switches

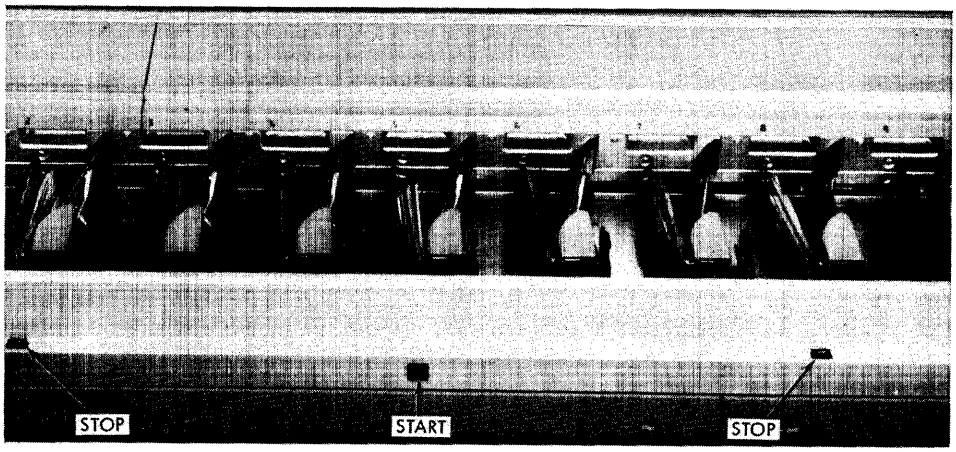
SWITCH	FUNCTION
STOP	This switch is used to stop the feeding of documents. An interlock prevents the covers from being raised. The sorter-reader remains in a "Ready" state when this switch is used. Item flow is resumed by using the START switch. Two other STOP switches are located in front of document pockets 2 and 8 for the operator's convenience (figure 2-19). **NOTE** The B 116 Sorter-Reader incorporates a start/stop bar that extends the length of the 16 pockets. This bar activates or stops the system when pressed.
	
	Figure 2-19. Auxiliary Start/Stop Switches
SINGLE ITEM	This switch must be used to put the sorter-reader in a "Ready" state after a "No Feed" or Area 1 or Area 2 stop condition has occurred. A document is not fed in this instance. This switch should not be used to feed a single document when the sorter-reader is used on-line.

TABLE 2-3

Sorter-Reader Control Panel
Indicators

INDICATOR	FUNCTION
(Left side of Control Panel—Top Row)	
UPPER LOWER	This is a two-part indicator that operates only during the endorsing operation of the B 103. The lower half is labeled LOWER and is green; the upper half is labeled UPPER and is amber. The lights indicate which of the two endorsing bands is active. When the endorser is active, one of the indicators will be lit.
ITEM IN STANDBY	This indicator appears only on the B 102. In demand mode, it indicates that an item is in the standby station awaiting disposition. In flow mode the indicator is inoperative.
EXTERNAL	This indicator indicates that the sorter-reader is being operated on-line and under control of the central processor. Sorting is determined by the program being executed.
SORT	This indicator is only operative when the sorter-reader is used off-line.
READY	This indicator signals that the sorter-reader is ready for use after power is turned on or a stop condition has been corrected.
POWER ON	This indicator lights when power is applied to the sorter-reader.
(Left side of Control Panel—Bottom Row)	
ENDORSER	This is a combination switch/indicator for control of the endorser device (B 103 only). When the endorser is off, pressing this switch will activate the device and the indicator will light. When the endorser is active, pressing this switch will turn the device off and the indicator will go out.
AREA 1	Signals a document jam or a potential jam condition, in the area between the acceleration drum and the chute blades. The indicator is turned off by pressing the SINGLE ITEM switch after Area 1 is checked and/or cleared, and the Area 1 cover is closed.

TABLE 2-3 (cont)

Sorter-Reader Control Panel
indicators

INDICATOR	FUNCTION
NO FEED	This indicator lights when an item is not fed from the document hopper within 150 milliseconds after the preceding item or when a document jam occurs in the document feeding area. The indicator is turned off by use of the SINGLE ITEM switch provided a stop condition is corrected and the Area 1 cover is closed.
EMPTY HOPPER	This indicator lights when a sorter-reader instruction cannot be executed because a document is not present at the read station due to an empty hopper condition. The system will halt when this occurs. To continue processing, the hopper must be refilled and the START switch pressed to turn off the indicator. If the processing run has been completed, the END OF FILE switch is used to complete the run.
FULL POCKET	This indicator lights when a pocket reaches capacity. Document feeding stops, and all documents in the transport system are directed to their respective pockets. At this point the system halts. The documents should be removed from the pocket and the START switch pressed to resume processing.
AREA 2	Signals a document jam or a potential jam, in the area encompassing the chute blades and the individual pockets. The indicator is turned off by use of the SINGLE ITEM switch.
AREA 2 COVER	On the B 116 Sorter-Reader, a two position switch is provided on the control panel for raising and lowering the area 2 cover. When the cover is raised, lights are lit to provide good visibility to the operator for clearing the jam and also to provide an additional warning that the cover is in the raised position. When the area 2 cover switch is set to the down position, there is a slight delay before the cover actually begins to lower. During this delay, the lights under the cover begin to flash as a warning that the cover is going to lower. These lights continue to flash until the cover has lowered into proper position. When two people are operating the sorter, the person at the control panel should take great caution to warn the pocket operator when the cover is going to be lowered.

NOTE

On the right side of the control panel is a six-digit, resettable item counter which counts the number of documents that pass through the sorter-reader. The switch to the right of the counter is used to reset the counter to 000000. The field and digit select switches located in the center of the control panel pertain only to the operation of the sorter-reader while in the off-line mode. These are described in the B 100 Sorter-Reader Operator's Manual, 1018678.

B 122 CARD READER

2-46. The B 122 Card Reader (figure 2-20) is designed for use as a compact general-purpose card reader capable of reading 80-column punched cards at a maximum rate of 200 cards-per-minute (CPM), under control of the central processor. Buffered operation permits computations to proceed while the card data is being read. The time required to transfer the contents of the buffer to memory is 2 milliseconds (ms.). The time required to process another card, which refills the buffer, is 300 ms. The card reader can handle cards that are cut on any four corners and cards that are notched during verification.

B 122 Card Reader Functional Characteristics

2-47. A single path mechanism transports cards from the picking mechanism, through the read station and into the stacker. A failure to feed or feed jams cause a "Not-Ready" signal to be relayed to the associated central processor. A jam will halt the Card Read operation with no more than two cards in a jammed condition. Information punched in the card is read, translated to BCL code, and transferred into the input buffer, parallel by bit, serially by column. By use of a switch on the control panel, the validity of each character in the card can be checked.

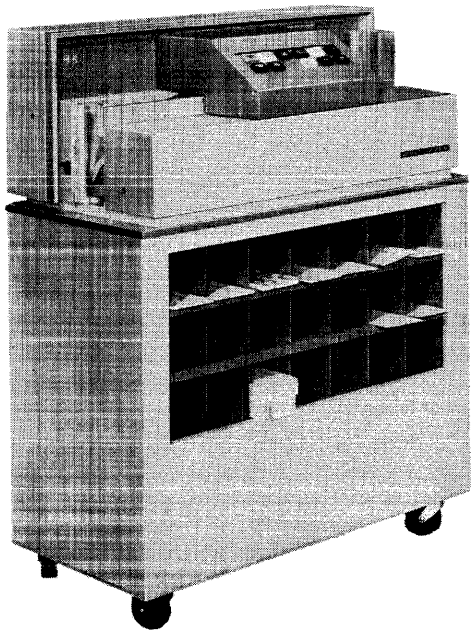


Figure 2-20. B 122 Card Reader

2-48. A demand-type card picking mechanism permits the complete reading of an 80-column card in a total time of 315 ms. or less after a start feed signal is received. The card hopper has a capacity of 450 cards. Cards can be placed into the hopper while the unit is operating as long as approximately 150 cards are still in the hopper. During loading, the cards in the hopper remain in proper position for continuous feeding, without manual support from the operator. A single one-column data reading station reads the cards column-by-column serially for the entire 80 columns. The card data read are in tabulating card code and are transferred to the input buffer of the associated central processor in six-bit binary BCL code. The cards are stacked in the stacker in the same

sequence as they are fed and cannot be removed from the stacker while the unit is operating.

2-49. VALID CHARACTER. As cards are read by the card readers, the character punched in each card column is tested. If it is an invalid character, and the VALIDITY ON switch is active, the following takes place:

a. A binary 12 (1001100) will be read into the buffer in lieu of the invalid character.

b. The system stops on the next Card Read instruction prior to the transfer of the contents of the buffer to core storage.

c. The VALIDITY CHECK indicator on the card reader control panel lights.

d. The card in error becomes the last card in the stacker.

2-50. When the VALIDITY ON switch is off, the following takes place:

a. A binary 12 (1001100) will be read into the buffer in lieu of the invalid character and the system continues its operation.

2-51. MARGINAL ELECTRONIC CIRCUIT DETECTION. The photoelectric read circuitry in the card reader is checked between read cycles to insure that it is functioning properly. If the circuitry is inoperable or below acceptable performance standards, the system will stop on the next Card Read instruction, indicating a read error condition.

B 122 Card Reader Control Panel

2-52. The B 122 Card Reader control panel (figure 2-21) contains the switches and indicators for operation of the unit and to indicate error conditions. The function of each of these elements is provided in table 2-4.

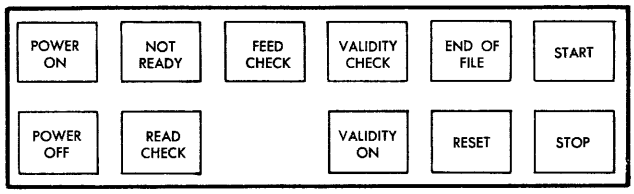


Figure 2-21. B 122 Card Reader Control Panel

TABLE 2-4

B 122 Card Reader Control Panel Switches and Indicators

SWITCH/INDICATOR	FUNCTION
POWER ON	This is a combination switch/indicator that applies power to the card reader and lights when it is pressed.
NOT READY	This indicator lights when any of the following conditions exist: card jam, stacker full, cover not in place, empty hopper, STOP switch pressed, read error, or VALIDITY CHECK indicator lit. The condition causing the NOT READY indicator to light must be corrected before processing can be resumed.

TABLE 2-4 (cont)

B 122 Card Reader Control Panel
Switches and Indicators

SWITCH/INDICATOR	FUNCTION
FEED CHECK	This indicator will light as a result of a card jam or a failure to feed or stack a card properly.
VALIDITY CHECK	This indicator lights when an invalid character is read by the card reader and the system will halt on the next Card Read instruction. The VALIDITY CHECK indicator and its associated circuitry are only operative when the VALIDITY ON switch/indicator is lit.
END OF FILE	When the last card is read from the hopper, the program will halt upon encountering the next Card Read instruction. By pressing this switch and then START, the program will branch automatically to the end-of-file routine specified by the BBB address of the Card Read instruction that caused the program to halt. This indicator will light when the switch is pressed.
START	This switch serves two purposes. First, it is used to condition the card reader (turn the NOT READY indicator off) for feeding cards under program control of the central processor. Second, it is used to restart the card reader after an empty hopper has been reloaded.
STOP	This switch is used to stop the card reader from feeding cards. When the switch is pressed, the program will halt upon encountering the next Card Read instruction.
RESET	This switch clears all error indicators on the card reader. However, the NOT READY indicator is not turned off by pressing this switch.
VALIDITY ON	This switch/indicator provides the means of performing a validity check by the card reader. Validity checking is performed when the switch is pressed and the indicator lights. Validity checking is disabled when the switch is pressed and the indicator goes out.
READ CHECK	This indicator lights when the read check circuitry detects an operational failure. The card reader is placed in a "Not-Ready" state and the system will halt upon encountering the next Card Read instruction.
POWER OFF	This switch removes power from the unit.

B 123/B 124/B 129 CARD READERS

2-53. The B 123, B 124 and B 129 are designed for use as heavy-duty, high-volume card readers. They are physically identical and differ only in their operating speed. That is, the B 123 Card Reader is designed to operate at speeds up to 475 cards-per-minute; the B 124 Card Reader operates at a speed of up to 800 cards-per-minute, and the B 129 is designed to read punched cards at speeds of up to 1400 cards-per-minute. Since the difference in the three units is their operating speed, only the B 124 Card Reader is described in this manual.

B 124 CARD READER

2-54. The B 124 Card Reader (figure 2-22) is used to process punched cards of 51-, 60-, 66-, or 80-columns of either standard or post-card thickness, under control of the central processor, at a rate of 800 cards-per-minute (CPM). An immediate access clutch provides demand feeding. Read data is transferred to the central processor through an 80-character input buffer. Time required to read one card and fill the input buffer is 75 ms. Cards cut on any four corners and cards that have been verified (notched on the right edge) may be used. However, card stock thickness and length must be consistent during any one run. Certain types of scored cards are acceptable for reading with the stubs removed. The scores may be on either edge of the card; however, it is recommended that the score not be used on the leading edge, unless specifically required, since the score does not always tear evenly and causes the card reader to reject the card.

2-55. The B 123/B 124/B 129 and the B 122 Card Readers are interchangeable; a maximum of two card readers may be used with any system, except when a sorter-reader is used as an input unit. When this is the case, only one card reader can be used (see table 1-1).

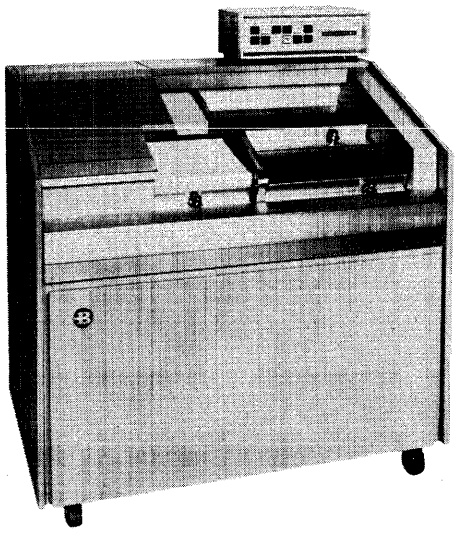


Figure 2-22. B 124 Card Reader

2-56. The following types of scored cards are acceptable to the B 123/B 124/B 129 Card Readers if the stubs are removed: 0M-2, M-2A, M-3, M-4, M-5, and 0M-3 (see figure 2-23). An adjustment to the B 129 Card Reader is required prior to reading the scored cards. The scores may be on either edge of the card; however, 0M-3 should not be used on the leading edge, unless specifically required, since the score does not always tear evenly and can cause the reader to reject the card. Scored cards with stubs attached should not be processed. When cards with stubs attached require processing, the following considerations must be made:

a. Use a card with the highest bursting strength.

b. A dual-geared stacker mechanism must be installed.

c. Custom circuitry, depending on user requirements, may be required with wide scores such as 0M-2. The scores cause read checks and/or validity checks with unmodified circuitry. The ability to process this type of card depends on the location of the score and the information required from the card by the user.

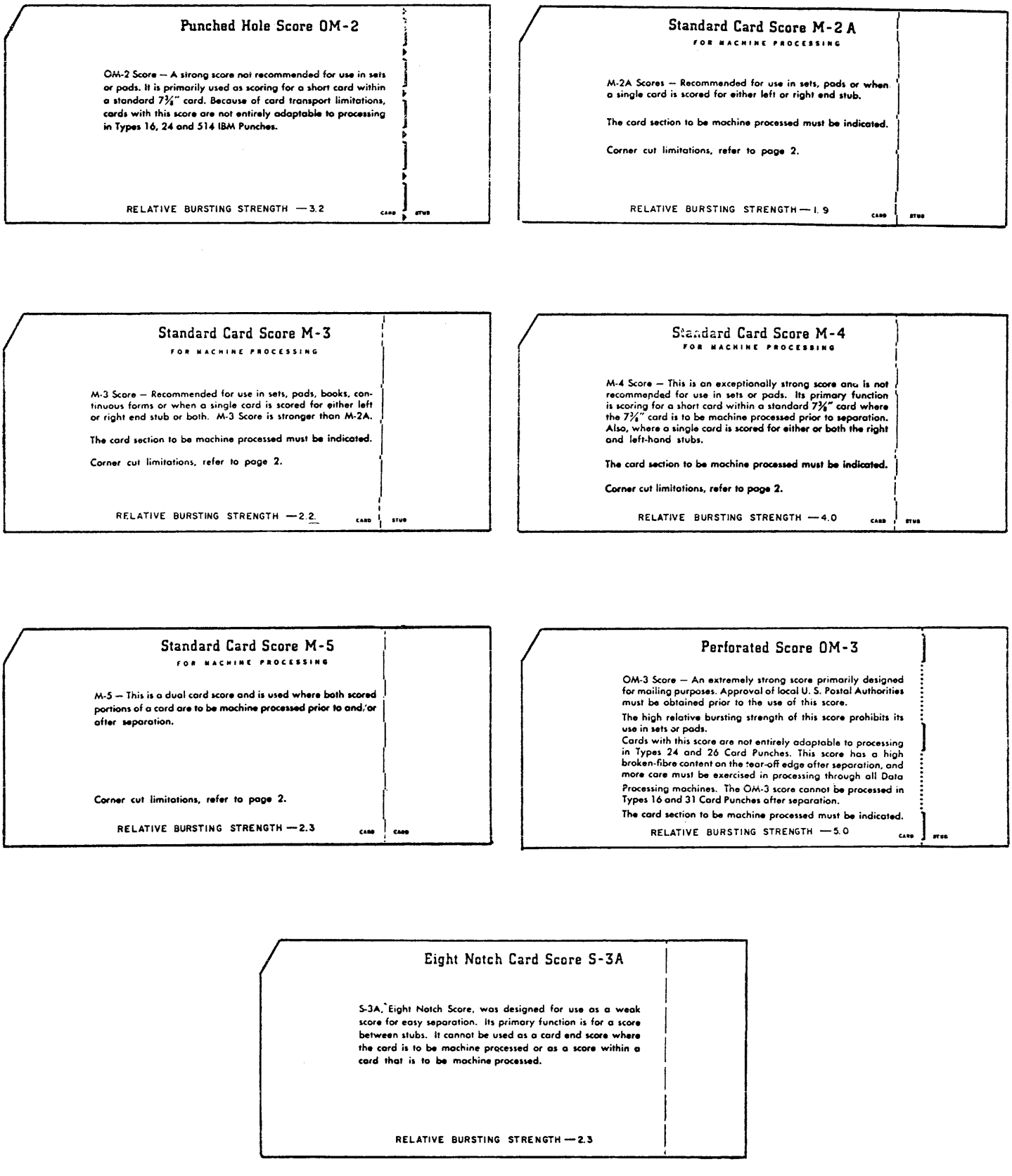


Figure 2-23. Scored Cards

d. Avoid scores such as S-3A, M-2A, and M-3 because they tear easily, interlock, and are generally difficult to handle.

B 124 Card Reader Functional Characteristics

2-57. A single one-column reading station reads the cards, column-by-column, with column 1 being read first. The tabulating card code is translated into six-bit binary coded decimal and transferred to the input buffer of the associated central processor. A demand-type card picking mechanism picks the cards from the card hopper. If an initial pick fails, a second pick is automatically attempted. Formatting of data is not done by the card reader. However, the unit provides 80 timing signals, one for each column position, regardless of card length and unpunched or missing columns are filled in as blanks.

2-58. The card hopper has a capacity of 2400 cards and can be loaded by the operator while the unit is operating. An empty hopper condition causes the transport to shut off. When cards are placed in the empty hopper, the transport restarts without additional operator action. The operator does not have to hold the cards already in the hopper in position when loading additional cards. Cards are conveyed from the hopper to the card stacker by means of a card transport mechanism. Failure to feed a card will cause a missing card condition and the card reader will be placed in a "Not-Ready" state. A card jam will not cause mechanical damage, but the unit will stop operating when two cards are jammed. The cards are then stacked into the card stacker in the same sequence and manner in which they were fed. The stacker will hold a maximum of 2400 cards. Cards may be removed from the stacker during operation without holding the remaining cards in position.

NOTE

Whenever a B 122 and a B 124 Card Reader are used in a single system, place the B 124 on input buffer No. 1 and the B 122 on input buffer No. 2. This permits either card reader to be turned off while the other card reader is operating. When two B 124 Card Readers are connected and only one is required, use the B 124 connected to input buffer No. 1, thus allowing the other B 124 to be turned off. Otherwise, turn both B 124 Card Readers on, thus permitting correct operation when either B 124 is in use.

2-59. A dual-gear stacker is included to assure proper stacking of 80-column Treasury Checks as well as other circulated cards. One gear is removable and may be installed by the operator. This removable gear is left in place for 80-column card operations and is removed for use with short card settings. When the gear is not used, it is stored in the clip provided.

2-60. As an optional feature, a 910 Postal Money Order modification may be made on the B 123/B 124/B 129 Card Readers when requested at time of purchase. The 910 allows the reading of postal money orders which consists of 66-column punch cards, punched with round holes, that occupy the space of two standard size rectangular holes. Also, a 40-Column Read switch may be added to the B 124/B 129 Card Readers. This 40-column read switch allows the card reader to read the first 40-columns of a punched card only, and will ignore the last 40-columns of information punched on the card.

B 124 Card Reader Control Panel

2-61. The B 124 Card Reader contains a control panel (figure 2-24) for communication with the central processor and to indicate error conditions. The function of each switch and indicator on the control panel is provided in table 2-5.

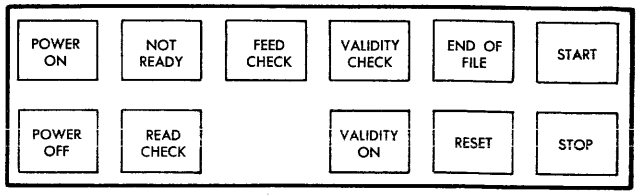


Figure 2-24. B 124 Card Reader Control Panel

TABLE 2-5

B 124 Card Reader Control Panel
Switches and Indicators

SWITCH/INDICATOR	FUNCTION
POWER ON	This is a combination switch/indicator that applies power to the card reader and lights when pressed.
NOT READY	This indicator lights when any one of the following conditions exists: card jam, stacker full, card line mechanism not locked, empty hopper, STOP switch pressed, read error, or VALIDITY CHECK indicator lit. The condition causing the NOT READY indicator to light must be corrected before processing can be resumed.
FEED CHECK	This indicator will light as a result of a card jam or a failure to feed or stack a card properly.
VALIDITY CHECK	This indicator lights when an invalid character is read by the card reader and the system will halt on the next Card Read instruction. The VALIDITY CHECK indicator and its associated circuitry are only operative when the VALIDITY ON switch-indicator is lit.
END OF FILE	When the last card is read from the hopper, the program will halt upon encountering the next Card Read instruction. By pressing this switch and then START, the program will branch to the end-of-file routine specified by the BBB address of the Card Read instruction that caused the program to halt. This indicator lights when the switch is pressed.
START	This switch serves two purposes. First, it is used to condition the card reader (turn the NOT READY indicator off) for feeding cards under program control of the central processor. Second, it is used to restart the card reader after an empty hopper has been reloaded.

TABLE 2-5 (cont)

B 124 Card Reader Control Panel
Switches and Indicators

SWITCH/INDICATOR	FUNCTION
STOP	This switch is used to stop the card reader from feeding cards. When the switch is pressed, the program halts upon encountering the next Card Read instruction.
RESET	This switch clears all error indicators on the card reader. However, the NOT READY indicator is not turned off by pressing this switch.
VALIDITY ON	This switch/indicator provides the means of performing a validity check by the card reader. Validity checking is performed when the switch is pressed and the indicator lights. Validity checking is disabled when the switch is pressed and the indicator goes out.
READ CHECK	This indicator lights when the read check circuitry detects an operational failure. The card reader is placed in a "Not-Ready" state and the system will halt upon encountering the next Card Read instruction.
POWER OFF	This switch removes power from the unit.
JAM AND FULL-STACKER INDICATORS	Two indicators are provided, one at each end of the panel, above the stacker (figure 2-25). The indicator at the left-end of the panel is a jam detector indicator that lights together with the FEED/CHECK indicator when a jam occurs. After the jam is cleared, pressing the FEED/CHECK switch will extinguish the jam indicator. The indicator located near the right end of the panel is a full-stacker indicator that lights when a full-stacker is detected and the card reader is in a "Not-Ready" condition.
1-40 NORMAL	This switch is included with card readers equipped with the Postal Money Order option and is located on the control panel. When in the 1-40 position, the card reader is placed in a 1-40 mode. Successive pressing of this switch causes the 1-40 column Read mode to alternate with the normal 1-80 column Read mode.

TABLE 2-5 (cont)

B 124 Card Reader Control Panel
Switches and Indicators

SWITCH/INDICATOR	FUNCTION
1-40 NORMAL (cont)	In the 1-40 Read mode, columns 1-40 are read and can be checked by the validity circuitry in accordance with the setting of the VALIDITY switch. Column 41 and the following columns are not read, nor checked by the validity circuitry. When in the NORMAL position, the card reader is functioning under normal conditions.

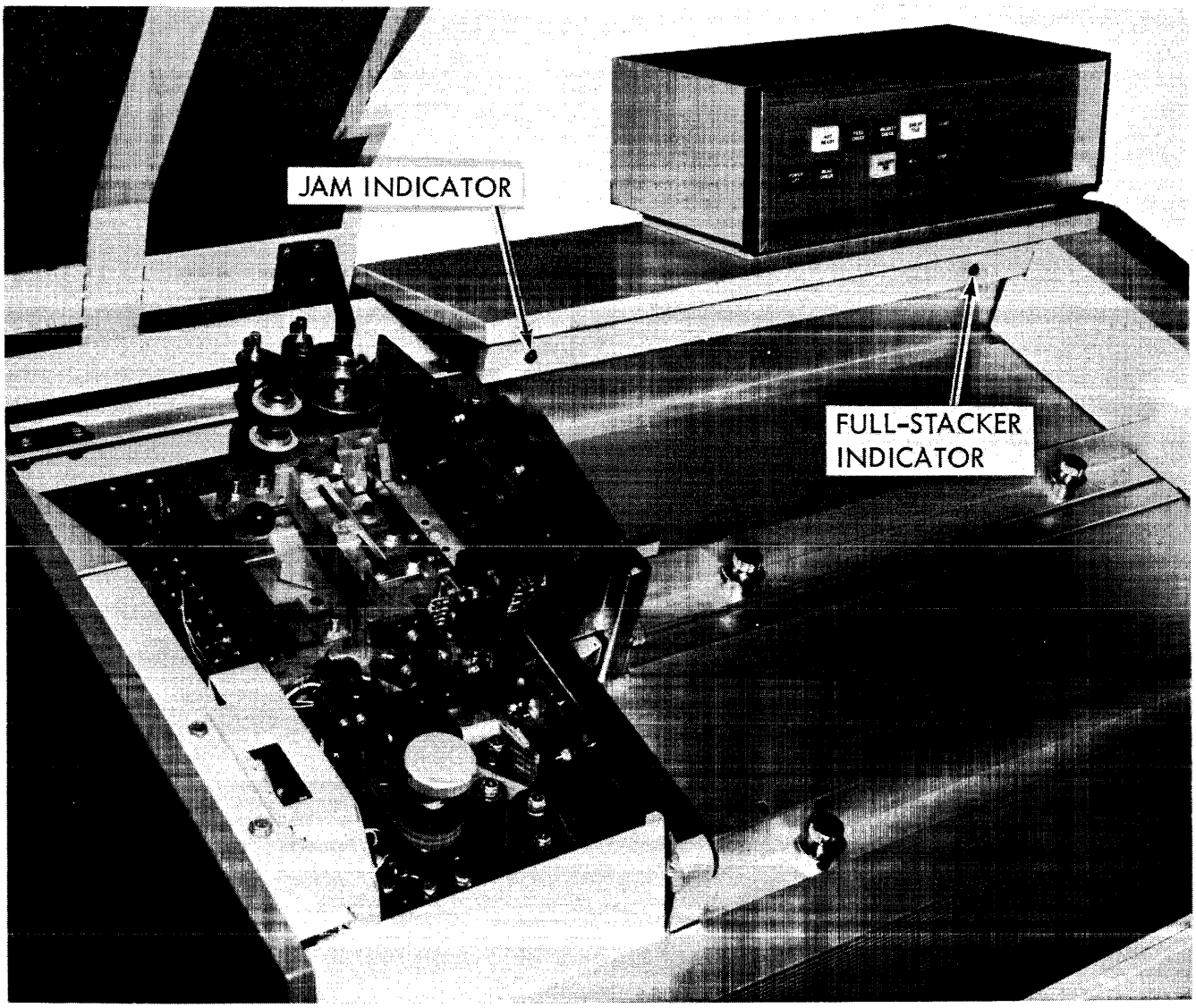


Figure 2-25. Jam and Full Stacker Indicators

B 303 CARD PUNCH

2-62. The B 303 Card Punch (figure 2-26) feeds, punches, checks, and stacks 80-column cards in both standard and post card thickness at the maximum rate of 100 cards per minute. The cards may be cut on any of four corners and may also be scribed for ease of folding or tearing. However, certain types of scribed cards may generate error signals if used with the PUNCH CHECK ON switch (table 2-6). The B 303 operation is completely buffered, thus allowing internal processing between card punch cycles. After the buffer is filled, a card is punched. The difference in time is necessitated by the clutching mechanism. When punching is intermittent, it is delayed until the clutch is properly positioned.

B 303 Card Punch Functional Characteristics

2-63. Cards that are to be punched are placed in the hopper face down, 12-edge first. Card stock thickness must be consistent during any one run and can be loaded into the hopper while the unit is operating without disturbing the cards that are already loaded in the hopper. Entry of cards into the feed rollers is accomplished by feed knives which select cards sequentially when activated by a feed signal. Cards are under positive control of pairs of feed rolls during their travel from hopper to stacker (figure 2-27).

2-64. The punch unit in the B 303 is capable of punching up to 80 columns simultaneously in any one row of a standard card without overloading. Up to 60 columns can be punched in post card stock cards. Card jams will not cause any damage to the punch mechanism.

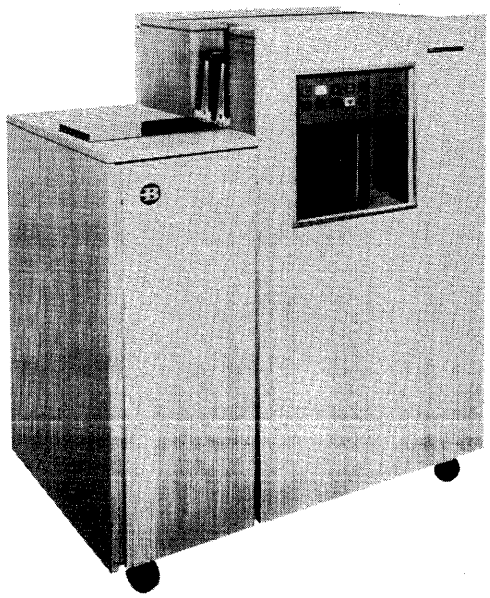


Figure 2-26. B 303 Card Punch

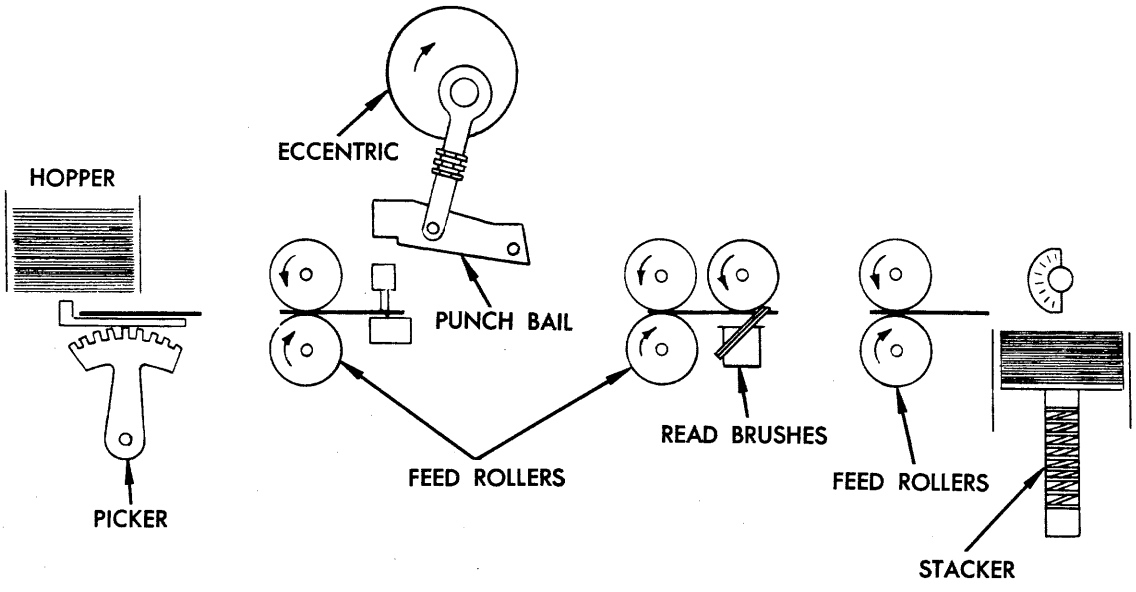


Figure 2-27. B 303 Card Punch Feed Mechanism

2-65. The stacker holds 800 cards and can be unloaded while the unit is punching. The B 303 is capable of idling with cards in the feed mechanism. Card movement is controlled by central processor signals. Card registration is not adversely affected.

B 303 Card Punch Control Panel

2-66. The B 303 Card Punch control panel (figure 2-28) contains switches and indicators for operation of the unit and indication of error conditions. The function of each of these elements is provided in table 2-6.

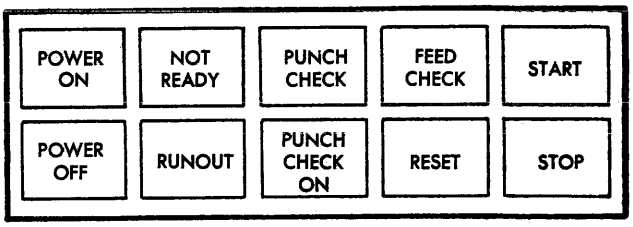


Figure 2-28. B 303 Card Punch Control Panel

TABLE 2-6

B 303 Card Punch Control Panel Switches and Indicators

SWITCH/INDICATOR	FUNCTION
POWER ON	This is a combination switch/indicator that applies power to the unit when pressed. The indicator lights when power is on.
NOT READY	This indicator will light when any one of the following conditions exists: STOP switch pressed, empty hopper, improperly registered card, punch die not in place, card line mechanism not locked, stacker full, chip box not in place, and punching error. The condition causing the Not-Ready state must be corrected and the start switch depressed before operation can be resumed.
PUNCH CHECK	This indicator will light if fewer than 80 data bits are received for each row or if more or fewer than 12 row cycles are counted (punch station check). It will also light if the number of punched holes does not agree with the number of bits in the original data received from the central processor (post-punch read station check).
FEED CHECK	This indicator will light if either a failure to feed or a jammed condition exists.
START	Pressing this switch causes one card to move from the hopper to the ready station, provided that all Not-Ready conditions listed above have been corrected. When pressed, the switch sends a signal to the central processor. Pressing the switch does not clear PUNCH CHECK or FEED CHECK conditions.

TABLE 2-6 (cont)

B 303 Card Punch Control Panel
Switches and Indicators

SWITCH/INDICATOR	FUNCTION
STOP	Pressing this switch will stop card feeding, light the NOT READY indicator, and set the unit to a Not-Ready state. When the switch is pressed, cards that are in motion will be processed completely through the duration of the cycle.
RESET	Pressing this switch clears the FEED CHECK and PUNCH CHECK conditions.
PUNCH CHECK ON	This is a switch indicator that selects between full punch checking and partial punch checking. The switch includes a mechanical toggle which reverses its choice each time it is pressed. When the switch is pressed and the indicator lights, a check is made of both punch station error conditions and post-punch read station error conditions. When the indicator is not lit, a check is only made on punch station error conditions. This feature allows the use of pre-punched and certain pre-scribed cards.
RUNOUT	As long as this switch is pressed, cards will pass through the unit without being punched. The switch is only effective when the unit is in a Not-Ready state. Error conditions, if any, are not cleared.
POWER OFF	Pressing this switch removes power from the unit.

B 304 CARD PUNCH

2-67. The B 304 Card Punch (figure 2-29) serves as a high-speed output device for B 100/200/300 Systems. It has a maximum card punching capacity of 300 cards-per-minute. The format of the output cards is under program control; therefore, no plugboard is used.

2-68. An 80-character output buffer in the central processor allows internal processing time between card punch and cycles. After the buffer is filled, a card is punched. Cards can be held at the punch station for as much as 5 minutes while awaiting a punch command without any damage to the card. After 5 minutes, the card is released to the error stacker. The next punch cycle will then require 400 ms. to complete. Cards can be held in the punch station for as long as 8 hours, with the unit turned off, without any apparent damage to the card.

2-69. Cards can be cut on any of four corners, or scribed for ease of tearing or folding. Certain types of scribing may generate error signals if used with the PUNCH CHECK ON switch (table 2-7). Cards of varying thicknesses CANNOT be used during any one run.

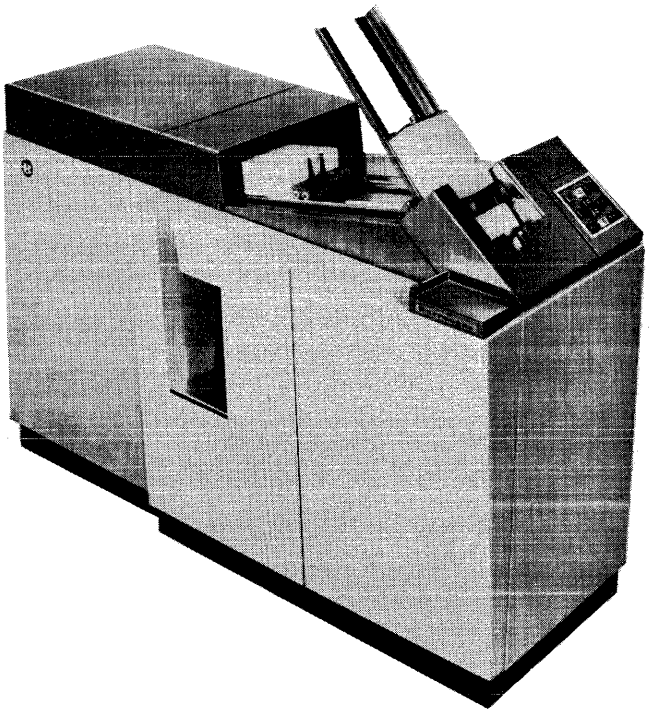


Figure 2-29. B 304 Card Punch

B 304 Card Punch Functional Characteristics

2-70. The B 304 card hopper holds approximately 500 eighty-column cards, of either standard or post card thickness, which are placed in the hopper face down, 12 edge first (figure 2-30). A removable ramp can be placed on the hopper to increase its capacity by an additional 3000 cards. The ramp automatically feeds cards into the hopper as they are required. As cards are fed from the ramp into the hopper, they are automatically "joggled." Cards can be loaded into the ramp while the unit is operating without holding the previous cards in position. When there are no cards in the ramp or if the ramp is not used, a follow block is required for proper feeding from the hopper.

2-71. Cards are punched by a single row of 80 punch dies. A punch station holds the card until it is punched. The same or random alphanumeric characters can be punched in all 80 columns of every card. Punching of all 960 holes in several successive cards due to punch or system malfunction does not result in equipment damage. Cards are not visibly deformed as a result of processing within the punch. A post-punch read station is used for punch checking. The reading is done by a row of 80 brushes.

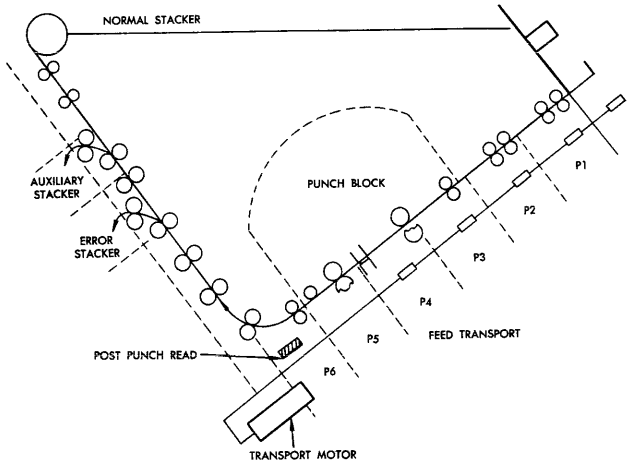


Figure 2-30. B 304 Card Punch Feed Mechanism

2-72. The B 304 includes three card stackers: primary, error, and auxiliary. The primary stacker is a ramp-type with a follow block that keeps the cards stacked neatly. Cards can be unloaded from the primary stacker while punching takes place. A full stacker will cause a Not-Ready condition. Error cards, ejected cards, and runout cards are stacked in the error stacker. A full stacker causes a Not-Ready condition. The capacity of this stacker is 750 cards.

2-73. The operator can manually switch from the primary stacker to the auxiliary stacker by means of a switch. The switch is not located on the control panel, but it is accessible to the operator. A full stacker causes a Not-Ready condition. The capacity of this stacker is 850 cards.

B 304 Card Punch Control Panel

2-74. The B 304 Card Punch control panel (figure 2-31) is located to the right of the card hopper and contains the switches and indicators for operation of the unit and for error indication. The function of these elements is contained in table 2-7.

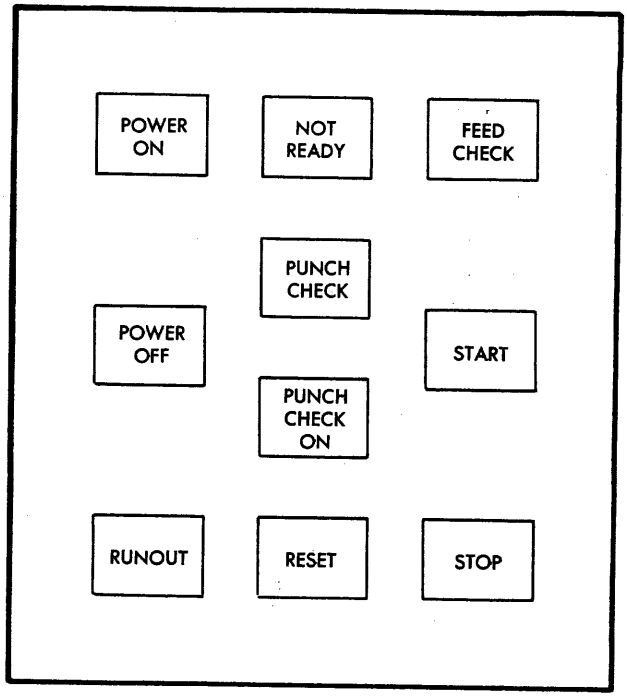


Figure 2-31. B 304 Card Punch Control Panel

TABLE 2-7

B 304 Card Punch Control Panel Switches and Indicators

SWITCH/INDICATOR	FUNCTION
POWER ON	This is a switch/indicator that applies power to the unit and lights when pressed.
NOT READY	This indicator lights when one of the following conditions exists: no card at the punch station; feed check condition; card transport mechanism open; punch die not in place; covers not in place; punch error; and primary, auxiliary, or error stacker full. The error conditions must be cleared before processing can begin.
FEED CHECK	This indicator lights when there is no card present at the punch station because of either a failure to feed or a card jam (except when automatically ejected because of delayed punching).

TABLE 2-7 (cont)

B 304 Card Punch Control Panel
Switches and Indicators

SWITCH/INDICATOR	FUNCTION
PUNCH CHECK	This indicator will light if fewer than 80 bits of data are received for each row, or if more or less than 12 row cycles are counted (punch station check). It will also light if the number of punched holes does not agree with the number of bits in the original data received from the central processor (post-punch read station check).
POWER OFF	This switch removes power from the unit.
START	This switch conditions the machine to accept start feed signals and causes cards to enter and follow the transport system to the proper card positions. It also sends a continue signal to the central processor only if the central processor is in a PCH command. The switch does not reset FEED CHECK or PUNCH CHECK error conditions.
PUNCH CHECK ON	This is a switch/indicator that selects between full punch checking and partial punch checking. The switch includes a mechanical toggle that reverses its choice each time it is pressed. When the switch is pressed and the indicator lights, a check is made of both punch station error conditions and post-punch read station error conditions. When the indicator is not lit, a check is only made on punch station error conditions. This feature allows the use of pre-scribed cards.
RUNOUT	This switch causes cards in the feed line to pass through the machine without being punched. No additional cards are fed from the hopper. The switch is only effective when the unit is in the Not-Ready state. Runout cards are directed to the error stacker. Error conditions, if any, are not reset.
RESET	This switch clears the FEED CHECK and PUNCH CHECK error conditions.
STOP	This switch causes the punch operation to stop after completing the punching of the card in the dies and then places the unit in the Not-Ready state.

B 141 PAPER TAPE READER

2-75. The B 141 Paper Tape Reader (figure 2-32) is capable of reading punched paper tape at speeds of 1000 characters per second. If metalized Mylar or fanfold tape is to be read, the maximum rate is 500 characters per second. The B 141 can accommodate 5, 6, 7, or 8 channel tape, as selected by the operator. Optional code translation facilities are available if required. Tape guides provide positive detent action to handle 11/16, 7/8, and 1-inch tape interchangeably. Beginning and end-of-tape are via adhesive opaque strips on the tape being read. Tape reels can be either 5.5 or 7 inches in diameter.

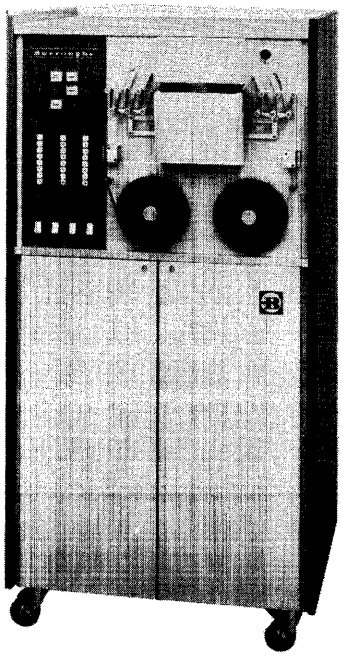


Figure 2-32. B 141 Paper Tape Reader

2-76. Up to two paper tape readers may be used in one system (figure 2-33). The unit makes use of the same input buffers as the card readers. Optional switches located on the paper tape readers can be used to change from punched card operation to paper tape operation (figure 2-34). If a Paper Tape instruction is encountered when the switch is in the card reader position, the central processor will halt.

SWITCH	INSTRUCTION	RESULT
P.T.	P.T.	RUN
P.T.	CARD	HALT
CARD	P.T.	HALT
CARD	CARD	RUN

The B 141 is also capable of checking a tape for parity errors as an on-line or off-line operation. In the off-line mode, the B 141 will stop upon detection of a parity error.

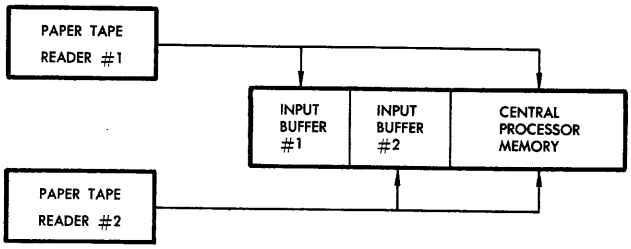


Figure 2-33. B 141 Paper Tape Reader Input

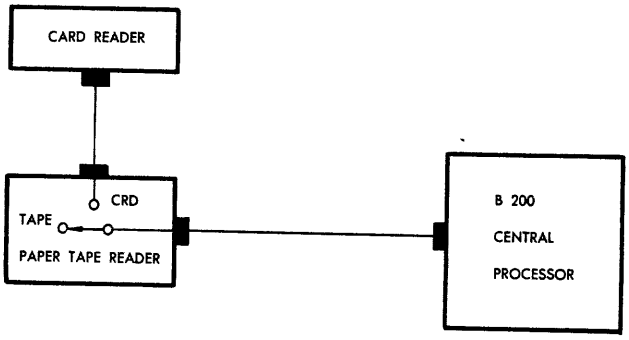


Figure 2-34. Optional Card Reader/Paper Tape Interchangeability Switch

B 141 Paper Tape Reader Functional Characteristics

2-77. Start time for the paper tape reader is 5 ms. or less. Start time (when using 10 characters per inch tape) is defined as the duration from the moment a start signal is received until the next character is read. The paper tape reader requires 20 ms. stop stabilization time prior to executing another

instruction. When reading paper tape or Mylar tape, punched 10 characters-per-inch at speeds up to 1000 characters-per-second, the B 141 will stop in position to read the next character when signaled from the central processor. A minimum of four feet of tape leader is required with reeling. For strip reading, a one-foot tape leader is required. If a broken tape condition occurs, the tape reel motors are shut off automatically. Rewind can be initiated by the central processor.

NOTE

Each B 141 is delivered with eight seven-inch reels, two five and one-half inch reels, ten five-inch wires, and ten bottle (Jack) plugs for use with the Channel Select Plugboard.

Channel Select Plugboard

2-78. A channel select plugboard is provided for interchanging channels to any format required. This action changes the bit configuration from paper tape to an interchanged bit configuration in memory.

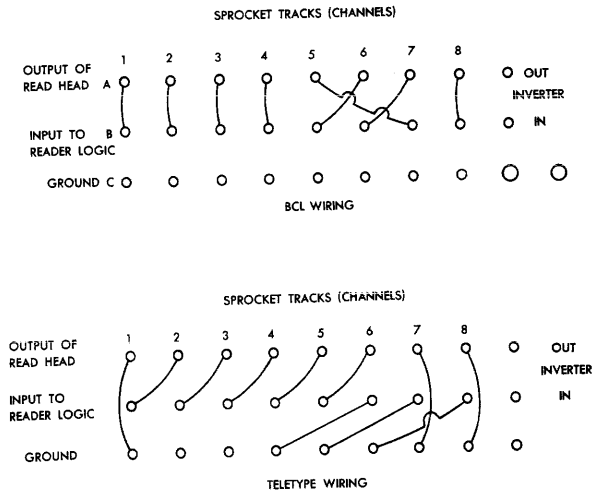


Figure 2-35. Channel Selector Plugboard

(All codes other than BCL will be converted to internal code as though it were BCL code. A direct image is not placed in memory.) Paper tape with even parity can be accommodated by inverting one channel. All unused channels must be connected to the corresponding C channel. Figure 2-35 illustrates the channel select plugboard BCL teletype wiring configuration. The Output read head hub is wired to the Inverter "In" hub and the Inverter "Out" hub is wired to the Input Reader Logic.

CODE TRANSLATOR

2-79. The code translator, which is an optional feature, permits translation of 5, 6, 7, or 8-level codes to BCL. Any one of 256 possible paper tape codes can be translated to any one of the 64 BCL characters. The code translator is located in the paper tape reader cabinet. Figure 2-36 describes the plugboard layout.

a. Exits ①. The exit hubs represent data as received from the paper tape channel select plugboard and consists of 256 possible configurations. Column numbers are the decimal equivalent of the binary numbers represented by the input-to-reader logic hubs (B) 1 to 4 of the channel select plugboard. An example of this would be:

Channel	1	2	3	4
Binary Equivalent	(1)	(2)	(4)	(8)
Input-to-Reader Logic (B)	0	1	0	1 = column 10

Row numbers are the decimal equivalent of the binary numbers represented by the input-to-reader logic hubs (B) 5 to 8 of the channel select plugboard. An example of this would be:

Channel	5	6	7	8
Binary Equivalent	(1)	(2)	(4)	(8)
Input-to Reader Logic (B)	0	1	1	1 = row 14

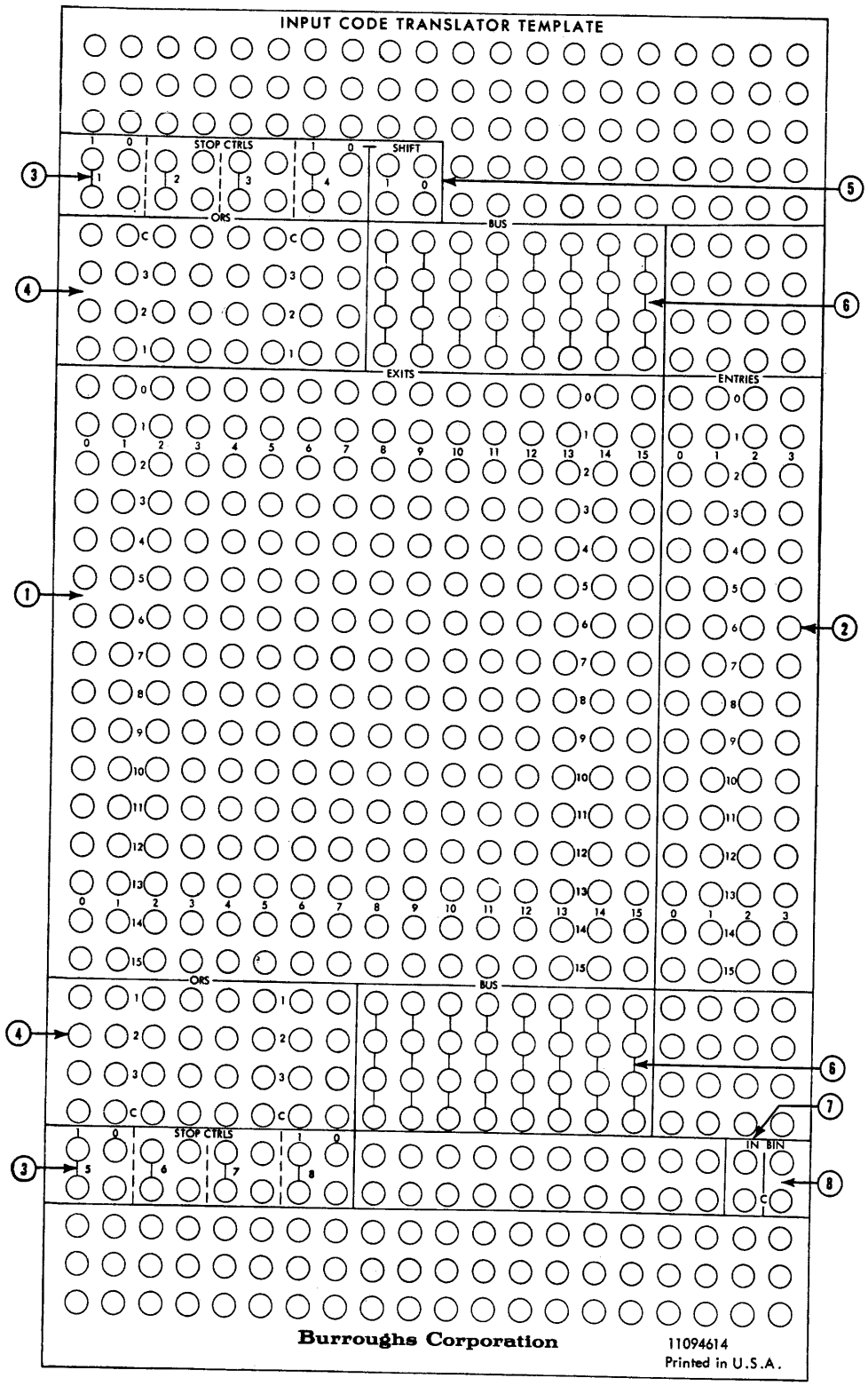


Figure 2-36. Plugboard Layout

b. Entries (2) . The entry hubs represent data sent to the central processor consisting of the possible 64 BCL combinations. Column numbers are the decimal equivalents of the binary numbers represented by the A and B bits of the BCL code (AB = 0, 1, 2, and 3). An A and B bit would represent column 3. To illustrate:

1 2 4 8 A B

0 0 0 0 1 1 = column 3

Row numbers are the decimal equivalents of the binary numbers represented by the 1, 2, 4, and 8 bits of the BCL code. If row 7 is connected, the bit configuration is represented as:

1 2 4 8 A B

1 1 1 0 0 0 = row 7

If row 7 of column 3 is connected, the bit configuration is represented as:

1 2 4 8 A B

1 1 1 0 1 1 = BCL character G

c. Stop Controls (3) . There are eight sets of stop control hubs. To designate a stop code, an exit hub is wired to the input of a stop control. Only one exit can be wired to an entry hub. Any exit code not wired is deleted and is not transferred to the central processor.

d. Shift Codes (5) . The shift code is designated by wiring an exit to the upper shift code input. An unshift code is designated by wiring an exit hub to the lower shift code input. The shift code is made functional by connecting two shift output hubs together. When in the shift case, channel 8 (channel select plugboard) is set to one. When in the unshift case, channel 8 is set to zero.

NOTE

Teletype code can be converted to a single case code via the teletype switch (no translation).

e. BCL/Binary Input (7) and (8) . To enable the translator, the two enable hubs must be connected together. If they are not connected, the translator is bypassed and normal BCL paper tape code to BCL code conversion takes place. When the binary hubs are connected together, the central processor will perform a BCL to internal code translation from the image sent from the channel select plugboard.

f. OR Hubs (4) . The OR hubs permit up to three different codes, designated by the exit hubs, to initiate one common code or action. The following combinations of OR hubs and BUS hubs are permitted:

(1) Up to nine exits can be connected to a single entry by using three OR elements and one BUS element.

(2) Up to nine exits can be connected to a single stop control by using three OR elements and one BUS element.

(3) Up to six exits can be connected to a single stop control by using two OR elements (no BUS required).

g. BUS Hubs (6) . There are eight sets of BUS hubs. Each set permits multiple connections to a single hub. The permissible combinations of BUS hubs and OR hubs are the same as those outlined in step f above.

NOTE

The following supplies are included with each optional Code Translator:

1 - Plugboard
100 - Six inch wires
25 - Nine inch wires
25 - Twelve inch wires
25 - Templates

B 141 Paper Tape Reader Control Panel

2-80. The B 141 Paper Tape Reader control panel (figure 2-37) contains switches and indicators for operation of the unit and for the detection of errors. The function of each of these elements is contained in table 2-8.

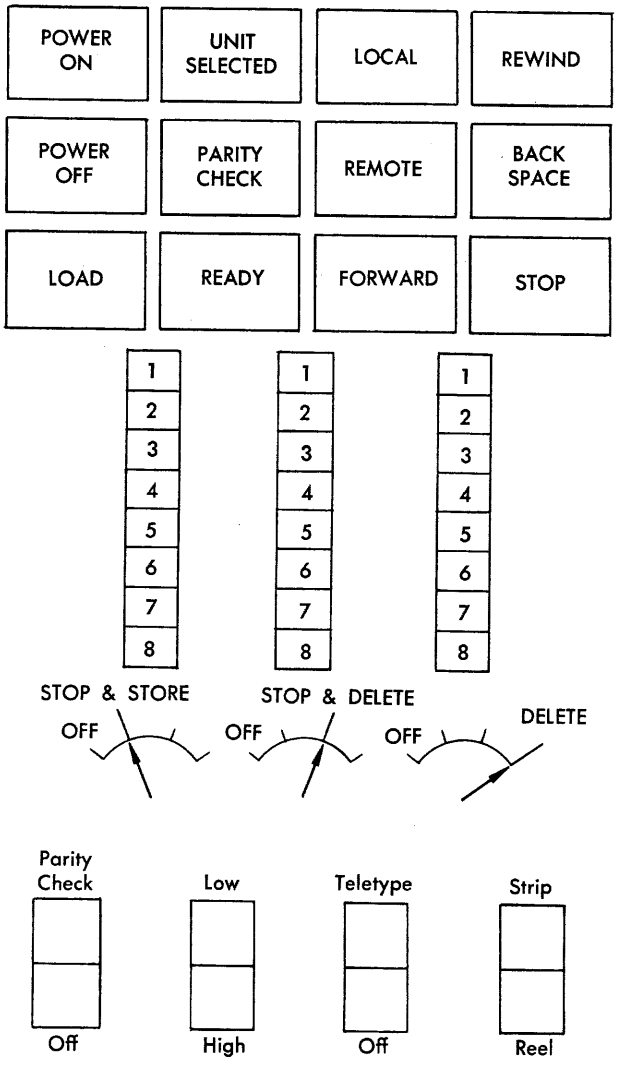


Figure 2-37. B 141 Paper Tape Reader Control Panel

TABLE 2-8

B 141 Paper Tape Reader Control Panel
Switches and Indicators

SWITCH/INDICATOR	FUNCTION
POWER ON	This switch/indicator lights when pressed, indicating that power is applied to the unit.
UNIT SELECTED	This indicator lights when the B 141 is selected by the operator.
LOCAL	This switch places the B 141 in a local condition and is not available to the associated central processor. The LOCAL indicator will also light.
REWIND	When pressed, the paper tape moves in the reverse direction until a beginning-of-tape condition is detected. The tape will then stop. This switch is active only when the unit is in a LOCAL state and the STRIP/REEL switch is in the REEL position.
POWER OFF	When pressed, removes power from the unit.
PARITY CHECK	This indicator lights when a parity error is detected.
REMOTE	This switch/indicator lights when pressed indicating that the unit is under control of the associated central processor.
BACK SPACE	Moves the tape in a reverse direction to the next control code, or beginning-of-tape. This switch is active only when the unit is in a local condition. The switch may also be used to check parity off-line while rewinding tape.
LOAD	This switch releases the brakes, allowing loading of the paper tape. This switch is active only when the unit is in the local condition.
READY	When pressed, this switch sets the brakes and starts the capstan rollers. The servos are also activated when the STRIP/REEL is in the REEL position and the tape properly positioned.
FORWARD	This switch moves the tape forward to the next control code or to the end-of-tape.
STOP	The operation of the B 141 will stop when this switch is pressed.

