Description

IBM 3708
Network
Conversion Unit

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IBM 3708 Network Conversion Unit

GA27-3768-01

Federal Communications Commission (FCC) Statement

Warning: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

Instructions to User: In many instances, shielded cables and connectors must be used for connection to peripherals. Proper IBM cables are available from authorized dealers. The manufacturer is not responsible for any radio or television interference caused by using other than the recommended cables or by unauthorized modifications to this equipment; it is the responsibility of the user to correct such interference.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful:

How to Identify and Resolve Radio-TV Interference Problems

This booklet is available from the following:

FOB Public Contact Branch
Room 725
1919 M St. NW
Washington, DC 20554
Tele. (202) 634-1940

Consumer Assistance and
Small Business Division
Room 254
1919 M St. NW
Washington, DC 20554
Tele. (202) 632-7000

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This edition obsoletes GA27-3768-0.

Changes are made periodically to the information herein; before using this publication in connection with the operation of IBM systems or equipment, consult the latest *IBM System/370, 30xx and 4300 Processors Bibliography*, GC20-0001; *System/38 Bibliography*, GH30-0233; and *8100 Bibliography*, GC20-8100, for the editions that are applicable and current.

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About This Book

This book contains descriptive information about the IBM 3708 Network Conversion Unit. It describes the 3708, its advantages, operating modes, and hardware and software requirements.

It is intended to be used by people who need an in-depth description of the 3708's components and operation. To use the information, you should be familiar with the following:

- American National Standard Code for Information Interchange (ASCII)
- Asynchronous (start-stop) devices
- IBM 3270 Information Display System
- Systems Network Architecture (SNA).

This book is not a standalone reference for planning, installing, and operating. It is recommended that you read the information in the planning chapters of the *IBM 3708 Network Conversion Unit Planning and Installation*, GA27-3766, before installing the 3708. For operational information, read *IBM 3708 Network Conversion Unit End-User Reference*, GA27-3765.

How This Book Is Organized

This book contains eight chapters and six appendixes:

Chapter 1, "Introduction" introduces the 3708 and describes its components and functions.

Chapter 2, "3708 Operation" describes areas of operation including: LED steady states, configurations, logs, timers, and establishing and disconnecting a session.

Chapter 3, "SDLC and SNA Communication" provides information about establishing host-to-3708 communication using SNA protocols.

Chapter 4, "Protocol Conversion Mode" describes the 3708's protocol conversion mode of operation.

Chapter 5, "3708 Protocol Enveloping Mode" describes the 3708's protocol enveloping mode of operation.

Chapter 6, "ASCII Pass-Through Mode" describes the 3708's ASCII pass-through mode of operation.

Chapter 7, "Nonstandard Operations" describes the nonstandard operating bits field of the General Definition screen.

Chapter 8, "Network Management and Problem Determination" discusses the 3708's Communication Network Management support.

Appendix A, "Host Considerations" provides consideration and restriction information for host support of the 3708.

Appendix B, "3708 Security" discusses the 3708's security features.

Appendix C, "Suggested Guidelines for Increasing 3708 Performance" lists actions that increase the performance and throughput of the 3708.

Appendix D, "Personal Computer File Transfer through the 3708" provides helpful information for customers developing their own programs to transfer files through the 3708.

Appendix E, "Key Data Formats and Control Blocks" contains a brief description of the 3708 control blocks and data areas.

Appendix F, "IBM-Supplied Translate Tables" shows the standard 3708 translate tables for EBCDIC and ASCII characters.

This book also contains a glossary and an index.

Related 3708 Library Publications

The following lists books and information for the 3708:

- *IBM 3708 Network Conversion Unit Setup*, GA27-3611, is shipped with the 3708 and describes how to set up and test the 3708, how to handle setup problems, and how to prepare the 3708 for relocation.
- *IBM 3708 Network Conversion Unit Planning and Installation*, GA27-3766, describes planning and installation information.
- *IBM 3708 Network Conversion Unit Problem Determination*, GA27-3767, provides procedures for solving 3708 problems.
- Unpacking instructions are printed on the 3708 shipping carton and show how to unpack the 3708.
- *IBM 3708 Network Conversion Unit Problem Report*, GA27-3638, which is shipped with the 3708, provides a means of recording problem diagnosis information, that is used by repair center representatives.
- *IBM 3708 Network Conversion Unit End-User Reference*, GA27-3765, describes the procedures for operating the 3708 and the 3708 screens.
- *IBM 3708 Network Conversion Unit Registration Address Form* is shipped with the 3708. This card must be completed and returned to IBM for you to automatically receive notification of changes in the 3708 microcode.
- IBM 3708 reference cards describe the keyboard functions of ASCII displays that can be connected to a 3708 and describes the general procedures for terminal users.

The end-user devices and the 3708 reference card order numbers are:

End-User Device	Form No.
IBM Personal Computer (PC) in 3101 Emulation Mode with standard 3101 keyboard functions	SX27-3635
IBM 3101 Display Terminal Models 10, 12, 13, 20, 22, and 23	SX27-3633
IBM 3151, 3161, 3162, 3163, and 3164	SX27-3862
IBM 3151, 3161, 3162, 3163, and 3164 (3708 Feature)	SX27-3867
ADDS Viewpoint® Display Station	SX27-3636
ADDS Viewpoint®/78	SX27-3706
Beehive™ ATL-078	SX27-3645
Data General Dasher® D210 Display Terminal	SX27-3652
DEC® Model VT100	SX27-3638
DEC® Model VT220 (Emulating a VT100)	SX27-3790
DEC® Model VT220	SX27-3639
DEC® Model VT52	SX27-3637
FALCO 500®	SX27-3864
Hazeltine Esprit I™ and II™	SX27-3640
Hazeltine 1500	SX27-3641
Hewlett-Packard 2621B Interactive Terminal	SX27-3651
Lear Siegler ADM 24E	SX27-3703
Lear Siegler ADM 3A Dumb Terminal®	SX27-3642
Lear Siegler ADM 31™	SX27-3704
Northern Telecom Displayphone™	SX27-3653
ROLM Cedar	SX27-3649
ROLM Cypress	SX27-3648
ROLM Juniper	SX27-3650
Teletype 5410 Async. Display Terminal	SX27-3646
Teletype 5420	SX27-3647
TeleVideo® 910	SX27-3643
TeleVideo® 912C	SX27-3705
TeleVideo® 950	SX27-3644
User-Defined Terminal	SX27-3654
WY-50®	SX27-3865

Service Information

For service on 3708 hardware and microcode problems, call the following number in the United States or Puerto Rico:

1 800 428-2569 (toll free)

In other countries, call the appropriate support group.

Changes Since the Last Edition

This edition contains the following new information:

- Descriptions of additional support in the nonstandard operations field
- Descriptions of the enhanced terminal support, including:
  - IBM 3270 Models 2, 3, 4, and 5 emulation
  - Customized UDT names
  - Customized terminal logon initialization sequences.
- A description of a new host port inactivity timeout option
- A description of a new printer option, "Perform Newline at Begin Bracket (LU_3)."

Contents

Figures

Chapter 1. Introduction

This chapter introduces the 3708, describes its components and functions, and explains host and ASCII device attachment.

Overview

The 3708 provides a physical and logical interface for connecting ASCII end-user devices to an SNA network. It has 10 communication ports that can be defined for various network configurations and operating modes. The network can contain ASCII hosts, which include personal computers, as well as SNA hosts.

The 3708 accommodates a large range of ASCII devices, including devices that support ANSI X3.64, and allows attachment to both SNA and ASCII hosts. It allows an ASCII device to communicate with a host by providing three modes of operation, which the 3708 can perform simultaneously, for different network configurations:

- *3270 applications running on an SNA host.* The 3708 provides *protocol conversion* mode for communication between an ASCII end-user device and 3270 applications running on an SNA host. This mode changes a start-stop data stream from an ASCII device into a 3270 data stream and provides 3274 Control Unit functions, including 3270 full-screen support.
- *Line-by-line applications running on an SNA host.* The 3708 provides *protocol enveloping* mode for communication between an ASCII end-user device and line oriented applications running on an SNA host. In this mode, the 3708 surrounds the data stream from an ASCII device with SNA headers. Devices that normally communicate with host applications through start-stop support of the Network Terminal Option (NTO) can communicate through the 3708. NTO start-stop support is not required for 3708 operations and can be eliminated from the communication controller.
- *Applications running on an ASCII host.* The 3708 provides *ASCII pass-through* mode for communication between an ASCII display and applications running on an ASCII host. This mode passes a start-stop data stream between an ASCII display and an ASCII host without changing the data stream in any way.

Note: Throughout this book, the term *ASCII devices* is used to refer to end-user devices that use asynchronous and start-stop data transmission. These devices include displays, printers, keyboard printers, keyboard displays with attached printers, plotters, personal computers, and devices that use ANSI X3.64.

The 3708 is small, lightweight, and portable. It is made of two modular, customer-replaceable hardware components: a *base* and a *cartridge*. The cartridge is inserted into the front of the base. Ten ports for attaching hosts and ASCII devices are on the back of the 3708. The 3708 measures 400 mm by 355 mm by 105 mm (15.7 in. by 13.9 in. by 3.9 in.) and weighs about 5.6 kg (12 1/2 lb).

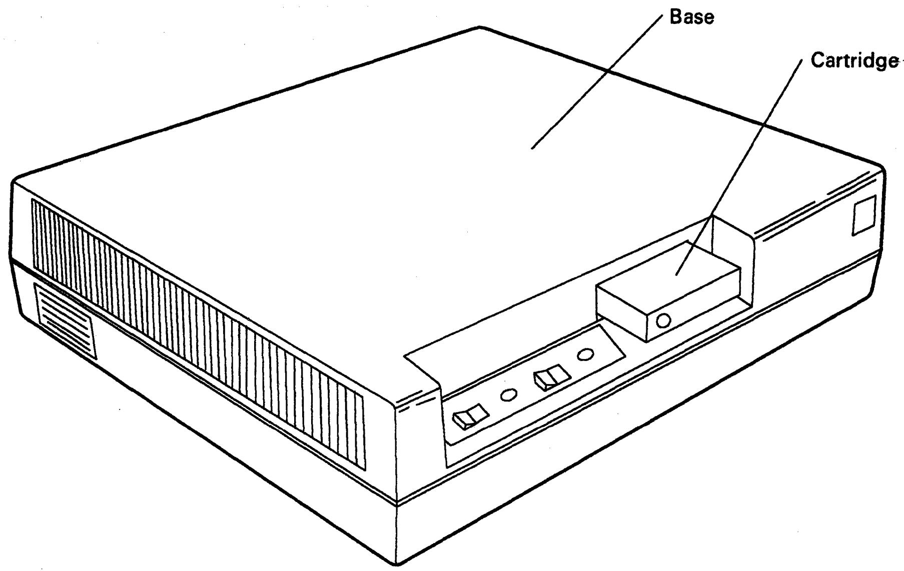

Figure 1-1. IBM 3708 Network Conversion Unit

Advantages

The 3708 provides the following major advantages:

- *It reduces communication costs* by reducing the number of telecommunication lines needed, by reducing the number of communication controller ports needed, and by allowing a display with a connected printer to share a single communication downstream line.
- *It supports personal computer file transfer* through the IBM PC/HOST File Transfer and Terminal Emulator Program (FTTERM).
- *It allows you to manage the configuration and microcode fixes* of the 3708s in a network from a central control point. This management capability is provided by 3708 Feature 3525 (Pluggable Cartridge with Central Site Configuration) and its associated PC aid.
- *It supports network management* by sending alert messages to NetView or to the Network Problem Determination Application (NPDA), and response time statistics to NetView or to the Network Logical Data Manager (NLDM) for displays that are connected for protocol conversion, and by notifying an SNA host of changes in the power status of attached ASCII end-user devices.
- *It supports multiple modes of operation.* Protocol conversion, protocol enveloping, and ASCII pass-through modes can be supported simultaneously.
- *It eliminates the need for NTO start-stop support in the communication controller* by providing protocol enveloping for ASCII end-user devices that are compatible with TWX 33/35.
- *It connects to most ASCII displays* using standard 128-character ASCII in protocol conversion mode. The 3708 provides ASCII-to-3270 keyboard mappings for many displays and allows additional keyboard mappings to be defined at the control terminal.
- *It supports IBM 3270 Models 2, 3, 4, and 5 emulation* when operating in protocol conversion mode.

- *It allows sharing of printers.* The printer can be defined to allow output from the host, local screen copies from one or more ASCII displays operating in protocol conversion mode, or both host output and local screen copies. It also supports printers that are connected to displays (MLU).
- *It reduces terminal costs* by allowing inexpensive ASCII end-user devices to be used in an SNA network.
- *It provides flexibility* by allowing a single ASCII device to be connected to either an SNA host or an ASCII host (which may be a personal computer) and by allowing access to ASCII and 3270 applications at an SNA host.
- *It helps in migrating to SNA* by allowing end users to access 3270 application programs through ASCII devices.
- *It provides security for data and applications* by allowing an optional password for each port, by allowing host and printer access to be defined, and by ending a session whenever it detects an abnormal disconnection.
- *It provides an optional inactivity timeout* that can be used to disconnect terminals, thereby reducing security exposures and limiting dial charges on switched lines.
- *It connects to devices that use special characters or nonstandard codes* by providing ASCII-to-EBCDIC translate tables. An additional translate table can be defined using the control terminal.
- *It allows the SNA host to dial-out* to devices in protocol enveloping mode.
- *It allows a display to dial out* to an ASCII host in ASCII pass-through mode.
- *It supports transparent operations* in protocol enveloping. Ports can be defined to allow transparent data flow to and from the host. This feature provides support for devices such as graphics displays, printers, and plotters.
- *It allows an operator to define the 3708 configuration* and to monitor and control the 3708 by using an ASCII display as a *control terminal.* A password protects access to control terminal functions. When not used as a control terminal, the ASCII display is available as an end-user device.
- *It allows a port to be defined to allow protocol conversion, protocol enveloping, or both* depending on the type of session requested by a host. All ports can be defined to allow ASCII pass-through.
- *It allows a port to be defined to automatically determine the parity and line speed* (from 110 to 4800 and 9600 bps) for both switched and nonswitched lines.
- *It attaches to the IBM cabling system.*
- *It has a built-in diagnostic test* that runs each time you turn the power on or initiate a restart at the control terminal.
- *It has a built-in, optional, extended diagnostic test program* that is available with port external wrap testing.
- *It provides a one-year warranty* and is supported by IBM service.

The 3708 in the Network

Of the 3708's ten ports, up to two can be used for attaching SNA hosts. No more than ten ports can be used for attaching any combination of ASCII hosts and ASCII devices.

A configuration with one SNA host and one ASCII host is shown in Figure 1-2.

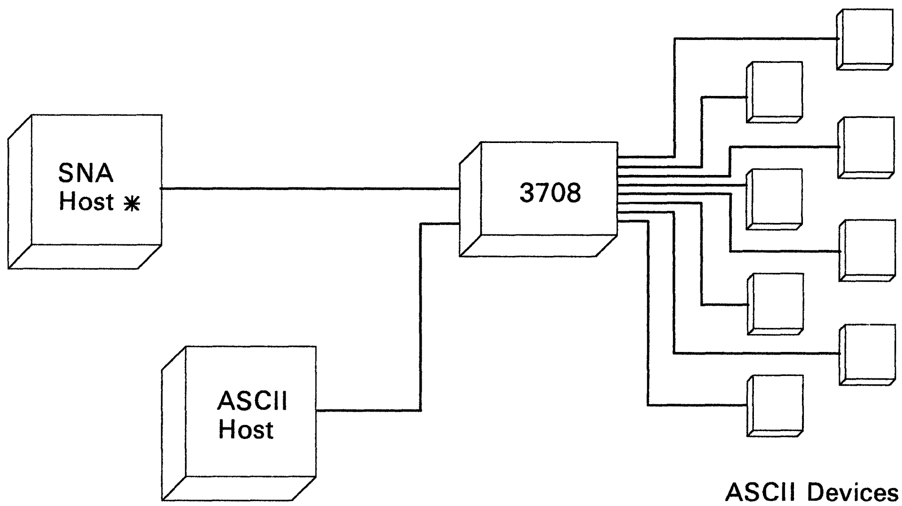

Figure 1-2. The 3708 in the Network

*For more information about attaching to an SNA host, see "SNA Hosts."

Hosts may be directly attached or may be remotely attached over nonswitched (leased) lines. ASCII devices may be directly attached or may be remotely attached over switched or nonswitched lines. Line speeds of up to 19.2 Kbps can be used.

Several ASCII devices can communicate with an SNA host simultaneously, and the data can be concentrated on a single line to the host. Several ASCII devices can communicate with an ASCII host simultaneously, but a separate line from the 3708 to the ASCII host is required for each device communicating at a time with that ASCII host.

The 3708 can have up to two SNA host connections, with both to the same SNA host or with each to a different SNA host. Figure 1-3 on page 1-5 shows the two kinds of dual connections.

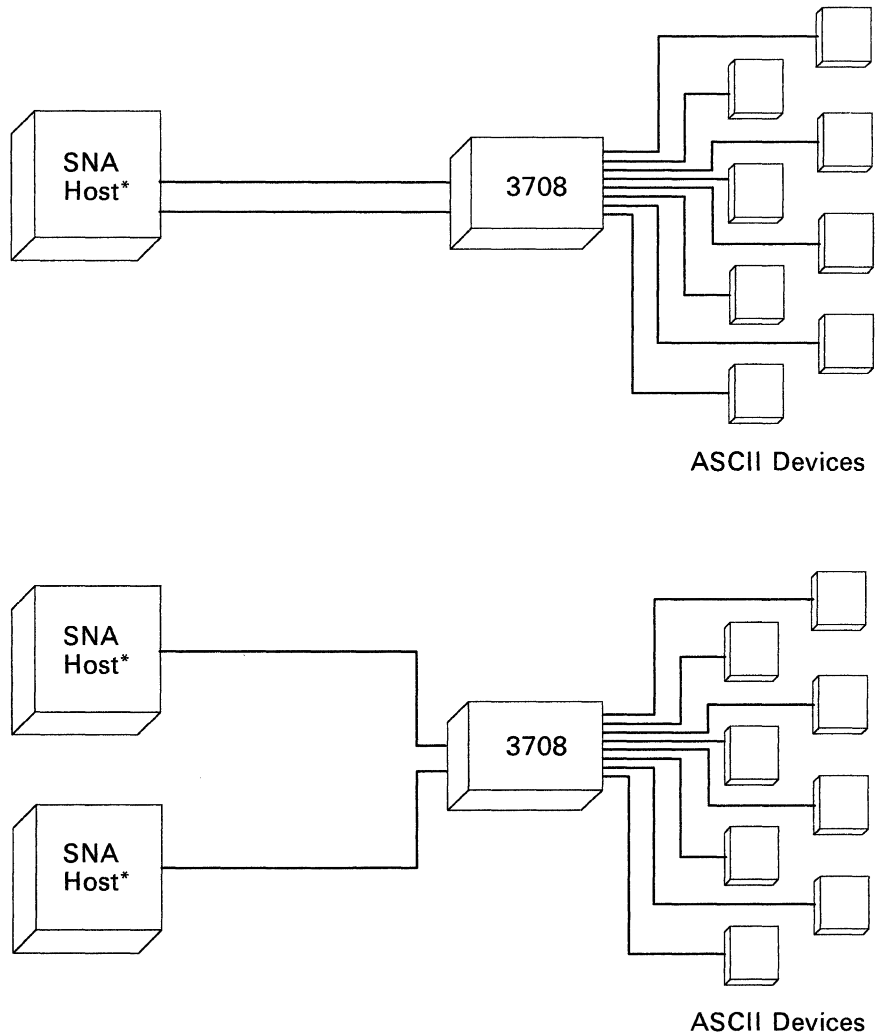

Figure 1-3. Two Kinds of Dual SNA Host Connections

*For more information about attaching to an SNA host, see "SNA Hosts."

Hardware Components of the 3708

The 3708 hardware consists of a base and cartridge. This section describes each of these parts.

3708 Base

The base contains the circuitry to operate the 3708. This includes:

- A Motorola MC68000 Microprocessor®
- EIA 232C Interface Drivers and Receivers
- EIA 422A Interface Drivers and Receivers
- A System Control Logic Module
- A red light emitting diode (LED), described in Chapter 2
- A green LED
- A power switch
- A test/normal switch
- 128K bytes of random access memory (RAM)

  The 128K of RAM is used for control blocks, buffers, and storing operational copies of the following:
  - Configuration
  - Error log
  - Alert log
  - User-defined translate table
  - User-defined terminal tables
  - Patch data.
- 8K bytes of electrically erasable programmable read only memory (EEPROM).

  The 8K of EEPROM is used to store the following:
  - Vital product data
  - Extended Error Information Field (EEIF)
  - Error log
  - Alert log
  - Patch data (microcode temporary fixes)
  - User-defined translate table
  - Six user-defined terminal tables
  - Customer configuration.

The base has ten ports for connecting EIA 232C or EIA 422A cables. Refer to *IBM 3708 Network Conversion Unit Planning and Installation* for a description of the 3708 EIA 232C and EIA 422A interfaces and cables. The base (as shown in Figure 1-1 on page 1-2) has two switches: a power switch and a test/normal switch. The test/normal switch is used for the following procedures:

- Initiate the 3708 extended diagnostic test
- Temporarily reinstate the IBM-supplied configuration
- Exit a port testing mode
- Exit a restart loop condition.

These procedures are described in *IBM 3708 Network Conversion Unit Problem Determination.*

3708 Cartridge

The cartridge contains 256K bytes of EPROM. The EPROM contains three types of data:

Microcode
: All of the 3708 diagnostic and operational microcode (except for patches) resides and executes on the cartridge.

Tables and constants
: The 3708 microcode uses the following data:

  - Vector tables
  - Control terminal screen panels and messages
  - IBM-supplied configuration
  - Terminal tables
  - Default and alternate translate tables.

Cartridge vital product data
: This data includes the following:

  - Microcode EC level
  - Cartridge checksum
  - Miscellaneous other fields.

Functions

This section gives an overview of protocol conversion, protocol enveloping, and ASCII pass-through modes. These functions are described in detail in the remaining chapters. It also includes a list of functions that can be performed from the control terminal.

Protocol Conversion

In protocol conversion mode, the 3708 provides all the functions in IBM 3274 Configuration Support A. It provides additional functions such as alert and response time monitor (RTM) data support and power on/off notification to the SNA hosts.

Display Support

An ASCII display operating in protocol conversion mode appears to the SNA host as an IBM 3278/3279 Display Station Model 2, 3, 4, or 5. The 3708 supports an ASCII display operating in protocol conversion mode as a logical unit (LU) type 2.

To support ASCII displays in protocol conversion mode, the 3708 does the following:

- It uses keyboard mappings to define keystroke sequences that are equivalent to IBM 3270 key functions. The 3708 provides mappings for many types of ASCII displays. In addition, up to six mappings can be user-defined for other types of ASCII displays. A display that has a user-defined mapping is referred to as a *user-defined terminal.*

- It supports the following ANSI X3.64 functions:
  - Cursor backward
  - Cursor down
  - Cursor forward
  - Cursor up
  - Cursor position
  - Erase in display.
- It translates ASCII data into EBCDIC and vice versa using one of two standard translate tables or a user-defined translate table.
- It supports the following screen sizes:

Display Model	**Rows x Columns**	**Status Line**
Model 2 Emulation	24 x 80	25
Model 3 Emulation	32 x 80	33
Model 4 Emulation	43 x 80	44
Model 5 Emulation	27 x 132	28

- It provides a 3270-like status line, using either the terminal's status area or the last line of the data area. When the last data line is used, the user can turn the status line on and off. If the status line is turned off and input is inhibited, the 3708 notifies the user by placing the cursor in the lower right corner of the screen.
- It provides a numeric lock function that reduces the chance of the end user entering non-numeric data when the application expects numeric data. The 3708 allows the end user to override this function by typing one of the following:
  - Any uppercase character or symbol into the numeric field
  - A blank into the first position in the numeric field. While the blank occupies the first position in the field, the user can type any character into the numeric field.
- It provides type-ahead key queuing that allows the user to enter new keystroke sequences on the keyboard while a preceding keyboard sequence is being processed. This function allows a user to request the next screen before the current screen is completely displayed. The user can turn type-ahead key queuing on and off.
- It provides enhanced null/blank processing that allows the user to use either the space bar or the cursor move keys to edit and separate fields. The 3708 allows trailing blanks or nulls to move off the end of a line when the user is inserting data in that line. When the user inserts the data, the 3708 converts imbedded nulls to blanks. The user can turn enhanced null/blank processing on and off.
- It supports highlighting and color for certain classes of displays. (See "Color and Highlighting Restrictions" on page 4-68 for more information.) Light pen operations can be simulated using a Cursor Select key sequence.

- It supports the following 3270 commands:
  - Erase All Unprotected
  - Erase/Write
  - Erase/Write Alternate
  - Read Buffer
  - Read Modified
  - Read Modified All
  - Write.
- It supports the following buffer formatting and control orders:
  - Start Field
  - Set Buffer Address
  - Inset Cursor
  - Program Tab
  - Repeat to Address
  - Erase Unprotected to Address.
- It notifies the user when it detects a framing or parity error by updating the status line. To continue, the user must reset the display using the 3270 reset function. (This function can be suppressed by configuring nonstandard operating bit 5 to 1. Refer to Chapter 7, "Nonstandard Operations.")
- It allows the user to display response-time statistics and error information, such as the alert log, at the control terminal. In addition, the response-time statistics and alerts can be displayed at the host using NetView or Network Logical Data Manager (NLDM) and the Network Problem Determination Application (NPDA). Full support for the 3708 alerts is available only through NetView.

Printer and Keyboard Printer Support

In protocol conversion mode, an ASCII printer or keyboard printer looks like an IBM 3287 Printer, Model 1 or 2, to the SNA host. The ASCII printer or keyboard printer can be configured to operate in three ways:

System mode. The host sends print data to the printer, which is either an LU type 1 or an LU type 3. The output format for an LU type 1 printer is controlled by SNA character string (SCS) characters. For an LU type 3 printer, the output can be formatted or unformatted. Unformatted output is controlled by 3270 data stream compatibility (DSC) print orders.

Local mode. A copy of the screen of a display that is operating in protocol conversion mode is printed at the printer. The host can start a local copy by sending a command, or the user of the display can select it with a print key sequence. When a printer port is configured for local mode, it cannot be used for LU type 1 or LU type 3 print operations.

Shared mode. The printer is available for both system mode and local mode operation. A local copy can be performed whenever the printer is not being used for an LU type 1 or LU type 3 print operation.

Keyboard printers operating in protocol conversion mode are supported as output devices and must be defined as printers.

Up to 256 characters (8-bit data with no parity) can be used with an output device operating in LU type 1 SCS transparency mode.

The 3708 supports the following input from a keyboard printer that is directly connected to the 3708:

- Hold Print/Enable Print
- Cancel Print (LU type 1 SCS only)
- PA1 and PA2 (LU type 1 SCS only).

Note: Keyboard printers operating in protocol conversion mode are supported as output devices and must be defined as printers.

Up to 256 characters (8-bit data with no parity) can be used with an output-only device operating in LU type 1 SCS transparency mode. (See "Transparent (TRN)" on page 4-23 for more information on LU type 1 transparency.)

Multiple Logical Unit Support

A printer connected to an auxiliary port on a display that supports remote access to its auxiliary port can be defined as a second LU on the 3708 port to which the display is connected. The printer can then be used in system mode, local mode, or shared mode. This support is referred to as multiple logical unit (MLU) support and operates only in protocol conversion mode.

If a printer is connected to an auxiliary port on a display and is not defined to the 3708, the printer can be used only for screen copy operations that are initiated by the user. The user enters a predefined key sequence that the 3708 echoes back to the display.

Input from devices that are connected to the auxiliary port of a display is not explicitly supported; any such input is assumed to be for the display.

Protocol Enveloping

In protocol enveloping mode, the 3708 supports an ASCII end-user device as an LU type 1 with a Network Terminal Option (NTO) appearance.

The 3708 does not provide any device-specific support other than that provided by NTO for devices that are compatible with TWX 33/35. The application program must provide any device-specific support. To support an ASCII end-user device in protocol enveloping mode, the 3708 can do the following:

- It may or may not modify the ASCII data, depending on how the port is configured. The data can be modified by using a translate table, delay characters, substitution characters, and other options that are defined during configuration. If the data is translated from ASCII to EBCDIC, the 3708 can use one of two standard translate tables or a user-defined translate table.
- It can provide a delay after a Carriage Return, Vertical Tab, Form Feed, or Horizontal Tab.
- It can use either a default substitution character or a user-defined substitution character when it detects a data error. When it detects a parity error in a character, the 3708 can replace the character with the Parity Error Substitution character configured in the 3708. When it detects a framing error, the 3708 always replaces the framing error with the Parity Error Substitution character.
- It can use up to five different turnaround characters, which are defined during configuration, to control communication. When the 3708 receives a line turnaround character from an end-user device, the 3708 sends data from the device to the host.
- It can tell the user when to enter data. Because the 3708 does not control the keyboard in protocol enveloping, users must be notified when they can and cannot enter data. A character string (Read Prompt) that tells the user when to enter data can be defined for each port.
- It can indicate keyboard data that is to be sent up on the SNA SSCP-SLU flow. Because the 3708 does not support keyboard mapping in protocol enveloping mode, an optional sequence (System Request Simulation String) is provided to indicate keyboard data that is to be sent up on the SNA SSCP-SLU flow.

The user can configure the 3708 for the following operations:

- Transparent data flow. In this mode, the 3708 supports 256 character sets and output-only devices, such as printers and plotters. See "Transparency" on page 5-14.
- Host dial out. The 3708 and an attached modem can also be configured to allow the host to dial out to devices. See "Host Autodial" on page 5-14.

ASCII Pass-Through

When the 3708 performs ASCII pass-through for an ASCII device, that device operates in *ASCII pass-through mode*. The 3708 serves as a wire connection between the ASCII device and an ASCII host. Data and protocol error checking are the responsibility of the ASCII host and the ASCII device.

Users may dial out to a programmable modem in ASCII pass-through and gain access to a remote ASCII host, printer, or other device.

If the user can log on to the 3708 and enter ASCII pass-through mode, the 3708 supports 8-bit data transfer during ASCII pass-through. During port logon and host selection, the 3708 uses 7-bit data transfer with or without parity.

Functions Available for Each Mode

The following table highlights the functions available for each of the three modes:

Function	Protocol Conversion	Protocol Enveloping	ASCII Pass-Through
3287 Model 1 or 2, 3178/3278 Model 2, 3, 4, or 5 emulation	Standard	n/a	n/a
IBM 3287 Printer, Models 1 and 2 emulation	Required	n/a	n/a
Four color support (3279-2A and 3179 emulation)	Optional	n/a	n/a
Highlighting support	Optional	n/a	n/a
Light pen emulation	Optional	n/a	n/a
Type-ahead	Optional	n/a	n/a
Enhanced null/blank processing	Optional	n/a	n/a
User-defined terminals	Optional	n/a	n/a
3270 status line emulation	Required	n/a	n/a
Response Time Monitoring (RTM)	Required	n/a	n/a
NTO-like function (LU type 1 NTO emulation)	n/a	Required	n/a
Full duplex operations	Required	Optional	Required
Half duplex operations	n/a	Optional	n/a
Parity and framing checking	Required	Optional	n/a
Ignore parity	n/a	Optional	Required
Character echoplexing	Required	Optional	n/a
No character echoplexing	n/a	Optional	Required
128 ASCII character support	Required	Optional	Optional
256 ASCII character support	n/a	Optional	Optional
256 ASCII character support (LU type 1 SCS)	Optional	n/a	n/a
Choose one of two standard translate tables	Optional	Optional	n/a
User-defined translation tables	Optional	Optional	n/a
No translation	n/a	Optional	Required

Function	Protocol Conversion	Protocol Enveloping	ASCII Pass-Through
3708 accepts XON/XOFF pacing	Optional	Optional	n/a
3708 transmits XON/XOFF pacing	Optional	Optional	n/a
LU type 1 SCS printer data stream support	Optional	n/a	n/a
LU type 3 DSC printer data stream support	Optional	n/a	n/a
System, local, or shared printer support	Optional	n/a	n/a
MLU support (a printer attached to the auxiliary port of a display.)	Optional	n/a	n/a
Autobaud/parity from 110 through 4800 and 9600 bps for downstream devices	Optional	Optional	Optional
Line speeds up to 19200 bps	Optional	Optional	Optional
EIA 232C support for (SNA and ASCII) host connection	Required	Required	Required
EIA 232C support for downstream device connection	Optional	Optional	Optional
EIA 422A support for downstream device connection	Optional	Optional	Optional
Alerts (Alerts generated for ASCII pass-through are transmitted to SNA hosts.)	Required	Required	Required
Selectable 3708 logon screens	Optional	Optional	Optional

Control Terminal Functions

Any supported display that can operate in protocol conversion mode can be used as the control terminal. Control terminal access can be configured on a port-by-port basis. The 3708 allows only one display at a time to operate in control terminal mode.

The control terminal operator can perform the following functions:

- Defining or changing the 3708 configuration:
  - Defining the host ports and host access
  - Defining the device ports
  - Setting the control terminal password and defining control terminal access
  - Setting port passwords
  - Defining a translate table
  - Defining up to six additional keyboard mappings (terminal definitions)
  - Defining printer access.
- Displaying information:
  - Displaying configuration data
  - Displaying response time statistics
  - Displaying alert log and other error information.
- Monitoring the 3708:
  - Checking port status
  - Looking at data transmitted on lines attached to the 3708.

Note: If a printer is attached to the 3708, the control terminal screens showing configuration information may be printed as a local copy operation.

IBM supplies a default configuration that allows you to do the following:

- Use a display as a control terminal. From the control terminal, you can define your own configuration and user-defined terminal tables. Initially, the display you use as a control terminal must have a keyboard map that matches one of the 3708 default maps. After you have defined a user-defined terminal, you can use that UDT as a control terminal.

- Configure your system for all output-only devices or no control terminal. Since the default configuration can always be invoked without the loss of any user-defined configuration, you can define a configuration of all output-only devices or no control terminal access.

  If you configure the 3708 for no control terminal or you do not have a dial-in modem, you cannot receive the 3708 remote problem determination service supplied by IBM. To receive this service, you must invoke the IBM-supplied configuration or redefine a port.

Hosts

The 3708 can be attached to SNA and ASCII hosts. The connection is with the standard EIA 232C interface. If a device is always to be connected to the same SNA host, the port for that device can be defined to suppress the 3708 logon host selection screen.

SNA Hosts

The 3708 can have one or two SNA host connections, with both to the same host or with each to a different host. Each line to an SNA host can support multiple concurrent sessions. The 3708 is defined as a separate physical unit (PU) to each SNA host.

The 3708 can be attached to an SNA host through any of the following:

- IBM 3720 Communications Controller
- IBM 37x5 Communications Controller
- IBM 3710 Network Controller
- IBM 43xx with an Integrated Communication Adapter
- IBM 4701 Model 003 Finance Communications Controller (using the Alternate Line Attachment adapter, SNA Primary to attach to the 4700)
- IBM 4702 Branch Automation Processor (using the Alternate Line Attachment adapter, SNA Primary to attach to the 4700)
- IBM 8100 System Data Link or Direct Attach
- IBM System/36 Communications Attachment (using the 3274 Remote Attach Support)
- IBM System/38 Communications Attachment (using the 3274 Remote Attach Support).

For network management at the host, the following programs can be used:

- NetView fully supports the 3708 alerts and response time monitor (RTM) data. NetView contains both Network Problem Determination Application (NPDA) and Network Logical Data Manager (NLDM).
- Network Problem Determination Application (NPDA), Version 3 or later, supports only the specific and general cause codes of 3708 alerts.
- Network Logical Data Manager (NLDM), Release 2 or later, supports response time statistics.

Attachment to an SNA host can be point-to-point or multipoint, and can be either direct or remote over a nonswitched line (leased). Line speeds up to and including 19.2 Kbps can be used. Half-duplex communications are used on a duplex or half-duplex communication facility. The SDLC protocol is used for communication between the 3708 and an SNA host. The 3708 supports both external and internal clocking for speeds up to 19.2 Kbps. The SNA host link can operate using NRZI or non-NRZI (NRZ) data encoding.

ASCII Hosts

In addition to or instead of having one or two SNA host connections, the 3708 can have up to nine ASCII host connections. A terminal that selects an ASCII host has exclusive use of the host line until disconnected. This prevents more than one terminal from using a single ASCII host line simultaneously. However, if multiple concurrent sessions are required for an ASCII host, multiple lines to the ASCII host may be defined. When the user logs on, connection to the ASCII host is permitted if a line to the host is available.

An ASCII host may be a personal computer, a printer, or any other ASCII device.

Attachment to an ASCII host is point-to-point, and can be either direct or remote over a switched or nonswitched (leased) line. Line speeds up to and including 19.2 Kbps can be used. When an ASCII device and an ASCII host are communicating through a 3708, the line speeds of the line to the device and the line to the host should be such that the transmission over the slower of the two lines is less than 979 characters behind the transmission over the faster line, or data may be lost. See Chapter 6, "ASCII Pass-Through Mode."

When an ASCII device and an ASCII host are communicating through the 3708, the 3708 transmits data unchanged and unchecked between the device and the host.

Dial out is allowed to an ASCII host. See "Dial Out" on page 6-4.

ASCII Devices

ASCII devices that can be attached to the 3708 include displays, printers, and keyboard printers. ASCII devices may be directly attached up to 50 feet with the EIA 232C interface or, for distances up to 4000 feet, with the direct-attach interface using EIA 422A signaling. They also may be remotely attached over switched or nonswitched lines.

Displays, printers, and keyboard printers can also be attached to the 3708 for operation in protocol conversion mode.

The following ASCII displays are explicitly supported by the 3708 and can operate in protocol conversion mode using keyboard mappings provided by the 3708:

- IBM 3101 Display Terminal Models 10, 12, 13, 20, 22, and 23
- IBM Personal Computer (PC) in 3101 emulation mode with standard 3101 keyboard functions
- IBM PC with a color monitor running the IBM PC/HOST File Transfer and Terminal Emulator Program (FTTERM)
- IBM PC with a monochrome monitor running the IBM PC/HOST File Transfer and Terminal Emulator Program (FTTERM)
- IBM 3151 ASCII Display Station
- IBM 3151 with cartridge to emulate IBM and DEC® terminals (Feature No. 8235)
- IBM 3151 Connectivity Feature Cartridge (Feature No. 8525)
- IBM 3151 with Expansion Feature Cartridge (Feature No. 8535)
- IBM 3161 ASCII Display Station
- IBM 3161 with Enhanced 3708 Attachment (Feature No. 8371)
- IBM 3162 ASCII Display Station
- IBM 3162 with 3708 Support Functions (Feature No. 8232)
- IBM 3163 ASCII Display Station
- IBM 3164 ASCII Color Display Station
- IBM 3163/3164 VT100/3708 Emulation Cartridge (Feature No. 8313)
- ADDS (Applied Digital Data Systems) Viewpoint®
- Beehive™ ATL-078
- Data General Dasher® D210 Display Terminal
- DEC® (Digital Equipment Corporation) Models VT52, VT100, and VT220
- FALCO 500®
- Hazeltine 1500, ESPRIT I™, and ESPRIT II™
- Hewlett-Packard 2621B Interactive Terminal
- Lear Siegler ADM 3A Dumb Terminal®
- Northern Telecom Displayphone™
- ROLM Cypress, Cedar, and Juniper (connected through ROLM CBX II)
- Teletype 5410 Asynchronous Display Terminal and 5420 Buffered Display
- TeleVideo® 910 and 950
- WY-50® (Wyse 50)
- Other terminals and personal computers emulating and compatible with one of the named devices.

Special Cartridges for the IBM 3151, 3161, 3162, 3163, and 3164

Special cartridges are available for the 3151, 3161, 3162, 3163, and 3164 terminals that enhance their usability. These cartridges are:

- IBM 3151 with Connectivity Feature Cartridge (Feature No. 8525)
- IBM 3151 with Expansion Feature Cartridge (Feature No. 8535)
- IBM 3161 with Enhanced 3708 Attachment (Feature No. 8371)
- IBM 3162 with 3708 Support Functions (Feature No. 8232)
- IBM 3163/3164 VT100/3708 Emulation Cartridge (Feature No. 8315).

These cartridges provide the following enhancements:

- The Send key performs the 3270 Enter key function.
- The Print key performs the 3270 Print key (local copy) function.
- The Backtab key performs the 3270 Backtab key function.
- The Return key performs the 3270 Newline key function.
- AUX port XON/XOFF Pacing allows a printer attached to the AUX port of the terminal allows the terminal to pace data being sent to the printer by the 3708.

Refer to *IBM 3708 Network Conversion Unit Planning and Installation*, GA27-3766, or *IBM 3708 Network Conversion Unit End User Reference*, GA27-3765, for specific information on terminal emulation and setup.

IBM 3151: Two cartridges are available for the IBM 3151:

- IBM 3151 with Connectivity Feature Cartridge
- IBM 3151 with Expansion Feature Cartridge.

The Connectivity Feature Cartridge is available only for Models 310 and 410, and is supported by Terminal ID 2A on the 3708's Terminal Selection (C2) screen. It provides the following additional enhancements:

- EIA-422A communications is supported.
- Line 25, the 3151 Operator Information Area (OIA), is used as the 3270 Status Line.
- Two host sessions can be supported by configuring the AUX port as the second host port. The user can connect to two ports on the 3708, establish two host sessions, and toggle between sessions. These can be two IBM host sessions, two ASCII host sessions, or one IBM host and one ASCII host session.

The Expansion Feature Cartridge is available only for Models 310 and 410, and is supported by Terminal ID 2A on the 3708's Terminal Selection (C2) screen. If the 3151 is configured for large screen support (28 x 132), it is also supported by Terminal ID 3B. The Expansion Feature Cartridge provides the following additional enhancements:

- EIA-422A communications is supported.

- IBM 3270 Model 5 emulation is supported when the terminal is configured for a screen size of 28 x 132.

- The 3151 OIA is used as the 3270 Status Line. The Operator Information Area is line 25 (or line 29 for model 5 emulation) of the display.

IBM 3161: The IBM 3161 with Enhanced 3708 Attachment is supported by Terminal ID 2A on the 3708's Terminal Selection (C2) screen. It provides the following additional enhancements:

- The Reset key performs the 3270 Reset key function.
- The 3161 OIA (line 25 of the display) is used as the 3270 Status Line.

IBM 3162: The IBM 3162 with 3708 Support Functions is supported by Terminal ID 2A on the 3708's Terminal Selection (C2) screen. It provides the following additional enhancements:

- The Reset key performs the 3270 Reset key function.[1]
- The 3162 OIA is used as the 3270 Status Line. The Operator Information Area is line 25 (or line 29 for model 5 emulation) of the display.
- The 3270 1A Keyboard is supported (122 keys). You can obtain this configuration by ordering 3162 Model 870[2] or 3162 Model 871[3] .

IBM 3163 and 3164: The IBM 3163/3164 VT100/3708 Emulation Cartridge is supported by Terminal ID 2A for the 3163 and Terminal ID 2B for the 3164 on the 3708's Terminal Selection (C2) screen. It provides the following additional enhancements:

- The Reset key performs the 3270 Reset key function.
- The 3163/3164 OIA (line 25 of the display) is used as the 3270 Status Line.
- The 3270 1A Keyboard is supported (122 keys). You can obtain this configuration by ordering part number 1390702 or 1390238.

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[1] A native 3162 can be configured, by host command, to allow the Reset key to operate. You may also use the UDT TLIS function to program the 3708 to send the sequence, `ESC ( :` (X'1B283A'), that enables the 3162 Reset AID function. The UDT must also specify `ESC ! z` (X'1B217A') as the Reset function. You can do this by creating a UDT (using the 3162 terminal table as the base) and setting address X'0A0' to the Reset key function number, 10.

[2] Model 870 consists of a green monitor, logic unit, and keyboard.

[3] Model 871 consists of an amber monitor, logic unit, and keyboard.

Chapter 2. 3708 Operation

Areas of operation described in this chapter include:

- LED sequences and steady states
- Configurations
- Establishing a session
- Logon
- Ending host sessions and disconnecting from the 3708
- XON/XOFF pacing
- Alert, error, and EEIF logs
- Timers and time stamps
- Hardware interface operation.

Any port on the 3708 can operate in one of three modes depending on configuration and host application:

- Protocol conversion
- Protocol enveloping
- ASCII pass-through.

The 3708 operates differently in each of these three modes. See Chapter 4, "Protocol Conversion Mode," Chapter 5, "3708 Protocol Enveloping Mode," and Chapter 6, "ASCII Pass-Through Mode" for a description of each mode.

LED Sequences and Steady States

The 3708 has three light emitting diode (LED) indicators that are used to show the operating state of the machine. There is a green light on the base used to indicate that the 3708 is powered on. There are two red lights, one on the base and one on the cartridge. The two red lights may go through one of three sequences when the 3708 is powered on. After the sequence is complete, they enter one of four steady states. The sequences and states are described in the next sections.

Note: If you suspect a problem with one of the 3708 lights, see the symptom listing in *IBM 3708 Network Conversion Unit Problem Determination* for problem handling procedures.

Sequences

The two red lights on the 3708 may go through one of the following three sequences when the 3708 is powered on.

Normal Power On and Restart Light Sequence

This sequence occurs each time the 3708 is powered on or a restart is requested at the control terminal.

Base	Cartridge	Seconds
On	On	0.25
Off	On	0.5
On	Off	5.0
Off	Off	5.0
On	Off	0.5
Off	On	0.5

Note: During the five seconds that both lights are off, the IBM-supplied configuration may be temporarily invoked by pressing the test/normal switch to the test position until the cartridge light comes on alone. Then release the test/normal switch. Refer to "Operational Configuration" on page 2-5.

When the red lights blink alternately, the 3708 initialization is complete, and normal operations may begin or resume. Rather than blinking alternately, the lights may immediately go out, indicating that an SNA host line has been activated. See the description that follows for more information about the LED steady states.

Extended Diagnostic Sequence

This sequence occurs if the 3708 is powered on while the test/normal switch is held to the test position.

Base	Cartridge	Seconds
On	On	0.25
Off	On	0.5
On	Off	45.0
Off	Off	5.0
On	On	0.5
Off	Off	0.5

When the lights begin blinking on and off together, port testing begins. The port wrap plug should be inserted into each port until the green light on the plug lights. This port testing step can be stopped at any time by pressing the test/normal switch to the test position.

After the port wrap plug has been inserted into each port, or the test/normal switch has been pressed, the lights begin to blink alternately, indicating the diagnostic tests and 3708 initialization are complete. Normal operations may begin or resume. Rather than blinking alternately, the lights may immediately go out, indicating that an SNA host line has been activated. See the description that follows for more information about the LED steady states.

Relocate Customer Setup Light Sequence

After relocation CSU (customer setup unit) is selected at the control terminal, the light sequences at the next time the power is turned on are:

Base	Cartridge	Seconds
On	On	0.25
Off	On	0.5
On	Off	5.0
Off	Off	5.0
On	Off	0.5
Off	On	0.5

During this sequence, which occurs only the first time the 3708 is turned on after relocation CSU has been selected, the IBM-supplied configuration is invoked. The error and alert logs in EEPROM are cleared, and a subset of the extended diagnostics is run. The customer configuration in EEPROM is not changed, and port wrap testing is not required.

To invoke the user-defined configuration, turn the 3708 off and back on again.

When the red lights blink alternately, the 3708 initialization is complete. Normal operations may begin or resume.

Steady States

A steady state on the 3708 red LEDs lasts for more than one minute after one of the sequences previously described has completed or while one of the sequences is being executed.

Base and Cartridge Lights Blinking Alternately

This is a normal condition when an SNA host has not activated the 3708. The 3708 has not received a valid SDLC SNRM command from the host to initialize communications. If LEDs continue to blink alternately, the 3708 SNA host ports have been configured incorrectly or do not match the definition of the SDLC links at the host. For example, the SDLC station addresses may be different.

If the 3708 has been configured with no SNA host, this is the normal state of the red LEDs.

Base and Cartridge Lights Both Off

This is a normal condition when a SNA host has activated the 3708. The 3708 has received a valid SDLC SNRM command from a host to initialize communication on at least one of the 3708 ports configured as SNA host connections.

If the 3708 has been configured with at least one SNA host port, this is the normal state of the red LEDs.

Base and Cartridge Lights Blinking Together

The 3708 is performing port diagnostics and is waiting for the port wrap plug to be inserted in each port. If the 3708 was performing setup procedures, the port wrap tests are required. Refer to *IBM 3708 Network Conversion Unit Setup*. If the 3708 was performing extended diagnostics, the port wrap tests can be stopped by pressing the test/normal switch to the test position (see "Extended Diagnostic Sequence" on page 2-2).

One or Both of the Lights on Solid

If either the base or the cartridge red LED comes on solid for more than one minute, an error condition exists. (During the sequences previously described, lights can be solid for up to 45 seconds. A light must be on solid for approximately one minute before you can be sure of an error condition.) This condition can occur while performing setup, while restarting the 3708 (either from the control terminal or by powering it on), or during normal operation.

The possible causes for this error condition are:

- During one of the initialization sequences, the base light on solid for more than one minute can indicate a cartridge is not seated correctly. To correct this, turn off the power to the 3708, remove the cartridge from the base unit, firmly reinsert it, and turn on the power to the 3708.
- During normal operation of the 3708 (after one of the initialization sequences has been completed), the base light on solid state can be caused by certain microcode errors when the 3708 is set for "STOP ON ERROR". (If set to "RESTART ON ERROR", these microcode errors would cause the 3708 to reinitialize itself, as if the control terminal operator had requested the restart function. The "STOP ON ERROR" setting allows special error information to be saved in the EEPROM for IBM service personnel to analyze. Refer to *IBM 3708 Network Conversion Unit Problem Determination* for more information about this facility.)
- Either (or both) light on solid for more than one minute can indicate that a hardware failure has occurred in either the base unit or the cartridge.

Restart on Error Loop

When Restart on Error is set at the control terminal, the 3708 does not halt when a severe error occurs; instead, it restarts automatically. If the 3708 restarts only once, the light sequence is the same as a normal power on. If the error continues, the 3708 may get caught in a restart loop; in this case, the sequence is unpredictable. Refer *IBM 3708 Network Conversion Unit Problem Determination* for information about exiting a restart loop.

Configurations

Before the 3708 can communicate with an SNA host, the 3708 must be configured to match the network. Although the 3708 operates using only one configuration, there can be as many as four different configurations in the 3708 at any time. These are:

- The IBM-supplied configuration
- The customer-defined configuration
- The operational configuration
- The update configuration.

IBM-Supplied Configuration

The IBM-supplied configuration is provided to allow initial connection to the 3708. When the 3708 is first installed, the user must connect a control terminal to the 3708 and create the customer-defined configuration. Refer to *IBM 3708 Network Conversion Unit Planning and Installation*, GA27-3766, for installation procedures and a description of the IBM-supplied configuration.

The IBM-supplied configuration allows initial access to the 3708 through one of the ports numbered 2 through 9. Each of the ports is defined differently in the IBM-supplied configuraton. Ports 3 and 7 are the most widely used because they represent two major types of connection, switched and nonswitched, respectively.

After the customer-defined configuration is created, the IBM-supplied configuration may never need to be used again. The only time it may be needed is to allow IBM service personnel to perform remote diagnostic service (refer to *IBM 3708 Network Conversion Unit Planning and Installation*, GA27-3766, and *IBM 3708 Network Conversion Unit Problem Determination*, GA27-3768, for information about remote service).

The IBM-supplied configuration resides in the cartridge (EPROM).

Customer-Defined Configuration

The customer-defined configuration can be entered into the 3708 through the control terminal. This configuration resides in the base (EEPROM). This configuration is not lost when the 3708 is powered off, power is lost, or a different cartridge is inserted.

Operational Configuration

The operational configuration is either the customer-defined configuration or the IBM-supplied configuration. Figure 2-1 on page 2-6 shows which configuration becomes the operational configuration.

When the power is turned on, the customer-defined configuration is copied from EEPROM into RAM unless the test/normal switch is pressed within a 5 second window. The window begins when both LEDs go out (approximately 5¾ seconds after power on), and it lasts for 5 seconds. Refer to "Normal Power On and Restart Light Sequence" on page 2-2. If the test/normal switch is pressed, the IBM-supplied configuration is copied into RAM and becomes the operational configuration.

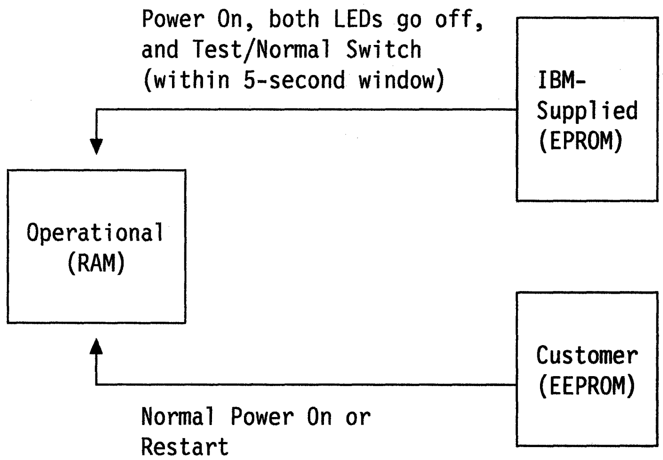


Figure 2-1. Operational Configuration

When the power is turned off, the operational configuration in RAM is lost. The IBM-supplied configuration remains in EPROM, and the customer configuration remains in EEPROM.

Update Configuration

This configuration is a work area for making changes to the customer-defined configuration.

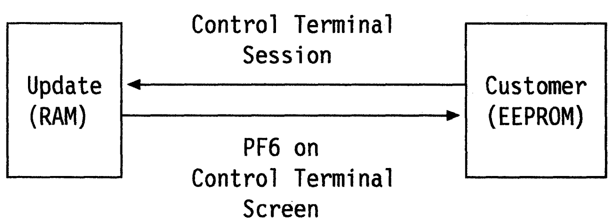


Figure 2-2. Update Configuration

To update a configuration, start a control terminal session. The customer-defined configuration is copied from EEPROM to RAM. Enter the necessary changes and press the PF6 key sequence to copy the updated configuration back to the customer configuration.

Permanently Reinstating the IBM-Supplied Configuration

The user can copy the IBM-supplied configuration into the operational area by pressing the test/normal switch within the 5-second window after power on. (See "Operational Configuration" on page 2-5.) Also, the user can permanently delete the customer-defined configuration by entering `replwibm` into the Name field and `config..` into the Version field on the General Definition screen (C127.1). Refer to *IBM 3708 Network Conversion Unit Planning and Installation* , GA27-3766, for more information about permanently reinstating the IBM-supplied configuration.

Note: Permanently reinstating the IBM-supplied configuration destroys the customer-defined configuration (except for any user-defined terminal tables or translate table).

Establishing a Session

Before establishing an SNA host or ASCII host session with a 3708, the user must complete the 3708 port logon procedures configured for the port. In addition:

- If the port is a dial in port, then the user must take whatever action is appropriate for the modem or dial unit being used at the terminal to cause it to dial the 3708 port through the public switched network or a private switched network.
- If the port is configured for either autobaud or auto parity, the terminal must send a carriage return (CR) to the 3708.
- If the port is configured for EIA 422A, the terminal must send a CR to the 3708.

Regardless of whether the sessions being established are with SNA hosts, ASCII hosts, or the 3708 control terminal, the appropriate 3708 logon procedures must be provided to the terminal users by the network or system administrator.

Logon Procedures

This section describes the logon procedures for the following:

- 3708 port
- Control terminal
- SNA host
- ASCII host.

3708 Port Logon Screens

The 3708 port logon is a procedure that the user of a display must complete to receive the host logon screen. The 3708 generates several logon screens, any or all of which can be suppressed in the 3708 configuration. These screens are shown in sequential order:

```
======IBM 3708===EC   A58809======RID 3708-008-01-0000222========PORT 07=======
C1:  Type port password

        To disconnect from the 3708, type "####."


===> _
```

Figure 2-3. Port Password Screen (C1)

```
======IBM 3708===EC   A58809======RID 3708-001 88-0000076========PORT 07======
C2:  Type the number of your terminal:

 1 -IBM 3101                              6 -TV 910         16 -HP 2621B
 1A-IBM PC/FTTERM COLOR                   7 -TV 950         17 -DG D210
 1B-IBM PC/FTTERM MONO                    8 -LS ADM3A       18 -ROLM DISPLAY
 2 -IBM 3161/62/63                        9 -ADDS VP        19 -BEEHIVE ATL078
 2A-IBM 3151/61/62/63 (3708 FEATURE)     10 -HAZEL 1500     20 -UDT01
 2B-IBM 3151                             11 -HAZEL ESP I    21 -UDT02
 2C-IBM 3151/62 (MODEL 5 EMULATION)      12 -HAZEL ESP II   22 -UDT03
 3 -IBM 3164                             13 -NT DISPLAY     23 -UDT04
 3A-IBM 3164 (3708 FEATURE)              14 -TT 5410        24 -UDT05
 4 -DEC VT52                             15 -TT 5420        25 -UDT06
 5 -DEC VT100
 5A-DEC VT220
 5B-FALCO 500 (DEC VT200 MODE)
 5C-WYSE 50
       For trademark acknowledgements, see 3708 publications

       To disconnect from the 3708, type "####."

===>_
```

Figure 2-4. Terminal Type Selection Screen (C2)

```
======IBM 3708===EC A58809======RID 3708-001 88-0000076========PORT 07======
C3:  Type the number of the desired connection:

 1-TSOHOST
 2-VMHOST
 c-Control Terminal

       To disconnect from the 3708, type "####."


===>_
```

Figure 2-5. Host Selection Screen (C3)

```
======IBM 3708===EC   A58809======RID 3708-008-01-0000222========PORT 07=======
C4:  You can now type your system logon

       To disconnect from the 3708, type "####."


===> _
```

Figure 2-6. Logon Indication Screen (C4)

```
======IBM 3708===EC   A58809======RID 3708-001 88-0000076========PORT 07======
C5:  Type control terminal password

        To disconnect from the 3708, type "####."

===>_
```

Figure 2-7. Control Terminal Password Screen (C5)

Each 3708 port can be customized to use any of the 3708 logon screens if the port is configured as follows:

- If a port is configured with no password, the Port Password screen (C1) is not displayed, even if the PORT PASSWORD SCREEN option is set to "Yes".
- If a port is configured for protocol enveloping mode only, the Terminal Type Selection screen (C2) is not displayed because the 3708 does not use the terminal ID in this operating mode.
- If a port is configured with no Terminal Type Selection screen (C2) and is used for protocol conversion mode, the correct terminal ID must be specified in the port configuration.
- If a port is configured with either no 3708 logon screens or no Host Selection screen (C3), the 3708 will not activate the port until an ACTLU is received from the host. For a switched connection, the 3708 will not activate its interface to the modem and will not answer a call from a user. (Some modems may be set so that they will answer a call, even if the interface to the 3708 is not active.) Also, you cannot access the 3708 control terminal if the Host Selection screen (C3) is suppressed or if all logon screens are suppressed.
- If a port is configured for protocol conversion only, the screen is cleared before each new logon screen, and just after an active host has been selected. This clearing mode begins after one of these conditions:
  - A correct response is received to the Terminal Type Selection screen (C2)
  - As soon as the port is activated (if screen C2 is not to be used).

Short Logon Screens

Another customization function available for the 3708 logon screens is short logon screens. When a port is configured for this option, the 3708 displays only three lines for each new logon screen. The three lines are:

1. The introducer line containing the 3708 EC number and the user's port number
2. The instruction line
3. The user input line.

If a "?" or incorrect response is entered, the 3708 displays the long form of the screen. Figure 2-8 on page 2-10 shows examples of the short screen format.

```
======IBM 3708===EC   A58809======RID 3708-008-01-0000222========PORT 07=======
C2:  Type the number of your terminal:
===> _
```

```
======IBM 3708===EC   A58809======RID 3708-008-01-0000222========PORT 07=======
C3:  Type the number of the desired connection:
===> _
```

Figure 2-8. Two Examples of Short Logon Screens

Note: During the logon process, the 3708 operates in a line-by-line (protocol enveloping) mode. Even if the port is configured for protocol conversion only, protocol enveloping configuration options such as Read Prompt and Turnaround Characters are used. To change or delete these options, configure the port for dynamic operation or first configure for dynamic operation, change or delete the options, then reconfigure the port for protocol conversion only.

Control Terminal Logon

If the control terminal option is selected during port logon, the user can log on to the control terminal. After the user enters the control terminal password, the 3708 operates in protocol conversion mode. The following functions are not supported in control terminal mode:

- CLEAR
- Erase EOF
- Erase Input
- Cursor Select
- PA1, PA2, or PA3
- Attention
- Delete
- System Request.

SNA Host Logon

Up to two SNA hosts can be listed on the 3708's Host Selection (C3) screen. The desired SNA host may be accessed by entering the number associated with the SNA host on the Host Selection screen and pressing Enter. If the host is not active (LU not activated), the 3708 notifies you with a `HOST UNAVAILABLE, RETRY LATER` message.

If the LU is active and the host is available, the 3708 transmits a NOTIFY (power on) command to the host immediately after the host is selected. The NOTIFY (power on) command informs the host that your terminal is active and ready to communicate.

If the 3708 logon screens are excluded or the Host Selection screen is suppressed, the 3708 transmits the NOTIFY (power on) command immediately after it has detected that the downstream device is active.

The 3708 then transmits its Logon Indication Screen (C4), if it is enabled, and you may enter your application logon. Depending upon the host's configuration, you may receive an SNA host logon screen (for example, VTAM message 10). This message follows the 3708's Logon Indication screen. The host may also be configured to automatically BIND the downstream device. The BIND flows from the host after the 3708 transmits the NOTIFY (power on).

Communication before the BIND is to the host system's SSCP (system services control point). Only after the host application transmits a BIND and Start Data Traffic (SDT) command can communication occur with the host application.

ASCII Host Logon

Up to nine ASCII hosts may be listed on the 3708's Host Selection (C3) screen. The desired ASCII host may be accessed by entering the number associated with the ASCII host on the Host Selection screen and pressing Enter. If the host is not active, the 3708 notifies you with a `HOST UNAVAILABLE, RETRY LATER` message.

If the host is available, the 3708 displays a `ASCII HOST CONNECTED` message and allow the user to logon to the ASCII host.

If the 3708 logon screens are excluded or the Host Selection (C3) screen is suppressed, access to ASCII host is not allowed.

The speed of the ASCII host and the ASCII terminal do not need to be the same. If there is a line speed difference, however, loss of data can occur if the accumulated backlog of data in the 3708 exceeds 979 bytes (see Chapter 6, "ASCII Pass-Through Mode" for more information).

Ending Host Sessions and Disconnecting from the 3708

When operating with the 3708, an end-user device can have two sessions to be concerned with: the session with the host application (either an SNA host or an ASCII host), and the session with the 3708. To distinguish between the two sessions, the device is said to be "in session" with the host and "connected to" the 3708.

SNA Hosts

This section describes the conditions under which the 3708 disconnects a device from an SNA host.

Unconditional Disconnection and Session Termination

If a device is in session with the host and the 3708 detects any of the following, the host session is ended and the device is be disconnected from the 3708:

- Loss of host connection (for example, DSR drop)
- Reset of SDLC link, SNRM command received
- Disconnect of SDLC link, DISC command received
- SDLC Inactivity Time Out value exceeded
- Unexpected DACTLU
- Deactivation of PU, DACTPU command received.

If the device is a display, the 3708 sends the message `HOST UNAVAILABLE, RETRY LATER` before disconnecting the device.

Conditional Disconnection

If the SNA host sends an UNBIND or DACTLU for a specific LU while an SLU-PLU session is active, the host session ends. In addition, the 3708 interrogates the DISCONNECT option value for the affected port to determine whether to disconnect the port. The possibilities are as follows:

0 — Unconditionally disconnect at UNBIND or DACTLU

1 — Never disconnect at UNBIND, but disconnect at DACTLU

2 — Disconnect at UNBIND, if UNBIND type is other than 2 or 3, and disconnect at DACTLU

3 — Disconnect at UNBIND, if UNBIND type is other than 1, 2 or 3, and disconnect at DACTLU

4 — Disconnect at UNBIND, if UNBIND type is other than 2 or 3, but do not disconnect at DACTLU

5 — Disconnect at UNBIND, if UNBIND type is other than 1, 2 or 3, but do not disconnect at DACTLU.

Note: Options 4 and 5 are provided primarily for TSO users. TSO normally sends a DACTLU rather than an UNBIND to end the session.

Unconditional Session Termination

If the 3708 detects the loss of a connection or the power off to a device that is in session with an SNA host, it ends the SNA session. The action taken depends upon the state of the SNA session and the host configuration.

State of the Session	Command Sent to the Host
BIND has been received, and the 3708 has responded positively to BIND. This indicates that an LU - LU session exists.	UNBIND(0F) or TERMSELF(40) or TERMSELF(4C)[1] NOTIFY, power off.
UNBIND has been received and BIND is forthcoming.	TERMSELF(4C) NOTIFY, power off.
BIND has not been received. This indicates that an SSCP - LU session exists, but not an LU - LU session.	NOTIFY, power off.

ASCII Hosts

This section describes the reasons that the 3708 disconnects a device from an ASCII host.

Session Termination

The 3708 allows the terminal user to terminate the ASCII host session by using the disconnect sequence defined for the ASCII host. It consists of the BREAK line condition followed by the 3-character ASCII host disconnect sequence.

When this sequence is used, the 3708 does not disconnect from either the ASCII host or the terminal. The terminal user is presented with the 3708 host selection screen (C3), and the ASCII host is immediately available for other terminal connections. For this reason, it is recommended that the terminal user issue any session ending sequences defined in the host protocol before entering the BREAK sequence. This precaution should prevent the next user of the ASCII host from accessing the previous user's session.

Unconditional Disconnection

When the 3708 recognizes the loss of connection or the power off of either the ASCII host or the terminal while they are involved in an ASCII pass-through session, the 3708 disconnects the interface to the partner as well. Each side is then reconnected. The ASCII host is available for selection by any user and a new 3708 port logon sequence is required at the terminal.

[1] Depending on a host port configuration option, the 3708 may transmit an UNBIND (0F) or a TERMSELF. If TERMSELF is specified, the 3708 transmits either a TERMSELF 40 (the default) or (if nonstandard operating bit 14 is set to 1) a TERMSELF 4C.

XON/XOFF Pacing

XON/XOFF pacing (also called DC1/DC3 pacing) is the method the 3708 has implemented for regulating data traffic with an asynchronous device. The 3708 allows XON/XOFF pacing to be configured individually for receive and transmit for maximum flexibility. An additional pacing option, RECEIVE QUEUE PACING THRESHOLD, is available when Transmit XON/XOFF pacing is configured that allows the 3708 to provide pacing on the receive queue.

Receive XON/XOFF

Choices are: 1=Yes or 0=No.

Many downstream devices use XON/XOFF pacing to control data flow. This configuration parameter informs the 3708 whether the downstream device will be using XON/XOFF pacing to regulate the transmission of data from the 3708. If receive pacing is configured, the 3708 monitors the data received from the downstream device and suspend data transmission on the detection of an XOFF (DC3 - X'13'). Data transmission is resumed on the receipt of XON (DC1 - X'11'). When Receive XON/XOFF is configured, the hexadecimal values X'11' and X'13' are not available for data because they are interpreted as control characters. If X'11' or X'13' are to be sent as data, they must be encrypted.

The 3708 should respond to XOFF after 8 or fewer characters have been transmitted for all device types.

