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IBM 3270 Information Display System

3271 Control Unit
3272 Control Unit
3275 Display Station
Description and Programmer's Guide

Systems

IBM

First Edition (November 1980)

The material in this publication was formerly contained in the *IBM 3270 Information Display System Component Description,* GA27-2749-10. For the applicable publications for other units of the IBM 3270 Information Display System, see the *IBM 3270 Information Display System Library User's Guide,* GA23-0058.

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Preface

This publication provides management, programmers, and system analysts with detailed reference material relating to the IBM 3270 Information Display System. The 3270 display system comprises the following units:

- IBM 3271 Control Unit Models 1, 2, 11, and 12
- IBM 3272 Control Unit Models 1 and 2
- IBM 3275 Display Station Models 1, 2, 11, and 12
- IBM 3277 Display Station Models 1 and 2
- IBM 3284 Printer Models 1, 2, and 3
- IBM 3286 Printer Models 1 and 2
- IBM 3287 Printer Models 1 and 2
- IBM 3288 Line Printer Model 2

Organization of This Publication

This publication is divided into eight chapters:

Chapter 1, Introduction, contains a general description of the individual 3270 units and features, and presents local and remote attachment configurations and system concepts.

Chapter 2, Terminal Operations, contains information on data buffering and display image and printout formatting. Display, keyboard, selector pen, printer, and operator identification card reader operations are described in detail.

Chapter 3, Commands and Orders, describes in detail the functions of the commands and orders that can be executed by the 3270.

Chapter 4, Local Operations, outlines the unique operations of locally attached 3270 systems. Described are operations with the channel, selection, command initiation and chaining, status bit definition, and error-recovery procedures.

Chapter 5, Remote Operations–BSC, discusses the unique operations of remotely attached 3270 systems using binary synchronous communication (BSC) line discipline. Described are BSC procedures, the functions and usage of data link control characters, 3270 command, selection, and polling operational sequences (including interaction with the access method and the channel program), remote 3270 command chaining, and error-recovery procedures.

Chapter 6, Remote Operations–SDLC, discusses the operation of remotely attached 3270 systems using synchronous data link control (SDLC) line discipline. This section describes command operation, data transfer, and error-recovery procedures.

Chapter 7, Screen Design, discusses the elements of screen design, field concepts, panel design, data stream coding, and the relationship between data streams.

Chapter 8, Screen Management, discusses the decoding and generating of data streams.

This publication also has six appendixes:

Appendix A, Indicators and Controls

Appendix B, Buffer Address I/O Interface Codes

Appendix C, Katakana Feature

Appendix D, Data Analysis–APL Feature

Appendix E, Abbreviations

Appendix F, Glossary

Related Publications

This document assumes that the reader has read the following publications, as appropriate:

- *IBM System/360 Principles of Operation,* GA22-6821
- *IBM System/370 Principles of Operation,* GA22-7000
- *General Information-Binary Synchronous Communications,* GA27-3004
- *IBM Synchronous Data Link Control General Information,* GA27-3093
- *IBM 2701 Data Adapter Unit Component Description,* GA22-6824
- *IBM 2703 Transmission Control Component Description,* GA27-2703
- *Introduction to the IBM 3704 and 3705 Communications Controllers,* GA27-3051
- *IBM System/3 Model 10 Components Reference Manual,* GA21-9103
- *IBM System/3 Model 10 Multi-line/Multi-point Binary Synchronous Communications Reference Manual,* GC21-7573
- *IBM Systems Network Architecture General Information,* GA27-3102
- *Virtual Storage Supplement,* GC20-0001, *for IBM System/360 and System/370 Bibliography,* GA22-6822

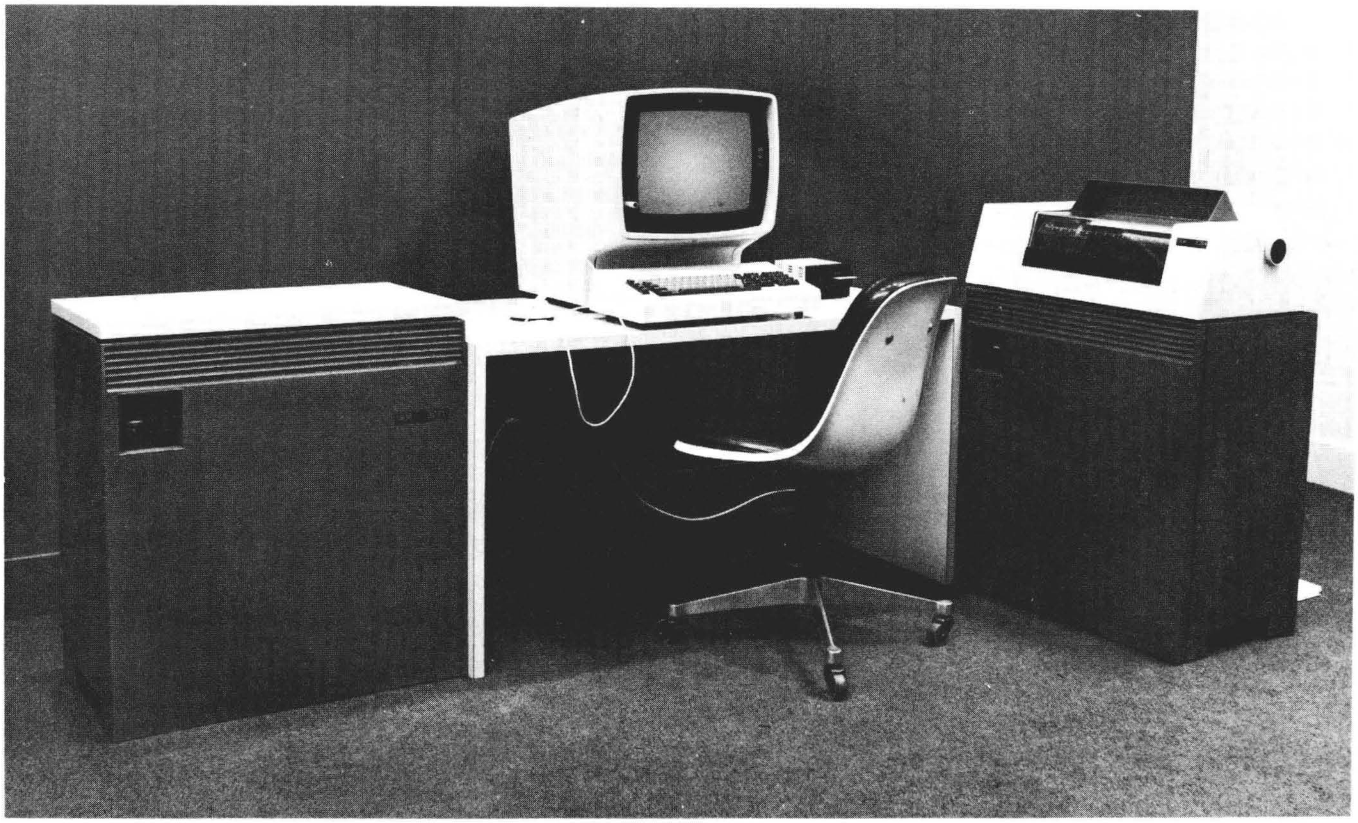
The following publications may also be of interest:

- *An Introduction to the IBM 3270 Information Display System,* GA27-2739
- *Operator's Guide for IBM 3270 Information Display Systems,* GA27-2742
- *IBM 3270 Information Display System Configurator,* GA27-2849
- *IBM 3270 Information Display System: Character Set Reference,* GA27-2837

For a description of all 3270 publications, see the *IBM 3270 Information Display System: Library User's Guide,* GA23-0058

Contents

Figures



Frontispiece. IBM 3270 Information Display System: 3271/3272 Control Unit, and Attached 3277 Display Station and 3284/3286 Printer

Chapter 1. Introduction

An example of an IBM 3270 Information Display System is shown in the frontispiece. The 3270 system offers the user a wide selection of components and configurations. Also available are a large variety of standard and special features that improve performance, provide additional operational capability, and permit expansion of the display system. See the *IBM 3270 Information Display System Configurator,* GA27-2849, for features and configurations.

The 3270 system can attach locally (via cable) or remotely (via common carrier or equivalent facilities) to a host sytem. Remote systems employ binary synchronous communication (BSC) or synchronous data link control (SDLC) line discipline.

Display System Components

The 3270 Information Display System has three types of components: control unit, display station, and printer.

Control Unit

The control unit provides for the 3270 system's attachment to a data processing system. It directs the operation of up to 32 attached 3270 display stations and printers. Two control units of the 3270 system are described in this publication:

3271 Control Unit

- Models 1 and 11 have a 480-character buffer capacity.
- Models 2 and 12 have a 1,920-character buffer capacity.
- Models 1 and 2 attach to a System/360 or System/370 via modems and a BSC data link, and operate with any of the following: an IBM 2701 Data Adapter Unit, an IBM 2703 Transmission Control Unit (TCU), an integrated communication adapter, or an IBM 3705 Communications Controller.
- Models 1 and 2 attach to System/3 Model 10 via a System/3 BSC adapter or to System/3 Model 15 via the local communication adapter.
- Models 11 and 12 attach to a System/370 via modems and an SDLC communication link, and operate in Network Control Program (NCP) mode with an IBM 3704 or 3705 Communications Controller.
- Models 1 and 2 attach to the 4300 Processors via a 2701 Data Adapter Unit or a 3704 or 3705 Communications Controller, and to the 4331 Processor via the communication adapter.

3272 Control Unit

- Model 1 has a 480-character buffer capacity.
- Model 2 has a 1,920-character buffer capacity.
- The unit attaches to a System/360 or System/370 via a selector, multiplexer, or block multiplexer channel.
- The unit attaches to the 4300 Processors via a byte multiplexer or block multiplexer channel.

Display Station

The display station provides image display of data transmitted from the data processing unit. A display station with an attached keyboard enables the user to enter, modify, or delete data on the display, and to cause the revised display to be returned to the processing system for storage or additional processing. Two display stations of the 3270 system are described in this publication:

3275 Display Station

- Models 1 and 11 have a 480-character buffer capacity.
- Models 2 and 12 have a 1,920-character buffer capacity.
- Models 1 and 2 are stand-alone units that attach to a System/360 or System/370 via modems or data access arrangements (DAAs) and any of the following: an IBM 2701, an IBM 2703, an integrated communication adapter, or an IBM 3705 Communications Controller.
- Models 1 and 2 attach to System/3 Model 10 or 15 via a BSC adapter or the local communication adapter.
- Models 11 and 12 attach to System/370 via modems and an SDLC communication link, and operate in NCP mode with a 3704 or 3705 Communications Controller.

3277 Display Station

- Model 1 has a 480-character display image.
- Model 2 has a 1,920-character display image.
- Model 1 attaches to a 3271 Control Unit (all models) or to a 3272 Control Unit Model 1 or 2.
- Model 2 attaches to a 3271 Control Unit Model 2 or 12 or to a 3272 Control Unit Model 2.
- Models 1 and 2 attach to the 3791 Controller (3790 Communication System).

Printer

The printer provides printed copy of data displayed at a display station or of data transmitted from the data processing system. Four printers of the 3270 system are described in this publication:

3284 Printer

- Model 1 has a 480-character buffer capacity with a 40-cps print rate.
- Model 1 attaches to a 3271 or a 3272 Control Unit (all models).
- Model 2 has a 1,920-character buffer capacity with a 40-cps print rate.
- Model 2 attaches to a 3271 Model 2 or 12 or to a 3272 Control Unit Model 2.
- Model 3 has no buffer; the print rate is 40 cps.
- Model 3 attaches to a 3275 Display Station (all models).

3286 Printer

- Model 1 has a 480-character buffer capacity with a 66-cps print rate.
- Model 1 attaches to a 3271 or a 3272 Control Unit (all models).
- Model 2 has a 1,920-character buffer capacity with a 66-cps print rate.
- Model 2 attaches to a 3271 Model 2 or 12 or to a 3272 Control Unit Model 2.

3287 Printer

- Model 1 has a 480- or 1,920-character buffer capacity with an 80-cps maximum print rate and 132 print positions.
- Model 2 has a 480- or 1,920-character buffer capacity with a 120-cps maximum print rate and 132 print positions.
- Both models attach to a 3271 or 3272 Control Unit (all models).

3288 Line Printer (Model 2 only)

- Model 2 has a 1,920-character buffer capacity. The average print rate is 120 lines per minute.
- Model 2 attaches to a 3271 Control Unit Model 2 or 12 or a 3272 Control Unit Model 2.

Display System Configurations

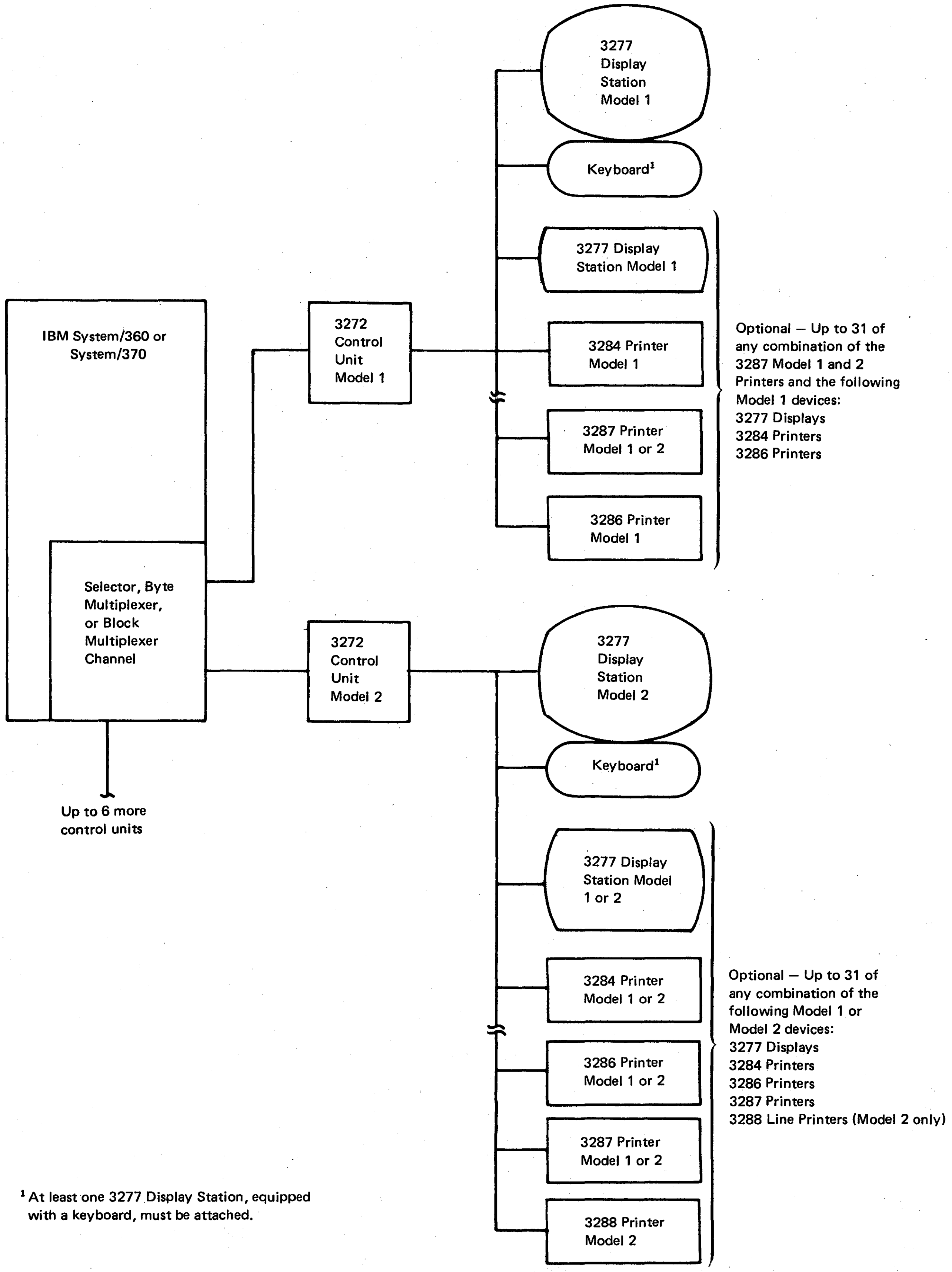
Local Attachment

Locally attached 3270 display systems (Figure 1-1) use a 3272 Control Unit Model 1 or 2. The 3272 Control Unit Model 1 can communicate with up to 32 devices, consisting of Model-1 3277 display stations, Model-1 3284 or 3286 printers, and Model-1 or Model-2 3287 printers. The 3272 Control Unit Model 2 can attach up to 32 devices, consisting of Model-1 or Model-2 3277 display stations, Model-1 or Model-2 3284, 3286, or 3287 printers, and Model-2 3288 Line Printers. At least one display station with a keyboard must be attached to any control unit. The 3272 is attached to a System/360 or System/370 through a block multiplexer, a byte multiplexer, or a selector channel via one of the eight control unit positions on the channel interface. The channel provides the 3272 with data to be displayed and with control information needed to direct the operation of the display station or printer attached to the 3272. Separate buffer storage in the display stations or printers holds digitally coded data for display or printing.

Remote Attachment

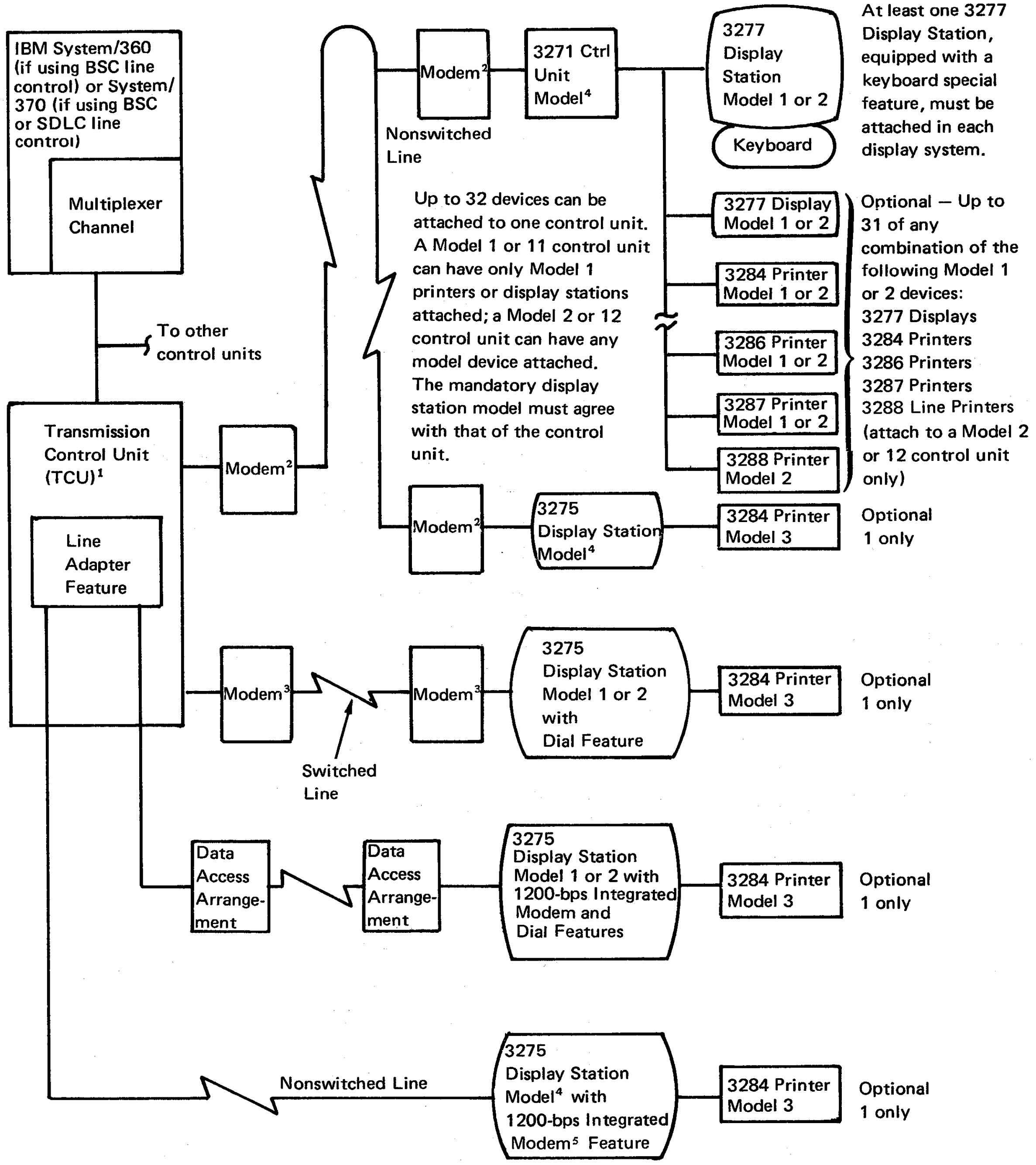
Remote attachment differs from local attachment in the medium through which the control unit and the system channel communicate. In a local configuration, the control unit is cabled directly to the system channel. In remote attachment, common-carrier (or equivalent customer) facilities of unlimited length are employed to communicate between the host and the 3270 system.

Two types of remote attachment are available: BSC data link mode and SDLC operating mode. Display data and control information are relayed from the system channel to a control unit by a TCU, an integrated communication adapter, or a communications controller in BSC mode of operation, or by use of a communications controller in SDLC operating mode. Transmission is via modems and common-carrier nonswitched network communication facilities, such as telephone lines, microwave transmission, and satellite, or via switched facilities (BSC mode only). See Figure 1-2.


3277 Display Station Model 1
Keyboard[1]
3277 Display Station Model 1
IBM System/360 or System/370
3272 Control Unit Model 1
3284 Printer Model 1
Optional – Up to 31 of any combination of the 3287 Model 1 and 2 Printers and the following Model 1 devices:
3277 Displays
3284 Printers
3286 Printers
3287 Printer Model 1 or 2
3286 Printer Model 1
Selector, Byte Multiplexer, or Block Multiplexer Channel
3272 Control Unit Model 2
3277 Display Station Model 2
Keyboard[1]
Up to 6 more control units
3277 Display Station Model 1 or 2
3284 Printer Model 1 or 2
Optional – Up to 31 of any combination of the following Model 1 or Model 2 devices:
3277 Displays
3284 Printers
3286 Printers
3287 Printers
3288 Line Printers (Model 2 only)
3286 Printer Model 1 or 2
3287 Printer Model 1 or 2
3288 Printer Model 2

[1] At least one 3277 Display Station, equipped with a keyboard, must be attached.

Figure 1-1. Locally Attached 3270 Information Display System


IBM System/360 (if using BSC line control) or System/370 (if using BSC or SDLC line control)
Multiplexer Channel
To other control units
Transmission Control Unit (TCU)[1]
Line Adapter Feature
Modem[2]
Nonswitched Line
Modem[2]
3271 Ctrl Unit Model[4]
3277 Display Station Model 1 or 2
Keyboard
At least one 3277 Display Station, equipped with a keyboard special feature, must be attached in each display system.
Up to 32 devices can be attached to one control unit. A Model 1 or 11 control unit can have only Model 1 printers or display stations attached; a Model 2 or 12 control unit can have any model device attached. The mandatory display station model must agree with that of the control unit.
3277 Display Model 1 or 2
3284 Printer Model 1 or 2
3286 Printer Model 1 or 2
3287 Printer Model 1 or 2
3288 Printer Model 2
Optional — Up to 31 of any combination of the following Model 1 or 2 devices: 3277 Displays 3284 Printers 3286 Printers 3287 Printers 3288 Line Printers (attach to a Model 2 or 12 control unit only)
Modem[2]
3275 Display Station Model[4]
3284 Printer Model 3
Optional 1 only
Modem[3]
Switched Line
Modem[3]
3275 Display Station Model 1 or 2 with Dial Feature
3284 Printer Model 3
Optional 1 only
Data Access Arrange-ment
Data Access Arrange-ment
3275 Display Station Model 1 or 2 with 1200-bps Integrated Modem and Dial Features
3284 Printer Model 3
Optional 1 only
Nonswitched Line
3275 Display Station Model[4] with 1200-bps Integrated Modem[5] Feature
3284 Printer Model 3
Optional 1 only

[1] 2701 Data Adapter Unit, 2703 Transmission Control (nonswitched with external modem only), 3705 Communications Controller, or equivalent Integrated Communication Adapter. In addition, the 3705 Communications Controller attaches to a selector or block multiplexer channel. In BSC mode, the choice of unit is dependent upon the processing system model, the type of channel, and the communication network selected. SDLC mode of operation requires a 3704 or 3705 Communications Controller.

[2] IBM 3872, 3874, 3875, or 4872 Modems (or equivalent), as required. When switched network backup capability is provided, an IBM 3872, 3874, or 3875 modem is used, with a dial telephone attached, to communicate with the transmission control unit.

[3] 1200-bps operation only.

[4] 3271 Control Unit Model 1 or 2 and 3275 Display Station Model 1 or 2 are required for BSC operation. 3271 Control Unit Model 11 or 12 and 3275 Display Station Model 11 or 12 are required when using the SDLC operating mode.

[5] 1200-bps operation only, on nonswitched line.

Figure 1-2. Remotely Attached 3270 Information Display System

Remotely Attached 3270 Systems Using BSC Operating Mode

A 3271 Control Unit Model 1 or 2 or a 3275 Display Station Model 1 or 2 is used to remotely attach a 3270 system to the teleprocessing network employing BSC operating mode, allowing communication with a host System/360 or System/370. A 2701 Data Adapter Unit, a 2703 Transmission Control Unit, a 3705 Communications Controller, or an equivalent integrated communication adapter, depending upon the host system and channel selected, connects the teleprocessing network to the host system channel.

The 3271 Control Unit Model 1 can attach up to 32 devices, consisting of Model-1 3277 display stations and Model-1 3284 or 3286 printers, or Model-1 or Model-2 3287 printers.

The 3271 Control Unit Model 2 can attach up to 32 devices, consisting of Model-1 or Model-2 3277 display stations, Model-1 or Model-2 3284, 3286, or 3287 printers, and Model-2 3288 line printers. One display station with a keyboard must attach to each control unit. The model number of the display station and that of the control unit must be the same.

The 3275 Display Station Model 1 or 2 provides added convenience for remote locations that require a single display device. The 3275 functions as a control unit and as a display station, and is therefore more economical than a 3271 with a single 3277 attached. The 3275 capabilities can be expanded by attaching a 3284 Printer Model 3 to provide a paper copy of displayed messages. The 3275 can be attached to (multidropped from) the same nonswitched communication line as other 3270 display systems and other IBM products that use the BSC mode of operation, or, with the Dial feature installed, it can be attached by use of a point-to-point common-carrier switched network.

Remotely Attached 3270 Systems Using SDLC Operating Mode

When employing SDLC line discipline, the 3270 system is remotely attached to a host System/370 via a 3271 Control Unit Model 11 or 12, or a 3275 Display Station Model 11 or 12, over a teleprocessing network. A 3704 or 3705 Communications Controller is required for this configuration. Display data and control information are relayed from the host system channel by the communications controller to the 3271 or 3275 Model 11 or 12 unit, via modems and common-carrier voice-grade lines.

The 3271 Control Unit Model 11 can communicate with up to 32 devices, consisting of Model-1 3277 Display Stations, 3284 or 3286 Model 1 Printers, and 3287 Model 1 or 2 Printers.

The 3271 Control Unit Model 12 can direct the operation of up to 32 Model-1 or Model-2 3277 Display Stations, 3284, 3286, or 3287 Printers, or Model-2 3288 Printers.

At least one display station with a keyboard must attach to a control unit.

The 3275 Display Station Model 11 or 12 does not require a control unit for attachment to a nonswitched line teleprocessing network. When a paper copy of a computer message is desired, a 3284 Model 3 Printer can be attached to the 3275 Display Station. The 3275 Display Station Model 11 or 12 can be attached to the same nonswitched remote communication line as other 3270 systems and other IBM products that use the SDLC mode of operation.

Teleprocessing Networks and Modems

Remotely attached 3270 display systems that use BSC or SDLC line discipline operate in half-duplex transmission mode on half-duplex or full-duplex communication facilities.

The 3271 Model 1 or 2 can attach to a multipoint nonswitched line network. The 3275 Model 1 or 2 can operate in multipoint mode on nonswitched lines or on switched network lines when the Dial feature is installed.

The 3271 and 3275 Models 11 and 12 can attach to multipoint nonswitched line networks. Messages may be simultaneously transmitted and received by the 3704 or 3705 units on full-duplex facilities (duplex-multipoint operation), when two or more SDLC devices are multidropped and attached to the same communications controllers.

IBM modems that can be used in remote systems that employ BSC or SDLC line control (specified in Figure 1-2) are as follows:

- 3872 Model 1 (2,400 bps)
- 3874 Model 1 (4,800 bps)
- 4872 Models 1 and 3 (4,800 bps)
- 3875 Model 1 (7,200 bps)

Switched network backup is a method of replacing a failing nonswitched line with a switched communication system. This capability is available when the IBM 3872 and 3875 Modems are being used. The 3875 operates on nonswitched lines at transmission speeds of 7,200 and 3,600 bps, and on switched lines at speeds of 3,600 and 1,800 bps. The 3872 operates at transmission speeds of 2,400 and 1,200 bps on both nonswitched and switched lines. If an excessively high error rate occurs during operation on a nonswitched line at the maximum transmission speed (7,200 or 2,400 bps), the speed is reduced by one-half at both modems used in the system, and a check is made for a continued high error rate. If the error rate is still high, the display-terminal operator establishes a switched-line connection by dialing the 2701 (or equivalent unit). If the 3872 or 3875 modem was operating at half-speed when the error condition began, the operator establishes the switched-line connection without first changing the transmission speed. The lower line speeds available for dial operation (1,800 or 1,200 bps) may be used if too many errors occur at the higher line speeds.

Features

No attempt has been made in this publication to catalog all the features available for the 3270 system, although some features are discussed. For details on the availability of various 3270 features, see the *IBM 3270 Information Display System Configurator,* GA27-2849, or discuss the matter with your IBM sales representative.

System Concepts

The 3271 and 3272 Control Units and the 3275 Display Station control the operations of, and the transfer of data to or from, their attached terminals. See Chapter 2, Terminal Operations, for details.

The 3271, 3272, and 3275 handle all communications with the host system, using the 3270 data stream and the appropriate interface codes.

Data Stream

The 3270 data stream consists of user-provided data, commands, and orders transmitted between the control unit and the host system (Figure 2-1). Control information, which governs the movement of the data stream, is also transmitted. The control units can differ as to the type of commands and/or transmission protocols employed.

Commands are issued to initiate such operations as the total or partial writing, reading, and erasing of data in a selected 3270 device buffer. Orders can be included in write data streams, either alone or intermixed with display or print data.

Two types of orders are available. One type is executed as it is received by the control unit. This type is used to position, define, and format data being written into the buffer, to erase selected unprotected data in the buffer, and to reposition the cursor. The second type or order specifies printer format. These orders are initially stored in the buffer as data and are executed only during a print operation.

See Chapter 3 for a detailed description of the 3270 commands and orders associated with the 3270 units described in this publication.

Interface Codes

Data, commands, and orders transmitted between the control unit and the host system are in the form of interface codes. Two different codes are used in the United States: extended binary-coded decimal interchange code (EBCDIC) and American National Standard Code for Information Interchange (ASCII). The EBCDIC codes are also used in the World Trade countries (ASCII is available only in the U.S.); refer to *IBM 3270 Information Display System: Character Set Reference,* GA27-2837, for details. (Chapter 2 contains the U.S. codes, Appendix C contains the Katakana codes, and Appendix D contains the Data Analysis–APL codes.)

Local and Remote Operations

See Chapter 4 for local operations, Chapter 5 for remote BSC operations, and Chapter 6 for remote SDLC operations.

Chapter 2. Terminal Operations

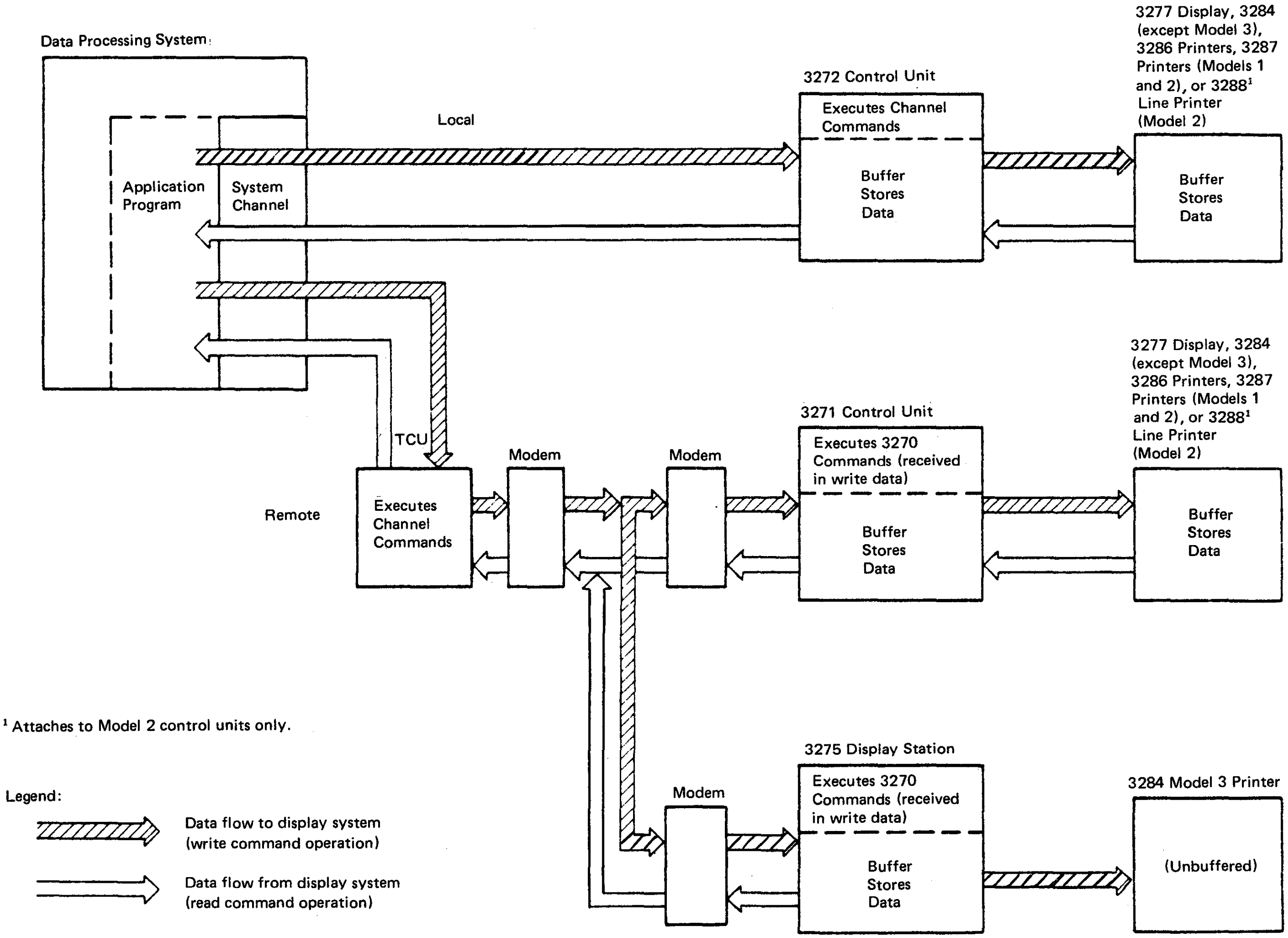
Buffer Concepts

Each unit in the 3270 Information Display System (except the 3284 Printer Model 3) has its own buffer for storing data (Figure 2-1).

Buffers are checked to determine whether all characters in the buffers have correct parity. A parity check error occurs when circuitry detects one or more characters with bad parity.

The 3275, as a stand-alone display station, contains its own control unit and executes commands in the same way as the 3271 with one device attached. The 3275 contains one buffer, which it uses both for preparing and for displaying data. When a printout is required at an attached 3284 Printer Model 3 (which has no buffer), the 3275 buffer is used to format and store the printer data.

When not executing a command operation, the 3271 and 3272 control unit hardware continually performs an internal poll of all attached devices. Internal polling is performed to determine what the device status is and whether the device has an input/output (I/O) pending condition.


Data Processing System
Application Program
System Channel
Local
3272 Control Unit
Executes Channel Commands
Buffer Stores Data
3277 Display, 3284 (except Model 3), 3286 Printers, 3287 Printers (Models 1 and 2), or 3288[1] Line Printer (Model 2)
Buffer Stores Data
Remote
TCU
Executes Channel Commands
Modem
Modem
3271 Control Unit
Executes 3270 Commands (received in write data)
Buffer Stores Data
3277 Display, 3284 (except Model 3), 3286 Printers, 3287 Printers (Models 1 and 2), or 3288[1] Line Printer (Model 2)
Buffer Stores Data
Modem
3275 Display Station
Executes 3270 Commands (received in write data)
Buffer Stores Data
3284 Model 3 Printer
(Unbuffered)
Legend:
Data flow to display system (write command operation)
Data flow from display system (read command operation)

[1] Attaches to Model 2 control units only.

Figure 2-1. Data Flow between Data Processing System and 3270 Information Display System

The current status of each device indicates to the control unit whether the device is available, ready, or busy. This information is recorded in the associated device adapter in the control unit.

When an I/O pending condition is detected at a device, polling stops and the control unit communicates solely with that device. When communication is ended, the control unit commences polling at the next sequential device.

In addition, when the program addresses a specific device, the control unit stops the sequential polling and polls the addressed device to obtain its latest status. If conditions permit, the control unit communicates solely with that device until the operation is completed. At that time, sequential polling is resumed.

The 3270 terminal operations are divided into display operations and printer operations.

Display Operations

This section provides information on the functions and operation of display stations and their associated special features. No distinction is made between the 3277 and 3275 Display Stations, since the units have the same display capabilities. In addition, no distinction is made between various keyboard special features unless they are pertinent to the topic being discussed.

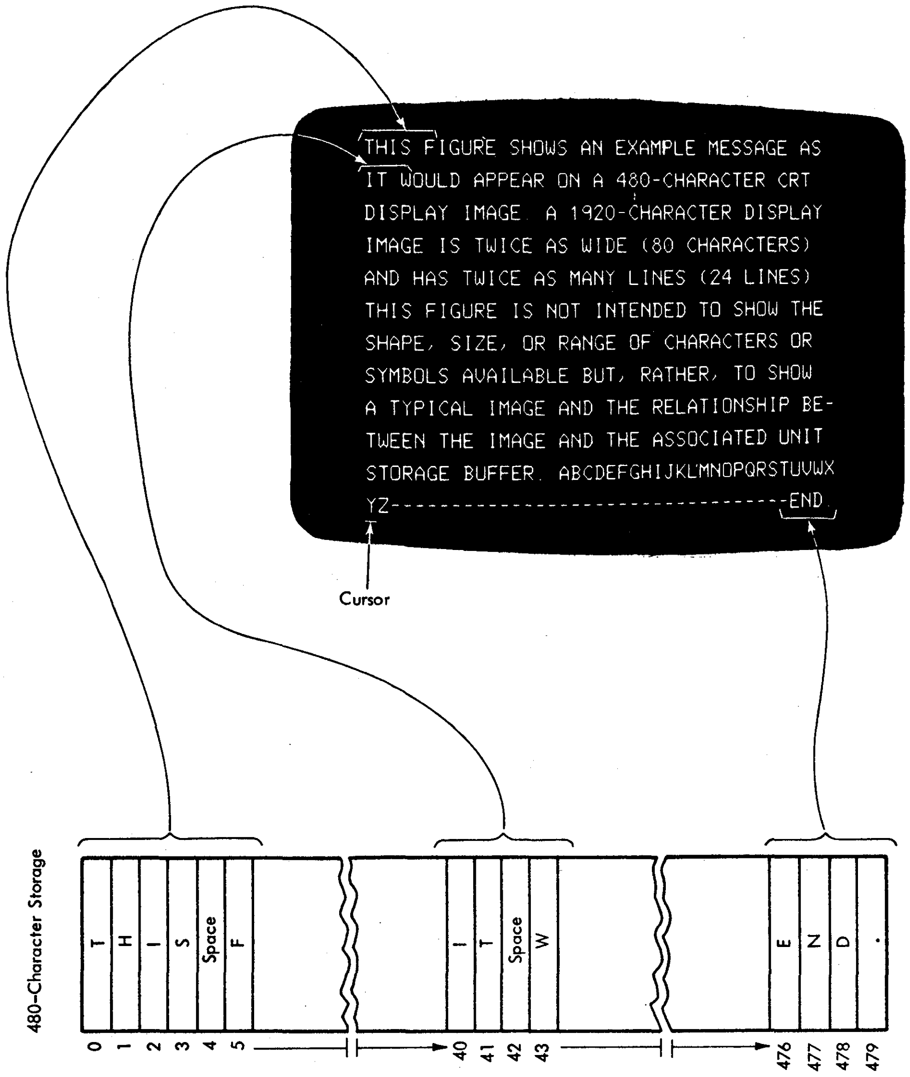
Display Images

Display data that is stored in a display station buffer is presented to the operator on a cathode-ray tube (CRT) screen in the form of alphameric characters and symbols.

When a keyboard is attached, input messages can be generated at the keyboard and displayed on the screen as they are composed.

The image on a 480-character unit is displayed on 12 horizontal rows of 40 characters each (Figure 2-2). The image on a 1,920-character unit is displayed on 24 horizontal rows of 80 characters each.

There is a fixed relationship between each display station buffer storage location and its related character position on the display screen (Figure 2-2). Buffer address locations are referenced from 0 (the first displayable character location in the upper-left corner of the screen) to 479 or 1,919 (the last displayable character location in the bottom-right corner of the screen). Figure 2-3 shows the layouts of these address locations for display buffers of both sizes. By using these address locations under appropriate commands, a program can load a display station buffer with many combinations of control and data characters to present to the operator a display image that exactly fits the application. A total of 93 character codes may be transferred from the sytem processor and stored in the display station buffer. These include the uppercase and lowercase alphameric characters and special characters shown in Figures 2-5 and 2-6. They include printer control characters EM, NL, and FF (which is displayed as < for the 3288 Line Printer) and two selector-pen-detectable control characters (? and >), also shown in Figures 2-5 and 2-6. They also include attribute characters described below under "Display Fields."



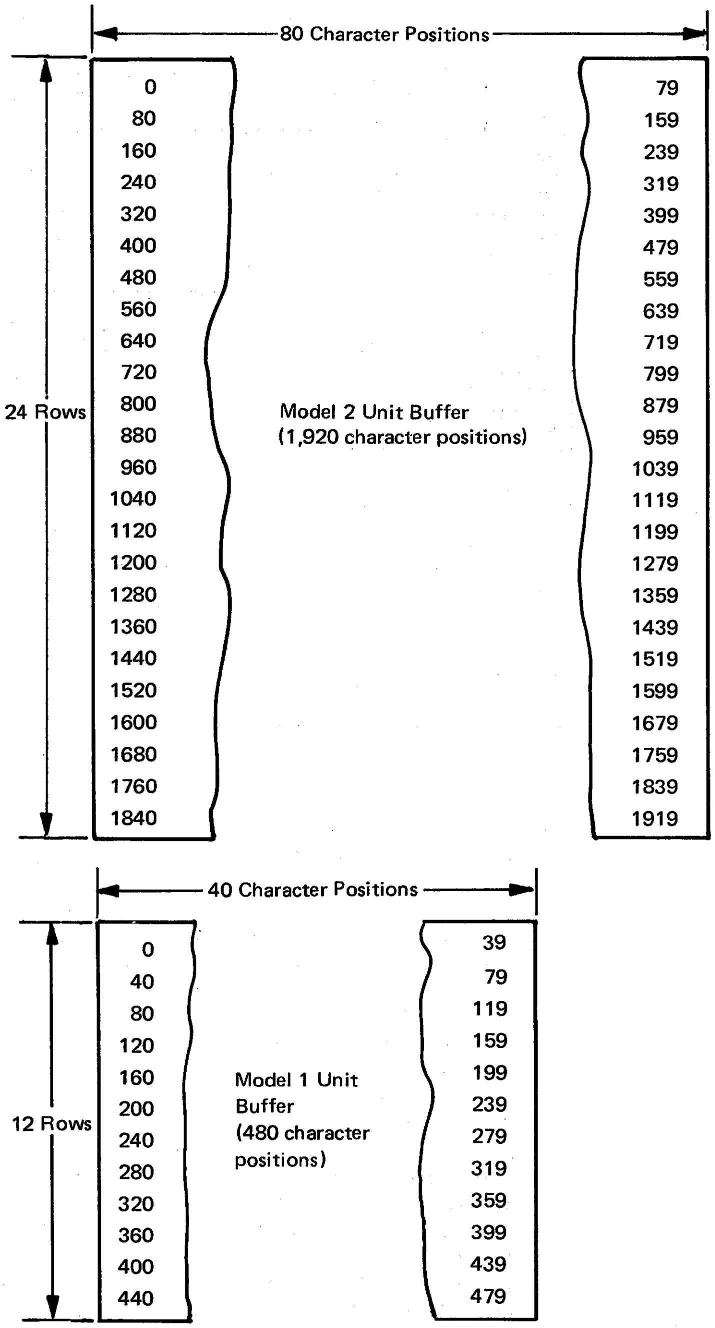
```
THIS FIGURE SHOWS AN EXAMPLE MESSAGE AS
IT WOULD APPEAR ON A 480-CHARACTER CRT
DISPLAY IMAGE. A 1920-CHARACTER DISPLAY
IMAGE IS TWICE AS WIDE (80 CHARACTERS)
AND HAS TWICE AS MANY LINES (24 LINES)
THIS FIGURE IS NOT INTENDED TO SHOW THE
SHAPE, SIZE, OR RANGE OF CHARACTERS OR
SYMBOLS AVAILABLE BUT, RATHER, TO SHOW
A TYPICAL IMAGE AND THE RELATIONSHIP BE-
TWEEN THE IMAGE AND THE ASSOCIATED UNIT
STORAGE BUFFER. ABCDEFGHIJKLMNOPQRSTUVWX
YZ---------------------------------END.
```

Figure 2-2. Relationship between Display Station Buffer and Character Position on Display Image Screen (Unformatted Display)

Unformatted and Formatted Display Images

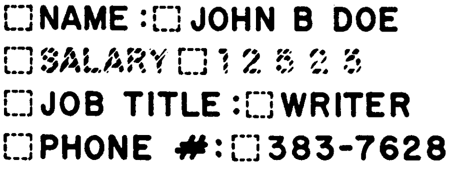
An application program can communicate with a display operator by one of two basic methods. In one method, the display screen is left unformatted and the display operator uses the screen in a free-form manner. In the second method, the display image is completely or partially formatted (organized or arranged) by the application program.

The display image shown in Figure 2-4 illustrates the flexibility available with 3270 display image formatting. In this example, the visible characters represent displayed data stored in the display buffer. Character positions indicated by dotted squares represent buffer locations where control characters are stored. Dotted characters represent display data that is defined by the program as not displayable, that is , not visible to the operator. In all display images, control characters stored in a display unit buffer are not displayed; data characters may or may not be displayed, depending upon program definition.



Note: *See Appendix B for hexadecimal equivalents.*

Figure 2-3. Buffer Addressing Layouts for Model 1 and Model 2 Devices



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□JOB TITLE :□WRITER

□PHONE #:□383-7628

Figure 2-4. Examples of Display Image Fields (Formatted Display)

		00				01				10				11				Bits 0,1
	Hex 1	00	01	10	11	00	01	10	11	00	01	10	11	00	01	10	11	2,3
Bits 4567		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	Hex 0
0000	0	NUL				SP	&	-									0	
0001	1		SBA					/		a	j			A	J		1	
0010	2		EUA							b	k	s		B	K	S	2	
0011	3		IC							c	l	t		C	L	T	3	
0100	4									d	m	u		D	M	U	4	
0101	5	PT	NL							e	n	v		E	N	V	5	
0110	6									f	o	w		F	O	W	6	
0111	7									g	p	x		G	P	X	7	
1000	8									h	q	y		H	Q	Y	8	
1001	9		EM							i	r	z		I	R	Z	9	
1010	A					¢	!	¦	:									
1011	B					.	$	,	#									
1100	C	FF	DUP		RA	<	*	%	@									
1101	D		SF			(	)	_	'									
1110	E		FM			+	;	>	=									
1111	F				SUB	|	¬	?	"									

Notes:

1. *Character code assignments other than those shown within all outlined areas of this chart are undefined. If an undefined character code is programmed, the character that will be displayed or printed is not specified. The character displayed by the 3277 or 3275 for a given undefined character code may be different for other devices. IBM reserves the right to change at any time the character displayed for an undefined character code.*
2. *Lowercase alphabetic characters (shown within the dotted outlined area) are converted to uppercase by the display station or printer and displayed or printed as uppercase characters.*
3. *NL, EM, FF, DUP, and FM control characters are displayed or printed as 5 9 < * and ; characters, respectively, except by printers under format control, in which case NL and EM do not result in the printing of a character, and by printers successfully executing FF, in which case < is not printed.*
4. *Bits 0 and 1 are assigned for the following characters: AID, attribute, write control (WCC), copy control (CCC), CU and device address, buffer address, sense, and status. Bits 0 and 1 are assigned so that each character can be represented by a graphic character within the solid outlined areas of the chart. See Figure 2-7.*
5. *This table also applies for Belgian, French, and Italian mono-case I/O interface codes and graphics.*
6. *The ¦ character (hex 6A) is not displayed and is printed by the 3287 and 3288 only.*
7. *For BSC data-link control characters, see Chapter 5.*
8. *See Appendix C for Katakana EBCDIC codes.*
9. *See Appendix D for Data Analysis — APL codes.*
10. *See* IBM 3270 Information Display System: Character Set Reference, *GA27-2837, for all interface codes for the 3270 system.*

Figure 2-5. United States I/O Interface Code – EBCDIC

		000	001	010	011	100	101	110	111	Bits 7, 6, 5
Bits 4321	Hex 1	0	1	2	3	4	5	6	7	Hex 0
0000	0	NUL		SP	0	@	P		p	
0001	1		SBA	!	1	A	Q	a	q	
0010	2		EUA	"	2	B	R	b	r	
0011	3		IC	#	3	C	S	c	s	
0100	4		RA	$	4	D	T	d	t	
0101	5			%	5	E	U	e	u	
0110	6			&	6	F	V	f	v	
0111	7			'	7	G	W	g	w	
1000	8			(	8	H	X	h	x	
1001	9	PT	EM	)	9	I	Y	i	y	
1010	A	NL	SUB	*	:	J	Z	j	z	
1011	B			+	;	K	[	k		
1100	C	FF	DUP	,	<	L	\	l		
1101	D		SF	–	=	M	]	m		
1110	E		FM	.	>	N	^	n		
1111	F			/	?	O	_	o		

Notes:

1. *Character code assignments other than those shown within all outlined areas of this chart are undefined. If an undefined character code is programmed, the character that will be displayed or printed and the I/O interface code returned on a subsequent read operation are not specified. The character displayed or printed by these terminals for a given undefined character code may be different for other terminals. IBM reserves the right to change at any time the character displayed or printed and the I/O interface code returned for an undefined character code.*
2. *Lowercase alphabetic characters (shown within the dotted outlined area) are converted to uppercase by the display station or printer and displayed or printed as uppercase characters.*
3. *NL, EM, FF, DUP, and FM control characters are displayed or printed as 5 9 < * and ; characters, respectively, except by printers under format control, in which case NL and EM do not result in the printing of a character, and by printers successfully executing FF, in which case < is not printed.*
4. *AID, attribute, write control (WCC), copy control (CCC), CU and device address, buffer address, sense, and status characters are assigned as specified in Figure 2-7 so that each character can be represented by a graphic character within the solid outlined portion of this chart.*
5. *ASCII A option displays and prints | and ¬ for interface codes 21 and 5E (hex), respectively. ASCII B option displays and prints ! and ∧ for codes 21 and 5E (hex), respectively.*
6. *The FF control character (0C) is returned to the host during a subsequent read operation as 46.*
7. *For BSC data-link control characters, see Chapter 5.*

Figure 2-6. United States I/O Interface Code – ASCII

Display Fields

The control characters (dotted squares) shown in Figure 2-4 are constructed by the program. They define the characteristics or attributes of the data that follow them and are called *attribute characters*. Each attribute character plus all the data following it up to the next attribute character is called a *field*. When a field "wraps" the screen, the field continues from the last character location in the buffer to the first location in the buffer until it is terminated by an attribute character. Figure 2-4 shows eight fields. Figures 2-5, 2-6, and 2-7 show the United States I/O interface codes used.

Organizing the display data into fields facilitates display operations for the program and for the operator. Fields are also used in most 3270 programming operations: functions that involve the storage, display, printing, or transmission of data are primarily field-oriented. Some operations performed on fields that wrap the screen are terminated by the last buffer address rather than by the field terminating attribute. This effect is noted in the descriptions of the specific operations.

Attribute characters, in addition to defining the start of a field, define the following field characteristics for all character locations contained in that field:

- Protected (from modification by a display operator) or unprotected (available for the operator to modify or enter data). The unprotected definition classifies a field as an input field.
- Alphameric (an input field in which an operator can enter alphabetic, numeric, or symbol characters) or numeric (has special meaning for protected fields, data entry keyboards, and the Numeric Lock special feature).
- Character display (nondisplay, display, intensified display).
- Detectable or nondetectable (by use of the selector pen).
- Tab stop positions (first character position of unprotected fields).

Each attribute character occupies one of the 480- or 1,920-character locations in the buffer, but it cannot be displayed or printed. During a display or a printout, its character location appears as a space. Figure 2-8 shows the bit definition for an attribute character.

Attribute characters are treated as characters that are protected from operator intervention; that is, they cannot be replaced by alphameric characters entered from the keyboard or modified by use of the selector pen. However, the modified data tab (MDT) bit (7) of the attribute character can be changed by an operator, as described in Figure 2-8. Also, attribute characters are not protected from being overwritten by alphameric data that is included in the data stream of a Write or Erase Write command. When the operator uses the CLEAR key, attribute characters and all characters in a formatted buffer are erased. See Chapter 7 for details of screen design. See Chapter 8 for screen management.

Programming Note: *Refer to "Selector Pen Operations" for use of intensified field attributes when formatting selector-pen-detectable fields.*

Bits 2–7	Graphic	EBCDIC	ASCII
00 0000	SP	40	20
00 0001	A	C1	41
00 0010	B	C2	42
00 0011	C	C3	43
00 0100	D	C4	44
00 0101	E	C5	45
00 0110	F	C6	46
00 0111	G	C7	47
00 1000	H	C8	48
00 1001	I	C9	49
00 1010	¢ [	4A —	— 5B
00 1011		4B	2E
00 1100	<	4C	3C
00 1101	(	4D	28
00 1110	+	4E	2B
00 1111	| !	4F —	— 21
01 0000	&	50	26
01 0001	J	D1	4A
01 0010	K	D2	4B
01 0011	L	D3	4C
01 0100	M	D4	4D
01 0101	N	D5	4E
01 0110	O	D6	4F
01 0111	P	D7	50
01 1000	Q	D8	51
01 1001	R	D9	52
01 1010	!]	5A —	— 5D
01 1011	$	5B	24
01 1100	*	5C	2A
01 1101	)	5D	29
01 1110	;	5E	3B
01 1111	¬ ∧	5F —	5E
10 0000	-	60	2D
10 0001	/	61	2F
10 0010	S	E2	53
10 0011	T	E3	54
10 0100	U	E4	55
10 0101	V	E5	56
10 0110	W	E6	57
10 0111	X	E7	58
10 1000	Y	E8	59
10 1001	Z	E9	5A
10 1010	¦ (EBCDIC)	6A	7C
10 1011	,	6B	2C
10 1100	%	6C	25
10 1101	—	6D	5F
10 1110	>	6E	3E
10 1111	?	6F	3F
11 0000	0	F0	30
11 0001	1	F1	31
11 0010	2	F2	32
11 0011	3	F3	33
11 0100	4	F4	34
11 0101	5	F5	35
11 0110	6	F6	36
11 0111	7	F7	37
11 1000	8	F8	38
11 1001	9	F9	39
11 1010	:	7A	3A
11 1011	#	7B	23
11 1100	@	7C	40
11 1101	'	7D	27
11 1110	=	7E	3D
11 1111	"	7F	22

Note: *The characters above are used as attribute, AID, write control (WCC), copy control (CCC), CU and device address, and buffer address. They are also used as status and sense. When any of these characters is transmitted to the program, the CU assigns the appropriate EBCDIC code. If transmission is in ASCII, the CU translates the EBCDIC code to ASCII code prior to transmission.*

To use this table to determine the hex code transmitted for an address or control character, first determine the values of bits 2–7. Select this bit configuration from the "Bits 2–7" column. The hex code that will be transmitted (either in EBCDIC or in ASCII) is to the right of the bit configuration.

Use this table also to determine equivalent EBCDIC and ASCII hex codes and their associated graphic characters. See Note 5 of Figure 2-6 for ASCII A and B graphic character difference for ASCII codes 21 and 5E (hex).

Graphic characters for the United States I/O interface codes are shown. Graphic characters might differ for particular World Trade I/O interface codes. Refer to IBM 3270 Information Display System: Character Set Reference, *GA27-2837, for possible graphic differences when these codes are used.*

Figure 2-7. Control Character I/O Codes

Attribute-Character Bit Assignments

X	1	U/P	A/N	D/SPD		Reserved	MDT
0	1	2	3	4	5	6	7

EBCDIC Bit	Field Description
0	Value determined by contents of bits 2-7. See Figure 2-7.
1	Always a 1.
2	0 = Unprotected 1 = Protected
3	0 = Alphameric 1 = Numeric (causes automatic upshift of data entry keyboard) **Note:** *Bits 2 and 3 equal to 11 causes an automatic skip. See text.*
4 & 5	00 = Display/not selector-pen-detectable. 01 = Display/selector-pen-detectable. 10 = Intensified display/selector-pen-detectable. 11 = Nondisplay, nonprint, nondetectable.
6	Reserved. Must always be 0.
7	Modified Data Tag (MDT); identifies modified fields during Read Modified command operations. 0 = Field has not been modified. 1 = Field has been modified by the operator. Can also be set by program in data stream.

Note: *Bits 0 and 1 are not decoded when received by the 3270. When characters are transferred to the CPU, bit 1 is a 1 and bit 0 is set (as shown in Figure 2-7), depending upon the character being transferred. All attribute characters are part of the defined character set. The default option (bits 2 through 7 all set to 0) results in an unprotected, alphameric, displayed, nondetectable field.*

Figure 2-8. Attribute-Character Bit Definition

Keyboard Operations

Keyboards, which can be attached to a 3277 or 3275, enable the operator to change, edit, or create character displays except within fields, defined by attribute characters, as protected from keyboard operations by the program. As messages are being composed or modified by keyboard operations, the changes are inserted in the buffer and displayed on the subsequent display regeneration cycle.

When the operator completes an operation and presses the ENTER key, an I/O pending interruption occurs. In local operations, this causes an interruption to inform the program; the program may then read the modified data fields from the display buffer. In remote operations, an interruption cannot be generated; instead, the modified data fields are read automatically in response to a Poll sequence.

Cursor

A special symbol (that resembles an underscore), called a *cursor*, is displayed beneath a character or character position on the display screen to indicate where the next character entered from the keyboard will be stored (Figure 2-2). For example, when the cursor is displayed under one character in a line of characters, that character can be changed or deleted by keyboard action. Also, if the cursor is displayed under a position without a display character, a character can be inserted in that position by keyboard action. All these operations, when performed on a formatted display, cause the MDT bit (7) of the attribute character for the field to be set to 1. However, when the cursor appears beneath a character in a protected field or an attribute character, that position cannot be modified by keyboard action, and the MDT bit is not set.

One, and only one, cursor is always displayed on the display. A cursor check occurs when the display station circuitry detects no cursor or more than one cursor in the buffer. When the display is turned on, the cursor is automatically generated and displayed in the first location on the screen. The cursor can be repositioned by the keyboard operator and also by the program. The cursor is not affected by field attributes or by the Key Lock special feature; it is displayed even when positioned in a nondisplay/nonprint field and when the Key Lock special feature (if installed) is turned off.

Keyboards

Four types of keyboards are available for the 3277 and 3275 Display Stations: typewriter, data entry, data entry–keypunch layout, and operator console keyboard. All keyboards have special symbol keys and control keys for entering data. The type of keyboard determines the characters and symbols that can be key-entered from the display station, but does not determine which type of characters and symbols can be transmitted from the system for the display image.

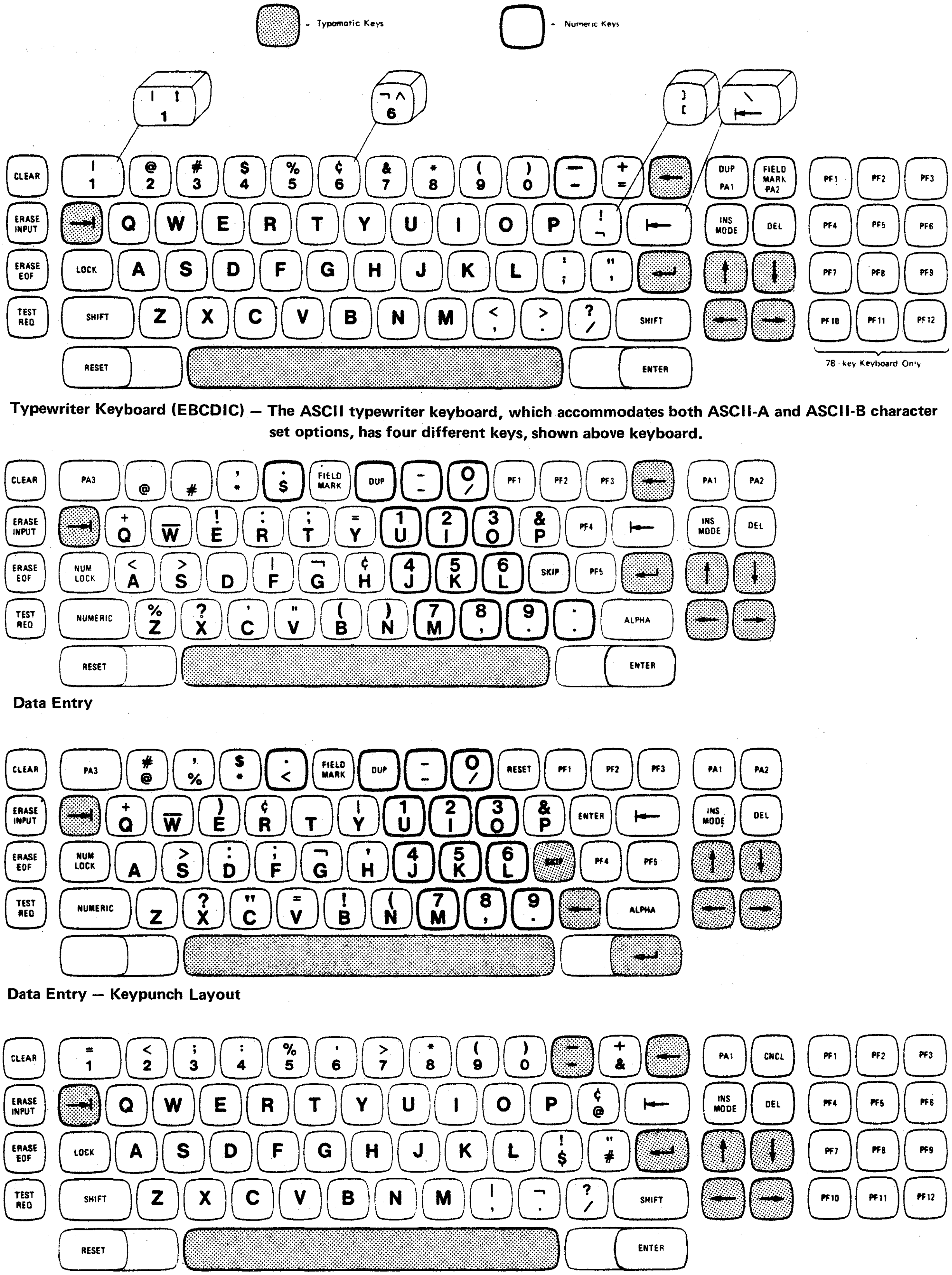
Variations between keyboards include 66-key and 78-key versions. The 66-key keyboard provides all the basic operator keys. The 78-key keyboard provides expanded operator-to-program message flexibility with 12 additional keys that may be defined to fit the requirements of the application program. The four basic types of keyboards, shown in Figure 2-9, are defined below. Refer to the *IBM 3270 Information Display System: Character Set Reference,* GA27-2837, for World Trade (WT) keyboard key layouts and nomenclature.

Typewriter Keyboard: This keyboard provides the basic typewriter key layout. Alphameric keys are encoded with both lowercase and uppercase codes. The typewriter keyboard is available with program-function keys PF1 through PF12 (78-key version) or without (66-key version).

Data Entry Keyboard: This keyboard provides the basic data-entry type of key layout. When characters are entered in a numeric field, the keyboard is automatically upshifted to take advantage of the grouped numeric keys (bold-outlined in Figure 2-9). The data entry keyboard contains 66 keys, including program-function keys PF1 through PF5.

Data Entry Keyboard–Keyboard Layout: This keyboard has the same keys and features as the data entry keyboard. The key layout of this keyboard more closely resembles the layout of the 29 Card Punch and 129 Card Data Recorder. In many cases the layout is identical with that of the keypunch units except for function-key designations. This keyboard is recommended for data entry applications.

Operator Console Keyboard: This keyboard provides an IBM 1052 Model 7 type of key layout. It has 78 keys, which include program-function keys PF1 through PF12.



Typewriter Keyboard (EBCDIC) — The ASCII typewriter keyboard, which accommodates both ASCII-A and ASCII-B character set options, has four different keys, shown above keyboard.

Data Entry

Data Entry — Keypunch Layout

Operator Console

Figure 2-9. Basic Keyboards for 3277 and 3275 Display Stations

Key Functions

Alphameric character keys encompass the complete 63-character EBCDIC and 64-character ASCII character sets (as shown within the bold outline in Figures 2-5 and 2-6, respectively), including Space.

Alphabetic characters can be entered into the display buffer in either uppercase or lowercase code, depending upon the position of the SHIFT key, from the typewriter or operator console keyboard. Only uppercase alphabetic codes can be entered from the data entry keyboards. All alphabetic characters in the buffer (uppercase or lowercase codes) are displayed as uppercase characters.

Keyboard entry of an alphameric character into the display buffer occurs at the cursor location, provided the cursor is located in an alphameric character location within an unprotected data field. (An attempt to enter an alphameric character into a protected data field or into an attribute character location is blocked.) Successful keyboard entry of the alphameric character causes the cursor to advance to the next character location within the unprotected data field.

Automatic-Skip: Upon entry of a character into the last character location of an unprotected data field, the cursor is repositioned according to the attribute character describing the next field.

If the attribute character defines the next field as (1) alphameric and either unprotected or protected, or (2) numeric and unprotected, the cursor skips the attribute character and is positioned to the first character location in that field.

If the attribute character defines the field as numeric and protected, the cursor automatically skips that field and is positioned to the first character location of the next unprotected field.

Character-Oriented Keys: A cluster of four keys (located to the right of the main keyboard) moves the cursor one location at a time into any character location: ↑ (up), ↓ (down), → (right), and ← (left). A fifth key, the backspace key, occupies its normal position on the main keyboard. It is also designated by ← and performs the same functions as the move-cursor-left key. The cursor may be moved into any character location, including unprotected and protected alphameric character and attribute character locations, through the use of these keys. Operation of these keys does not affect the MDT bit.

These keys are all capable of causing the cursor to wrap. Horizontal wrap always involves a vertical movement; the cursor repositions to the next or preceding row of characters. Vertical wrap due to operation of the up or down keys involves no horizontal movement: the cursor stays in the same character column.

These keys all have typamatic operation at a repeat rate of approximately 10 operations per second. (When a typamatic key is fully pressed, its function is repeated as long as the key is held pressed.)

Field-Oriented Keys: Any of four keys moves the cursor to the first position in a field. All four key operations can cause the cursor to wrap from the end of the last line on the display and to continue at the beginning of the top line. Operation of these keys does not affect the MDT bit.

→| ***(Tab) Key:*** Moves the cursor to the first character location of the next unprotected data field. In a display with no unprotected fields, the cursor is repositioned to character location 0. The Tab key has typamatic capability at a repeat rate of approximately 10 operations per second.

⇤ *(Backtab) Key:* When the cursor is located in the attribute character or the first alphameric character location of an unprotected data field or in any character location of a protected data field, this key moves the cursor to the first alphameric character location of the first preceding unprotected data field. When the cursor is located in any alphameric character location of an unprotected data field other than the first location, this key moves the cursor to the first alphameric character location of that field. In a display with no unprotected fields, the cursor is repositioned to character location 0. The Backtab key has no typamatic capability.

↵ *(New Line) Key:* Moves the cursor to the first unprotected character location of the next line. If the display has no unprotected data fields, the cursor is repositioned to character location 0. If the display contains no fields, the cursor is repositioned to the first character position of the next line. The New Line key has typamatic capability at a rate of approximately 10 operations per second.

SKIP Key (Data Entry Keyboards Only): Performs the same functions as the Tab key.

ERASE EOF (Erase to End of Field): If the cursor is located in an alphameric character location in an unprotected data field, this key clears the character location occupied by the cursor, and all remaining character locations in that field, to nulls. The operation can wrap from the end of the last line on the display to the beginning of the top line. The cursor does not move as a result of operating this key, and the MDT bit is set to 1.

Operation of this key when the cursor is located in an attribute character location or is within a protected data field disables the keyboard; no character locations are cleared, the cursor is not moved, and the MDT bit is not set.

ERASE INPUT Key: This key clears all unprotected character locations to nulls, resets the MDT bit to 0 in unprotected fields, and repositions the cursor to the first unprotected character location on the screen.

In a buffer with only protected data fields, no character locations are cleared and the cursor is repositioned to character location 0.

If the display contains no field, the entire buffer is cleared to nulls and the cursor is repositioned to location 0.

INS (Insert) MODE Key: This key lights the INSERT MODE indicator and places the keyboard controls in an insert mode of operation, regardless of the cursor location.

If the cursor is located in an unprotected data field having a null character either in the character location identified by the cursor or in any character location in the field beyond the cursor, operation of an alphameric key causes that alphameric character to be entered at the cursor and the MDT bit to be set to 1. The character formerly occupying the cursor location and all remaining characters within the field (except for null characters or characters to the right of null characters) are shifted one character location to the right. If the location identified by the cursor location at the time of the insert operation is a null, no character shifting occurs.

After all null characters at or beyond the cursor location in the field have been overwritten, or if there were no null characters, operation of an alphameric key disables the keyboard. Attribute characters remain in their fixed character locations and are not shifted as part of the insert operation.

If more than one row of characters is contained within the field, a character occupying the last character location in the row is shifted into the first character location of the next row.

Operating an alphameric key in insert mode when the cursor is located in an attribute character location or is within a protected data field disables the keyboard; no character locations are cleared, the cursor is not moved, and the MDT bit is not set.

Operation of the RESET key returns the keyboard to normal mode.

DEL (Delete) Key: If the cursor is located in an alphameric character in an unprotected field, operation of the DEL key deletes the character from the character location occupied by the cursor and sets the MDT bit to 1 (if it has not previously been set). The cursor does not move. All remaining characters in the unprotected field, to the right of the cursor and on the same row, shift one character location to the left. Vacated character locations at the end of the row are filled with nulls. If the unprotected field encompasses more than one row, characters in rows other than the row identified by the cursor are not affected.

Operating this key when the cursor is located in an attribute character location or is within a protected data field disables the keyboard; no character locations are cleared, the cursor is not moved, and the MDT bit is not set.

RESET Key: The RESET key is used to recover from a *keyboard* operation that has resulted in a disabled keyboard. When a keyboard is disabled, no other keyboard operations are honored. The RESET key will not reset a disabled keyboard when a command is being executed for the device to which the keyboard is attached or when a parity error or cursor check is detected in the device buffer.

DUP (Duplicate) Key: Operation of this key causes a unique character code to be entered into the display buffer, a standard Tab key operation to be performed, and the MDT bit to be set to 1. The DUP key is provided only on the typewriter, data entry, and data entry–keypunch layout keyboards. The DUP character provides a means of informing the application program that a "duplicate" operation is indicated for the rest of the field in which it is located. The DUP character is transferred as a DUP code (Figures 2-5 and 2-6) when the data is read from the display to the program. No duplicate operation is performed at the 3270 control unit. The DUP character, when stored in a device buffer, is displayed or printed as an asterisk (*).

Operation of this key when the cursor is located in an attribute character location or is within a protected data field disables the keyboard; no character locations are cleared, the cursor is not moved, and the MDT bit is not set.

FIELD MARK Key: Operation of this key causes a unique character code to be entered into the display buffer and the MDT bit to be set to 1. The field mark character provides a means of informing the application program of the end of a field in an unformatted buffer or subfield in a formatted buffer. The field mark character is transferred as an FM code (Figures 2-5 and 2-6) when the data is read from the display to the program. The field mark character, when stored in a device buffer, is displayed or printed as a semicolon (;). The field mark is not provided on operator console type keyboards.

Operating this key when the cursor is located in an attribute character location or is within a protected data field disables the keyboard; no character locations are cleared, the cursor is not moved, and the MDT bit is not set.

Program Attention Keys: These keys solicit program action by causing an I/O pending to occur at the device. The program is notified of the interruption by an Attention status indication in locally attached systems and by response to a poll in remotely attached systems. In remotely attached systems that are using a 3275 Display Station, the display screen momentarily goes blank while the program accepts and responds to the attention signal. An attention identification (AID) character is generated at the time of the interruption to identify which key caused the interruption, but the MDT bit is not affected. The program-attention keys are CLEAR, ENTER, CNCL (cancel), TEST REQ, all program-function (PF) keys, and the program-access (PA) keys. Operation of the CLEAR key also clears the entire display buffer to nulls and positions the cursor to character location 0.

Operation of any program-attention key disables the keyboard, lights the INPUT INHIBITED indicator, and extinguishes the SYSTEM AVAILABLE indicator.

Note: *Not all program-attention keys are available on each type of keyboard. See Figure 2-9.*

Numeric Lock Special Feature Operation

When the Numeric Lock special feature is installed, the operator may enter the characters 0-9, the period (.), the minus sign (-), and DUP in a field identified in the attribute byte as numeric and unprotected. Operation of any other key that can enter a displayable character lights the INPUT INHIBITED indicator and disables all keys except the RESET key. Operation of the RESET key enables the keyboard (if disabled) and extinguishes the INPUT INHIBITED light. The nondisplay/nonprint attribute bits 4 and 5 and MDT bit 7 operate normally.

On a data entry or data entry—keypunch layout keyboard (Figure 2-9), the Numeric Lock special feature is disabled while the ALPHA or NUMERIC key is operated.

On a typewriter or operator console keyboard, the characters that can be entered in the field identified in the attribute byte as numeric and unprotected are 0-9, the period (.), and the minus sign (-); in addition, on typewriter keyboards when the SHIFT or the LOCK key is operated, the DUP character may be entered by the operator. It is not possible to disable the Numeric Lock special feature for entry of other displayable characters.

Note: *On Austrian/German, Belgian, Danish, French, Italian, Norwegian, Portuguese, and Spanish keyboards with the Numeric Lock feature installed, the comma (,) replaces the period (.) as a valid numeric character.*

Keyboard Disabled (INPUT INHIBITED Indicator On)

When INPUT INHIBITED is on, the keyboard and other input devices are disabled. In cases caused by operator key action, the input-inhibited condition can be cleared by use of the RESET key unless one of the following conditions coexists:

- A command is being executed for a device to which the keyboard is attached.
- A card is being read at the operator identification card reader.
- The 3284 Printer Model 3 is printing.
- A parity error or cursor check is detected in a device buffer. (The INPUT INHIBITED indicator remains off as long as the RESET key is pressed, but turns on when the RESET key is released.)
- The security keylock is in the off position. (Turning on the security keylock clears this condition.)

The conditions that can be cleared by use of the RESET key are as follows:

- A program-attention key operation preceded initiation of a command for a device with an attached keyboard.
- A selector-pen attention operation preceded initiation of a command for a device with an attached keyboard.
- The operator initiated the input-inhibited condition by pressing an alphameric key not included in the numeric key grouping when the Numeric Lock special feature was installed.
- The operator tried to change the data displayed in a protected display field. (The CLEAR key can also be used in this case, which places nulls in all buffer positions and turns on the INPUT INHIBITED indicator. INPUT INHIBITED can then be turned off by pressing the RESET key prior to initiation of a command for a device with an attached keyboard.)

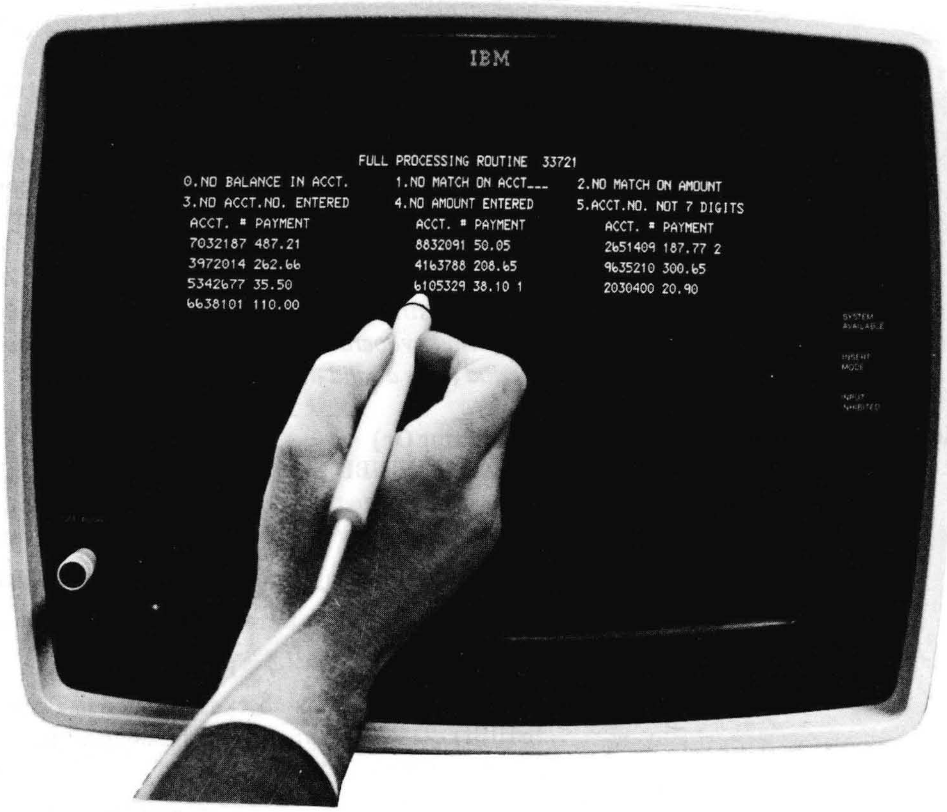
Indicators and Controls

See Appendix A for the functions of indicators and controls.

Selector-Pen Operations

The selector pen, shown in Figure 2-10, is a light-sensitive pen that can detect the light emitted from characters displayed on the 3275 or 3277. With the selector pen, the operator can select from a list or table of displayed items and can then cause those selections to be identified to the application program.

The selector pen is operated by pressing the tip of the pen against the screen on fields programmed for selector-pen operations.

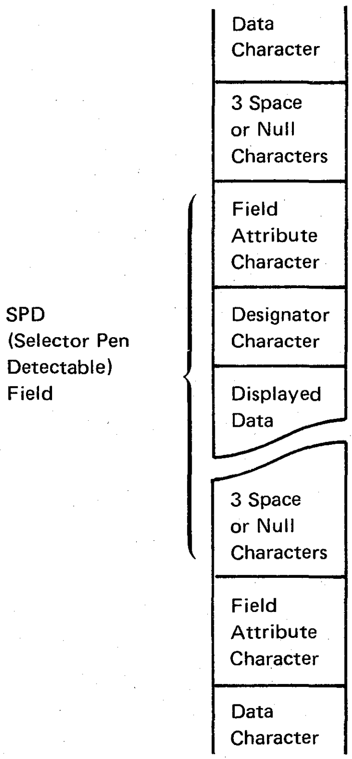


```
                         FULL PROCESSING ROUTINE  33721
 0.NO BALANCE IN ACCT.       1.NO MATCH ON ACCT___      2.NO MATCH ON AMOUNT
 3.NO ACCT.NO. ENTERED       4.NO AMOUNT ENTERED        5.ACCT.NO. NOT 7 DIGITS
  ACCT. # PAYMENT               ACCT. # PAYMENT             ACCT. # PAYMENT
  7032187 487.21                8832091 50.05               2651409 187.77 2
  3972014 262.66                4163788 208.65              9635210 300.65
  5342677 35.50                 6105329 38.10 1             2030400 20.90
  6638101 110.00
```

Figure 2-10. Selector Pen

Selector-Pen Field Format

A field that is to be used for selector-pen operations must be defined in the following format:



Data Character	Preceding field (on the same line as the SPD field).
3 Space or Null Characters	Three space or null characters must precede the field-attribute character defining the SPD field unless the attribute character is the first character on the line.
Field Attribute Character	The field attribute character defines the field as displayed and selector-pen-detectable. (An SPD field may be protected or unprotected, alphameric or numeric.)
Designator Character	The designator character defines the type of operation that will be performed by detection on this field.
Displayed Data	One or more displayed alphameric characters for sensing by the selector pen.
3 Space or Null Characters	Three space or null characters are required when a new field follows on the same line as the SPD field.
Field Attribute Character	Succeeding field (on the same line as the SPD field.)
Data Character	

Note: *On 3275 displays, selector-pen operation resets the same input-inhibited condition as the RESET key. After reset occurs, the functions are executed.*

The attribute character, the designator character, and displayed alphameric characters must be on the same line. If the field extends beyond one line, the selector pen can detect only those characters on the same line as the attribute character. A maximum of 6 detectable fields in the 3277 or 3275 Model 1, or 12 detectable fields in the 3277 or 3275 Model 2, may precede the last detectable field on any given line. When detectable and nondetectable fields are mixed, a maximum of 14 mixed fields on both Model 1 and Model 2 3277 and 3275 units may precede the last detectable field on any given line. In this situation, therefore, a nondetectable field could be one character long.

Designator Characters

Designator characters are used to define two types of selector-pen fields: selection fields and attention fields. Each type of field performs a different selector-pen operation.

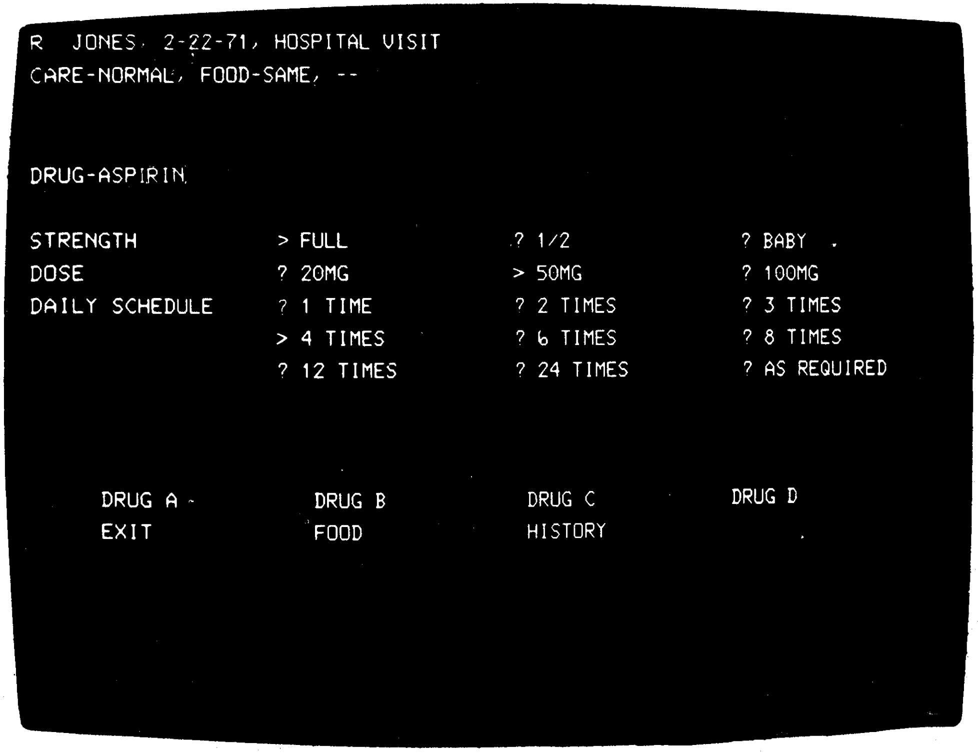
The selection field is defined by a question mark (?) designator character. When the selector pen detects on a selection field, the MDT bit in the attribute character for that field is set (1) in the display buffer. In addition, the designator character is automatically changed on the screen to a greater than (>) sign to indicate to the operator that the detection was successful. If a mistake was made and the operator again detects on that same field, the > reverts to a ? and the MDT bit for that field is reset (0).