TABLE 2-8 (cont)

B 141 Paper Tape Reader Control Panel
Switches and Indicators

SWITCH/INDICATOR	FUNCTION
CONTROL CODE	A set of three switches that provide manual selection of three different control codes. Any combination of control codes may be used concurrently. The control code characters may be stored or not stored, as selected. The button positions correspond to the B row of the channel select plugboard. A four position switch for each code set determines the action taken when the control code is detected. The Control Code switches are active in either the local or remote condition. The four positions of the switch are: OFF, STOP & STORE, STOP & DELETE, and DELETE.
PARITY ON-OFF	When in the ON position, parity checking is enabled. The parity error level is reset when in the OFF position.
HIGH-LOW	In the HIGH position, high speed operation is selected (1000 CPS); in the LOW position, low speed operation is selected (500 CPS).
TELETYPE ON-OFF	When in the ON position, a 6th level is added to the teletype code.
STRIP-REEL	In the STRIP position, the reel motors are deactivated and the NO TAPE switch is by-passed. In REEL position, the reel motors are activated and the NO TAPE switch is activated.
NO TAPE	This switch is activated when the STRIP REEL switch is in the REEL position and there is no tape loaded or the tape breaks. Activation of this switch deactivates the reel motors.
GUIDE SELECTION SWITCH	This switch is located to the right of the read mechanism. The switch adjusts the paper guiding to the width of the tape being used.

B 341 PAPER TAPE PUNCH

2-81. The B 341 Paper Tape Punch is basically a teletype paper tape punch which is capable of punching standard paper tape format in BCL code. The B 341 will punch 5, 6, 7, or 8-level tape at a minimum rate of 100 characters per second, ten characters per inch (figure 2-38). Standard tape widths of 11/16, 7/8 and 1 inch may be punched, as selected by the operator. Either oiled paper tape, dry paper tape, metalized or laminated Mylar paper tape may be used on the B 341 for punching information.

2-82. The maximum size supply reel that can be placed on the B 341 is eight inches in diameter. The reel hub measures two

inches in diameter. The punched tape is wound onto a five and one-half or seven-inch diameter take-up reel. It is not necessary to have the take-up reel when punching tape. The end-of-tape is indicated by the LOW TAPE indicator when approximately 35 feet of tape remain on the supply reel.

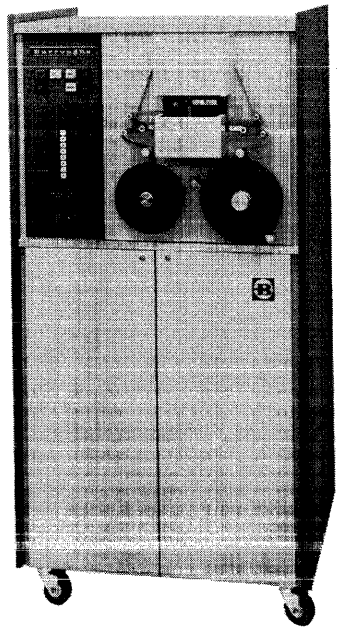


Figure 2-38. B 341 Paper Tape Punch

2-83. The B 341 uses the same output buffer as the card punch. To allow the accommodation of both the paper tape punch and the card punch, an optional switch located on the paper tape punch is used to change from paper tape operation to card punch operation (figure 2-39). If a paper tape instruction is encountered when the switch is in the CARD position, the central processor will halt. Conversely, if a punch card instruction is encountered when the switch is in the TAPE position, the central processor will halt.

B 341 Paper Tape Punch Functional Characteristics

2-84. A method is provided for the operator, through the channel select plugboard wiring, to interchange any of the 5, 6, 7, or 8 channels that might be desired. Undesignated channels in the channel select plugboard are not punched or sensed as controls for the B 341. Up to 64 different alphanumeric characters and special characters can be punched.

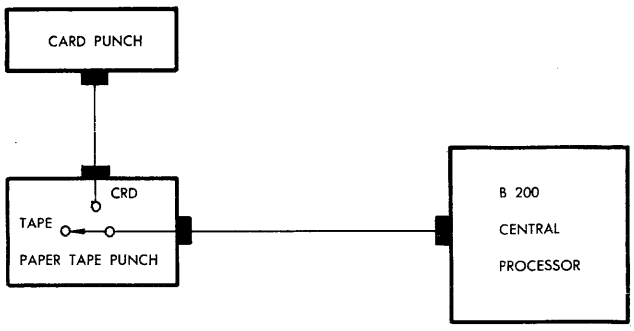


Figure 2-39. Optional Card Punch/Paper Tape Punch Interchangeability Switch

2-85. When the B 341 receives a paper tape write instruction from the central processor, paper tape will be punched in a forward direction. The output record length is determined by a specific control code in the data stream which is manually designated by a switch setting on the B 341 control panel or translator. The code is punched or suppressed as indicated by the control code switch or translator plugboard wiring. BCL codes are transferred from the central processor output buffer one-character-at-a-time to the paper tape punch.

2-86. The code translator permits the translation of BCL to a single frame code by means of a removable plugboard. Also, Teletype codes can be translated. Teletype is a double case code (Figures/Letters Shift) with several special requirements. To accommodate the shift used by Teletype Code, each of the allowable characters is designated as a Figures or a Letters code. Whenever a character is of a different case (figure/letter) than its predecessor, the appropriate shift code must be punched prior to the character. The two shift codes used for teletype tape can be designated by code translator plugboard wiring. The special requirements used for teletype codes are:

a. Automatic generation of codes for the Figures shift after SPACE, TAB, LINE FEED, and CARRIAGE RETURN.

b. Automatic generation of codes for the Carriage Return and Line Feed only must be generated immediately following all end-of-line codes.

Channel Select Plugboard

2-87. This plugboard is provided mainly for purposes not requiring a translator. It is possible for the operator to select any of the 6 BCL internal code levels and interchange them to any of the 8 possible paper tape channels. Paper tape with even parity can be accommodated by inverting one channel. All unused channels must be connected to the corresponding C channel. Figure 2-40 illustrates the channel select plugboard BCL and Teletype wiring configuration.

CODE TRANSLATOR

2-88. The code translator, which is an optional feature, permits translation of BCL code to any 5, 6, 7, or 8 channel code. Up to 64 codes can be translated. The code translator is located in the paper tape punch cabinet. Character (code) flow is from the processor to the translator to the channel select plugboard to the paper tape punch. The following describes the plugboard layout (figure 2-41).

a. Exits (1) . The exit hubs represent data sent from the central processor to the translator plugboard in any of the 64 BCL characters. Assume the following bit configuration:

Binary Equivalent 1 2 4 8 A B

Bits 0 1 1 0 1 1 = BCL character W

Bits A and B identify the exit columns 0-3. The example above shows column 3.

Bits 1, 2, 4, and 8 identify the exit rows 0-15. The example above shows row 6.

Therefore, the BCL character W would be represented by the hub located in column 3, row 6.

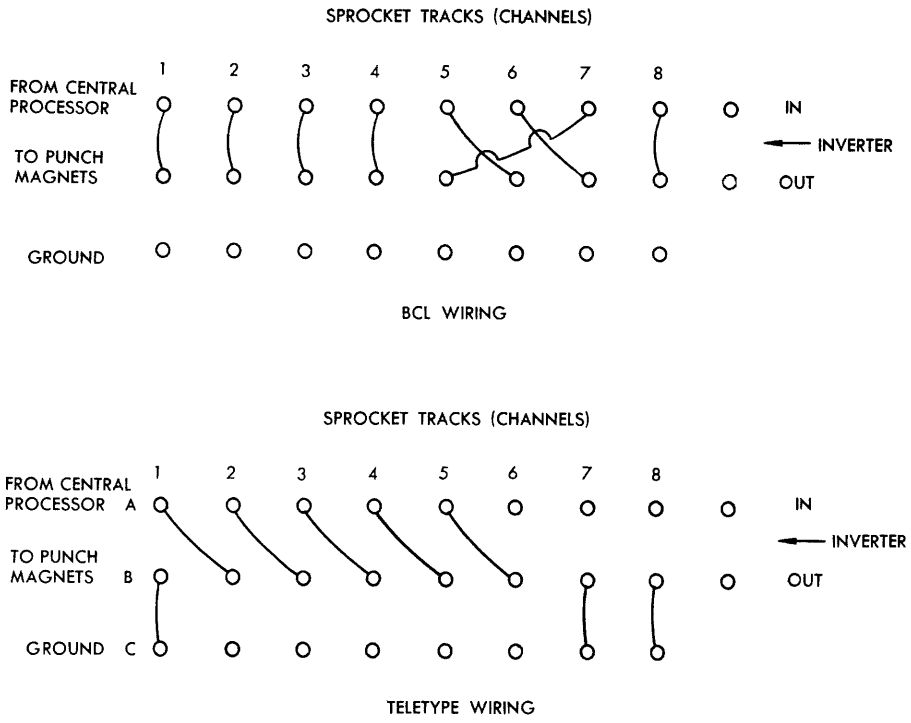


Figure 2-40. Channel Selector Plugboard

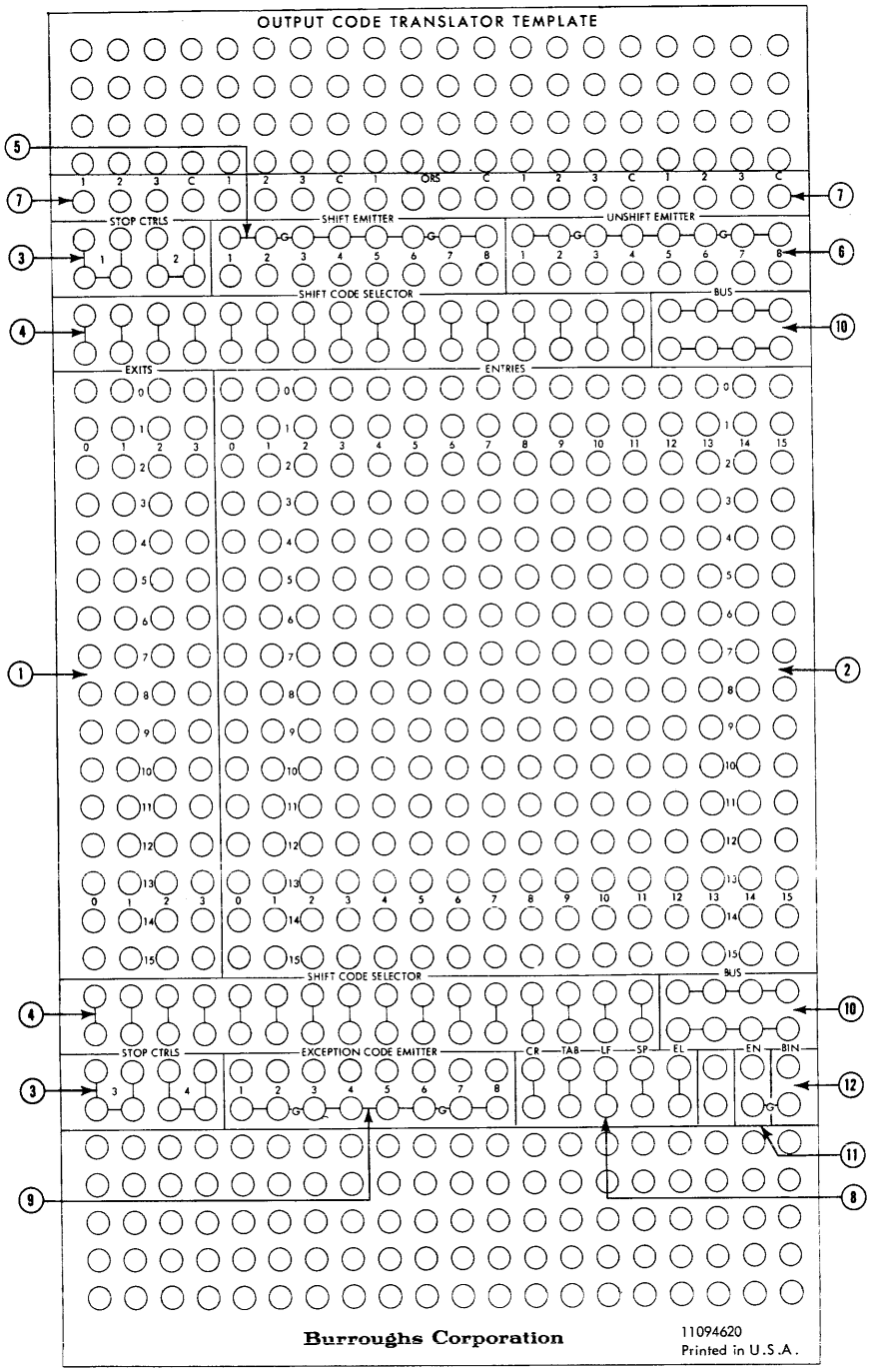


Figure 2-41. Plugboard Layout

b. Entries (2) . The entry hubs, when impulsed, generate the selected 5-, 6-, 7-, or 8-channel output character to be punched via the channel select plugboard. There are 256 possible combinations. The code that is punched is determined by column and row. The decimal value of the column and row is converted to a binary value and emitted from channel A of the channel select plugboard as follows:

(1) The binary value of the column is emitted from A channels 1-4 of the channel select plugboard. For example, column 10 would punch:

Channel	1	2	3	4
Binary Equivalent	(1)	(2)	(4)	(8)
Output from Translator (A)	0	1	0	1

(2) The binary value of the row is emitted from A channels 5-8 of the channel select plugboard. For example, row 7 would punch:

Channel	5	6	7	8
Binary Equivalent	(1)	(2)	(4)	(8)
Output from Translator (A)	1	1	1	0

(3) Therefore, if a column 10 of row 7 was impulsed, the following code would be emitted from the A channels.

Channel	1	2	3	4	5	6	7	8
Output from Translator (A)	0	1	0	1	1	1	1	0

c. Stop Controls (3) . There are four sets of stop control hubs. To designate a stop code, an exit hub is wired to a stop control hub. If the stop code is to be stored, a stop control hub, impulsed by a connected exit hub, is connected to the desired entry hub. If an entry hub is not connected to the stop control hub, the stop code will not be punched.

d. Shift Codes (4) . These hubs are required when the output data requires shift and unshift codes. These hubs are connected to exit hubs to determine which codes require a shift code (maximum 32). Any codes not connected to these hubs are considered as requiring unshift code. The associated hub is connected to an entry hub for the required code translation. Whenever a change is required from an unshift code to a shift code or vice versa, as selected on these hubs, the appropriate shift or unshift code is punched.

e. Shift Emitter (5) and (6) . Any 5-, 6-, 7-, or 8-bit code can be selected as the shift code by connecting the channel requiring a bit to the hub located directly above the designated channel. All channels unconnected will be considered as a zero (no bit). This code will be punched when required, as designated by the shift code selection.

Unshift Emitter. Any 5-, 6-, 7-, or 8-bit code can be selected as the unshift code by selecting the channel requiring a bit to the hub located directly above the designated channel. All channels unconnected will be considered as a zero (no bit). This code will be punched when required, as designated by the unselected codes; that is, those not connected to the shift code selector hubs.

f. OR Hubs (7) . The OR hubs permit up to three different codes, designated by the exit hubs, to initiate one common code or action. The following combinations of OR hubs and BUS hubs are permitted:

(1) Up to nine exits can be connected to a single entry by using three OR elements and one BUS element.

(2) Up to nine exits can be connected to a single stop control by using three OR elements and one BUS element.

(3) Up to nine exits can be connected to a single stop control by using three OR elements (no BUS required).

g. Exception Codes (8) . These hubs are provided to handle special teletype code set problems. These codes are CR, TAB, LF, SP, and EL. These codes are connected from the exit hubs and to the selected entry hubs. Since these codes will not be selected as shift codes, they will be considered as unshift codes. The

EL or end-of-line will initiate the punching of the exception code before the actual code is punched. The exception codes are set up in the exception code emitter.

h. Exception Code Emitter (9) . Any 5-, 6-, 7-, or 8-bit code can be selected as this code by connecting the channel requiring a bit to the hub located directly above the designated channel. All channels unconnected will be considered as a zero (no bit). This code will be punched when required by the designated EL code.

i. BUS Hubs (10) . There are two sets of BUS hubs. Each set permits connection to a single hub. The permissible combination of BUS hubs and OR hubs are the same as those outlined in step f above.

j. Enable Hubs (11) . These hubs must be connected to activate the translator. If not connected, the normal translation of BCL paper tape code will take place.

k. Binary Hubs (12) . When these hubs are connected together, only an internal to BCL code conversion will take place. All other translation in the B 341 will be bypassed.

B 341 Paper Tape Punch Control Panel

2-89. The B 341 Paper Tape Punch control panel (figure 2-42), contains the switches and indicators for operation and error indication. The function of each element is provided in table 2-9.

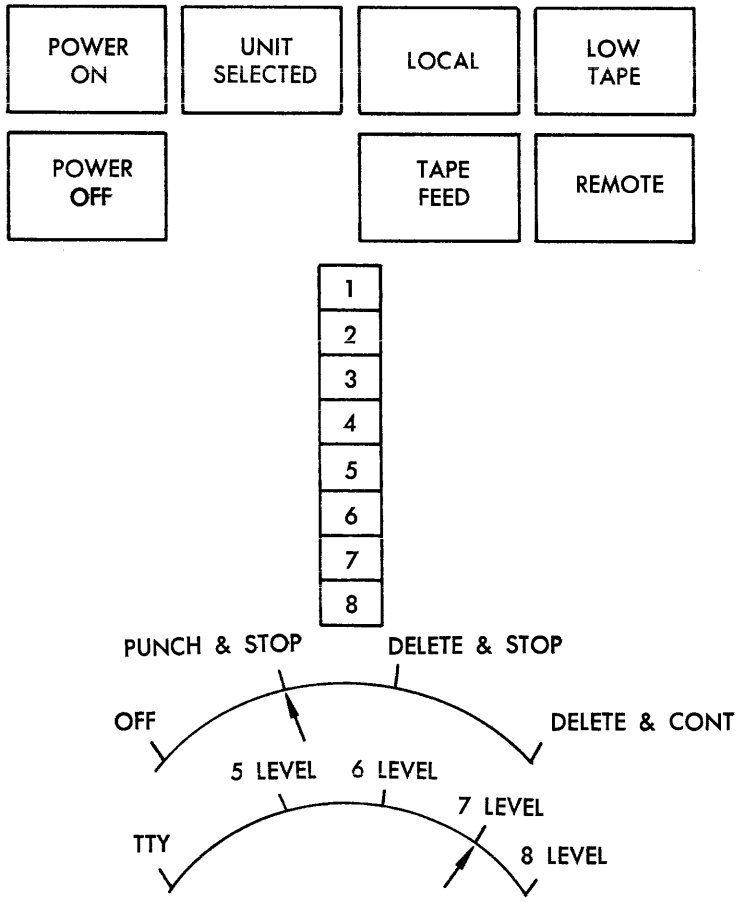


Figure 2-42. B 341 Paper Tape Punch Control Panel

TABLE 2-9

B 341 Paper Tape Punch Control Panel
Switches and Indicators

SWITCH/INDICATOR	FUNCTION
POWER ON	This switch/indicator lights when pressed indicating that power is applied to the unit.
UNIT SELECTED	This indicator will light when the paper tape punch is on-line.
LOCAL	This switch/indicator places the B 341 in a local condition and is not available to the associated central processor.
LOW TAPE	This indicator will light when 35 feet of tape, or less, remains on the supply reel.
POWER OFF	This switch removes power from the unit.
TAPE FEED	This switch feeds tape with all holes punched. The switch is active when the LOCAL switch is activated. Tape feed rate is 100 characters-per-second.
REMOTE	This switch/indicator lights when pressed, indicating that the unit is under control of the associated central processor.
CONTROL CODE	This switch allows the operator to designate a control code. The code may or may not be punched. The switch is active in REMOTE or LOCAL and has four positions which determine the action taken when a control code is detected. The four positions of the switch are: OFF, PUNCH & STOP, DELETE & STOP, and DELETE & CONTINUE.
LEVEL DESIGNATION	This switch is used to select the number of channels and type of paper tape to be used.

NOTE

Each B 341 Paper Tape Punch is delivered with one 1000 foot roll of paper tape; eight seven-inch reels, two five and one-half inch reels, ten five-inch wires and ten bottle (Jack) plugs. Also, the following supplies are included with each optional code translator:

1 - Plugboard
100 - Six inch wires
25 - Nine inch wires
25 - Twelve inch wires
25 - Bottle (Jack) plugs
25 - Templates

LINE PRINTERS

2-90. The Burroughs Line Printers are drum-type printers that provide high-quality, high-speed, alphanumeric output. Currently, five individual line printer models, varying in operating speeds from 475 LPM to a maximum of 1040 LPM, and available with either 120 or 132 print positions, are provided for use on B 100/200/300 Systems (see table 1-1).

2-91. The physical characteristics and operating function of the line printers are similar (with the exception of speed and print positions). Therefore, only one model, the B 321 Line Printer, will be described in this manual. When similarities differ between models, the model designation and the difference in similarities will be described.

B 321 LINE PRINTER

2-92. The B 321 Line Printer (figure 2-43) is a drum-type printer capable of printing 700 lines per minute when single spacing or 650 lines per minute when double spacing. Formatting, editing (the insertion of commas, decimals, dollar signs, zero print control, etc.), and forms skipping and spacing are under program control.

Figure 2-43. B 321 Line Printer

2-93. The B 321 accepts binary coded decimal, alphanumeric information from the associated central processor in parallel-by-bit, serial-by-character mode and stores this data in a 120-position buffer. Upon completion of buffer loading, and paper movement of the previous instruction, the format data is accepted from the central processor and the characters in the buffer are printed. The transfer of print buffer is accomplished in 1.3 ms.

2-94. The printer drum mechanism contains 120 print positions from which any one of the 64 characters may be printed, as specified by the data in the printer buffer. Horizontal spacing is 10 characters to the inch and vertical spacing can be either six or eight lines to the inch and is under control of the operator.

2-95. On B 325, B 328, and B 329 Line Printers, at the instant a character is printed, its buffer position is set to blank. When all characters in the buffer are blank, the printer is released for spacing. This allows paper to advance while unused character positions on the drum are passed.

B 321 Line Printer Functional Characteristics

2-96. The 64 characters contained in each print position consists of 26 alphabetic, 10 numeric, and 28 special characters (figure 2-44). When B 100/200/300 Systems are used as input/output conversion systems (satellite systems) for large-scale computers, they often require the use of special characters. For this reason, the 28-special character set is provided as standard equipment. These special characters are usually used for formulating problem statements in ALGOrithmic Language (ALGOL) and in COmmon Business Oriented Language (COBOL).

Blank	—
.	/
[	,
(	%
<	=
←	]
&	"
$	#
*	@
)	:
;	>
≤	≥
≠	+
×	?

Figure 2-44. Special Character Set

2-97. Printing is done on continuous paper forms which may be from 5 to 20 inches in width, including marginal punch strips. Length can be 22 inches (at 6 lines per inch) or 16-1/2 inches (at 8 lines-per-inch). The maximum length for B 325/328/329 is 20 inches. The forms are loaded in the cabinet below the printing mechanism. The forms are transported through the unit, by means of pinfed tractors, to the stacker. All printed forms are neatly stacked to a height of at least 7 inches without attention from the operator.

2-98. As many as five carbons plus the original may be printed. In general, the printer can process legible copy forms up to 0.02 inch in over-all thickness. The thinnest form that can be processed is 0.0025 inch. The optimum number of copies can be legibly printed by using premium paper and carbon. A clearance adjustment, required when changing from one form thickness to another, is available to the operator and can be accomplished within 30 seconds without the aid of tools.

2-99. TAPE CONTROLLED CARRIAGE. The B 321 Line Printer does not directly control the feeding and spacing of the forms. This is performed by the tape controlled carriage of the printer in conjunction with instructions from the central processor.

2-100. CONTROL TAPE. The carriage control tape (figure 2-45) has column positions (1-12) called channels. Horizontal lines can be skipped up to 132 lines for control of a form. For ease in preparation, the tape is somewhat longer than required. Prepunched holes located in the center of the tape are used by a pin feed mechanism to move the tape past the sensing device. Movement of the carriage control tape is synchronized with the movement of the form through the carriage.

2-101. Skipping the form to any predetermined position is accomplished by the central processor addressing any one of 11 holes in the carriage control tape. A twelfth channel in the control tape is used to signal the last

print line on the form. When a hole in this position is sensed, the printer sends a signal to the central processor which causes the Print or Skip instruction to take the end-of-page branch when programmatically desired, after printing on the last line has been accomplished.

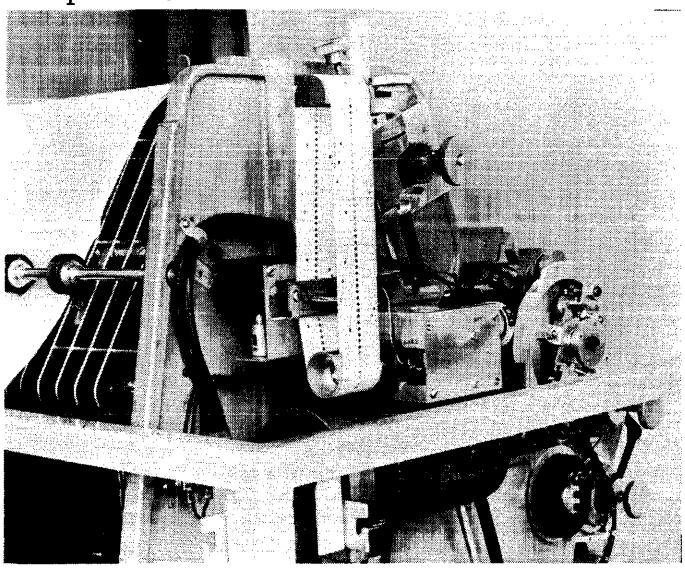


Figure 2-45. Carriage Control Tape

2-102. The twelve carriage control tape channels are usually punched to control the following functions:

a. Channel 1 will normally be used to identify the first print line (home station) of a form.

b. Channel 2 will usually be used to indicate the first body line of a form on which detail information appears. In an invoicing operation, where the first printing line and first body line are not one and the same, channel 1 would be used to indicate the first printing line of the form, in this case a name and address. Channel 2 would correspond to the first printed line of detail information.

c. Channel 3-11 will normally be used to identify any one of 9 user determined print positions. These channels may be used in any desired sequence.

d. Channel 12 is reserved for punching the hole indicative of the last printing line in the body of a form. When a channel 12 punch is sensed during a spacing operation, program control will branch to an end-of-page routine if programmatically desired, after printing on this line has been accomplished.

2-103. TAPE PUNCHING. A commercially available tape punch is used to punch carriage control tapes. Before punching, the tape should be marked to conform to the various predetermined positions on the form. This can be accomplished (when lines are printed six lines-per-inch) by laying the tape along side the left edge of the form with the first line of the tape even with the top edge of the form. A mark is made in the desired channel, normally channel 1, on the line that corresponds to the first print line of the form. Additional marks are made in the selected channels for each of the other skip stops. If forms are to be printed eight lines-per-inch, this relationship will not exist. One-sixth of an inch on the tape will correspond to one-eighth of an inch on the form (i.e., 2-1/2 inches of form equal 3-1/3 inches of tape).

2-104. The marking of the tape for one form should be duplicated on the remaining usable tape as many times as possible; therefore, a tape may usually be marked to control two 11-inch forms, three 7-inch forms, or one 12-inch form.

2-105. When the tape is used to control multiple forms per revolution, its life is increased. The last step in marking a tape consists of marking the line corresponding to the bottom edge of the last form to be controlled. After punching the holes in the marked channels, the tape will be cut at this mark.

2-106. The tape is inserted in the punch by placing the line to be punched over a guide line on the base of the punch and placing the

center feed holes of the tape over the pins projecting from the base. The dial is then turned until the arrow points to the number of the channel to be punched. Pressing on the top of the punch, toward the back, cuts a rectangular hole in the intersection of the vertical and horizontal line in the required channel of the tape. The tape may be punched with holes in more than one channel on the same line.

2-107. After the tape is punched, it is cut and looped into a continuous belt. The bottom line is glued to the top line, at the section marked GLUE, after the glaze has been removed with an ink eraser.

2-108. The last hole punched in the tape should not be less than four lines from the cut edge, since approximately the last half inch of the tape overlaps the GLUE section when the two ends are spliced. If it is necessary to punch a hole lower than four lines from the bottom of the form, punch the hole which may be overlapped after the tape has been glued.

B 321 Line Printer Control Panel

2-109. The B 321 Line Printer control panel (figure 2-46) contains switches and indicators for operation of the equipment and for error indications. The control panel is located at the front of the unit, to the right of the print section. The function of the switches and indicators is listed in table 2-10.

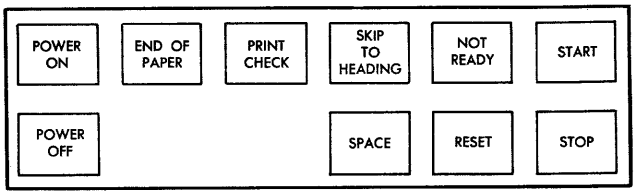


Figure 2-46. B 321 Line Printer Control Panel

NOTE

Five duplicate switches and a Not-Ready indicator are provided on the rear of the B 325, B 328, and B 329 Line Printers only.

TABLE 2-10

B 321 Line Printer Control Panel Switches and Indicators

SWITCH/INDICATOR	FUNCTION
POWER ON	This switch/indicator applies power to the unit and lights when it is pressed.
END OF PAPER	This switch/indicator signals nearing an out-of-paper condition. Pressing this switch removes the end-of-paper condition and extinguishes the light. One line can then be printed; thereafter, the unit returns to end-of-paper condition. Successive depressions of this switch enable printing successive lines.
PRINT CHECK	This indicator lights when a print check error has been sensed or when the print drum is not properly synchronized.

TABLE 2-10 (cont)

B 321 Line Printer Control Panel
Switches and Indicators

SWITCH/INDICATOR	FUNCTION
SKIP TO HEADING	Pressing this switch causes the carriage to skip to the first punch in Channel 1 of the carriage control tape.
NOT READY	This indicator lights when any one of the following conditions exists: the END OF PAPER indicator is lit, the 6/8 lines-per-inch switch is in position N, the unit "slews" paper for more than one second, or the START switch is not pressed.
START	This switch is used to signal the central processor that the line printer is ready for use. It is also used to restart system operations halted by a line printer "Not-Ready" condition.
STOP	Pressing this switch stops the line printer prior to the execution of the next Print instruction. The print buffer will not be loaded after the switch has been pressed, and the system will halt on the next Print instruction.
RESET	Pressing this switch resets the PRINT CHECK indicator.
SPACE	Pressing this switch causes the forms to be single spaced.
POWER OFF	This switch removes power from the unit.

MULTIPLE TAPE LISTERS

2-110. The Multiple Tape Lister (figure 2-47) is an electromechanical, buffered drum-type printer with six separate print units. Output from B 100/200/300 Systems can be printed out on one or two multiple tape listers. When two are used, they have the ability to print simultaneously on any two of 12 paper tapes at the rate of 1565 lines-per-minute-per-tape. Currently, Burroughs Corporation provides five models of Multiple Tape Listers for use on B 100/200/300 Systems (see table 1-1). These models are identical in physical appearance and operation; however, the speed of each unit varies. A general discussion of the Multiple Tape Lister is provided in the paragraphs that follow, and where similarities between models differ, the model number and the difference will be presented.

2-111. As an optional feature, the Multiple Tape Lister may be modified to skip all tapes (6 or 12) or all tapes with the exception of the master tape. This is accomplished by the addition of the B 327 Simultaneous Skipping of Listing Tape modification which may be field installed (table 1-1).

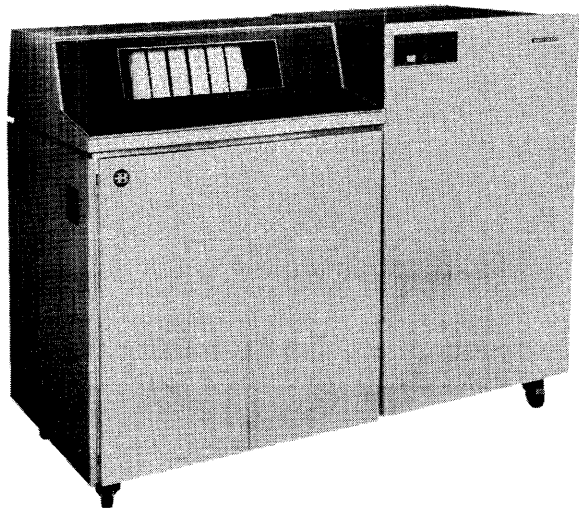


Figure 2-47. B 322 Multiple Tape Lister

2-112. The Multiple Tape Lister accepts binary coded decimal, alphanumeric information from the central processor in parallel-by-bit, serial-by-character mode and stores this data in a 44-position buffer. The central processor controls the formatting of the 22 print positions in accordance with an internally stored editing instruction. The Multiple Tape Lister can print the following 24 characters in any print position:

0	B (Batch)
1	C (Credit)
2	D (Difference)
3	L (List)
4	M (Misc.)
5	R (Reject)
6	S (Subtotal)
7	T (Total)
8	X (Pocket X)
9	Y (Pocket Y)
	. (Decimal Point)
	, (Comma)
	— (Minus)
	* (Asterisk)

2-113. Character spacing is 10 to the inch; line spacing is 6 to the inch. All forms are adding machine type without margin-hole strips. The forms may be single-part or two-part with carbon backed or plastic-backed first sheet. If single part forms are used, the form can be exited from the machine through either the top tear strip opening, or through the rear exit opening, as required by the operator. Forms exited from the rear opening can be torn off or fan folded. Single part forms that exit from the top tear strip opening cannot be fan-folded or restacked. Restacking of forms in the fan-fold condition can only be accomplished with forms that are exited through the rear opening. If two-part forms are used, both can be exited from the machine as a non-decollated unit through either the top tear strip opening or through the rear exit. The carbon copy from the rear exit can be re-stacked in fan-folds. The stacker (figure 2-48) has a capacity of 1000 feet (min) of single-part, fan-folded forms.

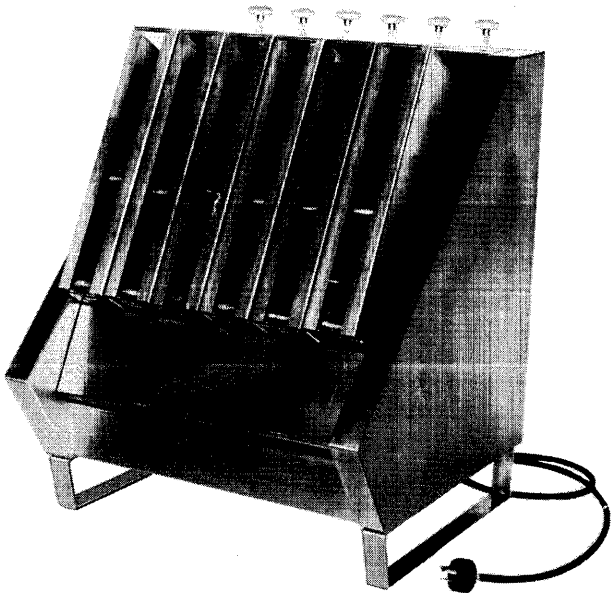


Figure 2-48. B 322 Stacker

2-114. The B 322 internal operations and performance differs only in the following exceptions. To maintain a printing rate of 1565 lines-per-minute, only 16 characters may be used. They are:

0-9
, (Comma)
. (Decimal)
x (Pocket X)
y (Pocket Y)
R (Reject)
* (Asterisk)

2-115. To process the full alpha-character set, a printing rate of 600 lines-per-minute is established. There are a total of 40 printable characters. They are:

0-9
, (Comma)
. (Decimal)
A thru Z
- (Hyphen)
* (Asterisk)

2-116. The B 327 Simultaneous Skipping of Lister Tapes is a standard feature on all B 323 Multiple Tape Listers. This allows the skipping of all tapes (6 or 12) or all tapes, except master tapes.

18-Tape Lister

2-117. The 18-Tape Lister has one master unit (B 332) which includes an operator control panel, electronic circuitry, and two slave units (B 333) which operate together at a maximum of 1565 lines-per-minute. All 18-Tape Lister configurations must have one master unit. The available configurations of the 18-Tape Lister are:

6 Tapes - Master Unit only (B 332)

12 Tapes - Master Unit (B 332) One Slave Unit (B 333)

18 Tapes - Master Unit (B 332) Two Slave Units (B 332)

2-118. The 18-Tape Lister accepts binary coded decimal, alphanumeric information in parallel-by-bit, serial-by-character mode and stores the data in a 44-position buffer. Upon the completion of buffer loading and paper movement, the characters in the buffer are printed. When invalid characters are received, the scan cycle will continue for a complete drum revolution. The numeric print rate will be reduced to the rated alphanumeric speed of 800 LPM for the print line with the invalid character. Also, the invalid character will cause a blank in the particular column.

2-119. The 18-Tape Lister operates in two modes: Normal (two-tape mode) or Multiprocessing (three-tape mode). In the Normal mode, two tapes maximum can be simultaneously printed by one command from the central processor. When in the Multiprocessing mode, the 18-Tape Lister simultaneously prints three tapes; the master, the detail tape, and the multiprocessing tape. The master and detail tapes print identical information from buffer positions 1 through 22. The multiprocessing tape prints information from buffer positions 23 through 44.

2-120. A Master-Tape Selector switch with seven positions, N and 1 through 6, is used to select the tape 1 through 6 on which the master information in buffer positions 1-22 is printed. The N position suppresses print of master information. The master information is printed on the master unit only if it is an 18-Tape Lister configuration. The central processor designates the detail tape which may be any of the 18 tapes not otherwise assigned. If the central processor supplies a detail designation of N=2-6, which equals the Master-Tape Selector switch setting, detail action is diverted to tape 1. This diversion always occurs, whether or not a

master unit designation was supplied by the central processor.

B 322 Multiple Tape Lister Control Panel

2-121. The Multiple Tape Lister control panel (figure 2-49) contains operating switches and indicators. The control panel is located on the front of the unit, to the right of the print section. In addition, several switches are provided at the rear of the unit (figure 2-50) for operator convenience. The function of the switches and indicators is provided in table 2-11.

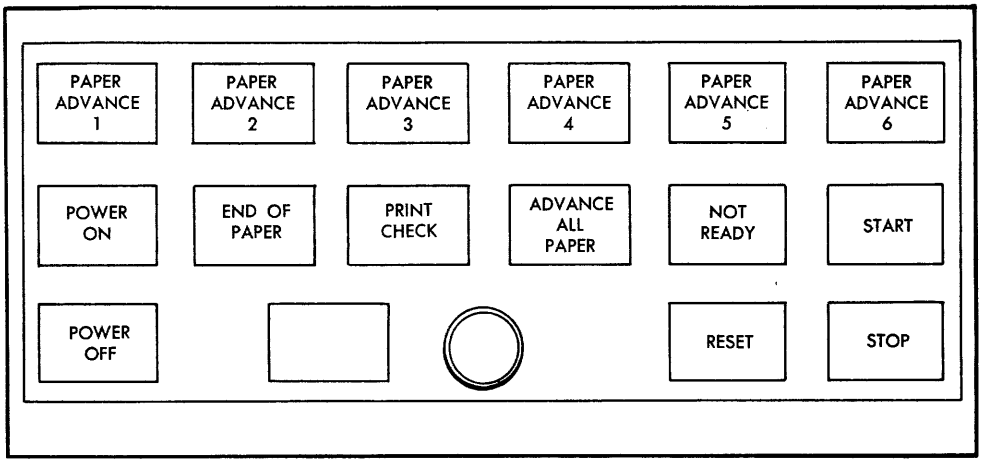


Figure 2-49. Multiple Tape Lister Control Panel

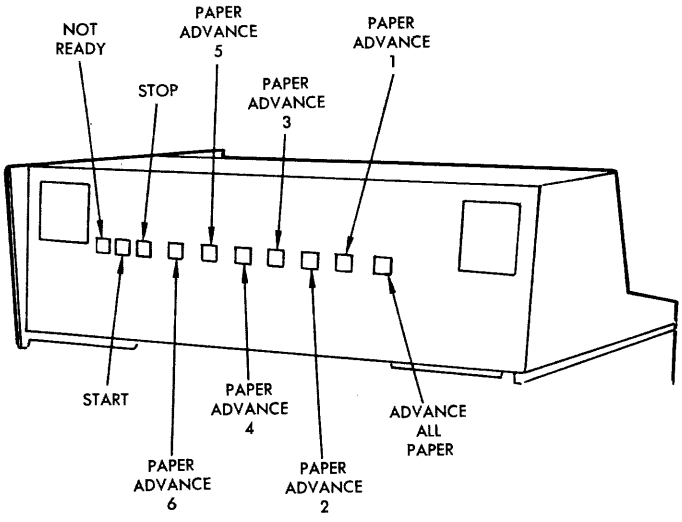


Figure 2-50. Rear Control Panel

TABLE 2-11

B 322 and B 323 Multiple Tape Lister Control Panel
Switches and Indicators

SWITCH/INDICATOR	FUNCTION
PAPER ADVANCE 1 through PAPER ADVANCE 6	Pressing these switches will cause the corresponding tape to be advanced until the switch is released, when in the Not-Ready condition. Duplicate switches are located at the rear of the unit.
POWER ON	Pressing this switch applies power to the unit.
END OF PAPER	This indicator will light when one of the sub-units is almost out of forms or if a feeding problem exists. If this condition is sensed during a Skip or Print instruction, the program will branch to the BBB address upon execution of the instruction. The condition causing the indicator to light must be corrected and the RESET and START switches pressed.
PRINT CHECK	This indicator will light when a print check error is sensed in any print position or if the drum is not synchronized with the drum position counter. A signal is sent to the central processor and the next Print instruction will be inhibited, thus causing the system to halt.
ADVANCE ALL PAPER	When in Not-Ready condition, pressing this switch causes all paper to be advanced until the switch is released. A duplicate switch is located at the rear of the unit.
NOT READY	This indicator will light if one of the following conditions exists: START switch not pressed, paper slews for more than one second, end-of-paper condition exists, or tears within the unit. A duplicate indicator is located at the rear of the unit.
START	Pressing this switch conditions the B 322 or B 323 to accept instructions from the central processor. A duplicate switch is located at the rear of the unit.
STOP	Pressing this switch places the unit in the Not-Ready state. If a B 322 or B 323 instruction is being executed when the switch is pressed, the instruction will be completed before the unit halts. Upon encountering the next instruction, the central processor will stop. A duplicate switch is located at the rear of the unit.

TABLE 2-11 (cont)

B 322 and B 323 Multiple Tape Lister Control Panel
Switches and Indicators

SWITCH/INDICATOR	FUNCTION
RESET	Pressing this switch with the unit in the Ready state resets the print check circuitry and extinguishes the PRINT CHECK indicator. With the lister in the Not-Ready state, pressing the switch clears all error circuitry except NOT READY. The START switch must be pressed to clear this indicator.
POWER OFF	Pressing this switch removes power from the unit.
MASTER CONTROL	This is a seven-position rotary switch for the selection of one of the six sub-units as the master tape. The switch positions (1 through 6 and N) are designated by use of a SPHERICULAR ® tube beside the the switch. When in the N position, the switch is disabled.
LISTER DESIGNATE	This four position switch is used to select the Unit-Master, Slave-1, Slave-2, or all units for which the tape advance switches on the control panel are to be affected. This switch has no affect on the tape advance switches on the rear of the units.
MASTER TAPE	This switch has seven positions and is used to select the tape 1 through 6 on which the master information in buffer positions 1 through 22 is printed. The N position is used to suppress print of master information.

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B 421 MAGNETIC TAPE UNIT

2-122. The B 421 Magnetic Tape Unit (figure 2-51), is capable of reading, writing, erasing, backspacing, and rewinding magnetic tape under control of the central processor. Each tape unit is capable of reading and writing magnetic tape at the following related speeds and densities:

a. 50,000 characters per second at a density of 555.5 characters per inch (50 KC/sec.).

b. 18,000 characters per second at a density of 200.0 characters per inch (18 KC/sec.).

NOTE

Reading is done only in the forward direction.

Each tape reel can hold up to 2400 feet of magnetic tape, thereby storing over 15,000,000 characters when using high density tape.

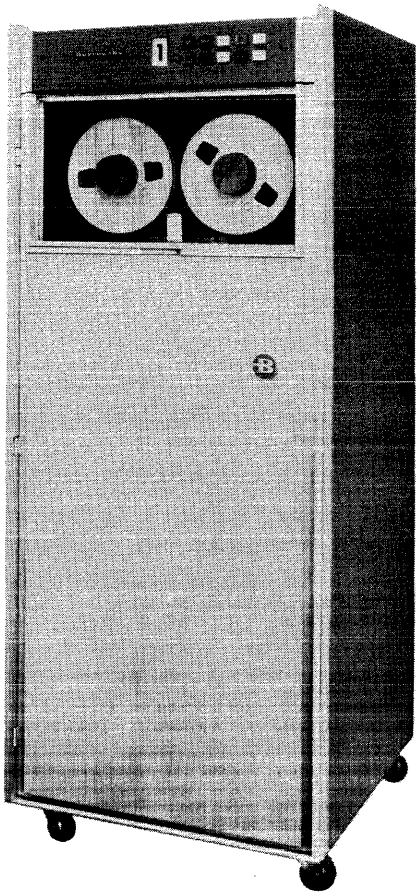


Figure 2-51. B 421 Magnetic Tape Unit

B 421 Magnetic Tape Unit Transport

2-123. Figure 2-52 illustrates the position of the tape reels in relation to the read-write head and feed rollers. When reading or writing, tape is passed from the file reel past the read-write head to the take-up reel. During rewind, the motion is reversed. To prevent tape breakage and to minimize start time, two vacuum columns are used. As the tape is drawn from one vacuum column, it is replenished from the reel above. As it is fed into the other vacuum, the associated reel takes up the slack tape. Movement of the tape past the read head is at 90 inches-per-second. Approximately 2400 feet of tape can be rewound in 90 seconds.

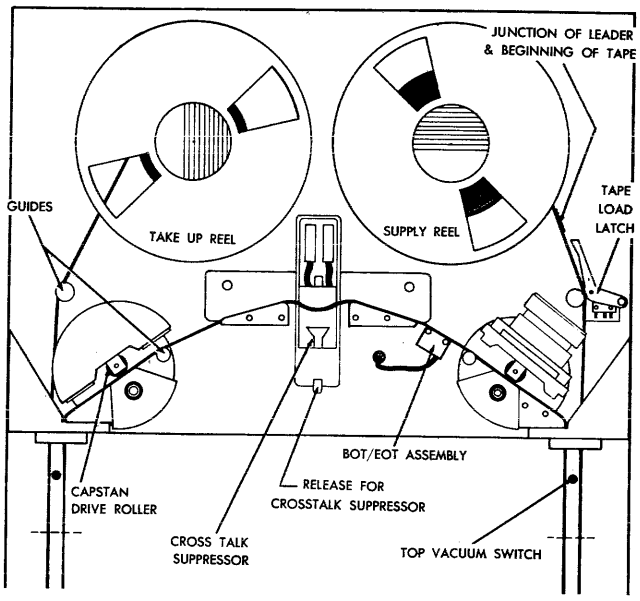


Figure 2-52. B 421 Magnetic Tape Unit Transport Mechanism

2-124. Start time is the time lapse between issuing a tape order (Read, Write, Erase, Backspace) until the first character is read, written, erased or bypassed. Start distance is not relevant.

2-125. MAGNETIC TAPE. The magnetic tape used with the Burroughs Magnetic Tape Units is 0.5 inch wide, 2.0 mils thick and approximately 2400 (±20) feet in length. The base material of the tape is Mylar with a heavy-duty binder for longer wearing characteristics. The magnetic tape units feature devices called "latch leaders" (figure 2-53). The purpose of the latch leader is to minimize tape load-unload time. The leaders are two-part: male and female. The male leader is opaque-black Mylar and is non magnetic. The length of this leader is approximately 6 inches from the end of the leader to the magnetic tape splice which is on the file reel. The leader is supplied on all late model Burroughs magnetic tape reels. Additional leaders can be obtained for splicing to other magnetic tapes. The female leader is opaque Mylar and is manually wound onto

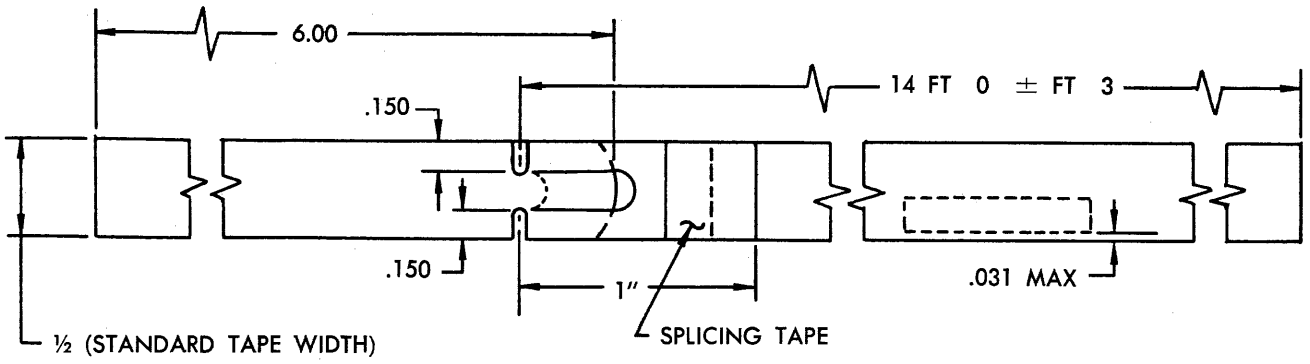


Figure 2-53. Latch Leaders

the take-up reel by the operator, one time only. The female leader is approximately 14 feet in length. A permanent female leader is provided with each take-up reel. Spares are also available. The tape unit contains a latching device holds the female eader in place during loading and unloading. When the reels rewind for unloading, the transport will move the leaders back until their connection is on the file reel-side of the tape latch. Then the latch is closed to grip the female leader while the male leader is disconnected. After a new file reel has been placed in the unit and leaders connected, the tape latch is opened.

2-126. MAGNETIC TAPE STORAGE. As many as 15,000,000 characters of information may be contained on a single reel of magnetic tape. To store this quantity of data on punched cards would require 187,500 cards with data punched in every one of the 80 available card columns.

2-127. Information is stored on magnetic tape in the form of records. Record lengths (i.e., number of characters-per-second) can vary from record to record, depending solely on the quantity of information required. This is in sharp contrast to the fixed record lengths associated with punched cards. In addition, magnetic tape is easily handled, reusable, and requires a minimum of storage space.

2-128. The magnetic tape used with B 100/B 200/B 300 Systems is made of a plastic material which is coated with a metallic oxide. The oxide coating has the property of being easily magnetized with patterns of tiny spots. A magnetic tape record is a series of characters (minimum of seven) recorded consecutively on the tape. Records are separated from each other by approximately 3/4-inch blank (unrecorded) tape which is called an interrecord gap. The characters are written on tape vertically in seven channels which correspond to the seven levels of core memory. Figure 2-54 illustrates a section of magnetic tape containing the characters "B 200 SERIES".

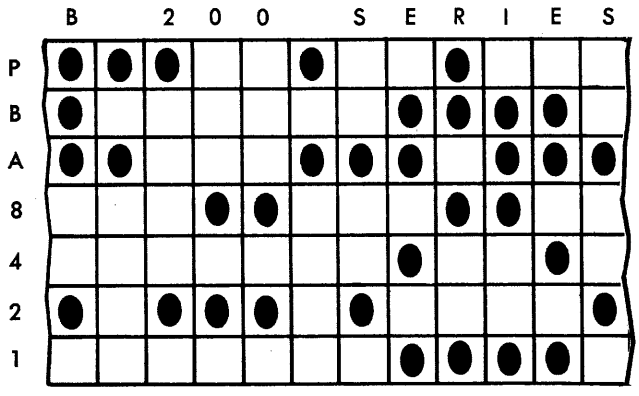


Figure 2-54. Magnetic Tape Character Representation

2-129. Six of the channels (1, 2, 4, 8, A, and B) are used to represent alphanumeric information. The seventh bit (P) is on if the number of bits comprising the character is odd. By using parity check on each character, accuracy for tape-read and tape-write operations is assured.

2-130. Following the last character in each record, there is a longitudinal check character (LCC). (See figure 2-55.) This check character consists of a check bit, automatically written into each channel for the entire record regardless of the code used. It should be noted that it is possible for the check character to be blank.

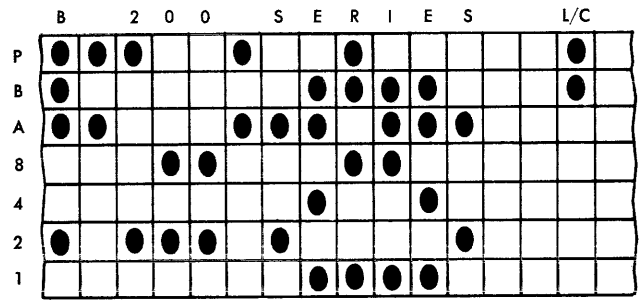


Figure 2-55. Magnetic Tape Longitudinal Check Character

2-131. A two-character gap exists between the last character of the record and the LCC. When this gap is sensed, a group mark (figure 2-56), is written in core memory or 0011111. When the LCC is sensed, it signals the central processor to cease reading from magnetic tape. It should be noted that the group mark appears only in memory, not on magnetic tape.

2-132. A tape mark (figure 2-57) is written on the tape after the last record of a file has been written. When reading magnetic tape, this mark will be recognized automatically, usually programmatically initiating an End-of-File routine. Several different files may be stored on one reel, each separated by a tape mark.

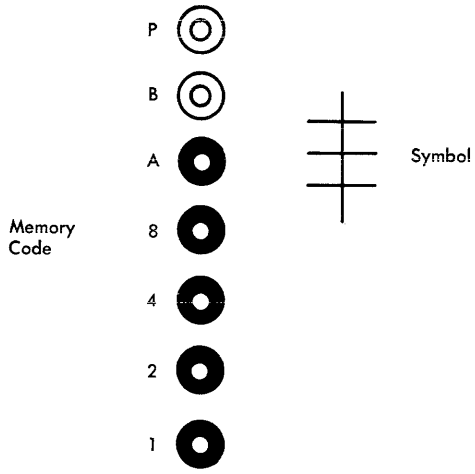


Figure 2-56. Group Mark

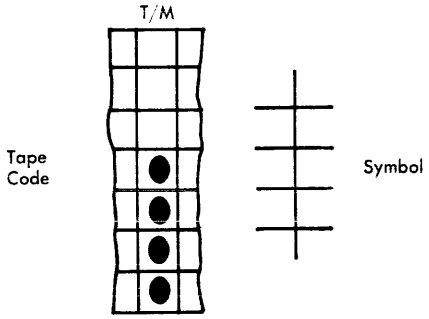


Figure 2-57. Tape Mark

NOTE

A two-character record consisting of Tape Mark-Group Mark constitutes an End-of-File record in memory.

B 421 Magnetic Tape Unit Control Panel

2-133. The B 421 Magnetic Tape Unit control panel (figure 2-58) contains switches and indicators for operation of the equipment. The function of these switches and indicators is contained in table 2-12.

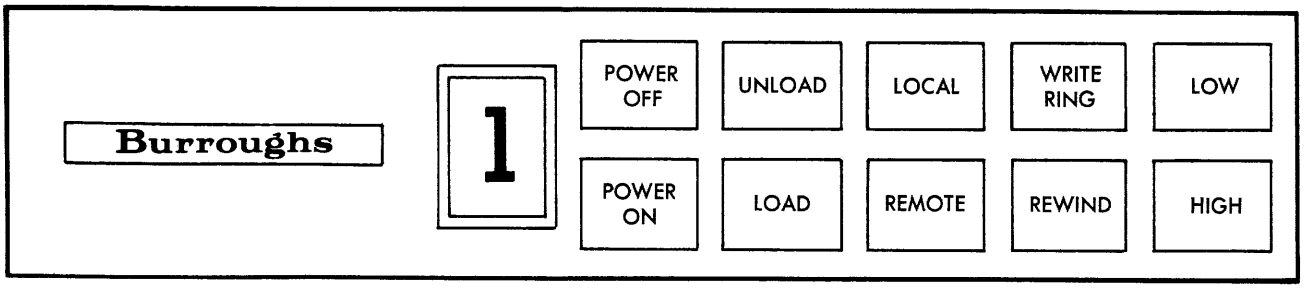


Figure 2-58. B 421 Magnetic Tape Unit, Control Panel

TABLE 2-12

B 421 Magnetic Tape Unit Control Panel Switches and Indicators

SWITCH/INDICATOR	FUNCTION
POWER OFF	Removes power from the magnetic tape unit.
UNLOAD	Positions tape to the point where the latch leader is on the file reel-side of the tape latch, thereby permitting the operator to unload the tape.
LOCAL	Removes the magnetic tape unit from control of the central processor. The switch lights when pressed.
WRITE RING	Signals that the file reel has a write ring installed and that writing can be performed on the tape.
LOW	Selects the 18.000 character-per-second reading and writing rate (200 characters/inch density). The switch lights when pressed.
HIGH	Selects the 50,000 character-per-second reading and writing rate (555.5 characters/inch density). The switch lights when pressed.
REWIND	Rewinds the tape to the beginning-of-tape mark. Rewind speed is 320 inches-per-second. This switch is active only when the unit is in a LOCAL condition.
REMOTE	Places the tape unit under control of the central processor. The switch lights when pressed.
LOAD	Causes tape to be drawn into the vacuum columns and moves the tape so that the beginning-of-tape is at the read-write head.
POWER ON	Applies power to the unit. The switch lights when pressed.
UNIT DESIGNATORS 1-6	Identifies a magnetic tape unit and relates it to a specific variant character in each magnetic tape command. This illuminated rotary switch should be operated only when the tape unit is in local mode. When a unit designate is at the blank (undesignated) position, it will operate as a unit designation of 6.

B 422 MAGNETIC TAPE UNIT

2-134. This magnetic tape unit has a tape speed rate of 120 inches-per-second with packing densities of both 200 (24KC) and 555.5 (66KC) frames-per-inch. The B 422 and B 421 Magnetic Tape Units physically appear the same and with the exception of different tape speeds, they are functionally identical; however, they cannot be intermixed on a system.

B 423 MAGNETIC TAPE UNIT

2-135. The B 423 Magnetic Tape Unit processes 10-1/2 inch tape reels of up to 2400 feet of 1/2 inch tape. The B 423 is designed to read and write on tape at a speed of 120 inches-per-second, with a recording density of 200 frames-per-inch (24KC). The B 421, B 422, and B 423 Magnetic Tape Units physically appear similar.

B 424 MAGNETIC TAPE UNIT

2-136. The B 424 Magnetic Tape Unit operates at 83 inches-per-second at 800 bits-per-inch density only, giving the B 424 a transfer rate of 66KC. The B 424 is physically and operationally identical to the B 422 and they may be combined together on the systems indicated in table 1-1.

B 425 MAGNETIC TAPE UNIT

2-137. The B 425 Magnetic Tape Unit may be used only on B 300 Systems and provides manual selection of 200, 556, or 800 bits-per-inch (BPI) packing density (see table 1-1). The transport operates at 90 inches-per-second, permitting transfer rates of 18, 50, or 72KC. The densities are operator selectable by pressing the required switch located on the control panel. This magnetic tape unit also appears physically and operates identically to the B 421 Magnetic Tape Unit described in paragraph 2-122.

B 450 DISK FILE/DATA COMMUNICATION BASIC CONTROL

2-138. The B 450 (figure 2-59) houses the disk file control and data communication control assemblies (B 247 and B 248) when attached to a B 273, B 283, or B 300 System. In addition, a B 451 (see paragraph 2-138) may be included with the B 450 for disk file expansion. The B 450 may contain two control assemblies (either disk file or data communication) and one or two B 451's. If more than two controls (either disk file or data communication) are required, a second B 450 must be used.

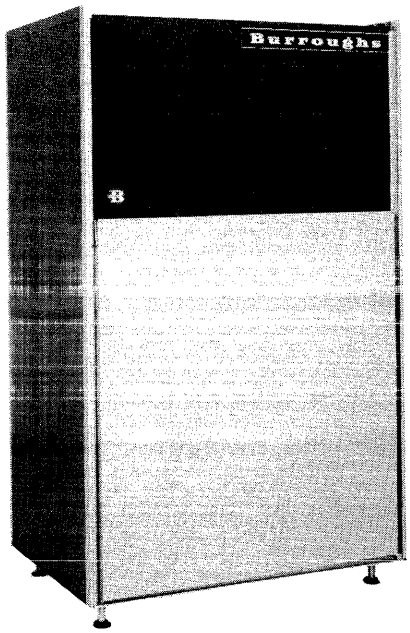


Figure 2-59. B 450 Disk File/Data Communication Basic Control

B 451 DISK FILE EXPANDED CONTROL UNIT

2-139. The B 451 Disk File Control Unit contains the circuitry necessary to control from 48 to 480 million characters of disk file storage for B 200/B 300 central processors and to control multiple processors accessing common disk file storage.

2-140. The following examples and related specifications illustrate the possible processor/subsystem configurations. Since there are many possible variations, it is necessary to look upon each application as unique.

2-141. Figure 2-60 illustrates a disk file subsystem with one or two processors and up to ten B 471 Electronic Units.

2-142. One B 451 is required for one B 247 Disk File Control Unit and two to five B 471 Disk File Electronics Units. One B 451 is required for two B 247 Disk File Control Units and one to five B 471 Disk File Electronics Units. Each central processor attached to the Disk File Subsystem requires a B 247 Disk File Control Unit.

2-143. Figure 2-61 also illustrates a Disk File Subsystem with one or two processors and up to ten B 471 Electronics Units.

