GA27-3097-5
File No. S370-09

Systems

IBM 3770
Data Communication System
System Components

IBM

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Sixth Edition (November, 1976)

This is a major revision of, and obsoletes, GA27-3097-4 and incorporates Technical Newsletter GN27-3191. The Summary of Amendments page describes the changes to this edition. Vertical bars throughout the manual show where changes have occurred. Changes are periodically made to the information herein; before using this publication in connection with the operation of IBM systems or equipment, refer to the *IBM System/370 Bibliography* (Order No. GC20-0001 and associated Technical Newsletters) for the editions that are applicable and current.

Requests for copies of IBM publications should be made to your IBM representative or to the IBM branch office serving your locality.

This manual has been prepared by the IBM System Communications Division, Publication Center, Department E01, P.O. Box 12195, Research Triangle Park, North Carolina 27709. A form for reader's comments is provided at the back of this publication. If the form has been removed, comments may be sent to the above address. Comments and suggestions become the property of IBM.

Preface

This publication presents introductory and reference information about the IBM 3770 Data Communication System. It describes the capabilities and functions provided by this system for those concerned with planning for a teleprocessing network or for integrating the terminals into an existing network. It is also a reference source for system and application programmers, and for personnel planning job setups for the 3770. Although it describes the operating controls, this manual is not intended to provide detailed operating procedures. These controls are described here only to illustrate the capabilities, functions, and features of the 3770 terminals. For the 3773, 3774, and 3775 programmable terminal models, this publication contains introductory information only, and is not intended as a reference source. Reference and programming information for these terminal models will be contained in separate programming publications. Application personnel planning job setups for the 3770 will also require a copy of the appropriate *Operating Procedures Guide*. (See the Publications Availability Guide.)

It is assumed that the reader of this manual understands the concept and application of the IBM System/370 in a teleprocessing environment, and is familiar with data link control procedures— Synchronous Data Link Control (SDLC) or Binary Synchronous Communication (BSC), whichever is used. General information about data link control procedures can be found in the *General Information* manuals for SDLC or BSC listed in the Publications Availability Guide. Specific information about BSC and SDLC required by system and application programmers is contained in this *System Components* manual.

Information about publications concerning host CPU programming systems can be found in the publication *IBM System/360—System/370 Bibliography*, GA22-6822. Other publications pertinent to the 3770 terminals are listed in the accompanying Publications Availability Guide.

Chapter 1 of this publication is an introduction to the IBM 3770 Data Communication System. Chapter 2 describes the IBM 3771 and 3773 Communication Terminals, Chapter 3 describes the 3774 and 3775 Communication Terminals, and Chapter 4 describes the 3776 Communication Terminal and the 3777 Communication Terminal Model 1. Chapter 5 describes the programmable 3773, 3774, and 3775 models. Chapter 6 describes the I/O devices attachable to the 3770 terminals. Chapter 7, "Programming Considerations–BSC," provides information about Binary Synchronous Communications as it applies to the 3770. Chapter 8, "Programming Consideration–SNA/SDLC" provides information about System Network Architecture/Synchronous Data Link Control Communications as it applies to the 3770. Chapter 9 describes the 3777 Communication Terminal Model 2 BSC MULTI-LEAVING Workstation. The appendixes A through G supply reference information (codes, character sets, card specifications, throughput, and data format) and recommended handling procedures for IBM Diskettes. Appendix H provides detailed information required for coding a Record Format feature specification.

Publications Availability Guide

- *IBM 3771/3773 Operating Procedures Guide,* GA27-3100
- *IBM 3774/3775 Operating Procedures Guide,* GA27-3094
- *IBM 3776 Operating Procedures Guide,* GA27-3107
- *IBM 3773, 3774, and 3775 Programmable Terminals Programmer's Guide,* GC30-3028
- *IBM 3773, 3774, 3775 Programmable Communication Terminals Operator's Guide,* GA27-3114
- *General Information–Binary Synchronous Communications,* GA27-3004
- *Synchronous Data Link Control General Information,* GA27-3093
- *Systems Network Architecture General Information,* GA27-3102
- *IBM Remote Multiplexers and Communications Terminals Installation Manual–Physical Planning,* GA27-3006
- *IBM 3770 Physical Planning Template,* GX27-2917
- *IBM 3770 Customer Site Preparation Guide,* GA27-3103
- *Printer Forms Layout Sheets,* GX20-1816
- *Forms Design Reference Guide for Printers,* GA24-3488
- *IBM System/360–System/370 Bibliography,* GA22-6822
- *Planning and Installation of a Data Communication System Using IBM Line Adapters,* GA24-3435
- *IBM 3872 Modem User's Guide,* GA27-3058
- *IBM 3874 Modem User's Guide,* GA33-0002

Summary of Changes for GA27-3097-3

In addition to minor editorial changes throughout the manual, this edition (GA27-3097-3) provided information about Systems Network Architecture/Synchronous Data Link Control Communications as it applies to the 3770 nonprogrammable models.

Additional information on SDLC communications was added to Chapters 2, 3, and 4 (3771/3773, 3774/3775, and 3776 respectively).

Programming considerations for SNA/SDLC were described in a new chapter (Chapter 8) added to this publication.

Additional information on diskette compatibility was added to Appendix E–Data Format.

Summary of Changes for GA27-3097-4

In addition to minor editorial corrections throughout the manual, this edition (GA27-3097-4) described the following new features and functions for the IBM 3770 Data Communication System:

- New 48-character EBCDIC print belt, HN character set for the 3776 printer.
- Three new 1416 Interchangeable Train Cartridges for the 3203-3 printer attached to the 3777 providing train arrangements equivalent to the three EBCDIC print belts available on the 3776 printer.
- Default to 88-line form on 8 lpi on 3776/3777.
- Automatic start of 2502 Card Reader for reader-to-line jobs on 3776/3777.
- Transparent data to the 3521 Card Punch or diskette on 3776/3777.
- Timeout restart on line-to-printer jobs on 3776/3777.

Also included were miscellaneous additions and changes throughout the manual.

Summary of Changes for GA27-3097-5

In addition to minor editorial corrections throughout the manual, this edition (GA27-3097-5) describes the following new features and functions for the IBM 3770 Data Communication System:

- Chapter 9 (new) describes the IBM 3777 Communication Terminal Model 2 BSC MULTI-LEAVING Workstation.
- Programmable Communications for the 3774/3775 Programmable Terminals has been added to Chapter 5.
- Decompaction of compacted data streams by the 3777 Model 1 has been added to Chapters 4 and 8.
- More parameters for the extended Bind command have been added to Chapter 8.

Additional information has been added to "Appendix D–Throughput" for SDLC networks at line speeds up to 9600 bps.

Additional information on diskette compatibility has been added to "Appendix E–Data Formats."

Contents

Figures

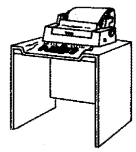
IBM 3770 Data Communication System

Models

Configurations

3771

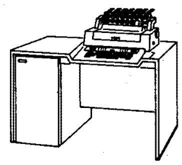
Model 1 40 cps Console Printer
Model 2 80 cps Console Printer
Model 3 120 cps Console Printer



3773

Model 1 40 cps Console Printer
Model P1 40 cps Console Printer
Model 2 80 cps Console Printer
Model P2 80 cps Console Printer
Model 3 120 cps Console Printer
Model P3 120 cps Console Printer

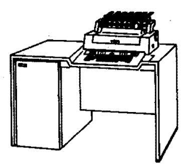
One Diskette Storage Device is standard on all 3773 Models



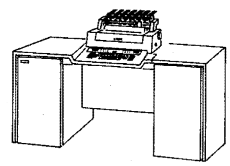
3774

Model 1 80 cps Console Printer
Model P1 80 cps Console Printer
Model 2 120 cps Console Printer
Model P2 120 cps Console Printer

One nonremovable Diskette Storage Device is standard on all programmable (P) models.



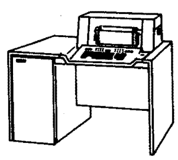
or



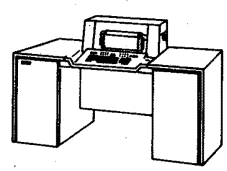
3775

Model 1 80/120 lpm Console Printer
Model P1 80/120 lpm Console Printer

One nonremovable Diskette Storage Device is standard on all programmable (P) models.

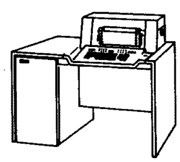


or



3776

Model 1 160/230/300 lpm Console Printer
Model 2 230/300/400 lpm Console Printer



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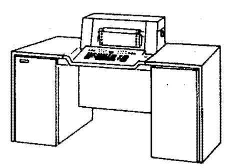
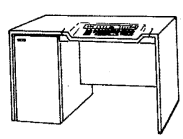


3777

Model 1 3203 Printer Model 3
530 to 1000 lpm
or
585 to 1200 lpm



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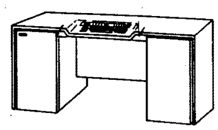
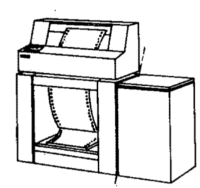
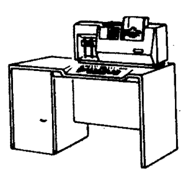


plus

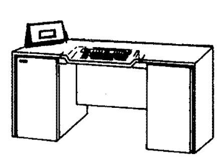


3203 Printer Model 3

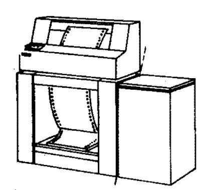
Model 2 3203 Printer Model 3
530 to 1000 lpm
or
585 to 1200 lpm
*2502 Card Reader
or
*Diskette Input Device
plus
Console Display Feature



or



plus

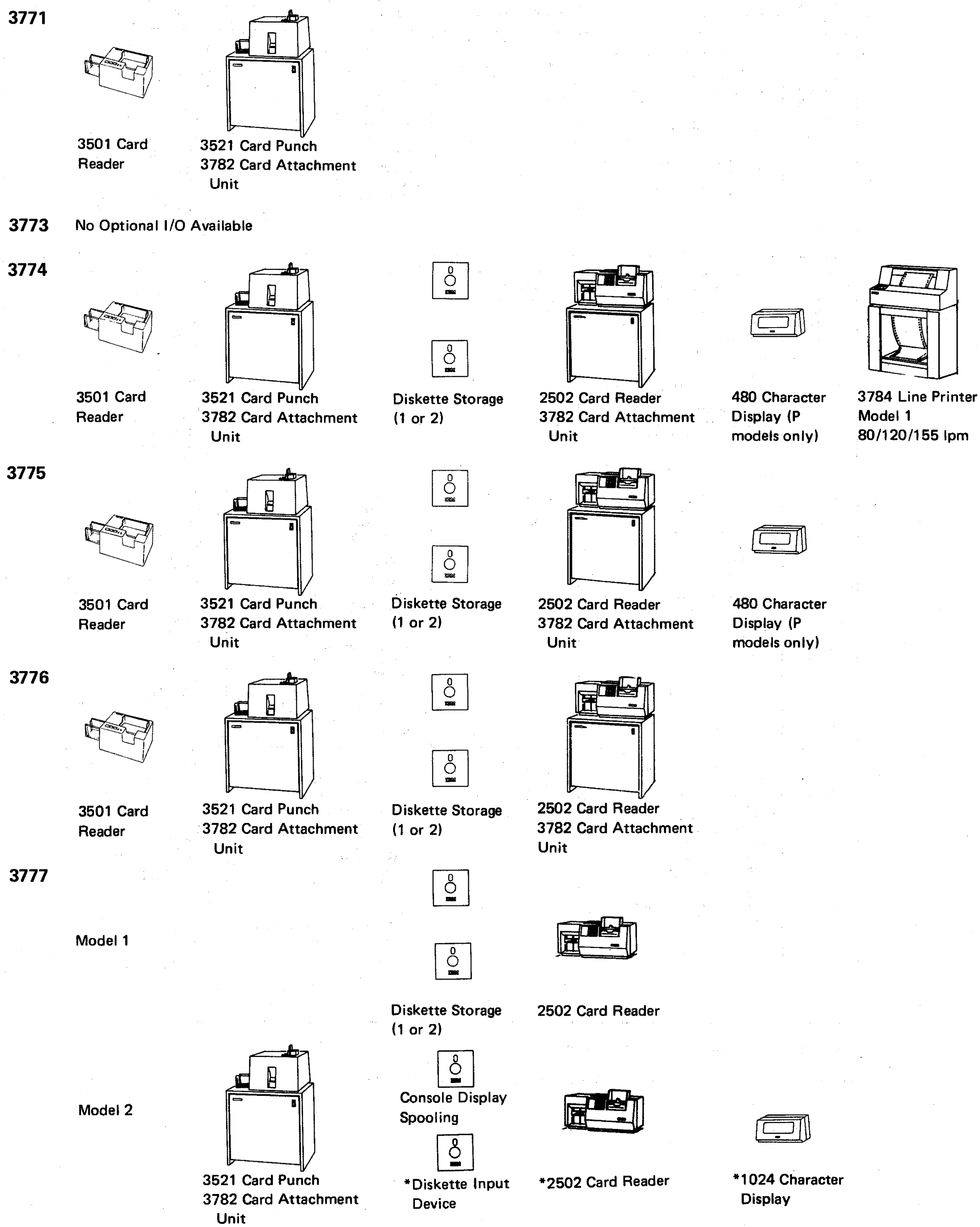


3203 Printer Model 3

*The minimum workstation configuration must include (a) the 3203 Printer, plus (b) the 2502 Card Reader, or (c) the Diskette Input Device plus the Console Display feature.

Figure 1-1. IBM 3770 Data Communication System (Part 1 of 2)

Optional I/O Equipment



*The minimum workstation configuration must include (a) the 3203 Printer, plus (b) the 2502 Card Reader, or (c) the Diskette Input Device plus the Console Display feature.

Figure 1-1. IBM 3770 Data Communication System (Part 2 of 2)

Machine Type	Description (Basic Machine)	Specify Features	Other Attachable I/O Media	Special Features and Accessories
3771 **Model 1** **Model 2** **Model 3**	Keyboard and Control Panel Printer (94-Character Set) —40 cps Bidirectional Printer —80 cps Bidirectional Printer —120 cps Bidirectional Printer 4800 bps Max. Line Speed Dual 256-byte Buffer Electronic Forms Control Automatic Answering Space Compression/Expansion Terminal ID Operator Attention Speaker	Language Group Keyboard Arrngmt.	3501 Card Reader (50 cpm) — OR — 3521 Card Punch (50 cpm) (Attach via 3782 Card Attachment Unit Model 1) (3521 can have Read Feature) The 3521 can have the Card Read and Card Print Special Features	1200 bps Integrated Modem EIA/CCITT Interface Forms Stand * Keylock Variable Width Forms Tractor Operator ID Reader Door Keylock Audible Alarm Communication Driver (With or Without Clocking) Communication Feature SDLC BSC Point-to-Point SDLC/BSC Switch Control BSC Multipoint Operation ASCII
3773** **Model 1** **Model 2** **Model 3**	Keyboard and Control Panel Printer (94-Character Set) —40 cps Bidirectional Printer —80 cps Bidirectional Printer —120 cps Bidirectional Printer 4800 bps Max. Line Speed Dual 256-byte Buffer Electronic Forms Control Automatic Answering Space Compression/Expansion Terminal ID Operator Attention Speaker Magnetic Diskette Storage (One Unit; 242,688 Bytes.	Language Group Remote Power Off Keyboard Arrngmt.	None	1200 bps Integrated Modem EIA/CCITT Interface Forms Stand * Keylock Variable Width Forms Tractor Operator ID Reader Door Keylock Audible Alarm Communication Driver (With or Without Clocking) Communication Feature SDLC BSC Point-to-Point SDLC/BSC Switch Control BSC Multipoint Operation ASCII
3774** **Model 1** **Model 2**	Keyboard and Control Panel Printer (94-Character Set) —80 cps Bidirectional Printer —120 cps Bidirectional Printer 4800 bps Max. Line Speed Dual 256-byte Buffer Electronic Forms Control Automatic Answering Space Compression/Expansion CPU Interrupt Terminal ID Operator Attention Speaker	Language Group Remote Power Off Keyboard Arrngmt.	Magnetic Diskette Storage (two Devices; 485, 376 bytes) †2502 Card Reader (150 or 300 cpm) 3501 Card Reader (50 cpm) †3521 Card Punch (50 cpm) 3784 Printer (80/120/155 lpm using 94/64/48 character set resp.) ——— †Attach via 3782 Card Attachment Unit. One card reader can be attached (2502 or 3501). The 3521 Card Punch can have the Card Read and Card Print Special Features.	1200 bps Integrated Modem 2400 bps Integrated Modem Switched Network Backup Fan Out EIA/CCITT Interface Forms Stand * Keylock Variable Width Forms Tractor Operator ID Reader Door Keylock Audible Alarm Record Format Feature Communication Driver (With or Without Clocking) Communication Feature SDLC BSC Point-to-Point SDLC/BSC Switch Control BSC Multipoint Operation ASCII
3775** **Model 1**	Keyboard and Control Panel Printer —80 or 120 lpm using 94- or 64-character set, respectively 4800 bps Max. Line Speed Dual 256-byte Buffer Electronic Forms Control Automatic Answering Space Compression/Expansion CPU Interrupt Terminal ID Operator Attention Speaker Variable Width Forms Tractor	Language Group Remote Power Off 64 or 94-Character Set Print Belt Keyboard Arrngmt.	Magnetic Diskette Storage (two Devices: 485,376 bytes) †2502 Card Reader (150 or 300 cpm) 3501 Card Reader (50 cpm) †3521 Card Punch (50 cpm) ——— †Attach via 3782 Card Attachment Unit. One card reader can be attached (2502 or 3501). The 3521 Card Punch can have the Card Read and Card Print Special Features.	1200 bps Integrated Modem 2400 bps Integrated Modem Switched Network Backup Fan Out EIA/CCITT Interface Forms Stand * Keylock Operator ID Reader Door Keylock Audible Alarm Record Format Feature Communicaion Driver (With or Without Clocking) Communication Feature SDLC BSC Point-to-Point SDLC/BSC Switch Control BSC Multipoint Operation ASCII Additional Print Belts *

*Purchase Only Accessories
**See Chapter 5 for programmable models of these terminals.

Figure 1-2. IBM 3770 Data Communication System Summary (Part 1 of 2)

Machine Type	Description (Basic Machine)	Specify Features	Other Attachable I/O Media	Special Features and Accessories
3776 Model 1 Model 2	Keyboard and Control Panel Printer –160, 230, or 300 lpm using 94-, 64-, or 48 character set respectively –230, 300, or 400 lpm using 94-, 64-, or 48 character set respectively 4800 bps Maximum Line Speed Operator Selectable Dual 256- or 512-Byte Buffer Electronic Forms Control Horizontal Format Control Automatic Answering Data Compression/Expansion Terminal ID Operator Attention Speaker Variable Width Forms Tractor Dual Data Path Record Compression of Basic Exchange Diskette Records Transmission Reversal	Language Group Remote Power Off Keyboard Arrangement 48-, 64-, or 94-Character Set Print Belt in Standard Character Set, or 48 Character Set Print Belt (in EBCDIC) in HN Character Set	Magnetic Diskette Storage (two Devices: 485,376 Bytes) 12502 Card Reader (150 or 300 cpm) 3501 Card Reader (50 cpm) †3521 Card Punch (50 cpm) †Attach via the 3782 Card Attachment Unit. One card reader can be attached (2502 or 3501). The 3521 Card Punch can have the Card Read and Card Print Special Features.	2400 bps Integrated Modem 4800 bps Integrated Modem Switched Network Backup Modem Fanout EIA/CCITT Interface Keylock Operator ID Reader Door Keylock Audible Alarm Communication Driver (Without Clocking) Communication Feature SDLC BSC Point-to-Point SDLC/BSC Switch Control BSC Multipoint Operation ASCII Additional Print Belts* Front (forms) Feed
3777 Model 1	Keyboard and Control Panel 3203 Printer Attachment –530 to 1000 or 585 to 1200 lines per minute using 120-, 48-character set 19.2 kbps Maximum Line Speed (20.4 kbps in World Trade) Operator Selectable Dual 256- or 512-Byte Buffer Electronic Forms Control Horizontal Format Control Automatic Answering Data Compression/Expansion Terminal ID Operator Attention Speaker Variable Width Forms Control Dual Data Path Record Compression of Basic Exchange Diskette Records Transmission Reversal Supports up to fifteen 1416 Print Train Arrangements for the 3203 Printer Remote Power Off	Language Group Keyboard Arrangement International Print Support (Includes two Katakana Print Train Arrangements and three Standard Character Sets available on the 3776. Replaces standard support.)	3203 Printer Model 3 (1000 lpm or 1200 lpm) 1416 Interchangeable Train Cartridges (3203 is part of minimum configuration.) Magnetic Diskette Storage (two Devices; 485,376 Bytes) 2502 Card Reader (150, 300, or 400 cpm)	EIA/CCITT Interface High Speed Digital Interface Keylock Operator ID Reader Door Keylock Audible Alarm Communication Driver (Without Clocking) Communication Feature SDLC BSC Point-to-Point SDLC/BSC Switch Control BSC Multipoint Operation ASCII Additional 1416 Interchangeable Train Cartridges (For 3203 Printer)
3777 Model 2	Keyboard and Control Panel 3203 Printer Attachment –530 to 1000 or 585 to 1200 lines per minute using 120-, 48-character set 19.2 kbps Maximum Line Speed (20.4 kbps in World Trade) Dual 512-Byte Buffers for Each I/O Device Attached Electronic Vertical Forms Control Data Compression/Expansion Operator Attention Speaker Variable Width Forms Control Transparent/Nontransparent Communication in EBCDIC Supports up to fifteen 1416 Print Train Arrangements for the 3203 Printer MULTI-LEAVING Workstation Program Execution	Language Group Keyboard Arrangement International Print Support (Includes two Katakana Print Train Arrangements and three Standard Character Sets available on the 3776. Replaces standard support.)	3203 Printer Model 3 (1000 lpm or 1200 lpm) 1416 Interchangeable Train Cartridge 2502 Card Reader (150, 300, or 400 cpm) 1024-Character Display Console Display Spooling 242,688 Bytes (1024-Character Display is a prerequisite feature.) 3521 Card Punch (50 cpm) (Attaches via the 3782 Card Attachment Unit) The 3521 can have the Card Read and Card Print Special Features. Diskette Input Device (One Device; 242, 688 Bytes)	EIA/CCITT Interface High Speed Digital Interface Keylock Operator ID Reader Door Keylock Audible Alarm BSC Communication Driver (Without Clocking) BSC Communication Point-to-Point Switched or Nonswitched Additional 1416 Interchangeable Train Cartridges (For 3203 Printer)

*Purchase Only Accessories

Figure 1-2. IBM 3770 Data Communication System Summary (Part 2 of 2)

Chapter 1. Introduction

The IBM 3770 Data Communication System shown in Figure 1-1, (see pages xxvi and xxvii) is a family of multi-purpose keyboard/printer terminals (fixed-function or programmable) and attachable I/O devices. The variety of options, features, I/O devices, and speeds offered by the 3770 terminals and other attachable devices permits configuration of a data communication system for many applications, including the following:

- Online Inquiry and Response
- Remote Key Entry
- Record Retrieval and Update
- Batch Data Handling
- Remote Job Entry
- Offline Keyboard/Printer-to-Diskette for Batch Data Entry
- BSC MULTI-LEAVING Workstation Program Execution

Programmable models of some 3770 terminals provide greater flexibility for more complex offline applications. These terminals are designed for standalone offline operation with deferred batch transmission to the CPU. With this type of operation, the programmable terminals provide:

- Document creation and data capture on diskettes
- Remote processing/update/correction of diskette-resident application data
- Different types of reports from same application data

Figure 1-2 (see pages xxviii and xxix) is a summary of the nonprogrammable terminal models, attachable input and output (I/O) media, and features offered by each of these terminals in the overall 3770 system. Programmable models of the 3773, 3774, and 3775 are summarized and described in more detail in Chapter 5 of this publication. The Extended Binary Coded Decimal Interchange Code (EBCDIC) is used by all terminals. ASCII-coded machines are available for use in the U.S. and Canada by special feature.

IBM 3771/3773 Communication Terminal

The IBM 3771 (Figure 1-3) and IBM 3773 (Figure 1-4) are multi-purpose terminals designed for a range of data-entry, inquiry, and remote printing and card-punching applications. The basic 3771 keyboard/printer terminal can perform online key-entry, inquiry, and remote printing operations. With the addition of a 50-cpm card reader or card punch, low-speed batch-data-entry or record-retrieval applications can also be accommodated.

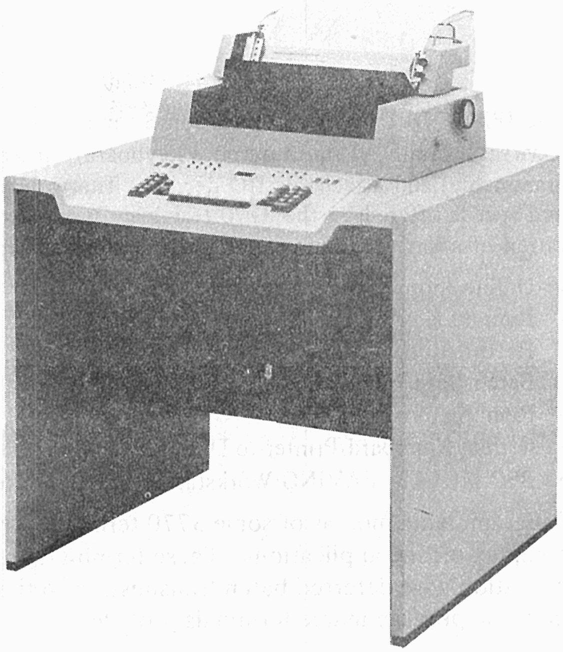


Figure 1-3. IBM 3771 Communication Terminal

The 3773 can perform all the same operations that the basic 3771 can perform, and also provides integrated diskette storage. With this storage, medium-speed batch data handling can be combined with key-entry, inquiry, and record-retrieval operations, thus more efficiently utilizing transmission facilities and reducing CPU processing requirements. Offline key entry to the diskette and subsequent batch transmission to the CPU eliminates the requirement for the terminal to be in constant communication with the CPU. An important advantage of this type of operation is that work at the terminal can continue even if the communications facility or CPU is temporarily out of service, since data entry to the diskette can continue indefinitely until the services are restored.

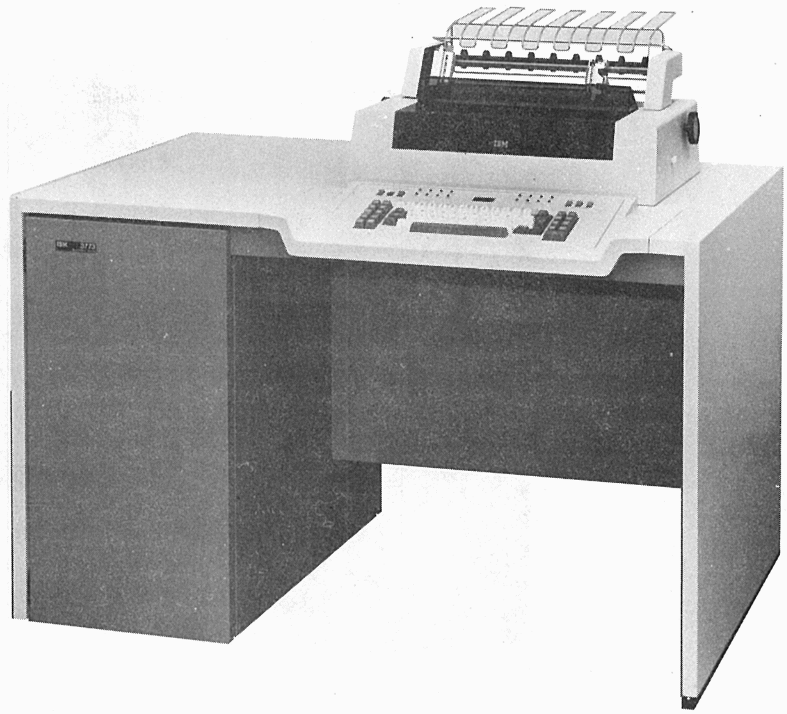


Figure 1-4. IBM 3773 Communication Terminal

IBM 3774/3775 Communication Terminal

The IBM 3774 (Figure 1-5) or IBM 3775 (Figure 1-6) terminal combines all the features and capability of the 3771 and 3773 into one versatile multiple-purpose terminal; and, in addition, it offers higher speed I/O, additional diskette storage capacity, and offline data manipulation capability. Both multiple-volume data sets (multiple diskettes for a single data set) and multiple data sets on a single diskette can be accommodated. Off-line capabilities using both card and diskette storage media permit recording of data from cards onto diskette and later online batch transmission to the CPU thereby reducing communication line time. This method avoids the situation that occurs, particularly at higher line speeds, when the card reader cannot fill the transmission buffers as fast as they empty, causing idle communication line time and expense. A similar situation occurs when receiving data to be printed or to be punched into cards; data cannot be printed or punched as fast as it is received. Writing received data onto the diskette and later printing or punching it offline permits maximum line utilization, since the line need not be idle while waiting for the transmission buffers to empty to a slower printer or card punch.

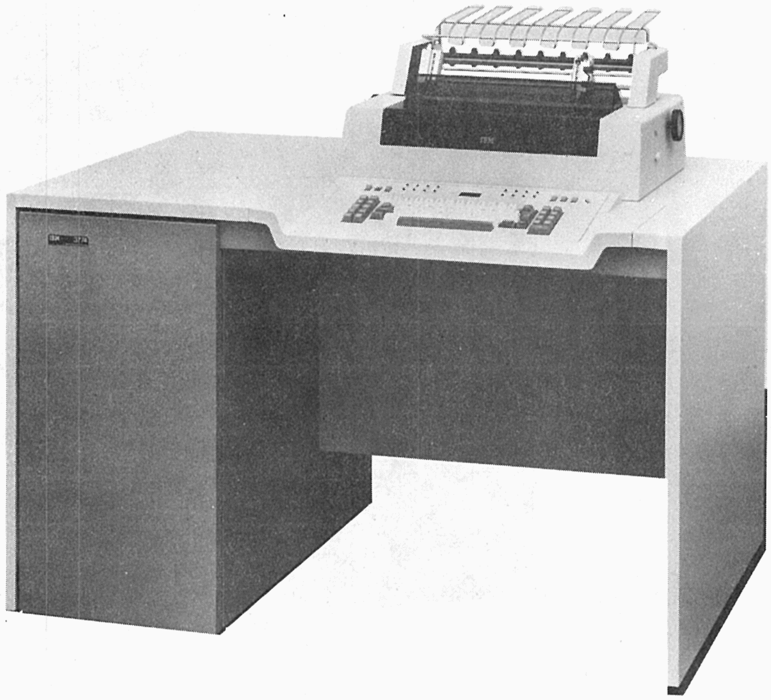


Figure 1-5. IBM 3774 Communication Terminal

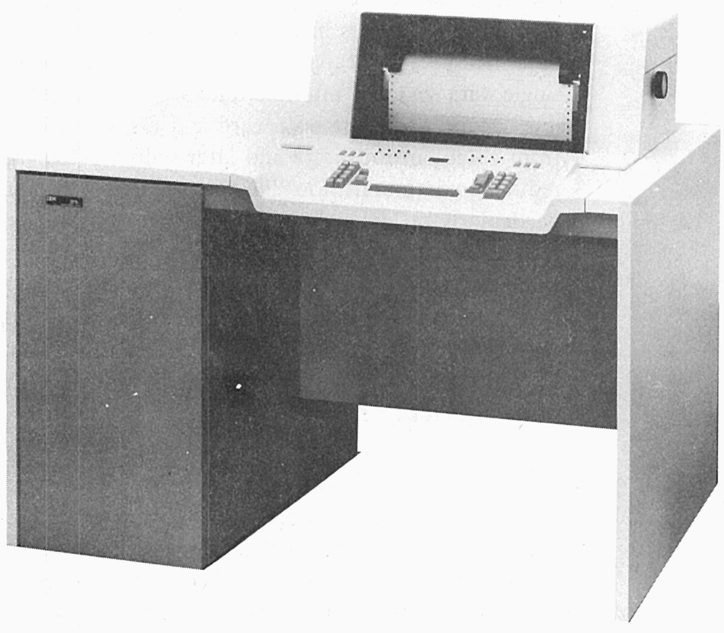


Figure 1-6. IBM 3775 Communication Terminal

The Record Format feature offered on the 3774 and 3775 provides extensive record formatting, editing, and checking capability in offline operation...functions that might previously have been performed by the CPU. With this feature, source data from the keyboard and from either card or diskette can be selected by field and merged on diskette during creation of printed documents at the terminal. Selected data, already edited, checked, and written on the diskette, can be transmitted to the CPU later during online operation. This feature also provides a 2048-byte buffer that can be used during keyboard-to-line or keyboard-to-diskette operations. The entire 2048 bytes of data remain available to the operator for additional editing until transmitted or written on the diskette.

IBM 3776 Communication Terminal

The IBM 3776 is similar in appearance to the 3775 (Figure 1-6) except for keyboard details. The card I/O and diskette storage attachments are the same as on the 3775, but the 3776 is functionally designed for batch data applications such as remote job entry (RJE). With the higher speed console printers (up to 400 lines per minute), and dual 512-byte buffering, the 3776 provides higher batch data throughput than the 3775. Dual 256/512-byte buffering is selectable by the operator.

IBM 3777 Communication Terminal, Model 1

The IBM 3777 Model 1 (Figure 1-7) is similar in function to the 3776, but has a different appearance from other 3770 terminals. Instead of a console printer, a standalone, high-speed line printer attaches to the 3777-1. Instead of the 2502 Model A1 or A2, the higher speed card reader, 2502 Model A3, can be physically mounted on the controller console; the same diskette storage attachments are offered as on the 3776 models. The 3777-1 is functionally designed for high-speed, remote-job-entry applications. With the high-speed printer (up to 1200 lines per minute), higher maximum line speed (19.2 kbps—20.4 kbps in World Trade Countries), and higher speed card reader (up to 400 cards per minute), the 3777-1 provides higher, remote-job entry throughput than the 3776. Dual 256 or dual-512 byte buffering is selectable by the operator.

Because they are not a requirement for batch data applications, offline keyboard entry, buffer edit, and diskette update functions are not provided on 3776 and 3777 models. The keyboard can be used for inquiry and for operator communication with the CPU.

Dual data paths on the 3776 and 3777-1 models allow concurrent online and offline operation. A 3776 or 3777-1 with the appropriate I/O attachments can concurrently (online) receive and print data, and (offline), (1) read cards to an attached diskette or (2) (on 3776 models only) read from the diskette and punch data into cards, or (3) read from one diskette and write to the other diskette.

The Record Compression function of the 3776 and 3777-1 models provides for rewriting records from basic exchange diskettes for transmission by the 3776 or 3777-1. Using two Diskette Storage Device features and the Record Compression function, records from basic exchange diskettes can be compressed and written onto a single diskette, in 3770 mode, for subsequent batch transmission. Using one Diskette Storage Device feature and the Record Compression function, records from basic exchange diskettes can be compressed into 256- or 512-byte blocks for transmission. (Although the buffer has a capacity of 512 bytes, only 511 bytes can be used for data transmission to maintain 3780 compatibility. Refer to Figure E-5.)

The Transmission Reversal function of the 3776 and 3777-1 permits the operator at the terminal keyboard to interrupt CPU-to-terminal data transmission and start terminal-to-CPU data transmission. Upon completion of terminal-to-CPU transmission, CPU-to-terminal transmission may resume. This function depends on associated programming support provided in the CPU.

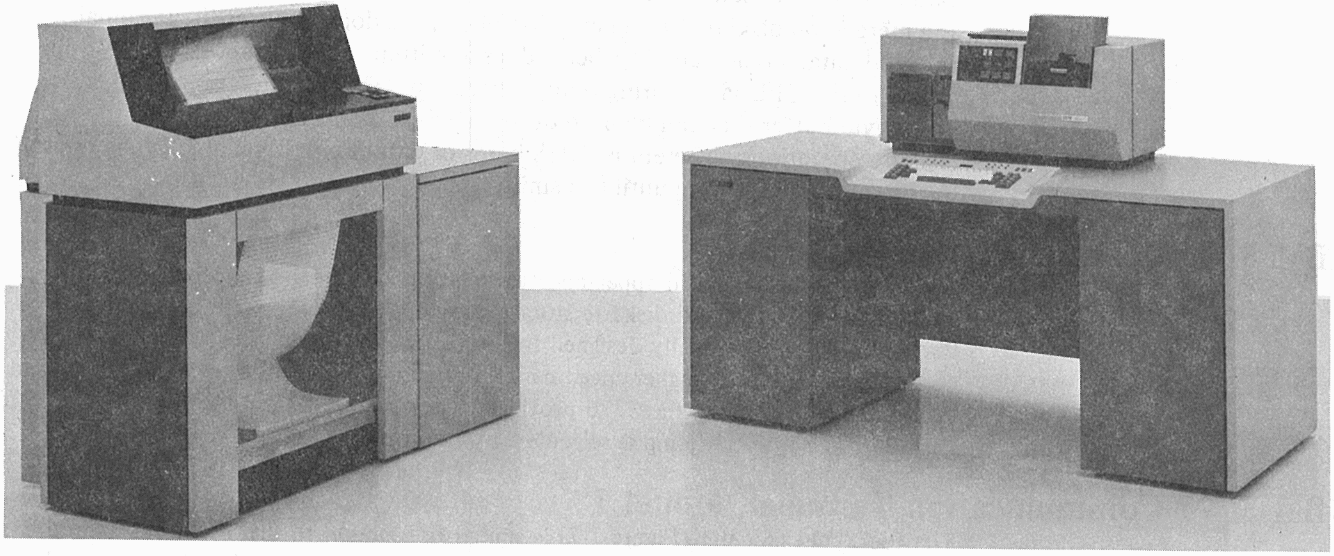


Figure 1-7. IBM 3777 Communication Terminal Model 1 (with IBM 2502 Card Reader and IBM 3203 Printer)

IBM 3777 Communication Terminal, Model 2

The IBM 3777 Model 2 (Figure 1-8) is similar in appearance to the 3777 Model 1, but has a different application and I/O configuration. The 3777 Model 2 functions as a BSC MULTI-LEAVING workstation under control of a remote-job-entry (RJE) subsystem in the host CPU. As part of the minimum workstation configuration, the 3777 attaches to: (1) an IBM 3203 Printer Model 3 with speeds up to 1200 lines per minute, (2) a Diskette Input Device and the Console Display feature or an IBM 2502 Card Reader with speeds up to 400 cards per minute, and (3) communicates with the host CPU at line speeds up to 19.2 kilo bits per second (up to 20.4 kbps in World Trade countries) using BSC MULTI-LEAVING.

Operating as a workstation terminal, the 3777-2 executes programs written for the System/360 Model 20 Submodel 5 BSC MULTI-LEAVING workstation and communicates through an RJE subsystem with a System/360 or System/370 host programming system that supports BSC MULTI-LEAVING workstations.

The keyboard and operator control panel on the basic 3777-2 are used for terminal setup and remote workstation functions.

In addition to the printer and card reader or diskette input device, the 3777 Model 2 can attach to three other I/O devices as special features: (1) a 1,024-character console display for workstation console use (operator messages), (2) one diskette storage device for spooling of console display messages, and (3) a 3521 Card Punch with the Card Read (punch checking only) and Card Print (interpret) special features. Both input devices, the 2502 Card Reader and the Diskette Input Device, can be installed on the 3777-2 to permit alternating the job input source. (Both input devices may not be operated simultaneously.)

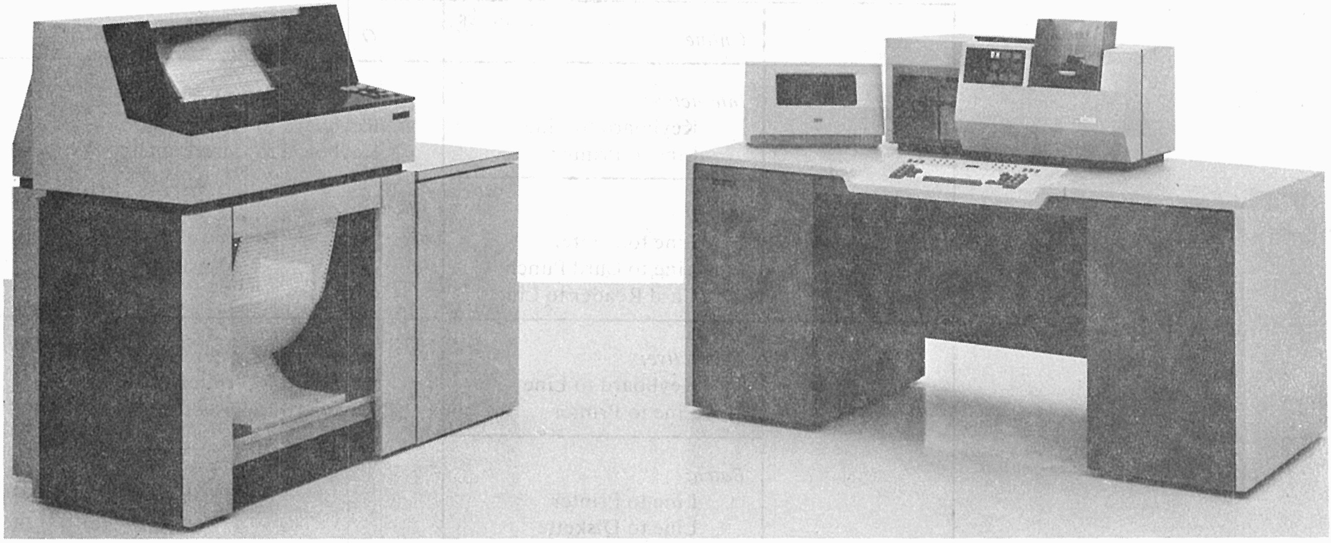


Figure 1-8. IBM 3777 Communication Terminal Model 2 (with IBM 2502 Card Reader, IBM 3203 Printer, Console Display Feature, and Diskette Input Device)

The following tabulation summarizes the online and offline operations that can be performed by each of the nonprogrammable (fully configured) terminals:

	Online	Offline
3771	*Interactive:* Keyboard to Line Line to Printer *Batch:* Line to Printer Line to Card Punch Card Reader to Line	Card Reader to Printer Keyboard to Printer Keyboard to Card Punch
3773	*Interactive:* Keyboard to Line Line to Printer *Batch:* Line to Printer Line to Diskette Diskette to Line	Diskette to Printer Keyboard to Printer Keyboard to Diskette
3774,3775	*Interactive:* Keyboard to Line Line to Cons. Printer *Batch:* Diskette to Line Card Reader to Line Line to Diskette Line to Card Punch Line to Console Printer Line to 3784 Printer (3774 Only)	Keyboard to Console Printer Keyboard to Card Punch Keyboard to Diskette Keyboard to 3784 Printer (3774 Only) Diskette to Console Printer Diskette to Diskette Diskette to Card Punch Diskette to 3784 Printer (3774 Only) Card Reader to Card Punch Card Reader to Diskette Card Reader to Printer Card Reader to 3784 Printer (3774 Only)
3776	*Batch:* Diskette to Line Card Reader to Line Line to Diskette Line to Printer Line to Card Punch *Dual Data Path:* Line to Printer —— *and*	Diskette to Printer Diskette to Card Punch Diskette to Diskette Card Reader to Card Punch Card Reader to Diskette Card Reader to Printer —— Card Reader to Diskette —OR— Diskette to Card Punch —OR— Diskette to Diskette
3777 Model 1	*Batch:* Diskette to Line Card Reader to Line Line to Diskette Line to Printer *Dual Data Path:* Line to Printer —— *and*	Diskette to Printer Diskette to Diskette Card Reader to Diskette Card Reader to Printer —— Card Reader to Diskette —OR— Diskette to Diskette

Programmable models of the 3773, 3774, and 3775 are similar in appearance to, and provide the same printer speeds as, the nonprogrammable (fixed-function) models just described, but function of these machines is under control of a user-written application program. Programs compiled by the host CPU are transmitted to the terminal and stored on the diskette from where they can be selected by the operator for execution. On the 3774 or 3775, programs can also be written onto the diskette from an attached card reader.

The 3773 programmable models have a single Diskette Storage Device with a removable diskette used to contain the 3770 programs, application data, and data captured during program execution (transaction data) that is to be transmitted later to the CPU. During document creation, diskette application data can be accessed, printed, and interspersed with keyboard-entered data. Selected data from either source can be validated, processed, edited, and formatted for local output to the printer and/or directed to the transaction data set for transmission to the CPU, or to locally generated application data sets.

The 3774 and 3775 programmable models have a single Diskette Storage Device with a nonremovable diskette. These terminals provide the same basic functions as the 3773, and also offer:

- Additional diskette storage features with removable diskettes for program, transaction, and application data set storage
- Card input and output attachments
- A Display Attachment feature for data display and display of user-programmed operator guidance messages

The 3773, 3774, and 3775 programmable models and features offered on these terminals are summarized and described in more detail in Chapter 5 of this publication.

Communications and Program Support

The 3770 terminals communicate with a remote System/370 with an attached IBM 3704 or 3705 Communications Controller, using either the Synchronous Data Link Control (SDLC) (except the 3777 Model 2) or the Binary Synchronous Communications (BSC) method of communication. (See "Features and Accessories" in Chapters 2, 3, 4, 5, and 9.)

Using BSC only (see "Using BSC Method of Communication" in this chapter), the 3770 can also communicate with the following System/360 and System/370 models:

- Via an Integrated Communications Adapter to a System/360 Model 25, or System/370 Model 115, 125, or 135
- Via an IBM 2701 Data Adapter Unit to a System/360 Model 22 through 195, or System/370 Model 115 through 195
- Via an IBM 3704 or 3705 Communications Controller to a System/360 Model 30, 40, 50, 65, 67 (in 65 mode), 75, or 195, or to a System/370 Model 115 through 195

Communication using either the SDLC or BSC method of communication can be point-to-point over switched communications facilities, or point-to-point or multipoint (except the 3777-2) over non-switched (private line) facilities. Details concerning BSC or SDLC operation, and restrictions in a particular access method, are found in the appropriate access method publications.

Using SDLC Method of Communication

The 3770 terminals operate in half-duplex mode over half-duplex or duplex communication channels. On duplex facilities, additional efficiency results from elimination of modem turnaround time. In multipoint operation, full advantage of the duplex facilities is realized because SDLC enables one secondary station to be sending while another secondary station is receiving on the same duplex channel.

Interchange or line-control-only messages are reduced because of the inherent multifunction capability of SDLC. In a single message (frame), for example, the following information can be conveyed within the control field:

- Presence or absence of an information field. If the field is absent, the type of command or response is conveyed.
- Transfer or retention of the communication channel when transmission of a frame is complete.
- A send and receive sequence number for acknowledgment of multiple frames, and the specific frames to retransmit if an error occurs in transmission.

All intelligible transmissions using SDLC procedures are subject to cyclic redundancy checking (CRC). This checking, in conjunction with the send and receive sequence numbers just mentioned, provides an extremely high degree of assurance that transmission errors will be detected and that no data is lost or duplicated.

Note: SDLC procedures do not apply to the 3777 Model 2.

General information about SDLC can be found in the publication *Synchronous Data Link Control General Information*, GA27-3093.

Using BSC Method of Communication

Application programs written to support communication with a 2770 Data Communication System can be used, with modification, to support the 3770 terminals (except the 3777-2). Programs written to support communication with an IBM 3780 Data Communication Terminal can be used, with modification, to support the 3776 and 3777 Model 1. Modifications may be required because some features or functions provided by the 2770 or 3780 are not present on the 3770 terminals, or operate in a different manner. Chapter 7 "Programming Considerations–Binary Synchronous Communications" shows the features provided by the 2770 and 3780, and shows what features are compatible with those of the 3770 terminals.

General information about BSC can be found in the publication *General Information—Binary Synchronous Communications*, GA27-3004.

Communication Facilities

The following facilities will support point-to-point or multipoint (with exceptions as noted) operation at the indicated line speeds:

- Common-carrier switched network (point-to-point) at 1200 or 2400 bits per second (also at 600 bps in World Trade countries and at 4800 bps in the U.S. and Canada).
- Common-carrier leased voice-grade private-line data channel (or equivalent privately-owned facilities) in a point-to-point or multipoint configuration at 1200, 2400, 4800, 7200, or 9600 bits per second, or at 19.2 kilobits per second (and at 600 bps or up to 9600 bps in World Trade countries). Line speeds above 4800 bps apply only to the 3777 Model 1.

- Common-carrier switched or nonswitched network (or equivalent privately-owned facilities) in a point-to-point switched or nonswitched configuration using BSC MULTI-LEAVING (3777-2 only) at 2400, 4800, 7200, or 9600 bits per second, or at 19.2 kilobits per second (U.S. and Canada only).
- Common-carrier wideband channel (or equivalent privately-owned facilities) for point-to-point synchronous operation at 19.2 kilobits per second (20.4 kbps in World Trade countries) on the 3777 Models 1 and 2 using the High-Speed Digital Interface feature or the V.35 interface feature (World Trade countries only).

Private-line channels may be half-duplex or duplex. Although the 3770 terminals operate only in half-duplex mode, duplex private-line facilities can be used to reduce line turnaround time. In multipoint configurations using SDLC (not the 3777-2), maximum utilization of duplex facilities is realized since one terminal can be transmitting while another terminal is receiving.

Data Communication Equipment (DCE)

The term Data Communication Equipment (DCE) is used to mean any equipment whose function is to convert the communication-terminal signals into a form suitable for transmission over a communication facility, and to convert signals received from the communication facility into a form suitable for transfer to the communication terminal. The DCE may be a modem (MOdulator/DEModulator) or other type of signal-converter equipment.

The DCE required for communication may be supplied by IBM, the common carrier, or the user. The grade of channel and type of channel conditioning required by a particular DCE operating at a specific line speed must be as specified by the DCE supplier.

IBM integrated modems are available for use at line speeds of 1200, 2400, and 4800 bits per second (not all speeds are available for all terminals). Connection to the common-carrier switched network using these modems is via a telephone-company-provided Data Access Arrangement (DAA) or an FCC-registered equivalent. These modems are described under Features and Accessories–Integrated Modems" in Chapters 2, 3, 4, and 5.

For the grade of channel and type of channel conditioning required by the IBM integrated modems, refer to "Communication Services Selection" in the *IBM 3770 Data Communication System – Customer Site Preparation Planning Guide,* GA27-3103.

Interface Requirements

Common-carrier or user-supplied DCE interfaces must conform to the electrical characteristics as specified by EIA Standard RS-232C in U.S. and Canada or by CCITT Recommendation V.24 or V.35 (ISO/IS 2593 - on 3777 Models) in World Trade Countries. The DCE interface must also be compatible with the EIA/CCITT Interface feature or the High Speed Digital Interface feature on the 3777 Models (see "Features and Accessories" in Chapters 2, 3, 4, 5, and 9) that is supplied when an IBM Integrated Modem is not used. The 3770 terminals connected to a switched network can automatically answer incoming calls, using either an external DCE or an integrated modem, if the DCE has this capability. The following circuits are utilized by the 3770:

EIA–RS-232C/CCITT–V.24 Interface:

Connector Pin	*RS-232C/V.24 Designation*	*Circuit Description*
1	AA	Protective Ground
2	BA	Transmitted Data
3	BB	Received Data
4	CA	Request to Send
5	CB	Clear to Send
6	CC	Data Set Ready
7	AB	Signal Ground (Common Return)
8	CF	Received Line Signal Detector
11	**	Select Standby (U.K. Speed Select)
15*	DB	Transmit Signal Element Timing
17*	DD	Receive Signal Element Timing
18	CI**	Test
20	CD	Data Terminal Ready
22	DE	Ring Indicator
23	CH	Speed Selector

*Not used when business-machine clocking is used.
**Not standardized by EIA; used for external IBM modem attachment (Select Standby not used on 3777 models).

CCITT–V.35 Interface (World Trade countries only):

Connector Pin	*V.35 Designation*	*Circuit Description*
B	102	Signal Ground (Common Return)
C	105	Request to Send
D	106	Clear to Send
E	107	Data Set Ready
F	109	Received Line Signal Detector
H	108/2	Data Terminal Ready
R	104	Received Data A-Wire
T	104	Received Data B-Wire
V	115	Receiver Signal Element Timing A-Wire
X	115	Receiver Signal Element Timing B-Wire
Y	114	Transmitter Signal Element Timing A-Wire
a	114	Transmitter Signal Element Timing B-Wire
P	103	Transmitted Data A-Wire
S	103	Transmitted Data B-Wire

High-Speed Digital Interface (HSDI):

Connector Pin	*HSDI Designation*	*Circuit Description*
C	CS	Clear to Send
D	RS	Request to Send
E	SD	Send Data
F	DSR	Data Set Ready (Center Conductor)
F	RI	Ring Indicator (Outer Conductor)
J	SCT	Serial Clock Transmit
K	RD	Receive Data
L	SCR	Serial Clock Receive
M	AGC	AGC (Carrier–Center Conductor)
M	DTR	Data Terminal Ready (Outer Conductor)

Additional Information

Additional information about DCE interfaces and communication facilities can be found in the following publications or can be obtained from your IBM teleprocessing representative:

- *IBM Remote Multiplexers and Communications Terminals Installation Manual–Physical Planning,* GA27-3006
- *Planning and Installation of a Data Communication System Using IBM Line Adapters,* GA24-3435
- *IBM 3872 Modem User's Guide,* GA27-3058 (2400 bps)
- *IBM 3874 Modem User's Guide,* GA33-0002 (4800 bps)
- *IBM 3875 Modem User's Guide,* GA33-0001 (7200 bps)
- *IBM 5979 L11/12 Baseboard Modem User's Guide,* GA11-8594 (9600 bps–World Trade only)

Chapter 2. IBM 3771/3773 Communication Terminal Models 1, 2, and 3

Components

Controller

The controller is contained in the terminal's base. It controls input and output operations, provides buffering for received and transmitted data, and provides the data link control.

The controller operates in three modes: local mode, offline mode, or online mode. After power on, or on completion of any job, the terminal is in local mode and can be used for document preparation, similar to typewriter operation. From local mode, the controller can be placed in either offline or online mode. In online mode, the terminal can receive or transmit data over the communication facility. In offline mode, the terminal can be used for data transfer between attached I/O devices.

Console Printer

The console printer used on these terminals is a serial wire-matrix type printer. The 3771 and 3773 models and printing speeds are as follows:

3771/3773 Model 1 . . . . 40 characters/second
3771/3773 Model 2 . . . . 80 characters/second
3771/3773 Model 3 . . . . 120 characters/second

These maximum printer speeds are attained during continuous printing on a line. During printing from the controller's buffer, printing is done as the carrier moves in either direction (left to right or right to left). This method of bidirectional printing eliminates the mechanical delay encountered in moving the print mechanism back to the beginning of the print line after each line is printed, as is commonly done on most serial printers. Right to left printing is done only when printing from the controller's buffer; during keyboard entry, the printer prints only left to right.

Printed characters are formed in a 7 × 8 dot pattern by selectively pushing the eight print wires forward to contact an inked ribbon and the paper as the print mechanism moves across the print line. A 94-character set, as shown in Appendix B, is provided on all printers. The printers can print up to 132 characters per line.

The printer's current print position is indicated by a scale and pointer on the print mechanism. Margins and horizontal tab stop settings are electronically controlled and are set by the operator before starting the job. These settings are stored in the terminal as described later under "Job Control."

This printer uses a friction-feed platen for forms feeding and can accept single-part continuous forms or 1-part to 3-part cut forms from 6 to 14-1/2 inches wide. A Variable Width Forms Tractor feature is available, and is required for feeding edge-punched multipart continuous forms. With this special feature, up to 6-part forms (depending on paper and carbon thickness) ranging from 3 to 15 inches wide can be used. Forms thickness cannot exceed 0.018 inch. Forms length can be from 3 to 14 inches. The following restrictions and recommendations must be observed when selecting forms for use on this printer:

- Continuous-form card stock is not recommended.
- Stapled forms are not allowed.
- Multiple-part cut forms must be glued together at the top.
- Partial forms separation is not allowed.
- Crimped multiple-part cut forms are not recommended because they tend to separate when wrapped around the platen.
- Continuous single-part forms used with the friction-feed platen must be periodically adjusted to keep them feeding straight.
- 5-part and 6-part forms should be tried to determine if legibility, forms feeding, and print registration is acceptable.

Forms design considerations can be found in the publication *Forms Design Reference Guide for Printers*, GA24-3488. To facilitate handling of continuous forms, the Forms Stand accessory is recommended.

Keyboard

The keyboard used on machines in the U.S. and Canada has 44 character keys and a space bar, and other typewriter-like control keys. The arrangement of keys is similar to those on a typewriter keyboard. On either side of the typewriter-like keys are keys for controlling terminal operation. Lights located above the keys provide indications of terminal status and error conditions. This keyboard provides 88 characters in upper and lowercase shift (refer to Figure 2-3).

Typamatic operation of the Space Bar and Backspace, Hyphen/Underscore, and PRINT CHAR(acter) keys cause repetitive functions simply by holding the key down.

Keyboards for use in World Trade countries other than the United Kingdom have 47 graphic keys, providing 94 characters. The keyboard for the United Kingdom has an additional key (48 keys), and provides 94 characters in upper and lowercase shift. This keyboard does not provide typamatic operation for the Hyphen/Underscore key. Keyboard characters present on all keyboards are shown in Appendix B.

Nomenclature on keyboard control keys, lights, and switches is provided for the following languages:

English
French
German
Italian
Japanese
Spanish

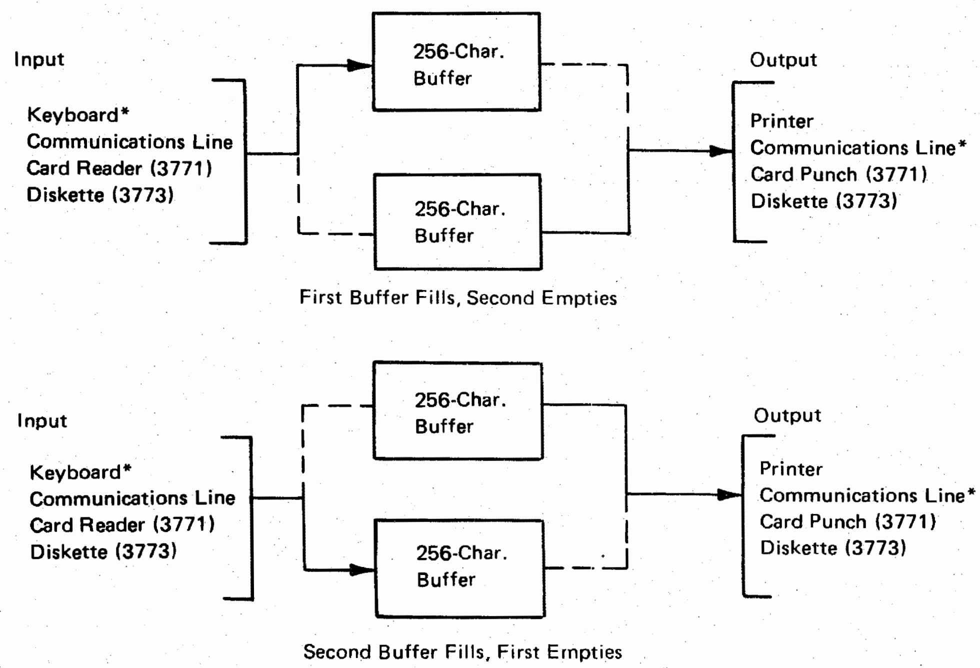
Operating Characteristics (3771/3773 Models 1, 2, and 3)

Controller

The controller uses two 256-character buffers for temporary data storage. The buffers alternate in use between input and output, and accept data from the input device character-by-character (Figure 2-1). During either offline mode or online mode operation, one buffer is dedicated to input and the other to output. While one buffer is accepting input data, the other may be sending output data. When the input buffer fills and the output buffer empties, they exchange functions. This arrangement allows:

- A consistent line rate with variable I/O (input/output) rate
- Overlap of input and output operations
- Checking of data before output or transmission

The alternating-buffer scheme can be disabled for keyboard-to-diskette or keyboard-to-line operations, making a single 512-byte buffer available for buffer editing. This is described in more detail under "Buffer Edit".



***See "Keyboard to Line or Diskette" for keyboard-to-line operation.**

Figure 2-1. 3771/3773 Dual Buffer Operation

Job Control

After the terminal's power is turned on, and with the HOLD PRINT switch off, the terminal is in local mode. The keyboard and printer are enabled, and can be used for keyboard entry and printing. If forms control is desired, margins and horizontal and vertical tab stops must be entered. These may be entered from the keyboard, or from an attached card reader on the 3771. On the 3773, the forms control information, once entered, may be stored on the diskette, from which the information may be recalled. These settings, however entered, are stored in the controller, and will remain in effect until changed by the operator, or until power is turned off. Parameters for the job or modes of operation that can be specified are:

- *Monocase Keyboard Entry.* This causes the 26 lowercase alphabetic characters a through z to be automatically converted to uppercase characters without use of the Shift key.
- *Transparent Mode.* This causes all card data to be transmitted in Transparent format.
- *Compress (3771 Only).* This causes space compression of data read from the card reader (refer to "Space Compression/Expansion" in this chapter).
- *Interpret or Inhibit Interpret.* Using the 3521 Card Print feature, Interpret must be specified to cause printing on the card while reading cards. Inhibit Interpret must be specified to inhibit printing while punching cards.
- *3521 Read.* This causes the 3521 to read cards, if the Read feature is installed.
- *Omit Readback Check (3521).* This disables the 3521 punch checking to allow punching of internally scored or prepunched cards.
- *Monitor Print (3771 Only).* This causes monitor printing of data received and punched into cards, or read from an attached card reader and transmitted.
- *Update Mode (3773 Only).* This mode can be selected for keyboard-to-diskette jobs for updating diskette records (see "Keyboard-to-Diskette Operation").
- *Manual Disconnect.* Manual disconnect prevents the modem from automatically disconnecting from the communication line when the line becomes idle.
- *Select Inquiry Mode Operation.* This mode can be selected on machines with the BSC Multipoint feature (see "Inquiry Mode" in Chapter 7).

On the 3773 using the diskette as the input device and the printer as the output device, the operator can also select either the data set written onto the diskette from the keyboard or the data set written from the line. Only the selected data set will be used for any job involving the diskette as the input device.

Offline and online jobs that may be selected on the 3771 are:

Input	(to)	*Output*
Keyboard	. .	Printer
Keyboard	. .	Line
Keyboard	. .	Card Punch
Card Reader	. .	Line
Card Reader	. .	Printer
Line	. . .	Printer
Line	. . .	Card Punch

Jobs that can be selected on the 3773 are:

Input	(to)	*Output*
Keyboard	. .	Printer
Keyboard	. .	Diskette
Keyboard	. .	Line
Line	. . .	Diskette
Line	. . .	Printer
Diskette	. .	Line
Diskette	. .	Printer

When the keyboard is selected as the input device, printing occurs on the printer as each character is keyed. If component selection (a DC character) is received (online mode) to select the console printer, data will be printed regardless of the setting of the 3771 PUNCH switch or the 3773 DISK switch. If component selection is not received by the 3771, data will be printed if the PUNCH switch is off, or punched if the PUNCH switch is on. On the 3773, data will be printed if the DISK switch is off, or written on the diskette if the DISK switch is on.

Buffer Edit

Buffer edit allows the operator to correct errors before data entered into the controller buffer is transmitted to the remote station, written to the 3773 diskette, or punched on the 3521 Card Punch attached to the 3771. Keyboard keys are provided to reset to the buffer beginning, to return to the beginning of the current line, or to backspace a character at a time. Data can then be printed out for verification, or altered before the buffer is read out to the output device.

In normal operation, one 256-byte buffer is filled and edited, and then transmitted. Buffer contents can be transmitted by pressing either EOB or EOM. If EOB is pressed to cause transmission, input can continue into the other buffer. If EOM is pressed, no further input can be accepted until the SYS REQ key is pressed. Buffer edit can be optionally extended to encompass both buffers, or 512 bytes, by turning the EXTEND/ALARM switch on. In this case, the dual alternating-buffer scheme is inactivated, and the buffers become a single 512-byte buffer dedicated to input from the keyboard. The 512-byte buffer is filled, edited, and transmitted, and must be properly acknowledged by the CPU before further input can be accepted from the keyboard. The buffer contents are transmitted in two 256-byte blocks. If EOM or EOB is pressed to cause transmission of the buffer contents after 256 or fewer characters have been entered, only one 256-byte block is transmitted.

On output from the buffer to the 3773 diskette Storage Device, the 512-byte buffer is written as two records onto the diskette before further keyboard entry is allowed. If 256 or fewer characters are entered, the second 256-byte record will consist of all NUL characters.

On the 3773, extended-buffer operation cannot be used in update diskette mode.

Compression/Expansion

Throughput on the 3771 may be increased by specifying Compress for jobs involving card reading. If this option is specified, consecutive space characters are removed from transmitted data and reinserted in output data by the receiver.

Using BSC–Space Compression/Expansion

When the 3771 is transmitting, and has read two or more consecutive space characters from a card reader, it will transmit an IGS (hex 'ID'), followed by a character (binary number) specifying the number of omitted spaces. This binary number represents a minimum of 2 and a maximum of 63 spaces. If more than 64 consecutive spaces are read from the input device, a second IGS sequence is transmitted.

The binary numbers representing the omitted spaces are defined as follows:

Number of Spaces	*EBCDIC: 0 1 2 3 4 5 6 7*
2	0 1 0 0 0 0 1 0
3	0 1 0 0 0 0 1 1
.	.
.	.
.	.
63	0 1 1 1 1 1 1 1

Space compress and transparent mode cannot both be specified in the job definition.

These sequences can also be received in data from the CPU and will cause reinsertion of the spaces into cards punched on the 3521 Card Punch or printed on the console printer. Compressed data received from the CPU onto the 3773 diskette will be expanded when the data is printed.

Using SDLC–Space or Data Compression/Expansion

When the 3771 is transmitting in SDLC from a card reader, a String Control Byte (SCB) character (see definition following) is transmitted either in front of each string of data characters or instead of consecutive (repeated) space characters (called *compression*). The SCB character identifies the type of data string and contains the binary count of the number of characters that follow, or the number of space characters to be inserted (repeated) at the receiver (called *expansion*). The binary number represents a minimum of 1 and a maximum of 63. If more than 63 characters are involved, a second SCB character is transmitted.

String Control Byte (SCB) Definition:

Bits 0 and 1 identify the data string:

- 00- No Compressed Characters. Count field (bits 2-7) contains the number of the bytes between this SCB and the next SCB.
- 01- Not used by the 3771/3773.
- 10- Compressed Space Characters. The count field contains the number of space characters represented by this SCB. The next SCB follows in the next byte.
- 11- Compressed Data Characters (Outbound only; CPU to 3771/3773). The count field contains the number of times the data character following this SCB is to be repeated at the receiver. The next SCB follows the data character to be repeated.

Bits 2 through 7 contain a binary count of the data characters that follow, or space or data characters to be inserted at the receiver.

Example: Repeat the asterisk (*) character (X'5C') 21 times.

SCB Character Bits

$$\underbrace{1\ 1\ \underbrace{0\ 1\ 0\ 1\ 0\ 1}_{\text{Binary } 21}}_{\text{X'D5'}}$$

(bit positions 0 1 2 3 4 5 6 7)

Repeated Character Bits

$$\underbrace{0\ 1\ 0\ 1\ 1\ 1\ 0\ 0}_{\text{X'5C'}}$$

(bit positions 0 1 2 3 4 5 6 7)

Problem Determination

The controller has built-in tests that run each time the power is turned on or the SYSTEM RESET switch is operated. These tests, when successfully completed, have checked the major portion of the controller and verified that the electronic circuits are operating properly. The tests require a few seconds to run and leave the terminal in local mode with the PROCEED indicator on. This informs the operator that operation can proceed. Any other indicator being on after the tests have run signals either that a failure occurred in the controller's electronic components, that one of the mode switches is on, or that the Keylock is turned off.

Problem determination tests selectable from the keyboard reside in the terminal. The operator can use these tests to isolate problems to the terminal or to the communication facilities. Communication-facility tests include online tests provided by the CPU access method.

Error Logging

Information about errors encountered during normal operation are recorded in an error log that can be printed out by the Print Error Log function. When errors that cannot be corrected by operator action occur, or when intermittent internal machine errors that impede operation occur, the operator should call for a printout of the error log before turning power off (the error log is lost when power is turned off). This printout should be retained and given to the service representative, who will use it to isolate the cause of the problem.

Operator Attention Speaker

This device produces an audible tone to signal the operator that a procedural error has occurred, or that some input or output device requires attention. Upon hearing the tone, the operator can refer to the keyboard indicators, which will indicate the cause of the tone. The speaker also sounds during keyboard/printer operations ten spaces before the printer's right margin is reached, or ten spaces before the buffer is full.

Console Printer

The printer is selected as an output device anytime the keyboard is selected as an input device. All data entered via the keyboard prints as the characters are keyed. During receiving from the CPU, received data prints unless some other device (a card punch attached to the 3771 or the 3773 diskette) is selected as the output device. The 3771 console printer can be used to monitor-print data that is read from an attached card reader and transmitted, or data that is received and punched on an attached 3521.

Before a job is started, margin settings and vertical and horizontal tab stops are entered and stored in the terminal. These forms controls remain in effect until different settings are entered, until power is turned off, or until a System Reset occurs.

Assuming a keyboard-to-line operation, data entered into the keyboard prints on the console printer as each character is keyed. The character also enters the transmission buffer, and the buffer is transmitted when the end of buffer is signaled.

Certain printer function characters can be received within data from the CPU to cause formatting of the data as it is printed on the console printer. The characters that can be recognized by the printer, and the operation they cause, are described in Chapter 7.

Vertical Forms Control

Vertical forms control allows the operator to specify the vertical format of forms by print areas and skip areas. Once the format is entered, automatic operation causes the forms to advance when specified text areas are completed. The procedure for entering the vertical forms control is contained in the *Operating Procedures Guide.* Control characters used for vertical forms control are described in Chapter 7.

Horizontal Format Control

Printer margins and horizontal tab settings are entered before the beginning of a job and stored in the terminal. The procedure for setting margins and horizontal tab stops is contained in the *Operating Procedures Guide.* Control characters used for horizontal format control are described in Chapter 7.

Horizontal tab setup permits the Tab key to be used to skip areas within a line that are not to be printed. This is similar to typewriter operation, except that the tabbing is electronically controlled. When Tab is pressed during keyboard entry, the print position moves to the right to the next tab stop, and an HT character is stored in the transmission buffer immediately following the last data character. Data for the next field then begins storing in the buffer immediately following the HT character.

The relationship between the print position indicated on the printer and the buffer position at which data is entered is not a one-to-one relationship. After power on, or after data has been read out of the buffer, new data will always begin storing into the first buffer position. Data begins printing, however, at wherever the left margin is set. Several lines of data, each delineated by format control characters, can be contained in a single buffer.

Keyboard

Keyboard Entry to Line or Diskette

Data entered via the keyboard is stored character by character into the buffer and remains there until the end of the buffer is signaled. As data is entered, it also prints on the console printer. The end-of-buffer signal is under control of Auto mode (a CODE key function).

In Auto Mode

In Auto mode, keying into the buffer is ended depending on the output device.

Diskette as Output: Using the Diskette as the output device, the buffer is ended automatically when the buffer becomes full (256 characters have been entered). Input to the other buffer can continue without interruption of the operator's normal keying cadence.

BSC Line as Output: When keying to a BSC line as an output device, Auto mode does not apply.

SDLC Line as Output: When keying to an SDLC line as an output device, the buffer is ended and will be transmitted when the CR (New Line) key is pressed. A NL (New Line) character is placed in the buffer as the last character.

Not in Auto Mode

When not in Auto mode, data from the keyboard is handled depending on the output device.

Diskette as Output: Using the diskette as the output device, data from the keyboard is not accepted after 256 characters have been entered (the operator Attention Speaker sounds to alert the operator). The operator must then press EOB or EOM to read the data out of the buffer. Input to the other buffer can continue while data previously entered is being read out.

BSC Line as Output: When keying to a BSC line as an output device, data from the keyboard is not accepted after 256 characters have been entered (the Operator Attention Speaker sounds to alert the operator). The operator must then press EOB or EOM to cause the buffer to be transmitted. If EOB is pressed, keying can continue into the other buffer. If EOM is pressed, no more keyboard input can be accepted.

SDLC Line as Output: When keying to an SDLC line as an output device, the buffer is ended automatically when 256 characters have been keyed in, and the buffer is transmitted to the line. Keying into the other buffer can continue without interruption of the operator's normal keying cadence. If less than 256 characters are keyed in, the buffer can be transmitted by pressing EOB or EOM. If EOB is pressed, keying can continue into another buffer. If EOM is pressed, no more keyboard input can be accepted.

Whether the 3770 is in Auto mode or not, less than 256 characters can be transmitted or read out by pressing EOB or EOM.

Monocase Output from Keyboard

For keyboard entry jobs, monocase (uppercase only) output from the keyboard can be specified. This permits uppercase alphabetic (26 characters A through Z) keyboard entry without use of the Shift key. Other uppercase characters must still be selected by use of the Shift key.

Keyboard Entry to Card Punch

When the card punch is used as output, Auto mode does not cause automatic buffer readout as is done when line or diskette is used as output. In Auto mode, buffer readout and punching takes place when the Return key is pressed. Also, in Auto mode, cards may be duplicated by pressing BUFFR LINE RTN and Return; by repeatedly pressing BUFFR LINE RTN and Return, as many cards as desired can be duplicated. When not in Auto mode, the EOB or EOM key must be pressed to cause the buffer to read out and punch.

3773 Magnetic Diskette Storage

The Diskette Storage Device is a compact unit contained in the 3773 base (Figure 2-2). Data is recorded on a small, flexible, operator-changeable diskette. The Diskette Storage Device can accept input data entered into the controller's buffer either from the communication line during online operation or from the terminal's keyboard during offline operation. Batch data can be stored on the diskette during offline operation and subsequently transmitted to the CPU, resulting in increased throughput and reduced communication costs in many applications. Each diskette provides a maximum of 242,688 bytes of data storage.

Forms control information (margin settings and vertical and horizontal tabs) may be stored on the diskette, and can be recalled from the diskette after a power off/power on sequence.

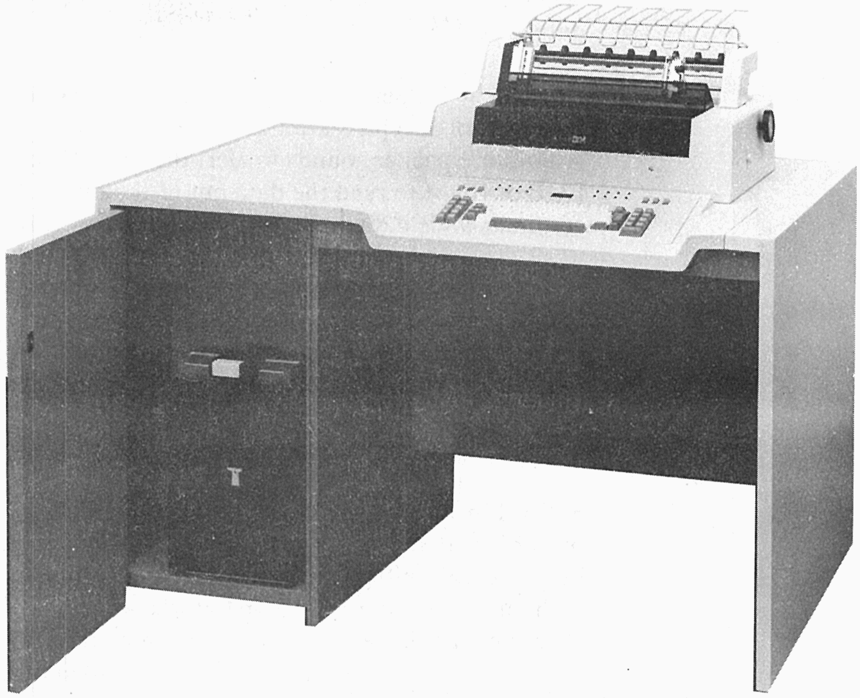


Figure 2-2. 3773 Magnetic Diskette Storage

Diskette Records

Each record written on the diskette is identified by a record number (1 through 948) assigned by the controller. This number can be used later to recall a record for updating and correcting the SK data set (see "3773 Diskette Data Sets" following). The 3773 starts a diskette-to-line or diskette-to-printer job from the SK data set at record 001. The only exception to this is when using update mode, in which case, the record number can be selected for printing and updating. For a diskette-to-printer job from the SL data set, the 3773 always begins at record 001. Updating cannot be performed with the SL data set. Each record consists of 256 bytes stored in two diskette sectors, thus providing a maximum diskette capacity of 242,688 bytes of data storage. Appendix E shows the diskette track and sector format. Records consisting of less than 256 significant bytes cause NUL characters (hex '00') to be inserted following the significant data, padding the record out to 256 bytes. As with any diskette of this type, defective sectors due to physical damage of the diskette will decrease the available storage capacity. Defective sectors are skipped over the first time they are encountered; thereafter, they are not used. An excessive number of defective sectors can cause a significant decrease in storage capacity, and will degrade performance.

When receiving data over the communication line for writing on the diskette, data blocks from the CPU cannot exceed 256 bytes. Blocks containing less than 256 bytes will be accepted and padded with NULs as they are written on the diskette. BSC transparent data cannot be written on the diskette.

3773 Diskette Data Sets

A data set name identifies a group of records for any particular job. The 3773 uses only three data set labels (see Appendix E for data set label descriptions).

Sector	3773 Data Set Name	Usage
8	OJDR	Operator Job Definition Record. This label is written at CREATE time on a 3773. Forms definitions may be written to and read from this data set (see "Using the Diskette Storage Device to Define Printer Margins and Tab Settings" in the *Operating Procedures Guide)*. If a diskette from a non-3770 is to be used, this label need not be used.
9	SK00	Keyboard to Diskette. This label is written at CREATE time. Keyboard-entered data is written to this data set. If data is transmitted, only this data set is transmitted. The data set name is not examined when data is written or read; therefore, the data set name may be any valid eight-character name. This data set with valid extents must be present for the SL00 data set to be written (see following description).
10	SL00	Line to Diskette. This label is written when data is first received from the line. Later, when more data is received, the end-of-extent and end-of-data identifiers are updated. This is the only data set that can be written with data from the line. This data set begins immediately after the data set described in the label in sector 9. Therefore, the label in sector 9 must be written before line-to-diskette data can be received.

When transmitting from the diskette device to the CPU, the entire data set (described in label sector 9) must be transmitted. Data can be received onto the diskette and written following any keyboard-entered data. Continuation of a data set from the keyboard will destroy previous data received from the CPU. In this case, the operator is warned by the 3773, but the warning can be overridden. Either data set (described in label sector 9 or 10) can be independently selected for printing.

Diskette Create Function

New diskettes, or diskettes that have been previously used on other machines (3741 or 3742, for example), must be prepared for use on the 3773 by performing the diskette Create function before they can be *written* on the 3773. Diskettes previously written on other machines in exchange format can be read on the 3773, however, without performing the diskette Create function. This function is under control of the keyboard CODE key. This procedure writes the Volume Label and Data Set Labels on track 00 of the diskette, as shown in Appendix E. Any data previously written on the diskette, including forms control information, cannot be accessed again.

Exchange Format

Exchange format (BSC) refers primarily to the sequence in which records are written on the diskette. In order to improve throughput on the 3773, this format is not used when writing a 3770 diskette in non-exchange format. For compatibility with non-3770 IBM products, the 3773 can write and read diskettes using this format; however, throughput is reduced when data is transmitted from the diskette, as shown in Appendix D. If a diskette is to be written in exchange format, it must be so specified during the diskette Create procedure.

Basic exchange data sets may be written by the 3773 from the line (SDLC only). If a basic exchange data set is to be written, the diskette must first have been specified as an exchange diskette during the Create function or must have the Extent Arrangement indicator set to 'P'. See *Appendix E* (Data Format) for more information.

Diskettes written on a non-3770 IBM product can be read on the 3773 for transmission (basic exchange only), but cannot be written on the 3773 without first performing the diskette Create function unless the Extent Arrangement indicator is set to 'P'; see *Appendix E* (Data Format). Data previously written on the diskette cannot be accessed after the diskette Create function is performed.

Data from diskettes written in exchange mode (BSC) on the 3773 is transmitted in 256-byte blocks (two 128-byte sectors per block). The block length transmitted by the 3770 from a basic exchange data set or any other diskette is the same as the block length defined in the Data Set Label for the data set (1 to 128 characters).

Keyboard-to-Diskette Operation

Offline key entry to the diskette is basically the same as keying to the line. Data enters the buffer character by character until the end of buffer is signaled; then the buffer data is written on the diskette. If the 3773 is placed in Auto mode at any time during the job, the buffer is automatically written to the diskette after 256 characters have been entered. If not in Auto mode, the code in the Numeric Position Readout (NPR...refer to "3771/3773 Operating Controls") indicates that 256 characters have been entered, and EOB or EOM must be pressed to write the buffer to the diskette. (Using SDLC, the EOM key causes the buffer to be written to the diskette with an End of Chain (EOC) indicator).

Update mode operation allows use of the record number to recall records from the diskette for update or correction. In this mode, records can be recalled into the 256-byte buffer. By use of the buffer edit keys to the right of the keyboard, the record can be printed, updated or corrected, and then written back to the diskette when the end-of-buffer is signaled. The end-of-buffer signal is automatic in Auto mode, as just described for keyboard-to-diskette operation. In Auto mode, the next sequential diskette record reads into the buffer automatically, and the new record number is displayed in the NPR.

Diskette-to-Printer Operation

Auto mode performs a special function during diskette-to-printer operation. When the 3773 is placed in Auto mode, the current diskette record prints and the machine stops. If desired, special instructions to the operator, such as type of forms to use for a job, can be placed in the first 256-byte diskette record. If the 3773 is placed in Auto mode at the beginning of the job, only the first record for the data set prints, and the machine halts to allow the operator to comply with the printed instructions before proceeding with the job. When Auto mode is reset and the job is resumed, the remainder of the data set prints without interruption, if no unusual condition occurs. If the 3773 is not placed in Auto mode at the beginning of the job, the entire data set prints without interruption. The HOLD PRINT switch can also be turned on at any time to halt the job temporarily so that, for instance, forms can be inserted or adjusted; printing stops at the end of the current print line, and resumes when the switch is turned off.

Diskettes

Diskettes used with the diskette Storage Device consist of a small flexible disk about 8 inches in diameter enclosed in a holder. Appendix F describes the diskette used with the 3773, and describes diskette labeling and recommended handling procedures.

Features and Accessories (3771/3773 Models 1, 2, and 3)

This section describes the special and specify features and accessories (purchase-only items) available for the 3771 and 3773 controllers and console printers. I/O devices (3501 or 3521) that can be cable-connected to the 3771 controller, and special features for these devices, are described in the "I/O Attachments" chapter.

Door Keylock (3773 Only)

This special feature adds a keylock to the control unit door on the 3773.

Audible Alarm

This special feature provides a signal louder than the Operator Attention Speaker. The alarm can be enabled or disabled by the operator. When enabled, and during any job not using keyboard input, the alarm sounds for any device-error or not-ready condition.

Keylock

This special feature provides a key-operated switch that can be turned off to disable the terminal. Online communication is possible with the Keylock off, if the terminal is placed in a ready state before turning the Keylock off, but any operator controls are disabled.

Operator ID Reader

This special feature is a desk-top unit that reads magnetic-stripe operator-identification cards. On machines using SDLC, the CPU can request the user's identification by sending a message to the terminal. The operator must then start a keyboard operation (which may or may not include keyed data), then, using a CODE key function, activate the ID reader. When the message code number appears in the NPR display, the operator inserts an ID card into the reader. ID card data is then transmitted to the CPU for verification; the CPU will allow further communication only after receiving a valid ID. The ID card data is not printed at the terminal, and cannot be buffer edited. An automatic EOB follows the ID card data; further keying may occur before the EOM key is pressed.

A magnetic card may be inserted at any time during a keyboard-to-line job, using the "Read ID" CODE key function. If the card is an operator identification, the card data prints and buffer editing can be performed; further, the operator may enter additional keyboard data if buffer space remains.

On BSC machines, the ID Reader cannot be selected from the CPU. The application program can be written to inform the operator, using a printed message, when to insert the ID card into the reader. A CODE key function causes a message code number to appear in the NPR and selects the ID Reader. This function may be used only on a keyboard-to-line operation. Data may be keyed before the function is used. When the badge is read, the buffer is sent to the CPU with an automatic EOM. The CPU must also provide checking and verification of received ID card data and take whatever action is necessary depending on the data received. Data read from the ID card is not printed on the terminal's console printer.

Card size must be 3-7/8 by 2-1/8 inches, and between 0.007 and 0.045 inch thick. The magnetic stripe must be encoded in the American Banking Association format, which provides for up to 40 characters, 37 of which are discretionary. Card format and character sets are shown in Appendix B.

Katakana Feature

This specify feature provides a Katakana 127-character set on the console printer. and a Katakan keyboard. The character set is shown in Appendix B.

EIA/CCITT Interface

This special feature is required for connection to common-carrier or customer-supplied Data Communication Equipment (DCE), or to IBM standalone modems, operating over a switched or non-switched communication facility. A 3771 or 3773 with this feature can also attach to a 3774, 3775, or 3776 with the Modem Fan Out feature and an IBM 2400 BPS Integrated Modem, Multipoint Tributary (see Figure 3-5). This feature provides an interface to the DCE that conforms to the characteristics and specifications of EIA Standard RS-232C (U.S. and Canada), or CCITT Recommendation V.24 (World Trade countries). The circuits utilized by the 3770 are described in Chapter 1.

Communication Driver

This special feature is required for communication. In addition, one of the line control disciplines as described under "Communication Feature" must also be selected. The Communication Driver is available in two versions: without business-machine clocking; or with 1200 bps business-machine clocking. Business-machine clocking must be used when the DCE does not supply clocking for received and transmitted data. On World Trade machines, the Driver with business-machine clocking can also operate at 600 bps.

Communication Feature

This special feature provides the line control discipline, and is available in three versions: SDLC; BSC Point-to-Point; and SDLC/BSC Switch Control. The SDLC/BSC Switch Control version provides both types of line control, selectable by a switch on the terminal. If BSC multipoint operation is desired, the BSC Multipoint feature must also be installed in conjunction with the BSC Point-to-Point or SDLC/BSC Switch Control Communication feature. SDLC can operate either point-to-point or multipoint.

BSC Multipoint

This special feature, installed in conjunction with the BSC Point-to-Point or SDLC/BSC Switch Control Communication feature, permits the 3770 terminal to be multidropped on the same non-switched communication facility with other appropriately featured 3770 terminals or with other compatible BSC terminals. With this feature, the terminal responds only to its specific address when polled or selected by the CPU.

Integrated Modems

Integrated modems (special features) are incorporated in the controller, eliminating the need for an EIA/CCITT Interface feature. Connection to common-carrier switched lines using these modems is via a common-carrier-supplied Data Access Arrangement. These modems are compatible with appropriately featured integrated modems available for the IBM 3704/3705 Communications Controllers.

Note: 1200 BPS Integrated Modems are *not* compatible with a 2400 bps modem operating at half speed (1200 bps).

1200 BPS Integrated Modem, Non-Switched Network

This modem operates at 1200 bps over leased or privately owned half-duplex or duplex lines. A 3770 terminal always operates in half-duplex mode, but line turnaround time can be reduced using a duplex communication line. The Communication Driver with business-machine clocking must be used with this modem. This modem is compatible with the IBM 3976 Modem that is available for use in World Trade countries.

1200 BPS Integrated Modem, Switched Network, with Auto Answer (U.S. and Canada)

This modem operates at 1200 bps over a switched network. With this modem, a 3770 terminal in unattended mode can automatically answer incoming calls. The Communication Driver with business-machine clocking must be used with this modem.

1200 BPS Integrated Modem, Switched Network, with Manual Answer (U.S. and Canada)

This modem operates at 1200 bps over a switched network. Incoming calls must be manually answered. The Communication Driver with business-machine clocking must be used with this modem.

1200 BPS Integrated Modem, World Trade Public Switched Network

This modem operates at 1200 bps over a public switched network in certain World Trade countries (not applicable in Japan). The Communication Driver with business-machine clocking must be used with this modem.

ASCII

This special feature is available for use in the U. S. and Canada. Differences between EBCDIC-coded and ASCII-coded machines are described in Appendix G.

Forms Stand Accessory

The Forms Stand accessory (purchase only) facilitates handling of continuous fan-fold forms used with the console printer.

Variable Width Forms Tractor

This special feature can be added to the 3771 and 3773 console printer for feeding edge-punched continuous forms. Forms ranging from 3 to 15 inches wide can be used. Up to 6-part forms can be used, with a total thickness not to exceed 0.018 inch. Refer to "Components—Console Printer" for forms restrictions and recommendations.

Operating Controls (3771/3773 Models 1, 2, and 3)

POWER ON/OFF Switch: This switch controls ac power to the terminal. When power is turned on, the bring-up diagnostics run and the terminal is left in local mode with the PROCEED indicator on. Any other indicator on signals either a failure in the terminal's electronic components, that the HOLD PRINT switch is on, or that the Keylock is off. The operator should proceed as described in the *Operating Procedures Guide.* If the tests complete successfully, the operator can proceed with terminal operation.

Keyboard Switches, Keys, and Lights (Figure 2-3)

Switches

HOLD PRINT: Turning this switch on suspends printing on the console printer and moves the print mechanism to the extreme left position so that forms may be inserted or adjusted. Printing resumes after the switch is turned off.

EXTEND/ALARM: This switch selects the single 512-byte buffer for keyboard-to-line or keyboard-to-diskette buffer edit operation. For jobs not using keyboard input, the switch causes the Audible Alarm, if present, to sound when a device-error or not-ready condition occurs.

PUNCH (3771 Only): This switch selects the 3521 Card Punch as the output device for an online mode job.

DISK (3773 Only): This switch selects the diskette Storage Device as an output device for an online mode job.

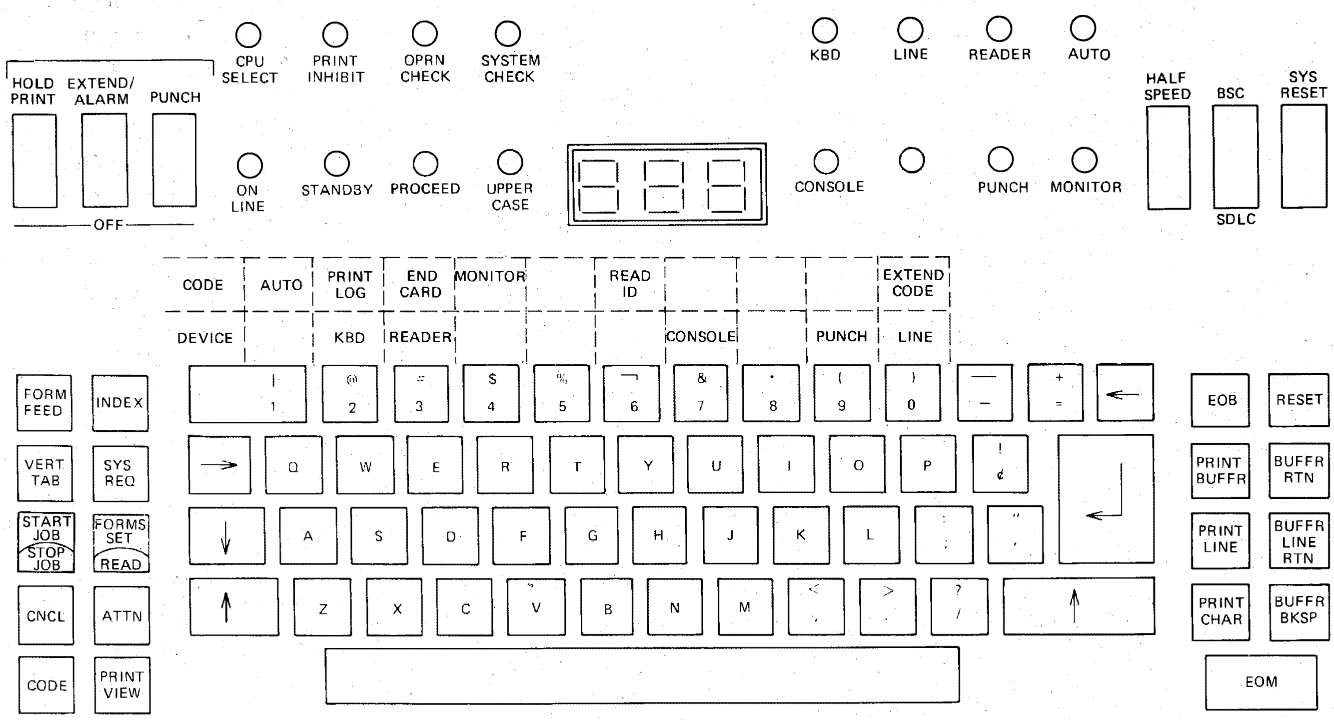
HALF SPEED: This switch is active on World Trade machines using a modem with half-speed capability. With the switch off, the modem operates at its maximum rated speed. With the switch on, the modem operates at half its rated speed.

BSC/SDLC: At power-on time this switch selects either the BSC or SDLC method of communication. The switch must be placed in the BSC position to communicate using BSC procedures (see *Chapter 7*), or in the SDLC position to communicate using SDLC procedures (see Chapter 8). After power-on, this switch may be used to change the communication method by changing the switch and pressing SYS RESET.

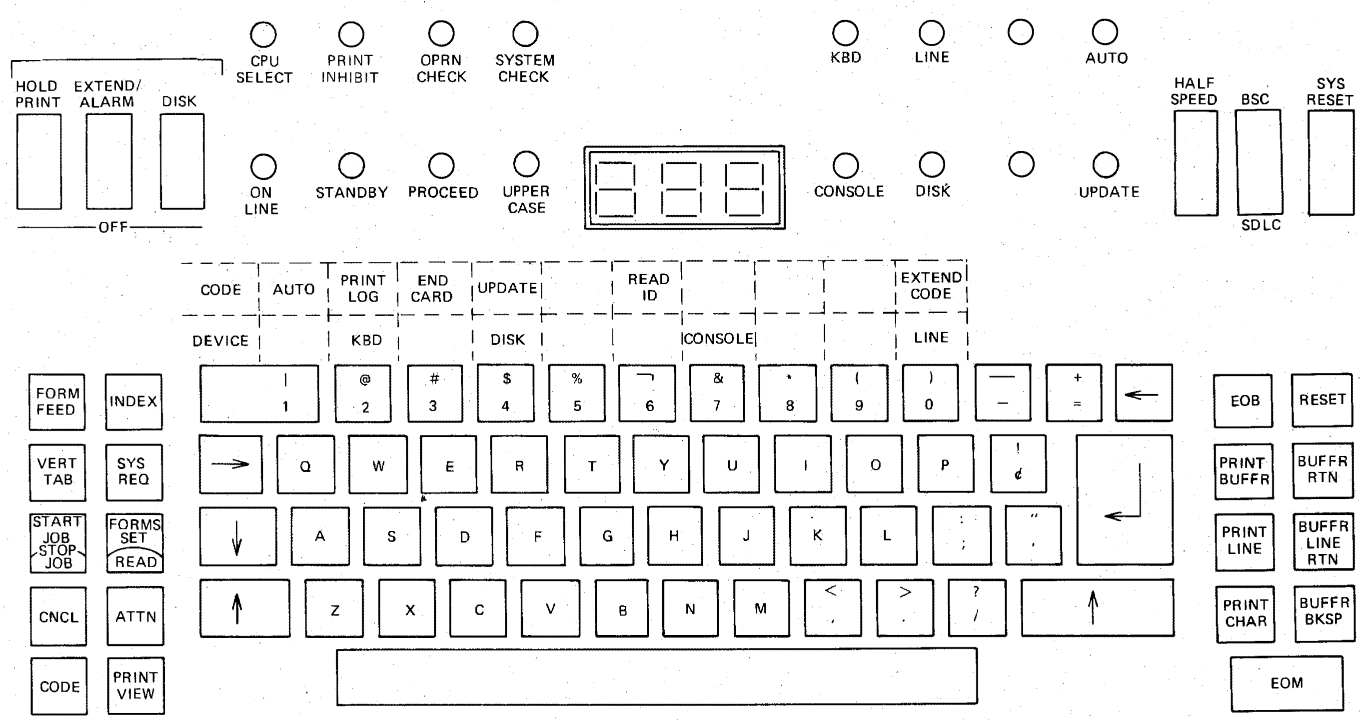
SYS RESET: This switch resets any machine errors, and causes the bring-up diagnostics to run. The terminal is left in the condition described under "POWER ON/OFF Switch."

Keys

INDEX: This key causes the forms to feed one line, and stores an LF character in the buffer. The next character entered will print in the next sequential print position. An index function under control of the CODE key can also be performed, and does not store a character in the buffer.



3771 Keyboard



3773 Keyboard

This figure shows the EBCDIC keyboard arrangement for use in the U.S. and Canada.

Figure 2-3. 3771/3773 Keyboards

FORM FEED: This key causes the forms to advance to the first printing line on the next form, and stores an FF character in the buffer. A form feed function under control of the CODE key can also be performed, and does not store a character in the buffer.

VERT TAB: This key causes the printer forms to advance to the next predefined vertical tab stop, and stores a VT character in the buffer. If no vertical tab stops are defined, the key causes a printer line feed.

SYS REQ (System Request): This key can be used to initiate a logon or logoff message if the terminal is in local mode, or if the STANDBY light is on after a previous online job.

START JOB/STOP JOB: Pressing this key starts a job. Pressing this key in conjunction with the CODE key stops the job.

FORMS SET/READ: Pressing this key initiates the prompting sequence for entering the margin settings and vertical and horizontal tab stops. On the 3773, the settings are then written on the diskette if the DISK switch is on. Pressing the CODE key in conjunction with this key reads the forms control information from the 3773 diskette, or from the card reader attached to the 3771.

CNCL (Cancel): This key clears the buffer of all data.

During an SDLC online job, the CNCL key operates as follows:

- Receiving: If the CNCL key is pressed while receiving data, the terminal transmits a negative response requesting a break in the output.
- Transmitting: If the CNCL key is pressed while transmitting data, the buffer is cleared of all data and Cancel request is sent to the host.

ATTN (Attention): This key is active only on SDLC machines, and causes transmission of an expedited Signal command to the CPU. The Signal request unit contains a Request-to-Send code to stop the CPU from sending so that the 3771/3773 can begin sending to the CPU. The application program in the CPU may or may not honor the Request to Send. (See the chart on "SNA Network Commands" in Chapter 8 – "Programming Considerations – SNA/SDLC Communications".)

CODE: This key is used in conjunction with certain numeric or alphabetic keyboard keys to select functions such as:

- Auto Mode Operation
- Print Error Log
- End Card—Inserts IRS character
- Select Monitor Print (3771 only)
- Read ID Badge
- Select Update Mode (3773 only)
- Read Forms Control from Cards (3771) or diskette (3773)
- Communications Facilities Testing
- Create diskette (3773)—Erases all information, including forms control
- Select Manual Disconnect Mode
- Select Inquiry Mode Operation
- Select Monocase

Keys used in conjunction with the CODE key to select these functions are described in the *Operating Procedures Guide.*

PRINT VIEW: When this key is pressed during key entry, the print mechanism moves to the right so that the last printed character can be seen. The print mechanism is automatically repositioned for printing when the next data character is entered. Pressing the key twice in succession causes the print mechanism to move aside after each data key is pressed. The printer remains in this mode of operation until the key is pressed again.

EOB (End of Block): Pressing this key causes the controller buffer's contents to be transmitted (online mode), or to be written to the 3773 diskette (offline mode). For BSC, the transmission block is ended with an ETB character. For SDLC, the buffer is transmitted indicating the data is not the last element of a chain (see Chapter 8).

RESET: Pressing this key for error conditions resets the Audible Alarm. Pressing this key after a buffer edit operation restores the buffer pointer to the first buffer position past the end of data in the buffer.

PRINT BUFFR (Print Buffer): Pressing this key causes data to be printed, beginning at the current buffer position, through the end of data contained in the buffer.

BUFFR RTN (Buffer Return): Pressing this key restores the buffer pointer to the beginning of the buffer. Data is not destroyed and can be printed out or corrected.

PRINT LINE: Pressing this key causes a line (or remainder of a line) to print, beginning at the current buffer position, through the next NL or IRS character, or to the end of the data contained in the buffer.

BUFFR LINE RTN (Buffer Line Return): Pressing this key restores the buffer pointer to the beginning of the current line, or to the beginning of the buffer if only one line has been entered.

During keyboard-to-card punch operation, if the 3771 is in Auto mode, pressing this key causes the previously punched card to be duplicated.

PRINT CHAR (Print Character): Pressing this key causes a character to print in the printer's current print position. Holding the key down causes typamatic operation (continuous printing) until the key is released.

BUFFR BKSP (Buffer Backspace): Pressing this key causes the buffer pointer to back up one position (one character space). Data is not destroyed when backspaced over, and can be printed out or corrected. The BUFFR BKSP key cannot be used to backspace into the previous line of data (as defined by the character ending the previous line) or to backspace over other control characters (such as HT, VT, or RS) contained in the buffer.

EOM (End of Message): Pressing this key causes data in the buffer to be transmitted (online mode), or to be written to an attached device (offline mode). For BSC, the transmission block is ended with an ETX character. Following a good reply to the block, the 3770 transmits EOT, ending the job. For SDLC, the buffer content is transmitted as the last element of a chain and the job ends (see Chapter 8).

Lights

Device Indicators: An indicator is provided for each attached I/O device. The device indicators are used to indicate device selection, not-ready conditions, and device errors. Certain device errors cause the device to lose its ready condition, and its associated light turns on to inform the operator that the device needs attention.

Numeric Position Readout (NPR): This is a three-digit numeric display that provides different indications depending on the operation being performed. On the 3773, record numbers associated with the diskette Storage Device are displayed here. On both the 3771 and 3773, message code numbers providing operator guidance and indicating system status and error conditions are indicated in the NPR. These code numbers, in conjunction with other operator panel indicators being on, are related to operating procedures described in the *Operating Procedures Guide.*

ON LINE: For BSC, this light is on whenever the communication line is selected as an input or output and the data link connection has been established. The light blinks while data is being transmitted or received, and turns off when the data link connection is broken. For SDLC, this light is on when the terminal is bound in a session with the CPU, and turns off when the session is terminated (see Chapter 8).

STANDBY: For BSC, this light turns on when a job involving the communication line is started. The light remains on until transmission begins, and then turns off. It is off until the job ends, and another online job can be started after the light turns on again. For SDLC, this light turns on when in communicate mode and there is no active line job. The light remains on until a job involving the communication line starts, and then turns off; it remains off until the job ends. When the STANDBY light turns on again, another online job can be started.

CPU SELECT: For BSC, this light indicates that the terminal has rejected a line bid, an MPLC polling sequence, or an MPLC selection sequence from the CPU because the terminal is not ready to operate in line mode. For SDLC, this light indicates that the terminal has rejected a Bind request, or that SIGNAL has been received from the CPU. (see Chapter 8).

OPRN CHECK (Operation Check): This light turns on and the Operator Attention Speaker sounds when the operator has performed an incorrect procedure, or when some I/O device needs attention. A device light will also be on if an I/O device needs attention. A message code number will be displayed in the NPR. This number corresponds to an explanation or procedure, as described in the *Operating Procedures Guide.*

PRINT INHIBIT: For BSC, this light is not used. For SDLC, this light turns on when the Inhibit Print command is received from the CPU and the keyboard is unlocked. This light is turned off when the Enable Print command is received.

SYSTEM CHECK: This light turns on and the Operator Attention Speaker sounds when certain machine errors occur. A message code number will be displayed in the NPR indicating the cause of the error. If an I/O device caused the error, the appropriate device indicator will also be on.

PROCEED: Data entry from the keyboard is permitted when this light is on.

UPPER CASE: This light turns on when the keyboard is in uppercase shift (Upper Shift key has been pressed).

AUTO: This light turns on when the terminal is in Auto mode.

MONITOR: This light is present only on the 3771, and turns on when monitor printing is selected.

UPDATE: This light is present only on the 3773, and turns on when the 3773 is placed in update diskette mode.

Chapter 3. IBM 3774 Communication Terminal Models 1 and 2 IBM 3775 Communication Terminal Model 1

Components

Controller

The controller is contained in the terminal's base. It controls input and output operations, provides buffering for received and transmitted data, and provides the data link control.

The controller operates in three modes: online mode, local mode, and offline mode. After power on, or after completion of any offline job, the terminal is in local mode, and can be used for document preparation, similar to typewriter operation. From local mode, the control unit can be placed in either offline mode or online mode. In online mode, the terminal can receive or transmit data over the communication facility. In offline mode, the terminal can be used for data transfer between attached I/O devices.

Mode of operation, device selection, forms control, and other parameters necessary to perform a job are under control of a job definition entered into the controller by the operator. Multiple (up to five) jobs can be defined and stored in the controller, and can be selectively recalled by the operator for processing. Other commonly used jobs can be selected without performing this complete job definition. Forms control and other parameters for these jobs are defined by the controller.

Printers

3774 Console Printer

The console printer used on the 3774 is a serial wire-matrix type printer. The printer prints as the carrier moves in either direction (left to right or right to left). The printer on the Model 1 prints up to 80 cps and the Model 2 prints up to 120 cps during continuous printing on a line. Right-to-left printing is done only when printing from the controller's buffer; during key entry, the printer prints only left to right.

Bidirectional printing eliminates the mechanical delay encountered in moving the print mechanism back to the beginning of the print line after each line is printed, as is commonly done on most serial printers.

Printed characters are formed in a 7 × 8 dot pattern by selectively pushing the eight print wires forward to contact an inked ribbon and the paper as the print mechanism moves across the print line. A 94-character set, as shown in Appendix B, is provided. The printer can print a maximum of 132 characters per line.

The printer's current print position is indicated by a scale and pointer on the print mechanism. Margins and horizontal tab stop settings are electronically controlled, and are set by the operator during the job definition procedure. These settings are stored as part of the job definition, as described later under "Job Controls."

This printer uses a friction-feed platen for forms feeding and can accept single-part continuous forms or 1-part to 3-part cut forms from 6 to 14-1/2 inches wide.

A Variable Width Forms Tractor special feature is available, and is required for feeding edge-punched multipart continuous forms. With this accessory, up to 6-part forms (depending on paper and carbon thickness) ranging from 3 to 15 inches wide can be used. Forms cannot be more than 0.018 inch thick, and can be from 3 to 14 inches long. The following restrictions and recommendations must be observed when selecting forms for use on this printer:

- Continuous-form card stock is not recommended.
- Stapled forms are not allowed.
- Multiple-part cut forms must be glued together at the top.
- Partial forms separation is not allowed.
- Crimped multiple-part cut forms are not recommended because they tend to separate when wrapped around the platen.
- Continuous single-part forms used with the friction-feed platen must be periodically adjusted to keep them feeding straight.
- 5-part and 6-part forms should be tried to determine if legibility, forms feeding, and print registration are acceptable.

Forms design considerations can be found in the publication *Forms Design Reference Guide for Printers*, GA24-3488. To facilitate handling of continuous forms, the Forms Stand accessory is recommended.

3775 Console Printer

The 3775 console printer operates as a serial printer during keyboard entry, or as a line printer when the keyboard is not the input device. Two character sets are available on the printer—a 64- or 94-character set. The character set desired is optional, and must be specified at time of ordering. Additional print belts can be purchased and can be changed by the operator. The characters provided by each of these character sets are shown in Appendix B. During continuous printing from the controller's buffer, the printer can print a line at a time at a maximum speed of 80 lines per minute using the 94-character set, or of 120 lines per minute using the 64-character set. The 94- and 64-character set belts are interchangeable, and the printing speed automatically adjusts to the belt installed. Using a 64-character set belt, the 3775 will convert the 26 lowercase alphabetic characters a through z to uppercase characters and print them. For Katakana machines, those Katakana characters having codes equivalent to EBCDIC lowercase alphabetic characters are converted to uppercase alphabetic characters. Maximum line length is 132 characters.

No job can be started with the printer in a not-ready condition. Always ensure that sufficient forms are installed before starting a job.

During keyboard entry, characters are printed when the operator stops keying momentarily before the end of the line is reached. If the operator does not pause, the entire line prints when the end of the line is reached. After printing, the platen is lowered, making the entire print line visible. The character print positions are shown by a numbered scale on the printer, and the next character to print is indicated by a row of lights (light emitting diodes), one for each print position. As the next character is struck, the platen raises, the character prints, and the print position lights indicate the next position to be printed.

The character set is contained on a continuously rotating metal belt. As the belt rotates, a comparison is made between the character in front of each hammer and the character that is to print in that position. When the desired character is in position to print, the hammer for that position is fired to force the paper and ribbon against the character face to print the character.