The attention field is defined by a space or null designator character. A detection on an attention field causes an I/O pending (attention) at the display. This I/O pending indicates to the program that the selector-pen operation has been completed. The program may then issue a Read Modified command to obtain the address of each field that the operator selected or modified.

Programming Notes:

1. *The application programmer should be aware that high-intensity/unprotected fields can be modified by the display station operator to become selector-pen-detectable fields.*
2. *Use of the selector pen feature is expected to be such that the program will correlate the address of each SPD field with the data associated with it. Therefore, to minimize TP line loading, channel loading, and buffer size requirements, only the addresses of selector-pen-detected fields are required to be sent to the application program; the field data is not included.*
3. *Users who wish to combine selector-pen-detect input with keyboard input must use the keyboard to generate the I/O pending. Use of the selector pen on an attention field to generate the I/O pending will result in transmission of only the addresses of the fields in which the MDT bit was set.*

Figure 2-11 shows a sample display with fields defined for selector-pen operation. In this sample, "FULL", "50MG", and "4 TIMES" are all preceded by > designator characters to indicate that they were selected by the operator. When the operator detects on the word "EXIT", which has no displayed designator character, an I/O pending will occur and the program will read the locations of the four selected fields.



```
R  JONES, 2-22-71, HOSPITAL VISIT
CARE-NORMAL, FOOD-SAME, --


DRUG-ASPIRIN

STRENGTH          > FULL         ? 1/2          ? BABY
DOSE              ? 20MG         > 50MG         ? 100MG
DAILY SCHEDULE    ? 1 TIME       ? 2 TIMES      ? 3 TIMES
                  > 4 TIMES      ? 6 TIMES      ? 8 TIMES
                  ? 12 TIMES     ? 24 TIMES     ? AS REQUIRED



   DRUG A -         DRUG B         DRUG C         DRUG D
   EXIT             FOOD           HISTORY
```

Figure 2-11. Sample Display Screen for Selector-Pen Operations

Security Keylock

The security keylock is a security-enhancement special feature that provides a key-controlled lock for 3275 and 3277 displays. When the key is in the off position or is removed from the display station, the message buffer is locked, preventing the entry, modification, and display of data. The display station is unavailable to programmed read or write operations and to operator inputs such as keyboard entry, card reader entry, and selector-pen operations.

Programmed attempts to access display stations that have the key turned off or removed from the lock cause the 3270 devices to return responses to the central processing unit (CPU). 3270 responses are device- and operation-dependent. They are summarized in the following table:

Device Attachment	Operation	Response
3272 Models 1 and 2	All	UC, IR Status and Sense
3271 (all models)	Specific Poll	IR Status and Sense
	General Poll	EOT
	Selection Addressing Sequence	RVI
3275 (all models)	Specific Poll General Poll	No response (timeout) EOT
	Selection Addressing Sequence	No response (timeout)

Programming Note: *When no response is received from a 3275 after a specific poll or selection-addressing sequence, a general poll should be issued. An end of transmission (EOT) response to the general poll indicates that the 3275 buffer is locked.*

Operator Identification Card Reader

The operator identification card reader (OICR), which is attached by a cable to a 3275 or 3277 (Figure 2-12), reads data, such as a unique operator ID number, encoded on a magnetic-striped card. As the card is inserted into the reader, the ID number is read from the magnetic stripe and written into the display buffer, in nondisplay mode and at the location specified by the cursor. The ID number, therefore, is not displayed on the screen. An I/O pending is generated at the display to inform the program that the ID number can be retrieved and transferred to main storage.

With the 10-character set, plus control characters (Figure 2-13), the maximum number of characters that can be read is 40 characters at 3 bits per millimeter (75 bits per inch). This number includes the start of record (SOR), longitudinal redundancy check (LRC), and either end of record (EOR) or end of inquiry (EOI) characters.

With the 10-character set shown in Figure 2-13, the maximum number of characters that can be read is:

- 40 characters at 3 bits per millimeter (75 bits per inch) and at 8.3 bits per millimeter (210 bits per inch)
- 100 characters at 5 bits per millimeter (128 bits per inch)

Note: *A minimum of seven characters must be encoded between the Start Sentinel and End Sentinel characters.*

The 10-character set may be used to log on and log off in systems network architecture (SNA) mode (LU-LU session only, *not SSCP-LU session*) or in a non-SNA mode.

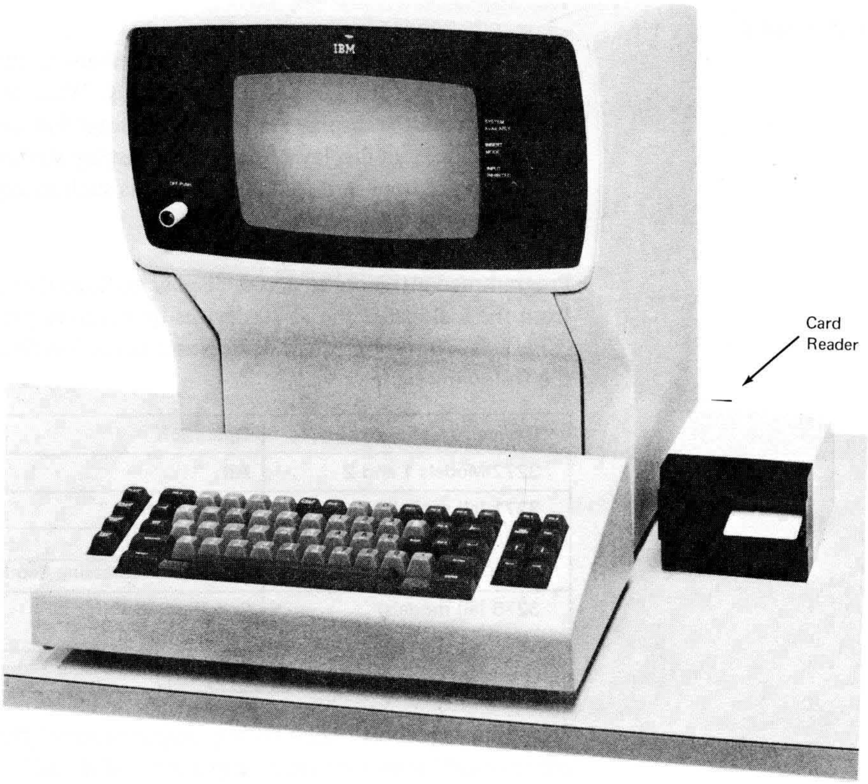


Figure 2-12. Operator Identification Card Reader

Character		Bit Pattern	Direction of Recording →				Hex Code	I/O Interface Code (Note 5)	
		2^0	2^1	2^2	2^3	P		EBCDIC	ASCII
Data	0	0	0	0	0	1	0	F0	30
	1	1	0	0	0	0	1	F1	31
	2	0	1	0	0	0	2	F2	32
	3	1	1	0	0	1	3	F3	33
	4	0	0	1	0	0	4	F4	34
	5	1	0	1	0	1	5	F5	35
	6	0	1	1	0	1	6	F6	36
	7	1	1	1	0	0	7	F7	37
	8	0	0	0	1	0	8	F8	38
	9	1	0	0	1	1	9	F9	39
Control	(Special - See Note 1)	0	1	0	1	1	A	7A	3A
	SOR (Note 2)	1	1	0	1	0	B	7B	23
	EOI (Note 3)	0	0	1	1	1	C	7C	40
	Field Separator	1	0	1	1	0	D	7D	27
	(Unassigned)	0	1	1	1	0	E	7E	3D
	EOR (Note 4)	1	1	1	1	1	F	7F	22

Notes:

1. *This character is reserved for operator identification only and must be located in the first data character position.*
2. *Start of Record*
3. *End of Inquiry. May also be used as a termination character on the operator identification card reader.*
4. *End of Record*
5. *Programmers use only the four least-significant bits of the hex codes.*

Figure 2-13. 10-Character Set Used with Operator Identification Card Reader

10-Character Set

The 10-character set shown in Figure 2-13 comprises 10 numeric characters, a field separator, and control characters. Each character is composed of a 4-bit pattern plus an odd-parity bit. This bit pattern is recorded with the low-order bit recorded first. An LRC character is placed at the end and is protected by an odd-parity bit of its own.

Characters are recorded, low-order bit first, beginning at the left-hand side of the magnetic stripe when the stripe is at the bottom of the card or badge as you face the magnetic material. The characters are read in one direction only.

Magnetic-Stripe Format

The format used on the magnetic stripe is in the sequence shown in Figure 2-14.

When the SOR character is read from the magnetic stripe, a field-attribute character is entered automatically into the cursor-identified location of the buffer (provided the cursor is at an uprotected character location). This attribute character defines the following data field as protected, alphameric, and nondisplay or nonprint. As the data characters are read into the buffer, they are stored starting at the first character location after the field-attribute character. As each data character is stored in the buffer, the cursor advances one buffer location. The cursor advancement is all the operator sees on the display screen when using the operator identification card reader.

Operational Differences Due to Screen Format

When the 10-character set is being used with the OICR, differences exist in the content of the data stream sent to the application program, depending upon whether the display screen is unformatted or formatted.

When an unformatted screen (that is, a screen without attribute characters or fields) is being used, the operation of the display results in an inbound data stream, as shown in Figure 2-15.

The reader operation formats the screen by the automatic generation of the field-attribute character at the cursor position by the reader.

A formatted screen has at least one field-attribute character defined at initial presentation. This may be the only field-attribute character, as in the instruction sequence ENTER ID; or one or more attributes may be required, as, for example, in the instruction sequence NAME, TITLE, ID CARD READER.

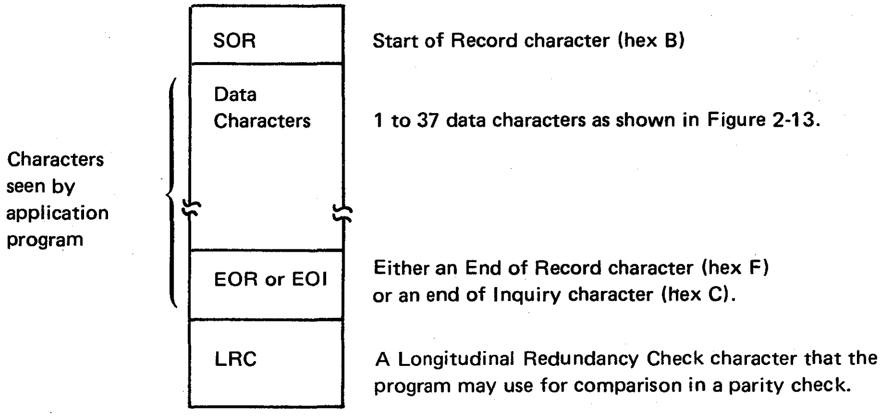
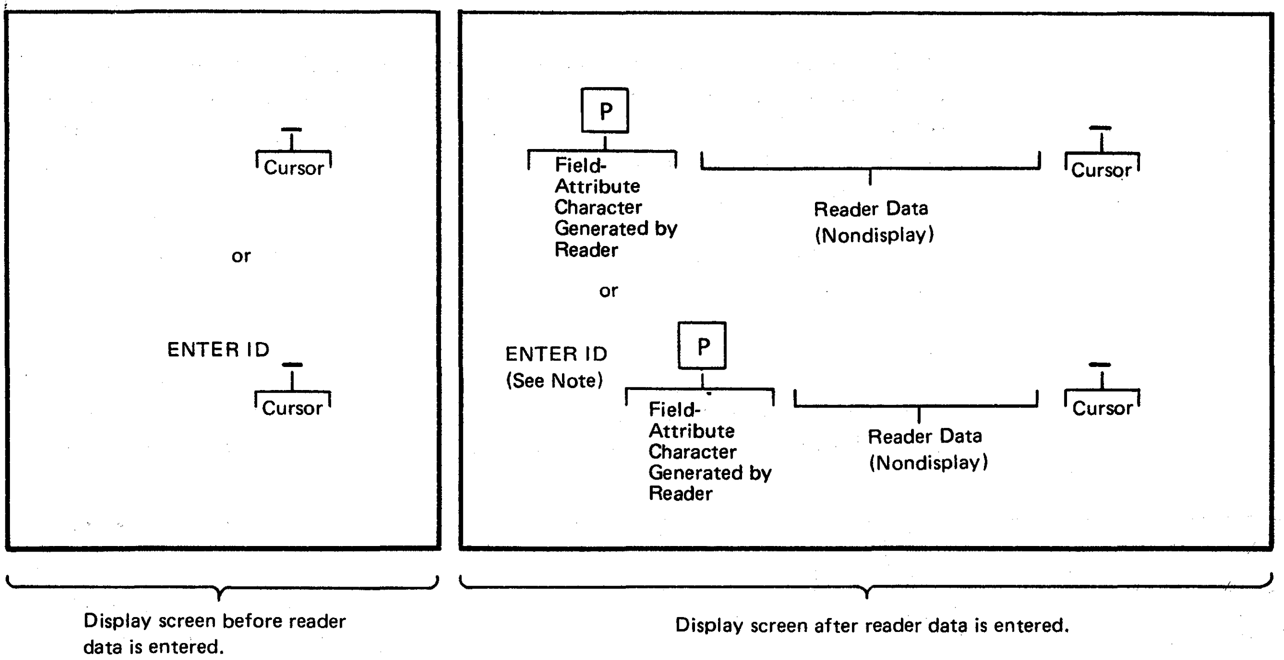

SOR
Start of Record character (hex B)
Data Characters
1 to 37 data characters as shown in Figure 2-13.
Characters seen by application program
EOR or EOI
Either an End of Record character (hex F) or an end of Inquiry character (hex C).
LRC
A Longitudinal Redundancy Check character that the program may use for comparison in a parity check.

Figure 2-14. Magnetic-Stripe Format (10-Character Set)


Cursor
or
ENTER ID
Cursor
P
Field-Attribute Character Generated by Reader
Reader Data (Nondisplay)
Cursor
or
ENTER ID (See Note)
P
Field-Attribute Character Generated by Reader
Reader Data (Nondisplay)
Cursor
Display screen before reader data is entered.
Display screen after reader data is entered.

Note: *The ENTER ID is not displayed, because it is within a nondisplay field, defined by the reader attribute character.*

P = Protected field-attribute character

Inbound Data Stream

AID	Set to indicate input from a magnetic-stripe reading device.
Cursor Address	Address of the cursor upon completion of the reader operation.
SBA	Set Buffer Address.
Start of Data Address	Address of the first data character following the field-attribute character.
Data	The reader data followed by any additional information present in the display buffer. The additional information can be initiated by the application program as ENTER ID (as shown in the example) or entered by the operator before the reader operation is started.

Note that with an unformatted screen the reader data is the first text in the data stream sent to the application program.

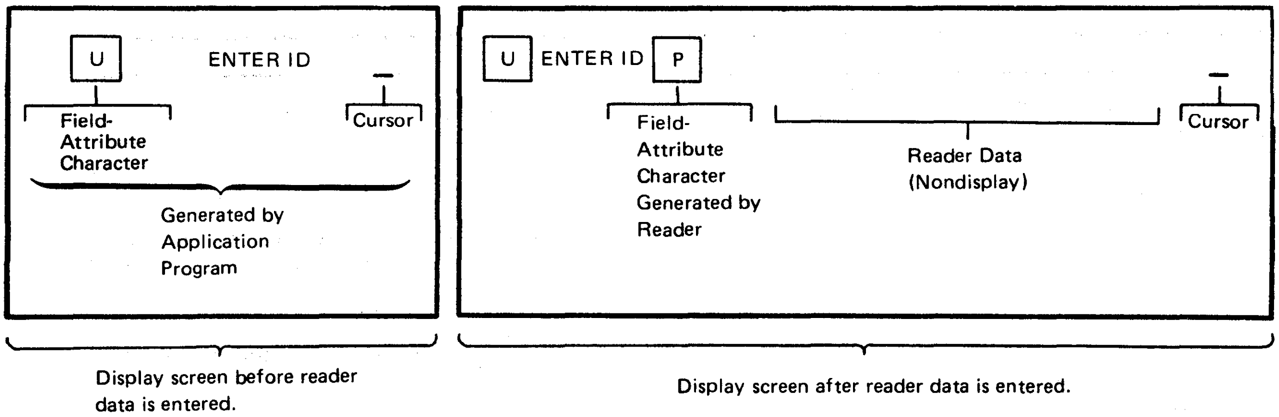
Figure 2-15. Operation of the Display with an Unformatted Screen (Using 10-Character Set)

Two fields (new data field and previous data field), with the MDT bits set, are sent to the application program, because the displays treat all information from the reader as data until the information has been written into the display buffer. In addition, the MDT bit is set in the reader-generated field-attribute character that was initiated when the data was entered.

The following examples are included to help clarify operation of the reader with a formatted screen.

Example 1

If the OICR field is set up by the application program as an unprotected field and contains instruction information, the inbound data stream is as shown in Figure 2-16.


U
ENTER ID
Field-Attribute Character
Cursor
Generated by Application Program
Display screen before reader data is entered.
U
ENTER ID
P
Field-Attribute Character Generated by Reader
Reader Data (Nondisplay)
Cursor
Display screen after reader data is entered.

Inbound Data Stream

AID	Set to indicate input from a magnetic-stripe reading device.
Cursor Address	Address of the cursor upon completion of the reader operation.
SBA	Set Buffer Address.
Start of Data Address	Address of the unprotected (U) field-attribute character + 1.
Data	ENTER ID, in the example above.
SBA	Set Buffer Address.
Start of Data Address	Address of the protected field-attribute character +1. In this case, the address of the first data character from the reader following the protected field-attribute character.
Data	The reader data (and any data between the cursor and the next field-attribute character).

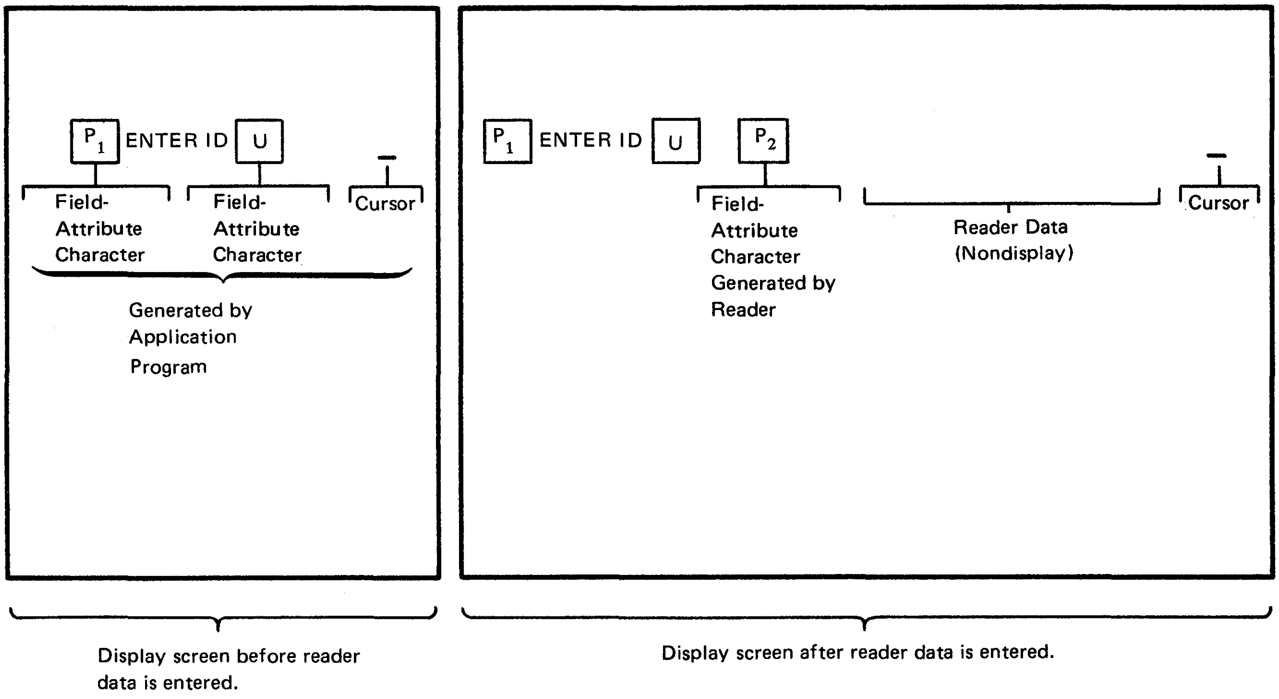
U = Unprotected field-attribute character

P = Protected field-attribute character

Figure 2-16. Operation of the Display with a Formatted Screen (Using 10-Character-Set), Example 1

Example 2

When the OICR field is set up by the application program as an unprotected field, with the cursor directly following an unprotected field-attribute character, the inbound data stream is as shown in Figure 2-17.



P1 ENTER ID U
Field-Attribute Character
Field-Attribute Character
Cursor
Generated by Application Program
P1 ENTER ID U P2
Field-Attribute Character Generated by Reader
Reader Data (Nondisplay)
Cursor
Display screen before reader data is entered.
Display screen after reader data is entered.

U = Unprotected field-attribute character

P = Protected field-attribute character

Note: ***Rules for positioning modified data on formatted screens apply. The position of reader data in the inbound data stream depends on the field position in the format.***

Inbound Data Stream

AID	Set to indicate input from magnetic-stripe reading device.
Cursor Address	Address of cursor upon completion of reader operation.
SBA	Set Buffer Address.
Start of Data Address	Address of the unprotected (U) field-attribute character + 1. In the example above, it will be the address of the P_2 field-attribute character.
SBA	Set Buffer Address.
Start of Data Address	Address of the P_2 field-attribute character + 1. In this case, the address of the first data character from the reader following the P_2 field-attribute character.
Data	The reader data (and any data between the cursor and the next field-attribute character).

Figure 2-17. Operation of the Display with a Formatted Screen (Using 10-Character Set), Example 2

Error Conditions

If any of the following error conditions exists when the magnetic stripe is read, OICR data will not be written into the display buffer:

- The SOR character is not successfully connected to a field-attribute in the display buffer.
- The cursor is located in a protected field.
- The cursor is located in a field-attribute character location.
- The display is busy performing another operation.

Programming Notes: *The proper use of the OICR as an identification and data-entry device requires that the application program perform certain validity tests. The following guidelines are recommended for proper operation:*

1. *No field should be accepted as reader input unless the reader AID code is set.*
2. *For preformatted displays, the application program must know the location of the field defined to receive the reader data and the exact location of the entered data, based upon the hardware operation that was previously defined. The use of the cursor address present in the inbound data stream, in combination with the AID byte to ensure reader input, is an additional technique that can be used to ensure the integrity of the data. For unformatted displays, the reader data is always presented as the first data entry in the input record to the application program.*
3. *For preformatted display, it is advisable to terminate the reader data field with another attribute byte.*
4. *Upon completion of the reader operation, the application program should check for the presence of the EOI/EOR character. Absence of this character means that the reader data has not been transferred successfully. This condition can occur under the following error conditions:*

    a. *Normal data flow from the reader has been interrupted.*

    b. *The cursor has been moved to a field-attribute character location. This means that the field defined for reader input is too small or that the cursor was not initially positioned at the beginning of a correct-length field.*

5. *Upon completion of the reader operation and a successful check for the EOI/EOR character, the LRC character may be used for a parity check to ensure integrity of the data.*

    Because of the makeup of the 10-character set codes (4 bits plus parity bit), only the right-hand four bits are of concern. The application program should set up a 1-byte field initialized to X'0B'. This is the SOR character, which is not included in the inbound data stream, but which is used to compute the LRC. As each character is checked for validity, it is exclusively ORed into this field. This operation should include the EOR/EOI character and the LRC, resulting in the byte containing zero. If the byte is nonzero, it means the result of the check on the data characters, including EOR/EOI, does not equal the LRC, and a parity error has occurred.

6. *If the reader input field is to be reused, the application program must remove the hardware-generated field-attribute character and reader input data. The location of this character can be derived from the inbound data stream by using one less than the start of the data address preceding the input data. In addition, the cursor is located one position beyond the end of the reader data field.*

    The card field may be reused if more than one card input is required or if the original attempt was unsuccessful and the application program desires to retry the operation.

7. *Text for all fields having the MDT bit set is transferred to main storage when the reader data is retrieved in response to the reader-generated I/O pending.*
8. *The cursor must be moved out of the reader-generated field before further keyboard activity is allowed.*
9. *A test card is delivered with each OICR and is available for system validation. The test card data (in 4-bit code) written into the display buffer is as follows:*

   BB1234567890123456789012345678955ABDEF7

   Care should be taken that this card is not accidentally auto-entered. The display should be placed in test mode to avoid auto-entering magnetic-stripe information to the host.

Printer Operations

Printers for the 3270 display system are used to provide a printed copy (for future reference) of information that is displayed at a 3277 or 3275, or of information written from the program. Printed data appears in the same alphameric characters and symbols that appear on a display image, and printouts can be formatted in the same manner as a display image. Cursor information is ignored by the printer.

Two types of printers are available, a buffered printer and an unbuffered printer. The buffered printer, with its own buffer and a unique device address, can be attached to a 3271 or 3272 and operates in the same manner as a 3277. The buffered printer includes the 3284, 3286, and 3287 Models 1 and 2 and the 3288 Model 2 Line Printer.

The unbuffered printer is the 3284 Model 3, which is provided for attachment to the 3275. The relationship between the 3284, 3286, 3287, or 3288 printer buffer or the 3275 Display Station buffer and a printout is shown in Figure 2-18.

Print Line Formatting

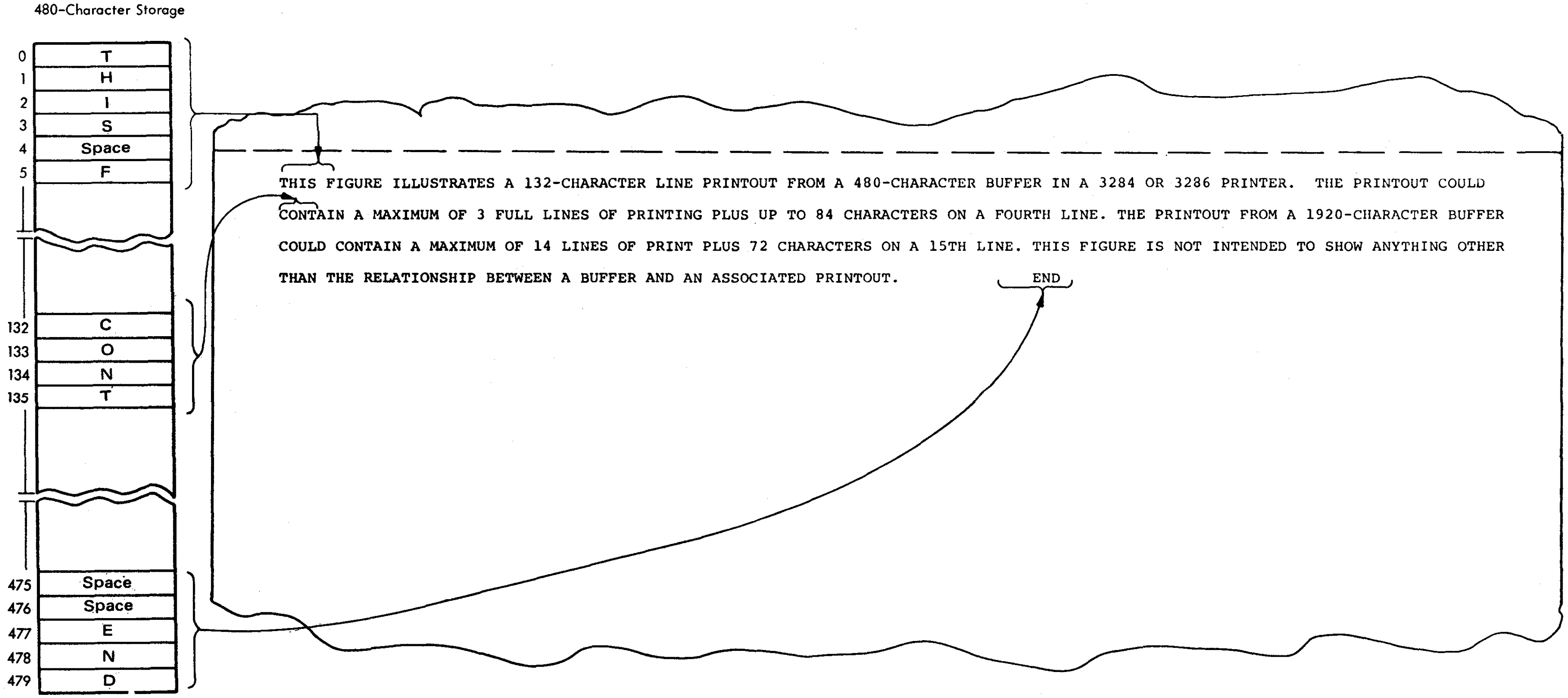
Printout operations are specified by a Write command or a Copy command (3271 only) addressed to the printer. The print line format in which the data is to be printed from the buffer can be specified as part of the command in one of three printer formats. These formats simply define the print line length: 40, 64, or 80 character positions per line. If a format is not specified, the print line length is determined by platen length on 3284 and 3286 printers, while the line length is 132 character positions on the 3287 and 3288 printers.

Programming Note: *To duplicate the copy function when operating with the 3272 local CU, the display buffer must be read and then written to the printer.*

NL, EM, and FF Printer Orders

New Line (NL), End of Message (EM), and Forms Feed (FF) printer orders are transferred as part of the data stream from the application program. They are stored in the buffer as data.

The NL order is executed only when encountered in a print field during a printout that does not have a line-length format specified. When an NL order is encountered in the buffer, the printer performs a new line function. If no NL order is encountered before the printer reaches the end of a line (as determined by the maximum carriage length), the printer automatically performs a line feed and continues printing. NL orders are not executed when located in a nondisplay/nonprint field; instead, they are treated as alphameric characters and printed as spaces. In addition, they are not executed when they are encountered in a print field during a printout that uses a line-length format; instead, they are printed as the graphic 5.



THIS FIGURE ILLUSTRATES A 132-CHARACTER LINE PRINTOUT FROM A 480-CHARACTER BUFFER IN A 3284 OR 3286 PRINTER. THE PRINTOUT COULD CONTAIN A MAXIMUM OF 3 FULL LINES OF PRINTING PLUS UP TO 84 CHARACTERS ON A FOURTH LINE. THE PRINTOUT FROM A 1920-CHARACTER BUFFER COULD CONTAIN A MAXIMUM OF 14 LINES OF PRINT PLUS 72 CHARACTERS ON A 15TH LINE. THIS FIGURE IS NOT INTENDED TO SHOW ANYTHING OTHER THAN THE RELATIONSHIP BETWEEN A BUFFER AND AN ASSOCIATED PRINTOUT.

Figure 2-18. Relationship between Buffer Data and Printer Data

For buffered printer operation (described under the heading "Buffered Printer Operation"), EM orders are executed only when they are encountered in a print field during a printout that does not have line-length format specified. EM orders are not executed when they are located in a nondisplay/nonprint field. They are treated as alphameric characters and printed as spaces. When encountered in a print field of a printout that uses line-length format, they are not executed; instead, they are printed as a graphic 9. For unbuffered printer operation (described under the heading "Unbuffered Printer Operation"), EM orders are executed when encountered, whether or not line-length format is specified. When an EM is encountered, the printing operation is terminated. None of the data following the EM order in the buffer is printed.

Valid FF orders are executed by the 3287 and 3288 printers during printouts, both with and without a line-length format specified. (The FF order is described under the heading "Page Length Control/VFC Operations.") When a valid FF order is encountered in the first print position of a line, the print form indexes to a predetermined print line on the next form.

Buffered Printer Operations

When a command specifying a printout is received from the system, the contents of the addressed printer are transferred to the 3271 or 3272 buffer, where they are modified and transferred back to the printer. The printout starts after the transfer from the control unit to the printer buffer is completed.

During the print operation, if line format is specified, data characters in the printer buffer are scanned one line at a time before they are printed. A line feed is executed after each line is printed. If a line contains one or more space characters only, a line feed is performed to cause a blank line in the printout. When null characters, attribute characters, or alphameric characters in the nonprint field are encountered, they are treated as follows:

- If embedded in a print line, they are printed as spaces.
- If they constitute an entire line, they are ignored and the line feed is not performed; as a result, a blank line does not appear in the printout, and the data is compressed vertically one line.

When line-length format is not specified, printout of the buffer data begins at buffer location 0 and continues until the last position of the buffer is printed or until a valid EM character is encountered. Each print line is left-justified. At the end of each printout, a final line feed is executed so that the printer is ready to start the next printout. When the print terminating EM order appears in the first print position of the print line, a final line feed is not executed, because the printer is already positioned at the left margin for the next printout.

Unbuffered Printer Operations

Attachment of an unbuffered printer to a 3275 does not affect operations between the 3275 and the system. However, when a printout is being executed, the 3275 will be busy to all other request command operations.

When a command specifying a printout is received from the system, the 3275 transfers its printer data to the printer. As characters are transferred to the printer, display regeneration continues and the cursor advances on the display screen by one position with each character transferred.

Data is not scanned before printout. Attribute characters, null characters, and alphameric characters in nondisplay/nonprint fields are transferred as spaces. When these characters constitute an entire line, that line will be printed as spaces and a blank line will appear in the printout. The print operation is terminated with the printing of the last buffer position, unless an EM order is encountered first.

The NL order is executed only when the line-length format is not specified. Whether or not line-length format is specified, EM orders are executed when encountered.

At the end of each printout, a final line feed is executed so that the printer is ready to start the next printout, except when the print terminating EM order appears in the first print position of the print line, in which case a final line feed is not executed, because the printer is already positioned at the left margin for the next printout.

Page Length Control/VFC Operations

The ability to index forms vertically under program control to a predetermined print line is provided by the page-length-control function for the 3287 Printer and by the vertical forms control (VFC) specify feature for the 3288. Special inks and preprinted forms containing index marks are not required to make this feature operational.

When a valid FF order is encountered in the buffer during a printout, the form skips to a predetermined line. Printing begins on the predetermined line; the first print position, the buffer location containing the FF character, is printed as a space character. Printing and skipping continue until the printout is terminated. The printer is *busy* while printing and skipping.

There is no limit on the number of FF orders that can be included in the printer buffer or on the frequency of their occurrence. However, for an FF order to be considered valid and thus initiate skipping, FF characters must be placed in buffer locations corresponding to the first position of a print line in a field designated either print or nonprint. This can be accomplished by placing the FF character (1) in the first character after the write control character (WCC) in a write, erase/write, or erase/write alternate data stream to the printer or (2) after a valid NL or CR order.

When an FF character is placed in the first character position of any print line (for example, in character position 41 in a buffer with a printout format of 40 characters per line specified, or in character position 133 in a buffer for an unformatted printout), the form skips to line 1, position 2.

An FF order in any other position (than the above) in the printer buffer is considered invalid; the skip operation is not executed, and the FF character prints as a "<" character, except when the FF order is located in a nonprint field. The "<" character prints during either formatted or unformatted printouts. When an FF order is sent to a 3288 that does not have the VFC feature installed, or if the skip operation is not executed, the FF character is printed as a "<" character. A valid FF order prints as a space character.

During a print operation, if a valid FF order is encountered when the form is located at the predetermined skip stop line (the first print line of each form) of a 3288, the skip operation is executed, and a blank form results. The 3287 will not skip a blank form.

Programming Note: *Placing the FF order at the end of a print buffer is not recommended. When a valid FF order is placed at the end of a print buffer and is followed by an EM order, the printers will stop printing and skip to line 2 of the next form.*

Before beginning page-length-control/VFC operations, forms must be loaded in the printer and aligned to the print line where skipping should stop and printing begin. If the forms are not aligned properly while initially being loaded, all forms will be misaligned. The page-length-control/VFC circuitry synchronizes with the skip stop line on the form as the cover is closed and the printer goes from not ready to ready. If the cover must be raised or if a not-ready condition occurs, the form must be checked to ensure that the skip stop line is in the proper position before the cover is reclosed.

The two Selector Switches must be set to the number corresponding to the total number of print lines from one skip stop line to the next for each page-length-control/VFC application. There can be up to 99 lines between successive skip stop lines. When uniform length forms are used, the setting for the switches is computed by multiplying the forms length in inches by the lines-per-inch setting: 6 lines per inch for the 3288; 6 or 8 lines per inch for the 3287 printers. (For example, when 11-inch forms are installed on the 3288, the switches should be set at 66.)

Programming Notes:

1. *If an NL order and an FF order appear on the last line of a 3288 printout and VFC is installed, FF is suppressed and the printer will not skip a full form. If this condition occurs on a 3287 printer, subsequent printing will begin on a new form.*
2. *The page-length-control function on the 3287 printer is synchronized when power is applied or when the FF switch is pressed.*
3. *If a 3287 or 3288 buffer containing FF characters (hex'0C') is read back by the program, the FF characters are returned to the program as '8C' (EBCDIC hex) or '46' (ASCII hex). This is a hardware function of the control units and should not be mistaken for a printer error.*

Error Conditions

Four error conditions may be encountered at both the buffered and unbuffered printers. In each of the following cases, when an error is detected, the program is notified. (Power should *never* be removed from unbuffered printers during a printout; the error conditions that may be returned to the program are unpredictable if this is done.)

Not Ready

A printer is defined as *not ready* when it is out of paper, its cover is open, or it is mechanically disabled (unable to advance to its proper position). When a 3284 or 3286 printer mechanism experiences a "printer hang" condition (see Appendix F, Glossary) during a printout, the printer stays busy with an equipment check (EC) present. For 15 seconds, the mechanism automatically attempts to recover. If the recovery attempt is successful, the printer returns to the ready condition. If the recovery attempt is not successful after 15 seconds, the printer becomes not ready, as indicated by Intervention Required (IR) status.

If a printer is not ready at the start of a printout, or if it becomes not ready during a printout operation, the print operation terminates. Error status is sent to the channel once when the condition occurs during a printout and again each time a printout is initiated.

When the 3287 detects other than parity errors, the Check indicator lights, and the associated error code is displayed in the 2-digit Status indicator. The operator may be able to correct the error and continue operation.

Character Generator or Sync Check Errors

The characters printed by a buffered or unbuffered printer are a function of the character generator or character belt installed. When an incorrectly formed character is printed during a printout (not the 3287), no attempt is made to replace or alter the character. When the printout operation is completed, a new line function is executed and an X is printed (feature-dependent). A sync check error occurs when a charact¬r belt hammer is out of sync.

Parity Error

If a parity error is detected on a character about to be printed, the graphic X (3284, 3286, 3288) or an error graphic (*prx10T,L*) (3287) is printed in place of the character with incorrect parity. The buffer continues printing until all printable characters have been printed. The printer prints a graphic X. The isolated X-character (specify feature on the 3287 and 3288) serves to indicate the detection of the parity error.

Command-Chaining

In local operations, if any command is chained to a command that initiates a print operation, an error condition occurs: no printout is performed, the command is aborted, and the system channel is notified of the error. In remote operations, if command chaining is attempted, error status is sent to the system channel but the printout is completed.

Unit and Model-Dependent Differences

The following differences between 3270 units affect printer operations.

Buffer Size

The buffer size of the 3284, 3286, and 3288 is model-dependent. Model 1 units contain 480 characters, and Model 2 units contain 1,920 characters.

The 3287 buffer size is specified as 480 or 1,920 bytes.

During an erase/write operation to a 3284, 3286, or 3288, the full 480- or 1,920-character buffer is erased. When an Erase/Write command is sent to the 3287, the buffer is erased up to the specified size (480 or 1,920 characters).

A data or attribute wrap operation to buffer position 0 occurs when data characters are addressed beyond the effective end of the buffer. The last effective position in the buffer is the default buffer size when operating in SNA/SDLC protocol.

Uppercase and Lowercase Printouts

The 3284, 3286, and 3288 print uppercase alphabetic characters unless the Extended Character Set feature is installed (which provides additional characters, including lowercase).

Printouts in either uppercase or lowercase characters may be obtained from the 3287 printer, depending upon the setting of the 3287 Change Case switch, and the command or print operation in process. During execution of an Erase/Write or Erase/Write Alternate command, the printer switch setting determines the character case, and the previous request is erased. During a Copy command or local print operation, the character case is determined by the setting of the Mono/Dual switch on the *from* display.

During a Write command or buffer reprint operation, the previous print case request is honored. Charge Case switch settings are ineffective during transmission of the SCS data stream to a 3287 (SCS is always dual case). The proper character code points must be used to ensure the correct printout.

Split Vertical Bar (¦) Character

The split vertical bar (¦) character, hex 6A, is available on the 3287 and 3288.

Chapter 3. Commands and Orders

Program control of 3270 operations is accomplished with a flexible set of commands and orders. Commands are issued by the channel program to initiate such operations as the total or partial writing, reading, and erasing of data in a selected 3270 device buffer. Orders can be included in write data streams, either alone or intermixed with display or print data.

Two types of orders are available. One type is executed as it is received by the 3271, 3272, or 3275. This type is used to position, define, and format data being written into the buffer, to erase selected unprotected data in the buffer, and to reposition the cursor. The second type of orders specifies printer format. These orders are initially stored in the buffer as data and are executed only during a print operation.

Commands

Four basic types of commands are executed by the 3270 system:

1. Write commands, which transfer data and orders from main storage to the 3270 system.
2. Read commands, which transfer 3270 buffer data, keyboard key data, and, for remote configurations, status information to main storage.
3. Control commands, which cause certain printer or display station operations.
4. Sense command (local configurations only), which transfers to main storage a byte of sense data that reflects certain control or check conditions existing in the device or control unit (CU) to which the command was addressed.

Figure 3-1 lists the commands, and associated codes, that can be executed by the 3270 system.

Timing Considerations

The rate at which data is transferred between main storage of the data processing system and a device attached to the 3270 display system depends on the information-transfer capability of the channel, on whether data or command codes are transferred, and on whether a local or remote 3270 system is attached.

In a local configuration, the 3272 CU provides information to, and accepts it from, the channel at a byte rate established by the channel or by the CU, whichever is the slower rate. The maximum data-transfer rate for a Write command operation is 650,000 bytes per second. For a read operation, the maximum data-transfer rate is 400,000 bytes per second.

	Local	Remote		
Command	EBCDIC (Hex)	EBCDIC (Hex)	ASCII (Hex)	Graphic
Write	01	F1	31	1
Erase/Write	05	F5	35	5
Read Buffer	02	F2	32	2
Read Modified	06	F6	36	6
Copy	NA	F7	37	7
Select	0B	NA	NA	NA
Erase All Unprotected	0F	6F	3F	?
No Operation	03	NA	NA	NA
Sense	04	NA	NA	NA

Figure 3-1. Local and Remote Command Codes

When a remotely attached 3270 display system is in operation, the rate at which data is transferred between the data processing system's main storage and the 3271 CU depends on the type of transmission control unit (TCU) and on the modems and communication facilities used. The 3270 system accepts data from, and provides data to, the TCU or communication facility at the byte rate established by the TCU or communication facility.

All command operations that direct movement of data to and from the 3270 system result in transfer of data between the CU and a device buffer. When commands are not being performed, the CU and the device buffer cycle asynchronously, and the last image displayed by a previous command is continuously regenerated at a visible rate.

The CU contains the timing controls required to move data between the CU and the device buffers. To accomplish a data transfer to a CU buffer from a device buffer, as, for example, during a Read command, the device buffer must first shift to the buffer position where data will initially be sent. Because buffers are loaded one position at a time, a 480-character device buffer can be filled faster than a 1,920-character buffer. During a read or write type command, the average time required to transfer data from a 1,920-character device buffer to the CU is approximately 50 milliseconds (ms). During execution of a Write command with a 1,920-character position buffer, approximately 80 ms (average time) is needed for buffer transfers, since the contents of the device buffer must first be brought from the device to the CU, where the contents are updated and then returned to the device.

An average time of approximately 30 ms is required to transfer data from a 480-character device buffer to a 480-character CU buffer during a read operation, and approximately 40 ms is needed for 480-character-buffer transfers during execution of a Write command. To obtain the total command execution time, the time needed to transfer information between the channel and the CU must be determined and added to the buffer transfer times given here.

During the short periods when information is transferred between buffers, the display buffer regeneration cycle is suspended, causing the display image to blink momentarily.

Read Commands

Two read-type commands are executed by the 3270: Read Buffer and Read Modified. Read Buffer, which is provided primarily for diagnostic purposes, causes the entire contents of the selected 3275, 3277, 3284 (Model 1 or 2), 3286 (Model 1 or 2), or 3288 (Model 2) buffer to be read into main storage. The operation initiated by Read Modified is determined by 3275 or 3277 operator actions. The information read during execution of Read Modified could consist of fields of data modified by keyboard, data entered by the card reader, buffer addresses or data of selector-pen fields, or the code of a program-function or program-access key.

In remote configurations, reading is normally accomplished by a General or Specific Poll sequence (described later under "Remote Operations"). In local configurations, an operator action that requires program interaction causes an attention interruption; the program would respond to this attention interruption with a read command. In remote, the 3271 or 3275 cannot generate attention interruptions. Instead, the program should issue poll sequences periodically. Upon receipt of a poll sequence, the 3271 or 3275 hardware initiates one of three operations:

1. If status and sense information is pending, this information is sent to the TCU.
2. If an operator action has occurred that requires reading by the program, and status and sense information is not pending, a hardware-generated Read Modified command operation is performed by the 3271 or 3275.

3. If no operator action has occurred and status and sense information is not pending, the 3271 or 3275 sends End of Transmission (EOT) to the TCU, terminating the operation.

Programming Note: *Unsolicited read commands are not recommended, because the information read by these commands may be incomplete.*

During a Read Buffer or Read Modified operation, a SUB character (3F in EBCDIC, 1A in ASCII) is sent in place of any byte that has bad parity. Also, a data-check sense condition is recorded. Normal transmission of the read data then continues until the usual ending point. At that time, the operation ends as follows: (1) in local, Unit Check is sent in the ending status byte; (2) in remote, the transmission is terminated with ENQ in place of ETX or ETB.

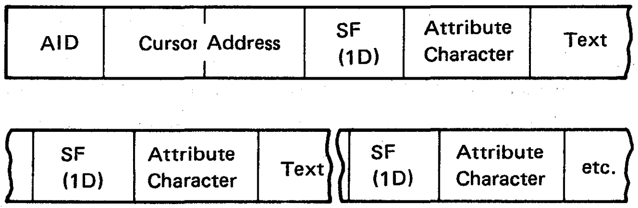
Read Buffer Command

Execution of the Read Buffer command causes all data in the addressed terminal buffer, from the buffer location at which reading starts through the last buffer location, to be transferred to main storage. This command is provided primarily for diagnostic purposes. The transfer of data begins:

1. From buffer address 0 if the Read Buffer command is unchained, or if it is chained from a Sense, Select, No Operation, or Copy command.
2. From the current buffer address if the Read Buffer command is chained from a Write, Erase/Write, Read Modified, or another Read Buffer command.

Regardless of where the transfer of data begins, data transfer from the buffer terminates when the last character location in the buffer has been transferred, or before the last character location has been transferred as follows: (1) in local configurations, when the channel byte count reaches 0 or (2) in remote configurations, when the last character of a text block has been transferred (described under "Remote Operations").

The transferred data stream begins with a 3-character read heading consisting of the attention identification (AID) character followed by a 2-character cursor address. The contents of all buffer locations are transferred, including nulls. The 3270 inserts Start Field (SF) order codes before each attribute character to identify the beginning of each field. An example of the read data stream follows:



The possible cursor address byte configurations are shown in Appendix B. The possible AID byte configurations are shown in Figure 3-2. An AID configuration other than 60 or E8 is set when the operator at the selected display station has performed an operation that requires program intervention: (1) pressing a program-function or program-access key, (2) entering a card into the card reader, or (3) with the selector pen, detecting on an attention field. The attribute character is shown in Figure 2-7.

AID	Hex Character (EBCDIC)	Hex Character (ASCII)	Graphic Character	Read Modified Command Operation	Resultant Transfer to CPU
No AID generated (Display or Display Station)	60	2D	–	Rd Mod	If performing a remote polling operation, no read operation occurs; otherwise, field addresses and text in the modified fields are transferred.
No AID generated (Printer)	E8	59	Y	Rd Mod	
ENTER key	7D	27	'	Rd Mod	AID code and cursor address, followed by an SBA order, attribute address +1, and text for each modified field. Nulls are suppressed.
PF 1 key	F1	31	1	Rd Mod	
PF 2 key	F2	32	2	Rd Mod	
PF 3 key	F3	33	3	Rd Mod	
PF 4 key	F4	34	4	Rd Mod	
PF 5 key	F5	35	5	Rd Mod	
PF 6 key	F6	36	6	Rd Mod	
PF 7 key	F7	37	7	Rd Mod	
PF 8 key	F8	38	8	Rd Mod	
PF 9 key	F9	39	9	Rd Mod	
PF 10 key	7A	3A	:	Rd Mod	
PF 11 key	7B See note.	23	#	Rd Mod	
PF 12 key	7C	40	@	Rd Mod	
Operator Identification Card Reader	E6	57	W	Rd Mod	
Selector Pen Attention	7E	3D	=	Rd Mod	AID code, cursor address, and field address only; no data.
PA 1 key	6C	25	%	Short Rd	AID code only.
PA 2 (CNCL) key	6E	3E	>	Short Rd	
PA 3 key	6B	2C	,	Short Rd	
CLEAR key	6D	5F	_	Short Rd	
TEST REQ key	F0	30	0	Tst Req Rd	A test request message. AID transferred on Read Buffer only.

Note: *Graphic characters for the United States I/O interface codes are shown. If a World Trade I/O interface code is used, refer to the applicable figure in the* IBM 3270 Information Display System: Character Set Reference, *GA27-2837, for possible graphic character differences.*

Figure 3-2. Attention ID (AID) Configurations

Read Modified Command

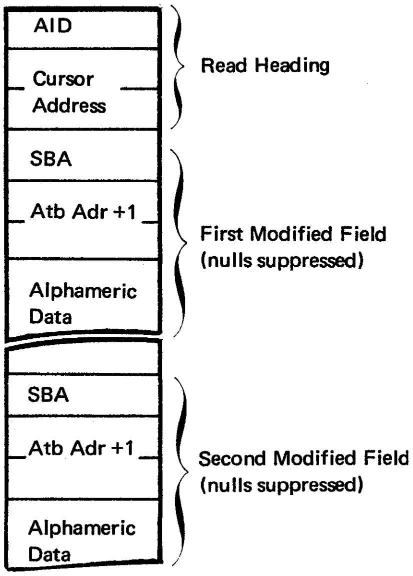
Read Modified initiates one of three operations, as determined by operator actions at the display station: (1) Read Modified, (2) Short Read, or (3) Test Request Read. Figure 3-2 lists the operator actions and the resulting Read Modified command operation initiated by each action. Read Modified commands are not normally used for remote configurations, since polling initiates a hardware-generated Read Modified operation if AID is generated and if status is not pending.

A major feature of Read Modified command operations is null suppression. When operations start at a device, the device buffer is cleared to all nulls (1) when the operator turns power on or presses the CLEAR key, or (2) when the erase portion of an Erase/ Write command is executed with that device selected. In addition, the Erase All Unprotected command and certain orders can clear selected portions of a buffer to nulls. During Read Modified command operations, all modified characters are sent to main storage; null codes are not sent.

Read Modified Operation. During a Read Modified command, if an AID other than Selector Pen Attention, a PA key, or CLEAR key is generated, all fields that have been modified by keyboard, selector-pen, or operator identification card reader (OICR) activity are transferred to the program. All nulls are suppressed during data transfer and thus are not included in the read data stream. As a field is modified by the operator, the modified data tag (MDT) bit is set in the attribute byte for that field. Then, when a read modified operation is performed, successive attribute bytes are examined for a set MDT bit. When the bit is found, the data in the associated field is read (with nulls suppressed) before the next attribute byte is examined.

The first three bytes of the read data stream are always the AID code (Figure 3-2) and the 2-byte cursor address; these bytes are called the *read heading.*

Following the read heading is the alphameric data of each modified field. The data for each field is preceded in the data stream by a hardware-generated Set Buffer Address (SBA) order code followed by the 2-byte buffer address of the first character position in that field (the attribute address +1). Thus, the read data stream when data has been modified is as follows:



If selector-pen-attention AID is generated, fields are not transferred to main storage during the Read Modified operation. Instead, when a set MDT bit is found (indicating selector-pen and/or keyboard activity), only the SBA order code and the attribute address +1 are transferred.

Note that if fields are modified by the keyboard, but completion of the modification is signaled by a selector-pen-attention operation, a resulting Read Modified operation will read only the address of the modified fields, not the modified data.

The buffer location at which the search begins for attribute bytes that define modified fields is a function of command chaining. This location is:

- Buffer address 0 if the Read Modified command is unchained or is chained from a Copy, Select, Sense, or No Operation command.
- The current address if the Read Modified command is chained from a Write, Erase/Write, Read Modified, or Read Buffer command.

The search for modified-field attribute bytes ends when the last buffer location is checked or, during 3272 operations, when the channel byte count reaches zero.

The transfer of read data is terminated as follows:

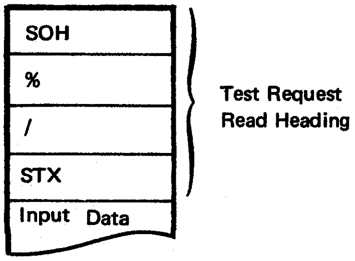
1. If the last modified field is wrapped from the last buffer location (479 or 1919) to the first location, the operation is terminated after all data in the field is transferred (nulls are suppressed). The buffer address at the end of the operation is the address of the next attribute byte in the buffer. For example, if a modified field extends from address 1900 (the attribute byte) to address 79 (wrapped field), the data from address 1901 through 79 is transferred (nulls are suppressed); in this case the read operation is terminated with the buffer address set to 80 (the attribute byte of the next field).
2. If the buffer does not contain a wrapped modified field and if the channel byte count has not reached zero (local operation only), the modified data stream is terminated when the last modified field is transferred; at the end of the operation, the buffer address is set to 0.
3. During 3272 operations, if the channel byte count reaches zero before all modified data is transferred, read operations are terminated and the remaining modified data is not transferred. The buffer address after termination is undefined.

If the buffer is formatted (contains fields) but none of the fields has been modified, the read data stream consists of the 3-byte read heading only.

If the buffer is unformatted (contains no fields), the read data stream consists of the 3-byte read heading followed by all alphameric data in the buffer (nulls are suppressed), even when part or all of the data has not been modified. Since an unformatted buffer contains no attribute bytes, no SBA codes or address characters are included in the data stream and the modification of data cannot be determined. Data transfer starts at address 0, regardless of command chaining, and continues to the end of the buffer. At the end of the operation, the buffer address is set to 0. This read operation can also be terminated by the channel byte count's reaching zero before all data is read; in this case, the buffer address after termination is undefined.

Short Read. The Read Modified command causes a short read operation if the CLEAR, CNCL, or a PA key has been pressed at the selected device. During the Short Read operation, only an AID byte is transferred to main storage. This AID byte identifies the key that was pressed.

Test Request Read. The Read Modifed command causes a Test Request Read operation if the TEST REQ key has been pressed at the selected device. The Test Request Read data stream sent to main storage is as follows:



The Test Request Read heading is generated by hardware. The remainder of the data stream is the same as described previously for Read Modified operations, excluding the 3-byte read heading (AID and cursor address). If the buffer is unformatted, all alphameric data in the buffer is included in the data stream (nulls are suppressed), starting at address 0. If the buffer is formatted, each attribute byte is examined for a set MDT bit. Each time a set MDT bit is found, the alphameric data in the field associated with that bit is sent to main storage (nulls are suppressed); if no MDT bits are set, the read data stream consists of the Test Request Read heading only. The buffer location at which the search for MDT bits begins and the transfer of data ends is the same as described for Read Modified operations.

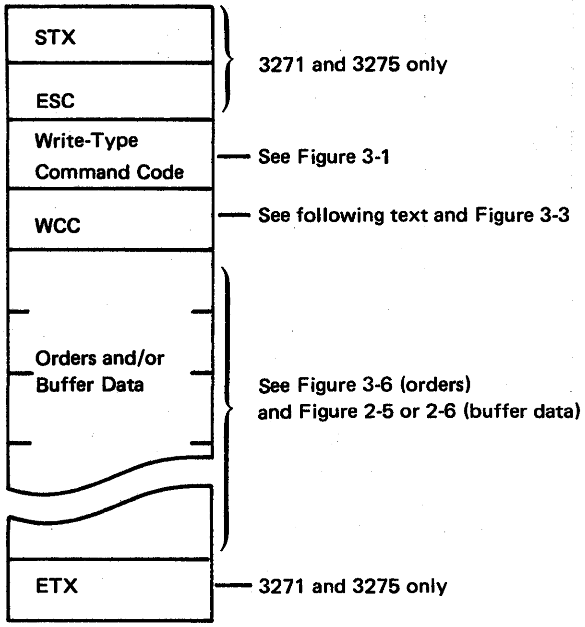
Test Request Read function usage is determined by the access method. Normally, the operator would (1) clear the display, (2) enter test request data in a predefined format, and then (3) press the TEST REQ key.

Write Commands

Two write-type commands, Write and Erase/Write, are used by the channel program to load, format, and selectively erase device buffer data. These commands can also initiate certain device operations, such as starting the printer, resetting the keyboard, and sounding the audible alarm. Write and Erase/Write operations are identical except that Erase/Write causes complete erasure of the selected buffer before the write operation is started. Thus, Erase/Write is used to load the buffer with completely new data, whereas Write can be used to modify existing buffer data. Because of this, the 3271 and the 3272 initiate a device-to-CU buffer transfer before Write command operations, but not before Erase/Write command operations.

Write Command

The bytes received by the 3271, 3272, or 3275 for Write command operation consist of a command code, a write control character (WCC), and any orders and/or new buffer data needed to modify the existing buffer contents. The 3271 or 3275 also receives appropriate framing (data-link control) characters. The sequence of bytes is as follows:


STX
ESC
3271 and 3275 only
Write-Type Command Code
See Figure 3-1
WCC
See following text and Figure 3-3
Orders and/or Buffer Data
See Figure 3-6 (orders) and Figure 2-5 or 2-6 (buffer data)
ETX
3271 and 3275 only

The minimum Write command data stream to the 3272 consists of one byte, a WCC. [This is assured since the byte count field of the write channel control word (CCW) must be set to a minimum of 1 or else the command code is not sent to the 3272.] The minimum Write command data stream to the 3271 or 3275 consists of framing characters (STX, ESC, and ETX) and the command code. To be meaningful, a WCC byte should follow the command code; if ETX follows the command code, hardware generates an all-zero WCC byte and command execution is ended normally. An order or display/print data byte that immediately follows the command code is interpreted by hardware as a WCC.

The WCC byte format is as follows:

*	WCC Reset Bit 1	Printout Format		Start Print	Sound Alarm	Keyboard Restore	Reset MDT Bits
0	1	2	3	4	5	6	7

*Determined by the configuration of bits 2-7. See Figure 2-7.

Figure 3-3 describes the function of each WCC bit. When the WCC specifies an operation that does not apply to the selected device (for example, if the Sound Alarm bit is set and the selected device does not have the audible alarm feature), the specified operation is not performed and status or sense information is not generated. When the WCC byte is followed by order or display/print data bytes, only the Reset MDT Bits function, if specified, is performed before the write operation; any other WCC function is deferred until all data is written and all orders are performed.

Bit	Explanation
0	Determined by the contents of bits 2—7 as shown in Figure 2-7.
1	Always a 1.
2, 3	Define the printout format, as follows: = 00 - The NL order in the data stream determines the print-line length. = 01 - Specifies 40-character print line. = 10 - Specifies 64-character print line. = 11 - Specifies 80-character print line.
4	Start Printer bit. When set to 1, initiates a printout operation at completion of the write operation.
5	The Sound Alarm bit. When set to 1, sounds the audible alarm at the selected device at the end of the operation if that device has an audible alarm.
6	The Keyboard Restore bit. When set to 1, restores operation of the keyboard by resetting the INPUT INHIBITED indicator. It also resets the AID byte at the termination of the I/O command.
7	Reset MDT bits. When set to 1, all MDT bits in the selected devices' existing buffer data are reset before any data is written or orders are executed.

Figure 3-3. Write Control Character (WCC)

Orders and buffer data can follow the WCC character. (Orders are described later in this chapter, following commands.) Buffer data can be written into any specified location of the buffer without erasing or modifying data in the other buffer locations. Data characters are stored in successive buffer locations until an order is encountered in the data stream that alters the buffer address, or until all the data has been entered. During the write operation, the buffer address is advanced one location as each character is stored.

The buffer location where data entry starts depends upon the following considerations:

- The starting location may be specified by a Set Buffer Address order that follows the WCC. (This order is described under "Orders.")
- The starting location will be the buffer address containing the cursor if the Write command is not chained or if it is chained from a control or Sense command.
- The starting location will be the current buffer address if the Write command is chained from a Read or another Write command.

The formatting and placement of write data and the modification of existing buffer data are described under "Orders."

Programming Notes:

1. *If commands are being chained, the Write or Erase/Write command with the Start Print WCC bit set must be the last command in the chain. If not:*
   a. *The 3272 aborts the Write or Erase/Write command that specifies Start Print.*
   b. *The 3271 or 3275 performs the print operation and aborts the next command.*
2. *The Printout Format bits are honored only if the Start Print bit is set in the same WCC.*
3. *In 3271 operations, if a Write command that includes data is chained from a previous Write command, a Set Buffer Address (SBA) order shall immediately follow the WCC to define the starting location at which data entry is to start; this permits recovery in case of an error condition that requires retransmission of that data.*

4. *Every text message to a 3275 must have an SBA order immediately following the WCC to enable recovery from a line error.*

Programming Restriction: *A write command should not be chained from an Erase All Unprotected command. If it is, the operation is undefined.*

Erase/Write Command

Execution of the Erase/Write command performs two operations: an erase operation and a write operation. For its erase operation, this command clears the entire device buffer to nulls (all zero characters), positions the cursor to character location 0, and resets the buffer address to 0.

Erase/Write then performs the write and WCC operations in the same manner as a Write command. If no WCC is sent, the Erase/Write command will not erase the buffer.

Control Commands

Control commands initiate certain CU and/or device operations not involved with the transfer of data (other than status). Four control-type commands are executed by the 3270: Copy, Select, Erase All Unprotected, and No Operation. Copy is valid for the 3271 only, Select and No Operation are valid for the 3272 only, and Erase All Unprotected is valid for the 3271, 3272, and 3275.

Copy Command

This command is executed by a 3271 only, and is invalid for the 3272 and 3275. Copy is used to transfer buffer data from one device to another device attached to the same 3271. The selected device is the *to* device, the one to which buffer data will be transferred. The *from* device, the source of the buffer data to be copied, is identified in the second of two bytes that follow the Copy command code; the first byte, called the *copy control character* (CCC), identifies the type of data to be copied. The CCC can also, at the *to* device, start print operations, specify the printout format for those operations, and sound the audible alarm.

The Copy data stream is as follows:

Byte		
0	STX	
1	ESC	
2	Copy Command Code	← See Figure 3-1
3	CCC	← See below and Figure 3-4
4	*From* Device Address	← See Figure 5-2
5	ETX	

The CCC-byte format is as follows:

*	1	Printout Format		Start Print	Sound Alarm	Type of Data to Be Copied	
0	1	2	3	4	5	6	7

*Determined by the configuration of bits 2-7. See Figure 2-7.

Figure 3-4 describes the function of each CCC bit. A CCC and an address byte must always follow the command code; if they do not, the 3271 aborts the command and generates error status.

Copy command operations are similar to Write command operations. After the 3271 accepts the Copy data stream, it initiates the transfer of all 480 or 1,920 bytes from the *from* device buffer to the 3271 buffer. Upon completion of this transfer, the 3271 inserts nulls in all character locations that do *not* contain the type of data specified by CCC bits 6 and 7. The updated CU buffer contents (480 or 1,920 bytes) are then transferred to the selected (*to*) device. At the completion of Copy command operations, the cursor is in the same character location at the *to* device as it was at the *from* device at the start of operations.

The *from* device buffer can be "locked" (made incapable of being copied) by writing a protected/alphameric attribute byte (bit 2=1 and 3=0) in address 0.

Programming Note: *Although not essential for locking, it is recommended that a null be written in address 1 of the buffer to facilitate possible future use of the address 1 position.*

The Copy command can specify as the *from* device the same device that is selected (the *to* device). This procedure provides a means of programming selective device buffer "erase" operations as specified by CCC bits 6 and 7. In this case, the device buffer contents are transferred to the CU, nulls are inserted as determined by the CCC, and the resulting buffer contents are transferred back to the same device buffer.

Programming Notes:

1. *Copy should not be chained* from *a Write or Erase/Write command, since it will destroy the data already written for the selected device.*
2. *If the CCC Start Print bit is set and commands are being chained, Copy should be the last command of the chain. If not, the 3271 aborts the subsequent command.*

Bit	Explanation
0	Determined by the contents of bits 2–7 as shown in Figure 2-7.
1	Always a 1.
2, 3	Define the printout format as follows: = 00 - The NL order in the data stream determines print line length. = 01 - Specifies a 40-character print line. = 10 - Specifies a 64-character print line. = 11 - Specifies an 80-character print line.
4	The Start Printer bit. When set to 1, initiates a printout operation at the *to* device after buffer transfers are completed.
5	The Sound Alarm bit. When set to 1, sounds the audible alarm at the *to* device after buffer transfers are completed if that device has an audible alarm.
6, 7	Define the type of data to be copied as follows: = 00 - Only attribute characters are copied. = 01 - Attribute characters and unprotected alphameric fields (including nulls) are copied. Nulls are transferred for the alphameric characters not copied from the protected fields. = 10 - All attribute characters and protected alphameric fields (including nulls) are copied. Nulls are transferred for the alphameric characters not copied from the unprotected fields. = 11 - The entire contents of the storage buffer (including nulls) are copied.

Figure 3-4. Copy Control Character (CCC)

Select Command

Select is an immediate command executed only by the 3272; it is invalid for the 3271 and 3275. The 3272 executes a Select command by performing a device-to-3272 buffer transfer. If not preceded by a Select command, this same buffer transfer operation is performed as part of an initial (unchained) Write, Read Modified, or Read Buffer command.

The advantages of Select command usage are realized when the 3272 is attached to a block multiplexer channel or to a byte multiplexer channel operating in forced burst mode for the complete data transfer. Upon receipt of Select, the 3272 sends Channel End as initial status to the channel. This frees a block multiplexer channel to perform other operations. Upon successful completion of the buffer transfer, the 3272 sends Device End status asynchronously to the channel. Upon receipt of this status by the channel, a chain operation to the desired command (Write, Read Modified, or Read Buffer) must be initiated for effective use of the Select command. Note that device-to-3272-buffer-transfer time is not part of the execution time for this command.

At the conclusion of the command following the Select command, the 3272 again issues Device End status. At this point, the channel may chain to another command of the same type or it may disconnect. If a chaining operation is performed, another Select command is unnecessary since the addressed-device buffer contents are already in the 3272 buffer.

Thus, the Select command is used to separate the device-to-3272 buffer transfer operation portion of a Write, Read Modified, or Read Buffer command from the actual execution of the command. By doing so, the channel can use the buffer transfer time for other operations.

Erase All Unprotected Command

This command performs five functions at the addressed device:

1. Clears all unprotected buffer character locations to nulls.
2. Resets to 0 the MDT bit for each unprotected field.
3. Unlocks the keyboard.
4. Resets the AID byte.
5. Repositions the cursor to the first character location in the first unprotected field of the buffer.

If the entire buffer is protected, buffer data is not cleared and MDT bits are not reset. However, the keyboard is unlocked, AID is reset, and the cursor is repositioned to buffer address 0.

If the first unprotected field wraps the buffer, the cursor is positioned to buffer location 0.

In local configurations, Erase All Unprotected is an immediate-type command. Upon acceptance of this command, the 3272 goes *busy* and sends Channel End initial status to the channel. Upon successful completion of this command, the 3272 sends Device End status asynchronously to the channel and then goes *not busy*.

Programming Restriction: *Erase All Unprotected should not be chained to a Write, Erase/Write, or Copy command. If it is, the resulting operation is not defined.*

No Operation Command

This command is valid for the 3272 only. It performs no functional operation in the 3272, but may be used to retrieve pending status. No Operation is an immediate command, and therefore Channel End and Device End normally will be presented as initial status unless pending status or a busy condition exists.

Sense Command

Sense is valid for the 3272 only. It should be issued in response to Unit Check status for further definition of the Unit Check condition. The 3272 responds to a Sense command by sending one byte of sense data to the channel and resets the sense register when the channel accepts the Device End (DE) for the command. All commands, except No Operation or Test I/O (command code X'00'), reset the sense register immediately when the command is issued, including a Sense command to a different address for which the sense data is pending. For this reason, the 3272 in a multiple-program environment may, at times, respond with zero sense data even after a unit check.

The sense byte configuration is as follows:

CR	IR	BOC	EC	DC	US	CC	OC
0	1	2	3	4	5	6	7

Figure 3-5 summarizes the significance of each sense bit. The various sense and status bit combinations are described in Figures 4-5, 4-6, and 4-7.

Bit	Name	Significance
0	Command Reject	Set if the 3272 has received an invalid command; the valid commands are listed in Figure 3-1.
1	Intervention Required (IR)	Set if a command other than Sense was addressed to a device that is unavailable or *not ready*.
2	Bus Out Check (BOC)	Set if the 3272 has detected bad parity on any command or data byte received from the channel.
3	Equipment Check (EC)	Set if (1) the 3272 has asynchronously detected a parity check on data received from a device in response to an internal poll for attention status (the internal poll is tried twice before EC is set), or (2) a printer error occurs. If this is a device-detected condition, Unit Specify is also set.
4	Data Check (DC)	Set if (1) the 3272 or a device has detected bad parity on data transferred internally or between the 3272 and a device during command operations, (2) a 3277 has detected a cursor check, or (3) a device has detected a buffer check. If this is a device-detected condition, Unit Specify is also set.
5	Unit Specify (US)	Set if the sense bits resulted from a device-detected error.
6	Control Check (CC)	Set when the 3272 has detected a timeout condition. (The addressed device fails to perform a specified operation or respond to the 3272 within a specified period of time.)
7	Operation Check (OC)	Set when the 3272 has received a valid command or order that it cannot execute, as follows: 1. SBA, RA, or EUA order specifies an illegal buffer address. 2. Write data stream ends before all required bytes of SBA, RA, EUA, or SF order sequence are received. 3. Write, or Erase/Write with Start Print bit set in WCC, is chained to the next command; the print operation is suppressed.

Figure 3-5. Sense Bit Description

Orders

Orders can be included in Write or Erase/Write command data streams, either alone or intermixed with display or print data. Two types of orders are available: printout format orders and buffer control orders. Printout format orders are initially stored in the buffer as data and are subsequently executed only during a print operation. (These orders are described under "Printer Operations" in Chapter 2.)

The following paragraphs describe buffer control orders, which are executed as they are received in the write data stream by the 3271, 3272, or 3275; these orders are not stored in the buffer. Six buffer control orders (see Figure 3-6) are provided (1) to position, define, and format data being written into the buffer, (2) to erase selected unprotected data in the buffer, and (3) to reposition the cursor.

Start Field (SF) Order

This order identifies to the CU that the next byte in the write data stream is an attribute character. (The attribute character is described in Figure 2-8.) The CU always stores the next byte as the attribute character at the current buffer address. As the attribute character is stored, the CU sets a control bit at that address; this bit identifies the byte as an attribute character during subsequent program or device operations with the buffer data.

During execution of a Read Buffer command, the CU automatically inserts SF order codes in the read data stream immediately before each attribute character. This permits identification of the attribute characters by the program and also permits correct storage of attribute characters in the buffer if the read data is used for subsequent write operations.

Order Sequence	Byte 1 (Order Code)				
Order	EBCDIC (Hex)	ASCII (Hex)	Byte 2	Byte 3	Byte 4
Start Field (SF)	1D	1D	Attribute Character[1]		
Set Buffer Address (SBA) (Starting Address)	11	11	1st Address Byte[2]	2nd Address Byte[2]	
Insert Cursor (IC)	13	13			
Program Tab (PT)	05	09			
Repeat to Address (RA) (Stop Address)	3C	14	1st Address Byte[2]	2nd Address Byte[2]	Character to Be Repeated[3]
Erase Unprotected to Address (EUA) (Stop Address)	12	12	1st Address Byte[2]	2nd Address Byte[2]	

[1] Figure 2-8 shows the attribute byte, and Figure 2-7 shows the coding of this byte.

[2] Appendix B lists the 2-byte code for each possible address. To be valid, an address must not exceed 479 (if issued to a Model 1) or 1,919 (if issued to a Model 2).

[3] Figures 2-5 and 2-6 show the coding of this byte.

Figure 3-6. Buffer Control Orders and Order Codes

Set Buffer Address (SBA) Order

This 3-byte order specifies a new buffer address from which write operations are to start or continue. Set Buffer Address orders can be used to write data into various areas of the buffer. An SBA order can also precede another order in the data stream (1) to specify the starting address for a PT, RA, or EUA order, (2) to specify the address at which an attribute byte is to be stored by an SF order, or (3) to specify the address at which the cursor is to be repositioned by an IC order.

Programming Note: *Every text message to a 3275 must have an SBA order immediately following the WCC to enable recovery from a line error.*

If the SBA order specifies an invalid address (greater than 479 if Model 1 or 1919 if Model 2), the write operation is terminated at this point.

When a Read Modified command is executed and an attribute character (initially sent to the device by writing an SF order) is detected with the MDT bit set, the CU inserts, in place of the attribute, an SBA code followed by the 2-byte buffer address of the first character in the modified field (attribute address +1). This permits identification by the CU of fields that are modified. When a Read Modified command is executed in a remote 3270 unit, this 3-byte sequence is always sent in the same text block. Remote 3270 units do not split this sequence between two successive blocks.

Insert Cursor (IC) Order

This order repositions the cursor to the location specified by the current buffer address. Execution of this order does not change the current buffer address. For example, if IC is issued when the current buffer address is 160 and the cursor is at location 80, the cursor is removed from location 80 and inserted at location 160. The current buffer address at the end of this operation would remain 160.

Program Tab (PT) Order

The PT order advances the current buffer address to the address of the first character position of the next unprotected field. If the PT is issued when the current buffer address is the location of an attribute byte of an unprotected field, the buffer address advances to the next location of that field (one location). In addition, if the PT order in the write data stream does not follow a control command, order, or order sequence such as WCC, IC, or RA (3-character sequence), nulls are inserted in the buffer from the current buffer address to the end of the field, regardless of the value of bit 2 (protected/unprotected) of the attribute character for the field. When the PT order follows a control command, order, or order sequence, the buffer is not modified.

The PT order stops its search at the last location in the buffer. If an attribute character for an unprotected field is not found by this point, the buffer address is set to location 0. (If the PT order finds an attribute character for an unprotected field in the last buffer location, the buffer address is also set to zero.)

To continue the search for an unprotected field, a second PT order must be issued immediately following the first one. Since the current buffer address was reset to 0 by the first PT order, the second PT order begins its search at buffer location 0. If the previous PT order was still inserting nulls in each character location when it terminated at the buffer location, the new PT order will continue to insert nulls from buffer location 0 to the end of the current field.

Programming Restriction (for Remote Operations): *Successive PT orders, without intervening characters or other orders (not including the Insert Cursor order), should not be issued to a 3271 Model 2 Control Unit when the buffer (1) contains one unprotected field or (2) is unformatted. To do so may cause the Write command to be aborted and error status to be generated.*

Repeat to Address (RA) Order

The RA order stores a specified alphameric or null character in all buffer locations, starting at the current buffer address and ending at (but not including) the specified stop address. This stop address and the character to be repeated are identified by the three bytes immediately following the RA order in the write data stream, as follows:

Byte		
0	RA Order	
1 2	Stop Address	See Appendix B for address.
3	Character to Be Repeated	See Figure 2-5 or 2-6 for codes

The third character following the RA order is always interpreted as the character that will be repeated. If an invalid stop address (greater than 479 if a Model 1, or 1919 if a Model 2) is specified, the write operation is terminated at this point without storing the character, and error status is generated.

When the stop address is lower than the current buffer address, the RA operation wraps from the bottom row of the buffer to the top row. When the stop address equals the current address, the specified character is stored in all buffer locations.

Attribute characters can be overwritten by the RA order if they occur before the RA order stop address.

Programming Note: *If the RA order specifies X'ID' to indicate a 2-byte character code (for the Data Analysis/APL feature), only X'ID' is repeated.*

Programming Restriction (for 3271 and 3275 Only): *If the RA order specifies storing a character in more than 480 locations, the write operation may be aborted and error status generated.*

Erase Unprotected to Address (EUA) Order

The EUA order inserts nulls in all unprotected buffer character locations, starting at the current buffer address and ending at, but not including, the specified stop address. This stop address is specified by two address bytes, which immediately follow the EUA order in the write data stream. If an invalid address (greater than 479 if a Model 1, or 1919 if a Model 2) is specified, the write operation is terminated at this point, no erasure (insertion of nulls) occurs, and error status is generated.

When the stop address is lower than the current buffer address, the EUA operation wraps from the bottom row of the buffer to the top row. When the stop address equals the current address, all unprotected character locations in the buffer are erased.

Attribute characters are not affected by the EUA order.

Chapter 4. Local Operations (3272 Models 1 and 2)

Introduction

The 3272 Control Unit Models 1 and 2 can attach to a selector channel, a byte multiplexer channel, or a block multiplexer channel, each through the I/O interface (Figure 4-1). When it is attached to a byte multiplexer channel, operations can be in forced-burst mode or in single-byte-multiplex mode. The channel, in turn, is attached to main storage and to the central processing unit (CPU).

The channel program controls all control unit operations by transmitting information across the I/O interface. This information consists of (1) an address byte, which selects one 3272 control unit and one device (display or printer) attached to the control unit, (2) command bytes, which specify the type of operation to be performed by the control unit for that device, (3) data bytes, which either are stored in the control unit buffer for ultimate use by the selected device as display or printout data or are decoded as orders and used by the control unit for formatting the buffer, and (4) various control signals. Status bytes, which are automatically generated by the control unit, inform the channel program (1) of the general condition of the control unit and selected device at various stages of command operations and (2) of unique conditions of the control unit and any attached device when command operations are not in progress.

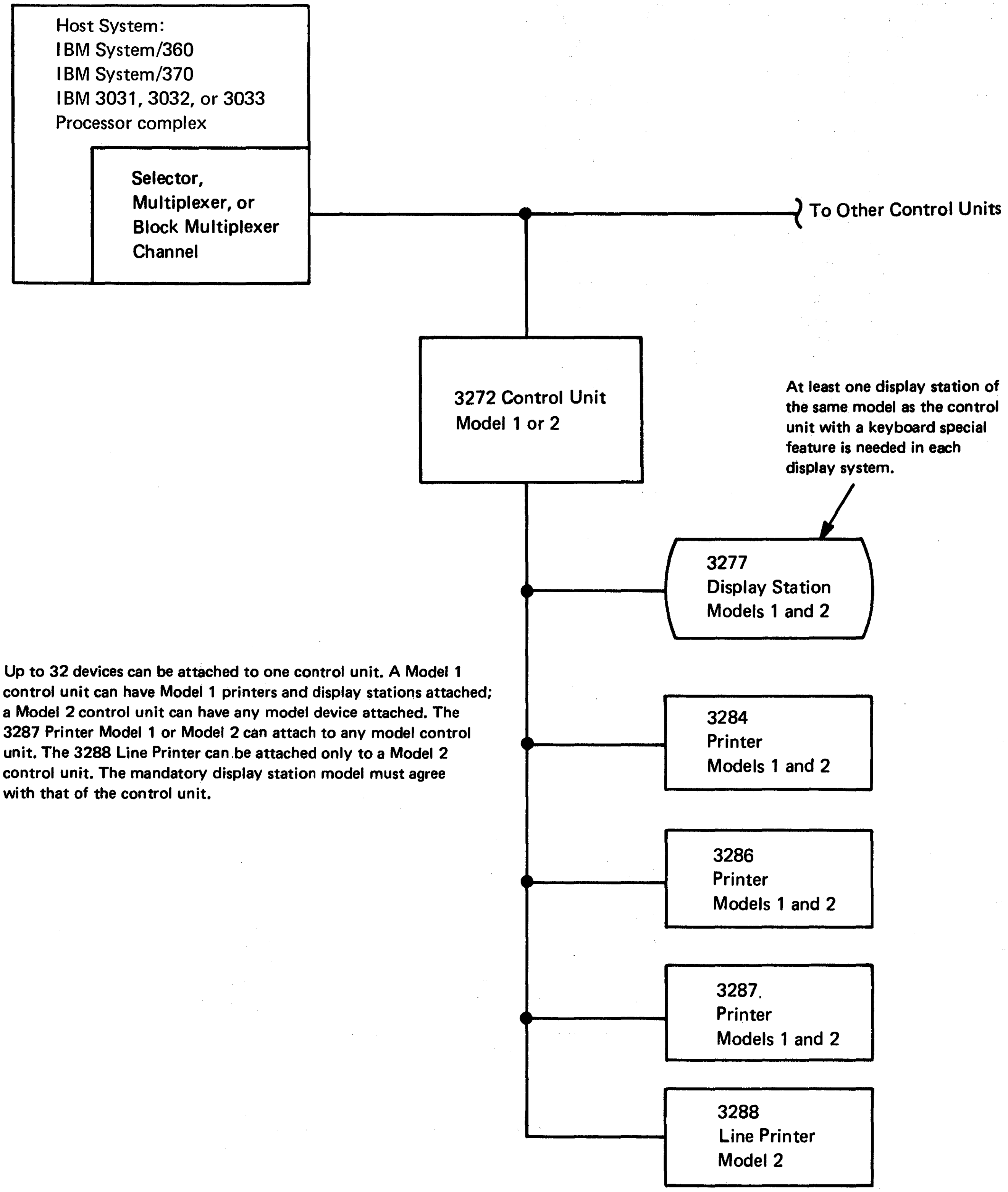
Interface Operations

Local interface operations are summarized in the following paragraphs and are described in detail in the *IBM System/370 Principles of Operation* manual, GA22-7000. The CPU program initiates control unit operations with a Start I/O instruction. This instruction identifies the I/O control unit and device (in this case, the control unit and a display or printer) and causes the channel to fetch a channel address word (CAW) from a fixed location in main storage. The CAW designates the storage protection key and the location in main storage from which the channel subsequently fetches the first channel command word (CCW). The CCW specifies the command to be executed and the number and address, in main storage, of any bytes to be transmitted.

Selection

The channel attempts to select the control unit and an attached device by sending a unique address byte to the control unit (and to all other control units attached to the same channel or subchannel). When a control unit has 16 or fewer devices attached, the first four bits of the address byte specify the control unit address and the last four bits of the address byte specify the device address (Figure 4-2). Up to 32 devices can attach to control units that have even-numbered addresses; these addresses are coded as shown in Figure 4-3. Note that no more than 16 devices can be attached to a control unit that has an odd-numbered address. Device address must always be assigned sequentially, starting with address 0. However, no priority is given to any particular device address.

When a control unit recognizes both addresses, it logically connects to the channel and responds to the selection by returning the address byte to the channel.



At least one display station of the same model as the control unit with a keyboard special feature is needed in each display system.

Up to 32 devices can be attached to one control unit. A Model 1 control unit can have Model 1 printers and display stations attached; a Model 2 control unit can have any model device attached. The 3287 Printer Model 1 or Model 2 can attach to any model control unit. The 3288 Line Printer can be attached only to a Model 2 control unit. The mandatory display station model must agree with that of the control unit.