2-144. In this configuration, two B 451 Units are required for one B 247 Disk File Control Unit and six to ten B 471 Disk File Electronics Units. Two B 451 units are required for two B 247 Disk File Control Units and six to ten B 471 Disk File Electronics Units. When two B 451 units are used, both are installed in a single B 450 DF/DC Control Cabinet. The B 451 units are included in the B 247 unit specified for processor 1.

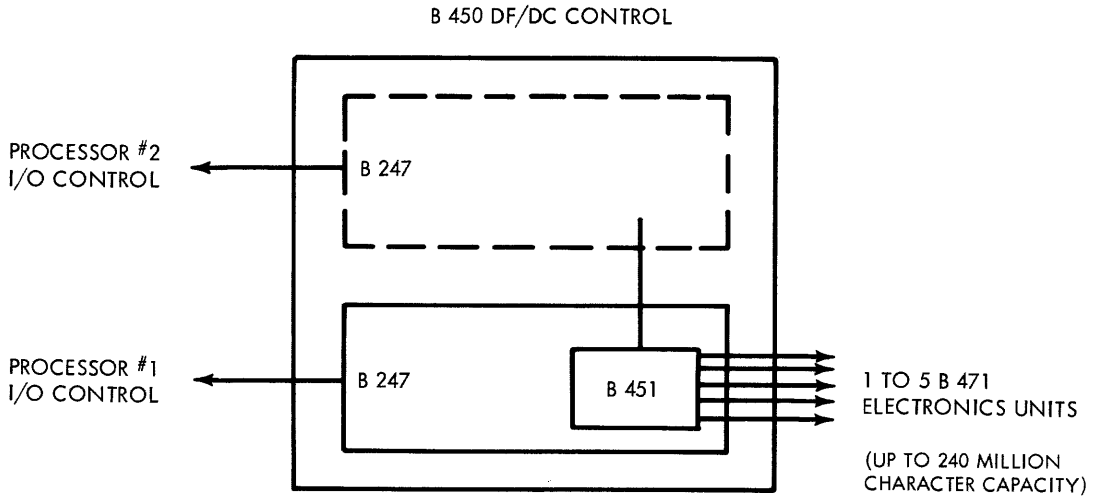


Figure 2-60. Disk File Subsystem 1

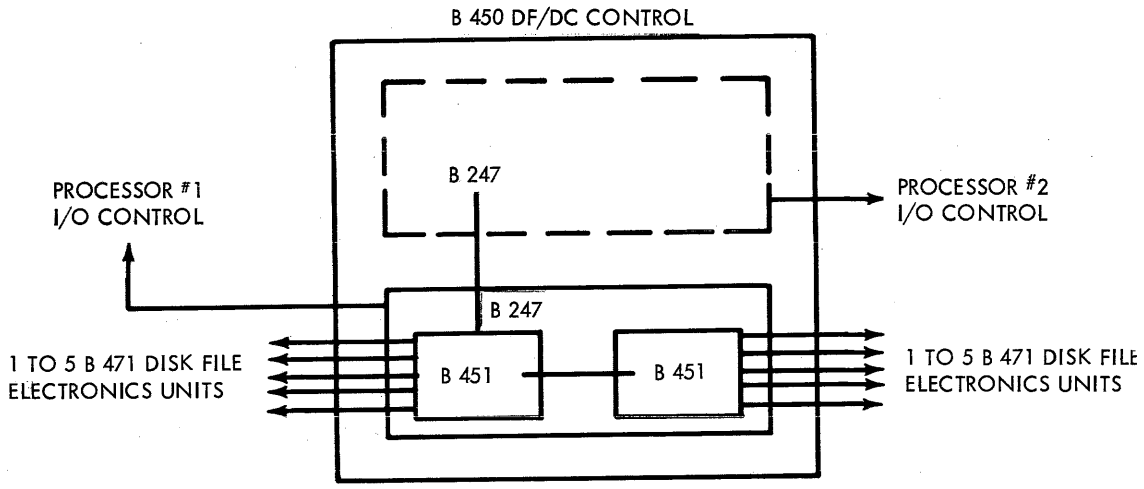


Figure 2-61. Disk File Subsystem 2

2-145. Figure 2-62 illustrates a Disk File Subsystem with the maximum processor configuration.

2-146. If two or more processors attempt to address the same Disk File Electronics Unit, one processor is serviced while the others wait. The queue discipline is first come first served when two B 247 Disk File Control Units are used. When the three or four Disk File Control Units are used, the queue discipline is the lowest designated number Disk File Control Unit served first. When three or four processors are used, a second B 450 DF/DC Control is required. When a second B 450 is required, it must be located adjacent to the first unit.

2-147. Figure 2-63 illustrates a Disk File Subsystem with multiple processors and optional data communications features.

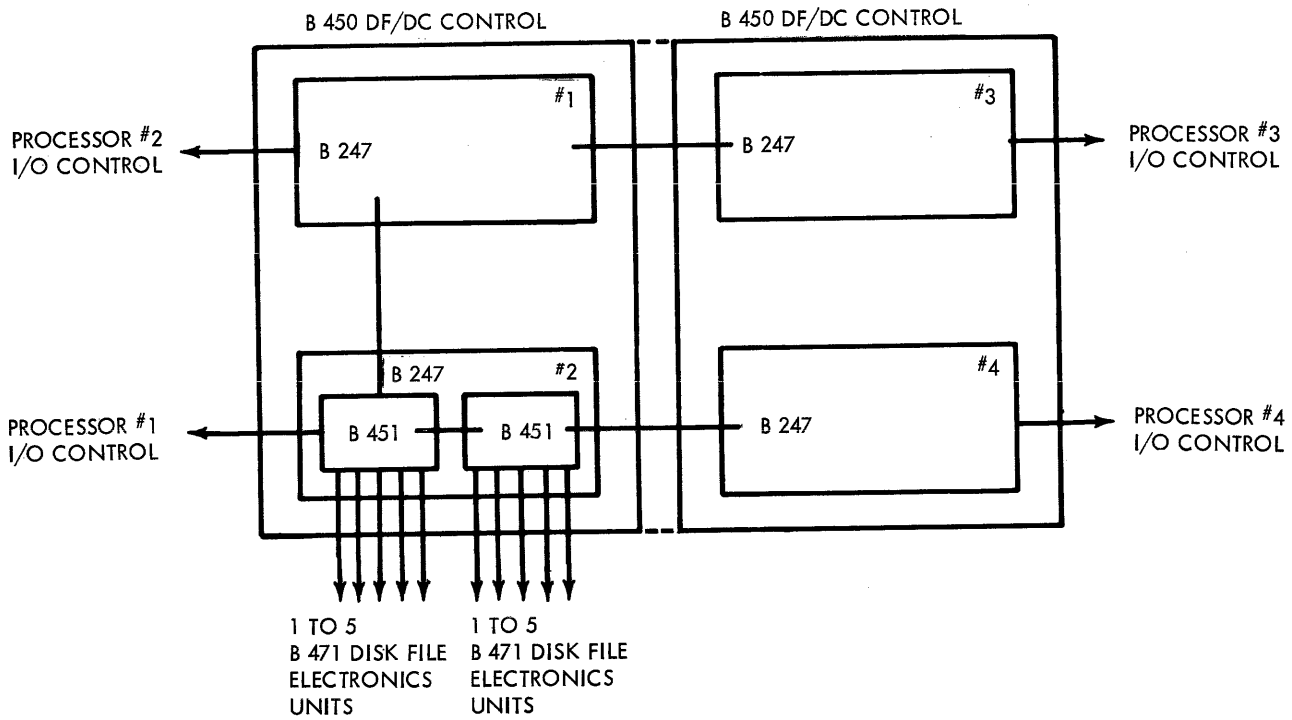


Figure 2-62. Disk File Subsystem with Maximum Processor Configuration

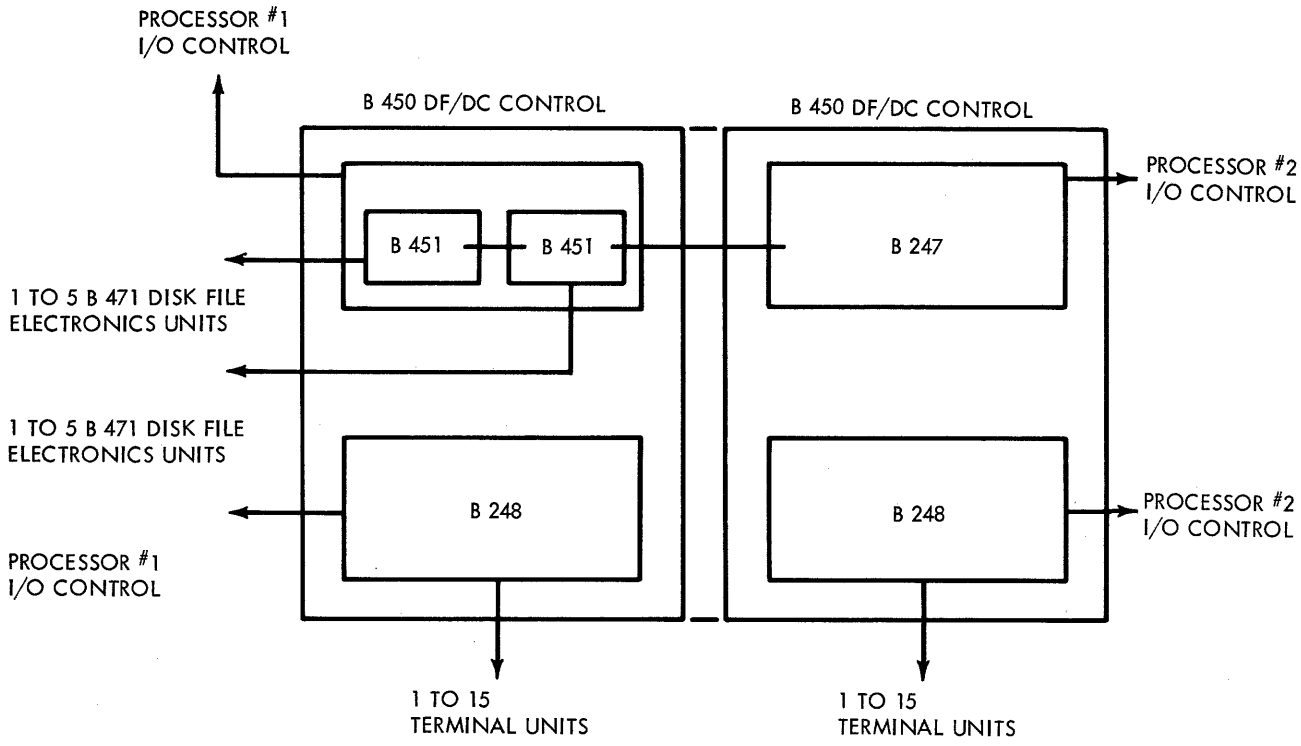


Figure 2-63. Disk File Subsystem with Multiple Processors and Optional Data Communications Features

2-148. When more than a total of two Disk File/Data Communications Control Units are used, a second B 450 DF/DC Control Cabinet is required and must be physically adjacent to the first DF/DC Control Unit. Each central processor utilizing data communications requires a B 248 Data Communications Control Unit (refer to paragraph 2-166).

Disk File Storage

2-149. A maximum of 9.6 million six-bit alphanumeric characters of information can be stored on four vertically mounted magnetic disks contained in each storage unit. Thus a total of 480,000,000 alphanumeric characters can be stored when a maximum of ten storage units are used. Table 2-13 lists the capacity of the disk file system.

2-150. The magnetic storage disk if designed and shaped similar to a commerical recording disk; however, it is much larger and is constructed of brass. The disk surface is plated with an extremely thin magnetic film.

2-151. Every disk surface contains 50 data tracks. One data track has a capacity of 24,000 characters. Each data track has a fixed predetermined clock frequency so that the information packing density in all of the data tracks will approximate 1000 bits per inch.

2-152. The data tracks are serviced by their own individual read/write head. The read/write head records the information to be stored onto the disk surface serially by bit in 48-bit words. In addition, each word contains check and spacer bits.

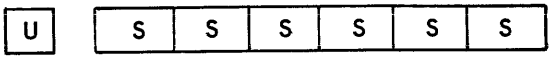
TABLE 2-13
Disk File System Capacity

	Alphanumeric Characters per—	Segments per—	Data Tracks per—	Disks per—	Modules per—	Storage Units per—	Control Units per—
Segments	96 240 480		250 100 50				
Data Tracks	24,000	50 480 char. 100 240 char. 250 96 char.					
Disk	2,400,000	5,000 480 char. 10,000 240 char. 25,000 96 char.					
Module	9,600,000	20,000 480 char. 40,000 240 char. 100,000 96 char.		4			
Storage Unit	48,000,000	100,000 480 char. 200,000 240 char. 500,000 96 char.		20	5		
Control	480,000,000	1,000,000 480 char. 2,000,000 240 char. 5,000,000 96 char.		200	50	10	
B 273 or B 283 or B 300	480,000,000	1,000,000 480 char. 2,000,000 240 char. 5,000,000 96 char.		200	50	10	1

2-153. Data tracks are further divided into addressable segments of 96, 240, or 480 alphanumeric characters. Segments are decimally and consecutively numbered within each storage unit. Consecutively numbered segments may be read or written with a single command.

2-154. Each segment is individually numbered within a storage unit and is assigned a seven-digit address. The address format and range varies with segment size. The following indicates the range and address format for each segment size:

96 CHARACTER SEGMENT ADDRESS FORMAT

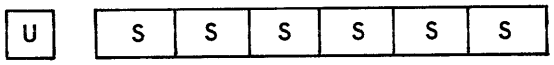


Storage Unit Number 0-9 — Segment Number 000000-499999

Number of addressable segments:

Module	100,000
Full Capacity Storage Unit	500,000

240 CHARACTER SEGMENT ADDRESS FORMAT.

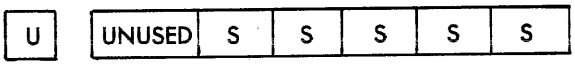


Storage Unit Number 0-9 — Segment Number 000000-199999

Number of addressable segments:

Module	40,000
Full Capacity Storage Unit	200,000

480 CHARACTER SEGMENT ADDRESS FORMAT.



Storage Unit Number 0-9 — Segment Number 00000-99999

Number of addressable segments:

Module	20,000
Full Capacity Storage Unit	100,000

2-155. The disk storage reading and writing speed is extremely fast, and transfer of information from and to the file occurs at the rate of 100,000 characters per second.

2-156. This data rate facilitates efficient loading and unloading of files, file scanning, sorting, and report generation. The time to read or write each of the three data segment sizes are:

Segment Size	Read/Write Time
96 char.	0.96 ms
240 char.	2.40 ms
480 char.	4.80 ms

B 247 DISK FILE CONTROL UNIT

2-157. The B 247 contains the power supply, control, and checking circuitry to accommodate a maximum of ten disk file storage units (48 million alphanumeric characters per storage unit). All information transfer and addressing from these storage units is controlled by the B 247.

2-158. Because independent checking features are incorporated in the unit, the central processor is free to execute other commands or input/output operations when the control unit is performing a check operation. Provision for checking of each disk file address, as it is transferred from the central processor, is provided; if a parity error occurs, the transfer operation stops and no data will be transferred. Also, an address parity indicator will be set. For each segment of data written during a write operation, a multiple character check code is developed and written. This code is regenerated and compared against the written check code during a read operation. If the comparison is unequal, an information error indicator is set. When a nonexistent address is referenced, the operation is terminated, and an invalid indicator is set. Attempting to write on a disk which is locked out will set a write lockout indicator. Reading or writing is prevented while the control unit is in a "Busy or Not-Ready" status. The control unit is in a "Not-Ready" status if either of the power switches (AC-DC) are OFF or if the REMOTE/LOCAL switch is set to the LOCAL position.

B 471 DISK FILE ELECTRONICS UNIT

2-159. The B 471 Disk File Electronics Unit (figure 2-64) incorporates all of the disk file system electronics for controlling a maximum of 48,000,000 alphanumeric characters of information (5 modules) in addressable segments of 96, 240, or 480 characters. The unit contains the main air pressure system starting controls, basic head switching logic, and read/write amplifiers for a maximum of five storage modules. Lockout switches for the unit and for individual disks are provided on the control panel. The unit lockout switch prevents writing on the entire unit. Individual disk lockout switches allow disks to be individually locked out. Whenever the unit or disk is placed in a write-lockout state, it is still possible to read from the unit and/or disk. The unit is made ready for operation when the POWER ON switch is ON and the REMOTE/LOCAL switch is set to the REMOTE position.

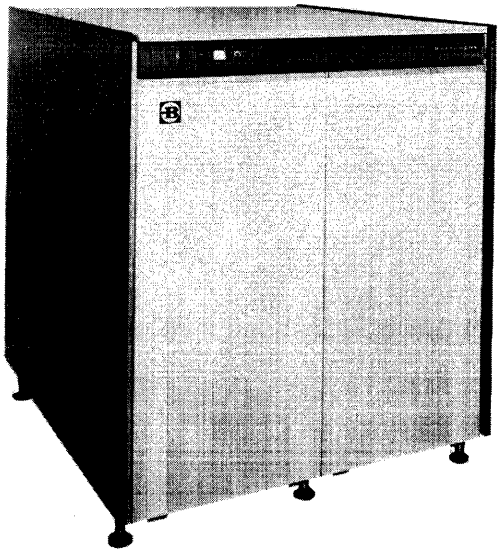


Figure 2-64. B 471 Electronics Unit

B 471 Control Panel

2-160. The switches and indicators located on the control panel (figure 2-65), used for the operation of the B 471 Disk File Electronics Unit, are described in table 2-14.

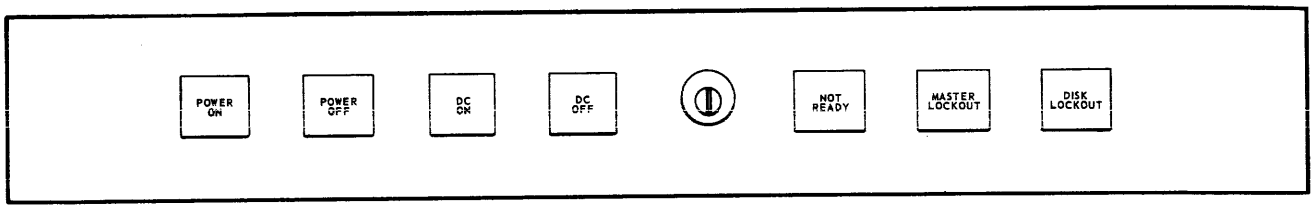


Figure 2-65. B 471 Control Panel

TABLE 2-14

B 471 Disk File Electronics Unit Control Panel Switches and Indicators

SWITCH/INDICATOR	FUNCTION
POWER ON	This switch applies AC power to the storage unit and the storage modules connected to it, provided that the AC ON switch of the B 247 Control Unit is also on.
POWER OFF	This switch removes AC power from the storage unit and from the storage modules connected to it. The switch should only be used when absolutely necessary since the storage modules require two hours to return to operating condition after power is turned on once more.
NOT READY	This indicator will light when one of the following conditions exists: AC power is off, DC power is off, REMOTE/LOCAL switch is in the LOCAL portion, all disks in the storage modules are not up to speed, or air pressure is low.
DC ON	This switch applies DC power to the storage unit and to the storage modules attached to it.
DC OFF	This switch removes DC power from the storage unit and the storage modules connected to it.
MASTER LOCKOUT	This indicator lights when the master lockout switch (located under a hinged cover) is pressed to lock out all of the disks connected to the particular disk file storage unit.
DISK LOCKOUT	This indicator lights when one or more of the disk lockout switches (located under the hinged cover) are pressed to lock out the disks connected to the particular disk file control unit.

B 475 Disk File Storage Module

2-161. The B 475 Disk File Storage Module (figure 2-66) consists of four vertically mounted magnetic disks comprising a storage capacity of 9.6 million alphanumeric characters. Each disk surface has 50 data tracks which are divided into addressable segment sizes of 96, 240, or 480 alphanumeric characters. One data track has a 24,000 character capacity. Every track is equipped with its own read/write head and by means of electronic switching, the heads can rapidly access data from the tracks. A fail-safe mechanism within each storage module prevents the read/write heads from contacting or damaging the magnetic disk surface.

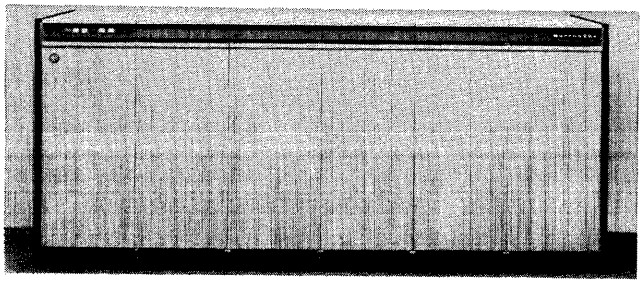


Figure 2-66. B 475 Disk File Storage Module

2-162. The magnetic disks rotate at 1500 revolutions-per-minute (RPM), and with the head-per-track design incorporated for reading and writing data, the average time required to access data from disk storage is one-half disk revolution, or 20 ms., regardless of file size or organization of records. All data recorded onto the disks will remain on the disks until replaced with new information. Transfer of information from and to the file is at a rate of 100,000 characters-per-second.

B 475 Disk File Storage Module Control Panel

2-163. The controls for operating the B 475 Storage Module are located on the B 471 Disk File Storage Unit. This unit provides individual disk lockout switches for the disks within the storage module. These switches allow individual disks to be locked out. For a complete functional description of the switches and indicators, refer to table 2-14.

B 478-1 DISK

2-164. The B 478-1 Disk File Storage Unit is basically identical to the B 471-B 475 except that the B 478-1 offers twice the storage capacity (19.2 million characters) with an average access time of 40 ms. The transfer rate of the B 478-1 is 134,000 characters-per-second and the segment size is 240 alphanumeric characters. The B 478-1 includes the electronics unit. It is then possible to add more disk file units (B 478-2).

B 478-2 DISK FILE

2-165. The B 478-2 Disk File Storage Unit is identical to the B 478-1 except for the electronics unit. Storage capacity, access time, transfer time, and segment size are all the same. The B 478-2 is intended for use as an expansion device in conjunction the B 478-1.

B 248 DATA COMMUNICATION CONTROL UNIT

2-166. The B 248 Data Communication Control Unit provides the interface between the central processor and the various terminal units. Only one B 248 may be connected to a B 273, B 283 or B 300 System and it can serve from one to fifteen terminal units of any combination. The B 248 may have a cable length of up to 50 feet from the associated central processor and is under control of the central processor only when loading or unloading a terminal unit buffer to or from core memory.

B 248 Functional Characteristics

2-167. The B 248 provides the code translation facility for conversion between Burroughs Common Language (BCL) and Baudot Code. In a system where different types of terminal units are used, BCL to Baudot conversion takes place only when the Scanner in the B 248 is addressing a teletype terminal unit.

2-168. The B 248 can recognize that any terminal unit is in one of four possible states: Busy, Input Ready, Output Ready, or Not-Ready.

2-169. When a designated terminal unit is in the "Busy" state, the associated central processor or the B 248 cannot communicate with that terminal unit. A "Busy" state occurs when: the terminal unit is receiving an input message from one of its stations, if the terminal unit is transmitting the contents of its buffer to an inquiry station, if there is a nonrelated call on the net of a teletype terminal unit, if the terminal unit is idle when designated by a read order, or when loading or unloading a terminal unit buffer to or from the central processor.

2-170. A terminal unit that has received a complete message from an inquiry station is in the "Input Ready" state. The completing of an input message is recognized by an end-of-message character which is transmitted to the associated central processor as a group mark (BCL-011 1111).

2-171. A terminal unit is in the "Output Ready" state after it has completed transferring the contents of its buffer to an inquiry station and has not detected an End-of-Reply (group mark) character.

2-172. The B 248 also provides an interrupt to the central processor. This interrupt is set when any terminal unit is in the "Input Ready" or the "Output Ready" state, and the terminal unit is being addressed by the scanner.

2-173. The character transfer rate through the B 248 is a maximum of 30,000 characters-per-second. Transfer is serial-by-character, parallel-by-bit; in all cases of inquiry reply, the message must be terminated by a group mark character.

2-174. The scanner in the B 248 has the facility to connect any of the terminal units to the central processor. The time required for the scanner to examine adjacent channels for "Ready" status is a maximum of 20 microseconds; the B 248 gives priority, in undirectional sequence, to terminal units that are in the "Output Ready State."

B 481 TELETYPE TERMINAL UNIT

2-175. The B 481 Teletype Terminal Unit provides the interface between the B 248 and the teletype stations on a net (see figure 2-67). From 1 to 399 teletype station sets may be serviced by a single B 481 Teletype Terminal allowing a possible 5,985 teletype stations in a network if only teletype terminals are used (1 to 15 terminal units per B 248). The B 481 may have a cable length of up to 50 feet from the B 248 and, as an optional device, may have a teletype page printer included as part of the terminal unit.

B 481 Functional Characteristics

2-176. The B 481 Teletype Terminal Unit provides serial-parallel code conversion, special teletype character deletion and insertion, and buffer storage capability. Control and timing levels are generated and sensed so that the B 481 is compatible with the B 248.

2-177. Physically, the B 481 is a model 28 Sequential Selector with selective calling features. A parallel to series converter is furnished as an available feature with the sequential selector; code reading contacts are used to convert serial-by-bit characters for transmission to the B 248. A character-control unit is provided for the insertion and deletion of special teletype characters such as "Line Feed." The character control also provides the end-of-reply, and the station disconnect signals for the teletype net. The character-control further inserts change of print mode signals in the data being sent to the teletype stations when there is a change from either figures (FIGS) to letters (LTRS).

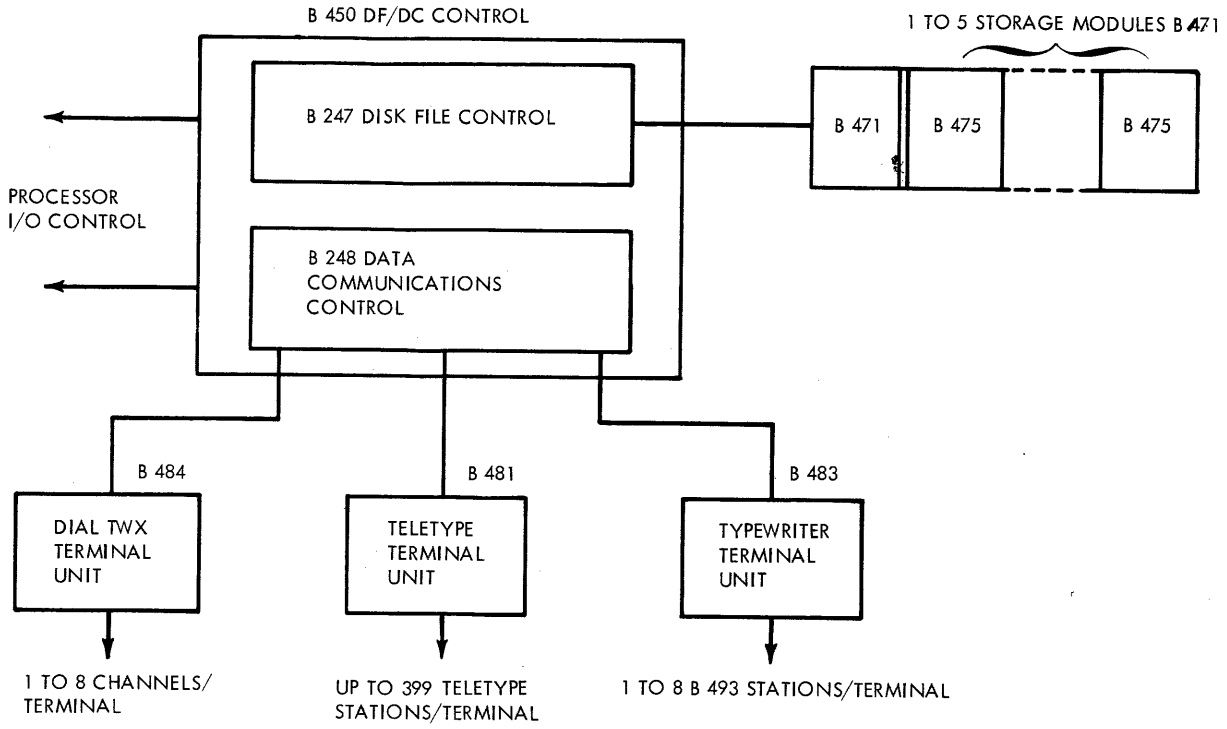


Figure 2-67. Disk File/Data Communication Subsystem with Representative Terminal Units

2-178. The B 481 Teletype Terminal Unit incorporates a buffer which stores six-bit characters. Buffer size may be 120 or 240 characters and the access time for the terminal buffer is 20 microseconds. An inquiry message may be entered via the keyboard of any station on the net by selectively calling the B 481. The B 481 Teletype Terminal Unit can service only one station at a time.

2-179. A teletype page printer may be included as part of the B 481 Teletype Terminal Unit. This printer can be used for monitoring all messages on the net.

B 483 TYPEWRITER TERMINAL UNIT

2-180. The B 483 Typewriter Terminal Unit provides the interface between the B 248 and the typewriter inquiry stations on a net. The B 483 provides facilities for one to eight typewriter stations and includes the input station selection circuitry, and an input/output buffer of 480 characters. Control and timing levels are generated and sensed so that it will be compatible with the B 248. The typewriter terminal unit may have a cable length of up to 50 feet from the B 248.

2-181. The unit provides buffers to store simultaneous inputs from each typewriter inquiry station. Buffer size for each typewriter inquiry station depends on the number of stations per terminal.

2-182. The B 483 Typewriter Terminal Unit also provides input scanning facilities to accept data from any of the eight possible typewriter inquiry stations. This data is picked off and stored as it is available, a character-at-a-time, and is directed to the proper portion of the buffer.

2-183. In addition, the unit provides an input latch facility which interrupts the scanner and holds the buffer to a station while data is transferred through the B 248 to the central processor. The latch is initiated when the end-of-message input character is stored.

2-184. The buffer will store a reply message from the processor when latched to the B 248. The flow of data into the buffer is governed by timing levels generated in the terminal unit. The buffer will unload a reply message when latched to the typewriter inquiry station and the flow of data from the buffer is

governed by timing levels generated in the typewriter inquiry station.

B 484 DIAL TWX TERMINAL UNIT

2-185. The B 484 Dial TWX Terminal Unit provides the interface between the dial TWX network and the B 248. It provides facilities for one to eight channels of the dial TWX network and an input/output buffer of up to 480 characters. A Dataset 103 is required for the interface to the dial TWX network and may be located 50 feet from the terminal unit.

B 484 Functional Characteristics

2-186. The terminal unit provides buffers to each channel. To store simultaneous messages for each channel depends on the number of channels required in the terminal. The operator dials the Dial TWX Terminal Unit using normal dialing procedures. When a connection has been established, the message is typed and stored until an "End-of-Message" signal is received.

2-187. The scanning facilities provided with the terminal unit provide a connection to each buffer when required and the input message is unloaded from the buffer to the system. The buffers will also store output messages from the processor when connected to the system. The flow rate of data into the buffer is governed in the terminal unit with the message being terminated by a group mark. The message is then transferred to the connected station while the terminal is servicing other channels.

B 493 TYPEWRITER INQUIRY STATION

2-188. The B 493 Typewriter Inquiry Station utilizes a Send-Receive Page Printer set. The alphanumeric keyboard is provided with contacts suitable for keying of alphanumeric input data.

B 493 Functional Characteristics

2-189. The B 493 Typewriter Inquiry Station communicates with the B 483 Typewriter Terminal Unit via a single multiple conductor cable. These cables may be up to 2000 feet from the B 483 to the inquiry station. The station set operates at a standard rate of 10 characters-per-second by selectively pressing the keys and space bar of the keyboard in the same manner as typing.

B 495 SUPERVISORY PRINTER

2-190. The B 495 Supervisory Printer (figure 2-68) furnishes a permanent printed document between the operator and the system through use of a modified electric typewriter as an input/output device. The printer can only be used with a B 273, B 283 or B 300 System and is most useful when associated with a control unit since it can print the beginning of a message and the end of the message. A LOCAL switch on the printer allows the operator to manually type comments when desired.

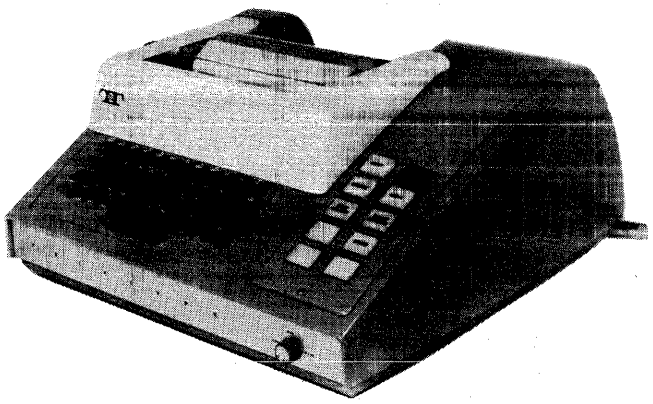


Figure 2-68. B 495 Supervisory Printer

B 495 Functional Characteristics

2-191. The B 495 has a print format of 10 characters-per-inch horizontally and six characters-per-inch vertically with an output rate of 10 characters-per-second. The printed output is displayed on continuous fan-fold paper of 9-7/8 inches. Two carbon copies can be printed with the original first print copy. The B 495 is permanently preset to provide a maximum line length of 72 characters with the left-hand margin preset at one inch from the left edge of the paper. Neither margin can be preset manually. The typing cylinder will return upon

pressing the return key, printing of the 72nd character in a line, a left pointing arrow (←) in the output data, or by depressing the end-of-message key during input.

B 495 Supervisory Printer Controls

2-192. The B 495 Supervisory Printer (figure 2-69) contains switches and indicators which control the operation of the printer. The switches and indicators are described in table 2-15.

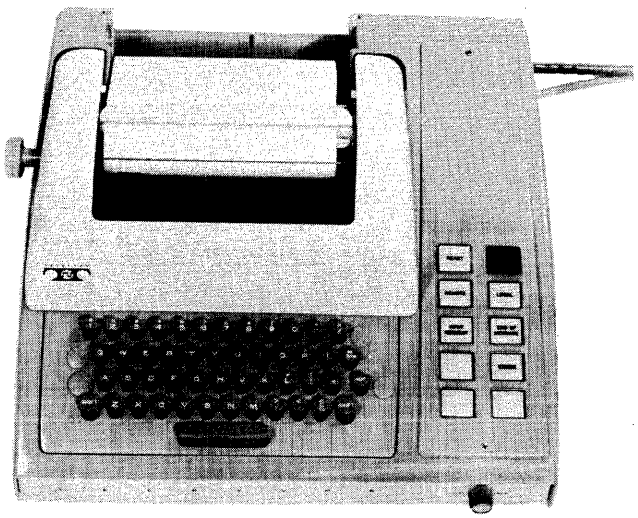


Figure 2-69. B 495 Controls

TABLE 2-15

B 495 Supervisory Printer Switches and Indicators

SWITCH/INDICATOR	FUNCTION
INPUT REQUEST	A momentary contact switch that generates an interrupt and requests system attention. The light remains lit until the SPO is read.
READY	This indicator lights when the computer reaches a Read Supervisory Print instruction.
REMOTE	A self-indicating switch that places the printer under control of the associated central processor.
LOCAL	A self-indicating switch that removes the printer from control of the central processor. The operator can type comments when this switch is on.
POWER ON	This indicator lights when power is applied to the unit.
ERROR	The operator momentarily presses this switch in the event of an operator input error (i.e., keystroke error). The program control will continue in sequence.
END OF MESSAGE	Momentarily pressing this switch terminates the message. A group mark is stored in memory and the READY indicator is extinguished.
OFF/LINE/LOCAL	This three-position switch: (1) removes power from the unit when in the OFF position, (2) connects the typewriter to the supervisory printer logic when in the LINE position, and (3) disconnects the logic from the typewriter when in the LOCAL position.

DATA TRANSMISSION SYSTEM

2-193. The Burroughs Data Transmission System is even more powerful and versatile than the Communication System. The Communication System could be more appropriately called an inquiry system because an inquiry must be "asked" before a reply can be given; i.e., the computer system is unable to transmit a message without first receiving an inquiry (with the exception of the teletype network).

2-194. All operations between any of the various types of stations and the computer system are completely buffered and independent. Transfer rate between the buffers and the computer system is 100 KC. The Data Transmission System has a much greater capacity to handle various types of transmission devices in any combination. These devices include:

a. Typewriter (64 stations).

b. TWX networks (64).

c. Teletype (25, 536 stations).

d. 801 automatic calling units.

e. UNIVAC 1004.

f. IBM 1050.

Functional Description

2-195. The Data Transmission System is composed of the following components:

a. B 452 Disk File/Data Transmission Basic Control.

b. B 249 Data Transmission Control Unit (DTCU).

c. B 487 Data Transmission Terminal Unit (DTTU).

d. Line Adaptors.

2-196. The B 452 houses the B 249, and the disk file control unit if it is used. The terminal units and adaptors are not free standing units but are, in fact, gates which are mounted inside the B 452 cabinet.

B 249 Data Transmission Control Unit

2-197. The DTCU serves as a multiplexing device which allows the B 300 System to handle up to 4 transmission terminal units. If only one terminal unit is on the system, the DTCU is not required.

2-198. One of the major functions of the DTCU is to provide code translation between the computing system and the transmission device. For example, typewriters and TWX networks both function in ASCII code; and, therefore, the DTCU must provide translation both ways between BCL and ASCII or ASCII and BCL. In the case of teletype networks, they function in Baudot code; and, therefore, the DTCU must provide translation between this code and BCL again, both on input and output.

NOTE

If a DTCU is not used, then it is the object program's function to provide the correct translation on both input and output.

B 487 Data Transmission Terminal Unit

2-199. A DTTU contains a message area of 448 characters of core memory, which is divided into sixteen 28-character subsections numbered 0 through 15. An adaptor is assigned a number of these subsections according to user and physical requirements. The division of the storage area into buffers is accomplished by placing line adaptors at line adaptor connection points. Each buffer area is then defined to start at the point

where its line adaptor is connected and to extend to the next line adaptor or the end of storage, whichever occurs first. The buffer address (or sometimes called station address) is actually composed of two quantities, the terminal unit number and the section number. When communicating with any transmission device, both of these quantities are required. The combination of both quantities shall henceforth be referred to as the "buffer address." For example, assume a terminal unit were assigned a number 2 (this is accomplished by its physical connection) and it had three adaptors. If the line adaptors were attached to the connection points at subsections 0, 3, and 7, the entire storage area would be divided into three message or information areas. The first area would have a buffer address of 20 and would be 84 characters in length. The second area would have a buffer address of 23 and would be 112 characters in length. The third area would have a buffer address of 27 and would be 252 characters in length.

2-200. When a message or group of characters is received from a transmission device, the information passes through a line adaptor into the adaptor's terminal unit information area. When the end-of-information is sensed, an interrupt level is produced by the terminal unit and sent either through the control unit (if it is present) to the computer system or directly to the computer system without a control unit, which subsequently causes the computer system to be interrupted. An "interrogate" is programmatically performed in order to determine the buffer address of the information and the status of the buffer which generated the interrupt.

2-201. At the completion of a data transmission operation (either input or output), a buffer address can be flagged as being either normal or abnormal. This flag of normal or abnormal in conjunction with an input or output operation can indicate a large number of combinations reflecting errors, special attention, etc.

2-202. BUFFER CONDITIONS. A buffer may be in one of the following conditions:

a. Idle - indicating that the buffer is not presently receiving a message from a transmission device nor is it transmitting information to that device.

b. Read Ready - indicating that an entire message has been received from a transmission device and the computer system should now process that information.

NOTE

When the computer system "reads" the information out of the buffer, the buffer is then returned to an idle condition.

It should also be noted that a computer-initiated message to a buffer is allowed any time a buffer is in an idle condition. Thus, at the completion of a read, the transmission device may continue sending information or the computer may send a reply concerning the information just read in from the buffer. In most cases of an operator-transmission device such as a typewriter or teletype, it would be advisable to send a reply (if only a carriage return and line feed) to indicate that the operator may continue with the input. When a message is transmitted to an idle buffer (complete with group mark), an interrupt is produced when the transmission device has fully accepted (i.e., typed) the output message; and an idle interrupt is produced to the computer system.

2-203. If, however, the output message sent to the buffer does not contain a group mark or end-of-message character, a write-ready interrupt is produced when the buffer has fully transmitted the information to the transmission device. A write-ready condition indicates that the buffer is now ready for the next portion of the total message. This

write-ready condition in previous terminal units caused a temporary lock-out of all other transmission/communication devices on that terminal unit during the time that multiple groups of information were being transmitted to the transmission device. In the B 487, however, this condition does not affect any other device.

NOTE

Whenever any interrupt of any type has been interrogated, that interrupt has been removed and will not cause another interrupt under any circumstances.

2-204. All of the above conditions can be flagged as being either normal or abnormal. For example, an operator typing the left arrow (end-of-message) key causes a read-ready normal interrupt. If, however, for some reason the operator keys in the end-of-transmission character, a read-ready abnormal interrupt is produced. On output, when the left arrow is encountered during the transfer of data from the buffer to the adaptor, the buffer assumes an idle normal condition with an interrupt. If, during the time that a message is being sent out of the buffer to a TWX adaptor and the operator should press the BREAK key, the buffer terminates the output of the message and immediately assumes a read-ready abnormal condition with an interrupt. These are but a few of the numerous combinations and conditions of input and output with errors, end of transmission, loss of carrier, buffer overflow, etc., that can occur and subsequently flag the operation as normal or abnormal. The handling of these conditions is totally left up to the object program.

NOTE

There is hardware priority available that causes selection of the lowest numbered buffer within a terminal unit for system attention.

2-205. LINE ADAPTORS. There is a specially designed line adaptor for each type of transmission device which serves to interface that device with the DTTU. With the appropriate line adaptor, it is possible to interface any device to a DTTU and thus achieve information exchange with the computer system.

2-206. TYPEWRITER/TWX. A single typewriter station connects with a typewriter line adaptor. A maximum of 16 typewriters can be connected with the 16 adaptors to a single DTTU. However, the buffer size of each would then be restricted to 28 characters. Each typewriter is entirely independent of all the other adaptors, regardless of what type they might be. If the buffer associated with a typewriter station is not "busy," the computer system can initiate at any time a message to be typed out on that station just as if it were a supervisory printer (SPO).

2-207. If, while typing a message in from the remote station, the operator notes a mistake, the operator can perform a "backspace" and thereby erase one character. This backspace may be performed as often as required. Another function is the ability to handle paper tape from a model 33 or 35 ASR typewriter station. Messages may be stacked on paper tape as shown in figure 2-70.

2-208. The computer system can exercise control over the paper tape by performing a "start paper tape" function (this is a reserved character), and then the paper tape will continue sending until a character on the paper tape indicates "stop paper tape." The paper tape will stop, the computer system will read the message, process it, and either send a reply back to the station where the reply will be typed out or simply send a control character to resume reading from the paper tape, or both.

NOTE

The buffer size will usually dictate format and/or length of the entries from the paper tape.

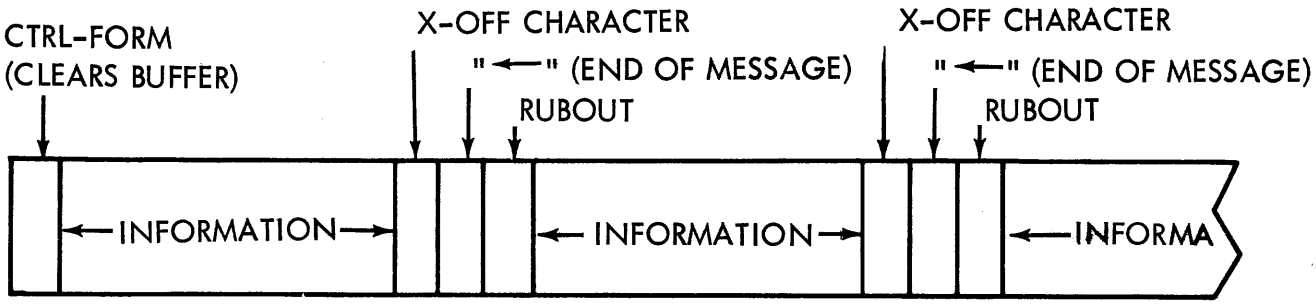


Figure 2-70. Sample Paper Tape Format

2-209. A TWX network is actually typewriters connected to the terminal unit buffer via data sets and the interconnecting telephone lines. The data set is, for all practical purposes, a telephone and has a dialable number. The operator at a remote TWX typewriter station dials the number of the data set connected to the adaptor; and, when the connection is made, the TWX station functions exactly like a typewriter station as previously described, with this exception: the data set is continuously monitoring the quality of the data carrier; and, if the quality drops below a certain threshold value, the data set performs a "loss of carrier disconnect." This can occur on either input or output. In both cases, however, an abnormal condition is flagged and an interrupt is produced.

2-210. TELETYPE NETWORKS. Each of the stations and the adaptor has a "2-character call." If the net, as it is called, is idle, the computer system can initiate a call sequence and/or message to any or all of the stations on the net. In the same manner, any station, if the net is idle, can call the adaptor and/or any other station and transmit information to it. Teletype networks have a standard calling and message discipline that is followed by all who use the net.

2-211. 801 AUTOMATIC CALLING UNIT (ACU). The 801 adaptor is first used to transmit a dial sequence through the 801 data set. The 801 data set is, in fact, connected to the telephone exchange through the normal data set that will be used once the telephone connection has been established. After the connection has been made, the information is processed to and from the remote station through the TWX adaptor. The 801 is not used during this period.

NOTE

At this writing, the connection/adaptor function between the UNIVAC 1004 and the IBM 1050 has not been thoroughly detailed and defined.

SECTION 3

STORED PROGRAM INSTRUCTIONS

GENERAL

3-1. Data processing has been defined as the performance of a series of actions and operations on data for the purpose of achieving desired results. In order to control the operation of data processing within a computer system, a series of instructions, called a program, is introduced to the computer to "tell it" under what circumstances to perform a particular operation on the data being processed. Since these instructions are held in core storage, they are referred to as the stored program.

3-2. This section contains a detailed description of the individual instructions that comprise the stored program within the B 100/200/300 Series System central processors.

INSTRUCTION DESCRIPTION

3-3. The instructions that comprise the stored program in all systems are usually classified into four categories. These categories are:

a. Input/Output Instructions - These instructions control on-line operation of tabulating card reading and punching, paper tape reading and punching, high speed printing and listing, MICR document reading, magnetic tape processing, disk file writing, reading, checking and interrogating, data communication reading, writing, and interrogating, and supervisory printer reading and writing.

b. Arithmetic Instructions - The central processor executes the standard operations of add, subtract, multiply, and divide. Each operation is accomplished with a single instruction. Multiply and divide operations do not require subroutines. The result of an arithmetic operation is stored in algebraic form (a negative result does not require further processing to convert or decomplement the answer).

c. Control Instructions - In data processing systems, control is defined as the ability to process data in accordance with conditions defined by the programmer. These logical functions are performed by the use of instructions which can test for a wide variety of conditions and, on the basis of the result, direct control to the required processing routines under program control. This is normally accomplished through the use of electronic devices (comparison indicators) within the central processor. The comparison indicators electronically indicate conditions resulting from the execution of various instructions. The conditions existing in the comparison indicators may be any one of the following, depending only upon the previously executed instruction; high (positive) or greater than zero, equal or zero, and low (negative) or less than zero. The comparison indicators may be interrogated under program control to direct processing as required.

d. Editing Instructions - Editing is the function of punctuating with commas, decimals, dollar signs, etc.), position-

ing, and zero-print controlling the data to be printed. All editing is performed under program control.

INSTRUCTION FORMAT

3-4. All instructions in core storage are a fixed length of 12-character positions. Since all instructions do not utilize the full complement of 12 characters, certain unused character positions are available for storage of constants, control counters, etc. These "free" positions are discussed in subsequent paragraphs, along with the discussion of the individual instructions. The instruction format and the identifying digit, or character, for each position is illustrated in figure 3-1. For reference purposes, the "0" position starting the instruction is the most significant digit (MSD) and the @ position is the least significant digit (LSD).

3-5. The instruction format is defined as follows:

a. O - A single character position which identifies the type of instruction to be executed. This operation code (Op Code) must be in the MSD position of the field.

b. M - The second character position of the instruction is termed the M variant. It is used to modify the Op Code by providing information such as field length, variations of the basic instruction, and forms control.

c. N - The third character position of the instruction is termed the N variant. It also is used to complete the definition of the Op Code by providing such information as field length, input/output unit numbers, forms control, sorter-reader pockets, etc.

d. AAA - The three-character address (MSD) position of a field or a character. Depending upon the Op Code, it is usually used to reference either data or another instruction.

e. BBB - The three-character address (MSD) position of a field or a character. Depending upon the Op Code, it is usually used to reference either data or another instruction.

f. CCC - The three-character address (MSD) position of a field or a character. Depending upon the Op Code, it is usually used to reference either data or another instruction.

3-6. As mentioned previously, there are some instructions which do not use all 12 available positions of core storage. These "free" positions are designated by a "b" in the description of the individual instructions and are classified as follows:

a. Available to Programmer - Positions with this classification may be used for any purpose as long as the adjacent characters or bits indicated for other uses are not disturbed.

b. Reserved for Expansion - These positions may NOT be used when programing and must be left blank. Future command modifications may be accomplished by using these positions.

Format	O	M	N	A_1	A_2	A_3	B_1	B_2	B_3	C_1	C_2	C_3
Digit	0	1	2	3	4	5	6	7	8	9	#	@

Figure 3-1. Instruction Format

c. Used by Machine - These positions are NOT to be used for data storage when programing any application. The positions are used by the hardware during the execution of the instruction in which they appear and any data stored there may either adversely affect the execution of the instruction, or may be affected adversely by the execution of the instruction.

3-7. In addition to the classifications mentioned above, the units position of the AAA, BBB, and CCC addresses are sometimes designated by a "b". This is normally the case when the address references an instruction. Since all instructions in B 100/ B 200/B 300 Series Systems contain 12 character positions, the third character of the instruction address is always zero. During processor operation, the unit's position of the instruction address is always treated as a zero unless the BCD value is greater than @ (11). Therefore, it is quite possible to use this unit position for storage if precautions are taken to make certain the stored character does not affect processor operation, or that the stored data is not destroyed by processor operation before the data can be used.

3-8. In the description of program instructions contained in this section, the format used is:

MSK 8 M N AAA BBB CCC Set to Equal (comparison indicator status)

The mnemonic code MSK which is used with the B 200 Assembler appears first, followed by the instruction format 8 M N AAA BBB CCC. The setting of the comparison indicators denotes their status AFTER the execution of the instruction. In the case of the instruction format (8 M N AAA BBB CCC), the capital letters M, N, A, B, and C in the proper position of the instruction designate that the position is used in the instruction execution. A "b" in any position denotes that that position is not used in the execution of the instruction and falls into one of the categories listed in paragraphs 3-6 and 3-7.

3-9. The instruction examples that follow are given in machine language. Instruction execution time is provided in section 5.

B 100 AND MODEL 0 CENTRAL PROCESSOR INSTRUCTIONS

3-10. A description of all instructions available for use with B 100 and Model 0 Central Processors is provided in the paragraphs that follow. Improved Model 0, B 263, B 273, B 283 and B 300 Central Processor instructions are discussed later in this section.

Input/Output Instructions

3-11. The various types of input/output equipment used with B 100 and Model 0 Central Processors necessitate the need for a wide variety of input/output instructions. This variety of instructions includes the following operations:

a. Punch card reading and punching.

b. High speed printing and listing.

c. MICR document reading.

d. Magnetic tape processing.

Card Read and Punch Instructions

3-12. There are two instructions, Card Read and Card Punch, which control the operation of the punch card equipment. As mentioned previously, the card units are completely buffered, thereby providing sufficient processing time between I/O instructions.

3-13. **CARD READ.** The format for this instruction is:

CRD # M N bbb BBb CCC Set to Equal

where:

O: Operation Code; #-machine language, CRD-symbolic

M: Reserved for expansion-must be left blank

N: Designates input buffer
1-buffer 1
2-buffer 2

AAA: Available to programmer

BBB: Branching address on End-of-File (MSD)

CCC: Store address (MSD)

3-14. This instruction transfers the contents of one of the input buffers (specified by an N variant of 1 or 2) into core storage at the location specified by CCC. The execution of this instruction also includes an automatic reload of the buffer with information from the next punched card as it passes the read station. The buffer unload operation mentioned above requires 2 milliseconds (ms). Reloading the buffer requires 73 ms. at 800 cards per minute (B 124 Card Reader) and 298 ms. at 200 cards per minute (B 122 Card Reader). The buffer is interlocked during this time.

3-15. If, during the reloading of the buffer, a card read error or a failure to feed occurs, the system will halt on the next Card Read instruction, thereby preventing the transfer of erroneous information into memory (VALIDITY ON).

3-16. When there are no cards left in the hopper, pressing the END OF FILE switch on the card reader and the CONTINUE switch on the central processor (or the START switch on the card reader) will cause the program to branch to BBb* immediately.

3-17. On all 51, 60, 66, and 80-column cards, column 1 is stored in the MSD position of the CCC address. On short cards (51, 60, and 66-columns), the buffer will contain blanks for the remaining number of unavailable card columns (29, 20, and 14 respectively).

3-18. **CARD PUNCH.** The format for this instruction is:

PCH @ b b AAA bbb bbb Not Affected

where:

O: Operation Code; @-machine language, PCH-symbolic

M: Reserved for expansion-must be left blank

N: Reserved for expansion-must be left blank

AAA: Transfer from address (MSD)

BBB: Available to programmer

CCC: Available to programmer

3-19. This instruction transfers the contents of 80 consecutive memory positions, starting at AAA, into the punch buffer within 2.5 ms., after which a card is punched. The actual punching requires a minimum of 197.5 ms. when using the B 304 Card Punch and 597.5 ms. when using the B 303 Card Punch. During these times, the buffer is interlocked. A punch error condition is detected at either the punch station or at the post-punch read station. The PUNCH CHECK indicator will light when an error is detected; however, the punch error signal is not made available to

*Refer to Branching, paragraph 3-90.

the central processor until the suspect card has passed the post-punch read station and the following card has been punched. The card that follows the suspect card will be punched regardless of the time interval between punch instructions. Therefore, if three cards are to be punched and a punch error occurs in the first card, the system will not halt until the third punch instruction is encountered, stopping the third from being punched. The first two cards will have been punched; therefore, if re-creation of mispunched cards proves difficult, the output should be programmatically "tanked."

Line Printer Instructions

3-20. Two instructions, Print on Printer and Skip Printer, are used to control operation of the line printer. The print instruction is used to print a line and to control skipping and/or spacing after printing. The skip instruction is used for forms control without printing.

3-21. In both instructions, the M and N variants are used for spacing and skipping respectively. The M variant digits of 0, 1, and 2 designate space suppression, single space, and double space. All spacing is performed after printing.

3-22. The N variant digits of 1 through 9, #, and @ which control skipping correspond to channels 1-11 in the carriage control tape. An N variant of 0 indicates no skipping. In all spacing operations N must be 0. The 12 channel in the carriage control tape is reserved for indicating End-of-Page to the central processor. End-of-Page indication is a means of identifying the last print line on a form, and permits programing a skip to the first print line of the next page.

3-23. **PRINT ON PRINTER.** The format for this instruction is:

PRT A M N AAA BBb bbb Not Affected

where:

O: Operation Code; A-machine language, PRT-symbolic

M: Form spacing after print (0, 1, 2)

*N: Form skipping after print (1-11, 12 is denoted by 0)

AAA: Print-form address (MSD)

BBB: Branching address on Page Overflow when N = 0

CCC: Available to programmer

3-24. This instruction transfers 120 characters from core storage beginning at the address specified by AAA to the printer buffer. When the printer buffer is filled (1.3 ms.), one line will be printed. Spacing after printing is controlled by the M variant. If skipping after printing is desired, the N variant is used. If a print error occurs, the system will stop on the next print instruction (print or skip) that references the printer. If an End-of-Page indication is sensed during a preceding space operation, the program will branch to BBb after printing without paper motion, if the present Print instruction contains an N variant of zero. The three character positions of the CCC address is available to the programmer and may be used for storage.

3-25. **SKIP ON PRINTER.** The format for this instruction is:

SKP B M N bbb BBb bbb Not Affected

where:

O: Operation Code; B-machine language, SKP-symbolic

M: Controls form spacing (0, 1, 2)

*N: Controls form skipping (1-11, 12 is denoted by 0)

*On B 263, B 273, B 283 or B 300 systems, a blank or any other character containing a B set in the N variant can never be used or a branch to the address specified by CCC will always be taken.

AAA: Available to programmer

BBB: Branch address on Page Overflow when N = 0

CCC: Available to programmer

3-26. This instruction controls spacing and skipping before printing and is included to complement the spacing and skipping features of the print instruction. If an End-of-Page indication is sensed during the previous space operation, the program will branch to BBb without paper motion, if the present Skip instruction contains an N variant of zero. The three character positions of the AAA and CCC addresses are available to the programmer and may be used for storage.

Multiple Tape Lister Instructions

3-27. A maximum of two B 322 Multiple Tape Listers may be used with B 100/ B 200/B 300 Systems. Each multiple tape lister contains six tapes. When one B 322 Tape Lister is used, one of the tapes will be designated the master and the other five will be detail tapes. When two B 322 Tape Listers are used, one master and 11 detail tapes are available.

3-28. By use of the M and N variants, it is possible to designate either one or two of the 12 lister tapes. Normally, the master (M variant) and one of the detail tapes (N variant) will be printed. This being the case, the master will be printed more than any of the detail tapes. As a result, the ribbon in the master tape area would have a tendency to wear out much sooner than the remainder of the ribbon. To avoid this situation, the B 322 Tape Lister is provided with a master tape selection switch.

3-29. The switch has seven positions, 1 through 6 and N. By use of the switch, the operator can designate any one of the six tapes as the master. When the switch is in the N position, it is disabled. If two B 322 Tape Listers are used, any one of the 12 tapes can be designated as the master. This is accomplished by the M variants of 0 and 1. An M variant of 1 will place the master tape in unit number 1. An M variant of 0 places the master in tape unit 2. The tape lister that does NOT contain the master tape must always have its master tape selection switch in the N position. When M is 0, the N variant can not be 7. If the M variant is 1, the N variant can not be 1. An M or N variant of BCD 15 will suppress printing.

3-30. If, during the printing of a master and detail tape, the detail tape specified by the N variant is the same as for the tape designated by the master tape selection switch, the detail information will be printed on the left most tape of the unit containing the master (1 or 7). For example, if the master tape selection switch is set to 3, all master information will be printed on tape 3 and all detail information programed to print on tape 3 will be printed on tape 1. If tape lister 2 contains the master tape and its switch is set to 3, the master information will be printed on tape 9 and the detail information will be printed on tape 7.

3-31. If both tape listers have their master tape selection switch set to N, all 12 tapes can be designated as detail tapes. However, in this situation, the first 22 positions of buffer storage will be lost and only the second 22 positions will be printed on the detail tape. The following M and N variants must be used with multiple tape lister instructions:

a. Printing.

(1) M - 0 Print master on unit 2 (master determined by switch setting). Unit 1 switch set to N.

1 Print master on unit 1 (master determined by switch setting). Unit 2 switch set to N.

15 Suppress master printing.

(2) N - 1 Not permissible when M = 1.
7 Not permissible when M = 0.

2-6
7-11 Designated detail tape (1 - 12)
0 (=12)

15 Suppresses detail designation.

b. Skipping.

M = 0 Skip master on unit 2 and skip detail.

2 Skip master on unit 1 and skip detail.

14 Suppress master and skip detail.

1 Space master on unit 1 and space detail.

7 Space master on unit 2 and space detail.

15 Suppress master and space detail.

c. N = 1-11,0 Designates detail tape. (0 = 12)

15 Suppress detail tape.

3-32. In addition to periodically changing the designation of the master tapes, it is recommended (when using two B 322 Tape Listers) that periodic changing of lister designations be made to lengthen the life of the mechanical components. This can be accomplished by a Field Engineer in a relatively short time.

3-33. **PRINT ON LISTER.** The format for this instruction is:

PRL A M N AAA BBb Not Affected

where:

O: Operation Code; A-machine language, PRL - symbolic

M: 0 - print master on lister 2

1 - print master on lister 1

15 - suppress print on master

With M = 1

N: 2-6, 7-11, 0 (for 12) - designates detail tape

1 - not permissible

15 - suppress detail designation

With M = 0

1-6, 8-11, 0 (for 12) - designates detail tape

7 - not permissible

15 - suppress detail designation

AAA: Transfer-from address (MSD)

BBB: Branching address on End-of-Paper

CCC: Reserved for expansion - must be left blank

3-34. Execution of the PRL instruction transfers the contents of 44 positions of storage, starting at the location specified by the AAA address, to the printer buffer in 0.7 ms. As soon as the buffer is filled, printing will take place. The first 22 positions of the buffer, as specified by AAA, will be printed on the tape designation by M. The second 22 positions will be printed on the tape designated by N. A variant of 15 indicates no printing. If a print error occurs, the system will stop when the next lister instruction is encountered. Single spacing is automatic.