The printer uses a pin-feed forms tractor for feeding 1-part to 6-part edge-punched continuous forms. The tractors are adjustable to accept forms ranging from 3-1/2 to 15 inches wide. Considerations for designing forms used with this printer can be found in *Forms Design Reference Guide for Printers*, GA24-3488.

Keyboard

The keyboard used on machines in the U.S. and Canada has 44 character keys and a space bar, and other typewriter-like control keys. The arrangement of keys is similar to that on a typewriter keyboard. On either side of the typewriter-like keys are keys for controlling terminal operation. Lights located above the keys provide indications of terminal status and error conditions. This keyboard provides 88 characters in upper and lowercase shift (refer to Figure 3-7).

Typamatic operation of the Space Bar and the Backspace, Hyphen/Underscore, and PRINT CHAR(acter) keys causes repetitive functions, simply by holding the key down.

Keyboards for use in World Trade countries other than the United Kingdom have 47 graphic keys, providing 94 characters. The keyboard for the United Kingdom has an additional key (48 keys), and provides 94 characters in upper and lowercase shift. This keyboard does not provide typamatic operation of the Hyphen/Underscore key. Keyboard characters present on all keyboards are shown in Appendix B.

Nomenclature on keyboard control keys, lights, and switches is provided for the following languages:

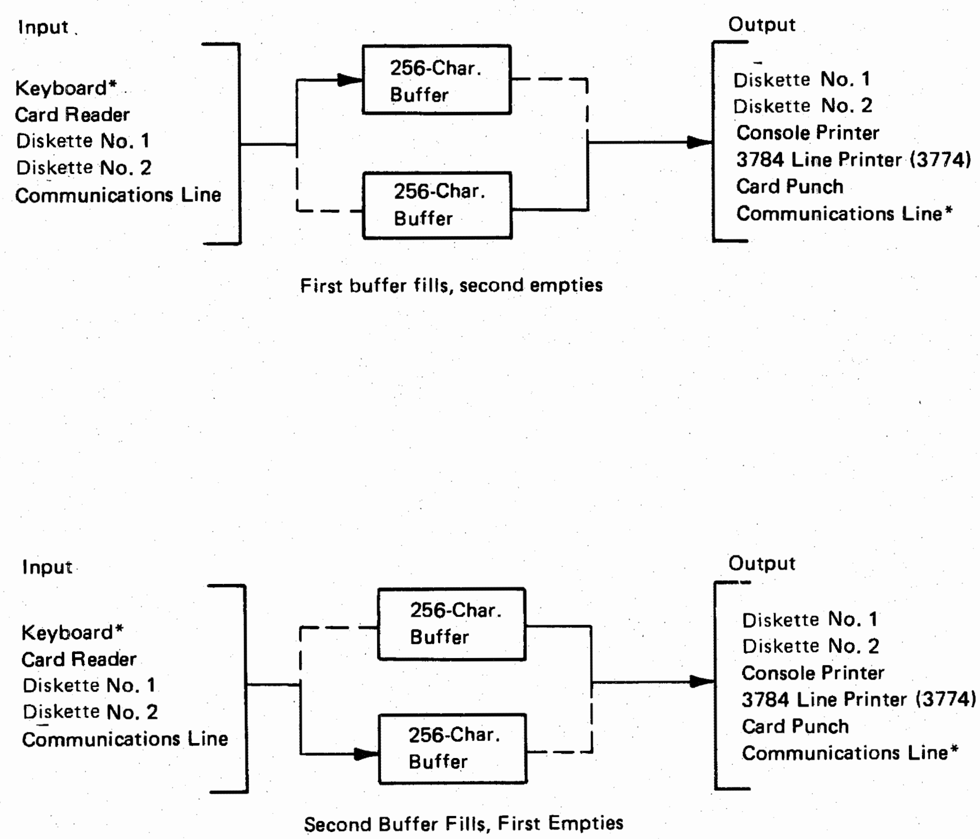
English
French
German
Italian
Japanese
Spanish

Operating Characteristics (3774/3775)

Controller

The controller uses two 256-character buffers for temporary data storage. The buffers alternate in use between input and output, and accept data from the input device character-by-character (Figure 3-1). During either offline mode or online mode operation, one buffer is always dedicated to input and the other to output. While one buffer is accepting input data, the other may be sending output data. When the input buffer fills and the output buffer empties, they exchange functions. This arrangement allows:

- A consistent line rate with variable I/O (input/output) rate
- Overlap of input and output operations
- Checking of data before output or transmission



*See "Keyboard to Line or Diskette" for keyboard-to-line operation.

Figure 3-1. 3774/3775 Dual Buffer Operation

The alternating-buffer scheme can be disabled for keyboard-to-diskette or keyboard-to-line operations, making a single 512-byte buffer available for buffer editing. This is described in more detail under "Buffer Edit."

Job Control

Job controls allow setup and selection of operator-defined jobs, or selection of certain terminal-defined jobs operating in either On-Line or Off-Line mode.

Operator Job Definition

The operator can define the parameters for a job by placing the terminal in define mode and following the prompting sequence as printed on the console printer. During this procedure, the operator enters information such as:

- A job identification number used to select the job for execution. Up to five operator job definitions can be entered and stored in the terminal.
- The input and output devices required for the job
- A data set name if the job involves a Diskette Storage Device
- Printer margin settings
- Printer horizontal tab settings
- Vertical forms control information

Other parameters that can be specified are:

- *Transparent Mode.* Causes all card or diskette data to be transmitted in transparent format.
- *Compress.* Causes compression of card data transmitted to the CPU or written on an attached diskette device.
- *Inhibit Interpret.* Causes interpreting (printing) to be inhibited on the 3521 Card Punch with the Card Print feature.
- *Delete Diskette Records after Read.* Deletes all records (except job definition) from the diskette after the specified data is read.
- *Select Record Format Operation* (see "Special Features—Record Format").
- *Omit Readback Check* (3521). Disables the readback (punch) check on the 3521.

The setup thus entered is stored in the terminal and remains available for selection and execution until power is turned off, or until replaced by a different setup. Five different jobs can be defined and stored, and are available for selection without the need for the operator to re-enter the setup each time it is desired.

If a card reader is attached, a procedure is available to allow the operator to enter the job definition from cards. If the Diskette Storage feature is installed, job definitions, once entered, can be stored on the diskette. This allows the operator to re-enter the job definition from an attached card reader or diskette device following a power-off/power-on sequence.

If the same job setup is to be used for multiple terminals in the teleprocessing system, it may be advantageous to supply, from a central location, diskettes already written with operator job definition. After the job definitions for up to five jobs are once entered and written out onto the diskette, that diskette can be removed, another diskette inserted, and the same job definition written again. Using this procedure, the same job definition can be written onto as many diskettes as desired.

Anytime the keyboard is selected as an input device (keyboard-to-line, for example), data entered at the keyboard prints on the console printer. If printing of data entered from any other input device is desired (such as card reader-to-line operation), monitor printing can be specified to cause data to print. The details for performing these procedures are in the *Operating Procedures Guide.*

System-Defined Jobs

For fast automatic selection, other fixed-function jobs that do not require an operator-definition procedure are also available. Input and output devices for these jobs are selectable by use of certain of the numeric keyboard keys; labels above these keys indicate what devices they select (see Figure 3-7). When the keyboard is selected as the input device (keyboard to line, diskette, or card punch), output to the printer also occurs. Data is printed as it is keyed. For jobs involving a diskette device, data set names (refer to "Magnetic Diskette Storage") are assigned by the system. The following jobs can be selected by use of these keys:

Input	(to)	*Output*
Card Reader	. .	Punch
Card Reader	. .	Console Printer
Card Reader	. .	Diskette (data set name is SC00)
Card Reader	. .	Line
Card Reader	. .	3784 Printer (3774 only)
Line	. . .	Card Punch
Line	. . .	Console Printer
Line	. . .	3784 Printer (3774 only)
Line	. . .	Diskette 1(Data Set name is SL00*)
Keyboard	. .	Line
Keyboard	. .	Diskette 1 (data set name is SK00)
Keyboard	. .	Card Punch
Diskette 1	. .	Line (all active data sets)
Diskette 1	. .	Card Punch (all active data sets)
Diskette 1	. .	Console Printer (all active data sets)
Diskette 1	. .	Diskette 2 (all active data sets)
Diskette 1	. .	3784 Printer (3774 only)
Diskette 2	. .	Line

*Incremented by 1 when an additional data set is written to the same diskette from the line.

For any of the above system-defined jobs or when not defined for operator-defined jobs, the total form length will be 66 lines, with 61 lines printed. Data from the CPU can be formatted by use of printer control characters. If not, 132-character lines are printed. Horizontal tab stops are set in all positions. If an attached 3521 has the Card Print feature, interpreting (printing) will occur unless Inhibit Interpret is specified for an operator-defined job.

Output device selection (other than the console printer) for a line mode receive operation can be overridden, and the diskette selected as the destination for received data, by turning on the DISK switch. With this switch on, data received over the communication line is written on the diskette...regardless of any output device component selection other than the console printer received from the CPU.

Job Selection

To begin a job, the operator may select one of the stored operator-defined jobs, or one of the system-defined jobs. At job-selection time, an additional parameter that can be specified for the job is a data set name, if the job involves an attached diskette device. If the diskette is the input device, the beginning record number of the data set for the job can be specified; if not, the data set begins with the first record of the data set.

After the job is selected and started, the active devices for the job are indicated in the keyboard device lights. When the diskette is selected for the job, the current record number is displayed in the NPR; otherwise the NPR is blank.

Buffer Edit

Buffer edit allows the operator to correct errors before data entered into the controller's buffer is transmitted to the remote station or written to an attached output device. Keyboard keys are provided to reset to the buffer beginning, return to the beginning of the current line, or to backspace a character at a time. Data can then be printed out for verification or altered before transmission.

In normal operation, one 256-byte buffer is filled, edited, and then transmitted. Buffer contents can be transmitted by pressing either EOB or EOM. If EOB is pressed to cause transmission, input can continue into the other buffer. If EOM is pressed, no further input can be accepted until the SYS REQ key is pressed. Buffer edit can be optionally extended to encompass both buffers, or 512 bytes, by turning the EXTEND/ALARM switch on. In this case, the dual alternating-buffer scheme is inactivated, and the buffers become a single 512-byte buffer dedicated to input from the keyboard. In keyboard-to-line operation, the 512-byte buffer is filled, edited, and transmitted and must be properly acknowledged by the CPU. The buffer contents are transmitted in two 256-byte blocks. If EOM or EOB is pressed to transmit the buffer contents after 256 or fewer characters have been entered, only one 256-byte block is transmitted.

On output from the buffer to an attached Diskette Storage Device, the 512-byte buffer is written as two 256-byte records onto the diskette before further keyboard entry is allowed. If EOM or EOB is pressed to cause output to the diskette device after 256 or fewer characters have been entered, the second 256-byte record consists of all NUL characters.

Buffer edit capability can be further extended by addition of the Record Format feature. This feature provides a 2048-byte buffer, which can be used during keyboard-to-line and keyboard-to-diskette applications. See "Features and Accessories—Record Format Feature" for additional information.

CPU Interrupt

This mode of operation allows an offline job to be suspended at the CPU's request, an online receive operation to be performed, and an automatic return to offline mode operation. Interrupt is not allowed when a Record Format job (see Appendix H) is in progress, or when one of the CODE key functions (see "Operating Controls" in this chapter) is in progress. When the INTRP (Interrupt) switch is on, and with the terminal operating in offline mode, a line bid (or MPLC selection) from the CPU will cause the offline job to be suspended.

The CPU may or may not use component selection to select the output device (diskette, printer, or punch) at the terminal. If the selected device is the printer or punch, and that device is being used by the offline job, a receiver abort (EOT) is sent to the CPU (switched network operation) and the terminal returns to offline mode. On multipoint machines, a NAK response is transmitted. This is done to prevent mixing of printed or punched data.

The diskette device can be selected and the offline job interrupted even though it is being used offline. The received data is written under a new data set name. When the offline job is resumed, the offline data set is continued as a segmented data set.

If component selection is not used, the console printer will be selected for data output if it is not being used by the offline job. The DISK switch can be used to override any component selection other than the console printer, and to cause any data received to be written onto the diskette.

Compression/Expansion

Throughput on machines may be increased by specifying Compress in the job definition. If this option is specified, consecutive space characters are removed from transmitted data from the card reader and reinserted in output data by the receiver.

Using BSC–Space Compression/Expansion

When the 3770 is transmitting in BSC, and has read two or more consecutive space characters from a card reader, it will transmit an IGS (hex '1D'), followed by a character (binary number) specifying the number of omitted spaces. This binary number represents a minimum of 2 and a maximum of 63 spaces. If more than 64 consecutive spaces are read from the input device, a second IGS sequence is transmitted.

The binary numbers representing the omitted spaces are defined as follows:

Number of Spaces	*EBCDIC: 0 1 2 3 4 5 6 7*
2	0 1 0 0 0 0 1 0
3	0 1 0 0 0 0 1 1
.	.
.	.
.	.
63	0 1 1 1 1 1 1 1

Space compress and transparent mode cannot both be specified in the job definition.

These sequences can also be received in data from a CPU, and will cause reinsertion of the spaces (expansion) into printed data or into cards punched on an attached 3521 Card Punch. Expansion is automatic and does not have to be specified in the job definition. Compressed data received onto an attached diskette device will be expanded on output from the diskette to another attached output device.

Using SDLC–Space or Data Compression/Expansion

When the 3770 is transmitting in SDLC from a card reader, a String Control Byte (SCB) character (see definition following) is transmitted either in front of each string of data characters or instead of consecutive (repeated) space characters (called *compression*). The SCB character identifies the type of data string and contains the binary count of the number of characters that follow, or the number of space characters to be inserted (repeated) at the receiver (called *expansion*). The binary number represents a minimum of 1 and a maximum of 63. If more than 63 characters are involved, a second SCB character is transmitted.

String Control Byte (SCB) Definition:

Bits 0 and 1 identify the data string:

00	-	No Compressed Characters. The binary count field (bits 2-7) contains the number of the bytes between this SCB and the next SCB.
01	-	Not used by the 3774/3775.
10	-	Compressed Space Characters. The count field contains the number of space characters represented by this SCB. The next SCB follows in the next byte.
11	-	Compressed Data Characters (Outbound only; CPU to 3774/3775). The count field contains the number of times the data character following this SCB is to be repeated at the receiver. The next SCB follows the data character to be repeated

Bits 2 through 7 contain a binary count of the data characters that follow, or space or data characters to be inserted at the receiver.

Example: Repeat the asterisk (*) character (X'5C') 21 times

SCB Character Bits

0 1 2 3 4 5 6 7

$$\underbrace{1\ 1\ \underbrace{0\ 1\ 0\ 1\ 0\ 1}_{\text{Binary 21}}}_{\text{X'D5'}}$$

Repeated Character Bits

0 1 2 3 4 5 6 7

$$\underbrace{0\ 1\ 0\ 1\ 1\ 1\ 0\ 0}_{\text{X'5C'}}$$

Problem Determination

The controller has built-in tests that run each time the power is turned on or the SYSTEM RESET switch is operated. These tests, when successfully completed, have checked the major portion of the controller and verified that the electronic circuits are operating properly. The terminal is then in local mode. The tests require a few seconds to run and leave the terminal in a state with the PROCEED indicator on; this informs the operator that operation can proceed. Any other indicator being on after the tests have run signals either that a failure occurred in the controller's electronic components, that one of the mode switches is on, or that the Keylock switch is turned off.

Problem determination tests selectable from the keyboard reside in the terminal. The operator can use these tests to isolate problems to the terminal or to the communication facilities. Communication-facility tests also include online tests provided by the CPU access method.

Error Logging

Information about errors encountered during normal operation are recorded in an error log that can be printed out by the Print Error Log function. When errors that cannot be corrected by operator action occur, or when intermittent internal machine errors that impede operation occur, the operator should call for a printout of the error log before turning the terminal's power off (the error log is lost when power is turned off). This information should be retained and given to the service representative, who will use it to isolate the cause of the problem.

Operator Attention Speaker

This device produces an audible tone to signal the operator that a procedural error has occurred, or that some input or output device requires attention. Upon hearing the tone, the operator can refer to the keyboard indicators, which will indicate the cause of the tone. The speaker also sounds during keyboard/printer operations ten spaces before the printer's right margin is reached, or ten spaces before the buffer is full.

Console Printer

The printer alone can be specified by the job definition as the output device, or can be selected for monitor printing of data to be transmitted or received. For example, an online job can specify the card reader as the input device, and the communication line as the output. If monitor printing is desired, data can then be printed locally and transmitted. For receiving, the line might be specified as the input and the diskette device as the output. If monitor printing is desired, received data is printed and written on the diskette. Monitor printing is selected by turning on the UPDATE/MONITOR switch. Monitor printing on the 3774 is not possible when the 3784 Line Printer is the primary output device.

During the job definition, margin settings and vertical and horizontal tab stops are entered and stored in the terminal. When the particular job is selected, these settings become effective. The settings remain in effect until a new job is called for, or power is turned off (see "Job Control—Operator Job Definition").

Assuming a keyboard-to-line operation, data entered into the keyboard prints on the console printer. The character also enters the transmission buffer, and the buffer is transmitted when the end of buffer or end of message is signaled.

Certain printer function characters can be received within data from the CPU to cause formatting of the data as it is printed on the console printer. The characters that can be recognized by the printer, and the operation they cause, are described in Chapter 7.

Vertical Forms Control

Vertical forms control allows the operator to specify the vertical format of forms by print areas and skip areas. Once the format is entered, automatic operation causes the forms to advance when specified text areas are completed. The procedure for entering the vertical forms control is contained in the *Operating Procedures Guide.* Control characters used for vertical forms control are described in Chapter 7.

Horizontal Format Control

Printer margins and horizontal tab settings are entered at the beginning of a job and stored in the terminal. The procedure for setting margins and horizontal tab stops is contained in the *Operating Procedures Guide.* These settings are entered during the job definition procedure, and remain available for selection until they are changed by the operator, or until power is turned off. Control characters used for horizontal format control are described in Chapter 7.

Horizontal tab setup permits the Tab key to be used to skip areas within a line that are not to be printed. This is similar to typewriter operation, except that the tabbing is electronically controlled. When Tab is pressed during keyboard entry, the print position moves to the right to the next tab stop, and an HT character is stored in the transmission buffer immediately following the last data character.

Data for the next field then begins storing in the buffer immediately following the HT character.

The relationship between the print position indicated on the printer and the buffer position at which data is entered is not a one-to-one relationship. At the beginning of a job, or after data has been read out of the buffer, new data will always begin storing into the first buffer position. Data begins printing, however, at wherever the left margin is set, as defined by the job definition. Several lines of data, each delineated by format control characters, can be contained in a single buffer.

Keyboard

Keyboard Entry to Line or Diskette

Data entered via the keyboard is stored character by character into the buffer and remains there until the end of the buffer is signaled. As data is entered, it also prints on the console printer. The end-of-buffer signal is under control of the Auto mode CODE key function.

In Auto Mode

In Auto mode, keying into the buffer is ended depending on the output device.

Diskette as Output: Using the diskette as the output device, the buffer is ended automatically when the buffer becomes full (256 characters have been entered). Input to the other buffer can continue without interruption of the operator's normal keying cadence.

BSC Line as Output: When keying to a BSC line as an output device, Auto mode does not apply.

SDLC Line as Output: When keying to an SDLC line as an output device, the buffer is ended and will be transmitted when the CR (New Line) key is pressed. A NL (New Line) character is placed in the buffer as the last character.

Not in Auto Mode

When not in Auto mode, data from the keyboard is handled depending on the output device.

Diskette as Output: Using the diskette as the output device, data from the keyboard is not accepted after 256 characters have been entered (the Operator Attention Speaker sounds to alert the operator). The operator must then press EOB or EOM to read the data out of the buffer. Input to the other buffer can continue while data previously entered is being read out.

BSC Line as Output: When keying to a BSC line as an output device, data from the keyboard is not accepted after 256 characters have been entered (the Operator Attention Speaker sounds to alert the operator). The operator must then press EOB or EOM to cause the buffer to be transmitted. If EOB is pressed, keying can continue into the other buffer. If EOM is pressed, no more keyboard input can be accepted.

SDLC Line as Output: When keying to an SDLC line as an output device, the buffer is ended automatically when 256 characters have been keyed in, and the buffer is transmitted to the line. Keying into the other buffer can continue without interruption of the operator's normal keying cadence. If less than 256 characters are keyed in, the buffer can be transmitted by pressing EOB or EOM. If EOB is pressed, keying can continue into another buffer. If EOM is pressed, no more keyboard input can be accepted. Whether the 3770 is in Auto mode or not, less than 256 characters can be transmitted or read out by pressing EOB or EOM.

Monocase Output from Keyboard

By use of a CODE key function, monocase (uppercase only) output from the keyboard can be specified. This permits uppercase alphabetic (26 characters A through Z) keyboard entry without use of the Shift key. Other uppercase characters must still be selected by use of the Shift key.

Keyboard Entry to Card Punch

Using the card punch as output, the AUTO switch being on does not cause automatic buffer readout as is done when using line or diskette as output. With the AUTO switch on, buffer readout and punching takes place when the Return key is pressed. Also, with the AUTO switch on, cards may be duplicated by pressing BUFFR LINE RTN and Return; by repeatedly pressing BUFFR LINE RTN and Return, as many cards as desired can be duplicated. With the AUTO switch OFF, EOM or EOB must be pressed to cause the buffer to read out and punch.

Features and Accessories (3774/3775)

This section describes the special and specify features and accessories (purchase-only items) available for the 3774 and 3775 controllers and console printers. I/O devices that can be cable-connected to the controller, and special features for these devices, are described under "I/O Attachments" (Chapter 6).

Magnetic Diskette Storage

The Diskette Storage Devices are compact units contained in the terminal's base. Data is recorded on a small flexible operator-changeable diskette. The Diskette Storage Device can accept input data entered into the controller's buffer either from the communication line during online operation, or from the terminal's keyboard or other attached input device during offline operation. Batch data can be stored on the diskette during offline operation and subsequently transmitted to the CPU, resulting in increased throughput and reduced communication costs in many applications.

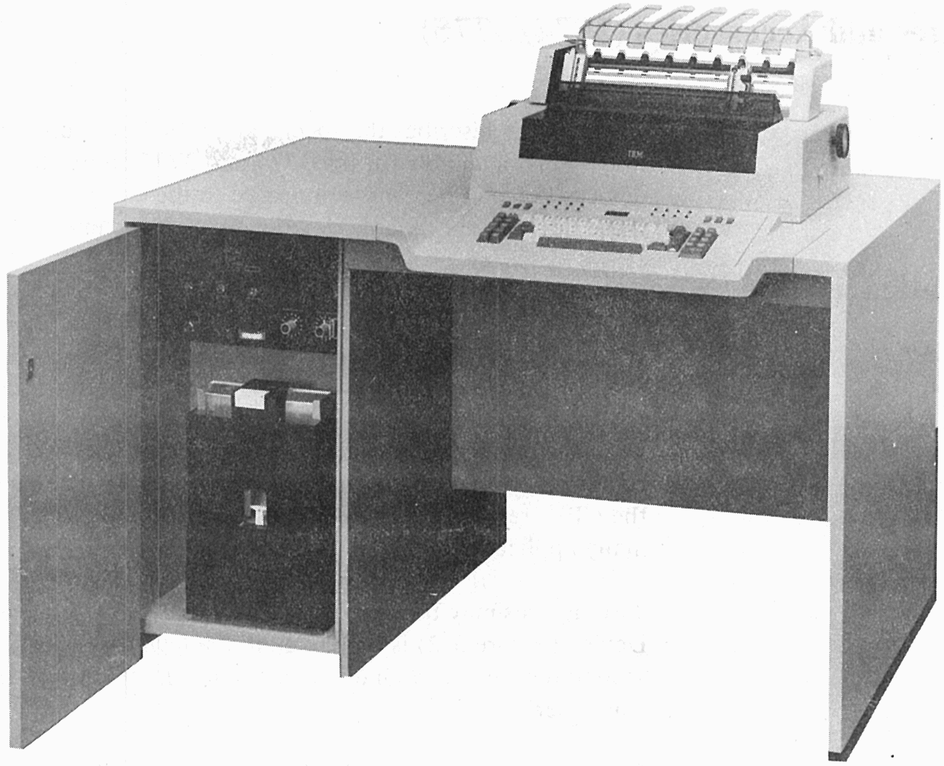
Two devices may be attached to the 3774 or 3775. The first Diskette Storage Device (Figure 3-2) is contained in the lower left side of the controller. The second device is contained in an extension attached to the right side of the controller.

Each diskette provides a maximum of 242,688 bytes of data storage. With the addition of a second Diskette Storage Device to the 3774 or 3775, the following operations are possible:

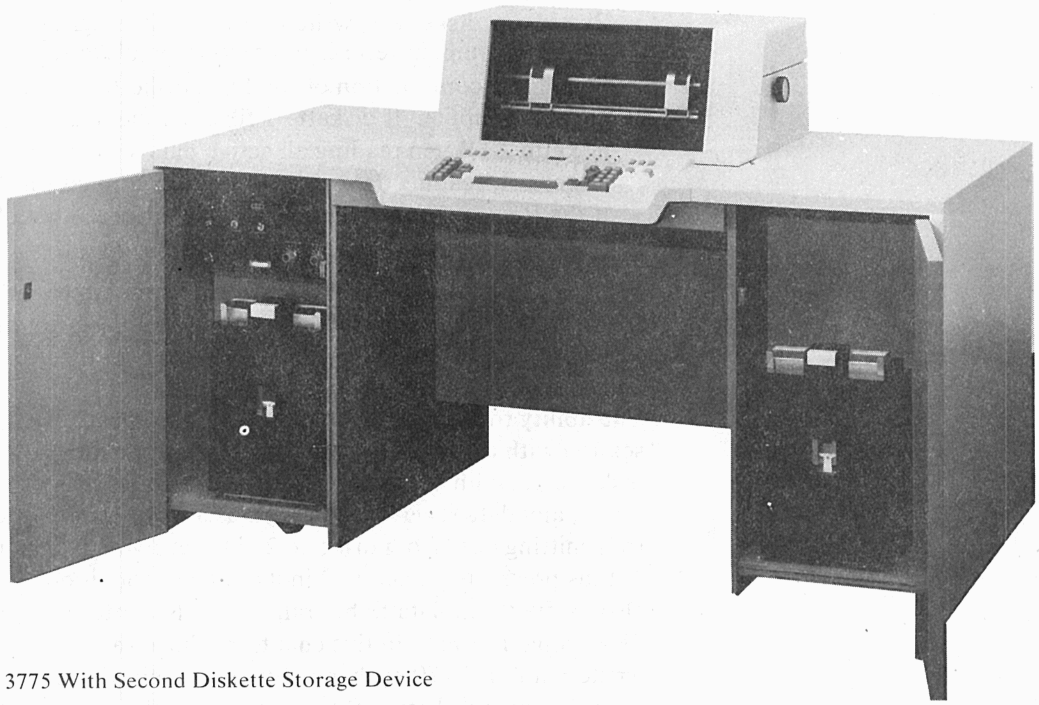
- Read from diskette 1, write to diskette 2 (single data set or all active data sets).
- Transmit from diskette 2 and receive on diskette 1.
- Automatic continuation of job from diskette 1 to diskette 2 (except with keyboard input). If diskette 1 fills, writing data will automatically continue on diskette 2. When reading all active data sets or a multivolume data set from diskette 1, reading data automatically continues on diskette 2.
- If the Record Format feature is installed: Read data from diskette, key in or update data, and write to either the same diskette or the other diskette.

With diskette storage, job-definition information can be stored on and recalled from diskette 1. If not stored on the diskette, job definition is lost after power is turned off, and must be re-entered after power is turned on.

The ability to transmit from diskette 2 and receive on diskette 1 during a single session with the CPU permits maintaining the integrity or format of data on diskette 2. With only one Diskette Storage Device, or if transmitting from diskette 1, any data received is written as a data set onto the same diskette. By transmitting data from diskette 2, any received data is then written onto diskette 1, thus preserving diskette 2 in its original condition. This type of operation is also useful when data to be transmitted is written in exchange format (see "Exchange Format" in this chapter). Since the 3770 cannot write on a diskette written in non-3770 exchange format, received data could not be written back onto the same diskette. By placing the exchange format diskette on diskette 2 for transmission, and receiving data onto diskette 1, this operation can be accomplished without operator intervention.



3774 With First Diskette Storage Device



3775 With Second Diskette Storage Device

Figure 3-2. Diskette Storage

Diskette Records

This section describes 3770 operation in reading E or T type data sets. Basic exchange data sets are described in Appendix E (Data Format). Each record written on the diskette is identified by a record number (1 through 948) that is assigned by the controller. This record number can be used in subsequent operations to selectively recall records from the diskette for update or correction, printing, transmission, etc. Each record consists of 256 bytes written into two 128-byte diskette sectors, thus providing a maximum capacity of 242,688 bytes of data storage on each diskette. Records consisting of less than 256 significant bytes cause NUL characters (hex '00') to be inserted following the significant data, padding the record out to 256 bytes. As with any diskette of this type, defective sectors due to physical damage of the diskette will decrease the available storage capacity. Defective sectors are skipped over the first time they are encountered; thereafter, they are not used. An excessive number of defective sectors can cause a significant decrease in storage capacity, and will degrade performance. On machines having two Diskette Storage Devices, data sets with an excessive number of defective sectors can be read from diskette 1 and written to diskette 2. Data copied on diskette 2 is thus "closed up" toward the beginning of the diskette, by elimination of the defective sectors.

When receiving data over the communication line for writing on the diskette, data blocks from the CPU cannot exceed 256 bytes. Blocks containing less than 256 bytes will be accepted and padded with NULs as they are written on the diskette.

Diskette Data Sets

Each group of records for a particular job is identified by a data set name that is entered by the operator or assigned by the terminal. On output from the diskette, all records written under this data set name comprise the data for that job. During online operation, all data sets on the diskette or any specified data set can be transmitted. After transmission, all diskette data can be deleted if specified by the job definition, to provide storage space for received data. If the data is not deleted, additional data received from the line is assigned to the next available diskette area. For system-defined jobs using the diskette device as output, data set names are assigned by the system. These data set names are defined under "System-Defined Jobs," and all begin with the letter "S". For operator-defined jobs, the data set name must be four characters. The first two characters must be alphabetic, and the second two numeric. The 3774 or 3775 can handle up to 18 different data sets on a single diskette.

Data sets exceeding the diskette capacity can be continued on another diskette. During an online receive operation or offline mode card-to-diskette operation, the controller signals the operator when the diskette capacity has been reached. The operator can continue the job after replacing the full diskette with another diskette. If a second Diskette Storage Device is present, continuation on the second diskette is automatic, if it is ready to operate.

Data Set Labels

Each data set on the diskette is identified in a Data Set Label, which is shown in Appendix E. A data set must be "closed" before it can be accessed for transmission, printing, punching, etc. A data set is closed (depending on the job) as follows:

- Card Reader to Diskette: EOF from the Card Reader.
- Line to Diskette: Block ended with ETX followed by EOT. 'Ignore ETX/EOT' should be specified by a CODE key function if it is desired that all data received from the line be written as a single data set. In this mode, the ETX/EOT causes the data set to be closed, but it is re-opened if additional data is received from the line.

  Note: Closing a data set requires that the disk head seek to track 0 on the diskette, thereby affecting throughput based on the number of tracks to be crossed.
- Stop Job is signaled by the operator.

A data set written on the diskette from the line (either during a CPU interrupt or when data is received onto the diskette before transmitting from the diskette), is flagged in the Data Set Label as "inactive." This prevents the data set from being transmitted or included in any intervening job until the operator changes its status to active. The operator may also change the status of any data set to inactive, thereby excluding it from any job.

As stated before, up to 18 data sets with different names can be accommodated on the diskette. Each different data set name requires one of the 18 sectors reserved on track 00 for a label for that data set. Anytime a data set is closed, another data set created, and a *previous* data set reopened, an additional data set label sector (one of the 18) is used. Thus it is possible that, using only two data set names and by alternately closing and reopening these two data sets, all 18 data set label sectors can be used up. When the last sector is used, only the last opened data set is available for further entry. (Any data set on a full diskette or one with all labels used may be updated.) On machines having a second diskette device, data sets so written can be copied from diskette 1 to diskette 2, and all segments of the data set will be written continuously using one data set label. So, to ensure maximum utilization of diskette storage capacity, the foregoing must be taken into consideration when designing applications and job setups for the terminal.

After a data set received from the line is closed as a result of a block ended with ETX followed by EOT ("ignore ETX/EOT inactive), another data set received from the line will cause the numeric portion of the data set name to be incremented (for example, AA00 becomes AA01). This new name is stored in the active job definition.

When a diskette fills from the line, and the data set is continued on a second diskette (multivolume data set), a data set is opened on the second diskette using the same name as the one that filled the first volume (the name is not incremented), provided that the same name does not already exist on the second volume. If the same data set name already exists on the second diskette, the numeric portion of the data set name is incremented unless "ignore ETX/EOT" is active. If "ignore ETX/EOT" is active, the data set name is never incremented, and data on the second volume will be linked to any existing data set with the same name. Therefore, the operator must be cautious and fully aware of diskette contents in order that multiple volume data set integrity be maintained.

Diskette Create Function

New diskettes, or diskettes that have been used previously on other machines (IBM 3741 or 3742, for example), must be prepared for use on the 3774 or 3775 by performing the Diskette Create function before they can be *written* on. Diskettes previously written on other machines in exchange format (see "Exchange Format" in this chapter) can be read on the 3774 or 3775, however, without performing the Diskette Create function. This function is under control of the keyboard CODE key. This procedure writes the Volume Label and Data Set Labels on track 00 of the diskette, as shown in Appendix E. Any data previously written on the diskette, including job definition, cannot be accessed again.

Exchange Format

Exchange format (BSC) refers primarily to the sequence in which records are written on the diskette. In order to improve throughput on the 3770, and to allow segmenting of data sets, this format is not used when writing a 3770 diskette in non-exchange format. For compatibility with non-3770 systems or devices, the 3770 can write and read diskettes using the exchange format; however, throughput is reduced when data is transmitted from a diskette written in exchange format, as shown in Appendix D.

If a diskette is to be written in exchange format, it must be so specified during the Diskette Create procedure. When writing on an exchange diskette during an offline job, CPU interrupt should not be allowed if this would cause segmenting of the data set. If a data set should become segmented on an exchange diskette, it can be copied to another exchange diskette if the machine has a second Diskette Storage Device, thus eliminating the segments. Because exchange format does not permit segmenting of data sets, the diskette could not subsequently be read by another non-3770 system. Data transmitted from diskettes written in exchange format by the 3770 is transmitted in 256-byte blocks (two 128-byte records per block). The block length (data) transmitted by the 3770 from a non-3770-created diskette is the same as the block length defined in the Data Set Label for the data set (1 to 128 characters).

Basic exchange data sets may be written by the 3774 or 3775 from the line (SDLC only). If a basic exchange data set is to be written, the diskette must first have been specified as an exchange diskette during the Create function and must have the Extent Arrangement indicator set to 'P'. See Appendix E (Data Format) for more information.

On machines with a second diskette Storage Device (referred to as diskette 2), a 3770 diskette (BSC) can be converted to an exchange diskette (BSC) by reading the 3770 diskette on diskette device 1 and writing on diskette device 2 in exchange format. Segmented data sets will be written as continuous data sets during this conversion. The diskette used in diskette 2 must have been previously prepared by the operator performing the Diskette Create function, with specification that the diskette be written in exchange format. Conversely, a diskette written in exchange format by the 3770 can be converted to a 3770 format diskette by reading the exchange diskette on diskette device 1 and writing on diskette device 2 in non-exchange format. The diskette used in diskette 2 must have been previously prepared by use of the Diskette Create function, *without* specification that it be written in exchange format.

Exchange diskettes written on a non-3770 IBM product can be read for transmission (basic exchange only), but cannot be written on, by the 3770 without first performing the Diskette Create function. Data previously written on the diskette cannot be accessed after this function is performed. Exchange diskettes written on a non-3770 IBM product cannot be copied, nor can individual data sets. Non-3770 diskettes are read one sector at a time into the buffer. When the buffer is written to the 3770 diskette, two sectors at a time are written; thus the data set from the non-3770 diskette would be doubled in size.

Keyboard-to-Diskette Operation

Offline key entry to the diskette is basically the same as keying to the line. Data enters the buffer character by character until the end of buffer is signaled; then the buffer data is written on the diskette. If the AUTO switch is on, the buffer is automatically written to the diskette after 256 characters have been entered. If the AUTO switch is OFF, the code in the Numeric Position Readout (NPR...see "3774/3775 Operating Controls") indicates that 256 characters have been entered, and EOB or EOM must be pressed to write the buffer to the diskette. (There is no difference in operation between using the EOB or EOM key to write the buffer to the diskette.) Data also prints on the console printer as each character is keyed.

Update mode operation allows use of the record number to recall records from the diskette into the 256-byte buffer for update or correction. By use of the buffer edit keys to the right of the keyboard, the record can be printed, updated or corrected, and then written back to the diskette when the end-of-buffer is signaled. After the buffer is written back to the diskette, if the AUTO switch is on, the next sequential diskette record reads into the buffer and the new record number is displayed in the NPR.

Diskette-to-Printer Operation

The AUTO switch performs a special function during a diskette-to-printer operation. When the AUTO switch is turned on, the current diskette record prints and the machine stops. This can be done to allow the operator to stop a job and later restart it. The job can be resumed at the point where it was stopped by specifying the buffer number at job-selection time when the job is restarted. If desired, special instructions to the operator (such as type of forms to use for a job) can be placed in the first 256-byte diskette record for the data set. If the AUTO switch is turned on at the beginning of the job, only the first diskette record for the data set prints, and the machine halts to allow the operator to comply with the printed instructions before proceeding. When the AUTO switch is turned OFF, the remainder of the data set is printed without interruption, if no unusual condition occurs. If the AUTO switch is OFF at the beginning of the job, the entire data set prints.

Diskettes

Diskettes used with the Diskette Storage Devices consist of a small flexible disk about 8 inches in diameter enclosed in a holder. Appendix F describes the diskettes used by the 3770, and describes diskette labeling and recommended handling procedures.

Record Format

The first Diskette Storage Device is a prerequisite for this special feature. The Record Format feature adds two separate functions to the 3774 or 3775, as follows:

- *Record Format Control*, which provides the capability to use multiple input and output devices for input and output by field within the media.
- *Variable Length Buffer*, which provides a 2048-byte buffer for additional buffer edit capability for keyboard entry to line or diskette.

Record Format Control

Record Format Control allows creation of output records from either or both of two input sources: the keyboard, and either a Diskette Storage Device (a prerequisite for the Record Format feature) or an attached card reader. Fields from the source data can be selected and merged in any sequence. Output of each selected field can then be directed to one or both of two outputs: the console printer, and either a Diskette Storage Device or an attached card punch (Figure 3-3).

Operations possible with this feature include:

- Different report and file outputs from the same file
- Random selection and sequencing of fields
- Sequential file search and file update
- Selective transaction processing
- Buffer print and edit of keyboard-entered data
- Use of same diskette for file update (one data set to another)

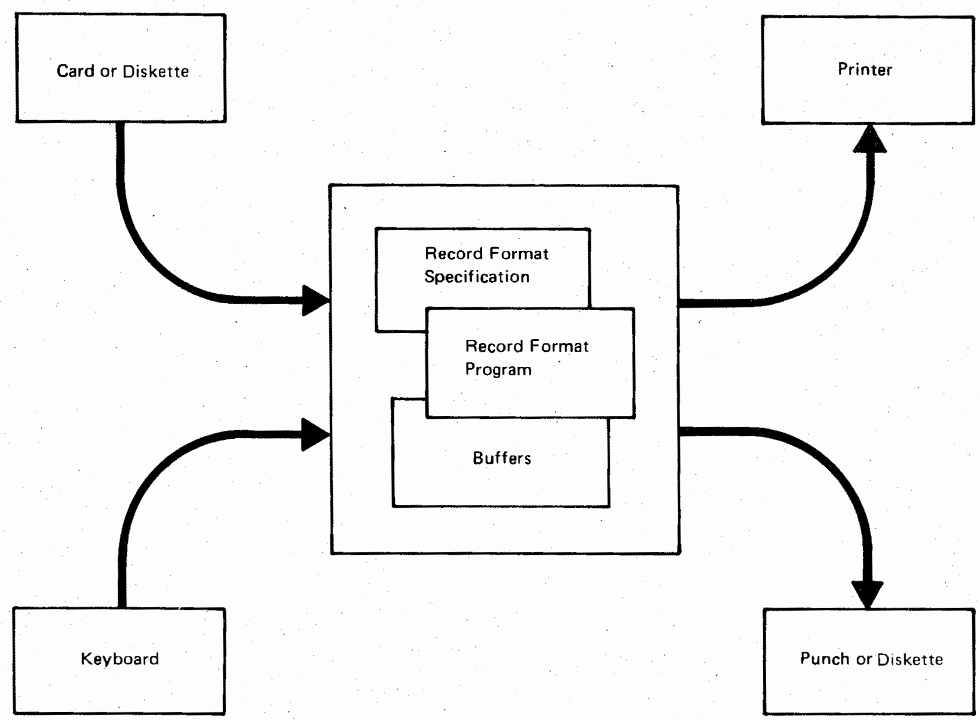


Figure 3-3. Record Format

A Record Format Specification describes the parameters necessary to select the input information and assemble the output information. Once coded, this specification is written on the Diskette Storage Device as a data set either from the CPU, from cards, or from the keyboard. This data set is then selected from the diskette device for execution when the Record Format job is started. Appendix H shows an example of a Record Format job and describes how to write a Record Format Specification.

Variable Length Buffer

The 2048-byte buffer provided with the Record Format feature can be used as a variable length buffer during keyboard to line or keyboard to diskette applications to extend the buffer edit capability. This buffer is selected by turning the

EXTEND/ALARM switch on. Without the Record Format feature, this switch would select single 512-byte buffer edit operation. Data is written to the 2048-byte variable-length buffer, where it remains until transmission to the CPU or writing on the diskette is desired by the operator. The entire 2048 bytes of data remains available to the operator for additional editing until it is transmitted or written to the diskette. Using the 2048-byte buffer, edit capability is extended to include insertion or deletion of characters. Data following the inserted or deleted characters is shifted in the buffer to accommodate inserted characters, or to "close up" data during deletion. Data is transmitted from the variable length buffer in 256-byte blocks, when transmission to the CPU or output to the Diskette Storage Device is called for. Update diskette mode operates with the variable length buffer in 256-byte blocks only.

Audible Alarm

This special feature provides a louder signal than the Operator Attention Speaker. The alarm can be enabled or disabled by the operator. When enabled, and during any job not using keyboard input, the alarm sounds for any device-error or not-ready condition.

Keylock

This special feature provides a key-operated switch which can be turned off to disable the terminal. On-line communication is possible with the Keylock off, if the terminal is placed in a ready state before turning the Keylock off, but any operator controls are disabled.

Operator ID Reader

This is a device that reads magnetic stripe operator identification cards. The reader is mounted behind the hinged door on the left of the controller's base (Figure 3-4).

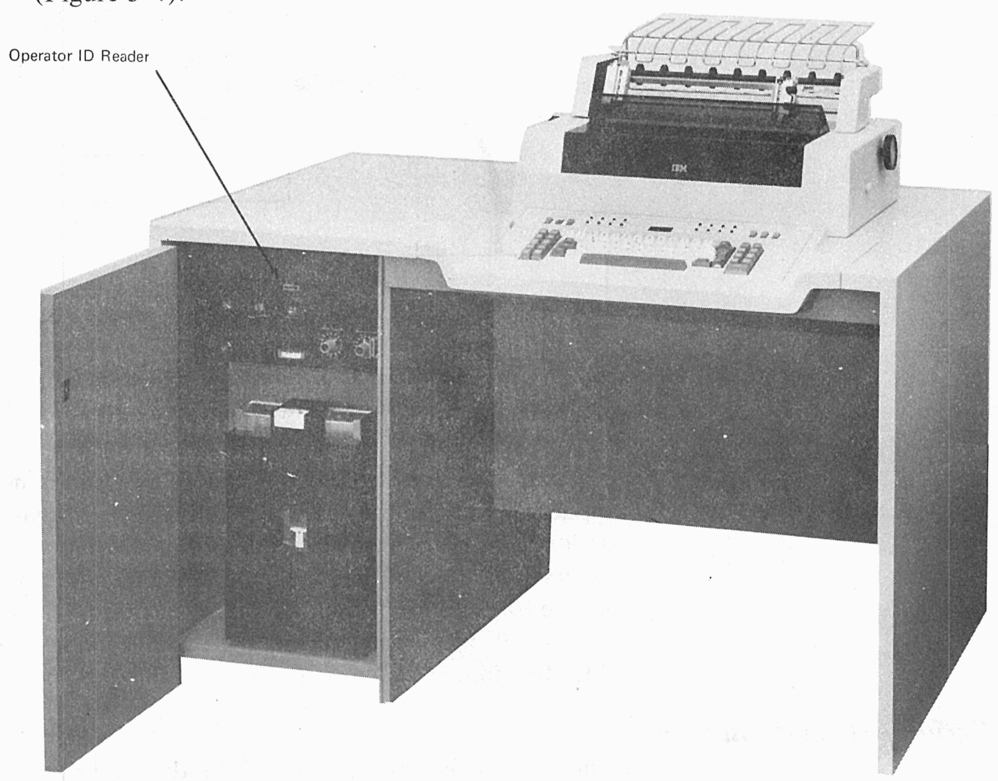


Figure 3-4. Operator ID Reader

On machines using SDLC, the CPU can request the user's identification by sending a message to the terminal. The operator must then start a keyboard operation (which may or may not include keyed data), then, using a CODE key function, activate the ID reader. When the message code number appears in the NPR display, the operator inserts an ID card into the reader. ID card data is then transmitted to the CPU for verification; the CPU will allow further communication only after receiving a valid ID. The ID card data is not printed at the terminal, and cannot be buffer edited. An automatic EOB follows the ID card data; further keying may occur before the EOM key is pressed.

A magnetic card may be inserted at any time during a keyboard-to-line job, using the "Read ID" CODE key function. If the card is an operator identification, it is read as described above. If it is not an operator identification, the card data prints and buffer editing can be performed; further, the operator may enter additional keyboard data if buffer space remains.

On BSC machines, the ID Reader cannot be selected from the CPU. The application program can be written to inform the operator, via a printed message, when to insert the ID card. A CODE key function causes a message code number to appear in the NPR and selects the ID Reader. This function may be used only on a keyboard-to-line operation. Data may be keyed before the function is used. When the badge is read, the buffer is sent to the CPU with an automatic EOM. The CPU must also provide checking and verification of received ID card data and take whatever action is necessary depending on the validity of the data. Data read from the ID card is not printed at the terminal.

Cards must be 3-7/8 by 2-1/8 inches, and between 0.007 and 0.045 inch thick. The magnetic stripe must be encoded in the American Banking Association format, which provides for up to 40 characters, 37 of which are discretionary. Card format and character sets are shown in Appendix B.

ASCII

This special feature is available for use in the U. S. and Canada. Differences between EBCDIC-coded and ASCII-coded machines are described in Appendix G.

Katakana Feature

This specify feature provides a Katakana 127-character set on the console printer, and a Katakana keyboard. The character set is shown in Appendix B. On the 3775 console printer, using this character set reduces printing speed to 40 lines per minute maximum. (Printing speeds are not affected on the 3774 console serial printer with the Katakana feature installed.)

The Katakana print belt can be interchanged with the optional 64-character set Japanese print belt on the 3775 console line printer with a resulting increase in throughput. When using a 64-character set print belt on a Katakana printer, the 3775 converts the EBCDIC equivalent of the lowercase alphabetic characters (a through z) to uppercase alphabetic characters before printing them. For example: EBCDIC hexadecimal '81' converts to hexadecimal 'C1'. If characters in print data are not present on the line printer belt, a hyphen (-) prints.

Communication Driver

This special feature is required for communication. In addition, one of the line control disciplines as described under "Communication Feature" must also be selected. The Communication Driver is available in two versions: without business-machine clocking; or with 1200 bps business-machine clocking. Business-machine clocking must be used when the DCE does not supply clocking for received and transmitted data. On World Trade machines, the Driver with business-machine clocking can also operate at 600 bps.

Communication Feature

This special feature provides the line control discipline, and is available in three versions: SDLC; BSC Point-to-Point; and SDLC/BSC Switch Control. The SDLC/BSC Switch Control version provides both types of line control, selectable by a switch on the terminal. If BSC multipoint operation is desired, the BSC Multipoint feature must also be installed in conjunction with the BSC Point-to-Point or SDLC/BSC Switch Control Communication feature. SDLC can operate either point-to-point or multipoint.

BSC Multipoint

This special feature, installed in conjunction with the BSC Point-to-Point or SDLC/BSC Switch Control Communication feature, permits the 3770 terminal to be multidropped on the same non-switched communication facility with other appropriately featured 3770 terminals or with other compatible BSC terminals. With this feature, the terminal responds only to its specific address when polled or selected by the CPU.

Integrated Modems

Integrated modems (special features) are incorporated in the controller, eliminating the need for an EIA/CCITT Interface feature. Connection to common-carrier switched lines using these modems is via a common-carrier-supplied Data Access Arrangement. These 1200 bps and 2400 bps Integrated Modems are compatible with appropriately featured integrated modems available for the IBM 3704 and 3705 Communications Controllers. Terminals using the IBM 2400 bps Integrated Modem are also compatible with an appropriately featured IBM 3872 Modem attached to the 3704 or 3705.

Note: 1200 BPS Integrated Modems are *not* compatible with a 2400 bps modem operating at half speed (1200 bps).

1200 BPS Integrated Modem, Non-Switched Network

This modem operates at 1200 bps over leased or privately owned half-duplex or duplex lines. A 3770 terminal always operates in half-duplex mode, but line turnaround time can be reduced using a duplex communication line. The Communication Driver with business-machine clocking must be used with this modem. This modem is compatible with the IBM 3976 Modem, which is available for use in World Trade countries.

1200 BPS Integrated Modem, Switched Network, with Auto Answer (U. S. and Canada)

This modem operates at 1200 bps over a switched network. With this modem, a 3770 terminal in unattended mode can automatically answer incoming calls. The Communication Driver with business-machine clocking must be used with this modem.

1200 BPS Integrated Modem, Switched Network, with Manual Answer (U. S. and Canada)

This modem operates at 1200 bps over a switched network. Incoming calls must be manually answered. The Communication Driver with business-machine clocking must be used with this modem.

1200 BPS Integrated Modem, World Trade Public Switched Network

This modem operates at 1200 bps over a public switched network in certain World Trade countries (not applicable in Japan). The Communication Driver with business-machine clocking must be used with this modem.

2400 BPS Integrated Modem, Switched Network (U. S. and Canada)

This modem operates at 2400 bps over a switched network, and provides half-speed (1200 bps) capability. This modem supplies clocking for received and transmitted data, and can automatically answer and disconnect incoming calls in unattended operation.

2400 BPS Integrated Modem, Point-to-Point

This modem operates at 2400 bps over half-duplex or duplex leased or privately-owned lines. The modem supplies the clocking for received and transmitted data, and can alternately operate at half speed (1200 bps).

The Auxiliary Operator's Panel has a signal quality meter to check the quality of the received signal, and a control to equalize the received signal.

2400 BPS Integrated Modem, Multipoint Tributary

This modem operates at 2400 bps on a duplex multipoint network. The modem supplies the clocking for received and transmitted data, and can alternately operate at half speed (1200 bps).

With this modem, a meter is provided on the Auxiliary Operator's Panel to check the quality of the received signal, and controls are provided to equalize the transmit and receive signals (see Figure 3-6).

2400 BPS Integrated Modem, Switched Caducee Network (France)

This modem operates at 2400 bps over the French PTT Caducee Network, and provides half-speed capability. The modem supplies clocking for received and transmitted data, and can automatically answer incoming calls. A TALK/DATA switch is provided on the Auxiliary Operator's Panel to allow alternate voice/data communications.

EIA/CCITT Interface

This special feature is required for connection to common-carrier-supplied or customer-supplied Data Communication Equipment (DCE), or to IBM standalone modems, operating over a switched or non-switched communication facility. It is also required on terminals connected to the host terminal containing the Modem Fan Out feature (Figure 3-5). This feature provides an interface to the DCE which conforms to the characteristics and specifications of EIA Standard RS-232C (U.S. and Canada), or CCITT Recommendation V.24 (World Trade countries). The circuits utilized by the 3770 are described in Chapter 1.

Modem Fan Out

This feature of the terminal can be used with the 2400 bps Integrated Modem (Multipoint Tributary) connected to a network configuration for multipoint operation. With this feature, up to three terminals can share a single modem located in the host 3774 or 3775. Terminals connected to the host terminal (Figure 3-5) must have the EIA/CCITT Interface feature.

Switched Network Backup (U. S. and Canada)

This feature of the terminal can be used with the 2400 bps Integrated Modem (Multipoint Tributary, or Point-to-Point) and allows alternate use of switched network facilities as backup communication lines. Switched-network operation can be specified at job-selection time. When the modem is connected to a switched network, calls must be dialed and answered manually. The same line control (non-switched point-to-point or multi-point) is used when operating on a switched network.

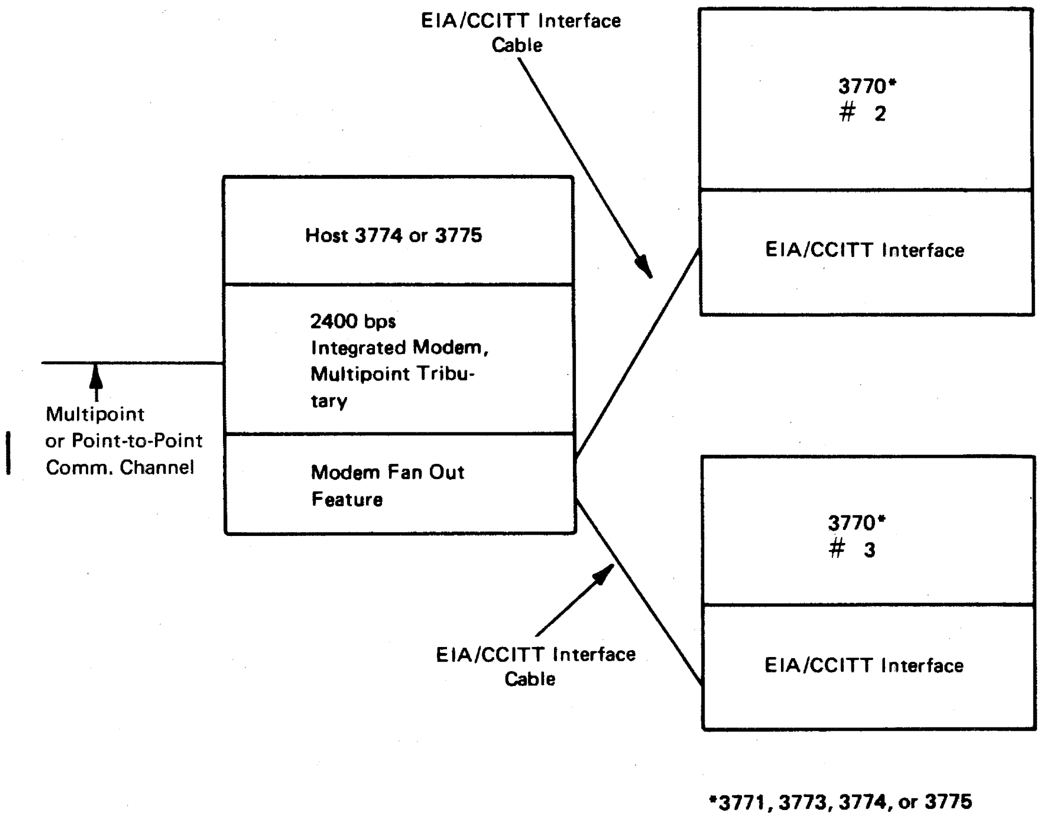


Figure 3-5. Modem Fan Out Configuration

Door Keylock

This feature adds a keylock to the right- or left-hand controller cabinet door. Two keys are provided with each lock.

Forms Stand Accessory

The Forms Stand (purchase only) facilitates handling of continuous fan-fold forms used with the console printer.

Variable Width Forms Tractor (3774 Only)

This special feature can be added to the 3774 console printer for feeding edge-punched continuous forms. Forms ranging from 3 to 15 inches wide can be used. Up to 6-part forms can be used, with a total thickness not to exceed 0.018 inch. Refer to "Components—3774 Console Printer" for forms restrictions and recommendations.

Additional Print Belts (3775 Only)

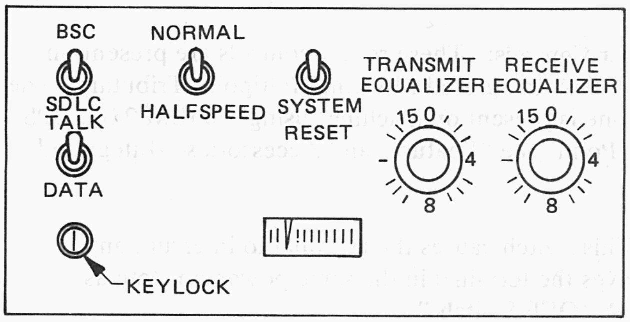
Additional print belts (purchase only accessories) are available for the 3775 console printer. Belts are available for the 64- and 94-character sets for various countries, as shown in Appendix B.

Operating Controls (3774/3775)

POWER ON/OFF Switch: This switch is located on the left side of the knee hole on the controller housing. It controls ac power to the terminal. When power is turned on, the bring-up diagnostics run and the terminal is left in local mode with the PROCEED indicator on. Any other indicator being on signals either a failure in the terminal's electronic components, that one of the MODE switches is on, or that the Keylock is off. The operator should proceed as described in the *Operating Procedures Guide.* If the tests complete successfully, the operator can continue with terminal operation.

Auxiliary Operator's Panel

The auxiliary operator's panel (Figure 3-6) is located behind the door on the controller base. It contains the SYSTEM RESET switch and certain special-feature controls, as follows.



Note: The TALK/DATA switch is present only on machines using the 2400 bps Integrated Modem, Switched Caducee Network (France).

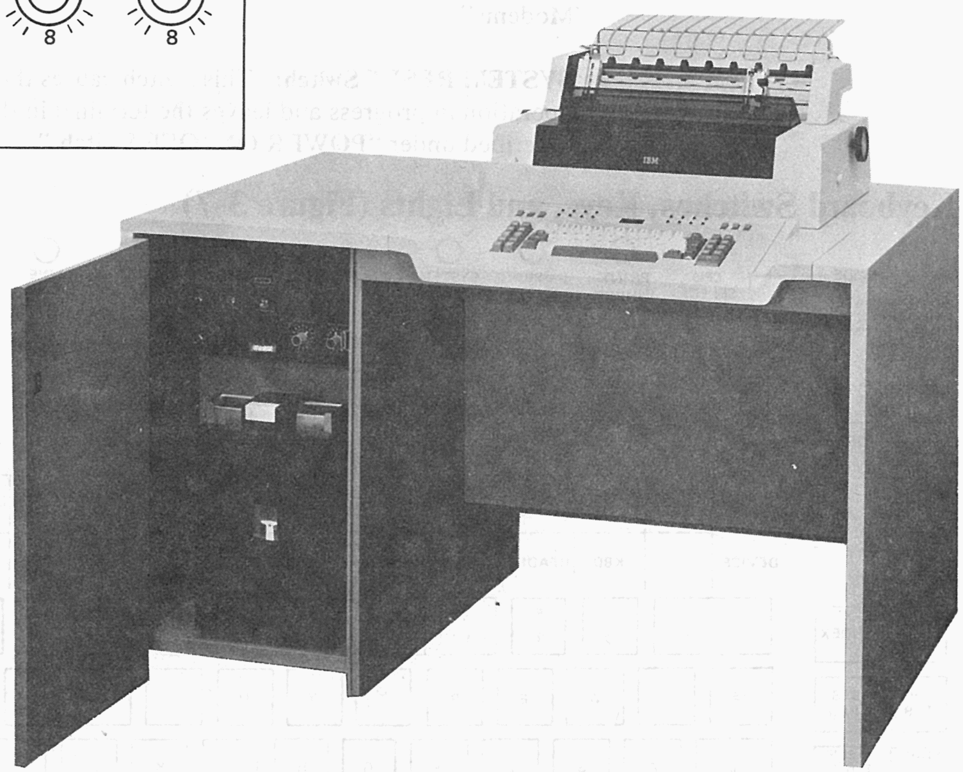


Figure 3-6. Auxiliary Operator's Panel

BSC/SDLC Switch: This switch is present on machines using the SDLC/BSC Switch Control Communication feature. The switch must be placed in the BSC position to communicate using BSC procedures (see Chapter 7), or in the SDLC position to communicate using SDLC procedures (see Chapter 8).

NORMAL/HALF-SPEED Switch: This switch is present on machines using the IBM 2400 BPS Integrated Modem, and is present on all World Trade machines. Using the 2400 BPS Integrated Modem, transmission is at 2400 BPS with the switch in the NORMAL position, or 1200 BPS with the switch in the HALF-SPEED position. On World Trade machines using either an Integrated Modem or an external DCE, line speed with the switch in the NORMAL position is at the modem's maximum rated speed. With the switch in the HALF-SPEED position, line speed is half of the modem's maximum rated speed, if the modem used has this capability.

TALK/DATA Switch: This switch is present only on machines using the IBM 2400 BPS Integrated Modem, Switched Caducee Network (France). It must be set to TALK for voice communication, or to DATA for data communication.

Keylock: This is the key-operated switch for the Keylock special feature.

Signal Quality Meter: This meter is present on machines using the IBM 2400 BPS Integrated Modem, Point-to-Point or Multipoint Tributary (see "Features and Accessories—Integrated Modems").

Transmit and Receive Equalizer Controls: These rotary controls are present on machines using the IBM 2400 BPS Integrated Modem, Multipoint Tributary. The Receive Equalizer control alone is present on machines using the IBM 2400 BPS Integrated Modem, Point-to-Point (see "Features and Accessories—Integrated Modems").

SYSTEM RESET Switch: This switch causes the terminal to interrupt any operation in progress and leaves the terminal in the same power-on state as described under "POWER ON/OFF Switch."

Keyboard Switches, Keys, and Lights (Figure 3-7)

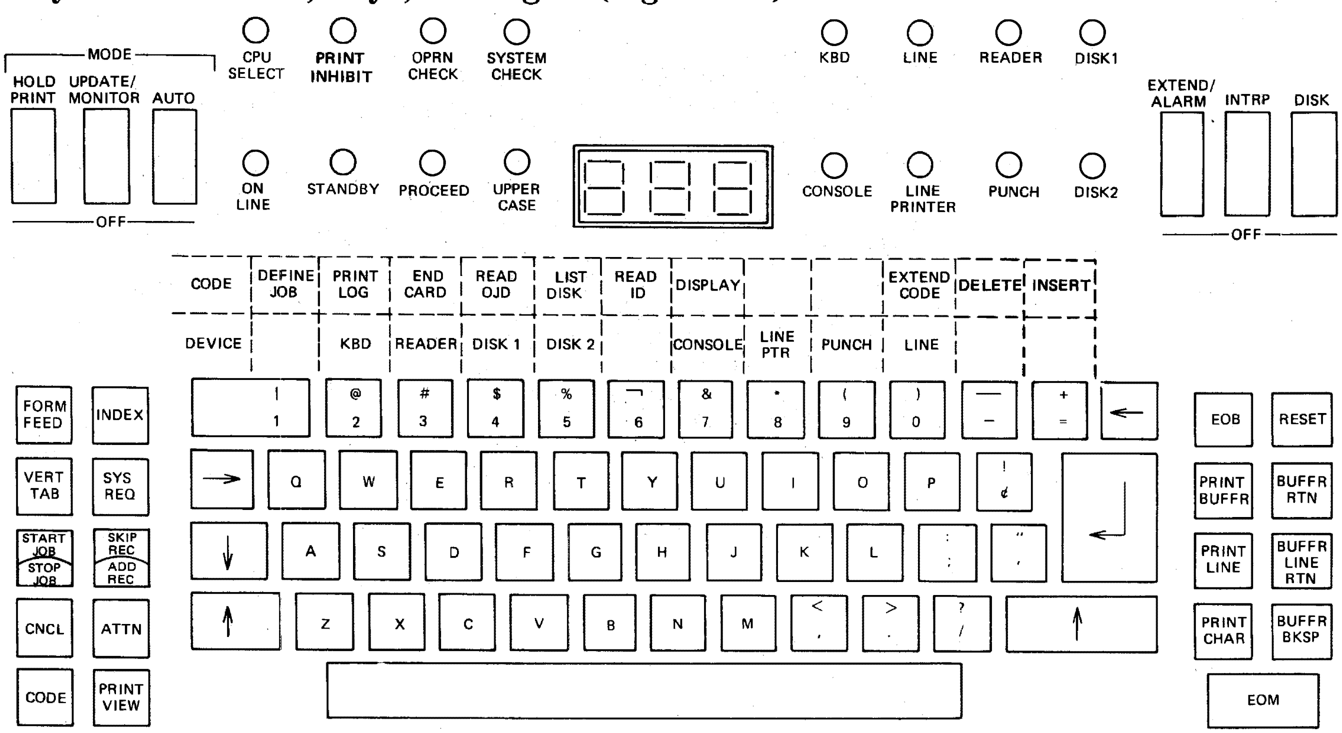


Figure 3-7. 3774/3775 Keyboard

This figure shows the EBCDIC keyboard arrangement for use in the U.S. and Canada.

Switches

HOLD PRINT: Turning this switch on suspends printing on the console printer so that forms may be inserted or adjusted. When the switch is turned off, printing resumes.

INTRP (Interrupt): When this switch is on during offline operation, the CPU can interrupt the offline job and transmit data to the 3774 or 3775 terminal. The terminal will disable the keyboard, stop the offline job, receive data from the CPU, and automatically return to the offline job after receiving EOT from the CPU (see "Operating Characteristics—CPU Interrupt").

DISK: This switch forces all data received from the CPU to be written on an attached Diskette Storage Device, regardless of any other component selection (except the console printer) received from the CPU. Data can be routed to the intended output in off-line operation by using a system-defined or operator-defined job.

EXTEND/ALARM: This switch selects the single 512-byte buffer for keyboard-to-line or keyboard-to-Diskette buffer edit operation. If the Record Format feature is installed, the 2048-byte variable length buffer function is activated.

For any job not involving the keyboard, this switch being on causes the Audible Alarm, if installed, to sound for any device-error or not-ready condition.

AUTO: During keyboard-to-diskette operations, this switch controls the output of data from the controller's buffer. With the AUTO switch OFF, the EOB or EOM key must be pressed to write the buffer contents to an attached Diskette Storage Device. If the AUTO switch is on, data is automatically written when the buffer becomes full (256 characters have been entered), or less than 256 characters can be read out by pressing the EOB or EOM key. Refer to the "Keyboard Entry to Line or Diskette" section in this chapter for a further description of the use of this switch during line or diskette jobs.

During keyboard-to-card punch operation, the AUTO switch being on causes a card to punch when the Return key is pressed, or causes the previous card to be duplicated when the BUFFR LINE RTN key and Return key are pressed.

During Diskette-to-printer operation, the AUTO switch being on causes printing to halt after the current record of the data set is printed.

UPDATE/MONITOR: This switch turned on during a keyboard-to-diskette job places the terminal in a mode that allows the operator to recall records from the diskette. Setting the switch on and entering a diskette record number reads the record into the controller's buffer. The record can then be printed, edited, or corrected. One 256-byte record at a time can be recalled, regardless of the setting of the EXTEND/ALARM switch.

After editing, the record can be read out of the controller's buffer and written back on the diskette by pressing the EOM or EOB key. If the AUTO switch is on, the next sequential diskette record automatically reads into the controller's buffer after the previous record is written to the diskette. If the AUTO switch is OFF, the next record can be recalled by entering the record number of the next desired record, or update mode can be ended by turning the UPDATE/MONITOR switch OFF.

For jobs other than keyboard-to-diskette, the switch is used to cause monitor printing on the console printer. On the 3774, monitor printing is not possible when an attached 3784 is the primary output device.

The 3775 nonprogrammable terminal will only interpret IRS characters when the primary output device is the 3521 Card Punch.

Keys

INDEX: This key causes the forms to feed one line, and stores a line feed (LF) character in the buffer. The next character entered will print in the next sequential print position. Pressing the CODE key in conjunction with this key causes an index function without storing a character in the buffer.

FORM FEED: This key causes the forms to advance to the first printing line on the next form, and stores an FF character in the controller's buffer. Pressing the CODE key in conjunction with this key causes a form feed function without storing a character in the buffer.

START/STOP JOB: Pressing this key followed by a job number selects one of the system-defined or operator-defined jobs and execution begins. Pressing the key in conjunction with the CODE key stops the job, and the terminal returns to local mode.

VERT TAB: This key causes the printer forms to advance to the next predefined vertical tab stop, and stores a VT character in the buffer. If no vertical tab stops are defined, pressing this key causes a printer line feed.

SYS REQ (System Request): This key can be used to initiate a logon or logoff message if the terminal is in local mode, or if the STANDBY light is on after a previous online job.

SKIP/ADD REC (Skip or Add Record): This key is active only during a Record Format Control job. In this mode of operation, pressing this key causes an input record to be skipped. Pressed in conjunction with the CODE key, it allows a record to be keyed in from the keyboard. See Appendix H for details on the use of this function key.

CNCL (Cancel): This key clears the buffer of all data.

When running an SDLC online job, the CNCL key operates as follows:

A. When receiving, the terminal transmits a negative response to the CPU that requests a break in data flow to the 3770.
B. When transmitting, the terminal clears the contents of the buffer and transmits a Cancel request to the host if needed.

ATTN (Attention): This key is active only on SDLC machines, and causes transmission of an expedited Signal command to the CPU. The Signal request unit contains a Request-to-Send code to stop the CPU from sending so that the 3774/3775 can begin sending to the CPU. The application program in the CPU may or may not honor the Request to Send. (See the chart on "SNA Network Commands" in Chapter 8 – "Programming Considerations – SNA/SDLC Communications".)

CODE, EXTEND CODE: These keys are used in conjunction with certain numeric or alphabetic keyboard keys to select functions such as:

- Define Job
- Print Error Log
- Communication Facilities Testing
- Stop Job
- End Card
- Display Input/Output Devices for Job (in NPR)
- Create Diskette (Delete all data including job definition)
- Change Data Set Status (Active or Inactive or Multivolume)
- Change Data Set Name
- Write Job Definition on Diskette
- Read Job Definition from Diskette or Cards
- List Diskette Data Sets
- Clear Diskette (Delete all data except job definition)
- Read Operator ID Card
- Set 8 Lines per Inch (3775 console printer)
- Set RJE (DC1 selection to 3784 printer)
- Set or Reset Switched Network Backup (SNBU)
- Print All Characters to Test Print Belt (3775 console printer)
- Insert and Delete Characters (Record Format feature)
- Set Monocase. This may be set to allow uppercase entry of the 26 alphabetic characters A through Z without use of the Shift keys.
- Set Manual or Auto Disconnect. This may be specified at any time. *Manual* may be specified to keep the line from disconnecting when the on-line job ends.
- Select Inquiry Mode Operation (see "Inquiry Mode" in Chapter 7).
- Set Ignore ETX/EOT. This may be specified any time the machine is in local mode, and causes all data to be written as a continuous data set regardless of whether ETX/EOT is received.
- Reset Ignore ETX/EOT, Inquiry Mode, and Monocase Operation.

Keys used in conjunction with the CODE and EXTEND CODE keys to select these functions are described in the *Operating Procedures Guide.*

PRINT VIEW: This key is active on the 3774 only. When the key is pressed during key entry, the print mechanism moves to the right so that the last printed character can be seen. The print mechanism is automatically repositioned for printing when the next character is struck. Pressing the key twice in succession causes the print mechanism to move aside, permitting viewing after each data key is pressed assuming that the operator's keying rate is slow enough to allow viewing. The printer remains in this mode of operation until the key is pressed again.

EOB (End of Block): Pressing this key causes the controller buffer's contents to be transmitted (online mode), or to be written to the diskette (offline mode). A BSC transmission block is ended with an ETB character. Using SDLC, the buffer content is transmitted indicating the data is not the last element of a chain (see Chapter 8).

RESET: Pressing this key resets the Audible Alarm. Pressing this key after a buffer edit operation restores the buffer pointer to the first buffer position past the end of data in the buffer. Pressing CODE and RESET resets the SYSTEM CHECK or OPRN CHECK indicator, resets the NPR, and turns the device indicator off.

PRINT BUFFR (Print Buffer): Pressing this key causes data to be printed, beginning at the current buffer position, through the end of data contained in the buffer.

BUFFR RTN (Buffer Return): Pressing this key restores the buffer pointer to the beginning of the buffer. Data is not destroyed and can be printed out or corrected.

PRINT LINE: Pressing this key causes a line (or remainder of a line) to print, beginning at the current buffer position, through the next NL or IRS character, or to the end of data contained in the buffer.

BUFFR LINE RTN (Buffer Line Return): Pressing this key restores the buffer pointer to the beginning of the current line, or to the beginning of the buffer if only one line has been entered. During keyboard-to-card punch operation, pressing this key causes a card to be duplicated if the AUTO switch is on.

PRINT CHAR (Print Character): Pressing this key causes a character from the current buffer position to print in the printer's current print position. Holding the key down causes typamatic operation (continuous printing) until the key is released.

BUFFR BKSP (Buffer Backspace): Pressing this key causes the buffer pointer to back up one position (one character space). Data is not destroyed when back-spaced over, and can be printed out or corrected. The BUFFR BKSP key cannot be used to backspace into the previous line of data (as defined by the character ending the previous line), or to backspace over other control characters (such as HT, VT, and IRS) contained in the buffer.

EOM (End of Message): Pressing this key causes data in the buffer to be transmitted (online mode), or to be written to an attached device (offline mode). For BSC, the transmission block is ended with an ETX character. Following a good reply to the block ended with ETX, the 3770 terminal transmits EOT, ending the job. For SDLC, the buffer content is transmitted indicating the data is the last element for a chain and the job ends.

Lights

Device Indicators: An indicator is provided for each I/O device. The device indicators are used to indicate the active devices for the selected job, not-ready conditions, and device errors. Certain device errors cause the device to lose its ready condition, and its associated light turns on and the Operator Attention Speaker sounds to inform the operator that the device needs attention.

Numeric Position Readout (NPR): This is a three-digit numeric display that provides different indications depending on the operation being performed. If the Diskette Storage feature is installed, record numbers associated with the Diskette records are indicated here. Message code numbers providing operator guidance and indicating system status and error conditions are displayed in the NPR. These code numbers, in conjunction with other operator panel indicators being on, are related to operating procedures described in the *Operating Procedures Guide.*

ON LINE: For BSC, this light is on whenever the communication line is selected and an input or output and the data link connection has been established. The light blinks while data is being transmitted or received, and turns off when the data link connection is broken.

For SDLC, this light is on when the terminal is bound in a session with the CPU, and turns off when the session is terminated.

STANDBY: For BSC, this light turns on when a job involving the communication line is started. The light remains on until transmission begins, and then turns off. It is off until the job ends, and then turns on. Another online job can be started after the light turns on again. For SDLC, this light turns on when in communicate mode and there is not an active line job. The light remains on until a job involving the communication line starts, and then turns off; it remains off until the job ends. When the STANDBY light turns on again, another online job can be started.

CPU SELECT: For BSC, this light indicates that the terminal has rejected a line bid, an MPLC polling sequence, or an MPLC selection sequence from the CPU because the terminal is not ready to operate in line mode. For SDLC, this light indicates that the terminal has rejected a BIND, or that SIGNAL has been received from the CPU (see Chapter 8).

OPRN CHECK (Operation Check): This light turns on and the Operator Attention Speaker sounds when the operator has performed an incorrect procedure, or when some I/O device needs attention. A device light will also be on if an I/O device needs attention. A message code number will be displayed in the NPR. This number corresponds to an explanation or procedure, as described in the *Operating Procedures Guide.*

PRINT INHIBIT: For BSC, this indicator is not used. For SDLC, this light turns on when the Inhibit Print command is received from the CPU and the keyboard is unlocked. This light turns off when the Enable Print command is received.

SYSTEM CHECK: This light turns on and the Operator Attention Speaker sounds when certain machine errors occur. A message code number will be displayed in the NPR indicating the cause of the error. If an I/O device caused the error, the appropriate device indicator will also be on.

PROCEED: Data entry from the keyboard is permitted when this light is on.

UPPER CASE: This light turns on when the keyboard is in uppercase shift (Upper Shift key has been pressed).

Chapter 4. IBM 3776 Communication Terminal Models 1 and 2 IBM 3777 Communication Terminal Model 1

Components

Controller

The controller is contained in the terminal's base. It controls input and output operations, provides buffering for received and transmitted data, and provides the data link control.

The controller operates in three modes: online mode, local mode, and offline mode. After power on, or after completion of any job, the terminal is in local mode. From local mode, the controller can be placed in either offline mode or online mode. In online mode, the terminal can receive or transmit data over the communication facility. In offline mode, the terminal can be used for data transfer between attached I/O devices.

Mode of operation, device selection, and other parameters necessary to perform a job are under operator control. Forms control information (margins, vertical and horizontal tab stops, and forms length) for up to five different job definitions can be entered into the controller by the operator and remain available for selection without the need to re-enter the setup each time it is desired. Forms control is accomplished by control characters within the data.

Dual data path operation allows an online mode line-to-printer job to run concurrently with an offline card reader-to-diskette or diskette-to-diskette with the addition of those devices to the 3776 or 3777-1. The online job can also run concurrently with an offline diskette-to-punch job with the addition of those devices to the 3776.

3776 Console Printer

The 3776 console printer operates as a line printer only and is not designed as an interactive type printer. That is, it does not provide the print visibility features nor the print position indicators as provided on the 3775 printer. Four character sets are available for the 3776 printer. In addition to the three EBCDIC character sets available in 48-, 64, or 94-character arrangements, another 48-character set (EBCDIC only) is available that is equivalent to the HN print train arrangement for the 3203 printer attached to the 3777 terminal. Two models of the 3776 are available and provide the following maximum printing speeds:

Model 1	300 lpm using the 48-character set 230 lpm using the 64-character set 160 lpm using the 94-character set
Model 2	400 lpm using the 48-character set 300 lpm using the 64-character set 230 lpm using the 94-character set

The character set desired is optional, and must be specified at time of ordering. Additional print belts can be purchased and can be changed by the operator. The characters provided by each of these character sets are shown in Appendix B. The 48-, 64-, and 94-character set belts are interchangeable, and the printing speed automatically adjusts to the belt installed. Print belts cannot be exchanged between a Model 1 and a Model 2, however. Using the 48- or 64-character set belt, the 3776 will convert the 26 lowercase alphabetic characters a through z to uppercase and print them. For Katakana machines, those Katakana characters having codes equivalent to EBCDIC lowercase alphabetic characters are converted to uppercase alphabetic characters. Maximum line length is 132 characters.

The character set is contained on a continuously rotating metal belt. As the belt rotates, a comparison is made between the character in front of each hammer and the character that is to print in that position. When the desired character is in position to print, the hammer for that position is fired to force the paper and ribbon against the character face to print the character.

The printer uses a pin-feed forms tractor for feeding 1-part to 6-part edge-punched continuous forms. The tractors are adjustable to accept forms ranging from 3-1/2 to 15 inches wide. Line spacing of 6 or 8 lines per inch can be selected by the operator. Considerations for designing forms used with this printer can be found in *Forms Design Reference Guide for Printers*, GA24-3488.

A forms enclosure on the 3776 Models 1 and 2 facilitates stacking of continuous, fan-fold forms.

3203 Printer (3777 Only)

A minimum configuration includes a 3777 Communication Terminal and a 3203-3 Printer. The 3203 Printer is described in Chapter 6 of this manual.

Keyboard

The keyboard used on machines in the U.S. and Canada has 44 character keys and a space bar, and other typewriter-like control keys. The arrangement of keys is similar to that on a typewriter keyboard. On either side of the typewriter-like keys are keys for controlling terminal operation. Lights located above the keys provide indications of terminal status and error conditions. This keyboard provides 88 characters in upper and lower case shift, (refer to Figure 4-7).

Typamatic operation of the Space Bar and of the Backspace, Hyphen/Underscore, and CHAR ADV (Character Advance) keys causes repetitive functions, simply by holding the key down.

Keyboards for use in World Trade countries other than the United Kingdom have 47 graphic keys, providing 94 characters. The keyboard for the United Kingdom has an additional key (48 keys), and provides 94 characters in upper and lowercase shift. This keyboard does not provide typamatic operation of the Hyphen/Underscore key. Keyboard characters present on all keyboards are shown in Appendix B.

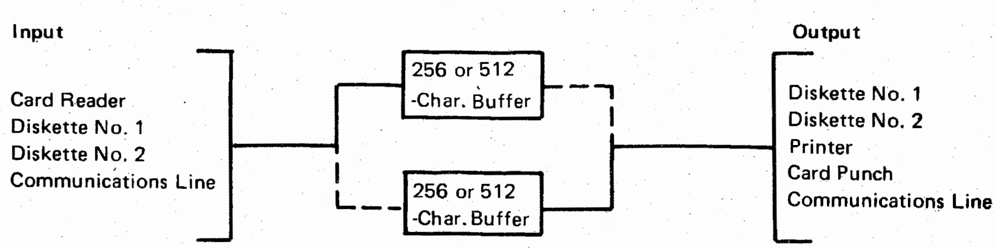
Nomenclature on keyboard control keys, lights, and switches is provided for the following languages:

English
French
German
Italian
Japanese
Spanish

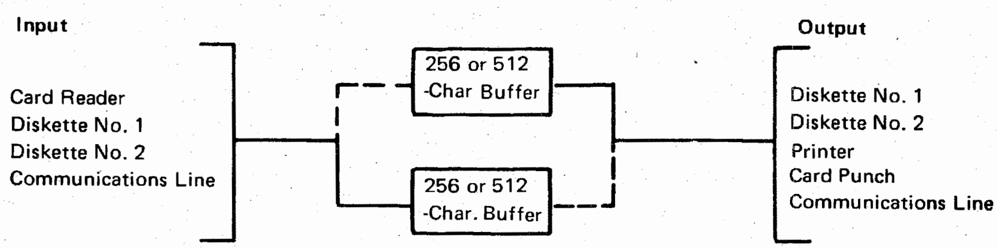
Operating Characteristics (3776/3777 Model 1)

Controller

The controller uses two alternating buffers for temporary data storage. Either dual 256-byte or dual 512-byte alternating buffer operation is selectable by a switch on the keyboard. A change in buffer size can be selected only at power-on time, or after the SYSTEM RESET switch is pressed. Position of the select switch prior to power on or system reset determines the active mode. In order to maintain 3780 compatibility, the 512-byte buffer may contain 511 bytes of data for transmission. However, the buffer will be referred to as a 512-byte buffer in the remainder of this manual (see chart with Figure E-5). The buffers alternate in use between input and output, and accept data from the input device character-by-character (Figure 4-1).



First buffer fills, second empties



Second Buffer Fills, First Empties

Figure 4-1. 3776/3777-1 Dual Buffer Operation

During either offline or online operation, one buffer is always dedicated to input and the other to output. While one buffer is accepting input data, the other may be sending output data. When the input buffer fills and the output buffer empties, they exchange functions. This arrangement allows:

- A consistent line rate with variable I/O (input/output) rate
- Overlap of input and output operations
- Checking of data before output or transmission.

Dual Data Path

Dual data path operation on the 3776/3777-1 allows concurrent execution of a line-to-printer job and either (a) a card reader-to-diskette, or (b) a diskette-to-diskette job. On the 3776, (c) a diskette-to-card punch job can be run concurrently with the line-to-printer job. The line-to-printer job (Job 1) uses either the dual 256-byte or dual 512-byte alternating buffers to accept data from the line and transfer it to the printer. A single 256-byte buffer (or 512-byte buffer if the EXTEND BUFFER switch is on) is used for data buffering between the input and output devices of Job 2. Job 1 and Job 2 can be started and stopped independently of each other by use of the keyboard START/STOP JOB and START/STOP DUAL keys.

Appendix D shows the throughput that can be expected using dual data path operations. The offline job (Job 2) throughput is less than it would be if the same job were run as Job 1, because of the single buffer Job 2 operation.

If the CPU should send a component selection for a device in use by Job 2, the selection will be rejected and the CPU SELECT light turns on. The operator may then stop Job 2 to make the device available to the line.

Job Control

Job controls allow setup and selection of a job running in either online or offline mode. After the terminal's power is turned on, and with the HOLD PRINT switch and Keylock off, the terminal is in local mode. To proceed with terminal operation, the operator must then set up the forms control for the job and define other parameters, or select them by use of the keyboard switches. Job control information, if desired, may be entered from the keyboard or if previously written on the diskette or punched into cards, be read into the controller from diskette or cards. These settings, however entered, remain in effect for the entire job.

Parameters, in addition to forms control, that may be specified or selected include:

- The input and output devices required for the job
- A data set name, if the job involves a Diskette Storage Device
- The beginning record number of the diskette data set, if other than the first one.
- Transparent Mode: This causes card data to be transmitted in Transparent format.
- Compress: This causes space compression of basic exchange diskette data sets or of input data from a card reader (see "Space Compression/Expansion").
- Interpret or Inhibit Interpret (3776 only): Using the 3521 Card Print feature, Interpret must be specified to cause printing on the card while reading cards. Inhibit Interpret must be specified to inhibit printing while punching cards.
- Omit Readback Check (3776 only): This disables the 3521 Punch Checking to allow punching of internally scored or prepunched cards.
- Delete Diskette Records after Read: This deletes all records (except forms control information) from the diskette after the specified data is read.

The online and offline jobs that can be selected are:

Input	(to)	*Output*	*3776*	*3777-1*
Card Reader	· ·	Card Punch	X	
Card Reader	· ·	Line	X	X
Card Reader	· ·	Printer	X	X
Card Reader	· ·	Diskette 1	X	X
Line	· ·	Card Punch	X	
Line	· ·	Printer	X	X
Line	· ·	Diskette	X*	X
Diskette 1	· ·	Line	X	X
Diskette 1	· ·	Card Punch	X	
Diskette 1	· ·	Printer	X	X
Diskette 1	· ·	Diskette 2	X	X
Diskette 2	· ·	Line	X	X
Diskette 2	· ·	Card Punch	X	
Diskette 2	· ·	Printer	X	X

*For BSC, non-transparent data goes to the diskette and transparent data goes to the card punch. Continuation on diskette 2 is automatic, if it is ready to operate.

Output device selection (other than for the console printer) can be overridden and the diskette device selected as the destination for received data by turning the DISK switch on. With the switch on, data received over the line is written on the diskette, regardless of component selection for the card punch.

| *Compression/Expansion*

Throughput on machines may be increased by selecting Compress for the job (See "Job Control"). If this option is specified, consecutive space characters are removed from transmitted data from the card reader and reinserted in output data by the receiver.

| Using BSC—Space Compression/Expansion

When the 3770 is transmitting in BSC, and has read two or more consecutive space characters from a card reader, it will transmit an IGS (hex '1D'), followed by a character (binary number) specifying the number of omitted spaces. This binary number represents a minimum of 2 and a maximum of 63 spaces. If more than 64 consecutive spaces are read from the input device, a second IGS sequence is transmitted. In 512-byte mode, a maximum of 511 bytes will be transmitted (see chart with Figure E-5).

The binary numbers representing the omitted spaces are defined as follows:

Number of Spaces	*EBCDIC:* *0 1 2 3 4 5 6 7*
2	0 1 0 0 0 0 1 0
3	0 1 0 0 0 0 1 1
.	.
.	.
.	.
63	0 1 1 1 1 1 1 1

Both space compress and transparent mode operation cannot be specified for a job. Transparent mode will override Compress if both are specified.

These sequences can also be received in data from a CPU, and will cause reinsertion of the spaces (expansion) into printed data. On the 3776 spaces will be reinserted into cards punched on an attached 3521 Card Punch; expansion is automatic and does not have to be specified for the job. Compressed data received onto an attached diskette device will be expanded on output from the diskette to another attached output device.

Using SDLC–Space or Data Compression/Expansion

When the 3776/3777-1 is transmitting in SDLC from a card reader, a String Control Byte (SCB) character (see definition following) is transmitted in front of each string of data characters or instead of consecutive (repeated) space or data characters (called *compression*). The SCB character identifies the type of data string and contains the binary count of the number of characters that follow, or the number of space or data characters to be inserted (repeated) at the receiver (called *expansion*). The binary number represents a minimum of 1 and a maximum of 63. If more than 63 characters are involved, a second SCB character is transmitted.

String Control Byte (SCB) Definition:

Bits 0 and 1 identify the data string:

00	-	No Compressed Characters. The binary count field (bits 2-7) contains the number of the bytes between this SCB and the next SCB.
01	-	Compacted Data String (CPU to 3777-1 Only). The count field contains the number of the bytes between this SCB and the next SCB. Each byte in the string may represent two consecutive master characters or a single character in the compact code subset. Both kinds of bytes may exist in the same character string. The previously received host-created decompaction table is stored in the 3777-1 controller.
10	-	Compressed Space Characters. The count field contains the number of space characters represented by this SCB. The next SCB follows in the next byte.
11	-	Compressed Data Characters. The count field contains the number of times the data character following this SCB is to be repeated at the receiver. The next SCB follows the data character to be repeated.

Bits 2 through 7 contain a binary count of the data characters that follow, or space or data characters to be inserted at the receiver.

Example: Repeat the asterisk (*) character (X'5C') 21 times

SCB Character Bits

$$\begin{array}{cccccccc} 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ \hline \end{array}$$
$$\underbrace{1\ \ 1\ \ \underbrace{0\ \ 1\ \ 0\ \ 1\ \ 0\ \ 1}_{\text{Binary 21}}}_{\text{X‘D5’}}$$

Repeated Character Bits

$$\begin{array}{cccccccc} 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ \hline \end{array}$$
$$\underbrace{0\ \ 1\ \ 0\ \ 1\ \ 1\ \ 1\ \ 0\ \ 0}_{\text{X‘5C’}}$$

Record Compression

Using two special feature diskette storage devices permits offline compression of records on Basic Exchange data sets onto a single 3776/3777-1 diskette for subsequent batch transmission. The compressed records are written on the diskette in 3770 mode. Record Compress using one diskette storage device, permits the compression of Basic Exchange diskette records into blocks of 256 bytes or 511 bytes for transmission (see chart with Figure E-5). An IRS character separates the records. In SDLC mode, the FM header built to define the data will set the MEDIA byte to X'20' e.g. "card data" if the data set block length is 80 bytes or less; otherwise, the MEDIA byte is set to X'10' e.g. "disk data". The PROPERTIES byte of the FM header has the CMI bit set to indicate the data is compressed. Record compression cannot be used in SDLC mode on machines with the ASCII character set.

Problem Determination

The controller has built-in tests that run each time the power is turned on or the SYSTEM RESET switch is operated. These tests, when successfully completed, have checked the major portion of the controller and verified that the electronic circuits are operating properly. The terminal is then in local mode. The tests require a few seconds to run and leave the terminal in a state with the PROCEED indicator on; this informs the operator that operation can proceed. Any other indicator being on after the tests have run signals either that a failure occurred in the controller's electronic components, that one of the mode switches is on, or that the Keylock is turned off.

Problem determination tests selectable from the keyboard reside in the terminal. The operator can use these tests to isolate problems to the terminal or to the communication facilities. Communication-facility tests also include online tests provided by the CPU access method.

Error Logging

Information about errors encountered during normal operation is recorded in an error log that can be printed out by the Print Error Log function. When errors that cannot be corrected by operator action occur, or when intermittent internal machine errors that impede operation occur, the operator should call for a printout of the error log before turning the terminal's power off (the error log is lost when power is turned off). This information should be retained and given to the service representative, who will use it to isolate the cause of the problem.

Operator Attention Speaker

This device produces an audible tone to signal the operator that a procedural error has occurred, or that some input or output device requires attention. Upon hearing the tone, the operator can refer to the keyboard indicators, which will indicate the cause of the tone.

Console Printer (3776 Only)

The console printer can be specified as the output device for the following jobs:

Input	*to*	*Output*
Line	..	Printer
Card Reader	..	Printer
Diskette 1	..	Printer
Diskette 2	..	Printer

Before starting a job using printer output, margin settings and vertical and horizontal tab stops, if desired, must be entered and stored in the terminal. These settings may be selected at any time, and remain in effect until the settings are redefined, or until power is turned off.

The printer operates only as a line printer. Keyboard-entered data does not print as it is entered, as on other 3770 terminals, but the data entered can be printed out after it is entered and prior to transmission by use of the PRINT VIEW key. The printer cannot be selected for monitor printing of data.

Certain printer function characters can be received within data from the CPU to cause formatting of the data as it is printed on the console printer. The characters that can be recognized by the printer, and the operation they cause, are described in Chapter 7.

Vertical Forms Control

Vertical forms control allows the operator to specify the vertical format of forms by print areas and skip areas. Once the format is entered, automatic operation causes the forms to advance when specified text areas are completed. The procedure for entering the vertical forms control is contained in the *Operating Procedures Guide.* Control characters used for vertical forms control are described in Chapter 7.

Horizontal Format Control

Printer margins and horizontal tab settings are entered and stored in the terminal. The procedure for setting margins and horizontal tab stops is contained in the *Operating Procedures Guide.* These settings are defined during the forms definition procedure, and remain in effect until they are changed by the operator, or until power is turned off. Control characters used for horizontal format control are described in Chapter 7.

Horizontal tab setup permits a Tab character to be used to skip areas within a line that are not to be printed. This is similar to typewriter operation, except that the tabbing is electronically controlled. When the Tab key is pressed during keyboard entry, the print position moves to the right to the next tab stop, and an HT character is stored in the transmission buffer immediately following the last data character. Data for the next field then begins storing in the buffer immediately following the HT character.

The relationship between the print position indicated on the printer and the buffer position at which data is entered is not a one-to-one relationship. At the beginning of a job, or after data has been read out of the buffer, new data will always begin storing into the first buffer position. Data begins printing, however, at wherever the left margin is set, as defined by the forms definition. Several lines of data, each delineated by format control characters, can be contained in a single buffer.

Forms Enclosure

A combination forms stand and stacker enclosure on the 3776 Models 1 and 2 facilitates feeding and stacking of continuous, fan-fold forms. The acoustical stacker enclosure permits quieter operation of the console line printer.

3203 Printer (3777 Only)

See Chapter 6 of this manual.

Keyboard

The keyboard cannot be selected for keyboard entry jobs, but is enabled by pressing the SYS REQ key before an online job is started, or when the STANDBY light is on after a previous online job. A logon or logoff message may be keyed into the buffer, and this message will be sent to the CPU before any other data is received or transmitted. On SDLC machines, if a message is keyed in with the STANDBY light on without first pressing the SYS REQ key, the message is routed to the application program at the host CPU. If the SYS REQ key is pressed before keying in the message, the message is routed to the System Services Control Point (SSCP) in the host CPU. Limited buffer editing of the message is possible by use of the BUFFR BKSP and CHAR ADV keys. The buffer may also be printed out before transmission of the message by pressing the PRINT VIEW key. If the Operator ID Reader Feature is present, magnetic card data may be sent in addition to keyed data. Refer to "Operator ID Reader" in the "Features and Accessories" section in this chapter.

Note: Some BSC Operating Systems examine the data in a logon message to determine if the data following the message is compressed. A logon message entered from the 3776/3777-1 is not compressed, therefore, cannot be used with these Operating Systems preceding compressed data. If compressed data is to be transmitted, the logon message must be transmitted from the card reader or from the diskette using a standard card reader-to-line or diskette-to-line job.

Features and Accessories (3776/3777 Model 1)

This section describes the special and specify features and accessories (purchase-only items) available for the 3776 and 3777-1 controllers and the 3776 console printer. I/O devices that can be cable-connected to the controller, and special features for these devices, are described under "I/O Attachments" (Chapter 6).

Magnetic Diskette Storage

The Diskette Storage Devices are compact units contained in the terminal's base. Data is recorded on a small flexible operator-changeable diskette. The Diskette Storage Device can accept input data entered into the controller buffer either from the communication line during online operation, or from an attached card reader during offline operation. Batch data can be stored on the diskette during offline operation and subsequently transmitted to the CPU, resulting in increased throughput and reduced communication costs in many applications.

Two devices may be obtained with the 3776 or 3777-1. The first Diskette Storage Device (Figure 4-2) is contained in the lower left side of the controller. The second is contained in an extension attached to the right side of the controller (Figure 4-3).

Figure 4-2. 3776 With First Diskette Storage Device

Figure 4-3. 3776 With Second Diskette Storage Device

Each diskette provides a maximum of 242,688 bytes of data storage. With the addition of a second Diskette Storage Device, the following operations are possible:

- Read from diskette 1, write to diskette 2 (single data set or all active data sets). or all active data sets).
- Automatic continuation of an online job from diskette 1 to diskette 2.
- Transmit from diskette 2, receive onto diskette 1.

With diskette storage, forms control information can be stored on and recalled from diskette 1. If not stored on the diskette, forms control information is lost after power is turned off, and must be re-entered after turning power on.

The ability to transmit from diskette 2 and receive onto diskette 1 during a single session with the CPU permits maintaining the integrity or format of data on the diskette used in diskette 2. With only one Diskette Storage Device, or if transmitting from diskette 1, any data received is written as a data set onto the same diskette. By transmitting data from diskette 2, any received data is then written onto diskette 1 thus preserving diskette 2 in its original condition. This type of operation is also useful when data to be transmitted is written in exchange format (see "Exchange Format" in this chapter). Since the 3770 cannot write on a diskette written in non-3770 exchange format in BSC mode, received data could not be written back onto the same diskette. By placing the exchange format on diskette 2 for transmission, and receiving data onto diskette 1, this operation can be accomplished without operator intervention.

Diskette Records

A record written on the diskette occupies either two sectors or four sectors, depending on the setting of the EXTEND BUFFER switch at system reset or power on time. With the switch off, the dual 256-byte buffers are selected, causing each buffer of data to be written into two 128-byte diskette sectors. With the switch on, the dual 512-byte buffers are selected, causing each buffer to be written into four 128-byte diskette sectors. Records consisting of less than 256 significant bytes (512 bytes with Extended Buffer) cause NUL characters (hex '00') to be inserted following the significant data, padding the record out to 256 (or 512) bytes. As with any diskette of this type, defective sectors due to physical damage of the diskette will decrease the available storage capacity. Defective sectors are skipped over the first time they are encountered; thereafter, they are not used. An excessive number of defective sectors can cause a significant decrease in storage capacity, and will degrade performance. On machines having two Diskette Storage Devices, data sets with an excessive number of defective sectors can be read from diskette 1 and written to diskette 2. Data on diskette 2 is "closed up" toward the beginning of the diskette by elimination of the bad sectors.

When receiving data over the communication line for writing on the diskette, data blocks from the CPU cannot exceed 256 bytes with the EXTEND BUFFER switch off, or 512 bytes with the switch on. Blocks containing less than 256 (or 512) bytes will be accepted and padded with NULs as they are written on the diskette. Diskettes written with the EXTEND BUFFER switch on cannot be read with that switch off. BSC transparent data can be written on the diskette, but any NUL characters at the end of the record being written will be lost when the diskette is read. The format of the output data, when the transparent diskette is read, is determined by the format of the output device as follows:

- Line—256- or 512-byte records depending on the setting of the EXTEND BUFFER switch and the number of NUL characters deleted.
- Printer—Depends on horizontal forms definition
- Punch—80-byte records.

Diskette Data Sets

Each group of records for a particular job is identified by a data set name that is entered by the operator or assigned by the terminal. On output from the diskette, all records written on the diskette under this data set name comprise the data for that job. During online operation, all data sets on the diskette or any specified data set can be transmitted. After transmission, all diskette data can be deleted if specified at job start time, to provide storage space for received data. If the diskette data is not deleted, additional data received from the line is assigned to the next available diskette area. If a data set name is not specified at the beginning of a card reader-to-diskette operation or a line-to-diskette operation, a data set name is assigned by the 3776/3777-1. For a card reader-to-diskette operation, the name SC00 is assigned. For a line-to-diskette operation, the name SL00 is assigned. If additional data is received from the line, the numeric characters of either the system or operator-assigned name (unless "Ignore EOT/ETX" is specified) are incremented for each additional data set received. Operator-assigned data set names must be four characters. The 3776/3777-1 can handle up to 18 different data sets on a single diskette. Data sets exceeding the diskette capacity can be continued on another diskette. During an online receive operation or an offline card-to-diskette operation, the controller signals the operator when the diskette capacity has been reached. The operator can continue the job after replacing the full diskette with another diskette. If a second Diskette Storage Device is present, continuation on the second diskette is automatic, if it is ready to operate.

Data Set Labels

Each data set on the diskette is identified in a Data Set Label, which is shown in Appendix E. A data set must be "closed" before it can be accessed for transmission, printing, punching, etc. A data set is closed (depending on the job) as follows:

- Card Reader to Diskette: EOF from the Card Reader.
- Line to Diskette (BSC): Block ended with ETX. 'Ignore ETX/EOT' should be specified by a CODE key function if it is desired that all data received from the line be written as a single data set. In this mode, the ETX/EOT causes the data set to be closed, but it is reopened if additional data is received from the line.
- Line to Diskette (SDLC): When an EDS FM header is recieved.

  Note: Closing a data set requires that the disk head seek to track 0 on the diskette, thereby affecting throughput based on the number of tracks to be crossed.

- Stop Job is signaled by the operator or the job aborts.

Data received from the line for writing on a diskette that already has data ready for transmission to the CPU is flagged in the Data Set Label as "inactive". This prevents the data set from being transmitted or included in any intervening job until the operator changes its status to active. The operator may also change the status of any data set to inactive, thereby excluding it from any transmit job. Whenever the diskette is selected by the line, the 'Delete after Transmit' option is reset by the terminal.

As stated before, up to 18 data sets with different names can be accommodated on the diskette. Each different data set name requires one of the 18 sectors reserved on track 00 for a label for that data set. Anytime a data set is closed, another data set created, and a *previous* data set reopened, an additional data set label sector (one of the 18) is used. Thus it is possible that, using only two data set names and by alternately closing and reopening these two data sets, all 18 data set label sectors can be used up. When the last sector is used, only the last opened data set is available for further entry. On machines having a second diskette device, data sets so written can be copied from diskette 1 to diskette 2, and all segments of the data set will be written continuously using one data set label. So, to ensure maximum utilization of diskette storage capacity, the foregoing must be taken into consideration when designing applications and job setups for the terminal.

After a data set received from the line is closed as a result of a block ended with ETX ("ignore ETX/EOT" inactive), another data set received from the line will cause the numeric portion of the data set name to be incremented (for example, AA00 becomes AA01).

When a diskette fills from the line, and the data set is continued on a second diskette (multivolume data set), a data set is opened on the second diskette using the same name as the one that filled the first volume (the name is not incremented), providing that the same name does not already exist on the second volume. If the same data set name already exists on the second diskette, the numeric portion of the data set name is incremented unless "ignore ETX/EOT" is active. If "ignore ETX/EOT" is active, the data set name is never incremented, and data on the second volume will be linked to any existing data set with the same name. Therefore, the operator must be cautious and fully aware of diskette contents in order that multiple volume data set integrity be maintained. On SDLC exchange diskettes, data sets are created only from the line (Refer to Chapter 8 - Outbound Diskette Data). These data sets may not be segmented. Also, since the OJDR dataset is not present, there are 19 available data set labels.

Diskette Create Function

New diskettes, or diskettes that have been used previously on other machines (IBM 3741 or 3742, for example), must be prepared for use on the 3776/3777 by performing the Diskette Create function before they can be *written* on. Diskettes previously written on other machines in exchange format can be read on the 3776/3777, however, without performing the Diskette Create function (except for SDLC exchange). This function is under control of the keyboard CODE key. This procedure writes the Volume Label and Data Set Labels on track 00 of the diskette, as shown in Appendix E. Any data previously written on the diskette, including forms definition, cannot be accessed again.

Exchange Format

Exchange format refers primarily to the sequence in which records are written on the diskette. In order to improve throughput on the 3770, and to allow segmenting of data sets, this format is not used when writing a diskette in non-exchange format. For compatibility with non-3770 systems or devices, the 3770 can write and read diskettes using this format; however, throughput is reduced when data is transmitted from diskettes so written, as shown in Appendix D.

If a diskette is to be written in exchange format, it must be so specified during the Diskette Create procedure. Data transmitted from diskettes written in BSC exchange format by the 3770 is transmitted in 256-byte blocks (two 128-byte records per block), or in 512-byte blocks (four 128-byte records per block). The block length transmitted by the 3770 from a non-3770-created diskette or from a 3776/3777 created SDLC exchange diskette is the same as the block length defined in the Data Set Label for the data set (1 to 128 characters).

Exchange diskettes written on a non-3770 IBM product can be read for transmission, but cannot be written on by the 3770 in BSC mode without first performing the Diskette Create function. In SDLC mode, exchange data sets from the line may be written on these diskettes. Data previously written on the diskette cannot be accessed after this function is performed.

On machines with a second Diskette Storage Device (referred to as diskette 2), a 3770 diskette can be converted to a BSC exchange diskette by reading the 3770 diskette on diskette 1 and writing on diskette 2 in exchange format. Segmented data sets will be written as continuous data sets during this conversion. The diskette used in diskette 2 must have been previously prepared by the operator performing the Diskette Create function, with specification that the diskette be written in exchange format. Conversely, a diskette written in exchange format by the 3770 can be converted to a 3770 format diskette by reading the exchange diskette on diskette 1 and writing onto diskette 2 in non-exchange format. The diskette used in diskette 2 must have been previously prepared by use of the Diskette Create function, without specification that it be written in exchange format.

Exchange diskettes written on a non-3770 IBM product cannot be copied, nor can individual data sets. Non-3770 diskettes are read into the 3770 buffer one 128-byte sector at a time. When the buffer is written to the 3770 diskette, two or four sectors at a time are written; thus, the data set written onto the 3770 diskette would be doubled or quadrupled in size.

Diskette-to-Printer Operation

The AUTO switch is active only during a diskette-to-printer job. When the AUTO switch is on at the beginning of a job, the first diskette record prints and the machine stops. If desired, special instructions to the operator (such as type of forms to use for a job) can be placed in the first 256- or 512-byte diskette record for the data set. If the AUTO switch is turned on at the beginning of the job, only the first diskette record for the data set prints, and the machine halts to allow the operator to comply with the printed instructions before proceeding. When the AUTO switch is turned OFF, the remainder of the data set is printed without interruption if no unusual condition occurs. If the AUTO switch is OFF at the beginning of the job, the entire data set prints.

Diskettes

Diskettes used with the Diskette Storage Devices consist of a small flexible disk about 8 inches in diameter enclosed in a holder. Appendix F describes the diskettes used by the 3770, and describes diskette labeling and recommended handling procedures.

Automatic Card Reader-to-Line Function (2502 Only)

Whenever the 3776/3777-1 terminal enters standby mode (an online job has just ended), a reader-to-line job is automatically started if the 2502 is ready, or is made ready. No START-JOB function is required. If the RVI or RECV REQT is received during a transmit job, the terminal will interrupt that job and must receive data before restarting the transmit job. Automatically started card reader-to-line jobs are set up only for the compress and nontransparent data. If the operator desires to set up a noncompress or transparent reader-to-line job, this must be done with the normal job definition and start procedures. The 2502 must be made not-ready or the terminal must be in an offline mode at the time this job is started to prevent the 2502 from being automatically started. If the 2502 is involved in a dual job at the time standby mode is entered, the ready status of the 2502 is ignored. The dual job must be stopped before the card reader-to-line job can be automatically started.

Audible Alarm

This special feature provides a louder signal than the Operator Attention Speaker. The alarm can be enabled or disabled by the operator. When enabled, and during any job not using keyboard input, the alarm sounds for any device-error or not-ready condition.

Keylock

This special feature provides a key-operated switch which can be turned off to disable the terminal. Online communication is possible with the Keylock off, if the terminal is placed in a ready state before turning the Keylock off, but any operator controls are disabled.

Operator ID Reader

This is a device that reads magnetic stripe operator identification cards. The reader is mounted behind the hinged door on the left of the controller base (Figure 4-4).