Figure 4-1. Locally Attached 3270 Information Display System

	8-Bit Local Address Byte	
	Control Unit	Device
Control Unit No.	0 1 2 3	4 5 6 7
0	0 0 0 0	XXXX
1	0 0 0 1	XXXX
2	0 0 1 0	XXXX
3	0 0 1 1	XXXX
4	0 1 0 0	XXXX
5	0 1 0 1	XXXX
6	0 1 1 0	XXXX
7	0 1 1 1	XXXX
8	1 0 0 0	XXXX
9	1 0 0 1	XXXX
10	1 0 1 0	XXXX
11	1 0 1 1	XXXX
12	1 1 0 0	XXXX
13	1 1 0 1	XXXX
14	1 1 1 0	XXXX
15	1 1 1 1	XXXX

Device No.	4 5 6 7 (XXXX)
0	0 0 0 0
1	0 0 0 1
2	0 0 1 0
3	0 0 1 1
4	0 1 0 0
5	0 1 0 1
6	0 1 1 0
7	0 1 1 1
8	1 0 0 0
9	1 0 0 1
10	1 0 1 0
11	1 0 1 1
12	1 1 0 0
13	1 1 0 1
14	1 1 1 0
15	1 1 1 1

Figure 4-2. 3272 and Device Addressing – 16 or Fewer Devices per Control Unit

	8-Bit Local Address Byte	
	Control Unit	Device
Control Unit No.	0 1 2	3 4 5 6 7
0	0 0 0	XXXXX
2	0 0 1	XXXXX
4	0 1 0	XXXXX
6	0 1 1	XXXXX
8	1 0 0	XXXXX
10	1 0 1	XXXXX
12	1 1 0	XXXXX
14	1 1 1	XXXXX

Device No.	3 4 5 6 7 (XXXXX)
0	0 0 0 0 0
1	0 0 0 0 1
2	0 0 0 1 0
3	0 0 0 1 1
4	0 0 1 0 0
5	0 0 1 0 1
6	0 0 1 1 0
7	0 0 1 1 1
8	0 1 0 0 0
9	0 1 0 0 1
10	0 1 0 1 0
11	0 1 0 1 1
12	0 1 1 0 0
13	0 1 1 0 1
14	0 1 1 1 0
15	0 1 1 1 1

Device No.	3 4 5 6 7 (XXXXX)
16	1 0 0 0 0
17	1 0 0 0 1
18	1 0 0 1 0
19	1 0 0 1 1
20	1 0 1 0 0
21	1 0 1 0 1
22	1 0 1 1 0
23	1 0 1 1 1
24	1 1 0 0 0
25	1 1 0 0 1
26	1 1 0 1 0
27	1 1 0 1 1
28	1 1 1 0 0
29	1 1 1 0 1
30	1 1 1 1 0
31	1 1 1 1 1

Note: *Control Unit Nos. 1, 3, 5, 7, 9, 11, 13, and 15 cannot be assigned when attached devices are assigned Device No. 16 or greater.*

Figure 4-3. 3272 and Device Addressing – 17 or More Devices per Control Unit

Command Initiation

Command operations by the control unit start when the control unit and a device are successfully selected. When a command is to be executed by the control unit (not by the channel alone), the channel sends the command code (CCW bits 0–7) to the control unit.

When execution of the command involves a transfer of data (such as Write or Read Modified), the control unit responds to the command with a status byte (called *initial* status) indicating whether it can execute the command. If the command can be executed, the channel is set up to respond automatically to service requests from the control unit, and the control unit assumes further control of the operation. Command operation can be terminated by the control unit or when the channel byte count reaches 0. At this time, the control unit sends the channel a second status byte (called *ending* status), which indicates whether the command operation was successfully performed.

When the function of the 3270 command does not involve the transfer of data (such as EAU), it is called an *immediate* command. The resulting control unit operation depends on the particular command, as follows. If the command is No Operation, ending status and initial status are combined to indicate to the channel that the control unit has completed execution of the command. If the command is Select or Erase All Unprotected, which initiate certain control unit and device operations, the initial status from the control unit is such that block and byte multiplexer channels are released to perform other operations (selector channels remain logically connected to the control unit). When command execution is completed by the control unit and selected device (and regains selection if attached to a block or byte multiplexer channel), the control unit sends ending status to the channel, indicating whether the command was successfully performed.

Chaining

When the channel has completed the operations specified by a CCW, it can continue the activity initiated by the Start I/O by fetching a new CCW, thereby starting execution of another command. The fetching of this new CCW is called *command chaining,* and the CCWs belonging to such a sequence are said to be chained. All CCWs in a chain apply to the control unit and device specified by the Start I/O instruction.

Either of two types of chaining can be specified by the current CCW (bits 32 and 33): data chaining or command chaining. During data chaining (current CCW bit 32=1), the new CCW fetched by the channel defines a new main storage area (data address) for the current command. During command chaining (current CCW bit 33=1), the new CCW specifies a new command and a data address for that new command.

Thus, when command chaining is used, the control unit is selected following the Start I/O instruction when the channel receives the first CCW in the chain that involves operations with the control unit. The control unit is dedicated to one CCW string until final channel-end time or until operations are abnormally terminated. Programming restrictions that must be observed when command chaining is used are described in Chapter 3, "Commands and Orders."

Status

The control unit generates a status byte to inform the channel of certain control unit and device conditions. This status byte can be generated synchronously (while the control unit is selected and performing a command operation with the channel) or asynchronously (while the control unit is not selected).

Synchronous status is passed to the channel as both *initial* and *ending* status to a command. Initial status reflects the condition of the selected device and/or control unit upon receipt of a command and indicates to the channel whether the command can be executed. Ending status reflects the condition of the control unit and selected device after all channel/3270 interface operations of a nonimmediate command are completed. Asynchronous status reflects (1) ending status for an immediate command other than No Operation, (2) a second ending status for a Write, Erase/Write, or Erase/Write Alternate command, indicating that the control-unit-to-device-buffer transfer is completed, or (3) an equipment condition or operator action not associated with command execution (an attention).

Figure 4-4 describes each bit of the status byte. Status is reset by the control unit once it has been accepted by the channel.

Bit	Name	Condition
0	Attention (A)	Indicates a request for services from a 3277 attached to a 3272. Set by certain keyboard, selector-pen, or card-reader activity at a 3277 (Figure 3-2). The program should respond by issuing a Read Modified command (chained from a Select command if block or byte multiplexer channel) to the 3277 requesting attention. The attention bit is also set with the Unit Check bit as a result of an asynchronously detected equipment malfunction; in this case, the program should respond by issuing a Sense command.
1	Status Modifier (SM)	Is set, with Busy bit, in initial status byte to indicate that there is pending status for a device other than the one selected.
2	Control Unit End (CUE)	Is set following a busy condition, after pending status is cleared or when control unit is no longer busy, to indicate that control unit is now not busy and is free to accept a new command.
3	Busy (B)	Is set alone in initial status byte when addressed device is busy because it is performing a print operation or an Erase All Unprotected command. Set with SM when addressed control unit is busy. When the channel addresses a device other than the one that is busy and control unit is not busy, addressed device becomes selected and the command is honored. Busy bit is also set with pending status if addressed device has such status; if pending status is for a device other than the one addressed, Status Modifier bit is also set.
4	Channel End (CE)	Indicates channel data transfer operations are completed. Is set alone (1) in initial status for Select or Erase All Unprotected command, or (2) as ending status for Write, Erase/Write, or Erase/Write Alternate command; in all cases, Device End status is sent asynchronously when device operations (command execution or control-unit-to-device-buffer transfer) are completed. Is set with Device End, to indicate that control unit and device operations (except printing) are completed (1) in initial status for No Operation command, (2) in ending status for Read Buffer, Read Modified, or Sense command, or (3) asynchronously if only Channel End status was pending and the device operation is completed before the channel accepts status. Is set with Device End and Unit Exception in initial status for Read or Write command if addressed device is busy executing another command.
5	Device End (DE)	Indicates that control unit and device have completed all command operations and are free to execute another command. Is set (1) in initial status for No Operation command, (2) in ending status for Read Buffer, Read Modified, or Sense command, and (3) in asynchronous status for Write, Erase/Write, Erase/Write Alternate, Select, or Erase All Unprotected command.
6	Unit Check (UC)	Is set when an irregular program or equipment condition is detected by control unit or the device. Program should always respond to Unit Check status by issuing a Sense command for further definition of condition.
7	Unit Exception (UE)	Is set in ending status (synchronous or asynchronous) when control unit has attempted to execute a command but has found, after initial status was returned, that addressed device was busy.

Figure 4-4. Status-Byte Bit Assignments for 3272

Initial Status

Initial status is generated by the control unit in response to initial selection, by the channel, of the control unit and an attached device. During the initial selection sequence, the status byte is sent to the channel after the control unit receives a command.

Figure 4-5 shows the possible initial status bit configurations. An all-zero status byte is sent when a nonimmediate command is accepted for execution by the control unit; it is also sent in response to Test I/O if other status is not pending. The unit-check bit is set if the command is not accepted by the control unit because of a program or equipment error.

Initial status to immediate commands is as follows. For No Operation, channel end and device end are both set to indicate completion of the command. For Select and Erase All Unprotected, which do not involve data transfer between the channel and the control unit, channel end is set. This frees a block or byte multiplexer channel for other operations while the command is being executed. When command execution is completed, ending status is presented asynchronously.

If a Start I/O Fast Release (SIOF) is executed by the channel, then unchained initial status becomes ending status. (See *System/370 Principles of Operation,* GA22-7000.)

Status[1] (Hex)	Sense (Hex)	Display	Printer	Error-Recovery Procedure	Condition
All Zeros (00)		X	X		Normal status for any command other than No Operation, Select, or Erase All Unprotected.
CE (08)		X	X		Normal status for a Select or Erase All Unprotected command.
CE, DE (0C)		X	X		Normal status for a No Operation command.
UC (02)	BOC (20)	X	X	1	A parity check was detected on the command byte.
UC (02)	IR (40)	X	X	2	A command other than Sense was addressed to a device that the control unit has recorded as *unavailable* or *not ready.*
UC (02)	CR (80)	X	X	3	An invalid command was issued to control unit.
UC (02)	None (00)	X	X	1	3272 sense data was reset by a command to another device on the control unit.
B (10)		X	X		Response to a command addressed to a device that is being serviced by the control unit or that is completing a command previously issued.
B, SM (50)		X	X		Response to a command addressed to a device other than a device whose status is pending or a device being serviced by the control unit.

[1] If an SIOF is executed by the channel, unchained initial status becomes ending status.

Figure 4-5. Initial Status and Sense Conditions for 3272

When status is pending (a previous status byte is awaiting transfer to the channel), the pending status byte, with the busy bit set, is sent to the channel in response to any command (not to a Test I/O instruction), and that command is not accepted by the control unit. For Test I/O, the pending status byte is presented without the Busy bit set. If the pending status is for a device other than the one selected during the initial command sequence, only busy, status modifier (B, SM) is presented to the channel and the pending status is retained at the control unit.

Ending Status

When the control unit completes channel operations for a nonimmediate command, it sends an ending status byte to the channel, freeing the channel for other operations. This status byte always relates to the command operation that has been executed. The normal ending status byte for a Read Buffer, Read Modified, or Sense command will have only the channel-end and device-end bits set, indicating that the command has been executed. Normal ending status for a Write, Erase/Write, or Erase/Write Alternate command is channel end alone. When the control-unit-to-device-buffer transfer is completed, ending the command operation, device-end status is sent to the channel as asynchronous status. Any error condition associated with the operation just executed will cause additional status bits to be set. Figure 4-6 shows the possible ending status bit configurations. Ending status causes an I/O interruption unless chaining is specified.

When the control unit has pending status, it attempts to gain selection of the channel asynchronously to pass this status. It is passed to the channel either when selection is accomplished or as initial status for the next command (with the busy bit set), whichever occurs first.

Asynchronous Status

Asynchronous status reflects (1) the ending status of an "immediate" command other than No Operation, (2) the second ending status for a Write, Erase/Write, or Erase/Write Alternate command, indicating that all command-initiated operations are completed, (3) an action by the device operator that requires program intervention (attention status), or (4) a control-unit or attached-device equipment malfunction. Figure 4-7 shows the possible asynchronous status bit configurations.

When an asynchronous status condition occurs, the control unit attempts to gain selection by the channel (this is a hardware function) and passes this status to the channel when selection is accomplished. This status is called *pending* status until selection is accomplished. If the channel issues a command before retrieving this pending status, the pending status is returned, with the Busy bit set, in place of initial status for the command; in this case, the command is not executed, unless it is a Test I/O instruction.

When an asynchronous condition occurs at a device while the control unit is performing command operations with another device, the asynchronous status remains pending until the control unit completes the current command operation, returns ending status to the channel, and becomes not busy. The control unit then retrieves the pending status from the device and attempts to present it to the channel in the same manner as other asynchronous statuses.

Some other conditions of multiple status that can occur are not covered here. These conditions can be caused by multiple error conditions occurring simultaneously.

Status (Hex)	Sense (Hex)	Display	Printer	Error-Recovery Procedure	Condition
CE[1] (08)		X	X		Sent at end of data stream on Write, Erase/Write, or Erase/Write Alternate command.
CE, DE[1,2] (0C)		X	X		Sent at end of data stream on a Read Buffer, Read Modified, or Sense command or when channel byte count goes to zero on a Read Modified or Read Buffer command.
CE, DE, UC[2] (0E)	BOC (20)	X	X	10	The control unit detected a parity error on a character in data stream of a Write, Erase/Write, or Erase/Write Alternate command.[3]
CE, DE, UC[1,2] (0E)	DC, US (0C)	X	X	1	Addressed device detected a parity or cursor check during a Write, Read Buffer, or Read Modified command.
CE, DE, UC[1,2] (0E)	DC (08)	X	X	1	The control unit detected a cursor or parity check during receipt of data stream on a Write, Erase/Write Alternate, or Erase/Write command.
CE, DE, UC[1,2] (0E)	DC (08)	X	X	10	The control unit detected a cursor or parity check during transmission of data stream on a Read Buffer or Read Modified command.
CE, DE, UC[1,2] (0E)	CC (02)	X	X	10	Addressed device failed to respond in a specified period of time to an Erase/Write, Erase/Write Alternate, unchained Read Buffer, Read Modified, or Write command.
CE, DE, UC[2] (0E)	OC (01)	X	X	3	The 3272 received an invalid buffer address in data stream of a Write, Erase/Write, or Erase/Write Alternate command, or data stream ended before providing all characters required for an SBA, RA, SF, or EUA order on a Write, Erase/Write, or Erase/Write Alternate command.
CE, DE, UC[2] (0E)	None (00)	X	X	1	3272 sense data was reset by a command to another device on the control unit.
CE, DE, UE[1,2] (0D)		X	X	9	The control unit attempted to perform Read Buffer, Read Modified, Write, Erase/Write, or Erase/Write Alternate command but found, after returning initial status, that the addressed device was busy.

[1] Occurs if a Start I/O Fast Release (SIOF) is executed by the channel for Select, Erase All Unprotected, or No Operation.

[2] If this status is stacked by the channel, CUE could be generated and combined with it before the stacked status is accepted by the channel.

[3] The 3272 updates the device buffer after the total data stream has been processed.

Figure 4-6. Ending Status and Sense Conditions for 3272

Status[1] (Hex)	Sense (Hex)	Display	Printer	Error-Recovery Procedure	Condition
A (80)		X			An attention-generating action (e.g., program access key has been depressed) was performed by the operator.
DE (04)		X	X		The control unit-to-device buffer transfer is completed on a Write, Erase/Write, or Erase/Write Alternate command which did not start a printer. The device becomes "not busy" after completing an Erase All Unprotected command or the printer becomes "not busy" after completing a printout. The device-to-control unit buffer transfer is completed on a Select command. A device changes from "not available" to "available" or from "not ready" to "ready". A device becomes "not busy" after having previously sent Unit Exception when the control unit attempted to execute a command with the device when it was "busy". The 3272 Online/Offline switch is thrown from Offline to Online. This causes each "available" device to present a Device End to the channel.
A, DE (84)		X			The 3272 Online/Offline switch is thrown from Offline to Online and an attention-generating action (e.g., program access key has been depressed) was performed by the operator.
A, UC[2] (82)	EC (10)	X	X	5	An idle 3272 polled a device twice and detected a "transmit" parity check each time on the data in the device reply.
A, UC[2] (82)	DC, US (0C)	X	X	1	An idle device detected a parity check or cursor check in its buffer.
A, DE, UC[2] (86)	DC, US (0C)	X	X	4 or 8	A device on a 3272 changes from "not available" to "available" or from "not ready" to "ready" and has detected a parity check or cursor check in its buffer or a printer detected parity check while printing.
A, DE, UC[2] (86)	IR (40)		X	6	The addressed printer became Not Ready (out of paper or cover open) before completion of a print operation.
DE, UC[2] (06)	IR (40)		X	6	A command attempting to start a printer found it Not Ready.
A, DE, UC[2] (86)	IR, EC, US (54)		X	6	A printer became mechanically disabled during a printout and an automatic recovery was not successful, the printer CARRIAGE MOTOR POWER switch was off, or the switch fuse was blown.
DE, UC[2] (06)	IR, EC, US (54)		X	6	A command attempted to start a print operation, but the printer CARRIAGE MOTOR POWER switch is turned off.
A, DE, UC[2] (86)	EC, US (14)		X	7	A printer character generator or sync check error occurred or the printer became mechanically disabled during printout, but restored itself.
DE, UC[2] (06)	DC (08)	X	X	10	During a Select, Erase/Write, or Erase/Write Alternate command the control unit (1) detected a parity or cursor error, or (2) detected a parity check on data received from the addressed device in response to an internal poll during a command.

Figure 4-7 (Part 1 of 2). Asynchronous Status and Sense Conditions for 3272

Status[1] (Hex)	Sense (Hex)	Display	Printer	Error-Recovery Procedure	Condition
DE, UC[2] (06)	DC (08)	X	X	1	During a Write command, the control unit (1) detected a parity or cursor error, or (2) detected a parity check on data received from the addressed device in response to an internal poll during a command.
DE, UC[2] (06)	DC, US (OC)	X	X	1	The addressed device detected a parity or cursor check while executing a Select, Write, Erase/Write, Erase/Write Alternate, or Erase All Unprotected command.
DE, UC[2] (06)	OC (01[3])	X	X	3	A Write, Erase/Write, or Erase/Write Alternate command, containing a WCC with a Start Print bit, is chained to a subsequent command
DE, UC[2] (06)	CC (02)	X	X	10	The addressed device failed to respond in a specified period of time to a Select, Write, Erase/Write, Erase/Write Alternate, or Erase All Unprotected command, a display was in test mode, or a printer was assigned as a local copy device. (UC, IR will be reported on a subsequent operation.)
DE, UE (05)		X		9	The control unit attempted to perform a Select or Erase All Unprotected command, but found, after returning initial status, that the addressed device was busy.
CUE (20)		X	X		The control unit had been addressed while busy, but is now not busy and is free to accept a new command.

[1] If this asynchronous status is stacked by the channel, an asynchronous CUE could be generated and combined with it before the stacked status is accepted by the channel.

[2] If the 3272 sense byte is zeros after a unit-check status, it can be assumed to have been reset by an intervening command to another device on the control unit. Use error-recovery procedure 1.

[3] The 3272 does not set OC upon receipt of a WCC=X'88'.

Figure 4-7 (Part 2 of 2). Asynchronous Status and Sense Conditions for 3272

Error-Recovery Procedures

3272 Device-Detected Errors

Error conditions detected by the control unit or by an attached device are indicated to the program by unit-check status. The program must respond to this status by using a Sense command for further definition of the condition. If a Sense command is not performed and the sense conditions still exist, the control unit will not honor any other interruptions from the devices. Subsequent recovery operations are then determined by the combined configurations of unit-check status bits and associated sense bits.

Figures 4-5, 4-6, and 4-7 list the initial, ending, and asynchronous status and sense bit combinations, respectively. The abbreviations used in these figures are as follows:

- Status Bits

B	–	Busy
CE	–	Channel end
DE	–	Device end
SM	–	Status modifier
UE	–	Unit exception
UC	–	Unit check

- Sense Bits

BOC	–	Bus out check
CC	–	Control check
CR	–	Command reject
DC	–	Data check
EC	–	Equipment check
IR	–	Intervention required
OC	–	Operation check
US	–	Unit specify

Recommended Procedures

The procedures referred to in the Error-Recovery Procedure column of Figures 4-5, 4-6, and 4-7 are as follows:

1. Reconstruct the entire buffer image, and retry the failing chain of commands. The sequence of commands used to reconstruct this image should start with an Erase/ Write command. If, after two retries, the problem is not corrected, follow procedure 4.
2. The error indicates the device is *unavailable.* Request and wait for operator intervention to *ready* the device; then, upon receipt of DE status, retry the chain of commands.
3. A nonrecoverable program error has occurred. Examine the data stream to locate the problem.
4. Request maintenance for the device that is giving trouble. After the repair, reconstruct the buffer image, starting with an Erase/Write command.
5. Record the error for future reference, and continue with the program. This error occurred while the control unit was *idle* and does not indicate a data error.
6. The error indicates the printer is out of paper, has the cover open, or has a disabled print mechanism. Request operator intervention to ready the printer; then, upon receipt of DE status, retry the print operation by issuing a Write command with the proper WCC and no data stream. (There is no data error; the data is still intact in the device buffer and can be reused.) If this procedure is unsuccessful, follow procedure 1.

7. The error occurred during a printout and indicates either a character generator or sync check error or a disabled print mechanism. There is no buffer data error. The proper error-recovery procedure is application-dependent, because the user may or may not want a new printout. Since the buffer contents are still good, procedure 6 may be followed.
8. A data error occurred at the device during a printout. Follow procedure 1.
9. A device is busy but the control unit was not informed of this in time to respond with busy status in the initial-status byte. A DE status will be generated asynchronously when the device becomes not busy. After the DE is received, retry the chain of commands that was being executed when the unit-exception (UE) status was received.
10. Retry the failing chain of commands. If, after two retries, the problem is not corrected, follow procedure 1.

Channel-Detected Errors

Errors detected by the channel are indicated to the program by the channel status byte in the channel status word (CSW). If the channel status byte indicates a channel control check, an interface control check, or a channel data check, the recommended error-recovery procedure is to retry the chain of commands. If the problem is not corrected after three retries, request maintenance for the channel that is giving trouble.

Chapter 5. Remote Operations – BSC (3271 and 3275 Models 1 and 2)

Introduction

When using binary synchronous communications (BSC) operating mode, the 3271 Model 1 and 2 and 3275 Model 1 and 2 units can communicate with the program via an IBM 2701, 2703, 3704, 3705, or an equivalent integrated communications adapter (hereafter called *TCU*) and appropriate data sets as specified for the control unit.

Note: *In the following paragraphs, the term* 3270 CU *is used in statements that apply to the 3271 and 3275 BSC units. If a statement applies to only one 3270 unit, the appropriate unit number is used.*

The 3270 CU uses BSC procedures over duplex or half-duplex facilities (nonswitched or privately owned); these communications use the Multipoint Data Link mode of operation only. A 3275 with the Dial feature uses the BSC point-to-point data link procedure over a switched line.

Code Structures

Each 3270 CU can operate with one of two code structures: extended binary-coded decimal interchange code (EBCDIC) or American National Standard Code for Information Interchange (ASCII). The choice of code depends on the application. For system compatibility, however, the same code must be chosen for all units on a particular communication line.

Channel Program Concepts

In remote configurations, the TCU becomes the intermediary between the 3270 CU and the channel program. As such, the TCU, not the 3270 CU, executes channel commands and initiates I/O interruptions. At the start of each I/O operation involving the TCU, the Start I/O instruction addresses the TCU and a communication line attached to that TCU; it does not address an individual remote control unit on that line. Subsequent CCWs in the channel program initiate TCU operations; they specify TCU commands, not 3270 commands.

Selection of a 3270 CU and all subsequent command operations are specified by character sequences in TCU Write CCW data streams. Write CCW data to the TCU communication line selected by Start I/O can contain (1) address bytes to select a control unit on that line, (2) the code of a command (such as Erase/Write or Write) to initiate a control unit operation, or (3) orders and/or display/print data for the control unit buffer. In addition, this write data will contain the appropriate data-link control characters. Thus, all characters sent by the TCU to a 3270 CU, with the exception of SYN, pad, and BCC characters, originate from the data stream of a Write CCW addressed to the TCU.

Programming Note: *All Write commands should be set for CCW chaining to a Read command when a response is expected. (This prevents a loss of data received by the TCU in response to Write command operations.) An exception to this requirement is the use of the Write command to issue EOT to the 3270.*

Text Blocking

The 3270 CU performs inbound text blocking. Each block of data can contain a maximum of 256 test characters. Of that total, each block contains the STX and ETB (or ETX) data link control characters. Two address bytes (CU poll address and device address) precede the read heading in the first block only and are included in the 256-character total. The last block of a message is terminated with ETX, which is also included in the 256-character total.

Programming Note: *If the automatic polling facility (auto poll) is used by the TCU, the auto-poll index byte will add 1 byte to the text block created by the 3270 CU.*

Block check characters (BCCs) are transmitted as the last characters of a data stream. (See "Redundancy Checking.") A BCC is not counted as text because it follows the ETX and ETB data link characters. Upon successful comparison of the received BCC with the accumulated BCC, the program should respond with ACK to read the next block of text; each subsequent block is preceded by STX to initiate BCC accumulation by the TCU.

Text blocking does not disjoin the 3-byte SBA order sequence (SBA code and 2-byte field address) generated during the execution of a Read Modified command. Therefore, the last characters of a block ending with an SBA sequence would be . . . SBA, address, address, ETB (or ETX).

Related Publications

Readers who are unfamiliar with the binary synchronous method of communication should review the following publications, as applicable:

- *General Information – Binary Synchronous Communications,* GA27-3004
- *IBM 2701 Data Adapter Unit Component Description,* GA22-6864 (especially the section that describes the Synchronous Data Adapter – Type II)
- *IBM 2703 Transmission Control Component Description,* A27-2703 (especially the section on BSC capabilites)
- *Introduction to the IBM 3704 and 3705 Communications Controller,* GA27-3051

Multipoint (Nonswitched Line) Data Link Control

Each 3270 CU can operate on a nonswitched communication line with multiple stations. Time-sharing of the line is accomplished by interleaving transmissions between the TCU and all units on the line. A 3271 or 3275 (without the Dial feature) operates multidropped on the same line with other properly featured units, such as other 3270 units, IBM 2770s, and IBM 2780s. [Differences for a 3275 with the Dial feature are discussed under "Point-to-Point (Switched Line) Data Link Control."]

The TCU is the *control station* of the multipoint, centralized network. All units attached by communication lines to the TCU are called *tributary stations.* The control station is the focal point of the network and maintains, under program control, an orderly flow of network traffic by initiating all data transfers. The control station is either the transmitter or the receiver of every communication.

3270 Modes of Operation

In the multipoint environment, the 3270 CU is always in one of three modes of operation: control mode, text mode, or transparent-monitor mode.

Control Mode

The 3270 CU enters control mode whenever it transmits or receives a valid EOT sequence. While in control mode, the unselected 3270 CU monitors the communication line for the following:

- A valid selection or poll addressing sequence, by which the 3270 CU will become selected for entry into text mode.
- A DLE-STX sequence, placing the 3270 CU in transparent-monitor mode.

Text Mode

Once a 3270 CU is successfully selected, it enters text mode. In text mode, the 3270 CU is either a master station or a slave station, as is the TCU. This status depends on the operation being performed. The station that is transmitting a message is called the *master station,* whereas the station that is receiving and acknowledging the message is called the *slave station.*

The 3270 CU becomes the master station (and the TCU the slave station) once it sends STX to the TCU while executing a Read command or a poll operation. As the master station, it can (1) transmit text messages and (2) transmit ENQ to request a reply or retransmission from the TCU. After transmission of the message is completed, the 3270 CU returns to control mode.

The 3270 CU becomes the slave station (and the TCU the master station) when executing a write-type command. As a slave station, it responds appropriately to master-station (TCU) transmissions.

Transparent-Monitor Mode

Transparent-monitor mode is provided with EBCDIC 3270 CUs only. It permits the transmission of data in any of the 256 possible EBCDIC bit patterns between the TCU and another unit on the same communication line with the 3270 CU. This data may be independent of the selected transmission code (EBCDIC). Examples of such format-independent data are packed-decimal data, programs (both source and object), core images, and other binary data. Thus, link control characters within this data will not inadvertently initiate a 3270 CU operation.

When an EBCDIC 3270 CU decodes a DLE STX sequence while in control mode, it enters transparent-monitor mode. While in this mode, the 3270 CU disregards *all* data configurations that may appear on the communication line except for (1) a transparent text sync sequence (DLE SYN) or (2) a transparent text-terminating sequence (DLE ITB, DLE ETX, DLE ETB, or DLE ENQ). The 3270 CU leaves transparent-monitor mode and returns to control mode (1) if a transparent text sync sequence is not received within any 3-second period or (2) if a transparent text-terminating sequence is decoded.

Redundancy Checking

A redundancy check is performed on the following communication line data:

- 3270 CU command-sequence characters (including the write data of a Write, Erase/Write, or Erase/Write Alternate command).
- Data transmitted to the TCU in response to a read-type command or to a polling sequence.

A BCC is accumulated for each block of data at both the TCU and the 3270 CU. If EBCDIC code is used, a 2-byte BCC is generated (cyclic redundancy check accumulation); if ASCII code is used, a 1-byte BCC is generated (longitudinal-redundancy-check accumulation).

BCC accumulation is initiated by, but does not include, the first STX or SOH framing character. All characters following this STX or SOH, up to and including the end-of-block character (ETB or ETX), are part of the accumulation. Following the ETB or ETX character, the transmitting unit transmits its BCC character(s). The receiving unit then compares this character(s) with the BCC it has accumulated. If the redundancy accumulations are different, a transmission error has occurred.

When the 3270 CU is the receiving unit and detects a BCC error, it responds to the transmission by sending EOT (3275) or NAK (3271) to the TCU. When the TCU is the receiving unit, it sets unit check in the ending status for the TCU command being executed when the BCC error was detected; it also sets data check in the sense byte.

Note: *BCC characters are removed from the data stream when received for comparison by the TCU or by the 3270 CU; they are not stored in main storage or in the 3270 CU buffer.*

In both EBCDIC and ASCII, transmission formats (data-link controls) are rigidly screened so that communication is orderly and accurate. Improper transmissions are ignored or rejected to prevent the acceptance of faulty messages. Received or transmitted data blocks are counted odd-even-odd-even, etc., by both the transmitter and the receiver (by means of ACK 0's and ACK 1's), and their counts must agree at each block-check point.

Data-Link Control Characters

Two types of characters are transmitted between the TCU and the 3270: CU data-link control characters and 3270 message data. Data-link control characters are used for such purposes as message framing, acknowledgment that received message data was valid or invalid, and identification of the start- or end-of-text transmission. Data-link control characters are used (singly or in sequences) by the TCU (under program control) and by the 3270 CU to establish and control all data-link operations in an orderly fashion. The 3270 message data consists of all address, command, order, and display/print characters sent to the 3270 CU and of all buffer data, AID bytes, and status/sense bytes read from the 3270 CU. Data-link control characters are described individually in the following paragraphs and are described with 3270 message data later in this chapter, under "Operational Sequences."

The data-link control characters, with their EBCDIC or ASCII codes, are as follows:

Data-Link Control Character	EBCDIC (hex)	ASCII (hex)
ACK 0 (2 bytes)	1070	1030
ACK 1 (2 bytes)	1061	1031
DLE	10	10
ENQ	2D	05
EOT	37	04
ESC	27	1B
ETB	26	17
ETX	03	03
ITB	1F	1F
NAK	3D	15
RVI (2 bytes)	107C	103C
SOH	01	01
STX	02	02
SYN	32	16
TTD	022D	0205
WACK	106B	103B

All control characters transmitted by the TCU (except pad and SYN) are issued by the channel program as part of a TCU Write CCW data stream. All control characters transmitted by the 3270 to the TCU are generated by the control unit; a Read command to the TCU is used to store these characters (except pad and SYN) into main storage for subsequent analysis by the access method.

Pad

Pad characters, leading and trailing, are generated by TCU or 3270 CU hardware to ensure complete transmission or receipt of the first and last significant characters of each transmission.

SYN (Synchronous Idle)

Two consecutive SYN characters are generated by TCU or 3270 CU hardware to establish character synchronization. The TCU can also embed SYN characters in text for time-fill to maintain synchronization; the 3270 CU discards these SYN characters (does not store them in the buffer).

DLE (Data Link Escape)

DLE is always the 1st byte in the following 2-byte control characters: ACK 0, ACK 1, WACK, and RVI. DLE is also used as the 1st character in several 2-character sequences that are used in transparent-monitor mode (described earlier in this chapter under "Transparent Monitor Mode").

ACK 0 (Even Acknowledge)

ACK 0 is a 2-byte character:

- EBCDIC: 1070 (hex)
- ASCII: 1030 (hex)

ACK 0 is transmitted by the 3270 CU after a successful selection addressing (not poll) sequence to indicate to the TCU that the 3270 CU is ready to accept transmission. ACK 0 is also transmitted by the 3270 CU or by the TCU upon receipt and validation of an even-numbered (2nd, 4th, etc.) text block.

ACK 1 (Odd Acknowledge)

ACK 1 is a 2-byte character:

- EBCDIC: 1061 (hex)
- ASCII: 1031 (hex)

ACK 1 is transmitted by the 3270 CU or TCU upon receipt and validation of an odd-numbered (1st, 3rd, etc.) text block.

NAK (Negative Acknowledgment)

NAK is transmitted by the 3270 CU in response to a TCU text transmission that (1) terminates with ENQ, (2) has ENQ embedded in text, (3) has invalid BCC (3271), (4) contains a TTD sequence (STX ENQ), or (5) has ETX missing (3271). (The 3275 responds with EOT to a TCU text transmission that has invalid BCC or missing ETX.)

When NAK is received by the 3270 CU in response to a text transmission, the 3270 CU retransmits the last block of text.

Programming Note: *The TCU should be programmed to respond with NAK to an ENQ (that ends a text block) from the 3270 CU; this NAK causes the 3270 CU to send EOT and retain the status for error recovery.*

ENQ (Enquiry)

The 3270 CU transmits ENQ (1) to request a reply from the TCU following a 3-second timeout, (2) to request retransmission of the previous reply from the TCU, or (3) as the last character of a text message in which a data check was detected by the 3270 CU. (See "Programming Note" above.)

When the 3270 CU receives ENQ in response to a transmission, the last 3270 CU transmission to the TCU is repeated. The 3270 CU responds with NAK when ENQ is received (1) as the last character of a TCU-aborted text transmission, (2) embedded in text, or (3) as part of a TTD sequence (STX ENQ).

To be addressed successfully, the 3270 CU must receive ENQ as the last character of a polling or selection addressing sequence.

WACK (Wait before Transmit)

WACK is a 2-byte character:

- EBCDIC: 106B (hex)
- ASCII: 103B (hex)

WACK is generated by the 3270 CU (1) in response to a selection addressing (not poll) sequence when a printer (attached to a 3270 CU) or a 3277 attached to a 3271 is busy, and (2) in response to a Write or Copy (3271) command text transmission when the Start Printer bit is set in the WCC or CCC. The 3270 CU responds with ENQ to a WACK from the TCU.

RVI (Reverse Interrupt)

RVI is a 2-byte character:

- EBCDIC: 1070 (hex)
- ASCII: 103C (hex)

RVI is generated by the 3270 CU in response to an attempted selection (not poll) by the TCU when the 3270 CU has a status and sense message to be transmitted. Whenever the 3270 CU accepts RVI from the TCU, the CU responds with EOT and resets all pending status and sense information.

STX (Start of Text)

The 3270 CU receives STX as the first character of a command or TTD sequence. The STX causes the 3270 CU to clear its BCC and start accumulating a new BCC (STX is not included in the accumulation). Subsequent STX (and SOH) characters are included in the BCC accumulation. STX is transmitted by the 3270 CU to the TCU as the 1st character of a read-data text block, except in a status or test-request message; this STX causes the TCU to start accumulating a new BCC (STX is not included in the accumulation).

The 1st character in status and test-request messages is SOH, with STX following 2 header characters. With a message of this type, the TCU starts BCC accumulation upon receipt of the first SOH; the subsequent STX character is included in the BCC accumulation.

SOH (Start of Heading)

The 3270 CU generates SOH in a 3-character heading sequence that identifies the accompanying data as a status message (SOH, %, R, STX, –––) or as a test-request message (SOH, %, /, STX, data –––). The TCU starts BCC accumulation upon receipt of SOH (SOH is not included in the accumulation).

ETB (End of Transmission Block)

During a message transfer operation, ETB informs the receiving unit that BCC follows. The 3270 CU treats ETB as though it were ETX by checking BCC and then generating the appropriate response; the 3270 CU does not accept conventionally blocked outbound text.

ETX (End of Text)

During a message transfer operation, ETX informs the receiving unit that BCC follows. The 3270 CU transmits ETX at the end of the last (or only) block of a text message. Then, upon successful comparison of the received BCC with the accumulated BCC, the program should respond with ACK to the 3270 CU. If the BCC comparison is unsuccessful, the TCU interrupts the program (channel-end, device-end, and unit-check status, with data check set in the sense byte); the program should respond with NAK to the 3270 CU. Receipt of ETX by the 3270 CU initiates a BCC comparison, causes a line turnaround, and causes generation of an appropriate response to the TCU.

EOT (End of Transmission)

EOT is transmitted by the 3270 CU (1) when the 3270 CU is a slave station and is unable to perform an operation requested by the TCU, (2) when the 3270 CU is a master station, as normal termination of a read operation, (3) when the 3271 has completed general-poll operations with each attached device, (4) as an answer to RVI sent by the TCU, (5) when the 3275 in text mode has invalid BCC, or (6) when the 3275 ETX is missing. Line synchronization is dropped, and the 3270 CU is returned to control mode. Note that the program can also issue EOT to the 3270 CU in order to drop line synchronization and return the 3270 CU to control mode. EOT does not reset status and sense in the 3270 CU; therefore, it should not be sent as a response to a status message.

ITB (End of Intermediate Transmission Block)

The 3270 CU does not accept conventionally blocked text. However, to coexist on a BSC multipoint line on which ITB may be used, the 3270 CU includes the ITB and associated BCC in its own BCC accumulation but then removes them from the data stream so that they are not stored in the buffer. The 3270 CU does not perform a BCC comparison at that time, but continues the receive operations until ETB or ETX is decoded.

ESC (Escape)

ESC must precede the command code in each command-sequence data stream transmitted to the 3270 CU, as follows: STX, ESC, CMD, ---. The 3270 CU does not generate ESC.

TTD (Temporary Text Delay)

TTD is a 2-character sequence: STX ENQ. The 3270 CU responds to TTD by transmitting NAK to the TCU. The 3270 CU does not generate TTD. TTD may also be used by the master station to terminate an operation (that is, initiate a forward abort). The 3270 CU (slave station) will always respond with a NAK, expecting the master station to transmit EOT. In this case, the slave station interprets this sequence as a controlled forward abort rather than an end of transmission.

Operational Sequences (Nonswitched Line)

The following paragraphs describe the various data and control sequences that can be performed with the 3270 operating on a nonswitched line. Differences for a 3275 with a Dial feature are discussed under "Operational Sequences (Switched Line)." These sequences are divided into four categories:

- Specific and General Poll
- Selection addressing
- Write and control-type commands
- Read-type commands

The description of each category is associated with a sequence/response diagram, which shows (1) all 3270 CU responses to program-generated transmissions by the TCU and (2) normal program-handling of 3270 CU transmissions. These diagrams show the I/O supervisor/access method as examining each 3270 response to determine which operation to initiate next; for specific applications, however, additional use of command chaining in the channel programs may be desirable.

A selection addressing sequence selects a 3270 CU and an attached device for subsequent command operations. Polling sequences are selection sequences used specifically to obtain pending status at a device. Either a Specific Poll sequence requesting status from a particular device or a General Poll sequence sent to all devices may be executed.

Remote Chaining of 3270 Commands

For remote operations, 3270 command codes are included in the data stream of a Write CCW to the TCU. Remote chaining of 3270 commands is defined as the transmission of more than one command sequence to a 3270 CU following a single selection addressing or poll sequence. This chaining normally is accomplished with separate Write CCWs in the channel program. For example, the channel program could (1) write a selection addressing sequence and read the response for evaluation by the I/O supervisor/access method, (2) write a 3270 Write command and text block and read the 3270 response for evaluation, and then (3) write a 3270 Write command followed by a second text block and read the 3270 response for evaluation.

The program may chain 3270 commands following a selection addressing sequence, provided that the BSC rules governing limited conversational mode are observed. (Refer to *General Information – Binary Synchronous Communications*, GA27-3004.) The 3270 CU permits any valid command to be chained following a poll sequence; Read Buffer or Read Modified should not be chained, however, because the BSC rules for limited conversational mode (a maximum of two consecutive data transfers without an intervening ACK) will be violated.

Any 3270 command (except Erase All Unprotected) may be chained from a Write, Erase/Write, Erase/Write Alternate, or Copy command. However, if the Write, Erase/Write, Erase/Write Alternate, or Copy command has started a print operation, the 3270 CU will abort the subsequent chained command (the print operation is completed normally).

General and Specific Poll Sequences

When a General or Specific Poll sequence is issued (Figure 5-1), one of three possible results occurs:

- If status and sense information is pending with or without an AID present, a status and sense message is generated.
- If status and sense information is not pending and an AID is present, a Read Modified command is executed.
- If there is no status or sense information or *no* AID pending, an EOT response is generated.

The conditions under which status and sense messages are transmitted are listed under "Error-Recovery Procedures."

Note: *When a program attention key is pressed at a 3275 Display Station, and status is not to be sent, the display station screen will momentarily go blank while the AID character is accepted during the polling cycle and a read or write type command reply is sent.*

Control unit and device address bytes transmitted for the General and Specific Poll sequences are as follows:

- General Poll address byte sequence:

  3270 CU Poll Address (See Figure 5-2.)
  3270 CU Poll Address (See Figure 5-2.)
  7F (EBCDIC) or 22 (ASCII) } Used in place of the 2
  7F (EBCDIC) or 22 (ASCII) } device-address bytes

- Specific Poll address byte sequence:

  3270 CU Poll Address (See Figure 5-2.)
  3270 CU Poll Address (See Figure 5-2.)
  Device Address } For the 3275, this is always the address of device 0.
  Device Address }

The selected 3270 CU remains selected at the completion of a poll operation so that the program can issue a Write, Erase/Write, Erase/Write Alternate, Copy, or EAU command without reselecting the 3270 CU and the device; command operations will be with (1) the device that was selected by Specific Poll or (2) the device from which a response was last received during the General Poll operation. Selection is dropped when the 3270 CU transmits EOT; the 3270 CU transmits EOT when the 3270 CU has no pending status or messages or after it receives NAK from the TCU in response to a message ending with ENQ.

Specific Poll addresses the 3270 CU and one device to determine whether status and sense information or a manually entered message is awaiting transfer to the TCU. The 3270 CU automatically transfers the pending status and sense information or message upon receipt of the Specific Poll addressing sequence.

General Poll addresses the 3270 CU and examines each attached device in sequence (starting at a random device address) to determine whether a status and sense or a manually entered message is awaiting transfer to the TCU. If a message is present, it is transferred to the TCU. Each message is accompanied by the address of the device from which it originated. The 3275 responds to a General Poll the same as a 3271 with one device attached.

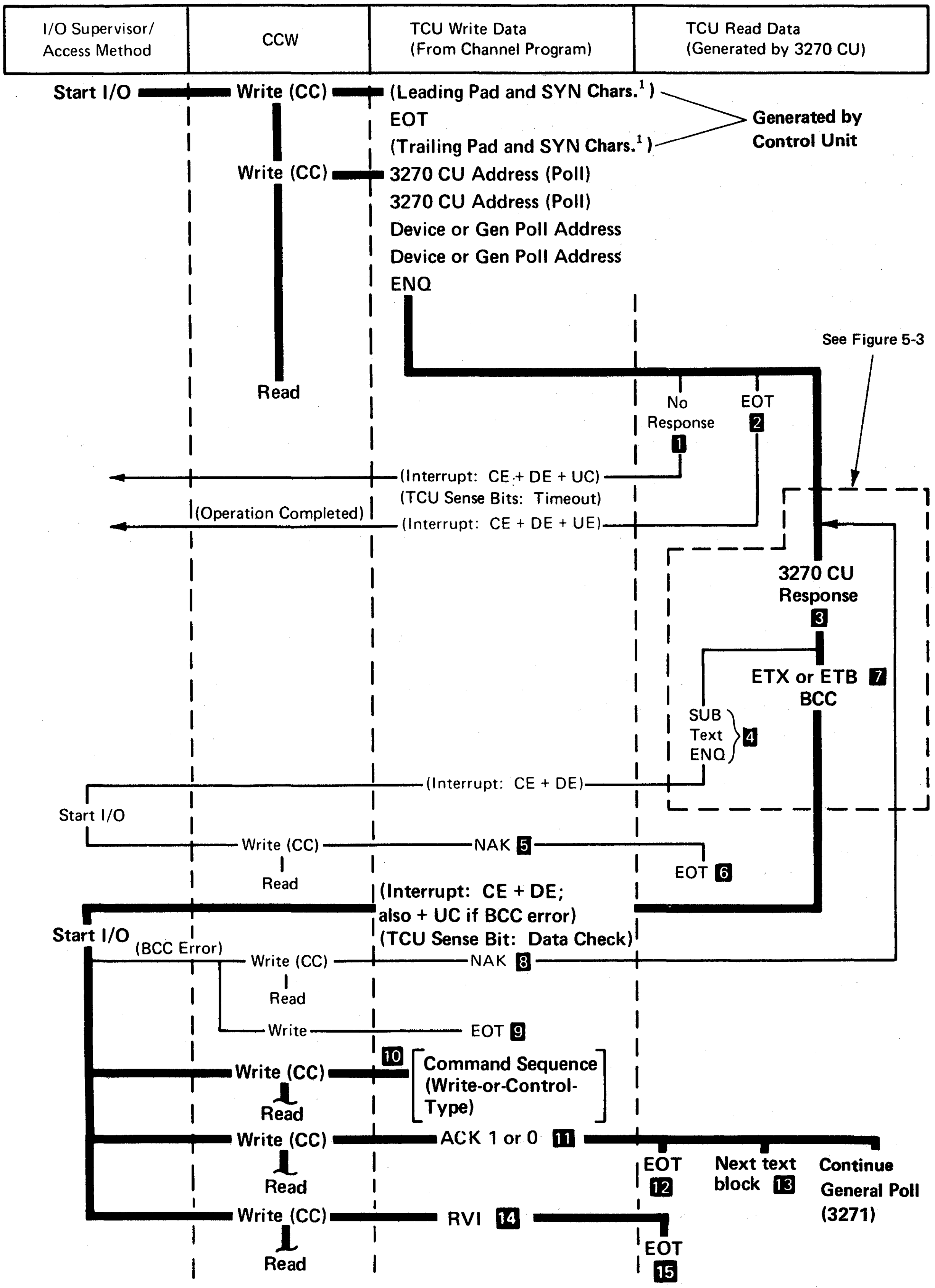
Upon completion of this transfer, an ACK response from the program causes the 3270 CU to continue the General Poll operation, either by transferring another block of a text message or by examining other attached devices for pending messages. The program could issue a command rather than ACK to the device from which the message was just received, only after inbound blocks that end with ETX. Once the 3270 CU has examined all attached devices and has successfully transferred all pending messages, it generates EOT and returns to control mode. If the program wishes to terminate the General Poll, an RVI may be issued to the 3270, forcing an EOT response. A command issued rather than the ACK (after blocks that end with ETX) will also terminate the General Poll.

Figure 5-3 shows the message formats. The Test Request, Read Modified, and Short Read operations and the resulting data are described under "Read Modified Command" in Chapter 3. Note that a device address is not provided in the heading of a Test Request message. The operator must enter an address manually as part of the text, because the operator may specify the address of another device for test operations with the program.

The status and sense bits are described in this chapter under "Status and Sense (S/S) Bytes."

Selection Addressing Sequence

The selection addressing sequence (Figure 5-4) specifies a 3270 CU and an attached device in preparation for write-, control-, or read-type command sequences. It is similar in format to a Specific Poll sequence in that a CU address is sent, followed by a device



[1] Only the critical framing characters (sync pattern and pad) are shown. All other framing characters are also hardware-generated as required. See *General Information - Binary Synchronous Communications,* GA27-3004, for a complete description.

Figure 5-1 (Part 1 of 2). General Poll and Specific Poll, Sequence/Response Diagram

Notes:

1 The 3270 CU will fail to respond to the addressing or polling sequence, causing a TCU timeout, for any of the following reasons:

- The 3270 CU is *unavailable* (has power off, is *offline*, or is not attached).
- The 3275 is *unavailable* to a Specific Poll sequence because the Security Keylock is in the off position.
- Any character in the polling sequence is invalid.
- The characters in the polling sequence are out of order.
- The polling sequence is incomplete (fewer than 7 characters).
- The 3270 CU address is incorrect in the write data stream.
- The addressed 3270 CU was left selected from the previous transmission.

2 There is no I/O pending or pending status. For General Poll, the CU sends EOT only after polling all devices.

3 The device response is a function of the kind of device and its status. Types of responses include Text, Status, and Test Request messages. (Refer to Figure 5-3.)

3271: For General Poll, the search for a response starts at some random device address and continues sequentially (as long as ACKs are received in response to text transmissions) until all devices are given the opportunity to respond.

4 Upon detection of an internal parity check or a cursor check, the 3270 CU (1) substitutes the SUB character for the character in error, (2) records Data Check status, and (3) transmits an ENQ in place of ETX (or ETB) and BCC at the end of the text block. The General Poll process is stopped.

5 Mandatory program response to a text block terminated in ENQ.

6 Terminates the operation. The nature of the error (parity or cursor check) does not warrant a retry. This response indicates that status and sense information is stored and that internal 3271/device polling is stopped. The status retrieval information included in Note **2** of Figure 5-6 applies.

7 ETB is used to frame each block of a blocked text message, except the last block. ETX is used to frame the last block of a blocked text message.

8 BCC error has been detected. The program issues NAK to cause the 3270 CU to repeat its last transmission.

9 Response issued by the program to terminate the operation if the TCU is unsuccessful in receiving a valid BCC following *n* attempts by the 3270 CU to transmit the message. This response does not cause the 3270 CU to reset its sense/status information. Therefore, the same status message will be transmitted if a Specific Poll is immediately issued to the same device.

10 This transmission must be a write or control-type command sequence (described in Figure 5-5). A read-type command would violate BSC standards on limited conversational mode.

3271: For General Poll, this transmission stops the polling operation. The General Poll must be reinitiated to ensure receipt of all pending device messages.

11 Positive acknowledgment. The text block has been successfully received by the TCU. The program issues ACK 1 in response to the first and all odd-numbered text blocks and issues ACK 0 in response to the second and all even-numbered text blocks. This response to a text block terminated in ETX turns on the 3275 SYSTEM AVAILABLE indicator.

12 Normal termination of a Specific Poll.

3271: Normal termination of a General Poll.

3275: No additional response is generated by the 3275 at the end of a General Poll.

13 The second and all succeeding text blocks are framed as the first except they do not include the 3270 CU/device address sequence.

14 RVI to terminate polling sequence.

15 Termination of polling sequence on receipt of RVI.

LEGEND:

(CC) = Chain Command (CC) Flag in CCW is set to 1.

(Interrupt) = TCU-generated interruption (CE = Channel End, DE = Device End, UE = Unit Exception, UC = Unit Check).

1 Reversed numbers refer to notes.

Figure 5-1 (Part 2 of 2). General Poll and Specific Poll, Sequence/Response Diagram

Column 1
Use this column for:

- Device Selection
- Specific Poll
- General Poll
- Fixed Return Addresses

CU or Device Number	EBCDIC I/O Char.	EBCDIC (Hex) (Note 1)	ASCII I/O Char.	ASCII (Hex)
0	SP (Note 2)	40	SP	20
1	A	C1	A	41
2	B	C2	B	42
3	C	C3	C	43
4	D	C4	D	44
5	E	C5	E	45
6	F	C6	F	46
7	G	C7	G	47
8	H	C8	H	48
9	I	C9	I	49
10	¢	4A	[	5B
11	.	4B	.	2E
12	<	4C	<	3C
13	(	4D	(	28
14	+	4E	+	2B
15	| or !	4F	!	21
16	&	50	&	26
17	J	D1	J	4A
18	K	D2	K	4B
19	L	D3	L	4C
20	M	D4	M	4D
21	N	D5	N	4E
22	O	D6	O	4F
23	P	D7	P	50
24	Q	D8	Q	51
25	R	D9	R	52
26	!	5A	]	5D
27	$	5B	$	24
28	*	5C	*	2A
29	)	5D	)	29
30	;	5E	;	3B
31	¬ or ∧	5F	∧	5E

Column 2
Use this column for:

- 3270 CU Selection Addresses
- Test Requests

CU Number	EBCDIC I/O Char.	EBCDIC (Hex) (Note 1)	ASCII I/O Char.	ASCII (Hex)
0	-	60	-	2D
1	/	61	/	2F
2	S	E2	S	53
3	T	E3	T	54
4	U	E4	U	55
5	V	E5	V	56
6	W	E6	W	57
7	X	E7	X	58
8	Y	E8	Y	59
9	Z	E9	Z	5A
10	¦	6A	|	7C
11	,	6B	,	2C
12	%	6C	%	25
13	—	6D	—	5F
14	>	6E	>	3E
15	?	6F	?	3F
16	0	F0	0	30
17	1	F1	1	31
18	2	F2	2	32
19	3	F3	3	33
20	4	F4	4	34
21	5	F5	5	35
22	6	F6	6	36
23	7	F7	7	37
24	8	F8	8	38
25	9	F9	9	39
26	:	7A	:	3A
27	#	7B	#	23
28	@	7C	@	40
29	'	7D	'	27
30	=	7E	=	3D
31	"(Note 3)	7F	"	22

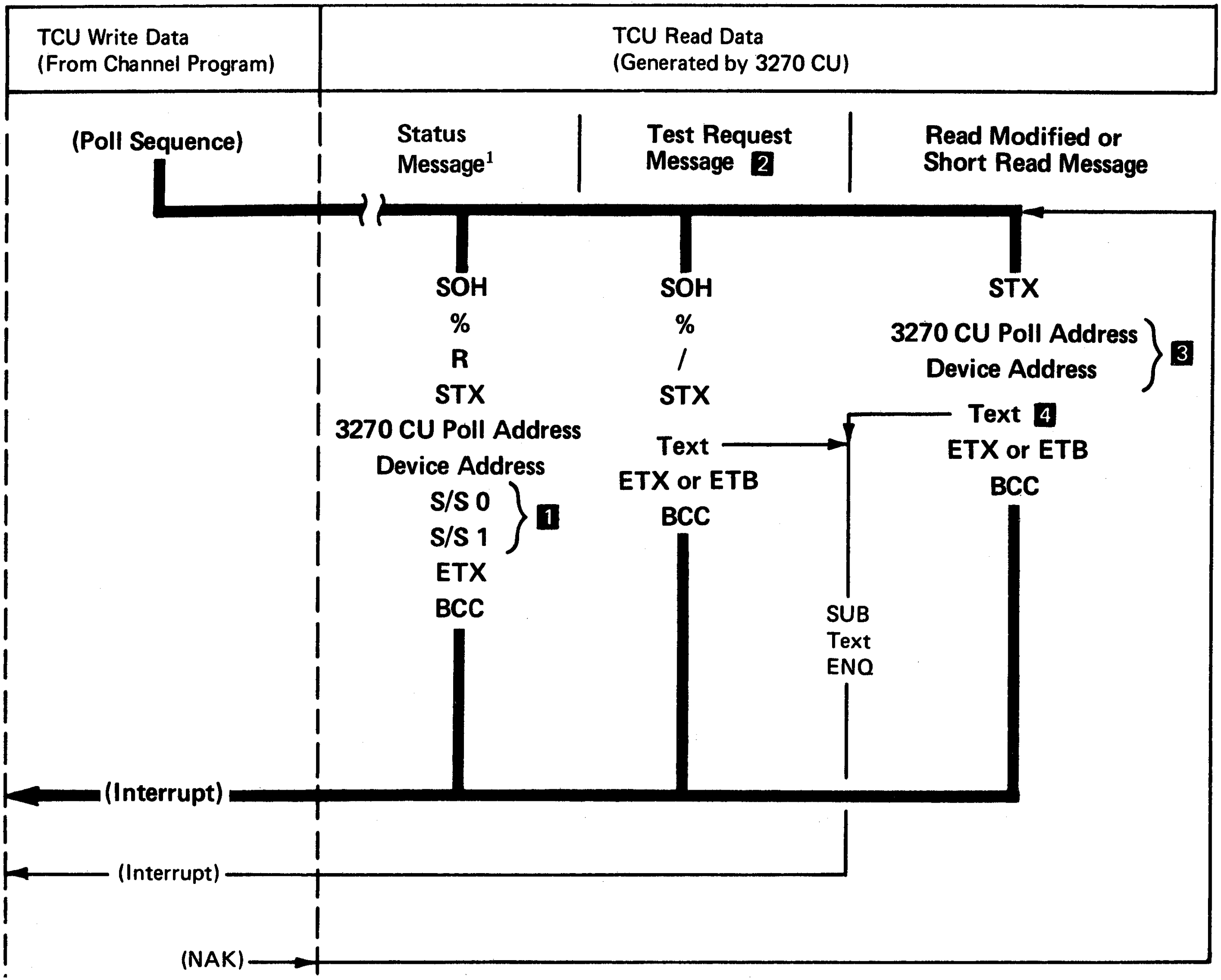
Examples:

3271 Addressing				3275 Addressing			
		EBCDIC	ASCII			EBCDIC	ASCII
General Poll CU5	CU Address	C5 C5	45 45	General Poll CU5	CU Address	C5 C5	45 45
	Device Address	7F 7F	22 22		Device Address	7F 7F	22 22
Specific Poll Device 4 on CU5	CU Address	C5 C5	45 45	Specific Poll CU5	CU Address	C5 C5	45 45
	Device Address	C4 C4	44 44		Device Address	40 40	20 20
Select Device 4 on CU5	CU Address	E5 E5	56 56	Select CU5	CU Address	E5 E5	56 56
	Device Address	C4 C4	44 44		Device Address	40 40	20 20

Notes:

1. *Graphic characters for the United States I/O interface codes are shown. Graphic characters for EBCDIC 4A, 5A, 5B, 7B, 7C, and 7F might differ for particular World Trade I/O interface codes. Refer to* IBM 3270 Information Display System: Character Set Reference, *GA27-2837, for possible graphic differences when these codes are used.*
2. *I/O character address (SP) is always used as the device address to select a 3275.*
3. *I/O character address (") is used as the device address to specify a General Poll operation.*

Figure 5-2. Remote Control Unit and Device Addressing – BSC



[1] Response to General Poll or Specific Poll only (*not* program-generated Read Modified command)

Notes:

1 A status message response is issued to a General or Specific Poll if (1) the 3270 CU has pending status (General Poll ignores Device Busy and device *unavailable* and the 3271 continues polling of next device) or (2) error status develops during execution of the poll. Status and sense bit assignments are described in Figure 5-7.

2 A Test Request Message response is issued to a General or Specific Poll if a TEST REQ key is pressed at the keyboard of a polled 3275 or 3277.

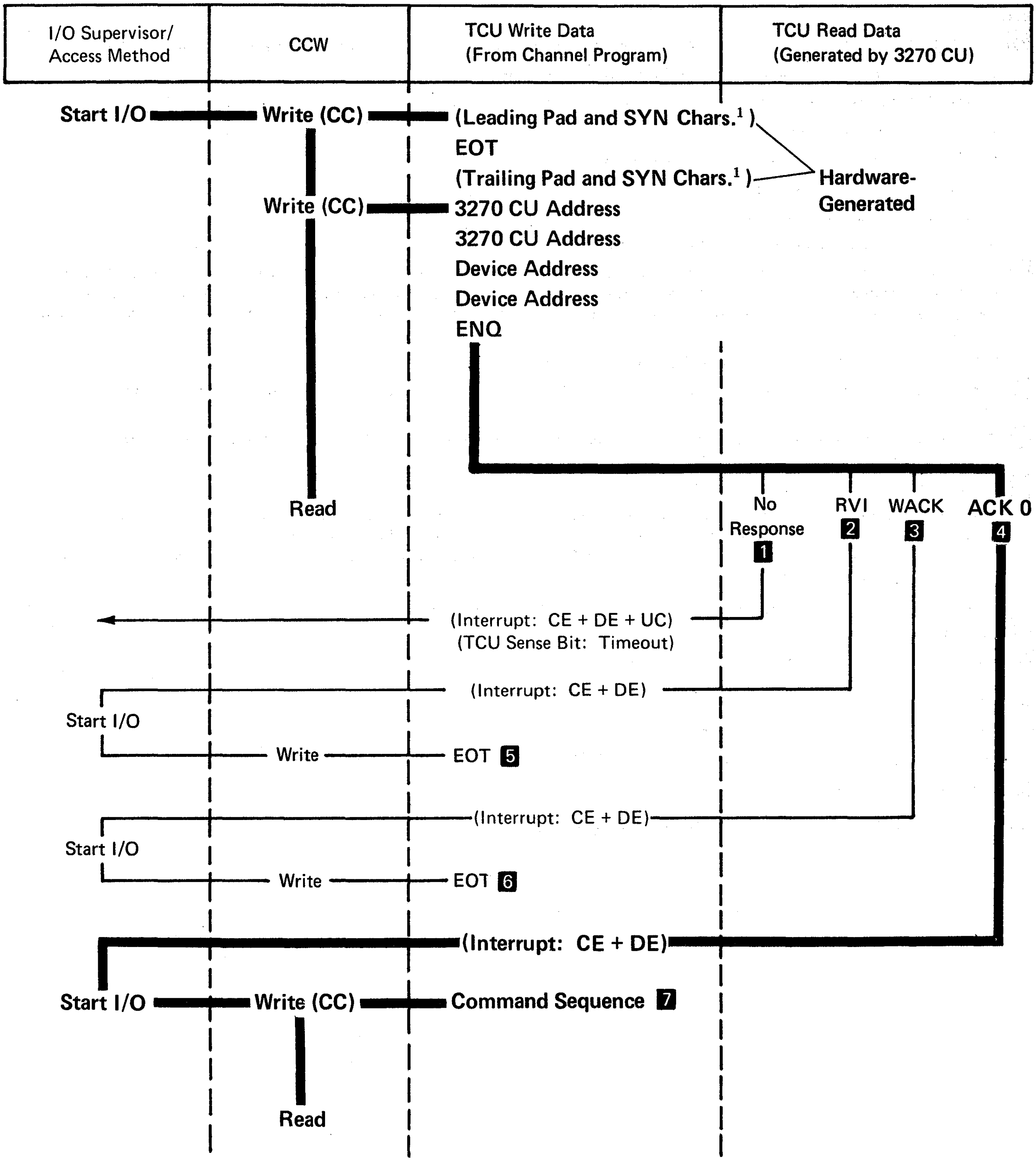
3 This address is included only in the first block of a blocked text message.

4 The text portion of this message is the result of either a Read Modified or Short Read operation by the 3270 CU. Figure 5-5 lists each operator action and the resulting read operation that will be performed. The read operations and the resulting data are described under "Read Modified Command" in Chapter 3.

LEGEND:
(Interrupt) = TCU-generated interruption.
1 Reversed numbers refer to notes.

Note: *This figure is referred to in Figures 5-1 and 5-6.*

Figure 5-3. 3270 CU Message Response to Polling or Read Modified Command



[1] Only the critical framing characters (sync pattern and pad) are shown. All other framing characters are also hardware-generated as required. See *General Information — Binary Synchronous Communications,* GA27-3004, for a complete description.

Figure 5-4 (Part 1 of 2). Selection Addressing, Sequence/Response Diagram

Notes:

1 The 3270 CU will fail to respond to the addressing or polling sequence, causing a TCU timeout, for any of the following reasons:

- The 3271 is *unavailable* (has power off, is *offline*, or is not attached).
- The 3275 is *unavailable* because the Security Keylock is in the off position).
- Any character in the polling sequence is invalid.
- The characters in the polling sequence are out of order.
- The polling sequence is incomplete (fewer than 7 characters).
- The 3270 CU address is incorrect in the write data stream.
- The addressed 3270 CU was left selected from the previous transmission.

2 3271: The addressed device has pending status (excluding Device Busy or a Device End) or is unavailable, the device-to-3271 buffer transfer was unsuccessful, the 3271 detected an internal parity or cursor check, or the addressed printer became *not ready* (out of paper, unrecoverable *hang*, power off, or cover open). The S/S information is stored in the 3271, and the internal 3271/device polling is stopped.

3275: The 3275 has pending status, excluding Device Busy or Device End.

3 The addressed 3271 device or the 3275, including the 3284-3 Printer, is busy. No S/S information is stored. An RVI response takes precedence over a WACK response.

4 The address has been successfully received, no status is pending, and, in the case of the 3271, the device-to-3271 buffer transfer is successfully completed.

5 Termination of attempted addressing sequence:

3271: The availability of valid status and sense information cannot be ensured unless a Specific Poll is issued to the responding device as the next addressing sequence issued to this 3271. Successful completion of a Specific Poll addressed to the responding device, a device selection addressed to any other device on the same 3271, or a General Poll addressed to the same 3271, is required to start the internal 3271 device polling operation.

3275: A Specific Poll to the 3275 retrieves the status existing at the time the RVI response was made.

6 Termination of attempted addressing sequence.

7 See Figure 5-5 or 5-6 for the desired command sequence.

LEGEND:

(CC) = Chain Command (CC) Flag in CCW is set to 1.

(Interrupt) = TCU-generated interruption (CE = Channel End, DE = Device End, and UC = Unit Check)

8 Reversed numbers refer to notes.

Figure 5-4 (Part 2 of 2). Selection Addressing, Sequence/Response Diagram

address, but different I/O characters and hex codes are used to represent the CU address bytes. Column 1 in Figure 5-2 lists the characters and hex codes used to complete the selection addressing sequence. Comparative examples showing CU and device address codes for General Poll, Specific Poll, and selection addressing sequences are given at the bottom of Figure 5-2.

For the 3270 CU, the selection addressing sequence performs a function similar to a local Select command in that it causes a device-to-control-unit buffer transfer. The 3270 CU returns ACK 0 if the selection and buffer transfer were completed successfully.

When a 3275 is to be selected, note that device number 0 is always addressed (Figure 5-2, Note 2).

Write-Type and Control-Type Command Sequences

The program initiates a Write, Erase/Write, Erase/Write Alternate, Copy, or EAU operation (Figure 5-5) by first writing a command and, except for EAU, a data sequence to the selected 3270 CU and then reading the response. A minimum of 1 data byte (the WCC or CCC byte) must follow all write-type and Copy commands. If the program reads a positive response (ACK) from the 3270 CU, it can terminate the operation or continue with another command. The program can write blocks of text to the 3270 CU by initiating, after receipt of each ACK, a Write command sequence for each block to be written.

The blocking of write data to devices attached to a 3271 control unit is accomplished as follows: Each time the 3271 receives a selection addressing sequence, it transfers the contents of the device buffer to the 3271 buffer before any data is received. After the 3271 has successfully completed execution of the Write command, the contents of the 3271 buffer are transferred to the device buffer. If the transfer of a block of write data to the 3271 is unsuccessful (for example, NAK reply), the 3271-to-device-buffer transfer is not performed. However, the 3271 can receive retransmission of that block; upon receipt of the command, the 3271 retrieves the device-buffer contents (which include any previous text blocks that were written successfully) before any write data is received.

The blocking of write data is of less value with a 3275 since the 3275 buffer is also the device buffer. Thus, if text-blocking is used and the 3275 fails to receive the block successfully, the buffer should be entirely written because orders within the unsuccessful data block may have affected data in any area of the buffer, possibly destroying the integrity of the buffer.

Read-Type Command Sequences

Programming Note: *Read Buffer is used primarily for diagnostic purposes, and Poll (General and Specific) is normally used in place of Read Modified for remote read operations.*

The program initiates a read operation (Figure 5-6) by first writing a command sequence to the selected 3270 CU and then reading the response. If the 3270 CU responds with text followed by ETB, and if BCC comparison at the TCU is successful, the program should write ACK to retrieve the next text block. This should continue until an error is detected or until a text block is followed by ETX. After ETX is received, the program should write ACK to the 3270 CU and then read the EOT reply. The three types of Read Modified message responses are shown in Figure 5-3.

Status and Sense (S/S) Bytes

All remote status and sense conditions are combined into 2 bytes. These 2 bytes are always sent in a status message. In EBCDIC code, the bits are transmitted as indicated in Figure 5-7. If the sense bytes are transmitted in ASCII code, the EBCDIC code defined below is translated into ASCII before transmission.

The 3270 records status and sense conditions for each device. These conditions may include busy or ready status or detected errors. Figure 5-8 shows how these status and sense conditions are interpreted for each error response that the 3270 transmits in response to a poll sequence from the TCU.

Error-Recovery Procedures

Errors detected at the 3270 system are indicated to the system processor by the following responses: RVI, NAK, EOT, or sense/status information. The meaning of the responses depends upon their sequences, as defined in Figures 5-1 and 5-3 through 5-6.

Figure 5-9 lists the various error combinations of sense/status bits [except for device busy (DB), which is not an error] and the recommended error-recovery procedure for each combination. Although there are 256 possible combinations of status and sense bits, only a portion of this total is normally used. Combinations other than those listed may occur. For example, an unpredictable catastrophic hardware failure could induce an undefined combination of status and sense bits. Errors that occur at the *from* device during a Copy command are identified by an operation check (OC) sense bit in addition to the sense bit representing the detected error.

The error-recovery procedures recommended in Figure 5-9 are as follows:

1. Execute a new address selection addressing sequence, and retransmit the message, starting with the command sequence that was being executed when the error occurred. If, after two retries, the operation is not successful, this should be considered a nonrecoverable error. Follow supplementary procedure B after two retries.
2. Reconstruct the entire device buffer if possible, and retry the failing chain of commands (within the BSC sequence of operations). The sequence of commands used to reconstruct the buffer should start with an Erase/Write or Erase/Write Alternate command. If the information in the screen buffer is such that it cannot, or need not, be reconstructed, the operation may still be retried. If, after three retries, the operation is not successful, this should be considered a nonrecoverable error. Follow supplementary procedure A.

Programming Note: *A cursor check in the 3284 is indistinguishable from a data check that occurred in the 3271 or from a second selection to a 3277 with a cursor check. A selection addressing sequence or a poll sequence to another device on the same control unit should be attempted before the control unit is flagged as inoperative. A successful sequence indicates that the CU is probably satisfactory, and that the device requires manual intervention to reset it (for example, a 3277 with a nonrecoverable data check). An unsuccessful sequence indicates that the CU may be at fault and requires manual intervention to reset it.*

3. The error occurred during execution of a Copy command. Execute procedure 2, except that it is the buffer of the *from* device specified by the Copy command that should be reconstructed. After three retries, follow supplementary procedure B.

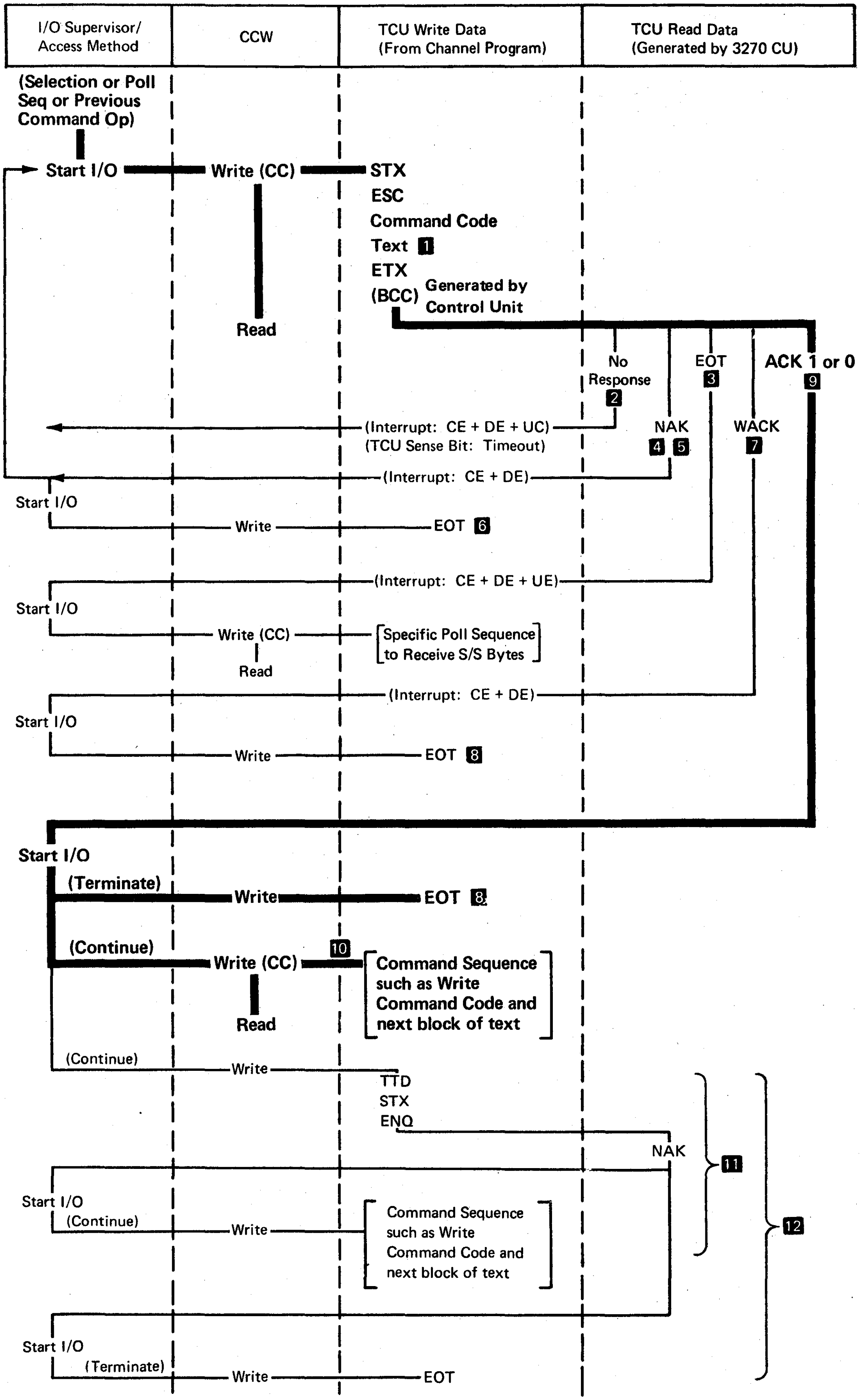

I/O Supervisor/ Access Method
CCW
TCU Write Data (From Channel Program)
TCU Read Data (Generated by 3270 CU)
(Selection or Poll Seq or Previous Command Op)
Start I/O
Write (CC)
Read
STX
ESC
Command Code
Text 1
ETX
(BCC) Generated by Control Unit
No Response 2
EOT 3
ACK 1 or 0 9
NAK 4 5
WACK 7
(Interrupt: CE + DE + UC)
(TCU Sense Bit: Timeout)
(Interrupt: CE + DE)
Start I/O
Write
EOT 6
(Interrupt: CE + DE + UE)
Start I/O
Write (CC)
Read
Specific Poll Sequence to Receive S/S Bytes
(Interrupt: CE + DE)
Start I/O
Write
EOT 8
Start I/O
(Terminate)
Write
EOT 8
(Continue)
Write (CC)
10
Read
Command Sequence such as Write Command Code and next block of text
(Continue)
Write
TTD
STX
ENQ
NAK
11
Start I/O
(Continue)
Write
Command Sequence such as Write Command Code and next block of text
12
Start I/O
(Terminate)
Write
EOT

Figure 5-5 (Part 1 of 2). Write-Type and Control-Type Commands, Sequence/Response Diagram—BSC

Notes:

1 No text is transmitted on an EAU command transmission.

2 The command transmission was not successfully received, because of invalid framing (STX missing), causing a timeout at the TCU.

3 3271: The control unit is unable to perform the operation indicated in the command transmission because of a busy/unavailable/not ready device or one of the following 3271-deteted check conditions:

- Receipt of an illegal command/order sequence
- Failure to decode a valid command
- An I/O interface *overrun*
- A parity/cursor check
- An illegal buffer address
- A locked buffer

In the case of the Copy command: The Copy feature is not installed (3271 only), the *from* device is busy or has a locked buffer, or the CCC is missing.

The EOT response to a command transmission indicates that status information is stored in the control unit and that internal 3271/device polling is stopped. To ensure retrieval of valid status, the program must issue a Specific Poll (addressing the device that was selected when EOT was generated) as the next addressing sequence to this control unit. Successful completion of a Specific Poll addressed to the responding device, a device selection addressed to any other device on the same control unit, or a General Poll addressed to the same control unit, is required to restart the internal control unit device polling operation.

3275: The 3275 is unable to perform the operation indicated in the command transmission because of (1) a BCC error, (2) a busy 3275 (including the attached 3284-3 Printer), or (3) a 3275-detected check condition (receipt of an illegal command/order sequence, failure to decode a valid command, an I/O interface *overrun*, a parity/cursor check, or missing ETX). A Specific Poll to the 3275 retrieves the status existing at the time the EOT response was made.

4 3271: If a transmission problem causes both a 3271-detected check condition and a BCC error, the BCC error takes precedence over all other check conditions, and a NAK is transmitted to the TCU.

5 3271: BCC error or missing ETX has been detected. The NAK response requests the program to repeat its last transmission.

Note: *The 3275 responds with EOT if it detects a BCC error or a missing ETX.*

6 Response issued by the program to terminate the operation if the 3270 CU is unsuccessful in receiving a valid BCC following *n* attempts by the program to transmit the message.

7 If the Start Printer bit is set in the WCC or CCC, a WACK response indicates that the text transmission was successfully received (and, if 3271, that the 3271-to-device buffer transfer was successfully completed) but that the printer is now busy and an additional chained command cannot be accepted.

If any of the conditions cited in Note **3** prevail, the EOT response takes precedence over the WACK response.

8 Normal termination of the operation by the program.

9 Command execution has been successfully completed and, in the case of the 3271, the 3271-to-device buffer transfer is successfully completed.

10 Repeat the operation shown in this figure or in Figure 5-6 for the next command sequence.

11 Example of a Temporary Text Delay (TTD) sequence.

12 Example of terminating an operation using TTD (a forward abort sequence).

LEGEND:

(CC) = Chain Command (CC) Flag in CCW is set to 1.

(Interrupt) = TCU-generated interruption (CE = Channel End, DE = Device End, UE = Unit Exception, UC = Unit Check).

1 = Number in parentheses refers to note.

Figure 5-5 (Part 2 of 2). Write-Type and Control-Type Commands, Sequence/Response Diagram—BSC

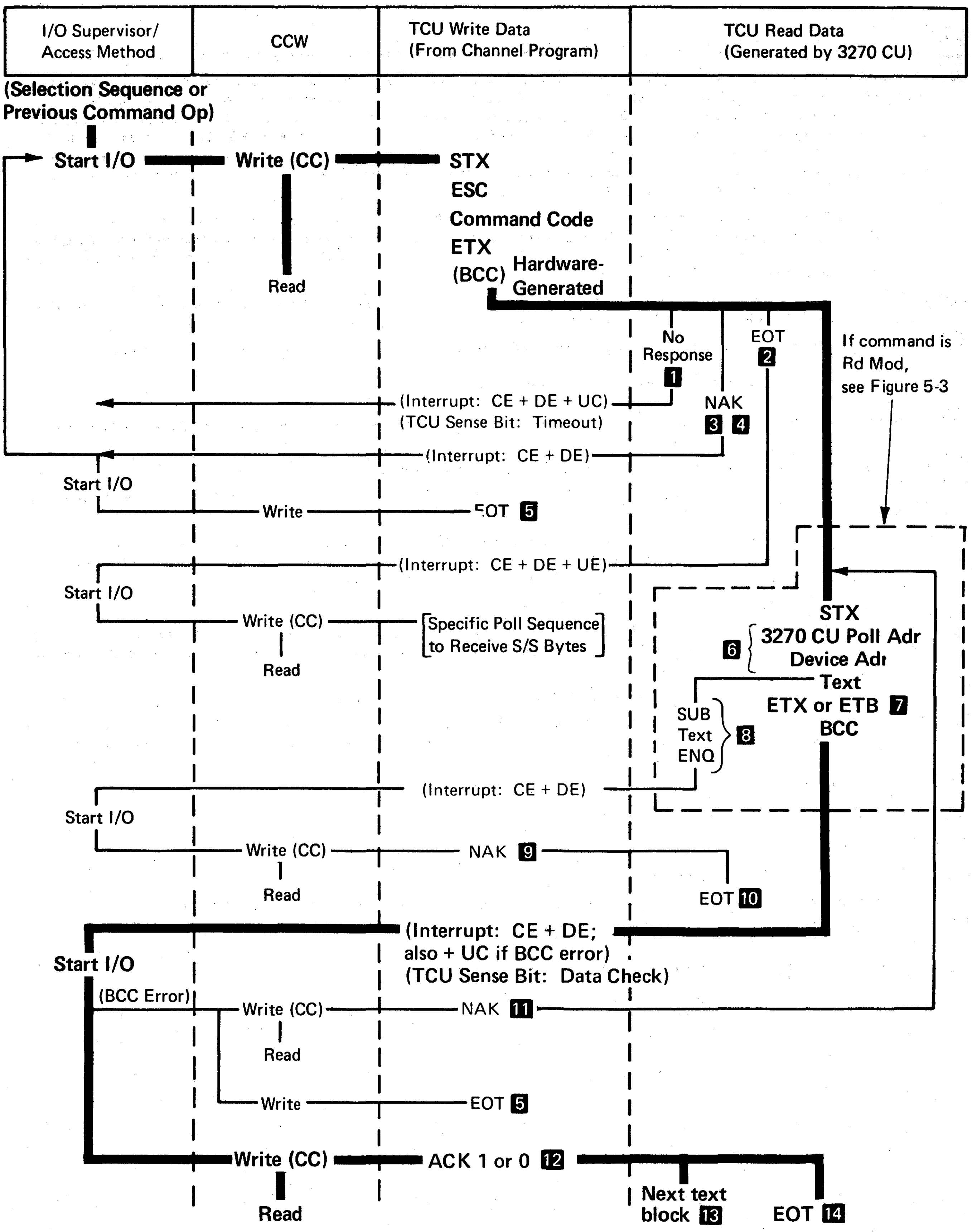


Figure 5-6 (Part 1 of 2). Read-Type Command, Sequence/Response Diagram–BSC

Notes:

1 The command transmission was not successfully received, because of invalid framing (STX missing), causing a timeout at the TCU.

2 3271, 3275: The 3270 CU is unable to perform the operation indicated in the command transmission because of a busy/unavailable/ not ready device or a 3270 CU-detected check condition (receipt of an illegal command/order sequence, failure to decode a valid command, or an I/O interface *overrun*). The EOT response to a command transmission indicates that status information is stored in the 3270 CU. To ensure retrieval of a valid status, a Specific Poll must be issued to the device-responding EOT as the next addressing sequence issued to this 3270 CU. Internal 3271/device polling is stopped. Restarting the internal 3271 polling operation requires the successful completion of a Specific Poll addressed to the responding device, a device selection addressed to any other device on the same 3271, or a General Poll addressed to the same 3271.

3275: The 3275 is unable to perform the operation indicated in the command transmission because it (1) has detected a BCC error, (2) is busy (includes an attached 3284-3 Printer), (3) has detected a check condition (has received an illegal command/order sequence, has failed to decode a valid command, or has detected an I/O interface *overrun* or a missing ETX). A Specific Poll to the 3275 retrieves the status existing at the time the EOT response was made.

3 3270 CU: If a transmission problem causes both a 3270 CU-detected check condition and a BCC error, the BCC error takes precedence over all other check conditions, and a NAK is transmitted to the TCU.

4 3271: BCC error or missing ETX has been detected. The NAK response requests the program to repeat its last transmission.

Note: *The 3275 responds with EOT if it detects a BCC error or a missing ETX.*

5 Response issued by the program to terminate the operation if the 3270 CU is unsuccessful in receiving a valid BCC following *n* attempts by the program to transmit the message.

6 This address sequence is included only in the first block of a blocked text message.

7 ETB is used to frame each block of a blocked text message, except for the last block. ETX is used to frame the last block of a blocked text message.

8 Upon detection of an internal parity check, the 3270 CU automatically substitutes the SUB character for the character in error. If a parity or cursor check is detected, ENQ is transmitted in place of ETX (or ETB) and BCC at the end of the text block and appropriate status and sense information is stored; also, internal 3271/device polling is stopped.

9 Mandatory program response to a text block terminated in ENQ.

10 Response to terminate the operation. The nature of the error (parity or cursor check) does not warrant a retry. This response indicates that appropriate status and sense information is stored and that internal 3271/device polling is stopped. The status retrieval information included in Note 2 applies.

