RAYTHEON

PTS-100

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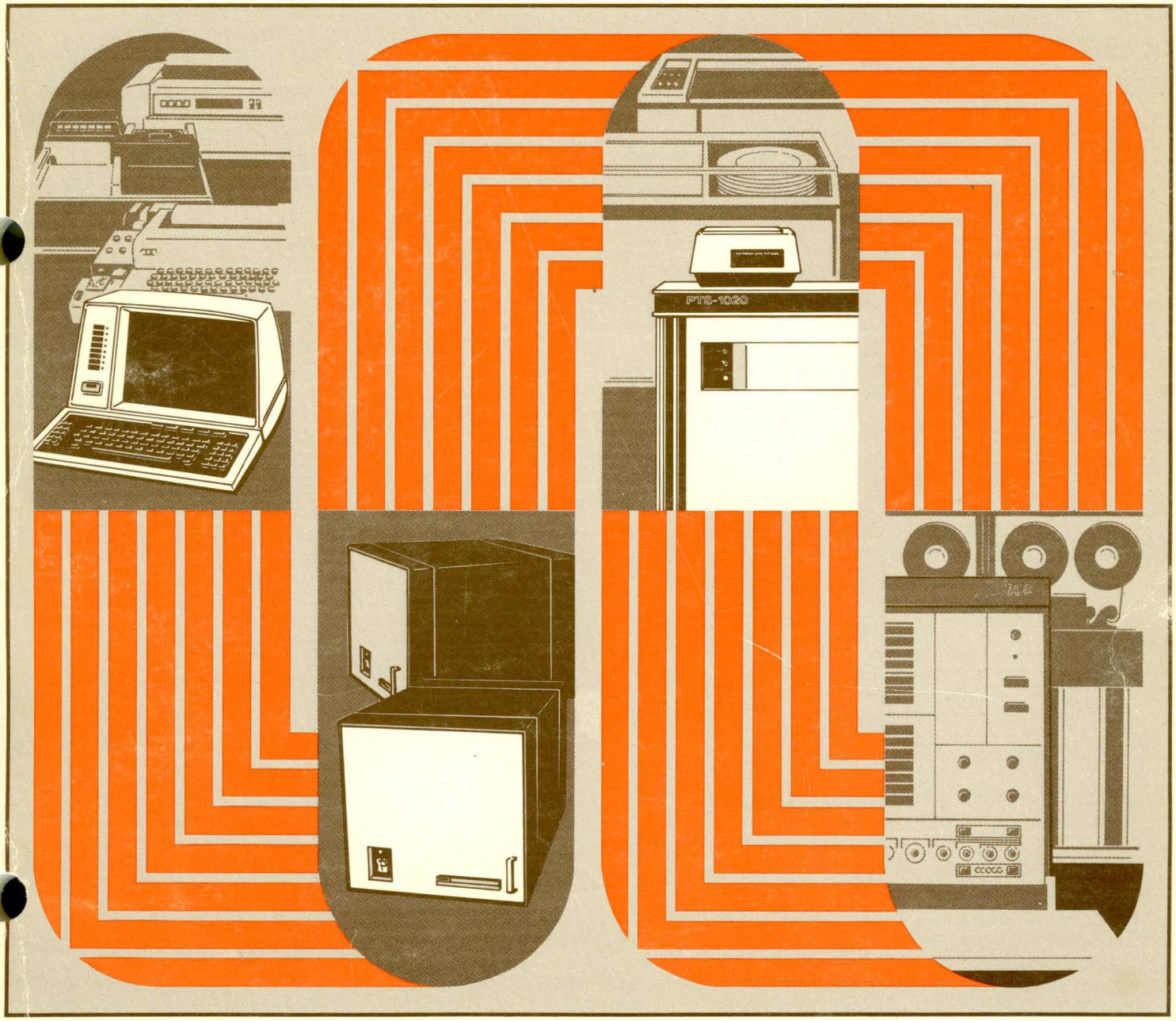
(3/80)

A. Wasilewsky

3274
REMOTE SNA/SDLC EMULATOR
PRODUCT SPECIFICATION

RAYTHEON DATA SYSTEMS



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PTS 3274 REMOTE SNA/SDLC EMULATOR

PRODUCT SPECIFICATION

NOTICE

This is a preliminary document
subject to change without notice.

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TABLE OF CONTENTS

TABLE OF CONTENTS (Cont)

TABLE OF CONTENTS (Cont)

TABLE OF CONTENTS (Cont)

TABLE OF CONTENTS (Cont)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Cont)

LIST OF TABLES

1. SYSTEM DESCRIPTION

1.1 Overview of 3274 Emulator System

The basic 3274 Emulator System consists of a PTS-100 intelligent controller and display terminals with or without magnetic stripe readers attached, and printers. The control units are programmable and can be expanded by the addition of device adapters to accommodate up to 32 display terminals and printers.

Network control of the PTS system is provided by the 370X Communications Controller. A functional block diagram of a typical system configuration is provided in Figure 1-1.

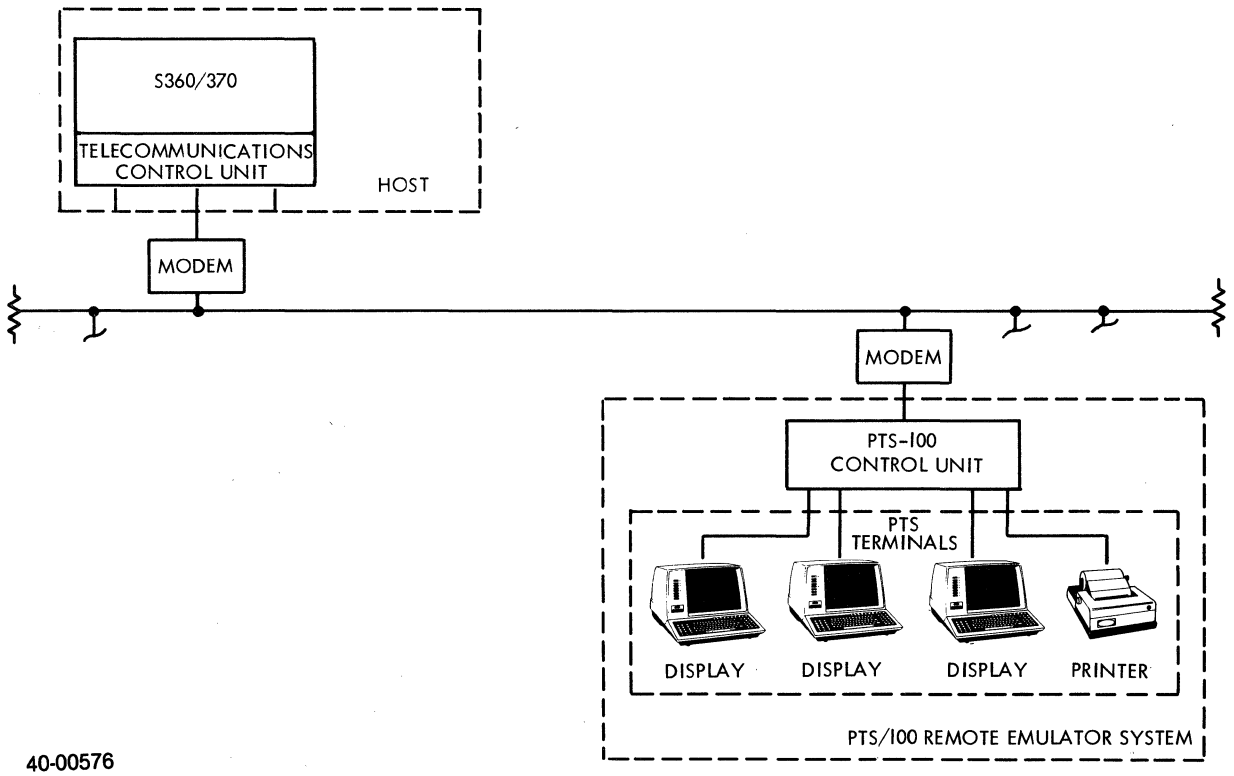

Figure 1-1. Typical PTS-100 System Configuration for the 3270

1.2 Host System Interface

The Raytheon PTS (Programmable Terminal System) 3274 Remote Emulator System is designed to be a plug-to-plug compatible substitute for the IBM 3274 display subsystem in the remote mode as defined in this specification. As such, the PTS system will operate in the remote mode with IBM central systems that support SDLC, e.g., with a central S360/370 system or a System 3 under OS and OS/VS using BTAM, under OS and OS/VS using TCAM, and under OS/VS and DOS/VS using VTAM, with specific IBM programs such as IMS, CICS, VIDEO 370, DATA 360, and TSO.

The term "host" will be used in this manual to describe the IBM central system that supports SDLC, e.g., the S360/370 and the 370X Communications Controller, which is the communications interface with its operating programs. The PTS Emulator System consists of a PTS processing unit that interfaces with a modem and PTS terminals (either display or printer). The phrase "3274 Remote Emulator System" may be contracted to "3274 Emulator," or simply, "emulator."

1.3 Communications Line Discipline

The PTS 3274 Emulator operates with the host using Synchronous Data Link Control (SDLC) line procedures. In particular, it uses the SDLC Multipoint Data Link mode of operation. In this discipline, the central system operates as a master station in a polling environment with the PTS 3274 emulator systems operating as slave stations, i.e., data is transmitted only when requested by the host. The operation of the total communication system network is governed by an overall group of procedures and protocols, referred to as System Network Architecture (SNA). In context with SNA protocol, the host is referred to as the Primary Logical Unit (PLU), and the device attached to the PTS-100 (display or printer) is referred to as the Secondary Logical Unit (SLU).

1.3.1 Modem Interface

Communication with the host is via a customer-provided modem over dedicated communication lines. These lines must be four-wire full duplex (the SDLC procedure is full duplex). The PTS 3274 Emulator System interfaces the modem with a standard RS-232-C synchronous interface at speeds up to 9600 bits per second.

1.3.2 Multipoint Operation

Operation on a communications line with other PTS 3274 Emulators, other 3270-type devices, and other SDLC terminals is permissible within the constraints of the SDLC Multipoint Data Link polling discipline and good communications practice insofar as communications line utilization is concerned.

1.3.3 Code Set

The PTS 3274 Emulator will operate in either EBCDIC or ASCII mode, regardless of line protocol in use. A full uppercase and lowercase display capability is provided for systems using typewriter, data entry, and keypunch-style keyboards.

Only one type (ASCII or EBCDIC) is supported by the physical unit at run-time. If ASCII is selected, all logical units will support ASCII only.

1.4 Configurations

The 3274 Remote Emulator requires 64K bytes of memory to support the SDLC protocol. Device adapter memory (2K bytes) is required for the buffer areas associated with each display or printer attached to the system.

The maximum number of terminals (displays and printers) that can be attached to the PTS-100 processing unit is as follows:

PTS-100 Controller Model	Communication Terminals Supported		
	Protocol Emulator	Basic Unit	Maximum Supported
1018R12-64	3274 SDLC	8	8/32
1018R12-128	3274 SDLC	16	32

1.4.1 Terminal Capability and Memory Requirements

The PTS 3274 Remote Emulator will support a mixture of display terminals and printer terminals as follows:

a. System Using Uniform Screen Sizes (1018R12-64)

Terminal Size	Number Displays Maximum	Number Printers Maximum	Total Terminals	Memory Requirements for N Terminals
960-character	8	7	8	$\leq$34K + 2.0 NK
1920-character	8	7	8	$\leq$34K + 2.0 NK

b. Systems Using Uniform Screen Sizes (1018R12-128)

Terminal Size	Number Displays Maximum	Number Printers Maximum	Total Terminals	Memory Requirements for N Terminals
960-character	32	31	32	$\leq$34K + 2.0 NK
1920-character	32	31	32	$\leq$34K + 2.0 NK

c. System Using Mixed Screen Sizes

No. 1920-Character Devices Maximum	No. 960-Character Devices Maximum	Total No. Printers Maximum	Total No. Devices Maximum	Memory Requirements
32	32	31	32	$\leq$34K + 2.0 NK

where N is the number of display terminals and printers. A 2K buffer is required for a 1920-character device and a 2K buffer is required for 960-character device.

2. EQUIPMENT CONFIGURATION

2.1 Basic PTS 3274 Emulator

The basic PTS 3274 Emulator System consists of a PTS control unit and PTS data display terminals. The PTS control unit is programmable and can be adapted by the addition of display adapter/memory units to accommodate up to 32 terminals and peripheral equipment as illustrated in Figure 2-1.

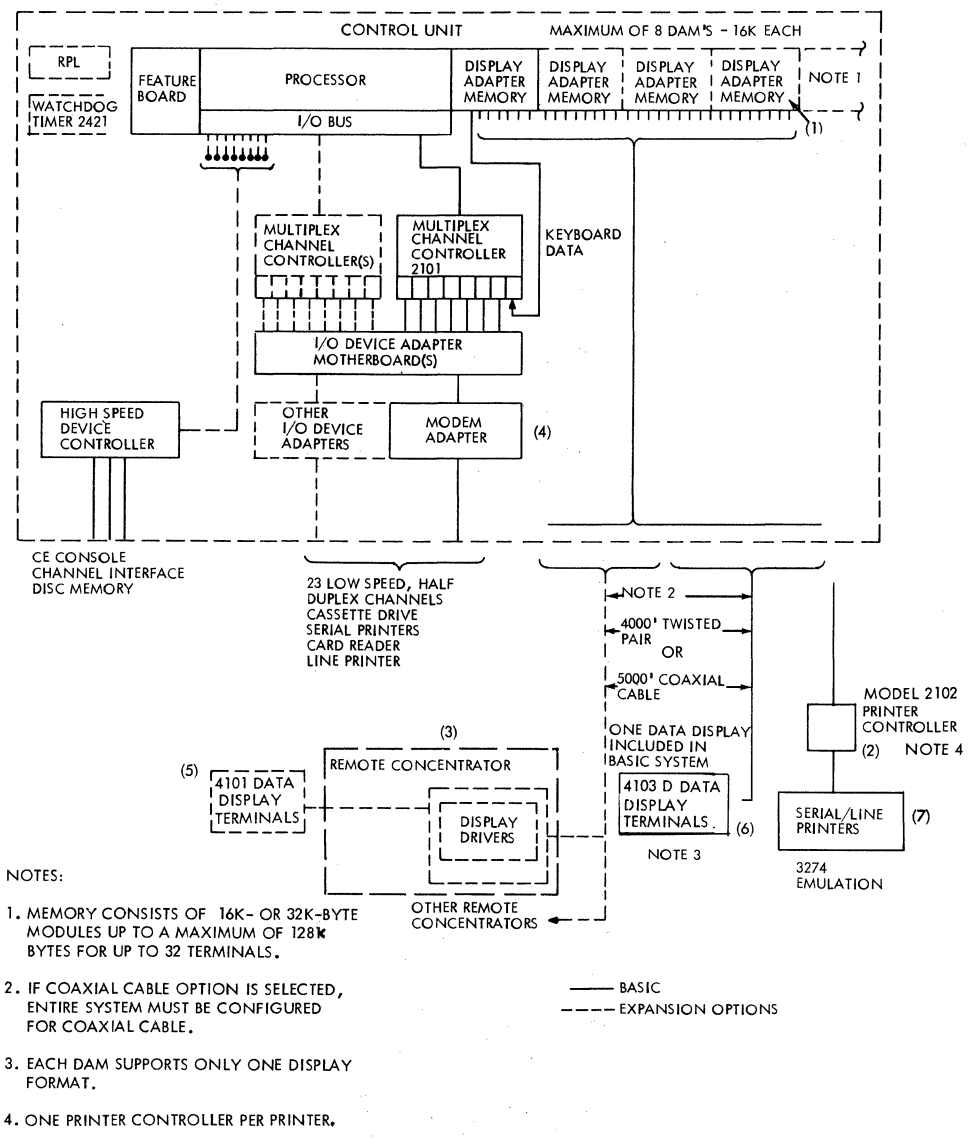

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Figure 2-1. Large Cluster Display System

2.1.1 Control Unit

The PTS control unit consists of a general purpose processing unit, magnetic tape cassette, modem adapter to interface with the remote host, and device adapter/memory modules (see Figure 2-2). The PTS Remote Emulator operates on the following system models:

1018 Large Remote Cluster Controller
1025 Large, Local, and Remote Cluster Controller

The Model 1018, functionally equivalent to IBM's 3274, supports up to 32 960- or 1920-character terminals and printers and supports SDLC. The Model 1018 Large Cluster Controller can support a mix of terminal sizes (960 and 1920 characters). The Model 1025 Large Cluster Controller is intended to support specialized installations.

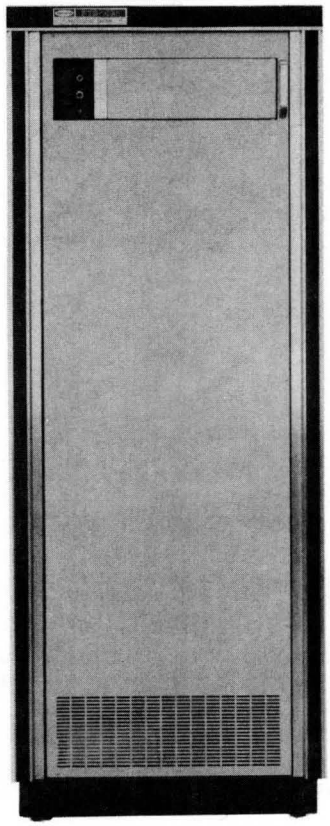

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Figure 2-2. Control Unit

As a programmable unit, the PTS system can have its program loaded locally. The local program load is performed via a magnetic tape cassette unit. The operator simply presses a button on the processor to cause the program to load.

2.1.2 Memory Units

The basic memory unit, shown as (2) in Figure 2-1, supplied is 64K byte display adapter/memory (DAM). The memory units are located in the control unit as shown in Figure 2-3. A DAM interfaces the Model 4103 Display Data Terminal directly via twisted-pair cable or optional coaxial cable. Additional DAMs are available in increments of 16K and 32K bytes up to a maximum of 128K bytes. Each DAM is supplied with eight ports to interface with up to 4000 feet of twisted-pair cable or (as an option) up to 5000 feet of coaxial cable.

The Model 4101 Display Data Terminal is supported via a remote concentrator. The use of twisted-pair cable and coaxial cable on a system is not permitted. For coaxial cable, specify Feature 2507-1.

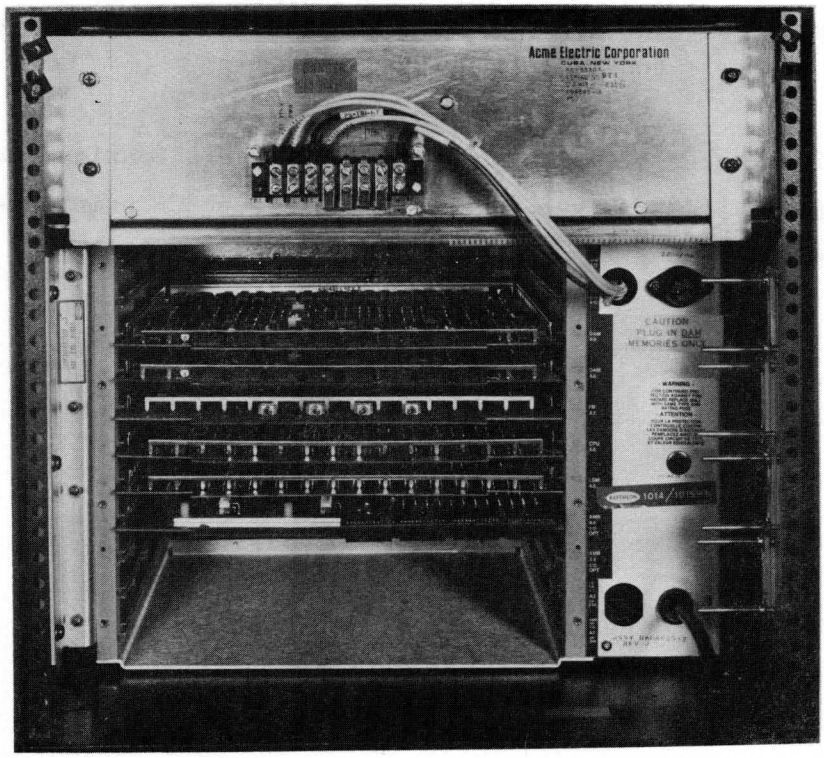

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Figure 2-3. Rear of Control Unit

2.1.3 Printer Controllers

One Model 2101 Printer Controller is required per printer. The printer controller, number (3) in Figure 2-1, interfaces a DAM via 4000 feet of twisted-pair cable (5000 feet of coaxial cable). A printer is connected to the printer controller by up to 50 feet of cable. The printer controller is an intelligent microprogrammable device with its own memory and buffer memory for the attached printer. The printer controller fully supports the SNA character string control codes and is capable of self-test as part of the system and as a standalone device. The controller is also fully functional in a non-SCS environment.

A rotary switch located on the front panel provides the following functions:

TEST	--	Off-line diagnostics
RUN	--	Normal run position
RUN MONO	--	Print uppercase only. Print uppercase/lowercase if commanded by host SCS.
MARGIN	--	Set MPP (maximum presentation position) using thumbwheel switches.

The thumbwheel switches are also used for setting MPL (maximum page length). All default values are as given for a 3274 in a non-SCS print message and a SCS print session.

Four keys located on top of the controller are as follows:

PA1
PA2
CANCEL PRINT
BUFFER REPRINT

Two LED indicators located on top of the controller indicate the status of the controller and the attached printer. The printer controller is also capable of printing a memory dump of the display buffer for diagnostic purposes.

2.1.4 Remote Concentrators

Both display system models (1018 and 1025) support the Model 4101 Display Terminal via a remote concentrator. Remote concentrators are referenced as (3) in Figure 2-1. The dc power and video to drive the Model 4101 are provided by monitor controllers which are housed in a remote concentrator located up to 4000 feet (5000 feet coaxial cable) from the processing unit. Displays may be located up to 200 feet from this remote concentrator.

2.1.5 Modem Adapters

The SDLC modem adapter provides the interface to the customer-supplied modem. The adapter, depicted as (4) in Figure 2-1, provides the following EIA RS-232-C or CCITT-V.24 standard signals:

Request to Send
Clear to Send
Transmit Data
Receive Data
Transmit Serial Clock
Receive Serial Clock
Data Set Ready
Carrier Detected

The adapter will allow transmission at speeds clocked by the modem. Speeds up to 9600 baud are allowable with the basic system. For ASCII (seven-bit plus parity) transmission, specify Feature 2504-01 at the time of the order; for EBCDIC, specify Feature 2504-02. Both NRZ and NRZ1 transmissions are supported.

2.1.6 Model 4101 Display Terminal

The Model 4101 Display Terminal, called out in Figure 2-1 as (5), is a self-contained unit (Figure 2-4) with a 15-inch rectangular CRT capable of displaying the following formats for 3274 emulation.

12 lines by 80 characters	=	960 characters
24 lines by 80 characters	=	1920 characters

The display requires no connection to an ac power source, power is derived from the remote concentrator. The character set displayed is shown in Appendix A for EBCDIC and Appendix B for ASCII.

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Figure 2-4. Model 4101 Display Data Terminal

2.1.7 Model 4103 Display Terminal

The Model 4103 Display Terminal, (6) in Figure 2-1, is functionally identical to the Model 4101. The terminal houses a 15-inch rectangular CRT, a power supply, video circuits, character generation circuits, and an MOS memory. The display requires connection to an ac supply. The display may be located up to 4000 feet via twisted-pair cable (5000 feet coaxial cable) from the processor. No provision is made for connection of a Model 4103 to a remote concentrator, the Model 4103 connects to Display Adapter/Memory (DAM) only.

Memory requirements for the 4103 are the same as for the Model 4101. The character set and keyboards offered with the 4103 are the same as for the Model 4101.

NOTES

1. 1920- and 960-character displays may not be mixed on the same display adapter or display adapter/ memory unit.

2. The minimum memory size is 64K bytes (50K bytes is required to load the emulator).

2.1.8 Printers

The standard 3274 Emulator will allow operation with up to 31 printers. Each printer, as shown in Figure 2-1 (7), requires a printer controller connected to the processing unit by up to 4000 feet of twisted-pair cable (5000 feet of coaxial cable). An additional 50 feet of cable is allowed between the printer controller and the attached printer. The two standard printers supported by the 3274 Emulator are described below.

2.1.9 Model 3472-2 Character Printer

This unit (Figure 2-5) operates at 120 characters/second. Printing motion is bidirectional with the logic seeking the closest position of the first printable characters in successive lines of data. The printer will accept form widths from 4 to 17.3 inches. It is capable of printing up to 132 characters to a line, 10 characters to the inch horizontally, and six or eight lines to the inch vertically, switch selectable. The following options are offered:

Feature 2418-1	Pin-feed platen, 14.8-inch width
Feature 2418-9	Pin-feed platen, 9.5-inch width
Feature 2413	Printer stand
Feature 2419	Uppercase/lowercase character set, 96 characters
Feature 4114-72	50 Hz, 220 Vac power

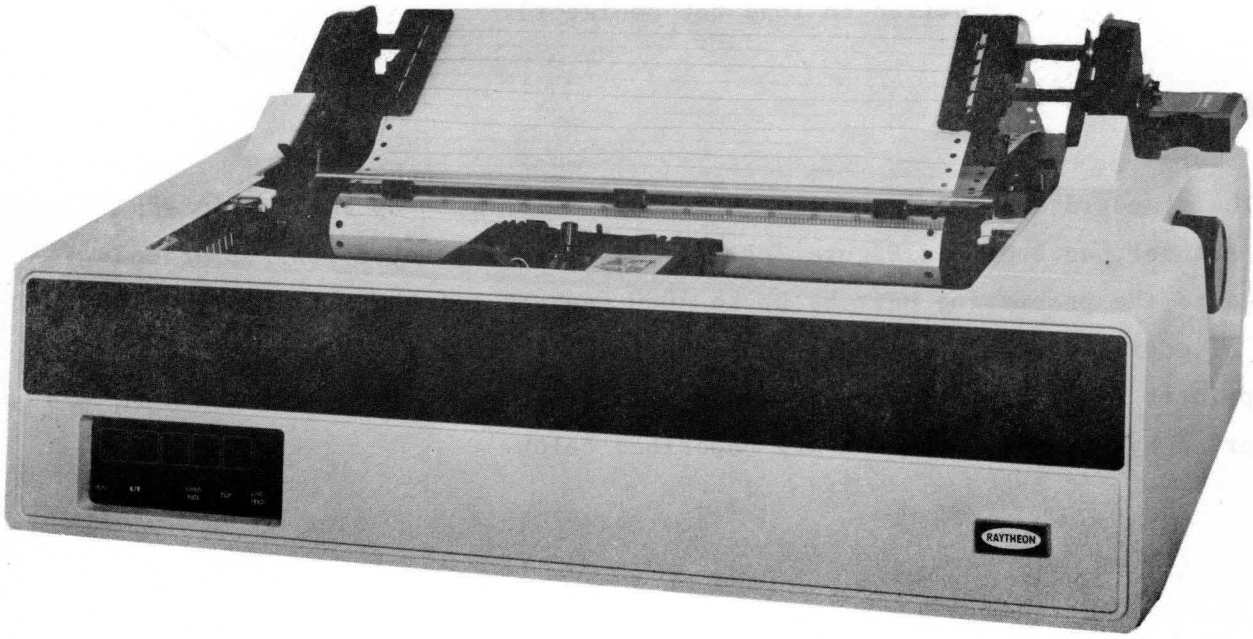

Figure 2-5. Model 3472 Character Printer

2.1.10 System Configuration - Multiple Devices

2.1.10.1 System Configuration (feature board). The feature board is used when the system supports no more than eight devices. The feature board contains 128 switches which are set upon system installation to define the system configuration. The first eight positions define the type of system (i.e., 3274, BSC or SDLC, ASCII or EBCDIC line codes). The next eight positions define the interchange address. Eight sets of fourteen switches each define the display/keyboard or printer attached to the system and the terminal address of each. On initial program load, the emulator software reads the switches to determine its own configuration. The software discards all modules not used, compacting itself into minimum run size.

2.1.10.2 System Configuration (interactive configurator). The interactive configurator is used when the system is to support more than eight devices and allows for options not available when using the feature board. The system configuration is defined by a software module that displays questions on a display. In response to the answers, a software module defines a table (in place of the feature board) which in turn selects the system software to be used.

2.1.10.3 Configuration Matrix. Once the emulator is configured and IPLed into the system, the display attached to device address zero will contain a matrix showing the configuration and the status of the devices attached. While determining configuration, no responses will be sent to link level polls. This matrix will reflect the information stored via the interactive configurator or the feature board manual data switches. The format of the matrix is as follows:

```
Columns:  0  1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16 . . . 31
Line 0    D  D  ?     ?  ?  D  D  D      ?   ?
```

D = Display ? = Printer with Unknown Status = Address Not Assigned

The columns of the display represent the device number of the the device. For example, Column 4 is device number 04 which is a printer of unknows status.

While configuration is in progress, the display on Device Address zero's keyboard will be locked, the INPUT INHIBIT indicator is on, and the cursor is not visible. Also, the device is placed off the system until configuration is complete, at which time the device is posted on the system in the reset state (a session state), the keyboard is unlocked, INPUT INHIBIT is extinguished, and the cursor is positioned at Line 0, Column 0.

During initialization, all printers are polled to determine their status. As status becomes available, the matrix will be updated with a "P" if the printer is available and ready to receive data or an "M" to indicate a malfunction of that printer. If a malfunction is indicated, the operator should check the printer controller and the printer to determine the reason for the malfunction. While the question mark is displayed, device off the system will be posted and remain in effect until the printer answers with good status. At this time the display is updated and the device is placed on the system in the reset state. If the printer does not answer with good status, it remains off the system until the malfunction is corrected, at which time it is placed on the system.

If a space is posted, no device is attached to that system address.

2.2 System Options

2.2.1 Keylock, Feature 6131-01

A security keylock feature is provided that will prohibit use of a display terminal and keyboard unless the lock is open. A keylock is mounted in the side of the display. The user must insert the proper key in the lock to turn on full power to the display subsystem. Without the proper key in the lock, data entered on the keyboard associated with that display will not enter the

system. When the key is in the "off" position, messages received from the host will be placed in the display buffer, but display images will not be visible to the operator.

2.2.2 Audible Alarm, Feature 6122-01 (with Indicator Panel)

Each data display may have an audible alarm device installed. This alarm has a duration of about one second and may be adjusted for volume. Alarm initiation is under central system program control. Although it will be sounded automatically when the cursor is on the next-to-last position of the last line, or when the operator makes an illegal field entry, e.g., types an alpha character in a numeric field, or in certain cases of printer failures during local print. The audible alarm feature is recommended when the data entry style keyboard is ordered.

Indicator Panel

An indicator panel containing red lamps is mounted vertically along the left side of the display (see Figure 2-6). The standard 3274 Emulator contains seven indicators:

IDENT
TRANSMIT/RECEIVE
DATA SET READY
INSERT MODE
INPUT INHIBITED (keyboard available)
SYSTEM AVAILABLE
POWER ON

The precise function of each indicator is described in Section 3.

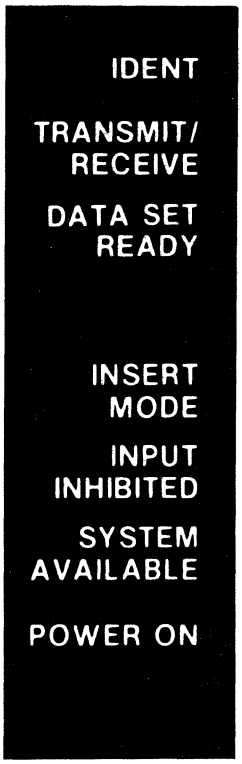

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Figure 2-6. Indicator Panel

2.2.3 Magnetic Stripe Card Reader, Feature 6150-01

A magnetic stripe card reader (Figure 2-7) can be provided with a display station. This magnetic stripe card reader provides the user with the ability to prevent access to the system or to verify the authenticity of the card. The unit is a microprocessor-based reader design which decodes the information contained on a stripe of magnetic tape embedded in plastic credit cards, conforming to ANSI specifications. The unit reads any one of the two tracks currently in use on magnetic stripe credit cards.

2.2.4 Power

All PTS processor units operate with standard 115 volt, 60 Hz power. PTS processors can be specified to operate from 47 to 63 Hz to 103 to 127 volts or 206 to 254 volts.

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Figure 2-7. Magnetic Stripe Card Reader

2.2.5 Character Generator

Uppercase and lowercase character generators are provided as standard.

2.2.6 Special Numeric Lock

For all keyboards, a numeric lock option is provided that prevents entry of keys excepting numeric and certain punctuation marks. If the operator attempts to enter keys other than the numeric and certain punctuation marks, the keyboard locks. The means of overriding this feature and the procedure to be followed once an error (keyboard lock) is made, are outlined in Section 3. To order this option, specify Feature 2503.