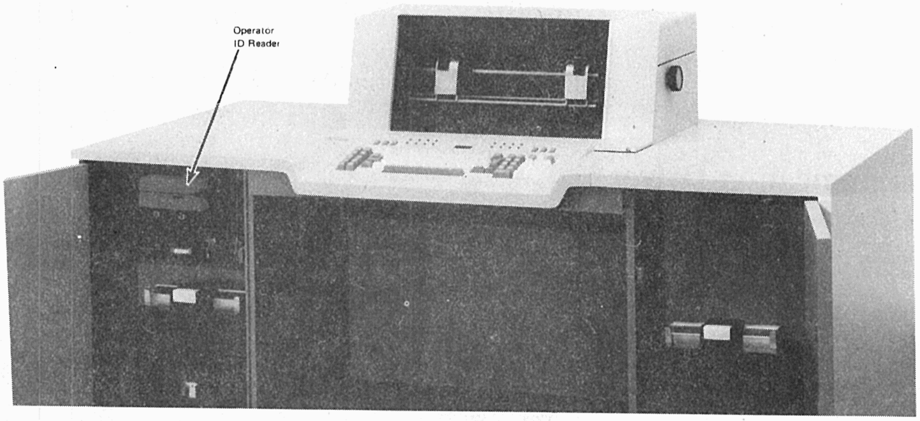


Figure 4-4. Operator ID Reader

The CPU can request user identification by sending a message to the printer. The operator must then initiate a SYS REQ operation. If data is keyed in, at least 41 positions must be left for ID card data. After data is keyed in, the operator activates the ID card reader using the code key function.

This function may be used only during the logon procedure. On BSC machines, when the badge is read, the buffer is sent to the CPU. On SDLC machines, further keying may be done following the badge data. If an operator ID card is read, however, no further use of the backspace buffer or print view keys will be permitted. The CPU must also provide checking and verification of received ID card data and take whatever action is necessary depending on the validity of the data. Data read from the ID card is not printed at the terminal.

Cards must be 3-7/8 by 2-1/8 inches, and between 0.007 and 0.045 inch thick. The magnetic stripe must be encoded in the American Banking Association format, which provides for up to 40 characters, 37 of which are discretionary. Card format and character sets are shown in Appendix B.

Katakana Feature

This specify feature provides a Katakana 127-character set on the 3776 console printer, and a Katakana keyboard. The character set is shown in Appendix B. Using this character set reduces printing speed to 80 lines per minute maximum on the 3776 Model 1, or 160 lines per minute maximum on the 3776 Model 2. The Katakana print belt can be interchanged with the optional 48- and 64-character set Japanese print belts on the 3776 Models 1 and 2 console line printer with a resulting increase in throughput.

When using a 48- or 64-character set print belt on a Katakana printer, the 3776 converts the EBCDIC equivalent of the lowercase alphabetic characters (a through z) to uppercase alphabetic characters before printing them. For example: EBCDIC hexadecimal '81' converts to hexadecimal 'C1'.

If characters in print data are not present on the line printer belt, a hyphen(-) prints.

Communication Driver

This special feature is required for communication with the CPU. In addition, one of the line control disciplines as described under "Communication Feature" must also be selected.

Communication Feature

This special feature provides the line control discipline, and is available in three versions: SDLC; BSC Point-to-Point; and SDLC/BSC Switch Control. The SDLC/BSC Switch Control version provides both types of line control, selectable by a switch on the terminal. If BSC multipoint operation is desired, the BSC Multipoint feature must also be installed in conjunction with the BSC Point-to-Point or SDLC/BSC Switch Control Communication feature. SDLC can operate either point-to-point or multipoint.

BSC Multipoint

This feature, installed in conjunction with the BSC Point-to-Point or SDLC/BSC Switch Control Communication feature, permits the 3770 terminal to be multi-dropped on the same non-switched communications facility with other appropriately featured 3770 terminals or with other compatible BSC terminals. With this feature, the terminal responds only to its specific address when polled or selected by the CPU.

Integrated Modems (3776 Only)

Integrated modems (special features) are incorporated in the controller, eliminating the need for an EIA/CCITT Interface feature. Connection to common-carrier switched lines using these modems is via a common-carrier-supplied Data Access Arrangement. These 2400 bps Integrated Modems are compatible with appropriately featured integrated modems available for the IBM 3704 and 3705 Communications Controllers, and with an appropriately featured IBM 3872 Modem attached to the 3704 or 3705. The 4800 bps Integrated Modems are compatible with appropriately featured IBM 3874 Modems attached to a 3704 or 3705.

Note: A 2400 bps (or 4800 bps) Integrated Modem operating at half-speed is not compatible with an integrated or external modem with a rated speed of 1200 bps (or 2400 bps).

2400 BPS Integrated Modem, Switched Network (U. S. and Canada)

This modem operates at 2400 bps over a switched network, and provides half-speed (1200 bps) capability. This modem supplies clocking for received and transmitted data, and can automatically answer and disconnect incoming calls in unattended operation.

2400 BPS Integrated Modem, Point-to-Point

This modem operates at 2400 bps over half-duplex or duplex leased private line or privately-owned facilities. The modem supplies the clocking for received and transmitted data, and can alternately operate at half speed (1200 bps).

The Auxiliary Operator's Panel has a signal quality meter to check the quality of the received signal, and a control to equalize the received signal.

2400 BPS Integrated Modem, Multipoint Tributary

This modem operates at 2400 bps on a duplex multipoint network. The modem supplies the clocking for received and transmitted data, and can alternately operate at half speed (1200 bps).

With this modem, a meter is provided on the Auxiliary Operator's Panel to check the quality of the received signal, and controls are provided to equalize the transmit and receive signals (see Figure 4-6).

2400 BPS Integrated Modem, Switched Caducee Network (France)

This modem operates at 2400 bps over the French PTT Caducee Network, and provides half-speed capability. The modem supplies clocking for received and transmitted data, and can automatically answer incoming calls. A TALK/DATA switch is provided on the Auxiliary Operator's Panel to allow alternate voice/data communications.

4800 BPS Integrated Modem, Switched Network

This modem operates at 4800 bps over a switched network, and provides half-speed (2400 bps) capability. This modem supplies clocking for received and transmitted data, and can automatically answer and disconnect incoming calls in unattended operation.

4800 BPS Integrated Modem, Point-to-Point

This modem operates at 4800 bps over half-duplex or duplex leased private lines or privately-owned facilities. The modem supplies clocking for received and transmitted data, and can alternately operate at half speed (2400 bps).

4800 BPS Integrated Modem, Multipoint Tributary

This modem operates at 4800 bps on a duplex multipoint network. The modem supplies the clocking for received and transmitted data, and can alternately operate at half-speed (2400 bps).

EIA/CCITT Interface

This special feature is used to connect the terminal to common-carrier-supplied or user supplied Data Communication Equipment (DCE), to digital communication services, or to IBM standalone modems, operating over a switched or non-switched communication facility. It is required on terminals connected to the host terminal containing the Modem Fan Out feature (Figure 4-5).

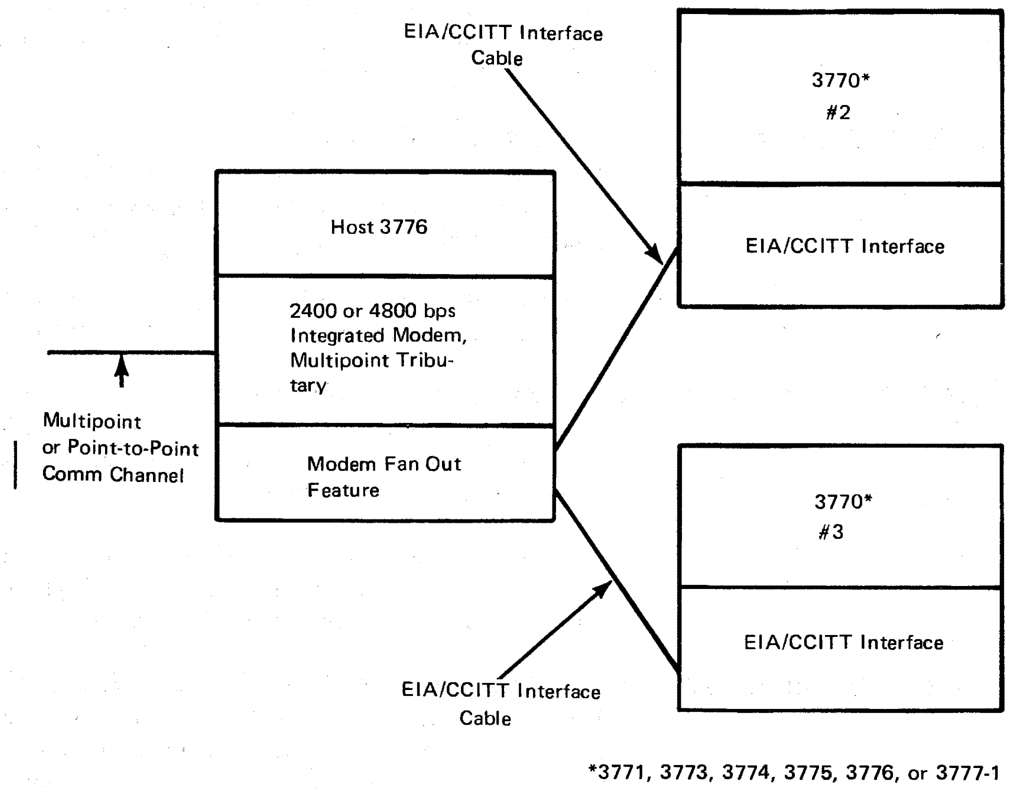


Figure 4-5. Modem Fan Out Configuration

This special feature provides an interface (and a cable for attachment to the DCE) which is compatible with the characteristics and specifications of EIA Standard RS-232C in U.S. and Canada (maximum line speed–19.2 kbps), or CCITT Recommendation V.24 (maximum line speed–9600 bps) or V.35 (ISO/IS 2593; maximum line speed–20.4 kbps) in World Trade countries. The circuits utilized by the 3770 are described in Chapter 1.

High-Speed Digital Interface (3777 Only)

This special feature on the 3777 Model 1 is used to connect the terminal to common-carrier-supplied or user-supplied Data Communication Equipment (DCE), or to IBM stand-alone modems. The High-Speed Digital Interface feature permits point-to-point synchronous operation at 19.2 kilobits per second (20.4 kbps in World Trade countries) on a wideband communication channel. This special feature provides an interface and a cable for attachment to the DCE.

Modem Fan Out (3776 Only)

This special feature can be used with the 2400 bps or 4800 bps Integrated Modem (Multipoint Tributary) connected to a network configuration for multipoint operation. With this feature, up to three terminals can share a single modem located in the host 3776. Terminals connected to the host terminal (Figure 4-5) must have the EIA/CCITT Interface feature.

Switched Network Backup (U. S. and Canada) (3776 Only)

This special feature can be used with the 2400 bps or 4800 bps Integrated Modem (Point-to-Point or Multipoint Tributary) and allows alternate use of switched network facilities as backup communication lines. Switched-network operation must be specified while in local mode. When the modem is connected to a switched network, calls must be dialed and answered manually. The same line control (non-switched point-to-point or multipoint) is used when operating on a switched network.

Door Keylock

This special feature adds a keylock to the right- or left-hand controller cabinet door. Two keys are provided with each lock.

ASCII

The ASCII special feature is available for use in the U.S. and Canada. Differences between EBCDIC-coded and ASCII-coded machines are described in Appendix G.

Additional Print Belts (3776 Only)

Additional print belts (purchase-only accessories) are available for the 3776 console printer. Belts are available for the 48-, 64-, and 94-character sets for various countries, as shown in Appendix B. Print belts are not interchangeable between the 3776 Model 1 and Model 2. ASCII character set belts are also available for use in the U.S. and Canada.

Additional Print Trains (3777 Only)

See Chapter 6.

Front Feed (3776 Only)

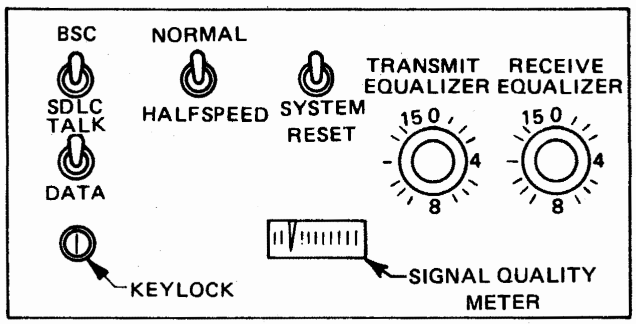
This special feature simplifies forms changes and reduces the operator set-up time required to renew the forms supply or to change the forms type. With the Front (forms) Feed Feature installed, the paper supply may be set on the floor directly under the keyboard to extend the height of the supply stack. Forms may be alternately loaded from the rear of the 3776 models. The forms stand/stacker enclosure at the rear remains a standard feature of the 3776 models with or without the Front Feed Feature.

Operating Controls (3776/3777 Model 1)

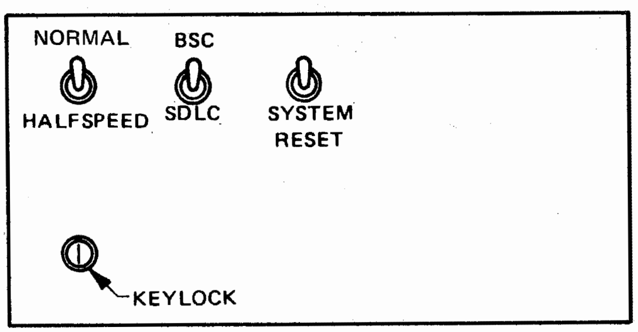
POWER ON/OFF Switch: This switch is located on the left side of the knee hole on the controller housing. It controls ac power to the terminal. When power is turned on, the bring-up diagnostics run and the terminal is left in local mode with the PROCEED indicator on. Any other indicator being on signals either a failure in the terminal's electronic components, that one of the MODE switches is on, or that the Keylock is off. The operator should proceed as described in the *Operating Procedures Guide.* If the tests complete successfully, the operator can continue with terminal operation.

Auxiliary Operator's Panel

The auxiliary operator's panel (Figure 4-6) is located behind the door on the controller base. It contains the SYSTEM RESET switch and certain special-feature controls, as follows.



IBM 3776



IBM 3777-1

Figure 4-6. Auxiliary Operator's Panel

BSC/SDLC Switch: This switch is present on machines using the SDLC/BSC Switch Control Communication feature. The switch must be placed in the BSC position to communicate using BSC procedures (see Chapter 7), or in the SDLC position to communicate using SDLC procedures (see Chapter 8).

NORMAL/HALF-SPEED Switch: This switch is present on machines using the 2400 bps or 4800 bps Integrated Moderm, and is present on all World Trade machines using the CCITT V.24 Interface feature. On the 3777-1, it is located to the left of the BSC/SDLC switch. Using an Integrated Modem, transmission is at the modems rated speed with the switch in the NORMAL position, or at half the rated speed with the switch in the HALF-SPEED position. On World Trade machines using either an Integrated Modem or an external DCE, line speed with the switch in the NORMAL position is at the DCE's maximum rated speed. With the switch in the HALF-SPEED position, line speed is half of the DCE's maximum rated speed, if the DCE used has this capability.

TALK/DATA Switch (3776 Only): This switch is present only on machines using the 2400 bps Integrated Modem, Switched Caducee Network (France). It must be set to TALK for voice communication, or to DATA for data communication.

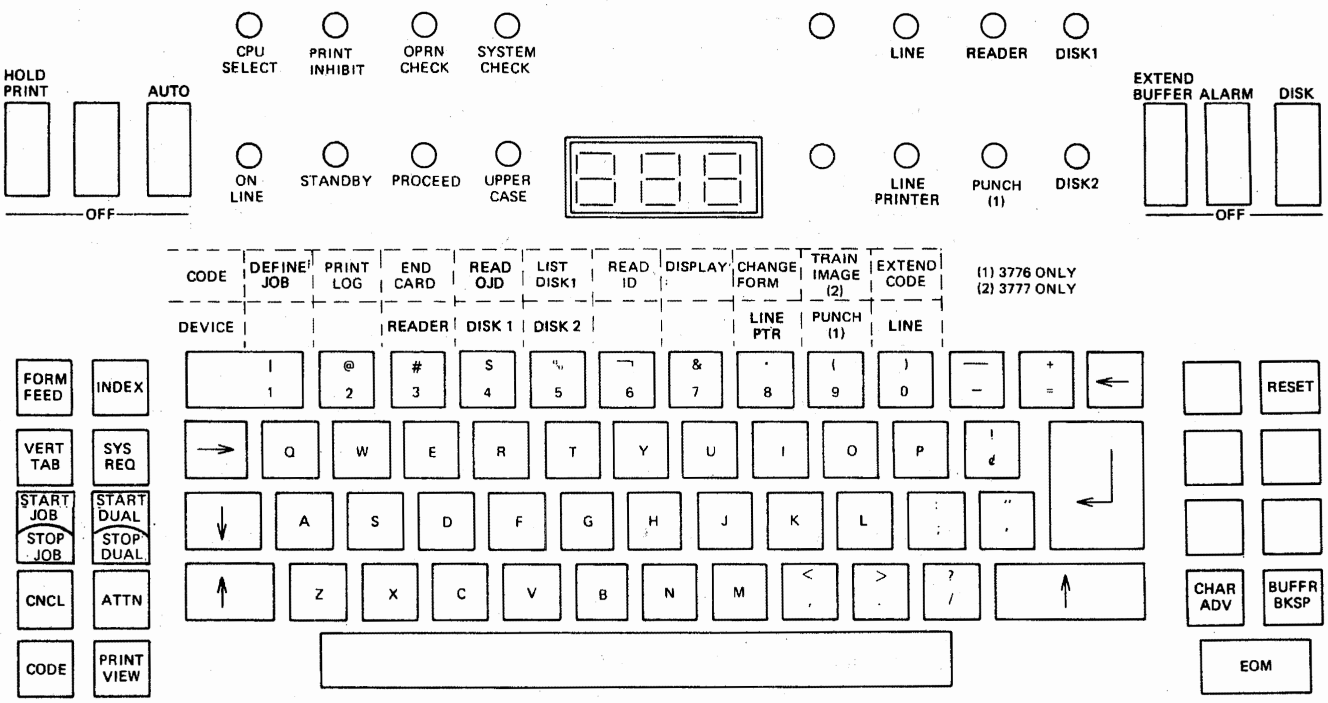
Keylock: This is the key-operated switch for the Keylock special feature.

Signal Quality Meter (3776 Only): This meter is present on machines using the 2400 bps Integrated Modem, Point-to-Point or Multipoint Tributary (see "Features and Accessories—Integrated Modems").

Transmit and Receive Equalizer Controls (3776 Only): These rotary controls are present on machines using the 2400 bps Integrated Modem, The Receive Equalizer control alone is present on machines using the 2400 bps Integrated Modem, Point-to-Point (see "Features and Accessories—Integrated Modems").

SYSTEM RESET Switch: This switch causes the terminal to interrupt any operation in progress and leaves the terminal in the same power-on state as described under "POWER ON/OFF Switch."

Keyboard Switches, Keys, and Lights (Figure 4-7)



This figure shows the EBCDIC keyboard arrangement for use in the U.S. and Canada.

Figure 4-7. 3776/3777 Model 1 Keyboard

Switches

HOLD PRINT: Turning this switch on suspends printing so that forms may be inserted or adjusted. When the switch is turned off, printing resumes.

AUTO: Turning the AUTO switch on at the beginning of a job causes printing to halt after the first record of the data set is printed. See "Diskette-to-Printer Operation"

EXTEND BUFFER: Turning this switch on selects the dual 512-byte alternating buffers. With the switch off, the dual 256-byte alternating buffers are selected. Changing the switch setting has an effect only at power on or system reset time.

ALARM: Turning this switch on enables the Audible Alarm, if installed.

DISK: This switch forces all data received from the CPU to be written on an attached Diskette Storage Device regardless of any other component selection (except the console printer) received from the CPU. In SDLC mode, data received without an FM header must go to the printer. If the machine is jumpered for ASCII and the Bind is for EBCDIC, the DISK switch is ignored.

Keys

FORM FEED: This key causes the forms to advance to the first printing line on the next form, and stores an FF character in the controller buffer.

INDEX: This key causes the forms to feed one line, and stores an LF character in the buffer. The next character entered will print in the next sequential print position.

VERT TAB: This key causes the printer forms to advance to the next predefined vertical tab stop, and stores a VT character in the buffer. If no vertical tab stops are defined, pressing this key causes a printer line feed.

SYS REQ (System Request): This key can be used to initiate a logon or logoff message if the terminal is in local mode. If the STANDBY light is on, a keyed message may be entered without first pressing this key. Refer to "Operating Characteristics–Keyboard" earlier in this chapter.

START/STOP JOB: Pressing this key starts an online or offline job. With dual data path operation, the key is used to start the online job or Job 1 (see "Operating Characteristics (3776/3777-1)–Controller" in this chapter). Pressing CODE in conjunction with this key stops the job.

START/STOP DUAL: Pressing this key starts the offline job (Job 2). (See "Operating Characteristics (3776/3777-1)–Controller" in this chapter). Pressing CODE in conjunction with this key stops the job.

CNCL (Cancel): This key aborts a SYS REQ message operation, or deletes a message that is awaiting transmission.

When running an SDLC online job, the CNCL key operates as follows:

- When receiving, the terminal transmits a negative response to the CPU that requests a break in the data flow to the 3776/3777-1.
- When transmitting, the terminal clears the contents of the buffer and transmits a Cancel request to the CPU if needed.

ATTN (Attention): For SDLC machines, this key causes transmission of an expedited Signal command to the CPU. The Signal request unit contains a Request-to-Send code to stop the CPU from sending so that the 3776/3777-1 can begin sending to the CPU. The application program in the CPU may or may not honor the Request to Send. (See the chart on "SNA Network Commands" in Chapter 8 – "Programming Considerations – SNA/SDLC Communications".)

For BSC machines , pressing the ATTN key during a receive job, line-to-printer, line-to-punch (3776 only) , or line-to-diskette job, causes an interrupt to be sent to the host CPU in one of the following ways depending on a system card jumper:

1. No jumper. With no jumper installed, pressing the ATTN key causes the 3780 Carriage Stop function to be emulated. WACK will be sent at the first opportunity; either in response to a data block being received or in response to the next data block received. WACK will be sent continuously (in response to ENQ) until both buffers are emptied by the output device and for approximately 10 seconds thereafter. At this point, EOT is sent and the terminal goes to

standby mode allowing the operator to start a transmit job. If a selection is received prior to (1) the operator keying a System Request, (2) starting an online job, or (3) at the same time the 3776 is establishing a transmit job (ENQ received in response to ENQ sent), the selection (depending on device availability) is accepted.

2. Jumper. With a jumper installed, pressing the ATTN key causes an RVI to be transmitted in response to the next correctly-received data block. If the CPU honors the interrupt, the CPU must transmit EOT prior to transmitting any additional data. Once the receive job has ended, the terminal goes to standby mode and the operator may start a transmit job or enter a System Request message. If a selection is received prior to the operator starting a job or keying a System Request, the selection is accepted.

CODE, EXTEND CODE: These keys are used in conjunction with certain numeric or alphabetic keyboard keys to select functions such as:

- Define Job
- Change Form (Change current forms control)
- Print Error Log
- Communications Facilities Testing
- Stop Job or Dual
- End Card
- Display Modes of Operation and or I/O devices for jobs (in NPR)
- Create Diskette (Delete all data including forms control)
- Change Data Set Status (Active or Inactive or Multivolume)
- Write Jobs on Diskette
- Change Data Set Name or Status
- Read Job Control from Diskette or Cards
- List Diskette Data Sets
- Clear Diskette (Delete all data except forms control)
- Read Operator ID Card
- Load train image buffer (3777-1 only)
- Set or Reset Switched Network Backup (SNBU)
- Print All Characters to Test Print Belt
- Select 6 or 8 lines per inch for printing
- Set Manual or Auto Disconnect. This may be specified at any time. *Manual* may be specified to keep the line from disconnecting when the online job ends.
- Select Inquiry Mode Operation (see Chapter 7.)
- Set Ignore ETX/EOT. This may be set to cause all received data to be written as a continuous data set regardless of ETX/EOT received.
- Set Monocase. This causes the 26 lowercase alphabetic characters a through z to be converted to uppercase characters.
- Set unattended operation, SDLC
- Reset Inquiry Mode, Ignore ETX/EOT, Monocase, and for SDLC machines, unattended mode.

Keys used in conjunction with the CODE and EXTEND CODE keys to select these functions are described in the *Operating Procedures Guide.*

PRINT VIEW: This key is active during job definition, following a SYS REQ when the operator is keying a message that will be routed to the system, or when entering an OLT message. The data entered will be printed followed by a sufficient number of line feeds to make the printed data visible on the printer.

RESET: Pressing this key resets the Audible Alarm, cancels a START JOB or an extended code entry prior to keying EOM. It may also be used to restore the buffer pointer to the next available position when entering a SYS REQ message or defining horizontal tab stops. Pressing CODE and RESET resets the SYSTEM CHECK or OPRN

CHECK indicator, resets the NPR, and turns off the device indicator. On BSC machines, the RESET key may also be used to prevent a line abort when an operator recoverable error occurs. Refer to the *Operating Procedures Guide* for the 3776 or 3777-1.

CHAR ADV (Character Advance): This key can be used to advance the buffer pointer (without printing) after backspacing or when a SYS REQ message or horizontal forms definition has been entered into the controller buffer.

BUFFR BSKP (Buffer Backspace): Pressing this key causes the buffer pointer to back up one position (one character space). Data is not destroyed when backspaced over, and can be printed out or corrected.

EOM (End of Message): Pressing this key terminates a SYS REQ message operation. This key also terminates a start job, extended CODE key, or job definition procedure.

Lights

Device Indicators: An indicator is provided for each I/O device. The device indicators are used to indicate the active devices for the selected job, not-ready conditions, and device errors. Certain device errors cause the device to lose its ready condition, and its associated light turns on and the Operator Attention Speaker sounds to inform the operator that the device needs attention.

Numeric Position Readout (NPR): This is a three-digit numeric display that provides different indications depending on the operation being performed. Message code numbers providing operator guidance and indicating system status and error conditions are displayed in the NPR. These code numbers, in conjunction with other operator panel indicators being on, are related to operating procedures described in the *Operating Procedures Guide.*

ON LINE: For BSC, this light is on whenever the communication line is selected as an input or output and the data link connection has been established. The light blinks while data is being transmitted or received, and turns off when the data link connection is broken.

For SDLC, this light is on when the terminal is bound in a session with the CPU, and turns off when the session is terminated.

STANDBY: For BSC, this light turns on when a job involving the communication line is started. The light remains on until transmission begins, and then turns off. It is off until the job ends, and then turns on. Another online job can be started after the light turns on again. For SDLC, this light turns on when in communicate mode and there is not an active line job. The light remains on until a job involving the communication line starts, and then turns off; it remains off until the job ends. When the STANDBY light turns on again, another job can be started.

CPU SELECT: For BSC, this light indicates that the terminal has rejected a line bid, an MPLC polling sequence, or an MPLC selection sequence from the CPU because the terminal is not ready to operate in line mode. For SDLC, this light indicates that the terminal has rejected a BIND, or that SIGNAL has been received from the CPU.

OPRN CHECK (Operation Check): This light turns on and the Operator Attention Speaker sounds when the operator has performed an incorrect procedure, or when some I/O device needs attention. A device light will also be on if an I/O device needs attention. A message code number will be displayed in the NPR.

This number corresponds to an explanation or procedure, as described in the *Operating Procedures Guide.*

PRINT INHIBIT: For BSC, this indicator is not used. For SNA/SDLC, this light turns on when the Inhibit Print command is received from the CPU and the SYSTEM REQUEST function is initiated. This light turns off when the SYSTEM REQUEST function is terminated, either by EOM or CANCEL. Receiving the Enable Print command from the CPU takes the terminal out of this mode of operation.

SYSTEM CHECK: This light turns on and the Operator Attention Speaker sounds when certain machine errors occur. A message code number will be displayed in the NPR indicating the cause of the error. If an I/O device caused the error, the appropriate device indicator turns on and the job is aborted.

PROCEED: Data entry from the keyboard is permitted when this light is on. This light is on all the time except when the keylock is turned off or the terminal is processing Operator ID Reader information.

UPPER CASE: This light turns on when the keyboard is in uppercase shift (Upper Shift key has been pressed).

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Machine Type	Description (Basic Machine)	Specify Features	Other Attachable I/O Media	Special Features
3773 Model P1 Model P2 Model P3	Keyboard Printer (94-Character Set) –40 cps Bidirectional Printer –80 cps Bidirectional Printer –120 cps Bidirectional Printer 4800 bps Max. Line Speed Dual 256-Byte Transmission Buffers Automatic Answering Terminal ID Operator Attention Speaker Diskette Storage (One Device) 4K User Storage	Language Group Color Remote Power Off Keyboard Arrangmt.	None	1200 BPS Integrated Modem EIA/CCITT Interface Forms Stand* Keylock Variable Width Forms Tractor Operator ID Reader Door Keylock Audible Alarm Communication Driver Communication Feature SDLC BSC BSC/SDLC Switch Control BSC Multipoint 4K or 8K Additional User Storage Keypad ASCII
3774 Model P1 Model P2	Keyboard Printer (94-Character Set) –80 cps Bidirectional Printer –120 cps Bidirectional Printer 4800 bps Max. Line Speed Dual 256-Byte Transmission Buffers CPU Interrupt Address Stop (Program Debug Facility) Automatic Answering Terminal ID Operator Attention Speaker Diskette Storage (One Device with nonremovable Diskette) 6K User Storage Programmable BSC Communications	Language Group Color Remote Power Off Keyboard Arrngmt.	Diskette Storage (2 Additional Devices) 2502 Card Reader** (150 or 300 cpm) 3501 Card Reader (50 cpm) 3521 Card Punch (50 cpm)** 480-Character Display 3784 Line Printer ** Attach via 3782 Card Attachment Unit. One card reader can be attached (2502 or 3501). The 3521 Card Punch can optionally be equipped with the Card Read and Card Print special features.	1200 BPS Integrated Modem 2400 BPS Integrated Modem Switched Network Backup Modem Fan Out EIA/CCITT Interface Forms Stand* Keylock Variable Width Forms Tractor Operator ID Reader Door Keylock Audible Alarm Communication Driver Communication Feature SDLC BSC SDLC/BSC Switch Control BSC Multipoint Keypad 4K, 8K, 12K, or 16K Additional User Storage ASCII
3775 Model P1	Keyboard Line Console Printer –80 or 120 lpm using 94- or 64-character set, resp. 4800 bps Max. Line Speed Dual 256-Byte Transmission Buffers CPU Interrupt Address Stop (Program Debug Facility) Automatic Answering Terminal ID Operator Attention Speaker Diskette Storage (One Device with nonremovable Diskette) 6K User Storage Variable Width Forms Tractor Programmable BSC Communications	Language Group Color Remote Power Off Keyboard Arrngmt. 64- or 94-character set	Diskette Storage (2 Additional Devices) 2502 Card Reader** (150 or 300 cpm) 3501 Card Reader (50 cpm) 3521 Card Punch (50 cpm)** 480-Character Display ** Attach via 3782 Card Attachment Unit. One card reader can be attached (2501 or 3501). The 3521 Card Punch can optionally be equipped with the Card Read and Card Print special features.	1200 bps Integrated Modem 2400 bps Integrated Modem Switched Network Backup Modem Fan Out EIA/CCITT Interface Forms Stand* Keylock Operator ID Reader Door Keylock Audible Alarm Communication Driver Communication Feature SDLC BSC SDLC/BSC Switch Control BSC Multipoint Keypad 4K, 8K, 12K, or 16K Additional User Storage ASCII Additional Print Belt* Dual Independent Forms Feed

*Purchase-Only Accessories

Figure 5-1. 3770 Programmable Terminals Summary

Chapter 5. 3770 Programmable Terminals

A summary of the programmable terminals, attachable input and output devices, and special features available for these terminals is shown in Figure 5-1. The 3773, 3774, and 3775 programmable terminals are similar in appearance to the nonprogrammable models, but their function can be controlled by a user-written program.

Operating offline, the 3773 programmable models can perform source recording and document preparation with selected data directed to a user-removable diskette. During document preparation, the 3773 programmable (3773P) models permit:

- Validation of data as it is entered (range check, self-check, alpha/numeric check, length check)
- Logical and arithmetic operations (add, subtract, multiply, divide, compare)
- Storage to storage, table lookup, and storage compare operations
- Format and edit operations (picture, justify, fill, case)
- Direct access to data on Diskettes

Operating online, the 3773P models permit:

- Online operations, between the communication subsystem in the host and the keyboard (logon/logoff), diskette data sets, or console printer, that are controlled by the communicate mode function (BSC or SDLC)

The 3774 and 3775 programmable (3774P/3775P) models have all the capabilities of the 3773 programmable models, and in addition provide:

- Additional Diskette Storage Devices (special features) with removable diskettes for program and data storage
- Card reader and card punch attachments
- 3784 Line Printer Attachment to 3774 Models P1 and P2
- Dual Independent Forms Feed (special feature) for the 3775 Model P1
- Program debug facility at the terminal
- Additional user-program-controlled operator guidance and data display capability with the Display special feature
- Communications with the host CPU controlled by a user-written application program in the terminal (Programmable Communications BSC only)
- Additional online operations, between the communication subsystem in the host and the optional card reader, card punch, or 3784 printer (3774P only), that are controlled by the communicate mode function (BSC only)
- Keyboard operations in a user-written program can overlap other processing to provide a performance improvement (not available on terminals with the ASCII feature)

Components

Controller

The controller processes the user-written 3770 program and provides the ability to communicate with the host CPU. The controller contains:

- Control storage for the support of features, functions, and attached I/O devices
- User storage to contain the user-written 3770 program
- Diskette storage for 3770 programs, application data, and transaction data

Figure 5-2 shows the user storage available on the 3773, 3774, and 3775 programmable models. The basic 3773P provides 4K bytes of storage to contain the 3770 programs and for use as buffers (K = 1,024). An additional 4K or 8K byte increment of storage is available as a special feature that can increase the total storage capacity to either 8K or 12K. The basic 3774P and 3775P provide 6K bytes of storage with one additional 4K-, 8K-, 12K-, or 16K-byte increment available as a special feature, for a total of 10K, 14K, 18K, or 22K bytes. The first 0.75K bytes of storage after the 3770 program are always allocated for three 256-byte buffers, with an additional 256-bytes that can be allocated by the 3770 Set Configuration Utility for the optional format image buffer (FIB). See the description under "Program Resources" later in this chapter. An additional 3K bytes of user storage can be allocated by the 3774P/3775P Set Configuration Utility for the Supervisor Control Program Residency option. Once allocated, this storage (and the FIB buffer) cannot be used for other functions until it is deallocated by the 3774P/3775P operator rerunning the Set Configuration Utility.

User storage can be allocated via the 3770 program for use as working storage or diskette buffers. Storage is also allocated for use by certain features and attachments, if their use is called for in the 3770 program beginning statement (see "Program Definition Statements" in this chapter). Storage is allocated as follows if the selected 3770 program defines storage usage, or calls for use of one or more of the following features or attachments:

- Working storage "X"K bytes, as specified (K = 1,024)
- Relative data set buffers "X"K bytes, as specified

On the 3774P or 3775P only, the following storage can also be allocated by the user-written 3770 program:

• Display feature	2.0K bytes
• Display feature/Katakana	2.5K bytes
• 2502	2.5K bytes
• 3501	1.75K bytes
• 3521	3.0K bytes
• Programmable Communications	2.0K bytes

The remaining user storage is available to contain the 3770 program.

	Standard	Special Feature
3773P User Storage	4K	4K or 8K

	Standard	Special Feature
3774P/3775P User Storage	6K	4K, 8K, 12K, or 16K

Figure 5-2. 3770 User Storage (Part 1 of 2)

					3774P or 3775P Only						
	"X"K	.75K	"X"K	"X"K	2.5K	1.75K	3.0K	2.0K	.25K	2.0K	3.0K
Allocation	3770 Program (1)	BUFFERS	STORAGE (1)	Relative Data Set Buffers (1)	2502 (2)	3501 (2)	3521 (2)	Display (3, 4)	Format Image Buffer (5)	Programmable Communications (2)	Resident Supervisor Control Program (5)

1. Allocated by user; program/application dependent.
2. Allocated when a 3770 program is selected that specifies use of this function or attachment.
3. Allocated as specified in 2, or when the 3774P/3775P DISPLAY switch is turned on.
4. Requires additional 0.5K storage if Katakana.
5. Allocated by the 3770 operator using the Set Configuration utility.

Figure 5-2. 3770 User Storage (Part 2 of 2)

Diskette Storage

A single Diskette Storage Device is standard on the 3773P, 3774P, and 3775P, and is used to contain the 3770 programs, application data sets, and the transaction data set. On the 3773P, the diskette can be removed from the diskette device; each diskette can store about 237K bytes of data on 73 tracks (K = 1,024), with thirteen 256-byte records/track, or 26 records/track of 128 bytes or less per record. On the 3774P and 3775P, the diskette cannot be removed from the diskette device. This device (referred to as device 0) can store 97.5K bytes of user-data and programs in 30 tracks, with thirteen 256-byte records/track, or 26 records/track of 128 bytes or less per record. Two additional devices (special features) are available on the 3774P or 3775P, with diskettes that can be removed by the operator. These devices are referred to as device 1 and device 2 and occupy the same physical location in the machine as those available on the nonprogrammable 3774 and 3775 models. Each removable diskette can store about 237K bytes in 73 tracks, with thirteen 256-byte records/track, or 26 records/track of 128 bytes or less per record. These devices can be used for additional 3770 program storage, and for application and transaction data sets.

Data Set Types

The programmable 3770 models can read or write on three types of data sets—exchange (space) with blocksize 1 to 128, 'E' (blocksize = 256), or 'T' (blocksize = 256). Any of these data set types can be used to read or write on both exchange format and non-exchange 3770 format diskettes. However, the programmable 3770 models cannot create the 'T' type data set but can read this data set type or modify individual records (keyboard-to-diskette function). For more information on data set usage on the programmable 3770 models, see "Programming and Data Sets" earlier in this chapter. For more information on compatibility, refer to "Appendix E—Data Formats."

Exchange Format

Exchange format (BSC) diskettes refer primarily to the sequence in which records are written on the diskette. To improve throughput on the 3770 terminals, this format is not used when writing a 3770 diskette in nonexchange format. For compatibility with non-3770 IBM products, the programmable 3770 models can read and write diskettes using the exchange format. For more performance information, refer to "Appendix D—Throughput."

All of the system utilities, host support and application support functions performed by the programmable 3770 terminals can read and write on an exchange format diskette. If a diskette is to be written in exchange format, it must be specified as such during the diskette Create function. Data sets can be created as basic exchange data sets by specifying the proper characteristics during the Data Set Create function (provided by the Data Set Support Utility or through message headers). For more information on the exchange format, refer to "Appendix E–Data Formats."

Diskette and Data Set Copying Considerations (3774P/3775P Only)

Exchange format diskettes cannot be copied onto a 3770 nonexchange diskette on programmable 3770 models. However, data sets on an exchange format diskette can be copied onto a data set created on a 3770 nonexchange diskette.

Printers

The printers used on these terminals are the same printers used on the nonprogrammable versions of these terminals described in Chapters 2 and 3 of this publication. The 3773P and 3774P use the serial wire-matrix console printer, and provide output at the following speeds during continuous printing:

3773 Model P1	40 characters per second (average)
3773 Model P2, 3774 Model P1	80 characters per second (maximum)
3773 Model P3, 3774 Model P2	120 characters per second (maximum)

The 3774 Models P1 and P2 (programmable terminals) can attach an IBM 3784 Line Printer as an additional I/O device. The 3784 printer is mechanically similar to the console line printer on the 3775 Model P1. Refer to Chapter 6 in this manual for more information about the 3784 printer.

The 3775 Model P1 (Programmable terminal) uses the console line printer and provides output at 80 lines per minute maximum using the 94-character set, or at 120 lines per minute maximum using the 64-character set.

Margins and horizontal and vertical tab stops are not set by the operator, as on the nonprogrammable terminals. Forms control and printing format may be set by the host CPU or placed under control of the user-written 3770 program, thus relieving the terminal operator of this task. The operator can select horizontal and vertical formats for the console printer from the format image buffer.

The user-written 3770P program can control the setting of line spacing on the console printer to 6 or 8 lines per inch (see "Set Configuration" under "Supervisor Program Operations" in this chapter). Operator controls on the 3784 line printer provide for setting 6 or 8 lines per inch spacing.

The same forms design considerations and restrictions described in Chapters 2 and 3, and in the publication *Forms Design Reference Guide for Printers*, GA24-3488, also apply to these printers.

Keyboard

Graphic keys provided on the 3773, 3774, and 3775 programmable terminals are identical to those of the nonprogrammable terminals described in Chapters 2 and 3. Control keys, switches, and indicators are different, however, since many of the operating functions are placed under control of the 3770 program. The EBCDIC keyboard for use in the U.S. and Canada is shown in Figure 5-5. World Trade keyboard characters are shown in Appendix B.

Nomenclature on keyboard control keys, lights, and switches is supplied in the following languages:

English	French	German
Italian	Japanese	Spanish

Programming and Data Sets

Program Creation

Operation of the 3770 is controlled by a user-written program that is executed by the 3770 controller. The program is written, using a subset of 3790 programming statements plus additional 3770 programming statements, to control input and output, perform arithmetic and logical functions, control sequence of execution, and build diskette data sets for transmission to the CPU. This source code is processed by the System/370 assembler using an IBM-supplied macro instruction library. The output produced by the assembler is validated and formatted using System/370 Program Validation Services (PVS) and transmitted by the host application program to the 3770 diskette from where it can be selected by the operator for execution. A user-written application program can be written to create and maintain a library of 3770 programs at the CPU, if desired. These 3770 programs can then be transmitted from this library to 3770 systems using a user-written application program. 3770 programs can also be punched into cards, either at the CPU or by a remote terminal, and these programs loaded onto a 3774P or 3775P diskette from an attached card reader.

For EBCDIC—coded machines using BSC, 3770 programs can be transmitted to the terminal in BSC transparent mode. For ASCII—coded BSC machines, and for EBCDIC coded machines if BSC transparent operation is not available, a user-written host CPU program must be used to convert each 8-bit byte of the 3770 program into two 8-bit bytes for transmission to the terminal. After the 3770 program is processed by System/370 PVS, the user-written host CPU program must perform the conversion shown in Figure 5-3 before the 3770 programs can be transmitted over an ASCII line or over an EBCDIC line if transparency is not available. The 3770 automatically converts the received data back to an 8-bit byte EBCDIC representation (on both EBCDIC and ASCII machines) and writes the programs on the diskette.

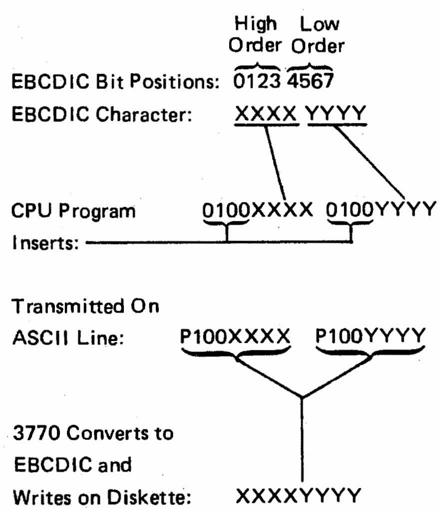


Figure 5-3. Preparing Programs for Transmission Using ASCII Line Control

Program Resources

Figure 5-4 shows the general data flow from the source to the controller to the primary output device (printer, or display on the 3774P or 3775P). The following resources are available to the 3770 programmer:

Buffers: Three 256-byte buffers provide working storage and data areas for application data set access.

Format Image Buffer: A 256-byte buffer holds up to seven horizontal/vertical formats for the 3774P/3775P console printer. The formats can be selected for use by the operator or the supervisor program. A supervisor program instruction loads the formats into the buffer. If the formats are not defined, the tab settings are forced to the system default which is all horizontal tabs and no vertical tabs.

Storage: Working storage can be specified by a programming statement. Working storage will include (overlay) the three 256-byte buffers.

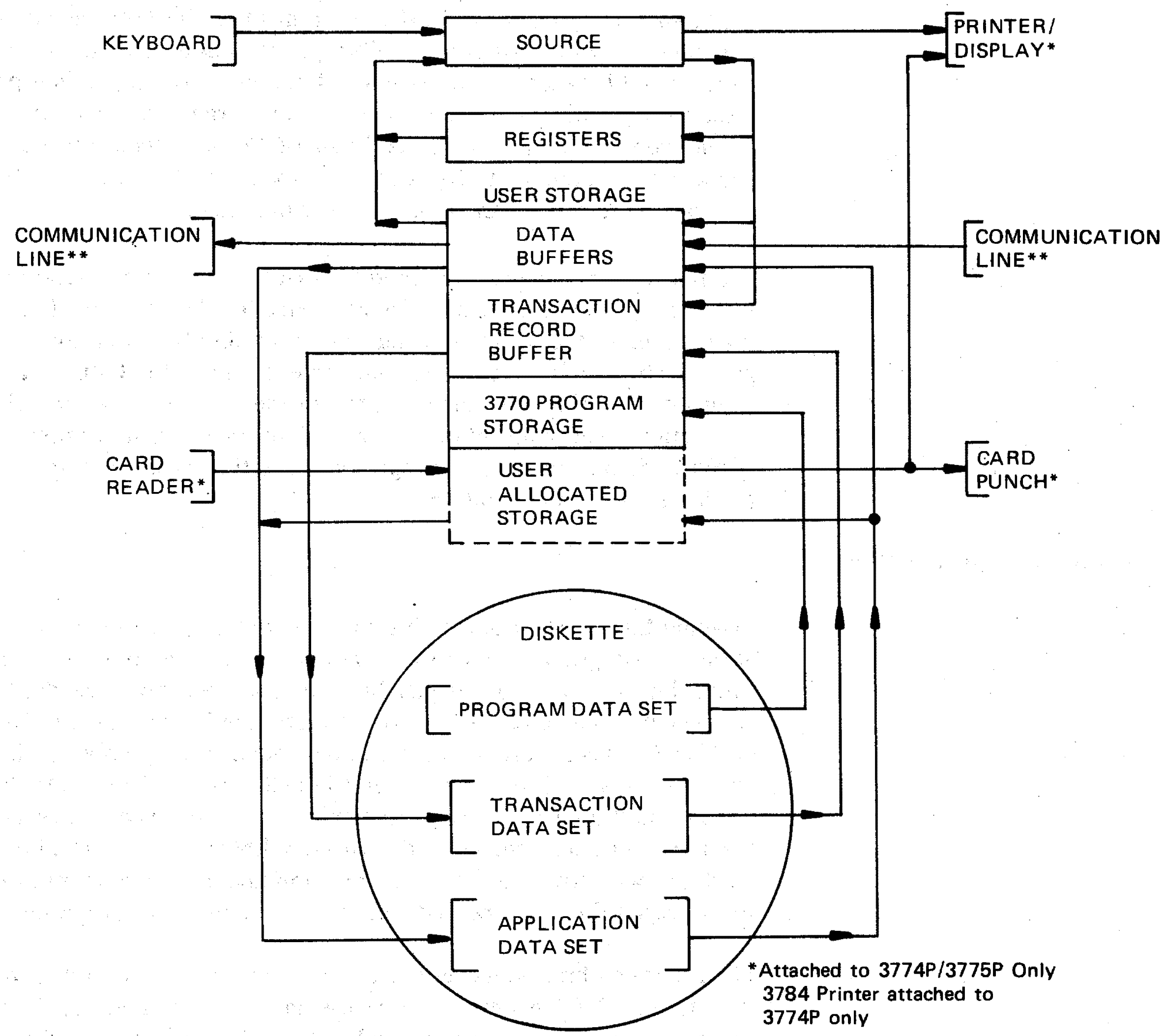
Registers: Eight registers consisting of ten decimal digits plus a sign and decimal point provide storage for numeric data. They are used for arithmetic operations and to transfer information.

Source Buffer: A 200-byte source buffer is used for keyboard entry, output to the printer (or Display on the 3774P and 3775P), and for transfer to or from registers and buffers. Data in the source buffer can be compared, checked, and edited before output.

Logical Indicators: Thirty-two logical indicators can be turned on or off and tested by the 3770 programmer.

Condition Codes: A one-byte (eight bit) condition code is set by execution of certain programming statements, and can be tested by the program to determine the results of the operation.

System Indicators: Eight system indicators are turned on or off during 3770 program execution and can be tested by the program to determine system status.



*Attached to 3774P/3775P Only
3784 Printer attached to
3774P only

**Used as an I/O device for
Programmable Communications
(BSC only)

Figure 5-4. Program Resources

Data Sets

In addition to the resources just described, data sets, either system-named or user-named, are available for the program's use. System-named data sets can be generated for the 3770 program library, for transaction data, for data received from the CPU without a message header, and for the supervisor program. User-named data sets can be generated for storage, retrieval, and update of application-oriented data. A maximum of 18 data sets can be contained on a single diskette, and up to five data sets (excluding the program library and the transaction data set) can be open at any one time.

All data sets must be user-defined by a Data Set Create function that writes a Data Set Label and allocates diskette space for the data set. This function can be done either by the operator using a system utility function, by a supervisor program, or by specification in a message header from the CPU. Data sets can be transmitted to the CPU under control of the operator or a supervisor program instruction. The transmit options are: transparent or nontransparent, blocked or unblocked, and spanned or unspanned. See the description under "Communicate Mode" for more information.

System-Named Data Sets

Program Library Data Set: This data set contains the user-written 3770 programs. A program library can be created containing up to 99 programs under a single data set name (as long as diskette capacity is not exceeded). The data set can reside on any of the three Diskette Storage Devices on a fully-featured 3774P or 3775P. This program library can be loaded from the host CPU, or can be loaded from a card reader attached to the 3774P or 3775P. On the 3774P or 3775P, additional 3770 programs could also be received in a user-named data set, and these programs copied to the program library data set (limited to EBCDIC machines with transparent communication lines). The amount of diskette storage space required for programs depends on the number of programs and their length.

The program library data set must contain two records of index which are initialized by the 3770 system utilities as the data set is created (by the operator, a supervisior program, or a message header). This data set should never be erased (the index is lost) but must be deleted and recreated to re-initialize the index.

On an ASCII machine, this data set is maintained in an EBCDIC representation on the diskette (data and binary index).

Transaction Data Set: The transaction data set is generated during execution of the 3770 program, and includes all data generated during program execution that is to be transmitted to the CPU.

Data from the transaction data set can be recalled from the diskette for rerun mode operation. Keyboard entered data is included in the data to facilitate transaction record review and error correction using rerun and error correct modes. Rerun mode can also be used to print out a clean copy of a form on the console printer.

The transaction data set holds a maximum of 923 records and can be contained on any of the three diskettes on a fully-featured 3774P or 3775P. The data set requires three tracks to contain an index to the records, plus the number of tracks required to contain the records, and is limited to the storage space available on a single diskette. The transaction data set has a partitioned directory (or index) and cannot be packed, reconfigured, or erased (except with the special Erase Transaction Data Set system utility).

On an ASCII machine, this data set is maintained in an EBCDIC representation on the diskette (data and binary index).

Interrupt Data Set: A predefined diskette data set with a system-supplied data set name and a partitioned index is loaded with data from the line when one of the following conditions is met:

1. Data is received from the host CPU without device selection and the DISK switch is on.
2. Data is received with no device selection, or a device selection other than the console printer and no message header exists.

If the interrupt data set diskette fills up, a message code is displayed in the NPR to alert the operator, and the terminal transmits WACK responses to the host. The operator has three minutes to mount another diskette (Change Diskette) before the terminal stops the operation. The new diskette must already have the interrupt data set (SYS.INTR) created on it.

The first two records of this data set are allocated to the index. This index is initialized through the 3770 system utilities when the data set is created and will be lost if the data set is erased. The data set must be deleted and recreated to re-initialize the index.

On an ASCII machine, this data set is maintained in an EBCDIC representation on the diskette (data and binary index).

Data on the interrupt data set can be examined by a user-written 3770P program or supervisor program and printed or punched on any available output device. The data can be reformatted, if desired, before output by the 3770 user-written program. The data set index contains information to indicate what device selection the data was received for and if the data is transparent.

Supervisor Program Data Set: This is a data set created for job control programs as described under "Operating Characteristics—Supervisor Program Operations" in this chapter. The data set can be loaded by a 3770 program, from data received from the host CPU, or from the keyboard with the Data Set Update system utility. The data set can be contained on any diskette device.

User-Named Data Sets

Application data sets can be defined by the user for storage, retrieval, and update of application data. These data sets can be defined by information contained in a message header from the CPU, or can be defined at the terminal by the operator or by a supervisor program as defined under "Operating Characteristics—Supervisor Program Operations" in this chapter.

Relative Data Sets: Relative data sets have a fixed record length and are accessed using sequential record numbers. Each diskette record contains a single fixed-length logical record with record length being 256 bytes (two diskette sectors), or any number of bytes from 1 to 128 (each record occupies one physical sector). The program specifies the transfer of a record between a buffer and the relative data set, or between storage and the data set using a relative record number (see

"I/O Control Statements" in this chapter). A single read operation can access any record in the data set. A host application program can transmit an entire copy of a data set to the 3770, and the 3770 can access and update individual records in the data set. There is no restriction on the number of records that can be contained in a relative data set, except that it cannot exceed the capacity of a single diskette. Once defined, the data set cannot be expanded.

User-Indexed Data Sets: Using the program statement table facilities, the user can construct indexed data sets permitting access to diskette records by a key. A two-dimensional table can be built in storage containing keys to the records, with each key associated with a relative record number. To access a record using this key, a table lookup, either sequential or binary, is done to find the matching key in the table and its associated record number used to access the physical diskette record. That record or optionally, from one to six 128-byte diskette sectors can be read into storage by a single diskette read instruction. This data can then be searched for the matching key to access the correct logical record within the diskette data. If desired, multiple levels of key search can be done, depending on data organization.

Program Structure

Programming statements available to the 3770 programmer can be grouped in the following categories:

- Program Definition
- Forms Definition
- Data Definition
- Data Movement
- Processing
- Execution Control
- Storage Operations
- I/O Control

Program Definition Statements

These statements define the beginning and end of a 3770 program and allocation of user storage for I/O buffers and working storage. Creation of a transaction data set, and packing options for transmitted data, can be specified.

The ending statement is used to terminate the program. On the 3774P and 3775P, the beginning statement also defines any I/O devices used by the 3770 program that require user storage (see "Components—Controller" in this chapter).

Forms Definition Statements

These statements define the page number and page height, and line number and line width for program reference.

Data Definition Statements

These statements describe the working-storage usage of a buffer and provide data definition (sequence, length, and data format) of fields within a buffer. Buffer fields, storage fields, registers, and indicators can also be assigned symbolic references for use in the procedural portion of the program.

Data Movement Statements

These statements establish program accessibility and system checks for data from various sources, reformat or edit the data, and specify movement to various destinations.

Source statements establish accessibility of data from the keyboard, a buffer field, a register, a task or system value field, an application data set, or from a program-imbedded string or table field. When the keyboard is used as the source, field length, data type, and input field checks can be specified. Input field checks that can be specified are:

- Alphabetic only—Checks for alphabetic, blanks, or NULs only.
- Numeric only—Checks for 0-9, decimal, plus or minus, NULs.
- Alphameric—Checks for alphabetic or numeric only.
- Length check—Checks that length of field is within limits specified in the program.
- Self-check (Modulus 10 or 11).

Edit statements can be used to re-format data fields made accessible by the previous source statement. Edit operations that are available are:

- Right or left justify and fill
- Character insert or fill
- Zero suppress
- Delete character
- Insert leading or trailing +, -, $ (static or drifting)
- Insert comma
- Insert CR or DB (credit or debit)
- Left fill with * or /

Destination statements are used to specify a destination for the data made accessible by a previous source statement. Destinations that can be specified are a register, a buffer field, an application data set record, a transaction data set record, or the console printer. On the 3774P or 3775P, the Display can also be specified.

Processing Statements

Processing statements available to the programmer can be used for the following types of operations:

- Arithmetic operations—add, subtract, multiply, divide
- Data compare
- Set/test indicators
- Zero, load, increment, or decrement registers
- Branch conditional/unconditional
- Define branch/index tables
- Program loop cyclic control

Arithmetic operations are performed on the contents of two registers. Compare operations can be performed on register or buffer contents and the results used to cause branching within the program.

Execution Control Statements

These statements are used to temporarily stop program execution at desired points, to cause a program to repeat, or to call in a different 3770 program for execution.

Storage Operation Statements

Storage space can be allocated in the program beginning statement for use as I/O buffers and for working storage. This storage space overlays buffers 1, 2, and 3, with the size of the storage space limited by the availability of user storage. Statements are provided to:

- Move data from storage to storage
- Move program-imbedded data to storage
- Compare storage to storage
- Compare storage to program-imbedded data
- Perform sequential or binary table lookup operations
- Scan storage

Table lookup can be done sequentially, or can be done more efficiently by a binary search.

Using the scan statement, storage can be examined for presence of any character, such as a delimiter or printer control character.

I/O Control Statements

These statements can be used to:

- Open and close diskette data sets
- Read or write diskette to/from buffers 1, 2, and 3
- Read or write diskettes to/from user storage
- Read data into user storage from an attached Operator ID Reader
- Read cards into storage from an attached card reader (3774P/3775P only)
- Punch cards from storage on an attached card punch (3774P/3775P only)
- Print from storage
- Display from storage (3774P/3775P only)

Storage referred to here is working storage allocated by the program beginning statement, up to the limit of available user storage. I/O operations are overlapped by the use of an instruction to interrogate device status (busy or complete). I/O complete status is indicated in the condition code and can be tested by the program to determine the current device status.

Separate diskette read/write statements are used for transfer of data between diskette and buffers 1, 2, and 3, or for transfer of data between diskette and storage. For transfer between the diskette and a buffer, the read or write statement specifies a specific relative record number. One diskette record can be read into a buffer, or written onto the diskette from a buffer using these statements.

The read/write diskette to/from storage statements can be used to read or write diskette records or from one to six sectors using a single statement. This statement can specify read or write of a specific record, or (after a specific record is read), can specify read or write of the next sequential record. Read or write next record can be used, after a specific record is accessed, as many times as desired to read or write successive sequential records. A single internal work buffer is allocated for reading and writing diskettes when a data set is opened. For more efficient operation and to allow overlap of processing, an additional 256-byte buffer can be allocated by the programmer in the opening statement.

Operating Characteristics

The programmable 3770 terminals are designed for standalone data entry and processing without supervision or control by a CPU. For online communication, communicate mode can be selected by the operator or by a supervisor program to transmit or receive data. (See "Supervisor Program Operations" in this chapter.) In communicate mode, two 256-byte alternating buffers identical to those described for the non programmable terminals are used for transmitting and receiving data.

Operating with System Network Architecture (SNA), the programmable terminals are a single physical unit/logical unit capable of maintaining a single batch session with the host CPU.

Operating in a BSC configuration, the programmable terminals can initiate, maintain, and terminate communication sessions with the host CPU for inquiry/response applications. See "Programmable Communications (3774P and 3775P BSC Only)" in this chapter.

The programmable terminals maintain an error log, similar to that on the nonprogrammable terminals, that records information about errors encountered during terminal operation. The error log can be printed out by a Print Error Log function or accessed directly by a supervisor instruction. The service representative uses the error log to isolate the cause of the problem.

Supervisor Program Operations

Certain 3770 operations can be specified by the user through the supervisor programs. These user-written job-control programs relieve the 3770 operator of manual selection of certain 3770 system utilities, user-written programs, and certain operating modes, thus reducing the operator action required to accomplish a series of tasks. Instruction sequences consisting of alphameric characters only (not part of the 3770 macro language) can be used to control supervisor program sequence of execution and to dynamically vary this sequence via the 3770 application program.

Data Set

A system-named data set (a maximum of 254 records of 256-bytes each) containing these supervisor programs can be created and loaded by a user-written 3770 program or from the host CPU. The supervisor data set may contain data as well as programs; this data can be accessed by user-written application programs and supervisor programs.

Instructions

Instructions that can be executed and operations that can be done using supervisor programs are as follows:

- Accumulate—Performs arithmetic operations.
- Branch—Used for a conditional or unconditional branch to any location within the currently executing supervisor program. The accumulator or the index register is tested for the conditional branch.
- Check—Loads the status of the I/O operation into the accumulator or force completion of the I/O operation.
- Close Data Set—Closes the specified data set.
- Create Data Set—Writes a data set header and allocates diskette space as specified for a user-defined data set.
- Create Diskette—Deletes all data sets and initializes the volume label (3774P/3775P only).

- Delete Data Set—Erases data in the specified data set and deallocates the diskette space.
- Execute Display Commands–Direct data to the Display, if attached, otherwise direct data to the console printer (3774P/3775P only).
- End Communicate Mode–Specifies when communicate mode is to be terminated and control passed back to the supervisor program. This mode is reset by a system reset. (See also the "Set Configuration" description in this list.)
- Enter Communicate Mode–Places terminal in communicate mode, and can specify transmission of up to five data sets from a diskette or a card reader to the CPU. Data set transmission options from the diskette include transparent/nontransparent, blocked/unblocked, and spanned/unspanned. From the card reader, options are transparent/nontransparent and compressed/not compressed.
- Enter Local Mode—Terminates the program executing and causes the terminal to go to local mode.
- Erase Data Set—Erases data in the specified data set, but does not deallocate diskette space.
- Execute Panel Commands—Perform the following: sound the horn, turn on/off the Audible Alarm, put accumulator in NPR, read the keyboard.
- Execute Print Commands—Direct data to the console printer.
- Execute 3770 Program—Selects, loads, and executes a 3770 program specified.
- Increment/Decrement Index Register—Increments/decrements the specified index register by a specified value.
- Force Data to Interrupt Data Set–Forces all data without a message header to the interrupt data set on the diskette. (See also the "Set Configuration" description in this list.)
- Link Supervisor—Calls in another supervisor program.
- List Diskette—Lists volume label, header labels, and error map label.
- Load—Loads the accumulator or index register with the specified value.
- Move—Moves specified characters into a specified address.
- Move Error Log—Moves the error log from the specified buffer and stores it in the specified address.
- Open Data set—Opens the specified data set on the specified diskette device, and closes any previously opened data set.
- Force a Skip to 1 (3774P/3775P only)–Forces a carriage skip to the top of the next form if an ESC S, / (slash), or T sequence attempts to advance the forms beyond the bottom margin. (See also the "Set Configuration" description in this list.)
- Print Error Log–Prints the error log on the console printer.
- Punch Card—Causes the 80 bytes in the specified buffer to be punched 3774P/3775P only).
- Read Card—Reads 80-bytes of card data into the specified buffer (3774P/3775P only).
- Read Configuration—Loads the acumulator with the specified configuration data.
- Read Diskette—Read the specified record into the specified buffer.
- Read Format Image buffer (3774P/3775P only)—Moves the 256-byte printer format buffer to the specified buffer (1, 2 or 3).
- Select Format Image (3774P/3775P)—Selects one of the images in the FIB to set horizontal and vertical tabs.
- Set Communication Options (3774P/3775P only)—Sets (1) End Communicate Mode, (2) Interrupt Data Set, and (3) Printer Carriage Control options. (See also the "Set Configuration" description in this list.)

- Set Configuration—Overrides the system configuration that was set by the operator. Options of the instructions are:

  Set the following operator panel switches on/off (overrides the operator's control). Settings are cleared by power-on reset.

  1. HOLD PRINT
  2. INTRP (Interrupt)
  3. DISK (Diskette)
  4. DISPLAY
  5. AUTO SKIP/DUP
  6. AUTO FEED
  7. Keylock

  Set the following operator controls on/off (overrides the operator's control). Settings are cleared by power-on reset.

  1. Select or Reset Monocase operation.
  2. Select Normal or Inquiry Mode.
  3. Select Automatic or Manual Disconnect.
  4. Set or Reset Switched Network Back Up.
  5. Enable or Disable Audible Alarm.
  6. Select 6 or 8 lines per inch.
  7. Reverse component selection for console printer and 3784 line printer (3774P only on BSC only)

  Reset Auto-Interrupt
  Disable Utility—Disables execution of specified utilities.
  End Communicate Mode Options—Settings are cleared by a system reset.

  1. Return to supervisor program or enter local mode.
  2. End communicate mode when standby mode is entered (BSC only).
  3. End communicate mode when EOT is transmitted (BSC only).
  4. End communicate mode when EOT is received (BSC only).

  Set Communication Options—Settings are cleared by a system reset.

  1. Execute either (1) an Execute Supervisor Program message header or (2) an Execute 3770 Program message header when communicate mode ends.
  2. Force all data without a message header to the SYS.INTR data set while in communicate mode (BSC only).
  3. Force a skip to line 1 of the next form if an ESC S, ESC /, or ESC T sequence attempts to move the form beyond the bottom margin (3774P/3775P only; BSC only).

  Set Page Height—Sets the number of lines per page.
  Set Bottom Margin
  Set Line Number—Sets the current line number (should be set to 1 when the page height is changed).

- Set Format Image Buffer (3774P/3775P only)—Loads the FIB from the specified buffer (1, 2, or 3) with up to seven horizontal and vertical format images.
- Set Console Horizontal and Vertical Tabs (3774P/3775P only)—These instructions set the horizontal and/or vertical tabs for the console printer.

- Store Accumulator in Buffer—Stores the contents of the accumulator in the specified buffer.
- Turn Power Off—Turns off terminal power if the terminal has the Power Off specify feature (does not turn off card I/O devices).
- Wait—Stops program execution for up to nine seconds.
- Write Diskette—These instructions take the record in the specified buffer and write it on the specified data set.

3770 programs can be sequentially called from the diskette program library and executed simply by writing a series of "execute 3770 program" statements. As one program completes, the next is called into user storage for execution. On completion of a 3770 program, communicate mode can be entered, data transmitted, and program execution resumed, local mode entered, or power turned off. Supervisor programs can communicate with user-written application programs by means of return codes and shared buffers.

Supervisor Address Stop

The address stop function may be selected after pressing the PGRM STOP key while a supervisor program is executing. It is used for debugging supervisor programs, and displays or prints the contents of specified registers, buffers, source buffers, condition code settings, and logical indicators prior to executing the instruction at the specified address.

Modes of Operation

Local Mode

The programmable 3770 terminals have built-in functional tests, similar to those on the nonprogrammable terminals, that are performed at power on or when the SYSTEM RESET switch is operated. After power is turned on and the functional tests have completed successfully, the terminal enters local mode. In this mode, the terminal can be used for keyboard-to-printer operation, or the operator can either select one of the 3770 system utilities, or select a 3770 user-written program or a supervisor program for execution. At power on or when the SYSTEM RESET switch is operated, the set configuration utility can direct the terminal to execute supervisor program 1 instead of going to local mode. (On the 3773P, the HOLD PRINT switch should be on at power-on time to allow changing the diskette from the IPL diskette to the user diskette contaning the supervisor data set. Supervisor program 1 is executed when the HOLD PRINT SWITCH is turned off.) This allows the supervisor program to set controls instead of the operator. (See "System Utilities—Set Configuration" and "Operating Characteristics—Supervisor Program Operations".)

Enter Mode

In enter mode, the 3770 operates offline under control of the user-written 3770 program. Depending on the program, data can be entered from the keyboard, or read from an Operator ID Reader, the diskette, or from a card reader attached to the 3774P or 3775P. The data can be processed and read out: (1) to the console printer, or (2) to the 3784 line printer (3774P only), (3) or diskette, or (4) to the card punch (3774P or 3775P only), or (5) to the Display (3774P or 3775P only).

Keyboard Entry: Keyboard entry can be allowed from the entire complement of keyboard keys including the Keypad, if installed. Parameters that can be specified for keyboard-entered data are:

- Optional or mandatory entry
- The number of characters (maximum and minimum) that will be allowed
- The type of characters that will be allowed (alpha, numeric, or alphanumeric)

- A range indicator is available to indicate the result of program-determined tests performed on the data.
- Self check

Data entered is placed in the source buffer where the data can be compared, edited, and/or moved to registers, buffers, or storage for further processing. Keyboard-entered data fields are also entered into the transaction record, if one is being created. The data entered can be printed or displayed (3774P/3775P only) by the program for verification by the operator, if so specified by the 3770 program.

Operator ID Reader: Data can be read under program control. Security of data read from the Operator ID Reader is dependent on the user-written 3770 program.

Diskette Entry: Application data can be read into the diskette buffer assigned by the program a record at a time, and is available to the program for further processing. Records are accessed by the 3770 program using a relative record number. Using a separate diskette read statement, multiple records (up to six 128-byte sectors) can be accessed and read into user storage by a single statement.

Card Entry: On the 3774P and 3775P, card data can be read under program control from an attached 2502, 3501, or 3521 with the Card Read feature. The card data reads into an 80-byte storage area from where it is available to the program for further processing. With the Card Print feature, the 3521 can print (interpret cards as they are read).

Printer Output: Output from the source field to the console printer or to the 3784 line printer (3774P only) can be specified by the program. In addition to the length of the field to be printed, the program also specifies:

- Vertical spacing or skipping to a specified line on the form, or skipping or spacing a specified number of lines
- Horizontal character position where printing is to begin

Format of printed data is entered under control of the 3770 program. Printer control characters as used by the nonprogrammable terminals and containing data for the printer are not automatically recognizable, but can be accommodated by user-written 3770 programs. The program must check for these control characters in the printer data and format the data accordingly for output using 3770 programming statements. Data can also be printed from the user-allocated storage by a separate print instruction.

Display: Output to the Display attached to the 3774P or 3775P can be specified by line, field, or character, and is basically the same as the Print function just described. The display can be erased entirely, if desired. When the source buffer is used for output to the printer, the Display, rather than the printer, can be selected for output of the data by turning on the DISPLAY switch.

Card Output: Data can be assembled in an 80-byte punch buffer defined in user storage from where it can be directed to a 3521 Card Punch attached to the 3774P or 3775P. Options that can be specified for a card punch operation are:

- Punch Only
- Punch and Read Check
- Punch and Interpret
- Punch, Read Check, and Interpret

Diskette Output: A transaction data set can be created during program execution and written on the diskette. During program execution, transaction records are built in a 256-byte transaction record buffer and written to the diskette when the buffer becomes full. The transaction data set index is updated on completion of the program.

All keyboard-entered fields are included in the transaction record, as are copies of all fields from any source that are specified for transmission to the CPU. Keyboard fields are inhibited when the data is later transmitted in online (communicate) mode.

Application data sets can also be built or updated in enter mode. Diskette buffers allocated by the programmer can be read out and written on the diskettes either record-by-record, or diskettes can be written from user storage by single or multiple-record blocks using separate I/O statements.

Rerun Mode

This mode allows the operator to recall records from the diskette transaction data set in order to make corrections or updates, or to print out a clean copy of a form on the console printer. The 3770 program that was used to create the record is restarted, and the program executes in the usual manner except for keyboard-entered fields. Keyboard fields are accessed from the transaction data record and printed out or displayed as they were previously entered. If the operator desires to alter previously entered data, error correct mode can be entered from rerun mode.

Error Correct Mode

Error correct mode can be entered from rerun or enter mode, and allows the operator to correct data previously entered on the current line. If a transaction record is being generated, correction can be done in any field entered on the current line. If a transaction record is not being generated, correction can be done only on the current field.

This mode is selected anytime the BKSP LINE, BKSP FIELD, or BKSP CHAR key is pressed, and the program returns to the beginning of the line or field, or to the previous character. The PRINT, LINE, FIELD, and CHAR keys can be used in Error Correct mode to cause printing of the data. The machine returns to enter and rerun mode automatically when it reaches the print position at which error correct mode was originally entered.

Program Address Stop (3774P/3775P Only)

The address stop function may be selected after pressing the PGRM STOP key while a user-written application program is executing. It is used for debugging programs, and displays or prints the contents of specified registers, buffers, source buffers, condition code settings, and logical indicators prior to executing the instruction at the specified address.

Communicate Mode

The communicate mode function is used to transmit data to and receive data from the host CPU. Communicate mode can be selected by the operator, or can be selected as described under "Supervisor Program Operations" in this section.

BSC Communications

Communication between the CPU and the 3773/3774/3775 programmable terminals is for the purpose of (1) sending logon or logoff messages to the CPU from the keyboard, (2) for exchanging data between the 3770 diskette(s) and the CPU, and (3) for sending messages from the CPU to the 3770 console printer. Additionally, on the appropriate I/O configurations of the 3774P/3775P, BSC communicate mode can be used (4) for exchanging data between the card reader and the CPU, (5) for exchanging data between the CPU and the card punch, and (6) on the 3774P only, for sending data from the CPU to the 3784 line printer.

Transmitting Data Sets or Card Files: When the terminal first enters BSC communicate mode, the operator can initiate transmission of up to five data sets or a card file to the host CPU. Data can be transmitted from a diskette device or a card reader (3774P/3775P only) in nontransparent or transparent mode. On entering communicate mode, the terminal transmits data to be sent before processing data received from the host CPU.

In addition to immediate transmission, the operator can initiate transmission of up to five data sets from the diskette when the STANDBY light is on. The transmission and blocking options on the 3773P/3774P/3775P are:

- *Nontransparent, blocked, and spanned* (the default option)—The data is blocked into a 256-byte buffer before transmission. Data set records may span the buffer boundary.
- *Nontransparent and unblocked*–If record length is 256, the transmission buffer size is 256 bytes minus any trailing space characters that are stripped from the data set record before transmission. If the record length is not 256, the transmission buffer size equals the data set record length.
- *Transparent, blocked, and spanned*—The data is blocked into a 256-byte buffer before transmission. Data set records may span the buffer boundary.
- *Transparent, blocked, and unspanned*—If the record length is 256, trailing null characters are stripped from the data set records before transmission. If the record length is not 256 and not 80, the transmission buffer size is equal to the record length. If the record length is 80, the data set records are blocked in threes for a transmission buffer size of 240 bytes.
- *Transparent and unblocked*—The transmission buffer size equals the data set record length.

The 3774P/3775P operator can also initiate transmission of a card file from the attached card reader when entering BSC communicate mode, or when the STANDBY light is on. All card input is sent unspanned. The transmission options are:

- *Nontransparent with blank compression* (the default option)–imbedded and trailing blanks are compressed using the IGS character sequences. The 256-byte transmission buffer is filled with card data (each card image is followed by an IRS character), until 81 characters are no longer available in the buffer.
- *Transparent*–Three 80-character card images are placed in each buffer and 240-character blocks are transmitted. Short cards (51- or 66-column option on the 2502) are transmitted as one card per block.
- *Nontransparent without blank compression*–trailing blanks are stripped from card data. The 256-byte transmission buffer is filled with card data (each card image is followed by an IRS character), until 81 characters are no longer available in the buffer.

Refer also, to "Card Image Formats" in Appendix E–"Data Format".

Logon/Logoff Messages: In communicate mode with the STANDBY light on, the operator can initiate a logon or logoff message by pressing the SYS REQ (System Request) key and entering a log message from the keyboard.

During a keyboard-to-line operation (logon), the operator can key in an IRS character (X'1E') so that up to 256 bytes of keyed data can be blocked to look like card data.

Set Printer Format (3774P/3775P Only): In communicate mode with the STANDBY light on, the 3774P/3775P operator can select one of the images in the format image buffer to set the horizontal and vertical tabs for the printer.

Message Headers: The diskette device(s) are always assumed to be the source of data transmitted to the CPU, or the destination for data received from the CPU if a message header is present. A message header (MH) must always be the first block of a message (or may be the only block) transmitted from the CPU to request one of the following functions to be performed by the 3770:

- Add a 3770 program to the program library
- Add records to an application data set
- Create an application data set
- Delete a specific application data set
- Delete a specific 3770 program from the program library
- Delete all application data sets
- Delete all 3770 programs from the program library
- Erase an application data set
- Execute a supervisor program (when EOT is received)
- Execute a 3770 program (when EOT is received)
- Read an application data set or the transaction data set (solicits transmission of the requested data set; see "Transmitting Data Sets" for blocking options)
- Read last error code recorded
- Stop communicate mode and return to local mode (when EOT is received)
- Update a record in an application data set

Interrupt Data Set: A predefined diskette data set (SYS.INTR) is loaded with data from the line.

On the 3774P/3775P, if the diskette fills up, a message code is displayed in the NPR to alert the operator and the terminal transmits WACK responses for up to three minutes. If the operator does not change the diskette within three minutes, the terminal stops the operation.

A supervisor program option on the 3774P/3775P overrides the component selection from the host and forces all data without a message header to the interrupt data set. The DISK switch can also be used to override all component selections except the console printer.

Programmable Communications (3774P and 3775P BSC Only): Using a function called Programmable Communications, a user-written program executing at a terminal can begin, maintain, and end standard BSC communication sessions with the host CPU. This is accomplished by using the macro instructions shown in Figure 5-5. These instructions open and close communication sessions, allocate resources (buffers and registers), and handle data to and from the host CPU. The application programmer can use these instructions to develop communication applications such as online inquiry/response and online updating of data files.

Instruction	Use In Programmable Communications
OPLINE	Causes online mode of operation to be entered. Begins a terminal session with the host CPU. Establishes direction of the transmission. Accepts or rejects a point-to-point line bid, multipoint poll or multipoint selection. Monitors the communication line for host activity.
PUTLINE	Sends up to 256-bytes of data to the host CPU. Indicates transparent or non-transparent data. Specifies which ending character(s) is to be appended to the data.
GETLINE	Receives data into a 256-byte buffer from the host CPU.
CLLINE	Ends online mode of operation.
*START2	Specifies whether or not the program uses Programmable Communications. Allocates 2K bytes of user storage.
*DEVCK	Indicates that the communication line status is to be checked.

*Currently used but modified for use with Programmable Communications

Figure 5-5. Programming Macro Instructions used in Programmable Communications

A session originates by either sending or receiving data but both functions are permitted during the session. Requests by the host CPU for line turnaround are reported to the user-written application program. When the terminal is sending data, the user-written program can interact with attached input/output (I/O) devices and perform arithmetic/logical/moving operations to build output records. The terminal considers the communication line as an output device on a per-record basis. When the terminal is receiving data, the user-written program can interact with attached I/O devices. The data is made available on a transmission block basis to the currently executing program. Data records from input devices can be manipulated automatically by the program or manually by the operator interacting with the program.

Communications is established by the host CPU in response to a request from the terminal or because a host system application program wishes to communicate with the terminal. Once communications is started, the terminal is responsible for maintaining communications and for processing data. The ONLINE indicator on the terminal's operator panel signals when communications is in progress.

A terminal program that uses Programmable Communications cannot be interrupted by the host CPU while in a Programmable Communications session (that is, between OPLINE and CLLINE).

Programmable Communications uses 2K bytes of user storage in its operation. The 2K will be loaded as the identifiers in the START2 macro are recognized. Therefore, the code will be resident even though the open session (OPLINE) macro has not been issued. This code is in addition to any code required for other I/O devices and resources.

Point-to-point, switched (manual or auto), multipoint, or Switched Network Backup (SNBU) BSC communication options are available to the Programmable Communications function.

The data transmitted or received may be transparent or nontransparent EBCDIC, or nontransparent ASCII. Inquiry mode functions available with BSC multipoint are also available. However, in each case the Programmable Communications function program has the responsibility to properly control the operation.

Online Operations: After entering BSC communicate mode, the following online operations will run under control of the communicate mode function:

Machine Type and Operation	*User-Storage Required*
For the 3773P/3774P/3775P:	
Diskette to Line Line to Diskette Line to Console Printer Keyboard to Line (Logon/Logoff)	No additional user-storage is required for these four operations: 3773P–4K basic 3774P/3775P–6K basic
For the 3774P/3775P:	
Card Reader to Line Line to Card Punch	With 4K additional user-storage, any one of these three operations can run.
For the 3774P:	
Line to 3784 Printer	

In addition to operator selection, the supervisor program can select the Diskette-to-Line or Card Reader-to-Line operation after placing the terminal in communicate mode. Data sets and card files are sent to the CPU in the transparent or nontransparent format. In the nontransparent format, trailing space characters are truncated or space characters are compressed if the option is specified (see "Transmitting Data Sets or Card Files" in this section).

Component selection characters in the data from the CPU select the diskette, console printer, card punch, or 3784 printer. For print applications, the operator or the supervisor program can reverse the component selection for the console printer and the 3784 line printer (see "Component Selection" in Chapter 7). On the 3774P and 3775P, the supervisor program can override the component selection and force all data to the diskette storage device. Later, a user-written program can direct the diskette data to the selected output device (see "Interrupt Data Set" under "Programming and Data Sets" in this chapter).

On the 3774P and 3775P, additional user storage is a prerequisite feature for line-to-3784 printer or card I/O online operations under control of the communicate mode function. An additional 4K must be available for the card reader or the card punch. If both card I/O devices are attached, an additional 8K of user storage should be available for efficient operation. With only 4K of additional storage, both the reader-to-line and line-to-punch operations can be executed in one session with the CPU. However, delays will occur when data flow changes direction on the line. For more information on I/O device operation with BSC communicate mode, refer to Chapter 6—"I/O Attachments" and Chapter 7—"Programming Considerations—Binary Synchronous Communications".

Note: An additional 4K of user storage can be part of the terminal configuration, yet not be available to the communicate mode function. For example, the Supervisor Control Program Residency option (or other options made resident) requires user storage. Once allocated, this storage cannot be used by other functions until it is deallocated by the operator rerunning the Set Configuration Utility.

CPU Interrupt (3774P/3775P Only): If a data link exists between the CPU and the 3774P or 3775P, and if the 3770 INTRP (Interrupt) switch is on, the CPU can interrupt program execution by the 3770 (except as noted under Programmable Communications above) and transmit data to it. (Refer to Figure 5-5.1.) The line-to-3784 printer and line-to-card punch operations cannot be initiated by the CPU interrupt. The only function (specified in the message header) that is initiated when a CPU interrupt occurs is "add to an application data set". Received data will be written into a diskette data set whose name is specified in the message header. If data is received without a message header, and a device other than the console printer is selected (or the DISK switch is on when no selection is present) the data is written onto the SYS.INTR data set. If the console printer is selected (or no selection is present and the DISK switch is off), the data will be written on the console printer. Data throughput may be reduced during a CPU interrupt as only a single data buffer is used (not dual data buffers). After transmission is complete, the 3770 program resumes execution from the point of interruption.

End Communicate Mode: The operator can terminate communicate mode by pressing the CODE/STOP JOB keys. A terminate communication message header received from the CPU, also stops communicate mode. In both of these cases, the terminal is returned to local mode.

When a supervisor program starts communicate mode, instructions are available to specify when communicate mode should be terminated and where control should be passed (BSC only). With default options, communicate mode ends when any terminate message header is received or when the operator presses the CODE/STOP JOB keys (control passes back to the supervisor program).

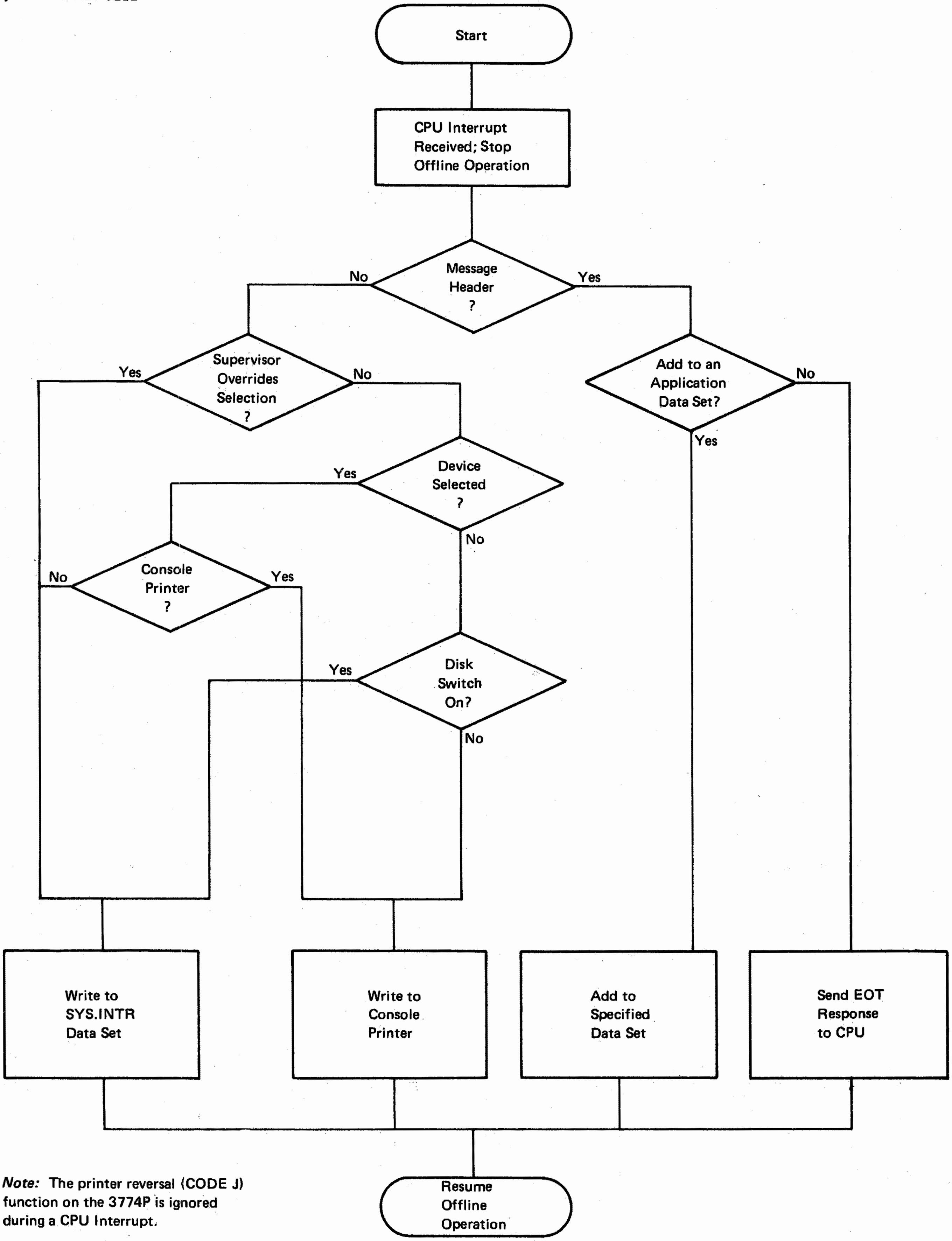
Other options allow the supervisor program to regain control after an EOT is sent, an EOT is received, or standby mode is entered. Other options determine if host requests for supervisor programs or 3770 programs are honored or ignored, and if control should go to local mode instead of to the supervisor program.

If control is returned to the supervisor program, a status flag is set to indicate if BSC errors have occurred during communicate mode.

Once specified, these options remain in effect until other options are specified or a power on reset occurs.

SDLC Communications

For information on communication between the host CPU and the 3773, 3774, and 3775 programmable terminals, refer to Chapter 8—"Programming Considerations—SNA/SDLC Communications" in this manual and to the *IBM 3773, 3774, and 3775 Programmable Communication Terminals Programmer's Guide,* GC30-3028.



Note: The printer reversal (CODE J) function on the 3774P is ignored during a CPU Interrupt.

Figure 5-5.1. CPU Interrupt on 3774P/3775P

System Utilities

System utility functions (IBM microcode) are used for batch communication, for offline data transfer between attached input and output devices, and for program debug and other terminal support functions.

Card System Utilities (3774P/3775P Only)

Card system utilities can be selected to perform the following offline operations using card input and output devices, if attached:

- Card Reader-to-Diskette
- Card Reader-to-Console Printer or 3784 Line Printer (3774P Only)
- Card Reader-to-Card Punch
- Keyboard-to-Card Punch
- Read Interpret (3521 with Card Print Feature)

Create Diskette

This utility deletes all data sets and creates a volume label and an error map. If the diskette is created in 3770 nonexchange mode, track one is allocated to an OJDR (job definition) data set (for 3770 compatibility.)

Data Set Support

This system utility allows the operator to perform the following functions:

- Bypass Data Set—Sets or resets the Bypass indicator in the header label (when set, prevents the 3770 from transmitting the data set to the host CPU).
- Create Data Set—Writes a header for, and allocates diskette space for an operator-defined data set.
- Delete Data Set—Deletes the header for, and deallocates diskette space for the data set. (After this utility is used, the diskette is no longer compatible with 3770 non-programmable terminals.)
- Erase Data Set—Deletes the data, but the diskette space remains allocated and the header reflects an empty data set. (Do not use on system data sets containing indexes.)
- Rename Data Set—Changes the data set name.
- Write Protect Data—Sets or resets the write protect indicator in the Header Label (when set, prevents writing on the data set by an off line operation).

Data Set Update

This system utility allows the operator to perform the following functions:

- Create Record—Displays a header for, and allocates buffer space for an operator-defined record. (Data can be entered in hexadecimal on the 3774P/3775P.)
- Read Record—Reads a record from the data set and displays the record with a header over the record. (Data can be displayed in hexadecimal on the 3774P/3775P.)
- Write Record—Writes the contents of the utility's buffer (resulting from a Create Record or Read Record function) onto the specified record.
- Dump Data Set (3774P/3775P Only)—Prints the contents of the data set up to the End of File on the console printer starting with the specified record.
- Hex Dump of Buffer (3774P/3775P Only)—Displays or prints the contents of the utility's buffer in hexadecimal notation.

Diskette to Diskette Utilities (3774P/3775P Only)

Diskette to diskette utilities are provided for the following functions:

- Copy Diskette—With multiple diskette devices, copies the physical track contents of one diskette to another diskette.
- Copy Data Set—Copies one data set to another. The data sets may be on any of the three diskette devices.

Error Log Print

This system utility can be selected to print out the machine's error log.

List Diskette

This system utility allows the operator to display or print the volume label, all the header labels, and the error map label (if it contains any entries in the 3770 nonexchange diskette format) of a diskette on any of the diskette devices on the terminal.

Program Library

This utility allows the operator to perform the following functions:

- Delete Program from Library—Deletes one or all of the programs on the library.
- Pack Program Library (3774P/3775P Only)—Compresses the library to eliminate unused space as a result of deleted programs.
- List Program Library—Displays or prints the contents of the program library.
- Load Program from Cards (3774P/3775P Only)—Adds a program to the end of the library.
- Load Program from Data Set (3774P/3775P Only)—Adds a program.
- Store Program on Data Set (3774P/3775P Only)—Removes a program from the library and stores it on the specified data set.

Set Configuration (3774P/3775P Only)

This utility displays or prints the I/O devices and features that are available on the terminal. Following the display or printing of configuration bytes, pressing the PRINT key displays/prints the following:

1. The number of 4K user-storage features in the current 3770 configuration.
2. Whether or not Supervisor Program 1 is to be executed at power on time or when the SYSTEM RESET switch is operated.
3. The I/O devices (Card Reader, Card Punch, Display) in the current 3770 configuration whose control program is to be resident in user storage.
4. Whether or not 256 bytes of user storage are allocated for the format image buffer.
5. Whether or not 3K bytes of user storage are allocated for Supervisor Control Program Residency.

Note: Items 1 and 2 are set by hardware on the 3773P.

This utility may be used by the operator to change the values for 2, 3, 4, and 5. When I/O devices are entered that will not be used by the application program, the size of user-storage is reduced unnecessarily. Once user storage is allocated for items 3, 4 and 5, no other functions can use or share this storage space until it is deallocated by this utility.

Features and Accessories

3773 Models P1, P2, and P3

All the special and specify features and accessories described for the 3773 Models 1, 2, and 3, as described in Chapter 2 of this publication and listed below, are available for the 3773 programmable models.

- Door Keylock
- Audible Alarm
- Keylock
- Katakana Specify Feature
- EIA/CCITT Interface
- Communication Driver
- Communication Feature
- BSC Multipoint
- 1200 bps Integrated Modems
- ASCII
- Forms Stand Accessory
- Variable Width Forms Tractor

In addition to these features and accessories, the following special features are available for the 3773 Models P1, P2, and P3:

Keypad

A 10-digit numeric keypad, with key arrangement similar to that on a 10-key adding machine (see Figure 5-5), can be obtained to facilitate entry of numeric data. The Keypad is enabled for numeric entry whenever the keyboard is selected by the 3770 program. The top right key (above the 9 key) on the Keypad is a data key that may be assigned a specific function by the user-written program.

Additional User Storage

An additional 4K- or 8K- byte increment of user storage can be installed, increasing user storage to a total of either 8K or 12K bytes (4K standard, plus an additional 4K or 8K).

Operator ID Reader

This feature for the 3773 Models P1, P2, and P3 is a desk-top unit that reads magnetic-stripe operator identification cards. Card data can be read into user storage under 3770 program control. Data can be validated by the 3770 program, or can be transmitted to the CPU for validation. Security of data read from the Operator ID Reader is entirely dependent upon the user-written 3770 program.

Cards used with the reader are the same as those used with the nonprogrammable models. Card format and character set are shown in Appendix B.

3774 Models P1 and P2
3775 Model P1

The attachable input and output devices listed below, and described in Chapter 6 of this publication, are available for the 3774 and 3775 programmable terminal models:

- IBM 2502 Card Reader Model A1 or A2
- IBM 3501 Card Reader
- IBM 3521 Card Punch
- IBM 3784 Line Printer (3774P Only)

The 2502 attaches to the 3774P/3775P through the IBM 3782 Card Attachment Unit Model 2. The 3521 attaches to the 3774P/3775P through the IBM 3782 Card Attachment Unit Model 1. One card reader can be attached, the 2502 or the 3501. The 3521 can optionally be equipped with the Card Read and Card Print special features. For more information on the operation of these I/O devices attached to programmable 3770 models, refer to "Operating Characteristics–Modes of Operation–Communicate Mode" in this chapter, and to Chapter 6–"I/O Attachments".

The special and specify features and accessories listed below, and described in Chapter 3 of this publication, are also available for the 3774 and 3775 programmable terminal models:

- Audible Alarm
- Keylock
- ASCII
- Katakana Specify Feature
- EIA/CCITT Interface
- Communication Driver
- Communication Feature
- BSC Multipoint
- 1200 bps Integrated Modems
- 2400 bps Integrated Modems
- Modem Fan Out
- Switched Network Backup
- Door Keylock
- Forms Stand Accessory
- Variable Width Forms Tractor (3774P Only—Standard on 3775P)
- Additional Print Belt Accessory (3775P Only)

In addition to these features and accessories, the following special features are available for the 3774 and 3775 programmable terminal models:

Keypad

A 10-digit numeric keypad, with key arrangement similar to that on a 10-key adding machine (see Figure 5-5) can be obtained to facilitate entry of numeric data. The Keypad is enabled for numeric entry whenever the keyboard is selected by the 3770 program. The top right key (above the 9 key) on the Keypad is a data key that may be assigned a specific function by the user-written program.

Additional User Storage

Additional user storage is available in increments of 4K, 8K, 12K, or 16K bytes (K = 1,024) increasing user storage to 10K, 14K, 18K, or 22K (maximum).

Magnetic Diskette Storage

In addition to the non-removable diskette device, one or two additional Diskette Storage Devices can be obtained on the 3774P or 3775P. These devices have operator-changeable diskettes and can be used for storage of 3770 programs and application data.

Each diskette can contain up to 242,944 bytes of data providing (on a fully featured machine) a total of 572K bytes of diskette storage (99,840 bytes on diskette device 0 plus 242,944 bytes on diskette device 1, plus 242,944 bytes on diskette device 2). Reading from and writing onto the diskette is under control of the 3770 program, and is done between the diskette and a buffer record-by-record, or, using separate I/O statements between user storage and diskette by single or multiple record blocks.

Display

The Display can be attached to the 3774 or 3775 programmable models, and can display up to 480 characters in 12 lines with 40 characters per line, in a display area of approximately 7 1/4 inches by 3 inches. Under 3770 program control, data can be displayed from storage a line, a field, or a character at a time. All characters of the 94-character set (or of the 127-character Katakana set) shown in Appendix B can be displayed.

The Display can be used for:

- Keyboard entry applications
- Diskette inquiry applications
- Operator assistance and guidance messages
- Display during program debug
- Display records for correction and update from the keyboard

Programming statements for the Display function include cursor positioning, and vertical and horizontal positioning of displayed data by line, field, and character, similar to that for the printer. Display statements can also specify that previous data displayed in the line be erased, allowing the programmer to add information to a line or display corrections to a line. Data in the source buffer that is normally being directed to the printer by the 3770 program (see "Program Structure—Data Movement Statements" in this chapter), can be displayed rather than printed, if the operator turns the DISPLAY switch on.

Operator ID Reader

This feature for the 3774 and 3775 programmable terminal models is located behind the left front controller access door, and reads magnetic-stripe operator identification cards. Operation is the same as described for the 3773 programmable terminal models.

Dual Independent Forms Feed (3775 Model P1 Only)

With this feature, the line console printer is capable of processing two forms simultaneously. The feature is made up of two independently operating forms carriages contained on one printer base. Each of the carriages is self-contained with facilities for forms movement and forms path checking. Either one of two forms can be processed at one time. For information about forms sizes and forms design, refer to *Forms Design Reference Guide for Printers*, GA24-3488.

The application programmer controls carriage selection, carriage movement and forms printing by programming statments in the user-written program.

Operating Controls

Power On/Off Switch: This switch controls ac power to the terminal. When power is turned on, the bring-up diagnostics run and the terminal is left in local mode with the PROCEED indicator on. (See "System Utilities–Set Configuration" for variations on this procedure.) Any other indication signals a failure in the terminal's electronic components, that a mode switch is on, or that the Keylock is off. In case of a failure in the electronic components, the operator should proceed as instructed in the appropriate *Operator's Guide*. If the tests complete successfully, the operator can continue with terminal operation.

3774P/3775P Auxiliary Operator's Panel

The Auxiliary Operator's Panel on the 3774P and 3775P is located behind the front left-hand controller door. It contains the SYSTEM RESET switch and certain special feature controls.

BSC/SDLC Switch: This switch is present on machines with the SDLC/BSC Switch Control feature. The switch must be placed in the BSC position to communicate using BSC procedures, or in the SDLC position to communicate using SDLC procedures.

NORMAL/HALF SPEED Switch: This switch is present on machines using a 2400 bps Integrated Modem, and is present on all World Trade machines. With a 2400 bps Integrated Modem, transmission is at 2400 bps with the switch in the NORMAL position, or at 1200 bps with the switch in the HALF SPEED position. On World Trade machines using either an integrated modem or external data communication equipment (DCE), line speed with the switch in the NORMAL position is at the modem's maximum rated speed. With the switch in the HALF SPEED position, line speed is at half of the modem's maximum rated speed, if the modem has this capability.

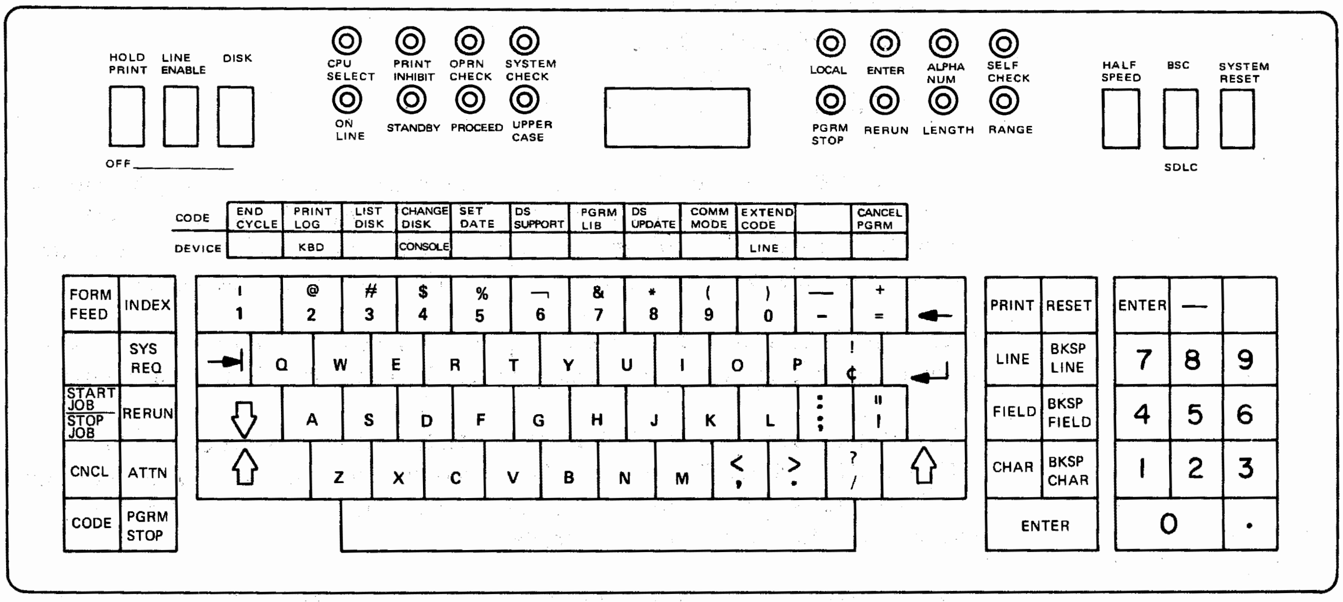
Keylock: This is the key-operated switch for the Keylock special feature.

Signal Quality Meter: This meter is present on machines using an IBM 2400 bps Integrated Modem, Point-to-Point or Multipoint Tributary (see Chapter 3—"Features and Accessories").

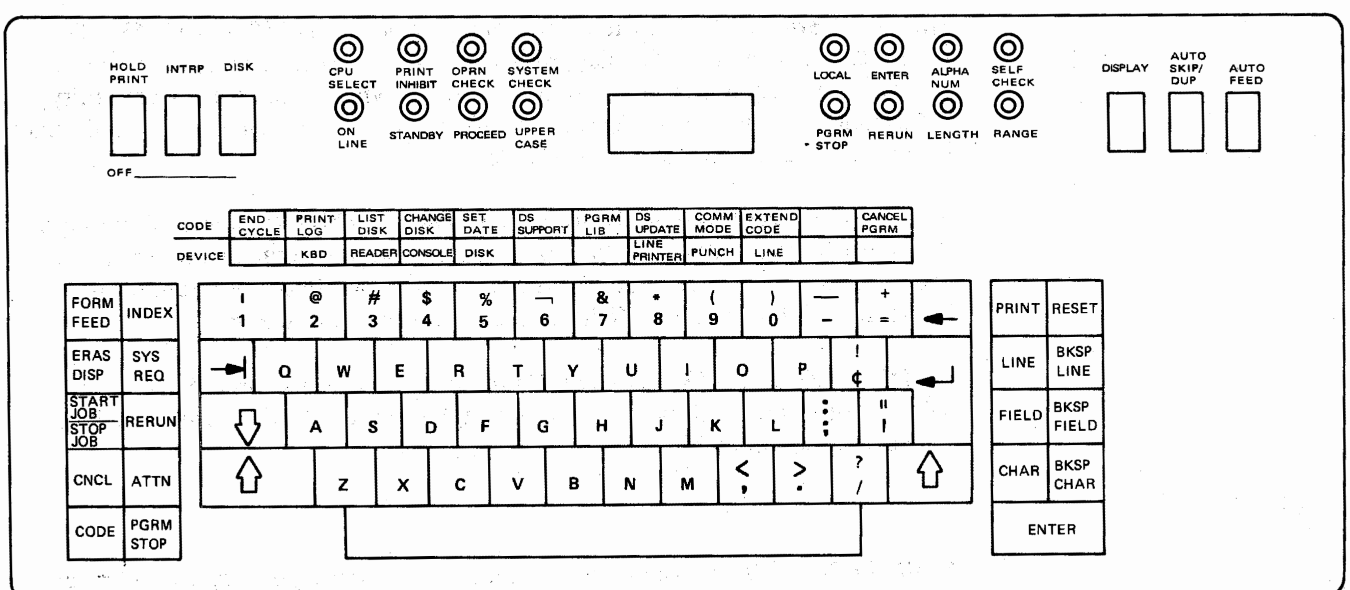
Transmit and Receive Equalizer Controls: These rotary controls are present on machines using an IBM 2400 bps Integrated Modem, Multipoint Tributary. The receive equalizer control alone is present on machines using the IBM 2400 bps Integrated Modem, Point-to-Point (see Chapter 3—"Features and Accessories").

SYSTEM RESET Switch: This switch causes the terminal to interrupt any operation in progress and leaves the terminal in the same power on state as described under "POWER ON/OFF Switch".

Keyboard Switches, Keys, and Lights (Figure 5-6)



3773 With Optional Keypad



3774/3775 Without Optional Keypad

Figure 5-6. 3770 Programmable Terminals Keyboards

Switches

On the 3773P, which has no Auxiliary Operator's Panel, the following switches are located on the keyboard and operate as described under "3774P and 3775P Auxiliary Operator's Panel":

- SYSTEM RESET Switch
- BSC/SDLC Switch
- NORMAL/HALF SPEED Switch

HOLD PRINT Switch: Turning this switch on suspends printing on the console printer so that forms can be inserted or adjusted. Printing resumes when the switch is turned off. If this switch is on at power-on time, the terminal will stop before entering local mode (or before executing supervisor program 1).

LINE ENABLE Switch (3773P Only): This switch is active when the 3773 is in local mode, and can be turned on to enable the host CPU to transmit data to the diskette.

INTRP (Interrupt) Switch (3774P/3775P Only): With this switch on, the host CPU can interrupt a 3774P or 3775P operating in enter mode or local mode and transmit data to the diskette or the console printer. The 3774P or 3775P returns to enter mode after transmission is complete.

DISK Switch: This switch is used by the operator to force data without a message header and without a console device selection to be stored on the SYS.INTR data set on the diskette. A user-written program can be used to format the data for output to the selected device.

DISPLAY Switch: This switch is present only on the 3774P and 3775P. Turning the switch on selects the Display, rather than the console printer, as the output device when output is from the source buffer or when running a system utility (see "Program Structure—Data Movement Statements" in this chapter). If a Display is not attached, the switch is inoperative.

AUTO SKIP/DUP Switch (3774P/3775P Only): This switch is used during the keyboard-to-punch utility. When this switch is on, the keyboard-entered data is processed automatically under control of the program in the program buffer. Skipping and duplication of fields in the card occurs automatically.

AUTO FEED Switch (3774P/3775P Only): This switch is used during the keyboard-to-punch utility. When this switch is on, the card is automatically punched as column 80 is entered.

Keys

FORM FEED: This key is active only in local mode. Pressing the key causes the forms to advance to the first printing line (line 1) on the next form. See "Forms Alignment Considerations" in Chapter 7.

INDEX: This key is active only in local mode. Pressing this key causes the forms to advance one line space.

ERAS DISP (Erase Display)(3774P/3775P Only): Pressing this key in local mode erases the display.

SYS REQ (System Request): This key can be used to initiate a logon or logoff message if the terminal is in local or communicate mode with the STANDBY light on.

START/STOP JOB: Pressing this key followed by a job number selects a user-written application program or supervisor program. Pressing this key in conjunction with the CODE key stops the job.

RERUN: This key selects rerun mode operation (see "Operating Characteristics—Rerun Mode").

CNCL (Cancel): Pressing this key clears the system request logon buffer of all data. When receiving an SDLC online job, this key transmits a negative response to the CPU that requests a break in data flow to the 3770.

ATTN (Attention): This key is inactive on programmable terminals.

CODE: This key, pressed in conjunction with other keyboard keys, permits selection of the following functions:

- End Cycle—Stops execution of a repetitious instruction loop in the user-written program if the loop contains a keyboard entry.
- Print Error Log.
- List Diskette (Volume ID and Data Set Labels).
- Change Diskette—Used when changing the source of a data set from one diskette device to another, when continuing the system interrupt data set from one diskette to another (3774P/3775P only), or when removing the program library diskette after a program has been loaded.
- Set Date
- Data Set Support

  Bypass Data Set
  Create Data Set
  Delete Data Set
  Erase Data Set
  Rename Data Set
  Write Protect Data Set
- Maintain Program Library Data Set

  Delete Program from Library
  Pack Program Library (3774P/3775P Only)
  List Program Library
  Load Program from Cards (3774P/3775P Only)
  Load Program from Data Set (3774P/3775P Only)
  Store Program on Data Set (3774P/3775P Only)
- Update Data Set

  Create Record
  Read Record
  Write Record
  Dump Data Set (3774P/3775P Only)
  Hex Dump of Buffer (3774P/3775P Only)
- Enter Communicate Mode
- Select Extended Code Functions (Refer to EXTEND CODE description).

- Cancel Program—Cancels user-written program that is executing and deletes transaction data set being created.
- Reset Line Counter to 1 (May be set in local mode only).
- Advance Forms Five Line Spaces (May be set in local mode only).
- Exit Communicate mode and Return to Local Mode
- Stop Execution of User-Written Program and Force a Repeat with Stop.
- Rerun Last Record Created on Transaction Data Set Library (May be set in local mode only).
- Rerun Record Just Processed—This may be done when the PGRM STOP light is flashing provided that a transaction data set was created.
- Reset Audible Alarm and/or CPU Select Light
- Reset CPU Selection (May be done if not in communicate mode or auto-interrupt mode).
- Reset NPR Error Indication (May be done in local mode only).
- Set Manual or Auto Disconnect of Communication Line.
- Set or Reset Inquiry Mode (See "Inquiry Mode" in Chapter 7).
- Enable or Disable Audible Alarm.
- Set or Reset Monocase—The monocase option causes the terminal to display, print, or transmit the keyed characters a through z as capitals.
- Set or Reset Switched Network Backup (SNBU).
- Reverse component selection for console printer and 3784 line printer (3774P only on BSC only). This option is reset only by the supervisor program or a system reset.