3-35. **SKIP ON LISTER.** The format for this instruction is:

SKL B M N bbb BBb bbb Not Affected where:

O: Operation Code; B-machine language. SKL - symbolic

M: 0 - skip the master designated by the selector switch on lister 2

2 - skip the master designated by the selector switch on lister 1

14 - suppress master

1 - space the master designated by the selector switch on lister 1

4 - skip all non-master tapes approximately 10 inches

9 - skip all tapes approximately 10 inches

7 - space the master designated by the selector switch on lister 2

15 - suppress master

*N: 2 through 11 or 0 when M = 1 or 2

1 through 6, 8 through 11, or 0 when M = 0 or 7

15 - suppress detail

AAA: Available to programmer

BBB: Branching address on End-of-Paper

CCC: Reserved for expansion - must be left blank

*ON B 263, 273, B 283 and B 300 Systems, a blank or any other character containing a B-bit in the N variant can never be used or a branch to the address specified by BBB will always be taken.

3-36. The SKL instruction controls forms movement of one lister tape when no printing is desired. An M variant of 0 denotes a forms skip of approximately 2.5 inches; an M variant of 1 denotes a single space. The N variant designates the tape that is to be spaced or skipped.

3-37. If an End-of-Paper condition is sensed during a skip or print operation, the program will branch to BBb upon execution of the instruction.

Sorter-Reader Instructions

3-38. The B 102/B 103 Sorter-Reader operates as an input device under program control. Three modes of operation are used with these units which are:

a. Flow Mode - documents are fed at speeds up to 1565 items per minute. The information from the documents is read directly into memory.

b. Buffered Flow Mode - operation is the same speed as flow mode with the exception that the information is read into the buffer instead of directly into memory.

c. Demand Mode - documents are fed, as required by the program, up to a maximum of 400 items per minute. The information is read into the buffer.

3-39. The complete function of reading an item in all modes is accomplished by two commands: the Control Sorter command and the Sorter Read command. Operating together, these two instructions perform the following sequence of operation:

a. Control Sorter instruction starts, stops, and maintains the mode of the Read operation and selects the pocket for all documents.

b. Sorter Read instruction reads the information either from the document or from the buffer and directs it to the memory, depending upon the type of Read instruction given.

3-40. This read cycle of two instructions (Control Sorter and Sorter Read) is maintained in all modes; therefore, a Control Sorter instruction is required prior to reading the first document to enter the system.

3-41. The formatting specifications of MICR data read into memory is outlined in section 6 under the paragraph entitled, Word Formatting of MICR Information in Storage.

3-42. Double document (piggyback item) detection will be active via a third transit symbol detector in all Read variants except when N is 5 (end read at second transit symbol.)

3-43. Sorter jams or feed check conditions will fill the read input area with blanks and exit via the Can't Read branch. Non-coded items will also fill the read input area with blanks and the Sorter Read instruction will exit via the Can't Read branch.

3-44. **SORTER READ FLOW.** The format for this instruction is:

SRF # M N AAb BBb CCC Set to Equal where:

O: Operation Code; #-machine language, SRF - symbolic

M: b or 0,1

N: 4 - stop at "F" light or end of document in flow mode

5 - stop read at second transit symbol in flow mode

6 - buffered read, demand and buffer flow modes

AAA: Branching address on Can't Read or non-encoded item signal

BBB: Branching address on End-of-File

CCC: Store address (MSD)

3-45. This instruction transfers characters from MICR documents directly to core storage, starting at the address specified by CCC. The information is represented in seven, twelve-character fields with the beginning amount symbol of the amount field stored in CCC + 83.

3-46. An N variant of 4 specifies that the entire document is to be read, while an N variant of 5 specifies that only those fields, up to and including the transit number, are to be read. When a Can't Read condition occurs, a binary coded 15 is inserted in core storage in place of the invalid character(s), and program control branches to AAb automatically.

3-47. When M is 1 and N is 4, the Can't Read branch (and validity check) is disabled after the second transit symbol is read. When M is 1 and N is 5, the Can't Read branch will be disabled after the first transit symbol, and reading will stop at the second transit symbol. When N is 4 or 5, a missing amount field will result in a Can't Read branch.

3-48. A Control Sorter instruction must follow an SRF instruction within a specified time (approximately 10 ms.) or the system will halt (see section 5).

3-49. If a Control Sorter instruction initiates a Stop Flow, or the batch ticket detection initiates a Stop Flow signal, the sorter feeder will be turned off. When an empty hopper condition exists, depression of the sorter END OF FILE switch and the sorter START switch will transfer control to the BBb address of the Sorter Read Flow instruction. If a Stop Flow is initiated by a CTL instruction, the sorter feeder will be turned off and approximately

three documents will be in the transport system of the sorter-reader. These documents must be processed. If the batch ticket detection device initiated a Stop Flow, the flow is stopped at the feeder by the batch ticket detector and no more items will be fed until a Start Flow is initiated by a Control Sorter instruction. The automatic End-of-File (BBb) exit must always be used in conjunction with a Stop Flow instruction or batch ticket detection. Start Flow can not be re-initiated within 300 milliseconds following a Stop Flow or batch ticket detection.

3-50. If a document reaches the read head before the SRF instruction is executed, all checks in the transport will reject, the feeder will turn off, and the sorter NO FEED indicator will light.

3-51. **SORTER READ DEMAND AND BUFFERED FLOW READ.** The format for this instruction is:

SRD # M N AAb BBb CCC Set to Equal

3-52. This instruction is used for either demand mode or buffered flow mode. It differs from the SRF instruction by an N variant of 6. Execution of the SRD instruction transfers MICR characters from the buffer to core storage, starting at the location specified by CCC. The information is formatted into seven, twelve-character fields. The beginning amount symbol will be in CCC + 83. A Control Sorter instruction must be used with the SRD instruction.

3-53. When M equals 1, the Can't Read branch (and validity check) is disabled after the second transit symbol is read. When a Can't Read condition occurs, program control branches to AAb automatically. An End-of-File condition may be initiated by the same technique described in the Sorter Read Flow discussion, starting with paragraph 3-44.

3-54. As in the Sorter Read Flow instruction, the low-order positions of the AAA and BBB addresses may be used for storage (refer to paragraph 3-90).

3-55. **CONTROL SORTER.** The format for this instruction is:

CTL C M N bbb bbb bbb Set to Equal where:

O: Operation Code; C-machine language, CTL - symbolic

M: Determines type of control (0, 2, 4, 6, 7, 8)

N: Selects pocket (0-11, 15)

AAA: Available to programmer

BBB: Available to programmer

CCC: Available to programmer

3-56. This instruction controls the pocket selection of items and maintains the mode of sorting (SRF and SRD). The M variant is used to designate the following types of control:

a. 0 - pocket select only (as designated by the N variant).

b. 2 - demand feed and pocket select, (B 102 only).

c. 4 - stop flow and pocket select.

d. 6 - start flow and pocket select.

e. 7 - start buffered flow and pocket select.

f. 8 - increase batch counter by 1 (B 103).

3-57. The N variants of 0 through 9, #, @, and ‡ correspond to pockets 0 through 9, X, Y, and R (reject) on the sorter-reader.

3-58. If a pocket select instruction has not been completed within 10 milliseconds after a document has reached the control point (beam-of-light) in flow mode, this document and all subsequent documents will reject. The feeder will turn off and the sorter indicator will light. This is termed an over-length program error.

Magnetic Tape Instructions

3-59. The machine language operation code for this instruction is the character D. The M variant is used to designate the type of tape instruction and the N variant (1-6) selects the proper magnetic tape unit.

3-60. **MAGNETIC TAPE READ.** The format for this instruction is:

TRD D M N AAb BBb CCC Set to Equal where:

O: Operation Code; D-machine language, TRD - symbolic

M: 1

N: Unit designation (1-6)

AAA: Branching address on read error

BBB: Branching address on tape mark (End-of-File)

CCC: Store address (MSD)

3-61. This instruction is identified by the M variant 1. The instruction reads data from the magnetic tape unit, specified by the N variant (1-6), into core storage starting at CCC, up to the first inter-record gap encountered. When this gap is sensed, reading will stop and a group mark (‡) will be stored in memory following the last information character read. If a parity error (either vertical or longitudinal) occurs during reading, the program will branch to the address specified by AAb. An End-of-File record (‡) will be sensed automatically and the program will branch to the BBb address after completion of the read instruction. A tape read error branch takes precedence over an End-of-File branch. Characters which produce parity errors during input will be translated to the question mark code in memory (8, 4 configuration).

3-62. **MAGNETIC TAPE WRITE.** The format for this instruction is:

TWR D M N AAA BBb CCb Set to Equal where:

O: Operation Code; D-machine language, TWR - symbolic

M: 2

N: Unit designation (1-6)

AAA: Transfer-from address (MSD)

BBB: Branch on Physical-End-of-Tape

CCC: Branch address on write error

3-63. This instruction is identified by an M variant of 2. The execution of this instruction causes the data beginning at the AAA address, up to but not including the first group mark, to be written onto magnetic tape. The tape unit is specified by the N variant (1-6). If Physical-End-of-Tape is sensed during a write instruction, the program will branch to the instruction specified by BBb, after execution. The routine starting in BBb should, among other things, write an EOF record on the tape. A tape write error will cause the program to branch immediately to the instruction specified by the CCb address, and takes precedence over a Physical-End-of-Tape branch. All tape records must be at least seven characters long in memory, including the group mark, with the exception of End-of-File records which must contain only two characters, EOF and group mark. The character, question mark (?) will be translated to the BCL Character representing greater than and equal to during output to tape.

3-64. **MAGNETIC TAPE ERASE.** The format for this instruction is:

TER D M N AAA BBb bbb Set to Equal where:

O: Operation Code; D-machine language, TER - symbolic

M: 3

N: Unit designation (1-6)

AAA: MSD of pseudo record

BBB: Branching address on End-of-Tape

CCC: Available to programmer

3-65. This instruction is identified by the M variant 3. This instruction causes the tape unit identified by N (1-6) to erase forward until a group mark is encountered in core storage. AAA will usually be the address of the record on which a write error occurred, thus ensuring that the corresponding length of tape is erased. This instruction is used in a corrective routine which will first backspace the tape to the end of the preceding record and attempt to re-write this record. If repeated attempts to write the record fail, a TER instruction will be given to cause the tape to move forward, erasing all recorded data (erroneous) previously written. The erase operation will stop when a group mark is encountered in storage. This will ensure that the record previously written on tape will be erased. The correction routine should also make provision for writing the record that was not written correctly the first time, or branch back to the original TWR instruction. The program will branch to the instruction specified by BBb if the End-of-Tape mark is encountered during the erase operation. An area of erased tape will have no effect upon the reading of the tape in a subsequent operation since the unit will consider it to be part of the normal inter-record gap.

3-66. **MAGNETIC TAPE BACKSPACE.** The format for this instruction is:

BSP D M N bbb bbb bbb Set to Equal where:

O: Operation Code; D-machine language, BSP - symbolic

M: 4

N: Unit designation (1-6)

AAA: Available to programmer

BBB: Available to programmer

CCC: Available to programmer

3-67. The M variant must be 4. Backspace the tape on the unit designated by the N variant (1-6) to the preceding inter-record gap. If a backspace is executed at Physical-Beginning-of-Tape, the unit referenced will go into a Not Ready status.

3-68. **MAGNETIC TAPE REWIND.** The format for this instruction is:

RWD D M N bbb bbb bbb Set to Equal where:

O: Operation Code; D-machine language, RWD - symbolic

M: 5

N: Unit designation (1-6)

AAA: Available to programmer

BBB: Available to programmer

CCC: Available to programmer

3-69. The M variant is 5. This instruction causes the tape on the unit specified by the N variant (1-6) to be rewound. Rewind speed is 320 inches per second and is accomplished independently of the central processor.

Arithmetic Instructions

3-70. Add, Subtract, Multiply, and Divide instructions are standard on B 100/200/300 Series Systems. These four instructions perform all necessary arithmetic operations.

3-71. In all arithmetic instructions, the M and N variants (1-@) specify the number of digits in the AAA and BBB fields respectively. When either M or N is blank (b) or 0, the length of the associated field is 12 digits.

3-72. The comparison indicators are set at the completion of each arithmetic instruction to correspond to one of the three conditions that can result from the execution of the instruction. The three conditions are; high or greater than zero, equal or zero, and low or less than zero.

3-73. In all arithmetic instructions, the signs of all fields are located in the LSD (units) position; zone bits other than in the units position of the fields starting at AAA and BBB will not be considered or stored in the result.

3-74. SIGN CONTROL. All arithmetic instructions resulting in significant digits in the result field are algebraically performed as illustrated in figures 3-2 through 3-5.

3-75. OVERFLOW. An overflow occurs when the result of executing an Add or Subtract instruction exceeds the size of the longest field. The only value that the overflow can ever represent is 1. Overflows are not detected in the central processor and their detection must be provided for by the programmer. This may be accomplished by increasing the length of the longest field by one position (the length and value of which must be known to the programmer in advance) which will, in turn, increase the size of the result field. Following the execution of either an Add or Subtract instruction, the value of the high-order position of the CCC field can be compared with the known value of the extended field. If a variance exists, an overflow occurred.

A FIELD	+	+	−	−
B FIELD	+	−	+	−
RESULT	+	SIGN OF GREATER		−

Figure 3-2. Sign Control, Addition

A FIELD	+	+	−	−
B FIELD	+	−	+	−
RESULT B > A	−	+	−	+
RESULT A > B	+	+	−	−

Figure 3-3. Sign Control, Subtraction

MULTIPLICAND (A)	+	+	−	−
MULTIPLIER (B)	+	−	+	−
PRODUCT	+	−	−	+

Figure 3-4. Sign Control, Multiplication

DIVIDEND (A)	+	+	−	−
DIVISOR (B)	+	−	+	−
QUOTIENT	+	−	−	+
REMAINDER	+	+	−	−

Figure 3-5. Sign Control, Division

3-76. DECIMAL POINT CONTROL. The B 100/200/300 and any other computer that operates with "fixed point" logic does not process data and keep track of the location of the decimal point. For example, 4725 could mean $47.25, $4.725, $.4725, etc. The value placed on the data must be known to the programmer.

3-77. **ADD.** The format for this instruction is:

ADD 1 M N AAA BBB CCC Conditioned where:

O: Operation Code; 1-machine language, ADD - symbolic

M: Length of A field: 1-11, 12 is denoted by a 0 or blank

N: Length of B field: 1-11, 12 is denoted by a 0 or blank

AAA: Addend address (MSD)

BBB: Augend address (MSD)

CCC: Sum address (MSD)

3-78. This instruction adds the numeric contents of the field starting at AAA to the numeric contents of the field starting at BBB and stores the result in the field starting at CCC. The length of CCC will equal the larger of the M and N variants. Figures 3-6 through 3-9 illustrate the results of several additions.

3-79. Notice, in the examples of "alpha addition" (figures 3-10 and 3-11), that the LSD of the field added makes a difference in whether the answer is positive or negative. This is caused by the computer's logic scan of the B bit position and actual addition of the numeric portions of the character.

OP	M	N	AAA	BBB	CCC
1	3	4	100	200	300

	BEFORE	AFTER
AAA	018+	018+
BBB	7018+	7018+
CCC	018+	7036+
COMP. INDIC.		High

Figure 3-6. Normal Addition

OP	M	N	AAA	BBB	CCC
1	3	5	100	200	300

	BEFORE	AFTER
AAA	072+	072+
BBB	42100—	42100—
CCC	72978	42028—
COMP. INDIC.		Low

Figure 3-7. Addition with Negative B Field

OP	M	N	AAA	BBB	CCC
1	3	3	100	200	300

	BEFORE	AFTER
AAA	909+	909+
BBB	181+	181+
CCC	xxx	090+
COMP. INDIC.	High	High

Figure 3-8. Addition with Carry Lost due to Insufficient Field Length

OP	M	N	AAA	BBB	CCC
1	2	2	100	200	300

	BEFORE	AFTER
AAA	09—	09—
BBB	02—	02—
CCC	xx	11—
COMP. INDIC.	Equal	Low

Figure 3-9. Adding Two Negative Amounts

OP	M	N	AAA	BBB	CCC
1	3	4	100	200	200

	BEFORE	AFTER
AAA	SAD+	SAD+
BBB	GLAD+	GLAD+
CCC	GLAD+	7528+
COMP. INDIC.	Equal	High

Figure 3-10. Adding Alphabetic Characters, Example 1

OP	M	N	AAA	BBB	CCC
1	2	4	100	200	300

	BEFORE	AFTER
AAA	UP—	UP—
BBB	DOWN—	DOWN—
CCC	xxxx	4712—
COMP. INDIC.	Equal	Low

Figure 3-11. Adding Alphabetic Characters, Example 2

3-80. **SUBTRACT.** The format for this instruction is:

SUB 2 M N AAA BBB CCC Conditioned where:

O: Operation Code; 2-machine language, SUB-symbolic

M: Length of A field: 1-11; 12 denoted by a 0 or blank

N: Length of B field: 1-11; 12 denoted by a 0 or blank

AAA: Minuend address (MSD)

BBB: Subtrahend address (MSD)

CCC: Difference address (MSD)

3-81. This instruction subtracts the numeric contents of the field starting at BBB from the numeric contents of the field starting at AAA and stores the numeric result in the field starting at CCC. The length of CCC will be equal to that specified by the larger of the M and N variants. Figures 3-12 through 3-16 illustrate the results of several subtractions.

OP	M	N	AAA	BBB	CCC
2	3	3	100	200	300

	BEFORE	AFTER
AAA	062+	062+
BBB	014+	014+
CCC	xxx	048+
COMP. INDIC.	Equal	High

Figure 3-12. Normal Subtraction

OP	M	N	AAA	BBB	CCC
2	3	3	100	200	300

	BEFORE	AFTER
AAA	029—	029—
BBB	035—	035—
CCC	xxx	006+
COMP. INDIC.	Low	High

Figure 3-13. Subtraction with Negative A and B Fields

OP	M	N	AAA	BBB	CCC
2	3	2	100	200	300

	BEFORE	AFTER
AAA	121+	121+
BBB	71—	71—
CCC	xxx	192+
COMP. INDIC.	Low	High

Figure 3-14. Subtraction with Negative B Field

OP	M	N	AAA	BBB	CCC
2	4	3	100	200	300

	BEFORE	AFTER
AAA	GLAD+	GLAD+
BBB	CAR—	CAR—
CCC	xxxx	7633+
COMP. INDIC.	High	High

Figure 3-15. Alphabetic Subtraction

OP	M	N	AAA	BBB	CCC
2	3	3	100	200	300

	BEFORE	AFTER
AAA	138+	138+
BBB	259+	259+
CCC	xxx	121—
COMP. INDIC.	Low	Low

Figure 3-16. Subtraction, B Greater than A

3-82. **MULTIPLY.** The format for this instruction is:

MUL 3 M N AAA BBB CCC Conditioned where:

O: Operation Code; 3-machine language, MUL-symbolic

M: Length of A field: 1-11; 12 is denoted by a 0 or blank

N: Length of B field: 1-11; 12 is denoted by a 0 or blank

AAA: Multiplicand address (MSD)

BBB: Multiplier address (MSD)

CCC: Product address (MSD)

3-83. This instruction multiplies the numeric contents of the field starting at AAA by the numeric contents of the field starting at BBB and stores the numeric result in the field starting at CCC. The length of the CCC field is the sum of the M and N digits. Figures 3-17 through 3-18 illustrate the result of two multiplications.

3-84. As may be noted in figure 3-19, the result of multiplication appears right justified in the CCC field.

OP	M	N	AAA	BBB	CCC
3	4	3	100	200	300

	BEFORE	AFTER
AAA	3487+	3487+
BBB	921—	921—
CCC	xxxxxxx	3211527—
COMP. INDIC.	Equal	Low

Figure 3-17. Multiplication of Unlike Signs

OP	M	N	AAA	BBB	CCC
3	4	2	100	200	300

	BEFORE	AFTER
AAA	1426—	1426—
BBB	AM—	AM—
CCC	xxxxxx	019964+
COMP. INDIC.	Equal	High

Figure 3-18. Multiplication of Like Signs, Alphabetic Multiplier

OP	M	N	AAA	BBB	CCC
3	4	2	100	200	300

	BEFORE	AFTER
AAA	1324+	1324+
BBB	11+	11+
CCC	329416—	014564+
COMP. INDIC.	Equal	High

Figure 3-19. Multiplication of Like Signs

3-85. **DIVISION.** The format for this instruction is:

DIV 4 M N AAA BBB CCC Conditioned where:

O: Operation Code; 4-machine language, DIV-symbolic

M: Length of A field: 1-11, 12 is denoted by a 0 or blank

N: Length of B field: 1-11; 12 is denoted by a 0 or blank

AAA: Dividend address (MSD)

BBB: Divisor address (MSD)

CCC: Quotient address (MSD)

3-86. This instruction divides the numeric contents of the field starting at AAA by the numeric contents of the field starting at BBB and stores the numeric result in the field starting at CCC. The dividend, AAA, will be set to zero and the remainder stored in AAA,

right justified. The CCC length is determined by the difference between M and N (e.g., CCC will be four characters long when M is nine and N is five).

3-87. The absolute value of the divisor must be greater than the absolute value of the corresponding high-order positions of the dividend; otherwise, the resulting quotient will be zero and the dividend modified. For example, if 75 were divided by 3, the result will be zero since the quotient can not be expressed in one position (length of dividend-length of divisor). However, if 075 were divided by 3, the result would be 25.

3-88. Anytime the M and N variants are equal in a Divide instruction, the unit will halt prior to executing the instruction and will display the operation code on the central processor control console. Figures 3-20 through 3-25 illustrate the results of several divisions.

OP	M	N	AAA	BBB	CCC
4	4	1	100	200	300

	BEFORE	AFTER
AAA	0101+	0002+
BBB	9+	9+
CCC	xxxx	011+
COMP. INDIC.	Low	High

Figure 3-20. Normal Division

OP	M	N	AAA	BBB	CCC
4	5	2	100	200	300

	BEFORE	AFTER
AAA	00187—	00007—
BBB	12—	12—
CCC	xxx	015+
COMP. INDIC.	High	High

Figure 3-21. Division with Negative Dividend and Divisor

OP	M	N	AAA	BBB	CCC
4	5	3	100	200	300

	BEFORE	AFTER
AAA	03920+	00140+
BBB	180—	180—
CCC	xx	21—
COMP. INDIC.	Equal	Low

Figure 3-22. Division with Negative Divisor

OP	M	N	AAA	BBB	CCC
4	4	3	100	200	300

	BEFORE	AFTER
AAA	AR1B+	0928+
BBB	9QD+	9QD+
CCC	x	1+
COMP. INDIC.	High	High

Figure 3-23. Alphabetic Division

OP	M	N	AAA	BBB	CCC
4	4	4	100	200	300

	BEFORE	AFTER
AAA	0452+	0452+
BBB	0012+	0012+
CCC	xxxx	xxxx
COMP. INDIC.	Low	Equal

Figure 3-24. Division where M and N Variants are Equal

OP	M	N	AAA	BBB	CCC
4	5	3	100	200	300

	BEFORE	AFTER
AAA	29451+	xxxxxx
BBB	017+	017+
CCC	xx	00+
COMP. INDIC.	Equal	Equal

Figure 3-25. Division where the Absolute Value of the Divisor is not Greater than Absolute Value of the Corresponding High Order Positions of the Dividend

Control Instructions

3-89. Unlike the previously discussed instructions which use data to provide an end result, the control instructions are used to analyze program operation and to control program routines. There are four basic control instructions, namely:

a. Branch.

b. Compare.

c. Halt.

d. No Operation.

Branching

3-90. There are two types of branching instructions: Branch Conditional and Branch Unconditional. Using the Branch Conditional instruction, the central processor interrogates the comparison indicators and branches (transfers control) to one of three addresses (AAb, BBb, or CCb) as a result of the instruction executed. Branch Unconditional causes the program to branch to the instruction located at the AAA address, regardless of the setting of the comparison indicators. Since the AAb, BBb, and CCb addresses of a branch conditional will always refer to an instruction location, the LSD of each address will be considered to be zero by the central processor, unless it exceeds BCD 11. If the LSD exceeds BCD11, a carry of 1 into the tens position will result.

3-91. **BRANCH CONDITIONAL.** The format for this instruction is:

BRC 6 M N AAb BBb CCb Not Affected

where:

O: Operation Code; 6-machine language, BRC-symbolic

M: 0

N: 0-no interrogation for third transit symbol (or with no sorter)

AAA: Branch address if comparison indicators are low or less then 0 (negative)

BBB: Branch address if comparison indicators are equal or zero

CCC: Branch address if comparison indicators are high, or greater than zero (positive)

3-92. This instruction is identified by the M variant 0. The comparison indicators determine which one of the three addresses the program will branch to. The program will branch to AAb if the comparison indicators are set to low or minus. The program will branch to BBb if the comparison indicators are set to equal or zero. The program will branch to CCb if the comparison indicators are set to high or plus. When a minus zero results from an arithmetic operation, control will be transferred to the BBb address.

3-93. **BRANCH UNCONDITIONAL.** The format for this instruction is:

BRU 6 M N AAb BBb bbb Not Affected

where:

O: Operation Code; 6-machine language, BRU-symbolic

M: 1-unconditional branch

N: 0-no interrogation for third transit symbol (piggyback item), or when no sorter-reader is used

1-interrogate for third transit symbol

AAA: N = 0, branch address on unconditional branch

N = 1, branch address if interrogation shows no third transit symbol (piggyback item)

BBB: N = 0, available to programmer

N = 1, branch address if interrogation detects a third transit symbol (piggyback item)

CCC: Available to programmer

3-94. This instruction is identified by an M variant of 1. With an N variant of 0 or blank, the program will branch automatically to the instruction located at AAb, regardless of the setting of the comparison indicators, prior to the execution of the instruction. An N variant of 1 is used to provide control over double feeding of documents in the B 102/ B 103 Sorter-Reader.

3-95. Due to extremely bad items, the sorter-reader may double feed a document (called a piggyback item). The logic of the sorter, combined with the logic of the central processor, performs a test of the item being read and checked for the presence of piggyback items. The BBb branch address will be taken should the previous Read instruction detect a piggyback item. Control will Branch Unconditionally to the AAb address if a double document has not been detected.

3-96. The branch control instruction can be employed at both the normal exit as well as the Can't Read exit of the sorter-reader instruction. It should be noted that the sorter double document detection feature is always in effect and cannot be programmed out of the Read instruction.

Comparing

3-97. This instruction is used in two ways: controlling and sequencing. Controlling is accomplished by comparing two fields and then branching. The branch will be determined by comparison indicators, usually based on either a comparison or an arithmetic operation. Sequencing permits the programmer to check the sequence of the input data and to arrange the data internally.

3-98. The following types of comparison may be performed by the central processor: alphabetic, zone, and numeric. The selected type of comparison is identified by the M variant. Alphabetic comparison is a comparison of both the numeric and zone bits of every character in the two fields being compared. Zone comparison is a comparison of the zone bits only (A and B); numeric comparison is a comparison of the numeric bits only (8, 4, 2, 1). The N variant designates the length of the AAA and BBB fields, both of which must be the same.

3-99. The three types of comparisons are made for either an equal or unequal condition, branching as a result of the comparison. For example, if the instruction was for an alphabetic comparison with a branch-on-equal designation, the AAA field would be compared to the BBB field and, if the fields were equal, control would immediately branch to the address specified by CCC. If either of the other two conditions (high or low) had been set, control would continue to the instruction immediately following the Compare instruction. Had the instruction specified a branch-on-unequal comparison, control would branch to CCC if the AAA and BBB fields were unequal.

3-100. The collating sequence for the alphabetic comparison is shown in abbreviated form in figure 3-26.

Special Characters		
12 Zone	A-I Alphabetic	A, No B
11 Zone	J-R Alphabetic	B, No A
0 Zone	S-Z Alphabetic	A, B
No Zone	0-9 Numeric	No A, No B

Figure 3-26. Collating Sequence

3-101. The numeric comparison is performed on a binary configuration of the 8, 4, 2, and 1 bits only. The comparison works on a low of zero to a high of 15.

3-102. The zone comparison is performed on the A and B bits of a character only. The sequence is illustrated in figure 3-27.

A bit	**LOW**
B bit	
A and B bit	
No A or B bit	**HIGH**

Figure 3-27. Zone Comparison Collating Sequence

3-103. **COMPARE ALPHABETIC, BRANCH ON EQUAL.** The format for this instruction is:

CAE 5 M N AAA BBB CCb Conditioned where:

O: Operation Code; 5-machine language, CAE-symbolic

M: 0-alpha compare, branch on equal

N: Length of A and B field; 1-11, 12 denoted by a 0 or blank

AAA: Address of field to be compared (MSD)

BBB: Address of field to be compared with (MSD)

CCC: Branch address if field A equal to field B

3-104. This instruction is identified by an M variant of 0. It makes an alphabetic comparison of the field beginning at AAA to the field beginning at BBB (zone bits and numeric bits). The N variant designates the length of both fields (1 -@, 0). If the field contents are equal, branch to CCb; if not, execute the next instruction in sequence. Two examples of the CAE instruction are provided in figures 3-28 and 3-29.

OP	M	N	AAA	BBB	CCC
5	0	5	100	200	xxx

	BEFORE	AFTER
AAA	SMILE+	SMILE+
BBB	FROWN—	FROWN—
CCC	xxx	xxx
COMP. INDIC.		High
No Branch		

Figure 3-28. Alphabetic Comparison for Equal, No Branch on Unequal

OP	M	N	AAA	BBB	CCC
5	0	5	100	200	xxx

	BEFORE	AFTER
AAA	79267+	79267+
BBB	79267+	79267+
CCC	xxx	xxx
COMP. INDIC.		Equal
Branch to instruction at xxx		

Figure 3-29. Alphabetic Comparison for Equal, Branch on Equal

3-105. **COMPARE ZONE, BRANCH ON EQUAL.** The format for this instruction is:

CZE 5 M N AAA BBB CCb Conditioned

This instruction is identified by an M variant of 1. It compares only the zone bits (A and B bits) in the fields beginning at AAA and BBB. The N variant designates the length (1-@, 0) of both fields. If the contents of both fields are equal, branch to CCb; if not, execute the next instruction in sequence. Figures 3-30 and 3-31 illustrate two results of zone comparison for equal.

OP	M	N	AAA	BBB	CCC
5	1	3	100	200	xxx

	BEFORE	AFTER
AAA	EF3	EF3
BBB	A62	A62
CCC	xxx	xxx
COMP. INDIC.		LOW

No Branch

Figure 3-30. Zone Comparison for Equal, No Branch on Unequal

OP	M	N	AAA	BBB	CCC
5	1	3	100	200	xxx

	BEFORE	AFTER
AAA	24A	24A
BBB	79B	79B
CCC	xxx	xxx
COMP. INDIC.		Equal

Branch to instruction at xxx

Figure 3-31. Zone Comparison for Equal, Branch on Equal

3-106. **COMPARE NUMERIC, BRANCH ON EQUAL.** The format for this instruction is:

CNE 5 M N AAA BBB CCb Conditioned

This instruction is identified by an M variant of 2. It compares only the numeric bits (8, 4, 2, 1) of all characters in the field beginning at AAA and BBB. The N variant designates the length of both fields. If the numeric bits of all characters in both fields are equal, branch to CCb; if unequal, execute the next instruction in sequence. Figures 3-32 and 3-33 illustrate the results of numeric comparisons for equal.

OP	M	N	AAA	BBB	CCC
5	2	1	100	200	xxx

	BEFORE	AFTER
AAA	6	6
BBB	F	F
CCC	xxx	xxx
COMP. INDIC.		EQUAL

Branch to instruction at xxx

Figure 3-32. Numeric Comparison for Equal, Branch on Equal

OP	M	N	AAA	BBB	CCC
5	2	1	100	200	xxx

	BEFORE	AFTER
AAA	6	6
BBB	G	G
CCC	xxx	xxx
COMP. INDIC.		Low

No Branch

Figure 3-33. Numeric Comparison for Equal, No Branch on Unequal

3-107. **COMPARE ALPHABETIC, BRANCH ON UNEQUAL.** The format for this instruction is:

CAU 5 M N AAA BBB CCb Conditioned

This instruction is identified by an M variant of 4. It alphabetically compares the contents of the fields beginning at AAA and BBB. The N variant designates the length of both fields. If the fields are not equal, branch to CCb; if equal, execute the next instruction in sequence. Figures 3-34 and 3-35 illustrate the results of two alphabetic comparisons for unequal.

OP	M	N	AAA	BBB	CCC
5	4	2	100	200	xxx

	BEFORE	AFTER
AAA	12+	12+
BBB	12+	12+
CCC	xxx	xxx
COMP. INDIC.		Equal

No Branch

Figure 3-34. Alphabetic Comparison for Unequal, No Branch on Equal

OP	M	N	AAA	BBB	CCC
5	4	2	100	200	xxx

	BEFORE	AFTER
AAA	12+	12+
BBB	17+	17+
CCC	xxx	xxx
COMP. INDIC.		Low

Branch to instruction at xxx

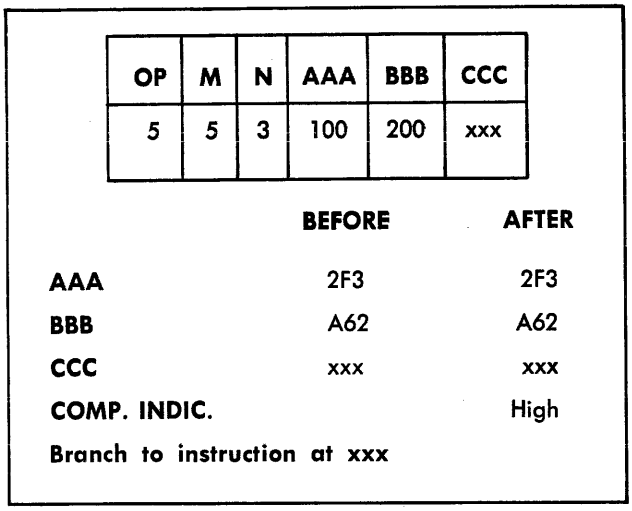
Figure 3-35. Alphabetic Comparison for Unequal, Branch on Unequal

3-108. **COMPARE ZONE, BRANCH ON UNEQUAL.** The format for this instruction is:

CZU 5 M N AAA BBB CCb Conditioned

This instruction is identified by an M variant of 5. It compares only the zone bits (A and B bits) in the fields beginning at AAA and

BBB. The N variant designates the length of both fields (1-@, 0). If the contents of both fields are not equal, branch to CCb; if equal, execute the next instruction in sequence. Two examples of this type of Compare are illustrated in figures 3-36 and 3-37.

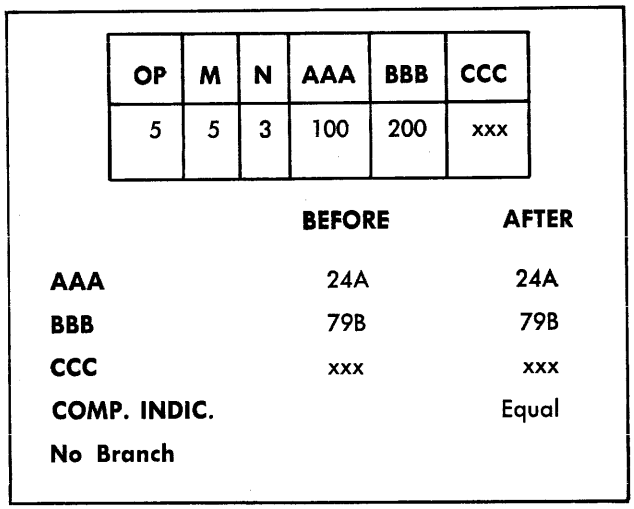


OP	M	N	AAA	BBB	CCC
5	5	3	100	200	xxx

	BEFORE	AFTER
AAA	2F3	2F3
BBB	A62	A62
CCC	xxx	xxx
COMP. INDIC.		High

Branch to instruction at xxx

Figure 3-36. Zone Comparison for Unequal, Branch on Unequal



OP	M	N	AAA	BBB	CCC
5	5	3	100	200	xxx

	BEFORE	AFTER
AAA	24A	24A
BBB	79B	79B
CCC	xxx	xxx
COMP. INDIC.		Equal

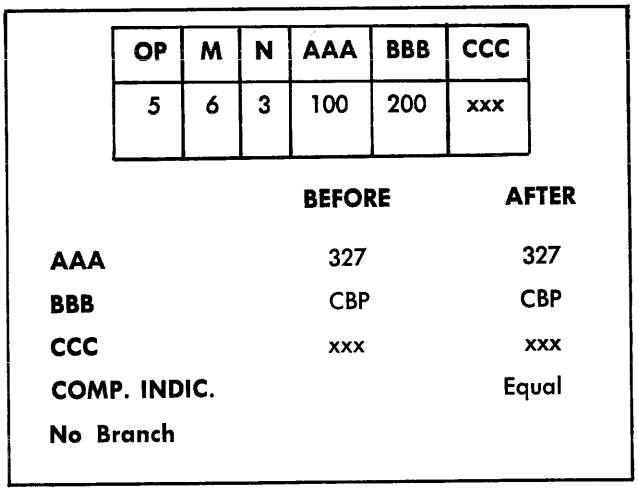
No Branch

Figure 3-37. Zone Comparison for Unequal, No Branch on Equal

3-109. **COMPARE NUMERIC, BRANCH ON UNEQUAL.** The format for this instruction is:

CNU 5 M N AAA BBB CCb Conditioned

This instruction is identified by an M variant of 6. The instruction causes a comparison of the numeric bits (8, 4, 2, 1) in the fields beginning at AAA and BBB. The N variant determines the number of characters to be compared. If the numeric bits are unequal, branch to CCb; if equal, execute the next instruction in sequence. Figures 3-38 and 3-39 illustrate the results of two numeric comparisons for unequal.

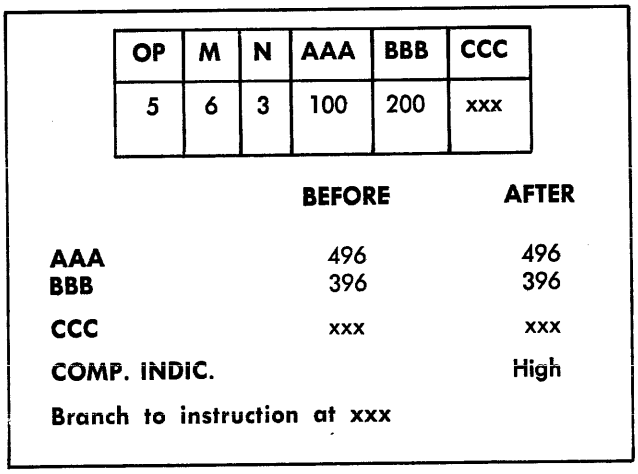


OP	M	N	AAA	BBB	CCC
5	6	3	100	200	xxx

	BEFORE	AFTER
AAA	327	327
BBB	CBP	CBP
CCC	xxx	xxx
COMP. INDIC.		Equal

No Branch

Figure 3-38. Numeric Comparison for Unequal, No Branch on Equal



OP	M	N	AAA	BBB	CCC
5	6	3	100	200	xxx

	BEFORE	AFTER
AAA	496	496
BBB	396	396
CCC	xxx	xxx
COMP. INDIC.		High

Branch to instruction at xxx

Figure 3-39. Numeric Comparison for Unequal, Branch on Unequal

Halt and No Operation

3-110. The Halt and No Operation instructions are used to modify and/or control various routines with a minimum of operator

intervention. By means of the M and N variants in the Halt instruction which are displayed on the central processor control console, the operator may be instructed to change magnetic tapes, change paper forms, or be alerted to any error condition that exists in the input data, etc. The No Operation instruction is normally used as a means of by-passing an instruction. This is done by coding the program so that under certain conditions, a blank or $\overset{+}{0}$ (Op Code for No Operation) is transferred into the Op Code position of another instruction. Assuming its instruction was a BRU, it will now be by-passed and the program will continue in sequence and not branch out. Usually, the first instruction following this modified BRU will set the instruction Op Code back to its original Op Code.

3-111. **HALT.** The format for this instruction is:

HLT 9 M N bbb bbb bbb Not Affected
where:

O: Operation Code; 9-machine language, HLT - symbolic

M: 0-15

N: 0-15

AAA: Available to programmer

BBB: Available to programmer

CCC: Available to programmer

3-112. This instruction halts the entire system after all operations in progress have been executed. The M and N variants may be any binary-coded digit 0-15. The central processor control console will display the Op Code, and the M and N digits of the instruction.

3-113. When used in conjunction with the B 103 Sorter-Reader, any M variant having a 1-bit on will cause a sorter-reader pocket light, as indicated by the N variant, to light while the system is stopped.

3-114. **NO OPERATION.** The format for this instruction is:

NOP b or $\overset{+}{0}$ b b bbb bbb bbb Not Affected
where:

O: Operation Code; b or $\overset{+}{0}$ -machine language, NOP - symbolic

M: Available to programmer

N: Available to programmer

AAA: Available to programmer

BBB: Available to programmer

CCC: Available to programmer

When this instruction is encountered, no action is taken and the program proceeds to the next instruction in sequence.

Editing Instructions

3-115. The editing instructions play an important role in the B 100/B 200/B 300 Series Systems. With the two editing instructions, Transfer and Mask, the programmer is able to accomplish formatting and transferring of data with a minimum amount of effort.

3-116. **TRANSFER.** The format for this instruction is:

TFR 7 M N AAA bbb CCC Not Affected
where:

O: Operation Code; 7-machine language, TFR - symbolic

M: Number of 12-character words: 0-9

N: Number of remaining characters: 1-11; 12 is denoted by a 0 or blank

AAA: Address of information to be transferred (MSD)

BBB: Available to programmer

CCC: Address to which information is to be transferred (MSD)

3-117. This instruction will transfer up to 120 characters of information from the field beginning at AAA to the field beginning at CCC. The number of characters to be transferred is determined by the M and N variants. The M variant (1-9 and 0) designates the number of 12-character fields to be transferred. The N variant (0-9, #, and @) designates the number of characters, 0-11. When M and N are both zero, 120 characters will be transferred. An example of a Transfer instruction is illustrated in figure 3-40.

OP	M	N	AAA	BBB	CCC
7	0	3	100		200

	BEFORE	AFTER
AAA	123+	123+
BBB	xxx	xxx
CCC	xxx	123+
COMP. INDIC.	NOT AFFECTED	

Figure 3-40. Transfer of Data

3-118. **MASK.** The format for this instruction is:

MSK 8 M b AAA BBB CCC Set to Equal

where:

O: Operating Code; 8-machine language, MSK- symbolic

M: Length of AAA: 1-11; 12 is denoted by a 0 or blank

N: Reserved for expansion-must be left blank

AAA: Address of field to be masked (MSD)

BBB: Address of mask (MSD)

CCC: Address of masked field (MSD)

3-119. This instruction transfers the contents of the field beginning at AAA to the field beginning at CCC, masking the information according to the mask in the field beginning at BBB. The M variant (1-9, #, @, and b or 0) determines the length of the AAA field, the maximum length of which is 12 digits. The length of the CCC field is the sum of the number of characters in the data field (AAA) plus the sign, plus the number of the following characters:

a. Dollar ($).

b. Comma (,).

c. Decimal point (.).

A typical mask would be:

$ * * * , b b b , b b b . b b -

3-120. The purpose of this instruction is to insert ($), (,), and (.)'s and enable zero suppression in numeric data. Zero suppression results from substitution of the mask character in place of each non-significant zero of the source (AAA). Should a character with zone bits occur in the source field, only its numeric bits are transferred to the result (CCC). The exception to this is the sign (low order position). An example of zero suppression is illustrated in figure 3-41.

Information	0 0 0 8 4 3 0
Mask	b b , b b b . b b —
Result	8 4 . 3 0 b

Figure 3-41. Zero Suppression

3-121. The first character transferred to the CCC field is the first character of the mask (BBB) except for the following:

a. If the first character of the mask (BBB) is a comma, the first character of result (CCC) will be a zero. This zero cannot be suppressed.

b. If the first source (AAA) character is non-zero and the first mask (BBB) character is not a ($) or (.), the first character of the result (CCC) is the first character of the source field (AAA).

3-122. In regions of non-significant zeros in the source (AAA), the corresponding mask character replaces each zero in the result (CCC). The previous mask character replaces commas in the mask.

3-123. A decimal point in the mask (BBB) or a non-zero digit in the source (AAA) establishes significance. Thereafter, digits are transferred from the source with dollar signs, commas, and decimal points inserted as such from the mask.

3-124. The decimal point position in a mask identifies the end of leading zero suppression. These positions in the mask, located to the right of the decimal point, are available for storing constants or working storage. The characters stored in these positions will not be inserted in the masked field; however, the LSD of the mask will be inserted if the sign is negative. An example of this is illustrated in figure 3-42.

Information	0 0 1 0 7 0 0̄
Mask	b b b . A B C D #
Result	1 . 0 7 0 0 #

Figure 3-42. Masking, Using Mask Position for Storage

3-125. The unit's position of the source field (AAA) is examined for sign control. If the unit's position contains a B bit, the sign character of the mask field (BBB) will be stored following the unit's position of the masked field (CCC). If the units position does not contain a B bit, a blank will be stored following the unit's position of the masked field (CCC). Figures 3-43 and 3-44 illustrate this point. It should also be noted that if leading zero suppression is not desired, zeros may be used in the mask instead of blanks.

Information	0 0 0 8 4 3 0̄
Mask	0 0 , 0 0 0 . b b #
Result	0 0 0 0 8 4 . 3 0 #

Figure 3-43. Masking a Negative Quantity with Sign Control

Information	0 0 0 8 4 3 0+
Mask	0 0 , 0 0 0 . b b —
Result	0 0 0 0 8 4 . 3 0 b

Figure 3-44. Masking a Positive Quantity with Sign Control

3-126. Since a decimal point establishes significance, ".00" will always result when masking a field which contains either zeros or blanks. In addition, if the field contains blanks, the sign character from the mask (BBB) will be printed immediately to the

right of the low order digit of the masked field (CCC) since a blank character contains a B bit, therefore being interpreted as a minus.

3-127. Check protection asterisks can be stored in the masked field (CCC) by use of the Mask instruction. Figure 3-45 illustrates the manner in which this can be accomplished.

Information	0 0 0 8 4 3 0 +
Mask	$ * * * * * . b b —
Result	$ * * * 8 4 . 3 0 b

Figure 3-45. Masking, Asterisks to Left of Significant Digits

3-128. The field to be masked (AAA) must be the same length as the number of characters other than $. , and sign characters in the mask. If a ten-digit field is masked conventionally, the mask will be ten digits long, plus a dollar sign, two commas, a decimal, and a sign character for a total of 15 positions.

Improved Model O Central Processor Instructions

3-129. The instructions listed below comprise the stored program capabilities of all Improved Model 0 Central Processors. To accommodate the added input/output capabilities of the Improved Model 0 Central Processors, additional as well as modified instructions are necessary. These instructions are denoted by an asterisk (*) and described in the paragraphs that follow:

3-130. **HALT (AND BRANCH).** This instruction format is the same as for B 100 and Model 0 Central Processors. The instruction has been modified so that if the 2-bit of the M

variant is on, the system will branch to the address specified by AAb when the system is restarted after the Halt has been executed. Thus, the system will branch to AAb whenever the M variant is equal to 2, 3, 6, 7, B, C, F, etc. Whenever the system halts, with branching to take place upon resuming operation, the address stored in AAb of the Halt instruction will be displayed in the MEMORY ADDRESS register.

3-131. This modification to the Halt instruction does not change the function of the 1-bit of the M variant as applied to systems using the B 102 or B 103 Sorter-Reader. If the 1-bit is also on in the N variant, a sorter-reader pocket light, as indicated by the N variant, will light while the system is stopped.

3-132. **PRINT ON PRINTER.** The format for this instruction is:

PRT A M N AAA BBb bbb Not Affected

where:

O: Operation Code; A-machine language, PRT- symbolic

M: Form spacing after print and unit selection

Select Printer 1	Select Printer 2 (Modular Option)
0-space suppress	4-space suppress
1-single space	5-single space
2-double space	6-double space

*N: Form skipping after print; 1-11, where 0 is "no skip"

AAA: Print-from address (MSD)

*On B 263, B 273, B 283 and B 300 Systems, a blank or any other character containing a B-bit in the N variant can never be used. The system will always branch to the address in CCC.

BBB: Branching address on Page Overflow when N = 0

CCC: Available to programmer

3-133. New variants are added to this instruction in order to control two line printers. The 120 characters of data will be transferred to the buffer of each line printer starting at address AAA. When the buffer is filled, one line of information will be printed. The comparison indicators are not affected by this instruction. The page format, spacing or skipping, is controlled by the M and N variants. Branching to address BBb will occur when a hole in the carriage tape, channel 12, has been sensed by a previous spacing operation (with or without printing).

3-134. Since skipping always takes precedence over spacing and page overflow 12-punches are not sensed during skipping, the BBb branch will not be taken during the execution of any print (or skip) instruction following a paper skip. When page overflow is taken, the paper will not move. On a sync or parity error, the next Print or Skip instruction that designates the printer containing the error will not be executed and the system will stop.

3-135. To use two B 321 Line Printers, the B 324 dual printer module must be installed in one of the line printers. Without this module, the 4-bit has no significance.

3-136. Designation of each printer is switch-set by the operator. When the switch is set to designate one printer as #1 and the other as #2, then the two printers will function independently. If the switch is set to activate both printers for every PRT instruction, commands for either designation will perform the same action on both printers simultaneously. Each printer contains its own buffer and both printers can operate at their rated speed. In order to place the second printer in operation (when using two printers), the first printer must be turned on.

3-137. **SKIP ON PRINTER.** The format for this instruction is:

SKP B M N bbb BBb bbb Not Affected

where:

O: Operation Code; B-machine language, SKP - symbolic

M: Controls form spacing and unit selection

	Select Printer 2
Select Printer 1	(Modular Option)
0-space suppress	4-space suppress
1-single space	5-single space
2-double space	6-double space

*N: Form skipping; 1-11, where 0 is "no skip"

AAA: Available to programmer

BBB: Branch address on Page Overflow when N = 0

CCC: Available to programmer

3-138. New variants are added to this instruction to control the spacing and skipping of two B 321 Line Printers in one system. The instruction is used to space or skip in accordance with the digits in the M and N variants. A branch to address BBb will occur when a punch in the carriage tape channel 12 has been sensed by a previous space operation. The comparison indicators are not affected by the instruction. To use the two line printers, it is mandatory that a B 324 dual printer module be installed in one of the printers. If the module is not installed, the 4-bit will have no significance.

*On B 263, B 273, B 283 and B 300 Systems, a blank or any other character containing a B-bit in the N variant can never be used. The system will always branch to the address in BBB.

3-139. With use of a switch, the operator can designate one printer as #1 and the other printer as #2. In this manner, the printers will function as independent units. However, if the switch is set to activate both printers on every printer instruction, commands for either designation will perform the same action on both printers simultaneously.

3-140. Both printers can operate at their rated speed. However, in order to use the second printer (not necessarily the printer designated as printer #2), the first printer must be turned on.

3-141. **ADDRESS MODIFICATION.** The format for this instruction is:

ADM J b b AAA BBB bbb Not Affected

where:

O: Operation Code; J-machine language, ADM - symbolic

M: Reserved for expansion-must be left blank

N: Reserved for expansion-must be left blank

AAA: The modifier (the quantity, not its address) 0-1199

BBB: Address of the three-character field to be modified (MSD)

CCC: Available to programmer

3-142. This instruction is used to increment one 3-character address, specified by BBB, by the quantity stored in the AAA address of the instruction. The address being incremented can be located anywhere in memory. However, the modified address cannot be relocated in memory by use of the ADM instruction. The quantity (AAA) is not altered when the instruction is executed.

3-143. When an address within an instruction is to be modified, B_1, B_2 (see figure 3-1) would specify the command, and B_3 would specify the address. If B_3 equals 3, the AAA address would be modified. If B_3 equals 6, the BBB address would be modified. If B_3 equals 9, the CCC address would be modified.

3-144. The modifier in AAA has a base-twelve unit's position and must be used in terms of words and characters. If an address is to be incremented by 14 character positions (1 word and 2 characters), AAA of the ADM instruction would be 012. The B 200 Assembler Program will convert total characters (0000-1199) to words and characters (000-99@). Figure 3-46 illustrates two methods of coding the ADM instruction. In the first example, the quantity (AAA) is given in symbolic language (38 characters). In the second example, the quantity is given in machine language (32 - meaning - three words and two characters).

NOTE

When coding the quantity (AAA) in machine language, on B 263, B 273, B 283, and B 300 Systems, always fill out the tens and hundreds positions with zeros when not required for word representation.

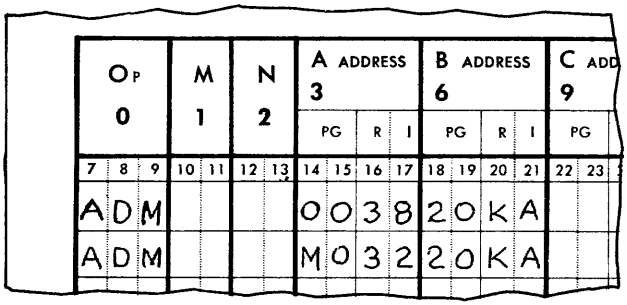
Illustrated below these two examples is the manner in which both ADM instructions would appear in the program listing.

3-145. One modifying command must be executed for each address modified; therefore, three modification instructions are required to modify all three addresses of one instruction.

NOTE

The quantity added to an address to modify it is placed in the modifying (ADM) command in character positions AA - i.e., this AAA is not an address, but a quantity expressed in machine language. Additions are always add absolute.

3-146. The instruction automatically modifies three characters: the first and second characters of the modifier are base 10 while the third character is base 12. Zone bits over the units position are unmodified. Zone bits over the tens position are changed if the address incrementation is from one 4.8K module to another.



O M N AAA BBB CCC
J 032 K03

Figure 3-46. Coding ADM Instruction

3-147. If modification creates an address greater than the maximum of the processor, it is translated as Mod 4800, (Mod 9600 on "double memory" systems or Mod 19200 on 19.2K memory systems) i.e., end-around-carry-over occurs. The comparison indicators are not affected by this command.

3-148. **TRANSFER ZONE.** The format for this instruction is:

TFZ P M N AAA bbb CCC Not Affected where:

O: Operation Code; P-machine language, TFZ - symbolic

M: Number of 12-character fields (0-9)

N: Number of remaining characters (0-11)

AAA: Address of information to be transferred (MSD)

BBB: Available to programmer

CCC: Address to which information is to be transferred (MSD)

3-149. This instruction transfers the zones (A and B bits) of (12 M + N) characters of information from address AAA to address CCC. The AAA characters are not changed, and the digits of the CCC field are not changed.

3-150. A zero in M or N denotes a field length of zero. When M and N are both equal to zero, the zone bits of 120 characters are transferred. Transfer starts with the MSD of the field. The comparison indicators are not affected by this instruction.

3-151. **PAPER TAPE WRITE.** The format for this instruction is:

PWR E M N AAA BBb CCb Not Affected where:

O: Operation Code; E-machine language, PWR - symbolic

M: 1 - punch all holes (tape feed) for each character position

2 - punch until a designated control code on the punch is detected, or 80 characters are punched, whichever occurs first.

N: Reserved for expansion - must be left blank

AAA: Transfer-from address (MSD)

BBB: Branch address on End-of-Paper detected during the preceding Paper Tape Write operation

CCC: Branch on Not-Ready

3-152. This instruction will load the output buffer with 80 characters. The contents of the output buffer are punched, a character at a time, until a designated control code is detected or the buffer is empty. The comparison indicators are not affected by this instruction.

3-153. After the output buffer is loaded, the operation is independent of the processor. Should an End-of-Paper condition occur during a Paper Tape Write operation, the operation continues in the normal manner. The control codes are set up by the operator using pushbutton switches located on the paper tape punch. Branch on Not-Ready takes precedence over branch on End-of-Tape.

3-154. **PAPER TAPE READ.** The format for this instruction is:

PRD F M N AAb BBb CCC Not Affected where:

O: Operation Code; F-machine language, PRD - symbolic

M: 1 - load 80 characters (maximum) or until a designated control code is detected (buffered mode)

2 - load to a designated control code or until end of memory is reached (unbuffered mode)

N: 1 - unit 1
2 - unit 2

AAA: Branch address if a parity error is detected during the transfer of information into memory

BBB: Branching address if End-of-Tape was detected during preceding operation

CCC: Store address (MSD)

3-155. When M equals 1, this instruction loads the contents of the designated input buffer (N) to memory starting at CCC, and reloads the input buffer. The buffer is not cleared between buffer reads. For example, when reading variable length records, if an 80-character record is read and then a 60-character record is read, the remaining 20 characters will still be in the buffer. If a parity error was detected during the preceding Paper Tape Read operation, branch to AAA after loading the erroneous buffer contents into memory. The buffer is then left empty.

3-156. When M equals 2, read directly into memory (unbuffered) until designated control code is detected or until the last location in memory is filled. If a parity error is detected during this Read command, branch to AAA after the read is completed.

3-157. The comparison indicators are not affected by this instruction. When M equals 1, the buffer load is independent of the processor after the contents of the input buffer are loaded into the processor memory. The first buffered Read command enters the first record in memory (through the designated buffer) and loads the buffer with the next record.

3-158. Detection of End-of-Tape during a Read operation stops the tape and terminates the operation. Parity error is reset by initiation of the next Read, Space, Backspace, or Rewind. Branching on parity error takes precedence over branch on End-of-Tape. If both a parity error and End-of-Tape occur during the reading of a record, part of the record will not be in memory.

3-159. Paper Tape programs can be loaded by pressing the LOAD switch if the paper tape reader is connected to the central processor as paper tape reader number 1. The operation is terminated by end-of-memory or by a stop character. Paper tape programs must consist of a continuous information stream of 4800, 9600, or less characters, NOT 60 program characters, 20 "unused" characters, 60 program characters, etc., as in auto-load punched cards. Do not intermix buffered and unbuffered Paper Tape Read commands.

3-160. **PAPER TAPE SPACE FORWARD.** The format for this instruction is:

PSF F M N bbb BBb bbb Not Affected where:

O: Operation Code; F-machine language, PSF - symbolic

M: 4 - space (forward motion)

N: 1 - unit 1
2 - unit 2

AAA: Available to programmer

BBB: Branching address if End-of-Tape was detected during preceding forward motion operation

CCC: Available to programmer

3-161. This instruction will space the tape to the next operator-designated control code on the unit specified by the N variant. After the operation is initiated, it proceeds independently of the central processor. The detection of an End-of-Tape during a space operation will stop the tape, terminate the operation, and branch to BBb. Initiation of a Space instruction clears the associated buffer which prevents any previously loaded information from being read into memory. The comparison indicators are not affected by this instruction.

3-162. **PAPER TAPE BACKSPACE.** The format for this instruction is:

PSB F M N bbb bbb CCb Not Affected where:

O: Operation Code; F-machine language, PSB - symbolic

M: & - space (backward motion - internal code = 01 1100)

N: 1 - unit 1
2 - unit 2

AAA: Available to programmer

BBB: Available to programmer

CCC: Branch address if Beginning-of-Tape was detected during a preceding Paper Tape Backspace operation (M = 12).

3-163. This instruction will backspace the tape to the next operator-designated control code on the unit specified by the N variant. Once the operation is initiated, it proceeds independently of the central processor.

3-164. When M equals 12, detection of Beginning-of-Tape during a backspace operation will stop the tape, terminate the operation, and branch to CCb. Initiation of the Backspace instruction clears the associated buffer which prevents any previously loaded information from being read into memory. The comparison indicators are not affected by this instruction.

3-165. **PAPER TAPE REWIND.** The format for this instruction is:

PRW F M N bbb BBb CCb Not Affected where:

O: Operation Code; F-machine language, PRW - symbolic

M: 8 - rewind

N: 1 - unit 1
2 - unit 2

AAA: Available to programmer

BBB: Branch address on Not- Ready

CCC: Branch address if Beginning-of-Tape was detected during a preceding operation.

3-166. This instruction will rewind the paper tape on the reader unit specified by the N variant. After the read operation is initiated, it proceeds independently of the central processor. The comparison indicators are not affected by this instruction.

3-167. The rewind operation is terminated if a Beginning-of-Tape condition exists at the time the command is executed and control branches to CCb. A Not-Ready condition causes control to branch to BBb. Branch on Not-Ready takes precedence over branch on Beginning-of-Tape. The initiation of a rewind command clears the associated buffer which prevents any previously loaded information from being read into memory. The paper tape punch cannot be rewound programmatically.

B 263/B 275 and B 283 Central Processor Instructions

3-168. The stored program for B 263, B 273, B 275 and B 283 Central Processors is comprised of the instructions listed below. The new and modified instructions used only in B 263/B 273/B 283 Central Processors are denoted by an asterisk (*) and described in the paragraphs that follow.

NOTE

For TRANSFER and TRANSFER ZONE: When the 132 print position feature is used, see paragraphs 3-229 through 3-332 (page 3-45).

3-169. **MASK.** The format for this instruction is:

MSK 8 M N AAA BBB CCC Set to Equal where:

O: Operation Code; 8-machine language, MSK - symbolic

M: Length of AAA; 1-11, 12 is denoted by a 0 or blank

N: 0 - standard mask

1 - inverted mask
Any character containing the appropriate bit will cause the inverted alphanumeric mask.

2 - alphanumeric mask
Any character containing the appropriate bit will cause the inverted alphanumeric mask.

AAA: Address of field to be masked (MSD)

BBB: Address of mask (MSD)

CCC: Address of masked field (MSD)

3-170. This instruction has been modified by adding new variants in order to perform special masking. The instruction transfers the contents of address AAA to address CCC, masking the information according to the mask in BBB. The length of the AAA field is determined by the M variant. The length of the CCC field is the sum of the M variant (plus one for the sign when N equals 0 or 1) and the number of insert characters in the mask. There are three types of masks as determined by the N variant: fiscal-standard, fiscal-inverted, and alphanumeric.

Fiscal-Standard: N = 0.