2.3 Keyboards

Ten keyboards are offered with the PTS 3274 Emulator. The standard versions are:

Feature Code	Type	Description
6107-01	75-key, Data Entry, EBCDIC	Figure 2-8
6107-02	75-key, Typewriter, ASCII	Figure 2-9
6107-04	75-key, Typewriter, EBCDIC	Figure 2-10
6107-05	75-key, Data Entry (keypunch style), EBCDIC	Figure 2-11
6108-02	87-key, Typewriter, ASCII	Figure 2-12
6108-04	87-key, Typewriter, EBCDIC	Figure 2-13
6108-05	87-key, Data Entry, EBCDIC/numeric keypad	Figure 2-14
6108-07	87-key, Typewriter, ASCII/numeric keypad	Figure 2-15
6108-08	87-key, Typewriter, EBCDIC/numeric keypad	Figure 2-16
6108-10	87-key, Data Entry (keypunch style), EBCDIC/numeric keypad	Figure 2-17

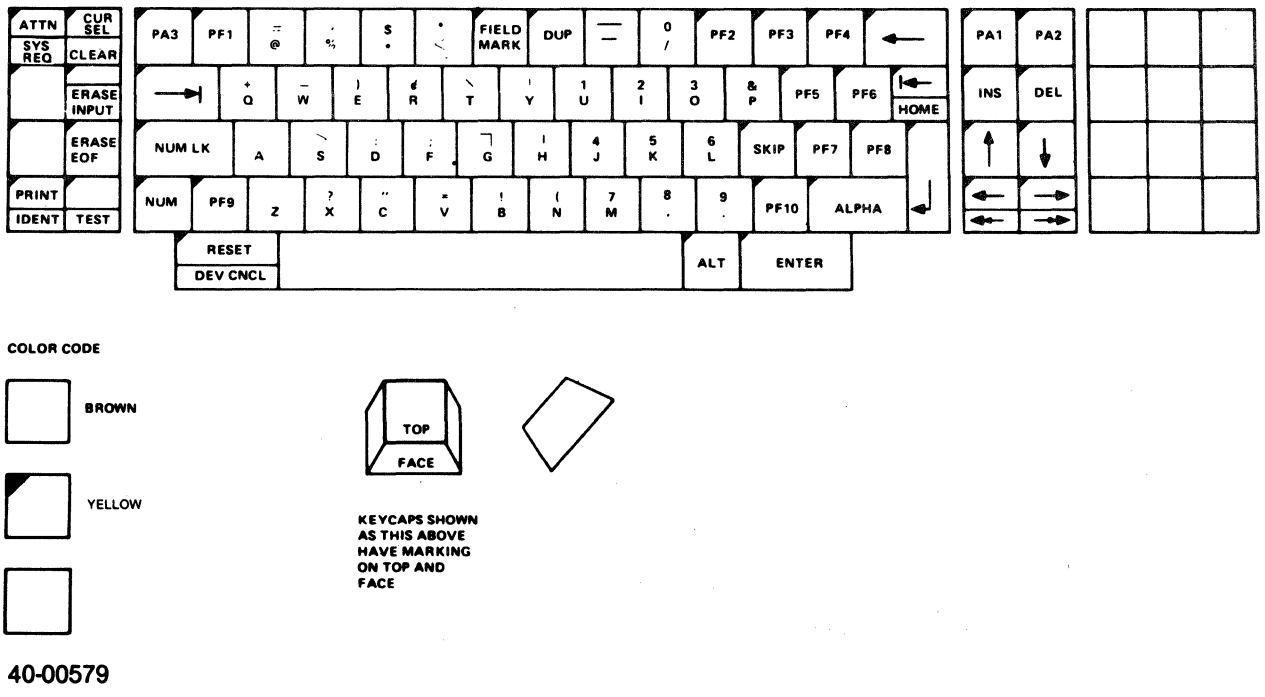

Figure 2-8. 75-key, Data Entry, EBCDIC

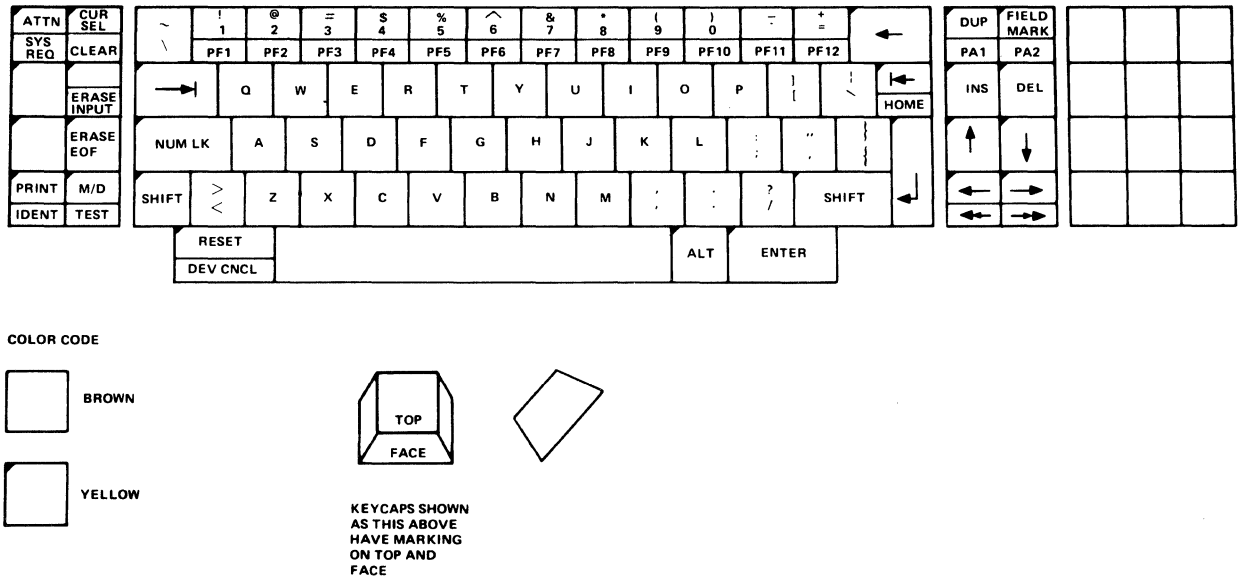

Figure 2-9. 75-key Typewriter, ASCII

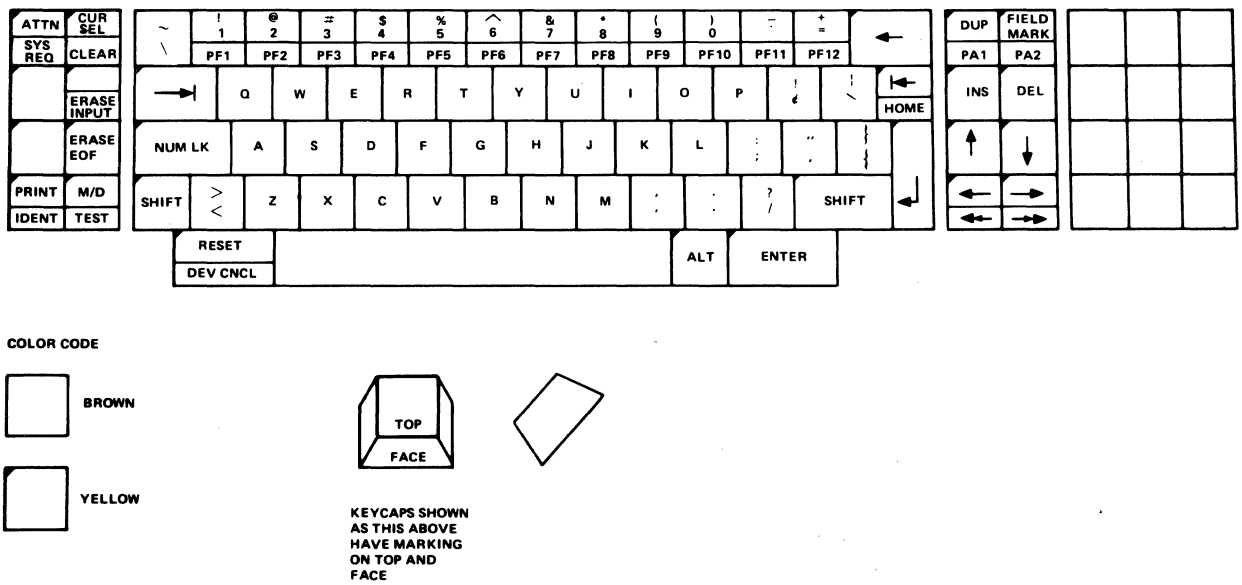

Figure 2-10. 75-key, Typewriter, EBCDIC

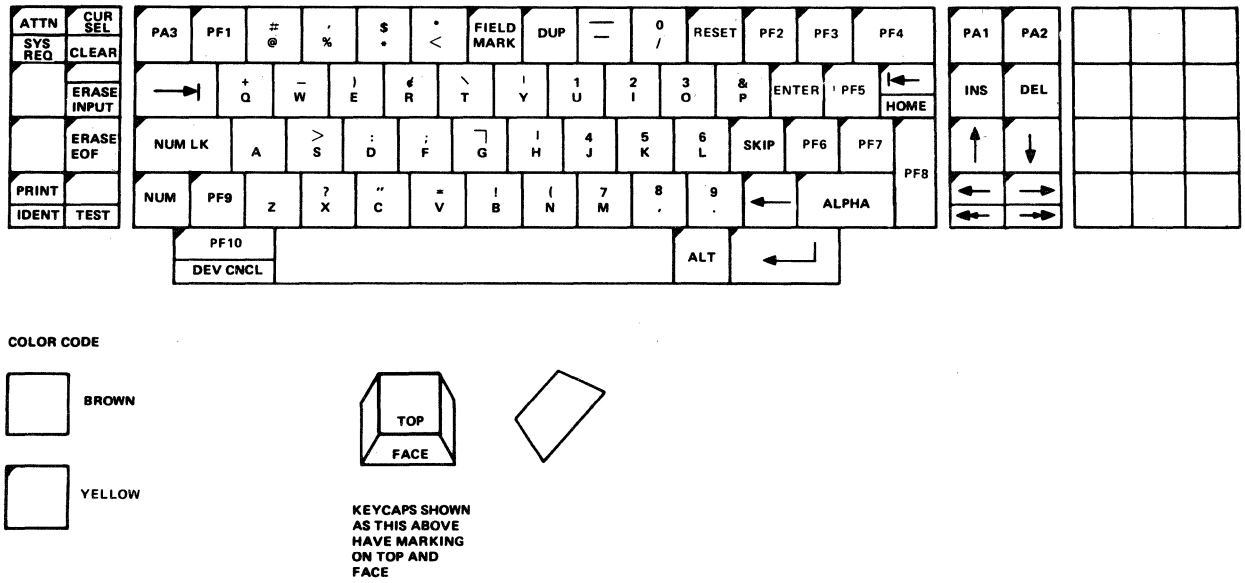

Figure 2-11. 75-key, Data Entry (keypunch style), EBCDIC

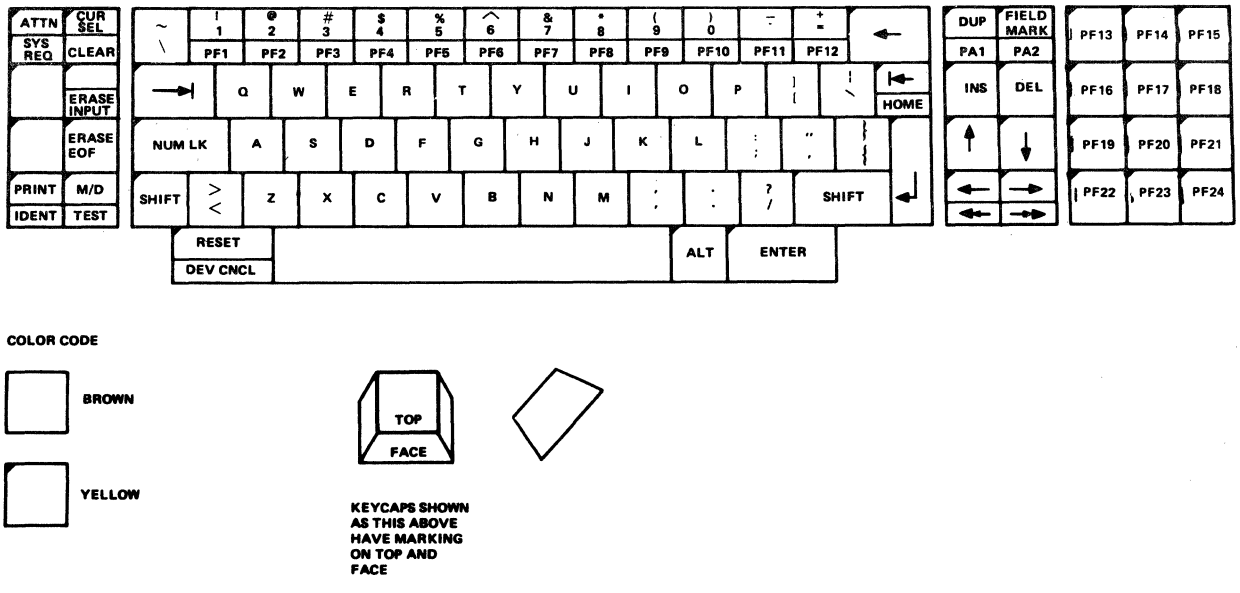

Figure 2-12. 87-key, Typewriter, ASCII

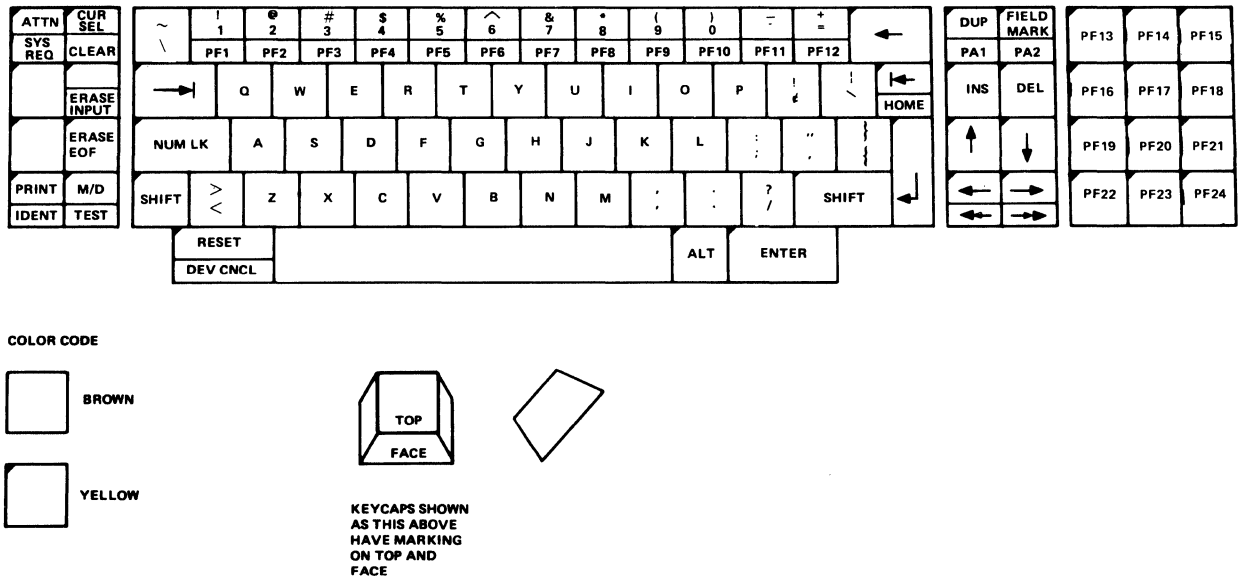

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Figure 2-13. 87-key, Typewriter, EBCDIC

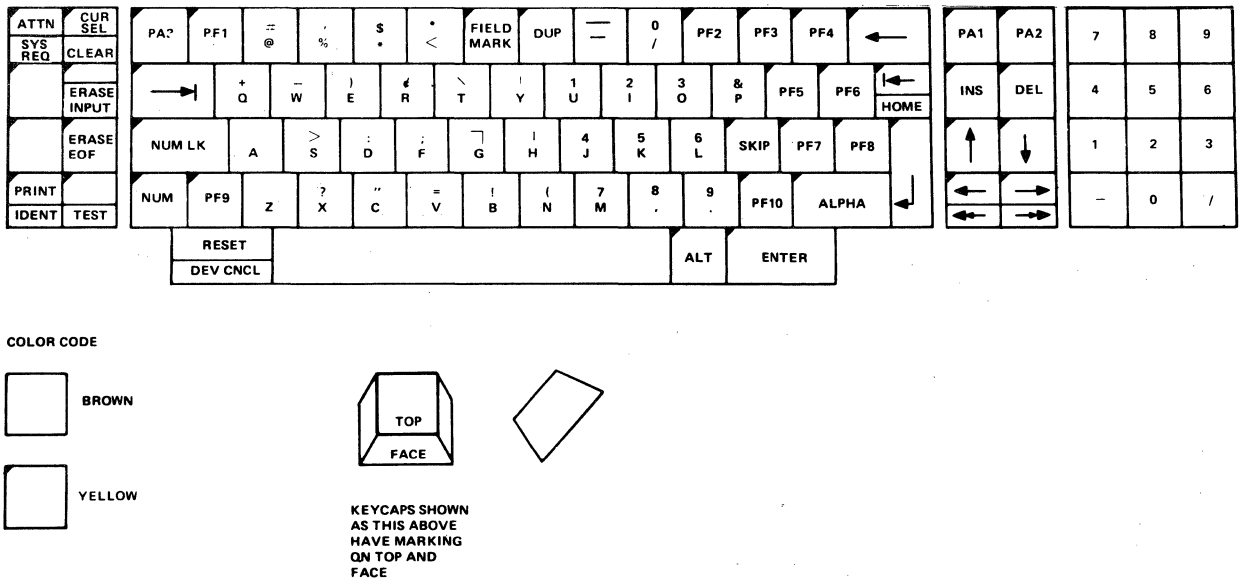

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Figure 2-14. 87-key, Data Entry, EBCDIC/numeric keypad

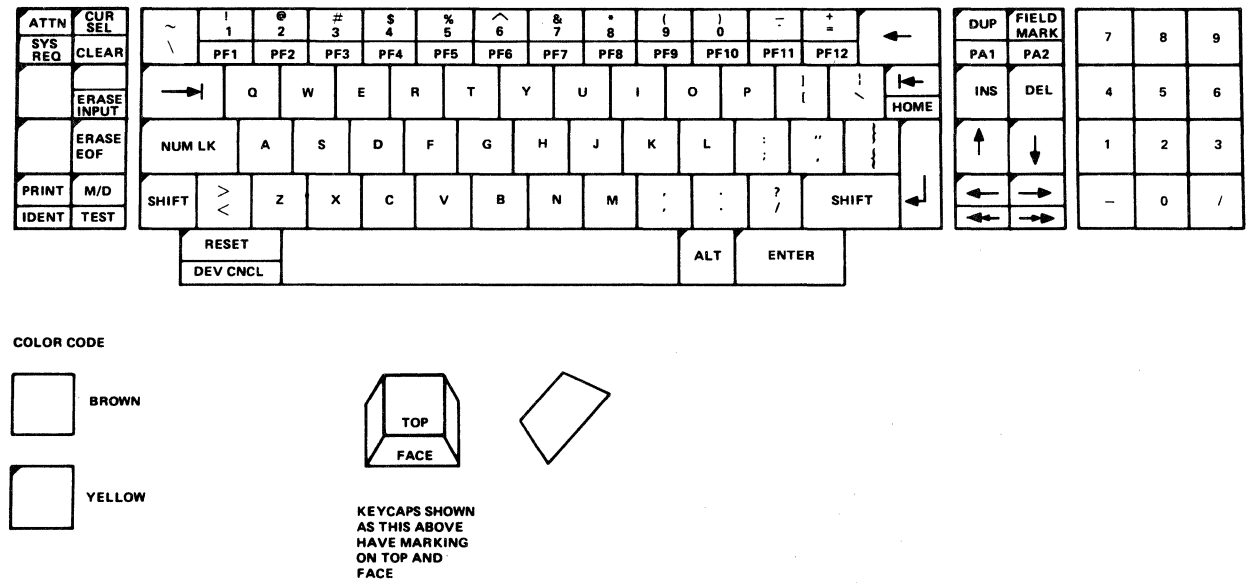

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Figure 2-15. 87-key, Typewriter, ASCII/numeric keypad

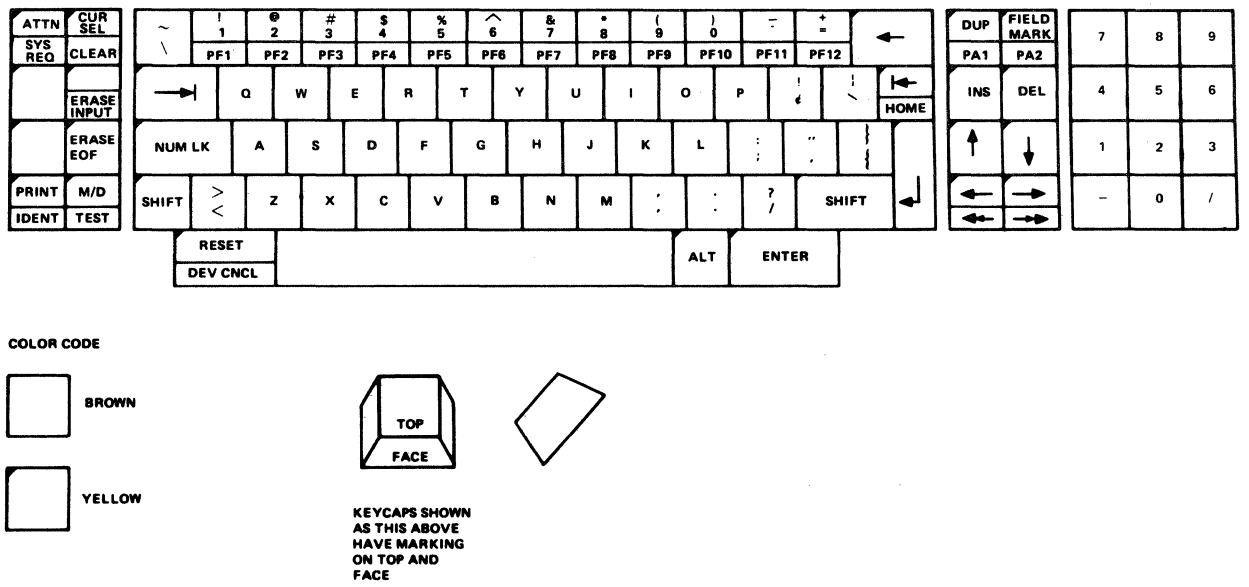

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Figure 2-16. 87-key, Typewriter, EBCDIC/numeric keypad

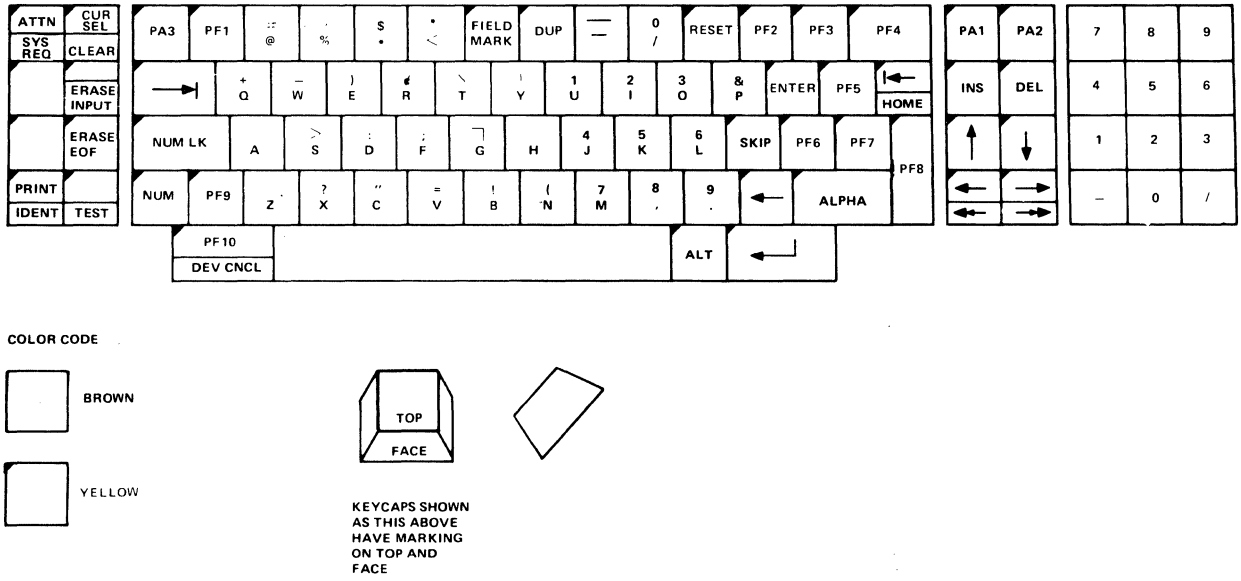

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Figure 2-17. 87-key, Data Entry (keypunch style), EBCDIC/numeric keypad

2.3.1 General Description of Keyboards

Keyboards can be located up to six feet from the display terminal. The keyboards feature n key rollover to ensure that simultaneous depression of more than one key does not cause loss of data. All alphameric keys, cursor move keys, and the ENTER key repeat automatically when depressed. The cursor left and right move keys cause the cursor to move two spaces at a time.

For all keyboards, a numeric lock option is provided that prevents entry of alpha data except certain punctuation marks and DUP. Should an operator attempt to enter data from other than the keys outlined while in a numeric field, the input will not be allowed. The means of overriding this function and the procedure to be followed when an error is made are outlined in Section 3.

3. SYSTEM OPERATION

The PTS 3274 Emulator exchanges data with the host via a strict control procedure. The data exchange is controlled by the central system. Section 6 of this specification provides the details of this line discipline as used by the PTS 3274 Emulator.

Through using an established line discipline, the PTS 3274 Emulator is selected by the central system. Information may then be exchanged. Included within the information interchanged are commands and orders that control the amount of data to be read, written, or copied in any data exchange. The commands and orders contain the description of what is to be done with the information and what positions (within the display screen) are to be affected. These commands and orders are described in Section 5.

This section describes the basic operation of the display through the use of attribute characters for field formatting. Also described in this section are keyboard operations, printer operations, and indicator lamp functions.

NOTE

Readers are advised to familiarize themselves with System Network Architecture nomenclature (Section 7). It is referenced in this and following sections.

3.1 Display Operations

Data received from the central system is stored in the processing system memory for each associated terminal. This data is presented to the operator in the form of alphanumeric 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 960-character unit is displayed on a screen composed of 12 horizontal rows of 80 characters each. The image on a 1920-character unit is displayed on a screen composed of 24 rows of 80 characters each.

3.1.1 Unformatted and Formatted Display Images

There is a fixed relationship between each display buffer storage location and its location on the display screen. Buffer locations begin at location 0 (the first character in the upper left position of the screen) and end at 959, or 1919 (the last character in the lower right position of the screen).

Characters in the buffer may be attribute or alphanumeric. Attribute characters define a field as alphanumeric or numeric, protected or unprotected, high or low intensity, or blank, etc. (i.e., they show how to treat the alphanumeric characters that follow).

When a display contains one or more attribute characters, it is broken into fields and called formatted. If no attribute characters are present, the display consists of no fields and is unformatted.

Attribute characters are present in the display buffer but are not displayed to the operator. They do, however, take up screen locations.

3.1.2 Attribute Characters

As shown in Table 3-1, attribute characters define the following characteristics of a field.

- -- Protected (operator cannot alter contents) or unprotected (operator can modify contents)
- -- Alphanumeric (can enter any character) or numeric (see subsection 3.2)
- -- Type of display (normal, high, or blanked)
- -- Tab stop positions (first position of unprotected fields)

-- Selector pen-detectable (i.e., detectable with a CURSOR SELECT

Attribute characters cannot be modified by keyboard operation.

Table 3-1. Attribute Character Bit Definition (from/to central system)

X	X	U/P	A/N	DISPLAY		RSVD	MDT
0	1	2	3	4	5	6	7

Bit	Field Description
0-1	See ASCII/EBCDIC bits 0 and 1
2	0 = unprotected 1 = protected
3	0 = alphameric 1 = numeric
4-5	00 = normal/not selector pen detectable 01 = normal/selector pen detectable 10 = high/selector pen detectable 11 = no display/no print/not detectable
6	reserved - must be 0
7	modified data tag: 0 = not modified 1 = modified by operator program

3.2 Keyboard Operations

3.2.1 Cursor

The cursor symbol indicates where the next character entered from the keyboard will be stored subject to the attributes of the field in which the cursor is located. For example, when the cursor is displayed in a character position, that character can be changed or deleted by keyboard action. However, when the cursor appears in a protected character position, that position cannot be changed by keyboard action.

Only one cursor is displayed on the screen. The cursor is not present in the IDENT mode. Upon initialization, the cursor is automatically generated and displayed in the first character position of the screen. The cursor can be repositioned by the keyboard operator and also by program. The cursor movement is not affected by field attributes (i.e., it is displayed even when positioned in a non-display field or when the lock keyboard function is in effect). The block cursor is offered as a standard feature. An underline cursor is provided at no additional cost.

Entry of an alphanumeric character from the keyboard occurs at the current cursor location if the cursor is in an alphanumeric character location within an unprotected data field. Entry into a protected field or an attribute location is inhibited. Upon entry of a character, the cursor will advance to the next character location within an unprotected field. If the character being entered is the last character of an unprotected field, the cursor will be repositioned according to the attribute character of the next field.

If the next field is alphanumeric and either unprotected or protected, or numeric and unprotected, the cursor will be located at the first character location on that field. If the field is numeric and unprotected, the PTS 3274 Emulator will provide for an automatic upshift for the data entry keyboard or downshifts (typewriter keyboard) the keyboard to permit numeric entries. (See also subsection 3.2.19.)

If the next field is numeric and protected, the cursor is positioned at the first character location of the next field that is not numeric and protected.

3.2.2 Cursor Control Keys

A group of six keys control cursor movement: ↑ (up), ↓ (down), → (right) ← (left), ALT and BACKSPACE. Depressing the ALT key and cursor left or right moves the cursor at double speed. The backspace key performs the same functions as the cursor left key.

The cursor may be moved into any character location including unprotected and protected alphanumeric locations and attribute character locations.

These six keys cause horizontal or vertical wraparound where appropriate. The up and down functions involve vertical movement in the same character position within a line. The right and left functions involve horizontal movement and, if appropriate, vertical movement to the next or previous line.

3.2.3 Field-oriented Cursor Keys

There are three field-oriented cursor control keys: →| (tab), |← (backtab), and ↵ (new line).

→| (tab) moves the cursor to the first location of the next unprotected field. If no unprotected fields exist, the cursor is positioned at the first character position of the first line.

|← (backtab) moves the cursor to the first attribute +1 location of the previous unprotected field if the current location of the cursor is a protected field. If the current position of the cursor is beyond the first position of an unprotected field but not beyond the end of an unprotected field, the cursor is moved to the first position of that field. If no unprotected fields exist, the cursor is positioned at the first character position of the first line.

↵ (new line) moves the cursor to the first unprotected location of the next line. If unprotected fields do not exist, the cursor is positioned at the first character position of the first line. If no fields (protected or unprotected) exist, the cursor is moved to the first position of the next line.

HOME moves the cursor to the first unprotected location of the display. The ALT key must be depressed to perform the home function.

3.2.4 ERASE to End of Field

If the cursor is in a character position of an unprotected field, this key clears to nulls all locations starting with the cursor location and ending with the last character location in that field. The MDT bit of the attribute controlling the field is set to 1, indicating that the field has been modified. Bottom to top wraparound may occur. The cursor remains stationary.

If the cursor is located in an attribute character position or is within a protected data field, no character locations are cleared, the cursor is not moved, and the keyboard is disabled. The keyboard must be reenabled by depressing the RESET key.

If the screen is unformatted, it will be cleared from the cursor location to the end of the screen.

3.2.5 ERASE INPUT

Depressing the key clears all unprotected character locations to nulls and repositions the cursor at the first unprotected character location on the screen. The MDT bit of the attribute controlling the field is reset to 0.

If no unprotected fields exist, no locations are cleared and the cursor is repositioned at the first character position of the first line.

If no fields exist, all locations are cleared to nulls and the cursor is repositioned at the first character position of the first line.

The ALT key must be depressed to perform the ERASE INPUT function.

3.2.6 INSert MODE Key

This key placed the keyboard in an insert mode of operations and illuminates the INSERT MODE lamp on the indicator panel.

If the cursor is located in an unprotected data field with a null character in the cursor location or a null character in any location in the field beyond the cursor, operation of an alphanumeric key causes that character to be entered at the cursor position. The character formerly in the cursor position and all remaining characters in the field (except for null characters and characters to the right of null characters) are shifted one position to the right. If the character at the cursor location at the time of the insert is a null, the character is entered there and no shifting occurs.

After all null characters at or beyond the cursor position in the field have been overwritten, or if there are no null characters originally, any attempt to insert causes the keyboard to be disabled. The insert operation does not affect attribute characters.

Line-to-line wraparound within a field may occur. The RESET key returns the keyboard to normal mode and extinguishes the INSERT MODE lamp. Also, the ENTER key or any key that initiates communication with the central system will return the keyboard to the normal mode.

3.2.7 DELete Key

If the cursor is positioned in an alphanumeric character in an unprotected field, this key causes deletion of the character at the cursor position and sets the MDT bit to 1. The cursor remains stationary, and all remaining characters in the unprotected field to the right of the cursor and on the same line will be shifted one character location to the left. Vacated positions at the end of a field or line will be filled with nulls. Characters within the same field but on a different line than the cursor will not be changed.

3.2.8 RESET Key

This key is used to recover from a keyboard operation that has disabled the keyboard. This key will also take the keyboard out of the insert mode and will turn off the INSERT MODE lamp on the indicator panel. The RESET key is not

honored if the TRANSMIT/RECEIVE lamp is illuminated on the indicator panel. When the keyboard is disabled, no other operations will be honored except for the DEVICE CANCEL key during certain print operations. The RESET key is also inoperative on device zero or on SDLC system address 02 during initialization of the Print Authorization Matrix by the Interactive Configurator (subsection 4.3, "Loading the Matrix").

3.2.9 DUPlicate Key

This key causes a unique character code to be entered into the display area and a tab operation to be performed automatically. This character code signals to the central computer that a duplicate operation is to be performed for the remainder of the field in which the duplicate character is located. The duplicate character is displayed as a $\overline{*}$ and printed as a * character.

3.2.10 FIELD MARK Key

This key causes a unique character code to be entered into the display area. This character code signals to the central computer the end of a field in an unformatted field or the end of a subfield in a formatted field. The field mark character is displayed as a $\overline{;}$ and printed as a * character.

3.2.11 Program Attention Keys

These keys solicit program action by causing the PTS 3274 Emulator to send a message to the central system (see Table 5-1 for AID codes and resulting action). An identification character is included in the message to identify the key that was pressed. The program attention keys are: ENTER, CLEAR, all program function (PF) keys, and the special program attention (PA) keys.

Operation of the CLEAR key causes the entire display area to be cleared to nulls and positions the cursor to the first character of the first line.

Any program attention key disables the keyboard and illuminates the INPUT INHIBITED indicator. The RESET key will clear the condition if it is depressed before the message is sent.

Upon completion of a keyboard entry, depressing ENTER or one of the program attention keys causes the emulator to initiate communication with the host.

3.2.12 CURSOR SELECT Key

This key performs the function of the Selector Light Pen, excepting the following restrictions need not be observed.