Note: Most personal computers, printers, and some keyboard displays support pacing. See *IBM 3708 Network Conversion Unit Planning and Installation* for a listing of suggested XON/XOFF settings for terminals that the 3708 supports.

Transmit XON/XOFF

Choices are: 1=Yes or 0=No.

When Transmit XON/XOFF pacing is configured, the 3708 uses pacing to prevent receive queue overrun.

The 3708's transmission of XON/XOFF is determined by the setting of the Receive Queue Pacing Threshold.

If the receive queue threshold is set to 0 and the 3708 is operating in protocol enveloping mode or processing 3708 logon screens, the 3708 sends XOFF at the following times:

- Upstream busy is detected by the receipt of an RNR from the host. XON is sent when an RR is received from the host indicating the busy condition has cleared.
- The 3708 enters buffer slowdown when system buffer availability is scarce. XON is sent when the buffer slowdown condition has been cleared.

If the receive queue threshold is set to a nonzero value, indicating that receive queue pacing is to be performed, the 3708 sends XOFF as follows:

- When the receive queue is 50% or 75% full depending on the threshold selected. XON is sent when the receive queue is 25% full.

If Transmit XON/XOFF pacing is configured, the 3708 always transmits XOFF followed immediately by XON in the following instances:

- After each 3708 logon screen is sent
- After each screen or status is sent in protocol conversion mode
- After each screen or status is sent in control terminal mode.

These XON/XOFF transmissions are not used to pace the downstream device, but are required for remote service.

Note: In order for a port to be used for remote service (Application of Microcode patches), Transmit XON/XOFF must be set to 1 = ON and the Receive Queue Pacing Threshold must be set to 0.

Receive Queue Pacing Threshold

Choices are: 0=None, 1=50% Full, or 2=75% Full.

The receive queue pacing threshold is used by the 3708 to determine how full the receive queue must be before pacing the downstream device. Receive queue pacing can be defeated by selecting 0. However, if the downstream service supports XON/XOFF pacing, and this port is not used for remote service, it is recommended that receive queue pacing be specified. Whether to select pacing when the queue is 50% full or 75% full depends on how fast the downstream device can stop transmitting after receiving an XOFF, and how large the receive queue is. Only the XOFF threshold can be selected, XON is sent when the receive queue is processed to a point that it is only 25% full. The following chart shows the number of receive queue character positions available when XOFF and XON is sent.

Receive Queue Size	Threshold Selected (# of Characters Available in Receive Queue)			
	50		75	
	XOFF	XON	XOFF	XON
S	40	60	20	60
M	260	390	130	390
L	520	810	270	810

Figure 2-9. Available Characters by Receive Queue Size

For optimum performance, select a threshold of 75%. This percentage limits the amount of pacing that must be done. A selection of 50% might be required when small queue is specified and the downstream device cannot stop within 20 characters after receiving XOFF. Another time that a 50% threshold may be required is for personal computers performing file transfers. Some file transfer programs recognize XOFF at block transfer boundaries. If this is the case, the receive queue size and threshold must be configured so that the 3708 can complete the reception of a complete block after transmitting XOFF. Otherwise, a receive queue overrun may occur.

Alert, Error, and EEIF Logs

The 3708 maintains three log areas in EEPROM; Alert Log, Error Log, and Extended Error Information Field. The Alert Log and the Error Log are updated in RAM and then written to EEPROM when the first error occurs after power on and after each four hours from that point on. A third log is the Extended Error Information Fields (EEIF). The EEIF is only written to EEPROM for a Stop on Error condition. None of these three logs are written to EEPROM when there is a Restart Loop.

Alert Log

The Alert Log gives the control terminal operator information about error conditions. This is in addition to the Alerts and Vectors which may have been sent to the NetView or NPDA program at the SNA Communications Network Management (CNM) Host. The logging of 3708 alerts is independent of whether or not there is an SNA host and whether or not the host link is active. Usually, normal 3708 operations continue after an entry is made in the alert log. The 3708 stores up to the last seven alerts.

Error Log

The error log gives 3708 maintenance personnel information about error conditions. The error log is presented as one entry per line. Each entry is 14 bytes of hexadecimal data. Usually, normal 3708 operations continue after an entry is made in the error log.

Extended Error Information Field (EEIF)

The EEIF area gives 3708 maintenance personnel data about serious error conditions. Data is only captured when a serious failure occurs and Stop on Error is set. The 3708 stops after the error information is written to EEPROM. The base Not Ready light is on solid and the cartridge light is off. Refer to *IBM 3708 Network Conversion Unit Problem Determination* for instructions.

Timers and Time Stamps

The 3708 hardware provides a quarter second timer, that operates continuously while the 3708 is powered on. This timer is used to create a programmable time out function that different tasks of the 3708 microcode can use. This function is used to provide the following timers:

- Control program 4-hour timer. When this timer expires, the current data in the RAM copies of the error and alert logs is copied to EEPROM.
- Control program 45-minute timer. When this timer expires, the relative time 1 field of the system time stamp is incremented by 1.
- Port inactivity timer (configurable). This timer is started when a character is received from the downstream device. When this expires, the port is disconnected from the 3708.
- Text timeout timer (configurable). This timer is started when a character is received from the downstream device. When it expires, any received data is sent to the host as if a line turnaround character had been received. The text timeout timer is used for protocol enveloping only.
- Port control timers. Various timers are used to determine whether a port's interface is ready for data transfer. For example, on a nonswitched line, the 3708 waits 3 seconds for DSR to be activated from the device.
- Task control timers. Microcode tasks within the 3708 may request timers for various functions. For example, the control terminal function uses a 5-second timer after displaying a full screen of port monitor data before wrapping to the top of the screen.

3708 Relative Time Clock

The 3708 does not contain a real time clock. Instead, the quarter second timer previously described is used to maintain a relative time clock. This clock is actually a 4-byte area in RAM that is defined as:

Bytes 0 and 1 contain the relative time 1 field which bits are used as follows:

Bits	Description	Meaning
0-10	Day count	Incremented every 24 hours. Also incremented each time the 3708 is turned on or restarted (wraps every 2048 days)
11-15	45-minute count	Incremented every 45 minutes (wraps every 24 hours)

Bytes 2 and 3 contain the relative time 2 field which bits are used as follows:

Bits	Description	Meaning
0-15	1/4 second timer	Wraps every 4.3 hours

Time Stamps and Error Log Entries

The time indicated on the relative time clock is used to create the time stamps that are a part of each error log entry, allowing a customer to determine the relative time of certain events.

At each power on of the 3708, the error log, alert log, and relative time clock areas of EEPROM are copied to RAM. The RAM versions are then updated as the 3708 operates. Every 4 hours, the RAM versions are copied back to EEPROM, if any changes have occurred. (Because of this copy function, it is possible to lose up to 4 hours of entries in the error and alert logs when the 3708 is powered off or restarted. The RAM copies are lost at each restart.)

At power on, or restart, a special error log entry is created as follows using the last relative time clock value that was saved in EEPROM.

    00 00 FE FE FE FE FE FE TTTT TTTT

TTTT TTTT is the relative time clock value.

After creating this entry, the day count of the relative time clock is incremented by 1, and the 45-minute count and the quarter second timer are reset to 0. For example, if the 3708 is powered off and back on, the restart error log entry might look like:

    00 00 FE FE FE FE FE FE 1980 0126

The 1980 0126 would have been the last clock value saved in EEPROM on the previous power on. After the entry is created, the clock is set to the value 19A0 0000 (day count incremented by 1, and 45 minute and quarter second counters set to 0).

Hardware Interface Operation

Connector Pin Definitions

To better understand the way the 3708 handles the communication interface, it is necessary to define the connector interface to the 3708. For cabling definitions refer to *IBM 3708 Network Conversion Unit Planning and Installation.* It is imperative, for correct operation, that only the pins called out in the cabling specifications are wired.

EIA 232C Definition

Pin 1 - Frame Ground

Pin 2 - TxD - Transmit Data (3708 output)

Pin 3 - RxD - Receive Data (3708 input)

Pin 4 - RTS - Request To Send (3708 output) For FDX facility with PRTS, RTS is active from the time the connection is established. For lines without PRTS, normally HDX communication facilities, RTS is active only when the 3708 has the line to transmit data. For lines without PRTS, RTS becomes active only when the 3708 has data to transmit and the remote device has turned the line around.

Pin 5 - CTS - Clear To Send (3708 input) Once the 3708 has RTS active, it waits up to 40 seconds (asynchronous connection) or 9 seconds (SDLC connection) for CTS to become active. For lines with PRTS, if CTS drops while traffic is on the line, the connection is broken. For lines with PRTS, if CTS drops while data is being transmitted, the connection is broken.

Pin 6 - DSR - Data Set Ready (3708 input) For nonswitched lines the 3708 activates Data Terminal Ready (DTR) and performs one of the following:

1. For SDLC connections and LINE TYPE=L configured in the 3708. If DSR is not presented within 3 seconds, a line fault is detected and reported. If DSR drops once it has become active, the connection is broken.
2. For SDLC connection and LINE TYPE=D configured in the 3708. The 3708 holds DTR until DSR is present.
3. For asynchronous connections. If DSR is not presented within 3 seconds, a line fault is detected and reported. If DSR drops once it has become active, the connection is broken.

For switched lines the 3708 tests the modem's DSR signal before attempting to establish a connection. Under normal conditions, the 3708 would either activate DTR when the port is enabled, or enable the port then wait for Ring Indicate (RI) before activating DTR, depending upon the setting of the CDSTL option. In both cases, DSR from the modem must not be active until the switched modem goes off hook to answer the incoming call. If DSR is active when the 3708 tests for DSR on a switched port, the 3708 assumes that a connection attempt is already in progress. The 3708 recognizes the DSR as an error condition and does not enable the port. The 3708 then waits 3 seconds and tries to enable the port again.

For lines operating without the CDSTL option, the 3708 activates DTR and waits for DSR to indicate a call has been received.

For lines operating with the CDSTL option, the 3708 waits for RI before activating DTR. Once DTR has been activated, DSR must be presented within 20 seconds or a line error is reported. For switched lines and nonswitched lines, if DSR drops after it has become active, the 3708 breaks the connection.

Pin 7 - Signal Ground

Pin 8 - DCD - Data Carrier Detect (3708 input) For lines that do not use PRTS, normally HDX communication facility, the 3708 will make sure that DCD is not present before transmitting. If DCD is present, it indicates that the line has not been turned around and that the remote device is still transmitting.

For lines with PRTS, when the Auto On-Hook option is specified, the 3708 detects the loss of DCD and breaks the connection.

Pin 15 - TxC - Transmit Clock (3708 input) This pin is used only for SDLC connections specifying external clocking. It provides the baud rate clock for transmitted data (TxD).

Pin 17 - RxC - Receive Clock (3708 input) This pin is used only for SDLC connections specifying external clocking. It provides the baud rate clock for received data (RxD).

Pin 18 - TC - Test Control This pin is not used by the 3708.

Pin 20 - DTR - Data Terminal Ready (3708 output) This pin is used by the 3708 to indicate that a connection should be established or maintained. The 3708 drops DTR whenever disconnecting.

For nonswitched lines, DTR is activated when the line is enabled and maintained until a line error is detected or the connection is broken by the host.

For switched lines not using CDSTL, DTR is activated when the line is enabled. For lines using CDSTL, DTR is not activated until RI has been detected. Once the connection is established, DTR is maintained until a line error is detected or the connection is broken by the host.

Pin 22 - RI - Ring Indicate (3708 input) This pin provides a signal from the modem indicating an incoming call. RI is monitored by the 3708 when the CDSTL option is selected. Once RI is presented, the 3708 activates DTR and wait for DSR to complete the connection.

Pin 23 - DRS - Data Rate Select This pin is not used by the 3708.

Pin 24 - DTE transmit clock (3708 output) When the 3708 is providing clock, it outputs the baud rate clock on pin 24. This is used for SDLC when the internal clock option is selected.

EIA 422A Definition

The EIA 422A circuitry uses balanced voltage circuitry employing a pair of conductors for receiving and transmitting data. Two pins are called out for both transmit data and receive data.

Pin 1 - Frame Ground

Pin 7 - Signal Ground

Pin 13 - Select EIA 422A (3708 input) When pin 13 is tied to signal ground (Pin 7), it selects EIA 422A for this 3708 port.

Pin 12 - (-) TxD - (-) Transmit Data (3708 output)

Pin 14 - (+) TxD - (+) Transmit Data (3708 output)

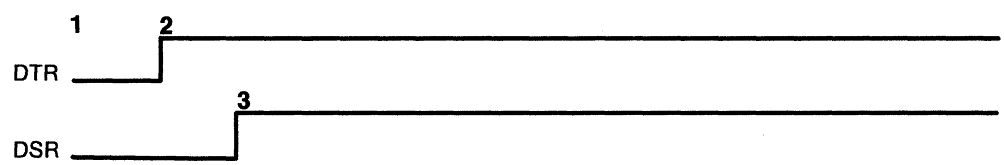
Pin 16 - (-) RxD - (-) Receive Data (3708 input)

Pin 19 - (+) RxD - (+) Receive Data (3708 input).

Interface Leads during Port Activation

The following figures show the states of the interface leads during port activation for the various line types that the 3708 supports.

Nonswitched Asynchronous Line Activation



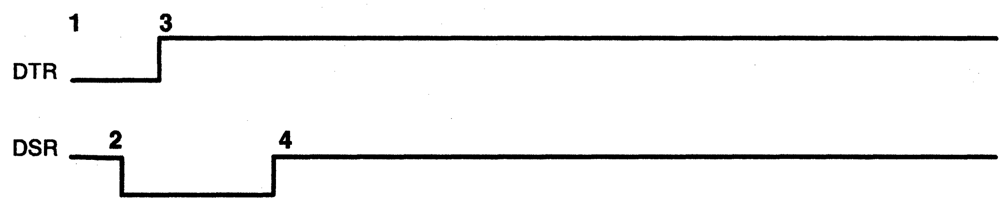
1 3708 enables port.

2 3708 raises DTR and waits for DSR.

3 DSR becomes active. Connection is established.
The time period the 3708 waits for DSR after activating DTR is three seconds.

Figure 2-10. Nonswitched Asynchronous Line Activation

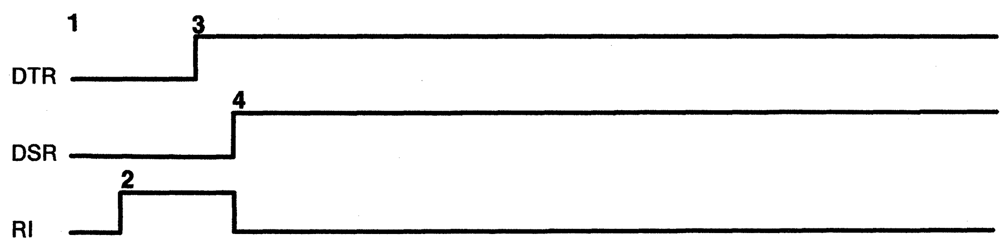
Switched Line Activation – Not CDSTL



1. 3708 enables switched line.
2. 3708 tests DSR. Normally DSR will not be present. However, if DSR is present, as in this example, the 3708 waits up to three seconds for DSR to drop.
3. After checking to ensure DSR is not present, 3708 activates DTR and waits for incoming call to be answered by modem and DSR to be presented. 3708 does not limit the time that it waits for DSR to be presented.
4. DSR comes active. Connection is established.

Figure 2-11. Switched Line Activation - not CDSTL

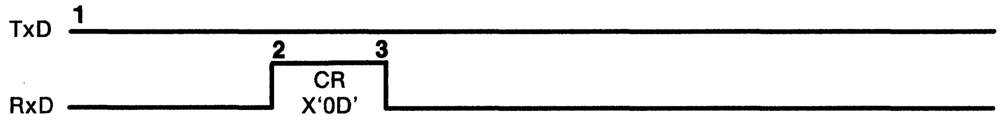
Switched Line Activation – CDSTL



1. 3708 enables line. 3708 ensures the DSR is not already present and begins monitoring RI. There is no time limit on incoming call.
2. Incoming call is received and modem presents RI.
3. 3708 activates DTR and waits up to 20 seconds for DSR.
4. Modem presents DSR. Connection is established.

Figure 2-12. Switched Line Activation - CDSTL

Asynchronous EIA 422A Line Activation



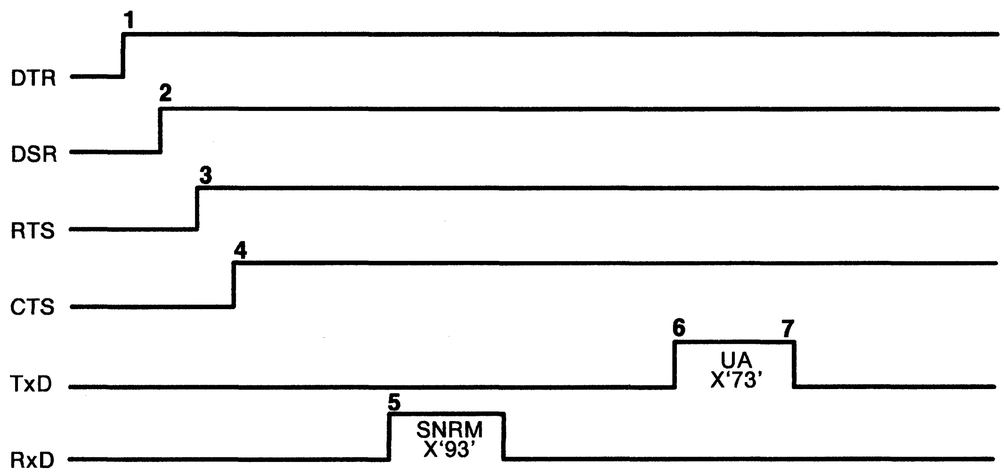
1 3708 port activated. 3708 waits for CR (X'0D') to indicate that downstream device is active. There is no time limit on downstream device becoming active.

2 3708 receives CR from downstream device.

3 Port activation is complete.
Active communication protocol is handled the same as with FDX communication facility with PRTS. Both HDX and FDX control units may be defined.

Figure 2-13. Asynchronous EIA 422A Line Activation

SDLC Link Activation PRTS



1 3708 is activated - DTR is activated.

2 3708 waits up to three seconds for DSR to be presented (if 3708 is configured for LINE TYPE = L) or 3708 holds DTR up until DSR is presented (if 3708 is configured for LINE TYPE = D).

3 3708 activates RTS.

4 Modem presents CTS - When 3708 has data to transmit, CTS must be presented within nine seconds.

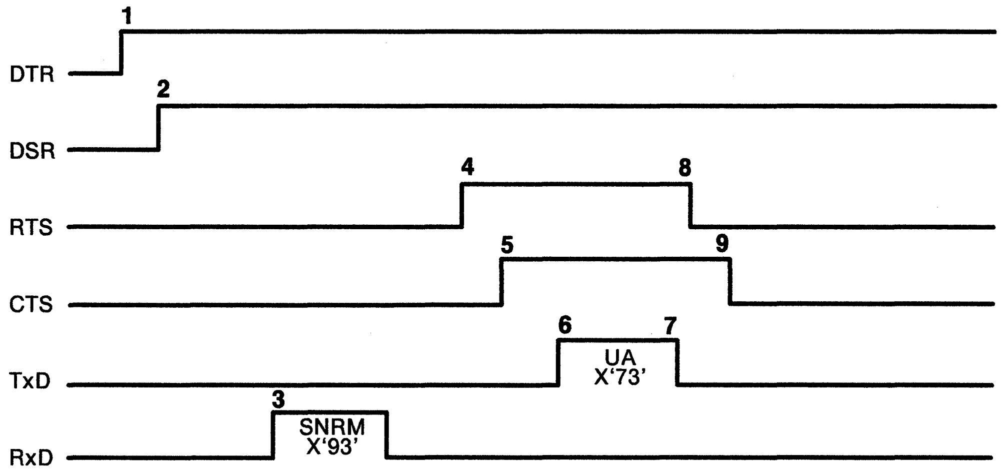
5 3708 receives SNRM from host.

6 3708 transmits flags for two msec. then UA is transmitted to host. Two msec. guarantees flags are presented before data.

7 UA transmission is completed.
Note: TxD returns to mark when NRZ.
TxD remains at last bit value when NRZI.

Figure 2-14. SDLC Link Activation PRTS

SDLC Link Activation Controlled RTS



1 3708 is activated - DTR is activated.

2 3708 waits up to three seconds for DSR (if 3708 is configured for LINE TYPE = L) or 3708 holds DTR up until DSR is present (if 3708 is configured for LINE TYPE = D).

3 3708 receives SNRM from the host.

4 3708 activates RTS and waits up to nine seconds for CTS.

5 Modem presents CTS.

6 3708 transmits two msec. of flags followed by UA. Two msec. guarantees flags are presented before data.

7 3708 finishes transmission of UA and transmits flags for four msec.

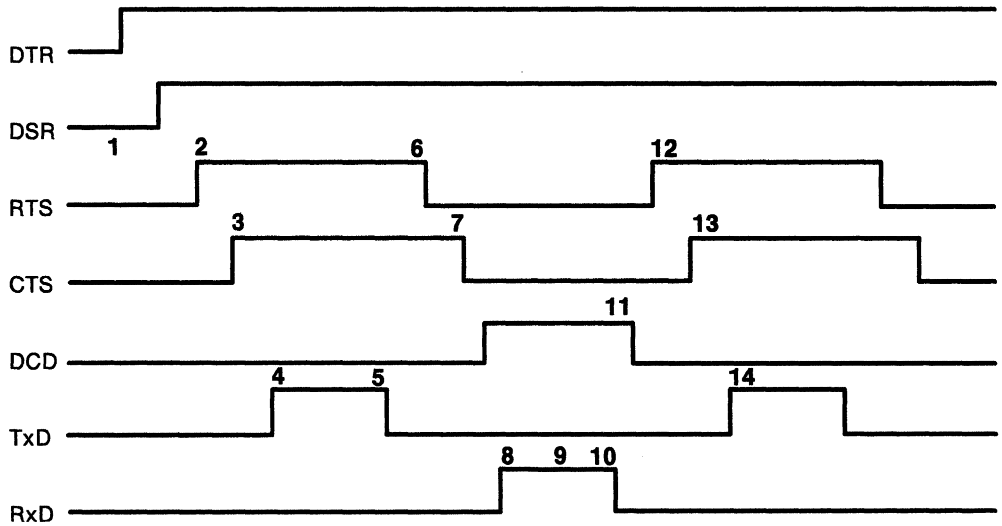
Note: TxD returns to mark when NRZ.
TxD remains at last bit value when NRZI.

8 3708 drops RTS.

9 Modem drops CTS.

Figure 2-15. SDLC Link Activation Controlled RTS

Asynchronous Line Operation – HDX Communication Facility – HDX Control Unit



1 3708 has data to transmit.

2 After ensuring that DCD is not present, 3708 activates RTS.

3 3708 waits up to 40 seconds for CTS - modem activates CTS.

4 3708 transmits data.

5 3708 completes transmitting data and sends four DEL characters, X'7F', to ensure that characters are received by remote device before remote device loses DCD.

6 3708 drops RTS.

7 Modem drops CTS.

8 3708 begins receiving data - DCD has been presented by modem.

9 3708 has data to transmit to remote device, waits for line turnaround.

10 3708 receives line turnaround and waits for DCD to drop.

11 DCD drops.

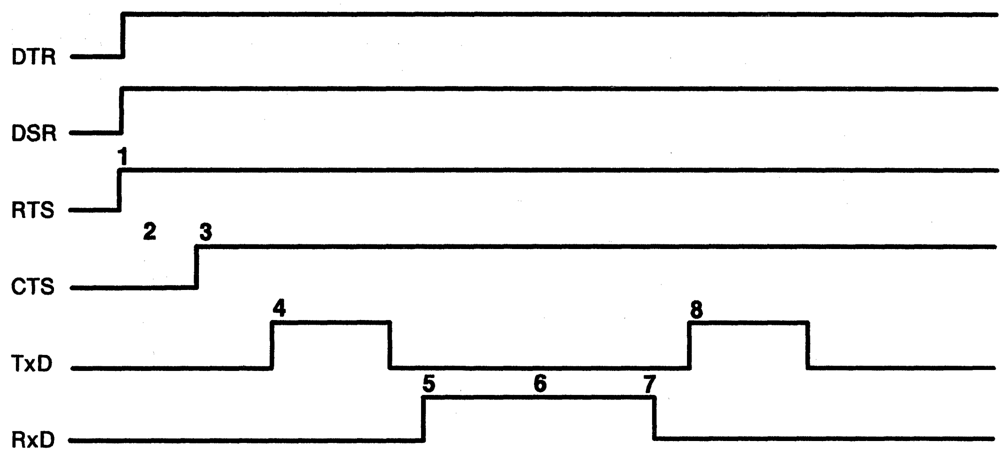
12 3708 activates RTS.

13 Modem presents CTS.

14 3708 transmits the number of DEL characters X'7F' specified in the configuration for line quiet time, followed by data. Line quiet time allows line to quiesce after turnaround from remote device.

Figure 2-16. Asynchronous Line Operation - HDX Communication Facility - HDX Control Unit

Asynchronous Line Operation – FDX Communication Facility, PRTS, HDX Control Unit



1 3708 activates RTS at line enable time <PRTS>.

2 3708 has data to transmit - CTS is monitored and must be presented within 40 seconds.

3 Modem presents CTS.

4 3708 transmits data.

5 3708 begins receiving data.

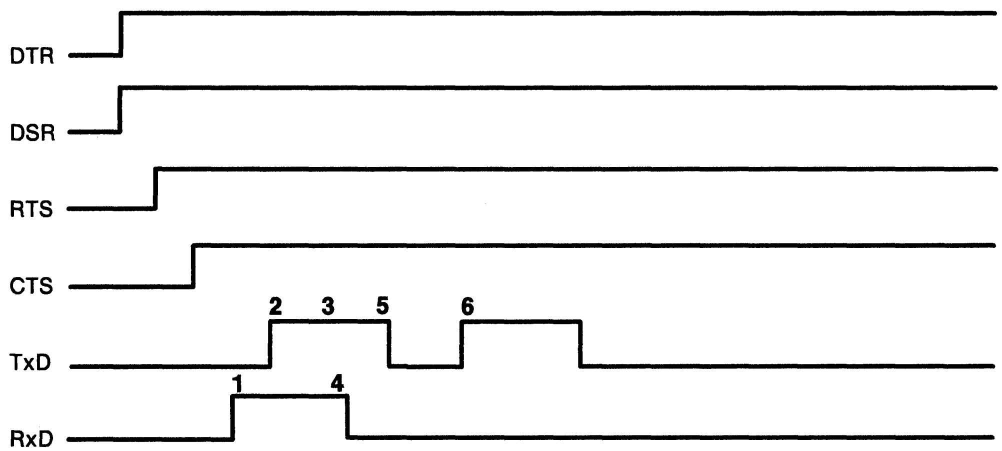
6 3708 has data to transmit. Data is held pending line turnaround.

7 Receive operation completes, 3708 receives line turnaround characters.

8 3708 transmits data.

Figure 2-17. Asynchronous Line Operation - FDX Communication Facility, PRTS, HDX Control Unit

Asynchronous Line Operation – FDX Communication Facility, PRTS, Echoplex (FDX or HDX CU)



1 3708 begins receiving data.

2 3708 echoes data.

3 3708 has "host" data to write, but if HDX control unit or Echoplex is configured, waits until receive operation is complete before transmitting. If characters have been received, the 3708 waits for receive to complete, only if HDX control unit is configured.
Note: Echoplex forces the 3708 to operate as an HDX control unit.

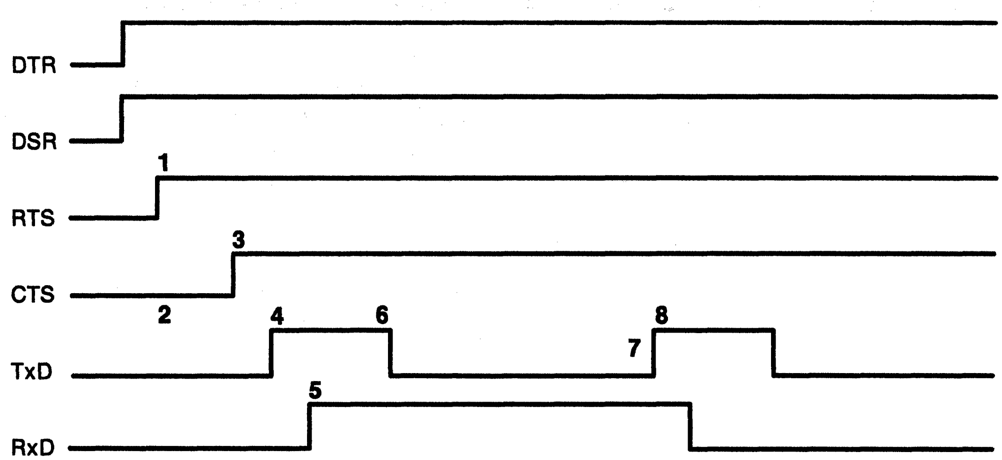
4 Terminal sends turnaround character to 3708.

5 3708 completes echo of receive data.

6 3708 transmits "host" data.

Figure 2-18. Asynchronous Line Operation - FDX Communication Facility, PRTS, Echoplex (FDX or HDX CU)

Asynchronous Line Operation – FDX Communication Facility PRTS – FDX Control Unit



1 3708 activates RTS at line enable time.

2 3708 has data to transmit, waits up to 40 seconds for CTS.

3 CTS is presented to 3708.

4 3708 begins transmitting data.

5 3708 receives data from remote device.

6 3708 finishes transmitting data.

7 3708 has more data to transmit.

8 3708 transmits data even though it is receiving data because this control unit is defined as FDX.

Figure 2-19. Asynchronous Line Operation - FDX Communication Facility PRTS - FDX Control Unit

Chapter 3. SDLC and SNA Communication

This chapter provides helpful information for the system analyst and the system programmer establishing host-to-3708 communication using Systems Network Architecture (SNA) protocols. A knowledge of the Network Control Program (NCP) and IBM access methods is assumed.

The topics discussed in this chapter are:

- Helpful publications
- SDLC transmission frames
- SDLC Inactivity Timeouts
- SNA sessions.

Helpful Publications

The following publications provide information to help the programmer for the host plan the use of SNA commands and access method macros:

VTAM:

ACF/VTAM General Information, GC27-0608
ACF/VTAM Programming, SC27-0449
ACF/VTAM Reference Summary, SX27-0027
ACF/VTAM Operation, SC27-0612
ACF/VTAM Messages and Codes, SC27-0614.

NCP:

IBM 3704/05 Principles of Operation, GA30-3004
IBM 3725 Communications Controller Network Control Principles of Operation, GA33-0013
Network Program Products: Planning, SC23-0110
ACF/NCP Customization, LY30-5571.

SNA:

SNA Concepts and Products, GC30-3072
SNA Technical Overview, GC30-3073
Systems Network Architecture Format and Protocol Reference Manual: Architecture Logic, SC30-3112
SNA Reference Summary, GA27-3160.

SDLC:

IBM Synchronous Data Link Control General Information, GA27-3093.

SDLC Transmission Frames

Transmission between an SNA host and the 3708 takes place according to a predefined frame format that consists of the following sequence of bytes:

Flag (F) Sequence	1 byte (X'7E')
Secondary Station Address (A)	1 byte
Control (C) Field	1 byte
Information (I) Field	Up to 256 bytes of message data, plus header information
Frame Check Sequence (FCS)	2 bytes
Flag (F) Sequence	1 byte (X'7E')

When sending or receiving over an SDLC link, the 3708 supports modulo-8 mode; that is, the 3708 can accept or transmit up to seven frames at a time.

Data link control for the 3708 is identical to that discussed in *IBM Synchronous Data Link Control General Information*, GA27-3093, with the exception that the Set Normal Response Mode command causes the 3708 to reset from an Activated Physical Unit (ACTPU) to a Deactivated Physical Unit (DACTPU). All sessions must be restarted by the sequence starting with ACTPU.

Normal Response Mode

The 3708 functions in two link operating modes: normal response mode (NRM) and normal disconnect mode (NDM). The 3708 can initiate transmission only as a result of receiving from the SNA host a frame that contains the P (Poll) bit set to 1. Single or multiple frames may be sent. The last frame (or a single frame) transmitted by the 3708 in response to a command received with the P bit set to 1 must have the F (Final) bit set to 1. When the 3708 has completed a transmission, a new transmission cannot be initiated until a subsequent frame is received from the SNA host that contains the P bit set to 1. A response transmission initiated by the 3708, which requires acknowledgment from the SNA host, is repeated each time the SNA host polls until the acknowledgment is received. There is no limit to the number of transmissions. Responses that require acknowledgment from the communications SNA host are information (I) frames, frame reject (FRMR), and receive ready (RR) when transmitted with the F bit set to 0, to report clearing of a busy condition.

Normal Disconnect Mode

When in NDM, the 3708 cannot accept or transmit I or supervisory (S) frames. Any I or S frames received by the 3708 is ignored and responded to with a disconnect mode (DM). Nonsequenced responses are not transmitted unless the 3708 is solicited to reply. Invalid or nonimplemented commands received in NDM cause the 3708 to transmit a DM response at the next response opportunity. DM can be retransmitted until a set normal response mode (SNRM) command is received. Command reject conditions are not present in NDM.

SDLC Station Address

The SDLC station address is a 1-byte address that must be selected in the customer configuration. This address must correspond with the Station Address parameter configured in the 3708. An SDLC station address of either X'00' or X'FF' cannot be assigned.

Control Field

The control field designates the frames as supervisory (S), nonsequenced (NS), or information (I).

Supervisory Commands

The 3708 supports only the supervisory commands Receive Ready (RR) and Receive Not Ready (RNR).

The control field formats are:

Bits	**012**	**3**	**4**	**5**	**6**	**7**
RR	Nr	P/F	0	0	0	1
RNR	Nr	P/F	0	1	0	1

Where: Nr = the sequence number of the next I frame that the 3708 expects to receive.

The 3708 transmits RNR when it cannot accept further data from the link.

When the reported RNR condition is cleared, the 3708 transmits an I frame or RR with the F (Final) bit on after a frame with the P (Poll) bit on is received.

If the 3708 has received an RNR, an I frame is not transmitted until an RR or I frame with the poll bit on is received.

The transmission or receipt of an NS frame does not indicate the RNR condition has cleared. (NS is the sequence number of the next I frame that the host expects.)

Nonsequenced Commands and Responses

The following nonsequenced commands and responses are supported by the 3708:

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

The SNRM command sets the 3708 in Normal Response mode. Receipt of SNRM causes the 3708 to deactivate the physical unit if it is in active state.

The DISC command sets the 3708 in NDM.

The UA response is sent by the 3708 to acknowledge receipt and acceptance of an SNRM or DISC command.

The Test command is used to initiate one round-trip transmission of test data both in NRM and NDM. The 3708 returns the Test response.

The Disconnect Mode (DM) response is sent by the 3708 in normal disconnect mode (NDM) to request online status. DM is sent in response to any command except Test and exchange identification (XID).

The FRMR response is implemented by the 3708 as described in *IBM Synchronous Data Link Control General Information*, GA27-3093. The FRMR is sent in response to any poll until an SNRM or DISC is received to reset the 3708

The XID command and response contains additional data beyond the C byte. The 3708 responds to the XID command in NRM or NDM, except when an FRMR condition exists, in which case the FRMR response takes precedence over XID. The additional data of the XID response consists of 48 bits defined as:

Bits	Meaning
0–3	ID format B'0000'
4–7	PU type B'0010'
8–15	Self-description X'00'
16–27	X'04B'
28–47	Terminal ID = 0

The 3708 normally sets the terminal ID field of the XID response to 0. However, if nonstandard operating bit 11 is set to 1, the 3708 sends the last 5 nibbles of the serial number. This function gives host programs the ability to distinguish between individual 3708s in a network.

Information Field

The information frame is used to transmit message data. When transmitted, the I frame contains a maximum of 256 bytes of RU message data preceded by 6 bytes of transmission header (TH) and, optionally, 3 bytes of request/response header (RH). For more information, see "SNA Commands" on page 3-15.

Sequence Error Recovery Procedures

A sequence error occurs when the 3708 receives an I frame with an incorrect NS sequence count and valid frame check sequence (FCS) bytes. The 3708 does not accept the I frame that caused the sequence error and rejects all following I frames until an I frame is received that contains the correct NS value. The sequence error condition is then reset.

The 3708 transmits I frames in the sequence indicated by the last NS count received, which may include retransmission of previously transmitted I frames that have not been acknowledged.

All I frames are transmitted in contiguous sequence according to the NS value within the constraints of the modulo count.

Abort Function

The abort function is used by the SNA host or by the 3708 when a frame being transmitted is to be discarded. The abort function is performed by transmitting eight contiguous 1 bits with no 0 inserted as soon as possible after an abort situation is recognized. No FCS is transmitted. When, for example, the 3708 receives seven contiguous 1 bits, it discards the aborted frame. The 3708 uses the abort function when an equipment malfunction causes an incorrect transmission.

SDLC Inactivity Time Out

The 3708 supports the use of an inactivity timeout on its SDLC links. The timeout is defined in half seconds and can be set to 0 or any number between 60 and 16383. Zero is the default. If you enter a number between 0 and 60, the 3708 displays an error message stating that the input is invalid.

The SDLC Inactivity Time Out option is useful in providing host system backup in environments where constant availability of a host is required. It is often difficult to determine whether the upstream connection is still active because certain cabling configurations and modems always present active EIA 232C leads to the 3708 even if the host is not active. Specifying an SDLC Inactivity Timeout value other than zero allows the 3708 to detect host failures independent of cabling and modem configurations.

How the Timer Works

The timer starts when the SDLC link enters an information transfer state, that is, when a valid SNRM has been received. The length of the timer is half that of the SDLC Inactivity Time Out value. While it is in an information transfer state, the 3708 checks if any valid frames are received. Frames with errors, such as FCS errors, are not considered valid frames.

The link is declared inactive if two consecutive timers expire and the 3708 has not received at least one valid frame. Because the 3708 checks for valid frames only after a timer expires, it can take a length of time equal to one or one and a half times the SDLC Inactivity Time Out value before the SDLC link is declared inactive. When the SDLC link is declared inactive, the 3708 does the following:

- Notifies users that the host connection is lost
- Disconnects all downstream ports connected to the SDLC line that exceeds the timer
- Generates an error log entry
- Generates and stores an alert A101.

When the SDLC link exits the information transfer state, the timer stops.

Whenever the upstream SNA connections are lost because of a malfunction, the terminal users are notified by a short message. The message consists of the current 3708 ID line followed by the `HOST UNAVAILABLE, RETRY LATER` message. The port is then disconnected.

For users operating in protocol conversion mode, the screen is cleared before the message is displayed.

Backing Up an SNA Host Link

The SDLC Time Out options can be used to backup an SNA host link. You can define two SNA host links but allow users access only to the primary link. When the primary link fails, the 3708 can activate the secondary or backup link automatically.

To define a backup system, do the following:

1. Define two SNA host links.
2. Define a nonzero SDLC Time Out value for both hosts.
3. Define all ports that have access to the backup system in the display source fields of both SNA hosts. (Printers can only be assigned to one host and, therefore, cannot be backed up.)
4. Allow the port access to only the primary host by suppressing the Host Selection (C3) screen for that port or by excluding all of the 3708's logon screens. (Excluding all logon screens prohibits control terminal access.)

If two LUs are defined for one port, the 3708 assigns the port to the first LU that becomes active. An LU is considered active when the 3708 receives and positively responds to its ACTLU command. To ensure that the port is assigned to the primary host, activate the primary host and allow it to transmit its ACTPU and ACTLU commands before activating the secondary host. The secondary host can be activated after the primary or when the primary fails. ACTPU and ACTLU commands from the secondary host receive positive responses, but the device is treated as if it is turned off.

If the primary host fails and the SDLC Time Out value is exceeded, the 3708 notifies all displays attached to that host that the link has failed. It sends the message `HOST UNAVAILABLE, RETRY LATER`. (Users linked through a switched line are disconnected and must dial into the 3708 port again.) If the secondary host is active, the 3708 can switch displays to the secondary host. For displays defined in the secondary host's source display list, the 3708 transmits a NOTIFY (power on) to the secondary host and allows the displays to attach to the new host.

When the primary host becomes active again and transmits ACTPU and ACTLU commands to the 3708, the secondary host can:

- Relinquish control.

  The secondary host relinquishes control by transmitting a DACTPU or DACTLU command. The DACTPU command disconnects all devices connected to the secondary host and switches all displays to the primary host. A DACTLU command switches only those displays attached to the 3708 port associated with the LU to the primary host. Users linked through a switched line must dial into the 3708 port again before they can connect to the primary host.

- Become the new primary host.

  If the two hosts are completely interchangeable, the primary host can be used to backup the secondary host.

SNA Sessions

Before communication can begin between a host application and the 3708, a set of logical SNA connections, called *sessions,* must be established to control the exchange of data and control information.

At the host system, the access method provides the System Services Control Point (SSCP) function for all sessions that are established with the 3708. The SSCP maintains information that allows an application to establish and maintain a session with a 3708. For 3708 operations, the host always contains the Primary Logical Unit (PLU), and the 3708 always contains the Secondary Logical Unit (SLU).

The sessions that must exist between the host system and the 3708 before an application program and the 3708 can exchange information are the following:

SSCP-PU (access method–3708 Physical Unit (PU))
SSCP-PLU (access method–host program)
SSCP-SLU (access method–3708 SLU)
PLU-SLU (host program–3708 SLU) (referred to as LU-LU).

The following sections discuss the sessions individually and identify how they are established and terminated. The SNA commands that establish and terminate the sessions are identified. SNA commands are discussed in detail under "SNA Commands" on page 3-15.

SSCP-PU Session

Before establishing the SSCP-PU (access method–3708 Physical Unit) session, the physical transmission connection to the host must be established.

The SSCP-PU session must be established before the SSCP-SLU or LU-LU sessions. When the network operator activates a specific 3708, the access method issues an ACTPU command to the 3708. A predefined start procedure for the access method may also request the activation of specific 3708 network conversion units. The SSCP-PU session is the first session established between the host system and the 3708.

The SSCP-PU session is terminated when the network operator deactivates the 3708. When all SSCP-LU sessions for the network conversion unit have been terminated, the access method issues a Deactivate Physical Unit (DACTPU) command that terminates the SSCP-PU session.

SSCP-Secondary LU Session

When the SSCP-PU session is established, an activate command is issued by the access method to establish the SSCP-SLU session. The access method issues an Activate Logical Unit (ACTLU) command for the appropriate SLU or SLUs in the 3708. The SSCP-SLU session must be established before the LU-LU session.

The SSCP-SLU session is terminated when the access method sends a DACTLU command to the specified 3708 SLU.

PLU-SLU Session

This section describes how to initiate and terminate LU-LU sessions.

Initiating an LU-LU Session

Four types of LU-LU sessions are supported by the 3708:

Type 1 (LU type 1 SCS)	The device attached to the 3708 is defined to the 3708 as a printer and the data stream is controlled by SNA character string (SCS) characters. The 3708 is operating in protocol conversion mode.
Type 1 (LU type 1 NTO)	The device attached to the 3708 is operating as a TWX 33/35 NTO device and is defined to the 3708 as either a keyboard/display or a keyboard/printer. The 3708 is operating in protocol enveloping mode.
Type 2 (LU type 2)	The device attached to the 3708 is defined as a keyboard/display, and the data stream is 3270. The 3708 is operating in protocol conversion mode.
Type 3 (LU type 3)	The device attached to the 3708 is defined as a printer and the data stream is controlled by 3270 data stream compatibility (DSC) mode format. The 3708 is operating in protocol conversion mode.

The SNA BIND command (byte 14) is used to differentiate between type 1, 2, or 3 sessions. If a type 1 BIND is received, LU type 1 SCS and LU type 1 NTO are differentiated by the device type defined to the 3708. For a display, the mode selection of Dynamic allows it to operate as LU type 1 NTO or LU type 2 depending on the SNA BIND byte 14.

The manner in which an LU-LU session may be initiated depends on the type of session being started:

- An LU type 1 SCS or LU type 3 DSC session must be initiated by the PLU.

  Both of these session types support printers only. Printers cannot initiate sessions.

- An LU type 2 session may be initiated by either the PLU or SLU.

  The LU type 2 session supports keyboard displays. Sessions can be initiated by the terminal operator or from simulated logon procedures defined at the host.

- An LU type 1 NTO session may be initiated by either the PLU or SLU.

  The LU type 1 NTO session supports both keyboard displays and keyboard printers. Sessions can be initiated by the terminal operator or from simulated logon procedures defined at the host.

Example of Establishing a Session

The command flow sequence required to establish a session is summarized in Figure 3-1 on page 3-11. The command flow nomenclature is generalized and access method specific macro names are not used. The example illustrates the connection process to one 3708 SLU and includes the following assumptions:

- No sessions are originally activated between the host and the 3708.
- The device connected to the 3708 is a keyboard display.
- No 3708 logon screens have been suppressed.
- The 3708 port has been defined for autobaud/autoparity and has a port password defined.

The access method sends the ACTPU command to establish the SSCP-PU session #1. (See #1 in Figure 3-1 on page 3-11.) An ACTLU command #2 is then sent to establish the SSCP-PLU and SSCP-SLU sessions. Typically, the SSCP would send an ACTLU command for each of the LUs defined for the 3708 in the host generation.

After transmitting a positive response to the ACTLU command, the 3708 sends a NOTIFY command #3 to the SSCP. This command tells the SSCP that although the LU in the 3708 has been activated, the device attached to that LU is not available for use (powered off). The 3708 SLU considers all devices powered off until a host selection is made.

After the display terminal operator has logged on to the 3708 #4, the 3708 transmits another NOTIFY command #5 to inform the SSCP that the display is active and ready to communicate with a host application. The 3708 transmits the NOTIFY immediately after the terminal operator has made a host selection.

If all 3708 logon screens are excluded, the NOTIFY (power on) is transmitted when the 3708 detects that the downstream device is powered on. If the Host Selection screen (C3) is suppressed, the NOTIFY (power on) is transmitted after the terminal type is determined.

If an SSCP Good Morning message, such as the VTAM USS message 10, is defined in the host, the SSCP message is transmitted through the 3708 to the display #6. This message, if defined, displaces the 3708 Logon Indication (C4) screen.

Note: If VTAM transmits the message 10 before the 3708 sends NOTIFY (power on), the 3708 rejects the message with a negative response (X'0831').

The network is now ready for LU-LU sessions to be established.

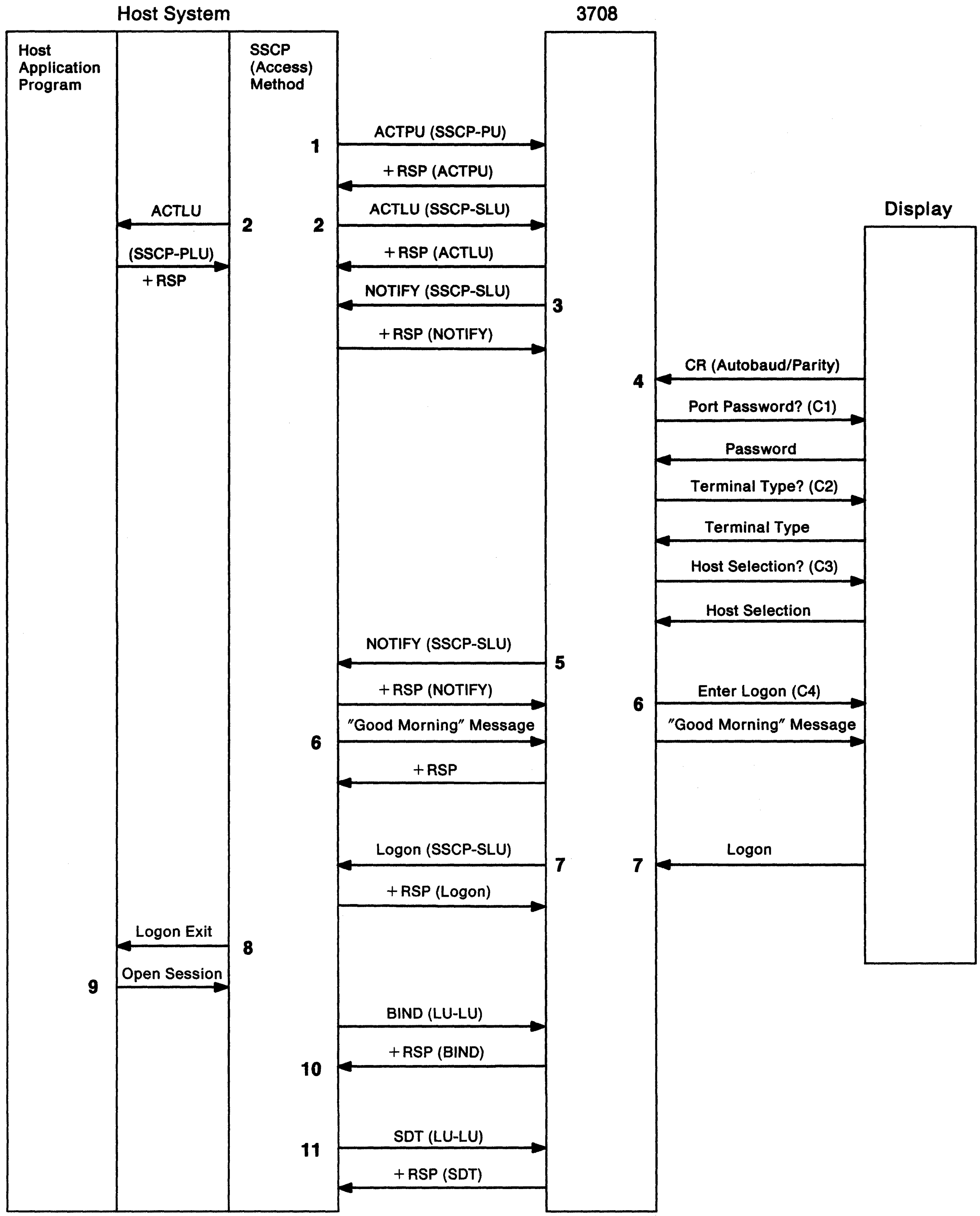


Figure 3-1. Establishing a Session with a 3708

An LU-LU session is started by the host application program when it issues the BIND request. The LU-LU session may be initiated by the host application program (for example, acquiring the terminal or by a simulated logon) or by the display terminal operator #7 (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 #8 for the PLU. After the PLU receives control at the logon exit, or when the PLU acquires the terminal, the PLU passes an open session request to the SSCP #9 which results in an SNA BIND #10 being passed to the 3708 SLU. The 3708 examines the session parameters of the BIND and, if they are acceptable, allows the session to be established by sending a positive response to the BIND command. See "BIND Check" on page 3-24 to verify acceptable session parameters. If the session parameters are not acceptable, the 3708 rejects the BIND command by returning a negative response (X'0821'), indicating that the session parameters are invalid.

Once accepted, the BIND determines the basic LU-LU session characteristics (LU type 1, LU type 2, or LU type 3). The 3708 also uses the device type defined in its configuration to distinguish between the two LU 1 types (LU type 1 SCS and LU type 1 NTO).

After the BIND command has been accepted with a positive response, the host program can issue the Start Data Traffic command #11 to allow data traffic to flow for the session.

Terminating an LU-LU Session

LU-LU sessions can be terminated in the following ways:

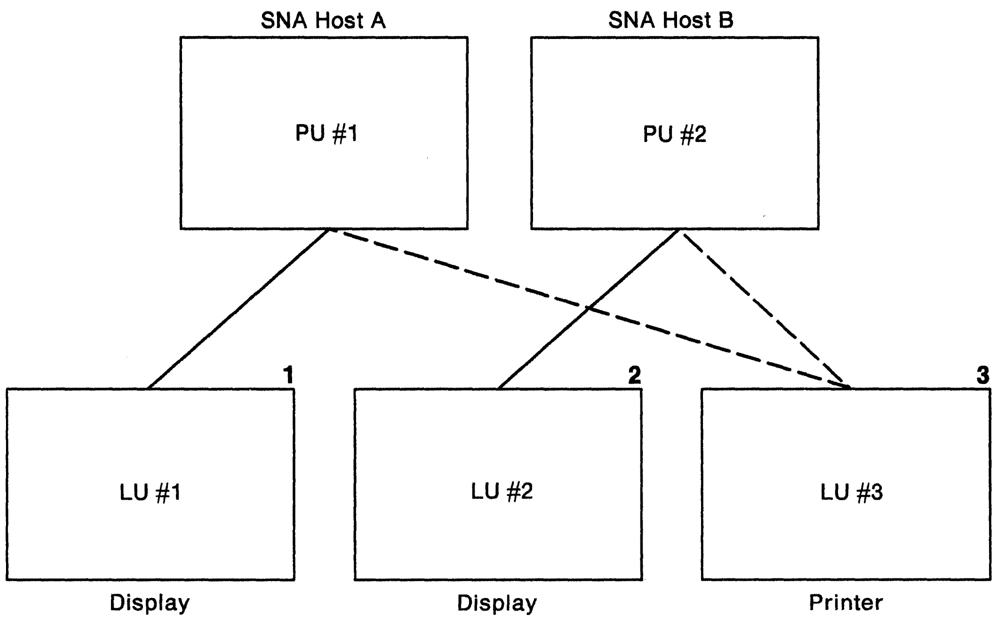
- The PLU can terminate an LU-LU session by requesting that the SSCP close the session. The SSCP then sends an UNBIND command to the 3708 SLU. The UNBIND terminates the LU-LU session.
- LU type 2 sessions can be terminated by the display operator in two ways:
  1. The display operator may inform the PLU, for example, by a logoff request (on the LU-LU session), that termination is desired. The PLU then terminates the session by transmitting an UNBIND command.
  2. The display operator changes from an LU-LU session to an SSCP-SLU session by using the System Request key sequence and enters a logoff message. If the logoff message is conditional, the SSCP passes the logoff request to the PLU. If the logoff message is unconditional, the SSCP transmits an UNBIND command to the 3708 SLU.
- LU type 1 NTO users may log off their applications by issuing a system request simulation string followed by their application's logoff sequence. These strings are defined in the 3708 configuration (the default is 99999).
- A PLU may close the session in an orderly fashion by issuing a Shutdown command. When the host program issues the Shutdown command, the 3708 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.
- If an ACTLU (Cold) command is received from the SSCP while an LU-LU session exists, the 3708 terminates the LU-LU session and reset the SSCP-LU session. (ACTLU (ERP) commands do not terminate the LU-LU session.)

3708 Sessions

This section describes the LUs that can be associated with 3708 ports and describes how the LUs are defined.

3708 Session Components

Each downstream port on the 3708 can have up to three LUs associated with it. See 3-2 for an example.



——— Indicates that LU # 3 can go to either host, but *not* both.

Figure 3-2. Maximum Number of LUs Associated with each 3708 Downstream Port

The LU #1 is used for communication with SNA host A and is associated with the 3708 PU defined for SNA host A. The LU #2 is used for communication with SNA host B and is associated with the 3708 PU defined for SNA host B. The LU #3 is used for printer communication when the downstream device has been defined to the 3708 for MLU support (keyboard/display with printer). It is associated at configuration time either with host A or host B, but not both.

All three of these LUs may be activated at the same time; however, only two (one display and one printer) may be bound (that is, in communication with a host application). Downstream devices can be bound to either SNA host A or SNA host B but not both at the same time. The LU associated with the MLU printer can be bound to either host A or host B. Although, in an MLU configuration, the printer's LU does not become bound unless its associated display is bound as an LU type 2. The MLU printer is not required to be bound to the same SNA host as its associated display.

With two SNA hosts defined, the 3708 can support up to 24 active LUs with as many as 16 of those LUs bound and in communication with host applications. With one SNA host defined, the 3708 can support as many as 18 active LUs with all 18 LUs capable of being bound and in session with host applications.

Associating 3708 LUs with Host LUs

Each 3708 LU is defined by an SNA LU device number. This number can be defined by the 3708 control terminal operator and is stored in the 3708 configuration. The control terminal operator can define the SNA LU device number for each of the three LUs associated with downstream 3708 ports.

The 3708 associates the SNA LU device number with two less than the LU address defined at the host (DAF'). For example, if the host generation defines the address of an LU as 2, the corresponding LU in the 3708 has an SNA LU device number of 0. The default SNA LU device numbers in the 3708 configuration are listed in the following table. The default LU device numbers are provided as if a display-with-printer were configured for each port.

Port	A Host	B Host	Printer
1	00	00	10
2	01	01	11
3	02	02	12
4	03	03	13
5	04	04	14
6	05	05	15
7	06	06	16
8	07	07	17
9	08	08	18
10	09	09	19

SNA LU device numbers may range from 00 to 31 and may be assigned to any port. The control terminal operator, however, must ensure that:

- All SNA LU device numbers assigned to a particular host are unique.
- All SNA LU device numbers assigned to MLU printers are unique and different from those SNA LU device numbers assigned to Host A or Host B.

Note: Device numbers should be unique. The 3708 does not check for duplicates. Duplicate device numbers can cause unpredictable results.

SNA Commands

This section describes the format of SNA commands and describes how the 3708 processes these commands.

Transmission Formats

The host program and the 3708 communicate using half-duplex/flip-flop or contention send/receive protocols. When the host program or the 3708 is transmitting data, it assumes the role of the sending 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 application program). The term *outbound* refers to transmissions from the host to the 3708. The term *inbound* refers to transmissions from the 3708 to the host.

The portions of an SNA transmission between the host and the 3708 are:

Transmission Header (TH)
: This header contains format identification, mapping fields, an expedited flow indicator, the destination address (DAF'), the origin address (OAF'), and a sequence number.

Request/Response Header (RH)
: This header describes the type of message being transmitted and contains indicators that control SNA protocols.

Request/Response Unit (RU)
: This unit contains the data or commands that flow in the transmission. A Null RU is an RU that contains no data.

The 3708 communicates with an SNA host system by means of a teleprocessing network that uses the synchronous data link control (SDLC) transmission format. See "SDLC Transmission Frames" on page 3-2 for information about SDLC.

Transmission Header

The 3708 supports FID2 transmission headers (TH). The transmission header consists of 6 bytes. The following table describes the transmission header.

TH Byte	Bits	Description
0	0-3 4-5 6 7	Format Identification (FID) Mapping Field (MPF) Reserved Expedited Flow Indicator (EFI)
1	0-7	Reserved
2	0-7	Destination Address Field (DAF')
3	0-7	Origin Address Field (OAF')
4-5		Sequence Number; ID number on expedited flow request and responses

The 3708 handles transmission headers received on outbound requests in the following ways:

- All reserved parameters are ignored on requests.
- The 3708 supports outbound segmenting for FM data in the MPF.
- The expedited flow indicator identifies normal (0) or expedited (1) flow requests.
- The 3708 supports the following requests as outbound expedited flow requests when EFI = 1:

RU Category	Expedited Request
Session Control (SC)	ACTPU, DACTPU, ACTLU, DACTLU, BIND, UNBIND, CLEAR, SDT
Network Control (NC)	Not Supported
Data Flow Control (DFC)	SIGNAL, SHUTDOWN
Function Management Data (FMD)	Not Supported

- The 3708 supports the following requests as outbound normal flow requests when EFI = 0:

RU Category	Normal Request
Session Control (SC)	Not Supported
Network Control (NC)	Not Supported
Data Flow Control (DFC)	CANCEL, BID, CHASE
Function Management Data (FMD) on PLU-SLU	Any Request
Function Management Data (FMD) on SSCP-SLU	Any Request in SCS format
Function Management Data (FMD) on SSCP-SPU	REQMS, NMVT

Supported SNA Commands

The RU category, flow (expedited or normal), and the direction of flow for each SNA command on a session are shown in the following table. Details of the processing for each command follows the table.

Command	Type	Flow	SSCP-PU	SSCP-SLU	PLU-SLU
ACTPU	SC	E	→		
ACTPU ERP	SC	E	→		
DACTPU	SC	E	→		
ACTLU	SC	E		→	
ACTLU ERP	SC	E		→	
DACTLU	SC	E		→	
BIND	SC	E			→
UNBIND	SC	E			←→
SDT	SC	E			→
Clear	SC	E			→
Cancel	DFC	N			←→
Chase	DFC	N			→
LUSTAT	DFC	N			←
SHUTD	DFC	E			→
SHUTC	DFC	N			←
RTR	DFC	N			←
BID	DFC	N			→
Signal	DFC	E			←→
Data	FMD	N			←→
REQMS	FMD	N	→		
RECFMS	FMD	N	←		
NMVT	FMD	N	←→		
NOTIFY	FMD	N		←	
TERM-SELF	FMD	N		←	

Activate Physical Unit (ACTPU)

The ACTPU command is sent by the access method to establish the SSCP-PU session with the 3708. The SSCP-PU session is established when the 3708 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 3708 receives the ACTPU command, all active sessions are terminated immediately unless ACTPU ERP is specified. The 3708 returns a positive response to the ACTPU command and the SSCP-PU session is reestablished.

An ACTPU ERP can be sent to the 3708 to activate or reset the SSCP-PU session without disrupting the LU-LU or SSCP-LU sessions associated with the 3708 PU.

Deactivate Physical Unit (DACTPU)

When the 3708 receives the DACTPU command, the SSCP-PU session and all of the LU-LU and SSCP-SLU sessions associated with the PU are terminated. All downstream 3708 devices are disconnected. If a command other than ACTPU is received after a positive response has been returned for the DACTPU command, the 3708 returns a negative response with sense data indicating PU not active (sense code X'8008').

Activate Logical Unit (ACTLU)

An ACTLU command is sent by the access method to establish the SSCP-SLU session with each 3708 SLU. The SSCP-SLU session is established when the 3708 returns a positive response to the ACTLU command. The SSCP-PU session must be established before the receipt of ACTLU.

If the 3708 receives a command other than ACTPU, ACTLU, or DACTPU after a positive response has been returned to the ACTPU command, a negative response is returned with sense data indicating LU not active (sense code X'8009'). If a DACTLU is received before the SSCP-LU session is established, the 3708 returns a negative response with a sense code of X'0816'.

The SLU in the 3708 can be activated even if the downstream device is not powered on or attached. The 3708's ACTLU response indicates power off (resource unavailable) status. A NOTIFY command is sent to indicate that the downstream device is available for use. Downstream devices are available for use when the devices are powered on and a host selection has been made. For EIA 232C devices, the 3708 detects a power on by transitions on the EIA 232C leads. For EIA 422A devices, power on is determined by the receipt of a carriage return character. If all 3708 logon screens are excluded, a NOTIFY (power on) is transmitted to the host only when the 3708 detects that the downstream device is powered on.

If an ACTLU command is received during an LU-LU session, the LU-LU session is terminated unless the ACTLU specifies ERP and the downstream device is disconnected. ACTLU ERP commands received during an LU-LU session reset the SSCP-LU session but do not disturb the current LU-LU session and do not disconnect the downstream device. ACTLU ERP commands received when no LU-LU session exists are treated exactly as an ACTLU command.

Deactivate Logical Unit (DACTLU)

Receipt of this command terminates the SSCP-SLU session. If an LU-LU session exists when the DACTLU command is received, the session is terminated.

If the 3708 has been configured for DISCONNECT = 4 or 5, the downstream device is not disconnected on a DACTLU. When the 3708 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').

NOTIFY

The 3708 transmits a NOTIFY to advise the SSCP when a downstream device is available for communication. By waiting to notify the SSCP until its downstream devices are actually ready to communicate with a host application, the 3708 prevents the access method from creating and maintaining unnecessary control blocks. Resources are therefore requested from the access method only as required.

The format of the NOTIFY command is:

TH0:	X'2C'	(Secondary → Primary, normal)
TH1:	X'00'	
DAF':	X'00'	
OAF':	Address of LU sending NOTIFY	
SNF:	X'0000'	
RH0:	X'0B'	(Request FMD, formatted, OC)
RH1:	X'80'	(DR1)
RH2:	X'00'	
RU0:	X'81'	Network Services
RU1:	X'06'	Session Service
RU2:	X'20'	Notify
RU3:	X'0C'	Vector key
RU4:	X'06'	Length
RU5:	b'0000 00x1'	
		x = 0 Secondary unavailable, power off. x = 1 Secondary available, power on.
RU6-7:	X'0001'	LU-LU session limit
RU8-9:	X'0000'	LU-LU session count
RU10:	X'00'	Reserved

After each ACTLU command, the 3708 transmits a NOTIFY (power off) command to the SSCP. This command performs two tasks. It notifies the SSCP that the downstream device is powered off, and it tests whether the access method supports the NOTIFY command. A negative response to the NOTIFY command indicates that the host access method does not support NOTIFY, and the 3708 does not transmit any more NOTIFY commands to the host.

If the host access method supports NOTIFY, the 3708 transmits a NOTIFY command in the following conditions:

- When the downstream device powers on and a host selection is made from the 3708's host selection (C3) logon screen.
- When an EIA 232C device powers on and all 3708 logon screens are excluded.
- When the user enters a CR on a EIA 422A connected device.
- When the terminal type is determined either by user selection or 3708 configuration and the Host Selection (C3) logon screen is suppressed.
- When an UNBIND (0F) or a TERM-SELF (40) is generated by the 3708. The UNBIND (0F) and TERM-SELF (40) are 3708 security features (see "Transmission of UNBIND(0F) and/or TERM-SELF(40)" on page B-2) that prevent dial-up users from gaining access to other user's applications. After transmitting the UNBIND (0F) or TERM-SELF (40), the 3708 transmits a NOTIFY to the SSCP to notify the access method of a power off condition.

The 3708 supports a negative response of X'0845' to a BIND when the downstream device is unavailable. X'0845' is the sense code in operation following an ACTLU until the port for the LU is active (device powered up) and a host is selected by the terminal user.

The 3708 uses the positive or negative response to the NOTIFY to determine whether the host can support the NOTIFY command. If NOTIFY receives a negative response (X'1003'), the 3708 assumes the SSCP does not support the NOTIFY command and sets the sense code to X'080A' for a negative response to BIND when the device is unavailable. The negative response X'080A' remains in effect until another ACTLU is received. Following an ACTLU, the default response code of X'0845' is in effect.

BIND

This command is sent by the access method to request an LU-LU session between an application program and a 3708 SLU. The 3708 returns a positive response to establish the LU-LU session. When the session cannot be established, the 3708 returns a negative response with sense data that describes the reason the session was rejected. See "SNA Sense Codes" on page 3-42.

The 3708 examines session parameters that are received in the BIND command. The values required depend on the type of session established. See "BIND Check" on page 3-24.

If the LU-LU session is not established and the 3708 receives a command other than the BIND command that flows in the LU-LU session, a negative response is returned with sense data indicating that no session is established (sense code X'8005').

When a LU-LU session exists, that is, a BIND has been accepted, and the 3708 receives a subsequent BIND command for the LU, a negative response is returned with sense data indicating function already active (sense code X'0805').

The following tables provide the suggested BIND settings and logmode table settings for protocol conversion mode (LU types 1, 2, and 3) and protocol enveloping (for TSO/VTAM, IMS/VS, and CICS/VS).