3-171. The purpose of this mask is to insert ($), (,), and (.)'s, and to permit leading zero suppression in numeric data. Zone bits occurring in the source field (AAA) will not be transferred to the result field (CCC).

a. The first character (MSD) of the mask field (BBB) is the first character transferred to the result field (CCC) if it is a dollar sign ($) or a decimal point (.).

b. In regions of non-significant zeros in the source field (AAA), the corresponding mask character replaces each zero in the result field (CCC), except if the corresponding mask character is a comma (,). In this case, the previous mask character replaces the non-significant zero in the result field.

c. A decimal point in the mask field, or a non-zero digit in the source field, establishes significance. Thereafter, digits are transferred from the source with ($), (,), and (.) characters inserted, as such, from the mask.

3-172. Characters in the mask, other than ($), (,), and (.)'s, can be alphanumeric characters. They will be transferred to the result field as described above. The comparison indicators are set to equal (zero) by this instruction.

3-173. Maximum length of the AAA field is 12 characters. Maximum length of the BBB field and CCC field is 24 characters. Normal length of an edited fiscal field, when AAA equals 12, is 18 digits in the CCC field. For example, $X,XXX,XXX,XXX.XXb (b - if negative). Characters are transferred from left to right.

Fiscal - Inverted: N = 1.

3-174. The conditions stated for fiscal-standard (N = 0) apply to fiscal-inverted (N = 1) except that a decimal point is treated functionally as a comma and a comma is treated functionally as a decimal point. Figure 3-47 illustrates this difference.

Alphanumeric Mask: (N = 2).

3-175. Normal data movement proceeds from the AAA field to the CCC field when an ampersand is contained in the corresponding BBB field. Any other character in the BBB field is inserted in the CCC field. Insertions can be any of 63 characters, including the "invalid character" but excluding the ampersand. Maximum field lengths are:

a. AAA - 12 characters.

b. BBB - 24 characters.

c. CCC - 24 characters.

FISCAL-STANDARD (N=0)

	+
INFORMATION	0 0 0 6 1 2 3 4 5
MASK	$ * , * * * , * * * . b b –
RESULT	$ * * * * 6 , 1 2 3 . 4 5 b

FISCAL-INVERTED (N=1)

	+
INFORMATION	0 0 0 6 1 2 3 4 5
MASK	$ * . * * * . * * * , b b –
RESULT	$ * * * * 6 . 1 2 3 , 4 5 b

Figure 3-47. Differences of Fiscal—Standard and Fiscal—Inverted Mask

3-176. The alphanumeric mask effects transfer of a field with insertions from a mask. When a character is inserted from the mask (BBB), no transfer from the source field (AAA) to the result field (CCC) takes place. Transfer of data from the source field to the result field takes place only as a result of an ampersand in the mask field. For example, if a social security number was to be printed with the appropriate spacing, the mask would be; &&&b&&b&&&& where b is blank. If dashes were to be inserted in place of blank spaces, the mask would appear as; &&&-&&-&&&&. Multiple insertions between characters may take place. If the social security number was to be printed as XXX - XX - XXXX, a mask of &&&b-b&&b-b&&&& would be used.

3-177. Alphanumeric information may be masked. The A and B bits will be transferred from the AAA field to the CCC field. No sign testing of the AAA field, or insertion of a sign character (or blank), will take place in the CCC field. If there are less & (ampersands) in the mask than data characters in length, masking will take place for 24 character positions (maximum length) thereby possibly replacing instructions or data.

3-178. **MAGNETIC TAPE MEMORY WRITE.** The format for this instruction is:

MWR D M N AAA BBb CCb Set to Equal where:

O: Operation Code; D-machine language, MWR - symbolic

M: 8 - Memory dump

N: Tape unit designate (1-6)

AAA: Transfer-from address (MSD)

BBB: Branch address on End-of-Tape

CCC: Branch address on write error

3-179. This instruction is identified by an M variant of 8. The instruction writes one tape record starting at address AAA onto the tape unit specified by the N variant. A tape record is defined as the information between address AAA and the end of memory. A group mark may be written. The comparison indicators are set to zero (equal) on this command.

NOTE

It should be pointed out that the MWR instruction is in BCL even parity. Although a group mark will not terminate the writing of a record, if there are group marks in the data written, they will stop the reading of a record when read back with the TRD instruction. This results in an erroneous short read.

3-180. With the exception of the tape mark, a minimum of seven characters must be written for all records. The Magnetic Tape Write instruction (TWR) is used to write a tape mark record.

3-181. If the end-of-tape reflective strip is sensed during the MWR instruction, a branch-to-address BBb will occur at the completion of the instruction. If an error is detected in the written information, a branch-to-address CCb will occur at the completion of the instruction. A branch-on-write-error takes precedence over a branch-on-end-of-tape. Write checking is accomplished with a dual-gap head.

The character question mark (?) will be translated to the BCL character representing greater than and equal to during output to tape.

3-182. **MAGNETIC TAPE WRITE BINARY.** The format for this instruction is:

BWR D M N AAA BBb CCb Set to Equal where:

O: Operation Code; D-machine language, BWR - symbolic

M: 10 - Binary Write (#)

N: Tape unit designation (1-6)

AAA: Transfer-from address (MSD)

BBB: Branch address on End-of-Tape

CCC: Branch address on write error

3-183. This instruction is identified by an M variant of 10. The instruction writes one tape record starting at address AAA onto the tape unit specified by the N variant. A tape record is defined as the information between address AAA and the end of memory. Tapes are written with odd vertical parity. Any character may be written and all information is written in internal BCL code. The comparison indicators are set to zero (equal) on this instruction.

3-184. A minimum of seven characters must be written for all valid records with the exception of a Tape Mark record which is a single character record. The Magnetic Tape Write instruction is used to write a Tape Mark record. If the end-of-tape reflective strip is sensed during the execution of the BWR instruction, a branch-to-address BBb will occur at the completion of the instruction. If an error is detected in the written information, a branch-to-address CCb will occur. The write error branch takes precedence over the end-of-tape branch. Write checking is accomplished with a dual-gap head. The character, question mark (?), will be written on tape as a question mark.

3-185. **MAGNETIC TAPE READ BINARY.** The format for this instruction is:

BRD D M N AAb BBb CCC Set to Equal where:

O: Operation Code; D-machine language, BRD - symbolic

M: 9 - Binary Read

N: Tape unit designation (1-6)

AAA: Branch address on read error

BBB: Branch address on End-of-File (tape mark)

CCC: Store address (MSD)

3-186. This instruction is identified by an M variant of 9. The instruction reads one record from the tape unit specified by the N variant and stores the record in memory, beginning at location CCC. The record can be of variable length, from seven characters to memory capacity. The inter-record gap on tape causes the operation to terminate. A group mark is not stored in memory. The comparison indicators are set to zero (equal) on this instruction.

3-187. If a vertical parity (odd) or longitudinal parity error occurs during the read, a branch to address AAb will occur. If a Tape Mark record is read, a branch to address BBb will occur after the read is completed. The end-of-file branch takes precedence over the read error branch. When reading fills memory (4800 or 9600 positions), the next character that is read is stored at memory location 000. Each following character is stored in a successively higher address. Characters which produce parity errors during input will be translated to the question mark code in memory.

3-188. **PRINT ON SUPERVISORY PRINTER.** The format for this instruction is:

SPO Q M b AAA bbb bbb Not Affected where:

O: Operation Code; Q-machine language, SPO - symbolic

M: 1 - print

N: Reserved for expansion - must be left blank

AAA: Source address (MSD)

BBB: Available to programmer

CCC: Available to programmer

3-189. This instruction will print on the supervisory printer the information stored in memory starting at the address specified by AAA. It will continue printing until a group mark is encountered. Carriage return and line feed take place at the end of each line of print (72 characters) and when the group mark is encountered. Upon detection of the group mark, the execution of the instruction is complete and the next instruction in sequence is executed. The group mark is not printed. If the printer is not ready when addressed by the processor, the system will halt.

3-190. **SUPERVISORY PRINTER READ.** The format for this instruction is:

SPR Q M N bbb BBb CCC Not Affected where:

O: Operation Code; Q-machine language; SPR - symbolic

M: 2 - read

N: Reserved for expansion - must be left blank

AAA: Available to programmer

BBB: Branch on input message

CCC: Destination address (MSD)

3-191. The operation sequence for this instruction is initiated in the following manner:

a. The operator presses the INPUT REQUEST key on the printer.

b. When the processor reaches a Supervisory Printer Read instruction, the READY indicator on the printer is turned on.

c. The operator enters the input message which is stored in memory starting at address CCC.

d. The operator terminates the message by pressing the END OF INPUT key (non-printing). A group mark is stored in memory and the READY indicator will go out. Carriage return-line feed takes place when the END OF MESSAGE key is pressed.

e. Control of the instruction sequence branches to the BBb address.

3-192. If the operator does not press the INPUT REQUEST key, or if the printer is not ready, the Supervisory Printer Read instruction acts as a No Op and control continues in sequence.

3-193. In the event of an operator input error (i.e., keystroke error), the operator presses the ERROR key. Program control will then continue in sequence. The operator may type comments without entering them into the processor by pressing the LOCAL key.

3-194. **PRINT ON LISTER.** The format for this instruction is:

PRL A M N AAA BBb CCC Not Affected where:

O: Operation Code; A-machine language, PRL - symbolic

Stop on Print Error

M: 0 - print master on lister #2
1 - print master on lister #1
15 - suppress print on master

Branch on Print Error

7 - print master on lister #2
2 - print master on lister #1
14 - suppress print on master

With M = 1

*N: 2-6, 7-11, 0 (for 12) - designates detail tape

1 - not admissable
15 - suppress detail designation

*On B 263, B 273, B 275 and B 283 Systems, a blank or any other character containing a B-bit in the N variant can never be used. A branch to the address specified by CCC will always be taken.

With M = 2

1-6, 8-11, 0 (for 12) - designates detail tape

7 - not admissable
15 - suppress detail designation

AAA: Transfer-from address (MSD)

BBB: Branch address on Out-of-Paper

CCC: When M = 7, 2, or 14 - branch address on print error
When M = 0, 1, or 15 - available to programmer

3-195. The function of this instruction is the same as discussed in paragraphs 3-32 through 3-34 except for the addition of a print error branch. This branch is affected through the use of an M variant of 7, 2, or 14 and the CCC address.

3-196. When a multiple tape lister receives a print instruction, after a Print Check error has occurred but is not cleared, the instruction is executed and the information is printed, thus clearing the error. Control will then branch to CCb. Branch on print error takes precedence over branch on Out-of-Paper. The comparison indicators are not affected by this instruction.

3-197. Printing of a master tape is also controlled by the M variants of 7 (print master on lister #1), 2 (print master on lister #2), and 14 (suppress print on master). If these three variants are not used to affect the print error branch, the CCC address of the instruction may be used by the programmer. It should be noted at this time that the Skip on Lister instruction does not halt on a print error.

3-198. **CARD READ**. The format for this instruction is:

CRD # M N AAb BBb CCC Set to Equal where:

O: Operation Code; #-machine language; CRD - symbolic

M: 0 - halt on not ready; wait for reloading on busy

1 - branch on busy or not ready (any character containing a 1-bit will cause branching)

N: Designates input buffer
1 - buffer 1
2 - buffer 2

AAA: When M = 0 - available to programmer
When M = 1 - branch address on busy or not ready (MSD)

BBB: Branching address on End-of-File (MSD)

CCC: Store address (MSD)

3-199. The function of this instruction is the same as described in paragraph 3-13 except for the addition of M variants. The function of this variant is as follows:

a. When M = 0:

(1) If the buffer is full, the contents of the buffer are transferred to memory starting at the address specified by CCC.

(2) If the card reader is busy, wait until the card has been read into the buffer, then transfer the buffer contents to memory starting at the address specified by CCC.

(3) If the card reader is not ready, halt.

b. When M = 1:

(1) If the buffer is full, the contents of the buffer are transferred to memory starting at the address specified by CCC.

(2) If the card reader is busy or not ready, branch to the address specified by AAA.

3-200. **CARD PUNCH.** The format for this instruction is:

PCH @ M b AAA bbb bbb Not Affected where:

O: Operation Code; @-machine language, PCH - symbolic

M: 0 - punch BCL code

1 - punch Bull code
Any character containing the appropriate bits will cause BULL or ICT punching

2 - punch ICT code
Any character containing the appropriate bits will cause BULL or ICT punching

N: Reserved for expansion - must be left blank

AAA: Transfer-from address (MSD)

BBB: Available to programmer

CCC: Available to programmer

3-201. The function of this instruction is the same as described in paragraph 3-18 except that it includes BULL and ICT capabilities. These capabilities are provided through use of M variants of 0, 1, and 2. An M variant of 0 permits punching of BCL codes, an M variant of 1 permits punching of BULL Codes, and an M variant of 2 permits punching of ICT codes. All other areas of the instruction are the same as described in paragraph 3-18.

3-202. **DISK FILE WRITE.** The format for this instruction is:

DFW K M N AAA BBB CCb Not Affected where:

O: Operation Code; K-machine language, DFW - symbolic

M: 0 - write

N: Number of segments; 1-9, 0 (0 = 10 segments)

AAA: Disk file address word (MSD)

BBB: Memory location containing data to be written (MSD)

CCC: Branch on designated storage unit not ready or beyond limits of disk file

3-203. This instruction is identified by an M variant of 0. The instruction transfers the contents of memory starting at BBB to the disk file. The disk file location is specified by a seven digit address which is stored in memory beginning at the address specified by AAA. The number of disk file segments to be written is specified by the N variant. From one to 10 segments may be written using N variants of 0-9, where 0 indicates 10 segments. An error check code is generated and written with each segment of data during the write operation. The comparison indicators are not affected by this instruction.

3-204. If the designated storage unit is not ready or the address specified is beyond limits of the disk file, the program will branch to the instruction specified by the CCb address. If a Disk File Write instruction is initiated without prior issuance of a Disk File Interrogate instruction (refer to paragraph 3-211), and the control unit is in a busy or not ready status, the processor will halt. A disk file address parity error will terminate

the operation, set an address parity error indicator, and continue the program in sequence without executing the instruction. An attempt to write on a locked-out storage unit or disk, or an invalid address, terminates the operation but does not halt the program. The write lockout indicator will be set.

3-205. **DISK FILE READ.** The format for this instruction is:

DFR K M N AAA BBB CCb Not Affected where:

O: Operation Code; K-machine language, DFR - symbolic

M: 2 - read

N: Number of data segments; 1-9, 0 (0 = 10 segments)

AAA: Disk file addressing word (MSD)

BBB: Memory location to receive data (MSD)

CCC: Branch on designated storage unit not ready or beyond limits of disk file

3-206. This instruction is identified by an M variant of 2. The instruction transfers the contents of a disk file, beginning with the data segment specified by the seven-digit disk file address, to core storage. The disk file address is stored in memory beginning at the address specified by AAA. The data from the disk file is transferred to memory beginning at the address specified by BBB. The number of segments to be read is specified by the N variant. From one to 10 segments may be read using the N variants of 0-9, where 0 indicates 10 segments. During the read operation, the error check code is regenerated and compared to the error check code written with the record. If the comparison is unequal, a read error indicator is set. The comparison indicators are not affected by this instruction.

3-207. If the designated storage unit is not ready or the address specified is beyond the limits of the disk file, the program will branch to the instruction specified by the CCb address. If a read operation is initiated without prior issuance of a Disk File Interrogate instruction, and the control unit is in a busy or not ready status, the processor will halt. A disk file address parity error will terminate the operation, set an address parity error indicator, and continue the program in sequence without executing the instruction.

3-208. **DISK FILE CHECK.** The format for this instruction is:

DFC K M N AAA bbb CCb Not Affected where:

O: Operation Code; K-machine language, DFC - symbolic

M: 4 - read check

N: Number of data segments; 1-9, 0 (0 = 10 segments)

AAA: Disk file addressing word (MSD)

BBB: Available to programmer

CCC: Branch on designated storage unit not ready or beyond limits of disk file

3-209. This instruction is identified by an M variant of 4. The instruction reads the record, regenerates the error check code, and compares it with the check code written with the record. No information is transferred to memory and the program will continue in sequence as soon as the operation is initiated. If the check code comparison is unequal, a check code indicator is set. The AAA address specifies the memory address of the disk file address to be used. The BBB portion of the instruction is not used and is available to the programmer. The comparison indicators are not affected by this instruction.

3-210. If the storage unit is not ready or the address specified is beyond the limits of the disk file, the program will branch to the instruction specified by the CCb address. If a Disk File Check instruction is initiated without prior issuance of a Disk File Interrogate instruction, and the control unit is in a busy or not ready status, the processor will halt. A disk file address parity error will terminate the operation, set an address parity error indicator, and continue the program in sequence without executing the instruction.

3-211. **DISK FILE INTERROGATE.** The format for this instruction is:

DFI K M b AAb BBb CCb Not Affected where:

O: Operation Code; K-machine language, DFI - symbolic

M: 8 - interrogate

N: Reserved for expansion - must be left blank

AAA: Branch on disk file control unit busy

BBB: Branch on error (address transfer error or read error)

CCC: Branch on write lockout or attempt to address a nonexistent disk, or an attempt to address beyond the maximum possible storage unit address

3-212. This instruction is identified by an M variant of 8. The instruction determines which of the three addresses, AAA, BBB, or CCC, the program will branch to in the following order of preference:

a. To AAA if the disk file control unit is busy or not ready.

b. To BBB if the address parity or read error indicator is on.

c. To CCC if write lockout occurs, addressing a nonexistent disk, or addressing beyond the maximum possible storage unit address.

3-213. The comparison indicators are not affected when the branch is taken.

3-214. **DATA COMMUNICATION WRITE.** The format for this instruction is:

DCW L M N AAA BBb CCb Not Affected where:

O: Operation Code; L-machine language, DCW- symbolic

M: 4 - write inquiry

N: Designates terminal unit (1-15)

AAA: Transfer address (MSD)

BBB: Branch on busy or "input ready"

CCC: Available to programmer

3-215. This instruction is identified by an M variant of 4. The execution of this instruction transfers the data beginning at memory location AAA to the terminal unit buffer designated by the N variant. Data transfer continues until either the buffer is full or until the first group mark is encountered in memory. The comparison indicators are not affected by this command. If the designated terminal unit is busy or "input ready", the program will branch to the instruction specified by the BBb address.

3-216. **DATA COMMUNICATION READ.** The format for this instruction is:

DCR L M N AAb BBb CCC Not Affected where:

O: Operation Code; L-machine language, DCR - symbolic

M: 2 - read inquiry

N: Designates terminal unit number (1-15)

AAA: Available to programmer

BBB: Branch on busy or "output ready"

CCC: Store address (MSD)

3-217. This instruction is identified by an M variant of 2. Execution of this instruction transfers the contents of the terminal unit buffer, designated by the N variant, to memory beginning at the location specified by CCC. Data transfer continues until either the buffer is empty or the end-of-message character in the inquiry is detected. The comparison indicators are not affected by this instruction.

3-218. If the designated terminal unit is busy or "output ready", the program will branch to the instruction specified by the BBb address.

3-219. **DATA COMMUNICATION INTERROGATE.** The format for this instruction is:

DCI L M N AAb BBB CCC Not Affected

where:

O: Operation Code; L-machine language, DCI - symbolic

M: 1 - interrogate inquiry ready

N: Designated terminal unit number (1-15) Inquiry control unit designated terminal number (0)

AAA: Branch on "input ready"

BBB: Terminal unit number store address

CCC: Branch on "output ready"

3-220. This instruction is identified by an M variant of 1. The execution of this instruction causes the data communication control unit scanner to stop at the terminal unit designated by the N variant (1-15) and interrogate its status. If the designated terminal unit is "input ready", the program will branch to the instruction specified by the AAb address. If the designated terminal unit is idle, busy, or not ready, the program continues in sequence. If the designated terminal unit is not ready, an ampersand (&) character is stored in the memory address specified by BBB, and the program continues in sequence.

3-221. If the N variant is 0, the control unit scans each terminal in sequence beginning with terminal #1 and stops at the first one which is ready. The comparison indicators are not affected by this instruction.

B 300 Central Processor Instructions

3-222. The stored program for the B 300 Central Processor is comprised of the instructions listed below. The new and modified or expanded instructions used in the B 300 Central Processor are denoted by an asterisk (*) and described in the paragraphs that follow:

3-223. **TRANSFER AND BRANCH.** The format for this instruction is:

O M N AAA BBb CCC Not Affected

where:

O: Operation Code; 7 (or P) - machine language, TCB (Transfer character) or TZB (Transfer zone)

M: Variant; Number of 12-character words; (0-9) B bit with 0-9 for controlled branching

M = + (A bit) and N = 1-11 Transfer 120 + N characters

M = + (A bit) and N = 0 or blank transfer 132 characters

N: Variant; 0-11, number of remaining characters

AAA: Address of information to be transferred (MSD)

BBB: Branch address if B bit of M variant is on

CCC: Address to which information is to be transferred (MSD)

3-224. This instruction has been modified by adding new variants in order to transfer up to 132 characters (or zones of characters) or information from the field beginning at AAA to the field beginning at CCC. The number of characters (or zones) is determined by the M and N variants.

3-225. When the M variant B bit is on, program control branches to the BBB address following the completion of the specified transfer. When the M variant B bit is off, the BBB address is available to the programmer.

3-226. This command provides the facility to perform a dual function by a single instruction. Functionally, it will move data from one area of memory to another and also direct a change of sequence in instruction execution. The comparison indicators are not affected by this command.

3-227. In order to conserve memory, programs are often structured so that a function common to many areas of the program can be shared (often called routines of subroutines). In order to use such a function on a sequential system, it is necessary to: (1) set the exit of the routine to return to the originating point and (2) transfer control to the routine. This dual function, formerly requiring two instructions, can be accomplished through this single Transfer and Branch instruction.

3-228. The Transfer and Branch feature functions with both the TRANSFER CHARACTER (TCB) and TRANSFER ZONE (TZB) instructions to provide program controlled branching following a specified transfer.

3-229. **TRANSFER.** The format for this instruction is:

TFR 7 M N AAA bbb CCC Not Affected where:

O: Operation Code; 7-machine language, TFR-symbolic

M: Number of 12-character words: 0-9

M = + (A bit) and N = 1-11 Transfer 120 + N characters

M = + (A bit) and N = 0 or blank transfer 132 characters

N: Number of remaining characters: 1-11; 12 is denoted by a 0

AAA: Address of information to be transferred (MSD)

BBB: Available to programmer

CCC: Address to which information is to be transferred (MSD)

3-230. This instruction has been modified by adding new variants in order to transfer up to 132 characters or information from the field beginning at AAA to the field beginning at CCC. The number of characters is determined by the M and N variants.

3-231. **TRANSFER ZONE.** The format for this instruction is:

TFZ P M N AAA bbb CCC Not Affected where:

O: Operation Code; P-machine language, TFZ - symbolic

M: Number of 12-character fields (0-9)

M + (A bit) and N = 1-11 Transfer 120 + N zones of characters

M = + (A bit) and N = O or blank transfer 132 zones of characters

N: Number of remaining characters (0-11)

AAA: Address of information to be transferred (MSD)

BBB: Available to programmer

CCC: Address to which information is to be transferred (MSD)

3-232. This instruction transfers the zones (A and B bits) of (12 M + N) characters of information from address AAA to address CCC. The AAA characters are not changed, and the digits of the CCC field are not changed.

3-233. **TRANSFER AND TRANSLATE.** The format for this instruction is:

O M N AAA bbb CCC Set to Equal where:

O: Operation Code; R-machine language; TT1, TT2, and TT3 - symbolic *

M: Variant; Number of 12-character words (0-9)

N: Variant; Number of remaining characters (0-11) *TT1 - use table I
TT2 - use table II
TT3 - use table I & II

No zone bits, use table I
A bit, use table II
B bit, 6-bit to 12-bit translation

AAA: MSD of address of information to be transferred and translated

BBB: Available to programmer

CCC: MSD of address to which information is to be transferred after translation

3-234. This new instruction permits internal translation of any 6-bit code to any other 6-bit code by transferring and translating any 12-character words designated by the M variant plus the remaining number of characters designated by the N variant from AAA address to CCC address. A zero in the M or N variant indicates a field length of zero; however, when the M and N variant both equal zero, 120 characters are transferred. The comparison indicators are not affected by this command.

3-235. The Transfer and Translate instruction also permits internal translation of any 6-bit code to any other 6-bit or 12-bit code, and provides an excellent data movement and translation facility. Frequently, data input to or output from the system is in a code structure which is not consistent with the internal structure of the system.

3-236. Through the use of programmatic tables, a single Transfer and Translate instruction can move as many as 120 characters, and at the same time, translate them to whatever bit structure is contained in the table. Since the tables are programmatically constructed and the translation process closely resembles a "table lookup" function, this instruction offers an efficient means of inputting and outputting non-BCL (Burroughs Common Language) code and translating it to the internal code structure for arithmetic and data manipulation capabilities. This instruction is particularly valuable in satellite operations because it aids binary to decimal conversion of data.

3-237. Memory addresses +00 to +77 are reserved for the required translation table. In addition, memory addresses A00 to A77 are required if use of translation table II, or if 6-bit to 12-bit translation, is desired.

3-238. On 6-bit to 6-bit translation, the 6-bit character to be translated is split into two octal characters. The two-octal characters are used to address the translation table (+00 to +77 or A00 to A77).

3-239. On 6-bit to 12-bit translation, the 6-bit character to be translated is split into two-octal characters. If the least significant bit of the characters to be translated is zero translation, table I (+00 to + 77) is addressed. If the least significant bit is one, translation table II (A00 to A77) is addressed.

NOTE

00 uses address +00 and +01 of translation table I. 01 uses address A00 and A01 of translation table II.

3-240. **INTERROGATE.** The format for this instruction is:

O M N AAb BBb CCC Not Affected where:

O: Operation Code; T-machine language, symbolic*

M: Variant:

Unit type

0 Reserved for Expansion

1	Card Reader or Paper Tape Reader	*ICR - Interrogate Card Reader or IPR - Interrogate Paper Tape Reader
2	Card Punch or Paper Tape Punch	ICP - Interrogate Card Punch or IPP - Interrogate Paper Tape Punch
3	Drum Printer or Multiple Tape Lister	ILP - Interrogate Line Printer or IPL - Interrogate Multiple Tape Lister
4	Supervisory Printer	ISP - Interrogate Supervisory Printer
5	Reserved for Expansion	
6	Reserved for Expansion	
7	Reserved for Expansion	
8	Magnetic Tape	IMR - Interrogate for MTU Ready
9	Magnetic Tape Write	IMW - Interrogate for MTU Write Ring
1-6	(Sense Switches when N = 8)	TSS - Test Sense Switches
Character (Interrogate bit)		BBE - Branch if bit equal (N = 9)
Character (Interrogate bit)		SBT - Set bit to equal (N = 10)
Character (Interrogate bit)		RSB - Reset bit (N = 11)
Character (Interrogate bit)		BBU - Branch if bit unequal (N = 12)

N: Variant;

1 - 6 Unit Number
8 Interrogate sense switches
9 Interrogate bit, branch on equal
10 Set bit
11 Reset bit
12 Interrogate bit, branch on unequal

AAA: Branch on Busy

When N = 8 Branch on sense switch

When N = 9 Branch on any bit equal

When N = 12 Branch on any bit unequal

BBB: Branch on Not Ready

CCC: Address of character under test when N = 9, 10, 11 or 12 Branch on Error (Interrogating a Card Reader, Card Punch, Line Printer or Multiple Tape Lister).

3-241. This new instruction provides the facility to test input/output units for Busy, Not Ready and errors with required branching facilities. Sense switches can be interrogated. Character bits can also be interrogated, set or reset. The Interrogate instruction serves a three-fold function. It provides a programmatic means of increas-

ing throughput in both serial processing and multiprocessing situations when multiple input/output units are being used. The comparison indicators are not affected by this command.

3-242. Through the Interrogate instruction, an effective "Program Interrupt" capability is provided, making it possible to immediately detect Busy status on any input/output unit and direct programmatic control to a different area of processing. This serves to eliminate loss of time due to waiting for an input/output unit to complete its processing cycle and become available for further instruction.

3-243. Secondly, a means of performing routines or programs under special conditions is provided when used in conjunction with the sense switches.

3-244. Thirdly, it provides a means of rapidly performing bit manipulation functions. This is particularly useful in decoding operations such as testing for multiple codes punched in one column of a card and, when used in conjunction with the Binary feature, permitting translation of Matrix punched cards.

3-245. Interrogate Magnetic Tape Write is used to test for the presence of a Write Ring and Not-Ready condition. If a Write Ring is not installed, the Not-Ready Branch is taken. A unit number which is nonexistent or if a unit has power off, it will register Not-Ready. Printer unit designation is meaningless when the Dual Printer Module is not installed. The Line Printer is not busy during skipping or spacing. The paper tape reader is not busy during stop stabilization time or during change of direction stabilization time.

3-246. To maintain the rated speed of the 300 CPM Card Punch, a Punch instruction must be given within 20 milliseconds after punching of the prior card is completed. The 300 CPM Card Punch is not busy during these 20 milliseconds. Busy has no significance during Magnetic Tape instructions and Supervisory Printer instructions. The N variant is used to designate the following types of control:

N = 9 (bit test, branch on equal):
If any bit of the M character is a one and the corresponding bit of the character under test is a one, the AAA branch is taken. If not, program control continues in sequence.

N = 10 (bit set):
If any bit of the M character is a one, the corresponding bit of the character under test (CCC address) is set to one. Program control continues in sequence.

N = 11 (bit reset):
If any bit of the M character is a one, the corresponding bit of the character under test (CCC address) is reset to zero. Program control continues in sequence.

N = 12 (bit test, branch on not equal):
If any bit of the M character is a one and the corresponding bit of the character under test is a one, program control continues in sequence. If not, the AAA branch is taken.

3-247. Punch check errors cause the Error Branch to be taken. When the Error Branch is taken, the error conditions are reset (providing card punch option is set this way).

3-248. When the Error Branch is taken for a 100 CPM card punch, the error condition is not reset. The card punch is Not Ready due to the error. Print check errors cause the Error Branch to be taken. When the Error Branch is taken, the error condition is RESET.

3-249. Read errors, Validity errors or reading other than 80 columns, cause the Error Branch to be taken. An empty hopper or a feed check causes the Not-Ready branch to be taken. End of file will not affect the interrogate branch.

3-250. **DATA COMPRESS.** The format for this instruction is:

O M N AAA BBB CCC Set to Equal where:

O: Operation Code; M - machine language, DCC - symbolic

M: Variant; Reserved for Expansion

N: Variant; Reserved for Expansion

AAA: Starting address (MSD) of record to be compressed, (numeric characters)

BBB: Length of record to be compressed

B_3B_2 - Number of 12 character words (0-99)

B_1 - Number of remaining characters (0-11)

CCC: Starting address (MSD) of compressed record (alphanumeric characters)

3-251. The Compress instruction packs data for faster storing and retrieval, allowing more efficient use of the amount of storage available. The characters of numeric data stored in the field indicated by the AAA address are compressed so that three 4-bit numeric characters fit into two 6-bit characters and are stored in the field indicated by the CCC address.

3-252. The zone bits of the AAA field are not transferred to the CCC field. The AAA field remains unchanged after execution of this instruction. BBB = 000 is a forbidden combination. The comparison indicators are set to equal for this instruction.

3-253. **DATA EXPAND.** The format for this instruction is:

O M N AAA BBB CCC Set to Equal where:

O: Operation Code; N-machine language; DEC - symbolic

M: Variant; Used by machine

N: Variant; Used by machine

AAA: Starting address (MSD) of record to be expanded (alphanumeric characters)

BBB: Length of expanded record

B_3 B_2 - Number of 12 character words (0-99)

B_1 - Number of remaining characters (0-11)

CCC: Starting address (MSD) of expanded record (numeric characters)

3-254. The Expand instruction provides a means of quickly exploding packed data into a form that more readily lends itself to arithmetic and data manipulation functions. The 6-bit characters of packed data, stored in the field indicated by the AAA address, are expanded from two 6-bit characters (three 4-bit digits) to three 6-bit numeric characters and stored in the field indicated by the CCC address. The zone bits of the CCC address are set to zero. BBB = 000 is a forbidden combination. The comparison indicators are set to equal by this instruction.

3-255. Considerable improvement in magnetic tape and disk file I/O transfer rates can be achieved through the use of the Compress and Expand instructions. A 50% improvement over standard transfer rates are achievable by compressing data before transferring to magnetic tape or disk file (Binary Magnetic Tape Read and Write must be used in magnetic tape operations). Compressing data before writing on tape or disk can also increase the effective storage capacity for numeric fields by 50%.

3-256. **BINARY CARD READ.** The format for this instruction is:

O M N AAA BBb CCC Set to Equal where:

O: Operation Code; #-machine language; - symbolic*

*CRD - Normal read
CRB - Binary read
CRI - Read, branch busy

M: Variant;

0 Read alphanumeric buffered
Halt on Not Ready
Wait for reloading on Busy

1 Read alphanumeric buffered
Branch on Busy or Not Ready

2 Reading binary, unbuffered
Halt on Not Ready

N: Variant;

Designates buffer
1 = Buffer 1
2 = Buffer 2

AAA: When M = 0 Available to programmer

When M = 1 Branch on Busy or Not Ready

When M = 2 Store address of binary card image: MSD

BBB: Branching address on end-of-file

CCC: Store address MSD

3-257. This instruction is the same as described in paragraph 3-199 except for the addition of M variant functions. The function of this variant is as follows:

a. When M = 0:

(1) If the buffer is full, the contents of the buffer are transferred to memory starting at CCC.

(2) If the card reader is busy, wait until the card has been read into the buffer, then transfer the buffer contents to memory starting at CCC.

(3) If the card reader is Not Ready, halt.

b. When M = 1:

(1) If the buffer is full, the contents of the buffer are transferred to memory starting at CCC.

(2) If the card reader is Busy or Not Ready, Branch to AAA.

c. When M = 2:

Read unbuffered. An alphanumeric card image is stored in memory starting at CCC (80 characters). A binary card image is stored in memory starting at AAA (160 characters, the upper six bits are most significant). If the card reader is Not-Ready, the central processor halts.

NOTE

Validity checking must be off for binary.

3-258. **BINARY CARD PUNCH.** The format for this instruction is:

O M N AAA bbb bbb Not Affected where:

O: Operation Code; U-machine language; PBN - symbolic

M: Variant;

0 or blank, Punch a card and select normal stacker (B 304 Card Punch only)

1, Punch a card and select auxiliary stacker (B 304 Card Punch only)

AAA: Transfer from address MSD

BBB: Reserved for expansion

CCC: Reserved for expansion

3-259. This new instruction provides the ability to punch cards in Binary mode. The 160 character binary card image, stored in memory, is punched with the most significant character beginning in the upper six rows of the first card column; the second character in the lower six rows of the first card column; the third character in the upper six rows of the second card column, etc.

3-260. Binary Card punching is unbuffered. The binary card image to be punched is stored in memory starting at AAA (160 characters).

a. A binary image of the most significant character is punched in the upper six rows of the first column.

b. A binary image of the second character is punched in the lower six rows of the first column.

c. A binary image of the third character is punched in the upper six rows of the second column.

If an error is detected during punching a card (#1), punching of that card is completed and the next card (#2) is punched; the command to punch the third card (#3) is not executed. Pressing RESET and then START conditions the punch unit to accept information.

3-261. Binary Card Read Instruction: The Card Read instruction (paragraph 3-198) can now be used to read a card in Binary mode through the use of an additional M variant. During the card read cycle, the contents of the card are transferred into core in two formats. An 80 character Hollerith translation is stored starting at the CCC address, and a 160 character binary image is stored starting at the AAA address.

3-262. Binary read is unbuffered. The 160 character binary card image is read with the most significant character beginning in the upper six rows of the first card column, the third character in the upper six rows of the second card column, etc.

3-263. The Binary Card Read and Binary Card Punch instruction provide the means of processing data in and out of the system in punched card record image form. In standard BCL mode, the card reader identifies a series of punches in a card column as a particular character and transmits the identification to the central processor and its internal bit configuration is established in memory. In binary mode, the series of punches in each card column is transmitted to memory (without interpretation) in image form. Each punch in each of the twelve positions of every column is represented by a bit in memory.

3-264. Another advantage of this instruction comes from the ability to handle data from punched cards which consists of multiple punches that may not necessarily be consistent with any of the valid character configurations. In order to store more data within the confines of a punched card, a user may choose to use punches in each row or combination of rows of any or all columns to represent certain conditions. The binary capability allows cards structured in this Matrix manner to be input to or from the B 300 at the rapid speeds of the input/output equipment.

3-265. **PRINT ON PRINTER** The format for this instructions is:

PRT A M N AAA BBb bbb Not Affected

where:

O: Operation Code; A-machine language; PRT - symbolic

M: Form spacing after print, unit selection and print width

120 Print Positions

Select Printer 1

0 - space suppress
1 - single space
2 - double space

Select Printer 2

4 - space suppress
5 - single space
6 - double space

132 Print Positions

Select Printer 1

+ - space suppress
A - single space
B - double space

Select Printer 2

D - space suppress
E - single space
F - double space

*N: Form skipping after print; 1-11, where 0 is "no skip"

AAA: Print-from address (MSD)

BBB: Branching address on Page Overflow when N = 0

CCC: Available to programmer

3-266. This instruction transfers 120 or 132 characters from core storage beginning at the address specified by AAA to the printer buffer. When the printer buffer is filled (1.3 ms.), one line will be printed. Spacing after printing is controlled by the M variant. If skipping after printing is desired, the N variant is used. If a print error occurs, the system will stop on the next print instruction (print or skip) that references the printer. If an End-of-Page indication is sensed during a preceding space operation, the program will branch to BBb after printing without paper motion if the present print instruction contains an N variant of zero. The three character positions of the CCC address are available to the programmer and may be used for storage.

3-267. The 120 print position variant can be used with a 132 print position printer; however, only 120 positions are printed, left justified. An attempt to print 132 positions on a 120 print position printer is a programing error and will cause the system to halt. To restart, the processor must be cleared and the error corrected.

3-268. Since skipping always takes precedence over spacing and page overflow, 12-punches are not sensed during skipping, the BBb branch will not be taken during the execution of any print (or skip) instruction following a paper skip. When page overflow is taken, the paper will not move. On a sync or parity error, the next Print or Skip instruction that designates the printer containing the error will not be executed and the system will stop.

*On B 300 Systems, a blank or any other character containing a B-bit in the N variant can never be used. The system will always branch to the address in BBB.

3-269. To use two B 321 Line Printers, the optional B 324 dual printer module must be installed in one of the line printers. Without this module, the 4-bit has no significance.

NOTE

If a 120 print position printer and a 132 print position printer are attached, using the optional dual printer module, an attempt to print 132 positions on the 120 position printer will not be detected.

3-270. Designation of each printer is switch-set by the operator. When the switch is set to designate one printer as #1 and the other as #2, the two printers will function independently. If the switch is set to activate both printers for every PRT instruction, commands for either designation will perform the same action on both printers simultaneously. Each printer contains its own buffer and both printers can operate at their rated speed. In order to place the second printer in operation (when using two printers), the first printer must be turned on.

B 300 Lister Instructions

3-271. The instructions described in the paragraphs that follow are used in conjunction with the B 322 Multiple Tape Lister for providing the ability to print on any three, selectable, lister tapes. Identical information is printed onto a master tape and detail tape from buffer positions 1 through 22. The contents of buffer positions 23 through 44 are printed on a third, or multiprocessing tape, as specified by the lister instruction.

3-272. **PRINT ON LISTER (NORMAL MODE).** The format for this instruction is:

O M N AAA BBb CCb Not Affected

where:

O: Operation Code; A-machine language; PLN - symbolic

M: Variant B, A, 8, 4, 2, 1 bit meaning:

B and A zone bits, zero-suppress master
A-bit - print master on unit #1
8-bit - print master on unit #2 (B 322/B 323 only)

8-bit, zero-stop on print error
8-bit - branch on print error

4, 2, 1 bits must be zero

The master tape is printed on unit 1 or 2 with characters 1-22 of the print buffer. Tape selection is controlled by the master selection switch on unit 1.

N: Variant B, A, 8, 4, 2, 1 bit meaning:

B and A zone bits, zero-suppress detail print

A-bit - print detail on unit 1
B-bit - print detail on unit 2
B and A bits - print detail on units 3 (18 tape lister only)

8-bit - must be zero

4, 2, 1 bits indicate detail tape number

The detail tape is printed with characters 23-44 of the print buffer. This tape cannot be tape 1 on unit 1.

AAA: Transfer from address

BBB: Branching address on out of paper

CCC: Branching address on print error when the 8-bit of the M variant is on; otherwise, it is reserved for expansion

NOTE

Single spacing occurs after printing.

3-273. **PRINT ON LISTER (MULTIPROCESSING MODE).** The format for this instruction is:

O M N AAA BBb CCb Not Affected

where:

O: Operation Code; A-machine language; PLM - symbolic

M: Variant B, A, 8, 4, 2, 1 bit meaning:

B and A zone bits, zero-suppress master and detail
A-bit - print detail on unit 1
B-bit - print detail on unit 2
B and A bit - print detail on unit 3

8-bit, zero-stop in print error
8-bit branch on print error

4, 2, 1 bits indicate detail tape number

The master tape is printed on unit 1 with characters 1-22 of the print buffer. Tape selection is controlled by the master selection switch. The detail tape is also printed from characters 1-22 of the print buffer.

N: Variant B, A, 8, 4, 2, 1 bit meaning:

B and A zone bits, zero-suppress multiprocessing tape
A-bit - print multiprocessing tape on unit 1
B-bit - print multiprocessing tape on unit 2
B and A bit - print multiprocessing tape on unit 3

8-bit - must be zero

4, 2, 1 bits indicate multiprocessing tape 1-6

The multiprocessing tape is printed with characters 23-44. The multiprocessing tape and the detail tape cannot be the same.

AAA: Transfer from address

BBB: Branching on out of paper

CCC: Branching address on print error when the 8-bit of the M variant is on; otherwise, it is reserved for expansion.

NOTE

Single spacing occurs after printing.

3-274. **SKIP LISTER.** The format for this instruction is:

O M N bbb BBb bbb Not Affected

where:

O: Operation Code; B-machine language; SKL - symbolic

M: Variant B, A, 8, 4, 2, 1 bit meaning:

B and A zone bits, zero-suppress master
A-bit - skip or space Master on unit 1
B-bit - skip or space Master on unit 2 (B 322/B 323 only)

8-bit, zero-space
8-bit - skip 2-1/2 inches

4, 2, 1 bits must be zero

N: Variant B, A, 8, 4, 2, 1 bit meaning:

B and A zone bits, zero-suppress non-master
A-bit - skip or space one non-master on unit 1
B-bit - skip or space one non-master on unit 2
B and A bit - skip or space one non-master on unit

8-bit, zero-space
8-bit - skip 2-1/2 inches

4, 2, 1 bits designate non-master tape number

AAA: Reserved for expansion

BBB: Branching address on end of paper

CCC: Reserved for expansion

NOTE

This instruction cannot be used to skip one tape and space another simultaneously.

3-275. **SLEW LISTER.** The format for this instruction is:

O M N bbb BBb bbb Not Affected

where:

O: Operation Code; B-machine language; SLL - symbolic

M: Variant B, A, 8, 4, 2, 1 bit meaning:

B and A zone bits, zero-suppress master
A-bit - slew master on unit 1
B-bit - slew master on unit 2 (B 322/B 323 only)

8-bit, must be zero

4-bit, slew all unit 3 tapes 10 inches

2-bit, slew all unit 2 tapes 10 inches

1-bit, slew all unit 1 tapes 10 inches

N: Variant B, A, 8, 4, 2, 1 bit meaning:

B and A zone bits, zero-slew multiprocessing tape
A-bit - suppress slew of multiprocessing tape on unit 1
B-bit - suppress slew of multiprocessing tape on unit 2
B and A - suppress slew of multiprocessing tape on unit 3

8-bit must be zero

4, 2, 1 bit designates the multiprocessing tape number

AAA: Reserved for expansion

BBB: Branching address on end of paper

CCC: Reserved for expansion

NOTE

When using B 322/B 323 Multiple Tape Listers, only slewing of all tapes or slewing all tapes except the master tape is allowed. The slew feature is not a standard item on B 322/B 323 Multiple Tape Lister.

3-276. **CONTROL SORTER.** The format for this instruction is:

O M N bbb bbb bbb Not Affected

where:

O: Operation Code; C-machine language; CTL - symbolic

M: Variant; Determine type of control (0, 2, 4, 6, 7, 8)

N: Variant; Select pocket 0-14, 15 equals reject pocket

AAA: Available to programmer

BBB: Available to programmer

CCC: Available to programmer

3-277. This instruction is the same as described in paragraph 3-55 except that the N variant is expanded to permit the selection of 16 pockets.

NOTE

When using machine language, an ampersand must be used to select pocket 12 in the N variant.

3-278. The added versatility of this instruction permits faster sorting with the B 116 Sorter-Reader by reducing the number of sort passes required to accomplish a sorting operation. The value of the B 116 is enhanced when used in conjunction with the 18 tape lister.

3-279. **HALT AND BRANCH.** The format for this instruction is:

O M N AAb bbb bbb Not Affected

where:

O: Operation Code; 9-machine language; HLT - symbolic

M: Variant; 0-9 halt identification

N: Variant; 0-14 pocket light identification

AAA: Branch address when M variant contains a 2-bit (2, 3, 6, 7)

BBB: Available to programmer

CCC: Available to programmer

3-280. The function of this instruction is the same as described in paragraph 3-130 except that the N variant has been expanded to include the additional pocket light identification of the B 116 Sorter-Reader.

NOTE

When using machine language; an ampersand must be used to select pocket light 12 in the N variant.

3-281. **CARD PUNCH.** The format for this instruction is:

O M N AAA bbb bbb Not Affected

where:

O: Operation Code; @-machine language; PCH - symbolic

M: Variant; Reserved for expansion

N: Variant; 0 or blank-normal stacker, 1-select auxiliary stacker (B 304) only

AAA: Transfer from address MSD

BBB: Available to programmer

CCC: Available to programmer

NOTE

Error stacker selection takes precedence over auxiliary stacker selection.

3-282. This instruction is the same as described in paragraph 3-18 except the N variant has been expanded to include selective stacking. The comparison indicators are not affected by this command.

3-283. The use of this instruction provides the facility to select the auxiliary pocket on the B 304 Card Punch. The sorting required for a particular job after punching can be reduced by the use of this feature. A specific card can be selected and sorted to the auxiliary stacker and after completion of the job, immediately stored for future use.

Data Communication Instructions

3-284. The data communication instructions for the B 300 differ from those of the B 263, B 273, B 275 and B 283 in order to accommodate the new B 487 DTTU and B 249 DTCU. These new instructions permit the addressing of buffers as well as terminals when using the B 487 DTTU. These changes are described below.

3-285. When using only B 487 DTTU's:

a. The zone bits of the N variant designate the terminal unit number (1-4 where zone 0 equals number 4).

b. The number bits of the N variant designate the buffer unit number (0-15).

3-286. When using B 487 DTTU's combined with previously released terminal units (B 249 DTCU must be present):

a. The zone bits of the N variant are used to designate the B 487 Terminal Unit (1-3) and the numeric bits designate the buffer number.

b. The zone bits of the N variant must be zero for previously released terminal units, and the numeric bits designate the terminal unit number (4-15).

3-287. **DATA COMMUNICATIONS WRITE**
The format for this instruction is:

DCW L M N AAA BBB CCC Affected
where:

O: Operation Code; L-machine language; DCW - symbolic

M: 4 or 12 - write inquiry
8-bit = 0 - recognize group marks (4)
8-bit = 1 - ignore group marks (&)

N: Zone - designates terminal unit number (1-4)
Numeric - designates buffer number (0-15)

AAA: Transfer address (MSD)

BBB: Branch on buffer Not Write Ready (and not Not Ready)

CCC: Branch on buffer Not Ready

3-288. This instruction is identified by an M variant of 4 or 12. The instruction loads the designated buffer from processor memory. If the data communication control is Not Ready, the processor halts.

3-289. A full buffer always terminates buffer loading. A group mark terminates buffer loading when the M variant 8-bit equals zero. When the M variant 8-bit equals 1, group marks are treated as data and do not terminate buffer loading.

3-290. The comparison indicators are affected by this command. They are normally set to equal but are set to high if an abnormal condition is detected.

3-291. When coding in machine language, an ampersand (&) must be used for 12 in the M and N variants.

3-292. **DATA COMMUNICATIONS READ**
The format for this instruction is:

DCR L M N AAA BBB CCC Affected
where:

O: Operation Code; L-machine language; DCR - symbolic

M: 2 or 10 - read inquiry
8-bit = 0 - recognize group marks (2)
8-bit = 1 - ignore group marks (#)

N: Zone - designates terminal unit number (1-4)
Numeric - designates buffer number (0-15)

AAA: Branch on buffer Not Ready

BBB: Branch on buffer Not Read-Ready (and not Not Ready)

CCC: Store Address (MSD)

3-293. This instruction is identified by an M variant of 2 or 10. The instruction transfers the contents of the designated buffer to processor memory. When the M variant equals 2 (8-bit = 0) group marks are recognized and the transfer of information between processor and the DTTU is terminated. When the 8-bit of the M variant equals 1, group marks are treated as data and do not terminate buffer loading. Reading the full buffer always terminates the read operation.

3-294. If there is an abnormal condition detected during input from the remote station to the terminal unit buffer, the comparison indicators are set high; otherwise, they are set to equal.

3-295. When coding in machine language, an ampersand (&) must be used for 12 in the N variant.

3-296. **DATA COMMUNICATIONS INTERROGATE (M=1)** The format for this instruction is:

DCI L M b AAA BBB CCC Affected where:

O: Operation Code; L-machine language; DCI - symbolic

M: 1 - interrogate data communication ready, data communication or terminal unit designated buffer

N: Reserved for expansion - must be left blank

AAA: Branch on "input ready" interrupt state or non-write ready interrupt state

BBB: Terminal unit number and buffer number store address

CCC: Branch on "write ready" interrupt state

3-297. This Interrogate instruction is identified by an M variant of 1. The instruction tests for any "input" or "output ready" condition and stores the terminal and buffer number at the location specified by BBB. The program will branch to AAA if the designated buffer is in the "input ready" interrupt state or on any non-write ready interrupt condition. If the designated buffer is in the "write ready" interrupt state, the program will branch to CCC.

3-298. When the AAA or CCC branch is taken, the terminal unit number and the buffer number are stored at the location specified by the BBB address.

3-299. If there is no interrupt condition, control continues in sequence. If the data communication control is Not Ready, the processor halts. The comparison indicators are affected by this command.

3-300. **DATA COMMUNICATIONS INTERROGATE (M=9)** The format for this instruction is:

DCI L M N AAA bbb CCC Affected where:

O: Operation Code; L-machine language; DCI - symbolic

M: 9 - interrogate data communication ready, N variant designated buffer

N: Zone - terminal unit number

$\overline{B}A$ 1

$B\overline{A}$ 2

BA 3

$\overline{BA}$ 4

Numeric - buffer number (0-15)

AAA: Branch on "input ready"

BBB: Reserved for expansion - must be left blank

CCC: Branch on "write ready"

3-301. This Interrogate instruction is identified by an M variant of 9. The instruction tests the buffer specified by the N variant for an "input" or "output ready" condition. The program will branch to AAA if the designated buffer is "input ready." If the designated buffer is in a "write ready" state, the program will branch to CCC.

3-302. If the addressed buffer is Not Ready, Idle, or Busy, the program continues in sequence. If the data communication control is Not Ready, the processor halts. The comparison indicators are affected by this command.

SECTION 4

SOFTWARE SYSTEMS

GENERAL

4-1. Along with the actual equipment (hardware), software programs designed for various computer applications are provided to the customer. These software programs are prepared for use with either a 4.8 K, 9.6 K, or 19.2 K memory system. The total software library for this equipment series consists of ten categories: application programs, assemblies, compilers, demonstration programs, generators, operating systems, simulators, service programs, service routines, and translators.

4-2. This section describes seven of these categories in detail. The Burroughs B 100/B 200/B 300 Software Library Catalog should be referenced for a complete listing and explanation of all software programs made available. It will also specify the system configuration required for each individual program.

ASSEMBLER PROGRAMS

4-3. An Assembler Program is a programing tool designed to alleviate part of the effort required in coding programs. Assemblers allow use of non-machine language. The conversion ratio is usually one machine language instruction for one symbolic entry. Two types of assembly languages are presently provided: Basic Assembler which consists of over nineteen versions designed to fit specific system configurations, and the Advanced Assembler I.

Basic Assembler

4-4. A total of nineteen Basic Assembler software programs are available for use with various type equipment configurations and memory capacity of the central processor in use (4.8 K, 9.2 K, or 19.2 K).

Advanced Assembler I

4-5. The Advanced Assembler is an enlarged and more sophisticated language, allowing users of magnetic tape and/or disk oriented systems to code their programs in a language that permits, among other features, labeling by name, program point labeling and extensive library routine capabilities. Advanced Assembler I will also accept programs written in Basic Assembler language to provide the users of Basic Assembler language with the same expanded capabilities. Two versions of Advanced Assembler I are available, one for 4.8 K systems and one for 9.6 K systems.

COMPILERS

4-6. A compiler program is also a programing tool designed to alleviate much of the coding effort by accepting problem oriented statements and converting these statements into machine language instructions. These statements often require more than one machine language instruction to perform the specified function.

Compact COBOL Compiler

4-7. The Compact COBOL Compiler is a subset of COBOL-1961 EXTENDED and primarily designed for medium and small computers. Compact COBOL consists of that

group of features and options, within the complete COBOL specifications for the year 1963, which have been designated as comprising the minimum subset of the total language which can be implemented.

Disk File COBOL Compiler

4-8. The Disk File COBOL Compiler is designed to meet the requirements outlined in COBOL specifications of CODASYL publications plus several elective features, and is used only on systems equipped with the Burroughs Disk File System. The compiler is almost totally modular in design. It is segmented into logical, independent processing modules incorporating a collection of space saving techniques whose benefits are significant enough to make this design (in which all tables are accessed while in memory) practical on the Burroughs B 200/B 300 Series Systems. Assuming an average, well-balanced source program and the equipment configuration outlined above, compilation speeds may be expected to range between 40 and 50 cards per minute.

GENERATOR PROGRAMS

4-9. Generators accept specifications describing required functions of programs to be produced. The output consists of printed documentation and program instructions in a form that is acceptable as direct input to the system.

Report Generators

4-10. Report Generators reduce the programing requirements of most installations by preparing programs which accept either punched card or magnetic tape input and, as a result, produce punched card and/or printed copy output. They are designed to accept and edit specification cards which describe a report's characteristics and produce either an autoload or symbolic program deck which is capable of producing the report.

Tape Sort Generators

4-11. These generators produce sort programs based on the individual file characteristics of the user. The object programs produced are in either symbolic or autoload format and nearly as efficient as sort programs written for a specific application. These sort programs are completely documented to provide instant reference to the user. Either blocked records or unit records can be sorted. The programs permit an alphabetic or numeric sort key located in up to ten fields within the record. Sort programs can be generated for either a three, four, five or six-tape system of either 4.8 K, 9.6 K or 19.2 K memory size.

Disk File Sort Generators

4-12. The disk sort generators will produce efficient, tailored programs utilizing the Burroughs Disk File System for sorting purposes. The object programs produced will sort the file type which has been specified by the user on either a 4.8 K, 9.6 K or 19.2 K memory system and for any disk segment size (96, 240, or 480). These object programs will accept input records from magnetic tape or from the disk file and will write final output on magnetic tape or on the disk file. The programs will sort files in ascending or descending order.

Cardatron Simulation Program Generator

4-13. This program generates the necessary routines to simulate the 220 Cardatron System, using a B 410 BCL Tape Control System and B 180/B 280 System. The programs used to accomplish this are the 220-410 BCL Input/Output Control Routine and the generated Cardatron System Simulation Program for the B 180/B 280. These are designed to minimize changes to existing 220 programs.

Flow Chart Generator

4-14. The Flow Chart Generator will produce fully documented, logic flow charts for any program coded in Burroughs Basic or Advanced Assembler language. The flow charts are printed in a horizontal manner and consist of standard flow charting symbols. In addition to the mnemonic operation code, the user-coded remarks are properly hyphenated and justified within each symbol. User's program labels or tags are shown above the corresponding symbols. The automatic program flow chart will be a helpful tool for program testing, periodic program modification, and/or final documentation.

OPERATING SYSTEMS

4-15. Operating Systems are designed to provide system control of processing so that the user may obtain maximum throughput from his system.

Magnetic Tape—Disk File Operating System

4-16. This program provides the capabilities of creating and maintaining a program library for either magnetic tape or disk file. It will provide system control over such items as system designation, program call-in and set-up, overlay call-in, program scheduling, etc. In addition, multiprocessing capabilities are provided which include Executive Routine control of up to three different programs, memory allocation, I/O unit designation, machine actual address assignment from relative address, and the rescheduling of the program mix as required.

Supervisory Control Program for On-line Banking (SCP)

4-17. The SCP is a Software Executive System designed primarily for on-line banking. It provides the programs and routines necessary for control over all areas affecting the on-line system. This software package is based on the following objectives.

a. To minimize operator intervention and processing time.

b. To simplify customer programing.

c. To allow system changes during operation.

d. To provide debugging aids for fast efficient debugging.

e. To provide short clear instructions to system supervisor for all exception conditions.

f. To provide maximum system backup capabilities.

SERVICE PROGRAMS

4-18. Service programs are designed to perform standard functions necessary in most computer installations. These functions, among others, include data conversion, editing and verifying, scheduling multiprograming packages, and various sorting programs.

Sort Generator Timing

4-19. These programs are used for computing sort times for programs produced by Sort Generators. The timing programs take all factors into consideration which have bearing on the time to run a sort. The number of records to be sorted, length and location of the key within each record, over-all length of the records themselves, size of the blocking factor, etc., are among the factors considered.

Card Edit

4-20. This program allows a deck of punched cards to be edited for necessary sequence

and content, or to establish a control total with which a deck may be subsequently edited. All card decks, whether program or data cards, may be edited to assure the user of their validity. Provision is included to allow read out of an established control total when a card punch is not available with the system. Two versions of the Card Edit Program are available. One is for Model 0, Improved Model 0, and B 263/B 283; a revised version is for the B 300.

Magnetic Tape Edit

4-21. This program provides a means of testing the physical characteristics of a reel of magnetic tape before recording significant data on it. By processing a reel of tape with the edit program, the user can determine what portion of the tape can be suitably recorded upon. The program will log the number of feet of usable magnetic tape for each reel processed. Tallies representing the number of write errors, number retries, and number of total failures after retry are recorded during the process.

Magnetic Tape Copy/Verify

4-22. This program provides a means of reproducing and/or verifying magnetic tape files. Reproduction is performed on a record image basis. Up to five control totals and a record count may be accumulated for each file being copied. The program will process either multiple-reel files (tape files consisting of more than one reel) or multiple-file reels (tape reels containing more than one file). In the case of multiple-file reels, the files to be processed are selected by the user. Magnetic tape files may also be processed to establish or verify control totals independent of copying.

Data Conversion

4-23. This program allows data to be converted, in image form, from one media to another. Conversions that can be performed include card, magnetic tape, or paper tape input to any combination of paper tape, punch card, line printer, or magnetic tape output, based upon selection of various specification cards.

Tape to Print Programs

4-24. The tape to print programs convert magnetic tape records to print. They will accept magnetic tape records formatted for printout on the IBM 720A, 730A, or 1403 and reformat them for printout on the Burroughs line printer. The program will accept blocked or unblocked magnetic tape records of fixed or variable length.

Program Schedular

4-25. This program permits users to package multiple programs for processing at the same time, thereby increasing the productivity of the system. Single instruction format cards must be input to the Program Schedular and these are produced by special versions of the basic assembler. The Program Schedular produces a fully documented program listing, and an auto-load program deck. Up to five programs may be packaged for subsequent multiprocessing. Since each program functions independently of all other programs, runs may be combined, started, or stopped at any time the user desires.

Multiple Program Productivity Advisor

4-26. This program serves as an advisor in determining the most efficient manner of using the Program Schedular in a given situation. The function of the Productivity Advisor is to accept basic data regarding the programs to be packaged and produce a series of tables displaying the productivity which would be achieved for each possible priority ratio combination. The user may select the ratio which will most effectively accomplish his purpose. This information is then used when processing unit programs with the Program Schedular.

Generalized Three Tape Sort

4-27. This program will accept two specification cards which describe the characteristics of the file to be sorted. The generalized sort program will be modified by these parameters and the sorting process will begin immediately. The logic of the generalized three-tape sort consists of Fibonacci stringing technique with an unbalanced merge. It will accept magnetic tape records of up to 1200 characters in length with a sort key of up to 47 characters. The sort key may be located in as many as 10 different fields within the record. Either blocked or unit records may be sorted.

Disk File Programs

4-28. A variety of disk file programs are available that will make possible the transcription of data to and from disk storage. Input/Output will be either magnetic tape, line printer or punched cards. Also, the transferring of data from one location of disk storage to another and resetting (or clearing) disk storage to a specific character is made possible by use of these programs.

SERVICE ROUTINES

4-29. Service Routines operate as a part of any program that requires the function they perform. Typical Service Routine functions include such things as performing standard Read/Write error correction procedures for magnetic tape and disk file operations, various scientific routines and diagnostic debugging procedures. Service routines are usually designed to use a minimum amount of memory.

Trace Routines

4-30. This routine can be assembled with object programs as a debugging aid. It will monitor the execution of object programs, and provide punched or printed records of the status of the areas of memory and comparison indicators affected by command execution. One line (or card) of monitor output will occur for every object program instruction executed. Tracing speed is directly related to the speed of the output unit used.