-- the cursor-select field does not require space or null character padding

-- within a selection field a cursor select can occur on a different line from the attribute that describes the field

If a selection occurs on a non-cursor-select field, the alarm will sound but the keyboard remains active.

Selection may be immediate or deferred. Deferred selection operates on selection fields. Immediate selection operates on attention fields.

1. Deferred Selection

   Deferred selection is used to select items in selection fields. A selection field is indicated by a question mark (?). Upon successful selection, the question mark symbol is changed to a greater than (>) symbol.

   If the operator determines that the selection is in error, the operator may depress this key again. The '>' reverts to a '?'.

2. Immediate Selection

Immediate selection selects from attention fields, and is required to notify the host application program of previous selections. There are two types of immediate selection, each defined by a different designator character.

a. Designator character defined by space or null

A successful selection causes an AID code, hex 7E to be sent to the program. The program may then issue a Read Modified command to obtain the address of each field that was selected.

b. Designator character defined by an ampersand (&)

Used when cursor selection is accompanied by keyboard input. Successful selection causes an AID code, hex 7D, to be sent to the program. A poll or a Read Modified command will return the address and data of each selected field to the program.

Use of the CURSOR SELECT key in any session except LU-LU causes the keyboard to lock and the INPUT INHIBIT LED to light.

3.2.13 ALTernate Key

This key selects the key functions identified on the front face of dual function keys.

3.2.14 TEST Key

This key (operable when the ALT key is depressed) allows a test of the memory buffer space that the display is attached to. If no errors are encountered, a spiral pattern is displayed. If an error is encountered, the spiral stops and a ⌀ symbol appears near the memory location in error. If the display is in an LU-LU session, an LUSTAT of hex '082B0000' is sent to the host.

3.2.15 MONO/DUAL Key

This key (used on typewriter keyboards only) allows the operator to change from uppercase/lowercase alpha characters to uppercase only. Depressing the key again returns the keyboard to uppercase/lowercase. Data already in the display buffer does not change.

3.2.16 PRINT Key

This key causes a local print of a display buffer. The printer selected to perform the local print is determined by a Print Authorization Matrix or the Default Matrix.

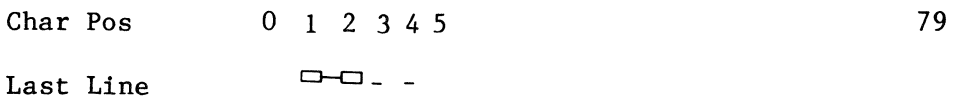
3.2.17 DEVICE CANCEL Key

This key cancels a pending print request if the printer or class of printers is busy (performing a local print or performing a host print request), or if a printer has malfunctioned, after which the keyboard is restored. The DEVICE CANCEL key is operational only when the ALT key is depressed.

This key also cancels a printer ID assignment operation. The cursor reappears. The previous printer assignment is not altered.

3.2.18 IDENT Key

The IDENT key is used to assign a printer or printer class to perform a local copy function. (The ALT key must be pressed to activate the IDENT key.) When the IDENT key is depressed, the cursor will disappear from the screen, the last line will be blanked and a message will be displayed in the first six character positions of the last line. (No data will be lost.) The message has the following format:



The operator now keys in the class (70-85) or the printer number desired. These characters will replace the underscores. If the user depresses any third character, the new printer ID will be saved, the cursor will reappear, and the screen will resume its original format.

When any third character is depressed, the validity of the new class or number is checked. If the specified print ID is not authorized by the matrix, the INPUT INHIBIT LED lights, the audible alarm sounds, and one of the following messages is displayed on the last line.

Char Pos	0	1	2	3	4	5	79
Last Line		0	U	n	n		

Displayed if the entered number is outside the range of the numbers allowed by the system type

⊏⊏ nn

Displayed if the entered number is for a device configured as a display

⊏ Xnn

Displayed if the entered number is unassigned

After RESET, the IDENT function must be restarted because the preceding attempt was unsuccessful.

3.2.19 ALPHA and NUMERIC Keys (data entry keyboards only)

ALPHA Key

If ALPHA is pressed, the keyboard is downshifted and keycodes will be accepted as lowercase.

NUMERIC Key

If NUMERIC is pressed, an upshift is performed and keycodes will be accepted as uppercase.

NUMERIC LOCK Key

This key fixes an upshift character selection, similar in function to the LOCK key on a typewriter keyboard.

Use of the Special Numeric Lock Feature

The keys above are used with the Special Numeric Lock feature in the following manner.

If the Numeric Lock feature is not installed:

a. The cursor in alphanumeric field will accept keyboard data as presented, i.e., normally lowercase unless NUMERIC is pressed.

b. The cursor in the numeric field will cause the emulator to assume the keyboard is upshifted. Therefore, all key codes will be interpreted as their uppercase equivalent. Pressing ALPHA will cause downshift and override this feature.

If the Special Numeric Lock feature is installed:

a. The cursor in an alphanumeric field is treated as in a. above.

b. The cursor in the numeric field will accept only the uppercase or lowercase codes for the uppercase characters 0 through 9, period (.), hyphen (-), and DUP (as indicated in the keyboard illustrations) and will interpret these as the proper uppercase equivalents. If ALPHA is pressed, all key codes will be accepted as lowercase. If NUMERIC

is pressed, other uppercase characters may be entered. If neither ALPHA nor NUMERIC is pressed, entry of any other character is treated as an error, the INPUT INHIBITED indicator is illuminated, and no data is moved to the buffer. The RESET key must be depressed to continue operation.

3.2.20 SHIFT and LOCK Keys (typewriter keyboards only)

SHIFT Key

The SHIFT key causes an upshift to be performed, with keycodes accepted as uppercase.

LOCK Key

The LOCK key fixes an upshift.

Use of the Special Numeric Lock Feature

Without the installation of the Special Numeric Lock feature, if the cursor is in a numeric field, the keyboard will function as a normal typewriter to permit numeric entries.

With the installation of the Special Numeric Lock feature, if the cursor is in a numeric field, only the characters 0 through 9, period (.), hyphen (-), and DUP will be accepted. No override is allowed. Entry of other characters will result in an operator error.

3.2.21 Disabled Keyboard

A keyboard is disabled when INPUT INHIBIT is on (refer to "INPUT INHIBIT" in this section). RESET will restore the keyboard and turn off the INPUT INHIBIT LED.

3.2.22 SYSTEM REQUEST Key

This key is used to switch ownership of an LU from LU-LU to SSCP-LU and vice versa. It also initiates a keyboard RESET and CLEAR function (without generating a message), despite INPUT INHIBIT. Exceptions are:

1. LU is in the Send-Xmit state

2. When the Device Busy or Printer Not Working symbols are displayed

3.2.23 ATTENTION Key

This key is used to get the host's attention. It is operative in an LU-LU session, except when the following conditions occur:

1. The LU is in the Send-Xmit state

2. When in shutdown

3. When in the Data Traffic Reset state

4. When a second attention occurs prior to the completion of the first attention. Use of the ATTENTION key will cause an IDENT operation to terminate. In any other session, it will cause the keyboard to lock and the INPUT INHIBIT LED to light.

3.3 Indicators

3.3.1 INSert MODE

This indicator is turned on by the keyboard INS MODE key to show that the keyboard is in insert mode. It is turned off by the keyboard RESET key. The indicator will be turned off by any I/O operation.

3.3.2 INPUT INHIBITED

This indicator is turned on by:

a. Any program attention key (see subsection 3.2.11 "Program Attention Keys") except ENTER, during an SSCP-SLU session

b. Attempting to enter alphanumeric characters into a numeric field or vice versa

c. An unsuccessful IDENT operation

d. Any operator keyboard error

e. Any operator attempt to modify protected data

f. A command in process that results in an I/O operation for the device to which the keyboard is attached

g. A print request not honored because of Device Busy, Device Very Busy, Printer Not Working, or Printer Failure ("Printer Status Line")

h. A local print request from the host

i. Depressing the TEST key

j. Depressing the ATTENTION key in any session but LU-LU

k. Depressing the SYS REQ key when in the Reset State (see "Data Traffic Reset/Active")

It is turned off by:

a. Operation of the keyboard RESET key. The RESET key operation is not honored under the following conditions:

   ° XMIT/RECEIVE LED is on or the LU is in the Receive State and the WCC with the keyboard reset bit on has not been received.

   ° A magnetic card read operation is in progress.

   ° The key lock is in the "off" position.

b. Receipt and execution of an Erase All Unprotected command

c. Receipt and execution of a Write Control Character (WCC) with the keyboard reset bit on.

d. Operation of the keyboard DEVICE CANCEL key before a print request is honored.

3.3.3 SYSTEM AVAILABLE

This indicator shows that the host application is in session with an end user device (LU-LU Session).

3.3.4 DATA SET READY

This indicator shows that the data set (modem) has power on and is receiving carrier.

3.3.5 POWER ON

This indicator shows that power to the display is on.

3.3.6 TRANSMIT/RECEIVE

This indicator is on when the emulator is in the process of transmitting or receiving a message for that particular display.

3.3.7 IDENT

This indicator is on when the keyboard IDENT key is depressed. The indicator is turned off by the completion of an IDENT operation or depression of the RESET key.

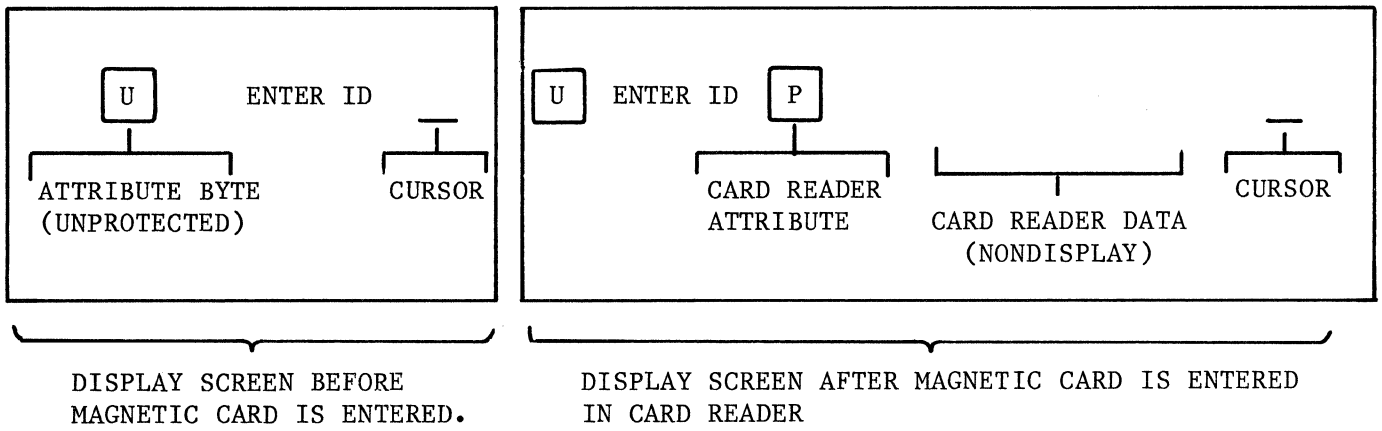
3.4 Magnetic Stripe Reader

The Magnetic Stripe Reader reads one of two information tracks on a magnetic tape embedded in a plastic credit card conforming to ANSI specifications. The operator places the card in a slot and manually passes the card through the slot. The magnetic stripe reader reads and verifies (compares an LRC character from the magnetic tape with an accumulated LRC) the data. The data on a magnetic stripe commences with a Start of Record (ASCII 23), followed by data, followed by an End of Record (ASCII 22), followed by an LRC character. The Start of Record character is replaced by an attribute character which is entered into the cursor-identified location of the display buffer providing the cursor is located at an unprotected character.

This attribute defines the data field that follows as protected, alphanumeric, nondisplay/nonprint. Data entered into the display buffer is stored in successive locations starting at the first location after the attribute character. The cursor advances one location as each character is entered. The data is not visible to the operator since it is defined as nondisplay/nonprint. The display buffer may be formatted or unformatted.

Example: A formatted display screen before a magnetic card is entered.

If the card reader is set up as an unprotected field containing instruction information, the 3274 data stream is as follows:



AID	SET TO INDICATE CARD READER INPUT
CURSOR ADDRESS	ADDRESS OF THE CURSOR UPON COMPLETION OF THE OPERATION
SBA	
START OF DATA ADDRESS	ADDRESS OF THE UNPROTECTED (U) ATTRIBUTE +1
DATA	ENTER ID (OR ANY INSTRUCTION INFORMATION) IN THE EXAMPLE ABOVE
SBA	
START OF DATA ADDRESS	ADDRESS OF THE PROTECTED ATTRIBUTE +1. IN THIS CASE, THE ADDRESS OF THE FIRST DATA CHARACTER FROM THE CARD READER FOLLOWING THE ATTRIBUTE BYTE.
DATA	THE CARD READER DATA (AND ANY DATA BETWEEN CURSOR AND NEXT ATTRIBUTE CHARACTER).

The location(s) of card reader data and instruction information are determined by the Read data stream (refer to subsection 5.1.1.2, "READ MODIFIED").

The keyboard is disabled during operation of the magnetic stripe reader. The magnetic stripe reader is physically and electrically connected to the keyboard and data from the reader is considered to be keyboard data. The magnetic stripe data format (track 1) conforms to International Air Travel Association and (track 2) conforms to American Banking Association specifications.

3.5 Printout Operations

Printout operations are specified by either of the following:

-- The host sends a Write Control Character (WCC) addressed to a printer.

-- The host sends a Write Control Character (WCC) with the start print bit on addressed to a display.

-- An operator requests a local printout.

Both actions result in the transfer of the entire contents of the designated buffer to a printer controller memory. The validity of data transfers is checked by the user of LRC characters before the data is printed. The data in the printer controller memory is retained and may be reprinted by depressing a key located on the printer controller.

Printout operations are specified by the Write Control Character (WCC) from the central system addressed to a printer.

The print line format in which the data is to be printed from the buffer is specified as part of the WCC. The format defines the print line as one of three lengths: 40, 64, or 80 character positions per line. If a format is not specified, the print line length is assumed to be 132 columns. Two printer orders, New Line (NL) and End of Message (EM) are sent by the central system and honored by the PTS 3274 Emulator if no printout format is specified.

NL and EM printer orders are transferred as part of the data stream from the central system. They are stored in the buffers as data and are executed only when encountered in a print field of unspecified length during a printout.

The NL order causes a new line function on the printer. If no NL is encountered before the printer reaches the end of the specified line or the platen, and if the line length is unspecified, an NL is automatically performed. An EM order causes the print operation to be terminated, even if additional data appears following. The user application program must ensure proper location of NL orders in the printer line if a format is not specified. All printers (both character and line) perform a new line function automatically when a full 132-character print line is received.

NL and EM are not displayed. They are not honored within a print field using line length format control and are printed as spaces.

If NL or EM is encountered in a nondisplay/nonprint field and line length is specified, they are not executed and are printed as spaces.

When Carriage Return (CR) is encountered in printable data, the next print position will be the left-most character position of the present line. CR will be ignored in nonprint fields if the line length was specified in the WCC. The CR will be printed as a space.

If Form Feed (FF) is detected as the first character of the buffer, the printer will index to a predetermined print line on the next form. The number of lines skipped is a function of the printer controller or the printer. An FF in any other position (other than the first character of the buffer) will be printed as a space.

If a print line contains space characters only, a new line function is performed to cause a blank line in the printout. When null, attribute, or alphanumeric characters are encountered in a nonprint field, they are treated as follows:

1. Printed as spaces is embedded in a print line

2. They are ignored if they constitute an entire line. A blank line does not appear in the printout and data is compressed vertically one space.

3.5.1 Printout Duration

Printout begins at location 0 of the print buffer and continues until the last location in the buffer is printed or until a valid EM character is encountered. At the end of the printout, a final new line function is performed to prepare the printer for the next printout.

3.5.2 Parity Feature Model 3472 Printer

If a parity error or errors occur during printout, the character(s) @ will be printed in place of the character(s) with bad parity. Following that printout, an additional line will be printed containing the character @ in the first position. This line flags an error in the printout.

3.5.3 SNA Character String (SCS) Control Codes

These SCS EBCDIC control codes provide printed page format control.

Code	EBCDIC	Name
BS	16	BACK SPACE
BEL	2F	BELL FUNCTION
CR	0D	CARRIAGE RETURN
ENP	14	ENABLE PRESENTATION
FF	0C	FORM FEED
HT	05	HORIZONTAL TAB
INP	24	INHIBIT PRESENTATION
IRS	1E	INTERCHANGE-RECORD SEPARATOR
LF	25	LINE FEED
NL	15	NEW LINE
SHF	2BC1	SET HORIZONTAL FORMAT
SVF	2BC2	SET VERTICAL FORMAT
TRN	35	TRANSPARENT
VCS	04	VERTICAL CHANNEL SELECT
VT	0B	VERTICAL TAB

The SVF sequence is:

'SVF' (cnt) (MPL) (TM) (BM) (TI)...(Tn)

MPL defines the page depth. All values betwen 0 and 127 are valid. The page depth as defined by the SVF takes precedence over the device default value.

TM specifies the line value used as the top representation line on the page. The top margin is also the first vertical tab stop on a page. Valid TMS are equal to or less than MPL. The default TM value is one.

BM specifies the line value that, if exceeded, causes an automatic skip to a new page. BM must be greater than or equal to TM and less than or equal to the MPL. The default BM value is the MPL value.

Vertical Channel Select (VCS) -- is a device control code that allows selection of one of 12 vertical channels to control vertical format. The first character of the code is the Select code, followed by a function value which selects the appropriate channel. When necessary, printers default the VCS code to an LF function. The printers skip to the channel, as specified by VCS.

Vertical Tab (VT) -- is a format control that moves the print position vertically down to the next vertical tab stop setting. Vertical tab stops are set by using the Set Vertical Format (SVF) function. If there are no vertical tab stops below the current print position, the vertical tab function results in an LF function.

Set Horizontal Format (SHF) -- is a data-defining control used to set the horizontal format controls. These include left and right margins and horizontal tab stops. A one-byte binary count follows the SHF code and indicates the number of bytes to the end of the SHF string, including the count byte. The first two bytes following the count byte define the maximum presentation position (MPP) and the left margin (LM). Tab stop settings follow the right margin position. All values are expressed as one-byte binary numbers.

The minimum SHF sequence is one byte in length, which sets the horizontal format controls to their default conditions. The SHF sequence is:

'SHF' (cnt) (MPP) (LM) (T1) (T2)....(Tn)

MPP is used to define a line length less than or equal to the platen length. The MPP default value is the platen length.

LM specifies the column value of the left-most print position. The LM also serves as the first horizontal tab stop. Valid LM values are less than or equal to the MPP. The LM default value is one.

T1...Tn are horizotal tab stop settings. Tab stops need not be in order. Valid tab stop values are equal to or less than MPP.

Set Vertical Format (SVF) -- sets vertical format controls, including the maximum presentation line (MLP), top margin (TM), bottom margin (BM), and vertical tab stops. A one-byte count field follows the SVF character to indicate the number of bytes, including the count byte, in the SVF string.

The first three values following the count in an SVF string are the maximum presentation line, the top margin, and the bottom margin, in that order. A zero for any of these values results in that function assuming the default value is one. Vertical tab stop values follow the bottom margin. All values are expressed as one-byte binary numbers.

The SCS control codes are defined as follows:

Back Space (BS) -- is a format control that moves the print position horizontally one position to the left. If the print position is at column 1, the function is inoperative. Left margin settings are ignored.

Carriage Return (CR) -- is a format control that moves the print position horizontally to the left margin on the same line. If the print position is already at the left margin, the function is inoperative.

Enable Presentation (ENP) -- is a formatting control character used to enable the printing of keyboard input data on the presentation space. This code performs no function on the LU type 1 device, but it is accepted without error response and without affecting format.

Form Feed (FF) -- is a format control that moves the print position to the top and left margin of the next form. If the maximum presentation line (MPL) value has not been set and there is no default value, the MPL defaults to one, and the print position moves to the left margin of the next line.

Horizontal Tab (HT) -- is a format control that moves the print position horizontally to the next tab stop setting. Horizontal tab stop values are set by using the Set Horizontal Format (SHF) function. If there are no horizontal tab stops set to the right of the current print position, the horizontal tab function results in a space.

PROGRAMMING NOTE

Horizontal tab placed after the MPP will cause a space in the first print position on the next line.

Inhibit Presentation (INP) -- is a format control character used to inhibit the printing of keyboard input data. This code performs no function on the LU type 1 device (SNA printer), but is accepted without error response and without affecting format.

Interrecord Separator (IRS) -- is a separator character, normally used on the SLU-SSCP session. If received on an LU-LU session, the IRS defaults to a New Line (NL) function.

Line Feed (LF) -- is a format control that moves the print position vertically down to the next line.

New Line (New Line) -- is a format control that moves the print position to the left margin and vertically down to the next line on which NL is functionally equivalent to CR followed by LF.

4. PRINTER AUTHORIZATION MATRIX

A Printer Authorization Matrix is always used by the 3274 to perform local copy operations; that is, to direct data from a display to a printer attached to the same control unit. The Print Authorization Matrix allows each installation to define classes of print devices to authorize their use by entry from displays to select printers for local copy operations.

4.1 Print Class Structure

The Printer Authorization Matrix provides the ability to define print classes. The definition of a class of printers is made by the customer and may be based on physical characteristics, location, security of the printer, or on those authorized to use it.

The Printer Authorization Matrix allows a maximum of 16 classes defined in each subsystem. In any configuration, a single printer may be in one of several classes or not in a class at all.

Printers may be in one of three modes as specified by the Printer Authorization Matrix: Local, System, or Shared.

4.1.1 Local Mode

A printer in the local mode may only be used for local copy and direct print operations from the host are not allowed.

A local copy operation, host or operator-initiated, involves the transfer of data from the display buffer to the printer buffer and the subsequent printing of that data. Local copy is initiated by an operator using the print key or by the host setting the Start Print Bit in WCC of a Write Command to the source display initiating the copy operation. A Bind Request to an LU Type 1 or 3 is rejected with a negative response (X'0801') when the printer is in Local Mode.

4.1.2 System Mode

A printer in system mode is entirely under host control. The printer cannot be used for operator-initiated local copy or host-initiated local copy (the Start Print Bit on in the WCC to a display).

4.1.3 Shared Mode

In Shared mode, the host-directed and local printing operations are accomplished on the same printer. When in System mode, the printer is protected from local copy and vice versa. In Shared mode, the system does not guarantee this type of integrity.

A printer in the Shared mode on the 3274 may be used for local copy when not in session with the PLU. The 3274 printer with the "between bracket printer sharing" option enabled may be used for local copy when the printer is not in brackets with the PLU.

4.2 Matrix Structure

The Printer Authorization Matrix consists of a number of Printer Device descriptions which have the following format:

Destination Address Mode Class Source Device List

Destination Address is the device address of the printer. Addresses 02 to 32 for the 3274 are valid.

Mode defines the printer as Local, System, or Shared.

The class field provides the ability to group printers into classes. This field is bit-coded, one bit for each 16 classes, so that a single printer may be in more than one class. Valid classes are designated 70 through 85, inclusive.

Source Device Address is a bit-coded field that specifies which displays are authorized to use the printer with this destination address. Each bit position is associated with the system address of the display.

Consider the following example:

Port Number	0	1	2	3	4	5	6	7	8	9
Terminal	D	D	P	D	D	D	0	0	0	D

with the following matrix:

			Source Device List									
Address	Mode	Class	0	1	2	3	4	5	6	7	8	9
02	LC		1	1	X	0	0	0	X	X	X	0
06	LC	71	0	0	X	1	1	1	X	X	X	0
07	SC	71	0	0	X	1	1	1	X	X	X	0
08	SY		0	0	X	0	0	0	X	X	X	0

In this example, the displays on Ports 0 and 1 can only print to the printer on Port 2. This printer is not addressable by class. The displays on Ports 3, 4, and 5 are authorized to print on either printer 6 or 7. If selected by address, the addressed printer is logically connected to the display for local copy operations. If selected by class, the entire class of printers is logically connected to the display for a local copy operation. In the class environment, printers are selected on a first available basis, providing the printer is authorized to communicate with the display. The display on Port 9 is not authorized to do a local copy operation. The printer on Port 8 can only do system prints. The printer on Port 7 can do either local copy or system prints since it is in the Shared mode.

A printer may belong to one or more classes, and several printers may belong to a single class. Note that source devices are associated with destination devices, not with classes. Thus, several printers may be defined to a

class, but a particular display may only be authorized for some or all printers in that class. When class identification is displayed on the last line of the display, copying is performed only to authorized printers in that class.

4.3 Loading the Matrix

The Print Authorization Matrix is used to perform a local copy operation. If the matrix is not loaded on the 3274 Emulator, the default condition for the cluster is that all printers are in System mode and local copy operations cannot be performed.

There are two methods of establishing the matrix:

-- With the use of the Interactive Configurator. The matrix is set up when configuring the system, written onto the emulator program load tape, and loaded when the program is loaded.

-- Through a transaction with the host application program, as follows:

1. The operator at the display with the lowest system address (ADDRESS X'02') initiates a transaction with the host program that is responsible for setting up, managing, and loading the Print Authorization matrix. This transaction may define a new matrix, redefine an existing matrix, or retrieve a previously defined matrix from storage.

2. The program then transmits the matrix data to the display in a data stream that resides in the display buffer as normal character/data.

3. The operator depresses the ALT key and the ERASE to End of Field key on the keyboard. This causes the buffer to be scanned for correctness and be stored in internal form in memory.

During the loading process, the INPUT INHIBIT indicator is on and the keyboard is locked. If the load is successful, the INPUT INHIBIT indicator is turned off and the keyboard is restored. The operator can then return to normal activity. Local printing can take place according to the authorization established in the matrix. If the load process is unsuccessful, the audible alarm sounds, the keyboard remains locked, and the status is displayed. Depressing the RESET key unlocks the keyboard and allows the operator to resume operation. Only those device descriptors that have been loaded take effect. It is the host program responsibility to ensure that correct matrix data is loaded. If invalid data is loaded, unexpected results may occur when the matrix is used. When the load process is complete, configuration data cannot be retrieved from the control unit for presentation back to the operator.

When the operator initiates the load operation from the keyboard, the Print Authorization Matrix must appear as follows:

1. The first two lines of the display are reserved for displaying descriptive information to the display operator. These positions are not scanned during the load process.

2. There must be a sequential string of attribute characters beginning at the first position of the third row as follows:

	Hex		
EBCDIC	ASCII	Graphic	Definition
60	2D	--	Protected
C1	41	A	Unprotected, MDT = 1
D4	4D	M	Unprotected, Numeric, CURSOR SELECT Detectable
60	2D	--	Protected

This four-byte sequence uniquely identifies the buffer data that follows as printer authorization data. If the sequence does not appear exactly as shown, the load process does not occur.

3. The remaining rows of the display contain the destination device descriptor. One descriptor is contained in each row. The descriptor format is as follows:

Column 1	Columns 2,3	Column 4	Columns 5-20	Columns 21-52
Protected Attribute One Byte	Address of Printer Two Bytes	Printer Mode One Byte	Print Class 16-Bytes	Source Device List -- 32-Bytes

The protected attribute defines the next 51 bytes as a destination device descriptor. If it does not appear in the first column of the row, a format violation occurs and the loading process is terminated at this point.

The two bytes immediately following the attribute provide the character codes decimal address of the printer being described. For example, the printer is identified by the character data '03', EBCDIC X'F0F3'. Addresses are validated at the time the matrix is loaded to ensure that addresses are within the range of the number of devices configured on the control unit. If an invalid device is specified, the keyboard remains locked, the audible alarm sounds, and the status is displayed.

Print mode is expressed as follows:

Mode	Hex EBCDIC	Hex ASCII	Graphic
Local	C3	4C	L
System	E2	53	S
Shared	D1	4A	J

Any other coding of this byte results in the printer being defined to be in System mode. There is no validation of this byte during loading of the matrix. If there is a conflict between mode definition and coding of the source list, the mode byte takes precedence.

Examples of such conflict are:

-- All columns are not set to zero in the Source Device List field, although the printer is defined as SYSTEM.

-- All columns are set to zero in the Source Device List field. The printer is defined as Local or Shared.

The next 16 characters define the printer classes that are applicable to the device. By coding this field, a device can be defined for multiple classes. Each character in this field is defined to be a character-coded digit, representing one entry in the class field of the device descriptor.

Display Column	Class
5	70
6	71
7	72
8	73
9	74
10	75
11	76
12	77
13	78
14	79
15	80
16	81
17	82
18	83
19	84
20	85

The source device list is a 32-byte field. Source device descriptors define which displays are authorized to local print to this destination device.

Display Column	Source Device Number
21	0
22	1
23	2
24	3
25	4
26	5
27	6
28	7
29	8
30	9
31	10
32	11
33	12
34	13
.	.
.	.
52	31

The character 1, EBCDIC X'F1' in any column of the printer class or source device list defines that printer's class or classes and defines which source devices can be connected to it. Any other value in this location indicates that the class or source device is not connected to it.

4. The end of the matrix is signaled by the following sequence of attribute bytes, beginning in the first column of the row following the last valid destination device descriptor.

EBCDIC	Hex ASCII	Graphic	Definition
60	2D	--	Protected
C5	45	E	Unprotected, MDT = 1, CURSOR SELECT Detectable
D5	4E	N	Unprotected, Numeric, MDT = 1
C4	44	D	Unprotected, CURSOR SELECT Detectable

Scanning the buffer terminates at this point. The configuration data and each device descriptor is stored in the emulator. If an already existing descriptor has been defined for a particular destination device, it is replaced by the one being loaded. There is no reset other than reinitializing the emulator. An existing descriptor, not replaced, is in effect for local copy operation. Only a format violation causes termination of the load processes prior to completion. If the configuration data is not valid, for example, a display is selected as a destination device, a status message is displayed. Validation of the matrix is a host program responsibility.

4.4 Mode Transitions

When a new Print Authorization Matrix is loaded into the control unit, unsatisfied print requests may still be queued. When new device descriptors are loaded into the system, outstanding print requests are satisfied (if possible) based on the new configuration matrix. If print requests cannot be satisfied, they are purged from the queue, the audible alarm sounds, the keyboard is locked, and the following symbol is displayed on the last line.

 nn An invalid matrix was loaded and a source device is attached to a source device.

 nn An invalid matrix was loaded and a source device is attached to a non-existent device.

 ?? A new matrix was loaded and this source device is not allowed to local print.

If a destination device changes from Local to System mode, a bind to the printer LU is allowed and any local copy requests queued for the printer are purged from the queue. When initiated by an operator, the Busy symbol on the requesting display changes to Operator Unauthorized. When initiated by the host a negative response, X'0801' Printer Not Available, is sent to the PLU. Any printing actually in process is completed. If a device changes from System to Local mode, subsequent transmissions to the SLU are responded to with X'0801' Printer Not Available. If the printer is not in session, the transition to Local mode is immediate. When changed from Shared to System mode, the transition is immediate if the printer is in session with a host PLU. If the printer LU is not in session, a session may be found (subsection 7.2.1.5, "Bind") to the printer LU. However, any outstanding print requests are purged from the print queue. When initiated by the operator print key, the Busy symbol is replaced with the Operator Unauthorized symbol. When initiated by the host, X'0801' Printer Not Available, is sent to the host. When changing from Local to Shared mode, and from System to Shared mode, the transition is immediate.

NOTE

For a description of status codes, refer to "SNA Sense Modifier Codes," Section 7.

4.5 Local Copy Operation

A local copy operation can be initiated by depressing the print key on the keyboard or receiving a Write command with the Start Print Bit on in the WCC. The emulator will search the Print Authorization Matrix for the first available printer in a class or the printer number specified. If the printer or all printers in a class are busy, the Device Busy or Device Very Busy symbol will be displayed on the last line. The emulator will continously search the matrix until an available printer is found, at which time the buffer to buffer transfer is accomplished. The Printer Printing symbols will be displayed on the last line. The keyboard is locked, the INPUT INHIBIT indicator is on, and the cursor is not visible until printing is complete. Upon printer completion, the

display returns to its original format, the keyboard is restored, and the cursor reappears. If an error occurs during the printout, the Printer Printing symbol changes to the Printer Has Failed symbol.

4.5.1 Operator-Initiated Copy

With the Printer Authorization Matrix loaded, the operator may initiate a local copy operation by pressing the PRINT key on the display keyboard. The PRINT key is active in a SNA environment under the following conditions:

1. No session has been established (prior to receipt of ACTLU, or after receipt of DACTLU).
2. Session is "Unowned" (see Section 7.1, "SNA Sessions").
3. Session owner is the SSCP, and the keyboard is unlocked.
4. Session owner is the PLU, the keyboard is unlocked, and the SLU is not in Receive state.

4.5.1.1 Host Interference with Operator Copy. Once the display operator initiates a local copy operation, any outbound FM data request is rejected with a Busy indication, X'082D' during the time that the operator request is queued or the buffer is transferred. Once the buffer transfer is complete, the display is free to receive outbound FM data requests. If a negative response is sent because of this condition, a LUSTAT of X'0001D000' is sent at the completion of the buffer transfer to notify the host that the Busy condition no longer exists. FM data may be written into the display buffer as soon as the buffer transfer is complete.

If the host is in LU-LU session with the printer, the local copy operation will not change the size of the printer as set by a Bind parameter.

4.5.2 Host-Initiated Local Copy

The host application program may initiate a local copy function in an SNA environment, by sending to the emulator a Write command with the Start Print

bit in the WCC. The emulator first interprets the WRITE data stream and updates the display buffer. During this time, the INPUT INHIBITED indicator is on. Once the buffer write is complete, the emulator attempts to use the printer(s) assigned to the display. The Source Device connected to Destination Device will be displayed. Once the buffer transfer is complete, Printer Printing replaces Source Device connected to Destination Device. The Printer Printing symbol always shows the specific terminal address of the printer actually doing the print operation.

The keyboard remains locked, regardless of keyboard RESET until the print operation is completed. When the print operation is completed, the keyboard unlocks according to the keyboard Reset in the WCC and the screen returns to its original format.

If a printer is not assigned to the SLU at the time the printer is selected, the control unit responds to the Write Type command with a negative response, (X'0801') "Printer Not Assigned".

On the 3274, if the selected printer or all printers in the selected class are busy because they are "in" session with a host application, the print request is refused. After the write operation is complete, the control unit will negatively respond to the print request with X'0807', Printer Busy.