EXTEND CODE: This key, pressed in conjunction with the CODE key and a numeric key permits selection of the following functions:

- Create Diskette—Deletes all header labels and creates a volume label on the diskette.
- Copy Diskette (3774P/3775P Only)
- Copy Data Set (3774P/3775P Only)
- Erase Transaction Data Set
- Test Communication Facilities
- Print All Characters to Test Line Printer Belt (3774P/3775P Only)
- Set or Verify 3770 System Configuration (3774P/3775P Only)

Keys used in conjunction with the CODE and EXTEND CODE keys to select these functions are described in the *Operator's Guide.*

PGRM STOP: This key can be pressed to stop 3770 user-written or supervisor program execution so that an address can be entered for the address stop function.

PRINT: This key is active in rerun or error correct mode, and causes the selected transaction record to begin printing.

RESET: Pressing this key resets any program-detected error condition.

LINE: This key is active in rerun or error correct mode. In rerun mode, it can be used to print out the transaction record line-by-line. If the PRINT key was used to initiate printing of the transaction record, pressing LINE causes printing to stop after the end of the current line at the next keyboard source field.

In error correct mode, the LINE key can be used after corrections are made to cause the current line to print and then terminate error correct mode.

BKSP LINE (Backspace Line): Pressing this key in enter or rerun mode causes the machine to enter error correct mode, and the program returns to the beginning of the current line. If a transaction record is being created, correction can be made in any or all fields from the beginning of the line. If a transaction record is not being created, all data that was entered after the beginning of the line is deleted and must be reentered.

FIELD: This key is active in rerun or error correct mode. In rerun mode, it can be used to print out the selected transaction record field-by-field. If the LINE key was used in rerun mode to stop printing of the transaction record, pressing the FIELD key causes printing to continue to the beginning of the next keyboard source field.

In error correct mode, the FIELD key can be pressed, after corrections are made, to print out the corrected field and terminate error correct mode.

BKSP FIELD (Backspace Field): Pressing this key in enter mode causes the machine to enter error correct mode and return to the beginning of the field. The field or partial field must be reentered.

CHAR (Character): This key is active in rerun or error correct mode. In rerun or error correct mode, it can be used to print out the transaction record character-by-character. If the LINE key was used to initiate printing in rerun mode, pressing the CHAR key causes printing to continue to the next character (up to the end of the current field).

BKSP CHAR (Backspace Character): Pressing this key in enter mode causes the machine to enter error correct mode.

ENTER: This key is used to terminate variable-length fields.

Lights

Numeric Position Readout (NPR): This is a three-digit numeric display that provides different indications depending on the operation being performed. Message code numbers providing operator guidance, and indicating system status and error conditions are also displayed. These code numbers, in conjunction with other operator panel indicators being on, are related to operating procedures described in the *Operator's Guide.*

CPU SELECT: With the INTRP switch off, this light turns on to indicate that the terminal has rejected a line bid, an MPLC polling sequence, or an MPLC selection sequence because the terminal is not ready to operate in on line mode. With the INTRP switch on, the light turns on when the terminal is selected, and 3770 program execution stops (3774P/3775P). The light turns off after data is received, and the 3770 program resumes execution (see "CPU Interrupt" in this chapter).

PRINT INHIBIT: For BSC, this indicator is not used. For SDLC, this light turns on when the Inhibit Print command is received from the CPU and the keyboard is unlocked for entry of security data. This light turns off when the Enable Print command is received from the CPU.

OPRN CHECK (Operation Check): This light turns on and the Operator Attention Speaker sounds when the operator has performed an incorrect procedure, or when an I/O device needs attention.

SYS CHECK (System Check): This light turns on and the Operator Attention Speaker sounds when certain machine errors occur. A message code number will appear in the NPR indicating the cause of the error.

ON LINE: This light turns on when a communication link with the CPU has been established. The light blinks during actual transmission.

STANDBY: This light turns on when communicate mode is selected, and turns off when transmission begins. It remains off until transmission is complete, and then turns back on.

PROCEED: Data entry from the keyboard is permitted when this light is on.

UPPER CASE: This light is on when the keyboard is in upper case shift.

LOCAL: This light turns on when the terminal is in local mode.

ENTER: This light being on indicates that the terminal is in enter mode (see "Operating Characteristics").

***ALPHA/NUM (Alpha/Numeric):** This light turns on when an attempt is made to enter alphabetic information in a field specified for numeric entry only, to enter numeric information in a field specified for alphabetic entry only, or to enter non-alphameric information in a field specified for alphameric entry only.

***SELF CHECK:** This light turns on if an error is detected in a self-checking field.

RERUN: This light on indicates that the terminal is in rerun mode (see "Operating Characteristics—Modes of Operation" in this chapter).

PGRM STOP (Program Stop): This light turns on and program execution stops when the program executes a stop instruction.

***LENGTH:** This light turns on when an attempt is made to skip a mandatory field, to enter less than the minimum number of characters, or to enter more than the maximum number of characters in a field, as specified by the 3770 program.

***RANGE:** This light indicates that the field content entered did not pass a range check specified by the 3770 program. The 3770 program must specify that the light turn on.

*These lights turn on when a control or data key is pressed that is inappropriate to the job being run. The RANGE and SELF CHECK lights both turn on when an incorrect key is pressed while a program is executing.

Chapter 6. I/O Attachments

IBM 3203 Printer Model 3

The IBM 3203 Printer Model 3 (Figure 6-1) is a standalone high-speed printer that is cable-connected to the 3777 controller. Maximum print speed of the 3203 is as follows:

1000 lpm using the 48-character set
951/297 lpm using the 52-character set*
870 lpm using the 60-character set
843/530 lpm using the 63-character set (ASCII)*
530 lpm using the 120-character set
717/530/297 lpm using the 107 Katakana character set*
530/297 lpm using the 127 Katakana character set*

***Note:** These trains are multilevel trains. Some characters in the set print faster than others. Refer to the *IBM 3203 Printer Component Description and Operator's Guide*, GA33-1515, for more information on preferred character set trains.

Speed Enhancement Feature

This special feature on the 3203 Model 3 increases the maximum print speed to 1200 lines per minute with a 48-character print set. A special feature on the 3777 is required to support the Speed Enhancement feature on the 3203. Print speed increases are as follows:

Character Set	*3202-3 Without Speed Enhancement*	*3203-3 With Speed Enhancement*
48	1000 lpm	1200 lpm
60	870	1020
84/107	717	815
120/127	530	585

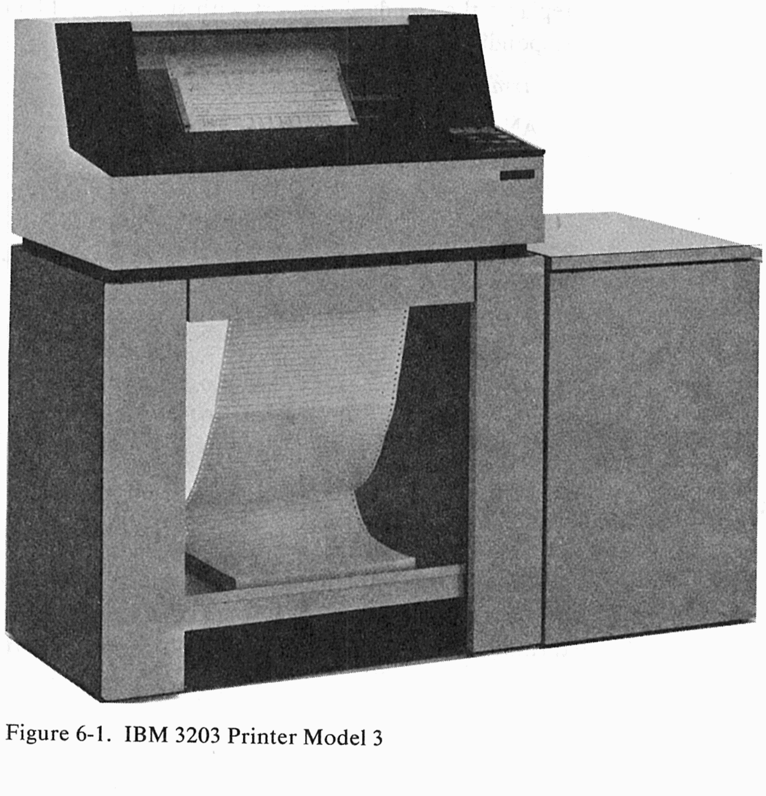


Figure 6-1. IBM 3203 Printer Model 3

The printer uses the IBM 1416 Interchangeable Train Cartridges which can be changed by the operator. Fifteen print train arrangements for the 3203/1416 are supported by the 3777 controller with the basic standard character set storage; eleven arrangements are supported with the optional International Print Support feature. The power-on default arrangement for EBCDIC on the 3777 is the AN print train arrangement; for ASCII, the default arrangement is GN. The corresponding 1416 Interchangeable Train Cartridge(s) must be ordered for the 3203 Printer.

Standard Character Set Trains

Included with the basic 3777 controller is storage for 15 print train arrangements for the corresponding 1416 train cartridges:

Arrangement	*Description*	*Character Set/Size*
AN	48 "A" Graphics	48 Graphics
HN	48 "H" Graphics	48 Graphics
PN	PL/1	60 Graphics
QN	PL/1–Scientific–Preferred	60 Graphics, 45 Preferred
RN	FORTRAN/COBOL Commercial	52 Graphics, 47 Preferred
GN	ASCII	63 Graphics
SN	Text Printing–Commercial	84 Graphics, 78 Preferred
TN	Text Printing–Scientific	120 Graphics
QNC	PL/1–Commercial–Preferred	60 Graphics, 45 Preferred
OAA	Alphameric	48 (5 "A" + 43 OCR-A)
PCS-AN	Preferred Character Set	48 "A", 3-level set
PCS-HN	Preferred Character Set	48 "H", 3-level set
ODA	Numeric	48 (38 "A" + OCR-A numeric)
OAB	Alphameric	48 (repr. of OCR-B graphics)
ONA	Numeric	48 (35 "A" + OCR-A numeric + 3 special characters)

International Print Support Feature Trains

An optional International Print Support specify feature is available on the 3777 and replaces the standard support with storage for 11 print train arrangements for the corresponding 1416 train cartridges:

Arrangement	*Description*	*Character Set/Size*
AN	48 "A" Graphics	48 Graphics
HN	48 "H" Graphics	48 Graphics
PN	PL/1	60 Graphics
QN	PL/1–Scientific–Preferred	60 Graphics, 45 Preferred
RN	FORTRAN/COBOL Commercial	52 Graphics, 47 Preferred
PCS-AN	Preferred Character Set	48 "A", 3-level set
KAT-107	Katakana Character Set	107
KAT	Katakana Character Set	127
AN-Modified	Equivalent to 3776/48-Char.	48
PN-Modified	Equivalent to 3776/64-Char.	64
SN-Modified	Equivalent to 3776/94-Char.	94

Printer Characteristics

Maximum print line length is 132 characters. Horizontal spacing is 10 characters per inch. Vertical spacing is six or eight lines per inch under control of the terminal operator. Carriage skipping speed is up to 18 inches per second.

The 3203 Printer is mechanically similar to the 1403 Printer Model N1. The character set is contained in a continuously rotating train within the interchangeable print cartridge. As the train rotates, it is continuously cleaned by a vacuum system built into the 3203. Inking is supplied by a fabric ribbon. Continuous edge-punched forms are fed by pin-feed forms tractors which are adjustable to accept forms ranging from 3 1/2 to 20 inches wide. Forms can vary in length from 3 to 24 inches. Design considerations for forms used with the 3203 Printer can be found in the publication *Forms Design Reference Guide for Printers*, GA24-3488.

The usage meter on the 3203 begins running when printing begins and stops running when the 3203 enters the not-ready state (the CARRIAGE SPACE and CARRIAGE RESTORE keys can be used). In addition, the 3777 Model 1 stops the usage meter at the end of a job (including local mode).

For more detailed information on the components, operation, and requirements of the 3203, refer to the *IBM 3203 Component Description and Operator's Guide*, GA33-1515.

3784 Line Printer

The 3784 Line Printer (Figure 6-2) is a line-type printer that can be cable-connected to the 3774 Model 1 or 2 or the programmable 3774 Model P1 or P2. Maximum print speed of the 3784 is as follows:

155 lpm using the 48-character set
120 lpm using the 64-character set
80 lpm using the 94-character set

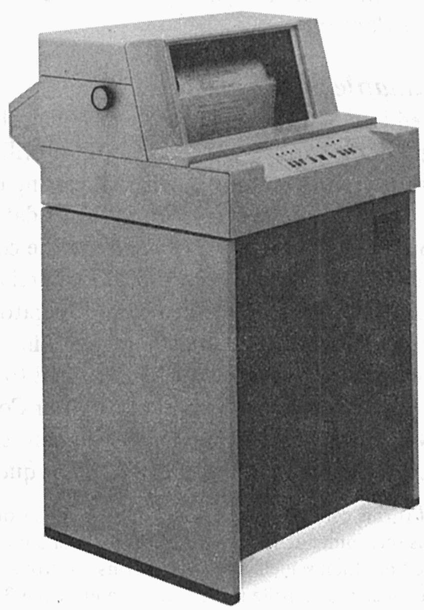


Figure 6-2. IBM 3784 Line Printer

The character set desired (48-, 64-, or 94-character set) must be specified when the 3784 is ordered. Additional print belts can be purchased, and can be changed by the operator. (ASCII print belts cannot be interchanged with EBCDIC print belts.) The printing speed automatically adjusts to the size of the character set contained on the print belt. Thus, depending on the job's printing requirements, the 48-character-set belt can be substituted for the 94-character-set belt, for example, to approximately double the printing speed. The characters provided by the 64- and 94-character sets are the same as those provided for the console printer; these and the 48-character set are shown in Appendix B. Using the 48- or 64-character set belt, the 3784 converts the 26 lowercase alphabetic characters a through z to uppercase and prints them. For Katakana machines, those Katakana characters having codes equivalent to EBCDIC lowercase alphabetic characters are converted to uppercase alphabetic characters. Maximum print line length is 132 characters.

The 3784 printer is mechanically similar to the 3775 and 3776 console line printer. The character set is contained on a continuously rotating metal belt, with inking supplied by a ribbon. This printer also uses a pin-feed forms tractor for feeding 1-part to 6-part edge-punched continuous forms. The tractors are adjustable to accept forms ranging from 3-1/2 to 15 inches wide. Forms design considerations for forms used with this printer can be found in the publication *Forms Design Reference Guide for Printers*, GA24-3488.

3784 Operation (Attached to Nonprogrammable 3774 Models)

The 3784 can be specified as the output device for either an operator-defined or a system-defined job, operating in either online or offline mode. Data to be printed (received from the communication line or read from a local device) is transferred from the 3774 dual controller buffer to an identical buffer in the 3784. From the dual 3784 buffer, data is transferred a line at a time to a 132-character print buffer for printing. Lines of data that are to be printed are delineated by NL, LF, FF, or IRS characters, as explained under "Printer Control Characters" in Chapter 7. If no control characters are included in the data, line spacing occurs after data fills a line as defined by the Horizontal Format Control.

3784 Operation (Attached to Programmable 3774 Models)

When attached to a 3774 programmable terminal, the 3784 is under control of the user-written program, the card reader-to-line printer utility, or the communicate mode function for an online job (BSC only). When operating under control of the user program, the program can either control all formatting of data in the program to be printed, or set up the format control in the 3784 and use the control characters (description following) to define format. The forms setup (horizontal and vertical tabs) must be performed under control of the user-written program. Operator control is not provided. When the 3784 receives a component selection for a BSC line-to-printer job it operates on the buffer of data in the same way as it does when attached to a nonprogrammable 3774 model. Refer to the previous description and to "Printer Control Characters" in Chapter 7. Horizontal and vertical formats set by a user program remain active for a BSC line-to-printer operation unless changed by ESC HT/ESC VT sequences from the host CPU.

Note: Default forms control is established only at power-on time. To ensure proper forms control, the following is recommended. If an operator starts a communications job on the 3774 console printer and the host then selects and sends forms control sequences to the 3784 printer, the host program should reselect the console printer at the end of the 3784 output job. This will prevent certain host application programs from printing under the wrong forms control.

Vertical Forms Control

Vertical forms control allows the forms to be vertically formatted by skip areas and print areas. Once the format is set, printer control characters contained in the print data cause the forms to advance as specified text areas are printed. Procedures for setting up the vertical forms control during an operator job definition are contained in the *Operating Procedures Guide.*

Horizontal Format Control

Horizontal format control allows horizontal formatting of print lines by print areas and tab areas, and eliminates the need to transmit spaces within the line. Once the format is set, HT characters contained in a line of print data cause tabbing (skipping) over areas that are not to be printed (see "Printer Control Characters" in Chapter 7). Procedures for setting the horizontal format control during an operator job-definition procedure are contained in the *Operating Procedures Guide.* As with the console printer, these settings are stored in the terminal as part of the job definition. A horizontal format message from the CPU can also be used to perform this setup, and will override any operator job definition. The horizontal tab format message is described in Chapter 7, "Programming Considerations."

Print Test

A pattern of all characters on the print belt can be printed for test purposes without the need for any 3774 job definition. The pattern can be repeated as long as desired, and checks the mechanical and electronic printer components.

Print Error Log

The 3784 Printer maintains an error log similar to the error log described for the 3774 terminal. This error log should be printed out by the operator when persistent errors occur on the 3784 Printer. The printout should be retained and given to the service representative, who will use it to determine the cause of the problem. The printout must be obtained before the 3784 power is turned off, because the error-log information is lost once power is turned off.

3784 Special Features and Accessories

Additional Print Belts

Additional print belts (purchase-only accessories) are available for the 3784 printer. Belts are available for EBCDIC or ASCII, and 48-, 64-, and 94-character sets for the various countries shown in Appendix B.

Katakana Feature

This special feature provides the 127-character Katakana set on the 3784 Printer, as shown in Appendix B. Printing speed is reduced to 40 lpm using the Katakana character set. The Katakana print belt can be interchanged with the optional 48- and 64-character set Japanese print belt on the 3784 line printer with a resulting increase in throughput.

When using a 48- or 64-character set print belt on a Katakana printer, the 3784 converts the EBCDIC equivalent of the lowercase alphabetic characters (a through z) to uppercase alphabetic characters before printing them. For example: EBCDIC hexadecimal '81' converts to hexadecimal 'C1'.

If characters in print data are not present on the line printer belt, a hyphen(-) prints.

Forms Stand Accessory

A Forms Stand accessory is available (purchase only) to facilitate handling of continuous fan-fold forms.

3784 Operator's Panel

The following switches and lights are located on the 3784 Line Printer operator's panel (Figure 6-3). Refer to the *Operating Procedures Guide* for actual machine operation.

MACHINE RESET Switch: Pressing this momentary switch causes the system to reset and to go through the same initialization sequence as occurs when the power is turned on.

8LPI/6LPI (8/6 Lines Per Inch) Switch: The position of this switch determines whether the 3784 prints 8 or 6 lines per vertical inch. The 8LPI/6LPI switch is operational only when the HOLD PRINT switch is on (the HOLD PRINT light is on).

FORM FEED Switch: Pressing this momentary switch causes the form to advance to the first print line relative to the job description on the next form (a carriage restore operation). The FORM FEED switch is operational only when the HOLD PRINT switch is on (the HOLD PRINT light is on).

HOLD PRINT Switch: Pressing this switch to the ON position stops the printer to permit manual operations such as loading or adjusting forms. On an end-of-forms condition, rocking this switch on and off causes one line at a time to print. Pressing this switch to the OFF position permits an active job to resume printing.

SET UP Switch: Pressing this switch causes one line of X's to print for initial forms alignment of pre-printed forms, for example. The SET UP switch is operational only when the HOLD PRINT switch is on (the HOLD PRINT light is on) and no printer job is active.

PRINT ERROR LOG Switch: Pressing this switch to the ON position causes the error log to be printed. The PRINT ERROR LOG switch is operational only when the HOLD PRINT switch is on (the HOLD PRINT light is on) and no printer job is active. This switch should be pressed to the OFF position after the error log printout is finished.

PRINT TEST Switch: Pressing this switch to the ON position starts an operation that tests the print belt. The PRINT TEST switch is operational only when the HOLD PRINT switch is on (the HOLD PRINT light is on) and no printer job is active. Pressing this switch to the OFF position stops the printing.

MACHINE CHECK Light: This light turns on to indicate a printer failure or error such as a thermal failure in the printer.

8LPI (8 Lines Per Inch) Light: This light indicates that the printer is set up to print 8 lines per inch (the 8LPI switch is on).

OPRN CHECK (Operation Check) Light: This light turns on to indicate that operator intervention is required to recover from an error.

HOLD PRINT Light: This light turns on when the HOLD PRINT switch is turned on.

PRINTER READY Light: When on, this light indicates that the printer is available to receive data from the controller.

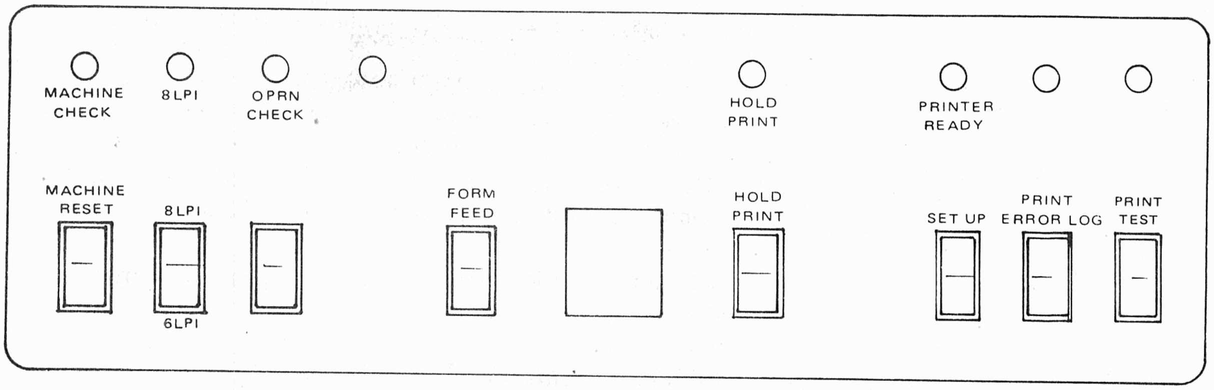


Figure 6-3. 3784 Operator's Panel

IBM 2502 Card Reader

Three models of the IBM 2502 card reader (Figure 6-4) can be attached to certain 3770 models. The 2502 Model A1 can read 150 cards per minute, the Model A2 can read 300 cards per minute, and the Model A3 can read 400 cards per minute. Model A1 or A2 of the 2502 attaches through the IBM 3782 Card Attachment Unit Model 2 to the 3774 Model 1, 2, P1 or P2; 3775 Model 1 or P1; or 3776 Model 1 or 2. The 3782 contains the power supply and other electronic circuitry, serves as the mounting base for the 2502 Model A1 or A2, and is cable-connected to the 3774, 3775, or 3776 controller. Model A1, A2, or A3 of the 2502 attaches to the 2502 Card Reader Attachment feature of the 3777 Models 1 and 2 and is physically mounted on the controller console (refer to Figures 1-7 and 1-8).

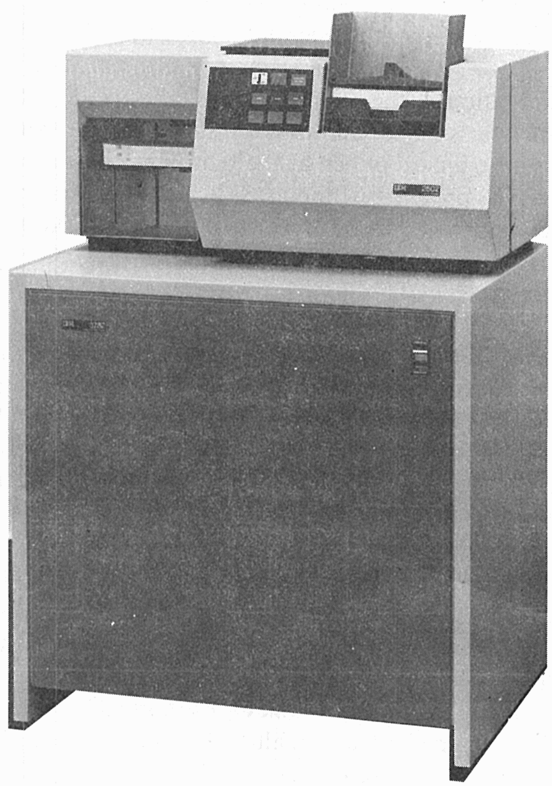


Figure 6-4. IBM 2502 card reader Model A1 or A2/3782 Card Attachment Unit, Model 2

Special features for the 2502 permit reading of 51- and 80-column cards interchangeably, or of 66- and 80-column cards interchangeably. The operator can easily change the machine to read either standard 80-column cards or one of the short-length cards. Both short-length cards cannot be read by the same machine, however. An Optical Mark Read feature (not available with the 3777 Models 1 and 2) equips the machine to read hand-marked or machine-marked cards in addition to punched cards. This feature can be used with any length (51-, 66-, or 80-column) cards.

Card codes and specifications for punched and marked cards are shown in Appendix C.

2502 Operation (Attached to Non-Programmable 3770 Models)

The 2502 feeds cards on command from the 3770 controller and reads card data to the buffer column-by-column. Each command from the controller transfers an entire card's data. The controller translates the card code to the 3770 internal code and stores it into the buffer. From the buffer, the 3770 terminal can read the data out to the communication line or to a locally attached output device.

Validity Checking

Each card column is checked for multipunches or multimarks in rows 1 through 7. An invalid code detected stops the 2502 and turns on the VALIDITY CHECK light. The CARD READER light on the 3770 terminal's console turns on to signal the operator that the 2502 requires attention, and an error code is displayed in the NPR.

BSC Nontransparent Operation

In BSC nontransparent operation, blank card columns are compressed when they are encountered between data fields (if the job definition specifies space compress), or stripped off if they appear toward the column-80 end of the card. Elimination of the blank columns takes place before the data enters the controller's buffer and thus conserves buffer space for storage of useful data. On output to a card punch at the remote CPU (online mode), or to an attached card punch or printer (offline mode), the blanks are reinserted into the output data stream, or expanded. Data written to the diskette device is not expanded, but will be expanded on output from the diskette device to the card punch (or by the CPU, if desired).

With the Optical Mark Read feature (not available with the 3777 Models 1 and 2), both punches and marks can be read from the same card by use of the "mark read transfer" character. Punches must be contained on the left side of the card, and marks on the right side. The mark read transfer character is punched at the end of the punched-data field, and causes the 2502 to switch to mark-read mode for the remainder of the card.

Cards continue to read and store into the buffer as long as sufficient buffer space remains to contain an entire card's data plus one space for the IRS character to indicate end-of-card. For example, assuming 80-column cards are being read, 81 buffer positions must be available if another card is to store in the buffer, regardless of the number of blank card columns in the next card. If less than 81 positions remain, the buffers alternate and the next card stores in the next buffer. The 3776 and 3777 are exceptions. If card data is being compressed, an attempt is made to write the next card into the current buffer regardless of the number of spaces remaining. When overflow occurs, the buffer is terminated with the last full card stored, and the card causing the overflow is stored in the next buffer.

Using fully punched or marked cards, the number of characters transferred to the controller's buffer is as follows:

Card Size	*Punched Data*	*OMR Data*	*OMR and Punched Data*
80 Column	80 Characters	40 Characters	See Note
66 Column	66 Characters	33 Characters	See Note
51 Column	51 Characters	26 Characters	See Note

Note: The number of characters transferred to the buffer depends on the position of the "mark read transfer" character. For a description of reader operation when both punches and marks are being read, refer to "Type-of-Data Selection" and "Mode Switch" under the discussion of the OMR special feature.

For blank fields of two or more columns between data fields, a count sequence is inserted into the buffer in place of the blank columns. This sequence is an IGS character followed by a count of the blank columns removed, as described under "Operating Characteristics–Space Compression/Expansion." On output at the CPU, or on output to an attached card punch, blanks compressed and replaced by this count sequence are reinserted into the output data stream.

BSC Transparent Operation

In transparent mode operation, blank columns are not stripped from data but are read into the buffer wherever they appear in the card. When short-length cards (51 or 66 columns) are used in this mode of operation, each buffer block contains one card of data, regardless of which card length is used or of the number of blank columns in the card; data blocks transmitted to the CPU always contain either 51 or 66 data characters, depending on which card length is used. When 80-column cards are used in this mode of operation, three cards of data (240 data characters, assuming fully punched cards) are contained in each transmission block. On the 3776 and 3777-1 using the 512-byte buffers, six cards (480 data characters) are contained in each block. (This section does not apply to the 3777 Model 2.)

SDLC Nontransparent Operation

This mode of operation is the same as BSC nontransparent with the exception that duplicate characters can be compressed as well as blank card columns (see "Operating Characteristics—SDLC Compression/ Expansion" in the appropriate chapter).

SDLC Transparent Operation

In this mode of operation, blank columns are stripped from the end of the card. Useful data is preceded by a TRN character (X'35') and a one-byte binary count of the transparent data. Following the data is an IRS character ('1E'). Short cards are handled in the same manner; therefore, multiple cards can be read into a single buffer until less than 81 positions remain in the buffer.

End of File

An EOF (end of file) switch on the 2502 operator's panel controls the EOF signal to the controller. When the EOF switch is ON and the last card is read, an end-of-file signal is sent to the controller causing the transmission frame or block for this buffer load to be flagged as the last block or frame of the job.

The EOF switch should be turned ON when the last batch of cards for the job is placed in the hopper. If the EOF switch is OFF when the last card feeds out of the hopper, the ATTENTION indicator turns on and the Operator Attention Speaker sounds. Unless the operator presses NPRO, places more cards in the hopper, and presses the START key within three minutes, the controller aborts and ends the job.

2502 Operation (Attached to Programmable 3770 Models)

When attached to a programmable 3774 or 3775, the 2502 is under control of (1) the user-written program, (2) one of the 3770P card system utilities (reader-to-diskette, reader-to-printer, or reader-to-punch), or (3) the communicate mode function for an online job (BSC only).

When operating under control of a user-written program, the 2502 reads a single card including blank columns, into an 80-byte area in user storage when a card read instruction is executed. From storage, the 3770 programmer can cause whatever processing is desired on the card data. If reading short cards, (51 or 66 columns), the remainder of the 80-byte storage area is filled with blanks.

For more information on the card system utilities and other programmable operations, refer to the *IBM 3773, 3774, and 3775 Programmable Communication Terminals Operator's Guide,* GA27-3114.

When the 2502 is selected by the operator or the supervisor program for a card reader-to-(BSC) communication line job, the data format options are the same as for a system-defined job on the nonprogrammable 3774 or 3775. The options are transparent, non-transparent, and space compression—the same options as are available to the card reader-to-diskette utility.

Validity checking is performed on card data in the same manner as described for a 2502 attached to a nonprogrammable terminal.

The EOF (end of file) signal is raised when the last card is read and the 2502 EOF switch is on or when a /*EOF card is read (/*EOF followed by 75 blanks). The EOF signal sets a condition code that can be tested by the 3770 program or is detected by the utility or the communicate mode function.

2502 Special Features

51-Column Interchangeable Feed Feature

This special feature (not available with the 3777 Model 2) allows the 2502 card reader to feed 51-column cards. The operator can easily change the 2502 from 80-column card processing to 51-column card processing and vice versa. 51-column and 80-column cards cannot be intermixed. Installation of the feature does not affect normal 2502 operations and does not change the card feed rate of 150, 300, or 400 cards per minute.

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

66-Column Interchangeable Feed Feature

This special feature (not available with the 3777 Model 2) allows the reader to feed 66-column cards. Otherwise, this feature is identical to the 51-column feature.

This feature can be installed in the field. A 2502 cannot have both this feature and the 51-Column Interchangeable Feed feature. 66-column and 80-column cards cannot be intermixed.

Optical Mark Read (OMR) Feature

This special feature (not available with the 3777 Models 1 and 2) provides the 2502 with a mark-read unit at the read station. This unit enables the 2502 to read vertical nonreflective marks, such as number-2 pencil marks, from mark positions in the mark-read field of the cards. Mark reading is controlled by a switch on the 2502 operator's panel. Mixed punched and OMR cards are not permitted in BSC Transparent mode. A companion OMR feature is also required on the 3782 Model 2.

Marking the OMR Card: Figure 6-5 shows a mark constraint. Every mark position used for the application must contain a mark constraint printed in reflective ink that will not be read by the 2502 (see "2502 OMR Card Specifications" in Appendix C).

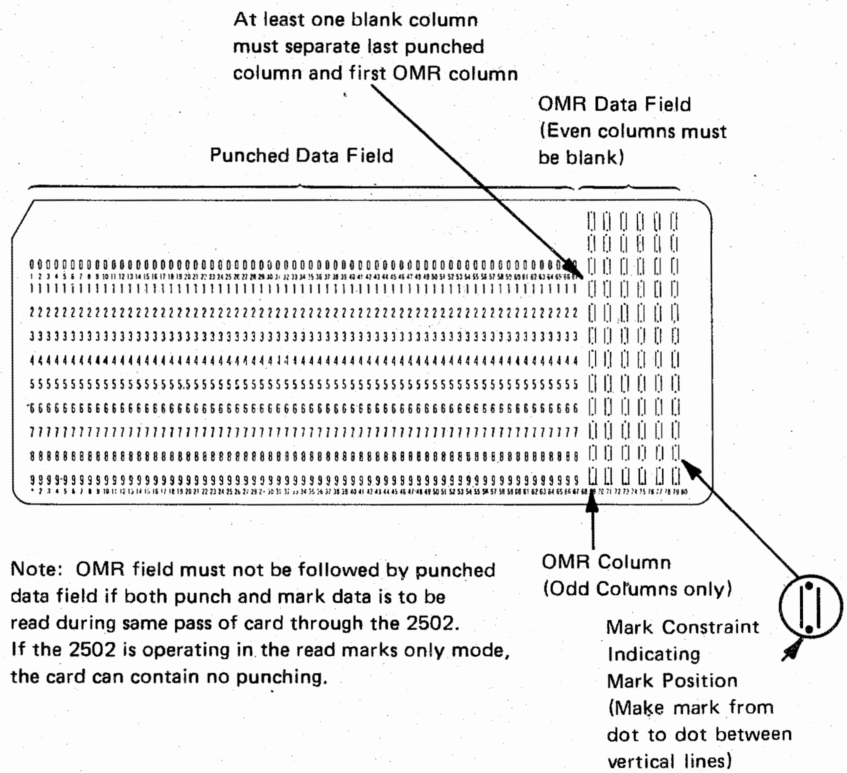


Figure 6-5. Punched and OMR Data

To enter mark data on the card, mark from dot to dot in each appropriate position, making certain that the mark falls between the constraint lines.

OMR specifications indicate the reflectance measurement required for reading marks, and for not reading erasures. Generally, heavy lines made carefully with a number 2 pencil are satisfactory. Erasures must be made carefully and completely to prevent the mark from being read. A card can contain nonreflective printing on the left of the card if there is a "mark read transfer" character at the right of all nonreflective printing and the Mode switch is set at its M/P setting (see "2502 Operator's Panel–Mode Switch" in this chapter). This transfer character is the EBCDIC IFS character (card code 11-9-8-4, hex '1C').

Mark-Read Data Validity: The 2502 treats a column of OMR data exactly as it treats a column of punched data, applying the same rules for data validity.

Type-of-Data Selection: A three-position switch on the 2502 operator's panel (see Figure 6-4) controls whether punches only, punches and marks, or marks only are to be read from the cards. If both punches and marks are to be read, the 2502 reads punched holes from the left of the card until it encounters a "mark read transfer" character (IFS) ending the punched-data field. The reader remains in mark-read mode for the remainder of the card, and switches to punch-read mode on the following card. The IFS character (X'1C') is treated as a data character. It is sent on the communication line or written on the output device. Combination cards (containing both punches and marks) should not be read in transparent mode.

The transfer character must be followed by at least one blank column. If the transfer character is punched in an even-numbered card column, it must be followed by two blank columns (since OMR data must be located in odd-numbered columns). For example, if the transfer character is punched in column 50, columns 51 and 52 are blank, and the first marked column is column 53.

Mark Reject: Each 2502 equipped with the OMR feature is also equipped with an offset-stacking feature. Whenever an undefined character (light mark or poor erasure) is detected while the 2502 is in mark-read mode, the card containing the undefined character is offset (toward the operator) about 0.7 inch from other cards in the stacker. Data from the card containing the undefined character is not transmitted to the output device.

2502 Operator's Panel

The following keys, lights, and switches are located on the 2502 card reader operator's panel (Figure 6-6).

START Key: Pressing this key causes a card to feed from the hopper to the cornering station and places the card reader in a "ready" status if the 2502 is assigned by the job definition and has cards in the hopper.

On the 3776 and 3777-1, a card reader-to-line job is automatically started when the 2502 is made ready, the terminal is in standby mode, and the 2502 is not involved in a dual job. Under these conditions, the START-JOB procedure is not necessary (see "Automatic Card Reader-to-Line Function" in Chapter 4).

STOP Key: Pressing this key stops the card reader after the card passing the read station is completely read and placed in the stacker. A signal is sent to the controller indicating that the card reader has lost its "ready" status.

STACKER UNLOAD Key: Pressing this key causes the card reader to stop for about 30 seconds (Model A1) or 15 seconds (Model A2) to allow time for unloading the stacker or adding cards to the hopper.

NPRO (Non-Process Run Out) Key: Pressing this key causes cards to be ejected from the card path without being read and resets any error conditions.

EOF (End of File) Switch: This switch should be set to the OFF position while any cards in the file being used are yet to be loaded into the hopper. When placing the last cards in the hopper, set the EOF switch to the ON position. When the last card has been read without error, the card reader signals an end-of-file condition to the controller or user-written program.

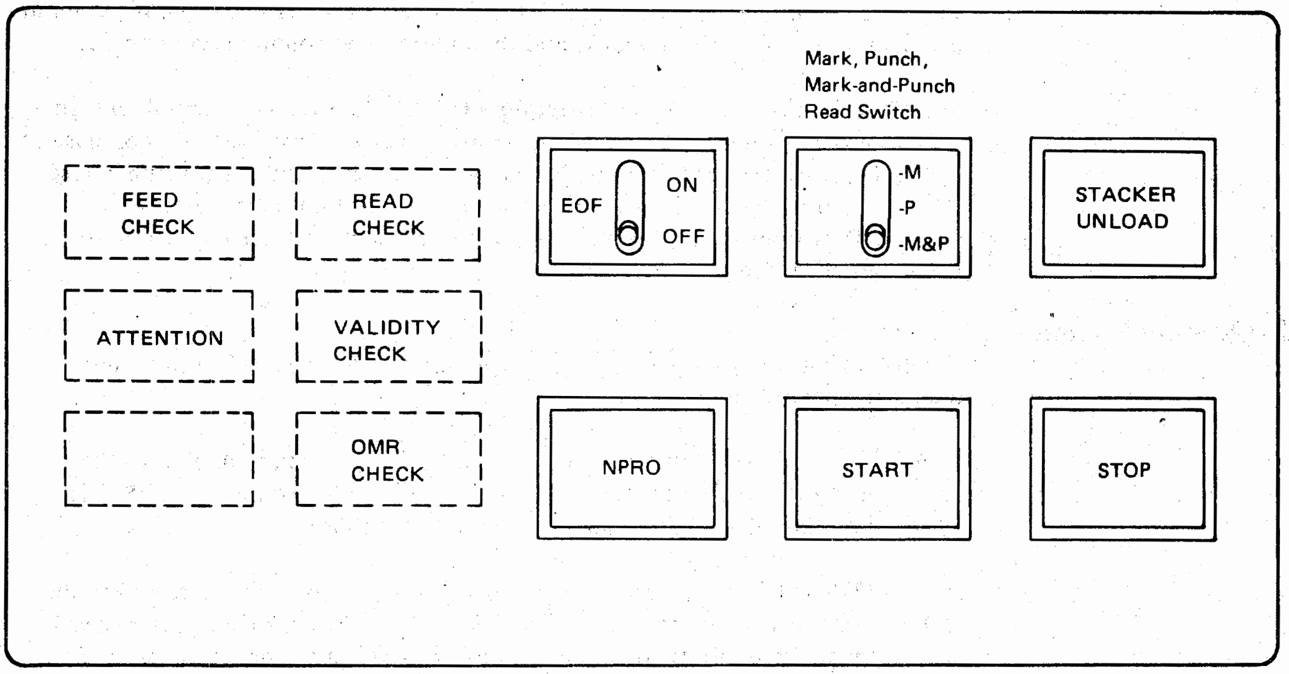


Figure 6-6. 2502 Operator's Panel

Mode Switch: This switch is present only on machines having the Optical Mark Read special feature. The switch has three positions:

M (Marks). Set the switch to this position when cards to be read contain marks only.

P (Punches). Set the switch to this position when cards to be read contain punches only. These cards may have marks and nonreflective printing in any location on the card.

M/P (Marks/Punches). Set the switch to this position when cards to be read contain punches followed by marks.

ATTENTION Light: This light turns on to indicate that the 2502 is not ready; it may indicate either a full stacker, an open cover, or a stacker jam, or that all cards have been read and the EOF switch is OFF (see "2502 Card Reader Operation—End of File").

READ CHECK Light: When on, this light indicates either that the card did not feed properly through the read head, the card punches are not in registration, or a card reader sensor failed.

FEED CHECK Light: When on, this light indicates that a card did not feed properly from the hopper.

VALIDITY CHECK Light: This light indicates that an invalid code (multipunch or multimark in card rows 1–7) was read.

OMR CHECK Light: This light indicates a mark that is too light, a poorly made erasure (or smudge), or that the OMR read unit lamp has overheated.

3501 Card Reader

The 3501 card reader (Figure 6-7) is a small tabletop unit that can be attached to the 3771, 3774, 3775, or 3776 for reading cards at a rated speed of 50 cards per minute. The reader is cable-connected to the 3770 controller. The 3501 can be placed on the work surface of the 3774, 3775, or 3776; otherwise, a table or stand for the card reader must be provided by the user.

Card codes and specifications for punched cards are shown in Appendix C. No special features are available for the 3501 card reader.

3501 Operation (Attached to Nonprogrammable 3770 Models)

The 3501 feeds cards on command from the terminal's controller and reads card data to the buffer column-by-column. Each command from the controller transfers an entire card's data. The controller translates the card code to the 3770 internal code and stores it into the buffer. From the buffer, the terminal can read the data out to the communications line (online mode) or to the selected output device (offline mode).

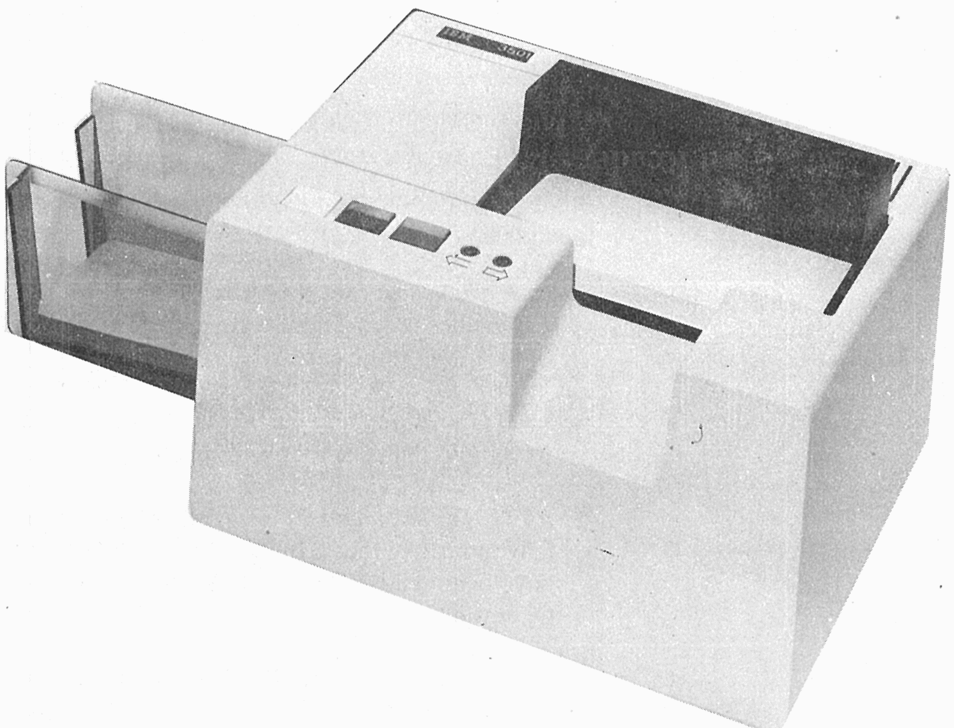


Figure 6-7. IBM 3501 card reader

Validity Checking

Each card column is checked for multipunches in rows 1 through 7. An invalid code detected stops the 3501, and the CARD READER light on the terminal's console turns on to signal the operator that the 3501 requires attention.

BSC Nontransparent Operation

In BSC nontransparent operation, blank card columns are compressed when they are encountered between data fields (if space compression is specified by the operator), or stripped off if they appear toward the column-80 end of the card (whether or not space compression is specified). Elimination of the blank columns takes place before the data enters the buffer and thus conserves buffer space for storage of useful data. On output to a card punch at the remote CPU (online mode), the blanks are reinserted into the output data stream, or expanded.

Cards continue to read and store into the buffer as long as sufficient buffer space remains to contain an entire card's data, plus one space for the IRS character to indicate end-of-card. If less than 81 positions remain, the buffers alternate and the next card stores in the next buffer, regardless of the number of blank card columns in the next card. The 3776 and 3777 are exceptions. If card data is being compressed, an attempt is made to write the next card into the current buffer regardless of the number of spaces remaining. When overflow occurs, the buffer is terminated with the last full card stored, and the card causing the overflow is stored in the next buffer.

For blank fields of two or more columns between data fields, a count sequence is inserted into the buffer in place of the blank columns. This sequence is an ESC character followed by a count of the blank columns removed, as described under "Operating Characteristics—Space Compression/Expansion." On output at the CPU, or on local output to an attached card punch, blanks compressed and replaced by this count sequence are reinserted into the output data stream.

BSC Transparent Operation

In transparent mode operation, blank columns are not compressed or stripped from data but are read into the controller's buffer wherever they appear in the card. In this mode, three cards (six cards on 3776 using 512-byte buffers) are contained in each buffer of data. Data blocks transmitted to the CPU always contain 240 bytes (480 bytes on 3776 using 512-byte buffers), assuming fully punched cards.

SDLC Nontransparent Operation

This mode of operation is the same as BSC nontransparent with the exception that duplicate characters can be compressed as well as blank card columns (see "Operating Characteristics—SDLC Compression/ Expansion" in the appropriate chapter).

SDLC Transparent Operation

In this mode of operation, blank columns are stripped from the end of the card. Useful data is preceded by a TRN character (X'35') and a one-byte binary count of the transparent data. Following the data is an IRS character ('1E'). Short cards are handles in the same manner; therefore, multiple cards can be read into a single buffer until less than 81 positions remain in the buffer.

End of File

The last card of a file must be punched with /*EOF (five characters) to indicate end-of-file to the controller. The five characters must be punched into a separate card containing these five characters in the first five columns with the remainder of the card blank.

3501 Operation (Attached to Programmable 3770 Models)

When attached to a programmable 3774 or 3775, the 3501 is under control of (1) the user-written program, (2) one of the 3770P card system utilities (reader-to-diskette, reader-to-printer, or reader-to-punch), or (3) the communicate mode function for an online job (BSC only).

When operating under control of a user-written program, the 3501 reads a single card, including blank columns, into an 80-byte area in user storage when a card read instruction is executed. From storage, the 3770 programmer can cause whatever processing is desired on the card data.

For more information on the card system utilities and other programmable operations, refer to the *IBM 3773, 3774, and 3775 Programmable Communication Terminals Operator's Guide,* GA27-3114.

When the 3501 is selected by the operator or the supervisor program for a card reader-to-(BSC) communication line job, the data format options are the same as for a system-defined job on the nonprogrammable 3774 or 3775. The options are transparent, non-transparent, and space compression–the same options as are available to the card reader-to-diskette utility.

Validity checking is performed on card data in the same manner as described for the 3501 attached to a nonprogrammable terminal.

The last card of a file must be punched with/*EOF (five characters) to indicate end-of-file to the program. The five characters must be punched into a separate card containing these characters in the first five columns with the remainder of the card blank. This card sets a condition code that can be tested by the 3770 program or is detected by the utility or the communicate mode function.

3501 Operator Controls

Lights

Two lights on the operator's panel are used to indicate ready and check conditions of the 3501. Both lights being on indicates that the card reader is ready; and one light off indicates a check condition. Check conditions indicated by the lights are: invalid punch (multipunch in rows 1 through 7), card feed failure, card jam, or empty hopper.

Keys

Two unlabeled keys, a green key and a red key, are used to start and stop the 3501 card reader. The green (start) key places the 3501 in a ready condition if the card reader is assigned by the job definition and has cards and card weight in the hopper. The red (stop) key stops the card reader and drops the ready condition to allow unloading the stacker or placing more cards in the hopper.

3521 Card Punch

The 3521 Card Punch (Figure 6-8) can be attached to a 3771, 3774, 3775, 3776, or 3777-2 to provide punched-card output into 80-column cards at 50 cards per minute. The 3521 is attached via a 3782 Card Attachment Unit Model 1, which is cable-connected to the terminal's controller.

Special features for the 3521 provide punch-checking capability, card reading, (except with the 3777-2) and printing (interpreting) on the card.

3521 Operation (Attached to Nonprogrammable 3770 Models)

(This section does not apply to the 3777 Model 2.) The 3521 operates under control of the 3770 terminal's controller. Data reads out of the controller's buffer byte-by-byte for punching.

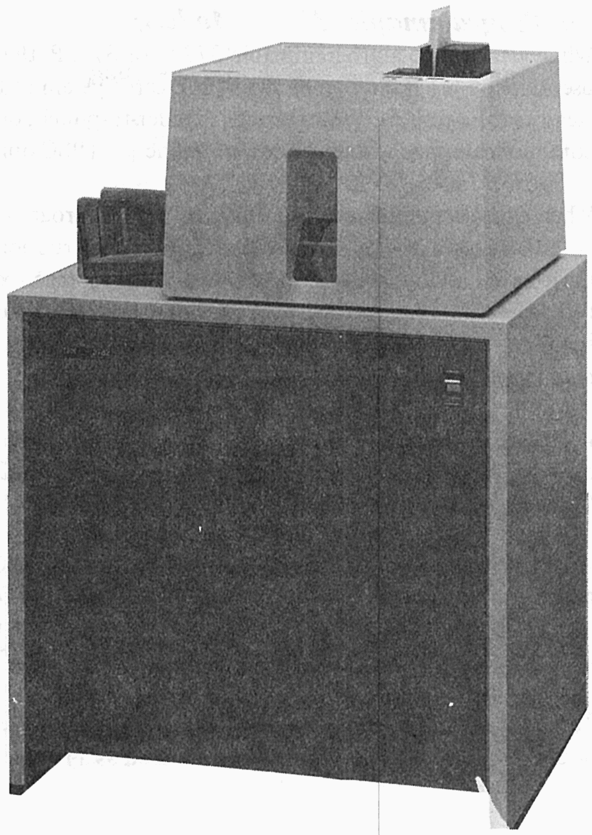


Figure 6-8. IBM 3521 Card Punch/3782 Card Attachment Unit, Model 1

When running at line speeds above 2400 bps to the 3521 Card Punch, Monitor Printing must be limited to those jobs that exclude card printing (interpreting) and card read-back checking (applies to the 3771, 3774 Models 1 and 2, and the 3775 Model 1).

BSC Nontransparent Operation

In this mode of operation, data is formatted in the buffer for punching by IRS characters, which signal the end of a card. On readout to the card punch, the IRS character causes punching to be suspended for the remainder of the card, and punching can resume in column 1 of the next card. If IRS characters are not used to format card data received from the CPU, 80 columns are punched. Assuming that full-buffer loads of data (256 bytes) are received, three full cards (240 bytes) and one partial card (16 bytes) are punched for each buffer. On the 3776 using the 512-byte alternating buffers, six full cards (480 bytes) and one partial card (32 bytes) are punched for each buffer.

Data that was compressed (BSC Space Compression) is expanded on output from the controller's buffer to the 3521. The spaces that were compressed (as explained under "Operating Characteristics—BSC Space Compression/Expansion") are reinserted into the data stream to the card punch.

BSC Transparent Operation

BSC transparent data from the CPU that is intended for punching must be transmitted one, two, or three full cards per block (80, 160, or 240 characters per block), with spaces (blanks) inserted wherever they are to appear in the card. On the 3776 using the 512-byte buffers, up to six full cards can be received in a block. IRS or other control characters within the data block will not be recognized as such in this mode, but will be punched as data.

3521 Operation (Attached to Programmable 3770 Models)

When attached to a programmable 3774P or 3775P, the 3521 is under control of the user-written program, one of the 3770P card system utilities (punch-to-punch [Card Read feature-to-Card Print feature], reader-to-punch, or keyboard-to-punch), or the communicate mode function for an online job (BSC only).

When operating under control of a user-written program, the 3521 punches a card from an 80-byte area in user storage when a punch instruction is executed. The card image must have previously been constructed in the storage area by the 3770 program. On a fully-featured 3521 (see 'Special Features' in this chapter) the punch instruction can specify 'Punch only', 'punch with read check', 'punch with interpret', or 'punch with read check and interpret'.

For more information on the card system utilities and other programmable operations, refer to the *IBM 3773, 3774, and 3775 Programmable Communication Terminals Operator's Guide,* GA27-3114.

When the 3521 receives a component selection for a BSC communication line-to-card punch job, the data is punched as described previously for the nonprogrammable 3774 or 3775. Punch options are: interpret when punching, no interpret when using the Card Read feature, and no inhibit of the read-back-check function.

The 3521 with the Card Read feature can operate in a card reader-to-line job like a 2502 or 3501. However, the 3521 cannot be used as a reader and a punch in the same session.

3521 Special Features

Card Read Feature

This feature adds a read station for reading 80-column cards and for punch checking. When both a 3521 with the Card Read feature and either a 2502 or 3501 are attached to a 3770 programmable terminal, device selection depends on the utility using the card reader or upon options specified in the read card instruction.

During *punching*, data punched into the card is compared with the data that was intended for punching. If the data does not compare, the punch stops and an error is indicated to the operator. Data is also checked for invalid characters, or multi-punches in rows 1 through 7. The punch-check can be disabled by specification in the punch card instruction, in order to prevent an error indication when punching internally scored or prepunched cards.

Card read operation and data format are the same as described for the 3501 card reader. During *read* operation, data is also checked for invalid characters and for multipunches in rows 1 through 7. During card read operation, the last card of a file must be punched with /*EOF (five characters) to indicate end-of-file to the controller. The five characters must be punched into the first five columns of a *separate* card.

Card Print Feature

With this feature, the 3521 can print (interpret) cards as they are punched or read. Printing is under control of the user-written program, as coded by the programmer. Printing is above the 12 row (top) of the card, column-for-column.

The EBCDIC 64-character set shown in Appendix B is provided on all machines. The characters are 0.062 inch wide by 0.079 inch high. Ink is supplied by an ink roll in contact with the type faces and is transferred directly from the type face to the card; no ribbon is used. The ASCII 64-character set is also available for use in the U. S. and Canada.

Katakana Card Print Feature

This feature allows the 3521 to print (interpret) the Katakana 127-character set on the card.

When this feature is installed, the 3521 speed is reduced to 25 cards per minute during punching, printing, or reading. The Katakana character set is shown in Appendix B.

3521 Operator's Panel

The following lights and keys are provided on the 3521 operator's panel.

Lights

Two lights on the operator's panel are used to indicate ready and check conditions of the 3521. Both lights being on indicates that the card punch is ready; and one light off indicates a check condition. Check conditions indicated by the lights are: card jam, empty hopper, and misfeed from the hopper. If the Card Read feature is installed, the lights also indicate a wrong punch (punch check), or multiple punches in rows 1 through 7 (invalid punch).

Keys

Three unlabeled keys (green, red, and blue) are used to control the 3521. The green (start) key causes a card to feed from the hopper and register at the punching station, if no error conditions exist, and places the card punch in a ready condition. The red (stop) key stops the card punch and drops the ready condition. The blue (nonprocess runout) key clears cards from the card feed and resets any error condition. These keys are active only when the 3521 code is loaded into user storage.

Chapter 7. Programming Considerations—Binary Synchronous Communications

The 3770 terminals conform to the rules for binary synchronous communications as described in the publication *General Information—Binary Synchronous Communications*, GA27-3004. This section provides specific information about use of certain data link and printer control characters, abort conditions, component selection procedures, and terminal identification.

Under normal MULTI-LEAVING operation of the 3777 Model 2, the information in this chapter does not apply. Refer to Chapter 9 for the 3777-2.

2770/3770 Compatibility

Non-Programmable 3770 Models

Those IBM programming systems identified as supporting the 2770 may also be used by the 3770 operating in BSC mode. Figure 7-1 is a comparison of features provided by the 2770 and by the 3770 terminals. Application programs written for communication with the 2770 can be used, with modification, for communication with the 3770 terminals. Modifications may be required because some features or functions provided by the 2770 are not present on the 3770 terminals, or operate in a different manner.

The 3770 must be defined to the using programming system as a 2770.

The using program must always define a 2770 with the 256/256 Character Alternating Buffer feature (Buffer Expansion), as this is the only buffer size available to the 3770.

Some of the 2770 component selection characters (component addresses) are customer specifiable and field changeable. The 3770 component selection characters cannot be changed. See "Component Selection" in this chapter for the 3770 component selection programming considerations. See "Appendix B" for World Trade special characters.

Programmable 3770 Models

The programmable 3770 models also use the same host CPU programming systems that support the 2770, but the programmable 3770 models are not directly compatible with the nonprogrammable models. Additional user application programming considerations for programmable models of the 3773, 3774, and 3775 are contained in the *IBM 3773, 3774, and 3775 Programmable Communication Terminals Programmer's Guide*, GC30-3028.

3780/3776 or 3777-1 Compatibility

Those IBM programming systems identified as supporting the 3780 may also be used by the 3776/3777-1 operating in BSC mode. Figure 7-2 is a summary of features provided by the 3780 and 3776/3777-1 terminals. Application programs written for communication with the 3780 can be used, with modification, for communication with the 3776 and 3777-1. Modifications may be required because some features or functions provided by the 3780 are not present on the 3776/3777-1 terminals, or operate in a different manner.

To be compatible with a 3780, using card input, a card reader must be attached to the 3776/3777-1. For the 3776, the card reader may be a 3501, a 2502, or a 3521 with the Read Feature. For the 3777-1, the card reader is a 2502. For compatibility with a 3780 with an attached 3781 Card Punch, the 3776 must have an attached 3521 Card Punch.

The 3776/3777-1 must be identified to the using programming system as a 3780. The 3780 with the Component Selection feature provides the option for using either a DC2 or DC3 character to select the 3781 Card Punch. On the 3776, the component selection character for selecting the card punch is a DC2 character, and cannot be changed. The DC3 character selects the Diskette Storage Device, if installed (refer to "Component Selection" in this chapter). Using MPLC, if a Select is received with no device specified, the printer will be selected. If no specific poll is received, a general poll is assumed.

2770 Feature	2770 Feature [1] Availability	3770 Feature [1] Availability	3770 Differences
EBCDIC or ASCII	Optional	EBCDIC–Standard ASCII–Special	See Appendix G for ASCII
128/128 Char Alternating Buffer	Standard	Not Avail.	
256/256 Char Alternating Buffer	Special	Standard	Transmission Blocks to and from the 3770 (except for 3776/3777-1) can never exceed 256 data characters. The 3776/3777-1 cannot exceed 256 characters with the EXTEND BUFFR switch off or 512 characters with the switch on.
512/512 Char Alternating Buffer	Special	Available only on 3776/3777-1	
EBCDIC Transparency	Special	Standard [2]	See "Programming Considerations–Receiver Abort" for limitations.
Extended Retry	Optional	Standard	
Multipoint	Special	Special	
Inquiry Mode	Special [3]	Special [3]	See "Inquiry Mode"
WACK Response	Standard	Standard	See "Control Characters–WACK" for 3770 usage.
Vertical Forms Control	Standard on 2213 Mod. 2	Standard	See "Printer Control Characters" for 3770 operational differences.
Horizontal Format Control	Special	Standard	
Terminal ID	Standard	Standard	See "Terminal ID" for permissible characters.
Device Selection	Standard	Standard	See "Component Selection" in this chapter.
Expanded Print Line	Special	See Note	*Note:* 132 PP on 3770, no options.
Transmit/Receive Monitor Print	Special	Standard [2,4,5]	Not Available on 3773, 3776/3777-1 or programmable models.
Space Compression/Expansion	Special	Standard	
Synchronous Clock	Special	Special [4]	
Auto Answer	Special	Standard	
Conversational Mode	Special	Not Avail.	3770 cannot operate in this mode.
Terminal-to-Terminal	Standard	Not Avail.	
Status Messages	Standard	Not Avail.	3770 cannot rcv. or tmt. 2770 status messages
Processor Interrupt	Standard	Standard [5]	See "Control Characters–RVI".
Security ID	Special	Not Avail.	
On-Line Test	Standard	Standard	
Keyboard Correction	Special	Standard [4,5]	Not Available on 3776/3777-1.

1. Optional–Provided at no additional charge, must be specified.
   Special–Special feature available at additional charge.
   Standard–Standard feature or capability of basic machine.
2. Not available on 3773 Models 1, 2, and 3
3. Provided with Multipoint feature.
4. Not available on 3776/3777-1.
5. Not available on programmable 3770 models

Figure 7-1. 3770/2770 Feature Summary

3780 Feature	3780 Feature* Availibility	3776/3777-1 Feature* Availability	3776/3777-1 Differences
EBCDIC/ASCII	Optional	EBCDIC-STD ASCII-Special	See Appendix G
512/512 Byte Buffer	Standard	Standard	256/256 Byte Buffer operator-selectable
Space Compression/Expansion	Standard	Standard	**Note:** In BSC 512-byte mode, a maximum of 511 bytes are transmitted.
Vertical Forms Control	Standard	Standard	See "Printer Control Characters"
Horizontal Format Control	Standard	Standard	
EBCDIC Transparency	Special	Standard	See "Programming Considerations–Receiver Abort" for limitations
Audible Alarm	Standard	Special	
Extended Retry	Optional	Standard	
Multipoint	Special	Special	
Inquiry Mode	Special**	Special**	See "Inquiry Mode"
Multiple 80-Column Card Records in Transparency	Special	Standard	
Switched Network Control	Special	Standard	Includes Auto Answer/Disconnect, Terminal ID See "Terminal ID"
Keylock	Special	Special	
Synchronous Clock (Business Machine Clock)	Special	Not Avail.	
Conversational Mode	Standard	Not Avail.	3776/3777-1 cannot operate in this mode
Terminal-to-Terminal	Standard	Not Avail.	3776/3777-1 cannot operate in this mode
Additional Print Positions	Special	Not Avail.	132 print positions on 3776/3777-1, no options
Processor Interrupt	Standard	Standard	See "Control Characters--RVI"
Component Selection	Special	Standard	See "Component Selection"
On-Line Test	Standard	Standard	
WACK Response	Standard	Standard	
Load Buffer Prior to Initial Poll	Optional	Not Avail.	
1200 bps communication	Standard	Not Avail.	
9600 bps communication	Not Avail.	Standard	3777-1 can operate at 19.2 kbps (20.4 in World Trade)

*Optional — Provided at no additional charge, must be specified
Special — Special feature available at additional charge
Standard — Standard feature or capability of basic machine
**Provided with Multipoint feature

Figure 7-2. 3776/3777-1/3780 Feature Summary

The 3780 terminal identification sequence consists of five characters when the 3780 transmits first after a connection has been established. The identification sequence for an initial line bid from a calling 3780 is as follows:

P S S	E P
A Y Y X X A B C	N A
D N N	Q D

Where: X can be any EBCDIC character from hex 'C0' through hex 'FF' (or ASCII character from hex '60' through hex '7F') and is transmitted twice. A, B, and C are three separate characters.

The 3776 does not use the A, B, C characters, but uses only the X character transmitted twice, as described under "Terminal Identification."

Data Link Control Characters

Figure 7-3 is a summary of the BSC control vocabulary. General usage of these characters is described in the *General Information* manual just mentioned. Specific use of certain of these control characters is described in the following paragraphs.

SOH (Start of Heading)

This character is not transmitted by a 3770 terminal except in a request for an online test from the CPU. SOH received as the first character of a block is treated as STX (Start of Text). An SOH character received by a nonprogrammable 3771/3773/3774/3775 following an ITB character is not stripped from the data. An STX following an ITB is stripped from data received from the CPU.

ITB (End of Intermediate Transmission Block)

ITB is not transmitted by a 3770 terminal, but can be received. Operation is as described in the *General Information* manual.

WACK (Wait Before Transmit Positive Acknowledgment)

The WACK response is transmitted by a 3770 terminal for an indefinite period under the following conditions:

a. After receiving an MPLC selection and the control unit buffer is still busy with output from an earlier receive operation. This is always an immediate WACK.
b. A two-second timeout* occurs after receiving ETB or ETX, if the controller's buffer is not empty within that time.

*An immediate WACK option can be specified to eliminate the two-second timeout. This option must be specified by the customer and jumpered in the machine by IBM. With this option, WACK is transmitted immediately.

WACK is also transmitted at two-second intervals for a period of three minutes if an operator-recoverable output device error occurs during a receive operation. This allows the operator three minutes to correct the error condition. If the operator has not corrected the error condition within three minutes, the 3770 terminal transmits EOT. Any ENQs received get a NAK response until the output device is ready.

The WACK response can also be received from the CPU and causes the 3770 terminal to reply with an ENQ.

Note: These characters are for communications control only. They are added to input data and deleted from output data.

Vocabulary Character	Character Name	Character Meaning		Character Structure	
		Control State	Message-Transfer State	EBCDIC	ASCII
*ENQ	Enquiry	Can you accept transmission (point-to-point)? Respond to your address (multipoint).	Between blocks: Please respond or repeat last response. Terminating a block: Discard this block and respond with NAK acknowledgment.	ENQ	ENQ
*ACK 0	Even affirmative acknowledgment	I can accept transmission.	Even block received and validated.	DLE (X'1070')	DLE 0
*ACK 1	Odd affirmative acknowledgment	None	Odd block received and validated.	DLE/ (X'1061')	DLE 1
STX	Start of Text	Change to message-transfer state and start computing check value. (3770 treates SOH as STX, normally sends only STX.)	Clear check circuits and start computing new check value. 3770 treats SOH as STX, normally sends only STX.)	STX	STX
*NAK	Negative acknowledgment	I cannot accept transmission.	Block not validated, can accept retransmission.	NAK	NAK
*TTD	Temporary Text Delay	Transmission will begin presently. Respond NAK and wait.	Transmission will continue presently. Respond NAK and wait.	STX ENQ	STX ENQ
*WACK	Wait Before Transmit	Enquire again later and delay transmission until an affirmative acknowledgment is received.	Enquire again later and delay further transmission until an affirmative acknowledgment is received. Block received and validated.	DLE (X'1068')	DLE;
*ETB	End of Text Block	None	Check value follows, then turnaround and response. Another text block to follow.	ETB	ETB
*ETX	End of Text	None	Check value follows, then turnaround and response. This completes the text of a job but does not release the data link.	ETX	ETX
*RVI	Reverse Interrupt	None	Affirmative acknowledgment and signal that processor slave station wants master 3770 to relinquish the line.	DLE@ (X'107C')	DLE<
EOT	End of Transmission	Drop synchronism and return to control state.	Drop synchronism and return to control state. Not valid in text.	EOT	EOT
PAD	Leading Pad	Establish bit synchronism.	Establish bit synchronism.	Hex '55'	Alternating Bits (01010101)
	Trailing Pad	Turnaround time.	Turnaround time.	All ones (Hex 'FF')	All ones
SYN	Synchronous Idle	Establish or assure character synchronism, or time-fill. Discard character.	Establish or assure character synchronism, or time-fill. Discard character.	SYN	SYN

*Line turnaround.

Figure 7-3. BSC Control Vocabulary

RVI (Reverse Interrupt)

An RVI response to a selection sequence is transmitted by the terminal when it must transmit first. RVI is not transmitted in response to data except on the 3776/3777-1 which respond with an RVI if the operator presses the ATTN key while receiving and the system card is jumpered for this feature.

When an RVI is received from the CPU in response to a data block, the terminal (1) transmits data contained in the buffer, (2) ends the last block with an ETX (ETB on the 3776/3777-1 if not the true End of Text block) followed by an EOT, and (3) prepares to receive data from the CPU.

Note: After honoring an RVI, the terminal must enter receive mode (receive an ENQ or a multipoint selection with or without data) before it enters transmit mode to automatically restart transmitting.

TTD (Temporary Text Delay)

TTD is transmitted by a 3770 terminal if a buffer of data is not yet ready for transmission when a reply to the last block is received. If the buffer fill operation takes longer than approximately three minutes, the 3770 terminal aborts the operation and transmits EOT. The terminal will reply NAK to a TTD received from the CPU.

TTDs are also transmitted at two-second intervals for a period of three minutes if an operator-recoverable input device error occurs during a transmit operation. If the operator has not corrected the error condition within three minutes, the 3770 terminal aborts the operation and transmits EOT.

NAK (Negative Acknowledgment)

NAK indicates that the previous block was received in error and the receiver is ready to accept a retransmission of the erroneous block. When the terminal receives a NAK reply to a transmitted block, it retransmits the block. The same block may be transmitted up to 15 times in an attempt to obtain the proper reply. If a NAK response is received 16 times in succession, the terminal transmits EOT.

NAK is also the not-ready reply to a line bid or MPLC selection if the terminal is not ready to go on line (operator has not started an online job, or an Auto Interrupt cannot be accepted). NAK is also the reply to a TTD received from the CPU.

Abort Conditions

Transmitter Abort

A 3770 terminal will abort transmission and send EOT anytime one of the following occurs while transmitting to the CPU:

- An EOT is received in reply to a data block, or in response to an ENQ (point-to-point or multipoint).
- A DLE EOT (disconnect) is received (switched network) before the terminal transmits EOT to indicate the end of the job.
- A 3770 terminal transmits 15 ENQs in succession and receives either no reply or invalid responses from the CPU.
- An unreadable diskette record is encountered.
- An operator-recoverable input device error occurs and the operator does not correct it within three minutes.
- The STOP JOB key is pressed before the normal end of the job (nonprogrammable 3770 models).
- After 16 consecutive NAKs are received in reply to a transmitted data block.

Receiver Abort

A 3770 terminal will abort the job and send EOT if any of the following occur while receiving from the CPU (data in the receiver buffers may be destroyed during a receiver abort):

- On nonprogrammable 3770 models if mixed non-transparent and transparent blocks are received between the first STX and ETX. An exception to this condition is when component selection is used preceding transparent data blocks. The component selection (DC) character must be contained in the first non-transparent block. Following blocks can be transparent, but cannot alternate between transparent and non-transparent thereafter. Transparent data can be directed only to an attached card punch except on the 3774/3775/3776/3777-1 where it can also be directed to the diskette.
- A data block with good CRC (LRC) is received which exceeds the 256-byte buffer capacity (or 512-byte buffer capacity on the 3776/3777-1).
- An EOT is received before the normal end of message (before ETX is received).
- An unrecoverable error occurs before the message is complete.
- The operator stops the job before the normal end of the job

Note: If an operator-recoverable output device error occurs and the operator does not correct it within three minutes (WACK responses are being sent to the host), the 3770 terminal sends an EOT but does not abort the job. Data remains in the buffers and subsequent point-to-point ENQs or multipoint selections are rejected with a NAK response until the operator intervenes.

For 3776/3777-1, if a line-to-printer job is in progress and HOLD PRINT is on during operator error recovery, this abort may be prevented by pressing RESET before the three-minute timeout. RESET causes the three-minute timeout to restart.

3770 Transmission of Null Buffer to CPU

Under certain conditions (list follows), 3770 terminals send a null buffer (STX ETX with no data) to the host. Some of the RJE subsystems in the host do not specifically check for a null buffer from the 3770 defined as a 2770. When the RJE subsystem attempts to process the null buffer as an 80-byte data record, the results may be unpredictable depending on the content of the previous data record. *To reduce the consequences of a null buffer sent from a 3770, all RJE users should end each "job" sent from a 3770 with a "/*" sequence.* Should a null buffer follow immediately, it causes a JCL error to be returned, but does not affect the preceding job.

Nonprogrammable Models

Nonprogrammable 3770 models send a null buffer under these conditions:

- During a diskette-to-line job when a data set contains null records
- After a diskette-to-line job of all active data sets
- After a card reader-to-line job when "/*EOF" would begin a new buffer
- At the end of a Monitor Print transmit job

Programmable Models

Programmable 3770 models send a null buffer under these conditions:

- During a diskette-to-line job when a data set contains null records
- During a diskette-to-line job when an existing but empty data set is transmitted
- After a diskette-to-line job for the Transaction Data Set when the last data set is transmitted
- After a card reader-to-line job when "/*EOF" would begin a new buffer.

Printer Control Characters

On nonprogrammable 3770 models format control characters are used to delineate lines of data entered into the buffer via the keyboard for transmission to the remote location, or for data received from the remote location for printing on the terminal. On programmable models of the 3773, 3774, and 3775, format of printed data sent to the CPU is under control of the 3770 program. When received from the line, the data can either be stored on the diskette and printed later under user-written program control; or printed directly from the line. (The 3773P supports only the following format control characters: NL, IRS, BS, IGS, ESC A, ESC ESC S, ESC T, ESC M, LF, and FF.)

Format control characters are entered into the buffer by certain keyboard keys and are transmitted within the data sent to the CPU. When received, these control characters read into the controller's buffer. As the buffer reads out to the printer, these characters are recognized as control characters, removed from the print data, and used to control the output format of the printed data.

When outputting multiple overstrike characters to the 3775/3776 console printers or the 3777-1/3784 line printers, no more than two characters may be printed in the same print position using backspace control. If more than one backspace is used to the same position with overprinting (to blot out a position, for example), only the first and last characters will print in that position. To print more than two characters in the same position (overstrikes), the CR (carriage return) or ESC M (space suppress) character must be used to return to the beginning of the line without indexing, and the desired characters overprinted. When outputting multiple overstrike characters to console printers on the 3770 programmable models, there are no restrictions. However, it can be advantageous to use the CR character or space suppress (ESC M) the desired characters. Each occurrence of a BS (backspace) character string causes that portion of a line to be printed. Thus, printer performance can be enhanced by using either the CR, ESC M, or contiguous BS characters when overstriking. The following characters are recognized.

NL (New Line)

The EBCDIC NL character defines the end of a print line. During key entry, this character is stored into the buffer when the Return key is pressed.

On buffer readout to the printer, either during key entry or receiving from the line, the NL character initiates a print cycle. After data in the print buffer is printed, the forms advance one line space and the horizontal print position is moved to the left margin regardless of the previous print position. After printing and forms movement is complete, the print buffer is loaded with the next line of print data. If the current line position is at or below the bottom margin, the NL character causes the forms to advance to line 1 of the next form.

IRS (Interrecord Separator)

During keyboard entry, this character is stored in the buffer by the End Card function under control of the CODE key, and is used to delineate card data to be punched. During key entry, or when the IRS character is recognized during output of received data to the printer, it causes a new line function to occur as described under "NL (New Line)."

CR (Carriage Return)

On buffer readout of received data to the printer, the CR character initiates a print cycle and moves the horizontal print position to the left margin regardless of the current print position or a previous automatic NL function. The vertical print position is not moved.

VT (Vertical Tab)

During key entry, this character is stored into the buffer when the VERT TAB key is pressed.

During key entry, or on buffer readout of received data to the printer, the VT character initiates a print cycle. After printing is complete, the forms advance to the next predefined vertical tab stop. The horizontal print position is not moved. After printing and forms movement are complete, the next line of data is printed.

A maximum of 12 vertical tab stops can occur on a single form. If a VT character is contained in data to be printed below the highest VT set on a form, the forms will skip to the lowest tab setting on the next form (except the 3784 which executes a line feed) If no vertical tabs are set, a VT function is executed as a LF function.

FF (Forms Feed)

During key entry, this character is stored into the current buffer position when the FORM FEED key is pressed.

During key entry, or on buffer readout of received data to the printer, the FF character initiates a print cycle. After printing stops, the forms advance to line 1 of the next form. The horizontal print position is moved to the left margin.

HT (Horizontal Tab)

During data entry, this character stores in the buffer when the Tab key is pressed. The next character entered will print at the next print position at which a horizontal tab stop is set, and it stores into the next sequential buffer position. If the current horizontal print position is equal to or greater than the rightmost tab setting, the HT function is rejected as an error.

On buffer readout to the printer, the first character following the HT character will be loaded into the print-buffer location at which the next horizontal tab stop is set. If an HT function is executed when the horizontal print position is to the left of the left margin, the left margin setting is not treated as a horizontal tab stop and is ignored by the HT function. If the current horizontal print position is equal to or greater than the rightmost tab setting, the HT function is executed as a New Line function.

LF (Line Feed)

During keyboard data entry, the LF character is stored into the buffer when the INDEX key is pressed.

During key entry, or on buffer readout to the printer, the LF character initiates a print cycle. After printing is complete, the forms advance to the next print line. Printing on the next line begins in the next sequential print position. If an LF function is executed at or below the bottom margin, the forms advance to line 1 of the next form.

BS (Back Space)

During key entry, this character is stored into the current buffer position when the backspace key(←) is pressed.

During key entry, or on buffer readout of received data to the printer, the backspace character initiates a print cycle and moves the horizontal print position one space to the left if the current print position is greater than 1. The left margin setting is ignored. If the current print position is 1, the backspace function is not executed.

BEL (Bell)—3775 Only

On buffer readout of received data to the printer, the BEL character stops the printing and causes a code to be displayed in the NPR on the 3775. All other 3770 terminals (including the 3775P) handle the BEL character as a nonprintable character and print a hyphen (-) instead.

NUL (Null)

On buffer readout of received data to the printer, the NUL character is printed as a hyphen (-) on nonprogrammable 3770 terminals or printed as a space on programmable 3770 terminals.

IGS (Space Expansion)

On buffer readout of received data to the printer, the IGS character begins a space expansion sequence. The low-order six bits of the byte following the IGS character is used as a binary count of the number of spaces (3 to 63). The high-order two bits of this count byte must be a binary 01. The number of spaces specified by the count byte are printed. In data directed to the 3521 Card Punch, IGS sequences cannot span two buffers.

BSC ESC (Escape) Sequences

In addition to the control characters just described, ESC sequences (an ESC character followed by another character) are used to provide multiple line spacing and additional skipping capability. This is functionally equivalent to multiple NL characters.

Figure 7-4 shows the ESC sequences used to control multiple spacing and skipping. ESC sequences can occur in data at any time within a line, but are not executed until a line feed occurs as a result of an EBCDIC NL or IRS character encountered to end the line. If more than one ESC sequence precedes a NL or IRS character, only the last ESC sequence preceding the the NL or IRS is executed. The ESC sequences are not printed when they appear in the data stream to the printer from the buffer. If no ESC sequences are included in received data, single line spacing occurs as the result of a NL, or after a full line (132 characters) is printed. If an ESC sequence is included, the ESC sequence is executed instead of the NL function.

ASCII Code Sequence	EBCDIC Code Sequence	Carriage Operation After Printing
ESC Q	ESC/	Single Line Feed
ESC R	ESC S	Double Line Feed
ESC S	ESC T	Triple Line Feed
ESC A	ESC A	Skip to 1st VT Stop
ESC B	ESC B	Skip to 2nd VT Stop
ESC C	ESC C	Skip to 3rd VT Stop
ESC D	ESC D	Skip to 4th VT Stop
ESC E	ESC E	Skip to 5th VT Stop
ESC F	ESC F	Skip to 6th VT Stop
ESC G	ESC G	Skip to 7th VT Stop
ESC H	ESC H	Skip to 8th VT Stop
ESC I	ESC I	Skip to 9th VT Stop
ESC J	ESC J	Skip to 10th VT Stop
ESC K	ESC K	Skip to 11th VT Stop
ESC L	ESC L	Skip to 12th VT Stop
ESC M	ESC M	Space Suppress

Figure 7-4. BSC Escape Sequences

During the forms definition at the terminal, the operator must enter a number from 1 to 12 for each line at which a stop is desired. Escape sequences ESC A through ESC L received in data from the CPU are directly related to tab stops 1 through 12 set up by the operator, as indicated in Figure 7-4. Thus, ESC A causes a skip to tab stop 1, ESC B to tab stop 2, etc. Vertical tab (channel) stops need not be sequential from the top to the bottom of the form, and multiple tab stops can be specified for the same line position. A skip to an undefined tab stop will cause an overflow to the next form. For example, if tab stop 6 is not defined by the operator, an ESC G received will cause a skip to line 1 on the next form.

As previously stated, 2770 or 3780 application programs can be used, with modification, to support the 3770 terminals. If these programs are used, they may or may not require modification of ESC sequences sent to control skipping on the console printer. A 3770 terminal can accept only one skip to each tab stop (channel) (ESC A through ESC L) on a single form, or a total of 12 skips per form. A second skip to a particular tab stop on the same form will cause a skip to the selected VT tab stop on the next form. Therefore, 2770 or 3780 application programs must be modified to remove more than one skip to the same vertical tab stop on a form, if this condition exists. ESC sequences used to control single, double, and triple spacing and space suppression may need to be modified in certain cases. Vertical spacing occurs regardless of last print line or form length, except for the 3774P and 3775P which provide an option to auto-skip from the last print line to line 1 of the next form. ESC sequences not listed in Figure 7-4 nor described in these paragraphs will produce invalid results.

The 3770 programmable terminals ignore invalid ESC sequences. The 3773P terminal does not support ESC HT or ESC VT sequences in tab format messages from the CPU (see the following descriptions). In data directed to the 3521 Card Punch, ESC sequences cannot span two buffers.

Horizontal Tab Format Message

This section applies only to the 3774P, 3775, 3775P, 3776, 3777-1, and the 3784 line printers. The horizontal tab format message is defined by an ESC HT sequence, followed by a space character for each print position where a tab stop is not desired and by an HT character for each position where a tab stop is desired, starting at print position 1. A New Line (NL) character terminates the tab format message, but is not executed. A CR, NL, or FF character should be sent after the HT format message to return the horizontal print position to the left margin. All characters other than NL and ESC sequences will be considered as spaces. The tab format message should not contain more space and HT characters than the number of print positions (132) on the printer. If the tab format message contains less than 132 characters, the higher printer tab stop positions are reset. The left margin is set to 1, forms width is set to 132, and maximum print position is set to 132 when this sequence is received.

Note: The 3775 differs from the 2770 in that unspecified tab stop positions are reset.

The ESC HT formatting controls remain in effect for online or offline jobs until they are reset or the power is turned off.

The horizontal tab format message is directed to an attached 3784 printer by means of the component selection character as described under "Component Selection" in this chapter.

Vertical Tab Format Message

This section applies only to the 3774P, 3775, 3775P, 3776, 3777-1, and the 3784 line printers. The vertical tab format message is defined by an ESC VT sequence followed by a three-digit line number for the form length, a three-digit number for the last print line, and a three-digit number for each vertical tab stop from 1 through 12 sequentially.

An IRS code terminates the message. The form length and last print line must always be included. The message may be terminated after the last tab position is defined; it is not necessary to transmit all twelve tab stops. However, tab stop line numbers *must* be transmitted sequentially.

The last tab stop position defined should be less than or equal to the last print line. If the last tab stop value in a message is incomplete (1 or 2 characters), it will not be set. If the characters describing a line number are not numeric values, they are folded into numeric values. For example, an alphabetic A (X'C1') is interpreted as a numeric 1. Any additional characters in the vertical tab format message after the tab stop value 12 are ignored.

For example:

```
E V                              I
S T 080 076 005 000 010 000 060 R
C                                S
```

This sequence defines an 80-line form with line 76 being the last valid print line. The first tab stop (or Channel 1) is line 5, the third tab stop is line 10, and the fifth tab stop is line 60. All other tab stops are reset. Tabs set below the last print line are functional (if the tab is set, a tab can be made to a line past the last print line). If the vertical tab format message contains no VT values, the VT settings are not changed.

A Form Feed (FF) character should precede this sequence. The maximum form length that can be specified in a vertical tab format message is 127 lines. The ESC VT formatting controls remain in effect for online or offline jobs until they are changed by another ESC VT sequence or by a stop job action, or are reset by a system reset or turning the power off.

Forms Alignment Considerations

When designing forms for the 3770 terminals, the first vertical tab must be set to the first printing line (line 1). When the operator aligns forms to start a job, the forms should be aligned vertically to the first printing line so that an FF or ESC A sequence advances the forms to the first printing line of the next form.

Line 1 (or the first printing line) is defined as the vertical print position at which the form is physically aligned when the forms definition process occurs.

For the 3774, 3775, 3784, 3776, and 3777-1 printers, forms definition is established by:

- The host (ESC VT messages) or
- The operator (Start Job or Define Job procedures).

For the 3774P and 3775P printers, forms definition is established by:

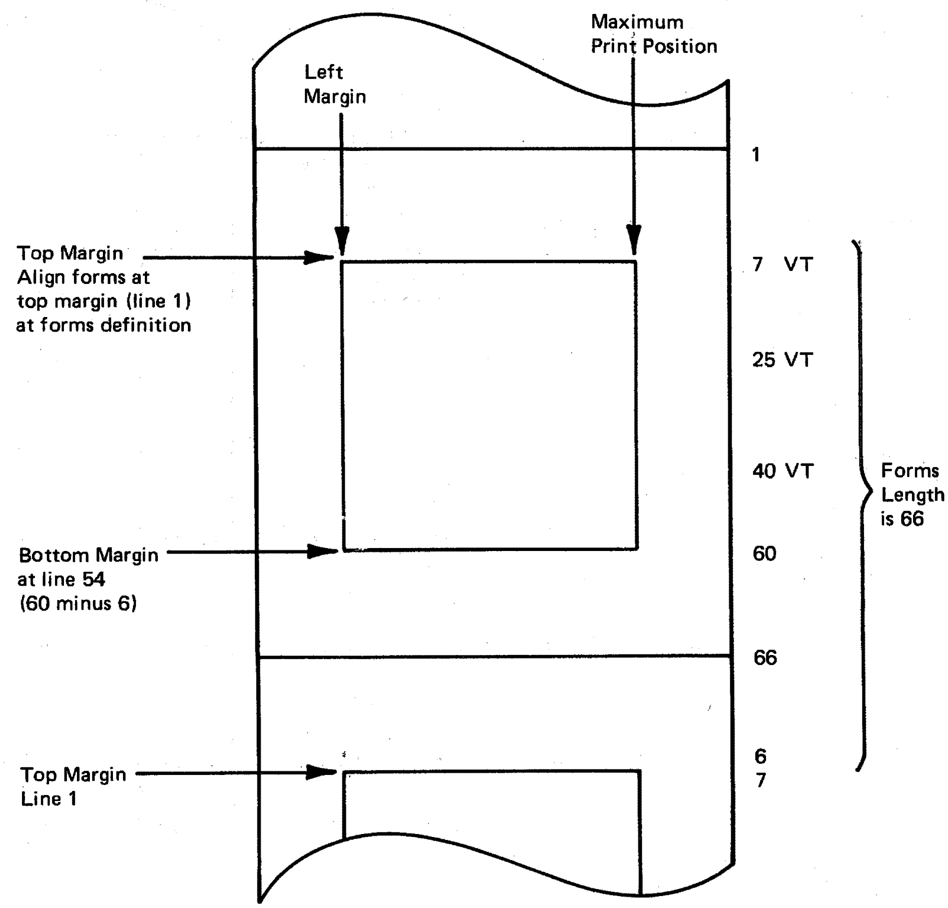
- The host (ESC VT messages),
- The supervisor program, or
- The operator (Start Job, 'F').

Note 1: The host should send a CR character following an ESC HT message to return the horizontal print position to the left margin (print position 1).

Note 2: On the 3774P and 3775P printers, line 1 can be reset to the current line in position to print by pressing the CODE and FORM FEED keys.

Figure 7-5 shows two forms design and alignment variations and their advantages and disadvantages.

Method A



FF function moves the forms to line 1 of the next form.

ESC A sequence moves the forms to the first VT setting on the next form.

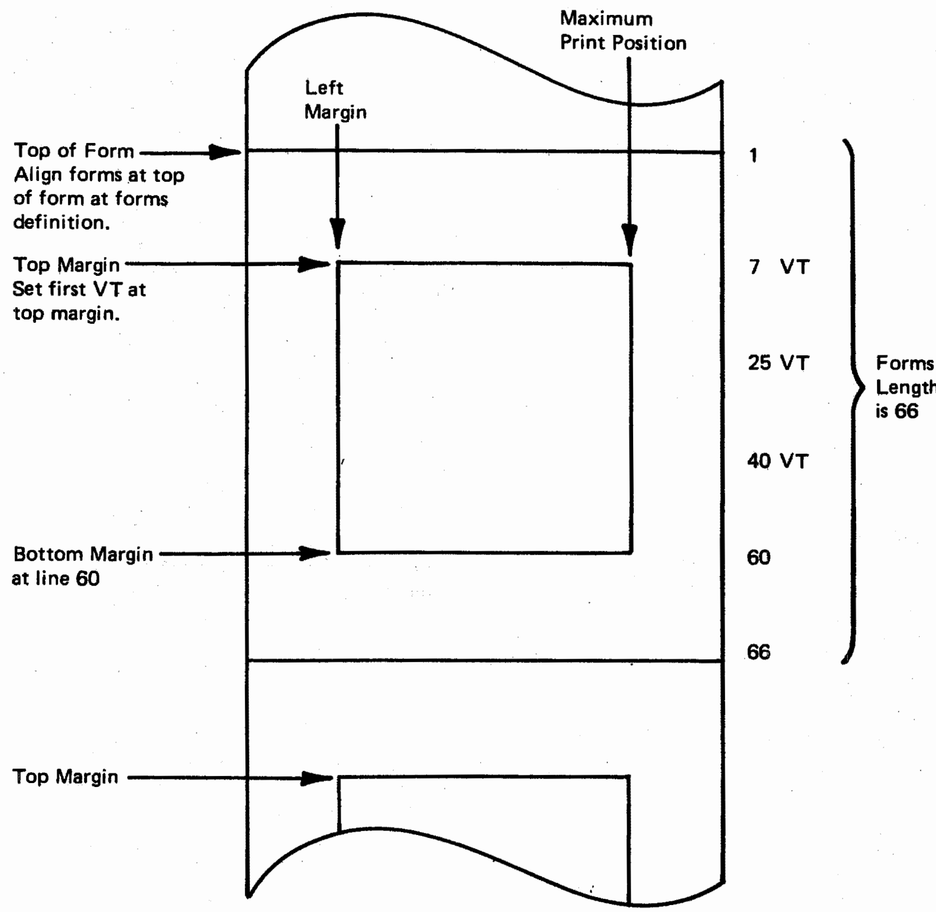
Note: If the first VT setting is equal to line 1, then a FF function moves the forms to the same vertical print position as an ESC A sequence.

Advantage: Compatible with 2770.

Disadvantage: Operator must know the top margin position in advance. Forms that are not pre-printed may be difficult to align after an end-of-forms condition.

Figure 7-5. Forms Alignment Considerations (Part 1 of 2)

Method B



FF function moves the forms to line 1 of the next form.

ESC A sequence moves the forms to the first VT setting of the next form.

Disadvantages:

1. An ESC A sequence must be executed to move the forms to the top margin of the next form (a FF function moves the forms to line 1 of the next form).
2. An ESC A sequence must be executed after forms definition to move the forms to the top margin.

Advantages:

1. Allows the host to set the top margin (TM) when the operator does not know what the TM setting should be (for example, on blank forms or for a special message to be printed above the normal top margin on preprinted forms).
2. Allows printing of special messages above the normal top margin.

Figure 7-5. Forms Alignment Considerations (Part 2 of 2)

Component Selection

This section describes component selection as used by BSC with the nonprogrammable and programmable 3770 models.

Component selection from the CPU allows the CPU to select the output device used by the terminal for output of a job.

Point-to-Point Networks

On a switched or leased point-to-point network, the component selection character is a valid selection character immediately following STX (and preferably by itself) in either the first block of received text or the block following an ETX block.

If the first character of received text is not a valid selection character, the character is handled as data and a default device is selected by the terminal. The normal default device for nontransparent data is the console printer, but this selection may be changed to the line printer or diskette on some 3770 terminals. The normal default device for transparent data is the card punch.

If the component selection character is included in the first text block, it reads into the buffers in the same manner as a data character, but it is ignored on output from the buffer. Thus, only 255 data characters (or 511 on the 3776/3777-1 with the EXTEND BUFFER switch on) can be accommodated in the first text block.

On a point-to-point network, selection can be made once for each message. The selection remains in effect until changed by a new selection following ETX or until EOT is received following ETX or until a receiver abort occurs. After an ETX block is received, and no valid component selection character is received in the next text block, the terminal continues to use the selection from the previous ETX block, rather than the normal default selection. After an ETB block is received, the terminal does not check the first data character of the next text block for a component selection character.

Multipoint Networks

On a multipoint network, the component selection character is contained in the multipoint line control (MPLC) selection sequence, immediately following the terminal's address and preceding the ENQ.

Exception Conditions (Point-to-Point and Multipoint)

If the selection character is absent, invalid, or a new selection is attempted while an old selection remains in effect, the selection is rejected with a NAK response. In the case of an absent selection on the 3776/3777-1 terminal, the default device for transparent data is the printer. An absent selection default on programmable terminals is accepted only on a point-to-point network.

When a component selection character is received on a multipoint network and that device is either not present (system card not jumpered for device) or not available (device in offline use—see " CPU Interrupt" in chapter 3), a NAK response is transmitted. On a point-to-point network under the same conditions, an EOT is transmitted.

If the device is available but not ready, received data is accepted until the terminal's buffers are full and then WACK responses are transmitted in response to the received data until the device is made ready. The device light or NPR indicators and the Operator Attention Speaker (or Audible Alarm, if installed) alert the operator. If the device is available and ready an ACK 0 response is transmitted.

If the DISK switch is on, component selection except for the console printer is ignored, and received data will be written on the diskette if it is ready. The DISK switch will not override selection of the console printer.

Selection Characters

Component selection characters used are as follows:

DC1 (EBCDIC '11')—Selects Console Printer*
DC2 (EBCDIC '12')—Selects Card Punch
DC3 (EBCDIC '13')—Selects Diskette
) (EBCDIC '5D')—Selects Line Printer (3784 printer)*

***Note:** On the 3774 nonprogrammable and programmable models (see Figures 7-6 and 7-7), using the CODE key function, with the CODE key, and the 'J' character key pressed, the DC1 and) selections are reversed for communicate mode:

DC1—Selects Line Printer (3784 printer)
)—Selects Console Printer

BSC transparent operation using component selection requires that the first block containing the component selection (DC) character be non-transparent in order to allow recognition of the DC character. The 3770 terminal can then change to transparent mode operation on the second block, but will not accept another non-transparent block until DLE ETX is received (see "Receiver Abort"). Transparent data can be sent only to a card punch except on the 3774/3775, 3773P, 3774P/3775P, and 3776/3777-1 where it can also be directed to the diskette. Transparent data received with no component selection normally defaults to the card punch. Programmable models support mixed transparent and nontransparent data.

On multipoint machines only, input-device component selection characters (transmitted as part of the MPLC polling sequence) are as follows:

0 (EBCDIC 'F0')—Selects any input device that is ready
5 (EBCDIC 'F5')—Selects Keyboard
6 (EBCDIC 'F6')—Selects Card Reader
7 (EBCDIC 'F7')—Selects Diskette
Blank–Selects any input device that is ready on the 3776/3777-1

Inquiry Mode (Nonprogrammable 3770 Models)

An additional function of the BSC Multipoint feature is "inquiry mode" operation. When inquiry mode is in effect at the 3770, and after the 3770 accepts a poll from the CPU, both buffers fill from the selected input device (see Note). The 3770 responds with EOT to this initial poll, and to all succeeding polls until both buffers have filled. After receiving a poll with the buffers full, the 3770 transmits two blocks as an incomplete message (the second block ends with ETB, a good response is received, and the 3770 sends EOT) and relinquishes the line. Two more blocks are automatically read (offline) from the input device. As before, a poll received before the buffers fill causes the 3770 to respond EOT. Once the 3770 begins inquiry mode operation, the initially selected input device remains selected until the 3770 sends the last block of the job (block ended with ETX).

Note: The CPU may use a device selection of 0 (see "Component Selection") to select whatever input device is specified by the 3770's job setup. If a specific device selection (5, 6, or 7) is received, and that device is not defined as the input device by the 3770 job setup, EOT is sent in response to the poll (the poll is rejected). Normal keyboard operation does not change (single-buffer transmission) when the 3770 is operating in inquiry mode.

ASSUMPTIONS:

1. Terminal is in BSC Communicate Mode
2. CPU Interrupt Switch is off
3. 3784 Printer is attached to the 3774

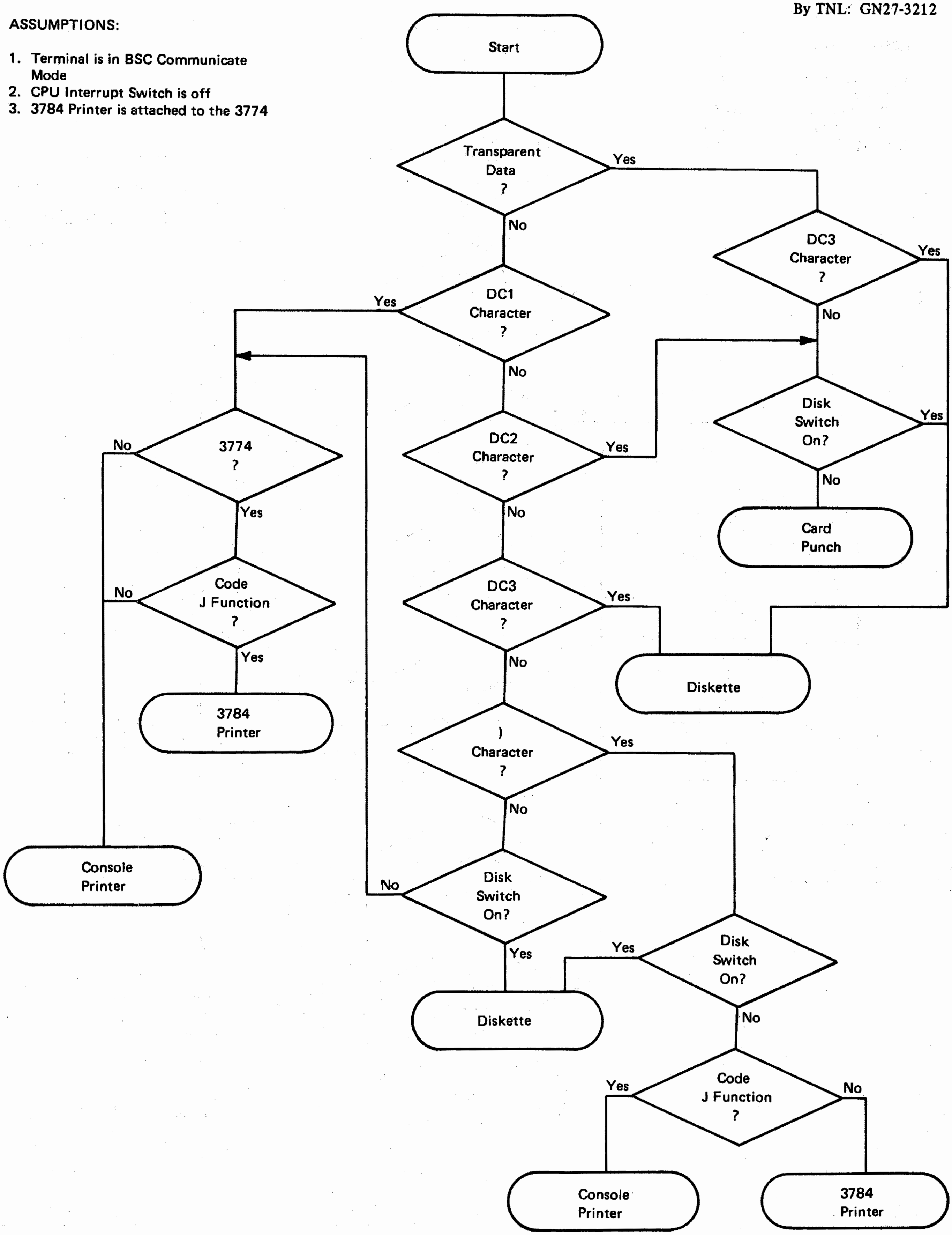


Figure 7-6. Component Selection for 3774/3775 Models

ASSUMPTIONS:

1. Terminal in BSC Communication Mode
2. CPU Interrupt Switch is off
3. No Message Header is received
4. 3784 Printer is attached to 3774P

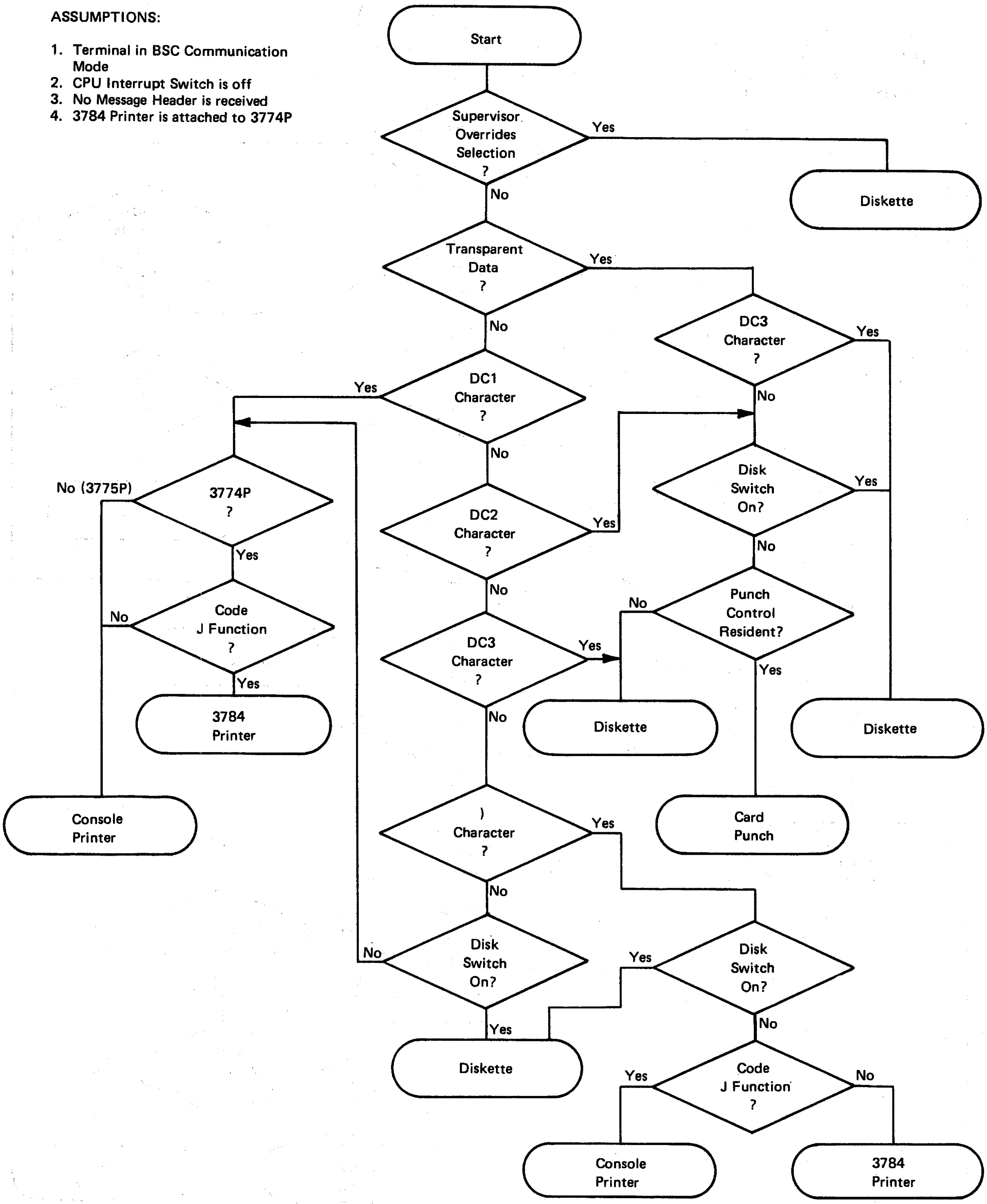


Figure 7-7. Component Selection for 3774P/3775P Models

When operating in inquiry mode, the 3770 will not normally send TTDs unless monitor printing is called for. TTDs may be transmitted in some cases to allow monitor printing to occur.

If an MPLC selection sequence is received after inquiry mode operation is begun, the 3770 transmits RVI, and the CPU must poll the terminal to allow it to transmit the data.

Throughput at a 3770 transmitting in inquiry mode is degraded; however, this mode of operation allows interleaving of inquiry messages from other stations that require fast response. Thus, the CPU can continue receiving a batch message from the 3770 without appreciably degrading inquiry operations.

To operate in inquiry mode when the 3770 is a receiver and to eliminate delays on the line, the CPU should transmit only two blocks of data per transmission to the 3770. The 3770 need not be in inquiry mode when receiving. The 3770 should have the immediate WACK option installed to eliminate delays in the block-checking response back to the CPU. Any delays incurred during the transfer of data to the selected output device are incurred "offline". The selected output device will remain selected until the job is complete (CPU sends ETX, receives a positive response, and transmits EOT). If the CPU selects the 3770, and the 3770 has not yet transferred the first block of data to the output device, a WACK response to the selection is sent. When receiving data onto the Diskette, 'ignore ETX/EOT' may be specified for the job to prevent creating another data set each time ETX/EOT is received.

Inquiry Mode (Programmable 3770 Models)

A mode is available that allows the programmable 3770 to respond with two buffers to each polling sequence until the job completes. This is similar to inquiry mode for the nonprogrammable models, except that input component selection is not supported.

Terminal Identification (Switched Network)

Terminal identification can be used when operating on a switched network to allow the CPU to identify the remote terminal. Each terminal on the network is assigned a single-character ID, which the terminal transmits twice (two contiguous characters) after the connection to the CPU is established. If the 3770 terminal transmits first, the ID is transmitted preceding the line-bid ENQ. If the CPU transmits first, the 3770 terminal transmits the ID characters immediately preceding the ACK 0 or NAK response.

The terminal ID desired for each terminal is specified by the customer and wired into the terminal by IBM. Characters that can be specified for terminal ID are the EBCDIC characters hex '40' through hex 'FF'. For multipoint operation, the multipoint address must be the same as the terminal identification address.

Remote Power Off

Remote Power Off is a standard feature for the 3777-1 and a specify feature for the 3773, 3774, 3775, 3776 and 3784. A 3784 that is specified for remote power off and attached to a 3774 will power off with the 3774; the 3784 cannot be remotely powered off independently. On the 3776/3777-1, the error log is automatically printed before the power off sequence completes. For nonprogrammable 3770 models using BSC, the CPU can cause the remote terminal to turn power off by transmitting the following non-transparent block:

```
S N    N E
T U P  U T
X L    L X
```

If this sequence is contained in the beginning of a block and followed by data, the data will be ignored. Card I/O device power is not turned off by this sequence.

For programmable 3770 models using BSC, power off can be specified in the Transmission Complete message header. Message headers are described in detail in the *3770 Programmer's Guide* for these terminals.

Programmable 3770 Models

BSC considerations for the 3770 programmable models are described in detail in the *IBM 3773, 3774, and 3775 Programmable Communication Terminals Programmer's Guide,* GC30-3028. Where common considerations exist for both the programmable and nonprogrammable models, they have been addressed in this chapter.

The following highlights the similarities and differences in the programmable and nonprogrammable models:

Common BSC Considerations

- Data link control characters
- Abort conditions
- Inquiry Mode
- Terminal Identification

Differences in Programmable BSC Considerations

- Horizontal and Vertical Tab Format Messages—Are not supported for 3773P
- Printer Control Characters—Are supported when data is received from the CPU and the console printer or the 3784 line printer is selected. In all other cases, printer control is a responsibility of the 3770P user-written program.
- Component Selection—For data written on the diskette, the 3770P user-written program controls the devices used for output.
- Message Headers (MH)–The programmable models check the first bytes of any block directed to the line printer received after an ETX (or after initial selection) for a message header. The first byte of the text block is the component selection character) [right parentheses - X'5D'] for the line printer. The header is variable in length and always has the following initial 4-byte format:

  ```
  N    N
  U xx U
  L    L
  ```

  The two alpha characters for xx define certain functions (see chapter 5).