Magnetic Tape and Disk File Read / Write Error Routines

4-31. These routines are available in symbolic form and must be assembled with the user's program. Upon detection of an error during a read or write operation, these routines will automatically attempt to reread or rewrite a record, and if successive failure occurs, the system will halt for corrective action.

Memory Print and Punch Routines

4-32. These routines will dump either 4800, 9600 or 19,200 characters of memory, depending on the routine used and size of memory. The routines are furnished in symbolic and machine language form.

4-33. The routines will provide a printout showing the contents of memory. The listing will consist of 40, 80 or 160 lines depending on the size of the memory. Some versions are punch routines which provide 80, 160 or 320 punched cards representing the contents of memory. These cards can be used as an autoload deck for information retry. Neither the identification information nor the sequence numbers normally in autoload, are punched into these cards.

Scientific Routines

4-34. Seven basic mathematical routines are provided. These are the natural and hyperbolic sine, cosine and tangent computations for angles between plus and minus 90

degrees and an exponential routine for any number from minus 9.999999 to plus 8.000000 with a range of accuracy from two to six decimal places.

TRANSLATOR PROGRAMS

4-35. Translator programs are used to translate or convert programs from one type of programing language to another. Translation may involve different computer systems, or different programing languages within the same computer system.

1401 SPS to B 200 Program Translator

4-36. This program translates 1401 SPS programs to symbolic programs. It performs as much automatic translation as possible to keep manual post-translation to a minimum. If a non-translatable area is encountered, it will produce comments to indicate this fact. The time required to translate, while fast, depends on the complexity of the SPS program being translated. Important factors include the type of programing techniques used and the amount of memory required by the program. No modifications are required to the 1401 SPS program prior to translation.

SECTION 5

TIMING CONSIDERATIONS

GENERAL

5-1. The Input/Output (I/O) and processing abilities of the B 100/B 200/B 300 Systems are used to the greatest advantage when applicable timings are considered during the development of the program. Because of the buffering of selected peripheral units, timing, while important, normally is not a critical factor. This section provides information for the calculation of the Input/Output and internal processing times.

TIMING INPUT/OUTPUT OPERATIONS

B 102/B 103 Sorter-Reader

5-2. Under program control, the sorter-reader operates in either demand or flow mode. In demand mode, or buffered flow mode, information is stored in input buffer number 2 upon executing a Control Sorter instruction and remains there until read into storage by a Sorter-Reader instruction (SRD). The demand-type of feeding does not require close timing.

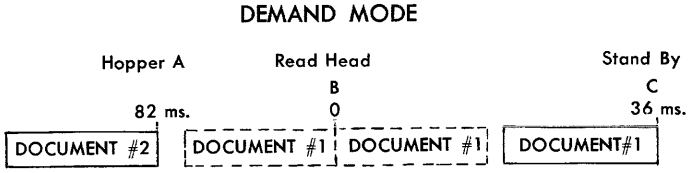
5-3. In unbuffered flow mode, information is read directly into core storage. This continuous type of operation requires close system timing in order to achieve maximum use of the available time and for maintaining proper operation.

Demand Mode (B 102 Only)

5-4. In demand mode, the program must contain one Sorter-Reader-Demand (#-SRD) and Control Sorter (C-CTL) instruction for every item. The transfer time of 84 characters from buffer to core storage requires 2.0 ms.

5-5. A Control Sorter instruction is executed in 120 microseconds (μs.). Following a Control Sorter instruction to pocket select and demand feed the next document, the buffer is refilled in 150 ms.

5-6. A Control Sorter instruction is always the first sorter-reader instruction in a program which utilizes the B 102 as an input device. The following is the minimum sorter-reader program timing (worst case) and sequence of operation when in demand mode operation:



a. Control Instruction - This instruction feeds the first document from the hopper, reads it into buffer number 2 and places it in the standby station.

b. Sorter-Read Instruction - This instruction transfers the contents from input buffer number 2 (first document) to memory.

c. Control Instruction - This instruction selects the pocket and reads the second document into input buffer number 2. No hardware timing restrictions are involved.

d. Sorter-Read Instruction - This instruction transfers the contents from buffer number 2 to memory for the second document.

e. Repeat Control and Read instructions (c and d).

f. The document is fed to the read head in 82 ms., to the leading edge of the document. It is read in 15 ms., placing the trailing edge at point B and is placed in standby in 21 ms. (leading edge).

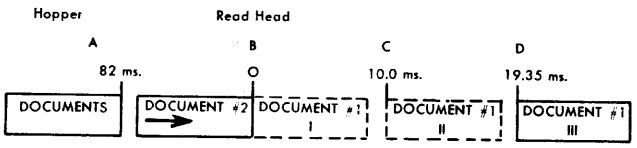
g. The pocket must be selected before the next read instruction is given. Pocket selection can be made at the programmer's option.

h. It requires 2 ms. processing time to unload the buffer and 2.5 ms. processing time to reload the buffer (40 μ s. per access, 63 accesses). The 2.5 ms. is maximum buffer access time during processing of the preceding document.

Flow Mode

5-7. In flow mode, information can be read from documents directly into core storage. Reading will stop after reading the ending transit number symbol of the Transit Field or after 7-3/4-inches of document has passed the read head of the sorter-reader. The stop read at the ending transit number symbol must be programed. If it is not programed, reading will automatically stop after 7-3/4-inches of document length. The following is the minimum program timing and sequence of operation of the sorter-reader when in unbuffered flow mode operation (worst case) condition:

UNBUFFERED FLOW MODE



a. Control Instruction (start flow) - This instruction begins feeding documents from the hopper.

b. Sorter-Read Instruction - This instruction reads the document directly into memory. The instruction must be initiated before the document reaches point B after leaving point A. (See document #2.)

c. Control Instruction (PS) - This instruction selects the pocket and must be given between points B and C.

d. Sorter-Read Instruction - This instruction reads the document directly into memory and must be initiated before the next document reaches the read head, point B (see document #1-III, and document #2).

e. Repeat Control (PS) and Read instruction (c and d).

f. Processing time of 82 ms. is available from the leading edge of the document at point A to the leading edge of the document at point B on the first document only. (See steps a and b.)

g. The central processor is required during the actual reading of the entire document - 15 ms.

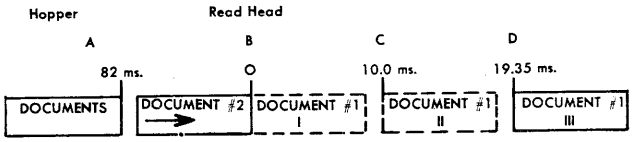
h. Processing time is available from the trailing edge of the document at point B (document #1-I) to the trailing edge of the document at point D (document #1-III) - 19.35 ms. When the trailing edge of document #1-III is at point D, the leading edge of document #2 is at point B, ready to read.

i. The pocket must be selected before or when it reaches point C which is 10.0 ms. after leaving point B. (See document #1-II and document #1-I.)

j. The available processing time after selection of a pocket is the total processing time (19.35 ms.) minus the time used through pocket select (maximum of 10 ms.).

5-8. The minimum program timing (worst case) and sequence of operation of the sorter-reader when in the buffered flow mode operation is as follows:

BUFFERED FLOW MODE



a. Control Instruction (start buffered flow) - This instruction begins feeding documents and fills input buffer number 2 from first document.

b. Read Instruction - This instruction transfers the contents of input buffer number 2 to memory. If the instruction is given before the first document is completely read into buffer number 2, internal processing will be inhibited.

c. Control Instruction (PS) - This instruction selects the pocket before the first document reaches point C and fills input buffer number 2 with second document.

d. Read Instruction - This instruction transfers the contents of the second document in input buffer number 2 to memory. If the instruction is initiated before document is completely read into input buffer number 2, internal processing will be inhibited.

e. Repeat Control and Read instruction (steps c and d).

f. The central processor is required for 2 ms. during buffer unload in b and d above.

g. The Control instruction for pocket selection must be given before the document in process reaches point C (document #1 - II); therefore, 10 ms. - 2 ms. (unload buffer) or 8 ms. after reading, the complete document is available for pocket selection.

h. Internal processing can take place for a total of 30.35 ms.

(1) 19.35 ms. from point B (trailing edge) to point D trailing edge minus 2 ms. for buffer reload.

(2) 15 ms. while loading buffer with information from next document (leading edge at point B to trailing edge at point B) minus 2.0 ms. for character transfer to the input buffer (buffer access time).

i. Buffer access time is dependent upon number of characters read at 40μs. per character.

j. Magnetic tape operations must take place before refilling of the input buffer begins (between trailing edge at point B and trailing edge at point D). Normally, a tape operation should take place immediately following pocket select. On this basis, the time available for magnetic tape operations ranges from 9.35 ms. to 17.23 ms. (a-b).

(1) Total time between documents (19.35 ms.).

(2) Processing time used through pocket select (including 2 ms. for buffer unload and 0.120 ms. for actual pocket selection).

k. When reading from or writing onto magnetic tape during MICR operations, provisions must be made to handle the additional 50 ms. required for travel time from load point to first record. This can be accomplished either by using header labels which are written or read before starting flow or by programing a stop flow before execution of the first magnetic tape operation (figure 5-1).

(1) The maximum block size for each MICR-to-magnetic tape program can be computed as follows:

$$R = N \frac{(19.35 - P - S)}{C}$$

where:

R = Number of records per block (result truncated to largest whole number).

N = Number of characters per millisecond which can be transferred to or from tape (excluding start/stop time) which are:

B 421 : High Density - 50
Low Density - 18

B 422 : High Density - 66.6
Low Density - 24

P = Total time used for pocket select including 2 ms. for buffer unload and 0.120 ms. for execution of the pocket select instruction, as well as all time required to determine correct pocket selection via the longest possible routing.

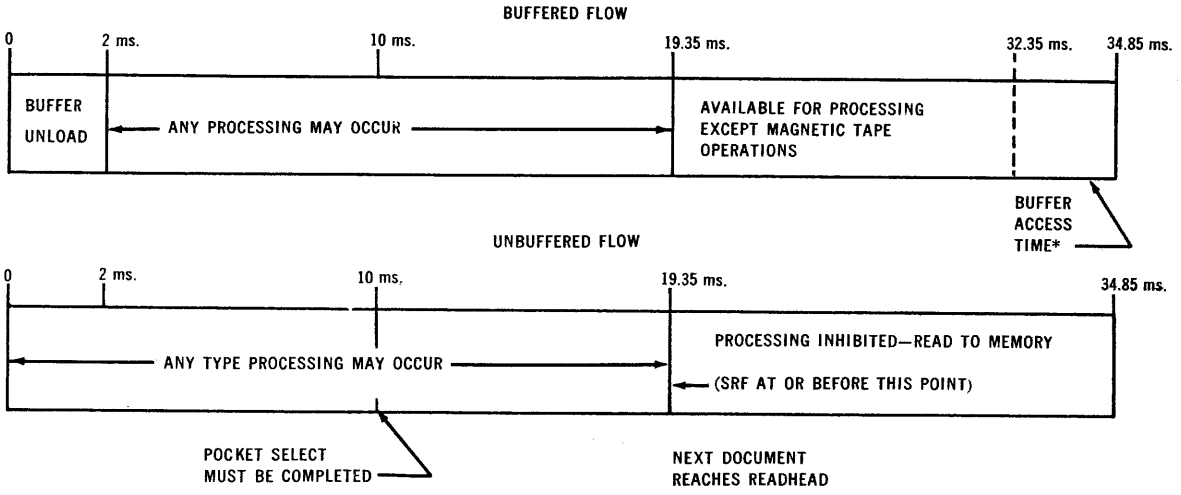
S = Start time for magnetic tape: Applicable times are:

B 421 : Write 6.7 ms.
Read 6.7 ms.

B 422 : Write 6.85 ms.
Read 6.85 ms.

C = Number of characters per record.

19.35 = total time between documents in which magnetic tape operations may take place.



*Buffer access time actually occurs throughout the read to buffer process (48 accesses x 40 μs. — 2 ms.). Net effect is that total processing time equals 30.35 ms. No additional time should be added to individual instructions for buffer access.

Figure 5-1. Magnetic Tape Operation When Using Sorter-Reader

Examples:

a. Assumption: Minimum time used for pocket select P = 2.12 ms., N = 50, (B 421), S = 6.7 ms., C = 25

$$R = N \frac{(19.35 - P - S)}{C}$$

$$R = 50 \frac{(19.35 - 2.12 - 6.7)}{25}$$

R = 21 records per block.

b. Assumption: Maximum time used for pocket select P = 10 ms., N = 50, (B 421), S = 6.7 ms., C = 25

$$R = N \frac{(19.35 - P - S)}{C}$$

$$R = 50 \frac{(19.35 - 10.0 - 6.7)}{25}$$

R = 5 records per block.

NOTE

For magnetic tape operations utilizing unbuffered flow mode, the following differences must be considered:

(1) No buffer unload time is required; therefore, the total time available for magnetic tape operations will be increased by 2 ms.

(2) However, since the read is directly to memory, total processing time will be 13 ms. (less 15 ms. for read, less 2 ms. for buffer access time).

5-9. A composite timing chart (figure 5-2), illustrates the timing available for computation on various size documents. There will be instances when all the documents being processed are identical in size; however, normally intermixed size documents will be processed. To prevent rejection of minimum size documents, it is recommended that timing be calculated on the basis of a minimum size document.

Document Length	Total Document Time Between Leading Edges (A)	Tolerance for Sorter-Reader Slippage (B)	Effective Document Time	Time to Read	
				Through 7¾″	Through Transit Number Symbol
5¾″	38.3 ms.	2.8 ms.	35.5 ms.	19.4 ms.	14.4 ms.
6″	40.0 ms.	3.0 ms.	37.0 ms.	19.4 ms.	14.4 ms.
6½″	43.3 ms.	3.3 ms.	40.0 ms.	19.4 ms.	14.4 ms.
7″	46.6 ms.	3.6 ms.	43.0 ms.	19.4 ms.	14.4 ms.
7½″	50.0 ms.	4.0 ms.	46.0 ms.	19.4 ms.	14.4 ms.
7¾″	51.6 ms.	4.2 ms.	47.4 ms.	19.4 ms.	14.4 ms.
8″	53.3 ms.	4.3 ms.	49.0 ms.	19.4 ms.	14.4 ms.
8½″	56.6 ms.	4.7 ms.	51.9 ms.	19.4 ms.	14.4 ms.
9″	60.0 ms.	5.0 ms.	55.0 ms.	19.4 ms.	14.4 ms.
9½″	63.3 ms.	5.3 ms.	58.0 ms.	19.4 ms.	14.4 ms.

Figure 5-2. Sorter-Reader Composite Timing Chart

a. This figure represents the amount of time available between Sorter-Read-Flow instruction for each given size of document. The formula used is shown below.

Length of Document in inches x 6-2/3 ms.

b. This figure represents the tolerance time which has been established for slippage in feeding of documents by the sorter-reader. It is calculated as follows:

(Length of Document in inches x 2/3 ms.) 1 ms.

NOTE

Computation times cannot be directly related to document lengths. Items, especially those in poor condition, may occasionally overlap while entering the feeder. The acceleration station will separate these documents; but when this process does not result in a minimum of 7-3/4-inches between the trailing edge of one document and the leading

edge of the next document, the items in the feed will be rejected and the sorter-reader will shut down. This separation process will result in a minimum available computation time of 19.35 ms. per item. Although this time may be increased slightly when processing documents greater than 6-1/2-inches in length, a higher incidence of rejected items will often result.

CARD READER TIMING

5-10. Each of the card readers used in a B 100/200/300 System is a demand-feed unit controlled by an electromagnetic clutch which feeds cards upon receiving a feed signal from the central processor. The two input buffers are used by the card readers.

5-11. The B 123 Card Reader may be used in place of either a B 122 or B 124 Card Reader. The characteristics of the B 123 are identical to the B 124 Card Reader with the exception of operating speed. The B 123 is designed to read cards at a speed of 475 cards per minute, which results in a time of 126 ms. per card. The time available for processing is 126 ms. minus 2.0 ms. (buffer unload time) minus 3.2 ms. (buffer access time), or 120.8 ms.

5-12. The associated input buffer of the central processor stores the characters as they are serially transferred from the card reader. Immediately upon executing a Card Read instruction, the contents of the 80-character input buffer are transferred to memory; the next card is moved past the read station, reading 80 characters into the buffer. Buffer to memory transfer requires 2 ms. Forty micro-seconds of central processor time are required as each character is read by the card reader and transferred to the buffer (buffer access time). All cards require an 80-character cycle. When card reader time exceeds internal processing time (input bound), available internal processing time can be used for multiprocessing.

B 122 Card Reader Timing

5-13. The B 122 Card Reader is a 200 cpm card reader that requires 300 ms. per card cycle. Internal processing can take place during the buffer reload time. The time available for processing would then be 300 ms. minus 2 ms. (buffer unload time) minus 40 μ s. per character (80 characters or 3.20 ms.) for a total of 294.8 ms.). The 320 ms. is considered buffer access time (figure 5-3).

5-14. In order to maintain the card reader input speed of 200 cards per minute, it is necessary to issue a second Card Read instruction within 300 ms. of the first Card Read instruction.

5-15. If the internal processing time between Card Read instructions is less than 294.8 ms., the 200 card-per-minute rate will be maintained. If the internal processing time between Card Read instructions is greater than 294.8 ms. and less than 309.8 ms. (hardware requires an additional 15 ms.), the effective reading rate is 190.4 cards-per-minute. When the time between Card Read instructions exceeds 315 ms. (this includes buffer transfer and buffer access time), the effective reading rate may be determined by dividing the total number of ms. processing time, plus buffer transfer and buffer access time, into 60,000 ms. (1 minute). The quotient will represent the actual speed, expressed in cards-per-minute, of the card reader.

B 124 Card Reader Timing

5-16. The B 124 Card Reader is an 800 card-per-minute reader which requires 75 ms. for each card cycle. Internal processing can take place during the buffer reload time. The time available for processing would then be 75 ms., minus 2 ms. (buffer unload time) minus 40 μ s. (80 characters) or 3.2 ms. for a total of 69.8 ms. The 3.2 ms. is considered as buffer access time (figure 5-4).

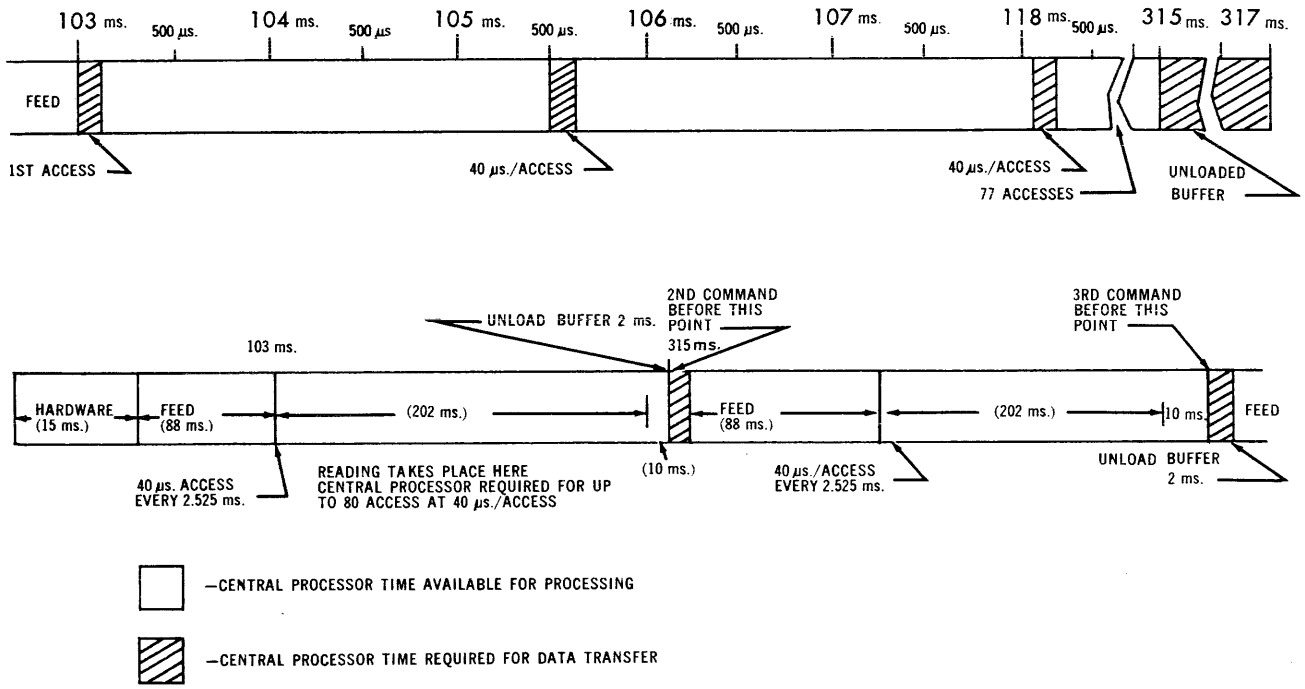


Figure 5-3. B 122 Card Reader,Timing Example

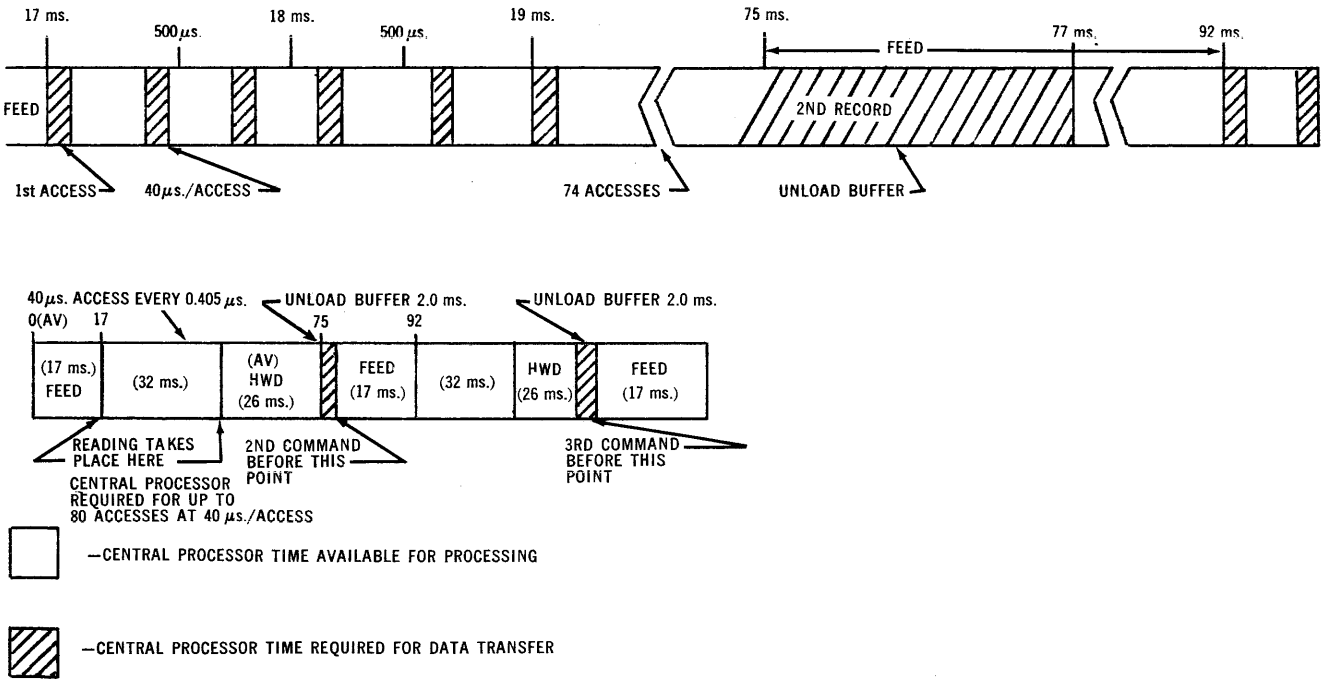


Figure 5-4. B 124 Card Reader, Timing Example

5-17. In order to maintain the rated input speed of 800 cards-per-minute, it is necessary to issue a second Card Read instruction within 75 ms. of the first Card Read instruction. If the internal processing time between Card Read instructions exceeds 69.8 ms., the effective reading rate may be determined by dividing the total number of ms. in internal processing time, plus buffer transfer (2 ms.) and buffer access time (3.2 ms.), into 60,000 ms. (1 minute). The quotient will represent the actual speed, expressed in cards per minute, of the card reader.

B 129 Card Reader Timing

5-18. The B 129 Card Reader is a 1400 card-per-minute card reader which requires 42.88 ms. for each card cycle. Internal processing can take place during the buffer reload time. An empty hopper condition causes the transport to shut off. When cards to be read are placed in the empty hopper, the transport restarts without additional operator action.

5-19. In order to maintain the rated speed of 1400 cards-per-minute, it is necessary to issue a second Card Read instruction within 42.88 ms. of the first Card Read instruction. If the internal processing time between Card Read instructions exceeds 37.68 ms., the effective reading rate may be determined by dividing the total number of ms. in internal processing time, plus buffer transfer (2 ms.) and buffer access time (3.2 ms.), into 60,000 ms. (1 minute). The quotient will represent the actual speed, expressed in cards per minute, of the card reader.

CARD PUNCH TIMING

5-20. Either a B 303 or B 304 Card Punch can be used in a B 200 Series configuration. A row buffer is supplied with both punches; therefore, one card row (80 bits) is punched at one time. This requires a total of 12 punch cycles to completely punch one card. When the punch instruction is executed, the central processor output buffer is loaded. The card will pass through the punch station and successive card rows will be punched from 12 to 9. Internal processing will take place during the punching of the card except for buffer load time and buffer access time. The output buffer is always interlocked for the duration of a card cycle.

5-21. When the punch time exceeds internal processing time (output bound), available processing time can be used for multiprocessing.

5-22. It should be noted that magnetic tape instructions may be given after the last punch cycle, for example, during the final 46.0 ms. on the B 303 Card Punch and during the final 30.8 ms. on the B 304 Card Punch.

B 303 Card Punch Timing

5-23. The B 303 Card Punch is a 100 card-per-minute punch which requires 600 ms. per-card-cycle. It is operated by a 14-tooth clutch which requires 50 ms. in addition to the 600 ms. when internal processing. Buffer transfer and buffer access cannot be accomplished within the 600 ms. card cycle (figure 5-5).

5-24. If the internal processing time between Card Punch instructions is less than 600 ms. minus 2.5 ms. (buffer load time), minus 1020 μs. for each row (12 rows or 12.24 ms.) for a total of 585.26 ms., the 100 cpm punching rate will be maintained. The 12.24 ms. represents buffer access time per-card-cycle. If internal processing is greater than 585.26 ms., an additional 50 ms. is required by the punch unit. The effective punching rate is 92.3 cpm when internal processing requires between 585.26 ms. and 635.26 ms. When internal processing is greater than 635.26 ms., the effecting punching rate may be determined by dividing the total number of ms. in internal processing time plus buffer load (2.5 ms.) and buffer access time (12.24 ms.) into 60,000 ms. (1 minute). The quotient will represent the actual speed, expressed in cards-per-minute, of the card punch.

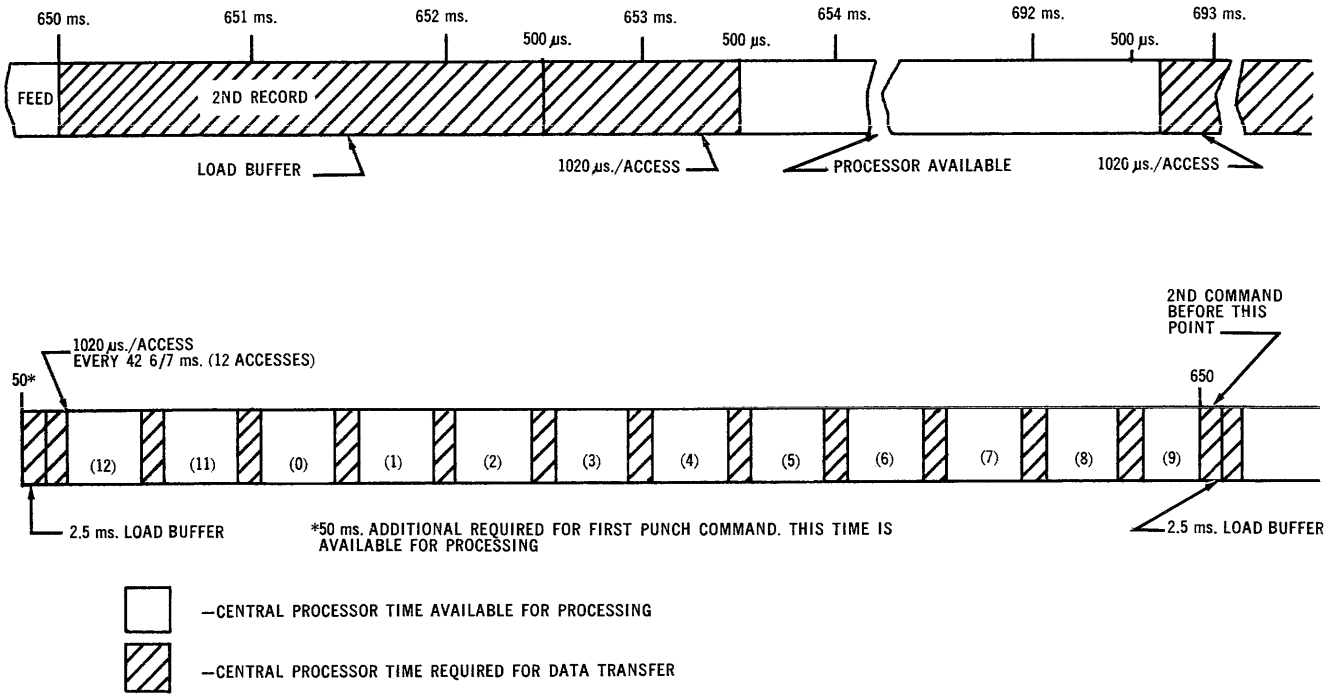


Figure 5-5. B 303 Card Punch, Timing Example

5-25. In some applications, the system may be output bound. That is, the time required to punch a card exceeds the buffer load time, plus internal processing time, plus buffer access time. In such a case, the total job time will be the number of cards to be punched, divided by the effective punching rate.

B 304 Card Punch Timing

5-26. The B 304 Card Punch is a 300 card-per-minute card punch which requires 200 ms. per-card-cycle. It is operated by a 1-tooth clutch; therefore, 400 ms. is required if the buffer access time exceeds 200 ms. If the internal processing time between Card Punch instructions is less than 200 ms. minus 2.5 ms. (buffer load time) minus 1020 µs. (12 rows or 12.24 ms.) for a total of 185.26 ms., the 300 cpm rate will be maintained. The 12.24 ms. represents buffer access time per-card-cycle. If internal processing is greater than 185.26 ms. or less than 385.26 ms., the effective punching rate is 150 cpm (figure 5-6).

5-27. When internal processing is greater than 385.26 ms., the effective punching rate may be determined by dividing the total number of ms. in internal processing time, plus buffer load time (2.5 ms.), plus buffer access time (12.24 ms.) into 60,000 ms. (1 minute). The quotient will represent the actual speed, expressed in cards-per-minute of the card punch.

B 320 LINE PRINTER TIMING

5-28. The B 320 Line Printer may be used with the B 200 Series in place of a B 321 Line Printer. The B 320 is physically and operationally identical to the B 321. However, the B 320 is designed to operate at speeds of up to 475 lines per minute when single spacing and 450 lines per minute when double spacing. Internal processing time is available for the entire print cycle except during buffer load time. The print cycle for the B 320 when printing 475 lines per minute requires 126.3 ms. This time, minus 1.3 ms. (buffer load time), or 125 ms., is available for processing.

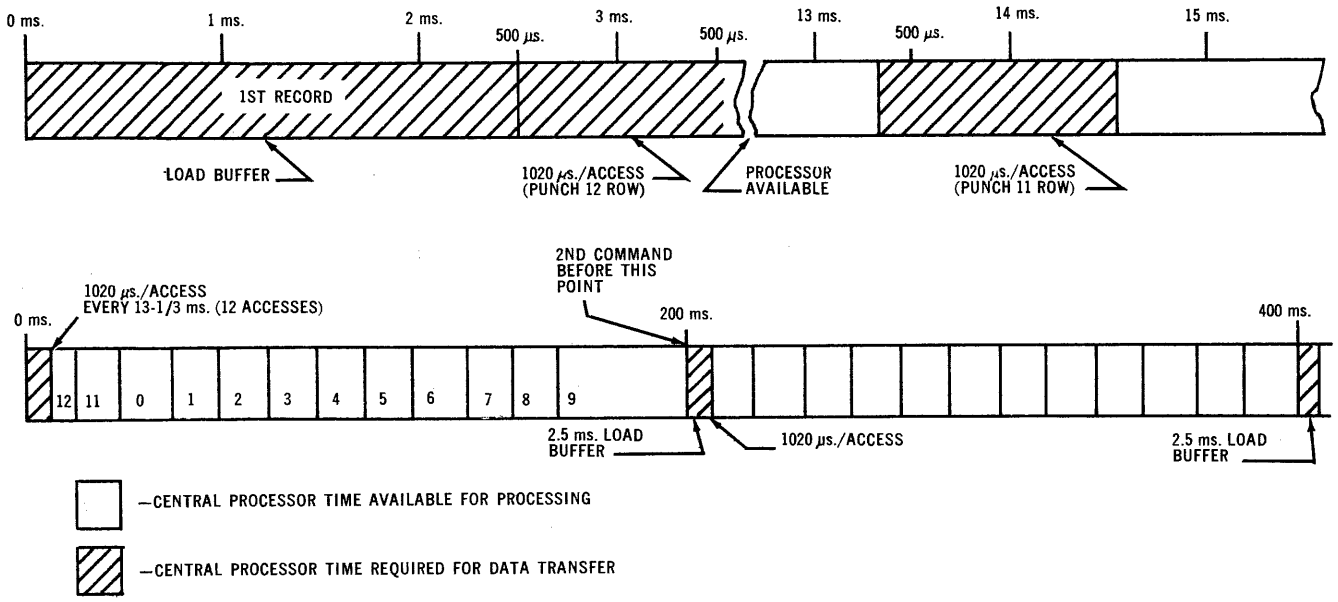


Figure 5-6. B 304 Card Punch, Timing Example

B 321 LINE PRINTER TIMING

5-29. The speed of the B 321 Line Printer is 700 lines-per-minute when single spacing, or 650 lines-per-minute when double spacing. Internal processing time is available for the entire print cycle, except during printer buffer load time.

5-30. The execution of the Print instruction causes the print buffer, located in the print unit, to be filled with data in 1.3 ms. As soon as the buffer is filled, a line will be printed. The buffer will remain interlocked for the duration of the print cycle. Buffer access time is not required because the printer contains its own buffer.

5-31. Double spacing and skipping after printing will interlock the print mechanism for additional time, but will not prevent a succeeding Print instruction from reloading the buffer if it is issued during the execution of the spacing or skipping operation. However, the central processor will be interlocked from the time the buffer is loaded, until the paper motion of the preceding command is completed.

5-32. If processing time (including buffer load time) exceeds 85.7 ms., the effective rate of printing may be calculated by dividing the total number of ms. processing time into 60,000 ms. (1 minute). The quotient will be the actual number of lines printed per minute (plus skipping time).

B 328 AND B 329 LINE PRINTER TIMING

5-33. The print drum on the B 328 and B 329 Line Printers revolves at a rate of 1040 rpm or one complete revolution every 57.6 ms. The character time for each of the 64 character positions is 0.9 ms. To advance the form a single space requires 24.3 ms. Each additional space requires 6.6 ms.

5-34. The 1040 lines-per-minute speed can be attained whenever all printing and spacing occurs during one revolution or every 57.6 ms; however, at least 24.3 ms. of spacing time must be masked in order to maintain this speed. This masking can occur if the equivalent number of consecutive characters are unused during the cycle (27 characters x .9 ms. per character = 24.3 ms.). Up to 37 consecutive alphanumeric characters can be

printed before spacing begins. This allows a single spaced speed of 1040 lines-per-minute whenever printing occurs within any 37 consecutive characters.

5-35. When a line to be printed is numeric only (10 consecutive locations) there are 54 unused positions, and the printer is released earlier for spacing. Up to four spaces between lines can be accommodated within the 48.6 ms. available for paper movement without affecting the 1040 rate.

5-36. A print line utilizing the entire 64 character range requires one complete revolution (57.6 ms.) plus 24.3 ms. for spacing, resulting in a single spaced speed of 734 lpm. Also, when printing within a range of 37 consecutive characters, spacing beyond one line will incur additional revolution time and the rate will be reduced as indicated below:

Number of Lines Spaced	L.P.M. With Various Consecutive Character Sets		
	10	37	64
1	1040	1040	734
2	1040	780	680
3	1040	715	625
4	1040	660	584
5	700	610	546

B 326 MULTIPLE TAPE LISTER TIMING

5-37. A B 326 Multiple Tape Lister may be used in place of either a B 322 or B 323 Multiple Tape Lister. The physical characteristics are identical to that of the B 322 and B 323. The only difference is that the B 326 is designed to operate at a speed of up to 1250 lines per minute. The print cycle requires 48 ms. However, 47.3 ms. is available for other processing since the only processor time necessary is the time to load the buffer which requires 0.7 ms. per line.

B 322 AND B 323 MULTIPLE TAPE LISTER TIMING

5-38. The B 322 and B 323 Multiple Tape Listers have a maximum speed of 1600 lines-per-minute. The 37.5 ms. print cycle allows 36.8 ms. for internal processing.

5-39. The execution of the Print instruction causes the print buffer, located in the Lister, to be filled with data in 0.7 ms. As soon as the buffer is filled, a line will be printed with the buffer remaining interlocked for the duration of the print cycle. Since the Lister contains its own buffer, buffer access time is not required.

5-40. Skipping after printing will interlock the print mechanism for an additional 100 ms., but will not prevent succeeding Print instruction from reloading the buffer if it is issued during the execution of the skipping operation.

5-41. If processing time (including buffer load time) exceeds 37.5 ms., the effective rate of printing may be calculated by dividing the total number of ms. processing time into 60,000 ms. (1 minute). The quotient will be the actual number of lines printed-per-minute.

B 332 AND B 333 MULTIPLE TAPE LISTER TIMING

5-42. A 6, 12, or 18-Tape Lister combination can be formed by utilizing a B 332 and a B 333 or a B 332 and two B 333's. The speed of any lister combination is 1565 lines-per-minute when the 24 character drum or the 16 characters of the alphanumeric drum are used. When full alphanumeric, 40 characters, are printed, the speed is 800 lines-per-minute.

5-43. When invalid characters are received, the scan cycle will continue for one complete drum revolution. The numeric print rate will be reduced to the rated alphanumeric speed

of 800 lines-per-minute for the print line with the invalid character. Also, the invalid character will cause a blank in the particular column. If the paper advances for more than one second, the drive mechanism is turned off and the NOT READY indicator lights.

B 421 MAGNETIC TAPE UNIT TIMING

5-44. The B 421 Magnetic Tape Unit permits reading and writing of data at either of two densities and speeds. They are:

50,000 characters-per-second at 555.5 characters-per-inch (50KC), or
18,000 characters-per-second at 200.0 characters-per-inch (18KC).

5-45. For 50KC, the transfer time per-character is 0.02 and 0.056 ms. for the 18KC rate. To determine the time required to read or write a record, the length of the record (number of characters plus 4.2) is multiplied by the character transfer rate (0.02 or 0.056 ms.). The product is then added to the time required to start tape movement, which is 5.4 ms. The resulting sum is the total time required to read or write the record. This same method of timing applies to Magnetic Tape Write and Erase instructions. Backspace requires 26.0 ms. plus character transfer time if it follows a Write instruction and 7.3 ms. plus character transfer time if it follows any other instruction.

5-46. Rewinding a tape requires 60 microseconds of central processor time, after which the rewinding is accomplished independently of the central processor. Total rewind time for a 2400 ft. reel is 90 seconds. This permits internal processing to continue while the tape is rewinding unless, of course, the tape unit being rewound is referenced by another instruction before the rewind operation is complete.

5-47. Magnetic tape instructions (rewind excluded) are not buffered and their execution times are to be considered as part of the total processing time. To calculate the total job time, the following factors are considered:

a. Tape Read + internal processing + Tape Write. The resulting sum, when divided into 60,000 ms. (1 minute), will express the number of records processed per-minute.

b. Dividing this quotient into the total number of records to be processed will give the total job time in minutes.

5-48. When a magnetic tape application utilizes short records, it is often advisable to pack, or combine, several such short records into one longer record. By so doing, the start time (6.7 ms.) normally required for each of the individual records is now considered only once per group, as this group of packed records will read in as one record. For example: to read 10 records of 30 characters each requires 7.36 ms. per-record or a total of 73.6 ms. total tape read time; however, if these same 10 records were combined into one record, the total time required to read in this record would be 12.76 ms. Using this simple technique can result in a considerable saving of tape time.

5-49. On various applications, the size of the magnetic tape file may require two or more reels of magnetic tape. Under this condition, and when the system being used has tape storage units not in normal use during the run, it is advantageous, from the job time and tape handling aspects, to mount the first reel on one unit and the second reel on another unit. When the end of the first reel is encountered during the processing run, the program (if so coded) will begin processing the tape from the second unit, while the first reel is being rewound. Then the third reel can be mounted in place of the first reel and the procedure repeated when the end of the second tape is encountered. This procedure of flip-flopping, either by manually changing

the unit designate number or by a self-modifying program, will reduce the over-all job time on applications which utilize large magnetic tape files.

B 422 MAGNETIC TAPE UNIT TIMING

5-50. The B 422 Magnetic Tape Unit is designed to read and write at two speeds, 24,000 characters-per-second or 66,600 characters-per-second. Transfer time when reading or writing at 24,000 characters-per-second, is 0.041 ms. per character. When reading or writing at 66,600 characters-per-second, the transfer time is 0.015 ms. per-character. The turn around time or the time to reverse the direction of the tape drive is 10.0 ms. Start time to begin reading or writing is 4.7 ms. Timing for the B 422 can be calculated in the same manner as described for the B 421.

B 423 MAGNETIC TAPE UNIT TIMING

5-51. The B 423 Magnetic Tape Unit may be used in place of either a B 421 or B 422 Magnetic Tape Unit. The B 423 Magnetic Tape Unit operates at a speed of 24,000 characters-per-second only. Timing for the B 423 may be obtained by referring to the B 422 Magnetic Tape Unit timing information.

B 424 MAGNETIC TAPE UNIT TIMING

5-52. The B 424 operates at a speed of 83 inches-per-second at 800 bits-per-inch density only, with a transfer rate of 66.6 KC. The B 424 may be used on a system either separately or in combination; however, when used in combination, it may only be combined with a B 422 Magnetic Tape Unit operating at 120 inches-per-second in either of two densities (200 or 555.5 B.P.I.).

B 425 MAGNETIC TAPE UNIT TIMING

5-53. The B 425 operates at a speed of 90 inches-per-second, permitting transfer rates of 18, 50 or 72 KC. Densities are operator selectable by pressing the required density switch located on the control panel. The B 425 is available for use with B 300 Systems only (table 1-1) and provides for manual selection of 200,556, or 800 bits-per-inch packing density.

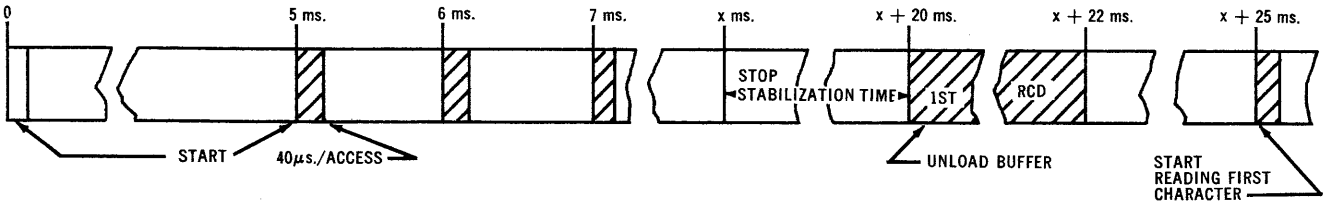
B 141 PAPER TAPE READER TIMING

5-54. The B 141 Paper Tape Reader can read punched paper tape at speeds of either 500 or 1000 characters-per-second. Fanfold tape, whether in strips or in reels, must be read at 500 characters-per-second.

5-55. The start time for the B 141 is 5 ms. and stop time is 1 ms. (oiled or non-oiled tape). The B 141 stops on the stop character or between characters at both high or low speeds. After the last character has been read, the B 141 requires 20 ms. stop stabilization time (this includes the 1 ms. stop time), prior to executing another command. A command given in less than 20 ms. waits for the 20 ms. time interval. If a broken tape condition occurs, the tape reel motors are automatically turned off. The total time between Paper Tape Reads is 25 ms. This includes the 20 ms. stop stabilization time, plus the 5 ms. start time (figure 5-7).

B 341 PAPER TAPE PUNCH TIMING

5-56. The B 341 Paper Tape Punch punches at a speed of 100 characters-per-second, 10 characters-per-inch. Through means of an output code translator, the translator allows translation of BCL code to any 6, 7, or 8-level code, in up to 64 different characters. The B 341 Paper Tape Punch automatically shuts off if it has not punched paper tape within one second. If a punch command is given while the paper tape punch is off, it will take less than one second before punching commences, after it is turned on (figure 5-8).



1000 CPM (40μs./ACCESS EVERY 1.0 ms. USING BUFFER) (2.0 ms.—UNLOAD BUFFER) (5.0 ms. START) (20.0 ms. STOP STABILIZATION)

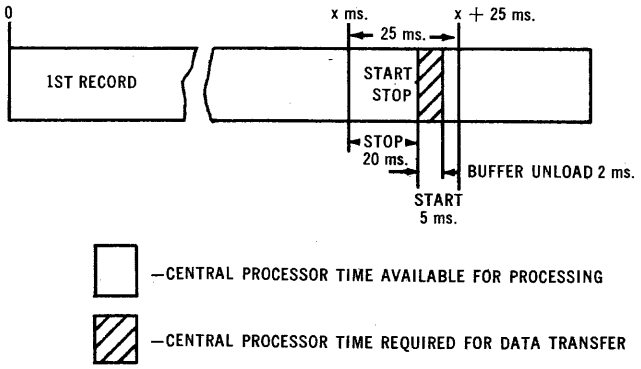


Figure 5-7. B 141 Paper Tape Reader, Timing Example

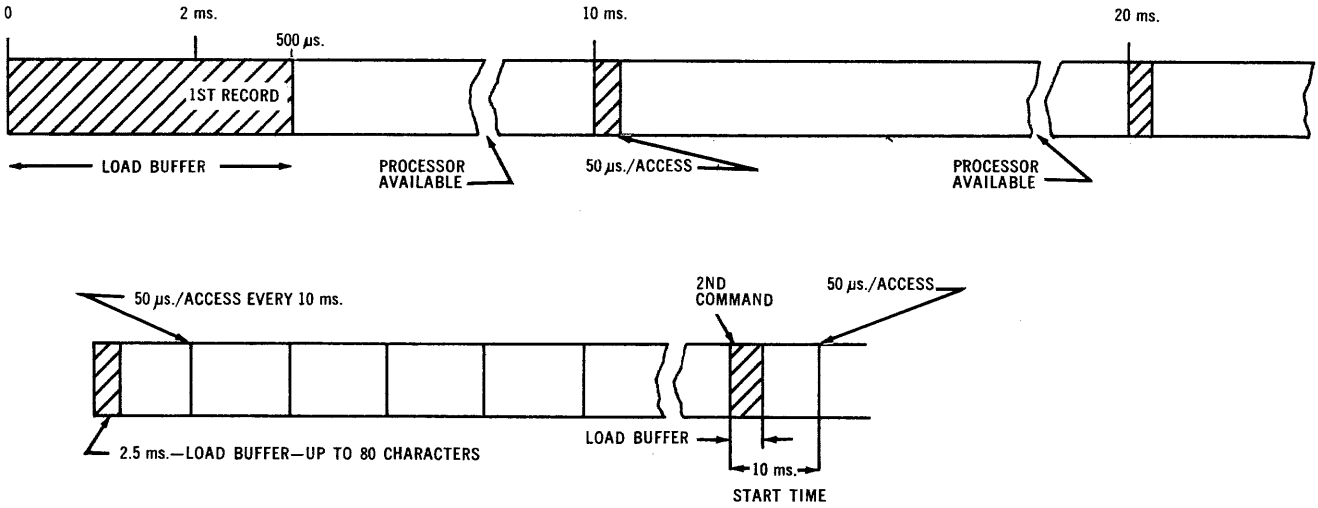


Figure 5-8. B 341 Paper Tape Punch, Timing Example

5-57. If the B 341 Paper Tape Punch has not been turned off, it will take approximately 10 ms. before punching commences.

DISK FILE AND DATA COMMUNICATION TIMING

5-58. The disk file has an average access time of 20 ms. and a maximum access time of 40 ms. Usually, the disk file functions fall into two categories. One involves locating and then reading or writing data only. The other involves locating, reading, and the writing back of data on the file. The total time for these typical processing cycles are listed in tables 5-1 and 5-2.

TABLE 5-1
Locate and Read or Write

OPERATION	TIME	EXPLANATION
Locate 240-character data segment.	20.0 ms.	Latency time only.
Read and transfer 240 char. to core memory. (Write and transfer 240 chars. to disk storage.)	2.4 ms.	Data is now available for processing, inquiry reply, printing, punching, magnetic tape writing, etc.
TOTAL CYCLE TIME	22.4 ms.	

Data Communication Timing

5-59. A maximum of fifteen teletype and/or typewriter units can be attached to one data communication control unit. Only one data communication control unit can be attached to a B 273, B 283 or B 300 System (table 1-1). One teletype terminal unit with a 120 or 240-character buffer can be connected to up to 399 teletype stations. The minimum data transfer rate is 30 KC between the terminal buffer and the central processor. The central processor replies are terminated by a group mark. Typewritten station inquiries are terminated by pressing the END-OF-MESSAGE key. All teletype inquiries are terminated by "bb" sequence.

TABLE 5-2
Locate, Read, Process, Write Back

OPERATION	TIME	EXPLANATION
Locate 240-character segment.	20.0 ms.	Latency time only.
Read & transfer 240 chars. to core memory.	2.4 ms.	Data is now available for processing.
Process data.	37.6 ms.	This is latency period while disk revolves to original data location. Data is manipulated and a write command is issued during this time. Printing, punching, magnetic tape writing, etc., can occur during this latency.
Write updated information.	2.4 ms.	Information has been written back on disk and system is free for next transaction or storage access.
TOTAL CYCLE TIME	*62.4 ms.	

NOTE
This cycle would be extended and another full revolution (40 ms.) added if the optional read check operation is performed. The central processor is free to perform functions both during disk revolution and read check time.

B 495 Supervisory Printer Timing

5-60. The B 495 Supervisory Printer uses a modified electric typewriter as an input/output device which can be field installed. The print format is 10 characters-per-inch horizontally, and six lines-per-inch vertically. The B 495 operates at the rate of 10 characters-per-second.

APPLICATION TIMING

5-61. Punch card and magnetic tape applications to be processed on B 100/200/300 Systems will fall into one of the following categories:

a. Required processing time is less than or equal to the available processing time.

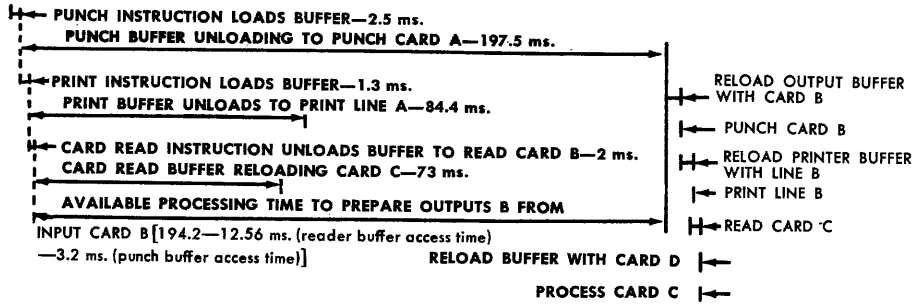
b. Required processing time is greater than the available processing time.

5-62. When processing can be accomplished within the time available on input/output instructions, the timing of the application will be based on the rated speed of the slowest input or output unit. In figure 5-9, timing is shown for an application which reads one card, then prints a line and punches a card before reading another card. Processing of this application will be at the rate of 300 transactions-per-minute, which is the speed of the punch unit involved.

5-63. When required processing time exceeds available processing time, the method of determining total job time changes. To accurately determine the total processing time required on a given application, it will be necessary to compute the time on every instruction in the routine and compare this to the available buffered processing time. The processing time is multiplied by the number of repetitions and the product, when converted from milliseconds to minutes, will be the job time required.

INSTRUCTION TIMINGS

5-64. Since all of the B 100/200/300 Systems are character oriented, the time required to execute most instructions will vary depending on the number of characters involved. A complete timing chart of the instructions used is included in the appendices.



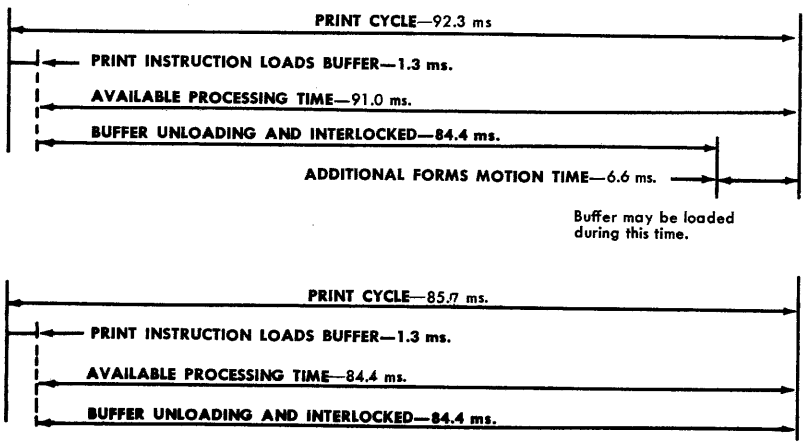


Figure 5-9. Application Timing Example

SECTION 6

INPUT/OUTPUT MEDIA AND FORMS DESIGN

GENERAL

6-1. Input/Output Media refers to the means by which information is entered into the computer and the means by which results of processing are obtained from the computer. Input media takes the form of punched cards, punched paper tape, magnetic tape, MICR documents, etc. The output media resulting from computation includes punched cards, punched paper tape, magnetic tape, and printed forms.

6-2. This section describes the various forms of input/output media used by the B 100/200/300 Systems. This media consists of the following:

a. 80-Column Cards

b. Paper Tape

c. Magnetic Tape

d. MICR Documents

e. Printed Forms

PUNCH CARD STOCK

6-3. The punch card peripheral units are capable of processing the following types of card stock:

B 122 Card Reader: 80 columns, standard thickness.

B 123 or B 124
Card Reader: Either 80-, 66-, 60-, or 51-column cards of either standard or postcard thickness.

B 303/B 304
Card Punch: 80-column cards of either standard or postcard thickness.

Number Of Columns

6-4. Up to 80 columns can be punched on the maximum-length card.

Card Description

6-5. The cards used with the B 100/200/300 Series have edges which must be free from creases and free of fuzz and particles which might affect electrical contacts. However, the B 124 Card Reader will read metalized cards.

Card Size

6-6. The length of an 80-column punched card at any point parallel to the bottom edge is 7.375 inches. The width of the card when measured at any point is 3.250 inches. The cards can have one or more corners cut at a 60^{o} angle to the top or bottom edge of the card.

Punched Hole Size and Location

6-7. The size of the punched hole is approximately 0.125 inch high and 0.055 inch wide.

The holes punched in the 80th column are centered on a line 0.251 inch from the right end of the card. Other columns of holes appear at 0.087 inch intervals. In each case, the tolerance for location is ±0.007 inch with the right end of the card as the reference point. Holes can appear in any 12 locations in each vertical column. The uppermost punching position is centered 0.250 inch from the upper edge of the card. Lower punching positions occur at 1/4-inch intervals.

Notched Cards

6-8. Cards can be notched (on the verifying machine) along the top and right edges to indicate errors or good verification, respectively. The notches resemble a half-moon and are punched over the error, or on the right edge of the card to indicate a correctly verified card. The card-correct notch is located between rows 0 and 1. Card-error is located on top of the column in error.

PAPER TAPE SPECIFICATIONS

6-9. Specifications for perforator tape used in B 100/B 200/B 300 Systems are described in the paragraphs that follow. They include the general physical characteristics: dimensions, grades, hole patterns and tolerances. Methods of marking beginning- and ending-of-tape and splicing are also included.

Environmental Standards

6-10. Supplies of perforated tape should be stored at least 24 hours in areas with a typical minimum acceptable environment for human occupancy by clerical workers or conditions normally found at a data processing installation.

Physical Characteristics

6-11. The different tape widths which can be used are: 0.687 (11/16), 0.875 (7/8), and 1.000 (1) inch, with a tolerance of plus or minus 0.003 inch. Tapes with a nominal thickness of 0.0030 to 0.0050 inch are acceptable, with a tolerance of plus or minus 0.0003 inch. The total thickness including splices should not exceed 0.010 inch. An opacity minimum of 60 per cent is acceptable for oiled and dry paper. A minimum opacity of 90 per cent for mylar and similar materials is required (see table 6-1).

TABLE 6-1

Paper Tape Physical Characteristics

	OILED PAPER TAPE	PAPER TAPE	PAPER COVERED MYLAR	METALIZED MYLAR
Material	Oiled Paper	Paper	Mylar with Paper Laminated to Both Sides	Aluminum Vapor Deposit Between Layers of Laminated Mylar
Color	Buff, Yellow, Red, White, Green, Black, Gray and Blue	Same as Oiled Tape	Blue, Green, Light Brown, Dark Brown	Blue
Stock	100% Bleached Chemical Wood Pulp	Same as Oiled Tape	-	-

TABLE 6-1 (cont)

Paper Tape Physical Characteristics

	OILED PAPER TAPE	PAPER TAPE	PAPER COVERED MYLAR	METALIZED MYLAR
Oil	Light Grade Paraffin Base Free from Acids and Odorless as possible.	-	-	-
Oil Content	12-22% Based on Weight of Deoiled Paper	-	-	-
Basis Weight (lbs)	Deoiled Paper 24 x 36/500. . . 50 ± 5%	Same as Oiled Tape	-	-
Thickness (in.)	.004 ± .0003	Same as Oiled Tape	.0045 ± .0003	.003 ± .0003
Tensile (lbs)	M.D. lbs/1 in. Strip: 30 min. C.D. lbs/in. Strip: 20 min.	Same as Oiled Tape	65 min.	65 min.
Tear (Grams)	M.D. 45 min.	Same as Oiled Tape	-	-
Fold (M.I.T.)	M.D. 75 min.	Same as Oiled Tape	-	-
Yield Point (PSI)	40 min.	Same as Oiled Tape	45 min.	40 min.
Ash Content	Deoiled 1% max.	1% max.	-	-
Acidity (PH)	4.2 min.	Same as Oiled Tape	-	-
Grit	0.04% max. Abrasive Impurities and Fillers (Deoiled Paper wt.)	Same as Oiled Tape	-	-

TABLE 6-1 (cont)

Paper Tape Physical Characteristics

	OILED PAPER TAPE	PAPER TAPE	PAPER COVERED MYLAR	METALIZED MYLAR
Break Elongation	-	-	2% max.	100% max.
Edge Tear (lbs)	-	-	84 min.	80 min.
Shrinkage	-	-	0.4% max.	0.1 % max.

6-12. The maximum diameter of rolled paper tape is 8.130 inches. The core must have an inside diameter of 2.000 inches plus or minus 0.100 inch, and a wall thickness of one-eighth to three-sixteenth inch. The tape must be wound evenly and tightly with clean, sheer-cut edges on one continuous roll without splices. It must be free from lint, wrinkles, pin holes, areas or spots of lesser opacity, tears or other imperfections.

Operating Requirements

6-13. The tape must be capable of giving clean cut holes and not cause excessive lint accumulation in punches and readers. It must withstand 50 single passes in the B 141 Paper Tape Reader with random start and stops without error due to tape deficiency.

Punched Hole Characteristics

6-14. The five types of punched tape normally considered for use with Paper Tape Systems are five-channel teletype, five-channel regular, six-channel, seven-channel and eight-channel. (See figure 6-1.) The channel numbers and punched hole dimensions are given in the following paragraphs.

6-15. Data hole diameters equal 0.072 plus 0.001 or minus 0.003 inch. The distance between holes (centers) is 0.100 plus or minus 0.002 inch, that is, between channels 1 and 2, etc. The distance between holes (centers) in adjacent characters is 0.100 plus or minus 0.003 inch with a cumulative tolerance over six inches of plus or minus 0.015 (distance between the hole in channel 1 of one character and the hole in channel 1 of adjacent characters).

6-16. The relation between codes and channels is similar to that shown in figure 6-2.

Suggested Procedures

6-17. End of Tape. The end-of-tape detector signals end of tape when all light is blocked by a fully opaque perforator tape with no holes. Use an insert or leader of fully opaque perforator tape with no holes.

6-18. As an alternative, opaque adhesive tape can be attached to the perforator tape. Black Scotch brand (MMM) acetate film tape #800 or equivalent of lesser width than the perforator tape, but at least 0.656 inch wide can be used. The opaque adhesive tape should be at least 12 inches long, aligned closely with the channel 1 edge without protrusion and without loose or rough edges.