11 BCC error has been detected. The program issues NAK to cause the 3270 CU to repeat its last transmission.

12 Positive acknowledgment. The text block has been successfully received by the TCU. The program issues ACK 1 in response to the first and all odd-numbered text blocks and issues ACK 0 in response to the second and all even-numbered text blocks. This response to a text block terminated in ETX turns on the device SYSTEM AVAILABLE indicator.

13 The second and all succeeding text blocks are framed as the first except that they do not include the 3270 CU/device address sequence.

14 Normal termination of the operation following transmission of the last text block.

LEGEND:

(CC) = Chain Command (CC) Flag in CCW is set to 1.

(Interrupt) = TCU-generated interrupt (CE = Channel End, DE = Device End, UE = Unit Exception, UC = Unit Check)

1 Reversed numbers refer to notes.

Figure 5-6 (Part 2 of 2). Read-Type Command, Sequence/Response Diagram–BSC

Bit No.	Bit Definition
	S/S Byte 0:
0	Dependent upon setting of bits 2-7.
1	Always a 1.
2	Reserved.
3	Reserved.
4	*Device Busy (DB)* – This bit indicates that the addressed device is busy executing an operation or that a busy detection was previously made by a command or Specific Poll. The device is busy when it is executing an Erase All Unprotected command or a print operation, accepting data from the operator identification card reader, or performing various keyboard operations (ERASE INPUT, Backtab, and CLEAR). This bit is set with Operation Check when a Copy command is received that specifies a *busy* device with its *from* address. This bit is set with Unit Specify when a command is addressed to a busy device. This can occur by chaining a command to a Write, Erase/Write, Erase/Write Alternate, or Copy command that started a printer or by chaining a command to a Specific Poll addressed to a busy device.
5	*Unit Specify (US)* – This bit is set if any S/S bit is set as a result of a device-detected error or if a command is addressed to a busy device.
6	*Device End (DE)* – This bit indicates that the addressed device has changed from *unavailable* to *available* and *not ready* to *ready,* or *busy* to *not busy*. This bit is included during a Specific or General Poll but is not considered pending status by a selection-addressing sequence. If a selection-addressing sequence detects that the addressed device has pending status and also detects one of the above status changes that warrants a Device End, then the Device End bit is set and preserved with the other pending status, and an RVI response is made.
7	*Transmission Check (TC)* – Not used by the 3271. This bit is set when the 3275 detects a BCC error on the TCU transmission.
	S/S Byte 1:
0	Dependent upon setting of bits 2-7.
1	Always a 1.
2	*Command Reject (CR)* – This bit is set upon receipt of an invalid 3270 command (or 3271 Copy command if this feature is not installed).
3	*Intervention Required (IR)* – This bit is set if: • A Copy command contains a *from* address in its data stream that specifies an unavailable device. • A command attempted to start a printer but found it *not ready*. The printout is suppressed. • The 3271 receives a selection-addressing sequence or a Specific Poll sequence for a device that is unavailable or that became *not ready* during a printout. A General Poll sequence does not respond to the *unavailable/not ready* indication and proceeds to determine the state of the next device. • The 3271 receives a command for a device that has been logged as unavailable or not ready.
4	*Equipment Check (EC)* – This bit indicates that a printer character generator or sync check error occurred, the printer became mechanically disabled, or a 3271 detected bad parity from the device.
5	*Data Check (DC)* – This bit indicates the detection of a parity or cursor check in either the 3271 or a device buffer or in the 3275 buffer, or a 3271 detected bad parity from the device.
6	*Control Check (CC)* – This bit is not used by the 3275. For the 3271, this bit indicates a timeout check. A timeout check occurs when a device fails to respond to 3271 communications within a specified time or when a device fails to complete an operation within a specified time.
7	*Operation Check (OC)* – This bit, when set alone, indicates one of the following: • Receipt of an illegal buffer address or of an incomplete order sequence on a Write, Erase/Write, or Erase/Write Alternate command. • The device did not receive a CCC or a *from* address on a Copy command. • Receipt of an invalid command sequence. (ESC is not received in the second data character position of the sequence.) • An I/O interface *overrun* is detected on a 3271. This occurs during a command when a data byte (character or order) is presented to the device by the TCU before the operation required by the previous data byte has been completed. This bit is set with Control Check, Intervention Required, Data Check, Device Busy, or Data Check with Unit Specify to indicate that the errors that set these sense bits were detected while the 3271 was executing an operation with the *from* device during a Copy command. This bit is set with Unit Specify to indicate that the *from* address on a Copy command specified a device with a *locked* buffer (the device data is secure).

Figure 5-7. Remote Status and Sense Byte Definitions – BSC

Device Response	Command	S/S Explanation
RVI	Selection	Outstanding Status – Pending information from a previous operation with the same device. (If the addressed device is busy, WACK is sent to the TCU instead of RVI, and no S/S bit is set.) **Note:** *A selection-addressing sequence does not recognize a Device End as pending status. If there is no other pending status, it resets this bit and proceeds with the selection. If the addressed device has other pending status, Device End remains set with it, and the RVI response is made as usual.* CC – A timeout check is caused by the addressed device. The operation is tried twice before this bit is set. IR – The addressed device is unavailable. DC, EC (either or both) – The 3271 detects bad parity on data received from the addressed device. DE, EC, US – A character generator or syn check error has occurred, or the printer was mechanically disabled but the condition has been corrected. DE, IR – The addressed printer is out of paper, its power has been turned off, or its cover is open. DE, IR, EC, US – The addressed printer is mechanically disabled and cannot recover. DE, DC, US – A parity error is detected at the printer. DC, US – A parity check or cursor check is detected by the addressed device on the data it is sending to the control unit.
EOT	Read Commands	CR – Invalid 3270 command is received. OC – Invalid command sequence (ESC is not in the second data character position), or data follows the command in the data stream received at the device. DB, US – The addressed device is busy. The command was chained to a Write, Erase/Write, Erase/Write Alternate, or Copy command which started a print, or it was chained to a Specific Poll. DB, US, DE – The addressed device becomes *not busy* before a Specific Poll is issued to retrieve the DB, US status. IR – A command is addressed to an unavailable device. (This is not applicable to the 3275.) DC ● A cursor check is detected at the 3271 before data transmission starts. The 3271 detects bad parity on data received from the addressed device. The operation is tried twice before this bit is set. No data is transmitted. ● A parity check is detected by the 3271 before it is transferred to the TCU. A SUB character is substituted for the error character during transmission. When the transmission is completed, the 3271 sends ENQ to indicate an error. When the TCU responds NAK, the 3271 responds EOT. ● A cursor check is detected by the 3271 during transmission to the TCU. When the transmission is completed, the 3271 sends ENQ to indicate an error. When the TCU responds NAK, the 3271 responds EOT. DC, US – The addressed device detects a parity check or cursor check on the data it is sending to the control unit. TC – A BCC error is detected at the 3275.
EOT	Write Commands	CR – An invalid or illegal 3270 command is received. OC – An invalid command sequence (ESC is not in the second data position), an illegal buffer address, or an incomplete order sequence is received, or a data byte was sent to the device during the Write command before the operation required by the previous data byte was completed. TC – A BCC error is detected at the 3275. DC – The 3271 detects a parity or cursor check on its buffer during command operation. The 3271 detects bad parity on data received from the addressed device. The operation is tried twice before this bit is set. DC, US – The device detects a parity or cursor check on its buffer during the command operation. CC – The device fails to complete an operation or respond to the 3271 in a certain time (timeout check). DB, US – The addressed device is busy. The message is accepted, but not stored in the 3271 or 3275 buffer. The command is aborted. DE, DB, US – The addressed device becomes *not busy* before a Specific Poll is issued to retrieve the DB, US status (described above).

Figure 5-8 (Part 1 of 3). Remote Error Status and Sense Responses – BSC

Device Response	Command	S/S Explanation
EOT	Copy Command	CC, OC – The *from* device fails to complete an operation or respond to the 3271 in a certain time (timeout check). DB, OC – The *from* device is busy. (The device is busy executing an operation, a printout, reading data from the operator identification card reader, or performing a keyboard operation.) The Copy command is aborted. IR, OC – The *from* device is not available. OC, US – The *from* device has a locked buffer. OC – The data stream contains other than 2 bytes (the CCC and the *from* address). The command is aborted. OC – The *from* device buffer is larger than the *to* device buffer. OC – The buffer of the *from* device (has APL/Text feature) contains APL/Text characters (entered since an Erase/Write or Erase/Write Alternate command or a CLEAR key operation), and the *to* device does not have the APL/Text feature. DC,OC – The 3271 detects a parity check on the data transferred from the *from* device. DC, OC, US – Set when the *from* device detects an internal parity or cursor check. DB, US – The addressed *to* device is busy. DB, US, OC – The addressed *to* device is also specified as the *from* device and is busy. DB, US, OC, DE – The addressed device becomes *not busy* before a Specific Poll is issued to retrieve the DB, US, OC status (described above).
EOT	Write, Erase/Write, Erase/Write Alternate, Copy Commands	IR – The addressed device is not available, or the addressed printer is not ready. IR, EC, US – A command attempted to start a printer operation, but the printer CARRIAGE MOTOR POWER switch (a CE service switch) is turned off.
EOT	Erase All Unprotected Command	OC – One or more data bytes followed the command (buffer overrun).
	Specific and General Poll	DE, IR, EC, US – An unrecoverable mechanical failure is detected at the printer. DE, EC, US – A character generator or sync check error or a mechanical failure is detected at a 3284/3286/3288 printer, but then recovered from. DC, US – A parity check or cursor check is detected by the addressed device on the data it is sending to the control unit. DC ● The 3271 detects a parity error on data to be transferred to the TCU. A SUB character is substituted for the error character during transmission. The transmission is completed, and the 3271 sends ENQ. When the TCU responds NAK, the 3271 responds EOT. ● A cursor check is detected at the 3271 before data transmission starts. (No data is transmitted.) ● The 3271 detects a cursor check during transmission to the TCU. The transmission is completed, and the 3271 sends ENQ. When the TCU responds NAK, the 3271 responds EOT. DC, EC (either or both) – The 3271 detects a parity check on data received from the device. DE – The poll finds a device (1), previously recorded as busy, now not busy or (2), previously recorded as unavailable *or* not ready, now available *and* ready. (The 3271 record is updated.) **Note:** ***When 3271 power is turned on, the DE bit is set for every available and ready device that is attached.*** IR, DE – The poll finds a device, previously recorded as ready, available, and busy, now not ready and not busy, or the printer went *not ready* during a printout. (The 3271 record is updated.)

Figure 5-8 (Part 2 of 3). Remote Error Status and Sense Responses – BSC

Device Response	Command	S/S Explanation
EOT	Erase All Unprotected Command Specific and General Poll	DC, US, DE — A parity error is detected at the printer. CC (Specific Poll only) — The poll finds a device, previously recorded as unavailable, still unavailable (timeout check). DC, DE — 3275 (only) detects an internal parity or cursor check on its buffer when the printer goes *not busy.* IR, EC, DE (3275 only) — The printer CARRIAGE MOTOR POWER switch (a CE service switch) is turned off, or a mechanical *hang* condition is detected. EC, DE (3275 only) — Character generator readout error.
	Specific Poll	CC — The poll finds a device, previously recorded as available and ready, now unavailable (timeout check). (The 3271 record is updated.) DB — The addressed device is busy.
NAK	Read and Write Commands	The 3271 transmits NAK when it detects a block check character (BCC) error on the TCU transmission. A BCC error has priority over all other detectable error conditions. If, for example, a BCC error and a parity error are detected during the same command transmission, the parity error condition is reset, and a NAK response is set by the 3271.

Figure 5-8 (Part 3 of 3). Remote Error Status and Sense Responses – BSC

Sense/ Status Bits	Detected during 3270 Operation						Transmitted in Response to:		Error Recovery Procedure			
	Hex		Selection Addressing Sequence	Specific Poll Sequence	General Poll Sequence	A 3270 Command	Specific Poll	General Poll	3271	3275	3274	3276
	EBCDIC	ASCII										
CR	40 60	20 2D				D, P	D, P		6	6	6	6
OC	40 C1	20 41				D, P	D, P		6	6	6	6
OC, US	C4 C1	44 41				D, P	D, P		13	NA	13	13
CC	40 C2	20 42	D, P	D, P		D, P	D, P		1	NA	NA	NA
CC, OC	40 C3	20 43				D, P	D, P		1	NA	NA	NA
IR	40 50	20 26	D, P	D, P		D, P	D, P		4	4	4	4
IR, OC	40 D1	20 4A				D, P	D, P		5	NA	5	5
DC	40 C4	20 44	D, P	D, P	D, P	D, P	D, P	D, P	1, 2	2	1	2
EC	40 C8	20 48	D, P	D, P	D, P	D, P	D, P	D, P	1, 2[1]	2	NA	NA
DC, EC	40 4C	20 3C	D, P	D, P	D, P	D, P	D, P	D, P	1, 2[1]	2	NA	NA
DC, OC	40 C5	20 45				D, P	D, P		1	NA	NA	NA
DC, US	C4 C4	44 44	D, P	D, P	D, P	D, P	D, P	D, P	2	NA	2	2
DC, OC, US	C4 C5	44 45				D, P	D, P		3	NA	3	3
DC, DE	C2 C4	42 44		P	P			P	NA	8	NA	NA
DC, US, DE	C6 C4	46 44		P	P		P	P	8	NA	8	8
IR, DE	C2 50	42 26		P	P		P	P	4	4	4	4
IR, EC, DE	C2 D8	42 51		P	P		P	P	NA	7	NA	NA
EC, DE	C2 C8	42 48		P	P		P	P	NA	7	NA	NA
EC, US, DE	C6 C8	46 48		P	P		P	P	7	NA	7[2]	NA
IR, EC, US, DE	C6 D8	46 51		P	P		P	P	7	NA	7	7
DB	C8 40	48 20	D, P	D, P			D, P		9	9	9	9
DB, DE[3]	4A 40	54 20					D		9	NA	NA	NA
DB, US[4]	4C 40	3C 20				D, P	D, P		10	10	10	10
DB, US, DE	4E 40	2B 20				D, P	D, P		1	1	NA	NA
OC, DB[4]	C8 C1	48 41				D, P	D, P		11	NA	11	11
TC	C1 40	41 20				D	D		NA	12	NA	NA
TC, OC	C1 C1	41 41				D	D		NA	12	NA	NA
TC, CR	C1 60	41 2D				D	D		NA	12	NA	NA
TC, DC	C1 C4	41 44				D	D		NA	12	NA	NA
DE	C2 40	42 20		D, P	D, P		D, P	D, P	None	None	None	None
IR, EC, US	C4 D8	44 51				P	P		7	NA	NA	NA
CC, IR	40 D2	20 4B		D, P	D, P	D, P	D, P		1	NA	NA	4

Note: *The attached device errors that are detected asynchronously do not cause a sense bit to set until the device is polled for status during a selection-addressing, Specific Poll, or General Poll sequence. Those error S/S bit combinations that contain DE were detected during a printout.*

[1] Perform error recovery procedure 1 if the error occurred during a read operation. Perform error recovery 2 if the error occurred during a write operation.

[2] Occurs only if the 3284, 3286, or 3288 printers are attached.

[3] The DB and DE S/S bits can occur together in response to a Specific Poll to a formatted 3277 if the operator has performed Backtab or Erase Input operations in rapid succession. Ignore Device End, and treat as Device Busy only.

[4] The DB, US, and OC S/S bits will be combined if a Copy command is addressed to a busy *to* device and the command also specifies the *from* device the same as *to* device.

Legend

NA	–	Not applicable
D	–	Display (3275, 3277)
P	–	Printer

Figure 5-9. Remote Status and Sense Conditions–BSC

4. The error indicates that the printer is out of paper, has its cover open, or has a disabled print mechanism; or it indicates that the device is unavailable. Request (or wait for) either the display or system operator to ready the device. Then, retry the printout by issuing a Write command with the proper WCC and no data stream. (There is no data error, and the data is still intact in the device buffer and can be reused.) Or, follow procedure 2.

5. The eror indicates that the *from* device specified by a Copy command is unavailable. Note that the device address associated with the error status and sense information does not indicate the device that actually required *readying*. The device that requires the corrective action is the device specified by the *from* address in the Copy command. When the device is determined and made *ready*, follow procedure 1.

6. The operation should be tried not more than six times. Continued failure implies an application programming problem, which can be detected by analysis of the failing write data stream.

7. The error occurred during a printout operation and indicates either a character-generator error or a disabled print mechanism. There is no data error. The proper error-recovery procedure is application-dependent, since the user may or may not want a new printout. If a new printout is required, follow procedure 4.

8. A data error occurred in the device buffer during a printout, and procedure 2 should be followed.

9. A Specific Poll detected that the addressed device is busy. Periodically issue a Specific Poll to pick up the device-end sense/status bit sent by the device when it becomes not-ready (unless this status change is detected on a selection addressing sequence).

10. Indicates that a command was erroneously addressed to a busy device. Periodically issue a General or Specific Poll to pick up the device-end sense/status bit sent by the device when it becomes not busy. Then follow procedure 1.

11. Indicates that, during an attempt to execute a Copy command, the *from* device was found to be busy. Follow procedure 1 when the *from* device becomes not busy. Note that the device address associated with the status and sense message is the address of the *to* device and not that of the busy *from* device. The *from* device will transmit device end via a Specific or General Poll when it becomes not busy.

12. Indicates that the 3275 detected a BCC error during text transmission from the TCU. Follow procedure 2 if the failing command is a Write command with a data stream of more than 1 byte or if it is in a chain of commands and one of the previous commands in the chain is a Write command without an SBA order immediately following the WCC character. In all other cases, follow supplementary procedure D. If, after the recommended procedure has been tried six times, the problem is not corrected, follow supplementary procedure A.

13. An attempt was made to execute a Copy command, but access to the *from* device data was not authorized. The device address associated with the error sense/status bits is that of the copy *to* device.

Supplementary Procedures

A. Request maintenance for the device that is giving trouble. After repair, reconstruct the screen buffer image. The sequence of commands used to reconstruct this image should start with an Erase/Write command. Retry the failing chain of commands according to the procedure that referred you to this supplementary procedure.

B. The *from* device specified by the Copy command in the failing chain of commands (CCWs) is malfunctioning. The *from* device should be determined from the data-stream information, and maintenance should be requested for the device. After the repair, reconstruct the buffer image. The sequence of commands used to reconstruct this image should start with an Erase/Write command. Retry the failing chain of commands according to the procedure that referred you to this supplementary procedure.

C. Same as procedure 1, except a new selection addressing sequence is not performed, and this message is transmitted as part of the present device selection.

D. Same as procedure 1, except retransmit the entire failing chain of commands.

NAK to a Text Block

When the 3271 detects a BCC error at the end of a text transmission, it transmits a NAK. The following recovery action should be taken:

> If the text is a write command sequence chained from a previous Write, Erase/Write, or Erase/Write Alternate command, and if the failing write command data stream contains more than 1 byte but does not contain an SBA order sequence immediately following the WCC, then procedure 2 (above) should be executed.
>
> In all other cases, supplementary procedure C (above) should be executed, except the number of retries should be six. If after these six retries the problem is not corrected, the program should issue an EOT and follow supplementary procedure A (above).

Notes:

1. *When the 3275 detects a BCC error, it will set the transmission-check (TC) sense/status bit and respond EOT.*
2. *An FF (hex) character in a data field will cause a BCC error.*

EOT to a Text Block

The recovery procedure recommended depends upon the type of error detected. A Specific Poll must be issued immediately following the EOT to obtain the error sense/status information. (If the Dial feature is installed, a Specific Poll is not needed, because the 3275 automatically bids for the line present sense/status information.) Then the recovery procedures recommended in Figure 5-9 should be executed.

Errors Detected during a Specific or General Poll Sequence

Any errors that result from execution of the poll sequence itself are listed in Figure 5-9, and those recovery procedures apply. The detected error bits are transmitted to the TCU in a status message during the poll sequence.

RVI to Selection Addressing Sequence

A Specific Poll must be issued immediately following the RVI to a selection addressing sequence to obtain the error sense/status information. Then the recovery procedures defined in Figure 5-9 should be followed.

Point-to-Point (Switched Line) Data Link Control

A 3275 with the Dial feature operates on a point-to-point, switched communication line. Data exchange takes place between a 3275 and a TCU, but not between 3275s.

Terminal Identification

Four terminal ID characters (4 bytes) are wired into each 3275 with the Dial feature. Only graphic characters can be assigned. The 1 character for 3270 devices is always f (for EBCDIC units) or F (for ASCII units). The remaining 3 characters can be assigned by IBM or by the customer at the customer's location. The non-IBM-assigned terminal ID characters consist of numbers and uppercase letters only. IBM-assigned terminal ID characters consist of lowercase letters and special graphics.

Contention Line Discipline

Bid Sequence

In switched-line operation, the stations are normally disconnected. When the TCU is dialed from a 3275, or a 3275 is dialed by the TCU and a connection is successfully made (with both stations in data mode), the data link is in point-to-point contention. Once a connection is made, either station can bid to become the control station by sending a terminal identification sequence. Normally, the control station would be the station that initiated the connection. The initial 3275 bid sequence is made up of the 4 terminal ID characters, followed by the character ENQ. Subsequent bids by the 3275 transmit only the ENQ character. The TCU bids for the line by sending the computer ID-ENQ sequence only during the first transmission and ENQ on the following bids. The bid sequence is used to maintain line discipline.

Note: *In the switched-line environment, the 3275 does not operate in transparent monitor mode.*

3275-Initiated Call

The telephone number of the desired computer system is dialed by the 3275 operator. Upon recognition of the answer tone from the called station, the modem (or line adapter) is automatically or manually switched into data mode. The 3275 operator then presses an attention ID (AID) key, usually ENTER, causing the following actions:

1. Disables the keyboard (except for the RESET key).
2. Turns on the INPUT INHIBITED indicator.
3. Initiates a bid for the line which, when successful, transfers a text message. The form of the message depends upon the key pressed (see Figure 3-2).

The SYSTEM AVAILABLE indicator's coming back on indicates to the operator that the 3275's message has been successfully transmitted. The operator can then press the RESET key, enabling the keyboard for transmitting another message, or disconnect, as desired. The keyboard can also be enabled by the computer's responding with a Write, Erase/Write, or EAU command and with the appropriate WCC.

Computer-Initiated Call

A 3275 with the Dial feature can be called from the computer. If an external modem, wired for auto answer, or the 1200-bps integrated modem with the Auto Answer feature is used, the 3275 can answer a call unattended. This is of use when the 3275 is unattended and a printer is attached.

An external modem or the 1200-bps integrated modem with Auto Answer feature will, upon recognizing the ringing signal, initiate off-hook, send an answer tone to the TCU, and automatically switch into data mode. The computer then begins transmission by sending a bid sequence.

In manual operation, the 3275 operator recognizes the ringing signal, lifts the telephone receiver (goes off-hook), and activates the exclusion key on the handset.

In all cases, data mode is indicated to the 3275 operator. In the manual case, data mode is implied by the handset's being out of the cradle. In the automatic case, an OFF HOOK indicator on the 3275 implies data mode.

Disconnection

Disconnection is the process of terminating a call. During this action, both stations should perform the disconnection. If only one station disconnects, the other station can stay connected and appear busy to incoming calls.

Manual Disconnection. To disconnect a 3275 manually, the operator must:

1. Raise and release the DISCONNECT switch on the 3275, causing the 3275 to send the disconnect sequence line control characters, DLE EOT. If the 3275 has an external modem wired for auto answer or a 1200-bps integrated modem with Auto Answer feature, the connection is automatically terminated.
2. On a 3275 without auto answer, the 3275 operator must replace the handset on-hook to achieve disconnection at the 3275. Replacing the handset restores the exclusion key to the talk position and disconnects the call. The handset should be cradled only following activation of the DISCONNECT switch, as confirmed by the SYSTEM READY indicator's turning off.

Automatic Disconnection. There are two ways to disconnect automatically, both requiring auto answer, either in an external modem or as part of the 2300-bps integrated modem:

1. By receipt of the disconnect sequence line control characters, DLE EOT.
2. By a 20-second timeout, which is enabled when the 3275 receives a ring signal from the CPU. The 20-second timeout is initiated each time a station transmits a valid header, text, response, or control transmission. It is reset each time a station receives two SYN characters from the line. Failing to reset the timer within 20 seconds causes the disconnect sequence of DLE EOT to be transmitted and causes the telephone to be hung up.

Data Link Control Characters

The use of some link control characters in the 3275 with the Dial feature differs from the use of those in the basic 3275, as follows.

ACK 0 and ACK 1 (Positive Acknowledgment)

When the 3275 responds to an initial bid for the line, the terminal ID precedes ACK 0. When an initial bid has been successfully completed, subsequent bids use only ACK 0.

The use of ACK 0 and ACK 1 to acknowledge data blocks positively is the same as for the basic 3275.

NAK (Negative Acknowledgment)

When the 3275 is called by the computer, but has pending status other than *printer busy*, the 3275 responds to the initial bid for the line with the terminal ID preceding NAK. NAK alone precedes all further bids for the line when status is pending. The 3270 CU transmits NAK in response to a text transmission that contains a TTD sequence (STX ENQ). When the 3275 receives the NAK in response to a text transmission, the 3275 retransmits the last block of text.

ENQ (Enquiry)

This character is transmitted by either station to bid for the line any time after it has transmitted or received EOT. However, ENQ is preceded by the terminal ID when the 3275 is making an initial bid for the line, and by the last character of a text message in which data check was detected by the 3275.

When the 3275 receives ENQ in response to a transmission, the last 3275 transmission to the TCU is repeated. The 3275 responds with NAK when ENQ is received (1) as the last character of a TCU-aborted text transmission, (2) embedded in text, or (3) as part of a TTD sequence (STX ENQ).

RVI (Reverse Interrupt)

Upon receipt of the RVI character, the 3275 with the Dial feature completes its buffer transfer before sending EOT.

EOT (End of Transmission)

EOT is transmitted by the master station (usully the caller) to indicate end of transmission. Either station is free to bid for the line following the EOT character.

When used as a response to a text block, EOT indicates that status is pending.

DLE EOT (Disconnect)

The DLE EOT is the disconnect signal. Any 3275 with the Dial feature can transmit DLE EOT (initiated by activating the DISCONNECT switch). However, only units that are equipped with auto answer have the ability to disconnect automatically.

Operational Sequences (Switched Line)

The following paragraphs describe the various data and control sequences that are unique to the 3275 with Dial feature operating on a switched line. Because operation is initiated differently from that of the basic 3275 operating on a leased line, neither selection nor polling applies to point-to-point contention operation. 3270 commands can be chained as described under "Remote Chaining of 3270 Commands."

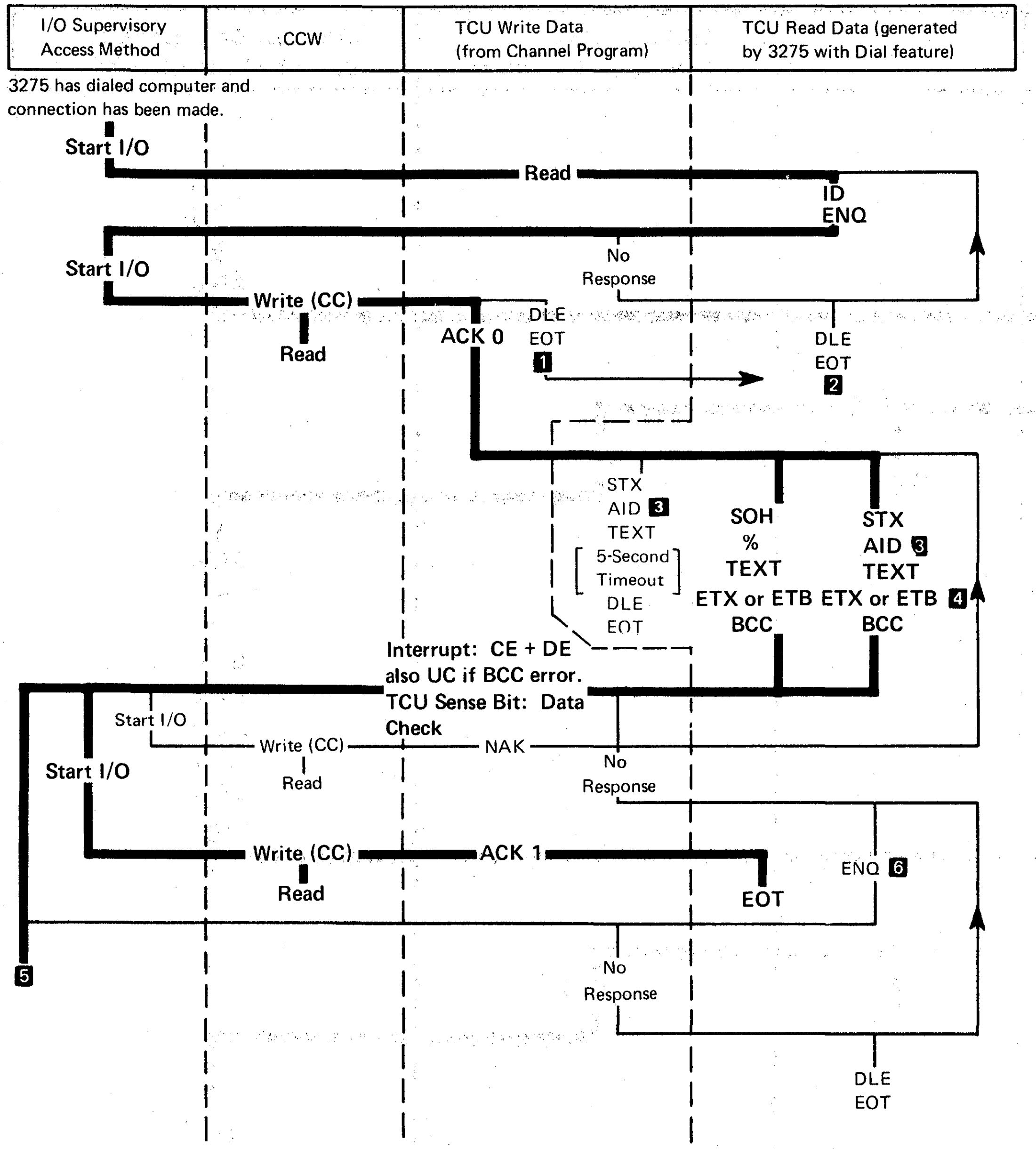
3275-Initiated Sequences

The 3275 with the Dial feature does not need a read-type command, including a poll, to start transmission of text entered into the buffer or a status message. Normally, a 3275 operator who intends to transmit a text message to the computer enters this message by keyboard into the buffer. After correction of keying errors, the computer is dialed. After the connection has been made, the operator presses an attention key (Figure 3-2). Pressing this key causes the 3275 to bid for the line by sending its 4 assigned terminal ID characters and ENQ.

Receiving a positive acknowledgment ends the identification phase and allows the 3275 to enter the data exchange phase. In the latter phase, assuming no status is pending, the 3275 transmits a text message that is identical with messages generated by the read-modified operation in the basic 3275 (see Figure 5-10). If status is pending, the 3275 transmits a status message (see Figure 5-11).

TCU-Initiated Sequences

The 3275 with the Dial feature can be called by the computer. The computer bids for the line with a computer ID-ENQ sequence or by sending ENQ only. (The computer ID of up to 15 characters is not decoded by the 3275.) When the 3275 responds with an ACK 0 or NAK to the initial line bid, the response character is prefaced by the 4 terminal ID characters. The program can then continue, as appropriate. Refer to Figure 5-12.



Notes:

1 Upon correct reception of an invalid terminal ID, the computer disconnects. The TCU may optionally send DLE EOT before disconnecting. This is defined in the BSC rules as an *unusual termination*.

2 The 3275 retries three times. When the number of retries is exhausted, the 3275 sends DLE EOT.

3 AID indicates which situation caused attention.

4 ETB is used to frame each block of a blocked text message, except the last block. ETX is used to frame the last block of a blocked text message.

5 The remainder of this sequence/response diagram is the same as that for a General or Specific Poll, as shown in Figure 5-1.

6 The 3275 as the master station solicits a response by sending ENQ. After the number of retries is exhausted, the 3275 acts as described in Note 2

LEGEND:

1 Reversed numbers refer to notes.

Figure 5-10. 3275-Initiated Transmission, Sequence/Response Diagram

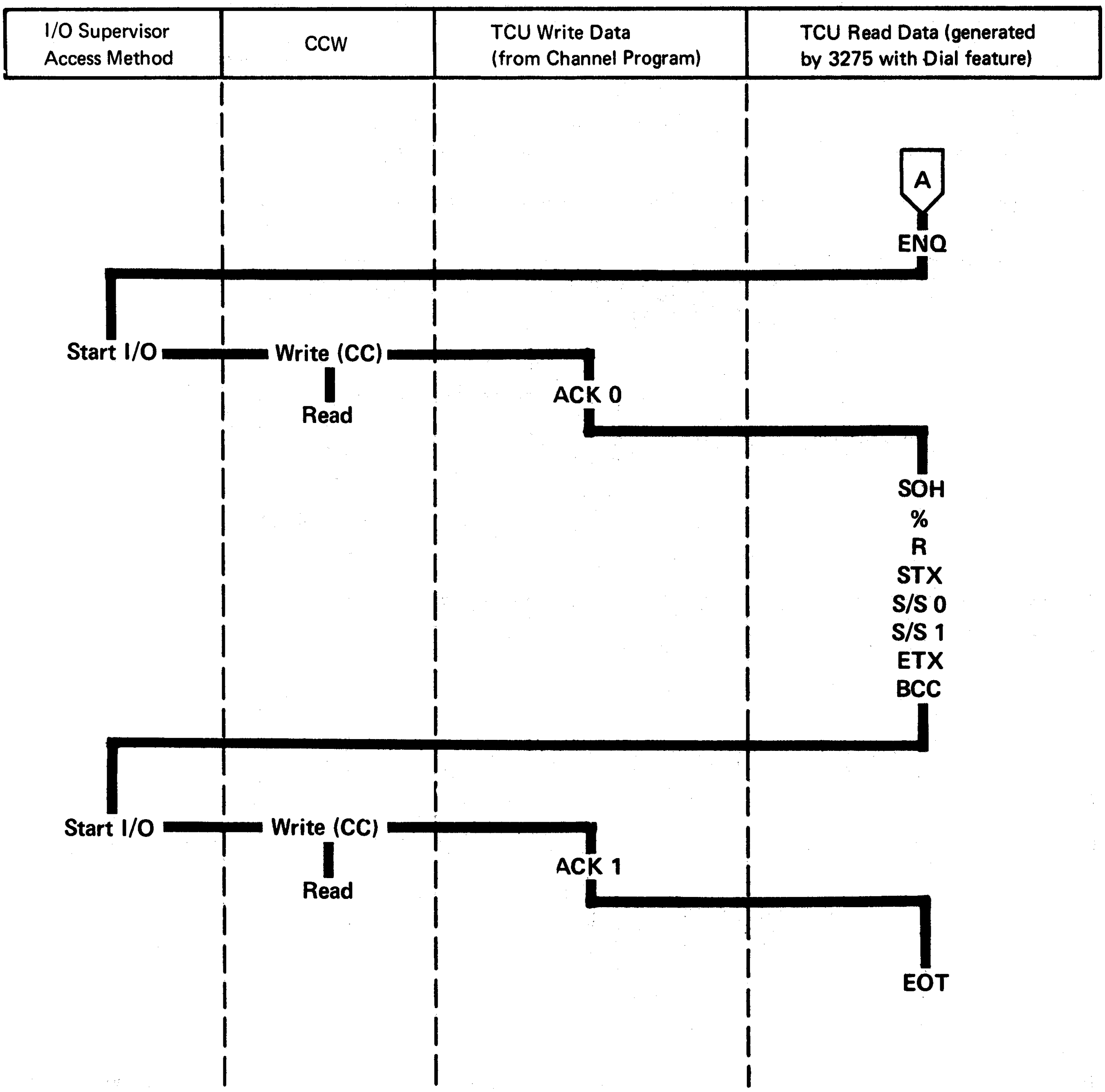
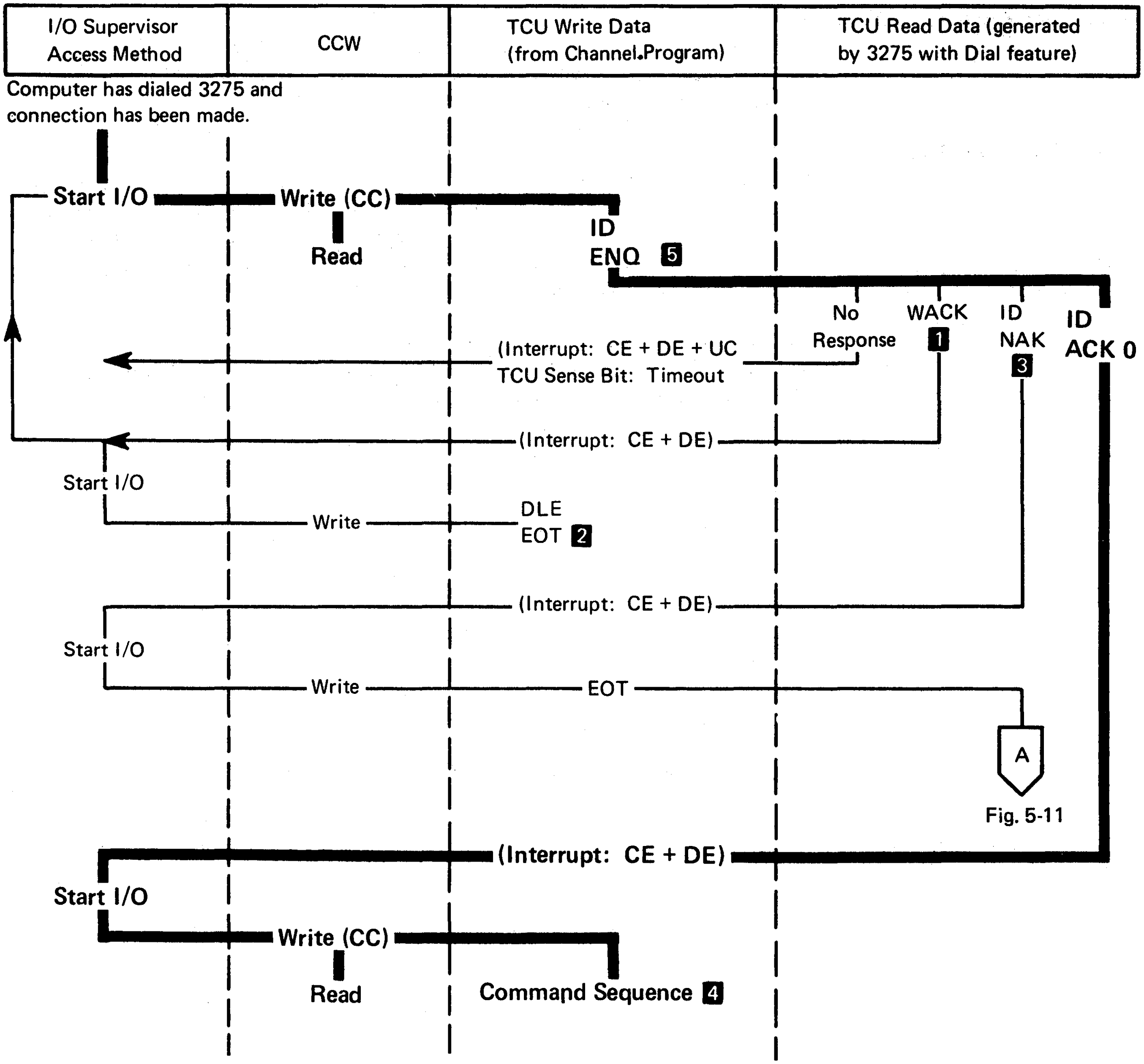

I/O Supervisor Access Method
CCW
TCU Write Data (from Channel Program)
TCU Read Data (generated by 3275 with Dial feature)
A
ENQ
Start I/O
Write (CC)
Read
ACK 0
SOH
%
R
STX
S/S 0
S/S 1
ETX
BCC
Start I/O
Write (CC)
Read
ACK 1
EOT

Figure 5-11 Status Message Transmission with Dial Feature, Sequence/Response Diagram



Notes:

1 The 3275 is not ready to receive, because of a printer, keyboard, or card reader operation.

2 The TCU should transmit DLE EOT before disconnecting. The 3275 with the Auto Answer feature will recognize DLE EOT and automatically disconnect.

3 The 3275 has status pending other than a busy printer and is not ready to receive. The 3275 monitors for EOT and prepares transmission of a status message.

4 Refer to Figure 5-5 or 5-6 for the desired command sequence.

5 Not decoded or used by the 3275.

LEGEND:

1 Reversed numbers refer to notes.

Figure 5-12. TCU-Initiated Transmission, Sequence/Response Diagram

Maintained Connection Sequences

Once either station has signaled EOT, either station can bid for the line with ENQ without further use of a computer ID or terminal ID. The response to the bid need not be preceded by the ID either. See Figure 5-13 for an example.

Device Busy and Device End

It is possible for a TCU line bid to find the terminal busy because of a printer, keyboard, or operator identification card reader operation. To an initial bid for the line, the busy 3275 responds WACK. The TCU might then either respond with a disconnection sequence DLE EOT or enter an ENQ/WACK loop, waiting for the busy-causing operation to end as indicated by a terminal ID-ACK response.

To a TCU line bid during a maintained connection, the busy 3275 also sends WACK. In this case, the program has a third choice of responding with just EOT. With EOT, the 3275 bids for the line and sends the device end status when the busy-causing operation ends.

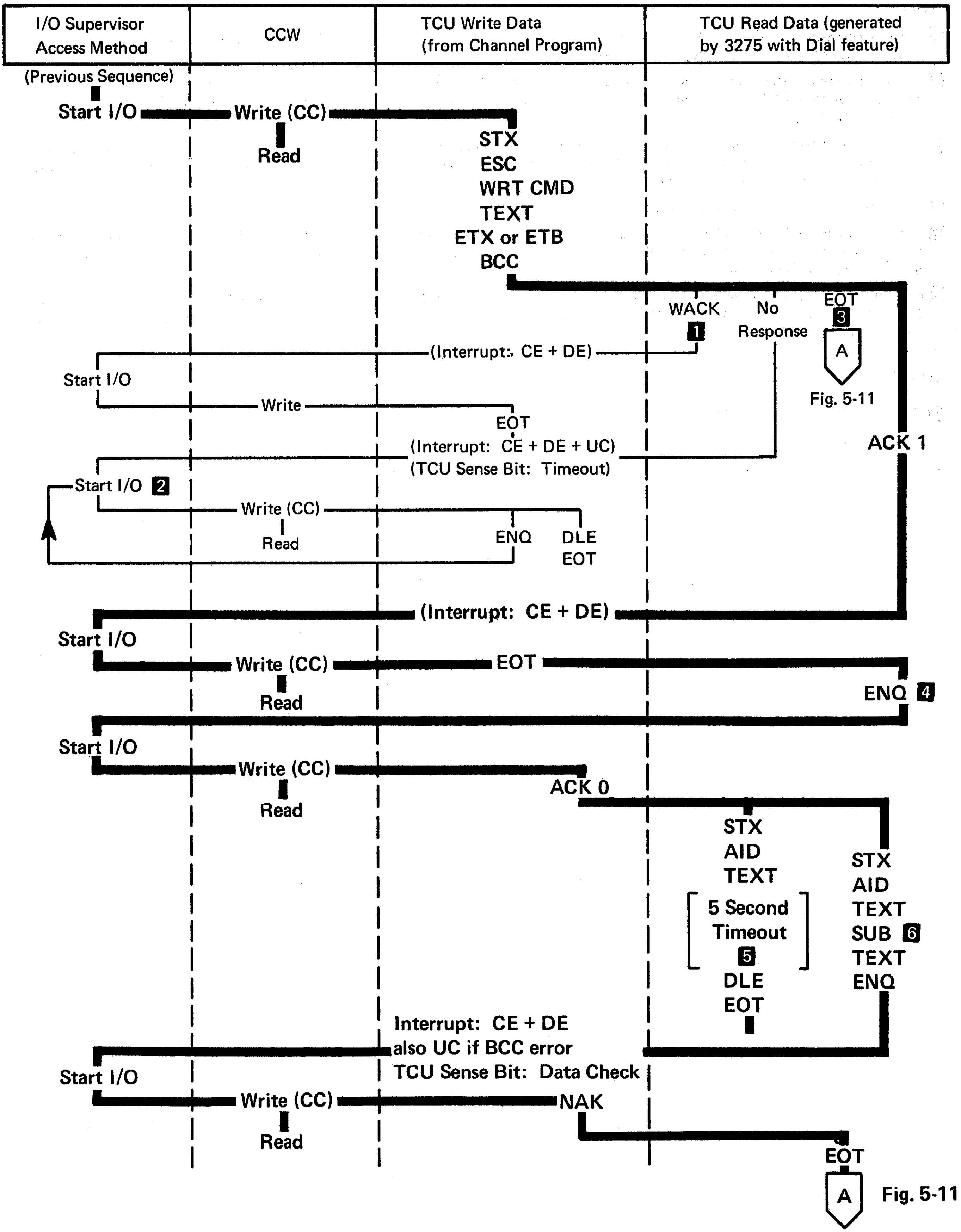


Figure 5-13 (Part 1 of 2). Example of Maintained Connection, Sequence/Response Diagram

Notes:

1 Positive acknowledgment, when the printer bit has been set in the Write Control Character (WCC) included with the Write command issued to a 3275 with attached printer. The printer is now busy.

2 The 3275 as the master station solicits a response by sending ENQ. After three retries, the 3275 that is equipped with the Auto Answer feature sends DLE EOT and disconnects automatically. The 3275 that is not so equipped sends DLE EOT. The operator should then manually disconnect.

3 The 3275 aborts because it is unable to receive or to execute the command. This condition causes status to be set and the transmission of a status message to be prepared. This situation could have been caused as the result of a command in a chain following a start-print operation or as the result of a BCC error.

4 The connection is still maintained. The 3275 has prepared another text message and bids for the line.

5 Here, it is assumed that the 3275 cannot complete transmission, because of a malfunction other than an internal parity check. A 5-second transmission timeout becomes effective, the uncompleted text transmission is terminated by DLE EOT, and, with auto answer installed. the telephone is automatically hung up.

6 Here, it is assumed that an internal parity error has been detected and the SUB character has been substituted for the character in error. The text block is terminated by ENQ. The mandatory response is NAK. In this situation, the 3275 is preparing for the transmission of a status message.

LEGEND:

1 Reversed numbers refer to notes.

Figure 5-13 (Part 2 of 2). Example of Maintained Connection, Sequence/Response Diagram

Chapter 6. Remote Operations – SDLC (3271 and 3275 Models 11 and 12)

Introduction

The 3271 Control Unit Models 11 and 12 and the 3275 Display Station Models 11 and 12 use synchronous data link control (SDLC) mode of operation and communicate, as terminal nodes, with the program via an IBM 3704 or 3705 Communications Controller and appropriate modems.

Note: *In the following paragraphs, the term* 3270 CU *is used in statements that apply to both a 3271 and a 3275. If a statement applies to only one 3270 unit, the appropriate unit number is used. The term* controller *is used in statements that apply to the 3704 and 3705 Communications Controllers.*

The 3270 CU that uses SDLC procedures provides half-duplex transmission over duplex or half-duplex facilities (nonswitched or privately owned). These communications use the multipoint data link mode of operation only.

When employing SDLC line discipline, the 3270 CU operates in extended binary-coded decimal interchange code (EBCDIC) or American National Standard Code for Information Interchange (ASCII) and performs as a PU type 1 unit.

Related Publications

The line discipline for management of information transfer between the controller and the 3270 CU, SDLC is one of several logical elements that the total communication system network comprises. The remainder of that network consists of the controller and the host System/370. The operation of the total communication system network is governed by an overall group of procedures and protocols, referred to as Systems Network Architecture (SNA).

This chapter makes use of SDLC terms and a limited number of SNA terms. Only a few SDLC terms are defined herein. Readers who are unfamiliar with SDLC concepts and terminology should review the *IBM Synchronous Data Link Control General Information* manual, GA27-3093. Readers who require an understanding of SNA should refer to the *IBM Systems Network Architecture General Information* manual, GA27-3102. A functional description of the controllers is given in the *Introduction to the IBM 3704 and 3705 Communications Controller,* GA27-3051.

An aid to programming the 3270 in this discipline can be found in *Introduction to Programming the 3270 Information Display System*, GC27-6999.

Multipoint (Nonswitched Line) Data Link Control

Each 3270 CU can operate on a nonswitched communication line with multiple stations. Time-sharing of the line is accomplished by interleaving transmissions between the controller and all units on the line. A 3271 Model 11 or 12 or 3275 Model 11 or 12 operates multidropped on the same line with properly featured units, such as other 3270 units employing SDLC, IBM 3601 Finance Communication Controllers, and IBM 3791 Controllers.

The controller is called the *primary* station of the multipoint network and controls operation of the communication link. All units attached by communication line to the controller are called *secondary* stations. The primary station is the focal point of the network and maintains, under program control, an orderly flow of network traffic by initiating all data transfers. The primary station is either the transmitter or the receiver of every communication. Secondary stations receive primary station controls and information and, as a result, initiate transmissions (responses and information) depending upon the specific command.

SDLC Transmission Blocks

SDLC transmission blocks are called *frames*. Frames, as defined for 3270 application, consist of a series of 8-bit, binary-coded bytes containing data and control information transmitted between the controller and the 3270 CU. Frames are subdivided into the following types of information, transmitted in the sequence listed:

1. Flag (F) sequence – 1 byte
2. Control unit address (A) – 1 byte
3. Control (C) field – 1 byte
4. Information (I) field – up to 256 bytes of message data preceded by header information
5. Frame check sequence (FCS) – 2 bytes
6. Flag (F) sequence – 1 byte

When sending information to the host system, these units operate in modulo-3 mode – that is, up to two frames at a time. When receiving information from the host system, they operate in modulo-8 mode. Note that the information in any particular transmission must be associated with only one device.

An information field is required within the frame only when message data is to be transmitted. The descriptions of the components of the SDLC frame, as given in *IBM Synchronous Data Link Control General Information*, GA27-3093, are applicable to the 3270 system, with the following qualifications:

- The 3270 system makes use of the Receive Ready (RR) and Receive Not Ready (RNR) supervisory commands and responses only. RR and RNR responses are always sent by the 3270 CU with the final bit set to 1.

  The C-field byte formats for RR and RNR are as follows:

RR	N_r	P/F	0 0	0 1
	012	3	4 5	6 7
RNR	N_r	P/F	0 1	0 1
	012	3	4 5	6 7

- The nonsequenced commands and responses employed by the 3270 system are limited to the following:

Command/Response	C-Field	Hex Code	
Set Normal Response Mode (SNRM) command	1 0 0 P 0 0 1 1 0 1 2 3 4 5 6 7	93	*
Disconnect (DISC) command	0 1 0 P 0 0 1 1 0 1 2 3 4 5 6 7	53	
Unnumbered Acknowledgment (UA) response	0 1 1 F 0 0 1 1 0 1 2 3 4 5 6 7	73	
Disconnect Mode (DM)	0 0 0 F 1 1 1 1 0 1 2 3 4 5 6 7	1F	
Frame Reject (FRMR) response	1 0 0 F 0 1 1 1 0 1 2 3 4 5 6 7	97	
Link Test	1 1 1 P/F0 0 1 1 0 1 2 3 4 5 6 7	F3	**

*Described in the *IBM Synchronous Data Link Control, General Information* manual, Form No. GA27-3093.

**Described in this section.

Link Test Command/Response

The Link Test command/response is a basic test of the data link between the controller and the 3270 CU. When the controller sends the Link Test command, the 3270 CU checks that the FCS field is valid and that the C-field poll bit is set to 1. Data may be sent to the 3270 CU that is included in the nonsequenced frame. If the command is received correctly, the 3270 CU sends the Link Test response to the controller. Data is not sent by the 3270 CU.

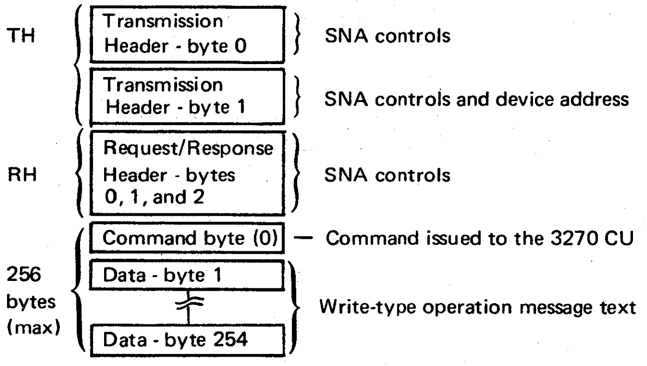
Information (I) Field

An information (I) field is required when message text is transmitted in either direction between the controller and the 3270 CU. The C-field format, which indicates that an I-field is being sent, is:

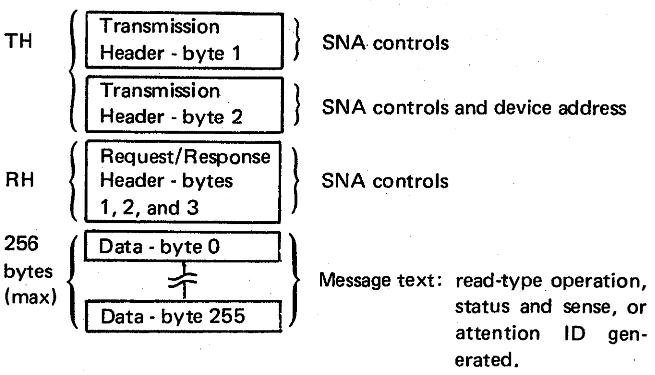
N_r	P/F	N_s	0
012	3	456	7

The I-field is transmitted as a series of 8-bit bytes in the following format:

I-field sent from the controller to the 3270 CU


TH
Transmission Header - byte 0
SNA controls
Transmission Header - byte 1
SNA controls and device address
RH
Request/Response Header - bytes 0, 1, and 2
SNA controls
Command byte (0)
— Command issued to the 3270 CU
256 bytes (max)
Data - byte 1
Data - byte 254
Write-type operation message text

I-field sent from the 3270 CU to the controller


TH
Transmission Header - byte 1
SNA controls
Transmission Header - byte 2
SNA controls and device address
RH
Request/Response Header - bytes 1, 2, and 3
SNA controls
256 bytes (max)
Data - byte 0
Data - byte 255
Message text: read-type operation, status and sense, or attention ID generated.

Transmission Header (TH)

A transmission header is always included in an I-field. The 2 bytes of the transmission header contain four SNA fields in the following format:

Byte 0				Byte 1	
Format Identifier Field (0011)	Mapping Field	Reserved	Expedited Flow Indicators	Logical Unit/ System Services Control Point	Device Address
0 1 2 3	4 5	6	7	0	1234567

SNA Controls

The SNA controls are employed by higher-level network management. A description of these controls, as implemented by the 3270 system, follows.

Bits 0, 1, 2, and 3 of byte 0 compose the format identifier (FID) field. The 3270 CU does not check these bits when they are received from the controller. When the TH is sent by the 3270 CU, FID 3 (0011) is used.

Bits 4 and 5 of byte 0 are the mapping field, which records the text segment format that is used when read or write type operations are performed. Text segments contain a maximum of 256 bytes. Bit assignments for the mapping field are as follows:

11 – Indicates a complete basic information unit (BIU); that is, the segment associated with the TH is a complete unit.

10 – Indicates that the segment associated with the TH is the first segment in the BIU.

01 – Indicates that the segment associated with the TH is the last segment in the BIU.

00 – Indicates that the segment associated with the TH is an intermediate segment within the BIU.

Bit 6 is reserved.

Bit 7 is the expedited flow indicator (EFI) and is not checked by the 3270 CU when it is received from the controller. The 3270 CU sends the EFI as 0 in all cases except when sending a clear response, in which case the EFI is sent as 1. The Clear command and response are described under the heading “Control Functions.”

Bit 0 of byte 1 is the Logical Unit/System Services Control Point (LU/SSCP) unit indicator. The 3270 CU stores this bit when it is received from the controller. When sending a response to the controller in reply to a request, the 3270 CU returns this bit as it was received. When an attention AID is generated, except when caused by a test request unit, the 3270 CU sets this bit to 1, indicating LU. A test request unit causes this bit to be set to 0, indicating SSCP.

The device address is contained in bits 1 through 7 of byte 1. When received by the 3270 CU, the device address is decoded as the destination address for which the transmission is intended. When transmitted by the 3270 CU, the address indicates the device that initiated the transmission. Bit 1 is always set to 1, and bit 2 is always a 0. Up to 32 addresses, designated 0 through 31, are available for attachment of display station or printers to a 3271 control unit (Figure 6-1). Device address 0 is used when communicating with a 3275 display station.

Request/Response Header (RH)

The request/response header contains 24 bits of SNA control information used by higher-level network controls to route and sequence transmissions and to indicate to the 3270 CU the form of response required. The RH and the message text contained in the text segment provide the basic exchange unit of control and data across the data link, called the *basic information unit* (BIU).

Each I-field may contain up to 256 bytes of message data. When the text of message exceeds 256 bytes, the message is segmented into a series of I-formatted frames. The first and all intermediate frames within the segmented group contain 256 bytes of message text. The last frame contains the remainder of the text being transmitted, up to 256 bytes. A request/response header is required when the message contains one I-frame (up to 256 bytes of message text) or within the initial I-frame of a segmented message.

The request/response header consists of 3 bytes with the following format:

Byte 0	R/R	RU Category		0	Format Indicator	Sense Data Included Indicator	1	1
	0	1	2	3	4	5	6	7
Byte 1	DR	0	0	EX	0	0	0	P
	0	1	2	3	4	5	6	7
Byte 2	BB	EB	0	0	Code Selection Indicator	0	0	0
	0	1	2	3	4	5	6	7

R/R = Request/Response
RU = Request/Response Unit
DR = Definite Response 1
EX = Exception Response
P = Pacing
BB = Begin Brackets
EB = End Brackets

Column 1
Use this column for:
- Device Selection
- Specific Poll
- General Poll
- Fixed Return Addresses

CU or Device Number	EBCDIC I/O Char.	EBCDIC (Hex) (Note 1)	ASCII I/O Char.	ASCII (Hex)
0	SP (Note 2)	40	SP	20
1	A	C1	A	41
2	B	C2	B	42
3	C	C3	C	43
4	D	C4	D	44
5	E	C5	E	45
6	F	C6	F	46
7	G	C7	G	47
8	H	C8	H	48
9	I	C9	I	49
10	¢	4A	[	5B
11	.	4B	.	2E
12	<	4C	<	3C
13	(	4D	(	28
14	+	4E	+	2B
15	| or !	4F	!	21
16	&	50	&	26
17	J	D1	J	4A
18	K	D2	K	4B
19	L	D3	L	4C
20	M	D4	M	4D
21	N	D5	N	4E
22	O	D6	O	4F
23	P	D7	P	50
24	Q	D8	Q	51
25	R	D9	R	52
26	!	5A	]	5D
27	$	5B	$	24
28	*	5C	*	2A
29	)	5D	)	29
30	;	5E	;	3B
31	¬ or ∧	5F	∧	5E

Column 2
Use this column for:
- 3270 CU Selection Addresses
- Test Requests

CU Number	EBCDIC I/O Char.	EBCDIC (Hex) (Note 1)	ASCII I/O Char.	ASCII (Hex)
0	-	60	-	2D
1	/	61	/	2F
2	S	E2	S	53
3	T	E3	T	54
4	U	E4	U	55
5	V	E5	V	56
6	W	E6	W	57
7	X	E7	X	58
8	Y	E8	Y	59
9	Z	E9	Z	5A
10	¦	6A	|	7C
11	,	6B	,	2C
12	%	6C	%	25
13	—	6D	—	5F
14	>	6E	>	3E
15	?	6F	?	3F
16	0	F0	0	30
17	1	F1	1	31
18	2	F2	2	32
19	3	F3	3	33
20	4	F4	4	34
21	5	F5	5	35
22	6	F6	6	36
23	7	F7	7	37
24	8	F8	8	38
25	9	F9	9	39
26	:	7A	:	3A
27	#	7B	#	23
28	@	7C	@	40
29	'	7D	'	27
30	=	7E	=	3D
31	"(Note 3)	7F	"	22

Examples:

3271 Addressing		EBCDIC	ASCII	3275 Addressing		EBCDIC	ASCII
General Poll CU5	CU Address	C5 C5	45 45	General Poll CU5	CU Address	C5 C5	45 45
	Device Address	7F 7F	22 22		Device Address	7F 7F	22 22
Specific Poll Device 4 on CU5	CU Address	C5 C5	45 45	Specific Poll CU5	CU Address	C5 C5	45 45
	Device Address	C4 C4	44 44		Device Address	40 40	20 20
Select Device 4 on CU5	CU Address	E5 E5	56 56	Select CU5	CU Address	E5 E5	56 56
	Device Address	C4 C4	44 44		Device Address	40 40	20 20

Notes:

1. *Graphic characters for the United States I/O interface codes are shown. Graphic characters for EBCDIC 4A, 5A, 5B, 7B, 7C, and 7F might differ for particular World Trade I/O interface codes. Refer to* IBM 3270 Information Display System: Character Set Reference, *GA27-2837, for possible graphic differences when these codes are used.*
2. *I/O character address (SP) is always used as the device address to select a 3275.*
3. *I/O character address (") is used as the device address to specify a General Poll operation.*

Figure 6-1. Remote Control Unit and Device Addressing – SDLC

Higher-level network controls determine the implementation and bit assignments within the RH. The response-indicating bits are definite response 1 (DR), exception response (EX), and pacing (P). Following are a detailed description of the response-indicating bits and a general description of the remaining RH bits.

The 3270 CU responds to combinations of response-indicating bits, specified in the RH received from the controller. The response generated by the 3270 CU consists of a frame containing the appropriate RH response bit(s) set to 1. (This is explained under the heading "3270 CU Responses.") Receipt of an RH by the 3270 CU with the DR bit set to 1 (byte 1, bit 0) indicates to the 3270 CU that a response must be sent when the specified command operation in the 3270 CU has been completed. An exception response (EX) is requested when RH bit 3 of byte 1 and the DR bit are set to 1. The 3270 CU generates an EX response if an error condition (other than an SDLC error) is detected during execution of a command. Error conditions are reported by the 3270 CU in the form of sense bytes contained within an I-field. If no error occurs, no response for the DR bit is sent. Pacing (P) is a response that allows the 3270 CU to indicate to the controller when message data can be sent for a device. The pacing response is returned when the requested operation is completed at the device.

The functions of the remaining 21 bits contained in the RH are summarized as follows:

Bit 0 of byte 0 is the request/response (RR) bit. The 3270 CU does not check the RR bit when it is received from the controller. It sends the RR bit to the controller as a 0 to indicate a request. This occurs when message text is sent as part of a read-type command or read-by-poll operation, or when asynchronous status or sense information is transmitted. The 3270 CU sends the RR bit as a 1 to indicate a response in reply to a definite or exception response (with or without pacing) requested by the controller.

Bits 1 and 2 of byte 0 are the request/response unit (RU Category) bits. They are stored, but not checked, by the 3270 CU when they are received from the controller. These bits are set, depending upon the contents of the RU, as follows:

RU	RU Category
Function Management (FM) Data	00
Network Control	01
Data Flow Control	10
Session Control	11

The 3270 CU sends FM data, except when sending a Clear or Pseudo Bid response, in which case bits 1 and 2 are sent in the same form in which they are received from the controller.

Bit 3 of byte 0 (always 0) is not used by the 3270 CU.

Bit 4 of byte 0 is the format indicator. The 3270 CU stores, but does not check, this bit when it is received from the controller. When the 3270 CU generates a request, the format indicator bit is sent as a 0; when sending a response, the 3270 CU sends this bit as it was received from the controller.

Bit 5 of byte 0 is the sense-data-included indicator. The 3270 CU does not check this bit when it is received from the controller. The 3270 CU sends this bit as a 1 when sense data is transmitted and as a 0 when sense information is not sent to the controller.

Bits 6 and 7 of byte 0 (always 1) are not used by the 3270 CU.

Bits 1, 2, 4, 5, and 6 of byte 1 (always 0) are not used by the 3270 CU.

Bit 0 of byte 2 is the begin bracket (BB) bit and is used by the 3270 CU in conjunction with the Pseudo Bid command (described under "Control Functions"). Receipt of the BB bit set decrements the poll counter in the 3270 CU.

Bit 1 (end brackets), and bits 2, 3, 5, 6, and 7 of byte 2 are always 0 and not used by the 3270 CU.

Bit 4 of byte 2 is the code selection indicator. This bit identifies the transmission code as EBCDIC (0), or ASCII (1).

Command Byte

The command contained in the command byte is sent after the RH by the controller for execution by the 3275 or by a device attached to the 3271. A list of command codes and a description of 3270 command operations appear in Chapter 3. Order codes, when employed, are transmitted within the message text following a Write or Erase/Write command.

The following conditions must be met to allow command execution:

- The frame must have a valid FCS character.
- The I-field must be the initial I-field of a segmented message or must contain the entire text of the message.
- The addressed device must be in a ready state (not busy).

3270 CU Responses

The 3270 CU responds to combinations of DR, EX, and P bit settings received from the controller in byte 1 of the RH. Valid request and response formats are listed in Figure 6-2.

Definite Response with Pacing

1. *Write and Erase/Write Commands for Display Stations and Printer.* When a write-type operation is successfully completed, the 3270 CU responds with a frame containing byte sequence F, A, C, TH, RH, FCS, F, with DR=1, EX=0, and P=1. Successful completion of a write operation to a printer occurs when the printout is completed. When the Write command, Start Print, and buffer data is successfully transferred from the 3271 CU to the printer, the RR response is sent to the controller. DR1 with the pacing response bit set on is sent only when printing has been completed. In the interim, the 3271 CU can process other messages to other devices. If an error is detected (other than an SDLC error) during command execution, the 3270 CU sends a response frame with DR=1, EX=1, and P=1 within the RH, and inserts a text segment containing a 4-byte sense RU to report the error condition. Sense RU format is defined under the heading "Error Responses and Error Recovery."
2. *Read Modified and Read Buffer Commands for Display Stations.* Successful completion of a read-type command occurs when the data has been sent and acknowledged at link level by the controller. The 3270 CU then replies with a frame containing DR=1, EX=0, and P=1 within the RH. If an error is detected (other than an SDLC error) while the device buffer is being obtained, the 3270 CU sends a response frame containing DR=1, EX=1, and P=1, and includes a sense RU text segment. If an error is detected during transmission of the message data to the

Response	Request format— sent by the controller:			Response format— sent in reply by the 3270 CU:			Explanation
	DR	EX	P	DR	EX	P	
Definite response with pacing	1	0	1	1	0	1	Indicates successful completion of a read or write type or Copy command by a display station; or a write type or Copy command by a printer.
				0 followed by: 1	0 0	0 1	1. Indicates that an error occurred during transmission of read data. In this case, the response may be preceded by a sense RU request containing an abort indication.
				1	1	1	2. Indicates that an error was detected while a device buffer was being obtained. **Note:** *The printer operates in definite response with pacing mode only. Therefore, when a command has been executed by a printer, the 3270 CU always responds with positive response with pacing (101 or 111), regardless of the request received.*
Exception response with pacing	1	1	1	0	0	1	Indicates successful completion of a read or write type or Copy command by a display station.
				1	1	1	1. Indicates that an error was detected while a device buffer was being obtained.
				0 followed by: 0	0 0	0 1	2. Indicates that an error occurred during transmission of read data. In this case, an exception request with an abort segment indication is transmitted before the response.
No response with pacing	0	0	1	0	0	1	Applicable to commands executed by display stations only. An error response (EX = 1) is not sent, regardless of how the operation ends. The 3270 CU transmits only an isolated pacing response.
Definite response, no pacing	1	0	0	1	0	0	Applicable to display station command operations only. The response description is the same as described above for positive response with pacing, except that the pacing bit is always set to 0.
Exception response, no pacing	1	1	0	0	0	0[1]	Applicable to display station command operations only. The response format is the same as explained above for exception response with pacing, except that the pacing bit is always set to 0.
				1	1	0	
No response, no pacing	0	0	0	0	0	0[1]	Applicable to display station command operations only. The 3270 CU does not send a response.

[1] A response format 000 indicates that no response is sent.

Figure 6-2. Request and Response Format

controller, the 3270 sends an exception request to the controller with an abort segment structure (DR1=0, EXC=0, and P=0) as described under the heading "Error Responses and Error Recovery." Following the exception request, a frame is sent containing DR=1, EX=0, and P=1. In this case, the read operation is considered completed, but unsuccessful.

3. *Copy Command for Display Stations and Printers.* When buffer data has been transferred from the *from* device to the *to* device without detection of an error, the operation is considered completed. The 3270 CU then sends a response frame with DR=1, EX=0, and P=1. If the *to* device is a printer, the response is delayed until the printout is completed. When the Copy command, Start Print, and buffer data is successfully transferred from the 3271 CU to the printer, the RR response is sent to the controller. DR1 with the pacing response bit set on is sent only when printing has been completed. In the interim, the 3271 CU can

process other messages to other devices. If an error is detected while the *from* device buffer is being obtained, the 3270 CU sends a sense RU response with DR=1, EX=1, and P=1. The address in the TH is the address of the *to* device, but the sense RU indicates that the error is in the *from* device or in the 3270 CU. If an error is detected during the transfer of data to the *to* device, the 3270 CU responds with a sense RU response with DR=1, EX=1, and P=1, with sense indicating an error condition (see Copy command).

Exception Responses with Pacing

1. *Write and Erase/Write Commands for Display Stations and Printers.* During execution of a write-type command to a printer, when the transfer of message text from the 3270 CU to the printer has been completed, the CU may begin servicing other attached devices.

   When the printer operation has been successfully completed, the form of the response requested within the RH for the printer message is no longer present in the 3270 CU. In this situation, the 3270 CU replies by sending a definite response with pacing (DR=1, EX=0, P=1).

   When the addressed device is a display station, the operation is the same as that described for Write and Erase/Write commands under "Definite Response with Pacing," except that successful command execution results in the 3270 CU's sending an isolated pacing response that is DR=0, EX=0, P=1.

2. *Read Modified and Read Buffer Commands for Display Stations.* The operation is the same as that described for Read Modified and Read Buffer commands under "Positive Response with Pacing," except that the 3270 CU sends DR=0, EX=0, P=1 when the command has been successfully completed.

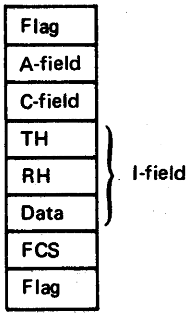
3. *Copy Command for Display Stations and Printers.* Since the printer must operate in positive response with pacing mode, the 3270 CU treats a request on Copy command operations to a printer as though positive response with pacing has been specified, regardless of the actual setting of the DR, EX, and P bits. The operation is the same as that described for the Copy command under "Definite Response with Pacing."

   When the *to* device is a display station, the operation is the same as that described under "Definite Response with Pacing," except that successful completion causes the 3270 CU to reply with an isolated pacing response, DR=0, EX=0, P=1.

Definite or Exception Responses without Pacing; No Response with or without Pacing. Definite or exception response without pacing, and no response with or without pacing, are four variations of responses based on the definite or exception response with pacing. The response formats and a description of the response operations are given in Figure 6-2.

Data Transmissions by the 3270 CU

Data transmitted by the 3270 CU can be message text, test request data, or status and sense information. Data is transmitted to the controller in the same SDLC frame format used by the controller except that a command code is not present within the text segment. The frame format is as follows:



Message Text. Message text can be transmitted following:

1. Receipt of a Read Buffer or Read Modified command with a poll bit set to 1 in the C-field, or when an RR command with the poll bit set to 1 is received after the frame containing the read-type command.
2. Receipt of an RR command with the poll bit set to 1 when an attention key is pressed (except the TEST REQ key).

The address contained in the TH is the address of the device that received the read-type command or the address of the device that had an attention key pressed when an RR command was received.

When more than 256 bytes of message text are transmitted, the data stream is segmented into 256-byte segments [as described previously for data transmissions to the 3270 CU under the heading "Request/Response Header (RH)"].

Test Request Messages. Test request messages can be entered from a display station keyboard when the operator has pressed the TEST REQ key and a Read Modified command is issued to the device. For a description of the test request operation, refer to the heading "Test Request Read" in Chapter 3.

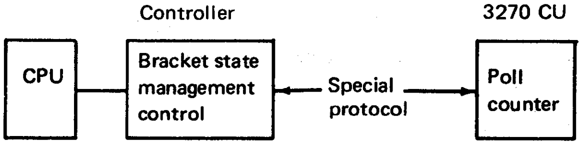
Control Functions

The Clear and Pseudo Bid control functions take the form of control commands issued by the controller in information format. The 3270 CU sends a Clear response when replying to the Clear command.

Clear Command/Response. The controller sends the Clear command to cancel pending DR and (or) pacing responses from the 3270 CU. The Clear command format consists of a 1-byte RU (hex A1), with the DR request bit set in the RH. The 3270 CU replies with a response frame in the same format received from the controller.

Pseudo Bid Command. The controller sends the Pseudo Bid command to cause the 3270 CU to do a Specific Poll to a specific device and, if no attention ID is pending, to execute a write-type command at the selected device. The Pseudo Bid command is sent in information format as 1 byte of data (hex F8). If an attention ID is not present at the addressed display station or printer and a request was sent by the controller, the 3270 CU replies with a response frame. The controller then sends an information frame containing a write-type command and the BB bit set in the RH. The operation then proceeds as a write-type command. Bracket protocol for the application program and the terminal operator is given in *Introduction to Programming the IBM 3270 Information Display System,* GC27-6999.

Generally, the bracket state management function resides within the SNA CU. In the 3270 system employing SNA, however, the controller provides bracket state management control for the 3270 CU. As a result, the controller controls the operation of the poll counter in the 3270 CU and generates the Pseudo Bid command.



The poll counter is used for bracket state management. A successful Pseudo Bid command operation at the 3270 CU (that is, no attention ID pending) increments the poll counter. Receipt of the BB bit set, with no attention ID pending, decrements the poll counter. The poll counter must be equal to zero to allow the 3270 CU to present attention-generated information to the controller. When the poll counter is not equal to zero, communication with the devices is inhibited.

SDLC Sequence/Response Diagrams

Figures 6-3, 6-4, and 6-5 are sequence/response diagrams showing, respectively, online/offline procedures, read-type commands, and write-type command operations. Only the portions of the SDLC frames essential to the operation are shown. The descriptive text in each diagram summarizes the flow of information between the controller and the 3270 CU.

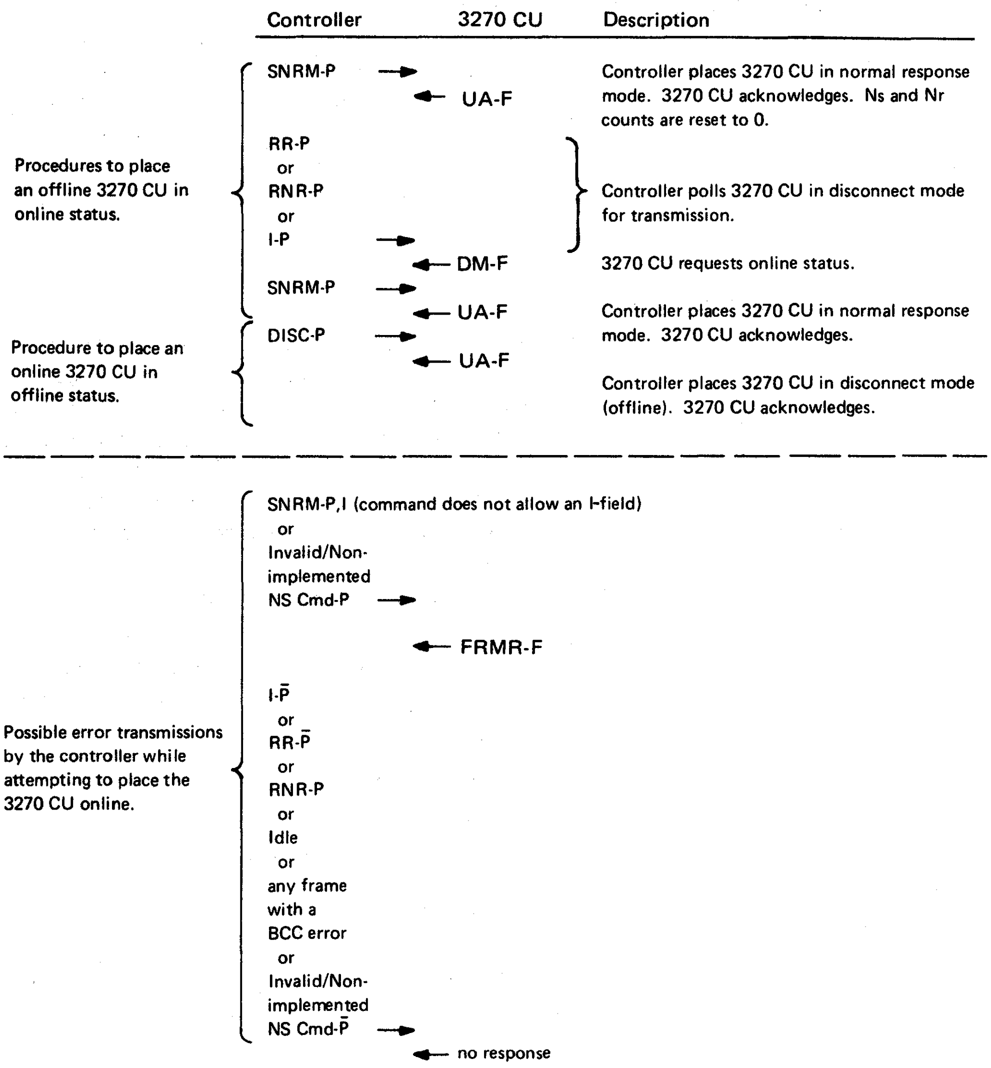
Status and Sense (S/S) Bytes

The 3270 CU records SNA and device status and sense (S/S) conditions for each attached device. All remote status and sense conditons are contained in 4 bytes, which are sent to the controller as an exception request or an exception response. Bytes 0 and 1 contain SNA S/S information, and bytes 2 and 3 contain device S/S information in the same format used for remotely attached BSC devices. An exception request or an exception response is returned to the controller when the 3270 CU has status pending and receives an RR command or I-formatted frame with the poll bit set to 1.

The status and sense message contains 9 bytes in the I-field in the following sequence:

TH – byte 0	Address of the device for which the transmission is intended, or the address of the device which originated the transmission
TH – byte 1	
RH – 3 bytes	
S/S – byte 0	SNA status/sense
S/S – byte 1	
S/S – byte 2	device status/sense
S/S – byte 3	

Figure 6-6 defines each S/S bit. Figure 6-7 shows how these status and sense conditions are interpreted for each error response or request transmitted by the 3270 CU.



Controller | 3270 CU | Description

Procedures to place an offline 3270 CU in online status.

SNRM-P →
← UA-F
Controller places 3270 CU in normal response mode. 3270 CU acknowledges. Ns and Nr counts are reset to 0.

RR-P
or
RNR-P
or
I-P →
Controller polls 3270 CU in disconnect mode for transmission.

← DM-F
3270 CU requests online status.

SNRM-P →
← UA-F
Controller places 3270 CU in normal response mode. 3270 CU acknowledges.

Procedure to place an online 3270 CU in offline status.

DISC-P →
← UA-F
Controller places 3270 CU in disconnect mode (offline). 3270 CU acknowledges.

Possible error transmissions by the controller while attempting to place the 3270 CU online.

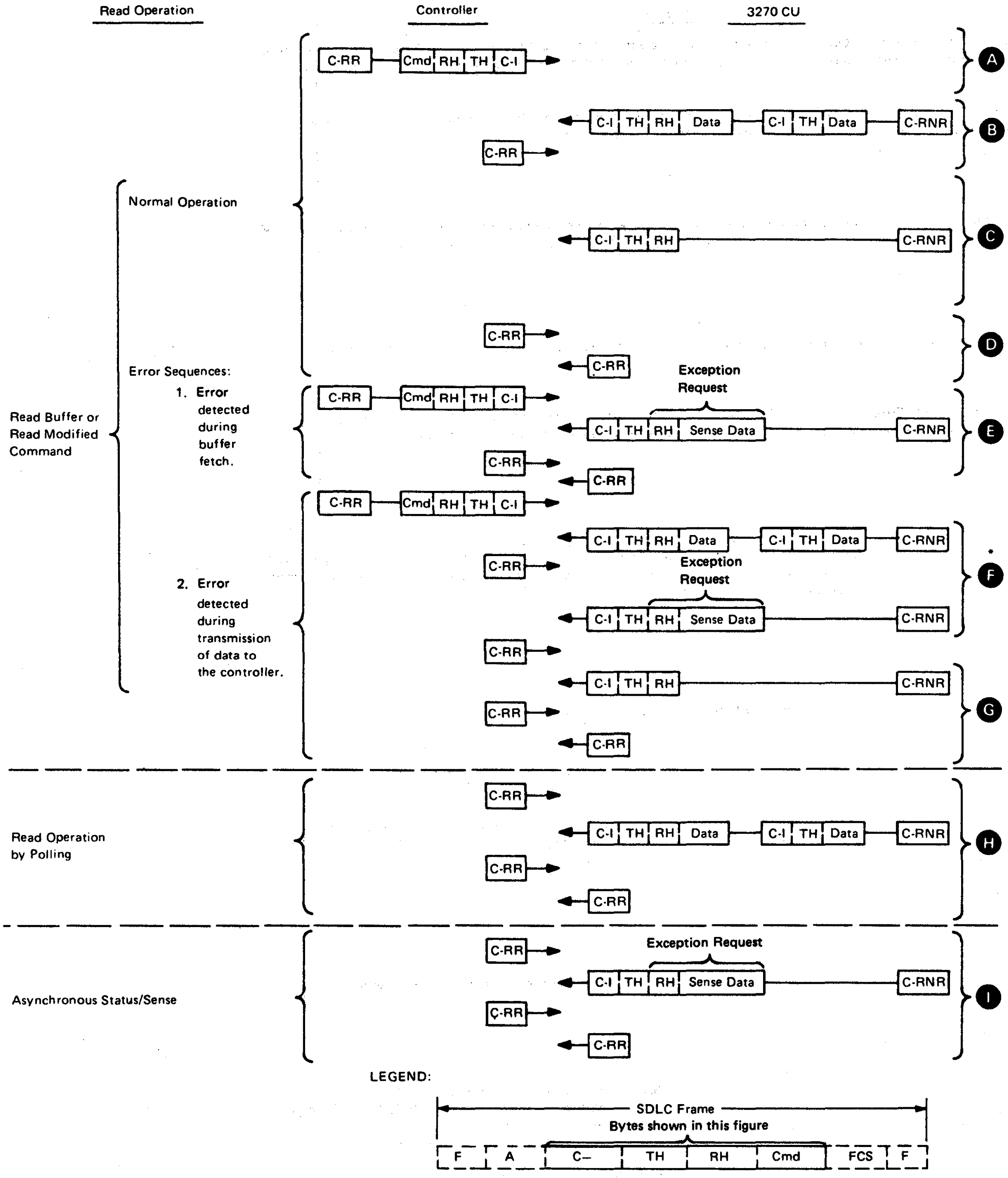
SNRM-P,I (command does not allow an I-field)
or
Invalid/Non-implemented NS Cmd-P →
← FRMR-F

I-$\bar{P}$
or
RR-$\bar{P}$
or
RNR-P
or
Idle
or
any frame with a BCC error
or
Invalid/Non-implemented NS Cmd-$\bar{P}$ →
← no response

Note: *Only SDLC bytes that are significant for the sequence being illustrated are shown in this figure.*

P/F=poll/final bit
I = information frame
dash (—) above a letter = not set to 1.

Figure 6-3. Online and Offline Procedures, Sequence/Response Diagram



Repetitive bytes: initial and ending F, A, and FCS bytes are omitted from this figure.

*Error occurred on this segment.

Figure 6-4 (Part 1 of 2). Read-Type Command, Sequence/Response Diagram – SDLC

Description

A Controller sends Read type command. Controller may send one I-frame with p=1, or send I-frame with p=0, followed by RR command frame with p=1. TH contains device address. If a response is required by the 3270 CU, the controller requests a response format in the RH.

B 3270 CU sends two I-frames of data followed by RNR with f=1. Controller acknowledges with RR command. Cycle is repeated until all I-frames have been sent. RH bytes are contained only in the first I-frame sent.