The message will also be sent to the PLU when a copy request is made, and the selected printer cannot perform the copy because of a feature mismatch between the display device and the printer.

In all the cases above mentioned, once the negative response is sent to the host, the 3274 enters the ERP-1 state.

NOTE

No printer status symbols are displayed in the above condition.

4.6 Printer Status

The operator will be notified of the condition of a print operation in the first six-character positions of the last line. The following is a list and a description of the various status conditions.

FVnn Format Violation Number

FV -- A format violation occurred during the loading of the Print Authorization Matrix. The load process has been terminated, the keyboard is locked, the INPUT INHIBIT indicator is on, and the audible alarm sounds. Only successfully loaded device descriptors take effect.

nn -- This is the number of the device in the device descriptor for which the last successful device was loaded. All devices above the number were loaded successfully and the devices below the number were not loaded. Also, the device number of the format violation is not loaded.

Recovery -- Depressing the RESET key restores the screen and keyboard and turns the INPUT INHIBIT indicator off.

OUnn Operator Unauthorized to Device nn

OU -- Operator Unauthorized because:

1. The operator has requested a local print to a device not currently authorized to communicate with this source device.

2. The operator has requested a local print to a destination device whose buffer is smaller than the source device.

3. During the IDENT operation, the operator has entered invalid digits in the underscore area.

nn -- The number of unauthorized device. When these symbols are displayed, the keyboard is locked, the INPUT INHIBIT indicator is on, and the audible alarm has sounded.

Recovery -- Depressing the RESET key restores the screen and keyboard and turns the INPUT INHIBIT indicator off.

▭—nn Printer Assignment

To find out which printer or class of printers are assigned to a particular source device, the operator holds the ALT key down and depresses the ERASE End of Field key. This should be done only when a matrix is not being loaded. After depressing the keys, either the first class of printers assigned to this source device by the matrix, the last class of printers assigned by a print IDENT, or the device number will be displayed. If the source device is not authorized to do a local print, no numbers will be displayed in "nn"; instead "??" will be displayed.

Recovery -- Depressing the RESET key restores the screen to its original configuration.

▭ ▭ -- Assign Printer

The operator has depressed the print IDENT key with the ALT key depressed. The operator may now enter the new printer number or the printer class desired. The IDENT indicator is turned on.

Recovery -- Depressing the RESET or DEVICE CANCEL key restores the screen to its original configuration and the old printer assignment stays active. Entering two characters over the underscore (02-32 or 70-85) will assign a new printer to this source device. Depressing a third key restores the screen to its original configuration.

 nn Printer Printing on Destination Device nn

A local print has been requested and is being printed on destination device nn. Keyboard is locked, the INPUT INHIBIT indicator is on, and the cursor is not visible. At the completion of printing, the screen is restored to its original configuration.

When displayed on the screen, this display notifies the operator that buffer transfer is complete and printing has started on device nn. All keys are disabled except DEVICE CANCEL which restores the keyboard and screen to its original configuration. If, during the printing, the printer malfunctions, the Printer Has Failed symbol will be displayed.

VBnn Very Busy

If the selected printer or printers in the printer class are busy with a host application; i.e., the selected printer, which is in shared mode, is "in" session, the Device Very Busy symbol is displayed. Recovery requires a DEVICE CANCEL which cancels printing when the key is depressed.

If the request is host-initiated:

1. Once the buffer write previous copy, requested copy, and buffer write is completed, the emulator sends a X'0801', Printer Not Assigned. The 3274 enters the ERP.1 state.

2. The host may choose to continue with other copying. The emulator is taken out of the ERP.1 state by the host. A LUSTAT must be sent when a printer becomes available. It is not repeated.

3. The 3274 will not hold the printer after sending a '0001B000' LUSTAT. The printer is then held until each of those displays has provided a release by one of the following:

   a. Its release when a valid FM data request is received which does not specify start print

   b. Its release because of a Clear request; the session is unbound

   c. The copy is completed after the PLU sends a Write-type command with the Start Print bit turned on in the WCC.

   d. The copy fails and a negative response is returned to the host because:

      - Ownership of the display is changed to other than the PLU
      - Temporary error on a printer or display is detected
      - IR (Intervention Required) conditions on a printer were detected

 nn Printer nn Has Failed

A local print was requested on device nn. During the printout the printer failed and the above symbol is displayed. "nn" specifies the failing printer -- not the print class.

- Operator-initiated requests -- The operator must depress the DEV CNCL key to continue. This action turns off the INPUT INHIBITED light and unlocks the keyboard, but the print request is not queued.

- Host-initiated requests -- The Write command is followed by an X'082E', Intervention Required, or X'082F', Permanent Printer Error. The display LU goes into the ERP.1 state, as defined for Device Very Busy.

Recovery may require operator action, e.g., loading forms.

- Operator-initiated requests -- As before, the operator must depress the DEV CNCL key to continue. The operator may choose an alternate action, or may attempt to print again.

- Host-initiated -- If the Intervention Required condition is cleared, the control unit will generate an LUSTAT X'0001B000' to the PLU "in" session with the display. After receiving the LUSTAT, the PLU may reinitiate the copy request by sending a Write command without data.

NOTE

Any FM data requests will clear a Printer Not Working symbol and will take the SLU out of an ERP.1 state (refer to subsection 7.1.3.5).

 nn Printer Not Working

A local print was requested of device nn or Class nn and that printer or all printers in that class have malfunctioned. The print request is dequeued.

Recovery is the same as for Printer nn Has Failed. If another device is available in the same printer class, the 3274 may generate a Printer Available LUSTAT immediately.

 nn Source Device Assigned to Source Device

When displayed, it indicates that an invalid matrix was loaded and a source device is listed as a destination device in the Print Authorization Matrix.

When displayed, the INPUT INHIBIT indicator is on, the keyboard is locked, and the cursor is not visible. Only the RESET key is active and, if depressed, the screen and keyboard are restored.

 nn Source Device Assigned to a Non-existent Destination Device

When displayed, it indicates that an invalid matrix was loaded or an invalid IDENT operation to a Destination Device that does not exist on this system.

Recovery is the same as for Source Device Assigned to Source Device.

 ?? Source Device Not Authorized to Local Print

When displayed, it indicates that the Print Authorization Matrix has not been loaded or this Source Device is not authorized to print via the matrix.

When displayed, the cursor is not visible, the keyboard is locked, and the INPUT INHIBIT indicator is on. Only the RESET key is active and, if depressed, the screen and keyboard is restored.

 nn Wait

A local print has started and the printer became deselected during the printout. When the printer is reselected, the Printer Printing symbol will be displayed. DEV CNCL will remove the wait status message.

5. COMMANDS AND ORDERS

After the LU to LU session is established, communication between the PTS 3274 Emulator and the central system is under control of the latter using a defined set of commands and orders. A command determines the basic function to be performed by the emulator. An order is used as part of the data stream following a Write command to define further subfunctions of the command.

5.1 Commands

Three basic types of commands are executed by the PTS 3274 Emulator:

-- Write commands are used to transfer data and orders from the central system to remote devices.

-- Read commands transfer buffer data, keyboard data, and status information to the central system.

-- Control commands cause certain printer or display operations.

Chaining of commands refers to a sequence where one command follows another. "Chained from" refers to the previous command issued.

Commands that can be issued by the central system and recognized by the PTS 3274 Emulator are listed below. The hexadecimal character codes used for remote configurations are included.

Command	ASCII	EBCDIC
Write	31	F1
Read Buffer	32	F2
Erase/Write	35	F5
Read Modified	36	F6
Erase All Unprotected	3F	6F
Erase/Write Alternate	3D	7E
Read Modified All	3E	6E

5.1.1 Read Commands

There are three types of read commands: Read Buffer, Read Modified, and Read Modified All. Read Buffer is intended mainly for diagnostic purposes and causes the entire contents of the selected device to be sent to the host. The operation of the Read Modified command depends upon the operator's action and could consist of fields of data modified by the keyboard, data entered by the magnetic stripe reader, buffer addresses, data of selector pen, codes for program function or program attention keys, etc.

Read Modified All is supported and is always sent by the host to a remote device and is not sent by the device in response to a poll sequence.

In remote operations, reading is normally accomplished by a poll sequence, which will initiate one of three operations:

a. Any pending status and sense information is sent to the central system

b. If an operator action has occurred that requires reading by the central system and status and sense information is not pending, an emulator-generated Read Modified is performed.

c. If neither of the above conditions is present, the PTS 3274 Emulator will respond with Receiver Ready Final to terminate the operation.

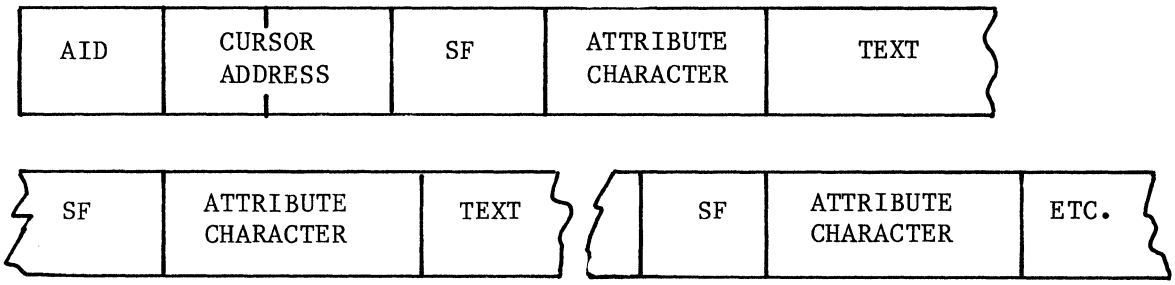
5.1.1.1 Read Buffer. Execution of the Read Buffer command causes all data in the addressed device buffer to be sent to the central system. Transfer of data begins:

a. From buffer address 0 if this command is unchained, or chained from a Copy command

b. From the current buffer address or chained from any other command

Data transfer terminates when the last character in the buffer has been transmitted.

The transferred data stream begins with a three-character Read heading consisting of the attention identification (AID) character, followed by a two-character cursor address. This is followed by the contents of the buffer (including nulls). The emulator inserts a Start Field (SF) order code before each attribute.



5.1.1.2 Read Modified. The Read Modified command initiates one of three operations: Read Modified, Short Read, or Test of System Request Read. Table 5-1 lists the AID characters generated as a result of operator depression of specific function keys.

In remote systems, these actions occur as the result of a poll; therefore, Read Modified is usually not issued by the central system.

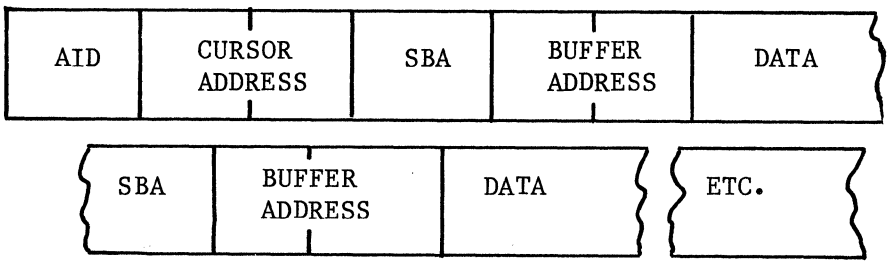
A major feature of the Read Modified (or poll) operations is null suppression. This means that any nulls in the device buffer are not transmitted, thus making line time more efficient.

Read Modified operation. All fields modified by keyboard, cursor select, or the magnetic stripe reader are transmitted to the central system, if an AID other than CURSOR SELECT, CLEAR or a Program Attention key is generated.

Table 5-1. AID Character Assignment

Function Key		EBCDIC	ASCII	Read Operation
ENTER key and Cursor Select Attention		7D	27	Read Modified
PF1 key		F1	31	Read Modified
PF2 key		F2	32	Read Modified
PF3 key		F3	33	Read Modified
PF4 key		F4	34	Read Modified
PF5 key		F5	35	Read Modified
PF6 key		F6	36	Read Modified
PF7 key		F7	37	Read Modified
PF8 key		F8	38	Read Modified
PF9 key		F9	39	Read Modified
PF10 key		7A	3A	Read Modified
PF11 key		7B	23	Read Modified
PF12 key		7C	40	Read Modified
PF13 key	87-Key Typewriter Keyboard Only	C1	41	Read Modified
PF14 key		C2	42	Read Modified
PF15 key		C3	43	Read Modified
PF16 key		C4	44	Read Modified
PF17 key		C5	45	Read Modified
PF18 key		C6	46	Read Modified
PF19 key		C7	47	Read Modified
PF20 key		C8	48	Read Modified
PF21 key		C9	49	Read Modified
PF22 key		4A	5B	Read Modified
PF23 key		4B	2E	Read Modified
PF24 key		4C	3C	Read Modified
Magnetic Stripe Reader		E6	57	Read Modified
Selector Pen Attention		7E	3D	Read Modified
PA1 key		6C	25	Short Read
PA2 (CNCL) key		6E	3E	Short Read AID
PA3 key		6B	2C	Short Read code
CLEAR key		6D	5F	Short Read only

The first three bytes of the read data stream are the same as for the Read Buffer operation (AID and cursor address). Following this is a sequence for each modified data field consisting of a Set Buffer Address (SBA) order, a two-byte buffer address for the first character position in that field (attribute address +1), followed by the alphanumeric data in the field.



The buffer location where the search begins for modified attribute bytes is:

a. Buffer location 0 if the command is unchained, or chained from a Copy command, or is an unformatted display

b. The current address if chained from any other command

The search for attributes ends as follows:

a. If the last modified field is wrapped from the last buffer location (959 or 1919) to the first location, the operation terminates when all data in that field has been transmitted. The buffer address at the end of the operation is the address of the next attribute byte.

b. If the buffer does not contain a wrapped modified field, the data stream is terminated when the last modified field in the buffer is transmitted. The buffer address is set to 0.

c. If the buffer is formatted but no fields have been modified, the data stream consists of the three-byte heading only. The buffer address is set to 0.

d. If the buffer is unformatted, the data stream consists of the three-byte heading, followed by all non-null data in the buffer. Since an unformatted buffer contains no attribute bytes, no SBA codes or buffer addresses are transmitted. Data transfer begins at location 0 and ends at the end of the buffer. Buffer address is set to 0.

Short Read Operation. The Read Modified command causes a Short Read operation if the CLEAR or PA key has been pressed at the selected device. During the Short Read, only an AID byte is sent to the central system. This AID byte identifies the key that was pressed.

The input data portion of the data stream, as well as the buffer start location for attribute search and end location, are the same as for the Read Modified operation, except that no AID or cursor address is transmitted.

Read Modified All operation. The Read Modified All command is supported for SDLC configuration only. The command operates like a Read Modified command except that addresses and data from all modified fields are sent to the central system, regardless of the AID character generated. The Read Modified All command is not sent by the device in response to a poll sequence. It is always sent by the central system.

5.1.2 Write Commands

Three write-type commands, Write, Erase/Write and Erase/Write Alternate are used by the central system to load, format, and selectively erase device buffer data. These commands can also indicate certain device operations such as starting the printer, resetting the keyboard, and sounding the alarm. Write and Erase/Write commands are identical except that Erase/Write causes complete erasure of the selected buffer before the write operation is started.

5.1.2.1 Write. The bytes received by the emulator for a Write command operation consist of a command code, a Write Control Character (WCC), orders, and buffer data as follows:

ESC	COMMAND CODE	WCC	ORDERS AND/OR DATA

The Write command may exclude orders and/or buffer data if necessary. Any operation that does not apply to the addressed device is ignored.

X	X	PRINTOUT FORMAT		START PRINT	SOUND ALARM	KBD RESTORE	RESET ALL MDT
0	1	2	3	4	5	6	7

WCC Bit	Explanation
0,1	See ASCII/EBCDIC bits 0 and 1
2,3	Printout format: 00 NL and EM should be honored 01 40-character print line 10 64-character print line 11 80-character print line
4	If set, initiate printout at completion of operation
5	If set, sound alarm at completion of operation
6	If set, restore keyboard operation and reset the AID byte at the termination of the I/O operation
7	If set, reset all MDT bits in the existing buffer before writing new data

During the Write operation, the buffer address is advanced by one each time a new character is stored. The buffer location where data entry starts depends upon:

a. The starting location specified by a Set Buffer Address (SBA) order that follows a WCC

b. The starting location will be in the buffer address containing the cursor if the Write command is not chained, or is chained from a Control command.

c. The starting location will be the current buffer address if chained from a Read or another Write command.

5.1.2.2 Erase/Write. This command clears the entire buffer to null, repositions the cursor and buffer address to 0, then performs like a Write command. If no WCC is sent, the Erase/Write command will not erase the buffer.

5.1.2.3 Erase/Write Alternate. This command enables application programs written for 1920-character displays and printers to be used without modification of screen or print format for 960-character displays and printers. It is also used to switch from a default to an alternate screen size or print buffer capacity in accordance with a Bind parameter definition (see Table 5-2). If the display or printer is placed in alternate mode (through this command and an X'7F' in byte 24 of the Bind parameter), operation continues in alternate mode until the operator presses CLEAR, SYS REQ, or TEST key; or, until an Erase/Write is received, the LU-LU session is unbound, or power fails at the control unit. Any of the above conditions returns the device to default value size. When in emulation mode (default value?) and the device is not in LU-LU session, the operator may set the device (printer also?) to maximum size by pressing the CLEAR key. (Refer to "Setting Screen Sizes", subsection 7.1.4.2 for changes in screen sizes when changing sessions.)

If the SET BUFFER ADDRESSes exceed buffer size, a negative response (X'1005') is returned.

A device operating as an LU Type 2 or Type 3 requires the Bind format shown in Table 5-2.

Table 5-2. Screen Print Buffer Size Bind Format

Byte	Bit	Contents	Description
20	0-7	X'0C' X'18'	Default number of rows 12 24
21	0-7	X'50'	Default number of columns 80
22	0-7	X'0C' X'18'	Alternate number of rows 12 24
23	0-7	X'50'	Alternate number of columns 80
24	0 1-7 1-7 1-7 1-7	RESERVED b'0000000' b'0000010' b'1111110' b'1111111'	 LU Type 2 Default Screen Size LU Type 3 Maximum Buffer Size LU Type 2 and 3, 24 x 80 LU Type 2 and 3, static size in bytes 20 and 21 LU Type 2 and 3, alternate size in bytes 22 and 23

LU Type 2 Bind parameters:

When bits 1-7 of byte 24 are coded b'0000000' (X'00'), 1920-character devices and 960-character devices are bound as 960-character (12 columns by 80 rows) devices for the session, with a buffer wrap occurring as defined for a 960-character device. When coded b'0000010' (X'02'), a 1920-character device is bound at this size for the entire session.

When coded b'11111101 (X'7E') device capacity is defined in bytes 20 and 21 for the entire session. Bytes 22 and 23 are ignored. Buffer wrap occurs after the row specified in byte 20. No state change occurs.

If b'1111111' (X'7F) is coded in bits 1-7 of byte 24, the alternate size is established when the Erase/Write command is received. Alternate size values are specified in bytes 22 and 23. Buffer wrap occurs after the row specified in byte 22.

LU Type 3 Bind parameters:

The row/column product determines the buffer wrap point.

A b'0000000' (X'00') in bits 1-7 of byte 24 sets the print buffer size to its physical capacity for the entire session.

5.1.3 Control Commands

The Control command Erase All Unprotected initiates control functions (not associated with data transfer) to or from the host.

5.1.3.1 Erase All Unprotected. This command operation performs the following five functions:

a. Sets all unprotected buffer character locations to null (00)

b. Resets the modified bits on all unprotected fields to show "not modified"

c. Unlocks the keyboard

d. Resets the Attention ID byte

e. Sets the cursor to the first unprotected character position in the device buffer

If the entire buffer is protected, the buffer data is not cleared and the modified bits are not reset; however, the keyboard is unlocked, the Attention ID byte is cleared, and the cursor is set to buffer location 0.

5.2 Orders

The orders are included in the data stream sent to a particular terminal and control the format and the data layout. The various orders and their effects are described below.

5.2.1 Start Field (SF - hex 1D)

This byte indicates that the next byte in sequence is an attribute character and should be converted to the particular attribute describing the associated field. These attribute characters are then checked by the emulator during all keyboard and display operations.

During a Read Buffer operation, the emulator inserts a Start Field code into the data message before each attribute character so the central system is able to identify each attribute character.

5.2.2 Set Buffer Address (SBA - hex 11)

This byte indicates that the next two bytes in the stream are the device buffer location:

a. to specify the starting location in the device buffer for a Program Tab (PT), Repeat to Address (RA), or Erase Unprotected to Address (EUA) order

b. to specify the location where an attribute character is to be stored by the SF

c. to specify the location of the cursor for an Insert Cursor (IC) order

If the address is invalid, the remainder of the operation is ignored.

When a Read Modified command is executed and an attribute character is detected with the MDT bit set, an SBA code is inserted in place of the attribute followed by the two-byte buffer address of the old attribue +1. This three-byte sequence is always sent in the same text block.

5.2.3 Insert Cursor (IC - hex 13)

This order positions the cursor to the location specified by the current buffer pointer without changing the current buffer location.

5.2.4 Program Tab (PT - hex EBCDIC 05, ASCII 09)

This order advances the current buffer location to the first character position of the next unprotected field. If the PT character is inserted in a data stream following a data character and the character was not the last character of the field, the following operation occurs:

a. The remainder of the field being written is cleared to null characters (hex 00).

b. The program then searches for the next attribute character defining an unprotected field.

c. The current buffer location is set to the buffer location following the attribute character, and continued data will be stored from that point.

The PT order terminates search at the end of the buffer and sets the current buffer location to 0 (first location) if no unprotected field is found. To continue the search, another PT must be inserted following the first one. If nulls were being inserted when the first order terminated at the end of buffer, the second PT order will continue to insert nulls in the field until

the next attribute character is found. The order then causes a search to the next unprotected field character, and sets the current location counter to this address.

5.2.5 Repeat to Address Order (RA - hex EBCDIC 3C, ASCII 14)

This order performs the following operations:

a. Interprets the next two bytes of the data stream as the ending address

b. Picks up the third byte of the data stream and stores it into all device locations starting at the current buffer location and ending at the location prior to the specified address -- Attributes will be overwritten if they occur before the ending address.

The third character following the RA order is always taken as the character to be repeated. If the specified ending address does not exist, the operation is not performed and error status is generated. If the specified ending address is less than the current buffer location, the character is inserted starting at the current location and wrapping around the screen to the location specified. If the specified ending address equals the current address, the screen is filled with the specified data character.

5.2.6 Erase Unprotected to Address (EUA - hex 12)

This order inserts null characters in all unprotected buffer locations starting at the current buffer location and stopping at the location prior to the specified ending address (the two bytes following the EUA). This follows the same function as the RA order:

a. If the ending address is invalid, the order is ignored, no nulls are inserted, and error status is generated.

b. If the ending address is less than the current buffer location, all unprotected fields (starting at current location and wrapping to the ending location) are set to null.

c. If the specified address equals current cursor location, all unprotected fields are set to null.

6. SYNCHRONOUS DATA LINK CONTROL LINE DISCIPLINE (SDLC)

6.1 Remote Operation SDLC/SNA

The PTS 3274 Emulator is capable of operating in a FID 2 SNA environment. Synchronous Data Line Control (SDLC) is the vehicle used to handle data flow from the host (Primary Logical Unit) to the 3274 (Secondary Logical Unit) Emulator.

6.2 Synchronous Data Link Control

SDLC is a line discipline used for the management of data transferred over a communication channel. Data blocks are referred to as frames and the connection between the host and the 3274 Emulator is referred to as a data link. (See Figure 6-1.) Both NRZ and NRZI transmissions are accepted by the emulator.

6.2.1 Frames and Sequencing

The frame is the vehicle for every command, response and information that is transferred via the data link. All frames contain sequence numbers for line control purposes. A station transmitting sequenced frames counts and numbers each frame. The count is known as the Number sent (Ns). A station receiving sequenced frames counts each error-free frame that it receives. The receive count is known as the Number received (Nr).

The Nr count advances when a frame is checked and found to be error free. Nr then becomes the count of the "next expected" frame and should agree with the next incoming Ns count. If the incoming Ns does not agree with Nr, the frame is out of sequence and the Nr does not advance.

The counting capacity for Nr or Ns is eight, using the digits 0 through 7. These counts can "wraparound;" that is, 7 is sequentially followed by 0.

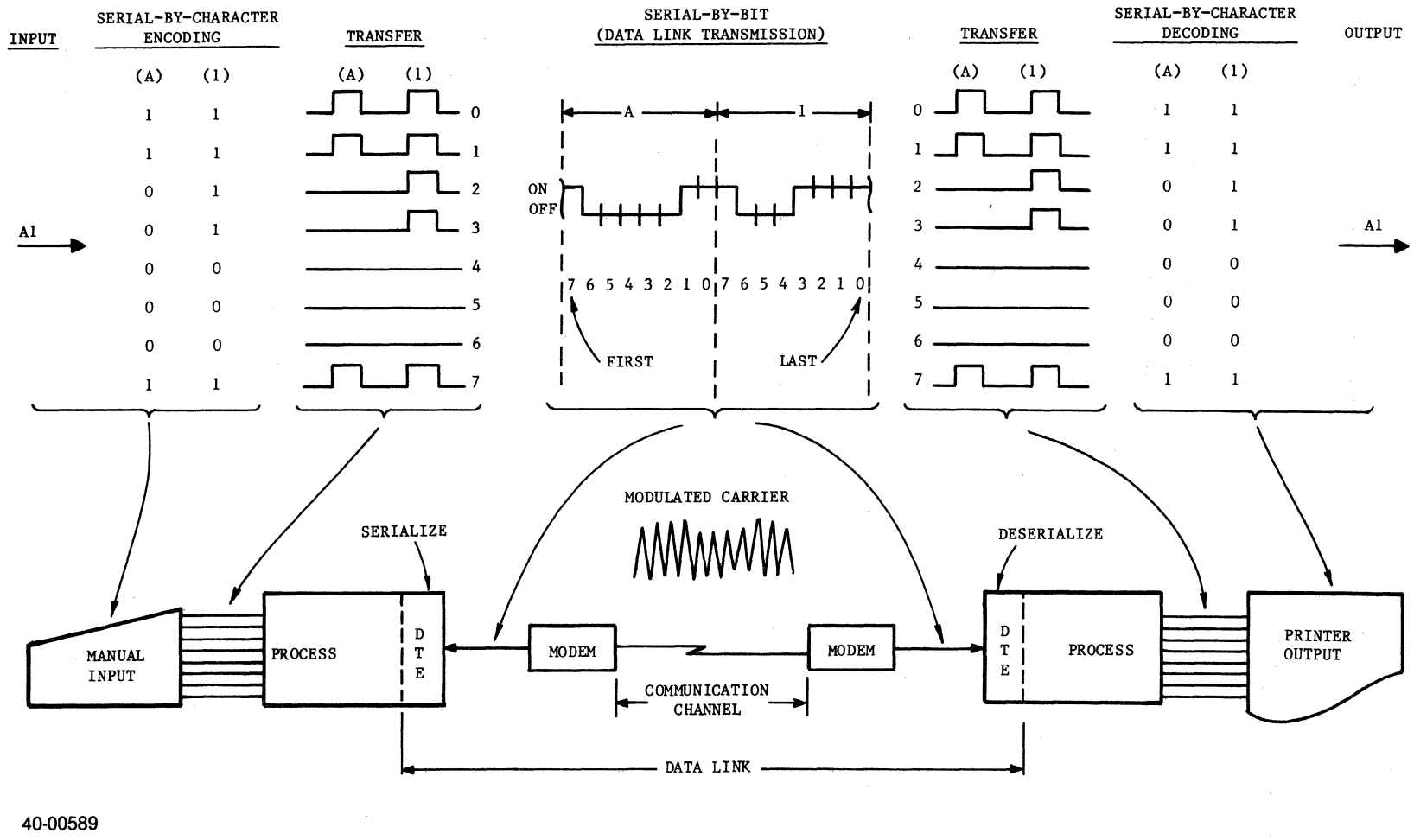
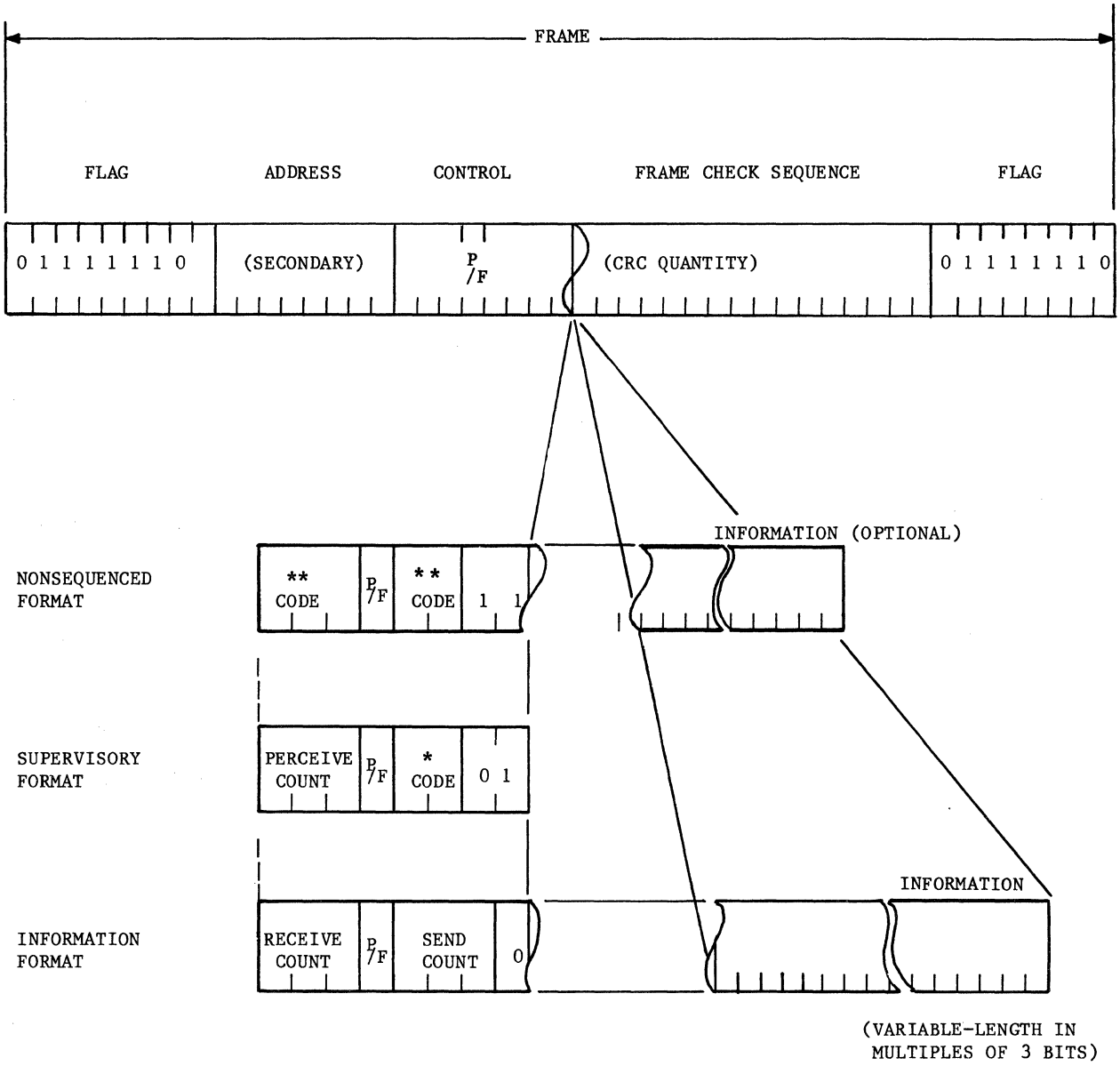


Figure 6-1. Data Link



* CODES FOR SUPERVISORY COMMANDS/RESPONSES
** CODES FOR NONSEQUENCED COMMANDS/RESPONSES

40-00590

Figure 6-2. SDLC Transmission Block (Frame)

Up to seven frames may be sent before the receiver reports its Nr count to the transmitter. All unconfirmed frames must be retained by the transmitter, as it may be necessary to repeat some or all of them.

The Nr and Ns counts of both stations are initialized to 0 at the discretion of the primary station. At other times, the counts advance as sequenced frames are sent and received.

6.2.2 Flag (F) Field

Two flags, the beginning F and the ending F, enclose the SDLC frame. The beginning F serves as a reference for the position of the A (Address) and (C) (Control) fields and initiates transmission error checking. The ending F terminates the check for transmission errors. Both beginning and ending Fs have the binary configuration 01111110. The bit orientation of SDLC allows the F to be recognized at any time.

Any F may be followed by a frame, by another F, or by an idle condition.

SDLC procedures require that only non-F bit patterns follow the first F. (The frame ends at the next F.) The transmitter meets this requirement by inserting a binary 0 after any succession of five contiguous 1s within the frame.

After testing for flag recognition, the receiver removes a 0 that follows a received succession of five continuous 1s. Inserted and removed 0s are not included in the transmission error check. (A 1 that follows five 1s not removed.

6.2.2.1 Address (A) Field. The address field contains the address of the Secondary station in both Command and Response frames. In Command frames (Primary-Station originated) the address identifies the desired Secondary station. In the Response frames (Secondary-Station originated) the address identifies the originating Secondary station.

6.2.2.2 Control (C) Field. The control (C) field contains, within its eight binary digits, the capability for encoding the commands and responses required to control a data link. The C/field consists of the following three formats:

a. Information Transfer Format

A C field in this format is a part of each sequenced frame that is transmitted over a data link. It contains the P/F bit and the Nr and Ns counts.

Stations transmitting sequenced information-transfer frames request confirmation by sending the Ns count; they confirm by sending the Nr count. In duplex information exchange, if the Nr count does not lag more than seven frames, a gap in transmission is necessary only to conclude the information transfer. Retransmission of the unconfirmed frames may be requested in the appropriate supervisory format frame.

b. Supervisory Format

This format is an adjunct to the information transfer format. Frames containing a C field of the supervisory format convey ready or busy conditions and may be used to report sequence errors (thus requesting retransmission). Such frames may be interspersed with frames having a C field of the information transfer format. Whether or not a primary station has information data to transmit, it may use a frame having a C field of the supervisory format to poll a secondary station; a secondary station may use the supervisory format to respond to a request for confirmation. Frames with a supervisory format C field are not counted in the Nr or Ns counts; I (information) fields are prohibited.

c. Nonsequenced Format

Command and response frames having a C field of this format are used for data link management. Data link management includes activating and initializing secondary stations, controlling the response made of secondary stations, and reporting procedural errors (not recoverable by retransmission). Data link management data may also be transmitted in an I field using a frame with a C field of the nonsequenced format. Frames with a non-sequenced format C field are not counted in the Nr or Ns counts.