BIND for Protocol Conversion (LU types 1 (SCS), 2, and 3 (DSC))

Byte	Value	Setting	Meaning
0	X'31'		Identifies RU as a BIND.
1	X'01'		BIND format and type. Ignored by the 3708
2	X'03'		Function Management Profile. Data flow commands and the request/response protocols are like FM profile 3.
3	X'03'		Transmission Services Profile. TS profile 3 is conformed to. Packing and sequence numbers are used with normal flow transmission and data flow is controlled by the Clear and Start Data Traffic commands.
4	X'91' or X'A1' or X'B1'		Primary LU Protocols
		1	Chaining: 1 = PLU sends single or multiple element chains
		. 0.	Request Mode Selection. 0 = Immediate request mode is used. Only one definite response request outstanding at a time. Response must be received before PLU can send the next RU.
		. . x x	Chaining Responses: 01 = PLU can request exception response 10 = PLU can request definite responses 11 = PLU can request definite or exception responses.
		. . . . 0 0 . .	Reserved
		. . . . . . 0 .	Compression Indicator. PLU cannot send compression. Must be 0.
		 1	Send End Bracket Indicator (EB) 1 = PLU can send EB.
5	X'X0'		Secondary LU Protocols
		x	0 = 3708 can send only single element chains. 1 = Can send single or multiple element chains. (0 or 1 for LU type 1 SCS OR 3; 1 for LU type 2)
		. 0	Request Mode Selection. 0 = Immediate request mode. 3708 can issue request for single definite response. Nothing sent until response received.
		. . x x	Chaining Responses: 01 = 3708 will request exception response 10 = 3708 will request definite responses 11 = Definite or exception response. (3708 will use exception request)
		. . . . 0 0 . .	Reserved
		. . . . . . 0 .	Compression Indicator. 0 = 3708 cannot send compressed data
		 0	Send End Bracket Indicator (EB) 0 = 3708 cannot send EB.

Byte	Value	Setting	Meaning
6	X'30'	 0 . . . . 0 . . . . 1 . . . . 1 . . . . 0 . . . . 0 0 0	Common Protocols Reserved Function Management Header usage: 0 = PLU and 3708 cannot exchange FM header Bracket Usage 1 = Bracketed session is used. Both PLU and 3708 must use bracket protocols. Bracket Termination Protocol 1 = Bracket termination rule 1 is used. Alternate Code Selection. Both the PLU and 3708 must use EBCDIC. Reserved.
7	X'80'	 1 0 . . . . 0 . . . . 0 . . . . 0 0 0 0	Common Protocols Normal Flow Send/Receive Mode Selection 10 = This session uses half-duplex, flip-flop transmissions (HDX-FF) Recovery Responsibility 0 = PLU is responsible for error recovery. Brackets First Speaker 0 = 3708 is always the first speaker. Reserved Contention Resolution 0 = Contention resolved in favor of the 3708
8	X'00'	0 0 0 0 0 0 0 0	Inbound pacing not supported by the 3708
9	X'XX'	0 0 x x x x x x	PLU to 3708 pacing value defining the number of RUs that can be received by 3708 before a pacing response must be returned. 0 = no pacing. If running LU type 1 SCS, this parameter must not be zero.
10	X'XX'		Max RU size sent by SLU. Expressed as a mantissa (8 - F) and an exponent of two by which the mantissa is multiplied. Example - X'85' = 256. See RU lengths supported for more information. If RU size is < 256, the 3708 rejects the BIND. Recommended size is X'85'.
11	X'XX'		Maximum RU size sent by the PLU. If size > 4096, 3708 rejects the BIND. Recommended size is X'85'.
12,13			Ignored by the 3708
14	X'0X'		X'01' = LU type 1 SCS X'02' = LU type 2 X'03' = LU type 3 DSC.
15-19			Ignored by the 3708
20	 X'18' X'20' X'2B' X'1B'		Default number of rows 24 32 43 27

Byte	Value	Setting	Meaning
21	 X'50' X'84'		Default number of columns 80 132
22	 X'18' X'20' X'2B' X'1B'		Alternate number of rows 24 32 43 27
23	 X'50' X'84'		Alternate number of columns 80 132
24		0 . . . . x x x x x x x	Reserved Session Screen Size b'0000000' Base default = 24x80 b'0000010' Base Model 2 = 24x80 b'1111110' Extended default size. Bytes 20 and 21 determine default screen size. b'1111111' Extended default and alternate size. Bytes 22 and 23 determine alternate screen size.
25+			Ignored by the 3708

BIND Check

Byte	Bit	LU Type 1 (SCS) Check	LU Type 1 (SCS) Reject if	LU Type 2 Check	LU Type 2 Reject if	LU Type 3 Check	LU Type 3 Reject if	LU-Type 1 NTO Check	LU-Type 1 NTO Reject if
1	0-3	C	¬ X'0'	C	¬ X'0'	C	¬ X'0'	C	¬ X'0'
	4-7	C	¬ X'1'	C	¬ X'1'	C	¬ X'1'	C	¬ X'1'
2,3		C	¬ X'03'	C	¬ X'03'	C	¬ X'03'	C	¬ X'03'
4	0	C	b'0'	C	b'0'	C	b'0'	C	b'0'
	1	C	b'1'	C	b'1'	C	b'1'	C	b'1'
	2,3	C	b'00'	C	b'00'	C	b'00'	C	b'00'
	4	C	b'1'	C	b'1'	C	b'1'	C	b'1'
	5	NC		NC		NC		NC	
	6	C	b'1'	C	b'1'	C	b'1'	C	b'1'
	7	C	b'0'	C	b'0'	C	b'0'	C	b'0'
5	0	NC		C	b'0'	NC		NC	
	1	C	b'1'	C	b'1'	C	b'1'	C	b'1'
	2,3	C	b'00'	C	b'00'	C	b'00'	C	b'00'
	4	C	b'1'	C	b'1'	C	b'1'	C	b'1'
	5	NC		NC		NC		NC	
	6	C	b'1'	C	b'1'	C	b'1'	C	b'1'
	7	C	b'1'	C	b'1'	C	b'1'	NC	
6	0	NC		NC		NC		NC	
	1	C	b'1'	C	b'1'	C	b'1'	C	b'1'
	2	C	b'0'	C	b'0'	C	b'0'	C	b'0'
	3	C	b'0'	C	b'0'	C	b'0'	C	b'0'
	4	C	b'1'	C	b'1'	C	b'1'	C	b'1'
	5-7	NC		NC		NC		NC	
7	0,1	C	¬ b'10'	C	¬ b'10'	C	¬ b'10'	C	b'11' or b'00'
	2	C	b'1'	C	b'1'	C	b'1'	C	b'1'
	3	C	b'1'	C	b'1'	C	b'1'	C	b'1'
	4-7	NC		NC		NC		NC	
8	0-7	NC		NC		NC		NC	
9	0,1	NC		NC		NC		NC	
	2-7	C	X'0'*	NC		NC		NC	
10	0-7	C	< 256	C	< 256	C	< 256	C	< 256
11	0-7	C	> 4096	C	> 4096	C	> 4096	C	> 32,767
12,13		NC		NC		NC		NC	
14	0-7	C	¬ X'01'	C	¬ X'02'	C	¬ X'03'	C	¬ X'01'
15-19		NC		NC		NC		NC	
20-24		NC		C	screen size not supported by terminal or port	C	screen is not 1920 characters (model 2)	NC	

Byte	Bit	LU Type 1 (SCS) Check Reject if	LU Type 2 Check Reject if	LU Type 3 Check Reject if	LU-Type 1 NTO Check Reject if
25+		NC	NC	NC	NC

C Check
NC No check
B Bit
¬ Logical Not
* If Definite Response mode is not specified.

Recommended Logmode Table Settings for Protocol Conversion

LU Type 1: The suggested settings for the access method logmode table for LU type 1 (SCS):

Byte	Hex Code	Binary Bits 01234567
0	31	00110001
1	01	00000001
2	03	00000011
3	03	00000011
4	B1	10110001
5	B0	10110000
6	30	00110000
7	80	10000000
8	00	00000000
9	01	00000001
10	85	10000101
11	85	10000101
12,13	00	00000000
14	01	00000001
15,19	00	00000000
20,23	00	00000000
24	00	00000000
25 +	00	00000000

For NCP-based hosts, the recommended logmode settings for LU type 1 (SCS) devices are:

```
MT3287  MODETAB
        MODEENT LOGMODE=SCS,    LU1 PRINTER (SCS)         X
                FMPROF=X'03',                             X
                TSPROF=X'03',                             X
                PRIPROT=X'B1',                            X
                SECPROT=X'B0',                            X
                COMPROT='3080',                           X
                RUSIZES='8585',                           X
                PSERVIC=X'010000000100000000000000',      X
                PSNDPAC=X'01',                            X
                SRCVPAC=X'01'
```

LU Type 2: The suggested settings for LU type 2 are the same as for LU type 1 (SCS) except:

Byte	Hex Code	Binary Bits 01234567
9	00	00000000
14	02	00000010

For NCP-based hosts, the recommended logmode settings for LU type 2 model 2 devices are:

```
MT327X  MODETAB
T3278M2 MODEENT  LOGMODE=T3278M2,  LU2 DISPLAY      X
                FMPROF=X'03',                       X
                TSPROF=X'03',                       X
                PRIPROT=X'B1',                      X
                SECPROT=X'B0',                      X
                COMPROT=X'3080',                    X
                RUSIZES=X'8585',                    X
                PSERVIC=X'020000000000185018507F00'
        MODEEND
        END
```

Note: PSERVIC values change depending on the model type being emulated.

LU Type 3: The suggested settings for LU type 3 (DSC) are the same as for LU type 1 (SCS) except:

Byte	Hex Code	Binary Bits 01234567
9	00	00000000
14	03	00000011

For NCP-based hosts, the recommended logmode settings for LU type 3 (DSC) devices are:

```
MODEENT LOGMODE=DSC2K,    LU3 PRINTER (DSC)  X
        FMPROF=X'03',                        X
        TSPROF=X'03',                        X
        PRIPROT=X'B1',                       X
        SECPROT=X'B0',                       X
        COMPROT=X'3080',                     X
        RUSIZES=X'8585',                     X
        PSERVIC=X'0300000000000C0'
MODEEND
END
```

BIND for Protocol Enveloping

Byte	Value	Setting	Meaning
0	X'31'		BIND request code.
1	X'01'		BIND type and format. Ignored by the 3708.
2	X'03'		Function Management Profile.
3	X'03'		Transmission Services Profile.
4	X'B1'	 1 . . . . 0 . . . . 1 1 . . . . 0 0 . . . . 0 1	Primary LU Protocols. Multi-chain RUs allowed from Primary. Immediate Request mode. Definite or exception response. Reserved No compression Primary may send end-bracket.
5	X'90'	 1 . . . . 0 . . . . 0 1 . . . . 0 0 . . . . 0 0	Secondary LU Protocols Multi-chain RUs allowed from Primary. (Can also be 0) Immediate request mode Exception response (Can also be 10 or 11) Reserved No compression 0 = Secondary will not send end-bracket. (Can also be set to 1).
6	X'30'	 0 . . . . 0 . . . . 1 . . . . 1 . . . . 0 . . . . 0 0 0	Common Protocols Reserved No FM headers Bracket reset state is BETB Rule 1 (cond brkt term) No alternate code Reserved.
7	X'40'	 0 1 . . . . 0 . . . . 0 . . . . 0 0 0 0	Common Protocols continued. Half-duplex contention (Can also be 10) Contention loser does recovery. Secondary wins contention. Reserved.
8	X'00'		Inbound pacing not supported.
9	X'00'		0 = no outbound pacing. Can be set to any valid setting.
10	X'85'		Maximum inbound RU size = 256 RU sizes > 256 will be accepted; RU sizes < 256 will be rejected.
11	X'85'		Maximum outbound RU size = 256 3708 accepts a maximum RU length 32,767.
12,13	X'00'		Ignored by the 3708.

Byte	Value	Setting	Meaning
14	X'01'		LU session type; A type = 0 is treated as an LU type 1 by the 3708.
15-25			Ignored by the 3708.

In addition to a BIND type of 1, the 3708 also accepts a BIND type of LU type 0. LU type 0 BINDs are treated exactly like LU type 1 NTO BINDs by the 3708.

Recommended Logmode Table Settings for Protocol Enveloping

For NCP-based hosts, the recommended logmode settings for LU type 1 (NTO) devices are:

```
MODETWX MODETAB
TWX     MODEENT  LOGMODE=TWX,               X
                FMPROF=X'03',              X
                TSPROF=X'03',              X
                PRIPROT=X'B1',             X
                SECPROT=X'90',             X
                COMPROT=X'3040',           X
                SSNDPAC=X'00',             X
                SRCVPAC=X'00',             X
                RUSIZES=X'8585',           X
                PSNDPAC=X'01',             X
                PSERVIC=X'010000000000000000000000'
        MODEEND
        END
```

UNBIND

When the 3708 receives this command, it terminates the LU-LU session and may or may not disconnect the downstream device.

Termination of LU-LU Session: When the 3708 receives this command, it terminates the LU-LU session between a host program and a 3708 SLU. The LU-LU session is terminated when the 3708 returns a positive response to the UNBIND command.

Depending on the disconnect option configured in the 3708, the downstream device may or may not be disconnected. Six options are available in the 3708 configuration:

0 - Unconditionally disconnect device when an UNBIND is received.

1 - Do not disconnect device when an UNBIND is received.

2 - Disconnect the device if an UNBIND other than types 02 or 03 is received.

3 - Disconnect the device if an UNBIND other than types 01, 02, or 03 is received.

4 - Disconnect the device if an UNBIND other than types 02 or 03 is received. However, do not disconnect on DACTLU.

5 - Disconnect the device if an UNBIND other than types 01, 02, or 03 is received. However, do not disconnect on DACTLU.

If the 3708 disconnects its downstream device, the following actions occur:

- Devices connected to a nonswitched line return to the first 3708 screen (if 3708 logon screens are not excluded).
- Devices connected to a switched line are disconnected. The user must dial again to gain access to the 3708.

If the 3708 does not disconnect its downstream device, the end user returns to the 3708's host selection screen (if the screen is not suppressed). Dial-up users are not disconnected.

If logon screens are excluded and the downstream device is not disconnected (or no host selection), the end user is returned to the SSCP-SLU session and may initiate another session.

Options 4 and 5 are designed to be used with TSO, which transmits an DACTLU/ACTLU sequence when the end user performs a normal logoff sequence. If the 3708 logon screens are excluded, or the host selection screen is suppressed in the 3708's configuration, the 3708 ignores any data input by the user between the DACTLU and the proceeding ACTLU.

Session Security: If the 3708 is configured to transmit an UNBIND for session security, the 3708 transmits an UNBIND (0F) command to the host when users are in session with their applications and power off their terminals or are abnormally disconnected. The UNBIND (0F) ensures that the session is terminated by the network and prevents another user from dialing in to the same 3708 port and gaining access to a previous user's application.

Session security cannot be guaranteed by the 3708 if the host application maintains resources over LU sessions or automatically reconnects the terminal when the UNBIND (0F) or TERMSELF (40) is received.

Clear

When the 3708 receives a Clear command, it forces the data-traffic-reset state upon the LU-LU session. Clear also causes the 3708 to initialize all inbound and outbound transmission buffers. When data-traffic-reset state is activated for an LU-LU session, only the following commands are valid for that session: UNBIND and Start Data Traffic (SDT).

If a SDT command is received, a second CLEAR command can be accepted. Two CLEAR commands in a row will not be accepted and are rejected with a negative sense code of X'2009'.

Start Data Traffic (SDT)

This command allows FM 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 3708. 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.

Cancel

When received, normal SNA use of this command directs the receiver to discard all elements of the chained transmission being received. The Cancel command thus serves to provide a proper termination for an otherwise incomplete chain. Processing of a chained transmission is terminated when the Cancel command is received. EB or CD may be sent with the command. A Cancel command received between chains is rejected by the 3708 with a negative sense code of X'2002'.

When a chained transmission is in progress and the 3708 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 3708.

The 3708 transmits the Cancel command when the following sequence occurs:

1. Data is being received from the downstream device.
2. The 3708 enters buffer slowdown.
3. The 3708 has already transmitted part of a chain to the host.

The Cancel command directs the PLU to stop processing a chained transmission and to discard all elements of the chain that have been received.

If the PLU returns a negative response for an element of a chain, the entire chain is transmitted before the PLU response is examined. Cancel is not sent. The PLU should discard all elements of a chained transmission after sending a negative response.

Chase

Chase is used to confirm that all preceding requests have passed through the network and have been processed. When this command is received, the 3708 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 responses 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.

BID

The BID command is sent by the PLU to a 3708 SLU to request permission to begin a bracket. The use of the BID command avoids long chains of data using transmission time and then being 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 begin-bracket-pending state and waits for the request containing BB.

A 3708 SLU that is configured for between-bracket printer sharing can reject a BID command by winning bracket contention for the following reasons:

- **LU type 2**
  - The 3708 is already in bracket (INB), and a PLU protocol error exists. The 3708 responds with a negative sense code of 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 initiated an inbound data stream. The sense code returned is X'081B'.
- **LU type 1 or 3**
  - The SLU is already INB and a host program protocol error exists. If the session is LU type 1 NTO, the 3708 responds with a negative sense code of X'080B' or a sense code of X'0813'.
  - The LU associated with a printer is busy doing a local copy operation. The sense code returned is X'0814'. The 3708 sends 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.

Signal

The PLU can send the Signal command to the 3708 SLU to request the Change Direction (CD) indicator. The SLU completes any chained transmissions in progress and sends the CD to the PLU. A request with CD but no data (a Null-RU) is sent if the SLU is in send state but has not started transmitting. If the SLU is already in receive state or BETB, the signal is positively responded to, but no SLU action is taken.

The 3708 sends the Signal command (X'00010000') in response to the following actions:

- The terminal operator presses the keyboard ATTN key (LU type 2).
- Either PA1 or PA2 is received from a keyboard/printer (LU type 1 SCS).
- The BREAK key is pressed in LU type 1 NTO mode and
  - The control unit is defined as full duplex in the 3708 configuration and
    - No data is being transmitted or received from the terminal.
    - Data is being transmitted to the terminal and no data is being received.
  - The control unit is defined as half duplex in the 3708 configuration and
    - No data is being transmitted or received from the terminal.
    - Data is being transmitted to the terminal.

The Signal command is expedited and has no effect on SLU states. Once a signal has been sent by an SLU, pressing the ATTN, PA, or BREAK keys do not cause a second signal until the 3708 has received a response to the first signal.

TERMSELF

If the 3708 is configured to transmit a TERMSELF for session security, the 3708 transmits either a TERMSELF (40) or a TERMSELF (4C) to the host when the end user is in the middle of an LU-LU session and the 3708 detects a disconnection. These commands are used as a security feature to prevent users from gaining access to other users' applications.

Configuring the 3708 to transmit a TERMSELF (40) for session security is recommended for CICS users. Without a user-modified exit routine (DFHZNEP), CICS automatically establishes a session with the next user after receiving an UNBIND (0F) or TERMSELF (4C). See "UNBIND" on page 3-28 for more information. When TERMSELF (40) is transmitted, CICS terminates the previous session and ensures session integrity.

Configuring the 3708 to transmit a TERMSELF (4C) is recommended for users of gateway applications accessing cross-domain host applications. TERMSELF (4C) causes VTAM to send a DACTLU to the 3708. However, the user must code the DFHZNEP exit routine. To get the 3708 to transmit a TERMSELF (4C), configure the host port to send a TERMSELF and set nonstandard operating bit 14 to 1.

Session security cannot be guaranteed by the 3708 if the host application maintains resources over LU sessions or automatically establishes a session with the terminal after the TERMSELF is transmitted.

Independent of its configuration, the 3708 transmits a TERMSELF (4C) under the following conditions:

- The 3708 is configured not to disconnect upon receipt of an UNBIND(02).
- The 3708 receives an UNBIND(02).
- The downstream device is disconnected or powered off.

The TERMSELF (4C) ensures that the network terminates the LU-LU session and prohibits another user from gaining access to the previous user's application.

LU Status (LUSTAT)

The 3708 SLU sends the LUSTAT command to notify the PLU that a change in the operational status of a device has occurred. The LUSTAT contains a 4-byte status code to describe the device status change.

When a display that is operating in protocol conversion mode exits SSCP-SLU mode, a LUSTAT (status code X'082B') is sent to the PLU to request that the screen be refreshed. After a host-initiated local copy has been rejected (sense code X'0807') and the printer has become available for local copy, the 3708 SLU transmits an LUSTAT (status code X'0001B000') to notify the PLU that the printer is now available. When a hold-print condition is recovered for LU type 1 or LU type 3, the 3708 SLU transmits an LUSTAT (status code X'00010000') to notify the PLU that the printer is now available.

If the 3708 SLU is running the HDX-FF mode and is in a SEND state, the change direction indicator of the RH on the LUSTAT command is sent. In this case, the 3708 moves from the SEND to the RCV state. Otherwise, LUSTAT does not cause a change in the send or receive state of the 3708 SLU.

Ready to Receive (RTR)

This command is transmitted by the 3708 in LU type 1 SCS and LU type 3 DSC mode 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 printer LU enters begin-bracket-pending state and expects the host program to begin a bracket.

REQMS

The Request Maintenance Statistics (REQMS) command is sent by the SSCP to a 3708 when the Network Determination Aid Processor (NDAP) requests PU performance statistics. Three types of requests can be made:

- Type 1 Link Test Statistics
- Type 2 Summary Counters
- Type 3 Communication Adapter Data Error Counts.

The state of the RESET/NO-RESET indicator in the REQMS request determines whether the 3708 clears the log area where the transmitted maintenance statistics are stored.

An REQMS request that cannot be executed by the 3708 is rejected with a negative response. An accepted REQMS request receives a positive response and the requested statistics (formatted as RECFMS) as an inbound message.

RECFMS

Record Formatted Maintenance Statistics (RECFMS) is sent by the 3708 to the SSCP in response to an REQMS command. The 3708 does not send unsolicited RECFMS requests to the host. The RECFMS maintenance statistics are recorded at the host by the Network Communications Control Facility (NCCF).

When the 3708 accepts an REQMS request, it transmits the maintenance statistics requested. If the REQMS specified RESET, the 3708 resets the error log area referred to by the REQMS after the RECFMS is transmitted. Otherwise, the error log area is not reset.

Shutdown

The PLU sends the Shutdown command. Receipt of this command directs the 3708 SLU to prepare for a session termination sequence. The 3708 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.

Shutdown Complete

This command is sent by the 3708 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 shutdown state is active, no data transmissions can be sent to the PLU. The PLU, however, may continue to send data to the 3708.

The PLU may either terminate the session using UNBIND when the Shutdown Complete command is received from the 3708 or use shutdown as a means of quiescing traffic. Leaving the Shutdown Complete state requires a clear and SDT command if the command is used to quiesce traffic.

FM Data

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

When communicating with a 3708 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 RUs 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.

Bracket Protocol: The 3708 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). These states are described under "Bracket States" on page 3-46.

A bracket is initiated when the Begin Bracket indicator is accepted by the primary or secondary LU. The bracket is usually ended when the End Bracket indicator is received by the secondary LU. The specific conditions that end a bracket are defined by SNA bracket termination rule 1. 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" on page 3-15.

The following protocols apply for 3708 bracket processing:

- 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.
- For type 1 and 3 sessions, the PLU may begin a bracket any time the session is between brackets (the only time the SLU begins a bracket is when the operator presses the 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 PLU's transmission and then discards all portions of the chain from the PLU. The SLU assumes that its transmission is accepted by the PLU.

If a BID or BB from the PLU is rejected, the 3708 does the following:

- For a session with a type 2 SLU, the SLU sends BB when it has data to send. The PLU may return its data when it receives Change Direction (CD).
- For a type 1 or 3 session with a 3708 configured for between-session printer sharing, the SLU does not reject the PLU's BID or BB unless a protocol error is detected. The PLU should restart the transaction.
- For a type 1 or 3 session with a 3708 configured for between-bracket printer sharing, the SLU only rejects 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 sends RTR.

The host program can end a bracket. The 3708 may end a bracket if operating in LU type 1 NTO mode. Bracket protocol establishes the following restrictions on beginning and ending brackets:

- BB and EB cannot be sent with response RUs.
- The EB cannot be sent with the BID or RTR command. All other normal flow DFC commands can end the bracket.

The 3708 supports bracket termination rule 1 as follows:

- When an EB is received and the last element of a chain requires definite response, the 3708 enters the between-bracket state (BETB) from the in-bracket state (INB) after a positive response to the chain or stay in the INB state after a negative response.
- When an EB is received and the last element of a chain requires exception response, the 3708 enters the BETB state from the INB state immediately.

The 3708 ignores the BB bit on all outbound requests except FM data and ignores EB on all outbound requests except FM data and the DFC commands Cancel and Chase.

For chains with EB set, CDI should not be set.

Chaining Protocol Definition: 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 in 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 = EC ¬BC).
Only in Chain (OIC)	Indicates a transmission consists of a single RU. Both the BC and EC indicators are included. The single RU is termed a single-element chain (RH = BCEC).

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

- FIC, LIC; or
- FIC, MIC,..., LIC; or
- OIC.

Any other sequence of chaining indicators causes a chaining error.

Chaining Operations: When the 3708 receives a chain with chaining indicators in an incorrect 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 3708 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 3708 responds to the OIC message with a negative sense code of X'2002'. Sending RUs with chaining indicators in the sequence FIC, MIC, OIC is a violation of chaining protocol. In this case, when the 3708 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 3708 is now ready to process the next chain normally.

The 3708's chain processing for protocol enveloping sessions differs from the 3708's chain processing for protocol conversion sessions. For protocol enveloping/NTO, each RU of a chain is processed and data may be transmitted to the device as soon as each RU is processed. For protocol conversion, each RU (chain element) is processed as it is received, but the entire chain must be received before transmitting data to the downstream device. Waiting for the entire chain is a requirement for LU type 2 and LU type 3 protocol conversion sessions. It does not apply to LU type 1 SCS protocol conversion session.

Change Direction: The 3708 uses a half-duplex, flip-flop (HDX-FF) mode to transfer normal flow data in protocol conversion. Only 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) must be active 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 that LU's turn to send. Each time an LU sends the CD in a request, that LU must then be prepared to receive. The 3708 always sends a CD with an LIC or OIC in an FMD RH. Exceptions may occur following negative responses.

Protocol enveloping LU type 1 (NTO) sessions may use a BIND specifying either half-duplex flip-flop or half-duplex contention.

When in half-duplex flip-flop mode at session activation, one half-session is designated HDX flip-flop bidder and the other is designated HDX flip-flop first speaker. The 3708 is always the first speaker. Using Bracket protocol with half-duplex flip-flop protocol requires a synchronization between the two half-sessions. When between brackets, each half-session is in contention state: either may send. The contention winner is always the first speaker. When not between brackets, the half-sessions are subject to the protocol: the send issues normal flow requests and the receiver issues responses. When the send completes its transmission of normal flow requests, it transfers its control of sending to the other half session by setting the Change Direction indicator on the last request sent.

When in half-duplex contention at session activation, one half session is designated the contention winner and the other, the contention loser. Initially, both winner and loser are in the contention state, and either one may independently begin sending normal flow requests. Normal flow requests arriving at the loser, if it is sending are queued. Normal flow requests arriving at the winner, if it is sending, may be temporarily queued or may be rejected with an appropriate response. Valid normal flow requests, arriving at a nonsending half session, place the half session in a receiving state. The contention winner or loser reverts to contention state after sending or receiving the last request of a chain. Upon reverting to the contention state, a contention loser or a contention winner that queues received BIUs may remove any requests and responses. Contention can be avoided through end user protocols or by use of the Change Direction indicator.

Sessions operating in HDX use the following error recovery procedure. The contention loser is responsible for the recovery. The contention loser half-session assumes an HDX sending state at the appropriate moment after detecting an error and initiates the sending of requests to attempt recovery. Correspondingly, the contention winner half-session assumes an HDX receiving state and awaits recovery requests from the contention loser.

If the 3708 is in flip-flop mode and receives an invalid frame, it sends a negative response and remains in a receive state even if the invalid frame contains CDI. If the 3708 is in contention mode, it sends a negative response and changes state if the invalid frame contains CDI. It enters a send state only at the end of the chain or if a CANCEL is received from the host.

Summary of SNA Commands

Table 3-1 summarizes valid SNA commands received by the 3708 in relation to the type of session (SSCP-PU, SSCP-LU, and LU-LU) and to two LU-LU session processing states (Data Traffic Reset and In Brackets). Table 3-2 on page 3-39 shows the same for SNA commands sent by the 3708.

The entries in these tables are defined as follows:

1 Command valid if in this processing state
E Command establishes this session
R Required state for this command to be valid
T Command terminates this session
X Command sets the processing state to the indicated status.

Table 3-1. Summary of SNA Commands Received

				LU - LU Session Processing States			
SNA Command Received	**SSCP-PU Session Active**	**SSCP-LU Session Active**	**LU-LU Session Active**	**DTR On**	**DTR Off**	**IB On**	**IB Off**
ACTLU	R	E	T				
ACTPU	E	T	T				
DACTLU	R	T	T				
DACTPU	R,T	T	T				
BIND			E,1	X			X
UNBIND			R,T				
Cancel			R		R		
Chase			R			R	
Clear			R	X	R		X
SDT			R	R	X		
Signal			R		R		
Shutdown			R		R		
FM Data			R		R	R	
REQMS	R						

Table 3-2. Summary of SNA Commands Sent							
				LU - LU Session Processing States			
SNA Command Sent	**SSCP-PU Session Active**	**SSCP-LU Session Active**	**LU-LU Session Active**	**DTR On**	**DTR Off**	**IB On**	**IB Off**
LUSTAT			R				
Signal			R		R		
Cancel			R		R	R	
Ready to REC			R		R		R
Shutdown Complete			R		R		R
FM Data			R		R	R	
RECFMS	R		R				
NOTIFY		R					
TERMSELF		R					

Pacing

The 3708 supports only outbound pacing. Outbound pacing is set in byte 9 of the BIND command and is used as a tuning parameter for the system. Usage comments are included in this discussion; however, control is under the user's discretion at NCP or some equivalent definition time.

The pacing count (N) determines the number of normal flow request RUs that can be accepted before a pacing response is required from the 3708 to allow the next group of N RUs to continue. A special response designated as Isolated Pacing Response (IPR) is used to return the pacing response. The 3708 indicates readiness with a pacing response as soon as all the received data has been transmitted to the downstream device. RUs may vary in length as specified in the BIND parameter.

Pacing (LU type 1 SCS)

The 3708 requires that outbound pacing be set to some nonzero value for LU type 1 SCS BINDs and rejects an LU type 1 SCS BIND with outbound pacing set to 0.

Outbound pacing is required to prevent the 3708 from going into buffer slowdown when supporting LU type 1 SCS data streams. As the 3708 receives chains of data from the host, it receives a piece of a chain or segment of data and then passes the data to the printer. If the host can transmit new data faster than the 3708 can transmit it to the printer, the 3708 is forced to store all of the unprocessed data in its internal system buffer area. Without outbound pacing, the host can cause the 3708 to use up all of its available system buffers, driving the 3708 into buffer slowdown mode, thus degrading the performance of the entire 3708, and resulting in loss of data. The outbound pacing parameter is used to ensure that there is adequate space in the 3708 so that buffer slowdown does not occur.

Pacing (LU type 2 and LU type 3 DSC)

For LU type 2, the 3708 generally operates faster than the link, and pacing is not required for the controllers.

For LU type 3, requiring a definite response indicator when the WCC Start Print bit is set is an effective alternative to pacing.

In telecommunication networks in which RUs are processed through more than one SNA host, outbound pacing may be required for type 2 and 3 LUs to prevent data traffic congestion in these SNA hosts.

Pacing for LU type 1 NTO Sessions

Outbound pacing may or may not be set for LU type 1 NTO sessions. Generally, if the device being supported is a printing device or a mechanical keyboard/printer, outbound pacing should be set to some nonzero value. If the downstream device is a keyboard/display, then outbound pacing may not be required.

SNA Responses

The SNA response header (RH) contains indicators that describe the type of response given. The indicators are Definite Response 1 (DR1) or Definite Response 2 (DR2). The RH also contains an Exception Response (EX) indicator that is used when describing the response protocol. Definite response protocol (DR1 or DR2) specifies that a response, either positive or negative, must be given. Exception response protocol specifies that only a negative response may, or need be, returned. The PLU must adhere to the response type specified in the BIND. If definite response is specified by the BIND, then requests sent with ERI is rejected by the 3708. If exception response is selected by the BIND, then requests sent with DR2 is rejected.

The only definite response type requested by the 3708 is Definite Response 1 (DR1). The response protocol requested by the 3708 (definite response and/or exception response) is defined in the BIND.

The 3708 responds to a message from the host with any requested response type (DR1, DR2, or both). The 3708 supports definite response and exception response protocols. A no response request is treated as an exception response request.

LU-LU Session Error Reporting

When the host program or the 3708 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 4-byte sense data RU sent with a negative response is as follows:

0	1	2 and 3
System Major Code	Sense Modifier	User Sense

Byte 0 of the sense data RU is bit-encoded to reflect one of six transmission error categories:

Byte 0	**Major Code**
X'80'	Path Error
X'40'	RH Error
X'20'	State Error
X'10'	Request Error
X'08'	Request Reject
X'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 zeros for all negative responses sent by the 3708. Section "SNA Sense Codes" defines the modifier encoding for each major code of system sense data that is issued by the 3708.

Note that the 3708 does not examine the sense data in a negative response from the host. All negative responses on the LU-LU session cause the 3708 to enter RCV state and await further action by the host.

SNA Sense Codes

Each major error code has modifiers for further description in sense byte 1. The modifier codes supported, and the SNA host or terminal condition causing the negative response to be returned, are described below:

Path Error X'80'

X'05'—NO SESSION
A BIND has not been received or accepted.

X'07'—Segmenting Error
Error is due to incorrect sequencing of segment elements.

X'08'—PU NOT Active
The 3708 has not received or accepted an ACTPU, or a control condition caused an internally generated DACTPU.

X'09'—LU NOT Active
The 3708 has not received or accepted an ACTLU, or a control condition caused an internally generated DACTLU.

X'0A'—PIU Too Long
If RU is greater than X'7FF' bytes long, and the BIND specifies a maximum RU length.

X'0E'—Unrecognized Origin
A request other than BIND is sent to an SLU that has already accepted a BIND, and the OAF' is not X'00' or the OAF in the accepted BIND.

X'0F'—Invalid Address Combination
A request was addressed to the PU (DAF'=X'00'), and the OAF was not SSCP (OAF'=X'00').

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'0F'—Format Indicator Not Allowed
An FM request received by the 3708 indicated a formatted header was included.

State Error X'20'

X'01'—Sequence Number Error
The sequence number of the normal flow request did not match the number expected.

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 request was received while the 3708 was in send state.

X'05'—Data Traffic Reset
An FM or DFC request was received before an SDT was received or accepted.

X'09'—Session control protocol violation
An FM request was received before an SDT is received.

Request Error X'10'

X'01'—RU Data Error
Data in the request RU is not acceptable to the receiving FM data stream component; for example, a character code is not in the set supported, a formatted data field is not acceptable to presentation services, or a required name in the request has been omitted.

X'02'—RU Length Error
TH and RH length is less than 9 bytes.

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
  - Data Following a Read, RM, RMA, or EAU command
  - For LU type 3, any Read, RM, or RMA command
- Unsupported FM Data, SSCP --> SLU

X'05'—Parameter Error
Invalid address following SBA, RA, or EUA order (SBA, RA, or EUA order without parameters), or SCS parameter error.

X'07'—Category Not Supported

- An FMD request from the SSCP was directed to a printer
- An unsupported network service message received
- An unsupported FM Data command received.

Request Reject X'08'

X'01'—Resource Not Available
For LU type 1 or 3, ACTLU is rejected for one of the following reasons:

- The printer is authorized for local mode only
- A host initiated print has been sent to a MLU display running model 5 emulation, and the platen length configured for the port is less than the screen size (132).

X'02'—Intervention Required
Sent when the 3708 doesn't receive input for more than 10 minutes after receiving an XOFF from a downstream printer.

X'05'—Session Limit Exceeded
A BIND was received when the SLU already bound.

X'06'—Resource Unknown

An ACTPU command was received whose address does not equal one of the two possible station addresses configured in the 3708, or an ACTPU command was received whose DAF (DAF'-2) is not equal to a Device Number configured in the 3708.

X'0A'—Permission Rejected

Display or printer power is off. The SSCP is not notified when the device powers on.

X'0B'—Bracket Race Error

This sense code is sent in protocol enveloping when the application transmits BB and the 3708 is already in brackets.

X'0C'—Procedure Not Supported

An unsupported REQMS type request was received.

X'11'—Break

- Sent in LU type 1 SCS mode when the operator presses the printer Hold Print Key followed by Cancel key, if a chain has not completed printing.
- Sent in LU type 1 NTO mode when the operator generates a break and the 3708 is in the middle of a chain from the host.

X'13'—Bracket BID Reject—(No RTR)

- Returned by LU type 1 to a BID or BID with begin bracket if the display has won contention and started a bracket.
- Returned in protocol conversion mode when a BID or begin bracket was received and INB state already exists. This may be a protocol error.

X'14'—Bracket BID Reject—(RTR to follow)

For LU type 1 or 3, the printer is busy doing local copy from a display. RTR is returned when the printer becomes not busy with local copy.

X'15'—Function Active

REQMS request is in process.

X'16'—Function Inactive

Sent if a DACTLU is received before the SSCP-LU session is established.

X'1A'—Request Sequence Error

Generated by the 3708 when the first RU in a configuration download is not NS_IPL_INIT.

X'1B'—Receiver in Transmit Mode

The SLU is between bracket, but a data key has been pressed.
BIND parameters do not match the 3708 BIND checks.

X'21'—Invalid Session Parameters

BIND indicated a screen size that was not supported by either the 3708 port or the terminal.

X'2B'—Presentation Space Integrity Lost

- A temporary error has occurred; for example, parity check in device.
- An operator has cleared the display by switching to SSCP-SLU Session or Test mode and returned to PLU-SLU session.

X'29'—Change Direction Required

Sent if a Read Buffer, Read Modify, or Read Modify All command was received without CDI or End Bracket.

X'2D'—LU Busy

An FM message was received from the SSCP while the display was owned by the PLU-SLU session or vice versa.

X'31'—Device Not Available

An FM message was received while the display was not ready (host not selected or device not powered on).

X'45'—Permission Rejected

Display or printer power is off. The SSCP is notified when the device powers on.

X'54'—3708 Specific Sense Code

These sense codes are transmitted to the host when attempting to download configuration data created by the 3708's central site configuration (CSC) aid. The possible values are described in the following table.

For codes that refer to a sequence number, the sequence number is the RU number as assigned by CSC (where NS_IPL_INIT is RU #0). Variable codes are denoted with xx and yy, where xx is the sequence number of the current RU + 1, and yy is the sequence number of the last RU + 2.

0010	Read or Write to EEPROM failure
00A1	Configuration incomplete, UDT incomplete, Translate incomplete, Patch data area incomplete, or no records sent in new configuration text chain. This may indicate that a second update type was started before receiving the NS_IPL_FINAL RU for a previous update type.
1003	Host function not supported. This is generated when a download is attempted for a 3708 that does not have CSC support.
2001	Host Configuration Download already in progress from a different host
2201	Configuration update by Control Terminal in progress
xx20	Invalid buffer length
xxA3	Invalid record type
00A4	Attempt to load standard UDTs when enhanced UDTs are currently defined
00A5	Attempt to load enhanced UDTs when standard UDTs are currently defined
00A6	Attempt to convert to enhanced UDTs when a default terminal type of 24 or 25 is currently defined for one or more 3708 ports
yyB1	Configuration records out of order (sequence number incorrect)

Session Processing States

The 3708 controls the processing of SNA commands, responses, and user data transmissions with a set of session states. Some of these states are defined by SNA, and others are unique 3708 definitions that cause SNA state transitions. When the 3708 receives the Clear or BIND command, all 3708 session states are reset.

This section describes the processing states used by the 3708. 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.

Bracket States

The 3708 has three major states associated with bracket protocols: Between Bracket (BETB), In Bracket (INB), and Pending Begin Bracket (PEND.BB). These states are used to ensure synchronization of traffic between the PLU and the SLU. Transitions between these states are controlled by the BB and EB bits and by the BID and RTR commands.

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 BB is sent by the SLU, BETB 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 3708 returns to BETB state. BETB state is normally assumed when an EB has been processed successfully.

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

The 3708 sets a BB on the first RU transmitted when the control unit enters INB state from BETB.

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

Pending Begin Bracket (PEND.BB) State

In the PEND.BB state, the 3708 is waiting for the host system to begin a bracket. The 3708 has either returned a positive response to a BID command or has received a positive response to a Ready to Receive command.

In Bracket (INB) State

INB state is entered when the 3708 receives a BB without the EB or when the 3708 begins a bracket. INB state is maintained by the 3708 until the positive response to the EB chain is returned to the host or until the 3708 receives the last element of the EB chain when exception response is requested.

3708 Bracket State Errors

Error codes generated for bracket error conditions are as follows. The bracket state conditions remain unchanged after sending the error code.

State	Chase and EB	Chase and ¬EB	BID	Cancel and EB	Cancel and ¬EB	FMD and BB	FMD and ¬BB
BETB	X'2003'	—	—	X'2003'	—	—	X'2003'
INB	—	—	X'0813'	—	—	X'080B'	—
PEND.BB	X'2003'	—	X'0813'	X'2003'	—	—	X'2003'

RU Lengths

Outbound to the 3708

The maximum RU length that a PLU can send is defined in byte 11 of BIND RU. If a maximum RU size is specified (PLU maximum send size), the maximum RU size received must be less than or equal to 32,767 bytes. A negative response with sense code X'080A' (too long PIU) occurs if the PLU transmits an FM data RU greater than 32,767 bytes. If a PLU maximum send size is not specified in the BIND, no length check is made on an FM data RU transmitted by the PLU to the 3708.

Note: The recommended, and most efficient, RU size is 256 bytes.

Inbound from the 3708

The 3708 accepts only a Multiple Element Chains BIND for inbound operation of display devices. The maximum RU length can be controlled by the PLU through byte 10 of the BIND RU. For the 3708, the RU size transmitted inbound is no greater than 256 bytes. If the value specified by byte 10 is greater than 256, the BIND is accepted, but the actual RU size is limited to device capabilities. The minimum value that may be specified by byte 10 of the BIND is 256 bytes. If a lesser value is specified, the BIND is rejected with a negative response, sense code X'0821'.

Segmenting of Request/Response Units

RUs sent to the 3708 can be 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 an RH and RU may be divided into smaller elements, called *segments,* that are transmitted over the link. The 3708 supports outbound segmenting on the LU-LU session.

The segment elements are defined as follows. The First in Segment (FIS) element is equated to Begin-BIU, not End-BIU. The Last in Segment (LIS) element equates to End-BIU, not Begin 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

Errors caused by incorrect sequencing of the segment elements cause the 3708 to respond with a negative sense code of X'8007'.

The PIU delivered to the 3708 must not exceed 265 bytes. A PIU with an OIS or FIS element can contain a maximum of 256 bytes of RU data plus 6 bytes of transmission header (TH) and 3 bytes of request/response header (RH). A PIU with an MIS or LIS element can contain a maximum of 259 bytes of RU data plus 6 bytes of TH. If the PIU exceeds 265 bytes, the 3708 rejects the segment with a SDLC frame reject.

Although outbound segmenting is supported by the 3708, it is not recommended because of slower screen updates. When segmenting is used, the 3708 must receive all the segments before starting any processing of the data stream. With chaining, data stream processing is done as each chain is received. With segmenting, none of the data is processed until all of the segments have been received. The 3708 does not start transmitting data to the downstream device until segments have been received and processed. Large segments require the use of more 3708 buffers. The 3708 may then be forced into slowdown mode and performance may suffer.

It is recommended that the host applications use chaining instead of segmenting. Chaining can be specified on the BIND command by defining bytes 10 and 11 as X'8585'. If chaining cannot be used, segments should be as small as possible.

Switching Between SSCP-LU and LU-LU Sessions

The 3708 allows its end users to switch between their LU-LU session and the supporting SSCP-LU session. Direct communication with the SSCP is possible in both LU type 1 NTO and LU type 2 operations.

SSCP Communications before the BIND

Before a BIND is received and after the ACTLU, all data input to the 3708 is transmitted to the SSCP. Typically, this action occurs during an application logon. All data is translated using the standard 3708 default translate table and no data formatting or manipulation is performed by the 3708.

SSCP data directed to the terminal is translated by the 3708 using its default translate table and no formatting is performed by the 3708. NL characters received from the host, however, is converted by the 3708 to a CR LF.

SSCP Communications after an LU type 2 BIND

After receiving an LU type 2 BIND, the 3708 establishes the LU-LU session. The 3708 indicates the successful establishment of an LU-LU session by displaying `4BMYJOB` on the 3708's status line. The notation `MYJOB` indicates that the user is in an LU-LU session.

The terminal operator may switch from the LU-LU session to the supporting SSCP-LU session by pressing the SYS REQ key sequence. Pressing the SYS REQ key sequence clears the terminal's screen and `MYJOB` is replaced by `SSCP` on the terminal's status line.

Pressing the SYS REQ key sequence interrupts communication taking place during the LU-LU session without waiting for completion of outbound chains. As long as the LU-LU session remains bound, depressing the SYS REQ key sequence again switches back to the LU-LU session.

The terminal may only be in communication with the host PLU or the SSCP. Communication to both the SSCP and the PLU is not supported. Any attempts to send FM data by the SSCP/PLU not currently in communication with the terminal is rejected by the 3708.

Data messages from the SSCP consists of byte strings containing SCS control codes and SSCP-supported graphic codes. The only valid SCS control codes are NL, NULL, IFS, and IRS. NULL, IFS, and IRS are treated as graphic characters and are displayed as a blank, an asterisk, and a semicolon, respectively. Any other binary combination in the SCS data stream is treated as a graphic. The characters appearing on the screen for code points other than supported graphics cannot be predicted.

Each message from the SSCP is displayed at the current cursor address. When the 3708 receives an NL control code in the SSCP message, it inserts nulls in the character positions remaining in the display line being written and position the cursor at the leftmost position of the next line. Characters following the NL code are displayed beginning at the new 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 received chain, the 3708 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.

SSCP Communications after an LU type 1 (NTO) BIND

The 3708 allows switching between the LU-LU session and the SSCP-LU sessions for LU type 1 NTO operations as well. SSCP communication is initiated by entering a system request simulation string from the terminal. This string may be configured through the 3708 control terminal. The default value is 99999 (5 nines). The system request simulation string can only be recognized when it is at the start of a transmission, not in the middle.

The SSCP message is entered immediately after the system request simulation string. The SSCP message may be up to 251 bytes long and must end with a defined line turnaround character. The 3708 transmits this message to the SSCP and returns to the LU-LU session. The 5-character string is deleted before the message is sent on the SSCP-SLU session.

SSCP Communication to Printers

SSCP data sent to a printer, whether in LU type 1 or LU type 3 mode, is rejected by the 3708 with a sense code of X'1007'.

SSCP Communication to Displays

When a user has put the display into SSCP mode by pressing the SYS REQ key sequence, all data entered is sent to the host control program on the SSCP-SLU session. The SSCP may also send data to the display in this mode.

Messages from the Host

The SSCP may send messages to a display when the SSCP-SLU session is in use. The messages are byte strings consisting of SCS control codes and SSCP-supported graphic codes. The only valid SCS control code is NL. Any other character in the data is treated as a graphic character. 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 location on the screen. When the 3708 receives an NL in the SSCP data, it inserts nulls in the character positions remaining in the display line being written, and positions the cursor at the left most position of the next line, using a Set Cursor Address sequence. Characters following the NL code are displayed beginning at the new 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 data.

After displaying the data, the 3708 places the cursor in the position next to the last character, or at the beginning of a line if the message ended with a NL. This cursor position address is called the initial cursor address and is stored to identify the starting position of the operator's input data.

Messages from the Terminal

When in SSCP mode, an operator can enter a message bound for the SSCP from the character position occupied by the cursor. After entering data, the operator must press the ENTER key sequence to send the data to the SSCP. Pressing other program attention keys has no effect, except for the CLEAR key. Pressing the CLEAR key sequence causes the display screen to be cleared, and the initial cursor address is reset to the first position of the screen. Pressing program attention keys other than ENTER or CLEAR causes the Input Inhibited Minus Function (X -F) message to be displayed in the status line. Erase Input and Erase EOF keys operate normally.

Data sent to the SSCP are always only-in-chain and have a maximum length of 256 bytes. When ENTER is pressed, the 3708 sends the data (excluding nulls) contained in the first 256 character positions including and following the initial cursor address, or to the end of the screen, whichever comes first.

SNA Printer Control

The following paragraphs describe the structure of the SNA session and the SNA control for printer operations. Details and constraints of subsystem operation are described under "Local Copy Function" on page 4-81.

Printers attached to the 3708 can be configured to operate in one of the three following modes:

System Mode. The printer is logically coupled with a type 1 or 3 SLU as the principal device; the SLU is in direct session with the PLU. The SLU type is selected at the time the session is bound using the BIND command and remains the same throughout the session. In this mode, the printer cannot be used for local copy functions.

Local Mode. The printer may be used by one or more type 2 SLUs as a subsidiary device for local copy functions. A copy request may be initiated by the SLU's PLU (WCC with Start Print=1) or by the operator using the Print key. In this mode, the printer cannot be used by a type 1 or 3 SLU. An ACTLU request for the SLU associated with the printer is rejected with sense code X'0801'.

Shared Mode. Both the SLU type 2 and the SLU type 1 or 3 may compete for use of the printer. The printer is used by the SLU type 1 or 3 as a principal device and by the SLU type 2 as a subsidiary device.

When in shared mode, printer contention is allowed to occur between brackets. When the printer's SLU enters BETB state (or if a session does not exist), the printer is available for either a local copy from an SLU type 2 or an SLU type 1 or 3 bracket, 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 is rejected with sense code X'0814' (Bracket Reject, RTR to Follow). When all local copies are completed, 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. (See "Local Copy Function" on page 4-81 for details.)

Chapter 4. Protocol Conversion Mode

This chapter describes the 3708's protocol conversion (PC) mode of operation. It includes a description of:

- The data flow through the 3708 in PC mode
- The data stream that the 3708 receives from the SNA host
- The data stream that the 3708 sends to the display or printer
- The configuration options that affect protocol conversion mode
- Displays and printers operating in PC mode.

This chapter also discusses the local copy function and displays with printers.

Data Flow in Protocol Conversion Mode

When operating in protocol conversion mode, the 3708 appears to the host as a 3270 controller with attached 3270 devices. The devices attached are either ASCII displays or ASCII printers. The 3708 receives data from the host in 3270 data stream format (LU type 1 SNA character stream (SCS), LU type 2, and LU type 3 Data Stream Compatibility (DSC) mode). The 3708 interprets the 3270 data stream and converts it into commands that the attached ASCII device understands. Also, the 3708 translates the EBCDIC characters to ASCII characters. (Translation is required. However, translation may be done using one of the two standard 3708 translate tables, or a user-defined translate table. Selection of the standard user table is optional and is set at configuration time).

Figure 4-1 on page 4-2 shows how data flows through the 3708 in protocol conversion mode.

Note: Refer to Appendix E, "Key Data Formats and Control Blocks" for a description of device buffers, system buffers, and receive queues.

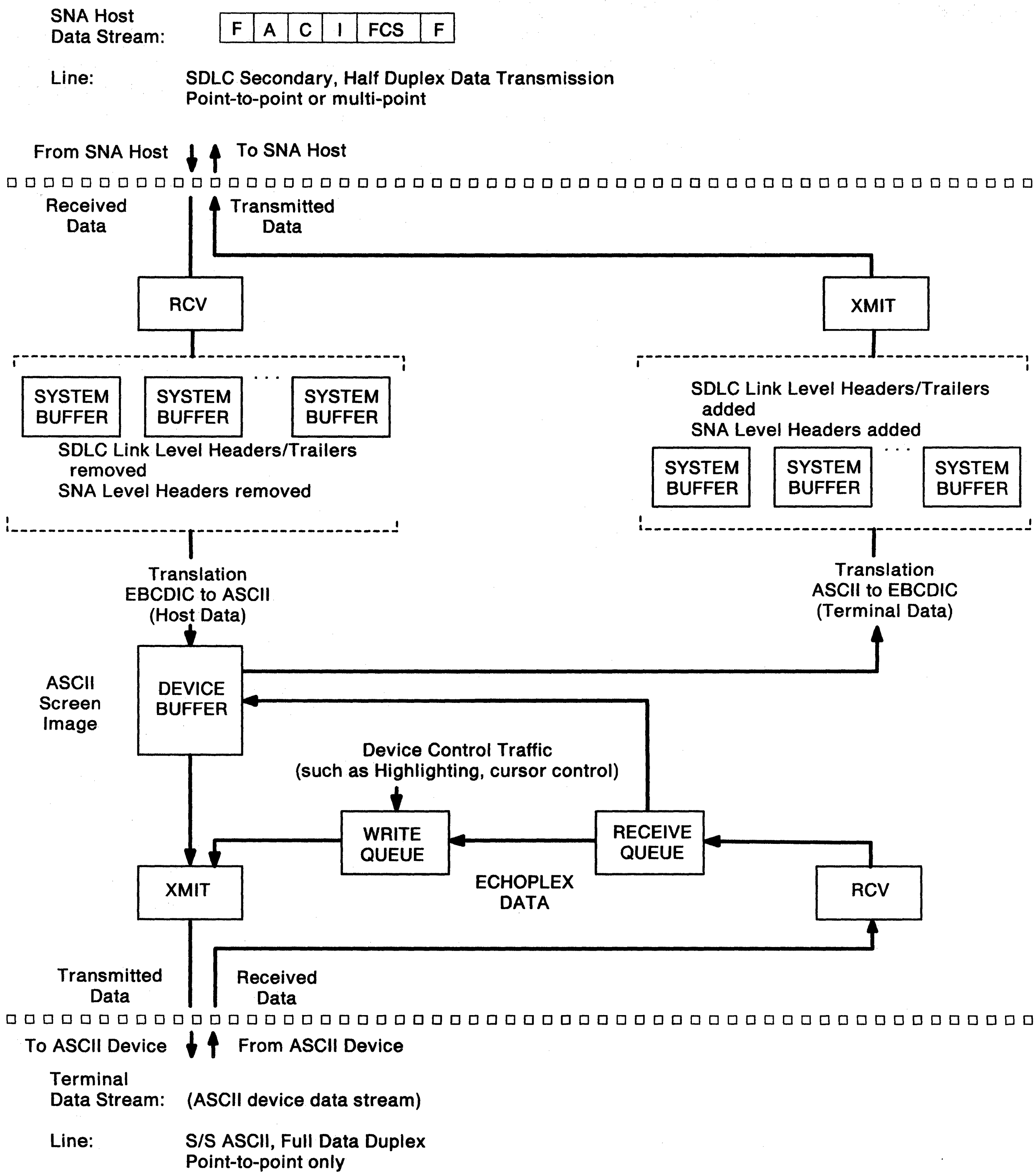


Figure 4-1. 3708 Protocol Conversion - Internal Data Flow

Flow of Data from the SNA Host

Data received from the SNA host over the SDLC link is placed directly into the system buffers. The data is checked for errors and the SNA headers and trailers are removed. As a chain of elements are received, the data is transferred to the device buffer. For segmenting, when all of the segments have been received, the data stream is processed and the data is transferred to the device buffer. The data is translated from EBCDIC to ASCII when it is transferred to the device buffer. In the device buffer, a screen image is formed from the data. For LU type 2 displays and LU type 3 printer sessions, the data is received in 3270 data stream format. After the entire data stream (a complete SNA chain) has been received, the data is written to the terminal.

If a sequence is needed to position the cursor on a display or move the print head on a printer, the sequences are built in the write queue. For displays, these sequences are created from the terminal tables that are in storage. (Refer to *IBM 3708 Network Conversion Unit Planning and Installation* for all of the default terminal tables.)

For LU type 2 sessions, host changes to the terminal screen image are tracked. Only changed fields or lines are written to the terminal.

For more information about protocol conversion data streams for LU type 1, type 2, and type 3, see "3270 Data Stream (LU type 2)," "3270 Data Stream (LU type 3)" on page 4-15, and "3270 Data Stream (LU type 1)" on page 4-19.

Flow of Data from the Terminal

As data is received from the terminal, it is placed in the receive queue (the size of which is configurable in the 3708). From the receive queue, the data is processed, and as a result, may be copied into the device buffer and echoed back to the terminal (the processing, called *keytracking*, is described in "Keytracking" on page 4-77). When the end user presses an AID key (for example, Enter), the data is moved from the device buffer, converted to a 3270 data stream and to the system buffers. In the system buffer, the SNA trailers and headers are added to the data stream and the data is sent to the host. For LU type 2 sessions, terminal changes to the terminal screen image are tracked. This allows the 3708 to send just the changed fields, if requested.

3270 Data Stream (LU type 2)

When an LU type 2 BIND is received from the host, the 3708 is operating in protocol conversion mode.

Note: The 3708 can operate in all three modes (protocol conversion, protocol enveloping, and ASCII pass-through) simultaneously. The BIND from the host and the 3708 configuration determine in which mode a single port operates.

When operating in protocol conversion mode, the 3708 accepts commands, orders, attributes, and data from the host. The 3708 processes the data and sends it to the ASCII display in the form of data and terminal control codes. The following section describes all of the 3270 data stream commands, orders, and attributes that the 3708 accepts. For more detailed information about the 3270 data stream, refer to the *IBM 3270 Information Display System Data Stream Programmer's Reference*, GA23-0059.

Buffer Addresses for Displays

Buffer address is a term used to identify a location in the device buffer corresponding to a position on the display screen. The buffer addresses begin with 0 for row 1, column 1. The maximum buffer addresses are as follows:

Address	Row, Column	Model Emulation
1919	24, 80	Model 2
2559	32, 80	Model 3
3439	40, 80	Model 4
3563	27, 132	Model 5

12/14 Bit Addressing

In the data stream sent from the host to the 3708, the buffer address is transferred using a 2-byte field. This field may be coded using either 12- or 14-bit buffer addressing. In the data stream sent from the 3708 to the host, the buffer address is transferred using a 2-byte field, but only 12-bit buffer addressing is used.

Host Data

In data from the host, the first 2 bits of the first address byte determine whether 12- or 14-bit addressing is used. These bits have the following values:

00 14-bit binary address follows
01 12-bit coded address follows
10 Reserved
11 12-bit coded address follows.

When the flag bits are 00, the next 14 bits are a buffer address in binary form. The 14 bits consist of the remainder of the current byte (6 bits) and 8 bits of the next byte. No address translation is necessary.

When the flag bits are 01 or 11, a 12-bit address is indicated. This is created from the remaining 6 bits of the first byte, concatenating them to the last 6 bits of the second byte.

When the flag bits are 10, a negative response of X'1005' is sent back to the host, and the write operation is terminated.

3270 Data Stream Commands

Commands are sent from the host application to the 3708 to initiate the total or partial writing, reading, or erasing of data in the 3708 device buffer. (For information about buffer addressing see "Converting Between ASCII and EBCDIC" on page F-1.) The following table shows the commands that the 3708 accepts, the abbreviation for that command, and the EBCDIC code for the command.

Command	Abbreviation	EBCDIC Code
Write	W	X'F1'
Erase All Unprotected	EAU	X'6F'
Erase/Write	EW	X'F5'
Erase/Write Alternate	EWA	X'7E'
Read Buffer	RB	X'F2'
Read Modified	RM	X'F6'
Read Modified All	RMA	X'6E'

Write Operation

The process of sending a write-type command and executing that command is called a *write operation*. The 3708 supports four write commands:

- Write (W)
- Erase/Write (EW)
- Erase/Write Alternate (EWA)
- Erase All Unprotected (EAU).

The W, EW, and EWA commands are used by the application program to load, format, and erase selectively areas of the device buffer within the 3708. These commands can also initiate certain display operations, such as copying the contents of the display screen, restoring the keyboard, and sounding an audible alarm at the display. In the data stream, they are normally followed by the Write Control Character Byte.

The Write Control Character (WCC) Byte

The Write Control Character (WCC) is not a unique code, but is identified by position. That is, it is the byte following the write-type command. If the WCC is omitted, whatever follows the write-type command is interpreted as the WCC. The data stream is normally a W, EW, or EWA command followed by the WCC, followed by any orders or data (see "Orders and Attributes" on page 4-10 for information about orders). If any write command (except EAU) is sent with no WCC or data, it is treated as a no operation.

The following table shows the format of the WCC byte. The printout format bits are ignored for LU type 2; they are used only for LU type 3. When orders or data follow the WCC, the 3708 performs the reset of the MDT before processing the rest of the data. After the processing is complete, all other WCC functions are performed.

Bit	Meaning
0,1	These bits are determined by bits 2 - 7 according to the control character I/O codes as described in Appendix E.
2,3	00 = Let NL, EM, and CR orders in the data determine line length. (Effectively provides a 132 character line length.) 01 = 40 character print line 10 = 64 character print line 11 = 80 character print line
4	When set to 1, start printing after write completed.
5	Sound alarm if device supports one.
6	Restore operation of the keyboard from input inhibited state.
7	Reset all MDT bits in device buffer before writing or executing orders.

Write Command

The Write command writes data into specified locations in the 3708 buffer without erasing or modifying data in the other locations. Data is stored in successive buffer locations until an order is encountered in the data stream that alters the buffer address, or until all the data has been stored. During the write operation, the buffer address is advanced one location as each character is stored.

The buffer location where the entry of data starts depends on the starting location specified by the Set Buffer Address order (see "Set Buffer Address (SBA)" on page 4-11) that follows the WCC. If an SBA does not follow the WCC, the starting location is the buffer address where the cursor is positioned. The formatting and placement of write data, and the modifying of existing buffer data, are described in "Orders and Attributes" on page 4-10.

Erase/Write Command

An Erase/Write command causes both an erase and a write operation. The erase operation clears the device buffer to nulls, positions the cursor to location 0, sets the buffer address to 0, and sets the screen size to the default size, if the default size is not currently in effect. The write operation is then performed in the same manner as for a Write command. If the data does not contain a WCC byte, the Erase/Write command does not cause the buffer to be erased.

Erase/Write Alternate Command

If the 3708 is configured for large screen emulation (3270 model emulation = 3, 4, or 5), the Erase/Write Alternate command does the following:

- Clears the device to nulls
- Positions the cursor to location 0
- Sets the buffer address to 0
- Puts the display in the alternate emulation mode type defined by the BIND (if the alternate size in not already in effect).

If the 3708 is not configured for large screen emulation (3270 model emulation = 2), the Erase/Write Alternate command is treated as if it were an Erase/Write command.

Erase All Unprotected (EAU) Command

This command does the following:

- Clears all the unprotected character locations to nulls and sets any character attributes affected to their default values.
- Resets to 0 the MDT bit in the field attribute for each unprotected field.
- Unlocks the keyboard.
- Resets the Attention Identification (AID).
- Repositions the cursor to the first character location, after the field attribute, in the first unprotected field of the device buffer.

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

Note: The EAU command does not have a WCC after it.

Read Operation

The process of sending data from the display to the host is called a *read operation.* A read operation can be initiated by:

- The host application sending an explicit read command
- An operator action (for example, pressing the ENTER key).

Note: Because the information that the host reads may be incomplete, it is recommended that the host application not send Read commands.

The 3708 supports three read commands:

- Read Buffer
- Read Modified
- Read Modified All.

These commands allow the host program to be informed of changes in the device's buffer that resulted from keyboard input. When sent by the host program, these commands cause a specific data stream to be sent in response. Also, the Read Modified response may be sent by the 3708 without having received the command from the host. This would be done when the terminal operator presses the keys to perform a function that requires a host response, such as ENTER or a PF key.

Read Buffer

The 3708 transfers all data in the device buffer to the host when it receives the Read Buffer command. The 3708 transfers data from location 0 to the end of buffer.

The response consists of a 3-byte read heading that contains the AID byte and a 2-byte cursor address. This is followed by the contents of the entire buffer, including null characters. At a location occupied by a field attribute byte, the 3708 inserts a Start Field order to identify the beginning of a field. (See "Start Field (SF)" on page 4-11 for the format of the Start Field order.)

The AID value is set when the terminal operator has performed an operation that requires host program intervention, such as pressing an Enter or PF key. Table 4-1 contains a list of the AID functions and their hex values.

Table 4-1. Responses for each AID Value

AID	HEX EBCDIC	Response
ENTER	7D	Full Read Modified
Light Pen (&)	F1	Full Read Modified
PF01	F2	Full Read Modified
PF02	F3	Full Read Modified
PF03	F4	Full Read Modified
PF04	F5	Full Read Modified
PF05	F6	Full Read Modified
PF06	F7	Full Read Modified
PF07	F8	Full Read Modified
PF08	F9	Full Read Modified
PF09	7A	Full Read Modified
PF10	7B	Full Read Modified
PF11	7C	Full Read Modified
PF12	C1	Full Read Modified
PF13	C2	Full Read Modified
PF14	C3	Full Read Modified
PF15	C4	Full Read Modified
PF16	C5	Full Read Modified
PF17	C6	Full Read Modified
PF18	C7	Full Read Modified
PF19	C8	Full Read Modified
PF20	C9	Full Read Modified
PF21	4A	Full Read Modified
PF22	4B	Full Read Modified
PF23	4C	Full Read Modified
PF24	7E	Select light pen
Light Pen (Space / Null)		
PA01	6C	Short Read
PA02	6E	Short Read
PA03	6B	Short Read
CLEAR	6D	Short Read

Read Modified Command

The Read Modified data stream is in one of three forms determined by the AID operation that has been initiated by the terminal operator. Table 4-1 indicates each AID, whether the resulting data stream is a full-read-modified response, a selector light-pen response, or a short read response. Each of these responses is discussed in the following paragraphs.

Full-read-modified response

If the terminal operator pressed an AID key other than CLEAR, PA1, PA2, or CURSR SEL on an '&' field, a full read modified response is sent to the host. All fields that have MDT set to 1 are sent to the host with nulls suppressed. (When a field is modified by the operator, the MDT bit is set in the attribute byte for that field.)

The first 3 bytes in the response data stream are always the read heading. The first byte is the AID code; the second 2 bytes contain the current cursor address. Following the read heading is the data of each modified field. The data for each field is preceded by an SBA order containing the 2-byte buffer address of the first character position in the field (the attribute address plus 1). Thus, the read data stream for this response would be as shown in Table 4-2.

Table 4-2. Format of Full-Read-Modified-Response

Response	**Description**
AID + Cursor Address	Read heading
SBA (X'11')	Set Buffer Address Order
Attribute Address + 1	Attribute Address plus one (identifies location of the field)
Data . . .	Nulls suppressed
SBA (X'11')	More modified fields if applicable.

The search for modified fields begins at buffer location 0, and continues until the last buffer location has been checked.

The data stream is terminated as follows:

- When the last modified field wraps from the end of buffer into the beginning of the buffer, the data stream includes all data in that field, and is the last piece of data.
- If the buffer does not have a wrapped modified field, the data stream ends after the last modified field.

When the buffer is formatted (contains fields) and no modification occurs, the data stream consists of the read heading only.

If the buffer is unformatted (contains no fields), the 3708 responds with the entire buffer regardless of whether it has been modified because there are no attribute bytes in the buffer, and modification of data cannot be determined. The read starts at location 0 and continues to the last location; nulls are suppressed.

Selector light-pen response

If CURSR SEL on a space or null field has been used to generate the AID, data from modified fields is not sent to the host program. The read heading and an SBA order for each modified field are sent, as shown in the following table:

Table 4-3. Format of Selector Light-Pen Response

Response	Description
AID + Cursor Address	Read heading
SBA (X'11')	Set Buffer Address Order
Attribute Address + 1	Attribute Address plus one (identifies location of the field)
SBA (X'11')	More modified fields if applicable.

The search for modified fields begins at buffer location 0, and continues until the last buffer location has been checked.

Note that if fields are modified by the keyboard, but completion of the modification is signaled by a selector-light-pen-attention operation on other than '&' character-designator fields, a resulting read-modified operation reads only the address of the modified fields, not the modified data. A Read Modified All command can be used to obtain both the address of, and the data in, each field that has the MDT bit set to 1.