C If a 3270 CU RH response had been specified by the controller, an I-frame containing the response format is sent, unless an Exception response has been requested and no errors have occurred. In this case, the I-frame C-I | TH | RH is not needed and the 3270 CU sends RR only.

D Controller and CU RR exchange to complete the read operation. RR is sent by the 3270 CU only at the completion of a command.

E Read type command initiated. Error detected while fetching device buffer. If a response was requested by the controller in the RH of the I-frame containing the command, the 3270 CU responds with error response in the RH and 4 bytes of sense data.

F Data check sensed by CU for second I-frame. If a response was requested by the controller in the RH of the I-frame containing the read command, the 3270 CU transmits a frame containing the error, followed by an exception request frame; if no error occurs, the exception request is not sent, and read command is completed as in normal operation.

G If a 3270 CU response had been requested, an I-frame is sent containing an error response.

H This condition is caused by an Attention ID. When the controller polls, I-frames are transmitted and acknowledged in groups of two frames, as in the read-by-command operation. Error sequences and termination of read are the same as shown for read by command. Read by poll does not require 3270 CU responses.

I An exception request is returned to the controller when the 3270 CU is polled and has status pending, and a read, write, or print operation is not in process.

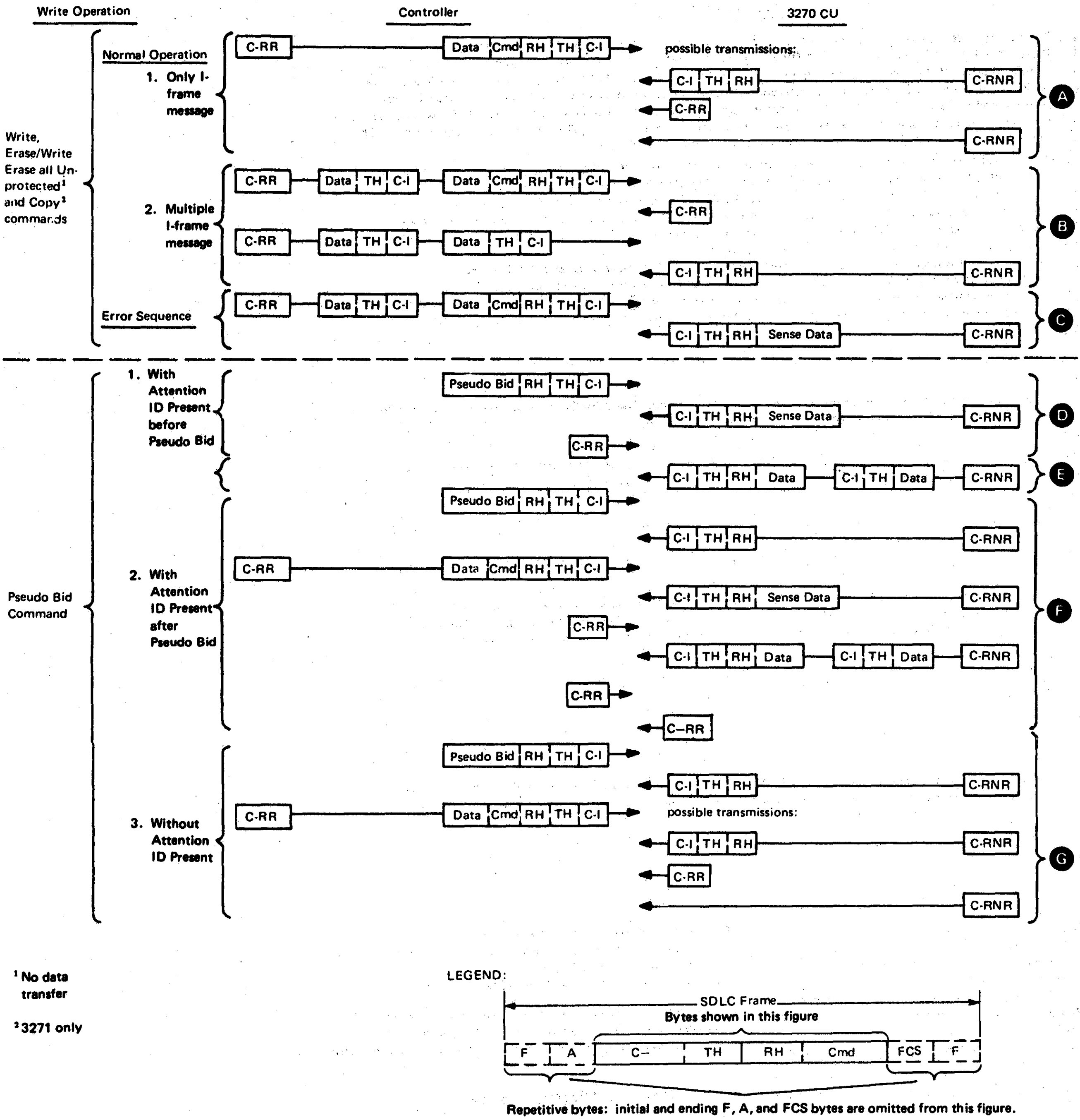
LEGEND: (continued)

F, 8-bit flag (01111110) sequence
A, 8-bit CU address field
C, 8-bit control field; specifies transmission format:
C-I (Information field)
C-RR/RNR (Supervisory Commands and Responses)
C-SNRM/DISC/UA/DM/FRMR (nonsequenced format)
FCS, 16-bit frame check sequence
TH, 16-bit transmission header; includes device address

RH, 24-bit request/response header; specifies definite response (DR), exception (EX), and pacing (P) request and response formats.
P/F bit, poll/final bit contained in the C-field

Note: *A number of DR, EX, and P request/response formats are available. For a description of the request/response formats applicable to each command, refer to the heading* "3270 CU Responses."

Figure 6-4 (Part 2 of 2). Read-Type Command, Sequence/Response Diagram – SDLC


Write Operation
Controller
3270 CU
Write, Erase/Write Erase all Unprotected¹ and Copy² commands
Normal Operation
1. Only I-frame message
C-RR
Data
Cmd
RH
TH
C-I
possible transmissions:
C-RNR
A
2. Multiple I-frame message
B
Error Sequence
Sense Data
C
Pseudo Bid Command
1. With Attention ID Present before Pseudo Bid
Pseudo Bid
D
E
2. With Attention ID Present after Pseudo Bid
F
C–RR
3. Without Attention ID Present
G
LEGEND:
SDLC Frame
Bytes shown in this figure
F
A
C–
TH
RH
Cmd
FCS
F
Repetitive bytes: initial and ending F, A, and FCS bytes are omitted from this figure.

[1] No data transfer

[2] 3271 only

Figure 6-5 (Part 1 of 2). Write-Type Command, Sequence/Response Diagram – SDLC

Description

A The controller sends a request consisting of a write-type command containing one I-frame of message data. If the poll bit is not = 1 in the I-frame, a frame with RR and the poll bit set to 1 is sent. The 3270 CU can send one of three possible replies: If the controller requests a response in the RH, the 3270 CU sends the response frame followed by RNR, unless an exception response had been requested and no errors had occurred. In this case, the frame is not required and RR is sent. If the 3270 CU cannot perform the operation indicated within 75 ms, RNR is sent to the controller. When the controller does not request a response from the 3270 CU, RR is returned to the controller. The final bit is set to 1 in all 3270 CU transmissions, except I-frame transmissions.

B The controller sends a write-type command containing a series of I-frames. If the poll bit is not = 1 in the last data frame sent, a frame with RR and the poll bit = 1 is sent. The controller may send a partial transmission of data or the entire message. If a partial transmission occurs, the 3270 CU acknowledges with RR, and the controller then sends additional I-frames. The cycle is repeated until the controller has sent the last I-frame. If the controller had requested a response, the 3270 CU sends the response frame followed by RNR, unless an exception response was requested and no errors occurred. In this case, only RR is sent.
Note: ***As in the example above, of a one I-frame message, the 3270 CU can reply with RNR if it cannot respond within 75 ms., or RR as the last transmission if a request was not sent by the controller.***

C A write type command is initiated. If a response was requested by the controller, and an error was detected during command execution, an exception response is sent by the 3270 CU after transmission of data from the controller is completed.

D The controller sends an I-frame containing the Pseudo Bid command. The 3270 CU, with an attention ID pending, replies with an exception response (Bracket Bid Reject).

E The 3270 CU sends read data in groups of two frames. If an error is detected, an exception response is sent to the controller, as shown in Figure 6-4, Read-Type Command, Sequence Response Diagram.

F The controller sends an I-frame containing the Pseudo Bid command. Because an attention ID is pending (Bracket Bid Reject) if a response had been requested, other than an exception response, a response frame is sent to the controller followed by RNR. Subsequently, the data that caused the attention is sent to the controller.

G The controller sends an I-frame containing a write type command with the BB bit set in the RH. The normal write type command operation takes place, as shown above in this diagram.

LEGEND: (continued)

F, 8-bit flag (01111110) sequence.
A, 8-bit CU address field.
C, 8-bit control field; specifies transmission format:
C-I (Information field)
C-RR/RNR (Supervisory Commands and Responses)
C-SNRM/DISC/UA/DM/FRMR (nonsequenced format)
FCS, 16-bit frame check sequence
TH, 16-bit transmission header; includes device address

RH, 24-bit request/response header; specifies definite response (DR), exception (EX), and pacing (P) request and response formats.
P/F bit, poll/final bit contained in the C field

Note: *A number of DR, EX, and P request/response formats are available. For a description of the request/response formats applicable to each command, refer to the heading* "3270 CU Responses."

Figure 6-5 (Part 2 of 2). Write-Type Command, Sequence/Response Diagram – SDLC

Bit No.	Bit Definition
S/S Byte 0:	
0	*Path Error* —For the 3271, this bit is set if the device address received (bits 1 through 7 of TH byte 1) is invalid, or if the device adapter card for the indicated address is not installed. For the 3275, this bit is set if the device address is not 1000000 (bits 1 through 7 of TH byte 1).
1,2	Reserved.
3	*Request Error* — This bit is set if the first byte of the RU is not recognized as a valid command or command function. Command Reject (CR), S/S byte 3, bit 2, is set when Request Error is set.
4	*Request Reject* — The bit is set if a Pseudo Bid command or begin bracket bit (set in the RH) is sent to a device that has an attention pending.
5,6,7	Reserved.
S/S Byte 1:	
0,1,2,4,5	Reserved.
3,6,7	These bits are set with *request reject* (bit 4, byte 0)
S/S Byte 2:	
0,1,2,3	Reserved.
4	*Device Busy (DB)* — This bit indicates that the addressed device is busy executing an operation. The device is busy when executing an Erase All Unprotected command, or a print operation, accepting data from the operator identification card reader, or performing various keyboard operations (ERASE INPUT, Backtab, and CLEAR).
5	*Unit Specify (US)* — This bit is set if any S/S bit is set as a result of a device-detected error.
6	*Device End (DE)* — This bit indicates that the addressed device has changed from unavailable to available and not ready to ready, or busy to not busy. When a printer goes from busy to not busy, a positive response with pacing is generated instead of DE.
7	Reserved.
S/S Byte 3:	
0,1	Reserved.
2	*Command Reject (CR)* — This bit is set upon receipt of an invalid 3270 command.
3	*Intervention Required (IR)* — This bit is set if: • A Copy command contains a *from* device address in its data stream which specifies an unavailable device.
S/S Byte 3 (cont)	
3	• A command attempted to start a printer but found it not ready. The printout is suppressed. • The 3271 receives a Pseudo Bid sequence for a device which is unavailable or which became not ready during a printout. • The 3270 CU receives a command for a device which the 3271 has logged as unavailable and not ready.
4	*Equipment Check (EC)* — This bit is set if: • A printer character generator error occurred, or the printer became mechanically disabled. • The 3270 CU detected bad parity from the device, or data transmitted in a device reply. **Note:** *The data check (DC) bit may also be set.*
5	*Data Check (DC)* — This bit indicates detection of a parity or cursor check in either the 3271 or a device buffer, or in the 3275 buffer, or that the 3271 detected bad parity from the device.
6	*Control Check (CC)* — This bit is not used for the 3275. For the 3271, this bit indicates a timeout check. A timeout check occurs when a device fails to respond to 3271 communications within a specified time period or when a device fails to complete an operation within a specified time period.
7	*Operation Check (OC)* — This bit, when set alone, indicates one of the following: • An invalid buffer address or an incomplete order sequence was received on a Write or Erase/Write command. • The device did not receive a CCC or a *from* address on a Copy command. • A Read, Read Modified, Copy, or Erase All Unprotected command was received with TH mapping field bits not equal to 11 (i.e., a complete BIU). • An I/O interface *overrun* is detected. This occurs if a data byte follows a Read Buffer, Read Modified, or Erase All Unprotected command, or if more than 2 data bytes follow a Copy command. This bit is set with Control Check, Intervention Required, Data Check, or Data Check with Unit Specify, to indicate that the errors that set these sense bits were detected while the 3270 CU was executing an operation with the *from* device during a Copy command.

Figure 6-6. Remote Status and Sense Byte Definitions–SDLC

Status/Sense Bits	Explanation	
	Response	Request
PE (Address not available)	Bits 1 through 7 of TH byte 2 are not a valid device address or the device adapter card is not installed in the 3271.	NA
CC	A timeout check is caused by the addressed device. The operation is tried twice before the CC bit is set.	NA
CC, OC	The *from* device fails to complete an operation or to respond to the 3271 within a specified time period (timeout check) during a Copy command operation.	NA
DC	1. The 3271 or 3275 detects a parity or cursor check in its buffer during a command operation. 2. The 3271 detects bad parity on data received from the addressed device. The operation is attempted twice before the DC bit is set.	A parity error is detected by the 3271 on a data transfer to the controller as a result of a poll or a parity error detected in the 3275,
DC, US (3271 only)	1. A parity check or cursor check is detected by the addressed device on the data it is sending to the 3270 CU. 2. The device detects a parity or cursor check in its buffer during a command operation.	A parity check or cursor check is detected by the polled device on the data it is sending to the 3271 CU.
DC, OC (3271 only)	The 3271 detects a parity check on the data transferred from the *from* device during a Copy command operation.	NA
DC, OC, US	Sent when the *from* device detects an internal parity or cursor check while performing the Copy command.	NA
IR	The addressed device is not available or the addressed printer is not ready.	NA
IR, OC (3271 only)	The *from* device is not available on a Copy command.	NA
IR, EC, US (3271 only)	The addressed printer is mechanically disabled and cannot recover.	NA
OC	1. The Copy command data stream contains more or less than 2 bytes (the CCC and the *from* device address). The Copy command is aborted. 2. One or more data bytes followed an Erase All Unprotected command (buffer overrun). 3. A data byte followed a read type command in the data stream received at the device.	NA NA NA
OC, US (3271 only)	The device has a locked buffer during a Copy command operation. (Refer to the heading "Copy Command" in Chapter 3, "Commands and Orders.")	NA
EC, US (3271 only)	A character generator error or a mechanical failure is detected at the printer, but recovery occurs.	NA
RE, CR	An invalid command is detected (first byte of data). For example, a Copy command is sent to the 3275.	NA
EC	Character generator error (3275 only) in printer.	Bad parity from a device (3271 only).

Figure 6-7 (Part 1 of 2). Remote Error Status and Sense Responses and Requests – SDLC

Status/Sense Bits	Explanation	
	Response	Request
EC, DC	Transmit parity error has occurred. If a buffer was obtained during the operation, the Data Check bit is also set.	NA
DE	The poll bit finds a device which was previously recorded as busy, as not busy. Transmission of an I-frame with read or write type data resets this bit.	The poll bit finds a device which was previously recorded as unavailable or not ready, as available and ready.
IR	The addressed printer is out of paper, power has been turned off, or the printer cover is open.	NA
IR, EC (3275 only)	Power is off at the 3284 Model 3 printer, or a malfunction is detected.	NA
OC, DB	The *from* device receiving a Copy command is busy. The device is busy performing an operation or a printout, reading data from the operator identification card reader, or performing a keyboard operation.	NA
DB	The addressed device is busy.	NA

Notes:

1. *There are other conditions of multiple status that can occur which are not included here; for example, an unpredictable catastrophic card failure or multiple error conditions occurring simultaneously could cause an undefined combination of status and sense bits. If a multiple-status condition occurs, each bit must be checked separately to determine the cause(s) of the failure.*
2. *See Figure 6-8 for error-recovery procedures that are applicable for certain combinations of status/sense bits.*

Figure 6-7 (Part 2 of 2). Remote Error Status and Sense Responses and Requests – SDLC

Error-Recovery Procedures

Errors detected by the 3270 CU are indicated to the system by a timeout, an FRMR response, or an exception request or response.

Figure 6-8 lists the various error combinations of sense/status bits (described in Figure 6-7) and refers to error-recovery procedures. The error-recovery procedures recommended in Figure 6-8 are as follows:

1. a. Any response other than NSA to a Set Mode command is discarded and results in *n* retries of the particular Set Mode command being attempted. If the timeout response persists, the system operator should take action to verify the link.

   b. Execute a new command sequence, starting with the command that was being executed when the error occurred. Executing a new command is a function of the access method or the application program and is the responsibility of the customer-written application program. If, after two retries, the operation is not successful, inform the system operator of the problem and follow procedure 4a.

   c. Perform procedure 1b, except, if operation is not successful, follow procedure 4b instead of 4a.

2. Notify the responsible application programmer that a nonrecoverable program error was detected.

Sense/ Status Bit	Detected during 3270 Operation Transmitted as:		Error Recovery Procedure:	
	Response	Request	3271	3275
PE (Address not available)	D, P		2	2
CC	D, P		1b	NA
CC, OC	D, P		1c	NA
DC	D, P	D, P	1b, 3a[1]	3a
DC, US	D, P	D, P	3a	NA
DC, OC	D, P		1c	NA
DC, OC, US	D, P		3b	NA
IR	D, P		6a	6a
IR, OC	D, P			NA
IR, EC, US	P		5	NA
OC	D, P		2	2
OC, US	D, P		7	NA
EC, US	P		5	NA
FIE, CR	D, P		2	2
EC	D, P	D, P	1b	5
DC, US, DE	D, P		3a	NA
IR, EC	D		NA	5
DE	D, P	D, P	None	None
OC, DB	D, P		8a	NA
RR	D, P		None	None
DB	D, P		8b	8b

Legend:

NA	–	Not applicable
D	–	Display (3277 or 3275)
P	–	Printer

[1] Perform error-recovery procedure 1b if error occurred during a read operation. Perform error-recovery procedure 3a if error occurred during a write operation.

Figure 6-8. Remote Status and Sense Conditions – SDLC

3. a. Reconstruct the entire device buffer image, starting with the first segment if a multisegment transmission occurred, and retry the failing sequence of commands. The sequence of commands used to reconstruct the image should start with an Erase/Write command to correct a possible missing- or multiple-cursor condition in the device buffer. This procedure is the responsibility of the customer-written application program. If, after a series of retries, the problem is not corrected, inform the system operator of the problem and follow procedure 4a.

   b. The error occurred during execution of a Copy command. Follow procedure 3a, and reconstruct the entire image of the device buffer of the *from* device specified by the Copy command. If, after a series of retries, the operation is not successful, follow procedure 4b.

4. a. Request the system operator to request maintenance support. Following repair, reconstruct the buffer image. The sequence of commands used to reconstruct the image should start with an Erase/Write command to correct a possible missing- or multiple-cursor condition in the device buffer.

   b. The *from* device specified by the Copy command in the failing chain of commands is malfunctioning. The device should be identified from the customer- written application program, and the system operator should be requested to have this device repaired. After repair, reconstruct the device buffer image. The sequence of commands used to reconstruct the image should start with an Erase/Write command to correct a possible missing- or multiple-cursor condition in the device buffer.

5. The error occurred during a printout operation and indicates either a character-generator error or a disabled print mechanism. There is no data error. The proper error-recovery procedure is application-dependent since the user may not want a new printout. In this case, the appropriate recovery procedure is the responsibility of the customer-written application program. If a new printout is required, follow procedure 6a.

6. a. The error indicates that the printer is out of paper, has its cover open, or has a disabled print mechanism, or it indicates that the device is unavailable. Request (or wait for) the terminal operator to ready the device. A Device End can be expected. Then retry the printout by issuing a Write command with the proper WCC and no data stream. (There is no data error, and the data is still intact in the device buffer and can be reused.) Or, follow procedure 3a.

   b. The error indicates that the *from* device specified by a Copy command is unavailable. The device address associated with the error status and sense information is not the device that requires reading. The device that requires reading is the *from* address specified in a Copy command. The responsible customer application programmer should determine the *from* device address and inform the system operator.

7. An attempt was made to execute a Copy command in which access to the *from* device data was not authorized. Determine the appropriate customer-written application program, and notify the customer. The device address associated with the error status/sense bits in the sense RU is that of the Copy command *to* device.

8. a. This indicates that, in attempting to execute a Copy command, the *from* device was found to be busy. Follow procedure 1b when the *from* device becomes not busy. Note that the device address associated with the S/S bits in the sense RU is the address of the *to* device and not that of the busy *from* device. The *from* device will transmit Device End when it becomes not busy.

   b. This indicates that the addressed device is busy. If the device is a display station, it will transmit Device End when it becomes not busy. If the device is a printer, a positive response with pacing is sent.

Timeout to a Poll

When the 3270 CU detects an FCS check, it initiates a timeout and does not respond to the controller. The controller retransmits the message several times, if necessary, in an attempt to correct the error.

CMDR Response to Invalid Nonsequenced Commands and I-Field Formats

The 3270 sends the FRMR response for invalid nonsequenced command formats and I-formats. The recovery action for FRMR response is the responsibility of the controller's.

ROL Response to a Poll

The 3270 CU sends a DM response upon receipt of an RR or RNR command with the poll bit set to 1, when it is in disconnect response mode. Disconnect response mode is a result of a DISC command's having been issued previously by the controller or of power's having been removed from the 3270 CU and then applied. The controller must issue an SNRM command to return the 3270 CU to online status.

Aborting an Inbound I-Frame

Data checks are sensed by the 3270 CU before a segment of message data is transmitted to the controller. If the segment assembled for transmission was the first or the only segment, an exception request is transmitted with the mapping bits set to indicate one segment (whole) in place of the segment of message data that contained the error. If the segment assembled for transmission was an intermediate, or the last, segment and contained an error, an exception request is transmitted with mapping bits indicating one segment. In either case of this abort-segment structure, RH byte 1 is DR1=0, EXC=0, PAC=0, and the sense and status data check indicator is on. As a result, the host discards all segments received up to and including the segment containing the exception request.

Chapter 7. Screen Design

Field Concept

People dealing with information see it as a collection of individual elements. For example, what we know about John Smith's employment may be a collection of individual elements: his name, serial number, location, and date of hire. The size of the element is the amount of data required to convey useful information. You think of *J* and *O* and *H* and *N* as useful, not individually, but collectively, as the name JOHN. You do not think of JOHNSMITH963981BOSTON070262 as being useful collectively, but see the elements individually – name: JOHN SMITH, serial number: 936981, location: BOSTON, date of hire: 07/02/62.

Each data element has its own characteristics. In this example, the serial number is 6 numeric digits and varies from employee to employee. The word *NAME* is 4 characters, is alphabetic, is all uppercase, and does not change. When people record these elements of data on paper, they take on such additional characteristics as position (where on the sheet of paper the item is written), color (what ink or medium is used), size of the letters, and writing style.

In the past, when information was handled by a data processing device, it was generally handled as an artificial entity called a *record.* The contents and characteristics of a record were primarily determined by device requirements, and little or no attention was given to the individual information elements. Data processing users had to adjust their thought pattern to the machine requirements.

The IBM 3270 Information Display System recognizes that people deal with individual units of information. The system has been designed to conform to human needs and requirements, and it enables you to deal with data by individual elements, or *fields,* each with its own characteristics.

You may describe data to the 3270 on a field basis and specify the characteristics, or *attributes,* of each individual field. The 3270 then provides program and data control on the basis of your individual field definitions.

How Fields Are Defined

Each data field is established by writing a field attribute control code, or attribute character, as the first position of the field. A field is defined as the attribute character, plus all the data following it up to the next attribute character. The placement of attribute characters defines the field lengths, and the content of the attribute characters defines the other field characteristics. In the following examples, the symbol □ designates an attribute character.

All the characters in a field, except the attribute character itself, assume identical characteristics based on the specifications within the attribute character. In Figure 7-1 the characteristics of the field NAME: are controlled by the attribute $\boxed{1}$, and terminated by the attribute $\boxed{2}$. The placement of attributes controls the length of the fields.

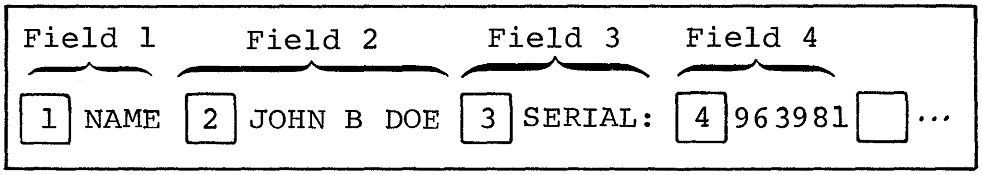


Figure 7-1. Example of Four Fields and Attribute Bytes

Field attributes can be modified or removed by a 3270 program. Removing the attribute character $\boxed{2}$ causes NAME: JOHN DOE to be considered by the 3270 as a single field. Changing the content of the attribute $\boxed{3}$ alters the characteristics of SERIAL: even though SERIAL: itself has not been altered and remains associated with that attribute.

What Attributes May Be Assigned to a Field

Besides length, which is controlled by the position of attributes, you may specify these additional characteristics with the attribute character.

Protection

A field is either protected or unprotected. When it is protected, the operator cannot enter or modify data in any location within that field.

In an unprotected field, the operator can enter characters or can delete or modify characters that are already there. Headings, labels, titles, and formats are commonly specified as protected. Any field in which the 3270 operator should enter or modify data must be specified as unprotected.

In Figure 7-1, NAME: would most likely be specified as protected. JOHN B DOE would be specified as protected if it were written by the computer and was to remain unchanged. If JOHN B DOE is to be entered or modified by the operator, the attribute $\boxed{2}$ must specify unprotected.

Character Content

A field is either alphameric or numeric. An operator can enter alphameric, numeric, or special characters in an alphameric field.

The numeric attribute is more complex; it depends upon whether the Numeric Lock feature is present and upon which keyboard is attached to the display. Figure 7-2 shows what characters may be entered with various combinations of keyboards and field types.

Visibility and Detectability

A field is either displayable or nondisplayable. When it is displayable and contains characters, those characters are displayed. When it is nondisplayable, any characters within that field are not displayed. The nondisplayable attribute is useful for entering classified or security information at a display unit that is in public view. Nondisplayable data is accepted by the 3270, but it is not visible on the screen.

All characters within a displayable field can be displayed at regular brightness or at a high intensity so that they stand out among regular display fields. High intensity may be used to call attention to error conditions or to highlight protected or format fields. Normal intensity may be used for all input fields, so the terminal operator can tell at a glance which fields require operator action. You should not specify unprotected fields as high intensity, since such fields may become selector-pen-detectable (if this feature is installed) if the operator enters a question mark or space as the first input character. Fields are specified as either detectable or nondetectable. When a field is detectable, it can be used for selector-pen operations. A nondetectable field location cannot be detected by the selector pen. You are urged to designate all detectable fields as protected to prevent the operator's changing the content of the sensitive field.

					Resulting Characters		
Keyboard Type	Keyboard Numeric Lock	Shift Key Pressed	Field Type	Protected	In Buffer	Displayed on Screen	Read into Storage
Typewriter	No	No	Alpha or Numeric	No	Lowercase	Uppercase	Lowercase
Typewriter	No	Yes	Alpha or Numeric	No	Uppercase	Uppercase	Uppercase
Typewriter	Yes	No	Alpha	No	Lowercase	Uppercase	Lowercase
Typewriter	Yes	Yes	Alpha	No	Uppercase	Uppercase	Uppercase
Typewriter	Yes	No	Numeric	No	Can only enter 0–9, period, and minus sign; any other characters lock keyboard.		
Typewriter	Yes	Yes	Numeric	No	Can only press dup key; any other action locks keyboard.		
Data Entry	No	–	Alpha	No	Alpha keys produce uppercase alpha characters. Numeric shift key produces numeric characters. Alpha shift key has no effect.		
Data Entry	No	–	Numeric	No	Numeric shift key has no effect. Alpha shift key overrides numeric specification and allows alpha character entry.		
Data Entry	Yes	–	Alpha	No	Alpha keys produce uppercase alpha characters. Numeric shift allows numeric character entry. Alpha shift key has no effect.		
Data Entry	Yes	–	Numeric	No	Can only enter 0–9, period, dup, and minus sign. Any other characters lock all keys except for RESET key. Numeric shift key allows numeric character entry; alpha shift key allows alpha character entry.		

Figure 7-2. Results of Keyboard and Field Combinations

Transmission

The most common operation of the 3270 (Read Modified) sends to the computer only those fields that have been entered, deleted, or changed by the operator. The 3270 keeps track of such modifications and uses that information to select data to send to the computer. If you wish to pass a field into the computer regardless of modification, you may assign the modified or modified data tag (MDT) attribute. You should note, however, that the operator can change the MDT attribute unless you also assign the protected attribute.

Certain attribute combinations produce additional characteristics. For example, the numeric (limiting keyboard use) and protected (eliminating keyboard use) attributes seem contradictory but, when specified together, automatically skip the cursor past the field.

You should also be aware that the computer is not limited by attributes. The computer can, for example, place alphabetic information in a field defined as numeric, or protected, or both. The operator does not have such liberty.

If you do not specify any combination of attributes, a field is assumed to have the following attributes:

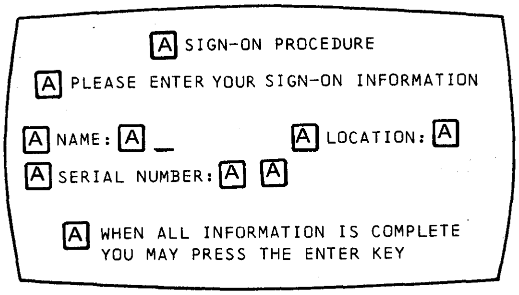
- Alphameric
- Unprotected
- Displayable (at regular brightness)
- Nondetectable by the selector pen or cursor select
- Not modified

You will find that these are the attributes most commonly used.

The attribute character for each field uses a single nondisplayed and protected character position on the screen and serves as a visual separation between successive fields.

Example of Field Definition

A typical sign-on procedure illustrates how you might define fields. Figure 7-3 illustrates a simple procedure in which the computer requests the operator to provide his name, location, and serial number.



```
            🄰 SIGN-ON PROCEDURE
  🄰 PLEASE ENTER YOUR SIGN-ON INFORMATION

🄰 NAME: 🄰 _                  🄰 LOCATION: 🄰
🄰 SERIAL NUMBER: 🄰 🄰

     🄰 WHEN ALL INFORMATION IS COMPLETE
       YOU MAY PRESS THE ENTER KEY
```

Figure 7-3. Example of Attribute Specification

Field 1: SIGN-ON PROCEDURE

This field is a heading that the operator should not be able to alter. It is unnecessary for the words "SIGN-ON PROCEDURE" to be returned to the computer when the ENTER key is pressed. This field should be protected, alphameric, displayed at normal intensity, not detectable by the selector pen or cursor select, and not modified. All default attributes can be assumed, except that you must specify this field as protected.

Field 2: PLEASE ENTER ... INFORMATION

You should specify this field as protected. Remember that the characteristics of a field are determined by the attribute character at the beginning of the field. Field 1 and field 2 have identical attributes and are adjacent to each other. You may choose to define them separately and use 2 attribute characters, or you may choose to omit the attribute character at the beginning of field 2. In the latter case, the two headings combine to become a single field of greater length.

Field 3: NAME:

This field should be protected, alphameric, not modified, and not detectable by the selector pen. The heading could be displayed at high intensity. Specify the protected and high-intensity attributes (the two deviations from the default attributes).

Field 4: The Area Following "NAME:"

The null area following NAME: is an input area for the operator and must therefore be unprotected. The 3270 marks this field as modified if anything is entered into it, so you should not specify the modified attribute. The default attributes (alphameric, unprotected, displayable at normal intensity, not detectable by the selector pen or cursor select, and not modified) apply. Use a default attribute at the beginning of this field.

The maximum number of characters the operator can enter is determined by the length of this field. The length is equivalent to the number of nulls, or available positions on the screen, between the attribute character for field 4 and the attribute character for field 5.

Field 5: LOCATION:

The attribute character for this field is the same as that specified for field 3: protected and high intensity should be specified. This attribute prevents the operator from keying a name longer than the maximum length desired. If the name is shorter than the maximum field size, the operator presses the TAB key when the name is complete. The TAB automatically skips the cursor past protected fields, such as this one, and stops at the first character position in which data can be entered (the next unprotected field). In this example, the cursor would be positioned for entry of location. If the operator attempts to key too many characters (a name greater than 17 characters in the example), the cursor is positioned under this attribute for the 18th character. The next keystroke attempts to destroy this attribute, but fails to do so because attribute characters are protected. The keyboard is inhibited, the clicker shuts off, and the ***input inhibited*** indicator is turned on. The operator's attention is assured, since this condition requires pressing the RESET key to continue.

If the attribute character for this field were omitted, the work *LOCATION:* would become part of field 4 and would be of normal intensity and unprotected. This is undesirable because the operator could continue entering name information beyond the desired maximum length and could modify the heading information by entering data in the screen locations occupied by LOCATION:.

Field 6: The Area Following "LOCATION:"

This field is for operator input and must therefore be unprotected. The rest of the default attribute values apply, and so a default attribute may be used. You need specify only that a field is to begin following LOCATION:. This field ends with the attribute character at the beginning of field 7, which determines the length of the field.

Field 7: SERIAL NUMBER:

This field, like NAME: and LOCATION:, should be specified as protected and of high intensity. This also limits the location field length to 5 characters. Note that if field 6, the input field for location, were defined as always being a 5-character code, field 7, SERIAL NUMBER:, could be defined as auto-skip to save the operator from having to press TAB after filing in the location code.

Field 8: The Area Following "SERIAL NUMBER:"

The null area following SERIAL NUMBER: is an input area for the operator and must be unprotected. It should also be specified as numeric so that, if the operator tries to enter alphabetic data in the field (and the keyboard has the Numeric Lock feature), the keyboard inhibits entry of the incorrect character, the keyboard clicker shuts off, and the *input inhibited* indicator appears to notify the operator of the error. The improper character does not appear on the screen, and the correct digit may be entered after the operator presses the RESET key.

The serial number in the example always contains a fixed number of digits and is the last field entered. The maximum length of the field is determined by the location of the attribute for the next field. But the next field in the example is too far away ("WHEN ALL . . . KEY").

By placing an additional attribute character following input field 8, the operator cannot enter a serial number that is too long. If the positions allocated to the serial number are filled, the next keystroke locks the keyboard, as in the name and location fields.

This additional length check is used here because this is the last field to be entered. If you had another field to enter after SERIAL NUMBER, it might be more advantageous to omit this length check, as explained in field 9.

Field 9: The Area between the Additional Attribute Described in Field 8 and "WHEN ALL . . . KEY"

By definition, the additional attribute character you used to delimit the serial number field begins a new field. The protected attribute alone is sufficient for this field, and this attribute limits length for the serial number field. Normally, however, protected (output) fields that follow fixed-length input fields should be defined as protected and numeric. The protected and numeric attribute defines a field as auto-skip. Auto-skip automatically positions the cursor at the location following the attribute character for the next unprotected field, which is the next place you want to key data. This technique saves keystrokes for the operator. When the operator keys the last character of the preceding fixed-length field, the cursor normally enters the next field, which may be protected. But since the next field is auto-skip, the cursor skips this intervening protected field and automatically positions itself for entry of the next field, without an extra keystroke.

Field 10: WHEN ALL . . . KEY

This field is a heading that the operator should not be allowed to change. It need not be of high intensity and, thus, may be defined as protected only. Field 10 does not automatically terminate when the last screen position is reached. The field definition continues from the bottom-right screen position to the upper-left screen position until the next attribute character is reached. This is called *wraparound.* Keep this in mind, particularly if you define the last field on a screen as unprotected!

Since fields 9, 10, and 1 are adjacent to each other (by wraparound) and have the same attributes, they may be combined into a single field by the omission of attributes before WHEN and SIGN-ON. The result is a single protected field beginning after the input area for serial number, wrapping around the screen, and terminating either at PLEASE or at NAME if fields 1 and 2 have been previously combined.

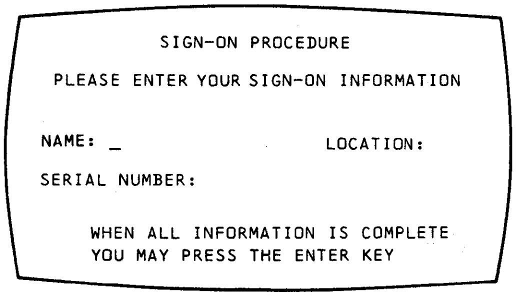
Combining fields in the above manner may be convenient, but may cause confusion and error if you change the screen layout later. It is a better practice to specify separate fields in all cases.

The panel is completely formatted when the fields are positioned, the attribute characters are all defined, and the cursor is placed. You must now begin the transition from the visual image, or human-oriented panel, to the detailed data necessary for the 3270 to implement your panel design.

Panel Design

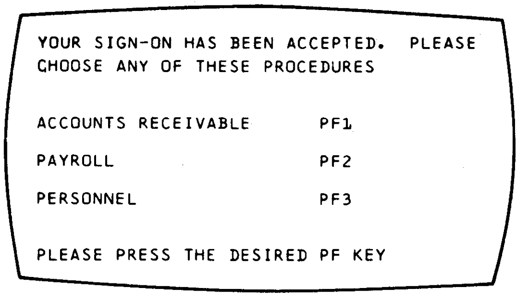
You can think of a panel as a single 3270 display screen image created by your program. (The term *screen* or *screen image* or *display image* could also have been used.)

If the terminal operator filled in the information requested in the panel in Figure 7-4, he might receive another panel, such as the one shown in Figure 7-5.



```
            SIGN-ON PROCEDURE

  PLEASE ENTER YOUR SIGN-ON INFORMATION


 NAME: _                     LOCATION:

 SERIAL NUMBER:


     WHEN ALL INFORMATION IS COMPLETE
     YOU MAY PRESS THE ENTER KEY
```

Figure 7-4. An Example of a Panel



```
 YOUR SIGN-ON HAS BEEN ACCEPTED.  PLEASE
 CHOOSE ANY OF THESE PROCEDURES


 ACCOUNTS RECEIVABLE          PF1

 PAYROLL                      PF2

 PERSONNEL                    PF3


 PLEASE PRESS THE DESIRED PF KEY
```

Figure 7-5. Another Example of a Panel

An Example of a Sequence of 3270 Panels

Assume you are given the assignment of designing the panels for an accounts-receivable application. You are to create the panels that will allow a terminal operator to post a customer payment against his unpaid invoices. The terminal operator will be sitting at a 3270 work station, removing checks and invoice copies from envelopes. If the invoice copies are returned with the check, the terminal operator will, for each invoice, enter the customer number, payment, and invoice number. If the invoice copies are not returned, the terminal operator will have to find the customer number based on the customer name and then decide which open invoices to apply the payment against. It will be helpful if the operator has some way of adding various open invoices to find a combination that totals the payment.

The 1,920-character panels that follow show one possible solution.

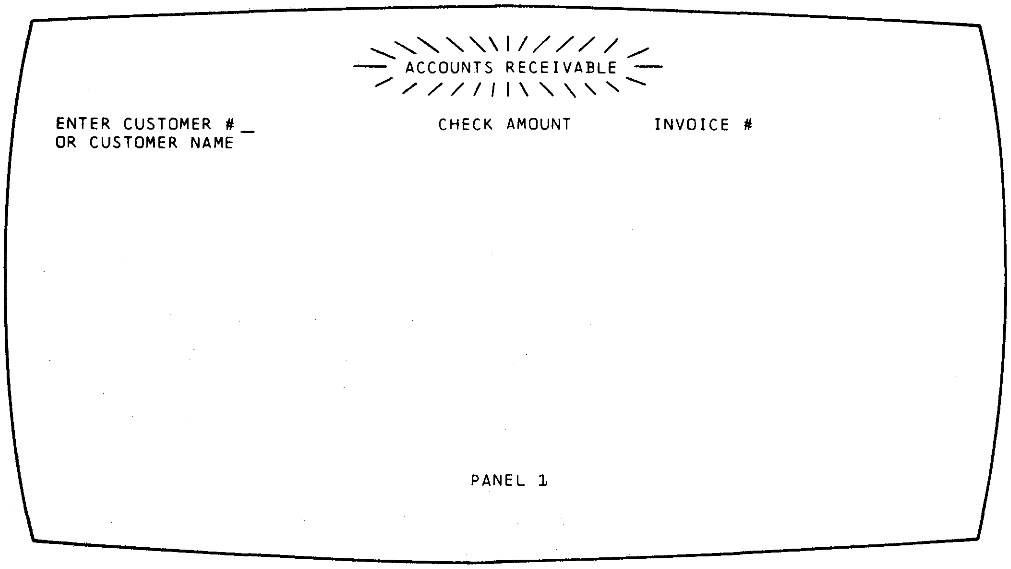
The first panel in the application is shown in Figure 7-6. If the invoice copies come with the check, the terminal operator can enter the customer number, amount, and invoice number, and press the ENTER key.

This posts the payment against the specified invoice. The terminal operator can then post the next payment, and so forth; as long as the customer number and the invoice number are known, only Panel 1 is displayed.

If, however, no invoice is returned and the customer number is not known, the customer name can be entered. The name need not be the complete name of the company; it can be the first name of the company. In our example, the check says only "CAPITOL" so that is what the operator enters. When the name has been entered, the terminal operator presses the ENTER key. The customer number is missing, so Panel 2 is displayed.

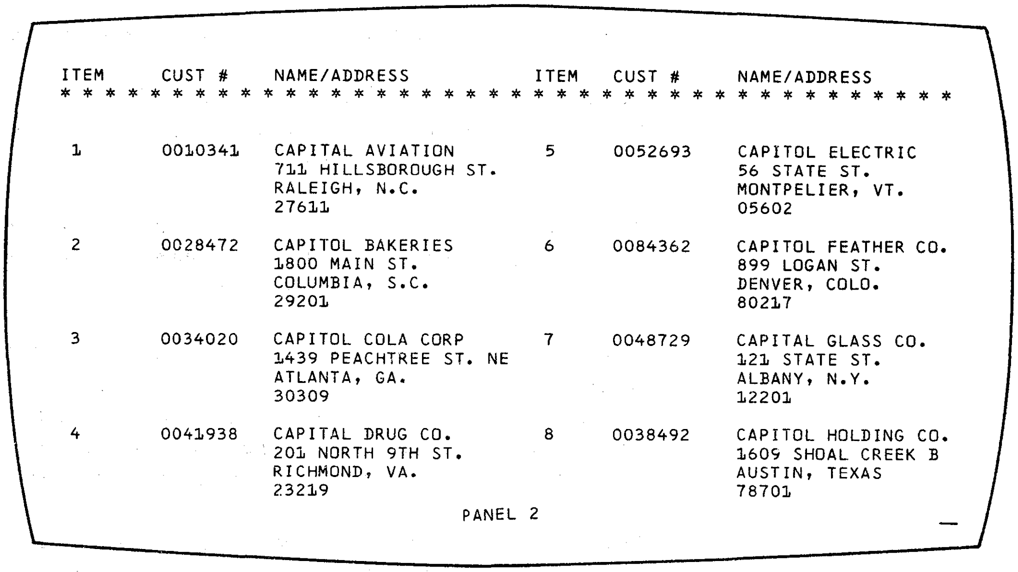
Panel 2, shown in Figure 7-7, shows all customers and customer numbers phonetically similar to the name entered in response to Panel 1. Item numbers in Panel 2 allow the terminal operator to select one by using a corresponding program-function (PF) key. (See "Program Attention Keys" in this chapter.)

As a result of terminal operator response to Panel 2, Panel 3 (shown in Figure 7-8) displays all open invoices for the identified customer. The terminal operator can now use the selector pen to specify the open invoices to which the payment applies. He does this by touching the selector pen to the question mark adjacent to each desired invoice number; selection is verified immediately by the question mark's changing to a > character. To post the payment against the selected invoice numbers, the operator can select APPLY. If, however, the operator cannot easily tell the invoices to which the payment is applied, he can select CALC instead of APPLY.



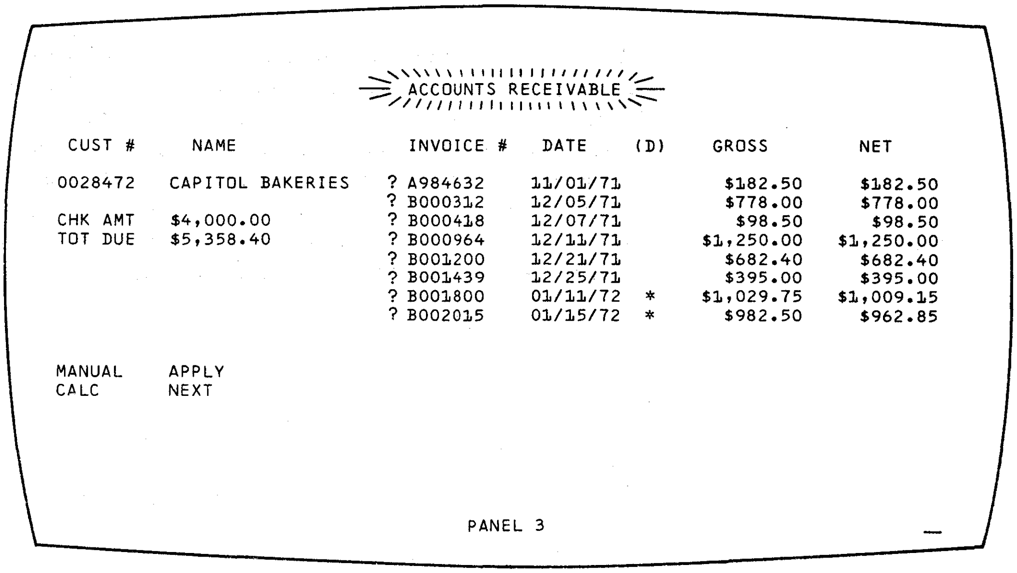
```
                         ACCOUNTS RECEIVABLE

ENTER CUSTOMER # _             CHECK AMOUNT        INVOICE #
OR CUSTOMER NAME




                               PANEL 1
```

Figure 7-6. Panel 1 of an Accounts Receivable Application



```
ITEM     CUST #     NAME/ADDRESS            ITEM    CUST #     NAME/ADDRESS
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

 1       0010341    CAPITAL AVIATION         5      0052693    CAPITOL ELECTRIC
                    711 HILLSBOROUGH ST.                       56 STATE ST.
                    RALEIGH, N.C.                              MONTPELIER, VT.
                    27611                                      05602

 2       0028472    CAPITOL BAKERIES         6      0084362    CAPITOL FEATHER CO.
                    1800 MAIN ST.                              899 LOGAN ST.
                    COLUMBIA, S.C.                             DENVER, COLO.
                    29201                                      80217

 3       0034020    CAPITOL COLA CORP        7      0048729    CAPITAL GLASS CO.
                    1439 PEACHTREE ST. NE                      121 STATE ST.
                    ATLANTA, GA.                               ALBANY, N.Y.
                    30309                                      12201

 4       0041938    CAPITAL DRUG CO.         8      0038492    CAPITOL HOLDING CO.
                    201 NORTH 9TH ST.                          1609 SHOAL CREEK B
                    RICHMOND, VA.                              AUSTIN, TEXAS
                    23219                                      78701
                                  PANEL 2                                        _
```

Figure 7-7. Panel 2, Showing the Results of a Search on a Customer Name

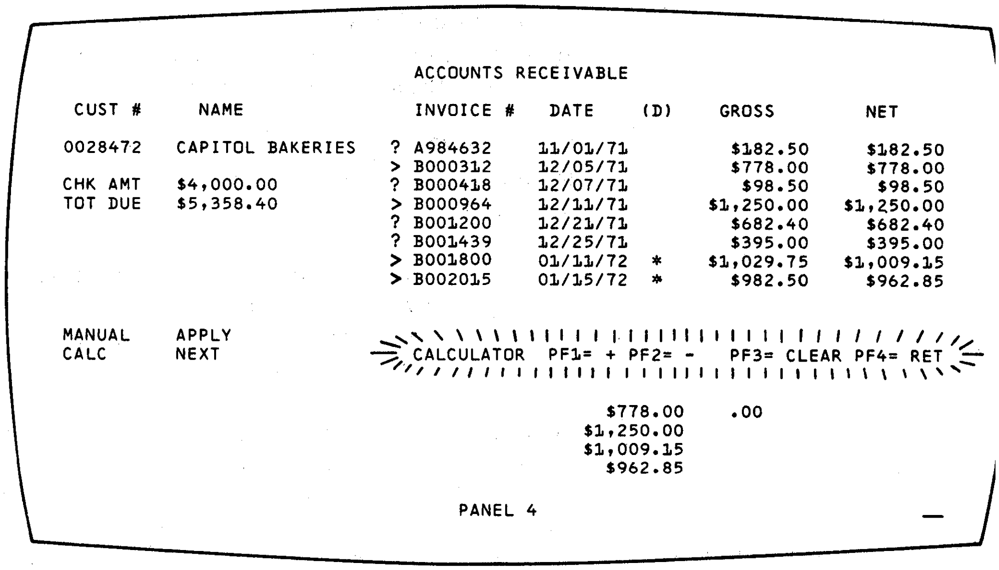


```
                              ACCOUNTS RECEIVABLE

 CUST #      NAME               INVOICE #    DATE    (D)     GROSS         NET

0028472    CAPITOL BAKERIES    ? A984632    11/01/71          $182.50      $182.50
                               ? B000312    12/05/71          $778.00      $778.00
CHK AMT    $4,000.00           ? B000418    12/07/71           $98.50       $98.50
TOT DUE    $5,358.40           ? B000964    12/11/71        $1,250.00    $1,250.00
                               ? B001200    12/21/71          $682.40      $682.40
                               ? B001439    12/25/71          $395.00      $395.00
                               ? B001800    01/11/72   *    $1,029.75    $1,009.15
                               ? B002015    01/15/72   *      $982.50      $962.85


MANUAL     APPLY
CALC       NEXT



                                  PANEL 3                                        _
```

Figure 7-8. Panel 3, Showing the Customer's Open Invoices

Selecting CALC displays Panel 4 (Figure 7-9); this is the same as Panel 3 except that ACCOUNTS RECEIVABLE, which was of high intensity in Panel 3, is now of normal intensity in Panel 4. A new line with CALCULATOR in high intensity indicates the screen mode and explains the functions of the PF keys. The terminal operator can now use the lower right-hand quadrant of the screen as a *scratch pad* to figure out a combination of open invoices that will total the payment check. This use of one part of the screen for a separate function is sometimes called a *split-screen capability.*

The calculator could be programmed a number of different ways. It could, as our example illustrates, show in one column in the CALCULATOR quadrant all invoice numbers selected (shown with > in Figure 7-9) prior to selecting CALC and in another column show any balance remaining from the check amount after subtracting the selected invoice numbers. In Figure 7-9, Panel 4 is shown as it would appear if the terminal operator had first selected four invoice numbers and then selected CALC. In this example, the selected invoices equal the check amount, so .00 is shown as the balance after subtraction of the selected invoices.

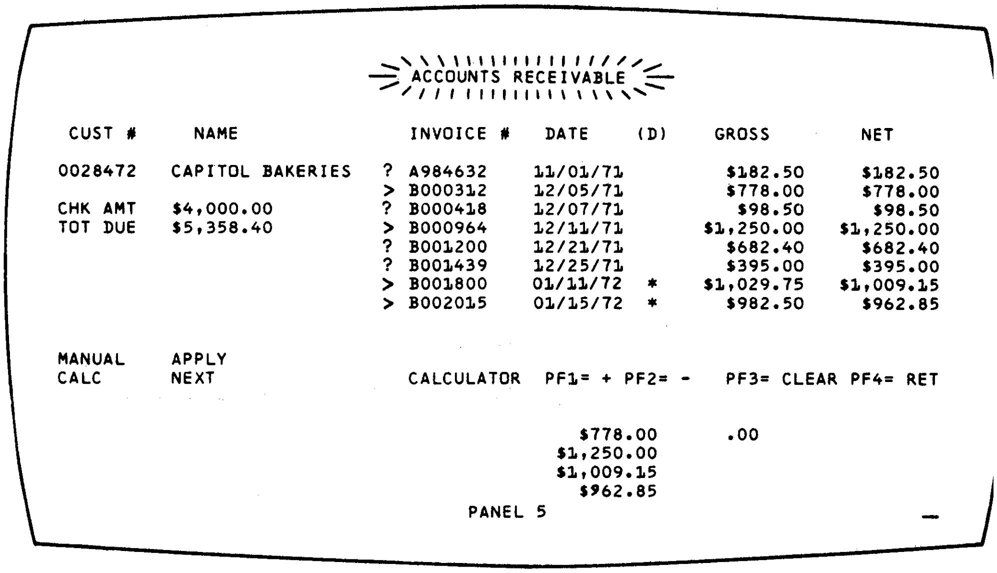


```
                                      ACCOUNTS RECEIVABLE

 CUST #      NAME                     INVOICE #   DATE     (D)      GROSS        NET

 0028472     CAPITOL BAKERIES       ? A984632     11/01/71            $182.50      $182.50
                                    > B000312     12/05/71            $778.00      $778.00
 CHK AMT     $4,000.00              ? B000418     12/07/71             $98.50       $98.50
 TOT DUE     $5,358.40              > B000964     12/11/71          $1,250.00    $1,250.00
                                    ? B001200     12/21/71            $682.40      $682.40
                                    ? B001439     12/25/71            $395.00      $395.00
                                    > B001800     01/11/72    *     $1,029.75    $1,009.15
                                    > B002015     01/15/72    *       $982.50      $962.85

 MANUAL      APPLY
 CALC        NEXT                     CALCULATOR  PF1= + PF2= -    PF3= CLEAR PF4= RET

                                                    $778.00      .00
                                                  $1,250.00
                                                  $1,009.15
                                                    $962.85

                                         PANEL 4                                   _
```

Figure 7-9. Panel 4, Showing Use of the Calculator

Panel 4 shows that the CALCULATOR could also allow the operator to key in amounts and to add them to or subtract them from the check amount (pressing PF1 in our example adds keyed-in amounts; PF2 subtracts one keyed-in amount from another). To start over at any point, the operator can press PF3 to clear the calculator quadrant. In our example, the selected invoices equal the check amount, so they can now be posted. But first the terminal operator must leave the CALCULATOR routine by pressing PF4 (RETURN). This displays Panel 5, shown in Figure 7-10.

Panel 5 is the same as Panel 4 except that, the operator having signaled completion of the CALCULATOR, that word now appears in normal intensity and ACCOUNTS RECEIVABLE once again appears in high intensity. The terminal operator can now, using the selector pen, select the invoices against which to apply the payment, and then select APPLY to post the payment.



```
                                      ACCOUNTS RECEIVABLE

 CUST #      NAME                     INVOICE #   DATE     (D)      GROSS        NET

 0028472     CAPITOL BAKERIES       ? A984632     11/01/71            $182.50      $182.50
                                    > B000312     12/05/71            $778.00      $778.00
 CHK AMT     $4,000.00              ? B000418     12/07/71             $98.50       $98.50
 TOT DUE     $5,358.40              > B000964     12/11/71          $1,250.00    $1,250.00
                                    ? B001200     12/21/71            $682.40      $682.40
                                    ? B001439     12/25/71            $395.00      $395.00
                                    > B001800     01/11/72    *     $1,029.75    $1,009.15
                                    > B002015     01/15/72    *       $982.50      $962.85

 MANUAL      APPLY
 CALC        NEXT                     CALCULATOR  PF1= + PF2= -    PF3= CLEAR PF4= RET

                                                    $778.00      .00
                                                  $1,250.00
                                                  $1,009.15
                                                    $962.85
                                         PANEL 5                                   _
```

Figure 7-10. Panel 5, Showing Selection of Invoices after Use of the Calculator

Panel 6 (Figure 7-11) shows the ACCOUNTS RECEIVABLE file for the customer after posting of the payment, with the new balance and the total amount applied. To continue to the next customer, the operator selects NEXT and returns to Panel 1.

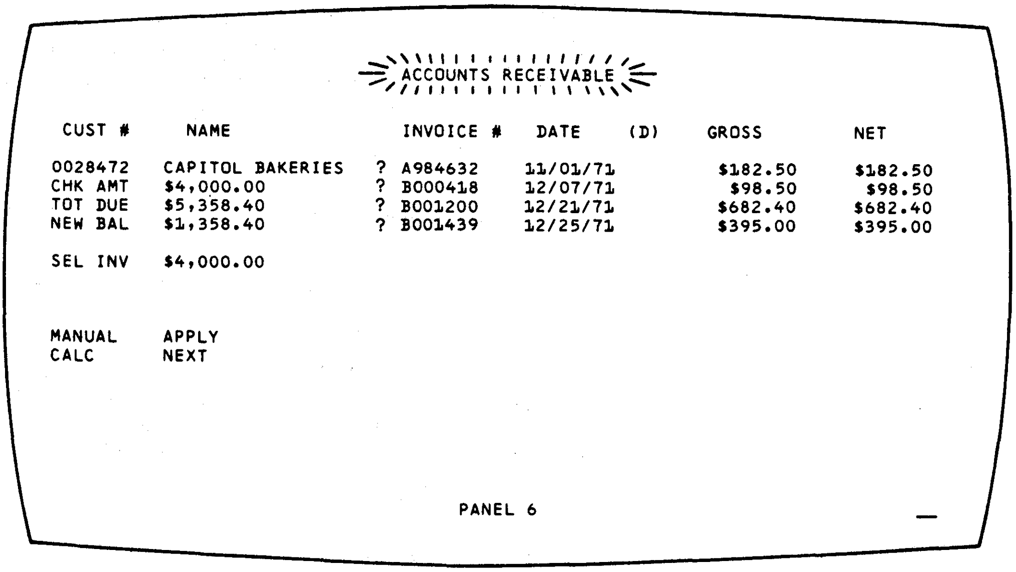
Not all the 3270's possibilities are shown in these six panels, and not all users will have the selector pen; this example was designed to show only what panels are and how the 3270 can be used.

Note that, in the above example, the terminal operator does not see as many panels as the programmer must create; not all panels necessarily appear to the operator in any given application. What the programmer regards as separate panels may appear to the terminal operator as one changing panel.

In the above example, a number of additional panels or variations to the panels shown would be required. For example, if the terminal operator presses an invalid PF key, a variation of the panel would be required to send a message to the operator over the panel presently at his display. In programming panels that are variations of one main panel, it may be useful to assign panel designations (for example, Panel 4A, 4B, and so forth) for variations of Panel 4.

Planning a Sequence of Panels

After an application program has been defined, the information that will be passed between the program and the terminal operator must be defined. This information can be thought of as output panels and input response to panels. Usually, you will be able to approximate the sequence of panels. The exact sequence of output panels often depends on the input response to panels. The following discussion shows one way to define a sequence of panels.



```
                          ACCOUNTS RECEIVABLE

 CUST #     NAME                 INVOICE #   DATE    (D)    GROSS       NET

0028472    CAPITOL BAKERIES    ? A984632    11/01/71           $182.50     $182.50
CHK AMT    $4,000.00           ? B000418    12/07/71            $98.50      $98.50
TOT DUE    $5,358.40           ? B001200    12/21/71           $682.40     $682.40
NEW BAL    $1,358.40           ? B001439    12/25/71           $395.00     $395.00

SEL INV    $4,000.00


MANUAL     APPLY
CALC       NEXT




                                PANEL 6                                   _
```

Figure 7-11. Panel 6, Showing New Balance after Posting

Defining the Purpose of Each Panel

Assuming you have a good understanding of the type of application program (such as data entry, order entry, or inquiry) and the kind of information that must be exchanged and processed (such as customer name, invoices, and check amounts), you can consider which panels come first. Suppose the first panel required is a sign-on panel, as shown in Figure 7-12.

After sign-on, the next panel might allow the terminal operator to choose one of several different applications or procedures that he would use. But what if the name or word entered was not an authorized sign-on? Another panel might tell the terminal operator about this and ask him to reenter a sign-on name. Figure 7-13 illustrates a technique, sometimes called *block diagramming,* that may help in laying out a sequence of panels.

Using the Panel Layout Sheet

After block diagramming the panels in the application or procedure, you are ready to decide on the exact contents of each panel: the fields that will be in the panel, what attributes each field will have, and what words will be displayed in the panel. This can be done on graph paper. The *IBM 3270 Information Display System Layout Sheet,* GX27-2951, is useful for layout.

One of these sheets can be used for each panel. After laying out a sequence of panels, you have a collection of panel layout sheets. With the information on these sheets and the block diagram showing the relationship between panels, the program can be written to send the panels to a terminal and handle an operator's response to them.

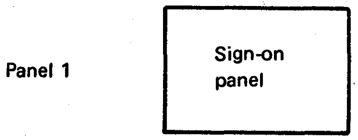


Figure 7-12. Sign-On Panel Block Diagram

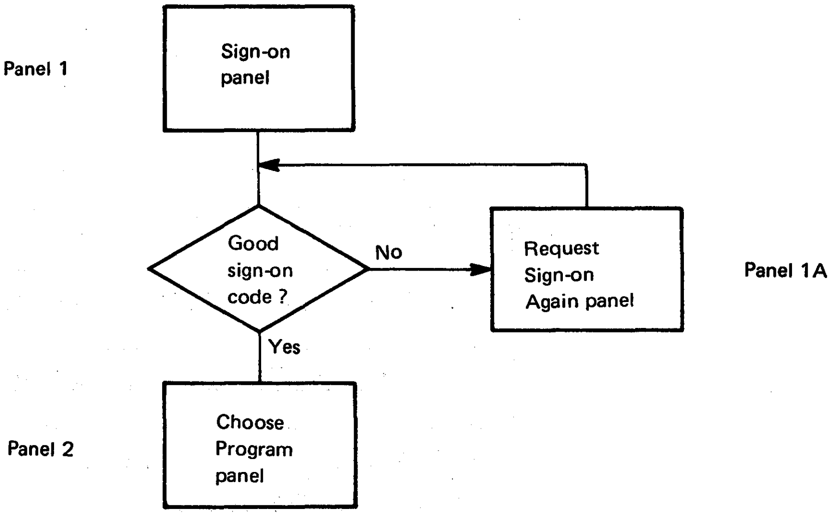


Figure 7-13. Block Diagramming

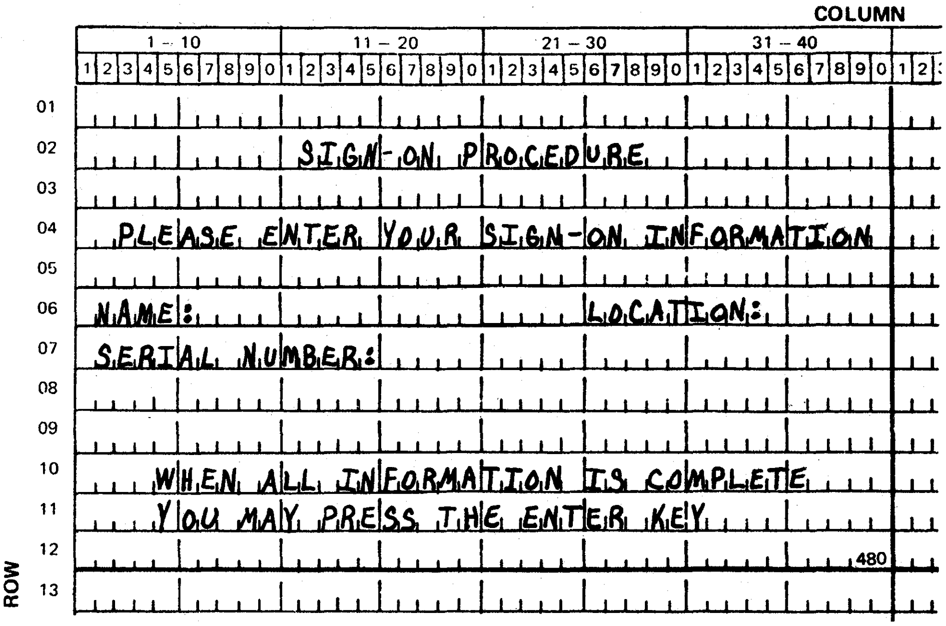
An Example of Laying Out a Panel

To lay out a panel, consider the sign-on panel shown in Figure 7-14. You might jot down on a piece of paper the information required for the panel, or you might write it directly on the panel layout sheet. Figure 7-14 shows what the panel part of the layout sheet might look like after you put the text you wanted for your sign-on panel on the layout sheet. It is assumed you are using the 480-character display.

Now that you have written out what you want the terminal operator to see, you can define as fields the separate items of displayed text and spaces you are allowing for operator input. Remember that a field is always preceded by an attribute character. The attribute character occupies a space on the panel even though it appears as a blank space to the operator. Before deciding the attributes of a field, insert a character such as $\boxed{A}$ on the layout sheet to indicate the space for the attribute character. As you get used to creating panels, you may want to enter the $\boxed{A}$ at the same time you are laying out the text. You should also show the cursor location on the panel layout sheet to indicate to the operator where to start his response. The cursor position can be indicated by an underscore (_) under the space where you want it to appear, or you might enclose the space or characters in a rectangle. After the indications for attribute characters and the cursor position have been added, the sign-on panel appears as shown in Figure 7-15.

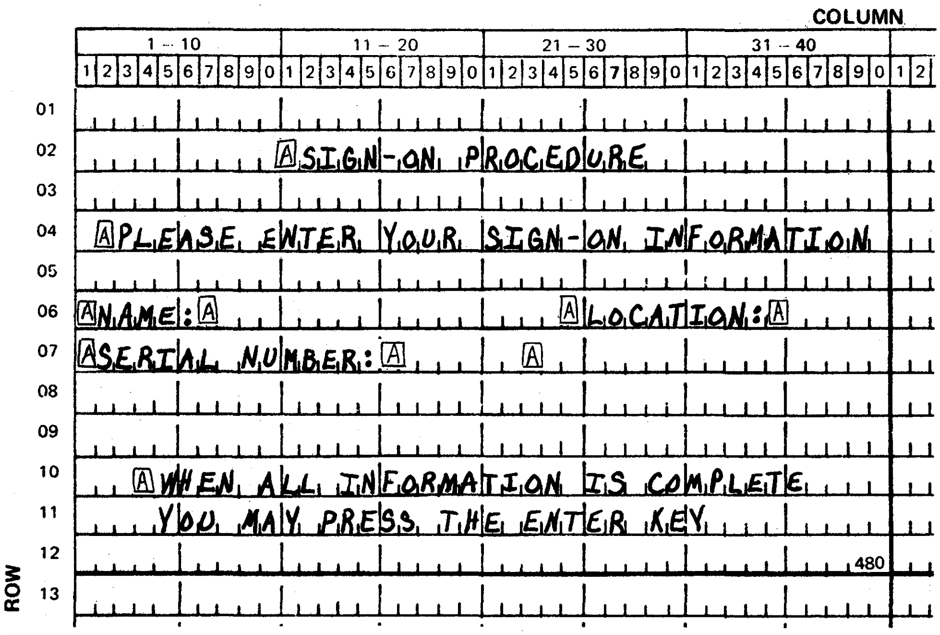
You could have designed the panel as one long field (or even no field at all), but, if you had, you would not have been taking advantage of the 3270's capabilities. If you designate various items on the panel as fields, each field can have different attributes, as discussed in "What Attributes May Be Assigned to a Field."

For example, you might want the fields NAME:, LOCATION:, and SERIAL NUMBER: to have high-intensity attribute to focus the operator's attention on them, because these fields indicate where the operator enters information. You might want to protect the fields other than the operator input fields so that the operator could not erase them; the operator input fields following NAME:, LOCATION:, and SERIAL NUMBER: should be unprotected so that the operator can type in information. The operator input field following SERIAL NUMBER: can be numeric to allow some work station editing; the operator would not be allowed to enter an alphabetic character accidentally. Field length can be defined by beginning a new field where you want the previous field to end. (In some cases, this new field serves only to give a length attribute to a previous field.)


COLUMN
1 – 10
11 – 20
21 – 30
31 – 40
ROW
480

```
02            SIGN-ON PROCEDURE
04   PLEASE ENTER YOUR SIGN-ON INFORMATION
06 NAME:                   LOCATION:
07  SERIAL NUMBER:
10     WHEN ALL INFORMATION IS COMPLETE
11     YOU MAY PRESS THE ENTER KEY
```

Figure 7-14. Sign-On Panel as Written Out on Layout Sheet



02 🄰SIGN-ON PROCEDURE

04 🄰PLEASE ENTER YOUR SIGN-ON INFORMATION

06 🄰NAME:🄰 🄰LOCATION:🄰

07 🄰SERIAL NUMBER:🄰 🄰

10 🄰WHEN ALL INFORMATION IS COMPLETE

11 YOU MAY PRESS THE ENTER KEY

12 480

Figure 7-15. Panel Layout, Including Attribute and Cursor Positions

Having decided on these attributes, you can use the columns on the reverse side of the layout sheet to record the locations and attributes of the fields you have created. Your recording in these columns might appear as shown in Figure 7-16.

The use of these columns depends on whether the panel designer also codes the panels or only designs them. The information now on the layout sheet can be used to write a line of code that, when sent to the display, displays your panel with its specified field characteristics. "Data Stream Coding" shows how the panel in this example is coded.

	Display/Printer		Buffer Address				Attribute					
Item	Row	Col	Dec	Hex	Orders		Prot	No.	High Int	Sel Det	Non-Disp Prt	MDT On
1	2	11					✓					
2	4	2					✓					
3	6	1					✓		✓			
4	6	7										
5	6	25					✓		✓			
6	6	35										
7	7	1					✓		✓			
8	7	16						✓				
9	7	23					✓					
10	10	4					✓					

Figure 7-16. Laying Out Field Attributes

Data Stream Coding

You must communicate certain information to a 3270 device or its control unit so that it can use the panels you have designed. This information includes commands, control characters, orders, and data.

Commands control such things as whether you write to or read from a display and whether the screen is erased before new data is written. For the examples given below, assume that you begin with a clear screen: all writes to the 3270 are Erase/Write commands, and all positions are set to nulls. (Commands are discussed in more detail in this chapter under "The Relationship of One Data Stream to Another." Refer to Chapter 3 for the command codes.) Control characters are used with certain commands to perform such functions as sounding the audible alarm, formatting the printer, and restoring or enabling the keyboard. (Control characters are discussed later in this chapter.) Orders are instructions writtten to the 3270 to tell the display unit how to format your panel. They control the creation and placement of fields and data. You may reduce the size of your data streams by careful order selection. (Orders are discussed below.)

Orders

Orders (1) position, define, and format data being written to the device, (2) erase selected unprotected data stored in the device, and (3) reposition the cursor.

Three orders provide enough instruction to format every panel:

- Start Field (SF) order: Specifies that the next character is an attribute character.
- Set Buffer Address (SBA) order: Specifies an address for data and successive orders.
- Insert Cursor (IC) order: Moves the cursor to the current buffer address.

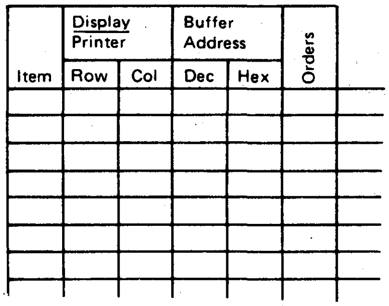
These orders are included with the text, which is both the data you have in your computer for the terminal operator, such as field headings or inquiry responses, and the data that the operator has that must be provided to the computer, such as serial number, part number, or quantity desired. The orders and text are sent to the display unit and are interpreted by a control unit to which the display unit is attached. The control unit formats the panel text before it is actually displayed at the display station.

Adding Orders to the Panel Layout Sheet

The back of the panel layout sheet is used for writing the panel orders. The column headings indicate what the columns should contain.

The first six columns, as shown in Figure 7-17, identify items in the text, their addresses, and the orders required to format them. The column headings are explained below:

- Item: Refers to any part of the panel that requires one or more orders to the control unit to format it. There are 11 items in the sign-on panel:
  1. SIGN-ON PROCEDURE
  2. PLEASE ENTER YOUR SIGN-ON INFORMATION
  3. NAME:
  4. Input field
  5. LOCATION:
  6. Input field
  7. SERIAL NUMBER:
  8. Input field
  9. Field to limit size of serial number input
  10. WHEN ALL INFORMATION IS COMPLETE
  11. YOU MAY PRESS THE ENTER KEY



Item	Display Printer		Buffer Address		Orders
	Row	Col	Dec	Hex	

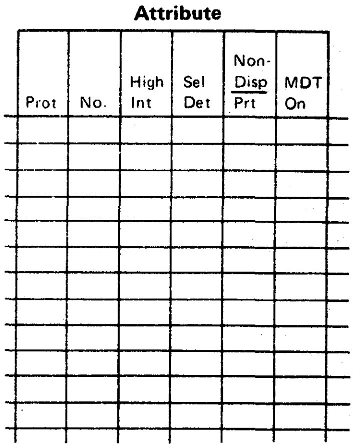
Figure 7-17. Text Items on Panel Layout Sheet

It is only by coincidence that the number of items in this example equals the number of fields. Since each field requires an SF order, there are always at least as many items as fields. There are more items than fields when, for example, the SBA order is used to space over unused positions within a single large field, as it item 11.

- Row, Col: Contain the starting location (row, column) address of each item.
- Dec, Hex: Are for a different addressing format, which you do not need if you use the row, column addressing format. Therefore, you may use these columns for any notes to yourself or leave them blank.
- Orders: Contains the orders you are writing, such as SBA, SF, or IC.

As shown in Figure 7-18, the next six columns under the word Attribute provide the field attributes that can be defined with each attribute character. The programmer checks the appropriate columns of the attributes he is changing from the default values:

- Prot: Protected
- No.: Numeric
- High Int: High intensity
- Sel Det: Selector-pen-detectable
- Non-Disp/Prt: Not displayed (nor printed at printer)
- MDT On: Modified data tag on

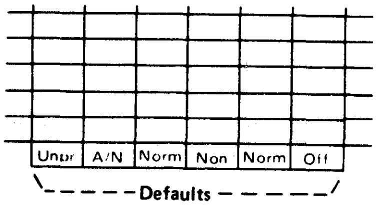


Attribute					
Prot	No.	High Int	Sel Det	Non-Disp Prt	MDT On

Figure 7-18. Field Attributes

At the bottom of the six columns are the attribute values (Figure 7-19) that are automatically provided unless you specify a change. You must, however, specify a hexadecimal order value for the default attributes, as discussed under "Coding the Panel" in this chapter. The default values are:

- Unpr: Unprotected
- A/N: Alphameric (alphabetic and numeric)
- Norm: Displayed at regular brightness
- Non: Not detectable by the selector pen
- Norm: Displayed (at regular brightness)
- Off: Not modified



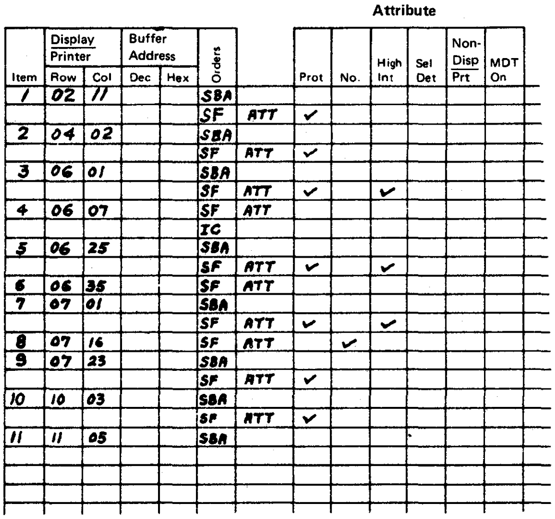
Unpr	A/N	Norm	Non	Norm	Off

\-----Defaults-----/

Figure 7-19. Attribute Default Values

You are now ready to add the required orders to the panel layout form. This may require that you rewrite the back of the form if it was originally prepared without regard to orders or if insufficient space was allowed.

Figure 7-20 shows a completed layout sheet containing all the orders to be sent with the sign-on panel. (The hexadecimal order values are discussed under "Coding the Panel" in this chapter.) Each item on the panel has been assigned a number to help you correlate the text with its associated orders.



	Display Printer		Buffer Address				Attribute					
Item	Row	Col	Dec	Hex	Orders		Prot	No.	High Int	Sel Det	Non-Disp Prt	MDT On
1	02	11			SBA							
					SF	ATT	✓					
2	04	02			SBA							
					SF	ATT	✓					
3	06	01			SBA							
					SF	ATT	✓		✓			
4	06	07			SF	ATT						
					IC							
5	06	25			SBA							
					SF	ATT	✓		✓			
6	06	35			SF	ATT						
7	07	01			SBA							
					SF	ATT	✓		✓			
8	07	16			SF	ATT		✓				
9	07	23			SBA							
					SF	ATT	✓					
10	10	03			SBA							
					SF	ATT	✓					
11	11	05			SBA							

Figure 7-20. Completed Order and Attribute Information

Item 1. SIGN-ON PROCEDURE

To write this title, you must tell the control unit:

- Where you want the title displayed on the panel. The SBA order sets the buffer address (SBA) to the location at row 2, column 11 (R2, C11).
- That this location is the start of a field. The SF order tells the control unit that the location contains an attribute character and not a text character. You also indicate which attributes the attribute character is defining. In this case, the field is protected. The rest of the attributes for the field are default attributes and, therefore, do not have to be changed.

Item 2. PLEASE ENTER YOUR SIGN-ON INFORMATION:

To write this information, the control unit must know only where the text is located. Therefore, you must write an SBA order followed by the address R4, C2. This is also the beginning of a protected field, so you should include an SF order and a protected attribute.

Item 3. NAME:

As with item 2, you must idenfity where this text is displayed. Therefore, you must write an SBA order followed by the buffer address R6, C1, where the text begins. R6, C1 is also the beginning of a protected, high-intensity field and you should include an SF and an attribute as shown.

Item 4. Input Field for operator's name

Since this item immediately follows item 3, the control unit already knows the correct address. Therefore, there is no reason to issue an SBA order. Item 4 is the start of a new field, however, so you must issue an SF order to instruct the display to expect an attribute character next. The attribute character defines the input field as unprotected (U), alphameric (A), of normal intensity, not detectable by selector pen, and with no MDT on. Because these are the default attributes, you do not have to check anything in the attribute definition columns.

The cursor should follow the attribute character to indicate where the operator should begin to enter information. The Insert Cursor (IC) order displays the cursor at this current buffer address. After the display has stored that attribute character in location R6, C7, the new current address is R6, C8; this is the place where the cursor appears on the panel.

Item 5. LOCATION:

The control unit must have two orders for this item which (1) give the starting buffer address (SBA) of the field as R6, C25, and (2) indicate that it is the start of a new field (SF), that it is protected, and that it has high intensity.

Item 6. Input field for operator's location code

This item immediately follows the text of the last item, so there is no need to set the buffer address. Write only the SF order to indicate the start of a new unprotected field, and use default attributes.

Item 7. SERIAL NUMBER:

This field requires an SBA to location R7, C1, and an SF to begin a new field. The attribute is specified the same as that for item 5.

Item 8. Input field for serial number

The attribute character for this input field immediately follows the last character of the previous field, so an SBA is not required. The attribute is numeric only.

Item 9. An extra field created to limit the size of the serial number input field.

This follows the input field and is protected only. An SBA is required for location R7, C23, for proper placement of the attribute.

Item 10. WHEN ALL . . . COMPLETE.

The control unit must have two orders for this item: an SBA order that gives the starting address of R10, C3, and an SF order to indicate that it is the start of a new field. The attribute character defines a protected field, and the rest of the field attributes take the default values.

Item 11. YOU MAY . . . KEY.

All the words from "WHEN ALL" through "KEY" could have been treated as a single item, but 8 blank spaces would have to be sent between "COMPLETE" and "YOU" to position "YOU" properly at R11, C5. Use only the 3 characters required for an SBA order and its associated address, breaking the field into 2 items, to position "YOU" at R11, C5.

Coding the Panel

To write a panel in assembler language so that it can be part of the application program, you must transfer the panel's text and orders to an assembler coding sheet or to any other form you find suitable.

On the coding sheet (and in your program), a panel is represented by a series of assembler DC statements, each with a name to which your program can refer. In the example given below, SIGNPANL is the name of the sign-on panel. When the application program wants to send the sign-on panel to a display unit, it issues an Erase/Write command and designates SIGNPANL as the panel for display.

The display orders must be written in the DC statements in the hexadecimal codes listed in Figure 7-21. Thus, SF is represented by 1D, SEA by 11, and IC by 13.

Order Sequence Order	Byte 1 (Order Code)		Byte 2	Byte 3	Byte 4
	EBCDIC (Hex)	ASCII (Hex)			
Start Field (SF)	1D	1D	Attribute		
Set Buffer Address (SBA)	11	11	Address	Address	
Insert Cursor (IC)	13	13			
Program Tab (PT)	05	09			
Repeat to Address (RA)	3C	14	Address	Address	Char.
Erase Unprotected to Address (EUA)	12	12	Address	Address	
Keyboard Only					
Duplicate (DUP)	1C	1C			
Field Mark (FM)	1E	1E			

Figure 7-21. Buffer Control Orders and Order Codes

Each part of each order must be written in hexadecimal, including the attribute character that follows the SF order and the buffer address that follows the SBA order. The *IBM 3270 Reference Summary,* GX20-1878, contains the hexadecimal codes for all the attribute character combinations and the hexadecimal code for every buffer location in both EBCDIC and ASCII.

Begin coding with the first item on the panel layout sheet, the title: SIGN-ON PROCEDURE. Start with the orders for the panel text, which must always precede the text itself so that the control unit knows what to do with the text.

The first order for the title is the SBA order. Figure 7-21 shows that the SBA hexadecimal code is 11, so you write this code in a DC statement as:

```
DC  X'11'
```

Now look up the R2, C11 address that must follow the SBA order. The EBCDIC address is 40F2, and it follows the SBA code in the DC statement:

```
DC  X'1140F2'
```

You should also record this statement in the Buffer Address Hex column to the left of the SBA on the layout form for possible future reference. You may, if you prefer, look up all the addresses and record them in a similar manner before you begin to write your DC statements. See Figure 7-22 for an example.