6.2.2.3 Information (I) Field. The I field contains data that is moved, via the data link, from place to place in the system. The I field is unrestricted in content; its content is transparent (invisible) to the components of data link control. I-field lengths are in a multiple of eight bits. In each eight-bit grouping, the low-order bit is sent first and the high-order bit last. The I-field is not restricted in length. The practical limitation is the maximum transmission length that can be expected to move error-free most of the time, using the particular communications channel.

An information field is normally included with every frame having a C field of the information transfer format. These information transfer frames are the only ones that are sequenced (counted for Nr or Ns counts).

There are provisions for an I field in frames with a nonsequenced format C field, but these are unprotected by sequence checking.

6.2.2.4 Frame Check Sequence (FCS) Field. The frame check sequence (FCS) field (sometimes called BC, for "Block Check") contain 16 binary digits. It follows the I field (if there is one; the C field, if not) and immediately precedes the ending F. These 16 digits result from a mathematical computation on the binary value of all bits (excluding inserted 0s) within the frame. The purpose is to validate transmission accuracy.

The transmitter performs the computation and sends the resulting FCS value. The receiver performs a similar computation and checks its results. The receiver accepts no information from a frame that is found to be in error, and does not advance its Nr count.

The process in which the FCS field functions is known as "cyclic redundancy checking" or CRC. In the SDLC application of CRC, the binary value of the transmission to be checked is divided by the generating polynomial, $X^{16} + X^{12} + X^5 + 1$. Integer quotient digits are ignored and the transmitter sends the complement of the resulting remainder value as the FCS field. The ending F follows the FCS field.

Description of C-Field Parameters

The C-field parameters consist of Ns, Nr, P/F bit codes for supervisory commands/responses and codes for nonsequenced commands/responses.

a. Ns -- Send Sequence Count

The transmitting station sends sequenced counts (Ns) indicating the sequence number associated with that frame. Thus, it is used as the identifier for the transmitted frame. Ns is only used in information frames. Ns is updated (incremented by one) by the transmitting station at the completion of transmitting each information format frame.

b. Nr -- Receive Sequence Count

The receive sequence count (Nr) is a count of the next expected information (I) frame to be received by the station. Therefore, Nr also indicates that the station has correctly received all I frames to Nr-1. At the beginning of data traffic, NR = 0 implies that the station has not received any I frame from the remote station. Upon correctly receiving each valid in-sequence information format frame, the receiving station updates Nr (increments Nr by one).

c. P/F -- Poll/Final Bit

The P/F bit is the send/receive control. A P (poll) bit is sent to a secondary station to require transmission. An F (final) bit is sent by a secondary station, in response to the P bit at the end of its transmission. Normally only one P bit is outstanding (unanswered by a final bit) on a data link.

d. Command/Response Codes

See Figure 6-3 for a summary of the command or response C-Fields and associated codes.

6.2.2.5 Ns (Nonsequenced) Format. A C field in this format (Figure 6-3) has the last two bits on (11). (These are the first C-field bits sent.) Nonsequenced communications are not sequence checked and do not use Nr or Ns; mode-setting nonsequenced commands reset Nr and Ns to 0. Excluding the P/F bit, the other five C-field bits are available for encoding the commands and responses listed as follows:

SNRM -- Set Normal Response Mode (mode-setting command)
DISC -- Disconnect (command)
UA -- Unnumbered Acknowledgment
DM -- Disconnect Mount
FRMR -- Frame Reject (response)
TEST -- Test (command or response)
XID -- Exchange Identification

SNRM (Set Normal Response Mode)

This command subordinates the receiving secondary station to the transmitting primary station. No unsolicited transmissions are allowed from a secondary station that is in normal response mode. UA is the expected response. The primary and secondary station Nr and Ns counts are reset to 0. The secondary

SUMMARY OF COMMAND OR RESPONSE C-FIELDS AND ASSOCIATED CODES

FORMAT	SEND LAST / SEND FIRST BINARY CONFIGURATION	ACRONYM	COMMAND	RESPONSE	I-FIELD PROHIBITED	RESETS Nr AND Ns	CONFIRMS FRAMES THRU Nr-1	DEFINING CHARACTERISTICS
NS	100 P 0011	SNRM	X		X	X		SET NORMAL RESPONSE MODE; TRANSMIT ON COMMAND.
	000 F 1111	ROL		X	X			THIS STATION IS OFFLINE.
	010 P 0011	DISC	X		X			DO NOT TRANSMIT OR RECEIVE INFORMATION.
	011 F 0011	NSA		X	X			ACKNOWLEDGE NS COMMANDS.
	100 F 0111	CMDR		X				NONVALID COMMAND RECEIVED. MUST RECEIVE SNRM, DISC.
	101 P/F 1111	XID	X	X				SYSTEM IDENTIFICATION IN I FIELD.
	111 P/F 0011	TEST	X	X				CHECK PATTERN IN I FIELD
S	Nr P/F 0001	RR	X	X	X		X	READY TO RECEIVE
	Nr P/F 0101	RNR	X	X	X		X	NOT READY TO RECEIVE.
I	Nr P/F Ns 0	I	X	X			X	SEQUENCED I-FRAME.

NS = NONSEQUENCED
S = SUPERVISORY
I = INFORMATION

40-00592

Figure 6-3. Command Response Codes

station remains in normal response mode until it receives a DISC command. Upon receipt of the SNRM, the Link Active symbol (▶) is displayed on the last line of all displays.

DISC (Disconnect)

This command terminates other modes and places the receiving secondary station effectively offline (Normal Disconnected Mode, NDM). The expected response is UA. A disconnected secondary station cannot receive or transmit information frames; it remains disconnected until it receives an SNRM command.

NOTE

Receipt of a SNRM or DISC command by the 3274 Emulator causes an internal Deactivation of the Physical Unit. All logical units are set to the Reset state (refer to "Data Traffic (Reset/Active) State," subsection 7.1.3.1).

UA (Unnumbered Acknowledgment)

This is the affirmative response to an SNRM or DISC command. Further transmissions are at the option of the primary station.

DM (Disconnect Mount)

This response is transmitted by the 3274 Emulator to indicate that it is in NDM. The 3274 Emulator in NDM transmits a DM to any command except TEST, XID, and SNRM.

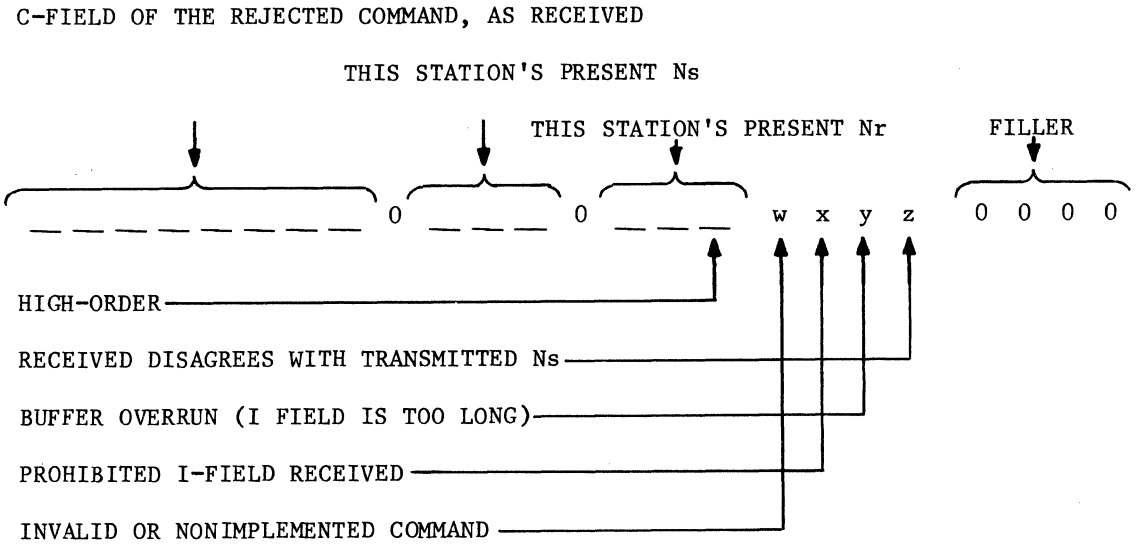
CMDR (Command Reject)

This response is transmitted by a secondary station in NRM (Normal Response Mode) when it receives a nonvalid command. A received command may be nonvalid for several reasons:

1. It is not implemented at the receiving station. This category includes unassigned commands.
2. The I field is too long to fit into the receiving station buffers.
3. The command received does not allow the I field that was also received.

The 3274 Emulator cannot release itself from the CMDR condition, nor does it act upon the command that caused the condition. It repeats CMDR whenever it responds, except to an acceptable mode-setting command: SNRM, DISC.

The 3274 Emulator sends an I field containing status information as part of the CMDR response frame (Figure 6-4). This I field provides the secondary station status data that the primary station needs to select appropriate recovery action. The 3274 Emulator in any mode solicits a TEST response. If an I field is included in the command, it is returned in the response.



NOTES

1. BIT w MUST BE A 1, IF BIT x IS A 1.
2. BIT y IS MUTUALLY EXCLUSIVE WITH BIT w. THE USE OF BIT y IS OPTIONAL DEPENDING UPON THE SYSTEM PLAN.
3. BIT z IS MUTUALLY EXCLUSIVE WITH BIT w.

40-00591

Figure 6-4. Information Field of the FRMR Response, as Transmitted

XID (Exchange Station Identification)

XID command and response contains additional data beyond the C byte. The 3274 Emulator responds to the XID command in NRM and NDM, except when a CMDR

condition exists, in which case CMDR responses take precedence over XID. The request/response unit (RU) to the XID response consists of 48 bits as follows:

Bits	Meaning
0-3	ID format B'0000'
4-7	PU type B'0010'
8-15	Self Description X'00'
16-27	X'017'
28-47	Reserved X'00'

6.2.2.6 Supervisory Format. The last two bits of a C field in this format (the first two bits sent) are 01. Excluding the four bits for P/F and the Nr count, two bits remain for encoding the commands and responses of the S format. The purpose of the S format is to initiate and control information transfer in the I format. These are the commands and responses:

RR -- Receive Ready (command or response)
RNR -- Receive Not Ready (command or response)

RR (Receive Ready)
Sent by either a primary or secondary station, RR confirms sequenced frames through Nr-1 and indicates that the originating station is ready to receive.

RNR (Receive Not Ready)
Sent by either a primary or secondary station, RNR indicates a temporarily busy condition in which no frames requiring buffer space can be accepted.

As a command or response, RNR confirms sequenced frames through NR-1 and indicates that frame Nr is expected next.

If the 3274 Emulator has received an RNR, an I frame will not be transmitted until an RR or I frame is received with the P bit on.

NOTE

Receipt of any Ns frames does not indicate the RNR condition has been cleared.

6.2.2.7 Information Format. Only frames with an I-format C field are sequenced. The Nr and Ns counts provide for numbering the frame being sent and the frame expected to be received next. When duplex information exchange is in a continual process, each station reports its Nr and Ns counts to the other continually. Confirmation must be requested if the maximum count of outstanding unconfirmed frames (seven) is reached. Retransmission, as required, is requested by an appropriate Supervisory format frame.

On half-duplex data lines, also, the I-format frame is the main information transfer vehicle. Frames are sequenced and polls and responses are in either the Supervisory or Information format.

A half-duplex primary station concludes the transmission of sequenced Information frames with a frame that has the P (poll) bit on. A half-duplex secondary station concludes with a frame that has the F (final) bit on. The expected acknowledgment is a Supervisory or Information format frame whose Nr count confirms correctly received frames (or, conversely, indicates which frames should be retransmitted). (Frames of the Supervisory format may be interspersed with Information format frames, as needed.)

6.2.3 Information Field

An information field is required when message text is transmitted in either direction between the primary and the secondary stations. The Information Field consists of three internal fields: the Transmission Header (TH), the Request/Response Header (RH), and the Data Field.

The I Field is transmitted to/from the PTS 3274 Emulator in series of eight-bit bytes in the format offered in Figure 6-5.

TH	TRANSMISSION HEADER -- BYTE 0 TRANSMISSION HEADER -- BYTE 5
RH	REQUEST/RESPONSE HEADER -- BYTES 0, 1, AND 2
DATA 256 BYTES (MAXIMUM)	COMMAND BYTE (0) DATA -- BYTE 1 DATA -- BYTE 255

40-00593

Figure 6-5. I-Frame Field Format

6.2.3.1 Transmission Header. A Transmission Header is always included in an I Field. The fields in the Transmission Header include:

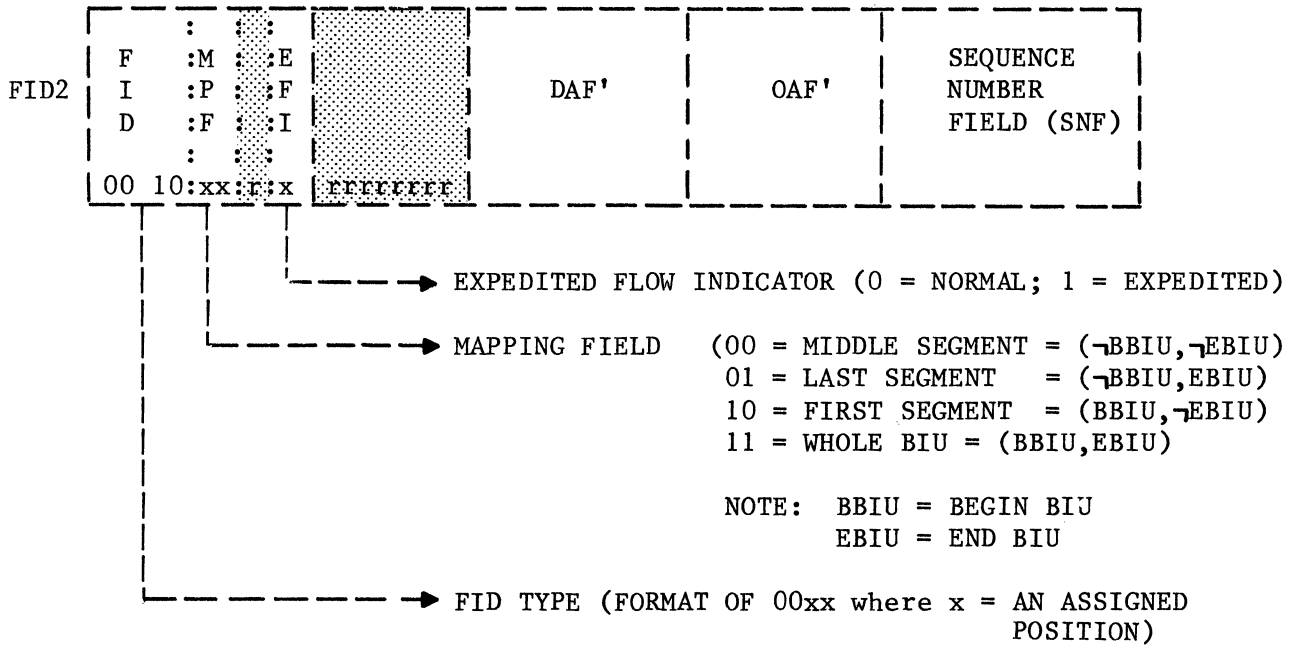
Format Identification Field
Mapping Field
Expedited Flow Indicator
Destination Address Field
Origin Address Field
Sequence Number Field

The first byte of any TH contains the Format Identification Field (FID), the Mapping Field (MFP), and the Expedited Flow Indicator (EFI).

FID is the first field of any TH and indicates the TH format (that is, the presence or absence of the various Transmission Header fields). The FID value is set to b'0010' (type FID2) by the 3274 Emulator.

Transmission Header field formats are shown in Figure 6-6, Transmission Header Format.

The MPF consists of bit 4, the Begin BIU (Basic Information Unit) bit, and bit 5, and End-BIU bit. It denotes whether the information field associated with the TH is a complete or partial BIU, and, if a partial BIU, whether it is the first, middle, or last segment.



40-00594

Figure 6-6. Transmission Header Format

10 -- First Segment of a BLU = (BBIU, ¬EBIU)

00 -- Middle segment of a BIU = (¬BBIU, ¬EBIU)

01 -- Last segment of a BIU = (¬BBIU, EBIU)

11 -- Whole BIU = (BBIU, EBIU)

Bit 6 of the TH is reserved.

The EFI (Expedited Flow Indicator) is bit 7 of the first byte of the TH. It has the following meaning:

1 -- Expedited Flow

0 -- Normal Flow

Byte 1 is a reserved byte.

Byte 2 contains the eight-bit Destination Address Field (DAF). It contains the local address of the device for which the transmission is intended.

Byte 3, Origin Address Field (OAF), is the one-byte local address of the device initiating the transmission.

Bytes 4 and 5 contain the Sequence Number Field (SNF). The SNF is a numerical identity for the associated BIU. Each request that is sent on the normal flow is assigned a sequence number. The sequence number is initialized to zero when the session is established and incremented by one before sending each Request Unit. After reaching 65,535, the sequence number wraps to zero. For expedited flow, SNF is used as a message identifier. The identifier is not managed like a sequence number but it must be unique for each message number sent.

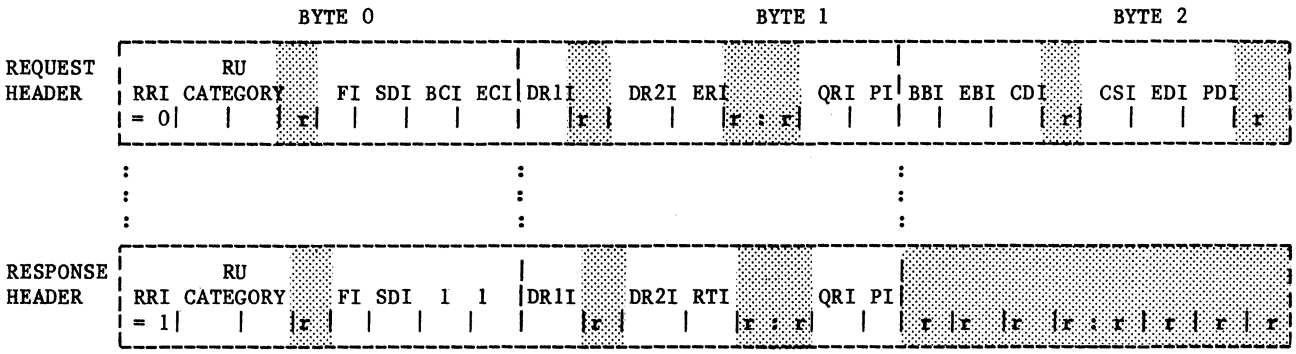
6.2.4 Request/Response Header

The Request/Response Header (RH) (format shown in Figure 6-7) is a three-byte field. It may be a request header or a response header.

The control fields in the Request Header include:

- Request indicator
- RU category
- Format indicator
- Sense Data Included indicator
- Chaining control (two fields)
- Form of Response requested (four fields)
- Pacing
- Bracket control (two fields)
- Change Direction control
- Code Selection indicator

FORMATS



FIELD	DESCRIPTION	EXPLANATION/USAGE
RRI	REQUEST-RESPONSE INDICATOR	0 = REQUEST (RQ); 1 = RESPONSE (RSP)
RU CATEGORY	REQUEST-RESPONSE UNIT CATEGORY	00 = FM DATA (FMD) 01 = NETWORK CONTROL (NC) 10 = DATA FLOW CONTROL (DFC) 11 = SESSION CONTROL (SC)
FI	FORMAT INDICATOR	0 = NO FM HEADER (¬FMH), for LU-LU SESSIONS; OR CHARACTER-CODED WITHOUT AN NS HEADER (¬NSH), FOR NETWORK SERVICES 1 = FM HEADER (FMH) FOLLOWS, FOR LU-LU SESSIONS; OR FIELD FORMATTED WITH AN NS HEADER (NSH), FOR NETWORK SERVICES
SDI	SENSE DATA INCLUDED INDICATOR	0 = NOT INCLUDED (¬SD); 1 = INCLUED (SD)
BCI	BEGIN CHAIN INDICATOR	0 = NOT FIRST IN CHAIN (¬BC); 1 = FIRST IN CHAIN (BC)
ECI	END CHAIN INDICATOR	0 = NOT LAST IN CHAIN (¬EC); 1 = LAST IN CHAIN (EC)
DR1I	DEFINITE RESPONSE 1 INDICATOR	0 = -DR1; 1 = DR1
DR2I	DEFINITE RESPONSE 2 INDICATOR	0 = -DR2; 1 = DR2
ERI	EXCEPTION RESPONSE INDICATOR	USED IN CONJUNCTION WITH DR1I AND DR2I TO INDICATE, IN A REQUEST, THE FORM OF RESPONSE REQUESTED: DR1I, DR2I, ERI = 000 MEANS NO-RESPONSE REQUESTED = 100|010|110 MEANS DEFINITE-RESPONSE REQUESTED = 101|011|111 MEANS EXCEPTION-RESPONSE REQUESTED (001 IS RESERVED)
RTI	RESPONSE TYPE INDICATOR	0 = POSITIVE (+); 1 = NEGATIVE (-)
PI	PACING INDICATOR	0 = ¬PAC; 1 = PAC
BBI	BEGIN BRACKET INDICATOR	0 = ¬BB; 1 = BB
EBI	END BRACKET INDICATOR	0 = ¬EB; 1 = EB
CDI	CHANGE DIRECTION INDICATOR	0 = DO NOT CHANGE DIRECTION (¬CD); 1 1 = CHANGE DIRECTION (CD)
CSI	CODE SELECTION INDICATOR	0 = CODE 0; 1 = CODE 1

|r| RESERVED

Figure 6-7. Request/Response Header Format

40-00595

The control fields in the Response Header include:

Response indicator
RU category
Format indicator
Sense Data Included indicator
Chaining control
Response type
Pacing

RH control fields (Figure 6-7) are described below:

Request/Response Indicator (RRI)

Denotes whether this is a request or a response.

RU Category

Denotes that the BIU belongs to one of four categories corresponding to the four principal function interpreters in each half session: Session Control (SC), Network Control (NC), Data Flow Control (DFC), or Function Management Data (FMD).

Format Indicator

Indicates which of two (denoted Format 1 and Format 0) is used by the associated RU (but not including the sense data field, if any).

For SC, NC, and DFC RUs, this indicator is always set to Format 1.

For SSCP-PU and SSCP-LU sessions, Format 1 indicates a network services request FMD RU that is field formatted (with various encodings, such as binary data or bit-significant data, in the individual fields). Format 0 indicates that the request RU is character coded. The Format indicator on the response has the same value as on the corresponding request.

In an LU-LU session, the meaning of the format indicator on both requests and responses is implementation-dependent.

A request that asks for an exception response or a definite response has one or both of the DR1 and DR2 bits set on (three combinations); a response to a request returns the same (DR1, DR2) bit combination.

The setting of the DR1, DR2, and ERI bits varies by RU category (SC, NC, DFC, FMD).

In the case of (LU, LU) sessions, a BIND parameter specifies the form(s) of response to be requested during the session. The specific meanings of the DR1 and DR2 bits (and distinctions among the three settings) are implementation dependent.

The (DR1, DR2, ERI) = (0, 0, 1) combination is reserved.

Response Type

In a response header, two basic response types can be indicated: positive response or negative response. For negative response, the RH is always immediately followed by four bytes of sense data in the RU.

There are three kinds of positive and negative responses corresponding to the three valid (DR1, DR2, and ERI) combinations allowed on requests. The settings of the DR1 and DR2 bits in a response must equal the settings of the DR1 and DR2 bits of the form-of-response-requested field of the corresponding request header.

Pacing

In a Request Header, the Pacing Request indicator denotes that the ending Connection Point Manager can accept a Pacing Response indicator.

The Pacing Response indicator in a response header is used to indicate to the receiving Connection Point Manager that additional requests may be sent on

the normal flow. The Pacing Response indicator may be on in a RH that is attached to a response RU, or, if desired, a separate or isolated response header may be used to which no RU is attached. A response RU is not required at the same time that a Pacing Response is required. This latter RH signals only the pacing response. It is called an ISOLATED PACING RESPONSE. Isolated and non-isolated pacing responses are functionally equivalent.

Bracket Control

Used to indicate the beginning or end of a group of exchanged requests and responses called a bracket.

Change Direction Control (CDI)

Used when there is half-duplex (HDX) control of the normal flows within a session (not to be confused with link-level HDX protocols). It permits sending half session to direct the receiving half session to send. The HDX protocol is useful to half sessions with limited input/output capabilities that cannot simulataneously send and receive user data.

Code Selector Indicator (CSI)

CSI specifies the encoding used for the associated FMD RU. When a session is activated, the half sessions can choose to allow use of the two codes in their FMD RUs (for example, EBCDIC and ASCII), which they designate as Code 0 and Code 1. FM headers and request and response codes are not affected by the Code Selection indicator. The 3274 Emulator supports only one code per Physical Unit (selectable at configuration).

For SC, NC and DFC RUs, this bit is reserved.

Data Field

The data field consists of commands and user-provided data which are transmitted between the 3274 Emulator and the host system.

The command byte contains the command sent/received by the PTS for execution. Commands consist of SNA commands and 3274 compatible commands. 3274 compatible

commands are discussed in more detail in Section 5 of this specification. SNA commands are discussed in Section 7.

SDLC Secondary Station Modes

The primary station (IBM Communication Controller) may command one of three modes at the linked secondary station: normal response mode, normal disconnected mode, or initialized mode. Procedures for initialization mode are specified by the using system. Normal response mode and normal disconnected mode are governed by the SDLC procedures and are described here.

Normal Response Mode (NRM)

A PTS in NRM does not initiate any unsolicited transmissions. It transmits only in response to a poll (a frame received from the primary station, with the P bit on in the C field). The PTS responds to the P bit with an F bit in the C field (of the last frame in half duplex). The primary station normally will not issue another P bit to any secondary station until it receives the F bit.

Normal Disconnected Mode (NDM)

The PTS is in NDM when it is off line. In this mode, the PTS honors only a test or mode setting command from the primary station. Other valid commands with the P bit on cause a disconnected PTS to respond with a request for on line status or initialization (DM); commands without a P bit are ignored.

A PTS 3274 that receives and accepts a DISC (Disconnect) command assumes NDM. It also assumes NDM at these times:

1. When power is turned on, or when the station is enabled for data link operation

2. Following a transient disabling condition (such as a power failure)

3. When a switched connection is made (always)

4. Detection of a segmenting error (see Data Link Errors)

6.2.5 Data Link Errors

The following error recovery/procedures are taken by the PTS upon detection of data link errors. The 3274 Emulator will:

1. Discard the frame if one of the following conditions exist.

    - CRC error detected
    - Sequenced frame is out of sequence (i.e., the Ns received from the primary does not agree with the Nr at the 3274)
    - The ending F is not displaced from the beginning F by a multiple of eight bits
    - Frame is less than 32 bits long
    - Segmenting error detected -- The 3274 will go to Normal Disconnect Mode (NDM) and internally Deactivate the Physical Unit (DACTPU).

2. Upon receipt of a non-valid command, do the following:

    - If in Normal Disconnect Mode (NDM), discard the frame and respond with a Disconnect Mount (DM).
    - If a Normal Response Mode (NRM), respond with a Command Reject (CDDR).

A command is non-valid if the following conditions exist:

- Command is non-valid (C field)
- Command is not implemented on the 3274
- The command does not allow the I Field that was also required

7. SNA OPERATION

7.1 SNA Sessions

Systems Network Architecture (SNA) refers to a set of protocols and commands for routing data through a communications network, and for establishing connections, called sessions, and accessing priorities between components or nodes of the network. For the Raytheon PTS 3274 Remote Emulator, the nodes are:

-- A host application program, termed the "Primary Logical Unit" (PLU)

-- Systems Services Control Point (SSCP), also termed "Access Method", which controls the entire communications network

-- The Physical Unit (PU), also referred to as the emulator control unit

-- The Secondary Logical Unit (SLU), which is part of the emulator and represents an end user at a device. The emulator can have 1-32 SLUs (addresses 02-33).

Interface between SNA and SDLC

Synchronous Data Link Control (SDLC) (described in Section 6) refers to a set of protocols, commands, and formats for controlling and safeguarding the physical transmission of data across a data link. SNA commands are implemented in the SDLC frame format.

7.1.1 Host Application Program -- To 3274 Emulator

Within SNA, the host program and the PTS 3274 communicate using half-duplex, flop-flop, send-receive protocols between Logical Units (LUs). When the host program is transmitting data, it assumes the role of the sending Logical Unit (LU). The LU to which the transmission is directed is the receiving LU. An

LU is the logical entity that communicates on behalf of an end user (such as a terminal or host application program). The term "Profile" refers to a set of session rules and parameters that govern the activity in a particular session.

7.1.2 SNA Session Activation Sequence

The sessions that must exist between the host system and the 3274 Emulator to exchange information are as follows:

-- SSCP-PU
-- Unowned Session
-- SSCP-SLU
-- PLU-SLU (LU-LU)

The following topics discuss the sessions individually and identify how they are established and terminated. The SNA commands that establish and terminate the sessions are identified. A detailed discussion of these is found in "Session Control Commands."

7.1.2.1 SSCP-PU Session (Reset Session). The SSCP is connected to the emulator control unit in this session. No keyboard data can be transmitted during this session. The SYSTEM AVAILABLE LED will be off. The SLU is said to be in RESET. To activate other sessions, this session must be active.

Activating the SSCP-PU

A request from the network operator will cause the SSCP to send an Activate Physical Unit (ACTPU) command to the emulator, which sends a positive response if the session parameters are acceptable. This session may also be activated, without intervention from the network operator, by a predefined start procedure within the SSCP. In either case, activating this session terminates all other sessions that are currently active.

Before activating this session, the data link to the emulator must first be established. Once the link is active (PU Receiving RR), the Link Active symbol (▶) is displayed on the last line of the screen.

Terminating the SSCP-PU Session

Upon request by the network operator, the SSCP sends a Deactivate Physical Unit (DACTPU) to the emulator. All other sessions that are currently active are also terminated.

7.1.2.2 Unowned Session. The Unowned session is said to establish SSCP-SLU session eligibility. During the Unowned session, the Unowned symbol (?) is displayed on the last screen line, next to the Link Active symbol. The SLU is in the Receive State (i.e., may not transmit requests). The screen size is set to that of the previous session owner.

NOTE

A session owner is the network node that is connected to an SLU and is said to "own" the session with the SLU, or simply, to "own" the SLU. An unowned SLU may not transmit data requests (refer to "Receive (RCV) state" in this section). In a SSCP-SLU session, the "owner" is the SSCP, while the PLU is the session "owner" when the session is LU-LU. When a session is "owned", the Unowned symbol is cleared from the display.

Activating the Unowned Session

A request may be issued by the network operator to activate this session. The SSCP will send an Activate Logical Unit (ACTLU) for the desired SLU(s).

Terminating the Unowned Session

At the request of the network operator, the SSCP will issue a Deactivate Logical Unit (DACTLU) for the SLU(s) to be terminated. The SSCP-SLU session is also terminated when eligibility viz a viz the Unowned session is terminated.

7.1.2.3 SSCP-SLU Session. This session is eligible for activation once the Unowned session has been activated. When active, this session allows the display operator to logon to a host application (refer to "Activating the LU-LU Session", subsection 7.3.1). The System Operator symbol is displayed (X).

Activating SSCP-SLU Session Ownership

The SSCP-SLU session is activated by changing ownership to the SSCP-SLU. There are two methods of implementing:

1. Upon request from the SSCP. This changes an Unowned session to an SSCP-SLU session. The SLU Receive state is changed to Contention state (refer to "SSCP-SLU Contention Operation" in this section). The screen is cleared and set to the maximum physical size.

2. The operator presses the SYSTEM REQUEST key. This changes an Unowned session to the SSCP-SLU session and the Receive state to Contention state. The screen is cleared and set to the maximum physical size.

The above methods are also used to switch ownership from an LU-LU session to an SSCP-SLU session. The LU-LU session does not terminate, as long as it is bound (see Bind, this section).

Terminating SSCP-SLU Session Ownership

The SYS REQ key, when depressed again, transfers ownership from the SSCP-SLU back to the LU-LU if it is still bound. Otherwise, SSCP-SLU ownership is transferred to the Unowned session. SSCP-SLU session eligibility is not terminated.

7.1.2.4 LU-LU Session. The LU-LU session allows the SLU to transmit data request units to a host application program (PLU).

The LU-LU session types are:

Type 1 -- The principal device attached to the 3274 SLU is a printer, and the data stream is in the SNA Character String (SCS). The subsidiary device is a display.

Type 2 -- The device attached to the 3274 SLU is a keyboard/display and the data stream is in the 3274 data stream capability (DSC) mode format. The subsidiary device is a printer.

Type 3 -- The device attached to the 3274 SLU is a printer, and the data stream is in the 3274 DSC mode format. The subsidiary device is a printer.

The SNA Bind command is used to differentiate between these types of sessions.

Activating the LU-LU Session

The command flow sequence required to establish a session is summarized in Figure 7-1. The command flow nomenclature is generalized. The example assumes that no sessions are active between the host and the 3274. The access method sends the ACTPU command to establish the SSCP-PU session (1). ACTLU commands (2) are then sent to establish SSCP-LU sessions. The network is now ready for LU-LU sessions to be established.

The LU-LU session may be initiated by the host application program or by the display terminal operator (3) (a character-coded logon). If a character-coded logon is received by the access method, the SSCP translates the logon request and schedules a logon exit (4) for the PLU. After the PLU receives control at the logon exit, or when the PLU acquires a terminal, the PLU passes an open session request to the access method (5) which results in an SNA Bind (6) being passed to the SLU. The LU examines the session parameters of the Bind and, if they are acceptable, allows the session to be established by sending a positive response (7) to the Bind command. If the session parameters are not acceptable, the 3274 LU rejects the Bind command by returning a negative response, indicating that the session parameters are invalid (sense code X'0821').

With the Bind command, session ownership is transferred from the SSCP-SLU session or from the Unowned session to the LU-LU session.