Short read response

If the CLEAR key or a PA key has been pressed, a short read operation is performed. The data stream of a short read contains only the AID byte. No cursor address is sent and no data is transferred.

Read Modified All Command

This command operates like a Read Modified command, except that the 3708 sends both the address and data from modified fields, regardless of the AID byte. The 3708 does not generate this type of read operation. The command must be sent by the host.

Orders and Attributes

Orders can be included in any of the write-command data streams, either alone or intermixed with data. Two types of orders are used: printout format orders and buffer control orders. Printout format orders are discussed in "3270 Data Stream (LU type 3)" on page 4-15. The following paragraphs describe the buffer control orders that are executed by the 3708. Figure 4-2 on page 4-11 shows the buffer control orders, their hex codes, and the format of any parameters. The printout format orders are shown in Table 4-4.

Note: The 3708 does not support the 3274 Structured Field and Attribute Processing option and the associated orders.

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

Figure 4-2. Buffer Control Orders and Order Codes

Start Field (SF)

The Start Field (SF) order tells the 3708 to start a field at the current buffer address. The second byte of the order is the attribute character that is to be associated with the field. The 3708 stores the attribute character at the current buffer address and then increments the buffer address by 1. Bits 0 and 1 of the character are set to '10' before it is stored in the buffer; this setting identifies the byte as an attribute character during subsequent operations.

The byte immediately following the Start Field order code in the data stream is always stored as an attribute, even when the byte was intended as an order or a data character.

During execution of a Read Buffer command, the 3708 automatically inserts SF order codes in the read data stream immediately before each attribute character. This placement permits identification of the attribute characters by the host program.

Set Buffer Address (SBA)

The Set Buffer Address order (SBA) specifies a new buffer address where writing resumes. The host program can use the order to write data into various areas of the buffer. The order can also precede any other order to define where the operation of the second order is to begin. For example, an SBA order would be used in front of a SF order to identify the beginning of the buffer address for the new field.

If the SBA has an invalid address, the write operation terminates, and a negative response (X'1005') is returned to the host program.

When a Read Modified data stream is being created, the 3708 searches for attributes with the MDT bit set. For each such attribute, the 3708 inserts the SBA order code followed by the 2-byte buffer address of the first character in the modified field (attribute address plus 1).

Insert Cursor (IC)

The Insert Cursor (IC) order positions the cursor to the location identified by the current buffer address. This order can be used by the host program to identify the position where the cursor is to be placed when the new data is displayed to the terminal operator.

Program Tab (PT)

The Program Tab (PT) order advances the current buffer address to the first character position of the next unprotected field. If the current buffer address (CBA) is at an attribute of an unprotected field, it updates the CBA to the next buffer location. When the PT order does not follow a command or an order, the PT causes nulls to be inserted to the end of current field, regardless of the value of bit 2 (protected/unprotected) of the attribute character for the field. If the PT follows a command or another order, the current field is left unchanged.

The PT does not tab beyond the end of the buffer. If an attribute for an unprotected field has not been found by this point, the CBA is set to 0. To continue the search for an unprotected field, a second PT order must be used immediately following the first. If the first PT order was causing nulls to be placed into the buffer when the operation was terminated at the last buffer location, a second PT order will continue to place nulls from buffer location 0 to the end of the current field.

Repeat to Address (RA)

The Repeat to Address (RA) order writes a specified character in all buffer locations from the current buffer address up to the stop address specified in the order. (The character is not placed at the location specified by the ending address). As shown in Figure 4-2 on page 4-11, the ending buffer address is specified in bytes 2 and 3 of the order, and the character to be repeated is found in byte 4. If the ending address is out of range, the write operation is terminated, and a negative response (X'1005') is sent to the host program.

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

Erase Unprotected to Address (EUA)

The Erase Unprotected to Address (EUA) order places nulls in all unprotected buffer locations from the current buffer address up to the stop address specified in the order. (A null is not placed at the location specified by the ending address.) As shown in Figure 4-2 on page 4-11, the ending buffer address is specified in bytes 2 and 3 of the order. If the ending address is out of range, the write operation is terminated, and a negative response (X'1005') is sent to the host program.

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

Processing the 3270 Data Stream

When operating in protocol conversion mode, the 3708 analyzes the LU type 2 data stream (see "3270 Data Stream (LU type 2)" on page 4-3), building a screen image in the 3708 device buffer for the port (see "Display Image" on page 4-29 for a brief description of the device buffer).

The order of processing is:

1. If the command is a Write and the WCC indicates that MDT bits are to be reset, the device buffer is searched for attribute bytes, and the MDT bit (bit 7) is set to 0.
2. If the command is an Erase/Write or an Erase/Write Alternate, the device buffer is cleared to nulls.
3. If the terminal is enabled for large screen support, the 3708 may transmit a sequence to the terminal to set the screen size.
   - If the terminal is not in the default screen size and an E/W is received, the 3708 transmits a sequence to the terminal to set its screen size to the default size specified in the BIND.
   - If an E/W Alternate is received and the terminal is not in alternate screen size, the 3708 transmits a sequence to set the terminal in the alternate screen size specified by the BIND.
4. The host data is analyzed for orders and data, and from these, the device buffer is updated to represent the display image. For each line of the display image, two column-number values are maintained. These are used to contain the rightmost and leftmost column positions that have been modified by the current Write command from the host. These values are used later when transmitting the data to the terminal.
5. An entire Write command is received and analyzed by the 3708 before any transmission to the terminal occurs. If the data has been split into chain elements, transmission to the terminal begins only after the element specifying End Chain has been received.
6. If the Type-ahead function has been activated, a positive SNA response is sent, if appropriate. The queue of characters received from the terminal is then checked. If data has been received, it is processed and (possibly) added to the device buffer data. When an AID type key sequence is detected in the received data, the appropriate indication is transmitted to the host program, and the receive queue processing terminates.

7. To transmit to the terminal, the 3708 uses the two column-number values previously described to determine, for each line of the display, what data must be transmitted. (As an example, if the host application had used a Write command to update the data in a field, but the new data was the same as the old, the column-number values would reflect that nothing changed, and no new data would actually be transmitted to the terminal.) Starting with line 1, the updated display image is sent to the terminal. Any field in a modified line that has not been changed is not transmitted to the downstream device. The sequences in the following list are obtained from the terminal control section of the terminal table that is in use:

   - The 3708 sends Set Cursor Address sequences to position data correctly on the screen.
   - If the terminal type being used supports highlighting, the 3708 sends highlighting ON/OFF sequences to cause characters to be correctly intensified, based on the field attributes sent in the host data stream.
   - If the terminal type being used supports colors, the 3708 sends the color sequences to cause characters to be the correct colors, based on the field attributes sent in the host data stream.
   - If characters at the end of a line are all blanks, nulls, or attribute bytes, the 3708 sends the Erase EOL (erase end of line) sequence, rather than transmitting many blank characters.

8. After the entire screen has been updated, the keyboard restore indicator of the WCC is checked. If it is set to 1, the status line of the display is updated to clear the message area where, usually, `X CLOCK` had been displayed.

   The setting of the WCC sound alarm bit (bit 5) is tested, and a BEL character is sent to the terminal, if necessary.

9. If Type-ahead was not in use, the positive SNA response would be sent at this time, if appropriate.

3270 Data Stream (LU type 3)

When an LU type 3 BIND is received from the host for a printer, the 3708 is operating in protocol conversion mode. Data Stream Compatibility (DSC) protocol is used to communicate with the printers. The 3708 interprets the 3270 DSC data stream and converts it into commands for the ASCII printer. This protocol uses a subset of the LU type 2 data stream. The 3708 uses a 1920 character buffer, just as it does for a display using a 3270 data stream for an LU type 2. (Other buffer sizes are not supported. If byte 24 of the BIND indicates other sizes, the BIND is rejected with SNA sense code X'0821'.) The Write commands with all their orders are processed in the same way as for a display. The Read commands cause an SNA negative response of X'1003.'

Commands

The Write, Erase/Write, and Erase/Write Alternate commands are processed for a printer the same way as a display (see "3270 Data Stream (LU type 2)" on page 4-3). In addition to all the buffer control orders that are used for display buffer formatting, there are four printer orders that can be included in the LU type 3 data stream:

- New Line (NL)
- End of Message (EM)
- Forms Feed (FF)
- Carriage Return (CR).

Print Line Formatting

LU type 3 printouts can be formatted or unformatted. For a formatted printout, the format of the device buffer controls the appearance of printer data. For an unformatted printout, printer orders are used to control the appearance of data at the printer.

Formatted Printouts

The host application can specify that a formatted printout is to occur by setting bits 2 and 3 in the WCC byte of a Write command, as shown in the following table (refer to "The Write Control Character (WCC) Byte" on page 4-5 for more information):

Bits 2 and 3	Meaning
01	Formatted printout, 40-character lines
10	Formatted printout, 64-character lines
11	Formatted printout, 80-character lines
00	Unformatted printout.

Data from the device buffer prints according to this print line length.

The following items describe how the 3708 causes data to print for a formatted printout.

Note: The newline function referred to below has three steps:

1. Carriage Return (X'0D').
2. Line Feed (X'0A').
3. If a carriage return delay is specified for the port to which the printer is attached, a number of ASCII DEL characters (X'7F') are sent to the printer. The number of DEL characters is determined by multiplying the configured carriage-return-delay value by the ratio of the current column to the platen width.

- A newline is performed at the beginning of a formatted printout. This can be suppressed by setting nonstandard operating bit 13 to 1.
- A newline function is performed by the 3708 when a Begin Bracket is received for the printer session.

  Note: This newline can be suppressed by configuring the 3708 option PERFORM NEWLINE AT BEGIN BRACKET to N.
- New Line (NL), Carriage Return (CR), and End of Message (EM) print as blanks and are otherwise ignored.
- A Form Feed (FF) order is valid in any position and causes the 3708 to send a FF character (X'0C') to the printer. If a form feed delay is specified for the port, that number of ASCII DEL characters (X'7F') are sent.
- After printing the last printable character on a line (determined by the print line format specified in the WCC), the 3708 performs a newline function.
- Null characters, attribute characters, or alphameric characters in nonprint or nondisplay fields are treated as follows:
  - If embedded in a print line (that is, they appear before the last printable character of the line), they print as blanks.
  - If they constitute an entire line, the line is not printed at all.

    Note: A blank line is printed if nonstandard operating bit 12 is set to 1.
- At the end of a printout, a newline function is performed.

Unformatted Printout

If bits 2 and 3 of the WCC are set to 00, an unformatted printout occurs. The platen length that has been configured for the 3708 port to which the printer is attached is used for the line length.

Printing starts from buffer location 0 and ends with the last position of the buffer. Printing can also end when the 3708 encounters an EM print order. If the print is ended with an EM order, the 3708 performs a newline function if the print element is not already positioned at the beginning of a line.

With unformatted printouts, the print orders that were sent in the data stream control the printed data format. The printer orders and their hexadecimal values are shown in Table 4-4.

Table 4-4. Print Orders and Hex Equivalents

Order	Hex Value
New Line (NL)	X'15'
End of Message (EM)	X'19'
Carriage Return (CR)	X'0D'
Form Feed (FF)	X'0C'

The 3708 stores these orders in the device buffer after setting the two high order bits to b'11'. (This setting causes the characters to appear as X'D5', X'D9', X'CD', and X'CC' in the buffer.) As data in the buffer is converted to a data stream for transmission to the printer, these bytes are interpreted as print orders. The printout format that results is described in the following paragraphs.

Note: The newline function referred to below has three steps:

1. Carriage Return (X'0D').
2. Line Feed (X'0A').
3. If a carriage return delay is specified for the port to which the printer is attached, a number of ASCII DEL characters (X'7F') are sent to the printer. The number of DEL characters is determined by multiplying the configured carriage-return-delay value by the ratio of the current column to the platen width.

A newline function is performed by the 3708 when a Begin Bracket is received for the printer session.

Note: This newline can be suppressed by configuring the 3708 option PERFORM NEWLINE AT BEGIN BRACKET to N.

New Line (NL): When an NL order is encountered in the buffer, the 3708 performs a newline function to advance the printer element to the left margin of the next line. Also, if no NL is encountered before the end of the line (as determined by the platen length), the 3708 performs the newline function.

If the NL order is encountered in a nondisplay/nonprint field, it does not cause a newline function; a blank is sent to the printer.

End Of Message (EM): The EM order is used to indicate the end of a message. When the EM order is encountered in the buffer, the 3708 resets the printer element to the start of the next line by performing a newline function. If the printer is already at the start of a line, the newline is not performed.

If the EM order is encountered in a nondisplay and nonprint field, it does not end the printout; a blank is sent to the printer.

If a valid EM order is not encountered during the printout, the 3708 transmits NLs for all null lines until it reaches the end of the print buffer.

Carriage Return (CR): The following data is sent to the printer:

1. Carriage Return (X'0D').
2. If a carriage return delay is specified for the port to which the printer is attached, a number of ASCII DEL characters (X'7F') are sent to the printer. The number of DEL characters is determined by multiplying the configured carriage-return-delay value by the ratio of the current column to the platen width.

A CR order is not executed if located in a nondisplay and nonprint field; a blank is sent to the printer.

Form Feed (FF): An FF order is valid in any position and causes the 3708 to send a FF character (X'0C') to the printer. If a form feed delay is specified for the port, that number of ASCII DEL characters (X'7F') are sent. (The printer buffer can contain any number of FF print orders.)

Printer Compatibility Features

The 3708 provides the following printer compatibility features:

- CR at maximum presentation position (MPP) plus 1 (LU type 3 Unformatted Mode)

  After printing characters out to the page width (MPP), the 3708 performs an automatic NL. The next codepoint in the buffer applies to the first print position of the next line. If the character is a CR, it is ignored. For example, the character A occurs at MPP followed by a CR and the character B. The character A prints in the last position of the current line. The character B prints in the first print position of the next line.

- NL at MPP plus 1 (LU type 3 Unformatted Mode)

  An NL in MPP plus 1 causes two NL functions, because of the automatic NL generated when reaching MPP. For example, the character A occurs at MPP followed by an NL and the character B. The character A prints in the last position of the current line. The character B prints in the first print position of the current line plus 2.

- Null line suppression (LU type 3 Formatted Mode)

  The 3708 does not print lines that contain *only*:

  - Nulls
  - Attribute characters
  - Nondisplay or nonprintable characters.

  The next print position is the first print position of the next line.

  Note: Null line suppression can be disabled by setting nonstandard operating bit 12 to 1. If bit 12 is set to 1, lines containing all nulls, attribute characters, nondisplay characters, or nonprintable characters appear as blank lines in the printout, and EM, NL, and CR are considered valid.

- Automatic NL after the end of print buffer.

  An NL occurs automatically after the print buffer completes for a formatted printout.

3270 Data Stream (LU type 1)

When the BIND for a printer attached to the 3708 indicates LU type 1 and the 3708 is configured for a printer, the LU type 1 SCS (SNA Character String) data stream is expected. This consists of a sequential string of control and data characters, which is used to provide printed page format control. When processing the LU type 1 data stream, the device buffer for the port is used only as a work area. The buffer is not used as a screen or printed page image. The controls in the data itself entirely format the print output.

Normally, LU type 1 print operations begin wherever the print element currently is. However, the 3708 port may be configured so that the 3708 sends a form feed to the printer when a "Begin Bracket" SNA indicator is received.

SCS Control Codes Overview

The SCS control codes are used to perform a variety of page formatting functions. The codes are shown in Table 4-5:

Table 4-5. SCS Control Codes

SCS Code	EBCDIC	Name
BS	X'16'	Back Space
BEL	X'2F'	Bell Function
CR	X'0D'	Carriage Return
ENP	X'14'	Enable Presentation
FF	X'0C'	Form Feed
GE	X'08'	Graphic Escape
HT	X'05'	Horizontal Tab
INP	X'24'	Inhibit Presentation
IRS	X'1E'	Interchange Record Separator
LF	X'25'	Line Feed
NL	X'15'	New Line
SA	X'28'	Set Attribute
SHF	X'2BC1'	Set Horizontal Format
SLD	X'2BC6'	Set Line Density
SVF	X'2BC2'	Set Vertical Format
TRN	X'35'	Transparent
VCS	X'04XX'	Vertical Channel Select
VT	X'0B'	Vertical Tab

SCS Control Code Descriptions

The following sections describe all of these SCS orders and explain how they are supported by the 3708. In the descriptions, XLATE (X'nn') is used to indicate the characters that the 3708 sends to the printer to perform each function. This nomenclature means that the EBCDIC value X'nn' is used as an index into the EBCDIC/ASCII translation table for the port. If one of the standard tables is in use, this results in the expected character (for example, EBCDIC "F" is X'25', and the translation for this is ASCII "LF", which is X'0A'.) If a user-defined translation table is in use, the ASCII character that has been set in the table is used.

Back Space (BS)

The 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, this control has no effect. The left margin setting is ignored.

To execute this command, the 3708 sends XLATE (X'16') to the printer.

Carriage Return (CR)

The Carriage Return (CR) is a format control that moves the print position horizontally to the left margin on the current line. If the print position is already at the left margin, this command has no effect.

To execute this command, the 3708 sends:

1. XLATE (X'0D')
2. If a carriage return delay is specified for the port to which the printer is attached, a number of ASCII DEL characters (X'7F') are sent to the printer. The number of DEL characters is determined by multiplying the configured carriage-return-delay value by the ratio of the current column to the platen width.
3. If the left margin (LM) is currently greater than 1, then LM minus 1 number of ASCII space characters (X'20') are sent.

Enable Presentation (ENP)

The Enable Presentation (ENP) is a format control that is used to enable the printing of keyboard input data. This command performs no function on an LU type 1 device. It is accepted by the 3708 without an error response and without affecting the printout format.

Form Feed (FF)

The Form Feed (FF) is a format control that moves the print position to the top and left margin of the next form.

To execute this command, the 3708 sends four or more characters to the printer.

1. The first character depends on the value of `3708 MAY TRANSMIT FORMFEED (LU_1 SCS)`.
   - If the value is Y, the 3708 sends XLATE (X'0C') to cause a form feed.
   - If the value is N, the 3708 sends the following characters:
     a. XLATE (X'0D') to perform carriage return functions
     b. CR delay (same as 2 under "New Line (NL)" on page 4-21)
     c. An appropriate number of ASCII line feed characters (X'0A') to position the print element on the first line of the next form.
2. If a form-feed delay is specified for the port to which the printer is attached, a number of ASCII DEL characters (X'7F') are sent to the printer. The number of DEL characters is equal to the form-feed delay value.

   Note: Instead of DEL (X'7F') characters, the user may configure the 3708 to transmit NULL (X'00') or XON (X'11X') by setting nonstandard bits 4 or 10 to 1.

3. If the top margin (TM) is currently greater than 1, then TM minus 1 of ASCII line feed characters (X'0A') are sent.
4. If the left margin (LM) is currently greater than 1, then LM minus 1 of ASCII space characters (X'20') are sent.

Horizontal Tab (HT)

The 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 generates a space.

To execute this command, the 3708 sends the number of ASCII space characters (X'20') required to cause the print element to move to the next tab setting.

Note: An HT placed after the MPP causes a space in the first print position of the next line.

Inhibit Presentation (INP)

The Inhibit Presentation (INP) is a format control used to inhibit the printing of keyboard input data. This command performs no function on an LU type 1 device. It is accepted by the 3708 without an error response and without affecting the printout format.

Interrecord Separator (IRS)

The Interrecord Separator (IRS) is a separator character that causes a newline function.

Line Feed (LF)

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

To execute this command, the 3708 sends XLATE (X'25').

New Line (NL)

The New Line (NL) is a format control that moves the print position to the left margin on the next line. This is functionally equivalent to a CR followed by a LF.

To execute this command, the 3708 sends:

1. XLATE (X'0D') to perform the carriage return function.
2. If a carriage return delay is specified for the port to which the printer is attached, a number of ASCII DEL characters (X'7F') are sent to the printer. The number of DEL characters is determined by multiplying the configured carriage-return-delay value by the ratio of the current column to the platen width.

   Note: Instead of DEL (X'7F') characters, the user may configure the 3708 to transmit NULL (X'00') or XON (X'11') by setting nonstandard bits 4 or 10 to 1.
3. If a carriage-return-delay character is specified for the port to which the printer is attached, a number of ASCII DEL characters (X'7F') are sent to the printer. The number of DEL characters is equal to the carriage-return-delay value.

Note: Instead of DEL (X'7F') characters, the user may configure the 3708 to transmit NULL (X'00') or XON (X'11') by setting nonstandard bits 4 or 10 to 1.

4. XLATE (X'25') to perform the line feed function.
5. If the left margin (LM) is currently greater than 1, then LM minus 1 of ASCII space characters (X'20') are sent.

Set Horizontal Format (SHF)

The Set Horizontal Format (SHF) is a data-defining control used to set the horizontal format controls. These controls include left and right margins and horizontal tab stops. A 1-byte binary count follows the SHF code that indicates the number of bytes to the end of the SHF string, including the count byte. The first 3 bytes following the count byte define the maximum presentation position (MPP), the left margin (LM), and the right margin (RM), respectively. (MPP is equivalent to line length.) Tab stop settings follow the right margin position.

A zero for any of these values results in a negative SNA response of X'1005'. All values are expressed as 1-byte binary numbers. The minimum SHF sequence is 1 byte, which sets the horizontal format controls to their default values. The following example shows the sequence of the SHF control.

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

MPP
: Defines a line length less than or equal to the maximum print position. The default value for MPP is the platen width that has been configured at the 3708 port.

  Note: If the MPP is set to a value greater than the physical page width, data may be lost (for example, printing on the platen, or the print head jams at the right margin).

  If the SHF command sets the page length greater than the configured maximum platen length value in the 3708 port configuration, the 3708 rejects the SHF command with a negative sense code of X'1005'.

LM
: Specifies the column value of the leftmost 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 1.

RM
: Not used in printing operations.

T1...Tn
: Specifies horizontal tab stop settings. The tab stops do not have to be in order. Valid tab stop values are less than or equal to the MPP and greater than 1.

Set Line Density (SLD)

The Set Line Density (SLD) is not recognized on by the 3708. It is normally followed by a 2-byte parameter. The 3708 accepts, but ignores SLDs of the formats X'2BC601' or X'2BC602xx'. Other formats cause a negative SNA response of X'1005', and the print operation is terminated.

Set Vertical Format (SVF)

The Set Vertical Format (SVF) is a control used to set the vertical format controls. These include top and bottom margins, vertical tab stops, and the maximum presentation line (MPL). (MPL is equivalent to the page length.) A 1-byte binary count follows the SVF code that indicates the number of bytes to the end of the SVF string, including the count byte. The first 3 bytes following the count byte define the MPL, the top margin (TM), and the bottom margin (BM), respectively. A zero for any of these values results in a negative SNA response of 1005.

Tab stop settings follow the bottom margin position. All values are expressed as 1-byte binary numbers. The minimum SVF sequence is 1 byte long, which sets the vertical format controls to their default values. The following example shows the sequence of the SVF control.

(SVF)(cnt)(MPL)(TM)(BM)(T1)(T2)...(Tn)

MPL Defines the page length. All values between 0 and 102 are valid. A value specified here takes precedence over the printer page length configured at the 3708 port. The default value for MPL is 1.

Note: If the MPL is set to a value greater than the physical page length, printing may occur on the form fold.

TM Specifies the line value of the first line on a page. The TM also serves as the first vertical tab stop. Valid TM values are less than or equal to the MPL. The TM default value is 1.

BM Specifies the line value that, when reached, 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.

The 3708 causes the automatic skip by executing an FF function (see "Form Feed (FF)" on page 4-20) when the BM is reached. LFs are then transmitted to the device to reach the TM, and spaces to reach the LM.)

T1...Tn Specify vertical tab stop settings. The tab stops do not have to be in order. Valid tab stop values are less than or equal to the MPL, and greater than or equal to the top margin.

Transparent (TRN)

The Transparent (TRN) is a data-definition character that allows the transmission of data in transparent mode. A 1-byte binary value follows the TRN code which specifies the number of bytes of transparent data to follow. The count does not include the length byte. Transparent data is user defined and is not scanned for SCS control normally translated. The 3708 translates transparent data from EBCDIC to ASCII if nonstandard operating bit 8 is set to 1. Otherwise, the data is sent to the device unchanged.

The transparent mode can be used to send data to an ASCII plotter or graphic device.

Vertical Channel Select (VCS)

The Vertical Channel Select (VCS) is a control code that causes a line feed function.

Vertical Tab (VT)

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

To execute this command, the 3708 sends the number of ASCII line feed characters ('0A') needed to move the print element to the correct line.

Graphic Escape (GE)

The Graphic Escape (GE) precedes another character and indicates that the character that follows is to be printed from an alternate character set. The 3708 does not provide this function. The GE is printed as X'60'.

Set Attribute (SA)

The Set Attribute (SA) is an attribute defining code used to associate colors and highlighting with strings of characters. These functions are not normally available on ASCII printers. The 3708 prints this code as X'40' with no other changes in format.

Configuration Options (Protocol Conversion)

The following configuration option definitions apply to protocol conversion mode. For configuration instructions, refer to *IBM 3708 Network Conversion Unit Planning and Installation.*

Device Class

Choices are Keyboard display, Keyboard printer, Printer, and Keyboard display with printer.

Valid choices for protocol conversion operations are: Keyboard display, Printer, and Keyboard display-with-printer.

Keyboard displays are video displays such as the IBM 3161. Printers are output only devices such as the IBM 4201 Proprinter. Keyboard displays with printers are video displays that allow their auxiliary ports to be remotely accessed, such as the IBM 3163. These devices are supported as multiple LU (MLU) devices by the 3708. Both the printer and the display can be accessed directly by the 3708.

Keyboard printers, which have a hard copy printer instead of a video display, can also be supported in protocol conversion mode but must be defined as printers. The 3708 accepts the following input from these devices:

- Hold Print ('H')/Enable Print ('E')
- Cancel Print ('C') - LU type 1 SCS only
- PA1/PA2 - LU type 1 SCS only.

Operating Mode

Choices are Protocol Enveloping, Protocol Conversion, and Dynamic.

Valid choices for protocol conversion operations are Protocol Conversion and Dynamic.

For a keyboard display, or part of a keyboard display with printer, protocol conversion operations begin after a LU type 2 BIND is received from the host. If defined for Dynamic operations, the 3708 also allows a LU type 1 BIND and begin operating in protocol enveloping mode. See the following table:

Device Class	Protocol Enveloping Only	Protocol Conversion Only	Dynamic
Keyboard Display	Only LU type 1 BINDs accepted; operate as LU type 1 NTO.	Only LU type 2 BINDs accepted; operate using 3270 data stream.	Either LU type 1 (NTO) or LU type 2 (3270 Data Stream) BIND accepted.
Keyboard Printer	Only LU type 1 BIND accepted, NTO.	N/A	N/A
Printer	N/A	Either LU type 3 (DSC) or LU type 1 (SCS) BINDs accepted.	Either LU type 3 (DSC) or LU type 1 (SCS) BINDs accepted.
Keyboard Display with Printer	Display same as "Keyboard Display"; Printer same as "Printer."	Display same as "Keyboard Display"; Printer same as "Printer."	Display same as "Keyboard Display"; Printer same as "Printer."

3270 Model Emulation

Choices are 2, 3, 4, and 5.

This option determines the maximum terminal screen size supported by this port. Screen sizes are:

Model Emulation	Rows x Columns
Model 2	24 x 80
Model 3	32 x 80
Model 4	43 x 80
Model 5	27 x 132

The default value is 2.

Screen sizes greater than Model 2 are selected at the expense of 3708 system buffers. To improve performance and throughput, 3708 ports should not be configured for screen sizes larger than are going to be used on the port.

Interface Type

Choices are EIA 232C and EIA 422A.

Both types of connections are supported for protocol conversion and enveloping modes. EIA 422A connections, however, are not supported if Device Mode = 2 is set for printers and are generally not available on a dial-in (switched) connection.

Parity

Choices are None, Odd, Even, Space, Mark, and Autoparity.

Valid options for protocol conversion operations are None, Odd, Even, and Autoparity. Autoparity is detected for odd and even parity for speeds from 110 to 4800 and 9600 bps.

In protocol conversion mode, 8-bit data can only be transmitted from a host application to a downstream printer or plotter using the LU type 1 SCS transparency mode. See "3270 Data Stream (LU type 1)" on page 4-19. In this mode, the 3708 should be configured for 7-bit data and Parity = None. If configured this way, the port should only be used to support LU type 1 SCS transparency.

Translation Options

Choices are Default, User, and Alternate.

Translation is specified separately for transmit and receive operations.

Most IBM hosts use EBCDIC (Extended Binary Coded Decimal Interchange Code) and most asynchronous devices use ASCII (American National Standard for Information Interchange). The 3708 provides two standard translation tables for converting EBCDIC to ASCII and vice versa. The tables are a default table and an alternate table. See Appendix F, "IBM-Supplied Translate Tables" for more information.

If neither the default nor the alternate translation table meet the requirements for your application, it is necessary to define a user-defined translate table and specify user-defined translation. The user-defined translate tables may be based on either the default table, the alternate table, or a previously defined user-defined translate table. No translation is only valid for protocol enveloping mode.

Note: Until a session has been established, the 3708 uses the default translation tables.

Bits/Character

Choices are 7-bit (plus parity set to odd, even, mark, or space) and 8-bit (no parity) data.

Both choices are valid for both protocol conversion and protocol enveloping modes. However, if 8-bit data is chosen for a protocol conversion port, it should be used only for LU type 1 SCS transparency operations.

Delay After Form Feed

This value is the number of DEL (X'7F') characters transmitted by he 3708 after a form feed. These characters are transmitted to provide the print head on certain mechanical devices time to reposition itself to the top of the next form.

A value of 0 disables this function and allows the 3708 to transmit data immediately after a form feed.

Delay After Carriage Return

This value is used in LU type 1 SCS and LU type 3 operations to determine the number of DEL (X'7F') characters for the 3708 to transmit in order to allow the print head of the downstream device time to reposition itself.

The 3708 uses this value multiplied by the ratio of the calculated position of the print head to the maximum platen length to determine the number of DEL character to transmit to the downstream device.

A value of 0 disables this function and allows the 3708 to transmit data to the downstream device immediately after a carriage return.

Maximum Platen Length

The field determines the maximum number of characters in a line. The maximum platen length defines the maximum print position possible on a printer. The valid range is from 000 to 255.

Printer Authorization Matrix Options

The following options are available:

Perform Form Feed After Local Copy: If **N** is configured for Form Feed After Local Copy, the 3708 does not generate an FF between local copy jobs. If **Y** is specified, the 3708 transmits an FF after each lo cal copy.

3708 May Transmit Form Feed (LU type 1 SCS): If **Y** is configured and an FF is detected in the LU type 1 SCS data stream, the 3708 performs one of the actions indicated below:

- If a SVF command has been received, the 3708 will:

  Transmit a CRLF and the correct number of LFs (based on the SVF command) to the printer to emulate the desired form feed function. For example, if in the SVF command the maximum page length is set to 6 and the host application writes one line then transmits an FF, the 3708 transmits a CRLF and five LFs to the printer.

- If a SVF command has not been received, the 3708 will:

  Transmit a CRLF and the appropriate number of LFs using the value configured in the Default Printer Page Length field as the page length.

  If the **N** is configured for Perform Form Feed at Begin Bracket, the 3708 does not transmit an FF to the printer whenever it receives a Begin Bracket command from the host for the printer LU. If **Y&** is specified, the 3708 transmits an FF to its downstream printer whenever a Begin Bracket is received.

Perform Form Feed at Begin Bracket (LU type 1 SCS): If Y is configured for 3708 May Transmit Form Feed, then the 3708 transmits an FF character to the printer when it detects a FF in the LU type 1 SCS data stream.

Perform Newline at Begin Bracket (LU type 3 DSC): When this option is set to "Y", the 3708 performs a newline after each Begin Bracket during a LU_3 printout. If it is set to "N", the 3708 suppresses the newline after each Begin Bracket. The default value for this option is "Y".

Nonstandard Operations

Several of the nonstandard operations flags can affect operations in protocol conversion mode. Refer to Chapter 7, "Nonstandard Operations" for a description of these flags.

Displays

This section describes how the 3708 controls displays when operating in protocol conversion mode. It includes descriptions of the following subjects:

- The image that appears on the display's screen
- The types of fields that may be on the image
- Support for IBM 3270 Models 2, 3, 4, and 5
- The special cartridges available for the IBM 3151, 3161, 3162, 3163, and 3164
- The status line area of the display image
- The keyboard functions that are available to the display operator.

Display Image

Data displayed on the screen of the ASCII display is stored in its ASCII form in a device buffer in the memory of the 3708. The device buffer contains as many locations as there are character positions on the screen. The buffer contains another 80 or 132 bytes in which the status line image is kept. The data for the screen image portion of the buffer may be loaded from the application program at the host, or from the keyboard of the attached display. Figure 4-3 on page 4-30 illustrates the relationship between locations in the device buffer and locations on the display screen.

In the example, the display image contains 24 horizontal rows with 80 character positions in each row (Model 2). The 3708 also supports screen sizes of 32 x 80 (Model 3), 43 x 80 (Model 4), and 27 x 132 (Model 5). Refer to "Support for the IBM 3270 Models 2, 3, 4, and 5" on page 4-33 for more information.

There is a fixed relationship between each location in the device buffer and each character position on the display screen. Buffer addresses start from 0, for the character position at the left of the top row, and proceed sequentially along the rows and down the screen to the character position at the right of the bottom row. The orders in the data stream to and from the host program use these buffer addresses to describe the locations of data and fields on the display image. The use and format of these orders are described in "Orders and Attributes" on page 4-10.

Each location in the buffer contains 1 byte of storage; values loaded into the buffer are 2-digit hexadecimal codes. Write commands from the host are used to load the screen image portion of the device buffer with the display image. The status line area of the device buffer is managed and loaded by the 3708.

Display images may be formatted or unformatted:

- Formatted Display: A formatted display is one that has separate fields defined by the host program. The first character position of each field contains a control character that defines the characteristics of the field. See "Attributes and Field Attribute Characters" on page 4-31 for a description of the control character.

- Unformatted Display: An unformatted display is one that has no defined fields. An operator may input data into any position on the screen.

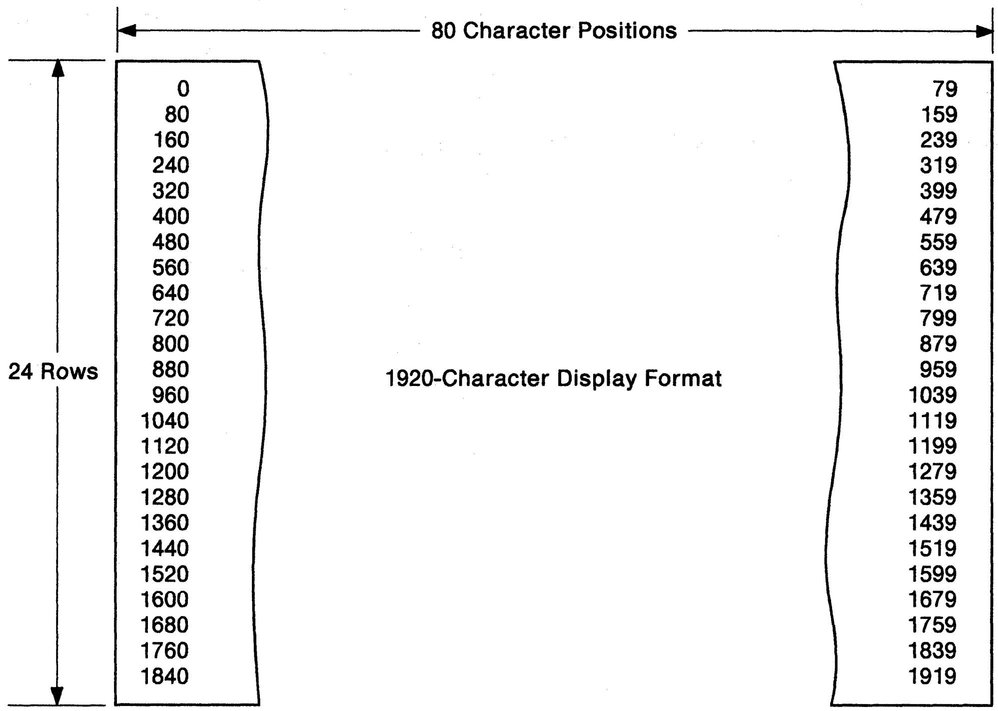


Figure 4-3. Buffer Addressing Layout for 1920-Character Terminal

Display Fields

A formatted display contains display fields defined by the host program. These fields consist of blocks of character positions bounded by control characters. The control character at the start of a field is set by the host program to determine the characteristics of the field. This character contains the field attributes. Fields containing character positions on more than one row "wrap" from the last character position on one row to the first character position on the next row. A field may wrap the screen. If the first character position on the screen does not contain a control character, the last field on the screen wraps from the last character position to the first. (Some field oriented operations are terminated early if the field wraps the screen. This effect is noted in the descriptions of the specific operations.)

Display fields simplify operations both for the operator and for the programmer. Headings can be displayed to prompt the operator as to the data that should be entered; and the program can identify fields that contain entered data without reading the entire display buffer. When data is being entered into a formatted display, the presence of a control character acts as a tab stop. Pressing the tab key advances the cursor from its current position to first character position in the next unprotected field. (An *unprotected field* is one that accepts data input from the keyboard.)

To define the start of a field, the program may issue a Write command transferring a Set Buffer Address (SBA) order and a Start Field (SF) order to the 3708. The specified buffer address is selected, and the control character specified by the SF order is loaded into the addressed location. Only the start of a field is defined. Starting a new field ends the previous field at the character position prior to the new control characters.

The 3708 sets the bits 0 and 1 of the control character to X'10' when storing it in the device buffer. This identifies the byte as a control character defining the start of a new field.

Attributes and Field Attribute Characters

The control character at the start of each field contains the field attributes (it is sometimes referred to as the "attribute byte"). Attributes contained in this character apply to all the data in the field. For example, the attribute character for the field containing a PHONE # might define the field as protected to ensure that the operator does not enter data into that field, while a field containing ###-#### would be defined as unprotected to allow the data to be changed.

The field-attribute character occupies the first character position of each display field in a formatted display. The corresponding character position on the display screen is always blank. This character is loaded by a Start Field order to define the start of a field and assign characteristics to the field.

Field attributes characters are protected against input from the keyboard; however, bit 7 (MDT) is set to 1 by the 3708 when the operator enters data into the field defined by the character. Also, bit 6 is used by the 3708 as an internal control. When receiving the data from the host and building the image in the device buffer, bit 6 of each attribute character is used to denote that the field needs to be updated on the ASCII device's screen. Attribute characters are not protected against operation of the CLEAR key function. Pressing CLEAR erases all locations in the device buffer.

Bit positions in the character are significant to the 3708. The value assigned to each bit or group of bits controls whether a specific attribute is applied.

Table 4-6 on page 4-32 shows the significance of the bits in the field attribute character. Possible attributes are:

Protected/Unprotected: An operator cannot enter data into, or modify the content of, a protected field. Input fields that require data from the operator must be unprotected.

Alphameric/Numeric: In an unprotected input field, alphameric/numeric defines the type of data that an operator can enter into the field. This attribute has special meaning for protected fields (see "Automatic Skip" on page 4-32).

Numeric lock function reduces the chance of the end user entering non-numeric data when the application expects numeric data. The 3708 allows the end user to override this function by typing:

- Any uppercase character or symbol into the numeric field.
- A blank into the first position in the numeric field. While the blank occupies the first position in the field, the user can type any character into the numeric field.

Nondisplay/Display/Intensified: Data contained in the field is either not displayed, displayed at normal intensity, or displayed at high intensity ("highlighted"). If the ASCII terminal supports colors, nonintensified fields and intensified fields are displayed in different colors. The actual colors are determined by the value of the Protected/Unprotected attribute. See "Colors" on page 4-33.

Some ASCII terminals do not support intensified, or "highlighted" characters. For these terminals, fields defined by the host as intensified appear the same as other fields.

Detectable/Nondetectable: Displayed data in a detectable field can be detected by the selector light pen. The 3708 does not support light pens, but does provide the ability to emulate the light pen using the CURSR SEL function.

Table 4-6. Attribute Character Definition

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

Because the 3708's internal representation of the attribute byte is as a byte in the device buffer having the high order bit on, only 7-bit data can be supported for 3270 LU type 2 or LU type 3 data streams.

Automatic Skip

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

- If the next field is alphanumeric, or numeric and unprotected, the cursor is positioned to the first character location in the field (that is, the attribute character location is skipped).
- If the field is numeric and protected, the cursor skips that field, and is positioned at the first character location of the next unprotected field.

Colors

The 3708 provides four-color support for certain classes of ASCII terminals that allow colors. (See "Color and Highlighting Restrictions" on page 4-68 for more information.) The IBM 3164 terminal allows colors and FTTERM has a color-terminal definition (terminal type 1A). User-defined tables may be set up to make use of a terminal's ability to display colors. See "The Terminal Table Format" on page 4-54 for a description of the terminal tables.

The field attribute character is used to assign color to each display field. The fields are defined in one of four colors — red, blue, green, or white — depending on the protect and intensify bits, as shown in the chart in Table 4-7. (For terminals that support color, the terminal tables contain control sequences for "Set Color 1", "Set Color 2", "Set Color 3", and "Set Color 4". These are used to determine the field's color as shown in the following table.) The integrity of the unprotected/protected attribute is preserved; the operator can enter data only into an unprotected field.

Table 4-7. Protected and Unprotected Fields

Attribute	Attribute Bits 2 3 4 5	3274 Color	3708 Color
Unprotected No highlight	0 X 0 X	green	color 1
Unprotected Highlighted	0 X 1 X	red	color 2
Protected No highlight	1 X 0 X	blue	color 3
Protected Highlighted	1 X 1 X	white	color 4

For some displays that have both highlighting and color sequences defined in the terminal table, the 3708 supports a 2/4 color toggle function. Refer to "2/4 Color Toggle" on page 4-52 for more information.

Support for the IBM 3270 Models 2, 3, 4, and 5

The 3708 provides support for large screen sizes similar to the 3270 Models 2, 3, 4, and 5. These screen sizes are:

Model	Rows x Columns
2	24 x 80
3	32 x 80
4	43 x 80
5	27 x 132

The 3708 allows dynamic selection of the screen size to be used in the SNA LU_2 protocol conversion session if all of the following are true:

- The terminal table is configured to allow it
- The port has been configured to allow it
- The terminal has the capability and is appropriately set up
- The BIND specifies a larger screen size.

Configuring the Terminal Table: Each terminal table (TUT/UDT) may specify that multiple 3270 Model 2, 3, 4, and 5 screen sizes are supported by the terminal. If the SET MODE SEQUENCE (see "Customization Section" on page 4-69) for a certain screen size is specified in the table, then that screen size is supported. If no SET MODE SEQUENCEs are defined, only Model 2 emulation is supported for the terminal.

Configuring the Port: The 3270 Model Emulation option on the C123.2 port definition screen defines the largest screen supported by the port. Valid input for this option is 2, 3, 4, or 5. The default value is 2.

If operating mode is defined for protocol enveloping only or device class is defined for printers or keyboard printers, the 3708 treats any value other than 2 as invalid for the 3270 Model Emulation option.

Setting Up the Terminal: The 3708 requires the terminal to be properly configured to allow the 3708 to select screen sizes and set the terminal's character generator to correspond to the model size being emulated. Depending on the terminal, the ports, pages, windows, line allocation, and character generation setup must all be enabled to support the screen size being emulated. The terminal setup is the responsibility of the terminal installer or the terminal user. The 3708 does not check to confirm the terminal is set up for any of the large or default screen sizes.

Specifying Sizes With the BIND: The BIND must specify a screen size (24 x 80, 32 x 80, 43 x 80, or 27 x 132). If a size is not specified, then 24 x 80 is assumed.

When the BIND is received, the 3708 checks the port configuration and the screen definitions in the terminal table for the size indicated in the BIND. If the terminal does not support that size or if the port is not configured for it, the 3708 rejects the BIND with a negative response code (X'0821').

How the Host Determines Screen Sizes

The 3708 does not support a READ QUERY REPLY or any other structured field command that allows the host application to interactively determine the characteristics of the attached display. Therefore, screen sizes must be statically defined at the host. For example, screen size information can be placed in LOGMODE tables, CICS Terminal Control Tables (TCTs), or IMS Terminal Control Tables.

The host can set the screen size in one of the following ways:

- The user can invoke the correct BIND by entering a logon message that tells the host what screen size to use. For example, the user may type `LOGON TSO M5` to invoke a Model 5 BIND image from the application.
- Since each port on the 3708 corresponds to a particular LU, the host application may simply transmit, for example, a Model 5 BIND to a given LU. This requires that all the terminals attached to that particular port support Model 5 emulation. If the terminal does not support a Model 5 screen size, the 3708 rejects the host BIND with a negative sense code of X'0821'.

Processing BINDs

The BIND may specify default and alternate screen sizes. Byte 24 is examined, bit 1 is reserved. For a LU type 2, byte 24 is interpreted as follows:

Value	Meaning
X'00'	Base Model 2, 24 x 80 screen size EWA same as EW.
X'02'	Model 2, 24 x 80 screen size EWA same as EW.
X'7E'	Use row-column of bytes 20, 21 for the default size. EWA same as EW.
X'7F'	Use row-column of bytes 20, 21 for the default size, and use row-column of bytes 22, 23 for the alternate size. EWA puts 3708 into alternate screen size.

Internal Storage Requirements for Large Screens

The 3270 Model Emulation values affect the 3708 internal storage calculations. Message C117 is displayed when the storage limit is exceeded:

C117 **BUFFER CONSTRAINT EXCEEDED; $P_m + 2(P_l) + 2(P_4) + 2(P_{ls}) < 40 - 2(P_{ne})$**

where:

P_m = The number of ports set for medium receive queue
P_l = The number of ports set for large receive queues
P_4 = The number of ports operating as device class = 4
P_{ls} = The number of ports enabled for model 3, 4, or 5 emulation
P_{ne} = The number of ASCII ports not excluded.

MLU operations are possible with large screen support, as long as all internal buffer requirements are met.

LOCAL COPY Functions With Large Screens

When LOCAL COPY of a screen is initiated by either a host or a terminal operator that is emulating model 5, the 3708 assumes that the Maximum Platen Length of the printer is 132. If the physical platen length of the printer is less than 132, data may be lost. It is recommended that local copy printers be grouped into classes based on their configured platen lengths.

The 3708 does not check the page length. As a result, screen text may spill onto more than one sheet of paper (depending on the screen size definition and the printer page length).

Ending the Alternate Mode

Once the display is put into alternate mode by a host Erase/Write Alternate command, it continues to operate in this mode until:

- The operator presses CLEAR

  You can override this by setting nonstandard operating bit 6 to 1. Refer to Chapter 7, "Nonstandard Operations" for more details.

- The operator presses SYS REQ
- An Erase/Write command is received
- The session is unbound
- The terminal is abnormally disconnected.

Status Line

The actual device buffer in the 3708 contains an 80- or 132-byte region that is used to hold the image of the status line. (Position 80 of the region is never used and is never transmitted to the display.) The status line emulates the operation information area of a 3270 device to:

- Inform the operator of the status of host and printer sessions
- Notify the operator of error conditions that prohibit data entry (keyboard lock conditions)
- Remind the operator of the activation of certain keyboard modes, such as insert mode.

For terminals that support an addressable status line, the 3708 places the status information on the following lines:

3270 Model Emulated	Screen Size	Status Line
Model 2	24 x 80	25
Model 3	32 x 80	33
Model 4	43 x 80	44
Model 5	27 x 132	28

If the terminal does not support an addressable status line, the 3708 places status information on the last line of the screen size. The user may then toggle the status line on and off by pressing a key sequence.

On all terminals, status line information is written in the first 79 character positions of the status line. If the line is longer that 80 characters, the rest of the line is filled with blanks.

How the 3708 Updates the Status Line

The 80- or 132-byte area in the device buffer is formatted to resemble the bottom line of an actual 3270 device. The 3708 modifies the data in this area whenever a event occurs that changes the information to be displayed. It then causes the new information to be displayed at the ASCII terminal:

- If the terminal provides an addressable status line, the 3708 sends the following sequence of information to the terminal:
  1. STOP PRINTER sequence, if MLU and last data was sent to the printer
  2. STATUS LINE ON sequence
  3. HIGHLIGHT ON sequence, if no colors, and if highlighting is currently not already activated
  4. SET COLOR 2 sequence, if colors are in use, and color 2 is not already activated
  5. All characters from the status line buffer
  6. STATUS LINE OFF sequence
  7. Set cursor address to position cursor back to correct location for data input
  8. Highlight or color sequence to reset to previous state
  9. BEL, if necessary.
- If the terminal does not have an addressable status line, and status line display on the last line of the screen size supported has been toggled on, the 3708 sends the following:
  1. STOP PRINTER sequence, if MLU and last data was sent to the printer
  2. SET CURSOR ADDRESS to position cursor on screen to the last row, column n, where n is the position of the first character that will be changed
  3. HIGHLIGHT ON sequence, if no colors, and if highlighting is currently not already activated
  4. SET COLOR 2 sequence, if colors are in use, and color 2 is not already activated
  5. Data that changed from column n to column m
  6. SET CURSOR ADDRESS to position cursor back to correct location for data input
  7. Highlight or color sequence to reset to previous state
  8. BEL, if necessary.
- If the terminal does not have an addressable status line, and the display of the status line has been toggled off, no data is sent to the terminal. A set cursor address may be sent to ensure the position of the cursor, and the BEL character will be sent if the keyboard is locked. If the keyboard is locked, the 3708 also positions the cursor in the lower right corner of the screen to indicate to the user that the status line should be toggled on and corrective action taken.

Displays With an Addressable Status Line

If the terminal has an addressable status line, the status line appears there. The terminals in this category are:

- IBM PC/HOST File Transfer and Terminal Emulator Program
- IBM 3151 with Expansion Cartridge (Feature No. 8535)
- IBM 3161 with Enhanced 3708 Attachment (Feature No. 8371)
- IBM 3162 with 3708/3710 Support Functions (Feature No. 8232).
- IBM 3163/3164 VT100/3708 with Emulation Cartridge (Feature No. 8313)
- Beehive ATL-078
- FALCO 500®
- TeleVideo 925
- TeleVideo 950.

In addition, user-defined terminals (UDTs), may be defined to support terminals with addressable status lines. When a condition occurs that changes the status, the 3708 updates the existing status line, as described in the previous section. The status line cannot be toggled off.

Displays Without an Addressable Status Line

For displays other than those listed in the last section, the status line information is seen on the last line of the screen size being emulated. The user should use the Status On/Off function to view either the status line information, or the normal line of data displayed by the application.

- When the status line is displayed, the user can also view the application's last line of data by moving the cursor into that line (by using the cursor movement keys or by entering data). The next time a condition occurs that causes a status line update, the status line reappears.
- If the status line is toggled on, it is updated as required by the 3708.
- The status line defaults to "off" at the beginning of a host LU type 2 session.
- The status line defaults to "on" at the beginning of a control terminal session.
- When the status line is not displayed, and an Input Inhibited condition occurs, the cursor moves to the lower right hand corner of the screen, and the terminal's bell sounds. The user may then use the Status On/Off function to display the status line. The information there explains why the keyboard is locked.
- In cases where the cursor is left in the last line, either by the terminal operator or the host program, and the status line is displayed, the 3708 positions the cursor in the last column of the last row. The cursor can then be positioned by the operator using the normal cursor movement keys.

Status Line Format

The status line is 80 characters long. They are arranged as follows:

1	2	3-10	11-38	39-40	41-44	45-60	61-80
Ready Status	Device Emulation	Session Indicator	Session Status	Insert Status	Null /Blank Status	Type-Ahead Status	Printer Status

Figure 4-4. IBM 3708 Status Line Format

All of the other characters are blank. For model 5 emulation, the 3708 blanks out characters from column 81 to 132.

The following is a description of the fields and codes in the status line.

Ready Status

4

Meaning: The 3708 is running and operating normally.

Action: None

Device Emulation

B

Meaning: The 3708 is using 3270 online **B** protocols. There are two basic protocol rules that govern communication with 3270 applications: A and **B**. The 3708 uses **B**.

Action: None

Session Indicator

MYJOB

Meaning: The session is connected to the host application or to the 3708 control terminal.

Action: None

SSCP

Meaning: The session is connected to the system operator (SSCP control program).

Action: None

Session Status

X CLOCK

Meaning: The system needs time to perform the requested function. The host application automatically unlocks the keyboard.

Action: Wait for the condition to clear.

X PC *nnn*

Meaning: Program Check. The 3708 detected an SNA data-stream error in the data from the host.

Action: See "NNN Codes" on page 4-44 for information.

X CC *nnn*

Meaning: Communication Check. A condition in the network is preventing communication with the host.

Action: See "NNN Codes" on page 4-44 for information.

X ?+

Meaning: Input not understood.

Action: Press the Reset key sequence defined for the terminal, check the screen, and try to enter the data again.

X –F

Meaning: Minus Function. The requested function is currently unavailable.

Action: Press the Reset key sequence defined for the terminal.

X PRTNW

Meaning: Printer Not Working. The printer assigned to the terminal is not active and no other printers in the class are available. The 3708 discards the print request.

Action: Press the Reset key sequence defined for the terminal, activate the printer, and try the function again.

X PRTBSY

Meaning: Printer Busy. The printer assigned to the terminal is busy and the 3708 has put the request in the queue.

Action: Wait for the printer to finish or press the DEV CNCL key sequence defined for the terminal to cancel the print request.

X OP X

Meaning: Operator Unauthorized. You requested a printer or print class that you are not authorized to use.

Action: Press the Reset key sequence defined for the terminal and retry the IDENT function specifying another print ID. To obtain authorization for that printer, contact the system administrator.

X <-OP-> X

Meaning: That Entry Prohibited Here. The entry you tried is invalid for that position on the screen. For example, entering data into a protected field is invalid.

Action: Press the Reset key sequence defined for the terminal; move the cursor to the correct position on the screen.

X OP>

Meaning: Too Much Data Entered. You tried to enter too much data into a field on the screen.

Action: Press the Reset key sequence defined for the terminal and enter the correct amount of data.

X OP#

Meaning: Numeric. You tried to enter a lowercase alphabetic character into a numeric field.

Action: Press the Reset key sequence for the terminal and enter the correct data in the field. To enter a lowercase alphabetic character in the field, override the numeric lock feature by typing a blank into the first character position of the field. When a blank occupies this position, enter any character into the field.

X OP#?

Meaning: Wrong Number. You entered an unacceptable number. This occurs when you use the IDENT function to assign a printer and the number is out of range or non-numeric.

Action: Press the Reset key sequence for the terminal and enter the correct data into the field.

X PARITY

Meaning: Parity Error. The 3708 detected a parity error in the data coming from the terminal. If the type-ahead key queuing function is on, the 3708 purges all characters that follow the character with the parity error.

Action: Press the Reset key sequence defined for the terminal and enter the data again.

X FRAME

Meaning: Frame Error. The 3708 detected a framing error on data from the terminal. If the type-ahead key queuing function is on, the 3708 purges all characters following the character with the parity error.

Action: Press the Reset key sequence defined for the terminal and enter the data again.

X OVRFLO

Meaning: 3708 Receive Queue Overflow. The receive queue can overflow when the following conditions occur:

- The host response time is very slow
- The 3708 is sending data too fast (for example, doing file transfer applications).

Action: Press the Reset key sequence defined for the terminal and enter the data again.

X STATLN

Meaning: Status Line Required for IDENT. The 3708 requires the status line to be on before assigning printers.

Action: Press the Reset key sequence defined for the terminal, turn on the 3708 status line, and try the IDENT function again.

X WAIT

Meaning: Wait for the 3708 to finish. The 3708 displays this message when you initiate a host data transfer while the 3708 is in slowdown mode. This condition occurs when the 3708 runs low on buffer space because of overloading.

Action: Press the Reset key sequence defined for the terminal. Continue to enter data characters, or try an Enter function. If the slowdown condition has been cleared, the data is sent to the host.

X HOST

Meaning: An upstream link has recorded a Receiver Not Ready (RNR) from host. The host is temporarily unable to accept more data.

Action: Press the Reset key sequence defined for the terminal and try the function again.

Insert Status

^

Meaning: You can insert characters into the middle of fields.

Action: None.

Null Blank Status

N/B

Meaning: Null/blank processing is enabled.

Action: None.

Type-Ahead Status

TYP

Meaning: The type-ahead key queuing function is enabled.

Action: None.

Printer Status

P *nn*

Meaning: Printer Assignment. The display is authorized to use printer address *nn*. Numbers may range from 1 to 31 for individual printers and from 70 to 85 for printer classes.

Action: None. To use a different printer or class, use the IDENT key sequence to redefine the printer access.

PRNT

Meaning: Printer Printing. The printer identified by *nn* is currently printing the information.

Action: None.

P _ _

Meaning: Printer Assignment. This value appears when you press the IDENT key sequence to assign printer access.

Action: Type in the number of the printer or class.

NNN Codes

The NNN codes appear in the Session Status field when one of the following occurs:

- The host generates an invalid SNA data stream, which is indicated by a Program Check (PC *nnn*).
- The communication link with the host fails, which is indicated by a Communication Check (CC *nnn*).

When the host application or system recovers, the status line is automatically cleared. If it is not cleared, contact the system administrator. Table 4-8 shows the NNN codes that appear in the Session Status field.

Table 4-8 (Page 1 of 2). NNN Codes in Session Status Field

NNN Code	Explanation	-RSP sent to the host
PC 401	Invalid command received.	1003
PC 402	The 3708 received an invalid (out of range) address following an SBA, RA, or EUA command.	1005
PC 403	The 3708 received data after a Read, Read Modified, or EAU command.	1003
PC 404	The data stream ended before the 3708 received all of the required bytes of an SBA, RA, or EAU command.	1005
PC 411	The LU type 1 RU received was longer than in the BIND specification.	1002
PC 413	The 3708 did not try to do the requested function.	1003
PC 422	A NO Response is not allowed.	400A
PC 423	The format indicator (FI) bit is not allowed, or the FI should have been sent but was not.	400F
PC 430	A sequence number error has occurred.	2001
PC 431	A bracket error has occurred.	2002
PC 432	A bracket error has occurred.	2003
PC 433	A data traffic reset has occurred.	2005
PC 434	A direction error has occurred.	2004
PC 440	A session limit has been exceeded.	0815
PC 442	The request is not executable.	081C
PC 443	A change direction is required.	0829
PC 445	ACTLU is not equal to COLD or ERP.	0821
PC 450	A profile error has occurred.	0821
PC 451	A primary protocol error has occurred.	0821
PC 452	A secondary protocol error has occurred.	0821
PC 453	A common protocol error has occurred.	0821

Table 4-8 (Page 2 of 2). NNN Codes in Session Status Field		
NNN Code	**Explanation**	**-RSP sent to the host**
PC 454	A screen size specification error has occurred.	0821
PC 455	An LU profile error has occurred.	0821
PC 456	An LU type-1 error has occurred.	0821
PC 457	BIND for cryptography was specified but is not supported by the	0821
CC 518	The 3708 received a segment with improperly sequenced TH MPF bits.	8007

The Keyboard and its Functions

The keyboard attached to the terminal allows the user to change, edit, or create character displays. As messages are being composed or modified by keyboard operations, the changes are remembered by the 3708. When the user completes an operation and presses the ENTER key sequence (or other attention type sequence) the data is transmitted to the host.

Cursor

A special symbol, called a cursor, is displayed on the display screen to show where the next character entered from the keyboard is stored. Depending on the device, the cursor may appear as an underscore, as a blinking underscore, or as a rectangular or blinking rectangular symbol imposed over a character. The device may allow the user to change the appearance of the cursor. See the device manual for instructions. The 3708 does not control the cursor appearance.

Successful keyboard entry of a character causes the cursor to advance to the next character location within the field. In some cases, the cursor advances to the beginning of the next input field.

Nulls vs. Blanks

On the display image, positions in input fields that do not contain characters may actually contain either a blank character or a null character. In most usages, blanks exist between other characters, and nulls exist in unused characters at the end of a field. This difference affects the user in the following ways:

- When the space bar or key on the keyboard is pressed, a blank character is placed in the field.
- When the cursor movement functions are used, no character is placed in the field, so that positions that were null remain null.
- When the Insert function is used, there must be null characters to the right of the cursor location. (See the description of the Insert function in "Key Sequences for 3270 Functions" on page 4-46.)
- When the Delete function is used, a null character is placed at the end of the field for each character deleted.

The 3708 feature called Enhanced Null/Blank Processing can be used to eliminate some of the confusion caused by the way nulls and blanks are used.

Terminal Controlled Keys

The device may provide typematic operation for some or all keys on the keyboard; see the device manual for details. (When a typematic key is pressed, its function is repeated as long as the key remains pressed.) Also, keys such as SHIFT and LOCK may exist on the device. Refer to the device documentation for a description of how the device supports them. These types of keys are not detected by the 3708 and are controlled entirely by the device.

Keys vs. Key Sequences

At an actual 3270 terminal, the keyboard functions are nearly always associated with one key on the keyboard. For example, the PF1 function is achieved by pressing the key labelled "PF1". However, the ASCII terminals that are supported by the 3708 generally do not provide keys labelled to match all the possible 3270 functions. Therefore, the user must sometimes press two keys to cause one function. (For example, ESC 1 causes the PF1 function on many of the supported terminals.) Every time the user presses a key (or in some cases "Alt" or "Ctrl" plus another key) on the terminal, a hexadecimal (ASCII) code is transmitted to the 3708. These codes are used to identify the function the user wants to do. The 3708 does whatever is necessary to perform the function: it may send other hexadecimal codes back to the device that cause the cursor to be repositioned; it may initiate the transmission of data to the host; or it may echo back a data character for display on the screen.

The keyboard map defined for the terminal type describes what keyboard function the 3708 associates with the key sequences pressed on the keyboard. For more description of the keyboard map, see "The Terminal Table Format" on page 4-54. To avoid confusion, this document refers to 3270 and non-3270 "functions" to identify keyboard activity that would be represented by one key on a real 3270 device. To perform one of these functions, a "key sequence" from the ASCII terminal is used. The keyboard map for the device tells the user exactly what key or keys on the keyboard to press to cause the desired function.

Key Sequences for 3270 Functions

The following descriptions of keyboard functions are applicable to all terminals supported by the 3708, except where noted. In some cases, these descriptions contain SNA protocol terms, references to local copy operations, or status line information.

Cursor Movement Function (Cursor Up, Cursor Down, Cursor Right, and Cursor Left): This set of four functions moves the cursor one position at a time into any character location. Using these functions, the cursor may be moved into any location, including unprotected and protected fields.

The following functions are all capable of causing the cursor to wrap:

- If the cursor is located in the last position of a line and you use the cursor right function, the cursor is positioned in the first position of the next line.
- If the cursor is located in the first position of a line and you use the cursor left function, the cursor is positioned in the last position of the previous line.
- If the cursor is located in the first line of the screen and you use the cursor up function, the cursor is positioned in the last line of the screen, without changing the column position.
- If the cursor is located in the last line of the screen and you use the cursor down function, the cursor is positioned in the first line of the screen, without changing the column position.

Cursor Movement Functions (Tab, Backtab, New Line, and Home): The following functions move the cursor to the first position in a field. All four functions can cause the cursor to wrap from the end of the last line on the display and to continue at the beginning of the top line.

- Tab—Moves the cursor to the first character location of the next input field. In a screen with no input fields, the cursor is positioned to the upper left hand corner of the screen.
- Backtab—When the cursor is located in the field attribute location or the first character location of an input field, the backtab function moves the cursor to the first character location of the preceding input field. When the cursor is located in any character location of an input field, other than the first location, this function moves the cursor to the first location of that field. If there are no input fields, the cursor is positioned to the upper left hand corner of the screen.
- New Line—Moves the cursor to the first input character location of the next line. If the next line has no input fields, the cursor is moved to the next line containing an input field. If the screen contains no fields, the cursor is repositioned to the first position of the next line.
- Home—Moves the cursor to the first input character position on the screen. If there are no input fields, the cursor is positioned to the upper left hand corner of the screen.

Erase EOF (End of Field): If the cursor is located in an input field, this function erases the characters from the cursor to the end of the field (erased characters are set to nulls). If the field spans more than one line, only the remainder of the current line is erased. The cursor does not move. This function cannot be used when operating as the 3708 control terminal.

Using this function when the cursor is located in an attribute character location or in a protected field locks the keyboard (the "go elsewhere" status line message, X <-OP->, is displayed). To unlock the keyboard, press the Reset Key sequence defined for your terminal and reposition the cursor.

Erase Input: This function erases the characters (sets them to nulls) in all input fields and then moves the cursor to the first input location on the screen. If the screen contains no input fields, nothing is cleared, and the cursor moves to the upper left hand corner of the screen. If the screen contains no fields at all, the entire screen is cleared and the cursor moves to the upper left hand corner. This function cannot be used when operating as the 3708 control terminal.

Insert: The insert function places the keyboard in an insert mode of operation. This mode allows you to insert a character or characters into the middle of an input field without changing the characters that are already displayed there. An insert symbol (∧) is displayed in the status line to remind you that insert mode is active.

The following items apply while the keyboard is in Insert mode:

- If the cursor is located in an input field having a null character in any location in the field beyond the cursor, entering a character causes the new character to be entered at the cursor location. All remaining characters within the field (except for null characters and characters to the right of a null character) are shifted one position to the right. If the location occupied by the cursor at the time of the insert operation is a null, no shifting occurs.

- After all null characters at or beyond the cursor location in the field have been overwritten, or if there are no null characters, attempting to enter another character locks the keyboard (the "more than," X OP >> indicator is displayed on the status line). To unlock the keyboard, press the Reset Key sequence defined for your terminal and reposition the cursor.
- If the current field spans more than one line of the screen, the insert operates only to the end of the current line.
- Using this function when the cursor is located in an attribute character location or is in a protected field locks the keyboard (the "go elsewhere" status line message, X <-OP->, is displayed). To unlock the keyboard, press the Reset Key sequence defined for your terminal and reposition the cursor.
- If the display is in enhanced null/blank processing mode, characters can be inserted when the field contains either trailing blanks or nulls.

To exit insert mode, press the key sequence for Reset, Enter, Cursor Select, or any other function that causes host communication.

Delete: If the cursor is located in an input field, using the Delete function deletes the character at the location occupied by the cursor. The cursor does not move. All remaining characters in the field to the right of the cursor and on the same line shift one location to the left. The empty position at the end of the row or field contains a null character. If the input field occupies more than one row, subsequent rows are not affected. This function cannot be used when operating as the 3708 control terminal.

Using this function when the cursor is located in an attribute character location or is in a protected field locks the keyboard (the "go elsewhere" status line message, X <-OP->, is displayed). To unlock the keyboard, press the Reset Key sequence defined for your terminal and reposition the cursor.

Reset: The Reset function is used to recover from a keyboard locked condition.

The Reset function does not reset a locked condition resulting from a command being executed for the terminal (X CLOCK on the status line).

Reset causes the IDENT operation to end (the original printer ID is displayed on the status line).

Reset causes insert mode to end.

DUP: Using the DUP function causes an asterisk (*) to be displayed at the current cursor location. Also, a Tab key operation is performed causing the cursor to be move to the first location of the next input field. The DUP character provides a means of informing the application program that a "duplicate" operation is required for the rest of the field in which it is located. This function cannot be used when operating as the 3708 control terminal.