The next order for the title is the SF order, which is followed by the attribute character. Attribute characters are shown in Figure 7-23. The SF code, 1D, and the attribute code, 60, are read from the table and added to the DC statement, which is then closed with a single quotation mark:

```
DC  X‘1140F21D60’
```

Following the DC statement containing the orders for the title is the DC statement containing the text for the title:

```
DC  X'1140F21D60'
DC  C'SIGN-ON PROCEDURE'
```

	Display/Printer		Buffer Address				Attribute					
Item	Row	Col	Dec	Hex	Orders		Prot	No.	High Int	Sel Det	Non-Disp/Prt	MDT On
1	02	11		40F2	SBA							
					SF	Att	✓					
2	04	02		C1F9	SBA							
					SF	Att	✓					
3	06	01		C3C8	SBA							
					SF	Att	✓		✓			
4	06	07			SF	Att						
					IC							
5	06	25		C360	SBA							
					SF	Att	✓		✓			
6	06	35			SF	Att						
7	07	01		C3F0	SBA							
					SF	Att	✓		✓			
8	07	16			SF	Att		✓				
9	07	23		C4C6	SBA							
					SF	Att	✓					
10	10	03		C56A	SBA							
					SF	Att	✓					
11	11	05		C6D4	SBA							

Figure 7-22. Sign-On Procedure Panel Orders and Attributes

ATTRIBUTE CHARACTER BIT DEFINITIONS

Attribute							
Prot	A/N'	MDT On	High Intens	Sel Det	Non-disp Prt	Bits 23 4567	Hex
U						00 0000	40
U		Y				00 0001	C1
U				Y		00 0100	C4
U		Y		Y		00 0101	C5
U			H	Y		00 1000	C8
U		Y	H	Y		00 1001	C9
U			–	–	Y	00 1100	4C
U		Y	–	–	Y	00 1101	4D
U	N					01 0000	50
U	N	Y				01 0001	D1
U	N			Y		01 0100	D4
U	N	Y		Y		01 0101	D5
U	N		H	Y		01 1000	D8
U	N	Y	H	Y		01 1001	D9
U	N		–	–	Y	01 1100	5C
U	N	Y	–	–	Y	01 1101	5D
P	-					10 0000	60
P		Y				10 0001	61
P				Y		10 0100	E4
P		Y		Y		10 0101	E5
P			H	Y		10 1000	E8
P		Y	H	Y		10 1001	E9
P			–	–	Y	10 1100	6C
P		Y	–	–	Y	10 1101	6D
P	S					11 0000	F0
P	S	Y				11 0001	F1
P	S			Y		11 0100	F4
P	S	Y		Y		11 0101	F5
P	S		H	Y		11 1000	F8
P	S	Y	H	Y		11 1001	F9
P	S		–	–	Y	11 1100	7C
P	S	Y	–	–	Y	11 1101	7D

S = Skip Y = Yes
U = Unprotected H = High
P = Protected N = Numeric

Note: *Hexadecimal values are given in EBCDIC.*

Figure 7-23. Attribute Character Combinations in Hexadecimal

To code an input field that contains no text, such as the input field for NAME:, write just one DC statement that contains the orders for that field:

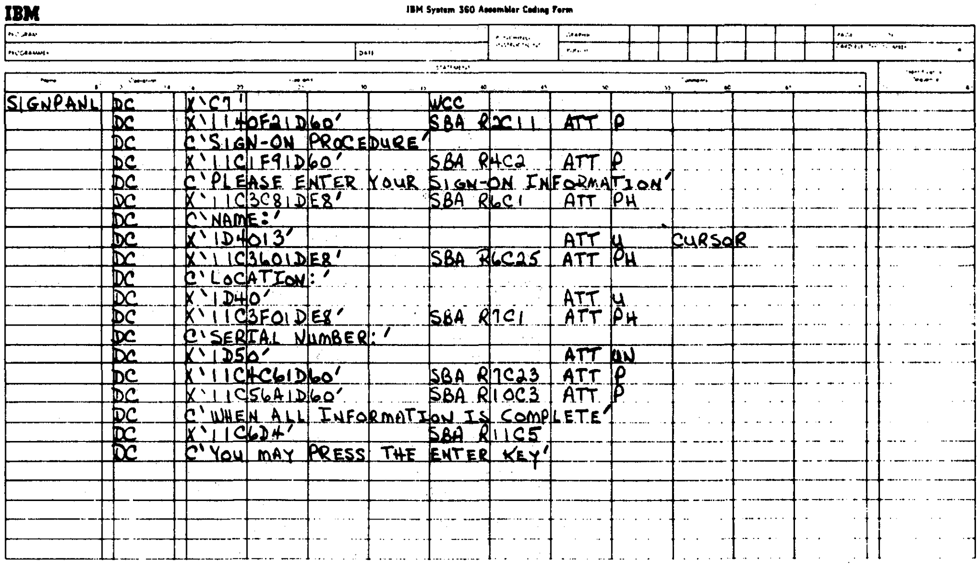
DC X'1D4013'

1D is the hexadecimal code for the SF order, 40 is the hexadecimal code for an attribute character that defines an unprotected field (and all other default attributes), and 13 is the hexadecimal code for the IC order.

A DC statement can be written as two or more statements. The DC statement above, for example, could be written as:

DC X'1D40'
DC X'13'

Each item from the panel layout sheet is coded in this fashion. Figure 7-24 shows the complete code required to display the sign-on panel. Except for one control character, it consists entirely of the panel text, preceded by the display orders for that text. (The control character is described under the heading "Write Control Character (WCC).")



IBM

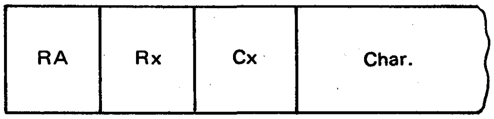
IBM System 360 Assembler Coding Form

```
SIGNPANL DC    X'C7'                    WCC
         DC    X'1140F21D60'            SBA R2C11   ATT P
         DC    C'SIGN-ON PROCEDURE'
         DC    X'11C1F91D60'            SBA R4C2    ATT P
         DC    C'PLEASE ENTER YOUR SIGN-ON INFORMATION'
         DC    X'11C3C81DE8'            SBA R6C1    ATT PH
         DC    C'NAME:'
         DC    X'1D4013'                            ATT U     CURSOR
         DC    X'11C3601DE8'            SBA R6C25   ATT PH
         DC    C'LOCATION:'
         DC    X'1D40'                              ATT U
         DC    X'11C3F01DE8'            SBA R7C1    ATT PH
         DC    C'SERIAL NUMBER:'
         DC    X'1D50'                              ATT UN
         DC    X'11C4C61D60'            SBA R7C23   ATT P
         DC    X'11C56A1D60'            SBA R10C3   ATT P
         DC    C'WHEN ALL INFORMATION IS COMPLETE'
         DC    X'11C6D4'                SBA R11C5
         DC    C'YOU MAY PRESS THE ENTER KEY'
```

Figure 7-24. Assembler Language Statements for Sign-On Panel

Repeat to Address Order

The Repeat to Address (RA) order stores a specified alphameric or null character in buffer locations, starting at the current buffer address and ending at (but not including) the specified stop address. The specified stop address then becomes the current buffer address. You specify the stop address immediately following the RA order, just as you specify an address after an SBA order. After the stop address, you specify the character that you want repeated. Symbolically this appears as:



RA is 3C in hexadecimal. RA can repeat null characters and can erase selected parts of the screen. You may also use it to repeat any other character. To put a row of asterisks under the last title in the sign-on panel, after the DC statement for YOU MAY PRESS THE ENTER KEY, you specify an SBA for R12, C1. The RA order should repeat the asterisk character to location R1, C1 (the address after the last *). This is noted on the layout form as shown in Figure 7-25.

The order in the example is coded as:

```
DC  X'3C4040'
DC  C'*'
```

If you want to delete a field already on the screen, you can repeat the *null* character to delete it.

	Display Printer		Buffer Address		Orders		Attribute					
Item	Row	Col	Dec	Hex			Prot	No.	High Int	Sel Det	Non-Disp Prt	MDT On
1	02	11		40F2	SBA							
					SF	ATT	✓					
2	04	02		C1F9	SBA							
					SF	ATT	✓					
3	06	01		C3C8	SBA							
					SF	ATT	✓		✓			
4	06	07			SF	ATT						
					IC							
5	06	25		C360	SBA							
					SF	ATT	✓		✓			
6	06	35			SF	ATT						
7	07	01		C3F0	SBA							
					SF	ATT	✓		✓			
8	07	16			SF	ATT		✓				
9	07	23		C4C6	SBA							
					SF	ATT	✓					
10	10	03		C56A	SBA							
					SF	ATT	✓					
11	11	05		C6D4	SBA							
12	01	01			RA	*						

Figure 7-25. Example of RA Order

Write Control Character (WCC)

The control unit to which the display unit is attached uses the orders to format the panel. One control character for the control unit must be included as the first character of every panel you write: the write control character (WCC). The WCC is a hexadecimal code that provides control information for the control unit and defines printer information for printing panels. The other information in the WCC specifies:

- Whether to sound the audible alarm. The audible alarm is an optional display unit and printer feature that sounds a tone at the display unit upon program request. You can request this function by selecting the appropriate WCC hexadecimal code. If this feature is not installed on a display unit, the request is ignored.
- Whether to restore the keyboard at the end of your panel operation. If this option is requested, the keyboard, which locks when the operator completes a panel operation, is automatically unlocked when the program has finished processing the operator's input. Keyboard restoration means the operator does not have to press the RESET key.

  You might not want to unlock the keyboard after each panel is displayed. For example, if you plan to write out another panel before you want to accept input, locking the keyboard prevents the operator from entering data before it is needed. Also, after writing an incorrect panel, you may want to force the operator to press the RESET key to make sure you have gained his attention.
- Whether to reset the modified data tag (MDT). If this option is specified, the attribute characters of all modified fields are reset. This function resets all input fields to their original (unmodified) status when an operation is completed so they are ready for the next operation.

Each panel written to a display unit or printer must begin with the WCC to identify whether these functions are requested.

The hexadecimal code for each possible WCC combination is shown in Figure 7-26.

The sign-on panel data is now complete and can be sent to the display unit.

WCCs for the Display

Start Printer	Sound Audible Alarm	Restore Keyboard	Reset MDTs	Code This Hex Value
No	Yes	Yes	Yes	C7
No	Yes	Yes	No	C6
No	Yes	No	Yes	C5
No	Yes	No	No	C4
No	No	Yes	Yes	C3
No	No	Yes	No	C2
No	No	No	Yes	C1
No	No	No	No	40

WCCs for the Printer

				Code This Hex Value If You Want			
Start Printer	Sound Audible Alarm	Restore Keyboard	Reset MDTs	NL and EM Codes Honored	40-Char. Line	64-Char. Line	80-Char. Line
Yes	Yes	Yes	Yes	4F	5F	6F	7F
Yes	Yes	Yes	No	4E	5E	6E	7E
Yes	Yes	No	Yes	4D	5D	6D	7D
Yes	Yes	No	No	4C	5C	6C	7C
Yes	No	Yes	Yes	4B	5B	6B	7B
Yes	No	Yes	No	4A	5A	6A	7A
Yes	No	No	Yes	C9	D9	E9	F9
Yes	No	No	No	C8	D8	E8	F8

Note: *Hexadecimal codes are given in EBCDIC.*

Figure 7-26. WCC Hexadecimal Codes

Analyzing Input Data

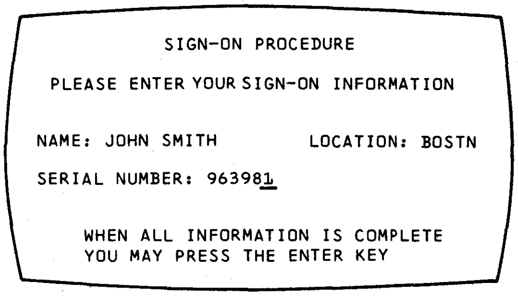
The Operator's Response

When the sign-on panel is displayed, the operator responds by entering name, location, and serial number as shown in Figure 7-27. As the operator keys this information, the entered data characters are stored in the display unit's buffer and are displayed as part of the panel. Data that is entered in a nondisplayable field is stored in the buffer, but does not appear on the panel.

When the operator finishes entering the requested sign-on data, he indicates the end of this operation by pressing the ENTER key, which causes an automatic Read Modified command execution and sends the following information to your program:

- An attention code to identify that the ENTER key was pressed
- The address of the cursor's location
- The start buffer address code to identify the next 2 characters as addresses
- The starting addresses of every modified field, followed by the data in the modified fields

Figure 7-28 shows this sequence of input data, which is explained below.



```
                 SIGN-ON PROCEDURE

   PLEASE ENTER YOUR SIGN-ON INFORMATION

NAME: JOHN SMITH            LOCATION: BOSTN

SERIAL NUMBER: 963981

      WHEN ALL INFORMATION IS COMPLETE
      YOU MAY PRESS THE ENTER KEY
```

Figure 7-27. Sign-On Panel with Operator's Input

AID for ENTER	Cursor address	SBA	Addr of first modified field	Text from first modified field	SBA	Addr of second modified field	Text from second modified field	

Figure 7-28. Input Data Sequence

Attention Identifier (AID)

The attention identifier (AID) is a hexadecimal code. By identifying this code, your program can determine in which of several possible ways the operator contacted the program and determine what request is being made. For example, pressing the ENTER key requests "Please enter this data."

The AID code is always the first code your program receives from the display unit. The hexadecimal codes for all AID codes are shown in Figure 7-29.

For a Read Modified, the AID code is followed by the cursor address, which is the hexadecimal code for the row and column location of the cursor when the operator contacted your program.

Input Data

All the modified fields from the panel follow the AID code and the cursor address. A modified field is any field whose attribute character has the MDT on. A modified field can be one that was modified by the operator or one that was defined by you in your program with the MDT on in its attribute character.

When any character location in an input field is modified by the operator, the MDT in the attribute character for that field is automatically turned on. An input field is not necessarily a modified field. If the operator made no entry in the SERIAL field, for example, only his name, location, and the date would be sent as modified fields to your program.

The display unit sends all the data in a modified field except nulls. When an operator finishes an operation, the display unit reads through the buffer for every attribute character whose code indicates that its MDT is on. Each time one is found, the display unit provides an SBA code and the starting address (the attribute character's address plus 1) of the modified field. The SBA code identifies to your program that an address follows. It is the same X'11' code that you coded in your panel to identify the starting locations of the panel's text.

Attention Identification (AID) Configuration

AID Values for Text Read

Graphic Char- acter	EBCDIC (Hex)	Operator Action
–	60	No action by display operator
Y	E8	No action (printer)
'	7D	ENTER key pressed
1	F1	PF key 1 pressed
2	F2	PF key 2 pressed
3	F3	PF key 3 pressed
4	F4	PF key 4 pressed
5	F5	PF key 5 pressed
6	F6	PF key 6 pressed
7	F7	PF key 7 pressed
8	F8	PF key 8 pressed
9	F9	PF key 9 pressed
:	7A	PF key 10 pressed
#	7B	PF key 11 pressed
@	7C	PF key 12 pressed
=	7E	Immediately detectable field selected
0	F0	TEST REQUEST key pressed
W	E6	Data transferred from card reader

AID Values for Short Read

–	6D	CLEAR key pressed (screen cleared)
%	6C	PA1 key pressed
>	6E	PA2 (cancel) key pressed
,	6B	PA3 key pressed

Figure 7-29. Attention Identifiers (AIDs) in Hexadecimal Codes (EBCDIC)

SBA Codes

SBA codes identify the incoming data by cross-referencing it to the correct input field.

For the sign-on panel, your program knows that row 6, column 8 (X'C34F') is the start of the name input field. When it receives the first SBA code (X'11'), it checks the address that follows to see whether it is (X'C34F'). If it is, your program knows that the text following it (until the next SBA code) is the operator's name and can process the input accordingly.

The first part of the input from the sign-on panel is as follows:

7D	C4	C6	11	C3	4F	J	O	H	N		S	M	I	T	H	. . .

The hexadecimal codes are:

7D: The AID code for the ENTER key. (See Figure 7-29.)

C4C6: The cursor address R7, C23. The cursor is at the next character location after the entered serial number.

11: The SBA (Set Buffer Address) order code, which tells the program that the next 2 characters are addresses. (See Figure 7-21.)

C34F: The location (R6, C8) where the following text is located on the panel.

JOHN SMITH . . .: The first modified field containing the operator's name.

Program Access Keys

Program Attention (PA) Keys

Each 3270 keyboard has at least one program (PA) key that the operator can use to request program attention without sending any input data.

The AID codes for the PA keys are shown under a separate heading in Figure 7-29 because they are not followed by input data, even though there may be modified fields on the panel when a PA key is pressed. All four short read codes consist of the AID code only.

Your program should use these keys for operator requests for immediate action, such as trouble alerts, or for requests for termination. For example, the assignment of several PA keys might be:

PA1: Terminate current application.
PA2: Return to starting (master) panel.
PA3: Explain system message.

Program Function (PF) Keys

Program function (PF) keys are a keyboard feature. Your program defines the function that each key requests when it is pressed by the operator.

There is a separate AID code for each PF key so that your program can quickly identify which key was pressed and, consequently, which function was requested. When a PF key is pressed, all modified fields on the panel and their addresses are sent with the AID code and cursor address, the same as the ENTER key. For this reason, a PF key can be a valuable timesaving device for the operator. For example, the assignment of several PF keys might be:

PF1:	Return to previous panel.
PF2:	Clear (without using data) and repeat current panel.
PF3:	Set up next panel.
PF4:	Page forward.
PF5:	Page backward.
PF6:	Return to page #1.

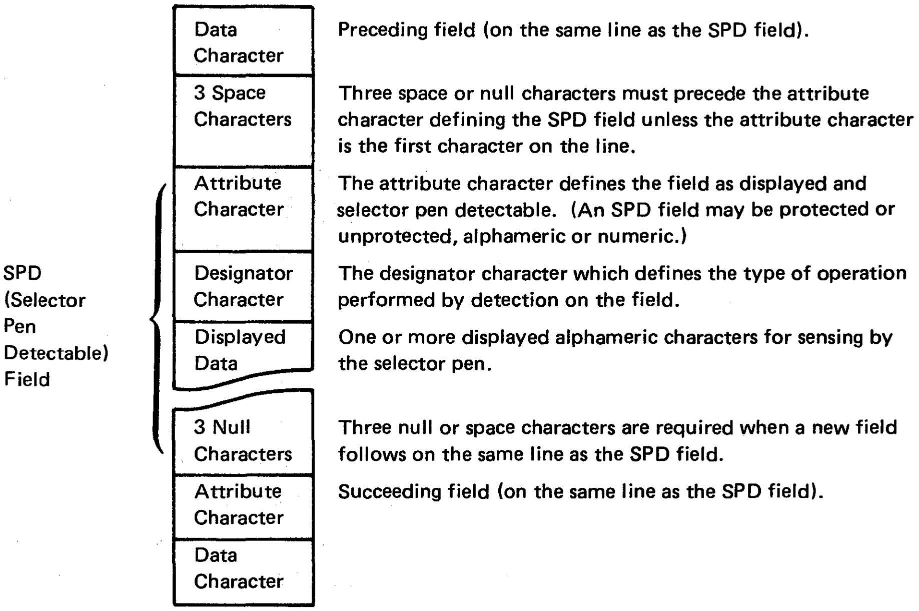
Selector-Pen Input and Output

Positioning data for selector-pen (optional feature) use and setting the attribute characters are the same as for any other type of data, but the selector pen has additional data-stream requirements.

Selector-Pen Field Format

A field for selector-pen operations must be defined as shown in Figure 7-30.

The attribute character, the designator character (described under the next heading), and displayed alphameric characters must be on the same line. If the field is longer than one line, only those characters on the same line as the attribute character can be detected by the selector pen.



Preceding field (on the same line as the SPD field).

Three space or null characters must precede the attribute character defining the SPD field unless the attribute character is the first character on the line.

The attribute character defines the field as displayed and selector pen detectable. (An SPD field may be protected or unprotected, alphameric or numeric.)

The designator character which defines the type of operation performed by detection on the field.

One or more displayed alphameric characters for sensing by the selector pen.

Three null or space characters are required when a new field follows on the same line as the SPD field.

Succeeding field (on the same line as the SPD field).

Figure 7-30. Definition of Field for Selector-Pen Operation

Designator Characters

Designator characters define two types of selector-pen fields: selection and attention. Each type of field performs a different selector-pen operation.

The selection field is defined by a question mark (?) designator character. When the selector pen detects a selection field, the MDT bit in the attribute character for that field is set in the display buffer. Also, the designator character is automatically changed on the screen to a greater-than (>) sign to provide a visible indication to the operator that the detection was successful. If a mistake was made and the operator again detects on the same field, the > reverts to a ? and the MDT is reset. The attention field is defined by a space or null designator character. Probing an attention field is similar to using an ENTER key. The input information is released to be read by the computer when it is ready to do so.

Figure 7-31 shows a sample selector-pen panel that illustrates some of the special input and output data stream considerations.

For output, an Erase/Write creates the panel. In the WCC, you enable input and optionally reset the MDTs. Next you specify an SBA sequence to get you to R1, C7, followed by an SF with a protected attribute.

This should be followed by the heading "PICK. . . COLUMN" and another SBA to R3, C9. Then specify an SF order, followed by a protected (detectable fields may be protected) and detectable attribute. Next you need the designator "?" followed by "RED":

C	O	L	U	M	N	SBA	R3	C9	SF	P+D	?	R	E	D

An SBA after "RED" to R3, C25, provides more than the 3 required null characters and positions the SF, attribute, and designator for "2 DOOR". This type of sequence is repeated for the remaining fields to location R7, C28. The designator here must be a null or a blank so that probing the ENTER field releases the selection to the computer.

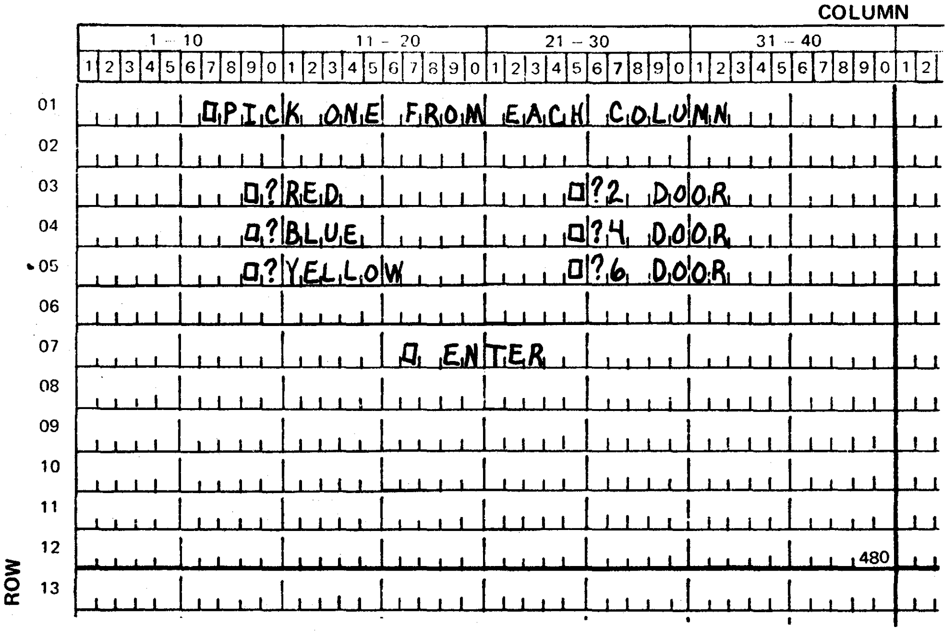


Figure 7-31. Sample Panel for Selector-Pen Detection

As the operator uses the selector pen, the program correlates the address of each selector-pen-detectable field with the data associated with it.

To combine selector-pen-detectable input with keyboard input, use the keyboard to release the data to the computer by pressing the ENTER key or a PF key. Use of the selector pen to release the data transmits only the addresses of the selector-pen-detected fields.

In this example, if you pick RED and 4 DOOR, the symbolic input would appear as follows:

Pen AID	Cursor Addr	SBA	R3	C10	SBA	R4	C26	

Shortening transmissions by eliminating unnecessary data requires some caution. If you design a panel requiring both pen selection and keyboard entry, do not put an attention designator (space or null) on the panel. An attention designator after keyboard entry transmits only the address of the keyboard input field and causes the loss of its contents. Not having an attention designator on the panel assures you that an ENTER or PF key will be used and the modified field contents will be transmitted (and the words "RED" and "4 DOOR" in the example).

The Relationship of One Data Stream to Another

The examples used so far have assumed that you started with a blank screen and that you built the entire panel into your data stream with ERASE or WRITE commands. This approach may lead to tedious work and lengthy data streams, which you can avoid if the panel you wish to display differs only slightly from the one that is presently displayed.

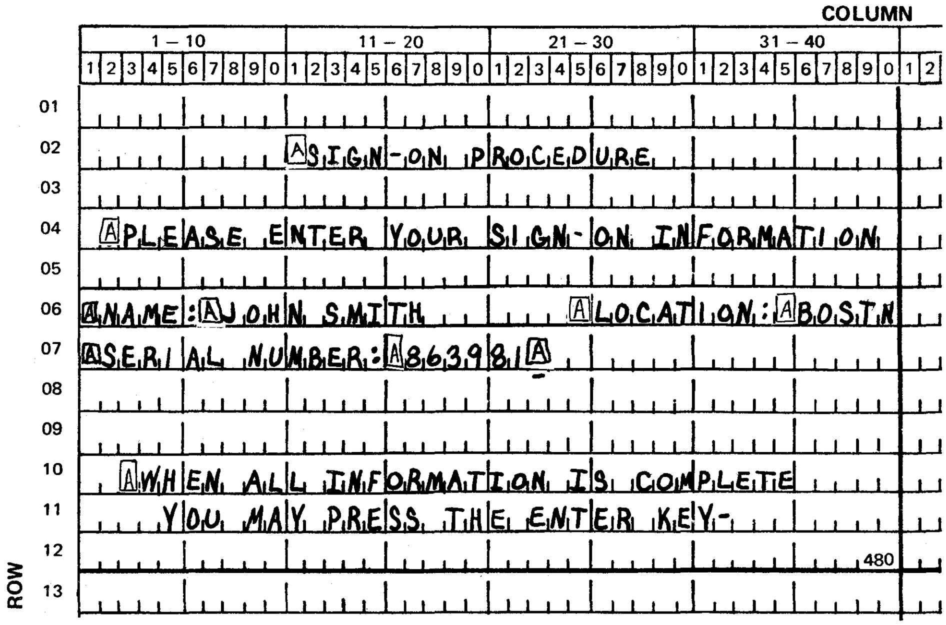
Modifying Existing Panels

Suppose the displayed panel is the sign-on panel in the previous sections. If the operator keys an invalid serial number, you may wish to notify him of his error and request reentry of the serial number field only. You could create a new error message panel, write it to the display, require that the operator acknowledge its receipt, create a special serial number entry panel, write it, and finally read the corrected serial number. A better way might be to use the existing sign-on panel.

After the operator has keyed the data and it is has been read into the computer, the screen appears as shown in Figure 7-32. You would like the screen to look like Figure 7-33. Most of the information you want displayed is already there. An Erase/Write command would clear the screen and require writing a data stream containing all the information for the new panel. You could use a Write command which modifies existing data in the 3270's buffer.

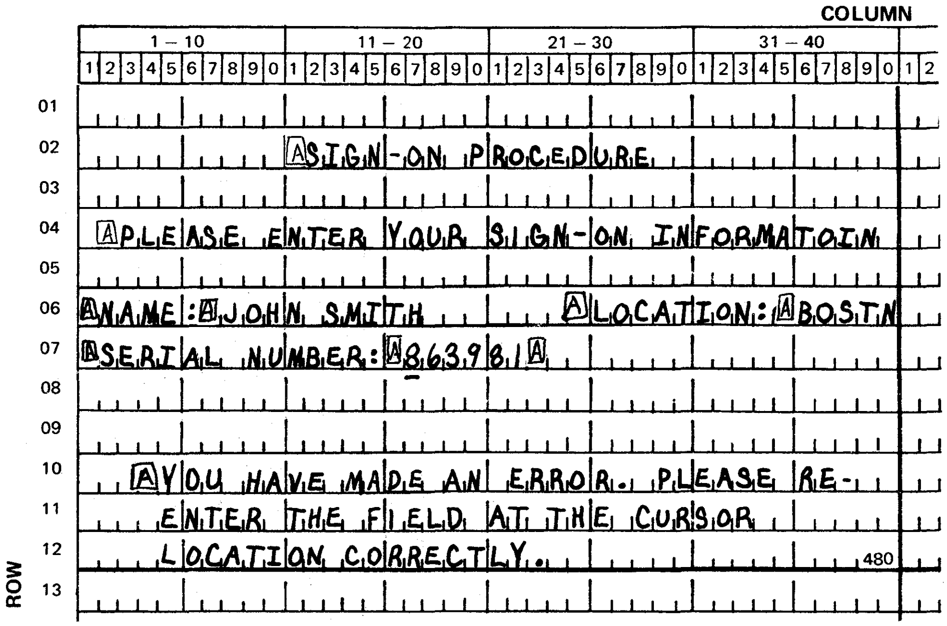
To change the panel in Figure 7-32 to look like Figure 7-33, you would:

1. Position the cursor at R7, C17,
2. Replace the message beginning at R10, C5 with the error message,
3. Change the attribute at R10, C4 to high intensity for the error message.


COLUMN
1 – 10
11 – 20
21 – 30
31 – 40
ROW
480

```
01
02           🄰SIGN-ON PROCEDURE
03
04  🄰PLEASE ENTER YOUR SIGN-ON INFORMATI ON
05
06 🄰NAME:🄰JOHN SMITH          🄰LOCATION:🄰BOSTN
07 🄰SERIAL NUMBER:🄰863981🄰
08
09
10   🄰WHEN ALL INFORMATION IS COMPLETE
11      YOU MAY PRESS THE ENTER KEY-
12
13
```

Figure 7-32. Modifying an Existing Panel – Basic Panel


COLUMN
1 – 10
11 – 20
21 – 30
31 – 40
ROW
480

```
01
02           🄰SIGN-ON PROCEDURE
03
04  🄰PLEASE ENTER YOUR SIGN-ON INFORMATOIN
05
06 🄰NAME:🄰JOHN SMITH          🄰LOCATION:🄰BOSTN
07 🄰SERIAL NUMBER:🄰863981🄰
08
09
10    🄰YOU HAVE MADE AN ERROR. PLEASE RE-
11      ENTER THE FIELD AT THE CURSOR
12      LOCATION CORRECTLY.
13
```

Figure 7-33. Existing Panel with Error Message

To do this the right side of your panel layout for the error panel might (in abbreviated form) look like Figure 7-34.

Item 1. Repositions the cursor to R7, C17.

Item 2. Changes the attribute at R10, C4 to protected and high intensity. If the designer of the sign-on panel had combined the original field at this location with the previous field, the SIGN-ON PROCEDURE field, and the following field by omitting the attributes at R10, C4, R2, C11, and R4, C2 (as you saw in the discussion of attributes), the result would have been undesirable. The attribute placed at R10, C4 would begin a new field. This would not affect the preceding field but, by wraparound, would cause SIGN-ON PROCEDURE and PLEASE . . . INFORMATION to be of high intensity, even though they were neither intended to be so nor rewritten. For this reason, you should adhere closely to the *Field Concept* and not combine fields unless necessary for efficiency; if you must combine fields, be very careful to avoid undesired results.

Item 3. Repositions the data flow to place the second line of the error message correctly: 3 characters are used instead of 6 null characters.

Item 4. Repositions the data flow for the third line of the error message.

Since there are two different types of Write commands, you must tell the I/O portion of your program which type to use for the data stream. You may want to indicate the type you want in a comment in the data stream. It is suggested that you establish some convention for indicating command selection by discussing it at your installation with the persons responsible for the I/O portion of the program.

	Display/Printer		Buffer Address				Attribute					
Item	Row	Col	Dec	Hex	Orders		Prot	No.	High Int	Sel Det	Non-Disp/Prt	MDT On
1	07	17			SBA							
					IC							
2	10	04			SBA							
					SF	Att	✓		✓			
		"LINE 1 OF ERROR MESSAGE'										
3	11	05			SBA							
		"LINE 2 OF ERROR MESSAGE"										
4	12	05			SBA							
		"LINE 3 OF ERROR MESSAGE"										

Figure 7-34. Panel Layout Changes for Error Message (Keyed to Text)

Write Control Character (WCC)

When the operator presses the ENTER key after filling in the sign-on panel, the keyboard automatically locks, as it always does after an operator-initiated input operation. One function of the WCC, which was also discussed under "Coding the Panel," is to enable the keyboard. You should now decide whether you want the WCC at the beginning of the error panel data stream to enable the keyboard for the operator. Though it is normal to enable the keyboard at this point, you may not want to do it here. It might be better for the operator to press the RESET key, calling further attention to the error panel.

In Figure 7-32, assume that the operator now keys 9 and presses the ENTER key. The 9 corrects the original entry error, and the serial number field now reads 963981. What goes into the computer? The prior discussion of input data streams shows the basic format, but which fields can you expect? You know that the serial number input field will be received in its entirety, since keying the 9 caused the 3270 to turn on the MDT for this field, and any field that has been modified is transmitted in its entirety (except nulls).

The input field MDTs for NAME, LOCATION, and SERIAL NUMBER were all turned on by the data entered into those fields in the sign-on panel. Though an Erase/Write resets all MDTs, a Write does not; therefore, if you do not reset them, all 3 input fields are returned to the computer. Since not all of them have changed, not all 3 should return to the computer. You may specify in the WCC that all MDTs in the device are reset *off* or *not modified* (you should do so here).

You may also want to sound the audible alarm, if you have one, with the error panel. A WCC to reset the keyboard, reset all MDTs, and sound the alarm is defined as DC X'C7' (see Figure 7-26). You can now use the Write command to change the sign-on panel into the error message panel.

Caution: As you have seen, the Write command allows you to modify an existing screen image while retaining all, or a portion of, the information already displayed. With the Write command, you can treat the 3270 as a typewriter-type terminal and write your panel line by line or field by field. Using multiple Write commands to create a panel, while technically possible, may create problems.

This operator might start keying data into the panel before you have finished writing it all to the screen. You can prevent this problem by not enabling the keyboard (see WCC above) until the last Write in the series.

Using successive Write commands to accomplish what one Write command can do is an inefficient use of the communication line on remote 3270s, and unnecessary I/O overhead on local 3270s. In addition, in both local and remote use, successive Write commands without an intervening READ may result in a *blinking* effect while you build up the panel. Blinking may be annoying to the operator.

Wherever possible, use a single Write command to avoid the inconveniences noted above.

Erase Unprotected to Address

The error panel shown in Figure 7-33 displayed the erroneous serial number. All the operator had to do was key over the incorrect digits. This may sometimes be confusing. You might instead want to erase only the serial number input field, as shown in Figure 7-35.

Begin again with the desired WCC. Place the cursor at R7, C17 with an SBA to R7, C17, followed by an IC order. To erase what was entered in the serial number input field, use the Erase Unprotected to Address order, or EUA (watch the sequence of these letters so you do not confuse them with EAU, which is discussed next.) The EUA order inserts nulls (erases all unprotected positions, including attributes) from the current buffer address up to, but not including, the specified stop address.

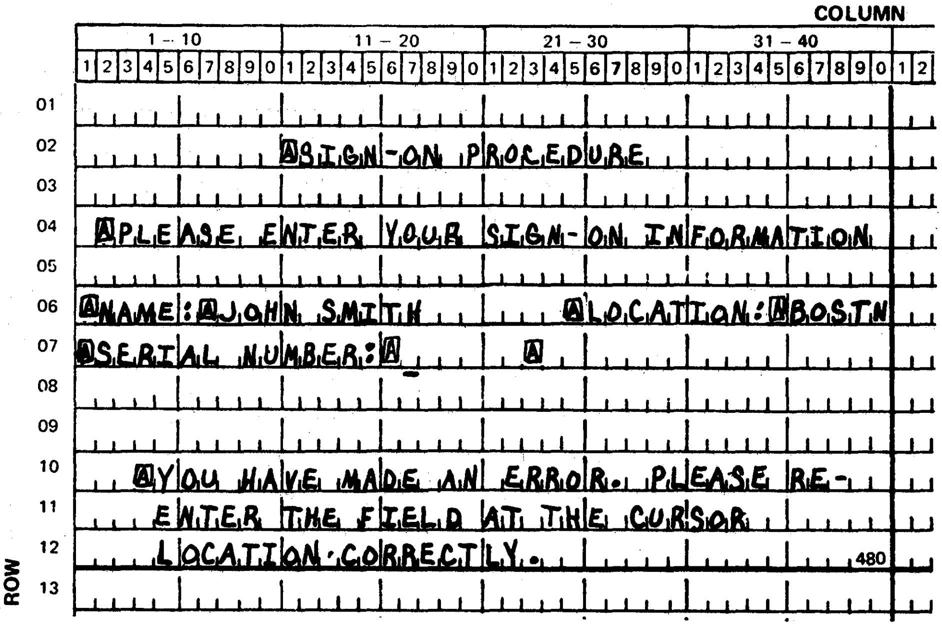
The specified stop address then becomes the current buffer address. The format of the order is similar to an SBA; the code for the order itself (X'12' EUA) is immediately followed by a row and column address.

At the first position to be erased (a result of prior operation), you should include an EUA order. For a terminating address, you may use R7, C23 (the first position after the last to be erased). There is a better stop address, however. Since EUA erases only unprotected fields, and since the field beginning at R7, C23 is protected, it can be included in the range covered by the EUA. If R10, C4 is used as the stop address, nothing additional is erased, but you can then write the next attribute without using an SBA, saving 3 characters of transmission (see Figure 7-36). The current buffer address is the stop address. Any data or SF order that follows goes into the buffer at this address.

The EUA order erases all unprotected fields within its range and can erase multiple fields. Suppose you wanted all three input fields erased on the error panel, as shown in Figure 7-37.

First place the cursor at R7, C17; then *back up* with an SBA to R6, C8 (the name input field) before issuing the EUA to R10, C4 (see Figure 7-38).

You could have started at R6, C8 with an SBA to R6, C8, followed by the EUA to R10, C4. Sometime later in the data stream, however, you would have had to *back up*, probably with an SBA to insert the cursor.


COLUMN
1 – 10
11 – 20
21 – 30
31 – 40
ROW
480

02 ⒶSIGN-ON PROCEDURE

04 ⒶPLEASE ENTER YOUR SIGN-ON INFORMATION

06 ⒶNAME:ⒶJOHN SMITH ⒶLOCATION:ⒶBOSTN

07 ⒶSERIAL NUMBER:Ⓐ_ Ⓐ

10 ⒶYOU HAVE MADE AN ERROR. PLEASE RE-

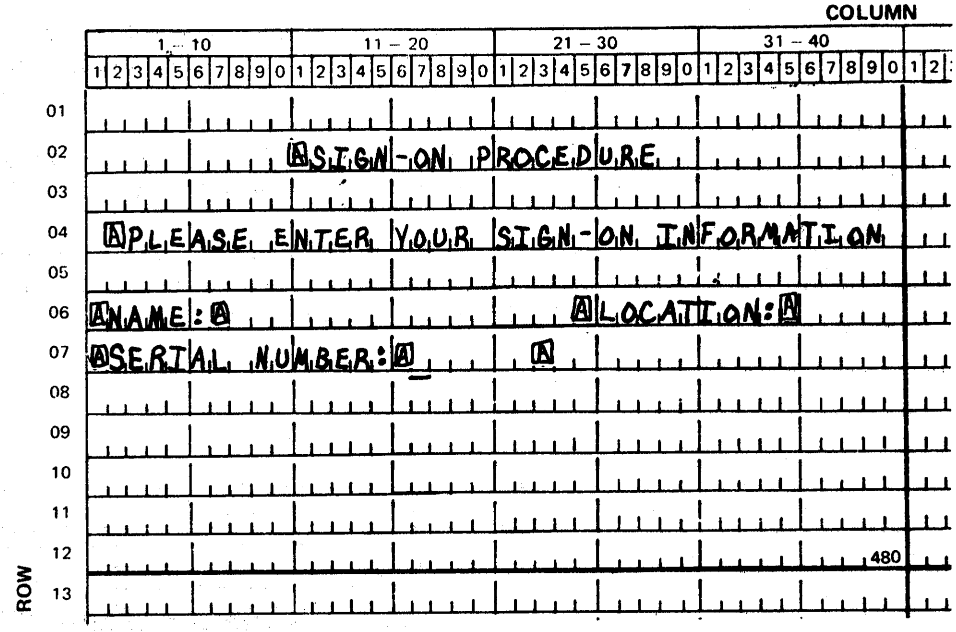
11 ENTER THE FIELD AT THE CURSOR

12 LOCATION CORRECTLY.

Figure 7-35. Error Message Panel with Serial Number Field Erased

	Display/Printer		Buffer Address				Attribute					
Item	Row	Col	Dec	Hex	Orders		Prot	No.	High Int	Sel Det	Non-Disp/Prt	MDT On
1	07	17			SBA							
					IC							
	10	04			EUA							
2					SF	AH	✓		✓			
	"LINE 1 OF ERROR MESSAGE"											
					•							
					•							
					•							

Figure 7-36. Example of EUA Use



```
COLUMN
        1 – 10      11 – 20     21 – 30     31 – 40
01
02                ⒶSIGN-ON PROCEDURE
03
04 ⒶPLEASE ENTER YOUR SIGN-ON INFORMATION
05
06 ⒶNAME:Ⓐ                       ⒶLOCATION:Ⓐ
07 ⒶSERIAL NUMBER:Ⓐ        Ⓐ
08
09
10
11
12                                            480
13
ROW
```

Figure 7-37. Sign-On Panel with Three Erased Fields

Item	Display Printer		Buffer Address		Orders		Attribute					
	Row	Col	Dec	Hex			Prot	No.	High Int	Sel Det	Non-Disp Prt	MDT On
01	07	17			SBA							
					IC							
	06	08			SBA							
	10	04			EUA							
					SF	Att	✓		✓			
					•							
					•							
					•							

Figure 7-38. Erasing Multiple Fields with EUA

Erase All Unprotected Command

In the preceding example, you wanted to erase all unprotected data, reposition the cursor, and add some titles to the sign-on panel to make it an error panel. The Erase All Unprotected (EAU) command:

- Clears all unprotected fields (except attributes) to nulls.
- Resets MDTs in all unprotected fields.
- Unlocks the keyboard.
- Resets the AID (see "Program Access Keys").
- Repositions the cursor to the first character of the first unprotected field.

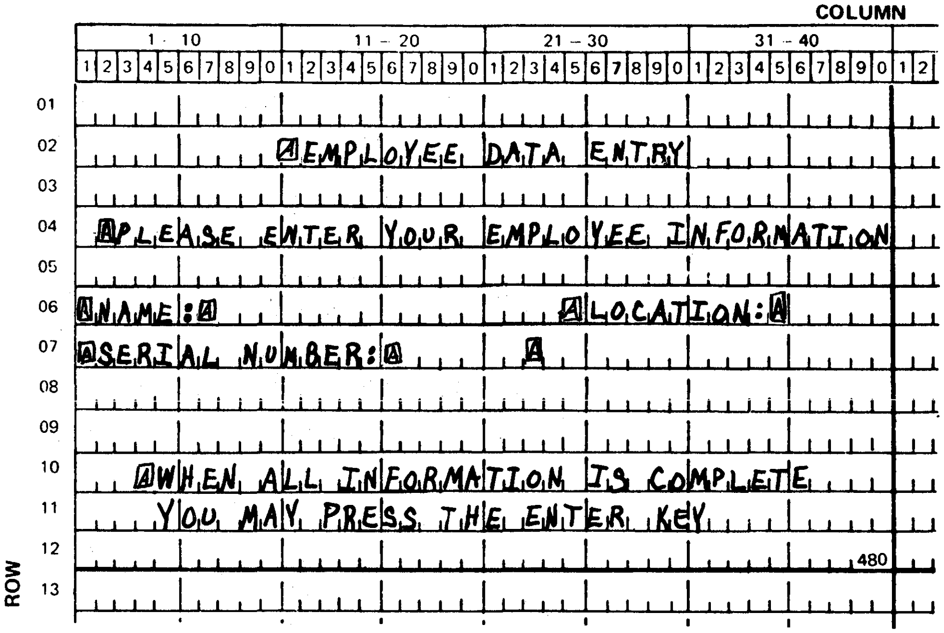
This command appears to do what you want (it even does what the WCC would have done), but it does not write any data to the screen. You could issue an Erase All Unprotected command before the Write command. Then you would just write the new titles in their proper positions. You have then issued two commands to create one panel. What, then, is EAU for? It logically resets the panel for repetitive input using the same panel. Do not use EAU to change panels.

Data Entry Example: You can use the EAU command to change a sign-on panel slightly and make it a data entry panel. Then the operator just keys in NAME, LOCATION, and SERIAL NUMBER for the first employee. If an error is made, an error panel is shown. If there is no error, you may want to clear the input, reset the MDTs, unlock the keyboard, and reposition the cursor.

The data entry panel might appear as shown in Figure 7-39.

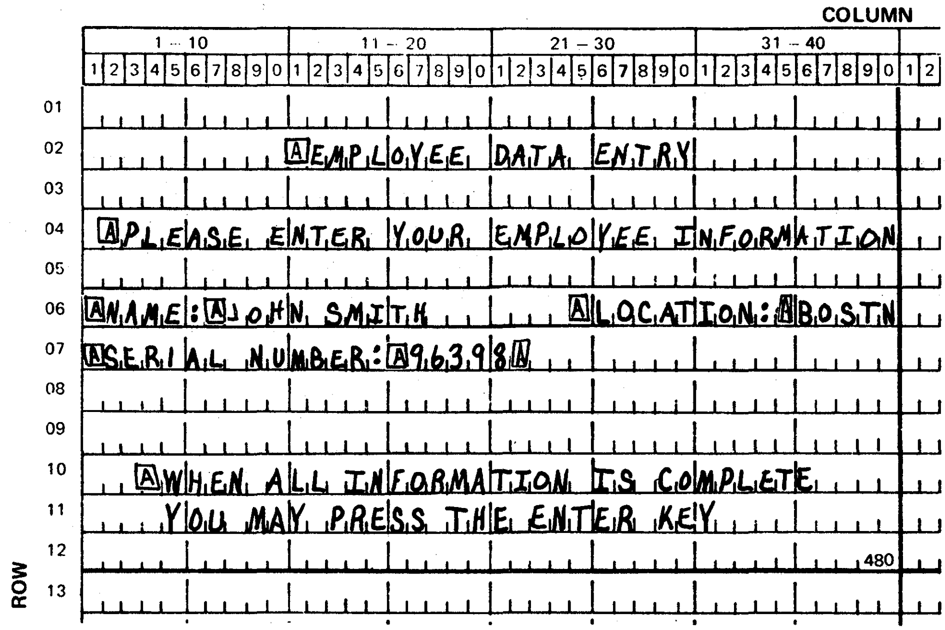
The operator keys JOHN SMITH, presses TAB, keys BOSTN, presses TAB, keys 963981, and presses ENTER (Figure 7-40).

You simply send the 3270 and EAU command to unlock the keyboard. The operator then sees the same panel as in Figure 7-39. The operator may now key data for the next employee. You have used your knowledge of what is displayed already to arrive at the next panel or to re-create the present panel.



```
02            🄰EMPLOYEE DATA ENTRY
04  🄰PLEASE ENTER YOUR EMPLOYEE INFORMATION
06 🄰NAME:🄰                🄰LOCATION:🄰
07 🄰SERIAL NUMBER:🄰      🄰
10   🄰WHEN ALL INFORMATION IS COMPLETE
11    YOU MAY PRESS THE ENTER KEY
```

Figure 7-39. Example of Data Entry Panel



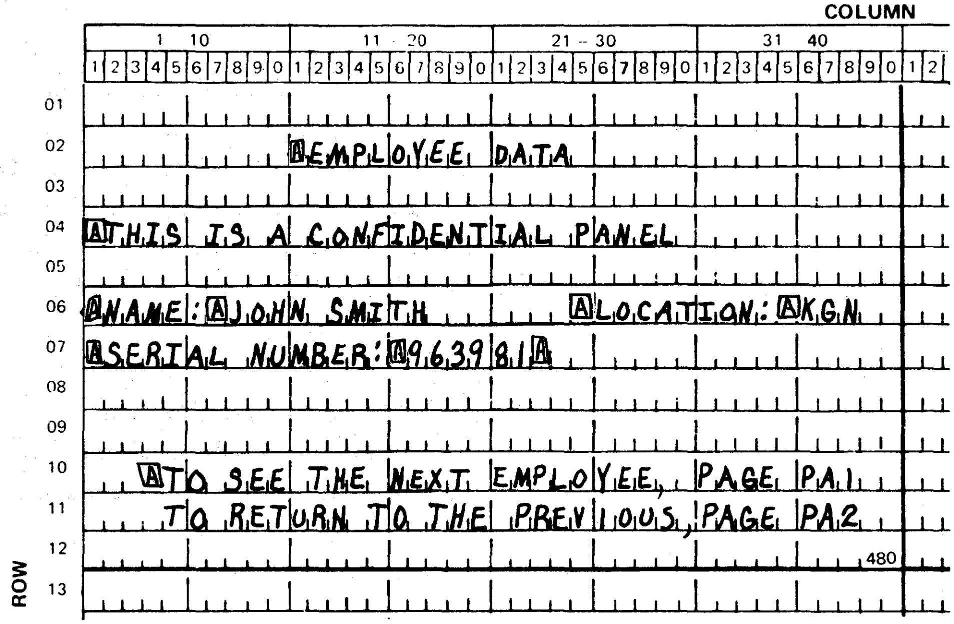
```
02            🄰EMPLOYEE DATA ENTRY
04 🄰PLEASE ENTER YOUR EMPLOYEE INFORMATION
06 🄰NAME:🄰JOHN SMITH        🄰LOCATION:🄰BOSTN
07 🄰SERIAL NUMBER:🄰963981🄰
10   🄰WHEN ALL INFORMATION IS COMPLETE
11    YOU MAY PRESS THE ENTER KEY
```

Figure 7-40. Data Entry Panel with Entered Data

Repetitive Output

In the data entry example, you used one panel repetitively for input of employee information. You can reverse the requirement and design an employee data screen. For this example, assume the application is inquiry with *browsing* capability. Assume also that the operator has previously used another panel to request the information for employee number 963981. The display might appear as shown in Figure 7-41.

At the bottom of the panel, the operator is instructed to use the PA1 key to see the next employee page, probably number 963982. The PA2 key is assigned to page backwards. Remember, PA keys are assigned by the program. Program access keys cause a short transmission; they do not even transmit the contents of changed fields. For an inquiry and browsing application, there should be no input. The PA key assures there is no input even if the operator changes one of the unprotected fields; its use is therefore preferred to that of the ENTER or PF keys.



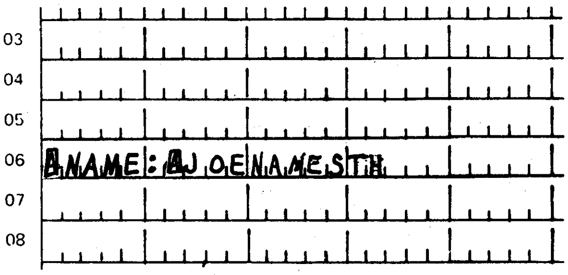
```
02            🄰EMPLOYEE DATA
04  🄰THIS IS A CONFIDENTIAL PANEL
06  🄰NAME:🄰JOHN SMITH            🄰LOCATION:🄰KGN
07  🄰SERIAL NUMBER:🄰963981🄰
10     🄰TO SEE THE NEXT EMPLOYEE, PAGE PA1
11      TO RETURN TO THE PREVIOUS, PAGE PA2
```

Figure 7-41. Employee Data Panel

Program Tab

The input fields in the previous examples are output fields in this example. You could designate them as protected, but, if you did, you could not use another 3270 function called *Program Tab*. The Program Tab (PT) order advances the current buffer address to the address of the first character location of the next unprotected field. When the PT order immediately follows an alphameric or null character (not another order) in the WRITE data stream (other than the character specified by the Repeat to Address order, which is discussed earlier), it also inserts nulls in all the character positions from the current buffer address to the end of the current field. The PT order can be used to page through the employee data file.

When the operator is ready to view the information for the next employee, he presses the PA1 key. Since you want only to modify the present panel, not erase it or blank the unprotected fields, you request a WRITE command with a WCC to unlock the keyboard. Because you are not sure of the present buffer address, you might begin with an SBA order to R6, C8 followed by the next employee name from the disk file – JOE AMES. Because this name contains fewer characters than JOHN SMITH, the screen would look like this if you did not clear the remainder of the field:



You must also place the location code at location R6, C36. You could use blanks after the name and an SBA sequence, or EUA with its associated address. Use PT instead. Insert a PT order after the "S" in "AMES". The single PT order clears the remainder of the unprotected name field to nulls and positions for the location code. PT should also follow the location code to position for the serial number. The data stream might look like this:

WCA	SBA	R6	C36	J	O	E		A	M	E	S	PT	K	N	G	S	T	PT	9	3	9	8	2

The screen would appear as shown in Figure 7-42.

As you have seen, you can write each new panel out in its entirety with an Erase/Write command. You should understand the relationship between the past data streams and the one you are building.

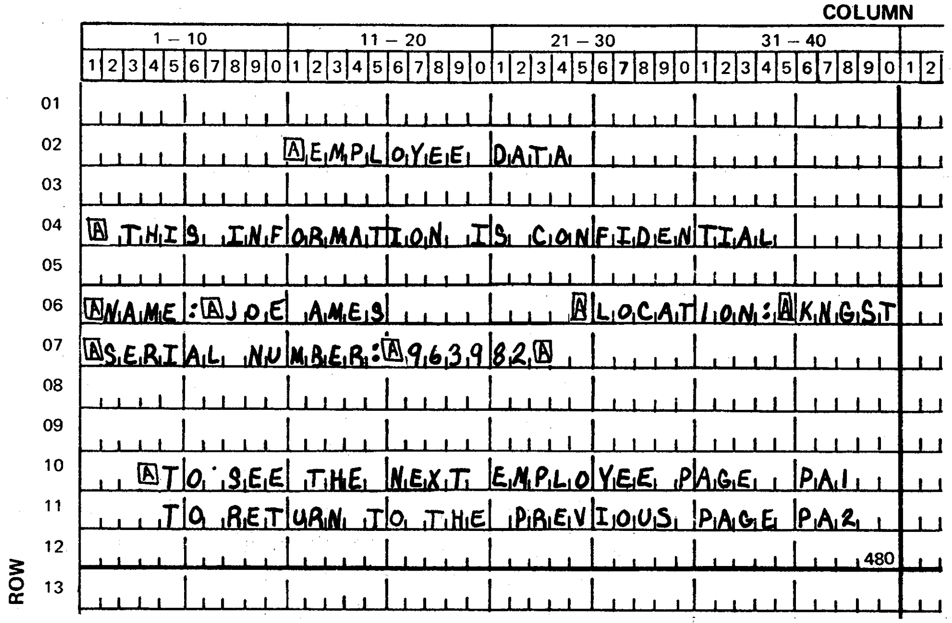


Figure 7-42. Panel Defined with Program Tab

Chapter 8. Screen Management

A screen-management program module is a set of subroutines physically separate from application programs and from the telecommunication-management program module of an online 3270 system. Figure 8-1 illustrates this relationship.

Support functions in a screen-management program may reduce the amount of detail work required by the application programs and effectively use the features of the 3270. The separation of screen management from the other programs also allows screen management to be modified with little or no impact on application programs or on the telecommunication-management programs.

Screen management might include:

- Decoding input data streams.
- Dynamic building of output data streams.
- Generating multiple I/O requests to the Line Control Module based upon a single request from an application program (that is, WRITE then READ).
- Automatic paging; the application program passes multiple pages to screen management, which asks the line control module to write a particular page to a display, depending on the display operator's request.
- Automatic copying (providing a hard copy of a display image).

The copy function supports data movement between any types of device attached to the same control unit: display to display, display to printer, printer to display, and printer to printer. To prevent copying information from an unauthorized device, the control unit provides a program-controlled copy lock for devices attached to it. If the first position of a device buffer contains an attribute character with the protected option and the second buffer position contains a null character, the control unit rejects any attempt to copy from that device.

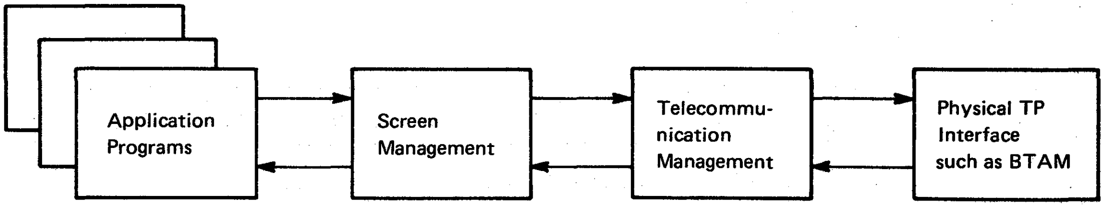

Application Programs
Screen Management
Telecommunication Management
Physical TP Interface such as BTAM

Figure 8-1. Relationship of Screen Management to Telecommunication Management and Application Programs

Decoding and Generating Data Streams

The data streams sent between application programs and the 3270 contain unique orders that request particular operations by the 3270 displays and printers. Generalized subroutines can be written to assist the application programmer's interface with the 3270 system, and an interface can be built to simplify online programs.

This chapter discusses several approaches to developing a screen-management module whose functions the application programmer can use to prepare output data streams and to decode input data streams. The approaches demonstrate how some 3270 device-dependent considerations can be removed from the application programmer's responsibility. The different techniques for 3270 input or output data stream manipulation can be used in various combinations to suit the needs of the installation.

This discussion assumes that the BTAM device management routines (line control) make the local and remote 3270 transparent to the application program. Therefore, discussion of data streams in this chapter ignores all header data in the input stream up to and including the AID character, and all header data in the output stream up to but not including the write control character (WCC).

Decoding Read Modified Input Data Stream

A Read Modified command for a display station with a formatted screen (a screen with at least one attribute character defined) produces a data stream consisting of the data from each field whose modified data tag has been turned on (either by program control or by data entered in the field). Each transmitted data field is preceded by the 3270 buffer address where that data is located on the display. The order of the fields transmitted from the screen is from left to right for each line, starting at the top of the screen and ending at the bottom of the screen. All null characters in a transmitted field are stripped out by the control unit during transmission.

The data stream, ignoring the header information up to and including the AID character, appears as:

SBA	A1 A2	Data	SBA	A1 A2	. . .

If the data entered in a field is of variable length or if a field can be skipped by the terminal operator, the data from a particular field on a given panel can appear in a different location within the data stream for each set of operator input. A Read Modified command produces a variable-length data stream of fixed-length fields and variable-length fields concatenated together.

Each 2-character screen address in the data stream is immediately preceded by a Set Buffer Address (SBA) order. The detection of each SBA order in the data stream identifies the next 2 characters in the stream as a 3270 screen address and also indicates the end of the preceding data field. The System/360 and System/370 Translate and Test instruction (TRT) can be used to scan the data stream and to stop at each main storage address containing an SBA order. If the detected main storage address of the current SBA order is known, the following calculations can be performed for a given data stream:

SBA(1), ADD(1A), ADD(1B), DATA FIELD(1),
SBA(2), ADD(2A), ADD(2B), DATA FIELD(2),
SBA(3),

The numbers in parentheses are used as subscripts to provide unique identification:

- The length of data field(1) = [Address of SBA(2) – Address of SBA(1)] -3.
- The 2-character 3270 screen address of data field(1) can be found at the address of SBA(1) +1.
- The length of data field(2) = [Address of SBA(3) – Address of SBA(2)] -3.
- The 2-character screen address of data field(2) can be found at the address of SBA(2) +1.

The 2-character 3270 screen address as it appears in the input stream does not provide a direct decimal or binary numeric value that can be used to calculate the relative position in the 3270 buffer from which the data was read. However, you can use the following routine to convert the 3270 address as it appears in the input data stream into a binary value that directly indicates the position (relative to zero) of the data in the 3270 buffer.

Assume that R3 contains the address of SBA(1) and that R4 and R5 are work registers. R5 will contain the result at the end of the routine.

```
ADDCNVRT  EQU  *
          SR   R4, R4        CLEAR WORK REG
          SR   R5, R5        CLEAR WORK REG
          IC   R4, 0 (R3)    GET FIRST ADDRESS CHAR (ADD (1A))
          N    R4, = F'63'   TURN OFF ALL BITS EXCEPT LAST SIX
          IC   R5, 1 (R3)    GET SECOND ADDRESS CHAR (ADD (1B))
          N    R5, = F'63'   TURN OFF ALL BITS EXCEPT LAST SIX
          SLL  R4, 6         SHIFT FIRST ADDRESS SIX BITS TO THE LEFT
          AR   R5, R4        ADD THE RESULTS TOGETHER
```

By use of the above technique, several approaches can be developed to a general-purpose subroutine that decodes the variable-field-length data stream for the application program, and returns the data in a more easily processed format.

Non-Selector-Pen Data Streams

Display Buffer Image Technique: By using the READ BUFFER command, you can use the display buffer image technique to return to the application program a main storage buffer area of the same size as the display buffer (480 or 1,920). The data read from the display is placed in the same relative position in the main storage buffer that it occupied in the display buffer, with all other positions in the returned buffer cleared to spaces.

For this technique, use the TRT instruction and the 3270 address conversion routine. You must know the relative locations in the display buffer where the operator can enter data, so that the decoded buffer can be processed when returned by the mapping subroutine. The completed layout sheet for the panel in which the operator enters data will give you the required addresses relative to the respective buffers.

With the image technique, all data received from the 3270 is left-justified in its respective fields. This has no effect on fixed-length fields, variable-length alphameric fields (which are normally left-justified), or omitted input fields. However, you must be aware of variable-length numeric fields where the operator can omit leading 0's.

Although the image technique requires little main storage for the mapping subroutine, main storage can be wasted if the routine returns a complete buffer with little data. To help overcome this problem, the decoding routine can pass back to the application program a field at the beginning of the buffer. The field indicates the total length of the buffer, which allows the decoding routine to use a buffer area just large enough to accommodate the relative address of the last data field read.

Mapping from a Table of Requirements: This mapping technique requires a table assembly for each unique input panel that the mapping subroutine decodes for the application program. The table provides information to the subroutine so that the input data stream in one main storage buffer can be decoded a field at a time and moved to a specified relative offset in another main storage buffer (the target buffer) according to the directions assembled in the table. The preassembled table could be used to specify the following information to the mapping subroutines:

1. The 3270 buffer address preceding each field, which could be read from a particular panel. This is the buffer address as it appears in the data stream that corresponds to the first data position in a field, not to the buffer location of the attribute character that defines the field. Any data fields in the 3270 input stream that do not have a matching buffer address in the table would be ignored by the typical mapping routine using the table approach.

2. An offset relative to zero that provides the starting position of each field in the target buffer. This information allows the application programmer to order the fields in the target buffer in a sequence that may or may not agree with the field sequence in the transmitted data stream.
3. A value that indicates the maximum length of each field in the target buffer. This information allows the mapping routine to truncate data stream fields that are too long for the target fields. The maximum field length value is also required if the mapping routine supports right justification of fields during mapping.
4. A flag byte consisting of bit switches that could indicate:
   - Whether left justification with low-order blank padding is requested
   - Whether right justification with high-order zero fill is requested
   - Whether the field should be translated to ensure uppercase characters only
   - Any additional functions the installation wishes to implement in the mapping routine

Figure 8-2 shows some typical logical contents of the table. The order of the elements within each table entry is optional.

Assume that you map the following input data stream in hexadecimal using the sample table in Figure 8-2:

1140D4F1F2F31140E8818283848511C1C6E385A7A3

The following target buffer, also in hexadecimal, would be returned to the application program:

C1C2C3C4C54040404040F0F0F1F2F3E385A7A34040

This approach to mapping makes the application program's input processing routine device-independent.

```
TABLE      DS  0H
ENTRY1     DC  X'40D4'    ACTUAL 3270 ADDRESS FOR POS 20
           DC  H'10'      RELATIVE OFFSET IN TARGET BUFFER
           DC  HL1'5'     MAX FIELD LENGTH OF TARGET FIELD
           DC  X'80'      RIGHT JUSTIFY, NO TRANSLATE FLAG
ENTRY2     DC  X'40E8'    ACTUAL 3270 ADDRESS FOR POS 40
           DC  H'0'       RELATIVE OFFSET IN TARGET BUFFER
           DC  HL1'10'    MAX FIELD LENGTH OF TARGET FIELD
           DC  X'40'      LEFT JUSTIFY, TRANSLATE FLAG
ENTRY3     DC  X'C1C6'    ACTUAL 3270 ADDRESS FOR POS 70
           DC  H'15'      RELATIVE OFFSET IN TARGET BUFFER
           DC  HL1'6'     MAX FIELD LENGTH OF TARGET FIELD
           DC  X'00'      LEFT JUSTIFY, NO TRANSLATE FLAG
ENDOLIST   DC  X'FF'      END OF LIST INDICATOR
```

Note: *3270 buffer addresses in the table are shown relative to buffer location zero; relative offsets in the target buffer are shown relative to zero.*

Figure 8-2. Table of Requirements

Instead of the mapping table, you could write a macro instruction to prepare the table; the macro would convert written requests into the proper machine language constants.

A typical format for a macro instruction to build the sample table shown in Figure 8-2 might be:

```
MAP    NAME=TABLE,MODEL=2
MAP    ADD=(1,21),OFFSET=11,MAXL=5,JUST=RIGHT
MAP    ADD=(1,41),OFFSET=1,MAXL=10,JUST=LEFT,TRAN=YES
MAP    ADD=(1,71),OFFSET=16,MAXL=6,JUST=LEFT
```

Note: *The ADD parameter specifies the 3270 buffer in row and column notation relative to 1. For example, buffer position 0 equals row 1, column 1. The offset values are expressed relative to 1. The macro instruction can have default options; for example, if JUST=RIGHT is not specified, JUST=LEFT can be assumed.*

The following example shows the logic flow for a table-driven input mapping technique:

1. Find the 3270 buffer address of a data field to be processed in the input data stream, using the TRT instruction.
2. Determine the length of the data field in the data stream, using the techniques discussed in this chapter.
3. Search the table of requirements, using the 3270 buffer address found in step 1 as a search argument, to find a matching entry.
4. Add the offset value from the entry found in the table to the starting address of the main storage map buffer, to produce the main storage address of the start of the receiving field.
5. If the length of the data field determined in step 2 is greater than the maximum field length value in the entry found in the table, go to step 10.
6. Check the flag byte in the entry found in the table. If left justification is requested, go to step 10. Otherwise, proceed to step 7 for right justification.
7. Move zoned decimal zeros to the receiving field, using the field starting address determined in step 4. Use the maximum field length value in the entry found in the table as the length for the move.
8. Develop a new main storage address for the start of the receiving field to accommodate the request for right justification. The right-justified starting address for the receiving field equals (field starting address determined in step 4 + maximum field length value in the entry found in the table) minus length of the data field in the data stream found in step 2.
9. Move the data field from the data stream to the main storage address developed in step 8, using the length of the data in the data stream determined in step 2. Return to the start of this routine to find the next data field in the data stream.
10. Move blanks to the receiving field, using the starting address of the field as determined in step 4. Use the maximum field length value in the entry found in the table as the length for the move.
11. Move the data field from the data stream to the receiving field, using the field address determined in step 4. Use the length of the data in the data stream (determined in step 2) as the length for the move.
12. Check the flag byte in the entry found in the table to determine whether uppercase translation is requested. If it is not requested, return to the start of this routine to find the next data field in the data stream.

13. Translate the data in the receiving field to uppercase; then return to the start of this routine to find the next data field in the data stream. The translation can be done in two ways:

    a. Use the TRANSLATE instruction with the translation table built to convert lowercase alphabetic characters to uppercase.

    b. Use the OR instruction to place spaces in the field. This will change the DUP and FM characters. The FM appears as a semicolon (;) on the screen, but appears in the data stream as X'1E'. It will be converted to a true ; (that is, X'5E'). The DUP appears as an asterisk (*) on the screen, but appears in the data stream as X'1C'. It will be converted to a true * (X'5C').

Immediate Selector-Pen Data Stream

When a Read Modified command is executed for a display station as a result of an immediate detection by the selector pen, the resulting data stream consists of address strings that identify the fields on the screen that have the modified data tag set; no field data is transmitted in the data stream.

The data stream, ignoring the header information up to and including the AID character, appears as:

SBA	A1 A2	SBA	A1 A2	. . .

If the operator keys into a field and an immediate selector field is selected, the keyed data is not transmitted. However, if keyed data is entered by the operator, delayed selector fields are selected, and the ENTER key or a PF key is pressed, then the address and data for all fields, whether selected or keyed, are included in the data stream.

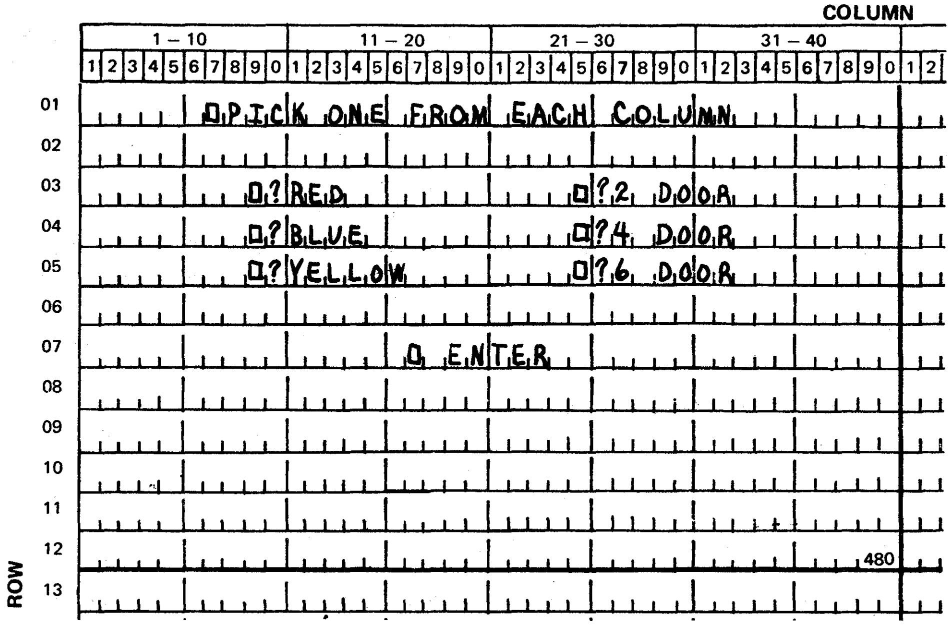
You can use a subroutine to free the application program from determining which fields were selected on a panel. A table can be built that consists of the 3270 buffer addresses, giving the location of each selectable field on a panel. The mapping routine can then compare the addresses in the table and return to the application program a list of indicators identifying the selected fields.

The list of indicators can be returned to the application program. A string of 1-position fields can be used, and each position can indicate with a unique character that a field was selected. The first position in the returned list can be marked if a field in the data stream has the same address as the first element in the address table; the second position in the returned list can be marked if a field in the data stream has the same address as the second element in the address table. The application program can then determine which relative positions in the list have been marked to determine which fields have been selected by the operator.

Because the input from a display using selector-pen detection is a series of fixed-length addresses, the mapping routine can analyze the input stream and decode it.

For example, using the selector panel illustration in Figure 8-3, assume that the operator has selected the delayed-detectable fields located at row 5, column 10 and row 3, column 26 and the immediate-detectable field located at row 7, column 18. The input data stream transmitted in hexadecimal from the display would be:

```
11C1E911C2E911C4C1
```



□ PICK ONE FROM EACH COLUMN

□?RED □?2 DOOR

□?BLUE □?4 DOOR

□?YELLOW □?6 DOOR

□ ENTER

Figure 8-3. Example of Selector-Pen Panel

Using the sample table in Figure 8-4, the mapping routine returns a list in hexadecimal to the application program:

406F40406F406F

This list indicates that the 2nd, 5th, and 7th fields were selected. Note that the addresses of the selected fields appear in the data stream in the same sequence that the fields appear in the display buffer. When a selector-pen panel is designed by columns, the address of the field selected from the first column may not occur before the address of the field selected from the second column in the input data stream.

You can write a macro instruction similar to the one used to build the table in Figure 8-2 to build the selector pen table:

```
MAP    NAME=SELTABLE,MODEL=1
MAP    ADD=(3,10)
MAP    ADD=(3,26)
MAP    ADD=(4,10)
. . .
```

```
SELTABLE        EQU   *          FOR MODEL 1 DISPLAY
                DC    X'C1D9'    ROW 3 COL 10
                DC    X'C1E9'    ROW 3 COL 26
                DC    X'C2C1'    ROW 4 COL 10
                DC    X'C2D1'    ROW 4 COL 26
                DC    X'C2E9'    ROW 5 COL 10
                DC    X'C2F9'    ROW 5 COL 26
                DC    X'C4C1'    ROW 7 COL 18
                DC    X'FF'      TABLE STOP INDICATOR
```

Note: *The 3270 addresses in the table correspond to the buffer position of the Selector Pen designator character in a field, not to the location of the attribute character that defines the field.*

Figure 8-4. Sample Mapping Table

Mixed Read Modified Input Data Streams

When some keyed input and some delayed selector-pen detection occur in a panel during the same input operation from a display, you can use the table-driven mapping technique for non-selector-pen panels. Specify the table elements so that all delayed selector fields have a maximum length of 1 character. The mapping routine places the 1st character from the appropriate data stream field into the target field. The 1st character in a delayed selector-pen field that has been selected is always a (>); that is, X'6E'. The application program can examine the target buffer for that character in the proper target field to determine whether the field has been selected.

Building Output Data Streams

The 3270 requires specific bit patterns for order sequences, control characters, and buffer addressing. The data streams can be prepared in several different ways. A data stream to build a static panel (a panel that will always be displayed in exactly the same manner) can be assembled in an application program as a set of data constants. A semidynamic panel, which may occasionally be modified or added to, can have the static portion assembled in the application program and have the program dynamically modify or add to the data stream. A data stream for a dynamic panel (a panel with a high degree of change) must be created or assembled as a unit at execution. Following is a discussion of how to reduce the considerations of device-dependency required to support static, semidynamic, and dynamic output data streams.

Static Data Streams

You can write macro instructions to simplify the preparation of static data streams for the 3270. One approach is to write a set of macro instructions in which each macro instruction prepares a single-order sequence. Another approach is to write one macro instruction that can prepare all types of order sequences, but prepares only one sequence for each execution of the macro instruction in a program.

A sample macro instruction of the first type might be:

$MOD MODEL = 1 , 2

This macro instruction sets a global value so that the specified model number is used until another $MOD macro instruction is encountered. The model number is required to calculate correctly the 3270 buffer addresses. The buffer address 'C2D5' represents column 4, row 30 for a Model 1 display, and column 2, row 70 for a Model 2 display.

The following are also examples of the first type of macro instruction:

$SBA (1,10) generates the SBA order sequence X'1140C9'.

$SF (PROT,NUM,SKIP,MDT,HI,DET,NONDISP)

generates an SF order (X'1D') followed by the appropriate attribute character defined by the options selected in parentheses. Notice that, if PROT is not specified, unprotected is assumed; if numeric is not specified, alphameric is assumed.

$RA (1,10,'*') generates the RA order sequence X'3C40C95C'.

$EUA (1,10) generates an EUA order sequence X'1240C9'.

$WCC (RESET,RESTORE,ALARM,PRINT,40CHAR,64CHAR,80CHAR,NL EM)

generates the proper WCC, depending on the options selected in parentheses.

$CCC (PRINT,40CHAR,64CHAR,80CHAR,ALARM,ATT,UNPROT,PROT,ALL)

generates the proper copy control character (CCC), depending on the options selected in parentheses. (The CCC identifies the type of data to be copied.)

$IC generates X‘13’.

$KBD KEYBOARD = APL

is used with the Data Analysis feature to identify the keyboard providing 3277 Model 2 display input.

$SI generates the Suppress Index character, valid for the 3288 Model 2 printer. Other printers receive 4 (the or bar) in place of the Suppress Index character.

After you have defined the macro instruction, the data stream required to build the sign-on panel shown in Figure 7-12 could be created as follows:

```
SIGNON    $MOD      MODEL=1
          $WCC      (RESET,RESTORE)
          $SBA      (2,11)
          $SF       (PROT)
          DC        C‘SIGN-ON PROCEDURE’
          $SBA      (4,2)
          $SF       (PROT)
          DC        C‘PLEASE ENTER YOUR SIGN-ON INFORMATION’
          $SBA      (6,1)
          $SF       (PROT,HI)
          DC        C‘NAME:’
          $SF
          $IC
          $SBA      (6,25)
          $SF       (PROT,HI)
          DC        C‘LOCATION:’
          $SF
          $SBA      (7,1)
          $SF       (PROT,HI)
          DC        C‘SERIAL NUMBER:’
          $SF       (NUM)
          $SBA      (7,23)
          $SF       (PROT)
          $SBA      (10,4)
          $SF       (PROT)
          DC        C‘WHEN ALL . . . ENTER KEY’
```

You could also write the second type of instruction, a single 3270 data-stream macro instruction, which might have the format:

```
[symbol]   $MAC              ,(attributes)                           1
                    op-type  ,(row,column)   [,character]   ,MODEL=  2
                                                                     3
                                                                     4
```

symbol
specifies a symbol that refers to the data stream.

op-type
specifies the type of screen control operation to generate. Valid values are SF, SBA, IC, RA, EUA, WCC, and CCC.

(row, column)
specifies the row (1 to 24) and column (1 to 80) where the operation starts or ends (depending on the op-type). This parameter is required for op-types SBA, RA, and EUA.

(attributes)
indicates attributes or control bits for SF, WCC, and CCC:

Some valid values for SF are PROT, SKIP, NUM, MDT, HI, DET, and NONDISP.

Some valid values for WCC are RESET, RESTORE, ALARM, PRINT, 40CHAR, 64CHAR, 80CHAR, and NLEM.

Some valid values for CCC are PRINT, 40CHAR, 64CHAR, 80CHAR, ALARM, ATT, UNPROT, PROT, and ALL.

character
specifies the character used in the RA function.

MODEL=
indicates the model of 3270. This model number is used to calculate the buffer address. This parameter is specified only once in the first macro instruction of a data-stream series or whenever the data stream to be generated is for a different model than the preceding series.

After you have defined the macro instruction, the data stream required to create the sign-on panel shown in Figure 7-14 could be as follows:

```
SIGNON   $MAC    WCC,(RESET,RESTORE),MODEL=1
         $MAC    SBA,(2,11)
         $MAC    SF,(PROT)
         DC      C'SIGN-ON PROCEDURE'
         $MAC    SBA,(4,2)
         $MAC    SF,(PROT)
         DC      C'PLEASE ENTER YOUR SIGN-ON INFORMATION'
         $MAC    SBA,(6,1)
         $MAC    SF,(PROT,HI)
         DC      C'NAME:'
         $MAC    SF
         $MAC    IC
         $MAC    SBA,(6,25)
         $MAC    SF,(PROT,HI)
         DC      C'LOCATION:'
         $MAC    SF
         $MAC    SBA,(7,1)
         $MAC    SF,(PROT,HI)
         DC      C'SERIAL NUMBER:'
         $MAC    SF,(NUM)
         $MAC    SBA,(7,23)
         $MAC    SF(PROT)
         $MAC    SBA,(10,4)
         $MAC    SF,(PROT)
         DC      C'WHEN ALL . . . ENTER KEY'
```

These two types of macro instructions can generate either a total static data stream or static sections of data streams that can be dynamically assembled at execution by the application program.

Semidynamic Output Streams

A semidynamic panel requires some dynamic modification. Perhaps an error message must be written to a particular part of the panel and the cursor must be moved to the input field in which an error was detected during editing. The application program can concatenate preassembled static data stream segments into the program, such as field error messages. The same macro instructions that build static data streams can build partial static streams. As the input from a panel is edited, the standard error message for each field can be assembled in the output buffer, thus allowing multiple brief messages to be sent to the display in one operation.

You may have to change one or two attribute characters from high intensity to low intensity and erase the unprotected fields on a display. For example, an error message segment may have changed a field to high intensity to call the operator's attention to the field; the operator has recognized the error and reentered the correct information. The display must now be made ready for the next input on the panel. Concatenate the order stream segments to change the attribute characters, and use the Erase Unprotected to Address (EUA) order to restore the panel; do not transmit all the data and orders to refresh the panel completely.

Dynamic Output Streams

It may become physically impossible to hold in main storage all possible output data and order stream combinations that could occur during the execution of an application. You can incorporate a subroutine into screen management to accept parameters from an application program to decode the parameters and to create the data stream. You can also write for the application program a macro instruction that builds a parameter list inline from entries you specify in the macro instruction, and then branches to the screen-management routine to build the required orders and data in the buffer area.

The macro instruction could appear as follows:

```
$BUILD ADD=ADDFIELD,ATT=(R3),DATA=(R4),LEN=(R5)
```

The ADDFIELD contains the 3270 buffer address in either row-column format, binary offset, or 3270 address form. R3 contains the address of the attribute character, R4 contains the address of the data to be entered in the field, and R5 contains the length of the data. The attribute character parameter is optional.

The subroutine could convert row and column buffer addresses relative to 1 to decimal offsets relative to 0 with the following formula:

Model 1 Buffer: ((R-1)X40) + (C-1)
Model 2 Buffer: ((R-1)X80) + (C-1)

If the row and column buffer addresses relative to 1 are in 2 single-byte areas in binary, the conversion to binary offsets relative to 0 can be coded as follows:

```
SR      R3,R3
IC      R3,COLUMN
BCTR    R3,0
SR      R4,R4
IC      R4,ROW
BCTR    R4,0
MH      R4,=H'40'  USE VALUE OF 80 FOR MODEL 2
AR      R4,R3  RESULT IN R4
```

The following subroutine converts a binary halfword that represents the offset relative to 0 of a position in a 3270 buffer to an equivalent 2-character 3270 address. R3 is a work register, and R4 points to the binary halfword to be converted. The converted result is found at ANSWER.

```
         LH     R3,0(R4)
         STC    R3,ANSWER+1
         SRL    R3,6
         STC    R3,ANSWER
         NI     ANSWER+1,X‘3F’
         TR     ANSWER(2),TAB
         .
         .
         .
         .
ANSWER   DC     X‘0000’
TAB      DC     X‘40C1C2C3C4C5C6C7C8C94A4B’
         DC     X‘4C4D4E4F50D1D2D3D4D5D6D7’
         DC     X‘D8D95A5B5C5D5E5F6061E2E3’
         DC     X‘E4E5E6E7E8E96A6B6C6D6E6F’
         DC     X‘F0F1F2F3F4F5F6F7F8F97A’
         DC     X‘7B7C7D7E7F’
```

Since buffer address wrapping is dependent on screen size, application programs should not depend on buffer wrap during write operations. In addition, field attributes must be appropriately placed to delimit the end of the screen image.

Copy Function for the 3271 and 3272

Many applications require complete and unaltered hard copy (printout) of the terminal's current screen contents for the display station operator. The printer on which the display contents are printed may support one or more display stations, depending on the 3270 configuration.

When using the copy function to obtain a printout on a 3288 Model 2 printer, remember that various print belts can be installed on the printer.

You should define a program-attention key so that a terminal operator can request hard copy on an assigned terminal printer. The screen-management program can be notified of the operator's request and perform the appropriate action.

When a data transfer to the computer occurs from pressing a program-attention key, a remote BSC 3277 or 3275 transmits AID and cursor address, and a local 3277 transfers only the AID character. The AID character identifies the key that transferred the data. No screen data is transmitted; so the program is notified of a specific request.

Once the request is identified by inspecting the AID character, the program must identify the type of unit that made the copy request. This can be done by examining the characteristics of the specific device in a terminal characteristics table that you can create. For example, depending on the type of device, the following procedures can be used to produce hard copy:

- To copy from a remote 3275 to the printer attached to the 3275, the program should send the WCC to the 3275. The WCC restores the keyboard, starts the printer, and prints 40 or 80 characters per line. Because the printer attached to the 3275 uses the same buffer as the display, all that is necessary to print the buffer (which contains the screen data) is the start-print bit in a WCC sent in a valid WRITE command sequence.

- To copy from a 3277 attached to a remote 3271 to a printer attached to the same 3271, the program should send the following data stream to the printer: STX, ESC, COPY command, CCC, from-device address, ETX. The CCC specifies start printer, the option to copy all data, and either 40 or 80 characters per line. A Model 2 display cannot be copied to a Model 1 printer, but all other copy combinations are valid. The device address following the CCC is a single-character address that identifies the device to be copied from and that is identical with the device address used to poll specifically the display requesting the copy function. The COPY command allows the buffer contents of a device attached to a 3271 to be copied to the buffer of another device attached to the same 3271, without moving the data to be copied to and from the computer. Once the prior data stream has been sent to the printer, the program should send the following data stream to the display station that requested the copy: STX, ESC, WRITE command, WCC, ETX. The WCC restores the keyboard. The operator has a positive response that the request has been honored, and the keyboard allows the operator to continue without manual intervention.
- To copy from a local 3277 to a local terminal printer, the program should execute a Read Buffer command to the display that made the copy request. The Read Buffer command is executed, and the display station transmits AID, a 2-byte cursor address, and the screen data to the computer. The program should then remove the AID character and the cursor address from the received data and, immediately preceding the remaining data, insert a WCC that specifies start printer and 40 or 80 characters per line. The altered data stream, beginning with WCC, should then be sent to the printer to copy the data. The program should then send a WCC with the restore keyboard option to the display that requested the copy function.

If the program determines that the receiving printer is busy, and the requested copy function cannot be immediately completed, one of the following actions should be taken:

3271: Notify the terminal operator of the situation, and ask the operator to wait or cancel the request.

3271 or 3272: Perform a Read Buffer to bring the screen data into the computer, where it can be queued until the printer is available, without delaying the operator.

Appendix A. Indicators and Controls

The indicators and controls associated with each 3270 unit, except the 3287 Printer, are listed in Figure A-1 and described below (the indicators and controls associated with the 3287 Printer are described in Figure A-2):

OFF-PUSH: This triple-function concentric switch/control is used to control the application of power to the unit, and to control the brightness (outer knob) and contrast (inner knob) of the displayed image.

BIT RATE: This two-position toggle switch, added by the Dial feature, allows the 3275 Model 1 or 2 operator to select a transmission rate of 600 or 1,200 bps.