After the Bind command has been accepted with a positive response, the host program can issue the Start Data Traffic command to allow FM data to flow for the session.

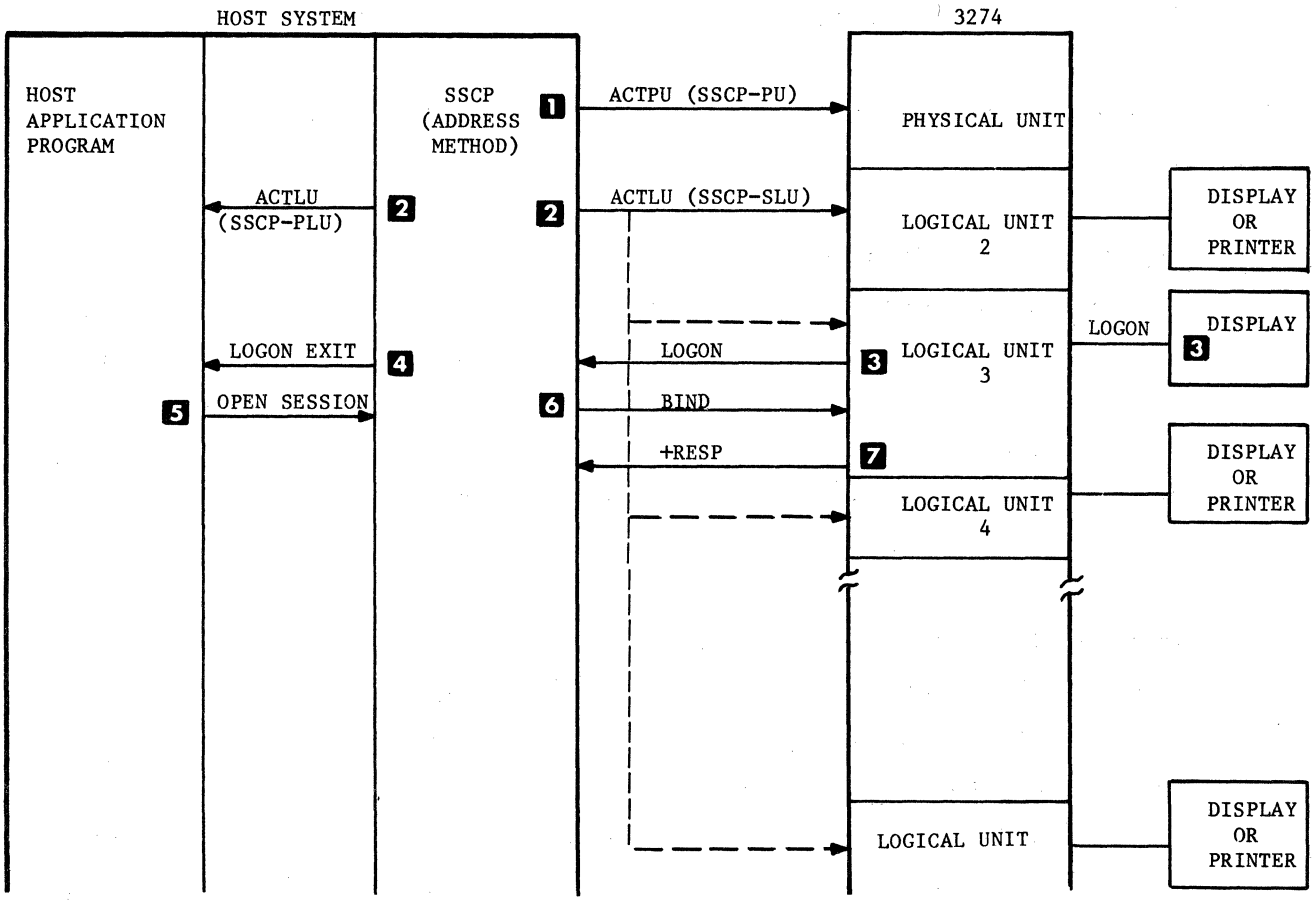


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Figure 7-1. Establishing a Session with a 3274

The manner in which an LU-LU session may be initiated depends on the type of session being started. A Type 1 or Type 3 session must be initialized by the PLU. A Type 2 session may be initiated by either the PLU or SLU.

Switching LU-LU Session Ownership

During an LU-LU session, the operator may change ownership of the SLU by depressing the SYS REQ key. This transfers ownership to the SSCP-SLU. Another depression of this key transfers ownership back to the LU-LU session as long as it remains bound. If unbound, it transfers to the Unowned session.

Terminating the LU-LU Session

The PLU can terminate the LU-LU session by requesting that the SSCP close the session. The SSCP then sends the Unbind command to the secondary LU and the LU-LU session is terminated.

Type 2 sessions can also be terminated by the display operator in one of two ways. The first method is to notify the PLU (where supported) on the LU-LU session that termination is desired; the PLU then terminates the session. In the second method, the display operator changes from an LU-LU session to an SSCP-SLU session, by use of the System Request key (SYS REQ), and enters a logoff message. The SSCP to SLU symbol is displayed on the last line of the display. The SSCP then passes the logoff request to the PLU if the logoff message is conditional, or issues the unbind for the PLU if the logoff message is unconditional.

A PLU may close the session in an orderly fashion by issuing a Shutdown command When the host program issues the Shutdown command, the 3274 Emulator returns the Shutdown Complete command after completing any outstanding operation and entering the Between Bracket state. The PLU must close a Bracket with End Bracket before the Shutdown command is effective.

7.1.3 SNA Session Processing States

The 3274 Emulator controls the processing of SNA commands, responses, and user data transmissions with a set of LU-LU session states. Some of these states are defined by SNA and others are unique 3274 definitions that cause SNA state transitions.

This section describes the processing states used by the emulator. When several states relate to a common processing function such as bracket or chain processing, they are described under a common heading. The remaining processing states are described individually.

7.1.3.1 Data Traffic (Reset/Active) State. Data Traffic Reset state is entered when a Bind or Clear command is received from the PLU. For any LU-LU session, the SLU cannot transmit data or commands to the host program. The host can send only session-recovery and session-termination commands.

When in Data Traffic Reset state and a data RU or a command other than SDT or Unbind is received from the host program, the 3274 returns a negative response with sense data indicating that data traffic is inactive (sense code X'2005'). No other state, except Contention, can exist when the SLU is in Data Traffic Reset state.

When Data Traffic Reset state is turned off by SDT, the state is referred to as Data Traffic Active. The 3274 accepts only data RUs for an LU-LU session during Data Traffic Active state.

7.1.3.2 Contention (CONT) State. The Contention state on the LU-LU session exists only between brackets. In this state, the LU resources are not allocated. All associated I/O devices are enabled and the SLU can accept data from either the terminal or the host, whichever occurs first. The first arrival triggers a change to Send or Receive state.

For the SSCP-SLU session, Contention state exists between the successful completion of all chains.

7.1.3.3 Send (SEND) State. The Send state is common to both Contention and HDX FF modes of operation. In Send state, the 3274 LU resources are allocated for inbound (to the primary) operations. Internally, there are two subdivisions of the Send state. These are referred to as send-.xmit (send-not-transmit) and send-xmit (send-transmit). Send-.xmit exists while the control

unit is entering data from a keyboard or MSR, into the device buffers. The state is entered from Contention by the first keystroke capable of changing data on the display, or by initial input from the Type 2 SLU MSR or CURSOR SELECT or the Type 1 SLU PA key. The state is maintained, until exited to send-xmit by an an action causing the data to be sent inbound, generally by depressing the ENTER key. The transition from send-.xmit to send-xmit also causes the transition to In Bracket (INB) state. The transition always causes the keyboard to be locked and the INPUT INHIBIT indicator to be turned on. When In Bracket, send-.xmit is entered from Receive state or ERP1 state after successfully processing an outbound chain carrying CD but not EB. The SLU will exit from Contention upon entering the send-.xmit state.

The Type 2 SLU keyboard does not automatically unlock when the Send state is entered from either Receive state or ERP1 state. The keyboard is unlocked only if:

1. A previous WCC specified keyboard restore
2. The SLU is in Send state and the terminal operator presses the RESET key

Within send-.xmit state, any normal outbound requests received on that session will be discarded and a negative response "Receiver in Transmit Mode" with sense code X'081B' will be sent. Once INB, any normal outbound requests received on that session (FMD with BB or Bid) while in Send state will be discarded and a negative response 'Bracket Bid Reject' and a sense code or X'0813' will be sent. Neither of these responses cause any state change in the SLU. If INB and in Send state, a request received that does not carry BB will be rejected by the 3274 with sense code X'2004'.

During send-xmit state, the data is being transferred from the device buffer to the PLU. Except for a possible LUSTAT, all normal flow chains on the LU-LU session will carry the CD. The transition out of send-xmit to Receive takes place. If an exception response is requested, the transition from Send to Receive takes place as soon as the end-of-chain has been successfully transferred to the transmission link.

The SSCP-SLU session operates in Definite Response mode only. The transition is from send-xmit to Contention upon the receipt of a positive response, or send-xmit to Receive if a negative response is returned.

7.1.3.4 Receive (RCV) State. The Receive state is common to both Contention and HDX-FF modes of operation. In this state, the LU resources are allocated for outbound (from the PLU) operations.

When the RCV state is active, inbound normal flow requests cannot be sent, except for responses, as requested, and control commands of the expedited flow.

Input devices may be activated by a WCC character that specifies keyboard restore. However, an attempt to send data to the PLU by an operator, by using the CURSOR SELECT or MSR, or by pressing the ENTER, PA, OR PF keys, will not be allowed.

Normal flow traffic from the PLU is passed to the device when it is in Receive state. This halts local device operations by causing the keyboard to be locked and the INPUT INHIBIT indicator to be turned on. A request with a WCC containing a restore keyboard bit to zero is treated as No-Op for the keyboard states. If the keyboard was unlocked before the write, it will remain unlocked after a successful write. If the keyboard was locked before the write, it will remain locked after the write.

For the LU-LU session, Receive state is entered from Contention state if an outbound normal flow message is accepted for processing. It is entered from send-xmit after receiving a response from an inbound request carrying CD and definite response, or after successfully transferring the chain to the data link when the inbound request carries CD and exception response. For the SSCP-LU session, Receive state is entered from Contention if an outbound normal flow message is accepted for processing. It is entered from send-xmit if a negative response is received for an inbound request.

Receive state is changed to send-.xmit after successfully processing a last-of-chain carrying the CD. Receive state is changed to Contention state after successfully processing and responding to a chain carrying EB, or after receiving a chain carrying EB which carries exception response requested. Receive state is changed to ERP1 state if any negative response except X'0813', X'0814', or X'081B' is returned to the outbound request.

For the SSCP-SLU session, Receive state is changed to Contention after returning the response to the outbound request.

7.1.3.5 ERP1 State. ERP1 is a special state created to allow for error recovery; therefore, the SLU state structure generally is awaiting an outbound request to correct the error condition. However, there are times when the SLU must first recover and notify the PLU of its recovery by use of LUSTAT command before the PLU can take action. Thus, the SLU ERP1 state allows a form of Contention mode within brackets. This state has the characteristic of being able to receive any request, but only sending LUSTATs.

When an LUSTAT flows inbound, the SLU remains in ERP1 state. This allows successive LUSTATs to flow without requiring the general exchange of CD between each LUSTAT. LUSTAT does not request change direction when sent while in ERP1 state.

ERP1 state is entered by an SLU after responding with any negative response except X'0813', X'0814', and X'081B'. If the negative response does not change the state to Between Brackets (BETB), the transition to ERP1 takes place at end of chain.

ERP1 state is changed by accepting an outbound chain carrying CD. Following processing of the CD bit, the transition is made to Send state.

When in ERP1 state, the keyboard is locked, except for the SYSTEM REQUEST and Attention Keys.

7.1.3.6 Bracket States. The 3274 has three major states associated with bracket protocols. These states are Between Bracket (BETB), In Bracket (INB), and Pending Begin Bracket (PEND.BB). These states are used to ensure synchronization of traffic between PLU and SLU. Transitions between these states are controlled by the BB and EB bits and by the Bid command.

Between Bracket (BETB) State

BETB state exists when the PLU and SLU are in contention to begin a bracket. This is the state entered after the SDT command is accepted. When the Bid or BB is accepted from the PLU or sent by the SLU BETB state ends. If the host program cancels the chain containing the Begin Bracket, or if the SLU sends negative response for the chain containing the Bid or BB, the 3274 returns to BETB state. BETB state is normally assumed when an EB has been processed successfully.

When a chain carrying both BB and EB is being processed, the BETB state is not changed.

The 3274 sets BB on the first RU transmitted when the control unit enters INB from BETB.

BETB is terminated and INB is entered when the first (or only) element of a chain with BB bit on is ready to be transmitted; when an ENTER, PA, PF, or other Attention key is pressed.

Pending Begin Bracket (PEND.BB) State

In the PEND.BB state, the 3274 is waiting for a bracket to be begun by the host system. The 3274 has either returned a positive response to a Bid command or has transmitted a Ready to Receive command. When the host program attempts to begin a bracket and the 3274 is in PEND.BB state, the 3274 will not reject the bracket.

In Bracket (INB) State

INB state is entered when the 3274 receives a BB without the EB or when the 3274 begins a bracket. INB state is maintained by the 3274 until the positive,

definite response to the EB chain is returned to the host or until the 3274 receives the last element of the EB chain when exception response is requested.

Bracket State Errors

Error codes generated for bracket error conditions are shown in Figure 7-2. The Bracket state conditions remain unchanged after sending the error code.

COMMAND / STATE	CHASE &EB	CHASE &¬EB	BID	CANCEL &EB	CANCEL &¬EB	FMD &BB	FMD &¬BB
BETB	2003	--	--	2003	--	--	2003
INB	--	--	0813	--	--	0813	--
PEND.BB	2003	--	--	2003	--	--	2003

40-00597

Figure 7-2. Bracket State Errors

7.1.4 SNA Session Interaction

Three sessions exist for the 3274 Emulator when operating with SNA protocols. These sessions are: SSCP-PU, SSCP-SLU, and PLU-SLU. The protocols and interactions between sessions are described in the following paragraphs.

7.1.4.1 Ownership States. The three sessions (Figure 7-3), SSCP-PU, SSCP-SLU, and PLU-SLU, activated in this order can exist simultaneously. The activation or termination of a session will not cause the deactivation of sessions required for that session. The SSCP-SLU and PLU-SLU sessions may wish to use the display simultaneously.

An interactive protocol is used for the 3274, in which only one of the sessions is defined as the device (display screen and keyboard) owner at any given time. During ownership, any attempt by the nonowner session to send FM data is rejected by 3274.

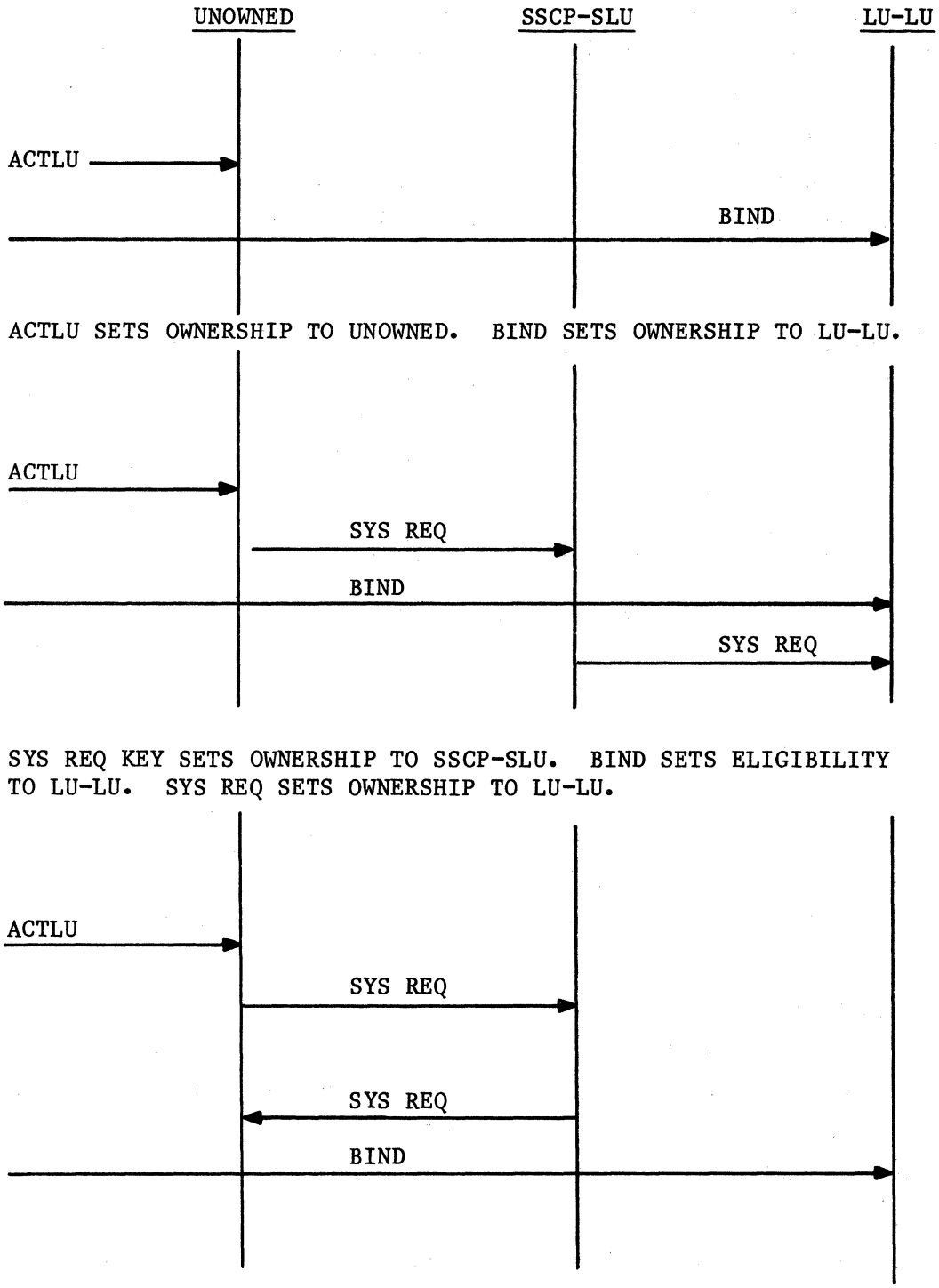

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Figure 7-3. Session Ownerships

If the SSCP is the owner, data received from the PLU will be negatively responded to with a X'081B'. If the PLU is the owner, data received from the SSCP will be responded to with an X'082D'.

The State diagram (Figure 7-3) shows the transfer of screen and keyboard ownership between the SSCP-SLU and the LU-LU session. Prior to ACTLU, or following DACTLU, no session can own the screen or keyboard. After returning a positive response to the ACTLU, the unowned symbol will be displayed on the last line of the screen.

After ACTLU is received, the SYS REQ key is used by the operator to control which session owns the device. When the LU-LU session is not bound, the SYS REQ key or an RU from the SSCP causes the SSCP-SLU session to own the screen and the System Operator symbol is displayed on the last line of the screen. The operator can then communicate with the SSCP.

A locked SSCP-SLU owned state can occur for printers since they do not support the SYS REQ key. Therefore, an FM data request to the SLU from the SSCP will be rejected with a category not supported sense code X'1007' if the LU-LU is not bound.

When communication on the SSCP-SLU session is finished, the operator presses the SYS REQ key to transfer ownership to the LU-LU session. If a Bind has been received and has been responded to positively, the transfer takes place immediately. If the Bind has not been received or has been negatively responded to, the state change is to Unowned. The acceptance of the Bind and SDT transfers the state from Unowned to LU-LU ownership, which removes the status line and turns on the SYSTEM AVAILABLE LED. This state change can take place with a PLU-initiated Bind and no operator logon. The SYS REQ key is also used to transfer ownership from the LU-LU owned session to the SSCP-SLU session. This transfer proceeds without waiting for completion of outbound chains in the LU-LU session. Inbound chains will complete unless a test is made for a pacing response.

7.1.4.2 Setting Screen Size. Switching between the 960 (80 x 12) and 1920 (80 x 24) screen size is controlled by the Bind Parameters, Bytes 20 through 24. (See Erase/Write Alternate.)

Pressing the SYS REQ key causes the screen to be cleared.

The screen also is cleared by the transfer of ownership from Unowned to SSCP owned when this state transfer is caused by an outbound RU from the SSCP. The screen size is the maximum physical size. When ownership is transferred to the Unowned session, the screen size is that of the previous owner.

7.1.5 Operation in SSCP-SLU

The following paragraphs describe the operational characteristics when the 3274 Emulator is exchanging display data on the SSCP-SLU session.

7.1.5.1 SSCP-SLU Contention Operation. The 3274 supports FM profile 0. Immediate control and immediate response is observed, and all requests are treated as definite requests.

HDX-contention is implemented, and a normal flow request must be processed and acknowledged by a response before an opposite-direction normal flow request can be accepted or processed.

The 3274 SLU is in Contention state whenever SSCP-SLU Session Ownership mode is entered by use of the SYS REQ key.

7.1.5.2 Non-error Operation. For non-error operation, the receipt of a positive response or transmission of the response initiates the transition to Contention state. The transition from Contention to Receive state is initiated by the recognition of an outbound request. The transition from Contention to send-.xmit is made when the first data key pressed is accepted. (Refer to Send State.) The transition to send-xmit is made when the ENTER key is accepted.

The keyboard is controlled by state conditions. It is locked when in Receive or send-xmit. The operative keys that are locked or unlocked are the same for the LU-LU session.

7.1.5.3 Error Operations. When a normal flow request has been transmitted inbound and a negative response is received, the SLU goes into Receive state and awaits an outbound request from the SSCP.

When the 3274 SLU detects a temporary or permanent error condition while in Send or Contention state, the SLU goes into Contention state. The SSCP is not notified of the error.

When a normal flow request is received but cannot be accepted, due to error or a not-available condition, the SLU goes into Contention state following the negative response.

7.1.5.4 Outbound Message Handling - SSCP to SLU. The SSCP may send messages to displays. The messages are byte strings consisting of SCS control codes and SSCP supported graphic codes. The only valid SCS control code for the 3274 display uses NL, NULL, IFS, and IRS are treated as graphics and displayed as blanks ( ), (*), and (;), respectively. Any other binary combination in the SCS data stream will be treated as a graphic. The characters appearing on the screen for code points other than supported graphics are unpredictable.

Each message from the SSCP is displayed at the current cursor address. When the 3274 receives an NL control code in the SSCP message, it will insert nulls in the character positions remaining in the display line being written and position the cursor at the left-most position of the next line. Characters following the NL code are displayed beginning at the cursor position. The message wraps to the top of the screen if the last line on the screen is written and additional characters remain in the message.

After displaying the data in the receive chain, the 3274 places the cursor in the position next to the last character if NL does not follow. If the

message is ended by NL, the remainder of the line is set to nulls and the cursor appears in the first character position of the next line. This cursor position address is called the initial cursor address and is stored to identify the starting position of the operator's display input data.

7.1.5.5 Inbound Message Handling -- SLU to SSCP. An operator can enter the message bound for the SSCP from the character position occupied by the cursor.

After entering a message, the operator must press the ENTER key to initiate a transmission of the inbound message to the SSCP. Pressing other PA keys has no effect, excepting the CLEAR key. Pressing the CLEAR key causes the display screen to be cleared and the initial cursor address is reset to zero. If other PA or PF keys are depressed, INPUT INHIBIT indicators are turned on and the audible alarm will sound. The ERASE INPUT and ERASE EOF keys operate as defined.

Chains sent on the SSCP-SLU session are OIC and have a maximum RU length or 256 bytes. The 3274 will search the screen including and following cursor position to end of screen, or until a 256-byte RU has been assembled. Null characters are suppressed and not sent.

7.1.5.6 System Logon. By means of the logon sequences, the terminal operator requests that a session be established with a primary logical unit.

The logon sequence is as follows:

1. The terminal operator presses the SYS REQ key to enter the SSCP-SLU owned session from the Unowned session if the System Operator symbol is not displayed, and then keys in a character logon coded request in a syntax defined by the installation. The operator presses the ENTER key and the logon message is sent to SSCP.

2. SSCP receives the logon request and sends a positive response.

3. SSCP may send a message, such as a prompting or error message, to the 3274, if necessary. When the 3274 receives this message, it sends a positive response if accepted for display, or negative response X'081B', if device ownership has been transferred to LU-LU session.

7.1.5.7 System Logoff. By performing the logoff sequence, the terminal operator requests the SSCP to terminate a session with the PLU.

The logoff sequence is as follows:

1. The operator presses the SYS REQ key to enter the SSCP-SLU owned session and keys in a character-coded logoff request in a syntax defined by the installation. When the operator presses the ENTER key, the logoff message is sent to SSCP.

2. SSCP receives the logoff request and sends a definite response.

3. SSCP may send a message. When the 3274 receives the message, it sends a Positive Response if accepted for display, or Negative Response X'081B' if device ownership has been transferred to LU-LU session.

7.1.6 SNA Printer Sessions

Printers attached to the 3274 Emulator can be configured in the Shared mode. In the Shared mode, both the SLU Type 2 and the SLU Type 1 or 3 may compete for use of the printer. Sharing may be done Between Brackets or between sessions.

Between Bracket Sharing

The 3274 Emulator allows contention for a printer in Shared mode to occur Between Brackets (BETB) or between sessions. The printer is available for allocation to an LU Type 2 operation (SLU-initiated transmission or a host-initiated local copy operation), or for an LU Type 1 or 3 operation (outbound

requests from the host) whichever occurs first. If a local copy function is being performed, for either a single SLU Type 2 or a queue of SLU Type 2 requests, a BB request for the Type 1 or 3 SLU will be rejected with sense code X'0814' (Bracket Reject, RTR to Follow). When all local copies are complete, the Type 1 or 3 SLU acquires the printer and sends RTR to the PLU. If the Type 1 or 3 SLU is in bracket, the printer is not available for local copy functions.

Between Session Sharing

The 3274 Emulator allows a printer in Shared mode to be used for local copy when the printer is not being used in an SLU Type 1 or 3 session. If a printer is being used for local copy and a Bind is received to initiate a Type 1 or 3 session, the 3274 allows the local copy in progress to complete and then sends a positive response to the PLU. All queued local copy requests will either be processed by an alternate printer or rejected with sense code X'0801' (No Printer Configured). This type of sharing biases the printer availability in favor of the Type 1 or 3 SLU session.

7.1.7 LU to LU Session, RUs

The Request/Response Unit (RU) is the fundamental unit pass between the host program and the PTS 3274. The RU contains commands for control of the network, responses to commands, user data and acknowledgment of user data.

7.1.7.1 RU Segmenting. RUs sent to network terminals are often larger than acceptable for optimum transfer of data by the link connecting the terminal to the network. Therefore, a Basic Information Unit (BIU) consisting of RH and RU may be divided into smaller elements, called segments, that are transmitted over the link. The 3274 supports inbound and outbound segmenting on the LU-LU session.

The segment elements are defined as follows: The first segment (FIS) element is equated to Begin-BIU, not End-BIU. The last segment (LIS) element equates to not Begin BIU, End-BIU. The middle in segment (MIS) equates to not Begin-BIU, not End-BIU. An Only In Segment (OIS) contains the entire BIU.

Sequencing of segments is in the correct order if the sequence consists of:

1. FIS, LIS
2. FIS, MIS, ..., LIS
3. OIS

7.1.7.2 Segmenting Outbound. Errors due to improper sequencing of the segment elements will cause the emulator to enter normal disconnect mode. This action does not permit sending a negative response to the PLU. The 3274 Emulator will also deactivate the physical unit and all logical units. The SYSTEM AVAILABLE LED will be turned off on all LUs.

The maximum size for segment elements (the NCP MAX DATA SIZE parameter) delivered to the 3274 must not exceed 256 bytes of data plus six bytes of TH and three bytes of RH for the first in segment, or Only In Segment. The maximum size for Middle In Segment, or Last In Segment must not exceed 256 bytes of data plus six bytes of TH. The 3274 will return a Command Reject for this condition. The bytes of data exceeding 256 will be lost.

7.1.7.3 Segmenting Inbound. Segmenting inbound is supported by the 3274 on the LU-LU session under the following conditions:

1. When maximum RU size is specified as 256 or less and accepting at Bind time, no segmenting is used by the 3274.

2. When maximum RU size is specified as greater than 256, the RUs are segmented into segment elements containing 256 data bytes each for FIS or MIS, provided sufficient data is transmitted to cause segmenting.

When the Bind maximum RU size is greater than 256 bytes, other considerations than maximum RU size and amount of data to be transmitted may determine the actual RU length (Max RU size) that is sent. The 3274 will never send an RU having more than 1024 bytes.

7.1.7.4 Outbound to the 3274 Emulator. The maximum RU length that a PLU is permitted to send is defined in Byte 11 of Bind. The 3274 supports a maximum RU size within the following constraints.

1. For a Type 1 LU in a 3274, the following formula applies:

$$MRU \leq BUFF \div PC$$

where MRU is the maximum RU size specified in byte 11 of the Bind.

PC is the pacing count specified in byte 9 of the Bind.

BUFF is the device buffer size.

A Bind reject with sense code X'0821' will occur if the Bind specifications do not meet these limits.

2. For Type 2 and 3 LUs in a 3274, there are no restrictions.

7.1.7.5 Inbound from the 3274 Emulator. The 3274 supports only "Multiple Element Chains" for inbound operations. The maximum RU size can be controlled by the PLU through byte 10 of the Bind request. For a 3274, the maximum RU size is 1024. If the value of byte 10 is greater than the 3274 capabilities, the Bind will be accepted, but the actual RU size will be limited to device capabilities.

The minimum value that may be specified by byte 10 of the Bind request is 64 bytes. If lesser values are specified, Bind will be rejected with a negative response, sense code X'0821'.

7.1.7.6 Chaining Description. A data chain is a complete unit of data that originates at a single LU. Data RU chaining provides a method of logically defining a complete unit of data regardless of whether the data is transmitted as a single RU or as a series of consecutive RUs. Each RU is associated with only one chain. An individual RU may be the beginning, middle, ending, or only both beginning and ending RU in the chain. The chaining indicators, Begin Chain (BC) and End Chain (EC), are contained in the request header. The following are definitions of each type of RU in a chain:

First in Chain (FIC) -- Identifies an RU that begins a chained transmission (RH = BC ¬EC)

Middle of Chain (MIC) -- Is transmitted with all RUs following the BC transmission, with the exception of the last RU in that chain (RH = ¬BC ¬EC)

Last in Chain (LIC) -- Identifies the RU that completes a chained transmission (RH = ¬BCEC)

Only in Chain (OIC) -- Both the BC and EC indicators are included to indicate a transmission that consists of a single RU. That RU is termed a single-element chain (RH = BCEC). The single-element chain is not supported inbound.

A chain is in correct order if the RUs consist of:

1. FIC, LIC
2. FIC, MIC, ..., LIC
3. OIC

Any other sequence of chaining indicators will cause a chaining error.

7.1.7.7 Chaining Operation. When the 3274 receives a chain with chaining indicators in an improper sequence (for example, FIC, MIC, FIC), a negative response, with sense data indicating a chaining error (sense code X'2002'), is returned to the host program. The 3274 purges the chain, ignoring subsequent elements of that chain until a data RU with the LIC or a Cancel command is received. Receipt of an OIC data RU terminates the purging of a chain. The OIC message is also purged. Sending RUs having chaining indicators in the sequence FIC, MIC, OIC is a violation of chaining protocol. In this case, when the 3274 receives the OIC transmission, the chaining error is detected, the OIC transmission is purged, purging of chain elements is stopped, and a negative response is sent for the OIC transmission. The 3274 is now ready to normally process the next chain.

7.1.7.8 Bracket Protocol. The 3274 provides a Bracket Protocol to delimit a series of related inbound and outbound requests. A bracket may consist of one input and one output, many sets of inputs and outputs, or a series of requests flowing in a single direction. The Begin Bracket (BB) and End Bracket (EB) indicators are used to delimit a bracket. References are made to bracket states (BETB and INB).

A bracket is initiated when the Begin Bracket indicator (BB) is accepted by the primary or secondary LU. The bracket is usually ended when the End Bracket indicator (EB) is received by the secondary LU. The specific conditions that end a bracket are defined by the SNA bracket termination rule 1 (see below). Two commands, Bid and Ready to Receive (RTR), are implemented to further define the initiation of a bracketed session. These commands are described under "SNA Commands".

The following protocols apply for 3274 bracket processing.

Type 2 Sessions

For sessions with Type 2 SLUs, the SLU may begin a bracket any time the session is between brackets. The PLU may request permission to begin a bracket using Bid. If the SLU returns a positive response, the PLU may begin a bracket. If the SLU returns a negative response, the PLU must wait for the next BB from the SLU.

Type 1 and 3 Sessions

For Type 1 and 3 sessions, the PLU may begin a bracket any time the session is between brackets (the only time the SLU will begin a bracket is when the operator presses a PA key). The PLU may start a bracket by sending a transmission that contains BB or by sending Bid, waiting for a positive response, and then sending a transmission that contains BB. The PLU may attempt to initiate a bracket by sending a transmission with BB. If a contention situation exists (the SLU begins a bracket before receiving BB from the PLU), the SLU returns a negative response to the PLUs transmission and then discards all portions of the chain from the PLU. The SLU assumes that its transmission will be accepted by the PLU.

If a Bid or BB from the PLU is rejected, the 3274 will do the following:

For a session with a Type 2 SLU, the SLU sends BB when it next has data to send. The PLU may return its data when it received change direction (CD).

For a Type 1 or 3 session with the 3274, the SLU will only reject the PLU's Bid or BB if the printer is performing a local print function or when a protocol error is detected. When the local print is completed, the SLU will send RTR.

Restrictions:

The host program can end a bracket. The 3274 cannot end a bracket.

Bracket protocol establishes the following restrictions on beginning and ending brackets:

1. BB and EB cannot be sent with response RUs.

2. EB cannot be sent with the Bid or RTR command. All other normal flow DFC commands can end the bracket.

3. All outbound chains that begin a bracket but do not carry EB must be sent with definite responses requested.

Bracket Termination Rule 1

The 3274 supports bracket termination rule 1 as follows:

1. When EB is received and the last element of a chain requires definite response, the 3274 will enter Between Bracket state (BETB) from In Bracket state (INB) after +RSP to the chain or stay INB after -RSP.