  Messages headers may be sent as transparent or nontransparent blocks and may end with either ETB or ETX. Further detail on formatting is included in the *3770 Programmer's Guide.*

  - Remote Power Off—Supported only through message headers
  - Transparency—Supported, can be used in EBCDIC to transmit 3770 application programs and data set to the terminal where they can be directed to the diskette or to the console.

(Note to reader: Please insert this page after Chapter 7, Programming Considerations – Binary Synchronous Communications. Additional information is provided under the following subject headings in Chapter 7.)

Printer Control Characters

HT (Horizontal Tab)

For nonprogrammable models, the left margin is treated as a horizontal tab stop.

BCS ESC (Escape) Sequence

For 3776/3777-1 and programmable models, vertical tab (channel) stops need not be sequential from the top to the bottom of the form.

Horizontal Tab Format Message

The 3774 and 3775 programmable models set all positions if no positions are defined in the ESC HT sequence.

Vertical Tab Format Message

Tab stop values on the 3775 nonprogrammable and 3784 printers must be set in ascending order.

Component Selection

Exception Conditions (Point-to-Point and Multipoint)

When a component selection character is received on a multipoint network and the device is either not present (system card not jumpered for the device) or not available (device in offline use), the programmable models direct the data to the interrupt data set.

If an output device is selected, and while it is receiving data it enters a not-ready condition, a WACK response is sent by the 3770 to the CPU. If the same device is selected again and it is still in the not-ready condition (operator intervention required), a NACK is sent. If any other device is selected, a WACK response is sent.

Chapter 8. Programming Considerations – SNA/SDLC Communications

Introduction to 3770 SNA

The 3770 Data Communication System communicates with the CPU using either Binary Synchronous Communication (BSC) or Systems Network Architecture (SNA). This chapter describes SNA as it is used by the 3770 Data Communication System.

For more information about SNA, refer to the *SNA General Information* manual listed in the preface of this publication and later in this chapter.

Components of the System

The basic components of the 3770 SNA network are:

- System/370 host processor
- VS operating system (OS/VS1, OS/VS2, or DOS/VS)
- VTAM, and/or TCAM through VTAM
- 3704 or 3705 Communications Controller with Network Control Program/VS (NCP/VS)
- Synchronous Data Link Control (SDLC)
- 3770 Data Communication System

Figure 8-1 shows the components of a 3770 SNA network.

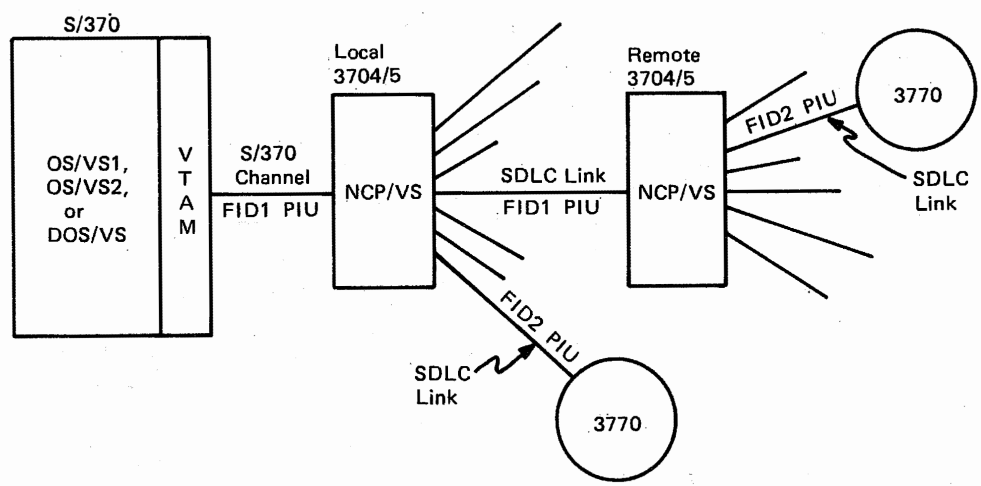


Figure 8-1. Example of an SNA Network

VTAM (Virtual Telecommunications Access Method)

VTAM directs the transmission of data between the host application programs and the 3770. VTAM 'owns' all of the network components, allocating their use to meet the needs of the application programs and the 3770 VTAM:

- Connects, disconnects, and controls access between the application program and the 3770.
- Controls data transfer between the application programs and the 3770.
- Allocates the 3770 and other terminals in the network for use by the application programs.

TCAM through VTAM

When queued control is required, application programs can use TCAM (Telecommunications Access Method) as an intermediary between the application programs and VTAM. TCAM provides general control over transaction activity; for example, data can be directed to an inactive 3770 and held in queue until the 3770 is activated.

3704/3705 Communications Controllers

In the 3770 SNA environment, VTAM allocates much of the network management responsiblity to the 3704/3705 Communications Controller. In addition to the locally attached communications controller, the network may also have remote communications controllers (see Figure 8-1).

The control program that operates in the 3704/3705 Communications Controller is the Network Control Program/VS (NCP/VS). The NCP/VS routes data through the network and furnishes such communications management services as: line control, insertion and deletion of line control information, dynamic buffering of data, and recovery from message errors.

Synchronous Data Link Control (SDLC)

SDLC is the standard line control discipline for SNA. It is designed for efficient control between communicating elements of the network. One transmission can carry data as well as confirmation of earlier transmissions. SDLC features inherent data transparency, therefore, it can convey any 8-bit character code, as well as non-coded information, without restrictions. SDLC accommodates both duplex and half-duplex operation.

3770 SNA Characteristics

Before VTAM can communicate with a terminal, it must know the terminal's SNA characteristics. The SNA characteristics of the 3770 are:

- Physical Unit Type 2
- Logical Unit Type 1
- Function Management Profile 3
- Transmission Services Profile 3
- FM Header Subset 1 All 3770 Terminals
  2 All 3770 Terminals
  3 Programmables Only

From these characteristics (specified at VTAM generation), VTAM determines the format of the transmission record and the type of control information required by the terminal.

3770 SNA Communications

Before the 3770 and the host application program can begin communications, certain protocol requirements must be met:

1. An SSCP-PU session must be established between VTAM and NCP physical services. VTAM does this by issuing an Activate Physical network command to the NCP.
2. Data flow must be enabled between VTAM and the NCP. VTAM does this with the Start Data Traffic network command.

3. The modem for the SDLC link between the communications controller and the 3770 must be activated. VTAM does this by issuing an Activate Link command to the NCP.
4. A physical connection must be made between the communications controller and the 3770. VTAM does this by issuing a Contact command to the NCP which then polls the 3770. After a connection is made, the NCP sends a Contacted command to VTAM.
5. An SSCP-PU session must be established between VTAM and the 3770 physical unit. VTAM does this with the Activate Physical network command.
6. An SSCP-LU session must be established between VTAM and the 3770 logical unit. VTAM does this by issuing an Activate Logical network command.
7. An APPL-LU session must be established between the host application program and the 3770 logical unit. This can be initiated two ways:
   - An active application program can issue an OPNDST macro to VTAM. This causes VTAM to issue a Bind command to the 3770 establishing the APPL-LU session. The NCP LU macro that describes the logical unit must specify PACING= (1,1).
   - The 3770 terminal operator can send a LOGON request to VTAM requesting a session with a particular application program. VTAM then activates the requested application program which initiates the APPL-LU session as described above.
8. Data flow must be enabled between the host application and the 3770. VTAM does this with the Start Data Traffic network command. Once data flow is enabled, data request units can flow between the application program and the 3770.

SNA communications can be terminated in the following manner:

1. The APPL-LU session must be terminated. This can be done two ways:
   - The application program can issue a CLSDST macro to VTAM. This causes VTAM to issue a Clear network command to the 3770 to purge any outstanding requests or responses. VTAM then issues the Unbind command to terminate the session.
   - The 3770 terminal operator can request that the session be terminated by sending a LOGOFF request unit to VTAM. VTAM then notifies the application program which initiates the session termination as described above.
2. VTAM terminates the SSCP-LU session by issuing a Deactivate Logical command to the 3770.
3. VTAM terminates the SSCP-PU session with the 3770 by issuing the Deactivate Physical command to the 3770. VTAM can power-down the 3770 with a certain bit setting in the Deactivate Physical request unit.
4. VTAM deactivates the modem for the link by issuing a Deactivate Link network command.
5. VTAM terminates the SSCP-PU session with the NCP by issuing a Deactivate Physical network command to the NCP.

Figures 8-2 and 8-3 are examples of establishing and terminating SNA communications with the 3770. Refer to Figure 8-4 for the SNA network commands that apply to the 3770.

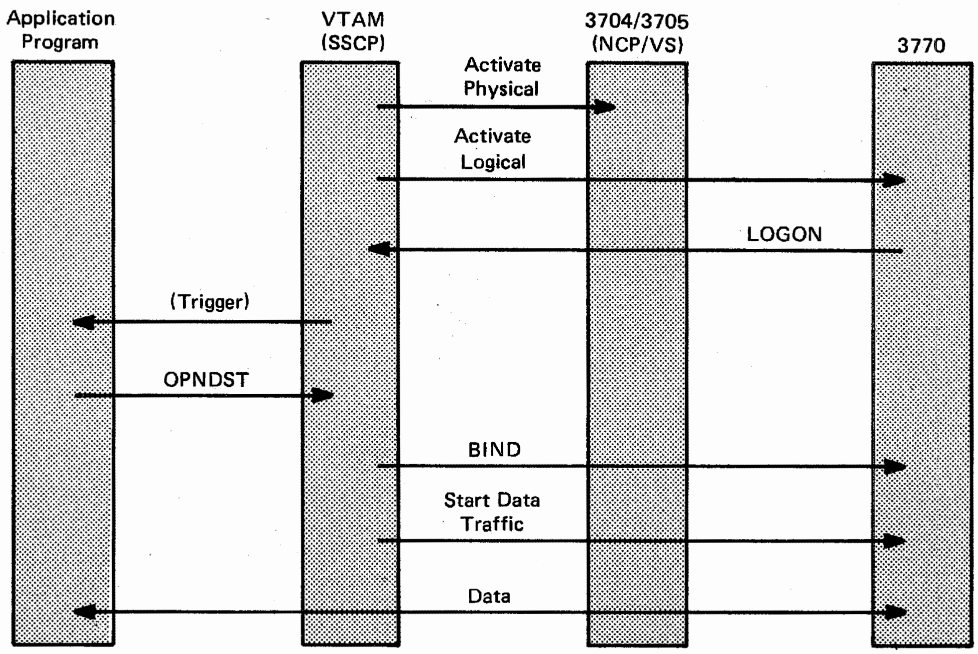


Figure 8-2. Example of Establishing SNA Communications

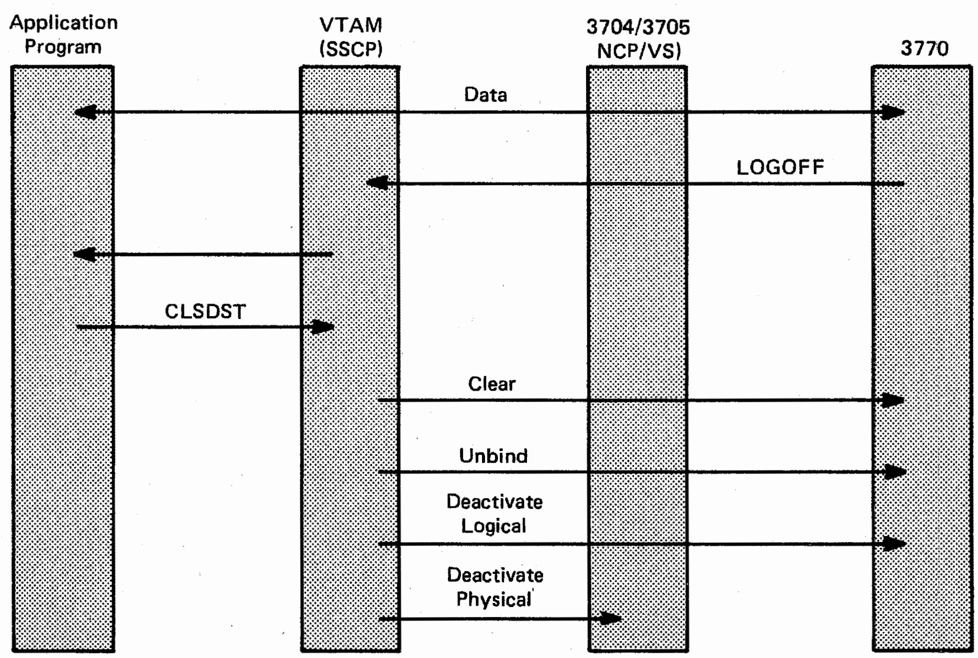


Figure 8-3. Example of Terminating SNA Communications

Command	Origin/Dest.	Function	Prerequisite	Request Unit (RU) Contents
Activate Link	VTAM/NCP	Activates the modem associated with the specified SDLC link.	Session between VTAM and NCP physical unit (SSCP-PU session).	Byte 0 = X'01' - Network services. Byte 1 = X'02' - Physical Configuration Services. Byte 2 = X'0A' - Request code. Bytes 3 - 4 = Network address of the link.
Activate Logical	VTAM/3770	Establishes a session between VTAM and the 3770 logical unit (SSCP-LU session).	Session between VTAM and 3770 physical unit (SSCP-PU session).	Byte 0 = X'0D' - Request code. Byte 1 = X'01' - Activation type: cold. Byte 2 = X'01' - DFC level.
Activate Physical	VTAM/NCP or VTAM/3770	Establishes a session between VTAM and the NCP or 3770 physical unit (SSCP-PU session).	No SSCP-PU session.	Byte 0 = X'11' - Request code. Byte 1 = X'01' - Activation type: cold. Byte 2 = X'01' - DFC level.
Bid	VTAM/3770	Sent by the VTAM application program to request permission from the 3770 to start a bracket.	Session between application and 3770 logical unit (APPL-LU session—between-bracket [BETB] state).	Byte 0 = X'C8' - Request code.
Bind	VTAM/3770	Establishes a session between a host application program and the 3770 logical unit (APPL-LU session).	Session between VTAM and the 3770 logical unit (SSCP-LU session)	Byte 0 = X'31' - Request code. Byte 1 = X'01' - Activation type: cold. Byte 2 = X'03' - FM profile for 3770. Byte 3 = X'03' - TS profile for 3770. Byte 4 - FM data protocol for host application: Bit 1 - Request mode: B'0' - Immediate. Bits 2 - 3 - Chain response: B'01' - Exception response. B'10' - Definite response. B'11' - Exception or Definite response. Bit 7 - Send end-bracket (EB) indicator: B'0' - Host will not send EB. B'1' - Host may send EB (programmable 3770 models only). Byte 5 - FM data protocol for 3770: Bit 0 - Chaining use: B'1' - Multiple RU chains allowed. Bit 1 - Request mode: B'0' - Immediate. Bits 2 - 3 - Response protocol: B'01' - Exception response. B'10' - Definite response. B'11' - Exception or Definite response (3770 defaults to Definite). Bit 6 - Compression: B '1' - Compression may be used. Bit 7 - Send end-bracket (EB) indicator: B'0' - 3770 will not send EB. B'1' - 3770 may send EB. Byte 6 - Common host - 3770 protocol: Bit 1 - FM header usage: B'1' - FM headers allowed. Bit 2 - Brackets: B'1' - Brackets will be used. Bit 3 - Bracket termination rule: B'1' - Bracket termination is controlled by the type of response requested by the CPU Bit 4 - Alternate code: B'1' - ASCII. B'0' - EBCDIC. Byte 7 - Common host - 3770 protocol: Bits 0 - 1 - FM transaction mode: B'01' - Half-duplex contention. B'10' - Half-duplex flip-flop.

Figure 8-4. SNA Network Commands (Part 1 of 5)

Command	Origin/Dest.	Function	Prerequisite	Request Unit (RU) Contents
Bind (Cont.)	VTAM/3770	Establishes a session between a host application program and the 3770 logical unit (APPL-LU session).	Session between VTAM and the 3770 logical unit (SSCP-LU session)	Byte 7 (Continued) Bit 2 - Recovery responsibility: B'0' - Host is responsible. Bit 3 - Brackets first speaker: B'0' - 3770 is first speaker. Bit 6 - Related chains: B'0' - No related chains. Bit 7 - Contention resolution: B'0' - 3770 speaks first in Data Traffic Active state. Byte 8 - Inbound Pacing: Bits 2-7 - Inbound pacing value Byte 9 - Outbound Pacing: Bits 2-7 - Receive pacing count: B'000000' or B'000001' - for non-programmable 3770 models B'000001' - for programmable 3770 models Byte 10 - Secondary Logical Unit (SLU) Inbound RU Size: Bits 0-3 = X'0' or X'8' } if 3770 is in 256-byte mode X'8' if 3770 is in 512-byte mode (3776/3777-1) Bits 4-7 = X'0' if Bits 0-3 = X'0' $\geq$ X'5' if Bits 0-3 = X'8' and 3770 is in 256-byte mode $\geq$ X'6' if Bits 0-3 = X'8' and 3770 is in 512-byte mode Byte 11 - Primary Logical Unit (PLU) Outbound RU Size: Bits 0-3 = X'0' or X'8' } if 3770 is in 256-byte mode X'8' if 3770 is in 512-byte mode Bits 4-7 = X'0' if Bits 0-3 = X'0' $\leq$ X'5' if Bits 0-3 = X'8' and 3770 is in 256-byte mode $\leq$ X'6' if Bits 0-3 = X'8' and 3770 is in 512-byte mode Byte 14 - Logical Unit (LU) Profile present: X'00' - None (Bytes 15-24 not checked by programmable models) X'01' - LU Profile 1 (See note 3) Byte 15 - FM Header Subset and Data Stream Profile (checked only by 3776/3777-1 models): Bits 0-3 - FM Header Subset: X'0' - Default X'1' - Header and Data combinations not permitted. X'2' - Header and Data combin-permitted. X'3' - Data Management Bits 4-7 - Data Stream Profile: X'0' - SCS Basic Controls Byte 16 - Logical Unit (LU) Profile: Bit 0 = B'0' - Interrupt level Bit 1 - Compacted data B'0' - Compacted data not allowed B'1' - Compacted data allowed (3777-1 only) Bits 2-7 - Reserved Byte 17 - (See note 4)

Notes:

1. Bytes 10, 11, 14, 15 and 16 are checked only by the 3776, 3777-1, and programmable 3770 models.
2. Bytes 12 and 13 are not checked by 3770 terminals.
3. If Byte 14 = X'01', Byte 16 Bits 0-3, 6, and 7 must be B'0' for programmable 3770 models. Bits 4 and 5 are not checked.
4. Bytes 17 through the end of the Bind RU are not checked by 3770 terminals.

Figure 8-4. SNA Network Commands (Part 2 of 5)

Command	Origin/Dest.	Function	Prerequisite	Request Unit (RU) Contents
Cancel	VTAM/3770 and 3770/VTAM	Indicates that an error has occurred in the current request unit chain. Preceding request units in the chain should be discarded. The next request unit sent should be either an only-in-chain request unit or first-in-chain request unit.	Data flow enabled.	Byte 0 = X'83' - Request code.
Chase	VTAM/3770	Ensures that the 3770 has received and responded to all outstanding requests. The 3770 processes all remaining requests in its buffers, then responds to the Chase.	Data flow enabled.	Byte 0 = X'84' - Request code.
Clear	VTAM/3770	Purges all outstanding requests and responses relating to the APPL-LU session. Clear is normally used after a catastrophic error as the first step in the data traffic recovery sequence or prior to an unconditional Unbind.	Data flow enabled.	Byte 0 = X'A1' - Request code.
Contact	VTAM/NCP	Causes the NCP to start a contact poll to the 3770. When the connection is made, the NCP returns a Contacted response to VTAM.	Session between VTAM and the 3770 physical unit (SSCP-PU session).	Byte 0 = X'01' - Network services. Byte 1 = X'02' - Configuration services. Byte 2 = X'01' - Request code. Bytes 3-4 - Network address of the 3770.
Contacted	NCP/VTAM	Informs VTAM that the NCP received a response to a contact poll, or an error occurred during a contact poll.	Session between VTAM and the 3770 physical unit (SSCP-PU session). Contact must be active.	Byte 0 = X'01' - Network services. Byte 1 = X'02' - Configuration services. Byte 2 = X'80' - Request code. Bytes 3 - 4 - Network address of the 3770. Byte 5 - Status: X'01' - Loaded. X'02' - Load required. X'03' - Error on contact.
Data	VTAM/3770 and 3770/VTAM	Transfers data between the application program and the 3770. User specified 3770 control information may precede the data.	Data flow enabled.	Optional 3770 control information and/or data. RH byte 0 bits 1, 2 = B'00' identify the RU contents as data.
Deactivate Link	VTAM/NCP	Deactivates the modem associated with the specified SDLC link.	Every resource on the link must be in the 'discontacted state': • A Contact was never issued to the resource. • A Discontact was issued to the resource. • An unrecoverable physical error occurred at the resource or on the link.	Byte 0 = X'01' - Network services. Byte 1 = X'02' - Configuration services. Byte 2 = X'0B' - Request code. Bytes 3 - 4 - Network address of the link.
Deactivate Logical	VTAM/NCP	Terminates the session Between VTAM and the 3770 logical unit.	SSCP-LU session.	Byte 0 = X'0E' - Request code.

Figure 8-4. SNA Network Commands (Part 3 of 5)

Command	Origin/Dest.	Function	Prerequisite	Request Unit (RU) Contents
Deactivate Physical	VTAM/NCP or VTAM/3770	Terminates the session between VTAM and the 3770 or NCP physical unit (SSCP-PU). Optionally powers-down the 3770.	SSCP-PU session.	Byte 0 = X'12' - Request code. Byte 1 - Type: X'01' - Final use; power-down the 3770. X'02' - Not final use.
Dial	VTAM/NCP	Causes the NCP to initiate an outbound call on an SDLC link. If autodial is specified, the NCP performs the dial operation. If manual dial is specified, the NCP enables the link and the operator performs the dial.	The modem must be active.	Byte 0 = X'01' - Network services. Byte 1 = X'02' - Configuration services. Byte 2 = X'0E' - Request code. Bytes 3-4 - Network address of the link. Byte 5 - SDLC addressing character for the 3770. Byte 6 - Type: Bit 0 = 1 - Secondary station. Bit 1 - Type of dial: B'0' - Autodial. B'1' - Manual dial. Byte 7 - Dial retry limit. Byte 8 - Number of dial digits. Bytes 9-n - Dial digits.
Discontact	VTAM/NCP	Causes the NCP to stop polling the 3770.	The link to the 3770 must not be active.	Byte 0 = X'01' - Network services. Byte 1 = X'02' - Configuration services. Byte 2 = X'02' - Request code. Bytes 3-4 - Network address of the 3770.
Entering Auto Network Shutdown	NCP/VTAM	Notifies VTAM that the NCP is entering auto network shutdown. The NCP sends the 3770 'path error' responses to requests directed to the host.	N/A	Byte 0-1 - Reason for ANS: X'0601' - ANS initiated by 3704/3705 operator. X'0602' - ANS entered because of channel timeout.
Entering Slowdown	NCP/VTAM	Informs VTAM that the normal flow of data through the NCP is impeded because of limited available buffers.	Session between VTAM and the NCP physical unit (SSCP-PU session).	Byte 0 = X'01' - Network services. Byte 1 = XX'02' - Configuration services. Byte 2 = X'02' - Request code. Bytes 3-4 - Network address of NCP physical services.
Execute Test	VTAM/NCP	Causes the NCP to execute an online line test (OLLT) for an SDLC link.	Session between VTAM and the NCP physical unit (SSCP-PU session).	Byte 0 = X'01' - Network services. Byte 1 = X'03' - Maintenance services. Byte 2 = X'01' - Request code. Bytes 3-n - Test data.
Exiting Slowdown	NCP/VTAM	Informs VTAM that the NCP buffer limitation has been lifted and normal data flow may resume.	Session between VTAM and NCP physical unit (SSCP-PU session).	Byte 0 = X'01' - Network services. Byte 1 = X'02' - Configuration services. Byte 2 = X'15' - Request code. Bytes 3-4 - Network address of NCP physical services.
Inoperative	NCP/VTAM	Informs VTAM that contact between the NCP and the 3770 has been lost. The Inoperative is sent only when an established contact is lost; not for failure to make contact.	SSCP-PU session and in 'contacted' state.	Byte 0 = X'01' - Network services. Byte 1 = X'02' - Configuration services. Byte 2 = X'81' - Request Code. Bytes 3-4 - Network address of the failing resource or link. Byte 5 - Cause: X'01' - Resource failed. X'02' - Link failed.
Logical Unit Status (LUSTAT)	3770/VTAM	Allows the 3770 to inform VTAM of a problem when a negative response cannot be sent.	Data flow enabled.	Byte 0 = X'04' - Request code. Bytes 1-2 - Status: X'081C' - Component failure; permanent error.

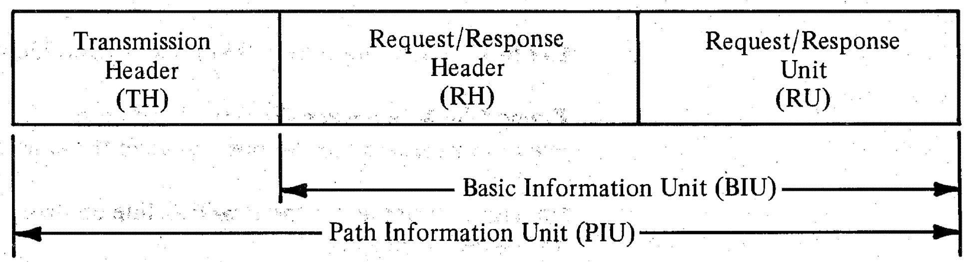
Figure 8-4. SNA Network Commands (Part 4 of 5)

Command	Origin/Dest.	Function	Prerequisite	Request Unit (RU) Contents
Off Hook	NCP/VTAM	Informs VTAM that a physical connection has been established between the NCP and the 3770.	Session between VTAM and the NCP physical unit (SSCP-PU session). Physical connection between NCP and the 3770.	Byte 0 = X'01' - Network services. Byte 1 = X'02' - Configuration services. Byte 2 = X'84' - Request code. Bytes 3-4 - Network address of the link. Bytes 5-10 - Station ID.
Record Maintenance Statistics	NCP/VTAM	Informs VTAM of error statistics when an unrecoverable error occurs on the link.	Session between VTAM and the NCP physical unit (SSCP-PU session).	Byte 0 = X'01' - Network services. Byte 1 = X'03' - Maintenance services. Byte 2 = X'81' - Request code. Bytes 3-4 - Network address of the failing link or 3770 terminal. Bytes 5-n - Error statistics (refer to the 3704/3705 Program Reference Handbook for MDR record formats).
Record Test Data	NCP/VTAM	Informs VTAM of the current status of an online line test (OLLT).	Session between VTAM and NCP physical unit (SSCP-PU session).	Byte 0 = X'01' - Network services. Byte 1 = X'03' - Maintenance services. Byte 2 = X'82' - Request code. Bytes 3-4 - Network address of the SDLC link being tested. Bytes 5-n - Test data.
Shutdown (SHUTD)	VTAM/3770	Requests that the 3770 stop sending data and to prepare for session termination.	Data flow enabled.	Byte 0 = X'C0' - Request code.
Shutdown Complete (SHUTC)	3770/VTAM	Informs VTAM that the 3770 is in the quiesce state.	Data flow enabled.	Byte 0 = X'C1' - Request code.
Request Shutdown (RSHUTD)	3770/VTAM	Informs the host that the 3770 wants to stop processing and end the SSCP-LU session. The 3770 remains in communicate mode until it receives a Clear and Unbind from the host.	Data flow enabled.	Byte 0 = X'C2' - Request code.
Signal	3770/VTAM	Sends an expedited signal to the host regardless of the normal flow.	Data flow enabled.	Byte 0 = X'C9' - Request code. Bytes 1-4 - Signal code.
Start Data Traffic (SDT)	VTAM/3770	Places the 3770 in the 'data flow enabled' state.	Session between the application program and the 3770 logical unit.	Byte 0 = X'A0' - Request code.
Unbind	VTAM/3770	Terminates the session between the host application program and the 3770 logical unit (APPL-LU).	APPL-LU session.	Byte 0 = X'32' - Request code. Byte 1 = X'01' - Unbind type.

Figure 8-4. SNA Network Commands (Part 5 of 5)

SNA Transmission Blocks

The basic unit of information in the SNA network is the Path Information Unit (PIU). A PIU may request a TP operation, transfer data, or indicate the result of a TP operation. The general format of the PIU is shown below.



Request/Response Unit (RU): The basic unit of information in the TP network. It may contain commands that control the flow of data through the network, responses to commands, acknowledgement of data, and optional data.

Request/Response Header (RH): Contains fields that identify the RU and control the flow of data through the network.

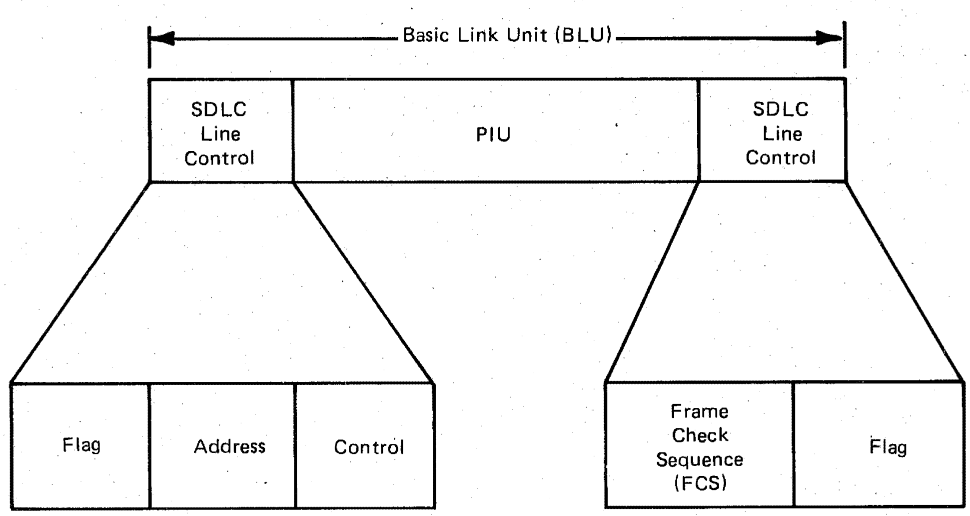
Basic Information Unit (BIU): An RU with its associated RH.

Transmission Header (TH): Used to route the PIU through the network to its destination.

Path Information Unit (PIU): A BIU with its associated TH.

In some SNA networks, multiple PIUs may be transmitted over an SDLC link in a single transmission block. These multiple PIUs are referred to as a Basic Transmission Unit (BTU). Since the 3770 allows only one PIU per transmission, the PIU and BTU are the same.

When the PIU is transmitted over an SDLC link, it must have SDLC link control information appended to it. The PIU with the SDLC line control information is called a Basic Link Unit (BLU).



Flag: 8-bit sequence (01111110) at the beginning and end of the BLU that serves as a delimiter. For contiguous BLUs, the ending flag of one BLU may be the beginning flag on the next.

Address: A one-byte station address. An address of all zeros is a null address that is used for testing.

Control: A one-byte field that controls and identifies the BLU.

Frame Check Sequence (FCS): A two-byte check character that is derived by the accumulation of all of the bits between the starting and ending flags.

For more information about SDLC line control, refer to the *IBM SDLC General Information* manual.

PIU Formats

The PIU in the 3770 SNA network can be in one of two formats depending on its origination and destination:

Format Identification One (FID1): Used for transmission between the host and the communications controller; also used for transmission between the local communications controller and a remote communications controller.

Format Identification Two (FID2): Used for transmission between the communications controller and the 3770.

The NCP converts the FID1 PIU to a FID2 PIU on requests that are directed to the 3770, and converts the FID2 PIU to a FID1 PIU on requests that are directed to the host.

Figure 8-5 shows the FID1 and FID2 PIU formats.

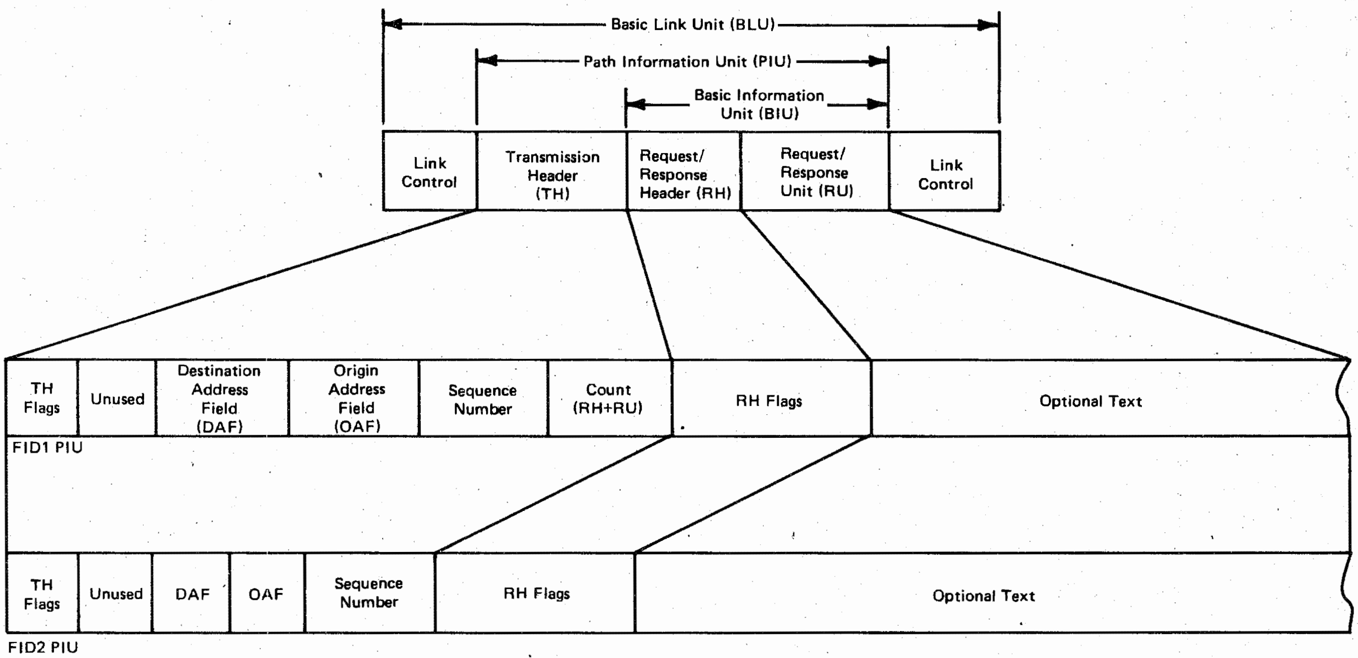


Figure 8-5. PIU Formats in the 3770 SNA Network

Data Chaining

In some cases it is desirable to send or receive a group of related requests through the network as a single entity. In an SNA network, this is done by 'data chaining'. A data chain begins with a request that is identified as *beginning-of-chain.* This first request unit of the chain may be followed by one or more *middle-of-chain* requests and the chain ends with an *end-of-chain* request. A chain can consist of only one request unit. In this case the request is called an *only-one (RU)-in-chain* request. The different request units of the chain are identified by flags in the request header (RH):

RH Byte 0, Bits 6 and 7

B'10' - Beginning-of-Chain (BOC)
B'01' - End-of-Chain (EOC)
B'00' - Middle-of-Chain (MOC)
B'11' - Only-one-in-Chain (OC)

The following rules apply to 3770 data chaining:

- If the 3770 receives a Cancel while receiving a chain of requests, it discards all previously received requests of the chain.
- If the 3770 sends a negative response to a request in a chain, it purges all further requests until it encounters an end-of-chain request or Cancel.

3770 SNA Bracket Protocol

Figure 8-7 shows examples of bracket protocol. SNA bracket protocol is used by the 3770 to resolve contention between the host application program and the 3770. Brackets are used to prevent a series of requests or chains from being interrupted. This series of requests or chains is referred to as a 'conversation'.

A conversation begins and ends with brackets. The brackets are identified by flags in the request header (RH):

RH Byte 2, Bits 0 and 1

B'10' - *Begin Bracket (BB)* - Identifies the first request unit of a conversation.

B'01' - *End Bracket (EB)* - Identifies the last request of a conversation or the first request in the last chain of a conversation.

A request unit may be both a begin bracket and end bracket. This indicates that it is the only request unit or chain in the conversation.

The 3770 manages bracket communications and is always the 'first speaker'. The first speaker either begins a conversation with a begin bracket or gives permission to the application program to begin a bracket. The host application program requests permission to begin a bracket by sending a Bid request to the 3770. The 3770 gives permission to the host application program by returning a positive response to the Bid. The application program then begins the conversation with a begin bracket request.

The host application program can also request permission to begin a bracket by sending a begin bracket request to the 3770. If the 3770 accepts the begin bracket, it returns a positive response. Otherwise, it returns a negative response to the host application program and the begin bracket request is discarded.

In order to manage bracket protocol, the 3770 maintains three bracket states:

- *Between Brackets (BETB)* - No conversation is taking place. A begin bracket request or Bid may be accepted.
- *Begin Bracket Pending (BBP)* - The 3770 has given permission to the application program to begin a bracket. The BBP state is entered from the BETB state when the 3770 sends a positive response to a Bid. The BBP state exits to the INB state when the begin bracket request is received.
- *In Brackets (INB)* - A conversation is taking place. The INB state is entered from the BETB state when a begin bracket request is initiated by the 3770 or accepted by the 3770. The INB state exist to the BETB state when the 3770 sends or receives an end bracket request.

Figure 8-6 shows 3770 bracket management decisions on accepting or rejecting bracket requests.

		Bracket State		
		BETB	INB	BBP
REQUEST UNIT	Not Begin Bracket Not End Bracket	Reject	Accept	Reject
	Begin Bracket Not End Bracket	Accept	Reject	Accept
	Not Begin Bracket End Bracket	Reject	Accept	Reject
	Begin Bracket End bracket	Accept	Reject	Accept
	Bid	Accept	Reject	Reject

Figure 8-6. Bracket Request Accept/Reject Table

Transaction Modes

The 3770 operates in one of two transaction modes which is specified in the Bind:

- *Contention Mode* - The 3770 and host go into contention within brackets at the end of every chain. This mode is allowed only in interactive sessions and is not allowed on 3776/3777-1 or programmable models.
- *Flip-Flop Mode* - The 3770 and host go into contention only between brackets. Flow within the brackets can change direction (flip-flop) at the end of any chain by setting the change direction indicator in the RH (RH byte 2, bit 2).

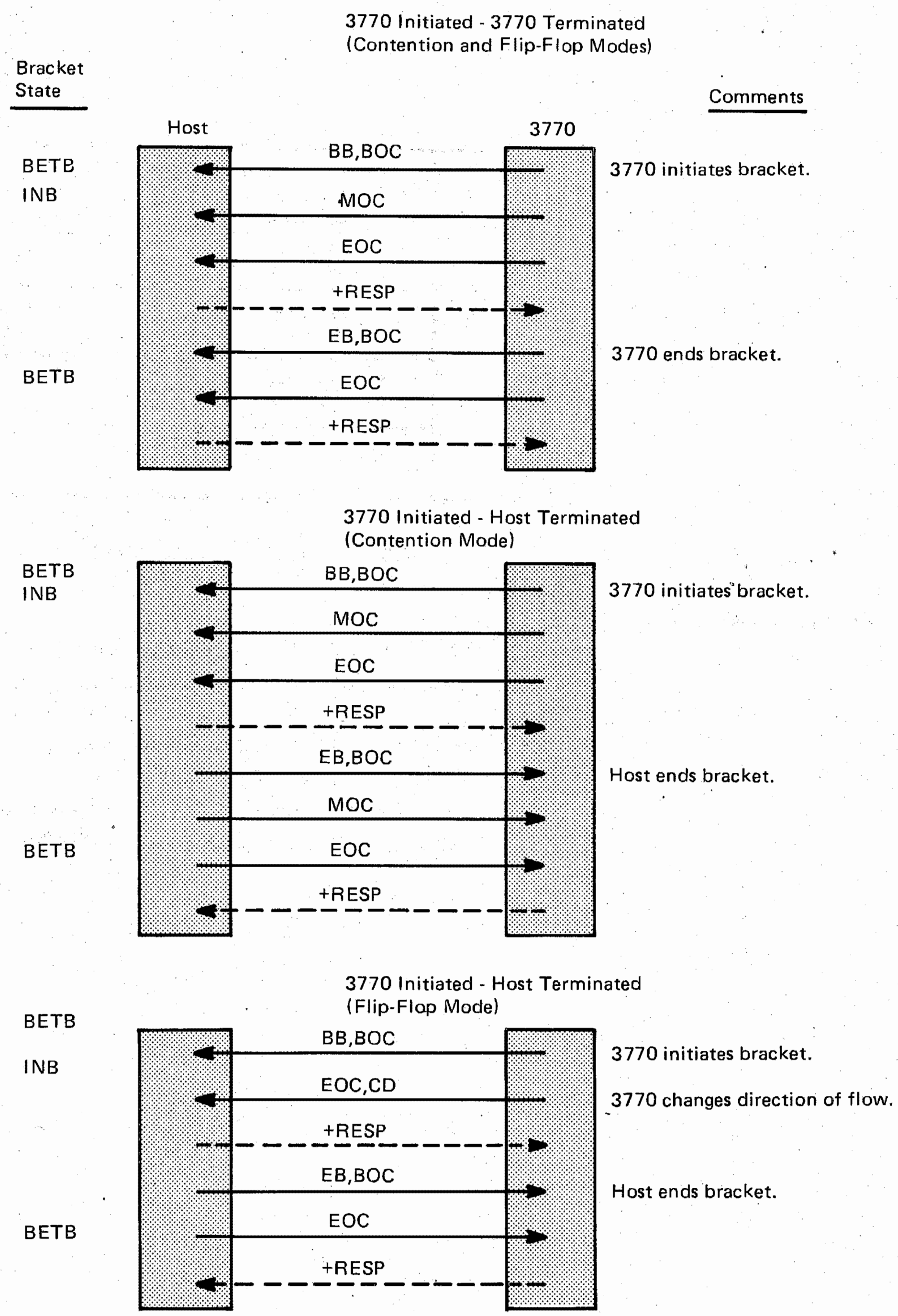
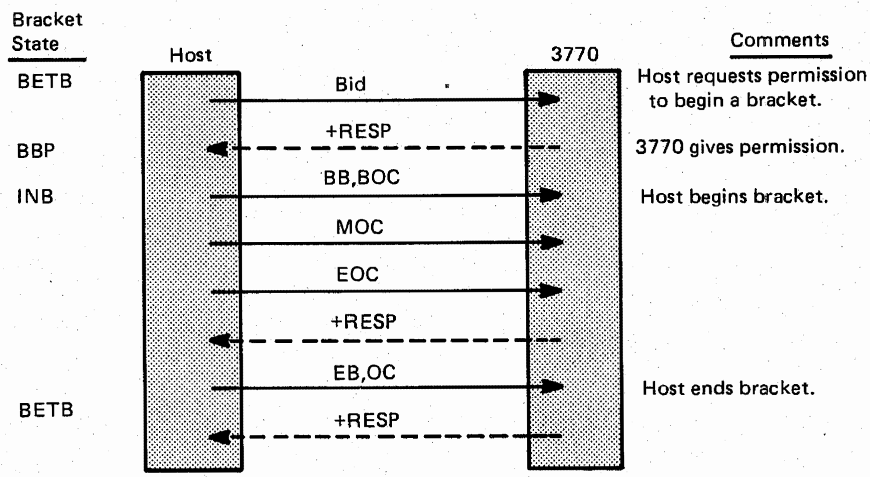
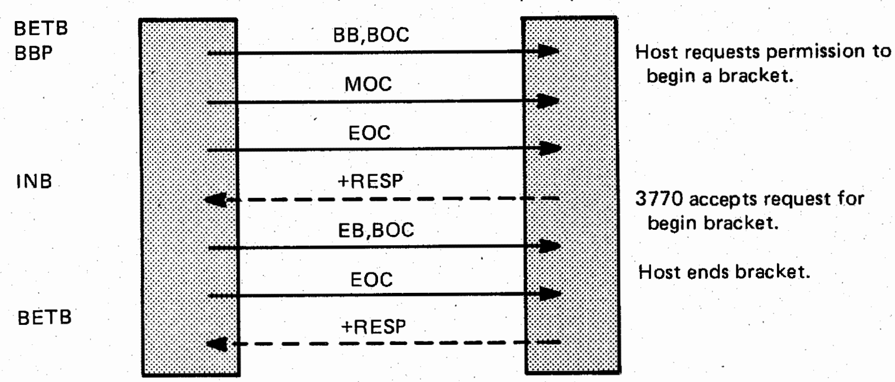


Figure 8-7. Examples of Bracket Protocol (1 of 2)

Host Initiated with Bid
(Contention and Flip-Flop Modes)



Host Initiated without Bid
(Contention and Flip-Flop Modes)



BB	—	Begin bracket
EB	—	End bracket
BOC	—	Beginning of chain
MOC	—	Middle of chain
EOC	—	End of chain
OC	—	Only of chain.
BETB	—	Between brackets
INB	—	In brackets
BBP	—	Begin bracket pending
RESP	—	Response

Figure 8-7. Examples of Bracket Protocol (2 of 2)

Installing an IBM 3770/SNA System

This section is a guide for those who install the IBM 3770 Data Communication System. It describes the steps required to install the 3770 system in an SNA/SDLC telecommunications network using; (1) an IBM 3704 or 3705 Communications Controller with Network Control Program/Virtual Storage (NCP/VS), and (2) an IBM System/370-VS with the Virtual Telecommunications Access Method (VTAM). Refer to Figure 8-8. This section highlights the aspects of the installation process that are unique to the 3770 system and directs the reader to other IBM publications that provide more information. The intent of this section is that it be used as a guide to the NCP, VTAM, and other publications; not a substitute for them.

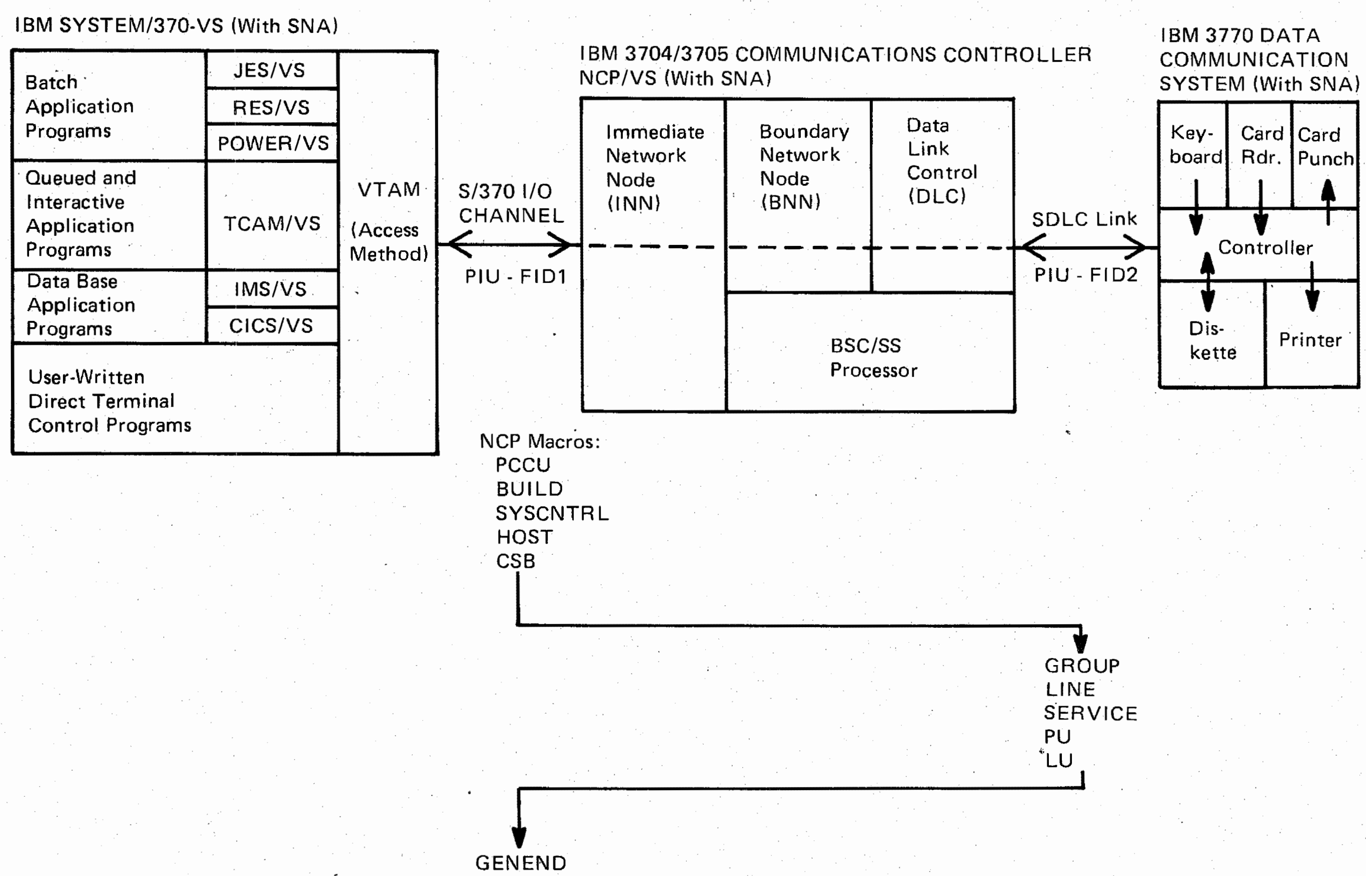


Figure 8-8. IBM 3770 Communication Terminal in an SNA/SDLC Network

Related Publications

When installing a 3770 programmable terminal on an SNA network, refer to the *IBM 3773, 3774, and 3775 Programmable Communication Terminals Programmer's Guide*, GC30-3028, in addition to this *3770 System Components* manual. Other manuals of a more general nature are listed in the Publications Availability Guide in the front of this manual. This section uses short titles from the following list to refer to other IBM publications that contain information necessary for the installation process or contain references to other IBM publications where that information may be found. For example, the *VTAM Concepts* *and Planning Manual* contains references to the appropriate manuals for installing VTAM, writing VTAM application programs, and operating VTAM.

Introduction and General Information Manuals

CICS General Information

Customer Information Control System (CICS/VS) General Information Manual, GH20-1280

IMS General Information

Information Management System Virtual Storage (IMS/VS) General Information Manual, GH20-1260

SDLC General Information

IBM Synchronous Data Link Control General Information, GA27-3093

SNA General Information

IBM Systems Network Architecture General Information, GA27-3102 (to be renamed *Technical Overview*)

SNA Introduction

IBM Systems Network Architecture Introduction (when available)

VTAM Introduction

Introduction to VTAM (Virtual Telecommunications Access Method, GC27-6987

3704/3705 Introduction

Introduction to the IBM 3704 and 3705 Communications Controllers, GA27-3051

Concepts, Facilities, and Planning Manuals

TCAM Concepts and Facilities

OS/VS TCAM Concepts and Facilities, GC30-2042

VTAM Concepts and Planning

VTAM Concepts and Planning, DOS/VS, OS/VS1, OS/VS2, GC27-6998

Program Generation and Installation Manuals

3770 Programmer's Guide

IBM 3773, 3774, and 3775 Programmable Communication Terminals Programmer's Guide, GC30-3028.

Information Management System

IMS MFS User's Guide, SH20-9053

NCP Generation and Utilities

IBM 3704 and 3705 Control Program Generation and Utilities Guide and Reference Manual, GC30-3008

TCAM Programmer's Guide

Refer to *TCAM Concepts and Facilities*, GC30-2042, for the appropriate programming publications for your operating system.

VTAM System Programmer's Guide

Refer to *VTAM Concepts and Planning*, GC27-6998, for the appropriate programming publications for your operating system.

Program Reference Manuals

CICS Reference Manuals

CICS Application Programmer's Reference Manual, SH20-9003

CICS System Programmer's Reference Manual, SH20-9004

IMS Reference Manuals

IMS Application Programmer's Reference Manual, SH20-9026

IMS System Programmer's Reference Manual, SH20-9027

Program Reference Handbook

IBM 3704 and 3705 Program Reference Handbook, GY30-3012

VTAM Macro Language Manuals

VTAM Macro Language Guide, GC27-6994

VTAM Macro Language Reference, GC27-6995

Operator's Manuals

VTAM Network Operating Procedures

Operator's Library: VTAM Network Operating Procedures, GC27-6997

Control Panel Guides

Guide to Using the IBM 3704 Communications Controller Control Panel, GA27-3086

Guide to Using the IBM 3705 Communications Controller Control Panel, GA27-3087

Writing NCP Generation Macro Instructions

The NCP macro instructions are used in two ways. First, they are used to generate the NCP load modules. Then, they are used by VTAM to get information about the network.

Most of the parameters specified in the NCP generation macro instructions are used only for generating the network control program. However, some parameters are used both in generating the NCP and again in defining the NCP network to VTAM. The jointly used parameters and the VTAM-only parameters are made available to VTAM when the NCP generation deck is filed during the network definition process. The *NCP Generation and Utilities* manual lists the VTAM-only macros and operands, and indicates where they must appear in the NCP source deck used for VTAM initialization. The *VTAM System Programmer's Guide* explains how to use the VTAM-only NCP macros and operands. Placing the VTAM-only macros in the deck before generating the NCP load module is recommended, because the syntax of the macros is checked. Adding them to the deck after generating the program can introduce errors (such as misspelled operands or misplaced cards).

There are several critical NCP coding requirements imposed by VTAM and the 3770 system.

System and Configuration Definition Macro Instructions

PCCU Macro (VTAM only)
BUILD Macro
SYSCNTRL Macro
HOST Macro
CSB Macro

The list of NCP macro instructions to be written is taken from the *System* and *Configuration Definition* lists in the *NCP Generation Macro Instructions* section of the *NCP Generation and Utilities* manual. The list is included here for reference only, with one exception. When writing the NEWNAME parameter in the BUILD macro, note that the name must be the same as the file name of the generated NCP phase (DOS/VS or the member name of the NCP (OS/VS).

Some Additional NCP/3770 Definition Considerations

The person who writes the NCP macro instructions should know the answers to the following questions or code the operands as indicated.

GROUP Macro Instruction

Parameter	NCP Operand
Type of line	DIAL=YES or NO
Type of line control	LNCTL=SDLC
Type of pacing	VPACING=1,1

LINE Macro Instruction

Parameter	NCP Operand
Line speed	SPEED=1200, 2400, 4800, or 9600
Type of station	PUTYPE=2
Half-duplex or duplex facility	DUPLEX=FULL or HALF

PU Macro Instruction

Parameter	NCP Operand
Type of station	PUTYPE=2
Segment Size	MAXDATA=265 for 256-byte buffer =521 for 512-byte buffer
Number of PIUs outstanding	MAXOUT=1
Service order table limit	PASSLIM=1

LU Macro Instruction (for nonswitched links only)

Parameter	NCP Operand
Pacing the logical unit	PACING=1,1

Generating the NCP Load Module

Generating the NCP module is a multistage process. It involves assembling the NCP macros, assembling NCP assembler code (derived from the macro assembly or directly coded by you), and link-editing the assembled code (along with IBM-supplied object modules that will be needed as indicated by the options selected in the NCP macro instructions).

Save the intermediate output of the generation process—the NCP load module and resource resolution tables—in case you wish to do partial NCP generations later. Refer to the *NCP Generation and Utilities* manual for more details.

DOS/VS only:

DOS/VS users must put generated NCP load module and initial test routines on NCP libraries with the CSERV utility.

Filing NCP Instructions for Use by VTAM

As part of the VTAM definition procedure, you must file the macro instructions you have written for each NCP. (See the *VTAM System Programmer's Guide* and *VTAM Network Operating Procedures.*) VTAM uses the NCP macro instructions to build its resource definition tables, which describe the components of the network. VTAM uses these tables to communicate with the network components.

Coding and Filing the VTAM Definition Statements

After you have generated your NCP load module, put the macro instructions in the VTAM definition file to provide a definition of the NCP and its network to VTAM.

Coding, Assembling, and Installing Application Programs that Use VTAM

The symbolic names that you use in your VTAM application programs to communicate with specific 3770 physical and logical units must match the NCP macro instruction labels for PU and LU macros. However, you do not have to know the symbolic names when you code your application program. If you write a LOGON exit-routine, VTAM will provide the program with the symbolic name of each 3770 logical unit when the 3770 logical unit requests connection. See the *VTAM Macro Language* manuals for details.

Activating and Loading the NCPs

When you start VTAM, VTAM will activate and load the NCPs named in the configuration list that you specified in the VTAM start parameter, CONFIG=.

NCPs that VTAM does not load (because you did not name them in a configuration list) can be loaded after you have started VTAM by using VTAM's VARY NET command.

Activating 3770 VTAM Operator Commands

Before VTAM can transmit to a 3770, both the 3770 physical unit (PU) and its logical unit (LU) must be active. There are two ways to activate physical and logical units with VTAM:

1. Specify ISTATUS=ACTIVE in the NCP macro instructions that describe 3770 logical units, to indicate that each is to be automatically activated when the NCP is activated.

   or

2. Activate each 3770 physical unit and logical unit individually by issuing VTAM's VARY NET command.

Operational Considerations

Transmission Headers

All 3770 terminals support "FID2" transmission and request/response headers (TH and RH). The headers consist of the nine bytes as shown in the Data Area Layouts section of the *IBM 3704 and 3705 Program Reference Handbook*, GY30-3012.

Sense Data—Inbound Error Response

The 3770 will set the ERR bit on inbound responses to identify an error response. Sense data will accompany the error response. The sense data consists of four bytes as follows:

Major Code (SB0)	*Modifiers (SB1)*	
Path Error (X'80')	X'04' -	Unrecognized DAF
	X'07' -	Segmenting Error
	X'09' -	LU not active
Request Header Error (X'40')		None
State Error (X'20')	X'01' -	Sequence Number
	X'02' -	Chaining
	X'05' -	Data Traffic Reset
Request Error (X'10')	X'02' -	RU Length Error
	X'03' -	Function Not Supported
	X'05' -	Parameter Error
	X'07' -	Category Not Supported
	X'08' -	Invalid FM Header
Request Reject (X'08')	X'02' -	Intervention Required
	X'05' -	Session Limit Exceeded
	X'0A' -	Permission Rejected
	X'0B' -	Bracket Race Error
	X'11' -	Break
	X'12' -	Insufficient resource
	X'13' -	Bracket Bid Reject - No RTR Forthcoming
	X'1B' -	Receiver in Transmit Mode
	X'1C' -	Request Not Executable
	X'21' -	Invalid Session Parameters
	X'25' -	Component Not Available

Note: 3770 nonprogrammable models will not set the user data sense bytes (SB2 and SB3) to anything other than X'0000'. Programmable models will set SB2 and SB3 for invalid Type 2 FM headers.

3770 Considerations for the Bind Command

The following Bind command parameters must be specified when the host issues a Bind command to a 3770 terminal.

Function Management (FM) Profile

The function management profile for the 3770 must be defined as FM Profile 3 or the 3770 rejects the Bind command.

Transmission Services (TS) Profile

The transmission services profile for the 3770 must be defined as TS Profile 3 or the 3770 rejects the Bind command.

Primary (Host) Protocol

The primary (host) request mode selection must specify immediate request mode. The primary (host) chain response protocol must not specify "no response" or the 3770 rejects the Bind command. For 3770 programmable models, the Bind command must allow the primary (host) to end brackets (EB).

Secondary (3770) Protocols

The following protocols on chains and brackets must be specified when the host issues a Bind command.

Chaining: The secondary (3770) chaining selection must specify that multiple request unit chains may be used.

Request Mode: The secondary (3770) request mode selection must specify immediate request mode.

Chaining Response: Three types of responses may be selected for chaining in the BIND command:

1. Exception response: If the Bind command to the 3770 specified exception response, the 3770 asks only for exception responses to request units sent to the host.
2. Definite response: If the Bind command to the 3770 specifies definite response, the 3770 requests a definite response only on the end-of-chain (EOC) request unit. For all other request units sent to the host, the 3770 requests only the exception response.
3. Both exception and definite responses: If both responses are specified in the Bind command, the 3770 assumes (defaults to) the definite response protocol.

End Bracket (EB): If the Bind command permits the 3770 to send the end-of-bracket indicator, the 3770 sends EB only if the 3770 initiated the bracket. The 3770 does not terminate a host-initiated bracket.

If the Bind command does not permit the 3770 to send the end-of-bracket indicator, the 3770 does not terminate any brackets regardless of which logical unit (host or 3770) initiated the bracket.

Common Protocols

The following protocols common to both logical units must be observed when the host issues a Bind command.

Batch or Interactive - FM Header Usage: If FM headers are allowed on request units, the 3770 assumes the batch mode of operation which can include all I/O devices attached.

If the Bind command does not allow FM headers, the 3770 assumes an interactive mode of operation which can include only the keyboard and the console printer.

Bracket Protocol: The 3770 logical unit requires that bracket protocol be specified in all Bind commands and that bracket termination rule one (1) be used as follows:

- If a definite response is requested by the sender, the bracket is not terminated until the sender receives a positive response.

- If an exception response is requested, the bracket is terminated unconditionally when the receiver processes the chain with the end-of-bracket (EB) request unit.
- If Begin Bracket (BB) and End Bracket (EB) indicators are both on in the same chain, the bracket is unconditionally terminated regardless of the type of request.

Data Transmission Code: If the alternate code is specified in the Bind command, the 3770 assumes ASCII is used for data transmission.

If the alternate code is not specified, the 3770 assumes EBCDIC is used for data transmission.

Function Management Transaction Mode: If the Bind command permits FM headers to be used (batch session), the 3770 must run in half-duplex, flip-flop mode.

If FM headers are not allowed (interactive session), the 3770 may run either in half-duplex flip-flop or half-duplex contention mode on a per-session basis except the 3776/3777-1 and programmable models. These run only in half-duplex flip-flop mode.

Recovery Responsibility: The 3770 requires the Bind command to specify that the primary logical unit (the host application program) be responsible for error recovery.

First Speaker in Brackets: The 3770 requires that the Bind command specify the secondary logical unit (the 3770) as the first speaker for bracket protocol. To resolve a contention situation when the host and the 3770 simultaneously issue a begin bracket (BB) request unit, the host must accept the 3770 BB request. The 3770 may reject a BB request unit from the host.

Responses

A response convention is used to assure the sender that the request unit was received and is acceptable to the receiver. The two types of convention that the 3770 supports are as follows:

1. Exception or error response. The request unit chain only requires a response if the request is in error or unacceptable.
2. Definite response. The request unit chain requires a response, either positive or negative.

Definite Response (DR 1/2)

This response indicates that a request unit has been received by the user. When sent without an error indicator, DR 1/2 indicates that the request unit was received successfully and acted upon.

Exception Response (EX)

This response indicates that the request unit has not been received successfully or could not be acted upon. This response is always sent in combination with a DR 1/2 response. This response is always accompanied by four bytes of sense information. The first two bytes are defined by the network and the last two bytes are set to zeroes by the 3770. All four bytes are supplied by the logical unit when sending an error response.

The VTAM application program may request that the 3770 send two types of responses for request units received from the VTAM application program, that is:

Exception response (DR 1/2, EX) only, which is negative only;
Definite response (DR 1/2, NEX), which is positive or negative as appropriate.

Only exception responses are required for the request units in the chain, except for the last request unit. The last request unit in the chain may require a definite response.

Interactive Operator Interface (Nonprogrammable Models)

ID Reader

The ID Reader may be activated by the 3770 operator via a code key function during a keyboard-to-line job on nonprogrammable 3770 models. A code will be displayed in the NPR to notify the operator that the ID Reader has been activated. Up to 213 characters may be entered into the buffer before inserting the badge in the reader. When the badge is read, the buffer is automatically transmitted to the CPU. Printing of the ID Reader data will be inhibited.

Note: A Longitudinal Redundancy Check (LRC) will be performed, but the LRC characters will not be transmitted.

Secure Data

The code functions Inhibit Print (INP) and Enable Print (ENP) are supported by 3770 to allow the host to control entry of secure data at the terminal. Upon receipt of INP, the print-inhibit state is entered. While in the print-inhibit state, if the keyboard is used as the input device, the Print Inhibit light will be turned on and any data entered via the keyboard will not be printed. Data received from the host during print-inhibit state will be printed, and the Print Inhibit light will be turned off. This will not affect the print-inhibit state in the terminal.

When ENP is received, print-inhibit state will be reset.

The ATTN key may be used during print-inhibit state to transmit SIGNAL. The function associated with this request is application dependent.

Function Management Header (Nonprogrammable Models)

All nonprogrammable models of the 3770 use type 1 function management (FM) headers. The 3777 Model 1, in addition to using the type 1 FM header (transmit and receive), accepts the type 3 FM header from the host provided that the header contains data decompaction information. Programmable models of the 3770 use both type 1 and type 2 FM headers. Refer to the *IBM 3773, 3774, and 3775 Programmable Communication Terminals Programmer's Guide,* GC30-3028, for a description of type 2 and extensions to type 1 FM headers and for other programming considerations when using 3770 programmable terminals on SNA networks.

The basic type 1 FM header is a six-byte control field that occurs at the beginning of a request unit. The presence of the FM header is indicated in the request header via the Formatted Indicator bit. The header may occur only on beginning-of-chain (BOC) or only-one-(RU)-in-chain (OC) request units. For the 3770, the functions provided by the FM header are:

- Component selection
- Data set delimiting
- String Control Byte (SCB) definition

Each inbound data set originating from the card reader or the diskette will be framed by FM headers. When the device from which the data originated is the keyboard, no FM headers are present. All outbound data sets should be framed by FM headers. If the 3770 receives a data set without an FM header (i.e., the Formatted Indicator in the request header is off), the console printer is selected.

The format of the FM header (Type 1) is as follows:

Byte	*Bits*	*Meaning*		
0	0-7	X'06' - Length of header		
1	0-7	X'01' - Type = 1		
2	0-3	Input/Output, Medium Select(Bit 0 must be 0 for 3770)		
		Output		
		X'0' - Console printer		
		X'1' - Exchange Diskette (Host to 3770 Only)		
		X'2' - Card punch		
		X'3' - Line printer		
		X'4' - Nonexchange Diskette, User Data Set Inbound/ Outbound, 3770P Only		
		X'5' - Print Data Set		
		X'6' - Transaction Data Set (3770-to-Host)		
		X'7' - Reserved		
		Input		
		X'0' - Console (keyboard)		
		X'1' - Diskette		
		X'2' - Card reader		
	4-7	Device address		
		X'0' - Console printer or line printer, card reader or punch, or diskette 1		
		X'1' - Diskette 2		
3	0-7	Reserved		
4	0-7	Properties		
	0	IDS	0	Resume data set
			1	Suspend data set
	1	BDS	0	Not beginning of data set
			1	Beginning of data set
	2	EDS	0	Not end of data set
			1	End of data set
	3	DST	0	Not basic exchange
			1	Basic exchange
	4	Reserved		
	5	CMI	0	Not compressed
			1	Compressed
	6	CPI	0	Not compacted
			1	Compacted data (Host to 3777-1 Only)
	7	Reserved		
5	0-7	ERCL	Reserved if media is not diskette. Exchange record length if media=diskette and DST=1.	

The format of the FM header (Type 3) is as follows:

Byte	*Value*	*Meaning*
*0	L	Length of header
1	X'03'	Type = 3
2	X'02'	Contents = decompaction table
*3	M	Number of master characters - X'03' → X'10'
*4	L-1	Master characters followed by any nonmaster characters

*See table below for values of variables.

The type 3 FM header is accepted only by the 3777 Model 1 and only if the FM header contains data decompaction information.

The number of characters in the decompaction table depends on the number of master characters. The hex values for the variables in the Type 3 FM header are given in the table below.

Number of Master Characters M		*Length of Header L*
Decimal	*Hex*	*Hex*
16	10	14
15	0F	23
14	0E	40
13	0D	5C
12	0C	74
11	0B	8C
10	0A	A0
9	09	B4
8	08	C4
7	07	D3
6	06	E0
5	05	EB
4	04	F4
3	03	FB

The master and non-master characters are defined beginning at byte 4 and ending at byte (L-1).

Note: Inbound Data from 3770 - Inbound FM headers will contain the device selection indicators for the device from which the data originated.

Outbound Data to 3770 - If the 3770 DISK switch is on, all valid selections except the console will be overridden unless the machine is jumpered for ASCII and the Bind is for EBCDIC. In this case the DISK switch is ignored. The only valid devices for 3770 are console printer, line printer, diskette, and punch. If the DISK switch is not on and the device select field specifies a valid device other than the line printer that is not attached to the 3770, an exception response (Component Not Available) will be sent. If the line printer is selected and the device is not attached, selection will be forced to the console printer. If the device select field specifies a device that is invalid for the 3770, the 3770 will send an exception response indicating an invalid FM header. On a 3770 with only one line-to-diskette data set, if the FM header is not compatible with the existing data set, the 3770 sends an exception response (Component Not Available).

Inbound Data from 3770 to CPU

Inbound Card Data (Nonprogrammable Models Only)

The 3770 will send card data to the CPU as follows:

Nontransparent Cards:

- TRN and IGS codes are not allowed in data*
- Trailing Blanks are truncated
- IRS code is appended to the resultant card image to denote end of record
- RU size can vary from 0 to 256 bytes (512 bytes on 3776/3777)
- 3770 will not span card records across RU boundaries

*Note: The 3770 does not check for TRN and IGS codes in card data. If these codes exist in card data, use the transparent mode of data transmission to ensure proper processing at the host CPU.

Transparent Cards:

- Trailing blanks are truncated
- TRN code followed by a one-byte binary count (0-80) precedes the truncated card image
- IRS code is appended to the resultant card image
- RU size can vary from 0-256 bytes (512 bytes on 3776/3777)
- 3770 will not span card records across RU boundaries

The card RUs are sent from the beginning of a card deck to the EOF as one data set and one bracket. The user can delimit jobs or transactions within the bracket by inserting an "end-of-chain" card(s) in the deck. Columns 1-6 of the card should contain /*EOC blank (all other columns are ignored). When the 3770 reads this card, the reader will stop and that RU will be sent as the end of chain. Reading will resume after the positive response to the chain has been received. The next RU from the reader will be a beginning of chain. If the 3770 is bound in a session requesting exception response chains, the reader will not stop when a /*EOC is read.

Note: The 3770 will not recognize the /*EOC card in transparent decks.

The 2502 has a switch to control the end-of-file condition when the hopper empties. The 3501 and 3521 use the /*EOF card to detect the EOF condition. The /*EOF will not be included in the data stream.

Inbound Disk Data (Nonprogrammable Models Only)

Transmission Data Sets

The RU structure and content of data originating from the diskette is identical to the format and content of the original source of input, and the media field in the FM header will identify the original source of the input. If the data originated from the card reader, the format will be as described for cards. One or more data sets will be sent as a bracket, and chains within the data set(s) will be sent if the /*EOC was used in the card to disk operation.

If the data originated from the keyboard, the data will be exactly as entered from the keyboard. Pressing the EOM key causes an IUS character to be written to the diskette. When the diskette is transmitted, the data set(s) is transmitted with chains within the data set(s) if the EOM key was used.

The IUS character will be stripped from the data stream before transmission. The RU size can vary from 0 to 256 bytes.

Basic Exchange Data Sets

The FM Header media field will identify the source of the input as diskette, and the entire data set will be transmitted as a single chain. The 3770 will read one sector at a time from the diskette and transmit one sector per RU. The nonprogrammable models will identify the source as the card reader if the data set block length is equal to or less than 80 bytes. This also applies to the Record Compress mode of operation where multiple sectors are contained in one RU.

Inbound Keyboard Data (Nonprogrammable Models Only)

The inbound keyboard data will be SNA character string as described later in this chapter. Pressing the EOM key forces an end bracket as well as an end-of-chain condition.

Outbound Data from CPU to 3770

Outbound Card Data (Nonprogrammable Models Only)

The format and content of the RUs for the punch should be identical to the inbound card formats except that data compression is allowed. The 3770 will not support punch records spanned across RU boundaries.

When the 3770 receives transparent data, it will not examine the characters to be punched; so all 256 codes can be punched.

Outbound Diskette Data

Each data set identified by the data set delimiting indicators in the FM header will create a new data set on the diskette. On a 3770 with only one line-to-diskette data set, if the FM header is not compatible with the existing data set, the 3770 sends an exception response (Component Not Available). The data set will be closed when an FM header with End Data Set on is received. The contents of the RUs should be formatted as they would for the final destination device.

When a data set to be written on diskette is received, the 3770 will write either a basic exchange data set or a "transmission" data set. The type of data set is determined by an indicator in the FM Header.

When writing a basic exchange data set, the 3770 uses the record length specified in the FM header to deblock the records in the RU. If the RU contains an uneven multiple of the specified record length, the record is padded with NULs to force an even multiple. One record per 128-byte sector is written to diskette. If the record length is less than 128, the 3770 will pad with nulls. A basic exchange data set may contain multiple chains, but the extent of the chains is lost once the data is written to diskette. Basic exchange data sets containing compressed data are not supported.

If Basic Exchange is not specified in the FM header, the 3770 will create a "Transmission" data set. Two (four, if in 512-byte mode on the 3776/3777-1) 128-byte sectors will be written per RU. If the RU contains fewer than 256 (512) bytes of data, 3770 will pad with nulls. The extent of each chain is maintained by inserting an IUS in the buffer before writing to the diskette. Compressed data is allowed in "transmission" data sets. For the nonprogrammable models, basic exchange and "transmission" data sets cannot be mixed on the same diskette.

Outbound Printer Data (Nonprogrammable Models Only)

The 3770 console printer and attached line printer use SNA character string (SCS) and data compression. The SCS for the console printer is that as described later in this chapter. The SCS for the attached line printer (3784 models) is the same except that Enabled Print and Inhibit Print are not applicable and will be treated as a no-op.

The 3770 will accept print records spanned across RU boundaries, but records may not be spanned across chains. SCBs may be used for data compression. The channel settings may be specified with the Set Vertical Format (SVF) sequence or set locally by the 3770 operator.

Format Controls

SNA Character String (SCS) Format Controls

The following summarizes the 3770 SCS used by the keyboard/console printer and the line printer for format control in both batch and interactive sessions.

Set Horizontal Format (SHF)

EBCDIC = 2BC1

This function sets horizontal formatting controls including maximum print position, left margin, right margin, and horizontal tab stops. A one-byte count follows the SHF code and is a binary byte count of the parameters that follow the SHF code (including the count parameter itself). The first three parameters following the count define the maximum print position (MPP), the left margin (LM), and the right margin (RM), respectively. Tab-stop column values start in the fifth parameter position following the SHF code. The SHF count code itself sets all horizontal formatting controls to their default values. If specific parameters are not present in the SHF sequence or have a value of zero, the values for those format controls remain equal to their default values. The following sequences (and only these) are valid:

SHF count				
SHF count	MPP			
SHF count	MPP	LM		
SHF count	MPP	LM	RM	
SHF count	MPP	LM	RM	T1 ... Tn

The first data printed after the SHF sequence uses the new horizontal forms control.

The SHF sequence will not be generated for inclusion in the 3770-to-CPU data stream.

Maximum Print Position Parameter (MPP)

This one-byte binary number specifies the maximum print position value to be used in place of the physical device maximum. The value assigned to maximum print position is as follows:

- If the value specified is greater than zero and less than or equal to 132 (device maximum print position for the serial printer and the line printer), then the maximum print position is set to the specified value.
- If the value specified is zero, then the maximum print position is set to 132 (default value for the serial printer and the line printer).
- If the maximum print position parameter is not specified, the maximum print position is set to 132 (default value for the serial printer and the line printer).
- If the specified value is greater than 132 (physical device maximum), an error response (with sense data included) is sent and processing of the request unit (RU) is terminated. All horizontal format controls will remain equal to their default values following the error detection.

Use of the maximum print position parameter is as follows:

Output Data to 3770: If an attempt is made to print a graphic character in maximum print position +1, (MPP+1) a new line function (CR + line feed) is performed automatically and the character printed at the print position defined by the left margin. If an attempt is made to perform a control function (VT, horizontal tab, IRS, ...) at MPP+1, the results depend on the function attempted and are detailed in the descriptions for each function.

Input Data from 3770: If an attempt is made by the terminal operator to print a graphic character at MPP+1, an error condition occurs. Control function results depend on the function attempted and are detailed in the descriptions for each function.

Left Margin Parameter (LM)

The left margin parameter value replaces column one as the left-most print position. Valid left margin values are less than or equal to the value of the maximum print position. The default value for the left margin parameter is column one. The left margin position value is stored as the first tab. Therefore, if a backspace is done to the left of the left margin position, a tab causes the print position to move to the left margin. The value assigned to the left margin is as follows:

- If the specified value is greater than zero and less than or equal to the maximum print position, then the left margin is set to the specified value.
- If the value specified is zero, then the left margin is set to column one.
- If the left margin parameter is not present, the left margin is set to column one.
- If the specified value is greater than the value of the maximum print position, an error response is generated. The processing of the request unit containing the error is terminated immediately, and all horizontal formats except maximum print position retain their default values.

Use of the left margin parameter is as follows:

Output Data to 3770: The left margin parameter defines the normal left-most boundary for printed output and is the resultant print position following a new line or carriage return function.

Input Data from 3770: Same as *Output Data to 3770.*

Right Margin Parameter (RM)

The right margin parameter is used to assist the operator when formatting a keyboard generated data stream. The right margin default value is the maximum print position. The value assigned to the right margin is as follows:

- If the specified value is greater than the value of the left margin and less than or equal to the value of the maximum print position, then the right margin is set to the specified value.
- If the specified value of the right margin is zero, the right margin is set to the maximum print position.
- If the the RM parameter is not specified, the right margin is set to the maximum print position.
- If the specified value of the right margin is greater than the value of the maximum print position, or less than or equal to the left margin an error response is generated. The processing of the request unit containing the error is terminated

immediately. All horizontal formats except the maximum print position and left margin remain equal to their default values following the error detection.

Use of this parameter is as follows:

Output Data to 3770: Ignored.

Input Data from 3770: An audible tone sounds when the operator prints a graphic character (space included) in print position RM-10. The tone is not generated if RM-10 is passed during either a horizontal tab function or a backspace function. In buffer edit mode, the alarm sounds if the operator keys a graphic character at RM-10 or presses PRINT CHAR at RM-10 and that character is a graphic character. The alarm will not sound if PRINT BUFR or PRINT LINE is pressed even though a graphic character may be printed in print position RM-10.

Tab Stop Parameters (T1...Tn)

The horizontal tab stop parameters set column values for use with the horizontal tab function and consist of a series of binary bytes. Valid tab stop column values are equal to or greater than the left margin (LM) and equal to or less than the maximum print position (MPP) parameter. If no tab stops are specified, the default is a tab stop at each column. The maximum number of stops that can be set is equal to the number of print positions for the physical device (132 for the serial printer or the line printer). More than 132 tab stops may be specified as long as they are valid (duplicate values can, therefore, exist). An error response is generated to the request unit (RU) if tab stop column values are specified that are outside the valid range. The processing of the RU containing the error is to be terminated immediately. The horizontal formats: maximum print position, left margin, and right margin remain as specified following the error detection, but the tab stops are in an undetermined state. There is no check to determine if equal tab stop values have been specified. The first unique tab stop value sets the stop and all subsequent identical values are effectively no-ops. The tab stop parameters do not have to be in any ordered sequence.

Set Vertical Format (SVF)

EBCDIC = 2BC2

This function sets vertical formatting controls including maximum print line, top margin, bottom margin, and vertical tab (T1...Tn) stops. A one-byte count follows the set vertical format code and is a binary count of the parameters that follow the SVF code (including the count parameter itself). The SVF count code itself sets all vertical formatting controls to their default values. The first three values following the count define the maximum print line, top margin, and bottom margin in that order. A zero value for any of these parameters is a no-op and results in the function retaining its default value. Vertical tab stop values start in the fifth parameter position following the SVF code. Parameters of SVF are one binary byte each. The following sequences (and only these) are valid:

SVF count				
SVF count	MPL			
SVF count	MPL	TM	BM	
SVF count	MPL	TM	BM	T1 . . . Tn

Since it is possible for the current line number to be outside the bounds specified in the set vertical format sequence after the new vertical formats are established, the current line number is reset to the top margin when the SVF code is detected prior to decoding the sequence. The SVF sequence does not result in any forms movement.

The set vertical format sequence is not generated for inclusion in the 3770-to-CPU data stream.

Maximum Print Line (MPL)

This one-byte binary value specifies the last usable line of a page (form). Valid values are from 1 to 127.

The maximum print line value is used to calculate the number of line feeds to perform when a form feed (FF) function is requested.

The default value of the maximum print line is one.

Top Margin (TM)

This one-byte binary value specifies the top margin of the page. It is assumed that the forms are positioned at the top margin when the set vertical format sequence is received and any subsequent forms feed function causes a skip to the top margin of the next page. The default value for the top margin is line 1. The top margin value is stored in channel one. Thus, a skip to channel one causes the forms to move to the top margin position.

Bottom Margin (BM)

This one-byte binary value specifies the line value following which an automatic skip to the top margin of the next page takes place. Whenever a line positioning function occurs which would cause the current line value to exceed the bottom margin, the skip function is executed. Valid bottom margin values are less than or equal to the maximum print line. If an invalid bottom margin value is detected, an error response is generated and processing of the request unit is terminated immediately. The vertical format parameter for maximum print line remains as specified, but the bottom margin and tab stops retain their default values.

Tab Stop Parameters (T1...Tn)

The vertical tab stop parameters set line number values for use with the vertical tab (VT) function or the select (SEL) function. Valid tab stop line values are between the top margin and the bottom margin. The maximum number of stops that can be set is 11. If the number of tab stops exceeds 11, then only the first 11 are set and the remainder are ignored with no error indicated. The 3774 and 3775 always have channel 1 set to line 1 (top margin).

Horizontal Tab (HT)

EBCDIC = 05

This function moves the print position from its current position to the column value specified by the next higher tab stop setting. If a tab stop is set in the current print position, that stop is ignored.

Output Data to 3770: If the current print position column value is equal to or greater than the highest tab stop setting (or if no stops have been set), the horizontal tab function executes the equivalent of a space function.

Note: For 3770 nonprogrammable models in BSC mode, this condition causes a default New Line function before printing resumes.

If the horizontal tab is specified at the maximum print position + 1, the following occurs:

a. If the current line number equals the bottom margin and the bottom margin is not equal to the maximum print line then the print position is moved to the left margin plus one on the top margin of the next page.
b. If the current line number equals the maximum print line, then the print position is moved to the left margin plus one on the top margin of the next page.
c. If neither the (a) nor the (b) condition exists, then the print position is moved to the left margin plus one on the next line.

Input Data from 3770: If the current print position is equal to or greater than the highest tab stop, pressing the horizontal tab key results in a space function. If no horizontal tab stops are set, the horizontal tab function will execute the equivalent of a space character. (For BSC machines, the HT is ignored.)

If the operator presses the tab key on the keyboard at print position MPP + 1, an error condition occurs and the tab is not inserted in the data stream.

The horizontal tab function code is always inserted in the 3770-to-CPU data stream even if no horizontal tab stops have been set and even if the horizontal tab key is pressed after the last tab stop.

Note: For nonprogrammable 3770 models in BSC mode, the HT character is not inserted in the data stream when no tab stops have been set.

Vertical Tab (VT)

EBCDIC = 0B

This function moves the print position vertically from its current line number to the line value specified by the next higher vertical tab stop setting. If a vertical tab stop function is set for the current line number, that stop is ignored.

Output Data to 3770: If no vertical tab stops have been set or if the current line number is equal to or greater than the highest tab stop value, the vertical tab function executes the equivalent of a line feed with the following resultant movement:

a. If the current line number equals the bottom margin and the bottom margin is not equal to the maximum print line then the print position is moved to the top margin of the next page.
b. If the current line number equals the maximum print line, then the print position is moved to the top margin of the next page.
c. If neither the (a) nor the (b) condition exists then the print position is moved to the next line.

There is no special consideration if the vertical tab is specified at print position MPP + 1.

Note: For nonprogrammable 3770 models in BSC mode, if no vertical tab stops have been set or if the current line number is equal to or greater than the highest tab stop value, the vertical tab function moves the print position to the top margin of the next page.

Input Data from 3770: If the current line number is equal to or greater than the highest tab stop value or if no stops have been set, pressing the vertical tab key will result in a line feed with the same results as explained for *Output Data to 3770.*

Note that there is no indication of automatic forms movement in the inbound data stream. The vertical tab function code is always inserted in the inbound data stream even if no stops have been set. There is no special consideration if the vertical tab function code is specified at print position MPP + 1.

Line Feed (LF)

EBCDIC = 25

This function moves the print position vertically from its current position to the next line.

Output Data to 3770: If the current line number equals the bottom margin or the maximum print line, the following can occur:

a. If the current line number equals the bottom margin and the bottom margin is not equal to the maximum print line then the print position is moved to the top margin of the next page.
b. If the current line number equals the maximum print line, then the print position is moved to the top margin of the next page.
c. If neither the (a) nor the (b) condition exists then the print position is moved to the next line.

There is no special consideration if the line feed is specified at print position MPP + 1.

Input Data from 3770: Same as *Output Data to 3770.*

Note that there is no indication of automatic forms movement in the 3770-to-CPU data stream. The line feed function code is always inserted in the 3770-to-CPU data stream. There is no special consideration if the line feed is specified at print position MPP + 1.

Form Feed (FF)

EBCDIC = 0C

This function moves the print position to the top margin line and the left margin print position of the next page.

Output Data to 3770: If default forms control has been specified (maximum print line = 1), the form feed function executes the equivalent of a NL function. Since the bottom margin must equal 1 if maximum print line = 1, the new line function moves the print position to the left margin of the next line. There is no special consideration if the current position equals MPP + 1.

Input Data from 3770: Same as *Output Data to 3770.*

The form feed function code is always inserted in the 3770-to-CPU data stream. There is no special consideration if the current print position equals MPP + 1.

Record Separator (IRS)

EBCDIC = 1E

This control code performs the function of terminating a line of print, a transparent data stream, or a secure data string. The following is a description of its use in terminating a line of print.

Output Data to 3770: The record separator (IRS) function code forces a carriage return (CR) and line feed (LF) function as follows:

a. If the current line number equals the bottom margin value and the bottom margin value is not equal to the maximum print line value then the print position is moved to the left margin print position and the top margin line of the next form.
b. If the current line number equals the maximum print line value, then the print position is moved to the left margin print position and the top margin line of the next form.
c. If neither the (a) nor the (b) condition exists, then the print position is moved to the left margin on the next line.

There is no special consideration if the IRS code is specified at print position MPP + 1.

Input Data from 3770: Same as *Output Data to 3770.*

Note that there is no indication of automatic forms movement in the 3770-to-CPU data stream. The IRS code is always inserted in the 3770-to-CPU data stream (END CARD key on keyboard). There is no special consideration if the IRS code is specified at print position MPP + 1.

New Line (NL)

EBCDIC = 15

Output Data to 3770: The new line function code forces a carriage return (CR) and line feed (LF) function as follows:

a. If the current line number equals the bottom margin value and the bottom margin value is not equal to the maximum print line value, then the print position is moved to the left margin print position and the top margin line of the next form.
b. If the current line number equals the maximum print line value, then the print position is moved to the left margin print position and the top margin line of the next form.
c. If neither the (a) nor the (b) condition exists then the print position is moved to the left margin on the next line.

Note: If data being printed contains compression/expansion characters and if the expansion moves the print position beyond the maximum print position, an automatic carriage return and line feed occurs.

Input Data from 3770: Same as *Output Data to 3770.*

Note that there is no indication of automatic forms movement in the 3770-to-CPU data stream. The new line code is always inserted in the 3770-to-CPU data stream. There is no special consideration if the new line function code is specified at print position MPP + 1.

Carriage Return (CR)

EBCDIC = 0D

Output Data to 3770: This function moves the print position from the current position to the left margin. If the current position equals the left margin, the function is effectively a no-op. There is no special consideration if the carriage return function code is specified at print position MPP + 1.

Input Data from 3770: This function is not available and will not be present in the 3770-to-CPU data stream.

Backspace (BS)

EBCDIC = 16

Output Data to 3770: This function moves the current print position one column position to the left. If the current print position equals the left margin, the backspace is performed. If the current print position equals column one, the backspace function will be a no-op. There is no special consideration if the backspace function code is specified at print position MPP + 1.

Input Data from 3770: This function moves the current print position one column position to the left and a backspace function code is stored in the 3770-to-CPU data stream. There is no special consideration if the backspace function code is specified at print position MPP + 1.

Inhibit Print (INP)

EBCIDC = 24

Output Data to 3770: This function disables the printing of keyboard-entered data and causes the PRINT INHIBIT light to be on when a keyboard operation is in progress.

Input Data from 3770: The inhibit print function code is not present in the 3770-to-CPU data stream.

Enable Print (ENP)

EBCDIC = 14

Output Data to 3770: This function restores the printing of keyboard-entered data.

Input Data from 3770: The enabled print function code is not present in the 3770-to-CPU data stream.

Secure String Reader (SSR)

EBCDIC = 0450

Output Data to 3770: SSR is not in the CPU-to-3770 data stream.

Input Data from 3770: If the Operator ID badge reader is used, the 3770 precedes the data from the card with an SSR and appends an IRS code to the reader data. Nonsecure badge reader data can be edited before the data is transmitted.

Select (SEL)

EBCDIC = 04

The SEL function is used for vertical forms control as defined by SVF or as set locally by the operator. The SEL function is followed by a one-byte parameter which specifies the channel number:

Channel	*Select Parameter*
1...9	X'81' ... X'89'
10...12	X'7A' ... X'7C'

The SEL function moves the print position vertically from its current line number to the line value specified by the channel number setting. If the channel number setting is less than or equal to the current line number, forms movement will be to that line number on the next form. If the channel number setting does not contain a line value, the SEL function executes the equivalent of a line feed (LF). An invalid selection sequence results in an error condition.

Output Data to 3770: If SEL is detected in the CPU-to-3770 data stream and the select parameter is valid, the 3770 executes the forms control function. If an invalid select parameter is received, the 3770 sends an error response and immediately terminates processing of the request unit.

Input Data from 3770: SEL is not present in the 3770-to-CPU data stream.

Transparent (TRN)

EBCDIC = 35

This control code is used to denote the start of a transparent data stream. It is followed by a one-byte binary count that indicates the number of bytes of transparent data. The transparent data stream is terminated by an IRS (record separator) character.

Undefined Graphics

If an undefined graphic (X'40'-X'FF') or an undefined SCS control code (beginning with a binary '00') is received, the 3770 prints a "-".

SCS Error Summary

Parameter Error: Sense = X'10050000'

MPP > 132
LM > MPP
RM > MPP
RM ≤ LM
TAB > MPP
TAB < LM
BM > MPL
TAB > BM
SEL - Invalid parameter
SHF Count = 0
SVF Count = 0

SDLC Considerations

Details of the SDLC link level control are included in *IBM Synchronous Data Link Control General Information*, GA27-3093.

Terminal ID

The ID information from the 3770 terminal for the SDLC XID command consists of six bytes. Part of this ID is supplied with the terminal when it is shipped; the rest is supplied by the user, in hexadecimal notation, to the IBM maintenance person installing the terminal. The format follows:

Byte	1	2	3	4	5	6
Value	02	00	0M	M0	0J	SS

ID Number (20 bits) where:

SS = SDLC address—supplied by user and jumpered by installer in TID Byte 1, Bits 0-7, on system card.
J = Jumper bits—supplied by user and jumpered by installer in TID Byte 2, Bits 0-3, on system card.
X'00'—supplied with terminal

Block Number (12 bits)—supplied with terminal, where:

MM = X'0F' for 3773
10 for 3774-1/3774-2/3775-1
11 for 3773P/3774P/3775P
12 for 3771
13 for 3776-1/3776-2/3777-1
X'0'—supplied with terminal

Reserved (8 bits)—supplied with terminal

Functional Level (8 bits)—supplied with terminal

For example, assume a 3776 terminal with J = X'B' and SS = X'C1'. The terminal ID bytes from the 3776 would be sent to the CPU as:

Byte	1	2	3	4	5	6
Hex	02	00	01	30	0B	C1

Outstanding Frames

The 3770 support in NCP should be generated so that only one request/response unit is outstanding before link level acknowledgement is required.

Fan Out and SNBU

The 3770 terminals use fan-out modems on a multipoint basis only.

Remote Power Down

If the 3770 receives a DACTPU command from VTAM with the FINAL bit on, the 3770 powers down following the NSA response to SDRM. The FINAL parameter is set through a host application write to operator (WTO) command that requests the system operator to perform a vary off with power down.

Chapter 9. IBM 3777 Communication Terminal Model 2–BSC Multi-Leaving Workstation

The IBM 3777 Communication Terminal Model 2 provides the functions necessary to execute a BSC MULTI-LEAVING workstation program written for the IBM System/360 Model 20, Submodel 5. As a remote MULTI-LEAVING workstation, the 3777 Model 2 communicates with the System/360 or System/370 programming system through one of the remote-job-entry (RJE) subsystems that support BSC MULTI-LEAVING operation:

- OS/VS1 RES – (Remote Entry Services)
- OS/VS2 HASP – (Houston Automatic Spooling Program)
- OS/VS2 JES2 – (Job Entry Subsystem)
- OS/VS2 ASP – (Asymmetric Multiprocessing System)
- OS/VS2 JES3 – (Job Entry Subsystem)
- VM/370 RSCS – (Remote Spooling Communications Subsystem)

The RJE subsystem permits the remote terminal operator at the 3777 Model 2 to submit jobs (the *job input stream*) that are sent over the BSC communication facilities for execution at the host processor site. After execution, the RJE subsystem sends the output of the jobs (the *job output stream*) back to the 3777-2 where it is directed to the appropriate output devices. System/360 Model 20 I/O devices and their corresponding 3777 Model 2 devices are:

Device	*S/360-20*	*3777-2*
Card Reader	2501	2502-A1/A2/A3 (or Diskette Input Device)
Printer	1403	3203-3
Console	2152	Keyboard with Console Display
Card Punch	1442	3521/3782

The following devices that can attach to a S/360-20 operating as a BSC MULTI-LEAVING workstation have no corresponding 3777-2 devices:

2520 Card Read Punch
2203 Printer
2560 Multi-Function Card Machine

The following devices and features that can attach to a 3777-2 BSC MULTI-LEAVING workstation have no corresponding S/360-20 devices or features:

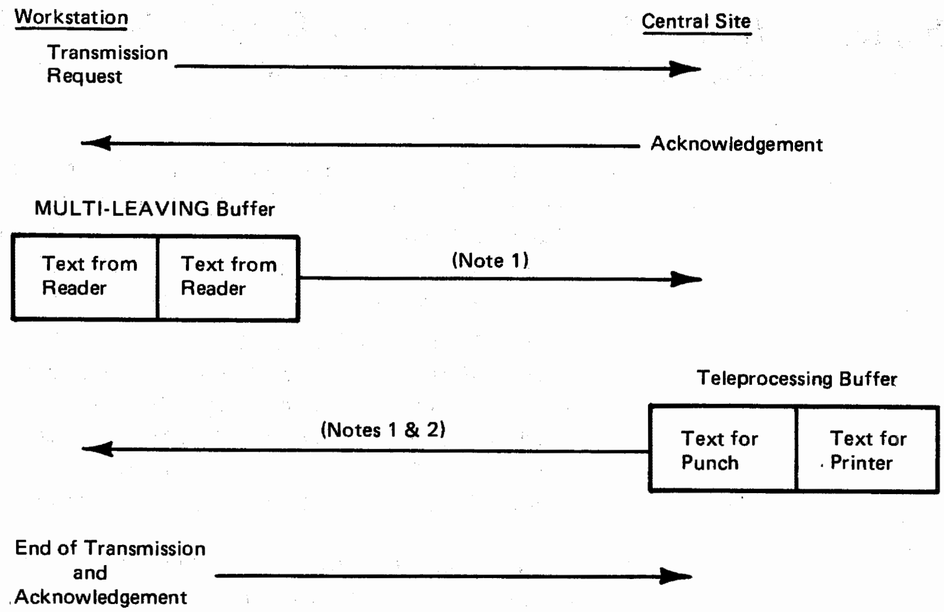
Console Display Spooling
Operator ID Reader
Audible Alarm

Multi-Leaving Concepts

MULTI-LEAVING is the fully synchronous, bidirectional transmission of a variable number of data streams between two computers using binary synchronous communications (BSC) facilities.

As shown in Figure 9-1, MULTI-LEAVING is accomplished by:

1. Block-multiplexing of multiple device streams into one transmission block. This increases the amount of data that can be transmitted without line turnaround.
2. Using the BSC line control method of acknowledging one block of text with another block of text and avoiding turnaround inefficiencies.



Notes:

1. Block multiplexing of multiple device streams
2. Acknowledging text with text

Figure 9-1. Example of How MULTI-LEAVING Works

Basic Workstation Functions

The 3777 Model 2 operates under the control of its own workstation program. At the central site, the 3777-2 user generates a workstation program deck for the particular 3777-2 configuration at the remote site. (This is the same program generated for the equivalent System/360 Model 20 workstation.) After the operator loads the workstation program deck into the 3777-2 and logs on to the CPU, the workstation performs these basic functions:

- Handles data transfer from and to specific devices attached to the 3777-2
- Handles data transfer to and from the RJE subsystem at the central site, using the MULTI-LEAVING interface built into the workstation program
- Handles local commands from the operator for controlling workstation devices
- Transfers system commands from the workstation operator to the central site
- Transfers operator messages from the central site to the workstation operator

Components of the 3777 Model 2 Workstation

The following standard and special feature components are available on the 3777 Model 2. A minimum workstation configuration includes the 3777-2, the 2502 or the Diskette Input Device and the Console Display, and the 3203. Figure 9-2 shows a maximum configuration.

Workstation Controller

The workstation controller is contained in the terminal's base. The terminal operator loads the workstation program into the controller during the IPL procedure. After the IPL and logon procedure, the workstation controls input and output operations, provides buffering for received and transmitted data, and provides the BSC MULTI-LEAVING data link control.

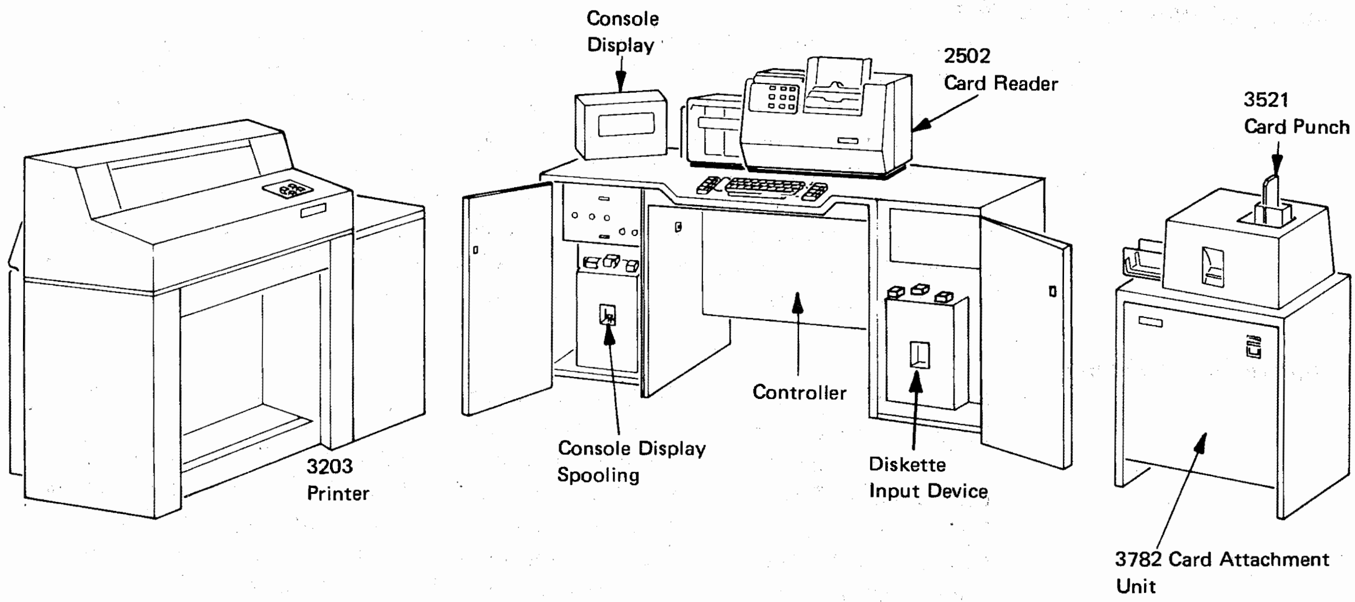


Figure 9-2. IBM 3777 Communication Terminal Model 2 (Maximum Configuration)

2502 Card Reader

The 2502 Card Reader special feature reads the workstation program deck during IPL, reads job entry decks into the system, enters system commands that are sent to the central site, and reads printer forms control cards. For more information on the 2502 Card Reader models, refer to Chapter 6 in this manual.

3203 Printer Model 3

The 3203 printer uses the IBM 1416 Interchangeable Train Cartridge to print at speeds up to 1000 lines per minute depending on which train cartridge is installed. With a special feature, the 3203-3 can print up to 1200 lines per minute.

Special print train arrangements may be loaded into the 3777 Model 2 using a deck provided with the 3777-2. The punched cards representing the print train image are identical to those used on the System/360 Model 20 and the 2922 Programmable Terminal. For more information on the 3203 printer and 1416 cartridges, refer to Chapter 6 in this manual. For more information on loading special print train arrangements, see the IBM 3777 Model 2 Communication Terminal Operator's Guide, GA27-3129.

Console Display Feature

The Console Display special feature can be attached to the 3777-2 to provide up to 1,024 characters of console display data for operator messages from the CPU and for operator-originated data. Information displayed on the screen is formatted into 16 lines of 64 characters each. For more information, refer to "Features and Accessories" in this chapter.

Console Display Spooling Feature

One Console Dispaly Spooling special feature can be installed in the terminal's left base to provide magnetic diskette storage for operator console messages. With this feature installed, operator console messages can be written to the spooling diskette and retained on a temporary basis for message reference. The workstation program can be stored on the spooling diskette and used to IPL the 3777-2. The spooling diskette can be removed for more permanent retention into a chronological file for audit purposes. The diskette used by this feature is referred to in this manual as the "spooling diskette" to avoid confusion with the "input diskette" used by the Diskette Input Device. For more information, refer to "Features and Accessories" in this chapter.

Diskette Input Device

One Diskette Input Device special feature can be installed in the terminal's right base to allow basic exchange data sets on diskettes to be read as if they were cards. This input device can be installed in addition to or instead of the 2502 Card Reader. If both the 2502 and the Diskette Input Device are attached to the 3777-2, these two input devices can be operated alternately (but not simultaneously) for remote job entry. The 3777-2 can also use the Diskette Input Device for IPL if the Console Display Spooling feature is not installed. (If the 2502 is not attached, the diskette containing the workstation program deck must have been written on another 3777-2 that has both the 2502 and at least one diskette feature.) The diskette used by the Diskette Input Device is referred to in this manual as the "input diskette" to avoid confusion with the "spooling diskette" used by the Console Display Spooling feature. A diskette used to IPL the 3777-2 without the Console Display Spooling feature is referred to as the "IPL diskette". The IPL diskette can be created on a 3777-2 with only the Diskette Input Device feature (not the Console Display Spooling feature) and the 2502 Card Reader. For more information, refer to "Features and Accessories" in this chapter.

3521 Card Punch

The 3521 Card Punch can be attached to the 3777 Model 2 to provide punched card output with or without the interpret feature at 50 cards per minute. The 3521 attaches to the 3777-2 through the 3782 Card Attachment Unit Model 1. For more information, refer to Chapter 6 in this manual.

Keyboard

The keyboard used on machines in the U.S. and Canada has 44 character keys and a space bar, and other typewriter-like control keys. The arrangement of keys is similar to that on a typewriter keyboard. On either side of the typewriter-like keys are keys for controlling terminal operation. Lights located above the keys provide indications of terminal status and error conditions. This keyboard provides 88 characters in upper and lower case shift, (refer to Figure 9-6).

Typamatic operation of the Space Bar and of the Backspace, Hyphen/Underscore, and CHAR ADV (Character Advance) keys causes repetitive functions, simply by holding the key down.

Keyboards for use in World Trade countries other than the United Kingdom have 47 graphic keys, providing 94 characters. The keyboard for the United Kingdom has an additional key (48 keys), and provides 94 characters in upper and lower-case shift. This keyboard does not provide typamatic operation of the Hyphen/Underscore key. Keyboard characters present on all keyboards are shown in Appendix B.

Nomenclature on keyboard control keys, lights, and switches is provided for the following languages:

English	Italian
French	Japanese
German	Spanish

Programming Considerations for System Generation of the IBM 3777-2

The following programming systems and their respective remote job entry subsystems support program generation and terminal operation of the 3777 Model 2 as a BSC MULTI-LEAVING workstation:

OS/VS1 RES
OS/VS2 HASP
OS/VS2 JES2
OS/VS2 ASP
OS/VS2 JES3
VM/370 RSCS

This section tells the host system programmer how to code the remote terminal program generation parameters of the respective RJE subsystems to produce a terminal object card deck called the workstation program deck. The initial program load procedure at the 3777-2 uses this workstation program deck as its source deck to prepare the 3777-2 to operate as an IBM System/360 Model 20 Submodel 5 BSC MULTI-LEAVING workstation. (If the Console Display Spooling feature is attached, the workstation program deck can be written on the diskette and retrieved for subsequent IPLs rather than being read from the card reader.)

Introduction to Generation Parameters

Some of the parameters that are coded to generate a S/360 M20-5 workstation program that will run in the 3777-2 are:

Card Reader	one 2502 (or Diskette Input Device) required—specify 2501
Printer	one 3203 Model 3 required—1403
Card Punch	one 3521 optional—specify 1442
Console (Display)	optional—specify 2152
Storage Size	must be coded 12K
Buffer Size	variable within 12K limits, 512 bytes is recommended for 3777 Model 2
Transparency of Line Transmission	depends on availability of feature in the host processor; transparent EBCDIC transmission is a standard feature on the 3777-2
Line Speed	2400, 4800, 7200, 9600, or 19,200 bps

These and other parameters itemized on the following pages are coded as if for a S/360 Model 20 Submodel (S/360 M20-5) using the I/O device numbers from that system rather than the I/O device numbers from the 3770 system.

System/360 Model 20 Functions Not Available on 3777 Model 2

The 3777 Model 2 does not execute some of the functions and instructions of the System/360 Model 20 Submodel 5:

S/360 M20-5	*3777 Model 2*
Time-Sharing Switch	No comparable function
Wait State Switch	No comparable function
Process Dial	PROCESS position only
Data Checking Operand Length Decimal Digit > 9 Valid Sign	The data checking functions listed are not done when executing S/360 M20-5 code. Such execution is not necessary because the workstation program is a running program that does not have these kinds of errors.
Any instruction that attempts a storage access beyond the end of storage (that is, a wraparound).	Execution of this type of instruction (where the beginning storage address is within the 12K limit) will cause unpredictable results if attempted on the 3777-2. If this occurs, turn off the power, then turn it on again.
Multiple printer CIO instructions before XIO, where the last one before XIO is CIO delay 1.	The CIO delay 1 instruction immediately before the XIO is ignored; the previous CIO delay is executed instead. The only CIO delay instruction that is ignored is CIO delay 1; any other number is executed the same as on the S/360 M20-5.

Purpose of This Section

The information in this section is intended to be an addition to and not a substitute for the information in the Programmer's Guide or User's Guide for the individual programming system/subsystem. The format of the information in this section varies. The intent is to follow the format of the individual Programmer's Guide or User's Guide.

OS/VS1 RES Generation

The following operands must be coded as shown to generate a 3777 Model 2 Workstation program deck for the BSC MULTI-LEAVING operation with OS/VS1 RES (Remote Entry Services). These and other operands that are necessary or optional to the proper generation and operation of BSC MULTI-LEAVING are described in *OS/VS1 RES System Programmer's Guide,* GC28-6878.

RTAM Generation

The following RTAM (remote terminal access method) generation macro instructions must be coded as shown for the 3777-2 (which is coded as if it were a S/360M20-5 or IBM 2922 Programmable Terminal).

LINE Macro

LDESCR=(type,code)

type=0	for half-duplex; 2400-9600 bps, or
type=1	for full-duplex; 2400-9600 bps
type=2	for full-duplex; 19.2 kbps
code=0	for EBCDIC; no transparency, or
code=1	for EBCDIC; transparency

TERMINAL Macro

TDESCR=(w,t,d,f)

w=3	for 132-character printer width
t=3	for S/360M20-5 or 3777-2

RDRS=rd

RDRS=1	for S/360M20-5, 2922, or 3777-2 (1 is the default value)

PTRS=pr

PTRS=1	for S/360M20-5, 2922, or 3777-2 (1 is the default value)

PCHS=pu

PCHS=0	if the optional 3521 Card Punch is *not* installed, or
PCHS=1	if the optional 3521 Card Punch is installed (1 is the default value)

Note: The RDRS and PTRS operands must not be altered from their default values.