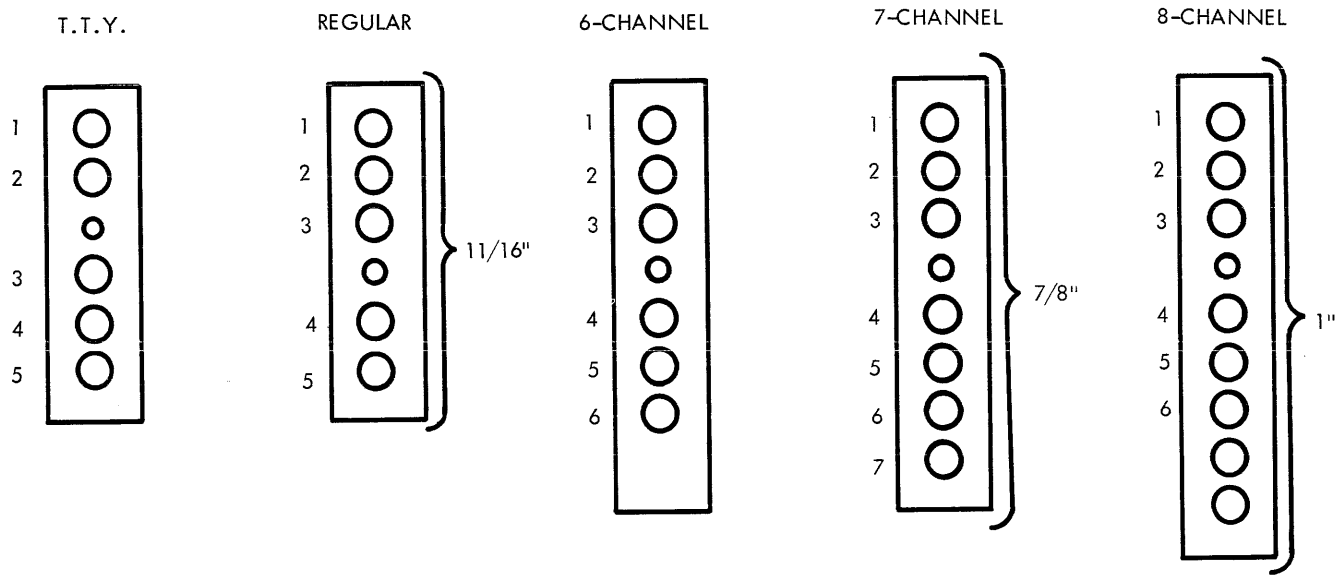


Figure 6-1. Punched Paper Tape Types

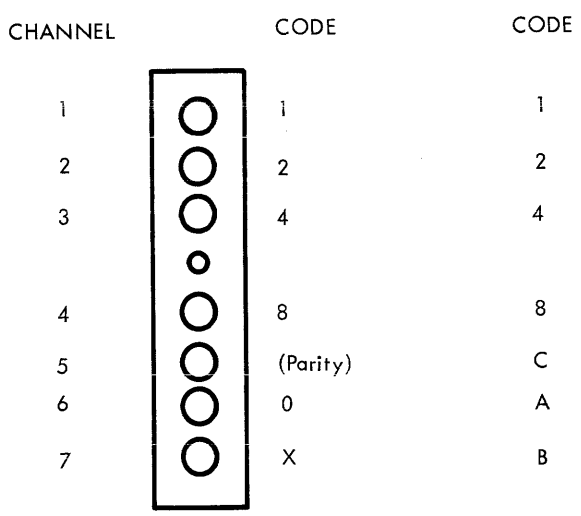


Figure 6-2. Punched Paper Tape, Channel-Code Relationship

6-19. Splicing. When splicing, use transparent Scotch brand (MMM) polyester film tape #853 or equivalent with a three-fourth to one-inch width. The spliced perforator tape should not have any areas or spots greater in thickness than the perforator tape thickness plus twice the thickness of the adhesive tape. Crumpled tape and fuzzy edges must be trimmed away before splicing.

6-20. If splicing by hand, align and overlap ends to be spliced before cutting both simultaneously. Butt ends together and apply adhesive tape parallel to the cut line and approximately centered on it. Apply adhesive tape to the reverse side and trim excess accurately, thereby maintaining uniform perforator width in the spliced area. Check the adhesive tape to ensure complete bind without loose or rough edges. Splicing of oiled tape should be avoided if at all possible.

LINE PRINTER SUPPLIES

6-21. The following specifications should be used to evaluate supplies for use in Burroughs Line Printers. They may also be used as a guide for customer purchases. Supplies that meet these specifications should perform in the line printer satisfactorily; however, it is the vendors' ultimate responsibility to make certain that his supplies give customer printing and printer-performance satisfaction.

Form Specifications

6-22. Single or multiple forms, and preprinted formats will be specified by the

customer. The pre-printed format must allow for printer and form tolerances. Printer tolerances are as follows:

a. Maximum vertical displacement per printed line is 0.134 inch.

b. Horizontal displacement between any two characters is plus or minus 0.003 inch.

6-23. Form tolerances must be considered in addition to the printer tolerances. Minimum width is five inches, maximum width is 20 inches (including punched margin strips). Maximum length between folds is 22 inches.

6-24. Multiple forms (paper and carbons) should be held together adequately to enable the multiple part to feed through the line printer satisfactorily. Stapled forms are not permitted. Solid pasting can be used for a particular application if the forms feed through the line printer satisfactorily. Crimping all the parts on both edges of the form, every two inches, is an acceptable method.

6-25. All forms should be punched and perforated adequately so that satisfactory continuous feeding through the line printer can be maintained. Also, the forms should be continuous fanfold, punched for feeding by tractor pins. Punched tractor feed holes shall have a 5/32-inch diameter, 1/2-inch between successive centers with the hole center 1/4-inch from the edge of the form. The maximum paper weights (17 x 22 - 500) recommended for various part forms are listed in table 6-2.

6-26. The parts for any multiple part form shall be determined by the weight, caliper, type, and number of papers and carbons required for a particular application.

6-27. Carbons should be a maximum of 9 pound sulphite. Print quality of the 6th and 7th copy of the 6 and 7 part forms will be improved by using 7.5 pound sulphite carbon paper throughout (see table 6-3).

TABLE 6-2

Paper Weights

NUMBER OF PARTS	PAPER WEIGHTS FOR EACH PART						
	1	2	3	4	5	6	7
1	25#*	-	-	-	-	-	-
2	15#	12#	-	-	-	-	-
3	15#	12#	12#	-	-	-	-
4	15#	12#	12#	12#	-	-	-
5	12#	12#	12#	12#	12#	-	-
6	12#	12#	12#	12#	12#	12#	-
7	11#	11#	11#	11#	11#	11#	11#

* (15# minimum)

TABLE 6-3

Forms and Carbon Paper Test Requirements
(Test Methods Obtainable from Burroughs Corporation)

CHARACTERISTICS	REQUIREMENTS	
	2 Thru 4 Parts	5 Thru 7 Parts
Transfer Characteristics	75 Min.	75 Min.
Impact Transfer	25 Max.	22 Max.
Smudge	76 Min.	81 Min.

NOTE

Other weights for special form applications (i.e., tab card stock, check stock, etc.) can be used at the customers' responsibility providing that they meet other specifications listed herein and do not increase maintenance service of the line printer.

6-28. Peaking of the forms at the perforation shall be limited to avoid ink tracking from the printer ribbon.

6-29. The forms should be stored in an atmosphere of $70^{o}F \pm 15^{o}$ and 40% ± 25% relative humidity. Storage in other than these environments may be detrimental to the performance of the media which must function satisfactorily under the machine operating environments shown in figure 6-3 (Operating Environment).

6-30. When physical tests of the paper are required, samples shall be conditioned at $73^{o} \pm 3^{o}$ and 50% ± 2% R.H. for at least 24 hours prior to conducting such tests. Forms test requirements are shown in table 6-4.

6-31. White paper is recommended for all forms. If colored paper is required in a multiple part form, the last two copies must be light enough in color to furnish the contrast required for legible print.

6-32. Refer to the Supplies Index (table 6-6) for approved vendors' form numbers. Detailed specifications required by vendors are contained in Burroughs Specifications for Fanfold Paper for Drum (line) Printer, 10264497 and 10264620, and can be obtained from Purchasing Department, 14300 Tireman, Detroit, Michigan 48228.

RIBBON SPECIFICATION

6-33. The ribbon should be stored in an atmosphere of $70^{o}F \pm 15^{o}$ and 40% ± 25% relative humidity (see figure 6-4). Storage in other than these environments may be detrimental to the performance of the media which must function satisfactorily under the operating environments shown in figure 6-1.

6-34. Where physical tests of the ribbon are required, samples should be conditioned at $73^{o}F \pm 3^{o}$ and 50% ± 2% R.H. for at least 24 hours prior to conducting such tests.

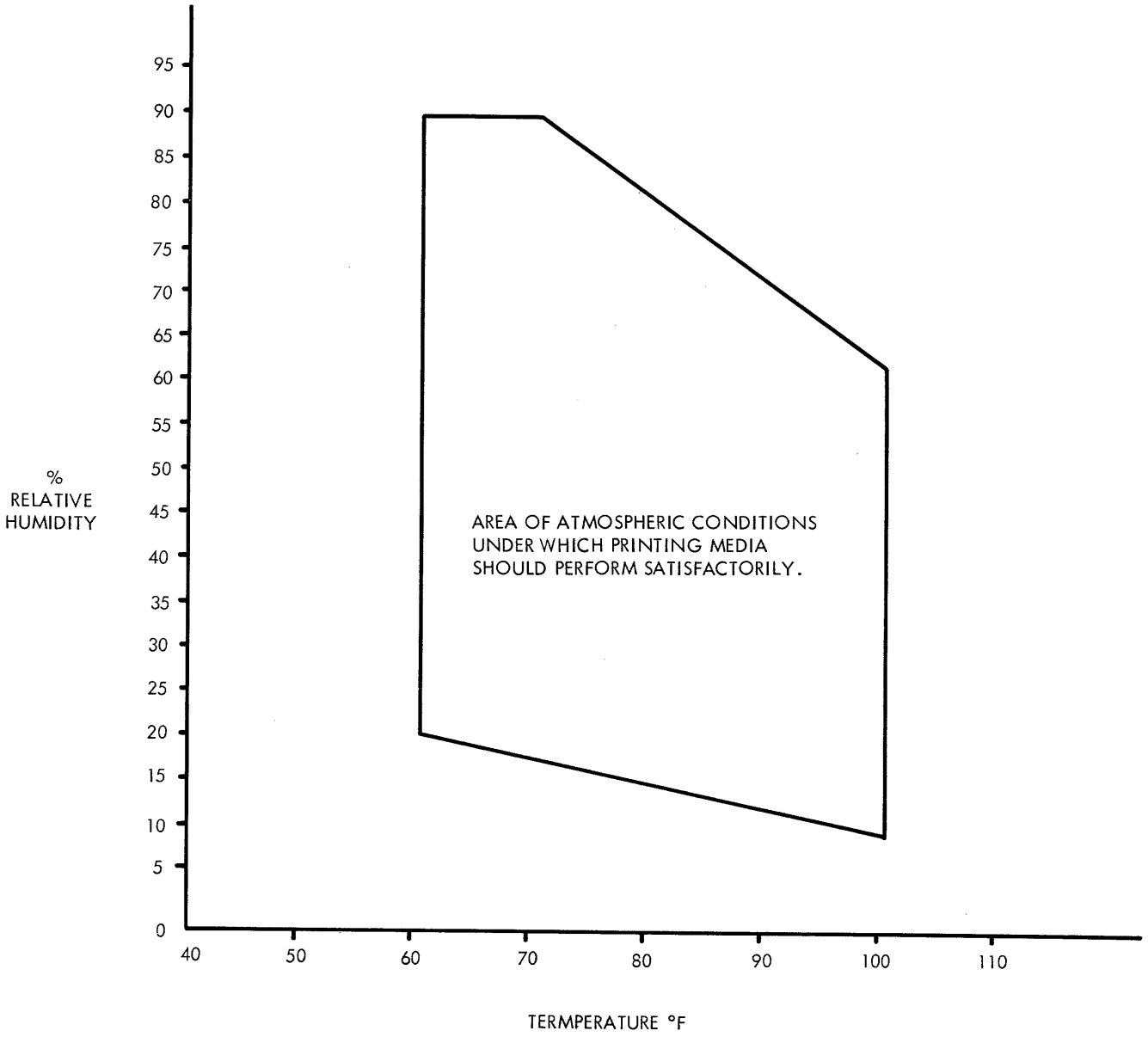


Figure 6-3. Temperature and Humidity Operating Environments for Line Printers

a. Ribbon Width - 17.50 ± 0.06 inches

b. Usable Ribbon Length - 50.00 ± 0.50 feet

6-35. The ribbon cloth must be continuous and uniform in texture, and there should be no imperfection in the ribbon cloth such as holes, patches, sewed areas, knots, etc., that would cause a noticeable variation in print, or interfere with ribbon backing to the line printer. It should be inked uniformly throughout the ribbon. Test requirements are shown in table 6-5.

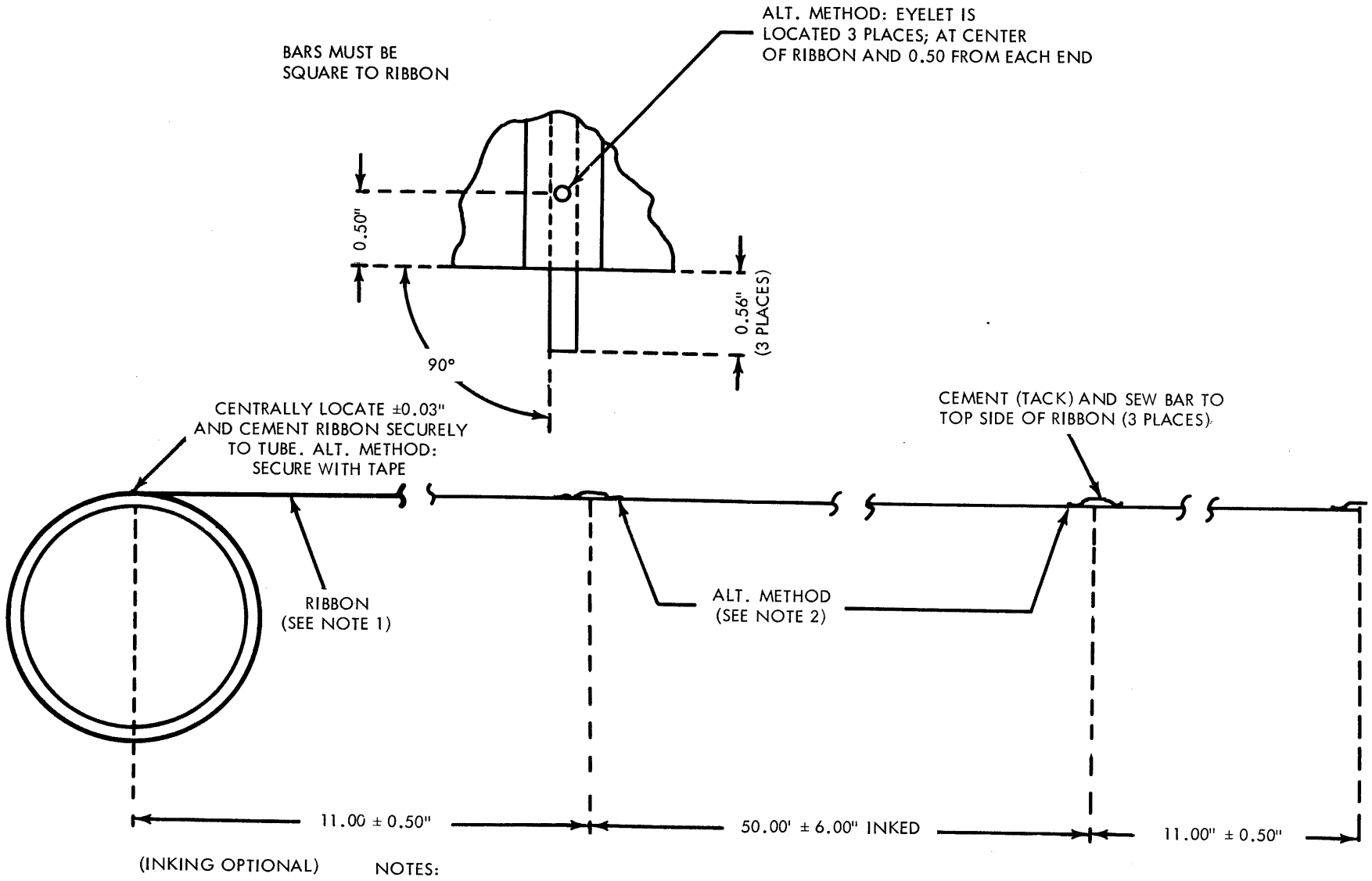
6-36. Detailed specifications required by vendors are contained in Burroughs Sub-Assembly Tube 17-1/2" Ribbon and Bar drawing 10011542 and Specification for Ribbon for Drum (Line) Printer, 10264521. They can be obtained from Purchasing Department, 14300 Tireman, Detroit, Michigan 48228.

TABLE 6-4

Forms Test Requirements

CHARACTERISTICS	REQUIREMENTS
Bursting Strength (Mullen)	1 point/pound of paper, minimum
Tear (Elmendorf)	M.D. 1.6 gm-cm minimum per pound of paper
Smoothness (Sheffield)	90 maximum value (multiple) 150 maximum (single)
Brightness (Photovolt)	76 minimum on white paper
Opacity	75 minimum (multiple) 80 minimum (single)
Tensile at perforations (First and last sheets) Press perforations Unit perforations	4.5 lbs. minimum per inch width 2.0 lbs. minimum inch width (multiple part only)
Number of cuts or ties at perforations across 2.5 inch span (single part form)	24 minimum
Ink writing	Must not feather*

* When writing on this paper with pen and ink at room temperature, there should be no sign of ink feathering.



NOTES:

1. RIBBON WIDTH 17.50 ± 0.06"
2. ALTERNATE METHOD. SECURE TWO DOUBLE BARS 10099018, ONE ON TOP SIDE AND ONE ON BOTTOM SIDE OF RIBBON, USING (3) EYELETS WITH RIBBON SANDWICHED BETWEEN.

Figure 6-4. Ribbon Specifications

TABLE 6-5

Ribbon Test Requirements

CHARACTERISTICS	REQUIREMENTS
Material	Nylon
Degree of Inking 20 second dwell 1 minute dwell 2 minute dwell	 60 Min. - 80 Max. 40 Min. - 60 Max. (photovolt units) 40 Min. - 60 Max.
Color	Black
Thread Count	280 ± 5 per square inch
Cloth	* 4332
Cloth Caliper	0.0050 ± 0.0002
Ribbon Edges	Heat fused 1/32 max.

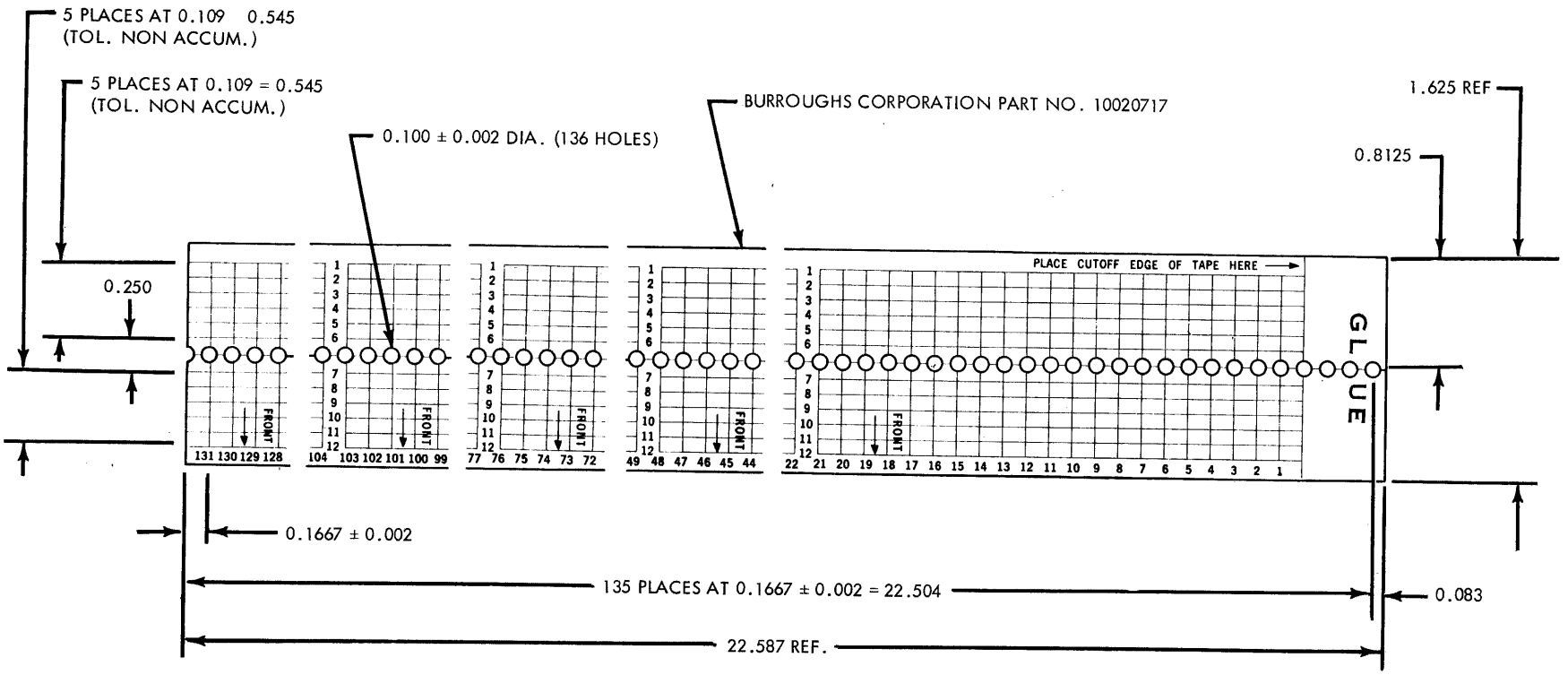
* Standard product - (woven by Burlington Mills or Engineering approved equivalent)

FORMAT TAPE SPECIFICATIONS

6-37. The format (carriage control) tape should be stored in an atmosphere of 70° ± 15° and 40% ± 25% relative humidity (see figure 6-5). Storage in other than these environments may be detrimental to the performance of the media which must function satisfactorily under the operation environments shown in figure 6-3.

6-38. The length of format tape is 22.587 ± 0.005 inches; the width is 1.625 ± 0.005 inches. Sprocket hole diameter is 0.100 ± 0.002 inch, the distance between centers is 0.1667 ± 0.002 inch. Tolerance over any 15 consecutive holes shall not exceed ± 0.015 inch. Material is grey RVCP-23 laminated mylar long fiber rope base paper, paper mylar paper bonded 0.0045 ± 0.0005 inch thick.

6-39. Detailed specifications required by vendors are contained in Burroughs Format Tape drawing 10020717 and Specification for Format Tape for the Drum (Line) Printer 10264463. They can be obtained from Purchasing Department, 14300 Tireman, Detroit, Michigan 48228.



NOTES:

1. MATERIAL TO BE GRAY RVCP-23 LAMINATED MYLAR LONG FIBER ROPE BASE PAPER, PAPER MYLAR PAPER BONDED 0.0045 ± 0.0005 THICK.
2. TOLERENCE OVER ANY 15 CONSECUTIVE HOLES NOT TO EXCEED ± 0.015.
3. PRINT TO BE BLACK CONDENSED GOTHIC 5 POINT TYPE EXCEPT THE WORD GLUE WHICH IS 9 POINT TYPE.

Figure 6-5. Format Tape Specifications

LINE PRINTER CARD STOCK SPECIFICATIONS

6-40. Pre-printed format will be specified by the customer. The pre-printed format must allow for printer and form tolerances. Printer tolerances are:

a. Maximum vertical displacement per printed line is 0.134 inch. Horizontal displacement between any two characters is plus or minus 0.003 inch.

b. Form tolerance must be considered in addition to the printer tolerances.

6-41. Minimum width is five inches, maximum width is 20 inches (including punched margin strips). Maximum length between folds is 22 inches.

6-42. The card stock should be continuous fanfold, punched and perforated adequately so that satisfactory continuous feeding through the line printer can be maintained. Punched tractor feed holes shall have a 5/32-inch diameter, 1/2-inch between successive centers with the hole center 1/4-inch from the edge of the form.

6-43. The maximum weight for card stock shall be 125# (24 x 36 - 500). A lower maximum weight may be required to avoid customer objection to ghost printing. Peaking of the card stock at the perforation shall be limited to avoid ink tracking from the line printer ribbon and excessive ghost printing.

6-44. Where physical tests of the card stock are required, samples should be conditioned at $73^{\circ}F \pm 3^{\circ}$ and $50\% \pm 2\%$ R.H. for at least 24 hours prior to conducting such tests.

6-45. The card stock should be stored in an atmosphere of $70^{\circ}F \pm 15^{\circ}$ and $40\% \pm 25\%$ relative humidity. Storage in other than these environments may be detrimental to the performance of the media which must function satisfactorily under the operating environments shown in figure 6-3. When writing on the card stock with pen and ink at room temperature, there shall be no sign of ink feathering.

6-46. Detailed specifications required by vendors are contained in the specification for Card Stock for the Drum (Line) Printer, 10264505. They can be obtained from the Purchasing Department, 14300 Tireman, Detroit, Michigan 48228.

SUPPLIES INDEX

6-47. The Supplies Index (table 6-6) lists vendors who have submitted their supplies to Burroughs for testing of important physical characteristics and performance requirements. This index does not in any way constitute an endorsement only of those vendors listed. Equivalent supplies from vendors not listed may be purchased providing those supplies meet Burroughs specifications and the performance requirements of the user.

6-48. All supplies should be ordered by the supplier's identification number (include Burroughs specification number). The size should always be listed. When purchasing paper forms, the number of parts should be specified. Detailed testing specifications will be supplied to the vendor upon request to the Purchasing Department, Burroughs Corporation, 14300 Tireman, Detroit, Michigan 48228.

TABLE 6-6

Line Printer Supplies Index

SUPPLIES	SINGLE PART FORM	2 PART THRU 4 PART	5 PART THRU 7 PART	CARD STOCK		RIBBON	FORMAT TAPE
MATERIAL OR BLUEPRINT	15 POUND			100 POUND	125 POUND	10011542	10020717
SPECIFICATION NO.	BURROUGHS NO. 10264497	BURROUGHS NO. 10264620	BURROUGHS NO. 10264620	BURROUGHS NO. 10264505	BURROUGHS NO. 10264505	BURROUGHS NO. 10264521	BURROUGHS NO. 10264463
BURROUGHS BUSINESS MACHINES LIMITED TORONTO, ONTARIO CAN.						27R10	
BURROUGHS CORP. BR. AND DIST. OFFICES IN UNITED STATES						① 04-2720-557 *04-2722-553	① 10020717
MOORE BUSINESS FORMS NIAGARA FALLS, N. Y.	① SEE BELOW	① SEE BELOW	FORM NO. 1413 7-1/2 TAB BLK.				
STANDARD REGISTER CO. DAYTON 1, OHIO	① SEE BELOW	① SEE BELOW	FORM NO. 1403				
UARCO BUSINESS FORMS WATSEKA, ILLINOIS	FORM NO. 811	FORM NO. 812UB	FORM NO. 911S				
MITTAG DIVISION BURROUGHS CORP. PARK RIDGE, N.J.						27R10	
H.M. STORMS CO. BROOKLYN, N.Y.						27R10	
WILCOX PRESS ITHACA, N.Y.							ARVEY RVCP-23

NOTE: 1. SHELF ITEMS ① READILY AVAILABLE.

2. ALWAYS USE BURROUGHS SPECIFICATION NUMBER OF THE FORM DESIRED PLUS INFORMATION IN THE BLOCKS, IF AVAILABLE, WHEN ORDERING ANY FORMS. ALSO DESIGNATE THE FORM WIDTH, DEPTH, AND NUMBER OF PARTS.

3. * RECOMMENDED WHEN MULTIPLE COPY FORMS ARE USED.

MAGNETIC TAPE

6-49. The magnetic tape used with the Burroughs Magnetic Tape Units is a heavy-duty Mylar tape. The main difference between Mylar and heavy-duty tape is wearability. Mylar tape is actually a standard tape with a wear factor of 1. Heavy-Duty Mylar tape has a wear factor of 15. The standard Mylar tape deteriorates rapidly (oxide flakes off, etc.) and is not recommended for use on the magnetic tape units. Burroughs Mylar tape is a heavy-duty Mylar tape which has an improved binder between the ferro-magnetic coating and the base material.

Physical Characteristics

6-50. The width of the magnetic tape used on the magnetic tape units is 0.5 inch with an approximate length of 2400 feet. The total thickness of the tape is 2.0 mils. The tape is wound on a 10-1/2 inch reel and shipped in a plastic box which is dust-proof; prevents motion of the reel inside the box; supports the reel at the hub, and has a positive lock.

Tape Life

6-51. The tape life is 15,000 useful passes, or one year, whichever occurs first. The number of useful passes is defined as the number of times any portion of the tape moves past the head in either direction without permanent error occuring as a result of wear or defects in the tape base or oxide materials. An error is defined as a system stop resulting in failure to read or write.

MICR CHARACTERS AND SPECIFICATIONS

6-52. Fourteen magnetic ink characters which conform to the standard established by the American Bankers Association (refer to ABA Publications 147 and 149), can be recognized by the sorter-reader. These characters consist of the 10 digits, 0 through 9 and four special symbols: Amount symbol, Dash symbol, Transit Number or Routing symbol, and an On-Us symbol. The 14 characters which are referred to as E13B type font are illustrated in figure 6-6.

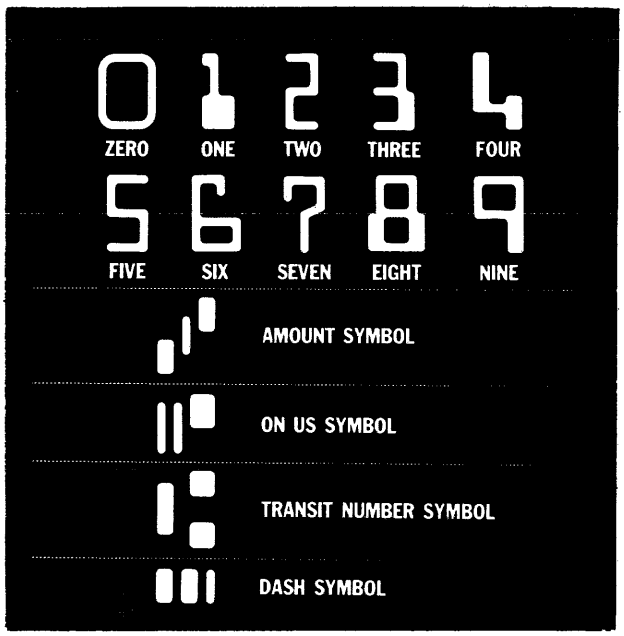


Figure 6-6. E13B Type Font Characters

6-53. Figure 6-7 illustrates a sample paper check encoded with the specifications set forth in ABA Publication 147. The location of the Amount and Transit Number fields in relation to the common or reference edge of the document is included in the illustration, along with the arrangement of 43 spaces intended for the character positions.

6-54. A field is defined as the space between a defined start and finish symbol which is sufficient to permit the encoding of the maximum number of characters required for identification and processing. This definition includes all possible variations; from a full distinct grouping such as the Amount Field, to the transaction code group in the On-Us Field.

Field Location Specifications

6-55. The following specifications are included to serve in understanding the encoded

information, its grouping into fields, the starting and ending symbols, and the normal contents of the fields.

6-56. THE AMOUNT FIELD (Figure 6-8).

Boundaries: 1/4" and 1-7/8" from the right reference edge with the first (or right) symbol located 5/16" plus or minus 1/16" from the reference edge.

Characters: 10 digits bracketed with two Amount Field symbols.

Contents: Amount of items with leading zeros.

6-57. THE ON-US FIELD (Figure 6-9).

Boundaries: 1-7/8" and 4-1/4" from the right reference edge.

Characters: 19 spaces, of which 18 are normally usable due to tolerance requirements between pre-printed and post-printed encoded information. When the contents of the On-Us Field are printed separately (Account Number and Transaction Code), each printing has a tolerance of plus or minus 1/16" on the horizontal plane. The result is 1/8" (one space) being used for the total tolerance. When On-Us data is printed simultaneously with the amount, it may appear immediately adjacent to the left Amount Symbol; and when On-Us data is printed simultaneously with the Transit Number data, it may appear immediately adjacent to the right Transit Number Symbol.

Contents: Usually Account Number and Transaction Code.

6-58. THE TRANSIT NUMBER FIELD (Figure 6-10).

Boundaries: 4-1/4" and 5-3/4" from the reference edge, with the right edge of the ending symbol located 5-9/16", plus or minus 1/16" from the reference edge.

Characters: Two groups of 4 digits each, separated by the Dash Symbol and bracketed by 2 Transit Number Symbols.

Contents: Transit Number and ABA Number.

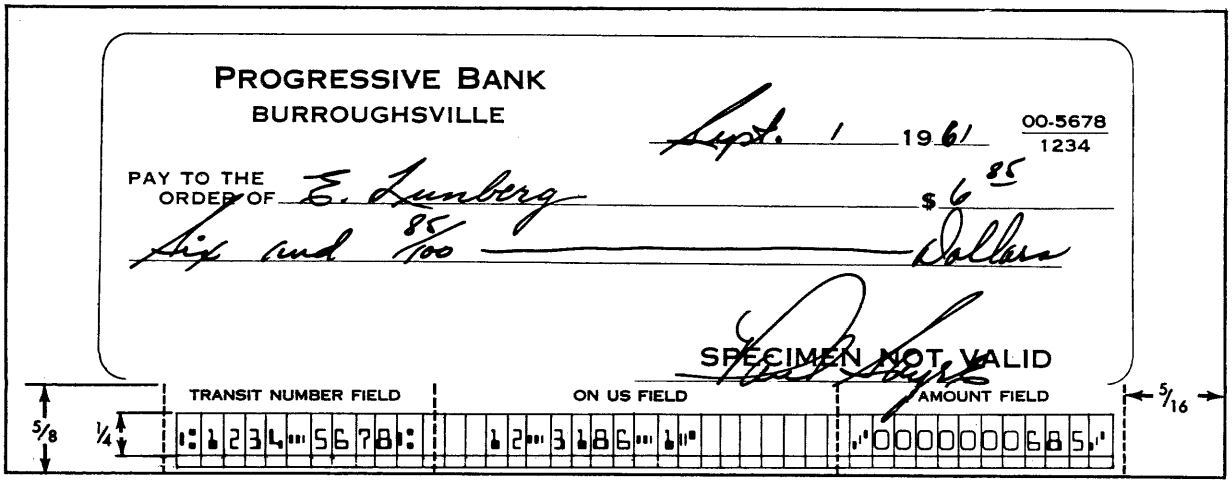


Figure 6-7. Sample Paper Check Encoding

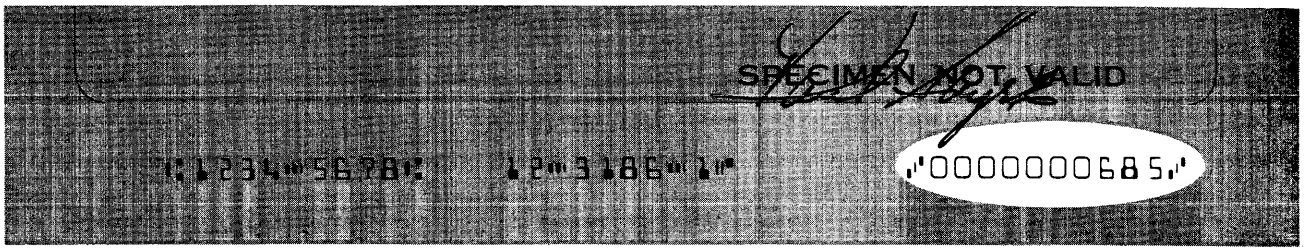


Figure 6-8. Amount Field Encoding

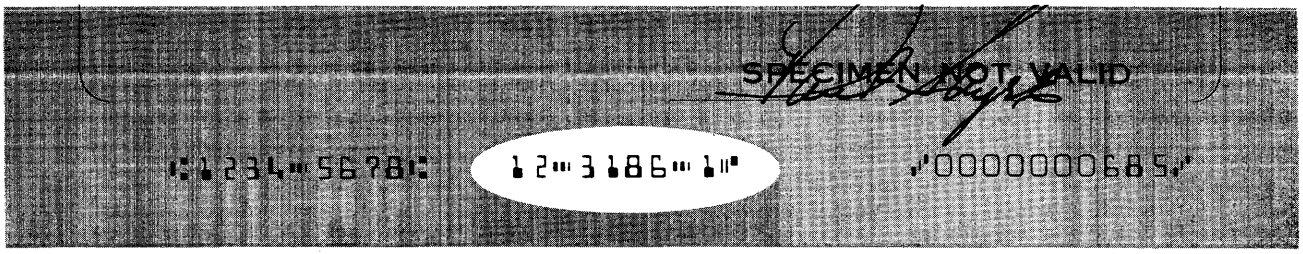


Figure 6-9. On-Us Field Encoding

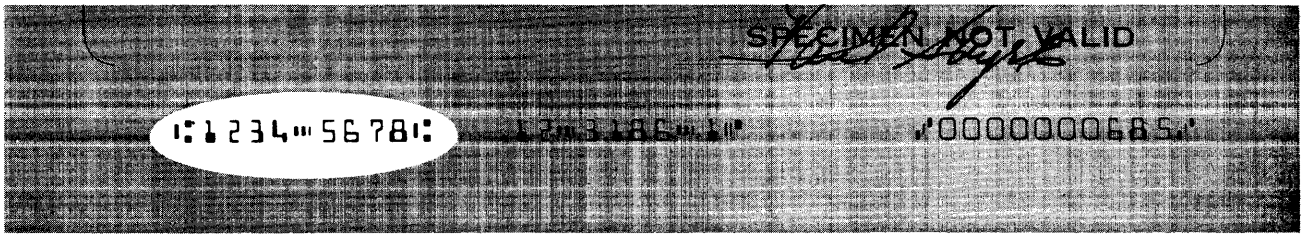


Figure 6-10. Transit Number Field Encoding

6-59. THE AUXILIARY ON-US FIELD (Figure 6-11).

⑈1548⑈3895⑈1234⑈5678⑈

Figure 6-11. Auxiliary On-Us Field Encoding

Boundaries: 5-3/4" to left border of check which exceeds 6" length; up to 7-3/4".

Characters: As many as can be bracketed between the ending symbol of the Transit Number Field, and the ending symbol of the Auxiliary On-Us Field, not to exceed 16 characters. The On-Us Field Symbol is used as an ending symbol in this field.

Contents: Optional.

Paper Specifications

6-60. Check size specifications which are shown on page 40 of the Bank Management Publication 147 prepared by the ABA, are as follows:

	MAXIMUM	MINIMUM
LENGTH	8-3/4"	6"
WIDTH	3-2/3"	2-3/4"

6-61. The sorter-reader specifications for all documents are determined by the ability of the equipment to handle paper of varying sizes at satisfactory effective speed. The tolerances are less restrictive than those stated above since they apply to internal documents as well as checks. All documents must fall within the following specifications if the sorter-reader is to sort them properly.

	MAXIMUM	MINIMUM
UNIFORM SIZE		
LENGTH	9-1/2"	5-3/4"
WIDTH	4-1/4"	2-1/2"
LENGTH TO WIDTH RATIO	3:1	1.6:1
INTERMIXED SIZE		
LENGTH	9-1/16"	5-15/16"
WIDTH	4-1/16"	2-11/16"
LENGTH TO WIDTH RATIO	3:1	1.6:1

6-62. The sorter-reader has been designed to handle a maximum document thickness of 0.0075 inch to a minimum thickness of 0.0040 inch. However, acceptable maximum and minimum document thickness cannot be defined in terms of thickness alone. Instead, the thickness is related to the following paper characteristics:

	24 lb.		20 lb.	
	MACHINE	CROSS	MACHINE	CROSS
STIFFNESS	2.7	1.3	1.9	.9
TENSILE STRENGTH	8.0	4.0	5.9	3.4
TEAR STRENGTH	55	62	45	53
BURST	35	35	28	28

a. Stiffness - The bending moment of 1/5 of a gram applied to a 1-1/2 inch wide specimen at a 5 centimeter test length flexing it to an angle of 15 degrees measured in the Machine (M) and cross machine (C) direction.

b. Tensile Strength - The force in kilograms required to tear a single sheet of paper 43 millimeters from an initial tear measured in the machine and cross machine directions. (Normally, four sheets are torn at a time to obtain any one reading.)

c. Bursting Strength - The hydrostatic pressure in pounds per square inch required to rupture the paper when the pressure is applied at a controlled rate through a rubber diaphragm of circular area 1.20 inches in diameter.

WORD FORMATTING OF MICR INFORMATION IN STORAGE

6-63. The magnetic ink characters on documents processed by the sorter-reader are either transferred to input buffer No. 2 and then to core storage (demand mode or buffered flow mode) or directly to core storage (unbuffered flow mode). In all cases, a minimum of 84 characters of information are stored in seven fields, each consisting of 12 characters.

6-64. Any character will initiate reading and is stored in the least significant digit position of the input area (CCC + 83). Normally this will be the beginning Amount symbol. If a symbol other than the Amount symbol is read, a read error condition will result. The 10 digits of the amount field are stored starting in the second least significant digit position. The second Amount symbol signals the end of the amount field and is stored in the most significant digit position to complete the first 12-character field of storage.

6-65. Storage of data continues, starting in the least significant digit position of the next storage field to the left, until the next symbol is sensed, at which time that symbol is stored in the next position. The remaining positions, if any, of that 12-character field are blanked out. Storage continues in this manner, until either the ending Transit symbol in the Auxiliary On-Us Field is sensed and stored or all the information on the document has been stored, depending on the sorter-reader instructions. If less than seven fields of information are encoded on a document or less than seven fields of information are read on a document, the remaining 12-character fields are blanked out.

6-66. To illustrate the formatting of MICR information in core storage, two examples are presented below. The Sorter-Read instruction used is:

O	M	N	AAA	BBB	CCC
#	0	4	400	300	144

6-67. Figure 6-12 illustrates a document on which the On-Us and Transit Number Field information has been pre-encoded. The contents of core storage after reading is shown in figure 6-13. Note that the dashes on the document are ignored as data. Character positions from 144 through 176 are blank.

6-68. Figure 6-14 illustrates a document that is post-encoded; that is, the account number in the On-Us Field has been encoded after the document is received. The contents of core storage after reading is shown in figure 6-15.

MULTIPLE TAPE LISTER LISTING TAPES

6-69. The listing tapes are each 2-1/2-inches wide. Fanfold paper is used and margins are not punched.

6-70. Forms used on the B 322 should conform to the following standards:

THICKNESS	LENGTH	NO. OF PARTS
.003" to .0035"	Continuous Form 8½" Fan Fold	1 or 2 carbons required

6-71. The forms hopper will hold in excess of 800 feet of a 2-part form. Individual stackers will permit stacking of at least 150 feet of continuous forms.

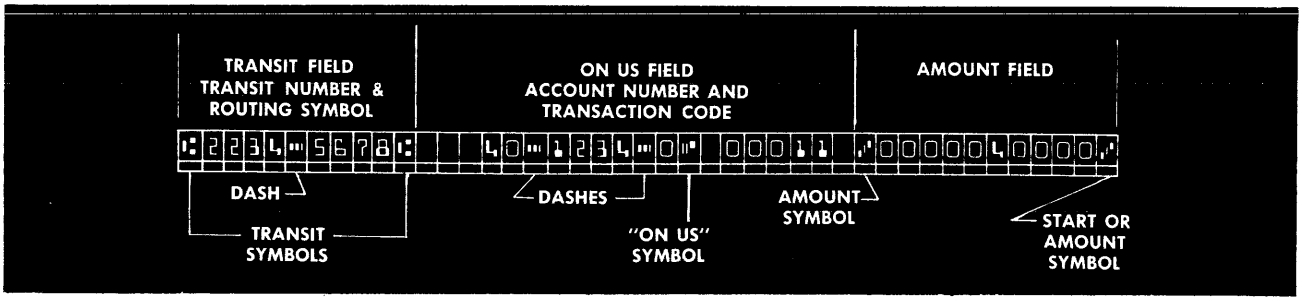


Figure 6-12. Pre-encoded MICR Document

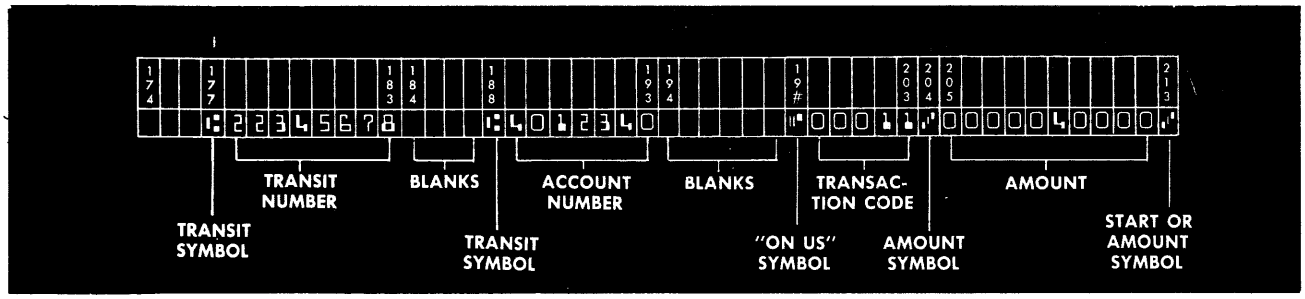


Figure 6-13. Contents of Storage for Pre-encoded Document

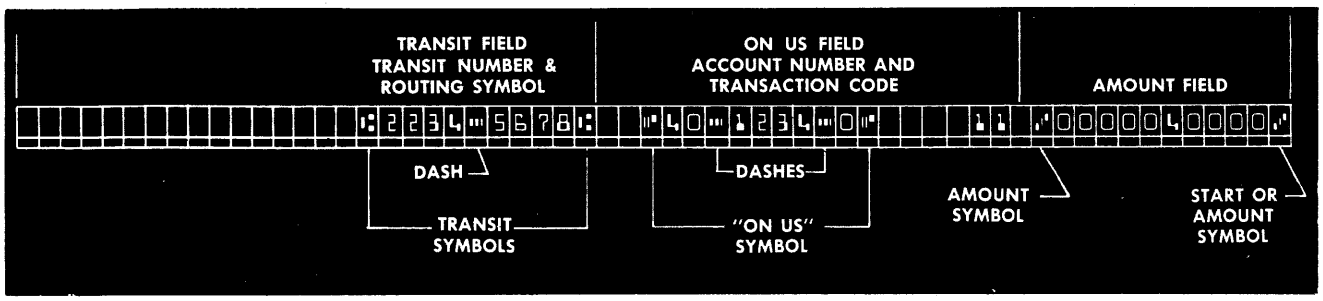


Figure 6-14. Post-encoded MICR Document

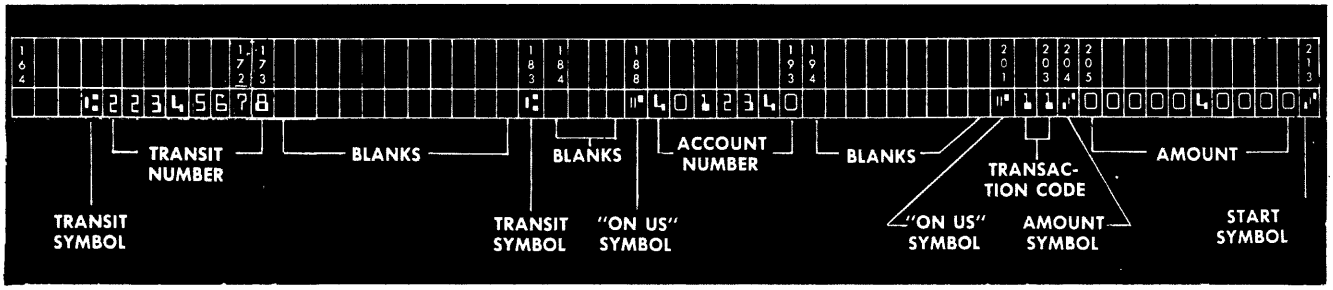


Figure 6-15. Contents of Storage for Post-encoded Document

APPENDIX A

INSTRUCTION LIST

OPERATION	OP CODE		M VARIANT			N VARIANT			AAA ADDRESS FUNCTION	BBB ADDRESS FUNCTION	CCC ADDRESS FUNCTION	COMPARISON INDICATORS
	SYM	M/L	SYM	M/L	FUNCTION	SYM	M/L	FUNCTION				
ARITHMETIC INSTRUCTIONS												
ADD	ADD	1	1-11, 12	1-@, 0 or b	AAA LENGTH	1-11, 12	1-@, 0 or b	BBB LENGTH	ADDEND	AUGEND	SUM	CONDITIONED
SUBTRACT	SUB	2	1-11, 12	1-@, 0 or b	AAA LENGTH	1-11, 12	1-@, 0 or b	BBB LENGTH	MINUEND	SUBTRAHEND	DIFFERENCE	CONDITIONED
MULTIPLY	MUL	3	1-11, 12	1-@, 0 or b	AAA LENGTH	1-11, 12	1-@, 0 or b	BBB LENGTH	MULTIPLICAND	MULTIPLIER	PRODUCT	CONDITIONED
DIVIDE	DIV	4	1-11, 12	1-@, 0 or b	AAA LENGTH	1-11	1-@	BBB LENGTH	DIVIDEND (BEFORE) REMAINDER (AFTER)	DIVISOR	QUOTIENT	CONDITIONED
CONTROL INSTRUCTIONS												
ADDRESS MODIFICATION	ADM	J	b	b	RESERVED FOR EXPANSION	b	b	RESERVED FOR EXPANSION	THE MODIFIER (THE QUANTITY, NOT ITS ADDRESS)	ADDRESS OF THE ADDRESS TO BE MODIFIED	AVAILABLE TO PROGRAMMER	NOT AFFECTED
COMPARE FOR =												
ALPHABETIC	CAE	5	b or 0	0	MODIFY OP CODE	1-11, 12	1-@, 0 or b	AAA & BBB LENGTH	FIELD COMPARED	FIELD COMPARED TO	BRANCH	CONDITIONED
ZONE	CZE	5	b or 0	1	MODIFY OP CODE	1-11, 12	1-@, 0 or b	AAA & BBB LENGTH	FIELD COMPARED	FIELD COMPARED TO	ADDRESS IF	CONDITIONED
NUMERIC	CNE	5	b or 0	2	MODIFY OP CODE	1-11, 12	1-@, 0 or b	AAA & BBB LENGTH	FIELD COMPARED	FIELD COMPARED TO	AAA: BBB EQUAL	CONDITIONED
COMPARE FOR ≠												
ALPHABETIC	CAU	5	b or 0	4	MODIFY OP CODE	1-11, 12	1-@, 0 or b	AAA & BBB LENGTH	FIELD COMPARED	FIELD COMPARED TO	BRANCH	CONDITIONED
ZONE	CZU	5	b or 0	5	MODIFY OP CODE	1-11, 12	1-@, 0 or b	AAA & BBB LENGTH	FIELD COMPARED	FIELD COMPARED TO	ADDRESS IF	CONDITIONED
NUMERIC	CNU	5	b or 0	6	MODIFY OP CODE	1-11, 12	1-@, 0 or b	AAA & BBB LENGTH	FIELD COMPARED	FIELD COMPARED TO	AAA: BBB UNEQUAL	CONDITIONED
BRANCH												
CONDITIONAL	BRC	6	b or 0	0	MODIFY OP CODE	b or 0	b or 0	RESERVED FOR EXPANSION	LOW BRANCH	EQUAL BRANCH	HIGH BRANCH	NOT AFFECTED
UNCONDITIONAL	BRU	6	b or 0	1	MODIFY OP CODE	b or 0	b or 0	NO INTERROGATION OF THIRD S_2	BRANCH TO	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	NOT AFFECTED
(102 103 ONLY)	BRU	6	b or 0	1	MODIFY OP CODE	1	1	INTERROGATE FOR THIRD S_2	BRANCH TO	BRU ON THIRD S_2	AVAILABLE TO PROGRAMMER	NOT AFFECTED
INTERROGATE	ICR	T	1	1	CARD READER	1-2	1-2	UNIT NUMBER	BRANCH ON BUSY	BRANCH ON NOT READY	BRANCH ON ERROR	NOT AFFECTED
INTERROGATE	IPR	T	1	1	PAPER TAPE READER	1-2	1-2	UNIT NUMBER	BRANCH ON BUSY	BRANCH ON NOT READY	RESERVED FOR EXPANSION	NOT AFFECTED
INTERROGATE	ICP	T	2	2	CARD PUNCH	1	1	UNIT NUMBER	BRANCH ON BUSY	BRANCH ON NOT READY	BRANCH ON ERROR	NOT AFFECTED
INTERROGATE	IPP	T	2	2	PAPER TAPE PUNCH	1	1	UNIT NUMBER	BRANCH ON BUSY	BRANCH ON NOT READY	RESERVED FOR EXPANSION	NOT AFFECTED
INTERROGATE	ILP	T	3	3	LINE PRINTER	1-2	1-2	UNIT NUMBER	BRANCH ON BUSY	BRANCH ON NOT READY	BRANCH ON ERROR	NOT AFFECTED
INTERROGATE	IPL	T	3	3	LISTER	1-2	1-2	UNIT NUMBER	BRANCH ON BUSY	BRANCH ON NOT READY	BRANCH ON ERROR	NOT AFFECTED
INTERROGATE	ISP	T	4	4	SUPERVISORY PRINTER				RESERVED FOR EXPANSION	BRANCH ON NOT READY	RESERVED FOR EXPANSION	NOT AFFECTED
INTERROGATE	IMR	T	8	8	MAGNETIC TAPE UNIT READY	1-6	1-6	UNIT NUMBER	RESERVED FOR EXPANSION	BRANCH ON NOT READY	RESERVED FOR EXPANSION	NOT AFFECTED
INTERROGATE	IMW	T	9	9	MAGNETIC TAPE UNIT WRITE	1-6	1-6	UNIT NUMBER	RESERVED FOR EXPANSION	BRANCH ON NOT READY	RESERVED FOR EXPANSION	NOT AFFECTED
INTERROGATE	TSS	T	1-6	1-6	SENSE SWITCH	8	8	INTERROGATE SENSE SWITCH	BRANCH WHEN ON	BRANCH ON NOT READY	RESERVED FOR EXPANSION	NOT AFFECTED
INTERROGATE	BBE	T	CHAR	CHAR	INTERROGATE BIT	9	9	INTERROGATE BIT	BRANCH ON EQUAL	RESERVED FOR EXPANSION	CHAR UNDER TEST	NOT AFFECTED
INTERROGATE	SBT	T	CHAR	CHAR	INTERROGATE BIT	10	#	SET BIT	RESERVED FOR EXPANSION	RESERVED FOR EXPANSION	CHAR UNDER TEST	NOT AFFECTED
INTERROGATE	RSB	T	CHAR	CHAR	INTERROGATE BIT	11	@	RESET BIT	RESERVED FOR EXPANSION	RESERVED FOR EXPANSION	CHAR UNDER TEST	NOT AFFECTED
INTERROGATE	BBU	T	CHAR	CHAR	INTERROGATE BIT	12	&	INTERROGATE BIT	BRANCH ON UNEQUAL	RESERVED FOR EXPANSION	CHAR UNDER TEST	NOT AFFECTED

APPENDIX A (cont'd)

OPERATION	OP CODE		M VARIANT			N VARIANT			AAA ADDRESS FUNCTION	BBB ADDRESS FUNCTION	CCC ADDRESS FUNCTION	COMPARISON INDICATORS
	SYM	M/L	SYM	M/L	FUNCTION	SYM	M/L	FUNCTION				
CONTROL INSTRUCTIONS (cont'd)												
NO-OPERATION	NOP	b, 0	b	b	AVAILABLE TO PROGRAMMER	b	b	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	NOT AFFECTED
HALT AND BRANCH	HLT	9	0-9	0-9	IDENTIFICATION AND BRANCHING	0-14	0-9, #, @, &, :, >	IDENTIFICATION - SR	BRANCH TO ⑤	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	NOT AFFECTED
EDITING INSTRUCTIONS												
TRANSFER	TFR	7	0, 1	0-9	NUMBER OF WORDS ①⑦	0-99	0-@	NUMBER OF CHARACTERS ①	FROM ADDRESS	AVAILABLE TO PROGRAMMER	TO ADDRESS	NOT AFFECTED
TRANSFER AND BRANCH	TCB	7	0, 1	0-9	NUMBER OF WORDS ①⑦	0-99	0-@	NUMBER OF CHARACTERS ①	FROM ADDRESS	BRANCH IF B-BIT OF M-VARIANT IS ON	TO ADDRESS	NOT AFFECTED
TRANSFER ZONE	TFZ	P	0, 1	0-9	NUMBER OF WORDS ①⑦	0-99	0-@	NUMBER OF CHARACTERS ①	FROM ADDRESS	AVAILABLE TO PROGRAMMER	TO ADDRESS	NOT AFFECTED
TRANSFER ZONE AND BRANCH	TZB	P	0, 1	0-9	NUMBER OF WORDS ①⑦	0-99	0-@	NUMBER OF CHARACTERS ①	FROM ADDRESS	BRANCH IF B-BIT OF M-VARIANT IS ON	TO ADDRESS	NOT AFFECTED
TRANSFER AND TRANSLATE	TT1	R	0, 1	0-9	NUMBER OF WORDS ①⑦	0-99	0-@	NUMBER OF CHARACTERS ①	FROM ADDRESS	AVAILABLE TO PROGRAMMER	TO ADDRESS	SET TO EQUAL
	TT2	R	0, 1	0-9		0-99	0-@					
	TT3	R	0, 1	0-9		0-99	0-@					
DATA COMPRESS	DCC	M	b	b	RESERVED FOR EXPANSION	b	b	RESERVED FOR EXPANSION	STARTING ADDRESS OF RECORD TO BE COMPRESSED	LENGTH OF RECORD TO BE COMPRESSED	STARTING ADDRESS OF COMPRESSED RECORD	SET TO EQUAL
DATA EXPAND	DEC	N	b	b	RESERVED FOR EXPANSION	b	b	RESERVED FOR EXPANSION	STARTING ADDRESS OF RECORD TO BE EXPANDED	LENGTH OF EXPANDED RECORD	STARTING ADDRESS OF EXPANDED RECORD	SET TO EQUAL
MASK	MSK	8	1-11, 12	1-@ 0 or b	AAA LENGTH	0 1 2	0 1 2	FISCAL STANDARD FISCAL INVERTED ALPHANUMERIC	FROM ADDRESS	THROUGH MASK	TO ADDRESS	SET TO EQUAL
CARD INPUT/OUTPUT INSTRUCTIONS												
CARD READ	CRD	#	0, 1	0, 1	HALT OR BRANCH	1, 2	1, 2	BUFFER NUMBER	M = 0 AP, M = 1 NOT READY BRANCH	EOF BRANCH	INPUT ADDRESS	SET TO EQUAL
CARD READ BRANCH BUSY	CRI	#	0, 1	0, 1	HALT OR BRANCH	1, 2	1, 2	BUFFER NUMBER	M = 0 AP, M = 1 BUSY OR NOT READY BRANCH	EOF BRANCH	INPUT ADDRESS	SET TO EQUAL
BINARY CARD READ	CRB	#	0	0	READ NORMAL, HALT ON NOT READY	1-2	1-2	BUFFER NUMBER	M = 0 AP	BRANCH ADDRESS ON END-OF-FILE	INPUT ADDRESS	SET TO EQUAL
	CRB	#	1	1	READ NORMAL, BRANCH BUSY OR NOT READY	1-2	1-2	BUFFER NUMBER	M = 1 BRANCH BUSY OR NOT READY	BRANCH ADDRESS ON END-OF-FILE	INPUT ADDRESS	SET TO EQUAL
	CRB	#	2	2	READ BINARY, HALT ON NOT READY	1-2	1-2	BUFFER NUMBER	M = 2 ADDRESS OF BINARY IMAGE	BRANCH ADDRESS ON END-OF-FILE	INPUT ADDRESS	SET TO EQUAL
CARD PUNCH	PCH	@	0, 1, 2	0, 1, 2	PUNCH BCL, BULL, OR ICT CODES	0, 1, or b	0, 1, or b	0 OR b = NORMAL STACK. 1 = AUXILIARY STACKER	TRANSFER FROM ADDRESS MSD	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	NOT AFFECTED
BINARY CARD PUNCH	PBN	U	b	b	RESERVED FOR EXPANSION	0, 1, or b	0, 1, or b	0 OR b = PUNCH CARD AND SELECT NORMAL STACKER. 1 = PUNCH CARD AND SELECT AUXILIARY STACKER (B 304 ONLY)	TRANSFER FROM ADDRESS MSD	RESERVED FOR EXPANSION	RESERVED FOR EXPANSION	NOT AFFECTED

APPENDIX A (cont'd)