	3270 Unit					
Indicator or Control	**3277**	**3275**	**3272**	**3271**	**3284, 3286**	**3288**
OFF-PUSH (Sw, Ctl)	X	X				
BIT RATE (Sw)		D				
DISCONNECT (Sw)		D				
INSERT MODE (Ind)	X	X				
INPUT INHIBITED (Ind)	X	X				
SYSTEM AVAILABLE (Ind)	X	X				X
Sys Avl (Ind)						X
SYSTEM READY (Ind)		X		X		
SYNC SEARCH (Ind)		X		X		
SELECTED (Ind)		X		X		
FLAG DETECT		S		S		
CU ACTIVE		S		S		
OFF HOOK (Ind)		D				
TRANSMIT (Ind)		X		X		
STATUS (Ind)		X		X		
POWER ON LOCAL MODE (Sw)			X			
POWER OFF LOCAL MODE (Sw)			X			
MAIN LINE ON/OFF (Sw)			X			
LOC/REM (Sw)			X			
ON LINE/OFF LINE (Sw)			X			
I/O INTF DSBLD (Sw)			X			
POWER ON/OFF (Sw)				X	X	X
Power On (I)/Power Off (O) (Sw)						X
Carriage Restore (Pb)						X
Start Test (Sw)						X
VFC Selector (Sw)						X
POWER ON (Ind)			X			
Ready (Ind)						X
Ops Chk (Ind)						X
Address I.D. (Label)	X	X			X	X

Key:

Ctl	–	Control
Ind	–	Indicator
Pb	–	Pushbutton
Sw	–	Switch
X	–	Basic
D	–	Dial Feature
S	–	SDLC

Note: *3287 controls and indicators are shown in Figure A-2.*

Figure A-1. Indicators and Controls

DISCONNECT: This momentary-contact toggle switch, added to the 3275 Model 1 or 2 by the Dial feature, is used by the 3275 operator when terminating a call.

INSERT MODE: This indicator is turned on by the keyboard INS MODE key to show that the unit is in Insert Mode of operation. It is turned off by the keyboard RESET key.

INPUT INHIBITED: When lighted, this indicator shows that manual input to the unit from the keyboard, selector pen, or operator identification card reader is inhibited.

It is turned on by:

- Operation of any program-attention key.
- A selector-pen-attention operation that caused an I/O interruption to occur.
- An operator-identification-card-reader operation that caused an I/O interruption to occur.
- Turning of the Security Key Lock to the OFF position if the Security Key Lock feature is installed.
- Initiation of a printout at an unbuffered printer attached to the 3275 Display Station.
- A system-initiated I/O operation addressed to that unit.
- Operation of any alphameric key or the DUP, FIELD MARK, ERASE EOF, or DEL key when the cursor is in a protected field.
- Operation of any alphameric key not included in the numeric key grouping when the cursor is in a numeric field, without simultaneous operation of either the ALPHA or NUMERIC shift key, when the Numeric Lock special feature is installed.
- Detection of a parity or cursor check in the device buffer.

It is turned off by:

- Receipt and execution of a WCC with the keyboard-restore bit set.
- Receipt and execution of an Erase All Unprotected command.
- Turning of the Security Key Lock to the On position (if it was turned on because the Security Key Lock was in the Off position).
- Operation of the keyboard RESET key, with the following exceptions:
  - The device is selected and executing a command from the control unit.
  - The display station is in the process of reading a magnetic card from the operator identification card reader.
  - A printout is in process at the attached 3284 Printer Model 3.
  - A parity or cursor check has been detected.
- Termination of an unbuffered printer printout (if it was turned on because an unbuffered printer printout was initiated).
- Correction of a parity or cursor-check condition and resetting of the error status by a Write or Erase/Write command addressed to that device.

SYSTEM AVAILABLE (3275 Models 1 and 2 and 3277), Sys Avl (3288): When lighted, this indicator shows that the unit has had successful communication with the system and is available to accept an operator-initiated transmission to the system.

It is turned on by:

- Successful completion of a Write, Erase/Write, Erase All Unprotected, Copy, Read Modified, or Read Buffer command, in local or remote operation.
- On a 3275 (Models 1 and 2), receipt of an ACK from the TCU in response to an ETX at the completion of a General or Specific Poll sequence.

It is turned off by:

- Any operator-generated I/O interruption.
- A parity or cursor check and resulting I/O interruption.
- Turning of the Security Key Lock to the Off position.

SYSTEM READY: When lighted, this indicator shows that the Data Set carrier is on and that the TCU is online. With the Dial feature installed, this indicator lights when a transmission is first sent or received and extinguishes when a disconnect sequence is sent or received.

SYNC SEARCH (3271 and 3275 Models 1 and 2 only): When lighted, this indicator shows that the unit is attempting to establish line synchronization.

SELECTED (3271 and 3275 Models 1 and 2 only): When lighted, this indicator shows that the unit has been selected; that is, it is in the process of executing a command or a chain of commands.

CU ACTIVE (3271 and 3275 Models 11 and 12 only): This indicator lights after selection, and remains set until the operation is completed.

FLAG DETECT (3271 and 3275 Models 11 and 12 only): This indicator lights when a valid flag character (7E) is received.

OFF HOOK/AUTO ANSWER: This indicator replaces the SELECTED indicator when the IBM Line Adapter or external modem with Auto Answer feature is installed. When lit, it indicates that a communications link to the 3275 (Models 1 and 2) is active (that is, the data access arrangement is *off hook*). When the Auto Answer feature is not installed, the OFF HOOK/AUTO ANSWER indicator is always lit during unit operation.

TRANSMIT: When lighted, this indicator shows that the unit is transmitting to the TCU.

STATUS: When lighted, this indicator shows that an error-status condition exists within the unit.

POWER ON LOCAL MODE: This momentary-contact switch is used to turn on dc power for a 3272.

POWER OFF LOCAL MODE: This momentary-contact switch is used to turn off dc power for a 3272.

MAIN LINE ON/OFF: This two-position toggle switch is used to turn on and turn off ac power for the 3272.

LOC/REM: This two-position rotary switch on the 3272, when placed in the REM (remote) position, gives control of the power supply activation to the CPU to which the control unit is attached. When placed in the LOC (local) position, power is controlled at the 3272 by using the POWER ON LOCAL MODE and POWER OFF LOCAL MODE switches.

ON LINE/OFF LINE: This two-position toggle switch, when placed in the ON LINE position (the operating position),connects the 3272 to the channel interface.

I/O INTF DSBLD: This indicator lights when the ON LINE/OFF LINE switch on the 3272 is in the OFF LINE position.

POWER ON: When lighted, this indicator shows that power has been turned on for a 3272.

POWER ON/OFF: This two-position toggle switch is used to turn on and turn off power for 3271 control units and all printers.

Ready: When lighted, this indicator shows that the 3288 Line Printer is ready to receive transmissions from the contol unit. It is turned on after a successful power-on sequence, when the belt is up to speed and the printer is ready to print data.

It is turned off by:

- Open machine covers.
- Open print unit.
- Running out of forms.
- A paper motion failure (forms jam, torn forms, or missing feed holes).
- An overheated printer mechanism.
- A hardware failure requiring a repair action.

Ops Chk: When blinking, this indicator shows that the 3288 Line Printer not-ready condition (shown by the Ready indicator's being off) can be corrected by the operator.

It is turned on by:

- Open machine covers.
- Open print unit.
- Running out of forms.
- A paper motion failure.
- The TEST switch (on test switch panel) in other than the ON LN (On Line) position.

It is turned off when the condition that caused it to light is corrected.

Address Identification: Provision is made on each display station and printer to identify both the physical (hexadecimal) and symbolic addresses assigned to that unit at installation time.

VFC Selector: The VFC Selector switches on the 3288 Line Printer are set (00-99) by the operator to determine the number of lines skipped in a VFC operation.

Carriage Restore: The Carriage Restore pushbutton on the 3288 Line Printer advances the forms to a predetermined print line established by the initial forms positioning and the settings of the VFC selector switches.

Power On/Power Off (Coded | and O): This two-position rocker switch is used to control power to the 3288 Line Printer.

Start Test: This switch on the 3288 is used in conjunction with the test switches located on the test switch panel under the top cover to initiate offline test printouts.

Figure A-2 lists and explains the indicators and controls associated with the 3287 Printer.

Indicator/Control	Explanation
Ready	This light indicates that the printer is available to print the data received from the controller. It goes off under any of the following conditions: ● Hold Print condition ● Test mode ● Check conditions ● Power off ● The printer runs out of paper This light blinks when the Hold Print light is on to indicate that SCS data is being processed.
Hold Print	This light indicates that the hold-print or set-alternate condition has been entered. It remains on continuously in the hold-print condition and blinks in the set-alternate condition.
CU Signal	This light indicates that the 3287 is connected to a control unit and communication can take place. It goes off when the printer does not receive a signal from the control unit for 30 seconds or when the printer is in test mode.
8 LPI	This light indicates that vertical line-spacing of eight lines per inch is being performed by the printer. If 6 LPI is selected with the Change LPI switch, and the control unit specifies 8 LPI, this light comes on only when printing is performed. The light shows the setting of the Change LPI switch when the printer is in the hold-print condition.
Check	This light indicates the detection of an error condition by the 3287. It goes off when all check conditions have been removed. The type of check condition is displayed in the Status indicator when the Check light comes on.
Double Space	This light indicates that double line-spacing is being performed by the printer. If single space is selected by the Change Space switch and the control unit specifies double space, this light comes on only when printing is performed. When the printer is in the hold-print condition, this light shows the setting of the Change Space switch.
Test	This light indicates that the automatic built-in tests are running in the 3287. It goes off at the error-free ending of all the tests.

Figure A-2 (Part 1 of 4). Indicators and Controls for 3287 Printer

Indicator/Control **Explanation**

Dual Case

This light indicates that dual-case printing is being performed by the printer. If mono case (uppercase only) is selected by the Change Case switch and the control unit specifies dual case (both uppercase and lowercase), this light is on only when printing is being performed. When the printer is in the hold-print condition, this light shows the setting of the Change Case switch.

Status

The Status indicator displays a two-digit code that represents the current status of the 3287, such as:

- A check condition
- An end-of-forms condition
- Printer Status Information
- The result of a test operation in which an error has been detected.

The *IBM 3287 Printer Problem Determination Guide*, GA27-3151, contains a list of all the error codes and the actions the operator is to take when a code appears.

Hold Print/Enable Print

Pressing this switch to the Hold Print position causes the 3287 to stop printing after it has completed the function in process. The print head moves to the leftmost position, the Hold Print light comes on, the Ready light goes off, and data is held in the printer buffer for additional printing.

The Set Alternate, Change LPI, Change Space, Change Case, Form Feed, Setup, Index, Cancel Print, Buffer Reprint, PA1, and PA2 switches are operational only when the printer is in the hold-print condition.

Selecting Enable Print causes the Hold Print light to go off and the Ready light to come on. Printing then continues, following the preceding print position.

Pressing the Hold Print switch on and off within 10 minutes does not have any effect on communication with the control unit.

If the operator leaves the printer in the hold-print condition for more than 10 minutes, an *Intervention Required* message is sent to the control unit. The operator must then press the Enable Print switch to return to normal operation.

Change LPI

This switch is used to select vertical line-spacing between lines. When either 6 or 8 LPI is selected by the switch, the LPI selection by the host or the control unit supersedes the switch selection.

If printing is being done in the 8 LPI format, or if the 8 LPI switch is pressed while the 3287 is not printing data, the 8 LPI light comes on. When a power-on reset is performed, the printer is initialized to the 6 LPI condition (the 8 LPI light is off). Reset has no effect on the switch setting. When the printer is operating in the SCS mode, it is initialized to the current switch setting.

Note: *If the platen has been moved by hand, line-spacing from the first to the second print line may be out of specification since the platen does not have mechanical indexing, but all lines printed after the second line will be in specification. Care should be taken, therefore, when the platen is adjusted by hand to align first print line. Maladjustment can cause the first and second print lines to touch when the 8 LPI format is selected.*

Figure A-2 (Part 2 of 4). Indicators and Controls for 3287 Printer

Indicator/Control	Explanation
Set Alternate/Set Parameter/Reset Alternate Switches	Pressing the Set Alternate switch when the printer is in the hold-print condition activates the alternate function for all the operator panel switches and causes the Hold print light to flash on and off. An operator can enter the maximum print position (MPP), using the hundreds, tens, and units alternate function switches, when the 3287 is in the alternate function mode of operation. Each time the Tens or Units switch is pressed, the Status indicator is incremented by 10 or 1, respectively. Pressing the Hundreds switch causes the Status indicator to flash for a 1XX selection and to remain on, continuously, for a 0XX selection. Once the MPP has been entered, pressing the Set Parameter switch causes the MPP selection to be saved for future use and to enter a hold-print condition. Pressing the Reset Alternate switch before pressing Set Parameter causes the printer to return to the primary functions of the switches in the hold-print condition without storing a newly set MPP value (the Hold Print light is on continuously). The MPP is initialized to 132 when a power-on reset is performed. Reset and test modes have no effect on the MPP selection. The MPP selection is valid only when processing information data.
Change Space	This switch, when set to Double Space, causes the printer to perform double line-spacing during printing. When a power-on reset is performed, the printer is initialized to a single space condition (the Double Space light is off). Reset mode and test mode have no effect on the switch setting.
Change Case	Selecting mono case with this switch causes the printer to print in uppercase characters only. Selecting dual case causes the printer to print in dual case (both uppercase and lowercase characters). The Dual Case light comes on for dual case printing. During a power-on reset, the printer is initialized to a mono case condition (the Dual Case light is off). Reset mode and test mode have no effect on the switch setting.
PA1 and PA2	These switches are operational only when the SCS Support feature is installed. Pressing either switch causes the printer to send a control code to the control unit and to display a function code in the Status indicator. The control unit and the printer communicate with each other and perform the operation the host program has defined for the PA1 and PA2 switches. When this is completed, the Status indicator light goes off. These switches are active only when the Hold Print light is on and the printer is operating in SCS mode.
Form Feed	This switch is operational only if the Page Length Control feature or the SCS Support feature is installed, and it is active only in the hold-print condition. The page size is defined by the operator using the Selector switches or by the host program in SCS mode. The page size defined by the host program supersedes that defined by the Selector switches. Pressing this switch causes the printer to advance the forms until the first print line of the next page is reached, if the forms have been properly aligned and its page size has been properly defined.
Buffer Reprint	Not operational when attached to a 3271 or 3272.
Setup	This switch is used for forms alignment and can be activated only when the 3287 printer is in the hold-print condition. Pressing this switch causes the printer to print *H* characters continuously until the MPP is reached. The print head then returns to print position 1 without movement of the forms. When operating in SCS mode, the print head returns to the maximum print position.

Figure A-2 (Part 3 of 4). Indicators and Controls for 3287 Printer

Indicator/Control	Explanation
Index	Pressing the Index switch causes the printer to advance forms continuously.
Reset	This switch is used to reset a check condition and to turn off any error indications. The printer indexes one line and printing continues if allowed by the control unit.
Cancel Print	This switch is operational only if the SCS Support feature is installed. Pressing this switch when the Hold Print light is on causes the printer to stop printing, to display a *cancel selected* code in the Status indicator, and to send a code for canceling the print operation to the control unit if the printer was processing an SCS message. If the printer was not printing SCS data, pressing the Cancel Print switch causes an *operator check* code to be displayed in the Status indicator.
Test	Pressing this switch causes the printer to enter test mode. When the 3287 is in test mode, it cannot communicate with the control unit.
Power (I/O)	The power switch controls power to the 3287. The I position is the *on* position, and the O is the *off* position.
Selector	The Selector switches are 2-digit, 10-position switches located on the operator's panel, used to specify the number of lines that can be printed on a form, from 00 through 99. Forms feeding is performed when the Form Feed switch is pressed or a forms-feed control code is received in the data for the number of lines specified. The page-length value is read from the Selector switches during a power-on reset or when the Forms Feed switch is pressed while the 3287 is in the hold-print condition. The Page Length Control feature must be installed for these switches to be operational. These switches are not operable for SCS print operations.
Set Function	Reserved for future use.

Figure A-2 (Part 4 of 4). Indicators and Controls for 3287 Printer

Appendix B. Buffer Address I/O Interface Codes

40 Col		80 Col		Position		Buffer Address (Hex)			
R	C	R	C	Dec	Hex	EBCDIC		ASCII	
01	01	01	01	0000	000	40	40	20	20
01	02	01	02	0001	001	40	C1	20	41
01	03	01	03	0002	002	40	C2	20	42
01	04	01	04	0003	003	40	C3	20	43
01	05	01	05	0004	004	40	C4	20	44
01	06	01	06	0005	005	40	C5	20	45
01	07	01	07	0006	006	40	C6	20	46
01	08	01	08	0007	007	40	C7	20	47
01	09	01	09	0008	008	40	C8	20	48
01	10	01	10	0009	009	40	C9	20	49
01	11	01	11	0010	00A	40	4A	20	5B
01	12	01	12	0011	00B	40	4B	20	2E
01	13	01	13	0012	00C	40	4C	20	3C
01	14	01	14	0013	00D	40	4D	20	28
01	15	01	15	0014	00E	40	4E	20	2B
01	16	01	16	0015	00F	40	4F	20	21
01	17	01	17	0016	010	40	50	20	26
01	18	01	18	0017	011	40	D1	20	4A
01	19	01	19	0018	012	40	D2	20	4B
01	20	01	20	0019	013	40	D3	20	4C
01	21	01	21	0020	014	40	D4	20	4D
01	22	01	22	0021	015	40	D5	20	4E
01	23	01	23	0022	016	40	D6	20	4F
01	24	01	24	0023	017	40	D7	20	50
01	25	01	25	0024	018	40	D8	20	51
01	26	01	26	0025	019	40	D9	20	52
01	27	01	27	0026	01A	40	5A	20	5D
01	28	01	28	0027	01B	40	5B	20	24
01	29	01	29	0028	01C	40	5C	20	2A
01	30	01	30	0029	01D	40	5D	20	29
01	31	01	31	0030	01E	40	5E	20	3B
01	32	01	32	0031	01F	40	5F	20	5E
01	33	01	33	0032	020	40	60	20	2D
01	34	01	34	0033	021	40	61	20	2F
01	35	01	35	0034	022	40	E2	20	53
01	36	01	36	0035	023	40	E3	20	54
01	37	01	37	0036	024	40	E4	20	55
01	38	01	38	0037	025	40	E5	20	56
01	39	01	39	0038	026	40	E6	20	57
01	40	01	40	0039	027	40	E7	20	58
02	01	01	41	0040	028	40	E8	20	59
02	02	01	42	0041	029	40	E9	20	5A
02	03	01	43	0042	02A	40	6A	20	7C
02	04	01	44	0043	02B	40	6B	20	2C
02	05	01	45	0044	02C	40	6C	20	25
02	06	01	46	0045	02D	40	6D	20	5F
02	07	01	47	0046	02E	40	6E	20	3E
02	08	01	48	0047	02F	40	6F	20	3F
02	09	01	49	0048	030	40	F0	20	30
02	10	01	50	0049	031	40	F1	20	31
02	11	01	51	0050	032	40	F2	20	32
02	12	01	52	0051	033	40	F3	20	33
02	13	01	53	0052	034	40	F4	20	34
02	14	01	54	0053	035	40	F5	20	35
02	15	01	55	0054	036	40	F6	20	36
02	16	01	56	0055	037	40	F7	20	37
02	17	01	57	0056	038	40	F8	20	38
02	18	01	58	0057	039	40	F9	20	39
02	19	01	59	0058	03A	40	7A	20	3A

40 Col		80 Col		Position		Buffer Address (Hex)			
R	C	R	C	Dec	Hex	EBCDIC		ASCII	
02	20	01	60	0059	03B	40	7B	20	23
02	21	01	61	0060	03C	40	7C	20	40
02	22	01	62	0061	03D	40	7D	20	27
02	23	01	63	0062	03E	40	7E	20	3D
02	24	01	64	0063	03F	40	7F	20	22
02	25	01	65	0064	040	C1	40	41	20
02	26	01	66	0065	041	C1	C1	41	41
02	27	01	67	0066	042	C1	C2	41	42
02	28	01	68	0067	043	C1	C3	41	43
02	29	01	69	0068	044	C1	C4	41	44
02	30	01	70	0069	045	C1	C5	41	45
02	31	01	71	0070	046	C1	C6	41	46
02	32	01	72	0071	047	C1	C7	41	47
02	33	01	73	0072	048	C1	C8	41	48
02	34	01	74	0073	049	C1	C9	41	49
02	35	01	75	0074	04A	C1	4A	41	5B
02	36	01	76	0075	04B	C1	4B	41	2E
02	37	01	77	0076	04C	C1	4C	41	3C
02	38	01	78	0077	04D	C1	4D	41	28
02	39	01	79	0078	04E	C1	4E	41	2B
02	40	01	80	0079	04F	C1	4F	41	21
03	01	02	01	0080	050	C1	50	41	26
03	02	02	02	0081	051	C1	D1	41	4A
03	03	02	03	0082	052	C1	D2	41	4B
03	04	02	04	0083	053	C1	D3	41	4C
03	05	02	05	0084	054	C1	D4	41	4D
03	06	02	06	0085	055	C1	D5	41	4E
03	07	02	07	0086	056	C1	D6	41	4F
03	08	02	08	0087	057	C1	D7	41	50
03	09	02	09	0088	058	C1	D8	41	51
03	10	02	10	0089	059	C1	D9	41	52
03	11	02	11	0090	05A	C1	5A	41	5D
03	12	02	12	0091	05B	C1	5B	41	24
03	13	02	13	0092	05C	C1	5C	41	2A
03	14	02	14	0093	05D	C1	5D	41	29
03	15	02	15	0094	05E	C1	5E	41	3B
03	16	02	16	0095	05F	C1	5F	41	5E
03	17	02	17	0096	060	C1	60	41	2D
03	18	02	18	0097	061	C1	61	41	2F
03	19	02	19	0098	062	C1	E2	41	53
03	20	02	20	0099	063	C1	E3	41	54
03	21	02	21	0100	064	C1	E4	41	55
03	22	02	22	0101	065	C1	E5	41	56
03	23	02	23	0102	066	C1	E6	41	57
03	24	02	24	0103	067	C1	E7	41	58
03	25	02	25	0104	068	C1	E8	41	59
03	26	02	26	0105	069	C1	E9	41	5A
03	27	02	27	0106	06A	C1	6A	41	7C
03	28	02	28	0107	06B	C1	6B	41	2C
03	29	02	29	0108	06C	C1	6C	41	25
03	30	02	30	0109	06D	C1	6D	41	5F
03	31	02	31	0110	06E	C1	6E	41	3E
03	32	02	32	0111	06F	C1	6F	41	3F
03	33	02	33	0112	070	C1	F0	41	30
03	34	02	34	0113	071	C1	F1	41	31
03	35	02	35	0114	072	C1	F2	41	32
03	36	02	36	0115	073	C1	F3	41	33
03	37	02	37	0116	074	C1	F4	41	34
03	38	02	38	0117	075	C1	F5	41	35
03	39	02	39	0118	076	C1	F6	41	36
03	40	02	40	0119	077	C1	F7	41	37
04	01	02	41	0120	078	C1	F8	41	38
04	02	02	42	0121	079	C1	F9	41	39

40 Col		80 Col		Position		Buffer Address (Hex)			
R	C	R	C	Dec	Hex	EBCDIC		ASCII	
04	03	02	43	0122	07A	C1	7A	41	3A
04	04	02	44	0123	07B	C1	7B	41	23
04	05	02	45	0124	07C	C1	7C	41	40
04	06	02	46	0125	07D	C1	7D	41	27
04	07	02	47	0126	07E	C1	7E	41	3D
04	08	02	48	0127	07F	C1	7F	41	22
04	09	02	49	0128	080	C2	40	42	20
04	10	02	50	0129	081	C2	C1	42	41
04	11	02	51	0130	082	C2	C2	42	42
04	12	02	52	0131	083	C2	C3	42	43
04	13	02	53	0132	084	C2	C4	42	44
04	14	02	54	0133	085	C2	C5	42	45
04	15	02	55	0134	086	C2	C6	42	46
04	16	02	56	0135	087	C2	C7	42	47
04	17	02	57	0136	088	C2	C8	42	48
04	18	02	58	0137	089	C2	C9	42	49
04	19	02	59	0138	08A	C2	C4	42	5B
04	20	02	60	0139	08B	C2	4B	42	2E
04	21	02	61	0140	08C	C2	4C	42	3C
04	22	02	62	0141	08D	C2	4D	42	28
04	23	02	63	0142	08E	C2	4E	42	2B
04	24	02	64	0143	08F	C2	4F	42	21
04	25	02	65	0144	090	C2	50	42	26
04	26	02	66	0145	091	C2	D1	42	4A
04	27	02	67	0146	092	C2	D2	42	4B
04	28	02	68	0147	093	C2	D3	42	4C
04	29	02	69	0148	094	C2	D4	42	4D
04	30	02	70	0149	095	C2	D5	42	4E
04	31	02	71	0150	096	C2	D6	42	4F
04	32	02	72	0151	097	C2	D7	42	50
04	33	02	73	0152	098	C2	D8	42	51
04	34	02	74	0153	099	C2	D9	42	52
04	35	02	75	0154	09A	C2	5A	42	5D
04	36	02	76	0155	09B	C2	5B	42	24
04	37	02	77	0156	09C	C2	5C	42	2A
04	38	02	78	0157	09D	C2	5D	42	29
04	39	02	79	0158	09E	C2	5E	42	3B
04	40	02	80	0159	09F	C2	5F	42	5E
05	01	03	01	0160	0A0	C2	60	42	2D
05	02	03	02	0161	0A1	C2	61	42	2F
05	03	03	03	0162	0A2	C2	E2	42	53
05	04	03	04	0163	0A3	C2	E3	42	54
05	05	03	05	0164	0A4	C2	E4	42	55
05	06	03	06	0165	0A5	C2	E5	42	56
05	07	03	07	0166	0A6	C2	E6	42	57
05	08	03	08	0167	0A7	C2	E7	42	58
05	09	03	09	0168	0A8	C2	E8	42	59
05	10	03	10	0169	0A9	C2	E9	42	5A
05	11	03	11	0170	0AA	C2	6A	42	7C
05	12	03	12	0171	0AB	C2	6B	42	2C
05	13	03	13	0172	0AC	C2	6C	42	25
05	14	03	14	0173	0AD	C2	6D	42	5F
05	15	03	15	0174	0AE	C2	6E	42	3E
05	16	03	16	0175	0AF	C2	6F	42	3F
05	17	03	17	0176	0B0	C2	F0	42	30
05	18	03	18	0177	0B1	C2	F1	42	31
05	19	03	19	0178	0B2	C2	F2	42	32
05	20	03	20	0179	0B3	C2	F3	42	33
05	21	03	21	0180	0B4	C2	F4	42	34
05	22	03	22	0181	0B5	C2	F5	42	35
05	23	03	23	0182	0B6	C2	F6	42	36
05	24	03	24	0183	0B7	C2	F7	42	37

40 Col		80 Col		Position		Buffer Address (Hex)			
R	C	R	C	Dec	Hex	EBCDIC		ASCII	
05	25	03	25	0184	0B8	C2	F8	42	38
05	26	03	26	0185	0B9	C2	F9	42	39
05	27	03	27	0186	0BA	C2	7A	42	3A
05	28	03	28	0187	0BB	C2	7B	42	23
05	29	03	29	0188	0BC	C2	7C	42	40
05	30	03	30	0189	0BD	C2	7D	42	27
05	31	03	31	0190	0BE	C2	7E	42	3D
05	32	03	32	0191	0BF	C2	7F	42	22
05	33	03	33	0192	0C0	C3	40	43	20
05	34	03	34	0193	0C1	C3	C1	43	41
05	35	03	35	0194	0C2	C3	C2	43	42
05	36	03	36	0195	0C3	C3	C3	43	43
05	37	03	37	0196	0C4	C3	C4	43	44
05	38	03	38	0197	0C5	C3	C5	43	45
05	39	03	39	0198	0C6	C3	C6	43	46
05	40	03	40	0199	0C7	C3	C7	43	47
06	01	03	41	0200	0C8	C3	C8	43	48
06	02	03	42	0201	0C9	C3	C9	43	49
06	03	03	43	0202	0CA	C3	4A	43	5B
06	04	03	44	0203	0CB	C3	4B	43	2E
06	05	03	45	0204	0CC	C3	4C	43	3C
06	06	03	46	0205	0CD	C3	4D	43	28
06	07	03	47	0206	0CE	C3	4E	43	2B
06	08	03	48	0207	0CF	C3	4F	43	21
06	09	03	49	0208	0D0	C3	50	43	26
06	10	03	50	0209	0D1	C3	D1	43	4A
06	11	03	51	0210	0D2	C3	D2	43	4B
06	12	03	52	0211	0D3	C3	D3	43	4C
06	13	03	53	0212	0D4	C3	D4	43	4D
06	14	03	54	0213	0D5	C3	D5	43	4E
06	15	03	55	0214	0D6	C3	D6	43	4F
06	16	03	56	0215	0D7	C3	D7	43	50
06	17	03	57	0216	0D8	C3	D8	43	51
06	18	03	58	0217	0D9	C3	D9	32	52
06	19	03	59	0218	0DA	C3	5A	43	5D
06	20	03	60	0219	0DB	C3	5B	43	24
06	21	03	61	0220	0DC	C3	5C	43	2A
06	22	03	62	0221	0DD	C3	5D	43	29
06	23	03	63	0222	0DE	C3	5E	43	3B
06	24	03	64	0223	0DF	C3	5F	43	5E
06	25	03	65	0224	0E0	C3	60	43	2D
06	26	03	66	0225	0E1	C3	61	43	2F
06	27	03	67	0226	0E2	C3	E2	43	53
06	28	03	68	0227	0E3	C3	E3	43	54
06	29	03	69	0228	0E4	C3	E4	43	55
06	30	03	70	0229	0E5	C3	E5	43	56
06	31	03	71	0230	0E6	C3	E6	43	57
06	32	03	72	0231	0E7	C3	E7	43	58
06	33	03	73	0232	0E8	C3	E8	43	59
06	34	03	74	0233	0E9	C3	E9	43	5A
06	35	03	75	0234	0EA	C3	6A	43	7C
06	36	03	76	0235	0EB	C3	6B	43	2C
06	37	03	77	0236	0EC	C3	6C	43	25
06	38	03	78	0237	0ED	C3	6D	43	5F
06	39	03	79	0238	0EE	C3	6E	43	3E
06	40	03	80	0239	0EF	C3	6F	43	3F
07	01	04	01	0240	0F0	C3	F0	43	30
07	02	04	02	0241	0F1	C3	F1	43	31
07	03	04	03	0242	0F2	C3	F2	43	32
07	04	04	04	0243	0F3	C3	F3	32	33
07	05	04	05	0244	0F4	C3	F4	43	34
07	06	04	06	0245	0F5	C3	F5	43	35

40 Col		80 Col		Position		Buffer Address (Hex)			
R	C	R	C	Dec	Hex	EBCDIC		ASCII	
07	07	04	07	0246	0F6	C3	F6	43	36
07	08	04	08	0247	0F7	C3	F7	43	37
07	09	04	09	0248	0F8	C3	F8	43	38
07	10	04	10	0249	0F9	C3	F9	43	39
07	11	04	11	0250	0FA	C3	7A	43	3A
07	12	04	12	0251	0FB	C3	7B	43	23
07	13	04	13	0252	0FC	C3	7C	43	40
07	14	04	14	0253	0FD	C3	7D	43	27
07	15	04	15	0254	0FE	C3	7E	43	3D
07	16	04	16	0255	0FF	C3	7F	43	22
07	17	04	17	0256	100	C4	40	44	20
07	18	04	18	0257	101	C4	C1	44	41
07	19	04	19	0258	102	C4	C2	44	42
07	20	04	20	0259	103	C4	C3	44	43
07	21	04	21	0260	104	C4	C4	44	44
07	22	04	22	0261	105	C4	C5	44	45
07	23	04	23	0262	106	C4	C6	44	46
07	24	04	24	0263	107	C4	C7	44	47
07	25	04	25	0264	108	C4	C8	44	48
07	26	04	26	0265	109	C4	C9	44	49
07	27	04	27	0266	10A	C4	4A	44	5B
07	28	04	28	0267	10B	C4	4B	44	2E
07	29	04	29	0268	10C	C4	4C	44	3C
07	30	04	30	0269	10D	C4	4D	44	28
07	31	04	31	0270	10E	C4	4E	44	2B
07	32	04	32	0271	10F	C4	4F	44	21
07	33	04	33	0272	110	C4	50	44	26
07	34	04	34	0273	111	C4	D1	44	4A
07	35	04	35	0274	112	C4	D2	44	4B
07	36	04	36	0275	113	C4	D3	44	4C
07	37	04	37	0276	114	C4	D4	44	4D
07	38	04	38	0277	115	C4	D5	44	4E
07	39	04	39	0278	116	C4	D6	44	4F
07	40	04	40	0279	117	C4	D7	44	50
08	01	04	41	0280	118	C4	D8	44	51
08	02	04	42	0281	119	C4	D9	44	52
08	03	04	43	0282	11A	C4	5A	44	5D
08	04	04	44	0283	11B	C4	5B	44	24
08	05	04	45	0284	11C	C4	5C	44	2A
08	06	04	46	0285	11D	C4	5D	44	29
08	07	04	47	0286	11E	C4	5E	44	3B
08	08	04	48	0287	11F	C4	5F	44	5E
08	09	04	49	0288	120	C4	60	44	2D
08	10	04	50	0289	121	C4	61	44	2E
08	11	04	51	0290	122	C4	E2	44	53
08	12	04	52	0291	123	C4	E3	44	54
08	13	04	53	0292	124	C4	E4	44	55
08	14	04	54	0293	125	C4	E5	44	56
08	15	04	55	0294	126	C4	E6	44	57
08	16	04	56	0295	127	C4	E7	44	58
08	17	04	57	0296	128	C4	E8	44	59
08	18	04	58	0297	129	C4	E9	44	5A
08	19	04	59	0298	12A	C4	6A	44	7C
08	20	04	60	0299	12B	C4	6B	44	2C
08	21	04	61	0300	12C	C4	6C	44	25
08	22	04	62	0301	12D	C4	6D	44	5F
08	23	04	63	0302	12E	C4	6E	44	3E
08	24	04	64	0303	12F	C4	6F	44	3F
08	25	04	65	0304	130	C4	F0	44	30
08	26	04	66	0305	131	C4	F1	44	31
08	27	04	67	0306	132	C4	F2	44	32
08	28	04	68	0307	133	C4	F3	44	33

40 Col		80 Col		Position		Buffer Address (Hex)			
R	C	R	C	Dec	Hex	EBCDIC		ASCII	
08	29	04	69	0308	134	C4	F4	44	34
08	30	04	70	0309	135	C4	F5	44	35
08	31	04	71	0310	136	C4	F6	44	36
08	32	04	72	0311	137	C4	F7	44	37
08	33	04	73	0312	138	C4	F8	44	38
08	34	04	74	0313	139	C4	F9	44	39
08	35	04	75	0314	13A	C4	7A	44	3A
08	36	04	76	0315	13B	C4	7B	44	23
08	37	04	77	0316	13C	C4	7C	44	40
08	38	04	78	0317	13D	C4	7D	44	27
08	39	04	79	0318	13E	C4	7E	44	3D
08	40	04	80	0319	13F	C4	7F	44	22
09	01	05	01	0320	140	C5	40	45	20
09	02	05	02	0321	141	C5	C1	45	41
09	03	05	03	0322	142	C5	C2	45	42
09	04	05	04	0323	143	C5	C3	45	43
09	05	05	05	0324	144	C5	C4	45	44
09	06	05	06	0325	145	C5	C5	45	45
09	07	05	07	0326	146	C5	C6	45	46
09	08	05	08	0327	147	C5	C7	45	47
09	09	05	09	0328	148	C5	C8	45	48
09	10	05	10	0329	149	C5	C9	45	49
09	11	05	11	0330	14A	C5	4A	45	5B
09	12	05	12	0331	14B	C5	4B	45	2E
09	13	05	13	0332	14C	C5	4C	45	3C
09	14	05	14	0333	14D	C5	4D	45	28
09	15	05	15	0334	14E	C5	4E	45	2B
09	16	05	16	0335	14F	C5	4F	45	21
09	17	05	17	0336	150	C5	50	45	46
09	18	05	18	0337	151	C5	D1	45	4A
09	19	05	19	0338	152	C5	D2	45	4B
09	20	05	20	0339	153	C5	D3	45	4C
09	21	05	21	0340	154	C5	D4	45	4D
09	22	05	22	0341	155	C5	D5	45	4E
09	23	05	23	0342	156	C5	D6	45	4F
09	24	05	24	0343	157	C5	D7	45	50
09	25	05	25	0344	158	C5	D8	45	51
09	26	05	26	0345	159	C5	D9	45	52
09	27	05	27	0346	15A	C5	5A	45	5D
09	28	05	28	0347	15B	C5	5B	45	24
09	29	05	29	0348	15C	C5	5C	45	2A
09	30	05	30	0349	15D	C5	5D	45	29
09	31	05	31	0350	15E	C5	5E	45	3B
09	32	05	32	0351	15F	C5	5F	45	5E
09	33	05	33	0352	160	C5	60	45	2D
09	34	05	34	0353	161	C5	61	45	2F
09	35	05	35	0354	162	C5	E2	45	53
09	36	05	36	0355	163	C5	E3	45	54
09	37	05	37	0356	164	C5	E4	45	55
09	38	05	38	0357	165	C5	E5	45	56
09	39	05	39	0358	166	C5	E6	45	57
09	40	05	40	0359	167	C5	E7	45	58
10	01	05	41	0360	168	C5	E8	45	59
10	02	05	42	0361	169	C5	E9	45	5A
10	03	05	43	0362	16A	C5	6A	45	7C
10	04	05	44	0363	16B	C5	6B	45	2C
10	05	05	45	0364	16C	C5	6C	45	25
10	06	05	46	0365	16D	C5	6D	45	5F
10	07	05	47	0366	16E	C5	6E	45	3E
10	08	05	48	0367	16F	C5	6F	45	3F
10	09	05	49	0368	170	C5	F0	45	30
10	10	05	50	0369	171	C5	F1	45	31

40 Col		80 Col		Position		Buffer Address (Hex)			
R	C	R	C	Dec	Hex	EBCDIC		ASCII	
10	11	05	51	0370	172	C5	F2	45	32
10	12	05	52	0371	173	C5	F3	45	33
10	13	05	53	0372	174	C5	F4	45	34
10	14	05	54	0373	175	C5	F5	45	35
10	15	05	55	0374	176	C5	F6	45	36
10	16	05	56	0375	177	C5	F7	45	37
10	17	05	57	0376	178	C5	F8	45	38
10	18	05	58	0377	179	C5	F9	45	39
10	19	05	59	0378	17A	C5	7A	45	3A
10	20	05	60	0379	17B	C5	7B	45	23
10	21	05	61	0380	17C	C5	7C	45	40
10	22	05	62	0381	17D	C5	7D	45	27
10	23	05	63	0382	17E	C5	7E	45	3D
10	24	05	64	0383	17F	C5	7F	45	22
10	25	05	65	0384	180	C6	40	46	20
10	26	05	66	0385	181	C6	C1	46	41
10	27	05	67	0386	182	C6	C2	46	42
10	28	05	68	0387	183	C6	C3	46	43
10	29	05	69	0388	184	C6	C4	46	44
10	30	05	70	0389	185	C6	C5	46	45
10	31	05	71	0390	186	C6	C6	46	46
10	32	05	72	0391	187	C6	C7	46	47
10	33	05	73	0392	188	C6	C8	46	48
10	34	05	74	0393	189	C6	C9	46	49
10	35	05	75	0394	18A	C6	4A	46	5B
10	36	05	76	0395	18B	C6	4B	46	2E
10	37	05	77	0396	18C	C6	4C	46	3C
10	38	05	78	0397	18D	C6	4D	46	28
10	39	05	79	0398	18E	C6	4E	46	2B
10	40	05	80	0399	18F	C6	4F	46	21
11	01	06	01	0400	190	C6	50	46	26
11	02	06	02	0401	191	C6	D1	46	4A
11	03	06	03	0402	192	C6	D2	46	4B
11	04	06	04	0403	193	C6	D3	46	4C
11	05	06	05	0404	194	C6	D4	46	4D
11	06	06	06	0405	195	C6	D5	46	4E
11	07	06	07	0406	196	C6	D6	46	4F
11	08	06	08	0407	197	C6	D7	46	50
11	09	06	09	0408	198	C6	D8	46	51
11	10	06	10	0409	199	C6	D9	46	52
11	11	06	11	0410	19A	C6	5A	46	5D
11	12	06	12	0411	19B	C6	5B	46	24
11	13	06	13	0412	19C	C6	5C	46	2A
11	14	06	14	0413	19D	C6	5D	46	29
11	15	06	15	0414	19E	C6	5E	46	3B
11	16	06	16	0415	19F	C6	5F	46	5E
11	17	06	17	0416	1A0	C6	60	46	2D
11	18	06	18	0417	1A1	C6	61	46	2F
11	19	06	19	0418	1A2	C6	E2	46	53
11	20	06	20	0419	1A3	C6	E3	46	54
11	21	06	21	0420	1A4	C6	E4	46	55
11	22	06	22	0421	1A5	C6	E5	46	56
11	23	06	23	0422	1A6	C6	E6	46	57
11	24	06	24	0423	1A7	C6	E7	46	58
11	25	06	25	0424	1A8	C6	E8	46	59
11	26	06	26	0425	1A9	C6	E9	46	5A
11	27	06	27	0426	1AA	C6	6A	46	7C
11	28	06	28	0427	1AB	C6	6B	46	2C
11	29	06	29	0428	1AC	C6	6C	46	25
11	30	06	30	0429	1AD	C6	6D	46	5F
11	31	06	31	0430	1AE	C6	6E	46	3E
11	32	06	32	0431	1AF	C6	6F	46	3F
11	33	06	33	0432	1B0	C6	F0	46	30

40 Col		80 Col		Position		Buffer Address (Hex)			
R	C	R	C	Dec	Hex	EBCDIC		ASCII	
11	34	06	34	0433	1B1	C6	F1	46	31
11	35	06	35	0434	1B2	C6	F2	46	32
11	36	06	36	0435	1B3	C6	F3	46	33
11	37	06	37	0436	1B4	C6	F4	46	34
11	38	06	38	0437	1B5	C6	F5	46	35
11	39	06	39	0438	1B6	C6	F6	46	36
11	40	06	40	0439	1B7	C6	F7	46	37
12	01	06	41	0440	1B8	C6	F8	46	38
12	02	06	42	0441	1B9	C6	F9	46	39
12	03	06	43	0442	1BA	C6	7A	46	3A
12	04	06	44	0443	1BB	C6	7B	46	23
12	05	06	45	0444	1BC	C6	7C	46	40
12	06	06	46	0445	1BD	C6	7D	46	27
12	07	06	47	0446	1BE	C6	7E	46	3D
12	08	06	48	0447	1BF	C6	7F	46	22
12	09	06	49	0448	1C0	C7	40	47	20
12	10	06	50	0449	1C1	C7	C1	47	41
12	11	06	51	0450	1C2	C7	C2	47	42
12	12	06	52	0451	1C3	C7	C3	47	43
12	13	06	53	0452	1C4	C7	C4	47	44
12	14	06	54	0453	1C5	C7	C5	47	45
12	15	06	55	0454	1C6	C7	C6	47	46
12	16	06	56	0455	1C7	C7	C7	47	47
12	17	06	57	0456	1C8	C7	C8	47	48
12	18	06	58	0457	1C9	C7	C9	47	49
12	19	06	59	0458	1CA	C7	4A	47	5B
12	20	06	60	0459	1CB	C7	4B	47	2E
12	21	06	61	0460	1CC	C7	4C	47	3C
12	22	06	62	0461	1CD	C7	4D	47	28
12	23	06	63	0462	1CE	C7	4E	47	2B
12	24	06	64	0463	1CF	C7	4F	47	21
12	25	06	65	0464	1D0	C7	50	47	26
12	26	06	66	0465	1D1	C7	D1	47	4A
12	27	06	67	0466	1D2	C7	D2	47	4B
12	28	06	68	0467	1D3	C7	D3	47	4C
12	29	06	69	0468	1D4	C7	D4	47	4D
12	30	06	70	0469	1D5	C7	D5	47	4E
12	31	06	71	0470	1D6	C7	D6	47	4F
12	32	06	72	0471	1D7	C7	D7	47	50
12	33	06	73	0472	1D8	C7	D8	47	51
12	34	06	74	0473	1D9	C7	D9	47	52
12	35	06	75	0474	1DA	C7	5A	47	5D
12	36	06	76	0475	1DB	C7	5B	47	24
12	37	06	77	0476	1DC	C7	5C	47	2A
12	38	06	78	0477	1DD	C7	5D	47	29
12	39	06	79	0478	1DE	C7	5E	47	3B
12	40	06	80	0479	1DF	C7	5F	47	5E
		07	01	0480	1E0	C7	60	47	2D
		07	02	0481	1E1	C7	61	47	2F
		07	03	0482	1E2	C7	E2	47	53
		07	04	0483	1E3	C7	E3	47	54
		07	05	0484	1E4	C7	E4	47	55
		07	06	0485	1E5	C7	E5	47	56
		07	07	0486	1E6	C7	E6	47	57
		07	08	0487	1E7	C7	E7	47	58
		07	09	0488	1E8	C7	E8	47	59
		07	10	0489	1E9	C7	E9	47	5A
		07	11	0490	1EA	C7	6A	47	7C
		07	12	0491	1EB	C7	6B	47	2C
		07	13	0492	1EC	C7	6C	47	25
		07	14	0493	1ED	C7	6D	47	5F
		07	15	0494	1EE	C7	6E	47	3E

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
07	16	0495	1EF	C7	6F	47	3F
07	17	0496	1F0	C7	F0	47	30
07	18	0497	1F1	C7	F1	47	31
07	19	0498	1F2	C7	F2	47	32
07	20	0499	1F3	C7	F3	47	33
07	21	0500	1F4	C7	F4	47	34
07	22	0501	1F5	C7	F5	47	35
07	23	0502	1F6	C7	F6	47	36
07	24	0503	1F7	C7	F7	47	37
07	25	0504	1F8	C7	F8	47	38
07	26	0505	1F9	C7	F9	47	39
07	27	0506	1FA	C7	7A	47	3A
07	28	0507	1FB	C7	7B	47	23
07	29	0508	1FC	C7	7C	47	40
07	30	0509	1FD	C7	7D	47	27
07	31	0510	1FE	C7	7E	47	3D
07	32	0511	1FF	C7	7F	47	22
07	33	0512	200	C8	40	48	20
07	34	0513	201	C8	C1	48	41
07	35	0514	202	C8	C2	48	42
07	36	0515	203	C8	C3	48	43
07	37	0516	204	C8	C4	48	44
07	38	0517	205	C8	C5	48	45
07	39	0518	206	C8	C6	48	46
07	40	0519	207	C8	C7	48	47
07	41	0520	208	C8	C8	48	48
07	42	0521	209	C8	C9	48	49
07	43	0522	20A	C8	4A	48	5B
07	44	0523	20B	C8	4B	48	2E
07	45	0524	20C	C8	4C	48	3C
07	46	0525	20D	C8	4D	48	28
07	47	0526	20E	C8	4E	48	2B
07	48	0527	20F	C8	4F	48	21
07	49	0528	210	C8	50	48	26
07	50	0529	211	C8	D1	48	4A
07	51	0530	212	C8	D2	48	4B
07	52	0531	213	C8	D3	48	4C
07	53	0532	214	C8	D4	48	4D
07	54	0533	215	C8	D5	48	4E
07	55	0534	216	C8	D6	48	4F
07	56	0535	217	C8	D7	48	50
07	57	0536	218	C8	D8	48	51
07	58	0537	219	C8	D9	48	52
07	59	0538	21A	C8	5A	48	5D
07	60	0539	21B	C8	5B	48	24
07	61	0540	21C	C8	5C	48	2A
07	62	0541	21D	C8	5D	48	29
07	63	0542	21E	C8	5E	48	3B
07	64	0543	21F	C8	5F	48	5E
07	65	0544	220	C8	60	48	2D
07	66	0545	221	C8	61	48	2F
07	67	0546	222	C8	E2	48	53
07	68	0547	223	C8	E3	48	54
07	69	0548	224	C8	E4	48	55
07	70	0549	225	C8	E5	48	56
07	71	0550	226	C8	E6	48	57
07	72	0551	227	C8	E7	48	58
07	73	0552	228	C8	E8	48	59
07	74	0553	229	C8	E9	48	5A
07	75	0554	22A	C8	6A	48	7C
07	76	0555	22B	C8	6B	48	2C
07	77	0556	22C	C8	6C	48	25

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
07	78	0557	22D	C8	6D	48	5F
07	79	0558	22E	C8	6E	48	3E
07	80	0559	22F	C8	6F	48	3F
08	01	0560	230	C8	F0	48	30
08	02	0561	231	C8	F1	48	31
08	03	0562	232	C8	F2	48	32
08	04	0563	233	C8	F3	48	33
08	05	0564	234	C8	F4	48	34
08	06	0565	235	C8	F5	48	35
08	07	0566	236	C8	F6	48	36
08	08	0567	237	C8	F7	48	37
08	09	0568	238	C8	F8	48	38
08	10	0569	239	C8	F9	48	39
08	11	0570	23A	C8	7A	48	3A
08	12	0571	23B	C8	7B	48	23
08	13	0572	23C	C8	7C	48	40
08	14	0573	23D	C8	7D	48	27
08	15	0574	23E	C8	7E	48	3D
08	16	0575	23F	C8	7F	48	22
08	17	0576	240	C9	40	49	20
08	18	0577	241	C9	C1	49	41
08	19	0578	242	C9	C2	49	42
08	20	0579	243	C9	C3	49	43
08	21	0580	244	C9	C4	49	44
08	22	0581	245	C9	C5	49	45
08	23	0582	246	C9	C6	49	46
08	24	0583	247	C9	C7	49	47
08	25	0584	248	C9	C8	49	48
08	26	0585	249	C9	C9	49	49
08	27	0586	24A	C9	4A	49	5B
08	28	0587	24B	C9	4B	49	2E
08	29	0588	24C	C9	4C	49	3C
08	30	0589	24D	C9	4D	49	28
08	31	0590	24E	C9	4E	49	2B
08	32	0591	24F	C9	4F	49	21
08	33	0592	250	C9	50	49	26
08	34	0593	251	C9	D1	49	4A
08	35	0594	252	C9	D2	49	4B
08	36	0595	253	C9	D3	49	4C
08	37	0596	254	C9	D4	49	4D
08	38	0597	255	C9	D5	49	4E
08	39	0598	256	C9	D6	49	4F
08	40	0599	257	C9	D7	49	50
08	41	0600	258	C9	D8	49	51
08	42	0601	259	C9	D9	49	52
08	43	0602	25A	C9	5A	49	5D
08	44	0603	25B	C9	5B	49	24
08	45	0604	25C	C9	5C	49	2A
08	46	0605	25D	C9	5D	49	29
08	47	0606	25E	C9	5E	49	3B
08	48	0607	25F	C9	5F	49	5E
08	49	0608	260	C9	60	49	2D
08	50	0609	261	C9	61	49	2F
08	51	0610	262	C9	E2	49	53
08	52	0611	263	C9	E3	49	54
08	53	0612	264	C9	E4	49	55
08	54	0613	265	C9	E5	49	56
08	55	0614	266	C9	E6	49	57
08	56	0615	267	C9	E7	49	58
08	57	0616	268	C9	E8	49	59
08	58	0617	269	C9	E9	49	5A
08	59	0618	26A	C9	6A	49	7C
08	60	0619	26B	C9	6B	49	2C

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
08	61	0620	26C	C9	6C	49	25
08	62	0621	26D	C9	6D	49	5F
08	63	0622	26E	C9	6E	49	3E
08	64	0623	26F	C9	6F	49	3F
08	65	0624	270	C9	F0	49	30
08	66	0625	271	C9	F1	49	31
08	67	0626	272	C9	F2	49	32
08	68	0627	273	C9	F3	49	33
08	69	0628	274	C9	F4	49	34
08	70	0629	275	C9	F5	49	35
08	71	0630	276	C9	F6	49	36
08	72	0631	277	C9	F7	49	37
08	73	0632	278	C9	F8	49	38
08	74	0633	279	C9	F9	49	39
08	75	0634	27A	C9	7A	49	3A
08	76	0635	27B	C9	7B	49	23
08	77	0636	27C	C9	7C	49	40
08	78	0637	27D	C9	7D	49	27
08	79	0638	27E	C9	7E	49	3D
08	80	0639	27F	C9	7F	49	22
09	01	0640	280	4A	40	5B	20
09	02	0641	281	4A	C1	5B	41
09	03	0642	282	4A	C2	5B	42
09	04	0643	283	4A	C3	5B	43
09	05	0644	284	4A	C4	5B	44
09	06	0645	285	4A	C5	5B	45
09	07	0646	286	4A	C6	5B	46
09	08	0647	287	4A	C7	5B	47
09	09	0648	288	4A	C8	5B	48
09	10	0649	289	4A	C9	5B	49
09	11	0650	28A	4A	4A	5B	5B
09	12	0651	28B	4A	4B	5B	2E
09	13	0652	28C	4A	4C	5B	3C
09	14	0653	28D	4A	4D	5B	28
09	15	0654	28E	4A	4E	5B	2B
09	16	0655	28F	4A	4F	5B	21
09	17	0656	290	4A	50	5B	26
09	18	0657	291	4A	D1	5B	4A
09	19	0658	292	4A	D2	5B	4B
09	20	0659	293	4A	D3	5B	4C
09	21	0660	294	4A	D4	5B	4D
09	22	0661	295	4A	D5	5B	4E
09	23	0662	296	4A	D6	5B	4F
09	24	0663	297	4A	D7	5B	50
09	25	0664	298	4A	D8	5B	51
09	26	0665	299	4A	D9	5B	52
09	27	0666	29A	4A	5A	5B	5D
09	28	0667	29B	4A	5B	5B	24
09	29	0668	29C	4A	5C	5B	2A
09	30	0669	29D	4A	5D	5B	29
09	31	0670	29E	4A	5E	5B	3B
09	32	0671	29F	4A	5F	5B	5E
09	33	0672	2A0	4A	60	5B	2D
09	34	0673	2A1	4A	61	5B	2F
09	35	0674	2A2	4A	E2	5B	53
09	36	0675	2A3	4A	E3	5B	54
09	37	0676	2A4	4A	E4	5B	55
09	38	0677	2A5	4A	E5	5B	56
09	39	0678	2A6	4A	E6	5B	57
09	40	0679	2A7	4A	E7	5B	58
09	41	0680	2A8	4A	E8	5B	59
09	42	0681	2A9	4A	E9	5B	5A

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
09	43	0682	2AA	4A	6A	5B	7C
09	44	0683	2AB	4A	6B	5B	2C
09	45	0684	2AC	4A	6C	5B	25
09	46	0685	2AD	4A	6D	5B	5F
09	47	0686	2AE	4A	6E	5B	3E
09	48	0687	2AF	4A	6F	5B	3F
09	49	0688	2B0	4A	F0	5B	30
09	50	0689	2B1	4A	F1	5B	31
09	51	0690	2B2	4A	F2	5B	32
09	52	0691	2B3	4A	F3	5B	33
09	53	0692	2B4	4A	F4	5B	34
09	54	0693	2B5	4A	F5	5B	35
09	55	0694	2B6	4A	F6	5B	36
09	56	0695	2B7	4A	F7	5B	37
09	57	0696	2B8	4A	F8	5B	38
09	58	0697	2B9	4A	F9	5B	39
09	59	0698	2BA	4A	7A	5B	3A
09	60	0699	2BB	4A	7B	5B	23
09	61	0700	2BC	4A	7C	5B	40
09	62	0701	2BD	4A	7D	5B	27
09	63	0702	2BE	4A	7E	5B	3D
09	64	0703	2BF	4A	7F	5B	22
09	65	0704	2C0	4B	40	2E	20
09	66	0705	2C1	4B	C1	2E	41
09	67	0706	2C2	4B	C2	2E	42
09	68	0707	2C3	4B	C3	2E	43
09	69	0708	2C4	4B	C4	2E	44
09	70	0709	2C5	4B	C5	2E	45
09	71	0710	2C6	4B	C6	2E	46
09	72	0711	2C7	4B	C7	2E	47
09	73	0712	2C8	4B	C8	2E	48
09	74	0713	2C9	4B	C9	2E	49
09	75	0714	2CA	4B	4A	2E	5B
09	76	0715	2CB	4B	4B	2E	2E
09	77	0716	2CC	4B	4C	2E	3C
09	78	0717	2CD	4B	4D	2E	28
09	79	0718	2CE	4B	4E	2E	2B
09	80	0719	2CF	4B	4F	2E	21
10	01	0720	2D0	4B	50	2E	26
10	02	0721	2D1	4B	D1	2E	4A
10	03	0722	2D2	4B	D2	2E	4B
10	04	0723	2D3	4B	D3	2E	4C
10	05	0724	2D4	4B	D4	2E	4D
10	06	0725	2D5	4B	D5	2E	4E
10	07	0726	2D6	4B	D6	2E	4F
10	08	0727	2D7	4B	D7	2E	50
10	09	0728	2D8	4B	D8	2E	51
10	10	0729	2D9	4B	D9	2E	52
10	11	0730	2DA	4B	5A	2E	5D
10	12	0731	2DB	4B	5B	2E	24
10	13	0732	2DC	4B	5C	2E	2A
10	14	0733	2DD	4B	5D	2E	29
10	15	0734	2DE	4B	5E	2E	3B
10	16	0735	2DF	4B	5F	2E	5E
10	17	0736	2E0	4B	60	2E	2D
10	18	0737	2E1	4B	61	2E	2F
10	19	0738	2E2	4B	E2	2E	53
10	20	0739	2E3	4B	E3	2E	54
10	21	0740	2E4	4B	E4	2E	55
10	22	0741	2E5	4B	E5	2E	56
10	23	0742	2E6	4B	E6	2E	57
10	24	0743	2E7	4B	E7	2E	58

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
10	25	0744	2E8	4B	E8	2E	59
10	26	0745	2E9	4B	E9	2E	5A
10	27	0746	2EA	4B	6A	2E	7C
10	28	0747	2EB	4B	6B	2E	2C
10	29	0748	2EC	4B	6C	2E	25
10	30	0749	2ED	4B	6D	2E	5F
10	31	0750	2EE	4B	6E	2E	3E
10	32	0751	2EF	4B	6F	2E	3F
10	33	0752	2F0	4B	F0	2E	30
10	34	0753	2F1	4B	F1	2E	31
10	35	0754	2F2	4B	F2	2E	32
10	36	0755	2F3	4B	F3	2E	33
10	37	0756	2F4	4B	F4	2E	34
10	38	0757	2F5	4B	F5	2E	35
10	39	0758	2F6	4B	F6	2E	36
10	40	0759	2F7	4B	F7	2E	37
10	41	0760	2F8	4B	F8	2E	38
10	42	0761	2F9	4B	F9	2E	39
10	43	0762	2FA	4B	7A	2E	3A
10	44	0763	2FB	4B	7B	2E	23
10	45	0764	2FC	4B	7C	2E	40
10	46	0765	2FD	4B	7D	2E	27
10	47	0766	2FE	4B	7E	2E	3D
10	48	0767	2FF	4B	7F	2E	22
10	49	0768	300	4C	40	3C	20
10	50	0769	301	4C	C1	3C	41
10	51	0770	302	4C	C2	3C	42
10	52	0771	303	4C	C3	3C	43
10	53	0772	304	4C	C4	3C	44
10	54	0773	305	4C	C5	3C	45
10	55	0774	306	4C	C6	3C	46
10	56	0775	307	4C	C7	3C	47
10	57	0776	308	4C	C8	3C	48
10	58	0777	309	4C	C9	3C	49
10	59	0778	30A	4C	4A	3C	5B
10	60	0779	30B	4C	4B	3C	2E
10	61	0780	30C	4C	4C	3C	3C
10	62	0781	30D	4C	4D	3C	28
10	63	0782	30E	4C	4E	3C	2B
10	64	0783	30F	4C	4F	3C	21
10	65	0784	310	4C	50	3C	26
10	66	0785	311	4C	D1	3C	4A
10	67	0786	312	4C	D2	3C	4B
10	68	0787	313	4C	D3	3C	4C
10	69	0788	314	4C	D4	3C	4D
10	70	0789	315	4C	D5	3C	4E
10	71	0790	316	4C	D6	3C	4F
10	72	0791	317	4C	D7	3C	50
10	73	0792	318	4C	D8	3C	51
10	74	0793	319	4C	D9	3C	52
10	75	0794	31A	4C	5A	3C	5D
10	76	0795	31B	4C	5B	3C	24
10	77	0796	31C	4C	5C	3C	2A
10	78	0797	31D	4C	5D	3C	29
10	79	0798	31E	4C	5E	3C	3B
10	80	0799	31F	4C	5F	3C	5E
11	01	0800	320	4C	60	3C	2D
11	02	0801	321	4C	61	3C	2F
11	03	0802	322	4C	E2	3C	53
11	04	0803	323	4C	E3	3C	54
11	05	0804	324	4C	E4	3C	55
11	06	0805	325	4C	E5	3C	56

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
11	07	0806	326	4C	E6	3C	57
11	08	0807	327	4C	E7	3C	58
11	09	0808	328	4C	E8	3C	59
11	10	0809	329	4C	E9	3C	5A
11	11	0810	32A	4C	6A	3C	7C
11	12	0811	32B	4C	6B	3C	2C
11	13	0812	32C	4C	6C	3C	25
11	14	0813	32D	4C	6D	3C	5F
11	15	0814	32E	4C	6E	3C	3E
11	16	0815	32F	4C	6F	3C	3F
11	17	0816	330	4C	F0	3C	30
11	18	0817	331	4C	F1	3C	31
11	19	0818	332	4C	F2	3C	32
11	20	0819	333	4C	F3	3C	33
11	21	0820	334	4C	F4	3C	34
11	22	0821	335	4C	F5	3C	35
11	23	0822	336	4C	F6	3C	36
11	24	0823	337	4C	F7	3C	37
11	25	0824	338	4C	F8	3C	38
11	26	0825	339	4C	F9	3C	39
11	27	0826	33A	4C	7A	3C	3A
11	28	0827	33B	4C	7B	3C	23
11	29	0828	33C	4C	7C	3C	40
11	30	0829	33D	4C	7D	3C	27
11	31	0830	33E	4C	7E	3C	3D
11	32	0831	33F	4C	7F	3C	22
11	33	0832	340	4D	40	28	20
11	34	0833	341	4D	C1	28	41
11	35	0834	342	4D	C2	28	42
11	36	0835	343	4D	C3	28	43
11	37	0836	344	4D	C4	28	44
11	38	0837	345	4D	C5	28	45
11	39	0838	346	4D	C6	28	46
11	40	0839	347	4D	C7	28	47
11	41	0840	348	4D	C8	28	48
11	42	0841	349	4D	C9	28	49
11	43	0842	34A	4D	4A	28	5B
11	44	0843	34B	4D	4B	28	2E
11	45	0844	34C	4D	4C	28	3C
11	46	0845	34D	4D	4D	28	28
11	47	0846	34E	4D	4E	28	2B
11	48	0847	34F	4D	4F	28	21
11	49	0848	350	4D	50	28	26
11	50	0849	351	4D	D1	28	4A
11	51	0850	352	4D	D2	28	4B
11	52	0851	353	4D	D3	28	4C
11	53	0852	354	4D	D4	28	4D
11	54	0853	355	4D	D5	28	4E
11	55	0854	356	4D	D6	28	4F
11	56	0855	357	4D	D7	28	50
11	57	0856	358	4D	D8	28	51
11	58	0857	359	4D	D9	28	52
11	59	0858	35A	4D	5A	28	5D
11	60	0859	35B	4D	5B	28	24
11	61	0860	35C	4D	5C	28	2A
11	62	0861	35D	4D	5D	28	29
11	63	0862	35E	4D	5E	28	3B
11	64	0863	35F	4D	5F	28	5E
11	65	0864	360	4D	60	28	2D
11	66	0865	361	4D	61	28	2F
11	67	0866	362	4D	E2	28	53
11	68	0867	363	4D	E3	28	54

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
11	69	0868	364	4D	E4	28	55
11	70	0869	365	4D	E5	28	56
11	71	0870	366	4D	E6	28	57
11	72	0871	367	4D	E7	28	58
11	73	0872	368	4D	E8	28	59
11	74	0873	369	4D	E9	28	5A
11	75	0874	36A	4D	6A	28	7C
11	76	0875	36B	4D	6B	28	2C
11	77	0876	36C	4D	6C	28	25
11	78	0877	36D	4D	6D	28	5F
11	79	0878	36E	4D	6E	28	3E
11	80	0879	36F	4D	6F	28	3F
12	01	0880	370	4D	F0	28	30
12	02	0881	371	4D	F1	28	31
12	03	0882	372	4D	F2	28	32
12	04	0883	373	4D	F3	28	33
12	05	0884	374	4D	F4	28	34
12	06	0885	375	4D	F5	28	35
12	07	0886	376	4D	F6	28	36
12	08	0887	377	4D	F7	28	37
12	09	0888	378	4D	F8	28	38
12	10	0889	379	4D	F9	28	39
12	11	0890	37A	4D	7A	28	3A
12	12	0891	37B	4D	7B	28	23
12	13	0892	37C	4D	7C	28	40
12	14	0893	37D	4D	7D	28	27
12	15	0894	37E	4D	7E	28	3D
12	16	0895	37F	4D	7F	28	22
12	17	0896	380	4E	40	2B	20
12	18	0897	381	4E	C1	2B	41
12	19	0898	382	4E	C2	2B	42
12	20	0899	383	4E	C3	2B	43
12	21	0900	384	4E	C4	2B	44
12	22	0901	385	4E	C5	2B	45
12	23	0902	386	4E	C6	2B	46
12	24	0903	387	4E	C7	2B	47
12	25	0904	388	4E	C8	2B	48
12	26	0905	389	4E	C9	2B	49
12	27	0906	38A	4E	4A	2B	5B
12	28	0907	38B	4E	4B	2B	2E
12	29	0908	38C	4E	4C	2B	3C
12	30	0909	38D	4E	4D	2B	28
12	31	0910	38E	4E	4E	2B	2B
12	32	0911	38F	4E	4F	2B	21
12	33	0912	390	4E	50	2B	26
12	34	0913	391	4E	D1	2B	4A
12	35	0914	392	4E	D2	2B	4B
12	26	0915	393	4E	D3	2B	4C
12	37	0916	394	4E	D4	2B	4D
12	38	0917	395	4E	D5	2B	4E
12	39	0918	396	4E	D6	2B	4F
12	40	0919	397	4E	D7	2B	50
12	41	0920	398	4E	D8	2B	51
12	42	0921	399	4E	D9	2B	52
12	43	0922	39A	4E	5A	2B	5D
12	44	0923	39B	4E	5B	2B	24
12	45	0924	39C	4E	5C	2B	2A
12	46	0925	39D	4E	5D	2B	29
12	47	0926	39E	4E	5E	2B	3B
12	48	0927	39F	4E	5F	2B	5E
12	49	0928	3A0	4E	60	2B	2D
12	50	0929	3A1	4E	61	2B	2F

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
12	51	0930	3A2	4E	E2	2B	53
12	52	0931	3A3	4E	E3	2B	54
12	53	0932	3A4	4E	E4	2B	55
12	54	0933	3A5	4E	E5	2B	56
12	55	0934	3A6	4E	E6	2B	57
12	56	0935	3A7	4E	E7	2B	58
12	57	0936	3A8	4E	E8	2B	59
12	58	0937	3A9	4E	E9	2B	5A
12	59	0938	3AA	4E	6A	2B	7C
12	60	0939	3AB	4E	6B	2B	2C
12	61	0940	3AC	4E	6C	2B	25
12	62	0941	3AD	4E	6D	2B	5F
12	63	0942	3AE	4E	6E	2B	3E
12	64	0943	3AF	4E	6F	2B	3F
12	65	0944	3B0	4E	F0	2B	30
12	66	0945	3B1	4E	F1	2B	31
12	67	0946	3B2	4E	F2	2B	32
12	68	0947	3B3	4E	F3	2B	33
12	69	0948	3B4	4E	F4	2B	34
12	70	0949	3B5	4E	F5	2B	35
12	71	0950	3B6	4E	F6	2B	36
12	72	0951	3B7	4E	F7	2B	37
12	73	0952	3B8	4E	F8	2B	38
12	74	0953	3B9	4E	F9	2B	39
12	75	0954	3BA	4E	7A	2B	3A
12	76	0955	3BB	4E	7B	2B	23
12	77	0956	3BC	4E	7C	2B	40
12	78	0957	3BD	4E	7D	2B	27
12	79	0958	3BE	4E	7E	2B	3D
12	80	0959	3BF	4E	7F	2B	22
13	01	0960	3C0	4F	40	21	20
13	02	0961	3C1	4F	C1	21	41
13	03	0962	3C2	4F	C2	21	42
13	04	0963	3C3	4F	C3	21	43
13	05	0964	3C4	4F	C4	21	44
13	06	0965	3C5	4F	C5	21	45
13	07	0966	3C6	4F	C6	21	46
13	08	0967	3C7	4F	C7	21	47
13	09	0968	3C8	4F	C8	21	48
13	10	0969	3C9	4F	C9	21	49
13	11	0970	3CA	4F	4A	21	5B
13	12	0971	3CB	4F	4B	21	2E
13	13	0972	3CC	4F	4C	21	3C
13	14	0973	3CD	4F	4D	21	28
13	15	0974	3CE	4F	4E	21	2B
13	16	0975	3CF	4F	4F	21	21
13	17	0976	3D0	4F	50	21	26
13	18	0977	3D1	4F	D1	21	4A
13	19	0978	3D2	4F	D2	21	4B
13	20	0979	3D3	4F	D3	21	4C
13	21	0980	3D4	4F	D4	21	4D
13	22	0981	3D5	4F	D5	21	4E
13	23	0982	3D6	4F	D6	21	4F
13	24	0983	3D7	4F	D7	21	50
13	25	0984	3D8	4F	D8	21	51
13	26	0985	3D9	4F	D9	21	52
13	27	0986	3DA	4F	5A	21	5D
13	28	0987	3DB	4F	5B	21	24
13	29	0988	3DC	4F	5C	21	2A
13	30	0989	3DD	4F	5D	21	29
13	31	0990	3DE	4F	5E	21	3B
13	32	0991	3DF	4F	5F	21	5E

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
13	33	0992	3E0	4F	60	21	2D
13	34	0993	3E1	4F	61	21	2F
13	35	0994	3E2	4F	E2	21	53
13	36	0995	3E3	4F	E3	21	54
13	37	0996	3E4	4F	E4	21	55
13	38	0997	3E5	4F	E5	21	56
13	39	0998	3E6	4F	E6	21	57
13	40	0999	3E7	4F	E7	21	58
13	41	1000	3E8	4F	E8	21	59
13	42	1001	3E9	4F	E9	21	5A
13	43	1002	3EA	4F	6A	21	7C
13	44	1003	3EB	4F	6B	21	2C
13	45	1004	3EC	4F	6C	21	25
13	46	1005	3ED	4F	6D	21	5F
13	47	1006	3EE	4F	6E	21	3E
13	48	1007	3EF	4F	6F	21	3F
13	49	1008	3F0	4F	F0	21	30
13	50	1009	3F1	4F	F1	21	31
13	51	1010	3F2	4F	F2	21	32
13	52	1011	3F3	4F	F3	21	33
13	53	1012	3F4	4F	F4	21	34
13	54	1013	3F5	4F	F5	21	35
13	55	1014	3F6	4F	F6	21	36
13	56	1015	3F7	4F	F7	21	37
13	57	1016	3F8	4F	F8	21	38
13	58	1017	3F9	4F	F9	21	39
13	59	1018	3FA	4F	7A	21	3A
13	60	1019	3FB	4F	7B	21	23
13	61	1020	3FC	4F	7C	21	40
13	62	1021	3FD	4F	7D	21	27
13	63	1022	3FE	4F	7E	21	3D
13	64	1023	3FF	4F	7F	21	22
13	65	1024	400	50	40	26	20
13	66	1025	401	50	C1	26	41
13	67	1026	402	50	C2	26	42
13	68	1027	403	50	C3	26	43
13	69	1028	404	50	C4	26	44
13	70	1029	405	50	C5	26	45
13	71	1030	406	50	C6	26	46
13	72	1031	407	50	C7	26	47
13	73	1032	408	50	C8	26	48
13	74	1033	409	50	C9	26	49
13	75	1034	40A	50	4A	26	5B
13	76	1035	40B	50	4B	26	2E
13	77	1036	40C	50	4C	26	3C
13	78	1037	40D	50	4D	26	28
13	79	1038	40E	50	4E	26	2B
13	80	1039	40F	50	4F	26	21
14	01	1040	410	50	50	26	26
14	02	1041	411	50	D1	26	4A
14	03	1042	412	50	D2	26	4B
14	04	1043	413	50	D3	26	4C
14	05	1044	414	50	D4	26	4D
14	06	1045	415	50	D5	26	4E
14	07	1046	416	50	D6	26	4F
14	08	1047	417	50	D7	26	50
14	09	1048	418	50	D8	26	51
14	10	1049	419	50	D9	26	52
14	11	1050	41A	50	5A	26	5D
14	12	1051	41B	50	5B	26	24
14	13	1052	41C	50	5C	26	2A
14	14	1053	41D	50	5D	26	29

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
14	15	1054	41E	50	5E	26	3B
14	16	1055	41F	50	5F	26	5E
14	17	1056	420	50	60	26	2D
14	18	1057	421	50	61	26	2F
14	19	1058	422	50	E2	26	53
14	20	1059	423	50	E3	26	54
14	21	1060	424	50	E4	26	55
14	22	1061	425	50	E5	26	56
14	23	1062	426	50	E6	26	57
14	24	1063	427	50	E7	26	58
14	25	1064	428	50	E8	26	59
14	26	1065	429	50	E9	26	5A
14	27	1066	42A	50	6A	26	7C
14	28	1067	42B	50	6B	26	2C
14	29	1068	42C	60	6C	26	25
14	30	1069	42D	50	6D	26	5F
14	31	1070	42E	50	6E	26	3E
14	32	1071	42F	50	6F	26	3F
14	33	1072	430	50	F0	26	30
14	34	1073	431	50	F1	26	31
14	35	1074	432	50	F2	26	32
14	36	1075	433	50	F3	26	33
14	37	1076	434	50	F4	26	34
14	38	1077	435	50	F5	26	35
14	39	1078	436	50	F6	26	36
14	40	1079	437	50	F7	26	37
14	41	1080	438	50	F8	26	38
14	42	1081	439	50	F9	26	39
14	43	1082	43A	50	7A	26	3A
14	44	1083	43B	50	7B	26	23
14	45	1084	43C	50	7C	26	40
14	46	1085	43D	50	7D	26	27
14	47	1086	43E	50	7E	26	3D
14	48	1087	43F	50	7F	26	22
14	49	1088	440	D1	40	4A	20
14	50	1089	441	D1	C1	4A	41
14	51	1090	442	D1	C2	4A	42
14	52	1091	443	D1	C3	4A	43
14	53	1092	444	D1	C4	4A	44
14	54	1093	445	D1	C5	4A	45
14	55	1094	446	D1	C6	4A	46
14	56	1095	447	D1	C7	4A	47
14	57	1096	448	D1	C8	4A	48
14	58	1097	449	D1	C9	4A	49
14	59	1098	44A	D1	4A	4A	5B
14	60	1099	44B	D1	4B	4A	2E
14	61	1100	44C	D1	4C	4A	3C
14	62	1101	44D	D1	4D	4A	28
14	63	1102	44E	D1	4E	4A	2B
14	64	1103	44F	D1	4F	4A	21
14	65	1104	450	D1	50	4A	26
14	66	1105	451	D1	D1	4A	4A
14	67	1106	452	D1	D2	4A	4B
14	68	1107	453	D1	D3	4A	4C
14	69	1108	454	D1	D4	4A	4D
14	70	1109	455	D1	D5	4A	4E
14	71	1110	456	D1	D6	4A	4F
14	72	1111	457	D1	D7	4A	50
14	73	1112	458	D1	D8	4A	51
14	74	1113	459	D1	D9	4A	52
14	75	1114	45A	D1	5A	4A	5D
14	76	1115	45B	D1	5B	4A	24

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
14	77	1116	45C	D1	5C	4A	2A
14	78	1117	45D	D1	5D	4A	29
14	79	1118	45E	D1	5E	4A	3B
14	80	1119	45F	D1	5F	4A	5E
15	01	1120	460	D1	60	4A	2D
15	02	1121	461	D1	61	4A	2F
15	03	1122	462	D1	E2	4A	53
15	04	1123	463	D1	E3	4A	54
15	05	1124	464	D1	E4	4A	55
15	06	1125	465	D1	E5	4A	56
15	07	1126	466	D1	E6	4A	57
15	08	1127	467	D1	E7	4A	58
15	09	1128	468	D1	E8	4A	59
15	10	1129	469	D1	E9	4A	5A
15	11	1130	46A	D1	6A	4A	7C
15	12	1131	46B	D1	6B	4A	2C
15	13	1132	46C	D1	6C	4A	25
15	14	1133	46D	D1	6D	4A	5F
15	15	1134	46E	D1	6E	4A	3E
15	16	1135	46F	D1	6F	4A	3F
15	17	1136	470	D1	F0	4A	30
15	18	1137	471	D1	F1	4A	31
15	19	1138	472	D1	F2	4A	32
15	20	1139	473	D1	F3	4A	33
15	21	1140	474	D1	F4	4A	34
15	22	1141	475	D1	F5	4A	35
15	23	1142	476	D1	F6	4A	36
15	24	1143	477	D1	F7	4A	37
15	25	1144	478	D1	F8	4A	38
15	26	1145	479	D1	F9	4A	39
15	27	1146	47A	D1	7A	4A	3A
15	28	1147	47B	D1	7B	4A	23
15	29	1148	47C	D1	7C	4A	40
15	30	1149	47D	D1	7D	4A	27
15	31	1150	47E	D1	7E	4A	3D
15	32	1151	47F	D1	7F	4A	22
15	33	1152	480	D2	40	4B	20
15	34	1153	481	D2	C1	4B	41
15	35	1154	482	D2	C2	4B	42
15	36	1155	483	D2	C3	4B	43
15	37	1156	484	D2	C4	4B	44
15	38	1157	485	D2	C5	4B	45
15	39	1158	486	D2	C6	4B	46
15	40	1159	487	D2	C7	4B	47
15	41	1160	488	D2	C8	4B	48
15	42	1161	489	D2	C9	4B	49
15	43	1162	48A	D2	4A	4B	5B
15	44	1163	48B	D2	4B	4B	2E
15	45	1164	48C	D2	4C	4B	3C
15	46	1165	48D	D2	4D	4B	28
15	47	1166	48E	D2	4E	4B	2B
15	48	1167	48F	D2	4F	4B	21
15	49	1168	490	D2	50	4B	26
15	50	1169	491	D2	D1	4B	4A
15	51	1170	492	D2	D2	4B	4B
15	52	1171	493	D2	D3	4B	4C
15	53	1172	494	D2	D4	4B	4D
15	54	1173	495	D2	D5	4B	4E
15	55	1174	496	D2	D6	4B	4F
15	56	1175	497	D2	D7	4B	50
15	57	1176	498	D2	D8	4B	51
15	58	1177	499	D2	D9	4B	52

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
15	59	1178	49A	D2	5A	4B	5D
15	60	1179	49B	D2	5B	4B	24
15	61	1180	49C	D2	5C	4B	2A
15	62	1181	49D	D2	5D	4B	29
15	63	1182	49E	D2	5E	4B	3B
15	64	1183	49F	D2	5F	4B	5E
15	65	1184	4A0	D2	60	4B	2D
15	66	1185	4A1	D2	61	4B	2F
15	67	1186	4A2	D2	E2	4B	53
15	68	1187	4A3	D2	E3	4B	54
15	69	1188	4A4	D2	E4	4B	55
15	70	1189	4A5	D2	E5	4B	56
15	71	1190	4A6	D2	E6	4B	57
15	72	1191	4A7	D2	E7	4B	58
15	73	1192	4A8	D2	E8	4B	59
15	74	1193	4A9	D2	E9	4B	5A
15	75	1194	4AA	D2	6A	4B	7C
15	76	1195	4AB	D2	6B	4B	2C
15	77	1196	4AC	D2	6C	4B	25
15	78	1197	4AD	D2	6D	4B	5F
15	79	1198	4AE	D2	6E	4B	3E
15	80	1199	4AF	D2	6F	4B	3F
16	01	1200	4B0	D2	F0	4B	30
16	02	1201	4B1	D2	F1	4B	31
16	03	1202	4B2	D2	F2	4B	32
16	04	1203	4B3	D2	F3	4B	33
16	05	1204	4B4	D2	F4	4B	34
16	06	1205	4B5	D2	F5	4B	35
16	07	1206	4B6	D2	F6	4B	36
16	08	1207	4B7	D2	F7	4B	37
16	09	1208	4B8	D2	F8	4B	38
16	10	1209	4B9	D2	F9	4B	39
16	11	1210	4BA	D2	7A	4B	3A
16	12	1211	4BB	D2	7B	4B	23
16	13	1212	4BC	D2	7C	4B	40
16	14	1213	4BD	D2	7D	4B	27
16	15	1214	4BE	D2	7E	4B	3D
16	16	1215	4BF	D2	7F	4B	22
16	17	1216	4C0	D3	40	4C	20
16	18	1217	4C1	D3	C1	4C	41
16	19	1218	4C2	D3	C2	4C	42
16	20	1219	4C3	D3	C3	4C	43
16	21	1220	4C4	D3	C4	4C	44
16	22	1221	4C5	D3	C5	4C	45
16	23	1222	4C6	D3	C6	4C	46
16	24	1223	4C7	D3	C7	4C	47
16	25	1224	4C8	D3	C8	4C	48
16	26	1225	4C9	D3	C9	4C	49
16	27	1226	4CA	D3	4A	4C	5B
16	28	1227	4CB	D3	4B	4C	2E
16	29	1228	4CC	D3	4C	4C	3C
16	30	1229	4CD	D3	4D	4C	28
16	31	1230	4CE	D3	4E	4C	2B
16	32	1231	4CF	D3	4F	4C	21
16	33	1232	4D0	D3	50	4C	26
16	34	1233	4D1	D3	D1	4C	4A
16	35	1234	4D2	D3	D2	4C	4B
16	36	1235	4D3	D3	D3	4C	4C
16	37	1236	4D4	D3	D4	4C	4D
16	38	1237	4D5	D3	D5	4C	4E
16	39	1238	4D6	D3	D6	4C	4F
16	40	1239	4D7	D3	D7	4C	50

80 Col		Position		Buffer Address (Hex)	
R	C	Dec	Hex	EBCDIC	ASCII
16	41	1240	4D8	D3 D8	4C 51
16	42	1241	4D9	D3 D9	4C 52
16	43	1242	4DA	D3 5A	4C 5D
16	44	1243	4DB	D3 5B	4C 24
16	45	1244	4DC	D3 5C	4C 2A
16	46	1245	4DD	D3 5D	4C 29
16	47	1246	4DE	D3 5E	4C 3B
16	48	1247	4DF	D3 5F	4C 5E
16	49	1248	4E0	D3 60	4C 2D
16	50	1249	4E1	D3 61	4C 2F
16	51	1250	4E2	D3 E2	4C 53
16	52	1251	4E3	D3 E3	4C 54
16	53	1252	4E4	D3 E4	4C 55
16	54	1253	4E5	D3 E5	4C 56
16	55	1254	4E6	D3 E6	4C 57
16	56	1255	4E7	D3 E7	4C 58
16	57	1256	4E8	D3 E8	4C 59
16	58	1257	4E9	D3 E9	4C 5A
16	59	1258	4EA	D3 6A	4C 7C
16	60	1259	4EB	D3 6B	4C 2C
16	61	1260	4EC	D3 6C	4C 25
16	62	1261	4ED	D3 6D	4C 5F
16	63	1262	4EE	D3 6E	4C 3E
16	64	1263	4EF	D3 6F	4C 3F
16	65	1264	4F0	D3 F0	4C 30
16	66	1265	4F1	D3 F1	4C 31
16	67	1266	4F2	D3 F2	4C 32
16	68	1267	4F3	D3 F3	4C 33
16	69	1268	4F4	D3 F4	4C 34
16	70	1269	4F5	D3 F5	4C 35
16	71	1270	4F6	D3 F6	4C 36
16	72	1271	4F7	D3 F7	4C 37
16	73	1272	4F8	D3 F8	4C 38
16	74	1273	4F9	D3 F9	4C 39
16	75	1274	4FA	D3 7A	4C 3A
16	76	1275	4FB	D3 7B	4C 23
16	77	1276	4FC	D3 7C	4C 40
16	78	1277	4FD	D3 7D	4C 27
16	79	1278	4FE	D3 7E	4C 3D
16	80	1279	4FF	D3 7F	4C 22
17	01	1280	500	D4 40	4D 20
17	02	1281	501	D4 C1	4D 41
17	03	1282	502	D4 C2	4D 42
17	04	1283	503	D4 C3	4D 43
17	05	1284	504	D4 C4	4D 44
17	06	1285	505	D4 C5	4D 45
17	07	1286	506	D4 C6	4D 46
17	08	1287	507	D4 C7	4D 47
17	09	1288	508	D4 C8	4D 48
17	10	1289	509	D4 C9	4D 49
17	11	1290	50A	D4 4A	4D 5B
17	12	1291	50B	D4 4B	4D 2E
17	13	1292	50C	D4 4C	4D 3C
17	14	1293	50D	D4 4D	4D 28
17	15	1294	50E	D4 4E	4D 2B
17	16	1295	50F	D4 4F	4D 21
17	17	1296	510	D4 50	4D 26
17	18	1297	511	D4 D1	4D 4A
17	19	1298	512	D4 D2	4D 4B
17	20	1299	513	D4 D3	4D 4C
17	21	1300	514	D4 D4	4D 4D
17	22	1301	515	D4 D5	4D 4E