RTAM Macro

MLBFSIZ=mlbfsiz

A variable number that specifies the size of the MULTI-LEAVING buffers.

MLBSIZ=512 is the value recommended for the 3777 Model 2

User Option Card Parameters

The following user option parameters must be coded for the 3777-2 (which is coded as if it were a System/360 Model 20 Submodel 5 or an IBM 2922 Programmable Terminal with exceptions as shown).

Parameters for System/360 Model 20, 2922, and 3777 Model 2 Workstation Programs

&CORESIZ=12	for the 3777 Model 2
&LINESPED=xxxx	2400, 4800, 7200, 9600, or 19,200 (bps) for the 3777 Model 2
&PRTSIZE=132	for 3203-3 Printer on 3777-2
&PDEV(1)=1403	for the 3203 Model 3 printer attached to the 3777 Model 2
&SUBMOD=5	for the 3777 Model 2
&UADR(1)=3	if the optional 3521 Card Punch is installed on the 3777 Model 2 (3 is the default value)
&UDEV(1)=0	if the optional 3521 Card Punch is *not* installed on the 3777 Model 2, or
&UDEV(1)=1442	if the optional 3521 Card Punch is installed on the 3777 Model 2 (1442 is the default value)
&WDEV(1)=2152	if the optional Console Display feature is installed on the 3777 Model 2, or
&WDEV(1)=0	if the optional Console Display feature is *not* installed on the 3777 Model 2 (0 is the default value)
&XPARENT=NO	if the optional transparency feature is *not* installed in the host processor (YES is the default value)

Note: The &RADR(1) and &RDEV(1) parameters for the card reader must not be altered from their default values.

Default Parameters

Some parameters must not be altered from their default values for proper generation and operation of the 3777 Model 2 as a BSC MULTI-LEAVING workstation. The default parameters by category are:

RTAM Generation

RDRS=1	in	TERMINAL Macro
PTRS=1	in	TERMINAL Macro

User Option Card Parameters

&RADR(1)=1	for S/360M20-5, 2922, and 3777-2
&RDEV(1)=2501	Workstation Programs

Other Parameters

All the other operands and parameters for the System/360 Model 20 Submodel 5 and 2922 Programmable Terminal may be allowed to default or may be coded as desired for the 3777 Model 2, according to their description under "RTAM Generation" and "User Option Card Parameters" in the *OS/VS1 RES System Programmer's Guide*, GC28-6878.

OS/VS2 HASP Generation

The following parameters must be coded as shown to generate a 3777 Model 2 Workstation program deck for BSC MULTI-LEAVING operation with OS/VS2 HASP. These and other parameters that are necessary or optional to the proper operation of BSC MULTI-LEAVING are described in *OS/VS2 HASP II Version 4 Systems Programmer's Guide,* GC27-6992.

HASPGEN Parameters

The following HASPGEN parameters must be coded for a 3777-2 (which is coded as if it were a S/360M20-5 with exceptions as shown)

&MLBFSIZ

Explanation: Variable symbol within 12K limits.
Recommended 3777-2 value: &MLBFSIZ=512

Note: Establishes dual 512-byte buffers within the 3777-2 for the maximum number of I/O devices that may be attached.

RMTnn (Remote Terminal)

Explanation: Ordinary symbols specify the characteristics of remote terminals used with HASP RJE in this format:

RMTnn=mmooppiillwtdf

For the 3777-2, specify:

w=3	for 132-character printer width
t=3	for System 360/20 Submodel 5 or 3777-2
f=1	if Console Display feature is not attached, or
f=3	if Console Display feature is attached

&BSCCPU

Explanation: Specifies inclusion, in HASP RTAM, of support for HASP MULTI-LEAVING RJE.

For 3777-2, code: &BSCCPU=YES

LINEmm

Explanation: Specifies the characteristics of data communication lines to be used by HASP RJE in this format:

LINEmm=aaalc

c=0	for EBCDIC	–	no transparency
c=1	for EBCDIC	–	transparency

RMTGEN Parameters

The following RMTGEN parameters must be coded for the 3777-2 (which is coded as if it were a S/360M20-5 with exceptions as shown).

&CORESIZ=12	for the 3777 Model 2
&LINESPD=xxxx	2400, 4800, 7200, 9600, or 19,200 (bps)
&PDEV(1)=1403	for the 3203 Model 3 Printer attached to the 3777-2
&PRTSIZE=132	for the 3203 Model 3 Printer attached to the 3777-2
&SUBMOD=5	for the 3777 Model 2
&UADR(1)=3	if the 3521 Card Punch is installed on the 3777-2
&UDEV(1)=0 &UDEV(1)=1442	if the optional 3521 Card Punch is *not* installed, or if the optional 3521 Card Punch is installed (1442 is the default value)
&WDEV(1)=2152 &WDEV(1)=0	if the optional Console Display feature is installed, or if the optional Console Display feature is *not* installed (0 is the default value)
&XPARENT=NO	if the optional transparency feature is *not* installed in the host processor

Default Parameters

Some parameters must not be altered from their default values for proper generation and operation of the 3777 Model 2 as a BSC MULTI-LEAVING workstation.

&RADR(1)=1	for 2501 Card Reader on S/360M20-5, and for 2502 Card Reader (or Diskette Input Device) on 3777-2
&RDEV(1)=2501	for the card reader attached to the S/360M20-5, and for the card reader attached to the 3777-2 (2502 or Diskette Input Device)

Other Parameters

All the other parameters for the S/360 Model 20 Submodel 5 may be allowed to default or may be altered as desired, according to their description under "HASPGEN Parameters" and "RMTGEN Parameters" in the *OS/VS2 HASP II Version 4 Systems Programmer's Guide,* GC28-6992.

ASP Remote Job Processing Support

ASP Remote Job Processing (RJP) is designed to support the HASP II remote terminal packages. The same parameters included here for OS/VS2 HASP II generation to support the 3777 Model 2 BSC MULTI-LEAVING Workstation also apply to OS/VS2 ASP. For more information, refer to *IBM System/360 and System/370 ASP Version 3 Asymmetric Multiprocessing System General Information Manual,* GH20-1173.

OS/VS2 JES2 Generation

The following parameters must be coded as shown to generate a 3777 Model 2 Workstation program deck for BSC MULTI-LEAVING operation with OS/VS2 JES2. These and other parameters that are necessary or optional to the proper generation and operation of BSC MULTI-LEAVING are described in *OS/VS2 MVS System Programming Library: JES2,* GC23-0001 for VS2 Release 3.7 and GC23-0002 for VS2 Release 4.0.

Installing JES2

The following JES2 parameters must be coded for the 3777 Model 2 (which is coded as if it were a System/360 Model 20 Submodel 5 or a 2922 Programmable Terminal with exceptions as shown).

Specifying the JES2 Parameters

Parameter	*Value*	*Explanation*
&BSCCPU=	YES	specifies the inclusion of support for JES2 MULTI-LEAVING RJE in RTAM (for releases after VS2 Release 3.7, this parameter is unnecessary).
&MLBFSIZ=	512	specifies the MULTI-LEAVING buffer size, in bytes, for the 3777 Model 2 (512 is the *recommended* size).
&SPOLMSG=	number (max. 256)	specifies number of physical records to be reserved for operator messages and JES2 messages for each JES2 remote terminal.

JES2 Initialization

The following JES2 initialization parameters must be coded as shown for the 3777 Model 2.

RMTnnn (Remote Terminal)

terminal type = M20-5	specifies the 3777 Model 2.
CONSOLE/NOCON	
CONSOLE	specifies that the optional Console Display feature is installed on the 3777 Model 2.
NOCON	specifies that the optional Console Display feature is *not* installed on the 3777 Model 2. (NOCON is the default value)
MULTI/HARDWARE	
MULTI	specifies that the 3777 Model 2 will use the BSC MULTI-LEAVING interfaces.

Remote Job Entry

The following JES2 remote job entry parameters must be coded as shown for the 3777 Model 2. RMT generation is the JES2 procedure for generating MULTI-LEAVING remote terminal processor (RTP) programs for remote job entry from programmable remote workstations.

RMT Parameters for the System/360 Model 20 and 3777 Model 2 BSC RTP Program

Parameter	*Value*	*Explanation*
&CORESIZ=	12	for the 3777 Model 2.
&LINESPD=	xxxx	2400, 4800, 7200, 9600, or 19,200 (bps) for the 3777 Model 2
&PDEV(1)=	1403	for the 3203 Model 3 Printer attached to the 3777 Model 2
&PRTCONS=	<u>0</u> 1 2	specifies the usage of the printer as an output console. If &WDEV(1) is not specified as 0, this parameter should be set to 0
&PRTSIZE=	132	for the 3203 Model 3 Printer attached to the 3777 Model 2.
&SUBMOD=	5	for the 3777 Model 2.
&UADR(1)=	<u>3</u>	if the optional 3521 Card Punch is installed on the 3777 Model 2 (3 is the default value).
&UDEV(1)=	0	if the optional 3521 Card Punch is *not* installed on the 3777 Model 2, or
&UDEV(1)=	<u>1442</u>	if the optional 3521 Card Punch is installed on the 3777 Model 2 (1442 is the default value).
&WDEV(1)=	2152	if the optional Console Display feature is installed on the 3777 Model 2, or
&WDEV(1)=	<u>0</u>	if the optional Console Display feature is *not* installed on the 3777 Model 2 (0 is the default value).
&XPARENT=	NO	if the optional transparency feature is not installed in the host processor (YES is the default value).

Default Parameters

Some parameters must not be altered from their default values for proper generation and operation of the 3777 Model 2 as a BSC MULTI-LEAVING workstation. The default parameters by category are:

Installing JES2

&USASCII=<u>NO</u>

JES2 Initialization

CODEB/<u>CODEA</u>	in	LINEnnn parameter
USASCII/<u>EBCDIC</u>	in	LINEnnn parameter

Remote Job Entry

&RADR(1)=1	in	RMT Parameters
&RDEV(1)=<u>2501</u>	in	RMT Parameters

Other Parameters

All the other parameters for the System/360 Model 20 Submodel 5 and 2922 Programmable Terminal may be allowed to default or may be altered as desired for the 3777 Model 2, according to the descriptions in the *OS/VS2 MVS System Programming Library: JES2,* GC23-0001 for VS2 Release 3.7 and GC23-0002 for VS2 Release 4.0.

OS/VS2 ASP Generation

ASP Remote Job Processing (RJP) is designed to support the HASP II remote terminal packages. The same parameters that are coded for OS/VS2 HASP generation to support the 3777 Model 2 BSC MULTI-LEAVING Workstation also apply to OS/VS2 ASP generation. Refer to "OS/VS2 HASP GENERATION" in this section.

ASP Requirements for RJP Terminals

Care must be taken in generating the HASP II remote terminal packages to assure compatibility in specifications of devices and buffer sizes with those specified at ASP initialization time.

Devices supported on the various terminals are described in the *IBM System/360 and System/370 ASP Version 3 Asymmetric Multiprocessing System—General Information Manual,* GH20-1173. The System/360 Model 20 Submodel 5 I/O device numbers are used, as explained in the introduction to this section, when coding parameters for the 3777 Model 2.

For more information on ASP Remote Job Processing, refer to the *IBM System/360 and System/370 ASP Version 3 Asymmetric Multiprocessing System—System Programmer's Manual,* GH20-1292.

OS/VS2 JES3 Generation

The following parameters must be coded as shown to generate a 3777 Model 2 Workstation program deck for BSC MULTI-LEAVING operation with OS/VS2 JES3. These and other parameters that are necessary or optional to the proper generation and operation of BSC MULTI-LEAVING are described in *OS/VS2 MVS System Programming Library: JES3,* GC28-0608.

JES3 Initialization Card Parameters

The following JES3 initialization card parameters must be coded for the 3777 Model 2 (which is coded as if it were a System/360 Model 20 Submodel 5 with exceptions as shown).

CONSOLE (Operator Console) Card

The CONSOLE card defines the RJP (Remote Job Processing) console which is the Console Display feature if installed on the 3777 Model 2.

CONSOLE,JNAME= {consname} {termname}	for the 3777-2 RJP console, *termname* must match the N parameter on the RJPTERM initialization card.
,TYPE= {modelnum} {RJP}	TYPE=RJP must be specified for the 3777-2 Console Display feature.
,DEST= {destclas}	specify DEST=NONE for the 3777-2 Console Display feature to receive messages intended for the 3777-2.
,LL=nnn	specifies the length of the longest line that may be printed on this console. Specify 123 for the 3777-2 Console Display feature.

DEVICE (Device Definition) Card

The DEVICE card defines those devices used by JES3 and managed by JES3.

DEVICE,DTYPE= {CNSxxxx } {PRTxxxx } {PUNxxxx } {RDRxxxx} {RMTxxxx} {TAxxxx } {NJPLINE } {SYSMAIN} {username }	for the 3777 Model 2 I/O devices, specify each of these physical devices on a separate DEVICE card *only if* the JES3 default characteristics provided on the RJPTERM card are not acceptable.

RJPLINE (Remote Job Processing Line) Card

The RJPLINE card defines a single BSC line to be used by the JES3 global processor for remote job processing.

RJPLINE,N=linename	
,S= {linespeed} {<u>2400</u>}	specify 2400, 4800, 7200, 9600, or 19,200 (bps) for 3777 Model 2.

RJPTERM (Remote Job Processing Terminal) Card

The RJPTERM card defines a single remote workstation terminal to the JES3 system.

RJPTERM,N=ddname	
,T=termtype	specify M205 for the System/360 Model 20 Submodel 5 and the 3777 Model 2.
,B= {buffsize} {400}	512 is the recommended buffer size for the 3777 Model 2; the default shown is for the S/360 M20-5.
,C= {R}	if the optional Console Display feature is installed on the 3777 Model 2.
,C= {S}	if the optional Console Display feature is *not* installed on the 3777 Model 2.
RJPTERM,PR=numofprt	specify 1 for the 3203 Model 3 Printer attached to the 3777 Model 2.
,PRW= {recsiz} {132}	allow this parameter to default for the 3203-3 printer attached to the 3777-2
,PU= {numofpun} {0}	specify 1 if the optional 3521 Card Punch is installed on the 3777 Model 2. allow this parameter to default if the 3521 is *not* installed on the 3777-2.
,PUW= {recsiz} {80}	allow this parameter to default if PU=1 was coded for the optional 3521 Card Punch on the 3777 Model 2.
,RD= {numofrdr} {0}	specify 1 for the 2502 Card Reader or Diskette Input Device attached to the 3777 Model 2.

JES3 Remote Workstation Package Generation

The remote workstation package (RMT) used by JES3 is the one supplied with JES2. The same RMT Parameters for JES2 Remote Job Entry (as described under "OS/VS2 JES2 Generation" in this section) that are altered for the 3777 Model 2, are punched as part of the RMT generation parameter card deck, and are used for JES3 RMT generation.

Refer to "Chapter 3: Extended Services and Utilities" in the *OS/VS2 MVS System Programming Library: JES3,* GC28-0608, for the JES3 RMT generation procedure. The following parameters are specified as shown:

&BSCCPU=YES	specifies inclusion of BSC MULTI-LEAVING RJE support in RTAM
&MLBFSIZ=512	512 is the recommended MULTI-LEAVING buffer size, in bytes, for the 3777 Model 2

Other Parameters

All the other parameters for the System/360 Model 20 Submodel 5 may be allowed to default or may be altered as desired for the 3777 Model 2, according to the descriptions in the *OS/VS2 MVS System Programming Library: JES3,* GC28-0608.

VM/370 RSCS Generation

The Remote Spooling Communications Subsystem (RSCS) is designed to support the HASP II remote terminal packages. The same parameters that are coded for OS/VS2 HASP generation to support the 3777 Model 2 BSC MULTI-LEAVING Workstation also apply to VM/370 RSCS generation. Refer to "OS/VS2 HASP Generation" in this section.

RSCS Requirements for RTP Program

The Remote Terminal Processor (RTP) program allows the 3777 Model 2, the System/360 Model 20 Submodel 5, and the 2922 Programmable Terminal to operate as remote workstations for MULTI-LEAVING operating systems such as HASP and ASP. A S/360 M20-5, 2922, or 3777-2 under control of the RTP program (identified as HASP/RTPM20) and communicating with RSCS can be viewed as a logical extension of the VM/370 spool system.

Devices supported on the various terminals are described in the *IBM Virtual Machine Facility/370: Remote Communications Spooling Subsystem (RSCS) User's Guide,* GC20-1816. The I/O device numbers for the System/360 Model 20 Submodel 5 are used, as explained in the introduction to this section, when coding parameters for the 3777 Model 2.

For more information on VM/370 data communication support of RSCS, refer to *IBM Virtual Machine Facility/370: System Programmer's Guide,* GC20-1807.

Care must be taken in generating the HASP II remote terminal packages to assure compatibility in specifications and buffer sizes with those specified at RSCS initialization time.

Operating Characteristics (3777 Model 2)

Workstation Controller

The workstation program in the controller uses alternating buffers for temporary data storage. The buffer size is variable and is specified during generation of the workstation program at the CPU. The recommended size for the 3777 Model 2 is 512 bytes as specified in the &MLBFSIZ (MULTI-LEAVING buffer size) parameter or its equivalent in the RJE subsystem.

The alternating buffers (called MULTI-LEAVING buffers) allow concurrent input/output device operation and workstation job stream transmission to/from the CPU.

Job Control

After the terminal's power is turned on, and with the HOLD PRINT switch off and Keylock on, the terminal is ready for initial program load (IPL) of the workstation program after the built-in tests run successfully. The IPL may be read from cards or from the diskette (if the workstation program deck had been previously written on the diskette SYSIPL data set). To proceed with workstation operation, the operator must align the forms and set up the forms control for the job and define other parameters, or select them by use of keyboard switches.

Parameters, in addition to forms control, that may be specified or selected include:

- Making ready the input and output devices required for the job
- Setting the train image for the 3203 printer/1416 cartridge
- Setting the lines per inch, 6 or 8 lpi, for the printer
- Setting the spooling diskette status: spool or no spool, retain or not retain operator messages, opening of spooling diskette
- Selecting Read Back Check on the 3521 Card Punch

After these and other parameters are set, the operator establishes a communication line and performs the logon or sign-on procedure to prepare the 3777-2 workstation for remote job processing.

Data and Space Compression/Expansion

Throughput on the 3777-2 workstation job streams may be increased by selecting Data and/or Space Compression/Expansion during the workstation program generation. If this option is specified, consecutive data or space characters are removed from transmitted data from the card reader and reinserted in output data at the CPU. Data or space compression can also be used in data received from the CPU, and will cause reinsertion (expansion) into printed or punched data. Expansion is automatic and does not have to be specified for a job whose data is compressed.

Problem Determination

The controller has built-in tests that run each time the power is turned on or the SYSTEM RESET switch is operated. These tests, when successfully completed, have checked the major portion of the controller and verified that the electronic circuits are operating properly. The terminal is then in local mode. The tests require a few seconds to run and leave the terminal in a state with the code 515 in the NPR; this informs the operator that the IPL must be done. Any other indicator being on after the tests have run signals either that a failure occurred in the controller's electronic components, that one of the mode switches is on, or that the Keylock is turned off, or that the printer is not ready.

Problem determination tests selectable from the keyboard reside in the terminal. The operator can use these tests to isolate problems to the terminal or to the communication facilities. Communication-facility tests also include online tests provided by the CPU access method. An online trace prints all online data sent and received including sense data.

Error Logging

Information about errors encountered during normal operation is recorded in an error log that can be printed out by the Print Error Log function. When errors that cannot be corrected by operator action occur, or when intermittent internal machine errors that impede operation occur, the operator should call for a printout of the error log before turning the terminal's power off (the error log is lost when power is turned off). This information should be retained and given to the service representative, who will use it to isolate the cause of the problem.

A storage dump facility prints the core storage and register storage contents of the workstation program.

Operator Attention Speaker

This device produces an audible tone to signal the operator that a procedural error has occurred, or that some input or output device requires attention. Upon hearing the tone, the operator can refer to the keyboard indicators, which will indicate the cause of the tone.

Keyboard

The keyboard is enabled for data entry by pressing the SYS REQ key provided the Console Display special feature is installed and the console is specified in the workstation program. A logon/sign-on or logoff message may be entered, displayed, and sent to the CPU. Limited editing of the message is possible by use of the CHAR BKSP and CHAR ADV keys. If the Operator ID Reader feature is present, magnetic card data may be sent in addition to keyed data. Refer to "Console Display Feature" and "Operator ID Reader" under "Features and Accessories" in this chapter for more information on keyboard operation with these features. Refer also to "Operating Controls" in this chapter for a functional description of individual keys, switches, and lights.

Features and Accessories (3777 Model 2)

This section describes the special and specify features and accessories (purchase-only items) available for the 3777 Model 2 controller. I/O devices that can be cable-connected to the controller, and features and accessories for these devices, are described under "I/O Attachments" in Chapter 6.

Console Display

The 3777 Model 2 can attach a 1024-character Console Display special feature for displaying messages sent from the host to the remote terminal operator and operator-initiated messages. This special feature shown in Figure 9-3 can display 16 lines with 64 characters in each line. The top 14 lines are used to display messages. The bottom two lines are reserved for data as it is keyed in or data requested by the 3777-2 operator.

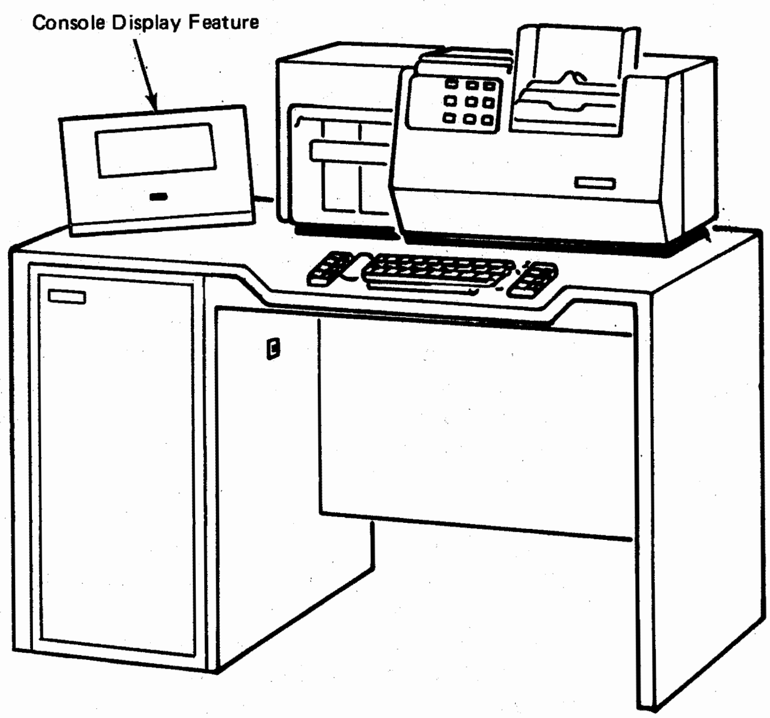


Figure 9-3. 3777 Model 2 Console Display Feature

Messages

Messages are displayed from top to bottom as they are received from the host or sent from the 3777-2. When the operator finishes keying a message, it is moved up on the screen as the most recent message. If the Console Display Spooling feature is also attached (see "Console Display Spooling" in this section), messages are also written on the spooling diskette. If a message is too long for one line, the display overflows to the next line and indents the overflow line for ease of viewing. When the display screen is full of messages, the most recent message wraps around to the top of the screen and displays over the oldest message on the screen. The most recent message received from the host processor is identified by an asterisk (*) in the left-most display position followed by a blank line.

Hold Mode

The operator can put the display in hold mode to prevent new messages from displaying. While in hold mode, another message received turns on the MSG ALERT light but is not displayed. The message is written onto the spooling diskette if the spooling feature is attached. The REL key may be used to release the display from hold mode. If the spooling feature is attached, the latest screenful of messages appears. Any new messages will then begin displaying. If many have been received, they will be displayed quite rapidly. To prevent this, the REL ONE MSG key may be pressed (instead of the REL key) to display one message at a time. When all received messages have been displayed, the MSG ALERT light turns off. The display is still in hold mode and the REL key must be used to release the display.

Retrieving Previous Messages

After messages are received and written on the spooling diskette, the operator can retrieve and display them using the MSGS BACK and MSGS ADV (Messages Back/Advance) keys. Pressing either of the "MSGS" keys puts the Console Display in hold mode, which prevents the display of system messages received from the host processor. (Any messages received in hold mode are written on the spooling diskette.)

The operator has the option of selecting the previous or next screen full of messages to be displayed using the most recently-displayed message as the reference point, or from the same reference point, searching backward or forward on the spooling diskette a maximum of 99,999 messages before starting the retrieval and display.

After viewing the selected messages, the operator has two options. (1) Pressing the REL key releases hold mode and the latest screenful of messages appears.
(2) Instead of REL, the operator may press the MSGS ADV key to display a screenful of messages at a time, advancing through the messages. When all messages have been displayed, hold mode is released and the MSG ALERT light is turned off.

Keyboard Input

The 3777-2 operator may use the keyboard in conjunction with the Console Display feature to enter (1) system commands and requests to the host processor and (2) local commands and requests to the 3777-2 controller. Refer to the *Operator's Guide* or *User's Guide* for the respective Remote Job Entry subsystem for system commands and requests. Refer to the 3777-2 *Operating Procedures Guide* for local commands. Local commands and requests include the following:

- Forms Definition information for the 3203 Model 3 Printer
- Print Train Arrangement Number in the Print Image Buffer
- Lines per inch setting
- Workstation Program Status

- Console Display Spooling Status
- Communication Line Statistics
- Commands to the 3777 Model 2

Keyboard Input–System Requests

The operator presses the SYS REQ key to enter the request. (If the Console Display feature is not attached, the 3777-2 ignores the SYS REQ key.) System request messages from the operator to the host are displayed on the bottom two lines of the display as they are keyed in. The character position that will receive the next keyed character is indicated by a small horizontal bar called a *cursor* beneath the character position. The 3777-2 converts lowercase alphabetic characters (a-z) to uppercase before displaying them (see Appendix B for the character set(s) used by the Console Display feature).

If the operator makes a keying error, the CHAR BKSP (Character Backspace) and CHAR ADV (Character Advance) keys can be used to edit the keyed data before pressing the EOM key to execute the command. The CHAR ADV key is typamatic.

After the operator finishes keying and editing the command, pressing the EOM key begins execution of the command, and moves the keyed entry up on the screen, out of the operator-originated area and into the system messages area where it is displayed as the most recent message. If the Console Display Spooling feature is attached, the system request message is also written on the spooling diskette with other spooled messages.

Console Display Spooling

The Console Display Spooling special feature uses a magnetic diskette storage device to spool system messages. The spooling diskette storage device is a compact unit contained in the terminal's left base (Figure 9-4). System messages are recorded (spooled) on a small flexible operator-changeable diskette. Messages are written to the spooling diskette from the buffer as it fills from the communication line. The spooling diskette feature, in conjunction with other I/O devices and features, permits:

- Retrieving and displaying previously-received messages
- Printing messages, at the operator's convenience, for a hard copy chronological file
- Retaining messages in a diskette chronological file by removing the spooling diskette when it is full and inserting another
- Writing new messages over old ones when the spooling diskette is full
- Storing the workstation program on a diskette and executing the IPL from the diskette, which is faster than from the card reader

Diskette Create Function

New diskettes, or diskettes that have been used on other machines, must be prepared for use on the 3777-2 by performing the Diskette Create function before they can be written on by the Console Display Spooling feature. This function is under control of an operator procedure that writes the Volume Label and Data Set Label(s) on track 00 of the diskette as shown in Appendix E. Any data previously written on the diskette cannot be accessed again.

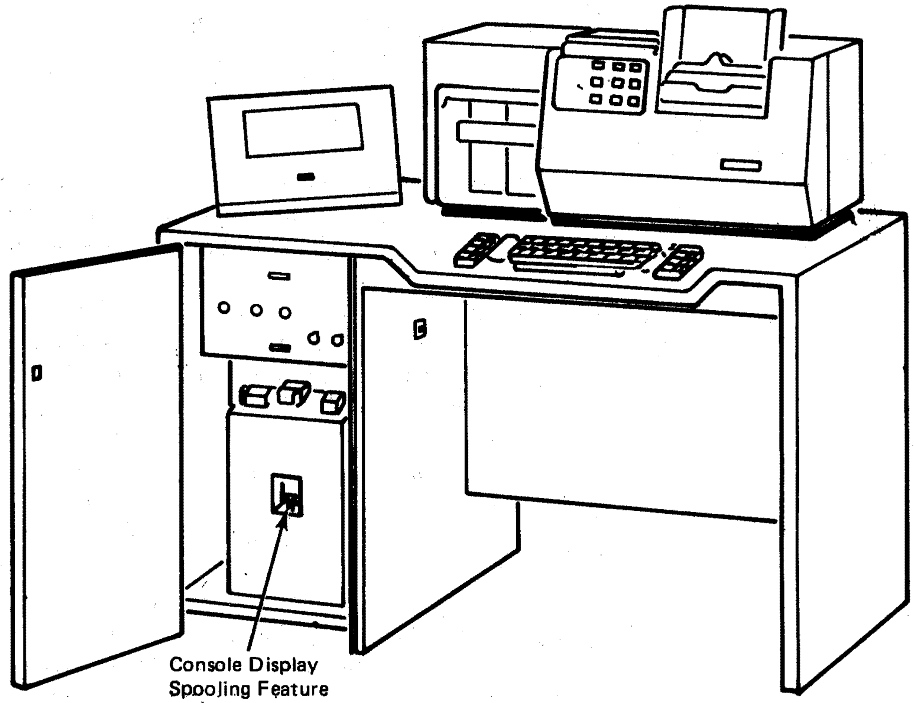


Figure 9-4. 3777 Model 2 Console Display Spooling Feature

When performing the Create function, the operator has the option of specifying that the IPL data set (SYSIPL) be written on the diskette as the first data set. The operator specifies a load address, loads the workstation program deck into the card reader, and the data is written on the diskette. The system messages data set (SYSMSGS) is written next, allocating the rest of the diskette tracks to one system messages data set. (If the SYSIPL data set is not written on the diskette, the SYSMSGS data set is allocated to the entire diskette data storage area.)

Spooling Diskette Records

System messages received from the host processor are written into a buffer until the most recent message overflows the 256-byte buffer. The most recent message is not inserted, the rest of the buffer is padded with NUL characters (Hex '00'), and the buffer is written onto 128-byte sectors on the spooling diskette in 3770 nonexchange mode. Each time a buffer of messages is written onto the spooling diskette, a buffer of zeroes is written following it. The next buffer of messages overlays the buffer of zeroes from the previous write operation and writes a buffer of zeroes. Thus, data integrity of messages already on the spooling diskettes is maintained. The buffer of zeroes marks the end of messages on the spooling diskette. A new buffer is started with the message that caused the overflow.

To estimate the number of messages that can be contained on the spooling diskette, use the following:

1. Buffer size is 252 bytes for messages.
2. To each message, add two control bytes.
3. Messages are not segmented across buffers.
4. With no SYSIPL, a maximum of 962 buffers are written. If defective sectors exist, this number decreases.

Since messages vary in length, only an approximate number can be computed.

As with any diskette of this type, defective sectors caused by physical damage to the diskette will decrease the available storage capacity. Defective sectors are skipped over the first time they are encountered; thereafter, they are not used. An excessive number of defective sectors can cause a significant decrease in storage capacity, and will degrade performance.

Spooling Diskette Data Sets

As mentioned previously, under "Diskette Create Function", the 3777-2 writes records into one or two spooling diskette data sets identified at Create time as SYSIPL (optional) and SYSMSGS.

Retain Data Set Function

If the RETAIN Disk mode light is on (set by the operator), when the spooling diskette fills with messages, the 3777-2 stops writing messages, closes the SYSMSGS data set, sounds the Operator Attention Speaker, and displays a code in the NPR. The operator replaces the full spooling diskette with another, performs the Create function (if necessary) on the next spooling diskette, and returns the 3777-2 to continue writing system messages on the next spooling diskette.

If the RETAIN DISK light is not on when the spooling diskette becomes full, the new messages will be written over old messages starting at the Beginning of Extent address.

Close Data Set Function

At any time, whether the RETAIN DISK light is on or off, the operator may select the Close Data Set (END) function. This function writes any buffered messages to the spooling diskette and closes the SYSMSGS data set. After closing the data set, the operator may remove the spooling diskette and insert another, or may reopen the data set and let the 3777-2 continue writing system messages on the rest of the spooling diskette.

No Spool Function

This function, selected by the operator, turns on the NO SPOOL light and prevents the writing of system messages on the spooling diskette. In this mode, system messages are displayed as they are received, but are not written on the spooling diskette.

Print Messages Operation

When the LIST DISK code function is executed, the contents of the spooling diskette can be printed on the 3203 printer. The printout begins with the volume label, the SYSIPL (if present) and SYSMSGS, data set label(s), followed by the SYSMSGS data set in chronological sequence. The printout may be stopped at any time.

During a spooling diskette operation if the Display is in hold mode, any system messages received cannot be written on the spooling diskette, but are held in the buffer. The MSG ALERT light turns on (similar to Display hold mode). After the operation ends, the spooling diskette must be opened. Any held messages are then displayed and written on the spooling diskette.

Diskettes

Diskettes used by the Console Display Spooling feature and the Diskette Input Device consist of a small flexible disk about 8 inches in diameter enclosed in a holder. Appendix F describes the diskette used by the 3777 Mo. . 2, and describes diskette labeling and recommended handling procedures.

Diskette Input Device

The Diskette Input Device special feature uses a magnetic diskette storage device to read basic exchange data sets from input diskettes as if they were 80-character cards. The input diskette storage device is a compact unit contained in the terminal's right base (Figure 9-5). Eighty-character card-image records are written on a basic exchange diskette by a terminal or machine other than the 3777-2. The basic exchange diskette is then transferred to the 3777-2 Diskette Input Device where it is read as the job input source.

Either (a) the 2502 Card Reader or (b) the Diskette Input Device and the Console Display feature is a prerequisite feature to the 3777-2. One of the above must be part of the minimum workstation configuration. If both the 2502 and the Diskette Input Device are attached to the 3777-2, the operator can alternate the job input source between cards and basic exchange diskettes. However, both of these input devices cannot be operated simultaneously.

The IPL diskette may be created on the Diskette Input Device if the Console Display Spooling feature is not attached. The IPL diskette format is the same as if it were created on the console Display Spooling feature (labels are written for SYSIPL and SYSMSGS data sets). With the Extended Forms Definition feature, additional forms definitions may be written on the IPL diskette preceding the workstation program. (Five printer forms definitions are a basic feature of the 3777-2.) If the Console Display Spooling feature is not attached, the 3777-2 can use the Diskette Input Device to read the diskette containing the workstation program deck during an IPL procedure. (If the 2502 is not attached the IPL diskette must have been written on another 3777-2 with a 2502 Card Reader and at least one diskette device feature.)

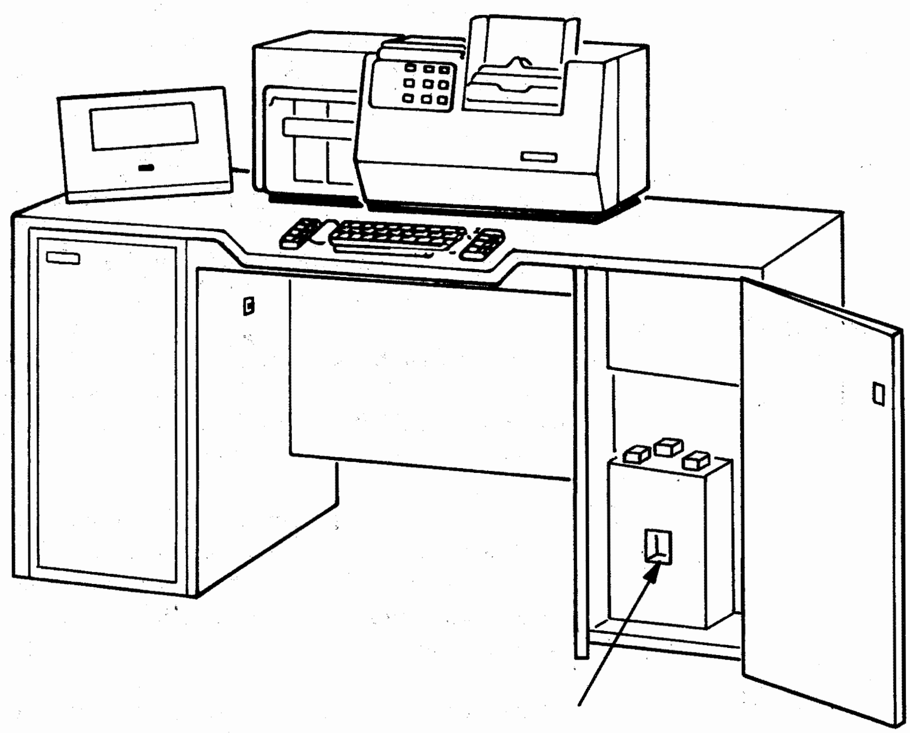


Figure 9-5. 3777 Model 2 Diskette Input Device Feature

Input Diskette Data Sets

The records on the input diskette must be read and processed by the 3777-2 as if they were cards. Consequently, the data sets must be the basic exchange type with a maximum block length of 80. Input diskette data sets may be continued from one diskette volume to another using the multivolume indicator in the data set label. These data sets may be written on another 3770 terminal (other than a 3777-2) or on another machine or terminal that can create a basic exchange data set.

List Diskette Function

When the LIST DISK code function is executed, the labels of the input diskette can be printed on the 3203 printer. The printout begins with the volume label, followed by the card-image data set labels. The printout may be stopped at any time. If the IPL diskette is used, the volume label is printed, followed by the SYSIPL and SYSMSGS labels.

Door Keylock

This special feature adds a keylock to the controller cabinet door. Two keys are provided.

Keylock

This special feature provides a key-operated switch on the Auxiliary Operator's Panel behind the cabinet door. This switch can be turned off to disable the terminal operation through the keyboard and must be on to start operations at the keyboard.

Audible Alarm

This special feature provides a louder signal than the Operator Attention Speaker. The alarm can be enabled or disabled by the operator. When enabled, the alarm sounds for any device error or not-ready condition.

Operator ID Reader

This special feature device reads magnetic stripe operator identification cards (or badges). The ID reader is mounted behind the controller cabinet door, above the Auxiliary Operator's Panel. This feature is enabled by a CODE key function, and uses the SYS REQ data format as if it had been keyed in. After the ID card data is read into the buffer, the 3777-2 generates an EOM and sends the data to the host processor.

Data from the ID card is not displayed, printed, or written on the spooling diskette to maintain security of the badge data at the terminal. However, the workstation program treats the ID card data the same way as keyed data; there is no special security treatment of badge data by the program. This CODE key function is not allowed if the line trace facility is being used, since the data would be printed.

Cards must be 3-7/8 by 2-1/8 inches, and between 0.007 and 0.045 inch thick. The magnetic stripe must be encoded in the American Banking Association format, which provides for up to 40 characters, 37 of which are discretionary. Card format and character sets are shown in Appendix B.

Katakana Character Set

Keyboard

This specify feature provides a 127-character keyboard for the 3777 Model 2 controller. The Katakana character set is shown in Appendix B.

Print Train Arrangements

The International Print Support specify feature for the 3777 Model 2 includes buffer storage for the 107- and 127-character Katakana print train arrangements. (With this feature installed, the 3777-2 also has buffer storage for print train arrangements equivalent to the 48-, 64-, and 94-character sets available for EBCDIC print belts used on the 3776 console line printer.) A corresponding 1416 Interchangeable Train Cartridge for the 3203 Model 3 Printer must also be ordered for each arrangement you want to print. This specify feature replaces the standard character set storage in the 3777-2. Refer to "IBM 3203 Printer Model 3" in Chapter 6 for more information.

EIA/CCITT Interface

This special feature is used to connect the terminal to the common-carrier supplied or user-supplied Data Communication Equipment (DCE), to digital communication services, or to IBM standalone modems, operating over switched or nonswitched communication facilities. This special feature provides an interface (and a cable for attachment to the DCE) which is compatible with the characteristics and specifications of EIA Standard RS-232C in U.S. and Canada (maximum line speed–19.2 kbps) or CCITT Recommendation V.24 (maximum line speed–9600 bps) or V.35 (ISO/IS 2593, maximum line speed–20.4 kbps) in World Trade countries. The circuits used by the 3770 are described in Chapter 1 under "Communication Facilities."

High-Speed Digital Interface

This special feature on the 3777 Model 2 is used to connect the terminal to common-carrier-supplied or user-supplied Data Communication Equipment (DCE), or to IBM standalone modems. The High-Speed Digital Interface feature permits point-to-point synchronous operation at 19.2 kilobits per second (20.4 kbps in World Trade countries) on a wide band communication channel. This special feature provides an interface and a cable for attachment to the DCE.

Operating Controls (3777 Model 2)

POWER ON/OFF Switch: This switch is located on the left side of the knee hole on the controller housing. It controls ac power to the terminal. When power is turned on, the bring-up diagnostics run and the terminal is left with all lights off except code 515 in the Numeric Position Readout (NPR) indicators. Any other indicator being on signals either a failure in the terminal's electronic components, or that the HOLD PRINT switch is on, or the Keylock is off, or the printer is not ready. If the bring-up diagnostics run successfully, the operator can initialize the terminal and establish a communication line. The operator should proceed as described in the 3777 Model 2 *Operating Procedures Guide.*

Auxiliary Operator's Panel

The auxiliary operator's panel (Figure 9-6) is located behind the door on the controller base. It contains the SYSTEM RESET switch and certain special feature controls, as follows:

NORMAL/HALF-SPEED Switch: This switch is present on all World Trade machines using the CCITT V.24 interface. With the switch in the NORMAL position, line speed is at the external Data Communication Equipment's (DCE) maximum rated speed. With the switch in the HALF-SPEED position, line speed is half of the DCE's maximum rated speed, if the DCE used has this capability.

SYSTEM RESET Switch: This switch causes the terminal to interrupt any operation in progress and leaves the terminal in the same power-on state as described under "POWER ON/OFF" switch. The SYSTEM RESET switch does not erase the error log, the line statistics, or the forms definitions.

Keylock: This is the key operated switch for the Keylock special feature.

Keyboard Switches, Keys, and Lights (Figure 9-7)

Switches

HOLD PRINT: Turning this switch on suspends printing so that forms on the 3203 printer can be adjusted or inserted. This switch must also be turned on to change the lines per inch setting, to change the print train image, or to change the forms definition. When this switch is turned off, printing resumes.

MSG ATTN (Message Attention): The setting of this switch determines whether or not the Operator Attention Speaker sounds when a message is displayed. In the MSG ATTN position, the speaker sounds when each message is first displayed to alert the operator to an unsolicited message. If the operator has made an inquiry and is expecting a response or if many messages are received, this switch should be turned off.

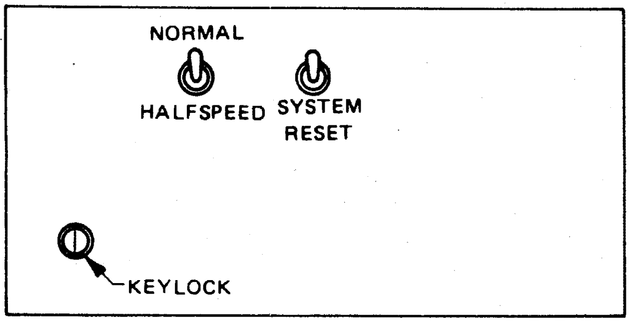


Figure 9-6. Auxiliary Operator's Panel

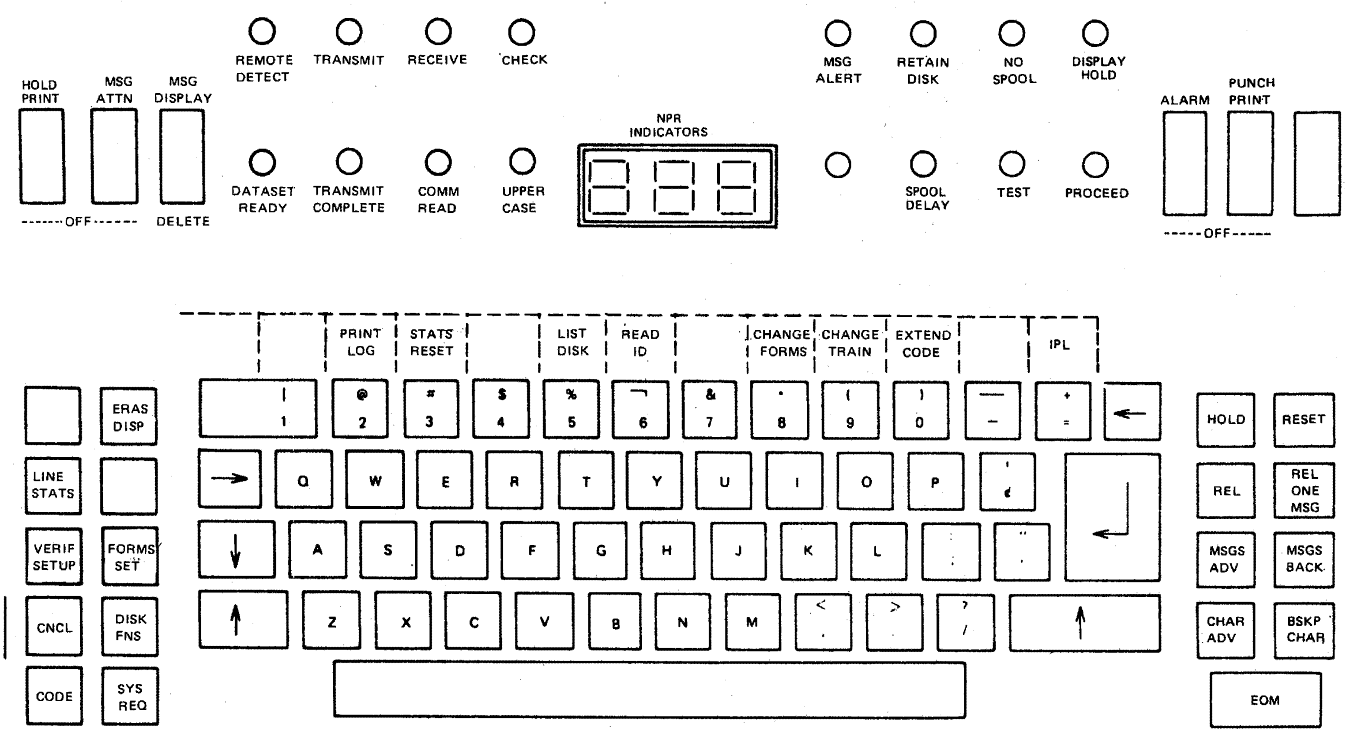


Figure 9-7. 3777 Model 2 Keyboard

MSG (Message) DISPLAY/DELETE: The setting of this switch determines whether or not the message selected by the operator is deleted when using the Message Compare/Delete EXTEND CODE function. In the DISPLAY position, the selected message is displayed and written on the spooling diskette (if the Console Display Spooling feature is attached). In the DELETE position, the selected message is not displayed or written on the spooling diskette. This function prevents potentially unimportant messages such as "UNIT CHECK" from filling the display or the spooling diskette.

ALARM: Turning this switch on enables the Audible Alarm feature, if installed, to sound when the Operator Attention Speaker sounds. The Audible Alarm is a louder and continuous signal.

PUNCH PRINT: Turning this switch on causes cards to be printed (interpreted) as they are punched (the 3521 must have the Card Print feature). The switch may be changed at any time. Refer to "3521 Special Features" in Chapter 6 for more information.

Keys

ERAS DISP (Erase Display): Pressing this key erases the entire display (system messages and operator-originated data).

LINE STATS (Statistics): This key causes the line statistics to be displayed (or printed if the Console Display feature is not attached). Statistics displayed/printed are: blocks sent and received successfully; CRC errors; NAKs received; read timeouts; and lost data.

VERIFY SETUP: Pressing this key displays (or prints, if the Console Display feature is not attached) the current forms definition, print train image number, lines per inch setting, operational status of the spooling diskette, number of basic exchange data sets read successfully from the input diskette, and the NPR code of any input diskette error. The information displays on the bottom two lines.

FORMS SET: Pressing this key allows the operator to change the active vertical forms definition for the 3203 printer. The operator may enter keyed responses to prompts in the NPR. Channels not defined, are set to line number one. Maximum form length is 255 lines.

CNCL (Cancel): Pressing this key cancels a keyed request or CODE key function (SYS REQ key not involved). The CNCL key discards any data keyed in as part of a SYS REQ message. The PROCEED light remains on until the EOM key is pressed (see "Operating Characteristics—Keyboard Input").

DISK FNS (Diskette Functions): Pressing this key allows the operator to select one of four spooling diskette functions or the create IPL function: Create Diskette (two variations); Close Data Set; Set/Reset Retain Mode, or No Spool (see "Features and Accessories—Console Display Spooling").

CODE: This key, pressed in conjunction with other keyboard keys, permits selection of the following functions:

- Print Error Log
- Reset Line Statistics Counters to Zero
- List Diskette–Prints the volume label, data set label(s), and the system messages data set from the spooling diskette or prints the volume label and data set labels from the input diskette.
- Enable Operator ID Reader
- Change Forms Definition, Train Image, and 8/6 Lines Per Inch setting
- Select a Print Train Image for the 3777-2 Controller
- Select Extended Code Functions (Refer to EXTEND CODE description)
- Execute an Initial Program Load (IPL) from Cards or Diskette (Operator can define forms definitions, train image, 8/6 lines per inch, and spool diskette setting.)
- Begin Diskette Input (Read Diskette)–Starts reading one or all active basic exchange data sets on the Diskette Input Device.
- End Diskette Input (Stop Diskette)–If the 3777-2 is reading the input diskette when this function is executed, the 3777-2 stops reading at the end of the current record. An End of File indicator is sent unless no EOF is specified.
- Reset NPR Error Indication & CHECK Light
- End FORMS SET Operation
- Reset 3203 Ripple Print Operation
- Reset Communication Facilities Test
- Stop Printing of List Diskette function
- Select 8 or 6 lines per inch for printing
- Disable/Enable Read Back Check on 3521 Card Punch

EXTEND CODE: This key, pressed in conjunction with the CODE key and a numeric key, permits selection of the following functions:

- Stop Workstation Program
- Restart Workstation Program
- Print All Characters to Clean 3203 Printer Belt (3203 Ripple Print)
- Delete Message from Display and Spooling Diskette
- Set Values–Setting of DATA and REGISTER DATA/ADDRESS dials on System/360 Model 20 Operator Console
- Test Communication Facilities
- Dump Storage–Performs storage dump of S/360 Model 20 program on 3203 printer.
- Print Line Trace–Prints all online data (degrades performance)

Keys used in conjunction with the CODE and EXTEND CODE keys to select these functions are described in the 3777 Model 2 *Operating Procedures Guide.*

SYS REQ (System Request): This key is active only if the Console Display feature is attached. This key is used to enter and display local commands to the workstation program in the 3777-2 or system commands to the RJE subsystem in the host processor.

HOLD: Pressing this key prevents the display of new messages and turns on the DISPLAY HOLD light. If messages are received while the display is in hold mode, they are written on the spooling diskette (if attached) and the MSG ALERT light turns on. Pressing the REL key returns the Console Display to normal display mode.

RESET: Pressing this key resets the Audible Alarm; returns the Console Display cursor to the next position to be keyed after pressing BKSP CHAR; and resets operator error codes in the NPR.

REL (Release): Pressing this key releases the Console Display from hold mode. Display hold mode can be entered by pressing the HOLD, or MSGS BACK keys. When the REL key is pressed, the MSG ALERT and DISPLAY HOLD lights are turned off and messages continue displaying. If the Console Display Spooling feature is attached, the most recent screenful of messages is displayed.

REL ONE MSG (Release One Message): This key is active only when the Console Display is in hold mode (the DISPLAY HOLD light is on). Pressing this key displays, one at a time, messages that were received since the Console Display entered hold mode. When the last held message is displayed, the MSG ALERT light is turned off, but the Console Display remains in hold mode until the REL key is pressed.

MSGS ADV/MSGS BACK (Messages Advance/Messages Back): These keys are active only if the Console Display Spooling feature is attached and the SYSMSG data set is open. Pressing one of these keys puts the Console Display in hold mode and permits the operator to retrieve and display previously-received messages. Using the most recently displayed message as a reference point, the operator enters a 1- to 5-digit number. Messages start displaying from the selected message. If no number is entered, the next screenful (MSGS ADV) or the previous screenful (MSGS BACK) of messages appears on the display.

CHAR ADV/BKSP CHAR (Character Advance/Backspace): These keys are active when data entered from the keyboard is being displayed. These two keys may be used to edit keyed data. Pressing the BKSP CHAR key causes a non-destructive backspace (one space at a time) over previously-keyed characters. Pressing the CHAR ADV key causes non-destructive spacing over previously keyed characters. CHAR ADV is a typamatic key.

EOM (End of Message): This key is pressed during a SYS REQ message operation to terminate the keying, start execution of the command, and move the message up on the display as the most recent message. Pressing this key also terminates selection and begins execution of CODE functions, MSGS ADV/BACK, FORMS SET, and DISK FNS requests.

Lights

The following six lights in the left upper part of the operator panel are used to indicate the operation of the data link: REMOTE DETECT, DATASET READY, TRANSMIT, TRANSMIT COMPLETE, RECEIVE, and COMM READ.

REMOTE DETECT: This light, when on, means that the line connection has been made and that the remote (host) modem is operational (the carrier detect response has been received).

DATASET READY: This light is on when the 3777-2 communication driver is enabled, and the local (terminal) modem is operational.

TRANSMIT: This light is on when a response or data is being transmitted and turns off when the transmission stops.

TRANSMIT COMPLETE: Turns on when a transmission completes and remains on until the next transmission starts.

RECEIVE: This light is on when a response or data is being received and turns off after received data stops.

COMM (Communication) READ: Turns on when the terminal is ready to receive and a read command has been received. Turns off when received data stops or after a read timeout has elapsed.

CHECK: This light turns on and the Operator Attention Speaker sounds when an error occurs, or some I/O device has an error or needs attention. A code number appears in the NPR to identify the error or condition. This number corresponds to an explanation or procedure described in the 3777 Model 2 *Operating Procedures Guide.*

UPPER CASE: This light turns on when the keyboard is in uppercase shift (Upper Shift key has been pressed).

Numeric Position Readout (NPR): This is a three-digit numeric display that provides different indications depending on what other lights are on and the operation being performed. Code numbers providing operator guidance (prompts) and indicating system status and error conditions are displayed in the NPR. These code numbers, in conjunction with other operator panel lights, are described in the 3777 Model 2 *Operating Procedures Guide.*

MSG (Message) ALERT: Turns on when a system operator message is received that cannot be displayed because the Console Display is in hold mode. The Console Display enters hold mode when the HOLD, or MSGS BACK key is pressed. The MSG ALERT light does not turn off until all held messages have been displayed.

RETAIN DISK (Diskette): This light is turned on by the Set Retain mode diskette function. When on, this light means that the diskette containing system messages (SYSMSGS data set) is to be saved and not overwritten. When the diskette becomes full, a code number appears in the NPR and the Operator Attention Speaker sounds. The operator removes the diskette and replaces it with another one.

SPOOL DELAY: When the SPOOL DELAY light is on, it means that the 3777-2 is attempting to write messages onto the diskettes, but is prevented from writing. If the diskette has not been opened or if a diskette error occurs, this light is on (not flickering).

NO SPOOL: This light is turned on by a diskette function (DISK FNS) and means that system messages are displayed but are not being written on the diskette (the SYSMSGS data set is not open).

TEST: This light is on during communication facilities testing (line trace or wrap test).

DISPLAY HOLD: This light is turned on by pressing the HOLD key and means that no new system messages will be displayed while in hold mode. If any system messages are received while in hold mode, they are written on the diskette (if attached and SYSMSGS is open) and the MSG ALERT light turns on. Pressing the REL key turns off the DISPLAY HOLD light and removes the Console Display from hold mode. If the Console Display Spooling feature is not attached, the message is held in the buffer; therefore, the buffer is not free to receive new line data.

PROCEED: This light is active only during a SYS REQ message operation and means that the message data can be keyed in.

Appendix A. Code Charts

Figures A-1 and A-2 show the code charts.

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

Sys 360 Byte 0 1 2 3 4 5 6 7

↑ First bit transmitted on the communications line

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

Figure A-1. EBCDIC Code Set (Part 1 of 2)

CHAR.	CARD CODE	EBCDIC CODE								HEX
	12-0-1-8	0								80
a	12-0-1	0							7	81
b	12-0-2	0						6		82
c	12-0-3	0						6	7	83
d	12-0-4	0					5			84
e	12-0-5	0					5		7	85
f	12-0-6	0					5	6		86
g	12-0-7	0					5	6	7	87
h	12-0-8	0				4				88
i	12-0-9	0				4			7	89
	12-0-2-8	0				4		6		8A
	12-0-3-8	0				4		6	7	8B
	12-0-4-8	0				4	5			8C
	12-0-5-8	0				4	5		7	8D
	12-0-6-8	0				4	5	6		8E
	12-0-7-8	0				4	5	6	7	8F
	12-11-1-8	0			3					90
j	12-11-1	0			3				7	91
k	12-11-2	0			3			6		92
l	12-11-3	0			3			6	7	93
m	12-11-4	0			3		5			94
n	12-11-5	0			3		5		7	95
o	12-11-6	0			3		5	6		96
p	12-11-7	0			3		5	6	7	97
q	12-11-8	0			3	4				98
r	12-11-9	0			3	4			7	99
	12-11-2-8	0			3	4		6		9A
	12-11-3-8	0			3	4		6	7	9B
	12-11-4-8	0			3	4	5			9C
	12-11-5-8	0			3	4	5		7	9D
	12-11-6-8	0			3	4	5	6		9E
	12-11-7-8	0			3	4	5	6	7	9F
	11-0-1-8	0		2						A0
~	11-0-1	0		2					7	A1
s	11-0-2	0		2				6		A2
t	11-0-3	0		2				6	7	A3
u	11-0-4	0		2			5			A4
v	11-0-5	0		2			5		7	A5
w	11-0-6	0		2			5	6		A6
x	11-0-7	0		2			5	6	7	A7
y	11-0-8	0		2		4				A8
z	11-0-9	0		2		4			7	A9
	11-0-2-8	0		2		4		6		AA
	11-0-3-8	0		2		4		6	7	AB
	11-0-4-8	0		2		4	5			AC
[	11-0-5-8	0		2		4	5		7	AD
	11-0-6-8	0		2		4	5	6		AE
	11-0-7-8	0		2		4	5	6	7	AF
	12-11-0-1-8	0		2	3					B0
	12-11-0-1	0		2	3				7	B1
	12-11-0-2	0		2	3			6		B2
	12-11-0-3	0		2	3			6	7	B3
	12-11-0-4	0		2	3		5			B4
	12-11-0-5	0		2	3		5		7	B5
	12-11-0-6	0		2	3		5	6		B6
	12-11-0-7	0		2	3		5	6	7	B7
	12-11-0-8	0		2	3	4				B8
	12-11-0-9	0		2	3	4			7	B9
	12-11-0-2-8	0		2	3	4		6		BA
	12-11-0-3-8	0		2	3	4		6	7	BB
	12-11-0-4-8	0		2	3	4	5			BC
]	12-11-0-5-8	0		2	3	4	5		7	BD
	12-11-0-6-8	0		2	3	4	5	6		BE
	12-11-0-7-8	0		2	3	4	5	6	7	BF
{	12-0	0	1							C0
A	12-1	0	1						7	C1
B	12-2	0	1					6		C2
C	12-3	0	1					6	7	C3
D	12-4	0	1				5			C4
E	12-5	0	1				5		7	C5
F	12-6	0	1				5	6		C6
G	12-7	0	1				5	6	7	C7
H	12-8	0	1			4				C8
I	12-9	0	1			4			7	C9
	12-0-2-8-9	0	1			4		6		CA
	12-0-3-8-9	0	1			4		6	7	CB
ʃ	12-0-4-8-9	0	1			4	5			CC
	12-0-5-8-9	0	1			4	5		7	CD
Ψ	12-0-6-8-9	0	1			4	5	6		CE
	12-0-7-8-9	0	1			4	5	6	7	CF
}	11-0	0	1		3					D0
J	11-1	0	1		3				7	D1
K	11-2	0	1		3			6		D2
L	11-3	0	1		3			6	7	D3
M	11-4	0	1		3		5			D4
N	11-5	0	1		3		5		7	D5
O	11-6	0	1		3		5	6		D6
P	11-7	0	1		3		5	6	7	D7
Q	11-8	0	1		3	4				D8
R	11-9	0	1		3	4			7	D9
	12-11-2-8-9	0	1		3	4		6		DA
	12-11-3-8-9	0	1		3	4		6	7	DB
	12-11-4-8-9	0	1		3	4	5			DC
	12-11-5-8-9	0	1		3	4	5		7	DD
	12-11-6-8-9	0	1		3	4	5	6		DE
	12-11-7-8-9	0	1		3	4	5	6	7	DF
\	0-2-8	0	1	2						E0
	11-0-1-9	0	1	2					7	E1
S	0-2	0	1	2				6		E2
T	0-3	0	1	2				6	7	E3
U	0-4	0	1	2			5			E4
V	0-5	0	1	2			5		7	E5
W	0-6	0	1	2			5	6		E6
X	0-7	0	1	2			5	6	7	E7
Y	0-8	0	1	2		4				E8
Z	0-9	0	1	2		4			7	E9
	11-0-2-8-9	0	1	2		4		6		EA
	11-0-3-8-9	0	1	2		4		6	7	EB
⑁	11-0-4-8-9	0	1	2		4	5			EC
	11-0-5-8-9	0	1	2		4	5		7	ED
	11-0-6-8-9	0	1	2		4	5	6		EE
	11-0-7-8-9	0	1	2		4	5	6	7	EF
0	0	0	1	2	3					F0
1	1	0	1	2	3				7	F1
2	2	0	1	2	3			6		F2
3	3	0	1	2	3			6	7	F3
4	4	0	1	2	3		5			F4
5	5	0	1	2	3		5		7	F5
6	6	0	1	2	3		5	6		F6
7	7	0	1	2	3		5	6	7	F7
8	8	0	1	2	3	4				F8
9	9	0	1	2	3	4			7	F9
	12-11-0-2-8-9	0	1	2	3	4		6		FA
	12-11-0-3-8-9	0	1	2	3	4		6	7	FB
	12-11-0-4-8-9	0	1	2	3	4	5			FC
	12-11-0-5-8-9	0	1	2	3	4	5		7	FD
	12-11-0-6-8-9	0	1	2	3	4	5	6		FE
	12-11-0-7-8-9	0	1	2	3	4	5	6	7	FF

Figure A-1. EBCDIC Code Set (Part 2 of 2)

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

CHAR.	CARD CODE	ASCII CODE								HEX
@	8-4							7		40
A	12-1	1						7	P	41
B	12-2		2					7	P	42
C	12-3	1	2					7		43
D	12-4			3				7	P	44
E	12-5	1		3				7		45
F	12-6		2	3				7		46
G	12-7	1	2	3				7	P	47
H	12-8				4			7	P	48
I	12-9	1			4			7		49
J	11-1		2		4			7		4A
K	11-2	1	2		4			7	P	4B
L	11-3			3	4			7		4C
M	11-4	1		3	4			7	P	4D
N	11-5		2	3	4			7	P	4E
O	11-6	1	2	3	4			7		4F
P	11-7					5		7	P	50
Q	11-8	1				5		7		51
R	11-9		2			5		7		52
S	0-2	1	2			5		7	P	53
T	0-3			3		5		7		54
U	0-4	1		3		5		7	P	55
V	0-5		2	3		5		7	P	56
W	0-6	1	2	3		5		7		57
X	0-7				4	5		7		58
Y	0-8	1			4	5		7	P	59
Z	0-9		2		4	5		7	P	5A
[	12-8-2	1	2		4	5		7		5B
\	0-8-2			3	4	5		7	P	5C
]	11-8-2	1		3	4	5		7		5D
∧	11-8-7		2	3	4	5		7		5E
—	0-8-5	1	2	3	4	5		7	P	5F
'	8-1						6	7	P	60
a	12-0-1	1					6	7		61
b	12-0-2		2				6	7		62
c	12-0-3	1	2				6	7	P	63
d	12-0-4			3			6	7		64
e	12-0-5	1		3			6	7	P	65
f	12-0-6		2	3			6	7	P	66
g	12-0-7	1	2	3			6	7		67
h	12-0-8				4		6	7		68
i	12-0-9	1			4		6	7	P	69
j	12-11-1		2		4		6	7	P	6A
k	12-11-2	1	2		4		6	7		6B
l	12-11-3			3	4		6	7	P	6C
m	12-11-4	1		3	4		6	7		6D
n	12-11-5		2	3	4		6	7		6E
o	12-11-6	1	2	3	4		6	7	P	6F
p	12-11-7					5	6	7		70
q	12-11-8	1				5	6	7	P	71
r	12-11-9		2			5	6	7	P	72
s	11-0-2	1	2			5	6	7		73
t	11-0-3			3		5	6	7	P	74
u	11-0-4	1		3		5	6	7		75
v	11-0-5		2	3		5	6	7		76
w	11-0-6	1	2	3		5	6	7	P	77
x	11-0-7				4	5	6	7	P	78
y	11-0-8	1			4	5	6	7		79
z	11-0-9		2		4	5	6	7		7A
{	12-0	1	2		4	5	6	7	P	7B
	12-11			3	4	5	6	7		7C
}	11-0	1		3	4	5	6	7	P	7D
~	11-0-1		2	3	4	5	6	7	P	7E
DEL	12-9-7	1	2	3	4	5	6	7		7F

Sys/360 Byte	0	1	2	3	4	5	6	7
ASCII Bit	P	7	6	5	4	3	2	1

P: Not included in the above Hex count

1: First bit transmitted on the communications line

Figure A-2. ASCII Code Set

Appendix B. Character Sets

Figure B-1 shows the printable characters for the various character sets. The International character set is available for all World Trade countries. For a particular country, substitute the characters shown opposite that country for those shown for the International character set. Where no difference is shown, the printable characters are the same as shown for the International set.

The 3775 console line printer can have either a 64- or 94-character print belt. The 3776 console printer and the 3784 Printer can have these same print belts, and can also have a 48-character print belt. The console serial printer on the 3771, 3773, or 3774 has the full 94-character set.

Characters shown for the printer that have no corresponding keyboard key can be printed only when received in data from a CPU or entered into the controller's buffer from an attached input device. Characters in print data that are not present on the line printer print belt will cause a hyphen to print.

There are some exceptions to the hyphen printing as the default character on the 3776 with a 48-character set print belt installed (character sets are shown in Figure B-1). Three "pairs" of characters are logically "OR-ed" together to allow interchangeability between the standard (AN) and the HN character set. The following table shows the interchangeability:

Hex code received by 3776 printer:	*Character printed by standard (AN) belt:*	*Character printed by HN print belt:*
X'6C' or X'5D'	%	)
X'7B' or X'4D'	#	(
X'7C' or X'7E'	@	=

The ASCII character set for use in the U.S. and Canada is shown in Figure B-2. The Katakana character set is shown in Figure B-3.

The Operator ID Card Reader character set is shown in Figure B-4.

The EBCDIC and Katakana character sets used by the 1,024-character Console Display Feature on the 3777 Model 2 are shown in Figures B-5 and B-6.

Refer to the *IBM 3203 Component Description and Operator's Guide*, GA33-1515 for charts of printable characters on the 3203/1416 attached to the 3777.

48-Character Set – AN

Hex	4B	4E	50	5B	5C	60	61	6B	6C	7B	7C	7D	C1-E9	F0-F9
U.S. and Canada	•	+	&	$	*	–	/	,	%	#	@	'	A-Z	0-9
International	•	+	&	$	*	–	/	,	%	#	@	'	A-Z	0-9
Austria/Germany				Ü						Ä	Ö			
Belgium											à			
Brazil				Ç						Õ	Ã			
Denmark/Norway				Å						Æ	Ø			
Finland/Sweden				Å						Ä	Ö			
France										£	à			
Italy										£	§			
Japan				¥										
Portugal										Ã	Õ			
Spain				₧						Ñ				
Spanish-Speaking										Ñ				
United Kingdom										£				

Figure B-1. EBCDIC Printable Characters (Part 1 of 4)

48-Character Set – HN

Hex	4B	4D	4E	50	5B	5C	5D	60	61	6B	7D	7E	CI-E9	F0-F9
U. S. and Canada	•	(	+	&	$	*	)	-	/	,	'	=	A-Z	0-9
International	•	(	+	&	$	*	)	-	/	,	'	=	A-Z	0-9
Austria/Germany		Ä			Ü							Ö		
Belguim												à		
Brazil		Õ			Ç							Ã		
Denmark/Norway		Æ			Å							Ø		
Finland/Sweden		Ä			Å							Ö		
France		£										à		
Italy		£										§		
Japan					¥									
Portugal		Ã										Õ		
Spain		Ñ			₧									
Spanish-Speaking		Ñ												
United Kingdom		£												

Figure B-1. EBDIC Printable Characters (Part 2 of 4)

64-Character Set

Hex	4A	4B	4C	4D	4E	4F	50	5A	5B	5C	5D	5E	5F	60	61	6B	6C	6D	6E	6F	79*	7A	7B	7C	7D	7E	7F	C1-D9	E0	E2-E9	F0-F9
U.S. and Canada	¢	.	<	(	+	|	&	!	$	*	)	;	¬	-	/	,	%	_	>	?	`	:	#	@	'	=	"	A-R	\	S-Z	0-9
International	[	.	<	(	+	!	&	]	$	*	)	;	^	-	/	,	%	_	>	?	`	:	#	@	'	=	"	A-R	\	S-Z	0-9
Austria/Germany	#							$	Ü				¬										Ä	Ö					§		
Belgium																								à					Ç		
Brazil	É							$	Ç												ã		Õ	Ã							
Denmark/Norway	#					|		¤	Å				¬										Æ	Ø							
Finland/Sweden	§					|		¤	Å				¬								é		Ä	Ö					É		
France	°							§															£	à					ç		
Italy	°							é													ù		£	§					ç		
Japan	£					|		!	¥				¬																$		
Portugal			Ç																				Ã	Õ					Ç		
Spain						|			₧				¬										Ñ								
Spanish-Speaking						|							¬										Ñ								
United Kingdom						|							¬										£								

*The 3521 with Card Print feature cannot print the hex '79' character.

For World Trade countries, substitute the character shown opposite the country for that shown for the International character set; where no difference is shown, the printable characters are the same as those shown for the International character set.

Figure B-1. EBCDIC Printable Characters (Part 3 of 4)

94-Character Set

Hex	4A	4B	4C	4D	4E	4F	50	5A	5B	5C	5D	5E	5F	60	61	6A	6B	6C	6D	6E	6F	79	7A	7B	7C	7D	7E	7F	81-89 91-99	A1	A2-A9	C0	C1-C9	D0	D1-D9	E0	E2-E9	F0-F9
U.S. and Canada	¢	.	<	(	+	|	&	!	$	*	)	;	¬	-	/	¦	,	%	_	>	?	`	:	#	@	'	=	"	a-r	~	s-z	{	A-I	}	J-R	\	S-Z	0-9
International	[	.	<	(	+	!	&	]	$	*	)	;	^	-	/	¦	,	%	_	>	?	`	:	#	@	'	=	"	a-r	~	s-z	{	A-I	}	J-R	\	S-Z	0-9
Austria/Germany	#							$	Ü				¬			ö								Ä	Ö					ß		ä		ü		§		
Belgium																ù									à					¨		é		è		ç		
Brazil	É							$	Ç							ç						ã		Õ	Ã							õ		é				
Denmark/Norway	#					|		¤	Å				¬			ø								Æ	Ø					ü		æ		å				
Finland/Sweden	§					|		¤	Å				¬			ö						é		Ä	Ö					ü		ä		å		É		
France	°							§								ù								£	à					¨		é		è		ç		
Italy	°							é								ò						ù		£	§					ì		à		è		ç		
Japan	£					|		!	¥				¬																	‾						$		
Portugal			Ç													õ								Ã	Õ					ç		ã		´		Ç		
Spain						|			₧				¬			ñ								Ñ						¨								
Spanish-Speaking						|							¬			ñ								Ñ						¨								
United Kingdom						|							¬											£						‾								

For World Trade countries, substitute the character shown opposite the country for that shown for the International character set; where no difference is shown, the printable characters are the same as those shown for the International character set.

Figure B-1. EBCDIC Printable Characters (Part 4 of 4)

48 – Character Set, U.S. and Canada, ASCII:
#$ % & ' * + , - . / 0123456789 @ ABCDEFGHIJKLMNOPQRSTUVWXYZ

64 – Character Set, U.S. and Canada, ASCII:
! " #$ % & ' ( ) * + , - . / 0123456789 : ; < = > ? @
ABCDEFGHIJKLMNOPQRSTUVWXYZ [\ ] ^ _ `

94 – Character Set*, U.S. and Canada, ASCII:
! " #$ % & ' ( ) * + , - . / 0123456789 : ; < = > ? @
ABCDEFGHIJKLMNOPQRSTUVWXYZ [\ ] ^ _ `
abcdefghijklmnopqrstuvwxyz { ¦ } ~

Figure B-2. ASCII Printable Characters

	HEX	CHARACTER
	40	SP
	41	。
	42	「
	43	」
	44	、
	45	・
	46	ヲ
*	47	ァ
*	48	ィ
*	49	ゥ
	4A	£
	4B	.
	4C	<
	4D	(
	4E	+
	4F	|
	50	&
*	51	ェ
*	52	ォ
*	53	ャ
*	54	ュ
*	55	ョ
*	56	ッ
†	58	—
	5A	!
	5B	¥
	5C	*
	5D	)
	5E	;
	5F	¬
†	60	-
	61	/
	6B	,
	6C	%
	6D	_
	6E	>
	6F	?
	7A	:
	7B	#
	7C	@
	7D	'
	7E	=
††	7F	"

	HEX	CHARACTER
	81	ア
	82	イ
	83	ウ
	84	エ
	85	オ
	86	カ
	87	キ
	88	ク
	89	ケ
	8A	コ
	8C	サ
	8D	シ
	8E	ス
	8F	セ
	90	ソ
	91	タ
	92	チ
	93	ツ
	94	テ
	95	ト
	96	ナ
	97	ニ
	98	ヌ
	99	ネ
	9A	ノ
	9D	ハ
	9E	ヒ
	9F	フ
*	A1	—
	A2	ヘ
	A3	ホ
	A4	マ
	A5	ミ
	A6	ム
	A7	メ
	A8	モ
	A9	ヤ
	AA	ユ
	AC	ヨ
	AD	ラ
	AE	リ
	AF	ル

	HEX	CHARACTER
	BA	レ
	BB	ロ
	BC	ワ
	BD	ン
††	BE	゛
	BF	゜
	C1	A
	C2	B
	C3	C
	C4	D
	C5	E
	C6	F
	C7	G
	C8	H
	C9	I
	D1	J
	D2	K
	D3	L
	D4	M
	D5	N
	D6	O
	D7	P
	D8	Q
	D9	R
	E0	$
	E2	S
	E3	T
	E4	U
	E5	V
	E6	W
	E7	X
	E8	Y
	E9	Z
	F0	0
	F1	1
	F2	2
	F3	3
	F4	4
	F5	5
	F6	6
	F7	7
	F8	8
	F9	9

*These characters are not displayed by the Console Display feature on the 3777 Model 2.
†The 3777-2 displays X'58' and X'60' as the same character.
††The 3777-2 displays X'7F' and X'BE' as the same character.

Figure B-3. Katakana Character Set

IDR READ	CHAR	EBCDIC XMIT HEX	ASCII XMIT HEX	BSC	SNA
0000	0	F0	30		
0001	1	F1	31		
0010	2	F2	32		
0011	3	F3	33		
0100	4	F4	34		
0101	5	F5	35		
0110	6	F6	36		
0111	7	F7	37		
1000	8	F8	38		
1001	9	F9	39		
1010		7A	3A	OID	OID Start Station
1011	%	6C	25	SOR	
1100	@	7C	40		
1101	¬ EBCDIC ∧ ASCII	5F	5E		FS
1110	=	7E	3D		
1111	?	6F	3F	EOC	

Format of magnetically recorded data:

Operator ID Card (Note 3)

SOR	OID	Up to 15 characters (excluding EOC)	EOC	LRC

Credit Card

SOR	Up to 37 characters (excluding EOC)	EOC	LRC

BSC format of data in buffer:

Operator ID Card

ESC	F4	OID	Up to 15 characters (excluding EOC)	EOC	IRS

Credit Card

ESC	F4	Up to 37 characters (excluding EOC)	EOC	IRS

SNA format of data in buffer:

Operator ID Card

04	50	Up to 15 characters (excluding EOC)	IRS

Credit Card

Up to 37 characters of badge data only (excluding EOC)

Notes:

1. A VRC bit is included in IDR read data. This bit is checked by the 3770 but is not included in the transmitted character. The bit is not shown above.
2. The LRC character is checked by the 3770. The LRC character contains a one bit in each bit position for which an even number of one bits occur in the recorded data.
3. The 3777-2 transmits this data as it appears on the badge (preceded by control bytes the same as from a SYS REQ).

Figure B-4. Operator Identification Card Reader Character Set

64-Character Set Hex	4A	4B	4C	4D	4E	4F	50	5A	5B	5C	5D	5E	5F	60	61	6B	6C	6D	6E	6F	79*	7A	7B	7C	7D*	7E	7F	C1-D9	E0	E2-E9	F0-F9
U.S. and Canada	¢	.	<	(	+	|	&	!	$	*	)	;	¬	-	/	,	%	_	>	?	`	:	#	@	'	=	"	A-R	\	S-Z	0-9
International	[	.	<	(	+	!	&	]	$	*	)	;	^	-	/	,	%	_	>	?	`	:	#	@	'	=	"	A-R	\	S-Z	0-9
Austria/Germany	#							$	Ü				¬										Ä	Ö					X		
Belgium																								X					Ç		
Brazil	É							$	Ç												X		Õ	Ã							
Denmark/Norway	#					|		X	Å				¬										Æ	Ø							
Finland/Sweden	X					|		X	Å				¬								X		Ä	Ö					É		
France	X							X															£	X					X		
Italy	X							X													X		£	X					X		
Japan	£					|		!	¥				¬																$		
Portugal			Ç																				Ã	Õ					Ç		
Spain						|			₧				¬										Ñ								
Spanish-Speaking						|							¬										Ñ								
United Kingdom						|							¬										£								

For World Trade countries, substitute the character shown opposite the country for that shown for the International character set.
Where no difference is shown, the displayable characters are the same as those shown for the International character set.
Where a large $\boxed{X}$ is shown, these EBCDIC values are displayed as a blank.

Figure B-5. EBCDIC Character Set for the Console Display Feature on the 3777 Model 2 (1,024-character display)

HEX	CHARACTER
40	SP
41	｡
42	｢
43	｣
44	､
45	･
46	ｦ
4A	£
4B	.
4C	<
4D	(
4E	+
4F	|
50	&
* 58	—
5A	!
5B	¥
5C	*
5D	)
5E	;
5F	¬
* 60	-
61	/
6B	,
6C	%
6D	_
6E	>
6F	?
7A	:
7B	#
7C	@
7D	'
7E	=
** 7F	"

HEX	CHARACTER
81	ｱ
82	ｲ
83	ｳ
84	ｴ
85	ｵ
86	ｶ
87	ｷ
88	ｸ
89	ｹ
8A	ｺ
8C	ｻ
8D	ｼ
8E	ｽ
8F	ｾ
90	ｿ
91	ﾀ
92	ﾁ
93	ﾂ
94	ﾃ
95	ﾄ
96	ﾅ
97	ﾆ
98	ﾇ
99	ﾈ
9A	ﾉ
9D	ﾊ
9E	ﾋ
9F	ﾌ
A2	ﾍ
A3	ﾎ
A4	ﾏ
A5	ﾐ
A6	ﾑ
A7	ﾒ
A8	ﾓ
A9	ﾔ
AA	ﾕ
AC	ﾖ
AD	ﾗ
AE	ﾘ
AF	ﾙ

HEX	CHARACTER
BA	ﾚ
BB	ﾛ
BC	ﾜ
BD	ﾝ
** BE	ﾞ
BF	ﾟ
C1	A
C2	B
C3	C
C4	D
C5	E
C6	F
C7	G
C8	H
C9	I
D1	J
D2	K
D3	L
D4	M
D5	N
D6	O
D7	P
D8	Q
D9	R
E0	$
E2	S
E3	T
E4	U
E5	V
E6	W
E7	X
E8	Y
E9	Z
F0	0
F1	1
F2	2
F3	3
F4	4
F5	5
F6	6
F7	7
F8	8
F9	9

*The 3777-2 displays X'58' (—) and X'60' (-) as the same character ( ).
**The 3777-2 displays X'7F' (") and X'BE' (ﾞ) as the same character (").

Figure B-6. Katakana Character Set for the Console Display Feature on the 3777 Model 2 (1,024-character display)

Appendix C. Card Specifications

2502 Punched Card Specifications

The following corner cuts can be used: C1, C2, C3, or C5.

The following scores are acceptable:

External: M-5, M-7, CF-4, and CF-11 on the high-numbered column end of the card; M-3, M-4, M-5, M-6, M-7, OM-2, OM-3, CF-4, and CF-11 on the column-1 end. Figure C-1 illustrates the positioning requirements for the M-5 and CF-4 scores.

Internal: M-4, M-5, S-1, S-2, ID-1, ID-2, and ID-3.

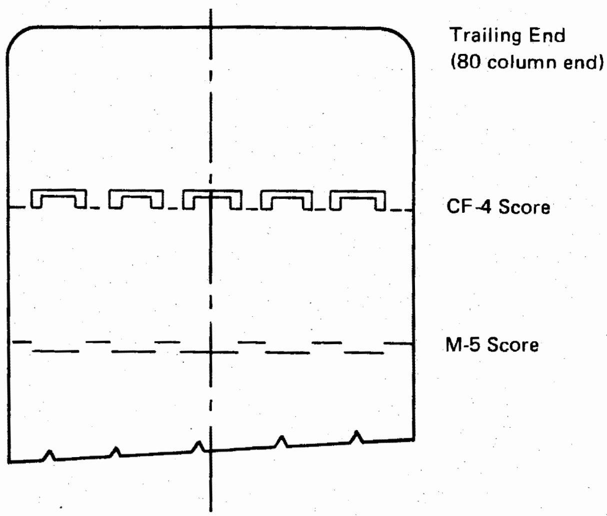


Figure C-1. Positioning of M-5 and CF-4 Scores

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

2502 OMR Card Specifications

Reflectance Measurements

Reflectance measurements specified herein have been measured with a Kidder Press Company, Inc., Model 081 Optical Character Tester, infrared section, with a 0.0125 inch diameter aperture. "Average reflectance" means the average of three readings on this test instrument at three separate locations on the card, mark, or erasure. The tester is calibrated using magnesium oxide as 100 percent.

Card Stock

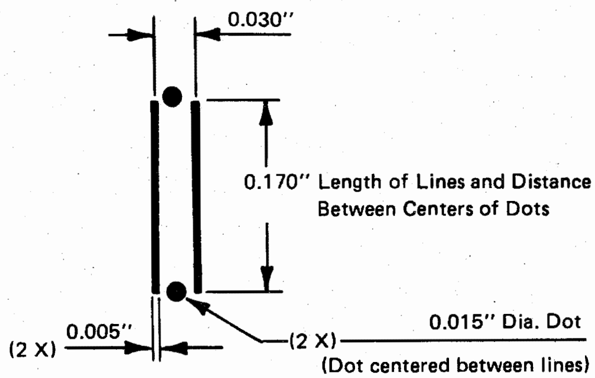
Any card acceptable for use as input to the 2502 can be used for an optical mark document with these provisions:

1. The average reflectance of the card stock must be between a minimum of 80 percent and a maximum of 90 percent.
2. Blemishes and printing in the marking field of the card must reflect at least 85 percent of the average reflectance of that particular card. Thus, a card whose average reflectance is 90 percent may not have a blemish or printed character that indicates less than 0.85 times 90 percent, or 76.5 percent reflectance.
3. White and natural cards are usually satisfactory.

4. Cards with marks in card column 1 must have square or C-5 corner cuts on the leading edge.
5. Only one side of the card may be printed.

Marking Constraints

Figures C-2 and C-3 specify the reflectance, size, and shape of the constraints.



NOTE:
Dots and vertical lines must be printed in reflective ink. (Reflectance must not be below 0.85 percent of the average background reflectance as measured by the Kidder Optical Character Tester, Model 81, which is a product of the Kidder Press Co., Inc.)

Figure C-2. Marking Constraint Specifications

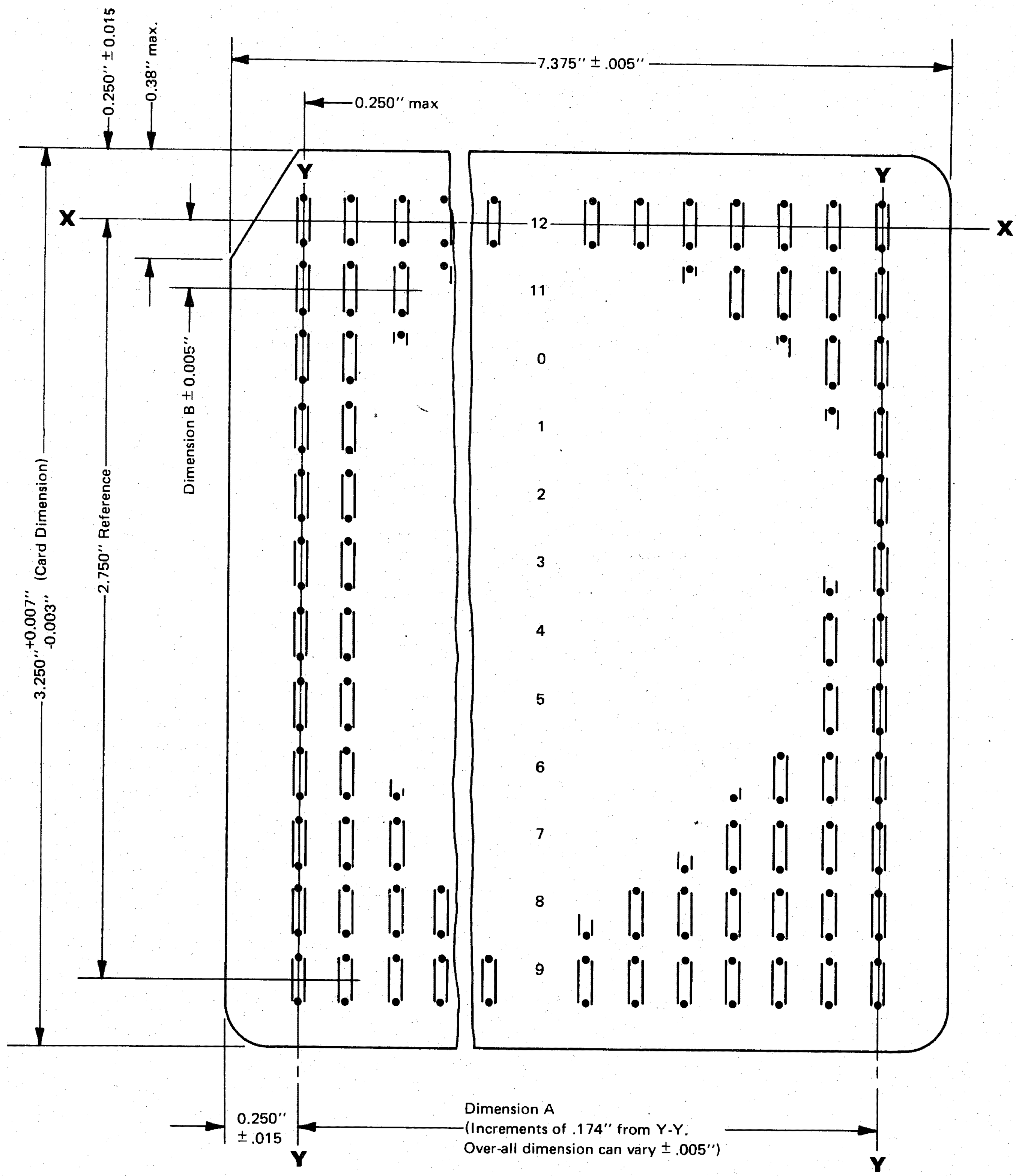
OMR Columns

An OMR column is a vertical arrangement of twelve mark positions. These correspond to the twelve punch positions in a column of a punched card. An OMR column must not contain punching or non-reflective printing or blemishes. The data marks in a column must represent valid codes. OMR columns must be located in odd-numbered columns of the standard card.

OMR Fields

An OMR field consists of one or more OMR columns. These rules apply to OMR fields:

1. No punching may occur either within or to the right of an OMR field to be read by the 2502.
2. At least one blank column must separate the last punch column from the first OMR column (last punch column will contain the IFS character that causes transfer from punch-data to mark-data reading).



Legend:

Y-Y = centerline through card column 1 and 80 on standard tabulating card.
X-X = centerline through row 12 on standard tabulating card.
Dimension A = distance between horizontal center of marking position or punch position and line Y-Y.
Dimension B = distance between vertical center of marking position or punch position and line X-X. This dimension increases in increments of 0.250" (distance from center of marking positions).
[•] = outline of marking position.

NOTE:
Information not to be read by the 2502 and mark constraints must be printed in reflective ink.

Figure C-3. OMR Input Card Specifications

3501 Card Specifications

The 3501 Card Reader can accept cards with the following corner cuts:

- C5 (round) on any corner
- C1, C2, or C3 on upper left or upper right corner

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

Internal scores are not permitted. The following external scores are permissible:

- M-3, M-4, or M-5 on column 1 end
- M-7 on column-80 end
- CF-11 on any edge

3521 Card Specifications

The 3521 Card Punch can accept cards with the following corner cuts:

- C1, C2, C3, or C5 (round) on any corner

Edge-coated and heavy duty cards can be used.

Cards with the following internal scores can be punched on the 3521 if the Card Read feature is not installed or is disabled:

- M-4, M-5, OM-2, OM-3, ID-1, ID-2, ID-3, and S-1

The following external scores are permitted:

- M-4 or M-6 on the column-80 end

Appendix D. Throughput

Throughput Controlling Factors

The factors controlling throughput in the 3770 are: (1) the transmission time required for a block of records (line-dependent throughput); and (2) the cycle time of the individual input/output device (device-dependent throughput). The total transmission time for a block of records includes the transmission time required to send the control and data characters of the block, the time required by the Data Communication Equipment (DCE) for turning the line around for the acknowledgment response, the transmission time for that response, and another turnaround delay before the next block of data can be transmitted.

Naturally, throughput is limited by the slowest I/O device involved with the job. Factors that affect individual-device rated speeds as stated in this manual for any device are: tolerances on power; mechanical adjustments; operating temperatures; component tolerances; and service time induced by the controller. In some cases, data patterns may affect throughput. Tolerances on the rated speeds of an individual device should not exceed 10%.

For programmable 3770 terminal models, rated device speeds shown in this appendix are applicable when operating with an associated system utility function, and with user-written 3770 programs in which processing does not interfere with device speed. Device speed will, of course, be decreased during 3770 program execution if the program issues I/O instructions at a rate slower than the device can perform.

The following paragraphs show the device speeds and the limiting factor (input device, output device, or line) for each 3770 job.

Note: Abbreviations used in the following paragraphs and tables include:

bpm	buffers per minute
bps	bits per second
char/line or *cpl*	characters per line
cps	characters per second
cpm	cards per minute
lpm	lines per minute
R/M	records per minute

3771, 3773, 3774 **Console Printer**

The console serial wire-matrix printer is rated for the speeds listed while printing on a line. In line mode, the bidirectional printer can print right to left as well as left to right (that is, can alternate direction as lines are indexed).

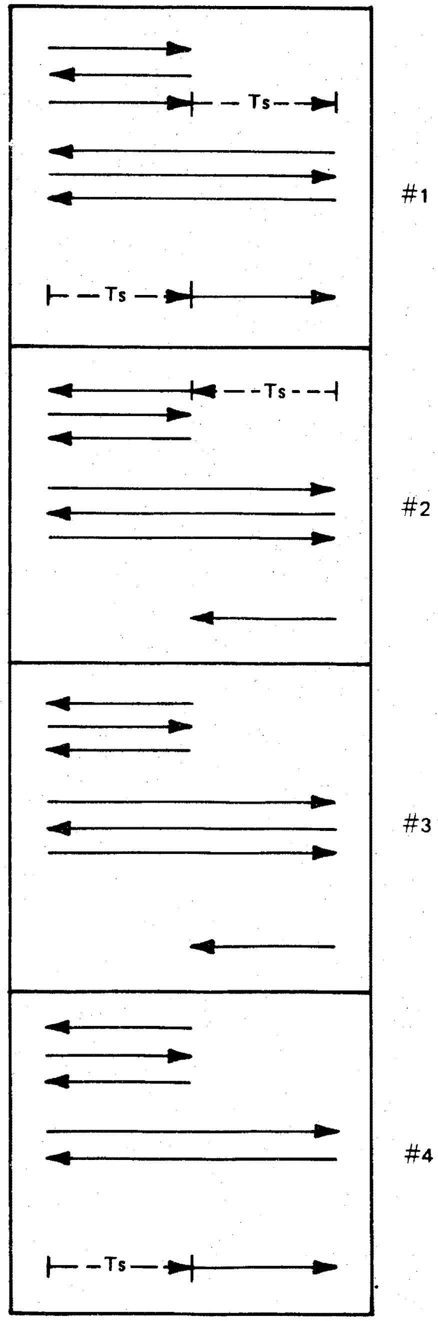
	*Lines per Minute (lpm)***		
Model	*40 cpl*	*70 cpl*	*132 cpl*
40 cps* Bi-Directional	53	32	17
80 cps* Bi-Directional	94	59	33
120 cps* Bi-Directional	125	82	46

*40 cps is the *average* print speed attained on the 40 cps printer. 80 or 120 cps is the *maximum* print speed attained on the 80 or 120 cps printer. For a shorter line, or a line containing more than 10 contiguous spaces, print speed may be other than 40 or 80 cps, as described in the following paragraphs.

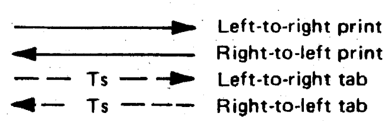
**Based upon packed lines (no multiple spaces or tabs) and single spacing vertically (no multiple skips).

The throughput for forms using multiple line feeds, and multiple tabs and spaces within lines, can be estimated. To do this estimate, however, requires an understanding of the print-carrier motion, as illustrated and discussed in the following example.

Example:



After a line is printed, the print carrier will move horizontally (either left to right or right to left) from the last printed character on the current line to the nearest "end character" on the next line. (The "end character" is the left-most or right-most character to be printed on the line.) From the accompanying sketch, it can be seen that the carrier motion may be in either the same or the opposite direction that it was traveling to print the preceding line. It can also be seen that, for a given line on a form, printing may not always occur in the same direction. Printing as shown in the sketch would be optimized on form #3 and all forms thereafter, unless a variable number of lines is introduced as shown on form #4, thereby introducing an additional delay (Ts). Therefore, when selecting a sample form for calculating the throughput, you should include in your summation the maximum number of carrier motions that could occur (worst case—form #1 in this example), so that the throughput will not be overly optimistic.



The throughput in lines per minute (lpm) for a particular form involving multiple tabs and spaces within a line, and/or multiple and variable line feeds, can be estimated within 10% as follows:

$$\text{lpm} = (\text{total number of printed lines}) \, [(60 \times 10^3)/T]$$

To find T (the total printing time in milliseconds for a single form), a sum of the times (in milliseconds) required to perform the following operations must be made:

- Character print time
- Time required for horizontal tabbing or spacing
- Time required for line spacing
- Time required for overprinting or underlining, if used

The time required to perform these operations is variable, depending on the printer speed (40, 80, or 120 cps), the number of characters tabbed or spaced over, the number of line spaces between lines, and the method used for overprinting or underscoring (underlining). Each of these operations having a different characteristic (such as a different number of character positions tabbed over) must be considered independently and summarized, necessitating multiple entries for Ts, Tl, and To in the following equation:

$$T = Tc + Ts + Tl + To$$

where:
- T = Total print time for a single form
- Tc = Total character print time
- Ts = Total time required for spacing or tabbing
- Tl = Total time required for line feeding (line spacing)
- To = Total time required for overprinting or underlining

The following paragraphs define these times required to perform the various operations.

Tc (Total Character Print Time)

40 cps printer:	25ms × number of characters
80 cps printer:	12.5ms × number of characters
120 cps printer:	8.33ms × number of characters

See the definition for "To" for underlined or overprinted characters (lines or words) or for programmable 3770 terminals when user-programming considerations force the data to be printed in other than normal sequence.

Ts (Total Time Required for Spacing or Tabbing)*

For 40 or 80 cps printers:

9 or less spaces:	12.5ms × (number of spaces)
10 or more spaces:	8.33ms × [(number of spaces) - 5] + 63.8

For 120 cps printer:

8.33 ms × number of characters

Each incident involving a different number of spaces will require separate consideration.

Note: If the Ts (for 40, 80, and 120 cps printers) required to go to the next print line is in the direction of the last printed character (for instance; see Example 1, line 3), add per print line the following time to Ts:

1 space:	0ms
2 spaces:	80ms
3 spaces:	110ms
4 spaces:	160ms
5 or more spaces:	0ms

Tl (Total Time Required for Line Feeding)*

1 line:	136ms
2 lines:	161ms
3 lines:	236ms
4 or more lines:	236ms + [25 × (number of lines in excess of 3)]

*After a vertical line feed, the print head may require repositioning to begin printing at the proper position (see "Example"). This is a tab operation, and also requires an entry into the summation.

Each incident involving a different number of line feeds will require separate consideration. The time required to skip to the first line of the next form must also be included. The times shown for multiple line feeds apply only to those caused by a vertical tab (VT), form feed (FF), or ESC sequence: they do not apply if multiple contiguous NL characters are used to cause multiple line feeds. In this case, each line feed requires 136ms.

To (Total Time Required for Underlining or Overprinting)

Underlining (or overprinting) can be done either by an entire line or by a word or a field.

Underline or Overprint a Line: The entire line can be printed, line feed suppressed, and the line underlined or overprinted. In this case, the additional time required to underline or overprint the *line* must be summarized (Tc + Ts); and 205ms added for the suppress-line-feed operation; or:

To = Tc + Ts + 205ms.

Notes: TS includes the spacing within the line as well as the carrier return spacing. If the total number of printed characters, underlined characters, and overprinted characters exceeds 132, add an additional 205ms to the "To" calculated from the formula.

Underline or Overprint a Word: A single word can be underlined (or overprinted) by printing the word, backspacing the same number of characters as contained in the word, and underscoring (or overprinting) the word. Backspacing occurs at the same speed as a tab or multiple space (see "Ts"). For an underlined word, using the values for Tc and Ts previously described, the time required to backspace and underline the word can be calculated by using:

To = Tc + Ts + 205ms

Programmable 3770 Terminals: When the user-written program directs the printer to move in a sequence other than discussed above, the following formula must be used to account for this additional movement of the print head. For each suppress-line-feed operation (a change in the direction of print head movement without a line feed), 205 ms must be added.

To = TS + 205ms

3775 and 3776 Console Printers, 3784 Line Printer

The belt printers are rated for speeds up to a certain lpm (lines per minute). These speeds are determined for a nominal situation; that is, two passes of the character set (on the print character belt) over the print line for the 3775 or 3784 or one pass for the 3776. One vertical line movement (carriage return and index) at the end of each print line is assumed. Selective text patterns may degrade these maximum rated speeds. Also, there are cases (short print line, data dependencies) that can cause printing above the rated speed.

3775, 3776, and 3784 Line Skip and Line Space Speeds

Line Space - 0.034 seconds per line
Line Skip - 6LPI - 0.014 seconds per line
8LPI - 0.0104 seconds per line

3775, 3776, and 3784 Line Printer Speeds

The following printer speeds are maximum lines per minute (lpm).

Lines per Minute (lpm) for character set size:

	*127 **	*94*	*64*	*48*
3775	40	80	120	
3776 Model 1	80	160	230	300
3776 Model 2	160	230	300	400
3784	40	80	120	155

	127*	107*	120*	63+	60	52	48
3777 Model 1**	530	717	530	843	870	951	1000

*Katakana only

+ASCII

**Refer to the 3203 Printer Model 3 description in Chapter 6.

Card Input/Output

	Rated Speed
Reader:	
2502 A1	150 cpm
2502 A2	300 cpm
2502 A3	400 cpm
3501	50 cpm
3521—with Read feature	50 cpm
Punch:	
3521	50 cpm
3521—with Card Print feature	50 cpm
3521—with Katakana Card Print feature	25 cpm

Diskette

Diskette rotational speed is about 360 rpm, and track-to-track head seek time is approximately 54 ms per track.

Communication Line Throughput

This section and subsequent sections that address communication line performance are valid for both BSC and SDLC machines unless specifically stated otherwise.

Use the following formula to calculate the throughput rate in records-per-minute for unique job and configuration combinations, or when turnaround times other than those specified in the figures in this appendix are used.

If the result of the calculation indicates that the throughput is less than the maximum throughput rate of the particular input/output device(s), the throughput is considered to be line-dependent. However, if the calculation results in a throughput rate greater than the physical limitations of the particular input/output device(s), the limitations imposed by the device(s) must be used (device-dependent throughput).

BSC

$$R[N(C) + (5+S)] + TA + R(3+S) = \text{Block Time (ms)}^*$$

SDLC Receiving

$$R[N(C) + 2P + F + 36] + TA + D\,[(R)\,(12+2P) + TA] = \text{Block Time (ms)}^*$$

SDLC Transmitting

$$R[N(C) + F + 21 + 2P] + TA = \text{Block Time (ms)}^*$$

F = Number of extra flag characters sent:

Where:
- R = Character rate in ms/character (see Figure D-1);
- N = Number of records (cards, for example) per block;
- C = Number of data plus device-control characters/record;
- TA = Turnaround delay (sum of transmit plus receive in ms—see Figure D-1);
- S = Number of leading synchronization characters (pad, sync) required: (5 for 3770 terminals).
- F = Number of extra flag characters sent:
  - 0 for 3777
  - 3 for non 3777
- P = Number of Pad characters required:
  - 3 for business machine clocking
  - 1 for no business machine clocking
- D = Delay factor:
  - 1 for 3777 at 9800 bps and other models at 2400 bps and 4800 bps
  - 0 otherwise

*Does not include CPU processing time or line propagation time.

To convert block time in milliseconds to records per minute (R/M—for example: cards per minute or lines per minute), use the following formula:

$$R/M = \frac{60{,}000N}{\text{Block Time (ms)}}$$

Where N = number of records per block

Figure D-1 shows representative modem turnaround times selectable by modem strapping but is not all-inclusive. Modem strapping depends on various factors (such as type of line—two-wire or four-wire, communication facility characteristics, etc.) as explained in the literature (User's Guide) for the particular modem.

Line Rate (bps)	ms/char	Turnaround Time in ms* Half Duplex	Duplex Multipoint	Duplex Point-to-Point	Common Carrier Type of Communications Service
600	13.33	180 or 500	80 or 200	0	Switched Telephone Network or Leased, Half-Duplex or Duplex,** Private-Line Data Channel
1200	6.67	180 or 500	80 or 200	0	Switched Telephone Network or Leased, Half-Duplex or Duplex,** Private-Line Data Channel
2000	4.00	400	8.75 or 200	0	Switched Telephone Network or Leased, Half-Duplex or Duplex,** Private-Line Data Channel
2400	3.33	150 or 400	8.75, 25, or 200	0	Switched Telephone Network or Leased, Half-Duplex or Duplex,** Private-Line Data Channel
4800	1.67	300	35	0	Switched Telephone Network or Leased, Half-Duplex or Duplex,** Private-Line Data Channel
7200	1.11	---	100	0	Leased or Private Line
9600	0.833	---	150-200	0	Leased or Private Line

*The turnaround time shown does not include the internal delay of the modem, communication channel propagation delay, or internal delay of the terminal or CPU. Consult the literature for the particular modem used.

**The communication channel may be duplex; the 3770 operation is half-duplex.

Figure D-1. Character Rates and Representative Turnaround Delays

For Space Compression/Expansion, use the following for the number of characters per card:

The number of punched columns plus single blank columns;

plus

2 control characters for each group of from 2 to 63 consecutive blank columns (plus 2 more control characters for a group of over 64 blank columns).

System Performance

Single Input, Single Output

3771

	Output						
	40 cps Serial Printer	*80 cps Serial Printer*	*120 cps Serial Printer*	*3521*	*Line Speed in bps* 1200*	*2400*	*4800*
Input							
3501**	RO	RIO	RI	RIO	RI	RI	RI
3521	RO	RI	RI	---	RI	RI	RI
4800 bps	RO	RO	RO	RO			
2400 bps	RO	RO	RO	RO			
1200 bps	RO	RO	RO	RO			

RO = Performance limited by output device.
RI = Performance limited by input device.
RIO = Performance limited by either input or output device.
L = Performance limited by line.

*All line throughput ratings have been stated with no turnaround delay (unless otherwise indicated). The line limitations are based upon two print lines per full 256-byte buffer. As the number of print lines per buffer increases, or with shorter lines or data compression, the line-limiting effect is decreased.

**Due to physical design, if the 3501 is not serviced in time, the reader will miss a complete feed cycle (it must complete that cycle before the next one can start). Thus, in some cases, the rated performance of the 3501 may be affected by up to 25%. 3501 to console serial printer jobs run at the rated speed as long as the print-line size is such that the printer lines-per-minute (lpm) exceeds the 3501 cpm.

3773

	Output				
	40,80,or 120 cps Serial Printer	*Diskette*	*Line Speed in bps* 1200	*2400*	*4800*
Input					
Diskette*	RO	---	(See "Diskette Performance" in this Appendix.)		
Line					
4800 bps	RO	(See "Diskette Performance")			
2400 bps	RO				
1200 bps	RO				

RO = Performance limited by output device.

*Diskette-to-printer throughput is based on two lines per 256-byte buffer.

3774, 3775, 3784 Attached to 3774

	Output											
	3784 Line Printer Char Set:			*3775, 3775P Line Printer Char Set:*		*80-cps Serial*	*120-cps Serial*			*Line Speed in bps**		
	*48***	*64*	*94*	*64*	*94*	*Printer*	*Printer*	*3521*	*Diskette‡‡*	*1200*	*2400*	*4800*
Input												
2502 A1	RIO	RO	RO	RO	RO	RO	RO	RO	RI‡‡‡	L	RI	RI
2502 A2	RO	RO	RO	RO	RO	RO	RO	RO	RI‡‡‡	L	L	RI
3501***	RI	RI	RI	RI	RI	RIO	RI	RIO	RI	RI	RI	RI
3521	RI	RI	RI	RI	RI	RI	RI	---	RI	RI	RI	RI
Diskette‡	RO	RO	RO	RO	RO	RO	RO	RO	---	(See "Diskette Performance")		
Line‡‡												
4800 bps	RO	RO	RO	(See		RO	RO	RO	(See "Diskette Performance")			
2400 bps	L	L	RO	Figure		RO	RO	RO				
1200 bps	L	L	L	D-1.1)		RO	RO	RO				

RO = Performance limited by output device.
RI = Performance limited by input device.
RIO = Performance limited by either input or output device.
L = Performance limited by line.

*All line throughput ratings have been stated with no turnaround delay (unless otherwise indicated). The line limitations are based upon two print lines per full 256-byte buffer. As the number of print lines per buffer increases, or with shorter lines or data compression, the line-limiting effect is decreased.

**Available only on 3784 Line Printer

***Due to physical design, if the 3501 is not serviced in time, the reader will miss a complete feed cycle (it must complete that cycle before the next one can start). Thus in some cases the rated performance of the 3501 may be affected by up to 10%. The 3501-to-console serial printer jobs run at the rated speed as long as the print-line size is such that the printer lines-per-minute (lpm) exceeds the 3501 cpm.

‡Diskette-to-printer throughput is based on two lines per 256-byte buffer.