2. When EB is received and the last element of a chain requires exception response, the 3274 will enter BETB from INB immediately.

The 3274 ignores the BB bit on all outbound requests except FM data, and ignores EB on all outbound requests except FM data and DFC commands "Cancel" and "Chase".

7.1.7.9 Pacing. Outbound and inbound pacing is supported by the 3274. Pacing is used as a tuning parameter for the system. Usage comments are included here; however, control is under user discretion at NCP or equivalent definition time.

The pacing count (N) determines the number of normal flow request RUs that can flow before a pacing response is required to allow the next group of N to continue. A special response designated as Isolated Pacing Response (IPR) is used to return the pacing response if a response to be the outbound request is not required at the time the pacing response is required. The 3274 will indicate readiness with a pacing response as soon as printer buffers become available after receiving the pacing request. Thus, the number of normal flow RUs allowed in the network due to pacing is up to 2N-1. RUs may vary in length as specified in the Bind parameter.

LU Type 1

For the 3274, device dependencies exist because the printer is slower than the displays. Care must be exercised in the use of pacing and/or definite response protocol.

During the transmission of multiple chains, interaction occurs between pacing and the type of response requested. When a definite response is requested, a response for a chain must be received by the PLU before it can send the next chain. When the exception response is requested, the PLU may send any number of consecutive chains without waiting for a response. Therefore, a definite response enforces a type of pacing.

When OIC RUs that are less than, or equal to, 256 bytes are used, it is redundant to specify both pacing and definite response. Unnecessary network traffic will occur if both are specified. When chains with multiple RUs are used, pacing is necessary even though a definite response is requested.

If the 3274 receives more normal flow requests than it is guaranteed by using the outbound pacing mechanism, it will reject the request with a Negative Response using sense code X'0801'.

LU Type 2

For LU Type 2, the 3274 will generally operate faster than the link, and pacing is not required for the controllers.

LU Type 3

For LU Type 3, the definite response required when the WCC print bit is set is an effective alternative to pacing.

Outbound Pacing

In telecommunication networks where RUs are processed through more than one communication controller (for example, a 3704 and a 3790 or two 3705s), outbound pacing may be required for Type 2 and 3 LUs to prevent data traffic congestion in these controllers.

Inbound Pacing

Inbound pacing is not supported by the 3274.

7.1.7.10 Change Direction. The 3274 uses a Half Duplex, Flip Flop (HDX-FF) mode to transfer normal flow data. One of the two LUs in the session may send at a given time. The flip-flop protocol demands that when one LU is sending, the other must be prepared to receive. Therefore, the two states of Send and Receive (RCV) exist on each end of the session.

A bit in the request header, called the change direction (CD) indicator, is used to keep the two end-point LUs in synchronization. Each time an LU accepts this CD in a request, it means it is the LU's turn to send. Each time an LU sends the CD in a request, that LU must then be prepared to receive. The 3274 always sends CD with EC or OC in an FMD RU. Exceptions may occur following negative responses. (See "ERP1" state.)

7.2 SNA Commands

SNA commands define a set of controls to establish and terminate sessions, and to assist in the management of host-to-3274 data flow and sessions.

Three types of SNA commands are discussed in the following topics:

Session Control (SC) commands	--	These commands establish and terminate sessions in the network.
Data Flow Control (DFC) commands	--	These commands control the flow of data in an LU-LU session.
Function Management Data (FMD) command	--	This command is used to transfer data in the LU-LU session.

Figure 7-4 lists the SNA commands and RU fields supported by the 3274.

RU BY CATEGORY	DATA FLOW	REQUEST LENGTH (BYTES)	REQUEST HEX CODE	ADDITIONAL FIELDS BYTE(S)	DISCUSSION
SESSION CONTROL					
ACTIVATE PHYSICAL UNIT (ACTPU)	P E	9	11	1 2 BITS 2 BITS 3-8	TYPE ACTIVATION REQUESTED: X'01' --COLD; X'02' --ERP 0-3 FM PROFILE 4-7 TS PROFILE SSCP ID: A SIX-BYTE FIELD WHICH INCLUDES THE ID OF THE SSCP ISSUING THE ACTPU. THE FIRST FOUR BITS SPECIFY THE FORMAT FOR THE REMAINING BITS. BITS 0-3 = 0000; BITS 4-7 -- PHYSICAL UNIT TYPE OF THE NODE CONTAINING THE SSCP: BITS 8-47 -- IMPLEMENTATION AND INSTALLATION DEPENDENT BINARY IDENTIFICATION.
DEACTIVATE PHYSICAL UNIT (DACTPU)	P E	2	12	1	TYPE DEACTIVATION REQUESTED: X'01' -- FINAL USE, PHYSICAL CONNECTION MAY BE BROKEN: X'02' -- NOT THE FINAL USE, PHYSICAL CONNECTION SHOULD NOT BE BROKEN
ACTIVATE LOGICAL UNIT (ACTLU)	P E	3	0D	1 2 BITS 2 BITS	TYPE ACTIVATION REQUESTED: X'01' -- COLD 0-3 FM PROFILE 4-7 TS PROFILE
DEACTIVATE LOGICAL UNIT(DACTLU)	P E	1	0E	----	
UNBIND SESSION (UNBIND)	P E	2	32	1	TYPE UNBIND: X'01' -- NORMAL END OF SESSION
START DATA TRAFFIC (SDT)	P E	1	A0	----	
CLEAR (CLEAR)	P E	1	A1	----	
DATA FLOW					
CANCEL (CANCEL)	P S N	1	83	----	
CHASE (CHASE)	P S N	1	84	----	
SHUTDOWN (SHUTD)	P E	1	C0	----	
SHUTDOWN COMPLETE (SHUTC)	S E	1	C1	----	
SIGNAL (SIG)	P S E	5	C9	1-4	SIGNAL CODE: VALUE SET BY THE SENDING END USER OR NAU SERVICES MANAGER; HAS MEANING ONLY TO THE NAU SERVICES LEVEL OR ABOVE
READY TO RECEIVE (RTR)	P S N	1	05	----	
BID (BID)	P S N	1	C8	----	
LOGICAL UNIT STATUS (LUSTAT)	P S N	5	04	1-4	SEE SECTION 2.9.6

P = PRIMARY TO SECONDARY S = SECONDARY TO PRIMARY N = NORMAL FLOW E = EXPEDITED FLOW

40-00599

Figure 7-4. SNA COMMANDS

7.2.1 Session Control Commands

7.2.1.1 Activate Physical Unit (ACTPU). The ACTPU command, X'11', is sent by the access method to establish the SSCP-PU session with the control unit. The SSCP-PU session is established when the control unit returns a positive response to the ACTPU command.

The ACTPU command can be transmitted when the SSCP-SLU and LU-LU sessions are active, for example, when an NCP restart procedure occurs. When the 3274 receives the ACTPU command, all active sessions are terminated immediately. The 3274 returns a positive response to the ACTPU command, and the SSCP-PU session is reestablished.

7.2.1.2 Deactivated Physical Unit (DACTPU). When the 3274 receives the DACTPU command, X'12', all LU-LU and SSCP-SLU sessions and the SSCP-PU session are terminated. If a command other than ACTPU is received after a positive response has been returned for the DACTPU command, the 3274 returns a negative response with sense data indicating PU not active (sense code X'8008').

7.2.1.3 Activate Logical Unit (ACTLU). The ACTLU command, X'0D', is sent by the access method to establish an SSCP-SLU session with a 3274 Control Unit LU. The SSCP-SLU session is established when the 3274 returns a positive response to the ACTLU command. The SSCP-PU session must be established prior to the receipt of ACTLU to allow the 3274 to return a positive response to this command. If the 3274 receives a command other than ACTPU, ACTLU, DACTPU, or DACTLU before the SSCP-LU session is established, a negative response is returned with sense data indicating LU not active (sense code X'8009'). Note that the SLU is in the emulator and the session can be activated without a display or printer being powered on or attached.

When an SSCP-SLU session has been previously established and the 3274 receives an ACTLU command for that LU, any active session between that LU and a host program is terminated. The 3274 returns a positive response to the ACTLU command, and the SSCP-LU session is reestablished.

7.2.1.4 Deactivate Logical Unit (DACTLU). Receipt of this command, X'0E', terminates the SSCP-SLU session. If an LU-LU session is established when the DACTLU command is received, the session is terminated. When the 3274 receives a command other than DACTPU, ACTPU, or ACTLU after a positive response has been returned for the DACTLU command, a negative response is returned with sense data indicating SLU not active (sense code X'8009').

7.2.1.5 Bind. This command, X'31', is sent by the access method to request an LU-LU session between an application program and an SLU. The 3274 returns a positive response to establish the LU-LU session. When the session cannot be established, the 3274 returns a negative response with sense data that describes the reason the session was rejected.

The 3274 examines session parameters that are received with the Bind command. The values required depend on the type of session established. Table 7-1 provides a detailed description of the session parameters that are sent with the Bind command.

When the SSCP-SLU session is established and the 3274 receives a command that flows in the LU-LU session, other than Bind, a negative response is returned with sense data indicating no session established (sense code X'8005').

When an LU-LU session exists, that is, one Bind has been accepted, and the 3274 receives a subsequent Bind command for the LU, a negative response is returned with sense data indicating session already exists (sense code X'0815') if the Bind sender address is the same as the session already found. A negative response indicating function active (sense code X'0805') is returned if the Bind sender address differs from the session already bound.

Session parameters included in the Bind command RU define the protocols that govern the session. Failure to properly specify the required session parameters results in rejection of the Bind command by the 3274 control (sense code X'0821').

Table 7-1. Bind Format

Byte	Hex Value	Bit Setting	Meaning
0	31		Identifies this RU as Bind command.
1	01		Bind type and format -- The only Bind types supported is Hex 01.
2	03		Function management (FM) profile -- Specifies that the data flow control command and the request/reponse protocols that are to be used for this session conform to FM Profile 3.
3	03		Transmission services (TS) profile -- Specifies that the 3274 conforms to TS Profile 3, that is pacing and sequence numbers are used with normal flow transmission and data traffic is controlled by the Clear and Start Data Traffic commands.
4			Primary LU Protocols
		x...	Chaining Use: 0 The PLU can send only single-element chains. 1 The PLU can send single or multiple-element chains
		.x..	Request Mode Selection: 0 Immediate request mode is used -- Only one definite response can be outstanding at a time. That response must be received before the PLU can send another RU.
		..xx	Chaining responses: 01 The PLU can request exception only responses. 10 The PLU can only request definite responses 11 The PLU can request definite or exception only responses.

Table 7-1. Bind Format (Cont)

Byte	Hex Value	Bit Setting	Meaning
		.... 00..	Reserved
		.... ..x.	Compression indicator: 0 The PLU cannot send compressed data.
		x	Send End Bracket Indicator (EB): 1 The PLU can send the EB.
5			Secondary LU Protocols.
		x...	Chaining use: 1 The 3274 can send single- or multiple-element chains.
		.x..	Request mode selection: 0 Immediate request mode is used The 3274 can issue a request for a single definite response. No further transmissions are sent until the 3274 receives the requested response.
		..xx	Chaining responses: 01 The 3274 can only request exception only responses. 10 The 3274 can only request definite responses. 11 The 3274 can request either definite or exception only responses. If both are allowed, the 3274 will request exception only responses.
		.... 00..	Reserved
		.... ..x.	Compression indicator: 0 The 3274 cannot send compressed data.

Table 7-1. Bind Format (Cont)

Byte	Hex Value	Bit Setting	Meaning
		x	Send End Bracket indicator (EB): 0 The 3274 cannot send the EB.
6			Common Protocols
		0...	Reserved
		.x..	Function Management (FM) header usage: 0 The PLU and the 3274 cannot exchange FM headers.
		..x.	Brackets usage: 1 Bracketed session is used -- Both the PLU and the 3274 must use bracket protocols.
		...x	Bracket termination protocol: 1 Bracket termination rule 1 is used (refer to "Bracket Protocol" for a description of bracket termination rule 1).
		.... x...	Alternate Code Selection: 0 Both the PLU and all LUs must use EBCDIC. 1 Both the host program and all LUs must use ASCII.
		.... .000	Reserved
7			Common Protocols
		xx..	Normal Flow Send/receive mode (selection): 10 This session uses half-duplex, flip-flop (HDX FF) transmissions.

Table 7-1. Bind Format (Cont)

Byte	Hex Value	Bit Setting	Meaning
		..x.	Recovery responsibility: 0 The PLU is responsible for error recovery.
		...x	Brackets first speaker: 0 The 3274 is always the first speaker.
		 0000	Reserved
		x	Contention resolution: 0 Contention (simultaneous) transmission from the host program and the 3274 is resolved in favor of the 3274.
			Presentation Services
8		00xx xxxx	Secondary-to-primary LU pacing count -- Set to zeros, pacing is not used.
9		00xx xxxx	The primary-to-secondary pacing value defines the number of RUs that may be received by the emulator before a pacing response must be returned to indicate readiness for another block of RUs. If set to zeros, pacing is not used. See "Pacing" for recommendations of pacing values.
10	xx		Maximum RU size sent by the secondary LU -- This value represents the largest RU that can be sent by the emulator. It is expressed as a mantissa (8 through F) and an exponent value of 2 by which the mantissa is multiplied. (A mantissa of less than 8 places no restriction on maximum RU size.) For example, when the mantissa is specified as 8 and the exponent of 2 is 5 (hex 85), the RU size represented is 256 bytes. Examples of mantissa and exponent values are shown below with the RU size they represent: 85 = 256 86 = 512 C6 = 768 87 = 1024 A7 = 1280 C7 = 1536 E7 = 1792 88 = 2048

Table 7-1. Bind Format (Cont)

Byte	Hex Value	Bit Setting	Meaning
11	xx		Maximum RU size sent by the primary LU -- This value represents the largest RU that can be sent by the PLU and is specified in the same format as for the secondary LU (byte 20). See "Segmenting Inbound" for detailed information about values supported.
12,13	0000		Reserved; must be set to hexadecimal zeros
For SLU Type 1			
14	01		Type 1 print function using SCS data stream
15-17	00		Reserved
18	E1		Sent but not checked by the emulator for LU Type 1
19			Reserved
20-24			Not supported for LU Type 1
For SLU Types 2 and 3			
14	02		Type 2 emulator data stream compatibility mode
14	03		Type 3 emulator print function using emulator data stream compatibility mode
15-19	00		Reserved
20-24	xx		Refer to Table 7-2 for LU Type 2 and LU Type 3.
For all SLU Types			
25+			Reserved

Bind Check

The Bind parameters sent to the 3274 will be checked according to Table 7-2.

Table 7-2. Bind Parameter Check Table

		LU Type 1 Reject		LU Type 2 Reject		LU Type 3 Reject	
Byte	Bit	Check	If	Check	If	Check	If
1	0-3	C	¬X'0'	C	¬X'0'	C	¬X'0'
	4-7	C	¬X'1'	C	¬X'1'	C	¬X'1'
2-3		C	¬X'03'	C	¬X'03'	C	¬X'03'
4	0	NC		NC		NC	
	1	C	B'1'	C	B'1'	C	B'1'
	2-3	C	B'00'	C	B'00'	C	B'00' B'01'
	4,5	NC		NC		NC	
	6	C	B'1'	C	B'1'	C	B'1'
	7	C	B'0'	C	B'0'	C	B'0'
5	0	NC		C	B'0'	NC	
	1	NC		NC		NC	
	2-3	C save	B'00'	C save	B'00'	C save	B'00'
	4-7	NC		NC		NC	
6	0	NC		NC		NC	
	1	C	B'1'	C	B'1'	C	B'1'
	2	C	B'0'	C	B'0'	C	B'0'
	3	C	B'0'	C	B'0'	C	B'0'
	4	C	**	C	**	C	**
	5-7	NC		NC		NC	
7	0,1	C	¬B'10'	C	¬B'10'	C	¬B'10'
	2	C	B'1'	C	B'1'	C	B'1'
	3	C	B'1'	C	B'1'	C	B'1'
	4-7	NC		NC		NC	
8		NC		NC		NC	
9	0,1	NC		NC		NC	
	2-7	C	X'00'	NC		NC	
10	0-7	C		C		NC	
11		C		NC		NC	
12,13		NC		NC		NC	
14		C	¬correct device	C	¬correct device	C	¬correct device
15-19		NC		NC		NC	
20-23		NC		C*		C*	
24		NC		C save		C save Device Dep	
25		NC		NC		NC	
26		C	¬X'00'	C	¬X'00'		¬X'00'

27+ All bytes ignored

* If byte 24, bits 4-7 has X'E' or X'F' these bytes are checked.
** Feature dependent

C -- Check
NC -- No check

The correct device check, an SLU type, is as follows:

01 03	valid for printers
02	valid for displays

7.2.1.6 Unbind. Receipt of this command, X'32', directs the 3274 to terminate the LU-LU session between a host program and an SLU. The LU-LU session is terminated when the 3274 returns a positive response to the Unbind command.

7.2.1.7 Start Data Traffic (SDT). This command, X'A0', allows data traffic to flow during an LU-LU session. The SDT command must be issued after a Bind command has established the LU-LU session. It is also sent after Clear to complete a session resynchronization sequence with the 3274. SDT is valid only when the Data Traffic Reset state is active for an LU-LU session.

To complete a session resynchronization sequence, the host program must request transmission of the SDT command from the access method.

7.2.1.8 Clear. On receipt of the Clear command, X'A1', the 3274 enforces the Data Traffic Reset state upon the LU-LU session. Clear also causes the 3274 to initialize all inbound and outbound transmission buffers. When the Data Traffic Reset state is activated for an LU-LU session, the following commands are valid for that session: Clear, Unbind, and Start Data Traffic (SDT).

7.2.2 Data Flow Control Commands

7.2.2.1 Cancel. When received, normal SNA usage of this command directs the receiver to discard all elements of the chained transmission being received. However, the 3274 processes data RUs to the display or printer as they are received without waiting until the end-of-chain. In this way, the Cancel command serves the purpose of providing a proper termination for an otherwise incomplete chain. A Cancel command received between chains only affects the 3274 state controlled by the Change Direction (CD) and End Bracket (EB) bit settings carried in the RH with Cancel command. Processing of a chained transmission is terminated when the Cancel command is received. EB or CD may be sent with the command

When a chained transmission is in progress, and the 3274 returns a negative response to an element of that chain, the PLU should terminate that chained transmission and issue the Cancel command if the last chain element has not already been sent to the 3274.

When the PLU returns a negative response for an element of a chain. The entire chain will be transmitted before the PLU response is examined. Cancel will not be sent.

The PLU should discard all elements of a chained transmission after sending a negative response.

7.2.2.2 Chase. Chase, X'83', is used to confirm that all preceding requests have passed through the network and have been processed. When this command is received, the 3274 returns a positive response to the PLU, indicating all previous chains have been processed.

The PLU should complete or cancel the current chained transmission before issuing the Chase command. When a chained transmission is sent with exception only response requested, the Chase command can be used to verify that all responses for that chain have been received. The EB or CD indicators can be issued with the Chase command.

7.2.2.3 Bid. The Bid command, X'C8', is sent by the PLU to a 3274 to request permission to begin a bracket. The use of Bid avoids the use of transmission time in sending long chains of data which are then discarded because the SLU won bracket contention. If the Bid is accepted by the SLU, a positive response is returned and the SLU goes to Pending Begin Bracket state and waits for the request containing BB.

SLUs can reject a Bid command by winning bracket contention for the following reasons:

1. LU Type 2

   - The 3274 is already In Bracket (INB) and a PLU protocol error exists. The sense code returned is X'0813'.

   - The operator has initiated an inbound data stream carrying Begin Bracket (BB). The sense code returned is X'0813'.

   - An operator has started to enter data on the screen but has not not initiated an inbound data stream. The sense code returned is X'081B'.

2. LU Type 1 and 3

   - The SLU is already INB and a host program protocol error exists. The sense code is X'0813'.

   - A printer attached to a 3274 is busy doing a local copy operation. The sense code returned is X'0814'. The 3274 will send the Ready To Receive (RTR) command to the host program when the printer becomes not busy and a BB can be accepted by the secondary LU.

7.2.2.4 Signal. The Signal command is only sent in an LU-LU session. The PLU can send the Signal command, X'C9', to the 3274 SLU to request the Change Direction (CD) indicator. The SLU will complete any chained transmissions that are in progress and send the CD to the PLU. A request with CD but no data (a null RU) will be sent if the SLU is in send state but has not started transmitting. If the SLU is in send state, BETB, or ERP1 state (see SNA Session Processing States, subsection 7.2.4), the signal is positively responded to but no SLU action is taken.

The 3274 will send the Signal command (X'0001 0000') when the operator presses the keyboard ATTN key or, for an LU Type 1, the printer PA key. The command is expedited and has no effect on SLU states. Once Signal has been sent by an SLU, pressing the ATTN or PA keys will not cause a second signal until the 3274 has received a response to the first signal.

7.2.2.5 LU Status (LUSTAT). The 3274 SLU sends the LUSTAT command, X'04', to notify the PLU that a processing error has been detected or that a change in the operational status of a device has occurred. A four-byte status code is sent by the 3274 SLU to describe the error condition or the device status change.

7.2.2.6 Ready to Receive (RTR). A 3274 Type 1 or 3 SLU sends this command, X'05', to indicate when a previously rejected bracket (with sense code X'0814') can be initiated by the host program. The RTR command is allowed only when the session is ready to receive a new bracket.

When the RTR command is sent and a positive response is received from the host program, the 3274 enters the Pending Begin Bracket state and expects the host program to begin a bracket.

7.2.2.7 Shutdown. The PLU sends the Shutdown command, X'C0'. Receipt of this command directs the 3274 SLU to prepare for a session termination sequence. The 3274 returns a positive response to the PLU, but data-transfer sequences are not inhibited.

The Shutdown command causes the session to enter Shutdown Complete Pending state. The Pending state is maintained until the SLU completes normal flow processing and goes Between Bracket (BETB). The SLU then sends the Shutdown Complete command to the PLU.

7.2.2.8 Shutdown Complete. This command, X'C1', is sent by the 3274 after the Shutdown command has been received from the host program and an End Bracket has caused the SLU to go to BETB state.

When the Shutdown Complete command is sent to the PLU, the session enters Shutdown state. When the Shutdown state is active, no data transmissions can be sent to the PLU; however, the PLU may continue to send to the 3274.

The PLU may either terminate the session using Unbind when the Shutdown Complete is received or use Shutdown as a means of quiescing traffic. Exit from Shutdown Complete requires a Clear and SDT if the command is used as a quiesce function.

7.2.3 Function Management Data Command

FM Data

This command is used to transfer data in the LU-LU session. It may only be sent when data traffic is allowed (SDT has been issued and received with a positive response).

When communicating with a 3274 SLU, the following FM data protocols are used:

- Bracket
  Bracket protocol is used to delimit a series of related inbound and outbound FM data request units (RUs); for example, all the RUs required to complete a transaction.

- Chaining
  Chaining logically connects one or more RU from a single LU, for example, all RUs required to complete a display image.

- Change Direction

  Change direction informs the receiving LU that the sending LU has completed transmission and expects the next transmission to be from the receiving LU. For example, the PLU has transmitted a complete form image and expects the next transmission to be from the display operator when the blank fields in the form image are filled in.

Figure 7-5 illustrates the commands received for each session and the state of data traffic in each session. Figure 7-6 illustrates the commands transmitted by the SLU.

Figures 7-7 through 7-13 are examples to further illustrate the usage of Bracketing, Chaining, and Change Direction on an LU-LU session.

SNA COMMAND RECEIVED	SSCP-PU SESSION ACTIVE	UNOWNED SESSION ACTIVE	LU-LU SESSION ACTIVE	LU-LU SESSION PROCESSING STATES			
				DATA TRAFFIC RESET		IN BRACKET	
				ON	OFF	ON	OFF
ACTLU	R	E	T				
ACTPU	E	T	T				
DACTLU	R	T	T				
DACTPU	R,T	T	T				
BIND	R	R	E,I	X			X
UNBIND	R	R	R,T				
CANCEL	R	R	R		R		
CHASE	R	R	R		R	R	
CLEAR	R	R	R	X			X
SDT	R	R	R	R	X		
SIGNAL	R	R	R		R		
SHUTDOWN	R	R	R		R		
FM DATA	R	R	R		R	R	

LEGEND:

R -- REQUIRED STATE FOR THIS COMMAND TO BE VALID.
I -- COMMAND INVALID IF IN THIS PROCESSING STATE
E -- COMMAND ESTABLISHES THIS SESSION.
T -- COMMAND TERMINATES THIS SESSION.
X -- COMMAND SETS THE PROCESSING STATE TO THE INDICATED STATUS.

40-00600

Figure 7-5. SNA Commands Received

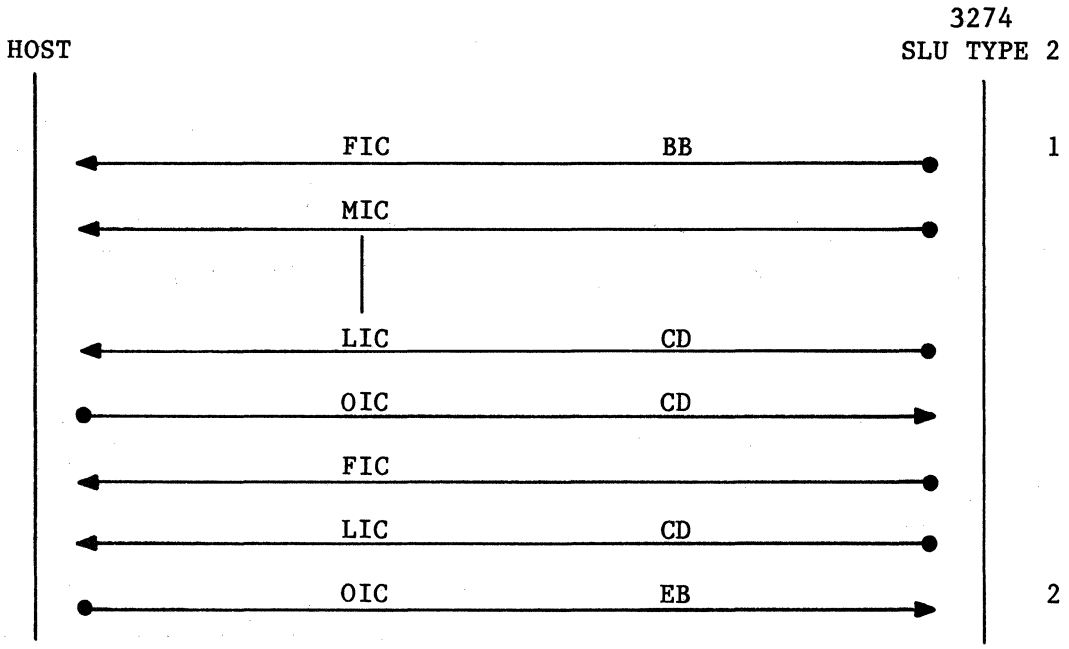
SNA COMMAND SENT	SSCP-PU SESSION ACTIVE	UNOWNED SESSION ACTIVE	LU-LU SESSION ACTIVE	LU-LU SESSION PROCESSING STATES			
				DATA TRAFFIC RESET		IN BRACKET	
				ON	OFF	ON	OFF
LUSTAT	R	R	R		R		
SIGNAL	R	R	R		R		
CANCEL	R	R	R		R	R	
READY TO RECEIVE	R	R	R		R		R
SHUTDOWN COMPLETE	R	R	R		R		R
FM DATA	R	R	R		R	R	

LEGEND:

R -- REQUIRED STATE FOR THIS COMMAND TO BE VALID.

40-00601

Figure 7-6. SNA Commands Transmitted

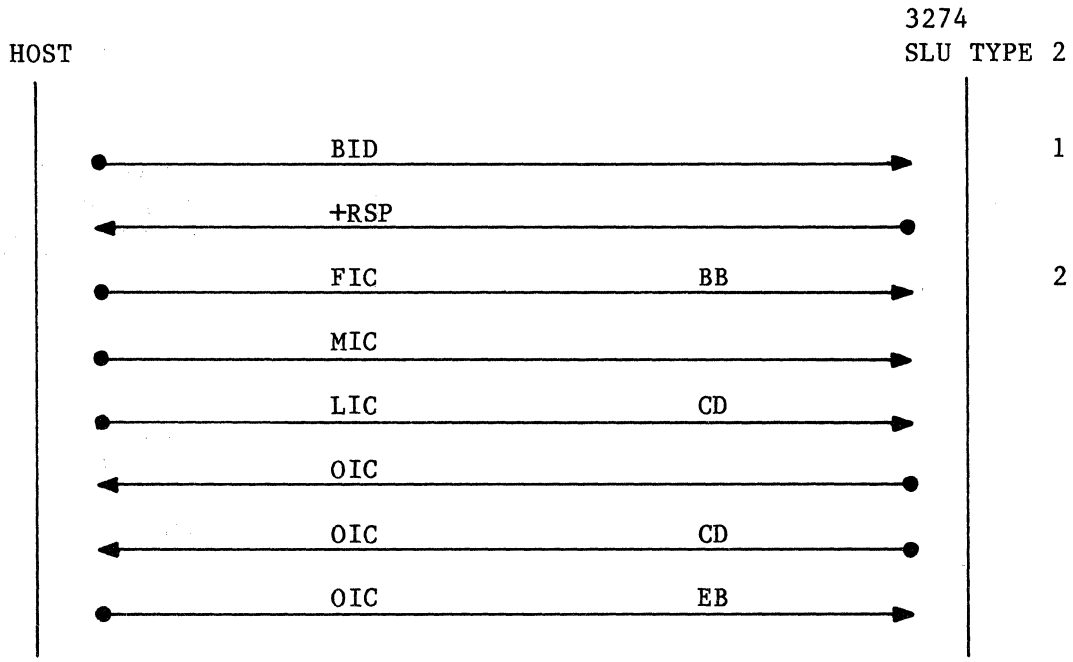


1 INITIAL CONDITIONS: SESSION ESTABLISHED AND BOTH ENDS IN CONTENTION BETWEEN BRACKET STATE. SLU TYPE 2 INITIATES A BRACKET AND SENDS A CHAIN AS A RESULT, FOR EXAMPLE, OF ENTER KEY DEPRESSION.

2 AFTER THE REQUIRED EXCHANGE OF CHAINS IS COMPLETED, THE HOST ENDS THE 'UNIT OF WORK' BY SENDING EB (AN LU TYPE 2 CANNOT SEND EB). THE EB CHAIN MAY CONTAIN DATA: FOR EXAMPLE, A WRITE TO THE SCREEN: OR IT MAY BE A NULL RU CHAIN, THAT IS, ONLY RHs.

40-00602

Figure 7-7. Bracket/Chain -- LU Type 2 Initiated (without contention)



1 INITIAL CONDITIONS: SESSION ESTABLISHED AND BOTH ENDS IN CONTENTION BETWEEN BRACKET STATE. HOST SENDS BID TO INDICATE INTENTION TO BEGIN A BRACKET.

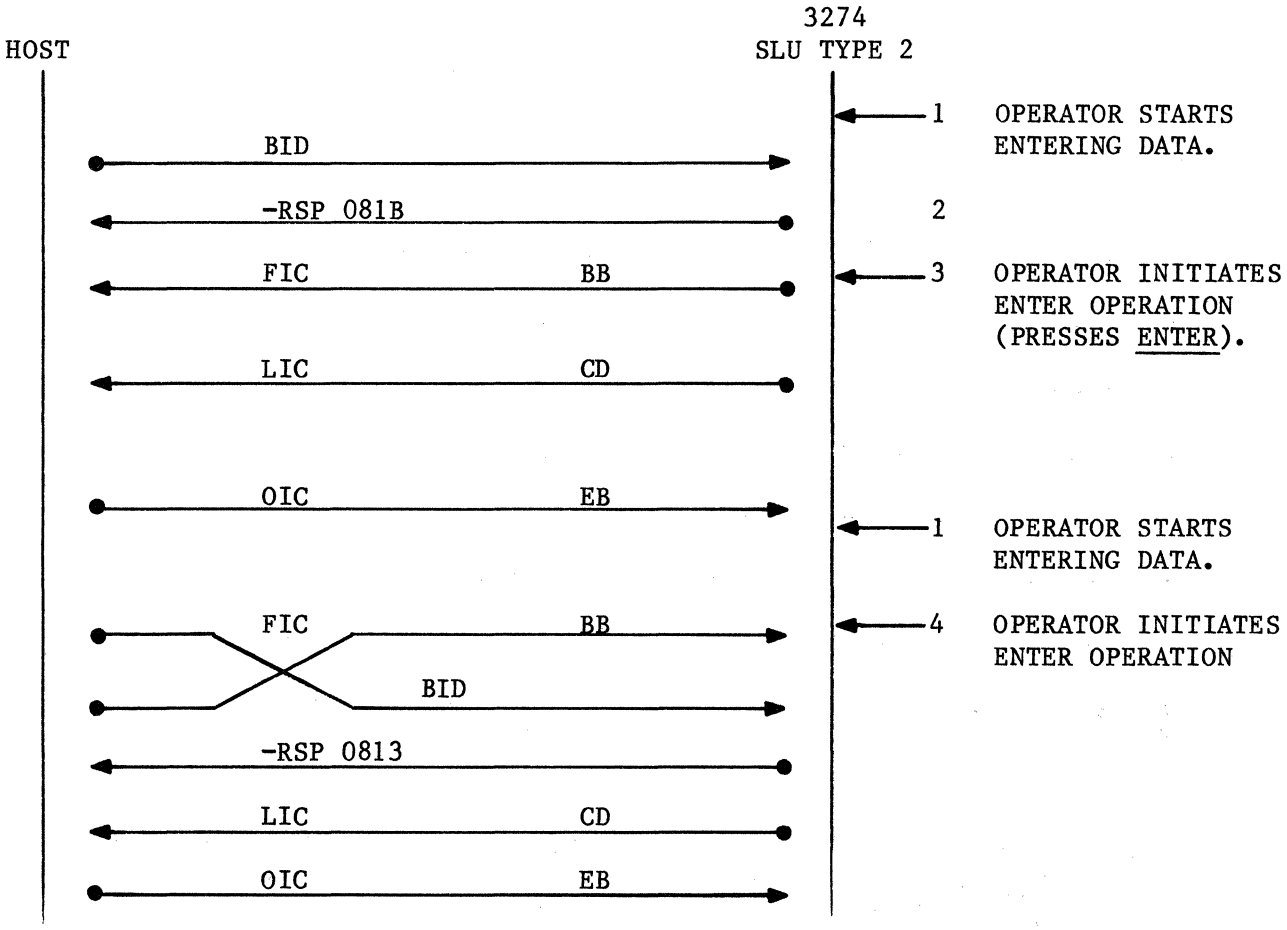
2 THE +RSP WAS SLU TYPE 2, GO AHEAD TO THE HOST. THE HOST INITIATED THE 'UNIT OF WORK' WITH BB.