Using this function when the cursor is located in an attribute character location or is in a protected field locks the keyboard (the "go elsewhere" (X <-OP->) status line message is displayed). To unlock the keyboard, press the Reset Key sequence defined for your terminal and reposition the cursor.

FM (Field Mark): Using the FM function causes a semicolon (;) to be displayed at the current cursor location. The field mark character is used to inform the application program of the end of a field (in an unformatted screen) or a subfield (in a formatted screen). This function cannot be used when operating as the 3708 control terminal.

Using this function when the cursor is located in an attribute character location or is in a protected field locks the keyboard (the "go elsewhere" (X <-OP->) status line message is displayed). To unlock the keyboard, press the Reset Key sequence defined for your terminal and reposition the cursor.

Program Attention Functions (Enter, Clear, PF keys, and PA keys): These functions cause the 3708 to transfer information to the host program. An Attention IDentification character (AID) is sent to the host which identifies which of the functions was used to cause the transfer. This function cannot be used when operating as the 3708 control terminal.

The Clear function clears all positions on the screen to nulls and positions the cursor to the upper left hand corner. When supporting large screens (3270 Model Emulation = 3, 4, or 5), pressing CLEAR returns the screen to its default size. This screen size is defined by the BIND command. To prevent the screen size from returning to the default size, set nonstandard operating bit 6 to 1.

Note: Using a PF key or PA key function while SSCP is displayed on the status line, locks the keyboard (the "function not supported" message (X -F) is displayed on the status line). To unlock the keyboard, press the Reset Key sequence defined for your terminal and reposition the cursor.

SYS REQ (System Request): Use the SYS REQ function to switch from communication with your application program to communication with the host control program. SYS REQ clears the screen and your terminal returns to the default screen size specified by the BIND. This function cannot be used when operating as the 3708 control terminal.

Logoff your application program using the SYS REQ function. Enter the SYS REQ key sequence to communicate with the host control program, then enter the logoff command.

See "SSCP Communication to Displays" on page 3-50 for a description of how the terminal operates when communicating with the host control program.

DEV CNCL (Device Cancel): If your keyboard is locked because of a "printer busy" condition (X PRTBSY on the status line), and you wish to cancel your print request, you should use the DEV CNCL function.

Using the DEV CNCL function during a IDENT operation causes the operation to end. The previous printer ID is displayed on the status line.

Once the printing has begun, the DEV CNCL function has no effect.

CURSR SEL (Cursor Select): This function allows the selector-light-pen-detection function to be performed from the keyboard. This function cannot be used when operating as the 3708 control terminal.

ATTN: The ATTN function is used to signal an attention condition to the host.

Using ATTN during a print IDENT operation causes the ID operation to end (the keyboard locks, and the previous printer ID and the "function not supported" message (X -F) are displayed on the status line). To unlock the keyboard, press the Reset Key sequence defined for your terminal and reposition the cursor. This function cannot be used when operating as the 3708 control terminal.

Print: The Print function causes the current screen to be printed. See "Local Copy Function" on page 4-81.

IDENT: The IDENT function is used to assign the printer or the print class to be used when a local copy function is initiated. See "Local Copy Function" on page 4-81.

Key Sequences for Non-3270 Functions

The following functions are available by entering key sequences, but are not normal 3270 functions. These functions are provided by the 3708 to make data entry at your terminal easier, to enable you to use the auxiliary port of your terminal for printing, and to allow you to control the display of the status line.

Null/Blank: The Null/Blank function either sets or resets (toggles) enhanced null/blank processing mode. When the mode is active, **N/B** appears on the status line.

Enhanced Null/Blank mode allows you to use either the space bar or the cursor movement keys to edit and separate fields. When you enter data, the 3708 converts imbedded nulls (nulls between two characters in a field) to blanks.

When in null/blank mode, the Insert function operates differently. Either trailing nulls or trailing blanks can be pushed off the end of the field when in insert mode. This saves you from having to explicitly delete trailing blanks in order to insert characters.

Type-ahead: The Type-ahead function either sets or resets (toggles) Type-ahead mode. When the mode is active, **TYP** appears on the status line.

Type-ahead mode allows you to queue several characters for processing. You can continue to enter key sequences (data or AID characters) while a previous sequence is being processed. For example, if you wanted to page forward five times in a file editing program without using type-ahead, you would have to enter the appropriate PF key sequence once, wait for the screen to be updated with the next page of data, then repeat this process four more times.

Using type-ahead, you press the PF key five times without waiting for the screen update to occur between each. Once the 3708 has received the screen update from the host for the first PF key and has processed it, but before the 3708 begins updating your screen, the next PF key is sent to the host. Depending on the response time from your host, this may result in a partial screen update occurring, and then being overlaid by a subsequent screen, or intermediate screens may not be displayed at all.

Status On/Off: The Status On/Off function is used to display the 3708 status line. You can turn the status line on or off at almost any time. If the keyboard is locked, enter the Status On/Off sequence to see the status line. See "How the 3708 Updates the Status Line" on page 4-37 for details about the 3708 status line emulation.

The Status On/Off function cannot be used if your terminal uses the last line for status.

2/4 Color Toggle: The 3708 supports a 2/4 color toggle for ASCII displays that support color modes if the terminal table defines both highlighting and color sequences. The highlighting sequences are used in 2-color mode, and the color sequences are used in 4-color mode.

At initialization, a terminal that has both highlighting and color sequences defined in the terminal table, defaults to four-color mode. When the toggle function is activated, the 3708 switches between modes and repaints the terminal's screen. If the table does not define both highlighting and color sequences, this function has no effect.

Refresh: The Refresh function causes the 3708 to clear your display screen and send image again. This is most useful when you are using a dial-in facility, and parity errors cause incorrect characters to appear on the screen.

Terminal Logon Initialization (TLIS) Refresh: Many terminals require that the 3708 transmit command sequences at the beginning of a session to put the terminal into the proper mode of operation (see "Special Processing Provided for Specific Terminal Types" on page 4-72). The 3708 can also be configured to send a user-defined initialization sequence to the terminal. The TLIS Refresh function allows the terminal user to, at any time during the session, cause the 3708 to transmit any defined initialization sequence to the terminal. This function is most often used to ensure that the terminal is in the proper mode for operation with the 3708.

Resume Display, Resume Printer, Suspend Display, Suspend Printer: These functions enable you to control whether the 3708 sends data to the display or to a printer attached to the auxiliary port of your terminal. If the interaction with your display is interrupted too often by data being sent to the printer, you can invoke the Suspend Printer function. This stops traffic to the printer until you use Resume Printer. Similarly, you can speed up printer traffic by using the Suspend Display function.

The only functions that you can use while the display is suspended are: Resume Display, Suspend Printer, and Resume Printer.

Once you have used the Suspend Display function, you must enter the Resume Display key sequence to use your display.

These functions are not available for terminal which do not have an auxiliary port. See "Displays with Printers" on page 4-89 for information about using the auxiliary port printer function.

Terminal Controlled Print Functions: You may be able to use special print keys on your terminal to print screen information on a printer attached to your terminal. For example, with the IBM 3101, the key labeled Print Line can be used to print one line of the display image. You should see your system administrator to find out if such keys on your terminal can be used.

Terminal Tables

The following section describes how terminal tables are used to control displays. It also describes the two types of terminal tables supported by the 3708.

Controlling Displays With Terminal Tables

When performing protocol conversion to a display, the 3708 must interpret the host data stream and convert it into control commands and data that the display understands. The 3708 must send ASCII sequences to the display to cause, for example, the terminal to clear its screen. However, the sequence required to cause the function may be different for each terminal type. For this reason, the 3708 uses a terminal table to control each type of terminal.

The terminal table also describes the keyboard map for the terminal. When a key (or in some cases "Alt" or "Ctrl" plus another key) is pressed at a terminal, a hexadecimal (ASCII) code is transmitted to the 3708. These codes are used to identify the desired function. Because the codes generated by one terminal type for a certain key (for example, PF1) may be different than the codes generated by another type, the terminal table must be used to define to the 3708 what to expect from the device.

The tables for the default terminals are part of the microcode contained in the 3708 cartridge; however, user-defined tables may be added as part of the configuration. These tables allow you to define a unique keyboard mapping for a supported terminal or define an entirely new terminal type. A user-defined table (UDT) is saved in the nonvolatile storage of the 3708 base unit.

Standard and Enhanced Terminal Tables

The 3708 has two sizes of terminal tables: standard and enhanced. Standard tables are 300 bytes long, and enhanced tables are 452 bytes long. Enhanced tables must be used for 3270 model 3, 4, and 5 emulation (large screens). Enhanced UDTs can be used to customize the UDT names that are displayed on the terminal selection screen (C2) when a user logs on to the 3708. Enhanced UDTs can also be used to customize the terminal initialization sequence that is sent to the terminal at the start of each protocol conversion session.

There are five restrictions in the use of enhanced UDTs:

1. You can define only four enhanced UDTs. You can use six standard UDTs.
2. You cannot mix standard and enhanced UDTs.
3. Before defining an enhanced UDT, you must convert the standard UDTs to enhanced UDTs. Refer to *IBM 3708 Network Conversion Unit Planning and Installation* for instructions.
4. You can also convert enhanced UDTs to standard UDTs. However, you lose the ability to have user-defined UDT names and user-defined initialization sequences, and you are not able to operate in large-screen mode using the UDTs. Refer to *IBM 3708 Network Conversion Unit Planning and Installation* for instructions.
5. If you have enhanced UDTs and you need to convert to a microcode level prior to A58809, you must first convert enhanced UDTs to standard UDTs.

The Terminal Table Format

This section describes in detail the three parts of each terminal table.

Each terminal table contains three sections:

- General description section (addresses X'00' to X'05')
- Keyboard mapping definition section (addresses X'06' to X'A5')
- Terminal control section (addresses X'A6' to X'12B').

Enhanced terminal tables contain an additional section:

- Customization section (addresses X'12C' to X'1C3').

The content of each section is shown in Table 4-9 through Table 4-12. A description of each section follows Table 4-12. Tables of values that can be used in the various fields follow each description. Addresses are given in hexadecimal format, which you should use when creating or modifying user-defined terminal tables.

Table 4-9. General Description Section of a Terminal Table

Hex Address	Description
00	Terminal ID
01	Flags
02	Cursor addressing class
03	Alternate control sequence character
04	Intermediate control sequence character
05	(Not used, set to X'00')

Table 4-10. Keyboard Mapping Section of a Terminal Table

Hex Address	Description
06 - 25	Function number for X'00' through X'1F'
26 - A5	Function number for ESC X'00' through ESC X'7F'

Table 4-11 (Page 1 of 2). Terminal Control Definition Section of a Terminal Table

Hex Address	Description
A6	Byte count for ERASE EOL sequence
A7-AB	ERASE EOL sequence
AC	Byte count for CLEAR SCREEN sequence
AD-B1	CLEAR SCREEN sequence
B2	Byte count for CURSOR UP sequence
B3-B7	CURSOR UP sequence

Table 4-11 (Page 2 of 2). Terminal Control Definition Section of a Terminal Table	
Hex Address	**Description**
B8	Byte count for CURSOR DOWN sequence
B9-BD	CURSOR DOWN sequence
BE	Byte count for CURSOR LEFT sequence
BF-C3	CURSOR LEFT sequence
C4	Byte count for CURSOR RIGHT sequence
C5-C9	CURSOR RIGHT sequence
CA	Byte count for SET CURSOR ADDRESS sequence
CB-CF	SET CURSOR ADDRESS sequence
DO	Byte count for HIGHLIGHT ON sequence
D1-D5	HIGHLIGHT ON sequence
D6	Byte count for HIGHLIGHT OFF sequence
D7-DB	HIGHLIGHT OFF sequence
DC	Byte count for BEL sequence
DD-E1	BEL sequence
E2	Byte count for SET COLOR 1 sequence
E3-E7	SET COLOR 1 sequence
E8	Byte count for SET COLOR 2 sequence
E9-ED	SET COLOR 2 sequence
EE	Byte count for SET COLOR 3 sequence
EF-F3	SET COLOR 3 sequence
F4	Byte count for SET COLOR 4 sequence
F5-F9	SET COLOR 4 sequence
FA	Byte count for STATUS LINE ON sequence
FB-FF	STATUS LINE ON sequence
100	Byte count for STATUS LINE OFF sequence
101-105	STATUS LINE OFF sequence
106	Byte count for ACTIVATE STATUS LINE sequence
107-10B	ACTIVATE STATUS LINE sequence
10C	Byte count for START PRINTER sequence
10D-111	START PRINTER sequence
112	Byte count for STOP PRINTER sequence
113-117	STOP PRINTER sequence
118-12B	(Used for VT220, FALCO 500, and IBM 3151/61/62/63/64 If the terminal is not one of these, set to X'00'.)

Table 4-12. Customization Section of a Terminal Table	
Hex Address	**Description**
12C	Byte count for Set 24 x 80 mode sequence
12D-13B	Set 24 x 80 mode sequence
13C	Byte count for Set 32 x 80 mode sequence
13D-14B	Set 32 x 80 mode sequence
14C	Byte count for Set 43 x 80 mode sequence
14D-15B	Set 43 x 80 mode sequence
15C	Byte count for Set 27 x 132 mode sequence
15D-16B	Set 27 x 132 mode sequence
16C	Byte count for UDT name
16D-174	UDT name
175	Byte count for user-defined TLIS
176-1B1	User-defined TLIS
1B2-1C3	Reserved

General Description Section

The general description section contains the following fields:

Terminal ID

This number is an **internal** id that specifies the terminal type being used. When you create a UDT, this field is set for you using the terminal type you specify as a base. The ID is used to determine if special processing or initialization sequences are required for the terminal. Do not change this field unless you plan to attach a terminal that is not one of the standard supported terminals. If your plan calls for a nonstandard terminal, type *00* in this field. Table 4-13 lists the IDs that you can enter in this field.

Note: A *00* in this field disables extended key functions. Refer to *IBM 3708 Network Conversion Unit Planning and Installation* for more details.

Table 4-13. Terminal IDs

Internal ID	Terminal Type	External ID
01	IBM 3101 Display Terminal	1
02	IBM 3161/3162/3163 ASCII Display Station	2
03	IBM 3164 ASCII Display Station	3
04	DEC® Model VT52	4
05	DEC® Model VT100	5
06	TeleVideo® 910	6
07	TeleVideo® 950	7
08	Lear Siegler ADM 3A Dumb Terminal®	8
09	ADDS Viewpoint®	9
0A	Hazeltine 1500	10
0B	Hazeltine Esprit I™	11
0C	Hazeltine Esprit II™	12
0D	Northern Telecom Displayphone™	13
0E	Teletype 5410 Asynchronous Display Terminal	14
0F	Teletype 5420	15
10	Hewlett-Packard 2621B Interactive Terminal	16
11	Data General Dasher® D210 Display	17
12	ROLM Cedar, Cypress, Juniper	18
13	Beehive™ ATL-078	19
1E	FTTERM COLOR	1A
1F	FTTERM MONO	1B
20	IBM 3151/61/62/63 (3708 Feature)	2A
21	DEC® Model VT220	5A
22	FALCO 500 (DEC VT200 Mode)	5B
23	WY-50	5C
24	IBM 3151/62 (Model 5 Emulation)	2C
25	IBM 3151	2B
26	IBM 3164 (3708 Feature)	3A

Flags

This is a 1-byte field that is broken down into eight 1-bit flags. Each flag is set to either 1 or 0, and the 8 bits together form a hexadecimal value. Refer to the appendixes in *IBM Network Conversion Unit Planning and Installation* to determine the correct hexadecimal value for the set of flags that you need.

The bits are numbered 1 through 8 and have the following meanings:

Bit 1—ANSI x3.64

If this set to 1, the terminal supports ANSI x3.64 formats. If this bit is set to 0, ANSI x3.64 is not used.

Bit 2—Status line

If this bit is set to 1, the terminal has an addressable information area separate from the normal screen display area on which the 3708 can display its status line. For example, when the terminal is operating in 24 x 80 (model 2) mode, the 3708 status line would appear on line 25. In this case, the START/STOP/ACTIVATE STATUS LINE sequences described in "Terminal Control Section" are used to control the terminal's information area.

If this bit is set to 0, the 3708 uses the last line of the normal screen display area for the status line information. For example, when the terminal is operating in 24 x 80 (model 2) mode, the status line would appear on line 24.

Bit 3—Scroll

If this bit is set to 1, the terminal shifts the entire screen of data up one line when a character is sent to the last column of the last line on the screen. For this case, the 3708 never sends a character for display in the last character position on the screen.

If this bit is set to 0, the 3708 sends characters for display in the last character position on the screen.

Bit 4—Extended Key Sequences

If this bit is set to 1, the extended terminal table function is required for this terminal. It is required for terminals that can send more than 3 characters per keystroke. It is supported for the IBM 3151, IBM 3161, IBM 3162, IBM 3163, IBM 3164, VT220, and FALCO 500. Refer to *IBM 3708 Network Conversion Unit Planning and Installation* for more information.

Bit 5—Field Attribute Byte

Terminals support two types of attribute processing to determine field characteristics: character attributes and field attributes. A terminal with character attributes remembers the current attribute setting, like highlighting, until it is changed. Character attributes do not occupy a screen character position. To support character attributes, bit 5 should be set to 0.

Field attributes occupy a screen position, much like 3270 displays. Unlike character attributes, field attributes are remembered and need to be rewritten only when they change. Whenever a field changes, the cursor must be positioned at the attribute position to change or eliminate it. To support field attributes, bit 5 should be set to 1.

If this bit is set to 1, the terminal being used reserves a position on the screen display every time a field attribute sequence is transmitted by the 3708. Of the default terminal tables, the WY-50® is the only one that operates in this manner. If this bit is 0, the terminal does not reserve a position of the screen for field attributes.

Bit 6—Exclude 3708 Initialization

If this bit is set to 1, the 3708 does not send the 3708 default terminal initialization sequence provided for the terminal type. This bit is used along with the user-defined terminal initialization sequence (see "Customization Section") to determine what should be sent to initialize the terminal.

If this bit is set to 0, the 3708 sends its default terminal initialization sequence provided for the terminal type, if one is defined. Refer to "Special Processing Provided for Specific Terminal Types" on page 4-72 for a description of the 3708 default initialization sequences.

Bit 7—Reserved

This bit is not used, and it should be set to 0.

Bit 8—Terminal Table Type

If this bit is set to 1, the table is an enhanced table (452 bytes long). If this bit is 0, the table is a standard table (300 bytes long). If you attempt to set this bit to 1 when standard tables are in use, or to 0 when enhanced tables are in use, the control terminal will not accept the change.

The following table shows the settings of the second through fifth bytes of the terminal tables for the supported terminals. The hexadecimal value for the Null character is X'00'.

Keyboard Device Mapped	ANSI	Addressable Status Line	No Scroll	Extended Key Sequence	Field Attributes	TLIS	Enhanced UDTs	Cursor Addressing Class	Alternate Control Sequence Character	Intermediate Control Sequence Character
IBM PC FTTERM Color	No	Yes	No	No	No	0	No	02	Null	Null
IBM PC FTTERM Mono	No	Yes	No	No	No	0	No	02	Null	Null
IBM 3101	No	No	No	No	No	0	No	02	Null	Null
IBM 3151/ 61/62/63/64	No	No	No	Yes	No	0	No	02	! (X'21')	Null
IBM 3151/ 61/62/63/64 (3708 Feature)	No	Yes	No	No	No	0	No	02	! (X'21')	Null
IBM 3151 (Model 5)	No	Yes	No	No	No	0	Yes	06	Null	Null
ADDS Viewpoint	No	No	No	No	No	0	No	02	Null	Null
Beehive ATL078	No	Yes	No	No	No	0	No	02	Null	Null
Data General Dasher D210	No	No	Yes	No	No	0	No	03	RS (X'1E')	Null
DEC VT52	No	No	No	No	No	0	No	02	? (X'3F')	Null
DEC VT100	Yes	No	No	No	No	0	No	01	0 (X'4F')	Null

Keyboard Device Mapped	ANSI	Address-able Status Line	No Scroll	Extended Key Sequence	Field Attributes	TLIS	Enhanced UDTs	Cursor Address-ing Class	Alternate Control Sequence Character	Intermediate Control Sequence Character
DEC VT220	Yes	No	No	Yes	No	0	No	01	0 (X'4F')	Null
FALCO 500	Yes	Yes	No	Yes	No	0	No	01	Null	Null
Hazeltine ESPRIT I ESPRIT II	No	No	Yes	No	No	0	No	03	? (X'3F')	Null
Hazeltine 1500	No	No	Yes	No	No	0	No	03	Null	¬ (X'7E')
Hewlett Packard 2621-B	No	No	No	No	No	0	No	00	Null	Null
Lear Siegler ADM-3A	No	No	No	No	No	0	No	02	Null	Null
Northern Telecom Displayphone	Yes	No	No	No	No	0	No	01	Null	Null
ROLM Cypress, Cedar, Juniper	No	No	No	No	No	0	No	02	Null	Null
Teletype 5410, 5420	Yes	No	No	No	No	0	No	01	Null	Null
TeleVideo 910	No	No	No	No	No	0	No	02	Null	Null
TeleVideo 950	No	Yes	Yes	No	No	0	No	02	Null	SOH (X'01')
WYSE 50	No	No	No	No	Yes	0	No	02	Null	SOH (X'01')

Cursor Addressing Class

This field contains the screen addressing class for the terminal. It defines the format of the character sequence that is accepted by the terminal to position the cursor. Table 4-14 lists the values that you can enter in this field.

Table 4-14 (Page 1 of 2). Cursor Addressing Classes

Class	Line Numbers	Column Numbers	Set Cursor Sequence
00	0-43	0-131	1. Any three ASCII characters 2. Line number (in ASCII characters)* 3. Any ASCII character 4. Column number (in ASCII characters)* 5. Any ASCII character Example: ESC & a 1 0 y 2 1 C In hex: 1B2661313079323143 * The numbers are ASCII representations of the decimal number; 10 = X'3130'; 21 = X'3231'. (This example positions the cursor at the 11th line, 22nd column.)
01	1-43	1-132	1. ESC 2. Left bracket 3. Line number (in ASCII characters)* 4. Any ASCII character 5. Column number (in ASCII characters)* 6. Any ASCII character Example: ESC 1b 11; 22 H In hex: 1B5B31313B323248 * The numbers are ASCII representations of the decimal number; 11 = X'3131'; 22 = X'3232'. (This example positions the cursor at the 11th line, 22nd column.)
02	0-23	0-79	1. Any two ASCII characters 2. Line number in hex plus X'20' 3. Column number in hex plus X'20' Example: ESC A X'2A' X'35' In hex: 1B412A35 (This example positions the cursor at the 11th line, 22nd column.)
03	0-23	0-79	1. One or two ASCII characters 2. Column number in hex 3. Line number in hex Example: ESC A X'15' X'0A' In hex: 1B41150A (This example positions the cursor at the 11th line, 22nd column. See note.)
04	0-23	0-79	1. One or two ASCII characters 2. Column number in hex plus X'20' 3. Line number in hex plus X'20' Example: ESC A X'35' X'2A' In hex: 1B41352A (This example positions the cursor at the 11th line, 22nd column.)

Class	Line Numbers	Column Numbers	Set Cursor Sequence
05	0-23	0-79	1. Any two ASCII characters 2. Line number in hex 3. Column number in hex Example: ESC A X'0A' X'15' In hex: 1B410A15 (This example positions the cursor at the 11th line, 22nd column. See note.)
06	0-42	0-131	1. Any three ASCII characters 2. Line number in hex plus X'20' 3. The first 3 bits of the column number in hex plus X'20' 4. The 5 rightmost bits of the column number in hex plus X'40' Example: ESC ybX'0A' X'20' X'56' In hex: 1B79200A2056 (This example positions the cursor at the 11th line, 22nd column.) Example: ESC ybX'0A' X'23' X'5A' In hex: 1B79200A235A (This example position the cursor at the 11th line, 122nd column.)

Table 4-14 (Page 2 of 2). Cursor Addressing Classes

Note: These cursor classes use hex values X'11' and X'13' for row and column addressing. Some modems may interpret these values as flow control (XON/XOFF), and data being sent from the 3708 to the terminal may be interrupted.

Alternate Control Sequence Character

If the terminal uses a control sequence that introduces characters other than, or in addition to, an ASCII ESC (X'1B'), this 1-byte field contains the alternate character. The TeleVideo® 925 and 950, for example, use the SOH (01) character as a control sequence introducer in addition to ESC.

Intermediate Control Sequence Character

Some terminals generate an intermediate control sequence character when sending an ESC sequence to the 3708. This field defines the intermediate control sequence character to the 3708. The 3708 discards and ignores this character when the character is received after the ESC (or after the alternate control sequence character). For example, the IBM 3161 sends ESC ! *nn* for certain keys. The ! (X'21') is defined as the intermediate control sequence character for these terminals. If the terminal is an ANSI X3.64 terminal, there is no need to define the left bracket as an intermediate control sequence character. The intermediate control sequence character cannot be the NULL (X'00') character.

Keyboard Mapping Definition Section

The keyboard mapping definition section contains two parts: one for mapping 1-byte ASCII control codes (X'00' through X'1F') and one for mapping the second characters of ESC sequences (X'00' through X'7F'). For each code, the table contains a 1-byte entry that contains the number of the function that the 3708 should perform when the character (or ESC plus the character) is received.

These function numbers, which are listed in Table 4-15, identify particular 3270 functions that are performed by the 3708.

Table 4-15. Keyboard Functions

Function Number	Function	Function Number	Function
00	PF01	21	CURSOR SEL
01	PF02	22	CURSOR UP
02	PF03	23	CURSOR DOWN
03	PF04	24	CURSOR LEFT
04	PF05	25	CURSOR RIGHT
05	PF06	26	TAB
06	PF07	27	BACK TAB
07	PF08	28	NEW LINE
08	PF09	29	HOME
09	PF10	2A	TYPE AHEAD
0A	PF11	2B	NULL/BLANK
0B	PF12	2C	FIELD MARK
0C	PF13	2D	DUP
0D	PF14	2E	ERASE EOF
0E	PF15	2F	ERASE INPUT
0F	PF16	30	INSERT
10	PF17	31	DELETE
11	PF18	32	ECHO
12	PF19	33	CLICK KEY
13	PF20	34	PRINT
14	PF21	35	IDENT
15	PF22	36	STATUS ON/OFF
16	PF23	37	REFRESH
17	PF24	38	SUSPEND DISPLAY
18	PA1	39	ENABLE DISPLAY
19	PA2	3A	SUSPEND PRINTER
1A	PA3	3B	ENABLE PRINTER
1B	ATTN	3C	ENABLE FILE TRANSFER
1C	SYS REQ	3D	DISABLE FILE TRANSFER
1D	RESET	3F	FTTERM COMPRESS
1E	DEV CNCL	40	2/4 COLOR TOGGLE
1F	ENTER	41	TLIS REFRESH
20	CLEAR	7F	EXTENDED TERMINAL TABLE

For example, for most terminals, pressing the backspace (BS) key causes X'08' to be sent from the device. If the backspace key is to be used for the CURSOR LEFT function, then address X'0E' in the terminal table should contain the function number for CURSOR LEFT, which is X'24'. (The address is calculated by adding the X'08' to the address of the beginning of this part of the table, which is X'06'.)

As an example of entries in the second part of this section, suppose the sequence ESC P is to be used for the 3270 PRINT function. P is represented in ASCII as X'50' so, at offset X'50', the function number for PRINT is entered. It is entered at address X'76', since this part of the table (an ESC followed by a character) begins at address X'26' (X'26' + X'50' = X'76').

All addresses must contain a function number, but function numbers need not be unique; two or more sequences can perform the same function. For example, any of the entries that correspond to undefined characters should contain the function number for the BEL function (X'33'), causing the terminal to beep when the key is pressed.

Special considerations for the keyboard mapping definition section are:

- For ANSI-compatible terminals, an ESC sequence often has a left bracket character inserted after the ESC character. This character should be ignored when defining the terminal table. The 3708 accounts for the possibility of receiving the left bracket based on the setting of the ANSI flag in terminal table byte 2.
- If the terminal generates a trailing character (for example, a carriage return) in the ESC sequence, add X'80' to the function number and delete the carriage return from the key sequence. For example, the 3101 generates ESC H CR when its PF8 key is pressed. To use the 3101 function PF8 for the 3270 function PF8, you must add X'80' to the PF8 function number X'07', resulting in X'87'.
- Whatever is specified as a function number for ESC is ignored. Also, if an alternate control sequence character is defined, the function numbers for this character, or ESC plus this character, are ignored.
- Control code X'7F' is not definable in the keyboard map definition section. This value is hardcoded in the 3708 and always represents the Delete function. Other keystrokes may be defined to perform Delete but any key that transmits X'7F' always performs the Delete function.

Terminal Control Section

The terminal control section contains the ASCII characters that the 3708 sends to the terminal to control the screen (such as cursor positioning and highlighting). There are 19 control functions with a 6-byte entry for each function. Table 4-16 describes the 19 functions.

Table 4-16. Terminal Control Functions

Function	Description
ERASE EOL	Erases the remainder of the line beginning with the current position of the cursor
CLEAR SCREEN	Clears the entire screen
CURSOR UP	Moves the cursor up one line
CURSOR DOWN	Moves the cursor down one line
CURSOR LEFT	Moves the cursor one position to the left
CURSOR RIGHT	Moves the cursor one position to the right
SET CURSOR ADDRESS	Positions the cursor at a specified line and column
HIGHLIGHT ON *	Causes subsequent characters received by the terminal to be highlighted
HIGHLIGHT OFF *	Causes subsequent characters received by the terminal not to be highlighted
BEL	Causes the terminal alarm (a beep) to sound
SET COLOR 1 *	Causes subsequent characters received by the terminal to be displayed in color 1
SET COLOR 2 *	Causes subsequent characters received by the terminal to be displayed in color 2
SET COLOR 3 *	Causes subsequent characters received by the terminal to be displayed in color 3
SET COLOR 4 *	Causes subsequent characters received by the terminal to be displayed in color 4
STATUS LINE ON	Causes the terminal to display subsequent characters on the addressable status line
STATUS LINE OFF	Tells the terminal that all status line characters have been sent
ACTIVATE STATUS LINE	Tells the terminal to expect the addressable status line to be used
START PRINTER	Enables the auxiliary port for print output; subsequent characters are sent to the printer
STOP PRINTER	Disables the auxiliary port; subsequent characters are sent to the printer

* Refer to "Attributes and Field Attribute Characters" on page 4-31 and "Colors" on page 4-33 for information on how highlighting and color are determined from the 3270 data stream.

Byte 1 is a count of the number of characters in the desired outbound control sequence. If the count is 0, the function is undefined for this terminal type. (Highlighting and colors, for example, are not provided by all terminals.)

Subsequent bytes contain the characters to be sent to the terminals for the desired function. For example, to cause the 3101 screen to be cleared, the sequence ESC L must be sent to the device. Therefore, the entry in the table for the CLEAR SCREEN function is 02 1B 4C 00 00 00 (since the count is 2, the last 3 bytes of this entry are unused).

Special considerations for the terminal control section are the following:

- SET CURSOR ADDRESS is unique in that it contains variable fields. The usual sequence for this function is ESC *X R C*, where *X* is some fixed character, and *R* and *C* are the line and column at which the cursor is to be positioned. This is represented in the terminal table as a 2-byte sequence, ESC *X*. The 3708 supplies the line and column values.
- ACTIVATE STATUS LINE is provided for a terminal that has an addressable status line, but which requires a special sequence that tells the terminal to expect the 3708 to send START STATUS and STOP STATUS. However, ACTIVATE STATUS LINE, if defined in the table, is sent to the terminal by the 3708 when beginning a protocol conversion session, regardless of the setting of the addressable status line flag in byte 2 of the terminal table. (This is the only time that ACTIVATE STATUS LINE is sent.) This allows ACTIVATE STATUS LINE to contain any terminal initialization sequence that may be useful.
- If the status line flag in the terminal table is 1 but the count field of the START STATUS sequence is 0, the 3708 uses normal SET CURSOR ADDRESS commands to position the cursor to write the status line. For example, if the terminal is operating in 3270 Model 2 mode (24 x 80), the 3708 sends a SET CURSOR ADDRESS sequence for row 25, column 1 to position the status line data.
- The format of the two highlight sequences and of the four color sequences must all be the same relative to the Terminal Field Attribute Byte or Non-Field Attribute Byte. Consult the reference manual for the terminal to determine which, if any, of the terminal visual attributes use a Field Attribute Byte.
- To match the basic four-color support of the 3270 data stream, colors 1, 2, 3, and 4 should be green, red, blue, and white, respectively. However, for a user-defined terminal, you can use any four colors that you prefer. All four colors must be filled in with correct sequences. Colors can be duplicated.
- If you are using highlighting, you must define both the highlight ON and highlight OFF sequences.
- ANSI visual attribute support, other than highlighting on/off, can require control sequences longer than the 5-character sequence that can be explicitly specified in the Terminal Control section. To allow additional flexibility in defining visual attributes, the 3708 provides a method for defining longer ANSI highlighting sequences. This method should be applied only to the highlighting on/off and color 1, 2, 3, and 4 fields of the TUT definition. However, the 3708 supports this method for all sequences from addresses X'0000A6' to X'000117', except SET CURSOR ADDRESS.

For ANSI-compatible devices, the sequences in this part of the table can be entered in two different formats:

1. If the entire sequence is 5 characters or less, enter the exact sequence, including the ESC [that normally introduces an ANSI sequence. However, for SET CURSOR ADDRESS, the 3708 inserts a semicolon (;) between the row and column values. Therefore, a semicolon should not be included in the table entry.

2. If the sequence is more than 5 characters long and is in the format for ANSI visual attributes, enter the sequence as follows:

   – Set the count field to the length of the entire sequence, minus the CSI (ESC [) and the separators (; X'3B').

   – Turn on the leftmost bit of the count field. This tells the 3708 to provide the CSI (ESC [X'1B5B') and the separators (X'3B').

   – Define only the parameters specifying the visual attributes.

   – Define the terminating character.

   Example

   To define a field with high intensity (1), blinking (5), and reverse video (7), the sequence in the UDT is X'85303135376D'. The 3708 sends this sequence to the terminal:

   `X'1B5B303B313B353B376D'  (ESC [ 0 ; 1 ; 5 ; 7 m)`

   Notes:

   a. This example assumes that reset, 0 (X'30X'—all attributes off), must also be sent.
   b. The numbers in parentheses specify the characters understood by the terminal for a particular visual attribute.

- The 3708 does not support reverse video or underlined fields explicitly, although you may define these attributes in your UDTs. Because of the way screen updates are done, blanks and nulls may not be rewritten when fields change. This may prevent reverse video and underlined data from appearing as it would on a 3270 device. (The 3708 does not support 3270 Extended Data Stream.)

Color and Highlighting Restrictions

The 3708 supports highlighted fields and colors for terminals that provide this function in character mode. These terminals must accept a SET ATTRIBUTE type command for highlighting or color.

How the highlighting and color are supported depends on the value of bit 5 of the Flag byte in the terminal table. If bit 5 is 0, the terminal must have the following characteristic:

- The highlighting or color mode remains active for all subsequent characters received by the terminal until another SET ATTRIBUTE command is received.

If bit 5 is 1, the terminal must have the following characteristics:

- The terminal reserves a byte on its screen for the attribute, but no character is displayed there.
- The "current" attribute defines a field that extends to the "next" attribute.
  - If the "next" attribute is in the middle of a line, the current field wraps from one line to the next.
  - If the "next" attribute is above the "current" attribute, the current field wraps from the bottom of the screen to the top.
- The terminal does not do any cursor manipulation based on the location of the attributes. That is, if the 3708 sends a command to move the cursor one position to the left, the terminal performs that action, even if the new position contains an attribute.
- The setting of bit 3 of the UDT Flag byte (SCROLL) must be zero. The 3708 must be able to send a character or attribute sequence to the last screen position.

As a result, a customer defining a UDT must determine which of these sets of requirements are satisfied by the terminal in question before defining the color or highlighting outbound functions.

A possible symptom of an error in this area would be that the keytracking provided by the 3708 (that is, cursor movement and so on) would appear to be wrong. For example, when a cursor left key is pressed, the cursor might not actually move, or when a TAB key is pressed, a blank may appear where data had already been entered.

The 3708 restrictions in this area apply to the following default terminals:

- IBM 3101 - Highlighting is not provided by the 3101 in character mode.
- Beehive ATL078 - Originally, the 3708 did not support terminals with the second set of characteristics above. Therefore, the default terminal table for this device has bit 5 set to 0 and no highlighting sequences defined.
- Northern Telecom Displayphone - Originally, the 3708 did not support terminals with the second set of characteristics above. Therefore, the default terminal table for this device has bit 5 set to 0 and no highlighting sequences defined.

Customization Section

The customization section (found only in enhanced tables) allows you to specify larger screen sizes, user-defined UDT names, and user-defined terminal initialization sequences.

Restrictions for Large Screen Sizes: For the larger screen sizes function to work, the terminal must have the capability and be at an appropriate EC level. The terminal installer must set up the terminal to be able to operate at the larger screen sizes.

When the terminal does not have screen sizes that match exactly the 3270 Model 3, 4, or 5 sizes, larger screens may be used. Consult the reference manual for the terminal you are using to determine what size can be used and the values to code in for the set screen size sequences.

The customization section contains the following fields:

Set 24 x 80 mode sequence (model 2)
: This is a 16-byte field used to define the ASCII sequence that should be sent to the terminal to cause it to use a screen size of 24 x 80. The first byte of the field should contain the count (in hexadecimal) of the number of characters in the sequence. The remaining bytes of the field contain the actual sequence to be sent and should be entered as the hexadecimal representation of ASCII characters. If the count is 0, the 3708 will not accept a BIND from a host application specifying a screen size of 24 x 80.

Set 32 x 80 mode sequence (model 3)
: This is a 16-byte field used to define the ASCII sequence that should be sent to the terminal to cause it to use a screen size of 32 x 80. The first byte of the field should contain the count (in hexadecimal) of the number of characters in the sequence. The remaining bytes of the field contain the actual sequence to be sent and should be entered as the hexadecimal representation of ASCII characters. If the count is 0, the 3708 will not accept a BIND from a host application specifying a screen size of 32 x 80.

Set 43 x 80 mode sequence (model 4)
: This is a 16-byte field used to define the ASCII sequence that should be sent to the terminal to cause it to use a screen size of 43 x 80. The first byte of the field should contain the count (in hexadecimal) of the number of characters in the sequence. The remaining bytes of the field contain the actual sequence to be sent and should be entered as the hexadecimal representation of ASCII characters. If the count is 0, the 3708 will not accept a BIND from a host application specifying a screen size of 43 x 80.

Set 27 x 132 mode sequence (model 5)
: This is a 16-byte field used to define the ASCII sequence that should be sent to the terminal to cause it to use a screen size of 27 x 132. The first byte of the field should contain the count (in hexadecimal) of the number of characters in the sequence. The remaining bytes of the field contain the actual sequence to be sent and should be entered as the hexadecimal representation of ASCII characters. If the count is 0, the 3708 will not accept a BIND from a host application specifying a screen size of 27 x 132.

User-defined UDT name

This is a 9-byte field used to define the name for the UDT. This name is displayed on the 3708 terminal selection screen (C2). This first byte of the field should contain the count (in hexadecimal) of the number of characters in the name, which should be entered as EBCDIC characters. If the count is not a number from 1 to 8, the default UDT name is used ("UDT01" - "UDT04").

User-Defined Terminal Logon Initialization Sequence (TLIS)

The 3708 lets you send a hard-coded terminal initialization sequence, a user-defined sequence (TLIS), both, or neither.

This is a 61-byte field used to define a sequence to be sent to the terminal at the beginning of the protocol conversion session. The first byte of the field should contain the count(in hexadecimal) of the number of characters in the sequence. The remaining 60 bytes of the field contain the actual sequence to be sent, and should be entered as ASCII characters. If the count is not a number from 1 to 60, a user-defined TLIS is not sent.

This field is used along with bit 6 of the flags field as follows:

Bit 6	TLIS Count	Meaning
0	= 0	Send only the 3708 initialization sequence
0	> 0	Send the 3708 initialization sequence followed by the user-defined sequence
1	= 0	Send no initialization sequence
1	> 0	Send only the user-defined sequence

Keyboard Maps for Supported Displays

This section lists the default keyboard maps for the displays supported by the 3708 and describes the special processing required for specific terminal types.

Supported Displays

The 3708 provides default keyboard mappings for the following displays:[1]

- IBM 3101 Display Terminal Models 10, 12, 13, 20, 22, and 23
- IBM Personal Computer (PC) in 3101 emulation mode with standard 3101 keyboard functions
- IBM PC with a color monitor running the IBM PC/HOST File Transfer and Terminal Emulator Program (FTTERM)
- IBM PC with a monochrome monitor running the IBM PC/HOST File Transfer and Terminal Emulator Program (FTTERM)
- IBM 3151 ASCII Display Station
- IBM 3151 with cartridge to emulate IBM and DEC® terminals (Feature No. 8235)
- IBM 3151 Connectivity Feature Cartridge (Feature No. 8525)
- IBM 3151 with Expansion Feature Cartridge (Feature No. 8535)
- IBM 3161 ASCII Display Station
- IBM 3161 with Enhanced 3708 Attachment (Feature No. 8371)
- IBM 3162 ASCII Display Station
- IBM 3162 with 3708 Support Functions (Feature No. 8232)
- IBM 3163 ASCII Display Station
- IBM 3164 ASCII Color Display Station
- IBM 3163/3164 VT100/3708 Emulation Cartridge (Feature No. 8313)
- ADDS (Applied Digital Data Systems) Viewpoint®
- Beehive™ ATL-078
- Data General Dasher® D210 Display Terminal
- DEC® (Digital Equipment Corporation) Models VT52, VT100, and VT220
- FALCO 500®
- Hazeltine 1500, ESPRIT I™, and ESPRIT II™
- Hewlett-Packard 2621B Interactive Terminal
- Lear Siegler ADM 3A Dumb Terminal®
- Northern Telecom Displayphone™
- ROLM Cypress, Cedar, and Juniper (connected through ROLM CBX II)
- Teletype 5410 Asynchronous Display Terminal and 5420 Buffered Display
- TeleVideo® 910 and 950
- WY-50® (Wyse 50)
- Other terminals and personal computers emulating and compatible with one of the named devices.

[1] The list of displays contains several trademarks and registered trademarks. Viewpoint is a registered trademark of Applied Digital Data Systems, Inc. BEEHIVE is a trademark of BEEHIVE International. Dasher is a registered trademark of the Data General Corporation. DEC is a registered trademark of the Digital Equipment Corporation. ESPRIT I and ESPRIT II are trademarks of Esprit Systems, Inc. FALCO 500 is a registered trademark of Falco Data Products, Inc. Dumb Terminal is a registered trademark of Lear Siegler, Inc. Displayphone is a trademark of Northern Telecom, Inc. TeleVideo is a registered trademark of TeleVideo Systems, Inc. WY-50 is a registered trademark of Wyse Technology.

In addition, terminals that have the following characteristics may operate in protocol conversion mode if they provide emulation of a supported device, or if a user-defined terminal has been created in the 3708:

- Operates in character mode
- Operates with 7-bit data, with odd, even, or no parity
- Provides a setting for host echo of data as opposed to terminal echo
- Can operate with a full duplex data flow
- Uses one of the cursor classes for positioning the cursor on the terminal's display screen.

Special Processing Provided for Specific Terminal Types

Some of these devices require special processing by the 3708, in addition to the information contained in the table on page 4-59.

Note: The special considerations described in this list are based on the terminal ID in byte 0 of the terminal table.

IBM 3161, 3162, and 3163, and IBM 3161 and 3162 (3708 Feature): Special processing is provided to handle PF keys 13 to 24. Pressing the PF1 key on these terminals sends ESC 1 (X'1B 31') to the 3708, and PF13 sends ESC ! 1 (X'1B 21 31'). Normally, the 3708 not distinguish between ESC and ESC !, and both sequences would cause the PF1 function. However, for these terminals, the 3708 detects the exclamation point (!), causing the PF13 function. The same special consideration applies to PF13 - PF24.

IBM 3164: When initiating a protocol conversion session, the 3708 sends the command to put the 3164 into program color mode. The command sequence is X'1B 21 39 44'. Also, the special processing described for the IBM 3161/3162/3163 PF keys applies to the 3164.

IBM 3151: When initializing a protocol conversion session, the 3708 sends two sequences to enable the Print Key Attention command and the Reset Key Attention command. The two sequences are X'1B 29 3A' and X'1B 28 3A'. Also, the special processing described for the IBM 3151 PF keys is the same as the IBM 3161, 3162, and 3163.

IBM PC/FTTERM Color and IBM PC/FTTERM Mono: When initializing personal computers that are running FTTERM, the 3708 transmits a sequence to FTTERM to determine its release level. The sequence is `ESC [ x m` where

x = a	if the 3708 is configured for Transmit XON/XOFF = 0 and Receive Queue Pacing Threshold = 0
x = b	if the 3708 is configured for Transmit XON/XOFF = 0 and Receive Queue Pacing Threshold > 0.

If FTTERM responds with an `ESC ~`, the 3708 uses a repeat-to-address scheme to reduce the number of characters transmitted to FTTERM.

DEC VT52, VT100, and VT220 (emulating a VT100): When initiating a protocol conversion session, the 3708 sends the command to put these terminals into extended keypad mode. The command sequence is X'1B 3D'.

DEC VT220: The DEC VT220 can generate escape sequences that are too long for the standard terminal table. To support these longer sequences, the VT220 terminal table has a fourth section that occupies addresses X'118' to X'12B'. These addresses contain the hex function numbers for each of the VT220 keys that generate long escape sequences (see Table 4-17). The 3708 recognizes this extended terminal table only when bit 4 of address X'002' is set to 1 and there is a X'7F' in the address for the first character after the X'1B5B' introductory sequence. (Because the VT220 is an ANSI X3.64 terminal, the left bracket (X'5B') is considered part of the introductory sequence is ignored.)

Table 4-17. DEC VT220 Extended Terminal Table

Address	VT220 Key	Sequence Generated	Hex Function	Function Description
000118	F6	1B5B31377E	0C	PF13
000119	F7	1B5B31387E	0D	PF14
00011A	F8	1B5B31397E	0E	PF15
00011B	F9	1B5B32307E	0F	PF16
00011C	F10	1B5B32317E	10	PF17
00011D	F11	1B5B32337E	11	PF18
00011E	F12	1B5B32347E	12	PF19
00011F	F13	1B5B32357E	13	PF20
000120	F14	1B5B32367E	14	PF21
000121	F15	1B5B32387E	15	PF22
000122	F16	1B5B32397E	16	PF23
000123	F17	1B5B33317E	17	PF24
000124	F18	1B5B33327E	18	PA1
000125	F19	1B5B33337E	19	PA2
000126	F20	1B5B33347E	1A	PA3
000127	Find	1B5B317E	27	Backtab
000128	Remove	1B5B337E	2F	Erase Input
000129	Select	1B5B347E	28	Newline
00012A	Prev Screen	1B5B357E	37	Refresh
00012B	Next Screen	1B5B367E	1C	Sys Request

FALCO 500®: At terminal initialization the 3708 sends the following sequences for the FALCO 500®:

1B3D	Sets application kbd mode
1B5B3C3253	Sets screen format 26 x 80
1B5B3C343B3170	Window starts at position 1
1B5B3C313B323670	Sets screen size to 26.

This sequence allows the use of the FALCO 500's internal status line. You can turn off the status line through the FALCO 500 setup procedure. The terminal must be configured for 7 bit VT220 mode before connecting it to the 3708.

The FALCO 500 keyboard map requires the following extended key sequence:

Address	FALCO 500 Key	Sequence Generated	Hex Function	Function Description
000118	F1	1B5B33317E	0C	PF1
000119	F2	1B5B33327E	0D	PF2
00011A	F3	1B5B33337E	0E	PF3
00011B	F4	1B5B33347E	0F	PF4
00011C	10	1B5B33357E	PF5	F5
00011D	F6	1B5B31377E	11	PF6
00011E	F7	1B5B31387E	12	PF7
00011F	F8	1B5B31397E	13	PF8
000120	F9	1B5B32307E	14	PF9
000121	F10	1B5B32317E	15	PF10
000122	F11	1B5B32337E	16	PF11
000123	F12	1B5B32347E	17	PF12
000124	F13	1B5B32357E	18	PF13
000125	F14	1B5B32367E	19	PF14
000126	F15	1B5B32387E	1A	PF15
000127	F16	1B5B32397E	2B	PF16
000128	Ins Line	1B5B317E	27	Backtab
000129	Del Line	1B5B347E	28	Newline
00012A	Prev Scrn	1B5B357E	37	Refresh
00012B	Next Scrn	1B5B367E	1C	System Request

Note: Three keys have fixed definitions and cannot be changed in a UDT. These are Insert, Clear Screen, and Delete.

Hazeltine ESPRIT1, and ESPRIT2: When initiating a protocol conversion session, the 3708 sends the command to put these terminals into extended keypad mode. The command sequence is X'1B 3D'.

TeleVideo 950: When initiating a protocol conversion session, the 3708 sends the command to redefine the function keys. The command sequence is X'1B 7C 31 31 01 4B 0D 19'. Also, when updating the status line on the 950, the 3708 does not send a command to activate highlighting, as it does for other terminals (because the 950 does not support highlighting for the status line area).

Beehive: The 3708 accepts DC2 and DC4 characters for pacing from the Beehive terminal, because the Beehive uses these characters to pace data to the printer port. The 3708 treats them exactly as if they were DC1 and DC3.

WY-50®: The 3708 sends a special screen attribute sequence for the Wyse WY-50® when a field wraps from the bottom of the screen to the top. This causes the portion of the field at the top to have the same characteristics as the portion at the bottom of the screen.

Processing for Terminal Functions

This section describes the processing for the following functions:

- Initialization
- Termination
- Keytracking.

Initialization

When the 3708 receives a BIND specifying LU type 2, or when the user enters the correct control terminal password, the port begins operating in protocol conversion mode. At this time, the 3708 sends a set of initialization commands to the device, as follows (the items in capital letters are control sequences, obtained from the terminal table that is being used):

1. If the terminal type is one described in the previous sections that requires an initialization sequence, the appropriate sequence is sent.
2. ACTIVATE STATUS LINE[2]
3. HIGHLIGHT OFF[2]
4. SET CURSOR ADDRESS to 0,0 (upper left hand corner)
5. CLEAR SCREEN
6. STOP PRINTER[2]
7. If the terminal supports an addressable status line (flag bit 1 is set to 1 in the terminal table), the status line is sent there, using the steps described in "How the 3708 Updates the Status Line" on page 4-37.
8. SET CURSOR ADDRESS to 0,0
9. HIGHLIGHT OFF or SET COLOR 1

   Note: If both highlighting and color are defined, the color function is performed; highlighting is ignored.

Termination

When an UNBIND is received to terminate the current LU type 2 session, the 3708 sends the following termination sequences to the device. Unless the UNBIND type and the DISCONNECT configuration option result in a disconnect, nothing is sent to the terminal.

1. STOP PRINTER[2]
2. STATUS LINE OFF[2]
3. SET CURSOR ADDRESS TO 0,0
4. CLEAR SCREEN.

[2] For these sequences, if the first byte of the sequence in the terminal table is 0, nothing is sent.

Keytracking

As a character is received from the attached device, either from the terminal operator pressing keys at the keyboard or from a personal computer program executing, it is placed in the port's receive queue. It has an accompanying status that indicates if the character was correctly received or had a parity or framing error. Also, if the device causes a Break condition to be detected by the 3708, a character is placed in the queue with status indicating the Break. The 3708 then performs the keytracking function, which interprets the character and its status to determine what keyboard service to perform.

For each of the received characters, one of the following applies:

- If the character is associated with a Break, the 3708 causes an update to the status line indicating an unsupported keystroke (X ?+), and places the device in a reset-required state. Remaining characters in the queue are discarded.
- If the character was received with incorrect framing or parity, the 3708 causes an update to the status line indicating the error (X FRAME or X PARITY), and places the device in a reset-required state. Remaining characters in the queue are discarded.
- If the previous character processed caused the 3708 to access a function number in the terminal table which had the high order bit set to 1, the current character is ignored.
- If the character (after the parity bit is removed) is an ASCII control character (X'00' to X'1F') and the previous character processed was not an ESC, Alternate Control Sequence Character, or Intermediate Control Sequence Character, the character itself is used as an index into the control code part of the keyboard mapping definition section of the terminal table being used. The 1-byte function number found at that location in the table is then used to determine the keyboard service to perform.
- If the character (after the parity bit is removed) is an ASCII character (X'00' to X'7F') and the previous character processed was an ESC, Alternate Control Sequence Character, or Intermediate Control Sequence Character, the character itself is used as an index into the escape sequence part of the keyboard mapping definition section of the terminal table being used. The 1-byte function number found at that location in the table is then used to determine the keyboard service to perform.
- If the character (after the parity bit is removed) is an ESC or Alternate Control Sequence Character, the 3708 remembers that the escape-sequence introducer character has been received.
- If the character (after the parity bit is removed) is the Intermediate Control Sequence Character, and the escape-sequence introducer character has been received, (either an ESC or the Alternate Control Sequence Character), the 3708 ignores the Intermediate Control Sequence Character.
- If the character (after the parity bit is removed) is a left bracket (X'5B'), and the terminal table indicates that the terminal is ANSI compatible (the flags in byte 1 of the table contain this indication) and the escape-sequence introducer character has been received, (either an ESC or the ASCS), the 3708 ignores the left bracket.
- If the character (after the parity bit is removed) is the DEL character (X'7F'), and an escape-sequence introducer character has not been received, the delete function is performed.

- If the character (after the parity bit is removed) is a noncontrol ASCII character (X'20' to X'7E'), and an escape-sequence introducer character has not been received, the character is handled as a data character. Depending on the current position of the cursor on the display screen, the character may:
  - Be accepted as data, entered into the device buffer, and because the current field is defined as displayable, be transmitted back to the terminal for display on the screen. If the cursor is located in a field whose attributes are different from those that were active when the last character was transmitted to the terminal, the 3708 may send an attribute defining sequence (highlighting on/off, or colors) before sending the echoed character.
  - Be accepted as data, entered into the device buffer, and because the current field is defined as nondisplayable, cause a blank to be transmitted back to the terminal for display on the screen.
  - Cause an input inhibited condition, because the cursor is currently located in a protected area of the screen.

  Note: The Echoplex function described here cannot be disabled by any configuration parameter. The 3708 always transmits a character back to the terminal for each character received.

Printers

Printers in a 3708 network environment operating in protocol conversion mode can provide a printed copy of information that is displayed at a terminal, or they can be used to print data from a host application program. Printed data appears in the same alphanumeric characters and symbols that appear on a display, and printouts can be formatted the same way a display is formatted.

The printers can be bound by the host applications to operate using either LU type 1 SCS protocol or LU type 3 DSC protocols, described earlier in this chapter.

The ASCII printers attached to a 3708 port in protocol conversion mode appear to the host as 3287 printers. The 3708 sends ASCII data and ASCII control characters, as described in the LU type 1 and LU type 3 data stream sections, that cause the host data to print on the ASCII device as it would on a 3287. In addition, plotters may be attached in this mode, and the LU type 1 transparency command can be used to cause graphic data to be transmitted to the plotter.

In order for a printer to be attached in this mode, it must have the following characteristics:

- Full duplex communication at speeds from 110 bps to 19.2 Kbps
- A serial interface (EIA 232C)
- ANSI 128-character set support (7-bit ASCII characters with or without parity)
- 256-character set support with the LU type 1 SCS data stream
- XON and XOFF pacing using only the DC1 and DC3 ASCII codes
- The printer must support the following ASCII control characters:
  - X'0D' -- CR -- Carriage Return
  - X'0A' -- LF -- Line Feed
  - X'7F' -- DEL -- Delete (the printer must ignore these characters)
- The printer must not perform a LF when a CR is received
- The printer must not perform a CR when a LF is received
- The printer must not require any special ASCII sequences to be sent to it for initialization.

Configuring a Printer for Protocol Conversion Mode

In order for a printer to operate in protocol conversion mode, the 3708 port must be configured with DEVICE TYPE = 3 (printer). It cannot be configured as a keyboard with printer, even though the device may, in fact, have a keyboard. (When the DEVICE TYPE is set to indicate a keyboard with printer, the 3708 assumes that it is operating in protocol enveloping mode.) A keyboard with printer configured for use as a printer will have output only capabilities, except for the following 3287 functions supported by the 3708:

Hold Print
Enable Print,
Cancel Print,
PA1, and
PA2.

Note: The printer of a keyboard display-with-printer device may also be defined so that it is accessible for host data and local copies. See "Displays with Printers" on page 4-89 for information on this type of device.

Other port configuration parameters that affect the printer's operation in this mode are:

- LU device number (The third one on the configuration screen is used)
- Receive XON/XOFF (If the printer in use sends XON/XOFF to pace the data from the 3708, this option must be set to 1; otherwise data may be lost.)
- Operating Mode (Parameter should be set to 1, protocol conversion.)
- Delay after Form Feed
- Delay after Carriage Return
- Maximum Platen Length
- Default Page Length (Parameter should be set to the length of page that should be used for LU type 1 data. If the LU type 1 data stream does not use the Set Vertical Format command to initialize the page length parameter (MPL), this configuration value must be set to the desired page length.
- Printer Authorization Matrix (Print mode, print classes, and source device list must be set up correctly to enable local copy and host printouts to occur as required.)
- Printer Form Feed Options.

In addition to the configuration of the port to which the printer is attached, the Host Printer Source Field of the host definition must indicate that a printer exists for the host. A printer can belong to only one host.

3287 Characteristics

For explanations of how the 3708 provides the 3287 emulation, see "3270 Data Stream (LU type 1)" on page 4-19 and "3270 Data Stream (LU type 3)" on page 4-15.

Printer Input

If the printer has a keyboard from which characters can be sent to the 3708, the following inputs are allowed:

Function	Char	Hex	LU_1	LU_3	Usage
Hold Print	H	X'48'	Y	Y	Temporarily halt current print output.
Enable Print	E	X'45'	Y	Y	Resume the current print output, after hold.
Cancel Print	C	X'43'	Y	N	Cancel the current print job.
PA1	1	X'31'	Y	N	Send attention to host.
PA2	2	X'32'	Y	N	Send attention to host.

In LU type 3 DSC mode, hold and enable print only are allowed.

In LU type 1 SCS mode, cancel print, PA1, and PA2 are allowed only after a Hold print has been performed.

PA1 and PA2 cause the 3708 to transmit RUs containing 'APAK 01' or 'APAK 02' to the host application. Also, receiving PA1 or PA2 will reset the hold condition.

Cancel Print causes the 3708 to discard all remaining parts of the current SNA chain.

Only the key sequences shown cause these functions; the user cannot define other key sequences.

Local Copy Function

The 3708 provides a local copy function that allows a copy of a display's screen image to be transferred to a printer attached to the 3708. The local copy function is directed by the 3708 Printer Authorization Matrix, that is defined when configuring the 3708.

A local copy function can be operator or host initiated. For operator-initiated copy, the operator uses the PRINT key sequence. The 3708 services the local copy request by transmitting the screen image to a selected printer.

Host-initiated local copy requests are initiated by the host application issuing a write-type command with the WCC Print Bit set to 1. Printer selection and servicing of the request proceed in much the same way as operator-initiated local copy requests.

Printer Authorization Matrix

The 3708 printer authorization matrix defines how displays use printers attached to the same 3708. When a 3708 port is configured for attachment to a printer or a display-with-printer, one entry of the matrix is defined. The entry defines the operating characteristics of the printer attached to the port. The matrix is used to perform the following actions:

- Establish Printer Mode. A printer can be reserved for exclusive use of either the host or the local copy function. A third mode allows sharing between these two functions.
- Assign Print Classes. A print class is a way of grouping printers for use by local copy. Output is directed to the first available printer in a class.
- Define Source Device Lists. The source device list for a specific printer specifies which displays can use the printer.

Printer Mode

A printer may be in one of three modes, specified in the printer authorization matrix as local, system, or shared mode. Printers that are specified as being in local mode or shared mode are available for local copy use.

Local Mode: A printer in local mode is used for local copy functions only. In local mode, displays may contend for use of the printer, but the host may not. The printer is not available for direct print operations from the host.

When a printer is set for local mode, an LU type 1 (SCS) or 3 (DSC) BIND request from the host is rejected with a negative response of X'0801' (printer not assigned).

System mode: A printer in system mode is entirely under host control. The printer cannot be used for operator-initiated or host-initiated copy operations.

Shared Mode: In shared mode, both host-directed printing operations and local copy operations are permitted on the same printer. The 3708 provides Between Bracket Printer Sharing for this type of printer. Local copy requests may be sent to the printer when it is not in session with a host application, or when it is in session, but not in brackets.

Printer Classes

The printer authorization matrix provides the ability to assign a printer to a class. The definition of a class of printers is determined by the customer environment. A class may be based on type, location, or other characteristic. For example, class 72 might be defined as all printers with yellow paper. Thus, an operator may select a printer on the basis of characteristics, rather than printer port address. When more than one printer is assigned to a class, copy output can be improved.

The matrix allows 16 classes with class numbers 70 through 85 to be defined. A display operator would select a printer by class by using the IDENT key sequence and entering the class number. With this type of operation, the 3708 selects which printer in the class to send the display image. A single printer may be in one or several classes, or not in any class. Several printers may be members of a single class.

Source Device List

Each printer may be defined to allow or prevent local copy requests from certain displays. Any given printer may be permitted to process copies from some, all, or none of the displays. The source device list for the printer contains this information.

When a local copy is directed to a print class, the printer selected is one that is authorized in the source device list to accept copies from the requesting display. Not all printers assigned to a particular class may be authorized for the same subset of display terminals.

Matrix Structure

The 3708 provides a configuration screen that enables the user to define one entry in the 3708 printer authorization matrix. See Figure 4-5 for an example.

PRINT CLASS, the third field of the screen, contains one position for each of the 16 classes, 70 through 85. Entering a 1 for a class allows the printer to accept local copy requests from displays selecting that class, provided it is authorized by the source device list.

SOURCE DEVICE LIST, the fourth field of the screen, contains one position for each of the 10 ports on the 3708. Entering a 1 for a port authorizes the display on that port to use the printer.

Note: If the printer that is being defined is the printer of a display-with-printer device, the source device list may contain a 1 in the position that corresponds to the printer's port. This allows the display to perform local copies to its attached printer.

```
C124.0

               3708 PRINTER AUTHORIZATION MATRIX

ENTER ANY DESIRED CHANGES:



            01                  PRINTER PORT ADDRESS
            3                   PRINTER MODE
            1111111111111111    PRINT CLASS
            0111111110          SOURCE DEVICE LIST
            66                  DEFAULT PRINTER PAGE LENGTH
            N                   PERFORM FORMFEED AFTER LOCAL COPY
            Y                   3708 MAY TRANSMIT FORMFEED (LU_1 SCS)
            Y                   PERFORM FORMFEED AT BEGIN BRACKET (LU_1 SCS)
            Y                   PERFORM NEWLINE AT BEGIN BRACKET (LU_3 DCS)



PRESS "ENTER" TO CONTINUE OR "PF2" TO QUIT
                                                                     P 00
4BMYJOB
```

Figure 4-5. The Printer Authorization Matrix Screen

The matrix entries defined for all printer ports are used by the 3708 to process local copy and host printer requests. While the entries are not stored in the 3708 in a table format, they can be thought of as if they were. The following example illustrates how the matrix entries define the printers and how local copy requests should be handled.

In this example, "D" denotes a display port, "P" a printer port, "M" a display-with-printer port (MLU), and "H" the host port. Ports 1 through 10 of a 3708 are attached to devices as follows:

Port Number	1	2	3	4	5	6	7	8	9	10
Device	D	D	M	M	D	D	P	P	D	H

The printer authorization entries for the printers result in the following table:

Printer Port Address	Mode	Class 70	71	72	72...	Port No.: / Device:	1 D	2 D	3 M	4 M	5 D	6 D	7 P	8 P	9 D	10 H
07	Local	0	1	0	0...		0	1	1	1	1	0	0	0	1	0
08	System	0	0	0	0...		0	0	0	0	0	0	0	0	0	0
03	Local	0	0	0	0...		1	0	1	0	0	0	0	0	0	0
04	Shared	0	1	0	0...		0	1	0	1	1	0	0	0	0	0

The display at port 1 copies only to the printer on port 3. This printer cannot be addressed by class (class = all zeros). The displays on ports 2 and 5 use either the printer on port 7 or the printer on port 4. The host can also use the printer on port 4 because its mode is shared. The display on port 9 is authorized to use only the printer on port 7. The display on port 3 may copy to its attached printer (port 3) or to the printer on port 7. Similarly, the display on port 4 may copy to its own printer (port 4) or to the port 7 printer. The display on port 6 is not authorized to used any printer as a local copy device. Also, the printer on port 8 is in system mode and therefore reserved for exclusive use by the host.

Note: Source devices are associated with destination devices instead of classes. For example, the user can define several printers in class 75, but may have authorized a particular display only for a subset or none of the printers in class 75.

Printer IDs in the Status Line

The status line of the display contains the Print ID that is associated with the display at any given time. This ID is used to select which printer a local copy request might be serviced by when the PRINT operation is performed. The ID can be either a class (70 - 85) or a printer port number.

A default Print ID is defined by the 3708 when the display begins its protocol conversion session. The printer authorization matrix is used to determine the default ID — the display associated with the printer with the lowest port number that the display is authorized to use. The print ID will then be the lowest class number, if the printer is a member of one or more classes, or the port number if the printer is not a member of any class. If the display is not authorized to use any printer, the ID is 00.

Note: When a display-with-printer device is involved in the print ID determination, the printer portion is treated as if its port number were increased by 10. For example, if a display is authorized to use a printer on port 4 (not a member of any class), and the printer of a display-with-printer on port 3, its default print ID would be 4. The port 3 printer is actually handled as if its port number were 13.

In the sample matrix above, the display on port 1 would have a default print ID of 03 because that is the only printer that the display is authorized to use, and it is not a member of any class. The displays on ports 2, 3, 4, 5, and 9 would have default ID of 71, and the display on port 6 would have default ID of 00.

The ID can be changed by the operator by using the IDENT function.

Local Copy Operation

The display operator can initiate a local copy function using the PRINT key sequence. The host application can initiate a local copy operation by sending a write-type command to the display with the Start Print bit turned on in the WCC.

This section describes the responses to these local copy requests. The responses depend upon the availability of printers within a selected print class. When a selected print class contains two or more printers, and no printers are available, the print request is queued. Printers are unavailable if they meet one of the following criteria:

- Processing a display printout for another display
- Allocated as LU type 1 or LU type 3 and is in session with a host application, in "in brackets" state
- Not functioning for one of the following reasons:
  - The printer is not physically attached to the 3708.
  - The printer is not powered on.
  - The printer is attached to a switched line and a call has not been established.
  - The printer is part of a display-with-printer configuration and the display is not active in an LU type 2 protocol conversion session.
  - The printer is configured to be "owned" by the other SNA host. That is, when a display is in session with host A, but the printer is defined to host B, the display is not permitted access to the printer.

  Note: The LU associated with the printer does not have to be active (ACTLU does not have to be received) for local copies to be performed; however, the printer must be defined to belong to an SNA host (must be included in the SNA host's printer device list).

Printer Selection

The print ID for a display determines how the 3708 chooses a printer to direct local copy requests.

When a display's print ID is a class, the 3708 selects the available printer with the lowest port number. The printer must be a member of the specified class and authorized to accept local copy requests from the display.

When the display's print ID is a printer port number, only one printer is selected. The print request runs on that printer when it becomes available. The display terminal operator may connect to another authorized printer by using the IDENT key sequence.