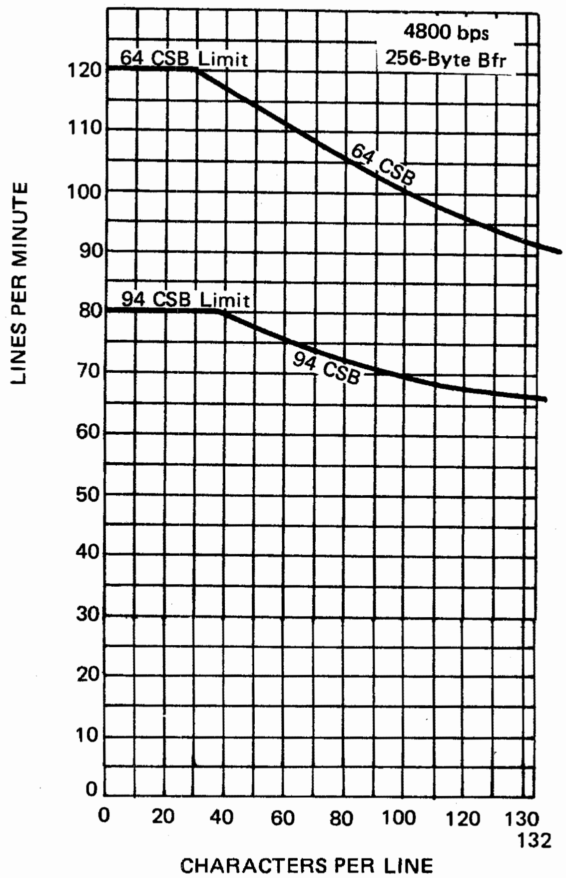
‡‡When transmitting ETX buffers line to diskette, the diskette data set will be closed on each ETX received. Closing a data set requires an access to track 0 which affects throughput depending on the number of tracks crossed.

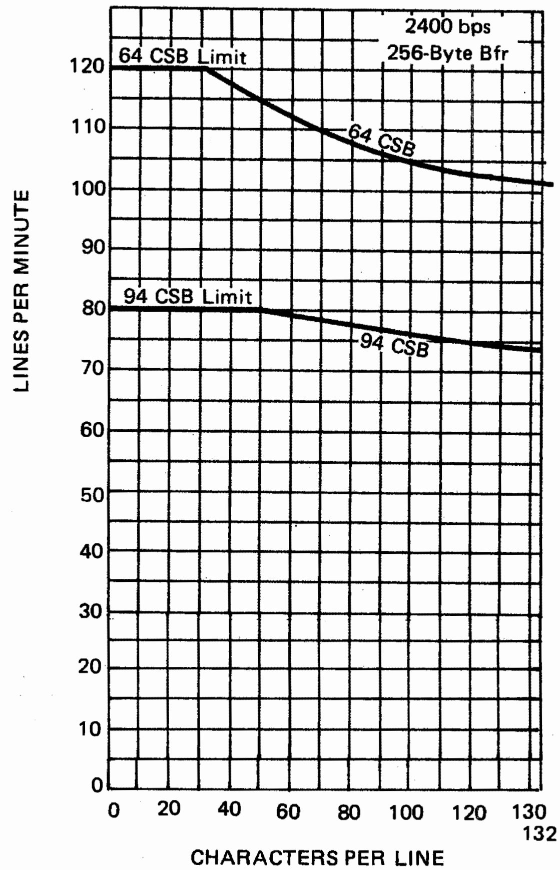
‡‡‡RIO for 3774P/3775P. The diskette output limits using the Card Reader-to-Diskette utility 2502 A2 are:

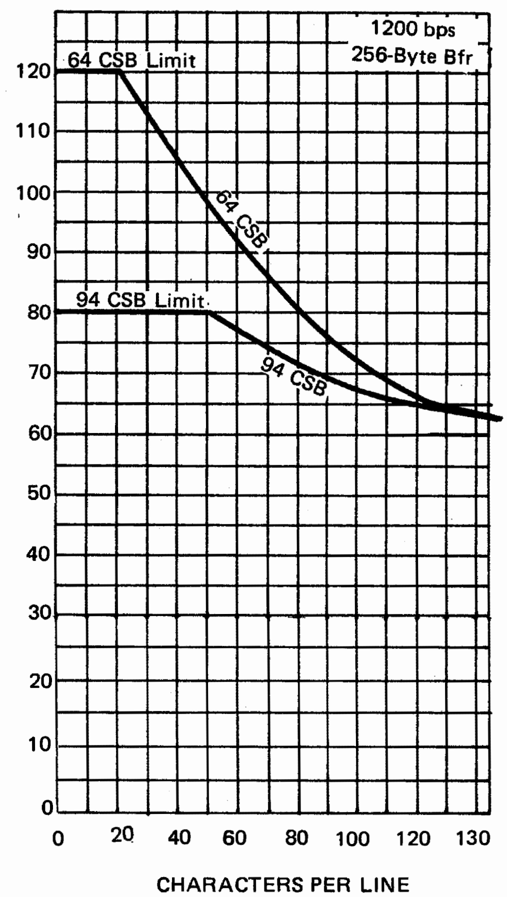
Exchange Format Diskettes	*Output Speed*
Blocksize = 256	216 cpm
= 1 to 80	121 cpm

3770 Nonexchange Diskettes	*Output Speed*
Blocksize = 256	300 cpm
= 1 to 80	160 cpm

Figures D-8 through D-11 show nominal throughput of the 2502 models at communication line speeds of 1200, 2000, 2400 and 4800 bps.







-bps = Bits Per Second
-CSB = Character Set Belt

ASSUMPTIONS:

Curves shown are based on the following assumptions:

1. Perfect transmission—no errors
2. Zero modem turnaround delay
3. Poll rate for SDLC:
   4800 bps — 1 poll per 0.7 second
   2400 bps — 1 poll per 0.07 second
   1200 bps — 1 poll per 0.14 second
4. "Characters Per Line" includes any compression and any printer forms handling characters (except line feed characters) sent on the communication facility.
5. A full buffer (256 bytes) is always received (with partial print line depending on line length).

Figure D-1.1 3775 Models 1 and P1 Line-to-Printer Throughput (BSC and SDLC)

	Output								
	3203 Line Printer Character Set:					*Line Speed in bps*		
	48	*52*	*63*	*127**	*Diskette*	*4800*	*7200*	*9600*
Input								
2502 A1	RI	RI	RI	RI	RI	RI	RI	RI
2502 A2	RI	RI	RI	RIO	RI	RI	RI	RI
2502 A3	RI	RI	RI	RIO	RI	RI	RI	RI
Diskette	(See Chart below)					(See "Diskette Performance")		

*Katakana print train

RI = Performance limited by input device
RIO = Performance limited by input or output device .

All line throughput ratings are stated with zero turnaround delay. Card input ratings are based on three cards per 256-byte buffer and six cards per 512-byte buffer.

Diskette to Printer - 3770 Nonexchange Diskette (BSC)

Print Line Length	*Print Speed**	*Diskette Speed 256-byte buffer*	*Diskette Speed 512-byte buffer*
40 char	950 lpm	158 bpm	79 bpm
60	895	222	111
80	790	262	131
128	492	262	131

*The lpm values shown are for an AN train. When a train with a speed rating lower than these numbers is used, the print speed will be the lesser of the number shown or the speed rating of the train.

Line to printer, card to line, and diskette performance information is presented in later sections of this appendix.

Single Input, Two Outputs - BSC

Monitor printing...that is, using the printer to maintain a log of data being transferred from the input to the output device...will cause an overall decrease in system performance whenever the print burden impacts either the input or primary output device. Print-line length will affect performance.

Impact on Job Performance--3774 or 3775*

	Output					
	Diskette—Monitor Print			*Line—Monitor Print*		
Input	*3775 64 set*	*3775 94 set*	*80 or 120-cps Serial Printer*	*3775 64 set*	*3775 94 set*	*80 or 120-cps Serial Printer*
2502 A1	50%	65%	70%	45%	60%	65%
2502 A2	60%	75%	80%	75%	80%	85%
3501	None	None	None	None	None	None
3521	None	None	None	None	None	None
Diskette	---	---	---	50–75%	60–80%	50–90%

*Expressed as a decrease in performance (versus the same job not using monitor printing) of up to X% (except for "None" which indicates that monitor printing does not degrade job performance).

Example:

The impact of monitor printing on job performance will vary with both print-line size and line speed. The following tabulation shows the effect of line speed.

- Impact on Job Performance—Diskette to Line/Monitor Print

	1200 bps	*2400 bps*	*4800 bps*
3775, 64-char set	50%	50%	75%
3775, 94-char set	60%	65%	80%
3774, 80-cps Printer	50%	80%	90%

Impact on Job Performance*- 3771

	Output	
	Line—Monitor Print	
Input	*40 cps Serial Printer*	*80 or 120 cps Serial Printer*
3501*	0–50%	None
3521*	0–50%	None

*Expressed as a decrease in performance (versus the same job not using monitor printing) of up to X% (except for none which indicates that monitor printing does not degrade job performance).

Impact on Print Speed*

	Output							
	Diskette—Monitor Print				*Line—Monitor Print*			
Input	*3775 64 set*	*3775 94 set*	*40 or 80cps Serial Printer*	*120cps Serial Printer*	*3775 64 set*	*3775 94 set*	*40 or 80cps Serial Printer*	*120cps Serial Printer*
2502 A1**	R	R	R	R	0–30%	0–20%	R	R
2502 A2**	R	R	R	R	0–30%	0–20%	R	R
3501	60%	30%	R***	35%	60%	30%	R***	35%
3521	60%	30%	R	35%	60%	30%	R	35%
Diskette					15–30%	10–20%	R	

*Expressed as a decrease in performance of up to X% of the rated printer speed (except for "R" which says that the printer will perform at rated speed). Serial printer lines-per-minute throughput is print-line-length dependent. An 80-character print line length is assumed for this table.

**The range of print speed degradation on a 2502-to-line job occurs due to both line length (characters per card) and communication line speed. A worst-case situation would occur with full 80-column cards at 1200 bps.

Example: 2502 A2 to Line (1200 bps), full 80-col cards.

3775/64-char set (rated 120 lpm).
Actual monitor print speed = 120 - 0.30 (120) = 84 lpm.

***Due to physical design, if the 3501 is not serviced in time, the reader will miss a complete feed cycle (it must complete that cycle before the next one can start). Thus, in some cases the rated performance of the 3501 may be affected by up to 25%. The 3501-to-console serial printer jobs run at the rated speed as long as the print line size is such that the printer lines-per-minute (lpm) exceeds the 3501 cpm.

Examples:

The impact on monitor printing speed by the 2502-to-line will vary from no impact up to the percent indicated, depending upon characters per card. The following tabulation shows what a job with mixed-length cards would yield.

- Impact on Print Speed—2502 to Line/Monitor Print (typical)

	1200 bps	*2400 bps*	*4800 bps*
3775, 64-char set	10%	6%	2%
3775, 94-char set	R	R	R

Monitor printing on the diskette-to-line job will decrease rated printing speeds by the factors indicated. The following tabulation shows the effect of line speed for this case.

- Impact on Print Speed—Diskette to Line/Monitor Print (typical)

	1200 bps	*2400 bps*	*4800 bps*
3775, 64-char set	30%	18%	15%
3775, 94-char set	20%	20%	10%

Two Inputs, Two Outputs

3776 Dual Data Path Operation—BSC

Refer to the section on the "Operating Characteristics (3776/3777 Model 1)" in chapter 4 for a discussion of Dual Data Path operation.

The tables below estimate the effects of Dual Data Path operation on terminal performance. The first table shows the printer and card I/O speeds for various combinations of character set (printer), line speed (communications), and line length (printer). The throughput experienced by Job 1 is dependent on the parameters shown in the tables, the buffer size used, and the devices used in the Dual Job. The throughput may be higher than that shown in the tables.

	2400 bps			*4800 bps*		
	127 cpl	*80 cpl*	*40 cpl*	*127 cpl*	*80 cpl*	*40 cpl*
	cpl=characters per line					
LINE to PRINTER - lines per minute (lpm)						
3776-1 Belt Size						
48-char set	110 lpm	170 lpm	270 lpm	210 lpm	260 lpm	270 lpm
64	110	165	230	185	220	230
94	100	160	160	160	160	160
LINE to PRINTER-lpm						
3776-2 Belt Size						
48-char set	120 lpm	180 lpm	370 lpm	210 lpm	330 lpm	370 lpm
64	110	180	300	210	270	300
94	100	180	230	210	230	230
CARD to DISKETTE - cards per minute (cpm)						
3776-1 with 48-char set belt						
2502A1	100 cpm	115 cpm	125 cpm	60 cpm	100 cpm	115 cpm
2502A2	100	150	150	75	130	150
3501	30	35	40	20	30	40
3521	40	40	40	30	40	40
DISKETTE to CARD - cpm						
3521	40 cpm	40 cpm	40 cpm	30 cpm	40 cpm	40 cpm
CARD to DISKETTE - cpm						
3776-2 with 48-char set belt						
2502A1	75 cpm	75 cpm	90 cpm	60 cpm	75 cpm	110 cpm
2502A2	150	150	150	75	100	150
3501	30	35	40	20	25	40
3521	40	40	40	30	30	40
DISKETTE to CARD - cpm						
3521	40 cpm	40 cpm	40 cpm	25 cpm	30 cpm	40 cpm

Job 1 performance may be decreased by more than shown in the preceding chart when running concurrently with a diskette-to-diskette Job 2. The rates given in the table below are for 4800 bps, 0 turnaround delay, 48-character set belt. Printer speed is measured in lines per minute (lpm) and diskette speed in buffers per minute (bpm). The line lengths include the NL (New Line) character. The rates shown in the following chart do not take into account data or space compression, diskette read/write errors that may be resolved by automatic retries, or line errors.

256-byte buffer		*128 cpl*	*64 cpl*	*32 cpl*
3776-1	Job 1	200 lpm	250 lpm	270 lpm
	Job 2	30 bpm	35 bpm	40 bpm
3776-2	Job 1	210 lpm	330 lpm	360 lpm
	Job 2	30 bpm	50 bpm	60 bpm
512-byte buffer				
3776-1	Job 1	210 lpm	260 lpm	270 lpm
	Job 2	15 bpm	30 bpm	35 bpm
3776-2	Job 1	210 lpm	330 lpm	360 lpm
	Job 2	15 bpm	30 bpm	35 bpm

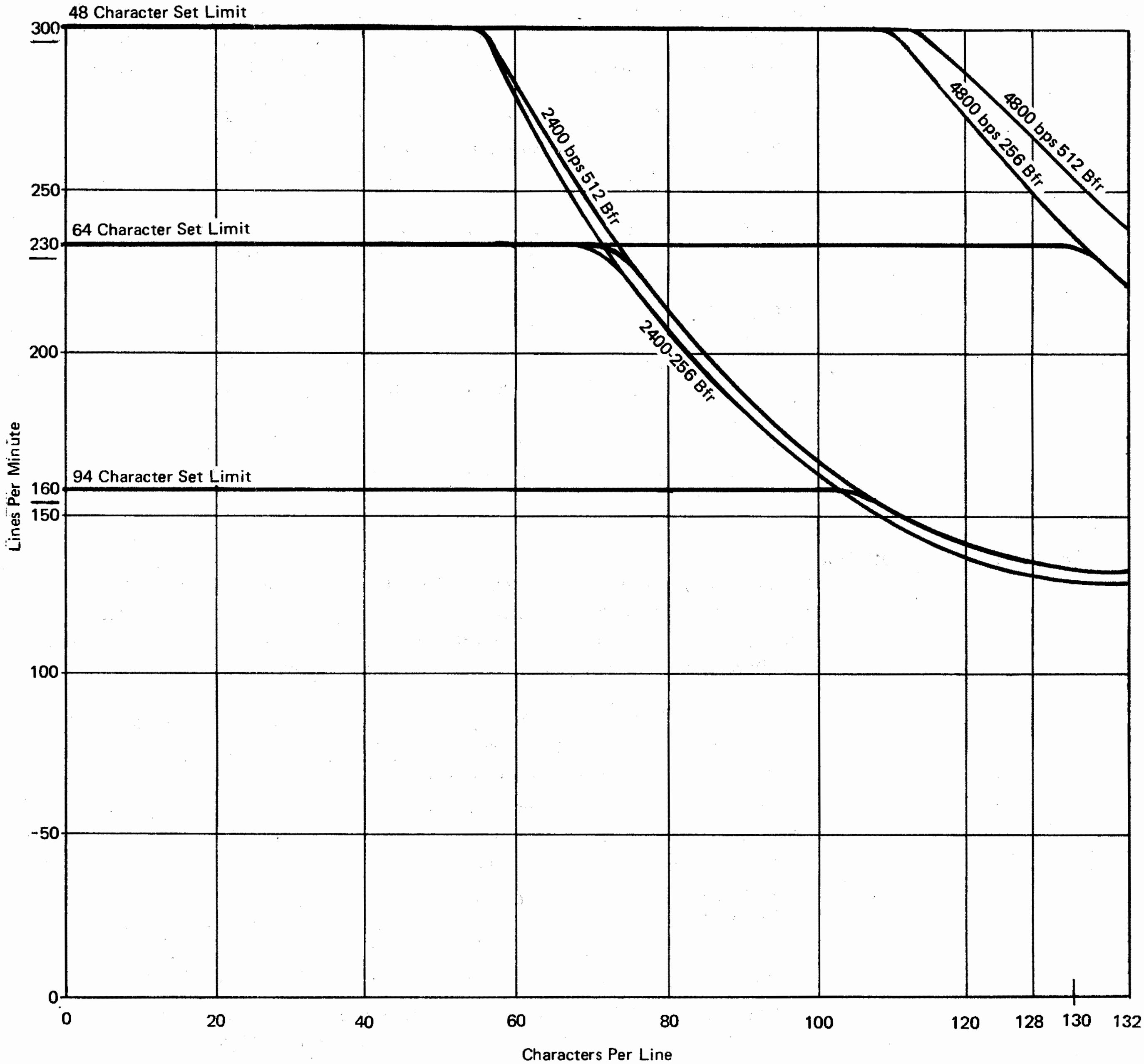
3777 Model 1 Dual Data Path Operation—BSC

The table below estimates the effects of Dual Data Path operation on terminal performance. The throughput experienced by the line-to-printer job depends on the parameters shown in the table, the buffer size used, and the devices used in the Dual Job. The throughput may be higher than that shown in the table.

	4800 bps			9600 bps		
	127 cpl	80 cpl	40 cpl	127 cpl	80 cpl	40 cpl
	cpl = characters per line					
LINE to PRINTER - lines per minute (lpm)						
AN-48 Char-set	250 lpm	400 lpm	755 lpm	475 lpm	765 lpm	1000 lpm
GN-63 Char-set	250	400	710	475	655	760
CARD to DISKETTE - cards per minute (cpm)						
2502 A1	150 cpm	150 cpm	150 cpm	150 cpm	150 cpm	150 cpm
2502 A2	200	200	200	190	200	200
2502 A3	200	200	200	190	200	200
DISKETTE to DISKETTE - buffers per minute (bpm)						
256-byte	70 bpm	70 bpm	70 bpm	70 bpm	70 bpm	70 bpm
512-byte	45	45	45	40	40	45

Device Performance - Online

The following charts estimate online performance for various devices, and indicate the effects of various parameters on performance.

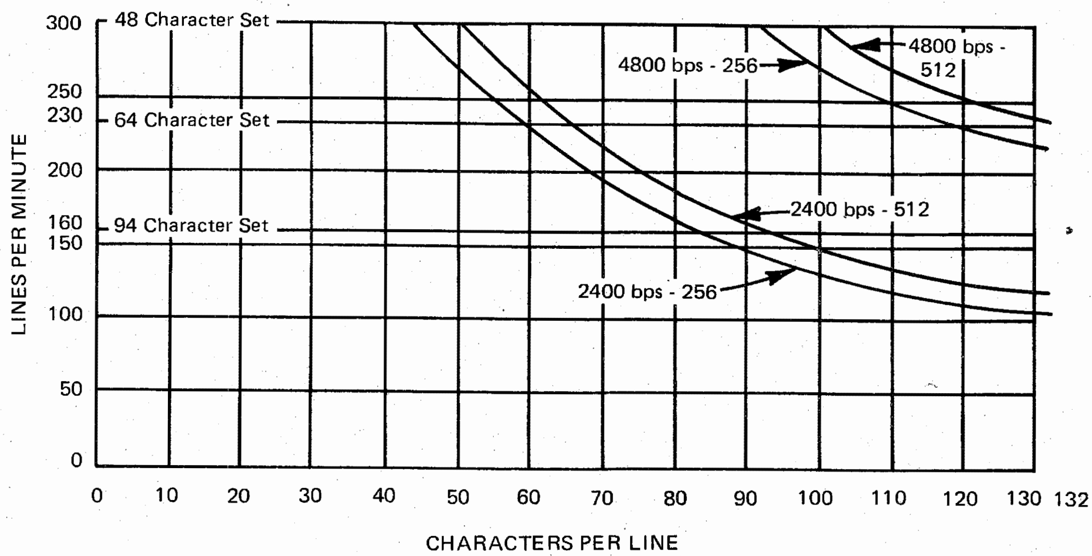


ASSUMPTIONS:

The curves shown are based on the following assumptions:

1. Perfect Transmissions — no CRC errors.
2. Zero modem turnaround delay — four-wire half-duplex communication facility.
3. No propagation delay through the modems or the communication network.
4. Other factors such as host processing delay are not taken into account.
5. "Characters Per Line" includes any compression and any printer forms handling characters (except line feed characters) sent on the communication facility.
6. A full buffer is always received (with partial print line depending on line length).
7. ASCII character sets may exhibit approximately 4% lower performance

Figure D-2. 3776 Model 1 Line-to-Printer Throughput (BSC)

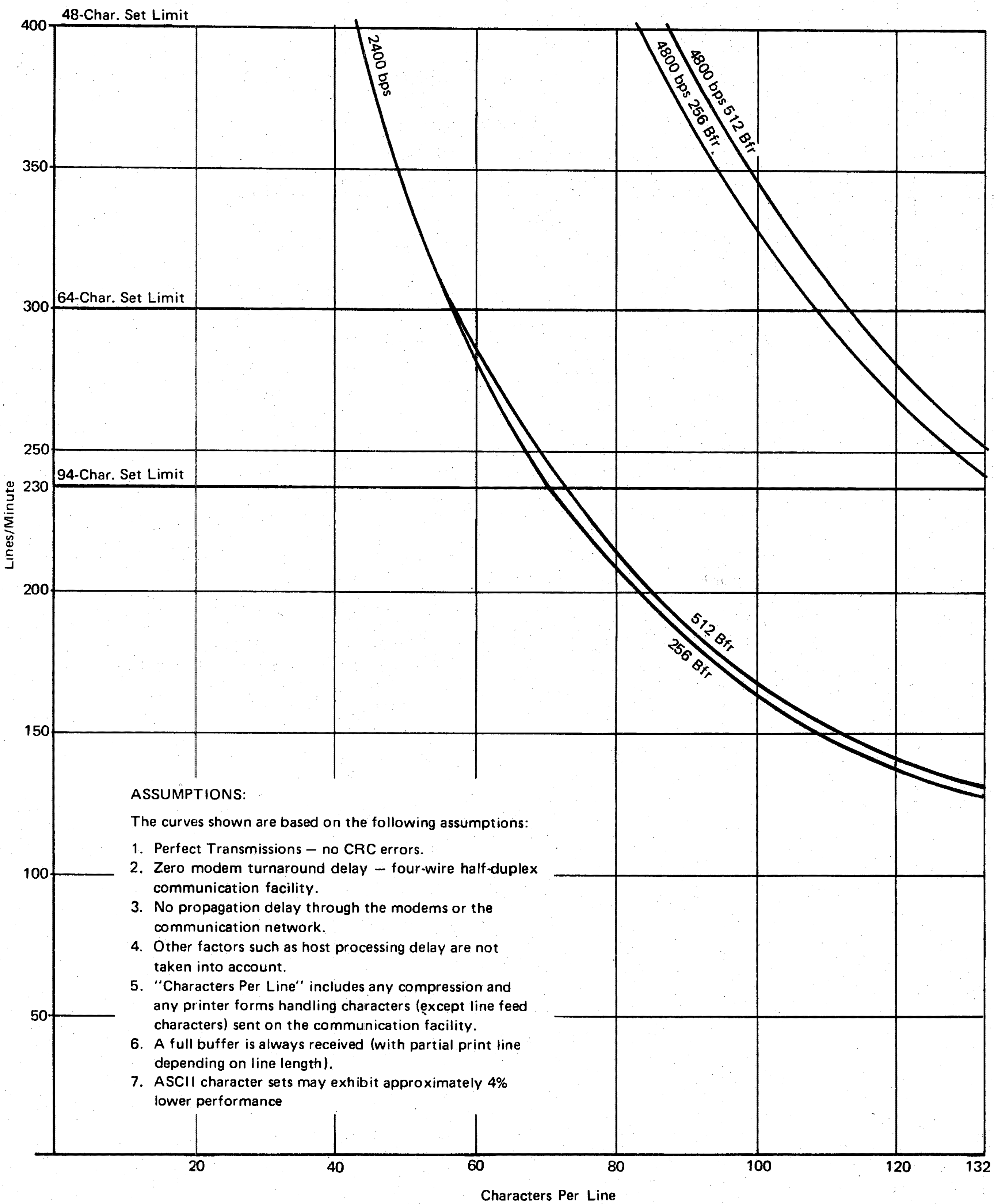


ASSUMPTIONS:

The curves shown are based on the following assumptions:

1. Perfect Transmissions — no CRC errors.
2. Zero modem turnaround delay — four-wire half-duplex communication facility.
3. No propagation delay through the modems or the communication network.
4. Other factors such as host processing delay are not taken into account.
5. "Characters Per Line" includes any compression and any printer forms handling characters (except line feed characters) sent on the communication facility.
6. A full buffer is always received (with partial print line depending on line length).
7. These curves are for EBCDIC only.

Figure D-3. 3776 Model 1 Line-to-Printer Throughput (SDLC)

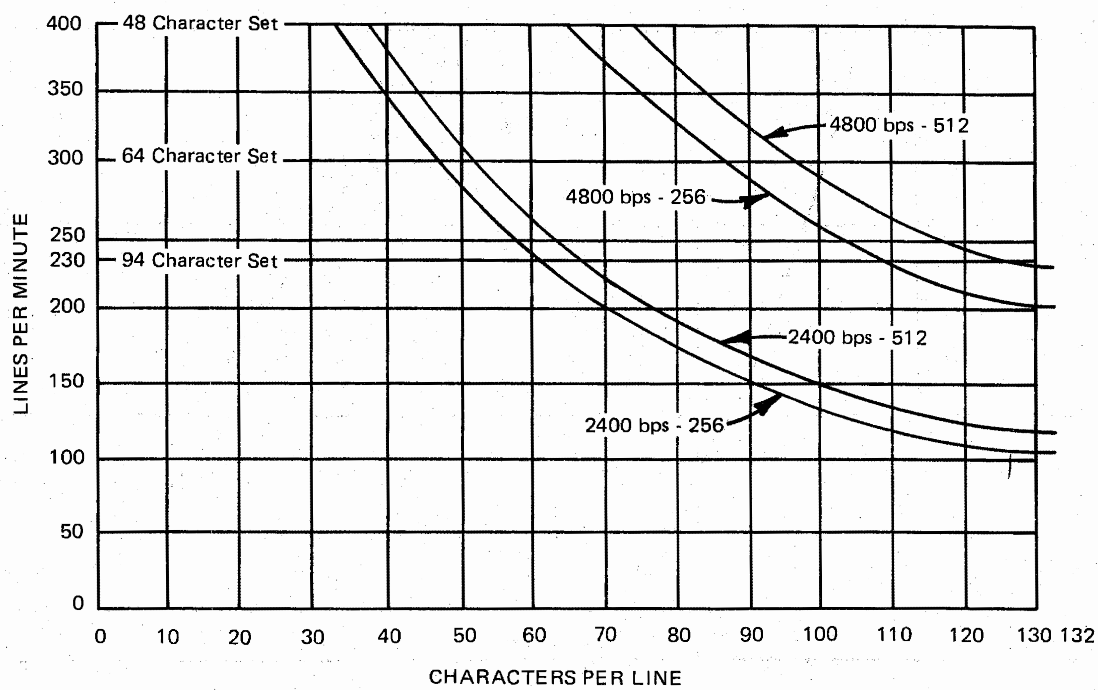


ASSUMPTIONS:

The curves shown are based on the following assumptions:

1. Perfect Transmissions — no CRC errors.
2. Zero modem turnaround delay — four-wire half-duplex communication facility.
3. No propagation delay through the modems or the communication network.
4. Other factors such as host processing delay are not taken into account.
5. "Characters Per Line" includes any compression and any printer forms handling characters (except line feed characters) sent on the communication facility.
6. A full buffer is always received (with partial print line depending on line length).
7. ASCII character sets may exhibit approximately 4% lower performance

Figure D-4. 3776 Model 2 Line-to-Printer Throughput (BSC)

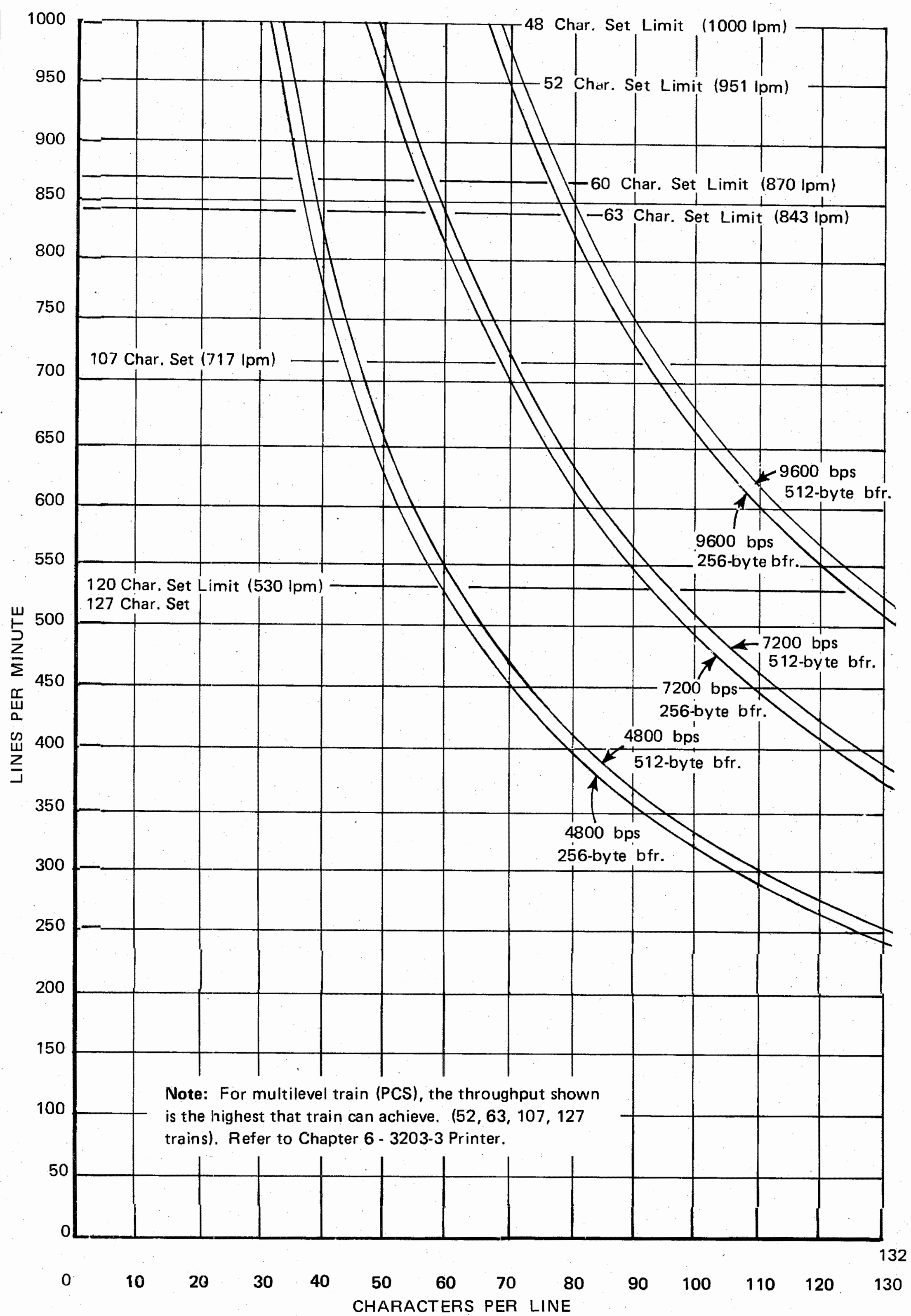


ASSUMPTIONS:

The curves shown are based on the following assumptions:

1. Perfect Transmissions — no CRC errors.
2. Zero modem turnaround delay — four-wire half-duplex communication facility.
3. No propagation delay through the modems or the communication network.
4. Other factors such as host processing delay are not taken into account.
5. "Characters Per Line" includes any compression and any printer forms handling characters (except line feed characters) sent on the communication facility.
6. A full buffer is always received (with partial print line depending on line length).
7. These curves are for EBCDIC only.

Figure D-5. 3776 Model 2 Line-to-Printer Throughput (SDLC)

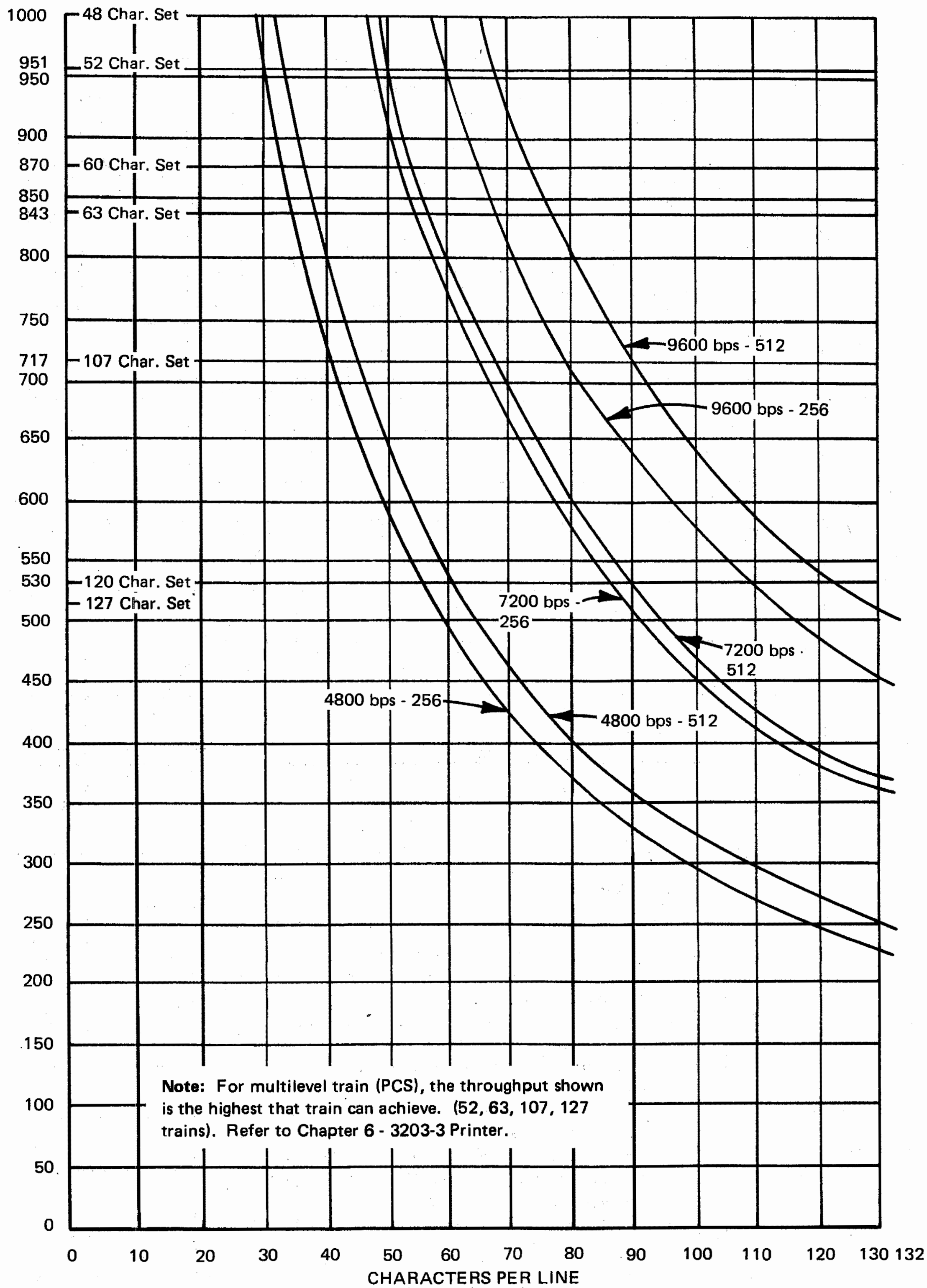


ASSUMPTIONS:

Curves shown are based on the following assumptions:

1. Perfect transmission — no CRC errors.
2. Zero modem turnaround delay — four-wire half-duplex communication facility.
3. No propagation delay through the modems or the communication network.
4. Other factors such as host processing delay are not taken into account.
5. 'Characters Per Line' includes any compression and any printer forms handling characters (except line feed characters) sent on the communication facility.
6. A full buffer is always received (with partial print line depending on the line length).
7. ASCII character sets may exhibit approximately 4% lower performance.

Figure D-6. 3777 Model 1 Line-to-Printer Throughput (BSC)



ASSUMPTIONS:

Curves shown are based on the following assumptions:

1. Perfect Transmissions — no CRC errors.
2. Zero modem turnaround delay — four wire half duplex communication facility.
3. No propagation delay through the modems or the network.
4. Other factors such as host processing delay are not taken into account.
5. "Characters Per Line" includes any compression and any printer forms handling characters (except line feed characters) sent on the communication facility.
6. A full buffer is always received (with partial print line depending on line length).
7. These curves are for EBCDIC only.

Figure D-7. 3777 Model 1 Line-to-Printer Throughput (SDLC)

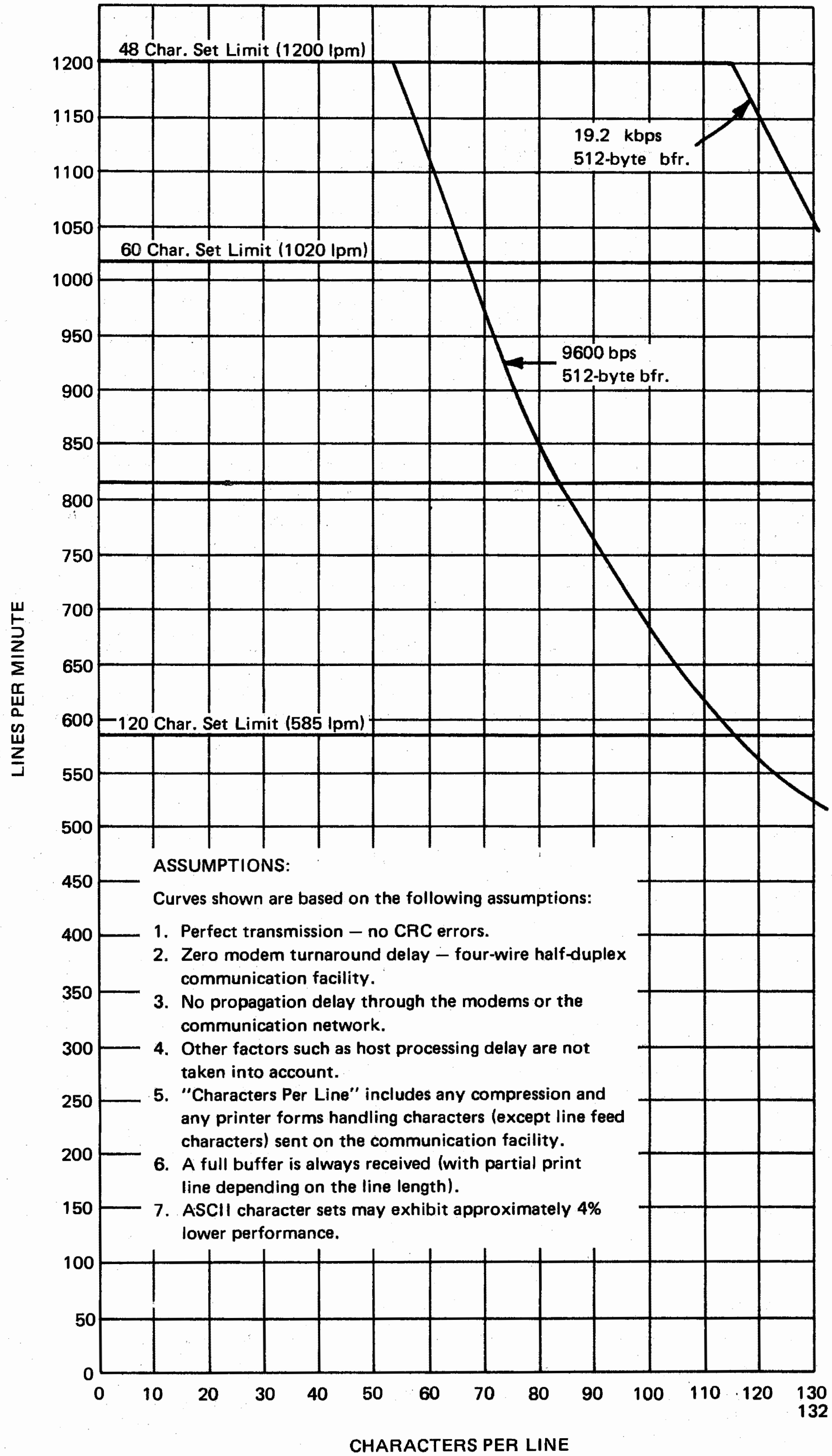
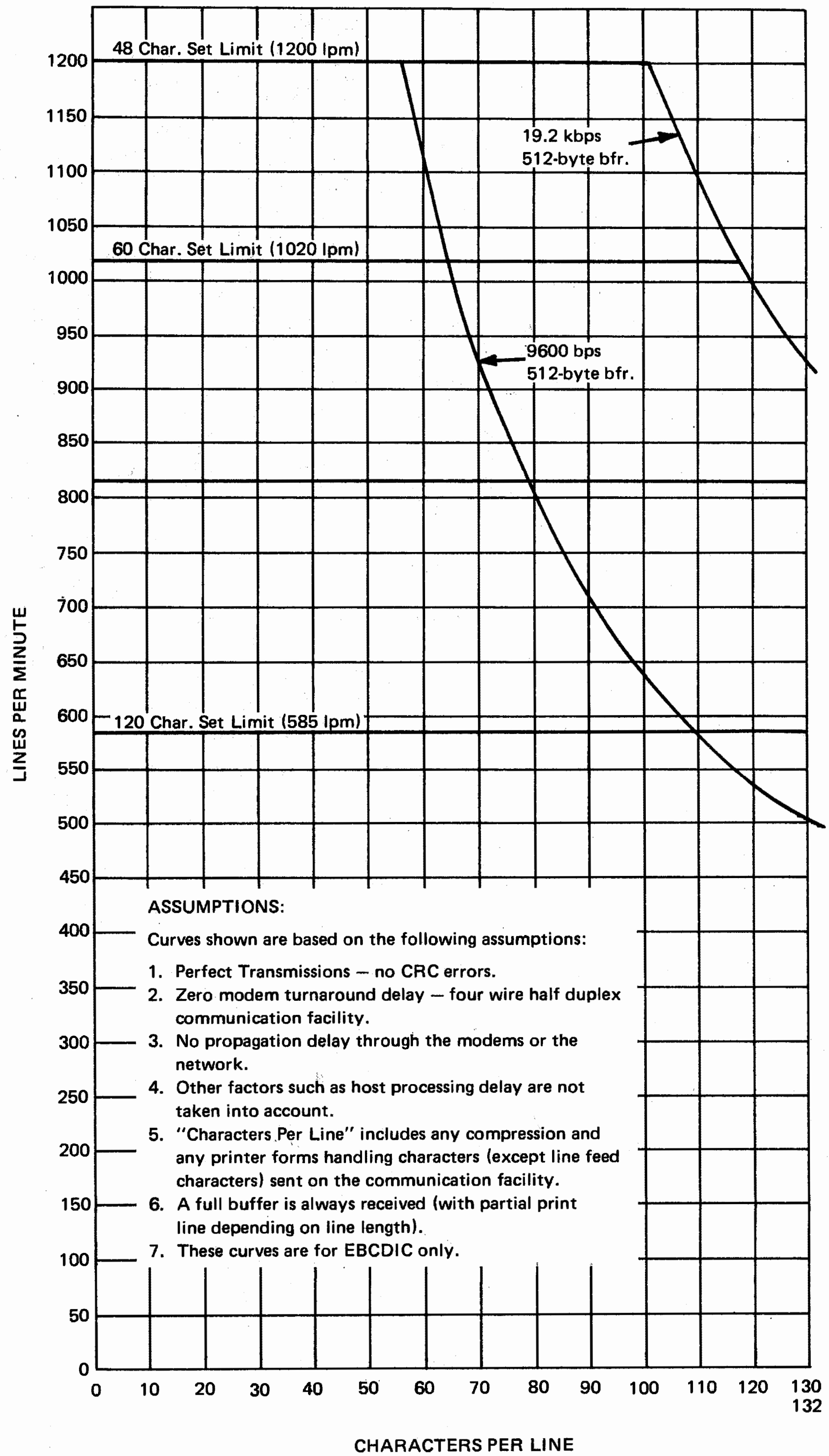


Figure D-7.1. 3777 Model 1 Line-to-Printer (1200 lpm) Throughput (BSC)



ASSUMPTIONS:

Curves shown are based on the following assumptions:

1. Perfect Transmissions – no CRC errors.
2. Zero modem turnaround delay – four wire half duplex communication facility.
3. No propagation delay through the modems or the network.
4. Other factors such as host processing delay are not taken into account.
5. "Characters Per Line" includes any compression and any printer forms handling characters (except line feed characters) sent on the communication facility.
6. A full buffer is always received (with partial print line depending on line length).
7. These curves are for EBCDIC only.

Figure D-7.2. 3777 Model 1 Line-to-Printer (1200 lpm) Throughput (SDLC)

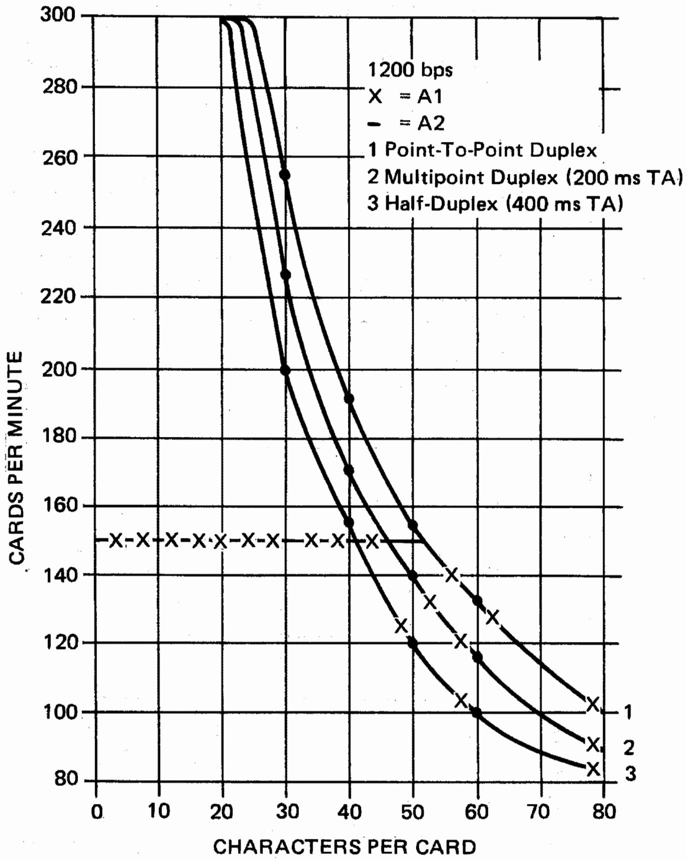
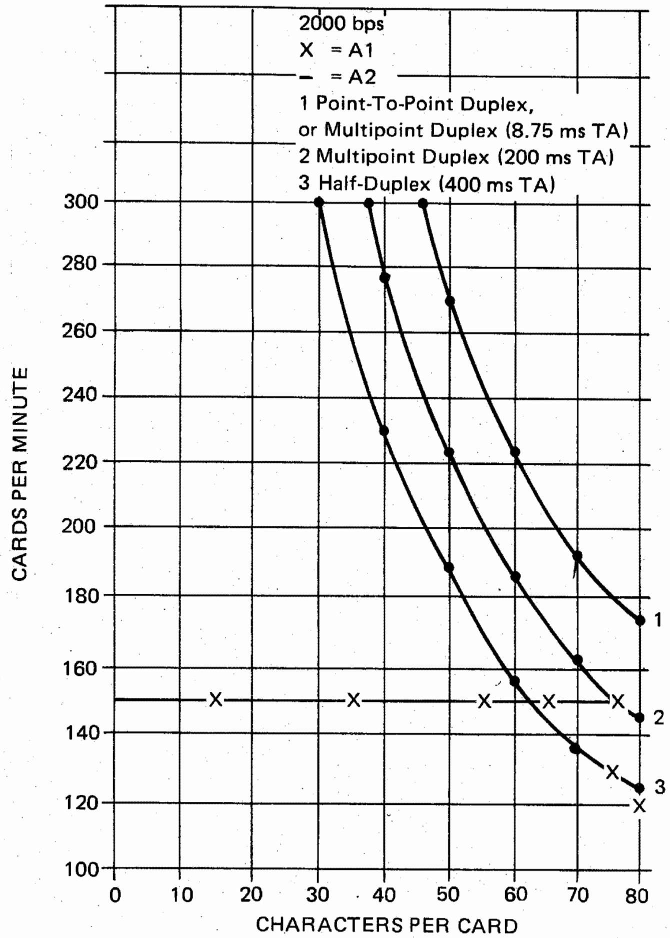
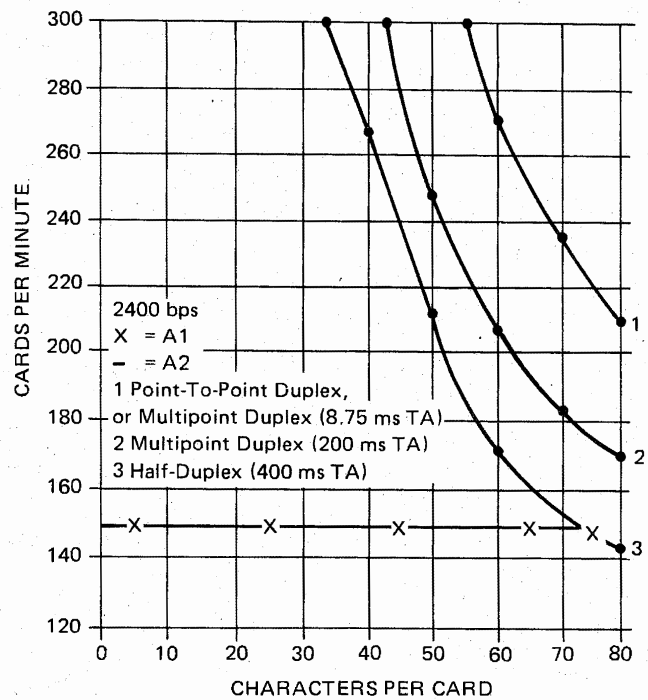


Figure D-8. 2502 (Models A1 and A2) 1200 bps–Nominal Throughput



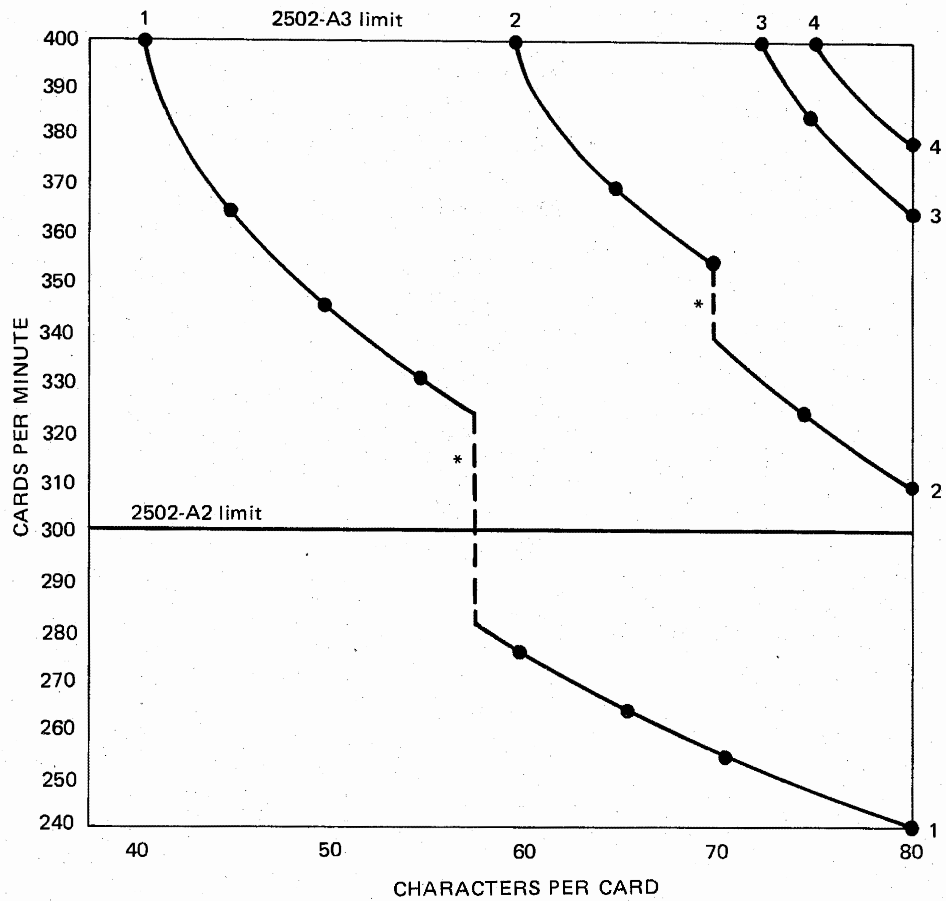
Note: On the 3776, 512-byte buffer operation increases throughput by about:
3% for line 1
12% for line 2
19% for line 3

Figure D-9. 2502 (Models A1 and A2) 2000 bps–Nominal Throughput



Note: On the 3776, 512-byte buffer operation increases throughput by about:
3% for line 1
13% for line 2
20% for line 3

Figure D-10. 2502 (Models A1 and A2) 2400 bps–Nominal Throughput



1 — 4800 bps, 300 msec TA, 256-byte buffer
2 — 4800 bps, 300 msec TA, 512-byte buffer
3 — 4800 bps, 50 msec TA, 256-byte buffer
4 — 4800 bps, 35 msec TA, 256-byte buffer

2502 operates at rated speed for 7200 and 9600 bps and TA $\leqslant$50 msec for 512-byte buffer

*Breakpoint caused by stripping of blanks on cards with less than 80 columns punched.

Figure D-11. 2502 (Models A-2 and A-3) 4800 bps – Nominal Throughput to Line on 3777 Model 1 (BSC)

Diskette Performance - BSC Nonprogrammable Models

The following tables estimate diskette performance on various nonprogrammable 3770 terminals in BSC mode.

Communication Line Performance

The information given below is based on the following assumptions:

1. Error free transmission
2. Full 256- or 512-byte buffers
3. Zero modem turnaround, network propagation, and host processing delays.

Diskette to Line - bpm

Terminal	*Buffer Size*	*Line Speed-bps* 1200	2400	4800	9600
3770 (except 3777)	256	30 bpm	57 bpm	110 bpm	
3776	512	15	29	59	
3777-1	256			120	190 bps
3777-1	512			60	105

Line to Diskette (3770 Nonexchange Diskette) - bpm

Terminal	*Buffer Size*	*Line Speed-bps* 1200	2400	4800	9600
3770 (except 3777)	256	30 bpm	52 bpm	99 bpm	
3776	512	15	29	55	
3777-1	256			120	120 bpm
3777-1	512			60	70

Effective Card Rate Online

The chart represents effective cards per minute (Eff. cpm) speed when transmitting diskettes that were loaded with card data offline.

Terminal	*Buffer Size*		*Line Speed-bps* 4800			9600		
		Data Char. Per Card →	40	60	80	40	60	80
		Eff. cpm ↘						
3776	256		700	450	345			
	512		770	520	390			
3777-1	256		750	495	402	1325	795	630
	512		770	536	402	1430	1000	750

Performance with Diskettes Created on IBM 3740

The tables below estimate the performance of the 3776 and 3777 when processing diskettes originating from an IBM 3740. The communication line performance assumptions, noted previously, apply to those tables showing communication line performance. The following terms are used in these tables:

Record Size: The IBM 3740 record contains the number of data characters shown plus enough space characters to fill an 80-byte record.

IBM 3740 Records Per Minute: Indicates the number of 3740 records processed per minute (R/M).

Dual Data Path - Simultaneous Operations

- Line to Printer - 63-character line, 48 character set
- Diskette to Diskette - with Record Compression

Terminal	*Buffer Size*	*Record Size*	*Line Speed 4800 3740 R/M*	*4800 lpm*	*9600 3740 R/M*	*9600 lpm*
3776-1	256	40	130	270		
		60	115	270		
		80	100	265		
	512	40	135	265		
		60	120	260		
		80	110	260		
3776-2	256	40	115	360		
		60	100	355		
		80	90	355		
	512	40	120	350		
		60	110	345		
		80	95	340		
3777-1	256	40	225	510	215	950
		60	190	500	185	950
		80	170	495	160	950
	512	40	240	525	235	985
		60	205	515	200	985
		80	185	510	180	970

Diskette to Diskette with Record Compression (Offline)

Terminal	*Record Size*	*IBM 3740 R/M 256-Byte Bfr*	*IBM 3740 R/M 512-Byte Bfr*
3776	40	140 R/M	140 R/M
	60	125	130
	80	115	120
3777-1	40	225	245
	60	195	210
	80	175	185

Diskette to Line

- Record Compression while transmitting diskette - Online Compression
- Transmission of 3770-mode diskette that resulted from offline diskette-to-diskette Record Compression operation - Effective IBM 3740 records per minute (Eff.R/M)

Terminal	*Buffer Size*	*Record Size*	*Line Speed-bps 4800 On Line*	*4800 EffR/M*	*9600 On Line*	*9600 EffR/M*
3776	256	40	170R/M	740R/M		
		60	170	495		
		80	170	385		
	512	40	170	785		
		60	170	525		
		80	170	400		
3777-1	256	40	330	770	335R/M	1300R/M
		60	330	515	332	870
		80	325	400	332	665
	512	40	330	795	335	1575
		60	330	530	332	1035
		80	330	410	332	800

Appendix E. Data Format

Diskette Track Formats

TRACK/SECTOR ASSIGNMENT
Non-Programmable 3770 Models

Track	Sector	Use
00	1-6	Not Used
	7	Volume Label
	8	Data Set Label for †Job Definition Record
	9-26	Data set labels for User Data Sets
01	1, 2	Job Definition Records
	3-26	User Data
02-73	1-26	User Data

†See exception for SDLC exchange diskettes under "TRACK 00- INDEX TRACK".

TRACK/SECTOR ASSIGNMENT
Programmable 3770 Models

Track	Sector	Use
00	1-4	Not Used
	5	Error Map
	6	Not Used
	7	Volume Label
	8-26	System- and User-Named Data Set Labels
01-74	1-26	User Data

TRACK 00–INDEX TRACK

The first track on a diskette is called the index track and is numbered 00. The index track's 26 sectors are reserved for system and data set label information. Each record on the index track has a record length of 80 characters. The first four and the sixth sectors of the index track are not used by the 3770, but may contain information if the diskette was used on another system or machine. Sector 5 contains the error map in the format TTSS where TT is the track number and SS is the logical record number of the defective sector. Sector 7 contains the volume label, which is written as shown in Figure E-2. Sectors 8 through 26 (19 sectors) contain data set labels for system-named data sets such as SYS.PGM, SYS.IBM, SYS.TDS, SYS.SUPR, and SYS.INTR; and user-named data sets. The data set labels are written as shown in Figure E-3.

TRACKS 01 THROUGH 74-DATA TRACKS

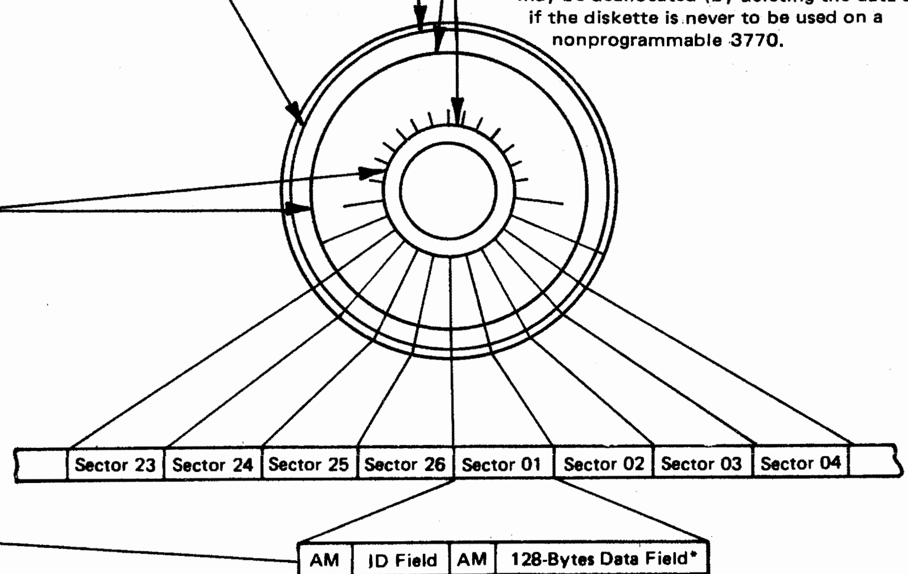
These tracks are used to store the data sets as defined by the data set labels on Track 00. On a 3770 nonexchange diskette, track 01 is allocated to the OJDR data set. This space may be deallocated (by deleting the data set) if the diskette is never to be used on a nonprogrammable 3770.

TRACK 00–INDEX TRACK

The first track on a diskette is called the index track and is numbered 00. The index track's 26 sectors are reserved for system and data set label information. Each record on the index track has a record length of 80 characters. The first six sectors of the index track are not used by the 3770, but may contain information if the diskette was used on another system or machine. Sector 7 contains the volume label, which is written as shown in Figure E-2. Sector 8 contains the data set label for the Job Definition Record (except on SDLC exchange diskettes where Sector 8 is used for user data set labels); sectors 9 through 26 (18 sectors) contain data set labels for user data sets. The data set labels are written as shown in Figure E-3.

TRACKS 01 THROUGH 73–DATA TRACKS

Track 01, Sectors 1 and 2 are reserved for Job Definition Records (up to 5 job definitions may be stored in these two sectors). Track 1, sectors 3 through 26, and tracks 2 through 73 (all sectors) are used to store customer data. The Job Definition Records are always identified as inactive, and cannot be transmitted, printed, or accessed in any way, except to read the job definition from the diskette into the controller for executing the job.



AM1 (ADDRESS MARKER 1)

Identifies bytes between this address mark and the following address mark as the address field of the sector.

Sector and track number used to identify the record.

EITHER AM2 OR AM3

These address markers both identify the following field (that is, the bytes between AM2 or AM3 and the next address marker) as a data field. AM2 indicates that the field contains a good record; AM3 indicates that the field contains a bad sector or a deleted record.

To read or write information, the diskette device locates the correct track and sector by reading the ID Field. When the correct field is located, the drive reads 128 bytes of data from two (four if 3776/3777 in 512-byte mode) sector data fields (256 or 512 bytes total) during a read operation, or writes 128 bytes of data into two (four if 3776/3777 in 512-byte mode) sector data fields (256 or 512 bytes total) during a write operation.

* 80-byte field for Index Track.

Note: The ID field and the data field each have two cyclic redundancy check (CRC) characters that the drive uses for automatic error checking.

Figure E-1. Diskette Track Formats

VOLUME LABEL TRACK 00—SECTOR 07

00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19
V	O	L	1	•	•	•	•	•	•	b	X	X	X	X	X	X	X	X	X

20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•	•	•

40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
•	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
X	X	X	X	X	X	X	X	X	X	X	X	*	*	X	*	*	*	X	W

b=blank (space character - X'40')

X=These fields contain information if the diskette was used on another machine type. Refer to the publication GA21-9182, for information contained in these fields.

*=See below.

0-3 Volume Label. Contains VOL1.

4-9 Volume ID. The volume ID field contains IBMIRD when the diskette is received from IBM. It is changed to 3770 when the Diskette Create function is performed on the 3770 (changed to 3777M2 by the 3777-2). On programmable models and the 3776/3777, the operator can set the field. The IPL diskettes for programmable models contain 'IBM $$$' in this field.

10 Accessibility Indicator. Must be a space character for the 3770 to read or write the diskette. The 3770 sets it to a space character when the Diskette Create function is performed.

37-50 Owner Identification. Contains 3770, 377X, or space characters as described in "Special Requirements Indicator", "Extent Arrangement Indicator", and "Owner Identification (ID) Field" in this appendix.

72 **Extent Arrangement Indicator. Contains 'P' or space character as described under "Extent Arrangement Indicator" in this appendix. Replaced by a space character on the programmable models when a data set is deleted.

73 **Special Requirements. Contains 'R' as described under "Special Requirements Indicator" in this appendix.

75 Physical Record Length. Must be a space character (indicating 128 bytes per sector) for the 3770 (and 3777-2) to read or write the diskette.

76-77 Sector Sequence Information. Must be a space character or 01. If not, will cause "no record found" condition when attempting to read on 3770.

79 Always W.

**These indicators may be left blank on early machines.

Figure E-2. Volume Label

DATA SET LABEL TRACK 00–SECTORS 8-26

Note: Sector 8 is reserved for Job Definition Record label on 3770 nonexchange diskettes; sectors 9-26 are for user data set labels.

00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19
H	D	R	1	b	*	*	*	*	*	*	*	*	X	X	X	X	X	X	X

20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
X	X	*	*	*	*	*	*	*	*	*	*	*	X	*	*	*	*	*	*

40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
*	X	*	*	*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
X	X	X	X	X	X	*	*	*	*	*	*	b	*	*	*	*	*	*	X

b=blank (space character - S'40')

X=These fields may contain information if the diskette was used on another machine type. Refer to the publication GA21-9182, for infor- information that may be contained in these fields.

*=See below.

00-03 Label Identifier. Contains HDR1.

05-12 Data Set Name. Will be OJDR for Job Definition Record (Sector 8).
For system defined jobs, data set names are:
Nonprogrammable models—four-character names:
SC00 – Card Reader-to-Diskette
SL00 – Communication Line-to-Diskette
SK00 – Keyboard-to-Diskette
Note: 00 is incremented for multiple data sets.
3777-2 Spooling/IPL diskette:
SYS IPL (if present)
SYS MSGS
Programmable models and 3777-2 Diskette Input Device—eight-character names (maximum):
AXXXXXXX – A must be alphabetic; some system-defined data set names are less than eight characters long.

22-26 Block Length. $\leq$ 80 for 3777-2 Diskette Input
$\leq$ 128 for Basic Exchange Data Sets
$\leq$ 128 or 256 for programmable 3770 models.
= 128 for exchange diskettes. } nonprogrammable
= 256 for 3770 diskettes and 3777-2 spooling diskettes. }
= 512 for 3776/3777-1 with EXTEND BUFFER on.

27 Record Attribute. Contains space character for 3770 diskettes; "don't care" for exchange diskettes; 'B' for 3777-2 spooling diskette.

28-32 Beginning of Extent (BOE). Described under "Special Requirements Indicator" in this appendix.

34-38 End of Extent (EOE). Described under "Special Requirements Indicator" in this appendix.

39 Record/Block Format. Contains space character for 3770 diskette "don't care" for exchange diskettes; 'U' for 3777-2 spooling diskette. The 3777-2 checks this field for a 'U' (unique to the 3777-2).

40 Bypass Indicator. Space character indicates active data set, 'B' indicates inactive data set. On programmable models, a 'B' indicates the data set cannot be transmitted online.

42 Write Protect Indicator. Must be a space character for 3770 to write on this data set. If set to 'P', 3770 cannot write. It is set to a space character by the 3770 Data Set Create function. Programmable models can write on a protected data set during online operations. The operator of the 3777-2 cannot set the Write Protect Indicator to protect data sets.

43 Exchange Type Indicator. Contains a space character, 'E', or 'T' as described under "Exchange Type Indicator" in this appendix.

44 Multivolume Indicator. A space character indicates that a data set is contained on one diskette; a 'C' indicates that a data set is continued on another diskette; an 'L' indicates that this is the last diskette of a continued data set. This field is always a space character on 3773, 3777-2 spooling diskettes, and 3770 programmable models.

66-71 Expiration Date. May contain expiration date if non-3770 exchange diskette. Set to all 9's on 3770-created data sets.

73 Data Set Organization. Contains 'D' for 3770 diskettes; "don't care" for exchange diskettes.

74 End of Data (EOD). Identifies the address of the next available sector (exchange) or next available logical record (nonexchange).

Figure E-3. Data Set Label

Diskette Compatibility

Exchange Type Indicator

Byte 43 in the data set label defines the format of the data within the data set. It is used along with the block length field of the data set label, the owner identification, extent arrangement indicator, and special requirements indicator of the volume label to determine diskette compatibility between the different 3770 terminal models. The exchange type indicator defines formats as follows:

Space (Basic Exchange Data Set)

- Any bad sector control records found in this data set are the 'relocated sequentially' type.
- Maximum of 128 bytes logical record length
- Fixed length records, unblocked and unspanned
- Physical record length of 128 bytes
- Data set name is a simple name up to 8 characters
- Data must be recorded exclusively in either EBCDIC or ASCII and must be in the same code as the data set label

E

An 'E' indicates that no summation of attributes exists. All supported fields must contain values that accurately describe the data set. All unsupported fields must contain space characters. These data sets (except for the IBM 3777-2) are compatible with card reader-to-line data from the IBM 2770 and IBM 3780. Block length may be 256- or 512-bytes. The format is as illustrated in Figure E-5. The IBM 3777-2 sets block length to 256 and record/block format to 'U' on spooling diskettes, indicating variable length records in a fixed length block.

T

A 'T' defines a data set similar to that defined by an 'E' except that the first record will contain a Type 1 function management header (FMH). The FMH is created along with the data set and contains information about the source of the data set. The T-format data set is created by a 3770 nonprogrammable SDLC terminal. The programmable 3770 models can read a T-format data set and can modify individual records, but cannot create a T-format data set. When programmable models receive a T-format data set from the communication line, the data is directed to the SYS.INTR data set with no FMH. On models where the keyboard-to-diskette function is permitted, modification of existing records is permitted. Block length will be 256-bytes except on models with the Extend Buffer switch, in which case it may be 512-bytes.

Special Requirements Indicator

An 'R' in Byte 73 of the volume label indicates that all of the data sets on this volume are on tracks that were recorded in a "logically nonsequential" order by the IBM 3770 system. The sequence is used to optimize performance. Sectors are read/written two (four for 512-byte buffer) at a time. For an exchange data set on this kind of diskette, the programmable models read or write the exchange data set one sector at a time. Use of a "logically sequential" order requires that the diskette make one complete revolution between reading/writing of each sector, thus, reducing throughput. The extent fields of the data set label reflect the logical addresses.

Note: Because early IBM 3770 systems did not set this field, the owner ID field was used. For this "logically nonsequential" sequence, the owner ID field is set to '3770'.

Beginning of Extent

Beginning of extent (BOE) specifies the beginning address of the extent. It contains a decimal address of the first logical record. This field is of the format CCHRR where:

CC = Track address (01-74)
H = Reserved; must be decimal zero
RR = Record address
(01-26 for 128-byte record)
(01-13 for 256-byte record)
(01-07 for 512-byte record)

The proper values must be entered when the label is created. A system, when writing the label, must check BOE and EOE to ensure that another extent is not assigned to the physical records of this data set.

End of Extent

End of extent (EOE) specifies the ending address of the extent. It contains the decimal address of the last logical record of the extent. This field has the same format as BOE and is entered and used as described above.

Extent Arrangement Indicator

Byte 72 of the volume label indicates the arrangement of the extents on the volume. The values entered in this field define the arrangements as follows;

Space

- The only constraints on the arrangement of the extents on the volume are (1) they must not overlap other extents and (2) they must begin and end at the addresses specified in their BOE and EOE fields in their associated data set labels.
- Unallocated space on the volume may appear anywhere on the volume other than on track 0, provided that it does not overlap any of the extents assigned in their associated BOE and EOE fields.
- Unallocated space need not be in a single extent or in contiguous extents and it need not be assigned a data set label.
- In order to assign space to a new extent (with the exception of the first extent on the volume), it is necessary to check all of the HDR1 labels to ensure that the assigned space does not overlap any of the previously assigned extents.
- The data set labels may appear in any of the label records on track 0. They need not be arranged contiguously or in the sequence of the extents they describe. Unused label records may be interspersed with those used to describe data sets.

P

- The extents on the volume must be arranged contiguously beginning at track 1, record 1. All unallocated space follows the last data set extent on the volume.
- The data set labels must be arranged contiguously beginning at track 0, record 8, and they must be arranged in the same sequence as the extents they describe. All unused label records appear following the last label record to which an extent is assigned.
- If unused space is created preceding any of the extents, or preceding any of their associated labels, then one of the following actions must be taken:

  1. Rearrange the extents and/or the labels on the volume to eliminate the unused space.
  2. Change the value of this label field to a space character.

A basic exchange data set may be recorded on a volume with either a 'space' or a 'P' in this field. The value for this field is set to a 'P' by the Diskette Create function. On the programmable models, it will be changed to a 'space' if a data set is deleted. Nonprogrammable terminals cannot write on the diskette if this field is not set to 'P'.

Note: Because early IBM 3770 systems did not set this field, the owner ID field is set to '3770' or '377X', depending on the sequence used.

Owner Identification (ID) Field

On some of the early terminals, the special requirements and extent arrangement indicators were not yet defined in the volume label. These terminals set and use the owner ID field, Bytes 37-40, as follows:

3770 (Nonexchange Diskette)

The data is recorded as described in "Special Requirements Indicator" above. The exchange-type indicator may be set to 'space', 'E', or 'T'.

377X (BSC Exchange Diskette)

The data is recorded both logically and physically in a sequential order. The data sets are formatted as described for an 'E' under "Exchange Type Indicator" for the purpose of 2770/3780 compatibility. However, the exchange type field is set to a space so that other systems can process the data. These data sets are read/written two (four for 512-byte buffers) sectors at a time.

Spaces (Basic Exchange Diskette)

On programmable models and SDLC machines, the owner ID field is set to spaces for basic exchange diskettes. The data is recorded both logically and physically in a sequential order. The data sets are formatted as described for a 'Space' under "Exchange Type Indicator" so that other systems can process the data.

Note: On nonprogrammable models in SDLC mode, basic exchange diskettes can be created only from data received over the communication line.

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Pertinent Vol 1 Label Fields			Pertinent HDR1 (Data Set) Label Fields		Support Provided By 3770 Communication Terminals											
					Binary Synchronous Communications (BSC)						Synchronous Data Link Control (SDLC)					
Owner ID	Extent Arrangement Indicator	Special Requirements Indicator	Block Length	Exchange Type Indicator	3770 (6)		3770P		3770RJE		3770 (6)		3770P		3770RJE	
Bytes 037-050	Byte(5) 072	Byte (5) 073	Bytes 022-026	Byte 043	Diskette	Data Set	Diskette	Data Set	Diskette	Data Set	Diskette	Data Set	Diskette	Data Set	Diskette	Data Set
'3770'	'P'	'R'	256	'E'	Create	Read Write	Create	Read Write	Create	Read Write	Create	Read	Create	Read Write	Create	Read
			512							R/W						Read
			1-128	Blank				R/W						R/W		
			256	'T'				Read(3) Write				Read Write		Read(3) Write		Read Write
			512													Read Write
'377X'	'P'	Blank	1-128	Blank	Create	Read(1) Write(7)		Read Write	Create	Read(1) Write(7)		Read(1)		Read Write		Read(1)
			256	'E'				Read Write						Read Write		
Blank	'P'	Blank	1-128	Blank		Read	Create	Read Write		Read	Create	Read(2) Write	Create	Read Write	Create	Read(2) Write
			256	'E'				Read Write						Read Write		
Any Owner ID	'P' or Blank	Blank	1-128	Blank		Read		Read Write		Read		Read(2) Write(4)		Read Write		Read(2) Write(4)
			256	'E'				Read Write						Read Write		

Figure E-4. Diskette Compatibility (Part 1 of 2)

Description of Terms:

Owner ID - Identifies the owner of the diskette volume.

Extent Arrangement Indicator - Indicates the arrangement of the extents on the diskette volume.

Space - There are no restrictions upon the arrangements of the extents, except that they cannot overlap.

'P' - The extents must be arranged contiguously, without any overlap.

Special Requirement Indicator - Used to describe special data accessing requirements. The 'R' character and the blank space mean the following:

"Space" - No special accessing requirements.

'R' - Indicates that the data is recorded in the normal 3770 system manner.

Exchange Type Indicator - Indicates that the data set has certain specified attributes. It is used as a summary indicator for certain other fields in the data set label. The meaning of the letters follows:

"Space" - A blank indicates that the data set is a Basic Exchange type of data set, with blocks of 128 bytes or less.

'E' - An 'E' indicates that the data set is recorded in the default block size used by the machine that created the data set. The format of the data set can be found in the appropriate manual(s) associated with the creating machine.

'T' - This data set is similar to an 'E' type of data set, but it also contains information about the source of the data, and it is created by nonprogrammable SDLC machines.

NOTES:

1. Two sectors are read or written during a read or write operation. An RJE terminal using BSC can process either 2 or 4 sectors.
2. Data can be written from the line only.
3. The 3770 programmable terminals cannot create 'T' type data sets, but they can write in them.
4. VOL1 Label byte 072 must be 'P'.
5. On some of the early 3770 terminals, VOL1 bytes 072 and 073 did not print on the diskette listing, in this case use Owner ID = 3770 or 377X
6. The 3773 nonprogrammable machine cannot 'list' a diskette.
7. Writes 128 byte blocks only.

Figure E-4. Diskette Compatibility (Part 2 of 2)

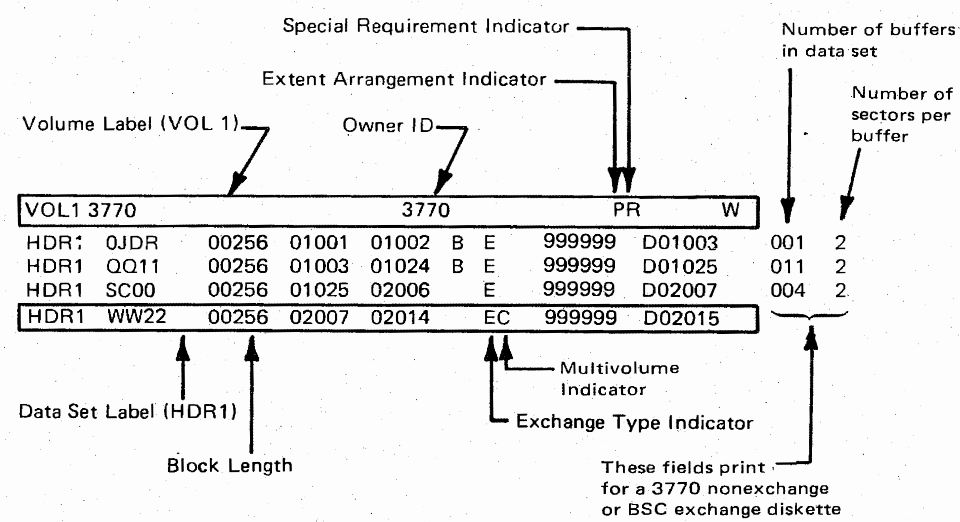


Figure A.

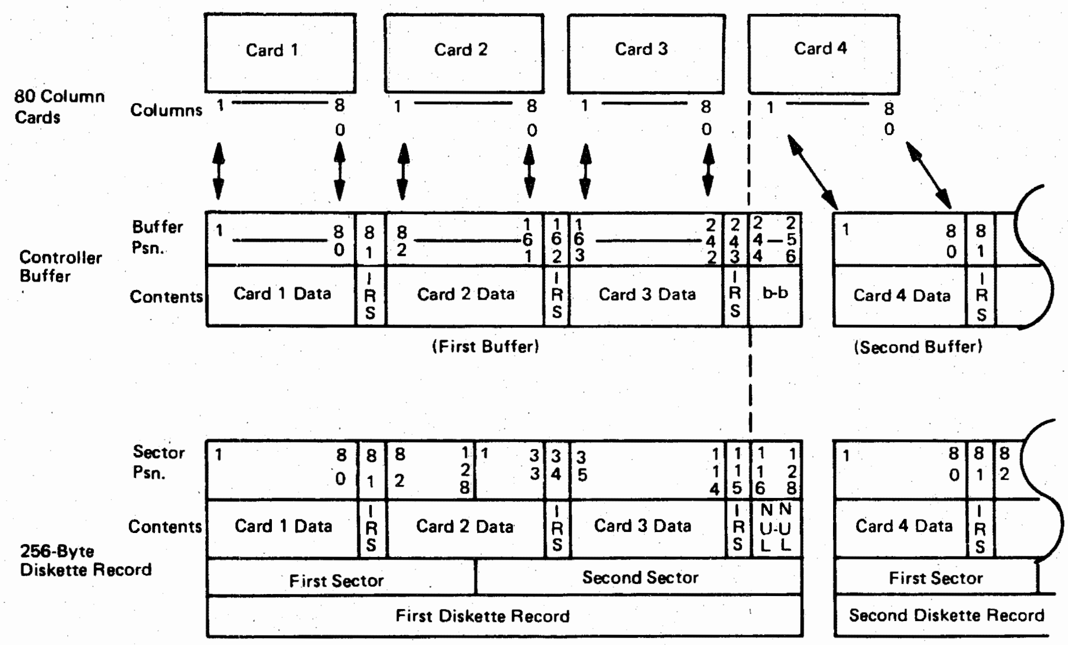
To Use This Chart:

1. Obtain a listing of the diskette to be compared.
2. Examine the 'pertinent' fields in the VOL1 and HDR1 labels and compare them with the chart. (Refer to Figure A) This procedure will identify a row in the chart.
3. Once a row has been located, look at the right side of the chart under BSC or SDLC and find the machine that will process the diskette.
4. After the machine has been located, it can be determined—
   a. If the diskette can be created on the chosen machine.
   b. If the selected terminal can read and/or write on the diskette.

Machine Categories:

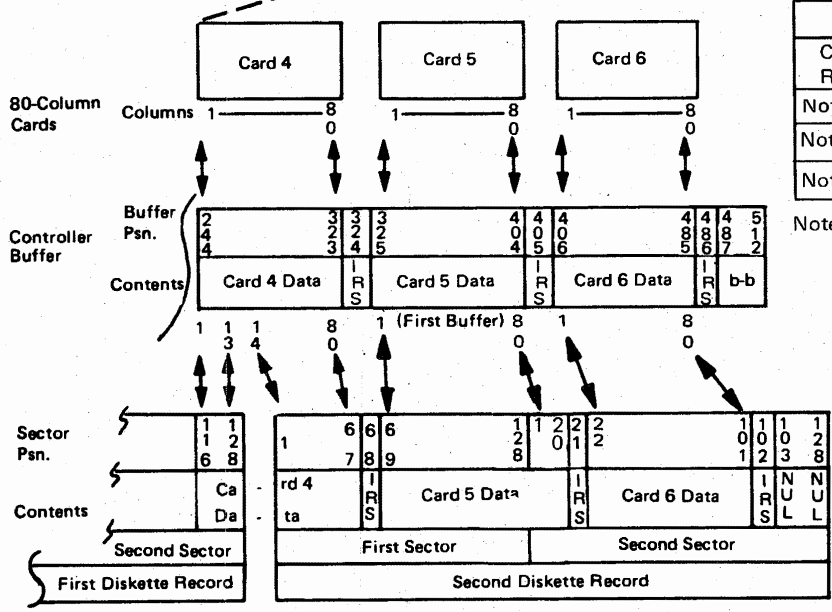
3770 = 3773, 3774, 3775 (nonprogrammable)
3770p = 3773, 3774, 3775 (programmable)
3770RJE = 3776, 3777-1

Card Image Formats



3776/3777-1 512-Byte Buffer

On the 3776/3777-1 using the 512-byte buffers, card 4 data begins storing immediately following the IRS ending Card 3 data as shown below.

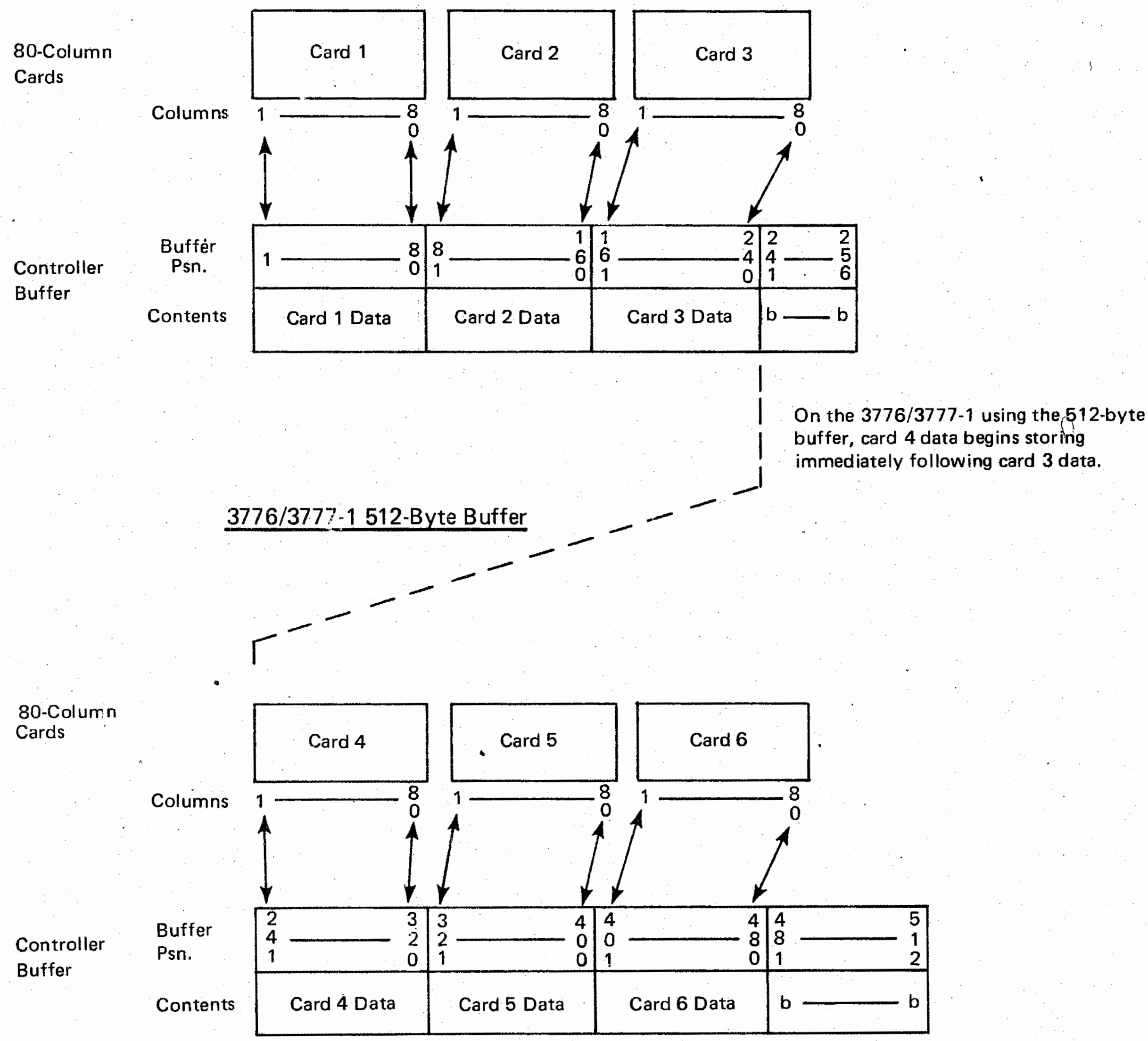


3776/3777-1 Record Compression Table

Input Device: Card Reader	Input Device: Exchange Diskette	Output Line Type	
Note 1	Notes 2, 3	BSC (Machines with BSC only)	
Notes 2, 3	Notes 2, 3	BSC position	Machines with BSC/SDLC Switch
Note 2	Note 2	SDLC position	

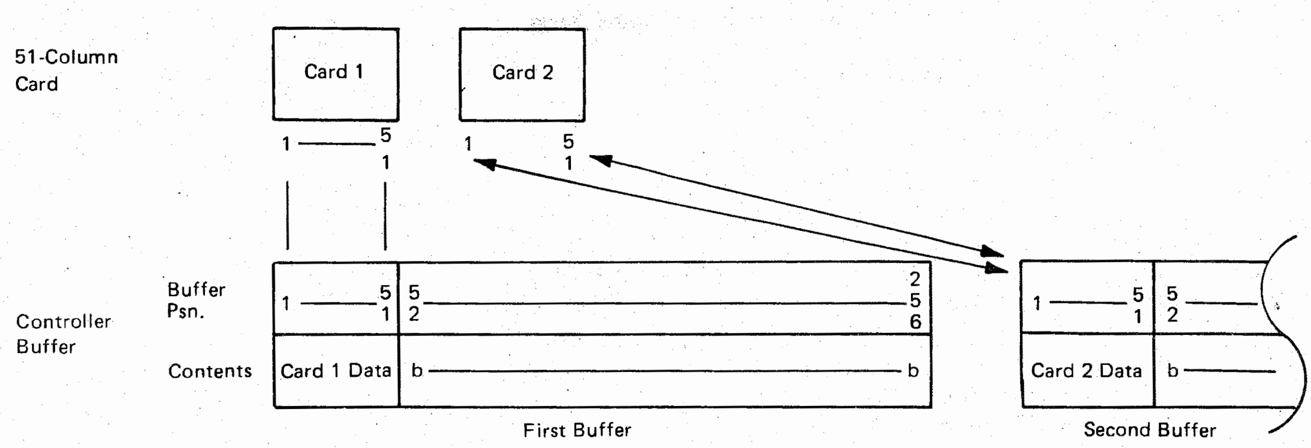
Notes:
1. As long as 82 positions remain in buffer.
2. 256-byte mode: as many full records/cards as possible with a maximum of 256 bytes.
3. 512-byte mode: as many full records/cards as possible with a maximum of 511 bytes.

Figure E-5. 80 Column Card Data, BSC Non-Transparent



- BSC Transparent data can be written onto the diskette; see description under "Diskette Record" in Chapter 4.
- Three cards (six cards with 3776/3777-1 512-byte buffer) are always contained in each buffer, regardless of the number of blanks contained in the card.
- IRS characters are not inserted to delineate card data.

Figure E-6. 80 Column Card Data, BSC Transparent



- BSC Transparent Data can be written on the diskette; see description under "Diskette Record" in Chapter 4.
- One card is always contained in each buffer.

Figure E-7. Short Card Data, BSC Transparent

Appendix F. Features, Care, and Handling of IBM Diskettes

The diskette (see Figure F-1) used by the 3770 is available from your IBM Information Records Division (IRD) representative as IBM part number 2305830. This diskette can be distinguished from other IBM diskettes by a white upper-left label with black printing.

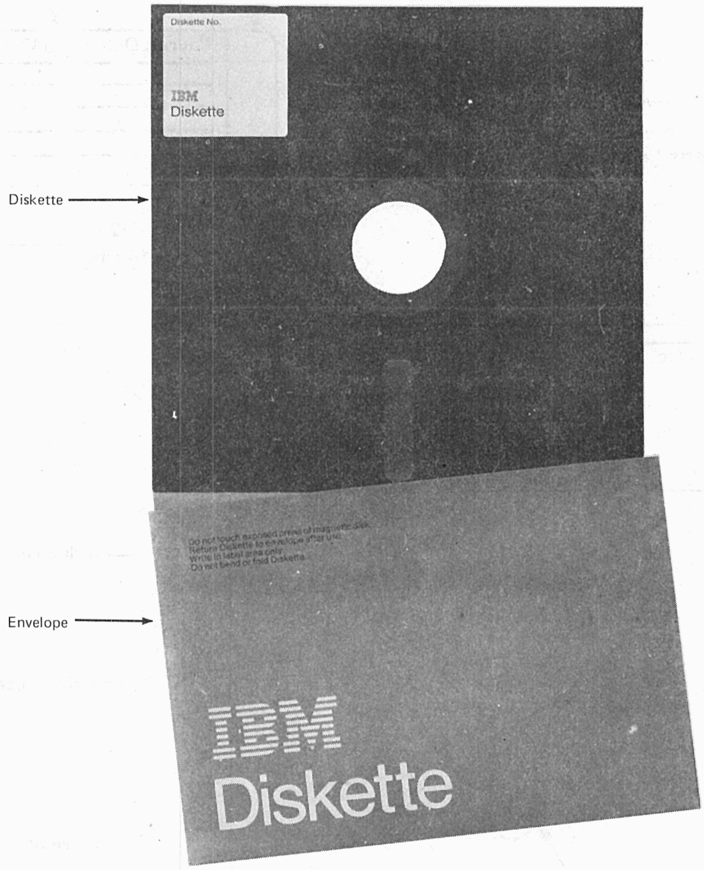


Figure F-1. IBM Diskette

The IBM diskette is manufactured and tested by IBM. At the time of shipment to the customer, the diskette is error-free. "Error-free" means that the disk surface has no manufacturing defects that would prevent accurate writing of data onto or reading of data from the disk.

Permanent Diskette Label

This label is permanently affixed to the diskette. It can be used to record permanent information, such as the diskette identification number, for quick visual identification of the diskette. (See "External Labels.")

Temporary Adhesive Identification Label

This label can be used to describe data stored on the diskette or to record other temporary information about the diskette. (See "External Labels.")

Physical Features (Figure F-2)

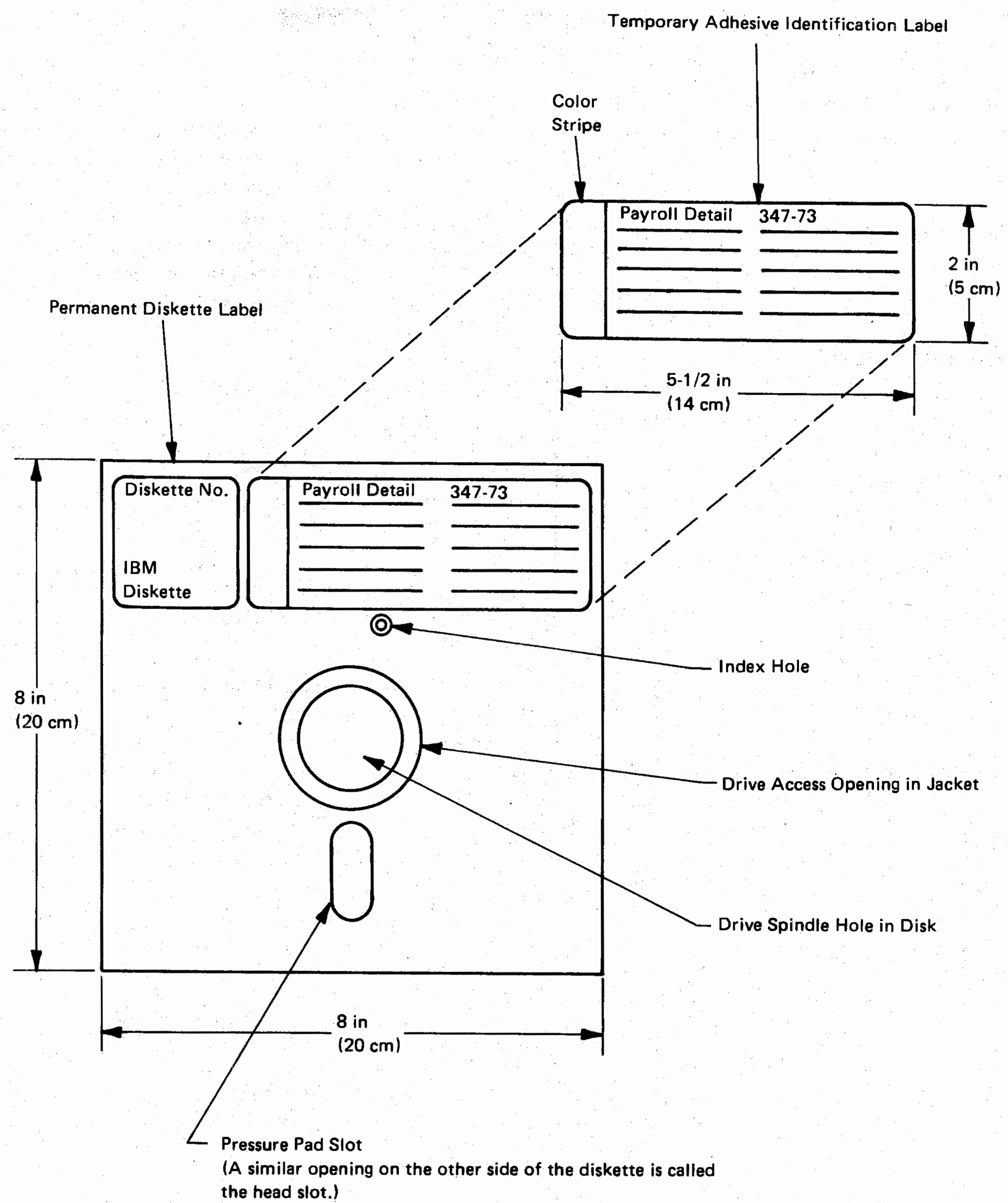


Figure F-2. Diskette Features

Index Hole

As shown in Figure F-2, a hole in the jacket (outer circle) exposes the index hole in the disk (inner circle). When these two holes are aligned as the disk revolves during data processing operations, a beam of light shining on one side of the diskette is sensed from the other side and used for timing functions.

Drive Access Opening and Drive Spindle Hole

After the diskette has been placed in the machine and the disk drive spindle has been inserted into the drive spindle hole in the disk (inner circle), the drive mechanism clamps onto a portion of the disk exposed by the drive access opening in the jacket (outer circle).

Pressure Pad Slot and Head Slot

The head slot (an opening on the other side of the diskette similar to the pressure pad slot shown in Figure F-2) exposes the recording surface of the disk as the disk turns in its jacket in the machine. The data recording and sensing unit of the diskette drive, which is called a "read/write head" and is similar to the record/playback head in a tape recorder, moves to specified positions along the length of the slot. Moving to a specified position is called "accessing a track." Data is recorded only on the side of the diskette that contains the head slot.

External Labels

Diskette users need to know two types of information about any diskette they are using, without having to use a machine to read the data. One type is information describing the physical disk, and this is the purpose of the permanent diskette label. The other type is information describing the data recorded on the disk, and this is the purpose of the temporary adhesive identification label.

"Permanent Diskette Label" Information

Information describing the physical disk should be recorded on the permanent label with a fiber-tip or ballpoint pen. The following two items are examples of such information:

a. A serial number assigned to the diskette.
b. The date the diskette was first used.

"Temporary Adhesive Identification Label" Information

Information directly related to the data stored on the diskette or about diskette processing is more temporary and subject to change, and should be recorded on the removable adhesive paper label. The following items are examples of such information:

a. What data is stored on the diskette—job name and number.
b. Who entered the data.

CAUTION
Information should be written on this label while the diskette is in the envelope or before the label has been affixed to the diskette. This prevents damaging or contaminating the recording surface of the disk. (An opening at the top of the protective envelope allows writing on the label while the diskette is still enclosed in the envelope.)

Whenever a new job is started on the diskette, the old information on the label should be crossed out but *not* erased. Crossing out instead of erasing information provides an audit trail as well as helping to keep the disk clean [that is, free of erasure droppings]. When a label becomes full, it should be removed before a new label is affixed. New labels pasted on top of old labels can cause a buildup that affects machine performance. Labels should not be affixed to the reverse side of the jacket, nor should they cover any of the holes.

Labels should be replaced every six months, whether filled or not. Otherwise, the adhesive may harden so that the label is difficult to remove.

IBM provides 30 blank temporary labels with each five diskettes purchased, six labels in each of the following color stripes: red, blue, yellow, green, and gray. Additional temporary identification labels may be ordered from the IBM IRD representative.

Color stripes can be used as coding to identify certain types of information at a glance. For example, color coding for an insurance installation might be:

Red	.	Reserved for program storage; do not use for data.
Green	.	For general data use.
Blue	.	Reserved for keying claims.
Yellow	.	For local or personal files (operator or job statistics, lists of job charge numbers, and so forth) not to be used for general data.
Gray	.	Reserved for new policy data.

IBM recommends that descriptive information about a diskette never be written on the diskette's envelope, because the diskette very likely may not always be returned to the same envelope after each use. In such an instance, the information on the envelope would not correctly describe the enclosed diskette.

Handling and Care

Diskettes may be used in the normal office environment.

Storage

Diskettes should always be stored in the following environment:

Temperature: 50° to 125°F (10.0° to 51.5°C)
Relative Humidity: 8% to 80%
Maximum Wet Bulb: 85°F (29.4°C)

Diskettes that are to be available for immediate use should be supported so that they do not lean or sag. They should not, however, be subjected to compressive stresses. Permanent deformation may result from improper storage.

Diskettes that are not needed for immediate use should be stored in their original shipping cartons, with each diskette in its protective envelope. The cartons should be stored either horizontally or vertically, and diskettes in the cartons should not be subjected to compressive force.

If a diskette has been exposed to temperatures outside of the machine's environmental range, five minutes acclimation time should be allowed before use. The diskette should be removed from its shipping container during this time.

Shipping and Receiving

- Ship Diskettes inside a suitable mailer. Such mailers are available from your IBM IRD representative.
- Always label the package: DO NOT EXPOSE TO HEAT OR SUNLIGHT.
- Upon receiving a diskette, check for carton and diskette damage. A damaged carton indicates possible damage to the disk or its protective jacket, either of which could damage the diskette drive if the diskette is used.
- Diskettes can be safely exposed to temperatures from -40°F (-40°C) to +125°F (+51.5°C) during shipment.

To properly package a single diskette for mailing, IBM recommends that you place the diskette in its protective envelope, and then in a single diskette carton. (See "Diskette and Associated Supplies Availability.")

For mailing any multiples of five diskettes, IBM recommends the following:

- Place each diskette in its protective envelope.
- Place each five diskettes in a 5-pack box (the box in which each five diskettes were originally shipped to you by IBM).
- Place each 5-pack box within a die-cut. (A die-cut is a piece of cardboard with the center cut to the size of the 5-pack box.) A 5-pack box held by a die-cut is partially insulated from shock and damage due to rough handling during shipment.
- Insert top and bottom pads for 5, 10, or 30 5-pack box cartons.
- Place the 5-pack boxes within the appropriate size 5-pack cartons.

Note: Fill any open space in partially filled 5-pack boxes and shipping cartons with a suitable filler. The filler must not be a material that can contaminate the diskette or enter the diskette jacket. Never fill open areas so full that diskettes are compressed tightly, because compression can cause diskettes to warp excessively.

Handling

Damaged diskettes should not be inserted into a disk drive. Diskettes that are physically damaged (torn, creased, warped) or contaminated may cause the read/write head to lift from the diskette, resulting in operation errors, equipment errors, or head contamination.

Placing heavy objects on diskettes can damage them.

- Return the diskette to its protective envelope whenever it is removed from the disk drive and whenever you are writing on a label affixed to the diskette.
- Do not use clips.
- Never write with an erasable pencil on a diskette or an identification label affixed to the diskette. IBM recommends using a fiber-tip or ballpoint pen.
- Do not touch or clean the disk surface.
- Keep diskettes away from magnetic fields and from ferromagnetic materials that might be magnetized. Any diskette exposed to a magnetic field may lose information.
- Do not expose diskettes to excessive heat or sunlight.

Diskette Replacement

If diskettes are physically damaged (torn, folded, creased), they must be replaced. If the recording surface becomes contaminated with foreign material, the diskette must be replaced. It is particularly important that diskettes that are contaminated with sticky fluids (such as soft drinks or coffee with sugar) or with abrasive substances (such as metal filings) on the recording surface *not* be placed in a 3770 diskette device. Placing such a diskette into the diskette device can contaminate the read/write head, damaging the equipment and causing operation errors. Furthermore, contaminants can be passed on to a clean diskette. If a foreign substance is spilled onto the diskette jacket, it may be carefully removed and the data recovered *only* if the contaminant has not reached the recording surface. After the data is recovered, such a diskette should be discarded.

Diskette and Associated Supplies Availability

The following supplies are available from your IBM Information Records Division representative:

Item	*Sold in Multiples of*	*Weight (in lbs)*
Diskettes*	5	1-1/4
Temporary Adhesive Identification Labels	30	------
5-Pack Box, Empty	30	17
Protective Envelopes (replacement)	50	5
Shipping Carton for 30 5-Packs	25	55
Top and Bottom Pads for above carton	50	25
Shipping Carton for 10 5-Packs	25	20
Top and Bottom Pads for above carton	50	8-1/2
Shipping Carton for 5 5-Packs	25	14
Top and Bottom Pads for above carton	50	3
Shipping Carton for 1 5-Pack	25	10
Shipping Carton for Single Diskette	25	7
Die-Cut (spacer) for a 5-Pack	25	5-1/2

*Diskettes are shipped in one 5-pack box for each five diskettes ordered, with each diskette enclosed in a protective envelope. Each 5-pack box also contains a "Recommended Handling Information Sheet" and a package containing 30 blank diskette labels, six each in red, blue, yellow, green, and gray colors.

Appendix G. ASCII Feature Differences

ASCII-coded machines are available in the U.S. and Canada by special feature. This appendix describes the differences in appearance and operation between the ASCII-coded and the EBCDIC-coded machines. Where no differences are described, appearance and operation of ASCII-coded machines are as described throughout this manual for EBCDIC-coded machines. BSC Transparent operation is not possible using ASCII. For transmission to an ACSII programmable 3770 terminal, 3770 programs must be converted by the CPU before they are transmitted to the terminal, as described in Chapter 5.

Keyboard

The ASCII keyboard is similar in appearance to the EBCDIC keyboard, but has 48 graphic keys and provides 94 characters. This 94-character set is shown in Appendix B.

Console Printer

The ASCII 94-character set as shown in Appendix B is provided on the 3771, 3773, or 3774 console printer. Either the ASCII 64- or 94-character set is available on the 3775 console printer. An alternate print belt (64- or 94-character set) can be purchased.

3784 Line Printer

The ASCII 48-, 64-, or 94-character set as shown in Appendix B is available for the 3784. Additional print belts can be purchased.

3521 Card Punch

The ASCII 64-character set (see Appendix B) is provided for the 3521 Card Print feature. Data punched on the 3521 will be punched in the Hollerith representation of the ASCII code, as shown in Appendix A.

Display (3774/3775 Programmable Models)

The Display attached to the 3774 Model P1 or P2, or 3775 Model P1 can display all characters of the ACSII 94-character set shown in Appendix B.

Operational Differences

Keyboard

The INDEX key on the ASCII keyboard performs no function when pressed by itself. Pressing the INDEX key in conjunction with the CODE key causes the console printer to perform a line feed function, and does not store a character in the buffer.

BSC Space Compression/Expansion (3770 Nonprogrammable Models)

The control character sequence inserted by the 3770 to identify compressed spaces is the ASCII GS character (hex '1D') followed by a character (binary number) specifying the number of omitted spaces. The binary numbers representing the omitted spaces are as follows:

Number of Spaces	*ASCII: 7 6 5 4 3 2 1*
2	1 0 0 0 0 1 0
3	1 0 0 0 0 1 1
.	.
.	.
.	.
63	1 1 1 1 1 1 1

2502/3782 with Optical Mark Read

The mark-read-transfer character used to indicate the end of a punched data field and transfer to mark-read mode is the ASCII FS character (card code 11-9-8-4, hex '1C').

Control Characters

The following tabulation shows the EBCDIC control characters and the equivalent ASCII characters:

EBCDIC	*ASCII*
IRS	RS
NL	LF
IGS	GS
IFS	FS

Substitute the ASCII character shown for the equivalent EBCDIC character wherever it appears in this manual. The EBCDIC LF character has no equivalent ASCII character.

3776 Performance

Rated printer performance of the ACSII 3776 will be about 2% less than the EBCDIC 3776.

Appendix H: Record Format Control

Record Format is a program defined procedure used to increase the offline flexibility in processing data on the 3774 or 3775. The first Diskette Storage Device is a prerequisite for this feature. Data can be accepted by the system for processing from the keyboard or from an alternate input device such as card reader or a second Diskette Storage Device. Processing capabilities include the following:

- editing
- validity checking
- character insertion
- source/sink designation.

The new data can then be printed on the console printer and/or sent to an alternate output device such as card punch, line printer, or a second Diskette Storage Device.

The Record Format Specification Data Set must be contained on the first Diskette Storage Device when using the procedure and can be punched in cards and written onto the diskette in the normal card reader-to-diskette operation. Or it can be entered through the keyboard or received from communication line. When coding the Record Format Specification Data Set, the following must be observed:

- Each character in a name must be converted to its hex representation.
- All decimal values must be converted to hex values.
- The two characters for each hex byte cannot span card boundaries, print lines, or input buffers.