NOTE

THE HOST HAS THE OPTION OF GOING DIRECTLY TO 2, THAT IS, SKIPPING THE BID. HOWEVER, THERE IS A POSSIBILITY OF BID REJECTION WHICH WOULD RESULT IN RESENDING THE DATA ASSOCIATED WITH 2.

40-00603

Figure 7-8. Bracket/Chain -- Host Initiated (without contention)



1 INITIAL CONDITIONS: SESSION ESTABLISHED AND BOTH ENDS ARE IN BETWEEN BRACKET STATE. THE FIRST OPERATOR KEYSTROKE PUTS THE TYPE 2 SLU IN THE SEND (BUT NOT TRANSMITTING) STATE.

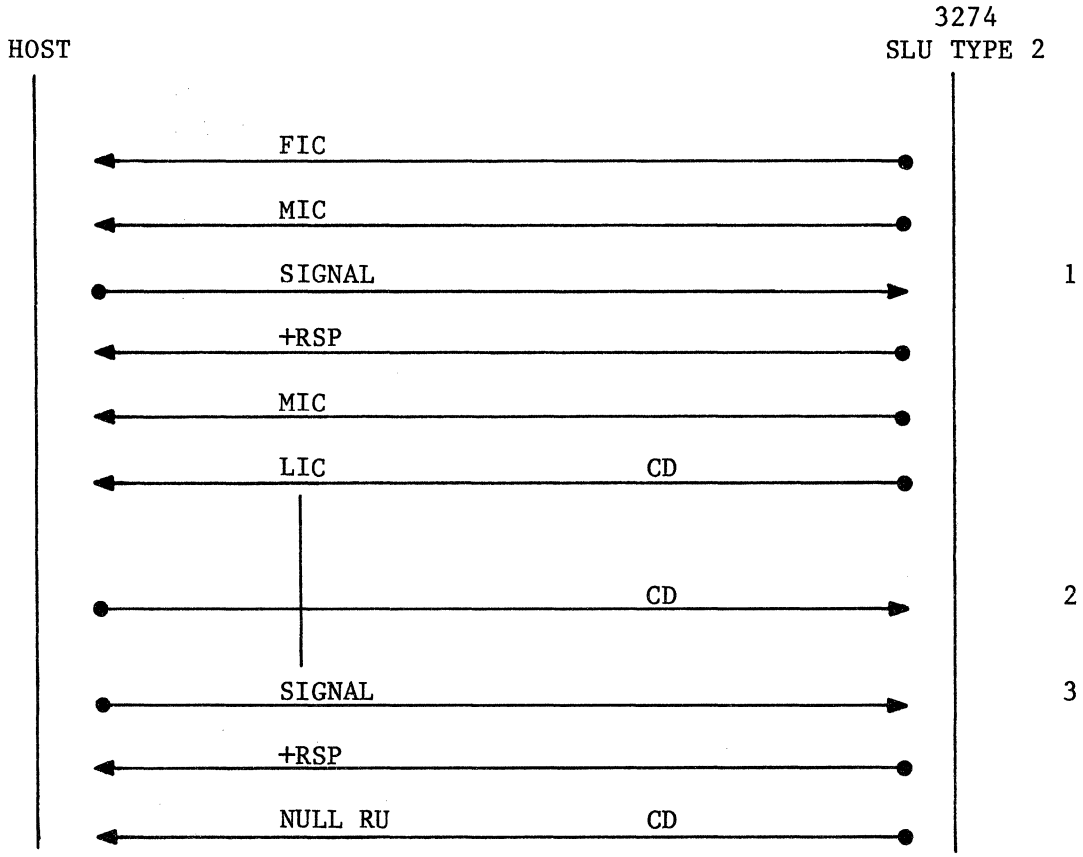
2 THE TYPE 2 SLU WILL REJECT A BID (OR BB) WITH 081B, RECEIVER IN TRANSMIT MODE.

3 THE OPERATOR INITIATES AN ENTER OPEATION: FOR EXAMPLE, HE PRESSES THE ENTER KEY. THE TYPE 2 SLU BEGINS A BRACKET AND TRANSMITS THE OPERATOR-ENTERED DATA.

4 WHEN THE OPERATOR PRESSES THE ENTER KEY, TYPE 2 SLU GOES TO IN BRACKET (INB) STATE. TYPE 2 SLU BEGINS A BRACKET AND STARTS SENDING DATA. THE HOST END HAS SENT A BID (OR BB) BEFORE THE TYPE 2 SLU FIRST CHAIN ELEMENT WAS RECEIVED. THE TYPE 2 SLU REJECTS THE BID (OR BB) WITH 0813. THE SENSE CODE DIFFERS FROM REFERENCE 2 BECAUSE THE BRACKET CHECK IS MADE BEFORE THE HDX STATE CHECK. IN REFERENCE 2, THE BRACKET CHECK WAS GOOD.

40-00604

Figure 7-9. Bracket/Chain -- Host/SLU Contention



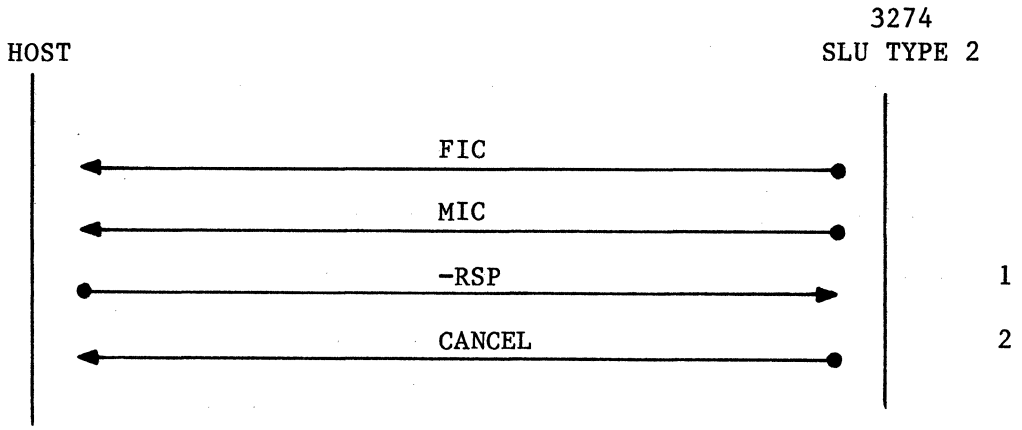
1 THE SLU TYPE 2 RECEIVES SIGNAL WHILE SENDING. THE +RSP IS RETURNED TO ACKNOWLEDGE RECEIPT OF SIGNAL. SIGNAL IS EFFECTIVELY TREATED AS A NO-OP, AND SLU COMPLETES SENDING OF THE CHAIN. THE SLU TYPE 2 ALWAYS SENDS CD WITH THE END OF A DATA CHAIN.

2 CD ALLOWS THE SLU TO SEND. THE OPERATOR STARTS KEYING IN DATA.

3 BEFORE THE OPERATOR INITIATES SENDING OF DATA, FOR EXAMPLE, PRESSES THE ENTER KEY, THE HOST SENDS SIGNAL. THE SLU SENDS +RSP TO SIGNAL, LOCKS THE KEYBOARD, AND SENDS CD.

40-00605

Figure 7-10. Signal from Host



1 THE TYPE 2 SLU RECEIVES -RSP TO A CHAIN ELEMENT.

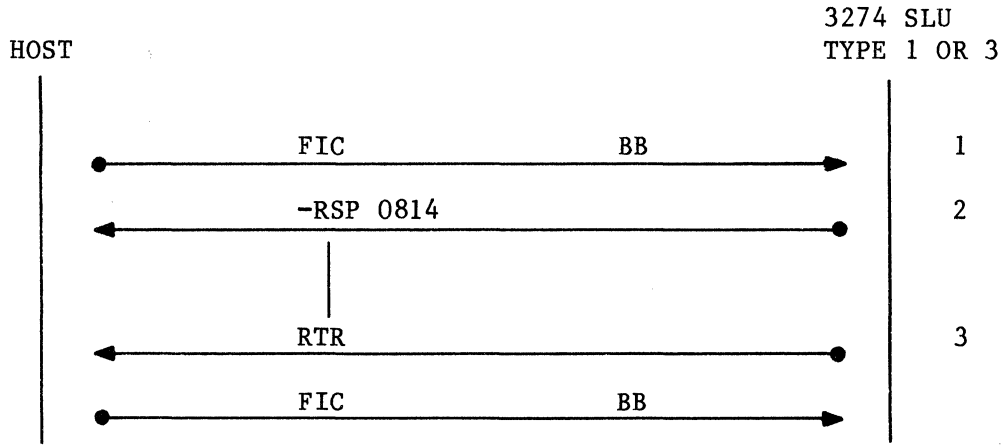
NOTE

NORMALLY, THE 3274 WILL NOT EXAMINE ANY RESPONSE UNTIL THE ENTIRE CHAIN HAS BEEN SENT AND WILL THEREFORE NOT SEND CANCEL AS THE RESULT OF RECEIVING A -RSP. HOWEVER, WHEN INBOUND PACING IS IN EFFECT, RESPONSES ARE EXAMINED WHEN THE SLU MUST RECEIVE A PACING RESPONSE BEFORE CONTINUING TRANSMISSION. A -RSP WILL THEN BE DETECTED AND CAUSE CANCEL TO BE SENT.

2 THE TYPE 2 SLU SENDS CANCEL TO DIRECT THE HOST TO DISCARD THE CHAIN ELEMENTS ALREADY RECEIVED. THE SLU GOES TO RECEIVE STATE, WAITING FOR HOST/RECOVERY ACTION.

40-00606

Figure 7-11. Cancel, SLU Type 2 Sending



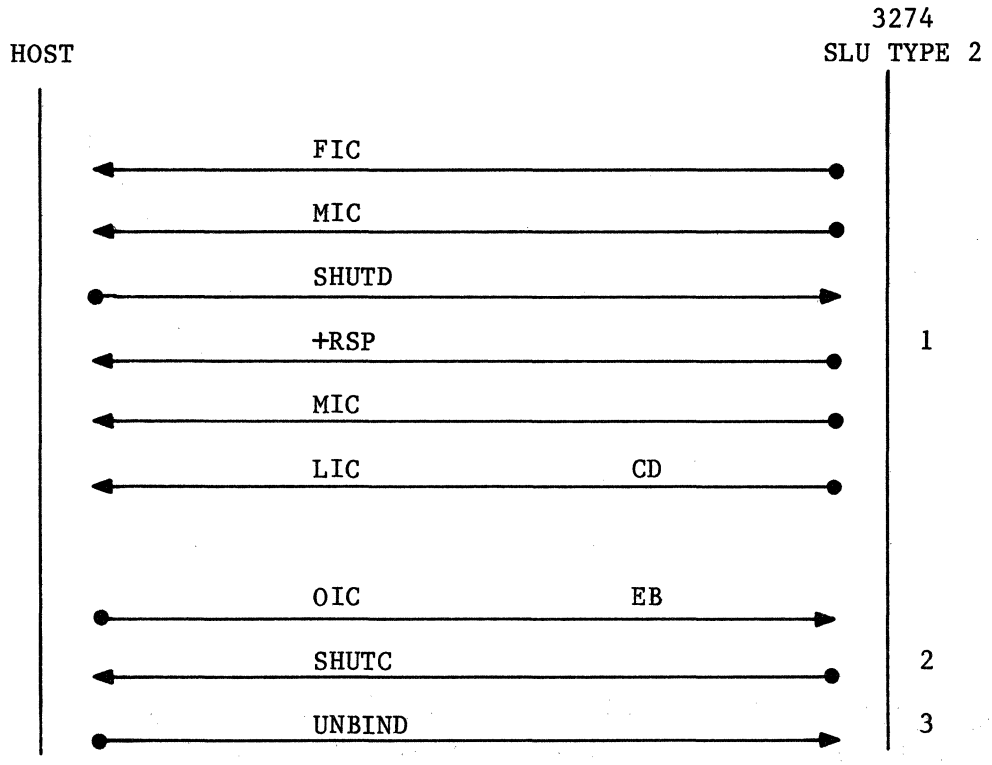
1 THE PRINTER ASSOCIATED WITH THE SLU TYPE 1 OR 3 IS NOT AVAILABLE BECAUSE A LOCAL COPY IS BEING DONE. CONSEQUENTLY, THE SLU TYPE 1 OR 3 CANNOT HONOR THE HOST BB (OR BID).

2 THE SLU TYPE 1 OR 3 REJECTS BB (OR BID) WITH -RSP X'0814' (BRACKET REJECT, RTR TO FOLLOW).

3 THE PRINTER BECOMES AVAILABLE, AND SLU TYPE 2 OR 3 SENDS RTR TO INDICATE TO THE HOST THAT A BRACKET MAY BE STARTED.

40-00607

Figure 7-12. RTR -- LU Type 1 or LU Type 3 Send



1 THE SLU TYPE 2 IS ALERTED THAT THE HOST WANTS TO SHUT DOWN. HOWEVER, A SYNCHRONIZING EB MUST BE RECEIVED BEFORE EFFECTING SHUTDOWN.

2 THE SLU GOES INTO SHUTDOWN; THAT IS, INBOUND NORMAL FLOW (INCLUDING SIGNAL) IS INHIBITED.

3 THE HOST TERMINATES THE SESSION.

NOTE

THE HOST COULD CLEAR THE CONDITION AND CONTINUE BY SENDING CLEAR, SDT INSTEAD OF TERMINATING THE SESSION.

40-00608

Figure 7-13. Shutdown/Shutdown Complete

7.2.4 Request Maintenance Statistics Command

The Request Maintenance Statistics (REQMS) command is sent by the SSCP to the 3274 PU to request that specific network management information be returned via the RECFMS request. REQMS is sent on the normal flow and has the HS header X'410304'. The 3274 PU responds to the REQMS requests for Link Test Statistics (Type Code X'01'), Summary Error Data (Type Code X'02'), Communication Adapter Data (Type Code X'03'), and EC Levels (Type Code X'05'). The 3274 PU returns a positive response to the REQMS and then returns the maintenance statistics requested via a RECFMS request unit. The format of the REQMS request unit is as follows:

Link Test Statistics

Bytes	3-4	X'0000'
	5-6	Reserved -- contents of this field are echoed in REQFMS response.
	7	Bit 0 -- reset indicator (when 1, reset counters after REQFMS is sent)
		Bits 1-7 -- Type code = '0000001'

Summary Error Data

Bytes	3-4	'0000'
	5-6	Reserved -- contents of this field are echoed in REQFMS response.
	7	Bit 0 -- Reset indicator (when 1, reset counters after REQFMS is sent)
		Bits 1-7 -- Type code = '0000010'

Communication Adapter Data

Bytes	3-4	X'0000'
	5-6	Reserved -- contents of this field are echoed in REQFMS response
	7	Bit 0 -- reset indicator (when 1, reset counters after RECFMS is sent)
		Bits 1-7 -- Type code = '0000011'

EC Levels

Byte	3-4	X'0000'
	5-6	Reserved -- contents of this field are echoed in REQFMS response
	7	Bit 0 -- always 0
		Bits 1-7 -- Type code = '0000101'

Possible negative response to REQMS is Sense = X'080C000', this is returned when the type code is not supported. Another negative response possible is X'10030000' "Function Not Supported" if RU-0 through RU-2 is not equal to X'410304'. PU "not active" X'8008' is sent if the PU is not active when the REQMS is received. Record Formatted Maintenance Statistics (RECFMS) is sent by the 3274 PU to the SSCP to communicate pertinent network management information. It is sent in response to REQMS, in which case the format of the RECFMS RU is dictated by the type code received in REQMS. The format of the RECFMS request units supported are as follows:

Byte	0-2	X'410384'

(The remaining bytes of the RU depend on the type code.)

Link Test Statistics

3-4	X'0000'
7	bit 0, solicitation indicator: 1 = solicited; sent in reply to REQMS bits 1-7, type code: B'0000001'
8-11	Station ID: bits 0-11 block no. of sending PU bits 12-31, specified ID of sending PU = X'01700000'
12-13	Reserved: Always 0
14-15	Counter: The number of times the secondary SDLC station has received an SDLC Test command.
16-17	Counter: The number of times the secondary SDLC station has transmitted an SDLC Test command -- always 0

(All counters in binary)

Summary Error Data
(Never Sent Unsolicited)

Bytes	3-4	X'0000'
	5-6	Reserved -- contents of this field are echoed in REQFMS response.
	7	bit 0, solicitation indicator: 1 = solicited, sent in reply to REQMS bits 1-7, Type code: B'0000010'
	8-11	Station ID: bits 0-11, block no. of sending PU bits 12-31, specific ID of sending PU = X'01700000'
	12-13	Reserved
	14	Summary counter validity mask: bit 0, set to 1 product check counter is valid bit 1, set to 1 communication check counter is valid bit 2, set to 1 SNA error counter is valid bits 3-7, reserved and is always 0
	15-16	Reserved and is always 0
	17-18	Machine check counter (Incremented on: invalid tumble table address, invalid keyboard character, PTS control unit to printer controller LRC error, error status returned from printer controller)
	19-20	Communication check counter (Incremented on: receipt of SDLC DISK command, invalid N_r count received, inconsistent mapping field received, inconsistent sequence number field received, PU not active sense returned, any communication adapter data counter incremented, and invalid C' field received)

NOTE

When one of the Summary Counters reaches its maximum value, it stays at that value until reset by a request from the host.

Communication Adapter Data

Bytes	3-4	X'0000'
	5-6	Reserved -- contents of this field are echoed in REQFMS response.
	7	Bit 0, solicitation indicator 1 = solicited, sent in reply to REQMS 1-7, Type code: B'000011'
	8-11	Station ID: Bits 0-11, block no. of sending PU Bits 12-31, specific ID of sending PU = X'01700000'
	12-13	Reserved and is always 0
	14	Adapter type: X'01' SDLC link adapter
	15	Communication adapter counter validity mask, byte 1 = X'5F' bit 0, set to 0, nonproductive timeout Receive Overrun counter is not valid. bit 1, set to 1 idle timeout counter is valid bit 2, set to 0 write retry counter is not valid bit 3, set to 1 overrun counter is valid bit 4, set to 1 underrun counter is valid bit 5, set to 1 connection problem counter is valid bit 6, set to 1 FCS error counter is valid bit 7, set to 1 primary station abort counter is valid
	16	Commmunication adapter counter validity mask, byte 2 = X'EO' bit 0, set to 1 command reject counter is valid bit 1, set to 1 DCE error counter is valid bit 2, set to 1 write timeout counter is valid bit 3, set to 0 invalid status counter is not valid bit 4, set to 0 I/O machine check counter is not valid bits 5-7 Reserved and are always 0
	17	Reserved and is always 0
	18	Non-productive Timeout/Receive Overrun Counter, always 0
	19	Idle timeout counter, incremented when communications timer from host times out
	20	Write retry counter, always 0

Bytes	21	Overrun counter, incremented on receiving oversize frame or overflow of internal IOCQ entries
	22	Underrun counter, incremented on receipt of error transmit status from SDLC adapter
	23	Connection problem counter, incremented on receipt of 20 ROLs, XIDs, or CMDRs
	24	FCS error counter, incremented on receipt of FCS in error
	25	Primary station abort counter, incremented on receipt of abort
	26	Command reject counter, incremented on transmission of SDLC command reject (CMDR)
	27	DCE error counter, incremented on receipt of error status from SDLC adapter on receive order line error, and receive device not ready status
	28	Write timeout counter, incremented when transmit order to SDLC adapter times out

EC Levels

Bytes	3-4	X'0000'
	5-6	Reserved -- contents of this field are echoed in REQFMS response.
	7	Bit 0, solicitation indicator 1 = solicited, sent in reply to REQMS bits 1-7, Type code: B'0000101'
	8-11	Station ID: bits 0-11, block no. of sending PU bits 12-31, specific ID of sending PU = X'01700000'
	12-13	Reserved and are always 0
	14-72	Implementation defined data describing configuration level:

X' 00 64 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
10 00 10 00 00 00 00 00 00 00 00 00 00 00 00'

The counters returned within the RECFMS request types 1, 2, and 3 are cleared after being returned in response to REQMS if bit 0 of bytes 7 indicate so.

NOTE

Messages to the SSCP are not sequenced or paced, always require a definite response, and are always in EBCDIC.

7.3 Session Error Reporting

A protocol has been established for the reporting of transmission errors and processing errors during sessions. When the host program or the SLU is the receiving LU, errors are reported by returning a negative response to the sending LU, with descriptive sense data included.

The format of the four-byte sense data RU, sent with a negative response, is as follows:

0	1	2 or 3
System Major Code	Sense Modifier	User Sense

Byte 0 of the sense RU is bit-encoded to reflect one of six transmission error categories, as follows:

Byte 0 in Hex	Major Code
'80'	Path Error
'40'	RH Error
'20'	State Error
'10'	Request Error
'08'	Request Reject
'00'	User-Defined Error

Byte 1 of the sense data RU is a binary modifier that further defines the error condition. The modifier encoding is unique to each major code.

Bytes 2 and 3 are zero.

NOTE

All negative responses cause the 3274 to enter ERP1 state and await further action by the host.

7.3.1 SNA Sense Modifier Codes

Each major error code has modifiers for further description in sense byte 1. The modifier codes supported and the controller or terminal condition causing the negative response to be returned are described in Table 7-3.

Table 7-3. SNA Sense Modifier Codes

Sense Byte One	Description
Path Error X'80'	
X'04'	Unrecognized DAF The DAF received in the TH was not configured on the system.
X'05'	NO Session A Bind has not been received or accepted by the 3274. A request other than Bind is sent to an SLU which has already accepted a Bind, and the OAF is not X'00' or the OAF in the accepted Bind.
X'08'	PU Not Active The 3274 has not received or accepted an ACTPU, or a control condition caused an internally generated DACTPU.
X'09'	LU Not Active The 3274 has not received or accepted an ACTLU, or control condition caused an internally generated DACTLU.
X'0F'	Invalid Address Combination A request was addressed to the PU (DAF = X'00'), and the OAF was not SSCP (OAF = X'00').

Table 7-3. SNA Sense Modifier Codes (Cont)

Sense Byte One	Description
RH Error X'40'	
X'06'	Exception Response Not Allowed LIC carried exception response when Bind specified definite response.
X'07'	Definite Response Not Allowed LIC carried definite response when Bind specified exception response or LIC carried definite response.
X'0A'	No-Response Not Allowed A chain element did not have DR1, DR2, or the exception bit set to 1.
X'0F'	Format Indicator Not Allowed An FM request received by the 3274 indicated formatted header included.
State Error X'20'	
X'01'	Sequence Number Error The sequence number of the normal flow request did not match the number expected by the 3274.
X'02'	Chaining Error Chain elements were out of protocol sequence.
X'03'	Bracket State Error A Bracket state error occurred.
X'04'	Direction Error A normal flow without begin bracket was received while the 3274 was in Send state.
X'05'	Data Traffic Reset An FM or DFC request was received before an SDT was received or accepted.

Table 7-3. SNA Sense Modifier Codes (Cont)

Sense Byte One	Description
Request Error X'10'	
X'03'	Function Not Supported Unsupported Session Control Request Unsupported Data Flow Control Request SIGNAL Code is not X'00010000' Network Control Request FM Data Stream Invalid Command Unsupported Fields in the RH -- Data Following a Read, RM, RMA, or EAU command -- For LU Type 3, any Read, RM, or RMA command
X'05'	Parameter Error Invalid address following SBA, RA, or EUA order or SCS parameter error
X'07'	Category Not Supported An FMD request from the SSCP was received by an SLU which is a printer. An unsupported network service message received
Request Reject X'08'	
X'01'	Resource Not Available LU Type 2 -- A printer is not allowed by the Authorization Matrix. For LU Type 1 or 3, Bind reject because printer is authorized for Local mode only. For LU Type 1, outbound pacing algorithm is overrun.
X'02'	Intervention Required (on principal device) For LU Type 1 or 3, printer condition such as end of form, paper jam, printer cover up, or hold timeout

Table 7-3. SNA Sense Modifier Codes (Cont)

Sense Byte One	Description
Request Reject X'08' (Cont)	
X'05'	Session Limit Exceeded A Bind was received whose OAF' differs from the PLU already bound.
X'06'	PLU Unavailable The operator has attempted to logon to an application not resident in the host.
X'07'	Subsidiary Device Temporarily Not Available For LU Type 2, a printer to be copied to is in Bracket on an LU Type 1 or 3 session, or an operator has depressed the DEVICE CANCEL key.
X'0A'	Permission Rejected Display or printer power is off. The SSCP will not be notified when the device power is on.
X'11'	Break Sent on LU Type 1 when the operator deselects the printer and depresses the CANCEL key, if a chain has not completed printing.
X'13'	Bracket Bid Reject -- (No RTR) Returned by LU Type 2 to a BID with Begin Bracket if the display has won contention and started a bracket
X'14'	Bracket Bid Reject -- (RTR to follow) For LU Type 1 or 3, the printer is busy with local copy from a display. RTR will be returned when the printer becomes not busy with local copy.
X'15'	Function Active Bind reject if the same OAF' already has an accepted Bind to the SLU

Table 7-3. SNA Sense Modifier Codes (Cont)

Sense Byte One	Description
Request Reject X'08' (Cont)	
X'1B'	Receiver in Transmit Mode The SLU is Between Bracket but a Data key has been depressed. An FM message was received from the SSCP while the display was owned by the PLU-SLU session. An SSCP FM message is rejected if local copy is taking place while the SSCP-SLU session owns the display.
X'1C'	Request Not Executable The 3274 has a nonrecoverable error.
X'21'	Invalid Session Parameters Bind parameters do not match the 3274 Bind checks. 3274 rejects an ACTPU or ACTLU if FM/TS profile byte is mpt X'01'
X'29'	Change Direction Required A 3274 Read-type command was received without a Change Direction, or with an End Bracket.
X'2B'	Presentation Space Integrity Lost An operator has cleared the display by switching to SSCP-SLU session and returned to PLU-SLU session.
X'2D'	SLU Busy LU Type 2 display is owned by SSCP-SLU session.
X'2E'	Intervention Required at Subsidiary Device For LU Type 2, a printer being copied to from a host-initiated print has intervention required type error. Refer X'0802'. Printer power off or not attached to the controller is included in this category.

Table 7-3. SNA Sense Modifier Codes (Cont)

Sense Byte One	Description
Request Reject X'08' (Cont)	
X'2F'	Request Not Executable because of LU Subsidiary Device For LU Type 2, a printer being copied to has a nonrecoverable error.
X'30'	Resource Not Available The device does not have a SYSTEM REQUEST key.
X'31'	LU Component Disconnected This response is returned if the device attached to the 3274 cannot be contacted by a device poll. This is due to device power off, cable detached from the controller part, or connecting cable broken.
X'43'	Required Function Manager Synchronization Not Supplied For LU Type 2 or 3 chains having the print bit on must be definite response, or exception response chain must carry CD.

7.3.2 Logical Unit Status (LUSTAT)

LUSTAT provides a means for the SLU to report exception conditions or status when the SLU is not in Receive state (a negative response is used when the SLU is in Receive state). The following are the CD settings that accompany LUSTAT and the state changes, if any, that occur:

SLU State when LUSTAT Sent	CD Setting	State Change
BETB	CD may be set	None
ERP1	CD not set	None
Send	CD set for principal device	To Receive
	CD not set for subsidiary device	

Inbound LUSTATs are sent with exception response by the 3274.

The following status codes will be used by 3274 to send information to the PLU, on the PLU-SLU session (Table 7-4).

Table 7-4. LUSTAT Values

Value	Explanation
X'0001Z000'*	Device now available; presentation space integrity is not destroyed
X'00020000'	Device has received CD, but has no input mechanism
X'081CZ000'*	Component Failure; Permanent Error
X'082B0000'	Device available; presentation space integrity lost
X'08310000'	Principal device is powered off or disconnected
X'0801Z000'	Printer has been removed from configured status

* Where Z specifies whether the status refers to the principal or subsidiary device. (Refer to subsection 7.2.7 for a description of principal and subsidiary devices.) The value of Z is defined as follows:

LU Type 1 Principal (printer)	Z = 0
LU Type 2 Principal (display)	Z = D
LU Type 2 Subsidiary (printer)	Z = B
LU Type 3 Principal (printer)	Z = 0

The priority of these status codes, in low to high order is assigned as:

LUSTAT Returned

NEGATIVE RESPONSE CODE	LU Type LU TYPE			
	T1	T2	T3	SSCP
0802	00010000 082B0000 081C0000 08310000	0001D000 082B0000 081CD000 08310000	00010000 082B0000 081C0000 08310000	NA
0807	NA	0001B000 0801B000 081CB000 081CD000	NA	NA
082D	NA	0001D000 082B0000 081CD000	NA	NA
082E	NA	0001B000 0801B000 081CB000 081CD000	NA	NA
0831	082B0000 081C0000	082B0000 081CD000	082B0000 081C0000	NA NA

Definition: (S,*R) = Send State, ERP1 state, or BETB state.

The upper section of the above illustration shows the LUSTAT codes that are returned to indicate recovery from the negative response condition listed in the left column. The lower section lists the LUSTAT codes that are used to report an SLU error condition instead of a negative response. The Xs show the sessions that use the code points.

The usages of LUSTAT are as follows:

Definition: (S,*R) = Send State, ERP1 state, or BETB state, for all LU types, when the 3274/6 has sent -RSP with X'0802' or X'082E' and this condition is reset, LUSTAT with X'0001P000' will be sent: Where the value P is X'01' for LU Type 1 or 3, X'D' for LU Type 2 principal (display), and X'B' for LU Type 2 subsidiary device (printer).

If the presentation integrity is lost while an X'0802' condition exists, LUSTAT with X'082B0000' will be sent instead of X'0001P000' when the X'802' condition is reset.

For LU Type 2, when the 3274 SLU has sent -RSP with Secondary component c-7 available (X'0807') and this condition is reset, LUSTAT with X'0001B000' will be sent.

For LU Types 1 and 3 supported by the 3274, the LUSTAT X'00020000' will be sent to the PLU when the 3274 accepts a normal flow request carrying CD.

For LU Type 2, when the 3274 has sent -RSP (Device Busy) (X'082D') to a PLU request because of session ownership change from PLU to SSCP, a LUSTAT with X'082B0000' will be sent to the PLU when returning to PLU-SLU session.

For LU Type 2, when 3274 has sent -RSP (Device Busy) (X'082D') to a PLU because the SLU is busy executing a local copy, the 3274 sends LUSTAT X'0001D000' component now available to the PLU when the busy condition clears.

For LU Type 2, if a 3274 in (S,*R) state finds a permanent error in the subsidiary device, the deterioration of the previous condition will not be reported. Instead, LUSTAT X'0001B000' will be sent, and the next outbound request will be rejected with the proper sense code.

For LU Type 2, if the 3274 in (S,*R) state finds the subsidiary device has been configured from Local or Shared mode to System mode, LUSTAT X'0801B000' will be sent if a PLU copy request has not been cancelled. The next outbound request will be rejected with the proper sense code.

APPENDIX A

UNITED STATES I/O INTERFACE CODE, EBCDIC

Bits 4567	Hex 1 ↓	00 0	00 1	00 2	00 3	01 4	01 5	01 6	01 7	10 8	10 9	10 A	10 B	11 C	11 D	11 E	11 F
0000	0	NUL	DLE			SP	&	-						{	}	\	0
0001	1	SOH	SBA					/		a	j	~		A	J		1
0010	2	STX	EUA		SYN					b	k	s		B	K	S	2
0011	3	ETX	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			ETB						f	o	w		F	O	W	6
0111	7			ESC	EOT					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	ENQ	NAK	(	)	_	'								
1110	E		FM			+	;	>	=								
1111	F		ITB		SUB	|	¬	?	"								

← Bits 0,1
← Bits 2,3
← Hex 0

Character code assignments other than those shown above are undefined. If an undefined character code is programmed, the character will be displayed as a space. The character displayed by the PTS 3274 for a given undefined character code may be different for other devices.

NOTES

1. DUP key code -- displayed as $\overline{*}$, printed as *
2. Field mark code -- displayed as $\overline{;}$, printed as *
3. NL code -- displayed as ◢, printed as a]
4. EM code -- displayed as ◀, printed as an _ (underline) on Model 3401 or ← on 3412 printers

APPENDIX B

UNITED STATES I/O INTERFACE CODE -- ASCII

b7	b6	b5			0	0	0	0	1	1	1	1
					0	0	1	1	0	0	1	1
b4	b3	b2	b1	Hex 0 → / Hex 1 ↓	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p
0	0	0	1	1	SOH	SBA	!	1	A	Q	a	q
0	0	1	0	2	STX	EUA	"	2	B	R	b	r
0	0	1	1	3	ETX	IC	#	3	C	S	c	s
0	1	0	0	4	EOT	RA	$	4	D	T	d	t
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	6		SYN	&	6	F	V	f	v
0	1	1	1	7		ETB	'	7	G	W	g	w
1	0	0	0	8			(	8	H	X	h	x
1	0	0	1	9	PT	EM	)	9	I	Y	i	y
1	0	1	0	A	NL[3]	SUB	•	:	J	Z	j	z
1	0	1	1	B		ESC	+	;	K	[	k	{
1	1	0	0	C	FF	DUP[1]	,	<	L	\	l	¦
1	1	0	1	D		SF	-	=	M	]	m	}
1	1	1	0	E		FM[2]	.	>	N	^	n	~
1	1	1	1	F		ITB	/	?	O	_	o	

Character code assignments other than those shown above are undefined. If an undefined character code is programmed, the character will be displayed as a space. The character displayed by the PTS 3274 display for a given undefined character code may be different for other devices.

NOTES

1. DUP key code -- displayed as $\overline{*}$, printed as *
2. Field mark code -- displayed as $\overline{;}$, printed as *
3. NL code -- displayed as ◢, printed as a]

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