The 3708 uses these rules for selecting a printer whether the local copy is initiated by the operator or by the host application.

If an application program requires a certain printer for copy output, it can begin a session by prompting the operator to select a certain printer class. The following is an example of a prompt message: `Select Print Class 79.`

The operator can then make the appropriate selection.

Changing the Print ID

The display operator can alter the print ID by using the IDENT key.

To select a new print class, press the IDENT key sequence and key in a two-digit ID between 70 and 85 when the `P_ _` is displayed in the status line. When the status line appears over the last line of the application, the cursor is positioned after the `P`. When the status line appears in a special status area below the last line of the application, the cursor is positioned on the last line of the application above the `P`. The user enters the new Print ID. When a class ID is entered, the 3708 ensures that the display is authorized to use at least one printer that is a member of that class.

To select a specific printer, press the IDENT key sequence and key in a two-digit port number between 01 and 10 when the `P __` is displayed in the status line. The 3708 ensures that the display is authorized to use the specified printer.

If the matrix does not permit the display to copy to the selected device or to members of a selected class, the Input Inhibited Operator Unauthorized (X OP X) message appears in the status line. The IDENT function ends and the keyboard locks. The user can press RESET and try the print ID sequence. The print ID returns to the ID in use before the IDENT function was started. If the selected print class or printer is authorized and is valid for this display, the print ID changes to indicate the new ID, and the IDENT function ends.

When the IDENT key sequence is pressed, the display is in print ID mode and the following rules apply:

- The RESET key and other keys that cause a reset operate normally and cause the print ID mode to terminate.
- The ATTN key, the DEV CNCL key, and the unsolicited host write operate normally; however, a 3708 print ID mode terminates when these keys are used.
- All other keys that do not operate when keyboard input is inhibited because the Input Inhibited What symbol to display and the print ID mode to terminate.

Performing an Operator-Initiated Local Copy

An operator can initiate a local copy operation by pressing the PRINT key sequence on the display keyboard. The print function can be used when the session owner is the SSCP and the keyboard is unlocked or when the session owner is the PLU, the keyboard is unlocked, and the SLU is not in receive state. A local copy cannot be initiated prior to the establishment of the LU type 2 protocol conversion session.

When the PRINT key sequence is pressed, the "current" print ID that is displayed in the status line determines to which printer the screen image is sent.

If the printer or all printers in the print class are busy, the Input Inhibited Printer Busy (X PRTBSY) message is displayed in the status line. Also, if the print ID is a class and all printers in the class are not functioning, this message would be displayed. In all these cases, the print request is queued, and the keyboard is locked until the copy can be performed or the operator cancels the print request. The RESET key has no effect while a print request is on the queue; however, the operator can cancel the local copy request by pressing the DEV CNCL key sequence while the request is on the queue. This action clears the Input Inhibited message, unlocks the keyboard, and removes the print request from the queue. The operator is then free to perform another task.

If the print ID is a port number, and the printer is not functioning, then the Input Inhibited Printer Not Working (X PRTNW) message is displayed in the status line and the keyboard is locked. The operator must press the RESET key to continue. This action clears the Input Inhibited message and unlocks the keyboard. The print request is not queued. The operator may then choose an alternate action.

If no valid print class or printer is defined for this display (print ID = 00) and the PRINT key is pressed, the Input Inhibited Operator Unauthorized (X OP X) message is displayed and the keyboard is locked. The operator must press the RESET key sequence to clear this condition.

When the 3708 determines that a printer is available to service the print request, the display buffer-to-printer transfer begins, the display keyboard is locked, and the Printer Busy symbol remains displayed The Printer Printing (PRNT) indicator replaces the print ID in the status line. Once the printing operation is complete, the Printer Printing indicator is replaced by the original print ID and the Printer Busy message is cleared.

If the printer stops during a local copy operation (out of paper, paper jam, or so on), the `Printer Not Working` message replaces the `Print Busy` message and the print is terminated. The keyboard remains locked. In this state, the RESET key clears the condition.

If a Model 5 terminal user performs a local copy to a printer configured with a platen length of less than 132 characters, output may be lost. It is recommended that Model 5 users perform local copies only to printers configured with platen lengths of 132 characters.

Host Interference with Operator Copy

Once the display operator has initiated a local copy operation, any outbound FM data request is rejected with a Busy sense code (082D), if it is received during the time that the operator request is queued or the data is being printed. Once the print has been completed, the display is free to receive outbound FM data requests.

Host-Initiated Local Copy

The host application program may initiate a local copy function by sending to the display station a write-type command with the Start Print bit in the WCC turned on. The 3708 performs the local copy function as required, using the print ID displayed in the status line. When a write-type command is sent to the display with the Start Print bit on, the 3708 first interprets the orders and data in the write data stream and updates the display screen. Once the screen update is completed, the 3708 attempts to use the printers it assigned to the display. The Time (X CLOCK) message is replaced by the `Input Inhibited Printer Busy (X PRTBSY)` message while the copy operation takes place.

The keyboard remains locked until the print operation is completed. When the print operation is completed, the keyboard unlocks according to the keyboard Restore in the WCC. The Printer Busy message is cleared, and the print ID replaces the Printer Printing symbol.

To perform the host-initiated local copy described above, the host program must send a write-type command with the Start Print bit turned on in the WCC as an RQD chain or as an RQE, CD, EB chain. Otherwise, the synchronization may be lost or the request rejected with response 0843.

Printer Busy Condition: If after performing the display screen update operation, the 3708 finds that the connected printer or all printers in the selected print class are busy with other local copy operations, the print request is queued. The Printer Busy message is displayed. The DEV CNCL key can be used to cancel the host-initiated requests in the queue.

Because the 3708 uses "between-bracket printer sharing," if the selected printer or all printers in the selected class are found to be "in brackets" with the PLU, the copy operation is refused. After the screen update is complete, the 3708 responds to the print request with a negative sense code of 0807, printer busy. Once a print request has been refused in this way, the 3708 sends LUSTAT of '0001B000' to the PLU when a printer becomes available. (Only one LUSTAT is returned per LU, regardless of the number of times the host LU may have requested a local print operation.) The host may choose not to wait for the LUSTAT but to continue with other display work. The 3708 sends the LUSTAT when a printer becomes available, whether or not the host LU has gone on to perform other display work.

Printer Not Working Condition: If no printer is functioning at the time the local copy request is processed, the Printer Not Working message replaces the Time message. The Write command is responded to with a negative response code (082F), permanent printer error.

If the PLU transmits any FM data request to the display and the Printer Not Working symbol has not been cleared by an operator RESET, the FM data request removes the Printer Not Working symbol.

If the printer malfunctions during the print operation, the Printer Not Working message is displayed. The print operation terminates, and the Write command is responded to with negative response code (082F). The keyboard remains locked and the system waits for some recovery action from the host.

Note that any FM data requests from the PLU clears a Printer Not Working symbol. This requires careful planning by an installation in the use of host- and operator-initiated printing.

Local Copy Printed Format

The 3708 sends a CR and LF sequence to the printer at the beginning of each screen copy. The data in the screen image is printed as if it were an LU type 3 formatted printout using 80-character lines. The following restrictions apply:

- The data is scanned a line at a time. If a line contains one or more data characters (including Space, NL, EM, and CR) in a display/print field, the line is printed and a line feed is performed. To produce a blank line, at least one space character must be present.

- If a line contains only nulls, attribute characters, or alphameric characters (including Space, NL, EM, FF, or CR) in a nonprint/nondisplay field, no line is printed and no line feed is performed. An exact screen facsimile can be obtained only when there is at least one space character in a displayable field on what would otherwise be a null line.

Local Copy While in Control Terminal Session

When a display is operating as the 3708 control terminal, it may also use the local copy function. The default print ID for the control terminal is 00, even though it may be authorized to use printers. The operator can use the IDENT function to request a specific printer port. A class request cannot be sent from a control terminal.

The control terminal operator is permitted to use printers that are "owned" by any SNA host, as long as the control terminal's port is included in the printer's source device list.

Displays with Printers

Some ASCII displays can route data to an attached printer. These display-with-printer devices may be attached to the 3708 in protocol conversion mode so that the display and printer share a single 3708 port while appearing as two distinct LUs to the SNA host. There is no host dependency for this function. The hosts is unaware that the two devices are sharing one physical port of the 3708.

The 3708 allows this feature if it is operating in protocol conversion mode; the display is operating in an LU type 2 session; and the printer is operating in either LU type 1 SCS or LU type 3 DSC mode. The display can also operate in a LU type 1 NTO, protocol enveloping session. However, while this session is active, the printer will not be used by the 3708, and no host session may be initiated to the printer.

For this feature to be used on the 3708, two requirements must be met:

1. The 3708 must be configured to allow this mode of operation. (The configuration restrictions are described below.)
2. An ASCII device must be used that allows the host (in this case, the host is the 3708) to send data to the auxiliary port of the device. Of the terminal types supported explicitly by the 3708, the following provide printer attachment:
   - IBM 3101 (requires manual intervention to direct data to its Aux port)
   - IBM 3151, 3161, 3162, 3163, and 3164
   - IBM 3151 with Cartridge to Emulate IBM and DEC® Terminals (Feature No. 8235)
   - IBM 3151 Connectivity Feature Cartridge (Feature No. 8525)
   - IBM 3151 Expansion Feature Cartridge (Feature No. 8535)
   - IBM 3161 with Enhanced 3708 Attachment (Feature No. 8371)
   - IBM 3162 with 3708/3710 Support Functions (Feature No. 8232)
   - IBM 3163/3164 VT100/3708 Emulation Cartridge (Feature No. 8313)
   - IBM PC/FTTERM (color and mono)
   - ADDS Viewpoint
   - Beehive ATL078.
   - DEC VT220
   - FALCO 500®

- Hazeltine ESPRIT I and ESPRIT II
- Hazeltine 1500 (requires manual intervention to direct data to its Aux port)
- Lear Siegler ADM 3A
- ROLM Cypress, Cedar (requires manual intervention to direct data to its Aux port)
- ROLM Juniper
- TeleVideo 910, 925, 950
- Teletype 5410 and 5420
- WY-50® (WYSE 50).

In addition, UDTs may be used to define this type of operation. See "The Terminal Table Format" on page 4-54 for details about the structure of terminal tables for UDTs. In particular, the START PRINTER and STOP PRINTER terminal control sequences, and the SUSPEND DISPLAY, RESUME DISPLAY, SUSPEND PRINTER, and RESUME PRINTER keyboard functions should be included in a UDT to provide display-with-printer functions.

Printers in this mode of operation, like printers attached directly to 3708 ports, are available for output from the SNA host or other displays in system, local, or shared mode. Input from printers attached to displays is not explicitly supported. All input from MLU configurations is assumed to come from the display.

3708 Configuration

To attach a display with an attached printer (MLU) to the 3708, the port must be configured for a keyboard display with printer. As with directly attached printers, the ports and host that can access the auxiliary port printer must also be defined as described in the next two sections.

Host Definition

In the definition of the host port at the 3708, the options that are affected by attachment of a display with printer are the Host Printer Source Field and the Host Keyboard Source Field. For each port defined as display with printer, the corresponding position in these fields is set to 1. Normally, this definition means that the positions in both source fields will be 1 as would be the case when the printer is defined to a particular host and the display is also defined so that it can communicate to that host. (If the configuration includes two SNA hosts, it is possible to have the display defined so that it can report only to host A and the printer only to host B.)

If there are two SNA hosts, the printer should appear in only one of the hosts' printer source fields, the same as for a directly attached printer.

Port Definition

The port configuration options that require special consideration to define a display-with-printer are as follows:

- LU device number — All three device numbers can be used for this type of port definition, depending on whether there are one or two SNA hosts in the configuration. The first device number defines the address for the display when it is communicating with host A; the second is the address for the display when communicating with host B; the third is the address for the printer on whichever host it is defined.

  Note: Device numbers should be unique. The 3708 does not check for duplicates. Duplicate device numbers can cause unpredictable results.

- Receive XON/XOFF — This option is particularly important for a display with printer, because the device may send XON/XOFF to pace printer data, even though it may not normally use pacing characters when receiving display data. This is particularly true if the line speed between the display and the printer is slower than that between the 3708 and the display, causing the display to buffer the printer data internally.
- Device Class — This option is set to 4 to define a display with printer.
- Operating Mode — This option is set to 1 or 2 because the port must be operating in protocol conversion mode for the printer to be used.
- Source Device List for the Printer Authorization Matrix — If the local copy function is to be used to copy the display screen image to the printer, then the display's port number must be included in this source device list. To prevent other users from performing local copy to the printer attached to a display, the other port numbers should be excluded from this list.
- Interface Type — Either an EIA 232C or EIA 422A can be used between the 3708 and the device. The connection between the printer and the display is not related to the 3708 and device interface. The primary consideration here is that the correct type of cable be used.

Other configuration options should be set as appropriate, using the normal considerations.

LU Session Restrictions

No printer session with the host or local copy from other users is allowed until the display is operating in an LU type 2 protocol conversion session (either to a host, or as the 3708 control terminal). After the LU type 2 BIND is processed for the display, a notification is sent to the appropriate host that the printer is available.

Whenever the display session ends, because of logoff or power off, the printer session is also terminated, and the printer becomes unavailable for either host data or local copy data.

Care should be taken when providing display with printer access for switched ports. Special consideration may be required in the host applications to prevent data that is intended for one user from being sent to another. This possibility could occur under the conditions in the following example:

> User X dials in to port 7 and requests the host to send print data on the active session to the user's attached printer.
>
> Before the print completes, or perhaps even before it begins, the connection to the device is lost. The connection could be lost because of a bad telephone connection or because someone accidentally powered off the modem on either end.
>
> The 3708 notifies the host that *both* display and printer sessions have been lost.
>
> User Y now dials in and makes a connection with port 7 of the 3708 and begins a protocol conversion session.
>
> The 3708 notifies the host that the printer is now available, and the host begins sending printer data to user Y that was intended for user X.

The 3708 has no control over this type of occurrence. All data buffered in the 3708 for the printer would be discarded when user X's session is lost; but output buffered in the host is beyond the control of the 3708.

How the 3708 Routes Data

The 3708 uses the START PRINTER and STOP PRINTER sequences from the terminal control section of the terminal table to route data to either the display or printer as appropriate. Input from, and output to, the display is given priority whenever possible, although certain LU type 1 data streams may generate large printouts before display data is processed. Response time for either device is, of course, affected by data transfer to the other.

If RECEIVE XON/XOFF is enabled for the port through the configuration, receipt of XOFF (DC3) from the device suspends transmission to both the printer and the display.

All input from the device is assumed to be display input. This means that the printer input sequences (Hold Print, Enable Print, Cancel Print, PA1, and PA2) are not available. However, the terminal operator can affect the data transfers; this is described in the next section.

How the Operator Can Control Where the Data Goes

The terminal operator can use the Suspend Display, Enable Display, Suspend Printer, and Enable Printer keyboard sequences to alter the way the 3708 sends data to the two devices. For example, to allow output to the printer and prevent display output, the user would enter the Suspend Display key sequence. This facility can be used when users notice that a printout is interrupting their display sessions too often and wish to force the printout to finish. To allow display output again, the user must enter the Resume Display key sequence.

Alternately, the user may prevent printer output temporarily by entering the Suspend Printer key sequence so that output to the display can finish. Entering the Resume Printer key sequence allows output to be directed to the printer from the 3708 again.

Special Information About Using the IBM 3101 and Hazeltine 1500

Although the IBM 3101 does allow data to be sent to a printer attached to its auxiliary port, remote control of the auxiliary port is not permitted. As a result, there are no START PRINTER and STOP PRINTER sequences that the 3708 can use to direct subsequent data. To route output to the auxiliary port of one of these terminals, the user must manually select the auxiliary port. For this type of device, the four keyboard sequences — Suspend Display, Resume Display, Suspend Printer, and Resume Printer — are used as follows:

- When the user wishes to direct output to his auxiliary port, he must:
  1. Enter the Suspend Display key sequence to halt all output from the 3708.
  2. Manually switch the display for auxiliary port operations.
  3. Enter the Resume Printer key sequence to notify the 3708 that printer data may be sent.
- When printing is finished, or the user wishes to suspend printing, the user must:
  1. Enter the Suspend Printer key sequence to halt output from the 3708.
  2. Manually switch the display for display operations.
  3. Enter the Resume Display key sequence to notify the 3708 that display data may be sent.

Screen Copy to the Auxiliary Port

Some ASCII displays allow the display operator to initiate a print of the display's screen to the printer attached on the auxiliary port. This operation is transparent to the 3708 and has nothing to do with display-with-printer operations or with the 3708 local copy function. The 3708 performs nothing special for this operation other than to recognize the keyboard sequence that initiates the operation and to echo it back to the display.

An example of this operation is the Print Line Key on the 3101. This key causes "ESC U" to be sent to the 3708. This sequence is mapped to the 3708 function ECHO, which causes the 3708 to echo the same sequence back to the 3101. When received there, the 3101 performs a line print operation.

These local screen capture sequences are already defined for supported terminals that provide such functions. For UDTs, they must be defined as the input function ECHO.

Note: If the printer is defined so that it is available for host data or local copy printouts, care must be taken in the use of the local screen capture functions. Careful coordination with other users and host applications must take place to prevent the ECHO functions from interfering with host data. The 3708 cannot prevent this from occurring.

A port should not be configured as a display with printer when the printer is only to be used for display-terminal local screen captures to a printer attached on the display's auxiliary port.

Chapter 5. 3708 Protocol Enveloping Mode

Protocol Enveloping Overview

The 3708 provides the NTO (Network Terminal Option) function for TWX 33/35 compatible asynchronous devices. This support allows non-SNA devices to attach to IBM SNA hosts. When operating in protocol enveloping mode, keyboard displays, keyboard printers (hard copy terminals), and printers (defined as keyboard printers) are supported by the 3708.

When in protocol enveloping mode, attached devices operate in a line-by-line manner. Very little data processing is performed by the 3708 in protocol enveloping mode. This allows the host applications to have virtually direct control of the downstream device. This flexibility allows a wide range of applications to be performed through the 3708 to asynchronous devices. Some examples are personal computer file transfer and graphic device attachment.

Protocol Enveloping Configuration Options

The following configuration option definitions apply to protocol enveloping mode. For configuration instructions, refer to *IBM 3708 Network Conversion Unit Planning and Installation.*

Device Class

Choices are Keyboard Display, Keyboard Printer, Printer, and Keyboard Display with Printer.

Of these options, only Keyboard Display and Keyboard Printer are valid for protocol enveloping. A keyboard display is a video display like the IBM 3161. A keyboard printer has a hard copy printer instead of the video display. Printers running in protocol enveloping mode should be defined as a keyboard printer.

Full Duplex Line

Choices are 1 (Full Duplex) or 2 (Half Duplex).

This configuration option describes the physical communication facility. If two-way simultaneous data flow is possible on this line, choose full duplex. Most nonswitched lines and all direct attach connections are full duplex. Many switched lines also provide a full duplex facility over telephone lines by multiplexing receive and transmit data.

A full duplex facility is desirable because it provides improved response times (no request to send, clear to send, or line quiet delays), allows echoplex operation, and enhances security (monitoring carrier detect).

Note: Many modems provide for FDX operation over standard telephone lines. Consult your modem manual to determine correct 3708 line definitions.

Full Duplex Control Unit

Choices are 1 (Full Duplex—FDX) and 0 (Half Duplex—HDX).

This option describes whether the downstream device is capable of two-way simultaneous data transfer. Normally terminals are considered half duplex devices. That is, either the user is entering data from the keyboard or receiving data from the host. In HDX, once characters are entered from the keyboard, any data received from the host is buffered in the 3708 until the user enters a line turnaround character (LTA), or the text timeout expires.

Notes:

1. Often in terminal manuals, the FDX/HDX option describes whether data entered at the terminal is written to the screen by the terminal or by the host (echoplex). Do not confuse the terminal's configuration setting for FDX/HDX with the 3708's control unit definition.
2. An FDX control unit requires an FDX line.
3. The BREAK key stops data being transmitted to the terminal only when an HDX control unit is specified.

Echoplex

Choices are 1 (Yes) or 0 (No).

When the echoplex option is selected, the 3708 transmits characters back to the terminal as they are received. This provides a way to verify that data is being correctly received by the 3708.

Notes:

1. Echoplex requires an FDX line definition.
2. Echoplex requires permanent request to send (PRTS).
3. Echoplex forces HDX control unit operations.

Permanent Request to Send (PRTS)

Choices are 1 (Yes) or 0 (No).

PRTS should be selected when operating on an FDX line. Performance will be better because there are no request to send or clear to send delays. PRTS cannot be selected when operating on an HDX line.

Note: PRTS is required when the echoplex option is selected.

Bits/Character

Choices are 7 or 8.

Normally 7-bit data plus parity is used for terminals. Some graphics devices or personal computers and terminals with extended character sets use 8-bit data. When 8-bit data is selected, the 3708 does not generate or check parity.

Parity

Choices are Odd, Even, Mark, Space, None, or Autoparity.

Configure the 3708 to match the parity setting of the attached device. If autoparity is selected, the 3708 matches the parity of the downstream device, if it is odd or even. When the None option is selected, parity is not generated by the 3708. An 8-bit character is still transmitted with the high order bit determined by the host data stream, or by the output from the translation tables if translation is specified. When the parity equals none option is selected, Ignore Parity should be selected on receive data. This option tells the 3708 to ignore the parity bit on received data, although the parity bit is still removed if 7-bit data is specified.

Ignore Parity

Choices are 1 (Yes) or 0 (No).

If this option is selected, the 3708 ignores any parity errors that occur on receive data. The 3708 removes the parity bit (parity bit set to zero) if 7-bit data is specified.

If Ignore Parity is configured to No, the 3708 replaces any character it receives from the downstream device with the parity error substitution character.

Note: This option should be used with parity option of None.

Parity Error Substitution Character

Choices are X'00' - X'FF'.

If Ignore Parity is configured to No and a character is received with a parity error, the 3708 transmits this character to the host in place of a bad character. The Parity Error Substitution Character is also used to replace characters that are received with framing errors. Characters with framing errors are always replaced in the data stream with the Parity Error Substitution Character. The Parity Error Substitution Character is inserted into the data instead of the received character which has the error. The substitution character is not translated. If the host is expecting EBCDIC characters, the substitution character should be specified in EBCDIC.

Recognize Terminal Attention

Choices are 1 (Yes) or 0 (No).

The 3708 recognizes the break line condition from the device as an attention or signal (SIG). The break line condition works as:

	Terminal Transmitting Data to 3708	3708 Transmitting Data to Terminal	No Data
Half Duplex Control Unit	ATTEN	SIG	SIG
Full Duplex Control Unit	ATTEN	ATTEN/SIG[1]	SIG

1 - The attention key substitution character is sent to the host when the break line condition is interpreted as an attention. The 3708 inserts the attention key substitution character into the data stream.

0 - The 3708 ignores the break line condition when it is interpreted as an attention.

If recognize terminal attention is configured, when a terminal break is processed as an attention, the attention substitution character is inserted in the user data and sent to the host. If recognize terminal attention is not configured, the attention is ignored.

Attention Key Substitution Character

Choices are X'00' - X'FF'.

The break key on asynchronous devices is used when emulating the terminal attention key while in protocol enveloping. When a terminal attention is recognized, the 3708 inserts the attention substitution character into the user data, if recognize terminal attention is specified. As with the parity error substitution character, the attention substitution character is not translated and should be the character the host application expects to receive for attention.

Allow Terminal Break

Choices are 1 (Yes) or 0 (No).

After a signal is received from the host, the 3708 checks the Allow Terminal Break option to see if the signal should be sent to the downstream device as a BREAK. If yes, the 3708 transmits a BREAK of between 500ms and 750ms. The BREAK is displayed differently by different terminals. The BREAK is a request to the downstream device to terminate data entry and allow host output.

[1] If data is also coming from the terminal, the 3708 transmits the attention substitute character (ATTEN) to the host.

Translate Option

Choices are None, Default, User (for transmit and receive), and Alternate.

Translation is specified separately for transmit and receive operations.

Most IBM hosts use EBCDIC (Extended Binary Coded Decimal Interchange Code) and most asynchronous devices use ASCII (American National Standard for Information Interchange). The 3708 provides two standard translation tables for converting EBCDIC to ASCII and ASCII to EBCDIC; a default table and an alternate table. See Appendix F, "IBM-Supplied Translate Tables" on page F-1 for more information. The default translation table causes the following unusual translations:

If neither the default nor alternate translation tables meet the requirements for the application, you may define a user-defined translate table. If no translation is required, or the host application provides it, the 3708 has a no translation option for protocol enveloping.

Notes:

1. Until a session has been established, the 3708 uses the default translation table.
2. Configuration items, such as, line turnaround characters should be specified as they would be seen at the host, after any specified translation is performed.

Turnaround Characters

Choices are X'01' - X'FF' (for up to five different characters).

Each of the defined line turnaround (LTA) characters act as end of message characters and tell the 3708 when the downstream device has finished data transmission. When operating with an HDX control unit, once a receive operation has begun, the 3708 does not begin the transmission of host data until line turnaround has taken place. When operating on an HDX facility, these characters should signal the physical line turnaround. The downstream device should drop RTS when one of the LTA characters is transmitted. Although LTA characters are not required for FDX control units, they are often used to signal the logical end-of-message and cause the 3708 to forward data to the host.

When the 3708 receives a LTA character, any data in the current data buffer, including the LTA character, is forwarded to the host. Commonly, carriage return (CR X'0D') is used as a LTA character.

Note: LTA characters must be specified as they appear at the host. Received characters are checked to see if they are LTA characters (after translation, if specified).

Warning: To prevent the 3708 from being driven into buffer slowdown when XON/XOFF pacing is not supported, no more than three of the same LTA character may be received consecutively. If TRANSMIT XON/XOFF is 0, the 3708 discards the additional LTA characters until it receives a character that is not a turnaround character or a different turnaround character.

Text Timeout

Choices are 000 - 255.

A text timeout value may be specified to signal a line turnaround in addition to any defined LTA characters. When data is entered from the downstream device, the text timer is started. If more data is entered, it is restarted. If the timer expires before more data is entered, the 3708 assumes line turnaround has occurred. Text timeout prevents the line from being unused when a user walks away from a terminal after starting to enter data, or when noise on the line is interpreted as data. The text timer should not be used on HDX communication facilities. On an HDX physical facility, the line must be physically turned around, that is the transmitting device must drop RTS. Most terminals do this when the key defined to generate the line turnaround character is pressed. The 3708 does not begin to transmit data to the downstream device until RTS drops.

Send Read Prompt

Choices are X'01' - X'FF' (up to 20 bytes).

Read prompt is a message that can indicate when user input is possible. The Read Prompt is transmitted to the downstream device at the completion of a host message (End of SNA Chain) or, if logon screens are suppressed, when an ACTLU has been received to indicate that the system logon may be entered.

Some host applications, like TSO, provide prompting messages. If the host application provides a prompt, it is desirable to turn off the read prompt by setting the read prompt to X'00'.

The read prompt may contain control characters, like CR, LF, or XON. These can be used to help format the screen, but can also be used to trigger a specific action. For example, a read prompt of XON might be used to indicate to a personal computer application running downstream of the 3708, that host transmission is complete and that the personal computer should transfer another record.

Read prompt should not be defined with XON/XOFF characters if TRANSMIT XON/XOFF = 1 and pacing threshold equals 50% or 75%.

Note: The read prompt is translated before it is sent, if translation is specified.

Recognize System Request Simulation

Choices are 0, 1, 2, or 3.

The system request simulation string provides a way to send a message on the SSCP - LU flow. The 3708 allows the choice of one of two user-defined system simulation request strings: the default system request simulation string (99999) or no system request simulation string.

The system request simulation string specified must be the first 5 characters of data. It is not recognized if it occurs in the middle of user data. After entering the system request simulation string, up to 251 characters may be entered. The message is ended by one of three actions: entering all 251 characters, entering a defined line turnaround character, or exceeding the text timeout. The 3708 transmits a message to the SSCP and return back to the application. The 5 characters making up the system request simulation string are not sent to the host.

Delete Rubout Character

Choices are 1 (Yes) or 0 (No).

If configured, the 3708 deletes rubout characters in the data received from the downstream device. The rubout character is X'7F' for 7-bit data or X'FF' for 8-bit data.

Delay after Carriage Return

Choices are 000 - 255.

This option applies to hard copy devices, keyboard printers, or printers defined as keyboard printers. This value defines the number of DEL characters, X'7F', to be sent after carriage return (CR) or horizontal tab (HT) to allow the print head to be repositioned before sending more data.

Notes:

1. Set to 0 for keyboard displays. If the DEL characters are unacceptable to the attached device, the 3708 can be set to send either NUL or XON (X'00' or X'11'). Refer to Chapter 7, "Nonstandard Operations" for more information.
2. This value is the value used when Delay After Receiving CR is selected.
3. Set to 0 for keyboard displays.

Delay after Form Feed

Choices are 000 - 255.

This option applies to hard copy devices, keyboard printers, or printers defined as keyboard printers. This value defines the number of DEL characters, X'7F', to be sent after form feed (FF) or vertical tab (VT) to allow the print head to be repositioned before sending more data.

Note: Set to 0 for keyboard displays. If the DEL characters are unacceptable to the attached device, the 3708 can be set to send either NUL or XON (X'00' or X'11'). Refer to Chapter 7, "Nonstandard Operations" for more information.

Delay after Receipt of CR

Choices are 1 (Yes) or 0 (No).

This option applies to hard copy devices, keyboard printers, or printers defined as keyboard printers. Because a carriage return is normally used as a line turnaround character, this configuration parameter causes the 3708 to delay before transmitting data after a receive operation is completed. The delay guarantees that the print head has been repositioned. The carriage return delay value is used for the number of DEL characters to send.

Notes:

1. Set to 0 for keyboard displays. If the DEL characters are unacceptable to the attached device, the 3708 can be set to send either NUL or XON (X'00' or X'11'). Refer to Chapter 7, "Nonstandard Operations" for more information.
2. Do not use for keyboard displays.

Line Quiet Time

Choices are 000 - 255.

Specify this option for HDX facilities only. When an HDX line turns around, it requires time to stabilize. The Line Quiet Time value specifies the number of DEL characters, X'7F', to be sent after line turnaround to guarantee the line has quiesced before transmitting.

Inactivity Time Out

Choices are 00000 - 16383.

This option determines the time interval before the 3708 disconnects switched line and EIA 422A connections, if no activity from the terminal is detected. This timer is reset when a character is received from the display. A zero value for this option turns off the timer.

Nonstandard Operations

Several of the nonstandard operations flags can affect operations in protocol enveloping mode. Refer to Chapter 7, "Nonstandard Operations" for a description of these flags.

Protocol Enveloping Host Considerations

SSCPFM

The 3708 can support either SSCPFM = USSNTO or SSCPFM = USSSCS. However, SSCPFM should be set to USSNTO when using protocol enveloping mode.

For a session bound as LU type 1 protocol enveloping, it is assumed that the host parameter SSCPFM has been set to USSNTO. No formatting is done by the 3708. Characters are translated using the specified EBCDIC/ASCII translation table, which is a one-to-one translation. (Or no translation is done, if that is what is configured for the port when in protocol enveloping mode). If the host parameter SSCPFM has been set to USSNTO, SSCP-LU data does not contain NL characters; CR/LF is used.

When SSCPFM = USSNTO, the XON, XOFF, and CR characters are defined as media control characters. These special input characters are processed at the host as:

- Media characters are stripped.
- Backspace characters are stripped along with the preceding character.
- The remaining characters are tested for valid input.
- The input data is interpreted if an interpretation table is defined for the device.

If USSSCS is used, the 3708 converts NL characters to CR/LF characters before it is bound. However, it does not perform the erase end of line function associated with NL. Once bound, NL is translated to LF, when default translation is selected. Therefore, SSCP data is not displayed correctly.

TERM = TWX

If LU type 1 NTO is to be supported, TERM = TWX must be specified in the host generation. This parameter tells VTAM applications using the Inquire command that the downstream device is a TWX device and that the data stream should not contain NL characters.

TSO Terminal Profile

The 3708 performs no text editing function other than rubout deletion, if specified. The backspace character is treated as any other data character. In order to have the backspace character function correctly when using TSO, it is necessary to define it as a text editing character in the TSO Terminal Profile.

BREAK Support

The BREAK function provides the ability to interrupt data flowing from the host to the terminal, or from the terminal back to the host.

BREAK from the Terminal

The 3708 supports the following functions:

- If the user enters a partial line of data at the terminal and presses BREAK, the 3708 performs the following action:

  Insert an attention substitution character into the data that is sent to the host when the normal turnaround character is entered.

The attention substitution character can be defined in the 3708 by the system administrator. The default value is a hex X'4F' (| character).

Typically, the attention substitution character would be defined so that the host application performs some function. For example, in TSO the attention substitution character can be defined as line delete control character through the TSO PROFILE command.

- If the host is transmitting data to the terminal and the user presses BREAK, the 3708 takes the action required by its configuration.
  - If the 3708 port is configured as a HDX control unit, it does the following:

    Transmit an SNA Signal command to the host application. Typically, this signal is used to interrupt data coming from the host. Once the 3708 receives the BREAK, it stops the current message that is being sent to the terminal from the host.
  - If the 3708 port is configured as a FDX control unit, it does the following:

    Transmit an SNA Signal command to the host application. The message being displayed is be stopped. It is the responsibility of the host application to stop transmitting data to the terminal.
- If no data is being transmitted by the user or the host and the user presses BREAK, the 3708 performs the following action:

  Transmits an SNA Signal command to the host application. Typically, this signal is used to break from application commands and subsystems.

BREAK to the Terminal

If the terminal supports BREAK and the 3708 has been configured to transmit BREAK, the 3708 transmits a BREAK to the terminal when it receives a Signal command from the host application.

SSCP Communication

The 3708 allows the user to switch communication from the host application to the system operator program (SSCP). SSCP communication is initiated by a system request simulation string. This string can be defined by the system administrator, or the 3708 default can be used.

To switch to the SSCP, the administrator must type the system request simulation string followed by the SSCP message. The SSCP message can be up to 251 bytes long and must end with a defined line turnaround character. The 3708 transmits the message to the SSCP and return to the application.

Note: If the user enters only the system request simulation string followed only by a LTA character, VTAM issues a USS message 2 (Command Unrecognized) and return to the application.

Data Flow Description

The following section describes the transmit and receive paths for the 3708. See also Appendix C, "Suggested Guidelines for Increasing 3708 Performance" for more performance information.

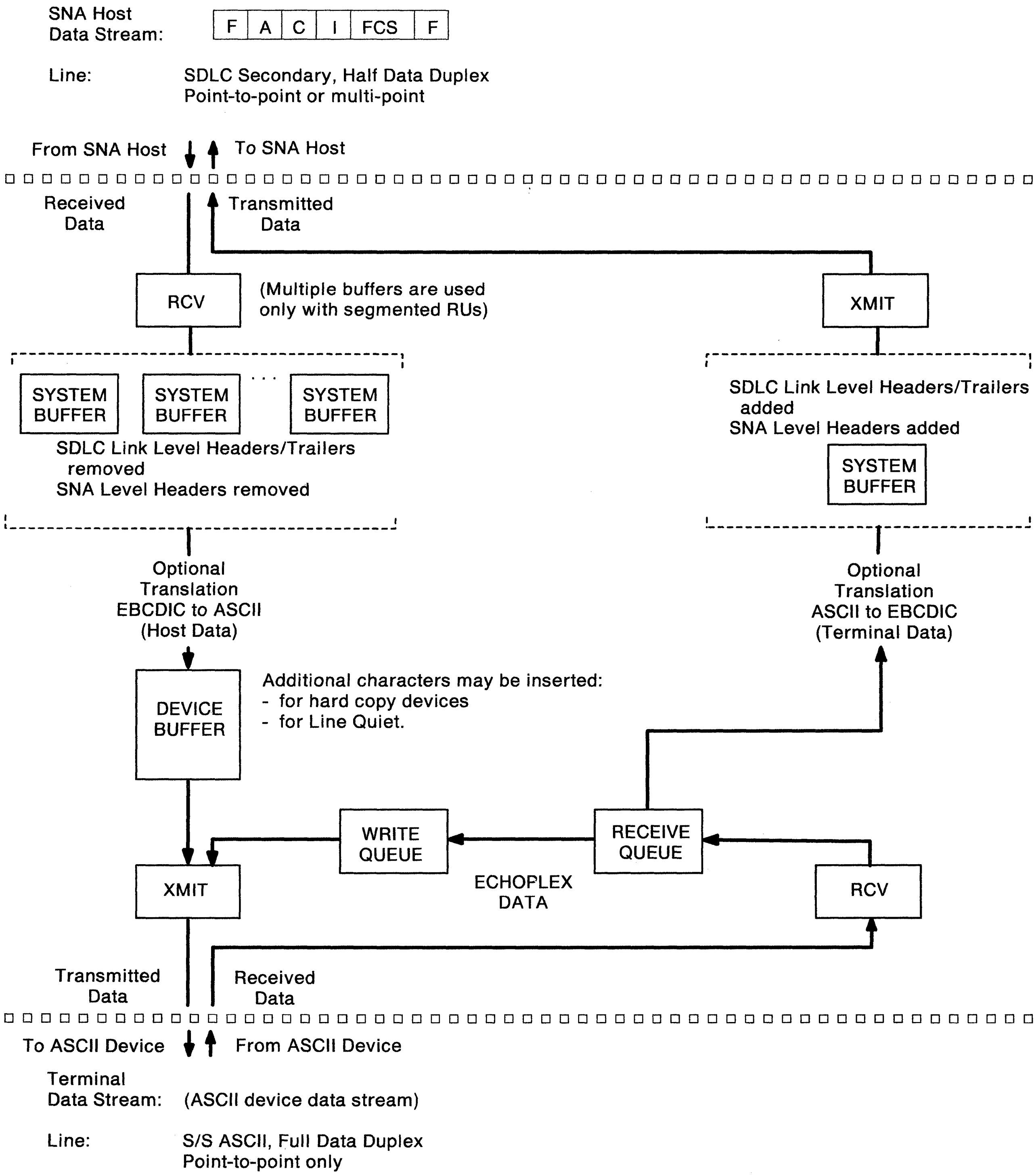


Figure 5-1. 3708 Protocol Enveloping - Internal Data Flow

Flow of Data from the SNA Host

As data is received from the host, the 3708 collects it in system buffers. Each system buffer holds a 256-byte RU. Data can be received as chain elements or segments. If data is segmented, all segments must be assembled before data is transmitted.

Once a chain element has been received and processed (or once all the segments have been assembled), the data is moved from the system buffers into the 3708 device buffer. If the 3708 is configured to translate data, it is done at this time. As the data is processed, printer delay characters (CR delay or FF delay) are inserted into the device buffer when appropriate. The data is processed until all of the chain element has been processed, or the device buffer is filled. (The device buffer is 2000 bytes).

Once the data has been translated and the data stream built, it is transmitted to the downstream device. For HDX control units, the data is not transmitted until any receive operation currently in progress is completed (completion is indicated by receipt of a line turnaround character or a text timeout).

After an entire host message has been transmitted to the downstream device (indicated by an only-in-chain or end-of-chain), a positive response is sent to the host for that chain if a defined response was requested in the SNA header. After the host message has been transmitted and if no more host data is waiting to be sent, the 3708 checks to see if a read prompt is defined. If a read prompt is defined, the read prompt message is translated (if specified) and sent to the downstream device. The read prompt completes this host transmission and indicates that data entry is expected.

Flow of Data from the Terminal

Once the line is enabled, the 3708 is always in receive state. Data from the downstream device is received into the receive queue. The receipt of data causes the text timer and inactivity timer to be restarted.

The 3708 processes the data from the receive queue unless it encounters one of the following conditions:

- The 3708 is in buffer slowdown.
- The host has indicated a busy condition (RNR received from host).
- Echoplex is specified and host data is currently being transmitted.

More than 1 character may be in the receive queue before it is processed. As data from the downstream device is processed off the receive queue, it is accumulated into system buffers. The following conditions cause the 3708 to forward the accumulated data to the host:

- A system buffer is filled (256 byte RU).
- A line turnaround character is received.
- A text timeout occurs.

Data bytes are removed from the receive queue, 1 byte at a time for processing. If echoplex is configured, each received byte is copied to the write queue (which is 40 bytes long) for transmission to the downstream device.

Each byte is checked for parity or framing errors. If a parity error is detected and ignore parity is not configured, or if a framing error is detected, the parity error substitution character is stored in a system buffer. The "bad" character is echoed to the device if echoplex is in use. If the port is configured for 7-bit data, the 3708 removes the parity from the character by placing a zero in the high order bit.

If either user-defined or default translation is specified, the received character is translated.

Note: Before a session is established, default translation is enforced.

After the character is translated, it is stored in a system buffer. The translated data character is tested to see if it is a LTA character. If the current receive transaction is terminated, the data contained in the current system buffer is transmitted to the host. If the character is not a LTA character, the system buffer is checked to see if it contains 256 bytes. (The maximum RU size for the 3708 is 256 bytes). If it does, the accumulated data is forwarded to the host as a first or middle chain element.

After processing characters from the queue, the following actions can occur:

- Any data on the write queue that is waiting to be transmitted is sent to the downstream device.
- If the 3708 is still in receive state (the last character processed was not a LTA character), the text timer is started.
- The inactivity timer is started, if specified.

Enveloping Features

Two functions supported in protocol enveloping mode are data transparency and host autodial. The following section describes their uses and how to configure the 3708 to perform them.

Transparency

With the appropriate configuration options, transparent operation can be obtained in protocol enveloping mode. One use of transparency is file transfer. The following configuration options are recommended for transparent operation:

Option	**Value**
Transmit XON/XOFF	OFF
Receive XON/XOFF	OFF
Delay after Form Feed	000
Delay after CR	000
Full Duplex Line	Full
Translate	000000
Parity	None
Bits/Character	8
Full Duplex Control Unit	Full
Delay after Receipt of CR	000
Recognize System Request Simulation	000
Send Read Prompt	00
Turnaround Characters	None

Because no line turnaround characters are defined, it may be necessary to define a short text timeout to trigger data transfer to the host. Otherwise, data should be padded to an RU boundary (256 bytes) to guarantee timely transfer to the host.

Host Autodial

While the 3708 does not explicitly support autodial, it is possible to perform autodial through the 3708 with a programmable modem and help from a host application.

The line definition for the 3708 must be leased, and Logon Screens must be excluded. It may also be necessary to turn the read prompt off. The modem should be configured for autodial support. The host application must send the 3708 the dial digits including the modem dial commands. The 3708 recognizes this data as any other data and sends the commands to the modem. If translation is specified, the dial digits are translated. Call progress signals from the modem are received by the 3708 and forwarded to the host when a LTA is received or a text timeout occurs. The host application must be able to interpret the call progress responses from the modem.

Note: Standard switched line security features are bypassed with this function.

Chapter 6. ASCII Pass-Through Mode

ASCII host pass-through mode allows a display attached to one port of the 3708 to communicate with a port defined as being connected to an ASCII host. The ASCII host port, even though it is configured to the 3708 as a "host," can actually be a device that is not a host. It can be an ASCII printer, a personal computer, or another display terminal. It is also possible to attach a programmable modem to the ASCII host port and initiate a switched call from a terminal attached to the 3708. This procedure is described later in this chapter.

Choosing an ASCII Host

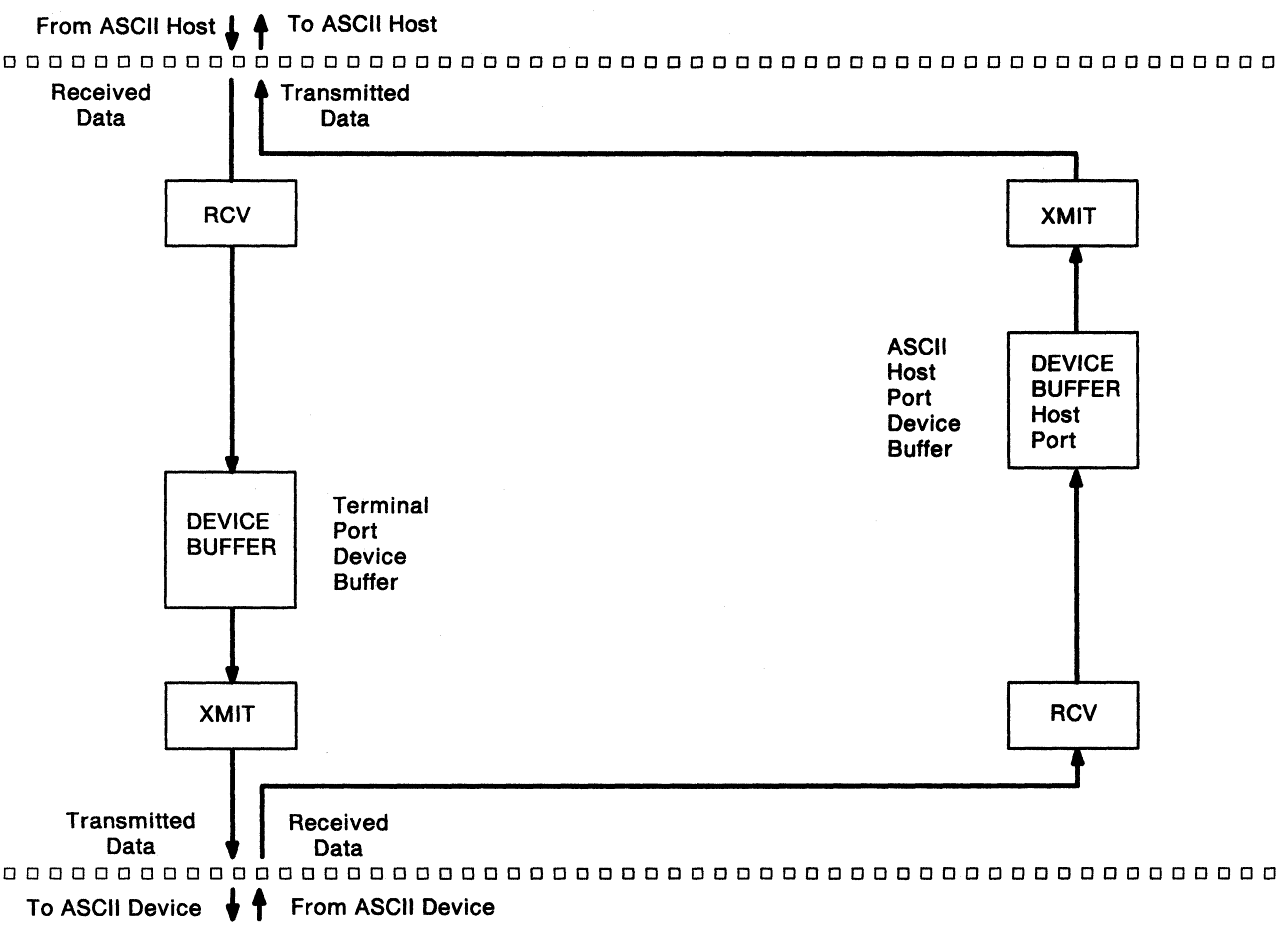
The definition of an ASCII host includes a source device list that identifies the display ports that may select the ASCII host. When one of these display ports logs on to the 3708, the ASCII host name is displayed on the host selection menu. If the operator chooses the ASCII host, and the host is active and not in use by another display, the display is connected to the host port and begins operating in pass-through mode.

If logon screens (or a host selection screen) are excluded for a port, ASCII hosts can not be accessed from that port.

Concentration: The 3708 does not concentrate traffic for ASCII Host Pass-Through

ASCII Host
Data Stream: (ASCII device data stream)

Line: S/S ASCII, Full Data Duplex
Point-to-point only



Terminal
Data Stream: (ASCII device data stream)

Line: S/S ASCII, Full Data Duplex
Point-to-point only

Figure 6-1. 3708 ASCII Host Pass-Through - Internal Data Flow

Operations in Pass-Through Mode

When pass-through mode is established, each of the two ports has a wraparound FIFO receive queue of 980 bytes. (The memory reserved for the device buffer is used for this queue.) Characters received from one port are placed in this area and transmitted from there to the other port. The 3708 does not move the data into system buffers. The receive/transmit process can be occurring simultaneously in both directions.

The hardware controlling the two ports is reset to provide 8-bit data with no parity. Characters are transmitted to one side exactly as they were received from the other.

Abnormal Conditions

When operating in pass-through mode, the 3708 can be compared to a "piece of cable." This similarity is accomplished through the following conditions:

- Parity errors — The 3708 does no parity checking on data. If a received character has a parity error, it is transmitted to the partner port with the same error.
- Framing errors — If the 3708 detects a framing error on a received character, it manipulates the hardware so that it sends a character with a framing error to the partner port.
- Line drop conditions — When one of the ports becomes disconnected because CTS or DSR drops, the 3708 drops the connection to the partner port.
- BREAK — When a BREAK is received from one of the ports, the 3708 generates a BREAK to the other; however, the length of the 3708-generated BREAK condition is not necessarily the same as the original.
- Pacing — The 3708 performs no pacing control on either of the ports. If one of the devices sends pacing characters, they are transmitted to the partner exactly as other characters. Some delay may be introduced by the 3708's processing. For this reason, XON/XOFF type pacing may not be effective, especially if the line speeds of the two devices are different.

Terminating Pass-Through Mode

If a termination sequence is defined for the host, the ASCII host connection may be broken by the display port. This sequence is a BREAK followed by the 3 characters that are part of the host port's configuration. This sequence of BREAK and 3 characters can still be sent on to the host as they are received. However, when the 3708 detects the third character, any outstanding transmissions are cancelled, and the connection between the two ports is broken. No physical disconnection takes place on either port, and the host port is made available for other ports. The display port is reset to its configured parity, data bit settings, and pacing, and the operator is presented with the host selection menu.

Configuration Notes

The following items should be considered when configuring the 3708 for ASCII pass-through mode:

- If a display port is set with Logon Screens Excluded or the Host Selection screen (C3) is suppressed, it is not allowed to access an ASCII host, even if the display port is included in an ASCII host's source device list.
- A printer can never make a connection to an ASCII host.
- The line speeds of the ASCII host and a display that can use it may be different. If large blocks of data (greater than 980 bytes) are to be transferred, a discrepancy in line speeds may result in a receive queue overrun. When this condition occurs, both ports are disconnected from the 3708. If possible, the two ports should be configured to operate at the same speeds. If not, make sure that the difference in line speeds and the large block size does not result in more than 979 bytes of data stored in the 3708's queue. The large blocks at different speeds can result in loss of data unless end-to-end pacing or self-imposed pacing is used to periodically slow the data traffic of the faster line. The same is true when the ASCII host is actually a modem.
- If your port is defined for protocol conversion only, the 3708 transmits a Clear Screen command to the terminal after the Terminal Type (C2) and Host Selection (C3) logon screens. To prevent this command from causing any possible problems with operating in ASCII pass-through mode, is recommended that you configure all ports that will support ASCII pass-through as dynamic.

Dial Out

The ASCII host port can be used as a dial-out port by attaching a programmable modem. The 3708 treats this port as a nonswitched line, so the modem must provide the DSR signal to the 3708 before the 3708 considers the port to be active. When the display port chooses a host and is connected to the ASCII host port, the display operator can enter the appropriate dialing characters and numbers to cause the modem to make a call. Any modem status messages are returned to the display.

Care must be taken when breaking this type of connection. If the 3708 detects the termination sequence, but the display operator has not directed the modem to "hang up," the call remains active. If another user requests the same host, the user will be connected to that call.

The display port can force the 3708 to disconnect from the modem by disconnecting itself from the 3708 without entering the termination sequence. The 3708 then drops all signals to the modem momentarily. After the switched connection through the dial-out modem has been disconnected, the 3708 attempts to establish a new connection to the modem to make it available for other display ports.

Chapter 7. Nonstandard Operations

This chapter describes the Nonstandard Operations field of the 3708 General Definition screen.

The nonstandard operations field is used to enable certain operating features that are not standard for the 3708. You should not use these features unless you have a specific need for them in your operating environment. The field has 32 bits as shown in this example:

xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx

The following list describes the feature that is enabled when each bit is set to 1.

1xxxxxxx xxxxxxxx...
: Bit 1 = 1—Do not accept a CR as a line turnaround (LTA) character during the 3708 logon sequence unless it is specified in the 3708's Line Turnaround Character configuration field. (See "Turnaround Characters" on page 5-5 for more information.) A zero in the bit disables the function.

x1xxxxxx xxxxxxxx...
: Bit 2 = 1—Default type-ahead key queuing and enhanced null/blank processing are set to ON for displays in protocol conversion mode. A zero in the bit results in a default of OFF.

xx1xxxxx xxxxxxxx...
: Bit 3 = 1—The 3708 transmits a BAT (Basic Assurance Test) test pattern to verify the readiness of 3708 USARTs during extended diagnostics testing only. This function is useful if the BAT test pattern causes an attached device to enter an undesired operating state. If bit 3 is set to zero, the 3708 transmits a BAT test pattern during power-on, restart, or extended diagnostics testing.

xxx1xxxx xxxxxxxx...
: Bit 4 = 1—The 3708 transmits a NULL (X'00') instead of a DEL (X'7F'), as an idle character, for delays after form feed or carriage return operations. (Refer to "Delay After Form Feed" on page 4-27 and "Delay After Carriage Return" on page 4-27). If bit 4 is set to zero, the 3708 transmits a DEL (X'7F') as an idle character. See the description of bit 10 for more information on idle characters.

xxxx1xxx xxxxxxxx...
: Bit 5 = 1—In protocol conversion mode, the 3708 substitutes a NULL (X'00') when it receives a character with a parity or framing error from the attached terminal. The 3708 does not update status or lock the user's keyboard when parity or framing errors occur. If bit 5 is set to zero and parity or framing errors occur, the 3708 updates status and locks the terminal user's keyboard. The terminal user must then repeat the keystroke.

xxxxx**1**xx xxxxxxxx...
Bit 6 = 1—When set to 1, the 3708 does not put a large screen terminal back into default screen size mode when Clear is entered by the operator. Specifying this bit as 1 causes the Clear key to operate differently than defined in the *IBM 3270 Information Display System: Data Stream Programmer's Reference*. Host applications conforming to this document may react unpredictably.

xxxxxx**1**x xxxxxxxx...
Bit 7 = 1—The 3708 discards all input between receipt of a line turnaround character and the start of a host write in protocol enveloping mode. This function emulates NTO's action between an internal READ and WRITE.

xxxxxxx**1** xxxxxxxx...
Bit 8 = 1—The 3708 translates LU_1 SCS transparency data using the configured translation table defined for printers. When set to zero, the 3708 does not translate LU_1 SCS transparency data.

xxxxxxxx **1**xxxxxxx...
Bit 9 = 1—The 3708 echos characters during the 3708 logon process. This parameter overrides the ECHOPLEX parameter defined in the 3708. This bit is used only before the BIND. After an LU_1 BIND is received and the 3708 begins protocol enveloping operations, the ECHOPLEX option is used. When this bit is set to zero, the ECHOPLEX option determines whether characters are echoed during 3708 logon.

xxxxxxxx x**1**xxxxxx...
Bit 10 = 1—The 3708 transmits an XON (X'11') instead of a DEL (X'7F'), as an idle character, for delays after form feed or carriage return operations.

If this bit is equal to 1, it overrides bit 4.

xxxxxxxx xx**1**xxxxx...
Bit 11 = 1—The 3708 places the rightmost 5 nibbles of the 3708 serial number into the terminal ID of the XID response. This support can be used to uniquely identify each 3708 to the host. If this bit is zero, the 3708 transmits all zeros for the terminal ID of the XID response.

xxxxxxxx xxx**1**xxxx...
Bit 12 = 1—The 3708 prints blank lines for lines consisting entirely of nondisplayable characters during a formatted printout. This includes local copy operations. When this bit is set to 1, CR, NL, and EM are considered valid print orders and are executed. When set to zero, CR, NL, and EM are not valid print orders and are printed as blanks.

If the bit is set to 1, bit 13 is ignored and formatted printouts (including local copies) are treated as unformatted printouts.

xxxxxxxx xxxx**1**xxx...
Bit 13 = 1—The 3708 does not insert a NL before formatted printouts. If this bit is set to zero, the 3708 inserts a NL before each formatted printout.

xxxxxxxx xxxxx**1**xx...

Bit 14 = 1—The 3708 transmits a TERMSELF (4C) to the host if the downstream device is disconnected in the middle of a session. The host port must be configured to transmit a TERMSELF. If this bit is set to 0 and the host is configured to send a TERMSELF, the 3708 transmits a TERMSELF (40).

This type of TERMSELF is useful when using gateway applications to cross-domain hosts.

xxxxxxxx xxxxxx**00 00000000 00000000**

Bits 15 - 32—These bits are reserved and should be set to zero.

Chapter 8. Network Management and Problem Determination

The 3708 provides several methods for identifying problems and improving the performance of your network. The following methods are discussed in this chapter:

- Using the 3708 alerts
- Using the control terminal diagnostic facilities
- Using the 3708 built-in diagnostic tests
- Using the response time monitor.

Using the 3708 Alerts

The 3708 has full Communication Network Management (CNM) support for centralized network control. Full support for the 3708 alerts is available only through NetView.[1]

The 3708 handles most error detection, recording, and recovery. It records errors such as:

- Hardware and microcode failures
- Errors that occur during sessions between ASCII hosts and ASCII devices

  This includes errors with the following hardware or software components:

  - Emulation protocol layer task
  - Port
  - Local modem interface, including the local terminal or modem
  - EIA cable
  - 3708 EIA drivers and receivers.

- Errors for temporarily unowned devices

  Unowned devices are devices that have logged onto the 3708 but have not yet been assigned to the SNA host. Errors for temporarily unowned devices are identical to errors for the ASCII pass-through mode and are transmitted to the control terminal and any active SNA hosts.

For each of these errors, the 3708 takes the following action:

- Logs the error in the 3708 error log
- Reports the error on all available SNA host links using an NMVT 0000 alert
- Enters an abbreviated entry in the alert log for display at the control terminal.

The 3708 sends alerts to the control terminal, NetView, and all owning SNA hosts. To analyze alerts from the 3708, the user can view alerts at the control terminal display or use NetView.

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[1] NetView is an IBM program product that provides all the functions previously available from three separate products — NCCF, NLDM, and NPDA. NetView also provides new functions beyond those previously available from the separate products such as simplified instruction and operation, status monitor, browse, and online help functions.

Types of Errors

The 3708 sends alerts for all errors that have not affected the integrity of the host connection. These errors include the following:

- A *permanent* error disables a device or causes the loss of a critical resource.
- A *temporary* error is one that is recoverable with some loss of productivity, and one that may cause loss of a noncritical resource.
- An *operational procedural* error indicates the inability of a user to access a logical or physical resource, the loss of a resource, or the inability to perform a requested function because of operational or procedural error.
- A *security* alert is used to report system detected incidents that indicate exposure to security problems.
- A *performance* alert is sent for a port that exceeds a predetermined traffic or error threshold but does not disable a device.
- *Response time* alerts by the 3708 are sent when a Response Time Monitor (RTM) counter overflows. For some critical errors, the 3708 automatically restarts and the error is lost. To capture the error information, the 3708 must be configured to Stop on Error; then, the 3708 stops on the next occurrence of the error, and an operator must power the 3708 off and then on.
- *Delayed recovered* alerts are sent to NetView after the 3708 establishes a SSCP-PU session.

Detecting Problems in an SNA and SDLC Network

Network problem determination can be enhanced by attachment of SDLC modems that support LPDA (IBM modems starting with the 386x support LPDA.) These modems allow the 37x5/NCP to perform the LPDA test; no support is required from the 3708.

With the upstream communication controller, the 3708 supports link level 2 tests by echoing TEST. The 3708 does not echo the data if it does not have available buffer space.

If the 3708 loses the upstream link, the 3708 logs this condition in the error log in RAM. If the 3708 detects an error on the upstream link, it may not be able to send the alert to the host. The 3708 stores the alert data for the error so the user can view the data at the control terminal.

The 3708 detects errors with the base, or cartridge, or with a downstream link. The 3708 error analysis (ERA) task identifies the probable cause of these errors. If the 3708 recovery routines cannot resolve a resource failure, the 3708 invokes the ERA task. The ERA task analyzes the error log to determine the most probable cause, then updates the failure related fields in the CNM alert with data from the error log.

The 3708 then sends the CNM alert to the host and stores the CNM alert summary for control terminal display.

If the error caused a failure in a downstream port or associated resource, the 3708 also sends the CNM problem determination vector NMVT 0025 to NetView. This vector contains the data-link traffic counter subvector.

Note: The 3708 does not have any online facility for recreating errors. The user cannot start offline diagnostics from NetView. The 3708 performs the offline diagnostics at system restart or power on.

CNM Formats Supported by the 3708

The 3708 supports the current REQMS/RECFMS and NMVT formats. The following list describes these formats:

REQMS/RECFMS Type 01 Secondary SDLC Test Counters

- For 3708 end of upstream link
- Not applicable for downstream ports
- Counters always solicited
- Counters at maximum values until sent and reset by a REQMS solicitation.

REQMS/RECFMS Type 02 Error Summary Data

- Counters for total port, internal product, and SNA negative response errors
- Support for 3708 end of upstream link
- Not applicable for downstream ports
- Does not distinguish request/response PIUs
- Cannot provide full account of secondary end
- Counters always solicited
- Counters at maximum value until reset by a REQMS solicitation.

REQMS/RECFMS Type 03 Port Error Counters

- Support for upstream port
- Support for counter set 2 for link adapter errors
- Not applicable for downstream ports
- Counters refer to secondary end of link
- Counters always solicited
- Counters at maximum value until reset by a REQMS solicitation.

NMVT 8080 Alert

- Response Time Monitor (RTM) Request/Control Vector
- Data collected for every LU or a specific LU on a 3708 port
- Data collected for all LUs whose counters are nonzero
- A session correlation vector returned to the host that allows the host to determine session paring after the unbind of the session
- For LU-LU session termination, unsolicited RTM data transmitted only if the host had originally transmitted a CNMI command to test whether the 3708 supported RTM data.

NMVT 0080 Alert

- Response Time Monitor (RTM) Data Reply Major Vector
- Solicited Data Collection
  - If the host requests RTM data for an LU whose RTM data is zero, the 3708 responds with all RTM information for that LU.
  - When the host requests RTM data for all nonzero LUs, the 3708 responds for only the LUs with nonzero data. The last LU is sent regardless of its state.
  - The 3708 rejects all other RUs while responding to an NMVT request RU.

- Unsolicited Data Collection
  - RTM data sent when sessions are unbound, or when a counter overflows.
  - Data sent on the SSCP-LU flow.
  - All counters and timers reset after RTM data is transmitted.
  - If data is sent because of a counter overflow, a bit is set to indicate that possible data loss has occurred.
  - If an UNBIND and then a BIND for another session are accepted before the RTM data for the first session can be sent, then the data for the first session is kept until it can be sent. All responses are discarded until the data can be sent. An indicator is sent that informs the host of possible data loss. The session correlation vector is updated after all data for the first session has been sent.
  - If a solicited response is pending on session unbind, or if an RTM counter overflows, flags are sent to indicate the multiple reasons for the reply being sent and only one RU flows. Data is automatically reset regardless of whether the reset was set in the host's RU.

NMVT 0000 Alert

- Reports downstream link errors, permanent internal failures, and diagnostic errors
- Alert sent unsolicited only
- For downstream link errors, NMVT 0025 (traffic and error counters) accompanies the alert.

NMVT 0025 Alert

- Reports counters for downstream ports
- Major vector sent unsolicited when traffic counters overflow. The 3708 does not send an alert for counter overflows.
- Major vector sent unsolicited following alerts for downstream link errors
- NetView does an error-to-traffic ratio using these counters.

Viewing Alerts at the Control Terminal Display

The 3708 sends alerts to the control terminal for display. The user can view up to seven alerts at the control terminal display. To help determine problems with the 3708, the control terminal displays the following for each of the seven alerts:

- A short probable cause description
- A recommended action
- A 24-byte failure code.

For more information about each description, refer to *IBM 3708 Network Conversion Unit Problem Determination.*

Using NetView

NetView is an IBM-written and owned application program that runs under control of the Network Communication Control Facility (NCCF) at the host computer. This section provides information about NetView operation host support requirements.

NetView provides the network user with problem determination information. This information is generated at resources that are both remote-attached and channel-attached to the host system. The problem determination information issued to the host consists of:

Statistics Defined in NetView as records of traffic and recoverable error counts that have been collected at certain resources and reported to the host system.

Events Defined in NetView as some unusual situation detected at the resource and reported to the host system. These reported situations are not necessarily errors or other undesirable incidents, but generally indicate the need for some form of attention or intervention. The event data is sent to the host system for NetView both to store in its data base and to analyze to determine whether to issue and record an alert.

Alerts Defined in NetView as high-priority events that warrant immediate attention. They are directed to the NCCF operator or the NetView operator.

Note: The host alert support does not identify the source of alert messages below the physical unit (PU) level, that is, the 3708. Therefore, all alert messages for a 3708 and attached devices are stored in the NetView data base under the 3708 name.

NetView Version 1 provides network management problem determination for the 3708. Problem determination includes the network management data base and alert processing using the resulting probable cause and user action screens.

The 3708 also uses the NPDA Version 3 Release 1 and Version 3 Release 2 unrecognized alert support facility. NPDA receives alerts from the 3708. If NPDA does not recognize the 3708 block identification, it uses descriptive text for the general cause code and the specific component code of the alert to create an alert display for problem determination.

The 3708 generates the entire alert record. NPDA recognizes only the general cause and specific component codes.

If NPDA recognizes the block identification from the 3708, normal problem determination is available, including recommended action screens and detail description screens.

NetView is required for the user to perform full problem determination. For a description of the alerts that the 3708 generates, refer to *IBM 3708 Network Conversion Unit Problem Determination.*

Sending Alerts to the SNA Hosts

The 3708 always sends alerts unsolicited to the SNA host. There are three categories of events that result in the generation of problem determination information (alert messages) that are transmitted to the host (NetView) by the 3708:

- Internal alert
- Downstream alert (modem/interface errors). For downstream link errors, NMVT 0025 (traffic and error counters) accompanies the alert.
- Security violations.

A fourth event causes the NMVT 0025 problem determination vector to be transmitted unaccompanied to NetView is counter overflow (for downstream ports).

The user can connect the 3708 to SNA hosts and ASCII hosts. If the 3708 is connected to multiple SNA hosts, it sends an alert to the SNA host that owns the resource for that alert. If the 3708 is connected to an ASCII host, problem determination for the 3708 consists of logging a generated alert at the control terminal and transmitting the alert to all active SNA hosts. The 3708 does not send an alert to an ASCII host connection.

The 3708 SNA alert function provides problem determination information, collected by the 3708 or entered by a control operator, to NetView. Existing versions of NPDA support the 3708 through default processing; only the text associated with the general cause and specific component codes are displayed on the Alerts Dynamic display.

Alert Message Formats

The 3708 uses Network Management Vector Transport (NMVT) records to send alerts and traffic data to SNA hosts.

The 3708 sends all alerts in the same specific NMVT (0000) format. Only the last three vectors (the detail qualifiers) vary in number, depending on the alert. For communication errors on downstream ports, another NMVT (0025) follows the alert. This NMVT contains the downstream traffic and error counters for the port on which the error was detected. In cases where the downstream traffic or error counters reach a threshold (as configured in the 3708 port definition), the NMVT (0025) is sent unsolicited to NetView for statistical processing.

The following sections list the 0000 and 0025 NMVT formats used by the 3708.

NMVT 0000 Alert Format

The 3708 uses an NMVT (0000) record to transmit unsolicited alerts to SNA hosts to describe the probable cause of a problem. For hosts without NetView or NPDA, the alerts are sent to the host in a 126-byte maximum length string. The basic format of the NMVT (0000) record is shown below, and details are listed in Table 8-1. A description of the major fields in the record follows the table.