OPERATION	OP CODE SYM	OP CODE M/L	M VARIANT SYM	M VARIANT M/L	M VARIANT FUNCTION	N VARIANT SYM	N VARIANT M/L	N VARIANT FUNCTION	AAA ADDRESS FUNCTION	BBB ADDRESS FUNCTION	CCC ADDRESS FUNCTION	COMPARISON INDICATORS
PRINTED OUTPUT INSTRUCTIONS												
PRINT ON PRINTER ④	PRT	A	0-2, 4-6	0-2, 4-6	FORMS SPACING	0-11	0- @	SKIP TO CHANNEL	TRANSFER FROM ADDRESS MSD	PG O' FLOW BRANCH ADDRESS	AVAILABLE TO PROGRAMMER	NOT AFFECTED
PRINT ON LISTER (B 100/B 200)	PRL	A	0, 1, 15, 7, 2, 14	0, 1, ≥ 7, 2, >	PRINT MASTER AND/OR SUPPRESS PRINT ON MASTER AND BRANCHING	1-12, 15 ②	0- @, ≥	DESIGNATES DETAIL SUB-UNIT AND/OR SUPPRESS DETAIL DESIGNATION	TRANSFER FROM ADDRESS MSD	BRANCHING ADDRESS ON OUT OF PAPER	WHEN M = 7, 2, OR 14, BRANCH ADDRESS ON PRINT ERROR WHEN M = 0, 1, OR 15– AVAILABLE TO PROGRAMMER	NOT AFFECTED
PRINT ON LISTER (NORMAL) (B 300)	PLN	A	B, A, 8, 4, 2, 1 BITS	B, A, 8, 4, 2, 1 BITS	⑧	B, A, 8, 4, 2, 1 BITS	B, A, 8, 4, 2, 1 BITS	⑨	TRANSFER FROM ADDRESS	BRANCHING ADDRESS ON OUT OF PAPER	BRANCHING ADDRESS WHEN M = 8, OTHERWISE RESERVED FOR EXPANSION	NOT AFFECTED
PRINT ON LISTER (MULTIPROCESSING MODE) (B 300)	PLM	A	B, A, 8, 4, 2, 1 BITS	B, A, 8 4, 2, 1 BITS	⑩	B, A, 8, 4, 2, 1 BITS	B, A, 8, 4, 2, 1 BITS	⑪	TRANSFER FROM ADDRESS	BRANCHING ADDRESS ON OUT OF PAPER	BRANCHING ADDRESS WHEN M = 8, OTHERWISE RESERVED FOR EXPANSION	NOT AFFECTED
SKIP/SPACE ON PRINTER ④	SKP	B	0-2, 4-6	0-2, 4-6	FORMS SPACING	0-11	0- @	SKIP TO CHANNEL	AVAILABLE TO PROGRAMMER	PG O' FLOW BRANCH ADDRESS	AVAILABLE TO PROGRAMMER	NOT AFFECTED
ON LISTER (B 100/B 200)	SKL	B	0, 2, 4, 9, 14 1, 7, 15	0, 2, 4, 9, > 1, 7, ≥	SKIP MASTER AND/OR DETAIL ⑥ SPACE MASTER AND/OR DETAIL	1-11, 12, 15 ③	1- @, 0, ≥	DETAIL TAPE NO.	AVAILABLE TO PROGRAMMER	OUT-OF-PAPER BRANCH ADDRESS	AVAILABLE TO PROGRAMMER	NOT AFFECTED
SKIP/SPACE ON LISTER (B 300)	SKL	B	B, A, 8, 4, 2, 1 BITS	B, A, 8, 4, 2, 1 BITS	⑫	B, A, 8, 4, 2, 1 BITS	B, A, 8, 4, 2, 1 BITS	⑬	RESERVED FOR EXPANSION	BRANCHING ADDRESS ON END OF PAPER	RESERVED FOR EXPANSION	NOT AFFECTED
SLEW LISTER (B 300)	SLL	B	B, A, 8, 4, 2, 1 BITS	B, A, 8, 4, 2, 1 BITS	⑭	B, A, 8, 4, 2, 1 BITS	B, A, 8, 4, 2, 1 BITS	⑮	RESERVED FOR EXPANSION	BRANCHING ADDRESS ON END OF PAPER	RESERVED FOR EXPANSION	NOT AFFECTED
PRINT ON SUPERVISORY PRINTER	SPO	Q	1	1	PRINT	b	b	RESERVED FOR EXPANSION	SOURCE ADDRESS MSD	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	NOT AFFECTED
SUPERVISORY PRINTER READ	SPR	Q	2	2	READ	b	b	RESERVED FOR EXPANSION	AVAILABLE TO PROGRAMMER	BRANCH ON INPUT MESSAGE	DESTINATION ADDRESS MSD	NOT AFFECTED
SORTER READER INSTRUCTIONS												
SORTER-READ DEMAND	SRD	#	b or 0, 1	b or 0, 1	VALIDITY CHECK	D	6	DEMAND FEED	CAN'T READ	EOF BRANCH	INPUT ADDRESS	SET TO EQUAL
FLOW	SRF	#	b or 0, 1	b or 0, 1	VALIDITY CHECK	E T B	4 5 6	ALL FIELDS THROUGH TRANSIT BUFFERED FLOW READ	BRANCH ADDRESS			
CONTROL SORTER	CTL	C	P	0	POCKET SELECT (PS)	0 THRU 15	0 THRU 9	SELECT POCKET	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	NOT AFFECTED
			D	2	DEMAND FEED & PS		#	SELECT POCKET	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	NOT AFFECTED
			S	4	STOP FLOW (SPF) & PS		@ &	SELECT POCKET	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	NOT AFFECTED
			C	6	START FLOW (STF) & PS		: >	SELECT POCKET	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	NOT AFFECTED
			B	7	STF & PS – BUFFERED		≥	SELECT POCKET	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	NOT AFFECTED
			I	8	INCREASE BATCH COUNTER BY 1 (B 103)	b	b	RESERVED FOR EXPANSION	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	NOT AFFECTED

APPENDIX A (cont'd)

OPERATION	OP CODE		M VARIANT			N VARIANT			AAA ADDRESS FUNCTION	BBB ADDRESS FUNCTION	CCC ADDRESS FUNCTION	COMPARISON INDICATORS
	SYM	M/L	SYM.	M/L	FUNCTION	SYM	M/L	FUNCTION				
MAGNETIC TAPE INSTRUCTION												
MAG. TAPE MEMORY WRITE	MWR	D	8	8	MEMORY DUMP	1-6	1-6	UNIT DESIGNATE	TRANSFER FROM ADDRESS MSD	BRANCH ON END-OF-TAPE	BRANCH ADDRESS ON WRITE ERROR	SET TO EQUAL
MAG. TAPE WRITE BINARY	BWR	D	10	#	BINARY WRITE	1-6	1-6	UNIT DESIGNATE	TRANSFER FROM ADDRESS MSD	BRANCH ON END-OF-TAPE	BRANCH ADDRESS ON WRITE ERROR	SET TO EQUAL
MAG. TAPE READ BINARY	BRD	D	9	9	BINARY READ	1-6	1-6	UNIT DESIGNATE	BRANCH ADDRESS ON READ ERROR	BRANCH ADDRESS ON END-OF-FILE (TAPE MARK)	STORE ADDRESS MSD	SET TO EQUAL
READ TAPE	TRD	D	b	1	MODIFY OP CODE	1-6	1-6	UNIT DESIGNATE	READ ERROR BRANCH	EOF BRANCH	INPUT ADDRESS	SET TO EQUAL
WRITE TAPE	TWR	D	b	2	MODIFY OP CODE	1-6	1-6	UNIT DESIGNATE	OUTPUT ADDRESS	EOT BRANCH	WRITE ERROR BRANCH	SET TO EQUAL
ERASE TAPE	TER	D	b	3	MODIFY OP CODE	1-6	1-6	UNIT DESIGNATE	PSEUDO RECORD ADDRESS	EOT BRANCH	AVAILABLE TO PROGRAMMER	SET TO EQUAL
BACKSPACE TAPE	BSP	D	b	4	MODIFY OP CODE	1-6	1-6	UNIT DESIGNATE	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	SET TO EQUAL
REWIND TAPE	RWD	D	b	5	MODIFY OP CODE	1-6	1-6	UNIT DESIGNATE	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	SET TO EQUAL
PAPER TAPE INSTRUCTIONS												
PAPER TAPE READ	PRD	F	1	1	BUFFERED MODE	1,2	1,2	BUFFER NUMBER	PARITY ERROR	EOT BRANCH ADDRESS	INPUT ADDRESS	NOT AFFECTED
			2	2	UNBUFFERED MODE	1,2	1,2	BUFFER NUMBER	BRANCH ADDRESS	EOT BRANCH ADDRESS	INPUT ADDRESS	NOT AFFECTED
PAPER TAPE SPACE FORWARD	PSF	F	b	4	MODIFY OP CODE	1,2	1,2	BUFFER NUMBER	AVAILABLE TO PROGRAMMER	EOT BRANCH ADDRESS	AVAILABLE TO PROGRAMMER	NOT AFFECTED
PAPER TAPE SPACE BACKWARD	PSB	F	b	&	MODIFY OP CODE	1,2	1,2	BUFFER NUMBER	AVAILABLE TO PROGRAMMER	AVAILABLE TO PROGRAMMER	BOT BRANCH ADDRESS	NOT AFFECTED
PAPER TAPE REWIND	PRW	F	b	8	MODIFY OP CODE	1,2	1,2	BUFFER NUMBER	AVAILABLE TO PROGRAMMER	NOT READY BRANCH ADDRESS	BOT BRANCH ADDRESS	NOT AFFECTED
PAPER TAPE WRITE	PWR	E	1	1	PUNCH ALL HOLES	b	b	RESERVED FOR EXPANSION	OUTPUT ADDRESS	EOT BRANCH ADDRESS	NOT READY BRANCH ADDRESS	NOT AFFECTED
			2	2	BUFFERED MODE	b	b	RESERVED FOR EXPANSION	OUTPUT ADDRESS	EOT BRANCH ADDRESS	NOT READY BRANCH ADDRESS	NOT AFFECTED
DISK FILE INSTRUCTIONS												
DISK FILE WRITE	DFW	K	0	0	WRITE	1-9,0(0=10)	1-9,0	NUMBER OF DATA SEGMENTS	MSD OF DISK FILE ADDRESSING WORD	MSD OF MEMORY LOCATION CONTAINING DATA TO BE WRITTEN	BRANCH ON DESIGNATED STORAGE UNIT NOT READY	NOT AFFECTED
DISK FILE READ	DFR	K	2	2	READ	1-9,0(0=10)	1-9,0	NUMBER OF DATA SEGMENTS	MSD OF DISK FILE ADDRESSING WORD	MSD OF MEMORY LOCATION CONTAINING DATA TO BE READ	BRANCH ON DESIGNATED STORAGE UNIT NOT READY	NOT AFFECTED
DISK FILE CHECK	DFC	K	4	4	READ CHECK	1-9,0(0=10)	1-9,0	NUMBER OF DATA SEGMENTS	MSD OF DISK FILE ADDRESSING WORD	AVAILABLE TO PROGRAMMER	BRANCH ON DESIGNATED STORAGE UNIT NOT READY	NOT AFFECTED
DISK FILE INTERROGATE	DFI	K	8	8	INTERROGATE	b	b	RESERVED FOR EXPANSION	BRANCH ON DISK FILE CONTROL UNIT BUSY	BRANCH ON ERROR (AFTER A DFR OR DFC HAS BEEN EXECUTED). PARITY ERROR OR READ ERROR	BRANCH ON INVALID ADDRESS OR AN ATTEMPT TO ADDRESS BEYOND THE MAXIMUM POSSIBLE ELECTRONIC UNIT ADDRESS, OR WRITE LOCKOUT	NOT AFFECTED

APPENDIX A (cont'd)

OPERATION	OP CODE		M VARIANT			N VARIANT			AAA ADDRESS FUNCTION	BBB ADDRESS FUNCTION	CCC ADDRESS FUNCTION	COMPARISON INDICATORS
	SYM	M/L	SYM	M/L	FUNCTION	SYM	M/L	FUNCTION				
DATA COMMUNICATION INSTRUCTIONS												
DATA COMMUNICATION READ	DCR	L	2	2	READ INQUIRY	1-15	1-≥	DESIGNATES TERMINAL UNIT NUMBER	AVAILABLE TO PROGRAMMER	BRANCH ON BUSY OUTPUT READY OR IDLE	STORE ADDRESS MSD	NOT AFFECTED
DATA COMMUNICATION WRITE	DCW	L	4	4	WRITE INQUIRY	1-15	1-≥	DESIGNATES TERMINAL UNIT NUMBER	TRANSFER ADDRESS MSD	BRANCH ON BUSY INPUT READY OR IDLE	AVAILABLE TO PROGRAMMER	NOT AFFECTED
DATA COMMUNICATION INTERROGATE	DCI	L	1	1	INTERROGATE INQUIRY READY	0,1-15	0,1-≥	0 = INQUIRY CONTROL UNIT DESIGNATED TERMINAL NUMBER 1-15 = DESIGNATED TERMINAL UNIT NUMBER	BRANCH ON INPUT READY	TERMINAL UNIT NUMBER STORE	BRANCH ON OUTPUT READY	NOT AFFECTED
	DCI	L	9	9	INTERROGATES SPECIFIC TERMINAL/BUFFER	Z=0-3 N=0,1-15	Z=0-3 N=0,1-15	DESIGNATES TERMINAL/BUFFER Z=$\overline{BA}$ 1 Z=$\overline{BA}$ 2 Z=$\overline{BA}$ 3 Z=$\overline{BA}$ 4 N=BUFFER NUMBER 0-15	READ READY	MUST BE LEFT BLANK	WRITE READY	CLEARED

① SYM – Number of characters expressed in hundreds, tens, and units
M/L – Number of characters expressed in number of words and remaining characters

② N = 1 Not permissible when M = 1 or 15
N = 7 Not permissible when M = 0 or 15

③ N = 1 Not permissible when M = 1 or 2
N = 7 Not permissible when M = 0 or 7

④ M = 0-2 For printer 1 } 120 Characters M = +,A,B For printer 1 } 132 Characters
M = 4-6 For printer 2 } M = D,E,F For printer 2 }

⑤ Branch Address when M variant contains 2 bit (2,3,6,7)

⑥ M = 4 Skip all non-master tape } Optional on B 322 Lister
M = 9 Skips all tapes } Standard on B 323 Lister

⑦ M = + (A bit) and N = 1-11, transfer 120 + N characters
M = + (A bit) and N = 0, transfer 132 characters

⑧ B and A zone bits, zero suppress master
A-bit – print master on unit 1
B-bit – print master on unit 2 (B 322/B 323 only)
8-bit, zero-stop on print error
8-bit-branch on print error
4,2,1 bits must be zero

⑨ B and A zone bits, zero-suppress detail print
A-bit – print detail on unit 1
B-bit – print detail on unit 2
B and A bits – print detail on unit 3 (18 tape lister only)
8-bit, must be zero
4,2,1 bits indicate detail tape number

⑩ B and A zone bits, zero-suppress master
A-bit – print master on unit 1
B-bit – print master on unit 2 (B 322/B 323 only)
B and A-bits – print detail on unit 3 (18 tape lister only)
8-bit, zero-stop on print error
8-bit – branch on print error
4,2,1 bits indicate detail tape number

⑪ B and A zone bits, zero-suppress multiprocessing tape
A-bit – print multiprocessing tape on unit 1
B-bit – print multiprocessing tape on unit 2
B and A bits – print multiprocessing tape on unit 3 (18 tape lister only)

⑫ B and A zone bits, zero-suppress master
A-bit – skip or space master on unit 1
B-bit – skip or space master on unit 2 (B 322/B 323 only)
8-bit, zero space
8-bit – skip 2-1/2 inches
4,2,1 bits must equal zero

⑬ B and A zone bits, zero-suppress non-master
A-bit – skip or space one non-master on unit 1
B-bit – skip or space one non-master on unit 2
B and A bits – skip or space one non-master on unit 3
8-bit, zero space
8-bit – skip 2-1/2 inches
4,2,1 bits designate non-master tape number

⑭ B and A zone bits, zero-suppress master
A-bit – slew master on unit 1
B-bit – slew master on unit 2 (B 322/B 323 only)
8-bit, must be zero
4-bit, slew all unit 3 tapes 10 inches
2-bit, slew all unit 2 tapes 10 inches
1-bit, slew all unit 1 tapes 10 inches

⑮ B and A zone bits, zero-slew multiprocessing tape
A-bit – suppress slew of multiprocessing tape on unit 1
B-bit – suppress slew of multiprocessing tape on unit 2
B and A bit – suppress slew of multiprocessing tape on unit 3

APPENDIX B B 100 CENTRAL PROCESSOR INSTRUCTION LIST

APPENDIX C B 200 MODEL 0 CENTRAL PROCESSOR INSTRUCTION LIST

APPENDIX D B 200 IMPROVED MODEL 0 CENTRAL PROCESSOR INSTRUCTION LIST

APPENDIX E B 263/B 273/B 275/B 283 CENTRAL PROCESSOR INSTRUCTION LIST

APPENDIX E (cont'd)

APPENDIX F B 300 CENTRAL PROCESSOR INSTRUCTION LIST

APPENDIX G INSTRUCTION TIMING

OPERATION	CLASS	EXECUTION TIME	UNIT
		INPUT/OUTPUT INSTRUCTIONS	
CARD READ	C	2.0 ms. unload buffer	ms.
CARD PUNCH	C	2.5 ms. load buffer	ms.
PRINT ON DRUM PRINTER	C	1.31 ms. + .03 ms. if branch is required	ms.
PRINT ON LISTERS	C	0.61 ms. + .03 ms. if branch is required	ms.
PRINT ON SUPERVISORY PRINTER	A	10 characters per second	Sec.
SUPERVISORY PRINTER READ	A	49 μs.	μs.
SKIP DRUM PRINTER	B	50 μs. + 30 μs. if branch is required	μs
SKIP LISTER	B	60 μs. + 30 μs. if branch is required	μs.
CONTROL SORTER	B	72-120 μs. except for change of mode	μs.
SORTER-READ	C	2 ms. demand or buffered flow, 14.4-19.4 ms. unbuffered flow	ms.
PAPER TAPE READ	C	M = 1 6(11+2n) μs. + 30 μs. if branch required	μs.
PAPER TAPE READ	A	M = 2 .006 ms. + n ms. (1000 CPS)	ms.
		.006 ms. + 2n ms. (500 CPS)	ms.
PAPER TAPE WRITE	C	6(10+2n) μs.	μs.
		6(8) μs. if branch is required	μs.
PAPER TAPE SPACE	A	6(.006) ms. + n ms. (1000 CPS)	ms.
		6(.006) ms. + 2n ms. (500 CPS)	ms.
		6(.009) ms. if branch is required	ms.
PAPER TAPE REWIND	B	Same as Paper Tape Space	
DISK FILE INTERROGATE	B	30 μs. (Without Branch), 48 μs. (With Branch)	μs.
DISK FILE READ	A	96 + 6.5N + 20,000	μs.
DISK FILE WRITE	A	96 + 6.5N + 20,000	μs.
DISK FILE READ CHECK	B	96 + 6.5N + 20,000	μs.
DATA COMMUNICATION INTERROGATE	A	Not Ready Terminal - 30 μs. Ready Terminal (N=0) - 84 μs. Ready Terminal (N≠0) - 60 μs.	μs.

APPENDIX G (cont'd)

OPERATION	CLASS	EXECUTION TIME	UNIT
		INPUT/OUTPUT INSTRUCTIONS	
DATA COMMUNICATION READ	A	Output Ready or Not Ready - 72 μs. Input Ready - 60 + 25 (n) μs.	μs.
DATA COMMUNICATION WRITE	A	Same as READ n = number of characters	μs.

B 421

MAGNETIC TAPE OPERATIONS	CLASS	TRANSPORT RELEASED AT	NEW TAPE COMMAND CAN BE ACCEPTED AT	UNIT
READ	A	5.4 + h(n)	11.0 + h(n)	ms.
WRITE	A	5.4 + h(n)	12.9 + h(n)	ms.
ERASE	A	5.4 + h(n)	10.9 + h(n)	ms.
REWIND	A	60 μs. (2400 reel of tape can be rewound in 90 seconds (320 inches per second).		
BACKSPACE	A	Backspace following write 26.0 + h(n)	Backspace following other command 7.3 + h(n)	μs.

B 422

MAGNETIC TAPE OPERATIONS	CLASS	TRANSPORT RELEASED AT	NEW TAPE COMMAND CAN BE ACCEPTED AT	UNIT
READ	A	4.7 + h(n)	10.1 + h(n)	ms.
WRITE	A	4.7 + h(n)	10.3 + h(n)	ms.
ERASE	A	4.7 + h(n)	10.0 + h(n)	ms.
REWIND	A	Same as 421		
BACKSPACE	A	Backspace following write 24.0 + h(n)	Backspace following other command 5.1 + h(n)	ms.

NOTE

If at a load point, add 50 milliseconds (average), or 55 milliseconds (maximum) to the time.

OPERATION	CLASS	EXECUTION TIME	UNIT
		ARITHMETIC INSTRUCTIONS	
ADD	B	$6\,[4 + 4\,(M + N) + 5L]$ (no decomplement) $6\,[4 + 4\,(M + N) + 6L]$ (with decomplement) L = Longer of M + N If M and N = 5, T = 83 μs. per digit	μs. μs.

APPENDIX G (cont'd)

OPERATION	CLASS	EXECUTION TIME	UNIT
		ARITHMETIC INSTRUCTIONS	
SUBTRACT	B	$6\,[4 + 4\,(M + N) + 5L]$ (no decomplement) $6\,[4 + 4\,(M + N) + 6L]$ (with decomplement)	µs.
MULTIPLY	B	$[3 + 6N + (16 + B_i)\,MN]\;6$ If M and N = 5, and B = 5, Avg. T = 0.670 ms/digit.	µs.
DIVIDE	B	$6\,\{(M + 1) + (M-N)\,[18 + Q_i\,(10N + 6) + 10N]\}$ (If M = 5, N = 2, Q_i = 5, T = 3.1 ms. total)	µs.
		CONTROL INSTRUCTIONS	
COMPARE	B	6 (4 + 10N) Without Branch 6 (7 + 10N) With Branch	µs.
INTERROGATE	A	UNIT	
		Busy & Not Ready - 36 µs.	µs.
		Ready - 18 µs.	µs.
		Sense Switch - 42 µs.	µs.
		Bit Test - 60 µs.	µs.
		Bit Set - 42 µs.	µs.
BRANCH	B	42 µs.	µs.
HALT	B	24 µs.	µs.
NO-OP	B	24 µs.	µs.
		EDITING INSTRUCTIONS	
TRANSFER	C	$6\,[10 + 2\,(12M + N)]$	µs.
*TRANSFER	C	$10\,[4 + 8\,(12M + N)]$	µs.
TRANSFER	C	$10\,[10 + 3\,(12M + N)]$	µs.
ZONE	C	$6\,[6 + 3\,(12M + N)]$ **	
TRANSFER &	C	$6 \rightarrow 6$, $t = 6\,[9 + 3\,(12M + N)]$	µs.
TRANSLATE	C	$6 \rightarrow 12$, $t = 6\,[9 + 5\,(12M + N)]$	
DATA COMPRESS	C	$6\left[12 + \frac{5\,(n)}{3}\right]$	µs.
DATA EXPAND	C	$6\left[12 + \frac{5\,(n)}{3}\right]$ n = length of field	µs.
MASK	B	$6\,[12 + (12M + 8n)]$ n = number of ($), (,) and (.) inserts	µs.
ADM	C	78 µs.	µs.

* B 100 and B 200 Model 0 only

** B 263/273/283 and B 300 only

SYMBOL	EXPLANATION
M	M Variant or number of positions in AAA field.
N	N Variant value or number of positions in BBB field.
L	Longer of M and N.
B	Average Value of digits in the number stored in BBB field.
CLASS A	Commands which allow no buffer access.
CLASS B	Commands which allow buffer access and in which execute time equals command time plus BAT.

h =

B 421		B 422	
200	555.5	200	555.5
.055 ms.	.020 ms.	.041 ms.	.015 ms.

n = number of characters.

CLASS C — These commands if encountered during buffer access require an additional command modification time. If buffer access occurs during an Improved Model 0, B 263, B 273, B 283, or B 300, Transfer command, an additional 42 μs. per access is required. All other Class C commands require an additional 18 μs. per buffer access if encountered.

NOTE

All times involving B 100 or B 200 Model 0 system processors should be multiplied by 1.67 to obtain execution times. The cycle time is 10 μs. on these systems versus the 6 μs. cycle time on later systems.

To aid in determining the process time of a record, five timing tables are provided in this appendix. These tables list the approximate timing for the following operations:

a. Compare (table G-1).
b. Arithmetic (table G-2).
c. Transfer (tables G-3 and G-4; Model 0 and improved Model 0 processor respectively).
d. Mask (table G-5).

TABLE G-1

Compare Instruction Timing

Number of Characters	Time in Milliseconds	Number of Characters	Time in Milliseconds
1	.14	7	.74
2	.24	8	.84
3	.34	9	.94
4	.44	10	1.04
5	.54	11	1.14
6	.64	12	1.24

NOTE

All times should be multiplied by 0.6 to obtain times for B 263/273/283/300 Systems

APPENDIX G (cont'd)

TABLE G-2

Arithmetic Instruction Timing

Number of Characters		Time in Milliseconds			Number of Characters		Time in Milliseconds			Number of Characters		Time in Milliseconds		
AAA	BBB	Add or Subtract	Multiply	Divide	AAA	BBB	Add or Subtract	Multiply	Divide	AAA	BBB	Add or Subtract	Multiply	Divide
1	1	.17	.30		6	3	.70	3.99	6.91	8	6	1.00	10.47	8.25
2	1	.26	.51	1.11	7	3	.79	4.62	9.20	9	6	1.09	11.73	12.34
3	1	.35	.72	2.20	8	3	.88	5.25	11.49	10	6	1.18	12.99	16.43
4	1	.44	.93	3.29	9	3	.97	5.88	13.78	11	6	1.27	14.25	20.52
5	1	.53	1.14	4.38	10	3	1.06	6.51	16.07	12	6	1.36	15.51	24.61
6	1	.62	1.35	5.47	11	3	1.15	7.14	18.36	7	7	.95	10.74	
7	1	.71	1.56	6.56	12	3	1.24	7.77	20.65	8	7	1.04	12.21	4.77
8	1	.80	1.77	7.65	4	4	.56	3.63		9	7	1.13	13.68	9.46
9	1	.89	1.98	8.74	5	4	.65	4.47	2.94	10	7	1.22	15.15	14.15
10	1	.98	2.19	9.83	6	4	.74	5.31	5.83	11	7	1.31	16.62	18.84
11	1	1.07	2.40	10.92	7	4	.83	6.15	8.72	12	7	1.40	18.09	23.53
12	1	1.16	2.61	12.01	8	4	.92	6.99	11.61	8	8	1.08	13.95	
2	2	.30	.99		9	4	1.01	7.83	14.50	9	8	1.17	15.63	5.38
3	2	.39	1.41	1.72	10	4	1.10	8.67	17.39	10	8	1.26	17.31	10.76
4	2	.48	1.83	3.41	11	4	1.19	9.51	20.28	11	8	1.35	18.99	15.96
5	2	.57	2.25	5.10	12	4	1.28	10.35	23.17	12	8	1.44	20.67	21.25
6	2	.66	2.67	6.79	5	5	.69	5.58		9	9	1.21	17.01	
7	2	.75	3.09	8.48	6	5	.78	6.63	3.55	10	9	1.30	19.47	5.99
8	2	.84	3.51	10.17	7	5	.87	7.68	7.04	11	9	1.39	21.36	11.88
9	2	.93	3.93	11.86	8	5	.96	8.73	10.53	12	9	1.48	23.25	17.77
10	2	1.02	4.35	13.55	9	5	1.05	9.78	14.02	10	10	1.34	21.63	
11	2	1.11	4.77	15.24	10	5	1.14	10.83	17.51	11	10	1.43	23.73	6.60
12	2	1.20	5.19	16.93	11	5	1.23	11.88	21.00	12	10	1.52	25.83	13.09
3	3	.43	2.10		12	5	1.32	12.93	24.49	11	11	1.47	26.10	
4	3	.52	2.73	2.33	6	6	.82	7.95		12	11	1.56	28.41	7.21
5	3	.61	3.36	4.62	7	6	.91	9.21	4.16	12	12	1.60	30.99	

NOTE

All times should be multiplied by 0.6 to obtain times for B 263/273/283/300 Systems

APPENDIX G (cont'd)

TABLE G-3
Transfer Instruction Timing
(B 100 and Model 0 Processor)

Number of Characters	Time in Milliseconds	Number of Characters	Time in Milliseconds	Number of Characters	Time in Milliseconds
1	.12	41	3.32	81	6.52
2	.20	42	3.40	82	6.60
3	.28	43	3.48	83	6.68
4	.36	44	3.56	84	6.76
5	.44	45	3.64	85	6.84
6	.52	46	3.72	86	6.92
7	.60	47	3.80	87	7.00
8	.68	48	3.88	88	7.08
9	.76	49	3.96	89	7.16
10	.84	50	4.04	90	7.24
11	.92	51	4.12	91	7.32
12	1.00	52	4.20	92	7.40
13	1.08	53	4.28	93	7.48
14	1.16	54	4.36	94	7.56
15	1.24	55	4.44	95	7.64
16	1.32	56	4.52	96	7.72
17	1.40	57	4.60	97	7.80
18	1.48	58	4.68	98	7.88
19	1.56	59	4.76	99	7.96
20	1.64	60	4.84	100	8.04
21	1.72	61	4.92	101	8.12
22	1.80	62	5.00	102	8.20
23	1.88	63	5.08	103	8.28
24	1.96	64	5.16	104	8.36
25	2.04	65	5.24	105	8.44
26	2.12	66	5.32	106	8.52
27	2.20	67	5.40	107	8.60
28	2.28	68	5.48	108	8.68
29	2.36	69	5.56	109	8.76
30	2.44	70	5.64	110	8.84
31	2.52	71	5.72	111	8.92
32	2.60	72	5.80	112	9.00
33	2.68	73	5.88	113	9.08
34	2.76	74	5.96	114	9.16
35	2.84	75	6.04	115	9.24
36	2.92	76	6.12	116	9.32
37	3.00	77	6.20	117	9.40
38	3.08	78	6.28	118	9.48
39	3.16	79	6.36	119	9.56
40	3.24	80	6.44	120	9.64

TABLE G-4
Transfer Instruction Timing
(Improved Model 0 Processor)

Number of Characters	Time in Milliseconds	Number of Characters	Time in Milliseconds	Number of Characters	Time in Milliseconds
1	.12	41	.92	81	1.72
2	.14	42	.94	82	1.74
3	.16	43	.96	83	1.76
4	.18	44	.98	84	1.78
5	.20	45	1.00	85	1.80
6	.22	46	1.02	86	1.82
7	.24	47	1.04	87	1.84
8	.26	48	1.06	88	1.86
9	.28	49	1.08	89	1.88
10	.30	50	1.10	90	1.90
11	.32	51	1.12	91	1.92
12	.34	52	1.14	92	1.94
13	.36	53	1.16	93	1.96
14	.38	54	1.18	94	1.98
15	.40	55	1.20	95	2.00
16	.42	56	1.22	96	2.02
17	.44	57	1.24	97	2.04
18	.46	58	1.26	98	2.06
19	.48	59	1.28	99	2.08
20	.50	60	1.30	100	2.10
21	.52	61	1.32	101	2.12
22	.54	62	1.34	102	2.14
23	.56	63	1.36	103	2.16
24	.58	64	1.38	104	2.18
25	.60	65	1.40	105	2.20
26	.62	66	1.42	106	2.22
27	.64	67	1.44	107	2.24
28	.66	68	1.46	108	2.26
29	.68	69	1.48	109	2.28
30	.70	70	1.50	110	2.30
31	.72	71	1.52	111	2.32
32	.74	72	1.54	112	2.34
33	.76	73	1.56	113	2.36
34	.78	74	1.58	114	2.38
35	.80	75	1.60	115	2.40
36	.82	76	1.62	116	2.42
37	.84	77	1.64	117	2.44
38	.86	78	1.66	118	2.46
39	.88	79	1.68	119	2.48
40	.90	80	1.70	120	2.50

NOTE: All times should be multiplied by 0.6 to obtain times for B263/273/283/300 Systems

TABLE G-5

Mask Instruction Timing

Number of Characters		Time in	Number of Characters		Time in	Number of Characters		Time in
AAA	BBB*	Milliseconds	AAA	BBB*	Milliseconds	AAA	BBB*	Milliseconds
1	0	.24	10	1	1.40	10	3	1.56
2	0	.36	11	1	1.52	11	3	1.68
3	0	.48	12	1	1.64	12	3	1.80
4	0	.60	2	2	.52	4	4	.92
5	0	.72	3	2	.64	5	4	1.04
6	0	.84	4	2	.76	6	4	1.16
7	0	.96	5	2	.88	7	4	1.28
8	0	1.08	6	2	1.00	8	4	1.40
9	0	1.20	7	2	1.12	9	4	1.52
10	0	1.32	8	2	1.24	10	4	1.64
11	0	1.44	9	2	1.36	11	4	1.76
12	0	1.56	10	2	1.48	12	4	1.88
1	1	.32	11	2	1.60	5	5	1.12
2	1	.44	12	2	1.72	6	5	1.24
3	1	.56	3	3	.72	7	5	1.36
4	1	.68	4	3	.84	8	5	1.48
5	1	.80	5	3	.96	9	5	1.60
6	1	.92	6	3	1.08	10	5	1.72
7	1	1.04	7	3	1.20	11	5	1.84
8	1	1.16	8	3	1.32	12	5	1.96
9	1	1.28	9	3	1.44			

*BBB – Inserts in Mask field ($, .).

NOTE

All times should be multiplied by 0.6 to obtain times for B 263/273/283/300 Systems

APPENDIX H INTERNAL CODE

B 100/200/300 PRINT SYMBOL	B 100/200/300 INTERNAL CODE							TAB CARD CODE		
	P	B	A	8	4	2	1	Z		N
Blank	1	1	1	0	0	0	0			
.	0	0	1	1	0	1	0	12	8	3
[	1	0	1	1	0	1	1	12	8	4
(	1	0	1	1	1	0	1	12	8	5
<	1	0	1	1	1	1	0	12	8	6
← (≢)	0	0	1	1	1	1	1	12	8	7
&	0	0	1	1	1	0	0	12		
$	0	1	0	1	0	1	0	11	8	3
*	1	1	0	1	0	1	1	11	8	4
)	1	1	0	1	1	0	1	11	8	5
;	1	1	0	1	1	1	0	11	8	6
≤	0	1	0	1	1	1	1	11	8	7
-	0	1	0	1	1	0	0	11		
/	0	1	1	0	0	0	1	0		1
,	1	1	1	1	0	1	0	0	8	3
%	0	1	1	1	0	1	1	0	8	4
=	0	1	1	1	1	0	1	0	8	5
]	0	1	1	1	1	1	0	0	8	6
"	1	1	1	1	1	1	1	0	8	7
# (≠)	1	0	0	1	0	1	0		8	3
@ (≡)	0	0	0	1	0	1	1		8	4
: (≡)	0	0	0	1	1	0	1		8	5
> (≡)	0	0	0	1	1	1	0		8	6
≥ (≢)	1	0	0	1	1	1	1		8	7
+	0	0	1	0	0	0	0	12		0
A	1	0	1	0	0	0	1	12		1
B	1	0	1	0	0	1	0	12		2
C	0	0	1	0	0	1	1	12		3

APPENDIX H (cont'd)

B 100/200/300 PRINT SYMBOL	B 100/200/300 INTERNAL CODE							TAB CARD CODE		
	P	B	A	8	4	2	1	Z		N
D	1	0	1	0	1	0	0	12		4
E	0	0	1	0	1	0	1	12		5
F	0	0	1	0	1	1	0	12		6
G	1	0	1	0	1	1	1	12		7
H	1	0	1	1	0	0	0	12		8
I	0	0	1	1	0	0	1	12		9
×	0	1	0	0	0	0	0	11		0
J	1	1	0	0	0	0	1	11		1
K	1	1	0	0	0	1	0	11		2
L	0	1	0	0	0	1	1	11		3
M	1	1	0	0	1	0	0	11		4
N	0	1	0	0	1	0	1	11		5
O	0	1	0	0	1	1	0	11		6
P	1	1	0	0	1	1	1	11		7
Q	1	1	0	1	0	0	0	11		8
R	0	1	0	1	0	0	1	11		9
≠	1	1	1	1	1	0	0	0	8	2
S	0	1	1	0	0	1	0	0		2
T	1	1	1	0	0	1	1	0		3
U	0	1	1	0	1	0	0	0		4
V	1	1	1	0	1	0	1	0		5
W	1	1	1	0	1	1	0	0		6
X	0	1	1	0	1	1	1	0		7
Y	0	1	1	1	0	0	0	0		8
Z	1	1	1	1	0	0	1	0		9
0	1	0	0	0	0	0	0			0
1	0	0	0	0	0	0	1			1

APPENDIX H (cont'd)

B 100/200/300 PRINT SYMBOL	B 100/200/300 INTERNAL CODE							TAB CARD CODE	
	P	B	A	8	4	2	1	Z	N
2	0	0	0	0	0	1	0		2
3	1	0	0	0	0	1	1		3
4	0	0	0	0	1	0	0		4
5	1	0	0	0	1	0	1		5
6	1	0	0	0	1	1	0		6
7	0	0	0	0	1	1	1		7
8	0	0	0	1	0	0	0		8
9	1	0	0	1	0	0	1		9
?	1	0	0	1	1	0	0	All Other Codes	

APPENDIX I BCL MAGNETIC TAPE CODE

B 100/200/300 PRINT SYMBOL	BCL MAGNETIC TAPE CODE							B 100/200/300 INTERNAL CODE							TAB CARD CODE		
	P	B	A	8	4	2	1	P	B	A	8	4	2	1			
Blank	1	0	1	0	0	0	0	1	1	1	0	0	0	0	Z		N
.	1	1	1	1	0	1	1	0	0	1	1	0	1	0	12	8	3
[	0	1	1	1	1	0	0	1	0	1	1	0	1	1	12	8	4
(	1	1	1	1	1	0	1	1	0	1	1	1	0	1	12	8	5
<	1	1	1	1	1	1	0	1	0	1	1	1	1	0	12	8	6
←	0	1	1	1	1	1	1	0	0	1	1	1	1	1	12	8	7
&	0	1	1	0	0	0	0	0	0	1	1	1	0	0	12		
$	0	1	0	1	0	1	1	0	1	0	1	0	1	0	11	8	3
*	1	1	0	1	1	0	0	1	1	0	1	0	1	1	11	8	4
)	0	1	0	1	1	0	1	1	1	0	1	1	0	1	11	8	5
;	0	1	0	1	1	1	0	1	1	0	1	1	1	0	11	8	6
≤	1	1	0	1	1	1	1	0	1	0	1	1	1	1	11	8	7
-	1	1	0	0	0	0	0	0	1	0	1	1	0	0	11		
/	0	0	1	0	0	0	1	0	1	1	0	0	0	1	0		1
,	0	0	1	1	0	1	1	1	1	1	1	0	1	0	0	8	3
%	1	0	1	1	1	0	0	0	1	1	1	0	1	1	0	8	4
=	0	0	1	1	1	0	1	0	1	1	1	1	0	1	0	8	5
]	0	0	1	1	1	1	0	0	1	1	1	1	1	0	0	8	6
"	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	8	7
#	1	0	0	1	0	1	1	1	0	0	1	0	1	0		8	3
@	0	0	0	1	1	0	0	0	0	0	1	0	1	1		8	4
:	1	0	0	1	1	0	1	0	0	0	1	1	0	1		8	5
>	1	0	0	1	1	1	0	0	0	0	1	1	1	0		8	6
≥	0	0	0	1	1	1	1	1	0	0	1	1	1	1		8	7
+	0	1	1	1	0	1	0	0	0	1	0	0	0	0	12		0
A	1	1	1	0	0	0	1	1	0	1	0	0	0	1	12		1
B	1	1	1	0	0	1	0	1	0	1	0	0	1	0	12		2
C	0	1	1	0	0	1	1	0	0	1	0	0	1	1	12		3

APPENDIX I (cont'd)

B 100/200/300 PRINT SYMBOL	BCL MAGNETIC TAPE CODE							B 100/200/300 INTERNAL CODE							TAB CARD CODE	
	P	B	A	8	4	2	1	P	B	A	8	4	2	1	Z	N
D	1	1	1	0	1	0	0	1	0	1	0	1	0	0	12	4
E	0	1	1	0	1	0	1	0	0	1	0	1	0	1	12	5
F	0	1	1	0	1	1	0	0	0	1	0	1	1	0	12	6
G	1	1	1	0	1	1	1	1	0	1	0	1	1	1	12	7
H	1	1	1	1	0	0	0	1	0	1	1	0	0	0	12	8
I	0	1	1	1	0	0	1	0	0	1	1	0	0	1	12	9
×	1	1	0	1	0	1	0	0	1	0	0	0	0	0	11	0
J	0	1	0	0	0	0	1	1	1	0	0	0	0	1	11	1
K	0	1	0	0	0	1	0	1	1	0	0	0	1	0	11	2
L	1	1	0	0	0	1	1	0	1	0	0	0	1	1	11	3
M	0	1	0	0	1	0	0	1	1	0	0	1	0	0	11	4
N	1	1	0	0	1	0	1	0	1	0	0	1	0	1	11	5
O	1	1	0	0	1	1	0	0	1	0	0	1	1	0	11	6
P	0	1	0	0	1	1	1	1	1	0	0	1	1	1	11	7
Q	0	1	0	1	0	0	0	1	1	0	1	0	0	0	11	8
R	1	1	0	1	0	0	1	0	1	0	1	0	0	1	11	9
≠	1	0	1	1	0	1	0	1	1	1	1	1	0	0	0	8 2
S	0	0	1	0	0	1	0	0	1	1	0	0	1	0	0	2
T	1	0	1	0	0	1	1	1	1	1	0	0	1	1	0	3
U	0	0	1	0	1	0	0	0	1	1	0	1	0	0	0	4
V	1	0	1	0	1	0	1	1	1	1	0	1	0	1	0	5
W	1	0	1	0	1	1	0	1	1	1	0	1	1	0	0	6
X	0	0	1	0	1	1	1	0	1	1	0	1	1	1	0	7
Y	0	0	1	1	0	0	0	0	1	1	1	0	0	0	0	8
Z	1	0	1	1	0	0	1	1	1	1	1	0	0	1	0	9
0	0	0	0	1	0	1	0	1	0	0	0	0	0	0		0
1	1	0	0	0	0	0	1	0	0	0	0	0	0	1		1

APPENDIX I (cont'd)

B 100/200/300 PRINT SYMBOL	BCL MAGNETIC TAPE CODE							B 100/200/300 INTERNAL CODE							TAB CARD CODE	
	P	B	A	8	4	2	1	P	B	A	8	4	2	1	Z	N
2	1	0	0	0	0	1	0	0	0	0	0	0	1	0		2
3	0	0	0	0	0	1	1	1	0	0	0	0	1	1		3
4	1	0	0	0	1	0	0	0	0	0	0	1	0	0		4
5	0	0	0	0	1	0	1	1	0	0	0	1	0	1		5
6	0	0	0	0	1	1	0	1	0	0	0	1	1	0		6
7	1	0	0	0	1	1	1	0	0	0	0	1	1	1		7
8	1	0	0	1	0	0	0	0	0	0	1	0	0	0		8
9	0	0	0	1	0	0	1	1	0	0	1	0	0	1		9
?	0	0	0	0	0	0	0	1	0	0	1	1	0	0	All Other Codes	

APPENDIX J BCL PAPER TAPE CODE

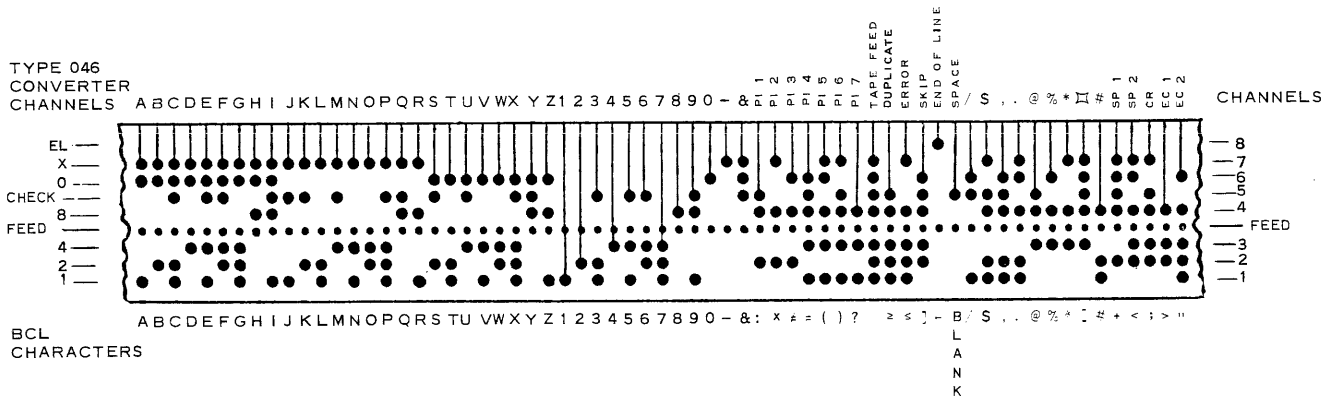
B 100/200/300 PRINT SYMBOL	BCL PAPER TAPE CODE								B 100/200/300 INTERNAL CODE							TAB CARD CODE		
	C	B	A	P	8	4	2	1	P	B	A	8	4	2	1			
Blank		0	0	1	0	0	0	0	1	1	1	0	0	0	0			
.		1	1	0	1	0	1	1	0	0	1	1	0	1	0	12	8	3
[		1	1	1	1	1	0	0	1	0	1	1	0	1	1	12	8	4
(		1	1	0	1	1	0	1	1	0	1	1	1	0	1	12	8	5
<		1	1	0	1	1	1	0	1	0	1	1	1	1	0	12	8	6
←	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	12	8	7
&		1	1	1	0	0	0	0	0	0	1	1	1	0	0	12	–	–
$		1	0	1	1	0	1	1	0	1	0	1	0	1	0	11	8	3
*		1	0	0	1	1	0	0	1	1	0	1	0	1	1	11	8	4
)		1	0	1	1	1	0	1	1	1	0	1	1	0	1	11	8	5
;		1	0	1	1	1	1	0	1	1	0	1	1	1	0	11	8	6
≤		1	0	0	1	1	1	1	0	1	0	1	1	1	1	11	8	7
–		1	0	0	0	0	0	0	0	1	0	1	1	0	0	11	–	–
/		0	1	1	0	0	0	1	0	1	1	0	0	0	1	0	1	
,		0	1	1	1	0	1	1	1	1	1	1	0	1	0	0	8	3
%		0	1	0	1	1	0	0	0	1	1	1	0	1	1	0	8	4
=		0	1	1	1	1	0	1	0	1	1	1	1	0	1	0	8	5
]		0	1	1	1	1	1	0	0	1	1	1	1	1	0	0	8	6
"		0	1	0	1	1	1	1	1	1	1	1	1	1	1	0	8	7
#		0	0	0	1	0	1	1	1	0	0	1	0	1	0	–	8	3
@		0	0	1	1	1	0	0	0	0	0	1	0	1	1	–	8	4
:		0	0	1	1	0	1	0	0	0	0	1	1	0	1	–	8	5
>		0	0	0	1	1	1	0	0	0	0	1	1	1	0	–	8	6
≥		0	0	1	1	1	1	1	1	0	0	1	1	1	1	–	8	7
+		1	1	1	1	0	1	0	0	0	1	0	0	0	0	12		
A		1	1	0	0	0	0	1	1	0	1	0	0	0	1	12	1	
B		1	1	0	0	0	1	0	1	0	1	0	0	1	0	12	2	
C		1	1	1	0	0	1	1	0	0	1	0	0	1	1	12	3	

APPENDIX J (cont'd)

B 100/200/300 PRINT SYMBOL	BCL PAPER TAPE CODE								B 100/200/300 INTERNAL CODE							TAB CARD CODE		
	C	B	A	P	8	4	2	1	P	B	A	8	4	2	1			
D		1	1	0	0	1	0	0	1	0	1	0	1	0	0	12	4	
E		1	1	1	0	1	0	1	0	0	1	0	1	0	1	12	5	
F		1	1	1	0	1	1	0	0	0	1	0	1	1	0	12	6	
G		1	1	0	0	1	1	1	1	0	1	0	1	1	1	12	7	
H		1	1	0	1	0	0	0	1	0	1	1	0	0	0	12	8	
I		1	1	1	1	0	0	1	0	0	1	1	0	0	1	12	9	
×		1	0	0	1	0	1	0	0	1	0	0	0	0	0	11	0	
J		1	0	1	0	0	0	1	1	1	0	0	0	0	1	11	1	
K		1	0	1	0	0	1	0	1	1	0	0	0	1	0	11	2	
L		1	0	0	0	0	1	1	0	1	0	0	0	1	1	11	3	
M		1	0	1	0	1	0	0	1	1	0	0	1	0	0	11	4	
N		1	0	0	0	1	0	1	0	1	0	0	1	0	1	11	5	
O		1	0	0	0	1	1	0	0	1	0	0	1	1	0	11	6	
P		1	0	1	0	1	1	1	1	1	0	0	1	1	1	11	7	
Q		1	0	1	1	0	0	0	1	1	0	1	0	0	0	11	8	
R		1	0	0	1	0	0	1	0	1	0	1	0	0	1	11	9	
≠		0	1	0	1	0	1	0	1	1	1	1	1	0	0	0	8	2
S		0	1	1	0	0	1	0	0	1	1	0	0	1	0	0	2	
T		0	1	0	0	0	1	1	1	1	1	0	0	1	1	0	3	
U		0	1	1	0	1	0	0	0	1	1	0	1	0	0	0	4	
V		0	1	0	0	1	0	1	1	1	1	0	1	0	1	0	5	
W		0	1	0	0	1	1	0	1	1	1	0	1	1	0	0	6	
X		0	1	1	0	1	1	1	0	1	1	0	1	1	1	0	7	
Y		0	1	1	1	0	0	0	0	1	1	1	0	0	0	0	8	
Z		0	1	0	1	0	0	1	1	1	1	1	0	0	1	0	9	
0		0	1	0	0	0	0	0	1	0	0	0	0	0	0	—	0	
1		0	0	0	0	0	0	1	0	0	0	0	0	0	1	—	1	

APPENDIX J (cont'd)

B 100/200/300 PRINT SYMBOL	BCL PAPER TAPE CODE								B 100/200/300 INTERNAL CODE							TAB CARD CODE
	C	B	A	P	8	4	2	1	P	B	A	8	4	2	1	
2		0	0	0	0	0	1	0	0	0	0	0	0	1	0	— 2
3		0	0	1	0	0	1	1	1	0	0	0	0	1	1	— 3
4		0	0	0	0	1	0	0	0	0	0	0	1	0	0	— 4
5		0	0	1	0	1	0	1	1	0	0	0	1	0	1	— 5
6		0	0	1	0	1	1	0	1	0	0	0	1	1	0	— 6
7		0	0	0	0	1	1	1	0	0	0	0	1	1	1	— 7
8		0	0	0	1	0	0	0	0	0	0	1	0	0	0	— 8
9		0	0	1	1	0	0	1	1	0	0	1	0	0	1	— 9
?		0	0	0	1	1	0	1	1	0	0	1	1	0	0	All Other Codes



8 - CHANNEL TAPE - TO - CARD CONVERTER CODES

APPENDIX K ICT CODE

ICT PRINT SYMBOL	B 100/200/300 INTERNAL CODE							ICT TAB CARD CODE		
	P	B	A	8	4	2	1			
Blank	1	1	1	0	0	0	0	—	—	—
.	0	0	1	1	0	1	0		1	7
'	1	0	1	1	0	1	1	12	8	4
(	1	0	1	1	1	0	1	12	8	5
1/4	1	0	1	1	1	1	0		1	3
←	0	0	1	1	1	1	1	12	8	7
&	0	0	1	1	1	0	0		0	1
£	0	1	0	1	0	1	0	11	8	3
*	1	1	0	1	0	1	1	11	8	4
)	1	1	0	1	1	0	1	11	8	5
1/2	1	1	0	1	1	1	0		1	6
10	0	1	0	1	1	1	1		12	
-	0	1	0	1	1	0	0		1	4
/	0	1	1	0	0	0	1		1	5
,	1	1	1	1	0	1	0	0	8	3
%	0	1	1	1	0	1	1		1	2
=	0	1	1	1	1	0	1	0	8	5
3/4	0	1	1	1	1	1	0		1	9
11	1	1	1	1	1	1	1		11	
#	1	0	0	1	0	1	0	—	8	3
@	0	0	0	1	0	1	1		1	8
:	0	0	0	1	1	0	1	—	8	5
>	0	0	0	1	1	1	0	—	8	6
<	1	0	0	1	1	1	1	—	8	7
+	0	0	1	0	0	0	0	12	0	
A	1	0	1	0	0	0	1	12	1	
B	1	0	1	0	0	1	0	12	2	
C	0	0	1	0	0	1	1	12	3	

APPENDIX K (cont'd)

ICT PRINT SYMBOL	B 100/200/300 INTERNAL CODE							ICT TAB CARD CODE		
	P	B	A	8	4	2	1			
D	1	0	1	0	1	0	0	12	4	
E	0	0	1	0	1	0	1	12	5	
F	0	0	1	0	1	1	0	12	6	
G	1	0	1	0	1	1	1	12	7	
H	1	0	1	1	0	0	0	12	8	
I	0	0	1	1	0	0	1	12	9	
×	0	1	0	0	0	0	0	11	0	
J	1	1	0	0	0	0	1	11	1	
K	1	1	0	0	0	1	0	11	2	
L	0	1	0	0	0	1	1	11	3	
M	1	1	0	0	1	0	0	11	4	
N	0	1	0	0	1	0	1	11	5	
O	0	1	0	0	1	1	0	11	6	
P	1	1	0	0	1	1	1	11	7	
Q	1	1	0	1	0	0	0	11	8	
R	0	1	0	1	0	0	1	11	9	
≠	1	1	1	1	1	0	0	0	8	2
S	0	1	1	0	0	1	0	0	2	
T	1	1	1	0	0	1	1	0	3	
U	0	1	1	0	1	0	0	0	4	
V	1	1	1	0	1	0	1	0	5	
W	1	1	1	0	1	1	0	0	6	
X	0	1	1	0	1	1	1	0	7	
Y	0	1	1	1	0	0	0	0	8	
Z	1	1	1	1	0	0	1	0	9	
0	1	0	0	0	0	0	0	—	0	
1	0	0	0	0	0	0	1	—	1	

APPENDIX K (cont'd)

ICT PRINT SYMBOL	B 100/200/300 INTERNAL CODE							ICT TAB CARD CODE
	P	B	A	8	4	2	1	
2	0	0	0	0	0	1	0	— 2
3	1	0	0	0	0	1	1	— 3
4	0	0	0	0	1	0	0	— 4
5	1	0	0	0	1	0	1	— 5
6	1	0	0	0	1	1	0	— 6
7	0	0	0	0	1	1	1	— 7
8	0	0	0	1	0	0	0	— 8
9	1	0	0	1	0	0	1	— 9
?	1	0	0	1	1	0	0	All Other Codes

APPENDIX L BULL CODE

BULL PRINT SYMBOL	B 100/200/300 INTERNAL CODE							BULL TAB CARD CODE		
	P	B	A	8	4	2	1			
Blank	1	1	1	0	0	0	0	—	—	—
.	0	0	1	1	0	1	0	11		
1/4	1	0	1	1	0	1	1	9	7	5
(	1	0	1	1	1	0	1	9	8	0
<	1	0	1	1	1	1	0	12	8	6
o̲	0	0	1	1	1	1	1	9	7	0
CR	0	0	1	1	1	0	0	9	8	5
$	0	1	0	1	0	1	0	9	7	12
*	1	1	0	1	0	1	1	12		
)	1	1	0	1	1	0	1	9	8	1
1/3	1	1	0	1	1	1	0	9	8	6
1/2	0	1	0	1	1	1	1	9	8	4
-	0	1	0	1	1	0	0	9	8	2
/	0	1	1	0	0	0	1	9	7	
,	1	1	1	1	0	1	0	9	8	11
%	0	1	1	1	0	1	1	9	7	4
=	0	1	1	1	1	0	1	9	8	
&	0	1	1	1	1	1	0	0	8	6
"	1	1	1	1	1	1	1	9	7	3
#	1	0	0	1	0	1	0	9	8	12
@	0	0	0	1	0	1	1	9	7	11
:	0	0	0	1	1	0	1	9	7	1
>	0	0	0	1	1	1	0	11	8	6
3/4	1	0	0	1	1	1	1	9	7	6
+	0	0	1	0	0	0	0	9	8	3
A	1	0	1	0	0	0	1		7	11
B	1	0	1	0	0	1	0		7	0
C	0	0	1	0	0	1	1		7	1

APPENDIX L (cont'd)

BULL PRINT SYMBOL	B 100/200/300 INTERNAL CODE							BULL TAB CARD CODE		
	P	B	A	8	4	2	1			
D	1	0	1	0	1	0	0		7	2
E	0	0	1	0	1	0	1		7	3
F	0	0	1	0	1	1	0		7	4
G	1	0	1	0	1	1	1		7	5
H	1	1	0	1	0	0	0		7	6
I	1	1	1	1	0	0	1		8	12
x	1	0	0	1	0	1	0	9	7	2
J	1	0	1	0	0	0	1	8	—	11
K	1	0	1	0	0	1	0	8	—	0
L	1	0	0	0	0	1	1	8	—	1
M	1	0	1	0	1	0	0	8	—	2
N	1	0	0	0	1	0	1	8	—	3
O	1	0	0	0	1	1	0	7	—	12
P	1	0	1	0	1	1	1	8	—	4
Q	1	0	1	1	0	0	0	8	—	5
R	1	0	0	1	0	0	1	8	—	6
Ø	0	1	0	1	0	1	0	9	—	12
S	0	1	1	0	0	1	0	9	—	11
T	0	1	0	0	0	1	1	9	—	0
U	0	1	1	0	1	0	0	9	—	1
V	0	1	0	0	1	0	1	9	—	2
W	0	1	0	0	1	1	0	9	—	3
X	0	1	1	0	1	1	1	9	—	4
Y	0	1	1	1	0	0	0	9	—	5
Z	0	1	0	1	0	0	1	9	—	6
0	0	1	0	0	0	0	0			0
1	0	0	0	0	0	0	1			1

APPENDIX L (cont'd)

BULL PRINT SYMBOL	B 100/200/300 INTERNAL CODE							BULL TAB CARD CODE
	P	B	A	8	4	2	1	
2	0	0	0	0	0	1	0	2
3	0	0	1	0	0	1	1	3
4	0	0	0	0	1	0	0	4
5	0	0	1	0	1	0	1	5
6	0	0	1	0	1	1	0	6
7	0	0	0	0	1	1	1	7
8	0	0	0	1	0	0	0	8
9	0	0	1	1	0	0	1	9
?	0	0	0	1	1	0	1	All Other Codes

APPENDIX M DATA COMMUNICATIONS CHARACTER CHART

BURROUGHS PRINT CHARACTER	ØCTAL INTERNAL BINARY	ØCTAL MAGNETIC TAPE	X3.2 CHARACTER	ØCTAL	BAUDØT CHARACTER	ØCTAL
BLANK	60	20	SPACE	40	SPACE	04
.	32	73	.	56	.	74
[	33	74	[	33	FIGS	73
(	35	75	(	50	(	57
<	36	76	<	74	———	———
←	37	77	←	37	BLANK	00
&	34	60	&	46	&	72
$	52	53	$	44	$	51
*	53	54	*	52	'	53
)	55	55	)	51	)	62
;	56	56	;	73	;	76
≤	57	57	' (CR)	47	CARRIAGE RETURN	10
-	54	40	-	55	-	43
/	61	21	/	57	/	75
,	72	33	,	54	,	54
%	73	34	%	45	———	———
=	75	35	=	75	———	———
]	76	36	]	35	LTRS	37
"	77	37	"	42	"	61
#	12	13	#	43	UPPER H	64
@	13	14	@	00	———	———
:	15	15	:	72	:	56
>	16	16	>	76	———	———
≥	17	17	! (D.C.)	41	!	55
+	20	72	+	53	———	———
A	21	61	A	01	A	03
B	22	62	B	02	B	31
C	23	63	C	03	C	16

APPENDIX M (cont'd)

BURROUGHS PRINT CHARACTER	ØCTAL INTERNAL BINARY	ØCTAL MAGNETIC TAPE	X3.2 CHARACTER	ØCTAL	BAUDØT CHARACTER	ØCTAL
D	24	64	D	04	D	11
E	25	65	E	05	E	01
F	26	66	F	06	F	15
G	27	67	G	07	G	32
H	30	70	H	10	H	24
I	31	71	I	11	I	06
×	40	52	\ (FØRM)	34	BELL	45
J	41	41	J	12	J	13
K	42	42	K	13	K	17
L	43	43	L	14	L	22
M	44	44	M	15	M	34
N	45	45	N	16	N	14
O	46	46	O	17	O	30
P	47	47	P	20	P	26
Q	50	50	Q	21	Q	27
R	51	51	R	22	R	12
≠	74	32	↑ (L.F.)	36	LINE FEED	02
S	62	22	S	23	S	05
T	63	23	T	24	T	20
U	64	24	U	25	U	07
V	65	25	V	26	V	36
W	66	26	W	27	W	23
X	67	27	X	30	X	35
Y	70	30	Y	31	Y	25
≢	71	31	≢	32	≢	21
0	00	12	0	60	0	66
1	01	01	1	61	1	67

APPENDIX M (cont'd)

BURROUGHS PRINT CHARACTER	ØCTAL INTERNAL BINARY	ØCTAL MAGNETIC TAPE	X3.2 CHARACTER	X3.2 ØCTAL	BAUDØT CHARACTER	BAUDØT ØCTAL
2	02	02	2	62	2	63
3	03	03	3	63	3	41
4	04	04	4	64	4	52
5	05	05	5	65	5	60
6	06	06	6	66	6	65
7	07	07	7	67	7	47
8	10	10	8	70	8	46
9	11	11	9	71	9	70
?	14	00	?	77	?	71

INDEX

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INDEX (cont'd)

Burroughs B 100/200/300 REFERENCE MANUAL

Wherever There's
Business There's Burroughs