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
17	23	1302	516	D4	D6	4D	4F
17	24	1303	517	D4	D7	4D	50
17	25	1304	518	D4	D8	4D	51
17	26	1305	519	D4	D9	4D	52
17	27	1306	51A	D4	5A	4D	5D
17	28	1307	51B	D4	5B	4D	24
17	29	1308	51C	D4	5C	4D	2A
17	30	1309	51D	D4	5D	4D	29
17	31	1310	51E	D4	5E	4D	3B
17	32	1311	51F	D4	5F	4D	5E
17	33	1312	520	D4	60	4D	2D
17	34	1313	521	D4	61	4D	2F
17	35	1314	522	D4	E2	4D	53
17	36	1315	523	D4	E3	4D	54
17	37	1316	524	D4	E4	4D	55
17	38	1317	525	D4	E5	4D	56
17	39	1318	526	D4	E6	4D	57
17	40	1319	527	D4	E7	4D	58
17	41	1320	528	D4	E8	4D	59
17	42	1321	529	D4	E9	4D	5A
17	43	1322	52A	D4	6A	4D	7C
17	44	1323	52B	D4	6B	4D	2C
17	45	1324	52C	D4	6C	4D	25
17	46	1325	52D	D4	6D	4D	5F
17	47	1326	52E	D4	6E	4D	3E
17	48	1327	52F	D4	6F	4D	3F
17	49	1328	530	D4	F0	4D	30
17	50	1329	531	D4	F1	4D	31
17	51	1330	532	D4	F2	4D	32
17	52	1331	533	D4	F3	4D	33
17	53	1332	534	D4	F4	4D	34
17	54	1333	535	D4	F5	4D	35
17	55	1334	536	D4	F6	4D	36
17	56	1335	537	D4	F7	4D	37
17	57	1336	538	D4	F8	4D	38
17	58	1337	539	D4	F9	4D	39
17	59	1338	53A	D4	7A	4D	3A
17	60	1339	53B	D4	7B	4D	23
17	61	1340	53C	D4	7C	4D	40
17	62	1341	53D	D4	7D	4D	27
17	63	1342	53E	D4	7E	4D	3D
17	64	1343	53F	D4	7F	4D	22
17	65	1344	540	D5	40	4E	20
17	66	1345	541	D5	C1	4E	41
17	67	1346	542	D5	C2	4E	42
17	68	1347	543	D5	C3	4E	43
17	69	1348	544	D5	C4	4E	44
17	70	1349	545	D5	C5	4E	45
17	71	1350	546	D5	C6	4E	46
17	72	1351	547	D5	C7	4E	47
17	73	1352	548	D5	C8	4E	48
17	74	1353	549	D5	C9	4E	49
17	75	1354	54A	D5	4A	4E	5B
17	76	1355	54B	D5	4B	4E	2E
17	77	1356	54C	D5	4C	4E	3C
17	78	1357	54D	D5	4D	4E	28
17	79	1358	54E	D5	4E	4E	2B
17	80	1359	54F	D5	4F	4E	21
18	01	1360	550	D5	50	4E	26
18	02	1361	551	D5	D1	4E	4A
18	03	1362	552	D5	D2	4E	4B
18	04	1363	553	D5	D3	4E	4C
18	05	1364	554	D5	D4	4E	4D

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
18	06	1365	555	D5	D5	4E	4E
18	07	1366	556	D5	D6	4E	4F
18	08	1367	557	D5	D7	4E	50
18	09	1368	558	D5	D8	4E	51
18	10	1369	559	D5	D9	4E	52
18	11	1370	55A	D5	5A	4E	5D
18	12	1371	55B	D5	5B	4E	24
18	13	1372	55C	D5	5C	4E	2A
18	14	1373	55D	D5	5D	4E	29
18	15	1374	55E	D5	5E	4E	3B
18	16	1375	55F	D5	5F	4E	5E
18	17	1376	560	D5	60	4E	2D
18	18	1377	561	D5	61	4E	2F
18	19	1378	562	D5	E2	4E	53
18	20	1379	563	D5	E3	4E	54
18	21	1380	564	D5	E4	4E	55
18	22	1381	565	D5	E5	4E	56
18	23	1382	566	D5	F6	4E	57
18	24	1383	567	D5	E7	4E	58
18	25	1384	568	D5	E8	4E	59
18	26	1385	569	D5	E9	4E	5A
18	27	1386	56A	D5	6A	4E	7C
18	28	1387	56B	D5	6B	4E	2C
18	29	1388	56C	D5	6C	4E	25
18	30	1389	56D	D5	6D	4E	5F
18	31	1390	56E	D5	6E	4E	3E
18	32	1391	56F	D5	6F	4E	3F
18	33	1392	570	D5	F0	4E	30
18	34	1393	571	D5	F1	4E	31
18	35	1394	572	D5	F2	4E	32
18	36	1395	573	D5	F3	4E	33
18	37	1396	574	D5	F4	4E	34
18	38	1397	575	D5	F5	4E	35
18	39	1398	576	D5	F6	4E	36
18	40	1399	577	D5	F7	4E	37
18	41	1400	578	D5	F8	4E	38
18	42	1401	579	D5	F9	4E	39
18	43	1402	57A	D5	7A	4E	3A
18	44	1403	57B	D5	7B	4E	23
18	45	1404	57C	D5	7C	4E	40
18	46	1405	57D	D5	7D	4E	27
18	47	1406	57E	D5	7E	4E	3D
18	48	1407	57F	D5	7F	4E	22
18	49	1408	580	D6	40	4F	20
18	50	1409	581	D6	C1	4F	41
18	51	1410	582	D6	C2	4F	42
18	52	1411	583	D6	C3	4F	43
18	53	1412	584	D6	C4	4F	44
18	54	1413	585	D6	C5	4F	45
18	55	1414	586	D6	C6	4F	46
18	56	1415	587	D6	C7	4F	47
18	57	1416	588	D6	C8	4F	48
18	58	1417	589	D6	C9	4F	49
18	59	1418	58A	D6	4A	4F	5B
18	60	1419	58B	D6	4B	4F	2E
18	61	1420	58C	D6	4C	4F	3C
18	62	1421	58D	D6	4D	4F	28
18	63	1422	58E	D6	4E	4F	2B
18	64	1423	58F	D6	4F	4F	21
18	65	1424	590	D6	50	4F	26
18	66	1425	591	D6	D1	4F	4A

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
18	67	1426	592	D6	D2	4F	4B
18	68	1427	593	D6	D3	4F	4C
18	69	1428	594	D6	D4	4F	4D
18	70	1429	595	D6	D5	4F	4E
18	71	1430	596	D6	D6	4F	4F
18	72	1431	597	D6	D7	4F	50
18	73	1432	598	D6	D8	4F	51
18	74	1433	599	D6	D9	4F	52
18	75	1434	59A	D6	5A	4F	5D
18	76	1435	59B	D6	5B	4F	24
18	77	1436	59C	D6	5C	4F	2A
18	78	1437	59D	D6	5D	4F	29
18	79	1438	59E	D6	5E	4F	3B
18	80	1439	59F	D6	5F	4F	5E
19	01	1440	5A0	D6	60	4F	2D
19	02	1441	5A1	D6	61	4F	2F
19	03	1442	5A2	D6	E2	4F	53
19	04	1443	5A3	D6	E3	4F	54
19	05	1444	5A4	D6	E4	4F	55
19	06	1445	5A5	D6	E5	4F	56
19	07	1446	5A6	D6	E6	4F	57
19	08	1447	5A7	D6	E7	4F	58
19	09	1448	5A8	D6	E8	4F	59
19	10	1449	5A9	D6	E9	4F	5A
19	11	1450	5AA	D6	6A	4F	7C
19	12	1451	5AB	D6	6B	4F	2C
19	13	1452	5AC	D6	6C	4F	25
19	14	1453	5AD	D6	6D	4F	5F
19	15	1454	5AE	D6	6E	4F	3E
19	16	1455	5AF	D6	6F	4F	3F
19	17	1456	5B0	D6	F0	4F	30
19	18	1457	5B1	D6	F1	4F	31
19	19	1458	5B2	D6	F2	4F	32
19	20	1459	5B3	D6	F3	4F	33
19	21	1460	5B4	D6	F4	4F	34
19	22	1461	5B5	D6	F5	4F	35
19	23	1462	5B6	D6	F6	4F	36
19	24	1463	5B7	D6	F7	4F	37
19	25	1464	5B8	D6	F8	4F	38
19	26	1465	5B9	D6	F9	4F	39
19	27	1466	5BA	D6	7A	4F	3A
19	28	1467	5BB	D6	7B	4F	23
19	29	1468	5BC	D6	7C	4F	40
19	30	1469	5BD	D6	7D	4F	27
19	31	1470	5BE	D6	7E	4F	3D
19	32	1471	5BF	D6	7F	4F	22
19	33	1472	5C0	D7	40	50	20
19	34	1473	5C1	D7	C1	50	41
19	35	1474	5C2	D7	C2	50	42
19	36	1475	5C3	D7	C3	50	43
19	37	1476	5C4	D7	C4	50	44
19	38	1477	5C5	D7	C5	50	45
19	39	1478	5C6	D7	C6	50	46
19	40	1479	5C7	D7	C7	50	47
19	41	1480	5C8	D7	C8	50	48
19	42	1481	5C9	D7	C9	50	49
19	43	1482	5CA	D7	4A	50	5B
19	44	1483	5CB	D7	4B	50	2E
19	45	1484	5CC	D7	4C	50	3C
19	46	1485	5CD	D7	4D	50	28
19	47	1486	5CE	D7	4E	50	2B
19	48	1487	5CF	D7	4F	50	21

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
19	49	1488	5D0	D7	50	50	26
19	50	1489	5D1	D7	D1	50	4A
19	51	1490	5D2	D7	D2	50	4B
19	52	1491	5D3	D7	D3	50	4C
19	53	1492	5D4	D7	D4	50	4D
19	54	1493	5D5	D7	D5	50	4E
19	55	1494	5D6	D7	D6	50	4F
19	56	1495	5D7	D7	D7	50	50
19	57	1496	5D8	D7	D8	50	51
19	58	1497	5D9	D7	D9	50	52
19	59	1498	5DA	D7	5A	50	5D
19	60	1499	5DB	D7	5B	50	24
19	61	1500	5DC	D7	5C	50	2A
19	62	1501	5DD	D7	5D	50	29
19	63	1502	5DE	D7	5E	50	3B
19	64	1503	5DF	D7	5F	50	5E
19	65	1504	5E0	D7	60	50	2D
19	66	1505	5E1	D7	61	50	2F
19	67	1506	5E2	D7	E2	50	53
19	68	1507	5E3	D7	E3	50	54
19	69	1508	5E4	D7	E4	50	55
19	70	1509	5E5	D7	E5	50	56
19	71	1510	5E6	D7	E6	50	57
19	72	1511	5E7	D7	E7	50	58
19	73	1512	5E8	D7	E8	50	59
19	74	1513	5E9	D7	E9	50	5A
19	75	1514	5EA	D7	6A	50	7C
19	76	1515	5EB	D7	6B	50	2C
19	77	1516	5EC	D7	6C	50	25
19	78	1517	5ED	D7	6D	50	5F
19	79	1518	5EE	D7	6E	50	3E
19	80	1519	5EF	D7	6F	50	3F
20	01	1520	5F0	D7	F0	50	30
20	02	1521	5F1	D7	F1	50	31
20	03	1522	5F2	D7	F2	50	32
20	04	1523	5F3	D7	F3	50	33
20	05	1524	5F4	D7	F4	50	34
20	06	1525	5F5	D7	F5	50	35
20	07	1526	5F6	D7	F6	50	36
20	08	1527	5F7	D7	F7	50	37
20	09	1528	5F8	D7	F8	50	38
20	10	1529	5F9	D7	F9	50	39
20	11	1530	5FA	D7	7A	50	3A
20	12	1531	5FB	D7	7B	50	23
20	13	1532	5FC	D7	7C	50	40
20	14	1533	5FD	D7	7D	50	27
20	15	1534	5FE	D7	7E	50	3D
20	16	1535	5FF	D7	7F	50	22
20	17	1536	600	D8	40	51	20
20	18	1537	601	D8	C1	51	41
20	19	1538	602	D8	C2	51	42
20	20	1539	603	D8	C3	51	43
20	21	1540	604	D8	C4	51	44
20	22	1541	605	D8	C5	51	45
20	23	1542	606	D8	C6	51	46
20	24	1543	607	D8	C7	51	47
20	25	1544	608	D8	C8	51	48
20	26	1545	609	D8	C9	51	49
20	27	1546	60A	D8	4A	51	5B
20	28	1547	60B	D8	4B	51	2E
20	29	1548	60C	D8	4C	51	3C
20	30	1549	60D	D8	4D	51	28

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
20	31	1550	60E	D8	4E	51	2B
20	32	1551	60F	D8	4F	51	21
20	33	1552	610	D8	50	51	26
20	34	1553	611	D8	D1	51	4A
20	35	1554	612	D8	D2	51	4B
20	36	1555	613	D8	D3	51	4C
20	37	1556	614	D8	D4	51	4D
20	38	1557	615	D8	D5	51	4E
20	39	1558	616	D8	D6	51	4F
20	40	1559	617	D8	D7	51	50
20	41	1560	618	D8	D8	51	51
20	42	1561	619	D8	D9	51	52
20	43	1562	61A	D8	5A	51	5D
20	44	1563	61B	D8	5B	51	24
20	45	1564	61C	D8	5C	51	2A
20	46	1565	61D	D8	5D	51	29
20	47	1566	61E	D8	5E	51	3B
20	48	1567	61F	D8	5F	51	5E
20	49	1568	620	D8	60	51	2D
20	50	1569	621	D8	61	51	2F
20	51	1570	622	D8	E2	51	53
20	52	1571	623	D8	E3	51	54
20	53	1572	624	D8	E4	51	55
20	54	1573	625	D8	E5	51	56
20	55	1574	626	D8	E6	51	57
20	56	1575	627	D8	E7	51	58
20	57	1576	628	D8	E8	51	59
20	58	1577	629	D8	E9	51	5A
20	59	1578	62A	D8	6A	51	7C
20	60	1579	62B	D8	6B	51	2C
20	61	1580	62C	D8	6C	51	25
20	62	1581	62D	D8	6D	51	5F
20	63	1582	62E	D8	6E	51	3E
20	64	1583	62F	D8	6F	51	3F
20	65	1584	630	D8	F0	51	30
20	66	1585	631	D8	F1	51	31
20	67	1586	632	D8	F2	51	32
20	68	1587	633	D8	F3	51	33
20	69	1588	634	D8	F4	51	34
20	70	1589	635	D8	F5	51	35
20	71	1590	636	D8	F6	51	36
20	72	1591	637	D8	F7	51	37
20	73	1592	638	D8	F8	51	38
20	74	1593	639	D8	F9	51	39
20	75	1594	63A	D8	7A	51	3A
20	76	1595	63B	D8	7B	51	23
20	77	1596	63C	D8	7C	51	40
20	78	1597	63D	D8	7D	51	27
20	79	1598	63E	D8	7E	51	3D
20	80	1599	63F	D8	7F	51	22
21	01	1600	640	D9	40	52	20
21	02	1601	641	D9	C1	52	41
21	03	1602	642	D9	C2	52	42
21	04	1603	643	D9	C3	52	43
21	05	1604	644	D9	C4	52	44
21	06	1605	645	D9	C5	52	45
21	07	1606	646	D9	C6	52	46
21	08	1607	647	D9	C7	52	47
21	09	1608	648	D9	C8	52	48
21	10	1609	649	D9	C9	52	49
21	11	1610	64A	D9	4A	52	5B
21	12	1611	64B	D9	4B	52	2E

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
21	13	1612	64C	D9	4C	52	3C
21	14	1613	64D	D9	4D	52	28
21	15	1614	64E	D9	4E	52	2B
21	16	1615	64F	D9	4F	52	21
21	17	1616	650	D9	50	52	26
21	18	1617	651	D9	D1	52	4A
21	19	1618	652	D9	D2	52	4B
21	20	1619	653	D9	D3	52	4C
21	21	1620	654	D9	D4	52	4D
21	22	1621	655	D9	D5	52	4E
21	23	1622	656	D9	D6	52	4F
21	24	1623	657	D9	D7	52	50
21	25	1624	658	D9	D8	52	51
21	26	1625	659	D9	D9	52	52
21	27	1626	65A	D9	5A	52	5D
21	28	1627	65B	D9	5B	52	24
21	29	1628	65C	D9	5C	52	2A
21	30	1629	65D	D9	5D	52	29
21	31	1630	65E	D9	5E	52	3B
21	32	1631	65F	D9	5F	52	5E
21	33	1632	660	D9	60	52	2D
21	34	1633	661	D9	61	52	2F
21	35	1634	662	D9	E2	52	53
21	36	1635	663	D9	E3	52	54
21	37	1636	664	D9	E4	52	55
21	38	1637	665	D9	E5	52	56
21	39	1638	666	D9	E6	52	57
21	40	1639	667	D9	E7	52	58
21	41	1640	668	D9	E8	52	59
21	42	1641	669	D9	E9	52	5A
21	43	1642	66A	D9	6A	52	7C
21	44	1643	66B	D9	6B	52	2C
21	45	1644	66C	D9	6C	52	25
21	46	1645	66D	D9	6D	52	5F
21	47	1646	66E	D9	6E	52	3E
21	48	1647	66F	D9	6F	52	3F
21	49	1648	670	D9	F0	52	30
21	50	1649	671	D9	F1	52	31
21	51	1650	672	D9	F2	52	32
21	52	1651	673	D9	F3	52	33
21	53	1652	674	D9	F4	52	34
21	54	1653	675	D9	F5	52	35
21	55	1654	676	D9	F6	52	36
21	56	1655	677	D9	F7	52	37
21	57	1656	678	D9	F8	52	38
21	58	1657	679	D9	F9	52	39
21	59	1658	67A	D9	7A	52	3A
21	60	1659	67B	D9	7B	52	23
21	61	1660	67C	D9	7C	52	40
21	62	1661	67D	D9	7D	52	27
21	63	1662	67E	D9	7E	52	3D
21	64	1663	67F	D9	7F	52	22
21	65	1664	680	5A	40	5D	20
21	66	1665	681	5A	C1	5D	41
21	67	1666	682	5A	C2	5D	42
21	68	1667	683	5A	C3	5D	43
21	69	1668	684	5A	C4	5D	44
21	70	1669	685	5A	C5	5D	45
21	71	1670	686	5A	C6	5D	46
21	72	1671	687	5A	C7	5D	47
21	73	1672	688	5A	C8	5D	48
21	74	1673	689	5A	C9	5D	49

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
21	75	1674	68A	5A	4A	5D	5B
21	76	1675	68B	5A	4B	5D	2E
21	77	1676	68C	5A	4C	5D	3C
21	78	1677	68D	5A	4D	5D	28
21	79	1678	68E	5A	4E	5D	2B
21	80	1679	68F	5A	4F	5D	21
22	01	1680	690	5A	50	5D	26
22	02	1681	691	5A	D1	5D	4A
22	03	1682	692	5A	D2	5D	4B
22	04	1683	693	5A	D3	5D	4C
22	05	1684	694	5A	D4	5D	4D
22	06	1685	695	5A	D5	5D	4E
22	07	1686	696	5A	D6	5D	4F
22	08	1687	697	5A	D7	5D	50
22	09	1688	698	5A	D8	5D	51
22	10	1689	699	5A	D9	5D	52
22	11	1690	69A	5A	5A	5D	5D
22	12	1691	69B	5A	5B	5D	24
22	13	1692	69C	5A	5C	5D	2A
22	14	1693	69D	5A	5D	5D	29
22	15	1694	69E	5A	5E	5D	3B
22	16	1695	69F	5A	5F	5D	5E
22	17	1696	6A0	5A	60	5D	2D
22	18	1697	6A1	5A	61	5D	2F
22	19	1698	6A2	5A	E2	5D	53
22	20	1699	6A3	5A	E3	5D	54
22	21	1700	6A4	5A	F4	5D	55
22	22	1701	6A5	5A	E5	5D	56
22	23	1702	6A6	5A	E6	5D	57
22	24	1703	6A7	5A	E7	5D	58
22	25	1704	6A8	5A	E8	5D	59
22	26	1705	6A9	5A	E9	5D	5A
22	27	1706	6AA	5A	6A	5D	7C
22	28	1707	6AB	5A	6B	5D	2C
22	29	1708	6AC	5A	6C	5D	25
22	30	1709	6AD	5A	6D	5D	5F
22	31	1710	6AE	5A	6E	5D	3E
22	32	1711	6AF	5A	6F	5D	3F
22	33	1712	6B0	5A	F0	5D	30
22	34	1713	6B1	5A	F1	5D	31
22	35	1714	6B2	5A	F2	5D	32
22	36	1715	6B3	5A	F3	5D	33
22	37	1716	6B4	5A	F4	5D	34
22	38	1717	6B5	5A	F5	5D	35
22	39	1718	6B6	5A	F6	5D	36
22	40	1719	6B7	5A	F7	5D	37
22	41	1720	6B8	5A	F8	5D	38
22	42	1721	6B9	5A	F9	5D	39
22	43	1722	6BA	5A	7A	5D	3A
22	44	1723	6BB	5A	7B	5D	23
22	45	1724	6BC	5A	7C	5D	40
22	46	1725	6BD	5A	7D	5D	27
22	47	1726	6BE	5A	7E	5D	3D
22	48	1727	6BF	5A	7F	5D	22
22	49	1728	6C0	5B	40	24	20
22	50	1729	6C1	5B	C1	24	41
22	51	1730	6C2	5B	C2	24	42
22	52	1731	6C3	5B	C3	24	43
22	53	1732	6C4	5B	C4	24	44
22	54	1733	6C5	5B	C5	24	45
22	55	1734	6C6	5B	C6	24	46
22	56	1735	6C7	5B	C7	24	47

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
22	57	1736	6C8	5B	C8	24	48
22	58	1737	6C9	5B	C9	24	49
22	59	1738	6CA	5B	4A	24	5B
22	60	1739	6CB	5B	4B	24	2E
22	61	1740	6CC	5B	4C	24	3C
22	62	1741	6CD	5B	4D	24	28
22	63	1742	6CE	5B	4E	24	2B
22	64	1743	6CF	5B	4F	24	21
22	65	1744	6D0	5B	50	24	26
22	66	1745	6D1	5B	D1	24	4A
22	67	1746	6D2	5B	D2	24	4B
22	68	1747	6D3	5B	D3	24	4C
22	69	1748	6D4	5B	D4	24	4D
22	70	1749	6D5	5B	D5	24	4E
22	71	1750	6D6	5B	D6	24	4F
22	72	1751	6D7	5B	D7	24	50
22	73	1752	6D8	5B	D8	24	51
22	74	1753	6D9	5B	D9	24	52
22	75	1754	6DA	5B	5A	24	5D
22	76	1755	6DB	5B	5B	24	24
22	77	1756	6DC	5B	5C	24	2A
22	78	1757	6DD	5B	5D	24	29
22	79	1758	6DE	5B	5E	24	3B
22	80	1759	6DF	5B	5F	24	5E
23	01	1760	6E0	5B	60	24	2D
23	02	1761	6E1	5B	61	24	2F
23	03	1762	6E2	5B	E2	24	53
23	04	1763	6E3	5B	E3	24	54
23	05	1764	6E4	5B	E4	24	55
23	06	1765	6E5	5B	E5	24	56
23	07	1766	6E6	5B	E6	24	57
23	08	1767	6E7	5B	E7	24	58
23	09	1768	6E8	5B	E8	24	59
23	10	1769	6E9	5B	E9	24	5A
23	11	1770	6EA	5B	6A	24	7C
23	12	1771	6EB	5B	6B	24	2C
23	13	1772	6EC	5B	6C	24	25
23	14	1773	6ED	5B	6D	24	5F
23	15	1774	6EE	5B	6E	24	3E
23	16	1775	6EF	5B	6F	24	3F
23	17	1776	6F0	5B	F0	24	30
23	18	1777	6F1	5B	F1	24	31
23	19	1778	6F2	5B	F2	24	32
23	20	1779	6F3	5B	F3	24	33
23	21	1780	6F4	5B	F4	24	34
23	22	1781	6F5	5B	F5	24	35
23	23	1782	6F6	5B	F6	24	36
23	24	1783	6F7	5B	F7	24	37
23	25	1784	6F8	5B	F8	24	38
23	26	1785	6F9	5B	F9	24	39
23	27	1786	6FA	5B	7A	24	3A
23	28	1787	6FB	5B	7B	24	23
23	29	1788	6FC	5B	7C	24	40
23	30	1789	6FD	5B	7D	24	27
23	31	1790	6FE	5B	7E	24	3D
23	32	1791	6FF	5B	7F	24	22
23	33	1792	700	5C	40	2A	20
23	34	1793	701	5C	C1	2A	41
23	35	1794	702	5C	C2	2A	42
23	36	1795	703	5C	C3	2A	43
23	37	1796	704	5C	C4	2A	44
23	38	1797	705	5C	C5	2A	45

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
23	39	1798	706	5C	C6	2A	46
23	40	1799	707	5C	C7	2A	47
23	41	1800	708	5C	C8	2A	48
23	42	1801	709	5C	C9	2A	49
23	43	1802	70A	5C	4A	2A	5B
23	44	1803	70B	5C	4B	2A	2E
23	45	1804	70C	5C	4C	2A	3C
23	46	1805	70D	5C	4D	2A	28
23	47	1806	70E	5C	4E	2A	2B
23	48	1807	70F	5C	4F	2A	21
23	49	1808	710	5C	50	2A	26
23	50	1809	711	5C	D1	2A	4A
23	51	1810	712	5C	D2	2A	4B
23	52	1811	713	5C	D3	2A	4C
23	53	1812	714	5C	D4	2A	4D
23	54	1813	715	5C	D5	2A	4E
23	55	1814	716	5C	D6	2A	4F
23	56	1815	717	5C	D7	2A	50
23	57	1816	718	5C	D8	2A	51
23	58	1817	719	5C	D9	2A	52
23	59	1818	71A	5C	5A	2A	5D
23	60	1819	71B	5C	5B	2A	24
23	61	1820	71C	5C	5C	2A	2A
23	62	1821	71D	5C	5D	2A	29
23	63	1822	71E	5C	5E	2A	3B
23	64	1823	71F	5C	5F	2A	5E
23	65	1824	720	5C	60	2A	2D
23	66	1825	721	5C	61	2A	2F
23	67	1826	722	5C	E2	2A	53
23	68	1827	723	5C	E3	2A	54
23	69	1828	724	5C	E4	2A	55
23	70	1829	725	5C	E5	2A	56
23	71	1830	726	5C	E6	2A	57
23	72	1831	727	5C	E7	2A	58
23	73	1832	728	5C	E8	2A	59
23	74	1833	729	5C	E9	2A	5A
23	75	1834	72A	5C	6A	2A	7C
23	76	1835	72B	5C	6B	2A	2C
23	77	1836	72C	5C	6C	2A	25
23	78	1837	72D	5C	6D	2A	5F
23	79	1838	72E	5C	6E	2A	3E
23	80	1839	72F	5C	6F	2A	3F
24	01	1840	730	5C	F0	2A	30
24	02	1841	731	5C	F1	2A	31
24	03	1842	732	5C	F2	2A	32
24	04	1843	733	5C	F3	2A	33
24	05	1844	734	5C	F4	2A	34
24	06	1845	735	5C	F5	2A	35
24	07	1846	736	5C	F6	2A	36
24	08	1847	737	5C	F7	2A	37
24	09	1848	738	5C	F8	2A	38
24	10	1849	739	5C	F9	2A	39
24	11	1850	73A	5C	7A	2A	3A
24	12	1851	73B	5C	7B	2A	23
24	13	1852	73C	5C	7C	2A	40
24	14	1853	73D	5C	7D	2A	27
24	15	1854	73E	5C	7E	2A	3D
24	16	1855	73F	5C	7F	2A	22
24	17	1856	740	5D	40	29	20
24	18	1857	741	5D	C1	29	41
24	19	1858	742	5D	C2	29	42
24	20	1859	743	5D	C3	29	43

80 Col		Position		Buffer Address (Hex)			
R	C	Dec	Hex	EBCDIC		ASCII	
24	21	1860	744	5D	C4	29	44
24	22	1861	745	5D	C5	29	45
24	23	1862	746	5D	C6	29	46
24	24	1863	747	5D	C7	29	47
24	25	1864	748	5D	C8	29	48
24	26	1865	749	5D	C9	29	49
24	27	1866	74A	5D	4A	29	5B
24	28	1867	74B	5D	4B	29	2E
24	29	1868	74C	5D	4C	29	3C
24	30	1869	74D	5D	4D	29	28
24	31	1870	74E	5D	4E	29	2B
24	32	1871	74F	5D	4F	29	21
24	33	1872	750	5D	50	29	26
24	34	1873	751	5D	D1	29	4A
24	35	1874	752	5D	D2	29	4B
24	36	1875	753	5D	D3	29	4C
24	37	1876	754	5D	D4	29	4D
24	38	1877	755	5D	D5	29	4E
24	39	1878	756	5D	D6	29	4F
24	40	1879	757	5D	D7	29	50
24	41	1880	758	5D	D8	29	51
24	42	1881	759	5D	D9	29	52
24	43	1882	75A	5D	5A	29	5D
24	44	1883	75B	5D	5B	29	24
24	45	1884	75C	5D	5C	29	2A
24	46	1885	75D	5D	5D	29	29
24	47	1886	75E	5D	5E	29	3B
24	48	1887	75F	5D	5F	29	5E
24	49	1888	760	5D	60	29	2D
24	50	1889	761	5D	61	29	2F
24	51	1890	762	5D	E2	29	53
24	52	1891	763	5D	E3	29	54
24	53	1892	764	5D	E4	29	55
24	54	1893	765	5D	E5	29	56
24	55	1894	766	5D	E6	29	57
24	56	1895	767	5D	E7	29	58
24	57	1896	768	5D	E8	29	59
24	58	1897	769	5D	E9	29	5A
24	59	1898	76A	5D	6A	29	7C
24	60	1899	76B	5D	6B	29	2C
24	61	1900	76C	5D	6C	29	25
24	62	1901	76D	5D	6D	29	5F
24	63	1902	76E	5D	6E	29	3E
24	64	1903	76F	5D	6F	29	3F
24	65	1904	770	5D	F0	29	30
24	66	1905	771	5D	F1	29	31
24	67	1906	772	5D	F2	29	32
24	68	1907	773	5D	F3	29	33
24	69	1908	774	5D	F4	29	34
24	70	1909	775	5D	F5	29	35
24	71	1910	776	5D	F6	29	36
24	72	1911	777	5D	F7	29	37
24	73	1912	778	5D	F8	29	38
24	74	1913	779	5D	F9	29	39
24	75	1914	77A	5D	7A	29	3A
24	76	1915	77B	5D	7B	29	23
24	77	1916	77C	5D	7C	29	40
24	78	1917	77D	5D	7D	29	27
24	79	1918	77E	5D	7E	29	3D
24	80	1919	77F	5D	7F	29	22

Appendix C. Katakana Feature

This appendix contains Katakana unique information interface codes and the keyboard shift operations.

Interface Codes

Figure C-1 show the Japanese Katakana EBCDIC interface codes. It corresponds to Figure 2-5 for U.S. codes.

Bits 4567	Hex 1	00				01				10				11				Bits ←0,1
		00	01	10	11	00	01	10	11	00	01	10	11	00	01	10	11	←2,3
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	← Hex 0
0000	0	NUL				SP	&	−			ｿ					$	0	
0001	1		SBA			｡	ｪ	/		ｱ	ﾀ			A	J		1	
0010	2		EUA			｢	ｫ			ｲ	ﾁ	ﾍ		B	K	S	2	
0011	3		IC			｣	ｬ			ｳ	ﾂ	ﾎ		C	L	T	3	
0100	4					､	ｭ			ｴ	ﾃ	ﾏ		D	M	U	4	
0101	5	PT	NL			･	ｮ			ｵ	ﾄ	ﾐ		E	N	V	5	
0110	6					ｦ	ｯ			ｶ	ﾅ	ﾑ		F	O	W	6	
0111	7					ｧ				ｷ	ﾆ	ﾒ		G	P	X	7	
1000	8					ｨ	ｰ			ｸ	ﾇ	ﾓ		H	Q	Y	8	
1001	9		EM			ｩ				ｹ	ﾈ	ﾔ		I	R	Z	9	
1010	A								:	ｺ	ﾉ	ﾕ	ﾚ					
1011	B					.	¥	,	#				ﾛ					
1100	C		DUP		RA	<	*	%	@	ｻ		ﾖ	ﾜ					
1101	D		SF			(	)	_	'	ｼ	ﾊ	ﾗ	ﾝ					
1110	E		FM			+	;	>	=	ｽ	ﾋ	ﾘ	ﾞ					
1111	F				SUB	|	¬	?		ｾ	ﾌ	ﾙ	ﾟ					

Notes:

1. *Character code assignments other than those shown within all outlined areas of this chart are undefined. If an undefined character code is programmed, the character that will be displayed or printed is not specified. The character displayed by the 3277 or 3275 for a given undefined character code may be different for other devices. IBM reserves the right to change at any time the character displayed for an undefined character code.*
2. *Hex codes 4A, 5A, 6A, and 7F are used for CU addressing, device addressing, buffer addressing, and control purposes (for example, WCC and CCC), but have no associated graphic characters.*
3. *The DUP and FM control characters are displayed or printed as * and; respectively.*
4. *NL and EM are stored in the buffer in two character locations. The Katakana hardware expands the NL and EM characters received from the program to the required 2-byte sequence. It also contracts the 2-byte buffer sequence to the single-byte EBCDIC NL or EM code on a subsequent read operation.*

   NL and EM display or print as blank 5 and blank 9 respectively, except for a printer not operating under format control, which executes NL and EM and prints blank blank.
5. *For AID, attribute, write control (WCC), copy control (CCC), CU and device address, buffer address, sense, and status characters, bits 0 and 1 are assigned so that each character can be represented by a graphic character in Figure 2-7.*
6. *For BSC data-link control characters, see Chapter 5.*

Figure C-1. Japanese Katakana EBCDIC I/O Interface Code

Keyboard Shift Operations: LATIN SHIFT and KANA SHIFT Keys

The shift operations of the Katakana keyboards are different from those of the other EBCDIC keyboards described in Chapter 2. The following paragraphs discuss the unique keys and operations.

To place the keyboard in the lower shift of either Latin or Katakana (Kana) mode, press and release the desired mode shift key. This enables the characters on the lower portion of each character key to be generated. Holding the shift key depressed while operating the character keys causes the upper-shift characters of the selected mode to be generated.

In addition, a single depression of the Lock key locks the keyboard in the upper shift of the selected mode. A second depression of the Lock key returns the keyboard to the lower shift of the selected mode.

With two exceptions, once a mode is selected, the keyboard remains in that mode until the operator changes the mode by operating the Alternate Shift key. The exceptions are as follows:

- When power is initially applied, the keyboard is automatically placed in Latin mode.
- (Data entry keyboards only) – When the cursor enters a numeric field, the data entry keyboard is automatically placed in upper-shift Latin mode. Only 0–9, minus (-), decimal sign, and DUP may be entered when in this mode.

While the cursor remains in the numeric field, the upper-shift Latin mode can be overridden, one character at a time, by pressing the appropriate shift key as follows:

Upper-shift Kana mode – While holding the KANA SHIFT key depressed, press the selected character key.

Lower-shift Kana mode – Press and release the KANA SHIFT key; then press the selected character key.

Upper-shift Latin mode – While holding the LATIN SHIFT key depressed, press the selected character key. This permits keying in uppper-shift Latin mode characters other than 0–9, minus (-), decimal sign, and DUP.

Lower-shift Latin mode – Press and release the LATIN SHIFT key; then press the selected character key.

In all cases, when the selected character has been entered and the key (or keys) released, the keyboard returns to upper-shift Latin mode.

When the cursor leaves the numeric field, the keyboard returns to lower shift of the most recent Latin or Kana mode used by the operator. This is independent of whether the last mode was caused by an override by the operator or the mode being used just prior to entry of the cursor into the numeric field.

Appendix D. Data Analysis – APL Feature

Figure D-1 shows the Data Analysis – APL feature and associated features; Figure D-2 shows the interface codes.

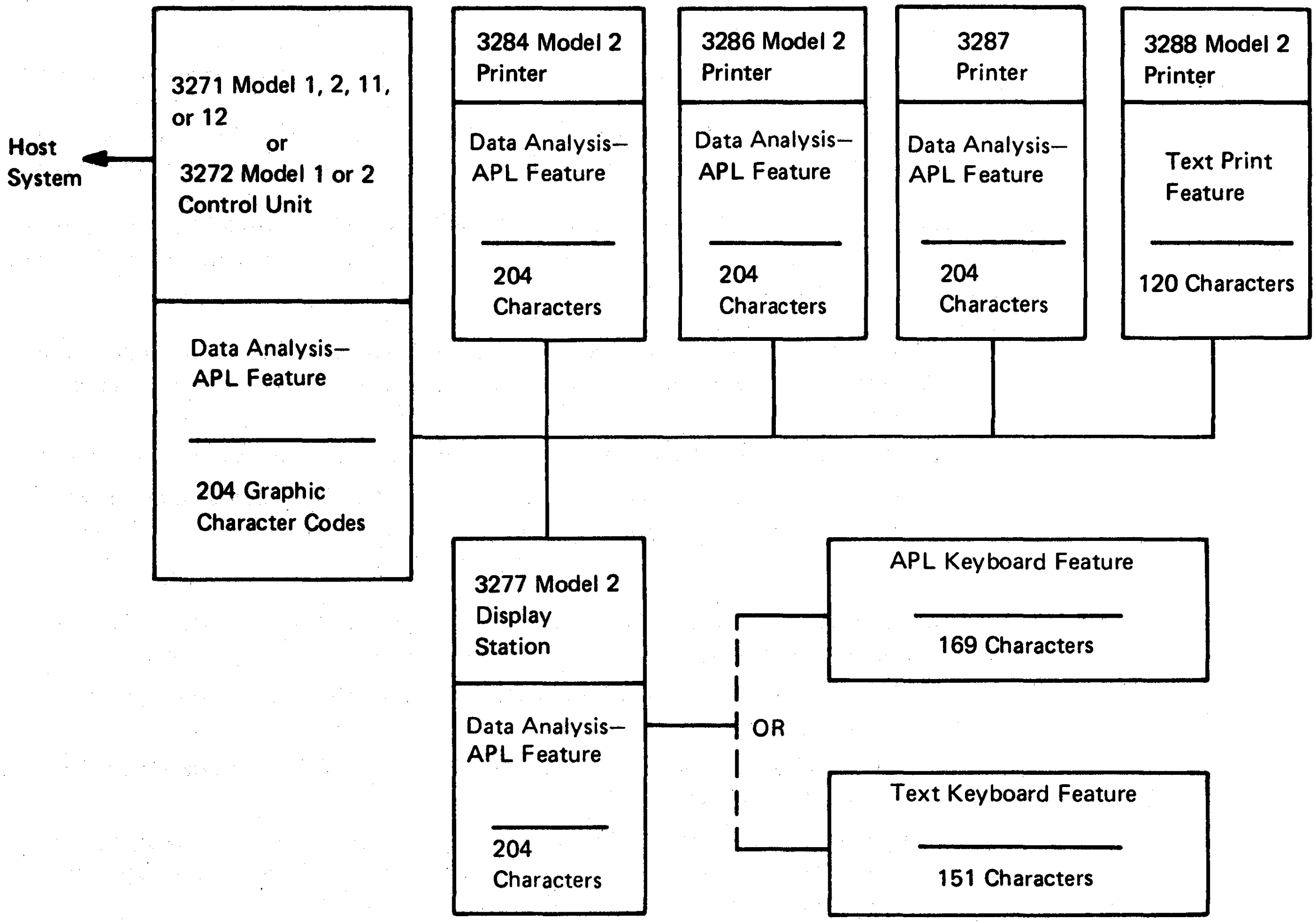


Figure D-1. Data Analysis – APL Feature and Associated Features

		00				01				10				11				← Bits 0,1
	Hex 1	00	01	10	11	00	01	10	11	00	01	10	11	00	01	10	11	← 2,3
Bits 4567	↓	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	← Hex 0
0000	0					SP	&	-			⎕	¯	◤ α				0	
0001	1							/		a	j		◤ ∊	A	J		1	
0010	2									b	k	s	◤ ⍳	B	K	S	2	
0011	3									c	l	t	◤ ⍴	C	L	T	3	
0100	4									d	m	u	◤ ⍵	D	M	U	4	
0101	5									e	n	v		E	N	V	5	
0110	6									f	o	w	◤ ×	F	O	W	6	
0111	7									g	p	x	\	G	P	X	7	
1000	8									h	q	y	◤ ÷	H	Q	Y	8	
1001	9									i	r	z		I	R	Z	9	
1010	A					¢	!		:	↑	◤ ⊃	◤ ∩	∇					
1011	B					.	$	,	#		◤ ⊂	◤ ∪	∆					
1100	C					<	*	%	@	≤		◤◢ ⊥	◤◢ ⊤					
1101	D					(	)	_	'	⌈	◤ ○	[	]					
1110	E					+	;	>	=	⌊		≥	≠					
1111	F					|	¬	?	"	→	←	◤ ∘	|					

Notes:

1. *NL, EM, DUP, and FM control characters are displayed or printed as 5, 9, *, and; characters, respectively, except by the printer under format control, in which case NL and EM do not result in a character's being printed.*
2. *The 89-character dual-case EBCDIC character set is shown within the bold outlines. All codes shown can be directly entered from the APL keyboard.*

Legend:

◤ Codes that cannot be entered from the text keyboard.

◤◢ Codes transmitted are unique to the APL keyboard. (See Part 2.)

Figure D-2 (Part 1 of 2). Data Analysis – APL Interface Codes

		00				01				10				11				Bits 0,1
	Hex 1	00	01	10	11	00	01	10	11	00	01	10	11	00	01	10	11	2,3
Bits 4567		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	Hex 0
0000	0										{	}	⊙					
0001	1									A̲	J̲	°	1					
0010	2									B̲	K̲	S̲	2	↓	⌶	⊖		
0011	3									C̲	L̲	T̲	3	¨	!	⌹		
0100	4									D̲	M̲	U̲	4					
0101	5		5							E̲	N̲	V̲						
0110	6									F̲	O̲	W̲	6	⍫	⍒	⍕		
0111	7									G̲	P̲	X̲	7	⍟	⍋	⍎		
1000	8									H̲	Q̲	Y̲	8					
1001	9		9							I̲	R̲	Z̲						
1010	A					⍲	⍞	∧		1	2	3	n					
1011	B					⍱	⍝	∨	∼		¤	└	┘					
1100	C									¯		┌	┐					
1101	D									(	)	⊢	⊤					
1110	E		±			⌽	⌿			+		⊣	⊥					
1111	F					⍉	⍀			┼	■	•	−					

Notes:

1. *These codes, preceded by a hex 1D control character, transmit the graphics shown.*
2. *Codes B5, B9, and 9E or codes 15, 19, and 1E can be used in program-to-terminal messages – characters 5, 9, and ±.*

Legend:

◸ Codes that cannot be entered from the text keyboard.

◹ Codes that are not directly entered from the APL keyboard (APL characters are shown within the bold outline).

◹◺ Codes transmitted are unique to the text keyboard. (See Part 1.)

Figure D-2 (Part 2 of 2). Data Analysis – APL Interface Codes

APL Keyboard Special Feature Operation (3277 Display Station Model 2)

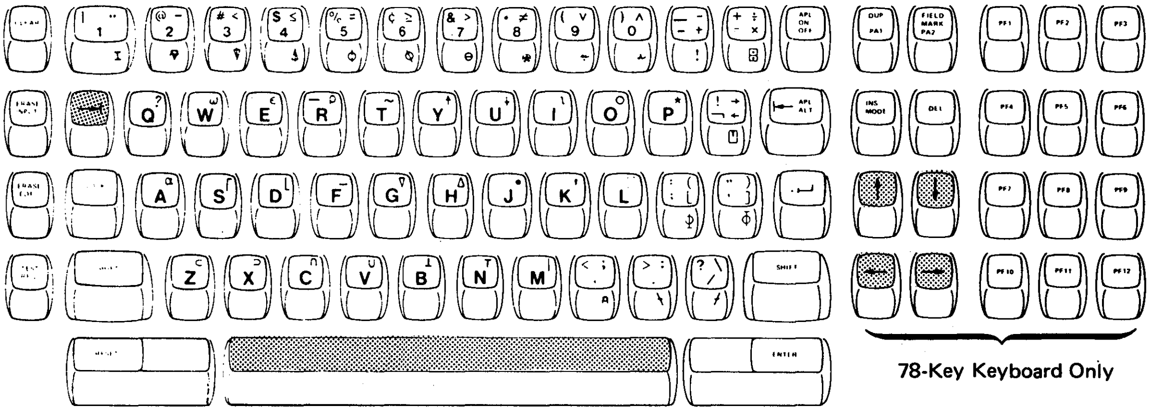
The APL keyboard (Figure D-3) allows the direct entry and display of the 133-character APL character set (Figure D-4). [For the Technical Notation (TN) character set, see Figure D-5.] In addition, this keyboard changes two standard typewriter keys: Backspace key to APL ON/OFF key, and Backtab key to Backtab/APL ALT key.

APL ON/OFF Key

At initial power-on, the keyboard operates as a typewriter keyboard. Pressing the APL ON/OFF key once invokes the APL keyboard graphics. When the APL ON/OFF key is pressed once more, the keyboard reverts to the U.S. EBCDIC character set and standard operation. Keyboard status may be determined by pressing an APL character key; it will cause that character to be displayed only if APL is on. If the standard keyboard character is displayed, APL is off.

APL ALT Key

In APL-ON status, the APL ALT key serves as an additional shift key. Holding it down while pressing a key that has a compound APL symbol on the front produces the corresponding character and output code. Holding down APL ALT while pressing an alphabetic character key produces an underscored uppercase character. In APL-OFF status, the APL ALT key retains its original backtab function.



Legend:

▨ Typamatic Keys

Figure D-3. APL Keyboard

APL Off		APL On		APL On with APL ALT
Lowercase Shift	Uppercase Shift	Lowercase Shift	Uppercase Shift	
a	A	A	⍺ (alpha)	A̲
b	B	B	⊥ (base)	B̲
c	C	C	∩ (cap)	C̲
d	D	D	⌊ (downstile)	D̲
e	E	E	∊ (epsilon)	E̲
f	F	F	_ (underbar)	F̲
g	G	G	∇ (del)	G̲
h	H	H	∆ (delta)	H̲
i	I	I	⍳ (iota)	I̲
j	J	J	∘ (null)	J̲
k	K	K	' (quote)	K̲
l	L	L	⎕ (quad)	L̲
m	M	M	| (stile)	M̲
n	N	N	⊤ (top)	N̲
o	O	O	○ (circle)	O̲
p	P	P	⋆ (star)	P̲
q	Q	Q	? (query)	Q̲
r	R	R	⍴ (rho)	R̲
s	S	S	⌈ (upstile)	S̲
t	T	T	∼ (tilde)	T̲
u	U	U	↓ (down)	U̲
v	V	V	∪ (cup)	V̲
w	W	W	⍵ (omega)	W̲
x	X	X	⊃ (close shoe)	X̲
y	Y	Y	↑ (up)	Y̲
z	Z	Z	⊂ (open shoe)	Z̲
1	|	1	¨ (dieresis)	⌶ (I-beam)
2	@	2	¯ (overbar)	⍫ (del tilde)
3	#	3	< (less)	⍒ (del stile)
4	$	4	≤ (not greater)	⍋ (delta stile)
5	%	5	= (equal)	⌽ (circle stile)
6	¢	6	≥ (not less)	⍉ (circle slope)
7	&	7	> (greater)	⊖ (circle bar)
8	* (asterisk)	8	≠ (not equal)	⍟ (log)
9	(	9	∨ (OR)	⍱ (NOR)
0	)	0	∧ (AND)	⍲ (NAND)
-	_	+	− (bar)	! (quote dot)
=	+	×	÷ (divide)	⌹ (domino)
¬	!	←	→ (right)	⍞ (quote quad)
;	:	[	((open paren)	⍎ (base null)
'	"	]	) (close paren)	⍕ (top null)
,	<	,	; (semicolon)	⍝ (cap null)
.	>	.	: (colon)	⍀ (slope bar)
/	?	/	\ (slope)	⌿ (slant bar)

Figure D-4. APL Keyboard Feature Character Set

TN Character	Keyboard Substitute (All with APL On)	
Subscript 1	⌊ 1	(APL downstile + digit)
Subscript 2	⌊ 2	(APL downstile + digit)
Subscript 3	⌊ 3	(APL downstile + digit)
Subscript n	⌊ N	(APL downstile + char.)
Superscript 0	⌈ 0	(APL upstile + digit)
Superscript 1	⌈ 1	(APL upstile + digit)
Superscript 2	⌈ 2	(APL upstile + digit)
Superscript 3	⌈ 3	(APL upstile + digit)
Superscript 4	⌈ 4	(APL upstile + digit)
Superscript 5	⌈ 5	(APL upstile + digit)
Superscript 6	⌈ 6	(APL upstile + digit)
Superscript 7	⌈ 7	(APL upstile + digit)
Superscript 8	⌈ 8	(APL upstile + digit)
Superscript 9	⌈ 9	(APL upstile + digit)
Superscript (	⌈ (	(APL upstile + char.)
Superscript +	⌈ +	(APL upstile + char.)
Superscript)	⌈)	(APL upstile + char.)
Superscript -	⌈ -	(APL upstile + char.)

TN Character		Keyboard Substitute (All with APL On)	
°	(degree)	∘	(APL null)
±	(plus or minus)	⍎	(APL base null)
(	(left brace)	∇	(APL del)
)	(right brace)	∆	(APL delta)
⌑	(lozenge)	⎕	(APL quad)
■	(histogram)	⌹	(APL domino)
●	(bullet)	⍟	(APL log)
┐	(upper right corner)	⊃	(APL close shoe)
┌	(upper left corner)	∩	(APL cap)
└	(lower left corner)	⊂	(APL open shoe)
┘	(lower right corner)	∪	(APL cup)
┬	(top junction)	⊤	(APL top)
├	(left junction)	⌿	(APL slant bar)
┴	(bottom junction)	⊥	(APL base)
┤	(right junction)	⍀	(APL slope bar)
+	(DA cross)	÷	(APL divide)
−	(extended dash)	¯	(APL overbar)

Notes:

1. The 3270 with the Data Analysis – APL feature provides the capability of screen display and printer output of the TN character set and certain other special characters not shown in Figure D-3. In addition, most of the TN characters may be directly entered from the 3270 APL keyboard. Characters that compose the total TN character set are shown above. along with the means of directly entering each character or a recommended substitution of one or two characters to be used for each character.
2. The following subset of TN characters may be directly entered on the keyboard (see Figure D-3 of this appendix for proper setting of shift or APL ON/OFF keys).

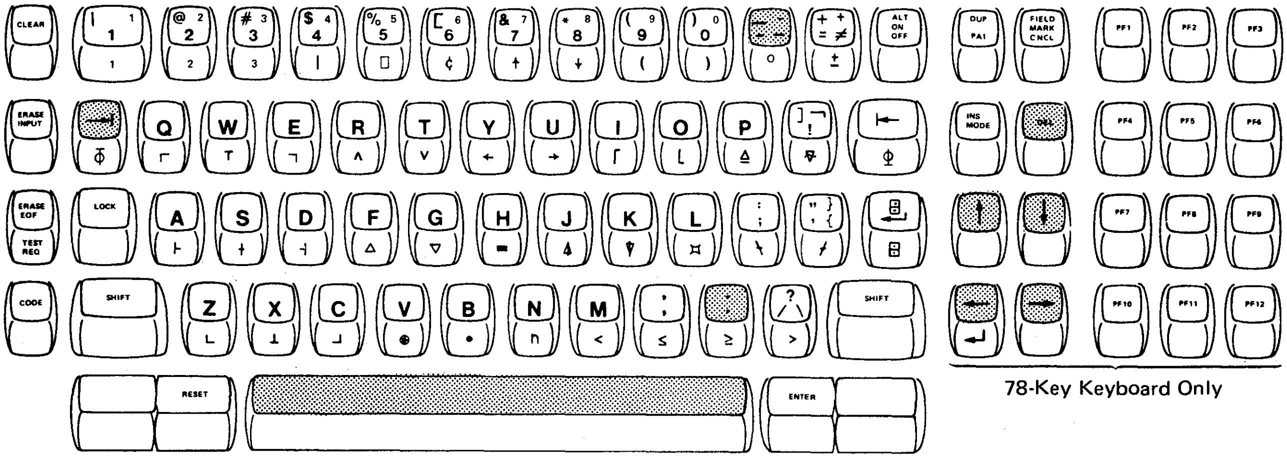
space	1
A–Z (uppercase)	26
a–z (lowercase)	26
0–9 (numeric)	10
↓ ↑ ≤ ≥ ≠ [ ] ← → \ ¦ (APL special characters)	11
- = ¬ ; ' , . / $ % c & * ( ) – + ǀ : " < > ? (non-APL special characters)	23

3. The subset of 35 TN characters, shown above, though they may not be directly entered, may be entered through use of the recommended substitution of APL characters not used in Note 2. Note that a user's application program would have the responsibility of decoding these substitutions. (Refer to Figure D-2, Data Analysis – APL Interface Codes.)

Figure D-5. APL Keyboard TN Character Availability

Text Keyboard Special Feature Operation (3277 Display Station Model 2)

The text keyboard (Figure D-6) contains 78 keys that permit direct entry and display of the 151-character text keyboard character set (Figure D-7) when the appropriate shift is used. This keyboard also contains a shift indicator light to simplify operator control over shift modes. The text keyboard has changes to six normal typewriter keyboard control keys: RESET and ENTER keys have been repositioned to reduce confusion with the uppercase/lowercase SHIFT keys, the Backspace key is the ALT ON/OFF key, the TEST REQ key is the CODE key, the ERASE EOF key is the ERASE EOF/TEST REQ key, and the New Line key is both a character and function key.



Legend:

▨ Typamatic keys

Figure D-6. Text Keyboard

ALT ON/OFF Key

At initial power-on, alternate mode is inactive and the ALT indicator (above the ALT ON/OFF key) is off. This allows the dual-case EBCDIC character set to be entered. (See Alternate Mode in Figure D-7.) Pressing the ALT ON/OFF key once turns on alternate mode and the ALT indicator and allows the characters in the center column of Figure D-7 to be entered and displayed. When the ALT ON/OFF key is pressed again, the ALT indicator is turned off and alternate mode becomes inactive.

When alternate mode is inactive and the keyboard is in lowercase (SHIFT key inactive) shift, the character in the lower left or the lowercase of the character in the center of the appropriate keytop can be entered. When alternate mode is inactive and the keyboard is in uppercase shift, the character in the upper left or the uppercase of the character in the center of the appropriate keytop can be entered.

When alternate mode is active and the keyboard is in lowercase (SHIFT key inactive), the character in the lower right or the lowercase of the character in the center of the appropriate keytop can be entered. When alternate mode is active and the keyboard is in uppercase, the character in the upper right or the uppercase of the character in the center of the appropriate keytop can be entered.

CODE Key

When the CODE key is held down, code shift is active in both ALT ON and ALT OFF conditions. Code shift active allows the character on the front face of each key to be entered and displayed. (See the column on the right side of Figure D-7.) Code shift becomes inactive when the CODE key is released.

ERASE EOF/TEST REQ Key

When this key is pressed and the code shift is inactive, the erase EOF function is inputted. When this key is pressed and the code shift is active, the test request function is inputted. The ERASE EOF and TEST REQ keys are described in Chapter 2 under "Keyboard Operations."

Standard Mode			Alternate Mode						
Lowercase Shift		Uppercase Shift	Lowercase Shift		Uppercase Shift		Code Mode		
a		A	a		A			├	(left junction)
b		B	b		B			•	(bullet)
c		C	c		C			┘	(lower right corner)
d		D	d		D			┤	(right junction)
e		E	e		E			┐	(upper right corner)
f		F	f		F			Δ	(delta)
g		G	g		G			∇	(del)
h		H	h		H			■	(histogram)
i		I	i		I			⌈	(upstile)
j		J	j		J			⍋	(delta stile)
k		K	k		K			⍒	(del stile)
l		L	l		L			⌑	(lozenge)
m		M	m		M			<	(less)
n		N	n		N			n	(subscript)
o		O	o		O			⌊	(downstile)
p		P	p		P			⍙	(delta underscore)
q		Q	q		Q			┌	(upper left corner)
r		R	r		R			∧	(AND)
s		S	s		S			+	(DA cross)
t		T	t		T			v	(OR)
u		U	u		U			→	(right)
v		V	v		V			⍟	(log)
w		W	w		W			⊤	(top junction)
x		X	x		X			⊥	(bottom junction)
y		Y	y		Y			←	(left)
z		Z	z		Z			└	(lower left corner)
1		I	1		1			1	
2		@	2		2		subscript	2	
3		#	3		3			3	
4		$	4		4			|	(stile)
5		%	5	super-	5			⎕	(quad)
6		[	6	script	6			¢	
7		&	7		7			↑	(up)
8		*	8		8			↓	(down)
9		(	9		9			(	(superscript)
0		)	0		0			)	
-	(hyphen)	—	—	(extended	-	(super-		°	
=		+	≠	dash)	+	script)		±	
!		]	!		¬			⍫	(del tilde)
;		:	;		:			⍀	
'		"	{		}			⌿	
,		,	,		,			≤	
.		.	.		.			≥	
/		?	\		?			>	
⌹	(domino)	⌹	⌹		⌹			⍕	(top null)
								⍎	(base null)

Figure D-7. Text Keyboard Feature Character Set

New Line Key

Pressing the New Line key (with alternate mode either ON or OFF) causes the new line character, :, to display and the new line function (index and cursor return to left margin) to occur. In code shift, the New Line key only enters the domino; the new line function is provided by the cursor left key in code shift only. The New Line key is not typamatic on the text keyboard.

Tab and Backtab Functions

The Tab and Backtab keys on the text keyboard operate in the same way as those on the typewriter keyboard. (See "Keyboard Operations" in Chapter 2.) In code shift, however, the functions are not performed; instead, the tab (Φ) and backtab (ɸ) symbols are entered and displayed for text application programs to format printed output. The Tab key is not typamatic in code shift.

3288 Printer/Text Print Feature

Figures D-8, D-9, and D-10 note the characters available for printing on the 3288 under various print modes.

Characters provided on the 120-character TN print belt:

See Note

a		A	¢	≤
b		B	.	{
c		C	<	†
d		D	(	⌑
e		E	+	}
f		F	|	■
g		G	&	°
h		H	!	±
i		I	$	⌊
j		J	*	⌈
k		K	)	≥
l		L	;	●
m		M	¬	¯
n		N	-	⌋
o		O	/	⌉
p		P	,	≠
q		Q	%	]
r		R	—	[
s		S	>	
t		T	?	
u		U	:	
v		V	#	
w		W	@	
x		X	'	
y		Y	=	
z		Z	"	
1		1	¦ (see Note)	
2		2		
3		3		
4		4		
5		5		
6		6		
7	superscripts	7		
8		8		
9		9		
0		0		
(				
)				
+				
-				

Note: *The characters listed in the second and third columns constitute the character set for the (optional) 64-character EBCDIC print belt. The broken vertical bar (¦) is not on the 120-character TN print belt and cannot be entered from the text keyboard.*

Figure D-8. Text Print Character Set for 3288 Printer Model 2

	H e x	00				01				10				11				Bits 0,1
		00	01	10	11	00	01	10	11	00	01	10	11	00	01	10	11	2,3
Bits 4567	1	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	Hex 0
0000	0					SP	&	–			^{5}	$^{-}$	^{0}				0	
0001	1							/		a	j	0	^{1}	A	J		1	
0010	2									b	k	s	^{2}	B	K	S	2	
0011	3									c	l	t	^{3}	C	L	T	3	
0100	4									d	m	u	^{4}	D	M	U	4	
0101	5									e	n	v		E	N	V	5	
0110	6									f	o	w	^{6}	F	O	W	6	
0111	7									g	p	x	^{7}	G	P	X	7	
1000	8									h	q	y	^{8}	H	Q	Y	8	
1001	9									i	r	z		I	R	Z	9	
1010	A					¢	!	¦ ^{9}	:	⩽	¤	±	–					
1011	B					.	$	,	#	(	)	└	┘					
1100	C					<	*	%	@			┌	┐					
1101	D					(	)	_	'	$^{(}$	$^{)}$	[	]					
1110	E					+	;	>	=	+		⩾	≠					
1111	F					|	¬	?	"	+	■	●	SI					

Notes:

1. Only those data characters shown within the bold outlines can be printed by the 3288 printer with the Text Print feature installed, using the 64-character EBCDIC print belt.
2. NL (hex 15), EM (hex 19), DUP (hex 1C), FM (hex 1E), and NUL (hex 00), and SI control characters are printed as 5, 9, *, ; and space characters, respectively, except when line length format is not specified, in which case NL and EM do not result in a character's being printed.
3. Hex 6A, superscript 9 shown above, causes a broken vertical bar (¦) to be printed when using the 64-character EBCDIC print belt.
4. SI (BF) is suppress index.

◥ Superscript

Figure D-9. 3288 Variant of EBCDIC for Text Print Feature

A	1	|	a	[
B	2	@	b	]
C	3	#	c	⩾
D	4	$	d	≠
E	5	%	e	NULL
F	6	¢	f	FF
G	7	&	g	DUP
H	8	*	h	FM
I	9	(	i	NL
J	0	)	j	EM
K	.	—	k	
L	=	+	l	
M	¬	!	m	
N	;	:	n	
O	,	"	o	
P	,	<	p	
Q	.	>	q	
R	/	?	r	
S	SPACE		s	
T			t	
U			u	
V			v	
W			w	
X			x	
Y			y	
Z			z	

Notes:

1. During execution of a Copy command, only the characters shown above are printed by the 3288 equipped with the Text Print feature and using the 120-character TN print belt.
2. If the 120-character TN print belt is replaced with a 64-character EBCDIC print belt, only the characters in the first 3 columns are printed.
3. The control codes NULL, FF, DUP, FM, NL, and EM are printed as space, <, *, ;, 5 and 9, respectively, regardless of which print belt is installed.
4. When additional character and control codes not shown above appear in the data stream, printing of undefined characters or erroneous printer operation results.

Figure D-10. 3288 Text Print Restricted Character Set (Copy Command)

Appendix E. Abbreviations

A. Attention.
ACK. Positive acknowledge.
AID. Attention identification.
ALPHA. Alphameric.
A/N. Alphameric (alphabetic/numeric)
ASCII. American Standard Code for Information Interchange.
async. Asynchronous.
atb. Attribute.

B. Busy.
BB. Begin bracket.
BCC. Block check character.
BIU. Basic information unit.
BOC. Bus out check.
bps. Bits per second.
BSC. Binary synchronous communications.
BTAM. Basic telecommunications access method.

C. Column.
CAW. Channel address word.
CC. Chain Command (flag), control check.
CCC. Copy control character.
CCW. Channel control word.
CE. Channel end.
char. Character.
cmd. Command.
cncl. Cancel.
cps. Characters per second.
CPU. Central processing unit.
CR. Command Reject.
CRT. Cathode-ray tube.
CSW. Channel status word.
ctl. Control.
CU. Control unit.
CUE. Control Unit End.

D. Display.
DAA. Data access arrangement.
DB. Device busy.
DC. Data check.
DE. Device end.
dec. Decimal.
del. Delete.
disc. Disconnect.
DLE. Data link escape.
DR. Definite response.
dup. Duplicate.

EAU. Erase All Unprotected.
EB. End brackets.
EBCDIC. Extended binary-coded-decimal interchange code.
EC. Equipment check.
EFI. expedited flow indicator.
EM. end of message.
ENQ. enquiry.
EOF. end of field.
EOI. end of inquiry.
EOR. end of record.
EOT. end of transmission.
ERP. error-recovery procedure.
ESC. escape.
ETB. end of transmission (block).
ETX. end of text.
EUA. Erase Unprotected to Address.
EX. Exception (response)

FF. Forms feed.
FID. Format identifier.
FIE. Function interpret error.
FM. Field mark, function management.

GP. General Poll.

hex. Hexadecimal.
Hz. Hertz.

I. Information (format).
IC. Insert Cursor.
ID. Identity.
ident. Identification.
ind. Indicator.
INS. Insert.
I/O. input/output.
IOS. Input/Output Supervisor.
IR. Intervention Required.
ITB. Intermediate transmission block.

kbd. Keyboard.

LRC. Longitudinal redundancy check.
LU/SSCP. Logical unit/system services control point.

MDT. Modified data tag.

NA. Not applicable.
NAK. Negative acknowledgment.
NCP. Network control program.
NL. New Line.
NS. Nonsequenced (format).
NSA. Nonsequenced acknowledgment.
NUL. Null.

OC. Operation Check.
OICR. Operator identification card reader.

P. Printer, protected.
PA. Program access.
PF. Program function.
PSI. Primary to secondary indicator.
PT. Program tab.

R. Row.
RA. Repeat to Address.
Rd Mod. Read Modified.
req. Request.
RH. Request/response header.
RNR. Request not ready.
ROL. Request online.
R/R. Request/response.
RR. Request ready.
RU. Request response unit.
RVI. Reverse interrupt.

S. Sequenced (format).
SA. Selection addressing.
SBA. Set Buffer Address.

SDLC. Synchronous data link control.
SF. Start Field.
SIOF. Start I/O Fast Release.
SM. Status modifier.
SNA. Systems network architecture.
SNRM. Set Normal Response Mode.
SOH. Start of heading.
SOR. Start of record.
SP. Space, Specific Poll
SPD. Selector-pen detect.
S/S. Status and sense.
STX. Start of text.
SUB. Substitute.
sw. Switch.
SYN. Synchronous idle.

TC. Transmission check.
TCU. Transmission control unit.
TH. Transmission header.
TTD. Temporary text delay.

U. Unpotected.
UC. Unit check.
UE. Unit exception.
US. Unit specify.

V. Volts
VFC. Vertical forms control.
VTAM. Virtual telecommunications access method.

WACK. Wait before transmit positive acknowledgment.
WCC. Write control character.
WT. World Trade.

Appendix F. Glossary

This glossary defines data processing and communication terms used in this publication and other terms as they apply to the 3270 Information Display System. For definitions of terms not included in this glossary, see *IBM Data Processing Glossary,* GC20-1699.

access method. A technique for moving data between main storage and input/output devices.

AID. *See* attention identifier.

alphameric field. A field that may contain any alphabetic, numeric, or special character that is available on any of the 3270 keyboards.

alphameric keyboard. A typewriter-like keyboard used to enter letters, numbers, and special characters into a display station buffer; also used to perform special functions (such as backspacing) and to produce special control signals.

attention. An occurrence, external to an operation, that would cause an interruption of the operation.

attention identifier (AID). A code that is recorded in the display station when the operator takes an action that produces an interruption.

attribute. A characteristic of a display field. The attributes of a display field include protected or unprotected (against manual input and copy operations); numeric-only or alphameric input control: displayed, nondisplayed, display-intensified; selector-pen-detectable or -nondetectable; and modified or not modified.

attribute character. A code that defines the attributes of the display field that follows. An attribute character is the first character in a display field, but it is not a displayable character.

audible alarm. An alarm that is activated when predetermined events occur that require operator attention or intervention or system operation.

auto-poll. A machine feature of a transmission control unit that permits it to handle negative responses to polling without interrupting the processing unit.

automatic polling. *See* auto-poll.

automatic skip. After entry of a character into the last character position of an unprotected display field, automatic repositioning of the cursor from a protected and numeric field to the first character position of the next unprotected display field.

automatic upshift. Automatic shift of the Data-Entry Keyboard when the cursor enters an unprotected numeric field to allow entry of only the upper symbols on dual-character keys.

available/unavailable. A device is available for CU-channel operation if (1) ac power is on at the device, (2) it is online, (3) it is physically attached to the CU, and (4) its security lock is turned on. The device is unavailable if any one of these conditions does not exist.

basic mode. A set of facilities (including the macro instructions needed to use them) that enable the application program to communicate with BSC and start-stop terminals, including the locally attached 3270 Information Display System. READ, WRITE, SOLICIT, RESET, DO, and LDO macro instructions are basic-mode macro instructions.

basic telecommunications access method (BTAM). An access method that permits read/write communications with remote devices.

binary synchronous communications (BSC). Communication using binary synchronous transmission.

bracket. In VTAM, an exchange of data between an application program and a logical unit that accomplishes some task defined by the user as uninterruptible.

BSC. *See* binary synchronous communications.

BTAM. *See* basic telecommunications access method.

buffer. The hardware portion of a display station, control unit, or buffered printer in which display or print data is stored.

buffer address. The address of a location in the buffer at which one character can be stored.

busy/not busy. The CU considers a device busy if (1) it is performing an operation initiated by the CU (namely, an erase-all-unprotected operation or a printing operation) or (2) the CU attempted to perform a command with the device but found the device busy executing a manually initiated operation. A manual operation can be initiated at the keyboard, operator identification card reader, or selector pen.

cathode-ray tube (CRT). A vacuum tube in which a slender beam of electrons is projected upon a fluorescent screen to produce a luminous glow corresponding to the path of the beam.

CCC. *See* copy control character.

character addressing. The capability of gaining access to any character position in the buffer by using an address.

character generator. A hardware unit contained in each 3275, 3277, and printer. It converts the digital code for a character into signals that cause the character to be printed or displayed.

character position. A location on the screen at which one character can be displayed; also, an addressed location in the buffer at which one character can be stored.

clear indicator. In VTAM, a SESSIONC indicator sent by one node to another that prevents the exchange of messages and responses.

cluster control unit. (1) A device that can control the input/output operations of more than one device. A remote cluster control unit can be attached to a host CPU only via a communication controller. A cluster control unit may be controlled by a program stored and executed in the unit, or it may be controlled entirely by hardware. (2) *See also* communication controller.

command. A request from a terminal for the performance of an operation or the execution of a particular program.

communication controller. (1) A type of communication control unit whose operations are controlled by a program stored and executed in the unit. Examples are the IBM 3704 and 3705 Communications Controllers. (2) *See also* cluster control unit.

communication facilities. Any media, such as a telephone circuit, that connects a remote 3270 unit (3271 or 3275) with a computer.

connection. In VTAM, in response to a request from an application program, the linking of VTAM control blocks in such a way that the program can communicate with a particular terminal. The connection process includes establishing and preparing the network path between the program and the terminal.

control character. A character whose occurrence in a particular context initiates, modifies, or stops a control operation.

conventional 3270. A locally attached 3270 terminal or a remotely attached 3270 terminal that uses the BSC line discipline.

copy control character (CCC). A character used in conjunction with the Copy command to specify the type of data to be copied.

copy operation. An operation that copies the contents of the buffer from one display station or printer to another display station or printer attached to the same control unit.

cursor. A visible, movable mark used to indicate a position on a display surface.

cursor check. An error condition that occurs when 3275 or 3277 circuitry detects no cursor or more than one cursor in the display buffer.

Data-Entry Keyboard. A standard typewriter keyboard on which the numeric keys are grouped in a format similar to the numeric keys on a card punch keyboard (to facilitate entry of numeric data). Other features include (1) automatic upshift of the keyboard when the cursor enters a numeric-only display field and (2) automatic prevention of entry of nonnumeric characters into a numeric-only display field, when the special Numeric Lock feature is installed.

data set. *See* modem.

data stream. All data transmitted through a channel in a single read cr write operation to a display station or printer.

data transfer. In data communications, the sending of data from a data source and the receiving of the data at a data sink.

data-transfer mode. (1) A set of facilities (including the macro instructions needed to use them) that enable the application program to communicate with terminals. (2) *See also* basic mode and record mode.

definite response 1. In VTAM, a response that indicates whether its associated message was successfully forwarded to its final destination (such as the display screen of an output device).

definite response 2. In VTAM, a response that indicates that the node sending the response has accepted recovery responsibility for the associated message.

definition statement. In VTAM, the means of describing an element of the telecommunication system.

designator character. A character that immediately follows the attribute character in a selector-pen-detectable field. The designator character controls whether a detect on the field will or will not cause an attention. For a nonattention-producing field, the designator character also determines whether the modified data tag for the field is to be set or reset as the result of a selector-pen detect.

detect. *See* selector-pen detect.

detectable. An attribute of a display field; determines whether the field can be sensed by the selector pen.

disconnection. In VTAM, the disassociation of VTAM control blocks in such a way as to end communication between the program and a connected terminal. The disconnection process includes suspending the use of the network path between the program and the terminal.

display field. An area in the display buffer, or on a screen, that contains a set of characters, manipulated or operated upon as a unit.

display operator. A person who uses the keyboard to perform operations at a display station.

erase all unprotected (EAU) command. A command that clears all unprotected fields to nulls, resets modified data tags in all unprotected fields, unlocks the keyboard, resets the attention identifier, and repositions the cursor to the first character of the first unprotected field.

erase unprotected to address (EUA) order. An order that erases all unprotected positions (inserts nulls) from the current buffer address up to, but not including, the specified stop address.

escape command sequence. A 2-character sequence used in remote operations that consists of ESC (27 hex in EBCDIC and 1B hex in ASCII) and the command character that follows and specifies the 3270 command.

field. *See* display field.

FME response. *See* definite response 1.

formatted display. A screen display in which a display field, or fields, has been defined as a result of storing at least one attribute character in the display buffer.

general polling. (1) An input technique for remote 3270 devices in which special invitation characters are sent to a device control unit instructing that control unit to begin transmission from all devices ready to enter data. (2) *See also* polling and specific polling.

incoming group. (1) In systems with TCAM, that portion of a message handler designed to handle messages arriving for handling by the message control program. (2) *See also* outgoing group.

input field. An unprotected field in which data can be entered, modified, or erased manually.

insert cursor (IC). An order that moves the cursor, if necessary, to the current buffer address.

intensified display. An attribute of a display field; causes data in that field to be displayed at a brighter level than other data displayed on the screen.

intensified field. Data in a field displayed at a brighter level than that for a nonintensified field.

interpret table. In VTAM, an installation-defined correlation list that translates an argument into a string of 8 characters. Interpret tables can be used to translate a logon message into the name of an application program for which the logon request is intended.

invitation list. In systems with the telecommunications access method (TCAM), a sequence of polling characters or identification sequences associated with the stations online; the order in which the characters are specified determines the order in which the stations are invited to enter a message.

I/O pending. The condition that results (1) in the generation of the attention status in a locally attached display station and (2) in a response to a polling operation in a remotely attached display station.

keyboard numeric lock. A special feature that allows entry of 0–9, minus (-), period (.), or DUP only; otherwise, the keyboard will be disabled.

leased line. *See* nonswitched line.

line adapter. 1200-bps Integrated Modem.

line control characters. Characters that regulate the transmission of data over a line; for example, delimiting messages, checking for transmission errors, and indicating whether a station has data to send or is ready to receive data.

line group. One or more communication lines, of the same type, that can be activated and deactivated as a unit.

local. Pertaining to the attachment of devices directly by channels to a host CPU. Contrast with *remote.*

logical unit. The combination of programming and hardware of a teleprocessing subsystem that constitutes a terminal for VTAM.

logoff. In VTAM, a request from a terminal to be disconnected from an application program.

logon. In VTAM, a request by or on behalf of a terminal to be connected to an application program.

logon message. In VTAM, the data that can accompany a logon request received by the application program to which the request is directed.

major node. A set of one or more minor nodes represented by a single symbolic name. A major node can be a set of local terminals, a set of application programs, or a network control program.

MCP. *See* message control program.

MDT. *See* modified data tag.

message control program (MCP). In TCAM, a program that is used to control the sending or receiving of messages to or from remote terminals.

message handler. In systems with the telecommunications access method (TCAM), a sequence of user-specified macro instructions that examine and process control information in message headers, and that perform functions necessary to prepare message segments for forwarding to their destinations. One message handler is required for each line group having unique message-handling requirements.

modem. A device that modulates and demodulates signals transmitted over communication facilities.

modified data tag (MDT). A bit in the field attribute of a display field, which, when set to 1, causes that field to be transferred to the host during a read modified operation.

multidrop. A line or circuit interconnecting several stations; synonymous with *multipoint line.*

NIB. *See* node initialization block.

node. A point in a telecommunication system defined to VTAM by a symbolic name. *See also* major node.

node initialization block (NIB). In VTAM, a control block, associated with a particular node, that contains information used by the application program to identify a node and indicate how communication requests directed at the node are to be implemented.

nonswitched line. A connection that does not have to be established by dialing.

null character. An all-0 character that occupies a position in the storage buffer and is displayed as a blank.

null suppression. In reading the contents of the buffer for a display or printer, the bypassing of all null characters in order to reduce the amount of data to be transmitted or printed.

order code. A code that may be included in the write data stream transmitted for a display station or printer; provides additional formatting or definition of the write data.

order sequence. A sequence in the data stream that starts with an order code and includes a character address and/or data characters related to the order code.

outgoing group. (1) In systems with TCAM, that section of a message handler that manipulates outgoing messages after they have been removed from their destination queues. (2) *See also* incoming group.

parity check. An error condition that occurs when 3270 system circuitry detects one or more characters with bad parity in a 3270 unit buffer.

PCI. *See* program-controlled interruption.

polling. A technique by which each of the terminals sharing a communication line is periodically interrogated to determine whether it requires servicing.

printer hang (3284/3286 only). This condition exists when the print mechanism is unable to advance successfully. This condition can occur at any time during a printout through to, and including, the carriage return and new line advance. The printer will try to recover, that is, mechanically restore its print mechanism to the starting position. This hang condition may be caused by a mechanical malfunction or by loss of ac power at the carriage motor.

program access (PA) key. A program attention key that may be defined to solicit program action that does not require data to be read from the buffer of the display station. If a Read Modified command is issued in response to the program-attention-key interruption, only the attention identification (AID) character is transferred to the program; no data from the buffer is transferred.

program attention key. On a display keyboard, a key that produces an interruption to solicit program action.

program-controlled interruption (PCI). An interruption that allows buffers to be deallocated continuously, replenishing the available unit pool.

program function (PF) key. On a display keyboard, a key that passes a signal to a program to solicit a particular program operation.

Program Tab (PT). An order that advances the current buffer address to the address of the first character location of the next unprotected field.

protected field. A display field for which the display operator cannot use the keyboard or operator identification card reader to enter, modify, or erase data.

read-modified operation. An operation in which only those display fields in which the modified data tag is set are read.

ready/not ready. The only devices that can be *not ready* are the attached printers. Thus, a printer is not ready to operate with the CU when (1) the printer's cover is open, (2) it is out of paper, or (3) a *hang* condition exists in the printer. (*See* Printer Hang.)

record mode. A set of facilities (and the macro instructions needed to use them) that enable the application program to communicate with logical units or with the locally or remotely attached 3270 Information Display System. SEND and RECEIVE are record-mode macro instructions.

remote. Pertaining to the attachment of devices to a central computer through a communication control unit. Contrast with *local.*

Repeat to Address (RA). An order that stores a specified alphameric or null character, starting at the current buffer address and ending at, but not including, the specified stop address.

request parameter list (RPL). In VTAM, a control block that contains the parameters necessary for processing a request for connection or communication, or a request for an operation related to connection or communication.

RPL. *See* request parameter list.

RRN response. *See* definite response 2.

SDLC. Synchronous data link control.

security key lock. A special feature that disables all input functions and blanks the display, except when the key is inserted in the lock and turned.

selector pen. A pen-like instrument that may be attached to the display station as a special feature. When pointed at a detectable portion of an image and then activated, the selector pen senses the presence of light at a display field and produces a selector-pen detect.

selector-pen attention. An interruption generated when a selector-pen detect occurs on a display field that has a null or space designator character. The attention concludes the selector-pen operation.

selector-pen detect. The sensing by the selector pen of the presence of light from data in a display field that has the detectable attribute. Depending on the designator character of that display field, the detection and location information is identified on the screeen (and stored in the buffer) or may produce an interruption that is transmitted to the CPU.

SESSIONC indicators. In VTAM, indicators that can be sent from one node to another without using SEND or RECEIVE macro instructions. SDT, clear, and STSN are SESSIONC indicators. All SESSIONC indicators are sent with a SESSIONC macro instruction.

Set Buffer Address (SBA). An order that sets the buffer address to a specified location.

Short Read. A Read Modifed command sent in reply to depression of the CLEAR CNCL key or of a PA key at a display station. Only an AID byte is transferrred to main storage.

SNA 3270. A 3270 terminal that uses synchronous data link control (SDLC) and is treated as a logical unit by VTAM.

specified polling. (1) A polling technique that sends invitation characters to a device to find out whether the device is ready to enter data. (2) *See also* general polling and polling.

Start Field (SF). An order that defines the start of a data field for display or printing.

Structured Data, 6-Bit. The low-order, 6-bit, binary-coded characters used internally by the CU. The 6-bit code is applicable to all characters received by the CU: graphic, AID, attribute, write control (WCC), copy control (CCC), CU and device address, buffer address, status and sense.

suppress index (SI) order. An order that generates the suppress index character, valid only for the 3288 Printer Model 2 (other printers receive I, an OR bar). This character inhibits a line index to allow overprinting.

switched line. A communication line in which the connection between the computer and a remote terminal is established by dialing.

TCAM. *See* telecommunications access method.

telecommunication network. In a telecommunication system, the combination of all terminals and other telecommunication devices and the lines that connect them.

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.

terminal. (1) *A point in a system or communication network at which data can either enter or leave. (2) Any device capable of sending and receiving information over a communication channel.

terminal-initiated logon. A logon request that originates from the terminal.

Test Request Read. A Read Modified command resulting from the operator's pressing the TEST REQ key to allow entry of a predefined test-request data format.

unformatted display. A screen display in which no attribute character (and, therefore, no display field) has been defined.

unprotected field. A display field for which the display station operator can manually enter, modify, or erase data.

virtual telecommunications access method (VTAM). A set of IBM programs that control communication between terminals and application programs running under DOS/VS, OS/VS1, and OS/VS2.

VTAM. *See* virtual telecommunications access method.

VTAM definition library. The DOS/VS files or OS/VS data sets that contain the VTAM definition statements filed during VTAM definition. These statements describe the telecommunication system to VTAM and can be used to tailor VTAM and the system to suit the needs of the installation.

WCC. *See* write control character.

wraparound. The continuation of an operation (for example, a read operation or a cursor movement operation) from the last character position in a buffer to the first character position in the buffer.

write control character (WCC). A character used in conjunction with a Write-type command to specify that a particular operation, or combination of operations, is to be performed at a display station or printer.

1200-bps Integrated Modem. A feature for the 3275 that provides a modem capable of operating at a speed of 1,200 bps over nonswitched communication facilities, or at speeds of 600/1,200 bps over switched communication facilities via a similarly equipped 2701 or 3705.

*American National Standards Institute (ANSI), *American National Dictionary for Information Processing.*

Index

IBM 3270 IDS 3271, 3272, 3275 Description and Programmer's Guide (File No. S360/S370/S3/4300-09) Printed in U.S.A. GA23-0060-0

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3271 Control Unit, 3272 Control Unit, 3275 Display Station
Description and Programmer's Guide

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