TH RH RU
- NMVT HEADER
- Length to End of RU
- Product Set ID Subvector
  - Product ID Subvector
    - Hardware Product ID Subfield
    - Emulated Hardware Product ID Subfield
- Relative Time Subvector
- Basic Alert Subvector
- Detail Qualifier Subvector (Hex or EBCDIC)
- Detail Qualifier Subvector (Hex or EBCDIC)
- Detail Qualifier Subvector (Hex or EBCDIC)
- Hierarchy Names Subvector.[2]

Table 8-1 (Page 1 of 3). NMVT (0000) Record Format

Byte	Description
0-2	X'41038D' NMVT header
3-4	X'0000' reserved
5-6	X'0000' PRID
7	Flags: Bit 0 b'0' always unsolicited Bit 1 b'0' always last RU Bit 2 b'0' always first RU Bits 3-7 Reserved
8-9	Major vector length (n+1)
10-11	Major vector ID X'0000' alert
12	Length of product set subvector X'10' (p+1)
13	Subvector ID X'10'
14	X'00' retired
15	Length of product identifier subvector X'11' (q+1)
16	Subvector ID X'11'
17	X'01' product classification
18	Length of hardware product identifier subfield X'00' (r+1)
19	X'00' hardware product identifier subfield

2 Sent only for downstream errors.

Table 8-1 (Page 2 of 3). NMVT (0000) Record Format	
Byte	**Description**
20	X'12' format type
21-24	Machine type ('3708' in EBCDIC)
25-27	Machine model number (in EBCDIC)
28-29	Serial number modifier (in EBCDIC)
30-36	Serial number (in EBCDIC)
37	X'09' length of subvector X'01' (r+1)
38	X'01' emulated hardware product identifier (X'01') product ID subfield
39-42	Machine type of product being emulated (in EBCDIC)
43-45	Machine model number of product being emulated (in EBCDIC)
46	X'07' length of subvector X'42' (p+1)
47	X'42' relative time subvector
48	X'EF' sequence number
49-52	X'xxxxxxxx' 3708 time stamp
53	Length of basic alert subvector (p+1)
54	X'91' type code for basic alert
55	X'00' retired field
56	Alert type
57	General cause code
58-59	Specific cause (component code)
60-61	Alert description code
62-63	User action code
64-65	Detailed text reference code (See "Detailed Text Reference Codes" on page 8-12.)
66	X'00' alert repetition count
67	X'0A' length of subvector X'A0' or X'A1' (q+1)
68	X'A0' or X'A1' detail qualifier subvector (EBCDIC or hexadecimal)
69-76	Detail qualifier
77	X'0A' length of subvector X'A0' or X'A1' (q+1)
78	X'A0' or X'A1' detail qualifier subvector (EBCDIC or hexadecimal)
79-86	Detail qualifier
87	X'0A' length of subvector X'A0' or X'A1' (q+1)
88	X'A0' or X'A1' detail qualifier subvector (EBCDIC or hexadecimal)

Table 8-1 (Page 3 of 3). NMVT (0000) Record Format	
Byte	**Description**
89-96	Detail qualifier
	The name subvector is sent only when the 3708 detects a link error or security violation.
97	Length of name subvector X'03' (p+1)
98	X'03' name subvector
99	X'00' name list is to be concatenated
100	X'02' count of names in vector (link and station) or X'01' count of names for modem interface errors (link)
101	X'09' length of this field and the next field (q+1)
102-109	Downstream line name in LP record (in EBCDIC) This name is equal to the Device Line Name configured in the 3708 by the control terminal operator.
110-113	X'D3C9D5C5' link type ('LINE' in EBCDIC)
114	X'09' length of this field and the next field (q+1)
115-122	Downstream display in the display record (in EBCDIC) This name is equal to the Device Name configured in the 3708 by the control terminal operator.
123-126	X'C4C5E540' terminal type ('DEV' in EBCDIC)

Alert Type

X'01'	Permanent error
X'02'	Temporary error
X'03'	Performance error
X'0D'	Operational procedural error
X'0E'	Security
X'0F'	Delayed recovered.

General Cause

X'01'	Hardware or microcode
X'02'	Software
X'03'	Communications
X'0B'	Hardware
X'0C'	Microcode
X'0D'	SNA-level protocol
X'0F'	Undetermined
X'11'	Operator error
X'12'	Customizing.

Specific Cause

X'0001'	Base processor
X'000E'	Remote product
X'0012'	3708 port
X'0025'	Local modem interface (DTE-DCE)
X'0056'	Application program check
X'00FF'	Undetermined.

Description/User-Action Code: In the following descriptions, the 3708 actually transmits a X'00' instead of X'4B'. The X'4B' is inserted by NetView.

X'4B01'	Delayed recovered control unit error
X'4B02'	Delayed recovered control unit error
X'4B03'	Delayed recovered control unit error
X'4B04'	Permanent control unit error
X'4B09'	Delayed recovered control unit error
X'4B0A'	Delayed recovered microcode error
X'4B0B'	Delayed recovered microcode error (control terminal task)
X'4B0C'	Delayed recovered microcode error (communication control task (EMPL))
X'4B0D'	Delayed recovered microcode error (LU task)
X'4B0E'	Delayed recovered control unit hardware error
X'4B0F'	Delayed recovered hardware error
X'4B10'	Delayed recovered microcode error
X'4B11'	Delayed recovered hardware error
X'4B14'	Temporary control unit error
X'4B15'	Permanent microcode error
X'4B16'	Permanent microcode error (control terminal task)
X'4B17'	Permanent microcode error (communication control task (EMPL))
X'4B18'	Permanent microcode error (LU task)
X'4B19'	Permanent microcode error
X'4B1A'	Permanent microcode error (control terminal task)
X'4B1B'	Permanent microcode error (communication control task (EMPL))
X'4B1C'	Permanent microcode error (LU task)
X'4B1E'	Permanent microcode error (3708 control program)
X'4B1F'	Delayed recovered microcode error (3708 control program)
X'4B20'	Permanent microcode error (PU task)
X'4B21'	Permanent microcode error (PU task)
X'4B22'	Delayed recovered microcode error (PU task)
X'4B28'	Permanent hardware error (base unit)
X'4B29'	Permanent hardware error (base unit)
X'4B2A'	Undetermined
X'4B2B'	Permanent microcode error
X'4B2C'	Temporary control unit error
X'4B2D'	Performance recovered from slowdown
X'4B2E'	Permanent microcode error
X'4B2F'	Permanent microcode error
X'4B32'	Permanent hardware error (port failure)
X'4B34'	Permanent hardware error (base unit)
X'4B36'	Temporary error
X'4B37'	Temporary error
X'4B39'	Permanent port error

X'4B3B'	Permanent communications error
X'4B3C'	Permanent communications error
X'4B3E'	Permanent modem error
X'4B3F'	Permanent communications error
X'4B61'	Permanent communications error
X'4B62'	Permanent communications error
X'4B64'	Permanent error remote product
X'4B65'	Permanent operator error
X'4B66'	Permanent error undetermined
X'4B69'	Security error (port)
X'4B6A'	Security error (control terminal)
X'4B6C'	Permanent port error
X'4B6F'	Response Time Monitor counter overflow
X'4B70'	Application program check (SNA level protocol).

Product Instance ID Vector Support: The 3708 supports the following fields in the product instance ID vector:

Machine type:	3708 in EBCDIC
Model:	XXX in EBCDIC
Plant of Manufacture:	XXXX in EBCDIC
Serial Number:	00XXXXX in EBCDIC
Emulated Product:	3274-61C in EBCDIC.

Detailed Text Reference Codes: The detail description code in the NMVT corresponds to an alert ID displayed on the alert log screen. The following is a cross-reference to alert descriptions:

Detail Code	Alert ID	Detail Code	Alert ID	Detail Code	Alert ID
X'01'	A001	X'19'	A025	X'34'	A052
X'02'	A002	X'1A'	A026	X'36'	A054
X'03'	A003	X'1B'	A027	X'37'	A055
X'04'	A004	X'1C'	A028	X'39'	A057
X'09'	A009	X'1E'	A030	X'3B'	A059
X'0A'	A010	X'1F'	A031	X'3C'	A060
X'0B'	A011	X'20'	A032	X'3E'	A062
X'0C'	A012	X'21'	A033	X'3F'	A063
X'0D'	A013	X'22'	A034	X'61'	A097
X'0E'	A014	X'28'	A040	X'62'	A098
X'0F'	A015	X'29'	A041	X'64'	A100
X'10'	A016	X'2A'	A042	X'65'	A101
X'11'	A017	X'2B'	A043	X'66'	A102
X'14'	A020	X'2C'	A044	X'69'	A105
X'15'	A021	X'2D'	A045	X'6A'	A106
X'16'	A022	X'2E'	A046	X'6C'	A108
X'17'	A023	X'2F'	A047	X'6F'	A111
X'18'	A024	X'32'	A050	X'70'	A112

NMVT 0025 Alert Format

The 3708 uses an NMVT (0025) record to send unsolicited data-link traffic counters to SNA hosts. The NMVT (0025) vector sends error and traffic counters in the 3708 downstream ports to the NetView or NPDA data base.

The NMVT 25 vector contains the Transmit Data Threshold, Transmit Error Threshold, Receive Data Threshold, and Receive Error Threshold counters. It is transmitted unsolicited to the host when any of these counters are exceeded or when the session ends abnormally. Each counter is reset when a new session begins. The value 00000 disables each of these functions.

How NetView Uses Traffic Statistics: NetView or NPDA uses the error and traffic statistics to compute a current error-to-traffic ratio. NetView or NPDA then compares the ratio to a NetView or NPDA threshold, which can be defined in one of the following ways:

- Specified by an initialization parameter
- Changed dynamically by a NetView command or by a NPDA command
- Set to accept a NetView default or a NPDA default.

If the threshold is exceeded, NetView or NPDA creates a performance threshold exceeded (PERF) event record and records the original data as a statistic.

The Most Recent Statistical Data screen at the host displays the error and traffic counters.

If NetView or NPDA recognizes the PERF event records as alerts, NetView or NPDA does the following as soon as the PERF event occurs:

- Records data about the alert
- Sends the data to the NetView or NPDA alerts-dynamic display terminals that recognize PERF events as alerts.

NetView or NPDA can warn the network operator of possible resource failures when the frequency of temporary errors is greater than an installation-defined threshold value.

The basic format of the NMVT (0025) record is shown below, and details are listed in Table 8-2. A description of the major fields in the record follows the table.

```
TH RH RU
 NMVT HEADER
 Length to End of RU
 Product Set ID Subvector
  Product ID Subvector
   Hardware Product ID Subfield
   Emulated Hardware Product ID Subfield
 Relative time Subvector
 Hierarchy Names Subvector
 Counter ID Subvector.
```

Table 8-2 (Page 1 of 2). NMVT (0025) Record Format	
Byte	**Description**
0-2	X'41038D' NMVT header
3-4	X'0000' reserved
5-6	X'0000' PRID
7	Flags: Bit 0 b'0' always unsolicited Bit 1 b'0' always last RU Bit 2 b'0' always first RU Bits 3-7 Reserved
8-9	Major vector length (n+1)
10-11	Major vector ID X'0025'
12	Length of product set subvector X'10' (p+1)
13	Subvector ID X'10'
14	X'00' retired
15	Length of product identifier subvector X'11' (q+1)
16	Subvector ID X'11'
17	X'01' product classification
18	Length of hardware product identifier subfield X'00' (r+1)
19	X'00' hardware product identifier subfield
20	X'12' format type
21-24	Machine type ('3708' in EBCDIC)
25-27	Machine model number (in EBCDIC)
28-29	Serial number modifier (in EBCDIC)
30-36	Serial number (in EBCDIC)
37	X'09' length of subvector X'01' (r+1)
38	X'01' emulated hardware product identifier (X'01') product ID subfield
39-42	Machine type of product being emulated (in EBCDIC)
43-45	Machine model number of product being emulated (in EBCDIC)
46	X'07' length of subvector X'42' (p+1)
47	X'42' relative time subvector
48	X'EF' sequence number
49-52	X'xxxxxxxx' 3708 time stamp
53	Length of name subvector X'03' (p+1)
54	X'03' name subvector
55	X'00' name list is to be concatenated

Byte	Description
56	X'02' count of names in vector (link and station)
57	X'09' length of this field and the next field
58-65	Downstream line name in LP record (in EBCDIC) This name is equal to the Device Line Name configured in the 3708 by the control terminal operator.
66-69	X'D3C9D5C5' link type ('LINE' in EBCDIC)
70	X'09' length of this field and the next field
71-78	Downstream display in the display record (in EBCDIC) This name is equal to the Device Name configured in the 3708 by the control terminal operator.
79-82	X'C4C5E540' terminal type ('DEV' in EBCDIC)
83	Length of counter subvector X'9A' (p+1)
84	X'9A' counter subvector ID
85	X'01' link type is start/stop
86-88	Validity mask (if set to b'1', the corresponding counter in bytes 89-98 is valid): Bit 0 Transmit data counter Bit 1 Poll counter Bit 2 Transmit error counter Bit 3 Receive data counter Bit 4 Receive data counter Bit 5-23 Reserved
89-90	Transmit data counter
91-92	Poll counter
93-94	Transmit error data counter
95-96	Receive data counter
97-98	Receive error data counter

Table 8-2 (Page 2 of 2). NMVT (0025) Record Format

Transmit Data Threshold: This field defines the number of messages transmitted by the 3708 until a NMVT 25 vector is sent to the host.

Transmit Error Threshold: Valid options for this field range from 00000 - 65535. This field defines the number of transmit errors that can be detected by the 3708 until a NMVT 25 vector is sent to the host. The following conditions may be considered transmit errors:

- Invalid link error log entry (Alert A047)
- Data Set Ready dropped (Alert A060)
- Clear To Send not active (Alert A062)
- Lost Carrier Detect (Alert A063)
- Autobaud/Parity Error (Alert A098)
- Device initially in transmit mode (Alert A100)
- S/S Write Timeout (Alert A108).

Receive Data Threshold: Valid options for this field range from 00000 - 65535. This field defines the number of messages received by the 3708 until a NMVT 25 vector is sent to the host.

Receive Error Threshold: Valid options for this field range from 00000 - 65535. This field defines the number of receive errors that can be detected by the 3708 before an NMVT 25 vector is sent to the host. The following conditions may be considered receive errors:

- Parity errors
- Framing errors
- Invalid link error log entry (Alert A047)
- Hardware overrun (Alert A057)
- Data Set Ready dropped (Alert A060)
- Clear To Send not active (Alert A062)
- Lost Carrier Detect (Alert A063)
- Receive line at space for more than two seconds (Alert A097)
- Autobaud/Parity Error (Alert A098)
- Inactivity timeout (Alert A101)
- Receive queue overrun (Alert A102)
- Port Password Retry limit exceeded (Alert A105)
- Control Terminal Password Retry limit exceeded (Alert A106).

Control Terminal Diagnostic Facilities

The customer can use the control terminal facilities for error detection and analysis. The tools provided are:

- Start-up options. The 3708 can be configured to STOP ON ERROR for certain unrecoverable errors. When this facility is used, special error information is saved in the EEIF area of EEPROM. This data would be used by IBM service personnel to determine the cause of the error.

- Error log display

- Alert log display

- Port data monitor. This option allows the customer to view data that is being sent and received through one 3708.

- RTM display

- Storage display

- Port status summary.

For detailed descriptions of the use of these facilities, refer to *IBM 3708 Network Conversion Unit Problem Determination.*

3708 Built-In Diagnostic Tests

The 3708 cartridge contains built-in diagnostic tests and the extended diagnostic tests. These tests allow the user to isolate problems in a 3708 at the machine component level. The 3708 cartridge contains five diagnostic tests. These tests are:

- *Basic assurance test.* This test verifies the operation of the 3708 microprocessor and communication components.
- *Communication test.* This test verifies communication between the port hardware and the base processor.
- *Interactive test.* This test verifies that active ports do not impact communication on other ports (they do not exhibit cross talking). It also verifies that ports are serviced in the proper priority.
- *Port wrap test.* This test verifies proper operation of the signal lines, transmitters and receivers on all ports.
- *Memory test.* This test verifies addressing and data signals, as well as data cells in the base.

The 3708 runs diagnostic tests in two situations:

- *In operating mode.* The 3708 runs the following three diagnostic tests at 3708 power on or when it receives a Restart command from the control terminal or an internal program:
  - Basic assurance test
  - Communication test
  - Interactive test.
- *In test mode (or Extended Diagnostics Mode).* The 3708 runs all five diagnostic tests when an installer, operator, or service person requests them by pressing the Test/Normal switch before turning on the power.

  This mode is for on-site testing during activities such as customer setup or servicing.

After running diagnostic tests, see "LED Sequences and Steady States" on page 2-1.

Using the Response Time Monitor

As networks become larger and more complex, many installations are having more and more difficulty effectively managing them. When components within these networks change due to installation of such functions as automatic switching from a telephone line to a satellite link, a new routing table, or a new version of software in one of the nodes, a display station operator may notice a significant improvement or degradation in response time. When response time increases and a complaint is registered with the network management desk at the host, the network manager has no way of verifying the problem.

The objective of the 3708 Response Time Monitor (RTM) function is to provide a means for the installation to manage the network by differentiating between a good and a bad response time (as well as a response time that is questionable). The RTM function accurately measures and records the transaction times of inbound host attention (AID) operations from display stations that communicate with the host. RTM information may be obtained by the control terminal operator and, if host support is provided, by a network management application in the host.

This section provides information about the following subjects:

- The 3708 and host requirements
- Supported devices
- RTM and response time definitions
- RTM host interface
- Host request and 3708 response formats.

Host Requirements

No specific host support is required; however, RTM has a host interface for SNA communication. Host programming support (NLDM Release 2) is available for the setting of RTM parameters from a host and for the collection and display of RTM information at a NCCF operator station. The 3708 does not support RTM in ASCII pass-through mode.

No host programming is required to use the 3708 Response Time Monitor function for the display of response times. When NLDM is not used, the default values for the 3708 RTM function parameters cannot be changed.

Supported Devices

The RTM function measures response times for keyboard displays operating in protocol conversion mode (LU type 2).

Response Time Definitions

The 3708 allocates a series of five counters (Figure 8-1 on page 8-19) for each configured device or logical terminal representing intervals of time into which the various response times are mapped. Up to four counters may be set up by specifying the maximum times, or boundaries, associated with each. If a response time is less than or equal to a particular boundary, the counter associated with that boundary is incremented at the end of the transaction. If not, the next boundary value is checked. If the response time does not fit within any of the boundaries, then it is mapped into the fifth, or overflow counter. Should any one of the four boundaries be specified as the maximum, the counter associated with that boundary becomes the overflow counter and subsequent counters are ignored. By specifying boundary values correctly, a user is able to obtain a distribution of network responses for each logical terminal.

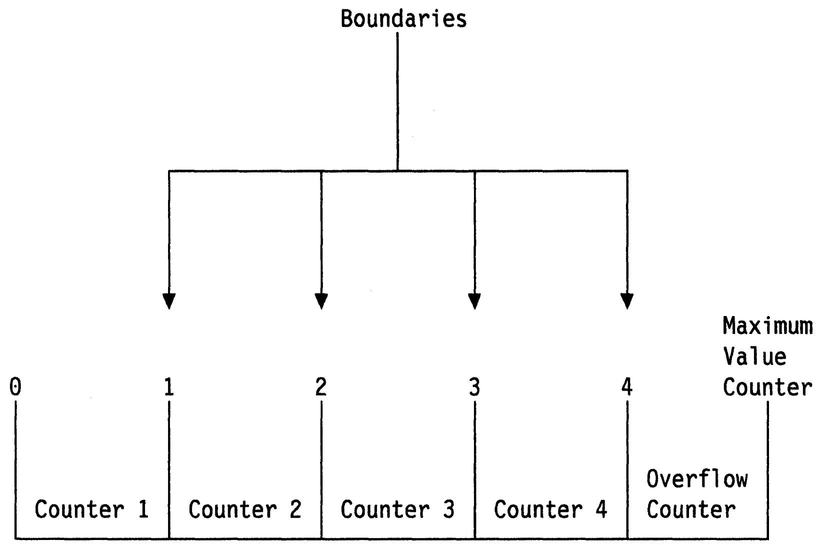

Figure 8-1. Counters and Boundaries

There are default values for the time boundaries built into the 3708. The default values may be overridden from the host using NLDM, Release 2. These changes are effective until the LU is deactivated, or until new values are defined by the host program.

Boundaries must be specified in order of increasing magnitude. The maximum boundary value is 27 minutes, 18.3 seconds. The maximum counter value is 65,535. The counter does not wrap around when this value is reached. If any of the boundaries is set to the maximum boundary value, the counter associated with it becomes the overflow counter. The default values for the boundaries are 1, 2, 5, and 10 seconds.

The total response time is also kept for each logical terminal. Each time a counter (including the overflow counter) is incremented, the corresponding transaction time is added to a total-time register for that device. By dividing this total time by the total number of transactions, the average response time may be calculated. This average response time is available only through the host application; it is not displayable at the control terminal.

Response time is measured from recognition of the inbound AID request in the 3708 until the end of the transaction. When the 3708 is attached via an SNA protocol, response time is measured on the LU-LU flow only; none is measured for the SSCP-LU session.

The default value built into the 3708 for the end-of-transaction parameter is "first character." This value may be overridden from the host using NLDM Release 2. Changes from the host for a specific LU are effective until the LU is deactivated, or until a new end-of-transaction parameter is defined by the host program for that LU.

The end-of-transaction parameter may be defined as one of the following:

- FIRST CHARACTER

  The measurement is terminated when the first character of the next outbound message is written to the terminal.

  With SNA protocols, the "first character" is the first character of "First in Segment." This character can be a Write, Erase/Write, Erase/Write Alternate, or Erase All Unprotected command. A Write with or without data terminates the RTM measurement. The commands and functions just noted are examples of outbound communication that could possibly be expected to modify the contents of the presentation space.

- KEYBOARD UNLOCKED

  With SNA protocols, the measurement is terminated when the next outbound operation (other than a read) to the terminal contains one or more of the following items:

  - Change Direction (CD) indicator
  - End Bracket (EB) indicator
  - Keyboard restore request.

    This request can be either a Write Control Character (WCC) with the keyboard restore bit set or an Erase All Unprotected command.

  The timer is stopped after "Last in Segment" of "Last in Chain" is processed.

  The correlation between the items above and the action taken by the 3708, is shown in the following table (0 = off, 1 = on):

Keyboard Restore Request	**EB**	**CD**	**3708 Action**
0	0	0	Timer NOT stopped
0	0	1	Timer stopped
0	1	0	Timer stopped
0	1	1	Timer stopped
1	0	0	Timer stopped
1	0	1	Timer stopped
1	1	0	Timer stopped
1	1	1	Timer stopped

- CD/EB

  The measurement is terminated upon receipt of a Change Direction (CD) or End Bracket (EB) indicator, which puts the terminal into send or contention state, respectively. Specifically, the timer is stopped after the last character of "Last in Segment" of "Last in Chain" is processed.

  The correlation between keyboard restore and the two indicators is shown in the following table (0 = off; 1 = on):

Keyboard Restore Request	**EB**	**CD**	**3708 Action**
0	0	0	Timer NOT stopped
0	0	1	Timer stopped
0	1	0	Timer stopped
0	1	1	Timer stopped
1	0	0	Timer NOT stopped
1	0	1	Timer stopped
1	1	0	Timer stopped
1	1	1	Timer stopped

  Notes:

  1. EB and CD received in an exception response request, or in a definite response, cause measurement to be terminated on Last in Chain (LIC).
  2. CD accompanying a Read command does not stop the timer.

```
D113.1
                    3708 RESPONSE TIME MONITOR DISPLAY

PORT  HOST  DEF  CTR#1  BDY#1  CTR#2  BDY#2  CTR#3  BDY#3  CTR#4  BDY#4   OU

*1

*2

*3

*4

 5     A     1    23    0:01    24    0:02    31    0:05    10    0:10    5

*6

*7

*8

 9     A     1    0     0:01    0     0:02    0     0:05    4     0:10    12

*10

* NO STATISTICS AVAILABLE

PRESS "ENTER" TO CONTINUE OR "PF2" TO QUIT

4BMYJOB                                                      P 00
```

Figure 8-2. Display of an RTM Log

RTM Host Interface

Using the request/response unit (RU) formats given at the end of this section, an SNA host application program can communicate with the RTM feature in the 3708 and can solicit RTM information from the following sources:

- One logical unit (LU)
- All LUs
- All LUs with nonzero RTM data.

The host application program can reset the RTM logs. Also, the host application program may change the parameters affecting collection of RTM information by updating the following on a one-or-all LU basis:

- Set RTM boundaries
- Set RTM definition code
- Activate/deactivate RTM data collection (host only)
- Return unsolicited data when a session ends
- Return unsolicited data when a counter overflows.

Note: An ACTPU/DACTPU causes the control unit to revert to the defaults for RTM parameters. All RTM data in the 3708 is lost.

Solicited RTM Information

When a request is made to the 3708 on an SSCP-PU session via a host request containing an RTM major vector, the 3708 examines the request. If the request is accepted, a positive response is returned to the host. If the host request does not solicit any data, the 3708 considers the request completed after sending the positive response and updating the appropriate RTM logs; it then reverts to contention state.

If the host request is soliciting information, one or more 3708 responses are then returned to the host as the solicited response. Each of these responses contain data pertinent to a specific LU attached to the 3708. If the reset bit is included in the request, the RTM data for that LU is reset upon transmission of the record. This reset function includes the RTM counters (including overflow) and the total transaction time.

If an outbound request is intended for a specific LU, it must contain an SNA address list with one element providing the 3708 with the local address of the LU. Each inbound request contains an SNA address list with two elements: the first element provides the local address of the PLU; the second element provides the local address of the associated SLU. Including of local addresses in the inbound RUs allows the host RTM application program to correlate response time data with the associated PLU and SLU session pair. Translation of the addresses into 8-byte EBCDIC names is the responsibility of one or more upstream nodes.

A session correlation vector is also returned with the RTM data that is unique to each session pertaining to a specific 3708. This allows a host application program to determine the appropriate session pair *after* that session has been unbound, provided that the application program was able to determine the session identity previously.

The RTM data is only collected when a device is in an LU-LU session. When unsolicited RTM transmission on UNBIND is not supported, the data associated with each logical terminal may pertain to multiple LU-LU sessions. Should multiple session data be present, a flag is set in the appropriate RTM log indicating this. The flag is reset when the RTM data is sent inbound. Note that the session correlation number is updated upon acceptance of each BIND for that LU.

Should a counter-overflow occur, collection of RTM data for that logical terminal is suspended until the RTM data is reset. This is done when a host request is received from the host for that terminal (or all terminals) containing a Reset vector, or when a request is received that changes the boundaries or definition for that LU, or when data is sent unsolicited to the host.

When the host requests RTM data from a specific LU whose RTM data is zero, all the RTM data is returned for that device. The no-data flag is set. This provides the host application program with the ability to determine the actual parameters associated with a given LU, regardless of the data contained in its RTM log.

When the host requests only nonzero RTM data from all LUs, only those LUs with nonzero RTM data responds, except for the last LU which responds regardless of its RTM data content.

While a request unit (RU) is in process, additional REQMS or RTM requests are rejected by the 3708 until a positive or negative response is received for the transmitted RU. Also, if the 3708 is busy processing an unsolicited alert or RTM response, the PU is in send state and any requests from the host are rejected until the unsolicited operation is completed and a response is received for the transmitted responses.

Unsolicited RTM Information

Besides allowing solicited information to flow on the SSCP-PU session, the host can enable the 3708 to transmit unsolicited RTM information when UNBIND is processed for an LU-LU session or when an RTM counter overflows. When one of these conditions occurs, the associated RTM information is scheduled within the 3708 for transmission to the host RTM application program on the SSCP-PU flow. Once transmitted, the data for that logical terminal is reset.

If the transmission was caused by an RTM counter overflow, a flag is set in the RTM data to indicate the potential loss of data. If the transmission was caused by an UNBIND and another BIND is accepted for that logical terminal before the RTM information can be transmitted, additional responses are discarded until the RTM data is transmitted. The session correlation vector is updated after the RTM information is transmitted. A potential loss of data because of the new BIND is indicated in the next RTM transmission (not the transmission just sent).

Negative Responses

The following negative responses may be returned from the 3708 in response to an REQMS or NMVT request:

1003 Negative Response: An NS (network services) header was received, but (1) it was neither REQMS nor NMVT, or (2) it was NMVT but RTM is not supported. The request is rejected and error recovery is the responsibility of the sender.

1007 Negative Response: An invalid NS header was received. The request is rejected and error recovery is the responsibility of the sender.

0815 Negative Response: Another NMVT request was in process in the 3708 when this request was received. The request is rejected and error recovery is the responsibility of the sender.

0835 Negative Response: An invalid parameter was contained in the host request. Two bytes of user sense data are included in the response indicating the byte in the request that caused the rejection. If more than 1 byte is not valid, only the position of the first byte that is determined to be invalid is returned.

The response has the form 0835 00XX, where XX is the position of the byte in the request that caused the rejection by the 3708. Note that XX varies depending on the inclusion of optional subvectors within the RU.

Only certain checks are performed by the 3708. Others are considered "sender" checks, and indeterminate results occur if they are received. See "Host Request and 3708 Response Formats" for the bytes that are checked by the 3708.

Host Request and 3708 Response Formats

This section contains the SNA transmission header (TH)/request header (RH)/request unit (RU) formats for the host request and the solicited and unsolicited 3708 responses.

Host Request Format

The basic format of the host request is:

TH
RH
RU
  RTM Header
  Length to End of RU
  RTM Request Control Vector
    SNA Address List (if required)
      Target LU (if required)
    RTM Request Vector
    RTM Control Vector (optional).

Table 8-3 shows the TH, RH, and RU definitions for the host request format.

Table 8-3 (Page 1 of 4). TH, RH, and RU Definitions for the Host Request

Byte	Bit	Value	Meaning
TH0	0-3 4-5 6 7	b'0010' b'--' b'0' b'0'	FID MPF (segment) Reserved EFI
TH1	-	X'00'	
TH2		X'00'	DAF'
TH3		X'00'	OAF'
TH4,5		X'0000'	SNF
RH0	0 1-2 3 4 5 6-7	b'0' b'00' b'0' b'1' b'0' b'11'	Request FMD Reserved Format indicator Sense data included Chain state indicator

Table 8-3 (Page 2 of 4). TH, RH, and RU Definitions for the Host Request			
Byte	**Bit**	**Value**	**Meaning**
RH1	0 1 2 3 4-5 6 7	b'1' b'0' b'0' b'0' b'00' b'0' b'0'	Definite response 1 Reserved Definite response 2 ERI Reserved QRI PI
RH2	-	X'00'	Not applicable
RU0	-	X'41'	RTM header
RU1	-	X'03'	RTM header
RU2	-	X'8D'	RTM header
RU3 RU4		X'0000'	Ignored (may be nonzero but not to be used)
RU5 RU6	0 1 2 3 4-15	b'0' b'0' b'0' b'0' -	Reserved Reserved Ignored Ignored PRID
RU7	0 1 2 3 4-7	b'0' b'0' b'0' b'-' b'0000'	Reserved Last RU First RU SNA address list indicator: 0 = No vector 1 = Vector describes specific LU Reserved
RU8	0 1-7	b'0' b'000 0000'	No concatenation Remaining length of this RU
RU9	0-7	X'--'	DATA and RESET vectors
RU10 RU11		X'8080'	Code point for RTM major vector
RU12		X'0A'	Length of SNA address list if RU7 bit 3 = 1
RU13		X'04'	Code point SNA address list
RU14		X'01'	Number of TAFs
RU15 through RU21		X'0000 0000 0000 aa'	Target address: 7 bytes aa = local destination address (DAF')
RU22		X'04'	Length of RTM request vector
RU23		X'92'	RTM request vector key

Table 8-3 (Page 3 of 4). TH, RH, and RU Definitions for the Host Request			
Byte	**Bit**	**Value**	**Meaning**
RU24	0 1 2 3 4 5-7	b'-' b'-' b'-' b'-' b'-' b'000'	0 = No reset 1 = Reset data upon reply transmission (or immediately if no reply is expected) 1 = Retrieve data/status for all LUs with nonzero counts 1 = Retrieve data/status for all LUs 1 = Retrieve data/status only of target LU 0 = Apply RTM control vectors to LU specified in SNA address vector 1 = Apply to all LUs Reserved
RU25		X'00'	Reserved
RU26		X'. .'	Length of RTM control vector
RU27		X'94'	RTM control vector key
RU28	 0 1 2 3 4 5 6 7	 b'-' b'-' b'-' b'0' b'-' b'-' b'0' b'-'	STATUS/PARAMETER CHANGE 1 = Activate/deactivate status 1 = Unsolicited on session end 1 = Unsolicited on counter overflow 1 = Unsolicited on time interval 1 = RTM definition code 1 = RTM boundaries 1 = Unsolicited on BIND 1 = Subsystem display enable/disable
RU29	0 1-7	b'-' '0000000'	1 = Activate/deactivate RTM alert Reserved
RU30	 0 1 2 3 4 5 6 7	 b'-' b'-' b'-' b'0' b'-' b'-' b'0' b'-'	STATUS INDICATORS 1 = Activate RTM; 0 = Deactivate RTM 1 = Unsolicited on session end; 0 = No 1 = Unsolicited on counter overflow; 0 = No 1 = Unsolicited on time interval 1 = RTM definition to be set; 0 = No 1 = RTM boundaries to be set; 0 = No 1 = Unsolicited on BIND 1 = Enable subsystem display
RU31	0 1-7	b'-' '0000000'	0 = Disable subsystem display 1 = Activate RTM alerts; 0 = Deactivate Reserved
RU32		X'00'	Reserved
RU33		X'xx'	Ignore (Unsolicited in time interval)

Table 8-3 (Page 4 of 4). TH, RH, and RU Definitions for the Host Request			
Byte	**Bit**	**Value**	**Meaning**
RU34		 X'00' X'01' X'02' X'03'	RTM DEFINITION Reserved First character on screen Keyboard usable CD/EB Other code points reserved
RU35		X'00'	RTM time increment = 100 msec
RU36 through RU41		X'00 00 00 00 00 00'	Reserved
RU42	0-3 4-7	b'0000' b'0---'	Reserved Number of boundaries (1-4)
RU43 RU44		X'----'	Boundary, if appropriate (must be in increasing value)
RU45 RU46		X'----'	Boundary, if appropriate
RU47 RU48		X'----'	Boundary, if appropriate
RU49 RU50		X'----'	Boundary, if appropriate

Notes:

1. The 3708 SSCP-PU session is defined as FM profile 0 and TS profile 1 (half-duplex definite response). Should the 3708 transmit an inbound message, it waits for a response (positive or negative) before transmitting or receiving additional messages on that session. If a response is somehow lost by the network, no other SSCP-PU activity is possible without first receiving an ACTPU. Data may be lost during recovery.
2. Because of the characteristics of the SSCP-PU session, the 3708 defaults to contention state. Should an alert, 3708 RTM response, or RECFMS be queued for inbound transmission, the 3708 goes into send state and rejects all outbound messages on that session until that message is transmitted and a response is received. Error recovery is the responsibility of the upstream node.
3. If the 3708 receives a host request with RU28 bits 3 or 6, RU29 bits 1 - 7, or the corresponding bits in RU30-31, it rejects the request.
4. RU-33 is ignored.
5. All other bytes are considered “sender checks” and indeterminate results occur if there are problems within them.
6. RTM statistics are only accumulated for devices while they are in LU-LU sessions (SNA only).
7. The RTM control vector key (X'94') and RTM request vector key (X'92') are applied immediately if no inbound RUs are to flow. Otherwise, they are applied after the requested data for each LU has been transmitted, not after the response has been received. The current data is reset if RU24 bit 0 = 1 in the request

vector key. In addition, if boundaries or the definitions are changed without requesting the current data, the data is reset.

8. If unsolicited-on-UNBIND or counter overflow is enabled, the RTM data for each LU is reset upon transmission.
9. If unsolicited-on-UNBIND is not enabled, the RTM counters are not reset upon receipt of a BIND. It is a host RTM program responsibility to solicit the RTM data before the counters overflow.
10. The 3708 requires that the RTM request vector key (X'92') precede the optional RTM control vector key (X'94'). If a host request is received with the RTM control vector key first, the host request is rejected.

Bytes checked by the 3708 in the host request are:

Table 8-4 (Page 1 of 2). Bytes Checked by the 3708

Bytes	**Negative Response**	**Potential Problem**
0-1	1007	Request contained an invalid network services (NS) header.
2	1003	Not an REQMS/RTM request.
7	0835	Only bit 3, SNA address list present, can be set.
9	0835	Invalid remaining length.
10-11	0835	Unsupported major vector.
12	0835	Invalid length for SNA address list.
13	0835	Byte 7, bit 3, indicated that an SNA address list is included when, in fact, it is not.
14	0835	More than one TAF.
15-20	0835	Reserved. All bits must be off.
21	0835	Invalid target address.
22	0835	Invalid subvector length.
23	0835	Invalid or unsupported subvector.
24	0835	Bits 3 or 4 specify a target LU, but the request does not contain a local address. Bits 5-7 are reserved and must be off.
25	0835	Reserved. All bits must be off.
26	0835	Invalid subvector length.
27	0835	Invalid or unsupported subvector.
28	0835	If bits 3 or 6 are set, bit 5 indicates setting RTM boundaries, but byte 42, number of boundaries, is missing.
29	0835	If bit 0 is set and alert is not customized, or if bits 1-7 are set.
30	0835	If bits 3 or 6 are set.
31	0835	If bit 0 is set and alert is not customized, or if bits 1-7 are set.

Table 8-4 (Page 2 of 2). Bytes Checked by the 3708		
Bytes	**Negative Response**	**Potential Problem**
32	0835	Reserved. All bits must be off.
34	0835	Unsupported RTM definition (RU30 bit 4 = 1).
35	0835	Unsupported RTM time increment.
36-41	0835	Reserved. All bits must be off.
42	0835	Invalid number of boundaries or bits 0-3 are reserved and must be off.
43-50	0835	Boundary was greater than 3FFF or bytes are not in ascending order.

Note that the byte positions contained in the 0835 negative responses assume the presence of an SNA address list and therefore, if one is not present, byte positions are adjusted accordingly.

3708 Responses Format

The basic format of the 3708 solicited and unsolicited response is:

TH
RH
RU
- RTM Header
- Length to End of RU
- RTM Data Reply Vector
  - SNA Address List
    - Target LU
    - PLU Associated with Target LU
  - Data Reset Flag Vector (if required)
  - RTM Status Response Vector
  - Relative Time Vector
  - RTM Data Vector (if required).

Table 8-5 on page 8-29 shows the SNA TH, RH, and RU definitions for the solicited and unsolicited 3708 response.

Table 8-5 (Page 1 of 5). SNA, TH, RH, and RU Definitions for Solicited and Unsolicited 3708 Responses			
Byte	**Bit**	**Value**	**Meaning**
TH0	0-3 4-5 6 7	b'0010' b'--' b'0' b'0'	FID MPF (segment) Reserved EFI
TH1	-	X'00'	
TH2		X'00'	DAF'
TH3		X'00'	OAF'
TH4,5		X'0000'	SNF

Table 8-5 (Page 2 of 5). SNA, TH, RH, and RU Definitions for Solicited and Unsolicited 3708 Responses			
Byte	**Bit**	**Value**	**Meaning**
RH0	0 1-2 3 4 5 6-7	b'0' b'00' b'0' b'1' b'0' b'11'	Request FMD Reserved Format indicator Sense data included Chain state indicator
RH1	0 1 2 3 4-5 6 7	b'1' b'0' b'0' b'0' b'00' b'0' b'0'	Definite response 1 Reserved Definite response 2 ERI Reserved QRI PI
RH2	-	X'00'	Not applicable
RU0	-	X'41'	RTM header
RU1	-	X'03'	RTM header
RU2	-	X'8D'	RTM header
RU3, 4		X'0000'	Ignored
RU5 RU6	0 1 2 3 4-15	b'0' b'0' b'0' b'0'	Reserved Reserved Ignored Ignored PRID from request (000 if unsolicited)
RU7	0 1 2 3 4-7	b'-' b'-' b'-' b'1' b'0000'	0 = Unsolicited; 1 = Solicited 0 = Last; 1 = Not last 0 = First; 1 = Not first SNA address list included Reserved
RU8	0 1-7	b'0' b'000 0000'	No concatenation Remaining length of this RU
RU9		X'25' X'27' X'46' X'48'	No DATA or RESET vectors No DATA vector but RESET vector DATA vector but no RESET vector DATA and RESET vectors
RU10, 11		X'0080'	Code point for RTM data reply
RU12		X'11'	Length of SNA address list
RU13		X'04'	Code point SNA address list
RU14		X'02'	Number of TAFs

Table 8-5 (Page 3 of 5). SNA, TH, RH, and RU Definitions for Solicited and Unsolicited 3708 Responses

Byte	Bit	Value	Meaning
RU15 through RU21		X'4000 0000 0000 aa'	TARGET ADDRESSES SLU local address: 7 bytes (40 = PLU follows) aa = local destination address (DAF')
RU22 through RU28		X'0000 0000 0000 pp'	PLU local address associated with above SLU address (OAF'): 7 bytes pp = OAF'
RU29		X'09'	Length of RTM status response vector
RU30		X'91'	RTM status response vector key
RU31			RESPONSE CODES
	0	b'0'	Reserved
	1	b'-'	0 = Data included; 1 = No data
	2	b'-'	1 = Specific RTM request for this LU, but RTM for this LU is not active
	3	b'-'	1 = First response for current LU-LU session
	4	b'-'	1 = BIND for new session received while in solicited mode only. Session data is combined.
	5-7	b'000'	Reserved
RU32			REASON FOR UNSOLICITED RESPONSE
	0	b'-'	1 = Session end
	1	b'-'	1 = Counter overflow
	2	b'0'	1 = Time interval expired
	3-7	b'00000'	Reserved
RU33			RESP CODE-POTENTIAL DATA LOSS
	0	b'0'	Reserved
	1	b'-'	1 = Counter overflowed All counters for LU frozen
	2	b'-'	1 = Control unit IMLed/ACTPU-Cold
	3	b'-'	1 = New session before data sent Potential loss of new data
	4	b'-'	1 = RTM definition/boundaries set without soliciting data; all old data lost.
	5-7	b'000'	Reserved

Table 8-5 (Page 4 of 5). SNA, TH, RH, and RU Definitions for Solicited and Unsolicited 3708 Responses

Byte	Bit	Value	Meaning
RU34	 0 1 2 3 4 5 6 7	 b'-' b'-' b'-' b'0' b'-' b'-' b'0' b'-'	STATUS INDICATORS 1 = RTM active; 0 = RTM inactive 1 = Unsolicited on session end 1 = Unsolicited on counter overflow 1 = Unsolicited on time interval 1 = RTM definition set by host 1 = RTM boundaries set by host 1 = Unsolicited on BIND 1 = Subsystem display of logs enabled
RU35	0 1-7	b'-' '0000000'	1 = RTM alerts active Reserved
RU36 RU37		X'rraa'	Session Correlation Number rr = number assigned at BIND by 3274 and incremented for each subsequent BIND for that LU: 00-FF with wrap aa = LU subsystem address
RU38		X'07'	Length of relative time vector
RU39		X'42'	Code point for relative time vector
RU40		X'EF'	Sequence number; not time
RU41 through RU44		X'-------'	Sequence number Starts at 0000 0000 at IML; incremented for each record sent indicating order of transmission
RU45		X'21'	Length of RTM data vector
RU46		X'93'	RTM data vector
RU47		 X'00' X'01' X'02' X'03'	RTM DEFINITION Reserved First character on screen Keyboard usable CD/EB Other code points reserved
RU49 RU50		X'00' X'00'	Reserved Reserved
RU51 RU52		X'0000'	Time interval from last data in seconds
RU53	0-3 4-7	b'0100' b'----'	Number of boundaries returned Number of valid boundaries: 1-4
RU54, 55		X'----'	Boundary 1
RU56, 57		X'----'	Boundary 2
RU58, 59		X'----'	Boundary 3

Table 8-5 (Page 5 of 5). SNA, TH, RH, and RU Definitions for Solicited and Unsolicited 3708 Responses

Byte	Bit	Value	Meaning
RU60, 61		X'----'	Boundary 4
RU62, 63		X'----'	Counter 1
RU64, 65		X'----'	Counter 2
RU66, 67		X'----'	Counter 3
RU68, 69		X'----'	Counter 4
RU70, 71		X'----'	Overflow counter
RU72 through RU75		X'--------'	Total response time Includes time for all counters including overflow
RU76, 77		X'----'	Last transaction time

Appendix A. Host Considerations

This appendix contains considerations for the following products:

- IBM 3705 with NCP
- IBM 3725 with NCP
- IBM 43xx ICA
- IBM 8100
- IBM System/38.

IBM 3705 or 3725 with NCP

This section describes considerations for the IBM 3705 or 3725 with NCP.

NCP Generation Parameters

The following is a list of NCP generation parameters recommended or required to support the 3708:

- Line Name

  It is recommended that the name associated with the line supporting the 3708 match the name defined in the SNA Line Network Name parameter of the 3708 configuration. This is not required, but because the 3708 uses the SNA Line Network Name in its alerts to the host, network management is easier if the two names are the same, related, or equivalent.

- CLOCKNG

  The 3708 can generate or receive a clocking signal from the host.

  3725

  - If CLOCKNG = EXT and ATTACH = DIRECT, the 3725 will provide the clocking signal and the 3708 should be configured for LINE SPEED = 00.
  - If CLOCKNG = EXT and ATTACH = MODEM, the 3725 expects to receive the clocking signal from either the 3708 or a modem. If the modem provides clock, then the 3708 should be configured for LINE SPEED = 00. If the 3708 provides clock, then LINE SPEED should be configured for the appropriate value.

  3705

  - If CLOCKNG = INT, the 3705 will provide the clock and the 3708 should be configured for LINE SPEED = 00.
  - If CLOCKNG = EXT, the 3705 expects to receive the clocking signal from either the 3708 or a modem. If the modem provides clock, then the 3708 should be configured for LINE SPEED = 00. If the 3708 provides clock, then LINE SPEED should be configured for the appropriate value.

- NRZI

  Both NRZI=YES and NRZI=NO may be supported. This value must match the value defined in the NRZI parameter of the 3708.

- DATMODE

  DATMODE must be HALF.

- PU ADDR

  The PU ADDR must equal the value configured for the station address defined in the 3708 for the SNA host.

- PU Name

  It is recommended that the name associated with the PU macro match the name defined in the 3708's SNA PU Network Name. This is not required, but because the 3708 uses the SNA PU Network Name in its alerts to the host, network management is easier if the two names are the same, related, or equivalent.

- MAXDATA

  MAXDATA must equal 265.

- PUTYPE

  PUTYPE must be 2.

- LU Name

  It is recommended that the name associated with the LU macro match the name defined in the 3708's SNA LU Network Name. This is not required, but because the 3708 uses the SNA LU Network Name in its alerts to the host, network management is easier if the two names are the same, related, or equivalent.

- LOCADDR

  The LOCADDR must be 2 greater than the value configured for the 3708's SNA LU Device Number.

- SSCPFM

  The 3708 can support either SSCPFM=USSNTO or SSCPFM=USSSCS.

  When a terminal attached to a 3708 port has received the screen numbered "C4" (`You can now type your system logon`), data received from the host, prior to a BIND, is assumed to be data from the SSCP, and is sent to the terminal using standard EBCDIC/ASCII translation. No formatting is done to the data by the 3708.

  The exception to this is that a NL character (newline) received is converted to a CR/LF (carriage return/line feed). If the host parameter "SSCPFM" has been set to USSSCS, host data contains NL characters; whereas if USSNTO is used, CR/LF is used.

  Note that when USSSCS is used, the host application may assume that when it sends a NL character, the remainder of the "current" line is erased before proceeding to the next line. This is not, however, done by the 3708 in this UNBOUND state.

Once a BIND has been received, the following rules apply to data that flows on the SSCP to LU session:

1. For a session bound as LU type 1 protocol enveloping, it is assumed that the host parameter SSCPFM has been set to USSNTO. This means that no formatting is done by the 3708. Characters are translated using the specified EBCDIC/ASCII translation table, which is a one-to-one translation. (Or no translation is done, if that is what is configured for the port when in protocol enveloping mode).

2. For a session bound as LU type 2 protocol conversion, it is assumed that the host parameter SSCPFM has been set to either USSNTO or USSSCS.

   Because the 3708 is emulating a 327x device at this point, the data is formatted on the screen as a 327x would format it. Normally, a 327x would expect to be using USSSCS; this would cause the host to use an NL character at the end of a "line" of data.

   In the 3708, an NL character is handled by blanking the remainder of the current line and positioning the cursor at the start of the next line. However, if USSNTO was chosen, the 3708 receives CR/LF from the host, rather than NL. This is treated in exactly the same way as the NL above.

   Therefore, the SSCP data received from the host when operating in protocol conversion mode (LU type 2) can be either USSNTO format or USSSCS format.

The result of this implementation is that a port that is configured as "dynamic," potentially running in both LU type 1 and LU type 2 mode, should have the corresponding host parameter set to USSNTO.

A port that will only be doing LU type 2 protocol conversion may have the host parameter USSSCS specified. But data received from the host prior to a BIND may not appear on the terminal exactly as expected because the ends of lines are not erased after an NL character is received.

- TERM=TWX

  If LU type 1 NTO is to be supported, TERM=TWX must be specified in the host generation.

IBM 43xx ICA

This section describes the generation parameters and restrictions that apply to the IBM 43xx ICA.

43xx ICA Generation Parameters

The same requirements/considerations that apply to NCP generation parameters apply to the 43xx ICA generation parameters. The parameters are defined on the LINE, PU, LU macros associated with the VBUILD TYPE=CA macro that supports the 3708.

43xx ICA Restrictions

The 43xx ICA does not allow the TERM=TWX parameter to be specified. This means that applications, such as TSO, which issue an INQUIRE macro to obtain the characteristics of the downstream device, cannot run in protocol enveloping (LU type 1 NTO). Applications that do not issue the INQUIRE, such as CICS and IMS, are able to run LU type 1 NTO mode to the 3708.

IBM 8100

This section describes the generation parameters and restrictions that apply to the IBM 8100.

8100 Generation Parameters

The following is a list of 8100 generation parameters recommended or required to support the 3708:

- Link Name

  It is recommended that the name defined in the NAME column in the system configuration panel for the 8100 Link match the name defined in the SNA PU Line Network Name parameter of the 3708 configuration. This is not required, but because the 3708 uses the SNA Line Network Name in its alerts to the host, network management is easier if the two names are the same, related, or equivalent.

- NRZI

  Both NRZI=YES and NRZI=NO may be supported. This value must match the value defined in the NRZI parameter of the 3708.

- STADDR

  Address defined in the STADDR column of the adapter configuration panel for the 3708 must match the Station Address parameter configured in the 3708.

- 3708 Name

  It is recommended that the name defined in the NAME column in the adapter configuration panel for the 3708 device match the name defined in the SNA PU Network Name parameter of the 3708 configuration. This is not required, but because the 3708 uses the SNA Line Network Name in its alerts to the host, network management is easier if the two names are the same, related, or equivalent.

- Device Name

  It is recommended that the name defined in the NAME column of the adapter configuration panel for a device attached to the 3708 match the SNA LU Device Name parameter in the 3708 configuration. This is not required, but because the 3708 uses the SNA Line Network Name in its alerts to the host, network management is easier if the two names are the same, related, or equivalent.

- LOCADR

  The address defined in the LOCADR column of the adapter configuration panel for a device attached to the 3708 must be 2 less than the SNA LU Device Address defined in the 3708.

8100 Restrictions/Considerations when Attaching to the 3708

Note that all of these restrictions/considerations apply when 3708 terminals are defined to DPPX as LU type 2 (3278) devices.

Restrictions

1. When logging onto a DPPX application, error messages that are displayed on the SSCP session is truncated to one line. For example, these error messages occur when a logon command is keyed incorrectly by the user.
2. In the 3708, the Attention key sequence is only recognized when the application the user has selected is not sending data to the terminal. The user must therefore wait for either the application to finish sending or for the screen to become full.

   When logged on to the DPPX Router, the CLEAR (0,0) option of the CONTROL.DPS command should not be used, because the time to clear the screen is set to 0. There is no window of time for the user to enter the Attention sequence.
3. When logged onto the DPPX Router, the router selection menu is not updated while the user is entering a command. The user must press ENTER after keying in the command in order for the screen to be updated by the router. The Type-ahead mode of the 3708 does not alter this situation.
4. When used for standalone operations, the 8100 does not support RTM data or 3708 alerts. Alerts are, however, be logged in the 8100 error log.

Considerations

1. The logon screens and/or read prompts that can be displayed by the 3708 after a terminal is UNBOUND by DPPX are displayed at the position that the cursor was left in after the last output from DPPX. This may result in the last output from DPPX being overwritten by the 3708. This may happen in any of the following scenarios:

   - When a logon command fails and the message displayed is from the DPPX application (on the LU session, not the SSCP session)
   - When a COPY.DATA command is entered by another user and the TARGET is an LU type 2 terminal attached to the 3708
   - When the DPPX Administrator performs a VERIFY.TERMINAL with WRITE to the LU type 2 terminal attached to the 3708
   - When the user of the Application Productivity Facility (APF) switches session (the user should ignore the 3708 prompts and wait for APF to BIND the terminal to the switched to session).

   The user of the 3708 can avoid these problems by configuring the 3708 for Dynamic mode and suppressing both the logon screens and the 3708's read prompt.
2. To use the environment switching feature of the APF, the 3708 must be configured to not disconnect when it receives an UNBIND (01) from the application. This is because, when the user switches environments, APF sends down an UNBIND (01) followed by a BIND.

IBM System/38

This section describes the generation parameters and restrictions that apply to the System/38.

System/38 Generation Parameters

The following sections describe the settings recommend or required in the System/38 generation to support the 3708.

- Line Description Name

  It is recommended that the line description name (LIND) associated with the System/38's line description definition match the name defined in the SNA Line Network Name parameter of the 3708 configuration. This is not required, but because the 3708 uses the SNA Line Network Name in its alerts to the host, network management is easier if the two names are the same, related, or equivalent.

- Line TYPE

  The line type defined in the System/38's line description definition must be *SDLCP.

- NONRTNZ

  Both NONRTNZ=YES and NONRTNZ=NO may be defined in the System/38's line definition description. If NONRTNZ=YES is defined, NRZI data encoding must be set to 1 in the 3708's configuration. If NONRTNZ=N0 is defined, NRZI data encoding must be set to 0.

- Control Unit Description Name

  It is recommended that the control unit description (CUD) name associated with the System/38's control unit description definition match the name defined in the 3708's SNA PU Network Name. This is not required, but because the 3708 uses the SNA PU Network Name in its alerts to the host, network management is easier if the two names are the same, related, or equivalent.

- Control Unit Type

  Control unit type must be defined as TYPE=3274.

- MODEL

  MODEL must be defined as *NONE is the System/38's device description definition.

- Control Unit Address

  The first 2 bytes of the control unit address (CTLADR) parameter in the System/38's control unit description must be equivalent to the station address defined in the 3708's configuration. The second 2 bytes of the CTLADR must be equivalent to the line number defined in the System/38's line description definition (LINNBR).

- Device Description Name

  Device description (DEVD) name associated with the System/38's device description definition must match the name defined in the 3708's SNA LU Network Name. This is not required, but because the 3708 uses the SNA LU Network Name in its alerts to the host, network management is easier if the two names are the same, related, or equivalent.

- Device Address

  The first 2 bytes of the device address (DEVADR) parameter in the System/38's device description definition defined for the 3708 must be equivalent to the value defined for the SNA LU Device Number + 2 defined for the device in the 3708's configuration. The next 2 bytes must be equivalent to the CTLADR and the last 2 bytes must be equivalent to the LINNBR parameter defined in the System/38.

- DEVTYPE=3277

  If the device attached to the 3708 is a display, DEVTYPE must be defined as a 3277 in the System/38's device description definition. If the device attached to the 3708 is a printer, DEVTYPE must be defined as a 3287.

- MODEL

  MODEL must be defined as *NONE in the System/38's device description definition.

System/38 Restrictions/Considerations when Attaching to the 3708

Restrictions

The System/38 possesses the following restrictions when used in standalone mode:

- Protocol enveloping (LU type 1 NTO) is not supported.
- System printers are only supported as LU type 1 SCS.
- RTM data is not supported.
- Alerts are not supported.
- Unformatted session services are not supported. Logons to the System/38 are accomplished by the normal System/38 signon screen. If unformatted data arrives before the session is bound, the data is ignored by the System/38.

Considerations

Ending the SNA session: When used in standalone mode, the System/38 does not transmit an UNBIND command to the 3708 to end the 3708 session. Users cannot disconnected from the System/38 without operator intervention. To get around this, two System/38 control language programs can be created. The first program (VARYOFF) varies the device off then on. The second program (SIGNOFF) submits a job to execute the VARYOFF program and then performs a SIGNOFF command.

From the display connected to the 3708, the user enters `CALL SIGNOFF`. The display is then signed off while the VARYOFF program is being loaded. The user sees the System/38 signon screen for a second or two before being prompted by the 3708's logon screens. At this point the user may then go through the normal 3708 logon procedure to gain access to another host application.

In order to make the programs more usable, the following functions are suggested:

- Create user menus for 3708 users that have a signoff option that calls the signoff program rather than requiring the users to type `CALL SIGNOFF`.
- Have the signoff program determine the name of the terminal device and send the name along with the submit job command.
- Set up a job queue in a subsystem for submitting these special jobs. This procedure can be implemented by submitting the job to a batch subsystem.
- Have the submitted job check to make sure that the terminal was signed off before doing the vary off/vary on.

Keyboard Mappings: Devices attached to the System/38 in standalone mode, emulate 5250 devices through the 3270 emulation of the 3708. There are several considerations due to this double emulation. The majority of these differences are described in the Table A-1 on page A-10. For more details, refer to the *IBM System/38 Programmers/Users Workstation Guide,* SC21-7744. In addition, attachment to a 3708 has the following considerations:

- System/38 command keys need to be preceded by a PA1 key. Usually this is an ESC, on the 3708. To perform the System/38 command 1 key, the user must press ESC, F1 sequence. The sequence ESC, F2 performs the System/38 command 2 key, and so on.
- Because the 3708 does not support the extended 3270 data stream, 5250 functions such as underlining of input fields, column separators, and reverse images are not supported.

Keyboard map definitions can be changed both in the 3708 and the System/38 workstation support to allow the user to customize keyboard maps to their own particular environments.

3270 Keyboard to 5250 Keyboard Mapping: The following table provides the default PF key assignments to perform the various 5250 functions. The user can specify different PF key assignments (masking) by using the Define Keyboard Map (DFNKBDMAP) command or the Change Keyboard Map (CHGKBDMAP) command. The Display Keyboard Map (DSPKBDMAP) command and the 3270 Help key lets the user see the present assignments for the work station.

Table A-1. 5250 Default PF Key Assignments

5250 Help Function	3270 Key(s) to Select Function
Help	PF1
3270 Help	PF2
Clear	PF3
Print	PF4
3270 Display of 5250 Extended Attributes	PF5
Test Request	PF6
Roll Down	PF7
Roll Up	PF8
Attention	PF9
Error Reset	PF10
Sys/Req	PF11
Record Backspace	PF12
CF1 through CF12	PA1 then PF1 through PF12
CF13 through CF24	PF13 through PF24 if present, or PA2 then PF1 through PF12
Field Exit	Erase EOF then Field Tab

Appendix B. 3708 Security

This appendix describes ways to control access to the system using features provided by the 3708.

Port Passwords

The 3708 allows the control terminal operator to define a port password for each downstream port. The port password may be up to 8 characters in length and can contain any combination of characters except #### (used to disconnect from the 3708), a comma, embedded blanks, and periods. It is suggested that passwords not contain vowels, nor be trivial or obvious.

The control terminal operator can also define the retry limit for each port password. Each port password retry limit may range from 1 to 9. Default value is 7. When the port password retry limit is exceeded, the 3708 will:

- Disconnect the user
- Transmit an A105 'Port xx Password Retry Limit xx Exceeded' alert to the SNA host(s) and control terminal's alert log
- Reset the port password retry limit to 1.

The 3708 continues to keep the port password limit at 1 until the correct password is chosen. Once the correct password is entered, the 3708 once again uses the defined port password retry limit.

Control Terminal Password

The 3708 allows the control terminal operator to define the control terminal password. The control terminal password may be up to 8 characters in length and can contain any combination of characters except #### (used to disconnect from the 3708), a comma, embedded blanks, and periods. It is suggested that passwords not contain vowels, nor be trivial or obvious.

The control terminal password retry limit is set by the 3708 to 3. This may not be changed. When the control terminal password retry limit is exceeded, the 3708 will:

- Disconnect the user
- Transmit an A106 "CT Password Retry Limit xx Exceeded - Port xx" alert to the SNA host(s) and control terminal's alert log
- Reset the control terminal password retry limit to 1.

The 3708 continues to keep the retry limit at 1 until the correct password is chosen. Once the correct password is entered, the 3708 once again resets the control terminal retry limit to 3.

Control Terminal Access

The 3708 allows the control terminal operator to exclude control terminal access on a port by port basis. If control terminal access is set to 'N' for a downstream port, access to control terminal functions is not possible. The user is not prompted with the "c - Control Terminal" option on the host selection screen and a 'c' input is rejected with an `Incorrect Response` message.

Multiple Control Terminal Sessions

The 3708 does not allow multiple control terminal sessions. If the control terminal is in use and an attempt to gain access to the control terminal is made by another user, the 3708 does the following:

- Rejects the second control terminal request with a `Control Terminal Already Active` message
- Notifies the existing control terminal that an attempt was made to gain access to the control terminal functions with a C100 `Activation of Another Control Terminal Session Rejected` message.

Transmission of UNBIND(0F) and/or TERM-SELF(40)

The 3708 transmits an UNBIND(0F) and NOTIFY (power off) or TERM-SELF(40) and NOTIFY (power off), or just NOTIFY (power off) SNA command to the host to terminate a user's LU-LU session under the following conditions:

- The user is disconnected or powers off in the middle of the session
- The 3708's inactivity timer expires.

The NOTIFY (power off) ensures that the SSCP is aware of the loss of a session. The UNBIND(0F) or TERM-SELF(40) command ensures that the network terminates the LU-LU session and prohibits another user from dialing into the same 3708 port and gaining access to the previous user's application. See "Ending Host Sessions and Disconnecting from the 3708" on page 2-12.

Inactivity Timeout

An inactivity timeout can be configured for each dial-in port or for each port using EIA 422A interface. The timer is reset each time a character is transmitted from the host or from the terminal. If the timer expires, the SNA session is broken. See "Ending Host Sessions and Disconnecting from the 3708" on page 2-12 for more information.

Disconnecting from a Session

Session security responsibility resides at the SNA host and the ASCII host because the 3708 cannot unconditionally break a session in a way that guarantees that the SNA host (or ASCII host) forces a new LOGON procedure. The host software may recognize a disconnect, but it may consider it to be an error to be recovered from if there is not appropriate host support. If the host institutes an error recovery procedure, then the session that was broken could be recovered by a host that disregards accounting and security measures.

Security Features

The 3708 monitors modem interface and disconnects-on-error in the following ways:

- DSR and CTS are monitored for error conditions.
- Auto-Answer On Hook Option is provided for monitoring of carrier detect. The 3708 disconnects on loss of carrier.
- On disconnection, the 3708 waits up to 3 seconds for DSR to drop.
- On switched connections, the port does not activate if DSR is present.

Appendix C. Suggested Guidelines for Increasing 3708 Performance

The following is a list of actions that increase the performance and throughput of the 3708:

- Maximize the number of internal 3708 system buffers.

  This can be done by taking one or more of the following actions:

  - Exclude unused 3708 ports
  - Minimize the number of medium and large 3708 receive queue buffers
  - Minimize the number of MLU ports defined for the 3708.

- Require the host application to chain and not segment the data transmitted to the 3708.

  This can be done by setting the maximum RU size in the BIND command to X'85'. The recommended setting for the 3708 for bytes 10 and 11 in the BIND is X'8585'.

- Use XON/XOFF pacing.

  If the downstream ASCII device supports XON/XOFF pacing, configure both the device and the 3708 to accept XON/XOFFs. Downstream device support of XON/XOFFs allows faster recovery from 3708 Slowdown mode should the condition ever occur.

- Minimize the upstream polling delays.

  This can be done by taking one of the following actions:

  - Define the connection between the host and the 3708 as point-to-point
  - Do not set the time between polls (PAUSE) to 0. Allow this option to default to 0.2 seconds.

- Enable outbound pacing.

  If the 3708 is entering buffer slowdown while running LU type 1 NTO or LU type 1 SCS, Slowdown mode can be avoided and performance enhanced for the entire 3708 by taking one of the following actions:

  - Decrease the outbound pacing parameter in byte 9 of the BIND command, for LU type 1 SCS operations. The minimum value accepted by the 3708 is 1.

  - Define the outbound pacing parameter in the BIND to a low nonzero value for LU type 1 NTO operations.

  Enabling outbound pacing prevents the host from flooding the 3708 with data when the 3708 is supporting a slow device, such as a printer or mechanical keyboard/display.

- Use exception response instead of definite response.

  If definite response is defined in the BIND command (bytes 4 and 5), the 3708 and/or host are forced to wait until a response is received for each RU until the next RU can be sent. To avoid this, the BIND can be changed to request exception responses only. With exception response, responses are sent only when an RU is in error. The transmitting device does not have to wait for a response to each RU.

  Definite response is recommended if running LU type 1 SCS mode, the 3708 is entering buffer slowdown, or a slow downstream device is causing 3708 performance to suffer. (These devices may be accommodated also by requiring outbound pacing in the BIND command).

- Increase the number of automatic host retries on SNA framing errors by taking one of the following actions:

  - Increase the number of automatic retransmissions on the line when a framing error occurs. With NCP systems this can be done by increasing the RETRIES values and decreasing the time between automatic polls.

  - Allow the host to automatically retransmit when an idle detect timeout occurs on the SDLC line. With NCP systems this can be done by defining IRETRY=YES in the NCP generation.

Appendix D. Personal Computer File Transfer through the 3708

The purpose of this appendix is to assist customers who wish to develop their own programs to transfer files through the 3708. Its intention is not to describe a particular implementation of personal computer (PC) file transfer, but rather to discuss the major features and functions of the 3708 that must be taken into account when transferring files.

IBM has developed its own software product, IBM PC/HOST File Transfer and Terminal Emulator Program (FTTERM), that uses an IBM PC to transfer files through the 3708.

Overview

Personal Computer file transfer with a 3708 refers to the ability of a personal computer (PC) to transfer data between its diskette and either an IBM SNA or ASCII host (which may be another PC).

To control the exchange of data, PC file transfer requires two compatible programs: one in the host and the other in the PC. These programs communicate between themselves and provide the set of rules and conventions necessary to transfer files in the customer's particular environment.

When the 3708 is present, it resides between the two communication programs and monitors the data stream between them. Depending upon its configuration and mode of operation, the 3708 performs certain functions; for example, when it recognizes certain characters (such as line turnaround or control characters) or detects error conditions (such as parity or framing errors) in the data stream.

These functions of the 3708 must be taken into account by the customer's file transfer programs and in some cases may be used by the customer to enhance the performance of their file transfers.