Odd characters (unpaired) in violation of the above, and characters other than 0-9 and A-F, are flagged as errors when the Record Format job is started.

Job Example

The following example illustrates Record Format operation.

In this example (Figure H-1) the user is a local store in a retail chain. The store sends out its own invoices to their charge customers and also transmits all charge sales to a master file at the chain's headquarters. Thus the user needs a printed invoice and a diskette for later transmission. He has a master card file of all his charge customers with name, address and identifying number; along with copies of the day's charges. Input from the master card file is used to print the name and address on an invoice. Input from copies of the day's charges is keyboard-entered for the body of the invoice. Selected information from both sources is directed to the diskette for later transmission.

The job definition for this job should specify the data set name for the Record Format Specification, the card reader as the alternate input device, and the diskette as the alternate output device. Vertical and horizontal tab stops must also be entered during the job definition; vertical and horizontal tabbing are under control of the Control Field Descriptors (CFDs) and Field Descriptors (FDs).

The header for this example would be as follows:

Field	Input Data Set Name	Output Data Set Name	Input Record Length	Output Record Length
Actual Name or Decimal Value	(none)	OR01	80	256
Entry	'00000000'	'D6D9F0F1'	'50'	'00'
	(Bytes 1-4)	(Bytes 5-8)	(Byte 9)	(Byte 10)

In this example, the logical input record length is 80 bytes. Data from this record is processed by CFD1 and its associated FDs. Each FD describes a field within the record. After the last FD or field is processed, the next CFD (CFD2) is activated. The FDs associated with this CFD all specify keyboard input, with item number and quantity fields directed to a diskette output record. This CFD and FDs are repeated for each line to be printed on the form. Processing using CFD2 repeats until the operator signifies (by use of the keyboard SKIP REC key) that there are no more items for this customer. When SKIP REC is pressed, CFD3 is activated to control printing of the total line.

A 256-byte output buffer is provided for assembling output records during processing. In the example, the customer number from each input card (logical record) and the keyboard-entered item number and quantity for each item charged are placed in the output buffer. The assembled record is then written onto the diskette. Using diskette output, it may be desirable to insert IRS characters between invoices, as shown, to separate customer orders. This information could later be punched into cards or printed, if desired, with a card punched or a line printed for each customer. Insertion of the IRS character in this example would be specified by the last FD processed under CFD3.

A variation of the job described might use card input for selected fields in the detail (body) lines of the form, with header cards identified by a '1' punch in column 80 (or other convenient column) and detail cards identified by a '2' punch. Using the argument capabilities under control of the CFDs, selective processing of CFDs is possible.

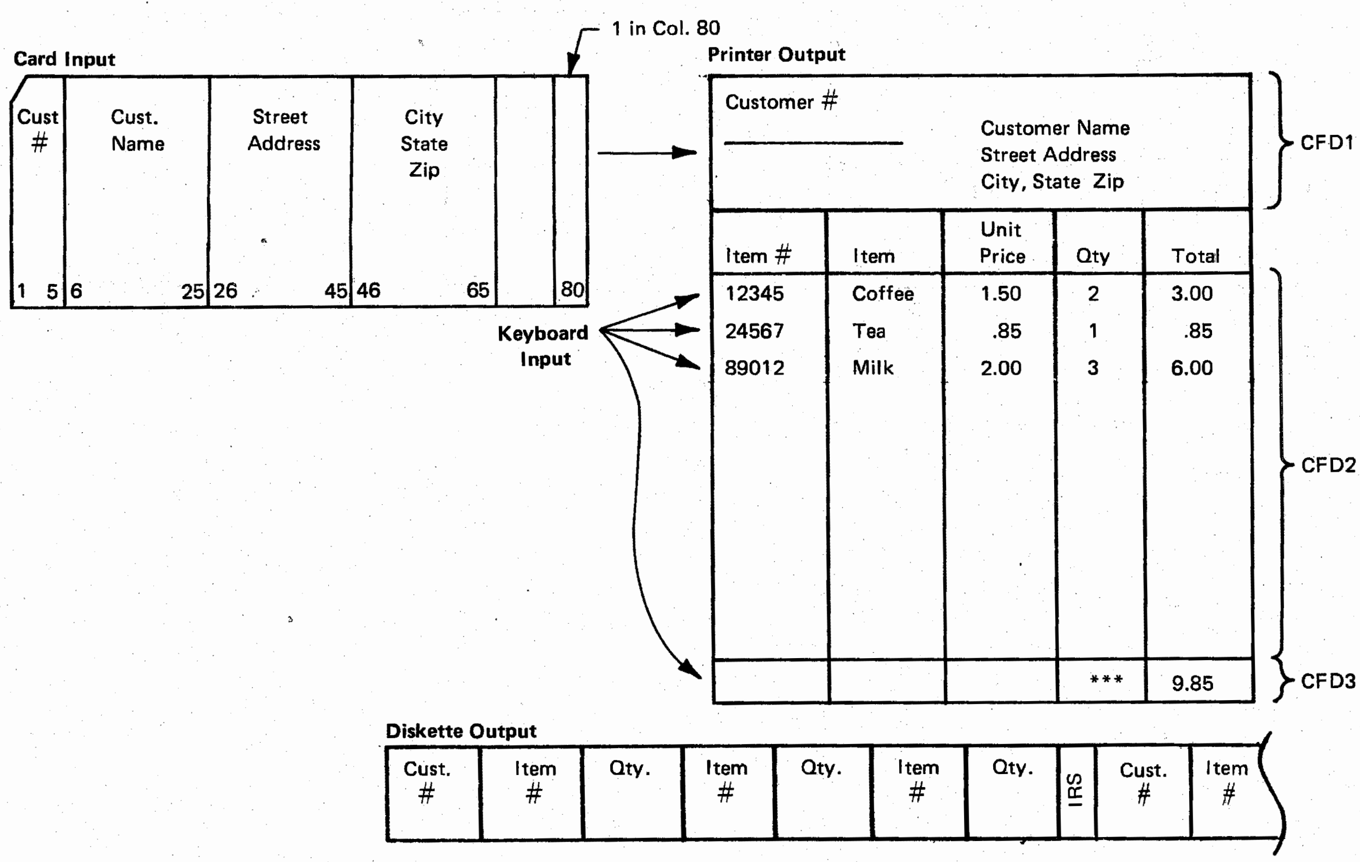


Figure H-1. Sample Job

Creating a Record Format Specification Data Set

The Record Format Specification data set must be contained on Diskette Storage Device 1 before using the Record Format Procedure. It may be written to the diskette from the communication line, card reader or the keyboard. The data set is assigned a data set name following the procedure for any other data set contained on diskettes. Example: RF01. This data set name is used when starting the Record Format job.

The Record Format Specification (see Figure H-2) consists of a 10-byte header, 5-byte control field descriptors (CFDs), and 5-byte field descriptors (FDs). A total of 200 descriptors can be accommodated for any Record Format job. The Record Format Specification must be written by the user.

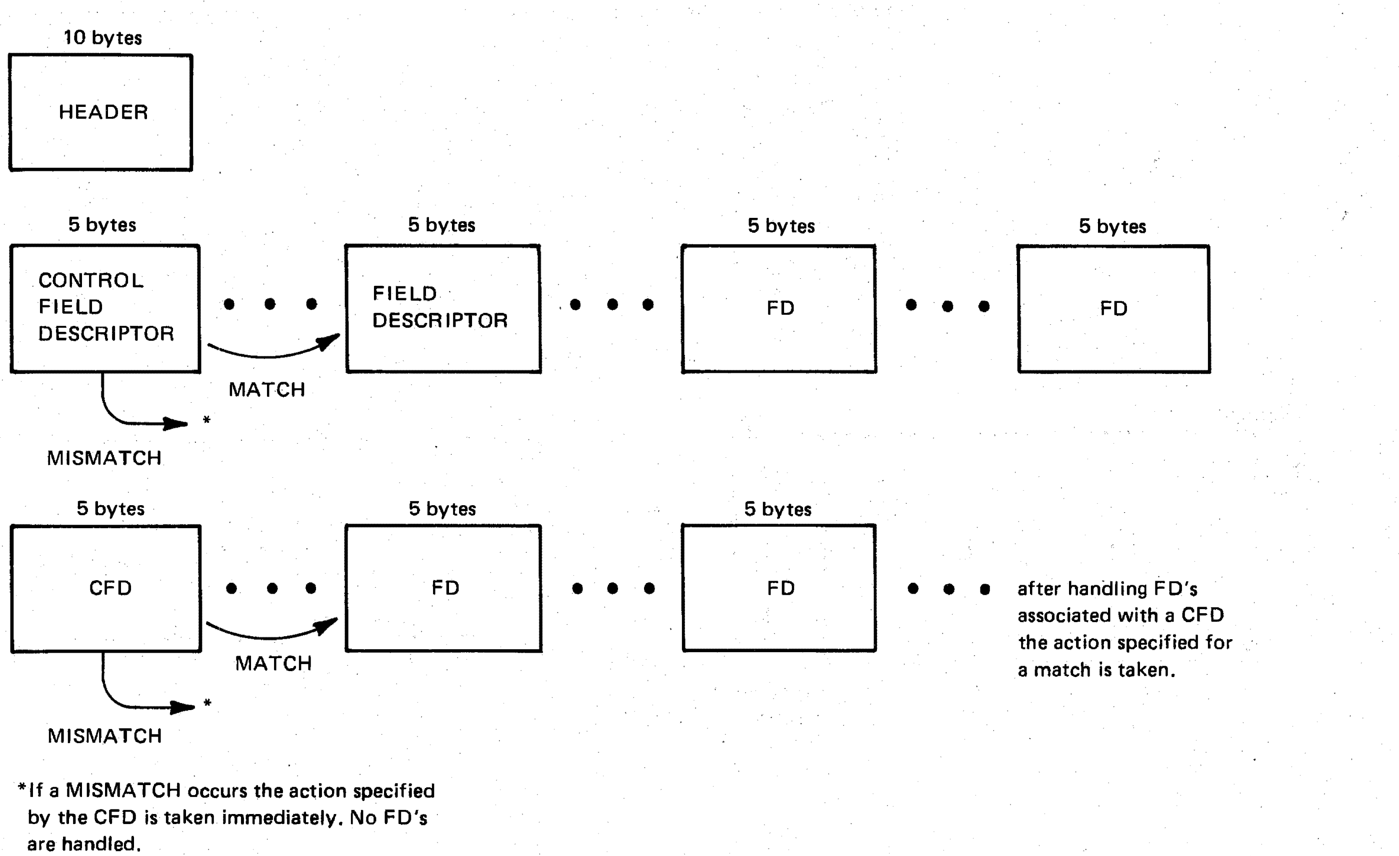


Figure H-2. Record Format Specification

Header

The header contains the data set names for the input and/or output files, if the diskette is used as the alternate input or output device. For example, assume that the data set name AA01 is used as an alternate input. Each character is converted to its hex representation. When punching the coded specification into cards, or entering it onto diskette from the keyboard, this two-digit representation for each character is entered directly. The entry for our example would be 'C1C1F0F1'. If any other device is used as an alternate, this field would be filled with NULs (hex 00). The logical input record length and output record length are likewise converted to hex and entered as bytes 9 and 10 respectively in the header. In these two bytes, '00' is entered if the length is 256. Figure H-3 shows the header format.

Input DSN	Output DSN	Logical Input Record Length	Output Record Length
4 Bytes	4 Bytes	1 Byte	1 Byte
Data set name of input data for diskette as alternate source	Data set name of output data for diskette as alternate output	Actual length or 00 if length is 256	Actual length or 00 if length is 256
or 00000000	or 00000000	Convert decimal length to hex.	Convert decimal length to hex.

10 Bytes

Figure H-3. Header Format

Control Field Descriptors

The control field descriptors, designed for program looping and branching, perform a test that determines whether or not the fields (designated by the field descriptors that follow a CFD) are to be handled. Each CFD contains a description of the test to be made and the next CFD to be examined as a result of the test. The CFD and the FDs that follow it describe the output selected from one logical input record plus the keyboard input that can be interspersed. See "Implementation Considerations–CFD Argument and Routing" in this section for details on CFD usage.

CONTROL FIELD DESCRIPTOR (5 BYTES)				
Control Byte	Displacement Byte	Length Byte	Attribute Byte	Immediate Byte
0 | 1 2 | 3 4 5 6 7	0 1 2 3 4 5 6 7	0 1 2 3 4 5 6 7	0 1 | 2 | 3 | 4 5 | 6 7	0 1 2 3 4 5 6 7
Bits 0 =0 CFD 1,2 =00 No vertical forms control =01 Skip to next form =10 New Line function =11 Vertical Tab function 3, 4, 5, 6, 7 =Binary representation of number of horizontal tab stops from left margin (00000= left margin)	Bits 0-7 Displacement of Argument field in alternate source record (in binary) 00 = no displacement	Bits 0-7 Length of Argument field (in binary) 00 = length of 256	Bits 0,1 (Argument) =00 None =01 Key/Alt. =10 Key/Imm =11 Alt./Imm 2 =1 Print Keybd Argument 3 =1 Reset Emitter Buffer Pointer 4,5 (Mis-match or Skip) =00 This CFD & Copy =01 This CFD =10 Next CFD =11 First CFD 6,7 (Match) =00 This CFD, override specified vertical forms movement, do New Line =01 This CFD =10 Next CFD =11 First CFD	Bits 0-7 Immediate Data used as argument, if specified

Figure H-4. Control Field Descriptor Format

Control Byte: Bit 0 of the control byte is always a "0", which identifies these five bytes as a CFD.

Bits 1 and 2 control the vertical forms movement. Forms movement occurs on a match condition, if bits 1 and 2 are other than "00".

Bits 3 through 7 control horizontal tabbing, and cause an immediate tab to whatever tab stop is specified, if the argument specifies a match condition.

Forms movement defined by the control byte will occur immediately regardless of a match or mismatch, if Kbd/Alt or Kbd/Imm, and Print Keyboard Argument are specified in attribute byte (bits 0, 1, and 2).

Displacement Byte: This byte specifies the beginning of the argument field, if used, from the alternate source. A displacement of up to 255 bytes can be specified, with the first position having a displacement of zero.

Length Byte: This byte specifies the length of the argument field. A length of 256 can be specified by coding "00" in this byte.

Attribute Byte: Bits 0 and 1 specify the data that will be compared, if an argument is specified. The comparison will be between keyboard-entered data and the argument field specified in the alternate-source data, between a keyboard-entered character and the character in the immediate byte, or between the argument field in the alternate-source field and the immediate byte. If a mismatch occurs, action will be whatever is specified in bits 4 and 5. If a match occurs, the action specified by bits 6 and 7 is taken. If 00 is specified in bits 0 and 1, a match action is forced.

Bit 2, if set to a "1", will cause printing of the keyboard-entered argument, if Kbd/Alt or Kbd/Imm is specified in bits 0 and 1. If bit 2 is "0", printing of the keyboard-entered field is suppressed.

Bit 3, if set to a "1", will cause the emitter buffer pointer to be reset to the beginning of the buffer. See "Implementation Considerations—Emitter Buffer as Source and Destination" in this appendix, for additional information on emitter buffer use.

Bits 4 and 5 specify the action to be taken when a mismatch (the argument specified in bits 0 and 1 does not result in an equal comparison) occurs, or when the SKIP REC key is pressed. When a mismatch occurs, the data specified by the following FDs is not included in the output record. If 4 and 5 equal "00", the action taken is to copy the current input record to the alternate output device if one is defined, or to the printer if alternate output is not defined. When copying to the printer, forms control specified in the CFD is used. The program then returns to the current CFD. Bits 4 and 5 equaling "01" causes the program to return to this CFD without the copy function. Bits 4 and 5 equaling "10" causes a branch to the next CFD, and equaling "11" causes a return to the first CFD.

Bits 6 and 7 specify the action to be taken when a match occurs in the argument. If a match occurs, field descriptors associated with the current CFD are handled before taking the match action. If 6 and 7 equal "00", the program returns to this CFD after the following FDs are processed, overrides any vertical forms movement specified in the control byte, and causes the printer to perform a new-line function. This option overrides a vertical tab or a new page only. If the CFD Control Byte bits 1 and 2 are "00", no forms movement occurs. In any case, forms movement on a CFD depends on the argument match or mismatch as described under "Control Byte". Bits 6 and 7 equaling "01" causes the program to return to this CFD without overriding the forms control. Bits 6 and 7 equaling "10" causes a branch to the next CFD, and equaling "11" causes a return to the first CFD.

Immediate Byte: This byte contains the character to be compared to the keyboard-entered character or alternate-source character if such an argument is specified in bits 0 and 1 of the Attribute Byte. For both EBCDIC and ASCII machines, the *EBCDIC* hex representation must be used (see Appendix A, Figure A-1).

Field Descriptors

The Field Descriptors (Figure H-5) describe each field for the job, as follows:

- The source of the input data (keyboard, alternate input, or immediate byte), the relative position of data in the alternate-source record, and the field length
- "Dummy" fields for the operator control functions Skip Record and Add Record
- Modulus 10 or 11 self-checking to be performed on keyboard input
- The output device (destination) for each field of data
- Decimal insertion
- Right justify and fill with immediate byte
- Numeric entry checking
- Vertical and horizontal tabbing
- An immediate byte for use as a constant, or as a fill character

FIELD DESCRIPTOR (5 BYTES)				
Control Byte	Displacement Byte	Length Byte	Attribute Byte	Immediate Byte
0 | 1 2 | 3 4 5 6 7	0 1 2 3 4 | 5 | 6 | 7	0 1 2 3 4 5 6 7	0 1 | 2 3 | 4 | 5 | 6 | 7	0 1 2 3 4 5 6 7
Bits 0 =1 FD	Bits 0-7 Displacement of data within the alternate source record (in binary) 00 = no displacement	Bits 0-7 Field length of source data (in binary) 00 = length of 256	Bits 0,1 (Source) =00 Emitter Buffer =01 Keyboard =10 Alternate =11 Immediate	Bits 0-7 Immediate Data used as source or fill data
1,2 =00 No vertical forms control =01 Skip to next form =10 New Line function =11 Vertical Tab function	0-7=FF Dummy Keyboard Entry		2,3 (Destination) =00 Emitter Buffer =01 Printer =10 Alternate =11 Both	
3, 4, 5, 6, 7 =Binary representation of number of horizontal tab stops from left margin (00000=left margin)	5 =1 Generate only		4 =1 New Record Out	
	6 =1 Modulus 10 Self-Check		5 =1 Decimal Insert	
	7 =1 Modulus 11 Self-Check		6 =1 Right justify and fill with Immediate	
			7 =1 Numeric Check	

Figure H-5. Field Descriptor Format

The sequence of the FDs themselves specifies the sequence in which the fields they describe will appear in the output.

Control Byte: Bit 0 of the control byte is always a "1", which identifies these five bytes as an FD.

Bits 1 and 2 control the vertical forms movement. Forms movement occurs immediately, if bits 1 and 2 are other than "00".

Bits 3 through 7 control horizontal tabbing and (if the field is to be printed) cause an immediate tab to whatever tab stop is specified.

Displacement Byte: This byte specifies the displacement of the data in the alternate-source record or emitter buffer. A displacement of up to 255 bytes can be specified. If "00" is specified, the source data begins with byte 1 of the record.

To allow insertion of records from the keyboard in a job normally using the alternate input device, a "dummy" keyboard field must be coded in an FD preceding the FD (or FDs) calling for the alternate source input. By coding "01" in attribute byte bits 0 and 1 (keyboard source) and 'FF' (all 1's) in the FD displacement byte, a dummy keyboard field is indicated. When this FD is encountered, FD execution stops and the operator may press either EOM to proceed to the next FD without keyboard entry, SKIP REC to skip the current logical record, or ADD REC (CODE/SKIP REC) to add a record from the keyboard. Pressing ADD REC (CODE/SKIP REC) causes all following FDs of this CFD group specifying alternate input to be replaced with signals for keyboard fields of the same length. This allows entry of a record from the keyboard in an otherwise all-alternate input job.

If the keyboard is the source, bits 5, 6, and 7 of the displacement byte indicate that a standard self-check digit algorithm is to be performed on the keyed data. Bit 5=1 indicates that the check digit is to be generated only and stored in the output field. Bit 6=1 invokes a modulus 10 algorithm; bit 7=1 invokes a modulus 11 algorithm. If bit 5=1, and bits 6 and 7 = 00, modulus 10 self-checking is assumed. Decimal insertion (attribute byte bit 5) and right justify and fill (attribute byte bit 6) cannot be specified for self-checking fields. The self-check field will not be tested for all numeric unless numeric checking is specified (see "Attribute Byte"). If numeric checking is not specified, self-checking is performed only on the numeric characters in the field: non-numeric data is ignored. See "Self-Checking" for an explanation of self-check operation; see "Implementation Considerations—Checking and Editing Functions" in this appendix for implementation considerations.

Length Byte: This byte specifies the length of the source field. If this field contains all zero bits, the field length will be 256 bytes.

Attribute Byte: Bits 0 and 1 specify the source of data, either emitter buffer, keyboard, alternate, or immediate byte, to be used as input for this FD.

Bits 2 and 3 specify the destination, either emitter buffer, printer, alternate, or both printer and alternate, to which the source data is directed. See "Implementation Considerations—Emitter Buffer as Source and Destination" in this appendix, for additional information on use of the emitter buffer.

Bit 4, if set to "1", causes the source data described by this FD to begin a new output record. Using card as alternate output, the assembled output record is punched. Using the diskette as the alternate output, the output record is written onto the diskette. If the output record buffer is empty, no record is punched or written.

Bit 5, if set to "1", causes a decimal to be inserted between the hundreds and tens position of the *printed* output field for this FD (the field directed to the alternate output device is not edited). Field length cannot exceed 255 for a field to be edited by decimal insertion.

Bit 6, if set to "1", causes the output field for this FD to be right-justified; that is, the field is shifted to the right until the rightmost character is non-blank. The field is filled on the left with the character specified in the immediate byte. If the input field is all blanks, an output field consisting of all fill characters is generated.

Bit 7, if set to "1", causes the terminal to perform a numeric check on the field. Numeric fields under Record Format follow these guidelines:

1. Leading blanks are allowed.
2. Leading '±' allowed.
3. Leading blanks up to '±' are allowed.
4. Items 1, 2, 3 are allowed, followed by any number of digits such that the total field length is less than 256.
5. Digits may be followed by any valid alphabetic character that creates the negative or positive zone overpunch of a valid digit (see Note 1), provided it is either the last character of the field or the remainder of the field is blank.
6. Trailing '±' is allowed if it is the first character after the last digit. the '±' may also appear as the character in the field length plus one position. Trailing '±' is allowed only for keyboard entered fields; trailing '-' causes the units position to be replaced with the zone punched character (see Note 1). The '±' character is

replaced with a blank character. Trailing '+' has no effect, but is replaced with a blank character.

Note 1: Conversion from numeric character to zone punched character:

Numeric	*Zoned '-'*	*Zoned '+'*	
0	**	**	(**= Nonprintable character)
1	J	A	
2	K	B	
3	L	C	
4	M	D	
5	N	E	
6	O	F	
7	P	G	
8	Q	H	
9	R	I	

Note 2: Use of the leading sign prohibits use of the zone punched character or trailing sign.

Note 3: Use of the zone punched character prohibits use of the trailing sign.
Examples of Numeric Check (Bit 7 set to 1):

Assume that the field length of the FD requesting numeric check is seven. The fields must follow one of the ofllowing patterns to pass the numeric test:

1. *No sign in the field:*

   ƀƀ123ƀƀ   ƀ = a blank.
   ƀƀ12345
   12345ƀƀ
   1234567

2. *Leading sign in the field:*

   (May not have zone punched units or trailing sign.)

   ƀ±123ƀƀ
   ƀ±12345
   ±1234ƀƀ
   ±123456

3. *Zone punched units digit:*

   (May not have leading or trailing sign.)

   ƀƀ12Lƀƀ
   ƀƀ1234N
   1234Eƀƀ
   123456G

4. *Trailing sign in field:*

(Keyboard entry fields only; may not have leading sign or zone punched units.)

ƀƀ123±ƀ
ƀƀ1234±
ƀƀ12345±
1234±ƀƀ
123456±
1234567±

All keyboard source fields print regardless of the specified destination. Keyboard fields to be edited are printed after editing takes place, unless self-checking is requested. This allows errors to be corrected before the field is printed. Fields on which self-checking is requested will print as keying takes place. See "Implementation Considerations—Checking and Editing Functions" for additional considerations.

Immediate Byte: This byte contains the character to be used as a source or as a fill character. For both EBCDIC and ASCII machines, the EBCDIC hex representation must be used (see Appendix A, Figure A1).

Implementation Considerations

Job Setup

The Record Format Specification must be written on Diskette 1 before a Record Format job can be selected for execution. The job definition entered by the operator must specify the data set name for the Record Specification, and the alternate input and output devices for the job; also the vertical and horizontal tab stops must be set up. When the job is selected for execution, the Record Format Specification reads in from the Diskette into the controller. A CPU Interrupt is not allowed during the job.

Input Record Processing

After execution of a CFD and its FDs (assuming that no argument is specified in the CFD), processing will always continue using the next sequential logical input record from the alternate input device. That is, when the last FD for the CFD is executed, the next reference to the alternate source record will access the next logical record. Alternate source record fields can be accessed and interspersed with keyboard-entered fields within the same CFD. There is no restriction on the number of times that the alternate source can be referred to, nor on the sequence in which the fields are referred to under a single CFD.

CFD Argument and Routing

Using the match and mismatch specifications of the CFD attribute byte, the user can cause different flow and processing of the input records. Following a matched argument and execution of the following FDs, processing continues with the next sequential logical record, using either the same, the next, or the first CFD. As long as the alternate input record is referred to in a CFD or its FDs, and a match occurs on the argument, processing continues in this manner. If the alternate source record is *not* referred to in a CFD or following FDs, processing continues using the *same* logical record. For example, a Keyboard/Immediate argument resulting in a match condition will not cause processing of the next logical record. The same record will be processed by whatever CFD (same, first, or next) is specified in the CFD attribute byte. Figure H-6 shows the CFD argument and routing, and logical record processing capabilities.

Using the Keyboard/Alternate argument, the alternate input file can be searched for a field that matches the keyboard-entered argument field. By coding a mismatch action of This CFD and Copy or This CFD, the same CFD will execute repetitively, comparing the original keyboard-entered argument against the alternate source field in successive logical records until a match is found. The keyboard-entered argument in this case is stored for use in successive argument comparisons. If no match is found, the search will continue to the end of the alternate input file.

Add Record/Skip Record Functions

The SKIP REC (Skip Record) function is allowed anytime a CFD is encountered that specifies either a Keyboard/Immediate or a Keyboard/Alternate argument. When such a CFD is encountered, execution stops to allow the operator to either:

1. Enter the keyboard argument, which results in a match or a mismatch condition, or
2. Press SKIP REC, which forces a mismatch condition.

If SKIP REC is pressed, the FDs following the CFD are not executed. Execution will continue using the same, next, or first CFD as specified by the mismatch action, and in any case using the next logical record.

The SKIP REC function is also allowed when an FD is encountered that specifies a keyboard-entry field. In this case, pressing the SKIP REC key causes any data fields already entered using this CFD (from the keyboard or alternate source) to be deleted from the output record. Processing continues with the CFD specified for the mismatch argument (first, next, or this) and using the next logical input record. If the CFD contains an FD that specifies New Record Out, the entire output record created up to this point is deleted.

For the ADD REC (Add Record) key to be a valid function, a keyboard source field must be specified in an FD. When the keyboard source FD is encountered, the operator may press ADD REC (CODE/SKIP REC), which causes all following FDs specifying alternate source to be replaced with signals for keyboard fields of the same length. This allows the entry of an entire record from the keyboard for an otherwise all-alternate input job. The next CFD processed will use the same alternate source record. The operator also has the option to press SKIP REC for the FD which causes the action described above, or may press EOM to cause a skip over the field specified in this FD and place blanks in the alternate output record. In this case, processing continues using the next sequential FD.

Checking and Editing Functions

Self-checking or numeric checking, or both, can be done on a keyboard-entry field. If self-checking only is specified in an FD, checking is done only on numeric characters contained in the field. Alphabetic or other characters will be allowed, but are ignored as far as calculation of the self-check digit is concerned. Numeric checking, if specified, will cause an error indication to the operator if entry of a non-numeric character is attempted. If self-checking fields should contain no non-numeric characters, then numeric checking should also be specified for self-check fields. Right justification and fill, and decimal insertion, cannot be specified for self-checking fields.

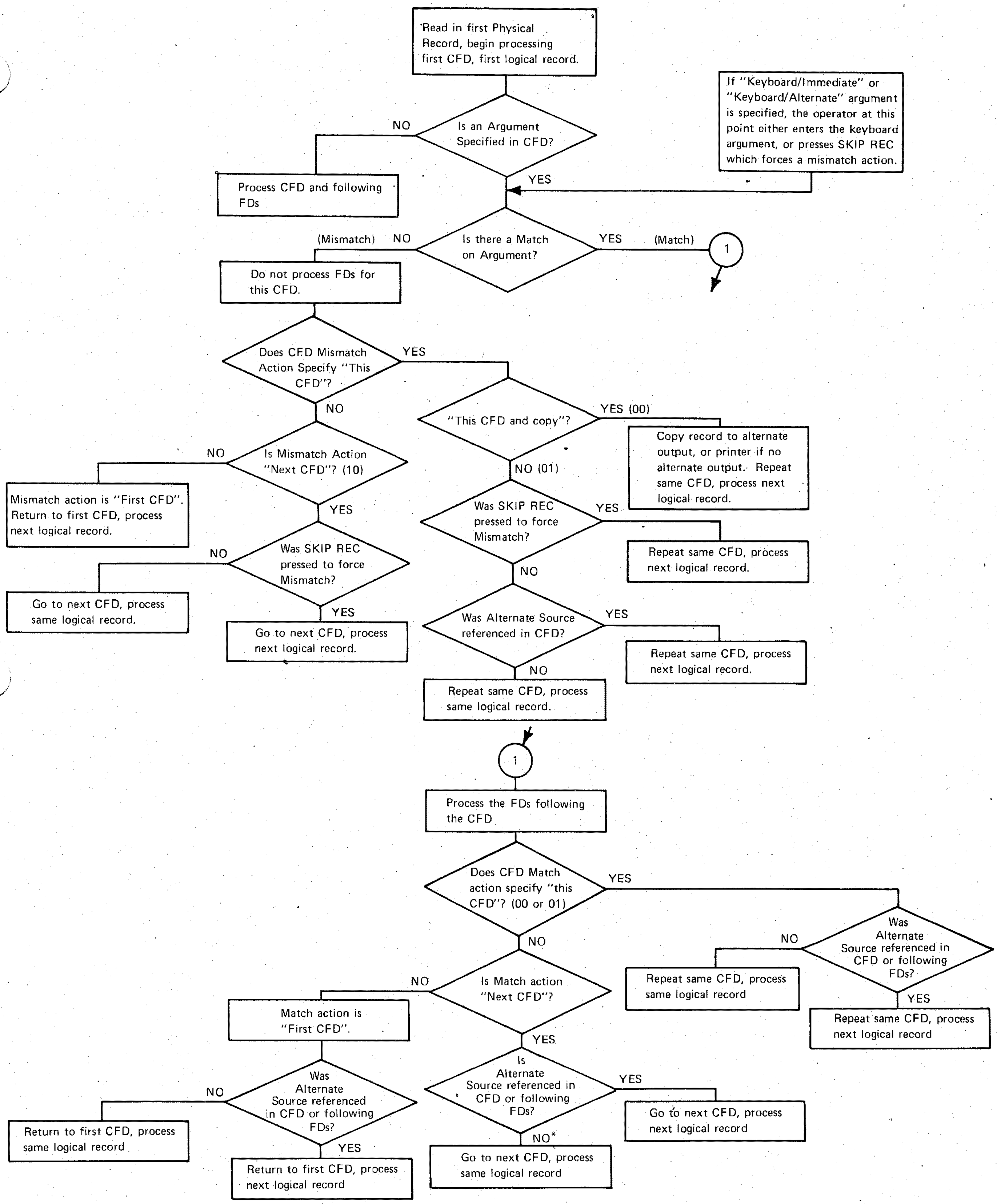


Figure H-6. CFD Argument and Routing

Numeric checking can also be done in conjunction with right justify and fill, and decimal insertion. All three of these could be specified and would be done in the following sequence:

1. Numeric Checking
2. Right Justify and Fill
3. Decimal Insertion

Decimal insertion can be specified for keyboard or alternate input fields, but editing is done only on a printed output field. A field directed to the alternate output is not edited. Right justify and fill can be specified for keyboard or alternate input fields, with editing done on both printed and alternate output.

Emitter Buffer as Source and Destination

An additional, 256-byte buffer is provided for use as both the source and destination for FDs. At the start of a Record Format job, the emitter buffer is initialized to spaces (X'40'). When used as a source, the displacement and length bytes of the FD specify the field in the same way as for the alternate-source fields, with one exception. The emitter buffer is 256 bytes long, but permits wraparound, continuous access. As shown in Figure H-7, when an FD requests a source field from the emitter buffer with a displacement of 240 and a length of 20, the FD accesses the *last* 16 bytes of the emitter buffer and appends to these the *first* four bytes of the buffer. This yields the requested, 20-character field.

Used as a destination for an FD, the same wraparound, continuous access applies to the emitter buffer. However, a displacement cannot be specified for fields sent to the emitter buffer. Output fields are stored sequentially, one after another, with wraparound, continuous access in effect. Using bit 3 of the CFD attribute byte, the user may specify that the emitter buffer pointer be reset to the beginning of the buffer before any further execution of FDs. When the pointer is reset, the next field sent to the emitter buffer is stored beginning in position one.

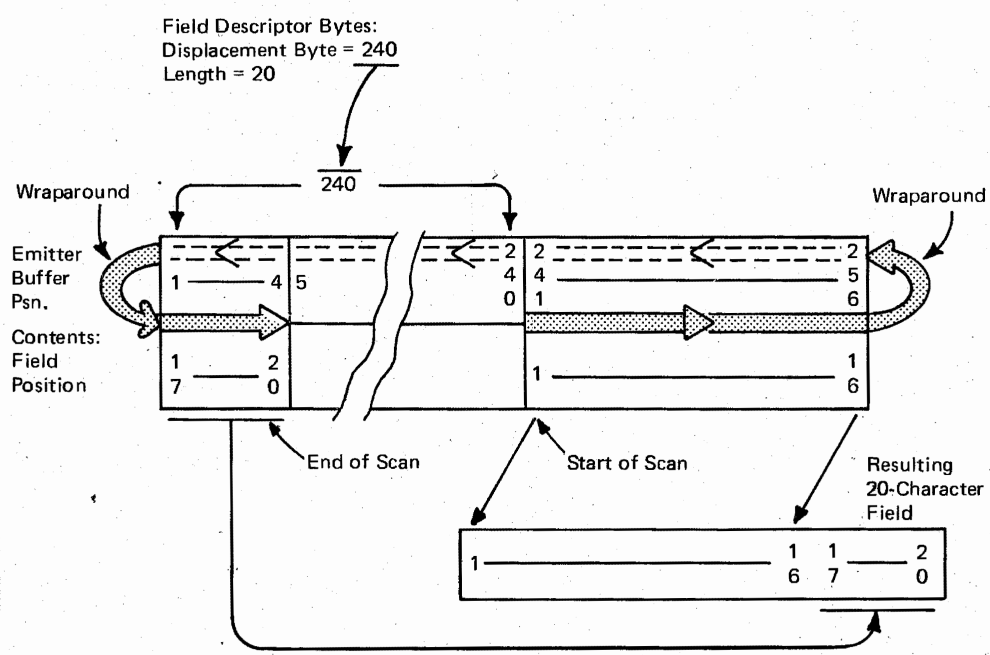


Figure H-7. Example of Emitter Buffer Wraparound

Ending a Job

Jobs with an alternate source device specified will terminate normally (come to normal job end) when the alternate source data is exhausted (end of file is reached). A partially filled output record buffer is read out to the alternate output device at normal job end. The STOP JOB key can be pressed at any time during the job, but will cause loss of data if a partially filled output record buffer has not been read out, either because New Record Out has not been requested or because the specified output record length has not been reached (see "Output Records" in this appendix).

Jobs using keyboard entry only must be terminated by use of the STOP JOB key. In this case, too, data can be lost if a partially filled output record buffer has not been read out to the alternate output device.

Self-Checking

A self-check digit is the units position of a self-checking number. The self-check digit is developed by calculations made on the base number (the original number without the self-check digit). The calculated digit is then included with the base number to create the self-checking number. When a self-checking number is entered into the 3774 or 3775, the calculations originally performed are repeated, and the generated digit is compared to the self-check digit in the number that was entered. If the numbers are not the same, a self-check error is indicated. Self-check compare will be made against the last character in the field. Therefore, when entering the self-check digit for a checking operation, the digit to be checked must be the last character in the field.

When the Field Descriptor displacement byte specifies "generate only", then the self-check digit is computed on all the digits in the number that is entered. In this case, only the base number is present when the self-checking procedure begins, so no comparison is made when the self-check digit is computed. Instead, the generated digit is inserted in the units position of the output field.

The self-check digit is calculated using either the Modulo-10 or Modulo-11 algorithm, depending on which was specified in displacement byte position 6 or 7. If "generate only" is specified, and bits 6 and 7 are 00, Modulo 10 is assumed. If you calculate your own self-checking digits, you must perform the same computations as the 3774 or 3775 does, or else the self-check digits will not be the same. The Modulo-10 algorithm operates as follows:

1. Disregarding the self-check digit (if present), multiply the base number's units position, and every alternate position moving leftward, by two. For example:

   ```
    6   1   2   4   8   1
   x2      x2      x2
   ---------------------
   12       4      16
   ```

2. Add the digits of these products to the digits of the base number which were not multiplied by two:

   1+2+1+4+4+1+6 = 19

3. Subtract this total from the next higher number ending in zero:

   ```
    20
   -19
   ---
     1
   ```

4. The result of this subtraction is the self-check digit (in this example, 1). Thus, the complete self-checking number is 612481. The 3774 or 3775 treats a self-check digit of 10 as a zero.

The Modulo-11 algorithm operates as follows:

1. Disregarding the self-check digit (if present), multiply the units position of the base number by two, the tens position by three, the hundreds position by four, and so forth. Continue this procedure until you have multiplied by seven (if the number contains that many digits), then begin multiplying by two again. For example:

5	6	6	2	1	8	6	5
x2	x7	x6	x5	x4	x3	x2	
10	42	36	10	4	24	12	

2. Add the products to each other.

   10+42+36+10+4+24+12 = 138

3. Divide the sum of the products by 11;

```
     12
  11/138
    11
     28
     22
      6
```

4. Subtract the remainder of this division from 11.

```
  11
  -6
   5
```

5. The result of this subtraction is the self-check digit (in this case, 5). Thus, the complete self-checking number is 56621865. The 3774 or 3775 treats a self-check digit of 11 as a zero.

Note: A number that generates a self-check digit of 10 is illegal, and cannot be processed by an IBM 29 Card Punch that has the self-checking number feature. You should not use such numbers as self-checking numbers. (If requested to generate a self-check digit on such a number, the 3774 or 3775 generates a zero.)

Example Specification

Figure H-8 shows an example for a Record Format job for processing a payroll application. In this example, the input devices are the keyboard and the card reader. The output devices are the printer and the diskette. Employee information (name, ID number, and hourly rate) is read from the master card file, and the hours worked is keyboard-entered. This input is used to create a payroll register and to create a diskette data set for transmission to the CPU.

Each input card is tested for a 1 punch in column 80, which indicates that the employee is non-exempt and should be processed. If there is not a match (no "1" punch in column 80), this input record is skipped (the following FDs are not processed), and processing continues with the next input record. If there is a match on this argument, the following FDs are executed. The first FD defines a keyboard-entered dummy field for which the operator has two options:

1. EOM may be pressed to proceed to the next FD (cause the employee name to print);
2. ADD REC (CODE and SKIP REC) may be pressed to add a line for a new employee for which no card exists.

The second FD prints the name field read from the card. The third FD defines a keyboard-entered dummy field for which the operator has two options:

1. EOM may be pressed to proceed to the next FD (cause ID field to print);
2. SKIP REC may be pressed to skip the card for this employee, and skip to the next card. This deletes the employee's record from the output file.

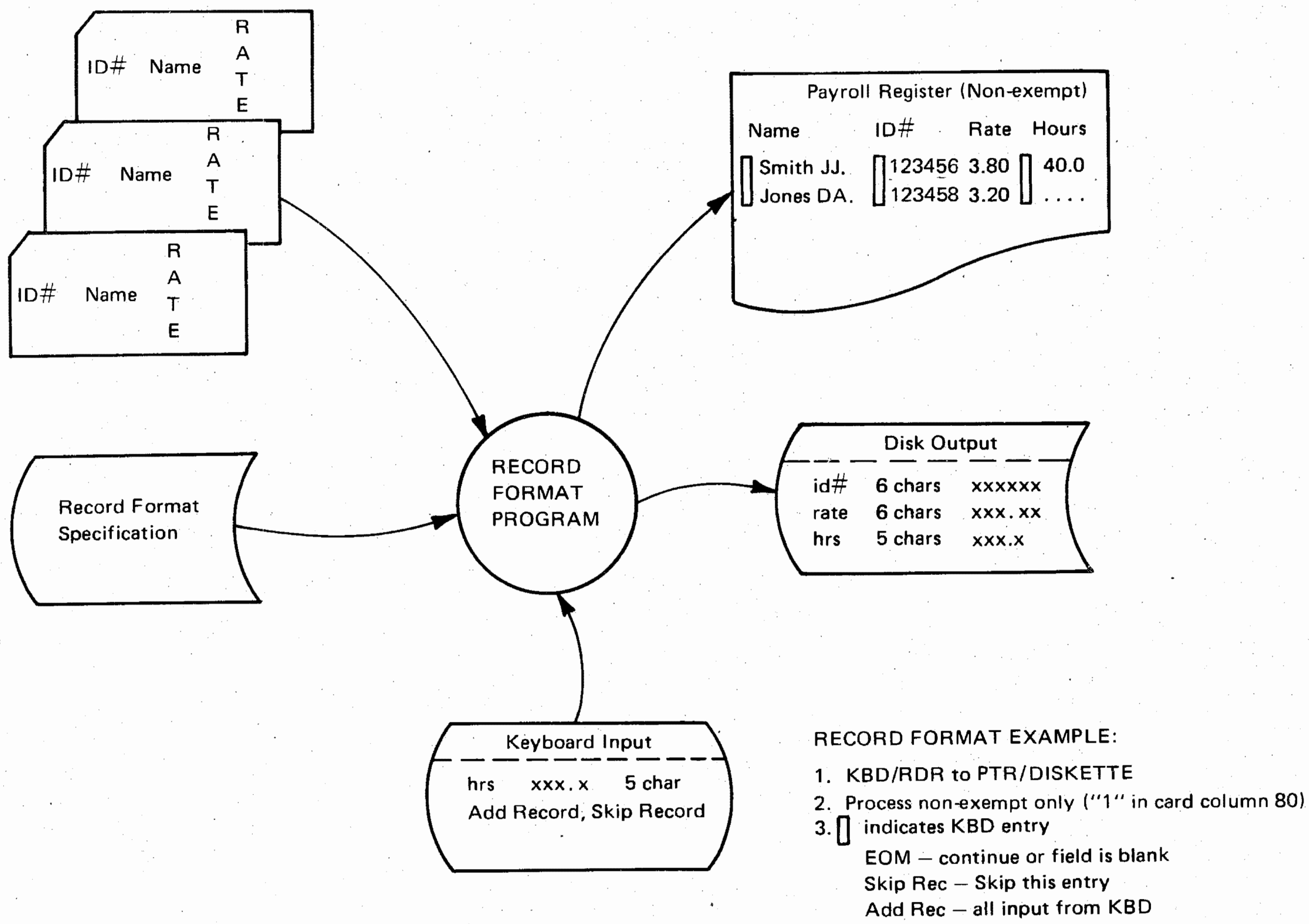


Figure H-8. Record Format Example (Part 1 of 2)

The fourth FD accesses the ID field of the card and directs it to both the printer and the diskette. The fifth FD accesses the hourly rate from the card data and directs it to both the printer and the diskette. The last FD defines a keyboard-entered field, and the operator has the option to press EOM (which leaves the field blank), or to enter the hours worked. FDs 4, 5, and 6 cause the ID number, rate, and hours worked to be included in the diskette output record. When the length of the output record becomes equal to that specified for the Output Record Length in the Header (170 bytes), the output record is written onto the Diskette. The hours worked, if entered, is directed to the printer and the diskette. When all cards have been processed, the job stops.

Alternate Input: Card Reader
Alternate Output: Diskette

	Input DSN				Output DSN				Input Rec Length	Output Record Length
Header:	00	00	00	00	D9	C6	F0	F1	50	AA

CFD:	40	4F	01	C4	F1	Start new page first time; NL otherwise. Test for 1 col. 80.
FD1	80	FF	00	50	00	No vertical forms control, no horizontal forms control, keyboard entry (dummy). Press CODE/ADD REC to insert new employee.
FD2	81	06	19	90	00	Get name field, no vertical forms control, tab to 1st horizontal tab stop and print.
FD3	82	FF	00	50	00	No vertical forms control, tab to 2nd horizontal tab stop. Press SKIP REC to delete employee information from output file.
FD4	82	00	06	B0	00	Get ID field, no vertical forms control, tab to 2nd horizontal tab stop, printer and diskette output.
FD5	83	1F	06	B0	00	Get rate field, no vertical forms control, tab to 3rd horizontal tab stop, printer and diskette output.
FD6	84	00	05	70	00	Keyboard entry, no vertical forms control, tab to 4th horizontal tab stop, printer and diskette output.

Figure H-8. Record Format Example (Part 2 of 2)

Appendix I. Abbreviations and Glossary

Abbreviations

ACK	affirmative acknowledgement
ANS	Automatic Network Shutdown
APPL	application program (in CPU)
ASCII	American National Standard Code for Information Interchange
ATTN	attention (key)
BB	beginning of bracket
BBP	begin bracket pending
BDS	beginning of data set
BETB	between brackets
BIU	basic information unit
BLU	basic link unit
BM	bottom margin (character)
BOC	beginning of chain
bpm	buffers per minute
bps	bits per second
BS	backspace (character)
BSC	Binary Synchronous Communications
BTU	basic transmission unit
CCITT	International Telephone and Telegraph Consultative Committee
CD	change direction
CFD	control field descriptor
CICS	Customer Information Control System
CLSDST	Close Destination
cpl	characters per line
cpm	cards per minute
cps	characters per second
CPU	central processing unit
CR	carriage return/carrier return (character)
CRC	cyclic redundancy check
DAA	data access arrangement
DAF	destination address field
DCE	data communication equipment
DFC	data flow control
DLC	data link control
DOS	Disk Operating System
DR	definite response
EB	end of bracket
EBCDIC	Extended Binary Coded Decimal Interchange Code
EDS	end of data set
EIA	Electronic Industries Association
ENP	enable print (character)
ENQ	enquiry
EOB	end of block
EOC	end of chain
EOF	end of file.
EOM	end of message
EOT	end of transmission
ESC	escape (character)
ETB	end of transmission block
ETX	end of text
EX	exception response
FCS	frame check sequence
FD	field descriptor
FID	format identification
FM	function management
FF	form feed (character)
FS	field separator (character)
HT	horizontal tabulation (character)
ID	identification
IFS	intermediate field separator (character)
IGS	information gap separator
IMS	Information Management System
INB	in brackets
INP	Inhibit Print (character)
I/O	input/output
IRS	interrecord separator (character)
ISO/IS	International Organization for Standardization/International Standard
ITB	end of intermediate transmission block
IUS	information unit separator (character)
JES	Job Entry Subsystem
k	kilo, that is, 1000 (as in kilobits)
K	1,024 (as in bytes of storage)
LF	line feed (character)
LM	left margin (character)
LRC	longitudinal redundancy check
lpm	lines per minute
LU	logical unit
MH	message header
MOC	middle of chain
MPL	maximum print line (character)
MPLC	multipoint line control
MPP	maximum print position (character)
N/A	not applicable
NAK	negative acknowledgment
NCP	network control program
NL	new line (character)
no-op	no operation
NPR	numeric position readout
NPRO	non-process run out
NUL	null (character)
OAF	origin address field
OC	only one (RU) in chain
OLT	online test
OMR	Optical Mark Read
OPNDST	Open Destination
OS	Operating System
PIU	path information unit
PTT	Postal Telephone and Telegraph
PU	physical unit
PVS	Program Validation Services
RES	Remote Entry Services
RESP	response
RH	request header/response header
RJE	Remote Job Entry
RJP	Remote Job Processor
RM	right margin (character)
R/M	records per minute
RS	record separator (character)
RSCS	Remote Spooling Communications Subsystem
RTAM	Remote terminal access method
RU	request unit/response unit
RVI	reverse interrupt
SCB	String Control Byte (character)
SCS	SNA character string
SDLC	Synchronous Data Link Control
SDT	Start Data Traffic

SEL	select (character)
SHF	set horizontal format (character)
SNA	Systems Network Architecture
SNBU	switched network back up
SOH	start of heading
spool	simultaneous peripheral operations online
SSCP	system services control point
SSR	secure string reader (character)
STX	start of text
SVF	set vertical format (character)
TCAM	Telecommunications Access Method
TH	transmission header
TM	top margin (character)
TRN	transparent (character)
TS	transmission services
TTD	temporary text delay
VFC	vertical forms control
VM/370	IBM Virtual Machine Facility/370
VS	Virtual Storage
VT	vertical tabulation (character)
VTAM	Virtual Telecommunications Access Method
WACK	wait-before-transmit-positive acknowledgment

Glossary

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In this glossary, a complete commentary taken from ANSI is identified by an asterisk(*) that appears between the entry and the beginning of the commentary; a single commentary taken from ANSI is identified by an asterisk (*) *after* the item number for that commentary.

abort. To prematurely discontinue a job.

access method. A technique for moving data between main storage and input/output devices.

application program. A program written for or by a user that applies to his own work.

ASCII (American National Standard Code for Information Interchange). * The standard code, using a coded character set consisting of 7-bit coded characters (8 bits including parity check), used for information interchange among data processing systems, communication systems, and associated equipment. The ASCII character set consists of control characters and graphic characters.

ASP. Asymmetric multiprocessing system. An extension to the IBM System/360 Operating System that provides increased automation of computer operations for large-scale data processing installations. See also JES3.

asynchronous. Without regular time relationship; unexpected or unpredictable with respect to the execution of a program's instructions.

audible alarm. An alarm that is activated when predetermined events occur that require operator attention or intervention for system operation.

automatic answering. The capability to automatically respond to an incoming call over a switched network.

***batch processing.** (1) The processing of data or the accomplishment of jobs accumulated in advance in such a manner that each accumulation thus formed is processed or accomplished in the same run. (2) Processing of data accumulated over a period of time. (3) Loosely, the execution of computer programs serially. (4) Pertaining to the technique of executing a set of computer programs such that each is completed before the next program of the set is started. (5) Pertaining to the sequential input of computer programs or data. (6) In real-time systems the processing of related transactions that have been grouped together.

batch session. A session established between a communication controller and the host system for the purpose of transmitting batches of records or messages.

bid. In the contention form of invitation or selection, an attempt by the computer or a station to seize control of a line so that it can transmit data.

bidder. In SNA, the logical unit defined at session initiation as having to request and receive permission from the other LU to begin a bracket. Contrast with first speaker. See also bracket protocol.

Binary Synchronous Communications (BSC). Use of a standardized set of control characters and control character sequences for synchronous transmission of binary-coded data between stations in a data communication system.

block. In BSC, a segment of data transmitted as a unit, framed by appropriate transmission control characters, and causing a line turnaround to verify the accuracy of the transmission.

bracket. (1) In VTAM, an exchange of one or more messages between an application program and a logical unit that accomplishes some task defined by the user as uninterruptable. (2) In SNA, an uninterruptible unit of work, consisting of one or more chains of request units and their responses, exchanged between two logical units. Examples are data base inquiries/responses, update transactions, remote job entry output sequences to work stations, and similar applications. The request/response header (RH) of the first request of the first chain of the bracket indicates "begin bracket," and the RH of the first request of the last chain of the bracket indicates "end bracket."

bracket protocol. (1) In SNA, a data flow control protocol in which exchanges between logical units (LUs) are achieved through the use of brackets, with one LU designated at session initiation as the first speaker, and the other LU as the bidder. The bracket protocol involves bracket initiation and termination rules. (2) A method of communication in which a new bracket is not started until the bracket in progress is completed.

buffer. *A routine or storage used to compensate for a difference in rate of flow of data, or time of occurrence of events, when transmitting data from one device to another.

CCITT (International Telephone and Telegraph Consultative Committee). An international organization that promotes the standardization and coordination of worldwide communication facilities.

central processor. (1)* Synonym for central processing unit. (2) See also host processor.

chaining of RUs. See RU chain.

clocking. In binary synchronous communication, the use of clock pulses to control synchronization of data and control characters.

common carrier. A government-regulated private company that furnishes the general public with telecommunications service facilities; for example, a telephone or telegraph company.

cyclic redundancy check (CRC). A system of error checking performed at both the sending and receiving station after a block check character has been accumulated. See also longitudinal redundancy check.

data access arrangement (DAA). Data communication equipment that permits attachment of privately owned data terminal equipment and data communication equipment to the network.

data communication equipment (DCE). Any equipment whose function is to convert the communication terminal signals into a form suitable for transmission over a communication facility, and to convert signals received from the communication facility into a form suitable for transfer to the communication terminal. The DCE may be a modem or other type of signal-converter equipment.

data link. (1) An assembly of those parts of two data terminal equipments that define the protocol together with their interconnecting data circuit. This assembly enables a data source to transfer data to a data sink. (2) The communication channel, modem, and communication controls of all stations connected to the communication channel, used in the transmission of information between two or more stations. (3) The physical connection and the connection protocols between the host and communication controller nodes via the host data channel. (4) Contrast with communication line.

Note: A communication line is the physical medium; e.g., a telephone wire, a microwave beam. A data link includes the physical medium of transmission, the protocol, and associated communication devices and programs–it is both logical and physical.

data set. The data written on a disk (or other storage medium) for retrieval through use of a particular data set name.

diskette. A thin, flexible magnetic disk and a semi-rigid protective jacket, in which the disk is permanently enclosed.

diskette storage device. A direct access storage device that uses diskettes as the storage medium.

display. (1)* A visual presentation of data. (2) To present a display image on a display surface. (3) Deprecated term for display device.

duplex. Pertaining to a simultaneous, independent, two-way transmission (transmission in both directions). (Contrast with *half-duplex.*)

EIA (Electronic Industries Association). An organization that promotes standardization and cooperation among electronic equipment industries.

extent. A continuous space on a direct access storage volume, occupied by or reserved for a particular data set, data space, or file.

first speaker. In SNA, the logical unit (LU) defined at session initiation as (1) having the freedom to begin a bracket without requesting permission from the other LU to do so, and (2) winning contention if both LUs attempt to begin a bracket simultaneously. Contrast with bidder. See also bracket protocol.

frame. In SDLC, the vehicle for every command, every response, and all information that is transmitted using SDLC procedures. Each frame begins and ends with a flag.

frame check sequence (FCS). In SDLC, sixteen bits in a frame that contain transmission-checking information.

***function.** (1)* A specific purpose of an entity, or its characteristic action. (2)* In data communication, a machine action such as carriage return or line feed.

function management (FM). In SNA, the layer of functional capability between the application layer and the transmission subsystem. It includes data flow control and function management data (FMD) services.

generate. (1)* To produce a computer program by selection of subsets from skeletal code under the control of parameters. (2) To produce assembler language statements from the model statements of a macro definition when the definition is called by a macro instruction.

half-duplex. Pertaining to alternating, one-way transmission (transmission in one direction at a time). (Contrast with *duplex.*)

HASP. Houston automatic spooling program. A computer program that provides supplementary job management, data management, and task management functions such as control of job flow, ordering of tasks, and spooling. See also JES2.

header label. A file or data set label that precedes the data records on a unit of recording media.

host CPU. See host processor.

host processor. (1) The central or controlling processing unit in a multiple processing unit configuration. (2) In a VTAM telecommunication system, the processing unit in which VTAM resides. Devices attached by channels to the host processor are said to be local devices. Remote devices must be attached to the host processor via a local communications controller.

IBM Virtual Machine Facility (VM/370). A time sharing system control program that consists of: (1) a control program (CP) that manages the resources of an IBM System/370 computing system in such a way that multiple remote terminal users have a functional simulation of a computing system (a virtual machine) at their disposal, and (2) the conversational monitor system (CMS), which provides general time sharing, program development, and problem solving facilities.

indexed data set. A type of data set in which records are stored and retrieved on the basis of keys that are within each record and are part of the data record itself.

input job stream. Synonym for input stream.

input stream. The sequence of job control statements and data submitted to an operating system on an input unit especially activated for this purpose by the operator. Synonymous with input job stream, job input stream.

interactive. Pertaining to an application in which each entry calls forth a response from a system or program, as in an inquiry system or an airline reservation system. An interactive system may also be conversational, implying a continuous dialog between the user and the system.

***interleave.** To arrange parts of one sequence of things or events so that they alternate with parts of one or more other sequences of things or events and so that each sequence retains its identity.

interleaving. (1) The act of accessing two or more bytes or streams of data from distinct storage units simultaneously. (2) The alternating of two or more operations or functions through the overlapped use of a computer facility.

JES2. A functional extension of the HASP II program that receives jobs into the system and processes all output data produced by the job.

JES3. A functional extension of the ASP program that receives jobs into the system and processes all output data produced by the job.

job. A set of data that completely defines a unit of work for a computer. A job usually includes all necessary computer programs, linkages, files, and instructions to the operating system.

job definition. A series of job control statements that define a job.

job entry subsystem (JES). A system facility for spooling, job queuing, and managing I/O. See also JES2, JES3.

job input stream. Synonym for input stream.

job output stream. Synonym for output stream.

job stream. See input stream, output stream.

leased facility. A non-switched private-line communication facility dedicated to a single customer; may be point-to-point or multipoint.

logical unit. (1) In VTAM, the combination of programming and hardware of a teleprocessing subsystem that comprises a terminal. (2) In SNA, one of three types of network addressable units (NAUs). It is the port through which an end user accesses function management in order to communicate with another end user. It is also the port through which the end user accesses the services provided by the system services control point (SSCP). It must be capable of supporting at least two sessions–one with the SSCP, and one with another logical unit. It may be capable of supporting many sessions with other logical units.

logoff. (1) The procedure by which a user ends a terminal session. (2) In VTAM, to request that a terminal be disconnected from a VTAM application program.

logon. (1) The procedure by which a user begins a terminal session. (2) In VTAM, to request that a terminal be connected to a VTAM application program.

longitudinal redundancy check (LRC). A system of error checking performed at the receiving station after a block check character has been accumulated.

LU-LU session. In SNA, a session between two logical units in the network. It provides communication between two end users, each associated with one of the logical units.

LU-SSCP session. In SNA, a session between a logical unit and the system services control point (SSCP). It is used to support logical unit-related control and use of the communication system. Each logical unit in the network participates in a session with the SSCP that provides services for that logical unit.

message. * An arbitrary amount of information whose beginning and end are defined or implied. (3) For BSC devices, the data unit from the beginning of a transmission to the first ETX character, or between two ETX characters. (4) A sequence of characters used to convey data. The sequence usually consists of three parts: the heading, the text, and one or more characters used for control or error-detection purposes.

message header. The leading part of a message that contains information such as the source or destination code of the message, the message priority, and the type of message.

modem. A "modulation/demodulation" device. A device that converts business machine output into signals suitable for transmission over a communication facility (modulation), and that converts signals received over a communication facility into input acceptable to a business machine (demodulation).

MULTI-LEAVING support. Fully synchronized two-directional transmission of a variable number of data streams between terminals and a computer, using BSC facilities.

multipoint line. A line or circuit interconnecting several stations. Synonymous with multidrop line.

multipoint network. In data communication, a configuration in which more than two terminal installations are connected. The network may include switching facilities.

network. (1) The assembly of equipment through which connections are made between terminal installations. (2) In data communication, a configuration in which two or more terminal installations are connected.

network control program (NCP). A program, generated by the user from a library of IBM-supplied modules, that controls the operation of the communication controller.

network control program/virtual storage. Any of the NCP versions supported under OS/VS or DOS/VS.

Operating System/Virtual Storage (OS/VS). A compatible extension of the IBM System/360 Operating System that supports relocation hardware and the extended control facilities of System/370.

OS/VS1. A virtual storage operating system that is an extension to OS/MFT.

OS/VS2. A virtual storage operating system that is an extension to OS/MVT.

output stream. Diagnostic messages and other output data issued by an operating system or a processing program on output devices especially activated for this purpose by the operator.

pacing. (1) In data communication, a technique by which a receiving station controls the rate of transmission of a sending station to prevent overrun. (2) In SNA, a mechanism that permits a receiving connection point (CP) manager to control the data transfer rate (the rate at which it receives request units) on the normal flow. It is used to prevent overloading a receiver with unprocessed requests when the sender can generate requests faster than either the receiver or the network can process them. (3) In the NCP, a means for limiting the number of basic information units (BIUs) sent to a logical unit on an SDLC link until the logical unit acknowledges its ability to receive more BIUs.

physical unit (PU). In SNA, one of three types of network addressable units; a PU is associated with each node that has been defined to a system services control point (SSCP). A PU controls the resources local to its associated node. The SSCP establishes a session with the physical unit as part of the bring-up process.

point-to-point connection. In data communication, a connection established between only two data stations. The connection may include switching facilities.

point-to-point line. A data link that connects a single remote station to the computer; it may be either switched or nonswitched.

program validation services. In the 3790 Communication System, a set of IBM-provided programs that are executed in the host system to check the syntax of statements in 3790 programs, test the programs, and format the programs for later processing by subsystem support services.

relative data set. A data set consisting of records that are accessed according to their relative position from the beginning of the data set.

remote entry services (RES). In OS/VS1, the set of functions added to the Job Entry Subsystem that allows jobs and their associated data to be entered from remote devices, processed at the central system, and then transmitted back to remote devices.

***remote job entry (RJE).** Submission of jobs through an input unit that has access to a computer through a data link.

remote terminal access method (RTAM). A facility that controls operations between the job entry subsystem (JES2 and JES3) and remote terminals.

request. (1) A directive (by means of a basic transmission unit) from an access method that causes the network control program to perform a data-transfer operation or auxiliary operation. (2) In SNA, synonym for request unit.

request header. In SNA, a request/response header that indicates a request.

request/response header (RH). In SNA, a control field, attached to a request/response unit (RU), that specifies the type of RU being transmitted—request or response—and contains control information associated with that RU.

request/response unit (RU). In SNA, the basic unit of information entering and exiting the transmission subsystem. It may contain data, acknowledgment of data, commands that control the flow of data through the network, or responses to commands.

request unit. In SNA, the request/response unit following a request header. Synonymous with request.

RTAM generation. The process of assembling the desired RTAM facilities and link editing them into VS1.

RU chain. In SNA, a set of related request units (RUs) that are consecutively transmitted on a given data flow. The chain is the unit of recovery; if one of the RUs in the chain cannot be processed, the entire chain must be discarded. Each RU belongs to only one chain, which has a beginning and an end indicated via control bits in the request headers for the RU chain. Each RU is marked as first-of-chain, last-of-chain, middle-of-chain, or only-element-of-chain. Response units are always sent as only-element-of-chain.

SDLC link. A data link over which communications are conducted using the synchronous data link control (SDLC) discipline.

session. (1) The period of time during which a user of a terminal can communicate with an interactive system; usually, the elapsed time from when a terminal user logs on the system until he logs off the system. (2) The period of time during which programs or devices can communicate with each other. (3) In SNA, a logical connection, established between two network addressable units (NAUs) to allow them to communicate. The session is uniquely identified by a pair of network addresses, identifying the origin and destination NAUs of any transmission exchanged during the session.

spooling. (1) * The reading of input from and the writing of output onto auxiliary storage concurrently with job execution in a form suitable for later processing or output operations.

station. (1) One of the input or output points of a system that uses communication facilities; for example, the telephone set in the telephone system or the point where the business machine interfaces with the channel on a leased private line. (2) In SNA, one of the input or output points on an SDLC data link. (3) One or more computers, terminals, or devices at a particular location.

subsystem. A secondary or subordinate system, usually capable of operating independently of, or asynchronously with, a controlling system.

supervisor. (1) The part of a control program that coordinates the use of resources and maintains the flow of CPU operations.

switched network. A network in which a dialed, point-to-point connection can be completed between any two stations.

switched network backup (SNBU). An optional facility that allows a user to specify, for certain types of stations, a switched line to be used as an alternate path (backup) if the primary line becomes unavailable or unusable.

Synchronous Data Link Control (SDLC). A discipline for the management of synchronous, transparent, serial-by-bit information transfer over a data communication channel. SDLC includes comprehensive detection and recovery procedures for transmission errors introduced by the communication channel.

synchronous transmission. Transmission in which the sending and receiving devices are operating continuously at substantially the same frequency and are being maintained, through correction, in a desired phase relationship.

system generation (SYSGEN). The process of selecting desired functions and operations of a system from various options and assembling and link-editing the IBM-supplied control program components that constitute an operating system.

systems network architecture (SNA). The total description of the logical structure, formats, protocols, and operational sequences for transmitting information units through the communication system. Communication system functions are separated into three discrete areas: the application layer, the function management layer, and the transmission subsystem layer. The structure of SNA allows the ultimate origins and destinations of information—that is, the end users—to be independent of, and unaffected by, the specific communication-system services and facilities used for information exchange.

system services control point (SSCP). In SNA, a network addressable unit that provides services via a set of command processors (network services) supporting physical units and logical units. The SSCP must be in session with each logical unit and each physical unit for which it provides services. It also provides services for the network operators or administrators who control the configuration. The SSCP is commonly located at a host node.

telecommunications access method (TCAM). A method used to transfer data between main storage and remote or local terminals. Application programs use either GET and PUT or READ and WRITE macro instructions to request the transfer of data, which is performed by a message control program. The message control program synchronizes the transfer, thus eliminating delays for terminal input/output operations.

terminal. (1)* A point in a system or communication network at which data can either enter or leave. (2) A device, usually equipped with a keyboard and some kind of display, capable of sending and receiving information over a communication channel. (3) In VTAM, an end point in a telecommunication network; that is, a physical or logical unit, a start-stop or BSC device, or a 3270 Information Display System.

time-out. (1) A time interval allotted for certain operations to occur; for example, response to polling or addressing before system operation is interrupted and must be restarted. (2) A terminal feature that logs off a user if an entry is not made within a specified period of time.

transaction. In batch or remote batch entry, a job or job step.

transaction data set. A data set used to store transaction records that are to be batch-transmitted to the host CPU and which are made available to the 3770 operator for transaction verification and correction.

transmission header (TH). In SNA, a control field attached to a basic information unit (BIU) or to a BIU segment, and used by path control. It is created by the sending path control component and interpreted by the receiving path control component.

transparent. In data communication, pertaining to information that is not recognized by the receiving program or device as transmission control characters.

turnaround time. (1)* The elapsed time between submission of a job and the return of complete results. (2) In data communication, the actual time required to reverse the direction of transmission from send to receive or vice versa when using a half-duplex circuit. For most communications facilities, there will be time required by line propagation and line effects, modem timing, and machine reaction. A typical time is 200 milliseconds on a half-duplex telephone connection.

unattended operation. The transmission and reception of messages, through the use of automatic features, by a station that is unattended by an operator.

universal character set (UCS). A printer feature that permits the use of a variety of character arrays.

user. Anyone who requires the services of a computing system.

utility program. *(1) A computer program in general support of the processes of a computer; for instance, a diagnostic program, a trace program, a sort program. Synonymous with service program. (2) A program designed to perform an everyday task such as copying data from one storage device to another.

virtual telecommunications access method (VTAM). A set of programs that control communication between terminals and application programs running under DOS/VS, OS/VS1, and OS/VS2.

voice-grade channel. A channel suitable for transmission of speech, digital or analog data, or facsimile, generally with a frequency range of about 300 to 3000 cycles per second.

Appendix J. IBM 3770 Programmable Communication Terminals Using SNA/SDLC Communications

Contents

Figures

Appendix J. IBM 3770 Programmable Communication Terminals Using SNA/SDLC Communications

Introduction

Information in this appendix is provided for your use in planning applications using the additional SNA functions. Detailed instructions on how to code a 3770 program using the additional SNA functions will be provided in the *3770P Programmer's Guide,* GC30-3028. Detailed operating procedures will be provided in the *3770P Operator's Guide,* GA27-3114.

The additional SNA functions for the IBM 3774 and 3775 Programmable Communication Terminals (3774P/3775P) using SDLC communications are similar to the functions for the 3770P terminals using BSC communications. The three categories of the functions are: (1) programmable communications using SNA protocols, (2) additional SDLC communicate mode functions, and (3) card-to-diskette utility using SNA formats.

Note: Descriptions in this appendix apply to terminals without the Emulator Feature.

Programmable Communications

With the programmable communications (PC) function, a user-written program executing in a 3774P or 3775P terminal can:

- Initiate, accept, and terminate an SNA session with a host CPU application program by issuing macro instructions.
- Send data to and receive data from the host on a record basis using the SDLC communication line for input and output.
- Test and respond to session indicators to maintain the SNA session and adhere to SNA formats and protocols.
- Interact with the rest of the 3770 program to support the application.

See the section entitled "SNA Programmable Communications" following for more information.

Communicate Mode

Data transmission over an SDLC line can also be controlled by communicate mode in the terminal's controller. In addition to the keyboard, console printer, and diskette operations, the following additional card I/O, 3784 printer, and miscellaneous operations and functions in communicate mode are:

- Transmit data—Card reader-to-communication line operation
- Transmit data—Communication line-to-card punch operation
- Transmit data—Communication line-to-3784 Line Printer operation
- Specify communicate mode ending options
- Force data to diskette on supervisor override
- Control console printer with SNA standard character string control characters
- Select console printer page format in online standby mode
- Send messages from the keyboard to the host application program
- Request data set transmission in online standby mode
- Select data set transmit options
- Use multiple SYS.INTR data sets
- Set unattended terminal mode

See the section entitled "SDLC Communicate Mode" following for more information.

Card-to-Diskette Utility

This offline utility can be used to create a data set in SNA format for subsequent online transmission to the host as remote job input. SNA transmission options are: transparent, nontransparent, and blank compression. See "Card-to-Diskette Utility Using SNA Formats" following for more information.

User Storage Considerations

The user storage requirements and methods of allocation for the 3773, 3774, and 3775 Programmable Communication Terminals are shown in Figure J-1.

Allocation	Amount	Function
Dedicated (1)	0.25K	Format image buffer. (3774P/3775P only)
Dedicated or Dynamically Allocated (2)	1.75K	3501 Card Reader. (3774P/3775P only)
	2.5K	2502 Card Reader. (3774P/3775P only)
	3.0K	3521 Card Punch. (3774P/3775P only)
	2.0K	Display. (5) (3774P/3775P only)
	3.0K	Resident supervisor control code. (Dynamic on 3773P)
Dynamically Allocated (3)	'x'K	Working storage. (Includes 0.75K for buffers)
	'x'K	3770 program(s).
	'x'K	Relative data set buffers. (5 maximum)
	2.0K	Programmable communications. (BSC and 3774P/3775P only)
	7.0K	Programmable communications. (6) (SDLC and 3774P/3775P only)
	6.0K	Communicate mode. (BSC or SDLC)
	1.0K	Communicate mode extension. (4) (BSC and 3774P/3775P only)
	2.75K	Communicate mode extension. (4) (SDLC and 3774P/3775P only)
	2.0K	Card-to-Disk utility. (3774P/3775P only)
	1.25K	Keyboard-to-Punch utility. (3774P/3775P only)
	1.0K	Set Terminal Configuration utility. (3774P/3775P only)
	0.75K	Copy Data Set utility.
	1.0K	Copy Diskette utility.
	3.0K	Data Set Maintenance utility.
	2.5K	Data Set Update utility.
	1.0K	List Diskette utility.
	1.0K	Print Error Log utility.
	3.0K	Program Library utility.
	0.5K	Ripple Print utility.
	0.25K	Set Date utility.
	0.75K	Multiple Interrupt Data Sets

1. User allocated with the Set Terminal Configuration utility. This storage is not available for other functions.
2. Allocated in one of two ways:
   - By the user with the Set Terminal Configuration utility. This improves performance, but the storage is not available for other functions.
   - By selection of the function by a 3770 program, Communicate mode option, utility program, DISPLAY switch, or supervisor program. This storage is available for use by other functions.
3. Allocated by selection of a 3770 program or utility program. This storage is available for use by other functions.
4. Allocated by an online selection of the line printer or card punch, or by a request for a card-to-line operation. The device storage (3521, 3501, or 2502) is also required. The user may override this allocation with the Set Terminal Configuration utility. If sufficient storage is not available or the function is overridden, data directed to the punch or line printer defaults to the interrupt data set, and card-to-line requests are not executed (ERR 594 3).
5. Requires an additional 0.5K if Katakana.
6. SNA programmable communications (PC) also requires two tracks of user data storage on the unremovable diskette, reducing this available user space from 30 to 28 tracks. If SNA PC will not be used on a particular terminal, this allocation can be removed by the user with the Set Terminal Configuration utility, thereby restoring 2 tracks of the diskette for user data.

Figure J-1. User Storage Allocation

Other Information Sources

For more information about Systems Network Architecture, refer to:

- *Systems Network Architecture Introduction,* GA27-3116
- *Systems Network Architecture General Information* (to be renamed Technical Overview), GA27-3102
- *Systems Network Architecture Format and Protocol Reference Manual: Architecture Logic,* SC30-3112

More detailed information on operating procedures for the additional SNA functions, will be included in *IBM 3773, 3774, and 3775 Programmable Communication Terminals Operator's Guide,* GA27-3114. More detailed programming information for the additional SNA functions will be included in *IBM 3773, 3774, and 3775 Programmable Communication Terminals Programmer's Guide,* GC30-3028.

SNA Programmable Communications

Using the additional SNA function called Programmable Communications (PC), a user-written program executing in a 3774P/3775P can begin, accept, maintain, and end an SNA communication session with the host CPU. The application programmer uses macro-instructions (also called 3770 programming statements) to open and close sessions, allocate buffers and registers, send data to and read data from the host, and test and respond to SNA status indicators.

The programmable communications function requires 7.0K bytes of user storage for the IBM-supplied terminal controller code to support execution of user-written programs incorporating programmable communications. The PC operand in the START2 statement causes loading of the controller code which is in addition to the user storage required for other I/O devices, for the 3770 program, and other resources.

When a session is being initiated and once it is established, the 3770 program is responsible for adhering to SNA communication protocols. Violations of SNA protocol will cause an abnormal end to the 3770 program.

A 3770 program using SNA programmable communications cannot be interrupted by the host (by the CPU Interrupt operation) while in an SNA session (between the OPNSESS and CLOSESS statements).

Information in this section is provided for planning applications using SNA programmable communications. Detailed instructions on how to code a 3770 program using SNA programmable communications will be provided in the *3770P Programmer's Guide,* GC30-3028. Detailed operating procedures will be provided in the *3770P Operator's Guide,* GA27-3114.

Starting an SNA Session

The Open Session (OPNSESS) statement is used to start an SNA session with the host. OPNSESS requests a session with a specific host application program (sends a logon request) or with any host program. This statement accepts or rejects session parameters received from the host and specifies brackets or no-brackets protocol. If session resynchronization is requested by the host as the result of a data traffic error that terminated the previous session, the OPNSESS statement may include send and receive sequence numbers as data. OPNSESS disables the CPU interrupt function of SDLC communicate mode.

Receiving Information From the Host

The Read Data (RDDATA) statement reads data, commands, and responses received by the terminal from the host and destined for the 3770 program. The data, commands, and responses from the host are stored in a specified 256-byte buffer. RDDATA specifies whether the terminal is to wait (see also DEVCK) or not wait until the read operation completes before passing control back to the 3770 program.

Sending Information to the Host

The following statements are used to send data, commands, and responses to the host.

The Write Data (WRTDATA) statement sends up to 256-bytes of data to the host from a specified buffer. WRTDATA specifies which request header (RH) indicators are to be set on and specifies either EBCDIC or ASCII data transmission.

The Write Command (WRTCMD) statement sends one of the following SNA commands to the host from the specified buffer: CANCEL, CHASE, LUSTAT, SIGNAL, RSHUTD, RTR, or QC. WRTCMD also specifies which request header indicators are to be set on for CANCEL, CHASE, or LUSTAT.

The Write Response (WRTRESP) statement sends a positive or negative response to the host in answer to a request. WRTRESP specifies the buffer source for a negative response.

Testing and Responding to Status Indicators

The following statements – IFH through ENDIFH – are used to test and respond to the SNA session indicators (see a listing following in Figure J-2). The DEVCK statement tests the SDLC line (and other I/O devices).

The IFH statement tests the session indicators, on or off, in logical AND/OR combinations with other indicators on/off up to a maximum of 10 indicators in one IFH statement. IFH is used to determine the proper response to host transmissions so that the 3770 program adheres to SNA protocols and thus prevents 3770 program abends.

The THENIFH statement indicates the 3770 programming statement to be executed when the previous IFH statement is true (all logical conditions are met).

The THENGO statement transfers control to the 3770 programming statement indicated by the THENIFH statement when the previous IFH statement is true.

The ELSEIFH statement indicates the 3770 programming statement to be executed when the previous IFH statement is false (all logical conditions are not met).

The ENDIF statement clears the condition set by the previous IFH statement. ENDIF must be issued to end processing of the previous IFH statement regardless of which instruction path is used.

The Device Check (DEVCK) statement checks the status of an I/O operation. For programmable communications, DEVCK determines whether the terminal controller's receive data operation (from the SDLC line) is complete or still busy. DEVCK must be issued after the RDDATA-NOWAIT statement and before another RDDATA statement is issued.

Resynchronizing Session Data Flow

The following statements are used to resynchronize session data flow between the host and the 3774P/3775P.

The Read Status (RDSTUS) statement gets the send sequence number and the receive sequence number for the last normal data-flow transmission between the terminal and the host and puts the numbers into the specified buffer. Sequence numbers are used to resynchronize session data flow between the host and the terminal either when starting a session (with the OPNSESS statement) or during a session (with the WRTCTL statement).

The Write Control (WRTCTL) statement can be used by the 3770 PC program to request resynchronization or to resynchronize when the host requests it. WRTCTL controls further 3770 PC program execution after the host stops data flow with a CLEAR command because of an error in data traffic. WRTCTL responds to the host request for session resynchronization by including (or not including) sequence numbers as data in the response unit (RU). Further session data flow after an error is possible with this statement.

Ending a Session

The Close Session (CLOSESS) statement terminates an SNA session between the host and the 3774P/3775P. CLOSESS must be issued after an OPNSESS statement or series of OPNSESS statements even if a session has not been established because of a protocol or data traffic problem. This statement enables the CPU interrupt function that is disabled by the OPNSESS statement. CLOSESS must be issued after the host sends an UNBIND command to the terminal.

SNA Session Indicators

The list of SNA session indicators available to a 3770 program using SNA programmable communications (the 3770 PC program) is shown in Figure J-2. This list is included for application planning. It demonstrates the interaction of the 3770 PC program with the host and the extent of the SNA protocols involved in this interaction. Detailed instructions on how to code a 3770 PC program to respond to the session indicators will be provided in the *3770 Programmer's Guide,* GC30-3028.

Part 1 of Figure J-2 lists the session indicators that are set according to the type of input last received from the host. Part 2 lists the session indicators that specify the state of the 3770 PC program in the session. Part 3 lists the session indicators that specify special conditions that affect the session.

Indication Abbrev.	Type of Indicator	Name	Meaning or Action Suggested
CMD	Command	Command	Command or command response received. Issue IFII to test.
CMDRES	Command	Command Response	Response received to command sent by 3770 program.
CMDRQ	Command	Command Received	Command received.
DATA	Command	Data	Data or data response received.
DATARES	Command	Data Response	Data response received.
DATARQ	Command	Data	Data received.
REQ	Command	Data or Command	Data or command received. Issue IFH to test indicators.
RESP	Command	Data Response or Command Response	Response received. Issue IFH statement to test indicators.
PACRES	Command	Pacing Response	Pacing response received.
BB	Request Header	Begin Bracket	First element of bracketed data received.
CD	Request Header	Change Direction	Change direction received.
CSI	Request Header	Alternate Code	Data received in ASCII.
DR1	Request Header	Definite Response Type 1	DR1 indicator received.
DR2	Request Header	Definite Response Type 2	DR2 indicator received.
EB	Request Header	End Bracket	Last element of bracketed data received.
FMI	Request Header	FM Header Included	Function management header received.
ME	Request Header	Message End	Message End indicator received.
NORES	Request Header	No Response Allowed	3770 program may not respond to last transmission from host.
RESPREQ	Request Header	Response Required	Issue IFH to test indicators to determine type of response.
XRESP	Request Header	Exception Response	Exception response received.
BID	Input	Bid	Bid command received.
CANCEL	Input	Cancel	Cancel command received.
CHASE	Input	Chase	Chase command received.
LUSTAT	Input	LUSTAT	Logical Unit Status command received.
QEC	Input	Quiesce at End of Chain	QEC command received.
RELQ	Input	Release Quiesce	RELQ command received.
SHUTD	Input	Shutdown	Shutdown command received.
SIGNAL	Input	Signal	Signal command received.

Figure J-2. SNA Session Indicators Available to the 3770 PC Program–Input Indicators (Part 1 of 3)

Indication Abbrev.	Name	Meaning or Action Suggested
BBP	Begin-Bracket-Pending State	Bid command accepted or 3770 program ready to receive.
BETB	Between-Bracket State	Session permits brackets. No bracket in progress.
CHAINP	Chain-Purging State	Discard all RUs of chain. Wait for CANCEL or ME.
EXRRSP	Exception-Response-Required State	Send negative response and sense data to host.
INB	In-Bracket State	Bracketed data being received.
QECPEND	Quiesce-Pending State	Issue WRTCMD-QC to enter Quiesce state.
QUIESCE	Quiesce State	3770 program cannot send data or commands to host.
RDCH	Read-Chain State	Data chain being received.
RDCHRSP	Receive-Response State	3770 program waiting for a required response to a data chain sent to the host.
REC	Receive State	3770 program can receive data but cannot send data.
RSYNPEND	Resynchronization-Pending State	WRTCTL recovery attempt failed or negative response received requiring resynchronization.
RTRP	Ready-to-Receive- Pending State	3770 program rejected host's Bid to begin bracket. Send WRTCMD-RTR when ready to receive.
SEND	Send State	3770 program can send data but cannot receive data; can receive responses and commands.
SHUT	Shutdown State	3770 program issued WRTCMD-SHUTC command indicating end-of-session processing is complete. 3770 program cannot send data or commands.
WRTCH	Write-Chain State	3770 program sending data chain to the host.
WRTCHRSP	Write-Data-Response State	Data chain received requiring a response.
WTCMDRSP	Write-Command-Response State	Command received requiring a response.

Figure J-2. SNA Session Indicators Available to the 3770 PC Program– State Indicators (Part 2 of 3)

BIND	Bind	Bind command received.
DATAQ	Host Input Available	Input for 3770 PC program received. Issue RDDATA statement to receive.
DISPEND	Disable Pending	Terminal controller requests termination of 3770 PC program.

Figure J-2. SNA Session Indicators Available to the 3770 PC Program–Condition Indicators (Part 3 of 3)

Application Considerations

The 3770 user-written program issues macro instructions, provided with the programmable communications (PC) function, to interact with the SDLC line as an I/O device. The 3770 user-written program can interact with the operator console (keyboard, console printer, and display) and other attached I/O devices by issuing other macro instructions in the main portion (body) of the 3770 program not directly associated with programmable communications. The programmable communications portion of the 3770 program may be integrated with and interact with the body of the program to support the user's application in the terminal.

For example (as shown in Figure J-3), the body of the program can interact with a card reader or a diskette device and perform arithmetic, logic, and move operations to build records for the programmable communications portion of the program to send to the host. This can be done on a per-record basis. Conversely, records received from the host through the programmable communications portion, can be manipulated by the body of the program to build (on a per-record basis) output records for the printer(s), card punch, or diskette.

Operating Controls Used With Programmable Communications

When a user-written 3770 program incorporating programmable communications is executing in the 3774P/3775P, it interacts with the keyboard switches, keys, and lights associated with host communications. The programmable communications portion of the 3770 program interacts directly with the switches and lights, and indirectly, through the body of the program, with the keys that control host communications.

Switches

The following switches affect programmable communications with the host.

INTRP (Interrupt): When this switch is on, the host CPU can normally interrupt 3770 program execution. To prevent an interruption when programmable communications is using the SDLC line, an OPNSESS statement disables the INTRP switch and a CLOSESS statement enables it.

DISK (Diskette): This switch normally controls routing of data received from the SDLC line, but is ignored by programmable communications.

Keys

The following keys have no direct effect on programmable communications since there are no PC statements to "read" these switches. The main portion of the 3770 program can, however, read these keys and may pass the requests on to the PC portion at the option of the application programmer. The following descriptions suggest ways to use these keys.

SYSREQ (System Request): This key is normally used to logon/logoff the terminal. If the 3770 PC program is not in session, an OPNSESS statement could be issued with the keyboard input used as logon data. If the 3770 PC program is in session, a CLOSESS statement could be issued to logoff from the host application program and end the session.

CNCL (Cancel): This key is normally used in SDLC communicate mode to request an immediate break in data flow to the terminal. The 3770 PC program could issue a WRTCMD-CANCEL to honor this request.

ATTN (Attention): This key is normally used with SDLC communicate mode to request the host to allow the terminal operator to send a message. The 3770 PC program could issue a WRTCMD-SIGNAL statement to duplicate this request.

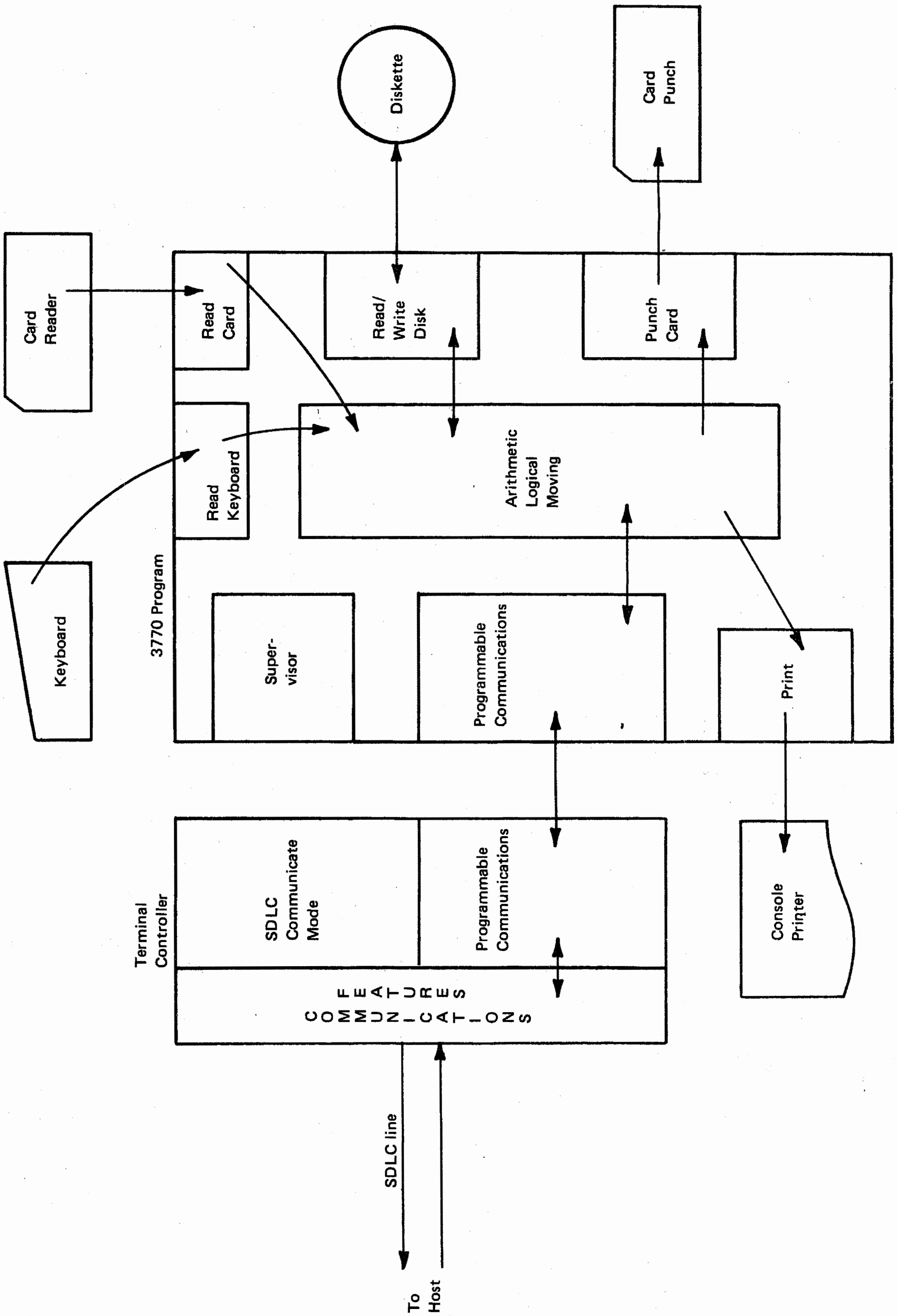

Figure J-3. Example of SNA Programmable Communications Application

Lights

The following lights on the operator control panel are directly affected by programmable communications.

CPU SELECT: This light is turned on by a host request to start a session that was rejected by the terminal. When the 3770 PC program issues an OPNSESS statement, this light turns off.

OPRN CHECK (Operation Check): This light is turned on when an SDLC line error occurs and there is no active session. An error code is displayed in the Numeric Position Readout (NPR) lights. When the 3770 PC program issues an OPNSESS statement, this light turns off.

SYS CHECK (System Check): This light is turned on when an SDLC line error occurs and the 3770 PC program is in session. An NPR error code is displayed. When the 3770 PC program issues a statement to accept and handle the error, this light turns off.

ON LINE: This light turns on when a Bind command is accepted by the 3770 PC program and turns off when an Unbind command is accepted.

STANDBY: This light turns on when the 3770 PC program is in session and enters the Between-Brackets state and turns off when the 3770 PC program enters another state associated with a send or receive operation.

SDLC Communicate Mode

Communications between the host CPU and the 3774/3775 Programmable Terminals under control of SDLC communicate mode, can be used for:

- Sending messages from the 3770 keyboard to the SSCP in the host
- Sending unformatted data from the host to the 3770 console printer
- Exchanging data sets between the 3770 diskette(s) and the host

With the appropriate I/O configuration of the 3774P/3775P and the additional SNA functions, SDLC communicate mode can also be used for:

- Sending a card file from the 3770's card reader to the host
- Sending a card image data set from the host to the 3521 card punch
- Sending formatted data from the host to the 3770 console printer or to the 3784 printer (3774P only)
- Sending data and messages from the keyboard to the application program in the host
- Requesting transmission of diskette data sets from the keyboard, and other operator-controlled operations
- Controlling SDLC communicate mode options with a supervisor program

Sending Data to the Host

For data transfer under control of the user-written program, see "SNA Programmable Communications" in this Appendix.

Sending Diskette Data

When entering SDLC communicate mode the operator or the supervisor program can initiate transmission of up to five data sets to the host CPU. The data is blocked into a 256-byte buffer before transmission. Data set records may span the buffer boundary and may be nontransparent or transparent. With the additional SNA functions, the operator can also initiate the transmission from the online standby mode; two more transmission options are available—SNA compressed card format and SNA noncompressed card format.

- *SNA Compressed and unblocked* – Trailing nulls are stripped from the data set records before transmission. Records are not blocked in the transmission buffer. The session parameters must allow for inbound compressed data or the data set is not sent and an error message is printed. A string control byte (SCB) character is transmitted in front of each stream of characters to identify what follows. Refer to "Compression/Expansion – Using SDLC" in Chapter 3 for a description of the SCB character.
- *SNA Noncompressed and unblocked* – Trailing nulls are stripped from the data set records before transmission. Records are not blocked in the transmission buffer.

For both SNA compressed and noncompressed formats, the FM header Media byte designates card input. For compressed data, the compressed bit (CMI) is on in the properties byte. (Refer to "Function Management Header" in Chapter 8.) With this additional SNA function, the "Nonprogrammable Models Only" restriction no longer applies to "Function Management Header" and "Inbound Data from 3770 to CPU – Inbound Diskette Data" in Chapter 8.

Sending Card Input

For those applications requiring card input, the additional SNA functions provide for card reader-to-line operations to be started when the terminal enters SDLC communicate mode (from the supervisor program or by the operator CODE key function). All card input is sent unspanned. The media byte in the FM header designates card reader input. Blank (space) compression is the only compression option used, and must be allowed by the session parameters or the data is not sent and an error message is printed. The transmission options are:

- *SNA Nontransparent and noncompressed* – Trailing blanks are stripped from card data. The 256-byte transmission buffer is filled with card data (each card image is followed by an IRS character), until 81 characters are no longer available in the buffer.
- *SNA Transparent* – The transparent character (TRN - X'35') and a one-byte binary count of data characters precedes each card image in the transmission buffer. Trailing blanks are stripped from card data and an IRS character (X'1E') is added to each card image. The 256-byte transmission buffer is filled with card data until one complete card image with its control characters will not fit. (See Figure J-4.)
- *SNA Nontransparent with blank compression (the default option)* – The 256-byte transmission buffer is filled with card data (each card image is followed by an IRS character) until one complete and appended card image (83 characters) will not fit. An SCB character is transmitted in front of each string of characters to identify what follows: nonduplicated data (no compressed characters) or compressed space (blank) characters. (Refer to "Compression/Expansion – Using SDLC" in Chapter 3 for a description of the SCB character.) Data compression strings are not transmitted inbound.

With this additional SNA function the "Nonprogrammable Models Only" restriction no longer applies to "Inbound Data from 3770 to CPU – Inbound Card Data" in Chapter 8. The "BSC only" restriction no longer applies to "2502 Operation (Attached to Programmable Models)" nor to "3501 Operation (Attached to Programmable Models)" in Chapter 6 of this manual.

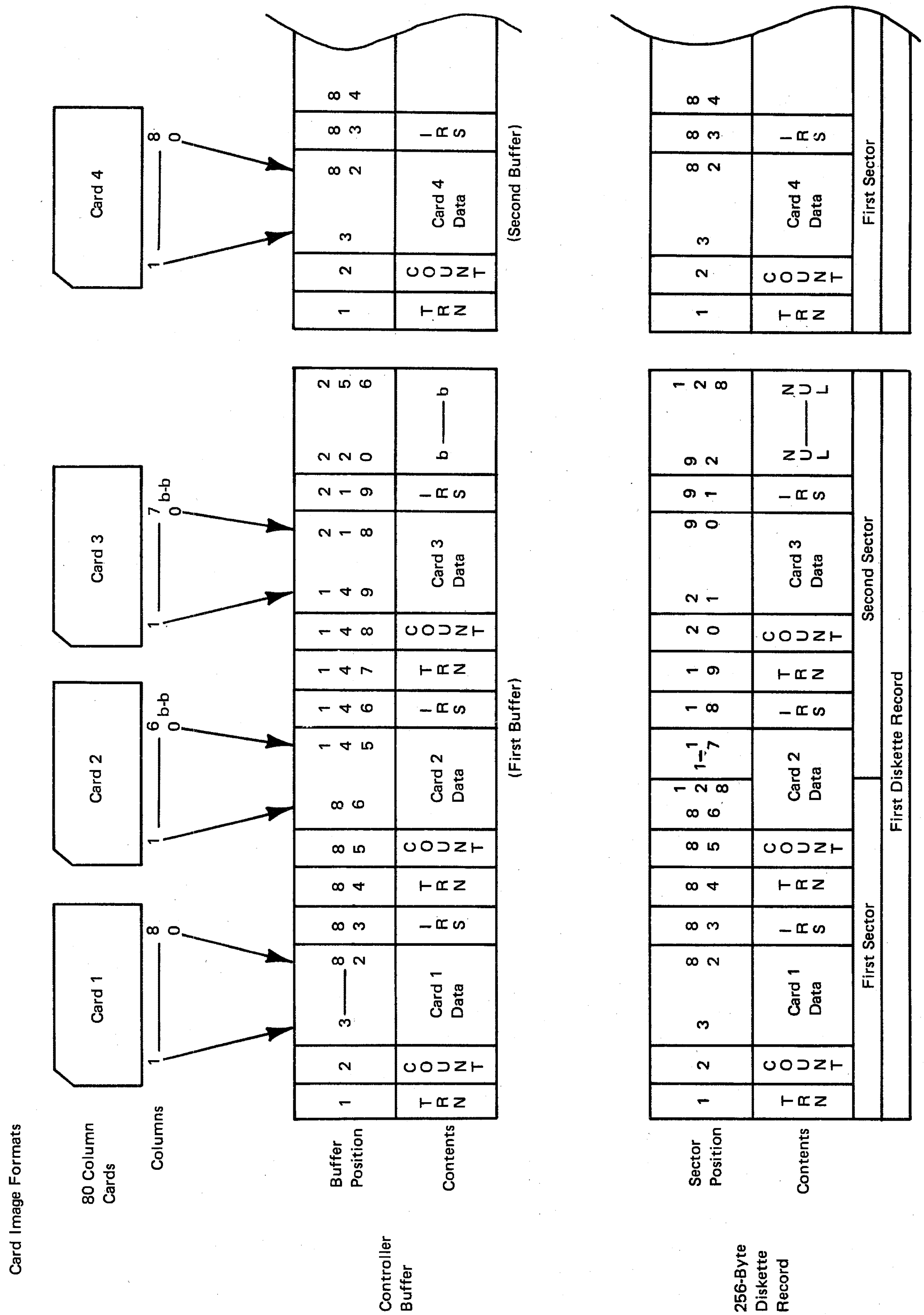

Figure J-4. 80-Column Card Data, SNA Transparent

Sending Keyboard Messages

The terminal operator can send messages to the access method or to the application program in the host CPU.

Logon/Logoff Messages to the SSCP: In SDLC communicate mode with the STANDBY light on, the operator can press the SYS REQ (System Request) key to initiate a logon or logoff message and enter the message from the keyboard. The logon/logoff message is directed to the system services control point (SSCP) in the access method in the host CPU. Pressing CNCL (before ENTER) clears the logon/logoff buffer of all data.

Data/Messages to the Application Program: With the additional SNA functions, the operator can initiate this message by requesting a change of direction when the host is sending data to the 3774P/3775P. Pressing the ATTN (Attention) key sends an expedited Signal command to the application program in the host that is in session with and sending data to the terminal. If the application program honors the Change Direction request, the terminal operator can enter keyed data into a 256-byte buffer and send it to the application program. (Refer to Figure 8-4 in Chapter 8 for the Signal command.)

Also, with the additional SNA functions, when the terminal is in the online standby mode (the between brackets state - still in session; data flow enabled) the operator can send a message to the application program currently in session.

Receiving Data From the Host

Once an SNA session has been established between the 3774P/3775P and the host and the operator has prepared the terminal to receive data, the host can initiate data transmission to the 3774P/3775P. (For data transfers to and under control of the user-written program in the terminal, see "SNA Programmable Communications" in this Appendix.)

FM Headers and Media Selections

Data Without FM Header: Data received from the host without an associated function management (FM) header is directed to the console printer unless the DISK switch is on or the supervisor override option is on. This data is written to the interrupt (SYS.INTR) data set on the diskette.

Data With FM Header(s): The FM headers are used to direct data to the console printer or the interrupt data set, select a diskette data set to be updated, control the flow of data, and indicate the format of the data stream following the FM header. (Refer to the *3770 Programmer's Guide,* GC30-3028, for more information on FM headers and media selections.)

With the additional SNA functions, FM headers may also be used to direct data received from the host to the IBM 3521 Card Punch or to the IBM 3784 Line Printer (3774P only). The DISK switch can be used to override all media selections except the console printer.

Supervisor Option to Override Media Selections: With the additional SNA functions, an option of the Set Configuration supervisor instruction forces all data received from the host to the diskette. If an FM header selects a data set by name, the maintenance will be performed. For all other data with or without an FM header, the terminal directs the data to the interrupt data set and records the selection and data stream information in the SYS.INTR index.

Multiple Interrupt Data Sets

This predefined diskette data set (SYS.INTR) with a partitioned index is loaded with data from the line under the following conditions:

- Data is received from the host without an FM header and the DISK switch is on
- Data is received from the host with an FM header that does not select a data set for maintenance and selects an I/O medium other than the console printer.
- With the additional SNA functions, data is received from the line that does not select a data set for maintenance. (The supervisor option overrides all media selections except the data set for maintenance.)

With the additional SNA functions, when data received from the host is written to the interrupt data set, the limit of each index entry is increased from 100 to 255 records of 256-bytes each. In addition, multiple indexes can be used for data accompanying a single selection from the host up to a maximum of 100 index entries. Consequently, during a single selection from the host, data can be stored up to the limit of the entire extent created for the interrupt data set.

When the SYS.INTR data set is filled, the terminal closes that data set. If 0.75K bytes of user storage are available for the Multiple SYS.INTR function, the terminal automatically searches for a data set with the same name on another attached diskette storage device. If another SYS.INTR data set is found, the terminal continues the write operation on that device. If another SYS.INTR data set is *not* found, a message code is displayed to alert the operator. The operator has approximately three minutes to mount another diskette (Change Diskette) with SYS.INTR created on it before the terminal stops the operation and sends a negative response to the host.

During a CPU interrupt operation, the terminal does *not* search for another SYS.INTR data set when the first data set is filled. If the terminal is operating in unattended mode and SYS.INTR fills, the terminal sends a negative response to the host if another SYS.INTR data set is *not* found.

CPU Interrupt

If a data link has been established between the host and the 3774P/3775P and the INTRP (Interrupt) switch is on, the host can suspend user-program execution (except for Programmable Communications when the user-written program is bound in a session with the host) and send data to the terminal. An FM header accompanying the data can direct the data to be written on a selected data set ("Add Record"). Any other selection causes a negative response to be sent to the host. Data received without an FM header is printed on the console printer if the DISK switch is off, or is written on the interrupt data set if the DISK switch is on. After the session is complete, the user-written program resumes execution from the point of interruption.

Setting Console Printer Formats

Horizontal and vertical format controls for the 3774P/3775P console printer can be set:

- By the host during a communication line-to-console printer operation
- By the supervisor program executing the Set Console (printer) series of instructions
- By the operator selecting a page format from the format image buffer (FIB) when the terminal is in local mode. With the additional SNA functions, the operator can also select the format from the FIB when the terminal is in online standby mode (the Between Brackets state).

The following SNA character string (SCS) controls, described in Chapter 8 – "Programming Considerations – SNA/SDLC Communications", are used by the console printer for page format control:

BS	Backspace
CR	Carriage Return
FF	Forms Feed
IRS	Inter-Record Separator
LF	Line Feed
NL	New Line

With the additional SNA functions, the following are also used:

ENP	Enable Print
HT	Horizontal Tab
INP	Inhibit Print
SCB	String Control Byte (described in Chapter 3)
SEL	Select Vertical Channel
SHF	Set Horizontal Format

with the following parameters:

MPP	Maximum Print Position
LM	Left Margin
RM	Right Margin
Tn(H)	Tab Stop (Horizontal)

SVF Set Vertical Format

with the following parameters:

MPL	Maximum Print Line
TM	Top Margin
BM	Bottom Margin
Tn(V)	Tab Stop (Vertical)

TRN	Transparent Data
VT	Vertical Tab

When no page formats have been set, the default values are:

Horizontal Format

MPP = 132
LM = 1
RM = MPP
Tn = Tab set in every position

Vertical Format

MPL = 1
TM = 1
BM = MPL
Tn = None

With the additional SNA functions for the 3774P/3775P, the "Nonprogrammable Models Only" restriction no longer applies to "Outbound Data from CPU to 3770 – Outbound Printer Data" in Chapter 8.

Line-to-Card Punch

With the additional SNA functions, data from the host with an FM header specifying "card punch" in the media select byte is directed to the 3521 Card Punch under these conditions:

1. The additional SNA functions controller code is loaded into user storage.
2. The DISK switch is off.
3. The supervisor instruction option to override media selections is not set.
4. The 3521 Card Punch special feature is attached (through the 3782-1) and actually a part of the terminal configuration.

If any of the above conditions is not met, the data is written to the interrupt data set on the diskette.

The SNA data format options for a 3521 attached to a 3774P/3775P are the same as those used when the 3521 is attached to a 3774/3775 nonprogrammable terminal. Card images do not span RU boundaries. Options are:

- Nontransparent and noncompressed data
- Transparent data
- Nontransparent with expansion of blank compressed and data compressed data strings using string control bytes (SCB)

Refer to "Sending Card Input" in this section for the transmission buffer format of these options. With the additional SNA functions, the "Nonprogrammable Models Only" restriction no longer applies to "Outbound Data from CPU to 3770 – Outbound Card Data" in Chapter 8. The "BSC only" restriction no longer applies to "3521 Operation (Attached to Programmable Models)" in Chapter 6 of this manual.

Line-to-3784 Printer (3774P Only)

With the additional SNA functions, data from the host with an FM header specifying "line printer" in the media select byte is directed to the 3784 Line Printer under these conditions:

1. The additional SNA functions controller code is loaded into user storage,
2. The DISK switch is off,
3. The supervisor instruction option to override media selections is not set, and
4. The 3784 Line Printer special feature is attached and actually a part of the 3774P terminal configuration.

If any of the above conditions is not met, the data is written to the interrupt data set on the diskette and the selection and data stream information is recorded in the SYS.INTR index. Subsequently, a user-written program or a supervisor program can retrieve data in SYS.INTR for output.

The 3784 printer uses the same SNA character string (SCS) format controls (except for ENP and INP) as does the 3774P/3775P console printer. Page format controls for the 3784 may be set only by SCS codes in data received over the SDLC line from the host (not by the operator or by the supervisor program). Refer to "SNA Character String (SCS) Format Controls" in Chapter 8 of this manual for a description of the SCS codes.

With the additional SNA functions the "Nonprogrammable Models Only" restriction no longer applies to "Outbound Data from CPU to 3770 – Outbound Printer Data" in Chapter 8. The "BSC only" restriction no longer applies to "3784 Operation (Attached to Programmable Models)" in Chapter 6 of this manual.

Setting Unattended Terminal Mode

With the additional SNA functions, when the 3774P/3775P terminal is in local mode, the operator can use a CODE key function to set unattended mode when the terminal enters SDLC communicate mode. In unattended mode, error recovery timeouts do not occur and a negative response is sent immediately to the host when a recoverable device error occurs. (Unattended mode applies only to those online operations in SDLC communicate mode that are equivalent to online operations performed by 3774/3775 nonprogrammable terminals.) Unattended mode remains in effect until reset by a system reset, a power-on reset, or is reset by a supervisor program instruction.

Ending SDLC Communicate Mode

The operator can request session termination by pressing the CODE/STOP JOB keys. The host can terminate SDLC communicate mode by sending an Unbind command to the terminal. In both of these cases, the terminal returns to local mode.

If the supervisor program started SDLC communicate mode, the Unbind command from the host causes control to be passed from SDLC communicate mode back to the supervisor program.

With the additional SNA functions, an option of the Set Configuration instruction in the supervisor program terminates SDLC communicate mode upon receipt of the Deactivate Physical (DACTPU) command rather than the Unbind command. With this option, multiple sessions (Bind, Data Flow, Unbind; Bind, Data Flow, Unbind; etc.; etc.; Bind, Data Flow, Unbind; DACTPU) may occur within a single SDLC communicate mode operation.

Card-to-Diskette Utility Using SNA Formats

With the additional SNA functions, two additional options are added to the utility to select the SNA format options. The diskette record length must be 256 bytes. Card images do not span diskette records.

- *SNA Transparent* – The TRN (X'35') character and a count byte precede each card image on the diskette record. Trailing blanks are stripped from card data and an IRS (X'1E') character is added to each card image. The 256-byte record is filled with card data until one complete card with trailing blanks stripped and an IRS character added will not fit.
- *SNA Nontransparent with blank compression* – The 256-byte diskette record is filled with compressed card data (each card is followed by an IRS character) until one compressed card will not fit. An SCB character is transmitted in front of each string of characters to identify what follows: nonduplicated data or compressed blanks.

The same response used for no BSC blank compression is used to select the SNA nontransparent and noncompressed option. Except for the 256-byte record requirement, the diskette data formats for subsequent SDLC transmission are the same as for subsequent BSC transmission. Refer to the *IBM 3773, 3774, and 3775 Programmable Communication Terminals Operator's Guide*, GA27-3114, when using this and other utilities.

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