The following sections examine these functions for each of the 3708's three modes of operation - protocol enveloping, protocol conversion, and ASCII pass-through.

Protocol Enveloping

In protocol enveloping mode, communication between a downstream device and an upstream SNA host occurs in a line-by-line manner. Generally, this is controlled through the use of line turnaround (LTA) characters. Up to five different LTA characters may be defined by the 3708's control terminal operator for each port on the 3708 capable of operating in protocol enveloping mode.

Protocol Enveloping Data Flow

When data is received by the 3708 from a downstream PC, the incoming data characters are stored in a receive queue. For more information on data flow in protocol enveloping mode, see "Data Flow Description" on page 5-11. For a description of 3708 queues and buffers, see Appendix E, "Key Data Formats and Control Blocks."

As the 3708 processes each character from the receive queue, it echoes the character back to the PC (if echoplexing is configured for the port) and places the character in a system buffer. Each system buffer holds 256 data characters plus the information necessary to envelop the data with SNA headers. When 256 characters are received, the 3708 transmits the system buffer to the host as either the first or middle element of an SNA chain.

The 3708 continues to process characters from its receive queue until it recognizes a defined LTA character or a configurable text timeout period is exceeded. At this point, the last bit of data (including the LTA character, if received) are transmitted to the host as the end element of the SNA chain. (If the text timer expires, or a LTA character is received before the first system buffer is filled, the 3708 transmits the system buffer as an "only in chain" element.)

Overflow of the Receive Queue

Depending upon the 3708's configuration, the speed at which file transfer is being performed and the work load on the 3708, it is possible to overflow the 3708's receive queue. Should this happen in protocol enveloping mode, the 3708 causes the session to be lost and transmits an alert, A102 'RCV QUEUE OVERRUN', to the control terminal and SNA host.

To prevent an overrun of the receive queue, the 3708 can be configured to transmit XON/XOFF pacing characters (TRANSMIT XON/XOFF = 1). When TRANSMIT XON/XOFF = 1 is configured for a port, the user may also specify the XOFF threshold with the RECEIVE QUEUE PACING THRESHOLD option. The RECEIVE QUEUE PACING THRESHOLD allows the user to specify whether the 3708 transmits an XOFF when its receive queue is 50% (RQPT=1) or 75% (RQPT=2) full. The 3708 transmits an XON (X'11') to the downstream device when the receive queue is 25% full.

For XON/XOFF pacing to successfully prevent the receive queue overrun, the downstream device must stop transmitting within a few character times after receiving a XOFF from the 3708. If the downstream device does not do this or does not recognize XON/XOFF characters (TRANSMIT XON /XOFF = 0), the 3708 allows the control terminal operator the ability to configure the size of the port's receive queue. The control terminal operator may chose one of three receive queue sizes (79, 519, and 1079 bytes) for each downstream port. The receive queue sizes may be configured independently of any of the pacing options.

The 79 byte receive queue is the default and is recommended for those ports that will be handling normal interactive traffic. The larger receive queues are chosen at the expense of 3708 system buffers. The constraint is:

(# of 519 byte ports) + 2(# of 1079 byte ports) + 2(# of MLU ports) +
2(# of large screen ports) < 40 - 2A

where MLUs are the number of ports defined for device type 4 (display-with-printer), large screen ports are the ports that have 3270 Model Emulation specified as 3, 4, or 5, and A is the number of ports not excluded.

Note: More system buffers are available and more larger receive queues can be supported if unused ports are excluded by the control terminal operator.

If XON/XOFF pacing is not supported, the customer's PC file transfer program must transmit "lines" of data less than the configured receive queue size.

A typical line is:

Data	Status	LTA

The PC file transfer program would read some amount of data to be transmitted to the host from its diskette. Appended to this data would usually be a status field of predetermined length to indicate the state of the transfer and a LTA character. The status would typically contain some sort of error checking field such as a checksum or CRC.

Upon receiving the PC's line of data, the host program would interpret the status and send its own line of data requesting that the PC resend the information, transmit the next line of data, or terminate the file transfer.

Encryption

Because the 3708 normally uses LTA characters to control communication between the PC and the host, LTA characters should appear only at the end of each line. LTA characters should not occur in either the data or status portion of a line.

Files containing LTA characters or binary data, which can be interpreted as LTA characters, must be encoded in some manner to be transferred successfully through the 3708.

Typically this is done through a byte expansion technique. The simplest technique (also the most expensive in terms of bandwidth) is a two-for-one expansion. In this method, two alphanumeric characters encode the binary representation of each character. For example, assume that an ESC (X'1B) is to be transmitted to the host. Using a two-for-one expansion, the ESC would be expanded and transmitted as two ASCII characters, X'31', X'42' (the number '1' and the letter 'B' in ASCII).

Files that contain binary data or embedded LTA characters can either be entirely encrypted or (to reduce the required bandwidth) may be encrypted using a "BSC like" transparency feature. Encoded characters are preceded and followed by some special delimiter sequences. For example, a DEL STX sequence may indicate the beginning of an encoded sequence, and a DEL ETX the end of the encoded sequence. Characters used in such delimiters cannot be defined as LTA characters and may require to be transmitted in a unique way when they occur in the file itself. For example in BSC transparency, a DEL DEL sequence is needed to transmit the single DEL character.

Other encoding schemes may also be employed to reduce the amount of bandwidth. For example, the 256 possible bit combinations can be divided up into quadrants. Displayable code characters are chosen to identify each quadrant and the hex codes within each quadrant. The algorithm to encode a file is:

- Find the code character for both the quadrant and the particular hex code.
- If the hex code was in the same quadrant as the previous hex code, transmit only the code character for the hex code.
- If the hex code was not in the same quadrant as the previous hex code, transmit code character for both the quadrant and the hex code.

This conversion scheme results in, at worst, a two-for-one expansion. A much lower expansion results by choosing the quadrants such that codes likely to appear adjacent to each other in the data stream are in the same quadrant.

Protocol Enveloping Features

The 3708 monitors the data stream coming from the PC for framing and parity errors. Checking for parity errors can be configured by the 3708's control terminal operator. There are several possibilities:

- Parity and echoplexing configured off and the 3708 receives bad parity.

  The 3708 transmits the character with the bad parity to the host. If communication lines are relatively free of noise, this configuration generally results in the fastest file transfers.

- Parity off and echoplexing on.

  The 3708 transmits the character with the bad parity to the host and the character with the bad parity is echoed back to the PC. Echoes can be used to check the validity of the data received by the 3708 and can also be used to prevent the overflow of the 3708's receive queue.

- Parity on and echoplexing off.

  When parity checking is configured on, the 3708 replaces any character with bad parity with a substitution character (defined at configuration for each port). The substitution character is then sent to the host.

- Parity on and echoplexing on.

  The 3708 transmits a substitution character to the host. The character with the bad parity is echoed back to the PC.

Error checking and recovery are the responsibility of the PC and host file transfer programs.

Independent of the parity and echoplexing configurations, the 3708 also checks for framing errors (that is, if a stop bit is expected but not received). If a framing error occurs, the 3708 replaces the character with the parity substitution character and sends the substitution character up to the host. If echoplexing is configured on, the 3708 echoes back the framing error to the PC.

Again, any error recovery is exclusive between the PC and the host file transfer programs. When retransmission of data is required, the PC must request the host to retransmit the data. Likewise, the host needs to request that the PC retransmit any data that the host program receives in error.

8-Bit Transparency

In protocol enveloping, the 3708 can be configured to support the transmission of 8-bit data to and from an SNA host. In this mode, the port should be configured with no LTA characters. Data is then transmitted from the 3708 to the host after a configurable text timeout period has expired. Although this means that the 3708 may spend time waiting for the text timeout, the advantages of configuring the 3708 this way include the ability to transfer 8-bit data (256 character sets) and to delete any encryption requirement.

Also note that when configured for 8-bit data, the 3708 does not perform any parity checking. Parity checking is strictly through an end-to-end protocol.

Protocol Enveloping PC File Transfer Summary

The following summarizes the scenario for PC file transfer in the 3708's protocol enveloping mode:

- The PC reads an amount of data from its diskette and creates a line of data to be transmitted to the host.

  Each line contains the data to be transmitted, status, and possibly a LTA character.

  If LTA characters are used to control communication:

  - All files containing LTA characters must be encrypted
  - All binary files must be encrypted
  - All binary fields, such as status fields, in each line must be encrypted.

  If text timeouts are used to control communication:

  - 8-bit transparency and the transfer of 256 character sets are possible
  - Encryption is not required.

- The PC transmits its line of data to the host (the receive queue cannot be overrun).
- The 3708 sends the line of data to the host in one or more SNA chains.
- After receiving the line, the host performs any necessary decryption, interprets the status, calculates any checksum or CRC, and responds with some indication to the PC to send the next line of data or to retransmit.
- The PC then either resends the line or transmits the next line of data.
- The process continues until the entire data file has been uploaded.

Besides compatibility with the PC program and the ability to operate in the LU type 1 NTO environment of the 3708's protocol enveloping mode, there are no restrictions on the host's file transfer program.

Protocol Conversion

In protocol conversion mode, PCs performing file transfer must emulate one of the 3708's supported displays. These consist of several default terminals and up to six user-defined terminals (UDTs).

Unlike in protocol enveloping mode, where file transfer is performed a "line" at a time, the transmission of files in protocol conversion is based on "screens" of data.

Protocol Conversion Data Flow

As in protocol enveloping, when data is received from a downstream PC, it is placed in a "receive queue". See Chapter 4, "Protocol Conversion Mode" for more detailed information on data flow in protocol conversion mode. See Appendix E, "Key Data Formats and Control Blocks" for a description of internal 3708 queues and buffers.

As the 3708 processes characters from the receive queue, it performs the protocol conversion, echoes the characters back to the PC, and places the data in a device buffer. The device buffer is used to emulate the terminal's screen (usually, 24 rows by 80 columns, plus 80 bytes for a status line).

The 3708 continues to process characters from its receive queue until it recognizes an AID key sequence (AID key sequences represent the PF1 - PF24, PA01 - PA03, Clear, and Enter functions). Upon processing an AID key sequence, the 3708 transfers any 3270 fields that have been modified into one or more system buffers and transmits the updates to the SNA host.

Overflow of the Receive Queue

As in protocol enveloping, it is possible to overflow the 3708's receive queue. Unlike protocol enveloping, however, if this should happen, the session is not ended; rather, the 3708 logically locks the PC's keyboard and either transmits an "OVRFLO" status line message to the PC (if the status line is toggled on or the terminal supports a 25th addressable line) or transmits a BEL character (if the status line is toggled off). In any case, the PC's file transfer program must be able to handle unsolicited status line (or BEL) notifications from the 3708.

To recover, the PC needs to transmit the RESET key sequence for the particular terminal it's emulating and retransmit the data. Thus, instead of using XON/XOFF pacing or the larger receive queue sizes, file transfer programs in protocol conversion may elect to wait for an overflow condition to occur and then recover, using the last character echoed by the 3708 to determine where their data stream was interrupted.

Encryption

In protocol conversion mode, the 3708 emulates 3270 functions via certain control character sequences. For example, on an IBM 3101 display, the keystroke sequence, ESC 8, represents the function key PF8. To transmit control characters such as ESC through the 3708, the customer's PC file transfer program must employ some encryption scheme.

Binary data must always be encrypted.

Protocol Conversion Features

In protocol conversion, the 3708 always checks for parity and framing errors. Both are handled in approximately the same manner. When the 3708 detects either a parity or framing error from the PC and the PC is not displaying a status line, the 3708 BELs the PC and refuses to process any more characters. If the PC is receiving a status line indication, the 3708 puts a PARITY or FRAME message on the status line depending upon which error condition occurred.

To proceed, the customer's PC file transfer program must send a RESET key sequence and begin retransmission. The entire screen may be retransmitted or the PC's file transfer program may back off (by examining the echoed characters from the 3708) and begin transmission at the bad character.

To enhance file transfer support, the 3708 also allows the downstream device to disable the 3708's normal keyboard lock when a parity or framing error occurs. Two key sequences can be defined to the 3708 – Enable File Transfer (function number X'3C) and Disable File Transfer (function number X'3D). For the IBM 3101, PC/FTTERM Color, and PC/FTTERM Mono keyboard maps, these functions are defined as ESC > and ESC <, respectively. If another type of terminal emulation is used, a UDT needs to be configured to define the Enable and Disable File Transfer key sequences.

After the 3708 receives an Enable File Transfer key sequence, it substitutes a null character for any character containing a parity or framing error. The status line is not updated and the keyboard is not locked. If enhanced null/blank processing is off, these null characters are suppressed when sent to the host. If enhanced null/blank processing is on, the nulls are converted to blanks and sent to the host. Because the 3708 does not enforce the correct parity and framing bits on data coming from the PC after an Enable File Transfer sequence, it is the responsibility of the host program to detect erroneous characters either by a length check or some sort of checksum or CRC.

When the 3708 receives a Disable File Transfer key sequence, normal parity and framing handling are once again in effect.

If the PC receives an erroneous character from the 3708, the customer's PC file transfer program may either request the host to send again or it may take advantage of the 3708's REFRESH function and get the 3708 to repaint the screen; thus saving time and network overhead.

When files are transmitted to the PC, the 3708 does not rely on any Auto Wrap or scroll capabilities of the PC. To ensure the correct positioning of the cursor, the 3708 transmits Set Cursor Address at the end of each line and screen of data. The PC's file transfer program must interpret these Set Cursor Address commands so that they are not stored as part of the file on the PC's diskette.

Because the high order bit is used by the 3708 to indicate whether or not a byte is an attribute byte for LU type 2 and LU type 3 sessions, 8-bit data transfer is not possible through the 3708 in protocol conversion mode.

Protocol Conversion PC File Transfer Summary

The following summarizes the scenario for PC file transfer in the 3708's protocol conversion mode:

- The PC reads a "screen" of data off its diskette for transmission to the host. If an entire screen (1920 characters) of data is to be transferred, the PC should have scrolling turned off.

  Any file that can contain control characters must be encrypted. Binary files must be encrypted. 8-bit data transfer is not possible.

- The PC transmits its screen of data to the 3708 followed by an AID key sequence.
- Upon processing the AID key sequence, the 3708 transfers the screen of data to the host.
- The host recognizes the AID key as signaling a screen full of data.
- After processing the data, the host updates the screen (perhaps by blanking out the screen or placing some character sequence in a reserved field) to indicate whether the data was stored or that the screen needs to be retransmitted.
- The PC recognizes the updated screen and either retransmits its data or sends the next screen of data.
- This continues until the entire file has been uploaded (a different AID key could signal the end of file transfer).
- If during transmission, a parity or framing error occurs, the PC program can either:
  - Have previously transmitted an Enable File Transfer key sequence

    Detection of the parity or framing error is then the responsibility of the host program.

  - Recognize that a parity or framing error has occurred (interrogate the status line), unlock the keyboard by transmitting a RESET key sequence, and retransmit the data in error.

The algorithm for the host program is similar:

1. The host transmits a screen of data to the PC.
2. Within this screen of data is an indication in a reserved field that tells the PC that the entire screen has been sent.
3. The PC must recognize and interpret the 3708's Set Cursor Address commands so that they are not stored on the diskette.
4. If the data was received correctly, the PC stores the data on its diskette and send an AID key to the host asking for the next screen of data.
5. If the data was received in error, the PC could either request retransmission from the 3708 by issuing a REFRESH key sequence or by requesting the host to retransmit via an AID key.

ASCII Pass-Through

In ASCII pass-through mode, the 3708 acts as a wire connection. The 3708 does not monitor the data stream, so data encryption is not necessary and 8-bit transparency (256 character sets) can be supported. See Chapter 6, "ASCII Pass-Through Mode" for more detailed information about data flow in ASCII pass-through mode. See Appendix E, "Key Data Formats and Control Blocks" for a description of internal 3708 queues and buffers.

In ASCII pass-through, data from the PC and the ASCII host is received in a 980 byte "receive" queue. Overflow of this receive queue results in loss of data. Generally, the PC and host file transfer programs recognize the loss of data and request a retransmission.

Because data is routed to and from the PC and the ASCII host, any two compatible PC file transfer programs can be used.

Finally, the ASCII host can also be another PC. It must, however, be defined to the 3708 as an ASCII host.

Appendix E. Key Data Formats and Control Blocks

This appendix briefly discusses the key data formats and control blocks. This is by no means an exhaustive list of the 3708 control blocks or data blocks. It is a very small subset.

System Buffers

System buffers are primarily used to receive traffic from an SNA host or to transmit traffic to an SNA host. When there are insufficient buffers, the 3708 temporarily enters "buffer slowdown." While in buffer slowdown, data traffic is not accepted from the SNA host. SNA activations are rejected. Traffic from protocol conversion keyboard displays may be stopped and loss of data from protocol enveloping keyboard displays may occur. It is undesirable for the 3708 to enter buffer slowdown.

The number of system buffers required to support SNA application sessions can be lessened by the host use of SNA pacing, use of SNA definite response chains, or end-to-end pacing.

Maximizing Available System Buffers

The actions suggested here reduce the numbers of, and sizes of, certain control blocks and data areas which might otherwise unnecessarily use up RAM space, thereby reducing the number of system buffers. The number of system buffers available is a function of the 3708 configuration. The following configuration options are suggested to increase the number of available system buffers:

1. Exclude ports from the configuration when/if it is known which ports are never going to be used.
2. Do not configure a port for a keyboard display-with-printer unless:
   - There really is such a device.
   - It will be running in protocol conversion mode.
   - Both LUs will be supported by host application(s).

   The keyboard display-with-printer support provides an appearance to the SNA host as if there were another port on the 3708 for the printer. The actual case is that the printer is on the same port and same cable as the keyboard display device which controls it. The keyboard display-with-printer support is intended for the case where:

   - The special support is in the device.
   - The two LUs are utilized in protocol conversion mode.
3. Do not configure for Model 2 emulation unless it is used.
4. Use small receive queues versus medium or large.
5. Do not configure two SNA hosts and allow access to both for all ports unless you really mean to do so.

Determining the Number of System Buffers

You can determine how many system buffers have been defined for your configuration and also how many are "free" at any given time by doing the following procedure:

> Using the 3708 control terminal, display memory at location 1B0A for 2 bytes. The data displayed is the count (in hex) of the number of system buffers that exist with the active configuration. Then display memory at location 1B10 for 2 bytes. The data displayed is the count (in hex) of free buffers. This number changes dynamically as data is transferred through the 3708, and as sessions become active or inactive.

Receive Queues

The receive queues can be configured as small (79 characters), medium (519 characters), and large (1079 characters). Small is the default. The larger sizes are provided primarily for protocol enveloping file transfer or data streaming applications of data from the terminal to the host having large block transfer sizes up to 540 or 1080 characters. Data blocks of up to these sizes might be sent by the terminal (or an IBM Personal Computer) in protocol enveloping mode to the host without any pause or acknowledgement. Medium or large receive queue sizes should be configured as necessary to satisfy the requirements of large block transfers from the terminal to the host. However, use of larger than necessary receive queue sizes provides no advantage, and unnecessarily uses up RAM space that would otherwise be available for system buffers.

Device Buffers

Device buffers are used with each port except SNA host ports. The buffers are 2126 bytes long, unless the port is configured to allow model 3, 4, or 5 emulation. The following table shows the buffer size for these ports:

Model Number	Buffer Size
3	2808
4	3746
5	3860

When a port is being used in protocol enveloping mode, the device buffer is merely used as a work area into which host data is copied during the translation step before being transmitted to the terminal.

When a port is being used in protocol conversion mode for an LU type 2 (keyboard display) or LU type 3 (DSC printer), the device buffer is used to contain the ASCII screen image as the image is formed during the translation step. Data is represented by 7-bit ASCII codes. The 3270 field attribute bytes are also imbedded in the screen image and represent the start of fields.

When a port is being used in protocol conversion mode for an LU type 1 (SNA character set printer), the device buffer is used to contain the expanded ASCII data stream formed as the host data is translated and the SCS printer orders are encountered. Data is represented by 7- or 8-bit ASCII codes.

Appendix F. IBM-Supplied Translate Tables

This appendix describes the character conversions that the 3708 performs before sending data to the host and the end user devices, and it gives the standard 3708 translate tables for EBCDIC and ASCII characters.

Converting Between ASCII and EBCDIC

All data, commands, and orders sent between the 3708 and the SNA host are in the Extended Binary-Coded Decimal Interchange Code (EBCDIC). The EBCDIC values that the 3708 accepts are outlined in Figure E-2. The 3708 translates the EBCDIC characters into ASCII characters to send to the device.

The following table, Figure F-1, shows the characters, the EBCDIC values, and bits 2 through 7 that are transmitted.

Note: If the 3708 receives a 08nn sequence (APL), the 3708 sends a colon (:). If the 3708 receives a print order, the 3708 sends a blank and stores the order in a buffer. If the high order bit in the translated character is on, the 3708 sends a colon (:).

Data that is sent to the host is translated from ASCII to EBCDIC. However, the translation can be changed to anything. For information on creating a user-defined translate table, refer to *IBM 3708 Network Conversion Unit Planning and Installation.*

In protocol conversion mode, attribute characters, buffer addresses, and write control characters (WCC) must be converted so that they can be represented by valid EBCDIC values. To do this, the last 6 bits are used to determine the first 2 bits using the table in figure E-2. For example, if the last 6 bits are b'001001', they would be mapped to the EBCDIC graphic character I and the EBCDIC value C9. Therefore, the first 2 bits are b'11' because C9 is b'11001001.'

Note: When operating in LU type 1 SCS transparency mode, no translation is done unless nonstandard operating bit 8 is set to 1.

Bits 0.1		00				01				10				11			
Bits 2.3	Hex 1	00	01	10	11	00	01	10	11	00	01	10	11	00	01	10	11
Bits 4567	Hex 0	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0000	0	NUL				SP	&							{	}	\	0
0001	1		SBA					/		a	j	~		A	J		1
0010	2		EUA							b	k	s		B	K	S	2
0011	3		IC							c	l	t		C	L	T	3
0100	4									d	m	u		D	M	U	4
0101	5	PT	NL							e	n	v		E	N	V	5
0110	6									f	o	w		F	O	W	6
0111	7									g	p	x		G	P	X	7
1000	8	GE		SA						h	q	y		H	Q	Y	8
1001	9		EM	SFE					`	i	r	z		I	R	Z	9
1010	A					¢	!	¦	:								
1011	B					.	$	,	#								
1100	C	FF	DUP	MF	RA	<	*	%	@								
1101	D	CR	SF			(	)	_	'								
1110	E		FM			+	;	>	=								
1111	F					|	¬	?	"								EO

Notes:

1. *Character code assignments other than those shown within all outlined areas of this chart are undefined. If an undefined character code is programmed, the character that will be displayed or printed is a colon (:); hex code 7A will be returned on a subsequent read operation.*

2. *CR, NL, EM, and FF control characters are displayed and printed as blank characters. The DUP and FM control characters are displayed respectively and are displayed and printed as * and .*

3. *Bits 0 and 1 are assigned for the following characters: AID, attribute, write control (WCC), buffer address. Bits 0 and 1 are assigned so that each character can be represented by a graphic character within the solid outlined areas of the chart.*

Figure F-1. United States EBCDIC I/O Interface Code for the 3708

Bits 2 - 7	Graphic Code	EBCDIC	Bits 2 - 7	Graphic Code	EBCDIC
00 0000	Space	40	10 0000	-	60
00 0001	A	C1	10 0001	/	61
00 0010	B	C2	10 0010	S	E2
00 0011	C	C3	10 0011	T	E3
00 0100	D	C4	10 0100	U	E4
00 0101	E	C5	10 0101	V	E5
00 0110	F	C6	10 0110	W	E6
00 0111	G	C7	10 0111	X	E7
00 1000	H	C8	10 1000	Y	E8
00 1001	I	C9	10 1001	Z	E9
00 1010	¢	4A	10 1010	splt bar	6A
00 1011	.	4B	10 1011	,	6B
00 1100	<	4C	10 1100	%	6C
00 1101	(	4D	10 1101	_	6D
00 1110	+	4E	10 1110	>	6E
00 1111	|	4F	10 1111	?	6F
01 0000	&	50	11 0000	0	F0
01 0001	J	D1	11 0001	1	F1
01 0010	K	D2	11 0010	2	F2
01 0011	L	D3	11 0011	3	F3
01 0100	M	D4	11 0100	4	F4
01 0101	N	D5	11 0101	5	F5
01 0110	O	D6	11 0110	6	F6
01 0111	P	D7	11 0111	7	F7
01 1000	Q	D8	11 1000	8	F8
01 1001	R	D9	11 1001	9	F9
01 1010	!	5A	11 1010	:	7A
01 1011	$	5B	11 1011	#	7B
01 1100	*	5C	11 1100	@	7C
01 1101	)	5D	11 1101	'	7D
01 1110	;	5E	11 1110	=	7E
01 1111	¬	5F	11 1111	"	7F

Figure F-2. Supported United States I/O Interface Codes

Standard Translate Tables

The 3708 provides two standard translate tables—a default table and an alternate table. The two tables are identical except for the characters listed below.

Default Translate Table

EBCDIC Code	EBCDIC Character	ASCII Code	ASCII Character
AD	[	3A	:
BD	]	3A	:
5A	!	5D	]
4F	|	21	!
4A	¢	5B	[

Alternate Translate Table

EBCDIC Code	EBCDIC Character	ASCII Code	ASCII Character
AD	[	5B	[
BD	]	5D	]
5A	!	21	!
4F	|	7C	¦
4A	¢	5C	\

Note: When using the alternate translate table, two sets of EBCDIC characters map into the same ASCII character. Both an EBCDIC \ (X'E0') and ¢ (X'5C') map into an ASCII \ (X'5C') and an EBCDIC | (X'4F') and ¦ (X'6A') map into an ASCII ¦ (X'7C'). The ASCII \ (X'5C') and ¦ (X'7C') are mapped into the EBCDIC characters ¢ (X'5C') and | (X'4F') respectively.

Default EBCDIC to ASCII Translate Table

The following table shows the EBCDIC code and character and the corresponding ASCII code and character for each address in the default translate table. Any characters that are not defined in ASCII are translated to X'3A' ASCII (:).

Address	EBCDIC Code	EBCDIC Character	ASCII Code	ASCII Character
000000	00	NUL	00	NUL
000001	01	SOH	01	SOH
000002	02	STX	02	STX
000003	03	ETX	03	ETX
000004	04	N/A	3A	:
000005	05	HT	09	HT
000006	06	N/A	3A	:
000007	07	DEL	7F	DEL
000008	08	N/A	3A	:
000009	09	N/A	3A	:
00000A	0A	N/A	3A	:
00000B	0B	VT	OB	VT
00000C	0C	FF	OC	FF
00000D	0D	CR	OD	CR
00000E	0E	SO	OE	SO
00000F	0F	SI	0F	SI
000010	10	DLE	10	DLE
000011	11	DC1(XON)	11	DC1(XON)
000012	12	DC2	12	DC2
000013	13	DC3(XOFF)	13	DC3(XOFF)
000014	14	N/A	3A	:
000015	15	NL	0A	LF
000016	16	BS	08	BS
000017	17	IL	7F	DEL
000018	18	CAN	18	CAN
000019	19	EM	19	EM
00001A	1A	N/A	3A	:
00001B	1B	N/A	3A	:
00001C	1C	FS	1C	FS
00001D	1D	GS	1D	GS
00001E	1E	RS	1E	RS
00001F	1F	US	1F	US
000020	20	N/A	3A	:
000021	21	N/A	3A	:
000022	22	N/A	3A	:
000023	23	N/A	3A	:
000024	24	N/A	3A	:
000025	25	LF	0A	LF
000026	26	ETB	17	ETB
000027	27	ESC	1B	ESC

Address	EBCDIC Code	EBCDIC Character	ASCII Code	ASCII Character
000028	28	N/A	3A	:
000029	29	N/A	3A	:
00002A	2A	N/A	3A	:
00002B	2B	N/A	3A	:
00002C	2C	N/A	3A	:
00002D	2D	ENQ	05	ENQ
00002E	2E	ACK	06	ACK
00002F	2F	BEL	07	BEL
000030	30	N/A	3A	:
000031	31	N/A	3A	:
000032	32	SYN	16	SYN
000033	33	N/A	3A	:
000034	34	N/A	3A	:
000035	35	N/A	3A	:
000036	36	N/A	3A	:
000037	37	EOT	04	EOT
000038	38	N/A	3A	:
000039	39	N/A	3A	:
00003A	3A	N/A	3A	:
00003B	3B	N/A	3A	:
00003C	3C	DC4	14	DC4
00003D	3D	NAK	15	NAK
00003E	3E	N/A	3A	:
00003F	3F	SUB	1A	SUB
000040	40	ƀ	20	ƀ
000041	41	N/A	3A	:
000042	42	N/A	3A	:
000043	43	N/A	3A	:
000044	44	N/A	3A	:
000045	45	N/A	3A	:
000046	46	N/A	3A	:
000047	47	N/A	3A	:
000048	48	N/A	3A	:
000049	49	N/A	3A	:
00004A	4A	¢	5B	[
00004B	4B	.	2E	.
00004C	4C	<	3C	<
00004D	4D	(	28	(
00004E	4E	+	2B	+
00004F	4F	|	21	!
000050	50	&	26	&
000051	51	N/A	3A	:
000052	52	N/A	3A	:
000053	53	N/A	3A	:

Address	EBCDIC Code	EBCDIC Character	ASCII Code	ASCII Character
000054	54	N/A	3A	:
000055	55	N/A	3A	:
000056	56	N/A	3A	:
000057	57	N/A	3A	:
000058	58	N/A	3A	:
000059	59	N/A	3A	:
00005A	5A	!	5D	]
00005B	5B	$	24	$
00005C	5C	*	2A	*
00005D	5D	)	29	)
00005E	5E	;	3B	;
00005F	5F	¬	5E	^
000060	60	-	2D	-
000061	61	/	2F	/
000062	62	N/A	3A	:
000063	63	N/A	3A	:
000064	64	N/A	3A	:
000065	65	N/A	3A	:
000066	66	N/A	3A	:
000067	67	N/A	3A	:
000068	68	N/A	3A	:
000069	69	N/A	3A	:
00006A	6A	¦	7C	¦
00006B	6B	,	2C	,
00006C	6C	%	25	%
00006D	6D	_	5F	_
00006E	6E	>	3E	>
00006F	6F	?	3F	?
000070	70	N/A	3A	:
000071	71	N/A	3A	:
000072	72	N/A	3A	:
000073	73	N/A	3A	:
000074	74	N/A	3A	:
000075	75	N/A	3A	:
000076	76	N/A	3A	:
000077	77	N/A	3A	:
000078	78	N/A	3A	:
000079	79	`	60	`
00007A	7A	:	3A	:
00007B	7B	#	23	#
00007C	7C	@	40	@
00007D	7D	'	27	'
00007E	7E	=	3D	=
00007F	7F	"	22	"

Address	EBCDIC Code	EBCDIC Character	ASCII Code	ASCII Character
000080	80	N/A	3A	:
000081	81	a	61	a
000082	82	b	62	b
000083	83	c	63	c
000084	84	d	64	d
000085	85	e	65	e
000086	86	f	66	f
000087	87	g	67	g
000088	88	h	68	h
000089	89	i	69	i
00008A	8A	N/A	3A	:
00008B	8B	N/A	3A	:
00008C	8C	N/A	3A	:
00008D	8D	N/A	3A	:
00008E	8E	N/A	3A	:
00008F	8F	N/A	3A	:
000090	90	N/A	3A	:
000091	91	j	6A	j
000092	92	k	6B	k
000093	93	l	6C	l
000094	94	m	6D	m
000095	95	n	6E	n
000096	96	o	6F	o
000097	97	p	70	p
000098	98	q	71	q
000099	99	r	72	r
00009A	9A	N/A	3A	:
00009B	9B	N/A	3A	:
00009C	9C	N/A	3A	:
00009D	9D	N/A	3A	:
00009E	9E	N/A	3A	:
00009F	9F	N/A	3A	:
0000A0	A0	N/A	3A	:
0000A1	A1	~	7E	~
0000A2	A2	s	73	s
0000A3	A3	t	74	t
0000A4	A4	u	75	u
0000A5	A5	v	76	v
0000A6	A6	w	77	w
0000A7	A7	x	78	x
0000A8	A8	y	79	y
0000A9	A9	z	7A	z
0000AA	AA	N/A	3A	:
0000AB	AB	N/A	3A	:
0000AC	AC	N/A	3A	:

Address	EBCDIC Code	EBCDIC Character	ASCII Code	ASCII Character
0000AD	AD	[	3A	:
0000AE	AE	N/A	3A	:
0000AF	AF	N/A	3A	:
0000B0	B0	N/A	3A	:
0000B1	B1	N/A	3A	:
0000B2	B2	N/A	3A	:
0000B3	B3	N/A	3A	:
0000B4	B4	N/A	3A	:
0000B5	B5	N/A	3A	:
0000B6	B6	N/A	3A	:
0000B7	B7	N/A	3A	:
0000B8	B8	N/A	3A	:
0000B9	B9	N/A	3A	:
0000BA	BA	N/A	3A	:
0000BB	BB	N/A	3A	:
0000BC	BC	N/A	3A	:
0000BD	BD	]	3A	:
0000BE	BE	N/A	3A	:
0000BF	BF	N/A	3A	:
0000C0	C0	{	7B	{
0000C1	C1	A	41	A
0000C2	C2	B	42	B
0000C3	C3	C	43	C
0000C4	C4	D	55	D
0000C5	C5	E	45	E
0000C6	C6	F	46	F
0000C7	C7	G	47	G
0000C8	C8	H	48	H
0000C9	C9	I	49	I
0000CA	CA	N/A	3A	:
0000CB	CB	N/A	3A	:
0000CC	CC	N/A	3A	:
0000CD	CD	N/A	3A	:
0000CE	CE	N/A	3A	:
0000CF	CF	N/A	3A	:
0000D0	D0	}	7D	}
0000D1	D1	J	4A	J
0000D2	D2	K	4B	K
0000D3	D3	L	4C	L
0000D4	D4	M	4D	M
0000D5	D5	N	4E	N
0000D6	D6	O	4F	O
0000D7	D7	P	50	P
0000D8	D8	Q	51	Q
0000D9	D9	R	52	R

Address	EBCDIC Code	EBCDIC Character	ASCII Code	ASCII Character
0000DA	DA	N/A	3A	:
0000DB	DB	N/A	3A	:
0000DC	DC	N/A	3A	:
0000DD	DD	N/A	3A	:
0000DE	DE	N/A	3A	:
0000DF	DF	N/A	3A	:
0000E0	E0	\	5C	\
0000E1	E1	N/A	3A	:
0000E2	E2	S	53	S
0000E3	E3	T	54	T
0000E4	E4	U	55	U
0000E5	E5	V	56	V
0000E6	E6	W	57	W
0000E7	E7	X	58	X
0000E8	E8	Y	59	Y
0000E9	E9	Z	5A	Z
0000EA	EA	N/A	3A	:
0000EB	EB	N/A	3A	:
0000EC	EC	N/A	3A	:
0000ED	ED	N/A	3A	:
0000EE	EE	N/A	3A	:
0000EF	EF	N/A	3A	:
0000F0	F0	0	30	0
0000F1	F1	1	31	1
0000F2	F2	2	32	2
0000F3	F3	3	33	3
0000F4	F4	4	34	4
0000F5	F5	5	35	5
0000F6	F6	6	36	6
0000F7	F7	7	37	7
0000F8	F8	8	38	8
0000F9	F9	9	39	9
0000FA	FA	N/A	3A	:
0000FB	FB	N/A	3A	:
0000FC	FC	N/A	3A	:
0000FD	FD	N/A	3A	:
0000FE	FE	N/A	3A	:
0000FF	FF	N/A	3A	:

Default ASCII to EBCDIC Translate Table

The following table shows the ASCII code and character and the corresponding EBCDIC code and character for each address in the default translate table. Any characters that are not defined in ASCII are translated to X'3A' ASCII (:).

Address	ASCII Code	ASCII Character	EBCDIC Code	EBCDIC Character
000100	00	NUL	00	NUL
000101	01	SOH	01	SOH
000102	02	STX	02	STX
000103	03	ETX	03	ETX
000104	04	EOT	37	EOT
000105	05	ENQ	2D	HT
000106	06	ACK	2E	ACK
000107	07	BEL	2F	DEL
000108	08	BS	16	BS
000109	09	HT	05	HT
00010A	0A	LF	25	LF
00010B	0B	VT	OB	VT
00010C	0C	FF	OC	FF
00010D	0D	CR	OD	CR
00010E	0E	SO	OE	SO
00010F	0F	SI	0F	SI
000110	10	DLE	10	DLE
000111	11	DC1(XON)	11	DC1(XON)
000112	12	DC2	12	DC2
000113	13	DC3(XOFF)	13	DC3(XOFF)
000114	14	DC4	3C	DC4
000115	15	NAK	3D	NAK
000116	16	SYN	32	SYN
000117	17	ETB	26	ETB
000118	18	CAN	18	CAN
000119	19	EM	19	EM
00011A	1A	SUB	3F	SUB
00011B	1B	ESC	27	ESC
00011C	1C	FS	1C	FS
00011D	1D	GS	1D	GS
00011E	1E	RS	1E	RS
00011F	1F	US	1F	US
000120	20	ƀ	40	ƀ
000121	21	!	4F	|
000122	22	"	7F	"
000123	23	#	7B	#
000124	24	$	5B	$
000125	25	%	6C	%
000126	26	&	50	&
000127	27	'	7D	'

Address	ASCII Code	ASCII Character	EBCDIC Code	EBCDIC Character
000128	28	(	4D	(
000129	29	)	5D	)
00012A	2A	*	5C	*
00012B	2B	+	4E	+
00012C	2C	,	6B	,
00012D	2D	-	60	-
00012E	2E	.	4B	.
00012F	2F	/	61	/
000130	30	0	F0	0
000131	31	1	F1	1
000132	32	2	F2	2
000133	33	3	F3	3
000134	34	4	F4	4
000135	35	5	F5	5
000136	36	6	F6	6
000137	37	7	F7	7
000138	38	8	F8	8
000139	39	9	F9	9
00013A	3A	:	7A	:
00013B	3B	;	5E	;
00013C	3C	<	4C	<
00013D	3D	=	7E	=
00013E	3E	>	6E	>
00013F	3F	?	6F	?
000140	40	@	7C	@
000141	41	A	C1	A
000142	42	B	C2	B
000143	43	C	C3	C
000144	44	D	C4	D
000145	45	E	C5	E
000146	46	F	C6	F
000147	47	G	C7	G
000148	48	H	C8	H
000149	49	I	C9	I
00014A	4A	J	D1	J
00014B	4B	K	D2	K
00014C	4C	L	D3	L
00014D	4D	M	D4	M
00014E	4E	N	D5	N
00014F	4F	O	D6	O
000150	50	P	D7	P
000151	51	Q	D8	Q
000152	52	R	D9	R
000153	53	S	E2	S
000154	54	T	E3	T

Address	ASCII Code	ASCII Character	EBCDIC Code	EBCDIC Character
000155	55	U	E4	U
000156	56	V	E5	V
000157	57	W	E6	W
000158	58	X	E7	X
000159	59	Y	E8	Y
00015A	5A	Z	E9	Z
00015B	5B	[	4A	¢
00015C	5C	\	E0	\
00015D	5D	]	5A	!
00015E	5E	^	5F	¬
00015F	5F	_	6D	_
000160	60	`	79	`
000161	61	a	81	a
000162	62	b	82	b
000163	63	c	83	c
000164	64	d	84	d
000165	65	e	85	e
000166	66	f	86	f
000167	67	g	87	g
000168	68	h	88	h
000169	69	i	89	i
00016A	6A	j	91	j
00016B	6B	k	92	k
00016C	6C	l	93	l
00016D	6D	m	94	m
00016E	6E	n	95	n
00016F	6F	o	96	o
000170	70	p	97	p
000171	71	q	98	q
000172	72	r	99	r
000173	73	s	A2	s
000174	74	t	A3	t
000175	75	u	A4	u
000176	76	v	A5	v
000177	77	w	A6	w
000178	78	x	A7	x
000179	79	y	A8	y
00017A	7A	z	A9	z
00017B	7B	{	C0	{
00017C	7C	¦	6A	¦
00017D	7D	}	D0	}
00017E	7E	~	A1	~
00017F	7F	DEL	07	DEL

List of Abbreviations

ACTLU	activated logical unit
ACTPU	activated physical unit
ADDS	applied digital data systems
AID	attention identification
ANSI	American National Standards Institute
APF	Application Productivity Facility
ASCII	American National Standard Code for Information Interchange
BB	begin bracket
BC	begin chain
BEL	bell function
BETB	between bracket state
BIU	basic information unit
BM	bottom margin
BS	back space
CBA	current buffer address
CD	change direction
CICS/VS	Customer Information Control System/virtual storage
CNM	communication network management
CNMI	Communication Network Management Initialization
CR	carriage return
CR	command reject
CR/LF	command reject/line feed
CSU	customer setup unit
CTLADR	control unit address
CTS	clear to send
CUD	control unit description
CURSR SEL	cursor select
DACTLU	deactivate logical unit
DACTPU	deactivate physical unit
DAF	destination address field
DAF'	destination address field prime (local address of SLU)
DCD	data carrier detect
DEC	Digital Equipment Corporation
DEV CNCL	device cancel
DEVADR	device address
DEVD	device description
DEVTYPE	device type
DFC	data flow control
DISC	disconnect
DM	disconnect mode
DR	definite response
DRS	data rate select
DSC	data stream compatibility
DSR	data set ready
DTE	data terminal equipment
DTR	data terminal ready
DUP	duplicate
EAU	erase all unprotected
EB	end brackets
EBCDIC	extended binary coded decimal interface character
EC	end chain, also engineering change
EEIF	extended error information field
EEPROM	electrically erasable programmable read only memory
EFI	expedited flow indicator
EM	end of message
EMPL	Emulation Protocol Layer
ENP	enable presentation
EOF	end of file
EOL	end of line
ERI	exception response indicator
ERP	error recovery procedure
ESC	escape
EUA	erase unprotected to address
EWA	erase/write alternate
EW	erase/write
EX	exception response
FCS	frame check sequence
FDX	full duplex data flow
FF	form feed
FIC	first in chain
FID	format identification
FIS	first in segment

FM	function management
FMD	function management data
FR	frame reject
FRMR	frame reject
FTTERM	IBM PC/HOST File Transfer and Terminal Emulator Program
GE	graphics escape
HDX	half-duplex data flow
HT	horizontal tab
IC	insert cursor
IML	initial microprogram load
IMS/VS	Information Management System/Virtual Storage
INB	in bracket
INP	inhibit presentation
IRS	interchange record separator
IRS	interrecord separator
LED	light emitting diode
LF	line feed
LIC	last in chain
LIS	last in segment
LM	left margin
LTA	line turnaround
LU	logical unit
LUSTAT	logical unit status
MDT	modified data tag
MIC	middle in chain
MIS	middle in segment
MLU	multiple logical unit
MPF	mapping field
MPL	maximum presentation line
MPP	maximum presentation position
msec	milliseconds
NC	network control
NCCF	Network Communication Control Facility
NCP	Network Control Program
NDAP	Network Determination Aid Processor
NDM	normal disconnect mode
NL	new line
NLDM	Network Logical Data Manager
NMVT	network management vector transport
NPDA	Network Problem Determination Application
NRM	normal response mode
NRZI	nonreturn to zero inverted
NS	network services
NTO	Network Terminal Option
OAF'	origin address field
OC	operations check
OIC	only in chain
OIS	only in segment
PA	program access
PC	protocol conversion or personal computer
PEND.BB	pending beginning bracket
PI	pacing indicator
PIU	path information unit
PLU	primary logical unit
PRID	procedure-related identifier
PRNT	printer printing
PRTS	permanent request to send
PT	program tab
PU	physical unit
QRI	queued response indicator
RA	repeat to address
RAM	random access memory
RAS	reliability, availability, and serviceability
RB	read buffer
RCV	receive
RECFMS	record formatted maintenance statistics
REQMS	request maintenance statistics
RH	request/response header
RI	ring indicate
RM	read modified
RMA	read modified all
RNR	receive not ready
RR	received ready
RSP	response
RTM	response time monitoring
RTR	ready to receive
RTS	request to send
RU	request/response unit

RxC	receive clock
RxD	receive data
SA	set attribute
SBA	set buffer address
SC	session control
SCS	SNA character string
SDLC	synchronous data link control
SDT	start data traffic
SF	start field
SHF	set horizontal format
SHUTC	shutdown complete
SHUTD	shutdown
SLD	set line density
SLU	secondary logical unit
SNA	systems network architecture
SNF	sequence number field
SNRM	set normal response mode
SNRT	set normal response time
SOH	start of heading
SSCP	system services control point
SVF	set vertical format
SYS REQ	system request
TAF	target address field
TC	test control
TCAM	telecommunication access method
TH	transmission header
TM	top margin
TRN	transparent
TS	transmission services
TSO	time sharing option
TSO/VTAM	time sharing option for the Virtual Telecommunication Access Method
TxC	transmit clock
TxD	transmit data
UA	unnumbered acknowledgment
UDT	user-defined terminal
VCS	vertical channel select
VT	vertical tab
VTAM	virtual telecommunication access method
W	write
WCC	write control character
X OP X	input inhibited operator unauthorized
X PRTBSY	input inhibited printer busy
X PRTNW	input inhibited printer not working
XID	exchange identification

Glossary

This glossary contains terms and abbreviations that are used in this book. It includes terms and definitions from *IBM Vocabulary for Data Processing, Telecommunications, and Office Systems*, GC20-1699. Symbols used in this glossary are as follows:

- An asterisk (*) identifies definitions from the *American National Dictionary for Information Processing*, published by the Computer and Business Equipment Manufacturers Association.
- The symbol **(CCITT/ITU)** identifies definitions from the *CCITT Sixth Plenary Assembly Orange Book, Terms and Definitions* and working documents published by the International Telecommunication Union, Geneva, 1978.
- The symbol **(ISO)** identifies definitions from published sections of the *ISO Vocabulary of Data Processing*, developed by the International Standards Organization, Technical Committee 97, Subcommittee 1.
- The symbol **(TC97)** identifies definitions from drafts and working papers under development by the International Standards Organization, Technical Committee 97, Subcommittee 1.

access method. A technique for moving data between main storage and input/output devices.

Advanced Communications Function for the Network Control Program (ACF/NCP). An IBM program product that provides communication controller support for single-domain and multiple-domain networks.

alert. In NetView NPDA or NPDA, a notification about a high priority event that warrants immediate attention. This data base record is generated for certain event types that are defined by user-constructed filters.

alphanumeric field. A field that may contain any alphabetic, numeric, or special characters.

alternate character set. A character set, located in the terminal, from which characters are obtained for display and printing by using the graphic escape character in the data stream.

alternate cursor. An image reversal of each dot in the character cell at the cursor position.

ANSI X3.64. American National Standard Additional Controls for Use with American National Standard Code for Information Interchange (ASCII). A standard that defines a set of control functions that augments ASCII control functions as described in ANSI X3.64 and that controls input and output for two-dimensional character-imaging devices, such as displays or printers.

* **ASCII**. American National Standard Code for Information Interchange. The standard code, using a coded character set consisting of 7-bit coded characters (8 bits including parity check), used for information interchange among data processing systems, data communication systems, and associated equipment. The ASCII set consists of control characters and graphic characters.

ASCII pass-through. For the 3708, the transmission of unmodified data between an ASCII device and an ASCII host.

ASCII pass-through mode. For an ASCII device attached to a 3708, a mode of operation in which the device communicates with an ASCII host.

asynchronous. Without regular time relationship; unexpected or unpredictable with respect to the execution of a program's instructions.

attention. An I/O interruption generated asynchronously by a display station, usually as a result of an action taken by the operator of the device.

attention identification (AID). A code that the terminal sends in the inbound data stream to identify the operator action or structured field function that caused the data stream to be sent to the application program. An AID is always sent as the first byte of the inbound data stream. Structured fields in the data stream may also contain an AID.

attribute. A characteristic.

attribute select keyboard. A keyboard that enables the operator, when permitted by the program, to change the character attributes of the keyed-in character.

attribute type. A code that identifies the characteristics from which the associated set of attribute values can be selected. See also *extended color, extended highlighting*, and *character set*.

attribute value. A code immediately following the attribute type in the data stream that specifies a particular characteristic from the set defined by the attribute type.

audible alarm. A special feature that sounds a short, audible tone automatically when a character is entered from the keyboard into the next-to-last character position on the screen. The tone can also be sounded under program control.

automatic polling. (1) A hardware feature of a telecommunications unit that processes a polling list, polling the terminals in order and handling negative responses to polling without interrupting the central processing unit. At the end of the list, polling is automatically begun again at the beginning of the list. Synonymous with *autopoll*. (2) See also *polling*.

automatic skip. After entry of a character into the last character position of an unprotected display field, automatic repositioning of the cursor from a protected and numeric field to the first character position of the next unprotected display field.

autopoll. Same as *automatic polling*.

auto-skip. Same as *automatic skip*.

base color. The capability to display or print all characters in a field, in one of four colors, on a color terminal by using combinations of the field protection and the field intensify bits of the field attribute.

Binary Synchronous Communications (BSC). Data transmission in which character synchronism is controlled by timing signals generated at the sending and receiving stations.

blink. An extended highlighting attribute value (for emphasis) of a field or character.

block matrix. The total array of dots that can be used to describe a graphic character for a 3270 display or printer.

bracket. In VTAM, an exchange of data between an application program and a logical unit which accomplishes some task.

break. (1) To interrupt the sending end and take control of the circuit at the receiving end. (2) A separation of continuous paper forms, usually at the perforation.

buffer address. The address of a location in the buffer at which one character can be stored.

character attribute. The properties of a character with respect to its color, highlighting, and character set. See also *extended field attribute*.

character buffer. The read/write storage used by a partition for storing character or graphic data for display or printing on a terminal.

character position. A location on the screen at which one character can be displayed; also, an addressed location in the buffer at which one character can be stored.

character set. (1) A defined collection of characters in a loadable or nonloadable set selected by means of a local character set identifier. (2) An attribute type in the extended field and character attributes. (3) An attribute passed between session partners in the Start Field Extended, Modify Field, and Set Attribute orders.

clear indicator. In VTAM, a SESSIONC indicator sent by one node to another that prevents the exchange of messages and responses.

cluster control unit. (1) A device that can control the input/output operations of more than one device. A remote cluster control unit can be attached to a host CPU only via a communications controller. A cluster control unit may be controlled by a program stored and executed in the unit, or it may be controlled entirely by hardware. (2) See also *communications controller*.

command. An instruction that directs a control unit or device to perform an operation or a set of operations.

communications controller. (1) A type of communication control unit whose operations are controlled by a program stored and executed in the unit. Examples are the IBM 3704 and 3705 Communications Controllers. (2) See also *cluster control unit*.

configuration. (1) (TC97) The arrangement of a computer system or network as defined by the nature, number, and the chief characteristics of its functional units. More specifically, the term configuration may refer to a hardware configuration or a software configuration. (2) The devices and programs that make up a system, subsystem, or network.

control character. A character used in conjunction with a Write command to specify that a control unit is to perform a particular operation.

control codes. The hexadecimal values hex 00 through hex 3F, and hex FF in the 3270 data stream.

control terminal. For the 3708, a display attached to a 3708 that enables an operator to communicate with the 3708 in order to control and monitor the 3708 and to define the 3708 configuration.

control terminal mode. For an ASCII device attached to a 3708, a mode of operation in which the device functions as the control terminal for the 3708.

copy control character (CCC). A character used in conjunction with the Copy command to specify the type of data to be copied.

copy operation. An operation that copies the contents of the buffer from one display station or printer to another display station or printer attached to the same control unit.

cursor. A unique symbol that identifies a character position in a screen display, usually the character position at which the next character to be entered from the keyboard will be displayed.

data chain. A complete unit of data that originates at a single LU.

data link. (1) * The physical means of connecting one location to another for the purpose of transmitting and receiving data. (2) (TC97) The assembly of parts of two data terminal equipments (DTEs) that are controlled by a link protocol, and that, together with the interconnecting data circuit, enables data to be transferred from a data source to a data sink. (3) The interconnecting data circuit between two or more equipments operating in accordance with a link protocol; it does not include the data source and the data sink. (4) In SNA, synonym for link(3).

data link escape character (DLE). (ISO) A transmission control character that changes the meaning of a limited number of contiguously following characters or coded representations and that is used exclusively to provide supplementary transmission control characters.

data stream. (1) All data transmitted through a data channel in a single read or write operation. (2) A continuous stream of data elements being transmitted, or intended for transmission, in character or binary-digit form, using a defined format.

data transfer. In telecommunications, the sending of data from one node to another.

data transfer mode. A set of facilities (including the macro instructions needed to use them) that enable the application program to communicate with terminals.

decode. (1) (ISO) To convert data by reversing the effect of some previous encoding. (2) To interpret a code. (3) Contrast with encode.

detectable. An attribute of a display field; determines whether the field can be sensed by the selector pen.

display. (1) * (ISO) A visual presentation of data. (2) (TC95) In word processing, a device for visual presentation of information on any temporary character imaging device. (3) (TC97) To present data visually.

display field. A group of consecutive characters (in the buffer) that starts with an attribute character (defining the characteristics of the field) and contains one or more alphanumeric characters. The field continues to, but does not include, the next attribute character.

duplex. (1) * In data communication, pertaining to a simultaneous two-way independent transmission in both directions. Synonymous with full duplex.

* **EBCDIC**. Extended binary-coded decimal interchange code. A coded character set consisting of 8-bit coded characters.

echo. A feature that makes a receiving device send back the characters it receives. Echo is controlled at three points within the data communications system:

- The user's terminal
- The dataline ECHO parameter
- The answering data resource.

If all three setting do not complement each other, the result is either a blank screen or double images when the user types at the terminal.

EEPROM. * Electrically erasable programmable read-only memory located in the base unit of the 3708.

EIA 232C. The EIA standard describing the electrical, mechanical, and functional interface between data terminal equipment and data communication equipment using serial binary data. The EIA 232C interface is the most common interface for attaching data communications devices. Cable length cannot exceed 50 feet.

EIA 422A. The EIA standard for serial data transmission. EIA 422A interface allows devices to be direct attached at greater distances, up to 4000 feet. The EIA 422A interface is only supported for asynchronous device attachment.

emulate. (1) To imitate one system with another, primarily by hardware, so that the imitating system accepts the same data, executes the same computer programs, and achieves the same results as the imitated computer system. (2) The use of programming techniques and special machine features to permit a computing system to execute programs written for another system.

encode. (1) * (ISO) To convert data by the use of a code or a coded character set in such a manner that reconversion to the original form is possible. Encode is sometimes loosely used when complete reconversion is not possible. (2) * (ISO) Contrast with decode.

EPROM. * Erasable programmable read-only memory located in the cartridge of the 3708.

Erase All Unprotected (EAU) command. A command that clears all unprotected fields to nulls, resets modified data tags in all unprotected fields, unlocks the keyboard, resets the attention identifier, and repositions the cursor to the first character of the first unprotected field.

Erase Unprotected to Address (EUA) order. An order that erases all unprotected positions (inserts nulls) from the current buffer address up to, but not including, the specified stop address.

ESC character. See *data link escape character*.

Extended Attribute Buffer (EAB). A buffer for storing extended field attributes and character attributes.

extended color. (1) A capability that allows color terminals to display or print fields or characters in colors using extended field and character attributes. (2) An attribute type in the extended field attribute and character attribute.

extended field attribute. Additional field definition to the field attribute that controls defining additional properties such as color, highlighting, character set, and field validation. The extended field attribute is altered by information passed in the Start Field Extended and Modify Field orders.

extended highlighting. (1) A function that provided blink, reverse video, and underscore for emphasizing fields or characters on devices supporting extended field attributes and character attributes. (2) An attribute type in the extended field attribute and character attribute. (3) An attribute passed between session partners in the Start Field Extended, Modify Field, and Set Attribute orders.

field. See *display field*.

field attribute. A control character stored in the character buffer in the first character position of a field. For those devices supporting the 3270 data stream, a field attribute defines protected/unprotected, alphanumeric/numeric, detectable/nondetectable, display/nondisplay, intensity, and modified data tag (MDT).

field inherit. A bit setting in the character attribute which defaults the character properties to the extended field attributes or device default if the buffer is unformatted.

formatted display. A screen display in which a display field, or fields, has been defined as a result of storing at least one attribute character in the display buffer.

full duplex. See *duplex*.

general polling. (1) An input technique for remote 3270 devices in which special invitation characters are sent to a device control unit instructing that control unit to begin transmission from all devices ready to enter data. (2) See also *polling* and *specific polling*.

***half duplex**. (1) In data communication, pertaining to an alternate, one way at a time, independent transmission. (2) Contrast with duplex.

host. (TC97) A processor that controls all or part of a user application network.

inactivity timer. This timer may be configured on switched connection or EIA 422A connections. It is used to force disconnection of a device after the specified length of time has passed with no input from downstream device. This timer is often used to prevent excessive telephone charges when a user forgets to disconnect.

inbound. Transmissions from the 3708 to the host.

Insert Cursor (IC) order. An order that displays the cursor at the current buffer address.

intensified display. An attribute of a display field; causes data in that field to be displayed at a brighter level than other data displayed on the screen.

keyboard mapping. For an ASCII device attached to the 3708 in protocol conversion mode, a table that defines which ASCII keyboard sequences are equivalent to 3270 functions.

leased line. See *nonswitched line*.

line control characters. Characters that regulate the transmission of data over a line; for example, delimiting messages, checking for transmission errors, and indicating whether a station has data to send or is ready to receive data.

line quiet time. Specifies the number of DEL characters, (X'7F'), the 3708 should transmit before transmitting host data after line turnaround. This ensures that the line has quiesced before host data is transmitted.

local. Pertaining to the direct attachment of devices by channels to a host CPU. Contrast with *remote*.

logical unit (LU). In SNA, a port through which an end user accesses the SNA network in order to communicate with another end user and through which the end user accesses the functions provided by system services control points (SSCPs).

modem eliminator. For nonswitched lines only, a device that replaces a pair of modems and communication lines between two local terminals. Some modem eliminators provide clocking for synchronous attachment and some redrive signals. A modem eliminator is a active device used to connect two DTEs together for communication purposes. A modem eliminator typically provides cross-over of required signals as well as redrive capability of the signals. In many cases, RTS and CTS delays can be provided by modem eliminators as with modems. A modem eliminator replaces a pair of modems and a phone line. Modem eliminators can be configured to provide clocking also.

modified data tag (MDT). A bit in the attribute character of a display field, which, when set, causes that field to be transferred to the channel during a read-modified operation. The modified data tag may be set by a keyboard input to the field, a selector-pen detection in the field, a card read-in operation, or program control. The modified data tag may be reset by a selector-pen detection in the field, program control, or ERASE INPUT key.

Modify Field (MF). An order that allows specified field attributes to be modified.

Network Logical Data Manager (NLDM). An IBM program product that collects and correlates LU-LU session-related data and provides the user with online access to the data. It runs as a Network Communications Control Facility (NCCF) communication network management application program.

Network Problem Determination Application (NPDA). An IBM program product that helps the user identify network problems from a central control point using interactive display techniques.

Network Terminal Option (NTO). An IBM program product that extends the capabilities of the ACF/NCP to support a select group of non-SNA devices.

nonswitched line. A telecommunication line on which connections do not have to be established by dialing. Contrast with switched line.

null modem. A type of modem eliminator that wraps signals but does not provide redrive or clocking of signals. A passive, device used to connect two DTEs together for communication purposes. A null modem typically provides cross-over only for the required signals (such as, Transmit Data and Receive Data) with no redrive. A null modem replaces a pair of modems on a phone line. Null modems do not provide clocking.

order code. A code that may be included in the write data stream transmitted for a display station or printer; provides additional formatting or definition of the write data.

order sequence. A sequence in the data stream that starts with an order code and includes a character address and/or data characters related to the order code.

outbound. Transmissions from the host to the 3708.

outgoing group. In systems with TCAM, that section of a message handler that manipulates outgoing messages after they have been removed from their destination queues.

pacing. (1) A technique by which a receiving station controls the rate of transmission of a sending station to prevent overrun. (2) In SNA, a technique by which a receiving component controls the rate of transmission of a sending component to prevent overrun or congestion.

physical unit (PU). In SNA, the component that manages and monitors the resources (such as attached links and adjacent link stations) of a node, as requested by an SSCP via an SSCP-SSCP session.

platen. (TC95) The part of a document copying machine, usually in the form of a glass plate that can be curved, upon which the original is placed for copying. A backing, usually cylindrical, against which printing mechanisms strike or otherwise deposit ink to produce an image.

point-to-point connection. A connection established between two data stations for data transmission. The connection may include switching facilities.

polling. A technique by which each of the terminals sharing a communication line is periodically interrogated to determine whether it requires servicing.

primary logical unit (PLU). In SNA, the logical unit (LU) that contains the primary half-session for a particular LU-LU session. Contrast with secondary logical unit.

printer authorization matrix. A matrix stored in the 3274 control unit that establishes printer assignment and classification.

program attention key. On a display device keyboard, a key that produces an interruption to solicit program action.

program function key. (1) (TC95) On a typewriter, a control by means of which a specified machine function is set, released or performed. (2) (TC97) In computer graphics, a button or switch that may be operated to send a signal to the computer program controlling the display. (3) On a terminal, a key, such as an ATTENTION or an ENTER key, that causes the transmission of a signal not associated with a printable or displayable character. Detection of the signal usually causes the system to perform some predefined function for the operator.

Program Tab (PT) order. An order that advances the current buffer address to the address of the first character location of the next unprotected field.

protected field. A display field for which the display operator cannot use the keyboard or operator identification card reader to enter, modify, or erase data.

protocol. (1) (CCITT/ITU) A specification for the format and relative timing of information exchanged between communicating parties. (2) In SNA, the meanings of, and the sequencing rules for, requests and responses used for managing the network, transferring data, and synchronizing the states of network components.

protocol conversion. For the 3708, the changing of start-stop data sent from an ASCII device to an SNA host into 3270 data, or the changing of a 3270 data sent from an SNA host to an ASCII device into ASCII start-stop data.

protocol conversion mode. For an ASCII device attached to a 3708, a mode of operation in which the device communicates with an SNA host as though it is a 3270 device.

protocol enveloping. For the 3708, the adding of SNA headers to data sent from an ASCII device to an SNA host, or the removing of SNA headers from data sent from an SNA host to an ASCII device.

protocol enveloping mode. For an ASCII device attached to a 3708, a mode of operation in which the device communicates with an SNA host as though it were an NTO device.

read operation. The process of sending data from the display to the host.

remote. Pertaining to the attachment of devices to a central computer through a communication control unit. Contrast with local.

routing. (1) The assignment of the path by which a message reaches its destination. (2) In SNA, the forwarding of a message unit along a particular path through a network, as determined by parameters carried in the message unit, such as the destination network address in a transmission header.

RS-232-C. See *EIA 232C*.

secondary logical unit (SLU). In SNA, the logical unit (LU) that contains the secondary half-session for a particular LU-LU session. Contrast with primary logical unit.

segments. Part of a Basic Information Unit (BIU).

selector pen. A pen-like instrument that may be attached to the display station as a special feature. When pointed at a detectable portion of an image and then activated, the selector pen senses the presence of a light at a display field and produces a selector-pen detect.

selector-pen detect. The sensing by the selector pen of the presence of light from data in a display field that has the detectable attribute. Depending on the designator character of that display field, the detection and location information is identified on the screen (and stored in the buffer) or may produce an interrupt that is transmitted to the CPU.

sessions. A set of logical SNA connections.

SESSIONC indicators. In VTAM, indicators that can be sent from one node to another without using SEND or RECEIVE macro instructions. SDT, clear, and STSN are SESSIONC indicators. All SESSIONC indicators are sent with a SESSIONC macro instruction.

Set Attribute (SA) order. An order that associates attributes in the EAB with individual characters.

Set Buffer Address (SBA) order. An order that sets the buffer address to a specified location.

slowdown. Available system buffers in the 3708 have reached a critical low point. The 3708 stops processing characters until enough system buffers become available. To increase the number of buffers available to the 3708, (1) exclude ports not used, (2) use small receive queue sizes, (3) reduce the number of MLU definitions.

SNA character string (SCS). A character string composed of EBCDIC controls, optionally intermixed with end-user data, that is carried within a request/response unit.

specific polling. (1) A polling technique that sends invitation characters to a device to find out whether the device is ready to enter data. (2) See also *general polling* and *polling*.

Start Field (SF) order. An order that indicates a specified location which contains an attribute byte and not a text character.

Start Field Extended (SFE) order. An order that generates an extended field attribute in the EAB and at the current buffer location.

Structured Field. A data stream format that permits variable-length data and controls to be parsed into its components without having to scan every byte.

Suppress Index (SI) order. An order that generates the suppress index character, valid only for the 3288-2 printer. This character inhibits a lines index to allow overprinting.

switched line. A communication line in which the connection between the computer and a remote terminal is established by dialing. Contrast with nonswitched line.

SNA character string (SCS). A character string composed of EBCDIC controls, optionally intermixed with end-user data, that is carried within a request/response unit.

Synchronous Data Link Control (SDLC). A discipline for managing synchronous, code-transparent, serial-by-bit information transfer over a link connection. Transmission exchanges may be duplex or half-duplex over switched or nonswitched links. The configuration of the link connection may be point-to-point, multipoint, or loop. SDLC conforms to subsets of the Advanced Data Communication Control Procedures of the American Standards Institute and High-Level Data

Link Control (HDLC) of the International Standards Organization.

Systems Network Architecture (SNA). The description of the logical structure, formats, protocols, and operational sequences for transmitting information units through and controlling the configuration and operation of networks.

telecommunications network. In a telecommunication system, the combination of all terminals and other telecommunication devices and the lines that connect them.

terminal. (1) A point in a system or communication network at which data can either enter or leave. (2) Any device capable of sending and receiving information over a communication channel.

terminal-initiated logon. A logon request that originates from the terminal.

translate table. For the 3708, a table that defines the translation of ASCII to EBCDIC and EBCDIC to ASCII and that allows the use of special characters and nonstandard codes.

turnaround character. A character that uniquely designates the end of a line of data, such as carriage return (CR) or line feed (LF). The default for the 3708 is two characters.

unformatted display. A screen display in which no attribute character (and, therefore, no display field) has been defined.

unprotected field. A display field for which the display station operator can manually enter, modify, or erase data.

user-defined terminal. An ASCII display that is attached to the 3708 and that operates in protocol conversion mode using a keyboard mapping defined by the user.

user-defined terminal table. A table that a customer creates in storage, which contains information for a keyboard mapping used to define a terminal.

wraparound. (1) (TC97)In computer graphics, the display at some point on the display space of the display elements whose coordinates lie outside of the display space. (2) (TC95)In display-based word processing equipment, the automatic disposition of a printable line of text onto two or more display lines necessitated by the horizontal limits of the display. (3) The continuation of an operation from the maximum addressable location in storage to the first addressable location. (4) The continuation of register addresses from the highest register address to the lowest.

write control character (WCC). A character used in conjunction with a Write command to specify that a particular operation, or combination of operations, is to be performed at a display station or printer.

Write Structured Field (WSF) command. A command used for processing structured fields.

3270 data stream. Data being transferred from or to an allocated primary or tertiary device, or to the host system, as a continuous stream of data and 3270 Information Display System control elements in character form.

3270 data-stream compatibility (DSC). The facility that provides access to System/370 applications that communicate with 3270 Information Display System terminals.

3708 Network Conversion Unit. A device that allows ASCII devices to communicate with an SNA host by providing protocol conversion and protocol enveloping and that allows ASCII devices to communicate with an ASCII host by providing ASCII pass-through.

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